

## FflasFpack

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<b>1 FFLAS-FFPACK Documentation.</b>	<b>1</b>
1.1 Introduction . . . . .	1
1.2 Goals . . . . .	1
1.3 Design . . . . .	1
1.4 Using FFLAS-FFPACK. . . . .	1
1.5 Contributing to fflas-ffpack, getting assistance. . . . .	2
1.6 Copying and Licence . . . . .	2
1.7 Tutorial . . . . .	2
1.8 Configuring and Installing FFLAS-FFPACK . . . . .	2
1.9 Architecture of the library. . . . .	2
<b>2 Bug List</b>	<b>3</b>
<b>3 Bibliography</b>	<b>7</b>
<b>4 Todo List</b>	<b>9</b>
<b>5 Topic Index</b>	<b>13</b>
5.1 Topics . . . . .	13
<b>6 Namespace Index</b>	<b>15</b>
6.1 Namespace List . . . . .	15
<b>7 Hierarchical Index</b>	<b>17</b>
7.1 Class Hierarchy . . . . .	17
<b>8 Data Structure Index</b>	<b>25</b>
8.1 Data Structures . . . . .	25
<b>9 File Index</b>	<b>33</b>
9.1 File List . . . . .	33
<b>10 Topic Documentation</b>	<b>41</b>
10.1 CHECKER . . . . .	41
10.2 FFLAS-FFPACK . . . . .	41
10.2.1 Detailed Description . . . . .	41
10.2.2 FFLAS . . . . .	42
10.2.3 Interfaces . . . . .	42
10.3 Matrix Multiplication Algorithms . . . . .	42
10.3.1 Detailed Description . . . . .	42
10.4 SIMD wrapper . . . . .	42
10.5 FFPACK . . . . .	43
10.5.1 Detailed Description . . . . .	43
10.6 FFLAS-FFPACK fields . . . . .	43
10.6.1 Detailed Description . . . . .	43
10.7 RNS . . . . .	43

<b>11 Namespace Documentation</b>	<b>45</b>
11.1 FFLAS Namespace Reference	45
11.1.1 Typedef Documentation	72
11.1.1.1 Checker_fgemm	72
11.1.1.2 Checker_ftrsm	72
11.1.1.3 ForceCheck_fgemm	72
11.1.1.4 ForceCheck_ftrsm	72
11.1.1.5 ZOSparseMatrix	72
11.1.1.6 NotZOSparseMatrix	72
11.1.1.7 SimdSparseMatrix	72
11.1.1.8 NoSimdSparseMatrix	72
11.1.1.9 MKLSparseMatrixFormat	72
11.1.1.10 NotMKLSparseMatrixFormat	73
11.1.1.11 has_plus	73
11.1.1.12 has_minus	73
11.1.1.13 has_equal	73
11.1.1.14 has_plus_eq	73
11.1.1.15 has_minus_eq	73
11.1.1.16 has_mul	73
11.1.1.17 has_mul_eq	73
11.1.1.18 Timer	74
11.1.1.19 BaseTimer	74
11.1.1.20 UserTimer	74
11.1.1.21 SysTimer	74
11.1.2 Enumeration Type Documentation	74
11.1.2.1 FFLAS_ORDER	74
11.1.2.2 FFLAS_TRANSPOSE	74
11.1.2.3 FFLAS_UPLO	74
11.1.2.4 FFLAS_DIAG	75
11.1.2.5 FFLAS_SIDE	75
11.1.2.6 FFLAS_BASE	75
11.1.2.7 number_kind	75
11.1.2.8 SparseMatrix_t	76
11.1.2.9 FFLAS_FORMAT	76
11.1.3 Function Documentation	76
11.1.3.1 InfNorm()	76
11.1.3.2 min3()	77
11.1.3.3 max3()	77
11.1.3.4 min4()	77
11.1.3.5 max4()	77
11.1.3.6 fadd() [1/8]	77
11.1.3.7 faddin() [1/5]	78

11.1.3.8 fsub() [1/4]	78
11.1.3.9 fsubin() [1/3]	78
11.1.3.10 fadd() [2/8]	78
11.1.3.11 pfadd()	79
11.1.3.12 pfsub()	79
11.1.3.13 pfaddin()	79
11.1.3.14 pfsubin()	79
11.1.3.15 fadd() [3/8]	80
11.1.3.16 fsub() [2/4]	80
11.1.3.17 faddin() [2/5]	81
11.1.3.18 faddin() [3/5]	81
11.1.3.19 fsubin() [2/3]	81
11.1.3.20 fadd() [4/8]	82
11.1.3.21 fassign() [1/10]	82
11.1.3.22 fassign() [2/10]	83
11.1.3.23 fassign() [3/10]	83
11.1.3.24 fassign() [4/10]	83
11.1.3.25 fassign() [5/10]	83
11.1.3.26 fassign() [6/10]	83
11.1.3.27 fassign() [7/10]	84
11.1.3.28 fassign() [8/10]	84
11.1.3.29 faxpy() [1/6]	84
11.1.3.30 faxpy() [2/6]	85
11.1.3.31 faxpy() [3/6]	85
11.1.3.32 faxpy() [4/6]	85
11.1.3.33 fdot() [1/11]	86
11.1.3.34 fdot() [2/11]	86
11.1.3.35 fdot() [3/11]	86
11.1.3.36 fdot() [4/11]	87
11.1.3.37 fdot() [5/11]	87
11.1.3.38 fdot() [6/11]	87
11.1.3.39 fdot() [7/11]	87
11.1.3.40 fdot() [8/11]	88
11.1.3.41 fgemm() [1/23]	88
11.1.3.42 fgemm() [2/23]	88
11.1.3.43 fgemm() [3/23]	89
11.1.3.44 fgemm() [4/23]	89
11.1.3.45 fgemm() [5/23]	90
11.1.3.46 fgemm() [6/23]	90
11.1.3.47 fsquare() [1/6]	91
11.1.3.48 fsquare() [2/6]	91
11.1.3.49 fsquare() [3/6]	92

11.1.3.50 fsquare() [4/6]	92
11.1.3.51 fsquare() [5/6]	92
11.1.3.52 fgemm() [7/23]	93
11.1.3.53 fgemm() [8/23]	93
11.1.3.54 fgemm() [9/23]	93
11.1.3.55 fgemm() [10/23]	94
11.1.3.56 fgemm() [11/23]	94
11.1.3.57 fgemm() [12/23]	95
11.1.3.58 fgemm() [13/23]	95
11.1.3.59 fgemm() [14/23]	95
11.1.3.60 fgemm() [15/23]	96
11.1.3.61 fgemm() [16/23]	96
11.1.3.62 fgemm() [17/23]	96
11.1.3.63 fgemm() [18/23]	97
11.1.3.64 fgemv() [1/19]	97
11.1.3.65 fgemv() [2/19]	98
11.1.3.66 fgemv() [3/19]	98
11.1.3.67 fgemv() [4/19]	98
11.1.3.68 fgemv() [5/19]	99
11.1.3.69 fgemv() [6/19]	99
11.1.3.70 fgemv() [7/19]	100
11.1.3.71 fgemv() [8/19]	100
11.1.3.72 fgemv() [9/19]	100
11.1.3.73 fgemv() [10/19]	101
11.1.3.74 fgemv() [11/19]	101
11.1.3.75 fgemv() [12/19]	101
11.1.3.76 fgemv() [13/19]	102
11.1.3.77 fgemv() [14/19]	102
11.1.3.78 fgemv() [15/19]	102
11.1.3.79 fgemv() [16/19]	103
11.1.3.80 fger() [1/12]	103
11.1.3.81 fger() [2/12]	104
11.1.3.82 fger() [3/12]	104
11.1.3.83 fger() [4/12]	104
11.1.3.84 fger() [5/12]	105
11.1.3.85 fger() [6/12]	105
11.1.3.86 fger() [7/12]	105
11.1.3.87 fger() [8/12]	106
11.1.3.88 fger() [9/12]	106
11.1.3.89 fger() [10/12]	106
11.1.3.90 fger() [11/12]	107
11.1.3.91 freduce() [1/11]	107

11.1.3.92 <code>freduce()</code> [2/11]	107
11.1.3.93 <code>freduce_constoverride()</code> [1/2]	108
11.1.3.94 <code>finit()</code> [1/8]	108
11.1.3.95 <code>finit()</code> [2/8]	108
11.1.3.96 <code>freduce()</code> [3/11]	109
11.1.3.97 <code>freduce()</code> [4/11]	109
11.1.3.98 <code>pfreduce()</code>	109
11.1.3.99 <code>freduce()</code> [5/11]	109
11.1.3.100 <code>freduce_constoverride()</code> [2/2]	110
11.1.3.101 <code>finit()</code> [3/8]	110
11.1.3.102 <code>finit()</code> [4/8]	110
11.1.3.103 <code>freduce()</code> [6/11]	111
11.1.3.104 <code>freduce()</code> [7/11]	111
11.1.3.105 <code>freivalds()</code>	111
11.1.3.106 <code>fscalin()</code> [1/10]	112
11.1.3.107 <code>fscal()</code> [1/10]	112
11.1.3.108 <code>fscal()</code> [2/10]	113
11.1.3.109 <code>fscal()</code> [3/10]	113
11.1.3.110 <code>fscalin()</code> [2/10]	113
11.1.3.111 <code>fscalin()</code> [3/10]	113
11.1.3.112 <code>fscalin()</code> [4/10]	113
11.1.3.113 <code>fscal()</code> [4/10]	114
11.1.3.114 <code>fscalin()</code> [5/10]	114
11.1.3.115 <code>fscal()</code> [5/10]	115
11.1.3.116 <code>fscalin()</code> [6/10]	115
11.1.3.117 <code>fscal()</code> [6/10]	115
11.1.3.118 <code>fscalin()</code> [7/10]	115
11.1.3.119 <code>fscal()</code> [7/10]	116
11.1.3.120 <code>fscalin()</code> [8/10]	116
11.1.3.121 <code>fscal()</code> [8/10]	116
11.1.3.122 <code>fsyr2k()</code>	116
11.1.3.123 <code>fsyrk()</code> [1/16]	117
11.1.3.124 <code>fsyrk()</code> [2/16]	118
11.1.3.125 <code>fsyrk()</code> [3/16]	118
11.1.3.126 <code>fsyrk()</code> [4/16]	118
11.1.3.127 <code>fsyrk()</code> [5/16]	119
11.1.3.128 <code>fsyrk()</code> [6/16]	119
11.1.3.129 <code>fsyrk()</code> [7/16]	119
11.1.3.130 <code>fsyrk()</code> [8/16]	120
11.1.3.131 <code>fsyrk()</code> [9/16]	120
11.1.3.132 <code>fsyrk()</code> [10/16]	120
11.1.3.133 <code>fsyrk()</code> [11/16]	121

11.1.3.134 fsyrk() [12/16]	121
11.1.3.135 fsyrk() [13/16]	122
11.1.3.136 fsyrk() [14/16]	122
11.1.3.137 computeS1S2()	123
11.1.3.138 fsyrk() [15/16]	123
11.1.3.139 fsyrk() [16/16]	124
11.1.3.140 fsyrk_strassen() [1/2]	124
11.1.3.141 ftrmm() [1/3]	124
11.1.3.142 ftrmm() [2/3]	125
11.1.3.143 ftrsm() [1/9]	126
11.1.3.144 ftrsm() [2/9]	126
11.1.3.145 ftrsm() [3/9]	127
11.1.3.146 ftrsm() [4/9]	127
11.1.3.147 ftrsm() [5/9]	127
11.1.3.148 cblas_imptrsm()	128
11.1.3.149 ftrsv() [1/2]	128
11.1.3.150 igemm_()	128
11.1.3.151 finit() [5/8]	129
11.1.3.152 fconvert() [1/3]	129
11.1.3.153 fnegin() [1/4]	130
11.1.3.154 fneg() [1/4]	130
11.1.3.155 fzero() [1/5]	131
11.1.3.156 frand() [1/2]	131
11.1.3.157 fiszero() [1/4]	131
11.1.3.158 fequal() [1/4]	132
11.1.3.159 faxpby() [1/2]	132
11.1.3.160 fdot() [9/11]	133
11.1.3.161 fswap() [1/2]	133
11.1.3.162 fzero() [2/5]	134
11.1.3.163 fzero() [3/5]	135
11.1.3.164 frand() [2/2]	135
11.1.3.165 fequal() [2/4]	136
11.1.3.166 fiszero() [2/4]	136
11.1.3.167 fidentity() [1/4]	137
11.1.3.168 fidentity() [2/4]	137
11.1.3.169 finit() [6/8]	137
11.1.3.170 fconvert() [2/3]	137
11.1.3.171 fnegin() [2/4]	138
11.1.3.172 fneg() [2/4]	138
11.1.3.173 faxpby() [2/2]	139
11.1.3.174 fmove() [1/2]	139
11.1.3.175 bitsize()	140



11.1.3.176 <code>bitsize&lt; Givaro::ZRing&lt; Givaro::Integer &gt; &gt;()</code>	140
11.1.3.177 <code>ftmv()</code>	141
11.1.3.178 <code>ftsm()</code> [6/9]	141
11.1.3.179 <code>fsyrk_strassen()</code> [2/2]	142
11.1.3.180 <code>pfgemm()</code> [1/7]	142
11.1.3.181 <code>pfgemm_1D_rec()</code>	143
11.1.3.182 <code>pfgemm_2D_rec()</code>	143
11.1.3.183 <code>pfgemm_3D_rec()</code>	143
11.1.3.184 <code>pfgemm_3D_rec2()</code>	144
11.1.3.185 <code>fgemm()</code> [19/23]	144
11.1.3.186 <code>ftsm()</code> [7/9]	144
11.1.3.187 <code>ftsm()</code> [8/9]	145
11.1.3.188 <code>fspmv()</code> [1/2]	145
11.1.3.189 <code>fspmm()</code>	145
11.1.3.190 <code>sparse_init()</code> [1/16]	146
11.1.3.191 <code>sparse_init()</code> [2/16]	146
11.1.3.192 <code>sparse_delete()</code> [1/12]	146
11.1.3.193 <code>sparse_delete()</code> [2/12]	146
11.1.3.194 <code>sparse_init()</code> [3/16]	146
11.1.3.195 <code>sparse_init()</code> [4/16]	147
11.1.3.196 <code>sparse_delete()</code> [3/12]	147
11.1.3.197 <code>sparse_delete()</code> [4/12]	147
11.1.3.198 <code>sparse_print()</code> [1/3]	147
11.1.3.199 <code>sparse_init()</code> [5/16]	147
11.1.3.200 <code>sparse_init()</code> [6/16]	148
11.1.3.201 <code>sparse_init()</code> [7/16]	148
11.1.3.202 <code>sparse_init()</code> [8/16]	148
11.1.3.203 <code>sparse_delete()</code> [5/12]	148
11.1.3.204 <code>sparse_init()</code> [9/16]	149
11.1.3.205 <code>sparse_init()</code> [10/16]	149
11.1.3.206 <code>sparse_init()</code> [11/16]	149
11.1.3.207 <code>sparse_delete()</code> [6/12]	149
11.1.3.208 <code>sparse_delete()</code> [7/12]	149
11.1.3.209 <code>sparse_init()</code> [12/16]	150
11.1.3.210 <code>sparse_init()</code> [13/16]	150
11.1.3.211 <code>sparse_delete()</code> [8/12]	150
11.1.3.212 <code>sparse_delete()</code> [9/12]	150
11.1.3.213 <code>sparse_print()</code> [2/3]	150
11.1.3.214 <code>sparse_delete()</code> [10/12]	150
11.1.3.215 <code>sparse_init()</code> [14/16]	151
11.1.3.216 <code>operator&lt;&lt;()</code>	151
11.1.3.217 <code>readSmsFormat()</code>	151

11.1.3.218 readSprFormat()	151
11.1.3.219 getDataTypes() [1/4]	151
11.1.3.220 getDataTypes() [2/4]	152
11.1.3.221 getDataTypes() [3/4]	152
11.1.3.222 getDataTypes() [4/4]	152
11.1.3.223 readMachineType()	152
11.1.3.224 readDnsFormat()	152
11.1.3.225 writeDnsFormat()	152
11.1.3.226 fspmv() [2/2]	153
11.1.3.227 sparse_delete() [11/12]	153
11.1.3.228 sparse_delete() [12/12]	153
11.1.3.229 sparse_print() [3/3]	153
11.1.3.230 sparse_init() [15/16]	153
11.1.3.231 sparse_init() [16/16]	153
11.1.3.232 computeDeviation()	154
11.1.3.233 getStat()	154
11.1.3.234 ftranspose()	154
11.1.3.235 maxCardinality()	154
11.1.3.236 maxCardinality< Givaro::Modular< int64_t > >()	154
11.1.3.237 maxCardinality< Givaro::Modular< int32_t > >()	154
11.1.3.238 minCardinality()	155
11.1.3.239 fflas_delete() [1/4]	155
11.1.3.240 fflas_delete() [2/4]	155
11.1.3.241 fflas_new() [1/7]	155
11.1.3.242 fflas_new() [2/7]	155
11.1.3.243 finit_rns() [1/2]	155
11.1.3.244 finit_trans_rns()	156
11.1.3.245 fconvert_rns() [1/2]	156
11.1.3.246 fconvert_trans_rns()	156
11.1.3.247 fflas_new() [3/7]	156
11.1.3.248 fflas_new() [4/7]	156
11.1.3.249 finit_rns() [2/2]	157
11.1.3.250 fconvert_rns() [2/2]	157
11.1.3.251 freduce() [8/11]	157
11.1.3.252 freduce() [9/11]	157
11.1.3.253 finit() [7/8]	158
11.1.3.254 fconvert() [3/3]	158
11.1.3.255 fnegin() [3/4]	159
11.1.3.256 fneg() [3/4]	159
11.1.3.257 fzero() [4/5]	160
11.1.3.258 fiszero() [3/4]	160
11.1.3.259 fequal() [3/4]	160

11.1.3.260 fassign() [9/10]	161
11.1.3.261 fscaln() [9/10]	161
11.1.3.262 fscal() [9/10]	162
11.1.3.263 faxpy() [5/6]	162
11.1.3.264 fdot() [10/11]	163
11.1.3.265 fswap() [2/2]	163
11.1.3.266 fadd() [5/8]	164
11.1.3.267 fsub() [3/4]	164
11.1.3.268 faddn() [4/5]	164
11.1.3.269 fadd() [6/8]	164
11.1.3.270 fassign() [10/10]	165
11.1.3.271 fzero() [5/5]	165
11.1.3.272 fequal() [4/4]	166
11.1.3.273 fiszero() [4/4]	166
11.1.3.274 fidentity() [3/4]	166
11.1.3.275 fidentity() [4/4]	167
11.1.3.276 freduce() [10/11]	167
11.1.3.277 freduce() [11/11]	167
11.1.3.278 finit() [8/8]	168
11.1.3.279 fnegin() [4/4]	168
11.1.3.280 fneg() [4/4]	168
11.1.3.281 fscaln() [10/10]	169
11.1.3.282 fscal() [10/10]	169
11.1.3.283 faxpy() [6/6]	170
11.1.3.284 fmove() [2/2]	170
11.1.3.285 fadd() [7/8]	171
11.1.3.286 fsub() [4/4]	171
11.1.3.287 fsubin() [3/3]	172
11.1.3.288 fadd() [8/8]	172
11.1.3.289 faddn() [5/5]	173
11.1.3.290 fgemv() [17/19]	173
11.1.3.291 fger() [12/12]	174
11.1.3.292 ftrsv() [2/2]	174
11.1.3.293 ftrsm() [9/9]	175
11.1.3.294 ftrmm() [3/3]	176
11.1.3.295 fgemm() [20/23]	176
11.1.3.296 fgemm() [21/23]	177
11.1.3.297 fgemm() [22/23]	177
11.1.3.298 fgemm() [23/23]	178
11.1.3.299 fsquare() [6/6]	178
11.1.3.300 BlockCuts() [1/2]	179
11.1.3.301 BlockCuts< CuttingStrategy::Single, StrategyParameter::Threads >()	179

11.1.3.302 BlockCuts< CuttingStrategy::Row, StrategyParameter::Fixed >()	179
11.1.3.303 BlockCuts< CuttingStrategy::Row, StrategyParameter::Grain >()	179
11.1.3.304 BlockCuts< CuttingStrategy::Block, StrategyParameter::Grain >()	180
11.1.3.305 BlockCuts< CuttingStrategy::Column, StrategyParameter::Fixed >()	180
11.1.3.306 BlockCuts< CuttingStrategy::Column, StrategyParameter::Grain >()	180
11.1.3.307 BlockCuts< CuttingStrategy::Block, StrategyParameter::Fixed >()	180
11.1.3.308 BlockCuts< CuttingStrategy::Row, StrategyParameter::Threads >()	180
11.1.3.309 BlockCuts< CuttingStrategy::Column, StrategyParameter::Threads >()	181
11.1.3.310 BlockCuts< CuttingStrategy::Block, StrategyParameter::Threads >()	181
11.1.3.311 BlockCuts() [2/2]	181
11.1.3.312 pfzero()	181
11.1.3.313 pfrand()	181
11.1.3.314 fdot() [11/11]	182
11.1.3.315 pfgemm() [2/7]	182
11.1.3.316 pfgemm() [3/7]	182
11.1.3.317 pfgemm() [4/7]	183
11.1.3.318 pfgemm() [5/7]	183
11.1.3.319 pfgemm() [6/7]	183
11.1.3.320 pfgemm() [7/7]	184
11.1.3.321 fgemv() [18/19]	184
11.1.3.322 fgemv() [19/19]	184
11.1.3.323 parseArguments()	185
11.1.3.324 getArgumentValue()	185
11.1.3.325 writeCommandString()	185
11.1.3.326 WriteMatrix() [1/2]	186
11.1.3.327 preamble()	186
11.1.3.328 ReadMatrix() [1/2]	186
11.1.3.329 ReadMatrix() [2/2]	187
11.1.3.330 WriteMatrix() [2/2]	187
11.1.3.331 WritePermutation()	187
11.1.3.332 alignable()	188
11.1.3.333 alignable< Givaro::Integer * >()	188
11.1.3.334 fflas_new() [5/7]	188
11.1.3.335 fflas_new() [6/7]	188
11.1.3.336 fflas_new() [7/7]	188
11.1.3.337 fflas_delete() [3/4]	188
11.1.3.338 fflas_delete() [4/4]	189
11.1.3.339 prefetch()	189
11.1.3.340 getTLBSize()	189
11.1.3.341 queryCacheSizes()	189
11.1.3.342 queryL1CacheSize()	189
11.1.3.343 queryTopLevelCacheSize()	189

11.1.3.344 getSeed()	189
11.2 FFLAS::_frtranspose_impl Namespace Reference	190
11.2.1 Function Documentation	190
11.2.1.1 not_inplace()	190
11.2.1.2 square_inplace()	190
11.2.1.3 nonsquare_inplace_v1()	190
11.2.1.4 nonsquare_inplace_v2()	191
11.3 FFLAS::BLAS3 Namespace Reference	191
11.3.1 Function Documentation	192
11.3.1.1 Bini()	192
11.3.1.2 WinoPar()	193
11.3.1.3 Winograd()	193
11.3.1.4 WinogradAcc_3_23()	193
11.3.1.5 WinogradAcc_3_21()	194
11.3.1.6 WinogradAcc_2_24()	194
11.3.1.7 WinogradAcc_2_27()	195
11.3.1.8 WinogradAcc_LR()	195
11.3.1.9 WinogradAcc_R_S()	195
11.3.1.10 WinogradAcc_L_S()	196
11.3.1.11 Winograd_LR_S()	196
11.3.1.12 Winograd_L_S()	196
11.3.1.13 Winograd_R_S()	197
11.4 FFLAS::csr_hyb_details Namespace Reference	197
11.5 FFLAS::CuttingStrategy Namespace Reference	197
11.5.1 Typedef Documentation	198
11.5.1.1 RNSModulus	198
11.6 FFLAS::details Namespace Reference	198
11.6.1 Function Documentation	199
11.6.1.1 fadd() [1/5]	199
11.6.1.2 fadd() [2/5]	200
11.6.1.3 fadd() [3/5]	200
11.6.1.4 fadd() [4/5]	200
11.6.1.5 fadd() [5/5]	201
11.6.1.6 faxpy() [1/2]	201
11.6.1.7 faxpy() [2/2]	201
11.6.1.8 freduce() [1/4]	201
11.6.1.9 freduce() [2/4]	202
11.6.1.10 freduce() [3/4]	202
11.6.1.11 freduce() [4/4]	202
11.6.1.12 fscaln() [1/2]	202
11.6.1.13 fscal() [1/2]	203
11.6.1.14 fscaln() [2/2]	203

11.6.1.15 fscal() [2/2]	203
11.6.1.16 igebb44()	203
11.6.1.17 igebb24()	204
11.6.1.18 igebb14()	204
11.6.1.19 igebb41()	204
11.6.1.20 igebb21()	204
11.6.1.21 igebb11()	205
11.6.1.22 igebp()	205
11.6.1.23 pack_lhs()	205
11.6.1.24 pack_rhs()	205
11.6.1.25 gebp()	206
11.6.1.26 BlockingFactor()	206
11.7 FFLAS::details_spmv Namespace Reference	206
11.8 FFLAS::ElementCategories Namespace Reference	206
11.9 FFLAS::FieldCategories Namespace Reference	206
11.9.1 Detailed Description	207
11.10 FFLAS::MMHelperAlgo Namespace Reference	207
11.11 FFLAS::ModeCategories Namespace Reference	207
11.11.1 Detailed Description	207
11.12 FFLAS::ParSeqHelper Namespace Reference	208
11.12.1 Detailed Description	208
11.13 FFLAS::Protected Namespace Reference	208
11.13.1 Function Documentation	211
11.13.1.1 computeFactorClassic() [1/3]	211
11.13.1.2 computeFactorClassic() [2/3]	211
11.13.1.3 computeFactorClassic() [3/3]	212
11.13.1.4 DotProdBoundClassic()	212
11.13.1.5 TRSMBound() [1/3]	212
11.13.1.6 TRSMBound() [2/3]	212
11.13.1.7 TRSMBound() [3/3]	212
11.13.1.8 fgemm_convert()	213
11.13.1.9 NeedPreAddReduction() [1/2]	213
11.13.1.10 NeedPreAddReduction() [2/2]	213
11.13.1.11 NeedPreSubReduction() [1/2]	213
11.13.1.12 NeedPreSubReduction() [2/2]	214
11.13.1.13 NeedDoublePreAddReduction() [1/2]	214
11.13.1.14 NeedDoublePreAddReduction() [2/2]	214
11.13.1.15 ScalAndReduce() [1/3]	214
11.13.1.16 ScalAndReduce() [2/3]	215
11.13.1.17 fsquareCommon()	215
11.13.1.18 WinogradThreshold() [1/4]	215
11.13.1.19 WinogradThreshold() [2/4]	215

11.13.1.20 WinogradThreshold() [3/4]	215
11.13.1.21 WinogradThreshold() [4/4]	216
11.13.1.22 WinogradSteps()	216
11.13.1.23 DynamicPeeling()	216
11.13.1.24 DynamicPeeling2()	217
11.13.1.25 WinogradCalc()	217
11.13.1.26 fgemv_convert()	217
11.13.1.27 fger_convert()	218
11.13.1.28 fsyrk_convert()	218
11.13.1.29 ScalAndReduce() [3/3]	218
11.13.1.30 NeedPreScalReduction() [1/2]	219
11.13.1.31 NeedPreScalReduction() [2/2]	219
11.13.1.32 NeedPreAxyReduction() [1/2]	219
11.13.1.33 NeedPreAxyReduction() [2/2]	219
11.13.1.34 min_types() [1/7]	219
11.13.1.35 min_types() [2/7]	220
11.13.1.36 min_types() [3/7]	220
11.13.1.37 min_types() [4/7]	220
11.13.1.38 min_types() [5/7]	220
11.13.1.39 min_types() [6/7]	220
11.13.1.40 min_types() [7/7]	220
11.13.1.41 unfit() [1/4]	220
11.13.1.42 unfit() [2/4]	220
11.13.1.43 unfit() [3/4]	221
11.13.1.44 unfit() [4/4]	221
11.13.1.45 igemm_colmajor() [1/2]	221
11.13.1.46 igemm_colmajor() [2/2]	221
11.13.1.47 igemm()	221
11.13.1.48 MatF2MatD_Triangular()	222
11.13.1.49 MatF2MatFI_Triangular()	222
11.14 FFLAS::sell_details Namespace Reference	222
11.15 FFLAS::sparse_details Namespace Reference	223
11.15.1 Function Documentation	226
11.15.1.1 init_y() [1/2]	226
11.15.1.2 init_y() [2/2]	226
11.15.1.3 fspmv_dispatch() [1/2]	226
11.15.1.4 fspmv_dispatch() [2/2]	226
11.15.1.5 fspmv() [1/12]	227
11.15.1.6 fspmv() [2/12]	227
11.15.1.7 fspmv() [3/12]	227
11.15.1.8 fspmv() [4/12]	227
11.15.1.9 fspmv() [5/12]	227

11.15.1.10 fspmv()	[ 6/12]	228
11.15.1.11 fspmv()	[ 7/12]	228
11.15.1.12 fspmv()	[ 8/12]	228
11.15.1.13 fspmv()	[ 9/12]	228
11.15.1.14 fspmm_dispatch()	[ 1/2]	229
11.15.1.15 fspmm_dispatch()	[ 2/2]	229
11.15.1.16 fspmm()	[ 1/9]	229
11.15.1.17 fspmm()	[ 2/9]	229
11.15.1.18 fspmm()	[ 3/9]	230
11.15.1.19 fspmm()	[ 4/9]	230
11.15.1.20 fspmm()	[ 5/9]	230
11.15.1.21 fspmm()	[ 6/9]	231
11.15.1.22 fspmm()	[ 7/9]	231
11.15.1.23 fspmm()	[ 8/9]	231
11.15.1.24 fspmm()	[ 9/9]	231
11.15.1.25 pfspmm_dispatch()	[ 1/2]	232
11.15.1.26 pfspmm_dispatch()	[ 2/2]	232
11.15.1.27 pfspmm()	[ 1/9]	232
11.15.1.28 pfspmm()	[ 2/9]	232
11.15.1.29 pfspmm()	[ 3/9]	233
11.15.1.30 pfspmm()	[ 4/9]	233
11.15.1.31 pfspmm()	[ 5/9]	233
11.15.1.32 pfspmm()	[ 6/9]	234
11.15.1.33 pfspmm()	[ 7/9]	234
11.15.1.34 pfspmm()	[ 8/9]	234
11.15.1.35 pfspmm()	[ 9/9]	234
11.15.1.36 pfspmv()	[ 1/6]	235
11.15.1.37 pfspmv()	[ 2/6]	235
11.15.1.38 pfspmv()	[ 3/6]	235
11.15.1.39 pfspmv()	[ 4/6]	235
11.15.1.40 pfspmv()	[ 5/6]	235
11.15.1.41 pfspmv()	[ 6/6]	236
11.15.1.42 fspmv()	[10/12]	236
11.15.1.43 fspmv()	[11/12]	236
11.15.1.44 fspmv()	[12/12]	236
11.16 FFLAS::sparse_details_impl Namespace Reference		237
11.16.1 Function Documentation		245
11.16.1.1 fspmm()	[ 1/15]	245
11.16.1.2 fspmm()	[ 2/15]	245
11.16.1.3 fspmm()	[ 3/15]	246
11.16.1.4 fspmm_simd_aligned()	[ 1/2]	246
11.16.1.5 fspmm_simd_unaligned()	[ 1/2]	246



11.16.1.6 fspmm_one() [1/4]	246
11.16.1.7 fspmm_mone() [1/4]	247
11.16.1.8 fspmm_one_simd_aligned() [1/3]	247
11.16.1.9 fspmm_one_simd_unaligned() [1/3]	247
11.16.1.10 fspmm_mone_simd_aligned() [1/3]	247
11.16.1.11 fspmm_mone_simd_unaligned() [1/3]	248
11.16.1.12 fspmv() [1/21]	248
11.16.1.13 fspmv() [2/21]	248
11.16.1.14 fspmv() [3/21]	248
11.16.1.15 fspmv_one() [1/10]	248
11.16.1.16 fspmv_mone() [1/10]	249
11.16.1.17 fspmv_one() [2/10]	249
11.16.1.18 fspmv_mone() [2/10]	249
11.16.1.19 pfspmm() [1/18]	249
11.16.1.20 pfspmm() [2/18]	249
11.16.1.21 pfspmm() [3/18]	250
11.16.1.22 pfspmm_one() [1/2]	250
11.16.1.23 pfspmm_mone() [1/2]	250
11.16.1.24 pfspmm_one() [2/2]	250
11.16.1.25 pfspmm_mone() [2/2]	251
11.16.1.26 pfspmv() [1/18]	251
11.16.1.27 pfspmv_task()	251
11.16.1.28 pfspmv() [2/18]	251
11.16.1.29 pfspmv() [3/18]	251
11.16.1.30 pfspmv_one() [1/8]	252
11.16.1.31 pfspmv_mone() [1/8]	252
11.16.1.32 pfspmv_one() [2/8]	252
11.16.1.33 pfspmv_mone() [2/8]	252
11.16.1.34 fspmm() [4/15]	252
11.16.1.35 fspmm() [5/15]	253
11.16.1.36 fspmm_simd_aligned() [2/2]	253
11.16.1.37 fspmm_simd_unaligned() [2/2]	253
11.16.1.38 fspmm() [6/15]	253
11.16.1.39 fspmm_one() [2/4]	254
11.16.1.40 fspmm_mone() [2/4]	254
11.16.1.41 fspmm_one_simd_aligned() [2/3]	254
11.16.1.42 fspmm_one_simd_unaligned() [2/3]	254
11.16.1.43 fspmm_mone_simd_aligned() [2/3]	255
11.16.1.44 fspmm_mone_simd_unaligned() [2/3]	255
11.16.1.45 fspmv() [4/21]	255
11.16.1.46 fspmv() [5/21]	255
11.16.1.47 fspmv() [6/21]	255

11.16.1.48 fspmv_one() [3/10]	256
11.16.1.49 fspmv_mone() [3/10]	256
11.16.1.50 fspmv_one() [4/10]	256
11.16.1.51 fspmv_mone() [4/10]	256
11.16.1.52 pfsppmm() [4/18]	256
11.16.1.53 pfsppmm() [5/18]	257
11.16.1.54 pfsppmm() [6/18]	257
11.16.1.55 pfsppmm() [7/18]	257
11.16.1.56 pfsppmm() [8/18]	257
11.16.1.57 pfsppmm() [9/18]	258
11.16.1.58 pfsppmv() [4/18]	258
11.16.1.59 pfsppmv() [5/18]	258
11.16.1.60 pfsppmv() [6/18]	258
11.16.1.61 fspmm() [7/15]	258
11.16.1.62 fspmm() [8/15]	259
11.16.1.63 fspmm() [9/15]	259
11.16.1.64 fspmv() [7/21]	259
11.16.1.65 fspmv() [8/21]	259
11.16.1.66 fspmv() [9/21]	259
11.16.1.67 pfsppmm() [10/18]	260
11.16.1.68 pfsppmm() [11/18]	260
11.16.1.69 pfsppmm() [12/18]	260
11.16.1.70 pfsppmm() [13/18]	260
11.16.1.71 pfsppmm() [14/18]	261
11.16.1.72 pfsppmm() [15/18]	261
11.16.1.73 pfsppmm_zo() [1/2]	261
11.16.1.74 pfsppmm_zo() [2/2]	261
11.16.1.75 pfsppmv() [7/18]	262
11.16.1.76 pfsppmv() [8/18]	262
11.16.1.77 pfsppmv() [9/18]	262
11.16.1.78 pfsppmv_one() [3/8]	262
11.16.1.79 pfsppmv_mone() [3/8]	262
11.16.1.80 pfsppmv_one() [4/8]	263
11.16.1.81 pfsppmv_mone() [4/8]	263
11.16.1.82 fspmm() [10/15]	263
11.16.1.83 fspmm() [11/15]	263
11.16.1.84 fspmm() [12/15]	264
11.16.1.85 fspmm_mone() [3/4]	264
11.16.1.86 fspmm_one() [3/4]	264
11.16.1.87 fspmm_mone() [4/4]	264
11.16.1.88 fspmm_one() [4/4]	265
11.16.1.89 fspmm_one_simd_aligned() [3/3]	265

11.16.1.90 fspmm_one_simd_unaligned() [3/3]	265
11.16.1.91 fspmm_mone_simd_aligned() [3/3]	265
11.16.1.92 fspmm_mone_simd_unaligned() [3/3]	266
11.16.1.93 fspmv() [10/21]	266
11.16.1.94 fspmv() [11/21]	266
11.16.1.95 fspmv() [12/21]	266
11.16.1.96 fspmv_one() [5/10]	266
11.16.1.97 fspmv_mone() [5/10]	267
11.16.1.98 fspmv_one() [6/10]	267
11.16.1.99 fspmv_mone() [6/10]	267
11.16.1.100 pfspmv() [10/18]	267
11.16.1.101 pfspmv() [11/18]	267
11.16.1.102 pfspmv() [12/18]	268
11.16.1.103 pfspmv_one() [5/8]	268
11.16.1.104 pfspmv_mone() [5/8]	268
11.16.1.105 pfspmv_one() [6/8]	268
11.16.1.106 pfspmv_mone() [6/8]	268
11.16.1.107 fspmv() [13/21]	269
11.16.1.108 fspmv_simd() [1/4]	269
11.16.1.109 fspmv() [14/21]	269
11.16.1.110 fspmv_simd() [2/4]	269
11.16.1.111 fspmv() [15/21]	269
11.16.1.112 fspmv_one() [7/10]	270
11.16.1.113 fspmv_mone() [7/10]	270
11.16.1.114 fspmv_one() [8/10]	270
11.16.1.115 fspmv_mone() [8/10]	270
11.16.1.116 fspmv_one_simd() [1/2]	270
11.16.1.117 fspmv_mone_simd() [1/2]	271
11.16.1.118 pfspmm() [16/18]	271
11.16.1.119 pfspmm() [17/18]	271
11.16.1.120 pfspmm() [18/18]	271
11.16.1.121 pfspmv() [13/18]	272
11.16.1.122 pfspmv() [14/18]	272
11.16.1.123 pfspmv() [15/18]	272
11.16.1.124 fspmm() [13/15]	272
11.16.1.125 fspmm() [14/15]	272
11.16.1.126 fspmm() [15/15]	273
11.16.1.127 fspmv() [16/21]	273
11.16.1.128 fspmv() [17/21]	273
11.16.1.129 fspmv() [18/21]	273
11.16.1.130 pfspmv() [16/18]	273
11.16.1.131 pfspmv() [17/18]	274

11.16.1.132 pfspmv() [18/18]	274
11.16.1.133 pfspmv_one() [7/8]	274
11.16.1.134 pfspmv_mone() [7/8]	274
11.16.1.135 pfspmv_one() [8/8]	274
11.16.1.136 pfspmv_mone() [8/8]	275
11.16.1.137 fspmv() [19/21]	275
11.16.1.138 fspmv_simd() [3/4]	275
11.16.1.139 fspmv() [20/21]	275
11.16.1.140 fspmv_simd() [4/4]	275
11.16.1.141 fspmv() [21/21]	276
11.16.1.142 fspmv_one() [9/10]	276
11.16.1.143 fspmv_mone() [9/10]	276
11.16.1.144 fspmv_one_simd() [2/2]	276
11.16.1.145 fspmv_mone_simd() [2/2]	276
11.16.1.146 fspmv_one() [10/10]	277
11.16.1.147 fspmv_mone() [10/10]	277
11.17 FFLAS::StrategyParameter Namespace Reference	277
11.18 FFLAS::StructureHelper Namespace Reference	277
11.18.1 Detailed Description	277
11.19 FFLAS::vectorised Namespace Reference	278
11.19.1 Function Documentation	279
11.19.1.1 VEC_ADD()	279
11.19.1.2 addp()	279
11.19.1.3 VEC_SUB()	280
11.19.1.4 subp()	280
11.19.1.5 add()	280
11.19.1.6 sub()	280
11.19.1.7 axpyp() [1/2]	280
11.19.1.8 axpyp() [2/2]	281
11.19.1.9 reduce() [1/9]	281
11.19.1.10 reduce() [2/9]	281
11.19.1.11 reduce() [3/9]	281
11.19.1.12 reduce() [4/9]	281
11.19.1.13 reduce() [5/9]	281
11.19.1.14 reduce() [6/9]	282
11.19.1.15 reduce() [7/9]	282
11.19.1.16 reduce() [8/9]	282
11.19.1.17 reduce() [9/9]	282
11.19.1.18 modp() [1/2]	282
11.19.1.19 modp() [2/2]	282
11.19.1.20 scalp() [1/3]	283
11.19.1.21 scalp() [2/3]	283

11.19.1.22 scalp() [3/3]	283
11.20 FFLAS::vectorised::unswitch Namespace Reference	283
11.20.1 Function Documentation	284
11.20.1.1 axpyp() [1/2]	284
11.20.1.2 axpyp() [2/2]	284
11.20.1.3 modp() [1/2]	285
11.20.1.4 modp() [2/2]	285
11.20.1.5 scalp() [1/3]	285
11.20.1.6 scalp() [2/3]	285
11.20.1.7 scalp() [3/3]	286
11.21 FFPACK Namespace Reference	286
11.21.1 Detailed Description	302
11.21.2 Typedef Documentation	302
11.21.2.1 Checker_PLUQ	302
11.21.2.2 Checker_Det	303
11.21.2.3 Checker_invert	303
11.21.2.4 Checker_charpoly	303
11.21.2.5 ForceCheck_PLUQ	303
11.21.2.6 ForceCheck_Det	303
11.21.2.7 ForceCheck_invert	303
11.21.2.8 ForceCheck_charpoly	303
11.21.3 Function Documentation	303
11.21.3.1 LAPACKPerm2MathPerm()	303
11.21.3.2 MathPerm2LAPACKPerm()	304
11.21.3.3 applyP() [1/4]	304
11.21.3.4 applyP() [2/4]	305
11.21.3.5 applyP() [3/4]	305
11.21.3.6 MonotonicApplyP()	305
11.21.3.7 fgetrs() [1/4]	306
11.21.3.8 fgetrs() [2/4]	307
11.21.3.9 fgesv() [1/4]	307
11.21.3.10 fgesv() [2/4]	308
11.21.3.11 ftrtri() [1/2]	309
11.21.3.12 trinv_left() [1/2]	309
11.21.3.13 ftrtrm() [1/2]	310
11.21.3.14 ftrstr()	310
11.21.3.15 ftrssyr2k()	311
11.21.3.16 fsytrf() [1/3]	311
11.21.3.17 fsytrf() [2/3]	312
11.21.3.18 fsytrf() [3/3]	312
11.21.3.19 fsytrf_nonunit() [1/3]	312
11.21.3.20 PLUQ() [1/6]	313

11.21.3.21 pPLUQ()	314
11.21.3.22 PLUQ() [2/6]	314
11.21.3.23 PLUQ() [3/6]	314
11.21.3.24 LUdivine() [1/4]	314
11.21.3.25 ColumnEchelonForm() [1/3]	315
11.21.3.26 pColumnEchelonForm()	316
11.21.3.27 ColumnEchelonForm() [2/3]	316
11.21.3.28 RowEchelonForm() [1/3]	316
11.21.3.29 pRowEchelonForm()	317
11.21.3.30 RowEchelonForm() [2/3]	317
11.21.3.31 ReducedColumnEchelonForm() [1/3]	318
11.21.3.32 pReducedColumnEchelonForm()	318
11.21.3.33 ReducedColumnEchelonForm() [2/3]	318
11.21.3.34 ReducedRowEchelonForm() [1/3]	319
11.21.3.35 pReducedRowEchelonForm()	319
11.21.3.36 ReducedRowEchelonForm() [2/3]	320
11.21.3.37 Invert() [1/4]	320
11.21.3.38 Invert() [2/4]	320
11.21.3.39 Invert2() [1/2]	321
11.21.3.40 CharPoly() [1/8]	322
11.21.3.41 CharPoly() [2/8]	322
11.21.3.42 CharPoly() [3/8]	323
11.21.3.43 MinPoly() [1/4]	323
11.21.3.44 MinPoly() [2/4]	324
11.21.3.45 MatVecMinPoly() [1/2]	324
11.21.3.46 Rank() [1/3]	325
11.21.3.47 pRank()	325
11.21.3.48 Rank() [2/3]	325
11.21.3.49 IsSingular() [1/2]	326
11.21.3.50 Det() [1/6]	326
11.21.3.51 pDet()	327
11.21.3.52 Det() [2/6]	327
11.21.3.53 Solve() [1/3]	327
11.21.3.54 Solve() [2/3]	328
11.21.3.55 pSolve()	328
11.21.3.56 RandomNullSpaceVector() [1/3]	328
11.21.3.57 NullSpaceBasis() [1/2]	329
11.21.3.58 RowRankProfile() [1/3]	329
11.21.3.59 pRowRankProfile()	330
11.21.3.60 RowRankProfile() [2/3]	330
11.21.3.61 ColumnRankProfile() [1/3]	330
11.21.3.62 pColumnRankProfile()	331

11.21.3.63 ColumnRankProfile() [2/3]	331
11.21.3.64 RankProfileFromLU()	331
11.21.3.65 LeadingSubmatrixRankProfiles()	332
11.21.3.66 RowRankProfileSubmatrixIndices() [1/2]	332
11.21.3.67 ColRankProfileSubmatrixIndices() [1/2]	333
11.21.3.68 RowRankProfileSubmatrix() [1/2]	334
11.21.3.69 ColRankProfileSubmatrix() [1/2]	334
11.21.3.70 getTriangular() [1/2]	335
11.21.3.71 getTriangular() [2/2]	335
11.21.3.72 getEchelonForm() [1/2]	336
11.21.3.73 getEchelonForm() [2/2]	337
11.21.3.74 getEchelonTransform()	337
11.21.3.75 getReducedEchelonForm() [1/2]	338
11.21.3.76 getReducedEchelonForm() [2/2]	339
11.21.3.77 getReducedEchelonTransform()	339
11.21.3.78 PLUQtoEchelonPermutation()	340
11.21.3.79 LTBruhatGen()	340
11.21.3.80 getLTBruhatGen() [1/2]	341
11.21.3.81 getLTBruhatGen() [2/2]	341
11.21.3.82 LTQSorder()	342
11.21.3.83 CompressToBlockBiDiagonal()	342
11.21.3.84 ExpandBlockBiDiagonalToBruhat()	343
11.21.3.85 Bruhat2EchelonPermutation()	344
11.21.3.86 TInverter() [1/2]	344
11.21.3.87 ComputeRPermutation() [1/2]	344
11.21.3.88 productBruhatxTS() [1/2]	344
11.21.3.89 LQUPtoInverseOfFullRankMinor() [1/2]	345
11.21.3.90 RandomNullSpaceVector() [2/3]	346
11.21.3.91 solveLB() [1/2]	346
11.21.3.92 solveLB2() [1/2]	346
11.21.3.93 TInverter() [2/2]	347
11.21.3.94 ComputeRPermutation() [2/2]	347
11.21.3.95 expandLCRE()	347
11.21.3.96 productBruhatxTS() [2/2]	348
11.21.3.97 Danilevski()	349
11.21.3.98 buildMatrix()	349
11.21.3.99 CharPoly() [4/8]	349
11.21.3.100 CharPoly() [5/8]	350
11.21.3.101 Det() [3/6]	350
11.21.3.102 Det() [4/6]	350
11.21.3.103 fsytrf_BC_Crout()	350
11.21.3.104 fsytrf_BC_RL()	351

11.21.3.105 fsytrf_UP_RPM_BC_RL()	351
11.21.3.106 fsytrf_LOW_RPM_BC_Crout()	351
11.21.3.107 fsytrf_UP_RPM_BC_Crout()	351
11.21.3.108 fsytrf_UP_RPM()	352
11.21.3.109 fsytrf_nonunit() [2/3]	352
11.21.3.110 fsytrf_nonunit() [3/3]	352
11.21.3.111 fsytrf_RPM()	352
11.21.3.112 getTridiagonal()	353
11.21.3.113 LUdivine_gauss() [1/2]	353
11.21.3.114 LUdivine_small() [1/2]	353
11.21.3.115 LUdivine() [2/4]	353
11.21.3.116 LUdivine() [3/4]	354
11.21.3.117 MonotonicCompress()	354
11.21.3.118 MonotonicCompressMorePivots()	354
11.21.3.119 MonotonicCompressCycles()	355
11.21.3.120 MonotonicExpand()	355
11.21.3.121 applyP_block()	355
11.21.3.122 doApplyS()	355
11.21.3.123 MatrixApplyS() [1/3]	356
11.21.3.124 MatrixApplyS() [2/3]	356
11.21.3.125 MatrixApplyS() [3/3]	356
11.21.3.126 PermApplyS()	356
11.21.3.127 doApplyT()	357
11.21.3.128 MatrixApplyT() [1/3]	357
11.21.3.129 MatrixApplyT() [2/3]	357
11.21.3.130 MatrixApplyT() [3/3]	357
11.21.3.131 PermApplyT()	358
11.21.3.132 composePermutationsLLL()	358
11.21.3.133 composePermutationsLLM()	358
11.21.3.134 composePermutationsMLM()	359
11.21.3.135 cyclic_shift_mathPerm()	359
11.21.3.136 cyclic_shift_row_col() [1/2]	359
11.21.3.137 cyclic_shift_row() [1/3]	359
11.21.3.138 cyclic_shift_row() [2/3]	360
11.21.3.139 cyclic_shift_col() [1/3]	360
11.21.3.140 cyclic_shift_col() [2/3]	360
11.21.3.141 PLUQ_basecaseV3()	360
11.21.3.142 PLUQ_basecaseV2()	360
11.21.3.143 PLUQ_basecaseCrout()	361
11.21.3.144 _PLUQ()	361
11.21.3.145 PLUQ() [4/6]	361
11.21.3.146 threads_fgemm()	361



11.21.3.147 threads_ftrsm()	362
11.21.3.148 PLUQ() [5/6]	362
11.21.3.149 fflas_const_cast() [1/3]	362
11.21.3.150 fflas_const_cast() [2/3]	362
11.21.3.151 cyclic_shift_row_col() [2/2]	362
11.21.3.152 cyclic_shift_row() [3/3]	363
11.21.3.153 cyclic_shift_col() [3/3]	363
11.21.3.154 applyP() [4/4]	363
11.21.3.155 fgetrs() [3/4]	363
11.21.3.156 fgetrs() [4/4]	364
11.21.3.157 fgesv() [3/4]	364
11.21.3.158 fgesv() [4/4]	364
11.21.3.159 ftrtri() [2/2]	364
11.21.3.160 trinv_left() [2/2]	365
11.21.3.161 ftrtm() [2/2]	365
11.21.3.162 PLUQ() [6/6]	365
11.21.3.163 LUdivine() [4/4]	365
11.21.3.164 LUdivine_small() [2/2]	366
11.21.3.165 LUdivine_gauss() [2/2]	366
11.21.3.166 RowEchelonForm() [3/3]	366
11.21.3.167 ReducedRowEchelonForm() [3/3]	366
11.21.3.168 ColumnEchelonForm() [3/3]	367
11.21.3.169 ReducedColumnEchelonForm() [3/3]	367
11.21.3.170 Invert() [3/4]	367
11.21.3.171 Invert() [4/4]	367
11.21.3.172 Invert2() [2/2]	367
11.21.3.173 CharPoly() [6/8]	368
11.21.3.174 CharPoly() [7/8]	368
11.21.3.175 CharPoly() [8/8]	368
11.21.3.176 MinPoly() [3/4]	368
11.21.3.177 MinPoly() [4/4]	368
11.21.3.178 MatVecMinPoly() [2/2]	369
11.21.3.179 KrylovElim()	369
11.21.3.180 SpecRankProfile()	369
11.21.3.181 Rank() [3/3]	369
11.21.3.182 IsSingular() [2/2]	369
11.21.3.183 Det() [5/6]	370
11.21.3.184 Det() [6/6]	370
11.21.3.185 Solve() [3/3]	370
11.21.3.186 solveLB() [2/2]	370
11.21.3.187 solveLB2() [2/2]	371
11.21.3.188 RandomNullSpaceVector() [3/3]	371

11.21.3.189 NullSpaceBasis() [2/2]	371
11.21.3.190 RowRankProfile() [3/3]	371
11.21.3.191 ColumnRankProfile() [3/3]	372
11.21.3.192 RowRankProfileSubmatrixIndices() [2/2]	372
11.21.3.193 ColRankProfileSubmatrixIndices() [2/2]	372
11.21.3.194 RowRankProfileSubmatrix() [2/2]	372
11.21.3.195 ColRankProfileSubmatrix() [2/2]	372
11.21.3.196 getTriangular< FFLAS_FIELD< FFLAS_ELT > >() [1/2]	373
11.21.3.197 getTriangular< FFLAS_FIELD< FFLAS_ELT > >() [2/2]	373
11.21.3.198 getEchelonForm< FFLAS_FIELD< FFLAS_ELT > >() [1/2]	373
11.21.3.199 getEchelonForm< FFLAS_FIELD< FFLAS_ELT > >() [2/2]	373
11.21.3.200 getEchelonTransform< FFLAS_FIELD< FFLAS_ELT > >() [1/2]	374
11.21.3.201 getReducedEchelonForm< FFLAS_FIELD< FFLAS_ELT > >() [1/2]	374
11.21.3.202 getReducedEchelonForm< FFLAS_FIELD< FFLAS_ELT > >() [2/2]	374
11.21.3.203 getReducedEchelonTransform< FFLAS_FIELD< FFLAS_ELT > >() [1/2]	374
11.21.3.204 LQUPtoInverseOfFullRankMinor() [2/2]	375
11.21.3.205 fflas_const_cast() [3/3]	375
11.21.3.206 failure()	375
11.21.3.207 isOdd() [1/3]	375
11.21.3.208 isOdd() [2/3]	375
11.21.3.209 isOdd() [3/3]	375
11.21.3.210 NonZeroRandomMatrix() [1/2]	376
11.21.3.211 NonZeroRandomMatrix() [2/2]	376
11.21.3.212 RandomMatrix() [1/2]	377
11.21.3.213 RandomMatrix() [2/2]	377
11.21.3.214 RandomTriangularMatrix() [1/2]	378
11.21.3.215 RandomTriangularMatrix() [2/2]	378
11.21.3.216 RandInt()	379
11.21.3.217 RandomSymmetricMatrix()	379
11.21.3.218 RandomMatrixWithRank() [1/2]	380
11.21.3.219 RandomMatrixWithRank() [2/2]	380
11.21.3.220 RandomIndexSubset()	381
11.21.3.221 RandomPermutation()	381
11.21.3.222 RandomRankProfileMatrix()	381
11.21.3.223 swapval()	382
11.21.3.224 RandomSymmetricRankProfileMatrix()	382
11.21.3.225 RandomLTQSRankProfileMatrix()	382
11.21.3.226 RandomMatrixWithRankandRPM() [1/2]	382
11.21.3.227 RandomMatrixWithRankandRPM() [2/2]	383
11.21.3.228 RandomSymmetricMatrixWithRankandRPM() [1/2]	384
11.21.3.229 RandomSymmetricMatrixWithRankandRPM() [2/2]	384
11.21.3.230 RandomMatrixWithRankandRandomRPM() [1/2]	385

11.21.3.231 RandomMatrixWithRankandRandomRPM() [2/2]	385
11.21.3.232 RandomSymmetricMatrixWithRankandRandomRPM() [1/2]	386
11.21.3.233 RandomSymmetricMatrixWithRankandRandomRPM() [2/2]	386
11.21.3.234 RandomMatrixWithDet() [1/2]	387
11.21.3.235 RandomMatrixWithDet() [2/2]	387
11.21.3.236 RandomLTQSMatrixWithRankandQSorder()	388
11.21.3.237 chooseField()	388
11.21.3.238 chooseField< Givaro::ZRing< int32_t > >()	388
11.21.3.239 chooseField< Givaro::ZRing< int64_t > >()	388
11.21.3.240 chooseField< Givaro::ZRing< float > >()	389
11.21.3.241 chooseField< Givaro::ZRing< double > >()	389
11.22 FFPACK::Protected Namespace Reference	389
11.22.1 Function Documentation	390
11.22.1.1 LUdivine_construct() [1/2]	390
11.22.1.2 GaussJordan()	391
11.22.1.3 KellerGehrig()	392
11.22.1.4 KGFast()	392
11.22.1.5 KGFast_generalized()	392
11.22.1.6 fgmv_kgf()	392
11.22.1.7 LUKrylov()	392
11.22.1.8 Danilevski()	393
11.22.1.9 RandomKrylovPrecond()	393
11.22.1.10 ArithProg()	393
11.22.1.11 LUKrylov_KGFast()	393
11.22.1.12 MatVecMinPoly()	394
11.22.1.13 Hybrid_KGF_LUK_MinPoly()	394
11.22.1.14 updateD()	394
11.22.1.15 newD()	394
11.22.1.16 CompressRows()	394
11.22.1.17 CompressRowsQK()	395
11.22.1.18 DeCompressRows()	395
11.22.1.19 DeCompressRowsQK()	395
11.22.1.20 CompressRowsQA()	395
11.22.1.21 DeCompressRowsQA()	396
11.22.1.22 LUdivine_construct() [2/2]	396
11.23 Givaro Namespace Reference	396
11.24 MKL_CONFIG Namespace Reference	396
11.25 Reclnt Namespace Reference	396
<b>12 Data Structure Documentation</b>	<b>397</b>
12.1 AlgoChooser< ModeT, ParSeq > Struct Template Reference	397
12.1.1 Member Typedef Documentation	397

12.1.1.1 value . . . . .	397
12.2 AlgoChooser< ModeCategories::ConvertTo< ElementCategories::RNSElementTag >, ParSeq > Struct Template Reference . . . . .	397
12.2.1 Member Typedef Documentation . . . . .	397
12.2.1.1 value [1/2] . . . . .	397
12.2.1.2 value [2/2] . . . . .	397
12.3 ALL< v > Struct Template Reference . . . . .	397
12.4 ALL< false, v... > Struct Template Reference . . . . .	398
12.4.1 Field Documentation . . . . .	398
12.4.1.1 value . . . . .	398
12.5 ALL< true, v... > Struct Template Reference . . . . .	398
12.5.1 Field Documentation . . . . .	398
12.5.1.1 value . . . . .	398
12.6 ALL<> Struct Reference . . . . .	398
12.6.1 Field Documentation . . . . .	398
12.6.1.1 value . . . . .	398
12.7 ArbitraryPrecIntTag Struct Reference . . . . .	398
12.7.1 Detailed Description . . . . .	398
12.8 AreEqual< X, Y > Class Template Reference . . . . .	399
12.8.1 Field Documentation . . . . .	399
12.8.1.1 value . . . . .	399
12.9 AreEqual< X, X > Class Template Reference . . . . .	399
12.9.1 Field Documentation . . . . .	399
12.9.1.1 value [1/2] . . . . .	399
12.9.1.2 value [2/2] . . . . .	399
12.10 Argument Struct Reference . . . . .	399
12.10.1 Field Documentation . . . . .	399
12.10.1.1 c . . . . .	399
12.10.1.2 example . . . . .	400
12.10.1.3 helpString . . . . .	400
12.10.1.4 type . . . . .	400
12.10.1.5 data . . . . .	400
12.11 array< T > Class Template Reference . . . . .	400
12.11.1 Detailed Description . . . . .	400
12.11.2 Field Documentation . . . . .	400
12.11.2.1 elements . . . . .	400
12.12 associatedDelayedField< Field > Struct Template Reference . . . . .	400
12.12.1 Member Typedef Documentation . . . . .	401
12.12.1.1 field . . . . .	401
12.12.1.2 type . . . . .	401
12.13 associatedDelayedField< const FFPACK::RNSIntegerMod< RNS > > Struct Template Reference . . . . .	401
12.13.1 Member Typedef Documentation . . . . .	401

12.13.1.1 field [1/2]	401
12.13.1.2 type [1/2]	401
12.13.1.3 field [2/2]	401
12.13.1.4 type [2/2]	401
12.14 associatedDelayedField< const Givaro::Modular< T, X > > Struct Template Reference	401
12.14.1 Member Typedef Documentation	402
12.14.1.1 field [1/2]	402
12.14.1.2 type [1/2]	402
12.14.1.3 field [2/2]	402
12.14.1.4 type [2/2]	402
12.15 associatedDelayedField< const Givaro::ModularBalanced< T > > Struct Template Reference	402
12.15.1 Member Typedef Documentation	402
12.15.1.1 field [1/2]	402
12.15.1.2 type [1/2]	402
12.15.1.3 field [2/2]	402
12.15.1.4 type [2/2]	403
12.16 associatedDelayedField< const Givaro::ZRing< T > > Struct Template Reference	403
12.16.1 Member Typedef Documentation	403
12.16.1.1 field [1/2]	403
12.16.1.2 type [1/2]	403
12.16.1.3 field [2/2]	403
12.16.1.4 type [2/2]	403
12.17 Auto Struct Reference	403
12.18 Bench< Elt > Class Template Reference	403
12.18.1 Member Typedef Documentation	404
12.18.1.1 Field	404
12.18.1.2 Elt_ptr	404
12.18.1.3 Residu	404
12.18.1.4 enable_if_t	404
12.18.1.5 is_same_element	405
12.18.1.6 enable_if_no_simd_t	405
12.18.1.7 enable_if_simd128_t	405
12.18.1.8 enable_if_simd256_t	405
12.18.1.9 enable_if_simd512_t	405
12.18.2 Constructor & Destructor Documentation	405
12.18.2.1 Bench()	405
12.18.3 Member Function Documentation	405
12.18.3.1 cardinality() [1/2]	405
12.18.3.2 cardinality() [2/2]	405
12.18.3.3 doBenchs()	405
12.18.3.4 run()	406
12.18.4 Field Documentation	406

12.18.4.1 F	406
12.18.4.2 m	406
12.18.4.3 n	406
12.18.4.4 iters	406
12.18.4.5 inplace	406
12.19 Bini Struct Reference	406
12.20 Block Struct Reference	406
12.21 BlockTransposeSIMD< Field, Simd, > Struct Template Reference	406
12.21.1 Member Function Documentation	407
12.21.1.1 size()	407
12.21.1.2 info()	407
12.21.1.3 transpose() [1/5]	407
12.21.1.4 transpose() [2/5]	407
12.21.1.5 transpose() [3/5]	408
12.21.1.6 transpose() [4/5]	408
12.21.1.7 transpose() [5/5]	408
12.22 callLUdivine_small< Element > Class Template Reference	408
12.22.1 Member Function Documentation	408
12.22.1.1 operator()	408
12.23 callLUdivine_small< double > Class Reference	409
12.23.1 Member Function Documentation	409
12.23.1.1 operator() [1/2]	409
12.23.1.2 operator() [2/2]	409
12.24 callLUdivine_small< float > Class Reference	410
12.24.1 Member Function Documentation	410
12.24.1.1 operator() [1/2]	410
12.24.1.2 operator() [2/2]	410
12.25 CharpolyFailed Class Reference	410
12.26 Checker_Empty< Field > Struct Template Reference	410
12.26.1 Constructor & Destructor Documentation	411
12.26.1.1 Checker_Empty()	411
12.26.2 Member Function Documentation	411
12.26.2.1 check()	411
12.27 CheckerImplem_charpoly< Field, Polynomial > Class Template Reference	411
12.27.1 Constructor & Destructor Documentation	411
12.27.1.1 CheckerImplem_charpoly() [1/2]	411
12.27.1.2 CheckerImplem_charpoly() [2/2]	411
12.27.1.3 ~CheckerImplem_charpoly()	412
12.27.2 Member Function Documentation	412
12.27.2.1 check()	412
12.28 CheckerImplem_charpoly< Givaro::ZRing< Givaro::Integer >, Polynomial > Class Template Reference	412

12.28.1 Member Typedef Documentation	412
12.28.1.1 Ring	412
12.28.2 Constructor & Destructor Documentation	412
12.28.2.1 CheckerImplem_charpoly() [1/4]	412
12.28.2.2 CheckerImplem_charpoly() [2/4]	413
12.28.2.3 ~CheckerImplem_charpoly() [1/2]	413
12.28.2.4 CheckerImplem_charpoly() [3/4]	413
12.28.2.5 CheckerImplem_charpoly() [4/4]	413
12.28.2.6 ~CheckerImplem_charpoly() [2/2]	413
12.28.3 Member Function Documentation	413
12.28.3.1 check() [1/2]	413
12.28.3.2 check() [2/2]	413
12.29 CheckerImplem_Det< Field > Class Template Reference	413
12.29.1 Constructor & Destructor Documentation	414
12.29.1.1 CheckerImplem_Det() [1/2]	414
12.29.1.2 CheckerImplem_Det() [2/2]	414
12.29.1.3 ~CheckerImplem_Det()	414
12.29.2 Member Function Documentation	414
12.29.2.1 check()	414
12.30 CheckerImplem_fgemm< Field > Class Template Reference	414
12.30.1 Constructor & Destructor Documentation	415
12.30.1.1 CheckerImplem_fgemm() [1/2]	415
12.30.1.2 CheckerImplem_fgemm() [2/2]	415
12.30.1.3 ~CheckerImplem_fgemm()	415
12.30.2 Member Function Documentation	415
12.30.2.1 check()	415
12.31 CheckerImplem_ftdsm< Field > Class Template Reference	416
12.31.1 Constructor & Destructor Documentation	416
12.31.1.1 CheckerImplem_ftdsm() [1/2]	416
12.31.1.2 CheckerImplem_ftdsm() [2/2]	416
12.31.1.3 ~CheckerImplem_ftdsm()	416
12.31.2 Member Function Documentation	416
12.31.2.1 check()	416
12.32 CheckerImplem_invert< Field > Class Template Reference	417
12.32.1 Constructor & Destructor Documentation	417
12.32.1.1 CheckerImplem_invert() [1/2]	417
12.32.1.2 CheckerImplem_invert() [2/2]	417
12.32.1.3 ~CheckerImplem_invert()	417
12.32.2 Member Function Documentation	417
12.32.2.1 check()	417
12.33 CheckerImplem_PLUQ< Field > Class Template Reference	417
12.33.1 Constructor & Destructor Documentation	418

12.33.1.1 CheckerImplem_PLUQ() [1/2]	418
12.33.1.2 CheckerImplem_PLUQ() [2/2]	418
12.33.1.3 ~CheckerImplem_PLUQ()	418
12.33.2 Member Function Documentation	418
12.33.2.1 check()	418
12.34 Classic Struct Reference	418
12.35 Column Struct Reference	419
12.36 CompactElement< Element > Struct Template Reference	419
12.36.1 Member Typedef Documentation	419
12.36.1.1 type	419
12.37 CompactElement< double > Struct Reference	419
12.37.1 Member Typedef Documentation	419
12.37.1.1 type [1/2]	419
12.37.1.2 type [2/2]	419
12.38 CompactElement< float > Struct Reference	419
12.38.1 Member Typedef Documentation	419
12.38.1.1 type [1/2]	419
12.38.1.2 type [2/2]	419
12.39 CompactElement< int16_t > Struct Reference	420
12.39.1 Member Typedef Documentation	420
12.39.1.1 type [1/2]	420
12.39.1.2 type [2/2]	420
12.40 CompactElement< int32_t > Struct Reference	420
12.40.1 Member Typedef Documentation	420
12.40.1.1 type [1/2]	420
12.40.1.2 type [2/2]	420
12.41 CompactElement< int64_t > Struct Reference	420
12.41.1 Member Typedef Documentation	420
12.41.1.1 type [1/2]	420
12.41.1.2 type [2/2]	420
12.42 compatible_data_type< Field > Struct Template Reference	421
12.42.1 Field Documentation	421
12.42.1.1 value	421
12.43 compatible_data_type< Givaro::ZRing< double > > Struct Reference	421
12.43.1 Field Documentation	421
12.43.1.1 value [1/2]	421
12.43.1.2 value [2/2]	421
12.44 compatible_data_type< Givaro::ZRing< float > > Struct Reference	421
12.44.1 Field Documentation	421
12.44.1.1 value [1/2]	421
12.44.1.2 value [2/2]	421
12.45 Compose< H1, H2 > Struct Template Reference	422



12.45.1 Constructor & Destructor Documentation	422
12.45.1.1 Compose() [1/5]	422
12.45.1.2 Compose() [2/5]	422
12.45.1.3 Compose() [3/5]	422
12.45.1.4 Compose() [4/5]	422
12.45.1.5 Compose() [5/5]	422
12.45.2 Member Function Documentation	422
12.45.2.1 first_component()	422
12.45.2.2 second_component()	422
12.45.3 Friends And Related Symbol Documentation	423
12.45.3.1 operator<<	423
12.46 array< T >::const_iterator Class Reference	423
12.46.1 Detailed Description	423
12.47 string::const_iterator Class Reference	423
12.47.1 Detailed Description	423
12.48 vector< T >::const_iterator Class Reference	423
12.48.1 Detailed Description	423
12.49 array< T >::const_reverse_iterator Class Reference	423
12.49.1 Detailed Description	423
12.50 string::const_reverse_iterator Class Reference	423
12.50.1 Detailed Description	423
12.51 vector< T >::const_reverse_iterator Class Reference	424
12.51.1 Detailed Description	424
12.52 Simd128_impl< true, true, false, 2 >::Converter Union Reference	424
12.52.1 Field Documentation	424
12.52.1.1 v	424
12.52.1.2 t	424
12.53 Simd128_impl< true, true, false, 4 >::Converter Union Reference	424
12.53.1 Field Documentation	424
12.53.1.1 v	424
12.53.1.2 t	424
12.54 Simd128_impl< true, true, false, 8 >::Converter Union Reference	424
12.54.1 Field Documentation	425
12.54.1.1 v	425
12.54.1.2 t	425
12.55 Simd128_impl< true, true, true, 2 >::Converter Union Reference	425
12.55.1 Field Documentation	425
12.55.1.1 v	425
12.55.1.2 t	425
12.56 Simd128_impl< true, true, true, 4 >::Converter Union Reference	425
12.56.1 Field Documentation	425
12.56.1.1 v	425

12.56.1.2 t . . . . .	425
12.57 Simd128_impl< true, true, true, 8 >::Converter Union Reference . . . . .	425
12.57.1 Field Documentation . . . . .	426
12.57.1.1 v . . . . .	426
12.57.1.2 t . . . . .	426
12.58 Simd256_impl< true, false, true, 8 >::Converter Union Reference . . . . .	426
12.58.1 Field Documentation . . . . .	426
12.58.1.1 v . . . . .	426
12.58.1.2 t . . . . .	426
12.59 Simd256_impl< true, true, false, 2 >::Converter Union Reference . . . . .	426
12.59.1 Field Documentation . . . . .	426
12.59.1.1 v . . . . .	426
12.59.1.2 t . . . . .	426
12.60 Simd256_impl< true, true, false, 4 >::Converter Union Reference . . . . .	426
12.60.1 Field Documentation . . . . .	427
12.60.1.1 v . . . . .	427
12.60.1.2 t . . . . .	427
12.61 Simd256_impl< true, true, false, 8 >::Converter Union Reference . . . . .	427
12.61.1 Field Documentation . . . . .	427
12.61.1.1 v . . . . .	427
12.61.1.2 t . . . . .	427
12.62 Simd256_impl< true, true, true, 2 >::Converter Union Reference . . . . .	427
12.62.1 Field Documentation . . . . .	427
12.62.1.1 v . . . . .	427
12.62.1.2 t . . . . .	427
12.63 Simd256_impl< true, true, true, 4 >::Converter Union Reference . . . . .	427
12.63.1 Field Documentation . . . . .	428
12.63.1.1 v . . . . .	428
12.63.1.2 t . . . . .	428
12.64 Simd256_impl< true, true, true, 8 >::Converter Union Reference . . . . .	428
12.64.1 Field Documentation . . . . .	428
12.64.1.1 v . . . . .	428
12.64.1.2 t . . . . .	428
12.65 Simd512_impl< true, true, false, 8 >::Converter Union Reference . . . . .	428
12.65.1 Field Documentation . . . . .	428
12.65.1.1 v . . . . .	428
12.65.1.2 t . . . . .	428
12.66 Simd512_impl< true, true, true, 8 >::Converter Union Reference . . . . .	428
12.66.1 Field Documentation . . . . .	429
12.66.1.1 v . . . . .	429
12.66.1.2 t . . . . .	429
12.67 ConvertTo< T > Struct Template Reference . . . . .	429

12.67.1 Detailed Description	429
12.68 Coo< ValT, IdxT > Struct Template Reference	429
12.68.1 Member Typedef Documentation	430
12.68.1.1 Self	430
12.68.2 Constructor & Destructor Documentation	430
12.68.2.1 Coo() [1/4]	430
12.68.2.2 Coo() [2/4]	430
12.68.2.3 Coo() [3/4]	430
12.68.2.4 Coo() [4/4]	430
12.68.3 Member Function Documentation	430
12.68.3.1 operator=() [1/2]	430
12.68.3.2 operator=() [2/2]	430
12.68.4 Field Documentation	430
12.68.4.1 val	430
12.68.4.2 row	430
12.68.4.3 col	431
12.69 Coo< Field > Struct Template Reference	431
12.69.1 Constructor & Destructor Documentation	431
12.69.1.1 Coo() [1/4]	431
12.69.1.2 Coo() [2/4]	431
12.69.1.3 Coo() [3/4]	431
12.69.1.4 Coo() [4/4]	431
12.69.2 Member Function Documentation	432
12.69.2.1 operator=() [1/2]	432
12.69.2.2 operator=() [2/2]	432
12.69.3 Field Documentation	432
12.69.3.1 val	432
12.69.3.2 col	432
12.69.3.3 row	432
12.69.3.4 deleted	432
12.70 Coo< ValT, IdxT > Struct Template Reference	432
12.70.1 Member Typedef Documentation	433
12.70.1.1 Self	433
12.70.2 Constructor & Destructor Documentation	433
12.70.2.1 Coo() [1/4]	433
12.70.2.2 Coo() [2/4]	433
12.70.2.3 Coo() [3/4]	433
12.70.2.4 Coo() [4/4]	433
12.70.3 Member Function Documentation	433
12.70.3.1 operator=() [1/2]	433
12.70.3.2 operator=() [2/2]	433
12.70.4 Field Documentation	433

12.70.4.1 val	433
12.70.4.2 row	433
12.70.4.3 col	434
12.71 CooMat< Field > Struct Template Reference	434
12.71.1 Field Documentation	434
12.71.1.1 _coo16	434
12.71.1.2 _coo32	434
12.71.1.3 _coo64	434
12.71.1.4 _coo16_zo	434
12.71.1.5 _coo32_zo	434
12.71.1.6 _coo64_zo	434
12.72 count_nonconst_lvalue_reference< T > Struct Template Reference	435
12.73 count_nonconst_lvalue_reference< const T &, O... > Struct Template Reference	435
12.73.1 Field Documentation	435
12.73.1.1 n	435
12.74 count_nonconst_lvalue_reference< T &, O... > Struct Template Reference	435
12.74.1 Field Documentation	435
12.74.1.1 n	435
12.75 count_nonconst_lvalue_reference< T, O... > Struct Template Reference	435
12.75.1 Field Documentation	435
12.75.1.1 n	435
12.76 count_nonconst_lvalue_reference<> Struct Reference	436
12.76.1 Field Documentation	436
12.76.1.1 n	436
12.77 CsrMat< Field > Struct Template Reference	436
12.77.1 Field Documentation	436
12.77.1.1 _csr16	436
12.77.1.2 _csr32	436
12.77.1.3 _csr64	436
12.77.1.4 _csr16_zo	436
12.77.1.5 _csr32_zo	436
12.77.1.6 _csr64_zo	436
12.78 DefaultBoundedTag Struct Reference	437
12.78.1 Detailed Description	437
12.79 DefaultTag Struct Reference	437
12.79.1 Detailed Description	437
12.80 DelayedTag Struct Reference	437
12.80.1 Detailed Description	437
12.81 DivideAndConquer Struct Reference	437
12.82 ElementTraits< Element > Struct Template Reference	437
12.82.1 Detailed Description	437
12.82.2 Member Typedef Documentation	438

12.82.2.1 value	438
12.83 ElementTraits< double > Struct Reference	438
12.83.1 Member Typedef Documentation	438
12.83.1.1 value [1/2]	438
12.83.1.2 value [2/2]	438
12.84 ElementTraits< FFPACK::rns_double_elt > Struct Reference	438
12.84.1 Member Typedef Documentation	438
12.84.1.1 value [1/2]	438
12.84.1.2 value [2/2]	438
12.85 ElementTraits< float > Struct Reference	438
12.85.1 Member Typedef Documentation	439
12.85.1.1 value [1/2]	439
12.85.1.2 value [2/2]	439
12.86 ElementTraits< Givaro::Integer > Struct Reference	439
12.86.1 Member Typedef Documentation	439
12.86.1.1 value [1/2]	439
12.86.1.2 value [2/2]	439
12.87 ElementTraits< int16_t > Struct Reference	439
12.87.1 Member Typedef Documentation	439
12.87.1.1 value [1/2]	439
12.87.1.2 value [2/2]	439
12.88 ElementTraits< int32_t > Struct Reference	440
12.88.1 Member Typedef Documentation	440
12.88.1.1 value [1/2]	440
12.88.1.2 value [2/2]	440
12.89 ElementTraits< int64_t > Struct Reference	440
12.89.1 Member Typedef Documentation	440
12.89.1.1 value [1/2]	440
12.89.1.2 value [2/2]	440
12.90 ElementTraits< int8_t > Struct Reference	440
12.90.1 Member Typedef Documentation	440
12.90.1.1 value [1/2]	440
12.90.1.2 value [2/2]	441
12.91 ElementTraits< Reclnt::rint< K > > Struct Template Reference	441
12.91.1 Member Typedef Documentation	441
12.91.1.1 value [1/2]	441
12.91.1.2 value [2/2]	441
12.92 ElementTraits< Reclnt::rmint< K, MG > > Struct Template Reference	441
12.92.1 Member Typedef Documentation	441
12.92.1.1 value [1/2]	441
12.92.1.2 value [2/2]	441
12.93 ElementTraits< Reclnt::ruint< K > > Struct Template Reference	441

12.93.1 Member Typedef Documentation . . . . .	442
12.93.1.1 value [1/2] . . . . .	442
12.93.1.2 value [2/2] . . . . .	442
12.94 ElementTraits< uint16_t > Struct Reference . . . . .	442
12.94.1 Member Typedef Documentation . . . . .	442
12.94.1.1 value [1/2] . . . . .	442
12.94.1.2 value [2/2] . . . . .	442
12.95 ElementTraits< uint32_t > Struct Reference . . . . .	442
12.95.1 Member Typedef Documentation . . . . .	442
12.95.1.1 value [1/2] . . . . .	442
12.95.1.2 value [2/2] . . . . .	443
12.96 ElementTraits< uint64_t > Struct Reference . . . . .	443
12.96.1 Member Typedef Documentation . . . . .	443
12.96.1.1 value [1/2] . . . . .	443
12.96.1.2 value [2/2] . . . . .	443
12.97 ElementTraits< uint8_t > Struct Reference . . . . .	443
12.97.1 Member Typedef Documentation . . . . .	443
12.97.1.1 value [1/2] . . . . .	443
12.97.1.2 value [2/2] . . . . .	443
12.98 EllMat< Field > Struct Template Reference . . . . .	443
12.98.1 Field Documentation . . . . .	444
12.98.1.1 _ell16 . . . . .	444
12.98.1.2 _ell32 . . . . .	444
12.98.1.3 _ell64 . . . . .	444
12.98.1.4 _ell16_zo . . . . .	444
12.98.1.5 _ell32_zo . . . . .	444
12.98.1.6 _ell64_zo . . . . .	444
12.99 Failure Class Reference . . . . .	444
12.99.1 Detailed Description . . . . .	445
12.99.2 Constructor & Destructor Documentation . . . . .	445
12.99.2.1 Failure() . . . . .	445
12.99.3 Member Function Documentation . . . . .	445
12.99.3.1 operator>() [1/2] . . . . .	445
12.99.3.2 operator>() [2/2] . . . . .	445
12.99.3.3 setErrorStream() . . . . .	445
12.99.3.4 print() . . . . .	445
12.99.4 Field Documentation . . . . .	446
12.99.4.1 _errorStream . . . . .	446
12.100 FailureCharpolyCheck Class Reference . . . . .	446
12.101 FailureDetCheck Class Reference . . . . .	446
12.102 FailureFgemmCheck Class Reference . . . . .	446
12.103 FailureInvertCheck Class Reference . . . . .	446

12.104 FailurePLUQCheck Class Reference . . . . .	446
12.105 FailureTrsmCheck Class Reference . . . . .	446
12.106 FieldSimd<_Field> Class Template Reference . . . . .	447
12.106.1 Member Typedef Documentation . . . . .	448
12.106.1.1 Field . . . . .	448
12.106.1.2 Element . . . . .	448
12.106.1.3 simd . . . . .	448
12.106.1.4 vect_t . . . . .	448
12.106.1.5 scalar_t . . . . .	448
12.106.2 Constructor & Destructor Documentation . . . . .	448
12.106.2.1 FieldSimd() [1/3] . . . . .	448
12.106.2.2 FieldSimd() [2/3] . . . . .	448
12.106.2.3 FieldSimd() [3/3] . . . . .	448
12.106.3 Member Function Documentation . . . . .	448
12.106.3.1 operator=() [1/2] . . . . .	448
12.106.3.2 operator=() [2/2] . . . . .	448
12.106.3.3 init() [1/2] . . . . .	449
12.106.3.4 init() [2/2] . . . . .	449
12.106.3.5 add() [1/2] . . . . .	449
12.106.3.6 add() [2/2] . . . . .	449
12.106.3.7 addin() . . . . .	449
12.106.3.8 add_r() [1/2] . . . . .	449
12.106.3.9 add_r() [2/2] . . . . .	449
12.106.3.10 addin_r() . . . . .	449
12.106.3.11 sub() [1/2] . . . . .	450
12.106.3.12 sub() [2/2] . . . . .	450
12.106.3.13 subin() . . . . .	450
12.106.3.14 sub_r() [1/2] . . . . .	450
12.106.3.15 sub_r() [2/2] . . . . .	450
12.106.3.16 subin_r() . . . . .	450
12.106.3.17 zero() [1/2] . . . . .	450
12.106.3.18 zero() [2/2] . . . . .	450
12.106.3.19 mod() . . . . .	450
12.106.3.20 mul() [1/2] . . . . .	451
12.106.3.21 mul() [2/2] . . . . .	451
12.106.3.22 mulin() . . . . .	451
12.106.3.23 mul_r() [1/2] . . . . .	451
12.106.3.24 mul_r() [2/2] . . . . .	451
12.106.3.25 axpy() [1/2] . . . . .	451
12.106.3.26 axpy() [2/2] . . . . .	451
12.106.3.27 axpyin() . . . . .	451
12.106.3.28 axpy_r() [1/2] . . . . .	452

12.106.3.29 axpy_r() [2/2]	452
12.106.3.30 axpyin_r()	452
12.106.3.31 maxpy() [1/2]	452
12.106.3.32 maxpy() [2/2]	452
12.106.3.33 maxpyin()	452
12.106.4 Field Documentation	452
12.106.4.1 vect_size	452
12.106.4.2 alignment	453
12.107 FieldTraits< Field > Struct Template Reference	453
12.107.1 Detailed Description	453
12.107.2 Member Typedef Documentation	453
12.107.2.1 category	453
12.107.3 Field Documentation	453
12.107.3.1 balanced	453
12.108 FieldTraits< FFPACK::RNSInteger< T > > Struct Template Reference	453
12.108.1 Member Typedef Documentation	454
12.108.1.1 category [1/2]	454
12.108.1.2 category [2/2]	454
12.108.2 Field Documentation	454
12.108.2.1 balanced [1/2]	454
12.108.2.2 balanced [2/2]	454
12.109 FieldTraits< FFPACK::RNSIntegerMod< T > > Struct Template Reference	454
12.109.1 Member Typedef Documentation	454
12.109.1.1 category [1/2]	454
12.109.1.2 category [2/2]	454
12.109.2 Field Documentation	454
12.109.2.1 balanced [1/2]	454
12.109.2.2 balanced [2/2]	455
12.110 FieldTraits< Givaro::Modular< Element > > Struct Template Reference	455
12.110.1 Member Typedef Documentation	455
12.110.1.1 category [1/2]	455
12.110.1.2 category [2/2]	455
12.110.2 Field Documentation	455
12.110.2.1 balanced [1/2]	455
12.110.2.2 balanced [2/2]	455
12.111 FieldTraits< Givaro::ModularBalanced< Element > > Struct Template Reference	455
12.111.1 Member Typedef Documentation	456
12.111.1.1 category [1/2]	456
12.111.1.2 category [2/2]	456
12.111.2 Field Documentation	456
12.111.2.1 balanced [1/2]	456
12.111.2.2 balanced [2/2]	456



12.112 FieldTraits< Givaro::ZRing< double > > Struct Reference	456
12.112.1 Member Typedef Documentation	456
12.112.1.1 category [1/2]	456
12.112.1.2 category [2/2]	456
12.112.2 Field Documentation	456
12.112.2.1 balanced [1/2]	456
12.112.2.2 balanced [2/2]	457
12.113 FieldTraits< Givaro::ZRing< float > > Struct Reference	457
12.113.1 Member Typedef Documentation	457
12.113.1.1 category [1/2]	457
12.113.1.2 category [2/2]	457
12.113.2 Field Documentation	457
12.113.2.1 balanced [1/2]	457
12.113.2.2 balanced [2/2]	457
12.114 FieldTraits< Givaro::ZRing< Givaro::Integer > > Struct Reference	457
12.114.1 Member Typedef Documentation	458
12.114.1.1 category [1/2]	458
12.114.1.2 category [2/2]	458
12.114.2 Field Documentation	458
12.114.2.1 balanced [1/2]	458
12.114.2.2 balanced [2/2]	458
12.115 FieldTraits< Givaro::ZRing< int16_t > > Struct Reference	458
12.115.1 Member Typedef Documentation	458
12.115.1.1 category [1/2]	458
12.115.1.2 category [2/2]	458
12.115.2 Field Documentation	458
12.115.2.1 balanced [1/2]	458
12.115.2.2 balanced [2/2]	458
12.116 FieldTraits< Givaro::ZRing< int32_t > > Struct Reference	459
12.116.1 Member Typedef Documentation	459
12.116.1.1 category [1/2]	459
12.116.1.2 category [2/2]	459
12.116.2 Field Documentation	459
12.116.2.1 balanced [1/2]	459
12.116.2.2 balanced [2/2]	459
12.117 FieldTraits< Givaro::ZRing< int64_t > > Struct Reference	459
12.117.1 Member Typedef Documentation	459
12.117.1.1 category [1/2]	459
12.117.1.2 category [2/2]	459
12.117.2 Field Documentation	460
12.117.2.1 balanced [1/2]	460
12.117.2.2 balanced [2/2]	460

12.118 FieldTraits< Givaro::ZRing< Reclnt::ruint< K > > > Struct Template Reference . . . . .	460
12.118.1 Member Typedef Documentation . . . . .	460
12.118.1.1 category [1/2] . . . . .	460
12.118.1.2 category [2/2] . . . . .	460
12.118.2 Field Documentation . . . . .	460
12.118.2.1 balanced [1/2] . . . . .	460
12.118.2.2 balanced [2/2] . . . . .	460
12.119 FieldTraits< Givaro::ZRing< uint16_t > > Struct Reference . . . . .	460
12.119.1 Member Typedef Documentation . . . . .	461
12.119.1.1 category [1/2] . . . . .	461
12.119.1.2 category [2/2] . . . . .	461
12.119.2 Field Documentation . . . . .	461
12.119.2.1 balanced [1/2] . . . . .	461
12.119.2.2 balanced [2/2] . . . . .	461
12.120 FieldTraits< Givaro::ZRing< uint32_t > > Struct Reference . . . . .	461
12.120.1 Member Typedef Documentation . . . . .	461
12.120.1.1 category [1/2] . . . . .	461
12.120.1.2 category [2/2] . . . . .	461
12.120.2 Field Documentation . . . . .	462
12.120.2.1 balanced [1/2] . . . . .	462
12.120.2.2 balanced [2/2] . . . . .	462
12.121 FieldTraits< Givaro::ZRing< uint64_t > > Struct Reference . . . . .	462
12.121.1 Member Typedef Documentation . . . . .	462
12.121.1.1 category [1/2] . . . . .	462
12.121.1.2 category [2/2] . . . . .	462
12.121.2 Field Documentation . . . . .	462
12.121.2.1 balanced [1/2] . . . . .	462
12.121.2.2 balanced [2/2] . . . . .	462
12.122 Fixed Struct Reference . . . . .	462
12.123 FixedPreclntTag Struct Reference . . . . .	462
12.123.1 Detailed Description . . . . .	463
12.124 ScalFunctionsBase< Element, typename enable_if< is_floating_point< Element >::value >::type >::FloatingPointTestDistribution Class Reference . . . . .	463
12.124.1 Member Typedef Documentation . . . . .	463
12.124.1.1 IntType . . . . .	463
12.124.2 Constructor & Destructor Documentation . . . . .	463
12.124.2.1 FloatingPointTestDistribution() . . . . .	463
12.124.3 Member Function Documentation . . . . .	463
12.124.3.1 operator>() . . . . .	463
12.125 ForStrategy1D< blocksize_t, Cut, Param > Struct Template Reference . . . . .	463
12.125.1 Constructor & Destructor Documentation . . . . .	464
12.125.1.1 ForStrategy1D() [1/2] . . . . .	464

12.125.1.2 ForStrategy1D() [2/2]	464
12.125.2 Member Function Documentation	464
12.125.2.1 build()	464
12.125.2.2 initialize()	464
12.125.2.3 isTerminated()	464
12.125.2.4 begin()	465
12.125.2.5 end()	465
12.125.2.6 numblocks()	465
12.125.2.7 blockindex()	465
12.125.2.8 operator++()	465
12.125.3 Field Documentation	465
12.125.3.1 ibeg	465
12.125.3.2 iend	465
12.125.3.3 current	465
12.125.3.4 firstBlockSize	465
12.125.3.5 lastBlockSize	465
12.125.3.6 changeBS	466
12.125.3.7 numBlock	466
12.126 ForStrategy2D< blocksize_t, Cut, Param > Struct Template Reference	466
12.126.1 Constructor & Destructor Documentation	467
12.126.1.1 ForStrategy2D()	467
12.126.2 Member Function Documentation	467
12.126.2.1 initialize()	467
12.126.2.2 isTerminated()	467
12.126.2.3 ibegin()	467
12.126.2.4 jbegin()	467
12.126.2.5 iend()	467
12.126.2.6 jend()	467
12.126.2.7 operator++()	467
12.126.2.8 rownumblocks()	467
12.126.2.9 colnumblocks()	468
12.126.2.10 blockindex()	468
12.126.2.11 rowblockindex()	468
12.126.2.12 colblockindex()	468
12.126.3 Friends And Related Symbol Documentation	468
12.126.3.1 operator<<	468
12.126.4 Field Documentation	468
12.126.4.1 _ibeg	468
12.126.4.2 _iend	468
12.126.4.3 _jbeg	468
12.126.4.4 _jend	468
12.126.4.5 rowBlockSize	469

12.126.4.6 colBlockSize	469
12.126.4.7 current	469
12.126.4.8 lastRBS	469
12.126.4.9 lastCBS	469
12.126.4.10 changeRBS	469
12.126.4.11 changeCBS	469
12.126.4.12 numRowsBlock	469
12.126.4.13 numColBlock	469
12.126.4.14 BLOCKS	469
12.127 ftrmmLeftLowerNoTransNonUnit< Element > Class Template Reference	470
12.128 ftrmmLeftLowerNoTransUnit< Element > Class Template Reference	470
12.129 ftrmmLeftLowerTransNonUnit< Element > Class Template Reference	470
12.130 ftrmmLeftLowerTransUnit< Element > Class Template Reference	470
12.131 ftrmmLeftUpperNoTransNonUnit< Element > Class Template Reference	470
12.132 ftrmmLeftUpperNoTransUnit< Element > Class Template Reference	470
12.133 ftrmmLeftUpperTransNonUnit< Element > Class Template Reference	470
12.134 ftrmmLeftUpperTransUnit< Element > Class Template Reference	471
12.135 ftrmmRightLowerNoTransNonUnit< Element > Class Template Reference	471
12.136 ftrmmRightLowerNoTransUnit< Element > Class Template Reference	471
12.137 ftrmmRightLowerTransNonUnit< Element > Class Template Reference	471
12.138 ftrmmRightLowerTransUnit< Element > Class Template Reference	471
12.139 ftrmmRightUpperNoTransNonUnit< Element > Class Template Reference	471
12.140 ftrmmRightUpperNoTransUnit< Element > Class Template Reference	471
12.141 ftrmmRightUpperTransNonUnit< Element > Class Template Reference	471
12.142 ftrmmRightUpperTransUnit< Element > Class Template Reference	472
12.143 ftrsmLeftLowerNoTransNonUnit< Element > Class Template Reference	472
12.144 ftrsmLeftLowerNoTransUnit< Element > Class Template Reference	472
12.145 ftrsmLeftLowerTransNonUnit< Element > Class Template Reference	472
12.146 ftrsmLeftLowerTransUnit< Element > Class Template Reference	472
12.147 ftrsmLeftUpperNoTransNonUnit< Element > Class Template Reference	472
12.147.1 Detailed Description	472
12.148 ftrsmLeftUpperNoTransUnit< Element > Class Template Reference	473
12.149 ftrsmLeftUpperTransNonUnit< Element > Class Template Reference	473
12.150 ftrsmLeftUpperTransUnit< Element > Class Template Reference	473
12.151 ftrsmRightLowerNoTransNonUnit< Element > Class Template Reference	473
12.152 ftrsmRightLowerNoTransUnit< Element > Class Template Reference	473
12.153 ftrsmRightLowerTransNonUnit< Element > Class Template Reference	473
12.154 ftrsmRightLowerTransUnit< Element > Class Template Reference	473
12.155 ftrsmRightUpperNoTransNonUnit< Element > Class Template Reference	473
12.156 ftrsmRightUpperNoTransUnit< Element > Class Template Reference	474
12.157 ftrsmRightUpperTransNonUnit< Element > Class Template Reference	474
12.158 ftrsmRightUpperTransUnit< Element > Class Template Reference	474

12.159 GenericTag Struct Reference	474
12.159.1 Detailed Description	474
12.160 GenericTag Struct Reference	474
12.160.1 Detailed Description	474
12.161 Grain Struct Reference	474
12.162 has_minus_eq_impl< C > Struct Template Reference	474
12.162.1 Field Documentation	475
12.162.1.1 value	475
12.163 has_minus_impl< C > Struct Template Reference	475
12.163.1 Field Documentation	475
12.163.1.1 value	475
12.164 has_mul_eq_impl< C > Struct Template Reference	475
12.164.1 Field Documentation	475
12.164.1.1 value	475
12.165 has_mul_impl< C > Struct Template Reference	475
12.165.1 Field Documentation	476
12.165.1.1 value	476
12.166 has_operation< T > Struct Template Reference	476
12.166.1 Field Documentation	476
12.166.1.1 value	476
12.167 has_plus_eq_impl< C > Struct Template Reference	476
12.167.1 Field Documentation	476
12.167.1.1 value	476
12.168 has_plus_impl< C > Struct Template Reference	476
12.168.1 Field Documentation	477
12.168.1.1 value	477
12.169 HelperFlag Struct Reference	477
12.169.1 Field Documentation	477
12.169.1.1 none	477
12.169.1.2 coo	477
12.169.1.3 csr	477
12.169.1.4 ell	477
12.169.1.5 aut	477
12.169.1.6 pm1	477
12.170 HelperMod< Field, ElementTraits > Struct Template Reference	477
12.171 HelperMod< Field, ElementCategories::MachineIntTag > Struct Template Reference	478
12.171.1 Constructor & Destructor Documentation	478
12.171.1.1 HelperMod() [1/2]	478
12.171.1.2 HelperMod() [2/2]	478
12.171.2 Field Documentation	478
12.171.2.1 p	478
12.171.2.2 invp	478

12.171.2.3 min	478
12.171.2.4 max	478
12.171.2.5 pow50rem	478
12.172 HelperMod< Field, FFLAS::ElementCategories::ArbitraryPrecIntTag > Struct Template Reference	479
12.172.1 Constructor & Destructor Documentation	479
12.172.1.1 HelperMod() [1/2]	479
12.172.1.2 HelperMod() [2/2]	479
12.172.2 Field Documentation	479
12.172.2.1 p	479
12.173 HelperMod< Field, FFLAS::ElementCategories::FixedPrecIntTag > Struct Template Reference	479
12.173.1 Constructor & Destructor Documentation	479
12.173.1.1 HelperMod() [1/2]	479
12.173.1.2 HelperMod() [2/2]	479
12.173.2 Field Documentation	480
12.173.2.1 p	480
12.174 HelperMod< Field, FFLAS::ElementCategories::MachineFloatTag > Struct Template Reference	480
12.174.1 Constructor & Destructor Documentation	480
12.174.1.1 HelperMod() [1/2]	480
12.174.1.2 HelperMod() [2/2]	480
12.174.2 Field Documentation	480
12.174.2.1 p	480
12.174.2.2 invp	480
12.174.2.3 min	480
12.174.2.4 max	480
12.175 Hybrid Struct Reference	481
12.176 Info Struct Reference	481
12.176.1 Constructor & Destructor Documentation	481
12.176.1.1 Info() [1/4]	481
12.176.1.2 Info() [2/4]	481
12.176.1.3 Info() [3/4]	481
12.176.1.4 Info() [4/4]	481
12.176.2 Member Function Documentation	481
12.176.2.1 operator=() [1/2]	481
12.176.2.2 operator=() [2/2]	481
12.176.3 Field Documentation	482
12.176.3.1 size	482
12.176.3.2 perm	482
12.176.3.3 begin	482
12.177 Info Struct Reference	482
12.177.1 Constructor & Destructor Documentation	482
12.177.1.1 Info() [1/4]	482
12.177.1.2 Info() [2/4]	482

12.177.1.3 Info() [3/4]	482
12.177.1.4 Info() [4/4]	482
12.177.2 Member Function Documentation	483
12.177.2.1 operator=() [1/2]	483
12.177.2.2 operator=() [2/2]	483
12.177.3 Field Documentation	483
12.177.3.1 size	483
12.177.3.2 perm	483
12.177.3.3 begin	483
12.178 is_all_same< Args > Struct Template Reference	483
12.179 is_all_same< T, Args... > Struct Template Reference	483
12.179.1 Field Documentation	483
12.179.1.1 value	483
12.180 is_all_same<> Struct Reference	483
12.180.1 Field Documentation	484
12.180.1.1 value	484
12.181 is_simd< T > Struct Template Reference	484
12.181.1 Member Typedef Documentation	484
12.181.1.1 type	484
12.181.2 Field Documentation	484
12.181.2.1 value	484
12.182 isSparseMatrix< Field, M > Struct Template Reference	484
12.183 isSparseMatrix< Field, Sparse< Field, SparseMatrix_t::COO > > Struct Template Reference	484
12.184 isSparseMatrix< Field, Sparse< Field, SparseMatrix_t::COO_ZO > > Struct Template Reference	485
12.185 isSparseMatrix< Field, Sparse< Field, SparseMatrix_t::CSR > > Struct Template Reference	485
12.186 isSparseMatrix< Field, Sparse< Field, SparseMatrix_t::CSR_HYB > > Struct Template Reference	485
12.187 isSparseMatrix< Field, Sparse< Field, SparseMatrix_t::CSR_ZO > > Struct Template Reference	486
12.188 isSparseMatrix< Field, Sparse< Field, SparseMatrix_t::ELL > > Struct Template Reference	486
12.189 isSparseMatrix< Field, Sparse< Field, SparseMatrix_t::ELL_simd > > Struct Template Reference	486
12.190 isSparseMatrix< Field, Sparse< Field, SparseMatrix_t::ELL_simd_ZO > > Struct Template Reference	486
12.191 isSparseMatrix< Field, Sparse< Field, SparseMatrix_t::ELL_ZO > > Struct Template Reference	487
12.192 isSparseMatrix< Field, Sparse< Field, SparseMatrix_t::HYB_ZO > > Struct Template Reference	487
12.193 isSparseMatrix< Field, Sparse< Field, SparseMatrix_t::SELL > > Struct Template Reference	487
12.194 isSparseMatrix< Field, Sparse< Field, SparseMatrix_t::SELL_ZO > > Struct Template Reference	487
12.195 isSparseMatrixMKLFormat< F, M > Struct Template Reference	488
12.196 isSparseMatrixSimdFormat< F, M > Struct Template Reference	488
12.197 isZOSparseMatrix< F, M > Struct Template Reference	488
12.198 isZOSparseMatrix< Field, Sparse< Field, SparseMatrix_t::COO_ZO > > Struct Template Reference	489
12.199 isZOSparseMatrix< Field, Sparse< Field, SparseMatrix_t::CSR_ZO > > Struct Template Reference	489
12.200 isZOSparseMatrix< Field, Sparse< Field, SparseMatrix_t::ELL_simd_ZO > > Struct Template Reference	489

12.201 isZOSparseMatrix< Field, Sparse< Field, SparseMatrix_t::ELL_ZO > > Struct Template Reference	489
12.202 isZOSparseMatrix< Field, Sparse< Field, SparseMatrix_t::SELL_ZO > > Struct Template Reference	490
12.203 Iterative Struct Reference	490
12.204 array< T >::iterator Class Reference	490
12.204.1 Detailed Description	490
12.205 string::iterator Class Reference	490
12.205.1 Detailed Description	490
12.206 vector< T >::iterator Class Reference	490
12.206.1 Detailed Description	490
12.207 LazyTag Struct Reference	490
12.207.1 Detailed Description	491
12.208 limits< T > Struct Template Reference	491
12.209 limits< char > Struct Reference	491
12.209.1 Member Typedef Documentation	491
12.209.1.1 T	491
12.209.2 Member Function Documentation	491
12.209.2.1 max()	491
12.209.2.2 min()	491
12.209.2.3 digits()	491
12.210 limits< double > Struct Reference	491
12.210.1 Member Typedef Documentation	492
12.210.1.1 T	492
12.210.2 Member Function Documentation	492
12.210.2.1 max()	492
12.210.2.2 min()	492
12.210.2.3 digits()	492
12.211 limits< float > Struct Reference	492
12.211.1 Member Typedef Documentation	492
12.211.1.1 T	492
12.211.2 Member Function Documentation	492
12.211.2.1 max()	492
12.211.2.2 min()	492
12.211.2.3 digits()	493
12.212 limits< Givaro::Integer > Struct Reference	493
12.212.1 Member Typedef Documentation	493
12.212.1.1 T	493
12.212.2 Member Function Documentation	493
12.212.2.1 max()	493
12.212.2.2 min()	493
12.213 limits< int > Struct Reference	493
12.213.1 Member Typedef Documentation	493



12.213.1.1 T	493
12.213.2 Member Function Documentation	494
12.213.2.1 max()	494
12.213.2.2 min()	494
12.213.2.3 digits()	494
12.214 limits< long > Struct Reference	494
12.214.1 Member Typedef Documentation	494
12.214.1.1 T	494
12.214.2 Member Function Documentation	494
12.214.2.1 max()	494
12.214.2.2 min()	494
12.214.2.3 digits()	494
12.215 limits< long long > Struct Reference	494
12.215.1 Member Typedef Documentation	495
12.215.1.1 T	495
12.215.2 Member Function Documentation	495
12.215.2.1 max()	495
12.215.2.2 min()	495
12.215.2.3 digits()	495
12.216 limits< Reclnt::rint< K > > Struct Template Reference	495
12.216.1 Member Typedef Documentation	495
12.216.1.1 T	495
12.216.2 Member Function Documentation	495
12.216.2.1 max()	495
12.216.2.2 min()	496
12.217 limits< Reclnt::ruint< K > > Struct Template Reference	496
12.217.1 Member Typedef Documentation	496
12.217.1.1 T	496
12.217.2 Member Function Documentation	496
12.217.2.1 max()	496
12.217.2.2 min()	496
12.218 limits< short int > Struct Reference	496
12.218.1 Member Typedef Documentation	497
12.218.1.1 T	497
12.218.2 Member Function Documentation	497
12.218.2.1 max()	497
12.218.2.2 min()	497
12.218.2.3 digits()	497
12.219 limits< signed char > Struct Reference	497
12.219.1 Member Typedef Documentation	497
12.219.1.1 T	497
12.219.2 Member Function Documentation	497

12.219.2.1 max()	497
12.219.2.2 min()	497
12.219.2.3 digits()	497
12.220 limits< unsigned char > Struct Reference	498
12.220.1 Member Typedef Documentation	498
12.220.1.1 T	498
12.220.2 Member Function Documentation	498
12.220.2.1 max()	498
12.220.2.2 min()	498
12.220.2.3 digits()	498
12.221 limits< unsigned int > Struct Reference	498
12.221.1 Member Typedef Documentation	498
12.221.1.1 T	498
12.221.2 Member Function Documentation	499
12.221.2.1 max()	499
12.221.2.2 min()	499
12.221.2.3 digits()	499
12.222 limits< unsigned long > Struct Reference	499
12.222.1 Member Typedef Documentation	499
12.222.1.1 T	499
12.222.2 Member Function Documentation	499
12.222.2.1 max()	499
12.222.2.2 min()	499
12.222.2.3 digits()	499
12.223 limits< unsigned long long > Struct Reference	499
12.223.1 Member Typedef Documentation	500
12.223.1.1 T	500
12.223.2 Member Function Documentation	500
12.223.2.1 max()	500
12.223.2.2 min()	500
12.223.2.3 digits()	500
12.224 limits< unsigned short int > Struct Reference	500
12.224.1 Member Typedef Documentation	500
12.224.1.1 T	500
12.224.2 Member Function Documentation	500
12.224.2.1 max()	500
12.224.2.2 min()	500
12.224.2.3 digits()	501
12.225 MachineFloatTag Struct Reference	501
12.225.1 Detailed Description	501
12.226 MachineIntTag Struct Reference	501
12.226.1 Detailed Description	501

12.227 MMHelper< Field, AlgoTrait, ModeTrait, ParSeqTrait > Struct Template Reference . . . . .	501
12.227.1 Member Typedef Documentation . . . . .	502
12.227.1.1 Self_t . . . . .	502
12.227.1.2 DelayedField_t . . . . .	502
12.227.1.3 DelayedField . . . . .	502
12.227.1.4 DFElt . . . . .	502
12.227.2 Constructor & Destructor Documentation . . . . .	502
12.227.2.1 MMHelper() [1/5] . . . . .	502
12.227.2.2 MMHelper() [2/5] . . . . .	503
12.227.2.3 MMHelper() [3/5] . . . . .	503
12.227.2.4 MMHelper() [4/5] . . . . .	503
12.227.2.5 MMHelper() [5/5] . . . . .	503
12.227.3 Member Function Documentation . . . . .	503
12.227.3.1 initC() . . . . .	503
12.227.3.2 initA() . . . . .	503
12.227.3.3 initB() . . . . .	503
12.227.3.4 initOut() . . . . .	503
12.227.3.5 MaxDelayedDim() . . . . .	504
12.227.3.6 Aunfit() . . . . .	504
12.227.3.7 Bunfit() . . . . .	504
12.227.3.8 setOutBounds() . . . . .	504
12.227.3.9 checkA() . . . . .	504
12.227.3.10 checkB() . . . . .	504
12.227.3.11 checkOut() [1/2] . . . . .	504
12.227.3.12 checkOut() [2/2] . . . . .	504
12.227.4 Friends And Related Symbol Documentation . . . . .	505
12.227.4.1 operator<< . . . . .	505
12.227.5 Field Documentation . . . . .	505
12.227.5.1 recLevel . . . . .	505
12.227.5.2 FieldMin . . . . .	505
12.227.5.3 FieldMax . . . . .	505
12.227.5.4 Amin . . . . .	505
12.227.5.5 Amax . . . . .	505
12.227.5.6 Bmin . . . . .	505
12.227.5.7 Bmax . . . . .	505
12.227.5.8 Cmin . . . . .	505
12.227.5.9 Cmax . . . . .	506
12.227.5.10 Outmin . . . . .	506
12.227.5.11 Outmax . . . . .	506
12.227.5.12 MaxStorableValue . . . . .	506
12.227.5.13 delayedField . . . . .	506
12.227.5.14 parseq . . . . .	506

12.228	<a href="#">ModeTraits&lt; Field &gt; Struct Template Reference</a>	506
12.228.1	<a href="#">Detailed Description</a>	506
12.228.2	<a href="#">Member Typedef Documentation</a>	506
12.228.2.1	<a href="#">value</a>	506
12.229	<a href="#">ModeTraits&lt; Givaro::Modular&lt; Element, Compute &gt; &gt; Struct Template Reference</a>	507
12.229.1	<a href="#">Member Typedef Documentation</a>	507
12.229.1.1	<a href="#">value [1/2]</a>	507
12.229.1.2	<a href="#">value [2/2]</a>	507
12.230	<a href="#">ModeTraits&lt; Givaro::Modular&lt; Givaro::Integer, Compute &gt; &gt; Struct Template Reference</a>	507
12.230.1	<a href="#">Member Typedef Documentation</a>	507
12.230.1.1	<a href="#">value [1/2]</a>	507
12.230.1.2	<a href="#">value [2/2]</a>	507
12.231	<a href="#">ModeTraits&lt; Givaro::Modular&lt; int16_t, Compute &gt; &gt; Struct Template Reference</a>	507
12.231.1	<a href="#">Member Typedef Documentation</a>	508
12.231.1.1	<a href="#">value [1/2]</a>	508
12.231.1.2	<a href="#">value [2/2]</a>	508
12.232	<a href="#">ModeTraits&lt; Givaro::Modular&lt; int32_t, Compute &gt; &gt; Struct Template Reference</a>	508
12.232.1	<a href="#">Member Typedef Documentation</a>	508
12.232.1.1	<a href="#">value [1/2]</a>	508
12.232.1.2	<a href="#">value [2/2]</a>	508
12.233	<a href="#">ModeTraits&lt; Givaro::Modular&lt; int64_t, uint64_t &gt; &gt; Struct Reference</a>	508
12.233.1	<a href="#">Member Typedef Documentation</a>	508
12.233.1.1	<a href="#">value [1/2]</a>	508
12.233.1.2	<a href="#">value [2/2]</a>	508
12.234	<a href="#">ModeTraits&lt; Givaro::Modular&lt; int8_t, Compute &gt; &gt; Struct Template Reference</a>	509
12.234.1	<a href="#">Member Typedef Documentation</a>	509
12.234.1.1	<a href="#">value [1/2]</a>	509
12.234.1.2	<a href="#">value [2/2]</a>	509
12.235	<a href="#">ModeTraits&lt; Givaro::Modular&lt; ReclInt::ruint&lt; K &gt;, Compute &gt; &gt; Struct Template Reference</a>	509
12.235.1	<a href="#">Member Typedef Documentation</a>	509
12.235.1.1	<a href="#">value [1/2]</a>	509
12.235.1.2	<a href="#">value [2/2]</a>	509
12.236	<a href="#">ModeTraits&lt; Givaro::Modular&lt; uint16_t, Compute &gt; &gt; Struct Template Reference</a>	509
12.236.1	<a href="#">Member Typedef Documentation</a>	510
12.236.1.1	<a href="#">value [1/2]</a>	510
12.236.1.2	<a href="#">value [2/2]</a>	510
12.237	<a href="#">ModeTraits&lt; Givaro::Modular&lt; uint32_t, Compute &gt; &gt; Struct Template Reference</a>	510
12.237.1	<a href="#">Member Typedef Documentation</a>	510
12.237.1.1	<a href="#">value [1/2]</a>	510
12.237.1.2	<a href="#">value [2/2]</a>	510
12.238	<a href="#">ModeTraits&lt; Givaro::Modular&lt; uint8_t, Compute &gt; &gt; Struct Template Reference</a>	510
12.238.1	<a href="#">Member Typedef Documentation</a>	510

12.238.1.1 value [1/2]	510
12.238.1.2 value [2/2]	510
12.239 ModeTraits< Givaro::ModularBalanced< Element > > Struct Template Reference	511
12.239.1 Member Typedef Documentation	511
12.239.1.1 value [1/2]	511
12.239.1.2 value [2/2]	511
12.240 ModeTraits< Givaro::ModularBalanced< Givaro::Integer > > Struct Reference	511
12.240.1 Member Typedef Documentation	511
12.240.1.1 value [1/2]	511
12.240.1.2 value [2/2]	511
12.241 ModeTraits< Givaro::ModularBalanced< int16_t > > Struct Reference	511
12.241.1 Member Typedef Documentation	512
12.241.1.1 value [1/2]	512
12.241.1.2 value [2/2]	512
12.242 ModeTraits< Givaro::ModularBalanced< int32_t > > Struct Reference	512
12.242.1 Member Typedef Documentation	512
12.242.1.1 value [1/2]	512
12.242.1.2 value [2/2]	512
12.243 ModeTraits< Givaro::ModularBalanced< int8_t > > Struct Reference	512
12.243.1 Member Typedef Documentation	512
12.243.1.1 value [1/2]	512
12.243.1.2 value [2/2]	512
12.244 ModeTraits< Givaro::Montgomery< T > > Struct Template Reference	513
12.244.1 Member Typedef Documentation	513
12.244.1.1 value [1/2]	513
12.244.1.2 value [2/2]	513
12.245 ModeTraits< Givaro::ZRing< double > > Struct Reference	513
12.245.1 Member Typedef Documentation	513
12.245.1.1 value [1/2]	513
12.245.1.2 value [2/2]	513
12.246 ModeTraits< Givaro::ZRing< float > > Struct Reference	513
12.246.1 Member Typedef Documentation	513
12.246.1.1 value [1/2]	513
12.246.1.2 value [2/2]	514
12.247 ModeTraits< Givaro::ZRing< Givaro::Integer > > Struct Reference	514
12.247.1 Member Typedef Documentation	514
12.247.1.1 value [1/2]	514
12.247.1.2 value [2/2]	514
12.248 ModularBalanced< T > Class Template Reference	514
12.249 ModularBalanced< T > Class Template Reference	514
12.250 ModularTag Struct Reference	514
12.250.1 Detailed Description	514

12.251 Montgomery< T > Class Template Reference . . . . .	514
12.252 need_field_characteristic< Field > Struct Template Reference . . . . .	515
12.252.1 Field Documentation . . . . .	515
12.252.1.1 value . . . . .	515
12.253 need_field_characteristic< Givaro::Modular< Field > > Struct Template Reference . . . . .	515
12.253.1 Field Documentation . . . . .	515
12.253.1.1 value [1/2] . . . . .	515
12.253.1.2 value [2/2] . . . . .	515
12.254 need_field_characteristic< Givaro::ModularBalanced< Field > > Struct Template Reference . . . . .	515
12.254.1 Field Documentation . . . . .	515
12.254.1.1 value [1/2] . . . . .	515
12.254.1.2 value [2/2] . . . . .	515
12.255 NoSimd< T > Struct Template Reference . . . . .	516
12.255.1 Member Typedef Documentation . . . . .	516
12.255.1.1 vect_t . . . . .	516
12.255.1.2 scalar_t . . . . .	516
12.255.1.3 aligned_allocator . . . . .	516
12.255.1.4 aligned_vector . . . . .	516
12.255.1.5 is_same_element . . . . .	516
12.255.2 Member Function Documentation . . . . .	516
12.255.2.1 type_string() . . . . .	516
12.255.2.2 valid() . . . . .	517
12.255.2.3 compliant() . . . . .	517
12.255.3 Field Documentation . . . . .	517
12.255.3.1 vect_size . . . . .	517
12.255.3.2 alignment . . . . .	517
12.256 Parallel< C, P > Struct Template Reference . . . . .	517
12.256.1 Member Typedef Documentation . . . . .	517
12.256.1.1 Cut . . . . .	517
12.256.1.2 Param . . . . .	517
12.256.2 Constructor & Destructor Documentation . . . . .	518
12.256.2.1 Parallel() . . . . .	518
12.256.3 Member Function Documentation . . . . .	518
12.256.3.1 numthreads() . . . . .	518
12.256.3.2 set_numthreads() . . . . .	518
12.256.4 Friends And Related Symbol Documentation . . . . .	518
12.256.4.1 operator<< . . . . .	518
12.257 RNSInteger< RNS >::RandIter Class Reference . . . . .	518
12.257.1 Constructor & Destructor Documentation . . . . .	519
12.257.1.1 RandIter() . . . . .	519
12.257.2 Member Function Documentation . . . . .	519
12.257.2.1 random() [1/2] . . . . .	519

12.257.2.2 random() [2/2]	519
12.257.2.3 operator>() [1/2]	519
12.257.2.4 operator>() [2/2]	519
12.257.2.5 ring()	519
12.258 RNSIntegerMod< RNS >::RandIter Class Reference	519
12.258.1 Constructor & Destructor Documentation	520
12.258.1.1 RandIter()	520
12.258.2 Member Function Documentation	520
12.258.2.1 random() [1/2]	520
12.258.2.2 random() [2/2]	520
12.258.2.3 operator>() [1/2]	520
12.258.2.4 operator>() [2/2]	520
12.258.2.5 ring()	520
12.259 readMyMachineType< Field, T > Struct Template Reference	520
12.259.1 Member Typedef Documentation	521
12.259.1.1 Element	521
12.259.1.2 Element_ptr	521
12.259.2 Member Function Documentation	521
12.259.2.1 operator>()	521
12.260 readMyMachineType< Field, mpz_t > Struct Template Reference	521
12.260.1 Member Typedef Documentation	521
12.260.1.1 Element [1/2]	521
12.260.1.2 Element_ptr [1/2]	522
12.260.1.3 Element [2/2]	522
12.260.1.4 Element_ptr [2/2]	522
12.260.2 Member Function Documentation	522
12.260.2.1 operator>() [1/2]	522
12.260.2.2 operator>() [2/2]	522
12.261 Recursive Struct Reference	522
12.262 Recursive Struct Reference	522
12.263 array< T >::reverse_iterator Class Reference	522
12.263.1 Detailed Description	523
12.264 string::reverse_iterator Class Reference	523
12.264.1 Detailed Description	523
12.265 vector< T >::reverse_iterator Class Reference	523
12.265.1 Detailed Description	523
12.266 rint< K > Class Template Reference	523
12.267 rns_double Struct Reference	523
12.267.1 Member Typedef Documentation	524
12.267.1.1 integer	524
12.267.1.2 ModField	524
12.267.1.3 BasisElement	524

12.267.1.4 Element	524
12.267.1.5 Element_ptr	524
12.267.1.6 ConstElement_ptr	524
12.267.2 Constructor & Destructor Documentation	525
12.267.2.1 rns_double() [1/4]	525
12.267.2.2 rns_double() [2/4]	525
12.267.2.3 rns_double() [3/4]	525
12.267.2.4 rns_double() [4/4]	525
12.267.3 Member Function Documentation	525
12.267.3.1 precompute_cst()	525
12.267.3.2 init() [1/3]	525
12.267.3.3 init() [2/3]	525
12.267.3.4 init_transpose()	526
12.267.3.5 convert() [1/2]	526
12.267.3.6 convert_transpose()	526
12.267.3.7 reduce()	526
12.267.3.8 init() [3/3]	526
12.267.3.9 convert() [2/2]	527
12.267.4 Field Documentation	527
12.267.4.1 _basis	527
12.267.4.2 _basisMax	527
12.267.4.3 _negbasis	527
12.267.4.4 _invbasis	527
12.267.4.5 _field_rns	527
12.267.4.6 _M	527
12.267.4.7 _Mi	527
12.267.4.8 _MMi	527
12.267.4.9 _crt_in	527
12.267.4.10 _crt_out	527
12.267.4.11 _size	528
12.267.4.12 _pbits	528
12.267.4.13 _ldm	528
12.267.4.14 _mi_sum	528
12.268 rns_double_elt Struct Reference	528
12.268.1 Constructor & Destructor Documentation	528
12.268.1.1 rns_double_elt() [1/3]	528
12.268.1.2 ~rns_double_elt()	528
12.268.1.3 rns_double_elt() [2/3]	529
12.268.1.4 rns_double_elt() [3/3]	529
12.268.2 Member Function Documentation	529
12.268.2.1 operator&() [1/2]	529
12.268.2.2 operator&() [2/2]	529



12.268.3 Field Documentation	529
12.268.3.1 _ptr	529
12.268.3.2 _stride	529
12.268.3.3 _alloc	529
12.269 rns_double_elt_cstptr Struct Reference	529
12.269.1 Constructor & Destructor Documentation	530
12.269.1.1 rns_double_elt_cstptr() [1/5]	530
12.269.1.2 rns_double_elt_cstptr() [2/5]	530
12.269.1.3 rns_double_elt_cstptr() [3/5]	530
12.269.1.4 rns_double_elt_cstptr() [4/5]	530
12.269.1.5 rns_double_elt_cstptr() [5/5]	530
12.269.2 Member Function Documentation	530
12.269.2.1 operator&() [1/2]	530
12.269.2.2 operator*()	530
12.269.2.3 operator[]() [1/2]	531
12.269.2.4 operator[]() [2/2]	531
12.269.2.5 operator++()	531
12.269.2.6 operator--()	531
12.269.2.7 operator+()	531
12.269.2.8 operator-()	531
12.269.2.9 operator+=()	531
12.269.2.10 operator-=()	531
12.269.2.11 operator=()	531
12.269.2.12 operator<()	531
12.269.2.13 operator"!="()	531
12.269.2.14 operator&() [2/2]	531
12.269.3 Field Documentation	532
12.269.3.1 other	532
12.269.3.2 _ptr	532
12.269.3.3 _stride	532
12.269.3.4 _alloc	532
12.270 rns_double_elt_ptr Struct Reference	532
12.270.1 Constructor & Destructor Documentation	533
12.270.1.1 rns_double_elt_ptr() [1/5]	533
12.270.1.2 rns_double_elt_ptr() [2/5]	533
12.270.1.3 rns_double_elt_ptr() [3/5]	533
12.270.1.4 rns_double_elt_ptr() [4/5]	533
12.270.1.5 rns_double_elt_ptr() [5/5]	533
12.270.2 Member Function Documentation	533
12.270.2.1 operator&() [1/2]	533
12.270.2.2 operator*()	533
12.270.2.3 operator[]() [1/2]	533

12.270.2.4 operator[]() [2/2]	533
12.270.2.5 operator++()	533
12.270.2.6 operator--()	533
12.270.2.7 operator+()	534
12.270.2.8 operator-()	534
12.270.2.9 operator+=()	534
12.270.2.10 operator-=()	534
12.270.2.11 operator=()	534
12.270.2.12 operator<()	534
12.270.2.13 operator"!=()	534
12.270.2.14 operator&() [2/2]	534
12.270.3 Field Documentation	534
12.270.3.1 other	534
12.270.3.2 _ptr	534
12.270.3.3 _stride	534
12.270.3.4 _alloc	534
12.271 rns_double_extended Struct Reference	535
12.271.1 Member Typedef Documentation	535
12.271.1.1 integer	535
12.271.1.2 ModField	535
12.271.1.3 BasisElement	536
12.271.1.4 Element	536
12.271.1.5 Element_ptr	536
12.271.1.6 ConstElement_ptr	536
12.271.2 Constructor & Destructor Documentation	536
12.271.2.1 rns_double_extended() [1/3]	536
12.271.2.2 rns_double_extended() [2/3]	536
12.271.2.3 rns_double_extended() [3/3]	536
12.271.3 Member Function Documentation	536
12.271.3.1 precompute_cst()	536
12.271.3.2 init() [1/3]	536
12.271.3.3 init() [2/3]	537
12.271.3.4 convert() [1/2]	537
12.271.3.5 init() [3/3]	537
12.271.3.6 convert() [2/2]	537
12.271.3.7 reduce()	537
12.271.4 Field Documentation	537
12.271.4.1 _basis	537
12.271.4.2 _basisMax	537
12.271.4.3 _negbasis	537
12.271.4.4 _invbasis	538
12.271.4.5 _field_rns	538

12.271.4.6 <code>_M</code> . . . . .	538
12.271.4.7 <code>_Mi</code> . . . . .	538
12.271.4.8 <code>_MMi</code> . . . . .	538
12.271.4.9 <code>_crt_in</code> . . . . .	538
12.271.4.10 <code>_crt_out</code> . . . . .	538
12.271.4.11 <code>_size</code> . . . . .	538
12.271.4.12 <code>_pbits</code> . . . . .	538
12.271.4.13 <code>_ldm</code> . . . . .	538
12.272 RNSElementTag Struct Reference . . . . .	538
12.272.1 Detailed Description . . . . .	538
12.273 RNSInteger< RNS > Class Template Reference . . . . .	538
12.273.1 Member Typedef Documentation . . . . .	539
12.273.1.1 <code>BasisElement</code> . . . . .	539
12.273.1.2 <code>integer</code> . . . . .	539
12.273.1.3 <code>Element</code> . . . . .	540
12.273.1.4 <code>Element_ptr</code> . . . . .	540
12.273.1.5 <code>ConstElement_ptr</code> . . . . .	540
12.273.2 Constructor & Destructor Documentation . . . . .	540
12.273.2.1 <code>RNSInteger()</code> [1/2] . . . . .	540
12.273.2.2 <code>RNSInteger()</code> [2/2] . . . . .	540
12.273.3 Member Function Documentation . . . . .	540
12.273.3.1 <code>rns()</code> . . . . .	540
12.273.3.2 <code>size()</code> . . . . .	540
12.273.3.3 <code>isOne()</code> . . . . .	540
12.273.3.4 <code>isMOne()</code> . . . . .	540
12.273.3.5 <code>isZero()</code> . . . . .	540
12.273.3.6 <code>characteristic()</code> . . . . .	541
12.273.3.7 <code>cardinality()</code> . . . . .	541
12.273.3.8 <code>init()</code> [1/2] . . . . .	541
12.273.3.9 <code>init()</code> [2/2] . . . . .	541
12.273.3.10 <code>reduce()</code> [1/2] . . . . .	541
12.273.3.11 <code>reduce()</code> [2/2] . . . . .	541
12.273.3.12 <code>convert()</code> . . . . .	541
12.273.3.13 <code>assign()</code> . . . . .	541
12.273.3.14 <code>write()</code> [1/2] . . . . .	541
12.273.3.15 <code>write()</code> [2/2] . . . . .	542
12.273.4 Field Documentation . . . . .	542
12.273.4.1 <code>_rns</code> . . . . .	542
12.273.4.2 <code>one</code> . . . . .	542
12.273.4.3 <code>mOne</code> . . . . .	542
12.273.4.4 <code>zero</code> . . . . .	542
12.274 RNSIntegerMod< RNS > Class Template Reference . . . . .	542

12.274.1 Member Typedef Documentation	543
12.274.1.1 Element	543
12.274.1.2 Element_ptr	543
12.274.1.3 ConstElement_ptr	544
12.274.1.4 BasisElement	544
12.274.1.5 ModField	544
12.274.1.6 integer	544
12.274.2 Constructor & Destructor Documentation	544
12.274.2.1 RNSIntegerMod()	544
12.274.3 Member Function Documentation	544
12.274.3.1 rns()	544
12.274.3.2 delayed()	544
12.274.3.3 size()	544
12.274.3.4 isOne()	544
12.274.3.5 isMOne()	544
12.274.3.6 isZero()	545
12.274.3.7 characteristic() [1/2]	545
12.274.3.8 characteristic() [2/2]	545
12.274.3.9 cardinality() [1/2]	545
12.274.3.10 cardinality() [2/2]	545
12.274.3.11 minElement()	545
12.274.3.12 maxElement()	545
12.274.3.13 init() [1/3]	545
12.274.3.14 init() [2/3]	545
12.274.3.15 reduce() [1/2]	545
12.274.3.16 reduce() [2/2]	546
12.274.3.17 init() [3/3]	546
12.274.3.18 convert()	546
12.274.3.19 assign()	546
12.274.3.20 add()	546
12.274.3.21 sub()	546
12.274.3.22 neg()	546
12.274.3.23 mul()	546
12.274.3.24 axpyin()	547
12.274.3.25 inv()	547
12.274.3.26 areEqual()	547
12.274.3.27 write() [1/2]	547
12.274.3.28 write() [2/2]	547
12.274.3.29 reduce_modp() [1/2]	547
12.274.3.30 write_matrix()	547
12.274.3.31 write_matrix_long()	547
12.274.3.32 reduce_modp() [2/2]	548

12.274.3.33 reduce_modp_rnsmajor()	548
12.274.4 Field Documentation	548
12.274.4.1 _p	548
12.274.4.2 _Mi_modp_rns	548
12.274.4.3 _iM_modp_rns	548
12.274.4.4 _rns	548
12.274.4.5 _F	548
12.274.4.6 _RNSdelayed	548
12.274.4.7 one	548
12.274.4.8 mOne	549
12.274.4.9 zero	549
12.275 rnsRandIter< RNS > Class Template Reference	549
12.275.1 Constructor & Destructor Documentation	549
12.275.1.1 rnsRandIter()	549
12.275.2 Member Function Documentation	549
12.275.2.1 random() [1/2]	549
12.275.2.2 operator>() [1/2]	550
12.275.2.3 operator>() [2/2]	550
12.275.2.4 random() [2/2]	550
12.275.2.5 ring()	550
12.276 Row Struct Reference	550
12.277 ruint< K > Class Template Reference	550
12.278 ScalFunctions< Element > Struct Template Reference	550
12.278.1 Member Typedef Documentation	551
12.278.1.1 vectElt	551
12.278.2 Member Function Documentation	551
12.278.2.1 genInputs()	551
12.278.2.2 genInputsWithZero()	551
12.278.2.3 zero()	551
12.278.2.4 vand()	552
12.278.2.5 vor()	552
12.278.2.6 vxor()	552
12.278.2.7 vandnot()	552
12.278.2.8 add()	552
12.278.2.9 addin()	552
12.278.2.10 sub()	552
12.278.2.11 subin()	552
12.278.2.12 mul()	552
12.278.2.13 mulin()	553
12.278.2.14 div()	553
12.278.2.15 fmadd()	553
12.278.2.16 fmaddin()	553

12.278.2.17 fmsub()	553
12.278.2.18 fmsubin()	553
12.278.2.19 fnmadd()	553
12.278.2.20 fnmaddin()	554
12.278.2.21 lesser()	554
12.278.2.22 lesser_eq()	554
12.278.2.23 greater()	554
12.278.2.24 greater_eq()	554
12.278.2.25 eq()	554
12.278.2.26 unpacklo()	554
12.278.2.27 unpackhi()	554
12.278.2.28 unpacklohi()	555
12.278.2.29 pack_even()	555
12.278.2.30 pack_odd()	555
12.278.2.31 pack()	555
12.278.2.32 blend()	555
12.279 ScalFunctionsBase< Element, Enable > Struct Template Reference	555
12.280 ScalFunctionsBase< Element, typename enable_if< is_floating_point< Element >::value >::type > Struct Template Reference	556
12.280.1 Member Function Documentation	556
12.280.1.1 get_default_random_generator()	556
12.280.1.2 ceil()	556
12.280.1.3 floor()	556
12.280.1.4 round()	556
12.280.1.5 blendv()	556
12.280.1.6 fma()	557
12.280.2 Field Documentation	557
12.280.2.1 _zero	557
12.280.2.2 cmp_true	557
12.280.2.3 cmp_false	557
12.281 ScalFunctionsBase< Element, typename enable_if< is_integral< Element >::value >::type > Struct Template Reference	557
12.281.1 Member Function Documentation	558
12.281.1.1 get_default_random_generator()	558
12.281.1.2 round()	558
12.281.1.3 fma()	558
12.281.1.4 mullo()	558
12.281.1.5 mulhi()	558
12.281.1.6 mulx()	558
12.281.1.7 fmaddx()	558
12.281.1.8 fmaddxin()	558
12.281.1.9 fmsubx()	559
12.281.1.10 fmsubxin()	559

12.281.1.11 fnmaddx()	559
12.281.1.12 fnmaddxin()	559
12.281.1.13 sra()	559
12.281.1.14 srl()	559
12.281.1.15 sll()	559
12.281.2 Field Documentation	559
12.281.2.1 _zero	559
12.281.2.2 cmp_true	560
12.281.2.3 cmp_false	560
12.282 Sequential Struct Reference	560
12.282.1 Constructor & Destructor Documentation	560
12.282.1.1 Sequential() [1/3]	560
12.282.1.2 Sequential() [2/3]	560
12.282.1.3 Sequential() [3/3]	560
12.282.2 Member Function Documentation	560
12.282.2.1 numthreads()	560
12.282.3 Friends And Related Symbol Documentation	560
12.282.3.1 operator<<	560
12.283 Simd128_impl< ArithType, Int, Signed, Size > Struct Template Reference	561
12.284 Simd128_impl< true, false, true, 4 > Struct Reference	561
12.285 Simd128_impl< true, false, true, 8 > Struct Reference	561
12.286 Simd128_impl< true, true, false, 2 > Struct Reference	561
12.286.1 Member Typedef Documentation	563
12.286.1.1 scalar_t	563
12.286.1.2 aligned_allocator	563
12.286.1.3 aligned_vector	563
12.286.1.4 is_same_element	563
12.286.1.5 vect_t	563
12.286.2 Member Function Documentation	563
12.286.2.1 type_string()	563
12.286.2.2 set1() [1/2]	563
12.286.2.3 set() [1/2]	564
12.286.2.4 gather() [1/2]	564
12.286.2.5 load() [1/2]	564
12.286.2.6 loadu() [1/2]	564
12.286.2.7 store() [1/2]	564
12.286.2.8 storeu() [1/2]	564
12.286.2.9 stream() [1/2]	564
12.286.2.10 sra()	564
12.286.2.11 greater()	564
12.286.2.12 lesser()	565
12.286.2.13 greater_eq()	565

12.286.2.14 lesser_eq()	565
12.286.2.15 mulhi()	565
12.286.2.16 mulx()	565
12.286.2.17 fmaddx()	565
12.286.2.18 fmaddxin()	565
12.286.2.19 fnmaddx()	565
12.286.2.20 fnmaddxin()	565
12.286.2.21 fmsubx()	566
12.286.2.22 fmsubxin()	566
12.286.2.23 hadd_to_scal()	566
12.286.2.24 valid()	566
12.286.2.25 compliant()	566
12.286.2.26 set1() [2/2]	566
12.286.2.27 set() [2/2]	566
12.286.2.28 gather() [2/2]	566
12.286.2.29 load() [2/2]	566
12.286.2.30 loadu() [2/2]	567
12.286.2.31 store() [2/2]	567
12.286.2.32 storeu() [2/2]	567
12.286.2.33 stream() [2/2]	567
12.286.2.34 sll()	567
12.286.2.35 srl()	567
12.286.2.36 shuffle()	567
12.286.2.37 unpacklo_intrinsic()	567
12.286.2.38 unpackhi_intrinsic()	567
12.286.2.39 unpacklo()	567
12.286.2.40 unpackhi()	568
12.286.2.41 unpacklohi()	568
12.286.2.42 pack_even()	568
12.286.2.43 pack_odd()	568
12.286.2.44 pack()	568
12.286.2.45 transpose()	568
12.286.2.46 blend()	568
12.286.2.47 add()	568
12.286.2.48 addin()	569
12.286.2.49 sub()	569
12.286.2.50 subin()	569
12.286.2.51 mullo()	569
12.286.2.52 mul()	569
12.286.2.53 fmadd()	569
12.286.2.54 fmaddin()	569
12.286.2.55 fnmadd()	569



12.286.2.56 fmaddin()	569
12.286.2.57 fmsub()	570
12.286.2.58 fmsubin()	570
12.286.2.59 eq()	570
12.286.2.60 round()	570
12.286.2.61 mod()	570
12.286.2.62 zero()	570
12.286.2.63 sll128()	570
12.286.2.64 srl128()	570
12.286.2.65 vand()	570
12.286.2.66 vor()	571
12.286.2.67 vxor()	571
12.286.2.68 vandnot()	571
12.286.3 Field Documentation	571
12.286.3.1 vect_size	571
12.286.3.2 alignment	571
12.287 Simd128_impl< true, true, false, 4 > Struct Reference	571
12.287.1 Member Typedef Documentation	573
12.287.1.1 scalar_t	573
12.287.1.2 aligned_allocator	573
12.287.1.3 aligned_vector	573
12.287.1.4 is_same_element	573
12.287.1.5 vect_t	573
12.287.2 Member Function Documentation	574
12.287.2.1 type_string()	574
12.287.2.2 set1() [1/2]	574
12.287.2.3 set() [1/2]	574
12.287.2.4 gather() [1/2]	574
12.287.2.5 load() [1/2]	574
12.287.2.6 loadu() [1/2]	574
12.287.2.7 store() [1/2]	574
12.287.2.8 storeu() [1/2]	574
12.287.2.9 stream() [1/2]	574
12.287.2.10 sra()	574
12.287.2.11 greater()	575
12.287.2.12 lesser()	575
12.287.2.13 greater_eq()	575
12.287.2.14 lesser_eq()	575
12.287.2.15 mulhi()	575
12.287.2.16 mulx()	575
12.287.2.17 fmaddx()	575
12.287.2.18 fmaddxin()	575

12.287.2.19 fnmaddx()	575
12.287.2.20 fnmaddxin()	576
12.287.2.21 fmsubx()	576
12.287.2.22 fmsubxin()	576
12.287.2.23 hadd_to_scal()	576
12.287.2.24 valid()	576
12.287.2.25 compliant()	576
12.287.2.26 set1() [2/2]	576
12.287.2.27 set() [2/2]	576
12.287.2.28 gather() [2/2]	576
12.287.2.29 load() [2/2]	577
12.287.2.30 loadu() [2/2]	577
12.287.2.31 store() [2/2]	577
12.287.2.32 storeu() [2/2]	577
12.287.2.33 stream() [2/2]	577
12.287.2.34 sll()	577
12.287.2.35 srl()	577
12.287.2.36 shuffle()	577
12.287.2.37 unpacklo_intrinsic()	577
12.287.2.38 unpackhi_intrinsic()	577
12.287.2.39 unpacklo()	578
12.287.2.40 unpackhi()	578
12.287.2.41 unpacklohi()	578
12.287.2.42 pack_even()	578
12.287.2.43 pack_odd()	578
12.287.2.44 pack()	578
12.287.2.45 transpose()	578
12.287.2.46 blend()	578
12.287.2.47 add()	578
12.287.2.48 addin()	579
12.287.2.49 sub()	579
12.287.2.50 subin()	579
12.287.2.51 mullo()	579
12.287.2.52 mul()	579
12.287.2.53 fmadd()	579
12.287.2.54 fmaddin()	579
12.287.2.55 fnmadd()	579
12.287.2.56 fnmaddin()	579
12.287.2.57 fmsub()	580
12.287.2.58 fmsubin()	580
12.287.2.59 eq()	580
12.287.2.60 round()	580

12.287.2.61 mod()	580
12.287.2.62 zero()	580
12.287.2.63 sll128()	580
12.287.2.64 srl128()	580
12.287.2.65 vand()	580
12.287.2.66 vor()	581
12.287.2.67 vxor()	581
12.287.2.68 vandnot()	581
12.287.3 Field Documentation	581
12.287.3.1 vect_size	581
12.287.3.2 alignment	581
12.288 Simd128_impl< true, true, false, 8 > Struct Reference	581
12.288.1 Member Typedef Documentation	583
12.288.1.1 scalar_t	583
12.288.1.2 aligned_allocator	583
12.288.1.3 aligned_vector	583
12.288.1.4 is_same_element	583
12.288.1.5 vect_t	584
12.288.2 Member Function Documentation	584
12.288.2.1 type_string()	584
12.288.2.2 set1() [1/2]	584
12.288.2.3 set() [1/2]	584
12.288.2.4 gather() [1/2]	584
12.288.2.5 load() [1/2]	584
12.288.2.6 loadu() [1/2]	584
12.288.2.7 store() [1/2]	584
12.288.2.8 storeu() [1/2]	584
12.288.2.9 stream() [1/2]	584
12.288.2.10 sra()	584
12.288.2.11 greater()	585
12.288.2.12 lesser()	585
12.288.2.13 greater_eq()	585
12.288.2.14 lesser_eq()	585
12.288.2.15 mullo()	585
12.288.2.16 mulhi()	585
12.288.2.17 mulx()	585
12.288.2.18 fmaddx()	585
12.288.2.19 fmaddxin()	585
12.288.2.20 fnmaddx()	586
12.288.2.21 fnmaddxin()	586
12.288.2.22 fmsubx()	586
12.288.2.23 fmsubxin()	586

12.288.2.24 hadd_to_scal()	586
12.288.2.25 valid()	586
12.288.2.26 compliant()	586
12.288.2.27 set1() [2/2]	586
12.288.2.28 set() [2/2]	586
12.288.2.29 gather() [2/2]	587
12.288.2.30 get()	587
12.288.2.31 load() [2/2]	587
12.288.2.32 loadu() [2/2]	587
12.288.2.33 store() [2/2]	587
12.288.2.34 storeu() [2/2]	587
12.288.2.35 stream() [2/2]	587
12.288.2.36 sll()	587
12.288.2.37 srl()	587
12.288.2.38 shuffle()	587
12.288.2.39 unpacklo_intrinsic()	588
12.288.2.40 unpackhi_intrinsic()	588
12.288.2.41 unpacklo()	588
12.288.2.42 unpackhi()	588
12.288.2.43 unpacklohi()	588
12.288.2.44 pack_even()	588
12.288.2.45 pack_odd()	588
12.288.2.46 pack()	588
12.288.2.47 transpose()	588
12.288.2.48 blend()	589
12.288.2.49 add()	589
12.288.2.50 addin()	589
12.288.2.51 sub()	589
12.288.2.52 subin()	589
12.288.2.53 mul()	589
12.288.2.54 fmadd()	589
12.288.2.55 fmaddin()	589
12.288.2.56 fnmadd()	589
12.288.2.57 fnmaddin()	590
12.288.2.58 fmsub()	590
12.288.2.59 fmsubin()	590
12.288.2.60 eq()	590
12.288.2.61 round()	590
12.288.2.62 mask_high()	590
12.288.2.63 mulhi_fast()	590
12.288.2.64 mod()	590
12.288.2.65 signbits()	590

12.288.2.66 zero()	591
12.288.2.67 sll128()	591
12.288.2.68 srl128()	591
12.288.2.69 vand()	591
12.288.2.70 vor()	591
12.288.2.71 vxor()	591
12.288.2.72 vandnot()	591
12.288.3 Field Documentation	591
12.288.3.1 vect_size	591
12.288.3.2 alignment	591
12.289 Simd128_impl< true, true, true, 2 > Struct Reference	591
12.289.1 Member Typedef Documentation	593
12.289.1.1 vect_t	593
12.289.1.2 scalar_t	593
12.289.1.3 aligned_allocator	594
12.289.1.4 aligned_vector	594
12.289.1.5 is_same_element	594
12.289.2 Member Function Documentation	594
12.289.2.1 type_string()	594
12.289.2.2 valid()	594
12.289.2.3 compliant()	594
12.289.2.4 set1()	594
12.289.2.5 set()	594
12.289.2.6 gather()	594
12.289.2.7 load()	594
12.289.2.8 loadu()	595
12.289.2.9 store()	595
12.289.2.10 storeu()	595
12.289.2.11 stream()	595
12.289.2.12 sll()	595
12.289.2.13 srl()	595
12.289.2.14 sra()	595
12.289.2.15 shuffle()	595
12.289.2.16 unpacklo_intrinsic()	595
12.289.2.17 unpackhi_intrinsic()	595
12.289.2.18 unpacklo()	596
12.289.2.19 unpackhi()	596
12.289.2.20 unpacklohi()	596
12.289.2.21 pack_even()	596
12.289.2.22 pack_odd()	596
12.289.2.23 pack()	596
12.289.2.24 transpose()	596

12.289.2.25 blend()	596
12.289.2.26 add()	597
12.289.2.27 addin()	597
12.289.2.28 sub()	597
12.289.2.29 subin()	597
12.289.2.30 mullo()	597
12.289.2.31 mul()	597
12.289.2.32 mulhi()	597
12.289.2.33 mulx()	597
12.289.2.34 fmadd()	597
12.289.2.35 fmaddin()	597
12.289.2.36 fmaddx()	598
12.289.2.37 fmaddxin()	598
12.289.2.38 fnmadd()	598
12.289.2.39 fnmaddin()	598
12.289.2.40 fnmaddx()	598
12.289.2.41 fnmaddxin()	598
12.289.2.42 fmsub()	598
12.289.2.43 fmsubin()	598
12.289.2.44 fmsubx()	598
12.289.2.45 fmsubxin()	599
12.289.2.46 eq()	599
12.289.2.47 greater()	599
12.289.2.48 lesser()	599
12.289.2.49 greater_eq()	599
12.289.2.50 lesser_eq()	599
12.289.2.51 hadd_to_scal()	599
12.289.2.52 round()	599
12.289.2.53 mod()	599
12.289.2.54 zero()	600
12.289.2.55 sll128()	600
12.289.2.56 srl128()	600
12.289.2.57 vand()	600
12.289.2.58 vor()	600
12.289.2.59 vxor()	600
12.289.2.60 vandnot()	600
12.289.3 Field Documentation	600
12.289.3.1 vect_size	600
12.289.3.2 alignment	600
12.290 Simd128_impl< true, true, true, 4 > Struct Reference	601
12.290.1 Member Typedef Documentation	602
12.290.1.1 vect_t	602

12.290.1.2 scalar_t	602
12.290.1.3 aligned_allocator	603
12.290.1.4 aligned_vector	603
12.290.1.5 is_same_element	603
12.290.2 Member Function Documentation	603
12.290.2.1 type_string()	603
12.290.2.2 valid()	603
12.290.2.3 compliant()	603
12.290.2.4 set1()	603
12.290.2.5 set()	603
12.290.2.6 gather()	603
12.290.2.7 load()	603
12.290.2.8 loadu()	603
12.290.2.9 store()	604
12.290.2.10 storeu()	604
12.290.2.11 stream()	604
12.290.2.12 sll()	604
12.290.2.13 srl()	604
12.290.2.14 sra()	604
12.290.2.15 shuffle()	604
12.290.2.16 unpacklo_intrinsic()	604
12.290.2.17 unpackhi_intrinsic()	604
12.290.2.18 unpacklo()	604
12.290.2.19 unpackhi()	605
12.290.2.20 unpacklohi()	605
12.290.2.21 pack_even()	605
12.290.2.22 pack_odd()	605
12.290.2.23 pack()	605
12.290.2.24 transpose()	605
12.290.2.25 blend()	605
12.290.2.26 add()	605
12.290.2.27 addin()	605
12.290.2.28 sub()	606
12.290.2.29 subin()	606
12.290.2.30 mullo()	606
12.290.2.31 mul()	606
12.290.2.32 mulhi()	606
12.290.2.33 mulx()	606
12.290.2.34 fmadd()	606
12.290.2.35 fmaddin()	606
12.290.2.36 fmaddx()	606
12.290.2.37 fmaddxin()	607

12.290.2.38	<a href="#">fnmadd()</a>	607
12.290.2.39	<a href="#">fnmaddin()</a>	607
12.290.2.40	<a href="#">fnmaddx()</a>	607
12.290.2.41	<a href="#">fnmaddxin()</a>	607
12.290.2.42	<a href="#">fmsub()</a>	607
12.290.2.43	<a href="#">fmsubin()</a>	607
12.290.2.44	<a href="#">fmsubx()</a>	607
12.290.2.45	<a href="#">fmsubxin()</a>	607
12.290.2.46	<a href="#">eq()</a>	608
12.290.2.47	<a href="#">greater()</a>	608
12.290.2.48	<a href="#">lesser()</a>	608
12.290.2.49	<a href="#">greater_eq()</a>	608
12.290.2.50	<a href="#">lesser_eq()</a>	608
12.290.2.51	<a href="#">hadd_to_scal()</a>	608
12.290.2.52	<a href="#">round()</a>	608
12.290.2.53	<a href="#">mod()</a>	608
12.290.2.54	<a href="#">zero()</a>	608
12.290.2.55	<a href="#">sll128()</a>	609
12.290.2.56	<a href="#">srl128()</a>	609
12.290.2.57	<a href="#">vand()</a>	609
12.290.2.58	<a href="#">vor()</a>	609
12.290.2.59	<a href="#">vxor()</a>	609
12.290.2.60	<a href="#">vandnot()</a>	609
12.290.3	<a href="#">Field Documentation</a>	609
12.290.3.1	<a href="#">vect_size</a>	609
12.290.3.2	<a href="#">alignment</a>	609
12.291	<a href="#">Simd128_impl&lt; true, true, true, 8 &gt; Struct Reference</a>	609
12.291.1	<a href="#">Member Typedef Documentation</a>	611
12.291.1.1	<a href="#">vect_t</a>	611
12.291.1.2	<a href="#">scalar_t</a>	612
12.291.1.3	<a href="#">aligned_allocator</a>	612
12.291.1.4	<a href="#">aligned_vector</a>	612
12.291.1.5	<a href="#">is_same_element</a>	612
12.291.2	<a href="#">Member Function Documentation</a>	612
12.291.2.1	<a href="#">type_string()</a>	612
12.291.2.2	<a href="#">valid()</a>	612
12.291.2.3	<a href="#">compliant()</a>	612
12.291.2.4	<a href="#">set1()</a>	612
12.291.2.5	<a href="#">set()</a>	612
12.291.2.6	<a href="#">gather()</a>	612
12.291.2.7	<a href="#">get()</a>	612
12.291.2.8	<a href="#">load()</a>	613



12.291.2.9 loadu()	613
12.291.2.10 store()	613
12.291.2.11 storeu()	613
12.291.2.12 stream()	613
12.291.2.13 sll()	613
12.291.2.14 srl()	613
12.291.2.15 sra()	613
12.291.2.16 shuffle()	613
12.291.2.17 unpacklo_intrinsic()	613
12.291.2.18 unpackhi_intrinsic()	614
12.291.2.19 unpacklo()	614
12.291.2.20 unpackhi()	614
12.291.2.21 unpacklohi()	614
12.291.2.22 pack_even()	614
12.291.2.23 pack_odd()	614
12.291.2.24 pack()	614
12.291.2.25 transpose()	614
12.291.2.26 blend()	614
12.291.2.27 add()	615
12.291.2.28 addin()	615
12.291.2.29 sub()	615
12.291.2.30 subin()	615
12.291.2.31 mullo()	615
12.291.2.32 mul()	615
12.291.2.33 mulhi()	615
12.291.2.34 mulx()	615
12.291.2.35 fmadd()	615
12.291.2.36 fmaddin()	615
12.291.2.37 fmaddx()	616
12.291.2.38 fmaddxin()	616
12.291.2.39 fnmadd()	616
12.291.2.40 fnmaddin()	616
12.291.2.41 fnmaddx()	616
12.291.2.42 fnmaddxin()	616
12.291.2.43 fmsub()	616
12.291.2.44 fmsubin()	616
12.291.2.45 fmsubx()	616
12.291.2.46 fmsubxin()	617
12.291.2.47 eq()	617
12.291.2.48 greater()	617
12.291.2.49 lesser()	617
12.291.2.50 greater_eq()	617

12.291.2.51 lesser_eq()	617
12.291.2.52 hadd_to_scal()	617
12.291.2.53 round()	617
12.291.2.54 mask_high()	617
12.291.2.55 mulhi_fast()	617
12.291.2.56 mod()	618
12.291.2.57 signbits()	618
12.291.2.58 zero()	618
12.291.2.59 sll128()	618
12.291.2.60 srl128()	618
12.291.2.61 vand()	618
12.291.2.62 vor()	618
12.291.2.63 vxor()	618
12.291.2.64 vandnot()	618
12.291.3 Field Documentation	619
12.291.3.1 vect_size	619
12.291.3.2 alignment	619
12.292 Simd128i_base Struct Reference	619
12.292.1 Member Typedef Documentation	619
12.292.1.1 vect_t	619
12.292.2 Member Function Documentation	619
12.292.2.1 zero()	619
12.292.2.2 sll128()	619
12.292.2.3 srl128()	620
12.292.2.4 vand()	620
12.292.2.5 vor()	620
12.292.2.6 vxor()	620
12.292.2.7 vandnot()	620
12.293 Simd256_impl< ArithType, Int, Signed, Size > Struct Template Reference	620
12.294 Simd256_impl< true, false, true, 4 > Struct Reference	620
12.295 Simd256_impl< true, false, true, 8 > Struct Reference	621
12.295.1 Member Typedef Documentation	622
12.295.1.1 vect_t	622
12.295.1.2 scalar_t	622
12.295.1.3 aligned_allocator	622
12.295.1.4 aligned_vector	622
12.295.1.5 is_same_element	622
12.295.2 Member Function Documentation	622
12.295.2.1 type_string()	622
12.295.2.2 valid()	623
12.295.2.3 compliant()	623
12.295.2.4 zero()	623

12.295.2.5 set1()	623
12.295.2.6 set()	623
12.295.2.7 gather()	623
12.295.2.8 load()	623
12.295.2.9 loadu()	623
12.295.2.10 store()	623
12.295.2.11 storeu()	623
12.295.2.12 stream()	624
12.295.2.13 unpacklo_intrinsic()	624
12.295.2.14 unpackhi_intrinsic()	624
12.295.2.15 unpacklo()	624
12.295.2.16 unpackhi()	624
12.295.2.17 unpacklohi()	624
12.295.2.18 pack_even()	624
12.295.2.19 pack_odd()	624
12.295.2.20 pack()	624
12.295.2.21 transpose()	625
12.295.2.22 blend()	625
12.295.2.23 blendv()	625
12.295.2.24 add()	625
12.295.2.25 addin()	625
12.295.2.26 sub()	625
12.295.2.27 subin()	625
12.295.2.28 mul()	625
12.295.2.29 mulin()	625
12.295.2.30 div()	626
12.295.2.31 fmadd()	626
12.295.2.32 fmaddin()	626
12.295.2.33 fnmadd()	626
12.295.2.34 fnmaddin()	626
12.295.2.35 fmsub()	626
12.295.2.36 fmsubin()	626
12.295.2.37 eq()	626
12.295.2.38 lesser()	626
12.295.2.39 lesser_eq()	627
12.295.2.40 greater()	627
12.295.2.41 greater_eq()	627
12.295.2.42 vand()	627
12.295.2.43 vor()	627
12.295.2.44 vxor()	627
12.295.2.45 vandnot()	627
12.295.2.46 floor()	627

12.295.2.47	<a href="#">ceil()</a>	627
12.295.2.48	<a href="#">round()</a>	627
12.295.2.49	<a href="#">hadd()</a>	628
12.295.2.50	<a href="#">hadd_to_scal()</a>	628
12.295.2.51	<a href="#">mod()</a>	628
12.295.3	Field Documentation	628
12.295.3.1	<a href="#">vect_size</a>	628
12.295.3.2	<a href="#">alignment</a>	628
12.296	<a href="#">Simd256_impl&lt; true, true, false, 2 &gt; Struct Reference</a>	628
12.296.1	Member Typedef Documentation	630
12.296.1.1	<a href="#">scalar_t</a>	630
12.296.1.2	<a href="#">aligned_allocator</a>	630
12.296.1.3	<a href="#">aligned_vector</a>	630
12.296.1.4	<a href="#">is_same_element</a>	630
12.296.1.5	<a href="#">simdHalf</a>	631
12.296.1.6	<a href="#">vect_t</a>	631
12.296.1.7	<a href="#">half_t</a>	631
12.296.2	Member Function Documentation	631
12.296.2.1	<a href="#">type_string()</a>	631
12.296.2.2	<a href="#">set1()</a> <small>[1/2]</small>	631
12.296.2.3	<a href="#">set()</a> <small>[1/2]</small>	631
12.296.2.4	<a href="#">gather()</a> <small>[1/2]</small>	631
12.296.2.5	<a href="#">load()</a> <small>[1/2]</small>	631
12.296.2.6	<a href="#">loadu()</a> <small>[1/2]</small>	631
12.296.2.7	<a href="#">store()</a> <small>[1/2]</small>	632
12.296.2.8	<a href="#">storeu()</a> <small>[1/2]</small>	632
12.296.2.9	<a href="#">stream()</a> <small>[1/2]</small>	632
12.296.2.10	<a href="#">sra()</a>	632
12.296.2.11	<a href="#">greater()</a>	632
12.296.2.12	<a href="#">lesser()</a>	632
12.296.2.13	<a href="#">greater_eq()</a>	632
12.296.2.14	<a href="#">lesser_eq()</a>	632
12.296.2.15	<a href="#">mulhi()</a>	632
12.296.2.16	<a href="#">mulx()</a>	632
12.296.2.17	<a href="#">fmaddx()</a>	633
12.296.2.18	<a href="#">fmaddxin()</a>	633
12.296.2.19	<a href="#">fnmaddx()</a>	633
12.296.2.20	<a href="#">fnmaddxin()</a>	633
12.296.2.21	<a href="#">fmsubx()</a>	633
12.296.2.22	<a href="#">fmsubxin()</a>	633
12.296.2.23	<a href="#">hadd_to_scal()</a>	633
12.296.2.24	<a href="#">valid()</a>	633

12.296.2.25 compliant()	633
12.296.2.26 set1() [2/2]	634
12.296.2.27 set() [2/2]	634
12.296.2.28 gather() [2/2]	634
12.296.2.29 load() [2/2]	634
12.296.2.30 loadu() [2/2]	634
12.296.2.31 store() [2/2]	634
12.296.2.32 storeu() [2/2]	634
12.296.2.33 stream() [2/2]	634
12.296.2.34 sll()	635
12.296.2.35 srl()	635
12.296.2.36 shuffle()	635
12.296.2.37 unpacklo_intrinsic()	635
12.296.2.38 unpackhi_intrinsic()	635
12.296.2.39 unpacklo()	635
12.296.2.40 unpackhi()	635
12.296.2.41 unpacklohi()	635
12.296.2.42 pack_even()	635
12.296.2.43 pack_odd()	635
12.296.2.44 pack()	636
12.296.2.45 transpose()	636
12.296.2.46 blend() [1/2]	636
12.296.2.47 blend() [2/2]	636
12.296.2.48 add()	636
12.296.2.49 addin()	636
12.296.2.50 sub()	636
12.296.2.51 subin()	637
12.296.2.52 mullo()	637
12.296.2.53 mul()	637
12.296.2.54 fmadd()	637
12.296.2.55 fmaddin()	637
12.296.2.56 fnmadd()	637
12.296.2.57 fnmaddin()	637
12.296.2.58 fmsub()	637
12.296.2.59 fmsubin()	637
12.296.2.60 eq()	638
12.296.2.61 round()	638
12.296.2.62 mod()	638
12.296.2.63 zero()	638
12.296.3 Field Documentation	638
12.296.3.1 vect_size	638
12.296.3.2 alignment	638

12.297 Simd256_impl< true, true, false, 4 > Struct Reference . . . . .	638
12.297.1 Member Typedef Documentation . . . . .	642
12.297.1.1 scalar_t [1/2] . . . . .	642
12.297.1.2 aligned_allocator [1/2] . . . . .	642
12.297.1.3 aligned_vector [1/2] . . . . .	642
12.297.1.4 is_same_element [1/2] . . . . .	642
12.297.1.5 simdHalf [1/2] . . . . .	642
12.297.1.6 scalar_t [2/2] . . . . .	642
12.297.1.7 aligned_allocator [2/2] . . . . .	642
12.297.1.8 aligned_vector [2/2] . . . . .	642
12.297.1.9 is_same_element [2/2] . . . . .	642
12.297.1.10 simdHalf [2/2] . . . . .	642
12.297.1.11 vect_t [1/2] . . . . .	642
12.297.1.12 vect_t [2/2] . . . . .	642
12.297.1.13 half_t [1/2] . . . . .	642
12.297.1.14 half_t [2/2] . . . . .	643
12.297.2 Member Function Documentation . . . . .	643
12.297.2.1 type_string() [1/2] . . . . .	643
12.297.2.2 set1() [1/3] . . . . .	643
12.297.2.3 set() [1/4] . . . . .	643
12.297.2.4 gather() [1/3] . . . . .	643
12.297.2.5 load() [1/3] . . . . .	643
12.297.2.6 loadu() [1/3] . . . . .	643
12.297.2.7 store() [1/3] . . . . .	643
12.297.2.8 storeu() [1/3] . . . . .	643
12.297.2.9 stream() [1/3] . . . . .	643
12.297.2.10 sra() [1/2] . . . . .	644
12.297.2.11 greater() [1/2] . . . . .	644
12.297.2.12 lesser() [1/2] . . . . .	644
12.297.2.13 greater_eq() [1/2] . . . . .	644
12.297.2.14 lesser_eq() [1/2] . . . . .	644
12.297.2.15 mulhi() [1/2] . . . . .	644
12.297.2.16 mulx() [1/2] . . . . .	644
12.297.2.17 fmaddx() [1/2] . . . . .	644
12.297.2.18 fmaddxin() [1/2] . . . . .	644
12.297.2.19 fnmaddx() [1/2] . . . . .	645
12.297.2.20 fnmaddxin() [1/2] . . . . .	645
12.297.2.21 fmsubx() [1/2] . . . . .	645
12.297.2.22 fmsubxin() [1/2] . . . . .	645
12.297.2.23 hadd_to_scal() [1/2] . . . . .	645
12.297.2.24 type_string() [2/2] . . . . .	645
12.297.2.25 set1() [2/3] . . . . .	645

12.297.2.26 set() [2/4]	645
12.297.2.27 gather() [2/3]	645
12.297.2.28 load() [2/3]	646
12.297.2.29 loadu() [2/3]	646
12.297.2.30 store() [2/3]	646
12.297.2.31 storeu() [2/3]	646
12.297.2.32 stream() [2/3]	646
12.297.2.33 sra() [2/2]	646
12.297.2.34 greater() [2/2]	646
12.297.2.35 lesser() [2/2]	646
12.297.2.36 greater_eq() [2/2]	646
12.297.2.37 lesser_eq() [2/2]	646
12.297.2.38 mulhi() [2/2]	647
12.297.2.39 mulx() [2/2]	647
12.297.2.40 fmaddx() [2/2]	647
12.297.2.41 fmaddxin() [2/2]	647
12.297.2.42 fnmaddx() [2/2]	647
12.297.2.43 fnmaddxin() [2/2]	647
12.297.2.44 fmsubx() [2/2]	647
12.297.2.45 fmsubxin() [2/2]	647
12.297.2.46 hadd_to_scal() [2/2]	647
12.297.2.47 valid() [1/2]	648
12.297.2.48 valid() [2/2]	648
12.297.2.49 compliant() [1/2]	648
12.297.2.50 compliant() [2/2]	648
12.297.2.51 set1() [3/3]	648
12.297.2.52 set() [3/4]	648
12.297.2.53 set() [4/4]	648
12.297.2.54 gather() [3/3]	649
12.297.2.55 load() [3/3]	649
12.297.2.56 loadu() [3/3]	649
12.297.2.57 store() [3/3]	649
12.297.2.58 storeu() [3/3]	649
12.297.2.59 stream() [3/3]	649
12.297.2.60 sll() [1/2]	649
12.297.2.61 sll() [2/2]	649
12.297.2.62 srl() [1/2]	649
12.297.2.63 srl() [2/2]	649
12.297.2.64 shuffle_twice() [1/2]	650
12.297.2.65 shuffle_twice() [2/2]	650
12.297.2.66 shuffle() [1/2]	650
12.297.2.67 shuffle() [2/2]	650

12.297.2.68 unpacklo_intrinsic() [1/2]	650
12.297.2.69 unpacklo_intrinsic() [2/2]	650
12.297.2.70 unpackhi_intrinsic() [1/2]	650
12.297.2.71 unpackhi_intrinsic() [2/2]	650
12.297.2.72 unpacklo() [1/2]	650
12.297.2.73 unpacklo() [2/2]	650
12.297.2.74 unpackhi() [1/2]	651
12.297.2.75 unpackhi() [2/2]	651
12.297.2.76 unpacklohi() [1/2]	651
12.297.2.77 unpacklohi() [2/2]	651
12.297.2.78 pack_even() [1/2]	651
12.297.2.79 pack_even() [2/2]	651
12.297.2.80 pack_odd() [1/2]	651
12.297.2.81 pack_odd() [2/2]	651
12.297.2.82 pack() [1/2]	651
12.297.2.83 pack() [2/2]	652
12.297.2.84 transpose() [1/2]	652
12.297.2.85 transpose() [2/2]	652
12.297.2.86 blend() [1/2]	652
12.297.2.87 blend() [2/2]	652
12.297.2.88 add() [1/2]	652
12.297.2.89 add() [2/2]	653
12.297.2.90 addin() [1/2]	653
12.297.2.91 addin() [2/2]	653
12.297.2.92 sub() [1/2]	653
12.297.2.93 sub() [2/2]	653
12.297.2.94 subin() [1/2]	653
12.297.2.95 subin() [2/2]	653
12.297.2.96 mullo() [1/2]	653
12.297.2.97 mullo() [2/2]	653
12.297.2.98 mul() [1/2]	653
12.297.2.99 mul() [2/2]	654
12.297.2.100 fmadd() [1/2]	654
12.297.2.101 fmadd() [2/2]	654
12.297.2.102 fmaddin() [1/2]	654
12.297.2.103 fmaddin() [2/2]	654
12.297.2.104 fnmadd() [1/2]	654
12.297.2.105 fnmadd() [2/2]	654
12.297.2.106 fnmaddin() [1/2]	654
12.297.2.107 fnmaddin() [2/2]	654
12.297.2.108 fmsub() [1/2]	655
12.297.2.109 fmsub() [2/2]	655



12.297.2.110 fmsubin() [1/2]	655
12.297.2.111 fmsubin() [2/2]	655
12.297.2.112 eq() [1/2]	655
12.297.2.113 eq() [2/2]	655
12.297.2.114 round() [1/2]	655
12.297.2.115 round() [2/2]	655
12.297.2.116 mod() [1/2]	655
12.297.2.117 mod() [2/2]	656
12.297.2.118 zero() [1/2]	656
12.297.2.119 zero() [2/2]	656
12.297.2.120 vor()	656
12.297.2.121 vxor()	656
12.297.2.122 vand()	656
12.297.2.123 vandnot()	656
12.297.3 Field Documentation	656
12.297.3.1 vect_size	656
12.297.3.2 alignment	656
12.298 Simd256_impl< true, true, false, 8 > Struct Reference	657
12.298.1 Member Typedef Documentation	659
12.298.1.1 scalar_t	659
12.298.1.2 aligned_allocator	659
12.298.1.3 aligned_vector	659
12.298.1.4 is_same_element	659
12.298.1.5 simdHalf	659
12.298.1.6 vect_t	659
12.298.1.7 half_t	659
12.298.2 Member Function Documentation	659
12.298.2.1 type_string()	659
12.298.2.2 set1() [1/2]	659
12.298.2.3 set() [1/2]	659
12.298.2.4 gather() [1/2]	660
12.298.2.5 load() [1/2]	660
12.298.2.6 loadu() [1/2]	660
12.298.2.7 store() [1/2]	660
12.298.2.8 storeu() [1/2]	660
12.298.2.9 stream() [1/2]	660
12.298.2.10 sra()	660
12.298.2.11 greater()	660
12.298.2.12 lesser()	660
12.298.2.13 greater_eq()	660
12.298.2.14 lesser_eq()	661
12.298.2.15 mullo()	661

12.298.2.16 mulhi()	661
12.298.2.17 mulx()	661
12.298.2.18 fmaddx()	661
12.298.2.19 fmaddxin()	661
12.298.2.20 fnmaddx()	661
12.298.2.21 fnmaddxin()	661
12.298.2.22 fmsubx()	661
12.298.2.23 fmsubxin()	662
12.298.2.24 hadd_to_scal()	662
12.298.2.25 valid()	662
12.298.2.26 compliant()	662
12.298.2.27 set1() [2/2]	662
12.298.2.28 set() [2/2]	662
12.298.2.29 gather() [2/2]	662
12.298.2.30 get()	662
12.298.2.31 load() [2/2]	662
12.298.2.32 loadu() [2/2]	662
12.298.2.33 store() [2/2]	663
12.298.2.34 storeu() [2/2]	663
12.298.2.35 stream() [2/2]	663
12.298.2.36 sll()	663
12.298.2.37 srl()	663
12.298.2.38 shuffle()	663
12.298.2.39 unpacklo_intrinsic()	663
12.298.2.40 unpackhi_intrinsic()	663
12.298.2.41 unpacklo()	663
12.298.2.42 unpackhi()	663
12.298.2.43 unpacklohi()	664
12.298.2.44 pack_even()	664
12.298.2.45 pack_odd()	664
12.298.2.46 pack()	664
12.298.2.47 transpose()	664
12.298.2.48 blend()	664
12.298.2.49 add()	664
12.298.2.50 addin()	664
12.298.2.51 sub()	664
12.298.2.52 subin()	665
12.298.2.53 mul()	665
12.298.2.54 fmadd()	665
12.298.2.55 fmaddin()	665
12.298.2.56 fnmadd()	665
12.298.2.57 fnmaddin()	665

12.298.2.58 fmsub()	665
12.298.2.59 fmsubin()	665
12.298.2.60 eq()	665
12.298.2.61 round()	666
12.298.2.62 mask_high()	666
12.298.2.63 mulhi_fast()	666
12.298.2.64 mod()	666
12.298.2.65 signbits()	666
12.298.2.66 zero()	666
12.298.3 Field Documentation	666
12.298.3.1 vect_size	666
12.298.3.2 alignment	666
12.299 Simd256_impl< true, true, true, 2 > Struct Reference	666
12.299.1 Member Typedef Documentation	668
12.299.1.1 vect_t	668
12.299.1.2 half_t	668
12.299.1.3 scalar_t	668
12.299.1.4 simdHalf	669
12.299.1.5 aligned_allocator	669
12.299.1.6 aligned_vector	669
12.299.1.7 is_same_element	669
12.299.2 Member Function Documentation	669
12.299.2.1 type_string()	669
12.299.2.2 valid()	669
12.299.2.3 compliant()	669
12.299.2.4 set1()	669
12.299.2.5 set()	669
12.299.2.6 gather()	670
12.299.2.7 load()	670
12.299.2.8 loadu()	670
12.299.2.9 store()	670
12.299.2.10 storeu()	670
12.299.2.11 stream()	670
12.299.2.12 sll()	670
12.299.2.13 srl()	670
12.299.2.14 sra()	670
12.299.2.15 shuffle()	670
12.299.2.16 unpacklo_intrinsic()	671
12.299.2.17 unpackhi_intrinsic()	671
12.299.2.18 unpacklo()	671
12.299.2.19 unpackhi()	671
12.299.2.20 unpacklohi()	671

12.299.2.21	<a href="#">pack_even()</a>	671
12.299.2.22	<a href="#">pack_odd()</a>	671
12.299.2.23	<a href="#">pack()</a>	671
12.299.2.24	<a href="#">transpose()</a>	671
12.299.2.25	<a href="#">blend()</a> [1/2]	672
12.299.2.26	<a href="#">blend()</a> [2/2]	672
12.299.2.27	<a href="#">add()</a>	672
12.299.2.28	<a href="#">addin()</a>	672
12.299.2.29	<a href="#">sub()</a>	672
12.299.2.30	<a href="#">subin()</a>	672
12.299.2.31	<a href="#">mullo()</a>	672
12.299.2.32	<a href="#">mul()</a>	673
12.299.2.33	<a href="#">mulhi()</a>	673
12.299.2.34	<a href="#">mulx()</a>	673
12.299.2.35	<a href="#">fmadd()</a>	673
12.299.2.36	<a href="#">fmaddin()</a>	673
12.299.2.37	<a href="#">fmaddx()</a>	673
12.299.2.38	<a href="#">fmaddxin()</a>	673
12.299.2.39	<a href="#">fnmadd()</a>	673
12.299.2.40	<a href="#">fnmaddin()</a>	673
12.299.2.41	<a href="#">fnmaddx()</a>	674
12.299.2.42	<a href="#">fnmaddxin()</a>	674
12.299.2.43	<a href="#">fmsub()</a>	674
12.299.2.44	<a href="#">fmsubin()</a>	674
12.299.2.45	<a href="#">fmsubx()</a>	674
12.299.2.46	<a href="#">fmsubxin()</a>	674
12.299.2.47	<a href="#">eq()</a>	674
12.299.2.48	<a href="#">greater()</a>	674
12.299.2.49	<a href="#">lesser()</a>	674
12.299.2.50	<a href="#">greater_eq()</a>	675
12.299.2.51	<a href="#">lesser_eq()</a>	675
12.299.2.52	<a href="#">hadd_to_scal()</a>	675
12.299.2.53	<a href="#">round()</a>	675
12.299.2.54	<a href="#">mod()</a>	675
12.299.2.55	<a href="#">zero()</a>	675
12.299.3	<a href="#">Field Documentation</a>	675
12.299.3.1	<a href="#">vect_size</a>	675
12.299.3.2	<a href="#">alignment</a>	675
12.300	<a href="#">Simd256_impl&lt; true, true, true, 4 &gt; Struct Reference</a>	675
12.300.1	<a href="#">Member Typedef Documentation</a>	679
12.300.1.1	<a href="#">vect_t</a> [1/2]	679
12.300.1.2	<a href="#">half_t</a> [1/2]	679

12.300.1.3 scalar_t [1/2]	679
12.300.1.4 simdHalf [1/2]	679
12.300.1.5 aligned_allocator [1/2]	679
12.300.1.6 aligned_vector [1/2]	679
12.300.1.7 is_same_element [1/2]	679
12.300.1.8 vect_t [2/2]	679
12.300.1.9 half_t [2/2]	679
12.300.1.10 scalar_t [2/2]	679
12.300.1.11 simdHalf [2/2]	679
12.300.1.12 aligned_allocator [2/2]	680
12.300.1.13 aligned_vector [2/2]	680
12.300.1.14 is_same_element [2/2]	680
12.300.2 Member Function Documentation	680
12.300.2.1 type_string() [1/2]	680
12.300.2.2 valid() [1/2]	680
12.300.2.3 compliant() [1/2]	680
12.300.2.4 set1() [1/2]	680
12.300.2.5 set() [1/2]	680
12.300.2.6 gather() [1/2]	680
12.300.2.7 load() [1/2]	680
12.300.2.8 loadu() [1/2]	681
12.300.2.9 store() [1/2]	681
12.300.2.10 storeu() [1/2]	681
12.300.2.11 stream() [1/2]	681
12.300.2.12 sll() [1/2]	681
12.300.2.13 srl() [1/2]	681
12.300.2.14 sra() [1/2]	681
12.300.2.15 shuffle_twice() [1/2]	681
12.300.2.16 shuffle() [1/2]	681
12.300.2.17 unpacklo_intrinsic() [1/2]	681
12.300.2.18 unpackhi_intrinsic() [1/2]	682
12.300.2.19 unpacklo() [1/2]	682
12.300.2.20 unpackhi() [1/2]	682
12.300.2.21 unpacklohi() [1/2]	682
12.300.2.22 pack_even() [1/2]	682
12.300.2.23 pack_odd() [1/2]	682
12.300.2.24 pack() [1/2]	682
12.300.2.25 transpose() [1/2]	682
12.300.2.26 blend() [1/2]	683
12.300.2.27 add() [1/2]	683
12.300.2.28 addin() [1/2]	683
12.300.2.29 sub() [1/2]	683

12.300.2.30 subin() [1/2]	683
12.300.2.31 mullo() [1/2]	683
12.300.2.32 mul() [1/2]	683
12.300.2.33 mulhi() [1/2]	683
12.300.2.34 mulx() [1/2]	683
12.300.2.35 fmadd() [1/2]	683
12.300.2.36 fmaddin() [1/2]	684
12.300.2.37 fmaddx() [1/2]	684
12.300.2.38 fmaddxin() [1/2]	684
12.300.2.39 fnmadd() [1/2]	684
12.300.2.40 fnmaddin() [1/2]	684
12.300.2.41 fnmaddx() [1/2]	684
12.300.2.42 fnmaddxin() [1/2]	684
12.300.2.43 fmsub() [1/2]	684
12.300.2.44 fmsubin() [1/2]	684
12.300.2.45 fmsubx() [1/2]	685
12.300.2.46 fmsubxin() [1/2]	685
12.300.2.47 eq() [1/2]	685
12.300.2.48 greater() [1/2]	685
12.300.2.49 lesser() [1/2]	685
12.300.2.50 greater_eq() [1/2]	685
12.300.2.51 lesser_eq() [1/2]	685
12.300.2.52 hadd_to_scal() [1/2]	685
12.300.2.53 round() [1/2]	685
12.300.2.54 mod() [1/2]	686
12.300.2.55 type_string() [2/2]	686
12.300.2.56 valid() [2/2]	686
12.300.2.57 compliant() [2/2]	686
12.300.2.58 set1() [2/2]	686
12.300.2.59 set() [2/2]	686
12.300.2.60 gather() [2/2]	686
12.300.2.61 load() [2/2]	687
12.300.2.62 loadu() [2/2]	687
12.300.2.63 store() [2/2]	687
12.300.2.64 storeu() [2/2]	687
12.300.2.65 stream() [2/2]	687
12.300.2.66 sll() [2/2]	687
12.300.2.67 srl() [2/2]	687
12.300.2.68 sra() [2/2]	687
12.300.2.69 shuffle_twice() [2/2]	687
12.300.2.70 shuffle() [2/2]	687
12.300.2.71 unpacklo_intrinsic() [2/2]	688

12.300.2.72 unpackhi_intrinsic() [2/2]	688
12.300.2.73 unpacklo() [2/2]	688
12.300.2.74 unpackhi() [2/2]	688
12.300.2.75 unpacklohi() [2/2]	688
12.300.2.76 pack_even() [2/2]	688
12.300.2.77 pack_odd() [2/2]	688
12.300.2.78 pack() [2/2]	688
12.300.2.79 transpose() [2/2]	688
12.300.2.80 blend() [2/2]	689
12.300.2.81 add() [2/2]	689
12.300.2.82 addin() [2/2]	689
12.300.2.83 sub() [2/2]	689
12.300.2.84 subin() [2/2]	689
12.300.2.85 mullo() [2/2]	689
12.300.2.86 mul() [2/2]	689
12.300.2.87 mulhi() [2/2]	689
12.300.2.88 mulx() [2/2]	690
12.300.2.89 fmadd() [2/2]	690
12.300.2.90 fmaddin() [2/2]	690
12.300.2.91 fmaddx() [2/2]	690
12.300.2.92 fmaddxin() [2/2]	690
12.300.2.93 fnmadd() [2/2]	690
12.300.2.94 fnmaddin() [2/2]	690
12.300.2.95 fnmaddx() [2/2]	690
12.300.2.96 fnmaddxin() [2/2]	690
12.300.2.97 fmsub() [2/2]	691
12.300.2.98 fmsubin() [2/2]	691
12.300.2.99 fmsubx() [2/2]	691
12.300.2.100 fmsubxin() [2/2]	691
12.300.2.101 eq() [2/2]	691
12.300.2.102 greater() [2/2]	691
12.300.2.103 lesser() [2/2]	691
12.300.2.104 greater_eq() [2/2]	691
12.300.2.105 lesser_eq() [2/2]	691
12.300.2.106 hadd_to_scal() [2/2]	692
12.300.2.107 round() [2/2]	692
12.300.2.108 mod() [2/2]	692
12.300.2.109 zero() [1/2]	692
12.300.2.110 zero() [2/2]	692
12.300.2.111 vor()	692
12.300.2.112 vxor()	692
12.300.2.113 vand()	692

12.300.2.114 vandnot()	692
12.300.3 Field Documentation	692
12.300.3.1 vect_size	692
12.300.3.2 alignment	693
12.301 Simd256_impl< true, true, true, 8 > Struct Reference	693
12.301.1 Member Typedef Documentation	695
12.301.1.1 vect_t	695
12.301.1.2 half_t	695
12.301.1.3 scalar_t	695
12.301.1.4 simdHalf	695
12.301.1.5 aligned_allocator	695
12.301.1.6 aligned_vector	695
12.301.1.7 is_same_element	695
12.301.2 Member Function Documentation	695
12.301.2.1 type_string()	695
12.301.2.2 valid()	695
12.301.2.3 compliant()	695
12.301.2.4 set1()	695
12.301.2.5 set()	696
12.301.2.6 gather()	696
12.301.2.7 get()	696
12.301.2.8 load()	696
12.301.2.9 loadu()	696
12.301.2.10 store()	696
12.301.2.11 storeu()	696
12.301.2.12 stream()	696
12.301.2.13 sll()	696
12.301.2.14 srl()	696
12.301.2.15 sra()	697
12.301.2.16 shuffle()	697
12.301.2.17 unpacklo_intrinsic()	697
12.301.2.18 unpackhi_intrinsic()	697
12.301.2.19 unpacklo()	697
12.301.2.20 unpackhi()	697
12.301.2.21 unpacklohi()	697
12.301.2.22 pack_even()	697
12.301.2.23 pack_odd()	697
12.301.2.24 pack()	698
12.301.2.25 transpose()	698
12.301.2.26 blend()	698
12.301.2.27 add()	698
12.301.2.28 addin()	698



12.301.2.29 sub()	698
12.301.2.30 subin()	698
12.301.2.31 mullo()	698
12.301.2.32 mul()	698
12.301.2.33 mulhi()	699
12.301.2.34 mulx()	699
12.301.2.35 fmadd()	699
12.301.2.36 fmaddin()	699
12.301.2.37 fmaddx()	699
12.301.2.38 fmaddxin()	699
12.301.2.39 fnmadd()	699
12.301.2.40 fnmaddin()	699
12.301.2.41 fnmaddx()	699
12.301.2.42 fnmaddxin()	700
12.301.2.43 fmsub()	700
12.301.2.44 fmsubin()	700
12.301.2.45 fmsubx()	700
12.301.2.46 fmsubxin()	700
12.301.2.47 eq()	700
12.301.2.48 greater()	700
12.301.2.49 lesser()	700
12.301.2.50 greater_eq()	700
12.301.2.51 lesser_eq()	701
12.301.2.52 hadd_to_scal()	701
12.301.2.53 round()	701
12.301.2.54 mask_high()	701
12.301.2.55 mulhi_fast()	701
12.301.2.56 mod()	701
12.301.2.57 signbits()	701
12.301.2.58 zero()	701
12.301.3 Field Documentation	701
12.301.3.1 vect_size	701
12.301.3.2 alignment	701
12.302 Simd256fp_base Struct Reference	702
12.303 Simd256i_base Struct Reference	702
12.303.1 Member Typedef Documentation	702
12.303.1.1 vect_t	702
12.303.2 Member Function Documentation	702
12.303.2.1 zero()	702
12.304 Simd512_impl< ArithType, Int, Signed, Size > Struct Template Reference	702
12.305 Simd512_impl< true, false, true, 4 > Struct Reference	702
12.306 Simd512_impl< true, false, true, 8 > Struct Reference	703

12.306.1 Member Typedef Documentation . . . . .	704
12.306.1.1 vect_t . . . . .	704
12.306.1.2 scalar_t . . . . .	704
12.306.1.3 aligned_allocator . . . . .	704
12.306.1.4 aligned_vector . . . . .	704
12.306.1.5 is_same_element . . . . .	704
12.306.2 Member Function Documentation . . . . .	704
12.306.2.1 type_string() . . . . .	704
12.306.2.2 valid() . . . . .	704
12.306.2.3 compliant() . . . . .	704
12.306.2.4 zero() . . . . .	705
12.306.2.5 set1() . . . . .	705
12.306.2.6 set() . . . . .	705
12.306.2.7 gather() . . . . .	705
12.306.2.8 load() . . . . .	705
12.306.2.9 loadu() . . . . .	705
12.306.2.10 store() . . . . .	705
12.306.2.11 storeu() . . . . .	705
12.306.2.12 stream() . . . . .	705
12.306.2.13 shuffle() . . . . .	705
12.306.2.14 unpacklo_intrinsic() . . . . .	706
12.306.2.15 unpackhi_intrinsic() . . . . .	706
12.306.2.16 unpacklo() . . . . .	706
12.306.2.17 unpackhi() . . . . .	706
12.306.2.18 unpacklohi() . . . . .	706
12.306.2.19 pack_even() . . . . .	706
12.306.2.20 pack_odd() . . . . .	706
12.306.2.21 pack() . . . . .	706
12.306.2.22 transpose() . . . . .	706
12.306.2.23 blend() . . . . .	707
12.306.2.24 blendv() . . . . .	707
12.306.2.25 add() . . . . .	707
12.306.2.26 addin() . . . . .	707
12.306.2.27 sub() . . . . .	707
12.306.2.28 subin() . . . . .	707
12.306.2.29 mul() . . . . .	707
12.306.2.30 mulin() . . . . .	707
12.306.2.31 div() . . . . .	707
12.306.2.32 fmadd() . . . . .	708
12.306.2.33 fmaddin() . . . . .	708
12.306.2.34 fnmadd() . . . . .	708
12.306.2.35 fnmaddin() . . . . .	708

12.306.2.36 fmsub()	708
12.306.2.37 fmsubin()	708
12.306.2.38 eq()	708
12.306.2.39 lesser()	708
12.306.2.40 lesser_eq()	708
12.306.2.41 greater()	709
12.306.2.42 greater_eq()	709
12.306.2.43 floor()	709
12.306.2.44 ceil()	709
12.306.2.45 round()	709
12.306.2.46 hadd()	709
12.306.2.47 hadd_to_scal()	709
12.306.3 Field Documentation	709
12.306.3.1 vect_size	709
12.306.3.2 alignment	709
12.307 Simd512_impl< true, true, false, 8 > Struct Reference	709
12.307.1 Member Typedef Documentation	712
12.307.1.1 scalar_t	712
12.307.1.2 aligned_allocator	712
12.307.1.3 aligned_vector	712
12.307.1.4 is_same_element	712
12.307.1.5 simdHalf	712
12.307.1.6 vect_t	712
12.307.1.7 half_t	712
12.307.2 Member Function Documentation	712
12.307.2.1 type_string()	712
12.307.2.2 set1() [1/2]	712
12.307.2.3 set() [1/3]	712
12.307.2.4 gather() [1/2]	713
12.307.2.5 load() [1/2]	713
12.307.2.6 loadu() [1/2]	713
12.307.2.7 store() [1/2]	713
12.307.2.8 maskstore() [1/2]	713
12.307.2.9 storeu() [1/2]	713
12.307.2.10 stream() [1/2]	713
12.307.2.11 sra()	713
12.307.2.12 greater()	713
12.307.2.13 lesser()	713
12.307.2.14 greater_eq()	714
12.307.2.15 lesser_eq()	714
12.307.2.16 mullo()	714
12.307.2.17 mulhi()	714

12.307.2.18 mulx()	714
12.307.2.19 fmaddx()	714
12.307.2.20 fmaddxin()	714
12.307.2.21 fnmaddx()	714
12.307.2.22 fnmaddxin()	714
12.307.2.23 fmsubx()	715
12.307.2.24 fmsubxin()	715
12.307.2.25 hadd_to_scal()	715
12.307.2.26 valid()	715
12.307.2.27 compliant()	715
12.307.2.28 set1() [2/2]	715
12.307.2.29 set() [2/3]	715
12.307.2.30 set() [3/3]	715
12.307.2.31 gather() [2/2]	715
12.307.2.32 load() [2/2]	716
12.307.2.33 loadu() [2/2]	716
12.307.2.34 store() [2/2]	716
12.307.2.35 maskstore() [2/2]	716
12.307.2.36 storeu() [2/2]	716
12.307.2.37 stream() [2/2]	716
12.307.2.38 sll()	716
12.307.2.39 srl()	716
12.307.2.40 shuffle()	716
12.307.2.41 unpacklo_intrinsic()	717
12.307.2.42 unpackhi_intrinsic()	717
12.307.2.43 unpacklo()	717
12.307.2.44 unpackhi()	717
12.307.2.45 unpacklohi()	717
12.307.2.46 pack_even()	717
12.307.2.47 pack_odd()	717
12.307.2.48 pack()	717
12.307.2.49 transpose()	717
12.307.2.50 blend()	718
12.307.2.51 add()	718
12.307.2.52 addin()	718
12.307.2.53 sub()	718
12.307.2.54 subin()	718
12.307.2.55 mul()	718
12.307.2.56 fmadd()	718
12.307.2.57 fmaddin()	718
12.307.2.58 fnmadd()	718
12.307.2.59 fnmaddin()	719

12.307.2.60 fmsub()	719
12.307.2.61 fmsubin()	719
12.307.2.62 eq()	719
12.307.2.63 round()	719
12.307.2.64 mask_high()	719
12.307.2.65 mulhi_fast()	719
12.307.2.66 mod()	719
12.307.2.67 signbits()	720
12.307.2.68 zero()	720
12.307.2.69 vor()	720
12.307.2.70 vxor()	720
12.307.2.71 vand()	720
12.307.2.72 vandnot()	720
12.307.3 Field Documentation	720
12.307.3.1 vect_size	720
12.307.3.2 alignment	720
12.308 Simd512_impl< true, true, true, 8 > Struct Reference	720
12.308.1 Member Typedef Documentation	722
12.308.1.1 vect_t	722
12.308.1.2 half_t	722
12.308.1.3 scalar_t	722
12.308.1.4 simdHalf	723
12.308.1.5 aligned_allocator	723
12.308.1.6 aligned_vector	723
12.308.1.7 is_same_element	723
12.308.2 Member Function Documentation	723
12.308.2.1 type_string()	723
12.308.2.2 valid()	723
12.308.2.3 compliant()	723
12.308.2.4 set1()	723
12.308.2.5 set() [1/2]	723
12.308.2.6 set() [2/2]	723
12.308.2.7 gather()	724
12.308.2.8 load()	724
12.308.2.9 loadu()	724
12.308.2.10 store()	724
12.308.2.11 maskstore()	724
12.308.2.12 storeu()	724
12.308.2.13 stream()	724
12.308.2.14 sll()	724
12.308.2.15 srl()	724
12.308.2.16 sra()	724

12.308.2.17 shuffle()	725
12.308.2.18 unpacklo_intrinsic()	725
12.308.2.19 unpackhi_intrinsic()	725
12.308.2.20 unpacklo()	725
12.308.2.21 unpackhi()	725
12.308.2.22 unpacklohi()	725
12.308.2.23 pack_even()	725
12.308.2.24 pack_odd()	725
12.308.2.25 pack()	725
12.308.2.26 transpose()	726
12.308.2.27 blend()	726
12.308.2.28 add()	726
12.308.2.29 addin()	726
12.308.2.30 sub()	726
12.308.2.31 subin()	726
12.308.2.32 mullo()	726
12.308.2.33 mul()	726
12.308.2.34 mulhi()	726
12.308.2.35 mulx()	727
12.308.2.36 fmadd()	727
12.308.2.37 fmaddin()	727
12.308.2.38 fmaddx()	727
12.308.2.39 fmaddxin()	727
12.308.2.40 fnmadd()	727
12.308.2.41 fnmaddin()	727
12.308.2.42 fnmaddx()	727
12.308.2.43 fnmaddxin()	727
12.308.2.44 fmsub()	728
12.308.2.45 fmsubin()	728
12.308.2.46 fmsubx()	728
12.308.2.47 fmsubxin()	728
12.308.2.48 eq()	728
12.308.2.49 greater()	728
12.308.2.50 lesser()	728
12.308.2.51 greater_eq()	728
12.308.2.52 lesser_eq()	728
12.308.2.53 hadd_to_scal()	729
12.308.2.54 round()	729
12.308.2.55 mask_high()	729
12.308.2.56 mulhi_fast()	729
12.308.2.57 mod()	729
12.308.2.58 signbits()	729

12.308.2.59 zero()	729
12.308.2.60 vor()	729
12.308.2.61 vxor()	729
12.308.2.62 vand()	729
12.308.2.63 vandnot()	730
12.308.3 Field Documentation	730
12.308.3.1 vect_size	730
12.308.3.2 alignment	730
12.309 Simd512i_base Struct Reference	730
12.309.1 Member Typedef Documentation	730
12.309.1.1 vect_t	730
12.309.2 Member Function Documentation	730
12.309.2.1 zero()	730
12.309.2.2 vor()	730
12.309.2.3 vxor()	731
12.309.2.4 vand()	731
12.309.2.5 vandnot()	731
12.310 SimdChooser< T, bool, bool > Struct Template Reference	731
12.311 SimdChooser< T, false, b > Struct Template Reference	731
12.311.1 Member Typedef Documentation	731
12.311.1.1 value	731
12.312 SimdChooser< T, true, false > Struct Template Reference	731
12.312.1 Member Typedef Documentation	732
12.312.1.1 value	732
12.313 SimdChooser< T, true, true > Struct Template Reference	732
12.313.1 Member Typedef Documentation	732
12.313.1.1 value	732
12.314 simdToType< T > Struct Template Reference	732
12.315 Single Struct Reference	732
12.316 Sparse< Field, SparseMatrix_t, IdxT, PtrT > Struct Template Reference	732
12.317 Sparse< _Field, SparseMatrix_t::COO > Struct Template Reference	732
12.317.1 Member Typedef Documentation	733
12.317.1.1 Field	733
12.317.2 Field Documentation	733
12.317.2.1 col	733
12.317.2.2 row	733
12.317.2.3 dat	733
12.317.2.4 delayed	733
12.317.2.5 kmax	733
12.317.2.6 m	733
12.317.2.7 n	733
12.317.2.8 nnz	734

12.317.2.9 nElements . . . . .	734
12.317.2.10 maxrow . . . . .	734
12.318 Sparse< _Field, SparseMatrix_t::COO_ZO > Struct Template Reference . . . . .	734
12.318.1 Member Typedef Documentation . . . . .	734
12.318.1.1 Field . . . . .	734
12.318.2 Field Documentation . . . . .	735
12.318.2.1 cst . . . . .	735
12.318.2.2 col . . . . .	735
12.318.2.3 row . . . . .	735
12.318.2.4 dat . . . . .	735
12.318.2.5 delayed . . . . .	735
12.318.2.6 kmax . . . . .	735
12.318.2.7 m . . . . .	735
12.318.2.8 n . . . . .	735
12.318.2.9 nnz . . . . .	735
12.318.2.10 nElements . . . . .	735
12.318.2.11 maxrow . . . . .	735
12.319 Sparse< _Field, SparseMatrix_t::CSR > Struct Template Reference . . . . .	736
12.319.1 Member Typedef Documentation . . . . .	736
12.319.1.1 Field . . . . .	736
12.319.2 Field Documentation . . . . .	736
12.319.2.1 delayed . . . . .	736
12.319.2.2 kmax . . . . .	736
12.319.2.3 m . . . . .	736
12.319.2.4 n . . . . .	736
12.319.2.5 nnz . . . . .	737
12.319.2.6 nElements . . . . .	737
12.319.2.7 maxrow . . . . .	737
12.319.2.8 col . . . . .	737
12.319.2.9 st . . . . .	737
12.319.2.10 stend . . . . .	737
12.319.2.11 dat . . . . .	737
12.320 Sparse< _Field, SparseMatrix_t::CSR_HYB > Struct Template Reference . . . . .	737
12.320.1 Member Typedef Documentation . . . . .	738
12.320.1.1 Field . . . . .	738
12.320.2 Field Documentation . . . . .	738
12.320.2.1 delayed . . . . .	738
12.320.2.2 col . . . . .	738
12.320.2.3 st . . . . .	738
12.320.2.4 dat . . . . .	738
12.320.2.5 kmax . . . . .	738
12.320.2.6 m . . . . .	738



12.320.2.7 n	738
12.320.2.8 nnz	738
12.320.2.9 nElements	738
12.320.2.10 maxrow	739
12.320.2.11 nOnes	739
12.320.2.12 nMOnes	739
12.320.2.13 nOthers	739
12.321 Sparse< _Field, SparseMatrix_t::CSR_ZO > Struct Template Reference	739
12.321.1 Member Typedef Documentation	740
12.321.1.1 Field	740
12.321.2 Field Documentation	740
12.321.2.1 cst	740
12.321.2.2 delayed	740
12.321.2.3 kmax	740
12.321.2.4 m	740
12.321.2.5 n	740
12.321.2.6 nnz	740
12.321.2.7 nElements	740
12.321.2.8 maxrow	740
12.321.2.9 col	740
12.321.2.10 st	740
12.321.2.11 stend	741
12.321.2.12 dat	741
12.322 Sparse< _Field, SparseMatrix_t::ELL > Struct Template Reference	741
12.322.1 Member Typedef Documentation	741
12.322.1.1 Field	741
12.322.2 Field Documentation	741
12.322.2.1 delayed	741
12.322.2.2 kmax	742
12.322.2.3 m	742
12.322.2.4 n	742
12.322.2.5 ld	742
12.322.2.6 nnz	742
12.322.2.7 nElements	742
12.322.2.8 maxrow	742
12.322.2.9 col	742
12.322.2.10 dat	742
12.323 Sparse< _Field, SparseMatrix_t::ELL_simd > Struct Template Reference	742
12.323.1 Field Documentation	743
12.323.1.1 delayed	743
12.323.1.2 chunk	743
12.323.1.3 m	743

12.323.1.4 n	743
12.323.1.5 ld	743
12.323.1.6 kmax	743
12.323.1.7 nnz	743
12.323.1.8 nElements	743
12.323.1.9 maxrow	744
12.323.1.10 nChunks	744
12.323.1.11 col	744
12.323.1.12 dat	744
12.324 Sparse< _Field, SparseMatrix_t::ELL_simd_ZO > Struct Template Reference	744
12.324.1 Field Documentation	744
12.324.1.1 cst	744
12.324.1.2 delayed	745
12.324.1.3 chunk	745
12.324.1.4 m	745
12.324.1.5 n	745
12.324.1.6 ld	745
12.324.1.7 kmax	745
12.324.1.8 nnz	745
12.324.1.9 nElements	745
12.324.1.10 maxrow	745
12.324.1.11 nChunks	745
12.324.1.12 col	745
12.324.1.13 dat	745
12.325 Sparse< _Field, SparseMatrix_t::ELL_ZO > Struct Template Reference	746
12.325.1 Member Typedef Documentation	746
12.325.1.1 Field	746
12.325.2 Field Documentation	746
12.325.2.1 cst	746
12.325.2.2 delayed	746
12.325.2.3 kmax	746
12.325.2.4 m	746
12.325.2.5 n	747
12.325.2.6 ld	747
12.325.2.7 nnz	747
12.325.2.8 nElements	747
12.325.2.9 maxrow	747
12.325.2.10 col	747
12.325.2.11 dat	747
12.326 Sparse< _Field, SparseMatrix_t::SELL > Struct Template Reference	747
12.326.1 Member Typedef Documentation	748
12.326.1.1 Field	748

12.326.2 Field Documentation	748
12.326.2.1 delayed	748
12.326.2.2 chunk	748
12.326.2.3 kmax	748
12.326.2.4 m	748
12.326.2.5 n	748
12.326.2.6 maxrow	748
12.326.2.7 sigma	749
12.326.2.8 nChunks	749
12.326.2.9 nnz	749
12.326.2.10 nElements	749
12.326.2.11 perm	749
12.326.2.12 st	749
12.326.2.13 chunkSize	749
12.326.2.14 col	749
12.326.2.15 dat	749
12.327 Sparse< _Field, SparseMatrix_t::SELL_ZO > Struct Template Reference	749
12.327.1 Member Typedef Documentation	750
12.327.1.1 Field	750
12.327.2 Field Documentation	750
12.327.2.1 cst	750
12.327.2.2 delayed	750
12.327.2.3 chunk	750
12.327.2.4 kmax	750
12.327.2.5 m	750
12.327.2.6 n	751
12.327.2.7 maxrow	751
12.327.2.8 sigma	751
12.327.2.9 nChunks	751
12.327.2.10 nnz	751
12.327.2.11 nElements	751
12.327.2.12 perm	751
12.327.2.13 st	751
12.327.2.14 chunkSize	751
12.327.2.15 col	751
12.327.2.16 dat	751
12.328 SpMat< Field, flag > Struct Template Reference	751
12.328.1 Field Documentation	752
12.328.1.1 _coo	752
12.328.1.2 _csr	752
12.328.1.3 _ell	752
12.329 StatsMatrix Struct Reference	752

12.329.1 Field Documentation	753
12.329.1.1 rowdim	753
12.329.1.2 coldim	753
12.329.1.3 nOnes	753
12.329.1.4 nMOnes	753
12.329.1.5 nOthers	753
12.329.1.6 nnz	753
12.329.1.7 maxRow	753
12.329.1.8 minRow	753
12.329.1.9 averageRow	753
12.329.1.10 deviationRow	753
12.329.1.11 maxCol	753
12.329.1.12 minCol	753
12.329.1.13 averageCol	753
12.329.1.14 deviationCol	754
12.329.1.15 minColDifference	754
12.329.1.16 maxColDifference	754
12.329.1.17 averageColDifference	754
12.329.1.18 deviationColDifference	754
12.329.1.19 minRowDifference	754
12.329.1.20 maxRowDifference	754
12.329.1.21 averageRowDifference	754
12.329.1.22 deviationRowDifference	754
12.329.1.23 nDenseRows	754
12.329.1.24 nDenseCols	754
12.329.1.25 nEmptyRows	754
12.329.1.26 nEmptyCols	754
12.329.1.27 nEmptyColsEnd	754
12.329.1.28 denseRows	754
12.329.1.29 denseCols	755
12.330 string Class Reference	755
12.330.1 Detailed Description	755
12.331 support_fast_mod< T > Struct Template Reference	755
12.332 support_fast_mod< double > Struct Reference	755
12.333 support_fast_mod< float > Struct Reference	756
12.334 support_fast_mod< int64_t > Struct Reference	756
12.335 support_simd< T > Struct Template Reference	756
12.336 support_simd_add< T > Struct Template Reference	756
12.337 support_simd_mod< T > Struct Template Reference	757
12.338 Test< Elt > Class Template Reference	757
12.338.1 Member Typedef Documentation	758
12.338.1.1 Field	758

12.338.1.2	Elt_ptr	758
12.338.1.3	Residu	758
12.338.1.4	enable_if_t	758
12.338.1.5	is_same_element	758
12.338.1.6	enable_if_no_simd_t	758
12.338.1.7	enable_if_simd128_t	758
12.338.1.8	enable_if_simd256_t	758
12.338.1.9	enable_if_simd512_t	758
12.338.2	Constructor & Destructor Documentation	759
12.338.2.1	Test()	759
12.338.3	Member Function Documentation	759
12.338.3.1	cardinality() [1/2]	759
12.338.3.2	cardinality() [2/2]	759
12.338.3.3	test_ftranspose()	759
12.338.3.4	doTests()	759
12.338.3.5	run()	759
12.338.4	Field Documentation	759
12.338.4.1	F	759
12.338.4.2	_mm	759
12.338.4.3	_nn	760
12.339	TestOneMethod< Simd > Class Template Reference	760
12.339.1	Member Typedef Documentation	761
12.339.1.1	Element	761
12.339.1.2	vect_t	761
12.339.1.3	vectElt	761
12.339.1.4	enable_if_t	761
12.339.2	Constructor & Destructor Documentation	761
12.339.2.1	TestOneMethod()	761
12.339.3	Member Function Documentation	761
12.339.3.1	evaluate_scalar_method() [1/3]	761
12.339.3.2	evaluate_scalar_method() [2/3]	761
12.339.3.3	evaluate_scalar_method() [3/3]	761
12.339.3.4	evaluate_simd_method() [1/2]	762
12.339.3.5	evaluate_simd_method() [2/2]	762
12.339.3.6	getStatus()	762
12.339.3.7	getTestName()	762
12.339.3.8	writeResultLine()	762
12.339.3.9	writeDebugData()	762
12.339.4	Field Documentation	762
12.339.4.1	vect_size	762
12.339.4.2	nb_lref	762
12.339.4.3	name	762

12.339.4.4 inputs . . . . .	762
12.339.4.5 outputs_simd . . . . .	763
12.339.4.6 outputs_scalar . . . . .	763
12.340 tfn_minus Struct Reference . . . . .	763
12.340.1 Member Function Documentation . . . . .	763
12.340.1.1 operator>() . . . . .	763
12.341 tfn_minus_eq Struct Reference . . . . .	763
12.341.1 Member Function Documentation . . . . .	763
12.341.1.1 operator>() . . . . .	763
12.342 tfn_mul Struct Reference . . . . .	763
12.342.1 Member Function Documentation . . . . .	764
12.342.1.1 operator>() . . . . .	764
12.343 tfn_mul_eq Struct Reference . . . . .	764
12.343.1 Member Function Documentation . . . . .	764
12.343.1.1 operator>() . . . . .	764
12.344 tfn_plus Struct Reference . . . . .	764
12.344.1 Member Function Documentation . . . . .	764
12.344.1.1 operator>() . . . . .	764
12.345 tfn_plus_eq Struct Reference . . . . .	765
12.345.1 Member Function Documentation . . . . .	765
12.345.1.1 operator>() . . . . .	765
12.346 Threads Struct Reference . . . . .	765
12.347 ThreeD Struct Reference . . . . .	765
12.348 ThreeDAdaptive Struct Reference . . . . .	765
12.349 ThreeDInPlace Struct Reference . . . . .	765
12.350 TRSMHelper< ReclterTrait, ParSeqTrait > Struct Template Reference . . . . .	765
12.350.1 Detailed Description . . . . .	766
12.350.2 Constructor & Destructor Documentation . . . . .	766
12.350.2.1 TRSMHelper() [1/3] . . . . .	766
12.350.2.2 TRSMHelper() [2/3] . . . . .	766
12.350.2.3 TRSMHelper() [3/3] . . . . .	766
12.350.3 Member Function Documentation . . . . .	766
12.350.3.1 pMMH() [1/2] . . . . .	766
12.350.3.2 pMMH() [2/2] . . . . .	767
12.350.4 Field Documentation . . . . .	767
12.350.4.1 parseq . . . . .	767
12.351 TwoD Struct Reference . . . . .	767
12.352 TwoDAdaptive Struct Reference . . . . .	767
12.353 UnparametricTag Struct Reference . . . . .	767
12.353.1 Detailed Description . . . . .	767
12.354 vector< T > Class Template Reference . . . . .	767
12.354.1 Detailed Description . . . . .	768

12.354.2 Field Documentation	768
12.354.2.1 elements	768
12.355 width< T > Struct Template Reference	768
12.355.1 Field Documentation	768
12.355.1.1 value	768
12.356 width< double > Struct Reference	768
12.356.1 Field Documentation	768
12.356.1.1 value [1/2]	768
12.356.1.2 value [2/2]	768
12.357 width< float > Struct Reference	769
12.357.1 Field Documentation	769
12.357.1.1 value [1/2]	769
12.357.1.2 value [2/2]	769
12.358 Winograd Struct Reference	769
12.359 WinogradPar Struct Reference	769
<b>13 File Documentation</b>	<b>771</b>
13.1 arithprog.C File Reference	771
13.1.1 Typedef Documentation	771
13.1.1.1 TTimer	771
13.1.2 Function Documentation	771
13.1.2.1 main()	771
13.2 autotune/charpoly.C File Reference	771
13.2.1 Macro Definition Documentation	772
13.2.1.1 CUBE	772
13.2.1.2 GFOPS	772
13.2.2 Typedef Documentation	772
13.2.2.1 TTimer	772
13.2.3 Function Documentation	772
13.2.3.1 main()	772
13.3 examples/charpoly.C File Reference	772
13.3.1 Function Documentation	772
13.3.1.1 main()	772
13.4 fsyrk.C File Reference	773
13.4.1 Macro Definition Documentation	773
13.4.1.1 CUBE	773
13.4.1.2 GFOPS	773
13.4.2 Function Documentation	773
13.4.2.1 main()	773
13.5 fsytrf.C File Reference	773
13.5.1 Macro Definition Documentation	774
13.5.1.1 CUBE	774

13.5.1.2 GFOPS	774
13.5.2 Function Documentation	774
13.5.2.1 main()	774
13.6 ftrtri.C File Reference	774
13.6.1 Macro Definition Documentation	774
13.6.1.1 CUBE	774
13.6.1.2 GFOPS	775
13.6.2 Function Documentation	775
13.6.2.1 main()	775
13.7 autotune/pluq.C File Reference	775
13.7.1 Macro Definition Documentation	775
13.7.1.1 CUBE	775
13.7.1.2 GFOPS	775
13.7.2 Function Documentation	776
13.7.2.1 main()	776
13.8 examples/pluq.C File Reference	776
13.8.1 Function Documentation	776
13.8.1.1 main()	776
13.9 winograd.C File Reference	776
13.9.1 Macro Definition Documentation	776
13.9.1.1 DOUBLE_TO_FLOAT_CROSSOVER	776
13.9.1.2 GFOPS	777
13.9.2 Function Documentation	777
13.9.2.1 balanced() [1/2]	777
13.9.2.2 balanced() [2/2]	777
13.9.2.3 main()	777
13.10 benchmark-charpoly-mp.C File Reference	777
13.10.1 Macro Definition Documentation	777
13.10.1.1 __FFLASFFPACK_FORCE_SEQ	777
13.10.2 Function Documentation	777
13.10.2.1 main()	777
13.11 benchmark-charpoly.C File Reference	778
13.11.1 Macro Definition Documentation	778
13.11.1.1 __FFLASFFPACK_OPENBLAS_NT_ALREADY_SET	778
13.11.2 Function Documentation	778
13.11.2.1 run_with_field()	778
13.11.2.2 main()	778
13.12 benchmark-checkers.C File Reference	778
13.12.1 Macro Definition Documentation	779
13.12.1.1 ENABLE_ALL_CHECKINGS	779
13.12.1.2 _NR_TESTS	779
13.12.1.3 _MAX_SIZE_MATRICES	779



13.12.1.4 CUBE . . . . .	779
13.12.2 Function Documentation . . . . .	779
13.12.2.1 main() . . . . .	779
13.13 benchmark-dgemm.C File Reference . . . . .	779
13.13.1 Macro Definition Documentation . . . . .	780
13.13.1.1 CBLAS_GEMM . . . . .	780
13.13.2 Typedef Documentation . . . . .	780
13.13.2.1 TTimer . . . . .	780
13.13.2.2 Floats . . . . .	780
13.13.3 Function Documentation . . . . .	780
13.13.3.1 main() . . . . .	780
13.14 benchmark-dgetrf.C File Reference . . . . .	780
13.14.1 Macro Definition Documentation . . . . .	781
13.14.1.1 __FBLASFFPACK_HAVE_DGETRF . . . . .	781
13.14.2 Function Documentation . . . . .	781
13.14.2.1 main() . . . . .	781
13.15 benchmark-dgetri.C File Reference . . . . .	781
13.15.1 Function Documentation . . . . .	781
13.15.1.1 main() . . . . .	781
13.16 benchmark-dsytrf.C File Reference . . . . .	781
13.16.1 Macro Definition Documentation . . . . .	782
13.16.1.1 EFFGFF . . . . .	782
13.16.2 Function Documentation . . . . .	782
13.16.2.1 main() . . . . .	782
13.17 benchmark-dtrsm.C File Reference . . . . .	782
13.17.1 Function Documentation . . . . .	782
13.17.1.1 main() . . . . .	782
13.18 benchmark-dtrtri.C File Reference . . . . .	782
13.18.1 Macro Definition Documentation . . . . .	783
13.18.1.1 __FBLASFFPACK_HAVE_DTRTRI . . . . .	783
13.18.2 Function Documentation . . . . .	783
13.18.2.1 main() . . . . .	783
13.19 benchmark-fadd-lvl2.C File Reference . . . . .	783
13.19.1 Macro Definition Documentation . . . . .	783
13.19.1.1 __FBLASFFPACK_OPENBLAS_NT_ALREADY_SET . . . . .	783
13.19.2 Function Documentation . . . . .	783
13.19.2.1 main() . . . . .	783
13.20 benchmark-fdot.C File Reference . . . . .	783
13.20.1 Macro Definition Documentation . . . . .	784
13.20.1.1 __FBLASFFPACK_OPENBLAS_NT_ALREADY_SET . . . . .	784
13.20.2 Function Documentation . . . . .	784
13.20.2.1 run_with_field() . . . . .	784

13.20.2.2 main()	784
13.21 benchmark-fgemm-mp.C File Reference	784
13.21.1 Macro Definition Documentation	785
13.21.1.1 __FFLASFFPACK_OPENBLAS_NT_ALREADY_SET	785
13.21.1.2 MG_DEFAULT	785
13.21.1.3 STD_RECINT_SIZE	785
13.21.2 Function Documentation	785
13.21.2.1 tmain()	785
13.21.2.2 main()	785
13.22 benchmark-fgemm-rns.C File Reference	785
13.22.1 Macro Definition Documentation	786
13.22.1.1 __FFLASFFPACK_OPENBLAS_NT_ALREADY_SET	786
13.22.2 Typedef Documentation	786
13.22.2.1 RNS	786
13.22.2.2 Field	786
13.22.2.3 Element_ptr	786
13.22.2.4 ConstElement_ptr	786
13.22.2.5 THREADS	786
13.22.2.6 GRAIN	786
13.22.2.7 TWOD	786
13.22.2.8 TWODA	786
13.22.2.9 THREED	786
13.22.2.10 THREEDA	786
13.22.2.11 THREEDIP	787
13.22.2.12 PSeq	787
13.22.3 Function Documentation	787
13.22.3.1 main()	787
13.23 benchmark-fgemm.C File Reference	787
13.23.1 Macro Definition Documentation	787
13.23.1.1 CLASSIC_HYBRID	787
13.23.2 Function Documentation	787
13.23.2.1 main()	787
13.24 benchmark-fgemv-mp.C File Reference	787
13.24.1 Macro Definition Documentation	788
13.24.1.1 __FFLASFFPACK_OPENBLAS_NT_ALREADY_SET	788
13.24.1.2 MG_DEFAULT	788
13.24.1.3 STD_RECINT_SIZE	788
13.24.2 Function Documentation	788
13.24.2.1 write_matrix()	788
13.24.2.2 tmain()	788
13.24.2.3 main()	788
13.25 benchmark-fgemv.C File Reference	789

13.25.1 Macro Definition Documentation	789
13.25.1.1 __FFLASFFPACK_OPENBLAS_NT_ALREADY_SET	789
13.25.2 Function Documentation	790
13.25.2.1 fill_value()	790
13.25.2.2 genData()	790
13.25.2.3 check_result()	790
13.25.2.4 benchmark_with_timer()	790
13.25.2.5 benchmark_disp()	791
13.25.2.6 benchmark_in_Field()	791
13.25.2.7 benchmark_with_field() [1/2]	791
13.25.2.8 benchmark_with_field() [2/2]	791
13.25.2.9 main()	792
13.26 benchmark-fgesv.C File Reference	792
13.26.1 Macro Definition Documentation	792
13.26.1.1 __FFLASFFPACK_OPENBLAS_NT_ALREADY_SET	792
13.26.2 Function Documentation	792
13.26.2.1 main()	792
13.27 benchmark-fsyr2k.C File Reference	792
13.27.1 Function Documentation	793
13.27.1.1 main()	793
13.28 benchmark-fsyrk.C File Reference	793
13.28.1 Macro Definition Documentation	793
13.28.1.1 __FFLASFFPACK_OPENBLAS_NT_ALREADY_SET	793
13.28.2 Function Documentation	793
13.28.2.1 main()	793
13.29 benchmark-fsytrf.C File Reference	793
13.29.1 Macro Definition Documentation	794
13.29.1.1 __FFPACK_FSYTRF_BC_CROUT	794
13.29.1.2 __FFLASFFPACK_OPENBLAS_NT_ALREADY_SET	794
13.29.1.3 CUBE	794
13.29.2 Function Documentation	794
13.29.2.1 main()	794
13.30 benchmark-ftsm-mp.C File Reference	794
13.30.1 Macro Definition Documentation	794
13.30.1.1 __FFLASFFPACK_OPENBLAS_NT_ALREADY_SET	794
13.30.2 Function Documentation	795
13.30.2.1 main()	795
13.31 benchmark-ftsm.C File Reference	795
13.31.1 Macro Definition Documentation	795
13.31.1.1 __FFLASFFPACK_OPENBLAS_NT_ALREADY_SET	795
13.31.2 Function Documentation	795
13.31.2.1 main()	795

13.32 benchmark-ftsrv.C File Reference	795
13.32.1 Macro Definition Documentation	796
13.32.1.1 __FflasFfpack_OPENBLAS_NT_ALREADY_SET	796
13.32.2 Function Documentation	796
13.32.2.1 main()	796
13.33 benchmark-ftsrti.C File Reference	796
13.33.1 Macro Definition Documentation	796
13.33.1.1 __FflasFfpack_OPENBLAS_NT_ALREADY_SET	796
13.33.1.2 CUBE	796
13.33.2 Function Documentation	796
13.33.2.1 main()	796
13.34 benchmark-inverse.C File Reference	796
13.34.1 Macro Definition Documentation	797
13.34.1.1 CUBE	797
13.34.2 Function Documentation	797
13.34.2.1 main()	797
13.35 benchmark-lqmp.C File Reference	797
13.35.1 Function Documentation	797
13.35.1.1 main()	797
13.36 benchmark-lqp.C File Reference	798
13.36.1 Macro Definition Documentation	798
13.36.1.1 CUBE	798
13.36.2 Function Documentation	798
13.36.2.1 main()	798
13.37 benchmark-pluq.C File Reference	798
13.37.1 Macro Definition Documentation	799
13.37.1.1 __FflasFfpack_OPENBLAS_NT_ALREADY_SET	799
13.37.1.2 CUBE	799
13.37.2 Typedef Documentation	799
13.37.2.1 Field	799
13.37.3 Function Documentation	799
13.37.3.1 verification_PLUQ()	799
13.37.3.2 Rec_Initialize()	799
13.37.3.3 main()	799
13.38 benchmark-quasisep.C File Reference	799
13.38.1 Macro Definition Documentation	800
13.38.1.1 __FflasFfpack_OPENBLAS_NT_ALREADY_SET	800
13.38.2 Function Documentation	800
13.38.2.1 run_with_field()	800
13.38.2.2 main()	800
13.39 benchmark-storage-transpose.C File Reference	800
13.39.1 Function Documentation	801

13.39.1.1 main()	801
13.40 benchmark-wino.C File Reference	801
13.40.1 Macro Definition Documentation	801
13.40.1.1 CUBE	801
13.40.2 Function Documentation	801
13.40.2.1 launch_wino()	801
13.40.2.2 main()	802
13.41 mainpage.doxy File Reference	802
13.42 det.C File Reference	802
13.42.1 Function Documentation	802
13.42.1.1 main()	802
13.43 matmul.C File Reference	802
13.43.1 Function Documentation	802
13.43.1.1 main()	802
13.44 rank.C File Reference	803
13.44.1 Function Documentation	803
13.44.1.1 main()	803
13.45 solve.C File Reference	803
13.45.1 Function Documentation	803
13.45.1.1 main()	803
13.46 checker_charpoly.inl File Reference	803
13.46.1 Macro Definition Documentation	804
13.46.1.1 __FflasFfpack_checker_charpoly_INL	804
13.47 checker_det.inl File Reference	804
13.47.1 Macro Definition Documentation	804
13.47.1.1 __FflasFfpack_checker_det_INL	804
13.48 checker_empty.h File Reference	804
13.49 checker_fgemm.inl File Reference	804
13.49.1 Macro Definition Documentation	805
13.49.1.1 __FflasFfpack_checker_fgemm_INL	805
13.50 checker_ftsm.inl File Reference	805
13.50.1 Macro Definition Documentation	805
13.50.1.1 __FflasFfpack_checker_ftsm_INL	805
13.51 checker_invert.inl File Reference	805
13.51.1 Macro Definition Documentation	805
13.51.1.1 __FflasFfpack_checker_invert_INL	805
13.52 checker_pluq.inl File Reference	805
13.52.1 Macro Definition Documentation	806
13.52.1.1 __FflasFfpack_checker_pluq_INL	806
13.53 checkers.doxy File Reference	806
13.54 checkers_fflas.h File Reference	806
13.55 checkers_fflas.inl File Reference	806

13.55.1 Macro Definition Documentation	807
13.55.1.1 FFLASFFPACK_checkers_fflas_inl_H	807
13.56 checkers_ffpack.h File Reference	807
13.57 checkers_ffpack.inl File Reference	807
13.57.1 Macro Definition Documentation	808
13.57.1.1 FFLASFFPACK_checkers_ffpack_inl_H	808
13.58 config-blas.h File Reference	808
13.58.1 Macro Definition Documentation	809
13.58.1.1 CBLAS_INT	809
13.58.1.2 CBLAS_ENUM_DEFINED_H	809
13.58.1.3 CBLAS_EXTERNALS	809
13.58.1.4 blas_enum	809
13.58.2 Enumeration Type Documentation	809
13.58.2.1 CBLAS_ORDER	809
13.58.2.2 CBLAS_TRANSPOSE	809
13.58.2.3 CBLAS_UPLO	810
13.58.2.4 CBLAS_DIAG	810
13.58.2.5 CBLAS_SIDE	810
13.58.3 Function Documentation	810
13.58.3.1 daxpy_()	810
13.58.3.2 saxpy_()	810
13.58.3.3 ddot_()	811
13.58.3.4 sdot_()	811
13.58.3.5 dasum_()	811
13.58.3.6 idamax_()	811
13.58.3.7 dnrm2_()	811
13.58.3.8 dgemv_()	811
13.58.3.9 sgemv_()	811
13.58.3.10 dger_()	812
13.58.3.11 sger_()	812
13.58.3.12 dcopy_()	812
13.58.3.13 scopy_()	812
13.58.3.14 dscal_()	812
13.58.3.15 sscal_()	813
13.58.3.16 dtrsm_()	813
13.58.3.17 strsm_()	813
13.58.3.18 dtrmm_()	813
13.58.3.19 strmm_()	813
13.58.3.20 sgemm_()	814
13.58.3.21 dgemm_()	814
13.58.3.22 cblas_dsyrc()	814
13.59 config.h File Reference	815

13.59.1 Macro Definition Documentation . . . . .	815
13.59.1.1 HAVE_BLAS . . . . .	815
13.59.1.2 HAVE_CBLAS . . . . .	815
13.59.1.3 HAVE_CXX11 . . . . .	816
13.59.1.4 HAVE_DLFCN_H . . . . .	816
13.59.1.5 HAVE_FLOAT_H . . . . .	816
13.59.1.6 HAVE_INT128 . . . . .	816
13.59.1.7 HAVE_INTTYPES_H . . . . .	816
13.59.1.8 HAVE_LAPACK . . . . .	816
13.59.1.9 HAVE_LIMITS_H . . . . .	816
13.59.1.10 HAVE_LITTLE_ENDIAN . . . . .	816
13.59.1.11 HAVE_PTHREAD_H . . . . .	816
13.59.1.12 HAVE_STDDEF_H . . . . .	816
13.59.1.13 HAVE_STDINT_H . . . . .	816
13.59.1.14 HAVE_STDIO_H . . . . .	816
13.59.1.15 HAVE_STDLIB_H . . . . .	816
13.59.1.16 HAVE_STRINGS_H . . . . .	816
13.59.1.17 HAVE_STRING_H . . . . .	816
13.59.1.18 HAVE_SYS_STAT_H . . . . .	817
13.59.1.19 HAVE_SYS_TIME_H . . . . .	817
13.59.1.20 HAVE_SYS_TYPES_H . . . . .	817
13.59.1.21 HAVE_UNISTD_H . . . . .	817
13.59.1.22 LT_OBJDIR . . . . .	817
13.59.1.23 OPENBLAS_NUM_THREADS . . . . .	817
13.59.1.24 PACKAGE . . . . .	817
13.59.1.25 PACKAGE_BUGREPORT . . . . .	817
13.59.1.26 PACKAGE_NAME . . . . .	817
13.59.1.27 PACKAGE_STRING . . . . .	817
13.59.1.28 PACKAGE_TARNAME . . . . .	817
13.59.1.29 PACKAGE_URL . . . . .	817
13.59.1.30 PACKAGE_VERSION . . . . .	817
13.59.1.31 SIZEOF_CHAR . . . . .	817
13.59.1.32 SIZEOF_INT . . . . .	817
13.59.1.33 SIZEOF_LONG . . . . .	818
13.59.1.34 SIZEOF_LONG_LONG . . . . .	818
13.59.1.35 SIZEOF_SHORT . . . . .	818
13.59.1.36 SIZEOF__INT64_T . . . . .	818
13.59.1.37 STDC_HEADERS . . . . .	818
13.59.1.38 USE_OPENMP . . . . .	818
13.59.1.39 VERSION . . . . .	818
13.60 fflas-ffpack/config.h File Reference . . . . .	818
13.60.1 Macro Definition Documentation . . . . .	819

13.60.1.1	<a href="#">__FFLASFFPACK_HAVE_BLAS</a>	819
13.60.1.2	<a href="#">__FFLASFFPACK_HAVE_CBLAS</a>	819
13.60.1.3	<a href="#">__FFLASFFPACK_HAVE_CXX11</a>	819
13.60.1.4	<a href="#">__FFLASFFPACK_HAVE_DLFCN_H</a>	819
13.60.1.5	<a href="#">__FFLASFFPACK_HAVE_FLOAT_H</a>	819
13.60.1.6	<a href="#">__FFLASFFPACK_HAVE_INT128</a>	819
13.60.1.7	<a href="#">__FFLASFFPACK_HAVE_INTTYPES_H</a>	819
13.60.1.8	<a href="#">__FFLASFFPACK_HAVE_LAPACK</a>	819
13.60.1.9	<a href="#">__FFLASFFPACK_HAVE_LIMITS_H</a>	819
13.60.1.10	<a href="#">__FFLASFFPACK_HAVE_LITTLE_ENDIAN</a>	819
13.60.1.11	<a href="#">__FFLASFFPACK_HAVE_PTHREAD_H</a>	819
13.60.1.12	<a href="#">__FFLASFFPACK_HAVE_STDDEF_H</a>	820
13.60.1.13	<a href="#">__FFLASFFPACK_HAVE_STDINT_H</a>	820
13.60.1.14	<a href="#">__FFLASFFPACK_HAVE_STDIO_H</a>	820
13.60.1.15	<a href="#">__FFLASFFPACK_HAVE_STDLIB_H</a>	820
13.60.1.16	<a href="#">__FFLASFFPACK_HAVE_STRINGS_H</a>	820
13.60.1.17	<a href="#">__FFLASFFPACK_HAVE_STRING_H</a>	820
13.60.1.18	<a href="#">__FFLASFFPACK_HAVE_SYS_STAT_H</a>	820
13.60.1.19	<a href="#">__FFLASFFPACK_HAVE_SYS_TIME_H</a>	820
13.60.1.20	<a href="#">__FFLASFFPACK_HAVE_SYS_TYPES_H</a>	820
13.60.1.21	<a href="#">__FFLASFFPACK_HAVE_UNISTD_H</a>	820
13.60.1.22	<a href="#">__FFLASFFPACK_LT_OBJDIR</a>	820
13.60.1.23	<a href="#">__FFLASFFPACK_OPENBLAS_NUM_THREADS</a>	820
13.60.1.24	<a href="#">__FFLASFFPACK_PACKAGE</a>	820
13.60.1.25	<a href="#">__FFLASFFPACK_PACKAGE_BUGREPORT</a>	820
13.60.1.26	<a href="#">__FFLASFFPACK_PACKAGE_NAME</a>	820
13.60.1.27	<a href="#">__FFLASFFPACK_PACKAGE_STRING</a>	821
13.60.1.28	<a href="#">__FFLASFFPACK_PACKAGE_TARNAME</a>	821
13.60.1.29	<a href="#">__FFLASFFPACK_PACKAGE_URL</a>	821
13.60.1.30	<a href="#">__FFLASFFPACK_PACKAGE_VERSION</a>	821
13.60.1.31	<a href="#">__FFLASFFPACK_SIZEOF_CHAR</a>	821
13.60.1.32	<a href="#">__FFLASFFPACK_SIZEOF_INT</a>	821
13.60.1.33	<a href="#">__FFLASFFPACK_SIZEOF_LONG</a>	821
13.60.1.34	<a href="#">__FFLASFFPACK_SIZEOF_LONG_LONG</a>	821
13.60.1.35	<a href="#">__FFLASFFPACK_SIZEOF_SHORT</a>	821
13.60.1.36	<a href="#">__FFLASFFPACK_SIZEOF___INT64_T</a>	821
13.60.1.37	<a href="#">__FFLASFFPACK_STDC_HEADERS</a>	821
13.60.1.38	<a href="#">__FFLASFFPACK_USE_OPENMP</a>	821
13.60.1.39	<a href="#">__FFLASFFPACK_VERSION</a>	821
13.61	<a href="#">fflas-ffpack-config.h File Reference</a>	821
13.61.1	<a href="#">Detailed Description</a>	822
13.61.2	<a href="#">Macro Definition Documentation</a>	822



13.61.2.1 GCC_VERSION . . . . .	822
13.62 fflas-ffpack-default-thresholds.h File Reference . . . . .	822
13.62.1 Macro Definition Documentation . . . . .	822
13.62.1.1 __FFLASFFPACK_WINOTHRESHOLD . . . . .	822
13.62.1.2 __FFLASFFPACK_WINOTHRESHOLD_FLT . . . . .	822
13.62.1.3 __FFLASFFPACK_WINOTHRESHOLD_BAL . . . . .	822
13.62.1.4 __FFLASFFPACK_WINOTHRESHOLD_BAL_FLT . . . . .	822
13.62.1.5 __FFLASFFPACK_PLUQ_THRESHOLD . . . . .	822
13.62.1.6 __FFLASFFPACK_CHARPOLY_LUKrylov_ArithProg_THRESHOLD . . . . .	822
13.62.1.7 __FFLASFFPACK_CHARPOLY_Danilevskii_LUKrylov_THRESHOLD . . . . .	823
13.62.1.8 __FFLASFFPACK_ARITHPROG_THRESHOLD . . . . .	823
13.62.1.9 __FFLASFFPACK_FTRTRI_THRESHOLD . . . . .	823
13.62.1.10 __FFLASFFPACK_FSYTRF_THRESHOLD . . . . .	823
13.62.1.11 __FFLASFFPACK_FSYRK_THRESHOLD . . . . .	823
13.63 fflas-ffpack-thresholds.h File Reference . . . . .	823
13.64 fflas-ffpack.doxy File Reference . . . . .	823
13.65 fflas-ffpack.h File Reference . . . . .	823
13.65.1 Detailed Description . . . . .	823
13.66 fflas.doxy File Reference . . . . .	823
13.67 fflas.h File Reference . . . . .	823
13.67.1 Detailed Description . . . . .	824
13.67.2 Macro Definition Documentation . . . . .	824
13.67.2.1 WINOTHRESHOLD . . . . .	824
13.67.2.2 DOUBLE_TO_FLOAT_CROSSOVER . . . . .	824
13.68 fflas_bounds.inl File Reference . . . . .	825
13.68.1 Macro Definition Documentation . . . . .	825
13.68.1.1 __FFLASFFPACK_fflas_bounds_INL . . . . .	825
13.68.1.2 FFLAS_INT_TYPE . . . . .	825
13.69 fflas_enum.h File Reference . . . . .	825
13.70 fflas_fadd.h File Reference . . . . .	826
13.71 fflas_fadd.inl File Reference . . . . .	827
13.71.1 Macro Definition Documentation . . . . .	828
13.71.1.1 __FFLASFFPACK_fadd_INL . . . . .	828
13.72 fflas_fassign.h File Reference . . . . .	828
13.73 fflas_fassign.inl File Reference . . . . .	829
13.73.1 Macro Definition Documentation . . . . .	829
13.73.1.1 __FFLASFFPACK_fassign_INL . . . . .	829
13.74 fflas_faxpy.inl File Reference . . . . .	829
13.74.1 Macro Definition Documentation . . . . .	830
13.74.1.1 __FFLASFFPACK_faxpy_INL . . . . .	830
13.75 fflas_fdot.inl File Reference . . . . .	830
13.75.1 Macro Definition Documentation . . . . .	831

13.75.1.1 <a href="#">__FFLASFFPACK_fdot_INL</a>	831
13.76 <a href="#">fflas_fgemm.inl</a> File Reference	831
13.76.1 Macro Definition Documentation	833
13.76.1.1 <a href="#">__FFLASFFPACK_fgemm_INL</a>	833
13.77 <a href="#">fgemm_classical.inl</a> File Reference	833
13.78 <a href="#">fgemm_classical_mp.inl</a> File Reference	833
13.78.1 Detailed Description	835
13.78.2 Macro Definition Documentation	835
13.78.2.1 <a href="#">__FFPACK_fgemm_classical_INL</a>	835
13.79 <a href="#">fgemm_winograd.inl</a> File Reference	835
13.79.1 Macro Definition Documentation	836
13.79.1.1 <a href="#">__FFLASFFPACK_fflas_fflas_fgemm_winograd_INL</a>	836
13.79.1.2 NEWWINO	837
13.80 <a href="#">matmul.doxy</a> File Reference	837
13.81 <a href="#">schedule_bini.inl</a> File Reference	837
13.81.1 Detailed Description	837
13.81.2 Macro Definition Documentation	837
13.81.2.1 <a href="#">__FFLASFFPACK_fgemm_bini_INL</a>	837
13.82 <a href="#">schedule_winograd.inl</a> File Reference	837
13.82.1 Macro Definition Documentation	838
13.82.1.1 <a href="#">__FFLASFFPACK_fgemm_winograd_INL</a>	838
13.83 <a href="#">schedule_winograd_acc.inl</a> File Reference	838
13.83.1 Macro Definition Documentation	838
13.83.1.1 <a href="#">__FFLASFFPACK_fgemm_winograd_acc_INL</a>	838
13.84 <a href="#">schedule_winograd_acc_ip.inl</a> File Reference	839
13.84.1 Macro Definition Documentation	839
13.84.1.1 <a href="#">__FFLASFFPACK_fgemm_winograd_acc_ip_INL</a>	839
13.85 <a href="#">schedule_winograd_ip.inl</a> File Reference	839
13.85.1 Macro Definition Documentation	840
13.85.1.1 <a href="#">__FFLASFFPACK_fgemm_winograd_ip_INL</a>	840
13.86 <a href="#">fflas_fgemv.inl</a> File Reference	840
13.86.1 Macro Definition Documentation	841
13.86.1.1 <a href="#">__FFLASFFPACK_fgemv_INL</a>	841
13.87 <a href="#">fflas_fgemv_mp.inl</a> File Reference	841
13.87.1 Macro Definition Documentation	842
13.87.1.1 <a href="#">__FFLASFFPACK_fgemv_mp_INL</a>	842
13.88 <a href="#">fflas_fger.inl</a> File Reference	842
13.88.1 Macro Definition Documentation	843
13.88.1.1 <a href="#">__FFLASFFPACK_fger_INL</a>	843
13.89 <a href="#">fflas_fger_mp.inl</a> File Reference	843
13.89.1 Macro Definition Documentation	844
13.89.1.1 <a href="#">__FFPACK_fger_mp_INL</a>	844

13.90 fflas_freduce.h File Reference . . . . .	844
13.91 fflas_freduce.inl File Reference . . . . .	845
13.91.1 Macro Definition Documentation . . . . .	846
13.91.1.1 __FFLASFFPACK_fflas_freduce_INL . . . . .	846
13.91.1.2 FFLASFFPACK_COPY_REDUCE . . . . .	846
13.92 fflas_freduce_mp.inl File Reference . . . . .	847
13.92.1 Macro Definition Documentation . . . . .	847
13.92.1.1 __FFLASFFPACK_fflas_freduce_mp_INL . . . . .	847
13.93 fflas_freivalds.inl File Reference . . . . .	847
13.93.1 Macro Definition Documentation . . . . .	847
13.93.1.1 __FFLASFFPACK_freivalds_INL . . . . .	847
13.94 fflas_fscal.h File Reference . . . . .	847
13.95 fflas_fscal.inl File Reference . . . . .	848
13.95.1 Macro Definition Documentation . . . . .	849
13.95.1.1 __FFLASFFPACK_fscal_INL . . . . .	849
13.96 fflas_fscal_mp.inl File Reference . . . . .	849
13.96.1 Macro Definition Documentation . . . . .	850
13.96.1.1 __FFLASFFPACK_fscal_mp_INL . . . . .	850
13.97 fflas_fsyr2k.inl File Reference . . . . .	850
13.97.1 Macro Definition Documentation . . . . .	850
13.97.1.1 __FFLASFFPACK_fflas_fsyr2k_INL . . . . .	850
13.98 fflas_fsyrk.inl File Reference . . . . .	850
13.98.1 Macro Definition Documentation . . . . .	852
13.98.1.1 __FFLASFFPACK_fflas_fsyrk_INL . . . . .	852
13.99 fflas_fsyrk_strassen.inl File Reference . . . . .	852
13.99.1 Macro Definition Documentation . . . . .	853
13.99.1.1 __FFLASFFPACK_fflas_fsyrk_strassen_INL . . . . .	853
13.100 fflas_ftrmm.inl File Reference . . . . .	853
13.100.1 Macro Definition Documentation . . . . .	854
13.100.1.1 __FFLASFFPACK_ftrmm_INL . . . . .	854
13.101 fflas_ftrsm.inl File Reference . . . . .	854
13.101.1 Macro Definition Documentation . . . . .	854
13.101.1.1 __FFLASFFPACK_ftrsm_INL . . . . .	854
13.102 fflas_ftrsm_mp.inl File Reference . . . . .	854
13.102.1 Detailed Description . . . . .	855
13.102.2 Macro Definition Documentation . . . . .	855
13.102.2.1 __FFPACK_ftrsm_mp_INL . . . . .	855
13.103 fflas_ftrsv.inl File Reference . . . . .	855
13.103.1 Macro Definition Documentation . . . . .	855
13.103.1.1 __FFLASFFPACK_ftrsv_INL . . . . .	855
13.104 fflas_helpers.inl File Reference . . . . .	855
13.104.1 Macro Definition Documentation . . . . .	856

13.104.1.1 <a href="#">__FFLASFFPACK_fflas_mmhelper_INL</a>	856
13.105 <a href="#">igemm.doxy</a> File Reference	857
13.106 <a href="#">igemm.h</a> File Reference	857
13.107 <a href="#">igemm.inl</a> File Reference	857
13.107.1 Macro Definition Documentation	858
13.107.1.1 <a href="#">__FFLASFFPACK_fflas_igemm_igemm_INL</a>	858
13.108 <a href="#">igemm_kernels.h</a> File Reference	858
13.109 <a href="#">igemm_kernels.inl</a> File Reference	858
13.109.1 Macro Definition Documentation	859
13.109.1.1 <a href="#">__FFLASFFPACK_fflas_igemm_igemm_kernels_INL</a>	859
13.110 <a href="#">igemm_tools.h</a> File Reference	859
13.111 <a href="#">igemm_tools.inl</a> File Reference	859
13.111.1 Macro Definition Documentation	860
13.111.1.1 <a href="#">__FFLASFFPACK_fflas_igemm_igemm_tools_INL</a>	860
13.112 <a href="#">fflas_level1.inl</a> File Reference	860
13.112.1 Macro Definition Documentation	862
13.112.1.1 <a href="#">__FFLASFFPACK_fflas_fflas_level1_INL</a>	862
13.113 <a href="#">fflas_level2.inl</a> File Reference	862
13.113.1 Macro Definition Documentation	865
13.113.1.1 <a href="#">__FFLASFFPACK_fflas_fflas_level2_INL</a>	865
13.114 <a href="#">fflas_level3.inl</a> File Reference	865
13.114.1 Macro Definition Documentation	867
13.114.1.1 <a href="#">__FFLASFFPACK_fflas_fflas_level3_INL</a>	867
13.114.1.2 <a href="#">__FFLAS__TRSM_READONLY</a>	867
13.115 <a href="#">fflas_pfgemm.inl</a> File Reference	867
13.115.1 Macro Definition Documentation	868
13.115.1.1 <a href="#">__FFLASFFPACK_fflas_pfgemm_INL</a>	868
13.115.1.2 <a href="#">__FFLASFFPACK_SEQPARTHRESHOLD</a>	868
13.115.1.3 <a href="#">__FFLASFFPACK_DIMKPENALTY</a>	868
13.116 <a href="#">fflas_pftsm.inl</a> File Reference	868
13.116.1 Macro Definition Documentation	869
13.116.1.1 <a href="#">__FFLASFFPACK_fflas_pftsm_INL</a>	869
13.116.1.2 <a href="#">PTRSM_HYBRID_THRESHOLD</a>	869
13.117 <a href="#">fflas_simd.h</a> File Reference	869
13.117.1 Macro Definition Documentation	870
13.117.1.1 <a href="#">SIMD_INT</a>	870
13.117.1.2 <a href="#">INLINE</a>	870
13.117.1.3 <a href="#">CONST</a>	870
13.117.1.4 <a href="#">PURE</a>	870
13.117.1.5 <a href="#">NORML_MOD</a>	870
13.117.1.6 <a href="#">FLOAT_MOD</a>	870
13.117.2 Typedef Documentation	870

13.117.2.1 Simd	870
13.118 simd.doxy File Reference	871
13.119 simd128.inl File Reference	871
13.119.1 Macro Definition Documentation	871
13.119.1.1 __FFLASFFPACK_fflas_ffpack_utils_simd128_INL	871
13.119.2 Typedef Documentation	871
13.119.2.1 Simd128	871
13.120 simd128_double.inl File Reference	871
13.120.1 Macro Definition Documentation	872
13.120.1.1 __FFLASFFPACK_fflas_ffpack_utils_simd128_double_INL	872
13.121 simd128_float.inl File Reference	872
13.121.1 Macro Definition Documentation	872
13.121.1.1 __FFLASFFPACK_fflas_ffpack_utils_simd128_float_INL	872
13.122 simd128_int16.inl File Reference	872
13.122.1 Macro Definition Documentation	872
13.122.1.1 __FFLASFFPACK_fflas_ffpack_utils_simd128_int16_INL	872
13.123 simd128_int32.inl File Reference	872
13.123.1 Macro Definition Documentation	873
13.123.1.1 __FFLASFFPACK_fflas_ffpack_utils_simd128_int32_INL	873
13.124 simd128_int64.inl File Reference	873
13.124.1 Macro Definition Documentation	873
13.124.1.1 __FFLASFFPACK_fflas_ffpack_utils_simd128_int64_INL	873
13.124.1.2 vect_t	873
13.125 simd256.inl File Reference	873
13.125.1 Macro Definition Documentation	874
13.125.1.1 __FFLASFFPACK_fflas_ffpack_utils_simd256_INL	874
13.125.2 Typedef Documentation	874
13.125.2.1 Simd256	874
13.126 simd256_double.inl File Reference	874
13.126.1 Macro Definition Documentation	874
13.126.1.1 __FFLASFFPACK_fflas_ffpack_utils_simd256_double_INL	874
13.127 simd256_float.inl File Reference	874
13.127.1 Macro Definition Documentation	875
13.127.1.1 __FFLASFFPACK_fflas_ffpack_utils_simd256_float_INL	875
13.128 simd256_int16.inl File Reference	875
13.128.1 Macro Definition Documentation	875
13.128.1.1 __FFLASFFPACK_fflas_ffpack_utils_simd256_int16_INL	875
13.129 simd256_int32.inl File Reference	875
13.129.1 Macro Definition Documentation	876
13.129.1.1 __FFLASFFPACK_fflas_ffpack_utils_simd256_int32_INL	876
13.130 simd256_int64.inl File Reference	876
13.130.1 Macro Definition Documentation	876

13.130.1.1 <a href="#">__FFLASFFPACK_fflas_ffpack_utils_simd256_int64_INL</a>	876
13.130.1.2 <a href="#">vect_t</a>	876
13.131 <a href="#">simd512.inl</a> File Reference	876
13.131.1 Macro Definition Documentation	877
13.131.1.1 <a href="#">__FFLASFFPACK_simd512_INL</a>	877
13.131.2 Typedef Documentation	877
13.131.2.1 <a href="#">Simd512</a>	877
13.132 <a href="#">simd512_double.inl</a> File Reference	877
13.132.1 Macro Definition Documentation	877
13.132.1.1 <a href="#">__FFLASFFPACK_simd512_double_INL</a>	877
13.133 <a href="#">simd512_float.inl</a> File Reference	877
13.133.1 Macro Definition Documentation	877
13.133.1.1 <a href="#">__FFLASFFPACK_simd512_float_INL</a>	877
13.134 <a href="#">simd512_int32.inl</a> File Reference	878
13.134.1 Macro Definition Documentation	878
13.134.1.1 <a href="#">__FFLASFFPACK_simd512_int32_INL</a>	878
13.135 <a href="#">simd512_int64.inl</a> File Reference	878
13.135.1 Macro Definition Documentation	878
13.135.1.1 <a href="#">_simd512_int64_INL</a>	878
13.135.1.2 <a href="#">vect_t</a>	878
13.136 <a href="#">simd_modular.inl</a> File Reference	879
13.137 <a href="#">fflas_sparse.h</a> File Reference	879
13.137.1 Macro Definition Documentation	883
13.137.1.1 <a href="#">index_t</a>	883
13.137.1.2 <a href="#">ROUND_DOWN</a>	883
13.137.1.3 <a href="#">__FFLASFFPACK_CACHE_LINE_SIZE</a>	883
13.137.1.4 <a href="#">assume_aligned</a>	883
13.137.1.5 <a href="#">DENSE_THRESHOLD</a>	883
13.138 <a href="#">fflas_sparse.inl</a> File Reference	883
13.138.1 Macro Definition Documentation	885
13.138.1.1 <a href="#">__FFLASFFPACK_fflas_fflas_sparse_INL</a>	885
13.139 <a href="#">coo.h</a> File Reference	885
13.140 <a href="#">coo_spm.inl</a> File Reference	886
13.140.1 Macro Definition Documentation	886
13.140.1.1 <a href="#">__FFLASFFPACK_fflas_sparse_coo_spm_INL</a>	886
13.141 <a href="#">coo_spmv.inl</a> File Reference	887
13.141.1 Macro Definition Documentation	887
13.141.1.1 <a href="#">__FFLASFFPACK_fflas_sparse_coo_spmv_INL</a>	887
13.142 <a href="#">coo_utils.inl</a> File Reference	887
13.142.1 Macro Definition Documentation	888
13.142.1.1 <a href="#">__FFLASFFPACK_fflas_sparse_coo_utils_INL</a>	888
13.143 <a href="#">csr.h</a> File Reference	888

13.144	<a href="#">csr_pspmm.inl File Reference</a>	888
13.144.1	<a href="#">Macro Definition Documentation</a>	889
13.144.1.1	<a href="#">__FFLASFFPACK_fflas_sparse_CSR_pspmm_INL</a>	889
13.145	<a href="#">csr_pspmv.inl File Reference</a>	889
13.145.1	<a href="#">Macro Definition Documentation</a>	890
13.145.1.1	<a href="#">__FFLASFFPACK_fflas_sparse_CSR_pspmv_INL</a>	890
13.146	<a href="#">csr_spm্ম.inl File Reference</a>	890
13.146.1	<a href="#">Macro Definition Documentation</a>	891
13.146.1.1	<a href="#">__FFLASFFPACK_fflas_sparse_CSR_spm্ম_INL</a>	891
13.147	<a href="#">csr_spmmv.inl File Reference</a>	891
13.147.1	<a href="#">Macro Definition Documentation</a>	892
13.147.1.1	<a href="#">__FFLASFFPACK_fflas_sparse_CSR_spmmv_INL</a>	892
13.148	<a href="#">csr_utils.inl File Reference</a>	892
13.149	<a href="#">csr_hyb.h File Reference</a>	893
13.150	<a href="#">csr_hyb_pspmm.inl File Reference</a>	893
13.150.1	<a href="#">Macro Definition Documentation</a>	894
13.150.1.1	<a href="#">__FFLASFFPACK_fflas_sparse_CSR_HYB_pspmm_INL</a>	894
13.151	<a href="#">csr_hyb_pspmv.inl File Reference</a>	894
13.151.1	<a href="#">Macro Definition Documentation</a>	894
13.151.1.1	<a href="#">__FFLASFFPACK_fflas_sparse_CSR_HYB_pspmv_INL</a>	894
13.152	<a href="#">csr_hyb_spm্ম.inl File Reference</a>	894
13.152.1	<a href="#">Macro Definition Documentation</a>	895
13.152.1.1	<a href="#">__FFLASFFPACK_fflas_sparse_CSR_HYB_spm্ম_INL</a>	895
13.153	<a href="#">csr_hyb_spmmv.inl File Reference</a>	895
13.153.1	<a href="#">Macro Definition Documentation</a>	895
13.153.1.1	<a href="#">__FFLASFFPACK_fflas_sparse_CSR_HYB_spmmv_INL</a>	895
13.154	<a href="#">csr_hyb_utils.inl File Reference</a>	895
13.154.1	<a href="#">Macro Definition Documentation</a>	896
13.154.1.1	<a href="#">__FFLASFFPACK_fflas_sparse_CSR_HYB_utils_INL</a>	896
13.155	<a href="#">ell.h File Reference</a>	896
13.156	<a href="#">ell_pspmm.inl File Reference</a>	896
13.156.1	<a href="#">Macro Definition Documentation</a>	897
13.156.1.1	<a href="#">__FFLASFFPACK_fflas_sparse_ELL_pspmm_INL</a>	897
13.157	<a href="#">ell_pspmv.inl File Reference</a>	897
13.157.1	<a href="#">Macro Definition Documentation</a>	898
13.157.1.1	<a href="#">__FFLASFFPACK_fflas_sparse_ELL_pspmv_INL</a>	898
13.158	<a href="#">ell_spm্ম.inl File Reference</a>	898
13.158.1	<a href="#">Macro Definition Documentation</a>	899
13.158.1.1	<a href="#">__FFLASFFPACK_fflas_sparse_ELL_spm্ম_INL</a>	899
13.159	<a href="#">ell_spmmv.inl File Reference</a>	899
13.159.1	<a href="#">Macro Definition Documentation</a>	899
13.159.1.1	<a href="#">__FFLASFFPACK_fflas_sparse_ELL_spmmv_INL</a>	899

13.160 ell_utils.inl File Reference . . . . .	899
13.160.1 Macro Definition Documentation . . . . .	900
13.160.1.1 __FFLASFFPACK_fflas_sparse_ELL_utils_INL . . . . .	900
13.161 ell_simd.h File Reference . . . . .	900
13.162 ell_simd_pspmv.inl File Reference . . . . .	901
13.162.1 Macro Definition Documentation . . . . .	901
13.162.1.1 __FFLASFFPACK_fflas_sparse_ELL_simd_pspmv_INL . . . . .	901
13.163 ell_simd_spmv.inl File Reference . . . . .	901
13.163.1 Macro Definition Documentation . . . . .	902
13.163.1.1 __FFLASFFPACK_fflas_sparse_ELL_simd_spmv_INL . . . . .	902
13.164 ell_simd_utils.inl File Reference . . . . .	902
13.164.1 Macro Definition Documentation . . . . .	903
13.164.1.1 __FFLASFFPACK_fflas_sparse_ELL_simd_utils_INL . . . . .	903
13.165 hyb_zo.h File Reference . . . . .	903
13.166 hyb_zo_pspmm.inl File Reference . . . . .	903
13.166.1 Macro Definition Documentation . . . . .	903
13.166.1.1 __FFLASFFPACK_fflas_sparse_HYB_ZO_pspmm_INL . . . . .	903
13.167 hyb_zo_pspmv.inl File Reference . . . . .	903
13.167.1 Macro Definition Documentation . . . . .	904
13.167.1.1 __FFLASFFPACK_fflas_sparse_HYB_ZO_pspmv_INL . . . . .	904
13.168 hyb_zo_spmmm.inl File Reference . . . . .	904
13.168.1 Macro Definition Documentation . . . . .	904
13.168.1.1 __FFLASFFPACK_fflas_sparse_HYB_ZO_spmmm_INL . . . . .	904
13.169 hyb_zo_spmv.inl File Reference . . . . .	904
13.169.1 Macro Definition Documentation . . . . .	905
13.169.1.1 __FFLASFFPACK_fflas_sparse_HYB_ZO_spmv_INL . . . . .	905
13.170 hyb_zo_utils.inl File Reference . . . . .	905
13.170.1 Macro Definition Documentation . . . . .	905
13.170.1.1 __FFLASFFPACK_fflas_sparse_HYB_ZO_utils_INL . . . . .	905
13.171 read_sparse.h File Reference . . . . .	905
13.171.1 Macro Definition Documentation . . . . .	906
13.171.1.1 DNS_BIN_VER . . . . .	906
13.171.1.2 mask_t . . . . .	906
13.172 sell.h File Reference . . . . .	906
13.173 sell_pspmv.inl File Reference . . . . .	907
13.173.1 Macro Definition Documentation . . . . .	907
13.173.1.1 __FFLASFFPACK_fflas_sparse_sell_pspmv_INL . . . . .	907
13.174 sell_spmv.inl File Reference . . . . .	907
13.174.1 Macro Definition Documentation . . . . .	908
13.174.1.1 __FFLASFFPACK_fflas_sparse_sell_spmv_INL . . . . .	908
13.175 sell_utils.inl File Reference . . . . .	908
13.175.1 Macro Definition Documentation . . . . .	909



13.175.1.1 <a href="#">__FFLASFFPACK_fflas_sparse_sell_utils_INL</a> . . . . .	909
13.176 <a href="#">sparse_matrix_traits.h</a> File Reference . . . . .	909
13.177 <a href="#">utils.h</a> File Reference . . . . .	910
13.178 <a href="#">fflas_transpose.h</a> File Reference . . . . .	911
13.178.1 Detailed Description . . . . .	912
13.178.2 Macro Definition Documentation . . . . .	912
13.178.2.1 <a href="#">FFLAS_TRANSPOSE_BLOCKSIZE</a> . . . . .	912
13.178.2.2 LD . . . . .	912
13.178.2.3 ST . . . . .	912
13.179 <a href="#">ffpack.dox</a> File Reference . . . . .	912
13.180 <a href="#">ffpack.h</a> File Reference . . . . .	912
13.180.1 Detailed Description . . . . .	921
13.180.2 Macro Definition Documentation . . . . .	921
13.180.2.1 <a href="#">__FFLASFFPACK_FTRSTR_THRESHOLD</a> . . . . .	921
13.180.2.2 <a href="#">__FFLASFFPACK_FTRSSYR2K_THRESHOLD</a> . . . . .	921
13.181 <a href="#">ffpack.inl</a> File Reference . . . . .	921
13.181.1 Macro Definition Documentation . . . . .	922
13.181.1.1 <a href="#">__FFLASFFPACK_ffpack_INL</a> . . . . .	922
13.182 <a href="#">ffpack_bruhatgen.inl</a> File Reference . . . . .	922
13.182.1 Macro Definition Documentation . . . . .	924
13.182.1.1 <a href="#">__FFLASFFPACK_ffpack_bruhatgen_inl</a> . . . . .	924
13.183 <a href="#">ffpack_charpoly.inl</a> File Reference . . . . .	924
13.183.1 Macro Definition Documentation . . . . .	924
13.183.1.1 <a href="#">__FFLASFFPACK_charpoly_INL</a> . . . . .	924
13.184 <a href="#">ffpack_charpoly_danilevski.inl</a> File Reference . . . . .	924
13.184.1 Macro Definition Documentation . . . . .	925
13.184.1.1 <a href="#">__FFLASFFPACK_ffpack_charpoly_danilveski_INL</a> . . . . .	925
13.185 <a href="#">ffpack_charpoly_kgfast.inl</a> File Reference . . . . .	925
13.185.1 Macro Definition Documentation . . . . .	925
13.185.1.1 <a href="#">__FFLASFFPACK_ffpack_charpoly_kgfast_INL</a> . . . . .	925
13.186 <a href="#">ffpack_charpoly_kgfastgeneralized.inl</a> File Reference . . . . .	925
13.186.1 Macro Definition Documentation . . . . .	926
13.186.1.1 <a href="#">__FFLASFFPACK_ffpack_charpoly_kgfastgeneralized_INL</a> . . . . .	926
13.187 <a href="#">ffpack_charpoly_kglu.inl</a> File Reference . . . . .	926
13.187.1 Macro Definition Documentation . . . . .	926
13.187.1.1 <a href="#">__FFLASFFPACK_ffpack_charpoly_kglu_INL</a> . . . . .	926
13.188 <a href="#">ffpack_charpoly_mp.inl</a> File Reference . . . . .	926
13.188.1 Macro Definition Documentation . . . . .	927
13.188.1.1 <a href="#">__FFPACK_charpoly_mp_INL</a> . . . . .	927
13.189 <a href="#">ffpack_det_mp.inl</a> File Reference . . . . .	927
13.189.1 Macro Definition Documentation . . . . .	927
13.189.1.1 <a href="#">__FFPACK_det_mp_INL</a> . . . . .	927

13.190 fpack_echelonforms.inl File Reference . . . . .	928
13.190.1 Macro Definition Documentation . . . . .	929
13.190.1.1 __FFLASFFPACK_fpack_echelon_forms_INL . . . . .	929
13.190.1.2 __FFLASFFPACK_GAUSSJORDAN_BASECASE . . . . .	929
13.191 fpack_fgesv.inl File Reference . . . . .	929
13.191.1 Macro Definition Documentation . . . . .	929
13.191.1.1 __FFLASFFPACK_fpack_fgesv_INL . . . . .	929
13.192 fpack_fgetrs.inl File Reference . . . . .	929
13.192.1 Macro Definition Documentation . . . . .	930
13.192.1.1 __FFLASFFPACK_fpack_fgetrs_INL . . . . .	930
13.193 fpack_frobenius.inl File Reference . . . . .	930
13.194 fpack_fsytrf.inl File Reference . . . . .	931
13.194.1 Macro Definition Documentation . . . . .	932
13.194.1.1 __FFLASFFPACK_fpack_fsytrf_INL . . . . .	932
13.195 fpack_ftrssyr2k.inl File Reference . . . . .	932
13.195.1 Macro Definition Documentation . . . . .	932
13.195.1.1 __FFLASFFPACK_fpack_ftrssyr2k_INL . . . . .	932
13.196 fpack_ftrstr.inl File Reference . . . . .	932
13.196.1 Macro Definition Documentation . . . . .	933
13.196.1.1 __FFLASFFPACK_fpack_ftrstr_INL . . . . .	933
13.197 fpack_ftrr.inl File Reference . . . . .	933
13.197.1 Macro Definition Documentation . . . . .	933
13.197.1.1 ENABLE_ALL_CHECKINGS . . . . .	933
13.197.1.2 __FFLASFFPACK_fpack_ftrr_INL . . . . .	933
13.198 fpack_invert.inl File Reference . . . . .	933
13.198.1 Macro Definition Documentation . . . . .	934
13.198.1.1 __FFLASFFPACK_fpack_invert_INL . . . . .	934
13.199 fpack_krylovelim.inl File Reference . . . . .	934
13.199.1 Macro Definition Documentation . . . . .	934
13.199.1.1 __FFLASFFPACK_fpack_krylovelim_INL . . . . .	934
13.200 fpack_ludivine.inl File Reference . . . . .	934
13.200.1 Macro Definition Documentation . . . . .	935
13.200.1.1 __FFLASFFPACK_fpack_ludivine_INL . . . . .	935
13.201 fpack_ludivine_mp.inl File Reference . . . . .	935
13.201.1 Macro Definition Documentation . . . . .	935
13.201.1.1 __FFPACK_ludivine_mp_INL . . . . .	935
13.202 fpack_minpoly.inl File Reference . . . . .	936
13.202.1 Macro Definition Documentation . . . . .	936
13.202.1.1 __FFLASFFPACK_fpack_minpoly_INL . . . . .	936
13.203 fpack_permutation.inl File Reference . . . . .	936
13.203.1 Macro Definition Documentation . . . . .	938
13.203.1.1 __FFLASFFPACK_fpack_permutation_INL . . . . .	938

13.203.1.2 FFLASFFPACK_PERM_BKSIZE . . . . .	938
13.204 fpack_pluq.inl File Reference . . . . .	939
13.204.1 Macro Definition Documentation . . . . .	939
13.204.1.1 __FFLASFFPACK_ffpack_pluq_INL . . . . .	939
13.204.1.2 CROUT . . . . .	939
13.205 fpack_pluq_mp.inl File Reference . . . . .	939
13.205.1 Macro Definition Documentation . . . . .	940
13.205.1.1 __FFPACK_pluq_mp_INL . . . . .	940
13.206 fpack_ppluq.inl File Reference . . . . .	940
13.206.1 Macro Definition Documentation . . . . .	940
13.206.1.1 __FFLASFFPACK_ffpack_ppluq_INL . . . . .	940
13.206.1.2 __FFLAS__TRSM_READONLY . . . . .	940
13.206.1.3 PBASECASE_K . . . . .	940
13.207 fpack_rankprofiles.inl File Reference . . . . .	941
13.207.1 Macro Definition Documentation . . . . .	942
13.207.1.1 __FFLASFFPACK_ffpack_rank_profiles_INL . . . . .	942
13.208 field-traits.h File Reference . . . . .	942
13.208.1 Detailed Description . . . . .	944
13.209 field.doxy File Reference . . . . .	944
13.210 rns-double-elt.h File Reference . . . . .	944
13.210.1 Detailed Description . . . . .	944
13.211 rns-double-recint.inl File Reference . . . . .	945
13.211.1 Macro Definition Documentation . . . . .	945
13.211.1.1 __FFLASFFPACK_field_rns_double_recint_INL . . . . .	945
13.212 rns-double.h File Reference . . . . .	945
13.212.1 Detailed Description . . . . .	946
13.212.2 Macro Definition Documentation . . . . .	946
13.212.2.1 ROUND_DOWN . . . . .	946
13.213 rns-double.inl File Reference . . . . .	946
13.213.1 Macro Definition Documentation . . . . .	946
13.213.1.1 __FFLASFFPACK_field_rns_double_INL . . . . .	946
13.214 rns-integer-mod.h File Reference . . . . .	946
13.214.1 Detailed Description . . . . .	947
13.215 rns-integer.h File Reference . . . . .	947
13.215.1 Detailed Description . . . . .	948
13.216 rns.h File Reference . . . . .	948
13.217 rns.inl File Reference . . . . .	948
13.217.1 Macro Definition Documentation . . . . .	948
13.217.1.1 __FFLASFFPACK_field_rns_INL . . . . .	948
13.218 interfaces.doxy File Reference . . . . .	948
13.219 fflas_c.h File Reference . . . . .	948
13.219.1 Macro Definition Documentation . . . . .	950

13.219.1.1 FFLAS_COMPILED . . . . .	950
13.219.2 Enumeration Type Documentation . . . . .	950
13.219.2.1 FFLAS_C_ORDER . . . . .	950
13.219.2.2 FFLAS_C_TRANSPOSE . . . . .	950
13.219.2.3 FFLAS_C_UPLO . . . . .	951
13.219.2.4 FFLAS_C_DIAG . . . . .	951
13.219.2.5 FFLAS_C_SIDE . . . . .	951
13.219.2.6 FFLAS_C_BASE . . . . .	951
13.219.3 Function Documentation . . . . .	952
13.219.3.1 freducein_1_modular_double() . . . . .	952
13.219.3.2 freduce_1_modular_double() . . . . .	952
13.219.3.3 fnegin_1_modular_double() . . . . .	952
13.219.3.4 fneg_1_modular_double() . . . . .	952
13.219.3.5 fzero_1_modular_double() . . . . .	952
13.219.3.6 fiszero_1_modular_double() . . . . .	952
13.219.3.7 fequal_1_modular_double() . . . . .	953
13.219.3.8 fassign_1_modular_double() . . . . .	953
13.219.3.9 fscaln_1_modular_double() . . . . .	953
13.219.3.10 fscal_1_modular_double() . . . . .	953
13.219.3.11 faxpy_1_modular_double() . . . . .	953
13.219.3.12 fdot_1_modular_double() . . . . .	953
13.219.3.13 fswap_1_modular_double() . . . . .	954
13.219.3.14 fadd_1_modular_double() . . . . .	954
13.219.3.15 fsub_1_modular_double() . . . . .	954
13.219.3.16 faddin_1_modular_double() . . . . .	954
13.219.3.17 fsubin_1_modular_double() . . . . .	954
13.219.3.18 fassign_2_modular_double() . . . . .	955
13.219.3.19 fzero_2_modular_double() . . . . .	955
13.219.3.20 fequal_2_modular_double() . . . . .	955
13.219.3.21 fiszero_2_modular_double() . . . . .	955
13.219.3.22 fidentity_2_modular_double() . . . . .	955
13.219.3.23 freducein_2_modular_double() . . . . .	956
13.219.3.24 freduce_2_modular_double() . . . . .	956
13.219.3.25 fnegin_2_modular_double() . . . . .	956
13.219.3.26 fneg_2_modular_double() . . . . .	956
13.219.3.27 fscaln_2_modular_double() . . . . .	956
13.219.3.28 fscal_2_modular_double() . . . . .	957
13.219.3.29 faxpy_2_modular_double() . . . . .	957
13.219.3.30 fmove_2_modular_double() . . . . .	957
13.219.3.31 fadd_2_modular_double() . . . . .	957
13.219.3.32 fsub_2_modular_double() . . . . .	957
13.219.3.33 fsubin_2_modular_double() . . . . .	958

13.219.3.34 faddin_2_modular_double()	958
13.219.3.35 fgemv_2_modular_double()	958
13.219.3.36 fger_2_modular_double()	958
13.219.3.37 ftrsv_2_modular_double()	959
13.219.3.38 ftrsm_3_modular_double()	959
13.219.3.39 ftrmm_3_modular_double()	959
13.219.3.40 fgemm_3_modular_double()	959
13.219.3.41 fsquare_3_modular_double()	960
13.220 fflas_L1_inst.C File Reference	960
13.220.1 Macro Definition Documentation	960
13.220.1.1 __FFLAS_L1_INST_C	960
13.220.1.2 INST_OR_DECL	960
13.220.1.3 FFLAS_FIELD [1/2]	961
13.220.1.4 FFLAS_ELT [1/6]	961
13.220.1.5 FFLAS_ELT [2/6]	961
13.220.1.6 FFLAS_ELT [3/6]	961
13.220.1.7 FFLAS_FIELD [2/2]	961
13.220.1.8 FFLAS_ELT [4/6]	961
13.220.1.9 FFLAS_ELT [5/6]	961
13.220.1.10 FFLAS_ELT [6/6]	961
13.221 fflas_L1_inst.h File Reference	961
13.221.1 Macro Definition Documentation	961
13.221.1.1 INST_OR_DECL	961
13.221.1.2 FFLAS_FIELD [1/2]	962
13.221.1.3 FFLAS_ELT [1/6]	962
13.221.1.4 FFLAS_ELT [2/6]	962
13.221.1.5 FFLAS_ELT [3/6]	962
13.221.1.6 FFLAS_FIELD [2/2]	962
13.221.1.7 FFLAS_ELT [4/6]	962
13.221.1.8 FFLAS_ELT [5/6]	962
13.221.1.9 FFLAS_ELT [6/6]	962
13.222 fflas_L1_inst_implem.inl File Reference	962
13.223 fflas_L2_inst.C File Reference	963
13.223.1 Macro Definition Documentation	964
13.223.1.1 __FFLAS_L2_INST_C	964
13.223.1.2 INST_OR_DECL	964
13.223.1.3 FFLAS_FIELD [1/2]	964
13.223.1.4 FFLAS_ELT [1/6]	964
13.223.1.5 FFLAS_ELT [2/6]	964
13.223.1.6 FFLAS_ELT [3/6]	964
13.223.1.7 FFLAS_FIELD [2/2]	964
13.223.1.8 FFLAS_ELT [4/6]	964

13.223.1.9 FFLAS_ELT [5/6]	964
13.223.1.10 FFLAS_ELT [6/6]	964
13.224 fflas_L2_inst.h File Reference	964
13.224.1 Macro Definition Documentation	965
13.224.1.1 INST_OR_DECL	965
13.224.1.2 FFLAS_FIELD [1/2]	965
13.224.1.3 FFLAS_ELT [1/6]	965
13.224.1.4 FFLAS_ELT [2/6]	965
13.224.1.5 FFLAS_ELT [3/6]	965
13.224.1.6 FFLAS_FIELD [2/2]	965
13.224.1.7 FFLAS_ELT [4/6]	965
13.224.1.8 FFLAS_ELT [5/6]	965
13.224.1.9 FFLAS_ELT [6/6]	965
13.225 fflas_L2_inst_implement.inl File Reference	965
13.226 fflas_L3_inst.C File Reference	967
13.226.1 Macro Definition Documentation	967
13.226.1.1 __FFLAS_L3_INST_C	967
13.226.1.2 INST_OR_DECL	968
13.226.1.3 FFLAS_FIELD [1/2]	968
13.226.1.4 FFLAS_ELT [1/6]	968
13.226.1.5 FFLAS_ELT [2/6]	968
13.226.1.6 FFLAS_ELT [3/6]	968
13.226.1.7 FFLAS_FIELD [2/2]	968
13.226.1.8 FFLAS_ELT [4/6]	968
13.226.1.9 FFLAS_ELT [5/6]	968
13.226.1.10 FFLAS_ELT [6/6]	968
13.227 fflas_L3_inst.h File Reference	968
13.227.1 Macro Definition Documentation	969
13.227.1.1 INST_OR_DECL	969
13.227.1.2 FFLAS_FIELD [1/2]	969
13.227.1.3 FFLAS_ELT [1/6]	969
13.227.1.4 FFLAS_ELT [2/6]	969
13.227.1.5 FFLAS_ELT [3/6]	969
13.227.1.6 FFLAS_FIELD [2/2]	969
13.227.1.7 FFLAS_ELT [4/6]	969
13.227.1.8 FFLAS_ELT [5/6]	969
13.227.1.9 FFLAS_ELT [6/6]	969
13.228 fflas_L3_inst_implement.inl File Reference	969
13.228.1 Macro Definition Documentation	970
13.228.1.1 __FFLAS__TRSM_READONLY	970
13.229 fflas_lvl1.C File Reference	970
13.229.1 Detailed Description	971

13.229.2 Function Documentation . . . . .	971
13.229.2.1 freducein_1_modular_double() . . . . .	971
13.229.2.2 freduce_1_modular_double() . . . . .	971
13.229.2.3 fnegin_1_modular_double() . . . . .	971
13.229.2.4 fneg_1_modular_double() . . . . .	972
13.229.2.5 fzero_1_modular_double() . . . . .	972
13.229.2.6 fiszero_1_modular_double() . . . . .	972
13.229.2.7 fequal_1_modular_double() . . . . .	972
13.229.2.8 fassign_1_modular_double() . . . . .	972
13.229.2.9 fscaln_1_modular_double() . . . . .	972
13.229.2.10 fscal_1_modular_double() . . . . .	973
13.229.2.11 faxpy_1_modular_double() . . . . .	973
13.229.2.12 fdot_1_modular_double() . . . . .	973
13.229.2.13 fswap_1_modular_double() . . . . .	973
13.229.2.14 fadd_1_modular_double() . . . . .	973
13.229.2.15 fsub_1_modular_double() . . . . .	974
13.229.2.16 faddin_1_modular_double() . . . . .	974
13.229.2.17 fsubin_1_modular_double() . . . . .	974
13.230 fflas_lvl2.C File Reference . . . . .	974
13.230.1 Detailed Description . . . . .	975
13.230.2 Function Documentation . . . . .	975
13.230.2.1 fassign_2_modular_double() . . . . .	975
13.230.2.2 fzero_2_modular_double() . . . . .	976
13.230.2.3 fequal_2_modular_double() . . . . .	976
13.230.2.4 fiszero_2_modular_double() . . . . .	976
13.230.2.5 fidentity_2_modular_double() . . . . .	976
13.230.2.6 freducein_2_modular_double() . . . . .	976
13.230.2.7 freduce_2_modular_double() . . . . .	976
13.230.2.8 fnegin_2_modular_double() . . . . .	977
13.230.2.9 fneg_2_modular_double() . . . . .	977
13.230.2.10 fscaln_2_modular_double() . . . . .	977
13.230.2.11 fscal_2_modular_double() . . . . .	977
13.230.2.12 faxpy_2_modular_double() . . . . .	977
13.230.2.13 fmove_2_modular_double() . . . . .	978
13.230.2.14 fadd_2_modular_double() . . . . .	978
13.230.2.15 fsub_2_modular_double() . . . . .	978
13.230.2.16 fsubin_2_modular_double() . . . . .	978
13.230.2.17 faddin_2_modular_double() . . . . .	979
13.230.2.18 fgemv_2_modular_double() . . . . .	979
13.230.2.19 fger_2_modular_double() . . . . .	979
13.230.2.20 ftrsv_2_modular_double() . . . . .	979
13.231 fflas_lvl3.C File Reference . . . . .	980

13.231.1 Detailed Description . . . . .	980
13.231.2 Function Documentation . . . . .	980
13.231.2.1 ftrsm_3_modular_double() . . . . .	980
13.231.2.2 ftrmm_3_modular_double() . . . . .	981
13.231.2.3 fgemm_3_modular_double() . . . . .	981
13.231.2.4 fsquare_3_modular_double() . . . . .	981
13.232 fflas_sparse.C File Reference . . . . .	981
13.232.1 Detailed Description . . . . .	981
13.233 ffpack.C File Reference . . . . .	982
13.233.1 Detailed Description . . . . .	985
13.233.2 Function Documentation . . . . .	985
13.233.2.1 LAPACKPerm2MathPerm() . . . . .	985
13.233.2.2 MathPerm2LAPACKPerm() . . . . .	985
13.233.2.3 MatrixApplyS_modular_double() . . . . .	985
13.233.2.4 PermApplyS_double() . . . . .	986
13.233.2.5 MatrixApplyT_modular_double() . . . . .	986
13.233.2.6 PermApplyT_double() . . . . .	986
13.233.2.7 composePermutationsLLM() . . . . .	986
13.233.2.8 composePermutationsLLL() . . . . .	986
13.233.2.9 composePermutationsMLM() . . . . .	987
13.233.2.10 cyclic_shift_mathPerm() . . . . .	987
13.233.2.11 cyclic_shift_row_modular_double() . . . . .	987
13.233.2.12 cyclic_shift_col_modular_double() . . . . .	987
13.233.2.13 applyP_modular_double() . . . . .	987
13.233.2.14 fgetrsin_modular_double() . . . . .	987
13.233.2.15 fgetrsv_modular_double() . . . . .	988
13.233.2.16 fgesvin_modular_double() . . . . .	988
13.233.2.17 fgesv_modular_double() . . . . .	988
13.233.2.18 ftrtri_modular_double() . . . . .	989
13.233.2.19 trinv_left_modular_double() . . . . .	989
13.233.2.20 ftrtrm_modular_double() . . . . .	989
13.233.2.21 PLUQ_modular_double() . . . . .	989
13.233.2.22 LUdivine_modular_double() . . . . .	989
13.233.2.23 ColumnEchelonForm_modular_double() . . . . .	990
13.233.2.24 RowEchelonForm_modular_double() . . . . .	990
13.233.2.25 ReducedColumnEchelonForm_modular_double() . . . . .	990
13.233.2.26 ReducedRowEchelonForm_modular_double() . . . . .	990
13.233.2.27 ColumnEchelonForm_modular_float() . . . . .	991
13.233.2.28 RowEchelonForm_modular_float() . . . . .	991
13.233.2.29 ReducedColumnEchelonForm_modular_float() . . . . .	991
13.233.2.30 ReducedRowEchelonForm_modular_float() . . . . .	991
13.233.2.31 ColumnEchelonForm_modular_int32_t() . . . . .	991



13.233.2.32 RowEchelonForm_modular_int32_t()	992
13.233.2.33 ReducedColumnEchelonForm_modular_int32_t()	992
13.233.2.34 ReducedRowEchelonForm_modular_int32_t()	992
13.233.2.35 pColumnEchelonForm_modular_double()	992
13.233.2.36 pRowEchelonForm_modular_double()	993
13.233.2.37 pReducedColumnEchelonForm_modular_double()	993
13.233.2.38 pReducedRowEchelonForm_modular_double()	993
13.233.2.39 pColumnEchelonForm_modular_float()	993
13.233.2.40 pRowEchelonForm_modular_float()	994
13.233.2.41 pReducedColumnEchelonForm_modular_float()	994
13.233.2.42 pReducedRowEchelonForm_modular_float()	994
13.233.2.43 pColumnEchelonForm_modular_int32_t()	994
13.233.2.44 pRowEchelonForm_modular_int32_t()	995
13.233.2.45 pReducedColumnEchelonForm_modular_int32_t()	995
13.233.2.46 pReducedRowEchelonForm_modular_int32_t()	995
13.233.2.47 Invertin_modular_double()	995
13.233.2.48 Invert_modular_double()	995
13.233.2.49 Invert2_modular_double()	996
13.233.2.50 KrylovElim_modular_double()	996
13.233.2.51 SpecRankProfile_modular_double()	996
13.233.2.52 Rank_modular_double()	996
13.233.2.53 IsSingular_modular_double()	996
13.233.2.54 Det_modular_double()	997
13.233.2.55 Solve_modular_double()	997
13.233.2.56 solveLB_modular_double()	997
13.233.2.57 solveLB2_modular_double()	997
13.233.2.58 RandomNullSpaceVector_modular_double()	998
13.233.2.59 NullSpaceBasis_modular_double()	998
13.233.2.60 RowRankProfile_modular_double()	998
13.233.2.61 ColumnRankProfile_modular_double()	998
13.233.2.62 RankProfileFromLU()	998
13.233.2.63 LeadingSubmatrixRankProfiles()	999
13.233.2.64 RowRankProfileSubmatrixIndices_modular_double()	999
13.233.2.65 ColRankProfileSubmatrixIndices_modular_double()	999
13.233.2.66 RowRankProfileSubmatrix_modular_double()	999
13.233.2.67 ColRankProfileSubmatrix_modular_double()	999
13.233.2.68 getTriangular_modular_double()	1000
13.233.2.69 getTriangularin_modular_double()	1000
13.233.2.70 getEchelonForm_modular_double()	1000
13.233.2.71 getEchelonFormin_modular_double()	1000
13.233.2.72 getEchelonTransform_modular_double()	1001
13.233.2.73 getReducedEchelonForm_modular_double()	1001

13.233.2.74 getReducedEchelonFormin_modular_double()	1001
13.233.2.75 getReducedEchelonTransform_modular_double()	1001
13.233.2.76 PLUQtoEchelonPermutation()	1002
13.234 fpack_c.h File Reference	1002
13.234.1 Macro Definition Documentation	1005
13.234.1.1 FFPACK_COMPILED	1005
13.234.2 Enumeration Type Documentation	1005
13.234.2.1 FFLAS_C_ORDER	1005
13.234.2.2 FFLAS_C_TRANSPOSE	1005
13.234.2.3 FFLAS_C_UPLO	1005
13.234.2.4 FFLAS_C_DIAG	1006
13.234.2.5 FFLAS_C_SIDE	1006
13.234.2.6 FFPACK_C_LU_TAG	1006
13.234.2.7 FFPACK_C_CHARPOLY_TAG	1006
13.234.2.8 FFPACK_C_MINPOLY_TAG	1006
13.234.3 Function Documentation	1007
13.234.3.1 LAPACKPerm2MathPerm()	1007
13.234.3.2 MathPerm2LAPACKPerm()	1007
13.234.3.3 MatrixApplyS_modular_double()	1007
13.234.3.4 PermApplyS_double()	1007
13.234.3.5 MatrixApplyT_modular_double()	1007
13.234.3.6 PermApplyT_double()	1008
13.234.3.7 composePermutationsLLM()	1008
13.234.3.8 composePermutationsLLL()	1008
13.234.3.9 composePermutationsMLM()	1008
13.234.3.10 cyclic_shift_mathPerm()	1008
13.234.3.11 cyclic_shift_row_modular_double()	1008
13.234.3.12 cyclic_shift_col_modular_double()	1008
13.234.3.13 applyP_modular_double()	1009
13.234.3.14 fgetrsin_modular_double()	1009
13.234.3.15 fgetrs_modular_double()	1009
13.234.3.16 fgesvin_modular_double()	1010
13.234.3.17 fgesv_modular_double()	1010
13.234.3.18 ftrtri_modular_double()	1010
13.234.3.19 trinv_left_modular_double()	1010
13.234.3.20 ftrtm_modular_double()	1010
13.234.3.21 PLUQ_modular_double()	1011
13.234.3.22 LUdivine_modular_double()	1011
13.234.3.23 LUdivine_small_modular_double()	1011
13.234.3.24 LUdivine_gauss_modular_double()	1011
13.234.3.25 ColumnEchelonForm_modular_double()	1012
13.234.3.26 RowEchelonForm_modular_double()	1012

13.234.3.27 ColumnEchelonForm_modular_float()	1012
13.234.3.28 RowEchelonForm_modular_float()	1012
13.234.3.29 ColumnEchelonForm_modular_int32_t()	1013
13.234.3.30 RowEchelonForm_modular_int32_t()	1013
13.234.3.31 ReducedColumnEchelonForm_modular_double()	1013
13.234.3.32 ReducedRowEchelonForm_modular_double()	1013
13.234.3.33 ReducedColumnEchelonForm_modular_float()	1013
13.234.3.34 ReducedRowEchelonForm_modular_float()	1014
13.234.3.35 ReducedColumnEchelonForm_modular_int32_t()	1014
13.234.3.36 ReducedRowEchelonForm_modular_int32_t()	1014
13.234.3.37 ReducedRowEchelonForm2_modular_double()	1014
13.234.3.38 REF_modular_double()	1015
13.234.3.39 Invertin_modular_double()	1015
13.234.3.40 Invert_modular_double()	1015
13.234.3.41 Invert2_modular_double()	1015
13.234.3.42 KrylovElim_modular_double()	1015
13.234.3.43 SpecRankProfile_modular_double()	1016
13.234.3.44 Rank_modular_double()	1016
13.234.3.45 IsSingular_modular_double()	1016
13.234.3.46 Det_modular_double()	1016
13.234.3.47 Solve_modular_double()	1016
13.234.3.48 solveLB_modular_double()	1017
13.234.3.49 solveLB2_modular_double()	1017
13.234.3.50 RandomNullSpaceVector_modular_double()	1017
13.234.3.51 NullSpaceBasis_modular_double()	1017
13.234.3.52 RowRankProfile_modular_double()	1018
13.234.3.53 ColumnRankProfile_modular_double()	1018
13.234.3.54 RankProfileFromLU()	1018
13.234.3.55 LeadingSubmatrixRankProfiles()	1018
13.234.3.56 RowRankProfileSubmatrixIndices_modular_double()	1018
13.234.3.57 ColRankProfileSubmatrixIndices_modular_double()	1019
13.234.3.58 RowRankProfileSubmatrix_modular_double()	1019
13.234.3.59 ColRankProfileSubmatrix_modular_double()	1019
13.234.3.60 getTriangular_modular_double()	1019
13.234.3.61 getTriangularin_modular_double()	1020
13.234.3.62 getEchelonForm_modular_double()	1020
13.234.3.63 getEchelonFormin_modular_double()	1020
13.234.3.64 getEchelonTransform_modular_double()	1020
13.234.3.65 getReducedEchelonForm_modular_double()	1021
13.234.3.66 getReducedEchelonFormin_modular_double()	1021
13.234.3.67 getReducedEchelonTransform_modular_double()	1021
13.234.3.68 PLUQtoEchelonPermutation()	1021

13.235 fpack_inst.C File Reference	1022
13.235.1 Macro Definition Documentation	1022
13.235.1.1 __FFPACK_INST_C	1022
13.235.1.2 FFLAS_COMPILED	1022
13.235.1.3 INST_OR_DECL	1022
13.235.1.4 FFLAS_FIELD [1/2]	1022
13.235.1.5 FFLAS_ELT [1/6]	1022
13.235.1.6 FFLAS_ELT [2/6]	1022
13.235.1.7 FFLAS_ELT [3/6]	1022
13.235.1.8 FFLAS_FIELD [2/2]	1022
13.235.1.9 FFLAS_ELT [4/6]	1023
13.235.1.10 FFLAS_ELT [5/6]	1023
13.235.1.11 FFLAS_ELT [6/6]	1023
13.236 fpack_inst.h File Reference	1023
13.236.1 Macro Definition Documentation	1023
13.236.1.1 FFLAS_COMPILED	1023
13.236.1.2 INST_OR_DECL	1023
13.236.1.3 FFLAS_FIELD [1/2]	1023
13.236.1.4 FFLAS_ELT [1/6]	1023
13.236.1.5 FFLAS_ELT [2/6]	1023
13.236.1.6 FFLAS_ELT [3/6]	1023
13.236.1.7 FFLAS_FIELD [2/2]	1024
13.236.1.8 FFLAS_ELT [4/6]	1024
13.236.1.9 FFLAS_ELT [5/6]	1024
13.236.1.10 FFLAS_ELT [6/6]	1024
13.237 fpack_inst_implem.inl File Reference	1024
13.238 blockcuts.inl File Reference	1027
13.238.1 Macro Definition Documentation	1028
13.238.1.1 __FFLASFFPACK_fflas_blockcuts_INL	1028
13.238.1.2 __FFLASFFPACK_MINBLOCKCUTS	1028
13.239 fflas_plevel1.h File Reference	1029
13.240 kaapi_routines.inl File Reference	1029
13.240.1 Macro Definition Documentation	1029
13.240.1.1 __FFLASFFPACK_KAAPI_ROUTINES_INL	1029
13.241 parallel.h File Reference	1029
13.241.1 Macro Definition Documentation	1030
13.241.1.1 __FFLASFFPACK_SEQUENTIAL	1030
13.241.1.2 index_t	1030
13.241.1.3 TASK	1030
13.241.1.4 WAIT	1030
13.241.1.5 CHECK_DEPENDENCIES	1030
13.241.1.6 BARRIER	1031

13.241.1.7 PAR_BLOCK . . . . .	1031
13.241.1.8 SYNCH_GROUP . . . . .	1031
13.241.1.9 THREAD_INDEX . . . . .	1031
13.241.1.10 NUM_THREADS . . . . .	1031
13.241.1.11 SET_THREADS . . . . .	1031
13.241.1.12 MAX_THREADS . . . . .	1031
13.241.1.13 READ . . . . .	1031
13.241.1.14 WRITE . . . . .	1031
13.241.1.15 READWRITE . . . . .	1031
13.241.1.16 CONSTREFERENCE . . . . .	1031
13.241.1.17 VALUE . . . . .	1031
13.241.1.18 BEGIN_PARALLEL_MAIN . . . . .	1032
13.241.1.19 END_PARALLEL_MAIN . . . . .	1032
13.241.1.20 FORBLOCK1D . . . . .	1032
13.241.1.21 FOR1D . . . . .	1032
13.241.1.22 PARFORBLOCK1D . . . . .	1032
13.241.1.23 PARFOR1D . . . . .	1032
13.241.1.24 FORBLOCK2D . . . . .	1033
13.241.1.25 FOR2D . . . . .	1033
13.241.1.26 PARFORBLOCK2D . . . . .	1033
13.241.1.27 PARFOR2D . . . . .	1033
13.241.1.28 COMMA . . . . .	1033
13.241.1.29 MODE . . . . .	1033
13.241.1.30 RETURNPARAM . . . . .	1034
13.241.1.31 NUMARGS . . . . .	1034
13.241.1.32 PP_NARG_ . . . . .	1034
13.241.1.33 PP_ARG_N . . . . .	1034
13.241.1.34 PP_RSEQ_N . . . . .	1035
13.241.1.35 NOSPLIT . . . . .	1035
13.241.1.36 splitting_0 . . . . .	1035
13.241.1.37 splitting_1 . . . . .	1036
13.241.1.38 splitting_2 . . . . .	1036
13.241.1.39 splitting_3 . . . . .	1036
13.241.1.40 splitt . . . . .	1036
13.241.1.41 SPLITTER . . . . .	1036
13.242 pfgemm_variants.inl File Reference . . . . .	1036
13.243 pfgemv.inl File Reference . . . . .	1037
13.244 align-allocator.h File Reference . . . . .	1037
13.245 args-parser.h File Reference . . . . .	1038
13.245.1 Macro Definition Documentation . . . . .	1038
13.245.1.1 TYPE_BOOL . . . . .	1038
13.245.1.2 END_OF_ARGUMENTS . . . . .	1038

13.245.1.3 type_integer . . . . .	1038
13.245.2 Enumeration Type Documentation . . . . .	1039
13.245.2.1 ArgumentType . . . . .	1039
13.245.3 Function Documentation . . . . .	1039
13.245.3.1 printHelpMessage() . . . . .	1039
13.245.3.2 findArgument() . . . . .	1039
13.245.3.3 getListArgs() . . . . .	1039
13.246 bit_manipulation.h File Reference . . . . .	1039
13.246.1 Macro Definition Documentation . . . . .	1040
13.246.1.1 __has_builtin . . . . .	1040
13.246.2 Function Documentation . . . . .	1040
13.246.2.1 clz() [1/2] . . . . .	1040
13.246.2.2 clz() [2/2] . . . . .	1040
13.246.2.3 ctz() [1/2] . . . . .	1040
13.246.2.4 ctz() [2/2] . . . . .	1040
13.247 cast.h File Reference . . . . .	1040
13.248 debug.h File Reference . . . . .	1040
13.248.1 Detailed Description . . . . .	1041
13.248.2 Macro Definition Documentation . . . . .	1041
13.248.2.1 FFLASFFPACK_check . . . . .	1041
13.248.2.2 FFLASFFPACK_abort . . . . .	1041
13.249 fflas_intrinsic.h File Reference . . . . .	1041
13.250 fflas_io.h File Reference . . . . .	1041
13.251 fflas_memory.h File Reference . . . . .	1042
13.252 fflas_randommatrix.h File Reference . . . . .	1043
13.253 flimits.h File Reference . . . . .	1045
13.253.1 Function Documentation . . . . .	1046
13.253.1.1 in_range() [1/3] . . . . .	1046
13.253.1.2 in_range() [2/3] . . . . .	1046
13.253.1.3 in_range() [3/3] . . . . .	1046
13.254 Matio.h File Reference . . . . .	1046
13.254.1 Function Documentation . . . . .	1046
13.254.1.1 read_field() . . . . .	1046
13.254.1.2 write_field() . . . . .	1046
13.255 test-utils.h File Reference . . . . .	1047
13.256 timer.h File Reference . . . . .	1047
13.257 cblas.C File Reference . . . . .	1048
13.257.1 Macro Definition Documentation . . . . .	1048
13.257.1.1 __FFLASFFPACK_CONFIGURATION . . . . .	1048
13.257.1.2 __FFLASFFPACK_HAVE_CBLAS . . . . .	1048
13.257.2 Function Documentation . . . . .	1048
13.257.2.1 main() . . . . .	1048

13.258 clapack.C File Reference . . . . .	1048
13.258.1 Macro Definition Documentation . . . . .	1048
13.258.1.1 __FFLASFFPACK_CONFIGURATION . . . . .	1048
13.258.1.2 __FFLASFFPACK_HAVE_LAPACK . . . . .	1048
13.258.1.3 __FFLASFFPACK_HAVE_CLAPACK . . . . .	1048
13.258.2 Function Documentation . . . . .	1049
13.258.2.1 main() . . . . .	1049
13.259 cuda.C File Reference . . . . .	1049
13.259.1 Function Documentation . . . . .	1049
13.259.1.1 main() . . . . .	1049
13.260 fblas.C File Reference . . . . .	1049
13.260.1 Macro Definition Documentation . . . . .	1049
13.260.1.1 __FFLASFFPACK_CONFIGURATION . . . . .	1049
13.260.2 Function Documentation . . . . .	1049
13.260.2.1 dgemm_() . . . . .	1049
13.260.2.2 main() . . . . .	1050
13.261 lapack.C File Reference . . . . .	1050
13.261.1 Macro Definition Documentation . . . . .	1050
13.261.1.1 __FFLASFFPACK_CONFIGURATION . . . . .	1050
13.261.1.2 __FFLASFFPACK_HAVE_LAPACK . . . . .	1050
13.261.2 Function Documentation . . . . .	1050
13.261.2.1 main() . . . . .	1050
13.262 regression-check.C File Reference . . . . .	1050
13.262.1 Function Documentation . . . . .	1051
13.262.1.1 check1() . . . . .	1051
13.262.1.2 check2() . . . . .	1051
13.262.1.3 check3() . . . . .	1051
13.262.1.4 check4() . . . . .	1051
13.262.1.5 checkZeroDimCharpoly() . . . . .	1051
13.262.1.6 checkZeroDimMinPoly() . . . . .	1051
13.262.1.7 gf2ModularBalanced() . . . . .	1051
13.262.1.8 main() . . . . .	1051
13.263 test-charpoly-check.C File Reference . . . . .	1051
13.263.1 Macro Definition Documentation . . . . .	1052
13.263.1.1 ENABLE_CHECKER_charpoly . . . . .	1052
13.263.1.2 TIME_CHECKER_CHARPOLY . . . . .	1052
13.263.2 Function Documentation . . . . .	1052
13.263.2.1 printPolynomial() . . . . .	1052
13.263.2.2 main() . . . . .	1052
13.264 test-charpoly.C File Reference . . . . .	1052
13.264.1 Function Documentation . . . . .	1052
13.264.1.1 launch_test() . . . . .	1052

13.264.1.2 run_with_field()	1053
13.264.1.3 main()	1053
13.265 test-compressQ.C File Reference	1053
13.265.1 Typedef Documentation	1053
13.265.1.1 Field	1053
13.265.2 Function Documentation	1053
13.265.2.1 printvect()	1053
13.265.2.2 main()	1054
13.266 test-det-check.C File Reference	1054
13.266.1 Macro Definition Documentation	1054
13.266.1.1 ENABLE_CHECKER_Det	1054
13.266.1.2 TIME_CHECKER_Det	1054
13.266.2 Function Documentation	1054
13.266.2.1 main()	1054
13.267 test-det.C File Reference	1054
13.267.1 Function Documentation	1055
13.267.1.1 test_det()	1055
13.267.1.2 main()	1055
13.268 test-echelon.C File Reference	1055
13.268.1 Macro Definition Documentation	1056
13.268.1.1 __FFLASFFPACK_SEQUENTIAL	1056
13.268.1.2 __FFLASFFPACK_GAUSSJORDAN_BASECASE	1056
13.268.1.3 __FFLASFFPACK_PLUQ_THRESHOLD	1056
13.268.2 Function Documentation	1056
13.268.2.1 test_colechelon()	1056
13.268.2.2 test_rowechelon()	1056
13.268.2.3 test_redcolechelon()	1056
13.268.2.4 test_redrowechelon()	1057
13.268.2.5 run_with_field()	1057
13.268.2.6 main()	1057
13.269 test-fadd.C File Reference	1057
13.269.1 Function Documentation	1058
13.269.1.1 test_fadd()	1058
13.269.1.2 test_faddin()	1058
13.269.1.3 test_fsub()	1058
13.269.1.4 test_fsubin()	1058
13.269.1.5 main()	1059
13.270 test-fdot.C File Reference	1059
13.270.1 Macro Definition Documentation	1059
13.270.1.1 ENABLE_ALL_CHECKINGS	1059
13.270.2 Function Documentation	1059
13.270.2.1 check_fdot()	1059



13.270.2.2 run_with_field()	1059
13.270.2.3 run_with_Integer()	1060
13.270.2.4 main()	1060
13.271 test-fgemm-check.C File Reference	1060
13.271.1 Macro Definition Documentation	1060
13.271.1.1 ENABLE_ALL_CHECKINGS	1060
13.271.2 Function Documentation	1060
13.271.2.1 launch_MM_dispatch()	1060
13.271.2.2 run_with_field()	1061
13.271.2.3 main()	1061
13.272 test-fgemm.C File Reference	1061
13.272.1 Macro Definition Documentation	1062
13.272.1.1 ENABLE_CHECKER_fgemm	1062
13.272.2 Function Documentation	1062
13.272.2.1 check_MM()	1062
13.272.2.2 launch_MM()	1062
13.272.2.3 launch_MM_dispatch()	1063
13.272.2.4 run_with_field()	1063
13.272.2.5 main()	1063
13.273 test-fgemv.C File Reference	1063
13.273.1 Function Documentation	1064
13.273.1.1 check_MV()	1064
13.273.1.2 launch_MV()	1064
13.273.1.3 launch_MV_dispatch()	1064
13.273.1.4 run_with_field()	1065
13.273.1.5 main()	1065
13.274 test-fger.C File Reference	1065
13.274.1 Macro Definition Documentation	1066
13.274.1.1 TIME	1066
13.274.2 Function Documentation	1066
13.274.2.1 check_fger()	1066
13.274.2.2 launch_fger()	1066
13.274.2.3 launch_fger_dispatch()	1066
13.274.2.4 run_with_field()	1067
13.274.2.5 main()	1067
13.275 test-fgesv.C File Reference	1067
13.275.1 Function Documentation	1067
13.275.1.1 test_square_fgesv()	1067
13.275.1.2 test_rect_fgesv()	1067
13.275.1.3 run_with_field()	1068
13.275.1.4 main()	1068
13.276 test-finit.C File Reference	1068

13.276.1 Function Documentation	1069
13.276.1.1 test_freduce()	1069
13.276.1.2 run_with_field()	1069
13.276.1.3 main()	1069
13.277 test-fscal.C File Reference	1069
13.277.1 Function Documentation	1070
13.277.1.1 test_fscal() [1/2]	1070
13.277.1.2 test_fscal() [2/2]	1070
13.277.1.3 test_fscaln() [1/2]	1070
13.277.1.4 test_fscaln() [2/2]	1070
13.277.1.5 main()	1070
13.277.1.6 RandomMatrix()	1071
13.278 test-fsyr2k.C File Reference	1071
13.278.1 Macro Definition Documentation	1071
13.278.1.1 ENABLE_ALL_CHECKINGS	1071
13.278.2 Function Documentation	1072
13.278.2.1 check_fsyr2k()	1072
13.278.2.2 run_with_field()	1072
13.278.2.3 main()	1072
13.279 test-fsyrrk.C File Reference	1072
13.279.1 Macro Definition Documentation	1073
13.279.1.1 ENABLE_ALL_CHECKINGS	1073
13.279.2 Function Documentation	1073
13.279.2.1 check_fsyrrk()	1073
13.279.2.2 check_fsyrrk_diag()	1073
13.279.2.3 check_fsyrrk_bkdiag()	1073
13.279.2.4 check_computeS1S2()	1074
13.279.2.5 run_with_field()	1074
13.279.2.6 main()	1074
13.280 test-fsytrf.C File Reference	1074
13.280.1 Function Documentation	1075
13.280.1.1 operator<<()	1075
13.280.1.2 test_RPM_fsytrf()	1075
13.280.1.3 test_generic_fsytrf()	1075
13.280.1.4 run_with_field()	1075
13.280.1.5 main()	1075
13.281 test-ftnrm.C File Reference	1075
13.281.1 Macro Definition Documentation	1076
13.281.1.1 __FFLASFFPACK_SEQUENTIAL	1076
13.281.2 Function Documentation	1076
13.281.2.1 check_ftnrm()	1076
13.281.2.2 run_with_field()	1076

13.281.2.3 main()	1077
13.282 test-frmvc.C File Reference	1077
13.282.1 Macro Definition Documentation	1077
13.282.1.1 __FFLASFFPACK_SEQUENTIAL	1077
13.282.1.2 ENABLE_ALL_CHECKINGS	1077
13.282.2 Function Documentation	1077
13.282.2.1 check_frmvc()	1077
13.282.2.2 run_with_field()	1078
13.282.2.3 main()	1078
13.283 test-frm-check.C File Reference	1078
13.283.1 Macro Definition Documentation	1078
13.283.1.1 ENABLE_ALL_CHECKINGS	1078
13.283.2 Function Documentation	1078
13.283.2.1 main()	1078
13.284 test-frm.C File Reference	1078
13.284.1 Macro Definition Documentation	1079
13.284.1.1 __FFLASFFPACK_SEQUENTIAL	1079
13.284.1.2 ENABLE_ALL_CHECKINGS	1079
13.284.2 Function Documentation	1079
13.284.2.1 check_frm()	1079
13.284.2.2 run_with_field()	1079
13.284.2.3 main()	1080
13.285 test-frmssyr2k.C File Reference	1080
13.285.1 Macro Definition Documentation	1080
13.285.1.1 ENABLE_ALL_CHECKINGS	1080
13.285.2 Function Documentation	1080
13.285.2.1 check_frmssyr2k()	1080
13.285.2.2 run_with_field()	1080
13.285.2.3 main()	1081
13.286 test-frmstr.C File Reference	1081
13.286.1 Macro Definition Documentation	1081
13.286.1.1 ENABLE_ALL_CHECKINGS	1081
13.286.2 Function Documentation	1081
13.286.2.1 check_frmstr()	1081
13.286.2.2 run_with_field()	1082
13.286.2.3 main()	1082
13.287 test-frmvc.C File Reference	1082
13.287.1 Macro Definition Documentation	1082
13.287.1.1 __FFLASFFPACK_SEQUENTIAL	1082
13.287.1.2 ENABLE_ALL_CHECKINGS	1082
13.287.2 Function Documentation	1082
13.287.2.1 check_frmvc()	1082

13.287.2.2 run_with_field()	1083
13.287.2.3 main()	1083
13.288 test-ftsrti.C File Reference	1083
13.288.1 Macro Definition Documentation	1083
13.288.1.1 __FFLASFFPACK_SEQUENTIAL	1083
13.288.1.2 ENABLE_ALL_CHECKINGS	1084
13.288.2 Function Documentation	1084
13.288.2.1 check_ftsrti()	1084
13.288.2.2 run_with_field()	1084
13.288.2.3 main()	1084
13.289 test-interfaces-c.c File Reference	1084
13.289.1 Function Documentation	1084
13.289.1.1 main()	1084
13.290 test-invert-check.C File Reference	1084
13.290.1 Macro Definition Documentation	1085
13.290.1.1 ENABLE_ALL_CHECKINGS	1085
13.290.2 Function Documentation	1085
13.290.2.1 main()	1085
13.291 test-io.C File Reference	1085
13.291.1 Function Documentation	1085
13.291.1.1 run_with_field()	1085
13.291.1.2 main()	1086
13.292 test-lu.C File Reference	1086
13.292.1 Macro Definition Documentation	1087
13.292.1.1 BASECASE_K	1087
13.292.1.2 __FFLASFFPACK_SEQUENTIAL	1087
13.292.1.3 __LUDIVINE_CUTOFF	1087
13.292.2 Function Documentation	1087
13.292.2.1 test_LUdivine()	1087
13.292.2.2 verifPLUQ()	1088
13.292.2.3 test_pluq()	1088
13.292.2.4 launch_test()	1089
13.292.2.5 run_with_field()	1089
13.292.2.6 main()	1089
13.292.3 Variable Documentation	1089
13.292.3.1 tperm	1089
13.292.3.2 tgemm	1089
13.292.3.3 tBC	1089
13.292.3.4 ttrsm	1089
13.292.3.5 trest	1090
13.292.3.6 timtot	1090
13.292.3.7 mvcnt	1090

13.293 test-maxdelayeddim.C File Reference . . . . .	1090
13.293.1 Macro Definition Documentation . . . . .	1090
13.293.1.1 MAX_WITH_SIZE_T . . . . .	1090
13.293.2 Function Documentation . . . . .	1090
13.293.2.1 test() . . . . .	1090
13.293.2.2 main() . . . . .	1090
13.294 test-minpoly.C File Reference . . . . .	1090
13.294.1 Function Documentation . . . . .	1091
13.294.1.1 check_minpoly() . . . . .	1091
13.294.1.2 run_with_field() . . . . .	1091
13.294.1.3 main() . . . . .	1091
13.295 test-multifile1.C File Reference . . . . .	1091
13.296 test-multifile2.C File Reference . . . . .	1091
13.296.1 Function Documentation . . . . .	1092
13.296.1.1 main() . . . . .	1092
13.297 test-nullspace.C File Reference . . . . .	1092
13.297.1 Function Documentation . . . . .	1092
13.297.1.1 checkingMessage() . . . . .	1092
13.297.1.2 readOrRandomMatrixWithRankAndRandomRPM() . . . . .	1092
13.297.1.3 test_nullspace() . . . . .	1093
13.297.1.4 run_with_field() . . . . .	1093
13.297.1.5 main() . . . . .	1093
13.298 test-permutations.C File Reference . . . . .	1093
13.298.1 Function Documentation . . . . .	1094
13.298.1.1 checkMonotonicApplyP() . . . . .	1094
13.298.1.2 main() . . . . .	1094
13.298.2 Variable Documentation . . . . .	1094
13.298.2.1 tperm . . . . .	1094
13.298.2.2 tgemm . . . . .	1094
13.298.2.3 tBC . . . . .	1094
13.298.2.4 ttrsm . . . . .	1094
13.298.2.5 trest . . . . .	1094
13.298.2.6 timtot . . . . .	1094
13.299 test-pluq-check.C File Reference . . . . .	1094
13.299.1 Macro Definition Documentation . . . . .	1095
13.299.1.1 ENABLE_ALL_CHECKINGS . . . . .	1095
13.299.2 Function Documentation . . . . .	1095
13.299.2.1 main() . . . . .	1095
13.300 test-quasisep.C File Reference . . . . .	1095
13.300.1 Function Documentation . . . . .	1095
13.300.1.1 test_BruhatGenerator() . . . . .	1095
13.300.1.2 launch_test() . . . . .	1096

13.300.1.3 testLTQSRPM()	1096
13.300.1.4 run_with_field()	1096
13.300.1.5 main()	1096
13.301 test-rankprofiles.C File Reference	1096
13.301.1 Macro Definition Documentation	1097
13.301.1.1 __FFLASFFPACK_SEQUENTIAL	1097
13.301.2 Function Documentation	1097
13.301.2.1 run_with_field()	1097
13.301.2.2 main()	1097
13.302 test-rpm.C File Reference	1097
13.302.1 Function Documentation	1097
13.302.1.1 checkRPM()	1097
13.302.1.2 checkSymmetricRPM()	1098
13.302.1.3 main()	1098
13.303 test-simd.C File Reference	1098
13.303.1 Macro Definition Documentation	1099
13.303.1.1 _TEST_ONE	1099
13.303.1.2 TEST_ONE_OP	1099
13.303.1.3 TEST_ONE_OP_WZ	1100
13.303.1.4 TEST_IMPL	1100
13.303.2 Function Documentation	1100
13.303.2.1 check_eq() [1/2]	1100
13.303.2.2 check_eq() [2/2]	1100
13.303.2.3 cmp()	1100
13.303.2.4 eval_func_on_array() [1/3]	1100
13.303.2.5 eval_func_on_array() [2/3]	1100
13.303.2.6 eval_func_on_array() [3/3]	1100
13.303.2.7 operator<<()	1101
13.303.2.8 test_impl_base() [1/2]	1101
13.303.2.9 test_impl_base() [2/2]	1101
13.303.2.10 test_impl()	1101
13.303.2.11 main()	1101
13.304 test-solve.C File Reference	1101
13.304.1 Function Documentation	1101
13.304.1.1 check_solve()	1101
13.304.1.2 run_with_field()	1102
13.304.1.3 main()	1102
13.305 test-storage-transpose.C File Reference	1102
13.305.1 Function Documentation	1102
13.305.1.1 main()	1102
13.306 101-fgemv.C File Reference	1102
13.306.1 Function Documentation	1103

13.306.1.1 main()	1103
13.307 2x2-fgemv.C File Reference	1103
13.307.1 Function Documentation	1103
13.307.1.1 main()	1103
13.308 2x2-ftrsv.C File Reference	1103
13.308.1 Function Documentation	1104
13.308.1.1 main()	1104
13.309 2x2-pluq.C File Reference	1104
13.309.1 Function Documentation	1104
13.309.1.1 main()	1104
13.310 fflas-101_1.C File Reference	1104
13.310.1 Function Documentation	1104
13.310.1.1 main()	1104
13.311 fflas-101_3.C File Reference	1104
13.311.1 Function Documentation	1105
13.311.1.1 main()	1105
13.312 fflas_101.C File Reference	1105
13.312.1 Function Documentation	1105
13.312.1.1 main()	1105
13.313 fflas_101_lvl1.C File Reference	1105
13.313.1 Function Documentation	1105
13.313.1.1 main()	1105
13.314 ffpack-fgesv.C File Reference	1106
13.314.1 Function Documentation	1106
13.314.1.1 main()	1106
13.315 ffpack-solve.C File Reference	1106
13.315.1 Function Documentation	1106
13.315.1.1 main()	1106





# Chapter 1

## FFLAS-FFPACK Documentation.

### 1.1 Introduction

FFLAS-FFPACK is a LGPL-2.1+ source code library for basic linear algebra operations over a finite field. It is inspired by BLAS interface (Basic Linear Algebra Subprograms) and the LAPACK library for numerical linear algebra, and shares part of their design. Yet it differs in many aspects due to the specifics of computing over a finite field:

- it is generic with respect to the finite field, so as to accomodate a large variety of field sizes and implementations;
- it is a pure source code library, to be included and compiled in the user's software. Its build system is only used for tests and benchmarks.

### 1.2 Goals

### 1.3 Design

### 1.4 Using FFLAS-FFPACK.

- [Copying and Licence](#).
- [Tutorial](#). This is a brief introduction to FFLAS-[FFPACK](#) capabilities.
- [Configuring and Installing FFLAS-FFPACK](#). Explains how to configure/install from sources or from the latest svn version.
- [Architecture of the library](#).. Describes how FFLAS-FFPACK is organized
- [Documentation for Users](#). If everything around is blue, then you are reading the lighter, user-oriented, documentation.
- [Documentation for Developers](#). If everything around is green, then you can get to everything (not necessarily yet) documented.

## 1.5 Contributing to fflas-ffpack, getting assistance.

Version

2.5.0

## 1.6 Copying and Licence

The FFLAS-FFPACK library is licensed under the terms of the GNU LGPL v2.1 or later.

See <https://www.gnu.org/licenses/lgpl-2.1.html>

## 1.7 Tutorial

no doc.

## 1.8 Configuring and Installing FFLAS-FFPACK

FFLAS-FFPACK is a header-only package.

Howver configuration process can be tweaked a lot. Configure looks for BLAS routines and [Givaro](#) library which are both mandatory dependencies. See the output of `./configure -help` for information about the LAPACK/↔ BLAS discovering strategies.

## 1.9 Architecture of the library.

no doc.

## Chapter 2

# Bug List

Global [DOUBLE\\_TO\\_FLOAT\\_CROSSOVER](#)

to be benchmarked.

Global [FFLAS::details::pack\\_lhs](#) (int64\_t \*XX, const int64\_t \*X, size\_t ldx, size\_t rows, size\_t cols)

this is fassign

this is fassign

Global [FFLAS::details::pack\\_rhs](#) (int64\_t \*XX, const int64\_t \*X, size\_t ldx, size\_t rows, size\_t cols)

this is fassign

this is fassign

Global [FFLAS::fconvert](#) (const [Field](#) &F, const size\_t n, OtherElement\_ptr X, const size\_t incX, typename [Field::ConstElement\\_ptr](#) Y, const size\_t incY)

use cblas\_(d)scal when possible

Global [FFLAS::fconvert](#) (const FFLAS\_FIELD< FFLAS\_ELT > &F, const size\_t n, FFLAS\_ELT \*X, const size\_t incX, const FFLAS\_ELT \*Y, const size\_t incY)

use cblas\_(d)scal when possible

Global [FFLAS::finit](#) (const [Field](#) &F, const size\_t n, const OtherElement\_ptr Y, const size\_t incY, typename [Field::Element\\_ptr](#) X, const size\_t incX)

use cblas\_(d)scal when possible

Global [FFLAS::finit](#) (const FFLAS\_FIELD< FFLAS\_ELT > &F, const size\_t n, const FFLAS\_ELT \*Y, const size\_t incY, FFLAS\_ELT \*X, const size\_t incX)

use cblas\_(d)scal when possible

Global [FFLAS::fneg](#) (const [Field](#) &F, const size\_t n, typename [Field::ConstElement\\_ptr](#) Y, const size\_t incY, typename [Field::Element\\_ptr](#) X, const size\_t incX)

use cblas\_(d)scal when possible

Global [FFLAS::fneg](#) (const FFLAS\_FIELD< FFLAS\_ELT > &F, const size\_t n, const FFLAS\_ELT \*Y, const size\_t incY, FFLAS\_ELT \*X, const size\_t incX)

use cblas\_(d)scal when possible

Global [FFLAS::fnegin](#) (const [Field](#) &F, const size\_t n, typename [Field::Element\\_ptr](#) X, const size\_t incX)

use cblas\_(d)scal when possible

Global **FFLAS::fnegin** (const FFLAS\_FIELD< FFLAS\_ELT > &F, const size\_t n, FFLAS\_ELT \*X, const size\_t incX)

use cblas\_(d)scal when possible

Global **FFLAS::freduce** (const **Field** &F, const size\_t n, typename **Field::Element\_ptr** X, const size\_t incX)

use cblas\_(d)scal when possible

Global **FFLAS::freduce** (const **Field** &F, const size\_t n, typename **Field::ConstElement\_ptr** Y, const size\_t incY, typename **Field::Element\_ptr** X, const size\_t incX)

use cblas\_(d)scal when possible

Global **FFLAS::freduce** (const FFLAS\_FIELD< FFLAS\_ELT > &F, const size\_t n, FFLAS\_ELT \*X, const size\_t incX)

use cblas\_(d)scal when possible

Global **FFLAS::freduce** (const FFLAS\_FIELD< FFLAS\_ELT > &F, const size\_t n, const FFLAS\_ELT \*Y, const size\_t incY, FFLAS\_ELT \*X, const size\_t incX)

use cblas\_(d)scal when possible

Global **FFLAS::fscal** (const **Field** &F, const size\_t n, const typename **Field::Element** alpha, typename **Field::ConstElement\_ptr** X, const size\_t incX, typename **Field::Element\_ptr** Y, const size\_t incY)

use cblas\_(d)scal when possible

Global **FFLAS::fscal** (const FFLAS\_FIELD< FFLAS\_ELT > &F, const size\_t n, const FFLAS\_ELT alpha, const FFLAS\_ELT \*X, const size\_t incX, FFLAS\_ELT \*Y, const size\_t incY)

use cblas\_(d)scal when possible

Global **FFLAS::fscaln** (const **Field** &F, const size\_t n, const typename **Field::Element** alpha, typename **Field::Element\_ptr** X, const size\_t incX)

use cblas\_(d)scal when possible

Global **FFLAS::fscaln** (const FFLAS\_FIELD< FFLAS\_ELT > &F, const size\_t n, const FFLAS\_ELT alpha, FFLAS\_ELT \*X, const size\_t incX)

use cblas\_(d)scal when possible

Global **FFLAS::fsquare** (const **Field** &F, const FFLAS\_TRANSPOSE ta, const size\_t n, const typename **Field::Element** alpha, typename **Field::ConstElement\_ptr** A, const size\_t lda, const typename **Field::Element** beta, typename **Field::Element\_ptr** C, const size\_t ldc)

why double ?

Global **FFLAS::fswap** (const **Field** &F, const size\_t N, typename **Field::Element\_ptr** X, const size\_t incX, typename **Field::Element\_ptr** Y, const size\_t incY)

use cblas\_dswap when double

Global **FFLAS::fswap** (const FFLAS\_FIELD< FFLAS\_ELT > &F, const size\_t N, FFLAS\_ELT \*X, const size\_t incX, FFLAS\_ELT \*Y, const size\_t incY)

use cblas\_dswap when double

Global **FFLAS::ftrsm** (const **Field** &F, const FFLAS\_SIDE Side, const FFLAS\_UPLO Uplo, const FFLAS\_TRANSPOSE TransA, const FFLAS\_DIAG Diag, const size\_t M, const size\_t N, const typename **Field::Element** alpha, typename **Field::ConstElement\_ptr** A, const size\_t lda, typename **Field::Element\_ptr** B, const size\_t ldb)

$\alpha$  must be non zero.

Global **FFLAS::ftrsm** (const FFLAS\_FIELD< FFLAS\_ELT > &F, const FFLAS\_SIDE Side, const FFLAS\_UPLO Uplo, const FFLAS\_TRANSPOSE TransA, const FFLAS\_DIAG Diag, const size\_t M, const size\_t N, const FFLAS\_ELT alpha, const FFLAS\_ELT \*A, const size\_t lda, FFLAS\_ELT \*B, const size\_t ldb)

$\alpha$  must be non zero.

Global **FFPACK::buildMatrix** (const Field &F, typename Field::ConstElement\_ptr E, typename Field::ConstElement\_ptr C, const size\_t lda, const size\_t \*B, const size\_t \*T, const size\_t me, const size\_t mc, const size\_t lambda, const size\_t mu)

is this :

Global **FFPACK::invert2** (const Field &F, const size\_t M, typename Field::Element\_ptr A, const size\_t lda, typename Field::Element\_ptr X, const size\_t ldx, int &nullity)

not tested.

Global **launch\_fger\_dispatch** (const Field &F, const size\_t nn, const typename Field::Element alpha, const size\_t iters, RandIter &G)

test for incx equal

test for transpo

Global **launch\_MM\_dispatch** (const Field &F, const int mm, const int nn, const int kk, const typename Field::Element alpha, const typename Field::Element beta, const size\_t iters, RandIter &G)

test for ldX equal

test for transpo

Global **launch\_MM\_dispatch** (const Field &F, const int mm, const int nn, const int kk, const typename Field::Element alpha, const typename Field::Element beta, const size\_t iters, const int nbw, const bool par, RandIter &G)

test for ldX equal

test for transpo

Global **printvect** (std::ostream &o, vector< T > &vect)

does not belong here



## Chapter 3

# Bibliography

Global `FFLAS::Protected::TRSMBound` (const `Givaro::ModularBalanced` < `Element` > &F)

- Dumas Giorgi Pernet 06, arXiv:cs/0601133

Global `FFPACK::LeadingSubmatrixRankProfiles` (const size\_t M, const size\_t N, const size\_t R, const size\_t LSm, const size\_t LSn, const size\_t \*P, const size\_t \*Q, size\_t \*RRP, size\_t \*CRP)

- Dumas J-G., Pernet C., and Sultan Z. *Simultaneous computation of the row and column rank profiles*, ISSAC'13.

Global `FFPACK::LUdivine` (const `Field` &F, const `FFLAS::FFLAS_DIAG` Diag, const `FFLAS::FFLAS_TRANSPOSE` trans, const size\_t M, const size\_t N, typename `Field::Element_ptr` A, const size\_t lda, size\_t \*P, size\_t \*Qt, const `FFPACK_LU_TAG` LuTag=FfpackSlabRecursive, const size\_t cutoff=\_\_FFLASFFPACK\_LUDIVINE\_THRESHOLD)

- Jeannerod C-P, Pernet, C. and Storjohann, A. *Rank-profile revealing Gaussian elimination and the CUP matrix decomposition*, J. of Symbolic Comp., 2013
- Pernet C, Brassel M *LUdivine, une divine factorisation LU*, 2002

Global `FFPACK::PLUQ` (const `Field` &F, const `FFLAS::FFLAS_DIAG` Diag, const size\_t M, const size\_t N, typename `Field::Element_ptr` A, const size\_t lda, size\_t \*P, size\_t \*Q)

- Dumas J-G., Pernet C., and Sultan Z. *Simultaneous computation of the row and column rank profiles*, ISSAC'13, 2013

Global `FFPACK::productBruhatxTS` (const `Field` &Fi, size\_t N, size\_t s, size\_t r, size\_t t, const size\_t \*P, const size\_t \*Q, typename `Field::ConstElement_ptr` Xu, size\_t ldu, size\_t NbBlocksU, const size\_t \*Ku, const size\_t \*Tu, const size\_t \*MU, typename `Field::ConstElement_ptr` XI, size\_t ldl, size\_t NbBlocksL, const size\_t \*KI, const size\_t \*TI, const size\_t \*ML, typename `Field::Element_ptr` B, size\_t ldb, const typename `Field::Element` beta, typename `Field::Element_ptr` D, size\_t ldd)

Pernet C. and Storjohann A. *Time and space efficient generators for quasiseparable matrices*, JSC (85), 2018, doi:10.1016/j.jsc.2017.07.010

Global `FFPACK::Protected::GaussJordan` (const `Field` &F, const `size_t` M, const `size_t` N, typename `Field::Element_ptr` A, const `size_t` lda, const `size_t` colbeg, const `size_t` rowbeg, const `size_t` colsize, `size_t` \*P, `size_t` \*Q, const `FFPACK::FFPACK_LU_TAG` LuTag)

- Algorithm 2.8 of A. Storjohann Thesis 2000,
- Algorithm 11 of Jeannerod C-P., Pernet, C. and Storjohann, A. *Rank-profile revealing Gaussian elimination and the CUP matrix decomposition*, J. of Symbolic Comp., 2013

Class `ftsrmlLeftUpperNoTransNonUnit` < `Element` >

- Dumas, Giorgi, Pernet 06, arXiv:cs/0601133.



## Chapter 4

# Todo List

File `debug.h`

we should put vector printing elsewhere.

Global `FFLAS::fadd` (const `Field` &F, const `size_t` N, typename `Field::ConstElement_ptr` A, const `size_t` inca, const typename `Field::Element` alpha, typename `Field::ConstElement_ptr` B, const `size_t` incb, typename `Field::Element_ptr` C, const `size_t` incc)

optimise here

Global `FFLAS::fassign` (const `Field` &F, const `size_t` N, typename `Field::ConstElement_ptr` Y, const `size_t` incY, typename `Field::Element_ptr` X, const `size_t` incX)

variant for triangular matrix

Global `FFLAS::fassign` (const `FFLAS_FIELD`< `FFLAS_ELT` > &F, const `size_t` N, const `FFLAS_ELT` \*Y, const `size_t` incY, `FFLAS_ELT` \*X, const `size_t` incX)

variant for triangular matrix

Global `FFLAS::fconvert` (const `Field` &F, const `size_t` m, const `size_t` n, `OtherElement_ptr` A, const `size_t` lda, typename `Field::ConstElement_ptr` B, const `size_t` ldb)

check if `n == lda`

Global `FFLAS::fneg` (const `Field` &F, const `size_t` m, const `size_t` n, typename `Field::ConstElement_ptr` B, const `size_t` ldb, typename `Field::Element_ptr` A, const `size_t` lda)

check if `n == lda`

Global `FFLAS::fnegin` (const `Field` &F, const `size_t` m, const `size_t` n, typename `Field::Element_ptr` A, const `size_t` lda)

check if `n == lda`

Global `FFLAS::fscal` (const `Field` &F, const `size_t` n, const typename `Field::Element` alpha, typename `Field::ConstElement_ptr` X, const `size_t` incX, typename `Field::Element_ptr` Y, const `size_t` incY)

check if comparison with `+/-1,0` is necessary.

Global `FFLAS::fscal` (const `FFLAS_FIELD`< `FFLAS_ELT` > &F, const `size_t` n, const `FFLAS_ELT` alpha, const `FFLAS_ELT` \*X, const `size_t` incX, `FFLAS_ELT` \*Y, const `size_t` incY)

check if comparison with `+/-1,0` is necessary.

Global `FFLAS::fscalin` (const `Field` &F, const `size_t` n, const typename `Field::Element` alpha, typename `Field::Element_ptr` X, const `size_t` incX)

check if comparison with `+/-1,0` is necessary.

Global **FFLAS::fscaln** (const FFLAS\_FIELD< FFLAS\_ELT > &F, const size\_t n, const FFLAS\_ELT alpha, FFLAS\_ELT \*X, const size\_t incX)

check if comparison with +/-1,0 is necessary.

Global **FFLAS::Protected::igemm** (const enum FFLAS\_TRANSPOSE TransA, const enum FFLAS\_TRANSPOSE TransB, size\_t rows, size\_t cols, size\_t depth, const int64\_t alpha, const int64\_t \*A, size\_t lda, const int64\_t \*B, size\_t ldb, const int64\_t beta, int64\_t \*C, size\_t ldc)

use primitive (no Field()) and specialise for int64.

Global **FFLAS::Protected::MatF2MatFI\_Triangular** (const Field &F, Givaro::FloatDomain::Element\_ptr S, const size\_t lds, typename Field::ConstElement\_ptr const E, const size\_t lde, const size\_t m, const size\_t n)

do finit(...,FFLAS\_TRANS,FFLAS\_DIAG)

do fconvert(...,FFLAS\_TRANS,FFLAS\_DIAG)

Global **FFPACK::getTriangular** (const Field &F, const FFLAS::FFLAS\_UPLO Uplo, const FFLAS::FFLAS\_DIAG diag, const size\_t M, const size\_t N, const size\_t R, typename Field::ConstElement\_ptr A, const size\_t lda, typename Field::Element\_ptr T, const size\_t ldt, const bool OnlyNonZeroVectors=false)

just one triangular fzero+fassign ?

Global **FFPACK::getTriangular** (const Field &F, const FFLAS::FFLAS\_UPLO Uplo, const FFLAS::FFLAS\_DIAG diag, const size\_t M, const size\_t N, const size\_t R, typename Field::Element\_ptr A, const size\_t lda)

just one triangular fzero+fassign ?

Global **FFPACK::Invert2** (const Field &F, const size\_t M, typename Field::Element\_ptr A, const size\_t lda, typename Field::Element\_ptr X, const size\_t ldx, int &>nullity)

this init is not all necessary (done after ftrtri)

Global **FFPACK::LUdivine** (const Field &F, const FFLAS::FFLAS\_DIAG Diag, const FFLAS::FFLAS\_TRANSPOSE trans, const size\_t M, const size\_t N, typename Field::Element\_ptr A, const size\_t lda, size\_t \*P, size\_t \*Q, const FFPACK::FFPACK\_LU\_TAG LuTag, const size\_t cutoff)

std::swap ?

Global **FFPACK::Protected::RandomKrylovPrecond** (const PolRing &PR, std::list< typename PolRing::Element > &completedFactors, const size\_t N, typename PolRing::Domain\_t::Element\_ptr A, const size\_t lda, size\_t &Nb, typename PolRing::Domain\_t::Element\_ptr &B, size\_t &ldb, typename PolRing::Domain\_t::RandIter &g, const size\_t degree=\_\_FFLASFFPACK\_ARITHPROG\_THRESHOLD)

swap to save space ??

don't assing K2 c\*noc x N but only mas (c,noc) x N and store each one after the other

## Module field

biblio

Global **launch\_fger\_dispatch** (const Field &F, const size\_t nn, const typename Field::Element alpha, const size\_t iters, RandIter &G)

does nbw actually do nbw recursive calls and then call blas (check ?) ?

Global **launch\_MM\_dispatch** (const Field &F, const int mm, const int nn, const int kk, const typename Field::Element alpha, const typename Field::Element beta, const size\_t iters, RandIter &G)

does nbw actually do nbw recursive calls and then call blas (check ?) ?

---

Global **launch\_MM\_dispatch** (const **Field** &F, const int mm, const int nn, const int kk, const typename **Field::Element** alpha, const typename **Field::Element** beta, const size\_t iters, const int nbw, const bool par, RandIter &G)

does nbw actually do nbw recursive calls and then call blas (check ?) ?

Module **MMalgos**

biblio

Module **simd**

biblio

Global **test\_colechelon** (**Field** &F, size\_t m, size\_t n, size\_t r, size\_t iters, FFPACK::FFPACK\_LU\_TAG LuTag, RandIter &G, bool par)

check Ida

Global **test\_det** (**Field** &F, size\_t n, int iter, RandIter &G)

test with stride

Global **test\_redcochelon** (**Field** &F, size\_t m, size\_t n, size\_t r, size\_t iters, FFPACK::FFPACK\_LU\_TAG LuTag, RandIter &G, bool par)

check Ida

Global **test\_redrowechelon** (**Field** &F, size\_t m, size\_t n, size\_t r, size\_t iters, FFPACK::FFPACK\_LU\_TAG LuTag, RandIter &G, bool par)

check Ida

Global **test\_rowechelon** (**Field** &F, size\_t m, size\_t n, size\_t r, size\_t iters, FFPACK::FFPACK\_LU\_TAG LuTag, RandIter &G, bool par)

check Ida



# Chapter 5

## Topic Index

### 5.1 Topics

Here is a list of all topics with brief descriptions:

CHECKER . . . . .	41
FFLAS-FFPACK . . . . .	41
FFLAS . . . . .	42
Interfaces . . . . .	42
Matrix Multiplication Algorithms . . . . .	42
SIMD wrapper . . . . .	42
FFPACK . . . . .	43
FFLAS-FFPACK fields . . . . .	43
RNS . . . . .	43



## Chapter 6

# Namespace Index

### 6.1 Namespace List

Here is a list of all namespaces with brief descriptions:

FFLAS	45
FFLAS::_ftranspose_impl	190
FFLAS::BLAS3	191
FFLAS::csr_hyb_details	197
FFLAS::CuttingStrategy	197
FFLAS::details	198
FFLAS::details_spmv	206
FFLAS::ElementCategories	206
FFLAS::FieldCategories	
Traits and categories will need to be placed in a proper file later	206
FFLAS::MMHelperAlgo	207
FFLAS::ModeCategories	
Specifies the mode of action for an algorithm w.r.t	207
FFLAS::ParSeqHelper	
ParSeqHelper for both fgemm and ftrsm	208
FFLAS::Protected	208
FFLAS::sell_details	222
FFLAS::sparse_details	223
FFLAS::sparse_details_impl	237
FFLAS::StrategyParameter	277
FFLAS::StructureHelper	
StructureHelper for ftrsm	277
FFLAS::vectorised	278
FFLAS::vectorised::unswitch	283
FFPACK	
Finite Field <b>PACK</b> Set of elimination based routines for dense linear algebra	286
FFPACK::Protected	389
Givaro	396
MKL_CONFIG	396
RecInt	396





## Chapter 7

# Hierarchical Index

### 7.1 Class Hierarchy

This inheritance list is sorted roughly, but not completely, alphabetically:

AlgoChooser< ModeT, ParSeq > . . . . .	397
AlgoChooser< ModeCategories::ConvertTo< ElementCategories::RNSElementTag >, ParSeq > . . . . .	397
ALL< v > . . . . .	397
ALL< false, v... > . . . . .	398
ALL< true, v... > . . . . .	398
ALL<> . . . . .	398
ArbitraryPrecIntTag . . . . .	398
AreEqual< X, Y > . . . . .	399
AreEqual< X, X > . . . . .	399
Argument . . . . .	399
array< T > . . . . .	400
associatedDelayedField< Field > . . . . .	400
associatedDelayedField< const FFPACK::RNSIntegerMod< RNS > > . . . . .	401
associatedDelayedField< const Givaro::Modular< T, X > > . . . . .	401
associatedDelayedField< const Givaro::ModularBalanced< T > > . . . . .	402
associatedDelayedField< const Givaro::ZRing< T > > . . . . .	403
Auto . . . . .	403
Bench< Elt > . . . . .	403
Bini . . . . .	406
Block . . . . .	406
BlockTransposeSIMD< Field, Simd, > . . . . .	406
callLUdivine_small< Element > . . . . .	408
callLUdivine_small< double > . . . . .	409
callLUdivine_small< float > . . . . .	410
CharpolyFailed . . . . .	410
Checker_Empty< Field > . . . . .	410
CheckerImplem_charpoly< Field, Polynomial > . . . . .	411
CheckerImplem_charpoly< Givaro::ZRing< Givaro::Integer >, Polynomial > . . . . .	412
CheckerImplem_Det< Field > . . . . .	413
CheckerImplem_fgemm< Field > . . . . .	414
CheckerImplem_ftsm< Field > . . . . .	416
CheckerImplem_invert< Field > . . . . .	417
CheckerImplem_PLUQ< Field > . . . . .	417
Classic . . . . .	418
Column . . . . .	419

CompactElement< Element > . . . . .	419
CompactElement< double > . . . . .	419
CompactElement< float > . . . . .	419
CompactElement< int16_t > . . . . .	420
CompactElement< int32_t > . . . . .	420
CompactElement< int64_t > . . . . .	420
compatible_data_type< Field > . . . . .	421
compatible_data_type< Givaro::ZRing< double > > . . . . .	421
compatible_data_type< Givaro::ZRing< float > > . . . . .	421
Compose< H1, H2 > . . . . .	422
array< T >::const_iterator . . . . .	423
string::const_iterator . . . . .	423
vector< T >::const_iterator . . . . .	423
array< T >::const_reverse_iterator . . . . .	423
string::const_reverse_iterator . . . . .	423
vector< T >::const_reverse_iterator . . . . .	424
Simd128_impl< true, true, false, 2 >::Converter . . . . .	424
Simd128_impl< true, true, false, 4 >::Converter . . . . .	424
Simd128_impl< true, true, false, 8 >::Converter . . . . .	424
Simd128_impl< true, true, true, 2 >::Converter . . . . .	425
Simd128_impl< true, true, true, 4 >::Converter . . . . .	425
Simd128_impl< true, true, true, 8 >::Converter . . . . .	425
Simd256_impl< true, false, true, 8 >::Converter . . . . .	426
Simd256_impl< true, true, false, 2 >::Converter . . . . .	426
Simd256_impl< true, true, false, 4 >::Converter . . . . .	426
Simd256_impl< true, true, false, 8 >::Converter . . . . .	427
Simd256_impl< true, true, true, 2 >::Converter . . . . .	427
Simd256_impl< true, true, true, 4 >::Converter . . . . .	427
Simd256_impl< true, true, true, 8 >::Converter . . . . .	428
Simd512_impl< true, true, false, 8 >::Converter . . . . .	428
Simd512_impl< true, true, true, 8 >::Converter . . . . .	428
ConvertTo< T > . . . . .	429
Coo< ValT, IdxT > . . . . .	429
Coo< Field > . . . . .	431
Coo< ValT, IdxT > . . . . .	432
CooMat< Field > . . . . .	434
count_nonconst_lvalue_reference< T > . . . . .	435
count_nonconst_lvalue_reference< const T &, O... > . . . . .	435
count_nonconst_lvalue_reference< T &, O... > . . . . .	435
count_nonconst_lvalue_reference< T, O... > . . . . .	435
count_nonconst_lvalue_reference<> . . . . .	436
CsrMat< Field > . . . . .	436
DefaultBoundedTag . . . . .	437
DefaultTag . . . . .	437
DelayedTag . . . . .	437
DivideAndConquer . . . . .	437
ElementTraits< Element > . . . . .	437
ElementTraits< double > . . . . .	438
ElementTraits< FFPACK::rns_double_elt > . . . . .	438
ElementTraits< float > . . . . .	438
ElementTraits< Givaro::Integer > . . . . .	439
ElementTraits< int16_t > . . . . .	439
ElementTraits< int32_t > . . . . .	440
ElementTraits< int64_t > . . . . .	440
ElementTraits< int8_t > . . . . .	440
ElementTraits< Reclnt::rint< K > > . . . . .	441
ElementTraits< Reclnt::rmint< K, MG > > . . . . .	441
ElementTraits< Reclnt::ruint< K > > . . . . .	441

ElementTraits< uint16_t > . . . . .	442
ElementTraits< uint32_t > . . . . .	442
ElementTraits< uint64_t > . . . . .	443
ElementTraits< uint8_t > . . . . .	443
EllMat< Field > . . . . .	443
Failure . . . . .	444
FailureCharpolyCheck . . . . .	446
FailureDetCheck . . . . .	446
FailureFgemmCheck . . . . .	446
FailureInvertCheck . . . . .	446
FailurePLUQCheck . . . . .	446
FailureTrsmCheck . . . . .	446
false_type	
isSparseMatrix< Field, Sparse< Field, SparseMatrix_t::COO > > . . . . .	484
isSparseMatrix< Field, Sparse< Field, SparseMatrix_t::COO_ZO > > . . . . .	485
isSparseMatrix< Field, Sparse< Field, SparseMatrix_t::CSR > > . . . . .	485
isSparseMatrix< Field, Sparse< Field, SparseMatrix_t::CSR_HYB > > . . . . .	485
isSparseMatrix< Field, Sparse< Field, SparseMatrix_t::CSR_ZO > > . . . . .	486
isSparseMatrix< Field, Sparse< Field, SparseMatrix_t::ELL > > . . . . .	486
isSparseMatrix< Field, Sparse< Field, SparseMatrix_t::ELL_ZO > > . . . . .	487
isSparseMatrix< Field, Sparse< Field, SparseMatrix_t::ELL_simd > > . . . . .	486
isSparseMatrix< Field, Sparse< Field, SparseMatrix_t::ELL_simd_ZO > > . . . . .	486
isSparseMatrix< Field, Sparse< Field, SparseMatrix_t::HYB_ZO > > . . . . .	487
isSparseMatrix< Field, Sparse< Field, SparseMatrix_t::SELL > > . . . . .	487
isSparseMatrix< Field, Sparse< Field, SparseMatrix_t::SELL_ZO > > . . . . .	487
isZOSparseMatrix< Field, Sparse< Field, SparseMatrix_t::COO_ZO > > . . . . .	489
isZOSparseMatrix< Field, Sparse< Field, SparseMatrix_t::CSR_ZO > > . . . . .	489
isZOSparseMatrix< Field, Sparse< Field, SparseMatrix_t::ELL_ZO > > . . . . .	489
isZOSparseMatrix< Field, Sparse< Field, SparseMatrix_t::ELL_simd_ZO > > . . . . .	489
isZOSparseMatrix< Field, Sparse< Field, SparseMatrix_t::SELL_ZO > > . . . . .	490
support_fast_mod< double > . . . . .	755
support_fast_mod< float > . . . . .	756
support_fast_mod< int64_t > . . . . .	756
isSparseMatrix< Field, M > . . . . .	484
isSparseMatrixMKLFormat< F, M > . . . . .	488
isSparseMatrixSimdFormat< F, M > . . . . .	488
isZOSparseMatrix< F, M > . . . . .	488
support_fast_mod< T > . . . . .	755
support_simd< T > . . . . .	756
support_simd_add< T > . . . . .	756
support_simd_mod< T > . . . . .	757
FieldSimd< _Field > . . . . .	447
FieldTraits< Field > . . . . .	453
FieldTraits< FFPACK::RNSInteger< T > > . . . . .	453
FieldTraits< FFPACK::RNSIntegerMod< T > > . . . . .	454
FieldTraits< Givaro::Modular< Element > > . . . . .	455
FieldTraits< Givaro::ModularBalanced< Element > > . . . . .	455
FieldTraits< Givaro::ZRing< double > > . . . . .	456
FieldTraits< Givaro::ZRing< float > > . . . . .	457
FieldTraits< Givaro::ZRing< Givaro::Integer > > . . . . .	457
FieldTraits< Givaro::ZRing< int16_t > > . . . . .	458
FieldTraits< Givaro::ZRing< int32_t > > . . . . .	459
FieldTraits< Givaro::ZRing< int64_t > > . . . . .	459
FieldTraits< Givaro::ZRing< ReclInt::ruint< K > > > . . . . .	460
FieldTraits< Givaro::ZRing< uint16_t > > . . . . .	460
FieldTraits< Givaro::ZRing< uint32_t > > . . . . .	461
FieldTraits< Givaro::ZRing< uint64_t > > . . . . .	462
Fixed . . . . .	462

FixedPrecIntTag . . . . .	462
ScalFunctionsBase< Element, typename enable_if< is_floating_point< Element >::value >::type >↔ ::FloatingPointTestDistribution . . . . .	463
ForStrategy1D< blocksize_t, Cut, Param > . . . . .	463
ForStrategy2D< blocksize_t, Cut, Param > . . . . .	466
ftmmLeftLowerNoTransNonUnit< Element > . . . . .	470
ftmmLeftLowerNoTransUnit< Element > . . . . .	470
ftmmLeftLowerTransNonUnit< Element > . . . . .	470
ftmmLeftLowerTransUnit< Element > . . . . .	470
ftmmLeftUpperNoTransNonUnit< Element > . . . . .	470
ftmmLeftUpperNoTransUnit< Element > . . . . .	470
ftmmLeftUpperTransNonUnit< Element > . . . . .	470
ftmmLeftUpperTransUnit< Element > . . . . .	471
ftmmRightLowerNoTransNonUnit< Element > . . . . .	471
ftmmRightLowerNoTransUnit< Element > . . . . .	471
ftmmRightLowerTransNonUnit< Element > . . . . .	471
ftmmRightLowerTransUnit< Element > . . . . .	471
ftmmRightUpperNoTransNonUnit< Element > . . . . .	471
ftmmRightUpperNoTransUnit< Element > . . . . .	471
ftmmRightUpperTransNonUnit< Element > . . . . .	471
ftmmRightUpperTransUnit< Element > . . . . .	472
ftsmLeftLowerNoTransNonUnit< Element > . . . . .	472
ftsmLeftLowerNoTransUnit< Element > . . . . .	472
ftsmLeftLowerTransNonUnit< Element > . . . . .	472
ftsmLeftLowerTransUnit< Element > . . . . .	472
ftsmLeftUpperNoTransNonUnit< Element > . . . . .	472
ftsmLeftUpperNoTransUnit< Element > . . . . .	473
ftsmLeftUpperTransNonUnit< Element > . . . . .	473
ftsmLeftUpperTransUnit< Element > . . . . .	473
ftsmRightLowerNoTransNonUnit< Element > . . . . .	473
ftsmRightLowerNoTransUnit< Element > . . . . .	473
ftsmRightLowerTransNonUnit< Element > . . . . .	473
ftsmRightLowerTransUnit< Element > . . . . .	473
ftsmRightUpperNoTransNonUnit< Element > . . . . .	473
ftsmRightUpperNoTransUnit< Element > . . . . .	474
ftsmRightUpperTransNonUnit< Element > . . . . .	474
ftsmRightUpperTransUnit< Element > . . . . .	474
GenericTag . . . . .	474
GenericTag . . . . .	474
Grain . . . . .	474
has_minus_eq_impl< C > . . . . .	474
has_minus_impl< C > . . . . .	475
has_mul_eq_impl< C > . . . . .	475
has_mul_impl< C > . . . . .	475
has_operation< T > . . . . .	476
has_plus_eq_impl< C > . . . . .	476
has_plus_impl< C > . . . . .	476
HelperFlag . . . . .	477
HelperMod< Field, ElementTraits > . . . . .	477
HelperMod< Field, ElementCategories::MachineIntTag > . . . . .	478
HelperMod< Field, FFLAS::ElementCategories::ArbitraryPrecIntTag > . . . . .	479
HelperMod< Field, FFLAS::ElementCategories::FixedPrecIntTag > . . . . .	479
HelperMod< Field, FFLAS::ElementCategories::MachineFloatTag > . . . . .	480
Hybrid . . . . .	481
Info . . . . .	481
Info . . . . .	482
is_all_same< Args > . . . . .	483
is_all_same< T, Args... > . . . . .	483

is_all_same<> . . . . .	483
is_simd< T > . . . . .	484
Iterative . . . . .	490
array< T >::iterator . . . . .	490
string::iterator . . . . .	490
vector< T >::iterator . . . . .	490
LazyTag . . . . .	490
limits< T > . . . . .	491
limits< char > . . . . .	491
limits< double > . . . . .	491
limits< float > . . . . .	492
limits< Givaro::Integer > . . . . .	493
limits< int > . . . . .	493
limits< long > . . . . .	494
limits< long long > . . . . .	494
limits< RecInt::rint< K > > . . . . .	495
limits< RecInt::ruint< K > > . . . . .	496
limits< short int > . . . . .	496
limits< signed char > . . . . .	497
limits< unsigned char > . . . . .	498
limits< unsigned int > . . . . .	498
limits< unsigned long > . . . . .	499
limits< unsigned long long > . . . . .	499
limits< unsigned short int > . . . . .	500
MachineFloatTag . . . . .	501
MachineIntTag . . . . .	501
MMHelper< Field, AlgoTrait, ModeTrait, ParSeqTrait > . . . . .	501
ModeTraits< Field > . . . . .	506
ModeTraits< Givaro::Modular< Element, Compute > > . . . . .	507
ModeTraits< Givaro::Modular< Givaro::Integer, Compute > > . . . . .	507
ModeTraits< Givaro::Modular< int16_t, Compute > > . . . . .	507
ModeTraits< Givaro::Modular< int32_t, Compute > > . . . . .	508
ModeTraits< Givaro::Modular< int64_t, uint64_t > > . . . . .	508
ModeTraits< Givaro::Modular< int8_t, Compute > > . . . . .	509
ModeTraits< Givaro::Modular< RecInt::ruint< K >, Compute > > . . . . .	509
ModeTraits< Givaro::Modular< uint16_t, Compute > > . . . . .	509
ModeTraits< Givaro::Modular< uint32_t, Compute > > . . . . .	510
ModeTraits< Givaro::Modular< uint8_t, Compute > > . . . . .	510
ModeTraits< Givaro::ModularBalanced< Element > > . . . . .	511
ModeTraits< Givaro::ModularBalanced< Givaro::Integer > > . . . . .	511
ModeTraits< Givaro::ModularBalanced< int16_t > > . . . . .	511
ModeTraits< Givaro::ModularBalanced< int32_t > > . . . . .	512
ModeTraits< Givaro::ModularBalanced< int8_t > > . . . . .	512
ModeTraits< Givaro::Montgomery< T > > . . . . .	513
ModeTraits< Givaro::ZRing< double > > . . . . .	513
ModeTraits< Givaro::ZRing< float > > . . . . .	513
ModeTraits< Givaro::ZRing< Givaro::Integer > > . . . . .	514
ModularBalanced< T > . . . . .	514
ModularBalanced< T > . . . . .	514
ModularTag . . . . .	514
Montgomery< T > . . . . .	514
need_field_characteristic< Field > . . . . .	515
need_field_characteristic< Givaro::Modular< Field > > . . . . .	515
need_field_characteristic< Givaro::ModularBalanced< Field > > . . . . .	515
NoSimd< T > . . . . .	516
Parallel< C, P > . . . . .	517
readMyMachineType< Field, T > . . . . .	520
readMyMachineType< Field, mpz_t > . . . . .	521

Recursive	522
Recursive	522
array< T >::reverse_iterator	522
string::reverse_iterator	523
vector< T >::reverse_iterator	523
rint< K >	523
rns_double	523
rns_double_elt	528
rns_double_elt_cstptr	529
rns_double_elt_ptr	532
rns_double_extended	535
RNSElementTag	538
RNSInteger< RNS >	538
RNSIntegerMod< RNS >	542
rnsRandIter< RNS >	549
RNSInteger< RNS >::RandIter	518
RNSIntegerMod< RNS >::RandIter	519
Row	550
ruint< K >	550
ScalFunctionsBase< Element, Enable >	555
ScalFunctions< Element >	550
ScalFunctionsBase< Element, typename enable_if< is_floating_point< Element >::value >::type >	556
ScalFunctionsBase< Element, typename enable_if< is_integral< Element >::value >::type >	557
Sequential	560
Simd128_impl< ArithType, Int, Signed, Size >	561
Simd128_impl< true, false, true, 4 >	561
Simd128_impl< true, false, true, 8 >	561
Simd128i_base	619
Simd128_impl< true, true, true, 2 >	591
Simd128_impl< true, true, false, 2 >	561
Simd128_impl< true, true, true, 4 >	601
Simd128_impl< true, true, false, 4 >	571
Simd128_impl< true, true, true, 8 >	609
Simd128_impl< true, true, false, 8 >	581
Simd256_impl< ArithType, Int, Signed, Size >	620
Simd256fp_base	702
Simd256_impl< true, false, true, 4 >	620
Simd256_impl< true, false, true, 8 >	621
Simd256i_base	702
Simd256_impl< true, true, true, 2 >	666
Simd256_impl< true, true, false, 2 >	628
Simd256_impl< true, true, true, 4 >	675
Simd256_impl< true, true, false, 4 >	638
Simd256_impl< true, true, false, 4 >	638
Simd256_impl< true, true, true, 8 >	693
Simd256_impl< true, true, false, 8 >	657
Simd512_impl< ArithType, Int, Signed, Size >	702
Simd512_impl< true, false, true, 4 >	702
Simd512_impl< true, false, true, 8 >	703
Simd512i_base	730
Simd256_impl< true, true, true, 4 >	675
Simd512_impl< true, true, true, 8 >	720
Simd512_impl< true, true, false, 8 >	709
SimdChooser< T, bool, bool >	731
SimdChooser< T, false, b >	731
SimdChooser< T, true, false >	731

SimdChooser< T, true, true > . . . . .	732
simdToType< T > . . . . .	732
Single . . . . .	732
Sparse< Field, SparseMatrix_t, IdxT, PtrT > . . . . .	732
Sparse< _Field, SparseMatrix_t::COO > . . . . .	732
Sparse< _Field, SparseMatrix_t::COO_ZO > . . . . .	734
Sparse< _Field, SparseMatrix_t::CSR > . . . . .	736
Sparse< _Field, SparseMatrix_t::CSR_ZO > . . . . .	739
Sparse< _Field, SparseMatrix_t::CSR_HYB > . . . . .	737
Sparse< _Field, SparseMatrix_t::ELL > . . . . .	741
Sparse< _Field, SparseMatrix_t::ELL_ZO > . . . . .	746
Sparse< _Field, SparseMatrix_t::ELL_simd > . . . . .	742
Sparse< _Field, SparseMatrix_t::ELL_simd_ZO > . . . . .	744
Sparse< _Field, SparseMatrix_t::SELL > . . . . .	747
Sparse< _Field, SparseMatrix_t::SELL_ZO > . . . . .	749
SpMat< Field, flag > . . . . .	751
StatsMatrix . . . . .	752
string . . . . .	755
Test< Elt > . . . . .	757
TestOneMethod< Simd > . . . . .	760
tfn_minus . . . . .	763
tfn_minus_eq . . . . .	763
tfn_mul . . . . .	763
tfn_mul_eq . . . . .	764
tfn_plus . . . . .	764
tfn_plus_eq . . . . .	765
Threads . . . . .	765
ThreeD . . . . .	765
ThreeDAdaptive . . . . .	765
ThreeDInPlace . . . . .	765
TRSMHelper< RectlerTrait, ParSeqTrait > . . . . .	765
true_type	
isSparseMatrix< Field, Sparse< Field, SparseMatrix_t::COO > > . . . . .	484
isSparseMatrix< Field, Sparse< Field, SparseMatrix_t::COO_ZO > > . . . . .	485
isSparseMatrix< Field, Sparse< Field, SparseMatrix_t::CSR > > . . . . .	485
isSparseMatrix< Field, Sparse< Field, SparseMatrix_t::CSR_HYB > > . . . . .	485
isSparseMatrix< Field, Sparse< Field, SparseMatrix_t::CSR_ZO > > . . . . .	486
isSparseMatrix< Field, Sparse< Field, SparseMatrix_t::ELL > > . . . . .	486
isSparseMatrix< Field, Sparse< Field, SparseMatrix_t::ELL_ZO > > . . . . .	487
isSparseMatrix< Field, Sparse< Field, SparseMatrix_t::ELL_simd > > . . . . .	486
isSparseMatrix< Field, Sparse< Field, SparseMatrix_t::ELL_simd_ZO > > . . . . .	486
isSparseMatrix< Field, Sparse< Field, SparseMatrix_t::HYB_ZO > > . . . . .	487
isSparseMatrix< Field, Sparse< Field, SparseMatrix_t::SELL > > . . . . .	487
isSparseMatrix< Field, Sparse< Field, SparseMatrix_t::SELL_ZO > > . . . . .	487
isZOSparseMatrix< Field, Sparse< Field, SparseMatrix_t::COO_ZO > > . . . . .	489
isZOSparseMatrix< Field, Sparse< Field, SparseMatrix_t::CSR_ZO > > . . . . .	489
isZOSparseMatrix< Field, Sparse< Field, SparseMatrix_t::ELL_ZO > > . . . . .	489
isZOSparseMatrix< Field, Sparse< Field, SparseMatrix_t::ELL_simd_ZO > > . . . . .	489
isZOSparseMatrix< Field, Sparse< Field, SparseMatrix_t::SELL_ZO > > . . . . .	490
support_fast_mod< double > . . . . .	755
support_fast_mod< float > . . . . .	756
support_fast_mod< int64_t > . . . . .	756
TwoD . . . . .	767
TwoDAdaptive . . . . .	767
UnparametricTag . . . . .	767
vector< T > . . . . .	767
width< T > . . . . .	768

width< double > . . . . .	768
width< float > . . . . .	769
Winograd . . . . .	769
WinogradPar . . . . .	769



## Chapter 8

# Data Structure Index

### 8.1 Data Structures

Here are the data structures with brief descriptions:

<a href="#">AlgoChooser&lt; ModeT, ParSeq &gt;</a>	397
<a href="#">AlgoChooser&lt; ModeCategories::ConvertTo&lt; ElementCategories::RNSElementTag &gt;, ParSeq &gt;</a>	397
<a href="#">ALL&lt; v &gt;</a>	397
<a href="#">ALL&lt; false, v... &gt;</a>	398
<a href="#">ALL&lt; true, v... &gt;</a>	398
<a href="#">ALL&lt;&gt;</a>	398
<a href="#">ArbitraryPrecIntTag</a>	
Arbitrary precision integers: GMP	398
<a href="#">AreEqual&lt; X, Y &gt;</a>	399
<a href="#">AreEqual&lt; X, X &gt;</a>	399
<a href="#">Argument</a>	399
<a href="#">array&lt; T &gt;</a>	
STL class	400
<a href="#">associatedDelayedField&lt; Field &gt;</a>	400
<a href="#">associatedDelayedField&lt; const FFPACK::RNSIntegerMod&lt; RNS &gt; &gt;</a>	401
<a href="#">associatedDelayedField&lt; const Givaro::Modular&lt; T, X &gt; &gt;</a>	401
<a href="#">associatedDelayedField&lt; const Givaro::ModularBalanced&lt; T &gt; &gt;</a>	402
<a href="#">associatedDelayedField&lt; const Givaro::ZRing&lt; T &gt; &gt;</a>	403
<a href="#">Auto</a>	403
<a href="#">Bench&lt; Elt &gt;</a>	403
<a href="#">Bini</a>	406
<a href="#">Block</a>	406
<a href="#">BlockTransposeSIMD&lt; Field, Simd, &gt;</a>	406
<a href="#">callLUdivine_small&lt; Element &gt;</a>	408
<a href="#">callLUdivine_small&lt; double &gt;</a>	409
<a href="#">callLUdivine_small&lt; float &gt;</a>	410
<a href="#">CharpolyFailed</a>	410
<a href="#">Checker_Empty&lt; Field &gt;</a>	410
<a href="#">CheckerImplem_charpoly&lt; Field, Polynomial &gt;</a>	411
<a href="#">CheckerImplem_charpoly&lt; Givaro::ZRing&lt; Givaro::Integer &gt;, Polynomial &gt;</a>	412
<a href="#">CheckerImplem_Det&lt; Field &gt;</a>	413
<a href="#">CheckerImplem_fgemm&lt; Field &gt;</a>	414
<a href="#">CheckerImplem_ftdsm&lt; Field &gt;</a>	416
<a href="#">CheckerImplem_invert&lt; Field &gt;</a>	417
<a href="#">CheckerImplem_PLUQ&lt; Field &gt;</a>	417

Classic	418
Column	419
CompactElement< Element >	419
CompactElement< double >	419
CompactElement< float >	419
CompactElement< int16_t >	420
CompactElement< int32_t >	420
CompactElement< int64_t >	420
compatible_data_type< Field >	421
compatible_data_type< Givaro::ZRing< double > >	421
compatible_data_type< Givaro::ZRing< float > >	421
Compose< H1, H2 >	422
array< T >::const_iterator	
STL iterator class	423
string::const_iterator	
STL iterator class	423
vector< T >::const_iterator	
STL iterator class	423
array< T >::const_reverse_iterator	
STL iterator class	423
string::const_reverse_iterator	
STL iterator class	423
vector< T >::const_reverse_iterator	
STL iterator class	424
Simd128_impl< true, true, false, 2 >::Converter	424
Simd128_impl< true, true, false, 4 >::Converter	424
Simd128_impl< true, true, false, 8 >::Converter	424
Simd128_impl< true, true, true, 2 >::Converter	425
Simd128_impl< true, true, true, 4 >::Converter	425
Simd128_impl< true, true, true, 8 >::Converter	425
Simd256_impl< true, false, true, 8 >::Converter	426
Simd256_impl< true, true, false, 2 >::Converter	426
Simd256_impl< true, true, false, 4 >::Converter	426
Simd256_impl< true, true, false, 8 >::Converter	427
Simd256_impl< true, true, true, 2 >::Converter	427
Simd256_impl< true, true, true, 4 >::Converter	427
Simd256_impl< true, true, true, 8 >::Converter	428
Simd512_impl< true, true, false, 8 >::Converter	428
Simd512_impl< true, true, true, 8 >::Converter	428
ConvertTo< T >	
Force conversion to appropriate element type of ElementCategory T	429
Coo< ValT, IdxT >	429
Coo< Field >	431
Coo< ValT, IdxT >	432
CooMat< Field >	434
count_nonconst_lvalue_reference< T >	435
count_nonconst_lvalue_reference< const T &, O... >	435
count_nonconst_lvalue_reference< T &, O... >	435
count_nonconst_lvalue_reference< T, O... >	435
count_nonconst_lvalue_reference<>	436
CsrMat< Field >	436
DefaultBoundedTag	
Use standard field operations, but keeps track of bounds on input and output	437
DefaultTag	
No specific mode of action: use standard field operations	437
DelayedTag	
Performs field operations with delayed mod reductions. Ensures result is reduced	437
DivideAndConquer	437

ElementTraits< Element >	
ElementTraits	437
ElementTraits< double >	438
ElementTraits< FFPACK::rns_double_elt >	438
ElementTraits< float >	438
ElementTraits< Givaro::Integer >	439
ElementTraits< int16_t >	439
ElementTraits< int32_t >	440
ElementTraits< int64_t >	440
ElementTraits< int8_t >	440
ElementTraits< Reclnt::rint< K > >	441
ElementTraits< Reclnt::rmint< K, MG > >	441
ElementTraits< Reclnt::ruint< K > >	441
ElementTraits< uint16_t >	442
ElementTraits< uint32_t >	442
ElementTraits< uint64_t >	443
ElementTraits< uint8_t >	443
ElMat< Field >	443
Failure	
A precondition failed	444
FailureCharpolyCheck	446
FailureDetCheck	446
FailureFgemmCheck	446
FailureInvertCheck	446
FailurePLUQCheck	446
FailureTrsmCheck	446
FieldSimd< _Field >	447
FieldTraits< Field >	
FieldTrait	453
FieldTraits< FFPACK::RNSInteger< T > >	453
FieldTraits< FFPACK::RNSIntegerMod< T > >	454
FieldTraits< Givaro::Modular< Element > >	455
FieldTraits< Givaro::ModularBalanced< Element > >	455
FieldTraits< Givaro::ZRing< double > >	456
FieldTraits< Givaro::ZRing< float > >	457
FieldTraits< Givaro::ZRing< Givaro::Integer > >	457
FieldTraits< Givaro::ZRing< int16_t > >	458
FieldTraits< Givaro::ZRing< int32_t > >	459
FieldTraits< Givaro::ZRing< int64_t > >	459
FieldTraits< Givaro::ZRing< Reclnt::ruint< K > > >	460
FieldTraits< Givaro::ZRing< uint16_t > >	460
FieldTraits< Givaro::ZRing< uint32_t > >	461
FieldTraits< Givaro::ZRing< uint64_t > >	462
Fixed	462
FixedPrecIntTag	
Fixed precision integers above machine precision: Givaro::reclnt	462
ScalFunctionsBase< Element, typename enable_if< is_floating_point< Element >::value >::type >::FloatingPointTestDistribution	
463	
ForStrategy1D< blocksize_t, Cut, Param >	463
ForStrategy2D< blocksize_t, Cut, Param >	466
ftmmLeftLowerNoTransNonUnit< Element >	470
ftmmLeftLowerNoTransUnit< Element >	470
ftmmLeftLowerTransNonUnit< Element >	470
ftmmLeftLowerTransUnit< Element >	470
ftmmLeftUpperNoTransNonUnit< Element >	470
ftmmLeftUpperNoTransUnit< Element >	470
ftmmLeftUpperTransNonUnit< Element >	470
ftmmLeftUpperTransUnit< Element >	471

<a href="#">ftrmmRightLowerNoTransNonUnit&lt; Element &gt;</a>	471
<a href="#">ftrmmRightLowerNoTransUnit&lt; Element &gt;</a>	471
<a href="#">ftrmmRightLowerTransNonUnit&lt; Element &gt;</a>	471
<a href="#">ftrmmRightLowerTransUnit&lt; Element &gt;</a>	471
<a href="#">ftrmmRightUpperNoTransNonUnit&lt; Element &gt;</a>	471
<a href="#">ftrmmRightUpperNoTransUnit&lt; Element &gt;</a>	471
<a href="#">ftrmmRightUpperTransNonUnit&lt; Element &gt;</a>	471
<a href="#">ftrmmRightUpperTransUnit&lt; Element &gt;</a>	472
<a href="#">ftrsmLeftLowerNoTransNonUnit&lt; Element &gt;</a>	472
<a href="#">ftrsmLeftLowerNoTransUnit&lt; Element &gt;</a>	472
<a href="#">ftrsmLeftLowerTransNonUnit&lt; Element &gt;</a>	472
<a href="#">ftrsmLeftLowerTransUnit&lt; Element &gt;</a>	472
<a href="#">ftrsmLeftUpperNoTransNonUnit&lt; Element &gt;</a>	472
Computes the maximal size for delaying the modular reduction in a triangular system resolution	472
<a href="#">ftrsmLeftUpperNoTransUnit&lt; Element &gt;</a>	473
<a href="#">ftrsmLeftUpperTransNonUnit&lt; Element &gt;</a>	473
<a href="#">ftrsmLeftUpperTransUnit&lt; Element &gt;</a>	473
<a href="#">ftrsmRightLowerNoTransNonUnit&lt; Element &gt;</a>	473
<a href="#">ftrsmRightLowerNoTransUnit&lt; Element &gt;</a>	473
<a href="#">ftrsmRightLowerTransNonUnit&lt; Element &gt;</a>	473
<a href="#">ftrsmRightLowerTransUnit&lt; Element &gt;</a>	473
<a href="#">ftrsmRightUpperNoTransNonUnit&lt; Element &gt;</a>	473
<a href="#">ftrsmRightUpperNoTransUnit&lt; Element &gt;</a>	474
<a href="#">ftrsmRightUpperTransNonUnit&lt; Element &gt;</a>	474
<a href="#">ftrsmRightUpperTransUnit&lt; Element &gt;</a>	474
<a href="#">GenericTag</a>	
Default is generic	474
<a href="#">GenericTag</a>	
Generic ring	474
<a href="#">Grain</a>	474
<a href="#">has_minus_eq_impl&lt; C &gt;</a>	474
<a href="#">has_minus_impl&lt; C &gt;</a>	475
<a href="#">has_mul_eq_impl&lt; C &gt;</a>	475
<a href="#">has_mul_impl&lt; C &gt;</a>	475
<a href="#">has_operation&lt; T &gt;</a>	476
<a href="#">has_plus_eq_impl&lt; C &gt;</a>	476
<a href="#">has_plus_impl&lt; C &gt;</a>	476
<a href="#">HelperFlag</a>	477
<a href="#">HelperMod&lt; Field, ElementTraits &gt;</a>	477
<a href="#">HelperMod&lt; Field, ElementCategories::MachineIntTag &gt;</a>	478
<a href="#">HelperMod&lt; Field, FFLAS::ElementCategories::ArbitraryPrecIntTag &gt;</a>	479
<a href="#">HelperMod&lt; Field, FFLAS::ElementCategories::FixedPrecIntTag &gt;</a>	479
<a href="#">HelperMod&lt; Field, FFLAS::ElementCategories::MachineFloatTag &gt;</a>	480
<a href="#">Hybrid</a>	481
<a href="#">Info</a>	481
<a href="#">Info</a>	482
<a href="#">is_all_same&lt; Args &gt;</a>	483
<a href="#">is_all_same&lt; T, Args... &gt;</a>	483
<a href="#">is_all_same&lt;&gt;&gt;</a>	483
<a href="#">is_simd&lt; T &gt;</a>	484
<a href="#">isSparseMatrix&lt; Field, M &gt;</a>	484
<a href="#">isSparseMatrix&lt; Field, Sparse&lt; Field, SparseMatrix_t::COO &gt;&gt;</a>	484
<a href="#">isSparseMatrix&lt; Field, Sparse&lt; Field, SparseMatrix_t::COO_ZO &gt;&gt;</a>	485
<a href="#">isSparseMatrix&lt; Field, Sparse&lt; Field, SparseMatrix_t::CSR &gt;&gt;</a>	485
<a href="#">isSparseMatrix&lt; Field, Sparse&lt; Field, SparseMatrix_t::CSR_HYB &gt;&gt;</a>	485
<a href="#">isSparseMatrix&lt; Field, Sparse&lt; Field, SparseMatrix_t::CSR_ZO &gt;&gt;</a>	486
<a href="#">isSparseMatrix&lt; Field, Sparse&lt; Field, SparseMatrix_t::ELL &gt;&gt;</a>	486
<a href="#">isSparseMatrix&lt; Field, Sparse&lt; Field, SparseMatrix_t::ELL_simd &gt;&gt;</a>	486

isSparseMatrix< Field, Sparse< Field, SparseMatrix_t::ELL_simd_ZO > > . . . . .	486
isSparseMatrix< Field, Sparse< Field, SparseMatrix_t::ELL_ZO > > . . . . .	487
isSparseMatrix< Field, Sparse< Field, SparseMatrix_t::HYB_ZO > > . . . . .	487
isSparseMatrix< Field, Sparse< Field, SparseMatrix_t::SELL > > . . . . .	487
isSparseMatrix< Field, Sparse< Field, SparseMatrix_t::SELL_ZO > > . . . . .	487
isSparseMatrixMKLFormat< F, M > . . . . .	488
isSparseMatrixSimdFormat< F, M > . . . . .	488
isZOSparseMatrix< F, M > . . . . .	488
isZOSparseMatrix< Field, Sparse< Field, SparseMatrix_t::COO_ZO > > . . . . .	489
isZOSparseMatrix< Field, Sparse< Field, SparseMatrix_t::CSR_ZO > > . . . . .	489
isZOSparseMatrix< Field, Sparse< Field, SparseMatrix_t::ELL_simd_ZO > > . . . . .	489
isZOSparseMatrix< Field, Sparse< Field, SparseMatrix_t::ELL_ZO > > . . . . .	489
isZOSparseMatrix< Field, Sparse< Field, SparseMatrix_t::SELL_ZO > > . . . . .	490
Iterative . . . . .	490
array< T >::iterator . . . . .	
STL iterator class . . . . .	490
string::iterator . . . . .	
STL iterator class . . . . .	490
vector< T >::iterator . . . . .	
STL iterator class . . . . .	490
LazyTag . . . . .	
Performs field operations with delayed mod only when necessary. Result may not be reduced . . . . .	490
limits< T > . . . . .	491
limits< char > . . . . .	491
limits< double > . . . . .	491
limits< float > . . . . .	492
limits< Givaro::Integer > . . . . .	493
limits< int > . . . . .	493
limits< long > . . . . .	494
limits< long long > . . . . .	494
limits< Reclnt::rint< K > > . . . . .	495
limits< Reclnt::ruint< K > > . . . . .	496
limits< short int > . . . . .	496
limits< signed char > . . . . .	497
limits< unsigned char > . . . . .	498
limits< unsigned int > . . . . .	498
limits< unsigned long > . . . . .	499
limits< unsigned long long > . . . . .	499
limits< unsigned short int > . . . . .	500
MachineFloatTag . . . . .	
Float or double . . . . .	501
MachineIntTag . . . . .	
Short, int, long, long long, and unsigned variants . . . . .	501
MMHelper< Field, AlgoTrait, ModeTrait, ParSeqTrait > . . . . .	501
ModeTraits< Field > . . . . .	
ModeTraits . . . . .	506
ModeTraits< Givaro::Modular< Element, Compute > > . . . . .	507
ModeTraits< Givaro::Modular< Givaro::Integer, Compute > > . . . . .	507
ModeTraits< Givaro::Modular< int16_t, Compute > > . . . . .	507
ModeTraits< Givaro::Modular< int32_t, Compute > > . . . . .	508
ModeTraits< Givaro::Modular< int64_t, uint64_t > > . . . . .	508
ModeTraits< Givaro::Modular< int8_t, Compute > > . . . . .	509
ModeTraits< Givaro::Modular< Reclnt::ruint< K >, Compute > > . . . . .	509
ModeTraits< Givaro::Modular< uint16_t, Compute > > . . . . .	509
ModeTraits< Givaro::Modular< uint32_t, Compute > > . . . . .	510
ModeTraits< Givaro::Modular< uint8_t, Compute > > . . . . .	510
ModeTraits< Givaro::ModularBalanced< Element > > . . . . .	511
ModeTraits< Givaro::ModularBalanced< Givaro::Integer > > . . . . .	511

ModeTraits< Givaro::ModularBalanced< int16_t > >	511
ModeTraits< Givaro::ModularBalanced< int32_t > >	512
ModeTraits< Givaro::ModularBalanced< int8_t > >	512
ModeTraits< Givaro::Montgomery< T > >	513
ModeTraits< Givaro::ZRing< double > >	513
ModeTraits< Givaro::ZRing< float > >	513
ModeTraits< Givaro::ZRing< Givaro::Integer > >	514
ModularBalanced< T >	514
ModularBalanced< T >	514
ModularTag	
This is a modular field like e.g. Modular<T> or ModularBalanced<T>	514
Montgomery< T >	514
need_field_characteristic< Field >	515
need_field_characteristic< Givaro::Modular< Field > >	515
need_field_characteristic< Givaro::ModularBalanced< Field > >	515
NoSimd< T >	516
Parallel< C, P >	517
RNSInteger< RNS >::RandIter	518
RNSIntegerMod< RNS >::RandIter	519
readMyMachineType< Field, T >	520
readMyMachineType< Field, mpz_t >	521
Recursive	522
Recursive	522
array< T >::reverse_iterator	
STL iterator class	522
string::reverse_iterator	
STL iterator class	523
vector< T >::reverse_iterator	
STL iterator class	523
rint< K >	523
rns_double	523
rns_double_elt	528
rns_double_elt_cstptr	529
rns_double_elt_ptr	532
rns_double_extended	535
RNSElementTag	
Representation in a Residue Number System	538
RNSInteger< RNS >	538
RNSIntegerMod< RNS >	542
rnsRandIter< RNS >	549
Row	550
ruint< K >	550
ScalFunctions< Element >	550
ScalFunctionsBase< Element, Enable >	555
ScalFunctionsBase< Element, typename enable_if< is_floating_point< Element >::value >::type >	556
ScalFunctionsBase< Element, typename enable_if< is_integral< Element >::value >::type >	557
Sequential	560
Simd128_impl< ArithType, Int, Signed, Size >	561
Simd128_impl< true, false, true, 4 >	561
Simd128_impl< true, false, true, 8 >	561
Simd128_impl< true, true, false, 2 >	561
Simd128_impl< true, true, false, 4 >	571
Simd128_impl< true, true, false, 8 >	581
Simd128_impl< true, true, true, 2 >	591
Simd128_impl< true, true, true, 4 >	601
Simd128_impl< true, true, true, 8 >	609
Simd128i_base	619
Simd256_impl< ArithType, Int, Signed, Size >	620

Simd256_impl< true, false, true, 4 > . . . . .	620
Simd256_impl< true, false, true, 8 > . . . . .	621
Simd256_impl< true, true, false, 2 > . . . . .	628
Simd256_impl< true, true, false, 4 > . . . . .	638
Simd256_impl< true, true, false, 8 > . . . . .	657
Simd256_impl< true, true, true, 2 > . . . . .	666
Simd256_impl< true, true, true, 4 > . . . . .	675
Simd256_impl< true, true, true, 8 > . . . . .	693
Simd256fp_base . . . . .	702
Simd256i_base . . . . .	702
Simd512_impl< ArithType, Int, Signed, Size > . . . . .	702
Simd512_impl< true, false, true, 4 > . . . . .	702
Simd512_impl< true, false, true, 8 > . . . . .	703
Simd512_impl< true, true, false, 8 > . . . . .	709
Simd512_impl< true, true, true, 8 > . . . . .	720
Simd512i_base . . . . .	730
SimdChooser< T, bool, bool > . . . . .	731
SimdChooser< T, false, b > . . . . .	731
SimdChooser< T, true, false > . . . . .	731
SimdChooser< T, true, true > . . . . .	732
simdToType< T > . . . . .	732
Single . . . . .	732
Sparse< Field, SparseMatrix_t, IdxT, PtrT > . . . . .	732
Sparse< _Field, SparseMatrix_t::COO > . . . . .	732
Sparse< _Field, SparseMatrix_t::COO_ZO > . . . . .	734
Sparse< _Field, SparseMatrix_t::CSR > . . . . .	736
Sparse< _Field, SparseMatrix_t::CSR_HYB > . . . . .	737
Sparse< _Field, SparseMatrix_t::CSR_ZO > . . . . .	739
Sparse< _Field, SparseMatrix_t::ELL > . . . . .	741
Sparse< _Field, SparseMatrix_t::ELL_simd > . . . . .	742
Sparse< _Field, SparseMatrix_t::ELL_simd_ZO > . . . . .	744
Sparse< _Field, SparseMatrix_t::ELL_ZO > . . . . .	746
Sparse< _Field, SparseMatrix_t::SELL > . . . . .	747
Sparse< _Field, SparseMatrix_t::SELL_ZO > . . . . .	749
SpMat< Field, flag > . . . . .	751
StatsMatrix . . . . .	752
string . . . . .	
STL class . . . . .	755
support_fast_mod< T > . . . . .	755
support_fast_mod< double > . . . . .	755
support_fast_mod< float > . . . . .	756
support_fast_mod< int64_t > . . . . .	756
support_simd< T > . . . . .	756
support_simd_add< T > . . . . .	756
support_simd_mod< T > . . . . .	757
Test< Elt > . . . . .	757
TestOneMethod< Simd > . . . . .	760
tfn_minus . . . . .	763
tfn_minus_eq . . . . .	763
tfn_mul . . . . .	763
tfn_mul_eq . . . . .	764
tfn_plus . . . . .	764
tfn_plus_eq . . . . .	765
Threads . . . . .	765
ThreeD . . . . .	765
ThreeDAdaptive . . . . .	765
ThreeDInPlace . . . . .	765

TRSMHelper< ReclterTrait, ParSeqTrait >	
TRSM Helper	765
TwoD	767
TwoDAdaptive	767
UnparametricTag	
If the field uses a representation with infix operators	767
vector< T >	
STL class	767
width< T >	768
width< double >	768
width< float >	769
Winograd	769
WinogradPar	769



# Chapter 9

## File Index

### 9.1 File List

Here is a list of all files with brief descriptions:

<a href="#">arithprog.C</a>	771
<a href="#">autotune/charpoly.C</a>	771
<a href="#">examples/charpoly.C</a>	772
<a href="#">fsyrk.C</a>	773
<a href="#">fsytrf.C</a>	773
<a href="#">ftrtri.C</a>	774
<a href="#">autotune/pluq.C</a>	775
<a href="#">examples/pluq.C</a>	776
<a href="#">winograd.C</a>	776
<a href="#">benchmark-charpoly-mp.C</a>	777
<a href="#">benchmark-charpoly.C</a>	778
<a href="#">benchmark-checkers.C</a>	778
<a href="#">benchmark-dgemm.C</a>	779
<a href="#">benchmark-dgetrf.C</a>	780
<a href="#">benchmark-dgetri.C</a>	781
<a href="#">benchmark-dsytrf.C</a>	781
<a href="#">benchmark-dtrsm.C</a>	782
<a href="#">benchmark-dtrtri.C</a>	782
<a href="#">benchmark-fadd-lvl2.C</a>	783
<a href="#">benchmark-fdot.C</a>	783
<a href="#">benchmark-fgemm-mp.C</a>	784
<a href="#">benchmark-fgemm-rns.C</a>	785
<a href="#">benchmark-fgemm.C</a>	787
<a href="#">benchmark-fgemv-mp.C</a>	787
<a href="#">benchmark-fgemv.C</a>	789
<a href="#">benchmark-fgesv.C</a>	792
<a href="#">benchmark-fsyr2k.C</a>	792
<a href="#">benchmark-fsyrk.C</a>	793
<a href="#">benchmark-fsytrf.C</a>	793
<a href="#">benchmark-ftrsm-mp.C</a>	794
<a href="#">benchmark-ftrsm.C</a>	795
<a href="#">benchmark-ftrsv.C</a>	795
<a href="#">benchmark-ftrtri.C</a>	796
<a href="#">benchmark-inverse.C</a>	796
<a href="#">benchmark-lqup-mp.C</a>	797

benchmark-lqup.C	798
benchmark-pluq.C	798
benchmark-quasisep.C	799
benchmark-storage-transpose.C	800
benchmark-wino.C	801
mainpage.doxy	802
det.C	802
matmul.C	802
rank.C	803
solve.C	803
checker_charpoly.inl	803
checker_det.inl	804
checker_empty.h	804
checker_fgemm.inl	804
checker_ftrsm.inl	805
checker_invert.inl	805
checker_pluq.inl	805
checkers.doxy	806
checkers_fflas.h	806
checkers_fflas.inl	806
checkers_ffpack.h	807
checkers_ffpack.inl	807
config-blas.h	808
config.h	815
fflas-ffpack/config.h	818
fflas-ffpack-config.h	
Defaults for optimised values	821
fflas-ffpack-default-thresholds.h	822
fflas-ffpack-thresholds.h	823
fflas-ffpack.doxy	823
fflas-ffpack.h	
Includes <b>FFLAS</b> and <b>FFPACK</b>	823
fflas.doxy	823
fflas.h	
<b>Finite Field Linear Algebra Subroutines</b>	823
fflas_bounds.inl	825
fflas_enum.h	825
fflas_fadd.h	826
fflas_fadd.inl	827
fflas_fassign.h	828
fflas_fassign.inl	829
fflas_faxpy.inl	829
fflas_fdot.inl	830
fflas_fgemm.inl	831
fgemm_classical.inl	833
fgemm_classical_mp.inl	
Matrix multiplication with multiprecision input (either over $\mathbb{Z}$ or over $\mathbb{Z}/p\mathbb{Z}$ )	833
fgemm_winograd.inl	835
matmul.doxy	837
schedule_bini.inl	
Bini implementation	837
schedule_winograd.inl	837
schedule_winograd_acc.inl	838
schedule_winograd_acc_ip.inl	839
schedule_winograd_ip.inl	839
fflas_fgmv.inl	840
fflas_fgmv_mp.inl	841
fflas_fger.inl	842

fflas_fger_mp.inl	843
fflas_freduce.h	844
fflas_freduce.inl	845
fflas_freduce_mp.inl	847
fflas_freivalds.inl	847
fflas_fscal.h	847
fflas_fscal.inl	848
fflas_fscal_mp.inl	849
fflas_fsyr2k.inl	850
fflas_fsyrk.inl	850
fflas_fsyrk_strassen.inl	852
fflas_ftmm.inl	853
fflas_ftsm.inl	854
fflas_ftsm_mp.inl	
Triangular system with matrix right hand side over multiprecision domain (either over $\mathbb{Z}$ or over $\mathbb{Z}/p\mathbb{Z}$ )	854
fflas_ftsv.inl	855
fflas_helpers.inl	855
igemm.doxy	857
igemm.h	857
igemm.inl	857
igemm_kernels.h	858
igemm_kernels.inl	858
igemm_tools.h	859
igemm_tools.inl	859
fflas_level1.inl	860
fflas_level2.inl	862
fflas_level3.inl	865
fflas_pfgemm.inl	867
fflas_pftsm.inl	868
fflas_simd.h	869
simd.doxy	871
simd128.inl	871
simd128_double.inl	871
simd128_float.inl	872
simd128_int16.inl	872
simd128_int32.inl	872
simd128_int64.inl	873
simd256.inl	873
simd256_double.inl	874
simd256_float.inl	874
simd256_int16.inl	875
simd256_int32.inl	875
simd256_int64.inl	876
simd512.inl	876
simd512_double.inl	877
simd512_float.inl	877
simd512_int32.inl	878
simd512_int64.inl	878
simd_modular.inl	879
fflas_sparse.h	879
fflas_sparse.inl	883
coo.h	885
coo_spm.inl	886
coo_spmv.inl	887
coo_utils.inl	887
csr.h	888
csr_pspm.inl	888

csr_pspmv.inl	889
csr_spmm.inl	890
csr_spmv.inl	891
csr_utils.inl	892
csr_hyb.h	893
csr_hyb_pspmm.inl	893
csr_hyb_pspmv.inl	894
csr_hyb_spmm.inl	894
csr_hyb_spmv.inl	895
csr_hyb_utils.inl	895
ell.h	896
ell_pspmm.inl	896
ell_pspmv.inl	897
ell_spmm.inl	898
ell_spmv.inl	899
ell_utils.inl	899
ell_simd.h	900
ell_simd_pspmv.inl	901
ell_simd_spmv.inl	901
ell_simd_utils.inl	902
hyb_zo.h	903
hyb_zo_pspmm.inl	903
hyb_zo_pspmv.inl	903
hyb_zo_spmm.inl	904
hyb_zo_spmv.inl	904
hyb_zo_utils.inl	905
read_sparse.h	905
sell.h	906
sell_pspmv.inl	907
sell_spmv.inl	907
sell_utils.inl	908
sparse_matrix_traits.h	909
utils.h	910
fflas_transpose.h	
Transpose the storage of the matrix (switch between row and col major mode)	911
ffpack.dox	912
ffpack.h	
Set of elimination based routines for dense linear algebra	912
ffpack.inl	921
ffpack_bruhatgen.inl	922
ffpack_charpoly.inl	924
ffpack_charpoly_danilevski.inl	924
ffpack_charpoly_kgfast.inl	925
ffpack_charpoly_kgfastgeneralized.inl	925
ffpack_charpoly_kglu.inl	926
ffpack_charpoly_mp.inl	926
ffpack_det_mp.inl	927
ffpack_echelonforms.inl	928
ffpack_fgesv.inl	929
ffpack_fgetrs.inl	929
ffpack_frobenius.inl	930
ffpack_fsytrf.inl	931
ffpack_ftrssyr2k.inl	932
ffpack_ftrstr.inl	932
ffpack_ftrtr.inl	933
ffpack_invert.inl	933
ffpack_krylovelim.inl	934
ffpack_ludivine.inl	934

ffpack_ludivine_mp.inl	935
ffpack_minpoly.inl	936
ffpack_permutation.inl	936
ffpack_pluq.inl	939
ffpack_pluq_mp.inl	939
ffpack_ppluq.inl	940
ffpack_rankprofiles.inl	941
field-traits.h	
Field Traits	942
field.doxy	944
rns-double-elt.h	
Rns elt structure with double support	944
rns-double-recint.inl	945
rns-double.h	
Rns structure with double support	945
rns-double.inl	946
rns-integer-mod.h	
Representation of $\mathbb{Z}/p\mathbb{Z}$ using <b>RNS</b> representation (note: fixed precision)	946
rns-integer.h	
Representation of $\mathbb{Z}$ using <b>RNS</b> representation (note: fixed precision)	947
rns.h	948
rns.inl	948
interfaces.doxy	948
fflas_c.h	948
fflas_L1_inst.C	960
fflas_L1_inst.h	961
fflas_L1_inst_implem.inl	962
fflas_L2_inst.C	963
fflas_L2_inst.h	964
fflas_L2_inst_implem.inl	965
fflas_L3_inst.C	967
fflas_L3_inst.h	968
fflas_L3_inst_implem.inl	969
fflas_lv1.C	
C functions calls for level 1 <b>FFLAS</b> in flas-c.h	970
fflas_lv2.C	
C functions calls for level 2 <b>FFLAS</b> in flas-c.h	974
fflas_lv3.C	
C functions calls for level 3 <b>FFLAS</b> in flas-c.h	980
fflas_sparse.C	
C functions calls for level 1.5 and 2.5 <b>FFLAS</b> in flas-c.h	981
ffpack.C	
C functions calls for <b>FFPACK</b> in ffpack-c.h	982
ffpack_c.h	1002
ffpack_inst.C	1022
ffpack_inst.h	1023
ffpack_inst_implem.inl	1024
blockcuts.inl	1027
fflas_plevel1.h	1029
kaapi_routines.inl	1029
parallel.h	1029
pfgemm_variants.inl	1036
pfgemv.inl	1037
align-allocator.h	1037
args-parser.h	1038
bit_manipulation.h	1039
cast.h	1040

debug.h	
Various utilities for debugging	1040
fflas_intrinsic.h	1041
fflas_io.h	1041
fflas_memory.h	1042
fflas_randommatrix.h	1043
flimits.h	1045
Matio.h	1046
test-utils.h	1047
timer.h	1047
cblas.C	1048
clapack.C	1048
cuda.C	1049
fblas.C	1049
lapack.C	1050
regression-check.C	1050
test-charpoly-check.C	1051
test-charpoly.C	1052
test-compressQ.C	1053
test-det-check.C	1054
test-det.C	1054
test-echelon.C	1055
test-fadd.C	1057
test-fdot.C	1059
test-fgemm-check.C	1060
test-fgemm.C	1061
test-fgemv.C	1063
test-fger.C	1065
test-fgesv.C	1067
test-finit.C	1068
test-fscal.C	1069
test-fsyr2k.C	1071
test-fsyrk.C	1072
test-fsytrf.C	1074
test-ftrmm.C	1075
test-ftrmv.C	1077
test-ftrsm-check.C	1078
test-ftrsm.C	1078
test-ftrssyr2k.C	1080
test-ftrstr.C	1081
test-ftrsv.C	1082
test-ftrtri.C	1083
test-interfaces-c.c	1084
test-invert-check.C	1084
test-io.C	1085
test-lu.C	1086
test-maxdelayeddim.C	1090
test-minpoly.C	1090
test-multifile1.C	1091
test-multifile2.C	1091
test-nullspace.C	1092
test-permutations.C	1093
test-pluq-check.C	1094
test-quasisep.C	1095
test-rankprofiles.C	1096
test-rpm.C	1097
test-simd.C	1098
test-solve.C	1101

test-storage-transpose.C	1102
101-fgemm.C	1102
2x2-fgemm.C	1103
2x2-ftrsv.C	1103
2x2-pluq.C	1104
fflas-101_1.C	1104
fflas-101_3.C	1104
fflas_101.C	1105
fflas_101_lvl1.C	1105
ffpack-fgesv.C	1106
ffpack-solve.C	1106





# Chapter 10

## Topic Documentation

### 10.1 CHECKER

Class CHECKER provides functions to verify computations in [FFLAS](#) and [FFPACK](#).

Class CHECKER provides functions to verify computations in [FFLAS](#) and [FFPACK](#).

### 10.2 FFLAS-FFPACK

the [FFLAS FFPACK](#) library

#### Topics

- [FFLAS](#)  
*The C-style wrapper of BLAS for finite field linear algebra.*
- [Interfaces](#)  
*Interfaces for FFLAS-FFPACK.*

#### 10.2.1 Detailed Description

the [FFLAS FFPACK](#) library

C++ header library for fast exact dense linear algebra

See also

[FFLAS](#)  
[FFPACK](#)

### 10.2.2 FFLAS

The C-style wrapper of BLAS for finite field linear algebra.

The C-style wrapper of BLAS for finite field linear algebra.

[FFLAS](#), Finite [Field](#) Linear Algebra Subroutines, provide basic linear algebra subroutines based on the BLAS interface. Therefore, the specifications are in C style; only the field given as a template parameter requires C++.

As much as possible, these routines use `ATLAS/BLAS` computations and achieve therefore high efficiency.

### 10.2.3 Interfaces

Interfaces for FFLAS-FFPACK.

Interfaces for FFLAS-FFPACK.

C interface in folder

See also

`libs`

## 10.3 Matrix Multiplication Algorithms

Matrix Multiplication (level 3) algorithms.

### Files

- file [schedule\\_bini.inl](#)  
*Bini implementation.*

### 10.3.1 Detailed Description

Matrix Multiplication (level 3) algorithms.

[Todo](#) biblio

## 10.4 SIMD wrapper

wraps SIMD functions Supportst SSE4.1, AVX, AVX2.

wraps SIMD functions Supportst SSE4.1, AVX, AVX2.

[Todo](#) biblio

## 10.5 FFPACK

Class [FFPACK](#) provides functions using fflas much as Lapack uses BLAS.

### Namespaces

- namespace [FFPACK](#)  
*Finite Field **PACK** Set of elimination based routines for dense linear algebra.*

### 10.5.1 Detailed Description

Class [FFPACK](#) provides functions using fflas much as Lapack uses BLAS.

## 10.6 FFLAS-FFPACK fields

fields in the FFLAS-FFPACK library

### Files

- file [rns-double-elt.h](#)  
*rns elt structure with double support*
- file [rns-double.h](#)  
*rns structure with double support*
- file [rns-integer-mod.h](#)  
*representation of  $\mathbb{Z}/p\mathbb{Z}$  using [RNS](#) representation (note: fixed precision)*
- file [rns-integer.h](#)  
*representation of  $\mathbb{Z}$  using [RNS](#) representation (note: fixed precision)*
- file [rns.h](#)

### 10.6.1 Detailed Description

fields in the FFLAS-FFPACK library

Unparametric/Random elements

[Todo](#) biblio

## 10.7 RNS

just include them all

just include them all



# Chapter 11

## Namespace Documentation

### 11.1 FFLAS Namespace Reference

#### Namespaces

- namespace [\\_frtranspose\\_impl](#)
- namespace [BLAS3](#)
- namespace [csr\\_hyb\\_details](#)
- namespace [CuttingStrategy](#)
- namespace [details](#)
- namespace [details\\_spmv](#)
- namespace [ElementCategories](#)
- namespace [FieldCategories](#)

*Traits and categories will need to be placed in a proper file later.*

- namespace [MMHelperAlgo](#)
- namespace [ModeCategories](#)

*Specifies the mode of action for an algorithm w.r.t.*

- namespace [ParSeqHelper](#)

*ParSeqHelper for both fgemm and ftrsm.*

- namespace [Protected](#)
- namespace [sell\\_details](#)
- namespace [sparse\\_details](#)
- namespace [sparse\\_details\\_impl](#)
- namespace [StrategyParameter](#)
- namespace [StructureHelper](#)

*StructureHelper for ftrsm.*

- namespace [vectorised](#)

#### Data Structures

- struct [AlgoChooser](#)
- struct [AlgoChooser< ModeCategories::ConvertTo< ElementCategories::RNSElementTag >, ParSeq >](#)
- struct [associatedDelayedField](#)
- struct [associatedDelayedField< const FFPACK::RNSIntegerMod< RNS > >](#)
- struct [associatedDelayedField< const Givaro::Modular< T, X > >](#)
- struct [associatedDelayedField< const Givaro::ModularBalanced< T > >](#)
- struct [associatedDelayedField< const Givaro::ZRing< T > >](#)

- struct [BlockTransposeSIMD](#)
- struct [Checker\\_Empty](#)
- class [CheckerImplem\\_fgemm](#)
- class [CheckerImplem\\_ftsrn](#)
- struct [CooMat](#)
- struct [CsrMat](#)
- struct [ElementTraits](#)
  - ElementTraits.*
- struct [ElementTraits< double >](#)
- struct [ElementTraits< FFPACK::rns\\_double\\_elt >](#)
- struct [ElementTraits< float >](#)
- struct [ElementTraits< Givaro::Integer >](#)
- struct [ElementTraits< int16\\_t >](#)
- struct [ElementTraits< int32\\_t >](#)
- struct [ElementTraits< int64\\_t >](#)
- struct [ElementTraits< int8\\_t >](#)
- struct [ElementTraits< Reclnt::rint< K > >](#)
- struct [ElementTraits< Reclnt::rmint< K, MG > >](#)
- struct [ElementTraits< Reclnt::ruint< K > >](#)
- struct [ElementTraits< uint16\\_t >](#)
- struct [ElementTraits< uint32\\_t >](#)
- struct [ElementTraits< uint64\\_t >](#)
- struct [ElementTraits< uint8\\_t >](#)
- struct [ElIMat](#)
- struct [FieldTraits](#)
  - FieldTrait.*
- struct [FieldTraits< FFPACK::RNSInteger< T > >](#)
- struct [FieldTraits< FFPACK::RNSIntegerMod< T > >](#)
- struct [FieldTraits< Givaro::Modular< Element > >](#)
- struct [FieldTraits< Givaro::ModularBalanced< Element > >](#)
- struct [FieldTraits< Givaro::ZRing< double > >](#)
- struct [FieldTraits< Givaro::ZRing< float > >](#)
- struct [FieldTraits< Givaro::ZRing< Givaro::Integer > >](#)
- struct [FieldTraits< Givaro::ZRing< int16\\_t > >](#)
- struct [FieldTraits< Givaro::ZRing< int32\\_t > >](#)
- struct [FieldTraits< Givaro::ZRing< int64\\_t > >](#)
- struct [FieldTraits< Givaro::ZRing< Reclnt::ruint< K > > >](#)
- struct [FieldTraits< Givaro::ZRing< uint16\\_t > >](#)
- struct [FieldTraits< Givaro::ZRing< uint32\\_t > >](#)
- struct [FieldTraits< Givaro::ZRing< uint64\\_t > >](#)
- struct [ForStrategy1D](#)
- struct [ForStrategy2D](#)
- struct [has\\_minus\\_eq\\_impl](#)
- struct [has\\_minus\\_impl](#)
- struct [has\\_mul\\_eq\\_impl](#)
- struct [has\\_mul\\_impl](#)
- struct [has\\_operation](#)
- struct [has\\_plus\\_eq\\_impl](#)
- struct [has\\_plus\\_impl](#)
- struct [HelperFlag](#)
- struct [isSparseMatrix](#)
- struct [isSparseMatrix< Field, Sparse< Field, SparseMatrix\\_t::COO > >](#)
- struct [isSparseMatrix< Field, Sparse< Field, SparseMatrix\\_t::COO\\_ZO > >](#)
- struct [isSparseMatrix< Field, Sparse< Field, SparseMatrix\\_t::CSR > >](#)

- struct [isSparseMatrix](#)< Field, Sparse< Field, SparseMatrix\_t::CSR\_HYB > >
- struct [isSparseMatrix](#)< Field, Sparse< Field, SparseMatrix\_t::CSR\_ZO > >
- struct [isSparseMatrix](#)< Field, Sparse< Field, SparseMatrix\_t::ELL > >
- struct [isSparseMatrix](#)< Field, Sparse< Field, SparseMatrix\_t::ELL\_simd > >
- struct [isSparseMatrix](#)< Field, Sparse< Field, SparseMatrix\_t::ELL\_simd\_ZO > >
- struct [isSparseMatrix](#)< Field, Sparse< Field, SparseMatrix\_t::ELL\_ZO > >
- struct [isSparseMatrix](#)< Field, Sparse< Field, SparseMatrix\_t::HYB\_ZO > >
- struct [isSparseMatrix](#)< Field, Sparse< Field, SparseMatrix\_t::SELL > >
- struct [isSparseMatrix](#)< Field, Sparse< Field, SparseMatrix\_t::SELL\_ZO > >
- struct [isSparseMatrixMKLFormat](#)
- struct [isSparseMatrixSimdFormat](#)
- struct [isZOSparseMatrix](#)
- struct [isZOSparseMatrix](#)< Field, Sparse< Field, SparseMatrix\_t::COO\_ZO > >
- struct [isZOSparseMatrix](#)< Field, Sparse< Field, SparseMatrix\_t::CSR\_ZO > >
- struct [isZOSparseMatrix](#)< Field, Sparse< Field, SparseMatrix\_t::ELL\_simd\_ZO > >
- struct [isZOSparseMatrix](#)< Field, Sparse< Field, SparseMatrix\_t::ELL\_ZO > >
- struct [isZOSparseMatrix](#)< Field, Sparse< Field, SparseMatrix\_t::SELL\_ZO > >
- struct [MMHelper](#)
- struct [ModeTraits](#)
  - *ModeTraits.*
  - struct [ModeTraits](#)< Givaro::Modular< Element, Compute > >
  - struct [ModeTraits](#)< Givaro::Modular< Givaro::Integer, Compute > >
  - struct [ModeTraits](#)< Givaro::Modular< int16\_t, Compute > >
  - struct [ModeTraits](#)< Givaro::Modular< int32\_t, Compute > >
  - struct [ModeTraits](#)< Givaro::Modular< int64\_t, uint64\_t > >
  - struct [ModeTraits](#)< Givaro::Modular< int8\_t, Compute > >
  - struct [ModeTraits](#)< Givaro::Modular< ReclInt::ruint< K >, Compute > >
  - struct [ModeTraits](#)< Givaro::Modular< uint16\_t, Compute > >
  - struct [ModeTraits](#)< Givaro::Modular< uint32\_t, Compute > >
  - struct [ModeTraits](#)< Givaro::Modular< uint8\_t, Compute > >
  - struct [ModeTraits](#)< Givaro::ModularBalanced< Element > >
  - struct [ModeTraits](#)< Givaro::ModularBalanced< Givaro::Integer > >
  - struct [ModeTraits](#)< Givaro::ModularBalanced< int16\_t > >
  - struct [ModeTraits](#)< Givaro::ModularBalanced< int32\_t > >
  - struct [ModeTraits](#)< Givaro::ModularBalanced< int8\_t > >
  - struct [ModeTraits](#)< Givaro::Montgomery< T > >
  - struct [ModeTraits](#)< Givaro::ZRing< double > >
  - struct [ModeTraits](#)< Givaro::ZRing< float > >
  - struct [ModeTraits](#)< Givaro::ZRing< Givaro::Integer > >
  - struct [readMyMachineType](#)
  - struct [readMyMachineType](#)< Field, mpz\_t >
  - struct [Sparse](#)
  - struct [Sparse](#)< \_Field, SparseMatrix\_t::COO >
  - struct [Sparse](#)< \_Field, SparseMatrix\_t::COO\_ZO >
  - struct [Sparse](#)< \_Field, SparseMatrix\_t::CSR >
  - struct [Sparse](#)< \_Field, SparseMatrix\_t::CSR\_HYB >
  - struct [Sparse](#)< \_Field, SparseMatrix\_t::CSR\_ZO >
  - struct [Sparse](#)< \_Field, SparseMatrix\_t::ELL >
  - struct [Sparse](#)< \_Field, SparseMatrix\_t::ELL\_simd >
  - struct [Sparse](#)< \_Field, SparseMatrix\_t::ELL\_simd\_ZO >
  - struct [Sparse](#)< \_Field, SparseMatrix\_t::ELL\_ZO >
  - struct [Sparse](#)< \_Field, SparseMatrix\_t::SELL >
  - struct [Sparse](#)< \_Field, SparseMatrix\_t::SELL\_ZO >
  - struct [SpMat](#)

- struct [StatsMatrix](#)
- struct [support\\_fast\\_mod](#)
- struct [support\\_fast\\_mod< double >](#)
- struct [support\\_fast\\_mod< float >](#)
- struct [support\\_fast\\_mod< int64\\_t >](#)
- struct [support\\_simd](#)
- struct [support\\_simd\\_add](#)
- struct [support\\_simd\\_mod](#)
- struct [tfn\\_minus](#)
- struct [tfn\\_minus\\_eq](#)
- struct [tfn\\_mul](#)
- struct [tfn\\_mul\\_eq](#)
- struct [tfn\\_plus](#)
- struct [tfn\\_plus\\_eq](#)
- struct [TRSMHelper](#)

*TRSM Helper.*

## Typedefs

- template<class [Field](#)>  
using [Checker\\_fgemm](#) = [FFLAS::Checker\\_Empty<Field>](#)
- template<class [Field](#)>  
using [Checker\\_ftrsm](#) = [FFLAS::Checker\\_Empty<Field>](#)
- template<class [Field](#)>  
using [ForceCheck\\_fgemm](#) = [CheckerImplem\\_fgemm<Field>](#)
- template<class [Field](#)>  
using [ForceCheck\\_ftrsm](#) = [CheckerImplem\\_ftrsm<Field>](#)
- using [ZOSparseMatrix](#) = std::true\_type
- using [NotZOSparseMatrix](#) = std::false\_type
- using [SimdSparseMatrix](#) = std::true\_type
- using [NoSimdSparseMatrix](#) = std::false\_type
- using [MKLSparseMatrixFormat](#) = std::true\_type
- using [NotMKLSparseMatrixFormat](#) = std::false\_type
- template<class T>  
using [has\\_plus](#) = typename std::conditional<std::is\_arithmetic<T>::value, std::true\_type, [has\\_plus\\_impl<T>](#)>>::type
- template<class T>  
using [has\\_minus](#) = typename std::conditional<std::is\_arithmetic<T>::value, std::true\_type, [has\\_minus\\_impl<T>](#)>>::type
- template<class T>  
using [has\\_equal](#) = typename std::conditional<std::is\_arithmetic<T>::value, std::true\_type, std::is\_copy\_assignable<T>>>::type
- template<class T>  
using [has\\_plus\\_eq](#) = typename std::conditional<std::is\_arithmetic<T>::value, std::true\_type, [has\\_plus\\_eq\\_impl<T>](#)>>::type
- template<class T>  
using [has\\_minus\\_eq](#) = typename std::conditional<std::is\_arithmetic<T>::value, std::true\_type, [has\\_minus\\_eq\\_impl<T>](#)>>::type
- template<class T>  
using [has\\_mul](#) = typename std::conditional<std::is\_arithmetic<T>::value, std::true\_type, [has\\_mul\\_impl<T>](#)>>::type
- template<class T>  
using [has\\_mul\\_eq](#) = typename std::conditional<std::is\_arithmetic<T>::value, std::true\_type, [has\\_mul\\_eq\\_impl<T>](#)>>::type
- typedef Givaro::Timer [Timer](#)
- typedef Givaro::BaseTimer [BaseTimer](#)
- typedef Givaro::UserTimer [UserTimer](#)
- typedef Givaro::SysTimer [SysTimer](#)



## Enumerations

- enum `FFLAS_ORDER` { `FflasRowMajor` = 101 , `FflasColMajor` = 102 }  
*Storage by row or col ?*
- enum `FFLAS_TRANSPOSE` { `FflasNoTrans` = 111 , `FflasTrans` = 112 }  
*Is matrix transposed ?*
- enum `FFLAS_UPLO` { `FflasUpper` = 121 , `FflasLower` = 122 , `FflasLeftTri` = 123 , `FflasRightTri` = 124 }  
*Is triangular matrix's shape upper ?*
- enum `FFLAS_DIAG` { `FflasNonUnit` = 131 , `FflasUnit` = 132 }  
*Is the triangular matrix implicitly unit diagonal ?*
- enum `FFLAS_SIDE` { `FflasLeft` = 141 , `FflasRight` = 142 }  
*On what side ?*
- enum `FFLAS_BASE` { `FflasDouble` = 151 , `FflasFloat` = 152 , `FflasGeneric` = 153 }  
*FFLAS\_BASE determines the type of the element representation for Matrix Mult kernel.*
- enum `number_kind` { `zero` = 0 , `one` = 1 , `mone` = -1 , `other` = 2 }
- enum class `SparseMatrix_t` {  
  `CSR` , `CSR_ZO` , `CSC` , `CSC_ZO` ,  
  `COO` , `COO_ZO` , `ELL` , `ELL_ZO` ,  
  `SELL` , `SELL_ZO` , `ELL_simd` , `ELL_simd_ZO` ,  
  `CSR_HYB` , `HYB_ZO` }
- enum `FFLAS_FORMAT` {  
  `FflasAuto` = 0 , `FflasDense` = 1 , `FflasSMS` = 2 , `FflasBinary` = 3 ,  
  `FflasMath` = 4 , `FflasMaple` = 5 , `FflasSageMath` = 6 }

## Functions

- `Givaro::Integer` `InfNorm` (const size\_t M, const size\_t N, const Givaro::Integer \*A, const size\_t lda)
- template<class T>  
  const T & `min3` (const T &m, const T &n, const T &k)
- template<class T>  
  const T & `max3` (const T &m, const T &n, const T &k)
- template<class T>  
  const T & `min4` (const T &m, const T &n, const T &k, const T &l)
- template<class T>  
  const T & `max4` (const T &m, const T &n, const T &k, const T &l)
- template<class Field>  
  void `fadd` (const Field &F, const size\_t N, typename Field::ConstElement\_ptr A, const size\_t inca, typename Field::ConstElement\_ptr B, const size\_t incb, typename Field::Element\_ptr C, const size\_t incc)
- template<class Field>  
  void `faddin` (const Field &F, const size\_t N, typename Field::ConstElement\_ptr B, const size\_t incb, typename Field::Element\_ptr C, const size\_t incc)
- template<class Field>  
  void `fsub` (const Field &F, const size\_t N, typename Field::ConstElement\_ptr A, const size\_t inca, typename Field::ConstElement\_ptr B, const size\_t incb, typename Field::Element\_ptr C, const size\_t incc)
- template<class Field>  
  void `fsubin` (const Field &F, const size\_t N, typename Field::ConstElement\_ptr B, const size\_t incb, typename Field::Element\_ptr C, const size\_t incc)
- template<class Field>  
  void `fadd` (const Field &F, const size\_t N, typename Field::ConstElement\_ptr A, const size\_t inca, const typename Field::Element alpha, typename Field::ConstElement\_ptr B, const size\_t incb, typename Field::Element\_ptr C, const size\_t incc)
- template<class Field>  
  void `pfadd` (const Field &F, const size\_t M, const size\_t N, typename Field::ConstElement\_ptr A, const size\_t lda, typename Field::ConstElement\_ptr B, const size\_t ldb, typename Field::Element\_ptr C, const size\_t ldc, const size\_t numths)

- `template<class Field>`  
`void pfsb (const Field &F, const size_t M, const size_t N, typename Field::ConstElement_ptr A, const size_t lda, typename Field::ConstElement_ptr B, const size_t ldb, typename Field::Element_ptr C, const size_t ldc, const size_t numths)`
- `template<class Field>`  
`void pfaddin (const Field &F, const size_t M, const size_t N, typename Field::ConstElement_ptr B, const size_t ldb, typename Field::Element_ptr C, const size_t ldc, size_t numths)`
- `template<class Field>`  
`void pfsubin (const Field &F, const size_t M, const size_t N, typename Field::ConstElement_ptr B, const size_t ldb, typename Field::Element_ptr C, const size_t ldc, size_t numths)`
- `template<class Field>`  
`void fadd (const Field &F, const size_t M, const size_t N, typename Field::ConstElement_ptr A, const size_t lda, typename Field::ConstElement_ptr B, const size_t ldb, typename Field::Element_ptr C, const size_t ldc)`  
*fadd : matrix addition.*
- `template<class Field>`  
`void fsub (const Field &F, const size_t M, const size_t N, typename Field::ConstElement_ptr A, const size_t lda, typename Field::ConstElement_ptr B, const size_t ldb, typename Field::Element_ptr C, const size_t ldc)`  
*fsub : matrix subtraction.*
- `template<class Field>`  
`void faddin (const Field &F, const size_t M, const size_t N, typename Field::ConstElement_ptr B, const size_t ldb, typename Field::Element_ptr C, const size_t ldc)`  
*faddin*
- `template<class Field>`  
`void faddin (const Field &F, const FFLAS_UPLO uplo, const size_t N, typename Field::ConstElement_ptr B, const size_t ldb, typename Field::Element_ptr C, const size_t ldc)`  
*fadding for symmetric matrices*
- `template<class Field>`  
`void fsubin (const Field &F, const size_t M, const size_t N, typename Field::ConstElement_ptr B, const size_t ldb, typename Field::Element_ptr C, const size_t ldc)`  
*fsubin  $C = C - B$*
- `template<class Field>`  
`void fadd (const Field &F, const size_t M, const size_t N, typename Field::ConstElement_ptr A, const size_t lda, const typename Field::Element alpha, typename Field::ConstElement_ptr B, const size_t ldb, typename Field::Element_ptr C, const size_t ldc)`  
*fadd : matrix addition with scaling.*
- `template<class Field>`  
`void fassign (const Field &F, const size_t N, typename Field::ConstElement_ptr Y, const size_t incY, typename Field::Element_ptr X, const size_t incX)`  
*fassign :  $x \leftarrow y$ .*
- `template<> void fassign (const Givaro::Modular< float > &F, const size_t N, const float *Y, const size_t incY, float *X, const size_t incX)`
- `template<> void fassign (const Givaro::ModularBalanced< float > &F, const size_t N, const float *Y, const size_t incY, float *X, const size_t incX)`
- `template<> void fassign (const Givaro::ZRing< float > &F, const size_t N, const float *Y, const size_t incY, float *X, const size_t incX)`
- `template<> void fassign (const Givaro::Modular< double > &F, const size_t N, const double *Y, const size_t incY, double *X, const size_t incX)`
- `template<> void fassign (const Givaro::ModularBalanced< double > &F, const size_t N, const double *Y, const size_t incY, double *X, const size_t incX)`
- `template<> void fassign (const Givaro::ZRing< double > &F, const size_t N, const double *Y, const size_t incY, double *X, const size_t incX)`
- `template<class Field>`  
`void fassign (const Field &F, const size_t m, const size_t n, typename Field::ConstElement_ptr B, const size_t ldb, typename Field::Element_ptr A, const size_t lda)`  
*fassign :  $A \leftarrow B$ .*

- `template<class Field>`  
`void faxpy (const Field &F, const size_t N, const typename Field::Element alpha, typename Field::ConstElement_ptr X, const size_t incX, typename Field::Element_ptr Y, const size_t incY)`  

$$faxpy : y \leftarrow \alpha \cdot x + y.$$
- `template<> void faxpy (const Givaro::DoubleDomain &, const size_t N, const Givaro::DoubleDomain::Element a, Givaro::DoubleDomain::ConstElement_ptr x, const size_t incx, Givaro::DoubleDomain::Element_ptr y, const size_t incy)`
- `template<> void faxpy (const Givaro::FloatDomain &, const size_t N, const Givaro::FloatDomain::Element a, Givaro::FloatDomain::ConstElement_ptr x, const size_t incx, Givaro::FloatDomain::Element_ptr y, const size_t incy)`
- `template<class Field>`  
`void faxpy (const Field &F, const size_t m, const size_t n, const typename Field::Element alpha, typename Field::ConstElement_ptr X, const size_t ldx, typename Field::Element_ptr Y, const size_t ldy)`  

$$faxpy : y \leftarrow \alpha \cdot x + y.$$
- `template<class Field>`  
`Field::Element fdot (const Field &F, const size_t N, typename Field::ConstElement_ptr x, const size_t incx, typename Field::ConstElement_ptr y, const size_t incy, ModeCategories::DefaultTag &MT)`
- `template<class Field>`  
`Field::Element fdot (const Field &F, const size_t N, typename Field::ConstElement_ptr x, const size_t incx, typename Field::ConstElement_ptr y, const size_t incy, ModeCategories::DelayedTag &MT)`
- `template<> Givaro::DoubleDomain::Element fdot (const Givaro::DoubleDomain &, const size_t N, Givaro::DoubleDomain::ConstElement_ptr x, const size_t incx, Givaro::DoubleDomain::ConstElement_ptr y, const size_t incy, ModeCategories::DefaultTag &MT)`
- `template<> Givaro::FloatDomain::Element fdot (const Givaro::FloatDomain &, const size_t N, Givaro::FloatDomain::ConstElement_ptr x, const size_t incx, Givaro::FloatDomain::ConstElement_ptr y, const size_t incy, ModeCategories::DefaultTag &MT)`
- `template<class Field, class T>`  
`Field::Element fdot (const Field &F, const size_t N, typename Field::ConstElement_ptr x, const size_t incx, typename Field::ConstElement_ptr y, const size_t incy, ModeCategories::ConvertTo< T > &MT)`
- `template<class Field>`  
`Field::Element fdot (const Field &F, const size_t N, typename Field::ConstElement_ptr x, const size_t incx, typename Field::ConstElement_ptr y, const size_t incy, ModeCategories::DefaultBoundedTag &dbt)`
- `template<class Field>`  
`Field::Element fdot (const Field &F, const size_t N, typename Field::ConstElement_ptr x, const size_t incx, typename Field::ConstElement_ptr y, const size_t incy, const ParSeqHelper::Sequential seq)`
- `template<class Field>`  
`Field::Element fdot (const Field &F, const size_t N, typename Field::ConstElement_ptr X, const size_t incX, typename Field::ConstElement_ptr Y, const size_t incY)`  

$$fdot: dot\ product\ x^T y.$$
- `template<class Field>`  
`Field::Element_ptr fgemm (const Field &F, const FFLAS_TRANSPOSE ta, const FFLAS_TRANSPOSE tb, const size_t m, const size_t n, const size_t k, const typename Field::Element alpha, typename Field::ConstElement_ptr A, const size_t lda, typename Field::ConstElement_ptr B, const size_t ldb, const typename Field::Element beta, typename Field::Element_ptr C, const size_t ldc, MMHelper< Field, MMHelperAlgo::Winograd, ModeCategories::ConvertTo< ElementCategories::MachineFloatTag >, ParSeqHelper::Sequential > &H)`
- `template<typename Field>`  
`Field::Element_ptr fgemm (const Field &F, const FFLAS_TRANSPOSE ta, const FFLAS_TRANSPOSE tb, const size_t m, const size_t n, const size_t k, const typename Field::Element alpha, typename Field::ConstElement_ptr A, const size_t lda, typename Field::ConstElement_ptr B, const size_t ldb, const typename Field::Element beta, typename Field::Element_ptr C, const size_t ldc, const ParSeqHelper::Sequential seq)`
- `template<typename Field, class Cut, class Param>`  
`Field::Element_ptr fgemm (const Field &F, const FFLAS_TRANSPOSE ta, const FFLAS_TRANSPOSE tb, const size_t m, const size_t n, const size_t k, const typename Field::Element alpha, typename Field::ConstElement_ptr A, const size_t lda, typename Field::ConstElement_ptr B, const size_t ldb, const typename Field::Element beta, typename Field::Element_ptr C, const size_t ldc, const ParSeqHelper::Parallel< Cut, Param > par)`

- `template<typename Field>`  
`Field::Element_ptr fgemm (const Field &F, const FFLAS_TRANSPOSE ta, const FFLAS_TRANSPOSE tb, const size_t m, const size_t n, const size_t k, const typename Field::Element alpha, typename Field::ConstElement_ptr A, const size_t lda, typename Field::ConstElement_ptr B, const size_t ldb, const typename Field::Element beta, typename Field::Element_ptr C, const size_t ldc)`  
*fgemm: Field GEneral Matrix Multiply.*
- `template<typename Field, class ModeT, class ParSeq>`  
`Field::Element_ptr fgemm (const Field &F, const FFLAS_TRANSPOSE ta, const FFLAS_TRANSPOSE tb, const size_t m, const size_t n, const size_t k, const typename Field::Element alpha, typename Field::ConstElement_ptr A, const size_t lda, typename Field::ConstElement_ptr B, const size_t ldb, const typename Field::Element beta, typename Field::Element_ptr C, const size_t ldc, MMHelper< Field, MMHelperAlgo::Auto, ModeT, ParSeq > &H)`
- `template<class Field>`  
`Field::Element_ptr fgemm (const Field &F, const FFLAS_TRANSPOSE ta, const FFLAS_TRANSPOSE tb, const size_t m, const size_t n, const size_t k, const typename Field::Element alpha, typename Field::ConstElement_ptr A, const size_t lda, typename Field::ConstElement_ptr B, const size_t ldb, const typename Field::Element beta, typename Field::Element_ptr C, const size_t ldc, MMHelper< Field, MMHelperAlgo::Winograd, ModeCategories::DelayedTag, ParSeqHelper::Sequential > &H)`
- `template<class Field>`  
`Field::Element_ptr fsquare (const Field &F, const FFLAS_TRANSPOSE ta, const size_t n, const typename Field::Element alpha, typename Field::ConstElement_ptr A, const size_t lda, const typename Field::Element beta, typename Field::Element_ptr C, const size_t ldc)`  
*fsquare: Squares a matrix.*
- `template<> double * fsquare (const Givaro::ModularBalanced< double > &F, const FFLAS_TRANSPOSE ta, const size_t n, const double alpha, const double *A, const size_t lda, const double beta, double *C, const size_t ldc)`
- `template<> float * fsquare (const Givaro::ModularBalanced< float > &F, const FFLAS_TRANSPOSE ta, const size_t n, const float alpha, const float *A, const size_t lda, const float beta, float *C, const size_t ldc)`
- `template<> double * fsquare (const Givaro::Modular< double > &F, const FFLAS_TRANSPOSE ta, const size_t n, const double alpha, const double *A, const size_t lda, const double beta, double *C, const size_t ldc)`
- `template<> float * fsquare (const Givaro::Modular< float > &F, const FFLAS_TRANSPOSE ta, const size_t n, const float alpha, const float *A, const size_t lda, const float beta, float *C, const size_t ldc)`
- `template<typename RNS, typename ParSeqTrait>`  
`FFPACK::RNSInteger< RNS >::Element_ptr fgemm (const FFPACK::RNSInteger< RNS > &F, const FFLAS_TRANSPOSE ta, const FFLAS_TRANSPOSE tb, const size_t m, const size_t n, const size_t k, const typename FFPACK::RNSInteger< RNS >::Element alpha, typename FFPACK::RNSInteger< RNS >::ConstElement_ptr Ad, const size_t lda, typename FFPACK::RNSInteger< RNS >::ConstElement_ptr Bd, const size_t ldb, const typename FFPACK::RNSInteger< RNS >::Element beta, typename FFPACK::RNSInteger< RNS >::Element_ptr Cd, const size_t ldc, MMHelper< FFPACK::RNSInteger< RNS >, MMHelperAlgo::Classic, ModeCategories::DefaultTag, ParSeqHelper::Compose< ParSeqHelper::Sequential, ParSeqTrait > > &H)`
- `template<typename RNS>`  
`FFPACK::RNSInteger< RNS >::Element_ptr fgemm (const FFPACK::RNSInteger< RNS > &F, const FFLAS_TRANSPOSE ta, const FFLAS_TRANSPOSE tb, const size_t m, const size_t n, const size_t k, const typename FFPACK::RNSInteger< RNS >::Element alpha, typename FFPACK::RNSInteger< RNS >::ConstElement_ptr Ad, const size_t lda, typename FFPACK::RNSInteger< RNS >::ConstElement_ptr Bd, const size_t ldb, const typename FFPACK::RNSInteger< RNS >::Element beta, typename FFPACK::RNSInteger< RNS >::Element_ptr Cd, const size_t ldc, MMHelper< FFPACK::RNSInteger< RNS >, MMHelperAlgo::Classic, ModeCategories::DefaultTag, ParSeqHelper::Sequential > &H)`
- `template<typename RNS, typename ParSeqTrait>`  
`FFPACK::RNSInteger< RNS >::Element_ptr fgemm (const FFPACK::RNSInteger< RNS > &F, const FFLAS_TRANSPOSE ta, const FFLAS_TRANSPOSE tb, const size_t m, const size_t n, const size_t k, const typename FFPACK::RNSInteger< RNS >::Element alpha, typename FFPACK::RNSInteger< RNS >::ConstElement_ptr Ad, const size_t lda, typename FFPACK::RNSInteger< RNS >::ConstElement_ptr Bd, const size_t ldb, const typename FFPACK::RNSInteger< RNS >::Element beta, typename FFPACK::RNSInteger< RNS >::Element_ptr Cd, const size_t ldc, MMHelper< FFPACK::RNSInteger< RNS >, MMHelperAlgo::Classic, ModeCategories::DefaultTag, ParSeqHelper::Sequential > &H)`

- >, MMHelperAlgo::Classic, ModeCategories::DefaultTag, ParSeqHelper::Compose< ParSeqHelper::Parallel< CuttingStrategy::RNSModulus, StrategyParameter::Threads >, ParSeqTrait > > &H)
- template<typename RNS, typename Cut, typename Param>
 FFPACK::RNSInteger< RNS >::Element\_ptr fgemm (const FFPACK::RNSInteger< RNS > &F, const FFLAS\_TRANSPOSE ta, const FFLAS\_TRANSPOSE tb, const size\_t m, const size\_t n, const size\_t k, const typename FFPACK::RNSInteger< RNS >::Element alpha, typename FFPACK::RNSInteger< RNS >::ConstElement\_ptr Ad, const size\_t lda, typename FFPACK::RNSInteger< RNS >::ConstElement\_ptr Bd, const size\_t ldb, const typename FFPACK::RNSInteger< RNS >::Element beta, typename FFPACK::RNSInteger< RNS >::Element\_ptr Cd, const size\_t ldc, MMHelper< FFPACK::RNSInteger< RNS >, MMHelperAlgo::Classic, ModeCategories::DefaultTag, ParSeqHelper::Parallel< Cut, Param > > &H)
- template<class ParSeq>
 Givaro::Integer \* fgemm (const Givaro::ZRing< Givaro::Integer > &F, const FFLAS\_TRANSPOSE ta, const FFLAS\_TRANSPOSE tb, const size\_t m, const size\_t n, const size\_t k, const Givaro::Integer alpha, const Givaro::Integer \*A, const size\_t lda, const Givaro::Integer \*B, const size\_t ldb, Givaro::Integer beta, Givaro::Integer \*C, const size\_t ldc, MMHelper< Givaro::ZRing< Givaro::Integer >, MMHelperAlgo::Classic, ModeCategories::ConvertTo< ElementCategories::RNSElementTag >, ParSeq > &H)
- template<typename RNS, class ModeT>
 RNS::Element\_ptr fgemm (const FFPACK::RNSInteger< RNS > &F, const FFLAS\_TRANSPOSE ta, const FFLAS\_TRANSPOSE tb, const size\_t m, const size\_t n, const size\_t k, const typename RNS::Element alpha, typename RNS::ConstElement\_ptr Ad, const size\_t lda, typename RNS::ConstElement\_ptr Bd, const size\_t ldb, const typename RNS::Element beta, typename RNS::Element\_ptr Cd, const size\_t ldc, MMHelper< FFPACK::RNSInteger< RNS >, MMHelperAlgo::Winograd, ModeT, ParSeqHelper::Sequential > &H)
- template<typename RNS>
 RNS::Element\_ptr fgemm (const FFPACK::RNSIntegerMod< RNS > &F, const FFLAS\_TRANSPOSE ta, const FFLAS\_TRANSPOSE tb, const size\_t m, const size\_t n, const size\_t k, const typename RNS::Element alpha, typename RNS::ConstElement\_ptr Ad, const size\_t lda, typename RNS::ConstElement\_ptr Bd, const size\_t ldb, const typename RNS::Element beta, typename RNS::Element\_ptr Cd, const size\_t ldc, MMHelper< FFPACK::RNSIntegerMod< RNS >, MMHelperAlgo::Winograd > &H)
- Givaro::Integer \* fgemm (const Givaro::Modular< Givaro::Integer > &F, const FFLAS\_TRANSPOSE ta, const FFLAS\_TRANSPOSE tb, const size\_t m, const size\_t n, const size\_t k, const Givaro::Integer alpha, const Givaro::Integer \*A, const size\_t lda, const Givaro::Integer \*B, const size\_t ldb, const Givaro::Integer beta, Givaro::Integer \*C, const size\_t ldc, MMHelper< Givaro::Modular< Givaro::Integer >, MMHelperAlgo::Classic, ModeCategories::ConvertTo< ElementCategories::RNSElementTag > > &H)
- template<class ParSeq>
 Givaro::Integer \* fgemm (const Givaro::Modular< Givaro::Integer > &F, const FFLAS\_TRANSPOSE ta, const FFLAS\_TRANSPOSE tb, const size\_t m, const size\_t n, const size\_t k, const Givaro::Integer alpha, const Givaro::Integer \*A, const size\_t lda, const Givaro::Integer \*B, const size\_t ldb, const Givaro::Integer beta, Givaro::Integer \*C, const size\_t ldc, MMHelper< Givaro::Modular< Givaro::Integer >, MMHelperAlgo::Auto, ModeCategories::ConvertTo< ElementCategories::RNSElementTag >, ParSeq > &H)
- template<size\_t K1, size\_t K2, class ParSeq>
 Reclnt::ruint< K1 > \* fgemm (const Givaro::Modular< Reclnt::ruint< K1 >, Reclnt::ruint< K2 > > &F, const FFLAS\_TRANSPOSE ta, const FFLAS\_TRANSPOSE tb, const size\_t m, const size\_t n, const size\_t k, const Reclnt::ruint< K1 > alpha, const Reclnt::ruint< K1 > \*A, const size\_t lda, const Reclnt::ruint< K1 > \*B, const size\_t ldb, Reclnt::ruint< K1 > beta, Reclnt::ruint< K1 > \*C, const size\_t ldc, MMHelper< Givaro::Modular< Reclnt::ruint< K1 >, Reclnt::ruint< K2 > >, MMHelperAlgo::Classic, ModeCategories::ConvertTo< ElementCategories::RNSElementTag >, ParSeq > &H)
- template<class Field, class ModeT>
 Field::Element\_ptr fgemm (const Field &F, const FFLAS\_TRANSPOSE ta, const FFLAS\_TRANSPOSE tb, const size\_t m, const size\_t n, const size\_t k, const typename Field::Element alpha, typename Field::ConstElement\_ptr A, const size\_t lda, typename Field::ConstElement\_ptr B, const size\_t ldb, const typename Field::Element beta, typename Field::Element\_ptr C, const size\_t ldc, MMHelper< Field, MMHelperAlgo::Winograd, ModeT > &H)
- template<class Field, class ModeT, class Cut, class Param>
 Field::Element\_ptr fgemm (const Field &F, const FFLAS\_TRANSPOSE ta, const FFLAS\_TRANSPOSE tb, const size\_t m, const size\_t n, const size\_t k, const typename Field::Element alpha, typename Field::ConstElement\_ptr A, const size\_t lda, typename Field::ConstElement\_ptr B, const size\_t ldb,



const typename [Field::Element](#) beta, typename [Field::Element\\_ptr](#) C, const size\_t ldc, [MMHelper](#)< [Field](#), [MMHelperAlgo::WinogradPar](#), ModeT, [ParSeqHelper::Parallel](#)< Cut, Param > > &H)

- template<class [Field](#)>

[Field::Element\\_ptr](#) [fgemv](#) (const [Field](#) &F, const [FFLAS\\_TRANSPOSE](#) ta, const size\_t M, const size\_t N, const typename [Field::Element](#) alpha, typename [Field::ConstElement\\_ptr](#) A, const size\_t lda, typename [Field::ConstElement\\_ptr](#) X, const size\_t incX, const typename [Field::Element](#) beta, typename [Field::Element\\_ptr](#) Y, const size\_t incY, [MMHelper](#)< [Field](#), [MMHelperAlgo::Classic](#), [ModeCategories::ConvertTo](#)< [ElementCategories::MachineFloatTag](#) > > &H)

- template<class [Field](#)>

[Field::Element\\_ptr](#) [fgemv](#) (const [Field](#) &F, const [FFLAS\\_TRANSPOSE](#) ta, const size\_t M, const size\_t N, const typename [Field::Element](#) alpha, typename [Field::ConstElement\\_ptr](#) A, const size\_t lda, typename [Field::ConstElement\\_ptr](#) X, const size\_t incX, const typename [Field::Element](#) beta, typename [Field::Element\\_ptr](#) Y, const size\_t incY, [MMHelper](#)< [Field](#), [MMHelperAlgo::Classic](#), [ModeCategories::DelayedTag](#) > &H)

- template<class [Field](#)>

[Field::Element\\_ptr](#) [fgemv](#) (const [Field](#) &F, const [FFLAS\\_TRANSPOSE](#) ta, const size\_t M, const size\_t N, const typename [Field::Element](#) alpha, typename [Field::ConstElement\\_ptr](#) A, const size\_t lda, typename [Field::ConstElement\\_ptr](#) X, const size\_t incX, const typename [Field::Element](#) beta, typename [Field::Element\\_ptr](#) Y, const size\_t incY, [MMHelper](#)< [Field](#), [MMHelperAlgo::Classic](#), [ModeCategories::DefaultTag](#) > &H)

- template<class [Field](#)>

[Field::Element\\_ptr](#) [fgemv](#) (const [Field](#) &F, const [FFLAS\\_TRANSPOSE](#) ta, const size\_t M, const size\_t N, const typename [Field::Element](#) alpha, typename [Field::ConstElement\\_ptr](#) A, const size\_t lda, typename [Field::ConstElement\\_ptr](#) X, const size\_t incX, const typename [Field::Element](#) beta, typename [Field::Element\\_ptr](#) Y, const size\_t incY, [MMHelper](#)< [Field](#), [MMHelperAlgo::Classic](#), [ModeCategories::LazyTag](#) > &H)

- template<class [Field](#)>

[Field::Element\\_ptr](#) [fgemv](#) (const [Field](#) &F, const [FFLAS\\_TRANSPOSE](#) TransA, const size\_t M, const size\_t N, const typename [Field::Element](#) alpha, typename [Field::ConstElement\\_ptr](#) A, const size\_t lda, typename [Field::ConstElement\\_ptr](#) X, const size\_t incX, const typename [Field::Element](#) beta, typename [Field::Element\\_ptr](#) Y, const size\_t incY)

*finite prime [Field](#) GEneral Matrix Vector multiplication.*

- Givaro::ZRing< int64\_t >::[Element\\_ptr](#) [fgemv](#) (const Givaro::ZRing< int64\_t > &F, const [FFLAS\\_TRANSPOSE](#) ta, const size\_t M, const size\_t N, const int64\_t alpha, const int64\_t \*A, const size\_t lda, const int64\_t \*X, const size\_t incX, const int64\_t beta, const int64\_t \*Y, const size\_t incY, [MMHelper](#)< Givaro::ZRing< int64\_t >, [MMHelperAlgo::Classic](#), [ModeCategories::DefaultTag](#) > &H)
  - Givaro::DoubleDomain::Element\_ptr [fgemv](#) (const Givaro::DoubleDomain &F, const [FFLAS\\_TRANSPOSE](#) ta, const size\_t M, const size\_t N, const Givaro::DoubleDomain::Element alpha, const Givaro::DoubleDomain::ConstElement\_ptr A, const size\_t lda, const Givaro::DoubleDomain::ConstElement\_ptr X, const size\_t incX, const Givaro::DoubleDomain::Element beta, Givaro::DoubleDomain::Element\_ptr Y, const size\_t incY, [MMHelper](#)< Givaro::DoubleDomain, [MMHelperAlgo::Classic](#), [ModeCategories::DefaultTag](#) > &H)
  - template<class [Field](#)>
- [Field::Element\\_ptr](#) [fgemv](#) (const [Field](#) &F, const [FFLAS\\_TRANSPOSE](#) ta, const size\_t M, const size\_t N, const typename [Field::Element](#) alpha, const typename [Field::ConstElement\\_ptr](#) A, const size\_t lda, const typename [Field::ConstElement\\_ptr](#) X, const size\_t incX, const typename [Field::Element](#) beta, typename [Field::Element\\_ptr](#) Y, const size\_t incY, [MMHelper](#)< [Field](#), [MMHelperAlgo::Classic](#), [ModeCategories::DefaultBoundedTag](#) > &H)
- Givaro::FloatDomain::Element\_ptr [fgemv](#) (const Givaro::FloatDomain &F, const [FFLAS\\_TRANSPOSE](#) ta, const size\_t M, const size\_t N, const Givaro::FloatDomain::Element alpha, const Givaro::FloatDomain::ConstElement\_ptr A, const size\_t lda, const Givaro::FloatDomain::ConstElement\_ptr X, const size\_t incX, const Givaro::FloatDomain::Element beta, Givaro::FloatDomain::Element\_ptr Y, const size\_t incY, [MMHelper](#)< Givaro::FloatDomain, [MMHelperAlgo::Classic](#), [ModeCategories::DefaultTag](#) > &H)
  - template<class [Field](#), class Cut, class Param>
- [Field::Element\\_ptr](#) [fgemv](#) (const [Field](#) &F, const [FFLAS\\_TRANSPOSE](#) ta, const size\_t m, const size\_t n, const typename [Field::Element](#) alpha, const typename [Field::ConstElement\\_ptr](#) A, const size\_t lda, const typename [Field::ConstElement\\_ptr](#) X, const size\_t incX, const typename [Field::Element](#) beta, typename [Field::Element\\_ptr](#) Y, const size\_t incY, [ParSeqHelper::Parallel](#)< Cut, Param > &parH)

- `template<class Field>`  
`Field::Element_ptr fgemv` (const `Field` &F, const `FFLAS_TRANSPOSE` ta, const `size_t` m, const `size_t` n, const typename `Field::Element` alpha, const typename `Field::ConstElement_ptr` A, const `size_t` lda, const typename `Field::ConstElement_ptr` X, const `size_t` incX, const typename `Field::Element` beta, typename `Field::Element_ptr` Y, const `size_t` incY, `ParSeqHelper::Sequential` &seqH)
- `FFPACK::rns_double::Element_ptr fgemv` (const `FFPACK::RNSInteger`< `FFPACK::rns_double` > &F, const `FFLAS_TRANSPOSE` ta, const `size_t` M, const `size_t` N, const `FFPACK::rns_double::Element` alpha, `FFPACK::rns_double::ConstElement_ptr` A, const `size_t` lda, `FFPACK::rns_double::ConstElement_ptr` X, const `size_t` incX, const `FFPACK::rns_double::Element` beta, `FFPACK::rns_double::Element_ptr` Y, const `size_t` incY, `MMHelper`< `FFPACK::RNSInteger`< `FFPACK::rns_double` >, `MMHelperAlgo::Classic`, `ModeCategories::DefaultTag` > &H)
- `FFPACK::rns_double::Element_ptr fgemv` (const `FFPACK::RNSIntegerMod`< `FFPACK::rns_double` > &F, const `FFLAS_TRANSPOSE` ta, const `size_t` M, const `size_t` N, const `FFPACK::rns_double::Element` alpha, `FFPACK::rns_double::ConstElement_ptr` A, const `size_t` lda, `FFPACK::rns_double::ConstElement_ptr` X, const `size_t` incX, const `FFPACK::rns_double::Element` beta, `FFPACK::rns_double::Element_ptr` Y, const `size_t` incY, `MMHelper`< `FFPACK::RNSIntegerMod`< `FFPACK::rns_double` >, `MMHelperAlgo::Classic`, `ModeCategories::DefaultTag` > &H)
- `Givaro::Integer * fgemv` (const `Givaro::ZRing`< `Givaro::Integer` > &F, const `FFLAS_TRANSPOSE` ta, const `size_t` m, const `size_t` n, const `Givaro::Integer` alpha, `Givaro::Integer *A`, const `size_t` lda, `Givaro::Integer *X`, const `size_t` ldx, `Givaro::Integer` beta, `Givaro::Integer *Y`, const `size_t` ldy, `MMHelper`< `Givaro::ZRing`< `Givaro::Integer` >, `MMHelperAlgo::Classic`, `ModeCategories::ConvertTo<ElementCategories::RNSElementTag>` > > &H)
- `Givaro::Integer * fgemv` (const `Givaro::Modular`< `Givaro::Integer` > &F, const `FFLAS_TRANSPOSE` ta, const `size_t` m, const `size_t` n, const `Givaro::Integer` alpha, `Givaro::Integer *A`, const `size_t` lda, `Givaro::Integer *X`, const `size_t` ldx, `Givaro::Integer` beta, `Givaro::Integer *Y`, const `size_t` ldy, `MMHelper`< `Givaro::Modular`< `Givaro::Integer` >, `MMHelperAlgo::Classic`, `ModeCategories::ConvertTo<ElementCategories::RNSElementTag>` > > &H)
- `template<size_t K1, size_t K2, class ParSeq>`  
`RecInt::ruint`< K1 > \* `fgemv` (const `Givaro::Modular`< `RecInt::ruint`< K1 >, `RecInt::ruint`< K2 > > &F, const `FFLAS_TRANSPOSE` ta, const `size_t` m, const `size_t` n, const `RecInt::ruint`< K1 > alpha, const `RecInt::ruint`< K1 > \*A, const `size_t` lda, const `RecInt::ruint`< K1 > \*X, const `size_t` incx, `RecInt::ruint`< K1 > beta, `RecInt::ruint`< K1 > \*Y, const `size_t` incy, `MMHelper`< `Givaro::Modular`< `RecInt::ruint`< K1 >, `RecInt::ruint`< K2 > >, `MMHelperAlgo::Classic`, `ModeCategories::ConvertTo<ElementCategories::RNSElementTag>` >, `ParSeq` > &H)
- `template<class Field>`  
`void fger` (const `Field` &F, const `size_t` M, const `size_t` N, const typename `Field::Element` alpha, typename `Field::ConstElement_ptr` x, const `size_t` incx, typename `Field::ConstElement_ptr` y, const `size_t` incy, typename `Field::Element_ptr` A, const `size_t` lda)  
*fger: rank one update of a general matrix*
- `template<class Field>`  
`void fger` (const `Field` &F, const `size_t` M, const `size_t` N, const typename `Field::Element` alpha, typename `Field::ConstElement_ptr` x, const `size_t` incx, typename `Field::ConstElement_ptr` y, const `size_t` incy, typename `Field::Element_ptr` A, const `size_t` lda, `MMHelper`< `Field`, `MMHelperAlgo::Classic`, `ModeCategories::ConvertTo<ElementCategories::MachineFloatTag>` > > &H)
- `template<class Field, class AnyTag>`  
`void fger` (const `Field` &F, const `size_t` M, const `size_t` N, const typename `Field::Element` alpha, typename `Field::ConstElement_ptr` x, const `size_t` incx, typename `Field::ConstElement_ptr` y, const `size_t` incy, typename `Field::Element_ptr` A, const `size_t` lda, `MMHelper`< `Field`, `MMHelperAlgo::Classic`, `AnyTag` > &H)
- `void fger` (const `Givaro::DoubleDomain` &F, const `size_t` M, const `size_t` N, const `Givaro::DoubleDomain::Element` alpha, const `Givaro::DoubleDomain::ConstElement_ptr` x, const `size_t` incx, const `Givaro::DoubleDomain::ConstElement_ptr` y, const `size_t` incy, `Givaro::DoubleDomain::Element_ptr` A, const `size_t` lda, `MMHelper`< `Givaro::DoubleDomain`, `MMHelperAlgo::Classic`, `ModeCategories::DefaultTag` > &H)
- `template<class Field>`  
`void fger` (const `Field` &F, const `size_t` M, const `size_t` N, const typename `Field::Element` alpha, const typename `Field::ConstElement_ptr` x, const `size_t` incx, const typename `Field::ConstElement_ptr` y, const `size_t` incy, typename `Field::Element_ptr` A, const `size_t` lda, `MMHelper`< `Field`, `MMHelperAlgo::Classic`, `ModeCategories::DefaultBoundedTag` > &H)

- void `fger` (const Givaro::FloatDomain &F, const size\_t M, const size\_t N, const Givaro::FloatDomain::Element alpha, const Givaro::FloatDomain::ConstElement\_ptr x, const size\_t incx, const Givaro::FloatDomain::ConstElement\_ptr y, const size\_t incy, Givaro::FloatDomain::Element\_ptr A, const size\_t lda, MMHelper< Givaro::FloatDomain, MMHelperAlgo::Classic, ModeCategories::DefaultTag > &H)
- template<class Field>  
void `fger` (const Field &F, const size\_t M, const size\_t N, const typename Field::Element alpha, typename Field::ConstElement\_ptr x, const size\_t incx, typename Field::ConstElement\_ptr y, const size\_t incy, typename Field::Element\_ptr A, const size\_t lda, MMHelper< Field, MMHelperAlgo::Classic, ModeCategories::LazyTag > &H)
- template<class Field>  
void `fger` (const Field &F, const size\_t M, const size\_t N, const typename Field::Element alpha, typename Field::ConstElement\_ptr x, const size\_t incx, typename Field::ConstElement\_ptr y, const size\_t incy, typename Field::Element\_ptr A, const size\_t lda, MMHelper< Field, MMHelperAlgo::Classic, ModeCategories::DelayedTag > &H)
- void `fger` (const Givaro::Modular< Givaro::Integer > &F, const size\_t M, const size\_t N, const typename Givaro::Integer alpha, typename Givaro::Integer \*x, const size\_t incx, typename Givaro::Integer \*y, const size\_t incy, typename Givaro::Integer \*A, const size\_t lda, MMHelper< Givaro::Modular< Givaro::Integer >, MMHelperAlgo::Classic, ModeCategories::ConvertTo< ElementCategories::RNSElementTag > > &H)
- template<typename RNS>  
void `fger` (const FFPACK::RNSInteger< RNS > &F, const size\_t M, const size\_t N, const typename FFPACK::RNSInteger< RNS >::Element alpha, typename FFPACK::RNSInteger< RNS >::Element\_ptr x, const size\_t incx, typename FFPACK::RNSInteger< RNS >::Element\_ptr y, const size\_t incy, typename FFPACK::RNSInteger< RNS >::Element\_ptr A, const size\_t lda, MMHelper< FFPACK::RNSInteger< RNS >, MMHelperAlgo::Classic, ModeCategories::DefaultTag > &H)
- template<typename RNS>  
void `fger` (const FFPACK::RNSIntegerMod< RNS > &F, const size\_t M, const size\_t N, const typename FFPACK::RNSIntegerMod< RNS >::Element alpha, typename FFPACK::RNSIntegerMod< RNS >::Element\_ptr x, const size\_t incx, typename FFPACK::RNSIntegerMod< RNS >::Element\_ptr y, const size\_t incy, typename FFPACK::RNSIntegerMod< RNS >::Element\_ptr A, const size\_t lda, MMHelper< FFPACK::RNSIntegerMod< RNS >, MMHelperAlgo::Classic > &H)
- template<class Field>  
void `freduce` (const Field &F, const size\_t n, typename Field::ConstElement\_ptr Y, const size\_t incY, typename Field::Element\_ptr X, const size\_t incX)  
$$\text{freduce } x \leftarrow y \bmod F.$$
- template<class Field>  
void `freduce` (const Field &F, const size\_t n, typename Field::Element\_ptr X, const size\_t incX)  
$$\text{freduce } x \leftarrow x \bmod F.$$
- template<class Field>  
void `freduce_constoverride` (const Field &F, const size\_t m, typename Field::ConstElement\_ptr A, const size\_t incX)
- template<class Field, class ConstOtherElement\_ptr>  
void `finit` (const Field &F, const size\_t n, ConstOtherElement\_ptr Y, const size\_t incY, typename Field::Element\_ptr X, const size\_t incX)
- template<class Field>  
void `finit` (const Field &F, const size\_t n, typename Field::Element\_ptr X, const size\_t incX)  
$$\text{finit initializes } X \text{ in } F^{\$}.$$
- template<class Field>  
void `freduce` (const Field &F, const size\_t m, const size\_t n, typename Field::Element\_ptr A, const size\_t lda)  
$$\text{freduce } A \leftarrow A \bmod F.$$
- template<class Field>  
void `freduce` (const Field &F, const FFLAS\_UPLO uplo, const size\_t N, typename Field::Element\_ptr A, const size\_t lda)  
$$\text{freduce for square symmetric matrices}$$
- template<class Field>  
void `pfreduce` (const Field &F, const size\_t m, const size\_t n, typename Field::Element\_ptr A, const size\_t lda, const size\_t numths)



- template<class [Field](#)>  
void [freduce](#) (const [Field](#) &F, const size\_t m, const size\_t n, typename [Field::ConstElement\\_ptr](#) B, const size\_t ldb, typename [Field::Element\\_ptr](#) A, const size\_t lda)  
$$\text{freduce } A \leftarrow B \bmod F.$$
- template<class [Field](#)>  
void [freduce\\_constoverride](#) (const [Field](#) &F, const size\_t m, const size\_t n, typename [Field::ConstElement\\_ptr](#) A, const size\_t lda)
- template<class [Field](#), class OtherElement\_ptr>  
void [finit](#) (const [Field](#) &F, const size\_t m, const size\_t n, const OtherElement\_ptr B, const size\_t ldb, typename [Field::Element\\_ptr](#) A, const size\_t lda)  
$$\text{finit } A \leftarrow B \bmod F.$$
- template<class [Field](#)>  
void [finit](#) (const [Field](#) &F, const size\_t m, const size\_t n, typename [Field::Element\\_ptr](#) A, const size\_t lda)
- template<> void [freduce](#) (const [FFPACK::RNSIntegerMod](#)< [FFPACK::rns\\_double](#) > &F, const size\_t n, [FFPACK::RNSIntegerMod](#)< [FFPACK::rns\\_double](#) >::Element\_ptr A, size\_t inc)
- template<> void [freduce](#) (const [FFPACK::RNSIntegerMod](#)< [FFPACK::rns\\_double](#) > &F, const size\_t m, const size\_t n, [FFPACK::rns\\_double::Element\\_ptr](#) A, size\_t lda)
- template<class [Field](#)>  
bool [freivalds](#) (const [Field](#) &F, const [FFLAS\\_TRANSPOSE](#) ta, const [FFLAS\\_TRANSPOSE](#) tb, const size\_t m, const size\_t n, const size\_t k, const typename [Field::Element](#) alpha, typename [Field::ConstElement\\_ptr](#) A, const size\_t lda, typename [Field::ConstElement\\_ptr](#) B, const size\_t ldb, typename [Field::ConstElement\\_ptr](#) C, const size\_t ldc)  
$$\text{freivalds: Freivalds } \mathbf{G} \mathbf{E} \mathbf{n} \mathbf{e} \mathbf{r} \mathbf{a} \mathbf{l} \mathbf{ } \mathbf{M} \mathbf{a} \mathbf{t} \mathbf{r} \mathbf{i} \mathbf{x} \mathbf{ } \mathbf{M} \mathbf{u} \mathbf{l} \mathbf{t} \mathbf{i} \mathbf{p} \mathbf{y} \mathbf{ } \mathbf{R} \mathbf{a} \mathbf{n} \mathbf{d} \mathbf{o} \mathbf{m} \mathbf{ } \mathbf{C} \mathbf{h} \mathbf{e} \mathbf{c} \mathbf{k}.$$
- template<class [Field](#)>  
void [fscal](#) (const [Field](#) &F, const size\_t n, const typename [Field::Element](#) alpha, typename [Field::Element\\_ptr](#) X, const size\_t incX)  
$$\text{fscal } x \leftarrow \alpha \cdot x.$$
- template<class [Field](#)>  
void [fscal](#) (const [Field](#) &F, const size\_t n, const typename [Field::Element](#) alpha, typename [Field::ConstElement\\_ptr](#) X, const size\_t incX, typename [Field::Element\\_ptr](#) Y, const size\_t incY)  
$$\text{fscal } y \leftarrow \alpha \cdot x.$$
- template<> void [fscal](#) (const Givaro::DoubleDomain &, const size\_t N, const Givaro::DoubleDomain::Element a, Givaro::DoubleDomain::ConstElement\_ptr x, const size\_t incx, Givaro::DoubleDomain::Element\_ptr y, const size\_t incy)
- template<> void [fscal](#) (const Givaro::FloatDomain &, const size\_t N, const Givaro::FloatDomain::Element a, Givaro::FloatDomain::ConstElement\_ptr x, const size\_t incx, Givaro::FloatDomain::Element\_ptr y, const size\_t incy)
- template<> void [fscal](#) (const Givaro::DoubleDomain &, const size\_t N, const Givaro::DoubleDomain::Element a, Givaro::DoubleDomain::Element\_ptr y, const size\_t incy)
- template<> void [fscal](#) (const Givaro::FloatDomain &, const size\_t N, const Givaro::FloatDomain::Element a, Givaro::FloatDomain::Element\_ptr y, const size\_t incy)
- template<class [Field](#)>  
void [fscal](#) (const [Field](#) &F, const size\_t m, const size\_t n, const typename [Field::Element](#) alpha, typename [Field::Element\\_ptr](#) A, const size\_t lda)  
$$\text{fscal } A \leftarrow a \cdot A.$$
- template<class [Field](#)>  
void [fscal](#) (const [Field](#) &F, const size\_t m, const size\_t n, const typename [Field::Element](#) alpha, typename [Field::ConstElement\\_ptr](#) A, const size\_t lda, typename [Field::Element\\_ptr](#) B, const size\_t ldb)  
$$\text{fscal } B \leftarrow a \cdot A.$$
- template<> void [fscal](#) (const [FFPACK::RNSInteger](#)< [FFPACK::rns\\_double](#) > &F, const size\_t n, const [FFPACK::rns\\_double::Element](#) alpha, [FFPACK::rns\\_double::Element\\_ptr](#) A, const size\_t inc)
- template<> void [fscal](#) (const [FFPACK::RNSInteger](#)< [FFPACK::rns\\_double](#) > &F, const size\_t n, const [FFPACK::rns\\_double::Element](#) alpha, [FFPACK::rns\\_double::ConstElement\\_ptr](#) A, const size\_t Ainc, [FFPACK::rns\\_double::Element\\_ptr](#) B, const size\_t Binc)
- template<> void [fscal](#) (const [FFPACK::RNSInteger](#)< [FFPACK::rns\\_double](#) > &F, const size\_t m, const size\_t n, const [FFPACK::rns\\_double::Element](#) alpha, [FFPACK::rns\\_double::Element\\_ptr](#) A, const size\_t lda)

- `template<> void fscal (const FFPACK::RNSInteger< FFPACK::rns_double > &F, const size_t m, const size_t n, const FFPACK::rns_double::Element alpha, FFPACK::rns_double::ConstElement_ptr A, const size_t lda, FFPACK::rns_double::Element_ptr B, const size_t ldb)`
- `template<> void fscaln (const FFPACK::RNSIntegerMod< FFPACK::rns_double > &F, const size_t n, const typename FFPACK::RNSIntegerMod< FFPACK::rns_double >::Element alpha, typename FFPACK::RNSIntegerMod< FFPACK::rns_double >::Element_ptr A, const size_t inc)`
- `template<> void fscal (const FFPACK::RNSIntegerMod< FFPACK::rns_double > &F, const size_t n, const FFPACK::rns_double::Element alpha, FFPACK::rns_double::ConstElement_ptr A, const size_t Ainc, FFPACK::rns_double::Element_ptr B, const size_t Binc)`
- `template<> void fscaln (const FFPACK::RNSIntegerMod< FFPACK::rns_double > &F, const size_t m, const size_t n, const FFPACK::rns_double::Element alpha, FFPACK::rns_double::Element_ptr A, const size_t lda)`
- `template<> void fscal (const FFPACK::RNSIntegerMod< FFPACK::rns_double > &F, const size_t m, const size_t n, const FFPACK::rns_double::Element alpha, FFPACK::rns_double::ConstElement_ptr A, const size_t lda, FFPACK::rns_double::Element_ptr B, const size_t ldb)`
- `template<class Field>`  
`Field::Element_ptr fsyr2k (const Field &F, const FFLAS_UPLO UpLo, const FFLAS_TRANSPOSE trans, const size_t n, const size_t k, const typename Field::Element alpha, typename Field::ConstElement_ptr A, const size_t lda, typename Field::ConstElement_ptr B, const size_t ldb, const typename Field::Element beta, typename Field::Element_ptr C, const size_t ldc)`  
*fsyr2k: Symmetric Rank 2K update*
- `template<class Field>`  
`Field::Element_ptr fsyrk (const Field &F, const FFLAS_UPLO UpLo, const FFLAS_TRANSPOSE trans, const size_t n, const size_t k, const typename Field::Element alpha, typename Field::ConstElement_ptr A, const size_t lda, const typename Field::Element beta, typename Field::Element_ptr C, const size_t ldc)`  
*fsyrk: Symmetric Rank K update*
- `template<class Field>`  
`Field::Element_ptr fsyrk (const Field &F, const FFLAS_UPLO UpLo, const FFLAS_TRANSPOSE trans, const size_t N, const size_t K, const typename Field::Element alpha, typename Field::ConstElement_ptr A, const size_t lda, const typename Field::Element beta, typename Field::Element_ptr C, const size_t ldc, const ParSeqHelper::Sequential seq)`
- `template<class Field>`  
`Field::Element_ptr fsyrk (const Field &F, const FFLAS_UPLO UpLo, const FFLAS_TRANSPOSE trans, const size_t N, const size_t K, const typename Field::Element alpha, typename Field::ConstElement_ptr A, const size_t lda, const typename Field::Element beta, typename Field::Element_ptr C, const size_t ldc, MMHelper< Field, MMHelperAlgo::Classic, ModeCategories::DefaultTag > &H)`
- `template<class Field>`  
`Field::Element_ptr fsyrk (const Field &F, const FFLAS_UPLO UpLo, const FFLAS_TRANSPOSE trans, const size_t N, const size_t K, const typename Field::Element alpha, typename Field::ConstElement_ptr A, const size_t lda, const typename Field::Element beta, typename Field::Element_ptr C, const size_t ldc, MMHelper< Field, MMHelperAlgo::Classic, ModeCategories::ConvertTo< ElementCategories::MachineFloatTag >, ParSeqHelper::Sequential > &H)`
- `template<class Field>`  
`Field::Element_ptr fsyrk (const Field &F, const FFLAS_UPLO UpLo, const FFLAS_TRANSPOSE trans, const size_t N, const size_t K, const typename Field::Element alpha, typename Field::ConstElement_ptr A, const size_t lda, const typename Field::Element beta, typename Field::Element_ptr C, const size_t ldc, MMHelper< Field, MMHelperAlgo::Classic, ModeCategories::DelayedTag > &H)`
- `template<class Field>`  
`Field::Element_ptr fsyrk (const Field &F, const FFLAS_UPLO UpLo, const FFLAS_TRANSPOSE trans, const size_t N, const size_t K, const typename Field::Element alpha, typename Field::ConstElement_ptr A, const size_t lda, const typename Field::Element beta, typename Field::Element_ptr C, const size_t ldc, MMHelper< Field, MMHelperAlgo::Classic, ModeCategories::LazyTag > &H)`
- `template<class Field, typename Mode>`  
`Field::Element_ptr fsyrk (const Field &F, const FFLAS_UPLO UpLo, const FFLAS_TRANSPOSE trans, const size_t N, const size_t K, const typename Field::Element alpha, typename Field::ConstElement_ptr A, const size_t lda, const typename Field::Element beta, typename Field::Element_ptr C, const size_t ldc, MMHelper< Field, MMHelperAlgo::DivideAndConquer, Mode > &H)`

- `template<class Field>`  
`Field::Element_ptr fsyrk` (const `Field` &F, const `FFLAS_UPLO` UpLo, const `FFLAS_TRANSPOSE` trans, const `size_t` N, const `size_t` K, const `typename Field::Element` alpha, `typename Field::ConstElement_ptr` A, const `size_t` lda, const `typename Field::Element` beta, `typename Field::Element_ptr` C, const `size_t` ldc, `MMHelper`< `Field`, `MMHelperAlgo::Classic`, `ModeCategories::DefaultBoundedTag` > &H)
- `Givaro::FloatDomain::Element_ptr fsyrk` (const `Givaro::FloatDomain` &F, const `FFLAS_UPLO` UpLo, const `FFLAS_TRANSPOSE` trans, const `size_t` N, const `size_t` K, const `Givaro::FloatDomain::Element` alpha, `Givaro::FloatDomain::ConstElement_ptr` A, const `size_t` lda, const `Givaro::FloatDomain::Element` beta, `Givaro::FloatDomain::Element_ptr` C, const `size_t` ldc, `MMHelper`< `Givaro::FloatDomain`, `MMHelperAlgo::Classic`, `ModeCategories::DefaultTag` > &H)
- `Givaro::DoubleDomain::Element_ptr fsyrk` (const `Givaro::DoubleDomain` &F, const `FFLAS_UPLO` UpLo, const `FFLAS_TRANSPOSE` trans, const `size_t` N, const `size_t` K, const `Givaro::DoubleDomain::Element` alpha, `Givaro::DoubleDomain::ConstElement_ptr` A, const `size_t` lda, const `Givaro::DoubleDomain::Element` beta, `Givaro::DoubleDomain::Element_ptr` C, const `size_t` ldc, `MMHelper`< `Givaro::DoubleDomain`, `MMHelperAlgo::Classic`, `ModeCategories::DefaultTag` > &H)
- `template<class Field>`  
`Field::Element_ptr fsyrk` (const `Field` &F, const `FFLAS_UPLO` UpLo, const `FFLAS_TRANSPOSE` trans, const `size_t` n, const `size_t` k, const `typename Field::Element` alpha, `typename Field::Element_ptr` A, const `size_t` lda, `typename Field::ConstElement_ptr` D, const `size_t` incD, const `typename Field::Element` beta, `typename Field::Element_ptr` C, const `size_t` ldc, const `size_t` threshold=`__FFLASFFPACK_FSYRK_THRESHOLD`)  
*fsyrk: Symmetric Rank K update with diagonal scaling*
- `template<class Field>`  
`Field::Element_ptr fsyrk` (const `Field` &F, const `FFLAS_UPLO` UpLo, const `FFLAS_TRANSPOSE` trans, const `size_t` N, const `size_t` K, const `typename Field::Element` alpha, `typename Field::Element_ptr` A, const `size_t` lda, `typename Field::ConstElement_ptr` D, const `size_t` incD, const `typename Field::Element` beta, `typename Field::Element_ptr` C, const `size_t` ldc, const `ParSeqHelper::Sequential` seq, const `size_t` threshold)
- `template<class Field, class Cut, class Param>`  
`Field::Element_ptr fsyrk` (const `Field` &F, const `FFLAS_UPLO` UpLo, const `FFLAS_TRANSPOSE` trans, const `size_t` N, const `size_t` K, const `typename Field::Element` alpha, `typename Field::Element_ptr` A, const `size_t` lda, `typename Field::ConstElement_ptr` D, const `size_t` incD, const `typename Field::Element` beta, `typename Field::Element_ptr` C, const `size_t` ldc, const `ParSeqHelper::Parallel`< `Cut`, `Param` > par, const `size_t` threshold)
- `template<class Field>`  
`Field::Element_ptr fsyrk` (const `Field` &F, const `FFLAS_UPLO` UpLo, const `FFLAS_TRANSPOSE` trans, const `size_t` n, const `size_t` k, const `typename Field::Element` alpha, `typename Field::Element_ptr` A, const `size_t` lda, `typename Field::ConstElement_ptr` D, const `size_t` incD, const `std::vector< bool >` &twoBlock, const `typename Field::Element` beta, `typename Field::Element_ptr` C, const `size_t` ldc, const `size_t` threshold=`__FFLASFFPACK_FSYRK_THRESHOLD`)  
*fsyrk: Symmetric Rank K update with diagonal scaling*
- `template<class Field, class FieldTrait>`  
`void computeS1S2` (const `Field` &F, const `FFLAS_TRANSPOSE` trans, const `size_t` N, const `size_t` K, const `typename Field::Element` x, const `typename Field::Element` y, `typename Field::Element_ptr` A, const `size_t` lda, `typename Field::Element_ptr` S, const `size_t` lds, `typename Field::Element_ptr` T, const `size_t` ldt, `MMHelper`< `Field`, `MMHelperAlgo::Winograd`, `FieldTrait` > &WH)
- `template<class Field>`  
`Field::Element_ptr fsyrk` (const `Field` &F, const `FFLAS_UPLO` UpLo, const `FFLAS_TRANSPOSE` trans, const `size_t` N, const `size_t` K, const `typename Field::Element` alpha, `typename Field::ConstElement_ptr` A, const `size_t` lda, const `typename Field::Element` beta, `typename Field::Element_ptr` C, const `size_t` ldc, `MMHelper`< `Field`, `MMHelperAlgo::Winograd`, `ModeCategories::DelayedTag`, `ParSeqHelper::Sequential` > &H)
- `template<class Field, class Mode>`  
`Field::Element_ptr fsyrk` (const `Field` &F, const `FFLAS_UPLO` UpLo, const `FFLAS_TRANSPOSE` trans, const `size_t` N, const `size_t` K, const `typename Field::Element` alpha, `typename Field::ConstElement_ptr` A, const `size_t` lda, const `typename Field::Element` beta, `typename Field::Element_ptr` C, const `size_t` ldc, `MMHelper`< `Field`, `MMHelperAlgo::Winograd`, `Mode` > &H)
- `template<class Field, class FieldTrait>`  
`Field::Element_ptr fsyrk_strassen` (const `Field` &F, const `FFLAS_UPLO` uplo, const `FFLAS_TRANSPOSE` trans, const `size_t` N, const `size_t` K, const `typename Field::Element` y1, const `typename Field::Element`

- y2, const typename [Field::Element](#) alpha, typename [Field::Element\\_ptr](#) A, const size\_t lda, const typename [Field::Element](#) beta, typename [Field::Element\\_ptr](#) C, const size\_t ldc, [MMHelper](#)< [Field](#), [MMHelperAlgo::Winograd](#), [FieldTrait](#) > &WH)
- template<class [Field](#)>  
void [ftrmm](#) (const [Field](#) &F, const [FFLAS\\_SIDE](#) Side, const [FFLAS\\_UPLO](#) Uplo, const [FFLAS\\_TRANSPOSE](#) TransA, const [FFLAS\\_DIAG](#) Diag, const size\_t M, const size\_t N, const typename [Field::Element](#) alpha, typename [Field::ConstElement\\_ptr](#) A, const size\_t lda, typename [Field::Element\\_ptr](#) B, const size\_t ldb)  
*ftrmm: **TRI**angular **M**atrix **M**ultiply.*
  - template<class [Field](#)>  
void [ftrmm](#) (const [Field](#) &F, const [FFLAS\\_SIDE](#) Side, const [FFLAS\\_UPLO](#) Uplo, const [FFLAS\\_TRANSPOSE](#) TransA, const [FFLAS\\_DIAG](#) Diag, const size\_t M, const size\_t N, const typename [Field::Element](#) alpha, typename [Field::ConstElement\\_ptr](#) A, const size\_t lda, typename [Field::ConstElement\\_ptr](#) B, const size\_t ldb, const typename [Field::Element](#) beta, typename [Field::Element\\_ptr](#) C, const size\_t ldc)  
*ftrmm: **TRI**angular **M**atrix **M**ultiply with 3 operands Computes  $C \leftarrow \alpha \text{op}(A)B + \text{beta}C$  or  $C \leftarrow \alpha \text{Bop}(A) + \text{beta}C$ .*
  - template<class [Field](#)>  
void [ftrsm](#) (const [Field](#) &F, const [FFLAS\\_SIDE](#) Side, const [FFLAS\\_UPLO](#) Uplo, const [FFLAS\\_TRANSPOSE](#) TransA, const [FFLAS\\_DIAG](#) Diag, const size\_t M, const size\_t N, const typename [Field::Element](#) alpha, typename [Field::Element\\_ptr](#) A, const size\_t lda, typename [Field::Element\\_ptr](#) B, const size\_t ldb)
  - template<class [Field](#)>  
void [ftrsm](#) (const [Field](#) &F, const [FFLAS\\_SIDE](#) Side, const [FFLAS\\_UPLO](#) Uplo, const [FFLAS\\_TRANSPOSE](#) TransA, const [FFLAS\\_DIAG](#) Diag, const size\_t M, const size\_t N, const typename [Field::Element](#) alpha, typename [Field::Element\\_ptr](#) A, const size\_t lda, typename [Field::Element\\_ptr](#) B, const size\_t ldb, const [ParSeqHelper::Sequential](#) &PSH)
  - template<class [Field](#), class Cut, class Param>  
void [ftrsm](#) (const [Field](#) &F, const [FFLAS\\_SIDE](#) Side, const [FFLAS\\_UPLO](#) Uplo, const [FFLAS\\_TRANSPOSE](#) TransA, const [FFLAS\\_DIAG](#) Diag, const size\_t M, const size\_t N, const typename [Field::Element](#) alpha, typename [Field::Element\\_ptr](#) A, const size\_t lda, typename [Field::Element\\_ptr](#) B, const size\_t ldb, const [ParSeqHelper::Parallel](#)< Cut, Param > &PSH)
  - template<class [Field](#), class ParSeqTrait = [ParSeqHelper::Sequential](#)>  
void [ftrsm](#) (const [Field](#) &F, const [FFLAS\\_SIDE](#) Side, const [FFLAS\\_UPLO](#) Uplo, const [FFLAS\\_TRANSPOSE](#) TransA, const [FFLAS\\_DIAG](#) Diag, const size\_t M, const size\_t N, const typename [Field::Element](#) alpha, typename [Field::Element\\_ptr](#) A, const size\_t lda, typename [Field::Element\\_ptr](#) B, const size\_t ldb, [TRSMHelper](#)< [StructureHelper::Recursive](#), ParSeqTrait > &H)
  - void [ftrsm](#) (const [Givaro::Modular](#)< [Givaro::Integer](#) > &F, const [FFLAS\\_SIDE](#) Side, const [FFLAS\\_UPLO](#) Uplo, const [FFLAS\\_TRANSPOSE](#) TransA, const [FFLAS\\_DIAG](#) Diag, const size\_t M, const size\_t N, const [Givaro::Integer](#) alpha, const [Givaro::Integer](#) \*A, const size\_t lda, [Givaro::Integer](#) \*B, const size\_t ldb)
  - void [cblas\\_imptrsm](#) (const enum [FFLAS\\_ORDER](#) Order, const enum [FFLAS\\_SIDE](#) Side, const enum [FFLAS\\_UPLO](#) Uplo, const enum [FFLAS\\_TRANSPOSE](#) TransA, const enum [FFLAS\\_DIAG](#) Diag, const int M, const int N, const [FFPACK::rns\\_double\\_elt](#) alpha, [FFPACK::rns\\_double\\_elt\\_cstptr](#) A, const int lda, [FFPACK::rns\\_double\\_elt\\_ptr](#) B, const int ldb)
  - template<class [Field](#)>  
void [ftrsv](#) (const [Field](#) &F, const [FFLAS\\_UPLO](#) Uplo, const [FFLAS\\_TRANSPOSE](#) TransA, const [FFLAS\\_DIAG](#) Diag, const size\_t N, typename [Field::ConstElement\\_ptr](#) A, const size\_t lda, typename [Field::Element\\_ptr](#) X, int incX)  
*ftrsv: **TRI**angular **S**ystem solve with **V**ector Computes  $X \leftarrow \text{op}(A^{-1})X$*
  - void [igemm](#) (const enum [FFLAS\\_ORDER](#) Order, const enum [FFLAS\\_TRANSPOSE](#) TransA, const enum [FFLAS\\_TRANSPOSE](#) TransB, const size\_t M, const size\_t N, const size\_t K, const int64\_t alpha, const int64\_t \*A, const size\_t lda, const int64\_t \*B, const size\_t ldb, const int64\_t beta, int64\_t \*C, const size\_t ldc)
  - template<class [Field](#), class OtherElement\_ptr>  
void [finit](#) (const [Field](#) &F, const size\_t n, const OtherElement\_ptr Y, const size\_t incY, typename [Field::Element\\_ptr](#) X, const size\_t incX)  
*finit  $x \leftarrow y \bmod F$ .*
  - template<class [Field](#), class OtherElement\_ptr>  
void [fconvert](#) (const [Field](#) &F, const size\_t n, OtherElement\_ptr X, const size\_t incX, typename [Field::ConstElement\\_ptr](#) Y, const size\_t incY)  
*fconvert  $x \leftarrow y \bmod F$ .*

- `template<class Field>`  
`void fnegin (const Field &F, const size_t n, typename Field::Element_ptr X, const size_t incX)`  

$$fnegin\ x \leftarrow -x.$$
- `template<class Field>`  
`void fneg (const Field &F, const size_t n, typename Field::ConstElement_ptr Y, const size_t incY, typename Field::Element_ptr X, const size_t incX)`  

$$fneg\ x \leftarrow -y.$$
- `template<class Field>`  
`void fzero (const Field &F, const size_t n, typename Field::Element_ptr X, const size_t incX)`  

$$fzero : A \leftarrow 0.$$
- `template<class Field, class RandIter>`  
`void frand (const Field &F, RandIter &G, const size_t n, typename Field::Element_ptr X, const size_t incX)`  

$$frand : A \leftarrow random.$$
- `template<class Field>`  
`bool fiszero (const Field &F, const size_t n, typename Field::ConstElement_ptr X, const size_t incX)`  

$$fiszero : test\ X = 0.$$
- `template<class Field>`  
`bool fequal (const Field &F, const size_t n, typename Field::ConstElement_ptr X, const size_t incX, typename Field::ConstElement_ptr Y, const size_t incY)`  

$$fequal : test\ X = Y.$$
- `template<class Field>`  
`void faxpby (const Field &F, const size_t N, const typename Field::Element alpha, typename Field::ConstElement_ptr X, const size_t incX, const typename Field::Element beta, typename Field::Element_ptr Y, const size_t incY)`  

$$faxpby : y \leftarrow \alpha \cdot x + \beta \cdot y.$$
- `template<typename Field, class Cut, class Param>`  
`Field::Element fdot (const Field &F, const size_t N, typename Field::ConstElement_ptr X, const size_t incX, typename Field::ConstElement_ptr Y, const size_t incY, const ParSeqHelper::Parallel< Cut, Param > par)`
- `template<class Field>`  
`void fswap (const Field &F, const size_t N, typename Field::Element_ptr X, const size_t incX, typename Field::Element_ptr Y, const size_t incY)`  

$$fswap : X \leftrightarrow Y.$$
- `template<class Field>`  
`void fzero (const Field &F, const size_t m, const size_t n, typename Field::Element_ptr A, const size_t lda)`  

$$fzero : A \leftarrow 0.$$
- `template<class Field>`  
`void fzero (const Field &F, const FFLAS_UPLO shape, const FFLAS_DIAG diag, const size_t n, typename Field::Element_ptr A, const size_t lda)`  

$$fzero : A \leftarrow 0\ for\ a\ triangular\ matrix.$$
- `template<class Field, class RandIter>`  
`void frand (const Field &F, RandIter &G, const size_t m, const size_t n, typename Field::Element_ptr A, const size_t lda)`  

$$frand : A \leftarrow random.$$
- `template<class Field>`  
`bool fequal (const Field &F, const size_t m, const size_t n, typename Field::ConstElement_ptr A, const size_t lda, typename Field::ConstElement_ptr B, const size_t ldb)`  

$$fequal : test\ A = B.$$
- `template<class Field>`  
`bool fiszero (const Field &F, const size_t m, const size_t n, typename Field::ConstElement_ptr A, const size_t lda)`  

$$fiszero : test\ A = 0.$$
- `template<class Field>`  
`void fidentity (const Field &F, const size_t m, const size_t n, typename Field::Element_ptr A, const size_t lda, const typename Field::Element &d)`

- creates a diagonal matrix*

  - template<class [Field](#)>  
void [fidentity](#) (const [Field](#) &F, const size\_t m, const size\_t n, typename [Field::Element\\_ptr](#) A, const size\_t lda)  
*creates a diagonal matrix*
  - template<class [Field](#), class OtherElement\_ptr>  
void [finit](#) (const [Field](#) &F, const size\_t m, const size\_t n, typename [Field::Element\\_ptr](#) A, const size\_t lda)  
*finit Initializes  $A$  in  $F$ .*
  - template<class [Field](#), class OtherElement\_ptr>  
void [fconvert](#) (const [Field](#) &F, const size\_t m, const size\_t n, OtherElement\_ptr A, const size\_t lda, typename [Field::ConstElement\\_ptr](#) B, const size\_t ldb)  
*fconvert  $A \leftarrow B \bmod F$ .*
  - template<class [Field](#)>  
void [fnegin](#) (const [Field](#) &F, const size\_t m, const size\_t n, typename [Field::Element\\_ptr](#) A, const size\_t lda)  
*fnegin  $A \leftarrow -A$ .*
  - template<class [Field](#)>  
void [fneg](#) (const [Field](#) &F, const size\_t m, const size\_t n, typename [Field::ConstElement\\_ptr](#) B, const size\_t ldb, typename [Field::Element\\_ptr](#) A, const size\_t lda)  
*fneg  $A \leftarrow -B$ .*
  - template<class [Field](#)>  
void [faxpby](#) (const [Field](#) &F, const size\_t m, const size\_t n, const typename [Field::Element](#) alpha, typename [Field::ConstElement\\_ptr](#) X, const size\_t ldx, const typename [Field::Element](#) beta, typename [Field::Element\\_ptr](#) Y, const size\_t ldy)  
*faxpby :  $y \leftarrow \alpha \cdot x + \beta \cdot y$ .*
  - template<class [Field](#)>  
void [fmove](#) (const [Field](#) &F, const size\_t m, const size\_t n, typename [Field::Element\\_ptr](#) A, const size\_t lda, typename [Field::Element\\_ptr](#) B, const size\_t ldb)  
*fmove :  $A \leftarrow B$  and  $B \leftarrow 0$ .*
  - template<class [Field](#)>  
size\_t [bitsize](#) (const [Field](#) &F, size\_t M, size\_t N, const typename [Field::ConstElement\\_ptr](#) A, size\_t lda)  
*bitsize: Computes the largest bitsize of the matrix' coefficients.*
  - template<> size\_t [bitsize](#)< [Givaro::ZRing](#)< [Givaro::Integer](#) > > (const [Givaro::ZRing](#)< [Givaro::Integer](#) > &F, size\_t M, size\_t N, const [Givaro::Integer](#) \*A, size\_t lda)
  - template<class [Field](#)>  
void [ftsmv](#) (const [Field](#) &F, const [FFLAS\\_UPLO](#) Uplo, const [FFLAS\\_TRANSPOSE](#) TransA, const [FFLAS\\_DIAG](#) Diag, const size\_t N, typename [Field::ConstElement\\_ptr](#) A, const size\_t lda, typename [Field::Element\\_ptr](#) X, int incX)  
*ftsm: **TRI**angular Matrix Vector prodcut Computes  $X \leftarrow \text{op}(A)X$*
  - template<class [Field](#)>  
void [ftrsm](#) (const [Field](#) &F, const [FFLAS\\_SIDE](#) Side, const [FFLAS\\_UPLO](#) Uplo, const [FFLAS\\_TRANSPOSE](#) TransA, const [FFLAS\\_DIAG](#) Diag, const size\_t M, const size\_t N, const typename [Field::Element](#) alpha, typename [Field::ConstElement\\_ptr](#) A, const size\_t lda, typename [Field::Element\\_ptr](#) B, const size\_t ldb)  
*ftrsm: **TRI**angular System solve with **M**atrix.*
  - template<class [Field](#), typename FieldTrait>  
[Field::Element\\_ptr](#) [fsyrk\\_strassen](#) (const [Field](#) &F, const [FFLAS\\_UPLO](#) UpLo, const [FFLAS\\_TRANSPOSE](#) trans, const size\_t N, const size\_t K, const typename [Field::Element](#) y1, const typename [Field::Element](#) y2, const typename [Field::Element](#) alpha, typename [Field::ConstElement\\_ptr](#) A, const size\_t lda, const typename [Field::Element](#) beta, typename [Field::Element\\_ptr](#) C, const size\_t ldc, [MMHelper](#)< [Field](#), [MMHelperAlgo::Winograd](#), FieldTrait > &H)
  - template<typename [Field](#)>  
[Field::Element\\_ptr](#) [pfgemm](#) (const [Field](#) &F, const [FFLAS\\_TRANSPOSE](#) ta, const [FFLAS\\_TRANSPOSE](#) tb, const size\_t m, const size\_t n, const size\_t k, const typename [Field::Element](#) alpha, typename [Field::ConstElement\\_ptr](#) A, const size\_t lda, typename [Field::ConstElement\\_ptr](#) B, const size\_t ldb, const typename [Field::Element](#) beta, typename [Field::Element\\_ptr](#) C, const size\_t ldc, size\_t numthreads=0)



- `template<class Field>`  
`Field::Element * pfgemm_1D_rec (const Field &F, const FFLAS_TRANSPOSE ta, const FFLAS_TRANSPOSE tb, const size_t m, const size_t n, const size_t k, const typename Field::Element alpha, const typename Field::Element_ptr A, const size_t lda, const typename Field::Element_ptr B, const size_t ldb, const typename Field::Element beta, typename Field::Element *C, const size_t ldc, size_t seuil)`
- `template<class Field>`  
`Field::Element * pfgemm_2D_rec (const Field &F, const FFLAS_TRANSPOSE ta, const FFLAS_TRANSPOSE tb, const size_t m, const size_t n, const size_t k, const typename Field::Element alpha, const typename Field::Element_ptr A, const size_t lda, const typename Field::Element_ptr B, const size_t ldb, const typename Field::Element beta, typename Field::Element *C, const size_t ldc, size_t seuil)`
- `template<class Field>`  
`Field::Element * pfgemm_3D_rec (const Field &F, const FFLAS_TRANSPOSE ta, const FFLAS_TRANSPOSE tb, const size_t m, const size_t n, const size_t k, const typename Field::Element alpha, const typename Field::Element_ptr A, const size_t lda, const typename Field::Element_ptr B, const size_t ldb, const typename Field::Element beta, typename Field::Element_ptr C, const size_t ldc, size_t seuil, size_t *x)`
- `template<class Field>`  
`Field::Element_ptr pfgemm_3D_rec2 (const Field &F, const FFLAS_TRANSPOSE ta, const FFLAS_TRANSPOSE tb, const size_t m, const size_t n, const size_t k, const typename Field::Element alpha, const typename Field::Element_ptr A, const size_t lda, const typename Field::Element_ptr B, const size_t ldb, const typename Field::Element beta, typename Field::Element_ptr C, const size_t ldc, size_t seuil, size_t *x)`
- `template<class Field, class ModeTrait, class Strat, class Param>`  
`std::enable_if<!std::is_same< ModeTrait, ModeCategories::ConvertTo< ElementCategories::RNSElementTag > >::value, typename Field::Element_ptr >::type fgemm (const Field &F, const FFLAS::FFLAS_TRANSPOSE ta, const FFLAS::FFLAS_TRANSPOSE tb, const size_t m, const size_t n, const size_t k, const typename Field::Element alpha, typename Field::ConstElement_ptr A, const size_t lda, typename Field::ConstElement_ptr B, const size_t ldb, const typename Field::Element beta, typename Field::Element_ptr C, const size_t ldc, MMHelper< Field, MMHelperAlgo::Winograd, ModeTrait, ParSeqHelper::Parallel< Strat, Param > > &H)`
- `template<class Field, class Cut, class Param>`  
`Field::Element_ptr ftrsm (const Field &F, const FFLAS::FFLAS_SIDE Side, const FFLAS::FFLAS_UPLO UpLo, const FFLAS::FFLAS_TRANSPOSE TA, const FFLAS::FFLAS_DIAG Diag, const size_t m, const size_t n, const typename Field::Element alpha, typename Field::Element_ptr A, const size_t lda, typename Field::Element_ptr B, const size_t ldb, TRSMHelper< StructureHelper::Iterative, ParSeqHelper::Parallel< Cut, Param > > &H)`
- `template<class Field, class Cut, class Param>`  
`Field::Element_ptr ftrsm (const Field &F, const FFLAS::FFLAS_SIDE Side, const FFLAS::FFLAS_UPLO UpLo, const FFLAS::FFLAS_TRANSPOSE TA, const FFLAS::FFLAS_DIAG Diag, const size_t m, const size_t n, const typename Field::Element alpha, typename Field::Element_ptr A, const size_t lda, typename Field::Element_ptr B, const size_t ldb, TRSMHelper< StructureHelper::Hybrid, ParSeqHelper::Parallel< Cut, Param > > &H)`
- `template<class Field, class SM>`  
`void fspmv (const Field &F, const SM &A, typename Field::ConstElement_ptr x, const typename Field::Element &beta, typename Field::Element_ptr y)`
- `template<class Field, class SM>`  
`void fspmm (const Field &F, const SM &A, size_t blockSize, typename Field::ConstElement_ptr x, int ldx, const typename Field::Element &beta, typename Field::Element_ptr y, int ldy)`
- `template<class Field, class IndexT>`  
`void sparse_init (const Field &F, Sparse< Field, SparseMatrix_t::COO > &A, const IndexT *row, const IndexT *col, typename Field::ConstElement_ptr dat, uint64_t rowdim, uint64_t coldim, uint64_t nnz)`
- `template<class Field, class IndexT>`  
`void sparse_init (const Field &F, Sparse< Field, SparseMatrix_t::COO_ZO > &A, const IndexT *row, const IndexT *col, typename Field::ConstElement_ptr dat, uint64_t rowdim, uint64_t coldim, uint64_t nnz)`
- `template<class Field>`  
`void sparse_delete (const Sparse< Field, SparseMatrix_t::COO > &A)`
- `template<class Field>`  
`void sparse_delete (const Sparse< Field, SparseMatrix_t::COO_ZO > &A)`

- `template<class Field, class IndexT>`  
`void sparse_init (const Field &F, Sparse< Field, SparseMatrix_t::CSR > &A, const IndexT *row, const IndexT *col, typename Field::ConstElement_ptr dat, uint64_t rowdim, uint64_t coldim, uint64_t nnz)`
- `template<class Field, class IndexT>`  
`void sparse_init (const Field &F, Sparse< Field, SparseMatrix_t::CSR_ZO > &A, const IndexT *row, const IndexT *col, typename Field::ConstElement_ptr dat, uint64_t rowdim, uint64_t coldim, uint64_t nnz)`
- `template<class Field>`  
`void sparse_delete (const Sparse< Field, SparseMatrix_t::CSR > &A)`
- `template<class Field>`  
`void sparse_delete (const Sparse< Field, SparseMatrix_t::CSR_ZO > &A)`
- `template<class Field>`  
`std::ostream & sparse_print (std::ostream &os, const Sparse< Field, SparseMatrix_t::CSR > &A)`
- `template<class IndexT>`  
`void sparse_init (const Givaro::Modular< Givaro::Integer > &F, Sparse< Givaro::Modular< Givaro::Integer >, SparseMatrix_t::CSR > &A, const IndexT *row, const IndexT *col, Givaro::Integer *dat, uint64_t rowdim, uint64_t coldim, uint64_t nnz)`
- `template<class IndexT>`  
`void sparse_init (const Givaro::ZRing< Givaro::Integer > &F, Sparse< Givaro::ZRing< Givaro::Integer >, SparseMatrix_t::CSR_ZO > &A, const IndexT *row, const IndexT *col, Givaro::Integer *dat, uint64_t rowdim, uint64_t coldim, uint64_t nnz)`
- `template<class IndexT, size_t RECINT_SIZE>`  
`void sparse_init (const Givaro::ZRing< RecInt::rmint< RECINT_SIZE > > &F, Sparse< Givaro::ZRing< RecInt::rmint< RECINT_SIZE > >, SparseMatrix_t::CSR_ZO > &A, const IndexT *row, const IndexT *col, typename Givaro::ZRing< RecInt::rmint< RECINT_SIZE > >::Element_ptr dat, uint64_t rowdim, uint64_t coldim, uint64_t nnz)`
- `template<class IndexT, size_t RECINT_SIZE>`  
`void sparse_init (const Givaro::ZRing< RecInt::rmint< RECINT_SIZE > > &F, Sparse< Givaro::ZRing< RecInt::rmint< RECINT_SIZE > >, SparseMatrix_t::CSR > &A, const IndexT *row, const IndexT *col, typename Givaro::ZRing< RecInt::rmint< RECINT_SIZE > >::Element_ptr dat, uint64_t rowdim, uint64_t coldim, uint64_t nnz)`
- `template<class Field>`  
`void sparse_delete (const Sparse< Field, SparseMatrix_t::CSR_HYB > &A)`
- `template<class Field, class IndexT>`  
`void sparse_init (const Field &F, Sparse< Field, SparseMatrix_t::CSR_HYB > &A, const IndexT *row, const IndexT *col, typename Field::ConstElement_ptr dat, uint64_t rowdim, uint64_t coldim, uint64_t nnz)`
- `template<class Field, class IndexT>`  
`void sparse_init (const Field &F, Sparse< Field, SparseMatrix_t::ELL > &A, const IndexT *row, const IndexT *col, typename Field::ConstElement_ptr dat, uint64_t rowdim, uint64_t coldim, uint64_t nnz)`
- `template<class Field, class IndexT>`  
`void sparse_init (const Field &F, Sparse< Field, SparseMatrix_t::ELL_ZO > &A, const IndexT *row, const IndexT *col, typename Field::ConstElement_ptr dat, uint64_t rowdim, uint64_t coldim, uint64_t nnz)`
- `template<class Field>`  
`void sparse_delete (const Sparse< Field, SparseMatrix_t::ELL > &A)`
- `template<class Field>`  
`void sparse_delete (const Sparse< Field, SparseMatrix_t::ELL_ZO > &A)`
- `template<class Field, class IndexT>`  
`void sparse_init (const Field &F, Sparse< Field, SparseMatrix_t::ELL_simd > &A, const IndexT *row, const IndexT *col, typename Field::ConstElement_ptr dat, uint64_t rowdim, uint64_t coldim, uint64_t nnz)`
- `template<class Field, class IndexT>`  
`void sparse_init (const Field &F, Sparse< Field, SparseMatrix_t::ELL_simd_ZO > &A, const IndexT *row, const IndexT *col, typename Field::ConstElement_ptr dat, uint64_t rowdim, uint64_t coldim, uint64_t nnz)`
- `template<class Field>`  
`void sparse_delete (const Sparse< Field, SparseMatrix_t::ELL_simd > &A)`
- `template<class Field>`  
`void sparse_delete (const Sparse< Field, SparseMatrix_t::ELL_simd_ZO > &A)`
- `template<class Field>`  
`void sparse_print (const Sparse< Field, SparseMatrix_t::ELL_simd > &A)`



- `template<class Field>`  
`void sparse_delete (const Sparse< Field, SparseMatrix_t::HYB_ZO > &A)`
- `template<class Field, class IndexT>`  
`void sparse_init (const Field &F, Sparse< Field, SparseMatrix_t::HYB_ZO > &A, const IndexT *row, const IndexT *col, typename Field::ConstElement_ptr dat, uint64_t rowdim, uint64_t coldim, uint64_t nnz)`
- `template<typename _Field>`  
`std::ostream & operator<< (std::ostream &os, const Sparse< _Field, SparseMatrix_t::HYB_ZO > &A)`
- `template<class Field, bool sorted = true, bool read_integer = false>`  
`void readSmsFormat (const std::string &path, const Field &f, index_t *&row, index_t *&col, typename Field::Element_ptr &val, index_t &rowdim, index_t &coldim, uint64_t &nnz)`
- `template<class Field>`  
`void readSprFormat (const std::string &path, const Field &f, index_t *&row, index_t *&col, typename Field::Element_ptr &val, index_t &rowdim, index_t &coldim, uint64_t &nnz)`
- `template<class T>`  
`std::enable_if< std::is_integral< T >::value, int > getDataType ()`
- `template<class T>`  
`std::enable_if< std::is_floating_point< T >::value, int > getDataType ()`
- `template<class T>`  
`std::enable_if< std::is_same< T, mpz_t >::value, int > getDataType ()`
- `template<class T>`  
`int getDataType ()`
- `template<class Field>`  
`void readMachineType (const Field &F, typename Field::Element &modulo, typename Field::Element_ptr val, std::ifstream &file, const uint64_t dims, const mask_t data_type, const mask_t field_desc)`
- `template<class Field>`  
`void readDnsFormat (const std::string &path, const Field &F, index_t &rowdim, index_t &coldim, typename Field::Element_ptr &val)`
- `template<class Field>`  
`void writeDnsFormat (const std::string &path, const Field &F, const index_t &rowdim, const index_t &coldim, typename Field::Element_ptr A, index_t lda)`
- `template<class Field>`  
`void fspmv (const Field &F, const Sparse< Field, SparseMatrix_t::SELL_ZO > &A, typename Field::ConstElement_ptr x, typename Field::Element_ptr y, FieldCategories::ModularTag)`
- `template<class Field>`  
`void sparse_delete (const Sparse< Field, SparseMatrix_t::SELL > &A)`
- `template<class Field>`  
`void sparse_delete (const Sparse< Field, SparseMatrix_t::SELL_ZO > &A)`
- `template<class Field>`  
`void sparse_print (const Sparse< Field, SparseMatrix_t::SELL > &A)`
- `template<class Field, class IndexT>`  
`void sparse_init (const Field &F, Sparse< Field, SparseMatrix_t::SELL > &A, const IndexT *row, const IndexT *col, typename Field::ConstElement_ptr dat, uint64_t rowdim, uint64_t coldim, uint64_t nnz, uint64_t sigma=0)`
- `template<class Field, class IndexT>`  
`void sparse_init (const Field &F, Sparse< Field, SparseMatrix_t::SELL_ZO > &A, const IndexT *row, const IndexT *col, typename Field::ConstElement_ptr dat, uint64_t rowdim, uint64_t coldim, uint64_t nnz)`
- `template<class It>`  
`double computeDeviation (It begin, It end)`
- `template<class Field>`  
`StatsMatrix getStat (const Field &F, const index_t *row, const index_t *col, typename Field::ConstElement_ptr val, uint64_t rowdim, uint64_t coldim, uint64_t nnz)`
- `template<typename Field, typename Simd = Simd<typename Field::Element>, size_t bs = FFLAS_TRANSPOSE_BLOCKSIZE,`  
`typename std::enable_if< Simd::template is_same_element< Field >::value >::type * = nullptr, typename std::enable_if< bs > = 1`  
`&& bs % Simd::vect_size == 0, ::type * = nullptr>`  
`Field::Element_ptr transpose (const Field &F, const size_t m, const size_t n, typename Field::ConstElement_ptr A, const size_t lda, typename Field::Element_ptr B, const size_t ldb)`

- template<class [Field](#), class enable = void>  
Field::Residu\_t [maxCardinality](#) ()
- template<> uint64\_t [maxCardinality](#)< Givaro::Modular< int64\_t > > ()
- template<> uint32\_t [maxCardinality](#)< Givaro::Modular< int32\_t > > ()
- template<class [Field](#)>  
Field::Residu\_t [minCardinality](#) ()
- template<> void [fflas\\_delete](#) (FFPACK::rns\_double\_elt\_ptr A)
- template<> void [fflas\\_delete](#) (FFPACK::rns\_double\_elt\_cstptr A)
- template<> [FFPACK::rns\\_double\\_elt\\_ptr fflas\\_new](#) (const [FFPACK::RNSIntegerMod](#)< [FFPACK::rns\\_double](#) > &F, const size\_t m, const Alignment align)
- template<> [FFPACK::rns\\_double\\_elt\\_ptr fflas\\_new](#) (const [FFPACK::RNSIntegerMod](#)< [FFPACK::rns\\_double](#) > &F, const size\_t m, const size\_t n, const Alignment align)
- template<typename [RNS](#)>  
void [finit\\_rns](#) (const [FFPACK::RNSIntegerMod](#)< [RNS](#) > &F, const size\_t m, const size\_t n, size\_t k, const Givaro::Integer \*B, const size\_t ldb, typename [RNS::Element\\_ptr](#) A)
- template<typename [RNS](#)>  
void [finit\\_trans\\_rns](#) (const [FFPACK::RNSIntegerMod](#)< [RNS](#) > &F, const size\_t m, const size\_t n, size\_t k, const Givaro::Integer \*B, const size\_t ldb, typename [RNS::Element\\_ptr](#) A)
- template<typename [RNS](#)>  
void [fconvert\\_rns](#) (const [FFPACK::RNSIntegerMod](#)< [RNS](#) > &F, const size\_t m, const size\_t n, Givaro::Integer alpha, Givaro::Integer \*B, const size\_t ldb, typename [RNS::ConstElement\\_ptr](#) A)
- template<typename [RNS](#)>  
void [fconvert\\_trans\\_rns](#) (const [FFPACK::RNSIntegerMod](#)< [RNS](#) > &F, const size\_t m, const size\_t n, Givaro::Integer alpha, Givaro::Integer \*B, const size\_t ldb, typename [RNS::ConstElement\\_ptr](#) A)
- template<> [FFPACK::rns\\_double\\_elt\\_ptr fflas\\_new](#) (const [FFPACK::RNSInteger](#)< [FFPACK::rns\\_double](#) > &F, const size\_t m, const Alignment align)
- template<> [FFPACK::rns\\_double\\_elt\\_ptr fflas\\_new](#) (const [FFPACK::RNSInteger](#)< [FFPACK::rns\\_double](#) > &F, const size\_t m, const size\_t n, const Alignment align)
- template<typename [RNS](#)>  
void [finit\\_rns](#) (const [FFPACK::RNSInteger](#)< [RNS](#) > &F, const size\_t m, const size\_t n, size\_t k, const Givaro::Integer \*B, const size\_t ldb, typename [FFPACK::RNSInteger](#)< [RNS](#) >::Element\_ptr A)
- template<typename [RNS](#)>  
void [fconvert\\_rns](#) (const [FFPACK::RNSInteger](#)< [RNS](#) > &F, const size\_t m, const size\_t n, Givaro::Integer alpha, Givaro::Integer \*B, const size\_t ldb, typename [FFPACK::RNSInteger](#)< [RNS](#) >::ConstElement\_ptr A)
- template [INST\\_OR\\_DECL](#) void [freduce](#) (const [FFLAS\\_FIELD](#)< [FFLAS\\_ELT](#) > &F, const size\_t n, [FFLAS\\_ELT](#) \*X, const size\_t incX)  
$$\text{freduce } x \leftarrow x \bmod F.$$
- template [INST\\_OR\\_DECL](#) void [freduce](#) (const [FFLAS\\_FIELD](#)< [FFLAS\\_ELT](#) > &F, const size\_t n, const [FFLAS\\_ELT](#) \*Y, const size\_t incY, [FFLAS\\_ELT](#) \*X, const size\_t incX)  
$$\text{freduce } x \leftarrow y \bmod F.$$
- template [INST\\_OR\\_DECL](#) void [finit](#) (const [FFLAS\\_FIELD](#)< [FFLAS\\_ELT](#) > &F, const size\_t n, const [FFLAS\\_ELT](#) \*Y, const size\_t incY, [FFLAS\\_ELT](#) \*X, const size\_t incX)  
$$\text{finit } x \leftarrow y \bmod F.$$
- template [INST\\_OR\\_DECL](#) void [fconvert](#) (const [FFLAS\\_FIELD](#)< [FFLAS\\_ELT](#) > &F, const size\_t n, [FFLAS\\_ELT](#) \*X, const size\_t incX, const [FFLAS\\_ELT](#) \*Y, const size\_t incY)  
$$\text{fconvert } x \leftarrow y \bmod F.$$
- template [INST\\_OR\\_DECL](#) void [fnegin](#) (const [FFLAS\\_FIELD](#)< [FFLAS\\_ELT](#) > &F, const size\_t n, [FFLAS\\_ELT](#) \*X, const size\_t incX)  
$$\text{fnegin } x \leftarrow -x.$$
- template [INST\\_OR\\_DECL](#) void [fneg](#) (const [FFLAS\\_FIELD](#)< [FFLAS\\_ELT](#) > &F, const size\_t n, const [FFLAS\\_ELT](#) \*Y, const size\_t incY, [FFLAS\\_ELT](#) \*X, const size\_t incX)  
$$\text{fneg } x \leftarrow -y.$$
- template [INST\\_OR\\_DECL](#) void [fzero](#) (const [FFLAS\\_FIELD](#)< [FFLAS\\_ELT](#) > &F, const size\_t n, [FFLAS\\_ELT](#) \*X, const size\_t incX)  
$$\text{fzero : } A \leftarrow 0.$$

- template `INST_OR_DECL` bool `fiszero` (const `FFLAS_FIELD`< `FFLAS_ELT` > &F, const `size_t` n, const `FFLAS_ELT` \*X, const `size_t` incX)  

$$fiszero : test X = 0.$$
- template `INST_OR_DECL` bool `fequal` (const `FFLAS_FIELD`< `FFLAS_ELT` > &F, const `size_t` n, const `FFLAS_ELT` \*X, const `size_t` incX, const `FFLAS_ELT` \*Y, const `size_t` incY)  

$$fequal : test X = Y.$$
- template `INST_OR_DECL` void `fassign` (const `FFLAS_FIELD`< `FFLAS_ELT` > &F, const `size_t` N, const `FFLAS_ELT` \*Y, const `size_t` incY, `FFLAS_ELT` \*X, const `size_t` incX)  

$$fassign : x \leftarrow y.$$
- template `INST_OR_DECL` void `fscal` (const `FFLAS_FIELD`< `FFLAS_ELT` > &F, const `size_t` n, const `FFLAS_ELT` alpha, `FFLAS_ELT` \*X, const `size_t` incX)  

$$fscal : x \leftarrow \alpha \cdot x.$$
- template `INST_OR_DECL` void `fscal` (const `FFLAS_FIELD`< `FFLAS_ELT` > &F, const `size_t` n, const `FFLAS_ELT` alpha, const `FFLAS_ELT` \*X, const `size_t` incX, `FFLAS_ELT` \*Y, const `size_t` incY)  

$$fscal : y \leftarrow \alpha \cdot x.$$
- template `INST_OR_DECL` void `faxpy` (const `FFLAS_FIELD`< `FFLAS_ELT` > &F, const `size_t` N, const `FFLAS_ELT` alpha, const `FFLAS_ELT` \*X, const `size_t` incX, `FFLAS_ELT` \*Y, const `size_t` incY)  

$$faxpy : y \leftarrow \alpha \cdot x + y.$$
- template `INST_OR_DECL` `FFLAS_ELT` `fdot` (const `FFLAS_FIELD`< `FFLAS_ELT` > &F, const `size_t` N, const `FFLAS_ELT` \*X, const `size_t` incX, const `FFLAS_ELT` \*Y, const `size_t` incY)  

$$faxpy : y \leftarrow \alpha \cdot x + \beta \cdot y.$$
- template `INST_OR_DECL` void `fswap` (const `FFLAS_FIELD`< `FFLAS_ELT` > &F, const `size_t` N, `FFLAS_ELT` \*X, const `size_t` incX, `FFLAS_ELT` \*Y, const `size_t` incY)  

$$fswap : X \leftrightarrow Y.$$
- template `INST_OR_DECL` void `fadd` (const `FFLAS_FIELD`< `FFLAS_ELT` > &F, const `size_t` N, const `FFLAS_ELT` \*A, const `size_t` inca, const `FFLAS_ELT` \*B, const `size_t` incb, `FFLAS_ELT` \*C, const `size_t` incc)
- template `INST_OR_DECL` void `fsub` (const `FFLAS_FIELD`< `FFLAS_ELT` > &F, const `size_t` N, const `FFLAS_ELT` \*A, const `size_t` inca, const `FFLAS_ELT` \*B, const `size_t` incb, `FFLAS_ELT` \*C, const `size_t` incc)
- template `INST_OR_DECL` void `faddin` (const `FFLAS_FIELD`< `FFLAS_ELT` > &F, const `size_t` N, const `FFLAS_ELT` \*B, const `size_t` incb, `FFLAS_ELT` \*C, const `size_t` incc)
- template `INST_OR_DECL` void `fadd` (const `FFLAS_FIELD`< `FFLAS_ELT` > &F, const `size_t` N, const `FFLAS_ELT` \*A, const `size_t` inca, const `FFLAS_ELT` alpha, const `FFLAS_ELT` \*B, const `size_t` incb, `FFLAS_ELT` \*C, const `size_t` incc)
- template `INST_OR_DECL` void `fassign` (const `FFLAS_FIELD`< `FFLAS_ELT` > &F, const `size_t` m, const `size_t` n, const `FFLAS_ELT` \*B, const `size_t` ldb, `FFLAS_ELT` \*A, const `size_t` lda)  

$$fassign : A \leftarrow B.$$
- template `INST_OR_DECL` void `fzero` (const `FFLAS_FIELD`< `FFLAS_ELT` > &F, const `size_t` m, const `size_t` n, `FFLAS_ELT` \*A, const `size_t` lda)  

$$fzero : A \leftarrow 0.$$
- template `INST_OR_DECL` bool `fequal` (const `FFLAS_FIELD`< `FFLAS_ELT` > &F, const `size_t` m, const `size_t` n, const `FFLAS_ELT` \*A, const `size_t` lda, const `FFLAS_ELT` \*B, const `size_t` ldb)  

$$fequal : test A = B.$$
- template `INST_OR_DECL` bool `fiszero` (const `FFLAS_FIELD`< `FFLAS_ELT` > &F, const `size_t` m, const `size_t` n, const `FFLAS_ELT` \*A, const `size_t` lda)  

$$fiszero : test A = 0.$$
- template `INST_OR_DECL` void `fidentity` (const `FFLAS_FIELD`< `FFLAS_ELT` > &F, const `size_t` m, const `size_t` n, `FFLAS_ELT` \*A, const `size_t` lda, const `FFLAS_ELT` &d)  

$$creates a diagonal matrix$$
- template `INST_OR_DECL` void `fidentity` (const `FFLAS_FIELD`< `FFLAS_ELT` > &F, const `size_t` m, const `size_t` n, `FFLAS_ELT` \*A, const `size_t` lda)  

$$creates a diagonal matrix$$

- template `INST_OR_DECL` void `freduce` (const `FFLAS_FIELD`< `FFLAS_ELT` > &F, const size\_t m, const size\_t n, `FFLAS_ELT` \*A, const size\_t lda)  

$$\text{freduce } A \leftarrow A \bmod F.$$
- template `INST_OR_DECL` void `freduce` (const `FFLAS_FIELD`< `FFLAS_ELT` > &F, const size\_t m, const size\_t n, const `FFLAS_ELT` \*B, const size\_t ldb, `FFLAS_ELT` \*A, const size\_t lda)  

$$\text{freduce } A \leftarrow B \bmod F.$$
- template `INST_OR_DECL` void `finit` (const `FFLAS_FIELD`< `FFLAS_ELT` > &F, const size\_t m, const size\_t n, const `FFLAS_ELT` \*B, const size\_t ldb, `FFLAS_ELT` \*A, const size\_t lda)  

$$\text{finit } A \leftarrow B \bmod F.$$
- template `INST_OR_DECL` void `fnegin` (const `FFLAS_FIELD`< `FFLAS_ELT` > &F, const size\_t m, const size\_t n, `FFLAS_ELT` \*A, const size\_t lda)  

$$\text{fnegin } A \leftarrow -A.$$
- template `INST_OR_DECL` void `fneg` (const `FFLAS_FIELD`< `FFLAS_ELT` > &F, const size\_t m, const size\_t n, const `FFLAS_ELT` \*B, const size\_t ldb, `FFLAS_ELT` \*A, const size\_t lda)  

$$\text{fneg } A \leftarrow -B.$$
- template `INST_OR_DECL` void `fscaln` (const `FFLAS_FIELD`< `FFLAS_ELT` > &F, const size\_t m, const size\_t n, const `FFLAS_ELT` alpha, `FFLAS_ELT` \*A, const size\_t lda)  

$$\text{fscaln } A \leftarrow a \cdot A.$$
- template `INST_OR_DECL` void `fscal` (const `FFLAS_FIELD`< `FFLAS_ELT` > &F, const size\_t m, const size\_t n, const `FFLAS_ELT` alpha, const `FFLAS_ELT` \*A, const size\_t lda, `FFLAS_ELT` \*B, const size\_t ldb)  

$$\text{fscal } B \leftarrow a \cdot A.$$
- template `INST_OR_DECL` void `faxpy` (const `FFLAS_FIELD`< `FFLAS_ELT` > &F, const size\_t m, const size\_t n, const `FFLAS_ELT` alpha, const `FFLAS_ELT` \*X, const size\_t idx, `FFLAS_ELT` \*Y, const size\_t ldy)  

$$\text{faxpy} : y \leftarrow \alpha \cdot x + y.$$
- template `INST_OR_DECL` void `fmove` (const `FFLAS_FIELD`< `FFLAS_ELT` > &F, const size\_t m, const size\_t n, `FFLAS_ELT` \*A, const size\_t lda, `FFLAS_ELT` \*B, const size\_t ldb)  

$$\text{faxpby} : y \leftarrow \alpha \cdot x + \beta \cdot y.$$
- template `INST_OR_DECL` void `fadd` (const `FFLAS_FIELD`< `FFLAS_ELT` > &F, const size\_t M, const size\_t N, const `FFLAS_ELT` \*A, const size\_t lda, const `FFLAS_ELT` \*B, const size\_t ldb, `FFLAS_ELT` \*C, const size\_t ldc)  

$$\text{fadd} : \text{matrix addition.}$$
- template `INST_OR_DECL` void `fsub` (const `FFLAS_FIELD`< `FFLAS_ELT` > &F, const size\_t M, const size\_t N, const `FFLAS_ELT` \*A, const size\_t lda, const `FFLAS_ELT` \*B, const size\_t ldb, `FFLAS_ELT` \*C, const size\_t ldc)  

$$\text{fsub} : \text{matrix subtraction.}$$
- template `INST_OR_DECL` void `fsubin` (const `FFLAS_FIELD`< `FFLAS_ELT` > &F, const size\_t M, const size\_t N, const `FFLAS_ELT` \*B, const size\_t ldb, `FFLAS_ELT` \*C, const size\_t ldc)  

$$\text{fsubin } C = C - B$$
- template `INST_OR_DECL` void `fadd` (const `FFLAS_FIELD`< `FFLAS_ELT` > &F, const size\_t M, const size\_t N, const `FFLAS_ELT` \*A, const size\_t lda, const `FFLAS_ELT` alpha, const `FFLAS_ELT` \*B, const size\_t ldb, `FFLAS_ELT` \*C, const size\_t ldc)  

$$\text{fadd} : \text{matrix addition with scaling.}$$
- template `INST_OR_DECL` void `faddin` (const `FFLAS_FIELD`< `FFLAS_ELT` > &F, const size\_t M, const size\_t N, const `FFLAS_ELT` \*B, const size\_t ldb, `FFLAS_ELT` \*C, const size\_t ldc)  

$$\text{faddin}$$
- template `INST_OR_DECL` `FFLAS_ELT` \* `fgemv` (const `FFLAS_FIELD`< `FFLAS_ELT` > &F, const `FFLAS_TRANSPOSE` TransA, const size\_t M, const size\_t N, const `FFLAS_ELT` alpha, const `FFLAS_ELT` \*A, const size\_t lda, const `FFLAS_ELT` \*X, const size\_t incX, const `FFLAS_ELT` beta, `FFLAS_ELT` \*Y, const size\_t incY)  

$$\text{finite prime } \text{FFLAS\_FIELD}<\text{FFLAS\_ELT}> \text{ GEneral Matrix Vector multiplication.}$$
- template `INST_OR_DECL` void `fger` (const `FFLAS_FIELD`< `FFLAS_ELT` > &F, const size\_t M, const size\_t N, const `FFLAS_ELT` alpha, const `FFLAS_ELT` \*x, const size\_t incx, const `FFLAS_ELT` \*y, const size\_t incy, `FFLAS_ELT` \*A, const size\_t lda)

*fger*: rank one update of a general matrix

- template [INST\\_OR\\_DECL](#) void [ftrsv](#) (const [FFLAS\\_FIELD](#)< [FFLAS\\_ELT](#) > &F, const [FFLAS\\_UPLO](#) Uplo, const [FFLAS\\_TRANSPOSE](#) TransA, const [FFLAS\\_DIAG](#) Diag, const size\_t N, const [FFLAS\\_ELT](#) \*A, const size\_t lda, [FFLAS\\_ELT](#) \*X, int incX)

*ftrsv*: *TRI*angular System solve with Vector Computes  $X \leftarrow \text{op}(A^{-1})X$

- template [INST\\_OR\\_DECL](#) void [ftrsm](#) (const [FFLAS\\_FIELD](#)< [FFLAS\\_ELT](#) > &F, const [FFLAS\\_SIDE](#) Side, const [FFLAS\\_UPLO](#) Uplo, const [FFLAS\\_TRANSPOSE](#) TransA, const [FFLAS\\_DIAG](#) Diag, const size\_t M, const size\_t N, const [FFLAS\\_ELT](#) alpha, const [FFLAS\\_ELT](#) \*A, const size\_t lda, [FFLAS\\_ELT](#) \*B, const size\_t ldb)

*ftrsm*: *TRI*angular System solve with *M*atrix.

- template [INST\\_OR\\_DECL](#) void [ftrmm](#) (const [FFLAS\\_FIELD](#)< [FFLAS\\_ELT](#) > &F, const [FFLAS\\_SIDE](#) Side, const [FFLAS\\_UPLO](#) Uplo, const [FFLAS\\_TRANSPOSE](#) TransA, const [FFLAS\\_DIAG](#) Diag, const size\_t M, const size\_t N, const [FFLAS\\_ELT](#) alpha, const [FFLAS\\_ELT](#) \*A, const size\_t lda, [FFLAS\\_ELT](#) \*B, const size\_t ldb)

*ftrmm*: *TRI*angular *M*atrix *M*ultiply.

- template [INST\\_OR\\_DECL](#) [FFLAS\\_ELT](#) \* [fgemm](#) (const [FFLAS\\_FIELD](#)< [FFLAS\\_ELT](#) > &F, const [FFLAS\\_TRANSPOSE](#) ta, const [FFLAS\\_TRANSPOSE](#) tb, const size\_t m, const size\_t n, const size\_t k, const [FFLAS\\_ELT](#) alpha, const [FFLAS\\_ELT](#) \*A, const size\_t lda, const [FFLAS\\_ELT](#) \*B, const size\_t ldb, const [FFLAS\\_ELT](#) beta, [FFLAS\\_ELT](#) \*C, const size\_t ldc)

*fgemm*: *F*ield *GE*neral *M*atrix *M*ultiply.

- template [INST\\_OR\\_DECL](#) [FFLAS\\_ELT](#) \* [fgemm](#) (const [FFLAS\\_FIELD](#)< [FFLAS\\_ELT](#) > &F, const [FFLAS\\_TRANSPOSE](#) ta, const [FFLAS\\_TRANSPOSE](#) tb, const size\_t m, const size\_t n, const size\_t k, const [FFLAS\\_ELT](#) alpha, const [FFLAS\\_ELT](#) \*A, const size\_t lda, const [FFLAS\\_ELT](#) \*B, const size\_t ldb, const [FFLAS\\_ELT](#) beta, [FFLAS\\_ELT](#) \*C, const size\_t ldc, const [ParSeqHelper::Sequential](#) seq)
- template [INST\\_OR\\_DECL](#) [FFLAS\\_ELT](#) \* [fgemm](#) (const [FFLAS\\_FIELD](#)< [FFLAS\\_ELT](#) > &F, const [FFLAS\\_TRANSPOSE](#) ta, const [FFLAS\\_TRANSPOSE](#) tb, const size\_t m, const size\_t n, const size\_t k, const [FFLAS\\_ELT](#) alpha, const [FFLAS\\_ELT](#) \*A, const size\_t lda, const [FFLAS\\_ELT](#) \*B, const size\_t ldb, const [FFLAS\\_ELT](#) beta, [FFLAS\\_ELT](#) \*C, const size\_t ldc, const [ParSeqHelper::Parallel](#)< [CuttingStrategy::Recursive](#), [StrategyParameter::TwoDAdaptive](#) > par)
- template [INST\\_OR\\_DECL](#) [FFLAS\\_ELT](#) \* [fgemm](#) (const [FFLAS\\_FIELD](#)< [FFLAS\\_ELT](#) > &F, const [FFLAS\\_TRANSPOSE](#) ta, const [FFLAS\\_TRANSPOSE](#) tb, const size\_t m, const size\_t n, const size\_t k, const [FFLAS\\_ELT](#) alpha, const [FFLAS\\_ELT](#) \*A, const size\_t lda, const [FFLAS\\_ELT](#) \*B, const size\_t ldb, const [FFLAS\\_ELT](#) beta, [FFLAS\\_ELT](#) \*C, const size\_t ldc, const [ParSeqHelper::Parallel](#)< [CuttingStrategy::Block](#), [StrategyParameter::Threads](#) > par)
- template [INST\\_OR\\_DECL](#) [FFLAS\\_ELT](#) \* [fsquare](#) (const [FFLAS\\_FIELD](#)< [FFLAS\\_ELT](#) > &F, const [FFLAS\\_TRANSPOSE](#) ta, const size\_t n, const [FFLAS\\_ELT](#) alpha, const [FFLAS\\_ELT](#) \*A, const size\_t lda, const [FFLAS\\_ELT](#) beta, [FFLAS\\_ELT](#) \*C, const size\_t ldc)

*fsquare*: Squares a matrix.

- template<class Cut = [CuttingStrategy::Block](#), class Strat = [StrategyParameter::Threads](#)>  
void [BlockCuts](#) (size\_t &RBLOCKSIZE, size\_t &CBLOCKSIZE, const size\_t m, const size\_t n, const size\_t numthreads)
- template<> void [BlockCuts](#)< [CuttingStrategy::Single](#), [StrategyParameter::Threads](#) > (size\_t &RBLOCKSIZE, size\_t &CBLOCKSIZE, const size\_t m, const size\_t n, const size\_t numthreads)
- template<> void [BlockCuts](#)< [CuttingStrategy::Row](#), [StrategyParameter::Fixed](#) > (size\_t &RBLOCKSIZE, size\_t &CBLOCKSIZE, const size\_t m, const size\_t n, const size\_t numthreads)
- template<> void [BlockCuts](#)< [CuttingStrategy::Row](#), [StrategyParameter::Grain](#) > (size\_t &RBLOCKSIZE, size\_t &CBLOCKSIZE, const size\_t m, const size\_t n, const size\_t grainsize)
- template<> void [BlockCuts](#)< [CuttingStrategy::Block](#), [StrategyParameter::Grain](#) > (size\_t &RBLOCKSIZE, size\_t &CBLOCKSIZE, const size\_t m, const size\_t n, const size\_t grainsize)
- template<> void [BlockCuts](#)< [CuttingStrategy::Column](#), [StrategyParameter::Fixed](#) > (size\_t &RBLOCKSIZE, size\_t &CBLOCKSIZE, const size\_t m, const size\_t n, const size\_t numthreads)
- template<> void [BlockCuts](#)< [CuttingStrategy::Column](#), [StrategyParameter::Grain](#) > (size\_t &RBLOCKSIZE, size\_t &CBLOCKSIZE, const size\_t m, const size\_t n, const size\_t grainsize)
- template<> void [BlockCuts](#)< [CuttingStrategy::Block](#), [StrategyParameter::Fixed](#) > (size\_t &RBLOCKSIZE, size\_t &CBLOCKSIZE, const size\_t m, const size\_t n, const size\_t numthreads)

- `template<> void BlockCuts< CuttingStrategy::Row, StrategyParameter::Threads > (size_t &RBLOCKSIZE, size_t &CBLOCKSIZE, const size_t m, const size_t n, const size_t numthreads)`
- `template<> void BlockCuts< CuttingStrategy::Column, StrategyParameter::Threads > (size_t &RBLOCKSIZE, size_t &CBLOCKSIZE, const size_t m, const size_t n, const size_t numthreads)`
- `template<> void BlockCuts< CuttingStrategy::Block, StrategyParameter::Threads > (size_t &RBLOCKSIZE, size_t &CBLOCKSIZE, const size_t m, const size_t n, const size_t numthreads)`
- `template<class Cut = CuttingStrategy::Block, class Param = StrategyParameter::Threads>  
void BlockCuts (size_t &rowBlockSize, size_t &colBlockSize, size_t &lastRBS, size_t &lastCBS, size_t &changeRBS, size_t &changeCBS, size_t &numRowBlock, size_t &numColBlock, size_t m, size_t n, const size_t numthreads)`
- `template<class Field>  
void pfzero (const Field &F, size_t m, size_t n, typename Field::Element_ptr C, size_t BS=0)`
- `template<class Field, class RandIter>  
void pfrand (const Field &F, RandIter &G, size_t m, size_t n, typename Field::Element_ptr C, size_t BS=0)`
- `template<class Field, class Cut, class Param>  
Field::Element &fdot (const Field &F, const size_t N, typename Field::ConstElement_ptr x, const size_t incx, typename Field::ConstElement_ptr y, const size_t incy, typename Field::Element &d, const ParSeqHelper::Parallel< Cut, Param > par)`
- `template<class Field, class AlgoT, class FieldTrait>  
Field::Element * pfgemm (const Field &F, const FFLAS_TRANSPOSE ta, const FFLAS_TRANSPOSE tb, const size_t m, const size_t n, const size_t k, const typename Field::Element alpha, const typename Field::ConstElement_ptr A, const size_t lda, const typename Field::ConstElement_ptr B, const size_t ldb, const typename Field::Element beta, typename Field::Element *C, const size_t ldc, MMHelper< Field, AlgoT, FieldTrait, ParSeqHelper::Parallel< CuttingStrategy::Block, StrategyParameter::Threads > > &H)`
- `template<class Field, class AlgoT, class FieldTrait>  
Field::Element * pfgemm (const Field &F, const FFLAS_TRANSPOSE ta, const FFLAS_TRANSPOSE tb, const size_t m, const size_t n, const size_t k, const typename Field::Element alpha, const typename Field::ConstElement_ptr AA, const size_t lda, const typename Field::ConstElement_ptr BB, const size_t ldb, const typename Field::Element beta, typename Field::Element *C, const size_t ldc, MMHelper< Field, AlgoT, FieldTrait, ParSeqHelper::Parallel< CuttingStrategy::Recursive, StrategyParameter::ThreeDAdaptive > > &H)`
- `template<class Field, class AlgoT, class FieldTrait>  
Field::Element * pfgemm (const Field &F, const FFLAS_TRANSPOSE ta, const FFLAS_TRANSPOSE tb, const size_t m, const size_t n, const size_t k, const typename Field::Element alpha, const typename Field::ConstElement_ptr AA, const size_t lda, const typename Field::ConstElement_ptr BB, const size_t ldb, const typename Field::Element beta, typename Field::Element *C, const size_t ldc, MMHelper< Field, AlgoT, FieldTrait, ParSeqHelper::Parallel< CuttingStrategy::Recursive, StrategyParameter::TwoDAdaptive > > &H)`
- `template<class Field, class AlgoT, class FieldTrait>  
Field::Element * pfgemm (const Field &F, const FFLAS_TRANSPOSE ta, const FFLAS_TRANSPOSE tb, const size_t m, const size_t n, const size_t k, const typename Field::Element alpha, const typename Field::ConstElement_ptr AA, const size_t lda, const typename Field::ConstElement_ptr BB, const size_t ldb, const typename Field::Element beta, typename Field::Element *C, const size_t ldc, MMHelper< Field, AlgoT, FieldTrait, ParSeqHelper::Parallel< CuttingStrategy::Recursive, StrategyParameter::TwoD > > &H)`
- `template<class Field, class AlgoT, class FieldTrait>  
Field::Element_ptr pfgemm (const Field &F, const FFLAS_TRANSPOSE ta, const FFLAS_TRANSPOSE tb, const size_t m, const size_t n, const size_t k, const typename Field::Element alpha, const typename Field::ConstElement_ptr A, const size_t lda, const typename Field::ConstElement_ptr B, const size_t ldb, const typename Field::Element beta, typename Field::Element_ptr C, const size_t ldc, MMHelper< Field, AlgoT, FieldTrait, ParSeqHelper::Parallel< CuttingStrategy::Recursive, StrategyParameter::ThreeD > > &H)`
- `template<class Field, class AlgoT, class FieldTrait>  
Field::Element * pfgemm (const Field &F, const FFLAS_TRANSPOSE ta, const FFLAS_TRANSPOSE tb, const size_t m, const size_t n, const size_t k, const typename Field::Element alpha, const typename Field::ConstElement_ptr A, const size_t lda, const typename Field::ConstElement_ptr B, const size_t ldb, const typename Field::Element beta, typename Field::Element_ptr C, const size_t ldc, MMHelper< Field, AlgoT, FieldTrait, ParSeqHelper::Parallel< CuttingStrategy::Recursive, StrategyParameter::ThreeDInPlace > > &H)`



- `template<class Field, class AlgoT, class FieldTrait>`  
`Field::Element_ptr fgemv` (const `Field` &F, const `FFLAS_TRANSPOSE` ta, const `size_t` m, const `size_t` n, const typename `Field::Element` alpha, const typename `Field::ConstElement_ptr` A, const `size_t` lda, const typename `Field::ConstElement_ptr` X, const `size_t` incX, const typename `Field::Element` beta, typename `Field::Element_ptr` Y, const `size_t` incY, `MMHelper`< `Field`, `AlgoT`, `FieldTrait`, `ParSeqHelper::Parallel`< `CuttingStrategy::Recursive`, `StrategyParameter::Threads` > > &H)
- `template<class Field, class AlgoT, class FieldTrait, class Cut>`  
`Field::Element_ptr fgemv` (const `Field` &F, const `FFLAS_TRANSPOSE` ta, const `size_t` m, const `size_t` n, const typename `Field::Element` alpha, const typename `Field::ConstElement_ptr` A, const `size_t` lda, const typename `Field::ConstElement_ptr` X, const `size_t` incX, const typename `Field::Element` beta, typename `Field::Element_ptr` Y, const `size_t` incY, `MMHelper`< `Field`, `AlgoT`, `FieldTrait`, `ParSeqHelper::Parallel`< `CuttingStrategy::Row`, `Cut` > > &H)
- `void parseArguments` (int argc, char \*\*argv, `Argument` \*args, bool printDefaults=true)
- `char * getArgumentValue` (int argc, char \*\*argv, int i)  
*Get the value of an argument and avoid core dump when no value was given after an argument.*
- `std::ostream & writeCommandString` (std::ostream &os, `Argument` \*args, const char \*programName=nullptr)  
*writes the values of all arguments, preceded by the programName*
- `template<class Field>`  
`std::ostream & WriteMatrix` (std::ostream &c, const `Field` &F, `size_t` m, `size_t` n, typename `Field::ConstElement_ptr` A, `size_t` lda, `FFLAS_FORMAT` format, bool column\_major)  
*WriteMatrix: write a matrix to an output stream.*
- `void preamble` (std::ifstream &if, `FFLAS_FORMAT` &format)
- `template<class Field>`  
`Field::Element_ptr ReadMatrix` (std::ifstream &if, `Field` &F, `size_t` &m, `size_t` &n, typename `Field::Element_ptr` &A, `FFLAS_FORMAT` format=`FflasAuto`)  
*ReadMatrix: read a matrix from an input stream.*
- `template<class Field>`  
`Field::Element_ptr ReadMatrix` (const std::string &matrix\_file, `Field` &F, `size_t` &m, `size_t` &n, typename `Field::Element_ptr` &A, `FFLAS_FORMAT` format=`FflasAuto`)  
*ReadMatrix: read a matrix from a file.*
- `template<class Field>`  
`void WriteMatrix` (std::string &matrix\_file, const `Field` &F, int m, int n, typename `Field::ConstElement_ptr` A, `size_t` lda, `FFLAS_FORMAT` format=`FflasDense`, bool column\_major=false)  
*WriteMatrix: write a matrix to a file.*
- `std::ostream & WritePermutation` (std::ostream &c, const `size_t` \*P, `size_t` N)  
*WritePermutation: write a permutation matrix to an output stream.*
- `template<class Element>`  
`bool alignable` ()
- `template<> bool alignable`< `Givaro::Integer` \* > ()
- `template<class Field>`  
`Field::Element_ptr fflas_new` (const `Field` &F, const `size_t` m, const `Alignment` align=`Alignment::DEFAULT`)
- `template<class Field>`  
`Field::Element_ptr fflas_new` (const `Field` &F, const `size_t` m, const `size_t` n, const `Alignment` align=`Alignment::DEFAULT`)
- `template<class Element>`  
`Element * fflas_new` (const `size_t` m, const `Alignment` align=`Alignment::DEFAULT`)
- `template<class Element_ptr>`  
`void fflas_delete` (`Element_ptr` A)
- `template<class Ptr, class ... Args>`  
`void fflas_delete` (Ptr p, Args ... args)
- `void prefetch` (const int64\_t \*)
- `void getTLBSize` (int &tlb)
- `void queryCacheSizes` (int &l1, int &l2, int &l3)
- `int queryL1CacheSize` ()
- `int queryTopLevelCacheSize` ()
- `uint64_t getSeed` ()

### 11.1.1 Typedef Documentation

#### 11.1.1.1 Checker\_fgemm

```
template<class Field>
using Checker_fgemm = FFLAS::Checker_Empty<Field>
```

#### 11.1.1.2 Checker\_ftrsm

```
template<class Field>
using Checker_ftrsm = FFLAS::Checker_Empty<Field>
```

#### 11.1.1.3 ForceCheck\_fgemm

```
template<class Field>
using ForceCheck_fgemm = CheckerImplem_fgemm<Field>
```

#### 11.1.1.4 ForceCheck\_ftrsm

```
template<class Field>
using ForceCheck_ftrsm = CheckerImplem_ftrsm<Field>
```

#### 11.1.1.5 ZOSparseMatrix

```
using ZOSparseMatrix = std::true_type
```

#### 11.1.1.6 NotZOSparseMatrix

```
using NotZOSparseMatrix = std::false_type
```

#### 11.1.1.7 SimdSparseMatrix

```
using SimdSparseMatrix = std::true_type
```

#### 11.1.1.8 NoSimdSparseMatrix

```
using NoSimdSparseMatrix = std::false_type
```

#### 11.1.1.9 MKLSparseMatrixFormat

```
using MKLSparseMatrixFormat = std::true_type
```



#### 11.1.1.10 NotMKLSparseMatrixFormat

```
using NotMKLSparseMatrixFormat = std::false_type
```

#### 11.1.1.11 has\_plus

```
template<class T>
using has_plus = typename std::conditional<std::is_arithmetic<T>::value, std::true_type,
has_plus_impl<T>>::type
```

#### 11.1.1.12 has\_minus

```
template<class T>
using has_minus = typename std::conditional<std::is_arithmetic<T>::value, std::true_type,
has_minus_impl<T>>::type
```

#### 11.1.1.13 has\_equal

```
template<class T>
using has_equal = typename std::conditional<std::is_arithmetic<T>::value, std::true_type,
std::is_copy_assignable<T>>::type
```

#### 11.1.1.14 has\_plus\_eq

```
template<class T>
using has_plus_eq = typename std::conditional<std::is_arithmetic<T>::value, std::true_type,
has_plus_eq_impl<T>>::type
```

#### 11.1.1.15 has\_minus\_eq

```
template<class T>
using has_minus_eq = typename std::conditional<std::is_arithmetic<T>::value, std::true_type,
has_minus_eq_impl<T>>::type
```

#### 11.1.1.16 has\_mul

```
template<class T>
using has_mul = typename std::conditional<std::is_arithmetic<T>::value, std::true_type, has_mul_impl<T>><←
::type
```

#### 11.1.1.17 has\_mul\_eq

```
template<class T>
using has_mul_eq = typename std::conditional<std::is_arithmetic<T>::value, std::true_type,
has_mul_eq_impl<T>>::type
```

**11.1.1.18 Timer**

```
typedef Givaro::Timer Timer
```

**11.1.1.19 BaseTimer**

```
typedef Givaro::BaseTimer BaseTimer
```

**11.1.1.20 UserTimer**

```
typedef Givaro::UserTimer UserTimer
```

**11.1.1.21 SysTimer**

```
typedef Givaro::SysTimer SysTimer
```

**11.1.2 Enumeration Type Documentation****11.1.2.1 FFLAS\_ORDER**

```
enum FFLAS_ORDER
```

Storage by row or col ?

Enumerator

FflasRowMajor	row major
FflasColMajor	col major

**11.1.2.2 FFLAS\_TRANSPOSE**

```
enum FFLAS_TRANSPOSE
```

Is matrix transposed ?

Enumerator

FflasNoTrans	Matrix is not transposed.
FflasTrans	Matrix is transposed.

**11.1.2.3 FFLAS\_UPLO**

```
enum FFLAS_UPLO
```

Is triangular matrix's shape upper ?

## Enumerator

FflasUpper	Triangular matrix is Upper triangular (if $i > j$ then $T_{i,j} = 0$ )
FflasLower	Triangular matrix is Lower triangular (if $i < j$ then $T_{i,j} = 0$ )
FflasLeftTri	Triangular matrix is Left triangular (if $j > n - i - 1$ then $T_{i,j} = 0$ )
FflasRightTri	Triangular matrix is Right triangular (if $j < n - i - 1$ then $T_{i,j} = 0$ )

## 11.1.2.4 FFLAS\_DIAG

enum [FFLAS\\_DIAG](#)

Is the triangular matrix implicitly unit diagonal ?

## Enumerator

FflasNonUnit	Triangular matrix has an explicit arbitrary diagonal.
FflasUnit	Triangular matrix has an implicit unit diagonal ( $T_{i,i} = 1$ )

## 11.1.2.5 FFLAS\_SIDE

enum [FFLAS\\_SIDE](#)

On what side ?

## Enumerator

FflasLeft	Operator applied on the left.
FflasRight	Operator applied on the righth.

## 11.1.2.6 FFLAS\_BASE

enum [FFLAS\\_BASE](#)[FFLAS\\_BASE](#) determines the type of the element representation for Matrix Mult kernel.

(deprecated, should not be used)

## Enumerator

FflasDouble	to use the double precision BLAS
FflasFloat	to use the single precision BLAS
FflasGeneric	for any other domain, that can not be converted to floating point integers

## 11.1.2.7 number\_kind

enum [number\\_kind](#)

## Enumerator

zero	
one	
mone	
other	

**11.1.2.8 SparseMatrix\_t**

```
enum class SparseMatrix_t [strong]
```

## Enumerator

CSR	
CSR_ZO	
CSC	
CSC_ZO	
COO	
COO_ZO	
ELL	
ELL_ZO	
SELL	
SELL_ZO	
ELL_simd	
ELL_simd_ZO	
CSR_HYB	
HYB_ZO	

**11.1.2.9 FFLAS\_FORMAT**

```
enum FFLAS_FORMAT
```

## Enumerator

FflasAuto	
FflasDense	
FflasSMS	
FflasBinary	
FflasMath	
FflasMaple	
FflasSageMath	

**11.1.3 Function Documentation****11.1.3.1 InfNorm()**

```
Givaro::Integer InfNorm (
    const size_t M,
    const size_t N,
    const Givaro::Integer * A,
    const size_t lda) [inline]
```

### 11.1.3.2 min3()

```
template<class T>
const T & min3 (
    const T & m,
    const T & n,
    const T & k)
```

### 11.1.3.3 max3()

```
template<class T>
const T & max3 (
    const T & m,
    const T & n,
    const T & k)
```

### 11.1.3.4 min4()

```
template<class T>
const T & min4 (
    const T & m,
    const T & n,
    const T & k,
    const T & l)
```

### 11.1.3.5 max4()

```
template<class T>
const T & max4 (
    const T & m,
    const T & n,
    const T & k,
    const T & l)
```

### 11.1.3.6 fadd() [1/8]

```
template<class Field>
void fadd (
    const Field & F,
    const size_t N,
    typename Field::ConstElement_ptr A,
    const size_t inca,
    typename Field::ConstElement_ptr B,
    const size_t incb,
    typename Field::Element_ptr C,
    const size_t incc)
```

**11.1.3.7 faddin()** [1/5]

```
template<class Field>
void faddin (
    const Field & F,
    const size_t N,
    typename Field::ConstElement_ptr B,
    const size_t incb,
    typename Field::Element_ptr C,
    const size_t incc)
```

**11.1.3.8 fsub()** [1/4]

```
template<class Field>
void fsub (
    const Field & F,
    const size_t N,
    typename Field::ConstElement_ptr A,
    const size_t inca,
    typename Field::ConstElement_ptr B,
    const size_t incb,
    typename Field::Element_ptr C,
    const size_t incc)
```

**11.1.3.9 fsubin()** [1/3]

```
template<class Field>
void fsubin (
    const Field & F,
    const size_t N,
    typename Field::ConstElement_ptr B,
    const size_t incb,
    typename Field::Element_ptr C,
    const size_t incc)
```

**11.1.3.10 fadd()** [2/8]

```
template<class Field>
void fadd (
    const Field & F,
    const size_t N,
    typename Field::ConstElement_ptr A,
    const size_t inca,
    const typename Field::Element alpha,
    typename Field::ConstElement_ptr B,
    const size_t incb,
    typename Field::Element_ptr C,
    const size_t incc)
```

**Todo** optimise here

#### 11.1.3.11 pfadd()

```
template<class Field>
void pfadd (
    const Field & F,
    const size_t M,
    const size_t N,
    typename Field::ConstElement_ptr A,
    const size_t lda,
    typename Field::ConstElement_ptr B,
    const size_t ldb,
    typename Field::Element_ptr C,
    const size_t ldc,
    const size_t numths)
```

#### 11.1.3.12 pfsbub()

```
template<class Field>
void pfsbub (
    const Field & F,
    const size_t M,
    const size_t N,
    typename Field::ConstElement_ptr A,
    const size_t lda,
    typename Field::ConstElement_ptr B,
    const size_t ldb,
    typename Field::Element_ptr C,
    const size_t ldc,
    const size_t numths)
```

#### 11.1.3.13 pfaddin()

```
template<class Field>
void pfaddin (
    const Field & F,
    const size_t M,
    const size_t N,
    typename Field::ConstElement_ptr B,
    const size_t ldb,
    typename Field::Element_ptr C,
    const size_t ldc,
    size_t numths)
```

#### 11.1.3.14 pfsubin()

```
template<class Field>
void pfsubin (
    const Field & F,
    const size_t M,
    const size_t N,
    typename Field::ConstElement_ptr B,
    const size_t ldb,
    typename Field::Element_ptr C,
    const size_t ldc,
    size_t numths)
```

**11.1.3.15 fadd()** [3/8]

```
template<class Field>
void fadd (
    const Field & F,
    const size_t M,
    const size_t N,
    typename Field::ConstElement_ptr A,
    const size_t lda,
    typename Field::ConstElement_ptr B,
    const size_t ldb,
    typename Field::Element_ptr C,
    const size_t ldc)
```

fadd : matrix addition.

Computes  $C = A + B$ .

**Parameters**

<i>F</i>	field
<i>M</i>	rows
<i>N</i>	cols
<i>A</i>	dense matrix of size MxN
<i>lda</i>	leading dimension of A
<i>B</i>	dense matrix of size MxN
<i>ldb</i>	leading dimension of B
<i>C</i>	dense matrix of size MxN
<i>ldc</i>	leading dimension of C

**11.1.3.16 fsub()** [2/4]

```
template<class Field>
void fsub (
    const Field & F,
    const size_t M,
    const size_t N,
    typename Field::ConstElement_ptr A,
    const size_t lda,
    typename Field::ConstElement_ptr B,
    const size_t ldb,
    typename Field::Element_ptr C,
    const size_t ldc)
```

fsub : matrix subtraction.

Computes  $C = A - B$ .

**Parameters**

<i>F</i>	field
<i>M</i>	rows
<i>N</i>	cols
<i>A</i>	dense matrix of size MxN



## Parameters

<i>lda</i>	leading dimension of A
<i>B</i>	dense matrix of size MxN
<i>ldb</i>	leading dimension of B
<i>C</i>	dense matrix of size MxN
<i>ldc</i>	leading dimension of C

## 11.1.3.17 faddin() [2/5]

```
template<class Field>
void faddin (
    const Field & F,
    const size_t M,
    const size_t N,
    typename Field::ConstElement_ptr B,
    const size_t ldb,
    typename Field::Element_ptr C,
    const size_t ldc)
```

faddin

## 11.1.3.18 faddin() [3/5]

```
template<class Field>
void faddin (
    const Field & F,
    const FFLAS_UPLO uplo,
    const size_t N,
    typename Field::ConstElement_ptr B,
    const size_t ldb,
    typename Field::Element_ptr C,
    const size_t ldc)
```

fadding for symmetric matrices

## 11.1.3.19 fsubin() [2/3]

```
template<class Field>
void fsubin (
    const Field & F,
    const size_t M,
    const size_t N,
    typename Field::ConstElement_ptr B,
    const size_t ldb,
    typename Field::Element_ptr C,
    const size_t ldc)
```

fsubin C = C - B

**11.1.3.20 fadd()** [4/8]

```
template<class Field>
void fadd (
    const Field & F,
    const size_t M,
    const size_t N,
    typename Field::ConstElement_ptr A,
    const size_t lda,
    const typename Field::Element alpha,
    typename Field::ConstElement_ptr B,
    const size_t ldb,
    typename Field::Element_ptr C,
    const size_t ldc)
```

fadd : matrix addition with scaling.

Computes  $C = A + \alpha B$ .

**Parameters**

<i>F</i>	field
<i>M</i>	rows
<i>N</i>	cols
<i>A</i>	dense matrix of size MxN
<i>lda</i>	leading dimension of A
<i>alpha</i>	some scalar
<i>B</i>	dense matrix of size MxN
<i>ldb</i>	leading dimension of B
<i>C</i>	dense matrix of size MxN
<i>ldc</i>	leading dimension of C

**11.1.3.21 fassign()** [1/10]

```
template<class Field>
void fassign (
    const Field & F,
    const size_t N,
    typename Field::ConstElement_ptr Y,
    const size_t incY,
    typename Field::Element_ptr X,
    const size_t incX) [inline]
```

fassign :  $x \leftarrow y$ .

X is preallocated

**Todo** variant for triangular matrix

**Parameters**

	<i>F</i>	field
	<i>N</i>	size of the vectors
out	<i>X</i>	vector in F
	<i>incX</i>	stride of X
in	<i>Y</i>	vector in F
	<i>incY</i>	stride of Y

**11.1.3.22 fassign() [2/10]**

```
template<>
void fassign (
    const Givaro::Modular< float > & F,
    const size_t N,
    const float * Y,
    const size_t incY,
    float * X,
    const size_t incX) [inline]
```

**11.1.3.23 fassign() [3/10]**

```
template<>
void fassign (
    const Givaro::ModularBalanced< float > & F,
    const size_t N,
    const float * Y,
    const size_t incY,
    float * X,
    const size_t incX) [inline]
```

**11.1.3.24 fassign() [4/10]**

```
template<>
void fassign (
    const Givaro::ZRing< float > & F,
    const size_t N,
    const float * Y,
    const size_t incY,
    float * X,
    const size_t incX) [inline]
```

**11.1.3.25 fassign() [5/10]**

```
template<>
void fassign (
    const Givaro::Modular< double > & F,
    const size_t N,
    const double * Y,
    const size_t incY,
    double * X,
    const size_t incX) [inline]
```

**11.1.3.26 fassign() [6/10]**

```
template<>
void fassign (
    const Givaro::ModularBalanced< double > & F,
    const size_t N,
    const double * Y,
    const size_t incY,
    double * X,
    const size_t incX) [inline]
```

**11.1.3.27 fassign()** [7/10]

```
template<>
void fassign (
    const Givaro::ZRing< double > & F,
    const size_t N,
    const double * Y,
    const size_t incY,
    double * X,
    const size_t incX) [inline]
```

**11.1.3.28 fassign()** [8/10]

```
template<class Field>
void fassign (
    const Field & F,
    const size_t m,
    const size_t n,
    typename Field::ConstElement_ptr B,
    const size_t ldb,
    typename Field::Element_ptr A,
    const size_t lda)
```

$\text{fassign} : A \leftarrow B.$

**Parameters**

$F$	field
$m$	number of rows to copy
$n$	number of cols to copy
$A$	matrix in $F$
$lda$	stride of $A$
$B$	vector in $F$
$ldb$	stride of $B$

**11.1.3.29 faxpy()** [1/6]

```
template<class Field>
void faxpy (
    const Field & F,
    const size_t N,
    const typename Field::Element alpha,
    typename Field::ConstElement_ptr X,
    const size_t incX,
    typename Field::Element_ptr Y,
    const size_t incY) [inline]
```

$\text{faxpy} : y \leftarrow \alpha \cdot x + y.$

**Parameters**

	$F$	field
--	-----	-------

## Parameters

	$N$	size of the vectors
	$\alpha$	scalar
in	$X$	vector in $F$
	$incX$	stride of $X$
in, out	$Y$	vector in $F$
	$incY$	stride of $Y$

## 11.1.3.30 faxpy() [2/6]

```
template<>
void faxpy (
    const Givaro::DoubleDomain & ,
    const size_t N,
    const Givaro::DoubleDomain::Element a,
    Givaro::DoubleDomain::ConstElement_ptr x,
    const size_t incx,
    Givaro::DoubleDomain::Element_ptr y,
    const size_t incy) [inline]
```

## 11.1.3.31 faxpy() [3/6]

```
template<>
void faxpy (
    const Givaro::FloatDomain & ,
    const size_t N,
    const Givaro::FloatDomain::Element a,
    Givaro::FloatDomain::ConstElement_ptr x,
    const size_t incx,
    Givaro::FloatDomain::Element_ptr y,
    const size_t incy) [inline]
```

## 11.1.3.32 faxpy() [4/6]

```
template<class Field>
void faxpy (
    const Field & F,
    const size_t m,
    const size_t n,
    const typename Field::Element alpha,
    typename Field::ConstElement_ptr X,
    const size_t ldx,
    typename Field::Element_ptr Y,
    const size_t ldy) [inline]
```

$\text{faxpy} : y \leftarrow \alpha \cdot x + y.$

## Parameters

	$F$	field
--	-----	-------

## Parameters

	$m$	row dimension
	$n$	column dimension
	$\alpha$	scalar
in	$X$	vector in $F$
	$ldx$	leading dimension of $X$
in, out	$Y$	vector in $F$
	$ldy$	leading dimension of $Y$

**11.1.3.33 fdot()** [1/11]

```
template<class Field>
Field::Element fdot (
    const Field & F,
    const size_t N,
    typename Field::ConstElement_ptr x,
    const size_t incx,
    typename Field::ConstElement_ptr y,
    const size_t incy,
    ModeCategories::DefaultTag & MT) [inline]
```

**11.1.3.34 fdot()** [2/11]

```
template<class Field>
Field::Element fdot (
    const Field & F,
    const size_t N,
    typename Field::ConstElement_ptr x,
    const size_t incx,
    typename Field::ConstElement_ptr y,
    const size_t incy,
    ModeCategories::DelayedTag & MT) [inline]
```

**11.1.3.35 fdot()** [3/11]

```
template<>
Givaro::DoubleDomain::Element fdot (
    const Givaro::DoubleDomain & ,
    const size_t N,
    Givaro::DoubleDomain::ConstElement_ptr x,
    const size_t incx,
    Givaro::DoubleDomain::ConstElement_ptr y,
    const size_t incy,
    ModeCategories::DefaultTag & MT) [inline]
```

**11.1.3.36 fdot()** [4/11]

```
template<>
Givaro::FloatDomain::Element fdot (
    const Givaro::FloatDomain & ,
    const size_t N,
    Givaro::FloatDomain::ConstElement_ptr x,
    const size_t incx,
    Givaro::FloatDomain::ConstElement_ptr y,
    const size_t incy,
    ModeCategories::DefaultTag & MT) [inline]
```

**11.1.3.37 fdot()** [5/11]

```
template<class Field, class T>
Field::Element fdot (
    const Field & F,
    const size_t N,
    typename Field::ConstElement_ptr x,
    const size_t incx,
    typename Field::ConstElement_ptr y,
    const size_t incy,
    ModeCategories::ConvertTo< T > & MT) [inline]
```

**11.1.3.38 fdot()** [6/11]

```
template<class Field>
Field::Element fdot (
    const Field & F,
    const size_t N,
    typename Field::ConstElement_ptr x,
    const size_t incx,
    typename Field::ConstElement_ptr y,
    const size_t incy,
    ModeCategories::DefaultBoundedTag & dbt) [inline]
```

**11.1.3.39 fdot()** [7/11]

```
template<class Field>
Field::Element fdot (
    const Field & F,
    const size_t N,
    typename Field::ConstElement_ptr x,
    const size_t incx,
    typename Field::ConstElement_ptr y,
    const size_t incy,
    const ParSeqHelper::Sequential seq) [inline]
```

**11.1.3.40 fdot()** [8/11]

```
template<class Field>
Field::Element fdot (
    const Field & F,
    const size_t N,
    typename Field::ConstElement_ptr X,
    const size_t incX,
    typename Field::ConstElement_ptr Y,
    const size_t incY) [inline]
```

fdot: dot product  $x^T y$ .

**Parameters**

$F$	field
$N$	size of the vectors
$X$	vector in $F$
$incX$	stride of $X$
$Y$	vector in $F$
$incY$	stride of $Y$

**11.1.3.41 fgemm()** [1/23]

```
template<class Field>
Field::Element_ptr fgemm (
    const Field & F,
    const FFLAS_TRANSPOSE ta,
    const FFLAS_TRANSPOSE tb,
    const size_t m,
    const size_t n,
    const size_t k,
    const typename Field::Element alpha,
    typename Field::ConstElement_ptr A,
    const size_t lda,
    typename Field::ConstElement_ptr B,
    const size_t ldb,
    const typename Field::Element beta,
    typename Field::Element_ptr C,
    const size_t ldc,
    MMHelper< Field, MMHelperAlgo::Winograd, ModeCategories::ConvertTo< ElementCategories::MachineFl
>, ParSeqHelper::Sequential > & H) [inline]
```

**11.1.3.42 fgemm()** [2/23]

```
template<typename Field>
Field::Element_ptr fgemm (
    const Field & F,
    const FFLAS_TRANSPOSE ta,
    const FFLAS_TRANSPOSE tb,
    const size_t m,
    const size_t n,
```



```

    const size_t k,
    const typename Field::Element alpha,
    typename Field::ConstElement_ptr A,
    const size_t lda,
    typename Field::ConstElement_ptr B,
    const size_t ldb,
    const typename Field::Element beta,
    typename Field::Element_ptr C,
    const size_t ldc,
    const ParSeqHelper::Sequential seq) [inline]

```

#### 11.1.3.43 fgemm() [3/23]

```

template<typename Field, class Cut, class Param>
Field::Element_ptr fgemm (
    const Field & F,
    const FFLAS_TRANSPOSE ta,
    const FFLAS_TRANSPOSE tb,
    const size_t m,
    const size_t n,
    const size_t k,
    const typename Field::Element alpha,
    typename Field::ConstElement_ptr A,
    const size_t lda,
    typename Field::ConstElement_ptr B,
    const size_t ldb,
    const typename Field::Element beta,
    typename Field::Element_ptr C,
    const size_t ldc,
    const ParSeqHelper::Parallel< Cut, Param > par) [inline]

```

#### 11.1.3.44 fgemm() [4/23]

```

template<typename Field>
Field::Element_ptr fgemm (
    const Field & F,
    const FFLAS_TRANSPOSE ta,
    const FFLAS_TRANSPOSE tb,
    const size_t m,
    const size_t n,
    const size_t k,
    const typename Field::Element alpha,
    typename Field::ConstElement_ptr A,
    const size_t lda,
    typename Field::ConstElement_ptr B,
    const size_t ldb,
    const typename Field::Element beta,
    typename Field::Element_ptr C,
    const size_t ldc) [inline]

```

**fgemm: Field GEneral Matrix Multiply.**

Computes  $C = \alpha \text{op}(A) \times \text{op}(B) + \beta C$  Automatically set Winograd recursion level

## Parameters

<i>F</i>	field.
<i>ta</i>	if <code>ta==FflasTrans</code> then $\text{op}(A) = A^t$ , else $\text{op}(A) = A$ ,
<i>tb</i>	same for matrix B
<i>m</i>	see A
<i>n</i>	see B
<i>k</i>	see A
<i>alpha</i>	scalar
<i>beta</i>	scalar
<i>A</i>	$\text{op}(A)$ is $m \times k$
<i>B</i>	$\text{op}(B)$ is $k \times n$
<i>C</i>	<i>C</i> is $m \times n$
<i>lda</i>	leading dimension of A
<i>ldb</i>	leading dimension of B
<i>ldc</i>	leading dimension of C
<i>w</i>	recursive levels of Winograd's algorithm are used. No argument (or -1) does auto computation of $w$ .

## Warning

$\alpha$  must be invertible

## 11.1.3.45 fgemm() [5/23]

```
template<typename Field, class ModeT, class ParSeq>
Field::Element_ptr fgemm (
    const Field & F,
    const FFLAS_TRANSPOSE ta,
    const FFLAS_TRANSPOSE tb,
    const size_t m,
    const size_t n,
    const size_t k,
    const typename Field::Element alpha,
    typename Field::ConstElement_ptr A,
    const size_t lda,
    typename Field::ConstElement_ptr B,
    const size_t ldb,
    const typename Field::Element beta,
    typename Field::Element_ptr C,
    const size_t ldc,
    MMHelper< Field, MMHelperAlgo::Auto, ModeT, ParSeq > & H) [inline]
```

## 11.1.3.46 fgemm() [6/23]

```
template<class Field>
Field::Element_ptr fgemm (
    const Field & F,
    const FFLAS_TRANSPOSE ta,
    const FFLAS_TRANSPOSE tb,
    const size_t m,
```

```

    const size_t n,
    const size_t k,
    const typename Field::Element alpha,
    typename Field::ConstElement_ptr A,
    const size_t lda,
    typename Field::ConstElement_ptr B,
    const size_t ldb,
    const typename Field::Element beta,
    typename Field::Element_ptr C,
    const size_t ldc,
    MMHelper< Field, MMHelperAlgo::Winograd, ModeCategories::DelayedTag, ParSeqHelper::Sequential
> & H) [inline]

```

### 11.1.3.47 fsquare() [1/6]

```

template<class Field>
Field::Element_ptr fsquare (
    const Field & F,
    const FFLAS_TRANSPOSE ta,
    const size_t n,
    const typename Field::Element alpha,
    typename Field::ConstElement_ptr A,
    const size_t lda,
    const typename Field::Element beta,
    typename Field::Element_ptr C,
    const size_t ldc) [inline]

```

fsquare: Squares a matrix.

compute  $C \leftarrow \alpha \text{op}(A) \text{op}(A) + \beta C$  over a [Field](#)  $F$  Avoid the conversion of  $B$

#### Parameters

<i>ta</i>	if $ta == \text{FflasTrans}$ , $\text{op}(A) = A^T$ .
<i>F</i>	field
<i>n</i>	size of A
<i>alpha</i>	scalar
<i>beta</i>	scalar
<i>A</i>	dense matrix of size $n \times n$
<i>lda</i>	leading dimension of A
<i>C</i>	dense matrix of size $n \times n$
<i>ldc</i>	leading dimension of C

**Bug** why double ?

### 11.1.3.48 fsquare() [2/6]

```

template<>
double * fsquare (
    const Givaro::ModularBalanced< double > & F,
    const FFLAS_TRANSPOSE ta,

```

```

    const size_t n,
    const double alpha,
    const double * A,
    const size_t lda,
    const double beta,
    double * C,
    const size_t ldc) [inline]

```

#### 11.1.3.49 fsquare() [3/6]

```

template<>
float * fsquare (
    const Givaro::ModularBalanced< float > & F,
    const FFLAS_TRANSPOSE ta,
    const size_t n,
    const float alpha,
    const float * A,
    const size_t lda,
    const float beta,
    float * C,
    const size_t ldc) [inline]

```

#### 11.1.3.50 fsquare() [4/6]

```

template<>
double * fsquare (
    const Givaro::Modular< double > & F,
    const FFLAS_TRANSPOSE ta,
    const size_t n,
    const double alpha,
    const double * A,
    const size_t lda,
    const double beta,
    double * C,
    const size_t ldc) [inline]

```

#### 11.1.3.51 fsquare() [5/6]

```

template<>
float * fsquare (
    const Givaro::Modular< float > & F,
    const FFLAS_TRANSPOSE ta,
    const size_t n,
    const float alpha,
    const float * A,
    const size_t lda,
    const float beta,
    float * C,
    const size_t ldc) [inline]

```

**11.1.3.52 fgemm()** [7/23]

```

template<typename RNS, typename ParSeqTrait>
FFPACK::RNSInteger< RNS >::Element_ptr fgemm (
    const FFPACK::RNSInteger< RNS > & F,
    const FFLAS_TRANSPOSE ta,
    const FFLAS_TRANSPOSE tb,
    const size_t m,
    const size_t n,
    const size_t k,
    const typename FFPACK::RNSInteger< RNS >::Element alpha,
    typename FFPACK::RNSInteger< RNS >::ConstElement_ptr Ad,
    const size_t lda,
    typename FFPACK::RNSInteger< RNS >::ConstElement_ptr Bd,
    const size_t ldb,
    const typename FFPACK::RNSInteger< RNS >::Element beta,
    typename FFPACK::RNSInteger< RNS >::Element_ptr Cd,
    const size_t ldc,
    MMHelper< FFPACK::RNSInteger< RNS >, MMHelperAlgo::Classic, ModeCategories::DefaultTag,
    ParSeqHelper::Compose< ParSeqHelper::Sequential, ParSeqTrait > > & H) [inline]

```

**11.1.3.53 fgemm()** [8/23]

```

template<typename RNS>
FFPACK::RNSInteger< RNS >::Element_ptr fgemm (
    const FFPACK::RNSInteger< RNS > & F,
    const FFLAS_TRANSPOSE ta,
    const FFLAS_TRANSPOSE tb,
    const size_t m,
    const size_t n,
    const size_t k,
    const typename FFPACK::RNSInteger< RNS >::Element alpha,
    typename FFPACK::RNSInteger< RNS >::ConstElement_ptr Ad,
    const size_t lda,
    typename FFPACK::RNSInteger< RNS >::ConstElement_ptr Bd,
    const size_t ldb,
    const typename FFPACK::RNSInteger< RNS >::Element beta,
    typename FFPACK::RNSInteger< RNS >::Element_ptr Cd,
    const size_t ldc,
    MMHelper< FFPACK::RNSInteger< RNS >, MMHelperAlgo::Classic, ModeCategories::DefaultTag,
    ParSeqHelper::Sequential > & H) [inline]

```

**11.1.3.54 fgemm()** [9/23]

```

template<typename RNS, typename ParSeqTrait>
FFPACK::RNSInteger< RNS >::Element_ptr fgemm (
    const FFPACK::RNSInteger< RNS > & F,
    const FFLAS_TRANSPOSE ta,
    const FFLAS_TRANSPOSE tb,
    const size_t m,
    const size_t n,
    const size_t k,
    const typename FFPACK::RNSInteger< RNS >::Element alpha,
    typename FFPACK::RNSInteger< RNS >::ConstElement_ptr Ad,

```

```

    const size_t lda,
    typename FFPACK::RNSInteger< RNS >::ConstElement_ptr Bd,
    const size_t ldb,
    const typename FFPACK::RNSInteger< RNS >::Element beta,
    typename FFPACK::RNSInteger< RNS >::Element_ptr Cd,
    const size_t ldc,
    MMHelper< FFPACK::RNSInteger< RNS >, MMHelperAlgo::Classic, ModeCategories::DefaultTag,
    ParSeqHelper::Compose< ParSeqHelper::Parallel< CuttingStrategy::RNSModulus, StrategyParameter::Threads
    >, ParSeqTrait > > & H) [inline]

```

#### 11.1.3.55 fgemm() [10/23]

```

template<typename RNS, typename Cut, typename Param>
FFPACK::RNSInteger< RNS >::Element_ptr fgemm (
    const FFPACK::RNSInteger< RNS > & F,
    const FFLAS_TRANSPOSE ta,
    const FFLAS_TRANSPOSE tb,
    const size_t m,
    const size_t n,
    const size_t k,
    const typename FFPACK::RNSInteger< RNS >::Element alpha,
    typename FFPACK::RNSInteger< RNS >::ConstElement_ptr Ad,
    const size_t lda,
    typename FFPACK::RNSInteger< RNS >::ConstElement_ptr Bd,
    const size_t ldb,
    const typename FFPACK::RNSInteger< RNS >::Element beta,
    typename FFPACK::RNSInteger< RNS >::Element_ptr Cd,
    const size_t ldc,
    MMHelper< FFPACK::RNSInteger< RNS >, MMHelperAlgo::Classic, ModeCategories::DefaultTag,
    ParSeqHelper::Parallel< Cut, Param > > & H) [inline]

```

#### 11.1.3.56 fgemm() [11/23]

```

template<class ParSeq>
Givaro::Integer * fgemm (
    const Givaro::ZRing< Givaro::Integer > & F,
    const FFLAS_TRANSPOSE ta,
    const FFLAS_TRANSPOSE tb,
    const size_t m,
    const size_t n,
    const size_t k,
    const Givaro::Integer alpha,
    const Givaro::Integer * A,
    const size_t lda,
    const Givaro::Integer * B,
    const size_t ldb,
    Givaro::Integer beta,
    Givaro::Integer * C,
    const size_t ldc,
    MMHelper< Givaro::ZRing< Givaro::Integer >, MMHelperAlgo::Classic, ModeCategories::ConvertTo<
    ElementCategories::RNSElementTag >, ParSeq > & H) [inline]

```

**11.1.3.57 fgemm()** [12/23]

```

template<typename RNS, class ModeT>
RNS::Element_ptr fgemm (
    const FFPACK::RNSInteger< RNS > & F,
    const FFLAS_TRANSPOSE ta,
    const FFLAS_TRANSPOSE tb,
    const size_t m,
    const size_t n,
    const size_t k,
    const typename RNS::Element alpha,
    typename RNS::ConstElement_ptr Ad,
    const size_t lda,
    typename RNS::ConstElement_ptr Bd,
    const size_t ldb,
    const typename RNS::Element beta,
    typename RNS::Element_ptr Cd,
    const size_t ldc,
    MMHelper< FFPACK::RNSInteger< RNS >, MMHelperAlgo::Winograd, ModeT, ParSeqHelper::Sequential
> & H) [inline]

```

**11.1.3.58 fgemm()** [13/23]

```

template<typename RNS>
RNS::Element_ptr fgemm (
    const FFPACK::RNSIntegerMod< RNS > & F,
    const FFLAS_TRANSPOSE ta,
    const FFLAS_TRANSPOSE tb,
    const size_t m,
    const size_t n,
    const size_t k,
    const typename RNS::Element alpha,
    typename RNS::ConstElement_ptr Ad,
    const size_t lda,
    typename RNS::ConstElement_ptr Bd,
    const size_t ldb,
    const typename RNS::Element beta,
    typename RNS::Element_ptr Cd,
    const size_t ldc,
    MMHelper< FFPACK::RNSIntegerMod< RNS >, MMHelperAlgo::Winograd > & H) [inline]

```

**11.1.3.59 fgemm()** [14/23]

```

Givaro::Integer * fgemm (
    const Givaro::Modular< Givaro::Integer > & F,
    const FFLAS_TRANSPOSE ta,
    const FFLAS_TRANSPOSE tb,
    const size_t m,
    const size_t n,
    const size_t k,
    const Givaro::Integer alpha,
    const Givaro::Integer * A,
    const size_t lda,
    const Givaro::Integer * B,

```

```

        const size_t ldb,
        const Givaro::Integer beta,
        Givaro::Integer * C,
        const size_t ldc,
        MMHelper< Givaro::Modular< Givaro::Integer >, MMHelperAlgo::Classic, ModeCategories::ConvertTo<
ElementCategories::RNSElementTag > > & H) [inline]

```

#### 11.1.3.60 fgemm() [15/23]

```

template<class ParSeq>
Givaro::Integer * fgemm (
    const Givaro::Modular< Givaro::Integer > & F,
    const FFLAS_TRANSPOSE ta,
    const FFLAS_TRANSPOSE tb,
    const size_t m,
    const size_t n,
    const size_t k,
    const Givaro::Integer alpha,
    const Givaro::Integer * A,
    const size_t lda,
    const Givaro::Integer * B,
    const size_t ldb,
    const Givaro::Integer beta,
    Givaro::Integer * C,
    const size_t ldc,
    MMHelper< Givaro::Modular< Givaro::Integer >, MMHelperAlgo::Auto, ModeCategories::ConvertTo<
ElementCategories::RNSElementTag >, ParSeq > & H) [inline]

```

#### 11.1.3.61 fgemm() [16/23]

```

template<size_t K1, size_t K2, class ParSeq>
RecInt::ruint< K1 > * fgemm (
    const Givaro::Modular< RecInt::ruint< K1 >, RecInt::ruint< K2 > > & F,
    const FFLAS_TRANSPOSE ta,
    const FFLAS_TRANSPOSE tb,
    const size_t m,
    const size_t n,
    const size_t k,
    const RecInt::ruint< K1 > alpha,
    const RecInt::ruint< K1 > * A,
    const size_t lda,
    const RecInt::ruint< K1 > * B,
    const size_t ldb,
    RecInt::ruint< K1 > beta,
    RecInt::ruint< K1 > * C,
    const size_t ldc,
    MMHelper< Givaro::Modular< RecInt::ruint< K1 >, RecInt::ruint< K2 > >, MMHelperAlgo::Classic,
ModeCategories::ConvertTo< ElementCategories::RNSElementTag >, ParSeq > & H) [inline]

```

#### 11.1.3.62 fgemm() [17/23]

```

template<class Field, class ModeT>
Field::Element_ptr fgemm (

```



```

const Field & F,
const FFLAS_TRANSPOSE ta,
const FFLAS_TRANSPOSE tb,
const size_t m,
const size_t n,
const size_t k,
const typename Field::Element alpha,
typename Field::ConstElement_ptr A,
const size_t lda,
typename Field::ConstElement_ptr B,
const size_t ldb,
const typename Field::Element beta,
typename Field::Element_ptr C,
const size_t ldc,
MMHelper< Field, MMHelperAlgo::Winograd, ModeT > & H) [inline]

```

### 11.1.3.63 fgemm() [18/23]

```

template<class Field, class ModeT, class Cut, class Param>
Field::Element_ptr fgemm (
    const Field & F,
    const FFLAS_TRANSPOSE ta,
    const FFLAS_TRANSPOSE tb,
    const size_t m,
    const size_t n,
    const size_t k,
    const typename Field::Element alpha,
    typename Field::ConstElement_ptr A,
    const size_t lda,
    typename Field::ConstElement_ptr B,
    const size_t ldb,
    const typename Field::Element beta,
    typename Field::Element_ptr C,
    const size_t ldc,
    MMHelper< Field, MMHelperAlgo::WinogradPar, ModeT, ParSeqHelper::Parallel< Cut,
Param > > & H) [inline]

```

### 11.1.3.64 fgemv() [1/19]

```

template<class Field>
Field::Element_ptr fgemv (
    const Field & F,
    const FFLAS_TRANSPOSE ta,
    const size_t M,
    const size_t N,
    const typename Field::Element alpha,
    typename Field::ConstElement_ptr A,
    const size_t lda,
    typename Field::ConstElement_ptr X,
    const size_t incX,
    const typename Field::Element beta,
    typename Field::Element_ptr Y,
    const size_t incY,
    MMHelper< Field, MMHelperAlgo::Classic, ModeCategories::ConvertTo< ElementCategories::MachineFlo
> > & H) [inline]

```

**11.1.3.65 fgemv()** [2/19]

```

template<class Field>
Field::Element_ptr fgemv (
    const Field & F,
    const FFLAS_TRANSPOSE ta,
    const size_t M,
    const size_t N,
    const typename Field::Element alpha,
    typename Field::ConstElement_ptr A,
    const size_t lda,
    typename Field::ConstElement_ptr X,
    const size_t incX,
    const typename Field::Element beta,
    typename Field::Element_ptr Y,
    const size_t incY,
    MMHelper< Field, MMHelperAlgo::Classic, ModeCategories::DelayedTag > & H) [inline]

```

**11.1.3.66 fgemv()** [3/19]

```

template<class Field>
Field::Element_ptr fgemv (
    const Field & F,
    const FFLAS_TRANSPOSE ta,
    const size_t M,
    const size_t N,
    const typename Field::Element alpha,
    typename Field::ConstElement_ptr A,
    const size_t lda,
    typename Field::ConstElement_ptr X,
    const size_t incX,
    const typename Field::Element beta,
    typename Field::Element_ptr Y,
    const size_t incY,
    MMHelper< Field, MMHelperAlgo::Classic, ModeCategories::DefaultTag > & H) [inline]

```

**11.1.3.67 fgemv()** [4/19]

```

template<class Field>
Field::Element_ptr fgemv (
    const Field & F,
    const FFLAS_TRANSPOSE ta,
    const size_t M,
    const size_t N,
    const typename Field::Element alpha,
    typename Field::ConstElement_ptr A,
    const size_t lda,
    typename Field::ConstElement_ptr X,
    const size_t incX,
    const typename Field::Element beta,
    typename Field::Element_ptr Y,
    const size_t incY,
    MMHelper< Field, MMHelperAlgo::Classic, ModeCategories::LazyTag > & H) [inline]

```

## 11.1.3.68 fgemv() [5/19]

```
template<class Field>
Field::Element_ptr fgemv (
    const Field & F,
    const FFLAS_TRANSPOSE TransA,
    const size_t M,
    const size_t N,
    const typename Field::Element alpha,
    typename Field::ConstElement_ptr A,
    const size_t lda,
    typename Field::ConstElement_ptr X,
    const size_t incX,
    const typename Field::Element beta,
    typename Field::Element_ptr Y,
    const size_t incY) [inline]
```

finite prime [Field](#) GEneral Matrix Vector multiplication.

Computes  $Y \leftarrow \alpha \text{op}(A)X + \beta Y$ .

## Parameters

	$F$	field
	$TransA$	if $TransA == FflasTrans$ then $\text{op}(A) = A^t$ .
	$M$	rows
	$N$	cols
	$alpha$	scalar
	$A$	dense matrix of size $M \times N$
	$lda$	leading dimension of $A$
	$X$	dense vector of size $N$
	$incX$	stride of $X$
	$beta$	scalar
out	$Y$	dense vector of size $M$
	$incY$	stride of $Y$

## 11.1.3.69 fgemv() [6/19]

```
Givaro::ZRing< int64_t >::Element_ptr fgemv (
    const Givaro::ZRing< int64_t > & F,
    const FFLAS_TRANSPOSE ta,
    const size_t M,
    const size_t N,
    const int64_t alpha,
    const int64_t * A,
    const size_t lda,
    const int64_t * X,
    const size_t incX,
    const int64_t beta,
    int64_t * Y,
    const size_t incY,
    MMHelper< Givaro::ZRing< int64_t >, MMHelperAlgo::Classic, ModeCategories::DefaultTag
> & H) [inline]
```

**11.1.3.70 fgemv()** [7/19]

```
Givaro::DoubleDomain::Element_ptr fgemv (
    const Givaro::DoubleDomain & F,
    const FFLAS_TRANSPOSE ta,
    const size_t M,
    const size_t N,
    const Givaro::DoubleDomain::Element alpha,
    const Givaro::DoubleDomain::ConstElement_ptr A,
    const size_t lda,
    const Givaro::DoubleDomain::ConstElement_ptr X,
    const size_t incX,
    const Givaro::DoubleDomain::Element beta,
    Givaro::DoubleDomain::Element_ptr Y,
    const size_t incY,
    MMHelper< Givaro::DoubleDomain, MMHelperAlgo::Classic, ModeCategories::DefaultTag
> & H) [inline]
```

**11.1.3.71 fgemv()** [8/19]

```
template<class Field>
Field::Element_ptr fgemv (
    const Field & F,
    const FFLAS_TRANSPOSE ta,
    const size_t M,
    const size_t N,
    const typename Field::Element alpha,
    const typename Field::ConstElement_ptr A,
    const size_t lda,
    const typename Field::ConstElement_ptr X,
    const size_t incX,
    const typename Field::Element beta,
    typename Field::Element_ptr Y,
    const size_t incY,
    MMHelper< Field, MMHelperAlgo::Classic, ModeCategories::DefaultBoundedTag > & H)
[inline]
```

**11.1.3.72 fgemv()** [9/19]

```
Givaro::FloatDomain::Element_ptr fgemv (
    const Givaro::FloatDomain & F,
    const FFLAS_TRANSPOSE ta,
    const size_t M,
    const size_t N,
    const Givaro::FloatDomain::Element alpha,
    const Givaro::FloatDomain::ConstElement_ptr A,
    const size_t lda,
    const Givaro::FloatDomain::ConstElement_ptr X,
    const size_t incX,
    const Givaro::FloatDomain::Element beta,
    Givaro::FloatDomain::Element_ptr Y,
    const size_t incY,
    MMHelper< Givaro::FloatDomain, MMHelperAlgo::Classic, ModeCategories::DefaultTag
> & H) [inline]
```

**11.1.3.73 fgemv()** [10/19]

```

template<class Field, class Cut, class Param>
Field::Element_ptr fgemv (
    const Field & F,
    const FFLAS_TRANSPOSE ta,
    const size_t m,
    const size_t n,
    const typename Field::Element alpha,
    const typename Field::ConstElement_ptr A,
    const size_t lda,
    const typename Field::ConstElement_ptr X,
    const size_t incX,
    const typename Field::Element beta,
    typename Field::Element_ptr Y,
    const size_t incY,
    ParSeqHelper::Parallel< Cut, Param > & parH)

```

**11.1.3.74 fgemv()** [11/19]

```

template<class Field>
Field::Element_ptr fgemv (
    const Field & F,
    const FFLAS_TRANSPOSE ta,
    const size_t m,
    const size_t n,
    const typename Field::Element alpha,
    const typename Field::ConstElement_ptr A,
    const size_t lda,
    const typename Field::ConstElement_ptr X,
    const size_t incX,
    const typename Field::Element beta,
    typename Field::Element_ptr Y,
    const size_t incY,
    ParSeqHelper::Sequential & seqH)

```

**11.1.3.75 fgemv()** [12/19]

```

FFPACK::rns_double::Element_ptr fgemv (
    const FFPACK::RNSInteger< FFPACK::rns_double > & F,
    const FFLAS_TRANSPOSE ta,
    const size_t M,
    const size_t N,
    const FFPACK::rns_double::Element alpha,
    FFPACK::rns_double::ConstElement_ptr A,
    const size_t lda,
    FFPACK::rns_double::ConstElement_ptr X,
    const size_t incX,
    const FFPACK::rns_double::Element beta,
    FFPACK::rns_double::Element_ptr Y,
    const size_t incY,
    MMHelper< FFPACK::RNSInteger< FFPACK::rns_double >, MMHelperAlgo::Classic, ModeCategories::Default
> & H) [inline]

```

**11.1.3.76 fgemv()** [13/19]

```
FFPACK::rns_double::Element_ptr fgemv (
    const FFPACK::RNSIntegerMod< FFPACK::rns_double > & F,
    const FFLAS_TRANSPOSE ta,
    const size_t M,
    const size_t N,
    const FFPACK::rns_double::Element alpha,
    FFPACK::rns_double::ConstElement_ptr A,
    const size_t lda,
    FFPACK::rns_double::ConstElement_ptr X,
    const size_t incX,
    const FFPACK::rns_double::Element beta,
    FFPACK::rns_double::Element_ptr Y,
    const size_t incY,
    MMHelper< FFPACK::RNSIntegerMod< FFPACK::rns_double >, MMHelperAlgo::Classic,
    ModeCategories::DefaultTag > & H) [inline]
```

**11.1.3.77 fgemv()** [14/19]

```
Givaro::Integer * fgemv (
    const Givaro::ZRing< Givaro::Integer > & F,
    const FFLAS_TRANSPOSE ta,
    const size_t m,
    const size_t n,
    const Givaro::Integer alpha,
    Givaro::Integer * A,
    const size_t lda,
    Givaro::Integer * X,
    const size_t ldx,
    Givaro::Integer beta,
    Givaro::Integer * Y,
    const size_t ldy,
    MMHelper< Givaro::ZRing< Givaro::Integer >, MMHelperAlgo::Classic, ModeCategories::ConvertTo<
    ElementCategories::RNSElementTag > > & H) [inline]
```

**11.1.3.78 fgemv()** [15/19]

```
Givaro::Integer * fgemv (
    const Givaro::Modular< Givaro::Integer > & F,
    const FFLAS_TRANSPOSE ta,
    const size_t m,
    const size_t n,
    const Givaro::Integer alpha,
    Givaro::Integer * A,
    const size_t lda,
    Givaro::Integer * X,
    const size_t ldx,
    Givaro::Integer beta,
    Givaro::Integer * Y,
    const size_t ldy,
    MMHelper< Givaro::Modular< Givaro::Integer >, MMHelperAlgo::Classic, ModeCategories::ConvertTo<
    ElementCategories::RNSElementTag > > & H) [inline]
```

**11.1.3.79 fgemv()** [16/19]

```

template<size_t K1, size_t K2, class ParSeq>
RecInt::ruint< K1 > * fgemv (
    const Givaro::Modular< RecInt::ruint< K1 >, RecInt::ruint< K2 > > & F,
    const FFLAS_TRANSPOSE ta,
    const size_t m,
    const size_t n,
    const RecInt::ruint< K1 > alpha,
    const RecInt::ruint< K1 > * A,
    const size_t lda,
    const RecInt::ruint< K1 > * X,
    const size_t incx,
    RecInt::ruint< K1 > beta,
    RecInt::ruint< K1 > * Y,
    const size_t incy,
    MMHelper< Givaro::Modular< RecInt::ruint< K1 >, RecInt::ruint< K2 > >, MMHelperAlgo::Classic,
    ModeCategories::ConvertTo< ElementCategories::RNSElementTag >, ParSeq > & H) [inline]

```

**11.1.3.80 fger()** [1/12]

```

template<class Field>
void fger (
    const Field & F,
    const size_t M,
    const size_t N,
    const typename Field::Element alpha,
    typename Field::ConstElement_ptr x,
    const size_t incx,
    typename Field::ConstElement_ptr y,
    const size_t incy,
    typename Field::Element_ptr A,
    const size_t lda) [inline]

```

fger: rank one update of a general matrix

Computes  $A \leftarrow \alpha x y^T + A$

**Parameters**

	$F$	field
	$M$	rows
	$N$	cols
	$\alpha$	scalar
in, out	$A$	dense matrix of size MxN and leading dimension lda
	$lda$	leading dimension of A
	$x$	dense vector of size M
	$incx$	stride of X
	$y$	dense vector of size N
	$incy$	stride of Y

**11.1.3.81 fger() [2/12]**

```

template<class Field>
void fger (
    const Field & F,
    const size_t M,
    const size_t N,
    const typename Field::Element alpha,
    typename Field::ConstElement_ptr x,
    const size_t incx,
    typename Field::ConstElement_ptr y,
    const size_t incy,
    typename Field::Element_ptr A,
    const size_t lda,
    MMHelper< Field, MMHelperAlgo::Classic, ModeCategories::ConvertTo< ElementCategories::MachineFlo
> > & H) [inline]

```

**11.1.3.82 fger() [3/12]**

```

template<class Field, class AnyTag>
void fger (
    const Field & F,
    const size_t M,
    const size_t N,
    const typename Field::Element alpha,
    typename Field::ConstElement_ptr x,
    const size_t incx,
    typename Field::ConstElement_ptr y,
    const size_t incy,
    typename Field::Element_ptr A,
    const size_t lda,
    MMHelper< Field, MMHelperAlgo::Classic, AnyTag > & H) [inline]

```

**11.1.3.83 fger() [4/12]**

```

void fger (
    const Givaro::DoubleDomain & F,
    const size_t M,
    const size_t N,
    const Givaro::DoubleDomain::Element alpha,
    const Givaro::DoubleDomain::ConstElement_ptr x,
    const size_t incx,
    const Givaro::DoubleDomain::ConstElement_ptr y,
    const size_t incy,
    Givaro::DoubleDomain::Element_ptr A,
    const size_t lda,
    MMHelper< Givaro::DoubleDomain, MMHelperAlgo::Classic, ModeCategories::DefaultTag
> & H) [inline]

```



**11.1.3.84 fger()** [5/12]

```

template<class Field>
void fger (
    const Field & F,
    const size_t M,
    const size_t N,
    const typename Field::Element alpha,
    const typename Field::ConstElement_ptr x,
    const size_t incx,
    const typename Field::ConstElement_ptr y,
    const size_t incy,
    typename Field::Element_ptr A,
    const size_t lda,
    MMHelper< Field, MMHelperAlgo::Classic, ModeCategories::DefaultBoundedTag > & H)
[inline]

```

**11.1.3.85 fger()** [6/12]

```

void fger (
    const Givaro::FloatDomain & F,
    const size_t M,
    const size_t N,
    const Givaro::FloatDomain::Element alpha,
    const Givaro::FloatDomain::ConstElement_ptr x,
    const size_t incx,
    const Givaro::FloatDomain::ConstElement_ptr y,
    const size_t incy,
    Givaro::FloatDomain::Element_ptr A,
    const size_t lda,
    MMHelper< Givaro::FloatDomain, MMHelperAlgo::Classic, ModeCategories::DefaultTag
> & H) [inline]

```

**11.1.3.86 fger()** [7/12]

```

template<class Field>
void fger (
    const Field & F,
    const size_t M,
    const size_t N,
    const typename Field::Element alpha,
    typename Field::ConstElement_ptr x,
    const size_t incx,
    typename Field::ConstElement_ptr y,
    const size_t incy,
    typename Field::Element_ptr A,
    const size_t lda,
    MMHelper< Field, MMHelperAlgo::Classic, ModeCategories::LazyTag > & H) [inline]

```

**11.1.3.87 fger()** [8/12]

```

template<class Field>
void fger (
    const Field & F,
    const size_t M,
    const size_t N,
    const typename Field::Element alpha,
    typename Field::ConstElement_ptr x,
    const size_t incx,
    typename Field::ConstElement_ptr y,
    const size_t incy,
    typename Field::Element_ptr A,
    const size_t lda,
    MMHelper< Field, MMHelperAlgo::Classic, ModeCategories::DelayedTag > & H) [inline]

```

**11.1.3.88 fger()** [9/12]

```

void fger (
    const Givaro::Modular< Givaro::Integer > & F,
    const size_t M,
    const size_t N,
    const typename Givaro::Integer alpha,
    typename Givaro::Integer * x,
    const size_t incx,
    typename Givaro::Integer * y,
    const size_t incy,
    typename Givaro::Integer * A,
    const size_t lda,
    MMHelper< Givaro::Modular< Givaro::Integer >, MMHelperAlgo::Classic, ModeCategories::ConvertTo<
ElementCategories::RNSElementTag > > & H) [inline]

```

**11.1.3.89 fger()** [10/12]

```

template<typename RNS>
void fger (
    const FFPACK::RNSInteger< RNS > & F,
    const size_t M,
    const size_t N,
    const typename FFPACK::RNSInteger< RNS >::Element alpha,
    typename FFPACK::RNSInteger< RNS >::Element_ptr x,
    const size_t incx,
    typename FFPACK::RNSInteger< RNS >::Element_ptr y,
    const size_t incy,
    typename FFPACK::RNSInteger< RNS >::Element_ptr A,
    const size_t lda,
    MMHelper< FFPACK::RNSInteger< RNS >, MMHelperAlgo::Classic, ModeCategories::DefaultTag
> & H) [inline]

```

**11.1.3.90 fger()** [11/12]

```

template<typename RNS>
void fger (
    const FFPACK::RNSIntegerMod< RNS > & F,
    const size_t M,
    const size_t N,
    const typename FFPACK::RNSIntegerMod< RNS >::Element alpha,
    typename FFPACK::RNSIntegerMod< RNS >::Element_ptr x,
    const size_t incx,
    typename FFPACK::RNSIntegerMod< RNS >::Element_ptr y,
    const size_t incy,
    typename FFPACK::RNSIntegerMod< RNS >::Element_ptr A,
    const size_t lda,
    MMHelper< FFPACK::RNSIntegerMod< RNS >, MMHelperAlgo::Classic > & H) [inline]

```

**11.1.3.91 freduce()** [1/11]

```

template<class Field>
void freduce (
    const Field & F,
    const size_t n,
    typename Field::ConstElement_ptr Y,
    const size_t incY,
    typename Field::Element_ptr X,
    const size_t incX)

```

freduce  $x \leftarrow y \bmod F$ .

**Parameters**

$F$	field
$n$	size of the vectors
$Y$	vector of Element
$incY$	stride of Y
$X$	vector in F
$incX$	stride of X

**Bug** use cblas\_(d)scal when possible

**11.1.3.92 freduce()** [2/11]

```

template<class Field>
void freduce (
    const Field & F,
    const size_t n,
    typename Field::Element_ptr X,
    const size_t incX)

```

freduce  $x \leftarrow x \bmod F$ .

## Parameters

$F$	field
$n$	size of the vectors
$X$	vector in $F$
$incX$	stride of $X$

**Bug** use `cblas_(d)scal` when possible

### 11.1.3.93 `freduce_constoverride()` [1/2]

```
template<class Field>
void freduce_constoverride (
    const Field & F,
    const size_t m,
    typename Field::ConstElement_ptr A,
    const size_t incX)
```

### 11.1.3.94 `finit()` [1/8]

```
template<class Field, class ConstOtherElement_ptr>
void finit (
    const Field & F,
    const size_t n,
    ConstOtherElement_ptr Y,
    const size_t incY,
    typename Field::Element_ptr X,
    const size_t incX)
```

### 11.1.3.95 `finit()` [2/8]

```
template<class Field>
void finit (
    const Field & F,
    const size_t n,
    typename Field::Element_ptr X,
    const size_t incX)
```

`finit` Initializes  $X$  in  $F$ .

## Parameters

$F$	field
$n$	size of the vectors
$X$	vector in $F$
$incX$	stride of $X$

**11.1.3.96 freduce()** [3/11]

```
template<class Field>
void freduce (
    const Field & F,
    const size_t m,
    const size_t n,
    typename Field::Element_ptr A,
    const size_t lda)
```

freduce  $A \leftarrow A \bmod F$ .

**Parameters**

$F$	field
$m$	number of rows
$n$	number of cols
$A$	matrix in F
$lda$	stride of A

**11.1.3.97 freduce()** [4/11]

```
template<class Field>
void freduce (
    const Field & F,
    const FFLAS_UPLO UpLo,
    const size_t N,
    typename Field::Element_ptr A,
    const size_t lda)
```

freduce for square symmetric matrices

**11.1.3.98 pfreduce()**

```
template<class Field>
void pfreduce (
    const Field & F,
    const size_t m,
    const size_t n,
    typename Field::Element_ptr A,
    const size_t lda,
    const size_t numths)
```

**11.1.3.99 freduce()** [5/11]

```
template<class Field>
void freduce (
    const Field & F,
    const size_t m,
    const size_t n,
    typename Field::ConstElement_ptr B,
    const size_t ldb,
    typename Field::Element_ptr A,
    const size_t lda)
```

freduce  $A \leftarrow B \bmod F$ .

## Parameters

$F$	field
$m$	number of rows
$n$	number of cols
$A$	matrix in $F$
$lda$	stride of $A$
$B$	matrix in <code>Element</code>
$ldb$	stride of $B$

**11.1.3.100 `freduce_constoverride()` [2/2]**

```
template<class Field>
void freduce_constoverride (
    const Field & F,
    const size_t m,
    const size_t n,
    typename Field::ConstElement_ptr A,
    const size_t lda)
```

**11.1.3.101 `finit()` [3/8]**

```
template<class Field, class OtherElement_ptr>
void finit (
    const Field & F,
    const size_t m,
    const size_t n,
    const OtherElement_ptr B,
    const size_t ldb,
    typename Field::Element_ptr A,
    const size_t lda)
```

$\text{finit } A \leftarrow B \bmod F.$

## Parameters

$F$	field
$m$	number of rows
$n$	number of cols
$A$	matrix in $F$
$lda$	stride of $A$
$B$	matrix in <code>OtherElement</code>
$ldb$	stride of $B$

**11.1.3.102 `finit()` [4/8]**

```
template<class Field>
void finit (
    const Field & F,
    const size_t m,
    const size_t n,
    typename Field::Element_ptr A,
    const size_t lda)
```

**11.1.3.103 freduce()** [6/11]

```
template<>
void freduce (
    const FFPACK::RNSIntegerMod< FFPACK::rns_double > & F,
    const size_t n,
    FFPACK::RNSIntegerMod< FFPACK::rns_double >::Element_ptr A,
    size_t inc) [inline]
```

**11.1.3.104 freduce()** [7/11]

```
template<>
void freduce (
    const FFPACK::RNSIntegerMod< FFPACK::rns_double > & F,
    const size_t m,
    const size_t n,
    FFPACK::rns_double::Element_ptr A,
    size_t lda) [inline]
```

**11.1.3.105 freivalds()**

```
template<class Field>
bool freivalds (
    const Field & F,
    const FFLAS_TRANSPOSE ta,
    const FFLAS_TRANSPOSE tb,
    const size_t m,
    const size_t n,
    const size_t k,
    const typename Field::Element alpha,
    typename Field::ConstElement_ptr A,
    const size_t lda,
    typename Field::ConstElement_ptr B,
    const size_t ldb,
    typename Field::ConstElement_ptr C,
    const size_t ldc) [inline]
```

freivalds: **Freivalds G**eneral **M**atrix **M**ultiply **R**andom **C**heck.

Randomly Checks  $C = \alpha \text{op}(A) \times \text{op}(B)$

**Parameters**

<i>F</i>	field.
<i>ta</i>	if ta==FflasTrans then $\text{op}(A) = A^t$ , else $\text{op}(A) = A$ ,
<i>tb</i>	same for matrix B
<i>m</i>	see A
<i>n</i>	see B
<i>k</i>	see A
<i>alpha</i>	scalar
<i>A</i>	$\text{op}(A)$ is $m \times k$
<i>B</i>	$\text{op}(B)$ is $k \times n$
<i>C</i>	<i>C</i> is $m \times n$
<i>lda</i>	leading dimension of A
<i>ldb</i>	leading dimension of B
<i>ldc</i>	leading dimension of C

**11.1.3.106 fscaln()** [1/10]

```
template<class Field>
void fscaln (
    const Field & F,
    const size_t n,
    const typename Field::Element alpha,
    typename Field::Element_ptr X,
    const size_t incX) [inline]
```

$\text{fscaln } x \leftarrow \alpha \cdot x.$

**Parameters**

$F$	field
$n$	size of the vectors
$\alpha$	scalar
$X$	vector in $\mathbb{F}$
$\text{incX}$	stride of $X$

**Bug** use `cblas_(d)scal` when possible

**Todo** check if comparison with  $\pm 1, 0$  is necessary.

**11.1.3.107 fscal()** [1/10]

```
template<class Field>
void fscal (
    const Field & F,
    const size_t n,
    const typename Field::Element alpha,
    typename Field::ConstElement_ptr X,
    const size_t incX,
    typename Field::Element_ptr Y,
    const size_t incY) [inline]
```

$\text{fscal } y \leftarrow \alpha \cdot x.$

**Parameters**

	$F$	field
	$n$	size of the vectors
	$\alpha$	scalar
in	$X$	vector in $\mathbb{F}$
	$\text{incX}$	stride of $X$
out	$Y$	vector in $\mathbb{F}$
	$\text{incY}$	stride of $Y$

**Bug** use `cblas_(d)scal` when possible

**Todo** check if comparison with  $\pm 1, 0$  is necessary.



**11.1.3.108 fscal()** [2/10]

```
template<>
void fscal (
    const Givaro::DoubleDomain & ,
    const size_t N,
    const Givaro::DoubleDomain::Element a,
    Givaro::DoubleDomain::ConstElement_ptr x,
    const size_t incx,
    Givaro::DoubleDomain::Element_ptr y,
    const size_t incy) [inline]
```

**11.1.3.109 fscal()** [3/10]

```
template<>
void fscal (
    const Givaro::FloatDomain & ,
    const size_t N,
    const Givaro::FloatDomain::Element a,
    Givaro::FloatDomain::ConstElement_ptr x,
    const size_t incx,
    Givaro::FloatDomain::Element_ptr y,
    const size_t incy) [inline]
```

**11.1.3.110 fscaln()** [2/10]

```
template<>
void fscaln (
    const Givaro::DoubleDomain & ,
    const size_t N,
    const Givaro::DoubleDomain::Element a,
    Givaro::DoubleDomain::Element_ptr y,
    const size_t incy) [inline]
```

**11.1.3.111 fscaln()** [3/10]

```
template<>
void fscaln (
    const Givaro::FloatDomain & ,
    const size_t N,
    const Givaro::FloatDomain::Element a,
    Givaro::FloatDomain::Element_ptr y,
    const size_t incy) [inline]
```

**11.1.3.112 fscaln()** [4/10]

```
template<class Field>
void fscaln (
    const Field & F,
    const size_t m,
    const size_t n,
    const typename Field::Element alpha,
    typename Field::Element_ptr A,
    const size_t lda) [inline]
```

$\text{fscaln } A \leftarrow a \cdot A.$

## Parameters

$F$	field
$m$	number of rows
$n$	number of cols
$\alpha$	homotecie scalar
$A$	matrix in $F$
$lda$	stride of $A$

## 11.1.3.113 fscal() [4/10]

```
template<class Field>
void fscal (
    const Field & F,
    const size_t m,
    const size_t n,
    const typename Field::Element alpha,
    typename Field::ConstElement_ptr A,
    const size_t lda,
    typename Field::Element_ptr B,
    const size_t ldb) [inline]
```

$\text{fscal } B \leftarrow a \cdot A.$

## Parameters

	$F$	field
	$m$	number of rows
	$n$	number of cols
	$\alpha$	homotecie scalar
in	$A$	matrix in $F$
	$lda$	stride of $A$
out	$B$	matrix in $F$
	$ldb$	stride of $B$

## 11.1.3.114 fscaln() [5/10]

```
template<>
void fscaln (
    const FFPACK::RNSInteger< FFPACK::rns_double > & F,
    const size_t n,
    const FFPACK::rns_double::Element alpha,
    FFPACK::rns_double::Element_ptr A,
    const size_t inc) [inline]
```

**11.1.3.115 fscal()** [5/10]

```
template<>
void fscal (
    const FFPACK::RNSInteger< FFPACK::rns_double > & F,
    const size_t n,
    const FFPACK::rns_double::Element alpha,
    FFPACK::rns_double::ConstElement_ptr A,
    const size_t Ainc,
    FFPACK::rns_double::Element_ptr B,
    const size_t Binc) [inline]
```

**11.1.3.116 fscaln()** [6/10]

```
template<>
void fscaln (
    const FFPACK::RNSInteger< FFPACK::rns_double > & F,
    const size_t m,
    const size_t n,
    const FFPACK::rns_double::Element alpha,
    FFPACK::rns_double::Element_ptr A,
    const size_t lda) [inline]
```

**11.1.3.117 fscal()** [6/10]

```
template<>
void fscal (
    const FFPACK::RNSInteger< FFPACK::rns_double > & F,
    const size_t m,
    const size_t n,
    const FFPACK::rns_double::Element alpha,
    FFPACK::rns_double::ConstElement_ptr A,
    const size_t lda,
    FFPACK::rns_double::Element_ptr B,
    const size_t ldb) [inline]
```

**11.1.3.118 fscaln()** [7/10]

```
template<>
void fscaln (
    const FFPACK::RNSIntegerMod< FFPACK::rns_double > & F,
    const size_t n,
    const typename FFPACK::RNSIntegerMod< FFPACK::rns_double >::Element alpha,
    typename FFPACK::RNSIntegerMod< FFPACK::rns_double >::Element_ptr A,
    const size_t inc) [inline]
```

**11.1.3.119 fscal()** [7/10]

```
template<>
void fscal (
    const FFPACK::RNSIntegerMod< FFPACK::rns_double > & F,
    const size_t n,
    const FFPACK::rns_double::Element alpha,
    FFPACK::rns_double::ConstElement_ptr A,
    const size_t Ainc,
    FFPACK::rns_double::Element_ptr B,
    const size_t Binc) [inline]
```

**11.1.3.120 fscaln()** [8/10]

```
template<>
void fscaln (
    const FFPACK::RNSIntegerMod< FFPACK::rns_double > & F,
    const size_t m,
    const size_t n,
    const FFPACK::rns_double::Element alpha,
    FFPACK::rns_double::Element_ptr A,
    const size_t lda) [inline]
```

**11.1.3.121 fscal()** [8/10]

```
template<>
void fscal (
    const FFPACK::RNSIntegerMod< FFPACK::rns_double > & F,
    const size_t m,
    const size_t n,
    const FFPACK::rns_double::Element alpha,
    FFPACK::rns_double::ConstElement_ptr A,
    const size_t lda,
    FFPACK::rns_double::Element_ptr B,
    const size_t ldb) [inline]
```

**11.1.3.122 fsyr2k()**

```
template<class Field>
Field::Element_ptr fsyr2k (
    const Field & F,
    const FFLAS_UPLO UpLo,
    const FFLAS_TRANSPOSE trans,
    const size_t n,
    const size_t k,
    const typename Field::Element alpha,
    typename Field::ConstElement_ptr A,
    const size_t lda,
    typename Field::ConstElement_ptr B,
    const size_t ldb,
    const typename Field::Element beta,
    typename Field::Element_ptr C,
    const size_t ldc) [inline]
```

fsyr2k: Symmetric Rank 2K update

Computes the Lower or Upper triangular part of  $C = \alpha(A \times B^T + B \times A^T) + \beta C$  or  $C = \alpha(A^T \times B + B^T \times A) + \beta C$

## Parameters

<i>F</i>	field.
<i>UpLo</i>	whether to compute the upper or the lower triangular part of the symmetric matrix C
<i>trans</i>	if <code>ta==FflasNoTrans</code> then compute $C = \alpha(A \times B^T + B \times A^T) + \beta C$ , else $C = \alpha(A^T \times B + B^T \times A) + \beta C$
<i>n</i>	order of matrix C
<i>k</i>	see A
<i>alpha</i>	scalar
<i>A</i>	<i>A</i> is $n \times k$ (FflasNoTrans) or <i>A</i> is $k \times n$ (FflasTrans)
<i>lda</i>	leading dimension of A
<i>beta</i>	scalar
<i>C</i>	<i>C</i> is $n \times n$
<i>ldc</i>	leading dimension of C

## Warning

$\alpha$  must be invertible

## 11.1.3.123 fsyrk() [1/16]

```
template<class Field>
Field::Element_ptr fsyrk (
    const Field & F,
    const FFLAS_UPLO UpLo,
    const FFLAS_TRANSPOSE trans,
    const size_t n,
    const size_t k,
    const typename Field::Element alpha,
    typename Field::ConstElement_ptr A,
    const size_t lda,
    const typename Field::Element beta,
    typename Field::Element_ptr C,
    const size_t ldc) [inline]
```

fsyrk: Symmetric Rank K update

Computes the Lower or Upper triangular part of  $C = \alpha A \times A^T + \beta C$  or  $C = \alpha A^T \times A + \beta C$

## Parameters

<i>F</i>	field.
<i>UpLo</i>	whether to compute the upper or the lower triangular part of the symmetric matrix C
<i>trans</i>	if <code>ta==FflasNoTrans</code> then compute $C = \alpha A \times A^T + \beta C$ , else $C = \alpha A^T \times A + \beta C$
<i>n</i>	order of matrix C
<i>k</i>	see A
<i>alpha</i>	scalar
<i>A</i>	<i>A</i> is $n \times k$ or <i>A</i> is $k \times n$
<i>lda</i>	leading dimension of A
<i>beta</i>	scalar
<i>C</i>	<i>C</i> is $n \times n$
<i>ldc</i>	leading dimension of C

**Warning**

$\alpha$  *must* be invertible

**11.1.3.124 fsyrk()** [2/16]

```
template<class Field>
Field::Element_ptr fsyrk (
    const Field & F,
    const FFLAS_UPLO UpLo,
    const FFLAS_TRANSPOSE trans,
    const size_t N,
    const size_t K,
    const typename Field::Element alpha,
    typename Field::ConstElement_ptr A,
    const size_t lda,
    const typename Field::Element beta,
    typename Field::Element_ptr C,
    const size_t ldc,
    const ParSeqHelper::Sequential seq) [inline]
```

**11.1.3.125 fsyrk()** [3/16]

```
template<class Field>
Field::Element_ptr fsyrk (
    const Field & F,
    const FFLAS_UPLO UpLo,
    const FFLAS_TRANSPOSE trans,
    const size_t N,
    const size_t K,
    const typename Field::Element alpha,
    typename Field::ConstElement_ptr A,
    const size_t lda,
    const typename Field::Element beta,
    typename Field::Element_ptr C,
    const size_t ldc,
    MMHelper< Field, MMHelperAlgo::Classic, ModeCategories::DefaultTag > & H) [inline]
```

**11.1.3.126 fsyrk()** [4/16]

```
template<class Field>
Field::Element_ptr fsyrk (
    const Field & F,
    const FFLAS_UPLO UpLo,
    const FFLAS_TRANSPOSE trans,
    const size_t N,
    const size_t K,
    const typename Field::Element alpha,
    typename Field::ConstElement_ptr A,
    const size_t lda,
    const typename Field::Element beta,
    typename Field::Element_ptr C,
    const size_t ldc,
    MMHelper< Field, MMHelperAlgo::Classic, ModeCategories::ConvertTo< ElementCategories::MachineFlo
>, ParSeqHelper::Sequential > & H) [inline]
```

**11.1.3.127 fsyrk()** [5/16]

```

template<class Field>
Field::Element_ptr fsyrk (
    const Field & F,
    const FFLAS_UPLO UpLo,
    const FFLAS_TRANSPOSE trans,
    const size_t N,
    const size_t K,
    const typename Field::Element alpha,
    typename Field::ConstElement_ptr A,
    const size_t lda,
    const typename Field::Element beta,
    typename Field::Element_ptr C,
    const size_t ldc,
    MMHelper< Field, MMHelperAlgo::Classic, ModeCategories::DelayedTag > & H) [inline]

```

**11.1.3.128 fsyrk()** [6/16]

```

template<class Field>
Field::Element_ptr fsyrk (
    const Field & F,
    const FFLAS_UPLO UpLo,
    const FFLAS_TRANSPOSE trans,
    const size_t N,
    const size_t K,
    const typename Field::Element alpha,
    typename Field::ConstElement_ptr A,
    const size_t lda,
    const typename Field::Element beta,
    typename Field::Element_ptr C,
    const size_t ldc,
    MMHelper< Field, MMHelperAlgo::Classic, ModeCategories::LazyTag > & H) [inline]

```

**11.1.3.129 fsyrk()** [7/16]

```

template<class Field, typename Mode>
Field::Element_ptr fsyrk (
    const Field & F,
    const FFLAS_UPLO UpLo,
    const FFLAS_TRANSPOSE trans,
    const size_t N,
    const size_t K,
    const typename Field::Element alpha,
    typename Field::ConstElement_ptr A,
    const size_t lda,
    const typename Field::Element beta,
    typename Field::Element_ptr C,
    const size_t ldc,
    MMHelper< Field, MMHelperAlgo::DivideAndConquer, Mode > & H) [inline]

```

**11.1.3.130 fsyrk() [8/16]**

```

template<class Field>
Field::Element_ptr fsyrk (
    const Field & F,
    const FFLAS_UPLO UpLo,
    const FFLAS_TRANSPOSE trans,
    const size_t N,
    const size_t K,
    const typename Field::Element alpha,
    typename Field::ConstElement_ptr A,
    const size_t lda,
    const typename Field::Element beta,
    typename Field::Element_ptr C,
    const size_t ldc,
    MMHelper< Field, MMHelperAlgo::Classic, ModeCategories::DefaultBoundedTag > & H)
[inline]

```

**11.1.3.131 fsyrk() [9/16]**

```

Givaro::FloatDomain::Element_ptr fsyrk (
    const Givaro::FloatDomain & F,
    const FFLAS_UPLO UpLo,
    const FFLAS_TRANSPOSE trans,
    const size_t N,
    const size_t K,
    const Givaro::FloatDomain::Element alpha,
    Givaro::FloatDomain::ConstElement_ptr A,
    const size_t lda,
    const Givaro::FloatDomain::Element beta,
    Givaro::FloatDomain::Element_ptr C,
    const size_t ldc,
    MMHelper< Givaro::FloatDomain, MMHelperAlgo::Classic, ModeCategories::DefaultTag
> & H) [inline]

```

**11.1.3.132 fsyrk() [10/16]**

```

Givaro::DoubleDomain::Element_ptr fsyrk (
    const Givaro::DoubleDomain & F,
    const FFLAS_UPLO UpLo,
    const FFLAS_TRANSPOSE trans,
    const size_t N,
    const size_t K,
    const Givaro::DoubleDomain::Element alpha,
    Givaro::DoubleDomain::ConstElement_ptr A,
    const size_t lda,
    const Givaro::DoubleDomain::Element beta,
    Givaro::DoubleDomain::Element_ptr C,
    const size_t ldc,
    MMHelper< Givaro::DoubleDomain, MMHelperAlgo::Classic, ModeCategories::DefaultTag
> & H) [inline]

```



**11.1.3.133 fsyrk()** [11/16]

```

template<class Field>
Field::Element_ptr fsyrk (
    const Field & F,
    const FFLAS_UPLO UpLo,
    const FFLAS_TRANSPOSE trans,
    const size_t n,
    const size_t k,
    const typename Field::Element alpha,
    typename Field::Element_ptr A,
    const size_t lda,
    typename Field::ConstElement_ptr D,
    const size_t incD,
    const typename Field::Element beta,
    typename Field::Element_ptr C,
    const size_t ldc,
    const size_t threshold = __FFLASFFPACK_FSYRK_THRESHOLD) [inline]

```

fsyrk: Symmetric Rank K update with diagonal scaling

Computes the Lower or Upper triangular part of  $C = \alpha A \times D \times A^T + \beta C$  or  $C = \alpha A^T \times D \times A + \beta C$  where D is a diagonal matrix. Matrix A is updated into  $D \times A$  (if trans = FflasTrans) or  $A \times D$  (if trans = FflasNoTrans).

**Parameters**

<i>F</i>	field.
<i>UpLo</i>	whether to compute the upper or the lower triangular part of the symmetric matrix C
<i>trans</i>	if ta==FflasNoTrans then compute $C = \alpha A \times A^T + \beta C$ , else $C = \alpha A^T \times A + \beta C$
<i>n</i>	order of matrix C
<i>k</i>	see A
<i>alpha</i>	scalar
<i>A</i>	A is $n \times k$ or A is $k \times n$
<i>lda</i>	leading dimension of A
<i>D</i>	D is $k \times k$ diagonal matrix, stored as a vector of k coefficients
<i>lda</i>	leading dimension of A
<i>beta</i>	scalar
<i>C</i>	C is $n \times n$
<i>ldc</i>	leading dimension of C

**Warning**

$\alpha$  must be invertible

**11.1.3.134 fsyrk()** [12/16]

```

template<class Field>
Field::Element_ptr fsyrk (
    const Field & F,
    const FFLAS_UPLO UpLo,
    const FFLAS_TRANSPOSE trans,
    const size_t N,

```

```

const size_t K,
const typename Field::Element alpha,
typename Field::Element_ptr A,
const size_t lda,
typename Field::ConstElement_ptr D,
const size_t incD,
const typename Field::Element beta,
typename Field::Element_ptr C,
const size_t ldc,
const ParSeqHelper::Sequential seq,
const size_t threshold) [inline]

```

#### 11.1.3.135 fsyrk() [13/16]

```

template<class Field, class Cut, class Param>
Field::Element_ptr fsyrk (
    const Field & F,
    const FFLAS_UPLO UpLo,
    const FFLAS_TRANSPOSE trans,
    const size_t N,
    const size_t K,
    const typename Field::Element alpha,
    typename Field::Element_ptr A,
    const size_t lda,
    typename Field::ConstElement_ptr D,
    const size_t incD,
    const typename Field::Element beta,
    typename Field::Element_ptr C,
    const size_t ldc,
    const ParSeqHelper::Parallel< Cut, Param > par,
    const size_t threshold) [inline]

```

#### 11.1.3.136 fsyrk() [14/16]

```

template<class Field>
Field::Element_ptr fsyrk (
    const Field & F,
    const FFLAS_UPLO UpLo,
    const FFLAS_TRANSPOSE trans,
    const size_t n,
    const size_t k,
    const typename Field::Element alpha,
    typename Field::Element_ptr A,
    const size_t lda,
    typename Field::ConstElement_ptr D,
    const size_t incD,
    const std::vector< bool > & twoBlock,
    const typename Field::Element beta,
    typename Field::Element_ptr C,
    const size_t ldc,
    const size_t threshold = __FFLASFFPACK_FSYRK_THRESHOLD) [inline]

```

fsyrk: Symmetric Rank K update with diagonal scaling

Computes the Lower or Upper triangular part of  $C = \alpha A \times \text{Delta} D \times A^T + \beta C$  or  $C = \alpha A^T \times \text{Delta} D \times A + \beta C$  where D is a diagonal matrix and Delta is a block diagonal with either 1 on the diagonal or 2x2 swap blocks Matrix A is updated into  $D \times A$  (if trans = FflasTrans) or  $A \times D$  (if trans = FflasNoTrans).

## Parameters

<i>F</i>	field.
<i>UpLo</i>	whether to compute the upper or the lower triangular part of the symmetric matrix <i>C</i>
<i>trans</i>	if <code>ta==FflasNoTrans</code> then compute $C = \alpha A \Delta D \times A^T + \beta C$ , else $C = \alpha A^T \Delta D \times A + \beta C$
<i>n</i>	see <i>B</i>
<i>k</i>	see <i>A</i>
<i>alpha</i>	scalar
<i>A</i>	<i>A</i> is $n \times k$ or <i>A</i> is $k \times n$
<i>lda</i>	leading dimension of <i>A</i>
<i>D</i>	<i>D</i> is $k \times k$ diagonal matrix, stored as a vector of <i>k</i> coefficients
<i>twoBlocks</i>	a vector boolean indicating the beginning of each 2x2 blocs in <i>Delta</i>
<i>lda</i>	leading dimension of <i>A</i>
<i>beta</i>	scalar
<i>C</i>	<i>C</i> is $n \times n$
<i>ldc</i>	leading dimension of <i>C</i>

## Warning

$\alpha$  must be invertible

## 11.1.3.137 computeS1S2()

```
template<class Field, class FieldTrait>
void computeS1S2 (
    const Field & F,
    const FFLAS_TRANSPOSE trans,
    const size_t N,
    const size_t K,
    const typename Field::Element x,
    const typename Field::Element y,
    typename Field::Element_ptr A,
    const size_t lda,
    typename Field::Element_ptr S,
    const size_t lds,
    typename Field::Element_ptr T,
    const size_t ldt,
    MMHelper< Field, MMHelperAlgo::Winograd, FieldTrait > & WH) [inline]
```

## 11.1.3.138 fsyrk() [15/16]

```
template<class Field>
Field::Element_ptr fsyrk (
    const Field & F,
    const FFLAS_UPLO UpLo,
    const FFLAS_TRANSPOSE trans,
    const size_t N,
    const size_t K,
    const typename Field::Element alpha,
```

```

    typename Field::ConstElement_ptr A,
    const size_t lda,
    const typename Field::Element beta,
    typename Field::Element_ptr C,
    const size_t ldc,
    MMHelper< Field, MMHelperAlgo::Winograd, ModeCategories::DelayedTag, ParSeqHelper::Sequential
> & H) [inline]

```

#### 11.1.3.139 fsyrk() [16/16]

```

template<class Field, class Mode>
Field::Element_ptr fsyrk (
    const Field & F,
    const FFLAS_UPLO UpLo,
    const FFLAS_TRANSPOSE trans,
    const size_t N,
    const size_t K,
    const typename Field::Element alpha,
    typename Field::ConstElement_ptr A,
    const size_t lda,
    const typename Field::Element beta,
    typename Field::Element_ptr C,
    const size_t ldc,
    MMHelper< Field, MMHelperAlgo::Winograd, Mode > & H) [inline]

```

#### 11.1.3.140 fsyrk\_strassen() [1/2]

```

template<class Field, class FieldTrait>
Field::Element_ptr fsyrk_strassen (
    const Field & F,
    const FFLAS_UPLO uplo,
    const FFLAS_TRANSPOSE trans,
    const size_t N,
    const size_t K,
    const typename Field::Element y1,
    const typename Field::Element y2,
    const typename Field::Element alpha,
    typename Field::Element_ptr A,
    const size_t lda,
    const typename Field::Element beta,
    typename Field::Element_ptr C,
    const size_t ldc,
    MMHelper< Field, MMHelperAlgo::Winograd, FieldTrait > & WH) [inline]

```

#### 11.1.3.141 ftrmm() [1/3]

```

template<class Field>
void ftrmm (
    const Field & F,
    const FFLAS_SIDE Side,
    const FFLAS_UPLO UpLo,
    const FFLAS_TRANSPOSE TransA,
    const FFLAS_DIAG Diag,

```

```

    const size_t M,
    const size_t N,
    const typename Field::Element alpha,
    typename Field::ConstElement_ptr A,
    const size_t lda,
    typename Field::Element_ptr B,
    const size_t ldb) [inline]

```

ftmmm: **TR**angular **M**atrix **M**ultiply.

Computes  $B \leftarrow \alpha \text{op}(A)B$  or  $B \leftarrow \alpha B \text{op}(A)$ .

#### Parameters

<i>F</i>	field
<i>Side</i>	if Side==FflasLeft then $B \leftarrow \alpha \text{op}(A)B$ is computed.
<i>Uplo</i>	if Uplo==FflasUpper then A is upper triangular
<i>TransA</i>	if TransA==FflasTrans then $\text{op}(A) = A^t$ .
<i>Diag</i>	if Diag==FflasUnit then A is implicitly unit.
<i>M</i>	rows of B
<i>N</i>	cols of B
<i>alpha</i>	scalar
<i>A</i>	triangular matrix. If Side==FflasLeft then A is $N \times N$ , otherwise A is $M \times M$
<i>lda</i>	leading dim of A
<i>B</i>	matrix of size MxN
<i>ldb</i>	leading dim of B

#### 11.1.3.142 ftmmm() [2/3]

```

template<class Field>
void ftmmm (
    const Field & F,
    const FFLAS_SIDE Side,
    const FFLAS_UPLO Uplo,
    const FFLAS_TRANSPOSE TransA,
    const FFLAS_DIAG Diag,
    const size_t M,
    const size_t N,
    const typename Field::Element alpha,
    typename Field::ConstElement_ptr A,
    const size_t lda,
    typename Field::ConstElement_ptr B,
    const size_t ldb,
    const typename Field::Element beta,
    typename Field::Element_ptr C,
    const size_t ldc) [inline]

```

ftmmm: **TR**angular **M**atrix **M**ultiply with 3 operands Computes  $C \leftarrow \alpha \text{op}(A)B + \beta C$  or  $C \leftarrow \alpha B \text{op}(A) + \beta C$ .

#### Parameters

<i>F</i>	field
<i>Side</i>	if Side==FflasLeft then $B \leftarrow \alpha \text{op}(A)B$ is computed.

## Parameters

<i>Uplo</i>	if <code>Uplo==FflasUpper</code> then A is upper triangular
<i>TransA</i>	if <code>TransA==FflasTrans</code> then $\text{op}(A) = A^t$ .
<i>Diag</i>	if <code>Diag==FflasUnit</code> then A is implicitly unit.
<i>M</i>	rows of B
<i>N</i>	cols of B
<i>alpha</i>	scalar
<i>A</i>	triangular matrix. If <code>Side==FflasLeft</code> then A is $N \times N$ , otherwise A is $M \times M$
<i>lda</i>	leading dim of A
<i>B</i>	matrix of size MxN
<i>ldb</i>	leading dim of B
<i>beta</i>	scalar
<i>C</i>	matrix of size MxN
<i>ldc</i>	leading dim of C

## 11.1.3.143 ftrsm() [1/9]

```
template<class Field>
void ftrsm (
    const Field & F,
    const FFLAS_SIDE Side,
    const FFLAS_UPLO Uplo,
    const FFLAS_TRANSPOSE TransA,
    const FFLAS_DIAG Diag,
    const size_t M,
    const size_t N,
    const typename Field::Element alpha,
    typename Field::Element_ptr A,
    const size_t lda,
    typename Field::Element_ptr B,
    const size_t ldb) [inline]
```

## 11.1.3.144 ftrsm() [2/9]

```
template<class Field>
void ftrsm (
    const Field & F,
    const FFLAS_SIDE Side,
    const FFLAS_UPLO Uplo,
    const FFLAS_TRANSPOSE TransA,
    const FFLAS_DIAG Diag,
    const size_t M,
    const size_t N,
    const typename Field::Element alpha,
    typename Field::Element_ptr A,
    const size_t lda,
    typename Field::Element_ptr B,
    const size_t ldb,
    const ParSeqHelper::Sequential & PSH) [inline]
```

**11.1.3.145 ftrsm()** [3/9]

```

template<class Field, class Cut, class Param>
void ftrsm (
    const Field & F,
    const FFLAS_SIDE Side,
    const FFLAS_UPLO Uplo,
    const FFLAS_TRANSPOSE TransA,
    const FFLAS_DIAG Diag,
    const size_t M,
    const size_t N,
    const typename Field::Element alpha,
    typename Field::Element_ptr A,
    const size_t lda,
    typename Field::Element_ptr B,
    const size_t ldb,
    const ParSeqHelper::Parallel< Cut, Param > & PSH) [inline]

```

**11.1.3.146 ftrsm()** [4/9]

```

template<class Field, class ParSeqTrait = ParSeqHelper::Sequential>
void ftrsm (
    const Field & F,
    const FFLAS_SIDE Side,
    const FFLAS_UPLO Uplo,
    const FFLAS_TRANSPOSE TransA,
    const FFLAS_DIAG Diag,
    const size_t M,
    const size_t N,
    const typename Field::Element alpha,
    typename Field::Element_ptr A,
    const size_t lda,
    typename Field::Element_ptr B,
    const size_t ldb,
    TRSMHelper< StructureHelper::Recursive, ParSeqTrait > & H) [inline]

```

**11.1.3.147 ftrsm()** [5/9]

```

void ftrsm (
    const Givaro::Modular< Givaro::Integer > & F,
    const FFLAS_SIDE Side,
    const FFLAS_UPLO Uplo,
    const FFLAS_TRANSPOSE TransA,
    const FFLAS_DIAG Diag,
    const size_t M,
    const size_t N,
    const Givaro::Integer alpha,
    const Givaro::Integer * A,
    const size_t lda,
    Givaro::Integer * B,
    const size_t ldb) [inline]

```

### 11.1.3.148 cblas\_impstrsm()

```
void cblas_impstrsm (
    const enum FFLAS_ORDER Order,
    const enum FFLAS_SIDE Side,
    const enum FFLAS_UPLO Uplo,
    const enum FFLAS_TRANSPOSE TransA,
    const enum FFLAS_DIAG Diag,
    const int M,
    const int N,
    const FFPACK::rns_double_elt alpha,
    FFPACK::rns_double_elt_cstptr A,
    const int lda,
    FFPACK::rns_double_elt_ptr B,
    const int ldb) [inline]
```

### 11.1.3.149 ftrsv() [1/2]

```
template<class Field>
void ftrsv (
    const Field & F,
    const FFLAS_UPLO Uplo,
    const FFLAS_TRANSPOSE TransA,
    const FFLAS_DIAG Diag,
    const size_t N,
    typename Field::ConstElement_ptr A,
    const size_t lda,
    typename Field::Element_ptr X,
    int incX) [inline]
```

ftrsv: TRIangular System solve with Vector Computes  $X \leftarrow \text{op}(A^{-1})X$

#### Parameters

<i>F</i>	field
<i>X</i>	vector of size N on a field F
<i>incX</i>	stride of X
<i>A</i>	a matrix of leading dimension lda and size N
<i>lda</i>	leading dimension of A
<i>N</i>	number of rows or columns of A according to TransA
<i>TransA</i>	if TransA==FflasTrans then $\text{op}(A) = A^t$ .
<i>Diag</i>	if Diag==FflasUnit then A is unit.
<i>Uplo</i>	if Uplo==FflasUpper then A is upper triangular

### 11.1.3.150 igemm\_()

```
void igemm_ (
    const enum FFLAS_ORDER Order,
    const enum FFLAS_TRANSPOSE TransA,
    const enum FFLAS_TRANSPOSE TransB,
    const size_t M,
```



```

    const size_t N,
    const size_t K,
    const int64_t alpha,
    const int64_t * A,
    const size_t lda,
    const int64_t * B,
    const size_t ldb,
    const int64_t beta,
    int64_t * C,
    const size_t ldc) [inline]

```

#### 11.1.3.151 finit() [5/8]

```

template<class Field, class OtherElement_ptr>
void finit (
    const Field & F,
    const size_t n,
    const OtherElement_ptr Y,
    const size_t incY,
    typename Field::Element_ptr X,
    const size_t incX)

```

$\text{finit } x \leftarrow y \bmod F.$

##### Parameters

$F$	field
$n$	size of the vectors
$Y$	vector of OtherElement
$incY$	stride of Y
$X$	vector in F
$incX$	stride of X

**Bug** use cblas\_(d)scal when possible

#### 11.1.3.152 fconvert() [1/3]

```

template<class Field, class OtherElement_ptr>
void fconvert (
    const Field & F,
    const size_t n,
    OtherElement_ptr X,
    const size_t incX,
    typename Field::ConstElement_ptr Y,
    const size_t incY)

```

$\text{fconvert } x \leftarrow y \bmod F.$

##### Parameters

$F$	field
$n$	size of the vectors

$Y$	vector of $F$
$incY$	stride of $Y$
$X$	vector in <code>OtherElement</code>
$incX$	stride of $X$

**Bug** use `cblas_(d)scal` when possible

#### 11.1.3.153 `fnegin()` [1/4]

```
template<class Field>
void fnegin (
    const Field & F,
    const size_t n,
    typename Field::Element_ptr X,
    const size_t incX)
```

`fnegin`  $x \leftarrow -x$ .

##### Parameters

$F$	field
$n$	size of the vectors
$X$	vector in $F$
$incX$	stride of $X$

**Bug** use `cblas_(d)scal` when possible

#### 11.1.3.154 `fneg()` [1/4]

```
template<class Field>
void fneg (
    const Field & F,
    const size_t n,
    typename Field::ConstElement_ptr Y,
    const size_t incY,
    typename Field::Element_ptr X,
    const size_t incX)
```

`fneg`  $x \leftarrow -y$ .

##### Parameters

$F$	field
$n$	size of the vectors
$X$	vector in $F$
$incX$	stride of $X$
$Y$	vector in $F$
$incY$	stride of $Y$

**Bug** use `cblas_(d)scal` when possible

**11.1.3.155 fzero()** [1/5]

```
template<class Field>
void fzero (
    const Field & F,
    const size_t n,
    typename Field::Element_ptr X,
    const size_t incX)
```

**fzero** :  $A \leftarrow 0$ .

**Parameters**

$F$	field
$n$	number of elements to zero
$X$	vector in $F$
$incX$	stride of $X$

**11.1.3.156 frand()** [1/2]

```
template<class Field, class RandIter>
void frand (
    const Field & F,
    RandIter & G,
    const size_t n,
    typename Field::Element_ptr X,
    const size_t incX)
```

**frand** :  $A \leftarrow random$ .

**Parameters**

$F$	field
$G$	randomiterator
$n$	number of elements to randomize
$X$	vector in $F$
$incX$	stride of $X$

**11.1.3.157 fiszero()** [1/4]

```
template<class Field>
bool fiszero (
    const Field & F,
    const size_t n,
    typename Field::ConstElement_ptr X,
    const size_t incX)
```

**fiszero** : test  $X = 0$ .

## Parameters

$F$	field
$n$	vector dimension
$X$	vector in $F$
$incX$	increment of $X$

**11.1.3.158 fequal()** [1/4]

```
template<class Field>
bool fequal (
    const Field & F,
    const size_t n,
    typename Field::ConstElement_ptr X,
    const size_t incX,
    typename Field::ConstElement_ptr Y,
    const size_t incY)
```

fequal : test  $X = Y$ .

## Parameters

$F$	field
$n$	vector dimension
$X$	vector in $F$
$incX$	increment of $X$
$Y$	vector in $F$
$incY$	increment of $Y$

**11.1.3.159 faxpby()** [1/2]

```
template<class Field>
void faxpby (
    const Field & F,
    const size_t N,
    const typename Field::Element alpha,
    typename Field::ConstElement_ptr X,
    const size_t incX,
    const typename Field::Element beta,
    typename Field::Element_ptr Y,
    const size_t incY)
```

faxpby :  $y \leftarrow \alpha \cdot x + \beta \cdot y$ .

## Parameters

	$F$	field
	$N$	size of the vectors
	$\alpha$	scalar
in	$X$	vector in $F$
	$incX$	stride of $X$

	<i>beta</i>	scalar
in, out	<i>Y</i>	vector in F
	<i>incY</i>	stride of Y

**Note**

this is a catlas function

**11.1.3.160 fdot()** [9/11]

```
template<typename Field, class Cut, class Param>
Field::Element fdot (
    const Field & F,
    const size_t N,
    typename Field::ConstElement_ptr X,
    const size_t incX,
    typename Field::ConstElement_ptr Y,
    const size_t incY,
    const ParSeqHelper::Parallel< Cut, Param > par) [inline]
```

**11.1.3.161 fswap()** [1/2]

```
template<class Field>
void fswap (
    const Field & F,
    const size_t N,
    typename Field::Element_ptr X,
    const size_t incX,
    typename Field::Element_ptr Y,
    const size_t incY)
```

fswap:  $X \leftrightarrow Y$ .

**Bug** use `cblas_dswap` when double

**Parameters**

<i>F</i>	field
<i>N</i>	size of the vectors
<i>X</i>	vector in F
<i>incX</i>	stride of X
<i>Y</i>	vector in F
<i>incY</i>	stride of Y

**11.1.3.162 fzero()** [2/5]

```
template<class Field>
void fzero (
    const Field & F,
    const size_t m,
    const size_t n,
    typename Field::Element_ptr A,
    const size_t lda)
```

$\text{fzero} : A \leftarrow 0.$

## Parameters

$F$	field
$m$	number of rows to zero
$n$	number of cols to zero
$A$	matrix in $F$
$lda$	stride of $A$

## Warning

may be buggy if Element is larger than int

**11.1.3.163 fzero()** [3/5]

```
template<class Field>
void fzero (
    const Field & F,
    const FFLAS_UPLO shape,
    const FFLAS_DIAG diag,
    const size_t n,
    typename Field::Element_ptr A,
    const size_t lda)
```

$fzero : A \leftarrow 0$  for a triangular matrix.

## Parameters

$F$	field
$shape$	shape of the triangular matrix
$m$	number of rows to zero
$n$	number of cols to zero
$A$	matrix in $F$
$lda$	stride of $A$

## Warning

may be buggy if Element is larger than int

**11.1.3.164 frand()** [2/2]

```
template<class Field, class RandIter>
void frand (
    const Field & F,
    RandIter & G,
    const size_t m,
    const size_t n,
    typename Field::Element_ptr A,
    const size_t lda)
```

$frand : A \leftarrow random$ .

## Parameters

$F$	field
$G$	randomiterator
$m$	number of rows to randomize
$n$	number of cols to randomize
$A$	matrix in $F$
$lda$	stride of $A$

**11.1.3.165 fequal()** [2/4]

```
template<class Field>
bool fequal (
    const Field & F,
    const size_t m,
    const size_t n,
    typename Field::ConstElement_ptr A,
    const size_t lda,
    typename Field::ConstElement_ptr B,
    const size_t ldb)
```

fequal : test  $A = B$ .

## Parameters

$F$	field
$m$	row dimension
$n$	column dimension
$A$	$m \times n$ matrix in $F$
$lda$	leading dimension of $A$
$B$	$m \times n$ matrix in $F$
$ldb$	leading dimension of $B$

**11.1.3.166 fiszero()** [2/4]

```
template<class Field>
bool fiszero (
    const Field & F,
    const size_t m,
    const size_t n,
    typename Field::ConstElement_ptr A,
    const size_t lda)
```

fiszero : test  $A = 0$ .

## Parameters

$F$	field
$m$	row dimension
$n$	column dimension
$A$	$m \times n$ matrix in $F$
$lda$	leading dimension of $A$



**11.1.3.167 fidentity()** [1/4]

```
template<class Field>
void fidentity (
    const Field & F,
    const size_t m,
    const size_t n,
    typename Field::Element_ptr A,
    const size_t lda,
    const typename Field::Element & d)
```

creates a diagonal matrix

**11.1.3.168 fidentity()** [2/4]

```
template<class Field>
void fidentity (
    const Field & F,
    const size_t m,
    const size_t n,
    typename Field::Element_ptr A,
    const size_t lda)
```

creates a diagonal matrix

**11.1.3.169 finit()** [6/8]

```
template<class Field, class OtherElement_ptr>
void finit (
    const Field & F,
    const size_t m,
    const size_t n,
    typename Field::Element_ptr A,
    const size_t lda)
```

finit Initializes A in F\$.

**Parameters**

$F$	field
$m$	number of rows
$n$	number of cols
$A$	matrix in F
$lda$	stride of A

**11.1.3.170 fconvert()** [2/3]

```
template<class Field, class OtherElement_ptr>
void fconvert (
    const Field & F,
    const size_t m,
    const size_t n,
    OtherElement_ptr A,
    const size_t lda,
    typename Field::ConstElement_ptr B,
    const size_t ldb)
```

fconvert  $A \leftarrow B \bmod F$ .

## Parameters

$F$	field
$m$	number of rows
$n$	number of cols
$A$	matrix in OtherElement
$lda$	stride of A
$B$	matrix in F
$ldb$	stride of B

**Todo** check if  $n == lda$

11.1.3.171 `fnegin()` [2/4]

```
template<class Field>
void fnegin (
    const Field & F,
    const size_t m,
    const size_t n,
    typename Field::Element_ptr A,
    const size_t lda)
```

`fnegin`  $A \leftarrow -A$ .

## Parameters

$F$	field
$m$	number of rows
$n$	number of cols
$A$	matrix in F
$lda$	stride of A

**Todo** check if  $n == lda$

11.1.3.172 `fneg()` [2/4]

```
template<class Field>
void fneg (
    const Field & F,
    const size_t m,
    const size_t n,
    typename Field::ConstElement_ptr B,
    const size_t ldb,
    typename Field::Element_ptr A,
    const size_t lda)
```

`fneg`  $A \leftarrow -B$ .

## Parameters

$F$	field
$m$	number of rows
$n$	number of cols
$A$	matrix in $F$
$lda$	stride of $A$

**Todo** check if  $n == lda$

**11.1.3.173 faxpby()** [2/2]

```
template<class Field>
void faxpby (
    const Field & F,
    const size_t m,
    const size_t n,
    const typename Field::Element alpha,
    typename Field::ConstElement_ptr X,
    const size_t ldx,
    const typename Field::Element beta,
    typename Field::Element_ptr Y,
    const size_t ldy)
```

$\text{faxpby} : y \leftarrow \alpha \cdot x + \beta \cdot y.$

## Parameters

	$F$	field
	$m$	row dimension
	$n$	column dimension
	$alpha$	scalar
in	$X$	vector in $F$
	$ldx$	leading dimension of $X$
	$beta$	scalar
in, out	$Y$	vector in $F$
	$ldy$	leading dimension of $Y$

## Note

this is a catlas function

**11.1.3.174 fmove()** [1/2]

```
template<class Field>
void fmove (
    const Field & F,
    const size_t m,
    const size_t n,
    typename Field::Element_ptr A,
    const size_t lda,
    typename Field::Element_ptr B,
    const size_t ldb)
```

$\text{fmove} : A \leftarrow B \text{ and } B \leftarrow 0.$

## Parameters

$F$	field
$m$	number of rows to copy
$n$	number of cols to copy
$A$	matrix in $F$
$lda$	stride of $A$
$B$	matrix in $F$
$ldb$	stride of $B$

**11.1.3.175 bitsize()**

```
template<class Field>
size_t bitsize (
    const Field & F,
    size_t M,
    size_t N,
    const typename Field::ConstElement_ptr A,
    size_t lda) [inline]
```

bitsize: Computes the largest bitsize of the matrix' coefficients.

If the matrix is over a modular prime field, it returns the bitsize of the largest element (in a bsolute value)

## Parameters

$F$	field
$M$	rows
$N$	cols
$incX$	stride of $X$
$A$	a matrix of leading dimension $lda$ and size $M \times N$
$lda$	leading dimension of $A$

**11.1.3.176 bitsize< Givaro::ZRing< Givaro::Integer > >()**

```
template<>
size_t bitsize< Givaro::ZRing< Givaro::Integer > > (
    const Givaro::ZRing< Givaro::Integer > & F,
    size_t M,
    size_t N,
    const Givaro::Integer * A,
    size_t lda) [inline]
```

**11.1.3.177 ftrmv()**

```
template<class Field>
void ftrmv (
    const Field & F,
    const FFLAS_UPLO Uplo,
    const FFLAS_TRANSPOSE TransA,
    const FFLAS_DIAG Diag,
    const size_t N,
    typename Field::ConstElement_ptr A,
    const size_t lda,
    typename Field::Element_ptr X,
    int incX)
```

ftrsm: TRiangular Matrix Vector prodcut Computes  $X \leftarrow \text{op}(A)X$

**Parameters**

<i>F</i>	field
<i>X</i>	vector of size N on a field F
<i>incX</i>	stride of X
<i>A</i>	a matrix of leading dimension lda and size N
<i>lda</i>	leading dimension of A
<i>N</i>	number of rows and columns of A
<i>TransA</i>	if TransA==FflasTrans then $\text{op}(A) = A^T$ .
<i>Diag</i>	if Diag==FflasUnit then A is unit diagonal.
<i>Uplo</i>	if Uplo==FflasUpper then A is upper triangular

**11.1.3.178 ftrsm() [6/9]**

```
template<class Field>
void ftrsm (
    const Field & F,
    const FFLAS_SIDE Side,
    const FFLAS_UPLO Uplo,
    const FFLAS_TRANSPOSE TransA,
    const FFLAS_DIAG Diag,
    const size_t M,
    const size_t N,
    const typename Field::Element alpha,
    typename Field::ConstElement_ptr A,
    const size_t lda,
    typename Field::Element_ptr B,
    const size_t ldb)
```

ftrsm: TRiangular System solve with Matrix.

Computes  $B \leftarrow \alpha \text{op}(A^{-1})B$  or  $B \leftarrow \alpha B \text{op}(A^{-1})$ .

**Parameters**

<i>F</i>	field
<i>Side</i>	if Side==FflasLeft then $B \leftarrow \alpha \text{op}(A^{-1})B$ is computed.

## Parameters

<i>Uplo</i>	if <code>Uplo==FflasUpper</code> then A is upper triangular
<i>TransA</i>	if <code>TransA==FflasTrans</code> then $\text{op}(A) = A^t$ .
<i>Diag</i>	if <code>Diag==FflasUnit</code> then A is unit.
<i>M</i>	rows of B
<i>N</i>	cols of B
<i>alpha</i>	scalar
<i>A</i>	triangular invertible matrix. If <code>Side==FflasLeft</code> then A is $N \times N$ , otherwise A is $M \times M$
<i>lda</i>	leading dim of A
<i>B</i>	matrix of size MxN
<i>ldb</i>	leading dim of B

**Bug**  $\alpha$  must be non zero.

## 11.1.3.179 fsyrk\_strassen() [2/2]

```
template<class Field, typename FieldTrait>
Field::Element_ptr fsyrk_strassen (
    const Field & F,
    const FFLAS_UPLO UpLo,
    const FFLAS_TRANSPOSE trans,
    const size_t N,
    const size_t K,
    const typename Field::Element y1,
    const typename Field::Element y2,
    const typename Field::Element alpha,
    typename Field::ConstElement_ptr A,
    const size_t lda,
    const typename Field::Element beta,
    typename Field::Element_ptr C,
    const size_t ldc,
    MMHelper< Field, MMHelperAlgo::Winograd, FieldTrait > & H) [inline]
```

## 11.1.3.180 pfgemm() [1/7]

```
template<typename Field>
Field::Element_ptr pfgemm (
    const Field & F,
    const FFLAS_TRANSPOSE ta,
    const FFLAS_TRANSPOSE tb,
    const size_t m,
    const size_t n,
    const size_t k,
    const typename Field::Element alpha,
    typename Field::ConstElement_ptr A,
    const size_t lda,
    typename Field::ConstElement_ptr B,
    const size_t ldb,
    const typename Field::Element beta,
    typename Field::Element_ptr C,
    const size_t ldc,
    size_t numthreads = 0)
```

**11.1.3.181 pfgemm\_1D\_rec()**

```

template<class Field>
Field::Element * pfgemm_1D_rec (
    const Field & F,
    const FFLAS_TRANSPOSE ta,
    const FFLAS_TRANSPOSE tb,
    const size_t m,
    const size_t n,
    const size_t k,
    const typename Field::Element alpha,
    const typename Field::Element_ptr A,
    const size_t lda,
    const typename Field::Element_ptr B,
    const size_t ldb,
    const typename Field::Element beta,
    typename Field::Element * C,
    const size_t ldc,
    size_t seuil)

```

**11.1.3.182 pfgemm\_2D\_rec()**

```

template<class Field>
Field::Element * pfgemm_2D_rec (
    const Field & F,
    const FFLAS_TRANSPOSE ta,
    const FFLAS_TRANSPOSE tb,
    const size_t m,
    const size_t n,
    const size_t k,
    const typename Field::Element alpha,
    const typename Field::Element_ptr A,
    const size_t lda,
    const typename Field::Element_ptr B,
    const size_t ldb,
    const typename Field::Element beta,
    typename Field::Element * C,
    const size_t ldc,
    size_t seuil)

```

**11.1.3.183 pfgemm\_3D\_rec()**

```

template<class Field>
Field::Element * pfgemm_3D_rec (
    const Field & F,
    const FFLAS_TRANSPOSE ta,
    const FFLAS_TRANSPOSE tb,
    const size_t m,
    const size_t n,
    const size_t k,
    const typename Field::Element alpha,
    const typename Field::Element_ptr A,
    const size_t lda,
    const typename Field::Element_ptr B,

```

```

    const size_t ldb,
    const typename Field::Element beta,
    typename Field::Element_ptr C,
    const size_t ldc,
    size_t seuil,
    size_t * x)

```

#### 11.1.3.184 pfgemm\_3D\_rec2()

```

template<class Field>
Field::Element_ptr pfgemm_3D_rec2 (
    const Field & F,
    const FFLAS_TRANSPOSE ta,
    const FFLAS_TRANSPOSE tb,
    const size_t m,
    const size_t n,
    const size_t k,
    const typename Field::Element alpha,
    const typename Field::Element_ptr A,
    const size_t lda,
    const typename Field::Element_ptr B,
    const size_t ldb,
    const typename Field::Element beta,
    typename Field::Element_ptr C,
    const size_t ldc,
    size_t seuil,
    size_t * x)

```

#### 11.1.3.185 fgemm() [19/23]

```

template<class Field, class ModeTrait, class Strat, class Param>
std::enable_if<!std::is_same< ModeTrait, ModeCategories::ConvertTo< ElementCategories::RNSElementTag
> >::value, typename Field::Element_ptr >::type fgemm (
    const Field & F,
    const FFLAS::FFLAS_TRANSPOSE ta,
    const FFLAS::FFLAS_TRANSPOSE tb,
    const size_t m,
    const size_t n,
    const size_t k,
    const typename Field::Element alpha,
    typename Field::ConstElement_ptr A,
    const size_t lda,
    typename Field::ConstElement_ptr B,
    const size_t ldb,
    const typename Field::Element beta,
    typename Field::Element_ptr C,
    const size_t ldc,
    MMHelper< Field, MMHelperAlgo::Winograd, ModeTrait, ParSeqHelper::Parallel< Strat,
Param > > & H) [inline]

```

#### 11.1.3.186 ftrsm() [7/9]

```

template<class Field, class Cut, class Param>
Field::Element_ptr ftrsm (

```



```

    const Field & F,
    const FFLAS::FFLAS_SIDE Side,
    const FFLAS::FFLAS_UPLO UpLo,
    const FFLAS::FFLAS_TRANSPOSE TA,
    const FFLAS::FFLAS_DIAG Diag,
    const size_t m,
    const size_t n,
    const typename Field::Element alpha,
    typename Field::Element_ptr A,
    const size_t lda,
    typename Field::Element_ptr B,
    const size_t ldb,
    TRSMHelper< StructureHelper::Iterative, ParSeqHelper::Parallel< Cut, Param > > &
H) [inline]

```

#### 11.1.3.187 ftrsm() [8/9]

```

template<class Field, class Cut, class Param>
Field::Element_ptr ftrsm (
    const Field & F,
    const FFLAS::FFLAS_SIDE Side,
    const FFLAS::FFLAS_UPLO UpLo,
    const FFLAS::FFLAS_TRANSPOSE TA,
    const FFLAS::FFLAS_DIAG Diag,
    const size_t m,
    const size_t n,
    const typename Field::Element alpha,
    typename Field::Element_ptr A,
    const size_t lda,
    typename Field::Element_ptr B,
    const size_t ldb,
    TRSMHelper< StructureHelper::Hybrid, ParSeqHelper::Parallel< Cut, Param > > & H)
[inline]

```

#### 11.1.3.188 fspmv() [1/2]

```

template<class Field, class SM>
void fspmv (
    const Field & F,
    const SM & A,
    typename Field::ConstElement_ptr x,
    const typename Field::Element & beta,
    typename Field::Element_ptr y) [inline]

```

#### 11.1.3.189 fspmm()

```

template<class Field, class SM>
void fspmm (
    const Field & F,
    const SM & A,
    size_t blockSize,
    typename Field::ConstElement_ptr x,
    int ldx,
    const typename Field::Element & beta,
    typename Field::Element_ptr y,
    int ldy) [inline]

```

**11.1.3.190 sparse\_init()** [1/16]

```
template<class Field, class IndexT>
void sparse_init (
    const Field & F,
    Sparse< Field, SparseMatrix_t::COO > & A,
    const IndexT * row,
    const IndexT * col,
    typename Field::ConstElement_ptr dat,
    uint64_t rowdim,
    uint64_t coldim,
    uint64_t nnz) [inline]
```

**11.1.3.191 sparse\_init()** [2/16]

```
template<class Field, class IndexT>
void sparse_init (
    const Field & F,
    Sparse< Field, SparseMatrix_t::COO_ZO > & A,
    const IndexT * row,
    const IndexT * col,
    typename Field::ConstElement_ptr dat,
    uint64_t rowdim,
    uint64_t coldim,
    uint64_t nnz) [inline]
```

**11.1.3.192 sparse\_delete()** [1/12]

```
template<class Field>
void sparse_delete (
    const Sparse< Field, SparseMatrix_t::COO > & A) [inline]
```

**11.1.3.193 sparse\_delete()** [2/12]

```
template<class Field>
void sparse_delete (
    const Sparse< Field, SparseMatrix_t::COO_ZO > & A) [inline]
```

**11.1.3.194 sparse\_init()** [3/16]

```
template<class Field, class IndexT>
void sparse_init (
    const Field & F,
    Sparse< Field, SparseMatrix_t::CSR > & A,
    const IndexT * row,
    const IndexT * col,
    typename Field::ConstElement_ptr dat,
    uint64_t rowdim,
    uint64_t coldim,
    uint64_t nnz) [inline]
```

**11.1.3.195 sparse\_init()** [4/16]

```
template<class Field, class IndexT>
void sparse_init (
    const Field & F,
    Sparse< Field, SparseMatrix_t::CSR_ZO > & A,
    const IndexT * row,
    const IndexT * col,
    typename Field::ConstElement_ptr dat,
    uint64_t rowdim,
    uint64_t coldim,
    uint64_t nnz) [inline]
```

**11.1.3.196 sparse\_delete()** [3/12]

```
template<class Field>
void sparse_delete (
    const Sparse< Field, SparseMatrix_t::CSR > & A) [inline]
```

**11.1.3.197 sparse\_delete()** [4/12]

```
template<class Field>
void sparse_delete (
    const Sparse< Field, SparseMatrix_t::CSR_ZO > & A) [inline]
```

**11.1.3.198 sparse\_print()** [1/3]

```
template<class Field>
std::ostream & sparse_print (
    std::ostream & os,
    const Sparse< Field, SparseMatrix_t::CSR > & A) [inline]
```

**11.1.3.199 sparse\_init()** [5/16]

```
template<class IndexT>
void sparse_init (
    const Givaro::Modular< Givaro::Integer > & F,
    Sparse< Givaro::Modular< Givaro::Integer >, SparseMatrix_t::CSR > & A,
    const IndexT * row,
    const IndexT * col,
    Givaro::Integer * dat,
    uint64_t rowdim,
    uint64_t coldim,
    uint64_t nnz) [inline]
```

**11.1.3.200 sparse\_init() [6/16]**

```

template<class IndexT>
void sparse_init (
    const Givaro::ZRing< Givaro::Integer > & F,
    Sparse< Givaro::ZRing< Givaro::Integer >, SparseMatrix_t::CSR_ZO > & A,
    const IndexT * row,
    const IndexT * col,
    Givaro::Integer * dat,
    uint64_t rowdim,
    uint64_t coldim,
    uint64_t nnz) [inline]

```

**11.1.3.201 sparse\_init() [7/16]**

```

template<class IndexT, size_t RECINT_SIZE>
void sparse_init (
    const Givaro::ZRing< RecInt::rmint< RECINT_SIZE > > & F,
    Sparse< Givaro::ZRing< RecInt::rmint< RECINT_SIZE > >, SparseMatrix_t::CSR_ZO >
& A,
    const IndexT * row,
    const IndexT * col,
    typename Givaro::ZRing< RecInt::rmint< RECINT_SIZE > >::Element_ptr dat,
    uint64_t rowdim,
    uint64_t coldim,
    uint64_t nnz) [inline]

```

**11.1.3.202 sparse\_init() [8/16]**

```

template<class IndexT, size_t RECINT_SIZE>
void sparse_init (
    const Givaro::ZRing< RecInt::rmint< RECINT_SIZE > > & F,
    Sparse< Givaro::ZRing< RecInt::rmint< RECINT_SIZE > >, SparseMatrix_t::CSR > &
A,
    const IndexT * row,
    const IndexT * col,
    typename Givaro::ZRing< RecInt::rmint< RECINT_SIZE > >::Element_ptr dat,
    uint64_t rowdim,
    uint64_t coldim,
    uint64_t nnz) [inline]

```

**11.1.3.203 sparse\_delete() [5/12]**

```

template<class Field>
void sparse_delete (
    const Sparse< Field, SparseMatrix_t::CSR_HYB > & A) [inline]

```

**11.1.3.204 sparse\_init()** [9/16]

```
template<class Field, class IndexT>
void sparse_init (
    const Field & F,
    Sparse< Field, SparseMatrix_t::CSR_HYB > & A,
    const IndexT * row,
    const IndexT * col,
    typename Field::ConstElement_ptr dat,
    uint64_t rowdim,
    uint64_t coldim,
    uint64_t nnz) [inline]
```

**11.1.3.205 sparse\_init()** [10/16]

```
template<class Field, class IndexT>
void sparse_init (
    const Field & F,
    Sparse< Field, SparseMatrix_t::ELL > & A,
    const IndexT * row,
    const IndexT * col,
    typename Field::ConstElement_ptr dat,
    uint64_t rowdim,
    uint64_t coldim,
    uint64_t nnz) [inline]
```

**11.1.3.206 sparse\_init()** [11/16]

```
template<class Field, class IndexT>
void sparse_init (
    const Field & F,
    Sparse< Field, SparseMatrix_t::ELL_ZO > & A,
    const IndexT * row,
    const IndexT * col,
    typename Field::ConstElement_ptr dat,
    uint64_t rowdim,
    uint64_t coldim,
    uint64_t nnz) [inline]
```

**11.1.3.207 sparse\_delete()** [6/12]

```
template<class Field>
void sparse_delete (
    const Sparse< Field, SparseMatrix_t::ELL > & A) [inline]
```

**11.1.3.208 sparse\_delete()** [7/12]

```
template<class Field>
void sparse_delete (
    const Sparse< Field, SparseMatrix_t::ELL_ZO > & A) [inline]
```

**11.1.3.209 sparse\_init()** [12/16]

```
template<class Field, class IndexT>
void sparse_init (
    const Field & F,
    Sparse< Field, SparseMatrix_t::ELL_simd > & A,
    const IndexT * row,
    const IndexT * col,
    typename Field::ConstElement_ptr dat,
    uint64_t rowdim,
    uint64_t coldim,
    uint64_t nnz) [inline]
```

**11.1.3.210 sparse\_init()** [13/16]

```
template<class Field, class IndexT>
void sparse_init (
    const Field & F,
    Sparse< Field, SparseMatrix_t::ELL_simd_ZO > & A,
    const IndexT * row,
    const IndexT * col,
    typename Field::ConstElement_ptr dat,
    uint64_t rowdim,
    uint64_t coldim,
    uint64_t nnz) [inline]
```

**11.1.3.211 sparse\_delete()** [8/12]

```
template<class Field>
void sparse_delete (
    const Sparse< Field, SparseMatrix_t::ELL_simd > & A) [inline]
```

**11.1.3.212 sparse\_delete()** [9/12]

```
template<class Field>
void sparse_delete (
    const Sparse< Field, SparseMatrix_t::ELL_simd_ZO > & A) [inline]
```

**11.1.3.213 sparse\_print()** [2/3]

```
template<class Field>
void sparse_print (
    const Sparse< Field, SparseMatrix_t::ELL_simd > & A) [inline]
```

**11.1.3.214 sparse\_delete()** [10/12]

```
template<class Field>
void sparse_delete (
    const Sparse< Field, SparseMatrix_t::HYB_ZO > & A) [inline]
```

**11.1.3.215 sparse\_init()** [14/16]

```
template<class Field, class IndexT>
void sparse_init (
    const Field & F,
    Sparse< Field, SparseMatrix_t::HYB_ZO > & A,
    const IndexT * row,
    const IndexT * col,
    typename Field::ConstElement_ptr dat,
    uint64_t rowdim,
    uint64_t coldim,
    uint64_t nnz) [inline]
```

**11.1.3.216 operator<<()**

```
template<typename _Field>
std::ostream & operator<< (
    std::ostream & os,
    const Sparse< _Field, SparseMatrix_t::HYB_ZO > & A)
```

**11.1.3.217 readSmsFormat()**

```
template<class Field, bool sorted = true, bool read_integer = false>
void readSmsFormat (
    const std::string & path,
    const Field & f,
    index_t *& row,
    index_t *& col,
    typename Field::Element_ptr & val,
    index_t & rowdim,
    index_t & coldim,
    uint64_t & nnz)
```

**11.1.3.218 readSprFormat()**

```
template<class Field>
void readSprFormat (
    const std::string & path,
    const Field & f,
    index_t *& row,
    index_t *& col,
    typename Field::Element_ptr & val,
    index_t & rowdim,
    index_t & coldim,
    uint64_t & nnz)
```

**11.1.3.219 getDataType()** [1/4]

```
template<class T>
std::enable_if< std::is_integral< T >::value, int > getDataType ()
```

**11.1.3.220** `getDataType()` [2/4]

```
template<class T>
std::enable_if< std::is_floating_point< T >::value, int > getDataType ()
```

**11.1.3.221** `getDataType()` [3/4]

```
template<class T>
std::enable_if< std::is_same< T, mpz_t >::value, int > getDataType ()
```

**11.1.3.222** `getDataType()` [4/4]

```
template<class T>
int getDataType ()
```

**11.1.3.223** `readMachineType()`

```
template<class Field>
void readMachineType (
    const Field & F,
    typename Field::Element & modulo,
    typename Field::Element_ptr val,
    std::ifstream & file,
    const uint64_t dims,
    const mask_t data_type,
    const mask_t field_desc)
```

**11.1.3.224** `readDnsFormat()`

```
template<class Field>
void readDnsFormat (
    const std::string & path,
    const Field & F,
    index_t & rowdim,
    index_t & coldim,
    typename Field::Element_ptr & val)
```

**11.1.3.225** `writeDnsFormat()`

```
template<class Field>
void writeDnsFormat (
    const std::string & path,
    const Field & F,
    const index_t & rowdim,
    const index_t & coldim,
    typename Field::Element_ptr A,
    index_t ldA)
```



**11.1.3.226 fspmv()** [2/2]

```
template<class Field>
void fspmv (
    const Field & F,
    const Sparse< Field, SparseMatrix_t::SELL_ZO > & A,
    typename Field::ConstElement_ptr x,
    typename Field::Element_ptr y,
    FieldCategories::ModularTag ) [inline]
```

**11.1.3.227 sparse\_delete()** [11/12]

```
template<class Field>
void sparse_delete (
    const Sparse< Field, SparseMatrix_t::SELL > & A) [inline]
```

**11.1.3.228 sparse\_delete()** [12/12]

```
template<class Field>
void sparse_delete (
    const Sparse< Field, SparseMatrix_t::SELL_ZO > & A) [inline]
```

**11.1.3.229 sparse\_print()** [3/3]

```
template<class Field>
void sparse_print (
    const Sparse< Field, SparseMatrix_t::SELL > & A) [inline]
```

**11.1.3.230 sparse\_init()** [15/16]

```
template<class Field, class IndexT>
void sparse_init (
    const Field & F,
    Sparse< Field, SparseMatrix_t::SELL > & A,
    const IndexT * row,
    const IndexT * col,
    typename Field::ConstElement_ptr dat,
    uint64_t rowdim,
    uint64_t coldim,
    uint64_t nnz,
    uint64_t sigma = 0) [inline]
```

**11.1.3.231 sparse\_init()** [16/16]

```
template<class Field, class IndexT>
void sparse_init (
    const Field & F,
    Sparse< Field, SparseMatrix_t::SELL_ZO > & A,
    const IndexT * row,
    const IndexT * col,
    typename Field::ConstElement_ptr dat,
    uint64_t rowdim,
    uint64_t coldim,
    uint64_t nnz) [inline]
```

**11.1.3.232 computeDeviation()**

```
template<class It>
double computeDeviation (
    It begin,
    It end)
```

**11.1.3.233 getStat()**

```
template<class Field>
StatsMatrix getStat (
    const Field & F,
    const index_t * row,
    const index_t * col,
    typename Field::ConstElement_ptr val,
    uint64_t rowdim,
    uint64_t coldim,
    uint64_t nnz)
```

**11.1.3.234 ftranspose()**

```
template<typename Field, typename Simd = Simd<typename Field::Element>, size_t bs = FFLAS_↵
TRANSPOSE_BLOCKSIZE, typename std::enable_if< Simd::template is_same_element< Field >::value
>::type * = nullptr, typename std::enable_if< bs > = 1 && bs % Simd::vect_size == 0, ::type *
= nullptr>
Field::Element_ptr ftranspose (
    const Field & F,
    const size_t m,
    const size_t n,
    typename Field::ConstElement_ptr A,
    const size_t lda,
    typename Field::Element_ptr B,
    const size_t ldb) [inline]
```

**11.1.3.235 maxCardinality()**

```
template<class Field, class enable = void>
Field::Residu_t maxCardinality () [inline]
```

**11.1.3.236 maxCardinality< Givaro::Modular< int64\_t > >()**

```
template<>
uint64_t maxCardinality< Givaro::Modular< int64_t > > () [inline]
```

**11.1.3.237 maxCardinality< Givaro::Modular< int32\_t > >()**

```
template<>
uint32_t maxCardinality< Givaro::Modular< int32_t > > () [inline]
```

**11.1.3.238 minCardinality()**

```
template<class Field>
Field::Residu_t minCardinality () [inline]
```

**11.1.3.239 fflas\_delete()** [1/4]

```
template<>
void fflas_delete (
    FFPACK::rns_double_elt_ptr A) [inline]
```

**11.1.3.240 fflas\_delete()** [2/4]

```
template<>
void fflas_delete (
    FFPACK::rns_double_elt_cstptr A) [inline]
```

**11.1.3.241 fflas\_new()** [1/7]

```
template<>
FFPACK::rns_double_elt_ptr fflas_new (
    const FFPACK::RNSIntegerMod< FFPACK::rns_double > & F,
    const size_t m,
    const Alignment align) [inline]
```

**11.1.3.242 fflas\_new()** [2/7]

```
template<>
FFPACK::rns_double_elt_ptr fflas_new (
    const FFPACK::RNSIntegerMod< FFPACK::rns_double > & F,
    const size_t m,
    const size_t n,
    const Alignment align) [inline]
```

**11.1.3.243 finit\_rns()** [1/2]

```
template<typename RNS>
void finit_rns (
    const FFPACK::RNSIntegerMod< RNS > & F,
    const size_t m,
    const size_t n,
    size_t k,
    const Givaro::Integer * B,
    const size_t ldb,
    typename RNS::Element_ptr A)
```

**11.1.3.244 finit\_trans\_rns()**

```
template<typename RNS>
void finit_trans_rns (
    const FFPACK::RNSIntegerMod< RNS > & F,
    const size_t m,
    const size_t n,
    size_t k,
    const Givaro::Integer * B,
    const size_t ldb,
    typename RNS::Element_ptr A)
```

**11.1.3.245 fconvert\_rns() [1/2]**

```
template<typename RNS>
void fconvert_rns (
    const FFPACK::RNSIntegerMod< RNS > & F,
    const size_t m,
    const size_t n,
    Givaro::Integer alpha,
    Givaro::Integer * B,
    const size_t ldb,
    typename RNS::ConstElement_ptr A)
```

**11.1.3.246 fconvert\_trans\_rns()**

```
template<typename RNS>
void fconvert_trans_rns (
    const FFPACK::RNSIntegerMod< RNS > & F,
    const size_t m,
    const size_t n,
    Givaro::Integer alpha,
    Givaro::Integer * B,
    const size_t ldb,
    typename RNS::ConstElement_ptr A)
```

**11.1.3.247 fflas\_new() [3/7]**

```
template<>
FFPACK::rns_double_elt_ptr fflas_new (
    const FFPACK::RNSInteger< FFPACK::rns_double > & F,
    const size_t m,
    const Alignment align) [inline]
```

**11.1.3.248 fflas\_new() [4/7]**

```
template<>
FFPACK::rns_double_elt_ptr fflas_new (
    const FFPACK::RNSInteger< FFPACK::rns_double > & F,
    const size_t m,
    const size_t n,
    const Alignment align) [inline]
```

**11.1.3.249 finit\_rns()** [2/2]

```
template<typename RNS>
void finit_rns (
    const FFPACK::RNSInteger< RNS > & F,
    const size_t m,
    const size_t n,
    size_t k,
    const Givaro::Integer * B,
    const size_t ldb,
    typename FFPACK::RNSInteger< RNS >::Element_ptr A)
```

**11.1.3.250 fconvert\_rns()** [2/2]

```
template<typename RNS>
void fconvert_rns (
    const FFPACK::RNSInteger< RNS > & F,
    const size_t m,
    const size_t n,
    Givaro::Integer alpha,
    Givaro::Integer * B,
    const size_t ldb,
    typename FFPACK::RNSInteger< RNS >::ConstElement_ptr A)
```

**11.1.3.251 freduce()** [8/11]

```
template INST_OR_DECL void freduce (
    const FFLAS_FIELD< FFLAS_ELT > & F,
    const size_t n,
    FFLAS_ELT * X,
    const size_t incX)
```

$\text{freduce } x \leftarrow x \bmod F.$

**Parameters**

$F$	field
$n$	size of the vectors
$X$	vector in $F$
$\text{incX}$	stride of $X$

**Bug** use `cblas_(d)scal` when possible

**11.1.3.252 freduce()** [9/11]

```
template INST_OR_DECL void freduce (
    const FFLAS_FIELD< FFLAS_ELT > & F,
    const size_t n,
    const FFLAS_ELT * Y,
    const size_t incY,
    FFLAS_ELT * X,
    const size_t incX)
```

$\text{freduce } x \leftarrow y \bmod F.$

## Parameters

$F$	field
$n$	size of the vectors
$Y$	vector of Element
$incY$	stride of $Y$
$X$	vector in $F$
$incX$	stride of $X$

**Bug** use `cblas_(d)scal` when possible

11.1.3.253 `finit()` [7/8]

```
template INST_OR_DECL void finit (
    const FFLAS_FIELD< FFLAS_ELT > & F,
    const size_t n,
    const FFLAS_ELT * Y,
    const size_t incY,
    FFLAS_ELT * X,
    const size_t incX)
```

`finit`  $x \leftarrow y \bmod F$ .

## Parameters

$F$	field
$n$	size of the vectors
$Y$	vector of OtherElement
$incY$	stride of $Y$
$X$	vector in $F$
$incX$	stride of $X$

**Bug** use `cblas_(d)scal` when possible

11.1.3.254 `fconvert()` [3/3]

```
template INST_OR_DECL void fconvert (
    const FFLAS_FIELD< FFLAS_ELT > & F,
    const size_t n,
    FFLAS_ELT * X,
    const size_t incX,
    const FFLAS_ELT * Y,
    const size_t incY)
```

`fconvert`  $x \leftarrow y \bmod F$ .

## Parameters

$F$	field
$n$	size of the vectors
$Y$	vector of $F$
$incY$	stride of $Y$
$X$	vector in <code>OtherElement</code>
$incX$	stride of $X$

**Bug** use `cblas_(d)scal` when possible

11.1.3.255 `fnegin()` [3/4]

```
template INST_OR_DECL void fnegin (
    const FFLAS_FIELD< FFLAS_ELT > & F,
    const size_t n,
    FFLAS_ELT * X,
    const size_t incX)
```

`fnegin`  $x \leftarrow -x$ .

## Parameters

$F$	field
$n$	size of the vectors
$X$	vector in $F$
$incX$	stride of $X$

**Bug** use `cblas_(d)scal` when possible

11.1.3.256 `fneg()` [3/4]

```
template INST_OR_DECL void fneg (
    const FFLAS_FIELD< FFLAS_ELT > & F,
    const size_t n,
    const FFLAS_ELT * Y,
    const size_t incY,
    FFLAS_ELT * X,
    const size_t incX)
```

`fneg`  $x \leftarrow -y$ .

## Parameters

$F$	field
$n$	size of the vectors
$X$	vector in $F$
$incX$	stride of $X$
$Y$	vector in $F$
$incY$	stride of $Y$

**Bug** use `cblas_(d)scal` when possible

**11.1.3.257 fzero()** [4/5]

```
template INST_OR_DECL void fzero (
    const FFLAS_FIELD< FFLAS_ELT > & F,
    const size_t n,
    FFLAS_ELT * X,
    const size_t incX)
```

fzero :  $A \leftarrow 0$ .

**Parameters**

$F$	field
$n$	number of elements to zero
$X$	vector in $F$
$incX$	stride of $X$

**11.1.3.258 fiszero()** [3/4]

```
template INST_OR_DECL bool fiszero (
    const FFLAS_FIELD< FFLAS_ELT > & F,
    const size_t n,
    const FFLAS_ELT * X,
    const size_t incX)
```

fiszero : test  $X = 0$ .

**Parameters**

$F$	field
$n$	vector dimension
$X$	vector in $F$
$incX$	increment of $X$

**11.1.3.259 fequal()** [3/4]

```
template INST_OR_DECL bool fequal (
    const FFLAS_FIELD< FFLAS_ELT > & F,
    const size_t n,
    const FFLAS_ELT * X,
    const size_t incX,
    const FFLAS_ELT * Y,
    const size_t incY)
```

fequal : test  $X = Y$ .

**Parameters**

$F$	field
$n$	vector dimension
$X$	vector in $F$
$incX$	increment of $X$
$Y$	vector in $F$
$incY$	increment of $Y$



**11.1.3.260 fassign()** [9/10]

```
template INST_OR_DECL void fassign (
    const FFLAS_FIELD< FFLAS_ELT > & F,
    const size_t N,
    const FFLAS_ELT * Y,
    const size_t incY,
    FFLAS_ELT * X,
    const size_t incX)
```

fassign :  $x \leftarrow y$ .

X is preallocated

**Todo** variant for triangular matrix

**Parameters**

	$F$	field
	$N$	size of the vectors
out	$X$	vector in $F$
	$incX$	stride of X
in	$Y$	vector in $F$
	$incY$	stride of Y

**11.1.3.261 fscaln()** [9/10]

```
template INST_OR_DECL void fscaln (
    const FFLAS_FIELD< FFLAS_ELT > & F,
    const size_t n,
    const FFLAS_ELT alpha,
    FFLAS_ELT * X,
    const size_t incX)
```

fscaln  $x \leftarrow \alpha \cdot x$ .

**Parameters**

$F$	field
$n$	size of the vectors
$alpha$	scalar
$X$	vector in $F$
$incX$	stride of X

**Bug** use cblas\_(d)scal when possible

**Todo** check if comparison with +/-1,0 is necessary.

**11.1.3.262 fscal()** [9/10]

```
template INST_OR_DECL void fscal (
    const FFLAS_FIELD< FFLAS_ELT > & F,
    const size_t n,
    const FFLAS_ELT alpha,
    const FFLAS_ELT * X,
    const size_t incX,
    FFLAS_ELT * Y,
    const size_t incY)
```

$\text{fscal } y \leftarrow \alpha \cdot x.$

**Parameters**

	$F$	field
	$n$	size of the vectors
	$\alpha$	scalar
in	$X$	vector in F
	$\text{incX}$	stride of X
out	$Y$	vector in F
	$\text{incY}$	stride of Y

**Bug** use cblas\_(d)scal when possible

**Todo** check if comparison with +/-1,0 is necessary.

**11.1.3.263 faxpy()** [5/6]

```
template INST_OR_DECL void faxpy (
    const FFLAS_FIELD< FFLAS_ELT > & F,
    const size_t N,
    const FFLAS_ELT alpha,
    const FFLAS_ELT * X,
    const size_t incX,
    FFLAS_ELT * Y,
    const size_t incY)
```

$\text{faxpy} : y \leftarrow \alpha \cdot x + y.$

**Parameters**

	$F$	field
	$N$	size of the vectors
	$\alpha$	scalar
in	$X$	vector in F
	$\text{incX}$	stride of X
in, out	$Y$	vector in F
	$\text{incY}$	stride of Y

**11.1.3.264 fdot()** [10/11]

```
template INST_OR_DECL FFLAS_ELT fdot (
    const FFLAS_FIELD< FFLAS_ELT > & F,
    const size_t N,
    const FFLAS_ELT * X,
    const size_t incX,
    const FFLAS_ELT * Y,
    const size_t incY)
```

faxpby :  $y \leftarrow \alpha \cdot x + \beta \cdot y$ .

**Parameters**

	$F$	field
	$N$	size of the vectors
	$\alpha$	scalar
in	$X$	vector in F
	$incX$	stride of X
	$\beta$	scalar
in, out	$Y$	vector in F
	$incY$	stride of Y

**Note**

this is a catlas function

fdot: dot product  $x^T y$ .

**Parameters**

$F$	field
$N$	size of the vectors
$X$	vector in F
$incX$	stride of X
$Y$	vector in F
$incY$	stride of Y

**11.1.3.265 fswap()** [2/2]

```
template INST_OR_DECL void fswap (
    const FFLAS_FIELD< FFLAS_ELT > & F,
    const size_t N,
    FFLAS_ELT * X,
    const size_t incX,
    FFLAS_ELT * Y,
    const size_t incY)
```

fswap:  $X \leftrightarrow Y$ .

**Bug** use cblas\_dswap when double

## Parameters

$F$	field
$N$	size of the vectors
$X$	vector in $F$
$incX$	stride of $X$
$Y$	vector in $F$
$incY$	stride of $Y$

**11.1.3.266 fadd()** [5/8]

```
template INST_OR_DECL void fadd (
    const FFLAS_FIELD< FFLAS_ELT > & F,
    const size_t N,
    const FFLAS_ELT * A,
    const size_t inca,
    const FFLAS_ELT * B,
    const size_t incb,
    FFLAS_ELT * C,
    const size_t incc)
```

**11.1.3.267 fsub()** [3/4]

```
template INST_OR_DECL void fsub (
    const FFLAS_FIELD< FFLAS_ELT > & F,
    const size_t N,
    const FFLAS_ELT * A,
    const size_t inca,
    const FFLAS_ELT * B,
    const size_t incb,
    FFLAS_ELT * C,
    const size_t incc)
```

**11.1.3.268 faddin()** [4/5]

```
template INST_OR_DECL void faddin (
    const FFLAS_FIELD< FFLAS_ELT > & F,
    const size_t N,
    const FFLAS_ELT * B,
    const size_t incb,
    FFLAS_ELT * C,
    const size_t incc)
```

**11.1.3.269 fadd()** [6/8]

```
template INST_OR_DECL void fadd (
    const FFLAS_FIELD< FFLAS_ELT > & F,
    const size_t N,
    const FFLAS_ELT * A,
    const size_t inca,
    const FFLAS_ELT alpha,
    const FFLAS_ELT * B,
    const size_t incb,
    FFLAS_ELT * C,
    const size_t incc)
```

**11.1.3.270 fassign()** [10/10]

```
template INST_OR_DECL void fassign (
    const FFLAS_FIELD< FFLAS_ELT > & F,
    const size_t m,
    const size_t n,
    const FFLAS_ELT * B,
    const size_t ldb,
    FFLAS_ELT * A,
    const size_t lda)
```

fassign :  $A \leftarrow B$ .

**Parameters**

$F$	field
$m$	number of rows to copy
$n$	number of cols to copy
$A$	matrix in $F$
$lda$	stride of $A$
$B$	vector in $F$
$ldb$	stride of $B$

**11.1.3.271 fzero()** [5/5]

```
template INST_OR_DECL void fzero (
    const FFLAS_FIELD< FFLAS_ELT > & F,
    const size_t m,
    const size_t n,
    FFLAS_ELT * A,
    const size_t lda)
```

fzero :  $A \leftarrow 0$ .

**Parameters**

$F$	field
$m$	number of rows to zero
$n$	number of cols to zero
$A$	matrix in $F$
$lda$	stride of $A$

**Warning**

may be buggy if Element is larger than int

**11.1.3.272 fequal()** [4/4]

```
template INST_OR_DECL bool fequal (
    const FFLAS_FIELD< FFLAS_ELT > & F,
    const size_t m,
    const size_t n,
    const FFLAS_ELT * A,
    const size_t lda,
    const FFLAS_ELT * B,
    const size_t ldb)
```

fequal : test  $A = B$ .

**Parameters**

$F$	field
$m$	row dimension
$n$	column dimension
$A$	m x n matrix in $F$
$lda$	leading dimension of A
$B$	m x n matrix in $F$
$ldb$	leading dimension of B

**11.1.3.273 fiszero()** [4/4]

```
template INST_OR_DECL bool fiszero (
    const FFLAS_FIELD< FFLAS_ELT > & F,
    const size_t m,
    const size_t n,
    const FFLAS_ELT * A,
    const size_t lda)
```

fiszero : test  $A = 0$ .

**Parameters**

$F$	field
$m$	row dimension
$n$	column dimension
$A$	m x n matrix in $F$
$lda$	leading dimension of A

**11.1.3.274 fidentity()** [3/4]

```
template INST_OR_DECL void fidentity (
    const FFLAS_FIELD< FFLAS_ELT > & F,
    const size_t m,
    const size_t n,
    FFLAS_ELT * A,
    const size_t lda,
    const FFLAS_ELT & d)
```

creates a diagonal matrix

**11.1.3.275 fidentity()** [4/4]

```
template INST_OR_DECL void fidentity (
    const FFLAS_FIELD< FFLAS_ELT > & F,
    const size_t m,
    const size_t n,
    FFLAS_ELT * A,
    const size_t lda)
```

creates a diagonal matrix

**11.1.3.276 freduce()** [10/11]

```
template INST_OR_DECL void freduce (
    const FFLAS_FIELD< FFLAS_ELT > & F,
    const size_t m,
    const size_t n,
    FFLAS_ELT * A,
    const size_t lda)
```

freduce  $A \leftarrow A \bmod F$ .

**Parameters**

$F$	field
$m$	number of rows
$n$	number of cols
$A$	matrix in F
$lda$	stride of A

**11.1.3.277 freduce()** [11/11]

```
template INST_OR_DECL void freduce (
    const FFLAS_FIELD< FFLAS_ELT > & F,
    const size_t m,
    const size_t n,
    const FFLAS_ELT * B,
    const size_t ldb,
    FFLAS_ELT * A,
    const size_t lda)
```

freduce  $A \leftarrow B \bmod F$ .

**Parameters**

$F$	field
$m$	number of rows
$n$	number of cols
$A$	matrix in F
$lda$	stride of A
$B$	matrix in Element
$ldb$	stride of B

**11.1.3.278 finit()** [8/8]

```
template INST_OR_DECL void finit (
    const FFLAS_FIELD< FFLAS_ELT > & F,
    const size_t m,
    const size_t n,
    const FFLAS_ELT * B,
    const size_t ldb,
    FFLAS_ELT * A,
    const size_t lda)
```

$\text{finit } A \leftarrow B \bmod F.$

**Parameters**

$F$	field
$m$	number of rows
$n$	number of cols
$A$	matrix in $F$
$lda$	stride of $A$
$B$	matrix in $F$
$ldb$	stride of $B$

**11.1.3.279 fnegin()** [4/4]

```
template INST_OR_DECL void fnegin (
    const FFLAS_FIELD< FFLAS_ELT > & F,
    const size_t m,
    const size_t n,
    FFLAS_ELT * A,
    const size_t lda)
```

$\text{fnegin } A \leftarrow -A.$

**Parameters**

$F$	field
$m$	number of rows
$n$	number of cols
$A$	matrix in $F$
$lda$	stride of $A$

**11.1.3.280 fneg()** [4/4]

```
template INST_OR_DECL void fneg (
    const FFLAS_FIELD< FFLAS_ELT > & F,
    const size_t m,
    const size_t n,
    const FFLAS_ELT * B,
    const size_t ldb,
    FFLAS_ELT * A,
    const size_t lda)
```

$\text{fneg } A \leftarrow -B.$



## Parameters

$F$	field
$m$	number of rows
$n$	number of cols
$A$	matrix in $F$
$lda$	stride of $A$

**11.1.3.281 fscaln()** [10/10]

```
template INST_OR_DECL void fscaln (
    const FFLAS_FIELD< FFLAS_ELT > & F,
    const size_t m,
    const size_t n,
    const FFLAS_ELT alpha,
    FFLAS_ELT * A,
    const size_t lda)
```

$\text{fscaln } A \leftarrow a \cdot A.$

## Parameters

$F$	field
$m$	number of rows
$n$	number of cols
$alpha$	homotecie scalar
$A$	matrix in $F$
$lda$	stride of $A$

**11.1.3.282 fscl()** [10/10]

```
template INST_OR_DECL void fscl (
    const FFLAS_FIELD< FFLAS_ELT > & F,
    const size_t m,
    const size_t n,
    const FFLAS_ELT alpha,
    const FFLAS_ELT * A,
    const size_t lda,
    FFLAS_ELT * B,
    const size_t ldb)
```

$\text{fscl } B \leftarrow a \cdot A.$

## Parameters

	$F$	field
	$m$	number of rows
	$n$	number of cols
	$alpha$	homotecie scalar
in	$A$	matrix in $F$
	$lda$	stride of $A$
out	$B$	matrix in $F$
	$ldb$	stride of $B$

**11.1.3.283 faxpy()** [6/6]

```
template INST_OR_DECL void faxpy (
    const FFLAS_FIELD< FFLAS_ELT > & F,
    const size_t m,
    const size_t n,
    const FFLAS_ELT alpha,
    const FFLAS_ELT * X,
    const size_t ldx,
    FFLAS_ELT * Y,
    const size_t ldy)
```

$\text{faxpy} : y \leftarrow \alpha \cdot x + y.$

**Parameters**

	$F$	field
	$m$	row dimension
	$n$	column dimension
	$\alpha$	scalar
in	$X$	vector in F
	$ldx$	leading dimension of X
in, out	$Y$	vector in F
	$ldy$	leading dimension of Y

**11.1.3.284 fmove()** [2/2]

```
template INST_OR_DECL void fmove (
    const FFLAS_FIELD< FFLAS_ELT > & F,
    const size_t m,
    const size_t n,
    FFLAS_ELT * A,
    const size_t lda,
    FFLAS_ELT * B,
    const size_t ldb)
```

$\text{faxpby} : y \leftarrow \alpha \cdot x + \beta \cdot y.$

**Parameters**

	$F$	field
	$m$	row dimension
	$n$	column dimension
	$\alpha$	scalar
in	$X$	vector in F
	$ldx$	leading dimension of X
	$\beta$	scalar
in, out	$Y$	vector in F
	$ldy$	leading dimension of Y

**Note**

this is a catlas function

$\text{fmove} : A \leftarrow B \text{ and } B \leftarrow 0.$

## Parameters

<i>F</i>	field
<i>m</i>	number of rows to copy
<i>n</i>	number of cols to copy
<i>A</i>	matrix in <i>F</i>
<i>lda</i>	stride of <i>A</i>
<i>B</i>	vector in <i>F</i>
<i>ldb</i>	stride of <i>B</i>

**11.1.3.285 fadd()** [7/8]

```
template INST_OR_DECL void fadd (
    const FFLAS_FIELD< FFLAS_ELT > & F,
    const size_t M,
    const size_t N,
    const FFLAS_ELT * A,
    const size_t lda,
    const FFLAS_ELT * B,
    const size_t ldb,
    FFLAS_ELT * C,
    const size_t ldc)
```

fadd : matrix addition.

Computes  $C = A + B$ .

## Parameters

<i>F</i>	field
<i>M</i>	rows
<i>N</i>	cols
<i>A</i>	dense matrix of size $M \times N$
<i>lda</i>	leading dimension of <i>A</i>
<i>B</i>	dense matrix of size $M \times N$
<i>ldb</i>	leading dimension of <i>B</i>
<i>C</i>	dense matrix of size $M \times N$
<i>ldc</i>	leading dimension of <i>C</i>

**11.1.3.286 fsub()** [4/4]

```
template INST_OR_DECL void fsub (
    const FFLAS_FIELD< FFLAS_ELT > & F,
    const size_t M,
    const size_t N,
    const FFLAS_ELT * A,
    const size_t lda,
    const FFLAS_ELT * B,
    const size_t ldb,
    FFLAS_ELT * C,
    const size_t ldc)
```

fsub : matrix subtraction.

Computes  $C = A - B$ .

## Parameters

<i>F</i>	field
<i>M</i>	rows
<i>N</i>	cols
<i>A</i>	dense matrix of size MxN
<i>lda</i>	leading dimension of A
<i>B</i>	dense matrix of size MxN
<i>ldb</i>	leading dimension of B
<i>C</i>	dense matrix of size MxN
<i>ldc</i>	leading dimension of C

**11.1.3.287 fsubin()** [3/3]

```
template INST_OR_DECL void fsubin (
    const FFLAS_FIELD< FFLAS_ELT > & F,
    const size_t M,
    const size_t N,
    const FFLAS_ELT * B,
    const size_t ldb,
    FFLAS_ELT * C,
    const size_t ldc)
```

fsubin C = C - B

**11.1.3.288 fadd()** [8/8]

```
template INST_OR_DECL void fadd (
    const FFLAS_FIELD< FFLAS_ELT > & F,
    const size_t M,
    const size_t N,
    const FFLAS_ELT * A,
    const size_t lda,
    const FFLAS_ELT alpha,
    const FFLAS_ELT * B,
    const size_t ldb,
    FFLAS_ELT * C,
    const size_t ldc)
```

fadd : matrix addition with scaling.

Computes  $C = A + \alpha B$ .

## Parameters

<i>F</i>	field
<i>M</i>	rows
<i>N</i>	cols
<i>A</i>	dense matrix of size MxN
<i>lda</i>	leading dimension of A
<i>alpha</i>	some scalar
<i>B</i>	dense matrix of size MxN
<i>ldb</i>	leading dimension of B
<i>C</i>	dense matrix of size MxN
<i>ldc</i>	leading dimension of C

**11.1.3.289 faddin()** [5/5]

```
template INST_OR_DECL void faddin (
    const FFLAS_FIELD< FFLAS_ELT > & F,
    const size_t M,
    const size_t N,
    const FFLAS_ELT * B,
    const size_t ldb,
    FFLAS_ELT * C,
    const size_t ldc)
```

faddin

**11.1.3.290 fgemv()** [17/19]

```
template INST_OR_DECL FFLAS_ELT * fgemv (
    const FFLAS_FIELD< FFLAS_ELT > & F,
    const FFLAS_TRANSPOSE TransA,
    const size_t M,
    const size_t N,
    const FFLAS_ELT alpha,
    const FFLAS_ELT * A,
    const size_t lda,
    const FFLAS_ELT * X,
    const size_t incX,
    const FFLAS_ELT beta,
    FFLAS_ELT * Y,
    const size_t incY)
```

finite prime FFLAS\_FIELD<FFLAS\_ELT> GEneral Matrix Vector multiplication.

Computes  $Y \leftarrow \alpha \text{op}(A)X + \beta Y$ .

**Parameters**

	$F$	field
	$TransA$	if $TransA == FflasTrans$ then $\text{op}(A) = A^t$ .
	$M$	rows
	$N$	cols
	$alpha$	scalar
	$A$	dense matrix of size $M \times N$
	$lda$	leading dimension of $A$
	$X$	dense vector of size $N$
	$incX$	stride of $X$
	$beta$	scalar
out	$Y$	dense vector of size $M$
	$incY$	stride of $Y$

**11.1.3.291 fger() [12/12]**

```
template INST_OR_DECL void fger (
    const FFLAS_FIELD< FFLAS_ELT > & F,
    const size_t M,
    const size_t N,
    const FFLAS_ELT alpha,
    const FFLAS_ELT * x,
    const size_t incx,
    const FFLAS_ELT * y,
    const size_t incy,
    FFLAS_ELT * A,
    const size_t lda)
```

fger: rank one update of a general matrix

Computes  $A \leftarrow \alpha x y^T + A$

**Parameters**

	$F$	field
	$M$	rows
	$N$	cols
	$\alpha$	scalar
in, out	$A$	dense matrix of size $M \times N$ and leading dimension $lda$
	$lda$	leading dimension of $A$
	$x$	dense vector of size $M$
	$incx$	stride of $X$
	$y$	dense vector of size $N$
	$incy$	stride of $Y$

**11.1.3.292 ftrsv() [2/2]**

```
template INST_OR_DECL void ftrsv (
    const FFLAS_FIELD< FFLAS_ELT > & F,
    const FFLAS_UPLO Uplo,
    const FFLAS_TRANSPOSE TransA,
    const FFLAS_DIAG Diag,
    const size_t N,
    const FFLAS_ELT * A,
    const size_t lda,
    FFLAS_ELT * X,
    int incX)
```

ftrsv: TRIangular System solve with Vector Computes  $X \leftarrow \text{op}(A^{-1})X$

**Parameters**

$F$	field
$X$	vector of size $N$ on a field $F$
$incX$	stride of $X$
$A$	a matrix of leading dimension $lda$ and size $N$
$lda$	leading dimension of $A$

## Parameters

<i>N</i>	number of rows or columns of A according to TransA
<i>TransA</i>	if TransA==FflasTrans then $\text{op}(A) = A^t$ .
<i>Diag</i>	if Diag==FflasUnit then A is unit.
<i>Uplo</i>	if Uplo==FflasUpper then A is upper triangular

## 11.1.3.293 ftrsm() [9/9]

```
template INST_OR_DECL void ftrsm (
    const FFLAS_FIELD< FFLAS_ELT > & F,
    const FFLAS_SIDE Side,
    const FFLAS_UPLO Uplo,
    const FFLAS_TRANSPOSE TransA,
    const FFLAS_DIAG Diag,
    const size_t M,
    const size_t N,
    const FFLAS_ELT alpha,
    const FFLAS_ELT * A,
    const size_t lda,
    FFLAS_ELT * B,
    const size_t ldb)
```

ftrsm: **T**Riangular **S**ystem solve with **M**atrix.

Computes  $B \leftarrow \alpha \text{op}(A^{-1})B$  or  $B \leftarrow \alpha B \text{op}(A^{-1})$ .

## Parameters

<i>F</i>	field
<i>Side</i>	if Side==FflasLeft then $B \leftarrow \alpha \text{op}(A^{-1})B$ is computed.
<i>Uplo</i>	if Uplo==FflasUpper then A is upper triangular
<i>TransA</i>	if TransA==FflasTrans then $\text{op}(A) = A^t$ .
<i>Diag</i>	if Diag==FflasUnit then A is unit.
<i>M</i>	rows of B
<i>N</i>	cols of B
<i>alpha</i>	scalar
<i>A</i>	triangular invertible matrix. If Side==FflasLeft then A is $N \times N$ , otherwise A is $M \times M$
<i>lda</i>	leading dim of A
<i>B</i>	matrix of size MxN
<i>ldb</i>	leading dim of B

**Bug**  $\alpha$  must be non zero.

**11.1.3.294 ftrmm()** [3/3]

```
template INST_OR_DECL void ftrmm (
    const FFLAS_FIELD< FFLAS_ELT > & F,
    const FFLAS_SIDE Side,
    const FFLAS_UPLO Uplo,
    const FFLAS_TRANSPOSE TransA,
    const FFLAS_DIAG Diag,
    const size_t M,
    const size_t N,
    const FFLAS_ELT alpha,
    const FFLAS_ELT * A,
    const size_t lda,
    FFLAS_ELT * B,
    const size_t ldb)
```

ftrmm: **TR**iangular **M**atrix **M**ultiply.

Computes  $B \leftarrow \alpha \text{op}(A)B$  or  $B \leftarrow \alpha B \text{op}(A)$ .

**Parameters**

<i>F</i>	field
<i>Side</i>	if Side==FflasLeft then $B \leftarrow \alpha \text{op}(A)B$ is computed.
<i>Uplo</i>	if Uplo==FflasUpper then A is upper triangular
<i>TransA</i>	if TransA==FflasTrans then $\text{op}(A) = A^t$ .
<i>Diag</i>	if Diag==FflasUnit then A is implicitly unit.
<i>M</i>	rows of B
<i>N</i>	cols of B
<i>alpha</i>	scalar
<i>A</i>	triangular matrix. If Side==FflasLeft then A is $N \times N$ , otherwise A is $M \times M$
<i>lda</i>	leading dim of A
<i>B</i>	matrix of size MxN
<i>ldb</i>	leading dim of B

**11.1.3.295 fgemm()** [20/23]

```
template INST_OR_DECL FFLAS_ELT * fgemm (
    const FFLAS_FIELD< FFLAS_ELT > & F,
    const FFLAS_TRANSPOSE ta,
    const FFLAS_TRANSPOSE tb,
    const size_t m,
    const size_t n,
    const size_t k,
    const FFLAS_ELT alpha,
    const FFLAS_ELT * A,
    const size_t lda,
    const FFLAS_ELT * B,
    const size_t ldb,
    const FFLAS_ELT beta,
    FFLAS_ELT * C,
    const size_t ldc)
```

fgemm: **F**ield **G**eneral **M**atrix **M**ultiply.

Computes  $C = \alpha \text{op}(A) \times \text{op}(B) + \beta C$  Automatically set Winograd recursion level



## Parameters

<i>F</i>	field.
<i>ta</i>	if <code>ta==FflasTrans</code> then $\text{op}(A) = A^t$ , else $\text{op}(A) = A$ ,
<i>tb</i>	same for matrix B
<i>m</i>	see A
<i>n</i>	see B
<i>k</i>	see A
<i>alpha</i>	scalar
<i>beta</i>	scalar
<i>A</i>	$\text{op}(A)$ is $m \times k$
<i>B</i>	$\text{op}(B)$ is $k \times n$
<i>C</i>	<i>C</i> is $m \times n$
<i>lda</i>	leading dimension of A
<i>ldb</i>	leading dimension of B
<i>ldc</i>	leading dimension of C
<i>w</i>	recursive levels of Winograd's algorithm are used. No argument (or -1) does auto computation of $w$ .

## Warning

$\alpha$  must be invertible

## 11.1.3.296 fgemm() [21/23]

```
template INST_OR_DECL FFLAS_ELT * fgemm (
    const FFLAS_FIELD< FFLAS_ELT > & F,
    const FFLAS_TRANSPOSE ta,
    const FFLAS_TRANSPOSE tb,
    const size_t m,
    const size_t n,
    const size_t k,
    const FFLAS_ELT alpha,
    const FFLAS_ELT * A,
    const size_t lda,
    const FFLAS_ELT * B,
    const size_t ldb,
    const FFLAS_ELT beta,
    FFLAS_ELT * C,
    const size_t ldc,
    const ParSeqHelper::Sequential seq)
```

## 11.1.3.297 fgemm() [22/23]

```
template INST_OR_DECL FFLAS_ELT * fgemm (
    const FFLAS_FIELD< FFLAS_ELT > & F,
    const FFLAS_TRANSPOSE ta,
    const FFLAS_TRANSPOSE tb,
    const size_t m,
    const size_t n,
    const size_t k,
```

```

    const FFLAS_ELT alpha,
    const FFLAS_ELT * A,
    const size_t lda,
    const FFLAS_ELT * B,
    const size_t ldb,
    const FFLAS_ELT beta,
    FFLAS_ELT * C,
    const size_t ldc,
    const ParSeqHelper::Parallel< CuttingStrategy::Recursive, StrategyParameter::TwoDAdaptive
> par)

```

### 11.1.3.298 fgemm() [23/23]

```

template INST_OR_DECL FFLAS_ELT * fgemm (
    const FFLAS_FIELD< FFLAS_ELT > & F,
    const FFLAS_TRANSPOSE ta,
    const FFLAS_TRANSPOSE tb,
    const size_t m,
    const size_t n,
    const size_t k,
    const FFLAS_ELT alpha,
    const FFLAS_ELT * A,
    const size_t lda,
    const FFLAS_ELT * B,
    const size_t ldb,
    const FFLAS_ELT beta,
    FFLAS_ELT * C,
    const size_t ldc,
    const ParSeqHelper::Parallel< CuttingStrategy::Block, StrategyParameter::Threads
> par)

```

### 11.1.3.299 fsquare() [6/6]

```

template INST_OR_DECL FFLAS_ELT * fsquare (
    const FFLAS_FIELD< FFLAS_ELT > & F,
    const FFLAS_TRANSPOSE ta,
    const size_t n,
    const FFLAS_ELT alpha,
    const FFLAS_ELT * A,
    const size_t lda,
    const FFLAS_ELT beta,
    FFLAS_ELT * C,
    const size_t ldc)

```

fsquare: Squares a matrix.

compute  $C \leftarrow \alpha \text{op}(A) \text{op}(A) + \beta C$  over a `FFLAS_FIELD <FFLAS_ELT> F` Avoid the conversion of B

#### Parameters

<i>ta</i>	if <code>ta==FflasTrans</code> , $\text{op}(A) = A^T$ .
<i>F</i>	field
<i>n</i>	size of A
<i>alpha</i>	scalar

## Parameters

<i>beta</i>	scalar
<i>A</i>	dense matrix of size $n \times n$
<i>lda</i>	leading dimension of <i>A</i>
<i>C</i>	dense matrix of size $n \times n$
<i>ldc</i>	leading dimension of <i>C</i>

**11.1.3.300 BlockCuts()** [1/2]

```
template<class Cut = CuttingStrategy::Block, class Strat = StrategyParameter::Threads>
void BlockCuts (
    size_t & RBLOCKSIZE,
    size_t & CBLOCKSIZE,
    const size_t m,
    const size_t n,
    const size_t numthreads) [inline]
```

**11.1.3.301 BlockCuts< CuttingStrategy::Single, StrategyParameter::Threads >()**

```
template<>
void BlockCuts< CuttingStrategy::Single, StrategyParameter::Threads > (
    size_t & RBLOCKSIZE,
    size_t & CBLOCKSIZE,
    const size_t m,
    const size_t n,
    const size_t numthreads) [inline]
```

**11.1.3.302 BlockCuts< CuttingStrategy::Row, StrategyParameter::Fixed >()**

```
template<>
void BlockCuts< CuttingStrategy::Row, StrategyParameter::Fixed > (
    size_t & RBLOCKSIZE,
    size_t & CBLOCKSIZE,
    const size_t m,
    const size_t n,
    const size_t numthreads) [inline]
```

**11.1.3.303 BlockCuts< CuttingStrategy::Row, StrategyParameter::Grain >()**

```
template<>
void BlockCuts< CuttingStrategy::Row, StrategyParameter::Grain > (
    size_t & RBLOCKSIZE,
    size_t & CBLOCKSIZE,
    const size_t m,
    const size_t n,
    const size_t grainsize) [inline]
```

**11.1.3.304 BlockCuts< CuttingStrategy::Block, StrategyParameter::Grain >()**

```
template<>
void BlockCuts< CuttingStrategy::Block, StrategyParameter::Grain > (
    size_t & RBLOCKSIZE,
    size_t & CBLOCKSIZE,
    const size_t m,
    const size_t n,
    const size_t grainsize) [inline]
```

**11.1.3.305 BlockCuts< CuttingStrategy::Column, StrategyParameter::Fixed >()**

```
template<>
void BlockCuts< CuttingStrategy::Column, StrategyParameter::Fixed > (
    size_t & RBLOCKSIZE,
    size_t & CBLOCKSIZE,
    const size_t m,
    const size_t n,
    const size_t numthreads) [inline]
```

**11.1.3.306 BlockCuts< CuttingStrategy::Column, StrategyParameter::Grain >()**

```
template<>
void BlockCuts< CuttingStrategy::Column, StrategyParameter::Grain > (
    size_t & RBLOCKSIZE,
    size_t & CBLOCKSIZE,
    const size_t m,
    const size_t n,
    const size_t grainsize) [inline]
```

**11.1.3.307 BlockCuts< CuttingStrategy::Block, StrategyParameter::Fixed >()**

```
template<>
void BlockCuts< CuttingStrategy::Block, StrategyParameter::Fixed > (
    size_t & RBLOCKSIZE,
    size_t & CBLOCKSIZE,
    const size_t m,
    const size_t n,
    const size_t numthreads) [inline]
```

**11.1.3.308 BlockCuts< CuttingStrategy::Row, StrategyParameter::Threads >()**

```
template<>
void BlockCuts< CuttingStrategy::Row, StrategyParameter::Threads > (
    size_t & RBLOCKSIZE,
    size_t & CBLOCKSIZE,
    const size_t m,
    const size_t n,
    const size_t numthreads) [inline]
```

**11.1.3.309 BlockCuts< CuttingStrategy::Column, StrategyParameter::Threads >()**

```
template<>
void BlockCuts< CuttingStrategy::Column, StrategyParameter::Threads > (
    size_t & RBLOCKSIZE,
    size_t & CBLOCKSIZE,
    const size_t m,
    const size_t n,
    const size_t numthreads) [inline]
```

**11.1.3.310 BlockCuts< CuttingStrategy::Block, StrategyParameter::Threads >()**

```
template<>
void BlockCuts< CuttingStrategy::Block, StrategyParameter::Threads > (
    size_t & RBLOCKSIZE,
    size_t & CBLOCKSIZE,
    const size_t m,
    const size_t n,
    const size_t numthreads) [inline]
```

**11.1.3.311 BlockCuts() [2/2]**

```
template<class Cut = CuttingStrategy::Block, class Param = StrategyParameter::Threads>
void BlockCuts (
    size_t & rowBlockSize,
    size_t & colBlockSize,
    size_t & lastRBS,
    size_t & lastCBS,
    size_t & changeRBS,
    size_t & changeCBS,
    size_t & numRowsBlock,
    size_t & numColBlock,
    size_t m,
    size_t n,
    const size_t numthreads) [inline]
```

**11.1.3.312 pfzero()**

```
template<class Field>
void pfzero (
    const Field & F,
    size_t m,
    size_t n,
    typename Field::Element_ptr C,
    size_t BS = 0)
```

**11.1.3.313 pfrand()**

```
template<class Field, class RandIter>
void pfrand (
    const Field & F,
    RandIter & G,
    size_t m,
    size_t n,
    typename Field::Element_ptr C,
    size_t BS = 0)
```

**11.1.3.314 fdot()** [11/11]

```
template<class Field, class Cut, class Param>
Field::Element & fdot (
    const Field & F,
    const size_t N,
    typename Field::ConstElement_ptr x,
    const size_t incx,
    typename Field::ConstElement_ptr y,
    const size_t incy,
    typename Field::Element & d,
    const ParSeqHelper::Parallel< Cut, Param > par) [inline]
```

**11.1.3.315 pfgemm()** [2/7]

```
template<class Field, class AlgoT, class FieldTrait>
Field::Element * pfgemm (
    const Field & F,
    const FFLAS_TRANSPOSE ta,
    const FFLAS_TRANSPOSE tb,
    const size_t m,
    const size_t n,
    const size_t k,
    const typename Field::Element alpha,
    const typename Field::ConstElement_ptr A,
    const size_t lda,
    const typename Field::ConstElement_ptr B,
    const size_t ldb,
    const typename Field::Element beta,
    typename Field::Element * C,
    const size_t ldc,
    MMHelper< Field, AlgoT, FieldTrait, ParSeqHelper::Parallel< CuttingStrategy::Block,
StrategyParameter::Threads > > & H)
```

**11.1.3.316 pfgemm()** [3/7]

```
template<class Field, class AlgoT, class FieldTrait>
Field::Element * pfgemm (
    const Field & F,
    const FFLAS_TRANSPOSE ta,
    const FFLAS_TRANSPOSE tb,
    const size_t m,
    const size_t n,
    const size_t k,
    const typename Field::Element alpha,
    const typename Field::ConstElement_ptr AA,
    const size_t lda,
    const typename Field::ConstElement_ptr BB,
    const size_t ldb,
    const typename Field::Element beta,
    typename Field::Element * C,
    const size_t ldc,
    MMHelper< Field, AlgoT, FieldTrait, ParSeqHelper::Parallel< CuttingStrategy::Recursive,
StrategyParameter::ThreeDAdaptive > > & H)
```

**11.1.3.317 pfgemm() [4/7]**

```
template<class Field, class AlgoT, class FieldTrait>
Field::Element * pfgemm (
    const Field & F,
    const FFLAS_TRANSPOSE ta,
    const FFLAS_TRANSPOSE tb,
    const size_t m,
    const size_t n,
    const size_t k,
    const typename Field::Element alpha,
    const typename Field::ConstElement_ptr AA,
    const size_t lda,
    const typename Field::ConstElement_ptr BB,
    const size_t ldb,
    const typename Field::Element beta,
    typename Field::Element * C,
    const size_t ldc,
    MMHelper< Field, AlgoT, FieldTrait, ParSeqHelper::Parallel< CuttingStrategy::Recursive,
StrategyParameter::TwoDAdaptive > > & H)
```

**11.1.3.318 pfgemm() [5/7]**

```
template<class Field, class AlgoT, class FieldTrait>
Field::Element * pfgemm (
    const Field & F,
    const FFLAS_TRANSPOSE ta,
    const FFLAS_TRANSPOSE tb,
    const size_t m,
    const size_t n,
    const size_t k,
    const typename Field::Element alpha,
    const typename Field::ConstElement_ptr AA,
    const size_t lda,
    const typename Field::ConstElement_ptr BB,
    const size_t ldb,
    const typename Field::Element beta,
    typename Field::Element * C,
    const size_t ldc,
    MMHelper< Field, AlgoT, FieldTrait, ParSeqHelper::Parallel< CuttingStrategy::Recursive,
StrategyParameter::TwoD > > & H)
```

**11.1.3.319 pfgemm() [6/7]**

```
template<class Field, class AlgoT, class FieldTrait>
Field::Element_ptr pfgemm (
    const Field & F,
    const FFLAS_TRANSPOSE ta,
    const FFLAS_TRANSPOSE tb,
    const size_t m,
    const size_t n,
    const size_t k,
    const typename Field::Element alpha,
    const typename Field::ConstElement_ptr A,
```

```

    const size_t lda,
    const typename Field::ConstElement_ptr B,
    const size_t ldb,
    const typename Field::Element beta,
    typename Field::Element_ptr C,
    const size_t ldc,
    MMHelper< Field, AlgoT, FieldTrait, ParSeqHelper::Parallel< CuttingStrategy::Recursive,
StrategyParameter::ThreeD > > & H)

```

### 11.1.3.320 pfgemm() [7/7]

```

template<class Field, class AlgoT, class FieldTrait>
Field::Element * pfgemm (
    const Field & F,
    const FFLAS_TRANSPOSE ta,
    const FFLAS_TRANSPOSE tb,
    const size_t m,
    const size_t n,
    const size_t k,
    const typename Field::Element alpha,
    const typename Field::ConstElement_ptr A,
    const size_t lda,
    const typename Field::ConstElement_ptr B,
    const size_t ldb,
    const typename Field::Element beta,
    typename Field::Element_ptr C,
    const size_t ldc,
    MMHelper< Field, AlgoT, FieldTrait, ParSeqHelper::Parallel< CuttingStrategy::Recursive,
StrategyParameter::ThreeDInPlace > > & H)

```

### 11.1.3.321 fgemv() [18/19]

```

template<class Field, class AlgoT, class FieldTrait>
Field::Element_ptr fgemv (
    const Field & F,
    const FFLAS_TRANSPOSE ta,
    const size_t m,
    const size_t n,
    const typename Field::Element alpha,
    const typename Field::ConstElement_ptr A,
    const size_t lda,
    const typename Field::ConstElement_ptr X,
    const size_t incX,
    const typename Field::Element beta,
    typename Field::Element_ptr Y,
    const size_t incY,
    MMHelper< Field, AlgoT, FieldTrait, ParSeqHelper::Parallel< CuttingStrategy::Recursive,
StrategyParameter::Threads > > & H)

```

### 11.1.3.322 fgemv() [19/19]

```

template<class Field, class AlgoT, class FieldTrait, class Cut>
Field::Element_ptr fgemv (

```



```

    const Field & F,
    const FFLAS_TRANSPOSE ta,
    const size_t m,
    const size_t n,
    const typename Field::Element alpha,
    const typename Field::ConstElement_ptr A,
    const size_t lda,
    const typename Field::ConstElement_ptr X,
    const size_t incX,
    const typename Field::Element beta,
    typename Field::Element_ptr Y,
    const size_t incY,
    MMHelper< Field, AlgoT, FieldTrait, ParSeqHelper::Parallel< CuttingStrategy::Row,
Cut > > & H)

```

### 11.1.3.323 parseArguments()

```

void parseArguments (
    int argc,
    char ** argv,
    Argument * args,
    bool printDefaults = true)

```

### 11.1.3.324 getArgumentValue()

```

char * getArgumentValue (
    int argc,
    char ** argv,
    int i)

```

Get the value of an argument and avoid core dump when no value was given after an argument.

#### Parameters

<i>argv</i>	argument value list
<i>i</i>	argument index

#### Returns

char\* argument value

### 11.1.3.325 writeCommandString()

```

std::ostream & writeCommandString (
    std::ostream & os,
    Argument * args,
    const char * programName = nullptr)

```

writes the values of all arguments, preceded by the programName

**11.1.3.326 WriteMatrix()** [1/2]

```
template<class Field>
std::ostream & WriteMatrix (
    std::ostream & c,
    const Field & F,
    size_t m,
    size_t n,
    typename Field::ConstElement_ptr A,
    size_t lda,
    FFLAS_FORMAT format,
    bool column_major) [inline]
```

WriteMatrix: write a matrix to an output stream.

**Parameters**

<i>c</i>	output stream
<i>F</i>	base field
<i>m</i>	row dimension
<i>n</i>	column dimension
<i>A</i>	matrix
<i>format</i>	input format (FflasAuto, FflasDense, FflasSMS, FflasBinary)
<i>column_major</i>	whether the matrix is stored in column or row major (row by default)

**11.1.3.327 preamble()**

```
void preamble (
    std::ifstream & ifs,
    FFLAS_FORMAT & format) [inline]
```

**11.1.3.328 ReadMatrix()** [1/2]

```
template<class Field>
Field::Element_ptr ReadMatrix (
    std::ifstream & ifs,
    Field & F,
    size_t & m,
    size_t & n,
    typename Field::Element_ptr & A,
    FFLAS_FORMAT format = FflasAuto)
```

ReadMatrix: read a matrix from an input stream.

**Parameters**

	<i>ifs</i>	input stream
	<i>F</i>	base field
out	<i>m</i>	row dimension
out	<i>n</i>	column dimension
out	<i>A</i>	output matrix
	<i>format</i>	input format (FflasAuto, FflasDense, FflasSMS, FflasBinary)

**11.1.3.329 ReadMatrix()** [2/2]

```
template<class Field>
Field::Element_ptr ReadMatrix (
    const std::string & matrix_file,
    Field & F,
    size_t & m,
    size_t & n,
    typename Field::Element_ptr & A,
    FFLAS_FORMAT format = FflasAuto) [inline]
```

ReadMatrix: read a matrix from a file.

**Parameters**

	<i>matrix_file</i>	filename
	<i>F</i>	base field
out	<i>m</i>	row dimension
out	<i>n</i>	column dimension
out	<i>A</i>	output matrix
	<i>format</i>	input format (FflasAuto, FflasDense, FflasSMS, FflasBinary)

**11.1.3.330 WriteMatrix()** [2/2]

```
template<class Field>
void WriteMatrix (
    std::string & matrix_file,
    const Field & F,
    int m,
    int n,
    typename Field::ConstElement_ptr A,
    size_t lda,
    FFLAS_FORMAT format = FflasDense,
    bool column_major = false)
```

WriteMatrix: write a matrix to a file.

**Parameters**

<i>matrix_file</i>	file name
<i>F</i>	base field
<i>m</i>	row dimension
<i>n</i>	column dimension
<i>A</i>	matrix
<i>format</i>	input format (FflasAuto, FflasDense, FflasSMS, FflasBinary)
<i>column_major</i>	whether the matrix is stored in column or row major (row by default)

**11.1.3.331 WritePermutation()**

```
std::ostream & WritePermutation (
    std::ostream & c,
    const size_t * P,
    size_t N) [inline]
```

WritePermutation: write a permutation matrix to an output stream.

## Parameters

<i>c</i>	output stream
<i>P</i>	permutation
<i>N</i>	size of the permutation

**11.1.3.332 alignable()**

```
template<class Element>
bool alignable () [inline]
```

**11.1.3.333 alignable< Givaro::Integer \* >()**

```
template<>
bool alignable< Givaro::Integer * > () [inline]
```

**11.1.3.334 fflas\_new() [5/7]**

```
template<class Field>
Field::Element_ptr fflas_new (
    const Field & F,
    const size_t m,
    const Alignment align = Alignment::DEFAULT) [inline]
```

**11.1.3.335 fflas\_new() [6/7]**

```
template<class Field>
Field::Element_ptr fflas_new (
    const Field & F,
    const size_t m,
    const size_t n,
    const Alignment align = Alignment::DEFAULT) [inline]
```

**11.1.3.336 fflas\_new() [7/7]**

```
template<class Element>
Element * fflas_new (
    const size_t m,
    const Alignment align = Alignment::DEFAULT) [inline]
```

**11.1.3.337 fflas\_delete() [3/4]**

```
template<class Element_ptr>
void fflas_delete (
    Element_ptr A) [inline]
```

**11.1.3.338 fflas\_delete()** [4/4]

```
template<class Ptr, class ... Args>
void fflas_delete (
    Ptr p,
    Args ... args) [inline]
```

**11.1.3.339 prefetch()**

```
void prefetch (
    const int64_t * ) [inline]
```

**11.1.3.340 getTLBSize()**

```
void getTLBSize (
    int & tlb) [inline]
```

**11.1.3.341 queryCacheSizes()**

```
void queryCacheSizes (
    int & l1,
    int & l2,
    int & l3) [inline]
```

Queries and returns the cache sizes in Bytes of the L1, L2, and L3 data caches respectively

**11.1.3.342 queryL1CacheSize()**

```
int queryL1CacheSize () [inline]
```

**Returns**

the size in Bytes of the L1 data cache

**11.1.3.343 queryTopLevelCacheSize()**

```
int queryTopLevelCacheSize () [inline]
```

**Returns**

the size in Bytes of the L2 or L3 cache if this later is present

**11.1.3.344 getSeed()**

```
uint64_t getSeed ()
```

## 11.2 FFLAS::\_ftranspose\_impl Namespace Reference

### Functions

- `template<size_t bs, typename Field, typename BTSimd>`  
`void not_inplace (const Field &F, const BTSimd &BTS, const size_t m, const size_t n, typename Field::ConstElement_ptr A, const size_t lda, typename Field::Element_ptr B, const size_t ldb)`
- `template<size_t bs, typename Field, typename BTSimd>`  
`void square_inplace (const Field &F, const BTSimd &BTS, const size_t m, typename Field::Element_ptr A, const size_t lda)`
- `template<size_t bs, typename Field, typename BTSimd>`  
`void nonsquare_inplace_v1 (const Field &F, const BTSimd &BTS, const size_t m, const size_t n, typename Field::Element_ptr A)`
- `template<size_t bs, typename Field, typename BTSimd>`  
`void nonsquare_inplace_v2 (const Field &F, const BTSimd &BTS, const size_t m, const size_t n, typename Field::Element_ptr A)`

### 11.2.1 Function Documentation

#### 11.2.1.1 not\_inplace()

```
template<size_t bs, typename Field, typename BTSimd>
void not_inplace (
    const Field & F,
    const BTSimd & BTS,
    const size_t m,
    const size_t n,
    typename Field::ConstElement_ptr A,
    const size_t lda,
    typename Field::Element_ptr B,
    const size_t ldb)
```

#### 11.2.1.2 square\_inplace()

```
template<size_t bs, typename Field, typename BTSimd>
void square_inplace (
    const Field & F,
    const BTSimd & BTS,
    const size_t m,
    typename Field::Element_ptr A,
    const size_t lda)
```

#### 11.2.1.3 nonsquare\_inplace\_v1()

```
template<size_t bs, typename Field, typename BTSimd>
void nonsquare_inplace_v1 (
    const Field & F,
    const BTSimd & BTS,
    const size_t m,
    const size_t n,
    typename Field::Element_ptr A)
```

#### 11.2.1.4 nonsquare\_inplace\_v2()

```
template<size_t bs, typename Field, typename BTSimd>
void nonsquare_inplace_v2 (
    const Field & F,
    const BTSimd & BTS,
    const size_t m,
    const size_t n,
    typename Field::Element_ptr A)
```

## 11.3 FFLAS::BLAS3 Namespace Reference

### Functions

- template<class Field>
 void Bini (const Field &F, const FFLAS\_TRANSPOSE ta, const FFLAS\_TRANSPOSE tb, const size\_t mr, const size\_t nr, const size\_t kr, const typename Field::Element alpha, const typename Field::Element\_ptr A, const size\_t lda, const typename Field::Element\_ptr B, const size\_t ldb, const typename Field::Element beta, typename Field::Element\_ptr C, const size\_t ldc, const size\_t kmax, const size\_t w, const FFLAS\_BASE base, const size\_t rec\_level)
- template<class Field, class FieldTrait, class Strat, class Param>
 Field::Element\_ptr WinoPar (const Field &F, const FFLAS\_TRANSPOSE ta, const FFLAS\_TRANSPOSE tb, const size\_t mr, const size\_t nr, const size\_t kr, const typename Field::Element alpha, typename Field::ConstElement\_ptr A, const size\_t lda, typename Field::ConstElement\_ptr B, const size\_t ldb, const typename Field::Element beta, typename Field::Element\_ptr C, const size\_t ldc, MMHelper< Field, MMHelperAlgo::WinogradPar, FieldTrait, ParSeqHelper::Parallel< Strat, Param > > &WH)
- template<class Field, class FieldTrait>
 void Winograd (const Field &F, const FFLAS\_TRANSPOSE ta, const FFLAS\_TRANSPOSE tb, const size\_t mr, const size\_t nr, const size\_t kr, const typename Field::Element alpha, typename Field::ConstElement\_ptr A, const size\_t lda, typename Field::ConstElement\_ptr B, const size\_t ldb, const typename Field::Element beta, typename Field::Element\_ptr C, const size\_t ldc, MMHelper< Field, MMHelperAlgo::Winograd, FieldTrait > &WH)
- template<class Field, class FieldTrait>
 void WinogradAcc\_3\_23 (const Field &F, const FFLAS\_TRANSPOSE ta, const FFLAS\_TRANSPOSE tb, const size\_t mr, const size\_t nr, const size\_t kr, const typename Field::Element alpha, typename Field::ConstElement\_ptr A, const size\_t lda, typename Field::ConstElement\_ptr B, const size\_t ldb, const typename Field::Element beta, typename Field::Element\_ptr C, const size\_t ldc, MMHelper< Field, MMHelperAlgo::Winograd, FieldTrait > &WH)
- template<class Field, class FieldTrait>
 void WinogradAcc\_3\_21 (const Field &F, const FFLAS\_TRANSPOSE ta, const FFLAS\_TRANSPOSE tb, const size\_t mr, const size\_t nr, const size\_t kr, const typename Field::Element alpha, typename Field::ConstElement\_ptr A, const size\_t lda, typename Field::ConstElement\_ptr B, const size\_t ldb, const typename Field::Element beta, typename Field::Element\_ptr C, const size\_t ldc, MMHelper< Field, MMHelperAlgo::Winograd, FieldTrait > &WH)
- template<class Field, class FieldTrait>
 void WinogradAcc\_2\_24 (const Field &F, const FFLAS\_TRANSPOSE ta, const FFLAS\_TRANSPOSE tb, const size\_t mr, const size\_t nr, const size\_t kr, const typename Field::Element alpha, const typename Field::Element\_ptr A, const size\_t lda, const typename Field::Element\_ptr B, const size\_t ldb, const typename Field::Element beta, typename Field::Element\_ptr C, const size\_t ldc, MMHelper< Field, MMHelperAlgo::Winograd, FieldTrait > &WH)
- template<class Field, class FieldTrait>
 void WinogradAcc\_2\_27 (const Field &F, const FFLAS\_TRANSPOSE ta, const FFLAS\_TRANSPOSE tb, const size\_t mr, const size\_t nr, const size\_t kr, const typename Field::Element alpha, const typename Field::Element\_ptr A, const size\_t lda, const typename Field::Element\_ptr B, const size\_t ldb, const typename Field::Element beta, typename Field::Element\_ptr C, const size\_t ldc, MMHelper< Field, MMHelperAlgo::Winograd, FieldTrait > &WH)

- `template<class Field, class FieldTrait>`  
`void WinogradAcc_LR (const Field &F, const FFLAS_TRANSPOSE ta, const FFLAS_TRANSPOSE tb, const size_t mr, const size_t nr, const size_t kr, const typename Field::Element alpha, typename Field::Element_ptr A, const size_t lda, typename Field::Element_ptr B, const size_t ldb, const typename Field::Element beta, typename Field::Element_ptr C, const size_t ldc, const MMHelper< Field, MMHelperAlgo::Winograd, Field↵Trait > &WH)`
- `template<class Field, class FieldTrait>`  
`void WinogradAcc_R_S (const Field &F, const FFLAS_TRANSPOSE ta, const FFLAS_TRANSPOSE tb, const size_t mr, const size_t nr, const size_t kr, const typename Field::Element alpha, const typename Field::Element_ptr A, const size_t lda, typename Field::Element_ptr B, const size_t ldb, const typename Field::Element beta, typename Field::Element_ptr C, const size_t ldc, const MMHelper< Field, MMHelperAlgo::Winograd, FieldTrait > &WH)`
- `template<class Field, class FieldTrait>`  
`void WinogradAcc_L_S (const Field &F, const FFLAS_TRANSPOSE ta, const FFLAS_TRANSPOSE tb, const size_t mr, const size_t nr, const size_t kr, const typename Field::Element alpha, typename Field::Element_ptr A, const size_t lda, const typename Field::Element_ptr B, const size_t ldb, const typename Field::Element beta, typename Field::Element_ptr C, const size_t ldc, const MMHelper< Field, MMHelperAlgo::Winograd, FieldTrait > &WH)`
- `template<class Field, class FieldTrait>`  
`void Winograd_LR_S (const Field &F, const FFLAS_TRANSPOSE ta, const FFLAS_TRANSPOSE tb, const size_t mr, const size_t nr, const size_t kr, const typename Field::Element alpha, typename Field::Element_ptr A, const size_t lda, typename Field::Element_ptr B, const size_t ldb, const typename Field::Element beta, typename Field::Element_ptr C, const size_t ldc, const MMHelper< Field, MMHelperAlgo::Winograd, Field↵Trait > &WH)`
- `template<class Field, class FieldTrait>`  
`void Winograd_L_S (const Field &F, const FFLAS_TRANSPOSE ta, const FFLAS_TRANSPOSE tb, const size_t mr, const size_t nr, const size_t kr, const typename Field::Element alpha, typename Field::Element_ptr A, const size_t lda, const typename Field::Element_ptr B, const size_t ldb, const typename Field::Element beta, typename Field::Element_ptr C, const size_t ldc, const MMHelper< Field, MMHelperAlgo::Winograd, FieldTrait > &WH)`
- `template<class Field, class FieldTrait>`  
`void Winograd_R_S (const Field &F, const FFLAS_TRANSPOSE ta, const FFLAS_TRANSPOSE tb, const size_t mr, const size_t nr, const size_t kr, const typename Field::Element alpha, const typename Field::Element_ptr A, const size_t lda, typename Field::Element_ptr B, const size_t ldb, const typename Field::Element beta, typename Field::Element_ptr C, const size_t ldc, const MMHelper< Field, MMHelperAlgo::Winograd, FieldTrait > &WH)`

### 11.3.1 Function Documentation

#### 11.3.1.1 Bini()

```
template<class Field>
void Bini (
    const Field & F,
    const FFLAS_TRANSPOSE ta,
    const FFLAS_TRANSPOSE tb,
    const size_t mr,
    const size_t nr,
    const size_t kr,
    const typename Field::Element alpha,
    const typename Field::Element_ptr A,
    const size_t lda,
    const typename Field::Element_ptr B,
    const size_t ldb,
    const typename Field::Element beta,
```



```

typename Field::Element_ptr C,
const size_t ldc,
const size_t kmax,
const size_t w,
const FFLAS_BASE base,
const size_t rec_level) [inline]

```

### 11.3.1.2 WinoPar()

```

template<class Field, class FieldTrait, class Strat, class Param>
Field::Element_ptr WinoPar (
    const Field & F,
    const FFLAS_TRANSPOSE ta,
    const FFLAS_TRANSPOSE tb,
    const size_t mr,
    const size_t nr,
    const size_t kr,
    const typename Field::Element alpha,
    typename Field::ConstElement_ptr A,
    const size_t lda,
    typename Field::ConstElement_ptr B,
    const size_t ldb,
    const typename Field::Element beta,
    typename Field::Element_ptr C,
    const size_t ldc,
    MMHelper< Field, MMHelperAlgo::WinogradPar, FieldTrait, ParSeqHelper::Parallel<
Strat, Param > > & WH) [inline]

```

### 11.3.1.3 Winograd()

```

template<class Field, class FieldTrait>
void Winograd (
    const Field & F,
    const FFLAS_TRANSPOSE ta,
    const FFLAS_TRANSPOSE tb,
    const size_t mr,
    const size_t nr,
    const size_t kr,
    const typename Field::Element alpha,
    typename Field::ConstElement_ptr A,
    const size_t lda,
    typename Field::ConstElement_ptr B,
    const size_t ldb,
    const typename Field::Element beta,
    typename Field::Element_ptr C,
    const size_t ldc,
    MMHelper< Field, MMHelperAlgo::Winograd, FieldTrait > & WH) [inline]

```

### 11.3.1.4 WinogradAcc\_3\_23()

```

template<class Field, class FieldTrait>
void WinogradAcc_3_23 (
    const Field & F,

```

```

const FFLAS_TRANSPOSE ta,
const FFLAS_TRANSPOSE tb,
const size_t mr,
const size_t nr,
const size_t kr,
const typename Field::Element alpha,
typename Field::ConstElement_ptr A,
const size_t lda,
typename Field::ConstElement_ptr B,
const size_t ldb,
const typename Field::Element beta,
typename Field::Element_ptr C,
const size_t ldc,
MMHelper< Field, MMHelperAlgo::Winograd, FieldTrait > & WH) [inline]

```

#### 11.3.1.5 WinogradAcc\_3\_21()

```

template<class Field, class FieldTrait>
void WinogradAcc_3_21 (
    const Field & F,
    const FFLAS_TRANSPOSE ta,
    const FFLAS_TRANSPOSE tb,
    const size_t mr,
    const size_t nr,
    const size_t kr,
    const typename Field::Element alpha,
    typename Field::ConstElement_ptr A,
    const size_t lda,
    typename Field::ConstElement_ptr B,
    const size_t ldb,
    const typename Field::Element beta,
    typename Field::Element_ptr C,
    const size_t ldc,
    MMHelper< Field, MMHelperAlgo::Winograd, FieldTrait > & WH) [inline]

```

#### 11.3.1.6 WinogradAcc\_2\_24()

```

template<class Field, class FieldTrait>
void WinogradAcc_2_24 (
    const Field & F,
    const FFLAS_TRANSPOSE ta,
    const FFLAS_TRANSPOSE tb,
    const size_t mr,
    const size_t nr,
    const size_t kr,
    const typename Field::Element alpha,
    const typename Field::Element_ptr A,
    const size_t lda,
    const typename Field::Element_ptr B,
    const size_t ldb,
    const typename Field::Element beta,
    typename Field::Element_ptr C,
    const size_t ldc,
    MMHelper< Field, MMHelperAlgo::Winograd, FieldTrait > & WH) [inline]

```

### 11.3.1.7 WinogradAcc\_2\_27()

```
template<class Field, class FieldTrait>
void WinogradAcc_2_27 (
    const Field & F,
    const FFLAS_TRANSPOSE ta,
    const FFLAS_TRANSPOSE tb,
    const size_t mr,
    const size_t nr,
    const size_t kr,
    const typename Field::Element alpha,
    const typename Field::Element_ptr A,
    const size_t lda,
    const typename Field::Element_ptr B,
    const size_t ldb,
    const typename Field::Element beta,
    typename Field::Element_ptr C,
    const size_t ldc,
    MMHelper< Field, MMHelperAlgo::Winograd, FieldTrait > & WH) [inline]
```

### 11.3.1.8 WinogradAcc\_LR()

```
template<class Field, class FieldTrait>
void WinogradAcc_LR (
    const Field & F,
    const FFLAS_TRANSPOSE ta,
    const FFLAS_TRANSPOSE tb,
    const size_t mr,
    const size_t nr,
    const size_t kr,
    const typename Field::Element alpha,
    typename Field::Element_ptr A,
    const size_t lda,
    typename Field::Element_ptr B,
    const size_t ldb,
    const typename Field::Element beta,
    typename Field::Element_ptr C,
    const size_t ldc,
    const MMHelper< Field, MMHelperAlgo::Winograd, FieldTrait > & WH) [inline]
```

### 11.3.1.9 WinogradAcc\_R\_S()

```
template<class Field, class FieldTrait>
void WinogradAcc_R_S (
    const Field & F,
    const FFLAS_TRANSPOSE ta,
    const FFLAS_TRANSPOSE tb,
    const size_t mr,
    const size_t nr,
    const size_t kr,
    const typename Field::Element alpha,
    const typename Field::Element_ptr A,
    const size_t lda,
    typename Field::Element_ptr B,
```

```

const size_t ldb,
const typename Field::Element beta,
typename Field::Element_ptr C,
const size_t ldc,
const MMHelper< Field, MMHelperAlgo::Winograd, FieldTrait > & WH) [inline]

```

#### 11.3.1.10 WinogradAcc\_L\_S()

```

template<class Field, class FieldTrait>
void WinogradAcc_L_S (
    const Field & F,
    const FFLAS_TRANSPOSE ta,
    const FFLAS_TRANSPOSE tb,
    const size_t mr,
    const size_t nr,
    const size_t kr,
    const typename Field::Element alpha,
    typename Field::Element_ptr A,
    const size_t lda,
    const typename Field::Element_ptr B,
    const size_t ldb,
    const typename Field::Element beta,
    typename Field::Element_ptr C,
    const size_t ldc,
    const MMHelper< Field, MMHelperAlgo::Winograd, FieldTrait > & WH) [inline]

```

#### 11.3.1.11 Winograd\_LR\_S()

```

template<class Field, class FieldTrait>
void Winograd_LR_S (
    const Field & F,
    const FFLAS_TRANSPOSE ta,
    const FFLAS_TRANSPOSE tb,
    const size_t mr,
    const size_t nr,
    const size_t kr,
    const typename Field::Element alpha,
    typename Field::Element_ptr A,
    const size_t lda,
    typename Field::Element_ptr B,
    const size_t ldb,
    const typename Field::Element beta,
    typename Field::Element_ptr C,
    const size_t ldc,
    const MMHelper< Field, MMHelperAlgo::Winograd, FieldTrait > & WH) [inline]

```

#### 11.3.1.12 Winograd\_L\_S()

```

template<class Field, class FieldTrait>
void Winograd_L_S (
    const Field & F,
    const FFLAS_TRANSPOSE ta,
    const FFLAS_TRANSPOSE tb,

```

```

const size_t mr,
const size_t nr,
const size_t kr,
const typename Field::Element alpha,
typename Field::Element_ptr A,
const size_t lda,
const typename Field::Element_ptr B,
const size_t ldb,
const typename Field::Element beta,
typename Field::Element_ptr C,
const size_t ldc,
const MMHelper< Field, MMHelperAlgo::Winograd, FieldTrait > & WH) [inline]

```

### 11.3.1.13 Winograd\_R\_S()

```

template<class Field, class FieldTrait>
void Winograd_R_S (
    const Field & F,
    const FFLAS_TRANSPOSE ta,
    const FFLAS_TRANSPOSE tb,
    const size_t mr,
    const size_t nr,
    const size_t kr,
    const typename Field::Element alpha,
    const typename Field::Element_ptr A,
    const size_t lda,
    typename Field::Element_ptr B,
    const size_t ldb,
    const typename Field::Element beta,
    typename Field::Element_ptr C,
    const size_t ldc,
    const MMHelper< Field, MMHelperAlgo::Winograd, FieldTrait > & WH) [inline]

```

## 11.4 FFLAS::csr\_hyb\_details Namespace Reference

### Data Structures

- struct [Coo](#)
- struct [Info](#)

## 11.5 FFLAS::CuttingStrategy Namespace Reference

### Data Structures

- struct [Block](#)
- struct [Column](#)
- struct [Recursive](#)
- struct [Row](#)
- struct [Single](#)

## Typedefs

- typedef [Row](#) [RNSModulus](#)

## 11.5.1 Typedef Documentation

### 11.5.1.1 RNSModulus

typedef [Row](#) [RNSModulus](#)

## 11.6 FFLAS::details Namespace Reference

### Functions

- template<class [Field](#), bool ADD>  
std::enable\_if< [FFLAS::support\\_simd\\_add](#)< typename [Field::Element](#) >::value, void >::type [fadd](#)  
(const [Field](#) &F, const size\_t N, typename [Field::ConstElement\\_ptr](#) A, const size\_t inca, typename [Field::ConstElement\\_ptr](#) B, const size\_t incb, typename [Field::Element\\_ptr](#) C, const size\_t incc, [FieldCategories::ModularTag](#))
- template<class [Field](#), bool ADD>  
std::enable\_if<![FFLAS::support\\_simd\\_add](#)< typename [Field::Element](#) >::value, void >::type [fadd](#)  
(const [Field](#) &F, const size\_t N, typename [Field::ConstElement\\_ptr](#) A, const size\_t inca, typename [Field::ConstElement\\_ptr](#) B, const size\_t incb, typename [Field::Element\\_ptr](#) C, const size\_t incc, [FieldCategories::ModularTag](#))
- template<class [Field](#), bool ADD>  
void [fadd](#) (const [Field](#) &F, const size\_t N, typename [Field::ConstElement\\_ptr](#) A, const size\_t inca, type-  
name [Field::ConstElement\\_ptr](#) B, const size\_t incb, typename [Field::Element\\_ptr](#) C, const size\_t incc, [FieldCategories::GenericTag](#))
- template<class [Field](#), bool ADD>  
std::enable\_if<![FFLAS::support\\_simd\\_add](#)< typename [Field::Element](#) >::value, void >::type [fadd](#)  
(const [Field](#) &F, const size\_t N, typename [Field::ConstElement\\_ptr](#) A, const size\_t inca, typename [Field::ConstElement\\_ptr](#) B, const size\_t incb, typename [Field::Element\\_ptr](#) C, const size\_t incc, [FieldCategories::UnparametricTag](#))
- template<class [Field](#), bool ADD>  
std::enable\_if< [FFLAS::support\\_simd\\_add](#)< typename [Field::Element](#) >::value, void >::type [fadd](#)  
(const [Field](#) &F, const size\_t N, typename [Field::ConstElement\\_ptr](#) A, const size\_t inca, typename [Field::ConstElement\\_ptr](#) B, const size\_t incb, typename [Field::Element\\_ptr](#) C, const size\_t incc, [FieldCategories::UnparametricTag](#))
- template<class [Field](#)>  
std::enable\_if< [FFLAS::support\\_fast\\_mod](#)< typename [Field::Element](#) >::value, void >::type [faxpy](#) (const [Field](#) &F, const size\_t N, const typename [Field::Element](#) a, typename [Field::ConstElement\\_ptr](#) X, const size\_t incX, typename [Field::Element\\_ptr](#) Y, const size\_t incY, [FieldCategories::ModularTag](#))
- template<class [Field](#), class FC>  
void [faxpy](#) (const [Field](#) &F, const size\_t N, const typename [Field::Element](#) a, typename [Field::ConstElement\\_ptr](#) X, const size\_t incX, typename [Field::Element\\_ptr](#) Y, const size\_t incY, FC)
- template<class [Field](#)>  
std::enable\_if< [FFLAS::support\\_fast\\_mod](#)< typename [Field::Element](#) >::value, void >::type [freduce](#) (const [Field](#) &F, const size\_t m, typename [Field::Element\\_ptr](#) A, const size\_t incX, [FieldCategories::ModularTag](#))
- template<class [Field](#)>  
std::enable\_if< [FFLAS::support\\_fast\\_mod](#)< typename [Field::Element](#) >::value, void >::type [freduce](#)  
(const [Field](#) &F, const size\_t m, typename [Field::ConstElement\\_ptr](#) B, const size\_t incY, typename [Field::Element\\_ptr](#) A, const size\_t incX, [FieldCategories::ModularTag](#))

- template<class [Field](#), class FC>  
void [freduce](#) (const [Field](#) &F, const size\_t m, typename [Field::Element\\_ptr](#) A, const size\_t incX, FC)
- template<class [Field](#), class FC>  
void [freduce](#) (const [Field](#) &F, const size\_t m, typename [Field::ConstElement\\_ptr](#) B, const size\_t incY, typename [Field::Element\\_ptr](#) A, const size\_t incX, FC)
- template<class [Field](#)>  
std::enable\_if< [FFLAS::support\\_fast\\_mod](#)< typename [Field::Element](#) >::value, void >::type [fscalin](#) (const [Field](#) &F, const size\_t N, const typename [Field::Element](#) a, typename [Field::Element\\_ptr](#) X, const size\_t incX, [FieldCategories::ModularTag](#))
- template<class [Field](#)>  
std::enable\_if< [FFLAS::support\\_fast\\_mod](#)< typename [Field::Element](#) >::value, void >::type [fscal](#) (const [Field](#) &F, const size\_t N, const typename [Field::Element](#) a, typename [Field::ConstElement\\_ptr](#) X, const size\_t incX, typename [Field::Element\\_ptr](#) Y, const size\_t incY, [FieldCategories::ModularTag](#))
- template<class [Field](#), class FC>  
void [fscalin](#) (const [Field](#) &F, const size\_t n, const typename [Field::Element](#) a, typename [Field::Element\\_ptr](#) X, const size\_t incX, FC)
- template<class [Field](#), class FC>  
void [fscal](#) (const [Field](#) &F, const size\_t N, const typename [Field::Element](#) a, typename [Field::ConstElement\\_ptr](#) X, const size\_t incX, typename [Field::Element\\_ptr](#) Y, const size\_t incY, FC)
- template<enum [number\\_kind](#) K>  
void [igebb44](#) (size\_t i, size\_t j, size\_t depth, size\_t pdeth, const int64\_t alpha, const int64\_t \*bIA, const int64\_t \*bIB, int64\_t \*C, size\_t ldc)
- template<enum [number\\_kind](#) K>  
void [igebb24](#) (size\_t i, size\_t j, size\_t depth, size\_t pdeth, const int64\_t alpha, const int64\_t \*bIA, const int64\_t \*bIB, int64\_t \*C, size\_t ldc)
- template<enum [number\\_kind](#) K>  
void [igebb14](#) (size\_t i, size\_t j, size\_t depth, size\_t pdeth, const int64\_t alpha, const int64\_t \*bIA, const int64\_t \*bIB, int64\_t \*C, size\_t ldc)
- template<enum [number\\_kind](#) K>  
void [igebb41](#) (size\_t i, size\_t j, size\_t depth, size\_t pdeth, const int64\_t alpha, const int64\_t \*bIA, const int64\_t \*bIB, int64\_t \*C, size\_t ldc)
- template<enum [number\\_kind](#) K>  
void [igebb21](#) (size\_t i, size\_t j, size\_t depth, size\_t pdeth, const int64\_t alpha, const int64\_t \*bIA, const int64\_t \*bIB, int64\_t \*C, size\_t ldc)
- template<enum [number\\_kind](#) K>  
void [igebb11](#) (size\_t i, size\_t j, size\_t depth, size\_t pdeth, const int64\_t alpha, const int64\_t \*bIA, const int64\_t \*bIB, int64\_t \*C, size\_t ldc)
- template<enum [number\\_kind](#) K>  
void [igebp](#) (size\_t rows, size\_t cols, size\_t depth, const int64\_t alpha, const int64\_t \*blockA, size\_t lda, const int64\_t \*blockB, size\_t ldb, int64\_t \*C, size\_t ldc)
- template<size\_t k, bool transpose>  
void [pack\\_lhs](#) (int64\_t \*XX, const int64\_t \*X, size\_t ldx, size\_t rows, size\_t cols)
- template<size\_t k, bool transpose>  
void [pack\\_rhs](#) (int64\_t \*XX, const int64\_t \*X, size\_t ldx, size\_t rows, size\_t cols)
- void [gebp](#) (size\_t rows, size\_t cols, size\_t depth, int64\_t \*C, size\_t ldc, const int64\_t \*blockA, size\_t lda, const int64\_t \*BlockB, size\_t ldb, int64\_t \*BlockW)
- void [BlockingFactor](#) (size\_t &m, size\_t &n, size\_t &k)

## 11.6.1 Function Documentation

### 11.6.1.1 fadd() [1/5]

```
template<class Field, bool ADD>
std::enable_if< FFLAS::support\_simd\_add< typename Field::Element >::value, void >::type fadd (
    const Field & F,
```

```

    const size_t N,
    typename Field::ConstElement_ptr A,
    const size_t inca,
    typename Field::ConstElement_ptr B,
    const size_t incb,
    typename Field::Element_ptr C,
    const size_t incc,
    FieldCategories::ModularTag )

```

#### 11.6.1.2 fadd() [2/5]

```

template<class Field, bool ADD>
std::enable_if<!FFLAS::support_simd_add< typenameField::Element >::value, void >::type fadd (
    const Field & F,
    const size_t N,
    typename Field::ConstElement_ptr A,
    const size_t inca,
    typename Field::ConstElement_ptr B,
    const size_t incb,
    typename Field::Element_ptr C,
    const size_t incc,
    FieldCategories::ModularTag )

```

#### 11.6.1.3 fadd() [3/5]

```

template<class Field, bool ADD>
void fadd (
    const Field & F,
    const size_t N,
    typename Field::ConstElement_ptr A,
    const size_t inca,
    typename Field::ConstElement_ptr B,
    const size_t incb,
    typename Field::Element_ptr C,
    const size_t incc,
    FieldCategories::GenericTag )

```

#### 11.6.1.4 fadd() [4/5]

```

template<class Field, bool ADD>
std::enable_if<!FFLAS::support_simd_add< typenameField::Element >::value, void >::type fadd (
    const Field & F,
    const size_t N,
    typename Field::ConstElement_ptr A,
    const size_t inca,
    typename Field::ConstElement_ptr B,
    const size_t incb,
    typename Field::Element_ptr C,
    const size_t incc,
    FieldCategories::UnparametricTag ) [inline]

```



**11.6.1.5 fadd()** [5/5]

```
template<class Field, bool ADD>
std::enable_if< FFLAS::support_simd_add< typenameField::Element >::value, void >::type fadd (
    const Field & F,
    const size_t N,
    typename Field::ConstElement_ptr A,
    const size_t inca,
    typename Field::ConstElement_ptr B,
    const size_t incb,
    typename Field::Element_ptr C,
    const size_t incc,
    FieldCategories::UnparametricTag ) [inline]
```

**11.6.1.6 faxpy()** [1/2]

```
template<class Field>
std::enable_if< FFLAS::support_fast_mod< typenameField::Element >::value, void >::type faxpy
(
    const Field & F,
    const size_t N,
    const typename Field::Element a,
    typename Field::ConstElement_ptr X,
    const size_t incX,
    typename Field::Element_ptr Y,
    const size_t incY,
    FieldCategories::ModularTag ) [inline]
```

**11.6.1.7 faxpy()** [2/2]

```
template<class Field, class FC>
void faxpy (
    const Field & F,
    const size_t N,
    const typename Field::Element a,
    typename Field::ConstElement_ptr X,
    const size_t incX,
    typename Field::Element_ptr Y,
    const size_t incY,
    FC ) [inline]
```

**11.6.1.8 freduce()** [1/4]

```
template<class Field>
std::enable_if< FFLAS::support_fast_mod< typenameField::Element >::value, void >::type freduce
(
    const Field & F,
    const size_t m,
    typename Field::Element_ptr A,
    const size_t incX,
    FieldCategories::ModularTag ) [inline]
```

**11.6.1.9 freduce()** [2/4]

```

template<class Field>
std::enable_if< FFLAS::support_fast_mod< typenameField::Element >::value, void >::type freduce
(
    const Field & F,
    const size_t m,
    typename Field::ConstElement_ptr B,
    const size_t incY,
    typename Field::Element_ptr A,
    const size_t incX,
    FieldCategories::ModularTag ) [inline]

```

**11.6.1.10 freduce()** [3/4]

```

template<class Field, class FC>
void freduce (
    const Field & F,
    const size_t m,
    typename Field::Element_ptr A,
    const size_t incX,
    FC ) [inline]

```

**11.6.1.11 freduce()** [4/4]

```

template<class Field, class FC>
void freduce (
    const Field & F,
    const size_t m,
    typename Field::ConstElement_ptr B,
    const size_t incY,
    typename Field::Element_ptr A,
    const size_t incX,
    FC ) [inline]

```

**11.6.1.12 fscaln()** [1/2]

```

template<class Field>
std::enable_if< FFLAS::support_fast_mod< typenameField::Element >::value, void >::type fscaln
(
    const Field & F,
    const size_t N,
    const typename Field::Element a,
    typename Field::Element_ptr X,
    const size_t incX,
    FieldCategories::ModularTag ) [inline]

```

**11.6.1.13 fscal()** [1/2]

```
template<class Field>
std::enable_if< FFLAS::support_fast_mod< typenameField::Element >::value, void >::type fscal
(
    const Field & F,
    const size_t N,
    const typename Field::Element a,
    typename Field::ConstElement_ptr X,
    const size_t incX,
    typename Field::Element_ptr Y,
    const size_t incY,
    FieldCategories::ModularTag ) [inline]
```

**11.6.1.14 fscaln()** [2/2]

```
template<class Field, class FC>
void fscaln (
    const Field & F,
    const size_t n,
    const typename Field::Element a,
    typename Field::Element_ptr X,
    const size_t incX,
    FC ) [inline]
```

**11.6.1.15 fscal()** [2/2]

```
template<class Field, class FC>
void fscal (
    const Field & F,
    const size_t N,
    const typename Field::Element a,
    typename Field::ConstElement_ptr X,
    const size_t incX,
    typename Field::Element_ptr Y,
    const size_t incY,
    FC ) [inline]
```

**11.6.1.16 igebb44()**

```
template<enum number_kind K>
void igebb44 (
    size_t i,
    size_t j,
    size_t depth,
    size_t pdeth,
    const int64_t alpha,
    const int64_t * blA,
    const int64_t * blB,
    int64_t * C,
    size_t ldc) [inline]
```

**11.6.1.17 igebb24()**

```
template<enum number_kind K>
void igebb24 (
    size_t i,
    size_t j,
    size_t depth,
    size_t pdeth,
    const int64_t alpha,
    const int64_t * blA,
    const int64_t * blB,
    int64_t * C,
    size_t ldc) [inline]
```

**11.6.1.18 igebb14()**

```
template<enum number_kind K>
void igebb14 (
    size_t i,
    size_t j,
    size_t depth,
    size_t pdeth,
    const int64_t alpha,
    const int64_t * blA,
    const int64_t * blB,
    int64_t * C,
    size_t ldc) [inline]
```

**11.6.1.19 igebb41()**

```
template<enum number_kind K>
void igebb41 (
    size_t i,
    size_t j,
    size_t depth,
    size_t pdeth,
    const int64_t alpha,
    const int64_t * blA,
    const int64_t * blB,
    int64_t * C,
    size_t ldc) [inline]
```

bug ,B\_0 dans VEC\_MADD\_32 ?

**11.6.1.20 igebb21()**

```
template<enum number_kind K>
void igebb21 (
    size_t i,
    size_t j,
    size_t depth,
    size_t pdeth,
    const int64_t alpha,
    const int64_t * blA,
    const int64_t * blB,
    int64_t * C,
    size_t ldc) [inline]
```

**11.6.1.21 igebb11()**

```
template<enum number_kind K>
void igebb11 (
    size_t i,
    size_t j,
    size_t depth,
    size_t pdeth,
    const int64_t alpha,
    const int64_t * blA,
    const int64_t * blB,
    int64_t * C,
    size_t ldc) [inline]
```

**11.6.1.22 igebp()**

```
template<enum number_kind K>
void igebp (
    size_t rows,
    size_t cols,
    size_t depth,
    const int64_t alpha,
    const int64_t * blockA,
    size_t lda,
    const int64_t * blockB,
    size_t ldb,
    int64_t * C,
    size_t ldc)
```

**11.6.1.23 pack\_lhs()**

```
template<size_t k, bool transpose>
void pack_lhs (
    int64_t * XX,
    const int64_t * X,
    size_t ldx,
    size_t rows,
    size_t cols)
```

**Bug** this is fassign**Bug** this is fassign**11.6.1.24 pack\_rhs()**

```
template<size_t k, bool transpose>
void pack_rhs (
    int64_t * XX,
    const int64_t * X,
    size_t ldx,
    size_t rows,
    size_t cols)
```

**Bug** this is fassign**Bug** this is fassign

### 11.6.1.25 gebp()

```
void gebp (
    size_t rows,
    size_t cols,
    size_t depth,
    int64_t * C,
    size_t ldc,
    const int64_t * blockA,
    size_t lda,
    const int64_t * BlockB,
    size_t ldb,
    int64_t * BlockW)
```

### 11.6.1.26 BlockingFactor()

```
void BlockingFactor (
    size_t & m,
    size_t & n,
    size_t & k) [inline]
```

## 11.7 FFLAS::details\_spmv Namespace Reference

### Data Structures

- struct [Coo](#)

## 11.8 FFLAS::ElementCategories Namespace Reference

### Data Structures

- struct [ArbitraryPrecIntTag](#)  
*Arbitrary precision integers: GMP.*
- struct [FixedPrecIntTag](#)  
*Fixed precision integers above machine precision: Givaro::reclnt.*
- struct [GenericTag](#)  
*default is generic*
- struct [MachineFloatTag](#)  
*float or double*
- struct [MachineIntTag](#)  
*short, int, long, long long, and unsigned variants*
- struct [RNSElementTag](#)  
*Representation in a Residue Number System.*

## 11.9 FFLAS::FieldCategories Namespace Reference

Traits and categories will need to be placed in a proper file later.

**Data Structures**

- struct [GenericTag](#)  
*generic ring.*
- struct [ModularTag](#)  
*This is a modular field like e.g. `Modular<T>` or `ModularBalanced<T>`*
- struct [UnparametricTag](#)  
*If the field uses a representation with infix operators.*

**11.9.1 Detailed Description**

Traits and categories will need to be placed in a proper file later.

**11.10 FFLAS::MMHelperAlgo Namespace Reference****Data Structures**

- struct [Auto](#)
- struct [Bini](#)
- struct [Classic](#)
- struct [DivideAndConquer](#)
- struct [Winograd](#)
- struct [WinogradPar](#)

**11.11 FFLAS::ModeCategories Namespace Reference**

Specifies the mode of action for an algorithm w.r.t.

**Data Structures**

- struct [ConvertTo](#)  
*Force conversion to appropriate element type of `ElementCategory T`.*
- struct [DefaultBoundedTag](#)  
*Use standard field operations, but keeps track of bounds on input and output.*
- struct [DefaultTag](#)  
*No specific mode of action: use standard field operations.*
- struct [DelayedTag](#)  
*Performs field operations with delayed mod reductions. Ensures result is reduced.*
- struct [LazyTag](#)  
*Performs field operations with delayed mod only when necessary. Result may not be reduced.*

**11.11.1 Detailed Description**

Specifies the mode of action for an algorithm w.r.t.

its field

## 11.12 FFLAS::ParSeqHelper Namespace Reference

[ParSeqHelper](#) for both fgemm and ftrsm.

### Data Structures

- struct [Compose](#)
- struct [Parallel](#)
- struct [Sequential](#)

### 11.12.1 Detailed Description

[ParSeqHelper](#) for both fgemm and ftrsm.

[ParSeqHelper](#) for both fgemm and ftrsm

## 11.13 FFLAS::Protected Namespace Reference

### Data Structures

- class [AreEqual](#)
- class [AreEqual< X, X >](#)
- class [ftrmmLeftLowerNoTransNonUnit](#)
- class [ftrmmLeftLowerNoTransUnit](#)
- class [ftrmmLeftLowerTransNonUnit](#)
- class [ftrmmLeftLowerTransUnit](#)
- class [ftrmmLeftUpperNoTransNonUnit](#)
- class [ftrmmLeftUpperNoTransUnit](#)
- class [ftrmmLeftUpperTransNonUnit](#)
- class [ftrmmLeftUpperTransUnit](#)
- class [ftrmmRightLowerNoTransNonUnit](#)
- class [ftrmmRightLowerNoTransUnit](#)
- class [ftrmmRightLowerTransNonUnit](#)
- class [ftrmmRightLowerTransUnit](#)
- class [ftrmmRightUpperNoTransNonUnit](#)
- class [ftrmmRightUpperNoTransUnit](#)
- class [ftrmmRightUpperTransNonUnit](#)
- class [ftrmmRightUpperTransUnit](#)
- class [ftrsmLeftLowerNoTransNonUnit](#)
- class [ftrsmLeftLowerNoTransUnit](#)
- class [ftrsmLeftLowerTransNonUnit](#)
- class [ftrsmLeftLowerTransUnit](#)
- class [ftrsmLeftUpperNoTransNonUnit](#)

*Computes the maximal size for delaying the modular reduction in a triangular system resolution.*

- class [ftrsmLeftUpperNoTransUnit](#)
- class [ftrsmLeftUpperTransNonUnit](#)
- class [ftrsmLeftUpperTransUnit](#)
- class [ftrsmRightLowerNoTransNonUnit](#)
- class [ftrsmRightLowerNoTransUnit](#)
- class [ftrsmRightLowerTransNonUnit](#)
- class [ftrsmRightLowerTransUnit](#)
- class [ftrsmRightUpperNoTransNonUnit](#)
- class [ftrsmRightUpperNoTransUnit](#)
- class [ftrsmRightUpperTransNonUnit](#)
- class [ftrsmRightUpperTransUnit](#)



## Functions

- `template<class Field>`  
`double computeFactorClassic (const Field &F)`
- `template<> double computeFactorClassic (const Givaro::ModularBalanced< double > &F)`
- `template<> double computeFactorClassic (const Givaro::ModularBalanced< float > &F)`
- `template<class Field>`  
`size_t DotProdBoundClassic (const Field &F, const typename Field::Element &beta)`
- `template<class Field>`  
`size_t TRSMBound (const Field &)`  
*TRSMBound.*
- `template<class Element>`  
`size_t TRSMBound (const Givaro::Modular< Element > &F)`  
*Specialization for positive modular representation over double Computes nmax s.t.*
- `template<class Element>`  
`size_t TRSMBound (const Givaro::ModularBalanced< Element > &F)`  
*Specialization for balanced modular representation over double.*
- `template<class NewField, class Field, class FieldMode>`  
`Field::Element_ptr fgemm_convert (const Field &F, const FFLAS_TRANSPOSE ta, const FFLAS_TRANSPOSE tb, const size_t m, const size_t n, const size_t k, const typename Field::Element alpha, typename Field::ConstElement_ptr A, const size_t lda, typename Field::ConstElement_ptr B, const size_t ldb, const typename Field::Element beta, typename Field::Element_ptr C, const size_t ldc, MMHelper< Field, MMHelperAlgo::Winograd, FieldMode > &H)`
- `template<class Field, class Element, class AlgoT, class ParSeqTrait>`  
`bool NeedPreAddReduction (Element &Outmin, Element &Outmax, Element &Op1min, Element &Op1max, Element &Op2min, Element &Op2max, MMHelper< Field, AlgoT, ModeCategories::LazyTag, ParSeqTrait > &WH)`
- `template<class Field, class Element, class AlgoT, class ModeT, class ParSeqTrait>`  
`bool NeedPreAddReduction (Element &Outmin, Element &Outmax, Element &Op1min, Element &Op1max, Element &Op2min, Element &Op2max, MMHelper< Field, AlgoT, ModeT, ParSeqTrait > &WH)`
- `template<class Field, class Element, class AlgoT, class ParSeqTrait>`  
`bool NeedPreSubReduction (Element &Outmin, Element &Outmax, Element &Op1min, Element &Op1max, Element &Op2min, Element &Op2max, MMHelper< Field, AlgoT, ModeCategories::LazyTag, ParSeqTrait > &WH)`
- `template<class Field, class Element, class AlgoT, class ModeT, class ParSeqTrait>`  
`bool NeedPreSubReduction (Element &Outmin, Element &Outmax, Element &Op1min, Element &Op1max, Element &Op2min, Element &Op2max, MMHelper< Field, AlgoT, ModeT, ParSeqTrait > &WH)`
- `template<class Field, class Element, class AlgoT, class ParSeqTrait>`  
`bool NeedDoublePreAddReduction (Element &Outmin, Element &Outmax, Element &Op1min, Element &Op1max, Element &Op2min, Element &Op2max, Element beta, MMHelper< Field, AlgoT, ModeCategories::LazyTag, ParSeqTrait > &WH)`
- `template<class Field, class Element, class AlgoT, class ModeT, class ParSeqTrait>`  
`bool NeedDoublePreAddReduction (Element &Outmin, Element &Outmax, Element &Op1min, Element &Op1max, Element &Op2min, Element &Op2max, Element beta, MMHelper< Field, AlgoT, ModeT, ParSeqTrait > &WH)`
- `template<class Field, class AlgoT, class ParSeqTrait>`  
`void ScalAndReduce (const Field &F, const size_t N, const typename Field::Element alpha, typename Field::Element_ptr X, const size_t incX, const MMHelper< Field, AlgoT, ModeCategories::LazyTag, ParSeqTrait > &H)`
- `template<class Field, class AlgoT, class ParSeqTrait>`  
`void ScalAndReduce (const Field &F, const size_t M, const size_t N, const typename Field::Element alpha, typename Field::Element_ptr A, const size_t lda, const MMHelper< Field, AlgoT, ModeCategories::LazyTag, ParSeqTrait > &H)`
- `template<class Field>`  
`Field::Element_ptr fsquareCommon (const Field &F, const FFLAS_TRANSPOSE ta, const size_t n, const typename Field::Element alpha, typename Field::ConstElement_ptr A, const size_t lda, const typename Field::Element beta, typename Field::Element_ptr C, const size_t ldc)`

- `template<class Field>`  
`int WinogradThreshold (const Field &F)`  
*Computes the number of recursive levels to perform.*
- `template<> int WinogradThreshold (const Givaro::Modular< float > &F)`
- `template<> int WinogradThreshold (const Givaro::ModularBalanced< double > &F)`
- `template<> int WinogradThreshold (const Givaro::ModularBalanced< float > &F)`
- `template<class Field>`  
`int WinogradSteps (const Field &F, const size_t &m)`  
*Computes the number of recursive levels to perform.*
- `template<class Field, class FieldMode>`  
`void DynamicPeeling (const Field &F, const FFLAS_TRANSPOSE ta, const FFLAS_TRANSPOSE tb, const size_t m, const size_t n, const size_t k, const size_t mr, const size_t nr, const size_t kr, const typename Field::Element alpha, typename Field::ConstElement_ptr A, const size_t lda, typename Field::ConstElement_ptr B, const size_t ldb, const typename Field::Element beta, typename Field::Element_ptr C, const size_t ldc, MMHelper< Field, MMHelperAlgo::Winograd, FieldMode > &H, const typename MMHelper< Field, MMHelperAlgo::Winograd, FieldMode >::DelayedField::Element Cmin, const typename MMHelper< Field, MMHelperAlgo::Winograd, FieldMode >::DelayedField::Element Cmax)`
- `template<class Field, class FieldMode>`  
`void DynamicPeeling2 (const Field &F, const FFLAS_TRANSPOSE ta, const FFLAS_TRANSPOSE tb, const size_t m, const size_t n, const size_t k, const size_t mr, const size_t nr, const size_t kr, const typename Field::Element alpha, typename Field::ConstElement_ptr A, const size_t lda, typename Field::ConstElement_ptr B, const size_t ldb, const typename Field::Element beta, typename Field::Element_ptr C, const size_t ldc, MMHelper< Field, MMHelperAlgo::Winograd, FieldMode > &H, const typename MMHelper< Field, MMHelperAlgo::Winograd, FieldMode >::DelayedField::Element Cmin, const typename MMHelper< Field, MMHelperAlgo::Winograd, FieldMode >::DelayedField::Element Cmax)`
- `template<class Field, class FieldMode>`  
`void WinogradCalc (const Field &F, const FFLAS_TRANSPOSE ta, const FFLAS_TRANSPOSE tb, const size_t mr, const size_t nr, const size_t kr, const typename Field::Element alpha, typename Field::ConstElement_ptr A, const size_t lda, typename Field::ConstElement_ptr B, const size_t ldb, const typename Field::Element beta, typename Field::Element_ptr C, const size_t ldc, MMHelper< Field, MMHelperAlgo::Winograd, FieldMode > &H)`
- `template<typename FloatElement, class Field>`  
`Field::Element_ptr fgemv_convert (const Field &F, const FFLAS_TRANSPOSE ta, const size_t M, const size_t N, const typename Field::Element alpha, typename Field::ConstElement_ptr A, const size_t lda, typename Field::ConstElement_ptr X, const size_t incX, const typename Field::Element beta, typename Field::Element_ptr Y, const size_t incY)`
- `template<class FloatElement, class Field>`  
`void fger_convert (const Field &F, const size_t M, const size_t N, const typename Field::Element alpha, typename Field::ConstElement_ptr x, const size_t incx, typename Field::ConstElement_ptr y, const size_t incy, typename Field::Element_ptr A, const size_t lda)`
- `template<class NewField, class Field, class FieldMode>`  
`Field::Element_ptr fsyrk_convert (const Field &F, const FFLAS_UPLO UpLo, const FFLAS_TRANSPOSE trans, const size_t N, const size_t K, const typename Field::Element alpha, typename Field::ConstElement_ptr A, const size_t lda, const typename Field::Element beta, typename Field::Element_ptr C, const size_t ldc, MMHelper< Field, MMHelperAlgo::Classic, FieldMode > &H)`
- `template<class Field, class AlgoT, class ParSeqTrait>`  
`void ScalAndReduce (const Field &F, const FFLAS_UPLO UpLo, const size_t N, const typename Field::Element alpha, typename Field::Element_ptr A, const size_t lda, const MMHelper< Field, AlgoT, ModeCategories::LazyTag, ParSeqTrait > &H)`
- `template<class Field, class Element, class AlgoT, class ParSeqTrait>`  
`bool NeedPreScalReduction (Element &Outmin, Element &Outmax, Element &Op1min, Element &Op1max, const Element &x, MMHelper< Field, AlgoT, ModeCategories::LazyTag, ParSeqTrait > &WH)`
- `template<class Field, class Element, class AlgoT, class ModeT, class ParSeqTrait>`  
`bool NeedPreScalReduction (Element &Outmin, Element &Outmax, Element &Op1min, Element &Op1max, const Element &x, MMHelper< Field, AlgoT, ModeT, ParSeqTrait > &WH)`
- `template<class Field, class Element, class AlgoT, class ParSeqTrait>`  
`bool NeedPreAxdyReduction (Element &Outmin, Element &Outmax, Element &Op1min, Element`

- &Op1max, Element &Op2min, Element &Op2max, const Element &x, [MMHelper](#)< [Field](#), AlgoT, [ModeCategories::LazyTag](#), ParSeqTrait > &WH)
- template<class [Field](#), class Element, class AlgoT, class ModeT, class ParSeqTrait>  
bool [NeedPreAxyReduction](#) (Element &Outmin, Element &Outmax, Element &Op1min, Element &Op1max, Element &Op2min, Element &Op2max, const Element &x, [MMHelper](#)< [Field](#), AlgoT, ModeT, ParSeqTrait > &WH)
- template<class DFE>  
size\_t [min\\_types](#) (const DFE &k)
- template<> size\_t [min\\_types](#) (const [Reclnt::rint](#)< 6 > &k)
- template<> size\_t [min\\_types](#) (const [Reclnt::rint](#)< 7 > &k)
- template<> size\_t [min\\_types](#) (const [Reclnt::rint](#)< 8 > &k)
- template<> size\_t [min\\_types](#) (const [Reclnt::rint](#)< 9 > &k)
- template<> size\_t [min\\_types](#) (const [Reclnt::rint](#)< 10 > &k)
- template<> size\_t [min\\_types](#) (const Givaro::Integer &k)
- template<class T>  
bool [unfit](#) (T x)
- template<> bool [unfit](#) (int64\_t x)
- template<size\_t K>  
bool [unfit](#) ([Reclnt::rint](#)< K > x)
- template<> bool [unfit](#) ([Reclnt::rint](#)< 6 > x)
- template<enum [FFLAS\\_TRANSPOSE](#) tA, enum [FFLAS\\_TRANSPOSE](#) tB>  
void [igemm\\_colmajor](#) (size\_t rows, size\_t cols, size\_t depth, const int64\_t alpha, const int64\_t \*A, size\_t lda, const int64\_t \*B, size\_t ldb, int64\_t \*C, size\_t ldc)
- template<enum [FFLAS\\_TRANSPOSE](#) tA, enum [FFLAS\\_TRANSPOSE](#) tB, enum [number\\_kind](#) alpha\_kind>  
void [igemm\\_colmajor](#) (size\_t rows, size\_t cols, size\_t depth, const int64\_t alpha, const int64\_t \*A, size\_t lda, const int64\_t \*B, size\_t ldb, int64\_t \*C, size\_t ldc)
- void [igemm](#) (const enum [FFLAS\\_TRANSPOSE](#) TransA, const enum [FFLAS\\_TRANSPOSE](#) TransB, size\_t rows, size\_t cols, size\_t depth, const int64\_t alpha, const int64\_t \*A, size\_t lda, const int64\_t \*B, size\_t ldb, const int64\_t beta, int64\_t \*C, size\_t ldc)
- template<class [Field](#)>  
void [MatF2MatD\\_Triangular](#) (const [Field](#) &F, Givaro::DoubleDomain::Element\_ptr S, const size\_t lds, typename [Field::ConstElement\\_ptr](#) const E, const size\_t lde, const size\_t m, const size\_t n)
- template<class [Field](#)>  
void [MatF2MatF\\_Triangular](#) (const [Field](#) &F, Givaro::FloatDomain::Element\_ptr S, const size\_t lds, typename [Field::ConstElement\\_ptr](#) const E, const size\_t lde, const size\_t m, const size\_t n)

## 11.13.1 Function Documentation

### 11.13.1.1 computeFactorClassic() [1/3]

```
template<class Field>
double computeFactorClassic (
    const Field & F) [inline]
```

### 11.13.1.2 computeFactorClassic() [2/3]

```
template<>
double computeFactorClassic (
    const Givaro::ModularBalanced< double > & F) [inline]
```

**11.13.1.3 computeFactorClassic()** [3/3]

```
template<>
double computeFactorClassic (
    const Givaro::ModularBalanced< float > & F) [inline]
```

**11.13.1.4 DotProdBoundClassic()**

```
template<class Field>
size_t DotProdBoundClassic (
    const Field & F,
    const typename Field::Element & beta) [inline]
```

**11.13.1.5 TRSMBound()** [1/3]

```
template<class Field>
size_t TRSMBound (
    const Field & ) [inline]
```

TRSMBound.

computes the maximal size for delaying the modular reduction in a triangular system resolution

This is the default version over an arbitrary field. It is currently never used (the recursive algorithm is run until  $n=1$  in this case)

**Parameters**

$F$	Finite Field/Ring of the computation
-----	--------------------------------------

**11.13.1.6 TRSMBound()** [2/3]

```
template<class Element>
size_t TRSMBound (
    const Givaro::Modular< Element > & F) [inline]
```

Specialization for positive modular representation over double Computes  $n_{\max}$  s.t.

$(p-1)/2 * (p^{\{n_{\max}-1\}} + (p-2)^{\{n_{\max}-1\}}) < 2^{53}$  See [Dumas Giorgi Pernet 06, arXiv:cs/0601133] Specialization for positive modular representation over float. Computes  $n_{\max}$  s.t.  $(p-1)/2 * (p^{\{n_{\max}-1\}} + (p-2)^{\{n_{\max}-1\}}) < 2^{24}$  @pbi See [Dumas Giorgi Pernet 06, arXiv:cs/0601133]

**11.13.1.7 TRSMBound()** [3/3]

```
template<class Element>
size_t TRSMBound (
    const Givaro::ModularBalanced< Element > & F) [inline]
```

Specialization for balanced modular representation over double.

Computes  $n_{\max}$  s.t.  $(p-1)/2 * (((p+1)/2)^{\{n_{\max}-1\}}) < 2^{53}$

**Bibliography** • Dumas Giorgi Pernet 06, arXiv:cs/0601133

**11.13.1.8 fgemm\_convert()**

```
template<class NewField, class Field, class FieldMode>
Field::Element_ptr fgemm_convert (
    const Field & F,
    const FFLAS_TRANSPOSE ta,
    const FFLAS_TRANSPOSE tb,
    const size_t m,
    const size_t n,
    const size_t k,
    const typename Field::Element alpha,
    typename Field::ConstElement_ptr A,
    const size_t lda,
    typename Field::ConstElement_ptr B,
    const size_t ldb,
    const typename Field::Element beta,
    typename Field::Element_ptr C,
    const size_t ldc,
    MMHelper< Field, MMHelperAlgo::Winograd, FieldMode > & H) [inline]
```

**11.13.1.9 NeedPreAddReduction() [1/2]**

```
template<class Field, class Element, class AlgoT, class ParSeqTrait>
bool NeedPreAddReduction (
    Element & Outmin,
    Element & Outmax,
    Element & Op1min,
    Element & Op1max,
    Element & Op2min,
    Element & Op2max,
    MMHelper< Field, AlgoT, ModeCategories::LazyTag, ParSeqTrait > & WH) [inline]
```

**11.13.1.10 NeedPreAddReduction() [2/2]**

```
template<class Field, class Element, class AlgoT, class ModeT, class ParSeqTrait>
bool NeedPreAddReduction (
    Element & Outmin,
    Element & Outmax,
    Element & Op1min,
    Element & Op1max,
    Element & Op2min,
    Element & Op2max,
    MMHelper< Field, AlgoT, ModeT, ParSeqTrait > & WH) [inline]
```

**11.13.1.11 NeedPreSubReduction() [1/2]**

```
template<class Field, class Element, class AlgoT, class ParSeqTrait>
bool NeedPreSubReduction (
    Element & Outmin,
    Element & Outmax,
    Element & Op1min,
    Element & Op1max,
    Element & Op2min,
    Element & Op2max,
    MMHelper< Field, AlgoT, ModeCategories::LazyTag, ParSeqTrait > & WH) [inline]
```

**11.13.1.12 NeedPreSubReduction() [2/2]**

```
template<class Field, class Element, class AlgoT, class ModeT, class ParSeqTrait>
bool NeedPreSubReduction (
    Element & Outmin,
    Element & Outmax,
    Element & Op1min,
    Element & Op1max,
    Element & Op2min,
    Element & Op2max,
    MMHelper< Field, AlgoT, ModeT, ParSeqTrait > & WH) [inline]
```

**11.13.1.13 NeedDoublePreAddReduction() [1/2]**

```
template<class Field, class Element, class AlgoT, class ParSeqTrait>
bool NeedDoublePreAddReduction (
    Element & Outmin,
    Element & Outmax,
    Element & Op1min,
    Element & Op1max,
    Element & Op2min,
    Element & Op2max,
    Element beta,
    MMHelper< Field, AlgoT, ModeCategories::LazyTag, ParSeqTrait > & WH) [inline]
```

**11.13.1.14 NeedDoublePreAddReduction() [2/2]**

```
template<class Field, class Element, class AlgoT, class ModeT, class ParSeqTrait>
bool NeedDoublePreAddReduction (
    Element & Outmin,
    Element & Outmax,
    Element & Op1min,
    Element & Op1max,
    Element & Op2min,
    Element & Op2max,
    Element beta,
    MMHelper< Field, AlgoT, ModeT, ParSeqTrait > & WH) [inline]
```

**11.13.1.15 ScalAndReduce() [1/3]**

```
template<class Field, class AlgoT, class ParSeqTrait>
void ScalAndReduce (
    const Field & F,
    const size_t N,
    const typename Field::Element alpha,
    typename Field::Element_ptr X,
    const size_t incX,
    const MMHelper< Field, AlgoT, ModeCategories::LazyTag, ParSeqTrait > & H) [inline]
```

**11.13.1.16 ScalAndReduce()** [2/3]

```
template<class Field, class AlgoT, class ParSeqTrait>
void ScalAndReduce (
    const Field & F,
    const size_t M,
    const size_t N,
    const typename Field::Element alpha,
    typename Field::Element_ptr A,
    const size_t lda,
    const MMHelper< Field, AlgoT, ModeCategories::LazyTag, ParSeqTrait > & H) [inline]
```

**11.13.1.17 fsquareCommon()**

```
template<class Field>
Field::Element_ptr fsquareCommon (
    const Field & F,
    const FFLAS_TRANSPOSE ta,
    const size_t n,
    const typename Field::Element alpha,
    typename Field::ConstElement_ptr A,
    const size_t lda,
    const typename Field::Element beta,
    typename Field::Element_ptr C,
    const size_t ldc) [inline]
```

**11.13.1.18 WinogradThreshold()** [1/4]

```
template<class Field>
int WinogradThreshold (
    const Field & F) [inline]
```

Computes the number of recursive levels to perform.

**Parameters**

<i>m</i>	the common dimension in the product AxB
----------	---

**11.13.1.19 WinogradThreshold()** [2/4]

```
template<>
int WinogradThreshold (
    const Givaro::Modular< float > & F) [inline]
```

**11.13.1.20 WinogradThreshold()** [3/4]

```
template<>
int WinogradThreshold (
    const Givaro::ModularBalanced< double > & F) [inline]
```

### 11.13.1.21 WinogradThreshold() [4/4]

```
template<>
int WinogradThreshold (
    const Givaro::ModularBalanced< float > & F) [inline]
```

### 11.13.1.22 WinogradSteps()

```
template<class Field>
int WinogradSteps (
    const Field & F,
    const size_t & m) [inline]
```

Computes the number of recursive levels to perform.

#### Parameters

$m$	the common dimension in the product $A \times B$
-----	--

### 11.13.1.23 DynamicPeeling()

```
template<class Field, class FieldMode>
void DynamicPeeling (
    const Field & F,
    const FFLAS_TRANSPOSE ta,
    const FFLAS_TRANSPOSE tb,
    const size_t m,
    const size_t n,
    const size_t k,
    const size_t mr,
    const size_t nr,
    const size_t kr,
    const typename Field::Element alpha,
    typename Field::ConstElement_ptr A,
    const size_t lda,
    typename Field::ConstElement_ptr B,
    const size_t ldb,
    const typename Field::Element beta,
    typename Field::Element_ptr C,
    const size_t ldc,
    MMHelper< Field, MMHelperAlgo::Winograd, FieldMode > & H,
    const typename MMHelper< Field, MMHelperAlgo::Winograd, FieldMode >::Delayed↔
Field::Element Cmin,
    const typename MMHelper< Field, MMHelperAlgo::Winograd, FieldMode >::Delayed↔
Field::Element Cmax) [inline]
```



## 11.13.1.24 DynamicPeeling2()

```

template<class Field, class FieldMode>
void DynamicPeeling2 (
    const Field & F,
    const FFLAS_TRANSPOSE ta,
    const FFLAS_TRANSPOSE tb,
    const size_t m,
    const size_t n,
    const size_t k,
    const size_t mr,
    const size_t nr,
    const size_t kr,
    const typename Field::Element alpha,
    typename Field::ConstElement_ptr A,
    const size_t lda,
    typename Field::ConstElement_ptr B,
    const size_t ldb,
    const typename Field::Element beta,
    typename Field::Element_ptr C,
    const size_t ldc,
    MMHelper< Field, MMHelperAlgo::Winograd, FieldMode > & H,
    const typename MMHelper< Field, MMHelperAlgo::Winograd, FieldMode >::Delayed↔
Field::Element Cmin,
    const typename MMHelper< Field, MMHelperAlgo::Winograd, FieldMode >::Delayed↔
Field::Element Cmax) [inline]

```

## 11.13.1.25 WinogradCalc()

```

template<class Field, class FieldMode>
void WinogradCalc (
    const Field & F,
    const FFLAS_TRANSPOSE ta,
    const FFLAS_TRANSPOSE tb,
    const size_t mr,
    const size_t nr,
    const size_t kr,
    const typename Field::Element alpha,
    typename Field::ConstElement_ptr A,
    const size_t lda,
    typename Field::ConstElement_ptr B,
    const size_t ldb,
    const typename Field::Element beta,
    typename Field::Element_ptr C,
    const size_t ldc,
    MMHelper< Field, MMHelperAlgo::Winograd, FieldMode > & H) [inline]

```

## 11.13.1.26 fgemv\_convert()

```

template<typename FloatElement, class Field>
Field::Element_ptr fgemv_convert (
    const Field & F,
    const FFLAS_TRANSPOSE ta,
    const size_t M,

```

```

    const size_t N,
    const typename Field::Element alpha,
    typename Field::ConstElement_ptr A,
    const size_t lda,
    typename Field::ConstElement_ptr X,
    const size_t incX,
    const typename Field::Element beta,
    typename Field::Element_ptr Y,
    const size_t incY) [inline]

```

#### 11.13.1.27 fger\_convert()

```

template<class FloatElement, class Field>
void fger_convert (
    const Field & F,
    const size_t M,
    const size_t N,
    const typename Field::Element alpha,
    typename Field::ConstElement_ptr x,
    const size_t incx,
    typename Field::ConstElement_ptr y,
    const size_t incy,
    typename Field::Element_ptr A,
    const size_t lda) [inline]

```

#### 11.13.1.28 fsyrk\_convert()

```

template<class NewField, class Field, class FieldMode>
Field::Element_ptr fsyrk_convert (
    const Field & F,
    const FFLAS_UPLO UpLo,
    const FFLAS_TRANSPOSE trans,
    const size_t N,
    const size_t K,
    const typename Field::Element alpha,
    typename Field::ConstElement_ptr A,
    const size_t lda,
    const typename Field::Element beta,
    typename Field::Element_ptr C,
    const size_t ldc,
    MMHelper< Field, MMHelperAlgo::Classic, FieldMode > & H) [inline]

```

#### 11.13.1.29 ScalAndReduce() [3/3]

```

template<class Field, class AlgoT, class ParSeqTrait>
void ScalAndReduce (
    const Field & F,
    const FFLAS_UPLO UpLo,
    const size_t N,
    const typename Field::Element alpha,
    typename Field::Element_ptr A,
    const size_t lda,
    const MMHelper< Field, AlgoT, ModeCategories::LazyTag, ParSeqTrait > & H) [inline]

```

**11.13.1.30 NeedPreScalReduction()** [1/2]

```
template<class Field, class Element, class AlgoT, class ParSeqTrait>
bool NeedPreScalReduction (
    Element & Outmin,
    Element & Outmax,
    Element & Op1min,
    Element & Op1max,
    const Element & x,
    MMHelper< Field, AlgoT, ModeCategories::LazyTag, ParSeqTrait > & WH) [inline]
```

**11.13.1.31 NeedPreScalReduction()** [2/2]

```
template<class Field, class Element, class AlgoT, class ModeT, class ParSeqTrait>
bool NeedPreScalReduction (
    Element & Outmin,
    Element & Outmax,
    Element & Op1min,
    Element & Op1max,
    const Element & x,
    MMHelper< Field, AlgoT, ModeT, ParSeqTrait > & WH) [inline]
```

**11.13.1.32 NeedPreAxyReduction()** [1/2]

```
template<class Field, class Element, class AlgoT, class ParSeqTrait>
bool NeedPreAxyReduction (
    Element & Outmin,
    Element & Outmax,
    Element & Op1min,
    Element & Op1max,
    Element & Op2min,
    Element & Op2max,
    const Element & x,
    MMHelper< Field, AlgoT, ModeCategories::LazyTag, ParSeqTrait > & WH) [inline]
```

**11.13.1.33 NeedPreAxyReduction()** [2/2]

```
template<class Field, class Element, class AlgoT, class ModeT, class ParSeqTrait>
bool NeedPreAxyReduction (
    Element & Outmin,
    Element & Outmax,
    Element & Op1min,
    Element & Op1max,
    Element & Op2min,
    Element & Op2max,
    const Element & x,
    MMHelper< Field, AlgoT, ModeT, ParSeqTrait > & WH) [inline]
```

**11.13.1.34 min\_types()** [1/7]

```
template<class DFE>
size_t min_types (
    const DFE & k) [inline]
```

**11.13.1.35 min\_types()** [2/7]

```
template<>
size_t min_types (
    const RecInt::rint< 6 > & k) [inline]
```

**11.13.1.36 min\_types()** [3/7]

```
template<>
size_t min_types (
    const RecInt::rint< 7 > & k) [inline]
```

**11.13.1.37 min\_types()** [4/7]

```
template<>
size_t min_types (
    const RecInt::rint< 8 > & k) [inline]
```

**11.13.1.38 min\_types()** [5/7]

```
template<>
size_t min_types (
    const RecInt::rint< 9 > & k) [inline]
```

**11.13.1.39 min\_types()** [6/7]

```
template<>
size_t min_types (
    const RecInt::rint< 10 > & k) [inline]
```

**11.13.1.40 min\_types()** [7/7]

```
template<>
size_t min_types (
    const Givaro::Integer & k) [inline]
```

**11.13.1.41 unfit()** [1/4]

```
template<class T>
bool unfit (
    T x) [inline]
```

**11.13.1.42 unfit()** [2/4]

```
template<>
bool unfit (
    int64_t x) [inline]
```

**11.13.143 unfit() [3/4]**

```
template<size_t K>
bool unfit (
    RecInt::rint< K > x) [inline]
```

**11.13.144 unfit() [4/4]**

```
template<>
bool unfit (
    RecInt::rint< 6 > x) [inline]
```

**11.13.145 igemm\_colmajor() [1/2]**

```
template<enum FFLAS_TRANSPOSE tA, enum FFLAS_TRANSPOSE tB>
void igemm_colmajor (
    size_t rows,
    size_t cols,
    size_t depth,
    const int64_t alpha,
    const int64_t * A,
    size_t lda,
    const int64_t * B,
    size_t ldb,
    int64_t * C,
    size_t ldc)
```

**11.13.146 igemm\_colmajor() [2/2]**

```
template<enum FFLAS_TRANSPOSE tA, enum FFLAS_TRANSPOSE tB, enum number_kind alpha_kind>
void igemm_colmajor (
    size_t rows,
    size_t cols,
    size_t depth,
    const int64_t alpha,
    const int64_t * A,
    size_t lda,
    const int64_t * B,
    size_t ldb,
    int64_t * C,
    size_t ldc)
```

**11.13.147 igemm()**

```
void igemm (
    const enum FFLAS_TRANSPOSE TransA,
    const enum FFLAS_TRANSPOSE TransB,
    size_t rows,
    size_t cols,
    size_t depth,
    const int64_t alpha,
```

```

const int64_t * A,
size_t lda,
const int64_t * B,
size_t ldb,
const int64_t beta,
int64_t * C,
size_t ldc) [inline]

```

**Todo** use primitive (no [Field\(\)](#)) and specialise for int64.

#### 11.13.148 MatF2MatD\_Triangular()

```

template<class Field>
void MatF2MatD_Triangular (
    const Field & F,
    Givaro::DoubleDomain::Element_ptr S,
    const size_t lds,
    typename Field::ConstElement_ptr const E,
    const size_t lde,
    const size_t m,
    const size_t n)

```

#### 11.13.149 MatF2MatFI\_Triangular()

```

template<class Field>
void MatF2MatFI_Triangular (
    const Field & F,
    Givaro::FloatDomain::Element_ptr S,
    const size_t lds,
    typename Field::ConstElement_ptr const E,
    const size_t lde,
    const size_t m,
    const size_t n)

```

**Todo** do finit(...,FFLAS\_TRANS,FFLAS\_DIAG)  
do fconvert(...,FFLAS\_TRANS,FFLAS\_DIAG)

## 11.14 FFLAS::sell\_details Namespace Reference

### Data Structures

- struct [Coo](#)
- struct [Info](#)

## 11.15 FFLAS::sparse\_details Namespace Reference

### Functions

- `template<class Field>`  
`void init_y (const Field &F, const size_t m, const typename Field::Element b, typename Field::Element_ptr y)`
- `template<class Field>`  
`void init_y (const Field &F, const size_t m, const size_t n, const typename Field::Element b, typename Field::Element_ptr y, const int ldy)`
- `template<class Field, class SM, class FC, class MZO>`  
`std::enable_if<!(std::is_same< typenameElementTraits< typenameField::Element >::value, ElementCategories::MachineFloat >::value)||std::is_same< typenameElementTraits< typenameField::Element >::value, ElementCategories::MachineIntTag >::value)>::type fspmv_dispatch (const Field &F, const SM &A, typename Field::ConstElement_ptr x, typename Field::Element_ptr y, FC fc, MZO mzo)`
- `template<class Field, class SM, class FC, class MZO>`  
`std::enable_if< std::is_same< typenameElementTraits< typenameField::Element >::value, ElementCategories::MachineFloat >::value)||std::is_same< typenameElementTraits< typenameField::Element >::value, ElementCategories::MachineIntTag >::value >::type fspmv_dispatch (const Field &F, const SM &A, typename Field::ConstElement_ptr x, typename Field::Element_ptr y, FC fc, MZO mzo)`
- `template<class Field, class SM>`  
`void fspmv (const Field &F, const SM &A, typename Field::ConstElement_ptr x, typename Field::Element_ptr y, FieldCategories::GenericTag, NotZOSparseMatrix)`
- `template<class Field, class SM>`  
`std::enable_if< !isSparseMatrixSimdFormat< Field, SM >::value >::type fspmv (const Field &F, const SM &A, typename Field::ConstElement_ptr x, typename Field::Element_ptr y, FieldCategories::UnparametricTag, NotZOSparseMatrix)`
- `template<class Field, class SM>`  
`std::enable_if< isSparseMatrixSimdFormat< Field, SM >::value >::type fspmv (const Field &F, const SM &A, typename Field::ConstElement_ptr x, typename Field::Element_ptr y, FieldCategories::UnparametricTag, NotZOSparseMatrix)`
- `template<class Field, class SM>`  
`std::enable_if< !isSparseMatrixSimdFormat< Field, SM >::value >::type fspmv (const Field &F, const SM &A, typename Field::ConstElement_ptr x, typename Field::Element_ptr y, FieldCategories::ModularTag, NotZOSparseMatrix)`
- `template<class Field, class SM>`  
`std::enable_if< isSparseMatrixSimdFormat< Field, SM >::value >::type fspmv (const Field &F, const SM &A, typename Field::ConstElement_ptr x, typename Field::Element_ptr y, FieldCategories::ModularTag, NotZOSparseMatrix)`
- `template<class Field, class SM>`  
`void fspmv (const Field &F, const SM &A, typename Field::ConstElement_ptr x, typename Field::Element_ptr y, FieldCategories::GenericTag, ZOSparseMatrix)`
- `template<class Field, class SM>`  
`std::enable_if< !isSparseMatrixSimdFormat< Field, SM >::value >::type fspmv (const Field &F, const SM &A, typename Field::ConstElement_ptr x, typename Field::Element_ptr y, FieldCategories::UnparametricTag, ZOSparseMatrix)`
- `template<class Field, class SM>`  
`std::enable_if< isSparseMatrixSimdFormat< Field, SM >::value >::type fspmv (const Field &F, const SM &A, typename Field::ConstElement_ptr x, typename Field::Element_ptr y, FieldCategories::UnparametricTag, ZOSparseMatrix)`
- `template<class Field, class SM>`  
`void fspmv (const Field &F, const SM &A, typename Field::ConstElement_ptr x, typename Field::Element_ptr y, FieldCategories::ModularTag, std::true_type)`
- `template<class Field, class SM, class FCat, class MZO>`  
`std::enable_if<!(std::is_same< typenameElementTraits< typenameField::Element >::value, ElementCategories::MachineFloat >::value)||std::is_same< typenameElementTraits< typenameField::Element >::value, ElementCategories::MachineIntTag >::value)>::type fspmm_dispatch (const Field &F, const SM &A, size_t blockSize, typename Field::ConstElement_ptr x, int ldx, typename Field::Element_ptr y, int ldy, FCat, MZO)`

- `template<class Field, class SM, class FCat, class MZO>`  
`std::enable_if< std::is_same< typenameElementTraits< typenameField::Element >::value, ElementCategories::MachineFloat >::value || std::is_same< typenameElementTraits< typenameField::Element >::value, ElementCategories::MachineIntTag >::value >::type fspmm_dispatch (const Field &F, const SM &A, size_t blockSize, typename Field::ConstElement_ptr x, int ldx, typename Field::Element_ptr y, int ldy, FCat, MZO)`
- `template<class Field, class SM>`  
`void fspmm (const Field &F, const SM &A, size_t blockSize, typename Field::ConstElement_ptr x, int ldx, typename Field::Element_ptr y, int ldy, FieldCategories::GenericTag, NotZOSparseMatrix)`
- `template<class Field, class SM>`  
`std::enable_if< support_simd< typenameField::Element >::value >::type fspmm (const Field &F, const SM &A, size_t blockSize, typename Field::ConstElement_ptr x, int ldx, typename Field::Element_ptr y, int ldy, FieldCategories::UnparametricTag, NotZOSparseMatrix)`
- `template<class Field, class SM>`  
`std::enable_if< !support_simd< typenameField::Element >::value >::type fspmm (const Field &F, const SM &A, size_t blockSize, typename Field::ConstElement_ptr x, int ldx, typename Field::Element_ptr y, int ldy, FieldCategories::UnparametricTag, NotZOSparseMatrix)`
- `template<class Field, class SM>`  
`std::enable_if< support_simd< typenameField::Element >::value >::type fspmm (const Field &F, const SM &A, size_t blockSize, typename Field::ConstElement_ptr x, int ldx, typename Field::Element_ptr y, int ldy, FieldCategories::ModularTag, NotZOSparseMatrix)`
- `template<class Field, class SM>`  
`std::enable_if< !support_simd< typenameField::Element >::value >::type fspmm (const Field &F, const SM &A, size_t blockSize, typename Field::ConstElement_ptr x, int ldx, typename Field::Element_ptr y, int ldy, FieldCategories::ModularTag, NotZOSparseMatrix)`
- `template<class Field, class SM>`  
`void fspmm (const Field &F, const SM &A, size_t blockSize, typename Field::ConstElement_ptr x, int ldx, typename Field::Element_ptr y, int ldy, FieldCategories::GenericTag, ZOSparseMatrix)`
- `template<class Field, class SM>`  
`std::enable_if< support_simd< typenameField::Element >::value >::type fspmm (const Field &F, const SM &A, size_t blockSize, typename Field::ConstElement_ptr x, int ldx, typename Field::Element_ptr y, int ldy, FieldCategories::UnparametricTag, ZOSparseMatrix)`
- `template<class Field, class SM>`  
`std::enable_if< !support_simd< typenameField::Element >::value >::type fspmm (const Field &F, const SM &A, size_t blockSize, typename Field::ConstElement_ptr x, int ldx, typename Field::Element_ptr y, int ldy, FieldCategories::UnparametricTag, ZOSparseMatrix)`
- `template<class Field, class SM>`  
`void fspmm (const Field &F, const SM &A, size_t blockSize, typename Field::ConstElement_ptr x, int ldx, typename Field::Element_ptr y, int ldy, FieldCategories::ModularTag, ZOSparseMatrix)`
- `template<class Field, class SM, class FCat, class MZO>`  
`std::enable_if< !(std::is_same< typenameElementTraits< typenameField::Element >::value, ElementCategories::MachineFloat >::value || std::is_same< typenameElementTraits< typenameField::Element >::value, ElementCategories::MachineIntTag >::value) >::type pfspmm_dispatch (const Field &F, const SM &A, size_t blockSize, typename Field::ConstElement_ptr x, int ldx, typename Field::Element_ptr y, int ldy, FCat, MZO)`
- `template<class Field, class SM, class FCat, class MZO>`  
`std::enable_if< std::is_same< typenameElementTraits< typenameField::Element >::value, ElementCategories::MachineFloat >::value || std::is_same< typenameElementTraits< typenameField::Element >::value, ElementCategories::MachineIntTag >::value >::type pfspmm_dispatch (const Field &F, const SM &A, size_t blockSize, typename Field::ConstElement_ptr x, int ldx, typename Field::Element_ptr y, int ldy, FCat, MZO)`
- `template<class Field, class SM>`  
`void pfspmm (const Field &F, const SM &A, size_t blockSize, typename Field::ConstElement_ptr x, int ldx, typename Field::Element_ptr y, int ldy, FieldCategories::GenericTag, NotZOSparseMatrix)`
- `template<class Field, class SM>`  
`std::enable_if< support_simd< typenameField::Element >::value >::type pfspmm (const Field &F, const SM &A, size_t blockSize, typename Field::ConstElement_ptr x, int ldx, typename Field::Element_ptr y, int ldy, FieldCategories::UnparametricTag, NotZOSparseMatrix)`
- `template<class Field, class SM>`  
`std::enable_if< !support_simd< typenameField::Element >::value >::type pfspmm (const Field &F, const SM`



- &A, size\_t blockSize, typename [Field::ConstElement\\_ptr](#) x, int ldx, typename [Field::Element\\_ptr](#) y, int ldy, [FieldCategories::UnparametricTag](#), [NotZOSparseMatrix](#))
- `template<class Field, class SM>`  
`std::enable_if<support\_simd< typenameField::Element >::value >::type pfspmm (const Field &F, const SM &A, size_t blockSize, typename Field::ConstElement\_ptr x, int ldx, typename Field::Element\_ptr y, int ldy, FieldCategories::ModularTag, NotZOSparseMatrix)`
  - `template<class Field, class SM>`  
`std::enable_if<!support\_simd< typenameField::Element >::value >::type pfspmm (const Field &F, const SM &A, size_t blockSize, typename Field::ConstElement\_ptr x, int ldx, typename Field::Element\_ptr y, int ldy, FieldCategories::ModularTag, NotZOSparseMatrix)`
  - `template<class Field, class SM>`  
`void pfspmm (const Field &F, const SM &A, size_t blockSize, typename Field::ConstElement\_ptr x, int ldx, typename Field::Element\_ptr y, int ldy, FieldCategories::GenericTag, ZOSparseMatrix)`
  - `template<class Field, class SM>`  
`std::enable_if<support\_simd< typenameField::Element >::value >::type pfspmm (const Field &F, const SM &A, size_t blockSize, typename Field::ConstElement\_ptr x, int ldx, typename Field::Element\_ptr y, int ldy, FieldCategories::UnparametricTag, ZOSparseMatrix)`
  - `template<class Field, class SM>`  
`std::enable_if<!support\_simd< typenameField::Element >::value >::type pfspmm (const Field &F, const SM &A, size_t blockSize, typename Field::ConstElement\_ptr x, int ldx, typename Field::Element\_ptr y, int ldy, FieldCategories::UnparametricTag, ZOSparseMatrix)`
  - `template<class Field, class SM>`  
`void pfspmm (const Field &F, const SM &A, size_t blockSize, typename Field::ConstElement\_ptr x, int ldx, typename Field::Element\_ptr y, int ldy, FieldCategories::ModularTag, ZOSparseMatrix)`
  - `template<class Field, class SM>`  
`void pfspmv (const Field &F, const SM &A, typename Field::ConstElement\_ptr x, typename Field::Element\_ptr y, FieldCategories::GenericTag, std::false_type)`
  - `template<class Field, class SM>`  
`void pfspmv (const Field &F, const SM &A, typename Field::ConstElement\_ptr x, typename Field::Element\_ptr y, FieldCategories::UnparametricTag, std::false_type)`
  - `template<class Field, class SM>`  
`void pfspmv (const Field &F, const SM &A, typename Field::ConstElement\_ptr x, typename Field::Element\_ptr y, FieldCategories::ModularTag, std::false_type)`
  - `template<class Field, class SM>`  
`void pfspmv (const Field &F, const SM &A, typename Field::ConstElement\_ptr x, typename Field::Element\_ptr y, FieldCategories::GenericTag, std::true_type)`
  - `template<class Field, class SM>`  
`void pfspmv (const Field &F, const SM &A, typename Field::ConstElement\_ptr x, typename Field::Element\_ptr y, FieldCategories::UnparametricTag, std::true_type)`
  - `template<class Field, class SM>`  
`void pfspmv (const Field &F, const SM &A, typename Field::ConstElement\_ptr x, typename Field::Element\_ptr y, FieldCategories::ModularTag, std::true_type)`
  - `template<class Field, class SM>`  
`std::enable_if<isSparseMatrixSimdFormat< Field, SM >::value &&support\_simd< typenameField::Element >::value >::type fspmv (const Field &F, const SM &A, typename Field::ConstElement\_ptr x, typename Field::Element\_ptr y, FieldCategories::UnparametricTag, NotZOSparseMatrix)`
  - `template<class Field, class SM>`  
`std::enable_if<isSparseMatrixSimdFormat< Field, SM >::value &&support\_simd< typenameField::Element >::value >::type fspmv (const Field &F, const SM &A, typename Field::ConstElement\_ptr x, typename Field::Element\_ptr y, FieldCategories::ModularTag, NotZOSparseMatrix)`
  - `template<class Field, class SM>`  
`std::enable_if<isSparseMatrixSimdFormat< Field, SM >::value &&support\_simd< typenameField::Element >::value >::type fspmv (const Field &F, const SM &A, typename Field::ConstElement\_ptr x, typename Field::Element\_ptr y, FieldCategories::UnparametricTag, ZOSparseMatrix)`

## 11.15.1 Function Documentation

### 11.15.1.1 `init_y()` [1/2]

```
template<class Field>
void init_y (
    const Field & F,
    const size_t m,
    const typename Field::Element b,
    typename Field::Element_ptr y) [inline]
```

### 11.15.1.2 `init_y()` [2/2]

```
template<class Field>
void init_y (
    const Field & F,
    const size_t m,
    const size_t n,
    const typename Field::Element b,
    typename Field::Element_ptr y,
    const int ldy) [inline]
```

### 11.15.1.3 `fspmv_dispatch()` [1/2]

```
template<class Field, class SM, class FC, class MZO>
std::enable_if<!(std::is_same< typenameElementTraits< typenameField::Element >::value, ElementCategories::Mac
>::value||std::is_same< typenameElementTraits< typenameField::Element >::value, ElementCategories::MachineInt
>::value)>::type fspmv_dispatch (
    const Field & F,
    const SM & A,
    typename Field::ConstElement_ptr x,
    typename Field::Element_ptr y,
    FC fC,
    MZO mzo) [inline]
```

### 11.15.1.4 `fspmv_dispatch()` [2/2]

```
template<class Field, class SM, class FC, class MZO>
std::enable_if< std::is_same< typenameElementTraits< typenameField::Element >::value, ElementCategories::Mac
>::value||std::is_same< typenameElementTraits< typenameField::Element >::value, ElementCategories::MachineInt
>::value >::type fspmv_dispatch (
    const Field & F,
    const SM & A,
    typename Field::ConstElement_ptr x,
    typename Field::Element_ptr y,
    FC fC,
    MZO mzo) [inline]
```

**11.15.1.5 fspmv()** [1/12]

```
template<class Field, class SM>
void fspmv (
    const Field & F,
    const SM & A,
    typename Field::ConstElement_ptr x,
    typename Field::Element_ptr y,
    FieldCategories::GenericTag ,
    NotZOSparseMatrix ) [inline]
```

**11.15.1.6 fspmv()** [2/12]

```
template<class Field, class SM>
std::enable_if<!isSparseMatrixSimdFormat< Field, SM >::value >::type fspmv (
    const Field & F,
    const SM & A,
    typename Field::ConstElement_ptr x,
    typename Field::Element_ptr y,
    FieldCategories::UnparametricTag ,
    NotZOSparseMatrix ) [inline]
```

**11.15.1.7 fspmv()** [3/12]

```
template<class Field, class SM>
std::enable_if< isSparseMatrixSimdFormat< Field, SM >::value >::type fspmv (
    const Field & F,
    const SM & A,
    typename Field::ConstElement_ptr x,
    typename Field::Element_ptr y,
    FieldCategories::UnparametricTag ,
    NotZOSparseMatrix ) [inline]
```

**11.15.1.8 fspmv()** [4/12]

```
template<class Field, class SM>
std::enable_if<!isSparseMatrixSimdFormat< Field, SM >::value >::type fspmv (
    const Field & F,
    const SM & A,
    typename Field::ConstElement_ptr x,
    typename Field::Element_ptr y,
    FieldCategories::ModularTag ,
    NotZOSparseMatrix ) [inline]
```

**11.15.1.9 fspmv()** [5/12]

```
template<class Field, class SM>
std::enable_if< isSparseMatrixSimdFormat< Field, SM >::value >::type fspmv (
    const Field & F,
    const SM & A,
    typename Field::ConstElement_ptr x,
    typename Field::Element_ptr y,
    FieldCategories::ModularTag ,
    NotZOSparseMatrix ) [inline]
```

**11.15.1.10 fspmv()** [6/12]

```
template<class Field, class SM>
void fspmv (
    const Field & F,
    const SM & A,
    typename Field::ConstElement_ptr x,
    typename Field::Element_ptr y,
    FieldCategories::GenericTag ,
    ZOSparseMatrix ) [inline]
```

**11.15.1.11 fspmv()** [7/12]

```
template<class Field, class SM>
std::enable_if<!isSparseMatrixSimdFormat< Field, SM >::value >::type fspmv (
    const Field & F,
    const SM & A,
    typename Field::ConstElement_ptr x,
    typename Field::Element_ptr y,
    FieldCategories::UnparametricTag ,
    ZOSparseMatrix ) [inline]
```

**11.15.1.12 fspmv()** [8/12]

```
template<class Field, class SM>
std::enable_if< isSparseMatrixSimdFormat< Field, SM >::value >::type fspmv (
    const Field & F,
    const SM & A,
    typename Field::ConstElement_ptr x,
    typename Field::Element_ptr y,
    FieldCategories::UnparametricTag ,
    ZOSparseMatrix ) [inline]
```

**11.15.1.13 fspmv()** [9/12]

```
template<class Field, class SM>
void fspmv (
    const Field & F,
    const SM & A,
    typename Field::ConstElement_ptr x,
    typename Field::Element_ptr y,
    FieldCategories::ModularTag ,
    std::true_type ) [inline]
```

**11.15.1.14 fspmm\_dispatch() [1/2]**

```
template<class Field, class SM, class FCat, class MZO>
std::enable_if<!(std::is_same< typenameElementTraits< typenameField::Element >::value, ElementCategories::MachineInt
>::value||std::is_same< typenameElementTraits< typenameField::Element >::value, ElementCategories::MachineInt
>::value)>::type fspmm_dispatch (
    const Field & F,
    const SM & A,
    size_t blockSize,
    typename Field::ConstElement_ptr x,
    int ldx,
    typename Field::Element_ptr y,
    int ldy,
    FCat ,
    MZO ) [inline]
```

**11.15.1.15 fspmm\_dispatch() [2/2]**

```
template<class Field, class SM, class FCat, class MZO>
std::enable_if< std::is_same< typenameElementTraits< typenameField::Element >::value, ElementCategories::MachineInt
>::value||std::is_same< typenameElementTraits< typenameField::Element >::value, ElementCategories::MachineInt
>::value >::type fspmm_dispatch (
    const Field & F,
    const SM & A,
    size_t blockSize,
    typename Field::ConstElement_ptr x,
    int ldx,
    typename Field::Element_ptr y,
    int ldy,
    FCat ,
    MZO ) [inline]
```

**11.15.1.16 fspmm() [1/9]**

```
template<class Field, class SM>
void fspmm (
    const Field & F,
    const SM & A,
    size_t blockSize,
    typename Field::ConstElement_ptr x,
    int ldx,
    typename Field::Element_ptr y,
    int ldy,
    FieldCategories::GenericTag ,
    NotZOSparseMatrix ) [inline]
```

**11.15.1.17 fspmm() [2/9]**

```
template<class Field, class SM>
std::enable_if< support_simd< typenameField::Element >::value >::type fspmm (
    const Field & F,
    const SM & A,
```

```

    size_t blockSize,
    typename Field::ConstElement_ptr x,
    int ldx,
    typename Field::Element_ptr y,
    int ldy,
    FieldCategories::UnparametricTag ,
    NotZOSparseMatrix ) [inline]

```

#### 11.15.1.18 fspmm() [3/9]

```

template<class Field, class SM>
std::enable_if<!support\_simd< typenameField::Element >::value >::type fspmm (
    const Field & F,
    const SM & A,
    size_t blockSize,
    typename Field::ConstElement_ptr x,
    int ldx,
    typename Field::Element_ptr y,
    int ldy,
    FieldCategories::UnparametricTag ,
    NotZOSparseMatrix ) [inline]

```

#### 11.15.1.19 fspmm() [4/9]

```

template<class Field, class SM>
std::enable_if< support\_simd< typenameField::Element >::value >::type fspmm (
    const Field & F,
    const SM & A,
    size_t blockSize,
    typename Field::ConstElement_ptr x,
    int ldx,
    typename Field::Element_ptr y,
    int ldy,
    FieldCategories::ModularTag ,
    NotZOSparseMatrix ) [inline]

```

#### 11.15.1.20 fspmm() [5/9]

```

template<class Field, class SM>
std::enable_if<!support\_simd< typenameField::Element >::value >::type fspmm (
    const Field & F,
    const SM & A,
    size_t blockSize,
    typename Field::ConstElement_ptr x,
    int ldx,
    typename Field::Element_ptr y,
    int ldy,
    FieldCategories::ModularTag ,
    NotZOSparseMatrix ) [inline]

```

**11.15.1.21 fspmm() [6/9]**

```
template<class Field, class SM>
void fspmm (
    const Field & F,
    const SM & A,
    size_t blockSize,
    typename Field::ConstElement_ptr x,
    int ldx,
    typename Field::Element_ptr y,
    int ldy,
    FieldCategories::GenericTag ,
    ZOSparseMatrix ) [inline]
```

**11.15.1.22 fspmm() [7/9]**

```
template<class Field, class SM>
std::enable_if< support_simd< typenameField::Element >::value >::type fspmm (
    const Field & F,
    const SM & A,
    size_t blockSize,
    typename Field::ConstElement_ptr x,
    int ldx,
    typename Field::Element_ptr y,
    int ldy,
    FieldCategories::UnparametricTag ,
    ZOSparseMatrix ) [inline]
```

**11.15.1.23 fspmm() [8/9]**

```
template<class Field, class SM>
std::enable_if< !support_simd< typenameField::Element >::value >::type fspmm (
    const Field & F,
    const SM & A,
    size_t blockSize,
    typename Field::ConstElement_ptr x,
    int ldx,
    typename Field::Element_ptr y,
    int ldy,
    FieldCategories::UnparametricTag ,
    ZOSparseMatrix ) [inline]
```

**11.15.1.24 fspmm() [9/9]**

```
template<class Field, class SM>
void fspmm (
    const Field & F,
    const SM & A,
    size_t blockSize,
    typename Field::ConstElement_ptr x,
    int ldx,
    typename Field::Element_ptr y,
    int ldy,
    FieldCategories::ModularTag ,
    ZOSparseMatrix ) [inline]
```

**11.15.1.25 pfspmm\_dispatch() [1/2]**

```
template<class Field, class SM, class FCat, class MZO>
std::enable_if<!(std::is_same< typenameElementTraits< typenameField::Element >::value, ElementCategories::MachineInt
>::value||std::is_same< typenameElementTraits< typenameField::Element >::value, ElementCategories::MachineInt
>::value)>::type pfspmm_dispatch (
    const Field & F,
    const SM & A,
    size_t blockSize,
    typename Field::ConstElement_ptr x,
    int ldx,
    typename Field::Element_ptr y,
    int ldy,
    FCat ,
    MZO ) [inline]
```

**11.15.1.26 pfspmm\_dispatch() [2/2]**

```
template<class Field, class SM, class FCat, class MZO>
std::enable_if< std::is_same< typenameElementTraits< typenameField::Element >::value, ElementCategories::MachineInt
>::value||std::is_same< typenameElementTraits< typenameField::Element >::value, ElementCategories::MachineInt
>::value >::type pfspmm_dispatch (
    const Field & F,
    const SM & A,
    size_t blockSize,
    typename Field::ConstElement_ptr x,
    int ldx,
    typename Field::Element_ptr y,
    int ldy,
    FCat ,
    MZO ) [inline]
```

**11.15.1.27 pfspmm() [1/9]**

```
template<class Field, class SM>
void pfspmm (
    const Field & F,
    const SM & A,
    size_t blockSize,
    typename Field::ConstElement_ptr x,
    int ldx,
    typename Field::Element_ptr y,
    int ldy,
    FieldCategories::GenericTag ,
    NotZOSparseMatrix ) [inline]
```

**11.15.1.28 pfspmm() [2/9]**

```
template<class Field, class SM>
std::enable_if< support_simd< typenameField::Element >::value >::type pfspmm (
    const Field & F,
    const SM & A,
```



```

    size_t blockSize,
    typename Field::ConstElement_ptr x,
    int ldx,
    typename Field::Element_ptr y,
    int ldy,
    FieldCategories::UnparametricTag ,
    NotZOSparseMatrix ) [inline]

```

#### 11.15.1.29 pfspmm() [3/9]

```

template<class Field, class SM>
std::enable_if<!support\_simd< typenameField::Element >::value >::type pfspmm (
    const Field & F,
    const SM & A,
    size_t blockSize,
    typename Field::ConstElement_ptr x,
    int ldx,
    typename Field::Element_ptr y,
    int ldy,
    FieldCategories::UnparametricTag ,
    NotZOSparseMatrix ) [inline]

```

#### 11.15.1.30 pfspmm() [4/9]

```

template<class Field, class SM>
std::enable_if< support\_simd< typenameField::Element >::value >::type pfspmm (
    const Field & F,
    const SM & A,
    size_t blockSize,
    typename Field::ConstElement_ptr x,
    int ldx,
    typename Field::Element_ptr y,
    int ldy,
    FieldCategories::ModularTag ,
    NotZOSparseMatrix ) [inline]

```

#### 11.15.1.31 pfspmm() [5/9]

```

template<class Field, class SM>
std::enable_if<!support\_simd< typenameField::Element >::value >::type pfspmm (
    const Field & F,
    const SM & A,
    size_t blockSize,
    typename Field::ConstElement_ptr x,
    int ldx,
    typename Field::Element_ptr y,
    int ldy,
    FieldCategories::ModularTag ,
    NotZOSparseMatrix ) [inline]

```

**11.15.1.32 pfspmm()** [6/9]

```
template<class Field, class SM>
void pfspmm (
    const Field & F,
    const SM & A,
    size_t blockSize,
    typename Field::ConstElement_ptr x,
    int ldx,
    typename Field::Element_ptr y,
    int ldy,
    FieldCategories::GenericTag ,
    ZOSparseMatrix ) [inline]
```

**11.15.1.33 pfspmm()** [7/9]

```
template<class Field, class SM>
std::enable_if< support_simd< typenameField::Element >::value >::type pfspmm (
    const Field & F,
    const SM & A,
    size_t blockSize,
    typename Field::ConstElement_ptr x,
    int ldx,
    typename Field::Element_ptr y,
    int ldy,
    FieldCategories::UnparametricTag ,
    ZOSparseMatrix ) [inline]
```

**11.15.1.34 pfspmm()** [8/9]

```
template<class Field, class SM>
std::enable_if< !support_simd< typenameField::Element >::value >::type pfspmm (
    const Field & F,
    const SM & A,
    size_t blockSize,
    typename Field::ConstElement_ptr x,
    int ldx,
    typename Field::Element_ptr y,
    int ldy,
    FieldCategories::UnparametricTag ,
    ZOSparseMatrix ) [inline]
```

**11.15.1.35 pfspmm()** [9/9]

```
template<class Field, class SM>
void pfspmm (
    const Field & F,
    const SM & A,
    size_t blockSize,
    typename Field::ConstElement_ptr x,
    int ldx,
    typename Field::Element_ptr y,
    int ldy,
    FieldCategories::ModularTag ,
    ZOSparseMatrix ) [inline]
```

**11.15.1.36 pfspmv()** [1/6]

```
template<class Field, class SM>
void pfspmv (
    const Field & F,
    const SM & A,
    typename Field::ConstElement_ptr x,
    typename Field::Element_ptr y,
    FieldCategories::GenericTag ,
    std::false_type ) [inline]
```

**11.15.1.37 pfspmv()** [2/6]

```
template<class Field, class SM>
void pfspmv (
    const Field & F,
    const SM & A,
    typename Field::ConstElement_ptr x,
    typename Field::Element_ptr y,
    FieldCategories::UnparametricTag ,
    std::false_type ) [inline]
```

**11.15.1.38 pfspmv()** [3/6]

```
template<class Field, class SM>
void pfspmv (
    const Field & F,
    const SM & A,
    typename Field::ConstElement_ptr x,
    typename Field::Element_ptr y,
    FieldCategories::ModularTag ,
    std::false_type ) [inline]
```

**11.15.1.39 pfspmv()** [4/6]

```
template<class Field, class SM>
void pfspmv (
    const Field & F,
    const SM & A,
    typename Field::ConstElement_ptr x,
    typename Field::Element_ptr y,
    FieldCategories::GenericTag ,
    std::true_type ) [inline]
```

**11.15.1.40 pfspmv()** [5/6]

```
template<class Field, class SM>
void pfspmv (
    const Field & F,
    const SM & A,
    typename Field::ConstElement_ptr x,
    typename Field::Element_ptr y,
    FieldCategories::UnparametricTag ,
    std::true_type ) [inline]
```

**11.15.1.41 pfspmv()** [6/6]

```
template<class Field, class SM>
void pfspmv (
    const Field & F,
    const SM & A,
    typename Field::ConstElement_ptr x,
    typename Field::Element_ptr y,
    FieldCategories::ModularTag ,
    std::true_type ) [inline]
```

**11.15.1.42 fspmv()** [10/12]

```
template<class Field, class SM>
std::enable_if< isSparseMatrixSimdFormat< Field, SM >::value &&support_simd< typenameField↵
::Element >::value >::type fspmv (
    const Field & F,
    const SM & A,
    typename Field::ConstElement_ptr x,
    typename Field::Element_ptr y,
    FieldCategories::UnparametricTag ,
    NotZOSparseMatrix ) [inline]
```

**11.15.1.43 fspmv()** [11/12]

```
template<class Field, class SM>
std::enable_if< isSparseMatrixSimdFormat< Field, SM >::value &&support_simd< typenameField↵
::Element >::value >::type fspmv (
    const Field & F,
    const SM & A,
    typename Field::ConstElement_ptr x,
    typename Field::Element_ptr y,
    FieldCategories::ModularTag ,
    NotZOSparseMatrix ) [inline]
```

**11.15.1.44 fspmv()** [12/12]

```
template<class Field, class SM>
std::enable_if< isSparseMatrixSimdFormat< Field, SM >::value &&support_simd< typenameField↵
::Element >::value >::type fspmv (
    const Field & F,
    const SM & A,
    typename Field::ConstElement_ptr x,
    typename Field::Element_ptr y,
    FieldCategories::UnparametricTag ,
    ZOSparseMatrix ) [inline]
```

## 11.16 FFLAS::sparse\_details\_impl Namespace Reference

### Functions

- `template<class Field>`  
`void fspmm (const Field &F, const Sparse< Field, SparseMatrix_t::COO > &A, size_t blockSize, typename Field::ConstElement_ptr x_, int ldx, typename Field::Element_ptr y_, int ldy, FieldCategories::GenericTag)`
- `template<class Field>`  
`void fspmm (const Field &F, const Sparse< Field, SparseMatrix_t::COO > &A, size_t blockSize, typename Field::ConstElement_ptr x_, int ldx, typename Field::Element_ptr y_, int ldy, FieldCategories::UnparametricTag)`
- `template<class Field>`  
`void fspmm (const Field &F, const Sparse< Field, SparseMatrix_t::COO > &A, size_t blockSize, typename Field::ConstElement_ptr x_, int ldx, typename Field::Element_ptr y_, int ldy, const int64_t kmax)`
- `template<class Field>`  
`void fspmm_simd_aligned (const Field &F, const Sparse< Field, SparseMatrix_t::COO > &A, size_t blockSize, typename Field::ConstElement_ptr x_, int ldx, typename Field::Element_ptr y_, int ldy, const int64_t kmax)`
- `template<class Field>`  
`void fspmm_simd_unaligned (const Field &F, const Sparse< Field, SparseMatrix_t::COO > &A, size_t blockSize, typename Field::ConstElement_ptr x_, int ldx, typename Field::Element_ptr y_, int ldy, const int64_t kmax)`
- `template<class Field>`  
`void fspmm_one (const Field &F, const Sparse< Field, SparseMatrix_t::COO_ZO > &A, size_t blockSize, typename Field::ConstElement_ptr x_, int ldx, typename Field::Element_ptr y_, int ldy, FieldCategories::GenericTag)`
- `template<class Field>`  
`void fspmm_mone (const Field &F, const Sparse< Field, SparseMatrix_t::COO_ZO > &A, size_t blockSize, typename Field::ConstElement_ptr x_, int ldx, typename Field::Element_ptr y_, int ldy, FieldCategories::GenericTag)`
- `template<class Field>`  
`void fspmm_one_simd_aligned (const Field &F, const Sparse< Field, SparseMatrix_t::COO_ZO > &A, size_t blockSize, typename Field::ConstElement_ptr x_, int ldx, typename Field::Element_ptr y_, int ldy, FieldCategories::UnparametricTag)`
- `template<class Field>`  
`void fspmm_one_simd_unaligned (const Field &F, const Sparse< Field, SparseMatrix_t::COO_ZO > &A, size_t blockSize, typename Field::ConstElement_ptr x_, int ldx, typename Field::Element_ptr y_, int ldy, FieldCategories::UnparametricTag)`
- `template<class Field>`  
`void fspmm_mone_simd_aligned (const Field &F, const Sparse< Field, SparseMatrix_t::COO_ZO > &A, size_t blockSize, typename Field::ConstElement_ptr x_, int ldx, typename Field::Element_ptr y_, int ldy, FieldCategories::UnparametricTag)`
- `template<class Field>`  
`void fspmm_mone_simd_unaligned (const Field &F, const Sparse< Field, SparseMatrix_t::COO_ZO > &A, size_t blockSize, typename Field::ConstElement_ptr x_, int ldx, typename Field::Element_ptr y_, int ldy, FieldCategories::UnparametricTag)`
- `template<class Field>`  
`void fspmv (const Field &F, const Sparse< Field, SparseMatrix_t::COO > &A, typename Field::ConstElement_ptr x_, typename Field::Element_ptr y_, FieldCategories::GenericTag)`
- `template<class Field>`  
`void fspmv (const Field &F, const Sparse< Field, SparseMatrix_t::COO > &A, typename Field::ConstElement_ptr x_, typename Field::Element_ptr y_, FieldCategories::UnparametricTag)`
- `template<class Field>`  
`void fspmv (const Field &F, const Sparse< Field, SparseMatrix_t::COO > &A, typename Field::ConstElement_ptr x_, typename Field::Element_ptr y_, const uint64_t kmax)`
- `template<class Field>`  
`void fspmv_one (const Field &F, const Sparse< Field, SparseMatrix_t::COO_ZO > &A, typename Field::ConstElement_ptr x_, typename Field::Element_ptr y_, FieldCategories::GenericTag)`

- `template<class Field>`  
`void fspmv_mone (const Field &F, const Sparse< Field, SparseMatrix_t::COO_ZO > &A, typename Field::ConstElement_ptr x_, typename Field::Element_ptr y_, FieldCategories::GenericTag)`
- `template<class Field>`  
`void fspmv_one (const Field &F, const Sparse< Field, SparseMatrix_t::COO_ZO > &A, typename Field::ConstElement_ptr x_, typename Field::Element_ptr y_, FieldCategories::UnparametricTag)`
- `template<class Field>`  
`void fspmv_mone (const Field &F, const Sparse< Field, SparseMatrix_t::COO_ZO > &A, typename Field::ConstElement_ptr x_, typename Field::Element_ptr y_, FieldCategories::UnparametricTag)`
- `template<class Field>`  
`void pfspmm (const Field &F, const Sparse< Field, SparseMatrix_t::CSR > &A, size_t blockSize, typename Field::ConstElement_ptr x_, int ldx, typename Field::Element_ptr y_, int ldy, FieldCategories::GenericTag)`
- `template<class Field>`  
`void pfspmm (const Field &F, const Sparse< Field, SparseMatrix_t::CSR > &A, size_t blockSize, typename Field::ConstElement_ptr x_, int ldx, typename Field::Element_ptr y_, int ldy, FieldCategories::UnparametricTag)`
- `template<class Field>`  
`void pfspmm (const Field &F, const Sparse< Field, SparseMatrix_t::CSR > &A, size_t blockSize, typename Field::ConstElement_ptr x_, int ldx, typename Field::Element_ptr y_, int ldy, const int64_t kmax)`
- `template<class Field>`  
`void pfspmm_one (const Field &F, const Sparse< Field, SparseMatrix_t::CSR_ZO > &A, size_t blockSize, typename Field::ConstElement_ptr x_, int ldx, typename Field::Element_ptr y_, int ldy, FieldCategories::GenericTag)`
- `template<class Field>`  
`void pfspmm_mone (const Field &F, const Sparse< Field, SparseMatrix_t::CSR_ZO > &A, size_t blockSize, typename Field::ConstElement_ptr x_, int ldx, typename Field::Element_ptr y_, int ldy, FieldCategories::GenericTag)`
- `template<class Field>`  
`void pfspmm_one (const Field &F, const Sparse< Field, SparseMatrix_t::CSR_ZO > &A, size_t blockSize, typename Field::ConstElement_ptr x_, int ldx, typename Field::Element_ptr y_, int ldy, FieldCategories::UnparametricTag)`
- `template<class Field>`  
`void pfspmm_mone (const Field &F, const Sparse< Field, SparseMatrix_t::CSR_ZO > &A, size_t blockSize, typename Field::ConstElement_ptr x_, int ldx, typename Field::Element_ptr y_, int ldy, FieldCategories::UnparametricTag)`
- `template<class Field>`  
`void pfspmv (const Field &F, const Sparse< Field, SparseMatrix_t::CSR > &A, typename Field::ConstElement_ptr x_, typename Field::Element_ptr y_, FieldCategories::GenericTag)`
- `template<class Field>`  
`void pfspmv_task (const Field &F, const Sparse< Field, SparseMatrix_t::CSR > &A, typename Field::ConstElement_ptr x_, typename Field::Element_ptr y_, const index_t iStart, const index_t iStop, FieldCategories::UnparametricTag)`
- `template<class Field>`  
`void pfspmv (const Field &F, const Sparse< Field, SparseMatrix_t::CSR > &A, typename Field::ConstElement_ptr x_, typename Field::Element_ptr y_, FieldCategories::UnparametricTag)`
- `template<class Field>`  
`void pfspmv (const Field &F, const Sparse< Field, SparseMatrix_t::CSR > &A, typename Field::ConstElement_ptr x_, typename Field::Element_ptr y_, const int64_t kmax)`
- `template<class Field>`  
`void pfspmv_one (const Field &F, const Sparse< Field, SparseMatrix_t::CSR_ZO > &A, typename Field::ConstElement_ptr x_, typename Field::Element_ptr y_, FieldCategories::GenericTag)`
- `template<class Field>`  
`void pfspmv_mone (const Field &F, const Sparse< Field, SparseMatrix_t::CSR_ZO > &A, typename Field::ConstElement_ptr x_, typename Field::Element_ptr y_, FieldCategories::GenericTag)`
- `template<class Field>`  
`void pfspmv_one (const Field &F, const Sparse< Field, SparseMatrix_t::CSR_ZO > &A, typename Field::ConstElement_ptr x_, typename Field::Element_ptr y_, FieldCategories::UnparametricTag)`

- `template<class Field>`  
`void pfspmv_mone (const Field &F, const Sparse< Field, SparseMatrix_t::CSR_ZO > &A, typename Field::ConstElement_ptr x_, typename Field::Element_ptr y_, FieldCategories::UnparametricTag)`
- `template<class Field>`  
`void fspmm (const Field &F, const Sparse< Field, SparseMatrix_t::CSR > &A, size_t blockSize, typename Field::ConstElement_ptr x_, int ldx, typename Field::Element_ptr y_, int ldy, FieldCategories::GenericTag)`
- `template<class Field>`  
`void fspmm (const Field &F, const Sparse< Field, SparseMatrix_t::CSR > &A, index_t blockSize, typename Field::ConstElement_ptr x_, index_t ldx, typename Field::Element_ptr y_, index_t ldy, FieldCategories::UnparametricTag)`
- `template<class Field>`  
`void fspmm_simd_aligned (const Field &F, const Sparse< Field, SparseMatrix_t::CSR > &A, size_t blockSize, typename Field::ConstElement_ptr x_, int ldx, typename Field::Element_ptr y_, int ldy, FieldCategories::UnparametricTag)`
- `template<class Field>`  
`void fspmm_simd_unaligned (const Field &F, const Sparse< Field, SparseMatrix_t::CSR > &A, size_t blockSize, typename Field::ConstElement_ptr x_, int ldx, typename Field::Element_ptr y_, int ldy, FieldCategories::UnparametricTag)`
- `template<class Field>`  
`void fspmm (const Field &F, const Sparse< Field, SparseMatrix_t::CSR > &A, size_t blockSize, typename Field::ConstElement_ptr x_, int ldx, typename Field::Element_ptr y_, int ldy, const int64_t kmax)`
- `template<class Field>`  
`void fspmm_one (const Field &F, const Sparse< Field, SparseMatrix_t::CSR_ZO > &A, size_t blockSize, typename Field::ConstElement_ptr x_, int ldx, typename Field::Element_ptr y_, int ldy, FieldCategories::GenericTag)`
- `template<class Field>`  
`void fspmm_mone (const Field &F, const Sparse< Field, SparseMatrix_t::CSR_ZO > &A, size_t blockSize, typename Field::ConstElement_ptr x_, int ldx, typename Field::Element_ptr y_, int ldy, FieldCategories::GenericTag)`
- `template<class Field>`  
`void fspmm_one_simd_aligned (const Field &F, const Sparse< Field, SparseMatrix_t::CSR_ZO > &A, size_t blockSize, typename Field::ConstElement_ptr x_, int ldx, typename Field::Element_ptr y_, int ldy, FieldCategories::UnparametricTag)`
- `template<class Field>`  
`void fspmm_one_simd_unaligned (const Field &F, const Sparse< Field, SparseMatrix_t::CSR_ZO > &A, size_t blockSize, typename Field::ConstElement_ptr x_, int ldx, typename Field::Element_ptr y_, int ldy, FieldCategories::UnparametricTag)`
- `template<class Field>`  
`void fspmm_mone_simd_aligned (const Field &F, const Sparse< Field, SparseMatrix_t::CSR_ZO > &A, size_t blockSize, typename Field::ConstElement_ptr x_, int ldx, typename Field::Element_ptr y_, int ldy, FieldCategories::UnparametricTag)`
- `template<class Field>`  
`void fspmm_mone_simd_unaligned (const Field &F, const Sparse< Field, SparseMatrix_t::CSR_ZO > &A, size_t blockSize, typename Field::ConstElement_ptr x_, int ldx, typename Field::Element_ptr y_, int ldy, FieldCategories::UnparametricTag)`
- `template<class Field>`  
`void fspmv (const Field &F, const Sparse< Field, SparseMatrix_t::CSR > &A, typename Field::ConstElement_ptr x_, typename Field::Element_ptr y_, FieldCategories::GenericTag)`
- `template<class Field>`  
`void fspmv (const Field &F, const Sparse< Field, SparseMatrix_t::CSR > &A, typename Field::ConstElement_ptr x_, typename Field::Element_ptr y_, FieldCategories::UnparametricTag)`
- `template<class Field>`  
`void fspmv (const Field &F, const Sparse< Field, SparseMatrix_t::CSR > &A, typename Field::ConstElement_ptr x_, typename Field::Element_ptr y_, const int64_t kmax)`
- `template<class Field>`  
`void fspmv_one (const Field &F, const Sparse< Field, SparseMatrix_t::CSR_ZO > &A, typename Field::ConstElement_ptr x_, typename Field::Element_ptr y_, FieldCategories::GenericTag)`

- `template<class Field>`  
`void fspmv_mone (const Field &F, const Sparse< Field, SparseMatrix_t::CSR_ZO > &A, typename Field::ConstElement_ptr x_, typename Field::Element_ptr y_, FieldCategories::GenericTag)`
- `template<class Field>`  
`void fspmv_one (const Field &F, const Sparse< Field, SparseMatrix_t::CSR_ZO > &A, typename Field::ConstElement_ptr x_, typename Field::Element_ptr y_, FieldCategories::UnparametricTag)`
- `template<class Field>`  
`void fspmv_mone (const Field &F, const Sparse< Field, SparseMatrix_t::CSR_ZO > &A, typename Field::ConstElement_ptr x_, typename Field::Element_ptr y_, FieldCategories::UnparametricTag)`
- `template<class Field>`  
`void pfspmm (const Field &F, const Sparse< Field, SparseMatrix_t::CSR_HYB > &A, size_t blockSize, typename Field::ConstElement_ptr x, typename Field::Element_ptr y, FieldCategories::GenericTag)`
- `template<class Field>`  
`void pfspmm (const Field &F, const Sparse< Field, SparseMatrix_t::CSR_HYB > &A, size_t blockSize, typename Field::ConstElement_ptr x, int ldx, typename Field::Element_ptr y, int ldy, FieldCategories::GenericTag)`
- `template<class Field>`  
`void pfspmm (const Field &F, const Sparse< Field, SparseMatrix_t::CSR_HYB > &A, size_t blockSize, typename Field::ConstElement_ptr x, typename Field::Element_ptr y, FieldCategories::UnparametricTag)`
- `template<class Field>`  
`void pfspmm (const Field &F, const Sparse< Field, SparseMatrix_t::CSR_HYB > &A, size_t blockSize, typename Field::ConstElement_ptr x, int ldx, typename Field::Element_ptr y, int ldy, FieldCategories::UnparametricTag)`
- `template<class Field>`  
`void pfspmm (const Field &F, const Sparse< Field, SparseMatrix_t::CSR_HYB > &A, size_t blockSize, typename Field::ConstElement_ptr x, typename Field::Element_ptr y, const int64_t kmax)`
- `template<class Field>`  
`void pfspmm (const Field &F, const Sparse< Field, SparseMatrix_t::CSR_HYB > &A, size_t blockSize, typename Field::ConstElement_ptr x, int ldx, typename Field::Element_ptr y, int ldy, const int64_t kmax)`
- `template<class Field>`  
`void pfspmv (const Field &F, const Sparse< Field, SparseMatrix_t::CSR_HYB > &A, typename Field::ConstElement_ptr x_, typename Field::Element_ptr y_, FieldCategories::GenericTag)`
- `template<class Field>`  
`void pfspmv (const Field &F, const Sparse< Field, SparseMatrix_t::CSR_HYB > &A, typename Field::ConstElement_ptr x_, typename Field::Element_ptr y_, FieldCategories::UnparametricTag)`
- `template<class Field>`  
`void pfspmv (const Field &F, const Sparse< Field, SparseMatrix_t::CSR_HYB > &A, typename Field::ConstElement_ptr x_, typename Field::Element_ptr y_, const int64_t kmax)`
- `template<class Field>`  
`void fspmm (const Field &F, const Sparse< Field, SparseMatrix_t::CSR_HYB > &A, size_t blockSize, typename Field::ConstElement_ptr x_, int ldx, typename Field::Element_ptr y_, int ldy, FieldCategories::GenericTag)`
- `template<class Field>`  
`void fspmm (const Field &F, const Sparse< Field, SparseMatrix_t::CSR_HYB > &A, size_t blockSize, typename Field::ConstElement_ptr x_, int ldx, typename Field::Element_ptr y_, int ldy, FieldCategories::UnparametricTag)`
- `template<class Field>`  
`void fspmm (const Field &F, const Sparse< Field, SparseMatrix_t::CSR_HYB > &A, size_t blockSize, typename Field::ConstElement_ptr x_, int ldx, typename Field::Element_ptr y_, int ldy, const int64_t kmax)`
- `template<class Field>`  
`void fspmv (const Field &F, const Sparse< Field, SparseMatrix_t::CSR_HYB > &A, typename Field::ConstElement_ptr x_, typename Field::Element_ptr y_, FieldCategories::GenericTag)`
- `template<class Field>`  
`void fspmv (const Field &F, const Sparse< Field, SparseMatrix_t::CSR_HYB > &A, typename Field::ConstElement_ptr x_, typename Field::Element_ptr y_, FieldCategories::UnparametricTag)`
- `template<class Field>`  
`void fspmv (const Field &F, const Sparse< Field, SparseMatrix_t::CSR_HYB > &A, typename Field::ConstElement_ptr x_, typename Field::Element_ptr y_, const uint64_t kmax)`
- `template<class Field>`  
`void pfspmm (const Field &F, const Sparse< Field, SparseMatrix_t::ELL > &A, size_t blockSize, typename Field::ConstElement_ptr x, typename Field::Element_ptr y, FieldCategories::GenericTag)`



- `template<class Field>`  
`void pfsppmm (const Field &F, const Sparse< Field, SparseMatrix_t::ELL > &A, size_t blockSize, typename Field::ConstElement_ptr x, int ldx, typename Field::Element_ptr y, int ldy, FieldCategories::GenericTag)`
- `template<class Field>`  
`void pfsppmm (const Field &F, const Sparse< Field, SparseMatrix_t::ELL > &A, size_t blockSize, typename Field::ConstElement_ptr x, typename Field::Element_ptr y, FieldCategories::UnparametricTag)`
- `template<class Field>`  
`void pfsppmm (const Field &F, const Sparse< Field, SparseMatrix_t::ELL > &A, size_t blockSize, typename Field::ConstElement_ptr x, int ldx, typename Field::Element_ptr y, int ldy, FieldCategories::UnparametricTag)`
- `template<class Field>`  
`void pfsppmm (const Field &F, const Sparse< Field, SparseMatrix_t::ELL > &A, size_t blockSize, typename Field::ConstElement_ptr x, typename Field::Element_ptr y, const int64_t kmax)`
- `template<class Field>`  
`void pfsppmm (const Field &F, const Sparse< Field, SparseMatrix_t::ELL > &A, size_t blockSize, typename Field::ConstElement_ptr x, int ldx, typename Field::Element_ptr y, int ldy, const int64_t kmax)`
- `template<class Field, class Func>`  
`void pfsppmm_zo (const Field &F, const Sparse< Field, SparseMatrix_t::ELL_ZO > &A, size_t blockSize, typename Field::ConstElement_ptr x, typename Field::Element_ptr y, Func &&func)`
- `template<class Field, class Func>`  
`void pfsppmm_zo (const Field &F, const Sparse< Field, SparseMatrix_t::ELL_ZO > &A, size_t blockSize, typename Field::ConstElement_ptr x, int ldx, typename Field::Element_ptr y, int ldy, Func &&func)`
- `template<class Field>`  
`void pfsppmv (const Field &F, const Sparse< Field, SparseMatrix_t::ELL > &A, typename Field::ConstElement_ptr x_, typename Field::Element_ptr y_, FieldCategories::GenericTag)`
- `template<class Field>`  
`void pfsppmv (const Field &F, const Sparse< Field, SparseMatrix_t::ELL > &A, typename Field::ConstElement_ptr x_, typename Field::Element_ptr y_, FieldCategories::UnparametricTag)`
- `template<class Field>`  
`void pfsppmv (const Field &F, const Sparse< Field, SparseMatrix_t::ELL > &A, typename Field::ConstElement_ptr x_, typename Field::Element_ptr y_, const int64_t kmax)`
- `template<class Field>`  
`void pfsppmv_one (const Field &F, const Sparse< Field, SparseMatrix_t::ELL_ZO > &A, typename Field::ConstElement_ptr x_, typename Field::Element_ptr y_, FieldCategories::GenericTag)`
- `template<class Field>`  
`void pfsppmv_mone (const Field &F, const Sparse< Field, SparseMatrix_t::ELL_ZO > &A, typename Field::ConstElement_ptr x_, typename Field::Element_ptr y_, FieldCategories::GenericTag)`
- `template<class Field>`  
`void pfsppmv_one (const Field &F, const Sparse< Field, SparseMatrix_t::ELL_ZO > &A, typename Field::ConstElement_ptr x_, typename Field::Element_ptr y_, FieldCategories::UnparametricTag)`
- `template<class Field>`  
`void pfsppmv_mone (const Field &F, const Sparse< Field, SparseMatrix_t::ELL_ZO > &A, typename Field::ConstElement_ptr x_, typename Field::Element_ptr y_, FieldCategories::UnparametricTag)`
- `template<class Field>`  
`void fspmm (const Field &F, const Sparse< Field, SparseMatrix_t::ELL > &A, size_t blockSize, typename Field::ConstElement_ptr x_, int ldx, typename Field::Element_ptr y_, int ldy, FieldCategories::GenericTag)`
- `template<class Field>`  
`void fspmm (const Field &F, const Sparse< Field, SparseMatrix_t::ELL > &A, size_t blockSize, typename Field::ConstElement_ptr x_, int ldx, typename Field::Element_ptr y_, int ldy, FieldCategories::UnparametricTag)`
- `template<class Field>`  
`void fspmm (const Field &F, const Sparse< Field, SparseMatrix_t::ELL > &A, size_t blockSize, typename Field::ConstElement_ptr x_, int ldx, typename Field::Element_ptr y_, int ldy, const int64_t kmax)`
- `template<class Field>`  
`void fspmm_mone (const Field &F, const Sparse< Field, SparseMatrix_t::ELL_ZO > &A, size_t blockSize, typename Field::ConstElement_ptr x_, int ldx, typename Field::Element_ptr y_, int ldy, FieldCategories::GenericTag)`

- `template<class Field>`  
`void fspmm_one (const Field &F, const Sparse< Field, SparseMatrix_t::ELL_ZO > &A, size_t blockSize, typename Field::ConstElement_ptr x_, int ldx, typename Field::Element_ptr y_, int ldy, FieldCategories::GenericTag)`
- `template<class Field>`  
`void fspmm_mone (const Field &F, const Sparse< Field, SparseMatrix_t::ELL_ZO > &A, size_t blockSize, typename Field::ConstElement_ptr x_, int ldx, typename Field::Element_ptr y_, int ldy, FieldCategories::UnparametricTag)`
- `template<class Field>`  
`void fspmm_one (const Field &F, const Sparse< Field, SparseMatrix_t::ELL_ZO > &A, size_t blockSize, typename Field::ConstElement_ptr x_, int ldx, typename Field::Element_ptr y_, int ldy, FieldCategories::UnparametricTag)`
- `template<class Field>`  
`void fspmm_one_simd_aligned (const Field &F, const Sparse< Field, SparseMatrix_t::ELL_ZO > &A, size_t blockSize, typename Field::ConstElement_ptr x_, int ldx, typename Field::Element_ptr y_, int ldy, FieldCategories::UnparametricTag)`
- `template<class Field>`  
`void fspmm_one_simd_unaligned (const Field &F, const Sparse< Field, SparseMatrix_t::ELL_ZO > &A, size_t blockSize, typename Field::ConstElement_ptr x_, int ldx, typename Field::Element_ptr y_, int ldy, FieldCategories::UnparametricTag)`
- `template<class Field>`  
`void fspmm_mone_simd_aligned (const Field &F, const Sparse< Field, SparseMatrix_t::ELL_ZO > &A, size_t blockSize, typename Field::ConstElement_ptr x_, int ldx, typename Field::Element_ptr y_, int ldy, FieldCategories::UnparametricTag)`
- `template<class Field>`  
`void fspmm_mone_simd_unaligned (const Field &F, const Sparse< Field, SparseMatrix_t::ELL_ZO > &A, size_t blockSize, typename Field::ConstElement_ptr x_, int ldx, typename Field::Element_ptr y_, int ldy, FieldCategories::UnparametricTag)`
- `template<class Field>`  
`void fspmv (const Field &F, const Sparse< Field, SparseMatrix_t::ELL > &A, typename Field::ConstElement_ptr x_, typename Field::Element_ptr y_, FieldCategories::GenericTag)`
- `template<class Field>`  
`void fspmv (const Field &F, const Sparse< Field, SparseMatrix_t::ELL > &A, typename Field::ConstElement_ptr x_, typename Field::Element_ptr y_, FieldCategories::UnparametricTag)`
- `template<class Field>`  
`void fspmv (const Field &F, const Sparse< Field, SparseMatrix_t::ELL > &A, typename Field::ConstElement_ptr x_, typename Field::Element_ptr y_, const uint64_t kmax)`
- `template<class Field>`  
`void fspmv_one (const Field &F, const Sparse< Field, SparseMatrix_t::ELL_ZO > &A, typename Field::ConstElement_ptr x_, typename Field::Element_ptr y_, FieldCategories::GenericTag)`
- `template<class Field>`  
`void fspmv_mone (const Field &F, const Sparse< Field, SparseMatrix_t::ELL_ZO > &A, typename Field::ConstElement_ptr x_, typename Field::Element_ptr y_, FieldCategories::GenericTag)`
- `template<class Field>`  
`void fspmv_one (const Field &F, const Sparse< Field, SparseMatrix_t::ELL_ZO > &A, typename Field::ConstElement_ptr x_, typename Field::Element_ptr y_, FieldCategories::UnparametricTag)`
- `template<class Field>`  
`void fspmv_mone (const Field &F, const Sparse< Field, SparseMatrix_t::ELL_ZO > &A, typename Field::ConstElement_ptr x_, typename Field::Element_ptr y_, FieldCategories::UnparametricTag)`
- `template<class Field>`  
`void pfspmv (const Field &F, const Sparse< Field, SparseMatrix_t::ELL_simd > &A, typename Field::ConstElement_ptr x_, typename Field::Element_ptr y_, FieldCategories::GenericTag)`
- `template<class Field>`  
`void pfspmv (const Field &F, const Sparse< Field, SparseMatrix_t::ELL_simd > &A, typename Field::ConstElement_ptr x_, typename Field::Element_ptr y_, FieldCategories::UnparametricTag)`
- `template<class Field>`  
`void pfspmv (const Field &F, const Sparse< Field, SparseMatrix_t::ELL_simd > &A, typename Field::ConstElement_ptr x_, typename Field::Element_ptr y_, const uint64_t kmax)`

- `template<class Field>`  
`void pfspmv_one (const Field &F, const Sparse< Field, SparseMatrix_t::ELL_simd_ZO > &A, typename Field::ConstElement_ptr x_, typename Field::Element_ptr y_, FieldCategories::GenericTag)`
- `template<class Field>`  
`void pfspmv_mone (const Field &F, const Sparse< Field, SparseMatrix_t::ELL_simd_ZO > &A, typename Field::ConstElement_ptr x_, typename Field::Element_ptr y_, FieldCategories::GenericTag)`
- `template<class Field>`  
`void pfspmv_one (const Field &F, const Sparse< Field, SparseMatrix_t::ELL_simd_ZO > &A, typename Field::ConstElement_ptr x_, typename Field::Element_ptr y_, FieldCategories::UnparametricTag)`
- `template<class Field>`  
`void pfspmv_mone (const Field &F, const Sparse< Field, SparseMatrix_t::ELL_simd_ZO > &A, typename Field::ConstElement_ptr x_, typename Field::Element_ptr y_, FieldCategories::UnparametricTag)`
- `template<class Field>`  
`void fspmv (const Field &F, const Sparse< Field, SparseMatrix_t::ELL_simd > &A, typename Field::ConstElement_ptr x_, typename Field::Element_ptr y_, FieldCategories::GenericTag)`
- `template<class Field>`  
`void fspmv_simd (const Field &F, const Sparse< Field, SparseMatrix_t::ELL_simd > &A, typename Field::ConstElement_ptr x_, typename Field::Element_ptr y_, FieldCategories::UnparametricTag)`
- `template<class Field>`  
`void fspmv (const Field &F, const Sparse< Field, SparseMatrix_t::ELL_simd > &A, typename Field::ConstElement_ptr x_, typename Field::Element_ptr y_, FieldCategories::UnparametricTag)`
- `template<class Field>`  
`void fspmv_simd (const Field &F, const Sparse< Field, SparseMatrix_t::ELL_simd > &A, typename Field::ConstElement_ptr x_, typename Field::Element_ptr y_, const uint64_t kmax)`
- `template<class Field>`  
`void fspmv (const Field &F, const Sparse< Field, SparseMatrix_t::ELL_simd > &A, typename Field::ConstElement_ptr x_, typename Field::Element_ptr y_, const uint64_t kmax)`
- `template<class Field>`  
`void fspmv_one (const Field &F, const Sparse< Field, SparseMatrix_t::ELL_simd_ZO > &A, typename Field::ConstElement_ptr x_, typename Field::Element_ptr y_, FieldCategories::GenericTag)`
- `template<class Field>`  
`void fspmv_mone (const Field &F, const Sparse< Field, SparseMatrix_t::ELL_simd_ZO > &A, typename Field::ConstElement_ptr x_, typename Field::Element_ptr y_, FieldCategories::GenericTag)`
- `template<class Field>`  
`void fspmv_one (const Field &F, const Sparse< Field, SparseMatrix_t::ELL_simd_ZO > &A, typename Field::ConstElement_ptr x_, typename Field::Element_ptr y_, FieldCategories::UnparametricTag)`
- `template<class Field>`  
`void fspmv_mone (const Field &F, const Sparse< Field, SparseMatrix_t::ELL_simd_ZO > &A, typename Field::ConstElement_ptr x_, typename Field::Element_ptr y_, FieldCategories::UnparametricTag)`
- `template<class Field>`  
`void fspmv_one_simd (const Field &F, const Sparse< Field, SparseMatrix_t::ELL_simd_ZO > &A, typename Field::ConstElement_ptr x_, typename Field::Element_ptr y_, FieldCategories::UnparametricTag)`
- `template<class Field>`  
`void fspmv_mone_simd (const Field &F, const Sparse< Field, SparseMatrix_t::ELL_simd_ZO > &A, typename Field::ConstElement_ptr x_, typename Field::Element_ptr y_, FieldCategories::UnparametricTag)`
- `template<class Field>`  
`void pfspmm (const Field &F, const Sparse< Field, SparseMatrix_t::HYB_ZO > &A, size_t blockSize, typename Field::ConstElement_ptr x, int ldx, typename Field::Element_ptr y, int ldy, FieldCategories::GenericTag)`
- `template<class Field>`  
`void pfspmm (const Field &F, const Sparse< Field, SparseMatrix_t::HYB_ZO > &A, size_t blockSize, typename Field::ConstElement_ptr x, int ldx, typename Field::Element_ptr y, int ldy, FieldCategories::UnparametricTag)`
- `template<class Field>`  
`void pfspmm (const Field &F, const Sparse< Field, SparseMatrix_t::HYB_ZO > &A, size_t blockSize, typename Field::ConstElement_ptr x, int ldx, typename Field::Element_ptr y, int ldy, uint64_t kmax)`
- `template<class Field>`  
`void pfspmv (const Field &F, const Sparse< Field, SparseMatrix_t::HYB_ZO > &A, typename Field::ConstElement_ptr x, typename Field::Element_ptr y, FieldCategories::GenericTag)`

- `template<class Field>`  
`void pfspmv (const Field &F, const Sparse< Field, SparseMatrix_t::HYB_ZO > &A, typename Field::ConstElement_ptr x, typename Field::Element_ptr y, FieldCategories::UnparametricTag)`
- `template<class Field>`  
`void pfspmv (const Field &F, const Sparse< Field, SparseMatrix_t::HYB_ZO > &A, typename Field::ConstElement_ptr x, typename Field::Element_ptr y, uint64_t kmax)`
- `template<class Field>`  
`void fspmm (const Field &F, const Sparse< Field, SparseMatrix_t::HYB_ZO > &A, size_t blockSize, typename Field::ConstElement_ptr x, int ldx, typename Field::Element_ptr y, int ldy, FieldCategories::GenericTag)`
- `template<class Field>`  
`void fspmm (const Field &F, const Sparse< Field, SparseMatrix_t::HYB_ZO > &A, size_t blockSize, typename Field::ConstElement_ptr x, int ldx, typename Field::Element_ptr y, int ldy, FieldCategories::UnparametricTag)`
- `template<class Field>`  
`void fspmm (const Field &F, const Sparse< Field, SparseMatrix_t::HYB_ZO > &A, size_t blockSize, typename Field::ConstElement_ptr x, int ldx, typename Field::Element_ptr y, int ldy, uint64_t kmax)`
- `template<class Field>`  
`void fspmv (const Field &F, const Sparse< Field, SparseMatrix_t::HYB_ZO > &A, typename Field::ConstElement_ptr x, typename Field::Element_ptr y, FieldCategories::GenericTag)`
- `template<class Field>`  
`void fspmv (const Field &F, const Sparse< Field, SparseMatrix_t::HYB_ZO > &A, typename Field::ConstElement_ptr x, typename Field::Element_ptr y, FieldCategories::UnparametricTag)`
- `template<class Field>`  
`void fspmv (const Field &F, const Sparse< Field, SparseMatrix_t::HYB_ZO > &A, typename Field::ConstElement_ptr x, typename Field::Element_ptr y, uint64_t kmax)`
- `template<class Field>`  
`void pfspmv (const Field &F, const Sparse< Field, SparseMatrix_t::SELL > &A, typename Field::ConstElement_ptr x_, typename Field::Element_ptr y_, FieldCategories::GenericTag)`
- `template<class Field>`  
`void pfspmv (const Field &F, const Sparse< Field, SparseMatrix_t::SELL > &A, typename Field::ConstElement_ptr x_, typename Field::Element_ptr y_, FieldCategories::UnparametricTag)`
- `template<class Field>`  
`void pfspmv (const Field &F, const Sparse< Field, SparseMatrix_t::SELL > &A, typename Field::ConstElement_ptr x_, typename Field::Element_ptr y_, const int64_t kmax)`
- `template<class Field>`  
`void pfspmv_one (const Field &F, const Sparse< Field, SparseMatrix_t::SELL_ZO > &A, typename Field::ConstElement_ptr x_, typename Field::Element_ptr y_, FieldCategories::GenericTag)`
- `template<class Field>`  
`void pfspmv_mone (const Field &F, const Sparse< Field, SparseMatrix_t::SELL_ZO > &A, typename Field::ConstElement_ptr x_, typename Field::Element_ptr y_, FieldCategories::GenericTag)`
- `template<class Field>`  
`void pfspmv_one (const Field &F, const Sparse< Field, SparseMatrix_t::SELL_ZO > &A, typename Field::ConstElement_ptr x_, typename Field::Element_ptr y_, FieldCategories::UnparametricTag)`
- `template<class Field>`  
`void pfspmv_mone (const Field &F, const Sparse< Field, SparseMatrix_t::SELL_ZO > &A, typename Field::ConstElement_ptr x_, typename Field::Element_ptr y_, FieldCategories::UnparametricTag)`
- `template<class Field>`  
`void fspmv (const Field &F, const Sparse< Field, SparseMatrix_t::SELL > &A, typename Field::ConstElement_ptr x_, typename Field::Element_ptr y_, FieldCategories::GenericTag)`
- `template<class Field>`  
`void fspmv_simd (const Field &F, const Sparse< Field, SparseMatrix_t::SELL > &A, typename Field::ConstElement_ptr x_, typename Field::Element_ptr y_, FieldCategories::UnparametricTag)`
- `template<class Field>`  
`void fspmv (const Field &F, const Sparse< Field, SparseMatrix_t::SELL > &A, typename Field::ConstElement_ptr x_, typename Field::Element_ptr y_, FieldCategories::UnparametricTag)`
- `template<class Field>`  
`void fspmv_simd (const Field &F, const Sparse< Field, SparseMatrix_t::SELL > &A, typename Field::ConstElement_ptr x_, typename Field::Element_ptr y_, const uint64_t kmax)`

- `template<class Field>`  
`void fspmv (const Field &F, const Sparse< Field, SparseMatrix_t::SELL > &A, typename Field::ConstElement_ptr x_, typename Field::Element_ptr y_, const uint64_t kmax)`
- `template<class Field>`  
`void fspmv_one (const Field &F, const Sparse< Field, SparseMatrix_t::SELL_ZO > &A, typename Field::ConstElement_ptr x_, typename Field::Element_ptr y_, FieldCategories::GenericTag)`
- `template<class Field>`  
`void fspmv_mone (const Field &F, const Sparse< Field, SparseMatrix_t::SELL_ZO > &A, typename Field::ConstElement_ptr x_, typename Field::Element_ptr y_, FieldCategories::GenericTag)`
- `template<class Field>`  
`void fspmv_one_simd (const Field &F, const Sparse< Field, SparseMatrix_t::SELL_ZO > &A, typename Field::ConstElement_ptr x_, typename Field::Element_ptr y_, FieldCategories::UnparametricTag)`
- `template<class Field>`  
`void fspmv_mone_simd (const Field &F, const Sparse< Field, SparseMatrix_t::SELL_ZO > &A, typename Field::ConstElement_ptr x_, typename Field::Element_ptr y_, FieldCategories::UnparametricTag)`
- `template<class Field>`  
`void fspmv_one (const Field &F, const Sparse< Field, SparseMatrix_t::SELL_ZO > &A, typename Field::ConstElement_ptr x_, typename Field::Element_ptr y_, FieldCategories::UnparametricTag)`
- `template<class Field>`  
`void fspmv_mone (const Field &F, const Sparse< Field, SparseMatrix_t::SELL_ZO > &A, typename Field::ConstElement_ptr x_, typename Field::Element_ptr y_, FieldCategories::UnparametricTag)`

## 11.16.1 Function Documentation

### 11.16.1.1 fspmm() [1/15]

```
template<class Field>
void fspmm (
    const Field & F,
    const Sparse< Field, SparseMatrix_t::COO > & A,
    size_t blockSize,
    typename Field::ConstElement_ptr x_,
    int ldx,
    typename Field::Element_ptr y_,
    int ldy,
    FieldCategories::GenericTag ) [inline]
```

### 11.16.1.2 fspmm() [2/15]

```
template<class Field>
void fspmm (
    const Field & F,
    const Sparse< Field, SparseMatrix_t::COO > & A,
    size_t blockSize,
    typename Field::ConstElement_ptr x_,
    int ldx,
    typename Field::Element_ptr y_,
    int ldy,
    FieldCategories::UnparametricTag ) [inline]
```

**11.16.1.3 fspmm()** [3/15]

```

template<class Field>
void fspmm (
    const Field & F,
    const Sparse< Field, SparseMatrix_t::COO > & A,
    size_t blockSize,
    typename Field::ConstElement_ptr x_,
    int ldx,
    typename Field::Element_ptr y_,
    int ldy,
    const int64_t kmax) [inline]

```

**11.16.1.4 fspmm\_simd\_aligned()** [1/2]

```

template<class Field>
void fspmm_simd_aligned (
    const Field & F,
    const Sparse< Field, SparseMatrix_t::COO > & A,
    size_t blockSize,
    typename Field::ConstElement_ptr x_,
    int ldx,
    typename Field::Element_ptr y_,
    int ldy,
    const int64_t kmax) [inline]

```

**11.16.1.5 fspmm\_simd\_unaligned()** [1/2]

```

template<class Field>
void fspmm_simd_unaligned (
    const Field & F,
    const Sparse< Field, SparseMatrix_t::COO > & A,
    size_t blockSize,
    typename Field::ConstElement_ptr x_,
    int ldx,
    typename Field::Element_ptr y_,
    int ldy,
    const int64_t kmax) [inline]

```

**11.16.1.6 fspmm\_one()** [1/4]

```

template<class Field>
void fspmm_one (
    const Field & F,
    const Sparse< Field, SparseMatrix_t::COO_ZO > & A,
    size_t blockSize,
    typename Field::ConstElement_ptr x_,
    int ldx,
    typename Field::Element_ptr y_,
    int ldy,
    FieldCategories::GenericTag ) [inline]

```

**11.16.1.7 fspmm\_mone()** [1/4]

```
template<class Field>
void fspmm_mone (
    const Field & F,
    const Sparse< Field, SparseMatrix_t::COO_ZO > & A,
    size_t blockSize,
    typename Field::ConstElement_ptr x_,
    int ldx,
    typename Field::Element_ptr y_,
    int ldy,
    FieldCategories::GenericTag ) [inline]
```

**11.16.1.8 fspmm\_one\_simd\_aligned()** [1/3]

```
template<class Field>
void fspmm_one_simd_aligned (
    const Field & F,
    const Sparse< Field, SparseMatrix_t::COO_ZO > & A,
    size_t blockSize,
    typename Field::ConstElement_ptr x_,
    int ldx,
    typename Field::Element_ptr y_,
    int ldy,
    FieldCategories::UnparametricTag ) [inline]
```

**11.16.1.9 fspmm\_one\_simd\_unaligned()** [1/3]

```
template<class Field>
void fspmm_one_simd_unaligned (
    const Field & F,
    const Sparse< Field, SparseMatrix_t::COO_ZO > & A,
    size_t blockSize,
    typename Field::ConstElement_ptr x_,
    int ldx,
    typename Field::Element_ptr y_,
    int ldy,
    FieldCategories::UnparametricTag ) [inline]
```

**11.16.1.10 fspmm\_mone\_simd\_aligned()** [1/3]

```
template<class Field>
void fspmm_mone_simd_aligned (
    const Field & F,
    const Sparse< Field, SparseMatrix_t::COO_ZO > & A,
    size_t blockSize,
    typename Field::ConstElement_ptr x_,
    int ldx,
    typename Field::Element_ptr y_,
    int ldy,
    FieldCategories::UnparametricTag ) [inline]
```

**11.16.1.11 fspmm\_mone\_simd\_unaligned()** [1/3]

```
template<class Field>
void fspmm_mone_simd_unaligned (
    const Field & F,
    const Sparse< Field, SparseMatrix_t::COO_ZO > & A,
    size_t blockSize,
    typename Field::ConstElement_ptr x_,
    int ldx,
    typename Field::Element_ptr y_,
    int ldY,
    FieldCategories::UnparametricTag ) [inline]
```

**11.16.1.12 fspmv()** [1/21]

```
template<class Field>
void fspmv (
    const Field & F,
    const Sparse< Field, SparseMatrix_t::COO > & A,
    typename Field::ConstElement_ptr x_,
    typename Field::Element_ptr y_,
    FieldCategories::GenericTag ) [inline]
```

**11.16.1.13 fspmv()** [2/21]

```
template<class Field>
void fspmv (
    const Field & F,
    const Sparse< Field, SparseMatrix_t::COO > & A,
    typename Field::ConstElement_ptr x_,
    typename Field::Element_ptr y_,
    FieldCategories::UnparametricTag ) [inline]
```

**11.16.1.14 fspmv()** [3/21]

```
template<class Field>
void fspmv (
    const Field & F,
    const Sparse< Field, SparseMatrix_t::COO > & A,
    typename Field::ConstElement_ptr x_,
    typename Field::Element_ptr y_,
    const uint64_t kmax) [inline]
```

**11.16.1.15 fspmv\_one()** [1/10]

```
template<class Field>
void fspmv_one (
    const Field & F,
    const Sparse< Field, SparseMatrix_t::COO_ZO > & A,
    typename Field::ConstElement_ptr x_,
    typename Field::Element_ptr y_,
    FieldCategories::GenericTag ) [inline]
```



**11.16.1.16 fspmv\_mone()** [1/10]

```
template<class Field>
void fspmv_mone (
    const Field & F,
    const Sparse< Field, SparseMatrix_t::COO_ZO > & A,
    typename Field::ConstElement_ptr x_,
    typename Field::Element_ptr y_,
    FieldCategories::GenericTag ) [inline]
```

**11.16.1.17 fspmv\_one()** [2/10]

```
template<class Field>
void fspmv_one (
    const Field & F,
    const Sparse< Field, SparseMatrix_t::COO_ZO > & A,
    typename Field::ConstElement_ptr x_,
    typename Field::Element_ptr y_,
    FieldCategories::UnparametricTag ) [inline]
```

**11.16.1.18 fspmv\_mone()** [2/10]

```
template<class Field>
void fspmv_mone (
    const Field & F,
    const Sparse< Field, SparseMatrix_t::COO_ZO > & A,
    typename Field::ConstElement_ptr x_,
    typename Field::Element_ptr y_,
    FieldCategories::UnparametricTag ) [inline]
```

**11.16.1.19 pfspmm()** [1/18]

```
template<class Field>
void pfspmm (
    const Field & F,
    const Sparse< Field, SparseMatrix_t::CSR > & A,
    size_t blockSize,
    typename Field::ConstElement_ptr x_,
    int ldx,
    typename Field::Element_ptr y_,
    int ldy,
    FieldCategories::GenericTag ) [inline]
```

**11.16.1.20 pfspmm()** [2/18]

```
template<class Field>
void pfspmm (
    const Field & F,
    const Sparse< Field, SparseMatrix_t::CSR > & A,
    size_t blockSize,
    typename Field::ConstElement_ptr x_,
    int ldx,
    typename Field::Element_ptr y_,
    int ldy,
    FieldCategories::UnparametricTag ) [inline]
```

**11.16.1.21 pfspmm()** [3/18]

```

template<class Field>
void pfspmm (
    const Field & F,
    const Sparse< Field, SparseMatrix_t::CSR > & A,
    size_t blockSize,
    typename Field::ConstElement_ptr x_,
    int ldx,
    typename Field::Element_ptr y_,
    int ldy,
    const int64_t kmax) [inline]

```

**11.16.1.22 pfspmm\_one()** [1/2]

```

template<class Field>
void pfspmm_one (
    const Field & F,
    const Sparse< Field, SparseMatrix_t::CSR_ZO > & A,
    size_t blockSize,
    typename Field::ConstElement_ptr x_,
    int ldx,
    typename Field::Element_ptr y_,
    int ldy,
    FieldCategories::GenericTag ) [inline]

```

**11.16.1.23 pfspmm\_mone()** [1/2]

```

template<class Field>
void pfspmm_mone (
    const Field & F,
    const Sparse< Field, SparseMatrix_t::CSR_ZO > & A,
    size_t blockSize,
    typename Field::ConstElement_ptr x_,
    int ldx,
    typename Field::Element_ptr y_,
    int ldy,
    FieldCategories::GenericTag ) [inline]

```

**11.16.1.24 pfspmm\_one()** [2/2]

```

template<class Field>
void pfspmm_one (
    const Field & F,
    const Sparse< Field, SparseMatrix_t::CSR_ZO > & A,
    size_t blockSize,
    typename Field::ConstElement_ptr x_,
    int ldx,
    typename Field::Element_ptr y_,
    int ldy,
    FieldCategories::UnparametricTag ) [inline]

```

**11.16.1.25 pfspmm\_mone()** [2/2]

```
template<class Field>
void pfspmm_mone (
    const Field & F,
    const Sparse< Field, SparseMatrix_t::CSR_ZO > & A,
    size_t blockSize,
    typename Field::ConstElement_ptr x_,
    int ldx,
    typename Field::Element_ptr y_,
    int ldy,
    FieldCategories::UnparametricTag ) [inline]
```

**11.16.1.26 pfspmv()** [1/18]

```
template<class Field>
void pfspmv (
    const Field & F,
    const Sparse< Field, SparseMatrix_t::CSR > & A,
    typename Field::ConstElement_ptr x_,
    typename Field::Element_ptr y_,
    FieldCategories::GenericTag ) [inline]
```

**11.16.1.27 pfspmv\_task()**

```
template<class Field>
void pfspmv_task (
    const Field & F,
    const Sparse< Field, SparseMatrix_t::CSR > & A,
    typename Field::ConstElement_ptr x_,
    typename Field::Element_ptr y_,
    const index_t iStart,
    const index_t iStop,
    FieldCategories::UnparametricTag ) [inline]
```

**11.16.1.28 pfspmv()** [2/18]

```
template<class Field>
void pfspmv (
    const Field & F,
    const Sparse< Field, SparseMatrix_t::CSR > & A,
    typename Field::ConstElement_ptr x_,
    typename Field::Element_ptr y_,
    FieldCategories::UnparametricTag ) [inline]
```

**11.16.1.29 pfspmv()** [3/18]

```
template<class Field>
void pfspmv (
    const Field & F,
    const Sparse< Field, SparseMatrix_t::CSR > & A,
    typename Field::ConstElement_ptr x_,
    typename Field::Element_ptr y_,
    const int64_t kmax) [inline]
```

**11.16.1.30 pfspmv\_one()** [1/8]

```
template<class Field>
void pfspmv_one (
    const Field & F,
    const Sparse< Field, SparseMatrix_t::CSR_ZO > & A,
    typename Field::ConstElement_ptr x_,
    typename Field::Element_ptr y_,
    FieldCategories::GenericTag ) [inline]
```

**11.16.1.31 pfspmv\_mone()** [1/8]

```
template<class Field>
void pfspmv_mone (
    const Field & F,
    const Sparse< Field, SparseMatrix_t::CSR_ZO > & A,
    typename Field::ConstElement_ptr x_,
    typename Field::Element_ptr y_,
    FieldCategories::GenericTag ) [inline]
```

**11.16.1.32 pfspmv\_one()** [2/8]

```
template<class Field>
void pfspmv_one (
    const Field & F,
    const Sparse< Field, SparseMatrix_t::CSR_ZO > & A,
    typename Field::ConstElement_ptr x_,
    typename Field::Element_ptr y_,
    FieldCategories::UnparametricTag ) [inline]
```

**11.16.1.33 pfspmv\_mone()** [2/8]

```
template<class Field>
void pfspmv_mone (
    const Field & F,
    const Sparse< Field, SparseMatrix_t::CSR_ZO > & A,
    typename Field::ConstElement_ptr x_,
    typename Field::Element_ptr y_,
    FieldCategories::UnparametricTag ) [inline]
```

**11.16.1.34 fspmm()** [4/15]

```
template<class Field>
void fspmm (
    const Field & F,
    const Sparse< Field, SparseMatrix_t::CSR > & A,
    size_t blockSize,
    typename Field::ConstElement_ptr x_,
    int ldx,
    typename Field::Element_ptr y_,
    int ldy,
    FieldCategories::GenericTag ) [inline]
```

**11.16.135 fspmm()** [5/15]

```
template<class Field>
void fspmm (
    const Field & F,
    const Sparse< Field, SparseMatrix_t::CSR > & A,
    index_t blockSize,
    typename Field::ConstElement_ptr x_,
    index_t ldx,
    typename Field::Element_ptr y_,
    index_t ldy,
    FieldCategories::UnparametricTag ) [inline]
```

**11.16.136 fspmm\_simd\_aligned()** [2/2]

```
template<class Field>
void fspmm_simd_aligned (
    const Field & F,
    const Sparse< Field, SparseMatrix_t::CSR > & A,
    size_t blockSize,
    typename Field::ConstElement_ptr x_,
    int ldx,
    typename Field::Element_ptr y_,
    int ldy,
    FieldCategories::UnparametricTag ) [inline]
```

**11.16.137 fspmm\_simd\_unaligned()** [2/2]

```
template<class Field>
void fspmm_simd_unaligned (
    const Field & F,
    const Sparse< Field, SparseMatrix_t::CSR > & A,
    size_t blockSize,
    typename Field::ConstElement_ptr x_,
    int ldx,
    typename Field::Element_ptr y_,
    int ldy,
    FieldCategories::UnparametricTag ) [inline]
```

**11.16.138 fspmm()** [6/15]

```
template<class Field>
void fspmm (
    const Field & F,
    const Sparse< Field, SparseMatrix_t::CSR > & A,
    size_t blockSize,
    typename Field::ConstElement_ptr x_,
    int ldx,
    typename Field::Element_ptr y_,
    int ldy,
    const int64_t kmax) [inline]
```

**11.16.1.39 fspmm\_one() [2/4]**

```

template<class Field>
void fspmm_one (
    const Field & F,
    const Sparse< Field, SparseMatrix_t::CSR_ZO > & A,
    size_t blockSize,
    typename Field::ConstElement_ptr x_,
    int ldx,
    typename Field::Element_ptr y_,
    int ldy,
    FieldCategories::GenericTag ) [inline]

```

**11.16.1.40 fspmm\_mone() [2/4]**

```

template<class Field>
void fspmm_mone (
    const Field & F,
    const Sparse< Field, SparseMatrix_t::CSR_ZO > & A,
    size_t blockSize,
    typename Field::ConstElement_ptr x_,
    int ldx,
    typename Field::Element_ptr y_,
    int ldy,
    FieldCategories::GenericTag ) [inline]

```

**11.16.1.41 fspmm\_one\_simd\_aligned() [2/3]**

```

template<class Field>
void fspmm_one_simd_aligned (
    const Field & F,
    const Sparse< Field, SparseMatrix_t::CSR_ZO > & A,
    size_t blockSize,
    typename Field::ConstElement_ptr x_,
    int ldx,
    typename Field::Element_ptr y_,
    int ldy,
    FieldCategories::UnparametricTag ) [inline]

```

**11.16.1.42 fspmm\_one\_simd\_unaligned() [2/3]**

```

template<class Field>
void fspmm_one_simd_unaligned (
    const Field & F,
    const Sparse< Field, SparseMatrix_t::CSR_ZO > & A,
    size_t blockSize,
    typename Field::ConstElement_ptr x_,
    int ldx,
    typename Field::Element_ptr y_,
    int ldy,
    FieldCategories::UnparametricTag ) [inline]

```

**11.16.143 fspmm\_mone\_simd\_aligned()** [2/3]

```
template<class Field>
void fspmm_mone_simd_aligned (
    const Field & F,
    const Sparse< Field, SparseMatrix_t::CSR_ZO > & A,
    size_t blockSize,
    typename Field::ConstElement_ptr x_,
    int ldx,
    typename Field::Element_ptr y_,
    int ldy,
    FieldCategories::UnparametricTag ) [inline]
```

**11.16.144 fspmm\_mone\_simd\_unaligned()** [2/3]

```
template<class Field>
void fspmm_mone_simd_unaligned (
    const Field & F,
    const Sparse< Field, SparseMatrix_t::CSR_ZO > & A,
    size_t blockSize,
    typename Field::ConstElement_ptr x_,
    int ldx,
    typename Field::Element_ptr y_,
    int ldy,
    FieldCategories::UnparametricTag ) [inline]
```

**11.16.145 fspmv()** [4/21]

```
template<class Field>
void fspmv (
    const Field & F,
    const Sparse< Field, SparseMatrix_t::CSR > & A,
    typename Field::ConstElement_ptr x_,
    typename Field::Element_ptr y_,
    FieldCategories::GenericTag ) [inline]
```

**11.16.146 fspmv()** [5/21]

```
template<class Field>
void fspmv (
    const Field & F,
    const Sparse< Field, SparseMatrix_t::CSR > & A,
    typename Field::ConstElement_ptr x_,
    typename Field::Element_ptr y_,
    FieldCategories::UnparametricTag ) [inline]
```

**11.16.147 fspmv()** [6/21]

```
template<class Field>
void fspmv (
    const Field & F,
    const Sparse< Field, SparseMatrix_t::CSR > & A,
    typename Field::ConstElement_ptr x_,
    typename Field::Element_ptr y_,
    const int64_t kmax) [inline]
```

**11.16.148 fspmv\_one()** [3/10]

```
template<class Field>
void fspmv_one (
    const Field & F,
    const Sparse< Field, SparseMatrix_t::CSR_ZO > & A,
    typename Field::ConstElement_ptr x_,
    typename Field::Element_ptr y_,
    FieldCategories::GenericTag ) [inline]
```

**11.16.149 fspmv\_mone()** [3/10]

```
template<class Field>
void fspmv_mone (
    const Field & F,
    const Sparse< Field, SparseMatrix_t::CSR_ZO > & A,
    typename Field::ConstElement_ptr x_,
    typename Field::Element_ptr y_,
    FieldCategories::GenericTag ) [inline]
```

**11.16.150 fspmv\_one()** [4/10]

```
template<class Field>
void fspmv_one (
    const Field & F,
    const Sparse< Field, SparseMatrix_t::CSR_ZO > & A,
    typename Field::ConstElement_ptr x_,
    typename Field::Element_ptr y_,
    FieldCategories::UnparametricTag ) [inline]
```

**11.16.151 fspmv\_mone()** [4/10]

```
template<class Field>
void fspmv_mone (
    const Field & F,
    const Sparse< Field, SparseMatrix_t::CSR_ZO > & A,
    typename Field::ConstElement_ptr x_,
    typename Field::Element_ptr y_,
    FieldCategories::UnparametricTag ) [inline]
```

**11.16.152 pfspmm()** [4/18]

```
template<class Field>
void pfspmm (
    const Field & F,
    const Sparse< Field, SparseMatrix_t::CSR_HYB > & A,
    size_t blockSize,
    typename Field::ConstElement_ptr x,
    typename Field::Element_ptr y,
    FieldCategories::GenericTag ) [inline]
```



**11.16.153 pfspmm()** [5/18]

```
template<class Field>
void pfspmm (
    const Field & F,
    const Sparse< Field, SparseMatrix_t::CSR_HYB > & A,
    size_t blockSize,
    typename Field::ConstElement_ptr x,
    int ldx,
    typename Field::Element_ptr y,
    int ldy,
    FieldCategories::GenericTag ) [inline]
```

**11.16.154 pfspmm()** [6/18]

```
template<class Field>
void pfspmm (
    const Field & F,
    const Sparse< Field, SparseMatrix_t::CSR_HYB > & A,
    size_t blockSize,
    typename Field::ConstElement_ptr x,
    typename Field::Element_ptr y,
    FieldCategories::UnparametricTag ) [inline]
```

**11.16.155 pfspmm()** [7/18]

```
template<class Field>
void pfspmm (
    const Field & F,
    const Sparse< Field, SparseMatrix_t::CSR_HYB > & A,
    size_t blockSize,
    typename Field::ConstElement_ptr x,
    int ldx,
    typename Field::Element_ptr y,
    int ldy,
    FieldCategories::UnparametricTag ) [inline]
```

**11.16.156 pfspmm()** [8/18]

```
template<class Field>
void pfspmm (
    const Field & F,
    const Sparse< Field, SparseMatrix_t::CSR_HYB > & A,
    size_t blockSize,
    typename Field::ConstElement_ptr x,
    typename Field::Element_ptr y,
    const int64_t kmax) [inline]
```

**11.16.1.57 pfspmm()** [9/18]

```
template<class Field>
void pfspmm (
    const Field & F,
    const Sparse< Field, SparseMatrix_t::CSR_HYB > & A,
    size_t blockSize,
    typename Field::ConstElement_ptr x,
    int ldx,
    typename Field::Element_ptr y,
    int ldy,
    const int64_t kmax) [inline]
```

**11.16.1.58 pfspmv()** [4/18]

```
template<class Field>
void pfspmv (
    const Field & F,
    const Sparse< Field, SparseMatrix_t::CSR_HYB > & A,
    typename Field::ConstElement_ptr x_,
    typename Field::Element_ptr y_,
    FieldCategories::GenericTag ) [inline]
```

**11.16.1.59 pfspmv()** [5/18]

```
template<class Field>
void pfspmv (
    const Field & F,
    const Sparse< Field, SparseMatrix_t::CSR_HYB > & A,
    typename Field::ConstElement_ptr x_,
    typename Field::Element_ptr y_,
    FieldCategories::UnparametricTag ) [inline]
```

**11.16.1.60 pfspmv()** [6/18]

```
template<class Field>
void pfspmv (
    const Field & F,
    const Sparse< Field, SparseMatrix_t::CSR_HYB > & A,
    typename Field::ConstElement_ptr x_,
    typename Field::Element_ptr y_,
    const int64_t kmax) [inline]
```

**11.16.1.61 fspmm()** [7/15]

```
template<class Field>
void fspmm (
    const Field & F,
    const Sparse< Field, SparseMatrix_t::CSR_HYB > & A,
    size_t blockSize,
    typename Field::ConstElement_ptr x_,
    int ldx,
    typename Field::Element_ptr y_,
    int ldy,
    FieldCategories::GenericTag ) [inline]
```

**11.16.1.62 fspmm()** [8/15]

```
template<class Field>
void fspmm (
    const Field & F,
    const Sparse< Field, SparseMatrix_t::CSR_HYB > & A,
    size_t blockSize,
    typename Field::ConstElement_ptr x_,
    int ldx,
    typename Field::Element_ptr y_,
    int ldy,
    FieldCategories::UnparametricTag ) [inline]
```

**11.16.1.63 fspmm()** [9/15]

```
template<class Field>
void fspmm (
    const Field & F,
    const Sparse< Field, SparseMatrix_t::CSR_HYB > & A,
    size_t blockSize,
    typename Field::ConstElement_ptr x_,
    int ldx,
    typename Field::Element_ptr y_,
    int ldy,
    const int64_t kmax) [inline]
```

**11.16.1.64 fspmv()** [7/21]

```
template<class Field>
void fspmv (
    const Field & F,
    const Sparse< Field, SparseMatrix_t::CSR_HYB > & A,
    typename Field::ConstElement_ptr x_,
    typename Field::Element_ptr y_,
    FieldCategories::GenericTag ) [inline]
```

**11.16.1.65 fspmv()** [8/21]

```
template<class Field>
void fspmv (
    const Field & F,
    const Sparse< Field, SparseMatrix_t::CSR_HYB > & A,
    typename Field::ConstElement_ptr x_,
    typename Field::Element_ptr y_,
    FieldCategories::UnparametricTag ) [inline]
```

**11.16.1.66 fspmv()** [9/21]

```
template<class Field>
void fspmv (
    const Field & F,
    const Sparse< Field, SparseMatrix_t::CSR_HYB > & A,
    typename Field::ConstElement_ptr x_,
    typename Field::Element_ptr y_,
    const uint64_t kmax) [inline]
```

**11.16.1.67 pfsppmm()** [10/18]

```
template<class Field>
void pfsppmm (
    const Field & F,
    const Sparse< Field, SparseMatrix_t::ELL > & A,
    size_t blockSize,
    typename Field::ConstElement_ptr x,
    typename Field::Element_ptr y,
    FieldCategories::GenericTag ) [inline]
```

**11.16.1.68 pfsppmm()** [11/18]

```
template<class Field>
void pfsppmm (
    const Field & F,
    const Sparse< Field, SparseMatrix_t::ELL > & A,
    size_t blockSize,
    typename Field::ConstElement_ptr x,
    int ldx,
    typename Field::Element_ptr y,
    int ldy,
    FieldCategories::GenericTag ) [inline]
```

**11.16.1.69 pfsppmm()** [12/18]

```
template<class Field>
void pfsppmm (
    const Field & F,
    const Sparse< Field, SparseMatrix_t::ELL > & A,
    size_t blockSize,
    typename Field::ConstElement_ptr x,
    typename Field::Element_ptr y,
    FieldCategories::UnparametricTag ) [inline]
```

**11.16.1.70 pfsppmm()** [13/18]

```
template<class Field>
void pfsppmm (
    const Field & F,
    const Sparse< Field, SparseMatrix_t::ELL > & A,
    size_t blockSize,
    typename Field::ConstElement_ptr x,
    int ldx,
    typename Field::Element_ptr y,
    int ldy,
    FieldCategories::UnparametricTag ) [inline]
```

**11.16.1.71 pfspmm()** [14/18]

```
template<class Field>
void pfspmm (
    const Field & F,
    const Sparse< Field, SparseMatrix_t::ELL > & A,
    size_t blockSize,
    typename Field::ConstElement_ptr x,
    typename Field::Element_ptr y,
    const int64_t kmax) [inline]
```

**11.16.1.72 pfspmm()** [15/18]

```
template<class Field>
void pfspmm (
    const Field & F,
    const Sparse< Field, SparseMatrix_t::ELL > & A,
    size_t blockSize,
    typename Field::ConstElement_ptr x,
    int ldx,
    typename Field::Element_ptr y,
    int ldy,
    const int64_t kmax) [inline]
```

**11.16.1.73 pfspmm\_zo()** [1/2]

```
template<class Field, class Func>
void pfspmm_zo (
    const Field & F,
    const Sparse< Field, SparseMatrix_t::ELL_ZO > & A,
    size_t blockSize,
    typename Field::ConstElement_ptr x,
    typename Field::Element_ptr y,
    Func && func) [inline]
```

**11.16.1.74 pfspmm\_zo()** [2/2]

```
template<class Field, class Func>
void pfspmm_zo (
    const Field & F,
    const Sparse< Field, SparseMatrix_t::ELL_ZO > & A,
    size_t blockSize,
    typename Field::ConstElement_ptr x,
    int ldx,
    typename Field::Element_ptr y,
    int ldy,
    Func && func) [inline]
```

**11.16.1.75 pfspmv()** [7/18]

```
template<class Field>
void pfspmv (
    const Field & F,
    const Sparse< Field, SparseMatrix_t::ELL > & A,
    typename Field::ConstElement_ptr x_,
    typename Field::Element_ptr y_,
    FieldCategories::GenericTag ) [inline]
```

**11.16.1.76 pfspmv()** [8/18]

```
template<class Field>
void pfspmv (
    const Field & F,
    const Sparse< Field, SparseMatrix_t::ELL > & A,
    typename Field::ConstElement_ptr x_,
    typename Field::Element_ptr y_,
    FieldCategories::UnparametricTag ) [inline]
```

**11.16.1.77 pfspmv()** [9/18]

```
template<class Field>
void pfspmv (
    const Field & F,
    const Sparse< Field, SparseMatrix_t::ELL > & A,
    typename Field::ConstElement_ptr x_,
    typename Field::Element_ptr y_,
    const int64_t kmax) [inline]
```

**11.16.1.78 pfspmv\_one()** [3/8]

```
template<class Field>
void pfspmv_one (
    const Field & F,
    const Sparse< Field, SparseMatrix_t::ELL_ZO > & A,
    typename Field::ConstElement_ptr x_,
    typename Field::Element_ptr y_,
    FieldCategories::GenericTag ) [inline]
```

**11.16.1.79 pfspmv\_mone()** [3/8]

```
template<class Field>
void pfspmv_mone (
    const Field & F,
    const Sparse< Field, SparseMatrix_t::ELL_ZO > & A,
    typename Field::ConstElement_ptr x_,
    typename Field::Element_ptr y_,
    FieldCategories::GenericTag ) [inline]
```

**11.16.1.80 pfspmv\_one()** [4/8]

```
template<class Field>
void pfspmv_one (
    const Field & F,
    const Sparse< Field, SparseMatrix_t::ELL_ZO > & A,
    typename Field::ConstElement_ptr x_,
    typename Field::Element_ptr y_,
    FieldCategories::UnparametricTag ) [inline]
```

**11.16.1.81 pfspmv\_mone()** [4/8]

```
template<class Field>
void pfspmv_mone (
    const Field & F,
    const Sparse< Field, SparseMatrix_t::ELL_ZO > & A,
    typename Field::ConstElement_ptr x_,
    typename Field::Element_ptr y_,
    FieldCategories::UnparametricTag ) [inline]
```

**11.16.1.82 fspmm()** [10/15]

```
template<class Field>
void fspmm (
    const Field & F,
    const Sparse< Field, SparseMatrix_t::ELL > & A,
    size_t blockSize,
    typename Field::ConstElement_ptr x_,
    int ldx,
    typename Field::Element_ptr y_,
    int ldy,
    FieldCategories::GenericTag ) [inline]
```

**11.16.1.83 fspmm()** [11/15]

```
template<class Field>
void fspmm (
    const Field & F,
    const Sparse< Field, SparseMatrix_t::ELL > & A,
    size_t blockSize,
    typename Field::ConstElement_ptr x_,
    int ldx,
    typename Field::Element_ptr y_,
    int ldy,
    FieldCategories::UnparametricTag ) [inline]
```

**11.16.1.84 fspmm()** [12/15]

```
template<class Field>
void fspmm (
    const Field & F,
    const Sparse< Field, SparseMatrix_t::ELL > & A,
    size_t blockSize,
    typename Field::ConstElement_ptr x_,
    int ldx,
    typename Field::Element_ptr y_,
    int ldy,
    const int64_t kmax) [inline]
```

**11.16.1.85 fspmm\_mone()** [3/4]

```
template<class Field>
void fspmm_mone (
    const Field & F,
    const Sparse< Field, SparseMatrix_t::ELL_ZO > & A,
    size_t blockSize,
    typename Field::ConstElement_ptr x_,
    int ldx,
    typename Field::Element_ptr y_,
    int ldy,
    FieldCategories::GenericTag ) [inline]
```

**11.16.1.86 fspmm\_one()** [3/4]

```
template<class Field>
void fspmm_one (
    const Field & F,
    const Sparse< Field, SparseMatrix_t::ELL_ZO > & A,
    size_t blockSize,
    typename Field::ConstElement_ptr x_,
    int ldx,
    typename Field::Element_ptr y_,
    int ldy,
    FieldCategories::GenericTag ) [inline]
```

**11.16.1.87 fspmm\_mone()** [4/4]

```
template<class Field>
void fspmm_mone (
    const Field & F,
    const Sparse< Field, SparseMatrix_t::ELL_ZO > & A,
    size_t blockSize,
    typename Field::ConstElement_ptr x_,
    int ldx,
    typename Field::Element_ptr y_,
    int ldy,
    FieldCategories::UnparametricTag ) [inline]
```



**11.16.1.88 fspmm\_one() [4/4]**

```
template<class Field>
void fspmm_one (
    const Field & F,
    const Sparse< Field, SparseMatrix_t::ELL_ZO > & A,
    size_t blockSize,
    typename Field::ConstElement_ptr x_,
    int ldx,
    typename Field::Element_ptr y_,
    int ldy,
    FieldCategories::UnparametricTag ) [inline]
```

**11.16.1.89 fspmm\_one\_simd\_aligned() [3/3]**

```
template<class Field>
void fspmm_one_simd_aligned (
    const Field & F,
    const Sparse< Field, SparseMatrix_t::ELL_ZO > & A,
    size_t blockSize,
    typename Field::ConstElement_ptr x_,
    int ldx,
    typename Field::Element_ptr y_,
    int ldy,
    FieldCategories::UnparametricTag ) [inline]
```

**11.16.1.90 fspmm\_one\_simd\_unaligned() [3/3]**

```
template<class Field>
void fspmm_one_simd_unaligned (
    const Field & F,
    const Sparse< Field, SparseMatrix_t::ELL_ZO > & A,
    size_t blockSize,
    typename Field::ConstElement_ptr x_,
    int ldx,
    typename Field::Element_ptr y_,
    int ldy,
    FieldCategories::UnparametricTag ) [inline]
```

**11.16.1.91 fspmm\_mone\_simd\_aligned() [3/3]**

```
template<class Field>
void fspmm_mone_simd_aligned (
    const Field & F,
    const Sparse< Field, SparseMatrix_t::ELL_ZO > & A,
    size_t blockSize,
    typename Field::ConstElement_ptr x_,
    int ldx,
    typename Field::Element_ptr y_,
    int ldy,
    FieldCategories::UnparametricTag ) [inline]
```

**11.16.1.92 fspmm\_mone\_simd\_unaligned()** [3/3]

```
template<class Field>
void fspmm_mone_simd_unaligned (
    const Field & F,
    const Sparse< Field, SparseMatrix_t::ELL_ZO > & A,
    size_t blockSize,
    typename Field::ConstElement_ptr x_,
    int ldx,
    typename Field::Element_ptr y_,
    int ldy,
    FieldCategories::UnparametricTag ) [inline]
```

**11.16.1.93 fspmv()** [10/21]

```
template<class Field>
void fspmv (
    const Field & F,
    const Sparse< Field, SparseMatrix_t::ELL > & A,
    typename Field::ConstElement_ptr x_,
    typename Field::Element_ptr y_,
    FieldCategories::GenericTag ) [inline]
```

**11.16.1.94 fspmv()** [11/21]

```
template<class Field>
void fspmv (
    const Field & F,
    const Sparse< Field, SparseMatrix_t::ELL > & A,
    typename Field::ConstElement_ptr x_,
    typename Field::Element_ptr y_,
    FieldCategories::UnparametricTag ) [inline]
```

**11.16.1.95 fspmv()** [12/21]

```
template<class Field>
void fspmv (
    const Field & F,
    const Sparse< Field, SparseMatrix_t::ELL > & A,
    typename Field::ConstElement_ptr x_,
    typename Field::Element_ptr y_,
    const uint64_t kmax) [inline]
```

**11.16.1.96 fspmv\_one()** [5/10]

```
template<class Field>
void fspmv_one (
    const Field & F,
    const Sparse< Field, SparseMatrix_t::ELL_ZO > & A,
    typename Field::ConstElement_ptr x_,
    typename Field::Element_ptr y_,
    FieldCategories::GenericTag ) [inline]
```

**11.16.197 fspmv\_mone()** [5/10]

```
template<class Field>
void fspmv_mone (
    const Field & F,
    const Sparse< Field, SparseMatrix_t::ELL_ZO > & A,
    typename Field::ConstElement_ptr x_,
    typename Field::Element_ptr y_,
    FieldCategories::GenericTag ) [inline]
```

**11.16.198 fspmv\_one()** [6/10]

```
template<class Field>
void fspmv_one (
    const Field & F,
    const Sparse< Field, SparseMatrix_t::ELL_ZO > & A,
    typename Field::ConstElement_ptr x_,
    typename Field::Element_ptr y_,
    FieldCategories::UnparametricTag ) [inline]
```

**11.16.199 fspmv\_mone()** [6/10]

```
template<class Field>
void fspmv_mone (
    const Field & F,
    const Sparse< Field, SparseMatrix_t::ELL_ZO > & A,
    typename Field::ConstElement_ptr x_,
    typename Field::Element_ptr y_,
    FieldCategories::UnparametricTag ) [inline]
```

**11.16.100 pfspmv()** [10/18]

```
template<class Field>
void pfspmv (
    const Field & F,
    const Sparse< Field, SparseMatrix_t::ELL_simd > & A,
    typename Field::ConstElement_ptr x_,
    typename Field::Element_ptr y_,
    FieldCategories::GenericTag ) [inline]
```

**11.16.101 pfspmv()** [11/18]

```
template<class Field>
void pfspmv (
    const Field & F,
    const Sparse< Field, SparseMatrix_t::ELL_simd > & A,
    typename Field::ConstElement_ptr x_,
    typename Field::Element_ptr y_,
    FieldCategories::UnparametricTag ) [inline]
```

**11.16.1.102 pfspmv()** [12/18]

```
template<class Field>
void pfspmv (
    const Field & F,
    const Sparse< Field, SparseMatrix_t::ELL_simd > & A,
    typename Field::ConstElement_ptr x_,
    typename Field::Element_ptr y_,
    const uint64_t kmax) [inline]
```

**11.16.1.103 pfspmv\_one()** [5/8]

```
template<class Field>
void pfspmv_one (
    const Field & F,
    const Sparse< Field, SparseMatrix_t::ELL_simd_ZO > & A,
    typename Field::ConstElement_ptr x_,
    typename Field::Element_ptr y_,
    FieldCategories::GenericTag ) [inline]
```

**11.16.1.104 pfspmv\_mone()** [5/8]

```
template<class Field>
void pfspmv_mone (
    const Field & F,
    const Sparse< Field, SparseMatrix_t::ELL_simd_ZO > & A,
    typename Field::ConstElement_ptr x_,
    typename Field::Element_ptr y_,
    FieldCategories::GenericTag ) [inline]
```

**11.16.1.105 pfspmv\_one()** [6/8]

```
template<class Field>
void pfspmv_one (
    const Field & F,
    const Sparse< Field, SparseMatrix_t::ELL_simd_ZO > & A,
    typename Field::ConstElement_ptr x_,
    typename Field::Element_ptr y_,
    FieldCategories::UnparametricTag ) [inline]
```

**11.16.1.106 pfspmv\_mone()** [6/8]

```
template<class Field>
void pfspmv_mone (
    const Field & F,
    const Sparse< Field, SparseMatrix_t::ELL_simd_ZO > & A,
    typename Field::ConstElement_ptr x_,
    typename Field::Element_ptr y_,
    FieldCategories::UnparametricTag ) [inline]
```

**11.16.1.107 fspmv()** [13/21]

```
template<class Field>
void fspmv (
    const Field & F,
    const Sparse< Field, SparseMatrix_t::ELL_simd > & A,
    typename Field::ConstElement_ptr x_,
    typename Field::Element_ptr y_,
    FieldCategories::GenericTag ) [inline]
```

**11.16.1.108 fspmv\_simd()** [1/4]

```
template<class Field>
void fspmv_simd (
    const Field & F,
    const Sparse< Field, SparseMatrix_t::ELL_simd > & A,
    typename Field::ConstElement_ptr x_,
    typename Field::Element_ptr y_,
    FieldCategories::UnparametricTag ) [inline]
```

**11.16.1.109 fspmv()** [14/21]

```
template<class Field>
void fspmv (
    const Field & F,
    const Sparse< Field, SparseMatrix_t::ELL_simd > & A,
    typename Field::ConstElement_ptr x_,
    typename Field::Element_ptr y_,
    FieldCategories::UnparametricTag ) [inline]
```

**11.16.1.110 fspmv\_simd()** [2/4]

```
template<class Field>
void fspmv_simd (
    const Field & F,
    const Sparse< Field, SparseMatrix_t::ELL_simd > & A,
    typename Field::ConstElement_ptr x_,
    typename Field::Element_ptr y_,
    const uint64_t kmax) [inline]
```

**11.16.1.111 fspmv()** [15/21]

```
template<class Field>
void fspmv (
    const Field & F,
    const Sparse< Field, SparseMatrix_t::ELL_simd > & A,
    typename Field::ConstElement_ptr x_,
    typename Field::Element_ptr y_,
    const uint64_t kmax) [inline]
```

**11.16.1.112 fspmv\_one()** [7/10]

```
template<class Field>
void fspmv_one (
    const Field & F,
    const Sparse< Field, SparseMatrix_t::ELL_simd_ZO > & A,
    typename Field::ConstElement_ptr x_,
    typename Field::Element_ptr y_,
    FieldCategories::GenericTag ) [inline]
```

**11.16.1.113 fspmv\_mone()** [7/10]

```
template<class Field>
void fspmv_mone (
    const Field & F,
    const Sparse< Field, SparseMatrix_t::ELL_simd_ZO > & A,
    typename Field::ConstElement_ptr x_,
    typename Field::Element_ptr y_,
    FieldCategories::GenericTag ) [inline]
```

**11.16.1.114 fspmv\_one()** [8/10]

```
template<class Field>
void fspmv_one (
    const Field & F,
    const Sparse< Field, SparseMatrix_t::ELL_simd_ZO > & A,
    typename Field::ConstElement_ptr x_,
    typename Field::Element_ptr y_,
    FieldCategories::UnparametricTag ) [inline]
```

**11.16.1.115 fspmv\_mone()** [8/10]

```
template<class Field>
void fspmv_mone (
    const Field & F,
    const Sparse< Field, SparseMatrix_t::ELL_simd_ZO > & A,
    typename Field::ConstElement_ptr x_,
    typename Field::Element_ptr y_,
    FieldCategories::UnparametricTag ) [inline]
```

**11.16.1.116 fspmv\_one\_simd()** [1/2]

```
template<class Field>
void fspmv_one_simd (
    const Field & F,
    const Sparse< Field, SparseMatrix_t::ELL_simd_ZO > & A,
    typename Field::ConstElement_ptr x_,
    typename Field::Element_ptr y_,
    FieldCategories::UnparametricTag ) [inline]
```

**11.16.1.117 fspmv\_mone\_simd()** [1/2]

```
template<class Field>
void fspmv_mone_simd (
    const Field & F,
    const Sparse< Field, SparseMatrix_t::ELL_simd_ZO > & A,
    typename Field::ConstElement_ptr x_,
    typename Field::Element_ptr y_,
    FieldCategories::UnparametricTag ) [inline]
```

**11.16.1.118 pfspmm()** [16/18]

```
template<class Field>
void pfspmm (
    const Field & F,
    const Sparse< Field, SparseMatrix_t::HYB_ZO > & A,
    size_t blockSize,
    typename Field::ConstElement_ptr x,
    int ldx,
    typename Field::Element_ptr y,
    int ldy,
    FieldCategories::GenericTag ) [inline]
```

**11.16.1.119 pfspmm()** [17/18]

```
template<class Field>
void pfspmm (
    const Field & F,
    const Sparse< Field, SparseMatrix_t::HYB_ZO > & A,
    size_t blockSize,
    typename Field::ConstElement_ptr x,
    int ldx,
    typename Field::Element_ptr y,
    int ldy,
    FieldCategories::UnparametricTag ) [inline]
```

**11.16.1.120 pfspmm()** [18/18]

```
template<class Field>
void pfspmm (
    const Field & F,
    const Sparse< Field, SparseMatrix_t::HYB_ZO > & A,
    size_t blockSize,
    typename Field::ConstElement_ptr x,
    int ldx,
    typename Field::Element_ptr y,
    int ldy,
    uint64_t kmax) [inline]
```

**11.16.1.121 pfspmv()** [13/18]

```
template<class Field>
void pfspmv (
    const Field & F,
    const Sparse< Field, SparseMatrix_t::HYB_ZO > & A,
    typename Field::ConstElement_ptr x,
    typename Field::Element_ptr y,
    FieldCategories::GenericTag ) [inline]
```

**11.16.1.122 pfspmv()** [14/18]

```
template<class Field>
void pfspmv (
    const Field & F,
    const Sparse< Field, SparseMatrix_t::HYB_ZO > & A,
    typename Field::ConstElement_ptr x,
    typename Field::Element_ptr y,
    FieldCategories::UnparametricTag ) [inline]
```

**11.16.1.123 pfspmv()** [15/18]

```
template<class Field>
void pfspmv (
    const Field & F,
    const Sparse< Field, SparseMatrix_t::HYB_ZO > & A,
    typename Field::ConstElement_ptr x,
    typename Field::Element_ptr y,
    uint64_t kmax) [inline]
```

**11.16.1.124 fspmm()** [13/15]

```
template<class Field>
void fspmm (
    const Field & F,
    const Sparse< Field, SparseMatrix_t::HYB_ZO > & A,
    size_t blockSize,
    typename Field::ConstElement_ptr x,
    int ldx,
    typename Field::Element_ptr y,
    int ldy,
    FieldCategories::GenericTag ) [inline]
```

**11.16.1.125 fspmm()** [14/15]

```
template<class Field>
void fspmm (
    const Field & F,
    const Sparse< Field, SparseMatrix_t::HYB_ZO > & A,
    size_t blockSize,
    typename Field::ConstElement_ptr x,
    int ldx,
    typename Field::Element_ptr y,
    int ldy,
    FieldCategories::UnparametricTag ) [inline]
```



**11.16.1.126 fspmm()** [15/15]

```
template<class Field>
void fspmm (
    const Field & F,
    const Sparse< Field, SparseMatrix_t::HYB_ZO > & A,
    size_t blockSize,
    typename Field::ConstElement_ptr x,
    int ldx,
    typename Field::Element_ptr y,
    int ldy,
    uint64_t kmax) [inline]
```

**11.16.1.127 fspmv()** [16/21]

```
template<class Field>
void fspmv (
    const Field & F,
    const Sparse< Field, SparseMatrix_t::HYB_ZO > & A,
    typename Field::ConstElement_ptr x,
    typename Field::Element_ptr y,
    FieldCategories::GenericTag ) [inline]
```

**11.16.1.128 fspmv()** [17/21]

```
template<class Field>
void fspmv (
    const Field & F,
    const Sparse< Field, SparseMatrix_t::HYB_ZO > & A,
    typename Field::ConstElement_ptr x,
    typename Field::Element_ptr y,
    FieldCategories::UnparametricTag ) [inline]
```

**11.16.1.129 fspmv()** [18/21]

```
template<class Field>
void fspmv (
    const Field & F,
    const Sparse< Field, SparseMatrix_t::HYB_ZO > & A,
    typename Field::ConstElement_ptr x,
    typename Field::Element_ptr y,
    uint64_t kmax) [inline]
```

**11.16.1.130 pfspmv()** [16/18]

```
template<class Field>
void pfspmv (
    const Field & F,
    const Sparse< Field, SparseMatrix_t::SELL > & A,
    typename Field::ConstElement_ptr x_,
    typename Field::Element_ptr y_,
    FieldCategories::GenericTag ) [inline]
```

**11.16.1.131 pfspmv()** [17/18]

```
template<class Field>
void pfspmv (
    const Field & F,
    const Sparse< Field, SparseMatrix_t::SELL > & A,
    typename Field::ConstElement_ptr x_,
    typename Field::Element_ptr y_,
    FieldCategories::UnparametricTag ) [inline]
```

**11.16.1.132 pfspmv()** [18/18]

```
template<class Field>
void pfspmv (
    const Field & F,
    const Sparse< Field, SparseMatrix_t::SELL > & A,
    typename Field::ConstElement_ptr x_,
    typename Field::Element_ptr y_,
    const int64_t kmax) [inline]
```

**11.16.1.133 pfspmv\_one()** [7/8]

```
template<class Field>
void pfspmv_one (
    const Field & F,
    const Sparse< Field, SparseMatrix_t::SELL_ZO > & A,
    typename Field::ConstElement_ptr x_,
    typename Field::Element_ptr y_,
    FieldCategories::GenericTag ) [inline]
```

**11.16.1.134 pfspmv\_mone()** [7/8]

```
template<class Field>
void pfspmv_mone (
    const Field & F,
    const Sparse< Field, SparseMatrix_t::SELL_ZO > & A,
    typename Field::ConstElement_ptr x_,
    typename Field::Element_ptr y_,
    FieldCategories::GenericTag ) [inline]
```

**11.16.1.135 pfspmv\_one()** [8/8]

```
template<class Field>
void pfspmv_one (
    const Field & F,
    const Sparse< Field, SparseMatrix_t::SELL_ZO > & A,
    typename Field::ConstElement_ptr x_,
    typename Field::Element_ptr y_,
    FieldCategories::UnparametricTag ) [inline]
```

**11.16.1.136 pfspmv\_mone()** [8/8]

```
template<class Field>
void pfspmv_mone (
    const Field & F,
    const Sparse< Field, SparseMatrix_t::SELL_ZO > & A,
    typename Field::ConstElement_ptr x_,
    typename Field::Element_ptr y_,
    FieldCategories::UnparametricTag ) [inline]
```

**11.16.1.137 fspmv()** [19/21]

```
template<class Field>
void fspmv (
    const Field & F,
    const Sparse< Field, SparseMatrix_t::SELL > & A,
    typename Field::ConstElement_ptr x_,
    typename Field::Element_ptr y_,
    FieldCategories::GenericTag ) [inline]
```

**11.16.1.138 fspmv\_simd()** [3/4]

```
template<class Field>
void fspmv_simd (
    const Field & F,
    const Sparse< Field, SparseMatrix_t::SELL > & A,
    typename Field::ConstElement_ptr x_,
    typename Field::Element_ptr y_,
    FieldCategories::UnparametricTag ) [inline]
```

**11.16.1.139 fspmv()** [20/21]

```
template<class Field>
void fspmv (
    const Field & F,
    const Sparse< Field, SparseMatrix_t::SELL > & A,
    typename Field::ConstElement_ptr x_,
    typename Field::Element_ptr y_,
    FieldCategories::UnparametricTag ) [inline]
```

**11.16.1.140 fspmv\_simd()** [4/4]

```
template<class Field>
void fspmv_simd (
    const Field & F,
    const Sparse< Field, SparseMatrix_t::SELL > & A,
    typename Field::ConstElement_ptr x_,
    typename Field::Element_ptr y_,
    const uint64_t kmax) [inline]
```

**11.16.1.141 fspmv()** [21/21]

```
template<class Field>
void fspmv (
    const Field & F,
    const Sparse< Field, SparseMatrix_t::SELL > & A,
    typename Field::ConstElement_ptr x_,
    typename Field::Element_ptr y_,
    const uint64_t kmax) [inline]
```

**11.16.1.142 fspmv\_one()** [9/10]

```
template<class Field>
void fspmv_one (
    const Field & F,
    const Sparse< Field, SparseMatrix_t::SELL_ZO > & A,
    typename Field::ConstElement_ptr x_,
    typename Field::Element_ptr y_,
    FieldCategories::GenericTag ) [inline]
```

**11.16.1.143 fspmv\_mone()** [9/10]

```
template<class Field>
void fspmv_mone (
    const Field & F,
    const Sparse< Field, SparseMatrix_t::SELL_ZO > & A,
    typename Field::ConstElement_ptr x_,
    typename Field::Element_ptr y_,
    FieldCategories::GenericTag ) [inline]
```

**11.16.1.144 fspmv\_one\_simd()** [2/2]

```
template<class Field>
void fspmv_one_simd (
    const Field & F,
    const Sparse< Field, SparseMatrix_t::SELL_ZO > & A,
    typename Field::ConstElement_ptr x_,
    typename Field::Element_ptr y_,
    FieldCategories::UnparametricTag ) [inline]
```

**11.16.1.145 fspmv\_mone\_simd()** [2/2]

```
template<class Field>
void fspmv_mone_simd (
    const Field & F,
    const Sparse< Field, SparseMatrix_t::SELL_ZO > & A,
    typename Field::ConstElement_ptr x_,
    typename Field::Element_ptr y_,
    FieldCategories::UnparametricTag ) [inline]
```

**11.16.1.146 fspmv\_one()** [10/10]

```
template<class Field>
void fspmv_one (
    const Field & F,
    const Sparse< Field, SparseMatrix_t::SELL_ZO > & A,
    typename Field::ConstElement_ptr x_,
    typename Field::Element_ptr y_,
    FieldCategories::UnparametricTag ) [inline]
```

**11.16.1.147 fspmv\_mone()** [10/10]

```
template<class Field>
void fspmv_mone (
    const Field & F,
    const Sparse< Field, SparseMatrix_t::SELL_ZO > & A,
    typename Field::ConstElement_ptr x_,
    typename Field::Element_ptr y_,
    FieldCategories::UnparametricTag ) [inline]
```

**11.17 FFLAS::StrategyParameter Namespace Reference****Data Structures**

- struct [Fixed](#)
- struct [Grain](#)
- struct [Threads](#)
- struct [ThreeD](#)
- struct [ThreeDAdaptive](#)
- struct [ThreeDInPlace](#)
- struct [TwoD](#)
- struct [TwoDAdaptive](#)

**11.18 FFLAS::StructureHelper Namespace Reference**

[StructureHelper](#) for ftrsm.

**Data Structures**

- struct [Hybrid](#)
- struct [Iterative](#)
- struct [Recursive](#)

**11.18.1 Detailed Description**

[StructureHelper](#) for ftrsm.

## 11.19 FFLAS::vectorised Namespace Reference

### Namespaces

- namespace [unswitch](#)

### Data Structures

- struct [HelperMod](#)
- struct [HelperMod](#)< [Field](#), [ElementCategories::MachineIntTag](#) >
- struct [HelperMod](#)< [Field](#), [FFLAS::ElementCategories::ArbitraryPrecIntTag](#) >
- struct [HelperMod](#)< [Field](#), [FFLAS::ElementCategories::FixedPrecIntTag](#) >
- struct [HelperMod](#)< [Field](#), [FFLAS::ElementCategories::MachineFloatTag](#) >

### Functions

- template<class SimdT, class Element, bool positive>  
std::enable\_if< [is\\_simd](#)< SimdT >::value, void >::type [VEC\\_ADD](#) (SimdT &C, SimdT &A, SimdT &B, SimdT &Q, SimdT &T, SimdT &P, SimdT &NEGP, SimdT &MIN, SimdT &MAX)
- template<bool positive, class Element, class T1, class T2>  
std::enable\_if< [FFLAS::support\\_simd\\_add](#)< Element >::value, void >::type [addp](#) (Element \*T, const Element \*TA, const Element \*TB, size\_t n, Element p, T1 min\_, T2 max\_)
- template<class SimdT, class Element, bool positive>  
std::enable\_if< [is\\_simd](#)< SimdT >::value, void >::type [VEC\\_SUB](#) (SimdT &C, SimdT &A, SimdT &B, SimdT &Q, SimdT &T, SimdT &P, SimdT &NEGP, SimdT &MIN, SimdT &MAX)
- template<bool positive, class Element, class T1, class T2>  
std::enable\_if< [FFLAS::support\\_simd\\_add](#)< Element >::value, void >::type [subp](#) (Element \*T, const Element \*TA, const Element \*TB, const size\_t n, const Element p, const T1 min\_, const T2 max\_)
- template<class Element>  
std::enable\_if< [FFLAS::support\\_simd\\_add](#)< Element >::value, void >::type [add](#) (Element \*T, const Element \*TA, const Element \*TB, size\_t n)
- template<class Element>  
std::enable\_if< [FFLAS::support\\_simd\\_add](#)< Element >::value, void >::type [sub](#) (Element \*T, const Element \*TA, const Element \*TB, size\_t n)
- template<class [Field](#)>  
std::enable\_if< [FFLAS::support\\_fast\\_mod](#)< typename [Field](#)::Element >::value, void >::type [axpyp](#) (const [Field](#) &F, const typename [Field](#)::Element a, typename [Field](#)::ConstElement\_ptr X, typename [Field](#)::Element\_ptr Y, const size\_t n)
- template<class [Field](#)>  
std::enable\_if< [FFLAS::support\\_fast\\_mod](#)< typename [Field](#)::Element >::value, void >::type [axpyp](#) (const [Field](#) &F, const typename [Field](#)::Element a, typename [Field](#)::ConstElement\_ptr X, typename [Field](#)::Element\_ptr Y, const size\_t n, const size\_t incX, const size\_t incY)
- template<class T>  
std::enable\_if< !std::is\_integral< T >::value, T >::type [reduce](#) (T A, T B)
- template<class T>  
std::enable\_if< std::is\_integral< T >::value, T >::type [reduce](#) (T A, T B)
- template<> [Givaro::Integer](#) [reduce](#) ([Givaro::Integer](#) A, [Givaro::Integer](#) B)
- float [reduce](#) (float A, float B, float invB, float min, float max)
- double [reduce](#) (double A, double B, double invB, double min, double max)
- int64\_t [reduce](#) (int64\_t A, int64\_t p, double invp, double min, double max, int64\_t pow50rem)
- template<class [Field](#)>  
[Field](#)::Element [reduce](#) (typename [Field](#)::Element A, [HelperMod](#)< [Field](#), [ElementCategories::MachineIntTag](#) > &H)

- `template<class Field>`  
`Field::Element reduce (typename Field::Element A, HelperMod< Field, ElementCategories::MachineFloatTag > &H)`
- `template<class Field>`  
`Field::Element reduce (typename Field::Element A, HelperMod< Field, ElementCategories::ArbitraryPrecIntTag > &H)`
- `template<class Field>`  
`std::enable_if< FFLAS::support_fast_mod< typenameField::Element >::value, void >::type modp (const Field &F, typename Field::ConstElement_ptr U, const size_t &n, typename Field::Element_ptr T)`
- `template<class Field>`  
`std::enable_if< FFLAS::support_fast_mod< typenameField::Element >::value, void >::type modp (const Field &F, typename Field::ConstElement_ptr U, const size_t &n, const size_t &incX, typename Field::Element_ptr T)`
- `template<class Field>`  
`std::enable_if< FFLAS::support_fast_mod< typenameField::Element >::value, void >::type scalp (const Field &F, typename Field::Element_ptr T, const typename Field::Element alpha, typename Field::ConstElement_ptr U, const size_t n)`
- `template<class Field>`  
`std::enable_if< FFLAS::support_fast_mod< typenameField::Element >::value, void >::type scalp (const Field &F, typename Field::Element_ptr T, const typename Field::Element alpha, typename Field::ConstElement_ptr U, const size_t n, const size_t &incX)`
- `template<class Field>`  
`std::enable_if< FFLAS::support_fast_mod< typenameField::Element >::value, void >::type scalp (const Field &F, typename Field::Element_ptr T, const typename Field::Element alpha, typename Field::ConstElement_ptr U, const size_t n, const size_t &incX, const size_t &incY)`

## 11.19.1 Function Documentation

### 11.19.1.1 VEC\_ADD()

```
template<class SimdT, class Element, bool positive>
std::enable_if< is_simd< SimdT >::value, void >::type VEC_ADD (
    SimdT & C,
    SimdT & A,
    SimdT & B,
    SimdT & Q,
    SimdT & T,
    SimdT & P,
    SimdT & NEGP,
    SimdT & MIN,
    SimdT & MAX) [inline]
```

### 11.19.1.2 addp()

```
template<bool positive, class Element, class T1, class T2>
std::enable_if< FFLAS::support_simd_add< Element >::value, void >::type addp (
    Element * T,
    const Element * TA,
    const Element * TB,
    size_t n,
    Element p,
    T1 min_,
    T2 max_) [inline]
```

### 11.19.1.3 VEC\_SUB()

```
template<class SimdT, class Element, bool positive>
std::enable_if< is\_simd< SimdT >::value, void >::type VEC_SUB (
    SimdT & C,
    SimdT & A,
    SimdT & B,
    SimdT & Q,
    SimdT & T,
    SimdT & P,
    SimdT & NEGP,
    SimdT & MIN,
    SimdT & MAX) [inline]
```

### 11.19.1.4 subp()

```
template<bool positive, class Element, class T1, class T2>
std::enable_if< FFLAS::support\_simd\_add< Element >::value, void >::type subp (
    Element * T,
    const Element * TA,
    const Element * TB,
    const size_t n,
    const Element p,
    const T1 min_,
    const T2 max_) [inline]
```

### 11.19.1.5 add()

```
template<class Element>
std::enable_if< FFLAS::support\_simd\_add< Element >::value, void >::type add (
    Element * T,
    const Element * TA,
    const Element * TB,
    size_t n) [inline]
```

### 11.19.1.6 sub()

```
template<class Element>
std::enable_if< FFLAS::support\_simd\_add< Element >::value, void >::type sub (
    Element * T,
    const Element * TA,
    const Element * TB,
    size_t n) [inline]
```

### 11.19.1.7 axpyp() [1/2]

```
template<class Field>
std::enable_if< FFLAS::support\_fast\_mod< typenameField::Element >::value, void >::type axpyp
(
    const Field & F,
    const typename Field::Element a,
    typename Field::ConstElement_ptr X,
    typename Field::Element_ptr Y,
    const size_t n) [inline]
```



**11.19.1.8 axpyp()** [2/2]

```
template<class Field>
std::enable_if< FFLAS::support_fast_mod< typenameField::Element >::value, void >::type axpyp
(
    const Field & F,
    const typename Field::Element a,
    typename Field::ConstElement_ptr X,
    typename Field::Element_ptr Y,
    const size_t n,
    const size_t incX,
    const size_t incY) [inline]
```

**11.19.1.9 reduce()** [1/9]

```
template<class T>
std::enable_if<!std::is_integral< T >::value, T >::type reduce (
    T A,
    T B) [inline]
```

**11.19.1.10 reduce()** [2/9]

```
template<class T>
std::enable_if< std::is_integral< T >::value, T >::type reduce (
    T A,
    T B) [inline]
```

**11.19.1.11 reduce()** [3/9]

```
template<>
Givaro::Integer reduce (
    Givaro::Integer A,
    Givaro::Integer B) [inline]
```

**11.19.1.12 reduce()** [4/9]

```
float reduce (
    float A,
    float B,
    float invB,
    float min,
    float max) [inline]
```

**11.19.1.13 reduce()** [5/9]

```
double reduce (
    double A,
    double B,
    double invB,
    double min,
    double max) [inline]
```

**11.19.1.14 reduce()** [6/9]

```
int64_t reduce (
    int64_t A,
    int64_t p,
    double invp,
    double min,
    double max,
    int64_t pow50rem) [inline]
```

**11.19.1.15 reduce()** [7/9]

```
template<class Field>
Field::Element reduce (
    typename Field::Element A,
    HelperMod< Field, ElementCategories::MachineIntTag > & H) [inline]
```

**11.19.1.16 reduce()** [8/9]

```
template<class Field>
Field::Element reduce (
    typename Field::Element A,
    HelperMod< Field, ElementCategories::MachineFloatTag > & H) [inline]
```

**11.19.1.17 reduce()** [9/9]

```
template<class Field>
Field::Element reduce (
    typename Field::Element A,
    HelperMod< Field, ElementCategories::ArbitraryPrecIntTag > & H) [inline]
```

**11.19.1.18 modp()** [1/2]

```
template<class Field>
std::enable_if< FFLAS::support_fast_mod< typenameField::Element >::value, void >::type modp (
    const Field & F,
    typename Field::ConstElement_ptr U,
    const size_t & n,
    typename Field::Element_ptr T) [inline]
```

**11.19.1.19 modp()** [2/2]

```
template<class Field>
std::enable_if< FFLAS::support_fast_mod< typenameField::Element >::value, void >::type modp (
    const Field & F,
    typename Field::ConstElement_ptr U,
    const size_t & n,
    const size_t & incX,
    typename Field::Element_ptr T) [inline]
```

**11.19.1.20 scalp() [1/3]**

```
template<class Field>
std::enable_if< FFLAS::support_fast_mod< typenameField::Element >::value, void >::type scalp
(
    const Field & F,
    typename Field::Element_ptr T,
    const typename Field::Element alpha,
    typename Field::ConstElement_ptr U,
    const size_t n) [inline]
```

**11.19.1.21 scalp() [2/3]**

```
template<class Field>
std::enable_if< FFLAS::support_fast_mod< typenameField::Element >::value, void >::type scalp
(
    const Field & F,
    typename Field::Element_ptr T,
    const typename Field::Element alpha,
    typename Field::ConstElement_ptr U,
    const size_t n,
    const size_t & incX) [inline]
```

**11.19.1.22 scalp() [3/3]**

```
template<class Field>
std::enable_if< FFLAS::support_fast_mod< typenameField::Element >::value, void >::type scalp
(
    const Field & F,
    typename Field::Element_ptr T,
    const typename Field::Element alpha,
    typename Field::ConstElement_ptr U,
    const size_t n,
    const size_t & incX,
    const size_t & incY) [inline]
```

**11.20 FFLAS::vectorised::unswitch Namespace Reference****Functions**

- template<class Field>  
std::enable\_if< !FFLAS::support\_simd\_mod< typenameField::Element >::value &&FFLAS::support\_fast\_mod< typenameField::Element >::value, void >::type axpyp (const Field &F, const typename Field::Element a, typename Field::ConstElement\_ptr X, typename Field::Element\_ptr Y, const size\_t n, HelperMod< Field > &H)
- template<class Field>  
std::enable\_if< FFLAS::support\_fast\_mod< typenameField::Element >::value, void >::type axpyp (const Field &F, const typename Field::Element a, typename Field::ConstElement\_ptr X, typename Field::Element\_ptr Y, const size\_t n, const size\_t incX, const size\_t incY, HelperMod< Field > &H)

- `template<class Field>`  
`std::enable_if<!FFLAS::support_simd_mod< typenameField::Element >::value &&FFLAS::support_fast_mod<`  
`typenameField::Element >::value, void >::type modp (const Field &F, typename Field::ConstElement_ptr U,`  
`const size_t &n, typename Field::Element_ptr T, HelperMod< Field > &H)`
- `template<class Field>`  
`std::enable_if< FFLAS::support_fast_mod< typenameField::Element >::value, void >::type modp`  
`(const Field &F, typename Field::ConstElement_ptr U, const size_t &n, const size_t &incX, typename`  
`Field::Element_ptr T, HelperMod< Field > &H)`
- `template<class Field>`  
`std::enable_if<!FFLAS::support_simd_mod< typenameField::Element >::value &&FFLAS::support_fast_mod<`  
`typenameField::Element >::value, void >::type scalp (const Field &F, typename Field::Element_ptr T, const`  
`typename Field::Element alpha, typename Field::ConstElement_ptr U, const size_t n, HelperMod< Field >`  
`&H)`
- `template<class Field>`  
`std::enable_if< FFLAS::support_fast_mod< typenameField::Element >::value, void >::type scalp`  
`(const Field &F, typename Field::Element_ptr T, const typename Field::Element alpha, typename`  
`Field::ConstElement_ptr U, const size_t n, const size_t &incX, HelperMod< Field > &H)`
- `template<class Field>`  
`std::enable_if< FFLAS::support_fast_mod< typenameField::Element >::value, void >::type scalp`  
`(const Field &F, typename Field::Element_ptr T, const typename Field::Element alpha, typename`  
`Field::ConstElement_ptr U, const size_t n, const size_t &incX, const size_t &incY, HelperMod< Field >`  
`&H)`

## 11.20.1 Function Documentation

### 11.20.1.1 axpyp() [1/2]

```
template<class Field>
std::enable_if<!FFLAS::support_simd_mod< typenameField::Element >::value &&FFLAS::support_fast_mod<
typenameField::Element >::value, void >::type axpyp (
    const Field & F,
    const typename Field::Element a,
    typename Field::ConstElement_ptr X,
    typename Field::Element_ptr Y,
    const size_t n,
    HelperMod< Field > & H) [inline]
```

### 11.20.1.2 axpyp() [2/2]

```
template<class Field>
std::enable_if< FFLAS::support_fast_mod< typenameField::Element >::value, void >::type axpyp
(
    const Field & F,
    const typename Field::Element a,
    typename Field::ConstElement_ptr X,
    typename Field::Element_ptr Y,
    const size_t n,
    const size_t incX,
    const size_t incY,
    HelperMod< Field > & H) [inline]
```

**11.20.1.3 modp() [1/2]**

```
template<class Field>
std::enable_if<!FFLAS::support_simd_mod< typenameField::Element >::value &&FFLAS::support_fast_mod<
typenameField::Element >::value, void >::type modp (
    const Field & F,
    typename Field::ConstElement_ptr U,
    const size_t & n,
    typename Field::Element_ptr T,
    HelperMod< Field > & H) [inline]
```

**11.20.1.4 modp() [2/2]**

```
template<class Field>
std::enable_if< FFLAS::support_fast_mod< typenameField::Element >::value, void >::type modp (
    const Field & F,
    typename Field::ConstElement_ptr U,
    const size_t & n,
    const size_t & incX,
    typename Field::Element_ptr T,
    HelperMod< Field > & H) [inline]
```

**11.20.1.5 scalp() [1/3]**

```
template<class Field>
std::enable_if<!FFLAS::support_simd_mod< typenameField::Element >::value &&FFLAS::support_fast_mod<
typenameField::Element >::value, void >::type scalp (
    const Field & F,
    typename Field::Element_ptr T,
    const typename Field::Element alpha,
    typename Field::ConstElement_ptr U,
    const size_t n,
    HelperMod< Field > & H) [inline]
```

**11.20.1.6 scalp() [2/3]**

```
template<class Field>
std::enable_if< FFLAS::support_fast_mod< typenameField::Element >::value, void >::type scalp
(
    const Field & F,
    typename Field::Element_ptr T,
    const typename Field::Element alpha,
    typename Field::ConstElement_ptr U,
    const size_t n,
    const size_t & incX,
    HelperMod< Field > & H) [inline]
```

### 11.20.1.7 `scalp()` [3/3]

```
template<class Field>
std::enable_if< FFLAS::support_fast_mod< typenameField::Element >::value, void >::type scalp
(
    const Field & F,
    typename Field::Element_ptr T,
    const typename Field::Element alpha,
    typename Field::ConstElement_ptr U,
    const size_t n,
    const size_t & incX,
    const size_t & incY,
    HelperMod< Field > & H) [inline]
```

## 11.21 FFPACK Namespace Reference

Finite Field **PACK** Set of elimination based routines for dense linear algebra.

### Namespaces

- namespace [Protected](#)

### Data Structures

- class [callLUdivine\\_small](#)
- class [callLUdivine\\_small< double >](#)
- class [callLUdivine\\_small< float >](#)
- class [CharpolyFailed](#)
- class [CheckerImplem\\_charpoly](#)
- class [CheckerImplem\\_charpoly< Givaro::ZRing< Givaro::Integer >, Polynomial >](#)
- class [CheckerImplem\\_Det](#)
- class [CheckerImplem\\_invert](#)
- class [CheckerImplem\\_PLUQ](#)
- class [Failure](#)
  - A precondition failed.*
- struct [rns\\_double](#)
- struct [rns\\_double\\_elt](#)
- struct [rns\\_double\\_elt\\_cstptr](#)
- struct [rns\\_double\\_elt\\_ptr](#)
- struct [rns\\_double\\_extended](#)
- class [RNSInteger](#)
- class [RNSIntegerMod](#)
- class [rnsRandIter](#)

## Typedefs

- template<class [Field](#)>  
using [Checker\\_PLUQ](#) = [FFLAS::Checker\\_Empty](#)<[Field](#)>
- template<class [Field](#)>  
using [Checker\\_Det](#) = [FFLAS::Checker\\_Empty](#)<[Field](#)>
- template<class [Field](#)>  
using [Checker\\_invert](#) = [FFLAS::Checker\\_Empty](#)<[Field](#)>
- template<class [Field](#), class Polynomial>  
using [Checker\\_charpoly](#) = [FFLAS::Checker\\_Empty](#)<[Field](#)>
- template<class [Field](#)>  
using [ForceCheck\\_PLUQ](#) = [CheckerImplem\\_PLUQ](#)<[Field](#)>
- template<class [Field](#)>  
using [ForceCheck\\_Det](#) = [CheckerImplem\\_Det](#)<[Field](#)>
- template<class [Field](#)>  
using [ForceCheck\\_invert](#) = [CheckerImplem\\_invert](#)<[Field](#)>
- template<class [Field](#), class Polynomial>  
using [ForceCheck\\_charpoly](#) = [CheckerImplem\\_charpoly](#)<[Field](#), Polynomial>

## Functions

- void [LAPACKPerm2MathPerm](#) (size\_t \*MathP, const size\_t \*LapackP, const size\_t N)  
*Conversion of a permutation from LAPACK format to Math format.*
- void [MathPerm2LAPACKPerm](#) (size\_t \*LapackP, const size\_t \*MathP, const size\_t N)  
*Conversion of a permutation from Maths format to LAPACK format.*
- template<class [Field](#)>  
void [applyP](#) (const [Field](#) &F, const [FFLAS::FFLAS\\_SIDE](#) Side, const [FFLAS::FFLAS\\_TRANSPOSE](#) Trans, const size\_t M, const size\_t ibeg, const size\_t iend, typename [Field::Element\\_ptr](#) A, const size\_t lda, const size\_t \*P)  
*Computes  $P1 \times \text{Diag}(I_R, P2)$  where  $P1$  is a LAPACK and  $P2$  a LAPACK permutation and store the result in  $P1$  as a LAPACK permutation.*
- template<class [Field](#)>  
void [applyP](#) (const [Field](#) &F, const [FFLAS::FFLAS\\_SIDE](#) Side, const [FFLAS::FFLAS\\_TRANSPOSE](#) Trans, const size\_t m, const size\_t ibeg, const size\_t iend, typename [Field::Element\\_ptr](#) A, const size\_t lda, const size\_t \*P, const [FFLAS::ParSeqHelper::Sequential](#) seq)
- template<class [Field](#), class Cut, class Param>  
void [applyP](#) (const [Field](#) &F, const [FFLAS::FFLAS\\_SIDE](#) Side, const [FFLAS::FFLAS\\_TRANSPOSE](#) Trans, const size\_t m, const size\_t ibeg, const size\_t iend, typename [Field::Element\\_ptr](#) A, const size\_t lda, const size\_t \*P, const [FFLAS::ParSeqHelper::Parallel](#)< Cut, Param > par)
- template<class [Field](#)>  
void [MonotonicApplyP](#) (const [Field](#) &F, const [FFLAS::FFLAS\\_SIDE](#) Side, const [FFLAS::FFLAS\\_TRANSPOSE](#) Trans, const size\_t M, const size\_t ibeg, const size\_t iend, typename [Field::Element\\_ptr](#) A, const size\_t lda, const size\_t \*P, const size\_t R)  
*Apply a R-monotonically increasing permutation P, to the matrix A.*
- template<class [Field](#)>  
void [fgetrs](#) (const [Field](#) &F, const [FFLAS::FFLAS\\_SIDE](#) Side, const size\_t M, const size\_t N, const size\_t R, typename [Field::Element\\_ptr](#) A, const size\_t lda, const size\_t \*P, const size\_t \*Q, typename [Field::Element\\_ptr](#) B, const size\_t ldb, int \*info)  
*Solve the system  $AX = B$  or  $XA = B$ .*
- template<class [Field](#)>  
[Field::Element\\_ptr](#) [fgetrs](#) (const [Field](#) &F, const [FFLAS::FFLAS\\_SIDE](#) Side, const size\_t M, const size\_t N, const size\_t NRHS, const size\_t R, typename [Field::Element\\_ptr](#) A, const size\_t lda, const size\_t \*P, const size\_t \*Q, typename [Field::Element\\_ptr](#) X, const size\_t ldx, typename [Field::ConstElement\\_ptr](#) B, const size\_t ldb, int \*info)  
*Solve the system  $AX = B$  or  $XA = B$ .*

- `template<class Field>`  
`size_t fgesv (const Field &F, const FFLAS::FFLAS_SIDE Side, const size_t M, const size_t N, typename Field::Element_ptr A, const size_t lda, typename Field::Element_ptr B, const size_t ldb, int *info)`  
*Square system solver.*
- `template<class Field>`  
`size_t fgesv (const Field &F, const FFLAS::FFLAS_SIDE Side, const size_t M, const size_t N, const size_t NRHS, typename Field::Element_ptr A, const size_t lda, typename Field::Element_ptr X, const size_t ldx, typename Field::ConstElement_ptr B, const size_t ldb, int *info)`  
*Rectangular system solver.*
- `template<class Field>`  
`void ftrtri (const Field &F, const FFLAS::FFLAS_UPLO Uplo, const FFLAS::FFLAS_DIAG Diag, const size_t N, typename Field::Element_ptr A, const size_t lda, const size_t threshold=__FFLASFFPACK_FTRTRI_THRESHOLD)`  
*Compute the inverse of a triangular matrix.*
- `template<class Field>`  
`void trinv_left (const Field &F, const size_t N, typename Field::ConstElement_ptr L, const size_t ldl, typename Field::Element_ptr X, const size_t ldx)`
- `template<class Field>`  
`void ftrtrm (const Field &F, const FFLAS::FFLAS_SIDE side, const FFLAS::FFLAS_DIAG diag, const size_t N, typename Field::Element_ptr A, const size_t lda)`  
*Compute the product of two triangular matrices of opposite shape.*
- `template<class Field>`  
`void ftrstr (const Field &F, const FFLAS::FFLAS_SIDE side, const FFLAS::FFLAS_UPLO Uplo, const FFLAS::FFLAS_DIAG diagA, const FFLAS::FFLAS_DIAG diagB, const size_t N, typename Field::ConstElement_ptr A, const size_t lda, typename Field::Element_ptr B, const size_t ldb, const size_t threshold=__FFLASFFPACK_FTRSTR_THRESHOLD)`  
*Solve a triangular system with a triangular right hand side of the same shape.*
- `template<class Field>`  
`void ftrssyr2k (const Field &F, const FFLAS::FFLAS_UPLO Uplo, const FFLAS::FFLAS_DIAG diagA, const size_t N, typename Field::ConstElement_ptr A, const size_t lda, typename Field::Element_ptr B, const size_t ldx, const size_t ldb, const size_t threshold=__FFLASFFPACK_FTRSSYR2K_THRESHOLD)`  
*Solve a triangular system in a symmetric sum: find B upper/lower triangular such that  $A^T B + B^T A = C$  where C is symmetric.*
- `template<class Field>`  
`bool fsytrf (const Field &F, const FFLAS::FFLAS_UPLO UpLo, const size_t N, typename Field::Element_ptr A, const size_t lda, const size_t threshold=__FFLASFFPACK_FSYTRF_THRESHOLD)`  
*Triangular factorization of symmetric matrices.*
- `template<class Field>`  
`bool fsytrf (const Field &F, const FFLAS::FFLAS_UPLO UpLo, const size_t N, typename Field::Element_ptr A, const size_t lda, const FFLAS::ParSeqHelper::Sequential seq, const size_t threshold=__FFLASFFPACK_FSYTRF_THRESHOLD)`
- `template<class Field, class Cut, class Param>`  
`bool fsytrf (const Field &F, const FFLAS::FFLAS_UPLO UpLo, const size_t N, typename Field::Element_ptr A, const size_t lda, const FFLAS::ParSeqHelper::Parallel< Cut, Param > par, const size_t threshold=__FFLASFFPACK_FSYTRF_THRESHOLD)`
- `template<class Field>`  
`bool fsytrf_nonunit (const Field &F, const FFLAS::FFLAS_UPLO UpLo, const size_t N, typename Field::Element_ptr A, const size_t lda, typename Field::Element_ptr D, const size_t incD, const size_t threshold=__FFLASFFPACK_FSYTRF_THRESHOLD)`  
*Triangular factorization of symmetric matrices.*
- `template<class Field>`  
`size_t PLUQ (const Field &F, const FFLAS::FFLAS_DIAG Diag, const size_t M, const size_t N, typename Field::Element_ptr A, const size_t lda, size_t *P, size_t *Q)`  
*Compute a PLUQ factorization of the given matrix.*
- `template<class Field>`  
`size_t pPLUQ (const Field &F, const FFLAS::FFLAS_DIAG Diag, const size_t M, const size_t N, typename Field::Element_ptr A, const size_t lda, size_t *P, size_t *Q)`



- `template<class Field>`  
`size_t PLUQ (const Field &F, const FFLAS::FFLAS_DIAG Diag, const size_t M, const size_t N, type-`  
`name Field::Element_ptr A, const size_t lda, size_t *P, size_t *Q, const FFLAS::ParSeqHelper::Sequential`  
`&PSHelper, size_t BCThreshold=__FFLASFFPACK_PLUQ_THRESHOLD)`
- `template<class Field, class Cut, class Param>`  
`size_t PLUQ (const Field &F, const FFLAS::FFLAS_DIAG Diag, const size_t M, const size_t N, typename`  
`Field::Element_ptr A, const size_t lda, size_t *P, size_t *Q, const FFLAS::ParSeqHelper::Parallel< Cut,`  
`Param > &PSHelper)`
- `template<class Field>`  
`size_t LUdivine (const Field &F, const FFLAS::FFLAS_DIAG Diag, const FFLAS::FFLAS_TRANSPOSE trans,`  
`const size_t M, const size_t N, typename Field::Element_ptr A, const size_t lda, size_t *P, size_t *Qt,`  
`const FFPACK_LU_TAG LuTag=FfpackSlabRecursive, const size_t cutoff=__FFLASFFPACK_LUDIVINE↵`  
`_THRESHOLD)`  

*Compute the CUP or PLE factorization of the given matrix.*
- `template<class Field>`  
`size_t ColumnEchelonForm (const Field &F, const size_t M, const size_t N, typename Field::Element_ptr`  
`A, const size_t lda, size_t *P, size_t *Qt, bool transform=false, const FFPACK_LU_TAG Lu↵`  
`Tag=FfpackSlabRecursive)`  

*Compute the Column Echelon form of the input matrix in-place.*
- `template<class Field>`  
`size_t pColumnEchelonForm (const Field &F, const size_t M, const size_t N, typename Field::Element_ptr A,`  
`const size_t lda, size_t *P, size_t *Qt, bool transform=false, size_t numthreads=0, const FFPACK_LU_TAG`  
`LuTag=FfpackTileRecursive)`
- `template<class Field, class PSHelper>`  
`size_t ColumnEchelonForm (const Field &F, const size_t M, const size_t N, typename Field::Element_ptr A,`  
`const size_t lda, size_t *P, size_t *Qt, const bool transform, const FFPACK_LU_TAG LuTag, const PSHelper`  
`&psH)`
- `template<class Field>`  
`size_t RowEchelonForm (const Field &F, const size_t M, const size_t N, typename Field::Element_ptr`  
`A, const size_t lda, size_t *P, size_t *Qt, const bool transform=false, const FFPACK_LU_TAG Lu↵`  
`Tag=FfpackSlabRecursive)`  

*Compute the Row Echelon form of the input matrix in-place.*
- `template<class Field>`  
`size_t pRowEchelonForm (const Field &F, const size_t M, const size_t N, typename Field::Element_ptr A,`  
`const size_t lda, size_t *P, size_t *Qt, const bool transform=false, size_t numthreads=0, const FFPACK_↵`  
`LU_TAG LuTag=FfpackTileRecursive)`
- `template<class Field, class PSHelper>`  
`size_t RowEchelonForm (const Field &F, const size_t M, const size_t N, typename Field::Element_ptr A,`  
`const size_t lda, size_t *P, size_t *Qt, const bool transform, const FFPACK_LU_TAG LuTag, const PSHelper`  
`&psH)`
- `template<class Field>`  
`size_t ReducedColumnEchelonForm (const Field &F, const size_t M, const size_t N, typename`  
`Field::Element_ptr A, const size_t lda, size_t *P, size_t *Qt, const bool transform=false, const FFPACK_↵`  
`LU_TAG LuTag=FfpackSlabRecursive)`  

*Compute the Reduced Column Echelon form of the input matrix in-place.*
- `template<class Field>`  
`size_t pReducedColumnEchelonForm (const Field &F, const size_t M, const size_t N, typename`  
`Field::Element_ptr A, const size_t lda, size_t *P, size_t *Qt, const bool transform=false, size_t numthreads=0,`  
`const FFPACK_LU_TAG LuTag=FfpackTileRecursive)`
- `template<class Field, class PSHelper>`  
`size_t ReducedColumnEchelonForm (const Field &F, const size_t M, const size_t N, typename`  
`Field::Element_ptr A, const size_t lda, size_t *P, size_t *Qt, const bool transform, const FFPACK_LU↵`  
`_TAG LuTag, const PSHelper &psH)`
- `template<class Field>`  
`size_t ReducedRowEchelonForm (const Field &F, const size_t M, const size_t N, typename Field::Element_ptr`  
`A, const size_t lda, size_t *P, size_t *Qt, const bool transform=false, const FFPACK_LU_TAG Lu↵`  
`Tag=FfpackSlabRecursive)`

*Compute the Reduced Row Echelon form of the input matrix in-place.*

- `template<class Field>`  
`size_t pReducedRowEchelonForm (const Field &F, const size_t M, const size_t N, typename Field::Element_ptr A, const size_t lda, size_t *P, size_t *Qt, const bool transform=false, size_t numthreads=0, const FFPACK_LU_TAG LuTag=FpackTileRecursive)`
- `template<class Field, class PSHelper>`  
`size_t ReducedRowEchelonForm (const Field &F, const size_t M, const size_t N, typename Field::Element_ptr A, const size_t lda, size_t *P, size_t *Qt, const bool transform, const FFPACK_LU_TAG LuTag, const PSHelper &psH)`
- `template<class Field>`  
`Field::Element_ptr Invert (const Field &F, const size_t M, typename Field::Element_ptr A, const size_t lda, int &>nullity)`  
*Invert the given matrix in place or computes its nullity if it is singular.*
- `template<class Field>`  
`Field::Element_ptr Invert (const Field &F, const size_t M, typename Field::ConstElement_ptr A, const size_t lda, typename Field::Element_ptr X, const size_t ldx, int &>nullity)`  
*Invert the given matrix or computes its nullity if it is singular.*
- `template<class Field>`  
`Field::Element_ptr Invert2 (const Field &F, const size_t M, typename Field::Element_ptr A, const size_t lda, typename Field::Element_ptr X, const size_t ldx, int &>nullity)`  
*Invert the given matrix or computes its nullity if it is singular.*
- `template<class PolRing>`  
`std::list< typename PolRing::Element > & CharPoly (const PolRing &R, std::list< typename PolRing::Element > &charp, const size_t N, typename PolRing::Domain_t::Element_ptr A, const size_t lda, typename PolRing::Domain_t::RandIter &G, const FFPACK_CHARPOLY_TAG CharpTag=FpackAuto, const size_t degree=__FFLASFFPACK_ARITHPROG_THRESHOLD)`  
*Compute the characteristic polynomial of the matrix A.*
- `template<class PolRing>`  
`PolRing::Element & CharPoly (const PolRing &R, typename PolRing::Element &charp, const size_t N, typename PolRing::Domain_t::Element_ptr A, const size_t lda, typename PolRing::Domain_t::RandIter &G, const FFPACK_CHARPOLY_TAG CharpTag=FpackAuto, const size_t degree=__FFLASFFPACK_ARITHPROG_THRESHOLD)`  
*Compute the characteristic polynomial of the matrix A.*
- `template<class PolRing>`  
`PolRing::Element & CharPoly (const PolRing &R, typename PolRing::Element &charp, const size_t N, typename PolRing::Domain_t::Element_ptr A, const size_t lda, const FFPACK_CHARPOLY_TAG CharpTag=FpackAuto, const size_t degree=__FFLASFFPACK_ARITHPROG_THRESHOLD)`  
*Compute the characteristic polynomial of the matrix A.*
- `template<class Field, class Polynomial>`  
`Polynomial & MinPoly (const Field &F, Polynomial &minP, const size_t N, typename Field::ConstElement_ptr A, const size_t lda)`  
*Compute the minimal polynomial of the matrix A.*
- `template<class Field, class Polynomial, class RandIter>`  
`Polynomial & MinPoly (const Field &F, Polynomial &minP, const size_t N, typename Field::ConstElement_ptr A, const size_t lda, RandIter &G)`  
*Compute the minimal polynomial of the matrix A.*
- `template<class Field, class Polynomial>`  
`Polynomial & MatVecMinPoly (const Field &F, Polynomial &minP, const size_t N, typename Field::ConstElement_ptr A, const size_t lda, typename Field::ConstElement_ptr v, const size_t incv)`  
*Compute the minimal polynomial of the matrix A and a vector v, namely the first linear dependency relation in the Krylov basis  $(v, Av, \dots, A^N v)$ .*
- `template<class Field>`  
`size_t Rank (const Field &F, const size_t M, const size_t N, typename Field::Element_ptr A, const size_t lda)`  
*Computes the rank of the given matrix using a PLUQ factorization.*
- `template<class Field>`  
`size_t pRank (const Field &F, const size_t M, const size_t N, typename Field::Element_ptr A, const size_t lda, size_t numthreads=0)`

- template<class [Field](#), class PSHelper>  
 size\_t [Rank](#) (const [Field](#) &F, const size\_t M, const size\_t N, typename [Field::Element\\_ptr](#) A, const size\_t lda, const PSHelper &psH)
- template<class [Field](#)>  
 bool [IsSingular](#) (const [Field](#) &F, const size\_t M, const size\_t N, typename [Field::Element\\_ptr](#) A, const size\_t lda)  
*Returns true if the given matrix is singular.*
- template<class [Field](#)>  
[Field::Element](#) & [Det](#) (const [Field](#) &F, typename [Field::Element](#) &det, const size\_t N, typename [Field::Element\\_ptr](#) A, const size\_t lda, size\_t \*P=NULL, size\_t \*Q=NULL)  
*Returns the determinant of the given square matrix.*
- template<class [Field](#)>  
[Field::Element](#) & [pDet](#) (const [Field](#) &F, typename [Field::Element](#) &det, const size\_t N, typename [Field::Element\\_ptr](#) A, const size\_t lda, size\_t numthreads=0, size\_t \*P=NULL, size\_t \*Q=NULL)
- template<class [Field](#), class PSHelper>  
[Field::Element](#) & [Det](#) (const [Field](#) &F, typename [Field::Element](#) &det, const size\_t N, typename [Field::Element\\_ptr](#) A, const size\_t lda, const PSHelper &psH, size\_t \*P=NULL, size\_t \*Q=NULL)
- template<class [Field](#)>  
[Field::Element\\_ptr](#) [Solve](#) (const [Field](#) &F, const size\_t M, typename [Field::Element\\_ptr](#) A, const size\_t lda, typename [Field::Element\\_ptr](#) x, const int incx, typename [Field::ConstElement\\_ptr](#) b, const int incb)  
*Solves a linear system  $AX = b$  using PLUQ factorization.*
- template<class [Field](#), class PSHelper>  
[Field::Element\\_ptr](#) [Solve](#) (const [Field](#) &F, const size\_t M, typename [Field::Element\\_ptr](#) A, const size\_t lda, typename [Field::Element\\_ptr](#) x, const int incx, typename [Field::ConstElement\\_ptr](#) b, const int incb, PSHelper &psH)
- template<class [Field](#)>  
[Field::Element\\_ptr](#) [pSolve](#) (const [Field](#) &F, const size\_t M, typename [Field::Element\\_ptr](#) A, const size\_t lda, typename [Field::Element\\_ptr](#) x, const int incx, typename [Field::ConstElement\\_ptr](#) b, const int incb, size\_t numthreads=0)
- template<class [Field](#)>  
 \*void [RandomNullSpaceVector](#) (const [Field](#) &F, const [FFLAS::FFLAS\\_SIDE](#) Side, const size\_t M, const size\_t N, typename [Field::Element\\_ptr](#) A, const size\_t lda, typename [Field::Element\\_ptr](#) X, const size\_t incX)  
*Solve  $LX = B$  or  $XL = B$  in place.*
- template<class [Field](#)>  
 size\_t [NullSpaceBasis](#) (const [Field](#) &F, const [FFLAS::FFLAS\\_SIDE](#) Side, const size\_t M, const size\_t N, typename [Field::Element\\_ptr](#) A, const size\_t lda, typename [Field::Element\\_ptr](#) &NS, size\_t &ldn, size\_t &NSdim)  
*Computes a basis of the Left/Right nullspace of the matrix A.*
- template<class [Field](#)>  
 size\_t [RowRankProfile](#) (const [Field](#) &F, const size\_t M, const size\_t N, typename [Field::Element\\_ptr](#) A, const size\_t lda, size\_t \*&rkprofile, const FFPACK\_LU\_TAG LuTag=[FfpackSlabRecursive](#))  
*Computes the row rank profile of A.*
- template<class [Field](#)>  
 size\_t [pRowRankProfile](#) (const [Field](#) &F, const size\_t M, const size\_t N, typename [Field::Element\\_ptr](#) A, const size\_t lda, size\_t \*&rkprofile, size\_t numthreads=0, const FFPACK\_LU\_TAG LuTag=[FfpackTileRecursive](#))
- template<class [Field](#), class PSHelper>  
 size\_t [RowRankProfile](#) (const [Field](#) &F, const size\_t M, const size\_t N, typename [Field::Element\\_ptr](#) A, const size\_t lda, size\_t \*&rkprofile, const FFPACK\_LU\_TAG LuTag, PSHelper &psH)
- template<class [Field](#)>  
 size\_t [ColumnRankProfile](#) (const [Field](#) &F, const size\_t M, const size\_t N, typename [Field::Element\\_ptr](#) A, const size\_t lda, size\_t \*&rkprofile, const FFPACK\_LU\_TAG LuTag=[FfpackSlabRecursive](#))  
*Computes the column rank profile of A.*
- template<class [Field](#)>  
 size\_t [pColumnRankProfile](#) (const [Field](#) &F, const size\_t M, const size\_t N, typename [Field::Element\\_ptr](#) A, const size\_t lda, size\_t \*&rkprofile, size\_t numthreads=0, const FFPACK\_LU\_TAG LuTag=[FfpackTileRecursive](#))

- template<class [Field](#), class PSHelper>  
 size\_t [ColumnRankProfile](#) (const [Field](#) &F, const size\_t M, const size\_t N, typename [Field::Element\\_ptr](#) A, const size\_t lda, size\_t \*rkprofile, const FFPACK\_LU\_TAG LuTag, PSHelper &psH)
- void [RankProfileFromLU](#) (const size\_t \*P, const size\_t N, const size\_t R, size\_t \*rkprofile, const FFPACK\_LU\_TAG LuTag)  
*Recovers the column/row rank profile from the permutation of an LU decomposition.*
- size\_t [LeadingSubmatrixRankProfiles](#) (const size\_t M, const size\_t N, const size\_t R, const size\_t LSm, const size\_t LSn, const size\_t \*P, const size\_t \*Q, size\_t \*RRP, size\_t \*CRP)  
*Recovers the row and column rank profiles of any leading submatrix from the PLUQ decomposition.*
- template<class [Field](#)>  
 size\_t [RowRankProfileSubmatrixIndices](#) (const [Field](#) &F, const size\_t M, const size\_t N, typename [Field::Element\\_ptr](#) A, const size\_t lda, size\_t \*&rowindices, size\_t \*&colindices, size\_t &R)  
*RowRankProfileSubmatrixIndices.*
- template<class [Field](#)>  
 size\_t [ColRankProfileSubmatrixIndices](#) (const [Field](#) &F, const size\_t M, const size\_t N, typename [Field::Element\\_ptr](#) A, const size\_t lda, size\_t \*&rowindices, size\_t \*&colindices, size\_t &R)  
*Computes the indices of the submatrix  $r \times r$  X of A whose columns correspond to the column rank profile of A.*
- template<class [Field](#)>  
 size\_t [RowRankProfileSubmatrix](#) (const [Field](#) &F, const size\_t M, const size\_t N, typename [Field::Element\\_ptr](#) A, const size\_t lda, typename [Field::Element\\_ptr](#) &X, size\_t &R)  
*Computes the  $r \times r$  submatrix X of A, by picking the row rank profile rows of A.*
- template<class [Field](#)>  
 size\_t [ColRankProfileSubmatrix](#) (const [Field](#) &F, const size\_t M, const size\_t N, typename [Field::Element\\_ptr](#) A, const size\_t lda, typename [Field::Element\\_ptr](#) &X, size\_t &R)  
*Compute the  $r \times r$  submatrix X of A, by picking the row rank profile rows of A.*
- template<class [Field](#)>  
 void [getTriangular](#) (const [Field](#) &F, const FFLAS::FFLAS\_UPLO Uplo, const FFLAS::FFLAS\_DIAG diag, const size\_t M, const size\_t N, const size\_t R, typename [Field::ConstElement\\_ptr](#) A, const size\_t lda, typename [Field::Element\\_ptr](#) T, const size\_t ldt, const bool OnlyNonZeroVectors=false)  
*Extracts a triangular matrix from a compact storage  $A=L\backslash U$  of rank R.*
- template<class [Field](#)>  
 void [getTriangular](#) (const [Field](#) &F, const FFLAS::FFLAS\_UPLO Uplo, const FFLAS::FFLAS\_DIAG diag, const size\_t M, const size\_t N, const size\_t R, typename [Field::Element\\_ptr](#) A, const size\_t lda)  
*Cleans up a compact storage  $A=L\backslash U$  to reveal a triangular matrix of rank R.*
- template<class [Field](#)>  
 void [getEchelonForm](#) (const [Field](#) &F, const FFLAS::FFLAS\_UPLO Uplo, const FFLAS::FFLAS\_DIAG diag, const size\_t M, const size\_t N, const size\_t R, const size\_t \*P, typename [Field::ConstElement\\_ptr](#) A, const size\_t lda, typename [Field::Element\\_ptr](#) T, const size\_t ldt, const bool OnlyNonZeroVectors=false, const FFPACK\_LU\_TAG LuTag=[FfpackSlabRecursive](#))  
*Extracts a matrix in echelon form from a compact storage  $A=L\backslash U$  of rank R obtained by RowEchelonForm or ColumnEchelonForm.*
- template<class [Field](#)>  
 void [getEchelonForm](#) (const [Field](#) &F, const FFLAS::FFLAS\_UPLO Uplo, const FFLAS::FFLAS\_DIAG diag, const size\_t M, const size\_t N, const size\_t R, const size\_t \*P, typename [Field::Element\\_ptr](#) A, const size\_t lda, const FFPACK\_LU\_TAG LuTag=[FfpackSlabRecursive](#))  
*Cleans up a compact storage  $A=L\backslash U$  obtained by RowEchelonForm or ColumnEchelonForm to reveal an echelon form of rank R.*
- template<class [Field](#)>  
 void [getEchelonTransform](#) (const [Field](#) &F, const FFLAS::FFLAS\_UPLO Uplo, const FFLAS::FFLAS\_DIAG diag, const size\_t M, const size\_t N, const size\_t R, const size\_t \*P, const size\_t \*Q, typename [Field::ConstElement\\_ptr](#) A, const size\_t lda, typename [Field::Element\\_ptr](#) T, const size\_t ldt, const FFPACK\_LU\_TAG LuTag=[FfpackSlabRecursive](#))  
*Extracts a transformation matrix to echelon form from a compact storage  $A=L\backslash U$  of rank R obtained by RowEchelonForm or ColumnEchelonForm.*

- `template<class Field>`  
`void getReducedEchelonForm (const Field &F, const FFLAS::FFLAS_UPLO Uplo, const size_t M, const size_t N, const size_t R, const size_t *P, typename Field::ConstElement_ptr A, const size_t lda, typename Field::Element_ptr T, const size_t ldt, const bool OnlyNonZeroVectors=false, const FFPACK_LU_TAG LuTag=FpackSlabRecursive)`  
*Extracts a matrix in echelon form from a compact storage  $A=L\backslash U$  of rank  $R$  obtained by `ReducedRowEchelonForm` or `ReducedColumnEchelonForm` with `transform = true`.*
- `template<class Field>`  
`void getReducedEchelonForm (const Field &F, const FFLAS::FFLAS_UPLO Uplo, const size_t M, const size_t N, const size_t R, const size_t *P, typename Field::Element_ptr A, const size_t lda, const FFPACK_LU_TAG LuTag=FpackSlabRecursive)`  
*Cleans up a compact storage  $A=L\backslash U$  of rank  $R$  obtained by `ReducedRowEchelonForm` or `ReducedColumnEchelonForm` with `transform = true`.*
- `template<class Field>`  
`void getReducedEchelonTransform (const Field &F, const FFLAS::FFLAS_UPLO Uplo, const size_t M, const size_t N, const size_t R, const size_t *P, const size_t *Q, typename Field::ConstElement_ptr A, const size_t lda, typename Field::Element_ptr T, const size_t ldt, const FFPACK_LU_TAG LuTag=FpackSlabRecursive)`  
*Extracts a transformation matrix to echelon form from a compact storage  $A=L\backslash U$  of rank  $R$  obtained by `RowEchelonForm` or `ColumnEchelonForm`.*
- `void PLUQtoEchelonPermutation (const size_t N, const size_t R, const size_t *P, size_t *outPerm)`  
*Auxiliary routine: determines the permutation that changes a PLUQ decomposition into a echelon form revealing PLUQ decomposition.*
- `template<class Field>`  
`size_t LTBruhatGen (const Field &Fi, const FFLAS::FFLAS_DIAG diag, const size_t N, typename Field::Element_ptr A, const size_t lda, size_t *P, size_t *Q)`  
*LTBruhatGen Suppose  $A$  is Left Triangular Matrix This procedure computes the Bruhat Representation of  $A$  and return the rank of  $A$ .*
- `template<class Field>`  
`void getLTBruhatGen (const Field &Fi, const size_t N, const size_t r, const size_t *P, const size_t *Q, typename Field::Element_ptr R, const size_t ldr)`  
*GetLTBruhatGen This procedure Computes the Rank Revealing Matrix based on the Bruhta representation of a Matrix.*
- `template<class Field>`  
`void getLTBruhatGen (const Field &Fi, const FFLAS::FFLAS_UPLO Uplo, const FFLAS::FFLAS_DIAG diag, const size_t N, const size_t r, const size_t *P, const size_t *Q, typename Field::ConstElement_ptr A, const size_t lda, typename Field::Element_ptr T, const size_t ldt)`  
*GetLTBruhatGen This procedure computes the matrix  $L$  or  $U$  f the Bruhat Representation Suppose that  $A$  is the bruhat representation of a matrix.*
- `size_t LTQSorder (const size_t N, const size_t r, const size_t *P, const size_t *Q)`  
*LTQSorder This procedure computes the order of quasiseparability of a matrix.*
- `template<class Field>`  
`size_t CompressToBlockBiDiagonal (const Field &Fi, const FFLAS::FFLAS_UPLO Uplo, size_t N, size_t s, size_t r, const size_t *P, const size_t *Q, typename Field::Element_ptr A, size_t lda, typename Field::Element_ptr X, size_t ldx, size_t *K, size_t *M, size_t *T)`  
*CompressToBlockBiDiagonal This procedure compress a compact representation of a row echelon form or column echelon form.*
- `template<class Field>`  
`void ExpandBlockBiDiagonalToBruhat (const Field &Fi, const FFLAS::FFLAS_UPLO Uplo, size_t N, size_t s, size_t r, typename Field::Element_ptr A, size_t lda, typename Field::Element_ptr X, size_t ldx, size_t NbBlocks, size_t *K, size_t *M, size_t *T)`  
*ExpandBlockBiDiagonal This procedure expand a compact representation of a row echelon form or column echelon form.*
- `void Bruhat2EchelonPermutation (size_t N, size_t R, const size_t *P, const size_t *Q, size_t *M)`  
*Bruhat2EchelonPermutation ( $N, R, P, Q$ ) Compute  $M$  such that  $LM$  or  $MU$  is in echelon form where  $L$  or  $U$  are factors of the Bruhat Representation.*
- `size_t * Tinverter (size_t *T, size_t r)`

- `template<class Field>`  
`void ComputeRPermutation (const Field &Fi, size_t N, size_t r, const size_t *P, const size_t *Q, size_t *R, size_t *MU, size_t *ML)`
- `template<class Field>`  
`void productBruhatxTS (const Field &Fi, size_t N, size_t s, size_t r, const size_t *P, const size_t *Q, const typename Field::Element_ptr Xu, size_t ldu, size_t NbBlocksU, size_t *Ku, size_t *Tu, size_t *MU, const typename Field::Element_ptr XI, size_t ldl, size_t NbBlocksL, size_t *KI, size_t *TI, size_t *ML, typename Field::Element_ptr B, size_t t, size_t ldb, typename Field::Element_ptr C, size_t ldc)`  
*productBruhatxTS Compute the product between the CRE compact representation of a matrix A and B a tall matrix*
- `template<class Field>`  
`Field::Element_ptr LQUPtoInverseOfFullRankMinor (const Field &F, const size_t rank, typename Field::Element_ptr A_factors, const size_t lda, const size_t *QtPointer, typename Field::Element_ptr X, const size_t ldx)`  
*LQUPtoInverseOfFullRankMinor.*
- `template<class Field>`  
`void RandomNullSpaceVector (const Field &F, const FFLAS::FFLAS_SIDE Side, const size_t M, const size_t N, typename Field::Element_ptr A, const size_t lda, typename Field::Element_ptr X, const size_t incX)`  
*Solve  $LX = B$  or  $XL = B$  in place.*
- `template<class Field>`  
`void solveLB (const Field &F, const FFLAS::FFLAS_SIDE Side, const size_t M, const size_t N, const size_t R, typename Field::Element_ptr L, const size_t ldl, const size_t *Q, typename Field::Element_ptr B, const size_t ldb)`
- `template<class Field>`  
`void solveLB2 (const Field &F, const FFLAS::FFLAS_SIDE Side, const size_t M, const size_t N, const size_t R, typename Field::Element_ptr L, const size_t ldl, const size_t *Q, typename Field::Element_ptr B, const size_t ldb)`
- `size_t * Tinverter (const size_t *T, size_t r)`
- `template<class Field>`  
`void ComputeRPermutation (const Field &Fi, size_t N, size_t r, const size_t *P, const size_t *Q, size_t *R, const size_t *MU, const size_t *ML)`
- `template<class Field>`  
`Field::Element_ptr expandLCRE (const Field &Fi, size_t N, size_t s, size_t r, size_t *R, size_t i, typename Field::ConstElement_ptr Xu, size_t ldu, size_t NbBlocksU, const size_t *Ku, const size_t *Tuinv, typename Field::ConstElement_ptr XI, size_t ldl, size_t NbBlocksL, const size_t *KI, const size_t *Tlinv, typename Field::Element_ptr CRE, size_t ldcre)`  
*Expands an anti-diagonal block of a left triangular matrix from its compact Bruhat representation.*
- `template<class Field>`  
`void productBruhatxTS (const Field &Fi, size_t N, size_t s, size_t r, size_t t, const size_t *P, const size_t *Q, typename Field::ConstElement_ptr Xu, size_t ldu, size_t NbBlocksU, const size_t *Ku, const size_t *Tu, const size_t *MU, typename Field::ConstElement_ptr XI, size_t ldl, size_t NbBlocksL, const size_t *KI, const size_t *TI, const size_t *ML, typename Field::Element_ptr B, size_t ldb, const typename Field::Element beta, typename Field::Element_ptr D, size_t ldd)`  
*Compute the product of a left-triangular quasi-separable matrix A, represented by a compact Bruhat generator, with a dense rectangular matrix  $B: C \leftarrow A \times B + \text{beta}C$ .*
- `template<class Field, class Polynomial>`  
`std::list< Polynomial > & Danilevski (const Field &F, std::list< Polynomial > &charp, const size_t N, typename Field::Element_ptr A, const size_t lda)`
- `template<class Field>`  
`Field::Element_ptr buildMatrix (const Field &F, typename Field::ConstElement_ptr E, typename Field::ConstElement_ptr C, const size_t lda, const size_t *B, const size_t *T, const size_t me, const size_t mc, const size_t lambda, const size_t mu)`
- `FFPACK::RNSInteger< FFPACK::rns_double >::Element_ptr CharPoly (const FFPACK::RNSInteger< FFPACK::rns_double > &F, typename FFPACK::RNSInteger< FFPACK::rns_double >::Element_ptr charp, const size_t N, typename FFPACK::RNSInteger< FFPACK::rns_double >::Element_ptr A, const size_t lda, Givaro::ZRing< Givaro::Integer >::RandIter &G, const FFPACK_CHARPOLY_TAG CharpTag, size_t degree)`



- `template<> Givaro::Poly1Dom< Givaro::ZRing< Givaro::Integer > >::Element & CharPoly` (const Givaro::Poly1Dom< Givaro::ZRing< Givaro::Integer > > &R, Givaro::Poly1Dom< Givaro::ZRing< Givaro::Integer > >::Element &charp, const size\_t N, Givaro::Integer \*A, const size\_t lda, Givaro::ZRing< Givaro::Integer >::RandIter &G, const FFPACK\_CHARPOLY\_TAG CharpTag, size\_t degree)
- `template<class PSHelper>`  
`FFPACK::RNSInteger< FFPACK::rns_double >::Element_ptr & Det` (const FFPACK::RNSInteger< FFPACK::rns\_double > &F, typename FFPACK::RNSInteger< FFPACK::rns\_double >::Element\_ptr &det, const size\_t N, typename FFPACK::RNSInteger< FFPACK::rns\_double >::Element\_ptr A, const size\_t lda, const PSHelper &psH)
- `template<class PSHelper>`  
`Givaro::Integer & Det` (const Givaro::ZRing< Givaro::Integer > &F, Givaro::Integer &det, const size\_t N, Givaro::Integer \*A, const size\_t lda, const PSHelper &psH, size\_t \*P, size\_t \*Q)
- `template<class Field>`  
`bool fsytrf_BC_Crout` (const Field &F, const FFLAS::FFLAS\_UPLO UpLo, const size\_t N, typename Field::Element\_ptr A, const size\_t lda, typename Field::Element\_ptr Dinv, const size\_t incDinv)
- `template<class Field>`  
`size_t fsytrf_BC_RL` (const Field &F, const FFLAS::FFLAS\_UPLO UpLo, const size\_t N, typename Field::Element\_ptr A, const size\_t lda, typename Field::Element\_ptr Dinv, const size\_t incDinv)
- `template<class Field>`  
`size_t fsytrf_UP_RPM_BC_RL` (const Field &F, const size\_t N, typename Field::Element\_ptr A, const size\_t lda, typename Field::Element\_ptr Dinv, const size\_t incDinv, size\_t \*P)
- `template<class Field>`  
`size_t fsytrf_LOW_RPM_BC_Crout` (const Field &F, const size\_t N, typename Field::Element\_ptr A, const size\_t lda, typename Field::Element\_ptr Dinv, const size\_t incDinv, size\_t \*P)
- `template<class Field>`  
`size_t fsytrf_UP_RPM_BC_Crout` (const Field &F, const size\_t N, typename Field::Element\_ptr A, const size\_t lda, typename Field::Element\_ptr Dinv, const size\_t incDinv, size\_t \*P)
- `template<class Field>`  
`size_t fsytrf_UP_RPM` (const Field &Fi, const size\_t N, typename Field::Element\_ptr A, const size\_t lda, typename Field::Element\_ptr Dinv, const size\_t incDinv, size\_t \*P, size\_t BCThreshold)
- `template<class Field>`  
`bool fsytrf_nonunit` (const Field &F, const FFLAS::FFLAS\_UPLO UpLo, const size\_t N, typename Field::Element\_ptr A, const size\_t lda, typename Field::Element\_ptr Dinv, const size\_t incDinv, FFLAS::ParSeqHelper::Sequential seq, size\_t threshold)
- `template<class Field, class Cut, class Param>`  
`bool fsytrf_nonunit` (const Field &F, const FFLAS::FFLAS\_UPLO UpLo, const size\_t N, typename Field::Element\_ptr A, const size\_t lda, typename Field::Element\_ptr Dinv, const size\_t incDinv, FFLAS::ParSeqHelper::Parallel< Cut, Param > par, size\_t threshold)
- `template<class Field>`  
`size_t fsytrf_RPM` (const Field &F, const FFLAS::FFLAS\_UPLO UpLo, const size\_t N, typename Field::Element\_ptr A, const size\_t lda, size\_t \*P, size\_t threshold)
- `template<class Field>`  
`void getTridiagonal` (const Field &F, const size\_t N, const size\_t R, typename Field::ConstElement\_ptr A, const size\_t lda, size\_t \*P, typename Field::Element\_ptr T, const size\_t ldt)
- `template<class Field>`  
`size_t LUdivine_gauss` (const Field &F, const FFLAS::FFLAS\_DIAG Diag, const size\_t M, const size\_t N, typename Field::Element\_ptr A, const size\_t lda, size\_t \*P, size\_t \*Q, const FFPACK::FFPACK\_LU\_TAG LuTag)
- `template<class Field>`  
`size_t LUdivine_small` (const Field &F, const FFLAS::FFLAS\_DIAG Diag, const FFLAS::FFLAS\_TRANSPOSE trans, const size\_t M, const size\_t N, typename Field::Element\_ptr A, const size\_t lda, size\_t \*P, size\_t \*Q, const FFPACK::FFPACK\_LU\_TAG LuTag)
- `template<class Field>`  
`size_t LUdivine` (const Field &F, const FFLAS::FFLAS\_DIAG Diag, const FFLAS::FFLAS\_TRANSPOSE trans, const size\_t M, const size\_t N, typename Field::Element\_ptr A, const size\_t lda, size\_t \*P, size\_t \*Q, const FFPACK::FFPACK\_LU\_TAG LuTag, const size\_t cutoff)

- `template<> size_t LUdivine (const Givaro::Modular< Givaro::Integer > &F, const FFLAS::FFLAS_DIAG Diag, const FFLAS::FFLAS_TRANSPOSE trans, const size_t M, const size_t N, typename Givaro::Integer *A, const size_t lda, size_t *P, size_t *Q, const FFPACK::FFPACK_LU_TAG LuTag, const size_t cutoff)`
- `template<class Field>`  
`void MonotonicCompress (const Field &F, const FFLAS::FFLAS_SIDE Side, const size_t M, typename Field::Element_ptr A, const size_t lda, const size_t incA, const size_t *MathP, const size_t R, const size_t maxpiv, const size_t rowstomove, const std::vector< bool > &ispiv)`
- `template<class Field>`  
`void MonotonicCompressMorePivots (const Field &F, const FFLAS::FFLAS_SIDE Side, const size_t M, typename Field::Element_ptr A, const size_t lda, const size_t incA, const size_t *MathP, const size_t R, const size_t rowstomove, const size_t lenP)`
- `template<class Field>`  
`void MonotonicCompressCycles (const Field &F, const FFLAS::FFLAS_SIDE Side, const size_t M, typename Field::Element_ptr A, const size_t lda, const size_t incA, const size_t *MathP, const size_t lenP)`
- `template<class Field>`  
`void MonotonicExpand (const Field &F, const FFLAS::FFLAS_SIDE Side, const size_t M, typename Field::Element_ptr A, const size_t lda, const size_t incA, const size_t *MathP, const size_t R, const size_t maxpiv, const size_t rowstomove, const std::vector< bool > &ispiv)`
- `template<class Field>`  
`void applyP_block (const Field &F, const FFLAS::FFLAS_SIDE Side, const FFLAS::FFLAS_TRANSPOSE Trans, const size_t M, const size_t ibeg, const size_t iend, typename Field::Element_ptr A, const size_t lda, const size_t *P)`
- `template<class Field>`  
`void doApplyS (const Field &F, typename Field::Element_ptr A, const size_t lda, typename Field::Element_ptr tmp, const size_t width, const size_t M2, const size_t R1, const size_t R2, const size_t R3, const size_t R4)`
- `template<class Field>`  
`void MatrixApplyS (const Field &F, typename Field::Element_ptr A, const size_t lda, const size_t width, const size_t M2, const size_t R1, const size_t R2, const size_t R3, const size_t R4)`
- `template<class Field>`  
`void MatrixApplyS (const Field &F, typename Field::Element_ptr A, const size_t lda, const size_t width, const size_t M2, const size_t R1, const size_t R2, const size_t R3, const size_t R4, const FFLAS::ParSeqHelper::Sequential seq)`
- `template<class Field, class Cut, class Param>`  
`void MatrixApplyS (const Field &F, typename Field::Element_ptr A, const size_t lda, const size_t width, const size_t M2, const size_t R1, const size_t R2, const size_t R3, const size_t R4, const FFLAS::ParSeqHelper::Parallel< Cut, Param > par)`
- `template<class T>`  
`void PermApplyS (T *A, const size_t lda, const size_t width, const size_t M2, const size_t R1, const size_t R2, const size_t R3, const size_t R4)`
- `template<class Field>`  
`void doApplyT (const Field &F, typename Field::Element_ptr A, const size_t lda, typename Field::Element_ptr tmp, const size_t width, const size_t N2, const size_t R1, const size_t R2, const size_t R3, const size_t R4)`
- `template<class Field>`  
`void MatrixApplyT (const Field &F, typename Field::Element_ptr A, const size_t lda, const size_t width, const size_t N2, const size_t R1, const size_t R2, const size_t R3, const size_t R4)`
- `template<class Field>`  
`void MatrixApplyT (const Field &F, typename Field::Element_ptr A, const size_t lda, const size_t width, const size_t N2, const size_t R1, const size_t R2, const size_t R3, const size_t R4, const FFLAS::ParSeqHelper::Sequential seq)`
- `template<class Field, class Cut, class Param>`  
`void MatrixApplyT (const Field &F, typename Field::Element_ptr A, const size_t lda, const size_t width, const size_t N2, const size_t R1, const size_t R2, const size_t R3, const size_t R4, const FFLAS::ParSeqHelper::Parallel< Cut, Param > par)`
- `template<class T>`  
`void PermApplyT (T *A, const size_t lda, const size_t width, const size_t N2, const size_t R1, const size_t R2, const size_t R3, const size_t R4)`
- `void composePermutationsLLL (size_t *P1, const size_t *P2, const size_t R, const size_t N)`



*Computes  $P1 \times \text{Diag}(I\_R, P2)$  where  $P1$  is a LAPACK and  $P2$  a LAPACK permutation and store the result in  $P1$  as a LAPACK permutation.*

- void [composePermutationsLLM](#) (size\_t \*MathP, const size\_t \*P1, const size\_t \*P2, const size\_t R, const size\_t N)

*Computes  $P1 \times \text{Diag}(I\_R, P2)$  where  $P1$  is a LAPACK and  $P2$  a LAPACK permutation and store the result in  $MathP$  as a MathPermutation format.*

- void [composePermutationsMLM](#) (size\_t \*MathP1, const size\_t \*P2, const size\_t R, const size\_t N)  
*Computes  $MathP1 \times \text{Diag}(I\_R, P2)$  where  $MathP1$  is a MathPermutation and  $P2$  a LAPACK permutation and store the result in  $MathP1$  as a MathPermutation format.*
- void [cyclic\\_shift\\_mathPerm](#) (size\_t \*P, const size\_t s)
- template<class Field>  
void [cyclic\\_shift\\_row\\_col](#) (const Field &F, typename Field::Element\_ptr A, size\_t m, size\_t n, size\_t lda)
- template<class Field>  
void [cyclic\\_shift\\_row](#) (const Field &F, typename Field::Element\_ptr A, size\_t m, size\_t n, size\_t lda)
- template<typename T>  
void [cyclic\\_shift\\_row](#) (const RNSIntegerMod< T > &F, typename T::Element\_ptr A, size\_t m, size\_t n, size\_t lda)
- template<class Field>  
void [cyclic\\_shift\\_col](#) (const Field &F, typename Field::Element\_ptr A, size\_t m, size\_t n, size\_t lda)
- template<typename T>  
void [cyclic\\_shift\\_col](#) (const RNSIntegerMod< T > &F, typename T::Element\_ptr A, size\_t m, size\_t n, size\_t lda)
- template<class Field>  
size\_t [PLUQ\\_basecaseV3](#) (const Field &Fi, const FFLAS::FFLAS\_DIAG Diag, const size\_t M, const size\_t N, typename Field::Element \*A, const size\_t lda, size\_t \*P, size\_t \*Q)
- template<class Field>  
size\_t [PLUQ\\_basecaseV2](#) (const Field &Fi, const FFLAS::FFLAS\_DIAG Diag, const size\_t M, const size\_t N, typename Field::Element \*A, const size\_t lda, size\_t \*P, size\_t \*Q)
- template<class Field>  
size\_t [PLUQ\\_basecaseCrout](#) (const Field &Fi, const FFLAS::FFLAS\_DIAG Diag, const size\_t M, const size\_t N, typename Field::Element\_ptr A, const size\_t lda, size\_t \*P, size\_t \*Q)
- template<class Field>  
size\_t [\\_PLUQ](#) (const Field &Fi, const FFLAS::FFLAS\_DIAG Diag, const size\_t M, const size\_t N, typename Field::Element\_ptr A, const size\_t lda, size\_t \*P, size\_t \*Q, size\_t BCThreshold)
- template<class Cut, class Param>  
size\_t [PLUQ](#) (const Givaro::Modular< Givaro::Integer > &F, const FFLAS::FFLAS\_DIAG Diag, const size\_t M, const size\_t N, typename Givaro::Integer \*A, const size\_t lda, size\_t \*P, size\_t \*Q, size\_t BCThreshold, FFLAS::ParSeqHelper::Parallel< Cut, Param > &PSHelper)
- template<class Field>  
void [threads\\_fgemm](#) (const size\_t m, const size\_t n, const size\_t r, int nbthreads, size\_t \*W1, size\_t \*W2, size\_t \*W3, size\_t gamma)
- template<class Field>  
void [threads\\_ftsm](#) (const size\_t m, const size\_t n, int nbthreads, size\_t \*t1, size\_t \*t2)
- template<class Field>  
size\_t [PLUQ](#) (const Field &Fi, const FFLAS::FFLAS\_DIAG Diag, const size\_t M, const size\_t N, typename Field::Element\_ptr A, const size\_t lda, size\_t \*P, size\_t \*Q, const FFLAS::ParSeqHelper::Parallel< FFLAS::CuttingStrategy::Recursive, FFLAS::StrategyParameter::Threads > &PSHelper)
- template<>  
size\_t [rns\\_double\\_elt\\_ptr\\_fflas\\_const\\_cast](#) (rns\_double\_elt\_cstptr x)
- template<>  
size\_t [rns\\_double\\_elt\\_cstptr\\_fflas\\_const\\_cast](#) (rns\_double\_elt\_ptr x)
- template<typename Base\_t>  
void [cyclic\\_shift\\_row\\_col](#) (Base\_t \*A, size\_t m, size\_t n, size\_t lda)
- template<INST\_OR\_DECL>  
void [cyclic\\_shift\\_row](#) (const FFLAS\_FIELD< FFLAS\_ELT > &F, FFLAS\_ELT \*A, size\_t m, size\_t n, size\_t lda)
- template<INST\_OR\_DECL>  
void [cyclic\\_shift\\_col](#) (const FFLAS\_FIELD< FFLAS\_ELT > &F, FFLAS\_ELT \*A, size\_t m, size\_t n, size\_t lda)

- template [INST\\_OR\\_DECL](#) void [applyP](#) (const [FFLAS\\_FIELD](#)< [FFLAS\\_ELT](#) > &F, const [FFLAS::FFLAS\\_SIDE](#) Side, const [FFLAS::FFLAS\\_TRANSPOSE](#) Trans, const size\_t M, const size\_t ibeg, const size\_t iend, [FFLAS\\_ELT](#) \*A, const size\_t lda, const size\_t \*P)
- template [INST\\_OR\\_DECL](#) void [fgetrs](#) (const [FFLAS\\_FIELD](#)< [FFLAS\\_ELT](#) > &F, const [FFLAS::FFLAS\\_SIDE](#) Side, const size\_t M, const size\_t N, const size\_t R, [FFLAS\\_ELT](#) \*A, const size\_t lda, const size\_t \*P, const size\_t \*Q, [FFLAS\\_ELT](#) \*B, const size\_t ldb, int \*info)
- template [INST\\_OR\\_DECL](#) [FFLAS\\_ELT](#) \* [fgetrs](#) (const [FFLAS\\_FIELD](#)< [FFLAS\\_ELT](#) > &F, const [FFLAS::FFLAS\\_SIDE](#) Side, const size\_t M, const size\_t N, const size\_t NRHS, const size\_t R, [FFLAS\\_ELT](#) \*A, const size\_t lda, const size\_t \*P, const size\_t \*Q, [FFLAS\\_ELT](#) \*X, const size\_t ldx, const [FFLAS\\_ELT](#) \*B, const size\_t ldb, int \*info)
- template [INST\\_OR\\_DECL](#) size\_t [fgesv](#) (const [FFLAS\\_FIELD](#)< [FFLAS\\_ELT](#) > &F, const [FFLAS::FFLAS\\_SIDE](#) Side, const size\_t M, const size\_t N, [FFLAS\\_ELT](#) \*A, const size\_t lda, [FFLAS\\_ELT](#) \*B, const size\_t ldb, int \*info)
- template [INST\\_OR\\_DECL](#) size\_t [fgesv](#) (const [FFLAS\\_FIELD](#)< [FFLAS\\_ELT](#) > &F, const [FFLAS::FFLAS\\_SIDE](#) Side, const size\_t M, const size\_t N, const size\_t NRHS, [FFLAS\\_ELT](#) \*A, const size\_t lda, [FFLAS\\_ELT](#) \*X, const size\_t ldx, const [FFLAS\\_ELT](#) \*B, const size\_t ldb, int \*info)
- template [INST\\_OR\\_DECL](#) void [ftrtri](#) (const [FFLAS\\_FIELD](#)< [FFLAS\\_ELT](#) > &F, const [FFLAS::FFLAS\\_UPLO](#) Uplo, const [FFLAS::FFLAS\\_DIAG](#) Diag, const size\_t N, [FFLAS\\_ELT](#) \*A, const size\_t lda, const size\_t threshold)
- template [INST\\_OR\\_DECL](#) void [trinv\\_left](#) (const [FFLAS\\_FIELD](#)< [FFLAS\\_ELT](#) > &F, const size\_t N, const [FFLAS\\_ELT](#) \*L, const size\_t ldl, [FFLAS\\_ELT](#) \*X, const size\_t ldx)
- template [INST\\_OR\\_DECL](#) void [ftrrm](#) (const [FFLAS\\_FIELD](#)< [FFLAS\\_ELT](#) > &F, const [FFLAS::FFLAS\\_SIDE](#) side, const [FFLAS::FFLAS\\_DIAG](#) diag, const size\_t N, [FFLAS\\_ELT](#) \*A, const size\_t lda)
- template [INST\\_OR\\_DECL](#) size\_t [PLUQ](#) (const [FFLAS\\_FIELD](#)< [FFLAS\\_ELT](#) > &F, const [FFLAS::FFLAS\\_DIAG](#) Diag, const size\_t M, const size\_t N, [FFLAS\\_ELT](#) \*A, const size\_t lda, size\_t \*P, size\_t \*Q)
- template [INST\\_OR\\_DECL](#) size\_t [LUdivine](#) (const [FFLAS\\_FIELD](#)< [FFLAS\\_ELT](#) > &F, const [FFLAS::FFLAS\\_DIAG](#) Diag, const [FFLAS::FFLAS\\_TRANSPOSE](#) trans, const size\_t M, const size\_t N, [FFLAS\\_ELT](#) \*A, const size\_t lda, size\_t \*P, size\_t \*Qt, const [FFPACK\\_LU\\_TAG](#) LuTag, const size\_t cutoff)
- template [INST\\_OR\\_DECL](#) size\_t [LUdivine\\_small](#) (const [FFLAS\\_FIELD](#)< [FFLAS\\_ELT](#) > &F, const [FFLAS::FFLAS\\_DIAG](#) Diag, const [FFLAS::FFLAS\\_TRANSPOSE](#) trans, const size\_t M, const size\_t N, [FFLAS\\_ELT](#) \*A, const size\_t lda, size\_t \*P, size\_t \*Q, const [FFPACK\\_LU\\_TAG](#) LuTag)
- template [INST\\_OR\\_DECL](#) size\_t [LUdivine\\_gauss](#) (const [FFLAS\\_FIELD](#)< [FFLAS\\_ELT](#) > &F, const [FFLAS::FFLAS\\_DIAG](#) Diag, const size\_t M, const size\_t N, [FFLAS\\_ELT](#) \*A, const size\_t lda, size\_t \*P, size\_t \*Q, const [FFPACK\\_LU\\_TAG](#) LuTag)
- template [INST\\_OR\\_DECL](#) size\_t [RowEchelonForm](#) (const [FFLAS\\_FIELD](#)< [FFLAS\\_ELT](#) > &F, const size\_t M, const size\_t N, [FFLAS\\_ELT](#) \*A, const size\_t lda, size\_t \*P, size\_t \*Qt, const bool transform, const [FFPACK\\_LU\\_TAG](#) LuTag)
- template [INST\\_OR\\_DECL](#) size\_t [ReducedRowEchelonForm](#) (const [FFLAS\\_FIELD](#)< [FFLAS\\_ELT](#) > &F, const size\_t M, const size\_t N, [FFLAS\\_ELT](#) \*A, const size\_t lda, size\_t \*P, size\_t \*Qt, const bool transform, const [FFPACK\\_LU\\_TAG](#) LuTag)
- template [INST\\_OR\\_DECL](#) size\_t [ColumnEchelonForm](#) (const [FFLAS\\_FIELD](#)< [FFLAS\\_ELT](#) > &F, const size\_t M, const size\_t N, [FFLAS\\_ELT](#) \*A, const size\_t lda, size\_t \*P, size\_t \*Qt, const bool transform, const [FFPACK\\_LU\\_TAG](#) LuTag)
- template [INST\\_OR\\_DECL](#) size\_t [ReducedColumnEchelonForm](#) (const [FFLAS\\_FIELD](#)< [FFLAS\\_ELT](#) > &F, const size\_t M, const size\_t N, [FFLAS\\_ELT](#) \*A, const size\_t lda, size\_t \*P, size\_t \*Qt, const bool transform, const [FFPACK\\_LU\\_TAG](#) LuTag)
- template [INST\\_OR\\_DECL](#) [FFLAS\\_ELT](#) \* [Invert](#) (const [FFLAS\\_FIELD](#)< [FFLAS\\_ELT](#) > &F, const size\_t M, [FFLAS\\_ELT](#) \*A, const size\_t lda, int &nullity)
- template [INST\\_OR\\_DECL](#) [FFLAS\\_ELT](#) \* [Invert](#) (const [FFLAS\\_FIELD](#)< [FFLAS\\_ELT](#) > &F, const size\_t M, const [FFLAS\\_ELT](#) \*A, const size\_t lda, [FFLAS\\_ELT](#) \*X, const size\_t ldx, int &nullity)
- template [INST\\_OR\\_DECL](#) [FFLAS\\_ELT](#) \* [Invert2](#) (const [FFLAS\\_FIELD](#)< [FFLAS\\_ELT](#) > &F, const size\_t M, [FFLAS\\_ELT](#) \*A, const size\_t lda, [FFLAS\\_ELT](#) \*X, const size\_t ldx, int &nullity)
- template [INST\\_OR\\_DECL](#) std::list< [Givaro::Poly1Dom](#)< [FFLAS\\_FIELD](#)< [FFLAS\\_ELT](#) > >::Element > & [CharPoly](#) (const [Givaro::Poly1Dom](#)< [FFLAS\\_FIELD](#)< [FFLAS\\_ELT](#) > > &R, std::list< [Givaro::Poly1Dom](#)< [FFLAS\\_FIELD](#)< [FFLAS\\_ELT](#) > >::Element > &charp, const size\_t N, [FFLAS\\_ELT](#) \*A, const size\_t lda, [FFLAS\\_FIELD](#)< [FFLAS\\_ELT](#) >::RandIter &G, const [FFPACK\\_CHARPOLY\\_TAG](#) CharpTag, const size\_t degree)

- template [INST\\_OR\\_DECL](#) Givaro::Poly1Dom< [FFLAS\\_FIELD](#)< [FFLAS\\_ELT](#) > >::Element & [CharPoly](#) (const Givaro::Poly1Dom< [FFLAS\\_FIELD](#)< [FFLAS\\_ELT](#) > > &R, Givaro::Poly1Dom< [FFLAS\\_FIELD](#)< [FFLAS\\_ELT](#) > >::Element &charp, const size\_t N, [FFLAS\\_ELT](#) \*A, const size\_t lda, [FFLAS\\_FIELD](#)< [FFLAS\\_ELT](#) >::RandIter &G, const FFPACK\_CHARPOLY\_TAG CharpTag, const size\_t degree)
- template [INST\\_OR\\_DECL](#) Givaro::Poly1Dom< [FFLAS\\_FIELD](#)< [FFLAS\\_ELT](#) > >::Element & [CharPoly](#) (const Givaro::Poly1Dom< [FFLAS\\_FIELD](#)< [FFLAS\\_ELT](#) > > &R, Givaro::Poly1Dom< [FFLAS\\_FIELD](#)< [FFLAS\\_ELT](#) > >::Element &charp, const size\_t N, [FFLAS\\_ELT](#) \*A, const size\_t lda, const FFPACK\_CHARPOLY\_TAG CharpTag, const size\_t degree)
- template [INST\\_OR\\_DECL](#) std::vector< [FFLAS\\_ELT](#) > & [MinPoly](#) (const [FFLAS\\_FIELD](#)< [FFLAS\\_ELT](#) > &F, std::vector< [FFLAS\\_ELT](#) > &minP, const size\_t N, const [FFLAS\\_ELT](#) \*A, const size\_t lda, [FFLAS\\_FIELD](#)< [FFLAS\\_ELT](#) >::RandIter &G)
- template [INST\\_OR\\_DECL](#) std::vector< [FFLAS\\_ELT](#) > & [MinPoly](#) (const [FFLAS\\_FIELD](#)< [FFLAS\\_ELT](#) > &F, std::vector< [FFLAS\\_ELT](#) > &minP, const size\_t N, const [FFLAS\\_ELT](#) \*A, const size\_t lda)
- template [INST\\_OR\\_DECL](#) std::vector< [FFLAS\\_ELT](#) > & [MatVecMinPoly](#) (const [FFLAS\\_FIELD](#)< [FFLAS\\_ELT](#) > &F, std::vector< [FFLAS\\_ELT](#) > &minP, const size\_t N, const [FFLAS\\_ELT](#) \*A, const size\_t lda, const [FFLAS\\_ELT](#) \*V, const size\_t incv)
- template [INST\\_OR\\_DECL](#) size\_t [KrylovElim](#) (const [FFLAS\\_FIELD](#)< [FFLAS\\_ELT](#) > &F, const size\_t M, const size\_t N, [FFLAS\\_ELT](#) \*A, const size\_t lda, size\_t \*P, size\_t \*Q, const size\_t deg, size\_t \*iterates, size\_t \*inviterates, const size\_t maxit, size\_t virt)
- template [INST\\_OR\\_DECL](#) size\_t [SpecRankProfile](#) (const [FFLAS\\_FIELD](#)< [FFLAS\\_ELT](#) > &F, const size\_t M, const size\_t N, [FFLAS\\_ELT](#) \*A, const size\_t lda, const size\_t deg, size\_t \*rankProfile)
- template [INST\\_OR\\_DECL](#) size\_t [Rank](#) (const [FFLAS\\_FIELD](#)< [FFLAS\\_ELT](#) > &F, const size\_t M, const size\_t N, [FFLAS\\_ELT](#) \*A, const size\_t lda)
- template [INST\\_OR\\_DECL](#) bool [IsSingular](#) (const [FFLAS\\_FIELD](#)< [FFLAS\\_ELT](#) > &F, const size\_t M, const size\_t N, [FFLAS\\_ELT](#) \*A, const size\_t lda)
- template [INST\\_OR\\_DECL](#) [FFLAS\\_ELT](#) & [Det](#) (const [FFLAS\\_FIELD](#)< [FFLAS\\_ELT](#) > &F, [FFLAS\\_ELT](#) &det, const size\_t N, [FFLAS\\_ELT](#) \*A, const size\_t lda, size\_t \*P, size\_t \*Q)
- template [INST\\_OR\\_DECL](#) [FFLAS\\_ELT](#) & [Det](#) (const [FFLAS\\_FIELD](#)< [FFLAS\\_ELT](#) > &F, [FFLAS\\_ELT](#) &det, const size\_t N, [FFLAS\\_ELT](#) \*A, const size\_t lda, const [FFLAS::ParSeqHelper::Parallel](#)< [FFLAS::CuttingStrategy::Recursive](#), [FFLAS::StrategyParameter::Threads](#) > &parH, size\_t \*P, size\_t \*Q)
- template [INST\\_OR\\_DECL](#) [FFLAS\\_ELT](#) \* [Solve](#) (const [FFLAS\\_FIELD](#)< [FFLAS\\_ELT](#) > &F, const size\_t M, [FFLAS\\_ELT](#) \*A, const size\_t lda, [FFLAS\\_ELT](#) \*x, const int incx, const [FFLAS\\_ELT](#) \*b, const int incb)
- template [INST\\_OR\\_DECL](#) void [solveLB](#) (const [FFLAS\\_FIELD](#)< [FFLAS\\_ELT](#) > &F, const [FFLAS::FFLAS\\_SIDE](#) Side, const size\_t M, const size\_t N, const size\_t R, [FFLAS\\_ELT](#) \*L, const size\_t ldl, const size\_t \*Q, [FFLAS\\_ELT](#) \*B, const size\_t ldb)
- template [INST\\_OR\\_DECL](#) void [solveLB2](#) (const [FFLAS\\_FIELD](#)< [FFLAS\\_ELT](#) > &F, const [FFLAS::FFLAS\\_SIDE](#) Side, const size\_t M, const size\_t N, const size\_t R, [FFLAS\\_ELT](#) \*L, const size\_t ldl, const size\_t \*Q, [FFLAS\\_ELT](#) \*B, const size\_t ldb)
- template [INST\\_OR\\_DECL](#) void [RandomNullSpaceVector](#) (const [FFLAS\\_FIELD](#)< [FFLAS\\_ELT](#) > &F, const [FFLAS::FFLAS\\_SIDE](#) Side, const size\_t M, const size\_t N, [FFLAS\\_ELT](#) \*A, const size\_t lda, [FFLAS\\_ELT](#) \*X, const size\_t incX)
- template [INST\\_OR\\_DECL](#) size\_t [NullSpaceBasis](#) (const [FFLAS\\_FIELD](#)< [FFLAS\\_ELT](#) > &F, const [FFLAS::FFLAS\\_SIDE](#) Side, const size\_t M, const size\_t N, [FFLAS\\_ELT](#) \*A, const size\_t lda, [FFLAS\\_ELT](#) \*&NS, size\_t &ldn, size\_t &NSdim)
- template [INST\\_OR\\_DECL](#) size\_t [RowRankProfile](#) (const [FFLAS\\_FIELD](#)< [FFLAS\\_ELT](#) > &F, const size\_t M, const size\_t N, [FFLAS\\_ELT](#) \*A, const size\_t lda, size\_t \*&rkprofile, const FFPACK\_LU\_TAG LuTag)
- template [INST\\_OR\\_DECL](#) size\_t [ColumnRankProfile](#) (const [FFLAS\\_FIELD](#)< [FFLAS\\_ELT](#) > &F, const size\_t M, const size\_t N, [FFLAS\\_ELT](#) \*A, const size\_t lda, size\_t \*&rkprofile, const FFPACK\_LU\_TAG LuTag)
- template [INST\\_OR\\_DECL](#) size\_t [RowRankProfileSubmatrixIndices](#) (const [FFLAS\\_FIELD](#)< [FFLAS\\_ELT](#) > &F, const size\_t M, const size\_t N, [FFLAS\\_ELT](#) \*A, const size\_t lda, size\_t \*&rowindices, size\_t \*&colindices, size\_t &R)
- template [INST\\_OR\\_DECL](#) size\_t [ColRankProfileSubmatrixIndices](#) (const [FFLAS\\_FIELD](#)< [FFLAS\\_ELT](#) > &F, const size\_t M, const size\_t N, [FFLAS\\_ELT](#) \*A, const size\_t lda, size\_t \*&rowindices, size\_t \*&colindices, size\_t &R)
- template [INST\\_OR\\_DECL](#) size\_t [RowRankProfileSubmatrix](#) (const [FFLAS\\_FIELD](#)< [FFLAS\\_ELT](#) > &F, const size\_t M, const size\_t N, [FFLAS\\_ELT](#) \*A, const size\_t lda, [FFLAS\\_ELT](#) \*&X, size\_t &R)

- template [INST\\_OR\\_DECL](#) size\_t [ColRankProfileSubmatrix](#) (const [FFLAS\\_FIELD](#)< [FFLAS\\_ELT](#) > &F, const size\_t M, const size\_t N, [FFLAS\\_ELT](#) \*A, const size\_t lda, [FFLAS\\_ELT](#) \*&X, size\_t &R)
- template [INST\\_OR\\_DECL](#) void [getTriangular](#)< [FFLAS\\_FIELD](#)< [FFLAS\\_ELT](#) > > (const [FFLAS\\_FIELD](#)< [FFLAS\\_ELT](#) > &F, const [FFLAS::FFLAS\\_UPLO](#) Uplo, const [FFLAS::FFLAS\\_DIAG](#) diag, const size\_t M, const size\_t N, const size\_t R, const [FFLAS\\_ELT](#) \*A, const size\_t lda, [FFLAS\\_ELT](#) \*T, const size\_t ldt, const bool OnlyNonZeroVectors)
- template [INST\\_OR\\_DECL](#) void [getTriangular](#)< [FFLAS\\_FIELD](#)< [FFLAS\\_ELT](#) > > (const [FFLAS\\_FIELD](#)< [FFLAS\\_ELT](#) > &F, const [FFLAS::FFLAS\\_UPLO](#) Uplo, const [FFLAS::FFLAS\\_DIAG](#) diag, const size\_t M, const size\_t N, const size\_t R, [FFLAS\\_ELT](#) \*A, const size\_t lda)
- template [INST\\_OR\\_DECL](#) void [getEchelonForm](#)< [FFLAS\\_FIELD](#)< [FFLAS\\_ELT](#) > > (const [FFLAS\\_FIELD](#)< [FFLAS\\_ELT](#) > &F, const [FFLAS::FFLAS\\_UPLO](#) Uplo, const [FFLAS::FFLAS\\_DIAG](#) diag, const size\_t M, const size\_t N, const size\_t R, const size\_t \*P, const [FFLAS\\_ELT](#) \*A, const size\_t lda, [FFLAS\\_ELT](#) \*T, const size\_t ldt, const bool OnlyNonZeroVectors, const [FFPACK\\_LU\\_TAG](#) LuTag)
- template [INST\\_OR\\_DECL](#) void [getEchelonForm](#)< [FFLAS\\_FIELD](#)< [FFLAS\\_ELT](#) > > (const [FFLAS\\_FIELD](#)< [FFLAS\\_ELT](#) > &F, const [FFLAS::FFLAS\\_UPLO](#) Uplo, const [FFLAS::FFLAS\\_DIAG](#) diag, const size\_t M, const size\_t N, const size\_t R, const size\_t \*P, [FFLAS\\_ELT](#) \*A, const size\_t lda, const [FFPACK\\_LU\\_TAG](#) LuTag)
- template [INST\\_OR\\_DECL](#) void [getEchelonTransform](#)< [FFLAS\\_FIELD](#)< [FFLAS\\_ELT](#) > > (const [FFLAS\\_FIELD](#)< [FFLAS\\_ELT](#) > &F, const [FFLAS::FFLAS\\_UPLO](#) Uplo, const [FFLAS::FFLAS\\_DIAG](#) diag, const size\_t M, const size\_t N, const size\_t R, const size\_t \*P, const size\_t \*Q, const [FFLAS\\_ELT](#) \*A, const size\_t lda, [FFLAS\\_ELT](#) \*T, const size\_t ldt, const [FFPACK\\_LU\\_TAG](#) LuTag)
- template [INST\\_OR\\_DECL](#) void [getReducedEchelonForm](#)< [FFLAS\\_FIELD](#)< [FFLAS\\_ELT](#) > > (const [FFLAS\\_FIELD](#)< [FFLAS\\_ELT](#) > &F, const [FFLAS::FFLAS\\_UPLO](#) Uplo, const size\_t M, const size\_t N, const size\_t R, const size\_t \*P, const [FFLAS\\_ELT](#) \*A, const size\_t lda, [FFLAS\\_ELT](#) \*T, const size\_t ldt, const bool OnlyNonZeroVectors, const [FFPACK\\_LU\\_TAG](#) LuTag)
- template [INST\\_OR\\_DECL](#) void [getReducedEchelonForm](#)< [FFLAS\\_FIELD](#)< [FFLAS\\_ELT](#) > > (const [FFLAS\\_FIELD](#)< [FFLAS\\_ELT](#) > &F, const [FFLAS::FFLAS\\_UPLO](#) Uplo, const size\_t M, const size\_t N, const size\_t R, const size\_t \*P, [FFLAS\\_ELT](#) \*A, const size\_t lda, const [FFPACK\\_LU\\_TAG](#) LuTag)
- template [INST\\_OR\\_DECL](#) void [getReducedEchelonTransform](#)< [FFLAS\\_FIELD](#)< [FFLAS\\_ELT](#) > > (const [FFLAS\\_FIELD](#)< [FFLAS\\_ELT](#) > &F, const [FFLAS::FFLAS\\_UPLO](#) Uplo, const size\_t M, const size\_t N, const size\_t R, const size\_t \*P, const size\_t \*Q, const [FFLAS\\_ELT](#) \*A, const size\_t lda, [FFLAS\\_ELT](#) \*T, const size\_t ldt, const [FFPACK\\_LU\\_TAG](#) LuTag)
- template [INST\\_OR\\_DECL](#) [FFLAS\\_ELT](#) \* [LQUPtoInverseOfFullRankMinor](#) (const [FFLAS\\_FIELD](#)< [FFLAS\\_ELT](#) > &F, const size\_t rank, [FFLAS\\_ELT](#) \*A\_factors, const size\_t lda, const size\_t \*QtPointer, [FFLAS\\_ELT](#) \*X, const size\_t ldx)
- template<class T, class CT = const T>  
T [fflas\\_const\\_cast](#) (CT x)
- [Failure](#) & [failure](#) ()
- template<class T>  
bool [isOdd](#) (const T &a)
- bool [isOdd](#) (const float &a)
- bool [isOdd](#) (const double &a)
- template<class [Field](#), class RandIter>  
[Field::Element\\_ptr](#) [NonZeroRandomMatrix](#) (const [Field](#) &F, size\_t m, size\_t n, typename [Field::Element\\_ptr](#) A, size\_t lda, RandIter &G)  
*Random non-zero Matrix.*
- template<class [Field](#), class RandIter>  
[Field::Element\\_ptr](#) [NonZeroRandomMatrix](#) (const [Field](#) &F, size\_t m, size\_t n, typename [Field::Element\\_ptr](#) A, size\_t lda)  
*Random non-zero Matrix.*
- template<class [Field](#), class RandIter>  
[Field::Element\\_ptr](#) [RandomMatrix](#) (const [Field](#) &F, size\_t m, size\_t n, typename [Field::Element\\_ptr](#) A, size\_t lda, RandIter &G)  
*Random Matrix.*
- template<class [Field](#)>  
[Field::Element\\_ptr](#) [RandomMatrix](#) (const [Field](#) &F, size\_t m, size\_t n, typename [Field::Element\\_ptr](#) A, size\_t lda)

*Random Matrix.*

- template<class [Field](#), class RandIter>  
[Field::Element\\_ptr](#) RandomTriangularMatrix (const [Field](#) &F, size\_t m, size\_t n, const [FFLAS::FFLAS\\_UPLO](#) UpLo, const [FFLAS::FFLAS\\_DIAG](#) Diag, bool nonsingular, typename [Field::Element\\_ptr](#) A, size\_t lda, RandIter &G)

*Random Triangular Matrix.*

- template<class [Field](#)>  
[Field::Element\\_ptr](#) RandomTriangularMatrix (const [Field](#) &F, size\_t m, size\_t n, const [FFLAS::FFLAS\\_UPLO](#) UpLo, const [FFLAS::FFLAS\\_DIAG](#) Diag, bool nonsingular, typename [Field::Element\\_ptr](#) A, size\_t lda)

*Random Triangular Matrix.*

- size\_t RandInt (size\_t a, size\_t b)
- template<class [Field](#), class RandIter>  
[Field::Element\\_ptr](#) RandomSymmetricMatrix (const [Field](#) &F, size\_t n, bool nonsingular, typename [Field::Element\\_ptr](#) A, size\_t lda, RandIter &G)

*Random Symmetric Matrix.*

- template<class [Field](#), class RandIter>  
[Field::Element\\_ptr](#) RandomMatrixWithRank (const [Field](#) &F, size\_t m, size\_t n, size\_t r, typename [Field::Element\\_ptr](#) A, size\_t lda, RandIter &G)

*Random Matrix with prescribed rank.*

- template<class [Field](#)>  
[Field::Element\\_ptr](#) RandomMatrixWithRank (const [Field](#) &F, size\_t m, size\_t n, size\_t r, typename [Field::Element\\_ptr](#) A, size\_t lda)

*Random Matrix with prescribed rank.*

- size\_t \* RandomIndexSubset (size\_t N, size\_t R, size\_t \*P)  
*Pick uniformly at random a sequence of  $R$  distinct elements from the set  $\{0, \dots, N - 1\}$  using Knuth's shuffle.*
- size\_t \* RandomPermutation (size\_t N, size\_t \*P)  
*Pick uniformly at random a permutation of size  $N$  stored in LAPACK format using Knuth's shuffle.*
- void RandomRankProfileMatrix (size\_t M, size\_t N, size\_t R, size\_t \*rows, size\_t \*cols)  
*Pick uniformly at random an  $R$ -subpermutation of dimension  $M \times N$ : a matrix with only  $R$  non-zeros equal to one, in a random rook placement.*
- void swapval (size\_t k, size\_t N, size\_t \*P, size\_t val)
- void RandomSymmetricRankProfileMatrix (size\_t N, size\_t R, size\_t \*rows, size\_t \*cols)  
*Pick uniformly at random a symmetric  $R$ -subpermutation of dimension  $N \times N$ : a symmetric matrix with only  $R$  non-zeros, all equal to one, in a random rook placement.*
- void RandomLTQSRankProfileMatrix (size\_t n, size\_t r, size\_t t, size\_t \*rows, size\_t \*cols)
- template<class [Field](#), class RandIter>  
[Field::Element\\_ptr](#) RandomMatrixWithRankandRPM (const [Field](#) &F, size\_t M, size\_t N, size\_t R, typename [Field::Element\\_ptr](#) A, size\_t lda, const size\_t \*RRP, const size\_t \*CRP, RandIter &G)

*Random Matrix with prescribed rank and rank profile matrix Creates an  $m \times n$  matrix with random entries and rank  $r$ .*

- template<class [Field](#)>  
[Field::Element\\_ptr](#) RandomMatrixWithRankandRPM (const [Field](#) &F, size\_t M, size\_t N, size\_t R, typename [Field::Element\\_ptr](#) A, size\_t lda, const size\_t \*RRP, const size\_t \*CRP)

*Random Matrix with prescribed rank and rank profile matrix Creates an  $m \times n$  matrix with random entries and rank  $r$ .*

- template<class [Field](#), class RandIter>  
[Field::Element\\_ptr](#) RandomSymmetricMatrixWithRankandRPM (const [Field](#) &F, size\_t N, size\_t R, typename [Field::Element\\_ptr](#) A, size\_t lda, const size\_t \*RRP, const size\_t \*CRP, RandIter &G)

*Random Symmetric Matrix with prescribed rank and rank profile matrix Creates an  $n \times n$  symmetric matrix with random entries and rank  $r$ .*

- template<class [Field](#)>  
[Field::Element\\_ptr](#) RandomSymmetricMatrixWithRankandRPM (const [Field](#) &F, size\_t M, size\_t N, size\_t R, typename [Field::Element\\_ptr](#) A, size\_t lda, const size\_t \*RRP, const size\_t \*CRP)

*Random Symmetric Matrix with prescribed rank and rank profile matrix Creates an  $n \times n$  symmetric matrix with random entries and rank  $r$ .*

- `template<class Field, class RandIter>`  
`Field::Element_ptr RandomMatrixWithRankandRandomRPM` (const `Field` &F, size\_t M, size\_t N, size\_t R, typename `Field::Element_ptr` A, size\_t lda, RandIter &G)  
*Random Matrix with prescribed rank, with random rank profile matrix Creates an  $m \times n$  matrix with random entries, rank  $r$  and with a rank profile matrix chosen uniformly at random.*
- `template<class Field>`  
`Field::Element_ptr RandomMatrixWithRankandRandomRPM` (const `Field` &F, size\_t M, size\_t N, size\_t R, typename `Field::Element_ptr` A, size\_t lda)  
*Random Matrix with prescribed rank, with random rank profile matrix Creates an  $m \times n$  matrix with random entries, rank  $r$  and with a rank profile matrix chosen uniformly at random.*
- `template<class Field, class RandIter>`  
`Field::Element_ptr RandomSymmetricMatrixWithRankandRandomRPM` (const `Field` &F, size\_t N, size\_t R, typename `Field::Element_ptr` A, size\_t lda, RandIter &G)  
*Random Symmetric Matrix with prescribed rank, with random rank profile matrix Creates an  $n \times n$  matrix with random entries, rank  $r$  and with a rank profile matrix chosen uniformly at random.*
- `template<class Field>`  
`Field::Element_ptr RandomSymmetricMatrixWithRankandRandomRPM` (const `Field` &F, size\_t N, size\_t R, typename `Field::Element_ptr` A, size\_t lda)  
*Random Symmetric Matrix with prescribed rank, with random rank profile matrix Creates an  $n \times n$  matrix with random entries, rank  $r$  and with a rank profile matrix chosen uniformly at random.*
- `template<class Field>`  
`Field::Element_ptr RandomMatrixWithDet` (const `Field` &F, size\_t n, const typename `Field::Element` d, typename `Field::Element_ptr` A, size\_t lda)  
*Random Matrix with prescribed det.*
- `template<class Field, class RandIter>`  
`Field::Element_ptr RandomMatrixWithDet` (const `Field` &F, size\_t n, const typename `Field::Element` d, typename `Field::Element_ptr` A, size\_t lda, RandIter &G)  
*Random Matrix with prescribed det.*
- `template<class Field, class RandIter>`  
`Field::Element_ptr RandomLTQSMMatrixWithRankandQSorder` (`Field` &F, size\_t n, size\_t r, size\_t t, typename `Field::Element_ptr` A, size\_t lda, RandIter &G)
- `template<typename Field>`  
`Field * chooseField` (Givaro::Integer q, uint64\_t b, uint64\_t seed)
- `template<> Givaro::ZRing< int32_t > * chooseField< Givaro::ZRing< int32_t > >` (Givaro::Integer q, uint64\_t b, uint64\_t seed)
- `template<> Givaro::ZRing< int64_t > * chooseField< Givaro::ZRing< int64_t > >` (Givaro::Integer q, uint64\_t b, uint64\_t seed)
- `template<> Givaro::ZRing< float > * chooseField< Givaro::ZRing< float > >` (Givaro::Integer q, uint64\_t b, uint64\_t seed)
- `template<> Givaro::ZRing< double > * chooseField< Givaro::ZRing< double > >` (Givaro::Integer q, uint64\_t b, uint64\_t seed)

### 11.21.1 Detailed Description

**Finite Field PACK** Set of elimination based routines for dense linear algebra.

This namespace enlarges the set of BLAS routines of the class `FFLAS`, with higher level routines based on elimination.

### 11.21.2 Typedef Documentation

#### 11.21.2.1 Checker\_PLUQ

```
template<class Field>
using Checker_PLUQ = FFLAS::Checker_Empty<Field>
```



**11.21.2.2 Checker\_Det**

```
template<class Field>
using Checker_Det = FFLAS::Checker_Empty<Field>
```

**11.21.2.3 Checker\_invert**

```
template<class Field>
using Checker_invert = FFLAS::Checker_Empty<Field>
```

**11.21.2.4 Checker\_charpoly**

```
template<class Field, class Polynomial>
using Checker_charpoly = FFLAS::Checker_Empty<Field>
```

**11.21.2.5 ForceCheck\_PLUQ**

```
template<class Field>
using ForceCheck_PLUQ = CheckerImplem_PLUQ<Field>
```

**11.21.2.6 ForceCheck\_Det**

```
template<class Field>
using ForceCheck_Det = CheckerImplem_Det<Field>
```

**11.21.2.7 ForceCheck\_invert**

```
template<class Field>
using ForceCheck_invert = CheckerImplem_invert<Field>
```

**11.21.2.8 ForceCheck\_charpoly**

```
template<class Field, class Polynomial>
using ForceCheck_charpoly = CheckerImplem_charpoly<Field, Polynomial>
```

**11.21.3 Function Documentation****11.21.3.1 LAPACKPerm2MathPerm()**

```
void LAPACKPerm2MathPerm (
    size_t * MathP,
    const size_t * LapackP,
    const size_t N) [inline]
```

Conversion of a permutation from LAPACK format to Math format.

### 11.21.3.2 MathPerm2LAPACKPerm()

```
void MathPerm2LAPACKPerm (
    size_t * LapackP,
    const size_t * MathP,
    const size_t N) [inline]
```

Conversion of a permutation from Maths format to LAPACK format.

### 11.21.3.3 applyP() [1/4]

```
template<class Field>
void applyP (
    const Field & F,
    const FFLAS::FFLAS_SIDE Side,
    const FFLAS::FFLAS_TRANSPOSE Trans,
    const size_t M,
    const size_t ibeg,
    const size_t iend,
    typename Field::Element_ptr A,
    const size_t lda,
    const size_t * P) [inline]
```

Computes  $P1 \times \text{Diag}(I_R, P2)$  where  $P1$  is a LAPACK and  $P2$  a LAPACK permutation and store the result in  $P1$  as a LAPACK permutation.

#### Parameters

in, out	$P1$	a LAPACK permutation of size N
	$P2$	a LAPACK permutation of size N-R

Applies a permutation  $P$  to the matrix  $A$ . Apply a permutation  $P$ , stored in the LAPACK format (a sequence of transpositions) between indices  $ibeg$  and  $iend$  of  $P$  to  $(iend-ibeg)$  vectors of size  $M$  stored in  $A$  (as column for NoTrans and rows for Trans).  $Side == \text{FFLAS::FflasLeft}$  for row permutation  $Side == \text{FFLAS::FflasRight}$  for a column permutation  $Trans == \text{FFLAS::FflasTrans}$  for the inverse permutation of  $P$

#### Parameters

$F$	base field
$Side$	decides if rows (FflasLeft) or columns (FflasRight) are permuted
$Trans$	decides if the matrix is seen as columns (FflasTrans) or rows (FflasNoTrans)
$M$	size of the elements to permute
$ibeg$	first index to consider in $P$
$iend$	last index to consider in $P$
$A$	input matrix
$lda$	leading dimension of $A$
$P$	permutation in LAPACK format
$psh$	(optional): a sequential or parallel helper, to choose between sequential or parallel execution

#### Warning

not sure the submatrix is still a permutation and the one we expect in all cases... examples for  $iend=2$ ,  $ibeg=1$  and  $P=[2,2,2]$



**11.21.3.4 applyP() [2/4]**

```
template<class Field>
void applyP (
    const Field & F,
    const FFLAS::FFLAS_SIDE Side,
    const FFLAS::FFLAS_TRANSPOSE Trans,
    const size_t m,
    const size_t ibeg,
    const size_t iend,
    typename Field::Element_ptr A,
    const size_t lda,
    const size_t * P,
    const FFLAS::ParSeqHelper::Sequential seq) [inline]
```

**11.21.3.5 applyP() [3/4]**

```
template<class Field, class Cut, class Param>
void applyP (
    const Field & F,
    const FFLAS::FFLAS_SIDE Side,
    const FFLAS::FFLAS_TRANSPOSE Trans,
    const size_t m,
    const size_t ibeg,
    const size_t iend,
    typename Field::Element_ptr A,
    const size_t lda,
    const size_t * P,
    const FFLAS::ParSeqHelper::Parallel< Cut, Param > par) [inline]
```

**11.21.3.6 MonotonicApplyP()**

```
template<class Field>
void MonotonicApplyP (
    const Field & F,
    const FFLAS::FFLAS_SIDE Side,
    const FFLAS::FFLAS_TRANSPOSE Trans,
    const size_t M,
    const size_t ibeg,
    const size_t iend,
    typename Field::Element_ptr A,
    const size_t lda,
    const size_t * P,
    const size_t R) [inline]
```

Apply a R-monotonically increasing permutation P, to the matrix A.

MonotonicApplyP Apply a permutation defined by the first R entries of the vector P (the pivots).

The permutation represented by P is defined as follows:

- the first R values of P is a LAPACK representation (a sequence of transpositions)
- the remaining iend-ibeg-R values of the permutation are in a monotonically increasing progression Side==FFLAS::FflasLeft for row permutation Side==FFLAS::FflasRight for a column permutation Trans==FFLAS::FflasTrans for the inverse permutation of P

## Parameters

<i>F</i>	base field
<i>Side</i>	selects if it is a row (FflasLeft) or column (FflasRight) permutation
<i>Trans</i>	inverse permutation (FflasTrans/NoTrans)
<i>M</i>	
<i>ibeg</i>	
<i>iend</i>	
<i>A</i>	input matrix
<i>lda</i>	leading dimension of A
<i>P</i>	LAPACK permuation
<i>R</i>	first values of P

The non pivot elements, are located in montonically increasing order.

## 11.21.3.7 fgetrs() [1/4]

```
template<class Field>
void fgetrs (
    const Field & F,
    const FFLAS::FFLAS_SIDE Side,
    const size_t M,
    const size_t N,
    const size_t R,
    typename Field::Element_ptr A,
    const size_t lda,
    const size_t * P,
    const size_t * Q,
    typename Field::Element_ptr B,
    const size_t ldb,
    int * info)
```

Solve the system  $AX = B$  or  $XA = B$ .

Solving using the PLUQ decomposition of A already computed inplace with PLUQ (FFLAS::FflasNonUnit). Version for A square. If A is rank deficient, a solution is returned if the system is consistent, Otherwise an info is 1

## Parameters

<i>F</i>	base field
<i>Side</i>	Determine wheter the resolution is left (FflasLeft) or right (FflasRight) looking.
<i>M</i>	row dimension of B
<i>N</i>	col dimension of B
<i>R</i>	rank of A
<i>A</i>	input matrix
<i>lda</i>	leading dimension of A
<i>P</i>	row permutation of the PLUQ decomposition of A
<i>Q</i>	column permutation of the PLUQ decomposition of A
<i>B</i>	Right/Left hand side matrix. Initially stores B, finally stores the solution X.
<i>ldb</i>	leading dimension of B
<i>info</i>	Success of the computation: 0 if successfull, >0 if system is inconsistent

**11.21.3.8 fgetrs()** [2/4]

```

template<class Field>
Field::Element_ptr fgetrs (
    const Field & F,
    const FFLAS::FFLAS_SIDE Side,
    const size_t M,
    const size_t N,
    const size_t NRHS,
    const size_t R,
    typename Field::Element_ptr A,
    const size_t lda,
    const size_t * P,
    const size_t * Q,
    typename Field::Element_ptr X,
    const size_t ldx,
    typename Field::ConstElement_ptr B,
    const size_t ldb,
    int * info)

```

Solve the system  $A X = B$  or  $X A = B$ .

Solving using the PLUQ decomposition of A already computed inplace with PLUQ(FFLAS::FflasNonUnit). Version for A rectangular. If A is rank deficient, a solution is returned if the system is consistent, Otherwise an info is 1

**Parameters**

<i>F</i>	base field
<i>Side</i>	Determine wheter the resolution is left (FflasLeft) or right (FflasRight) looking.
<i>M</i>	row dimension of A
<i>N</i>	col dimension of A
<i>NRHS</i>	number of columns (if Side = FFLAS::FflasLeft) or row (if Side = FFLAS::FflasRight) of the matrices X and B
<i>R</i>	rank of A
<i>A</i>	input matrix
<i>lda</i>	leading dimension of A
<i>P</i>	row permutation of the PLUQ decomposition of A
<i>Q</i>	column permutation of the PLUQ decomposition of A
<i>X</i>	solution matrix
<i>ldx</i>	leading dimension of X
<i>B</i>	Right/Left hand side matrix.
<i>ldb</i>	leading dimension of B
<i>info</i>	Succes of the computation: 0 if successfull, >0 if system is inconsistent

**11.21.3.9 fgesv()** [1/4]

```

template<class Field>
size_t fgesv (
    const Field & F,
    const FFLAS::FFLAS_SIDE Side,
    const size_t M,
    const size_t N,

```

```

typename Field::Element_ptr A,
const size_t lda,
typename Field::Element_ptr B,
const size_t ldb,
int * info)

```

Square system solver.

#### Parameters

<i>F</i>	The computation domain
<i>Side</i>	Determine wheter the resolution is left (FflasLeft) or right (FflasRight) looking
<i>M</i>	row dimension of B
<i>N</i>	col dimension of B
<i>A</i>	input matrix
<i>lda</i>	leading dimension of A
<i>B</i>	Right/Left hand side matrix. Initially contains B, finally contains the solution X.
<i>ldb</i>	leading dimension of B
<i>info</i>	Success of the computation: 0 if successfull, >0 if system is inconsistent

#### Returns

the rank of the system

Solve the system  $A X = B$  or  $X A = B$ . Version for A square. If A is rank deficient, a solution is returned if the system is consistent, Otherwise an info is 1

#### 11.21.3.10 fgesv() [2/4]

```

template<class Field>
size_t fgesv (
    const Field & F,
    const FFLAS::FFLAS_SIDE Side,
    const size_t M,
    const size_t N,
    const size_t NRHS,
    typename Field::Element_ptr A,
    const size_t lda,
    typename Field::Element_ptr X,
    const size_t ldx,
    typename Field::ConstElement_ptr B,
    const size_t ldb,
    int * info)

```

Rectangular system solver.

#### Parameters

<i>F</i>	The computation domain
<i>Side</i>	Determine wheter the resolution is left (FflasLeft) or right (FflasRight) looking
<i>M</i>	row dimension of A
<i>N</i>	col dimension of A

## Parameters

<i>NRHS</i>	number of columns (if Side = <a href="#">FFLAS::FflasLeft</a> ) or row (if Side = <a href="#">FFLAS::FflasRight</a> ) of the matrices X and B
<i>A</i>	input matrix
<i>lda</i>	leading dimension of A
<i>B</i>	Right/Left hand side matrix. Initially contains B, finally contains the solution X.
<i>ldb</i>	leading dimension of B
<i>X</i>	
<i>ldx</i>	
<i>info</i>	Success of the computation: 0 if successfull, >0 if system is inconsistent

## Returns

the rank of the system

Solve the system  $A X = B$  or  $X A = B$ . Version for A square. If A is rank deficient, a solution is returned if the system is consistent, Otherwise an info is 1

**11.21.3.11 ftrtri()** [1/2]

```
template<class Field>
void ftrtri (
    const Field & F,
    const FFLAS::FFLAS_UPLO Uplo,
    const FFLAS::FFLAS_DIAG Diag,
    const size_t N,
    typename Field::Element_ptr A,
    const size_t lda,
    const size_t threshold = __FFLASFFPACK_FTRTRI_THRESHOLD)
```

Compute the inverse of a triangular matrix.

## Parameters

<i>F</i>	base field
<i>Uplo</i>	whether the matrix is upper or lower triangular
<i>Diag</i>	whether the matrix is unit diagonal (FflasUnit/NoUnit)
<i>N</i>	input matrix order
<i>A</i>	the input matrix
<i>lda</i>	leading dimension of A

**11.21.3.12 trinv\_left()** [1/2]

```
template<class Field>
void trinv_left (
    const Field & F,
    const size_t N,
    typename Field::ConstElement_ptr L,
    const size_t ldl,
    typename Field::Element_ptr X,
    const size_t ldx)
```

**11.21.3.13 ftrtrm()** [1/2]

```
template<class Field>
void ftrtrm (
    const Field & F,
    const FFLAS::FFLAS_SIDE side,
    const FFLAS::FFLAS_DIAG diag,
    const size_t N,
    typename Field::Element_ptr A,
    const size_t lda)
```

Compute the product of two triangular matrices of opposite shape.

Product UL or LU of the upper, resp lower triangular matrices U and L stored one above the other in the square matrix A.

**Parameters**

<i>F</i>	base field
<i>Side</i>	set to FflasLeft to compute the product UL, FflasRight to compute LU
<i>diag</i>	whether the matrix U is unit diagonal (FflasUnit/NoUnit)
<i>N</i>	input matrix order
<i>A</i>	the input matrix
<i>lda</i>	leading dimension of A

**11.21.3.14 ftrstr()**

```
template<class Field>
void ftrstr (
    const Field & F,
    const FFLAS::FFLAS_SIDE side,
    const FFLAS::FFLAS_UPLO Uplo,
    const FFLAS::FFLAS_DIAG diagA,
    const FFLAS::FFLAS_DIAG diagB,
    const size_t N,
    typename Field::ConstElement_ptr A,
    const size_t lda,
    typename Field::Element_ptr B,
    const size_t ldb,
    const size_t threshold = __FFLASFFPACK_FTRSTR_THRESHOLD) [inline]
```

Solve a triangular system with a triangular right hand side of the same shape.

**Parameters**

<i>F</i>	base field
<i>Side</i>	set to FflasLeft to compute $U1^{-1} * U2$ or $L1^{-1} * L2$ , FflasRight to compute $U1 * U2^{-1}$ or $L1 * L2^{-1}$
<i>Uplo</i>	whether the matrix A is upper or lower triangular
<i>diag1</i>	whether the matrix U1 or L2 is unit diagonal (FflasUnit/NoUnit)
<i>diag2</i>	whether the matrix U2 or L2 is unit diagonal (FflasUnit/NoUnit)
<i>N</i>	order of the input matrices
<i>A</i>	the input matrix to be inverted (U1 or L1)
<i>lda</i>	leading dimension of A
<i>B</i>	the input right hand side (U2 or L2)
<i>ldb</i>	leading dimension of B

## 11.21.3.15 ftrssyr2k()

```

template<class Field>
void ftrssyr2k (
    const Field & F,
    const FFLAS::FFLAS_UPLO Uplo,
    const FFLAS::FFLAS_DIAG diagA,
    const size_t N,
    typename Field::ConstElement_ptr A,
    const size_t lda,
    typename Field::Element_ptr B,
    const size_t ldb,
    const size_t threshold = __FFLASFFPACK_FTRSSYR2K_THRESHOLD) [inline]

```

Solve a triangular system in a symmetric sum: find B upper/lower triangular such that  $A^T B + B^T A = C$  where C is symmetric.

C is overwritten by B.

## Parameters

	<i>F</i>	base field
	<i>Side</i>	set to FflasLeft to compute $U1^{-1} * U2$ or $L1^{-1} * L2$ , FflasRight to compute $U1 * U2^{-1}$ or $L1 * L2^{-1}$
	<i>Uplo</i>	whether the matrix A is upper or lower triangular
	<i>diagA</i>	whether the matrix A is unit diagonal (FflasUnit/NoUnit)
	<i>N</i>	order of the input matrices
	<i>A</i>	the input matrix
	<i>lda</i>	leading dimension of A
in, out	<i>B</i>	the input right hand side where the output is written
	<i>ldb</i>	leading dimension of B

## 11.21.3.16 fsytrf() [1/3]

```

template<class Field>
bool fsytrf (
    const Field & F,
    const FFLAS::FFLAS_UPLO UpLo,
    const size_t N,
    typename Field::Element_ptr A,
    const size_t lda,
    const size_t threshold = __FFLASFFPACK_FSYTRF_THRESHOLD)

```

Triangular factorization of symmetric matrices.

## Parameters

	<i>F</i>	The computation domain
	<i>UpLo</i>	Determine wheter to store the upper (FflasUpper) or lower (FflasLower) triangular factor
	<i>N</i>	order of the matrix A
in, out	<i>A</i>	input matrix
	<i>lda</i>	leading dimension of A

## Returns

false if the  $A$  does not have generic rank profile, making the computation fail.

Compute the a triangular factorization of the matrix  $A$ :  $A = L \times D \times L^T$  if UpLo = FflasLower or  $A = U^T \times D \times U$  otherwise.  $D$  is a diagonal matrix. The matrices  $L$  and  $U$  are unit diagonal lower (resp. upper) triangular and overwrite the input matrix  $A$ . The matrix  $D$  is stored on the diagonal of  $A$ , as the diagonal of  $L$  or  $U$  is known to be all ones. If  $A$  does not have generic rank profile, the LDLT or UTDU factorizations is not defined, and the algorithm returns false.

## 11.21.3.17 fsytrf() [2/3]

```
template<class Field>
bool fsytrf (
    const Field & F,
    const FFLAS::FFLAS_UPLO UpLo,
    const size_t N,
    typename Field::Element_ptr A,
    const size_t lda,
    const FFLAS::ParSeqHelper::Sequential seq,
    const size_t threshold = __FFLASFFPACK_FSYTRF_THRESHOLD) [inline]
```

## 11.21.3.18 fsytrf() [3/3]

```
template<class Field, class Cut, class Param>
bool fsytrf (
    const Field & F,
    const FFLAS::FFLAS_UPLO UpLo,
    const size_t N,
    typename Field::Element_ptr A,
    const size_t lda,
    const FFLAS::ParSeqHelper::Parallel< Cut, Param > par,
    const size_t threshold = __FFLASFFPACK_FSYTRF_THRESHOLD) [inline]
```

## 11.21.3.19 fsytrf\_nonunit() [1/3]

```
template<class Field>
bool fsytrf_nonunit (
    const Field & F,
    const FFLAS::FFLAS_UPLO UpLo,
    const size_t N,
    typename Field::Element_ptr A,
    const size_t lda,
    typename Field::Element_ptr D,
    const size_t incD,
    const size_t threshold = __FFLASFFPACK_FSYTRF_THRESHOLD)
```

Triangular factorization of symmetric matrices.

## Parameters

	$F$	The computation domain
	$UpLo$	Determine wheter to store the upper (FflasUpper) or lower (FflasLower) triangular factor



	$N$	order of the matrix $A$
$in, out$	$A$	input matrix
$in, out$	$D$	
	$lda$	leading dimension of $A$

**Returns**

false if the  $A$  does not have generic rank profile, making the computation fail.

Compute the a triangular factorization of the matrix  $A$ :  $A = L \times D_{inv} \times L^T$  if  $UpLo = FflasLower$  or  $A = U^T \times D \times U$  otherwise.  $D$  is a diagonal matrix. The matrices  $L$  and  $U$  are lower (resp. upper) triangular and overwrite the input matrix  $A$ . The matrix  $D$  need to be stored separately, as the diagonal of  $L$  or  $U$  are not unit. If  $A$  does not have generic rank profile, the LDLT or UTDU factorizations is not defined, and the algorithm returns false.

**11.21.3.20 PLUQ() [1/6]**

```
template<class Field>
size_t PLUQ (
    const Field & F,
    const FFLAS::FFLAS_DIAG Diag,
    const size_t M,
    const size_t N,
    typename Field::Element_ptr A,
    const size_t lda,
    size_t * P,
    size_t * Q) [inline]
```

Compute a PLUQ factorization of the given matrix.

Return its rank. The permutations  $P$  and  $Q$  are represented using LAPACK's convention.

**Parameters**

$F$	base field
$Diag$	whether $U$ should have a unit diagonal ( $FflasUnit$ ) or not ( $FflasNoUnit$ )
$M$	matrix row dimension
$N$	matrix column dimension
$A$	input matrix
$lda$	leading dimension of $A$
$P$	the row permutation
$Q$	the column permutation

**Returns**

the rank of  $A$

**Bibliography**

- Dumas J-G., Pernet C., and Sultan Z. *Simultaneous computation of the row and column rank profiles*, ISSAC'13, 2013

**11.21.3.21 pPLUQ()**

```
template<class Field>
size_t pPLUQ (
    const Field & F,
    const FFLAS::FFLAS_DIAG Diag,
    const size_t M,
    const size_t N,
    typename Field::Element_ptr A,
    const size_t lda,
    size_t * P,
    size_t * Q) [inline]
```

**11.21.3.22 PLUQ() [2/6]**

```
template<class Field>
size_t PLUQ (
    const Field & F,
    const FFLAS::FFLAS_DIAG Diag,
    const size_t M,
    const size_t N,
    typename Field::Element_ptr A,
    const size_t lda,
    size_t * P,
    size_t * Q,
    const FFLAS::ParSeqHelper::Sequential & PSHelper,
    size_t BCThreshold = __FFLASFFPACK_PLUQ_THRESHOLD) [inline]
```

**11.21.3.23 PLUQ() [3/6]**

```
template<class Field, class Cut, class Param>
size_t PLUQ (
    const Field & F,
    const FFLAS::FFLAS_DIAG Diag,
    const size_t M,
    const size_t N,
    typename Field::Element_ptr A,
    const size_t lda,
    size_t * P,
    size_t * Q,
    const FFLAS::ParSeqHelper::Parallel< Cut, Param > & PSHelper)
```

**11.21.3.24 LUdivine() [1/4]**

```
template<class Field>
size_t LUdivine (
    const Field & F,
    const FFLAS::FFLAS_DIAG Diag,
    const FFLAS::FFLAS_TRANSPOSE trans,
    const size_t M,
    const size_t N,
    typename Field::Element_ptr A,
```

```

const size_t lda,
size_t * P,
size_t * Qt,
const FFPACK_LU_TAG LuTag = FfpackSlabRecursive,
const size_t cutoff = __FFLASFFPACK_LUDIVINE_THRESHOLD)

```

Compute the CUP or PLE factorization of the given matrix.

Using a block algorithm and return its rank. The permutations P and Q are represented using LAPACK's convention.

#### Parameters

<i>F</i>	base field
<i>Diag</i>	whether the transformation matrix (U of the CUP, L of the PLE) should have a unit diagonal (FflasUnit) or not (FflasNoUnit)
<i>trans</i>	whether to compute the CUP decomposition (FflasNoTrans) or the PLE decomposition (FflasTrans)
<i>M</i>	matrix row dimension
<i>N</i>	matrix column dimension
<i>A</i>	input matrix
<i>lda</i>	leading dimension of A
<i>P</i>	the factor of CUP or PLE
<i>Q</i>	a permutation indicating the pivot position in the echelon form C or E in its first r positions
<i>LuTag</i>	flag for setting the earling termination if the matrix is singular
<i>cutoff</i>	threshold to basecase

#### Returns

the rank of A

#### Bibliography

- Jeannerod C-P, Pernet, C. and Storjohann, A. *Rank-profile revealing Gaussian elimination and the CUP matrix decomposition*, J. of Symbolic Comp., 2013
- Pernet C, Brassel M *LUdivine, une divine factorisation LU*, 2002

#### 11.21.3.25 ColumnEchelonForm() [1/3]

```

template<class Field>
size_t ColumnEchelonForm (
    const Field & F,
    const size_t M,
    const size_t N,
    typename Field::Element_ptr A,
    const size_t lda,
    size_t * P,
    size_t * Qt,
    bool transform = false,
    const FFPACK_LU_TAG LuTag = FfpackSlabRecursive) [inline]

```

Compute the Column Echelon form of the input matrix in-place.

If LuTag == FfpackTileRecursive, then after the computation  $A = [M \setminus V]$  such that  $AU = C$  is a column echelon decomposition of A, with  $U = P^T [V]$  and  $C = M + Q [I_r] [0 \text{ } I_{n-r}] [0]$  If LuTag == FfpackTileRecursive then  $A = [N \setminus V]$  such that the same holds with  $M = Q N$

$Q_t = Q^T$  If transform=false, the matrix V is not computed. See also test-colechelon for an example of use

## Parameters

	$F$	base field
	$M$	number of rows
	$N$	number of columns
in	$A$	input matrix
	$lda$	leading dimension of $A$
	$P$	the column permutation
	$Qt$	the row position of the pivots in the echelon form
	$transform$	decides whether $V$ is computed
	$LuTag$	chooses the elimination algorithm. SlabRecursive for LUdivine, TileRecursive for PLUQ

## 11.21.3.26 pColumnEchelonForm()

```
template<class Field>
size_t pColumnEchelonForm (
    const Field & F,
    const size_t M,
    const size_t N,
    typename Field::Element_ptr A,
    const size_t lda,
    size_t * P,
    size_t * Qt,
    bool transform = false,
    size_t numthreads = 0,
    const FFPACK_LU_TAG LuTag = FfpackTileRecursive) [inline]
```

## 11.21.3.27 ColumnEchelonForm() [2/3]

```
template<class Field, class PSHelper>
size_t ColumnEchelonForm (
    const Field & F,
    const size_t M,
    const size_t N,
    typename Field::Element_ptr A,
    const size_t lda,
    size_t * P,
    size_t * Qt,
    const bool transform,
    const FFPACK_LU_TAG LuTag,
    const PSHelper & psH) [inline]
```

## 11.21.3.28 RowEchelonForm() [1/3]

```
template<class Field>
size_t RowEchelonForm (
    const Field & F,
    const size_t M,
    const size_t N,
    typename Field::Element_ptr A,
```

```

const size_t lda,
size_t * P,
size_t * Qt,
const bool transform = false,
const FFPACK_LU_TAG LuTag = FfpackSlabRecursive) [inline]

```

Compute the Row Echelon form of the input matrix in-place.

If `LuTag == FfpackTileRecursive`, then after the computation  $A = [L \setminus M]$  such that  $X A = R$  is a row echelon decomposition of  $A$ , with  $X = [L \ 0] P$  and  $R = M + [I \ 0] Q^T [In-r]$ . If `LuTag == FfpackTileRecursive` then  $A = [L \setminus N]$  such that the same holds with  $M = N Q^T Q^T = Q^T$ . If `transform=false`, the matrix  $L$  is not computed. See also `test-rowechelon` for an example of use

#### Parameters

	$F$	base field
	$M$	number of rows
	$N$	number of columns
in	$A$	the input matrix
	$lda$	leading dimension of $A$
	$P$	the row permutation
	$Qt$	the column position of the pivots in the echelon form
	<i>transform</i>	decides whether $L$ is computed
	<i>LuTag</i>	chooses the elimination algorithm. SlabRecursive for LUdivine, TileRecursive for PLUQ

#### 11.21.3.29 pRowEchelonForm()

```

template<class Field>
size_t pRowEchelonForm (
    const Field & F,
    const size_t M,
    const size_t N,
    typename Field::Element_ptr A,
    const size_t lda,
    size_t * P,
    size_t * Qt,
    const bool transform = false,
    size_t numthreads = 0,
    const FFPACK_LU_TAG LuTag = FfpackTileRecursive) [inline]

```

#### 11.21.3.30 RowEchelonForm() [2/3]

```

template<class Field, class PSHelper>
size_t RowEchelonForm (
    const Field & F,
    const size_t M,
    const size_t N,
    typename Field::Element_ptr A,
    const size_t lda,
    size_t * P,
    size_t * Qt,
    const bool transform,
    const FFPACK_LU_TAG LuTag,
    const PSHelper & psH) [inline]

```

**11.21.3.31 ReducedColumnEchelonForm()** [1/3]

```
template<class Field>
size_t ReducedColumnEchelonForm (
    const Field & F,
    const size_t M,
    const size_t N,
    typename Field::Element_ptr A,
    const size_t lda,
    size_t * P,
    size_t * Qt,
    const bool transform = false,
    const FFPACK_LU_TAG LuTag = FfpackSlabRecursive) [inline]
```

Compute the Reduced Column Echelon form of the input matrix in-place.

After the computation  $A = [V]$  such that  $AX = R$  is a reduced col echelon  $[M\ 0]$  decomposition of  $A$ , where  $X = P^T [V]$  and  $R = Q [I_r] [0\ I_{n-r}] [M\ 0]$   $Qt = Q^T$  If transform=false, the matrix  $X$  is not computed and the matrix  $A = R$

**Parameters**

	$F$	base field
	$M$	number of rows
	$N$	number of columns
in	$A$	input matrix
	$lda$	leading dimension of $A$
	$P$	the column permutation
	$Qt$	the row position of the pivots in the echelon form
	$transform$	decides whether $X$ is computed
	$LuTag$	chooses the elimination algorithm. SlabRecursive for LUdivine, TileRecursive for PLUQ

**11.21.3.32 pReducedColumnEchelonForm()**

```
template<class Field>
size_t pReducedColumnEchelonForm (
    const Field & F,
    const size_t M,
    const size_t N,
    typename Field::Element_ptr A,
    const size_t lda,
    size_t * P,
    size_t * Qt,
    const bool transform = false,
    size_t numthreads = 0,
    const FFPACK_LU_TAG LuTag = FfpackTileRecursive) [inline]
```

**11.21.3.33 ReducedColumnEchelonForm()** [2/3]

```
template<class Field, class PSHelper>
size_t ReducedColumnEchelonForm (
    const Field & F,
```

```

const size_t M,
const size_t N,
typename Field::Element_ptr A,
const size_t lda,
size_t * P,
size_t * Qt,
const bool transform,
const FFPACK_LU_TAG LuTag,
const PSHelper & psH) [inline]

```

### 11.21.3.34 ReducedRowEchelonForm() [1/3]

```

template<class Field>
size_t ReducedRowEchelonForm (
    const Field & F,
    const size_t M,
    const size_t N,
    typename Field::Element_ptr A,
    const size_t lda,
    size_t * P,
    size_t * Qt,
    const bool transform = false,
    const FFPACK_LU_TAG LuTag = FfpackSlabRecursive) [inline]

```

Compute the Reduced Row Echelon form of the input matrix in-place.

After the computation  $A = [V1 \ M]$  such that  $X A = R$  is a reduced row echelon  $[V2 \ 0]$  decomposition of  $A$ , where  $X = [V1 \ 0] P$  and  $R = [I_r \ M] Q^T [V2 \ In-r] [0] Qt = Q^T$  If  $transform=false$ , the matrix  $X$  is not computed and the matrix  $A = R$

#### Parameters

	$F$	base field
	$M$	number of rows
	$N$	number of columns
in	$A$	input matrix
	$lda$	leading dimension of $A$
	$P$	the row permutation
	$Qt$	the column position of the pivots in the echelon form
	$transform$	decides whether $X$ is computed
	$LuTag$	chooses the elimination algorithm. SlabRecursive for LUdivine, TileRecursive for PLUQ

### 11.21.3.35 pReducedRowEchelonForm()

```

template<class Field>
size_t pReducedRowEchelonForm (
    const Field & F,
    const size_t M,
    const size_t N,
    typename Field::Element_ptr A,
    const size_t lda,
    size_t * P,
    size_t * Qt,
    const bool transform = false,
    size_t numthreads = 0,
    const FFPACK_LU_TAG LuTag = FfpackTileRecursive) [inline]

```

**11.21.3.36 ReducedRowEchelonForm()** [2/3]

```
template<class Field, class PSHelper>
size_t ReducedRowEchelonForm (
    const Field & F,
    const size_t M,
    const size_t N,
    typename Field::Element_ptr A,
    const size_t lda,
    size_t * P,
    size_t * Qt,
    const bool transform,
    const FFPACK_LU_TAG LuTag,
    const PSHelper & psH) [inline]
```

**11.21.3.37 Invert()** [1/4]

```
template<class Field>
Field::Element_ptr Invert (
    const Field & F,
    const size_t M,
    typename Field::Element_ptr A,
    const size_t lda,
    int & nullity)
```

Invert the given matrix in place or computes its nullity if it is singular.

An inplace  $2n^3$  algorithm is used.

**Parameters**

	$F$	The computation domain
	$M$	order of the matrix
in, out	$A$	input matrix ( $M \times M$ )
	$lda$	leading dimension of A
	$nullity$	dimension of the kernel of A

**Returns**

pointer to  $A$  and  $A \leftarrow A^{-1}$

**11.21.3.38 Invert()** [2/4]

```
template<class Field>
Field::Element_ptr Invert (
    const Field & F,
    const size_t M,
    typename Field::ConstElement_ptr A,
    const size_t lda,
    typename Field::Element_ptr X,
    const size_t ldx,
    int & nullity)
```

Invert the given matrix or computes its nullity if it is singular.

**Precondition**

$X$  is preallocated and should be large enough to store the  $m \times m$  matrix  $A$ .



## Parameters

	$F$	The computation domain
	$M$	order of the matrix
in	$A$	input matrix ( $M \times M$ )
	$lda$	leading dimension of A
out	$X$	this is the inverse of A if A is invertible (non NULL and nullity = 0). It is untouched otherwise.
	$ldx$	leading dimension of X
	$nullity$	dimension of the kernel of A

## Returns

pointer to  $X = A^{-1}$

## 11.21.3.39 Invert2() [1/2]

```
template<class Field>
Field::Element_ptr Invert2 (
    const Field & F,
    const size_t M,
    typename Field::Element_ptr A,
    const size_t lda,
    typename Field::Element_ptr X,
    const size_t ldx,
    int & nullity)
```

Invert the given matrix or computes its nullity if it is singular.

An  $2n^3f$  algorithm is used. This routine can be % faster than `FFPACK::Invert` but is not totally inplace.

## Precondition

X is preallocated and should be large enough to store the  $m \times m$  matrix A.

## Warning

A is overwritten here !

**Bug** not tested.

## Parameters

	$F$	the computation domain
	$M$	order of the matrix
in, out	$A$	input matrix ( $M \times M$ ). On output, A is modified and represents a "psychological" factorisation LU.
	$lda$	leading dimension of A
out	$X$	this is the inverse of A if A is invertible (non NULL and nullity = 0). It is untouched otherwise.
	$ldx$	leading dimension of X
	$nullity$	dimension of the kernel of A

## Returns

pointer to  $X = A^{-1}$

**Todo** this init is not all necessary (done after ftrtri)

**11.21.3.40 CharPoly()** [1/8]

```
template<class PolRing>
std::list< typename PolRing::Element > & CharPoly (
    const PolRing & R,
    std::list< typename PolRing::Element > & charp,
    const size_t N,
    typename PolRing::Domain_t::Element_ptr A,
    const size_t lda,
    typename PolRing::Domain_t::RandIter & G,
    const FFPACK_CHARPOLY_TAG CharpTag = FfpackAuto,
    const size_t degree = __FFLASFFPACK_ARITHPROG_THRESHOLD) [inline]
```

Compute the characteristic polynomial of the matrix A.

**Parameters**

	<i>R</i>	the polynomial ring of charp (contains the base field)
out	<i>charp</i>	the characteristic polynomial of as a list of factors
	<i>N</i>	order of the matrix A
in	<i>A</i>	the input matrix ( $N \times N$ ) (could be overwritten in some algorithmic variants)
	<i>lda</i>	leading dimension of A
	<i>CharpTag</i>	the algorithmic variant
	<i>G</i>	a random iterator (required for the randomized variants LUKrylov and ArithProg)

**11.21.3.41 CharPoly()** [2/8]

```
template<class PolRing>
PolRing::Element & CharPoly (
    const PolRing & R,
    typename PolRing::Element & charp,
    const size_t N,
    typename PolRing::Domain_t::Element_ptr A,
    const size_t lda,
    typename PolRing::Domain_t::RandIter & G,
    const FFPACK_CHARPOLY_TAG CharpTag = FfpackAuto,
    const size_t degree = __FFLASFFPACK_ARITHPROG_THRESHOLD) [inline]
```

Compute the characteristic polynomial of the matrix A.

**Parameters**

	<i>R</i>	the polynomial ring of charp (contains the base field)
out	<i>charp</i>	the characteristic polynomial of as a single polynomial
	<i>N</i>	order of the matrix A
in	<i>A</i>	the input matrix ( $N \times N$ ) (could be overwritten in some algorithmic variants)
	<i>lda</i>	leading dimension of A
	<i>CharpTag</i>	the algorithmic variant
	<i>G</i>	a random iterator (required for the randomized variants LUKrylov and ArithProg)

**11.21.3.42 CharPoly()** [3/8]

```
template<class PolRing>
PolRing::Element & CharPoly (
    const PolRing & R,
    typename PolRing::Element & charp,
    const size_t N,
    typename PolRing::Domain_t::Element_ptr A,
    const size_t lda,
    const FFPACK_CHARPOLY_TAG CharpTag = FfpackAuto,
    const size_t degree = __FFLASFFPACK_ARITHPROG_THRESHOLD) [inline]
```

Compute the characteristic polynomial of the matrix A.

**Parameters**

	<i>R</i>	the polynomial ring of charp (contains the base field)
out	<i>charp</i>	the characteristic polynomial of A as a single polynomial
	<i>N</i>	order of the matrix A
in	<i>A</i>	the input matrix ( $N \times N$ ) (could be overwritten in some algorithmic variants)
	<i>lda</i>	leading dimension of A
	<i>CharpTag</i>	the algorithmic variant

**11.21.3.43 MinPoly()** [1/4]

```
template<class Field, class Polynomial>
Polynomial & MinPoly (
    const Field & F,
    Polynomial & minP,
    const size_t N,
    typename Field::ConstElement_ptr A,
    const size_t lda) [inline]
```

Compute the minimal polynomial of the matrix A.

The algorithm is randomized probabilistic, and computes the minimal polynomial of the Krylov iterates of a random vector:  $(v, Av, \dots, A^k v)$

**Parameters**

	<i>F</i>	the base field
out	<i>minP</i>	the minimal polynomial of A
	<i>N</i>	order of the matrix A
in	<i>A</i>	the input matrix ( $N \times N$ )
	<i>lda</i>	leading dimension of A

**11.21.3.44 MinPoly()** [2/4]

```
template<class Field, class Polynomial, class RandIter>
Polynomial & MinPoly (
    const Field & F,
    Polynomial & minP,
    const size_t N,
    typename Field::ConstElement_ptr A,
    const size_t lda,
    RandIter & G) [inline]
```

Compute the minimal polynomial of the matrix A.

The algorithm is randomized probabilistic, and computes the minimal polynomial of the Krylov iterates of a random vector:  $(v, Av, \dots, A^k v)$

**Parameters**

	$F$	the base field
out	$minP$	the minimal polynomial of A
	$N$	order of the matrix A
in	$A$	the input matrix ( $N \times N$ )
	$lda$	leading dimension of A
	$G$	a random iterator

**11.21.3.45 MatVecMinPoly()** [1/2]

```
template<class Field, class Polynomial>
Polynomial & MatVecMinPoly (
    const Field & F,
    Polynomial & minP,
    const size_t N,
    typename Field::ConstElement_ptr A,
    const size_t lda,
    typename Field::ConstElement_ptr v,
    const size_t incv) [inline]
```

Compute the minimal polynomial of the matrix A and a vector v, namely the first linear dependency relation in the Krylov basis  $(v, Av, \dots, A^N v)$ .

**Parameters**

	$F$	the base field
out	$minP$	the minimal polynomial of A and v
	$N$	order of the matrix A
in	$A$	the input matrix ( $N \times N$ )
	$lda$	leading dimension of A
	$K$	an $N \times (N + 1)$ matrix containing the vector v on its first row
	$ldk$	leading dimension of K
	$P$	[out] (optional) the permutation used in the elimination of the Krylov matrix K

**11.21.3.46 Rank()** [1/3]

```
template<class Field>
size_t Rank (
    const Field & F,
    const size_t M,
    const size_t N,
    typename Field::Element_ptr A,
    const size_t lda)
```

Computes the rank of the given matrix using a PLUQ factorization.

The input matrix is modified.

**Parameters**

	$F$	base field
	$M$	row dimension of the matrix
	$N$	column dimension of the matrix
in	$A$	input matrix
	$lda$	leading dimension of A
	$psH$	(optional) a ParSeqHelper to choose between sequential and parallel execution

**11.21.3.47 pRank()**

```
template<class Field>
size_t pRank (
    const Field & F,
    const size_t M,
    const size_t N,
    typename Field::Element_ptr A,
    const size_t lda,
    size_t numthreads = 0)
```

**11.21.3.48 Rank()** [2/3]

```
template<class Field, class PSHelper>
size_t Rank (
    const Field & F,
    const size_t M,
    const size_t N,
    typename Field::Element_ptr A,
    const size_t lda,
    const PSHelper & psH)
```

**11.21.3.49 IsSingular()** [1/2]

```
template<class Field>
bool IsSingular (
    const Field & F,
    const size_t M,
    const size_t N,
    typename Field::Element_ptr A,
    const size_t lda)
```

Returns true if the given matrix is singular.

The method is a block elimination with early termination

using LQUP factorization with early termination. If  $M \neq N$ , then the matrix is virtually padded with zeros to make it square and it's determinant is zero.

**Warning**

The input matrix is modified.

**Parameters**

	$F$	base field
	$M$	row dimension of the matrix
	$N$	column dimension of the matrix.
in, out	$A$	input matrix
	$lda$	leading dimension of A

**11.21.3.50 Det()** [1/6]

```
template<class Field>
Field::Element & Det (
    const Field & F,
    typename Field::Element & det,
    const size_t N,
    typename Field::Element_ptr A,
    const size_t lda,
    size_t * P = NULL,
    size_t * Q = NULL) [inline]
```

Returns the determinant of the given square matrix.

The method is a block elimination using PLUQ factorization. The input matrix A is overwritten.

**Warning**

The input matrix is modified.

**Parameters**

	$F$	base field
out	$det$	the determinant of A
	$N$	the order of the square matrix A.
in, out	$A$	input matrix
	$lda$	leading dimension of A
	$psH$	(optional) a ParSeqHelper to choose between sequential and parallel execution
	$P, Q$	(optional) row and column permutations to be used by the PLUQ factorization. randomized checkers (see checker_det.inl) need them for certification

## 11.21.3.51 pDet()

```
template<class Field>
Field::Element & pDet (
    const Field & F,
    typename Field::Element & det,
    const size_t N,
    typename Field::Element_ptr A,
    const size_t lda,
    size_t numthreads = 0,
    size_t * P = NULL,
    size_t * Q = NULL) [inline]
```

## 11.21.3.52 Det() [2/6]

```
template<class Field, class PSHelper>
Field::Element & Det (
    const Field & F,
    typename Field::Element & det,
    const size_t N,
    typename Field::Element_ptr A,
    const size_t lda,
    const PSHelper & psH,
    size_t * P = NULL,
    size_t * Q = NULL)
```

## 11.21.3.53 Solve() [1/3]

```
template<class Field>
Field::Element_ptr Solve (
    const Field & F,
    const size_t M,
    typename Field::Element_ptr A,
    const size_t lda,
    typename Field::Element_ptr x,
    const int incx,
    typename Field::ConstElement_ptr b,
    const int incb) [inline]
```

Solves a linear system  $AX = b$  using PLUQ factorization.

@oaram F base field @oaram M matrix order

## Parameters

in	<i>A</i>	input matrix
	<i>lda</i>	leading dimension of <i>A</i>
out	<i>x</i>	output solution vector
	<i>incx</i>	increment of <i>x</i>
	<i>b</i>	input right hand side of the system
	<i>incb</i>	increment of <i>b</i>

**11.21.3.54 Solve()** [2/3]

```
template<class Field, class PSHelper>
Field::Element_ptr Solve (
    const Field & F,
    const size_t M,
    typename Field::Element_ptr A,
    const size_t lda,
    typename Field::Element_ptr x,
    const int incx,
    typename Field::ConstElement_ptr b,
    const int incb,
    PSHelper & pSH)
```

**11.21.3.55 pSolve()**

```
template<class Field>
Field::Element_ptr pSolve (
    const Field & F,
    const size_t M,
    typename Field::Element_ptr A,
    const size_t lda,
    typename Field::Element_ptr x,
    const int incx,
    typename Field::ConstElement_ptr b,
    const int incb,
    size_t numthreads = 0) [inline]
```

**11.21.3.56 RandomNullSpaceVector()** [1/3]

```
template<class Field>
*void RandomNullSpaceVector (
    const Field & F,
    const FFLAS::FFLAS_SIDE Side,
    const size_t M,
    const size_t N,
    typename Field::Element_ptr A,
    const size_t lda,
    typename Field::Element_ptr X,
    const size_t incX)
```

Solve  $LX = B$  or  $XL = B$  in place.

L is  $M \times M$  if Side == [FFLAS::FflasLeft](#) and  $N \times N$  if Side == [FFLAS::FflasRight](#), B is  $M \times N$ . Only the R non trivial column of L are stored in the  $M \times R$  matrix L Requirement : so that L could be expanded in-place Computes a vector of the Left/Right nullspace of the matrix A.

**Parameters**

	<i>F</i>	The computation domain
	<i>Side</i>	decides whether it computes the left (FflasLeft) or right (FflasRight) nullspace
	<i>M</i>	number of rows
	<i>N</i>	number of columns
in, out	<i>A</i>	input matrix of dimension $M \times N$ , A is modified to its LU version
	<i>lda</i>	leading dimension of A
out	<i>X</i>	output vector
	<i>incX</i>	increment of X



**11.21.3.57 NullSpaceBasis()** [1/2]

```
template<class Field>
size_t NullSpaceBasis (
    const Field & F,
    const FFLAS::FFLAS_SIDE Side,
    const size_t M,
    const size_t N,
    typename Field::Element_ptr A,
    const size_t lda,
    typename Field::Element_ptr & NS,
    size_t & ldn,
    size_t & NSdim)
```

Computes a basis of the Left/Right nullspace of the matrix A.

return the dimension of the nullspace.

**Parameters**

	<i>F</i>	The computation domain
	<i>Side</i>	decides whether it computes the left (FflasLeft) or right (FflasRight) nullspace
	<i>M</i>	number of rows
	<i>N</i>	number of columns
in, out	<i>A</i>	input matrix of dimension M x N, A is modified
	<i>lda</i>	leading dimension of A
out	<i>NS</i>	output matrix of dimension N x NSdim (allocated here)
out	<i>ldn</i>	leading dimension of NS
out	<i>NSdim</i>	the dimension of the Nullspace (N-rank(A))

**11.21.3.58 RowRankProfile()** [1/3]

```
template<class Field>
size_t RowRankProfile (
    const Field & F,
    const size_t M,
    const size_t N,
    typename Field::Element_ptr A,
    const size_t lda,
    size_t *& rkprofile,
    const FFPACK_LU_TAG LuTag = FfpackSlabRecursive) [inline]
```

Computes the row rank profile of A.

**Parameters**

	<i>F</i>	base field
	<i>M</i>	number of rows
	<i>N</i>	number of columns
in	<i>A</i>	input matrix of dimension M x N
	<i>lda</i>	leading dimension of A
out	<i>rkprofile</i>	return the rank profile as an array of row indexes, of dimension r=rank(A)
	<i>LuTag</i>	chooses the elimination algorithm. SlabRecursive for LUdivine, TileRecursive for PLUQ

A is modified rkprofile is allocated during the computation.

## Returns

R

## 11.21.3.59 pRowRankProfile()

```
template<class Field>
size_t pRowRankProfile (
    const Field & F,
    const size_t M,
    const size_t N,
    typename Field::Element_ptr A,
    const size_t lda,
    size_t *rkprofile,
    size_t numthreads = 0,
    const FFPACK_LU_TAG LuTag = FfpackTileRecursive) [inline]
```

## 11.21.3.60 RowRankProfile() [2/3]

```
template<class Field, class PSHelper>
size_t RowRankProfile (
    const Field & F,
    const size_t M,
    const size_t N,
    typename Field::Element_ptr A,
    const size_t lda,
    size_t *rkprofile,
    const FFPACK_LU_TAG LuTag,
    PSHelper & pSH) [inline]
```

## 11.21.3.61 ColumnRankProfile() [1/3]

```
template<class Field>
size_t ColumnRankProfile (
    const Field & F,
    const size_t M,
    const size_t N,
    typename Field::Element_ptr A,
    const size_t lda,
    size_t *rkprofile,
    const FFPACK_LU_TAG LuTag = FfpackSlabRecursive) [inline]
```

Computes the column rank profile of A.

## Parameters

	$F$	base field
	$M$	number of rows
	$N$	number of columns
in	$A$	input matrix of dimension
	$lda$	leading dimension of A
out	$rkprofile$	return the rank profile as an array of row indexes, of dimension $r=\text{rank}(A)$
	$LuTag$	chooses the elimination algorithm. SlabRecursive for LUdivine, TileRecursive for PLUQ

A is modified rkprofile is allocated during the computation.

## Returns

R

## 11.21.3.62 pColumnRankProfile()

```
template<class Field>
size_t pColumnRankProfile (
    const Field & F,
    const size_t M,
    const size_t N,
    typename Field::Element_ptr A,
    const size_t lda,
    size_t *rkprofile,
    size_t numthreads = 0,
    const FFPACK_LU_TAG LuTag = FfpackTileRecursive) [inline]
```

## 11.21.3.63 ColumnRankProfile() [2/3]

```
template<class Field, class PSHelper>
size_t ColumnRankProfile (
    const Field & F,
    const size_t M,
    const size_t N,
    typename Field::Element_ptr A,
    const size_t lda,
    size_t *rkprofile,
    const FFPACK_LU_TAG LuTag,
    PSHelper & psH) [inline]
```

## 11.21.3.64 RankProfileFromLU()

```
void RankProfileFromLU (
    const size_t * P,
    const size_t N,
    const size_t R,
    size_t * rkprofile,
    const FFPACK_LU_TAG LuTag) [inline]
```

Recovers the column/row rank profile from the permutation of an LU decomposition.

Works with both the CUP/PLE decompositions (obtained by LUdivine) or the PLUQ decomposition. Assumes that the output vector containing the rank profile is already allocated.

## Parameters

	<i>P</i>	the permutation carrying the rank profile information
	<i>N</i>	the row/col dimension for a row/column rank profile
	<i>R</i>	the rank of the matrix
out	<i>rkprofile</i>	return the rank profile as an array of indices
	<i>LuTag</i>	chooses the elimination algorithm. SlabRecursive for LUdivine, TileRecursive for PLUQ

### 11.21.3.65 LeadingSubmatrixRankProfiles()

```
size_t LeadingSubmatrixRankProfiles (
    const size_t M,
    const size_t N,
    const size_t R,
    const size_t LSm,
    const size_t LSn,
    const size_t * P,
    const size_t * Q,
    size_t * RRP,
    size_t * CRP) [inline]
```

Recovers the row and column rank profiles of any leading submatrix from the PLUQ decomposition.

Only works with the PLUQ decomposition Assumes that the output vectors containing the rank profiles are already allocated.

#### Parameters

$P$	the permutation carrying the rank profile information
$M$	the row dimension of the initial matrix
$N$	the column dimension of the initial matrix
$R$	the rank of the initial matrix
$LSm$	the row dimension of the leading submatrix considered
$LSn$	the column dimension of the leading submatrix considered
$P$	the row permutation of the PLUQ decomposition
$Q$	the column permutation of the PLUQ decomposition
$RRP$	return the row rank profile of the leading submatrix

#### Returns

the rank of the  $LSm \times LSn$  leading submatrix

A is modified

**Bibliography** • Dumas J-G., Pernet C., and Sultan Z. *Simultaneous computation of the row and column rank profiles*, ISSAC'13.

### 11.21.3.66 RowRankProfileSubmatrixIndices() [1/2]

```
template<class Field>
size_t RowRankProfileSubmatrixIndices (
    const Field & F,
    const size_t M,
    const size_t N,
    typename Field::Element_ptr A,
    const size_t lda,
    size_t * rowindices,
    size_t * colindices,
    size_t & R)
```

RowRankProfileSubmatrixIndices.

Computes the indices of the submatrix  $r \times r$  X of A whose rows correspond to the row rank profile of A.

## Parameters

	$F$	base field
	$M$	number of rows
	$N$	number of columns
in	$A$	input matrix of dimension
	<i>rowindices</i>	array of the row indices of X in A
	<i>colindices</i>	array of the col indices of X in A
	<i>lda</i>	leading dimension of A
out	$R$	list of indices

rowindices and colindices are allocated during the computation. A is modified

## Returns

R

## 11.21.3.67 ColRankProfileSubmatrixIndices() [1/2]

```
template<class Field>
size_t ColRankProfileSubmatrixIndices (
    const Field & F,
    const size_t M,
    const size_t N,
    typename Field::Element_ptr A,
    const size_t lda,
    size_t *& rowindices,
    size_t *& colindices,
    size_t & R)
```

Computes the indices of the submatrix  $r \times r$  X of A whose columns correspond to the column rank profile of A.

## Parameters

	$F$	base field
	$M$	number of rows
	$N$	number of columns
in	$A$	input matrix of dimension
	<i>rowindices</i>	array of the row indices of X in A
	<i>colindices</i>	array of the col indices of X in A
	<i>lda</i>	leading dimension of A
out	$R$	list of indices

rowindices and colindices are allocated during the computation.

## Warning

A is modified

## Returns

R

**11.21.3.68 RowRankProfileSubmatrix()** [1/2]

```
template<class Field>
size_t RowRankProfileSubmatrix (
    const Field & F,
    const size_t M,
    const size_t N,
    typename Field::Element_ptr A,
    const size_t lda,
    typename Field::Element_ptr & X,
    size_t & R)
```

Computes the  $r \times r$  submatrix  $X$  of  $A$ , by picking the row rank profile rows of  $A$ .

**Parameters**

	$F$	base field
	$M$	number of rows
	$N$	number of columns
in	$A$	input matrix of dimension $M \times N$
	$lda$	leading dimension of $A$
out	$X$	the output matrix
out	$R$	list of indices

$A$  is not modified  $X$  is allocated during the computation.

**Returns**

$R$

**11.21.3.69 ColRankProfileSubmatrix()** [1/2]

```
template<class Field>
size_t ColRankProfileSubmatrix (
    const Field & F,
    const size_t M,
    const size_t N,
    typename Field::Element_ptr A,
    const size_t lda,
    typename Field::Element_ptr & X,
    size_t & R)
```

Compute the  $r \times r$  submatrix  $X$  of  $A$ , by picking the row rank profile rows of  $A$ .

**Parameters**

	$F$	base field
	$M$	number of rows
	$N$	number of columns
in	$A$	input matrix of dimension $M \times N$
	$lda$	leading dimension of $A$
out	$X$	the output matrix
out	$R$	list of indices

$A$  is not modified  $X$  is allocated during the computation.

## Returns

R

## 11.21.3.70 getTriangular() [1/2]

```
template<class Field>
void getTriangular (
    const Field & F,
    const FFLAS::FFLAS_UPLO Uplo,
    const FFLAS::FFLAS_DIAG diag,
    const size_t M,
    const size_t N,
    const size_t R,
    typename Field::ConstElement_ptr A,
    const size_t lda,
    typename Field::Element_ptr T,
    const size_t ldt,
    const bool OnlyNonZeroVectors = false) [inline]
```

Extracts a triangular matrix from a compact storage  $A=L\backslash U$  of rank  $R$ .

if OnlyNonZeroVectors is false, then T and A have the same dimensions Otherwise, T is  $R \times N$  if UpLo = FflasUpper, else T is  $M \times R$

## Parameters

	<i>F</i>	base field
	<i>UpLo</i>	selects if the upper (FflasUpper) or lower (FflasLower) triangular matrix is returned
	<i>diag</i>	selects if the triangular matrix unit-diagonal (FflasUnit/NoUnit)
	<i>M</i>	row dimension of T
	<i>N</i>	column dimension of T
	<i>R</i>	rank of the triangular matrix (how many rows/columns need to be copied)
in	<i>A</i>	input matrix
	<i>lda</i>	leading dimension of A
out	<i>T</i>	output matrix
	<i>ldt</i>	leading dimension of T
	<i>OnlyNonZeroVectors</i>	decides whether the last zero rows/columns should be ignored

**Todo** just one triangular fzero+fassign ?

## 11.21.3.71 getTriangular() [2/2]

```
template<class Field>
void getTriangular (
    const Field & F,
    const FFLAS::FFLAS_UPLO Uplo,
    const FFLAS::FFLAS_DIAG diag,
    const size_t M,
    const size_t N,
    const size_t R,
    typename Field::Element_ptr A,
    const size_t lda) [inline]
```

Cleans up a compact storage  $A=L\backslash U$  to reveal a triangular matrix of rank  $R$ .

## Parameters

	<i>F</i>	base field
	<i>UpLo</i>	selects if the upper (FflasUpper) or lower (FflasLower) triangular matrix is revealed
	<i>diag</i>	selects if the triangular matrix unit-diagonal (FflasUnit/NoUnit)
	<i>M</i>	row dimension of A
	<i>N</i>	column dimension of A
	<i>R</i>	rank of the triangular matrix
in, out	<i>A</i>	input/output matrix
	<i>lda</i>	leading dimension of A

**Todo** just one triangular fzero+fassign ?

### 11.21.3.72 getEchelonForm() [1/2]

```
template<class Field>
void getEchelonForm (
    const Field & F,
    const FFLAS::FFLAS_UPLO Uplo,
    const FFLAS::FFLAS_DIAG diag,
    const size_t M,
    const size_t N,
    const size_t R,
    const size_t * P,
    typename Field::ConstElement_ptr A,
    const size_t lda,
    typename Field::Element_ptr T,
    const size_t ldt,
    const bool OnlyNonZeroVectors = false,
    const FFPACK_LU_TAG LuTag = FfpackSlabRecursive) [inline]
```

Extracts a matrix in echelon form from a compact storage A=L\U of rank R obtained by RowEchelonForm or ColumnEchelonForm.

Either L or U is in Echelon form (depending on Uplo) The echelon structure is defined by the first R values of the array P. row and column dimension of T are greater or equal to that of A

## Parameters

	<i>F</i>	base field
	<i>UpLo</i>	selects if the upper (FflasUpper) or lower (FflasLower) triangular matrix is returned
	<i>diag</i>	selects if the echelon matrix has unit pivots (FflasUnit/NoUnit)
	<i>M</i>	row dimension of T
	<i>N</i>	column dimension of T
	<i>R</i>	rank of the triangular matrix (how many rows/columns need to be copied)
	<i>P</i>	positions of the R pivots
in	<i>A</i>	input matrix
	<i>lda</i>	leading dimension of A
out	<i>T</i>	output matrix
	<i>ldt</i>	leading dimension of T
	<i>OnlyNonZeroVectors</i>	decides whether the last zero rows/columns should be ignored
	<i>LuTag</i>	which factorized form (CUP/PLE if FfpackSlabRecursive, PLUQ if FfpackTileRecursive)



**11.21.3.73 getEchelonForm()** [2/2]

```
template<class Field>
void getEchelonForm (
    const Field & F,
    const FFLAS::FFLAS_UPLO Uplo,
    const FFLAS::FFLAS_DIAG diag,
    const size_t M,
    const size_t N,
    const size_t R,
    const size_t * P,
    typename Field::Element_ptr A,
    const size_t lda,
    const FFPACK_LU_TAG LuTag = FfpackSlabRecursive) [inline]
```

Cleans up a compact storage  $A=L\backslash U$  obtained by RowEchelonForm or ColumnEchelonForm to reveal an echelon form of rank  $R$ .

Either  $L$  or  $U$  is in Echelon form (depending on Uplo) The echelon structure is defined by the first  $R$  values of the array  $P$ .

**Parameters**

	$F$	base field
	$UpLo$	selects if the upper (FflasUpper) or lower (FflasLower) triangular matrix is returned
	$diag$	selects if the echelon matrix has unit pivots (FflasUnit/NoUnit)
	$M$	row dimension of $A$
	$N$	column dimension of $A$
	$R$	rank of the triangular matrix (how many rows/columns need to be copied)
	$P$	positions of the $R$ pivots
in, out	$A$	input/output matrix
	$lda$	leading dimension of $A$
	$LuTag$	which factorized form (CUP/PLE if FfpackSlabRecursive, PLUQ if FfpackTileRecursive)

**11.21.3.74 getEchelonTransform()**

```
template<class Field>
void getEchelonTransform (
    const Field & F,
    const FFLAS::FFLAS_UPLO Uplo,
    const FFLAS::FFLAS_DIAG diag,
    const size_t M,
    const size_t N,
    const size_t R,
    const size_t * P,
    const size_t * Q,
    typename Field::ConstElement_ptr A,
    const size_t lda,
    typename Field::Element_ptr T,
    const size_t ldt,
    const FFPACK_LU_TAG LuTag = FfpackSlabRecursive) [inline]
```

Extracts a transformation matrix to echelon form from a compact storage  $A=L\backslash U$  of rank  $R$  obtained by Row↔EchelonForm or ColumnEchelonForm.

If Uplo == FflasLower:  $T$  is  $N \times N$  (already allocated) such that  $A T = C$  is a transformation of  $A$  in Column echelon form Else  $T$  is  $M \times M$  (already allocated) such that  $T A = E$  is a transformation of  $A$  in Row Echelon form

## Parameters

	$F$	base field
	$UpLo$	Lower (FflasLower) means Transformation to Column Echelon Form, Upper (FflasUpper), to Row Echelon Form
	$diag$	selects if the echelon matrix has unit pivots (FflasUnit/NoUnit)
	$M$	row dimension of A
	$N$	column dimension of A
	$R$	rank of the triangular matrix
	$P$	permutation matrix
in	$A$	input matrix
	$lda$	leading dimension of A
out	$T$	output matrix
	$ldt$	leading dimension of T
	$LuTag$	which factorized form (CUP/PLE if FfpackSlabRecursive, PLUQ if FfpackTileRecursive)

11.21.3.75 `getReducedEchelonForm()` [1/2]

```
template<class Field>
void getReducedEchelonForm (
    const Field & F,
    const FFLAS::FFLAS_UPLO Uplo,
    const size_t M,
    const size_t N,
    const size_t R,
    const size_t * P,
    typename Field::ConstElement_ptr A,
    const size_t lda,
    typename Field::Element_ptr T,
    const size_t ldt,
    const bool OnlyNonZeroVectors = false,
    const FFPACK_LU_TAG LuTag = FfpackSlabRecursive) [inline]
```

Extracts a matrix in echelon form from a compact storage  $A=L\backslash U$  of rank  $R$  obtained by `ReducedRowEchelonForm` or `ReducedColumnEchelonForm` with `transform = true`.

Either  $L$  or  $U$  is in Echelon form (depending on `Uplo`) The echelon structure is defined by the first  $R$  values of the array  $P$ . row and column dimension of  $T$  are greater or equal to that of  $A$

## Parameters

	$F$	base field
	$UpLo$	selects if the upper (FflasUpper) or lower (FflasLower) triangular matrix is returned
	$diag$	selects if the echelon matrix has unit pivots (FflasUnit/NoUnit)
	$M$	row dimension of T
	$N$	column dimension of T
	$R$	rank of the triangular matrix (how many rows/columns need to be copied)
	$P$	positions of the R pivots
in	$A$	input matrix
	$lda$	leading dimension of A
	$ldt$	leading dimension of T

## Parameters

	<i>LuTag</i>	which factorized form (CUP/PLE if FfpackSlabRecursive, PLUQ if FfpackTileRecursive)
	<i>OnlyNonZeroVectors</i>	decides whether the last zero rows/columns should be ignored

11.21.3.76 `getReducedEchelonForm()` [2/2]

```
template<class Field>
void getReducedEchelonForm (
    const Field & F,
    const FFLAS::FFLAS_UPLO Uplo,
    const size_t M,
    const size_t N,
    const size_t R,
    const size_t * P,
    typename Field::Element_ptr A,
    const size_t lda,
    const FFPACK_LU_TAG LuTag = FfpackSlabRecursive) [inline]
```

Cleans up a compact storage  $A=L\backslash U$  of rank  $R$  obtained by `ReducedRowEchelonForm` or `ReducedColumnEchelonForm` with `transform = true`.

Either  $L$  or  $U$  is in Echelon form (depending on `Uplo`) The echelon structure is defined by the first  $R$  values of the array  $P$ .

## Parameters

	<i>F</i>	base field
	<i>UpLo</i>	selects if the upper (FflasUpper) or lower (FflasLower) triangular matrix is returned
	<i>diag</i>	selects if the echelon matrix has unit pivots (FflasUnit/NoUnit)
	<i>M</i>	row dimension of $A$
	<i>N</i>	column dimension of $A$
	<i>R</i>	rank of the triangular matrix (how many rows/columns need to be copied)
	<i>P</i>	positions of the $R$ pivots
<i>in, out</i>	<i>A</i>	input/output matrix
	<i>lda</i>	leading dimension of $A$
	<i>LuTag</i>	which factorized form (CUP/PLE if FfpackSlabRecursive, PLUQ if FfpackTileRecursive)

11.21.3.77 `getReducedEchelonTransform()`

```
template<class Field>
void getReducedEchelonTransform (
    const Field & F,
    const FFLAS::FFLAS_UPLO Uplo,
    const size_t M,
    const size_t N,
    const size_t R,
    const size_t * P,
    const size_t * Q,
```

```

typename Field::ConstElement_ptr A,
const size_t lda,
typename Field::Element_ptr T,
const size_t ldt,
const FFPACK_LU_TAG LuTag = FfpackSlabRecursive) [inline]

```

Extracts a transformation matrix to echelon form from a compact storage  $A=LU$  of rank  $R$  obtained by Row↔EchelonForm or ColumnEchelonForm.

If Uplo == FflasLower:  $T$  is  $N \times N$  (already allocated) such that  $A T = C$  is a transformation of  $A$  in Column echelon form Else  $T$  is  $M \times M$  (already allocated) such that  $T A = E$  is a transformation of  $A$  in Row Echelon form

#### Parameters

	$F$	base field
	$UpLo$	selects Col (FflasLower) or Row (FflasUpper) Echelon Form
	$diag$	selects if the echelon matrix has unit pivots (FflasUnit/NoUnit)
	$M$	row dimension of $A$
	$N$	column dimension of $A$
	$R$	rank of the triangular matrix
	$P$	permutation matrix
in	$A$	input matrix
	$lda$	leading dimension of $A$
out	$T$	output matrix
	$ldt$	leading dimension of $T$
	$LuTag$	which factorized form (CUP/PLE if FfpackSlabRecursive, PLUQ if FfpackTileRecursive)

#### 11.21.3.78 PLUQtoEchelonPermutation()

```

void PLUQtoEchelonPermutation (
    const size_t N,
    const size_t R,
    const size_t * P,
    size_t * outPerm) [inline]

```

Auxiliary routine: determines the permutation that changes a PLUQ decomposition into a echelon form revealing PLUQ decomposition.

#### 11.21.3.79 LTBruhatGen()

```

template<class Field>
size_t LTBruhatGen (
    const Field & Fi,
    const FFLAS::FFLAS_DIAG diag,
    const size_t N,
    typename Field::Element_ptr A,
    const size_t lda,
    size_t * P,
    size_t * Q) [inline]

```

LTBruhatGen Suppose  $A$  is Left Triangular Matrix This procedure computes the Bruhat Representation of  $A$  and return the rank of  $A$ .

## Parameters

<i>Fi</i>	base <a href="#">Field</a>
<i>diag</i>	
<i>N</i>	size of A
<i>A</i>	the matrix we search the Bruhat representation
<i>lda</i>	the leading dimension of A
<i>P</i>	a permutation matrix
<i>Q</i>	a permutation matrix

11.21.3.80 `getLTBruhatGen()` [1/2]

```
template<class Field>
void getLTBruhatGen (
    const Field & Fi,
    const size_t N,
    const size_t r,
    const size_t * P,
    const size_t * Q,
    typename Field::Element_ptr R,
    const size_t ldr) [inline]
```

`GetLTBruhatGen` This procedure Computes the Rank Revealing Matrix based on the Bruhta representation of a Matrix.

## Parameters

<i>Fi</i>	base <a href="#">Field</a>
<i>N</i>	size of the matrix
<i>r</i>	the rank of the matrix
<i>P</i>	a permutation matrix
<i>Q</i>	a permutation matrix
<i>R</i>	the matrix that will contain the rank revealing matrix
<i>ldr</i>	the leading fimension of R

11.21.3.81 `getLTBruhatGen()` [2/2]

```
template<class Field>
void getLTBruhatGen (
    const Field & Fi,
    const FFLAS::FFLAS\_UPLO Uplo,
    const FFLAS::FFLAS\_DIAG diag,
    const size_t N,
    const size_t r,
    const size_t * P,
    const size_t * Q,
    typename Field::ConstElement_ptr A,
    const size_t lda,
    typename Field::Element_ptr T,
    const size_t ldt) [inline]
```

`GetLTBruhatGen` This procedure computes the matrix L or U f the Bruhat Representation Suppose that A is the bruhat representation of a matrix.

## Parameters

<i>Fi</i>	base <a href="#">Field</a>
<i>Uplo</i>	choose if the procedure return L or U
<i>diag</i>	
<i>N</i>	size of A
<i>r</i>	rank of A
<i>P</i>	permutaion matrix
<i>Q</i>	permutation matrix
<i>A</i>	a bruhat representation
<i>lda</i>	leading dimension of A
<i>T</i>	matrix that will contains L or U
<i>ldt</i>	leading dimension of T

**11.21.3.82 LTQSorter()**

```
size_t LTQSorter (
    const size_t N,
    const size_t r,
    const size_t * P,
    const size_t * Q) [inline]
```

LTQSorter This procedure computes the order of quasiseparability of a matrix.

## Parameters

<i>N</i>	size of the matrix
<i>r</i>	rank of the matrix
<i>P</i>	permutation matrix
<i>Q</i>	permutation matrix

**11.21.3.83 CompressToBlockBiDiagonal()**

```
template<class Field>
size_t CompressToBlockBiDiagonal (
    const Field & Fi,
    const FFLAS::FFLAS_UPLO Uplo,
    size_t N,
    size_t s,
    size_t r,
    const size_t * P,
    const size_t * Q,
    typename Field::Element_ptr A,
    size_t lda,
    typename Field::Element_ptr X,
    size_t ldx,
    size_t * K,
    size_t * M,
    size_t * T) [inline]
```

CompressToBlockBiDiagonal This procedure compress a compact representation of a row echelon form or column echelon form.

## Parameters

<i>Fi</i>	base <a href="#">Field</a>
<i>Uplo</i>	chosse if the procedure is based on row or column
<i>N</i>	size of the matrix
<i>s</i>	order of qausiseparability
<i>r</i>	rank
<i>P</i>	permutation matrix
<i>Q</i>	permutation matrix
<i>A</i>	the matrix to compact
<i>lda</i>	leading dimension of A
<i>X</i>	matrix that will stock the representation
<i>ldx</i>	leading dimension of X
<i>K</i>	stock the position of the blocks in A
<i>M</i>	permutation matrix
<i>T</i>	stock the operation done in the procedure

## 11.21.3.84 ExpandBlockBiDiagonalToBruhat()

```
template<class Field>
void ExpandBlockBiDiagonalToBruhat (
    const Field & Fi,
    const FFLAS::FFLAS\_UPLO Uplo,
    size_t N,
    size_t s,
    size_t r,
    typename Field::Element\_ptr A,
    size_t lda,
    typename Field::Element\_ptr X,
    size_t ldx,
    size_t NbBlocks,
    size_t * K,
    size_t * M,
    size_t * T) [inline]
```

**ExpandBlockBiDiagonal** This procedure expand a compact representation of a row echelon form or column echelon form.

## Parameters

<i>Fi</i>	base <a href="#">Field</a>
<i>Uplo</i>	chosse if the procedure is based on row or column
<i>N</i>	size of the matrix
<i>s</i>	order of qausiseparability
<i>r</i>	rank
<i>A</i>	the matrix that will sotck the expanded representation
<i>lda</i>	leading dimension of A
<i>X</i>	matrix to expand
<i>ldx</i>	leading dimension of X
<i>K</i>	stock the position of the blocks in A
<i>M</i>	permutation matrix
<i>T</i>	stock the operation done in the procedure

**11.21.3.85 Bruhat2EchelonPermutation()**

```
void Bruhat2EchelonPermutation (
    size_t N,
    size_t R,
    const size_t * P,
    const size_t * Q,
    size_t * M) [inline]
```

Bruhat2EchelonPermutation (N,R,P,Q) Compute M such that LM or MU is in echelon form where L or U are factors of the Bruhat Rpresentation.

**Parameters**

in	$N$	size of the matrix
in	$R$	rank
in	$P$	permutation Matrix
in	$Q$	permutation Matrix
out	$M$	output permutation matrix

**11.21.3.86 TInverter() [1/2]**

```
size_t * TInverter (
    size_t * T,
    size_t r)
```

**11.21.3.87 ComputeRPermutation() [1/2]**

```
template<class Field>
void ComputeRPermutation (
    const Field & Fi,
    size_t N,
    size_t r,
    const size_t * P,
    const size_t * Q,
    size_t * R,
    size_t * MU,
    size_t * ML)
```

**11.21.3.88 productBruhatxTS() [1/2]**

```
template<class Field>
void productBruhatxTS (
    const Field & Fi,
    size_t N,
    size_t s,
    size_t r,
    const size_t * P,
    const size_t * Q,
    const typename Field::Element_ptr Xu,
    size_t ldu,
```



```

size_t NbBlocksU,
size_t * Ku,
size_t * Tu,
size_t * MU,
const typename Field::Element_ptr Xl,
size_t ldl,
size_t NbBlocksL,
size_t * Kl,
size_t * Tl,
size_t * ML,
typename Field::Element_ptr B,
size_t t,
size_t ldb,
typename Field::Element_ptr C,
size_t ldc)

```

productBruhatxTS Compute the product between the CRE compact representation of a matrix A and B a tall matrix

### 11.21.3.89 LQUPtoInverseOfFullRankMinor() [1/2]

```

template<class Field>
Field::Element_ptr LQUPtoInverseOfFullRankMinor (
    const Field & F,
    const size_t rank,
    typename Field::Element_ptr A_factors,
    const size_t lda,
    const size_t * QtPointer,
    typename Field::Element_ptr X,
    const size_t ldx)

```

LQUPtoInverseOfFullRankMinor.

Suppose A has been factorized as L.Q.U.P, with rank r. Then Qt.A.Pt has an invertible leading principal r x r submatrix This procedure efficiently computes the inverse of this minor and puts it into X.

#### Note

It changes the lower entries of A\_factors in the process (NB: unless A was nonsingular and square)

#### Parameters

<i>F</i>	base field
<i>rank</i>	rank of the matrix.
<i>A_factors</i>	matrix containing the L and U entries of the factorization
<i>lda</i>	leading dimension of A
<i>QtPointer</i>	theLQUP->getQ()->getPointer() (note: getQ returns Qt!)
<i>X</i>	desired location for output
<i>ldx</i>	leading dimension of X

**11.21.3.90 RandomNullSpaceVector()** [2/3]

```
template<class Field>
void RandomNullSpaceVector (
    const Field & F,
    const FFLAS::FFLAS_SIDE Side,
    const size_t M,
    const size_t N,
    typename Field::Element_ptr A,
    const size_t lda,
    typename Field::Element_ptr X,
    const size_t incX)
```

Solve  $LX = B$  or  $XL = B$  in place.

L is  $M \times M$  if `Side == FFLAS::FflasLeft` and  $N \times N$  if `Side == FFLAS::FflasRight`, B is  $M \times N$ . Only the R non trivial column of L are stored in the  $M \times R$  matrix L Requirement : so that L could be expanded in-place Computes a vector of the Left/Right nullspace of the matrix A.

**Parameters**

	<i>F</i>	The computation domain
	<i>Side</i>	decides whether it computes the left (FflasLeft) or right (FflasRight) nullspace
	<i>M</i>	number of rows
	<i>N</i>	number of columns
in, out	<i>A</i>	input matrix of dimension $M \times N$ , A is modified to its LU version
	<i>lda</i>	leading dimension of A
out	<i>X</i>	output vector
	<i>incX</i>	increment of X

**11.21.3.91 solveLB()** [1/2]

```
template<class Field>
void solveLB (
    const Field & F,
    const FFLAS::FFLAS_SIDE Side,
    const size_t M,
    const size_t N,
    const size_t R,
    typename Field::Element_ptr L,
    const size_t ldl,
    const size_t * Q,
    typename Field::Element_ptr B,
    const size_t ldb)
```

**11.21.3.92 solveLB2()** [1/2]

```
template<class Field>
void solveLB2 (
    const Field & F,
    const FFLAS::FFLAS_SIDE Side,
    const size_t M,
```

```

    const size_t N,
    const size_t R,
    typename Field::Element_ptr L,
    const size_t ldl,
    const size_t * Q,
    typename Field::Element_ptr B,
    const size_t ldb)

```

### 11.21.3.93 Tinverter() [2/2]

```

size_t * Tinverter (
    const size_t * T,
    size_t r) [inline]

```

### 11.21.3.94 ComputeRPermutation() [2/2]

```

template<class Field>
void ComputeRPermutation (
    const Field & Fi,
    size_t N,
    size_t r,
    const size_t * P,
    const size_t * Q,
    size_t * R,
    const size_t * MU,
    const size_t * ML) [inline]

```

### 11.21.3.95 expandLCRE()

```

template<class Field>
Field::Element_ptr expandLCRE (
    const Field & Fi,
    size_t N,
    size_t s,
    size_t r,
    size_t * R,
    size_t i,
    typename Field::ConstElement_ptr Xu,
    size_t ldu,
    size_t NbBlocksU,
    const size_t * Ku,
    const size_t * Tuinv,
    typename Field::ConstElement_ptr Xl,
    size_t ldl,
    size_t NbBlocksL,
    const size_t * Kl,
    const size_t * Tlinv,
    typename Field::Element_ptr CRE,
    size_t ldcre) [inline]

```

Expands an anti-diagonal block of a left triangular matrix from its compact Bruhat representation.

## 11.21.3.96 productBruhatxTS() [2/2]

```

template<class Field>
void productBruhatxTS (
    const Field & Fi,
    size_t N,
    size_t s,
    size_t r,
    size_t t,
    const size_t * P,
    const size_t * Q,
    typename Field::ConstElement_ptr Xu,
    size_t ldu,
    size_t NbBlocksU,
    const size_t * Ku,
    const size_t * Tu,
    const size_t * MU,
    typename Field::ConstElement_ptr Xl,
    size_t ldl,
    size_t NbBlocksL,
    const size_t * Kl,
    const size_t * Tl,
    const size_t * ML,
    typename Field::Element_ptr B,
    size_t ldb,
    const typename Field::Element beta,
    typename Field::Element_ptr D,
    size_t ldd) [inline]

```

Compute the product of a left-triangular quasi-separable matrix A, represented by a compact Bruhat generator, with a dense rectangular matrix B:  $C \leftarrow A \times B + \text{beta}C$ .

## Parameters

	<i>F</i>	the base field
	<i>N</i>	the order of A
	<i>s</i>	the order of quasiseparability of A
	<i>r</i>	the number of pivots in the left-triangular par of the rank profile matrix of A
	<i>t</i>	the number of columns of B
	<i>P</i>	the row indices of the pivots of A
	<i>Q</i>	the column indices of the pivots of A
	<i>Xu</i>	the compact storage of U: Du blocks in the first s rows, Su blocks in the last s rows
	<i>ldxu</i>	the leading dimension of Xu
	<i>NbBlocksU</i>	the number of diagonal blocks in the compact storage of U
	<i>Ku</i>	the list of starting column positions for each block of the storage of U
	<i>Tu</i>	the folding matrix for the compact storage of U: $Du + TuSu$ is in row echelon form
	<i>Mu</i>	a permutation matrix such that $Mu(Du + TuSu)$ is the U factor of the Bruhat generator
	<i>Xl</i>	the compact storage of L: Dl blocks in the first s columns, Sl blocks in the last s columns
	<i>ldxl</i>	the leading dimension of Xl
	<i>NbBlocksL</i>	the number of diagonal blocks in the compact storage of L
	<i>Kl</i>	the list of starting row positions for each block of the storage of L
	<i>Tl</i>	the folding matrix for the compact storage of L: $Dl + SlTl$ is in column echelon form

## Parameters

	$MI$	a permutation matrix such that $(DI + TISI)MI$ is the L factor of the Bruhat generator
	$B$	an $N \times t$ dense matrix
	$ldb$	leading dimension of B
	$\beta$	scaling constant
in, out	$C$	output matrix
	$ldc$	leading dimension of C

**Bibliography** Pernet C. and Storjohann A. *Time and space efficient generators for quasiseparable matrices*, JSC (85), 2018, doi:10.1016/j.jsc.2017.07.010

**11.21.3.97 Danilevski()**

```
template<class Field, class Polynomial>
std::list< Polynomial > & Danilevski (
    const Field & F,
    std::list< Polynomial > & charp,
    const size_t N,
    typename Field::Element_ptr A,
    const size_t lda)
```

**11.21.3.98 buildMatrix()**

```
template<class Field>
Field::Element_ptr buildMatrix (
    const Field & F,
    typename Field::ConstElement_ptr E,
    typename Field::ConstElement_ptr C,
    const size_t lda,
    const size_t * B,
    const size_t * T,
    const size_t me,
    const size_t mc,
    const size_t lambda,
    const size_t mu)
```

**Bug** is this :

**11.21.3.99 CharPoly()** [4/8]

```
FFPACK::RNSInteger< FFPACK::rns_double >::Element_ptr CharPoly (
    const FFPACK::RNSInteger< FFPACK::rns_double > & F,
    typename FFPACK::RNSInteger< FFPACK::rns_double >::Element_ptr charp,
    const size_t N,
    typename FFPACK::RNSInteger< FFPACK::rns_double >::Element_ptr A,
    const size_t lda,
    Givaro::ZRing< Givaro::Integer >::RandIter & G,
    const FFPACK_CHARPOLY_TAG CharpTag,
    size_t degree) [inline]
```

**11.21.3.100 CharPoly()** [5/8]

```
template<>
Givaro::Poly1Dom< Givaro::ZRing< Givaro::Integer > >::Element & CharPoly (
    const Givaro::Poly1Dom< Givaro::ZRing< Givaro::Integer > > & R,
    Givaro::Poly1Dom< Givaro::ZRing< Givaro::Integer > >::Element & charp,
    const size_t N,
    Givaro::Integer * A,
    const size_t lda,
    Givaro::ZRing< Givaro::Integer >::RandIter & G,
    const FFPACK_CHARPOLY_TAG CharpTag,
    size_t degree) [inline]
```

**11.21.3.101 Det()** [3/6]

```
template<class PSHelper>
FFPACK::RNSInteger< FFPACK::rns_double >::Element_ptr & Det (
    const FFPACK::RNSInteger< FFPACK::rns_double > & F,
    typename FFPACK::RNSInteger< FFPACK::rns_double >::Element_ptr & det,
    const size_t N,
    typename FFPACK::RNSInteger< FFPACK::rns_double >::Element_ptr A,
    const size_t lda,
    const PSHelper & psH) [inline]
```

**11.21.3.102 Det()** [4/6]

```
template<class PSHelper>
Givaro::Integer & Det (
    const Givaro::ZRing< Givaro::Integer > & F,
    Givaro::Integer & det,
    const size_t N,
    Givaro::Integer * A,
    const size_t lda,
    const PSHelper & psH,
    size_t * P,
    size_t * Q) [inline]
```

**11.21.3.103 fsytrf\_BC\_Crout()**

```
template<class Field>
bool fsytrf_BC_Crout (
    const Field & F,
    const FFLAS::FFLAS_UPLO UpLo,
    const size_t N,
    typename Field::Element_ptr A,
    const size_t lda,
    typename Field::Element_ptr Dinv,
    const size_t incDinv) [inline]
```

**11.21.3.104 fsytrf\_BC\_RL()**

```
template<class Field>
size_t fsytrf_BC_RL (
    const Field & F,
    const FFLAS::FFLAS_UPLO UpLo,
    const size_t N,
    typename Field::Element_ptr A,
    const size_t lda,
    typename Field::Element_ptr Dinv,
    const size_t incDinv) [inline]
```

**11.21.3.105 fsytrf\_UP\_RPM\_BC\_RL()**

```
template<class Field>
size_t fsytrf_UP_RPM_BC_RL (
    const Field & F,
    const size_t N,
    typename Field::Element_ptr A,
    const size_t lda,
    typename Field::Element_ptr Dinv,
    const size_t incDinv,
    size_t * P) [inline]
```

**11.21.3.106 fsytrf\_LOW\_RPM\_BC\_Crout()**

```
template<class Field>
size_t fsytrf_LOW_RPM_BC_Crout (
    const Field & F,
    const size_t N,
    typename Field::Element_ptr A,
    const size_t lda,
    typename Field::Element_ptr Dinv,
    const size_t incDinv,
    size_t * P) [inline]
```

**11.21.3.107 fsytrf\_UP\_RPM\_BC\_Crout()**

```
template<class Field>
size_t fsytrf_UP_RPM_BC_Crout (
    const Field & F,
    const size_t N,
    typename Field::Element_ptr A,
    const size_t lda,
    typename Field::Element_ptr Dinv,
    const size_t incDinv,
    size_t * P) [inline]
```

### 11.21.3.108 fsytrf\_UP\_RPM()

```
template<class Field>
size_t fsytrf_UP_RPM (
    const Field & Fi,
    const size_t N,
    typename Field::Element_ptr A,
    const size_t lda,
    typename Field::Element_ptr Dinv,
    const size_t incDinv,
    size_t * P,
    size_t BCThreshold) [inline]
```

MathP <-[ [ I ] x P1 | ] [ L\_(N1+R2) ] [ P2^T ] | ] x [ P3^T ] [ -----|---- ] [ Q2^T ]

Changing [ U1 V1 | E1 E21 E22 ] into [ U1 E11 E12 V1 E\* E\* ] [ 0 | L2 \ U2 V21 V22 ] [ U4 V41 0 V42 V43 ] [ 0 | M2 0 0 ] [ U3 0 0 V3 ] [ ----|----- ] [ 0 0 0 ] [ 0 | H1 H21 H22 ] [ 0 | U3 V3 ] [ 0 | 0 ] where U4 is the 2R2 x 2R2 matrix formed by interleaving U2, L2^T and H1

### 11.21.3.109 fsytrf\_nonunit() [2/3]

```
template<class Field>
bool fsytrf_nonunit (
    const Field & F,
    const FFLAS::FFLAS_UPLO UpLo,
    const size_t N,
    typename Field::Element_ptr A,
    const size_t lda,
    typename Field::Element_ptr Dinv,
    const size_t incDinv,
    FFLAS::ParSeqHelper::Sequential seq,
    size_t threshold) [inline]
```

### 11.21.3.110 fsytrf\_nonunit() [3/3]

```
template<class Field, class Cut, class Param>
bool fsytrf_nonunit (
    const Field & F,
    const FFLAS::FFLAS_UPLO UpLo,
    const size_t N,
    typename Field::Element_ptr A,
    const size_t lda,
    typename Field::Element_ptr Dinv,
    const size_t incDinv,
    FFLAS::ParSeqHelper::Parallel< Cut, Param > par,
    size_t threshold) [inline]
```

### 11.21.3.111 fsytrf\_RPM()

```
template<class Field>
size_t fsytrf_RPM (
    const Field & F,
    const FFLAS::FFLAS_UPLO UpLo,
    const size_t N,
    typename Field::Element_ptr A,
    const size_t lda,
    size_t * P,
    size_t threshold) [inline]
```



**11.21.3.112 getTridiagonal()**

```
template<class Field>
void getTridiagonal (
    const Field & F,
    const size_t N,
    const size_t R,
    typename Field::ConstElement_ptr A,
    const size_t lda,
    size_t * P,
    typename Field::Element_ptr T,
    const size_t ldt) [inline]
```

**11.21.3.113 LUdivine\_gauss() [1/2]**

```
template<class Field>
size_t LUdivine_gauss (
    const Field & F,
    const FFLAS::FFLAS_DIAG Diag,
    const size_t M,
    const size_t N,
    typename Field::Element_ptr A,
    const size_t lda,
    size_t * P,
    size_t * Q,
    const FFPACK::FFPACK_LU_TAG LuTag) [inline]
```

**11.21.3.114 LUdivine\_small() [1/2]**

```
template<class Field>
size_t LUdivine_small (
    const Field & F,
    const FFLAS::FFLAS_DIAG Diag,
    const FFLAS::FFLAS_TRANSPOSE trans,
    const size_t M,
    const size_t N,
    typename Field::Element_ptr A,
    const size_t lda,
    size_t * P,
    size_t * Q,
    const FFPACK::FFPACK_LU_TAG LuTag) [inline]
```

**11.21.3.115 LUdivine() [2/4]**

```
template<class Field>
size_t LUdivine (
    const Field & F,
    const FFLAS::FFLAS_DIAG Diag,
    const FFLAS::FFLAS_TRANSPOSE trans,
    const size_t M,
    const size_t N,
    typename Field::Element_ptr A,
```

```

    const size_t lda,
    size_t * P,
    size_t * Q,
    const FFPACK::FFPACK_LU_TAG LuTag,
    const size_t cutoff) [inline]

```

**Todo** std::swap ?

#### 11.21.3.116 LUdivine() [3/4]

```

template<>
size_t LUdivine (
    const Givaro::Modular< Givaro::Integer > & F,
    const FFLAS::FFLAS_DIAG Diag,
    const FFLAS::FFLAS_TRANSPOSE trans,
    const size_t M,
    const size_t N,
    typename Givaro::Integer * A,
    const size_t lda,
    size_t * P,
    size_t * Q,
    const FFPACK::FFPACK_LU_TAG LuTag,
    const size_t cutoff) [inline]

```

#### 11.21.3.117 MonotonicCompress()

```

template<class Field>
void MonotonicCompress (
    const Field & F,
    const FFLAS::FFLAS_SIDE Side,
    const size_t M,
    typename Field::Element_ptr A,
    const size_t lda,
    const size_t incA,
    const size_t * MathP,
    const size_t R,
    const size_t maxpiv,
    const size_t rowstomove,
    const std::vector< bool > & ispiv) [inline]

```

#### 11.21.3.118 MonotonicCompressMorePivots()

```

template<class Field>
void MonotonicCompressMorePivots (
    const Field & F,
    const FFLAS::FFLAS_SIDE Side,
    const size_t M,
    typename Field::Element_ptr A,
    const size_t lda,
    const size_t incA,
    const size_t * MathP,
    const size_t R,
    const size_t rowstomove,
    const size_t lenP) [inline]

```

**11.21.3.119 MonotonicCompressCycles()**

```
template<class Field>
void MonotonicCompressCycles (
    const Field & F,
    const FFLAS::FFLAS_SIDE Side,
    const size_t M,
    typename Field::Element_ptr A,
    const size_t lda,
    const size_t incA,
    const size_t * MathP,
    const size_t lenP) [inline]
```

**11.21.3.120 MonotonicExpand()**

```
template<class Field>
void MonotonicExpand (
    const Field & F,
    const FFLAS::FFLAS_SIDE Side,
    const size_t M,
    typename Field::Element_ptr A,
    const size_t lda,
    const size_t incA,
    const size_t * MathP,
    const size_t R,
    const size_t maxpiv,
    const size_t rowstomove,
    const std::vector< bool > & ispiv)
```

**11.21.3.121 applyP\_block()**

```
template<class Field>
void applyP_block (
    const Field & F,
    const FFLAS::FFLAS_SIDE Side,
    const FFLAS::FFLAS_TRANSPOSE Trans,
    const size_t M,
    const size_t ibeg,
    const size_t iend,
    typename Field::Element_ptr A,
    const size_t lda,
    const size_t * P) [inline]
```

**11.21.3.122 doApplyS()**

```
template<class Field>
void doApplyS (
    const Field & F,
    typename Field::Element_ptr A,
    const size_t lda,
    typename Field::Element_ptr tmp,
    const size_t width,
    const size_t M2,
    const size_t R1,
    const size_t R2,
    const size_t R3,
    const size_t R4) [inline]
```

**11.21.3.123 MatrixApplyS() [1/3]**

```
template<class Field>
void MatrixApplyS (
    const Field & F,
    typename Field::Element_ptr A,
    const size_t lda,
    const size_t width,
    const size_t M2,
    const size_t R1,
    const size_t R2,
    const size_t R3,
    const size_t R4) [inline]
```

**11.21.3.124 MatrixApplyS() [2/3]**

```
template<class Field>
void MatrixApplyS (
    const Field & F,
    typename Field::Element_ptr A,
    const size_t lda,
    const size_t width,
    const size_t M2,
    const size_t R1,
    const size_t R2,
    const size_t R3,
    const size_t R4,
    const FFLAS::ParSeqHelper::Sequential seq) [inline]
```

**11.21.3.125 MatrixApplyS() [3/3]**

```
template<class Field, class Cut, class Param>
void MatrixApplyS (
    const Field & F,
    typename Field::Element_ptr A,
    const size_t lda,
    const size_t width,
    const size_t M2,
    const size_t R1,
    const size_t R2,
    const size_t R3,
    const size_t R4,
    const FFLAS::ParSeqHelper::Parallel< Cut, Param > par) [inline]
```

**11.21.3.126 PermApplyS()**

```
template<class T>
void PermApplyS (
    T * A,
    const size_t lda,
    const size_t width,
    const size_t M2,
    const size_t R1,
    const size_t R2,
    const size_t R3,
    const size_t R4) [inline]
```

**11.21.3.127 doApplyT()**

```
template<class Field>
void doApplyT (
    const Field & F,
    typename Field::Element_ptr A,
    const size_t lda,
    typename Field::Element_ptr tmp,
    const size_t width,
    const size_t N2,
    const size_t R1,
    const size_t R2,
    const size_t R3,
    const size_t R4) [inline]
```

**11.21.3.128 MatrixApplyT() [1/3]**

```
template<class Field>
void MatrixApplyT (
    const Field & F,
    typename Field::Element_ptr A,
    const size_t lda,
    const size_t width,
    const size_t N2,
    const size_t R1,
    const size_t R2,
    const size_t R3,
    const size_t R4) [inline]
```

**11.21.3.129 MatrixApplyT() [2/3]**

```
template<class Field>
void MatrixApplyT (
    const Field & F,
    typename Field::Element_ptr A,
    const size_t lda,
    const size_t width,
    const size_t N2,
    const size_t R1,
    const size_t R2,
    const size_t R3,
    const size_t R4,
    const FFLAS::ParSeqHelper::Sequential seq) [inline]
```

**11.21.3.130 MatrixApplyT() [3/3]**

```
template<class Field, class Cut, class Param>
void MatrixApplyT (
    const Field & F,
    typename Field::Element_ptr A,
    const size_t lda,
    const size_t width,
```

```

const size_t N2,
const size_t R1,
const size_t R2,
const size_t R3,
const size_t R4,
const FFLAS::ParSeqHelper::Parallel< Cut, Param > par) [inline]

```

### 11.21.3.131 PermApplyT()

```

template<class T>
void PermApplyT (
    T * A,
    const size_t lda,
    const size_t width,
    const size_t N2,
    const size_t R1,
    const size_t R2,
    const size_t R3,
    const size_t R4) [inline]

```

### 11.21.3.132 composePermutationsLLL()

```

void composePermutationsLLL (
    size_t * P1,
    const size_t * P2,
    const size_t R,
    const size_t N) [inline]

```

Computes  $P1 \times \text{Diag}(I_R, P2)$  where  $P1$  is a LAPACK and  $P2$  a LAPACK permutation and store the result in  $P1$  as a LAPACK permutation.

#### Parameters

in, out	$P1$	a LAPACK permutation of size N
	$P2$	a LAPACK permutation of size N-R

### 11.21.3.133 composePermutationsLLM()

```

void composePermutationsLLM (
    size_t * MathP,
    const size_t * P1,
    const size_t * P2,
    const size_t R,
    const size_t N) [inline]

```

Computes  $P1 \times \text{Diag}(I_R, P2)$  where  $P1$  is a LAPACK and  $P2$  a LAPACK permutation and store the result in  $\text{MathP}$  as a  $\text{MathPermutation}$  format.

#### Parameters

out		
-----	--	--

a  $\text{MathPermutation}$  of size N

## Parameters

<i>P1</i>	a LAPACK permutation of size N
<i>P2</i>	a LAPACK permutation of size N-R

**11.21.3.134 composePermutationsMLM()**

```
void composePermutationsMLM (
    size_t * MathP1,
    const size_t * P2,
    const size_t R,
    const size_t N) [inline]
```

Computes MathP1 x Diag (I\_R, P2) where MathP1 is a MathPermutation and P2 a LAPACK permutation and store the result in MathP1 as a MathPermutation format.

## Parameters

in, out	<i>MathP1</i>	a MathPermutation of size N
	<i>P2</i>	a LAPACK permutation of size N-R

**11.21.3.135 cyclic\_shift\_mathPerm()**

```
void cyclic_shift_mathPerm (
    size_t * P,
    const size_t s) [inline]
```

**11.21.3.136 cyclic\_shift\_row\_col()** [1/2]

```
template<class Field>
void cyclic_shift_row_col (
    const Field & F,
    typename Field::Element_ptr A,
    size_t m,
    size_t n,
    size_t lda) [inline]
```

**11.21.3.137 cyclic\_shift\_row()** [1/3]

```
template<class Field>
void cyclic_shift_row (
    const Field & F,
    typename Field::Element_ptr A,
    size_t m,
    size_t n,
    size_t lda) [inline]
```

**11.21.3.138 cyclic\_shift\_row()** [2/3]

```
template<typename T>
void cyclic_shift_row (
    const RNSIntegerMod< T > & F,
    typename T::Element_ptr A,
    size_t m,
    size_t n,
    size_t lda) [inline]
```

**11.21.3.139 cyclic\_shift\_col()** [1/3]

```
template<class Field>
void cyclic_shift_col (
    const Field & F,
    typename Field::Element_ptr A,
    size_t m,
    size_t n,
    size_t lda) [inline]
```

**11.21.3.140 cyclic\_shift\_col()** [2/3]

```
template<typename T>
void cyclic_shift_col (
    const RNSIntegerMod< T > & F,
    typename T::Element_ptr A,
    size_t m,
    size_t n,
    size_t lda) [inline]
```

**11.21.3.141 PLUQ\_basecaseV3()**

```
template<class Field>
size_t PLUQ_basecaseV3 (
    const Field & Fi,
    const FFLAS::FFLAS_DIAG Diag,
    const size_t M,
    const size_t N,
    typename Field::Element * A,
    const size_t lda,
    size_t * P,
    size_t * Q) [inline]
```

**11.21.3.142 PLUQ\_basecaseV2()**

```
template<class Field>
size_t PLUQ_basecaseV2 (
    const Field & Fi,
    const FFLAS::FFLAS_DIAG Diag,
    const size_t M,
    const size_t N,
    typename Field::Element * A,
    const size_t lda,
    size_t * P,
    size_t * Q) [inline]
```



**11.21.3.143 PLUQ\_basecaseCrout()**

```
template<class Field>
size_t PLUQ_basecaseCrout (
    const Field & Fi,
    const FFLAS::FFLAS_DIAG Diag,
    const size_t M,
    const size_t N,
    typename Field::Element_ptr A,
    const size_t lda,
    size_t * P,
    size_t * Q) [inline]
```

**11.21.3.144 \_PLUQ()**

```
template<class Field>
size_t _PLUQ (
    const Field & Fi,
    const FFLAS::FFLAS_DIAG Diag,
    const size_t M,
    const size_t N,
    typename Field::Element_ptr A,
    const size_t lda,
    size_t * P,
    size_t * Q,
    size_t BCThreshold) [inline]
```

**11.21.3.145 PLUQ() [4/6]**

```
template<class Cut, class Param>
size_t PLUQ (
    const Givaro::Modular< Givaro::Integer > & F,
    const FFLAS::FFLAS_DIAG Diag,
    const size_t M,
    const size_t N,
    typename Givaro::Integer * A,
    const size_t lda,
    size_t * P,
    size_t * Q,
    size_t BCThreshold,
    FFLAS::ParSeqHelper::Parallel< Cut, Param > & PSHelper) [inline]
```

**11.21.3.146 threads\_fgemm()**

```
template<class Field>
void threads_fgemm (
    const size_t m,
    const size_t n,
    const size_t r,
    int nbthreads,
    size_t * W1,
    size_t * W2,
    size_t * W3,
    size_t gamma)
```

**11.21.3.147 threads\_ftrsm()**

```
template<class Field>
void threads_ftrsm (
    const size_t m,
    const size_t n,
    int nbthreads,
    size_t * t1,
    size_t * t2)
```

**11.21.3.148 PLUQ() [5/6]**

```
template<class Field>
size_t PLUQ (
    const Field & Fi,
    const FFLAS::FFLAS_DIAG Diag,
    const size_t M,
    const size_t N,
    typename Field::Element_ptr A,
    const size_t lda,
    size_t * P,
    size_t * Q,
    const FFLAS::ParSeqHelper::Parallel< FFLAS::CuttingStrategy::Recursive, FFLAS::StrategyParameter
> & PSHelper) [inline]
```

**11.21.3.149 fflas\_const\_cast() [1/3]**

```
template<>
rns_double_elt_ptr fflas_const_cast (
    rns_double_elt_cstptr x) [inline]
```

**11.21.3.150 fflas\_const\_cast() [2/3]**

```
template<>
rns_double_elt_cstptr fflas_const_cast (
    rns_double_elt_ptr x) [inline]
```

**11.21.3.151 cyclic\_shift\_row\_col() [2/2]**

```
template<typename Base_t>
void cyclic_shift_row_col (
    Base_t * A,
    size_t m,
    size_t n,
    size_t lda)
```

**11.21.3.152 cyclic\_shift\_row()** [3/3]

```
template INST_OR_DECL void cyclic_shift_row (
    const FFLAS_FIELD< FFLAS_ELT > & F,
    FFLAS_ELT * A,
    size_t m,
    size_t n,
    size_t lda)
```

**11.21.3.153 cyclic\_shift\_col()** [3/3]

```
template INST_OR_DECL void cyclic_shift_col (
    const FFLAS_FIELD< FFLAS_ELT > & F,
    FFLAS_ELT * A,
    size_t m,
    size_t n,
    size_t lda)
```

**11.21.3.154 applyP()** [4/4]

```
template INST_OR_DECL void applyP (
    const FFLAS_FIELD< FFLAS_ELT > & F,
    const FFLAS::FFLAS_SIDE Side,
    const FFLAS::FFLAS_TRANSPOSE Trans,
    const size_t M,
    const size_t ibeg,
    const size_t iend,
    FFLAS_ELT * A,
    const size_t lda,
    const size_t * P)
```

**11.21.3.155 fgetrs()** [3/4]

```
template INST_OR_DECL void fgetrs (
    const FFLAS_FIELD< FFLAS_ELT > & F,
    const FFLAS::FFLAS_SIDE Side,
    const size_t M,
    const size_t N,
    const size_t R,
    FFLAS_ELT * A,
    const size_t lda,
    const size_t * P,
    const size_t * Q,
    FFLAS_ELT * B,
    const size_t ldb,
    int * info)
```

**11.21.3.156 fgetrs()** [4/4]

```
template INST_OR_DECL FFLAS_ELT * fgetrs (
    const FFLAS_FIELD< FFLAS_ELT > & F,
    const FFLAS::FFLAS_SIDE Side,
    const size_t M,
    const size_t N,
    const size_t NRHS,
    const size_t R,
    FFLAS_ELT * A,
    const size_t lda,
    const size_t * P,
    const size_t * Q,
    FFLAS_ELT * X,
    const size_t ldx,
    const FFLAS_ELT * B,
    const size_t ldb,
    int * info)
```

**11.21.3.157 fgesv()** [3/4]

```
template INST_OR_DECL size_t fgesv (
    const FFLAS_FIELD< FFLAS_ELT > & F,
    const FFLAS::FFLAS_SIDE Side,
    const size_t M,
    const size_t N,
    FFLAS_ELT * A,
    const size_t lda,
    FFLAS_ELT * B,
    const size_t ldb,
    int * info)
```

**11.21.3.158 fgesv()** [4/4]

```
template INST_OR_DECL size_t fgesv (
    const FFLAS_FIELD< FFLAS_ELT > & F,
    const FFLAS::FFLAS_SIDE Side,
    const size_t M,
    const size_t N,
    const size_t NRHS,
    FFLAS_ELT * A,
    const size_t lda,
    FFLAS_ELT * X,
    const size_t ldx,
    const FFLAS_ELT * B,
    const size_t ldb,
    int * info)
```

**11.21.3.159 ftrtri()** [2/2]

```
template INST_OR_DECL void ftrtri (
    const FFLAS_FIELD< FFLAS_ELT > & F,
```

```

    const FFLAS::FFLAS_UPLO Uplo,
    const FFLAS::FFLAS_DIAG Diag,
    const size_t N,
    FFLAS_ELT * A,
    const size_t lda,
    const size_t threshold)

```

#### 11.21.3.160 trinv\_left() [2/2]

```

template INST_OR_DECL void trinv_left (
    const FFLAS_FIELD< FFLAS_ELT > & F,
    const size_t N,
    const FFLAS_ELT * L,
    const size_t ldl,
    FFLAS_ELT * X,
    const size_t ldx)

```

#### 11.21.3.161 ftrtrm() [2/2]

```

template INST_OR_DECL void ftrtrm (
    const FFLAS_FIELD< FFLAS_ELT > & F,
    const FFLAS::FFLAS_SIDE side,
    const FFLAS::FFLAS_DIAG diag,
    const size_t N,
    FFLAS_ELT * A,
    const size_t lda)

```

#### 11.21.3.162 PLUQ() [6/6]

```

template INST_OR_DECL size_t PLUQ (
    const FFLAS_FIELD< FFLAS_ELT > & F,
    const FFLAS::FFLAS_DIAG Diag,
    const size_t M,
    const size_t N,
    FFLAS_ELT * A,
    const size_t lda,
    size_t * P,
    size_t * Q)

```

#### 11.21.3.163 LUdivine() [4/4]

```

template INST_OR_DECL size_t LUdivine (
    const FFLAS_FIELD< FFLAS_ELT > & F,
    const FFLAS::FFLAS_DIAG Diag,
    const FFLAS::FFLAS_TRANSPOSE trans,
    const size_t M,
    const size_t N,
    FFLAS_ELT * A,
    const size_t lda,
    size_t * P,
    size_t * Qt,
    const FFPACK_LU_TAG LuTag,
    const size_t cutoff)

```

**11.21.3.164 LUdivine\_small() [2/2]**

```
template INST_OR_DECL size_t LUdivine_small (
    const FFLAS_FIELD< FFLAS_ELT > & F,
    const FFLAS::FFLAS_DIAG Diag,
    const FFLAS::FFLAS_TRANSPOSE trans,
    const size_t M,
    const size_t N,
    FFLAS_ELT * A,
    const size_t lda,
    size_t * P,
    size_t * Q,
    const FFPACK_LU_TAG LuTag)
```

**11.21.3.165 LUdivine\_gauss() [2/2]**

```
template INST_OR_DECL size_t LUdivine_gauss (
    const FFLAS_FIELD< FFLAS_ELT > & F,
    const FFLAS::FFLAS_DIAG Diag,
    const size_t M,
    const size_t N,
    FFLAS_ELT * A,
    const size_t lda,
    size_t * P,
    size_t * Q,
    const FFPACK_LU_TAG LuTag)
```

**11.21.3.166 RowEchelonForm() [3/3]**

```
template INST_OR_DECL size_t RowEchelonForm (
    const FFLAS_FIELD< FFLAS_ELT > & F,
    const size_t M,
    const size_t N,
    FFLAS_ELT * A,
    const size_t lda,
    size_t * P,
    size_t * Qt,
    const bool transform,
    const FFPACK_LU_TAG LuTag)
```

**11.21.3.167 ReducedRowEchelonForm() [3/3]**

```
template INST_OR_DECL size_t ReducedRowEchelonForm (
    const FFLAS_FIELD< FFLAS_ELT > & F,
    const size_t M,
    const size_t N,
    FFLAS_ELT * A,
    const size_t lda,
    size_t * P,
    size_t * Qt,
    const bool transform,
    const FFPACK_LU_TAG LuTag)
```

**11.21.3.168 ColumnEchelonForm()** [3/3]

```
template INST_OR_DECL size_t ColumnEchelonForm (
    const FFLAS_FIELD< FFLAS_ELT > & F,
    const size_t M,
    const size_t N,
    FFLAS_ELT * A,
    const size_t lda,
    size_t * P,
    size_t * Qt,
    const bool transform,
    const FFPACK_LU_TAG LuTag)
```

**11.21.3.169 ReducedColumnEchelonForm()** [3/3]

```
template INST_OR_DECL size_t ReducedColumnEchelonForm (
    const FFLAS_FIELD< FFLAS_ELT > & F,
    const size_t M,
    const size_t N,
    FFLAS_ELT * A,
    const size_t lda,
    size_t * P,
    size_t * Qt,
    const bool transform,
    const FFPACK_LU_TAG LuTag)
```

**11.21.3.170 Invert()** [3/4]

```
template INST_OR_DECL FFLAS_ELT * Invert (
    const FFLAS_FIELD< FFLAS_ELT > & F,
    const size_t M,
    FFLAS_ELT * A,
    const size_t lda,
    int & nullity)
```

**11.21.3.171 Invert()** [4/4]

```
template INST_OR_DECL FFLAS_ELT * Invert (
    const FFLAS_FIELD< FFLAS_ELT > & F,
    const size_t M,
    const FFLAS_ELT * A,
    const size_t lda,
    FFLAS_ELT * X,
    const size_t ldx,
    int & nullity)
```

**11.21.3.172 Invert2()** [2/2]

```
template INST_OR_DECL FFLAS_ELT * Invert2 (
    const FFLAS_FIELD< FFLAS_ELT > & F,
    const size_t M,
    FFLAS_ELT * A,
    const size_t lda,
    FFLAS_ELT * X,
    const size_t ldx,
    int & nullity)
```

**11.21.3.173 CharPoly() [6/8]**

```
template INST_OR_DECL std::list< Givaro::Poly1Dom< FFLAS_FIELD< FFLAS_ELT > >::Element > &
CharPoly (
    const Givaro::Poly1Dom< FFLAS_FIELD< FFLAS_ELT > > & R,
    std::list< Givaro::Poly1Dom< FFLAS_FIELD< FFLAS_ELT > >::Element > & charp,
    const size_t N,
    FFLAS_ELT * A,
    const size_t lda,
    FFLAS_FIELD< FFLAS_ELT >::RandIter & G,
    const FFPACK_CHARPOLY_TAG CharpTag,
    const size_t degree)
```

**11.21.3.174 CharPoly() [7/8]**

```
template INST_OR_DECL Givaro::Poly1Dom< FFLAS_FIELD< FFLAS_ELT > >::Element & CharPoly (
    const Givaro::Poly1Dom< FFLAS_FIELD< FFLAS_ELT > > & R,
    Givaro::Poly1Dom< FFLAS_FIELD< FFLAS_ELT > >::Element & charp,
    const size_t N,
    FFLAS_ELT * A,
    const size_t lda,
    FFLAS_FIELD< FFLAS_ELT >::RandIter & G,
    const FFPACK_CHARPOLY_TAG CharpTag,
    const size_t degree)
```

**11.21.3.175 CharPoly() [8/8]**

```
template INST_OR_DECL Givaro::Poly1Dom< FFLAS_FIELD< FFLAS_ELT > >::Element & CharPoly (
    const Givaro::Poly1Dom< FFLAS_FIELD< FFLAS_ELT > > & R,
    Givaro::Poly1Dom< FFLAS_FIELD< FFLAS_ELT > >::Element & charp,
    const size_t N,
    FFLAS_ELT * A,
    const size_t lda,
    const FFPACK_CHARPOLY_TAG CharpTag,
    const size_t degree)
```

**11.21.3.176 MinPoly() [3/4]**

```
template INST_OR_DECL std::vector< FFLAS_ELT > & MinPoly (
    const FFLAS_FIELD< FFLAS_ELT > & F,
    std::vector< FFLAS_ELT > & minP,
    const size_t N,
    const FFLAS_ELT * A,
    const size_t lda,
    FFLAS_FIELD< FFLAS_ELT >::RandIter & G)
```

**11.21.3.177 MinPoly() [4/4]**

```
template INST_OR_DECL std::vector< FFLAS_ELT > & MinPoly (
    const FFLAS_FIELD< FFLAS_ELT > & F,
    std::vector< FFLAS_ELT > & minP,
    const size_t N,
    const FFLAS_ELT * A,
    const size_t lda)
```



**11.21.3.178 MatVecMinPoly()** [2/2]

```
template INST_OR_DECL std::vector< FFLAS_ELT > & MatVecMinPoly (
    const FFLAS_FIELD< FFLAS_ELT > & F,
    std::vector< FFLAS_ELT > & minP,
    const size_t N,
    const FFLAS_ELT * A,
    const size_t lda,
    const FFLAS_ELT * V,
    const size_t incv)
```

**11.21.3.179 KrylovElim()**

```
template INST_OR_DECL size_t KrylovElim (
    const FFLAS_FIELD< FFLAS_ELT > & F,
    const size_t M,
    const size_t N,
    FFLAS_ELT * A,
    const size_t lda,
    size_t * P,
    size_t * Q,
    const size_t deg,
    size_t * iterates,
    size_t * inviterates,
    const size_t maxit,
    size_t virt)
```

**11.21.3.180 SpecRankProfile()**

```
template INST_OR_DECL size_t SpecRankProfile (
    const FFLAS_FIELD< FFLAS_ELT > & F,
    const size_t M,
    const size_t N,
    FFLAS_ELT * A,
    const size_t lda,
    const size_t deg,
    size_t * rankProfile)
```

**11.21.3.181 Rank()** [3/3]

```
template INST_OR_DECL size_t Rank (
    const FFLAS_FIELD< FFLAS_ELT > & F,
    const size_t M,
    const size_t N,
    FFLAS_ELT * A,
    const size_t lda)
```

**11.21.3.182 IsSingular()** [2/2]

```
template INST_OR_DECL bool IsSingular (
    const FFLAS_FIELD< FFLAS_ELT > & F,
    const size_t M,
    const size_t N,
    FFLAS_ELT * A,
    const size_t lda)
```

**11.21.3.183 Det()** [5/6]

```
template INST_OR_DECL FFLAS_ELT & Det (
    const FFLAS_FIELD< FFLAS_ELT > & F,
    FFLAS_ELT & det,
    const size_t N,
    FFLAS_ELT * A,
    const size_t lda,
    size_t * P,
    size_t * Q)
```

**11.21.3.184 Det()** [6/6]

```
template INST_OR_DECL FFLAS_ELT & Det (
    const FFLAS_FIELD< FFLAS_ELT > & F,
    FFLAS_ELT & det,
    const size_t N,
    FFLAS_ELT * A,
    const size_t lda,
    const FFLAS::ParSeqHelper::Parallel< FFLAS::CuttingStrategy::Recursive, FFLAS::StrategyParameter
> & parH,
    size_t * P,
    size_t * Q)
```

**11.21.3.185 Solve()** [3/3]

```
template INST_OR_DECL FFLAS_ELT * Solve (
    const FFLAS_FIELD< FFLAS_ELT > & F,
    const size_t M,
    FFLAS_ELT * A,
    const size_t lda,
    FFLAS_ELT * x,
    const int incx,
    const FFLAS_ELT * b,
    const int incb)
```

**11.21.3.186 solveLB()** [2/2]

```
template INST_OR_DECL void solveLB (
    const FFLAS_FIELD< FFLAS_ELT > & F,
    const FFLAS::FFLAS_SIDE Side,
    const size_t M,
    const size_t N,
    const size_t R,
    FFLAS_ELT * L,
    const size_t ldl,
    const size_t * Q,
    FFLAS_ELT * B,
    const size_t ldb)
```

**11.21.3.187 solveLB2() [2/2]**

```
template INST_OR_DECL void solveLB2 (
    const FFLAS_FIELD< FFLAS_ELT > & F,
    const FFLAS::FFLAS_SIDE Side,
    const size_t M,
    const size_t N,
    const size_t R,
    FFLAS_ELT * L,
    const size_t ldl,
    const size_t * Q,
    FFLAS_ELT * B,
    const size_t ldb)
```

**11.21.3.188 RandomNullSpaceVector() [3/3]**

```
template INST_OR_DECL void RandomNullSpaceVector (
    const FFLAS_FIELD< FFLAS_ELT > & F,
    const FFLAS::FFLAS_SIDE Side,
    const size_t M,
    const size_t N,
    FFLAS_ELT * A,
    const size_t lda,
    FFLAS_ELT * X,
    const size_t incX)
```

**11.21.3.189 NullSpaceBasis() [2/2]**

```
template INST_OR_DECL size_t NullSpaceBasis (
    const FFLAS_FIELD< FFLAS_ELT > & F,
    const FFLAS::FFLAS_SIDE Side,
    const size_t M,
    const size_t N,
    FFLAS_ELT * A,
    const size_t lda,
    FFLAS_ELT *& NS,
    size_t & ldn,
    size_t & NSdim)
```

**11.21.3.190 RowRankProfile() [3/3]**

```
template INST_OR_DECL size_t RowRankProfile (
    const FFLAS_FIELD< FFLAS_ELT > & F,
    const size_t M,
    const size_t N,
    FFLAS_ELT * A,
    const size_t lda,
    size_t *& rkprofile,
    const FFPACK_LU_TAG LuTag)
```

**11.21.3.191 ColumnRankProfile() [3/3]**

```
template INST_OR_DECL size_t ColumnRankProfile (
    const FFLAS_FIELD< FFLAS_ELT > & F,
    const size_t M,
    const size_t N,
    FFLAS_ELT * A,
    const size_t lda,
    size_t *& rkprofile,
    const FFPACK_LU_TAG LuTag)
```

**11.21.3.192 RowRankProfileSubmatrixIndices() [2/2]**

```
template INST_OR_DECL size_t RowRankProfileSubmatrixIndices (
    const FFLAS_FIELD< FFLAS_ELT > & F,
    const size_t M,
    const size_t N,
    FFLAS_ELT * A,
    const size_t lda,
    size_t *& rowindices,
    size_t *& colindices,
    size_t & R)
```

**11.21.3.193 ColRankProfileSubmatrixIndices() [2/2]**

```
template INST_OR_DECL size_t ColRankProfileSubmatrixIndices (
    const FFLAS_FIELD< FFLAS_ELT > & F,
    const size_t M,
    const size_t N,
    FFLAS_ELT * A,
    const size_t lda,
    size_t *& rowindices,
    size_t *& colindices,
    size_t & R)
```

**11.21.3.194 RowRankProfileSubmatrix() [2/2]**

```
template INST_OR_DECL size_t RowRankProfileSubmatrix (
    const FFLAS_FIELD< FFLAS_ELT > & F,
    const size_t M,
    const size_t N,
    FFLAS_ELT * A,
    const size_t lda,
    FFLAS_ELT *& X,
    size_t & R)
```

**11.21.3.195 ColRankProfileSubmatrix() [2/2]**

```
template INST_OR_DECL size_t ColRankProfileSubmatrix (
    const FFLAS_FIELD< FFLAS_ELT > & F,
    const size_t M,
    const size_t N,
    FFLAS_ELT * A,
    const size_t lda,
    FFLAS_ELT *& X,
    size_t & R)
```

**11.21.3.196 getTriangular< FFLAS\_FIELD< FFLAS\_ELT > >() [1/2]**

```
template INST_OR_DECL void getTriangular< FFLAS_FIELD< FFLAS_ELT > > > (
    const FFLAS_FIELD< FFLAS_ELT > & F,
    const FFLAS::FFLAS_UPLO Uplo,
    const FFLAS::FFLAS_DIAG diag,
    const size_t M,
    const size_t N,
    const size_t R,
    const FFLAS_ELT * A,
    const size_t lda,
    FFLAS_ELT * T,
    const size_t ldt,
    const bool OnlyNonZeroVectors)
```

**11.21.3.197 getTriangular< FFLAS\_FIELD< FFLAS\_ELT > >() [2/2]**

```
template INST_OR_DECL void getTriangular< FFLAS_FIELD< FFLAS_ELT > > > (
    const FFLAS_FIELD< FFLAS_ELT > & F,
    const FFLAS::FFLAS_UPLO Uplo,
    const FFLAS::FFLAS_DIAG diag,
    const size_t M,
    const size_t N,
    const size_t R,
    FFLAS_ELT * A,
    const size_t lda)
```

**11.21.3.198 getEchelonForm< FFLAS\_FIELD< FFLAS\_ELT > >() [1/2]**

```
template INST_OR_DECL void getEchelonForm< FFLAS_FIELD< FFLAS_ELT > > > (
    const FFLAS_FIELD< FFLAS_ELT > & F,
    const FFLAS::FFLAS_UPLO Uplo,
    const FFLAS::FFLAS_DIAG diag,
    const size_t M,
    const size_t N,
    const size_t R,
    const size_t * P,
    const FFLAS_ELT * A,
    const size_t lda,
    FFLAS_ELT * T,
    const size_t ldt,
    const bool OnlyNonZeroVectors,
    const FFPACK_LU_TAG LuTag)
```

**11.21.3.199 getEchelonForm< FFLAS\_FIELD< FFLAS\_ELT > >() [2/2]**

```
template INST_OR_DECL void getEchelonForm< FFLAS_FIELD< FFLAS_ELT > > > (
    const FFLAS_FIELD< FFLAS_ELT > & F,
    const FFLAS::FFLAS_UPLO Uplo,
    const FFLAS::FFLAS_DIAG diag,
    const size_t M,
    const size_t N,
    const size_t R,
    const size_t * P,
    FFLAS_ELT * A,
    const size_t lda,
    const FFPACK_LU_TAG LuTag)
```

**11.21.3.200 getEchelonTransform< FFLAS\_FIELD< FFLAS\_ELT > >()**

```
template INST_OR_DECL void getEchelonTransform< FFLAS_FIELD< FFLAS_ELT > > (
    const FFLAS_FIELD< FFLAS_ELT > & F,
    const FFLAS::FFLAS_UPLO Uplo,
    const FFLAS::FFLAS_DIAG diag,
    const size_t M,
    const size_t N,
    const size_t R,
    const size_t * P,
    const size_t * Q,
    const FFLAS_ELT * A,
    const size_t lda,
    FFLAS_ELT * T,
    const size_t ldt,
    const FFPACK_LU_TAG LuTag)
```

**11.21.3.201 getReducedEchelonForm< FFLAS\_FIELD< FFLAS\_ELT > >() [1/2]**

```
template INST_OR_DECL void getReducedEchelonForm< FFLAS_FIELD< FFLAS_ELT > > (
    const FFLAS_FIELD< FFLAS_ELT > & F,
    const FFLAS::FFLAS_UPLO Uplo,
    const size_t M,
    const size_t N,
    const size_t R,
    const size_t * P,
    const FFLAS_ELT * A,
    const size_t lda,
    FFLAS_ELT * T,
    const size_t ldt,
    const bool OnlyNonZeroVectors,
    const FFPACK_LU_TAG LuTag)
```

**11.21.3.202 getReducedEchelonForm< FFLAS\_FIELD< FFLAS\_ELT > >() [2/2]**

```
template INST_OR_DECL void getReducedEchelonForm< FFLAS_FIELD< FFLAS_ELT > > (
    const FFLAS_FIELD< FFLAS_ELT > & F,
    const FFLAS::FFLAS_UPLO Uplo,
    const size_t M,
    const size_t N,
    const size_t R,
    const size_t * P,
    FFLAS_ELT * A,
    const size_t lda,
    const FFPACK_LU_TAG LuTag)
```

**11.21.3.203 getReducedEchelonTransform< FFLAS\_FIELD< FFLAS\_ELT > >()**

```
template INST_OR_DECL void getReducedEchelonTransform< FFLAS_FIELD< FFLAS_ELT > > (
    const FFLAS_FIELD< FFLAS_ELT > & F,
    const FFLAS::FFLAS_UPLO Uplo,
    const size_t M,
```

```

    const size_t N,
    const size_t R,
    const size_t * P,
    const size_t * Q,
    const FFLAS_ELT * A,
    const size_t lda,
    FFLAS_ELT * T,
    const size_t ldt,
    const FFPACK_LU_TAG LuTag)

```

#### 11.21.3.204 LQUPtoInverseOfFullRankMinor() [2/2]

```

template INST_OR_DECL FFLAS_ELT * LQUPtoInverseOfFullRankMinor (
    const FFLAS_FIELD< FFLAS_ELT > & F,
    const size_t rank,
    FFLAS_ELT * A_factors,
    const size_t lda,
    const size_t * QtPointer,
    FFLAS_ELT * X,
    const size_t ldx)

```

#### 11.21.3.205 fflas\_const\_cast() [3/3]

```

template<class T, class CT = const T>
T fflas_const_cast (
    CT x)

```

#### 11.21.3.206 failure()

```

Failure & failure () [inline]

```

#### 11.21.3.207 isOdd() [1/3]

```

template<class T>
bool isOdd (
    const T & a) [inline]

```

#### 11.21.3.208 isOdd() [2/3]

```

bool isOdd (
    const float & a) [inline]

```

#### 11.21.3.209 isOdd() [3/3]

```

bool isOdd (
    const double & a) [inline]

```

**11.21.3.210 NonZeroRandomMatrix()** [1/2]

```
template<class Field, class RandIter>
Field::Element_ptr NonZeroRandomMatrix (
    const Field & F,
    size_t m,
    size_t n,
    typename Field::Element_ptr A,
    size_t lda,
    RandIter & G) [inline]
```

Random non-zero Matrix.

Creates a  $m \times n$  matrix with random entries, and at least one of them is non zero.

**Parameters**

	$F$	field
	$m$	number of rows in A
	$n$	number of cols in A
out	$A$	the matrix (preallocated to at least $m \times lda$ field elements)
	$lda$	leading dimension of A
	$G$	a random iterator

**Returns**

A.

**11.21.3.211 NonZeroRandomMatrix()** [2/2]

```
template<class Field, class RandIter>
Field::Element_ptr NonZeroRandomMatrix (
    const Field & F,
    size_t m,
    size_t n,
    typename Field::Element_ptr A,
    size_t lda) [inline]
```

Random non-zero Matrix.

Creates a  $m \times n$  matrix with random entries, and at least one of them is non zero.

**Parameters**

	$F$	field
	$m$	number of rows in A
	$n$	number of cols in A
out	$A$	the matrix (preallocated to at least $m \times lda$ field elements)
	$lda$	leading dimension of A

**Returns**

A.



**11.21.3.212 RandomMatrix()** [1/2]

```
template<class Field, class RandIter>
Field::Element_ptr RandomMatrix (
    const Field & F,
    size_t m,
    size_t n,
    typename Field::Element_ptr A,
    size_t lda,
    RandIter & G) [inline]
```

Random Matrix.

Creates a  $m \times n$  matrix with random entries.

**Parameters**

	$F$	field
	$m$	number of rows in A
	$n$	number of cols in A
out	$A$	the matrix (preallocated to at least $m \times lda$ field elements)
	$lda$	leading dimension of A
	$G$	a random iterator

**Returns**

A.

**11.21.3.213 RandomMatrix()** [2/2]

```
template<class Field>
Field::Element_ptr RandomMatrix (
    const Field & F,
    size_t m,
    size_t n,
    typename Field::Element_ptr A,
    size_t lda) [inline]
```

Random Matrix.

Creates a  $m \times n$  matrix with random entries.

**Parameters**

	$F$	field
	$m$	number of rows in A
	$n$	number of cols in A
out	$A$	the matrix (preallocated to at least $m \times lda$ field elements)
	$lda$	leading dimension of A

**Returns**

A.

**11.21.3.214 RandomTriangularMatrix()** [1/2]

```
template<class Field, class RandIter>
Field::Element_ptr RandomTriangularMatrix (
    const Field & F,
    size_t m,
    size_t n,
    const FFLAS::FFLAS_UPLO UpLo,
    const FFLAS::FFLAS_DIAG Diag,
    bool nonsingular,
    typename Field::Element_ptr A,
    size_t lda,
    RandIter & G) [inline]
```

Random Triangular Matrix.

Creates a  $m \times n$  triangular matrix with random entries. The `UpLo` parameter defines whether it is upper or lower triangular.

**Parameters**

	<i>F</i>	field
	<i>m</i>	number of rows in A
	<i>n</i>	number of cols in A
	<i>UpLo</i>	whether A is upper or lower triangular
out	<i>A</i>	the matrix (preallocated to at least $m \times lda$ field elements)
	<i>lda</i>	leading dimension of A
	<i>G</i>	a random iterator

**Returns**

A.

**11.21.3.215 RandomTriangularMatrix()** [2/2]

```
template<class Field>
Field::Element_ptr RandomTriangularMatrix (
    const Field & F,
    size_t m,
    size_t n,
    const FFLAS::FFLAS_UPLO UpLo,
    const FFLAS::FFLAS_DIAG Diag,
    bool nonsingular,
    typename Field::Element_ptr A,
    size_t lda) [inline]
```

Random Triangular Matrix.

Creates a  $m \times n$  triangular matrix with random entries. The `UpLo` parameter defines whether it is upper or lower triangular.

## Parameters

	$F$	field
	$m$	number of rows in $A$
	$n$	number of cols in $A$
	$UpLo$	whether $A$ is upper or lower triangular
out	$A$	the matrix (preallocated to at least $m \times lda$ field elements)
	$lda$	leading dimension of $A$

## Returns

$A$ .

## 11.21.3.216 RandInt()

```
size_t RandInt (
    size_t a,
    size_t b) [inline]
```

## 11.21.3.217 RandomSymmetricMatrix()

```
template<class Field, class RandIter>
Field::Element_ptr RandomSymmetricMatrix (
    const Field & F,
    size_t n,
    bool nonsingular,
    typename Field::Element_ptr A,
    size_t lda,
    RandIter & G) [inline]
```

Random Symmetric Matrix.

Creates a  $m \times n$  triangular matrix with random entries. The  $UpLo$  parameter defines whether it is upper or lower triangular.

## Parameters

	$F$	field
	$n$	order of $A$
out	$A$	the matrix (preallocated to at least $n \times lda$ field elements)
	$lda$	leading dimension of $A$
	$G$	a random iterator

## Returns

$A$ .

**11.21.3.218 RandomMatrixWithRank()** [1/2]

```
template<class Field, class RandIter>
Field::Element_ptr RandomMatrixWithRank (
    const Field & F,
    size_t m,
    size_t n,
    size_t r,
    typename Field::Element_ptr A,
    size_t lda,
    RandIter & G) [inline]
```

Random Matrix with prescribed rank.

Creates an  $m \times n$  matrix with random entries and rank  $r$ .

**Parameters**

$F$	field
$m$	number of rows in A
$n$	number of cols in A
$r$	rank of the matrix to build
$A$	the matrix (preallocated to at least $m \times lda$ field elements)
$lda$	leading dimension of A
$G$	a random iterator

**Returns**

A.

**11.21.3.219 RandomMatrixWithRank()** [2/2]

```
template<class Field>
Field::Element_ptr RandomMatrixWithRank (
    const Field & F,
    size_t m,
    size_t n,
    size_t r,
    typename Field::Element_ptr A,
    size_t lda) [inline]
```

Random Matrix with prescribed rank.

Creates an  $m \times n$  matrix with random entries and rank  $r$ .

**Parameters**

	$F$	field
	$m$	number of rows in A
	$n$	number of cols in A
	$r$	rank of the matrix to build
out	$A$	the matrix (preallocated to at least $m \times lda$ field elements)
	$lda$	leading dimension of A

**Returns**

A.

**11.21.3.220 RandomIndexSubset()**

```
size_t * RandomIndexSubset (
    size_t N,
    size_t R,
    size_t * P) [inline]
```

Pick uniformly at random a sequence of  $R$  distinct elements from the set  $\{0, \dots, N - 1\}$  using Knuth's shuffle.

**Parameters**

	$N$	the cardinality of the sampling set
	$R$	the number of elements to sample
out	$P$	the output sequence (pre-allocated to at least $R$ indices)

**11.21.3.221 RandomPermutation()**

```
size_t * RandomPermutation (
    size_t N,
    size_t * P) [inline]
```

Pick uniformly at random a permutation of size  $N$  stored in LAPACK format using Knuth's shuffle.

**Parameters**

	$N$	the length of the permutation
out	$P$	the output permutation (pre-allocated to at least $N$ indices)

**11.21.3.222 RandomRankProfileMatrix()**

```
void RandomRankProfileMatrix (
    size_t M,
    size_t N,
    size_t R,
    size_t * rows,
    size_t * cols) [inline]
```

Pick uniformly at random an  $R$ -subpermutation of dimension  $M \times N$  : a matrix with only  $R$  non-zeros equal to one, in a random rook placement.

**Parameters**

	$M$	row dimension
	$N$	column dimension
out	<i>rows</i>	the row position of each non zero element (pre-allocated)
out	<i>cols</i>	the column position of each non zero element (pre-allocated)

**11.21.3.223 swapval()**

```
void swapval (
    size_t k,
    size_t N,
    size_t * P,
    size_t val) [inline]
```

**11.21.3.224 RandomSymmetricRankProfileMatrix()**

```
void RandomSymmetricRankProfileMatrix (
    size_t N,
    size_t R,
    size_t * rows,
    size_t * cols) [inline]
```

Pick uniformly at random a symmetric  $R$ -subpermutation of dimension  $N \times N$  : a symmetric matrix with only  $R$  non-zeros, all equal to one, in a random rook placement.

**Parameters**

	$N$	matrix order
out	$rows$	the row position of each non zero element (pre-allocated)
out	$cols$	the column position of each non zero element (pre-allocated)

**11.21.3.225 RandomLTQSRankProfileMatrix()**

```
void RandomLTQSRankProfileMatrix (
    size_t n,
    size_t r,
    size_t t,
    size_t * rows,
    size_t * cols) [inline]
```

**11.21.3.226 RandomMatrixWithRankandRPM()** [1/2]

```
template<class Field, class RandIter>
Field::Element_ptr RandomMatrixWithRankandRPM (
    const Field & F,
    size_t M,
    size_t N,
    size_t R,
    typename Field::Element_ptr A,
    size_t lda,
    const size_t * RRP,
    const size_t * CRP,
    RandIter & G) [inline]
```

Random Matrix with prescribed rank and rank profile matrix Creates an  $m \times n$  matrix with random entries and rank  $r$ .

## Parameters

<i>F</i>	field
<i>m</i>	number of rows in A
<i>n</i>	number of cols in A
<i>r</i>	rank of the matrix to build
<i>A</i>	the matrix (preallocated to at least $m \times lda$ field elements)
<i>lda</i>	leading dimension of A
<i>RRP</i>	the R dimensional array with row positions of the rank profile matrix' pivots
<i>CRP</i>	the R dimensional array with column positions of the rank profile matrix' pivots
<i>G</i>	a random iterator

## Returns

A.

## 11.21.3.227 RandomMatrixWithRankandRPM() [2/2]

```
template<class Field>
Field::Element_ptr RandomMatrixWithRankandRPM (
    const Field & F,
    size_t M,
    size_t N,
    size_t R,
    typename Field::Element_ptr A,
    size_t lda,
    const size_t * RRP,
    const size_t * CRP) [inline]
```

Random Matrix with prescribed rank and rank profile matrix Creates an  $m \times n$  matrix with random entries and rank  $r$ .

## Parameters

<i>F</i>	field
<i>m</i>	number of rows in A
<i>n</i>	number of cols in A
<i>r</i>	rank of the matrix to build
<i>A</i>	the matrix (preallocated to at least $m \times lda$ field elements)
<i>lda</i>	leading dimension of A
<i>RRP</i>	the R dimensional array with row positions of the rank profile matrix' pivots
<i>CRP</i>	the R dimensional array with column positions of the rank profile matrix' pivots

## Returns

A.

**11.21.3.228 RandomSymmetricMatrixWithRankandRPM()** [1/2]

```
template<class Field, class RandIter>
Field::Element_ptr RandomSymmetricMatrixWithRankandRPM (
    const Field & F,
    size_t N,
    size_t R,
    typename Field::Element_ptr A,
    size_t lda,
    const size_t * RRP,
    const size_t * CRP,
    RandIter & G) [inline]
```

Random Symmetric Matrix with prescribed rank and rank profile matrix Creates an  $n \times n$  symmetric matrix with random entries and rank  $r$ .

**Parameters**

$F$	field
$n$	order of $A$
$r$	rank of $A$
$A$	the matrix (preallocated to at least $n \times lda$ field elements)
$lda$	leading dimension of $A$
$RRP$	the $R$ dimensional array with row positions of the rank profile matrix' pivots
$CRP$	the $R$ dimensional array with column positions of the rank profile matrix' pivots
$G$	a random iterator

**Returns**

$A$ .

**11.21.3.229 RandomSymmetricMatrixWithRankandRPM()** [2/2]

```
template<class Field>
Field::Element_ptr RandomSymmetricMatrixWithRankandRPM (
    const Field & F,
    size_t M,
    size_t N,
    size_t R,
    typename Field::Element_ptr A,
    size_t lda,
    const size_t * RRP,
    const size_t * CRP) [inline]
```

Random Symmetric Matrix with prescribed rank and rank profile matrix Creates an  $n \times n$  symmetric matrix with random entries and rank  $r$ .

**Parameters**

$F$	field
$n$	order of $A$
$r$	rank of $A$
$A$	the matrix (preallocated to at least $n \times lda$ field elements)



<i>lda</i>	leading dimension of <i>A</i>
<i>RRP</i>	the <i>R</i> dimensional array with row positions of the rank profile matrix' pivots
<i>CRP</i>	the <i>R</i> dimensional array with column positions of the rank profile matrix' pivots

**Returns**

*A*.

**11.21.3.230 RandomMatrixWithRankandRandomRPM() [1/2]**

```
template<class Field, class RandIter>
Field::Element_ptr RandomMatrixWithRankandRandomRPM (
    const Field & F,
    size_t M,
    size_t N,
    size_t R,
    typename Field::Element_ptr A,
    size_t lda,
    RandIter & G) [inline]
```

Random Matrix with prescribed rank, with random rank profile matrix Creates an  $m \times n$  matrix with random entries, rank  $r$  and with a rank profile matrix chosen uniformly at random.

**Parameters**

<i>F</i>	field
<i>m</i>	number of rows in <i>A</i>
<i>n</i>	number of cols in <i>A</i>
<i>r</i>	rank of the matrix to build
<i>A</i>	the matrix (preallocated to at least $m \times lda$ field elements)
<i>lda</i>	leading dimension of <i>A</i>
<i>G</i>	a random iterator

**Returns**

*A*.

**11.21.3.231 RandomMatrixWithRankandRandomRPM() [2/2]**

```
template<class Field>
Field::Element_ptr RandomMatrixWithRankandRandomRPM (
    const Field & F,
    size_t M,
    size_t N,
    size_t R,
    typename Field::Element_ptr A,
    size_t lda) [inline]
```

Random Matrix with prescribed rank, with random rank profile matrix Creates an  $m \times n$  matrix with random entries, rank  $r$  and with a rank profile matrix chosen uniformly at random.

## Parameters

$F$	field
$m$	number of rows in $A$
$n$	number of cols in $A$
$r$	rank of the matrix to build
$A$	the matrix (preallocated to at least $m \times lda$ field elements)
$lda$	leading dimension of $A$

## Returns

$A$ .

### 11.21.3.232 RandomSymmetricMatrixWithRankandRandomRPM() [1/2]

```
template<class Field, class RandIter>
Field::Element_ptr RandomSymmetricMatrixWithRankandRandomRPM (
    const Field & F,
    size_t N,
    size_t R,
    typename Field::Element_ptr A,
    size_t lda,
    RandIter & G) [inline]
```

Random Symmetric Matrix with prescribed rank, with random rank profile matrix Creates an  $n \times n$  matrix with random entries, rank  $r$  and with a rank profile matrix chosen uniformly at random.

## Parameters

$F$	field
$n$	order of $A$
$r$	rank of $A$
$A$	the matrix (preallocated to at least $n \times lda$ field elements)
$lda$	leading dimension of $A$
$G$	a random iterator

## Returns

$A$ .

### 11.21.3.233 RandomSymmetricMatrixWithRankandRandomRPM() [2/2]

```
template<class Field>
Field::Element_ptr RandomSymmetricMatrixWithRankandRandomRPM (
    const Field & F,
    size_t N,
    size_t R,
    typename Field::Element_ptr A,
    size_t lda) [inline]
```

Random Symmetric Matrix with prescribed rank, with random rank profile matrix Creates an  $n \times n$  matrix with random entries, rank  $r$  and with a rank profile matrix chosen uniformly at random.

## Parameters

<i>F</i>	field
<i>n</i>	order of A
<i>r</i>	rank of A
<i>A</i>	the matrix (preallocated to at least $n \times lda$ field elements)
<i>lda</i>	leading dimension of A

## Returns

A.

**11.21.3.234 RandomMatrixWithDet()** [1/2]

```
template<class Field>
Field::Element_ptr RandomMatrixWithDet (
    const Field & F,
    size_t n,
    const typename Field::Element d,
    typename Field::Element_ptr A,
    size_t lda) [inline]
```

Random Matrix with prescribed det.

Creates a  $m \times n$  matrix with random entries and rank  $r$ .

## Parameters

<i>F</i>	field
<i>d</i>	the prescribed value for the determinant of A
<i>n</i>	number of cols in A
<i>A</i>	the matrix to be generated (preallocated to at least $n \times lda$ field elements)
<i>lda</i>	leading dimension of A

## Returns

A.

**11.21.3.235 RandomMatrixWithDet()** [2/2]

```
template<class Field, class RandIter>
Field::Element_ptr RandomMatrixWithDet (
    const Field & F,
    size_t n,
    const typename Field::Element d,
    typename Field::Element_ptr A,
    size_t lda,
    RandIter & G) [inline]
```

Random Matrix with prescribed det.

Creates a  $m \times n$  matrix with random entries and rank  $r$ .

## Parameters

$F$	field
$d$	the prescribed value for the determinant of $A$
$n$	number of cols in $A$
$A$	the matrix to be generated (preallocated to at least $n \times lda$ field elements)
$lda$	leading dimension of $A$

## Returns

$A$ .

**11.21.3.236 RandomLTQSMatrixWithRankandQSorder()**

```
template<class Field, class RandIter>
Field::Element_ptr RandomLTQSMatrixWithRankandQSorder (
    Field & F,
    size_t n,
    size_t r,
    size_t t,
    typename Field::Element_ptr A,
    size_t lda,
    RandIter & G) [inline]
```

**11.21.3.237 chooseField()**

```
template<typename Field>
Field * chooseField (
    Givaro::Integer q,
    uint64_t b,
    uint64_t seed)
```

**11.21.3.238 chooseField< Givaro::ZRing< int32\_t > >()**

```
template<>
Givaro::ZRing< int32_t > * chooseField< Givaro::ZRing< int32_t > > (
    Givaro::Integer q,
    uint64_t b,
    uint64_t seed)
```

**11.21.3.239 chooseField< Givaro::ZRing< int64\_t > >()**

```
template<>
Givaro::ZRing< int64_t > * chooseField< Givaro::ZRing< int64_t > > (
    Givaro::Integer q,
    uint64_t b,
    uint64_t seed)
```

**11.21.3.240 chooseField< Givaro::ZRing< float > >()**

```
template<>
Givaro::ZRing< float > * chooseField< Givaro::ZRing< float > > (
    Givaro::Integer q,
    uint64_t b,
    uint64_t seed)
```

**11.21.3.241 chooseField< Givaro::ZRing< double > >()**

```
template<>
Givaro::ZRing< double > * chooseField< Givaro::ZRing< double > > (
    Givaro::Integer q,
    uint64_t b,
    uint64_t seed)
```

**11.22 FFPACK::Protected Namespace Reference****Functions**

- template<class [Field](#)>  
size\_t [LUdivine\\_construct](#) (const [Field](#) &F, const [FFLAS::FFLAS\\_DIAG](#) Diag, const size\_t M, const size\_t N, typename [Field::ConstElement\\_ptr](#) A, const size\_t lda, typename [Field::Element\\_ptr](#) X, const size\_t ldx, typename [Field::Element\\_ptr](#) u, const size\_t incu, size\_t \*P, bool computeX, const FFPACK\_MINPOLY\_TAG MinTag=[FpackDense](#), const size\_t kg\_mc=0, const size\_t kg\_mb=0, const size\_t kg\_j=0)
- template<class [Field](#)>  
size\_t [GaussJordan](#) (const [Field](#) &F, const size\_t M, const size\_t N, typename [Field::Element\\_ptr](#) A, const size\_t lda, const size\_t colbeg, const size\_t rowbeg, const size\_t colsize, size\_t \*P, size\_t \*Q, const FFPACK::FFPACK\_LU\_TAG LuTag)  
*Gauss-Jordan algorithm computing the Reduced Row echelon form and its transform matrix.*
- template<class [Field](#), class Polynomial>  
std::list< Polynomial > & [KellerGehrig](#) (const [Field](#) &F, std::list< Polynomial > &charp, const size\_t N, typename [Field::ConstElement\\_ptr](#) A, const size\_t lda)
- template<class [Field](#), class Polynomial>  
int [KGFast](#) (const [Field](#) &F, std::list< Polynomial > &charp, const size\_t N, typename [Field::Element\\_ptr](#) A, const size\_t lda, size\_t \*kg\_mc, size\_t \*kg\_mb, size\_t \*kg\_j)
- template<class [Field](#), class Polynomial>  
std::list< Polynomial > & [KGFast\\_generalized](#) (const [Field](#) &F, std::list< Polynomial > &charp, const size\_t N, typename [Field::Element\\_ptr](#) A, const size\_t lda)
- template<class [Field](#)>  
void [fgemv\\_kgf](#) (const [Field](#) &F, const size\_t N, typename [Field::ConstElement\\_ptr](#) A, const size\_t lda, typename [Field::ConstElement\\_ptr](#) X, const size\_t incX, typename [Field::Element\\_ptr](#) Y, const size\_t incY, const size\_t kg\_mc, const size\_t kg\_mb, const size\_t kg\_j)
- template<class [Field](#), class Polynomial, class RandIter>  
std::list< Polynomial > & [LUKrylov](#) (const [Field](#) &F, std::list< Polynomial > &charp, const size\_t N, typename [Field::Element\\_ptr](#) A, const size\_t lda, typename [Field::Element\\_ptr](#) U, const size\_t ldu, RandIter &G)
- template<class [Field](#), class Polynomial>  
std::list< Polynomial > & [Danilevski](#) (const [Field](#) &F, std::list< Polynomial > &charp, const size\_t N, typename [Field::Element\\_ptr](#) A, const size\_t lda)
- template<class PolRing>  
void [RandomKrylovPrecond](#) (const PolRing &PR, std::list< typename PolRing::Element > &completed← Factors, const size\_t N, typename PolRing::Domain\_t::Element\_ptr A, const size\_t lda, size\_t &Nb, typename PolRing::Domain\_t::Element\_ptr &B, size\_t &ldb, typename PolRing::Domain\_t::RandIter &g, const size\_t ← t degree=\_\_FFLASFFPACK\_ARITHPROG\_THRESHOLD)

- `template<class PolRing>`  
`std::list< typename PolRing::Element > & ArithProg (const PolRing &PR, std::list< typename PolRing::Element > &frobeniusForm, const size_t N, typename PolRing::Domain_t::Element_ptr A, const size_t lda, const size_t degree)`
- `template<class Field, class Polynomial>`  
`std::list< Polynomial > & LUKrylov_KGFast (const Field &F, std::list< Polynomial > &charp, const size_t N, typename Field::Element_ptr A, const size_t lda, typename Field::Element_ptr X, const size_t ldx)`
- `template<class Field, class Polynomial>`  
`Polynomial & MatVecMinPoly (const Field &F, Polynomial &minP, const size_t N, typename Field::ConstElement_ptr A, const size_t lda, typename Field::Element_ptr v, const size_t incv, typename Field::Element_ptr K, const size_t ldk, size_t *P)`
- `template<class Field, class Polynomial>`  
`Polynomial & Hybrid_KGF_LUK_MinPoly (const Field &F, Polynomial &minP, const size_t N, typename Field::ConstElement_ptr A, const size_t lda, typename Field::Element_ptr X, const size_t ldx, size_t *P, const FFPACK_MINPOLY_TAG MinTag=FFPACK::FfpackDense, const size_t kg_mc=0, const size_t kg_mb=0, const size_t kg_j=0)`
- `template<class Field>`  
`size_t updateD (const Field &F, size_t *d, size_t k, std::vector< std::vector< typename Field::Element > > &minpt)`
- `template<class Field>`  
`size_t newD (const Field &F, size_t *d, bool &KeepOn, const size_t l, const size_t N, typename Field::Element_ptr X, const size_t *Q, std::vector< std::vector< typename Field::Element > > &minpt)`
- `template<class Field>`  
`void CompressRows (Field &F, const size_t M, typename Field::Element_ptr A, const size_t lda, typename Field::Element_ptr tmp, const size_t ldtmp, const size_t *d, const size_t nb_blocs)`
- `template<class Field>`  
`void CompressRowsQK (Field &F, const size_t M, typename Field::Element_ptr A, const size_t lda, typename Field::Element_ptr tmp, const size_t ldtmp, const size_t *d, const size_t deg, const size_t nb_blocs)`
- `template<class Field>`  
`void DeCompressRows (Field &F, const size_t M, const size_t N, typename Field::Element_ptr A, const size_t lda, typename Field::Element_ptr tmp, const size_t ldtmp, const size_t *d, const size_t nb_blocs)`
- `template<class Field>`  
`void DeCompressRowsQK (Field &F, const size_t M, const size_t N, typename Field::Element_ptr A, const size_t lda, typename Field::Element_ptr tmp, const size_t ldtmp, const size_t *d, const size_t deg, const size_t nb_blocs)`
- `template<class Field>`  
`void CompressRowsQA (Field &F, const size_t M, typename Field::Element_ptr A, const size_t lda, typename Field::Element_ptr tmp, const size_t ldtmp, const size_t *d, const size_t nb_blocs)`
- `template<class Field>`  
`void DeCompressRowsQA (Field &F, const size_t M, const size_t N, typename Field::Element_ptr A, const size_t lda, typename Field::Element_ptr tmp, const size_t ldtmp, const size_t *d, const size_t nb_blocs)`
- `template<class Field>`  
`size_t LUdivine_construct (const Field &F, const FFLAS::FFLAS_DIAG Diag, const size_t M, const size_t N, typename Field::ConstElement_ptr A, const size_t lda, typename Field::Element_ptr X, const size_t ldx, typename Field::Element_ptr u, const size_t incu, size_t *P, bool computeX, const FFPACK::FFPACK_MINPOLY_TAG MinTag, const size_t kg_mc, const size_t kg_mb, const size_t kg_j)`

## 11.22.1 Function Documentation

### 11.22.1.1 LUdivine\_construct() [1/2]

```
template<class Field>
size_t LUdivine_construct (
    const Field & F,
    const FFLAS::FFLAS_DIAG Diag,
```

```

const size_t M,
const size_t N,
typename Field::ConstElement_ptr A,
const size_t lda,
typename Field::Element_ptr X,
const size_t ldx,
typename Field::Element_ptr u,
const size_t incu,
size_t * P,
bool computeX,
const FFPACK_MINPOLY_TAG MinTag = FfpackDense,
const size_t kg_mc = 0,
const size_t kg_mb = 0,
const size_t kg_j = 0)

```

### 11.22.1.2 GaussJordan()

```

template<class Field>
size_t GaussJordan (
    const Field & F,
    const size_t M,
    const size_t N,
    typename Field::Element_ptr A,
    const size_t lda,
    const size_t colbeg,
    const size_t rowbeg,
    const size_t colsize,
    size_t * P,
    size_t * Q,
    const FFPACK::FFPACK_LU_TAG LuTag) [inline]

```

Gauss-Jordan algorithm computing the Reduced Row echelon form and its transform matrix.

- Bibliography**
- Algorithm 2.8 of A. Storjohann Thesis 2000,
  - Algorithm 11 of Jeannerod C-P., Pernet, C. and Storjohann, A. *Rank-profile revealing Gaussian elimination and the CUP matrix decomposition*, J. of Symbolic Comp., 2013

#### Parameters

	<i>M</i>	row dimension of A
	<i>N</i>	column dimension of A
<i>in, out</i>	<i>A</i>	an m x n matrix
	<i>lda</i>	leading dimension of A
	<i>P</i>	row permutation
	<i>Q</i>	column permutation
	<i>LuTag</i>	set the base case to a Tile (FfpackGaussJordanTile) or Slab (FfpackGaussJordanSlab) recursive RedEchelon

where the transformation matrix is stored at the pivot column position

### 11.22.1.3 KellerGehrig()

```
template<class Field, class Polynomial>
std::list< Polynomial > & KellerGehrig (
    const Field & F,
    std::list< Polynomial > & charp,
    const size_t N,
    typename Field::ConstElement_ptr A,
    const size_t lda)
```

### 11.22.1.4 KGFast()

```
template<class Field, class Polynomial>
int KGFast (
    const Field & F,
    std::list< Polynomial > & charp,
    const size_t N,
    typename Field::Element_ptr A,
    const size_t lda,
    size_t * kg_mc,
    size_t * kg_mb,
    size_t * kg_j)
```

### 11.22.1.5 KGFast\_generalized()

```
template<class Field, class Polynomial>
std::list< Polynomial > & KGFast_generalized (
    const Field & F,
    std::list< Polynomial > & charp,
    const size_t N,
    typename Field::Element_ptr A,
    const size_t lda)
```

### 11.22.1.6 fgemv\_kgf()

```
template<class Field>
void fgemv_kgf (
    const Field & F,
    const size_t N,
    typename Field::ConstElement_ptr A,
    const size_t lda,
    typename Field::ConstElement_ptr X,
    const size_t incX,
    typename Field::Element_ptr Y,
    const size_t incY,
    const size_t kg_mc,
    const size_t kg_mb,
    const size_t kg_j)
```

### 11.22.1.7 LUKrylov()

```
template<class Field, class Polynomial, class RandIter>
std::list< Polynomial > & LUKrylov (
    const Field & F,
    std::list< Polynomial > & charp,
    const size_t N,
    typename Field::Element_ptr A,
    const size_t lda,
    typename Field::Element_ptr U,
```



```
const size_t ldu,
RandIter & G)
```

### 11.22.1.8 Danilevski()

```
template<class Field, class Polynomial>
std::list< Polynomial > & Danilevski (
    const Field & F,
    std::list< Polynomial > & charp,
    const size_t N,
    typename Field::Element_ptr A,
    const size_t lda)
```

### 11.22.1.9 RandomKrylovPrecond()

```
template<class PolRing>
void RandomKrylovPrecond (
    const PolRing & PR,
    std::list< typename PolRing::Element > & completedFactors,
    const size_t N,
    typename PolRing::Domain_t::Element_ptr A,
    const size_t lda,
    size_t & Nb,
    typename PolRing::Domain_t::Element_ptr & B,
    size_t & ldb,
    typename PolRing::Domain_t::RandIter & g,
    const size_t degree = __FFLASFFPACK_ARITHPROG_THRESHOLD) [inline]
```

**Todo** swap to save space ??

**Todo**

**Todo** don't assing K2 c\*noc x N but only mas (c,noc) x N and store each one after the other

### 11.22.1.10 ArithProg()

```
template<class PolRing>
std::list< typename PolRing::Element > & ArithProg (
    const PolRing & PR,
    std::list< typename PolRing::Element > & frobeniusForm,
    const size_t N,
    typename PolRing::Domain_t::Element_ptr A,
    const size_t lda,
    const size_t degree) [inline]
```

### 11.22.1.11 LUKrylov\_KGFast()

```
template<class Field, class Polynomial>
std::list< Polynomial > & LUKrylov_KGFast (
    const Field & F,
    std::list< Polynomial > & charp,
    const size_t N,
    typename Field::Element_ptr A,
    const size_t lda,
    typename Field::Element_ptr X,
    const size_t ldx)
```

**11.22.1.12 MatVecMinPoly()**

```
template<class Field, class Polynomial>
Polynomial & MatVecMinPoly (
    const Field & F,
    Polynomial & minP,
    const size_t N,
    typename Field::ConstElement_ptr A,
    const size_t lda,
    typename Field::Element_ptr v,
    const size_t incv,
    typename Field::Element_ptr K,
    const size_t ldk,
    size_t * P) [inline]
```

**11.22.1.13 Hybrid\_KGF\_LUK\_MinPoly()**

```
template<class Field, class Polynomial>
Polynomial & Hybrid_KGF_LUK_MinPoly (
    const Field & F,
    Polynomial & minP,
    const size_t N,
    typename Field::ConstElement_ptr A,
    const size_t lda,
    typename Field::Element_ptr X,
    const size_t ldx,
    size_t * P,
    const FFPACK_MINPOLY_TAG MinTag = FFPACK::FfpackDense,
    const size_t kg_mc = 0,
    const size_t kg_mb = 0,
    const size_t kg_j = 0)
```

**11.22.1.14 updateD()**

```
template<class Field>
size_t updateD (
    const Field & F,
    size_t * d,
    size_t k,
    std::vector< std::vector< typename Field::Element > > & minpt)
```

**11.22.1.15 newD()**

```
template<class Field>
size_t newD (
    const Field & F,
    size_t * d,
    bool & KeepOn,
    const size_t l,
    const size_t N,
    typename Field::Element_ptr X,
    const size_t * Q,
    std::vector< std::vector< typename Field::Element > > & minpt)
```

**11.22.1.16 CompressRows()**

```
template<class Field>
void CompressRows (
    Field & F,
```

```

    const size_t M,
    typename Field::Element_ptr A,
    const size_t lda,
    typename Field::Element_ptr tmp,
    const size_t ldtmp,
    const size_t * d,
    const size_t nb_blocs) [inline]

```

#### 11.22.1.17 CompressRowsQK()

```

template<class Field>
void CompressRowsQK (
    Field & F,
    const size_t M,
    typename Field::Element_ptr A,
    const size_t lda,
    typename Field::Element_ptr tmp,
    const size_t ldtmp,
    const size_t * d,
    const size_t deg,
    const size_t nb_blocs) [inline]

```

#### 11.22.1.18 DeCompressRows()

```

template<class Field>
void DeCompressRows (
    Field & F,
    const size_t M,
    const size_t N,
    typename Field::Element_ptr A,
    const size_t lda,
    typename Field::Element_ptr tmp,
    const size_t ldtmp,
    const size_t * d,
    const size_t nb_blocs) [inline]

```

#### 11.22.1.19 DeCompressRowsQK()

```

template<class Field>
void DeCompressRowsQK (
    Field & F,
    const size_t M,
    const size_t N,
    typename Field::Element_ptr A,
    const size_t lda,
    typename Field::Element_ptr tmp,
    const size_t ldtmp,
    const size_t * d,
    const size_t deg,
    const size_t nb_blocs) [inline]

```

#### 11.22.1.20 CompressRowsQA()

```

template<class Field>
void CompressRowsQA (
    Field & F,
    const size_t M,
    typename Field::Element_ptr A,
    const size_t lda,

```

```

typename Field::Element_ptr tmp,
const size_t ldtmp,
const size_t * d,
const size_t nb_blocs) [inline]

```

### 11.22.1.21 DeCompressRowsQA()

```

template<class Field>
void DeCompressRowsQA (
    Field & F,
    const size_t M,
    const size_t N,
    typename Field::Element_ptr A,
    const size_t lda,
    typename Field::Element_ptr tmp,
    const size_t ldtmp,
    const size_t * d,
    const size_t nb_blocs) [inline]

```

### 11.22.1.22 LUdivine\_construct() [2/2]

```

template<class Field>
size_t LUdivine_construct (
    const Field & F,
    const FFLAS::FFLAS_DIAG Diag,
    const size_t M,
    const size_t N,
    typename Field::ConstElement_ptr A,
    const size_t lda,
    typename Field::Element_ptr X,
    const size_t ldX,
    typename Field::Element_ptr u,
    const size_t incu,
    size_t * P,
    bool computeX,
    const FFPACK::FFPACK_MINPOLY_TAG MinTag,
    const size_t kg_mc,
    const size_t kg_mb,
    const size_t kg_j)

```

## 11.23 Givaro Namespace Reference

### Data Structures

- class [ModularBalanced](#)
- class [Montgomery](#)

## 11.24 MKL\_CONFIG Namespace Reference

## 11.25 Reclnt Namespace Reference

### Data Structures

- class [rint](#)
- class [ruint](#)

# Chapter 12

## Data Structure Documentation

### 12.1 AlgoChooser< ModeT, ParSeq > Struct Template Reference

#### Public Types

- typedef [MMHelperAlgo::Winograd value](#)

#### 12.1.1 Member Typedef Documentation

##### 12.1.1.1 value

```
template<class ModeT, class ParSeq>
typedef MMHelperAlgo::Winograd value
```

The documentation for this struct was generated from the following file:

- [fflas\\_helpers.inl](#)

### 12.2 AlgoChooser< ModeCategories::ConvertTo< ElementCategories::RNSElementTag >, ParSeq > Struct Template Reference

#### Public Types

- typedef [MMHelperAlgo::Classic value](#)
- typedef [MMHelperAlgo::Winograd value](#)

#### 12.2.1 Member Typedef Documentation

##### 12.2.1.1 value [1/2]

```
template<class ParSeq>
typedef MMHelperAlgo::Classic value
```

##### 12.2.1.2 value [2/2]

```
typedef MMHelperAlgo::Winograd value
```

The documentation for this struct was generated from the following file:

- [fflas\\_helpers.inl](#)

### 12.3 ALL< v > Struct Template Reference

The documentation for this struct was generated from the following file:

- [test-simd.C](#)

## 12.4 ALL< false, v... > Struct Template Reference

### Static Public Attributes

- static constexpr bool [value](#) = false

### 12.4.1 Field Documentation

#### 12.4.1.1 value

```
template<bool... v>
bool value = false [static], [constexpr]
```

The documentation for this struct was generated from the following file:

- [test-simd.C](#)

## 12.5 ALL< true, v... > Struct Template Reference

### Static Public Attributes

- static constexpr bool [value](#) = [ALL<v...>::value](#)

### 12.5.1 Field Documentation

#### 12.5.1.1 value

```
template<bool... v>
bool value = ALL<v...>::value [static], [constexpr]
```

The documentation for this struct was generated from the following file:

- [test-simd.C](#)

## 12.6 ALL<> Struct Reference

### Static Public Attributes

- static constexpr bool [value](#) = true

### 12.6.1 Field Documentation

#### 12.6.1.1 value

```
bool value = true [static], [constexpr]
```

The documentation for this struct was generated from the following file:

- [test-simd.C](#)

## 12.7 ArbitraryPrecIntTag Struct Reference

Arbitrary precision integers: GMP.

```
#include <field-traits.h>
```

### 12.7.1 Detailed Description

Arbitrary precision integers: GMP.

The documentation for this struct was generated from the following file:

- [field-traits.h](#)

## 12.8 AreEqual< X, Y > Class Template Reference

```
#include <fflas_enum.h>
```

### Static Public Attributes

- static const bool [value](#) = false

### 12.8.1 Field Documentation

#### 12.8.1.1 value

```
template<class X, class Y>
const bool value = false [static]
```

The documentation for this class was generated from the following file:

- [fflas\\_enum.h](#)

## 12.9 AreEqual< X, X > Class Template Reference

```
#include <fflas_enum.h>
```

### Static Public Attributes

- static const bool [value](#) = true
- static const bool [value](#)

### 12.9.1 Field Documentation

#### 12.9.1.1 value [1/2]

```
template<class X>
const bool value = true [static]
```

#### 12.9.1.2 value [2/2]

```
const bool value [static]
```

The documentation for this class was generated from the following file:

- [fflas\\_enum.h](#)

## 12.10 Argument Struct Reference

```
#include <args-parser.h>
```

### Data Fields

- char [c](#)
- const char \* [example](#)
- const char \* [helpString](#)
- [ArgumentType](#) type
- void \* [data](#)

### 12.10.1 Field Documentation

#### 12.10.1.1 c

```
char c
```

### 12.10.1.2 example

```
const char* example
```

### 12.10.1.3 helpString

```
const char* helpString
```

### 12.10.1.4 type

```
ArgumentType type
```

### 12.10.1.5 data

```
void* data
```

The documentation for this struct was generated from the following file:

- [args-parser.h](#)

## 12.11 `array< T >` Class Template Reference

STL class.

### Data Structures

- class [const\\_iterator](#)  
*STL iterator class.*
- class [const\\_reverse\\_iterator](#)  
*STL iterator class.*
- class [iterator](#)  
*STL iterator class.*
- class [reverse\\_iterator](#)  
*STL iterator class.*

### Data Fields

- `T elements`  
*STL member.*

### 12.11.1 Detailed Description

STL class.

### 12.11.2 Field Documentation

#### 12.11.2.1 elements

```
T elements
```

STL member.

The documentation for this class was generated from the following files:

## 12.12 `associatedDelayedField< Field >` Struct Template Reference

```
#include <field-traits.h>
```



**Public Types**

- typedef [Field](#) [field](#)
- typedef [Field](#) & [type](#)

**12.12.1 Member Typedef Documentation****12.12.1.1 field**

```
template<class Field>
typedef Field field
```

**12.12.1.2 type**

```
template<class Field>
typedef Field& type
```

The documentation for this struct was generated from the following file:

- [field-traits.h](#)

## 12.13 associatedDelayedField< const FFPACK::RNSIntegerMod< RNS > > Struct Template Reference

```
#include <field-traits.h>
```

**Public Types**

- typedef [FFPACK::RNSInteger](#)< [RNS](#) > [field](#)
- typedef [FFPACK::RNSInteger](#)< [RNS](#) > [type](#)
- typedef const [FFPACK::RNSIntegerMod](#)< [RNS](#) > [field](#)
- typedef const [FFPACK::RNSIntegerMod](#)< [RNS](#) > & [type](#)

**12.13.1 Member Typedef Documentation****12.13.1.1 field [1/2]**

```
template<typename RNS>
typedef FFPACK::RNSInteger<RNS> field
```

**12.13.1.2 type [1/2]**

```
template<typename RNS>
typedef FFPACK::RNSInteger<RNS> type
```

**12.13.1.3 field [2/2]**

```
typedef const FFPACK::RNSIntegerMod< RNS > field
```

**12.13.1.4 type [2/2]**

```
typedef const FFPACK::RNSIntegerMod< RNS >& type
```

The documentation for this struct was generated from the following file:

- [field-traits.h](#)

## 12.14 associatedDelayedField< const Givaro::Modular< T, X > > Struct Template Reference

```
#include <field-traits.h>
```

## Public Types

- `typedef Givaro::ZRing< T > field`
- `typedef Givaro::ZRing< T > type`
- `typedef const Givaro::Modular< T, X > field`
- `typedef const Givaro::Modular< T, X > & type`

### 12.14.1 Member Typedef Documentation

#### 12.14.1.1 `field` [1/2]

```
template<typename T, typename X>
typedef Givaro::ZRing<T> field
```

#### 12.14.1.2 `type` [1/2]

```
template<typename T, typename X>
typedef Givaro::ZRing<T> type
```

#### 12.14.1.3 `field` [2/2]

```
typedef const Givaro::Modular< T, X > field
```

#### 12.14.1.4 `type` [2/2]

```
typedef const Givaro::Modular< T, X > & type
```

The documentation for this struct was generated from the following file:

- [field-traits.h](#)

## 12.15 `associatedDelayedField< const Givaro::ModularBalanced< T > >` Struct Template Reference

```
#include <field-traits.h>
```

## Public Types

- `typedef Givaro::ZRing< T > field`
- `typedef Givaro::ZRing< T > type`
- `typedef const Givaro::ModularBalanced< T > field`
- `typedef const Givaro::ModularBalanced< T > & type`

### 12.15.1 Member Typedef Documentation

#### 12.15.1.1 `field` [1/2]

```
template<typename T>
typedef Givaro::ZRing<T> field
```

#### 12.15.1.2 `type` [1/2]

```
template<typename T>
typedef Givaro::ZRing<T> type
```

#### 12.15.1.3 `field` [2/2]

```
typedef const Givaro::ModularBalanced< T > field
```

**12.15.1.4 type** [2/2]

```
typedef const Givaro::ModularBalanced< T >& type
```

The documentation for this struct was generated from the following file:

- [field-traits.h](#)

**12.16 associatedDelayedField< const Givaro::ZRing< T > > Struct Template Reference**

```
#include <field-traits.h>
```

**Public Types**

- typedef Givaro::ZRing< T > [field](#)
- typedef Givaro::ZRing< T > [type](#)
- typedef const Givaro::ZRing< T > [field](#)
- typedef const Givaro::ZRing< T > & [type](#)

**12.16.1 Member Typedef Documentation****12.16.1.1 field** [1/2]

```
template<typename T>
typedef Givaro::ZRing<T> field
```

**12.16.1.2 type** [1/2]

```
template<typename T>
typedef Givaro::ZRing<T> type
```

**12.16.1.3 field** [2/2]

```
typedef const Givaro::ZRing< T > field
```

**12.16.1.4 type** [2/2]

```
typedef const Givaro::ZRing< T >& type
```

The documentation for this struct was generated from the following file:

- [field-traits.h](#)

**12.17 Auto Struct Reference**

The documentation for this struct was generated from the following file:

- [fflas\\_helpers.inl](#)

**12.18 Bench< Elt > Class Template Reference****Public Types**

- using [Field](#) = Modular<Elt>
- using [Elt\\_ptr](#) = typename [Field::Element\\_ptr](#)
- using [Residu](#) = typename [Field::Residu\\_t](#)
- template<bool B, class T = void>
 using [enable\\_if\\_t](#) = typename std::enable\_if<B, T>::type

- `template<typename Simd>`  
using `is_same_element` = `typename Simd::template is_same_element<Field>`
- `template<typename E>`  
using `enable_if_no_simd_t` = `enable_if_t<Simd<E>::vect_size == 1>`
- `template<typename E>`  
using `enable_if_simd128_t` = `enable_if_t<sizeof(E)*Simd<E>::vect_size == 16>`
- `template<typename E>`  
using `enable_if_simd256_t` = `enable_if_t<sizeof(E)*Simd<E>::vect_size == 32>`
- `template<typename E>`  
using `enable_if_simd512_t` = `enable_if_t<sizeof(E)*Simd<E>::vect_size == 64>`

## Public Member Functions

- `Bench` (`size_t m`, `size_t n`, `size_t iters`, `bool inplace`)
- `template<typename Simd = NoSimd<Elt>, enable_if_t<is_same_element< Simd >::value > * = nullptr>`  
void `doBenchs` ()
- `template<typename _E = Elt, enable_if_t< is_same< _E, Elt >::value > * = nullptr, enable_if_no_simd_t< _E > * = nullptr>`  
void `run` (`bool allsimd`)

## Static Public Member Functions

- `template<typename _E = Elt, enable_if_t<!is_same< _E, Givaro::Integer >::value > * = nullptr>`  
static `Residu cardinality` ()
- `template<typename _E = Elt, enable_if_t< is_same< _E, Givaro::Integer >::value > * = nullptr>`  
static `Residu cardinality` ()

## Protected Attributes

- `Field F`
- `const size_t m`
- `const size_t n`
- `const size_t iters`
- `const bool inplace`

## 12.18.1 Member Typedef Documentation

### 12.18.1.1 Field

```
template<typename Elt>
using Field = Modular<Elt>
```

### 12.18.1.2 Elt\_ptr

```
template<typename Elt>
using Elt_ptr = typename Field::Element_ptr
```

### 12.18.1.3 Residu

```
template<typename Elt>
using Residu = typename Field::Residu_t
```

### 12.18.1.4 enable\_if\_t

```
template<typename Elt>
template<bool B, class T = void>
using enable_if_t = typename std::enable_if<B, T>::type
```

### 12.18.1.5 is\_same\_element

```
template<typename Elt>
template<typename Simd>
using is_same_element = typename Simd::template is_same_element<Field>
```

### 12.18.1.6 enable\_if\_no\_simd\_t

```
template<typename Elt>
template<typename E>
using enable_if_no_simd_t = enable_if_t<Simd<E>::vect_size == 1>
```

### 12.18.1.7 enable\_if\_simd128\_t

```
template<typename Elt>
template<typename E>
using enable_if_simd128_t = enable_if_t<sizeof(E)*Simd<E>::vect_size == 16>
```

### 12.18.1.8 enable\_if\_simd256\_t

```
template<typename Elt>
template<typename E>
using enable_if_simd256_t = enable_if_t<sizeof(E)*Simd<E>::vect_size == 32>
```

### 12.18.1.9 enable\_if\_simd512\_t

```
template<typename Elt>
template<typename E>
using enable_if_simd512_t = enable_if_t<sizeof(E)*Simd<E>::vect_size == 64>
```

## 12.18.2 Constructor & Destructor Documentation

### 12.18.2.1 Bench()

```
template<typename Elt>
Bench (
    size_t m,
    size_t n,
    size_t iters,
    bool inplace) [inline]
```

## 12.18.3 Member Function Documentation

### 12.18.3.1 cardinality() [1/2]

```
template<typename Elt>
template<typename _E = Elt, enable_if_t<!is_same< _E, Givaro::Integer >::value > * = nullptr>
static Residu cardinality () [inline], [static]
```

### 12.18.3.2 cardinality() [2/2]

```
template<typename Elt>
template<typename _E = Elt, enable_if_t< is_same< _E, Givaro::Integer >::value > * = nullptr>
static Residu cardinality () [inline], [static]
```

### 12.18.3.3 doBenchs()

```
template<typename Elt>
template<typename Simd = NoSimd<Elt>, enable_if_t< is_same_element< Simd >::value > * =
nullptr>
void doBenchs () [inline]
```

#### 12.18.3.4 run()

```
template<typename Elt>
template<typename _E = Elt, enable_if_t< is_same< _E, Elt >::value > * = nullptr, enable_if_no_simd_t<
_E > * = nullptr>
void run (
    bool allsimd) [inline]
```

### 12.18.4 Field Documentation

#### 12.18.4.1 F

```
template<typename Elt>
Field F [protected]
```

#### 12.18.4.2 m

```
template<typename Elt>
const size_t m [protected]
```

#### 12.18.4.3 n

```
template<typename Elt>
const size_t n [protected]
```

#### 12.18.4.4 iters

```
template<typename Elt>
const size_t iters [protected]
```

#### 12.18.4.5 inplace

```
template<typename Elt>
const bool inplace [protected]
```

The documentation for this class was generated from the following file:

- [benchmark-storage-transpose.C](#)

## 12.19 Bini Struct Reference

The documentation for this struct was generated from the following file:

- [fflas\\_helpers.inl](#)

## 12.20 Block Struct Reference

The documentation for this struct was generated from the following file:

- [blockcuts.inl](#)

## 12.21 BlockTransposeSIMD< Field, Simd, > Struct Template Reference

```
#include <fflas_transpose.h>
```

## Public Member Functions

- `template<size_t _s = Simd::vect_size, IsSimdSize< _s, 1 > * = nullptr>`  
void [transpose](#) (const [Field](#) &F, ConstElement\_ptr A, size\_t lda, Element\_ptr B, size\_t ldb) const
- `template<size_t _s = Simd::vect_size, IsSimdSize< _s, 2 > * = nullptr>`  
void [transpose](#) (const [Field](#) &F, ConstElement\_ptr A, size\_t lda, Element\_ptr B, size\_t ldb) const
- `template<size_t _s = Simd::vect_size, IsSimdSize< _s, 4 > * = nullptr>`  
void [transpose](#) (const [Field](#) &F, ConstElement\_ptr A, size\_t lda, Element\_ptr B, size\_t ldb) const
- `template<size_t _s = Simd::vect_size, IsSimdSize< _s, 8 > * = nullptr>`  
void [transpose](#) (const [Field](#) &F, ConstElement\_ptr A, size\_t lda, Element\_ptr B, size\_t ldb) const
- `template<size_t _s = Simd::vect_size, IsSimdSize< _s, 16 > * = nullptr>`  
void [transpose](#) (const [Field](#) &F, ConstElement\_ptr A, size\_t lda, Element\_ptr B, size\_t ldb) const

## Static Public Member Functions

- static constexpr size\_t [size](#) ()
- static const std::string [info](#) ()

## 12.21.1 Member Function Documentation

### 12.21.1.1 [size\(\)](#)

```
template<typename Field, typename Simd, typename std::enable_if< Simd::template is_same_↵
element< Field >::value >::type * = nullptr>
static constexpr size_t size () [inline], [static], [constexpr]
```

### 12.21.1.2 [info\(\)](#)

```
template<typename Field, typename Simd, typename std::enable_if< Simd::template is_same_↵
element< Field >::value >::type * = nullptr>
static const std::string info () [inline], [static]
```

### 12.21.1.3 [transpose\(\)](#) [1/5]

```
template<typename Field, typename Simd, typename std::enable_if< Simd::template is_same_↵
element< Field >::value >::type * = nullptr>
template<size_t _s = Simd::vect_size, IsSimdSize< _s, 1 > * = nullptr>
void transpose (
    const Field & F,
    ConstElement_ptr A,
    size_t lda,
    Element_ptr B,
    size_t ldb) const [inline]
```

### 12.21.1.4 [transpose\(\)](#) [2/5]

```
template<typename Field, typename Simd, typename std::enable_if< Simd::template is_same_↵
element< Field >::value >::type * = nullptr>
template<size_t _s = Simd::vect_size, IsSimdSize< _s, 2 > * = nullptr>
void transpose (
    const Field & F,
    ConstElement_ptr A,
    size_t lda,
    Element_ptr B,
    size_t ldb) const [inline]
```

### 12.21.1.5 transpose() [3/5]

```
template<typename Field, typename Simd, typename std::enable_if< Simd::template is_same_↵
element< Field >::value >::type * = nullptr>
template<size_t _s = Simd::vect_size, IsSimdSize< _s, 4 > * = nullptr>
void transpose (
    const Field & F,
    ConstElement_ptr A,
    size_t lda,
    Element_ptr B,
    size_t ldb) const [inline]
```

### 12.21.1.6 transpose() [4/5]

```
template<typename Field, typename Simd, typename std::enable_if< Simd::template is_same_↵
element< Field >::value >::type * = nullptr>
template<size_t _s = Simd::vect_size, IsSimdSize< _s, 8 > * = nullptr>
void transpose (
    const Field & F,
    ConstElement_ptr A,
    size_t lda,
    Element_ptr B,
    size_t ldb) const [inline]
```

### 12.21.1.7 transpose() [5/5]

```
template<typename Field, typename Simd, typename std::enable_if< Simd::template is_same_↵
element< Field >::value >::type * = nullptr>
template<size_t _s = Simd::vect_size, IsSimdSize< _s, 16 > * = nullptr>
void transpose (
    const Field & F,
    ConstElement_ptr A,
    size_t lda,
    Element_ptr B,
    size_t ldb) const [inline]
```

The documentation for this struct was generated from the following file:

- [fflas\\_transpose.h](#)

## 12.22 callLUdivine\_small< Element > Class Template Reference

### Public Member Functions

- template<class Field>
 size\_t operator() (const Field &F, const FFLAS::FFLAS\_DIAG Diag, const FFLAS::FFLAS\_TRANSPOSE
 trans, const size\_t M, const size\_t N, typename Field::Element\_ptr A, const size\_t lda, size\_t \*P, size\_t
 \*Q, const FFPACK::FFPACK\_LU\_TAG LuTag)

### 12.22.1 Member Function Documentation

#### 12.22.1.1 operator>()()

```
template<class Element>
template<class Field>
size_t operator() (
    const Field & F,
    const FFLAS::FFLAS_DIAG Diag,
    const FFLAS::FFLAS_TRANSPOSE trans,
    const size_t M,
```



```

const size_t N,
typename Field::Element_ptr A,
const size_t lda,
size_t * P,
size_t * Q,
const FFPACK::FFPACK_LU_TAG LuTag) [inline]

```

The documentation for this class was generated from the following file:

- [ffpack\\_ludivine.inl](#)

## 12.23 callLUdivine\_small< double > Class Reference

### Public Member Functions

- `template<class Field>`  
`size_t operator()` (const `Field` &F, const `FFLAS::FFLAS_DIAG` Diag, const `FFLAS::FFLAS_TRANSPOSE` trans, const `size_t` M, const `size_t` N, typename `Field::Element_ptr` A, const `size_t` lda, `size_t` \*P, `size_t` \*Q, const `FFPACK::FFPACK_LU_TAG` LuTag)
- `size_t operator()` (const `Field` &F, const `FFLAS::FFLAS_DIAG` Diag, const `FFLAS::FFLAS_TRANSPOSE` trans, const `size_t` M, const `size_t` N, typename `Field::Element_ptr` A, const `size_t` lda, `size_t` \*P, `size_t` \*Q, const `FFPACK::FFPACK_LU_TAG` LuTag)

### 12.23.1 Member Function Documentation

#### 12.23.1.1 operator>() [1/2]

```

template<class Field>
size_t operator() (
    const Field & F,
    const FFLAS::FFLAS_DIAG Diag,
    const FFLAS::FFLAS_TRANSPOSE trans,
    const size_t M,
    const size_t N,
    typename Field::Element_ptr A,
    const size_t lda,
    size_t * P,
    size_t * Q,
    const FFPACK::FFPACK_LU_TAG LuTag) [inline]

```

#### 12.23.1.2 operator>() [2/2]

```

size_t operator() (
    const Field & F,
    const FFLAS::FFLAS_DIAG Diag,
    const FFLAS::FFLAS_TRANSPOSE trans,
    const size_t M,
    const size_t N,
    typename Field::Element_ptr A,
    const size_t lda,
    size_t * P,
    size_t * Q,
    const FFPACK::FFPACK_LU_TAG LuTag) [inline]

```

The documentation for this class was generated from the following file:

- [ffpack\\_ludivine.inl](#)

## 12.24 callLUdivine\_small< float > Class Reference

### Public Member Functions

- `template<class Field>`  
`size_t operator()` (const `Field` &`F`, const `FFLAS::FFLAS_DIAG` `Diag`, const `FFLAS::FFLAS_TRANSPOSE` `trans`, const `size_t` `M`, const `size_t` `N`, typename `Field::Element_ptr` `A`, const `size_t` `lda`, `size_t` \*`P`, `size_t` \*`Q`, const `FFPACK::FFPACK_LU_TAG` `LuTag`)
- `size_t operator()` (const `Field` &`F`, const `FFLAS::FFLAS_DIAG` `Diag`, const `FFLAS::FFLAS_TRANSPOSE` `trans`, const `size_t` `M`, const `size_t` `N`, typename `Field::Element_ptr` `A`, const `size_t` `lda`, `size_t` \*`P`, `size_t` \*`Q`, const `FFPACK::FFPACK_LU_TAG` `LuTag`)

### 12.24.1 Member Function Documentation

#### 12.24.1.1 operator>() [1/2]

```
template<class Field>
size_t operator() (
    const Field & F,
    const FFLAS::FFLAS_DIAG Diag,
    const FFLAS::FFLAS_TRANSPOSE trans,
    const size_t M,
    const size_t N,
    typename Field::Element_ptr A,
    const size_t lda,
    size_t * P,
    size_t * Q,
    const FFPACK::FFPACK_LU_TAG LuTag) [inline]
```

#### 12.24.1.2 operator>() [2/2]

```
size_t operator() (
    const Field & F,
    const FFLAS::FFLAS_DIAG Diag,
    const FFLAS::FFLAS_TRANSPOSE trans,
    const size_t M,
    const size_t N,
    typename Field::Element_ptr A,
    const size_t lda,
    size_t * P,
    size_t * Q,
    const FFPACK::FFPACK_LU_TAG LuTag) [inline]
```

The documentation for this class was generated from the following file:

- [ffpack\\_ludivine.inl](#)

## 12.25 CharpolyFailed Class Reference

```
#include <ffpack.h>
```

The documentation for this class was generated from the following file:

- [ffpack.h](#)

## 12.26 Checker\_Empty< Field > Struct Template Reference

```
#include <checker_empty.h>
```

**Public Member Functions**

- `template<typename... Params>`  
[Checker\\_Empty](#) (Params... parameters)
- `template<typename... Params>`  
 bool [check](#) (Params... parameters)

**12.26.1 Constructor & Destructor Documentation****12.26.1.1 Checker\_Empty()**

```
template<class Field>
template<typename... Params>
Checker_Empty (
    Params... parameters) [inline]
```

**12.26.2 Member Function Documentation****12.26.2.1 check()**

```
template<class Field>
template<typename... Params>
bool check (
    Params... parameters) [inline]
```

The documentation for this struct was generated from the following file:

- [checker\\_empty.h](#)

**12.27 CheckerImplem\_charpoly< Field, Polynomial > Class Template Reference****Public Member Functions**

- [CheckerImplem\\_charpoly](#) (const [Field](#) &F\_, const size\_t n\_, typename [Field::ConstElement\\_ptr](#) A, size\_t lda\_)
- [CheckerImplem\\_charpoly](#) (typename [Field::RandIter](#) &G, const size\_t n\_, typename [Field::ConstElement\\_ptr](#) A, size\_t lda\_)
- [~CheckerImplem\\_charpoly](#) ()
- bool [check](#) (Polynomial &g)

**12.27.1 Constructor & Destructor Documentation****12.27.1.1 CheckerImplem\_charpoly() [1/2]**

```
template<class Field, class Polynomial>
CheckerImplem_charpoly (
    const Field & F_,
    const size_t n_,
    typename Field::ConstElement_ptr A,
    size_t lda_) [inline]
```

**12.27.1.2 CheckerImplem\_charpoly() [2/2]**

```
template<class Field, class Polynomial>
CheckerImplem_charpoly (
    typename Field::RandIter & G,
    const size_t n_,
    typename Field::ConstElement_ptr A,
    size_t lda_) [inline]
```

### 12.27.1.3 ~CheckerImplem\_charpoly()

```
template<class Field, class Polynomial>
~CheckerImplem_charpoly () [inline]
```

## 12.27.2 Member Function Documentation

### 12.27.2.1 check()

```
template<class Field, class Polynomial>
bool check (
    Polynomial & g) [inline]
```

The documentation for this class was generated from the following file:

- [checker\\_charpoly.inl](#)

## 12.28 CheckerImplem\_charpoly< Givaro::ZRing< Givaro::Integer >, Polynomial > Class Template Reference

### Public Types

- typedef Givaro::ZRing< Givaro::Integer > [Ring](#)

### Public Member Functions

- [CheckerImplem\\_charpoly](#) (const [Ring](#) &F\_, const size\_t n\_, typename Ring::ConstElement\_ptr A, size\_t lda\_)
- [CheckerImplem\\_charpoly](#) (typename Ring::RandIter &G, const size\_t n\_, typename Ring::ConstElement\_ptr A, size\_t lda\_)
- [~CheckerImplem\\_charpoly](#) ()
- bool [check](#) (Polynomial &g)
- [CheckerImplem\\_charpoly](#) (const Givaro::ZRing< Givaro::Integer > &F\_, const size\_t n\_, typename Givaro::ZRing< Givaro::Integer >::ConstElement\_ptr A, size\_t lda\_)
- [CheckerImplem\\_charpoly](#) (typename Givaro::ZRing< Givaro::Integer >::RandIter &G, const size\_t n\_, typename Givaro::ZRing< Givaro::Integer >::ConstElement\_ptr A, size\_t lda\_)
- [~CheckerImplem\\_charpoly](#) ()
- bool [check](#) (Polynomial &g)

### 12.28.1 Member Typedef Documentation

#### 12.28.1.1 Ring

```
template<class Polynomial>
typedef Givaro::ZRing<Givaro::Integer> Ring
```

## 12.28.2 Constructor & Destructor Documentation

### 12.28.2.1 CheckerImplem\_charpoly() [1/4]

```
template<class Polynomial>
CheckerImplem_charpoly (
    const Ring & F_,
    const size_t n_,
    typename Ring::ConstElement_ptr A,
    size_t lda_) [inline]
```

**12.28.2.2 CheckerImplem\_charpoly() [2/4]**

```
template<class Polynomial>
CheckerImplem_charpoly (
    typename Ring::RandIter & G,
    const size_t n_,
    typename Ring::ConstElement_ptr A,
    size_t lda_) [inline]
```

**12.28.2.3 ~CheckerImplem\_charpoly() [1/2]**

```
template<class Polynomial>
~CheckerImplem_charpoly () [inline]
```

**12.28.2.4 CheckerImplem\_charpoly() [3/4]**

```
CheckerImplem_charpoly (
    const Givaro::ZRing< Givaro::Integer > & F_,
    const size_t n_,
    typename Givaro::ZRing< Givaro::Integer >::ConstElement_ptr A,
    size_t lda_) [inline]
```

**12.28.2.5 CheckerImplem\_charpoly() [4/4]**

```
CheckerImplem_charpoly (
    typename Givaro::ZRing< Givaro::Integer >::RandIter & G,
    const size_t n_,
    typename Givaro::ZRing< Givaro::Integer >::ConstElement_ptr A,
    size_t lda_) [inline]
```

**12.28.2.6 ~CheckerImplem\_charpoly() [2/2]**

```
~CheckerImplem_charpoly () [inline]
```

**12.28.3 Member Function Documentation****12.28.3.1 check() [1/2]**

```
template<class Polynomial>
bool check (
    Polynomial & g) [inline]
```

**12.28.3.2 check() [2/2]**

```
bool check (
    Polynomial & g) [inline]
```

The documentation for this class was generated from the following file:

- [checker\\_charpoly.inl](#)

**12.29 CheckerImplem\_Det< Field > Class Template Reference****Public Member Functions**

- [CheckerImplem\\_Det](#) (const [Field](#) &F\_, size\_t n\_, typename [Field::ConstElement\\_ptr](#) A, size\_t lda)
- [CheckerImplem\\_Det](#) (typename [Field::RandIter](#) &G, size\_t n\_, typename [Field::ConstElement\\_ptr](#) A, size\_t lda)
- [~CheckerImplem\\_Det](#) ()
- bool [check](#) (const typename [Field::Element](#) &det, typename [Field::ConstElement\\_ptr](#) LU, size\_t lda, size\_t \*P, size\_t \*Q) const

*check if the Det factorization is correct.*

## 12.29.1 Constructor & Destructor Documentation

### 12.29.1.1 CheckerImplem\_Det() [1/2]

```
template<class Field>
CheckerImplem_Det (
    const Field & F_,
    size_t n_,
    typename Field::ConstElement_ptr A,
    size_t lda) [inline]
```

### 12.29.1.2 CheckerImplem\_Det() [2/2]

```
template<class Field>
CheckerImplem_Det (
    typename Field::RandIter & G,
    size_t n_,
    typename Field::ConstElement_ptr A,
    size_t lda) [inline]
```

### 12.29.1.3 ~CheckerImplem\_Det()

```
template<class Field>
~CheckerImplem_Det () [inline]
```

## 12.29.2 Member Function Documentation

### 12.29.2.1 check()

```
template<class Field>
bool check (
    const typename Field::Element & det,
    typename Field::ConstElement_ptr LU,
    size_t lda,
    size_t * P,
    size_t * Q) const [inline]
```

check if the Det factorization is correct.

Needs matrix in LU form

#### Parameters

<i>LU,storage</i>	for L and U
<i>det</i>	
<i>P</i>	
<i>Q</i>	

The documentation for this class was generated from the following file:

- [checker\\_det.inl](#)

## 12.30 CheckerImplem\_fgemm< Field > Class Template Reference

### Public Member Functions

- [CheckerImplem\\_fgemm](#) (const [Field](#) &F\_, const size\_t m\_, const size\_t n\_, const size\_t k\_, const typename [Field::Element](#) beta, typename [Field::Element\\_ptr](#) C, const size\_t ldc\_)

- [CheckerImplem\\_fgemm](#) (typename [Field::RandIter](#) &G, const size\_t m\_, const size\_t n\_, const size\_t k\_, const typename [Field::Element](#) beta, typename [Field::Element\\_ptr](#) C, const size\_t ldc\_)
- [~CheckerImplem\\_fgemm](#) ()
- bool [check](#) (const [FFLAS::FFLAS\\_TRANSPOSE](#) ta, const [FFLAS::FFLAS\\_TRANSPOSE](#) tb, const typename [Field::Element](#) alpha, typename [Field::ConstElement\\_ptr](#) A, const size\_t lda, typename [Field::ConstElement\\_ptr](#) B, const size\_t ldb, typename [Field::ConstElement\\_ptr](#) C)

## 12.30.1 Constructor & Destructor Documentation

### 12.30.1.1 CheckerImplem\_fgemm() [1/2]

```
template<class Field>
CheckerImplem_fgemm (
    const Field & F_,
    const size_t m_,
    const size_t n_,
    const size_t k_,
    const typename Field::Element beta,
    typename Field::Element_ptr C,
    const size_t ldc_) [inline]
```

### 12.30.1.2 CheckerImplem\_fgemm() [2/2]

```
template<class Field>
CheckerImplem_fgemm (
    typename Field::RandIter & G,
    const size_t m_,
    const size_t n_,
    const size_t k_,
    const typename Field::Element beta,
    typename Field::Element_ptr C,
    const size_t ldc_) [inline]
```

### 12.30.1.3 ~CheckerImplem\_fgemm()

```
template<class Field>
~CheckerImplem_fgemm () [inline]
```

## 12.30.2 Member Function Documentation

### 12.30.2.1 check()

```
template<class Field>
bool check (
    const FFLAS::FFLAS_TRANSPOSE ta,
    const FFLAS::FFLAS_TRANSPOSE tb,
    const typename Field::Element alpha,
    typename Field::ConstElement_ptr A,
    const size_t lda,
    typename Field::ConstElement_ptr B,
    const size_t ldb,
    typename Field::ConstElement_ptr C) [inline]
```

The documentation for this class was generated from the following file:

- [checker\\_fgemm.inl](#)

## 12.31 CheckerImplem\_ftrsm< Field > Class Template Reference

### Public Member Functions

- [CheckerImplem\\_ftrsm](#) (const [Field](#) &F\_, const size\_t m, const size\_t n, const typename [Field::Element](#) alpha, const typename [Field::ConstElement\\_ptr](#) B, const size\_t ldb)
- [CheckerImplem\\_ftrsm](#) (typename [Field::RandIter](#) &G, const size\_t m, const size\_t n, const typename [Field::Element](#) alpha, const typename [Field::ConstElement\\_ptr](#) B, const size\_t ldb)
- [~CheckerImplem\\_ftrsm](#) ()
- bool [check](#) (const [FFLAS::FFLAS\\_SIDE](#) side, const [FFLAS::FFLAS\\_UPLO](#) uplo, const [FFLAS::FFLAS\\_TRANSPOSE](#) trans, const [FFLAS::FFLAS\\_DIAG](#) diag, const size\_t m, const size\_t n, typename [Field::Element\\_ptr](#) A, size\_t lda, const typename [Field::ConstElement\\_ptr](#) X, size\_t ldx)

### 12.31.1 Constructor & Destructor Documentation

#### 12.31.1.1 CheckerImplem\_ftrsm() [1/2]

```
template<class Field>
CheckerImplem_ftrsm (
    const Field & F_,
    const size_t m,
    const size_t n,
    const typename Field::Element alpha,
    const typename Field::ConstElement_ptr B,
    const size_t ldb) [inline]
```

#### 12.31.1.2 CheckerImplem\_ftrsm() [2/2]

```
template<class Field>
CheckerImplem_ftrsm (
    typename Field::RandIter & G,
    const size_t m,
    const size_t n,
    const typename Field::Element alpha,
    const typename Field::ConstElement_ptr B,
    const size_t ldb) [inline]
```

#### 12.31.1.3 ~CheckerImplem\_ftrsm()

```
template<class Field>
~CheckerImplem_ftrsm () [inline]
```

### 12.31.2 Member Function Documentation

#### 12.31.2.1 check()

```
template<class Field>
bool check (
    const FFLAS::FFLAS_SIDE side,
    const FFLAS::FFLAS_UPLO uplo,
    const FFLAS::FFLAS_TRANSPOSE trans,
    const FFLAS::FFLAS_DIAG diag,
    const size_t m,
    const size_t n,
    typename Field::Element_ptr A,
    size_t lda,
    const typename Field::ConstElement_ptr X,
    size_t ldx) [inline]
```

The documentation for this class was generated from the following file:

- [checker\\_ftrsm.inl](#)



## 12.32 CheckerImplem\_invert< Field > Class Template Reference

### Public Member Functions

- [CheckerImplem\\_invert](#) (const [Field](#) &F\_, const size\_t m\_, typename [Field::ConstElement\\_ptr](#) A, const size\_t lda\_)
- [CheckerImplem\\_invert](#) (typename [Field::RandIter](#) &G, const size\_t m\_, typename [Field::ConstElement\\_ptr](#) A, const size\_t lda\_)
- [~CheckerImplem\\_invert](#) ()
- bool [check](#) (typename [Field::ConstElement\\_ptr](#) A, int nullity)

### 12.32.1 Constructor & Destructor Documentation

#### 12.32.1.1 CheckerImplem\_invert() [1/2]

```
template<class Field>
CheckerImplem_invert (
    const Field & F_,
    const size_t m_,
    typename Field::ConstElement_ptr A,
    const size_t lda_) [inline]
```

#### 12.32.1.2 CheckerImplem\_invert() [2/2]

```
template<class Field>
CheckerImplem_invert (
    typename Field::RandIter & G,
    const size_t m_,
    typename Field::ConstElement_ptr A,
    const size_t lda_) [inline]
```

#### 12.32.1.3 ~CheckerImplem\_invert()

```
template<class Field>
~CheckerImplem_invert () [inline]
```

### 12.32.2 Member Function Documentation

#### 12.32.2.1 check()

```
template<class Field>
bool check (
    typename Field::ConstElement_ptr A,
    int nullity) [inline]
```

The documentation for this class was generated from the following file:

- [checker\\_invert.inl](#)

## 12.33 CheckerImplem\_PLUQ< Field > Class Template Reference

### Public Member Functions

- [CheckerImplem\\_PLUQ](#) (const [Field](#) &F\_, size\_t m\_, size\_t n\_, typename [Field::ConstElement\\_ptr](#) A, size\_t lda)
- [CheckerImplem\\_PLUQ](#) (typename [Field::RandIter](#) &G, size\_t m\_, size\_t n\_, typename [Field::ConstElement\\_ptr](#) A, size\_t lda)
- [~CheckerImplem\\_PLUQ](#) ()
- bool [check](#) (typename [Field::ConstElement\\_ptr](#) A, size\_t lda, const [FFLAS::FFLAS\\_DIAG](#) Diag, size\_t r, size\_t \*P, size\_t \*Q) const  
*check if the PLUQ factorization is correct.*

## 12.33.1 Constructor & Destructor Documentation

### 12.33.1.1 CheckerImplem\_PLUQ() [1/2]

```
template<class Field>
CheckerImplem_PLUQ (
    const Field & F_,
    size_t m_,
    size_t n_,
    typename Field::ConstElement_ptr A,
    size_t lda) [inline]
```

### 12.33.1.2 CheckerImplem\_PLUQ() [2/2]

```
template<class Field>
CheckerImplem_PLUQ (
    typename Field::RandIter & G,
    size_t m_,
    size_t n_,
    typename Field::ConstElement_ptr A,
    size_t lda) [inline]
```

### 12.33.1.3 ~CheckerImplem\_PLUQ()

```
template<class Field>
~CheckerImplem_PLUQ () [inline]
```

## 12.33.2 Member Function Documentation

### 12.33.2.1 check()

```
template<class Field>
bool check (
    typename Field::ConstElement_ptr A,
    size_t lda,
    const FFLAS::FFLAS_DIAG Diag,
    size_t r,
    size_t * P,
    size_t * Q) const [inline]
```

check if the PLUQ factorization is correct.

Returns true if  $w - P(L(U(Q.v))) == 0$

#### Parameters

$A$	
$r$	
$P$	
$Q$	

The documentation for this class was generated from the following file:

- [checker\\_pluq.inl](#)

## 12.34 Classic Struct Reference

The documentation for this struct was generated from the following file:

- [fflas\\_helpers.inl](#)

## 12.35 Column Struct Reference

The documentation for this struct was generated from the following file:

- [blockcuts.inl](#)

## 12.36 CompactElement< Element > Struct Template Reference

### Public Types

- typedef Element [type](#)

### 12.36.1 Member Typedef Documentation

#### 12.36.1.1 type

```
template<class Element>
typedef Element type
```

The documentation for this struct was generated from the following file:

- [test-io.C](#)

## 12.37 CompactElement< double > Struct Reference

### Public Types

- typedef int32\_t [type](#)
- typedef double [type](#)

### 12.37.1 Member Typedef Documentation

#### 12.37.1.1 type [1/2]

```
typedef int32_t type
```

#### 12.37.1.2 type [2/2]

```
typedef double type
```

The documentation for this struct was generated from the following file:

- [test-io.C](#)

## 12.38 CompactElement< float > Struct Reference

### Public Types

- typedef int16\_t [type](#)
- typedef float [type](#)

### 12.38.1 Member Typedef Documentation

#### 12.38.1.1 type [1/2]

```
typedef int16_t type
```

#### 12.38.1.2 type [2/2]

```
typedef float type
```

The documentation for this struct was generated from the following file:

- [test-io.C](#)

## 12.39 CompactElement< int16\_t > Struct Reference

### Public Types

- typedef int8\_t [type](#)
- typedef int16\_t [type](#)

### 12.39.1 Member Typedef Documentation

#### 12.39.1.1 type [1/2]

typedef int8\_t [type](#)

#### 12.39.1.2 type [2/2]

typedef int16\_t [type](#)

The documentation for this struct was generated from the following file:

- [test-io.C](#)

## 12.40 CompactElement< int32\_t > Struct Reference

### Public Types

- typedef int16\_t [type](#)
- typedef int32\_t [type](#)

### 12.40.1 Member Typedef Documentation

#### 12.40.1.1 type [1/2]

typedef int16\_t [type](#)

#### 12.40.1.2 type [2/2]

typedef int32\_t [type](#)

The documentation for this struct was generated from the following file:

- [test-io.C](#)

## 12.41 CompactElement< int64\_t > Struct Reference

### Public Types

- typedef int32\_t [type](#)
- typedef int64\_t [type](#)

### 12.41.1 Member Typedef Documentation

#### 12.41.1.1 type [1/2]

typedef int32\_t [type](#)

#### 12.41.1.2 type [2/2]

typedef int64\_t [type](#)

The documentation for this struct was generated from the following file:

- [test-io.C](#)

## 12.42 compatible\_data\_type< Field > Struct Template Reference

### Static Public Attributes

- static constexpr bool [value](#) = true

### 12.42.1 Field Documentation

#### 12.42.1.1 value

```
template<typename Field>
bool value = true [static], [constexpr]
```

The documentation for this struct was generated from the following file:

- [benchmark-fgemv.C](#)

## 12.43 compatible\_data\_type< Givaro::ZRing< double > > Struct Reference

### Static Public Attributes

- static constexpr bool [value](#) = false
- static constexpr bool [value](#)

### 12.43.1 Field Documentation

#### 12.43.1.1 value [1/2]

```
bool value = false [static], [constexpr]
```

#### 12.43.1.2 value [2/2]

```
bool value [static], [constexpr]
```

The documentation for this struct was generated from the following file:

- [benchmark-fgemv.C](#)

## 12.44 compatible\_data\_type< Givaro::ZRing< float > > Struct Reference

### Static Public Attributes

- static constexpr bool [value](#) = false
- static constexpr bool [value](#)

### 12.44.1 Field Documentation

#### 12.44.1.1 value [1/2]

```
bool value = false [static], [constexpr]
```

#### 12.44.1.2 value [2/2]

```
bool value [static], [constexpr]
```

The documentation for this struct was generated from the following file:

- [benchmark-fgemv.C](#)

## 12.45 Compose< H1, H2 > Struct Template Reference

### Public Member Functions

- [Compose](#) ()
- [Compose](#) (const [Compose](#) &*other*)
- [Compose](#) (const [Sequential](#) &*S*)
- [Compose](#) (size\_t *th1*, size\_t *th2*)
- [Compose](#) (const H1 &*o1*, const H2 &*o2*)
- H1 [first\\_component](#) () const
- H2 [second\\_component](#) () const

### Friends

- std::ostream & [operator<<](#) (std::ostream &*o*, const [Compose](#) &*c*)

## 12.45.1 Constructor & Destructor Documentation

### 12.45.1.1 Compose() [1/5]

```
template<typename H1 = Sequential, typename H2 = Sequential>
Compose () [inline]
```

### 12.45.1.2 Compose() [2/5]

```
template<typename H1 = Sequential, typename H2 = Sequential>
Compose (
    const Compose< H1, H2 > & other) [inline]
```

### 12.45.1.3 Compose() [3/5]

```
template<typename H1 = Sequential, typename H2 = Sequential>
Compose (
    const Sequential & S) [inline]
```

### 12.45.1.4 Compose() [4/5]

```
template<typename H1 = Sequential, typename H2 = Sequential>
Compose (
    size_t th1,
    size_t th2) [inline]
```

### 12.45.1.5 Compose() [5/5]

```
template<typename H1 = Sequential, typename H2 = Sequential>
Compose (
    const H1 & o1,
    const H2 & o2) [inline]
```

## 12.45.2 Member Function Documentation

### 12.45.2.1 first\_component()

```
template<typename H1 = Sequential, typename H2 = Sequential>
H1 first\_component () const [inline]
```

### 12.45.2.2 second\_component()

```
template<typename H1 = Sequential, typename H2 = Sequential>
H2 second\_component () const [inline]
```

## 12.45.3 Friends And Related Symbol Documentation

### 12.45.3.1 operator<<

```
template<typename H1 = Sequential, typename H2 = Sequential>
std::ostream & operator<< (
    std::ostream & o,
    const Compose< H1, H2 > & c) [friend]
```

The documentation for this struct was generated from the following file:

- [blockcuts.inl](#)

## 12.46 array< T >::const\_iterator Class Reference

STL iterator class.

### 12.46.1 Detailed Description

STL iterator class.

The documentation for this class was generated from the following files:

## 12.47 string::const\_iterator Class Reference

STL iterator class.

### 12.47.1 Detailed Description

STL iterator class.

The documentation for this class was generated from the following files:

## 12.48 vector< T >::const\_iterator Class Reference

STL iterator class.

### 12.48.1 Detailed Description

STL iterator class.

The documentation for this class was generated from the following files:

## 12.49 array< T >::const\_reverse\_iterator Class Reference

STL iterator class.

### 12.49.1 Detailed Description

STL iterator class.

The documentation for this class was generated from the following files:

## 12.50 string::const\_reverse\_iterator Class Reference

STL iterator class.

### 12.50.1 Detailed Description

STL iterator class.

The documentation for this class was generated from the following files:

## 12.51 `vector< T >::const_reverse_iterator` Class Reference

STL iterator class.

### 12.51.1 Detailed Description

STL iterator class.

The documentation for this class was generated from the following files:

## 12.52 `Simd128_impl< true, true, false, 2 >::Converter` Union Reference

### Data Fields

- [`vect\_t v`](#)
- [`scalar\_t t\[vect\_size\]`](#)

### 12.52.1 Field Documentation

#### 12.52.1.1 `v`

[`vect\_t`](#) `v`

#### 12.52.1.2 `t`

[`scalar\_t`](#) `t[vect_size]`

The documentation for this union was generated from the following file:

- [`simd128\_int16.inl`](#)

## 12.53 `Simd128_impl< true, true, false, 4 >::Converter` Union Reference

### Data Fields

- [`vect\_t v`](#)
- [`scalar\_t t\[vect\_size\]`](#)

### 12.53.1 Field Documentation

#### 12.53.1.1 `v`

[`vect\_t`](#) `v`

#### 12.53.1.2 `t`

[`scalar\_t`](#) `t[vect_size]`

The documentation for this union was generated from the following file:

- [`simd128\_int32.inl`](#)

## 12.54 `Simd128_impl< true, true, false, 8 >::Converter` Union Reference

### Data Fields

- [`vect\_t v`](#)
- [`scalar\_t t\[vect\_size\]`](#)



### 12.54.1 Field Documentation

#### 12.54.1.1 v

`vect_t` v

#### 12.54.1.2 t

`scalar_t` t[`vect_size`]

The documentation for this union was generated from the following file:

- [simd128\\_int64.inl](#)

## 12.55 Simd128\_impl< true, true, true, 2 >::Converter Union Reference

### Data Fields

- [vect\\_t](#) v
- [scalar\\_t](#) t[`vect_size`]

### 12.55.1 Field Documentation

#### 12.55.1.1 v

`vect_t` v

#### 12.55.1.2 t

`scalar_t` t[`vect_size`]

The documentation for this union was generated from the following file:

- [simd128\\_int16.inl](#)

## 12.56 Simd128\_impl< true, true, true, 4 >::Converter Union Reference

### Data Fields

- [vect\\_t](#) v
- [scalar\\_t](#) t[`vect_size`]

### 12.56.1 Field Documentation

#### 12.56.1.1 v

`vect_t` v

#### 12.56.1.2 t

`scalar_t` t[`vect_size`]

The documentation for this union was generated from the following file:

- [simd128\\_int32.inl](#)

## 12.57 Simd128\_impl< true, true, true, 8 >::Converter Union Reference

### Data Fields

- [vect\\_t](#) v
- [scalar\\_t](#) t[`vect_size`]

### 12.57.1 Field Documentation

#### 12.57.1.1 `v`

`vect_t v`

#### 12.57.1.2 `t`

`scalar_t t[vect_size]`

The documentation for this union was generated from the following file:

- [simd128\\_int64.inl](#)

## 12.58 `Simd256_impl< true, false, true, 8 >::Converter Union Reference`

### Data Fields

- [vect\\_t v](#)
- [scalar\\_t t\[vect\\_size\]](#)

### 12.58.1 Field Documentation

#### 12.58.1.1 `v`

`vect_t v`

#### 12.58.1.2 `t`

`scalar_t t[vect_size]`

The documentation for this union was generated from the following file:

- [simd256\\_double.inl](#)

## 12.59 `Simd256_impl< true, true, false, 2 >::Converter Union Reference`

### Data Fields

- [vect\\_t v](#)
- [scalar\\_t t\[vect\\_size\]](#)

### 12.59.1 Field Documentation

#### 12.59.1.1 `v`

`vect_t v`

#### 12.59.1.2 `t`

`scalar_t t[vect_size]`

The documentation for this union was generated from the following file:

- [simd256\\_int16.inl](#)

## 12.60 `Simd256_impl< true, true, false, 4 >::Converter Union Reference`

### Data Fields

- [vect\\_t v](#)
- [scalar\\_t t\[vect\\_size\]](#)

### 12.60.1 Field Documentation

#### 12.60.1.1 v

`vect_t` v

#### 12.60.1.2 t

`scalar_t` t

The documentation for this union was generated from the following files:

- [simd256\\_int32.inl](#)
- [simd512\\_int32.inl](#)

## 12.61 Simd256\_impl< true, true, false, 8 >::Converter Union Reference

### Data Fields

- [vect\\_t](#) v
- [scalar\\_t](#) t [vect\_size]

### 12.61.1 Field Documentation

#### 12.61.1.1 v

`vect_t` v

#### 12.61.1.2 t

`scalar_t` t [vect\_size]

The documentation for this union was generated from the following file:

- [simd256\\_int64.inl](#)

## 12.62 Simd256\_impl< true, true, true, 2 >::Converter Union Reference

### Data Fields

- [vect\\_t](#) v
- [scalar\\_t](#) t [vect\_size]

### 12.62.1 Field Documentation

#### 12.62.1.1 v

`vect_t` v

#### 12.62.1.2 t

`scalar_t` t [vect\_size]

The documentation for this union was generated from the following file:

- [simd256\\_int16.inl](#)

## 12.63 Simd256\_impl< true, true, true, 4 >::Converter Union Reference

### Data Fields

- [vect\\_t](#) v
- [scalar\\_t](#) t [vect\_size]

### 12.63.1 Field Documentation

#### 12.63.1.1 `v`

`vect_t v`

#### 12.63.1.2 `t`

`scalar_t t`

The documentation for this union was generated from the following files:

- [simd256\\_int32.inl](#)
- [simd512\\_int32.inl](#)

## 12.64 `Simd256_impl< true, true, true, 8 >::Converter Union Reference`

### Data Fields

- `vect_t v`
- `scalar_t t [vect_size]`

### 12.64.1 Field Documentation

#### 12.64.1.1 `v`

`vect_t v`

#### 12.64.1.2 `t`

`scalar_t t [vect_size]`

The documentation for this union was generated from the following file:

- [simd256\\_int64.inl](#)

## 12.65 `Simd512_impl< true, true, false, 8 >::Converter Union Reference`

### Data Fields

- `vect_t v`
- `scalar_t t [vect_size]`

### 12.65.1 Field Documentation

#### 12.65.1.1 `v`

`vect_t v`

#### 12.65.1.2 `t`

`scalar_t t [vect_size]`

The documentation for this union was generated from the following file:

- [simd512\\_int64.inl](#)

## 12.66 `Simd512_impl< true, true, true, 8 >::Converter Union Reference`

### Data Fields

- `vect_t v`
- `scalar_t t [vect_size]`

## 12.66.1 Field Documentation

### 12.66.1.1 v

`vect_t` v

### 12.66.1.2 t

`scalar_t` t[`vect_size`]

The documentation for this union was generated from the following file:

- [simd512\\_int64.inl](#)

## 12.67 ConvertTo< T > Struct Template Reference

Force conversion to appropriate element type of ElementCategory T.

`#include <field-traits.h>`

### 12.67.1 Detailed Description

**template<class T>**

**struct FFLAS::ModeCategories::ConvertTo< T >**

Force conversion to appropriate element type of ElementCategory T.

e.g.

- [ConvertTo<ElementCategories::MachineFloatTag>](#) tries conversion of Modular<int> to Modular<double>
- [ConvertTo<ElementCategories::FixedPreIntTag>](#) tries conversion of Modular<Integer> to Modular<[Reclnt<K>](#)>
- [ConvertTo<ElementCategories::ArbitraryPreIntTag>](#) tries conversion of Modular<Integer> to RNSInteger

The documentation for this struct was generated from the following file:

- [field-traits.h](#)

## 12.68 Coo< ValT, IdxT > Struct Template Reference

### Public Types

- using [Self](#) = [Coo](#)<ValT, IdxT>

### Public Member Functions

- [Coo](#) (ValT v, IdxT r, IdxT c)
- [Coo](#) ()=default
- [Coo](#) (const [Self](#) &)=default
- [Coo](#) ([Self](#) &&)=default
- [Self](#) & [operator=](#) (const [Self](#) &)=default
- [Self](#) & [operator=](#) ([Self](#) &&)=default

### Data Fields

- ValT [val](#) = 0
- IdxT [row](#) = 0
- IdxT [col](#) = 0

## 12.68.1 Member Typedef Documentation

### 12.68.1.1 Self

```
template<class ValT, class IdxT>
using Self = Coo<ValT, IdxT>
```

## 12.68.2 Constructor & Destructor Documentation

### 12.68.2.1 Coo() [1/4]

```
template<class ValT, class IdxT>
Coo (
    ValT v,
    IdxT r,
    IdxT c) [inline]
```

### 12.68.2.2 Coo() [2/4]

```
template<class ValT, class IdxT>
Coo () [default]
```

### 12.68.2.3 Coo() [3/4]

```
template<class ValT, class IdxT>
Coo (
    const Self & ) [default]
```

### 12.68.2.4 Coo() [4/4]

```
template<class ValT, class IdxT>
Coo (
    Self && ) [default]
```

## 12.68.3 Member Function Documentation

### 12.68.3.1 operator=() [1/2]

```
template<class ValT, class IdxT>
Self & operator= (
    const Self & ) [default]
```

### 12.68.3.2 operator=() [2/2]

```
template<class ValT, class IdxT>
Self & operator= (
    Self && ) [default]
```

## 12.68.4 Field Documentation

### 12.68.4.1 val

```
template<class ValT, class IdxT>
ValT val = 0
```

### 12.68.4.2 row

```
template<class ValT, class IdxT>
IdxT row = 0
```

### 12.68.4.3 `col`

```
template<class ValT, class IdxT>
IdxT col = 0
```

The documentation for this struct was generated from the following file:

- [csr\\_hyb\\_utils.inl](#)

## 12.69 `Coo< Field >` Struct Template Reference

```
#include <read_sparse.h>
```

### Public Member Functions

- `Coo()`=default
- `Coo` (typename `Field::Element` v, `index_t` r, `index_t` c)
- `Coo` (const `Self` &)=default
- `Coo` (`Self` &&)=default
- `Self` & `operator=` (const `Self` &)=default
- `Self` & `operator=` (`Self` &&)=default

### Data Fields

- `Field::Element` val = 0
- `index_t` col = 0
- `index_t` row = 0
- bool `deleted` = false

## 12.69.1 Constructor & Destructor Documentation

### 12.69.1.1 `Coo()` [1/4]

```
template<class Field>
Coo () [default]
```

### 12.69.1.2 `Coo()` [2/4]

```
template<class Field>
Coo (
    typename Field::Element v,
    index_t r,
    index_t c) [inline]
```

### 12.69.1.3 `Coo()` [3/4]

```
template<class Field>
Coo (
    const Self & ) [default]
```

### 12.69.1.4 `Coo()` [4/4]

```
template<class Field>
Coo (
    Self && ) [default]
```

## 12.69.2 Member Function Documentation

### 12.69.2.1 operator=() [1/2]

```
template<class Field>
Self & operator= (
    const Self & ) [default]
```

### 12.69.2.2 operator=() [2/2]

```
template<class Field>
Self & operator= (
    Self && ) [default]
```

## 12.69.3 Field Documentation

### 12.69.3.1 val

```
template<class Field>
Field::Element val = 0
```

### 12.69.3.2 col

```
template<class Field>
index_t col = 0
```

### 12.69.3.3 row

```
template<class Field>
index_t row = 0
```

### 12.69.3.4 deleted

```
template<class Field>
bool deleted = false
```

The documentation for this struct was generated from the following file:

- [read\\_sparse.h](#)

## 12.70 Coo< ValT, IdxT > Struct Template Reference

### Public Types

- using [Self](#) = [Coo](#)<ValT, IdxT>

### Public Member Functions

- [Coo](#) (ValT v, IdxT r, IdxT c)
- [Coo](#) ()=default
- [Coo](#) (const [Self](#) &)=default
- [Coo](#) ([Self](#) &&)=default
- [Self](#) & [operator=](#) (const [Self](#) &)=default
- [Self](#) & [operator=](#) ([Self](#) &&)=default

### Data Fields

- ValT [val](#) = 0
- IdxT [row](#) = 0
- IdxT [col](#) = 0



## 12.70.1 Member Typedef Documentation

### 12.70.1.1 Self

```
template<class ValT, class IdxT>
using Self = Coo<ValT, IdxT>
```

## 12.70.2 Constructor & Destructor Documentation

### 12.70.2.1 Coo() [1/4]

```
template<class ValT, class IdxT>
Coo (
    ValT v,
    IdxT r,
    IdxT c) [inline]
```

### 12.70.2.2 Coo() [2/4]

```
template<class ValT, class IdxT>
Coo () [default]
```

### 12.70.2.3 Coo() [3/4]

```
template<class ValT, class IdxT>
Coo (
    const Self & ) [default]
```

### 12.70.2.4 Coo() [4/4]

```
template<class ValT, class IdxT>
Coo (
    Self && ) [default]
```

## 12.70.3 Member Function Documentation

### 12.70.3.1 operator=() [1/2]

```
template<class ValT, class IdxT>
Self & operator= (
    const Self & ) [default]
```

### 12.70.3.2 operator=() [2/2]

```
template<class ValT, class IdxT>
Self & operator= (
    Self && ) [default]
```

## 12.70.4 Field Documentation

### 12.70.4.1 val

```
template<class ValT, class IdxT>
ValT val = 0
```

### 12.70.4.2 row

```
template<class ValT, class IdxT>
IdxT row = 0
```

### 12.70.4.3 col

```
template<class ValT, class IdxT>
IdxT col = 0
```

The documentation for this struct was generated from the following file:

- [sell\\_utils.inl](#)

## 12.71 CooMat< Field > Struct Template Reference

```
#include <fflas_sparse.h>
```

### Data Fields

- [FFLAS::Sparse< Field, SparseMatrix\\_t::COO, int16\\_t > \\* \\_coo16](#) = nullptr
- [FFLAS::Sparse< Field, SparseMatrix\\_t::COO, int32\\_t > \\* \\_coo32](#) = nullptr
- [FFLAS::Sparse< Field, SparseMatrix\\_t::COO, int64\\_t > \\* \\_coo64](#) = nullptr
- [FFLAS::Sparse< Field, SparseMatrix\\_t::COO\\_ZO, int16\\_t > \\* \\_coo16\\_zo](#) = nullptr
- [FFLAS::Sparse< Field, SparseMatrix\\_t::COO\\_ZO, int32\\_t > \\* \\_coo32\\_zo](#) = nullptr
- [FFLAS::Sparse< Field, SparseMatrix\\_t::COO\\_ZO, int64\\_t > \\* \\_coo64\\_zo](#) = nullptr

### 12.71.1 Field Documentation

#### 12.71.1.1 \_coo16

```
template<class Field>
FFLAS::Sparse<Field, SparseMatrix_t::COO, int16_t>* _coo16 = nullptr
```

#### 12.71.1.2 \_coo32

```
template<class Field>
FFLAS::Sparse<Field, SparseMatrix_t::COO, int32_t>* _coo32 = nullptr
```

#### 12.71.1.3 \_coo64

```
template<class Field>
FFLAS::Sparse<Field, SparseMatrix_t::COO, int64_t>* _coo64 = nullptr
```

#### 12.71.1.4 \_coo16\_zo

```
template<class Field>
FFLAS::Sparse<Field, SparseMatrix_t::COO_ZO, int16_t>* _coo16_zo = nullptr
```

#### 12.71.1.5 \_coo32\_zo

```
template<class Field>
FFLAS::Sparse<Field, SparseMatrix_t::COO_ZO, int32_t>* _coo32_zo = nullptr
```

#### 12.71.1.6 \_coo64\_zo

```
template<class Field>
FFLAS::Sparse<Field, SparseMatrix_t::COO_ZO, int64_t>* _coo64_zo = nullptr
```

The documentation for this struct was generated from the following file:

- [fflas\\_sparse.h](#)

## 12.72 `count_nonconst_lvalue_reference< T >` Struct Template Reference

The documentation for this struct was generated from the following file:

- [test-simd.C](#)

## 12.73 `count_nonconst_lvalue_reference< const T &, O... >` Struct Template Reference

### Static Public Attributes

- static constexpr `size_t n` = `count_nonconst_lvalue_reference<O...>::n`

### 12.73.1 Field Documentation

#### 12.73.1.1 `n`

```
template<typename T, typename... O>
size_t n = count_nonconst_lvalue_reference<O...>::n [static], [constexpr]
```

The documentation for this struct was generated from the following file:

- [test-simd.C](#)

## 12.74 `count_nonconst_lvalue_reference< T &, O... >` Struct Template Reference

### Static Public Attributes

- static constexpr `size_t n`

### 12.74.1 Field Documentation

#### 12.74.1.1 `n`

```
template<typename T, typename... O>
size_t n [static], [constexpr]
Initial value:
= std::integral_constant<size_t, 1>::value
  + count_nonconst_lvalue_reference<O...>::n
```

The documentation for this struct was generated from the following file:

- [test-simd.C](#)

## 12.75 `count_nonconst_lvalue_reference< T, O... >` Struct Template Reference

### Static Public Attributes

- static constexpr `size_t n` = `count_nonconst_lvalue_reference<O...>::n`

### 12.75.1 Field Documentation

#### 12.75.1.1 `n`

```
template<typename T, typename... O>
size_t n = count_nonconst_lvalue_reference<O...>::n [static], [constexpr]
```

The documentation for this struct was generated from the following file:

- [test-simd.C](#)

## 12.76 count\_nonconst\_lvalue\_reference<> Struct Reference

### Static Public Attributes

- static constexpr size\_t [n](#) = std::integral\_constant<size\_t, 0>::value

### 12.76.1 Field Documentation

#### 12.76.1.1 [n](#)

size\_t [n](#) = std::integral\_constant<size\_t, 0>::value [static], [constexpr]

The documentation for this struct was generated from the following file:

- [test-simd.C](#)

## 12.77 CsrMat< Field > Struct Template Reference

```
#include <fflas_sparse.h>
```

### Data Fields

- [FFLAS::Sparse< Field, SparseMatrix\\_t::CSR, int16\\_t > \\* \\_csr16](#) = nullptr
- [FFLAS::Sparse< Field, SparseMatrix\\_t::CSR, int32\\_t > \\* \\_csr32](#) = nullptr
- [FFLAS::Sparse< Field, SparseMatrix\\_t::CSR, int64\\_t > \\* \\_csr64](#) = nullptr
- [FFLAS::Sparse< Field, SparseMatrix\\_t::CSR\\_ZO, int16\\_t > \\* \\_csr16\\_zo](#) = nullptr
- [FFLAS::Sparse< Field, SparseMatrix\\_t::CSR\\_ZO, int32\\_t > \\* \\_csr32\\_zo](#) = nullptr
- [FFLAS::Sparse< Field, SparseMatrix\\_t::CSR\\_ZO, int64\\_t > \\* \\_csr64\\_zo](#) = nullptr

### 12.77.1 Field Documentation

#### 12.77.1.1 [\\_csr16](#)

```
template<class Field>
FFLAS::Sparse<Field, SparseMatrix_t::CSR, int16_t>* _csr16 = nullptr
```

#### 12.77.1.2 [\\_csr32](#)

```
template<class Field>
FFLAS::Sparse<Field, SparseMatrix_t::CSR, int32_t>* _csr32 = nullptr
```

#### 12.77.1.3 [\\_csr64](#)

```
template<class Field>
FFLAS::Sparse<Field, SparseMatrix_t::CSR, int64_t>* _csr64 = nullptr
```

#### 12.77.1.4 [\\_csr16\\_zo](#)

```
template<class Field>
FFLAS::Sparse<Field, SparseMatrix_t::CSR_ZO, int16_t>* _csr16_zo = nullptr
```

#### 12.77.1.5 [\\_csr32\\_zo](#)

```
template<class Field>
FFLAS::Sparse<Field, SparseMatrix_t::CSR_ZO, int32_t>* _csr32_zo = nullptr
```

#### 12.77.1.6 [\\_csr64\\_zo](#)

```
template<class Field>
FFLAS::Sparse<Field, SparseMatrix_t::CSR_ZO, int64_t>* _csr64_zo = nullptr
```

The documentation for this struct was generated from the following file:

- [fflas\\_sparse.h](#)

## 12.78 DefaultBoundedTag Struct Reference

Use standard field operations, but keeps track of bounds on input and output.

```
#include <field-traits.h>
```

### 12.78.1 Detailed Description

Use standard field operations, but keeps track of bounds on input and output.

The documentation for this struct was generated from the following file:

- [field-traits.h](#)

## 12.79 DefaultTag Struct Reference

No specific mode of action: use standard field operations.

```
#include <field-traits.h>
```

### 12.79.1 Detailed Description

No specific mode of action: use standard field operations.

The documentation for this struct was generated from the following file:

- [field-traits.h](#)

## 12.80 DelayedTag Struct Reference

Performs field operations with delayed mod reductions. Ensures result is reduced.

```
#include <field-traits.h>
```

### 12.80.1 Detailed Description

Performs field operations with delayed mod reductions. Ensures result is reduced.

The documentation for this struct was generated from the following file:

- [field-traits.h](#)

## 12.81 DivideAndConquer Struct Reference

The documentation for this struct was generated from the following file:

- [fflas\\_helpers.inl](#)

## 12.82 ElementTraits< Element > Struct Template Reference

[ElementTraits](#).

```
#include <field-traits.h>
```

### Public Types

- typedef [ElementCategories::GenericTag](#) value

### 12.82.1 Detailed Description

```
template<class Element>
```

```
struct FFLAS::ElementTraits< Element >
```

[ElementTraits](#).

## 12.82.2 Member Typedef Documentation

### 12.82.2.1 value

```
template<class Element>
```

```
typedef ElementCategories::GenericTag value
```

The documentation for this struct was generated from the following file:

- [field-traits.h](#)

## 12.83 ElementTraits< double > Struct Reference

```
#include <field-traits.h>
```

### Public Types

- typedef [ElementCategories::MachineFloatTag](#) value
- typedef [ElementCategories::GenericTag](#) value

### 12.83.1 Member Typedef Documentation

#### 12.83.1.1 value [1/2]

```
typedef ElementCategories::MachineFloatTag value
```

#### 12.83.1.2 value [2/2]

```
typedef ElementCategories::GenericTag value
```

The documentation for this struct was generated from the following file:

- [field-traits.h](#)

## 12.84 ElementTraits< FFPACK::rns\_double\_elt > Struct Reference

```
#include <field-traits.h>
```

### Public Types

- typedef [ElementCategories::RNSElementTag](#) value
- typedef [ElementCategories::GenericTag](#) value

### 12.84.1 Member Typedef Documentation

#### 12.84.1.1 value [1/2]

```
typedef ElementCategories::RNSElementTag value
```

#### 12.84.1.2 value [2/2]

```
typedef ElementCategories::GenericTag value
```

The documentation for this struct was generated from the following file:

- [field-traits.h](#)

## 12.85 ElementTraits< float > Struct Reference

```
#include <field-traits.h>
```

**Public Types**

- typedef [ElementCategories::MachineFloatTag](#) value
- typedef [ElementCategories::GenericTag](#) value

**12.85.1 Member Typedef Documentation****12.85.1.1 value [1/2]**

```
typedef ElementCategories::MachineFloatTag value
```

**12.85.1.2 value [2/2]**

```
typedef ElementCategories::GenericTag value
```

The documentation for this struct was generated from the following file:

- [field-traits.h](#)

**12.86 ElementTraits< Givaro::Integer > Struct Reference**

```
#include <field-traits.h>
```

**Public Types**

- typedef [ElementCategories::ArbitraryPrecIntTag](#) value
- typedef [ElementCategories::GenericTag](#) value

**12.86.1 Member Typedef Documentation****12.86.1.1 value [1/2]**

```
typedef ElementCategories::ArbitraryPrecIntTag value
```

**12.86.1.2 value [2/2]**

```
typedef ElementCategories::GenericTag value
```

The documentation for this struct was generated from the following file:

- [field-traits.h](#)

**12.87 ElementTraits< int16\_t > Struct Reference**

```
#include <field-traits.h>
```

**Public Types**

- typedef [ElementCategories::MachineIntTag](#) value
- typedef [ElementCategories::GenericTag](#) value

**12.87.1 Member Typedef Documentation****12.87.1.1 value [1/2]**

```
typedef ElementCategories::MachineIntTag value
```

**12.87.1.2 value [2/2]**

```
typedef ElementCategories::GenericTag value
```

The documentation for this struct was generated from the following file:

- [field-traits.h](#)

## 12.88 ElementTraits< int32\_t > Struct Reference

```
#include <field-traits.h>
```

### Public Types

- typedef [ElementCategories::MachineIntTag](#) value
- typedef [ElementCategories::GenericTag](#) value

### 12.88.1 Member Typedef Documentation

#### 12.88.1.1 value [1/2]

```
typedef ElementCategories::MachineIntTag value
```

#### 12.88.1.2 value [2/2]

```
typedef ElementCategories::GenericTag value
```

The documentation for this struct was generated from the following file:

- [field-traits.h](#)

## 12.89 ElementTraits< int64\_t > Struct Reference

```
#include <field-traits.h>
```

### Public Types

- typedef [ElementCategories::MachineIntTag](#) value
- typedef [ElementCategories::GenericTag](#) value

### 12.89.1 Member Typedef Documentation

#### 12.89.1.1 value [1/2]

```
typedef ElementCategories::MachineIntTag value
```

#### 12.89.1.2 value [2/2]

```
typedef ElementCategories::GenericTag value
```

The documentation for this struct was generated from the following file:

- [field-traits.h](#)

## 12.90 ElementTraits< int8\_t > Struct Reference

```
#include <field-traits.h>
```

### Public Types

- typedef [ElementCategories::MachineIntTag](#) value
- typedef [ElementCategories::GenericTag](#) value

### 12.90.1 Member Typedef Documentation

#### 12.90.1.1 value [1/2]

```
typedef ElementCategories::MachineIntTag value
```



**12.90.1.2 value [2/2]**

```
typedef ElementCategories::GenericTag value
```

The documentation for this struct was generated from the following file:

- [field-traits.h](#)

**12.91 ElementTraits< RecInt::rint< K > > Struct Template Reference**

```
#include <field-traits.h>
```

**Public Types**

- typedef [ElementCategories::FixedPrecIntTag](#) value
- typedef [ElementCategories::GenericTag](#) value

**12.91.1 Member Typedef Documentation****12.91.1.1 value [1/2]**

```
template<size_t K>
typedef ElementCategories::FixedPrecIntTag value
```

**12.91.1.2 value [2/2]**

```
typedef ElementCategories::GenericTag value
```

The documentation for this struct was generated from the following file:

- [field-traits.h](#)

**12.92 ElementTraits< RecInt::rmint< K, MG > > Struct Template Reference**

```
#include <field-traits.h>
```

**Public Types**

- typedef [ElementCategories::FixedPrecIntTag](#) value
- typedef [ElementCategories::GenericTag](#) value

**12.92.1 Member Typedef Documentation****12.92.1.1 value [1/2]**

```
template<size_t K, int MG>
typedef ElementCategories::FixedPrecIntTag value
```

**12.92.1.2 value [2/2]**

```
typedef ElementCategories::GenericTag value
```

The documentation for this struct was generated from the following file:

- [field-traits.h](#)

**12.93 ElementTraits< RecInt::ruint< K > > Struct Template Reference**

```
#include <field-traits.h>
```

**Public Types**

- typedef [ElementCategories::FixedPrecIntTag](#) value
- typedef [ElementCategories::GenericTag](#) value

**12.93.1 Member Typedef Documentation****12.93.1.1 value [1/2]**

```
template<size_t K>
typedef ElementCategories::FixedPrecIntTag value
```

**12.93.1.2 value [2/2]**

```
typedef ElementCategories::GenericTag value
```

The documentation for this struct was generated from the following file:

- [field-traits.h](#)

**12.94 ElementTraits< uint16\_t > Struct Reference**

```
#include <field-traits.h>
```

**Public Types**

- typedef [ElementCategories::MachineIntTag](#) value
- typedef [ElementCategories::GenericTag](#) value

**12.94.1 Member Typedef Documentation****12.94.1.1 value [1/2]**

```
typedef ElementCategories::MachineIntTag value
```

**12.94.1.2 value [2/2]**

```
typedef ElementCategories::GenericTag value
```

The documentation for this struct was generated from the following file:

- [field-traits.h](#)

**12.95 ElementTraits< uint32\_t > Struct Reference**

```
#include <field-traits.h>
```

**Public Types**

- typedef [ElementCategories::MachineIntTag](#) value
- typedef [ElementCategories::GenericTag](#) value

**12.95.1 Member Typedef Documentation****12.95.1.1 value [1/2]**

```
typedef ElementCategories::MachineIntTag value
```

### 12.95.1.2 value [2/2]

typedef [ElementCategories::GenericTag](#) value

The documentation for this struct was generated from the following file:

- [field-traits.h](#)

## 12.96 ElementTraits< uint64\_t > Struct Reference

```
#include <field-traits.h>
```

### Public Types

- typedef [ElementCategories::MachineIntTag](#) value
- typedef [ElementCategories::GenericTag](#) value

### 12.96.1 Member Typedef Documentation

#### 12.96.1.1 value [1/2]

typedef [ElementCategories::MachineIntTag](#) value

#### 12.96.1.2 value [2/2]

typedef [ElementCategories::GenericTag](#) value

The documentation for this struct was generated from the following file:

- [field-traits.h](#)

## 12.97 ElementTraits< uint8\_t > Struct Reference

```
#include <field-traits.h>
```

### Public Types

- typedef [ElementCategories::MachineIntTag](#) value
- typedef [ElementCategories::GenericTag](#) value

### 12.97.1 Member Typedef Documentation

#### 12.97.1.1 value [1/2]

typedef [ElementCategories::MachineIntTag](#) value

#### 12.97.1.2 value [2/2]

typedef [ElementCategories::GenericTag](#) value

The documentation for this struct was generated from the following file:

- [field-traits.h](#)

## 12.98 EIIMat< Field > Struct Template Reference

```
#include <fflas_sparse.h>
```

## Data Fields

- [FFLAS::Sparse](#)< [Field](#), [SparseMatrix\\_t::ELL](#), [int16\\_t](#) > \* [\\_ell16](#) = nullptr
- [FFLAS::Sparse](#)< [Field](#), [SparseMatrix\\_t::ELL](#), [int32\\_t](#) > \* [\\_ell32](#) = nullptr
- [FFLAS::Sparse](#)< [Field](#), [SparseMatrix\\_t::ELL](#), [int64\\_t](#) > \* [\\_ell64](#) = nullptr
- [FFLAS::Sparse](#)< [Field](#), [SparseMatrix\\_t::ELL\\_ZO](#), [int16\\_t](#) > \* [\\_ell16\\_zo](#) = nullptr
- [FFLAS::Sparse](#)< [Field](#), [SparseMatrix\\_t::ELL\\_ZO](#), [int32\\_t](#) > \* [\\_ell32\\_zo](#) = nullptr
- [FFLAS::Sparse](#)< [Field](#), [SparseMatrix\\_t::ELL\\_ZO](#), [int64\\_t](#) > \* [\\_ell64\\_zo](#) = nullptr

## 12.98.1 Field Documentation

### 12.98.1.1 [\\_ell16](#)

```
template<class Field>
FFLAS::Sparse<Field, SparseMatrix\_t::ELL, int16\_t>* \_ell16 = nullptr
```

### 12.98.1.2 [\\_ell32](#)

```
template<class Field>
FFLAS::Sparse<Field, SparseMatrix\_t::ELL, int32\_t>* \_ell32 = nullptr
```

### 12.98.1.3 [\\_ell64](#)

```
template<class Field>
FFLAS::Sparse<Field, SparseMatrix\_t::ELL, int64\_t>* \_ell64 = nullptr
```

### 12.98.1.4 [\\_ell16\\_zo](#)

```
template<class Field>
FFLAS::Sparse<Field, SparseMatrix\_t::ELL\_ZO, int16\_t>* \_ell16\_zo = nullptr
```

### 12.98.1.5 [\\_ell32\\_zo](#)

```
template<class Field>
FFLAS::Sparse<Field, SparseMatrix\_t::ELL\_ZO, int32\_t>* \_ell32\_zo = nullptr
```

### 12.98.1.6 [\\_ell64\\_zo](#)

```
template<class Field>
FFLAS::Sparse<Field, SparseMatrix\_t::ELL\_ZO, int64\_t>* \_ell64\_zo = nullptr
```

The documentation for this struct was generated from the following file:

- [fflas\\_sparse.h](#)

## 12.99 Failure Class Reference

A precondition failed.

```
#include <debug.h>
```

### Public Member Functions

- [Failure](#) ()
- void [operator\(\)](#) (const char \*function, int line, const char \*check)
- void [operator\(\)](#) (const char \*function, const char \*file, int line, const char \*check)
- void [setErrorStream](#) (std::ostream &stream)
- std::ostream & [print](#) (std::ostream &o) const

### Protected Attributes

- std::ostream \* [\\_errorStream](#)

## 12.99.1 Detailed Description

A precondition failed.

The `throw` mechanism is usually used here as in

```
if (!check)
    failure()(__func__, __LINE__, "this check just failed");
```

The parameters of the constructor help debugging.

## 12.99.2 Constructor & Destructor Documentation

### 12.99.2.1 Failure()

```
Failure () [inline]
```

## 12.99.3 Member Function Documentation

### 12.99.3.1 operator>() [1/2]

```
void operator() (
    const char * function,
    int line,
    const char * check) [inline]
```

A precondition failed.

#### Parameters

<i>function</i>	usually <code>__func__</code> , the function that threw the error
<i>line</i>	usually <code>__LINE__</code> , the line where it happened
<i>check</i>	a string telling what failed.

### 12.99.3.2 operator>() [2/2]

```
void operator() (
    const char * function,
    const char * file,
    int line,
    const char * check) [inline]
```

A precondition failed. The parameter help debugging. This is not much different from the previous except we can digg faster in the file where the exception was triggered.

#### Parameters

<i>function</i>	usually <code>__func__</code> , the function that threw the error
<i>file</i>	usually <code>__FILE__</code> , the file where this function is
<i>line</i>	usually <code>__LINE__</code> , the line where it happened
<i>check</i>	a string telling what failed.

### 12.99.3.3 setErrorMessage()

```
void setErrorMessage (
    std::ostream & stream)
```

### 12.99.3.4 print()

```
std::ostream & print (
    std::ostream & o) const [inline]
```

overload the virtual print of `LinboxError`.

## Parameters

<i>o</i>	output stream
----------	---------------

## 12.99.4 Field Documentation

### 12.99.4.1 `_errorStream`

```
std::ostream* _errorStream [protected]
```

The documentation for this class was generated from the following file:

- [debug.h](#)

## 12.100 FailureCharpolyCheck Class Reference

```
#include <checkers_ffpack.h>
```

The documentation for this class was generated from the following file:

- [checkers\\_ffpack.h](#)

## 12.101 FailureDetCheck Class Reference

```
#include <checkers_ffpack.h>
```

The documentation for this class was generated from the following file:

- [checkers\\_ffpack.h](#)

## 12.102 FailureFgemmCheck Class Reference

```
#include <checkers_fflas.h>
```

The documentation for this class was generated from the following file:

- [checkers\\_fflas.h](#)

## 12.103 FailureInvertCheck Class Reference

```
#include <checkers_ffpack.h>
```

The documentation for this class was generated from the following file:

- [checkers\\_ffpack.h](#)

## 12.104 FailurePLUQCheck Class Reference

```
#include <checkers_ffpack.h>
```

The documentation for this class was generated from the following file:

- [checkers\\_ffpack.h](#)

## 12.105 FailureTrsmCheck Class Reference

```
#include <checkers_fflas.h>
```

The documentation for this class was generated from the following file:

- [checkers\\_fflas.h](#)

## 12.106 FieldSimd<\_Field> Class Template Reference

### Public Types

- using `Field` = `_Field`
- using `Element` = `typename Field::Element`
- using `simd` = `Simd<typename Field::Element>`
- using `vect_t` = `typename simd::vect_t`
- using `scalar_t` = `typename simd::scalar_t`

### Public Member Functions

- `FieldSimd` (const `Field` &f)
- `FieldSimd` (const `Self` &)=default
- `FieldSimd` (`Self` &&)=default
- `Self` & `operator=` (const `Self` &)=default
- `Self` & `operator=` (`Self` &&)=default
- `INLINE vect_t` `init` (`vect_t` &x, const `vect_t` a) const
- `INLINE vect_t` `init` (const `vect_t` a) const
- `INLINE vect_t` `add` (`vect_t` &c, const `vect_t` a, const `vect_t` b)
- `INLINE vect_t` `add` (const `vect_t` a, const `vect_t` b)
- `INLINE vect_t` `addin` (`vect_t` &a, const `vect_t` b) const
- `INLINE vect_t` `add_r` (`vect_t` &c, const `vect_t` a, const `vect_t` b) const
- `INLINE vect_t` `add_r` (const `vect_t` a, const `vect_t` b) const
- `INLINE vect_t` `addin_r` (`vect_t` &a, const `vect_t` b) const
- `INLINE vect_t` `sub` (`vect_t` &c, const `vect_t` a, const `vect_t` b)
- `INLINE vect_t` `sub` (const `vect_t` a, const `vect_t` b)
- `INLINE vect_t` `subin` (`vect_t` &a, const `vect_t` b) const
- `INLINE vect_t` `sub_r` (`vect_t` &c, const `vect_t` a, const `vect_t` b) const
- `INLINE vect_t` `sub_r` (const `vect_t` a, const `vect_t` b) const
- `INLINE vect_t` `subin_r` (`vect_t` &a, const `vect_t` b) const
- `INLINE vect_t` `zero` (`vect_t` &x) const
- `INLINE vect_t` `zero` () const
- `INLINE vect_t` `mod` (`vect_t` &c) const
- `INLINE vect_t` `mul` (`vect_t` &c, const `vect_t` a, const `vect_t` b) const
- `INLINE vect_t` `mul` (const `vect_t` a, const `vect_t` b) const
- `INLINE vect_t` `mulin` (`vect_t` &a, const `vect_t` b) const
- `INLINE vect_t` `mul_r` (`vect_t` &c, const `vect_t` a, const `vect_t` b) const
- `INLINE vect_t` `mul_r` (const `vect_t` a, const `vect_t` b) const
- `INLINE vect_t` `axpy` (`vect_t` &r, const `vect_t` a, const `vect_t` b, const `vect_t` c) const
- `INLINE vect_t` `axpy` (const `vect_t` c, const `vect_t` a, const `vect_t` b) const
- `INLINE vect_t` `axpyin` (`vect_t` &c, const `vect_t` a, const `vect_t` b) const
- `INLINE vect_t` `axpy_r` (`vect_t` &r, const `vect_t` a, const `vect_t` b, const `vect_t` c) const
- `INLINE vect_t` `axpy_r` (const `vect_t` c, const `vect_t` a, const `vect_t` b) const
- `INLINE vect_t` `axpyin_r` (`vect_t` &c, const `vect_t` a, const `vect_t` b) const
- `INLINE vect_t` `maxpy` (`vect_t` &r, const `vect_t` a, const `vect_t` b, const `vect_t` c) const
- `INLINE vect_t` `maxpy` (const `vect_t` c, const `vect_t` a, const `vect_t` b) const
- `INLINE vect_t` `maxpyin` (`vect_t` &c, const `vect_t` a, const `vect_t` b) const

### Static Public Attributes

- static const constexpr size\_t `vect_size` = `simd::vect_size`
- static const constexpr size\_t `alignment` = `simd::alignment`

## 12.106.1 Member Typedef Documentation

### 12.106.1.1 Field

```
template<class _Field>
using Field = _Field
```

### 12.106.1.2 Element

```
template<class _Field>
using Element = typename Field::Element
```

### 12.106.1.3 simd

```
template<class _Field>
using simd = Simd<typename _Field::Element>
```

### 12.106.1.4 vect\_t

```
template<class _Field>
using vect_t = typename simd::vect_t
```

### 12.106.1.5 scalar\_t

```
template<class _Field>
using scalar_t = typename simd::scalar_t
```

## 12.106.2 Constructor & Destructor Documentation

### 12.106.2.1 FieldSimd() [1/3]

```
template<class _Field>
FieldSimd (
    const Field & f) [inline]
```

### 12.106.2.2 FieldSimd() [2/3]

```
template<class _Field>
FieldSimd (
    const Self & ) [default]
```

### 12.106.2.3 FieldSimd() [3/3]

```
template<class _Field>
FieldSimd (
    Self && ) [default]
```

## 12.106.3 Member Function Documentation

### 12.106.3.1 operator=() [1/2]

```
template<class _Field>
Self & operator= (
    const Self & ) [default]
```

### 12.106.3.2 operator=() [2/2]

```
template<class _Field>
Self & operator= (
    Self && ) [default]
```



**12.106.3.3 init() [1/2]**

```
template<class _Field>
INLINE vect_t init (
    vect_t & x,
    const vect_t a) const [inline]
```

**12.106.3.4 init() [2/2]**

```
template<class _Field>
INLINE vect_t init (
    const vect_t a) const [inline]
```

**12.106.3.5 add() [1/2]**

```
template<class _Field>
INLINE vect_t add (
    vect_t & c,
    const vect_t a,
    const vect_t b) [inline]
```

**12.106.3.6 add() [2/2]**

```
template<class _Field>
INLINE vect_t add (
    const vect_t a,
    const vect_t b) [inline]
```

**12.106.3.7 addin()**

```
template<class _Field>
INLINE vect_t addin (
    vect_t & a,
    const vect_t b) const [inline]
```

**12.106.3.8 add\_r() [1/2]**

```
template<class _Field>
INLINE vect_t add_r (
    vect_t & c,
    const vect_t a,
    const vect_t b) const [inline]
```

**12.106.3.9 add\_r() [2/2]**

```
template<class _Field>
INLINE vect_t add_r (
    const vect_t a,
    const vect_t b) const [inline]
```

**12.106.3.10 addin\_r()**

```
template<class _Field>
INLINE vect_t addin_r (
    vect_t & a,
    const vect_t b) const [inline]
```

**12.106.3.11 sub() [1/2]**

```
template<class _Field>
INLINE vect_t sub (
    vect_t & c,
    const vect_t a,
    const vect_t b) [inline]
```

**12.106.3.12 sub() [2/2]**

```
template<class _Field>
INLINE vect_t sub (
    const vect_t a,
    const vect_t b) [inline]
```

**12.106.3.13 subin()**

```
template<class _Field>
INLINE vect_t subin (
    vect_t & a,
    const vect_t b) const [inline]
```

**12.106.3.14 sub\_r() [1/2]**

```
template<class _Field>
INLINE vect_t sub_r (
    vect_t & c,
    const vect_t a,
    const vect_t b) const [inline]
```

**12.106.3.15 sub\_r() [2/2]**

```
template<class _Field>
INLINE vect_t sub_r (
    const vect_t a,
    const vect_t b) const [inline]
```

**12.106.3.16 subin\_r()**

```
template<class _Field>
INLINE vect_t subin_r (
    vect_t & a,
    const vect_t b) const [inline]
```

**12.106.3.17 zero() [1/2]**

```
template<class _Field>
INLINE vect_t zero (
    vect_t & x) const [inline]
```

**12.106.3.18 zero() [2/2]**

```
template<class _Field>
INLINE vect_t zero () const [inline]
```

**12.106.3.19 mod()**

```
template<class _Field>
INLINE vect_t mod (
    vect_t & c) const [inline]
```

**12.106.3.20 mul() [1/2]**

```
template<class _Field>
INLINE vect_t mul (
    vect_t & c,
    const vect_t a,
    const vect_t b) const [inline]
```

**12.106.3.21 mul() [2/2]**

```
template<class _Field>
INLINE vect_t mul (
    const vect_t a,
    const vect_t b) const [inline]
```

**12.106.3.22 mulin()**

```
template<class _Field>
INLINE vect_t mulin (
    vect_t & a,
    const vect_t b) const [inline]
```

**12.106.3.23 mul\_r() [1/2]**

```
template<class _Field>
INLINE vect_t mul_r (
    vect_t & c,
    const vect_t a,
    const vect_t b) const [inline]
```

**12.106.3.24 mul\_r() [2/2]**

```
template<class _Field>
INLINE vect_t mul_r (
    const vect_t a,
    const vect_t b) const [inline]
```

**12.106.3.25 axpy() [1/2]**

```
template<class _Field>
INLINE vect_t axpy (
    vect_t & r,
    const vect_t a,
    const vect_t b,
    const vect_t c) const [inline]
```

**12.106.3.26 axpy() [2/2]**

```
template<class _Field>
INLINE vect_t axpy (
    const vect_t c,
    const vect_t a,
    const vect_t b) const [inline]
```

**12.106.3.27 axpyin()**

```
template<class _Field>
INLINE vect_t axpyin (
    vect_t & c,
```

```
const vect_t a,
const vect_t b) const [inline]
```

#### 12.106.3.28 axpy\_r() [1/2]

```
template<class _Field>
INLINE vect_t axpy_r (
    vect_t & r,
    const vect_t a,
    const vect_t b,
    const vect_t c) const [inline]
```

#### 12.106.3.29 axpy\_r() [2/2]

```
template<class _Field>
INLINE vect_t axpy_r (
    const vect_t c,
    const vect_t a,
    const vect_t b) const [inline]
```

#### 12.106.3.30 axpyin\_r()

```
template<class _Field>
INLINE vect_t axpyin_r (
    vect_t & c,
    const vect_t a,
    const vect_t b) const [inline]
```

#### 12.106.3.31 maxpy() [1/2]

```
template<class _Field>
INLINE vect_t maxpy (
    vect_t & r,
    const vect_t a,
    const vect_t b,
    const vect_t c) const [inline]
```

#### 12.106.3.32 maxpy() [2/2]

```
template<class _Field>
INLINE vect_t maxpy (
    const vect_t c,
    const vect_t a,
    const vect_t b) const [inline]
```

#### 12.106.3.33 maxpyin()

```
template<class _Field>
INLINE vect_t maxpyin (
    vect_t & c,
    const vect_t a,
    const vect_t b) const [inline]
```

### 12.106.4 Field Documentation

#### 12.106.4.1 vect\_size

```
template<class _Field>
const constexpr size_t vect_size = simd::vect_size [static], [constexpr]
```

**12.106.4.2 alignment**

```
template<class _Field>
const constexpr size_t alignment = simd::alignment [static], [constexpr]
The documentation for this class was generated from the following file:
```

- [simd\\_modular.inl](#)

**12.107 FieldTraits< Field > Struct Template Reference**

```
FieldTrait.
#include <field-traits.h>
```

**Public Types**

- typedef [FieldCategories::GenericTag](#) category

**Static Public Attributes**

- static const bool [balanced](#) = false

**12.107.1 Detailed Description**

```
template<class Field>
struct FFLAS::FieldTraits< Field >
```

```
FieldTrait.
```

**12.107.2 Member Typedef Documentation****12.107.2.1 category**

```
template<class Field>
typedef FieldCategories::GenericTag category
```

**12.107.3 Field Documentation****12.107.3.1 balanced**

```
template<class Field>
const bool balanced = false [static]
The documentation for this struct was generated from the following file:
```

- [field-traits.h](#)

**12.108 FieldTraits< FFPACK::RNSInteger< T > > Struct Template Reference**

```
#include <field-traits.h>
```

**Public Types**

- typedef [FieldCategories::UnparametricTag](#) category
- typedef [FieldCategories::GenericTag](#) category

**Static Public Attributes**

- static const bool [balanced](#) = false
- static const bool [balanced](#)

## 12.108.1 Member Typedef Documentation

### 12.108.1.1 category [1/2]

```
template<typename T>
typedef FieldCategories::UnparametricTag category
```

### 12.108.1.2 category [2/2]

```
typedef FieldCategories::GenericTag category
```

## 12.108.2 Field Documentation

### 12.108.2.1 balanced [1/2]

```
template<typename T>
const bool balanced = false [static]
```

### 12.108.2.2 balanced [2/2]

```
const bool balanced [static]
```

The documentation for this struct was generated from the following file:

- [field-traits.h](#)

## 12.109 FieldTraits< FFPACK::RNSIntegerMod< T > > Struct Template Reference

```
#include <field-traits.h>
```

### Public Types

- typedef [FieldCategories::ModularTag](#) category
- typedef [FieldCategories::GenericTag](#) category

### Static Public Attributes

- static const bool [balanced](#) = false
- static const bool [balanced](#)

## 12.109.1 Member Typedef Documentation

### 12.109.1.1 category [1/2]

```
template<typename T>
typedef FieldCategories::ModularTag category
```

### 12.109.1.2 category [2/2]

```
typedef FieldCategories::GenericTag category
```

## 12.109.2 Field Documentation

### 12.109.2.1 balanced [1/2]

```
template<typename T>
const bool balanced = false [static]
```

### 12.109.2.2 balanced [2/2]

```
const bool balanced [static]
```

The documentation for this struct was generated from the following file:

- [field-traits.h](#)

## 12.110 FieldTraits< Givaro::Modular< Element > > Struct Template Reference

```
#include <field-traits.h>
```

### Public Types

- typedef [FieldCategories::ModularTag](#) category
- typedef [FieldCategories::GenericTag](#) category

### Static Public Attributes

- static const bool [balanced](#) = false
- static const bool [balanced](#)

### 12.110.1 Member Typedef Documentation

#### 12.110.1.1 category [1/2]

```
template<class Element>
typedef FieldCategories::ModularTag category
```

#### 12.110.1.2 category [2/2]

```
typedef FieldCategories::GenericTag category
```

### 12.110.2 Field Documentation

#### 12.110.2.1 balanced [1/2]

```
template<class Element>
const bool balanced = false [static]
```

#### 12.110.2.2 balanced [2/2]

```
const bool balanced [static]
```

The documentation for this struct was generated from the following file:

- [field-traits.h](#)

## 12.111 FieldTraits< Givaro::ModularBalanced< Element > > Struct Template Reference

```
#include <field-traits.h>
```

### Public Types

- typedef [FieldCategories::ModularTag](#) category
- typedef [FieldCategories::GenericTag](#) category

**Static Public Attributes**

- static const bool [balanced](#) = true
- static const bool [balanced](#)

**12.111.1 Member Typedef Documentation****12.111.1.1 category [1/2]**

```
template<class Element>
typedef FieldCategories::ModularTag category
```

**12.111.1.2 category [2/2]**

```
typedef FieldCategories::GenericTag category
```

**12.111.2 Field Documentation****12.111.2.1 balanced [1/2]**

```
template<class Element>
const bool balanced = true [static]
```

**12.111.2.2 balanced [2/2]**

```
const bool balanced [static]
```

The documentation for this struct was generated from the following file:

- [field-traits.h](#)

**12.112 FieldTraits< Givaro::ZRing< double > > Struct Reference**

```
#include <field-traits.h>
```

**Public Types**

- typedef [FieldCategories::UnparametricTag](#) category
- typedef [FieldCategories::GenericTag](#) category

**Static Public Attributes**

- static const bool [balanced](#) = false
- static const bool [balanced](#)

**12.112.1 Member Typedef Documentation****12.112.1.1 category [1/2]**

```
typedef FieldCategories::UnparametricTag category
```

**12.112.1.2 category [2/2]**

```
typedef FieldCategories::GenericTag category
```

**12.112.2 Field Documentation****12.112.2.1 balanced [1/2]**

```
const bool balanced = false [static]
```



**12.112.2.2 balanced** [2/2]

```
const bool balanced [static]
```

The documentation for this struct was generated from the following file:

- [field-traits.h](#)

**12.113 FieldTraits< Givaro::ZRing< float > > Struct Reference**

```
#include <field-traits.h>
```

**Public Types**

- typedef [FieldCategories::UnparametricTag](#) category
- typedef [FieldCategories::GenericTag](#) category

**Static Public Attributes**

- static const bool [balanced](#) = false
- static const bool [balanced](#)

**12.113.1 Member Typedef Documentation****12.113.1.1 category** [1/2]

```
typedef FieldCategories::UnparametricTag category
```

**12.113.1.2 category** [2/2]

```
typedef FieldCategories::GenericTag category
```

**12.113.2 Field Documentation****12.113.2.1 balanced** [1/2]

```
const bool balanced = false [static]
```

**12.113.2.2 balanced** [2/2]

```
const bool balanced [static]
```

The documentation for this struct was generated from the following file:

- [field-traits.h](#)

**12.114 FieldTraits< Givaro::ZRing< Givaro::Integer > > Struct Reference**

```
#include <field-traits.h>
```

**Public Types**

- typedef [FieldCategories::UnparametricTag](#) category
- typedef [FieldCategories::GenericTag](#) category

**Static Public Attributes**

- static const bool [balanced](#) = false
- static const bool [balanced](#)

### 12.114.1 Member Typedef Documentation

#### 12.114.1.1 category [1/2]

```
typedef FieldCategories::UnparametricTag category
```

#### 12.114.1.2 category [2/2]

```
typedef FieldCategories::GenericTag category
```

### 12.114.2 Field Documentation

#### 12.114.2.1 balanced [1/2]

```
const bool balanced = false [static]
```

#### 12.114.2.2 balanced [2/2]

```
const bool balanced [static]
```

The documentation for this struct was generated from the following file:

- [field-traits.h](#)

## 12.115 FieldTraits< Givaro::ZRing< int16\_t > > Struct Reference

```
#include <field-traits.h>
```

### Public Types

- typedef [FieldCategories::UnparametricTag](#) category
- typedef [FieldCategories::GenericTag](#) category

### Static Public Attributes

- static const bool [balanced](#) = false
- static const bool [balanced](#)

### 12.115.1 Member Typedef Documentation

#### 12.115.1.1 category [1/2]

```
typedef FieldCategories::UnparametricTag category
```

#### 12.115.1.2 category [2/2]

```
typedef FieldCategories::GenericTag category
```

### 12.115.2 Field Documentation

#### 12.115.2.1 balanced [1/2]

```
const bool balanced = false [static]
```

#### 12.115.2.2 balanced [2/2]

```
const bool balanced [static]
```

The documentation for this struct was generated from the following file:

- [field-traits.h](#)

## 12.116 FieldTraits< Givaro::ZRing< int32\_t > > Struct Reference

```
#include <field-traits.h>
```

### Public Types

- typedef [FieldCategories::UnparametricTag](#) category
- typedef [FieldCategories::GenericTag](#) category

### Static Public Attributes

- static const bool [balanced](#) = false
- static const bool [balanced](#)

### 12.116.1 Member Typedef Documentation

#### 12.116.1.1 category [1/2]

```
typedef FieldCategories::UnparametricTag category
```

#### 12.116.1.2 category [2/2]

```
typedef FieldCategories::GenericTag category
```

### 12.116.2 Field Documentation

#### 12.116.2.1 balanced [1/2]

```
const bool balanced = false [static]
```

#### 12.116.2.2 balanced [2/2]

```
const bool balanced [static]
```

The documentation for this struct was generated from the following file:

- [field-traits.h](#)

## 12.117 FieldTraits< Givaro::ZRing< int64\_t > > Struct Reference

```
#include <field-traits.h>
```

### Public Types

- typedef [FieldCategories::UnparametricTag](#) category
- typedef [FieldCategories::GenericTag](#) category

### Static Public Attributes

- static const bool [balanced](#) = false
- static const bool [balanced](#)

### 12.117.1 Member Typedef Documentation

#### 12.117.1.1 category [1/2]

```
typedef FieldCategories::UnparametricTag category
```

#### 12.117.1.2 category [2/2]

```
typedef FieldCategories::GenericTag category
```

## 12.117.2 Field Documentation

### 12.117.2.1 `balanced` [1/2]

```
const bool balanced = false [static]
```

### 12.117.2.2 `balanced` [2/2]

```
const bool balanced [static]
```

The documentation for this struct was generated from the following file:

- [field-traits.h](#)

## 12.118 `FieldTraits< Givaro::ZRing< RecInt::ruint< K > > >` Struct Template Reference

```
#include <field-traits.h>
```

### Public Types

- typedef [FieldCategories::UnparametricTag](#) `category`
- typedef [FieldCategories::GenericTag](#) `category`

### Static Public Attributes

- static const bool [balanced](#) = false
- static const bool [balanced](#)

## 12.118.1 Member Typedef Documentation

### 12.118.1.1 `category` [1/2]

```
template<size_t K>
typedef FieldCategories::UnparametricTag category
```

### 12.118.1.2 `category` [2/2]

```
typedef FieldCategories::GenericTag category
```

## 12.118.2 Field Documentation

### 12.118.2.1 `balanced` [1/2]

```
template<size_t K>
const bool balanced = false [static]
```

### 12.118.2.2 `balanced` [2/2]

```
const bool balanced [static]
```

The documentation for this struct was generated from the following file:

- [field-traits.h](#)

## 12.119 `FieldTraits< Givaro::ZRing< uint16_t > >` Struct Reference

```
#include <field-traits.h>
```

## Public Types

- typedef [FieldCategories::UnparametricTag](#) category
- typedef [FieldCategories::GenericTag](#) category

## Static Public Attributes

- static const bool [balanced](#) = false
- static const bool [balanced](#)

## 12.119.1 Member Typedef Documentation

### 12.119.1.1 category [1/2]

```
typedef FieldCategories::UnparametricTag category
```

### 12.119.1.2 category [2/2]

```
typedef FieldCategories::GenericTag category
```

## 12.119.2 Field Documentation

### 12.119.2.1 balanced [1/2]

```
const bool balanced = false [static]
```

### 12.119.2.2 balanced [2/2]

```
const bool balanced [static]
```

The documentation for this struct was generated from the following file:

- [field-traits.h](#)

## 12.120 FieldTraits< Givaro::ZRing< uint32\_t > > Struct Reference

```
#include <field-traits.h>
```

## Public Types

- typedef [FieldCategories::UnparametricTag](#) category
- typedef [FieldCategories::GenericTag](#) category

## Static Public Attributes

- static const bool [balanced](#) = false
- static const bool [balanced](#)

## 12.120.1 Member Typedef Documentation

### 12.120.1.1 category [1/2]

```
typedef FieldCategories::UnparametricTag category
```

### 12.120.1.2 category [2/2]

```
typedef FieldCategories::GenericTag category
```

## 12.120.2 Field Documentation

### 12.120.2.1 `balanced` [1/2]

```
const bool balanced = false [static]
```

### 12.120.2.2 `balanced` [2/2]

```
const bool balanced [static]
```

The documentation for this struct was generated from the following file:

- [field-traits.h](#)

## 12.121 `FieldTraits< Givaro::ZRing< uint64_t > >` Struct Reference

```
#include <field-traits.h>
```

### Public Types

- typedef [FieldCategories::UnparametricTag](#) `category`
- typedef [FieldCategories::GenericTag](#) `category`

### Static Public Attributes

- static const bool [balanced](#) = false
- static const bool [balanced](#)

## 12.121.1 Member Typedef Documentation

### 12.121.1.1 `category` [1/2]

```
typedef FieldCategories::UnparametricTag category
```

### 12.121.1.2 `category` [2/2]

```
typedef FieldCategories::GenericTag category
```

## 12.121.2 Field Documentation

### 12.121.2.1 `balanced` [1/2]

```
const bool balanced = false [static]
```

### 12.121.2.2 `balanced` [2/2]

```
const bool balanced [static]
```

The documentation for this struct was generated from the following file:

- [field-traits.h](#)

## 12.122 Fixed Struct Reference

The documentation for this struct was generated from the following file:

- [blockcuts.inl](#)

## 12.123 `FixedPrecIntTag` Struct Reference

Fixed precision integers above machine precision: `Givaro::reclnt`.

```
#include <field-traits.h>
```

### 12.123.1 Detailed Description

Fixed precision integers above machine precision: Givaro::reclnt.  
The documentation for this struct was generated from the following file:

- [field-traits.h](#)

## 12.124 ScalFunctionsBase< Element, typename enable\_if< is\_floating\_point< Element >::value >::type >::FloatingPointTestDistribution Class Reference

### Public Types

- using [IntType](#) = typename make\_unsigned\_int<Element>::type

### Public Member Functions

- [FloatingPointTestDistribution](#) ()
- template<class Generator>  
Element [operator\(\)](#) (Generator &g)

### 12.124.1 Member Typedef Documentation

#### 12.124.1.1 IntType

```
template<typename Element>
using IntType = typename make_unsigned_int<Element>::type
```

### 12.124.2 Constructor & Destructor Documentation

#### 12.124.2.1 FloatingPointTestDistribution()

```
template<typename Element>
FloatingPointTestDistribution () [inline]
```

### 12.124.3 Member Function Documentation

#### 12.124.3.1 operator()()

```
template<typename Element>
template<class Generator>
Element operator() (
    Generator & g) [inline]
```

The documentation for this class was generated from the following file:

- [test-simd.C](#)

## 12.125 ForStrategy1D< blocksize\_t, Cut, Param > Struct Template Reference

### Public Member Functions

- [ForStrategy1D](#) (const blocksize\_t n, const [ParSeqHelper::Parallel](#)< Cut, Param > H)
- [ForStrategy1D](#) (const blocksize\_t b, const blocksize\_t e, const [ParSeqHelper::Parallel](#)< Cut, Param > H)
- void [build](#) (const blocksize\_t n, const [ParSeqHelper::Parallel](#)< Cut, Param > H)
- blocksize\_t [initialize](#) ()
- bool [isTerminated](#) () const
- blocksize\_t [begin](#) () const

- `blocksize_t end () const`
- `blocksize_t numblocks () const`
- `blocksize_t blockindex () const`
- `blocksize_t operator++ ()`

### Protected Attributes

- `blocksize_t ibeg`
- `blocksize_t iend`
- `blocksize_t current`
- `blocksize_t firstBlockSize`
- `blocksize_t lastBlockSize`
- `blocksize_t changeBS`
- `blocksize_t numBlock`

## 12.125.1 Constructor & Destructor Documentation

### 12.125.1.1 ForStrategy1D() [1/2]

```
template<typename blocksize_t = size_t, typename Cut = CuttingStrategy::Block, typename Param
= StrategyParameter::Threads>
ForStrategy1D (
    const blocksize_t n,
    const ParSeqHelper::Parallel< Cut, Param > H) [inline]
```

### 12.125.1.2 ForStrategy1D() [2/2]

```
template<typename blocksize_t = size_t, typename Cut = CuttingStrategy::Block, typename Param
= StrategyParameter::Threads>
ForStrategy1D (
    const blocksize_t b,
    const blocksize_t e,
    const ParSeqHelper::Parallel< Cut, Param > H) [inline]
```

## 12.125.2 Member Function Documentation

### 12.125.2.1 build()

```
template<typename blocksize_t = size_t, typename Cut = CuttingStrategy::Block, typename Param
= StrategyParameter::Threads>
void build (
    const blocksize_t n,
    const ParSeqHelper::Parallel< Cut, Param > H) [inline]
```

### 12.125.2.2 initialize()

```
template<typename blocksize_t = size_t, typename Cut = CuttingStrategy::Block, typename Param
= StrategyParameter::Threads>
blocksize_t initialize () [inline]
```

### 12.125.2.3 isTerminated()

```
template<typename blocksize_t = size_t, typename Cut = CuttingStrategy::Block, typename Param
= StrategyParameter::Threads>
bool isTerminated () const [inline]
```



#### 12.125.2.4 begin()

```
template<typename blocksize_t = size_t, typename Cut = CuttingStrategy::Block, typename Param
= StrategyParameter::Threads>
blocksize_t begin () const [inline]
```

#### 12.125.2.5 end()

```
template<typename blocksize_t = size_t, typename Cut = CuttingStrategy::Block, typename Param
= StrategyParameter::Threads>
blocksize_t end () const [inline]
```

#### 12.125.2.6 numblocks()

```
template<typename blocksize_t = size_t, typename Cut = CuttingStrategy::Block, typename Param
= StrategyParameter::Threads>
blocksize_t numblocks () const [inline]
```

#### 12.125.2.7 blockindex()

```
template<typename blocksize_t = size_t, typename Cut = CuttingStrategy::Block, typename Param
= StrategyParameter::Threads>
blocksize_t blockindex () const [inline]
```

#### 12.125.2.8 operator++()

```
template<typename blocksize_t = size_t, typename Cut = CuttingStrategy::Block, typename Param
= StrategyParameter::Threads>
blocksize_t operator++ () [inline]
```

### 12.125.3 Field Documentation

#### 12.125.3.1 ibeg

```
template<typename blocksize_t = size_t, typename Cut = CuttingStrategy::Block, typename Param
= StrategyParameter::Threads>
blocksize_t ibeg [protected]
```

#### 12.125.3.2 iend

```
template<typename blocksize_t = size_t, typename Cut = CuttingStrategy::Block, typename Param
= StrategyParameter::Threads>
blocksize_t iend [protected]
```

#### 12.125.3.3 current

```
template<typename blocksize_t = size_t, typename Cut = CuttingStrategy::Block, typename Param
= StrategyParameter::Threads>
blocksize_t current [protected]
```

#### 12.125.3.4 firstBlockSize

```
template<typename blocksize_t = size_t, typename Cut = CuttingStrategy::Block, typename Param
= StrategyParameter::Threads>
blocksize_t firstBlockSize [protected]
```

#### 12.125.3.5 lastBlockSize

```
template<typename blocksize_t = size_t, typename Cut = CuttingStrategy::Block, typename Param
= StrategyParameter::Threads>
blocksize_t lastBlockSize [protected]
```

### 12.125.3.6 changeBS

```
template<typename blocksize_t = size_t, typename Cut = CuttingStrategy::Block, typename Param
= StrategyParameter::Threads>
blocksize_t changeBS [protected]
```

### 12.125.3.7 numBlock

```
template<typename blocksize_t = size_t, typename Cut = CuttingStrategy::Block, typename Param
= StrategyParameter::Threads>
blocksize_t numBlock [protected]
```

The documentation for this struct was generated from the following file:

- [blockcuts.inl](#)

## 12.126 ForStrategy2D< blocksize\_t, Cut, Param > Struct Template Reference

### Public Member Functions

- [ForStrategy2D](#) (const blocksize\_t m, const blocksize\_t n, const [ParSeqHelper::Parallel](#)< Cut, Param > H)
- blocksize\_t [initialize](#) ()
- bool [isTerminated](#) () const
- blocksize\_t [ibegin](#) () const
- blocksize\_t [jbegin](#) () const
- blocksize\_t [iend](#) () const
- blocksize\_t [jend](#) () const
- blocksize\_t [operator++](#) ()
- blocksize\_t [rownumblocks](#) () const
- blocksize\_t [colnumblocks](#) () const
- blocksize\_t [blockindex](#) () const
- blocksize\_t [rowblockindex](#) () const
- blocksize\_t [colblockindex](#) () const

### Protected Attributes

- blocksize\_t [\\_ibeg](#)
- blocksize\_t [\\_iend](#)
- blocksize\_t [\\_jbeg](#)
- blocksize\_t [\\_jend](#)
- blocksize\_t [rowBlockSize](#)
- blocksize\_t [colBlockSize](#)
- blocksize\_t [current](#)
- blocksize\_t [lastRBS](#)
- blocksize\_t [lastCBS](#)
- blocksize\_t [changeRBS](#)
- blocksize\_t [changeCBS](#)
- blocksize\_t [numRowBlock](#)
- blocksize\_t [numColBlock](#)
- blocksize\_t [BLOCKS](#)

### Friends

- std::ostream & [operator<<](#) (std::ostream &out, const [ForStrategy2D](#) &FS2D)

## 12.126.1 Constructor & Destructor Documentation

### 12.126.1.1 ForStrategy2D()

```
template<typename blocksize_t = size_t, typename Cut = CuttingStrategy::Block, typename Param
= StrategyParameter::Threads>
ForStrategy2D (
    const blocksize_t m,
    const blocksize_t n,
    const ParSeqHelper::Parallel< Cut, Param > H) [inline]
```

## 12.126.2 Member Function Documentation

### 12.126.2.1 initialize()

```
template<typename blocksize_t = size_t, typename Cut = CuttingStrategy::Block, typename Param
= StrategyParameter::Threads>
blocksize_t initialize () [inline]
```

### 12.126.2.2 isTerminated()

```
template<typename blocksize_t = size_t, typename Cut = CuttingStrategy::Block, typename Param
= StrategyParameter::Threads>
bool isTerminated () const [inline]
```

### 12.126.2.3 ibegin()

```
template<typename blocksize_t = size_t, typename Cut = CuttingStrategy::Block, typename Param
= StrategyParameter::Threads>
blocksize_t ibegin () const [inline]
```

### 12.126.2.4 jbegin()

```
template<typename blocksize_t = size_t, typename Cut = CuttingStrategy::Block, typename Param
= StrategyParameter::Threads>
blocksize_t jbegin () const [inline]
```

### 12.126.2.5 iend()

```
template<typename blocksize_t = size_t, typename Cut = CuttingStrategy::Block, typename Param
= StrategyParameter::Threads>
blocksize_t iend () const [inline]
```

### 12.126.2.6 jend()

```
template<typename blocksize_t = size_t, typename Cut = CuttingStrategy::Block, typename Param
= StrategyParameter::Threads>
blocksize_t jend () const [inline]
```

### 12.126.2.7 operator++()

```
template<typename blocksize_t = size_t, typename Cut = CuttingStrategy::Block, typename Param
= StrategyParameter::Threads>
blocksize_t operator++ () [inline]
```

### 12.126.2.8 rownumblocks()

```
template<typename blocksize_t = size_t, typename Cut = CuttingStrategy::Block, typename Param
= StrategyParameter::Threads>
blocksize_t rownumblocks () const [inline]
```

**12.126.2.9 colnumblocks()**

```
template<typename blocksize_t = size_t, typename Cut = CuttingStrategy::Block, typename Param
= StrategyParameter::Threads>
blocksize_t colnumblocks () const [inline]
```

**12.126.2.10 blockindex()**

```
template<typename blocksize_t = size_t, typename Cut = CuttingStrategy::Block, typename Param
= StrategyParameter::Threads>
blocksize_t blockindex () const [inline]
```

**12.126.2.11 rowblockindex()**

```
template<typename blocksize_t = size_t, typename Cut = CuttingStrategy::Block, typename Param
= StrategyParameter::Threads>
blocksize_t rowblockindex () const [inline]
```

**12.126.2.12 colblockindex()**

```
template<typename blocksize_t = size_t, typename Cut = CuttingStrategy::Block, typename Param
= StrategyParameter::Threads>
blocksize_t colblockindex () const [inline]
```

**12.126.3 Friends And Related Symbol Documentation****12.126.3.1 operator<<**

```
template<typename blocksize_t = size_t, typename Cut = CuttingStrategy::Block, typename Param
= StrategyParameter::Threads>
std::ostream & operator<< (
    std::ostream & out,
    const ForStrategy2D< blocksize_t, Cut, Param > & FS2D) [friend]
```

**12.126.4 Field Documentation****12.126.4.1 \_ibeg**

```
template<typename blocksize_t = size_t, typename Cut = CuttingStrategy::Block, typename Param
= StrategyParameter::Threads>
blocksize_t _ibeg [protected]
```

**12.126.4.2 \_iend**

```
template<typename blocksize_t = size_t, typename Cut = CuttingStrategy::Block, typename Param
= StrategyParameter::Threads>
blocksize_t _iend [protected]
```

**12.126.4.3 \_jbeg**

```
template<typename blocksize_t = size_t, typename Cut = CuttingStrategy::Block, typename Param
= StrategyParameter::Threads>
blocksize_t _jbeg [protected]
```

**12.126.4.4 \_jend**

```
template<typename blocksize_t = size_t, typename Cut = CuttingStrategy::Block, typename Param
= StrategyParameter::Threads>
blocksize_t _jend [protected]
```

**12.126.4.5 rowBlockSize**

```
template<typename blocksize_t = size_t, typename Cut = CuttingStrategy::Block, typename Param
= StrategyParameter::Threads>
blocksize_t rowBlockSize [protected]
```

**12.126.4.6 colBlockSize**

```
template<typename blocksize_t = size_t, typename Cut = CuttingStrategy::Block, typename Param
= StrategyParameter::Threads>
blocksize_t colBlockSize [protected]
```

**12.126.4.7 current**

```
template<typename blocksize_t = size_t, typename Cut = CuttingStrategy::Block, typename Param
= StrategyParameter::Threads>
blocksize_t current [protected]
```

**12.126.4.8 lastRBS**

```
template<typename blocksize_t = size_t, typename Cut = CuttingStrategy::Block, typename Param
= StrategyParameter::Threads>
blocksize_t lastRBS [protected]
```

**12.126.4.9 lastCBS**

```
template<typename blocksize_t = size_t, typename Cut = CuttingStrategy::Block, typename Param
= StrategyParameter::Threads>
blocksize_t lastCBS [protected]
```

**12.126.4.10 changeRBS**

```
template<typename blocksize_t = size_t, typename Cut = CuttingStrategy::Block, typename Param
= StrategyParameter::Threads>
blocksize_t changeRBS [protected]
```

**12.126.4.11 changeCBS**

```
template<typename blocksize_t = size_t, typename Cut = CuttingStrategy::Block, typename Param
= StrategyParameter::Threads>
blocksize_t changeCBS [protected]
```

**12.126.4.12 numRowsBlock**

```
template<typename blocksize_t = size_t, typename Cut = CuttingStrategy::Block, typename Param
= StrategyParameter::Threads>
blocksize_t numRowsBlock [protected]
```

**12.126.4.13 numColBlock**

```
template<typename blocksize_t = size_t, typename Cut = CuttingStrategy::Block, typename Param
= StrategyParameter::Threads>
blocksize_t numColBlock [protected]
```

**12.126.4.14 BLOCKS**

```
template<typename blocksize_t = size_t, typename Cut = CuttingStrategy::Block, typename Param
= StrategyParameter::Threads>
blocksize_t BLOCKS [protected]
```

The documentation for this struct was generated from the following file:

- [blockcuts.inl](#)

### 12.127 **ftrmmLeftLowerNoTransNonUnit**< **Element** > **Class Template Reference**

The documentation for this class was generated from the following file:

- [fflas\\_level3.inl](#)

### 12.128 **ftrmmLeftLowerNoTransUnit**< **Element** > **Class Template Reference**

The documentation for this class was generated from the following file:

- [fflas\\_level3.inl](#)

### 12.129 **ftrmmLeftLowerTransNonUnit**< **Element** > **Class Template Reference**

The documentation for this class was generated from the following file:

- [fflas\\_level3.inl](#)

### 12.130 **ftrmmLeftLowerTransUnit**< **Element** > **Class Template Reference**

The documentation for this class was generated from the following file:

- [fflas\\_level3.inl](#)

### 12.131 **ftrmmLeftUpperNoTransNonUnit**< **Element** > **Class Template Reference**

The documentation for this class was generated from the following file:

- [fflas\\_level3.inl](#)

### 12.132 **ftrmmLeftUpperNoTransUnit**< **Element** > **Class Template Reference**

The documentation for this class was generated from the following file:

- [fflas\\_level3.inl](#)

### 12.133 **ftrmmLeftUpperTransNonUnit**< **Element** > **Class Template Reference**

The documentation for this class was generated from the following file:

- [fflas\\_level3.inl](#)

## 12.134 ftrmmLeftUpperTransUnit< Element > Class Template Reference

The documentation for this class was generated from the following file:

- [fflas\\_level3.inl](#)

## 12.135 ftrmmRightLowerNoTransNonUnit< Element > Class Template Reference

The documentation for this class was generated from the following file:

- [fflas\\_level3.inl](#)

## 12.136 ftrmmRightLowerNoTransUnit< Element > Class Template Reference

The documentation for this class was generated from the following file:

- [fflas\\_level3.inl](#)

## 12.137 ftrmmRightLowerTransNonUnit< Element > Class Template Reference

The documentation for this class was generated from the following file:

- [fflas\\_level3.inl](#)

## 12.138 ftrmmRightLowerTransUnit< Element > Class Template Reference

The documentation for this class was generated from the following file:

- [fflas\\_level3.inl](#)

## 12.139 ftrmmRightUpperNoTransNonUnit< Element > Class Template Reference

The documentation for this class was generated from the following file:

- [fflas\\_level3.inl](#)

## 12.140 ftrmmRightUpperNoTransUnit< Element > Class Template Reference

The documentation for this class was generated from the following file:

- [fflas\\_level3.inl](#)

## 12.141 ftrmmRightUpperTransNonUnit< Element > Class Template Reference

The documentation for this class was generated from the following file:

- [fflas\\_level3.inl](#)

## 12.142 `ftrmmRightUpperTransUnit< Element >` Class Template Reference

The documentation for this class was generated from the following file:

- [fflas\\_level3.inl](#)

## 12.143 `ftrsmLeftLowerNoTransNonUnit< Element >` Class Template Reference

The documentation for this class was generated from the following file:

- [fflas\\_level3.inl](#)

## 12.144 `ftrsmLeftLowerNoTransUnit< Element >` Class Template Reference

The documentation for this class was generated from the following file:

- [fflas\\_level3.inl](#)

## 12.145 `ftrsmLeftLowerTransNonUnit< Element >` Class Template Reference

The documentation for this class was generated from the following file:

- [fflas\\_level3.inl](#)

## 12.146 `ftrsmLeftLowerTransUnit< Element >` Class Template Reference

The documentation for this class was generated from the following file:

- [fflas\\_level3.inl](#)

## 12.147 `ftrsmLeftUpperNoTransNonUnit< Element >` Class Template Reference

Computes the maximal size for delaying the modular reduction in a triangular system resolution.

### 12.147.1 Detailed Description

```
template<class Element>
```

```
class FFLAS::Protected::ftrsmLeftUpperNoTransNonUnit< Element >
```

Computes the maximal size for delaying the modular reduction in a triangular system resolution.

Compute the maximal dimension  $k$ , such that a unit diagonal triangular system of dimension  $k$  can be solved over  $Z$  without overflow of the underlying floating point representation.

**Bibliography** • Dumas, Giorgi, Pernet 06, arXiv:cs/0601133.

Parameters

$F$	Finite Field/Ring of the computation
-----	--------------------------------------

The documentation for this class was generated from the following file:

- [fflas\\_level3.inl](#)



## 12.148 ftrsmLeftUpperNoTransUnit< Element > Class Template Reference

The documentation for this class was generated from the following file:

- [fflas\\_level3.inl](#)

## 12.149 ftrsmLeftUpperTransNonUnit< Element > Class Template Reference

The documentation for this class was generated from the following file:

- [fflas\\_level3.inl](#)

## 12.150 ftrsmLeftUpperTransUnit< Element > Class Template Reference

The documentation for this class was generated from the following file:

- [fflas\\_level3.inl](#)

## 12.151 ftrsmRightLowerNoTransNonUnit< Element > Class Template Reference

The documentation for this class was generated from the following file:

- [fflas\\_level3.inl](#)

## 12.152 ftrsmRightLowerNoTransUnit< Element > Class Template Reference

The documentation for this class was generated from the following file:

- [fflas\\_level3.inl](#)

## 12.153 ftrsmRightLowerTransNonUnit< Element > Class Template Reference

The documentation for this class was generated from the following file:

- [fflas\\_level3.inl](#)

## 12.154 ftrsmRightLowerTransUnit< Element > Class Template Reference

The documentation for this class was generated from the following file:

- [fflas\\_level3.inl](#)

## 12.155 ftrsmRightUpperNoTransNonUnit< Element > Class Template Reference

The documentation for this class was generated from the following file:

- [fflas\\_level3.inl](#)

## 12.156 `ftrsmRightUpperNoTransUnit< Element >` Class Template Reference

The documentation for this class was generated from the following file:

- [fflas\\_level3.inl](#)

## 12.157 `ftrsmRightUpperTransNonUnit< Element >` Class Template Reference

The documentation for this class was generated from the following file:

- [fflas\\_level3.inl](#)

## 12.158 `ftrsmRightUpperTransUnit< Element >` Class Template Reference

The documentation for this class was generated from the following file:

- [fflas\\_level3.inl](#)

## 12.159 GenericTag Struct Reference

default is generic

```
#include <field-traits.h>
```

### 12.159.1 Detailed Description

default is generic

The documentation for this struct was generated from the following file:

- [field-traits.h](#)

## 12.160 GenericTag Struct Reference

generic ring.

```
#include <field-traits.h>
```

### 12.160.1 Detailed Description

generic ring.

The documentation for this struct was generated from the following file:

- [field-traits.h](#)

## 12.161 Grain Struct Reference

The documentation for this struct was generated from the following file:

- [blockcuts.inl](#)

## 12.162 `has_minus_eq_impl< C >` Struct Template Reference

```
#include <sparse_matrix_traits.h>
```

**Static Public Attributes**

- static constexpr bool [value](#) = type::value

**12.162.1 Field Documentation****12.162.1.1 value**

```
template<typename C>
bool value = type::value [static], [constexpr]
```

The documentation for this struct was generated from the following file:

- [sparse\\_matrix\\_traits.h](#)

**12.163 has\_minus\_impl< C > Struct Template Reference**

```
#include <sparse_matrix_traits.h>
```

**Static Public Attributes**

- static constexpr bool [value](#) = type::value

**12.163.1 Field Documentation****12.163.1.1 value**

```
template<typename C>
bool value = type::value [static], [constexpr]
```

The documentation for this struct was generated from the following file:

- [sparse\\_matrix\\_traits.h](#)

**12.164 has\_mul\_eq\_impl< C > Struct Template Reference**

```
#include <sparse_matrix_traits.h>
```

**Static Public Attributes**

- static constexpr bool [value](#) = type::value

**12.164.1 Field Documentation****12.164.1.1 value**

```
template<typename C>
bool value = type::value [static], [constexpr]
```

The documentation for this struct was generated from the following file:

- [sparse\\_matrix\\_traits.h](#)

**12.165 has\_mul\_impl< C > Struct Template Reference**

```
#include <sparse_matrix_traits.h>
```

**Static Public Attributes**

- static constexpr bool [value](#) = type::value

## 12.165.1 Field Documentation

### 12.165.1.1 value

```
template<typename C>
bool value = type::value [static], [constexpr]
```

The documentation for this struct was generated from the following file:

- [sparse\\_matrix\\_traits.h](#)

## 12.166 has\_operation< T > Struct Template Reference

```
#include <sparse_matrix_traits.h>
```

### Static Public Attributes

- static constexpr bool [value](#)

## 12.166.1 Field Documentation

### 12.166.1.1 value

```
template<class T>
bool value [static], [constexpr]
```

#### Initial value:

```
= (has_plus<T>::value && has_minus<T>::value && has_equal<T>::value &&
    has_plus_eq<T>::value && has_minus_eq<T>::value && has_mul<T>::value
    && has_mul_eq<T>::value)
```

The documentation for this struct was generated from the following file:

- [sparse\\_matrix\\_traits.h](#)

## 12.167 has\_plus\_eq\_impl< C > Struct Template Reference

```
#include <sparse_matrix_traits.h>
```

### Static Public Attributes

- static constexpr bool [value](#) = type::value

## 12.167.1 Field Documentation

### 12.167.1.1 value

```
template<typename C>
bool value = type::value [static], [constexpr]
```

The documentation for this struct was generated from the following file:

- [sparse\\_matrix\\_traits.h](#)

## 12.168 has\_plus\_impl< C > Struct Template Reference

```
#include <sparse_matrix_traits.h>
```

### Static Public Attributes

- static constexpr bool [value](#) = type::value

## 12.168.1 Field Documentation

### 12.168.1.1 value

```
template<typename C>
```

```
bool value = type::value [static], [constexpr]
```

The documentation for this struct was generated from the following file:

- [sparse\\_matrix\\_traits.h](#)

## 12.169 HelperFlag Struct Reference

```
#include <fflas_sparse.h>
```

### Static Public Attributes

- static constexpr uint64\_t [none](#) = 0\_ui64
- static constexpr uint64\_t [coo](#) = 1\_ui64
- static constexpr uint64\_t [csr](#) = 1\_ui64 << 1
- static constexpr uint64\_t [ell](#) = 1\_ui64 << 2
- static constexpr uint64\_t [aut](#) = 1\_ui64 << 32
- static constexpr uint64\_t [pm1](#) = 1\_ui64 << 33

## 12.169.1 Field Documentation

### 12.169.1.1 none

```
uint64_t none = 0_ui64 [static], [constexpr]
```

### 12.169.1.2 coo

```
uint64_t coo = 1_ui64 [static], [constexpr]
```

### 12.169.1.3 csr

```
uint64_t csr = 1_ui64 << 1 [static], [constexpr]
```

### 12.169.1.4 ell

```
uint64_t ell = 1_ui64 << 2 [static], [constexpr]
```

### 12.169.1.5 aut

```
uint64_t aut = 1_ui64 << 32 [static], [constexpr]
```

### 12.169.1.6 pm1

```
uint64_t pm1 = 1_ui64 << 33 [static], [constexpr]
```

The documentation for this struct was generated from the following file:

- [fflas\\_sparse.h](#)

## 12.170 HelperMod< Field, ElementTraits > Struct Template Reference

The documentation for this struct was generated from the following file:

- [fflas\\_freduce.inl](#)

## 12.171 HelperMod< Field, ElementCategories::MachineIntTag > Struct Template Reference

### Public Member Functions

- [HelperMod \(\)](#)
- [HelperMod \(const \[Field\]\(#\) &F\)](#)

### Data Fields

- [Field::Element p](#)
- double [invp](#)
- double [min](#)
- double [max](#)
- int64\_t [pow50rem](#)

### 12.171.1 Constructor & Destructor Documentation

#### 12.171.1.1 HelperMod() [1/2]

```
template<class Field>
HelperMod () [inline]
```

#### 12.171.1.2 HelperMod() [2/2]

```
template<class Field>
HelperMod (
    const Field & F) [inline]
```

### 12.171.2 Field Documentation

#### 12.171.2.1 p

```
template<class Field>
Field::Element p
```

#### 12.171.2.2 invp

```
template<class Field>
double invp
```

#### 12.171.2.3 min

```
template<class Field>
double min
```

#### 12.171.2.4 max

```
template<class Field>
double max
```

#### 12.171.2.5 pow50rem

```
template<class Field>
int64_t pow50rem
```

The documentation for this struct was generated from the following file:

- [fflas\\_freduce.inl](#)

## 12.172 HelperMod< Field, FFLAS::ElementCategories::ArbitraryPrecIntTag > Struct Template Reference

### Public Member Functions

- [HelperMod \(\)](#)
- [HelperMod \(const \[Field\]\(#\) &F\)](#)

### Data Fields

- [Field::Element p](#)

### 12.172.1 Constructor & Destructor Documentation

#### 12.172.1.1 HelperMod() [1/2]

```
template<class Field>
HelperMod () [inline]
```

#### 12.172.1.2 HelperMod() [2/2]

```
template<class Field>
HelperMod (
    const Field & F) [inline]
```

### 12.172.2 Field Documentation

#### 12.172.2.1 p

```
template<class Field>
Field::Element p
```

The documentation for this struct was generated from the following file:

- [fflas\\_freduce.inl](#)

## 12.173 HelperMod< Field, FFLAS::ElementCategories::FixedPrecIntTag > Struct Template Reference

### Public Member Functions

- [HelperMod \(\)](#)
- [HelperMod \(const \[Field\]\(#\) &F\)](#)

### Data Fields

- [Field::Element p](#)

### 12.173.1 Constructor & Destructor Documentation

#### 12.173.1.1 HelperMod() [1/2]

```
template<class Field>
HelperMod () [inline]
```

#### 12.173.1.2 HelperMod() [2/2]

```
template<class Field>
HelperMod (
    const Field & F) [inline]
```

## 12.173.2 Field Documentation

### 12.173.2.1 p

```
template<class Field>
Field::Element p
```

The documentation for this struct was generated from the following file:

- [fflas\\_freduce.inl](#)

## 12.174 HelperMod< Field, FFLAS::ElementCategories::MachineFloatTag > Struct Template Reference

### Public Member Functions

- [HelperMod](#) ()
- [HelperMod](#) (const [Field](#) &F)

### Data Fields

- [Field::Element](#) p
- [Field::Element](#) invp
- [Field::Element](#) min
- [Field::Element](#) max

## 12.174.1 Constructor & Destructor Documentation

### 12.174.1.1 HelperMod() [1/2]

```
template<class Field>
HelperMod () [inline]
```

### 12.174.1.2 HelperMod() [2/2]

```
template<class Field>
HelperMod (
    const Field & F) [inline]
```

## 12.174.2 Field Documentation

### 12.174.2.1 p

```
template<class Field>
Field::Element p
```

### 12.174.2.2 invp

```
template<class Field>
Field::Element invp
```

### 12.174.2.3 min

```
template<class Field>
Field::Element min
```

### 12.174.2.4 max

```
template<class Field>
Field::Element max
```

The documentation for this struct was generated from the following file:

- [fflas\\_freduce.inl](#)



## 12.175 Hybrid Struct Reference

The documentation for this struct was generated from the following file:

- [fflas\\_helpers.inl](#)

## 12.176 Info Struct Reference

### Public Member Functions

- [Info](#) (uint64\_t it, uint64\_t s, uint64\_t p)
- [Info](#) ()=default
- [Info](#) (const [Info](#) &)=default
- [Info](#) ([Info](#) &&)=default
- [Info](#) & [operator=](#) (const [Info](#) &)=default
- [Info](#) & [operator=](#) ([Info](#) &&)=default

### Data Fields

- uint64\_t [size](#) = 0
- uint64\_t [perm](#) = 0
- uint64\_t [begin](#) = 0

### 12.176.1 Constructor & Destructor Documentation

#### 12.176.1.1 Info() [1/4]

```
Info (
    uint64_t it,
    uint64_t s,
    uint64_t p) [inline]
```

#### 12.176.1.2 Info() [2/4]

```
Info () [default]
```

#### 12.176.1.3 Info() [3/4]

```
Info (
    const Info & ) [default]
```

#### 12.176.1.4 Info() [4/4]

```
Info (
    Info && ) [default]
```

### 12.176.2 Member Function Documentation

#### 12.176.2.1 operator=() [1/2]

```
Info & operator= (
    const Info & ) [default]
```

#### 12.176.2.2 operator=() [2/2]

```
Info & operator= (
    Info && ) [default]
```

### 12.176.3 Field Documentation

#### 12.176.3.1 size

`uint64_t size = 0`

#### 12.176.3.2 perm

`uint64_t perm = 0`

#### 12.176.3.3 begin

`uint64_t begin = 0`

The documentation for this struct was generated from the following file:

- [csr\\_hyb\\_utils.inl](#)

## 12.177 Info Struct Reference

### Public Member Functions

- [Info](#) ([uint64\\_t](#) it, [uint64\\_t](#) s, [uint64\\_t](#) p)
- [Info](#) ()=default
- [Info](#) (const [Info](#) &)=default
- [Info](#) ([Info](#) &&)=default
- [Info](#) & [operator=](#) (const [Info](#) &)=default
- [Info](#) & [operator=](#) ([Info](#) &&)=default

### Data Fields

- [uint64\\_t](#) [size](#) = 0
- [uint64\\_t](#) [perm](#) = 0
- [uint64\\_t](#) [begin](#) = 0

### 12.177.1 Constructor & Destructor Documentation

#### 12.177.1.1 Info() [1/4]

```
Info (
    uint64_t it,
    uint64_t s,
    uint64_t p) [inline]
```

#### 12.177.1.2 Info() [2/4]

```
Info () [default]
```

#### 12.177.1.3 Info() [3/4]

```
Info (
    const Info & ) [default]
```

#### 12.177.1.4 Info() [4/4]

```
Info (
    Info && ) [default]
```

## 12.177.2 Member Function Documentation

### 12.177.2.1 operator=() [1/2]

`Info` & operator= (   
                   const `Info` & ) [default]

### 12.177.2.2 operator=() [2/2]

`Info` & operator= (   
                   `Info` && ) [default]

## 12.177.3 Field Documentation

### 12.177.3.1 size

`uint64_t` size = 0

### 12.177.3.2 perm

`uint64_t` perm = 0

### 12.177.3.3 begin

`uint64_t` begin = 0

The documentation for this struct was generated from the following file:

- [sell\\_utils.inl](#)

## 12.178 is\_all\_same< Args > Struct Template Reference

The documentation for this struct was generated from the following file:

- [test-simd.C](#)

## 12.179 is\_all\_same< T, Args... > Struct Template Reference

### Static Public Attributes

- static constexpr bool `value` = `ALL`<std::is\_same<typename decay<T>::type, typename decay<Args>::type>::value...>::value

## 12.179.1 Field Documentation

### 12.179.1.1 value

template<typename T, typename... Args>  
 bool value = `ALL`<std::is\_same<typename decay<T>::type, typename decay<Args>::type>::value...>↵  
 ::value [static], [constexpr]

The documentation for this struct was generated from the following file:

- [test-simd.C](#)

## 12.180 is\_all\_same<> Struct Reference

### Static Public Attributes

- static constexpr bool `value` = true

### 12.180.1 Field Documentation

#### 12.180.1.1 value

```
bool value = true [static], [constexpr]
```

The documentation for this struct was generated from the following file:

- [test-simd.C](#)

## 12.181 is\_simd< T > Struct Template Reference

```
#include <fflas_simd.h>
```

### Public Types

- using [type](#) = std::integral\_constant<bool, false>

### Static Public Attributes

- static const constexpr bool [value](#) = false

### 12.181.1 Member Typedef Documentation

#### 12.181.1.1 type

```
template<class T>
```

```
using type = std::integral_constant<bool, false>
```

### 12.181.2 Field Documentation

#### 12.181.2.1 value

```
template<class T>
```

```
const constexpr bool value = false [static], [constexpr]
```

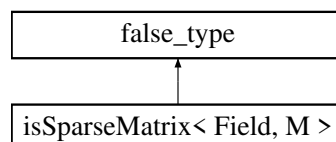
The documentation for this struct was generated from the following file:

- [fflas\\_simd.h](#)

## 12.182 isSparseMatrix< Field, M > Struct Template Reference

```
#include <sparse_matrix_traits.h>
```

Inheritance diagram for isSparseMatrix< Field, M >:



The documentation for this struct was generated from the following file:

- [sparse\\_matrix\\_traits.h](#)

## 12.183 isSparseMatrix< Field, Sparse< Field, SparseMatrix\_t::COO > > Struct Template Reference

```
#include <sparse_matrix_traits.h>
```

Inheritance diagram for isSparseMatrix< Field, Sparse< Field, SparseMatrix\_t::COO > >:



The documentation for this struct was generated from the following file:

- [sparse\\_matrix\\_traits.h](#)

## 12.184 isSparseMatrix< Field, Sparse< Field, SparseMatrix\_t::COO\_ZO > > Struct Template Reference

```
#include <sparse_matrix_traits.h>
```

Inheritance diagram for isSparseMatrix< Field, Sparse< Field, SparseMatrix\_t::COO\_ZO > >:



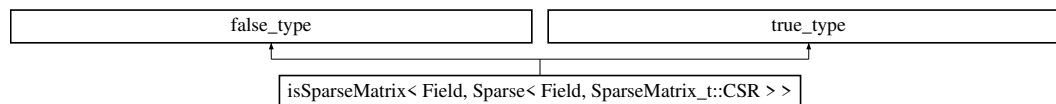
The documentation for this struct was generated from the following file:

- [sparse\\_matrix\\_traits.h](#)

## 12.185 isSparseMatrix< Field, Sparse< Field, SparseMatrix\_t::CSR > > Struct Template Reference

```
#include <sparse_matrix_traits.h>
```

Inheritance diagram for isSparseMatrix< Field, Sparse< Field, SparseMatrix\_t::CSR > >:



The documentation for this struct was generated from the following file:

- [sparse\\_matrix\\_traits.h](#)

## 12.186 isSparseMatrix< Field, Sparse< Field, SparseMatrix\_t::CSR\_HYB > > Struct Template Reference

```
#include <sparse_matrix_traits.h>
```

Inheritance diagram for isSparseMatrix< Field, Sparse< Field, SparseMatrix\_t::CSR\_HYB > >:



The documentation for this struct was generated from the following file:

- [sparse\\_matrix\\_traits.h](#)

## 12.187 `isSparseMatrix< Field, Sparse< Field, SparseMatrix_t::CSR_ZO > >` Struct Template Reference

```
#include <sparse_matrix_traits.h>
```

Inheritance diagram for `isSparseMatrix< Field, Sparse< Field, SparseMatrix_t::CSR_ZO > >`:



The documentation for this struct was generated from the following file:

- [sparse\\_matrix\\_traits.h](#)

## 12.188 `isSparseMatrix< Field, Sparse< Field, SparseMatrix_t::ELL > >` Struct Template Reference

```
#include <sparse_matrix_traits.h>
```

Inheritance diagram for `isSparseMatrix< Field, Sparse< Field, SparseMatrix_t::ELL > >`:



The documentation for this struct was generated from the following file:

- [sparse\\_matrix\\_traits.h](#)

## 12.189 `isSparseMatrix< Field, Sparse< Field, SparseMatrix_t::ELL_simd > >` Struct Template Reference

```
#include <sparse_matrix_traits.h>
```

Inheritance diagram for `isSparseMatrix< Field, Sparse< Field, SparseMatrix_t::ELL_simd > >`:



The documentation for this struct was generated from the following file:

- [sparse\\_matrix\\_traits.h](#)

## 12.190 `isSparseMatrix< Field, Sparse< Field, SparseMatrix_t::ELL_simd_ZO > >` Struct Template Reference

```
#include <sparse_matrix_traits.h>
```

Inheritance diagram for `isSparseMatrix< Field, Sparse< Field, SparseMatrix_t::ELL_simd_ZO > >`:



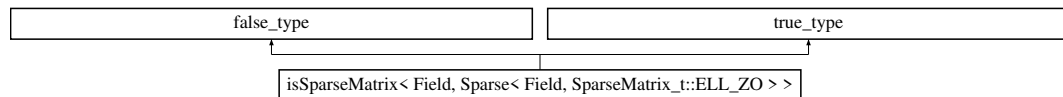
The documentation for this struct was generated from the following file:

- [sparse\\_matrix\\_traits.h](#)

## 12.191 isSparseMatrix< Field, Sparse< Field, SparseMatrix\_t::ELL\_ZO > > Struct Template Reference

```
#include <sparse_matrix_traits.h>
```

Inheritance diagram for isSparseMatrix< Field, Sparse< Field, SparseMatrix\_t::ELL\_ZO > >:



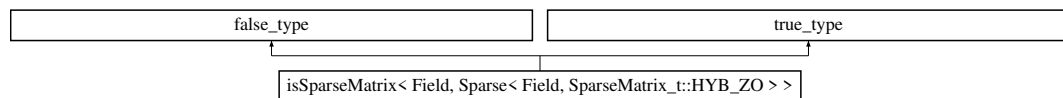
The documentation for this struct was generated from the following file:

- [sparse\\_matrix\\_traits.h](#)

## 12.192 isSparseMatrix< Field, Sparse< Field, SparseMatrix\_t::HYB\_ZO > > Struct Template Reference

```
#include <sparse_matrix_traits.h>
```

Inheritance diagram for isSparseMatrix< Field, Sparse< Field, SparseMatrix\_t::HYB\_ZO > >:



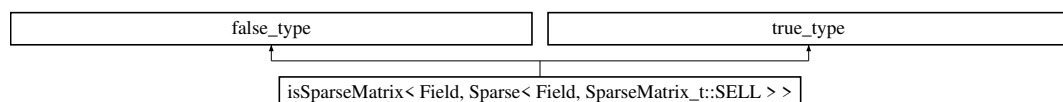
The documentation for this struct was generated from the following file:

- [sparse\\_matrix\\_traits.h](#)

## 12.193 isSparseMatrix< Field, Sparse< Field, SparseMatrix\_t::SELL > > Struct Template Reference

```
#include <sparse_matrix_traits.h>
```

Inheritance diagram for isSparseMatrix< Field, Sparse< Field, SparseMatrix\_t::SELL > >:



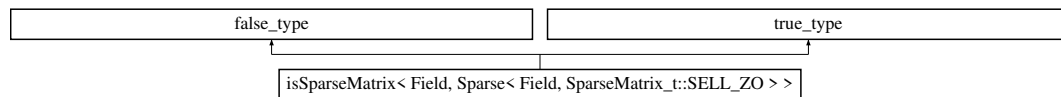
The documentation for this struct was generated from the following file:

- [sparse\\_matrix\\_traits.h](#)

## 12.194 isSparseMatrix< Field, Sparse< Field, SparseMatrix\_t::SELL\_ZO > > Struct Template Reference

```
#include <sparse_matrix_traits.h>
```

Inheritance diagram for isSparseMatrix< Field, Sparse< Field, SparseMatrix\_t::SELL\_ZO > >:



The documentation for this struct was generated from the following file:

- [sparse\\_matrix\\_traits.h](#)

## 12.195 isSparseMatrixMKLFormat< F, M > Struct Template Reference

```
#include <sparse_matrix_traits.h>
```

Inheritance diagram for isSparseMatrixMKLFormat< F, M >:



The documentation for this struct was generated from the following file:

- [sparse\\_matrix\\_traits.h](#)

## 12.196 isSparseMatrixSimdFormat< F, M > Struct Template Reference

```
#include <sparse_matrix_traits.h>
```

Inheritance diagram for isSparseMatrixSimdFormat< F, M >:



The documentation for this struct was generated from the following file:

- [sparse\\_matrix\\_traits.h](#)

## 12.197 isZOSparseMatrix< F, M > Struct Template Reference

```
#include <sparse_matrix_traits.h>
```

Inheritance diagram for isZOSparseMatrix< F, M >:



The documentation for this struct was generated from the following file:

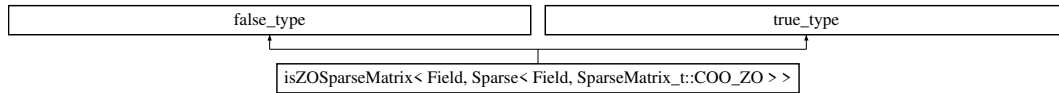
- [sparse\\_matrix\\_traits.h](#)



## 12.198 isZOSparseMatrix< Field, Sparse< Field, SparseMatrix\_t::COO\_ZO > > Struct Template Reference

```
#include <sparse_matrix_traits.h>
```

Inheritance diagram for isZOSparseMatrix< Field, Sparse< Field, SparseMatrix\_t::COO\_ZO > >:



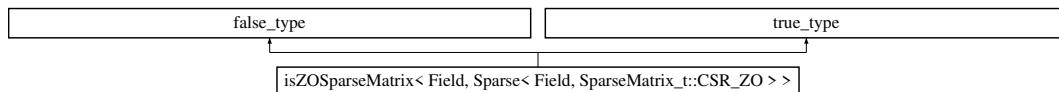
The documentation for this struct was generated from the following file:

- [sparse\\_matrix\\_traits.h](#)

## 12.199 isZOSparseMatrix< Field, Sparse< Field, SparseMatrix\_t::CSR\_ZO > > Struct Template Reference

```
#include <sparse_matrix_traits.h>
```

Inheritance diagram for isZOSparseMatrix< Field, Sparse< Field, SparseMatrix\_t::CSR\_ZO > >:



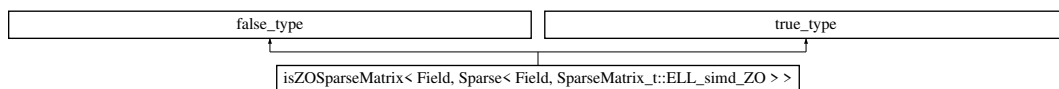
The documentation for this struct was generated from the following file:

- [sparse\\_matrix\\_traits.h](#)

## 12.200 isZOSparseMatrix< Field, Sparse< Field, SparseMatrix\_t::ELL\_simd\_ZO > > Struct Template Reference

```
#include <sparse_matrix_traits.h>
```

Inheritance diagram for isZOSparseMatrix< Field, Sparse< Field, SparseMatrix\_t::ELL\_simd\_ZO > >:



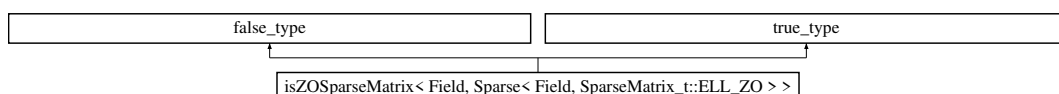
The documentation for this struct was generated from the following file:

- [sparse\\_matrix\\_traits.h](#)

## 12.201 isZOSparseMatrix< Field, Sparse< Field, SparseMatrix\_t::ELL\_ZO > > Struct Template Reference

```
#include <sparse_matrix_traits.h>
```

Inheritance diagram for isZOSparseMatrix< Field, Sparse< Field, SparseMatrix\_t::ELL\_ZO > >:



The documentation for this struct was generated from the following file:

- [sparse\\_matrix\\_traits.h](#)

## 12.202 isZOSparseMatrix< Field, Sparse< Field, SparseMatrix\_t::SELL\_ZO > > Struct Template Reference

```
#include <sparse_matrix_traits.h>
```

Inheritance diagram for isZOSparseMatrix< Field, Sparse< Field, SparseMatrix\_t::SELL\_ZO > >:



The documentation for this struct was generated from the following file:

- [sparse\\_matrix\\_traits.h](#)

## 12.203 Iterative Struct Reference

The documentation for this struct was generated from the following file:

- [fflas\\_helpers.inl](#)

## 12.204 array< T >::iterator Class Reference

STL iterator class.

### 12.204.1 Detailed Description

STL iterator class.

The documentation for this class was generated from the following files:

## 12.205 string::iterator Class Reference

STL iterator class.

### 12.205.1 Detailed Description

STL iterator class.

The documentation for this class was generated from the following files:

## 12.206 vector< T >::iterator Class Reference

STL iterator class.

### 12.206.1 Detailed Description

STL iterator class.

The documentation for this class was generated from the following files:

## 12.207 LazyTag Struct Reference

Performs field operations with delayed mod only when necessary. Result may not be reduced.

```
#include <field-traits.h>
```

### 12.207.1 Detailed Description

Performs field operations with delayed mod only when necessary. Result may not be reduced.  
The documentation for this struct was generated from the following file:

- [field-traits.h](#)

## 12.208 limits< T > Struct Template Reference

The documentation for this struct was generated from the following file:

- [flimits.h](#)

## 12.209 limits< char > Struct Reference

```
#include <flimits.h>
```

### Public Types

- typedef char [T](#)

### Static Public Member Functions

- static constexpr char [max](#) () noexcept
- static constexpr char [min](#) () noexcept
- static constexpr int32\_t [digits](#) () noexcept

### 12.209.1 Member Typedef Documentation

#### 12.209.1.1 T

```
typedef char T
```

### 12.209.2 Member Function Documentation

#### 12.209.2.1 max()

```
static constexpr char max () [inline], [static], [constexpr], [noexcept]
```

#### 12.209.2.2 min()

```
static constexpr char min () [inline], [static], [constexpr], [noexcept]
```

#### 12.209.2.3 digits()

```
static constexpr int32_t digits () [inline], [static], [constexpr], [noexcept]
```

The documentation for this struct was generated from the following file:

- [flimits.h](#)

## 12.210 limits< double > Struct Reference

```
#include <flimits.h>
```

### Public Types

- typedef double [T](#)

### Static Public Member Functions

- static constexpr int64\_t [max](#) () noexcept
- static constexpr int64\_t [min](#) () noexcept
- static constexpr int32\_t [digits](#) () noexcept

## 12.210.1 Member Typedef Documentation

### 12.210.1.1 T

```
typedef double T
```

## 12.210.2 Member Function Documentation

### 12.210.2.1 max()

```
static constexpr int64_t max () [inline], [static], [constexpr], [noexcept]
```

### 12.210.2.2 min()

```
static constexpr int64_t min () [inline], [static], [constexpr], [noexcept]
```

### 12.210.2.3 digits()

```
static constexpr int32_t digits () [inline], [static], [constexpr], [noexcept]
```

The documentation for this struct was generated from the following file:

- [flimits.h](#)

## 12.211 limits< float > Struct Reference

```
#include <flimits.h>
```

### Public Types

- typedef float [T](#)

### Static Public Member Functions

- static constexpr int32\_t [max](#) () noexcept
- static constexpr int32\_t [min](#) () noexcept
- static constexpr int32\_t [digits](#) () noexcept

## 12.211.1 Member Typedef Documentation

### 12.211.1.1 T

```
typedef float T
```

## 12.211.2 Member Function Documentation

### 12.211.2.1 max()

```
static constexpr int32_t max () [inline], [static], [constexpr], [noexcept]
```

### 12.211.2.2 min()

```
static constexpr int32_t min () [inline], [static], [constexpr], [noexcept]
```

### 12.211.2.3 digits()

```
static constexpr int32_t digits () [inline], [static], [constexpr], [noexcept]
```

The documentation for this struct was generated from the following file:

- [flimits.h](#)

## 12.212 limits< Givaro::Integer > Struct Reference

```
#include <flimits.h>
```

### Public Types

- typedef Givaro::Integer [T](#)

### Static Public Member Functions

- static constexpr int [max](#) () noexcept
- static constexpr int [min](#) () noexcept

### 12.212.1 Member Typedef Documentation

#### 12.212.1.1 T

```
typedef Givaro::Integer T
```

### 12.212.2 Member Function Documentation

#### 12.212.2.1 max()

```
static constexpr int max () [inline], [static], [constexpr], [noexcept]
```

#### 12.212.2.2 min()

```
static constexpr int min () [inline], [static], [constexpr], [noexcept]
```

The documentation for this struct was generated from the following file:

- [flimits.h](#)

## 12.213 limits< int > Struct Reference

```
#include <flimits.h>
```

### Public Types

- typedef int [T](#)

### Static Public Member Functions

- static constexpr int [max](#) () noexcept
- static constexpr int [min](#) () noexcept
- static constexpr int32\_t [digits](#) () noexcept

### 12.213.1 Member Typedef Documentation

#### 12.213.1.1 T

```
typedef int T
```

## 12.213.2 Member Function Documentation

### 12.213.2.1 max()

```
static constexpr int max () [inline], [static], [constexpr], [noexcept]
```

### 12.213.2.2 min()

```
static constexpr int min () [inline], [static], [constexpr], [noexcept]
```

### 12.213.2.3 digits()

```
static constexpr int32_t digits () [inline], [static], [constexpr], [noexcept]
```

The documentation for this struct was generated from the following file:

- [flimits.h](#)

## 12.214 limits< long > Struct Reference

```
#include <flimits.h>
```

### Public Types

- typedef long [T](#)

### Static Public Member Functions

- static constexpr long [max](#) () noexcept
- static constexpr long [min](#) () noexcept
- static constexpr int32\_t [digits](#) () noexcept

## 12.214.1 Member Typedef Documentation

### 12.214.1.1 T

```
typedef long T
```

## 12.214.2 Member Function Documentation

### 12.214.2.1 max()

```
static constexpr long max () [inline], [static], [constexpr], [noexcept]
```

### 12.214.2.2 min()

```
static constexpr long min () [inline], [static], [constexpr], [noexcept]
```

### 12.214.2.3 digits()

```
static constexpr int32_t digits () [inline], [static], [constexpr], [noexcept]
```

The documentation for this struct was generated from the following file:

- [flimits.h](#)

## 12.215 limits< long long > Struct Reference

```
#include <flimits.h>
```

### Public Types

- typedef long long [T](#)

**Static Public Member Functions**

- static constexpr long long [max](#) () noexcept
- static constexpr long long [min](#) () noexcept
- static constexpr int32\_t [digits](#) () noexcept

**12.215.1 Member Typedef Documentation****12.215.1.1 T**

```
typedef long long T
```

**12.215.2 Member Function Documentation****12.215.2.1 max()**

```
static constexpr long long max () [inline], [static], [constexpr], [noexcept]
```

**12.215.2.2 min()**

```
static constexpr long long min () [inline], [static], [constexpr], [noexcept]
```

**12.215.2.3 digits()**

```
static constexpr int32_t digits () [inline], [static], [constexpr], [noexcept]
```

The documentation for this struct was generated from the following file:

- [flimits.h](#)

**12.216 limits< RecInt::rint< K > > Struct Template Reference**

```
#include <flimits.h>
```

**Public Types**

- typedef [RecInt::ruint](#)< K > T

**Static Public Member Functions**

- static constexpr [RecInt::rint](#)< K > [max](#) () noexcept
- static constexpr [RecInt::rint](#)< K > [min](#) () noexcept

**12.216.1 Member Typedef Documentation****12.216.1.1 T**

```
template<size_t K>
typedef RecInt::ruint<K> T
```

**12.216.2 Member Function Documentation****12.216.2.1 max()**

```
template<size_t K>
static constexpr RecInt::rint< K > max () [inline], [static], [constexpr], [noexcept]
```

### 12.216.2.2 min()

```
template<size_t K>
static constexpr RecInt::rint< K > min () [inline], [static], [constexpr], [noexcept]
```

The documentation for this struct was generated from the following file:

- [flimits.h](#)

## 12.217 limits< RecInt::ruint< K > > Struct Template Reference

```
#include <flimits.h>
```

### Public Types

- typedef [RecInt::ruint< K > T](#)

### Static Public Member Functions

- static constexpr [RecInt::ruint< K > max](#) () noexcept
- static constexpr [RecInt::ruint< K > min](#) () noexcept

### 12.217.1 Member Typedef Documentation

#### 12.217.1.1 T

```
template<size_t K>
typedef RecInt::ruint<K> T
```

### 12.217.2 Member Function Documentation

#### 12.217.2.1 max()

```
template<size_t K>
static constexpr RecInt::ruint< K > max () [inline], [static], [constexpr], [noexcept]
```

#### 12.217.2.2 min()

```
template<size_t K>
static constexpr RecInt::ruint< K > min () [inline], [static], [constexpr], [noexcept]
```

The documentation for this struct was generated from the following file:

- [flimits.h](#)

## 12.218 limits< short int > Struct Reference

```
#include <flimits.h>
```

### Public Types

- typedef short int [T](#)

### Static Public Member Functions

- static constexpr short int [max](#) () noexcept
- static constexpr short int [min](#) () noexcept
- static constexpr int32\_t [digits](#) () noexcept



## 12.218.1 Member Typedef Documentation

### 12.218.1.1 T

```
typedef short int T
```

## 12.218.2 Member Function Documentation

### 12.218.2.1 max()

```
static constexpr short int max () [inline], [static], [constexpr], [noexcept]
```

### 12.218.2.2 min()

```
static constexpr short int min () [inline], [static], [constexpr], [noexcept]
```

### 12.218.2.3 digits()

```
static constexpr int32_t digits () [inline], [static], [constexpr], [noexcept]
```

The documentation for this struct was generated from the following file:

- [flimits.h](#)

## 12.219 limits< signed char > Struct Reference

```
#include <flimits.h>
```

### Public Types

- typedef signed char [T](#)

### Static Public Member Functions

- static constexpr signed char [max](#) () noexcept
- static constexpr signed char [min](#) () noexcept
- static constexpr int32\_t [digits](#) () noexcept

## 12.219.1 Member Typedef Documentation

### 12.219.1.1 T

```
typedef signed char T
```

## 12.219.2 Member Function Documentation

### 12.219.2.1 max()

```
static constexpr signed char max () [inline], [static], [constexpr], [noexcept]
```

### 12.219.2.2 min()

```
static constexpr signed char min () [inline], [static], [constexpr], [noexcept]
```

### 12.219.2.3 digits()

```
static constexpr int32_t digits () [inline], [static], [constexpr], [noexcept]
```

The documentation for this struct was generated from the following file:

- [flimits.h](#)

## 12.220 limits< unsigned char > Struct Reference

```
#include <flimits.h>
```

### Public Types

- typedef unsigned char [T](#)

### Static Public Member Functions

- static constexpr unsigned char [max](#) () noexcept
- static constexpr unsigned char [min](#) () noexcept
- static constexpr int32\_t [digits](#) () noexcept

### 12.220.1 Member Typedef Documentation

#### 12.220.1.1 T

```
typedef unsigned char T
```

### 12.220.2 Member Function Documentation

#### 12.220.2.1 max()

```
static constexpr unsigned char max () [inline], [static], [constexpr], [noexcept]
```

#### 12.220.2.2 min()

```
static constexpr unsigned char min () [inline], [static], [constexpr], [noexcept]
```

#### 12.220.2.3 digits()

```
static constexpr int32_t digits () [inline], [static], [constexpr], [noexcept]
```

The documentation for this struct was generated from the following file:

- [flimits.h](#)

## 12.221 limits< unsigned int > Struct Reference

```
#include <flimits.h>
```

### Public Types

- typedef unsigned int [T](#)

### Static Public Member Functions

- static constexpr unsigned int [max](#) () noexcept
- static constexpr unsigned int [min](#) () noexcept
- static constexpr int32\_t [digits](#) () noexcept

### 12.221.1 Member Typedef Documentation

#### 12.221.1.1 T

```
typedef unsigned int T
```

## 12.221.2 Member Function Documentation

### 12.221.2.1 max()

```
static constexpr unsigned int max () [inline], [static], [constexpr], [noexcept]
```

### 12.221.2.2 min()

```
static constexpr unsigned int min () [inline], [static], [constexpr], [noexcept]
```

### 12.221.2.3 digits()

```
static constexpr int32_t digits () [inline], [static], [constexpr], [noexcept]
```

The documentation for this struct was generated from the following file:

- [flimits.h](#)

## 12.222 limits< unsigned long > Struct Reference

```
#include <flimits.h>
```

### Public Types

- typedef unsigned long [T](#)

### Static Public Member Functions

- static constexpr unsigned long [max](#) () noexcept
- static constexpr unsigned long [min](#) () noexcept
- static constexpr int32\_t [digits](#) () noexcept

## 12.222.1 Member Typedef Documentation

### 12.222.1.1 T

```
typedef unsigned long T
```

## 12.222.2 Member Function Documentation

### 12.222.2.1 max()

```
static constexpr unsigned long max () [inline], [static], [constexpr], [noexcept]
```

### 12.222.2.2 min()

```
static constexpr unsigned long min () [inline], [static], [constexpr], [noexcept]
```

### 12.222.2.3 digits()

```
static constexpr int32_t digits () [inline], [static], [constexpr], [noexcept]
```

The documentation for this struct was generated from the following file:

- [flimits.h](#)

## 12.223 limits< unsigned long long > Struct Reference

```
#include <flimits.h>
```

### Public Types

- typedef unsigned long long [T](#)

### Static Public Member Functions

- static constexpr unsigned long long [max](#) () noexcept
- static constexpr unsigned long long [min](#) () noexcept
- static constexpr int32\_t [digits](#) () noexcept

## 12.223.1 Member Typedef Documentation

### 12.223.1.1 T

```
typedef unsigned long long T
```

## 12.223.2 Member Function Documentation

### 12.223.2.1 max()

```
static constexpr unsigned long long max () [inline], [static], [constexpr], [noexcept]
```

### 12.223.2.2 min()

```
static constexpr unsigned long long min () [inline], [static], [constexpr], [noexcept]
```

### 12.223.2.3 digits()

```
static constexpr int32_t digits () [inline], [static], [constexpr], [noexcept]
```

The documentation for this struct was generated from the following file:

- [flimits.h](#)

## 12.224 limits< unsigned short int > Struct Reference

```
#include <flimits.h>
```

### Public Types

- typedef unsigned short int [T](#)

### Static Public Member Functions

- static constexpr unsigned short int [max](#) () noexcept
- static constexpr unsigned short int [min](#) () noexcept
- static constexpr int32\_t [digits](#) () noexcept

## 12.224.1 Member Typedef Documentation

### 12.224.1.1 T

```
typedef unsigned short int T
```

## 12.224.2 Member Function Documentation

### 12.224.2.1 max()

```
static constexpr unsigned short int max () [inline], [static], [constexpr], [noexcept]
```

### 12.224.2.2 min()

```
static constexpr unsigned short int min () [inline], [static], [constexpr], [noexcept]
```

### 12.224.2.3 digits()

```
static constexpr int32_t digits () [inline], [static], [constexpr], [noexcept]
```

The documentation for this struct was generated from the following file:

- [flimits.h](#)

## 12.225 MachineFloatTag Struct Reference

float or double

```
#include <field-traits.h>
```

### 12.225.1 Detailed Description

float or double

The documentation for this struct was generated from the following file:

- [field-traits.h](#)

## 12.226 MachineIntTag Struct Reference

short, int, long, long long, and unsigned variants

```
#include <field-traits.h>
```

### 12.226.1 Detailed Description

short, int, long, long long, and unsigned variants

The documentation for this struct was generated from the following file:

- [field-traits.h](#)

## 12.227 MMHelper< Field, AlgoTrait, ModeTrait, ParSeqTrait > Struct Template Reference

### Public Types

- typedef [MMHelper](#)< [Field](#), [AlgoTrait](#), [ModeTrait](#), [ParSeqTrait](#) > [Self\\_t](#)
- typedef [associatedDelayedField](#)< [constField](#) >::type [DelayedField\\_t](#)
- typedef [associatedDelayedField](#)< [constField](#) >::field [DelayedField](#)
- typedef [DelayedField::Element](#) [DFElt](#)

### Public Member Functions

- void [initC](#) ()
- void [initA](#) ()
- void [initB](#) ()
- void [initOut](#) ()
- [size\\_t](#) [MaxDelayedDim](#) ([DFElt](#) beta)
- bool [Aunfit](#) ()
- bool [Bunfit](#) ()
- void [setOutBounds](#) (const [size\\_t](#) k, const [DFElt](#) alpha, const [DFElt](#) beta)
- bool [checkA](#) (const [Field](#) &F, const [FFLAS::FFLAS\\_TRANSPOSE](#) ta, const [size\\_t](#) M, const [size\\_t](#) N, typename [Field::ConstElement\\_ptr](#) A, const [size\\_t](#) lda)
- bool [checkB](#) (const [Field](#) &F, const [FFLAS::FFLAS\\_TRANSPOSE](#) tb, const [size\\_t](#) M, const [size\\_t](#) N, typename [Field::ConstElement\\_ptr](#) B, const [size\\_t](#) ldb)
- bool [checkOut](#) (const [Field](#) &F, const [size\\_t](#) M, const [size\\_t](#) N, typename [Field::ConstElement\\_ptr](#) A, const [size\\_t](#) lda)

- bool `checkOut` (const `Field` &F, `FFLAS_UPLO` uplo, const size\_t M, const size\_t N, typename `Field::ConstElement_ptr` A, const size\_t lda)
- `MMHelper` ()
- `MMHelper` (const `Field` &F, size\_t m, size\_t k, size\_t n, ParSeqTrait \_PS)
- `MMHelper` (const `Field` &F, int w, ParSeqTrait \_PS=ParSeqTrait())
- template<class F2, typename AlgoT2, typename FT2, typename PS2>  
`MMHelper` (`MMHelper`< F2, AlgoT2, FT2, PS2 > &WH)
- `MMHelper` (const `Field` &F, int w, `DFElt` \_Amin, `DFElt` \_Amax, `DFElt` \_Bmin, `DFElt` \_Bmax, `DFElt` \_Cmin, `DFElt` \_Cmax, ParSeqTrait \_PS=ParSeqTrait())

## Data Fields

- int `recLevel`
- `DFElt` `FieldMin`
- `DFElt` `FieldMax`
- `DFElt` `Amin`
- `DFElt` `Amax`
- `DFElt` `Bmin`
- `DFElt` `Bmax`
- `DFElt` `Cmin`
- `DFElt` `Cmax`
- `DFElt` `Outmin`
- `DFElt` `Outmax`
- `DFElt` `MaxStorableValue`
- const `DelayedField_t` `delayedField`
- ParSeqTrait `parseq`

## Friends

- std::ostream & `operator<<` (std::ostream &out, const `Self_t` &M)

## 12.227.1 Member Typedef Documentation

### 12.227.1.1 Self\_t

```
template<class Field, typename AlgoTrait, typename ModeTrait, typename ParSeqTrait>
typedef MMHelper<Field,AlgoTrait,ModeTrait,ParSeqTrait> Self_t
```

### 12.227.1.2 DelayedField\_t

```
template<class Field, typename AlgoTrait, typename ModeTrait, typename ParSeqTrait>
typedef associatedDelayedField<constField>::type DelayedField_t
```

### 12.227.1.3 DelayedField

```
template<class Field, typename AlgoTrait, typename ModeTrait, typename ParSeqTrait>
typedef associatedDelayedField<constField>::field DelayedField
```

### 12.227.1.4 DFElt

```
template<class Field, typename AlgoTrait, typename ModeTrait, typename ParSeqTrait>
typedef DelayedField::Element DFElt
```

## 12.227.2 Constructor & Destructor Documentation

### 12.227.2.1 MMHelper() [1/5]

```
template<class Field, typename AlgoTrait, typename ModeTrait, typename ParSeqTrait>
MMHelper () [inline]
```

**12.227.2.2 MMHelper() [2/5]**

```
template<class Field, typename AlgoTrait, typename ModeTrait, typename ParSeqTrait>
MMHelper (
    const Field & F,
    size_t m,
    size_t k,
    size_t n,
    ParSeqTrait _PS) [inline]
```

**12.227.2.3 MMHelper() [3/5]**

```
template<class Field, typename AlgoTrait, typename ModeTrait, typename ParSeqTrait>
MMHelper (
    const Field & F,
    int w,
    ParSeqTrait _PS = ParSeqTrait()) [inline]
```

**12.227.2.4 MMHelper() [4/5]**

```
template<class Field, typename AlgoTrait, typename ModeTrait, typename ParSeqTrait>
template<class F2, typename AlgoT2, typename FT2, typename PS2>
MMHelper (
    MMHelper< F2, AlgoT2, FT2, PS2 > & WH) [inline]
```

**12.227.2.5 MMHelper() [5/5]**

```
template<class Field, typename AlgoTrait, typename ModeTrait, typename ParSeqTrait>
MMHelper (
    const Field & F,
    int w,
    DFelt _Amin,
    DFelt _Amax,
    DFelt _Bmin,
    DFelt _Bmax,
    DFelt _Cmin,
    DFelt _Cmax,
    ParSeqTrait _PS = ParSeqTrait()) [inline]
```

**12.227.3 Member Function Documentation****12.227.3.1 initC()**

```
template<class Field, typename AlgoTrait, typename ModeTrait, typename ParSeqTrait>
void initC () [inline]
```

**12.227.3.2 initA()**

```
template<class Field, typename AlgoTrait, typename ModeTrait, typename ParSeqTrait>
void initA () [inline]
```

**12.227.3.3 initB()**

```
template<class Field, typename AlgoTrait, typename ModeTrait, typename ParSeqTrait>
void initB () [inline]
```

**12.227.3.4 initOut()**

```
template<class Field, typename AlgoTrait, typename ModeTrait, typename ParSeqTrait>
void initOut () [inline]
```

**12.227.3.5 MaxDelayedDim()**

```
template<class Field, typename AlgoTrait, typename ModeTrait, typename ParSeqTrait>
size_t MaxDelayedDim (
    DFElt beta) [inline]
```

**12.227.3.6 Aunfit()**

```
template<class Field, typename AlgoTrait, typename ModeTrait, typename ParSeqTrait>
bool Aunfit () [inline]
```

**12.227.3.7 Bunfit()**

```
template<class Field, typename AlgoTrait, typename ModeTrait, typename ParSeqTrait>
bool Bunfit () [inline]
```

**12.227.3.8 setOutBounds()**

```
template<class Field, typename AlgoTrait, typename ModeTrait, typename ParSeqTrait>
void setOutBounds (
    const size_t k,
    const DFElt alpha,
    const DFElt beta) [inline]
```

**12.227.3.9 checkA()**

```
template<class Field, typename AlgoTrait, typename ModeTrait, typename ParSeqTrait>
bool checkA (
    const Field & F,
    const FFLAS::FFLAS_TRANSPOSE ta,
    const size_t M,
    const size_t N,
    typename Field::ConstElement_ptr A,
    const size_t lda) [inline]
```

**12.227.3.10 checkB()**

```
template<class Field, typename AlgoTrait, typename ModeTrait, typename ParSeqTrait>
bool checkB (
    const Field & F,
    const FFLAS::FFLAS_TRANSPOSE tb,
    const size_t M,
    const size_t N,
    typename Field::ConstElement_ptr B,
    const size_t ldb) [inline]
```

**12.227.3.11 checkOut() [1/2]**

```
template<class Field, typename AlgoTrait, typename ModeTrait, typename ParSeqTrait>
bool checkOut (
    const Field & F,
    const size_t M,
    const size_t N,
    typename Field::ConstElement_ptr A,
    const size_t lda) [inline]
```

**12.227.3.12 checkOut() [2/2]**

```
template<class Field, typename AlgoTrait, typename ModeTrait, typename ParSeqTrait>
bool checkOut (
```



```

    const Field & F,
    FFLAS_UPLO uplo,
    const size_t M,
    const size_t N,
    typename Field::ConstElement_ptr A,
    const size_t lda) [inline]

```

## 12.227.4 Friends And Related Symbol Documentation

### 12.227.4.1 operator<<

```

template<class Field, typename AlgoTrait, typename ModeTrait, typename ParSeqTrait>
std::ostream & operator<< (
    std::ostream & out,
    const Self_t & M) [friend]

```

## 12.227.5 Field Documentation

### 12.227.5.1 recLevel

```

template<class Field, typename AlgoTrait, typename ModeTrait, typename ParSeqTrait>
int recLevel

```

### 12.227.5.2 FieldMin

```

template<class Field, typename AlgoTrait, typename ModeTrait, typename ParSeqTrait>
DFElt FieldMin

```

### 12.227.5.3 FieldMax

```

template<class Field, typename AlgoTrait, typename ModeTrait, typename ParSeqTrait>
DFElt FieldMax

```

### 12.227.5.4 Amin

```

template<class Field, typename AlgoTrait, typename ModeTrait, typename ParSeqTrait>
DFElt Amin

```

### 12.227.5.5 Amax

```

template<class Field, typename AlgoTrait, typename ModeTrait, typename ParSeqTrait>
DFElt Amax

```

### 12.227.5.6 Bmin

```

template<class Field, typename AlgoTrait, typename ModeTrait, typename ParSeqTrait>
DFElt Bmin

```

### 12.227.5.7 Bmax

```

template<class Field, typename AlgoTrait, typename ModeTrait, typename ParSeqTrait>
DFElt Bmax

```

### 12.227.5.8 Cmin

```

template<class Field, typename AlgoTrait, typename ModeTrait, typename ParSeqTrait>
DFElt Cmin

```

**12.227.5.9 Cmax**

```
template<class Field, typename AlgoTrait, typename ModeTrait, typename ParSeqTrait>
DFelt Cmax
```

**12.227.5.10 Outmin**

```
template<class Field, typename AlgoTrait, typename ModeTrait, typename ParSeqTrait>
DFelt Outmin
```

**12.227.5.11 Outmax**

```
template<class Field, typename AlgoTrait, typename ModeTrait, typename ParSeqTrait>
DFelt Outmax
```

**12.227.5.12 MaxStorableValue**

```
template<class Field, typename AlgoTrait, typename ModeTrait, typename ParSeqTrait>
DFelt MaxStorableValue
```

**12.227.5.13 delayedField**

```
template<class Field, typename AlgoTrait, typename ModeTrait, typename ParSeqTrait>
const DelayedField_t delayedField
```

**12.227.5.14 parseq**

```
template<class Field, typename AlgoTrait, typename ModeTrait, typename ParSeqTrait>
ParSeqTrait parseq
```

The documentation for this struct was generated from the following file:

- [fflas\\_helpers.inl](#)

**12.228 ModeTraits< Field > Struct Template Reference**

[ModeTraits.](#)

```
#include <field-traits.h>
```

**Public Types**

- typedef [ModeCategories::DefaultTag](#) value

**12.228.1 Detailed Description**

```
template<class Field>
struct FFLAS::ModeTraits< Field >
```

[ModeTraits.](#)

**12.228.2 Member Typedef Documentation****12.228.2.1 value**

```
template<class Field>
typedef ModeCategories::DefaultTag value
```

The documentation for this struct was generated from the following file:

- [field-traits.h](#)

## 12.229 ModeTraits< Givaro::Modular< Element, Compute > > Struct Template Reference

```
#include <field-traits.h>
```

### Public Types

- typedef [ModeCategories::DelayedTag](#) value
- typedef [ModeCategories::DefaultTag](#) value

### 12.229.1 Member Typedef Documentation

#### 12.229.1.1 value [1/2]

```
template<typename Element, typename Compute>
typedef ModeCategories::DelayedTag value
```

#### 12.229.1.2 value [2/2]

```
typedef ModeCategories::DefaultTag value
```

The documentation for this struct was generated from the following file:

- [field-traits.h](#)

## 12.230 ModeTraits< Givaro::Modular< Givaro::Integer, Compute > > Struct Template Reference

```
#include <field-traits.h>
```

### Public Types

- typedef [ModeCategories::ConvertTo< ElementCategories::RNSElementTag >](#) value
- typedef [ModeCategories::DefaultTag](#) value

### 12.230.1 Member Typedef Documentation

#### 12.230.1.1 value [1/2]

```
template<typename Compute>
typedef ModeCategories::ConvertTo<ElementCategories::RNSElementTag> value
```

#### 12.230.1.2 value [2/2]

```
typedef ModeCategories::DefaultTag value
```

The documentation for this struct was generated from the following file:

- [field-traits.h](#)

## 12.231 ModeTraits< Givaro::Modular< int16\_t, Compute > > Struct Template Reference

```
#include <field-traits.h>
```

### Public Types

- typedef [ModeCategories::ConvertTo< ElementCategories::MachineFloatTag >](#) value
- typedef [ModeCategories::DefaultTag](#) value

## 12.231.1 Member Typedef Documentation

### 12.231.1.1 value [1/2]

```
template<typename Compute>
typedef ModeCategories::ConvertTo<ElementCategories::MachineFloatTag> value
```

### 12.231.1.2 value [2/2]

```
typedef ModeCategories::DefaultTag value
```

The documentation for this struct was generated from the following file:

- [field-traits.h](#)

## 12.232 ModeTraits< Givaro::Modular< int32\_t, Compute > > Struct Template Reference

```
#include <field-traits.h>
```

### Public Types

- typedef [ModeCategories::ConvertTo< ElementCategories::MachineFloatTag > value](#)
- typedef [ModeCategories::DefaultTag value](#)

## 12.232.1 Member Typedef Documentation

### 12.232.1.1 value [1/2]

```
template<typename Compute>
typedef ModeCategories::ConvertTo<ElementCategories::MachineFloatTag> value
```

### 12.232.1.2 value [2/2]

```
typedef ModeCategories::DefaultTag value
```

The documentation for this struct was generated from the following file:

- [field-traits.h](#)

## 12.233 ModeTraits< Givaro::Modular< int64\_t, uint64\_t > > Struct Reference

```
#include <field-traits.h>
```

### Public Types

- typedef [ModeCategories::DefaultTag value](#)
- typedef [ModeCategories::DefaultTag value](#)

## 12.233.1 Member Typedef Documentation

### 12.233.1.1 value [1/2]

```
typedef ModeCategories::DefaultTag value
```

### 12.233.1.2 value [2/2]

```
typedef ModeCategories::DefaultTag value
```

The documentation for this struct was generated from the following file:

- [field-traits.h](#)

## 12.234 ModeTraits< Givaro::Modular< int8\_t, Compute > > Struct Template Reference

```
#include <field-traits.h>
```

### Public Types

- typedef [ModeCategories::ConvertTo< ElementCategories::MachineFloatTag > value](#)
- typedef [ModeCategories::DefaultTag value](#)

### 12.234.1 Member Typedef Documentation

#### 12.234.1.1 value [1/2]

```
template<typename Compute>
typedef ModeCategories::ConvertTo<ElementCategories::MachineFloatTag> value
```

#### 12.234.1.2 value [2/2]

```
typedef ModeCategories::DefaultTag value
```

The documentation for this struct was generated from the following file:

- [field-traits.h](#)

## 12.235 ModeTraits< Givaro::Modular< RecInt::ruint< K >, Compute > > Struct Template Reference

```
#include <field-traits.h>
```

### Public Types

- typedef [ModeCategories::ConvertTo< ElementCategories::RNSElementTag > value](#)
- typedef [ModeCategories::DefaultTag value](#)

### 12.235.1 Member Typedef Documentation

#### 12.235.1.1 value [1/2]

```
template<typename Compute, size_t K>
typedef ModeCategories::ConvertTo<ElementCategories::RNSElementTag> value
```

#### 12.235.1.2 value [2/2]

```
typedef ModeCategories::DefaultTag value
```

The documentation for this struct was generated from the following file:

- [field-traits.h](#)

## 12.236 ModeTraits< Givaro::Modular< uint16\_t, Compute > > Struct Template Reference

```
#include <field-traits.h>
```

### Public Types

- typedef [ModeCategories::ConvertTo< ElementCategories::MachineFloatTag > value](#)
- typedef [ModeCategories::DefaultTag value](#)

## 12.236.1 Member Typedef Documentation

### 12.236.1.1 value [1/2]

```
template<typename Compute>
typedef ModeCategories::ConvertTo<ElementCategories::MachineFloatTag> value
```

### 12.236.1.2 value [2/2]

```
typedef ModeCategories::DefaultTag value
```

The documentation for this struct was generated from the following file:

- [field-traits.h](#)

## 12.237 ModeTraits< Givaro::Modular< uint32\_t, Compute > > Struct Template Reference

```
#include <field-traits.h>
```

### Public Types

- typedef [ModeCategories::ConvertTo< ElementCategories::MachineFloatTag > value](#)
- typedef [ModeCategories::DefaultTag value](#)

## 12.237.1 Member Typedef Documentation

### 12.237.1.1 value [1/2]

```
template<typename Compute>
typedef ModeCategories::ConvertTo<ElementCategories::MachineFloatTag> value
```

### 12.237.1.2 value [2/2]

```
typedef ModeCategories::DefaultTag value
```

The documentation for this struct was generated from the following file:

- [field-traits.h](#)

## 12.238 ModeTraits< Givaro::Modular< uint8\_t, Compute > > Struct Template Reference

```
#include <field-traits.h>
```

### Public Types

- typedef [ModeCategories::ConvertTo< ElementCategories::MachineFloatTag > value](#)
- typedef [ModeCategories::DefaultTag value](#)

## 12.238.1 Member Typedef Documentation

### 12.238.1.1 value [1/2]

```
template<typename Compute>
typedef ModeCategories::ConvertTo<ElementCategories::MachineFloatTag> value
```

### 12.238.1.2 value [2/2]

```
typedef ModeCategories::DefaultTag value
```

The documentation for this struct was generated from the following file:

- [field-traits.h](#)

## 12.239 ModeTraits< Givaro::ModularBalanced< Element > > Struct Template Reference

```
#include <field-traits.h>
```

### Public Types

- typedef [ModeCategories::DelayedTag](#) value
- typedef [ModeCategories::DefaultTag](#) value

### 12.239.1 Member Typedef Documentation

#### 12.239.1.1 value [1/2]

```
template<typename Element>
typedef ModeCategories::DelayedTag value
```

#### 12.239.1.2 value [2/2]

```
typedef ModeCategories::DefaultTag value
```

The documentation for this struct was generated from the following file:

- [field-traits.h](#)

## 12.240 ModeTraits< Givaro::ModularBalanced< Givaro::Integer > > Struct Reference

```
#include <field-traits.h>
```

### Public Types

- typedef [ModeCategories::ConvertTo< ElementCategories::RNSElementTag >](#) value
- typedef [ModeCategories::DefaultTag](#) value

### 12.240.1 Member Typedef Documentation

#### 12.240.1.1 value [1/2]

```
typedef ModeCategories::ConvertTo<ElementCategories::RNSElementTag> value
```

#### 12.240.1.2 value [2/2]

```
typedef ModeCategories::DefaultTag value
```

The documentation for this struct was generated from the following file:

- [field-traits.h](#)

## 12.241 ModeTraits< Givaro::ModularBalanced< int16\_t > > Struct Reference

```
#include <field-traits.h>
```

### Public Types

- typedef [ModeCategories::ConvertTo< ElementCategories::MachineFloatTag >](#) value
- typedef [ModeCategories::DefaultTag](#) value

## 12.241.1 Member Typedef Documentation

### 12.241.1.1 value [1/2]

typedef [ModeCategories::ConvertTo<ElementCategories::MachineFloatTag>](#) value

### 12.241.1.2 value [2/2]

typedef [ModeCategories::DefaultTag](#) value

The documentation for this struct was generated from the following file:

- [field-traits.h](#)

## 12.242 ModeTraits< Givaro::ModularBalanced< int32\_t > > Struct Reference

```
#include <field-traits.h>
```

### Public Types

- typedef [ModeCategories::ConvertTo< ElementCategories::MachineFloatTag >](#) value
- typedef [ModeCategories::DefaultTag](#) value

## 12.242.1 Member Typedef Documentation

### 12.242.1.1 value [1/2]

typedef [ModeCategories::ConvertTo<ElementCategories::MachineFloatTag>](#) value

### 12.242.1.2 value [2/2]

typedef [ModeCategories::DefaultTag](#) value

The documentation for this struct was generated from the following file:

- [field-traits.h](#)

## 12.243 ModeTraits< Givaro::ModularBalanced< int8\_t > > Struct Reference

```
#include <field-traits.h>
```

### Public Types

- typedef [ModeCategories::ConvertTo< ElementCategories::MachineFloatTag >](#) value
- typedef [ModeCategories::DefaultTag](#) value

## 12.243.1 Member Typedef Documentation

### 12.243.1.1 value [1/2]

typedef [ModeCategories::ConvertTo<ElementCategories::MachineFloatTag>](#) value

### 12.243.1.2 value [2/2]

typedef [ModeCategories::DefaultTag](#) value

The documentation for this struct was generated from the following file:

- [field-traits.h](#)



## 12.244 ModeTraits< Givaro::Montgomery< T > > Struct Template Reference

```
#include <field-traits.h>
```

### Public Types

- typedef [ModeCategories::DefaultBoundedTag](#) value
- typedef [ModeCategories::DefaultTag](#) value

### 12.244.1 Member Typedef Documentation

#### 12.244.1.1 value [1/2]

```
template<class T>
typedef ModeCategories::DefaultBoundedTag value
```

#### 12.244.1.2 value [2/2]

```
typedef ModeCategories::DefaultTag value
```

The documentation for this struct was generated from the following file:

- [field-traits.h](#)

## 12.245 ModeTraits< Givaro::ZRing< double > > Struct Reference

```
#include <field-traits.h>
```

### Public Types

- typedef [ModeCategories::DefaultBoundedTag](#) value
- typedef [ModeCategories::DefaultTag](#) value

### 12.245.1 Member Typedef Documentation

#### 12.245.1.1 value [1/2]

```
typedef ModeCategories::DefaultBoundedTag value
```

#### 12.245.1.2 value [2/2]

```
typedef ModeCategories::DefaultTag value
```

The documentation for this struct was generated from the following file:

- [field-traits.h](#)

## 12.246 ModeTraits< Givaro::ZRing< float > > Struct Reference

```
#include <field-traits.h>
```

### Public Types

- typedef [ModeCategories::DefaultBoundedTag](#) value
- typedef [ModeCategories::DefaultTag](#) value

### 12.246.1 Member Typedef Documentation

#### 12.246.1.1 value [1/2]

```
typedef ModeCategories::DefaultBoundedTag value
```

**12.246.1.2 value [2/2]**

```
typedef ModeCategories::DefaultTag value
```

The documentation for this struct was generated from the following file:

- [field-traits.h](#)

**12.247 ModeTraits< Givaro::ZRing< Givaro::Integer > > Struct Reference**

```
#include <field-traits.h>
```

**Public Types**

- typedef [ModeCategories::ConvertTo< ElementCategories::RNSElementTag > value](#)
- typedef [ModeCategories::DefaultTag value](#)

**12.247.1 Member Typedef Documentation****12.247.1.1 value [1/2]**

```
typedef ModeCategories::ConvertTo<ElementCategories::RNSElementTag> value
```

**12.247.1.2 value [2/2]**

```
typedef ModeCategories::DefaultTag value
```

The documentation for this struct was generated from the following file:

- [field-traits.h](#)

**12.248 ModularBalanced< T > Class Template Reference**

The documentation for this class was generated from the following file:

- [field-traits.h](#)

**12.249 ModularBalanced< T > Class Template Reference**

The documentation for this class was generated from the following file:

- [field-traits.h](#)

**12.250 ModularTag Struct Reference**

This is a modular field like e.g. [Modular<T>](#) or [ModularBalanced<T>](#)

```
#include <field-traits.h>
```

**12.250.1 Detailed Description**

This is a modular field like e.g. [Modular<T>](#) or [ModularBalanced<T>](#)

The documentation for this struct was generated from the following file:

- [field-traits.h](#)

**12.251 Montgomery< T > Class Template Reference**

The documentation for this class was generated from the following file:

- [field-traits.h](#)

## 12.252 need\_field\_characteristic< Field > Struct Template Reference

### Static Public Attributes

- static constexpr bool [value](#) = false

### 12.252.1 Field Documentation

#### 12.252.1.1 value

```
template<typename Field>
bool value = false [static], [constexpr]
```

The documentation for this struct was generated from the following file:

- [benchmark-fgemv.C](#)

## 12.253 need\_field\_characteristic< Givaro::Modular< Field > > Struct Template Reference

### Static Public Attributes

- static constexpr bool [value](#) = true
- static constexpr bool [value](#)

### 12.253.1 Field Documentation

#### 12.253.1.1 value [1/2]

```
template<typename Field>
bool value = true [static], [constexpr]
```

#### 12.253.1.2 value [2/2]

```
bool value [static], [constexpr]
```

The documentation for this struct was generated from the following file:

- [benchmark-fgemv.C](#)

## 12.254 need\_field\_characteristic< Givaro::ModularBalanced< Field > > Struct Template Reference

### Static Public Attributes

- static constexpr bool [value](#) = true
- static constexpr bool [value](#)

### 12.254.1 Field Documentation

#### 12.254.1.1 value [1/2]

```
template<typename Field>
bool value = true [static], [constexpr]
```

#### 12.254.1.2 value [2/2]

```
bool value [static], [constexpr]
```

The documentation for this struct was generated from the following file:

- [benchmark-fgemv.C](#)

## 12.255 NoSimd< T > Struct Template Reference

```
#include <fflas_simd.h>
```

### Public Types

- using `vect_t` = T\*
- using `scalar_t` = T
- using `aligned_allocator` = AlignedAllocator<`scalar_t`, Alignment(`alignment`)>
- using `aligned_vector` = std::vector<`scalar_t`, `aligned_allocator`>
- template<class `Field`>  
using `is_same_element` = std::is\_same<typename `Field::Element`, T>

### Static Public Member Functions

- static const std::string `type_string` ()
- template<class TT>  
static constexpr bool `valid` (TT p)
- template<class TT>  
static constexpr bool `compliant` (TT n)

### Static Public Attributes

- static const constexpr size\_t `vect_size` = 1
- static const constexpr size\_t `alignment` = static\_cast<size\_t>(Alignment::Normal)

## 12.255.1 Member Typedef Documentation

### 12.255.1.1 vect\_t

```
template<typename T>  
using vect_t = T*
```

### 12.255.1.2 scalar\_t

```
template<typename T>  
using scalar_t = T
```

### 12.255.1.3 aligned\_allocator

```
template<typename T>  
using aligned_allocator = AlignedAllocator<scalar_t, Alignment(alignment)>
```

### 12.255.1.4 aligned\_vector

```
template<typename T>  
using aligned_vector = std::vector<scalar_t, aligned_allocator>
```

### 12.255.1.5 is\_same\_element

```
template<typename T>  
template<class Field>  
using is_same_element = std::is_same<typename Field::Element, T>
```

## 12.255.2 Member Function Documentation

### 12.255.2.1 type\_string()

```
template<typename T>  
static const std::string type_string () [inline], [static]
```

**12.255.2.2 valid()**

```
template<typename T>
template<class TT>
static constexpr bool valid (
    TT p) [inline], [static], [constexpr]
```

**12.255.2.3 compliant()**

```
template<typename T>
template<class TT>
static constexpr bool compliant (
    TT n) [inline], [static], [constexpr]
```

**12.255.3 Field Documentation****12.255.3.1 vect\_size**

```
template<typename T>
const constexpr size_t vect_size = 1 [static], [constexpr]
```

**12.255.3.2 alignment**

```
template<typename T>
const constexpr size_t alignment = static_cast<size_t>(Alignment::Normal) [static], [constexpr]
```

The documentation for this struct was generated from the following file:

- [fflas\\_simd.h](#)

**12.256 Parallel< C, P > Struct Template Reference****Public Types**

- typedef C [Cut](#)
- typedef P [Param](#)

**Public Member Functions**

- [Parallel](#) (size\_t n=[NUM\\_THREADS](#))
- size\_t [numthreads](#) () const
- size\_t & [set\\_numthreads](#) (size\_t n)

**Friends**

- std::ostream & [operator<<](#) (std::ostream &out, const [Parallel](#) &p)

**12.256.1 Member Typedef Documentation****12.256.1.1 Cut**

```
template<typename C = CuttingStrategy::Block, typename P = StrategyParameter::Threads>
typedef C Cut
```

**12.256.1.2 Param**

```
template<typename C = CuttingStrategy::Block, typename P = StrategyParameter::Threads>
typedef P Param
```

## 12.256.2 Constructor & Destructor Documentation

### 12.256.2.1 Parallel()

```
template<typename C = CuttingStrategy::Block, typename P = StrategyParameter::Threads>
Parallel (
    size_t n = NUM_THREADS) [inline]
```

## 12.256.3 Member Function Documentation

### 12.256.3.1 numthreads()

```
template<typename C = CuttingStrategy::Block, typename P = StrategyParameter::Threads>
size_t numthreads () const [inline]
```

### 12.256.3.2 set\_numthreads()

```
template<typename C = CuttingStrategy::Block, typename P = StrategyParameter::Threads>
size_t & set_numthreads (
    size_t n) [inline]
```

## 12.256.4 Friends And Related Symbol Documentation

### 12.256.4.1 operator<<

```
template<typename C = CuttingStrategy::Block, typename P = StrategyParameter::Threads>
std::ostream & operator<< (
    std::ostream & out,
    const Parallel< C, P > & p) [friend]
```

The documentation for this struct was generated from the following file:

- [blockcuts.inl](#)

## 12.257 RNSInteger< RNS >::RandIter Class Reference

```
#include <rns-integer.h>
```

Inheritance diagram for RNSInteger< RNS >::RandIter:



### Public Member Functions

- [RandIter](#) (const [RNSInteger< RNS >](#) &F, uint64\_t seed=0)
- [RNS::Element & random](#) (typename [RNS::Element](#) &elt) const  
*RNS ring Element random assignement.*
- [RNS::Element random](#) () const
- [RNS::Element & operator\(\)](#) (typename [RNS::Element](#) &elt) const
- [RNS::Element operator\(\)](#) () const
- const [RNS & ring](#) () const

## 12.257.1 Constructor & Destructor Documentation

### 12.257.1.1 RandIter()

```
template<typename RNS>
RandIter (
    const RNSInteger< RNS > & F,
    uint64_t seed = 0) [inline]
```

## 12.257.2 Member Function Documentation

### 12.257.2.1 random() [1/2]

```
template<typename RNS>
RNS::Element & random (
    typename RNS::Element & elt) const [inline], [inherited]
```

RNS ring [Element](#) random assignment.

[Element](#) is supposed to be initialized

Returns

random ring [Element](#)

### 12.257.2.2 random() [2/2]

```
template<typename RNS>
RNS::Element random () const [inline], [inherited]
```

### 12.257.2.3 operator>() [1/2]

```
template<typename RNS>
RNS::Element & operator() (
    typename RNS::Element & elt) const [inline], [inherited]
```

### 12.257.2.4 operator>() [2/2]

```
template<typename RNS>
RNS::Element operator() () const [inline], [inherited]
```

### 12.257.2.5 ring()

```
template<typename RNS>
const RNS & ring () const [inline], [inherited]
```

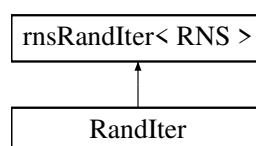
The documentation for this class was generated from the following file:

- [rns-integer.h](#)

## 12.258 RNSIntegerMod< RNS >::RandIter Class Reference

```
#include <rns-integer-mod.h>
```

Inheritance diagram for RNSIntegerMod< RNS >::RandIter:



## Public Member Functions

- [RandIter](#) (const [RNSIntegerMod](#)< [RNS](#) > &F, uint64\_t seed=0)
- [RNS::Element](#) & [random](#) (typename [RNS::Element](#) &elt) const
- [RNS::Element](#) [random](#) () const
- [RNS::Element](#) & [operator\(\)](#) (typename [RNS::Element](#) &elt) const
- [RNS::Element](#) [operator\(\)](#) () const
- const [RNS](#) & [ring](#) () const

## 12.258.1 Constructor & Destructor Documentation

### 12.258.1.1 RandIter()

```
template<typename RNS>
RandIter (
    const RNSIntegerMod< RNS > & F,
    uint64_t seed = 0) [inline]
```

## 12.258.2 Member Function Documentation

### 12.258.2.1 random() [1/2]

```
template<typename RNS>
RNS::Element & random (
    typename RNS::Element & elt) const [inline]
```

### 12.258.2.2 random() [2/2]

```
template<typename RNS>
RNS::Element random () const [inline], [inherited]
```

### 12.258.2.3 operator>() [1/2]

```
template<typename RNS>
RNS::Element & operator() (
    typename RNS::Element & elt) const [inline], [inherited]
```

### 12.258.2.4 operator>() [2/2]

```
template<typename RNS>
RNS::Element operator() () const [inline], [inherited]
```

### 12.258.2.5 ring()

```
template<typename RNS>
const RNS & ring () const [inline], [inherited]
```

The documentation for this class was generated from the following file:

- [rns-integer-mod.h](#)

## 12.259 readMyMachineType< Field, T > Struct Template Reference

```
#include <read_sparse.h>
```

## Public Types

- typedef [Field::Element](#) [Element](#)
- typedef [Field::Element\\_ptr](#) [Element\\_ptr](#)



## Public Member Functions

- void [operator\(\)](#) (const [Field](#) &F, [Element](#) &modulo, [Element\\_ptr](#) val, std::ifstream &file, const uint64\_t dims, const [mask\\_t](#) data\_type, const [mask\\_t](#) field\_desc)

## 12.259.1 Member Typedef Documentation

### 12.259.1.1 Element

```
template<class Field, class T>
typedef Field::Element Element
```

### 12.259.1.2 Element\_ptr

```
template<class Field, class T>
typedef Field::Element\_ptr Element\_ptr
```

## 12.259.2 Member Function Documentation

### 12.259.2.1 operator()()

```
template<class Field, typename T>
void operator() (
    const Field & F,
    Element & modulo,
    Element\_ptr val,
    std::ifstream & file,
    const uint64_t dims,
    const mask\_t data_type,
    const mask\_t field_desc)
```

The documentation for this struct was generated from the following file:

- [read\\_sparse.h](#)

## 12.260 readMyMachineType< Field, mpz\_t > Struct Template Reference

```
#include <read_sparse.h>
```

## Public Types

- typedef [Field::Element](#) [Element](#)
- typedef [Field::Element\\_ptr](#) [Element\\_ptr](#)
- typedef [Field::Element](#) [Element](#)
- typedef [Field::Element\\_ptr](#) [Element\\_ptr](#)

## Public Member Functions

- void [operator\(\)](#) (const [Field](#) &F, [Element](#) &modulo, [Element\\_ptr](#) val, std::ifstream &file, const uint64\_t dims, const [mask\\_t](#) data\_type, const [mask\\_t](#) field\_desc)
- void [operator\(\)](#) (const [Field](#) &F, [Element](#) &modulo, [Element\\_ptr](#) val, std::ifstream &file, const uint64\_t dims, const [mask\\_t](#) data\_type, const [mask\\_t](#) field\_desc)

## 12.260.1 Member Typedef Documentation

### 12.260.1.1 Element [1/2]

```
template<class Field>
typedef Field::Element Element
```

**12.260.1.2 Element\_ptr [1/2]**

```
template<class Field>
typedef Field::Element_ptr Element_ptr
```

**12.260.1.3 Element [2/2]**

```
typedef Field::Element Element
```

**12.260.1.4 Element\_ptr [2/2]**

```
typedef Field::Element_ptr Element_ptr
```

**12.260.2 Member Function Documentation****12.260.2.1 operator>() [1/2]**

```
template<class Field>
void operator() (
    const Field & F,
    typename Field::Element & modulo,
    typename Field::Element_ptr val,
    std::ifstream & file,
    const uint64_t dims,
    const mask_t data_type,
    const mask_t field_desc)
```

**12.260.2.2 operator>() [2/2]**

```
void operator() (
    const Field & F,
    Element & modulo,
    Element_ptr val,
    std::ifstream & file,
    const uint64_t dims,
    const mask_t data_type,
    const mask_t field_desc)
```

The documentation for this struct was generated from the following file:

- [read\\_sparse.h](#)

**12.261 Recursive Struct Reference**

The documentation for this struct was generated from the following file:

- [blockcuts.inl](#)

**12.262 Recursive Struct Reference**

The documentation for this struct was generated from the following file:

- [fflas\\_helpers.inl](#)

**12.263 array< T >::reverse\_iterator Class Reference**

STL iterator class.

### 12.263.1 Detailed Description

STL iterator class.

The documentation for this class was generated from the following files:

## 12.264 string::reverse\_iterator Class Reference

STL iterator class.

### 12.264.1 Detailed Description

STL iterator class.

The documentation for this class was generated from the following files:

## 12.265 vector< T >::reverse\_iterator Class Reference

STL iterator class.

### 12.265.1 Detailed Description

STL iterator class.

The documentation for this class was generated from the following files:

## 12.266 rint< K > Class Template Reference

The documentation for this class was generated from the following file:

- [field-traits.h](#)

## 12.267 rns\_double Struct Reference

```
#include <rns-double.h>
```

### Public Types

- typedef Givaro::Integer [integer](#)
- typedef Givaro::Modular< double > [ModField](#)
- typedef double [BasisElement](#)
- typedef [rns\\_double\\_elt](#) [Element](#)
- typedef [rns\\_double\\_elt\\_ptr](#) [Element\\_ptr](#)
- typedef [rns\\_double\\_elt\\_cstptr](#) [ConstElement\\_ptr](#)

### Public Member Functions

- [rns\\_double](#) (const [integer](#) &bound, size\_t pbits, bool rnsmod=false, long seed=time(NULL))
- [rns\\_double](#) (size\_t pbits, size\_t size, long seed=time(NULL))
- template<typename Vect>  
  [rns\\_double](#) (const Vect &basis, bool rnsmod=false, long seed=time(NULL))
- [rns\\_double](#) (const [RNSIntegerMod](#)< [rns\\_double](#) > &basis, bool rnsmod=false, long seed=time(NULL))
- void [precompute\\_cst](#) (size\_t K=0)
- template<typename T>  
  void [init](#) (size\_t m, size\_t n, double \*Arns, size\_t rda, const T \*A, size\_t lda, const [integer](#) &maxA, bool RNS\_MAJOR=false) const
- void [init](#) (size\_t m, size\_t n, double \*Arns, size\_t rda, const [integer](#) \*A, size\_t lda, size\_t k, bool RNS\_MAJOR=false) const

- void [init\\_transpose](#) (size\_t m, size\_t n, double \*Arns, size\_t rda, const [integer](#) \*A, size\_t lda, size\_t k, bool RNS\_MAJOR=false) const
- void [convert](#) (size\_t m, size\_t n, [integer](#) gamma, [integer](#) \*A, size\_t lda, const double \*Arns, size\_t rda, bool RNS\_MAJOR=false) const
- void [convert\\_transpose](#) (size\_t m, size\_t n, [integer](#) gamma, [integer](#) \*A, size\_t lda, const double \*Arns, size\_t rda, bool RNS\_MAJOR=false) const
- void [reduce](#) (size\_t n, double \*Arns, size\_t rda, bool RNS\_MAJOR=false) const
- template<size\_t K>  
void [init](#) (size\_t m, size\_t n, double \*Arns, size\_t rda, const [Reclnt::ruint](#)< K > \*A, size\_t lda, size\_t k, bool RNS\_MAJOR=false) const
- template<size\_t K>  
void [convert](#) (size\_t m, size\_t n, [integer](#) gamma, [Reclnt::ruint](#)< K > \*A, size\_t lda, const double \*Arns, size\_t rda, [integer](#) p=0, bool RNS\_MAJOR=false) const

## Data Fields

- std::vector< double, AlignedAllocator< double, Alignment::CACHE\_LINE > > [\\_basis](#)
- std::vector< double, AlignedAllocator< double, Alignment::CACHE\_LINE > > [\\_basisMax](#)
- std::vector< double, AlignedAllocator< double, Alignment::CACHE\_LINE > > [\\_negbasis](#)
- std::vector< double, AlignedAllocator< double, Alignment::CACHE\_LINE > > [\\_invbasis](#)
- std::vector< [ModField](#) > [\\_field\\_rns](#)
- [integer](#) [\\_M](#)
- std::vector< [integer](#) > [\\_Mi](#)
- std::vector< double > [\\_MMi](#)
- std::vector< double > [\\_crt\\_in](#)
- std::vector< double > [\\_crt\\_out](#)
- size\_t [\\_size](#)
- size\_t [\\_pbits](#)
- size\_t [\\_ldm](#)
- [integer](#) [\\_mi\\_sum](#)

## 12.267.1 Member Typedef Documentation

### 12.267.1.1 integer

```
typedef Givaro::Integer integer
```

### 12.267.1.2 ModField

```
typedef Givaro::Modular<double> ModField
```

### 12.267.1.3 BasisElement

```
typedef double BasisElement
```

### 12.267.1.4 Element

```
typedef rns\_double\_elt Element
```

### 12.267.1.5 Element\_ptr

```
typedef rns\_double\_elt\_ptr Element\_ptr
```

### 12.267.1.6 ConstElement\_ptr

```
typedef rns\_double\_elt\_cstptr ConstElement\_ptr
```

## 12.267.2 Constructor & Destructor Documentation

### 12.267.2.1 rns\_double() [1/4]

```
rns_double (
    const integer & bound,
    size_t pbits,
    bool rnsmod = false,
    long seed = time(NULL)) [inline]
```

### 12.267.2.2 rns\_double() [2/4]

```
rns_double (
    size_t pbits,
    size_t size,
    long seed = time(NULL)) [inline]
```

### 12.267.2.3 rns\_double() [3/4]

```
template<typename Vect>
rns_double (
    const Vect & basis,
    bool rnsmod = false,
    long seed = time(NULL)) [inline]
```

### 12.267.2.4 rns\_double() [4/4]

```
rns_double (
    const RNSIntegerMod< rns_double > & basis,
    bool rnsmod = false,
    long seed = time(NULL)) [inline]
```

## 12.267.3 Member Function Documentation

### 12.267.3.1 precompute\_cst()

```
void precompute_cst (
    size_t K = 0) [inline]
```

### 12.267.3.2 init() [1/3]

```
template<typename T>
void init (
    size_t m,
    size_t n,
    double * Arns,
    size_t rda,
    const T * A,
    size_t lda,
    const integer & maxA,
    bool RNS_MAJOR = false) const [inline]
```

### 12.267.3.3 init() [2/3]

```
void init (
    size_t m,
    size_t n,
    double * Arns,
    size_t rda,
    const integer * A,
```

```

size_t lda,
size_t k,
bool RNS_MAJOR = false) const [inline]

```

#### 12.267.3.4 init\_transpose()

```

void init_transpose (
    size_t m,
    size_t n,
    double * Arns,
    size_t rda,
    const integer * A,
    size_t lda,
    size_t k,
    bool RNS_MAJOR = false) const [inline]

```

#### 12.267.3.5 convert() [1/2]

```

void convert (
    size_t m,
    size_t n,
    integer gamma,
    integer * A,
    size_t lda,
    const double * Arns,
    size_t rda,
    bool RNS_MAJOR = false) const [inline]

```

#### 12.267.3.6 convert\_transpose()

```

void convert_transpose (
    size_t m,
    size_t n,
    integer gamma,
    integer * A,
    size_t lda,
    const double * Arns,
    size_t rda,
    bool RNS_MAJOR = false) const [inline]

```

#### 12.267.3.7 reduce()

```

void reduce (
    size_t n,
    double * Arns,
    size_t rda,
    bool RNS_MAJOR = false) const [inline]

```

#### 12.267.3.8 init() [3/3]

```

template<size_t K>
void init (
    size_t m,
    size_t n,
    double * Arns,
    size_t rda,
    const RecInt::ruint< K > * A,
    size_t lda,

```

```
size_t k,
bool RNS_MAJOR = false) const [inline]
```

### 12.267.3.9 convert() [2/2]

```
template<size_t K>
void convert (
    size_t m,
    size_t n,
    integer gamma,
    RecInt::ruint< K > * A,
    size_t lda,
    const double * Arns,
    size_t rda,
    integer p = 0,
    bool RNS_MAJOR = false) const [inline]
```

## 12.267.4 Field Documentation

### 12.267.4.1 \_basis

```
std::vector<double, AlignedAllocator<double, Alignment::CACHE_LINE> > _basis
```

### 12.267.4.2 \_basisMax

```
std::vector<double, AlignedAllocator<double, Alignment::CACHE_LINE> > _basisMax
```

### 12.267.4.3 \_negbasis

```
std::vector<double, AlignedAllocator<double, Alignment::CACHE_LINE> > _negbasis
```

### 12.267.4.4 \_invbasis

```
std::vector<double, AlignedAllocator<double, Alignment::CACHE_LINE> > _invbasis
```

### 12.267.4.5 \_field\_rns

```
std::vector<ModField> _field_rns
```

### 12.267.4.6 \_M

```
integer _M
```

### 12.267.4.7 \_Mi

```
std::vector<integer> _Mi
```

### 12.267.4.8 \_MMi

```
std::vector<double> _MMi
```

### 12.267.4.9 \_crt\_in

```
std::vector<double> _crt_in
```

### 12.267.4.10 \_crt\_out

```
std::vector<double> _crt_out
```

**12.267.4.11 \_size**

```
size_t _size
```

**12.267.4.12 \_pbits**

```
size_t _pbits
```

**12.267.4.13 \_ldm**

```
size_t _ldm
```

**12.267.4.14 \_mi\_sum**

```
integer _mi_sum
```

The documentation for this struct was generated from the following files:

- [rns-double.h](#)
- [rns-double-recint.inl](#)
- [rns-double.inl](#)

**12.268 rns\_double\_elt Struct Reference**

```
#include <rns-double-elt.h>
```

Inheritance diagram for rns\_double\_elt:

**Public Member Functions**

- [rns\\_double\\_elt\(\)](#)
- [~rns\\_double\\_elt\(\)](#)
- [rns\\_double\\_elt\(double \\*p, size\\_t r, size\\_t a=false\)](#)
- [rns\\_double\\_elt\\_ptr operator&\(\)](#)
- [rns\\_double\\_elt\\_cstptr operator&\(\) const](#)
- [rns\\_double\\_elt\(const rns\\_double\\_elt &x\)](#)

**Data Fields**

- [double \\*\\_ptr](#)
- [size\\_t \\_stride](#)
- [bool \\_alloc](#)

**12.268.1 Constructor & Destructor Documentation****12.268.1.1 rns\_double\_elt() [1/3]**

```
rns_double_elt () [inline]
```

**12.268.1.2 ~rns\_double\_elt()**

```
~rns_double_elt () [inline]
```



**12.268.1.3 rns\_double\_elt()** [2/3]

```
rns_double_elt (
    double * p,
    size_t r,
    size_t a = false) [inline]
```

**12.268.1.4 rns\_double\_elt()** [3/3]

```
rns_double_elt (
    const rns_double_elt & x) [inline]
```

**12.268.2 Member Function Documentation****12.268.2.1 operator&()** [1/2]

```
rns_double_elt_ptr operator& () [inline]
```

**12.268.2.2 operator&()** [2/2]

```
rns_double_elt_cstptr operator& () const [inline]
```

**12.268.3 Field Documentation****12.268.3.1 \_ptr**

```
double* _ptr
```

**12.268.3.2 \_stride**

```
size_t _stride
```

**12.268.3.3 \_alloc**

```
bool _alloc
```

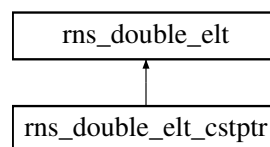
The documentation for this struct was generated from the following file:

- [rns-double-elt.h](#)

**12.269 rns\_double\_elt\_cstptr Struct Reference**

```
#include <rns-double-elt.h>
```

Inheritance diagram for rns\_double\_elt\_cstptr:

**Public Member Functions**

- [rns\\_double\\_elt\\_cstptr](#) ()
- [rns\\_double\\_elt\\_cstptr](#) (double \*p, size\_t r)
- [rns\\_double\\_elt\\_cstptr](#) (const [rns\\_double\\_elt\\_ptr](#) &x)
- [rns\\_double\\_elt\\_cstptr](#) (const [rns\\_double\\_elt\\_cstptr](#) &x)
- [rns\\_double\\_elt\\_cstptr](#) ([rns\\_double\\_elt\\_cstptr](#) &&)=default
- [rns\\_double\\_elt\\_cstptr](#) \* [operator&](#) ()
- [rns\\_double\\_elt](#) & [operator\\*](#) () const

- `rns_double_elt operator[]` (`size_t i`) `const`
- `rns_double_elt & operator[]` (`size_t i`)
- `rns_double_elt_cstptr operator++` ()
- `rns_double_elt_cstptr operator--` ()
- `rns_double_elt_cstptr operator+` (`size_t inc`) `const`
- `rns_double_elt_cstptr operator-` (`size_t inc`) `const`
- `rns_double_elt_cstptr & operator+=` (`size_t inc`)
- `rns_double_elt_cstptr & operator-=` (`size_t inc`)
- `rns_double_elt_cstptr & operator=` (`const rns_double_elt_cstptr &x`)
- `bool operator<` (`const rns_double_elt_cstptr &x`)
- `bool operator!=` (`const rns_double_elt_cstptr &x`)
- `rns_double_elt_cstptr operator&` () `const`

### Data Fields

- `rns_double_elt other`
- `double * _ptr`
- `size_t _stride`
- `bool _alloc`

## 12.269.1 Constructor & Destructor Documentation

### 12.269.1.1 `rns_double_elt_cstptr()` [1/5]

```
rns_double_elt_cstptr () [inline]
```

### 12.269.1.2 `rns_double_elt_cstptr()` [2/5]

```
rns_double_elt_cstptr (
    double * p,
    size_t r) [inline]
```

### 12.269.1.3 `rns_double_elt_cstptr()` [3/5]

```
rns_double_elt_cstptr (
    const rns_double_elt_ptr & x) [inline]
```

### 12.269.1.4 `rns_double_elt_cstptr()` [4/5]

```
rns_double_elt_cstptr (
    const rns_double_elt_cstptr & x) [inline]
```

### 12.269.1.5 `rns_double_elt_cstptr()` [5/5]

```
rns_double_elt_cstptr (
    rns_double_elt_cstptr && ) [default]
```

## 12.269.2 Member Function Documentation

### 12.269.2.1 `operator&()` [1/2]

```
rns_double_elt_cstptr * operator& () [inline]
```

### 12.269.2.2 `operator*()`

```
rns_double_elt & operator* () const [inline]
```

**12.269.2.3 operator[]()** [1/2]

```
rns_double_elt operator[] (
    size_t i) const [inline]
```

**12.269.2.4 operator[]()** [2/2]

```
rns_double_elt & operator[] (
    size_t i) [inline]
```

**12.269.2.5 operator++()**

```
rns_double_elt_cstptr operator++ () [inline]
```

**12.269.2.6 operator--()**

```
rns_double_elt_cstptr operator-- () [inline]
```

**12.269.2.7 operator+()**

```
rns_double_elt_cstptr operator+ (
    size_t inc) const [inline]
```

**12.269.2.8 operator-()**

```
rns_double_elt_cstptr operator- (
    size_t inc) const [inline]
```

**12.269.2.9 operator+=()**

```
rns_double_elt_cstptr & operator+= (
    size_t inc) [inline]
```

**12.269.2.10 operator-=()**

```
rns_double_elt_cstptr & operator-= (
    size_t inc) [inline]
```

**12.269.2.11 operator=()**

```
rns_double_elt_cstptr & operator= (
    const rns_double_elt_cstptr & x) [inline]
```

**12.269.2.12 operator<()**

```
bool operator< (
    const rns_double_elt_cstptr & x) [inline]
```

**12.269.2.13 operator"!=()**

```
bool operator!= (
    const rns_double_elt_cstptr & x) [inline]
```

**12.269.2.14 operator&()** [2/2]

```
rns_double_elt_cstptr operator& () const [inline], [inherited]
```

### 12.269.3 Field Documentation

#### 12.269.3.1 other

`rns_double_elt` other

#### 12.269.3.2 \_ptr

`double* _ptr` [inherited]

#### 12.269.3.3 \_stride

`size_t _stride` [inherited]

#### 12.269.3.4 \_alloc

`bool _alloc` [inherited]

The documentation for this struct was generated from the following file:

- [rns-double-elt.h](#)

## 12.270 rns\_double\_elt\_ptr Struct Reference

```
#include <rns-double-elt.h>
```

Inheritance diagram for `rns_double_elt_ptr`:



### Public Member Functions

- [rns\\_double\\_elt\\_ptr](#) ()
- [rns\\_double\\_elt\\_ptr](#) (double \*p, size\_t r)
- [rns\\_double\\_elt\\_ptr](#) (const [rns\\_double\\_elt\\_ptr](#) &x)
- [rns\\_double\\_elt\\_ptr](#) (const [rns\\_double\\_elt\\_cstptr](#) &x)
- [rns\\_double\\_elt\\_ptr](#) ([rns\\_double\\_elt\\_ptr](#) &&)=default
- [rns\\_double\\_elt\\_ptr](#) \* [operator&](#) ()
- [rns\\_double\\_elt](#) & [operator\\*](#) ()
- [rns\\_double\\_elt](#) [operator\[\]](#) (size\_t i) const
- [rns\\_double\\_elt](#) & [operator\[\]](#) (size\_t i)
- [rns\\_double\\_elt\\_ptr](#) [operator++](#) ()
- [rns\\_double\\_elt\\_ptr](#) [operator--](#) ()
- [rns\\_double\\_elt\\_ptr](#) [operator+](#) (size\_t inc)
- [rns\\_double\\_elt\\_ptr](#) [operator-](#) (size\_t inc)
- [rns\\_double\\_elt\\_ptr](#) & [operator+=](#) (size\_t inc)
- [rns\\_double\\_elt\\_ptr](#) & [operator-=](#) (size\_t inc)
- [rns\\_double\\_elt\\_ptr](#) & [operator=](#) (const [rns\\_double\\_elt\\_ptr](#) &x)
- bool [operator<](#) (const [rns\\_double\\_elt\\_ptr](#) &x)
- bool [operator!=](#) (const [rns\\_double\\_elt\\_ptr](#) &x)
- [rns\\_double\\_elt\\_cstptr](#) [operator&](#) () const

**Data Fields**

- [rns\\_double\\_elt](#) other
- double \* [\\_ptr](#)
- size\_t [\\_stride](#)
- bool [\\_alloc](#)

**12.270.1 Constructor & Destructor Documentation****12.270.1.1 rns\_double\_elt\_ptr() [1/5]**

```
rns_double_elt_ptr () [inline]
```

**12.270.1.2 rns\_double\_elt\_ptr() [2/5]**

```
rns_double_elt_ptr (
    double * p,
    size_t r) [inline]
```

**12.270.1.3 rns\_double\_elt\_ptr() [3/5]**

```
rns_double_elt_ptr (
    const rns_double_elt_ptr & x) [inline]
```

**12.270.1.4 rns\_double\_elt\_ptr() [4/5]**

```
rns_double_elt_ptr (
    const rns_double_elt_cstptr & x) [inline]
```

**12.270.1.5 rns\_double\_elt\_ptr() [5/5]**

```
rns_double_elt_ptr (
    rns_double_elt_ptr && ) [default]
```

**12.270.2 Member Function Documentation****12.270.2.1 operator&() [1/2]**

```
rns_double_elt_ptr * operator& () [inline]
```

**12.270.2.2 operator\*()**

```
rns_double_elt & operator* () [inline]
```

**12.270.2.3 operator[]() [1/2]**

```
rns_double_elt operator[] (
    size_t i) const [inline]
```

**12.270.2.4 operator[]() [2/2]**

```
rns_double_elt & operator[] (
    size_t i) [inline]
```

**12.270.2.5 operator++()**

```
rns_double_elt_ptr operator++ () [inline]
```

**12.270.2.6 operator--()**

```
rns_double_elt_ptr operator-- () [inline]
```

**12.270.2.7 operator+()**

```
rns_double_elt_ptr operator+ (
    size_t inc) [inline]
```

**12.270.2.8 operator-()**

```
rns_double_elt_ptr operator- (
    size_t inc) [inline]
```

**12.270.2.9 operator+=()**

```
rns_double_elt_ptr & operator+= (
    size_t inc) [inline]
```

**12.270.2.10 operator-=()**

```
rns_double_elt_ptr & operator-= (
    size_t inc) [inline]
```

**12.270.2.11 operator=()**

```
rns_double_elt_ptr & operator= (
    const rns_double_elt_ptr & x) [inline]
```

**12.270.2.12 operator<()**

```
bool operator< (
    const rns_double_elt_ptr & x) [inline]
```

**12.270.2.13 operator"!="()**

```
bool operator!= (
    const rns_double_elt_ptr & x) [inline]
```

**12.270.2.14 operator&() [2/2]**

```
rns_double_elt_cstptr operator& () const [inline], [inherited]
```

**12.270.3 Field Documentation****12.270.3.1 other**

```
rns_double_elt other
```

**12.270.3.2 \_ptr**

```
double* _ptr [inherited]
```

**12.270.3.3 \_stride**

```
size_t _stride [inherited]
```

**12.270.3.4 \_alloc**

```
bool _alloc [inherited]
```

The documentation for this struct was generated from the following file:

- [rns-double-elt.h](#)

## 12.271 rns\_double\_extended Struct Reference

```
#include <rns-double.h>
```

### Public Types

- typedef Givaro::Integer [integer](#)
- typedef Givaro::ModularExtended< double > [ModField](#)
- typedef double [BasisElement](#)
- typedef [rns\\_double\\_elt](#) [Element](#)
- typedef [rns\\_double\\_elt\\_ptr](#) [Element\\_ptr](#)
- typedef [rns\\_double\\_elt\\_cstptr](#) [ConstElement\\_ptr](#)

### Public Member Functions

- [rns\\_double\\_extended](#) (const [integer](#) &bound, size\_t pbits, bool rnsmod=false, long seed=time(NULL))
- [rns\\_double\\_extended](#) (size\_t pbits, size\_t size, long seed=time(NULL))
- template<typename Vect>  
  [rns\\_double\\_extended](#) (const Vect &basis, bool rnsmod=false, long seed=time(NULL))
- void [precompute\\_cst](#) ()
- void [init](#) (size\_t m, size\_t n, double \*Arns, size\_t rda, const [integer](#) \*A, size\_t lda, const [integer](#) &maxA, bool RNS\_MAJOR=false) const
- void [init](#) (size\_t m, size\_t n, double \*Arns, size\_t rda, const [integer](#) \*A, size\_t lda, size\_t k, bool RNS\_↔MAJOR=false)
- void [convert](#) (size\_t m, size\_t n, [integer](#) gamma, [integer](#) \*A, size\_t lda, const double \*Arns, size\_t rda, bool RNS\_MAJOR=false)
- void [init](#) (size\_t m, double \*Arns, const [integer](#) \*A, size\_t lda) const
- void [convert](#) (size\_t m, [integer](#) \*A, const double \*Arns) const
- void [reduce](#) (size\_t n, double \*Arns, size\_t rda, bool RNS\_MAJOR=false) const

### Data Fields

- std::vector< double, AlignedAllocator< double, Alignment::CACHE\_LINE > > [\\_basis](#)
- std::vector< double, AlignedAllocator< double, Alignment::CACHE\_LINE > > [\\_basisMax](#)
- std::vector< double, AlignedAllocator< double, Alignment::CACHE\_LINE > > [\\_negbasis](#)
- std::vector< double, AlignedAllocator< double, Alignment::CACHE\_LINE > > [\\_invbasis](#)
- std::vector< [ModField](#) > [\\_field\\_rns](#)
- [integer](#) [\\_M](#)
- std::vector< [integer](#) > [\\_Mi](#)
- std::vector< double > [\\_MMi](#)
- std::vector< double > [\\_crt\\_in](#)
- std::vector< double > [\\_crt\\_out](#)
- size\_t [\\_size](#)
- size\_t [\\_pbits](#)
- size\_t [\\_ldm](#)

## 12.271.1 Member Typedef Documentation

### 12.271.1.1 integer

```
typedef Givaro::Integer integer
```

### 12.271.1.2 ModField

```
typedef Givaro::ModularExtended<double> ModField
```

**12.271.1.3 BasisElement**

```
typedef double BasisElement
```

**12.271.1.4 Element**

```
typedef rns_double_elt Element
```

**12.271.1.5 Element\_ptr**

```
typedef rns_double_elt_ptr Element_ptr
```

**12.271.1.6 ConstElement\_ptr**

```
typedef rns_double_elt_cstptr ConstElement_ptr
```

**12.271.2 Constructor & Destructor Documentation****12.271.2.1 rns\_double\_extended() [1/3]**

```
rns_double_extended (
    const integer & bound,
    size_t pbits,
    bool rnsmod = false,
    long seed = time(NULL)) [inline]
```

**12.271.2.2 rns\_double\_extended() [2/3]**

```
rns_double_extended (
    size_t pbits,
    size_t size,
    long seed = time(NULL)) [inline]
```

**12.271.2.3 rns\_double\_extended() [3/3]**

```
template<typename Vect>
rns_double_extended (
    const Vect & basis,
    bool rnsmod = false,
    long seed = time(NULL)) [inline]
```

**12.271.3 Member Function Documentation****12.271.3.1 precompute\_cst()**

```
void precompute_cst () [inline]
```

**12.271.3.2 init() [1/3]**

```
void init (
    size_t m,
    size_t n,
    double * Arns,
    size_t rda,
    const integer * A,
    size_t lda,
    const integer & maxA,
    bool RNS_MAJOR = false) const [inline]
```



**12.271.3.3 init() [2/3]**

```
void init (
    size_t m,
    size_t n,
    double * Arns,
    size_t rda,
    const integer * A,
    size_t lda,
    size_t k,
    bool RNS_MAJOR = false) [inline]
```

**12.271.3.4 convert() [1/2]**

```
void convert (
    size_t m,
    size_t n,
    integer gamma,
    integer * A,
    size_t lda,
    const double * Arns,
    size_t rda,
    bool RNS_MAJOR = false) [inline]
```

**12.271.3.5 init() [3/3]**

```
void init (
    size_t m,
    double * Arns,
    const integer * A,
    size_t lda) const [inline]
```

**12.271.3.6 convert() [2/2]**

```
void convert (
    size_t m,
    integer * A,
    const double * Arns) const [inline]
```

**12.271.3.7 reduce()**

```
void reduce (
    size_t n,
    double * Arns,
    size_t rda,
    bool RNS_MAJOR = false) const [inline]
```

**12.271.4 Field Documentation****12.271.4.1 \_basis**

```
std::vector<double, AlignedAllocator<double, Alignment::CACHE_LINE> > _basis
```

**12.271.4.2 \_basisMax**

```
std::vector<double, AlignedAllocator<double, Alignment::CACHE_LINE> > _basisMax
```

**12.271.4.3 \_negbasis**

```
std::vector<double, AlignedAllocator<double, Alignment::CACHE_LINE> > _negbasis
```

**12.271.4.4 \_invbasis**

```
std::vector<double, AlignedAllocator<double, Alignment::CACHE_LINE> > _invbasis
```

**12.271.4.5 \_field\_rns**

```
std::vector<ModField> _field_rns
```

**12.271.4.6 \_M**

```
integer _M
```

**12.271.4.7 \_Mi**

```
std::vector<integer> _Mi
```

**12.271.4.8 \_MMi**

```
std::vector<double> _MMi
```

**12.271.4.9 \_crt\_in**

```
std::vector<double> _crt_in
```

**12.271.4.10 \_crt\_out**

```
std::vector<double> _crt_out
```

**12.271.4.11 \_size**

```
size_t _size
```

**12.271.4.12 \_pbits**

```
size_t _pbits
```

**12.271.4.13 \_ldm**

```
size_t _ldm
```

The documentation for this struct was generated from the following files:

- [rns-double.h](#)
- [rns-double.inl](#)

**12.272 RNSElementTag Struct Reference**

Representation in a Residue Number System.

```
#include <field-traits.h>
```

**12.272.1 Detailed Description**

Representation in a Residue Number System.

The documentation for this struct was generated from the following file:

- [field-traits.h](#)

**12.273 RNSInteger< RNS > Class Template Reference**

```
#include <rns-integer.h>
```

## Data Structures

- class [RandIter](#)

## Public Types

- typedef [RNS::Element](#) [Element](#)
- typedef [RNS::Element\\_ptr](#) [Element\\_ptr](#)
- typedef [RNS::ConstElement\\_ptr](#) [ConstElement\\_ptr](#)

## Public Member Functions

- [RNSInteger](#) (const [RNS](#) &myrns)
- template<typename T>  
  [RNSInteger](#) (const T &F)
- const [RNS](#) & [rns](#) () const
- size\_t [size](#) () const
- bool [isOne](#) (const [Element](#) &x) const
- bool [isMOne](#) (const [Element](#) &x) const
- bool [isZero](#) (const [Element](#) &x) const
- [integer characteristic](#) ([integer](#) &p) const
- [integer cardinality](#) ([integer](#) &p) const
- [Element](#) & [init](#) ([Element](#) &x) const
- [Element](#) & [init](#) ([Element](#) &x, const Givaro::Integer &y) const
- [Element](#) & [reduce](#) ([Element](#) &x, const [Element](#) &y) const
- [Element](#) & [reduce](#) ([Element](#) &x) const
- Givaro::Integer [convert](#) (Givaro::Integer &x, const [Element](#) &y) const
- [Element](#) & [assign](#) ([Element](#) &x, const [Element](#) &y) const
- std::ostream & [write](#) (std::ostream &os, const [Element](#) &y) const
- std::ostream & [write](#) (std::ostream &os) const

## Data Fields

- [Element one](#)
- [Element mOne](#)
- [Element zero](#)

## Protected Types

- typedef [RNS::BasisElement](#) [BasisElement](#)
- typedef Givaro::Integer [integer](#)

## Protected Attributes

- const [RNS](#) \* [\\_rns](#)

## 12.273.1 Member Typedef Documentation

### 12.273.1.1 BasisElement

```
template<typename RNS>
typedef RNS::BasisElement BasisElement [protected]
```

### 12.273.1.2 integer

```
template<typename RNS>
typedef Givaro::Integer integer [protected]
```

**12.273.1.3 Element**

```
template<typename RNS>
typedef RNS::Element Element
```

**12.273.1.4 Element\_ptr**

```
template<typename RNS>
typedef RNS::Element_ptr Element_ptr
```

**12.273.1.5 ConstElement\_ptr**

```
template<typename RNS>
typedef RNS::ConstElement_ptr ConstElement_ptr
```

**12.273.2 Constructor & Destructor Documentation****12.273.2.1 RNSInteger() [1/2]**

```
template<typename RNS>
RNSInteger (
    const RNS & myrns) [inline]
```

**12.273.2.2 RNSInteger() [2/2]**

```
template<typename RNS>
template<typename T>
RNSInteger (
    const T & F) [inline]
```

**12.273.3 Member Function Documentation****12.273.3.1 rns()**

```
template<typename RNS>
const RNS & rns () const [inline]
```

**12.273.3.2 size()**

```
template<typename RNS>
size_t size () const [inline]
```

**12.273.3.3 isOne()**

```
template<typename RNS>
bool isOne (
    const Element & x) const [inline]
```

**12.273.3.4 isMOne()**

```
template<typename RNS>
bool isMOne (
    const Element & x) const [inline]
```

**12.273.3.5 isZero()**

```
template<typename RNS>
bool isZero (
    const Element & x) const [inline]
```

**12.273.3.6 characteristic()**

```
template<typename RNS>
integer characteristic (
    integer & p) const [inline]
```

**12.273.3.7 cardinality()**

```
template<typename RNS>
integer cardinality (
    integer & p) const [inline]
```

**12.273.3.8 init() [1/2]**

```
template<typename RNS>
Element & init (
    Element & x) const [inline]
```

**12.273.3.9 init() [2/2]**

```
template<typename RNS>
Element & init (
    Element & x,
    const Givaro::Integer & y) const [inline]
```

**12.273.3.10 reduce() [1/2]**

```
template<typename RNS>
Element & reduce (
    Element & x,
    const Element & y) const [inline]
```

**12.273.3.11 reduce() [2/2]**

```
template<typename RNS>
Element & reduce (
    Element & x) const [inline]
```

**12.273.3.12 convert()**

```
template<typename RNS>
Givaro::Integer convert (
    Givaro::Integer & x,
    const Element & y) const [inline]
```

**12.273.3.13 assign()**

```
template<typename RNS>
Element & assign (
    Element & x,
    const Element & y) const [inline]
```

**12.273.3.14 write() [1/2]**

```
template<typename RNS>
std::ostream & write (
    std::ostream & os,
    const Element & y) const [inline]
```

**12.273.3.15 write()** [2/2]

```
template<typename RNS>
std::ostream & write (
    std::ostream & os) const [inline]
```

**12.273.4 Field Documentation****12.273.4.1 \_rns**

```
template<typename RNS>
const RNS* _rns [protected]
```

**12.273.4.2 one**

```
template<typename RNS>
Element one
```

**12.273.4.3 mOne**

```
template<typename RNS>
Element mOne
```

**12.273.4.4 zero**

```
template<typename RNS>
Element zero
```

The documentation for this class was generated from the following files:

- [field-traits.h](#)
- [rns-integer.h](#)

**12.274 RNSIntegerMod< RNS > Class Template Reference**

```
#include <rns-integer-mod.h>
```

**Data Structures**

- class [RandIter](#)

**Public Types**

- typedef [RNS::Element](#) [Element](#)
- typedef [RNS::Element\\_ptr](#) [Element\\_ptr](#)
- typedef [RNS::ConstElement\\_ptr](#) [ConstElement\\_ptr](#)

**Public Member Functions**

- [RNSIntegerMod](#) (const [integer](#) &p, const [RNS](#) &myrns)
- const [rns\\_double](#) & [rns](#) () const
- const [RNSInteger](#)< [RNS](#) > & [delayed](#) () const
- size\_t [size](#) () const
- bool [isOne](#) (const [Element](#) &x) const
- bool [isMOne](#) (const [Element](#) &x) const
- bool [isZero](#) (const [Element](#) &x) const
- [integer](#) & [characteristic](#) ([integer](#) &p) const
- [integer](#) [characteristic](#) () const
- [integer](#) & [cardinality](#) ([integer](#) &p) const
- [integer](#) [cardinality](#) () const

- [integer minElement](#) () const
- [integer maxElement](#) () const
- [Element & init](#) ([Element](#) &x) const
- [Element & init](#) ([Element](#) &x, const [Givaro::Integer](#) &y) const
- [Element & reduce](#) ([Element](#) &x, const [Element](#) &y) const
- [Element & reduce](#) ([Element](#) &x) const
- [Element & init](#) ([Element](#) &x, const [Element](#) &y) const
- [Givaro::Integer convert](#) ([Givaro::Integer](#) &x, const [Element](#) &y) const
- [Element & assign](#) ([Element](#) &x, const [Element](#) &y) const
- [Element & add](#) ([Element](#) &x, const [Element](#) &y, const [Element](#) &z) const
- [Element & sub](#) ([Element](#) &x, const [Element](#) &y, const [Element](#) &z) const
- [Element & neg](#) ([Element](#) &x, const [Element](#) &y) const
- [Element & mul](#) ([Element](#) &x, const [Element](#) &y, const [Element](#) &z) const
- [Element & axpyin](#) ([Element](#) &x, const [Element](#) &y, const [Element](#) &z) const
- [Element & inv](#) ([Element](#) &x, const [Element](#) &y) const
- [bool areEqual](#) (const [Element](#) &x, const [Element](#) &y) const
- [std::ostream & write](#) ([std::ostream](#) &os, const [Element](#) &y) const
- [std::ostream & write](#) ([std::ostream](#) &os) const
- [void reduce\\_modp](#) (size\_t n, [Element\\_ptr](#) B) const
- [std::ostream & write\\_matrix](#) ([std::ostream](#) &c, const double \*E, int n, int m, int lda) const
- [std::ostream & write\\_matrix\\_long](#) ([std::ostream](#) &c, const double \*E, int n, int m, int lda) const
- [void reduce\\_modp](#) (size\_t m, size\_t n, [Element\\_ptr](#) B, size\_t lda) const
- [void reduce\\_modp\\_rnsmajor](#) (size\_t n, [Element\\_ptr](#) B) const

## Data Fields

- [Element one](#)
- [Element mOne](#)
- [Element zero](#)

## Protected Types

- [typedef RNS::BasisElement BasisElement](#)
- [typedef Givaro::Modular< BasisElement > ModField](#)
- [typedef Givaro::Integer integer](#)

## Protected Attributes

- [integer \\_p](#)
- [std::vector< BasisElement, AlignedAllocator< BasisElement, Alignment::CACHE\\_LINE > > \\_Mi\\_modp\\_rns](#)
- [std::vector< BasisElement, AlignedAllocator< BasisElement, Alignment::CACHE\\_LINE > > \\_iM\\_modp\\_rns](#)
- [const RNS \\* \\_rns](#)
- [Givaro::Modular< Givaro::Integer > \\_F](#)
- [RNSInteger< RNS > \\_RNSdelayed](#)

## 12.274.1 Member Typedef Documentation

### 12.274.1.1 Element

```
template<typename RNS>
typedef RNS::Element Element
```

### 12.274.1.2 Element\_ptr

```
template<typename RNS>
typedef RNS::Element_ptr Element_ptr
```

**12.274.1.3 ConstElement\_ptr**

```
template<typename RNS>
typedef RNS::ConstElement_ptr ConstElement_ptr
```

**12.274.1.4 BasisElement**

```
template<typename RNS>
typedef RNS::BasisElement BasisElement [protected]
```

**12.274.1.5 ModField**

```
template<typename RNS>
typedef Givaro::Modular<BasisElement> ModField [protected]
```

**12.274.1.6 integer**

```
template<typename RNS>
typedef Givaro::Integer integer [protected]
```

**12.274.2 Constructor & Destructor Documentation****12.274.2.1 RNSIntegerMod()**

```
template<typename RNS>
RNSIntegerMod (
    const integer & p,
    const RNS & myrns) [inline]
```

**12.274.3 Member Function Documentation****12.274.3.1 rns()**

```
template<typename RNS>
const rns_double & rns () const [inline]
```

**12.274.3.2 delayed()**

```
template<typename RNS>
const RNSInteger< RNS > & delayed () const [inline]
```

**12.274.3.3 size()**

```
template<typename RNS>
size_t size () const [inline]
```

**12.274.3.4 isOne()**

```
template<typename RNS>
bool isOne (
    const Element & x) const [inline]
```

**12.274.3.5 isMOne()**

```
template<typename RNS>
bool isMOne (
    const Element & x) const [inline]
```



**12.274.3.6 isZero()**

```
template<typename RNS>
bool isZero (
    const Element & x) const [inline]
```

**12.274.3.7 characteristic() [1/2]**

```
template<typename RNS>
integer & characteristic (
    integer & p) const [inline]
```

**12.274.3.8 characteristic() [2/2]**

```
template<typename RNS>
integer characteristic () const [inline]
```

**12.274.3.9 cardinality() [1/2]**

```
template<typename RNS>
integer & cardinality (
    integer & p) const [inline]
```

**12.274.3.10 cardinality() [2/2]**

```
template<typename RNS>
integer cardinality () const [inline]
```

**12.274.3.11 minElement()**

```
template<typename RNS>
integer minElement () const [inline]
```

**12.274.3.12 maxElement()**

```
template<typename RNS>
integer maxElement () const [inline]
```

**12.274.3.13 init() [1/3]**

```
template<typename RNS>
Element & init (
    Element & x) const [inline]
```

**12.274.3.14 init() [2/3]**

```
template<typename RNS>
Element & init (
    Element & x,
    const Givaro::Integer & y) const [inline]
```

**12.274.3.15 reduce() [1/2]**

```
template<typename RNS>
Element & reduce (
    Element & x,
    const Element & y) const [inline]
```

**12.274.3.16 reduce()** [2/2]

```
template<typename RNS>
Element & reduce (
    Element & x) const [inline]
```

**12.274.3.17 init()** [3/3]

```
template<typename RNS>
Element & init (
    Element & x,
    const Element & y) const [inline]
```

**12.274.3.18 convert()**

```
template<typename RNS>
Givaro::Integer convert (
    Givaro::Integer & x,
    const Element & y) const [inline]
```

**12.274.3.19 assign()**

```
template<typename RNS>
Element & assign (
    Element & x,
    const Element & y) const [inline]
```

**12.274.3.20 add()**

```
template<typename RNS>
Element & add (
    Element & x,
    const Element & y,
    const Element & z) const [inline]
```

**12.274.3.21 sub()**

```
template<typename RNS>
Element & sub (
    Element & x,
    const Element & y,
    const Element & z) const [inline]
```

**12.274.3.22 neg()**

```
template<typename RNS>
Element & neg (
    Element & x,
    const Element & y) const [inline]
```

**12.274.3.23 mul()**

```
template<typename RNS>
Element & mul (
    Element & x,
    const Element & y,
    const Element & z) const [inline]
```

**12.274.3.24 axpyin()**

```
template<typename RNS>
Element & axpyin (
    Element & x,
    const Element & y,
    const Element & z) const [inline]
```

**12.274.3.25 inv()**

```
template<typename RNS>
Element & inv (
    Element & x,
    const Element & y) const [inline]
```

**12.274.3.26 areEqual()**

```
template<typename RNS>
bool areEqual (
    const Element & x,
    const Element & y) const [inline]
```

**12.274.3.27 write() [1/2]**

```
template<typename RNS>
std::ostream & write (
    std::ostream & os,
    const Element & y) const [inline]
```

**12.274.3.28 write() [2/2]**

```
template<typename RNS>
std::ostream & write (
    std::ostream & os) const [inline]
```

**12.274.3.29 reduce\_modp() [1/2]**

```
template<typename RNS>
void reduce_modp (
    size_t n,
    Element_ptr B) const [inline]
```

**12.274.3.30 write\_matrix()**

```
template<typename RNS>
std::ostream & write_matrix (
    std::ostream & c,
    const double * E,
    int n,
    int m,
    int lda) const [inline]
```

**12.274.3.31 write\_matrix\_long()**

```
template<typename RNS>
std::ostream & write_matrix_long (
    std::ostream & c,
    const double * E,
    int n,
```

```
int m,
int lda) const [inline]
```

### 12.274.3.32 reduce\_modp() [2/2]

```
template<typename RNS>
void reduce_modp (
    size_t m,
    size_t n,
    Element_ptr B,
    size_t lda) const [inline]
```

### 12.274.3.33 reduce\_modp\_rnsmajor()

```
template<typename RNS>
void reduce_modp_rnsmajor (
    size_t n,
    Element_ptr B) const [inline]
```

## 12.274.4 Field Documentation

### 12.274.4.1 \_p

```
template<typename RNS>
integer _p [protected]
```

### 12.274.4.2 \_Mi\_modp\_rns

```
template<typename RNS>
std::vector<BasisElement, AlignedAllocator<BasisElement, Alignment::CACHE_LINE> > _Mi_modp_↵
rns [protected]
```

### 12.274.4.3 \_iM\_modp\_rns

```
template<typename RNS>
std::vector<BasisElement, AlignedAllocator<BasisElement, Alignment::CACHE_LINE> > _iM_modp_↵
rns [protected]
```

### 12.274.4.4 \_rns

```
template<typename RNS>
const RNS* _rns [protected]
```

### 12.274.4.5 \_F

```
template<typename RNS>
Givaro::Modular<Givaro::Integer> _F [protected]
```

### 12.274.4.6 \_RNSdelayed

```
template<typename RNS>
RNSInteger<RNS> _RNSdelayed [protected]
```

### 12.274.4.7 one

```
template<typename RNS>
Element one
```

#### 12.274.4.8 mOne

```
template<typename RNS>
Element mOne
```

#### 12.274.4.9 zero

```
template<typename RNS>
Element zero
```

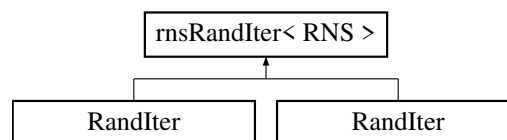
The documentation for this class was generated from the following files:

- [field-traits.h](#)
- [rns-integer-mod.h](#)

## 12.275 rnsRandIter< RNS > Class Template Reference

```
#include <rns-double.h>
```

Inheritance diagram for rnsRandIter< RNS >:



### Public Member Functions

- [rnsRandIter](#) (const [RNS](#) &R, uint64\_t seed=0)
- [RNS::Element](#) & [random](#) (typename [RNS::Element](#) &elt) const  
*RNS ring Element random assignment.*
- [RNS::Element](#) & [operator\(\)](#) (typename [RNS::Element](#) &elt) const
- [RNS::Element](#) [operator\(\)](#) () const
- [RNS::Element](#) [random](#) () const
- const [RNS](#) & [ring](#) () const

### 12.275.1 Constructor & Destructor Documentation

#### 12.275.1.1 rnsRandIter()

```
template<typename RNS>
rnsRandIter (
    const RNS & R,
    uint64_t seed = 0) [inline]
```

### 12.275.2 Member Function Documentation

#### 12.275.2.1 random() [1/2]

```
template<typename RNS>
RNS::Element & random (
    typename RNS::Element & elt) const [inline]
```

[RNS](#) ring Element random assignment.

Element is supposed to be initialized

#### Returns

random ring Element

**12.275.2.2 operator>() [1/2]**

```
template<typename RNS>
RNS::Element & operator() (
    typename RNS::Element & elt) const [inline]
```

**12.275.2.3 operator>() [2/2]**

```
template<typename RNS>
RNS::Element operator() () const [inline]
```

**12.275.2.4 random() [2/2]**

```
template<typename RNS>
RNS::Element random () const [inline]
```

**12.275.2.5 ring()**

```
template<typename RNS>
const RNS & ring () const [inline]
```

The documentation for this class was generated from the following file:

- [rns-double.h](#)

**12.276 Row Struct Reference**

The documentation for this struct was generated from the following file:

- [blockcuts.inl](#)

**12.277 rint< K > Class Template Reference**

The documentation for this class was generated from the following file:

- [field-traits.h](#)

**12.278 ScalFunctions< Element > Struct Template Reference**

Inheritance diagram for ScalFunctions< Element >:

**Public Types**

- using [vectElt](#) = [vector](#)<Element>

**Static Public Member Functions**

- static void [genInputs](#) ([vector](#)< [vectElt](#) > &inputs)
- static void [genInputsWithZero](#) ([vector](#)< [vectElt](#) > &inputs)
- static Element [zero](#) ()
- static Element [vand](#) (Element x1, Element x2)
- static Element [vor](#) (Element x1, Element x2)

- static Element `vxor` (Element x1, Element x2)
- static Element `vandnot` (Element x1, Element x2)
- static Element `add` (Element x1, Element x2)
- static Element `addin` (Element &x1, Element x2)
- static Element `sub` (Element x1, Element x2)
- static Element `subin` (Element &x1, Element x2)
- static Element `mul` (Element x1, Element x2)
- static Element `mulin` (Element &x1, Element x2)
- static Element `div` (Element x1, Element x2)
- static Element `fmadd` (Element x1, Element x2, Element x3)
- static Element `fmaddin` (Element &x1, Element x2, Element x3)
- static Element `fmsub` (Element x1, Element x2, Element x3)
- static Element `fmsubin` (Element &x1, Element x2, Element x3)
- static Element `fnmadd` (Element x1, Element x2, Element x3)
- static Element `fnmaddin` (Element &x1, Element x2, Element x3)
- static Element `lesser` (Element x1, Element x2)
- static Element `lesser_eq` (Element x1, Element x2)
- static Element `greater` (Element x1, Element x2)
- static Element `greater_eq` (Element x1, Element x2)
- static Element `eq` (Element x1, Element x2)
- static `vectElt unpacklo` (`vectElt` a, `vectElt` b)
- static `vectElt unpackhi` (`vectElt` a, `vectElt` b)
- static void `unpacklohi` (`vectElt` &lo, `vectElt` &hi, `vectElt` a, `vectElt` b)
- static `vectElt pack_even` (`vectElt` a, `vectElt` b)
- static `vectElt pack_odd` (`vectElt` a, `vectElt` b)
- static void `pack` (`vectElt` &even, `vectElt` &odd, `vectElt` a, `vectElt` b)
- `template<uint16_t s>`  
static `vectElt blend` (`vectElt` a, `vectElt` b)

## 12.278.1 Member Typedef Documentation

### 12.278.1.1 vectElt

```
template<typename Element>
using vectElt = vector<Element>
```

## 12.278.2 Member Function Documentation

### 12.278.2.1 genInputs()

```
template<typename Element>
static void genInputs (
    vector< vectElt > & inputs) [inline], [static]
```

### 12.278.2.2 genInputsWithZero()

```
template<typename Element>
static void genInputsWithZero (
    vector< vectElt > & inputs) [inline], [static]
```

### 12.278.2.3 zero()

```
template<typename Element>
static Element zero () [inline], [static]
```

#### 12.278.2.4 vand()

```
template<typename Element>
static Element vand (
    Element x1,
    Element x2) [inline], [static]
```

#### 12.278.2.5 vor()

```
template<typename Element>
static Element vor (
    Element x1,
    Element x2) [inline], [static]
```

#### 12.278.2.6 vxor()

```
template<typename Element>
static Element vxor (
    Element x1,
    Element x2) [inline], [static]
```

#### 12.278.2.7 vandnot()

```
template<typename Element>
static Element vandnot (
    Element x1,
    Element x2) [inline], [static]
```

#### 12.278.2.8 add()

```
template<typename Element>
static Element add (
    Element x1,
    Element x2) [inline], [static]
```

#### 12.278.2.9 addin()

```
template<typename Element>
static Element addin (
    Element & x1,
    Element x2) [inline], [static]
```

#### 12.278.2.10 sub()

```
template<typename Element>
static Element sub (
    Element x1,
    Element x2) [inline], [static]
```

#### 12.278.2.11 subin()

```
template<typename Element>
static Element subin (
    Element & x1,
    Element x2) [inline], [static]
```

#### 12.278.2.12 mul()

```
template<typename Element>
static Element mul (
```



```
Element x1,  
Element x2) [inline], [static]
```

#### 12.278.2.13 mulin()

```
template<typename Element>  
static Element mulin (  
    Element & x1,  
    Element x2) [inline], [static]
```

#### 12.278.2.14 div()

```
template<typename Element>  
static Element div (  
    Element x1,  
    Element x2) [inline], [static]
```

#### 12.278.2.15 fmadd()

```
template<typename Element>  
static Element fmadd (  
    Element x1,  
    Element x2,  
    Element x3) [inline], [static]
```

#### 12.278.2.16 fmaddin()

```
template<typename Element>  
static Element fmaddin (  
    Element & x1,  
    Element x2,  
    Element x3) [inline], [static]
```

#### 12.278.2.17 fmsub()

```
template<typename Element>  
static Element fmsub (  
    Element x1,  
    Element x2,  
    Element x3) [inline], [static]
```

#### 12.278.2.18 fmsubin()

```
template<typename Element>  
static Element fmsubin (  
    Element & x1,  
    Element x2,  
    Element x3) [inline], [static]
```

#### 12.278.2.19 fnmadd()

```
template<typename Element>  
static Element fnmadd (  
    Element x1,  
    Element x2,  
    Element x3) [inline], [static]
```

**12.278.2.20 fnmaddin()**

```
template<typename Element>
static Element fnmaddin (
    Element & x1,
    Element x2,
    Element x3) [inline], [static]
```

**12.278.2.21 lesser()**

```
template<typename Element>
static Element lesser (
    Element x1,
    Element x2) [inline], [static]
```

**12.278.2.22 lesser\_eq()**

```
template<typename Element>
static Element lesser_eq (
    Element x1,
    Element x2) [inline], [static]
```

**12.278.2.23 greater()**

```
template<typename Element>
static Element greater (
    Element x1,
    Element x2) [inline], [static]
```

**12.278.2.24 greater\_eq()**

```
template<typename Element>
static Element greater_eq (
    Element x1,
    Element x2) [inline], [static]
```

**12.278.2.25 eq()**

```
template<typename Element>
static Element eq (
    Element x1,
    Element x2) [inline], [static]
```

**12.278.2.26 unpacklo()**

```
template<typename Element>
static vectElt unpacklo (
    vectElt a,
    vectElt b) [inline], [static]
```

**12.278.2.27 unpackhi()**

```
template<typename Element>
static vectElt unpackhi (
    vectElt a,
    vectElt b) [inline], [static]
```

**12.278.2.28 unpacklohi()**

```
template<typename Element>
static void unpacklohi (
    vectElt & lo,
    vectElt & hi,
    vectElt a,
    vectElt b) [inline], [static]
```

**12.278.2.29 pack\_even()**

```
template<typename Element>
static vectElt pack_even (
    vectElt a,
    vectElt b) [inline], [static]
```

**12.278.2.30 pack\_odd()**

```
template<typename Element>
static vectElt pack_odd (
    vectElt a,
    vectElt b) [inline], [static]
```

**12.278.2.31 pack()**

```
template<typename Element>
static void pack (
    vectElt & even,
    vectElt & odd,
    vectElt a,
    vectElt b) [inline], [static]
```

**12.278.2.32 blend()**

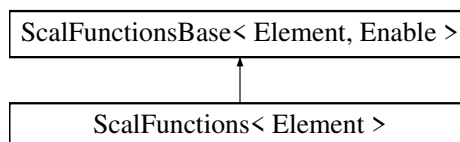
```
template<typename Element>
template<uint16_t s>
static vectElt blend (
    vectElt a,
    vectElt b) [inline], [static]
```

The documentation for this struct was generated from the following file:

- [test-simd.C](#)

## 12.279 ScalFunctionsBase< Element, Enable > Struct Template Reference

Inheritance diagram for ScalFunctionsBase< Element, Enable >:



The documentation for this struct was generated from the following file:

- [test-simd.C](#)

## 12.280 ScalFunctionsBase< Element, typename enable\_if< is\_floating\_point< Element >::value >::type > Struct Template Reference

### Data Structures

- class [FloatingPointTestDistribution](#)

### Static Public Member Functions

- static [FloatingPointTestDistribution](#) [get\\_default\\_random\\_generator](#) ()
- static Element [ceil](#) (Element x)
- static Element [floor](#) (Element x)
- static Element [round](#) (Element x)
- static Element [blendv](#) (Element a, Element b, Element mask)
- static Element [fma](#) (Element x, Element y, Element z)

### Static Public Attributes

- static constexpr Element [\\_zero](#) = 0.0
- static constexpr Element [cmp\\_true](#) = NAN
- static constexpr Element [cmp\\_false](#) = \_zero

## 12.280.1 Member Function Documentation

### 12.280.1.1 [get\\_default\\_random\\_generator\(\)](#)

```
template<typename Element>
static FloatingPointTestDistribution get\_default\_random\_generator () [inline], [static]
```

### 12.280.1.2 [ceil\(\)](#)

```
template<typename Element>
static Element ceil (
    Element x) [inline], [static]
```

### 12.280.1.3 [floor\(\)](#)

```
template<typename Element>
static Element floor (
    Element x) [inline], [static]
```

### 12.280.1.4 [round\(\)](#)

```
template<typename Element>
static Element round (
    Element x) [inline], [static]
```

### 12.280.1.5 [blendv\(\)](#)

```
template<typename Element>
static Element blendv (
    Element a,
    Element b,
    Element mask) [inline], [static]
```

### 12.280.1.6 fma()

```
template<typename Element>
static Element fma (
    Element x,
    Element y,
    Element z) [inline], [static]
```

## 12.280.2 Field Documentation

### 12.280.2.1 \_zero

```
template<typename Element>
Element _zero = 0.0 [static], [constexpr]
```

### 12.280.2.2 cmp\_true

```
template<typename Element>
Element cmp_true = NAN [static], [constexpr]
```

### 12.280.2.3 cmp\_false

```
template<typename Element>
Element cmp_false = _zero [static], [constexpr]
```

The documentation for this struct was generated from the following file:

- [test-simd.C](#)

## 12.281 ScalFunctionsBase< Element, typename enable\_if< is\_integral< Element >::value >::type > Struct Template Reference

### Static Public Member Functions

- static uniform\_int\_distribution< Element > [get\\_default\\_random\\_generator](#) ()
- static Element [round](#) (Element x)
- static Element [fma](#) (Element x, Element y, Element z)
- static Element [mullo](#) (Element x1, Element x2)
- static Element [mulhi](#) (Element x1, Element x2)
- static Element [mulx](#) (Element x1, Element x2)
- static Element [fmaddx](#) (Element x1, Element x2, Element x3)
- static Element [fmaddxin](#) (Element &x1, Element x2, Element x3)
- static Element [fmsubx](#) (Element x1, Element x2, Element x3)
- static Element [fmsubxin](#) (Element &x1, Element x2, Element x3)
- static Element [fnmaddx](#) (Element x1, Element x2, Element x3)
- static Element [fnmaddxin](#) (Element &x1, Element x2, Element x3)
- template<int s>  
static Element [sra](#) (Element x1)
- template<int s>  
static Element [srl](#) (Element x1)
- template<int s>  
static Element [sll](#) (Element x1)

### Static Public Attributes

- static constexpr Element [\\_zero](#) = 0
- static constexpr Element [cmp\\_true](#) = -1
- static constexpr Element [cmp\\_false](#) = \_zero

## 12.281.1 Member Function Documentation

### 12.281.1.1 `get_default_random_generator()`

```
template<typename Element>
static uniform_int_distribution< Element > get_default_random_generator () [inline], [static]
```

### 12.281.1.2 `round()`

```
template<typename Element>
static Element round (
    Element x) [inline], [static]
```

### 12.281.1.3 `fma()`

```
template<typename Element>
static Element fma (
    Element x,
    Element y,
    Element z) [inline], [static]
```

### 12.281.1.4 `mullo()`

```
template<typename Element>
static Element mullo (
    Element x1,
    Element x2) [inline], [static]
```

### 12.281.1.5 `mulhi()`

```
template<typename Element>
static Element mulhi (
    Element x1,
    Element x2) [inline], [static]
```

### 12.281.1.6 `mulx()`

```
template<typename Element>
static Element mulx (
    Element x1,
    Element x2) [inline], [static]
```

### 12.281.1.7 `fmaddx()`

```
template<typename Element>
static Element fmaddx (
    Element x1,
    Element x2,
    Element x3) [inline], [static]
```

### 12.281.1.8 `fmaddxin()`

```
template<typename Element>
static Element fmaddxin (
    Element & x1,
    Element x2,
    Element x3) [inline], [static]
```

### 12.281.1.9 fmsubx()

```
template<typename Element>
static Element fmsubx (
    Element x1,
    Element x2,
    Element x3) [inline], [static]
```

### 12.281.1.10 fmsubxin()

```
template<typename Element>
static Element fmsubxin (
    Element & x1,
    Element x2,
    Element x3) [inline], [static]
```

### 12.281.1.11 fnmaddx()

```
template<typename Element>
static Element fnmaddx (
    Element x1,
    Element x2,
    Element x3) [inline], [static]
```

### 12.281.1.12 fnmaddxin()

```
template<typename Element>
static Element fnmaddxin (
    Element & x1,
    Element x2,
    Element x3) [inline], [static]
```

### 12.281.1.13 sra()

```
template<typename Element>
template<int s>
static Element sra (
    Element x1) [inline], [static]
```

### 12.281.1.14 srl()

```
template<typename Element>
template<int s>
static Element srl (
    Element x1) [inline], [static]
```

### 12.281.1.15 sll()

```
template<typename Element>
template<int s>
static Element sll (
    Element x1) [inline], [static]
```

## 12.281.2 Field Documentation

### 12.281.2.1 \_zero

```
template<typename Element>
Element _zero = 0 [static], [constexpr]
```

### 12.281.2.2 `cmp_true`

```
template<typename Element>
Element cmp_true = -1 [static], [constexpr]
```

### 12.281.2.3 `cmp_false`

```
template<typename Element>
Element cmp_false = _zero [static], [constexpr]
```

The documentation for this struct was generated from the following file:

- [test-simd.C](#)

## 12.282 Sequential Struct Reference

### Public Member Functions

- [Sequential](#) ()
- [Sequential](#) (size\_t nth)
- template<class Cut, class Param>  
[Sequential](#) ([Parallel](#)< Cut, Param > &)
- size\_t [numthreads](#) () const

### Friends

- std::ostream & [operator<<](#) (std::ostream &out, const [Sequential](#) &)

## 12.282.1 Constructor & Destructor Documentation

### 12.282.1.1 `Sequential()` [1/3]

```
Sequential () [inline]
```

### 12.282.1.2 `Sequential()` [2/3]

```
Sequential (  
    size_t nth) [inline]
```

### 12.282.1.3 `Sequential()` [3/3]

```
template<class Cut, class Param>
Sequential (  
    Parallel< Cut, Param > & ) [inline]
```

## 12.282.2 Member Function Documentation

### 12.282.2.1 `numthreads()`

```
size_t numthreads () const [inline]
```

## 12.282.3 Friends And Related Symbol Documentation

### 12.282.3.1 `operator<<`

```
std::ostream & operator<< (  
    std::ostream & out,  
    const Sequential & ) [friend]
```

The documentation for this struct was generated from the following file:

- [blockcuts.inl](#)



## 12.283 Simd128\_impl< ArithType, Int, Signed, Size > Struct Template Reference

The documentation for this struct was generated from the following file:

- [simd128.inl](#)

## 12.284 Simd128\_impl< true, false, true, 4 > Struct Reference

The documentation for this struct was generated from the following file:

- [simd128\\_float.inl](#)

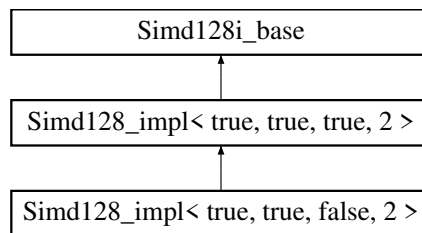
## 12.285 Simd128\_impl< true, false, true, 8 > Struct Reference

The documentation for this struct was generated from the following file:

- [simd128\\_double.inl](#)

## 12.286 Simd128\_impl< true, true, false, 2 > Struct Reference

Inheritance diagram for Simd128\_impl< true, true, false, 2 >:



### Data Structures

- union [Converter](#)

### Public Types

- using [scalar\\_t](#) = uint16\_t
- using [aligned\\_allocator](#) = AlignedAllocator<[scalar\\_t](#), Alignment([alignment](#))>
- using [aligned\\_vector](#) = std::vector<[scalar\\_t](#), [aligned\\_allocator](#)>
- template<class [Field](#)>  
using [is\\_same\\_element](#) = std::is\_same<typename [Field](#)::Element, [scalar\\_t](#)>
- using [vect\\_t](#) = \_\_m128i

### Static Public Member Functions

- static const std::string [type\\_string](#) ()
- static [INLINE CONST vect\\_t set1](#) (const [scalar\\_t](#) x)
- static [INLINE CONST vect\\_t set](#) (const [scalar\\_t](#) x0, const [scalar\\_t](#) x1, const [scalar\\_t](#) x2, const [scalar\\_t](#) x3, const [scalar\\_t](#) x4, const [scalar\\_t](#) x5, const [scalar\\_t](#) x6, const [scalar\\_t](#) x7)
- template<class T>  
static [INLINE PURE vect\\_t gather](#) (const [scalar\\_t](#) \*const p, const T \*const idx)
- static [INLINE PURE vect\\_t load](#) (const [scalar\\_t](#) \*const p)
- static [INLINE PURE vect\\_t loadu](#) (const [scalar\\_t](#) \*const p)
- static [INLINE void store](#) ([scalar\\_t](#) \*p, [vect\\_t](#) v)

- static **INLINE** void **storeu** (scalar\_t \*p, vect\_t v)
- static **INLINE** void **stream** (scalar\_t \*p, const vect\_t v)
- template<int s>
  - static **INLINE** **CONST** vect\_t **sra** (const vect\_t a)
- static **INLINE** **CONST** vect\_t **greater** (vect\_t a, vect\_t b)
- static **INLINE** **CONST** vect\_t **lesser** (vect\_t a, vect\_t b)
- static **INLINE** **CONST** vect\_t **greater\_eq** (const vect\_t a, const vect\_t b)
- static **INLINE** **CONST** vect\_t **lesser\_eq** (const vect\_t a, const vect\_t b)
- static **INLINE** **CONST** vect\_t **mulhi** (const vect\_t a, const vect\_t b)
- static **INLINE** **CONST** vect\_t **mulx** (const vect\_t a, const vect\_t b)
- static **INLINE** **CONST** vect\_t **fmaddx** (const vect\_t c, const vect\_t a, const vect\_t b)
- static **INLINE** vect\_t **fmaddxin** (vect\_t &c, const vect\_t a, const vect\_t b)
- static **INLINE** **CONST** vect\_t **fnmaddx** (const vect\_t c, const vect\_t a, const vect\_t b)
- static **INLINE** vect\_t **fnmaddxin** (vect\_t &c, const vect\_t a, const vect\_t b)
- static **INLINE** **CONST** vect\_t **fmsubx** (const vect\_t c, const vect\_t a, const vect\_t b)
- static **INLINE** vect\_t **fmsubxin** (vect\_t &c, const vect\_t a, const vect\_t b)
- static **INLINE** **CONST** scalar\_t **hadd\_to\_scal** (const vect\_t a)
- template<class T>
  - static constexpr bool **valid** (T \*p)
- template<class T>
  - static constexpr bool **compliant** (T n)
- static **INLINE** **CONST** vect\_t **set1** (const scalar\_t x)
- static **INLINE** **CONST** vect\_t **set** (const scalar\_t x0, const scalar\_t x1, const scalar\_t x2, const scalar\_t x3, const scalar\_t x4, const scalar\_t x5, const scalar\_t x6, const scalar\_t x7)
- template<class T>
  - static **INLINE** **PURE** vect\_t **gather** (const scalar\_t \*const p, const T \*const idx)
- static **INLINE** **PURE** vect\_t **load** (const scalar\_t \*const p)
- static **INLINE** **PURE** vect\_t **loadu** (const scalar\_t \*const p)
- static **INLINE** void **store** (scalar\_t \*p, vect\_t v)
- static **INLINE** void **storeu** (scalar\_t \*p, vect\_t v)
- static **INLINE** void **stream** (scalar\_t \*p, const vect\_t v)
- template<int s>
  - static **INLINE** **CONST** vect\_t **sll** (const vect\_t a)
- template<int s>
  - static **INLINE** **CONST** vect\_t **srl** (const vect\_t a)
- template<uint32\_t s>
  - static **INLINE** **CONST** vect\_t **shuffle** (const vect\_t a)
- static **INLINE** **CONST** vect\_t **unpacklo\_intrinsic** (const vect\_t a, const vect\_t b)
- static **INLINE** **CONST** vect\_t **unpackhi\_intrinsic** (const vect\_t a, const vect\_t b)
- static **INLINE** **CONST** vect\_t **unpacklo** (const vect\_t a, const vect\_t b)
- static **INLINE** **CONST** vect\_t **unpackhi** (const vect\_t a, const vect\_t b)
- static **INLINE** void **unpacklohi** (vect\_t &lo, vect\_t &hi, const vect\_t a, const vect\_t b)
- static **INLINE** **CONST** vect\_t **pack\_even** (const vect\_t a, const vect\_t b)
- static **INLINE** **CONST** vect\_t **pack\_odd** (const vect\_t a, const vect\_t b)
- static **INLINE** void **pack** (vect\_t &even, vect\_t &odd, const vect\_t a, const vect\_t b)
- static **INLINE** void **transpose** (vect\_t &r0, vect\_t &r1, vect\_t &r2, vect\_t &r3, vect\_t &r4, vect\_t &r5, vect\_t &r6, vect\_t &r7)
- template<uint8\_t s>
  - static **INLINE** **CONST** vect\_t **blend** (const vect\_t a, const vect\_t b)
- static **INLINE** **CONST** vect\_t **add** (const vect\_t a, const vect\_t b)
- static **INLINE** vect\_t **addin** (vect\_t &a, const vect\_t b)
- static **INLINE** **CONST** vect\_t **sub** (const vect\_t a, const vect\_t b)
- static **INLINE** vect\_t **subin** (vect\_t &a, const vect\_t b)
- static **INLINE** **CONST** vect\_t **mullo** (const vect\_t a, const vect\_t b)
- static **INLINE** **CONST** vect\_t **mul** (const vect\_t a, const vect\_t b)

- static `INLINE CONST vect_t fmadd` (const `vect_t` c, const `vect_t` a, const `vect_t` b)
- static `INLINE vect_t fmaddin` (`vect_t` &c, const `vect_t` a, const `vect_t` b)
- static `INLINE CONST vect_t fnmadd` (const `vect_t` c, const `vect_t` a, const `vect_t` b)
- static `INLINE vect_t fnmaddin` (`vect_t` &c, const `vect_t` a, const `vect_t` b)
- static `INLINE CONST vect_t fmsub` (const `vect_t` c, const `vect_t` a, const `vect_t` b)
- static `INLINE vect_t fmsubin` (`vect_t` &c, const `vect_t` a, const `vect_t` b)
- static `INLINE CONST vect_t eq` (const `vect_t` a, const `vect_t` b)
- static `INLINE CONST vect_t round` (const `vect_t` a)
- static `INLINE vect_t mod` (`vect_t` &C, const `vect_t` &P, const `__m64` &INVP, const `vect_t` &NEGP, const `vect_t` &MIN, const `vect_t` &MAX, `vect_t` &Q, `vect_t` &T)
- static `INLINE CONST vect_t zero` ()
- template<uint8\_t s>  
static `INLINE CONST vect_t sll128` (const `vect_t` a)
- template<uint8\_t s>  
static `INLINE CONST vect_t srl128` (const `vect_t` a)
- static `INLINE CONST vect_t vand` (const `vect_t` a, const `vect_t` b)
- static `INLINE CONST vect_t vor` (const `vect_t` a, const `vect_t` b)
- static `INLINE CONST vect_t vxor` (const `vect_t` a, const `vect_t` b)
- static `INLINE CONST vect_t vandnot` (const `vect_t` a, const `vect_t` b)

### Static Public Attributes

- static const constexpr size\_t `vect_size` = 8
- static const constexpr size\_t `alignment` = 16

## 12.286.1 Member Typedef Documentation

### 12.286.1.1 scalar\_t

```
using scalar_t = uint16_t
```

### 12.286.1.2 aligned\_allocator

```
using aligned_allocator = AlignedAllocator<scalar_t, Alignment(alignment)>
```

### 12.286.1.3 aligned\_vector

```
using aligned_vector = std::vector<scalar_t, aligned_allocator>
```

### 12.286.1.4 is\_same\_element

```
template<class Field>
using is_same_element = std::is_same<typename Field::Element, scalar_t>
```

### 12.286.1.5 vect\_t

```
using vect_t = __m128i [inherited]
```

## 12.286.2 Member Function Documentation

### 12.286.2.1 type\_string()

```
static const std::string type_string () [inline], [static]
```

### 12.286.2.2 set1() [1/2]

```
static INLINE CONST vect_t set1 (
    const scalar_t x) [inline], [static]
```

**12.286.2.3 set()** [1/2]

```
static INLINE CONST vect_t set (
    const scalar_t x0,
    const scalar_t x1,
    const scalar_t x2,
    const scalar_t x3,
    const scalar_t x4,
    const scalar_t x5,
    const scalar_t x6,
    const scalar_t x7) [inline], [static]
```

**12.286.2.4 gather()** [1/2]

```
template<class T>
static INLINE PURE vect_t gather (
    const scalar_t *const p,
    const T *const idx) [inline], [static]
```

**12.286.2.5 load()** [1/2]

```
static INLINE PURE vect_t load (
    const scalar_t *const p) [inline], [static]
```

**12.286.2.6 loadu()** [1/2]

```
static INLINE PURE vect_t loadu (
    const scalar_t *const p) [inline], [static]
```

**12.286.2.7 store()** [1/2]

```
static INLINE void store (
    scalar_t * p,
    vect_t v) [inline], [static]
```

**12.286.2.8 storeu()** [1/2]

```
static INLINE void storeu (
    scalar_t * p,
    vect_t v) [inline], [static]
```

**12.286.2.9 stream()** [1/2]

```
static INLINE void stream (
    scalar_t * p,
    const vect_t v) [inline], [static]
```

**12.286.2.10 sra()**

```
template<int s>
static INLINE CONST vect_t sra (
    const vect_t a) [inline], [static]
```

**12.286.2.11 greater()**

```
static INLINE CONST vect_t greater (
    vect_t a,
    vect_t b) [inline], [static]
```

**12.286.2.12 lesser()**

```
static INLINE CONST vect_t lesser (  
    vect_t a,  
    vect_t b) [inline], [static]
```

**12.286.2.13 greater\_eq()**

```
static INLINE CONST vect_t greater_eq (  
    const vect_t a,  
    const vect_t b) [inline], [static]
```

**12.286.2.14 lesser\_eq()**

```
static INLINE CONST vect_t lesser_eq (  
    const vect_t a,  
    const vect_t b) [inline], [static]
```

**12.286.2.15 mulhi()**

```
static INLINE CONST vect_t mulhi (  
    const vect_t a,  
    const vect_t b) [inline], [static]
```

**12.286.2.16 mulx()**

```
static INLINE CONST vect_t mulx (  
    const vect_t a,  
    const vect_t b) [inline], [static]
```

**12.286.2.17 fmaddx()**

```
static INLINE CONST vect_t fmaddx (  
    const vect_t c,  
    const vect_t a,  
    const vect_t b) [inline], [static]
```

**12.286.2.18 fmaddxin()**

```
static INLINE vect_t fmaddxin (  
    vect_t & c,  
    const vect_t a,  
    const vect_t b) [inline], [static]
```

**12.286.2.19 fnmaddx()**

```
static INLINE CONST vect_t fnmaddx (  
    const vect_t c,  
    const vect_t a,  
    const vect_t b) [inline], [static]
```

**12.286.2.20 fnmaddxin()**

```
static INLINE vect_t fnmaddxin (  
    vect_t & c,  
    const vect_t a,  
    const vect_t b) [inline], [static]
```

**12.286.2.21 fmsubx()**

```
static INLINE CONST vect_t fmsubx (
    const vect_t c,
    const vect_t a,
    const vect_t b) [inline], [static]
```

**12.286.2.22 fmsubxin()**

```
static INLINE vect_t fmsubxin (
    vect_t & c,
    const vect_t a,
    const vect_t b) [inline], [static]
```

**12.286.2.23 hadd\_to\_scal()**

```
static INLINE CONST scalar_t hadd_to_scal (
    const vect_t a) [inline], [static]
```

**12.286.2.24 valid()**

```
template<class T>
static constexpr bool valid (
    T * p) [inline], [static], [constexpr], [inherited]
```

**12.286.2.25 compliant()**

```
template<class T>
static constexpr bool compliant (
    T n) [inline], [static], [constexpr], [inherited]
```

**12.286.2.26 set1() [2/2]**

```
static INLINE CONST vect_t set1 (
    const scalar_t x) [inline], [static], [inherited]
```

**12.286.2.27 set() [2/2]**

```
static INLINE CONST vect_t set (
    const scalar_t x0,
    const scalar_t x1,
    const scalar_t x2,
    const scalar_t x3,
    const scalar_t x4,
    const scalar_t x5,
    const scalar_t x6,
    const scalar_t x7) [inline], [static], [inherited]
```

**12.286.2.28 gather() [2/2]**

```
template<class T>
static INLINE PURE vect_t gather (
    const scalar_t *const p,
    const T *const idx) [inline], [static], [inherited]
```

**12.286.2.29 load() [2/2]**

```
static INLINE PURE vect_t load (
    const scalar_t *const p) [inline], [static], [inherited]
```

**12.286.2.30 loadu() [2/2]**

```
static INLINE PURE vect_t loadu (  
    const scalar_t *const p) [inline], [static], [inherited]
```

**12.286.2.31 store() [2/2]**

```
static INLINE void store (  
    scalar_t * p,  
    vect_t v) [inline], [static], [inherited]
```

**12.286.2.32 storeu() [2/2]**

```
static INLINE void storeu (  
    scalar_t * p,  
    vect_t v) [inline], [static], [inherited]
```

**12.286.2.33 stream() [2/2]**

```
static INLINE void stream (  
    scalar_t * p,  
    const vect_t v) [inline], [static], [inherited]
```

**12.286.2.34 sll()**

```
template<int s>  
static INLINE CONST vect_t sll (  
    const vect_t a) [inline], [static], [inherited]
```

**12.286.2.35 srl()**

```
template<int s>  
static INLINE CONST vect_t srl (  
    const vect_t a) [inline], [static], [inherited]
```

**12.286.2.36 shuffle()**

```
template<uint32_t s>  
static INLINE CONST vect_t shuffle (  
    const vect_t a) [inline], [static], [inherited]
```

**12.286.2.37 unpacklo\_intrinsic()**

```
static INLINE CONST vect_t unpacklo_intrinsic (  
    const vect_t a,  
    const vect_t b) [inline], [static], [inherited]
```

**12.286.2.38 unpackhi\_intrinsic()**

```
static INLINE CONST vect_t unpackhi_intrinsic (  
    const vect_t a,  
    const vect_t b) [inline], [static], [inherited]
```

**12.286.2.39 unpacklo()**

```
static INLINE CONST vect_t unpacklo (  
    const vect_t a,  
    const vect_t b) [inline], [static], [inherited]
```

**12.286.2.40 unpackhi()**

```
static INLINE CONST vect_t unpackhi (
    const vect_t a,
    const vect_t b) [inline], [static], [inherited]
```

**12.286.2.41 unpacklohi()**

```
static INLINE void unpacklohi (
    vect_t & lo,
    vect_t & hi,
    const vect_t a,
    const vect_t b) [inline], [static], [inherited]
```

**12.286.2.42 pack\_even()**

```
static INLINE CONST vect_t pack_even (
    const vect_t a,
    const vect_t b) [inline], [static], [inherited]
```

**12.286.2.43 pack\_odd()**

```
static INLINE CONST vect_t pack_odd (
    const vect_t a,
    const vect_t b) [inline], [static], [inherited]
```

**12.286.2.44 pack()**

```
static INLINE void pack (
    vect_t & even,
    vect_t & odd,
    const vect_t a,
    const vect_t b) [inline], [static], [inherited]
```

**12.286.2.45 transpose()**

```
static INLINE void transpose (
    vect_t & r0,
    vect_t & r1,
    vect_t & r2,
    vect_t & r3,
    vect_t & r4,
    vect_t & r5,
    vect_t & r6,
    vect_t & r7) [inline], [static], [inherited]
```

**12.286.2.46 blend()**

```
template<uint8_t s>
static INLINE CONST vect_t blend (
    const vect_t a,
    const vect_t b) [inline], [static], [inherited]
```

**12.286.2.47 add()**

```
static INLINE CONST vect_t add (
    const vect_t a,
    const vect_t b) [inline], [static], [inherited]
```



**12.286.2.48 addin()**

```
static INLINE vect_t addin (  
    vect_t & a,  
    const vect_t b) [inline], [static], [inherited]
```

**12.286.2.49 sub()**

```
static INLINE CONST vect_t sub (  
    const vect_t a,  
    const vect_t b) [inline], [static], [inherited]
```

**12.286.2.50 subin()**

```
static INLINE vect_t subin (  
    vect_t & a,  
    const vect_t b) [inline], [static], [inherited]
```

**12.286.2.51 mullo()**

```
static INLINE CONST vect_t mullo (  
    const vect_t a,  
    const vect_t b) [inline], [static], [inherited]
```

**12.286.2.52 mul()**

```
static INLINE CONST vect_t mul (  
    const vect_t a,  
    const vect_t b) [inline], [static], [inherited]
```

**12.286.2.53 fmadd()**

```
static INLINE CONST vect_t fmadd (  
    const vect_t c,  
    const vect_t a,  
    const vect_t b) [inline], [static], [inherited]
```

**12.286.2.54 fmaddin()**

```
static INLINE vect_t fmaddin (  
    vect_t & c,  
    const vect_t a,  
    const vect_t b) [inline], [static], [inherited]
```

**12.286.2.55 fnmadd()**

```
static INLINE CONST vect_t fnmadd (  
    const vect_t c,  
    const vect_t a,  
    const vect_t b) [inline], [static], [inherited]
```

**12.286.2.56 fnmaddin()**

```
static INLINE vect_t fnmaddin (  
    vect_t & c,  
    const vect_t a,  
    const vect_t b) [inline], [static], [inherited]
```

**12.286.2.57 fmsub()**

```
static INLINE CONST vect_t fmsub (
    const vect_t c,
    const vect_t a,
    const vect_t b) [inline], [static], [inherited]
```

**12.286.2.58 fmsubin()**

```
static INLINE vect_t fmsubin (
    vect_t & c,
    const vect_t a,
    const vect_t b) [inline], [static], [inherited]
```

**12.286.2.59 eq()**

```
static INLINE CONST vect_t eq (
    const vect_t a,
    const vect_t b) [inline], [static], [inherited]
```

**12.286.2.60 round()**

```
static INLINE CONST vect_t round (
    const vect_t a) [inline], [static], [inherited]
```

**12.286.2.61 mod()**

```
static INLINE vect_t mod (
    vect_t & C,
    const vect_t & P,
    const __m64 & INVp,
    const vect_t & NEGP,
    const vect_t & MIN,
    const vect_t & MAX,
    vect_t & Q,
    vect_t & T) [inline], [static], [inherited]
```

**12.286.2.62 zero()**

```
static INLINE CONST vect_t zero () [inline], [static], [inherited]
```

**12.286.2.63 sll128()**

```
template<uint8_t s>
static INLINE CONST vect_t sll128 (
    const vect_t a) [inline], [static], [inherited]
```

**12.286.2.64 srl128()**

```
template<uint8_t s>
static INLINE CONST vect_t srl128 (
    const vect_t a) [inline], [static], [inherited]
```

**12.286.2.65 vand()**

```
static INLINE CONST vect_t vand (
    const vect_t a,
    const vect_t b) [inline], [static], [inherited]
```

**12.286.2.66 vor()**

```
static INLINE CONST vect_t vor (
    const vect_t a,
    const vect_t b) [inline], [static], [inherited]
```

**12.286.2.67 vxor()**

```
static INLINE CONST vect_t vxor (
    const vect_t a,
    const vect_t b) [inline], [static], [inherited]
```

**12.286.2.68 vandnot()**

```
static INLINE CONST vect_t vandnot (
    const vect_t a,
    const vect_t b) [inline], [static], [inherited]
```

**12.286.3 Field Documentation****12.286.3.1 vect\_size**

```
const constexpr size_t vect_size = 8 [static], [constexpr], [inherited]
```

**12.286.3.2 alignment**

```
const constexpr size_t alignment = 16 [static], [constexpr], [inherited]
```

The documentation for this struct was generated from the following file:

- [simd128\\_int16.inl](#)

**12.287 Simd128\_impl< true, true, false, 4 > Struct Reference**

Inheritance diagram for Simd128\_impl< true, true, false, 4 >:

**Data Structures**

- union [Converter](#)

**Public Types**

- using [scalar\\_t](#) = uint32\_t
- using [aligned\\_allocator](#) = AlignedAllocator<[scalar\\_t](#), Alignment([alignment](#))>
- using [aligned\\_vector](#) = std::vector<[scalar\\_t](#), [aligned\\_allocator](#)>
- template<class [Field](#)>
  - using [is\\_same\\_element](#) = std::is\_same<typename [Field](#)::Element, [scalar\\_t](#)>
- using [vect\\_t](#) = \_\_m128i

## Static Public Member Functions

- static const std::string [type\\_string](#) ()
- static [INLINE CONST vect\\_t set1](#) (const [scalar\\_t](#) x)
- static [INLINE CONST vect\\_t set](#) (const [scalar\\_t](#) x0, const [scalar\\_t](#) x1, const [scalar\\_t](#) x2, const [scalar\\_t](#) x3)
- template<class T>
  - static [INLINE PURE vect\\_t gather](#) (const [scalar\\_t](#) \*const p, const T \*const idx)
- static [INLINE PURE vect\\_t load](#) (const [scalar\\_t](#) \*const p)
- static [INLINE PURE vect\\_t loadu](#) (const [scalar\\_t](#) \*const p)
- static [INLINE](#) void [store](#) ([scalar\\_t](#) \*p, [vect\\_t](#) v)
- static [INLINE](#) void [storeu](#) ([scalar\\_t](#) \*p, [vect\\_t](#) v)
- static [INLINE](#) void [stream](#) ([scalar\\_t](#) \*p, const [vect\\_t](#) v)
- template<int s>
  - static [INLINE CONST vect\\_t sra](#) (const [vect\\_t](#) a)
- static [INLINE CONST vect\\_t greater](#) ([vect\\_t](#) a, [vect\\_t](#) b)
- static [INLINE CONST vect\\_t lesser](#) ([vect\\_t](#) a, [vect\\_t](#) b)
- static [INLINE CONST vect\\_t greater\\_eq](#) (const [vect\\_t](#) a, const [vect\\_t](#) b)
- static [INLINE CONST vect\\_t lesser\\_eq](#) (const [vect\\_t](#) a, const [vect\\_t](#) b)
- static [INLINE CONST vect\\_t mulhi](#) (const [vect\\_t](#) a, const [vect\\_t](#) b)
- static [INLINE CONST vect\\_t mulx](#) (const [vect\\_t](#) a, const [vect\\_t](#) b)
- static [INLINE CONST vect\\_t fmadddx](#) (const [vect\\_t](#) c, const [vect\\_t](#) a, const [vect\\_t](#) b)
- static [INLINE](#) [vect\\_t fmadddxin](#) ([vect\\_t](#) &c, const [vect\\_t](#) a, const [vect\\_t](#) b)
- static [INLINE CONST vect\\_t fnmadddx](#) (const [vect\\_t](#) c, const [vect\\_t](#) a, const [vect\\_t](#) b)
- static [INLINE](#) [vect\\_t fnmadddxin](#) ([vect\\_t](#) &c, const [vect\\_t](#) a, const [vect\\_t](#) b)
- static [INLINE CONST vect\\_t fmsubx](#) (const [vect\\_t](#) c, const [vect\\_t](#) a, const [vect\\_t](#) b)
- static [INLINE](#) [vect\\_t fmsubxin](#) ([vect\\_t](#) &c, const [vect\\_t](#) a, const [vect\\_t](#) b)
- static [INLINE CONST scalar\\_t hadd\\_to\\_scal](#) (const [vect\\_t](#) a)
- template<class T>
  - static constexpr bool [valid](#) (T \*p)
- template<class T>
  - static constexpr bool [compliant](#) (T n)
- static [INLINE CONST vect\\_t set1](#) (const [scalar\\_t](#) x)
- static [INLINE CONST vect\\_t set](#) (const [scalar\\_t](#) x0, const [scalar\\_t](#) x1, const [scalar\\_t](#) x2, const [scalar\\_t](#) x3)
- template<class T>
  - static [INLINE PURE vect\\_t gather](#) (const [scalar\\_t](#) \*const p, const T \*const idx)
- static [INLINE PURE vect\\_t load](#) (const [scalar\\_t](#) \*const p)
- static [INLINE PURE vect\\_t loadu](#) (const [scalar\\_t](#) \*const p)
- static [INLINE](#) void [store](#) ([scalar\\_t](#) \*p, [vect\\_t](#) v)
- static [INLINE](#) void [storeu](#) ([scalar\\_t](#) \*p, [vect\\_t](#) v)
- static [INLINE](#) void [stream](#) ([scalar\\_t](#) \*p, const [vect\\_t](#) v)
- template<int s>
  - static [INLINE CONST vect\\_t sll](#) (const [vect\\_t](#) a)
- template<int s>
  - static [INLINE CONST vect\\_t srl](#) (const [vect\\_t](#) a)
- template<uint8\_t s>
  - static [INLINE CONST vect\\_t shuffle](#) (const [vect\\_t](#) a)
- static [INLINE CONST vect\\_t unpacklo\\_intrinsic](#) (const [vect\\_t](#) a, const [vect\\_t](#) b)
- static [INLINE CONST vect\\_t unpackhi\\_intrinsic](#) (const [vect\\_t](#) a, const [vect\\_t](#) b)
- static [INLINE CONST vect\\_t unpacklo](#) (const [vect\\_t](#) a, const [vect\\_t](#) b)
- static [INLINE CONST vect\\_t unpackhi](#) (const [vect\\_t](#) a, const [vect\\_t](#) b)
- static [INLINE](#) void [unpacklohi](#) ([vect\\_t](#) &lo, [vect\\_t](#) &hi, const [vect\\_t](#) a, const [vect\\_t](#) b)
- static [INLINE CONST vect\\_t pack\\_even](#) (const [vect\\_t](#) a, const [vect\\_t](#) b)
- static [INLINE CONST vect\\_t pack\\_odd](#) (const [vect\\_t](#) a, const [vect\\_t](#) b)
- static [INLINE](#) void [pack](#) ([vect\\_t](#) &even, [vect\\_t](#) &odd, const [vect\\_t](#) a, const [vect\\_t](#) b)
- static [INLINE](#) void [transpose](#) ([vect\\_t](#) &r0, [vect\\_t](#) &r1, [vect\\_t](#) &r2, [vect\\_t](#) &r3)

- `template<uint8_t s>`  
`static INLINE CONST vect_t blend (const vect_t a, const vect_t b)`
- `static INLINE CONST vect_t add (const vect_t a, const vect_t b)`
- `static INLINE vect_t addin (vect_t &a, const vect_t b)`
- `static INLINE CONST vect_t sub (const vect_t a, const vect_t b)`
- `static INLINE vect_t subin (vect_t &a, const vect_t b)`
- `static INLINE CONST vect_t mullo (const vect_t a, const vect_t b)`
- `static INLINE CONST vect_t mul (const vect_t a, const vect_t b)`
- `static INLINE CONST vect_t fmadd (const vect_t c, const vect_t a, const vect_t b)`
- `static INLINE vect_t fmaddin (vect_t &c, const vect_t a, const vect_t b)`
- `static INLINE CONST vect_t fnmadd (const vect_t c, const vect_t a, const vect_t b)`
- `static INLINE vect_t fnmaddin (vect_t &c, const vect_t a, const vect_t b)`
- `static INLINE CONST vect_t fmsub (const vect_t c, const vect_t a, const vect_t b)`
- `static INLINE vect_t fmsubin (vect_t &c, const vect_t a, const vect_t b)`
- `static INLINE CONST vect_t eq (const vect_t a, const vect_t b)`
- `static INLINE CONST vect_t round (const vect_t a)`
- `static INLINE vect_t mod (vect_t &C, const vect_t &P, const vect_t &INVP, const vect_t &NEGP, const vect_t &MIN, const vect_t &MAX, vect_t &Q, vect_t &T)`
- `static INLINE CONST vect_t zero ()`
- `template<uint8_t s>`  
`static INLINE CONST vect_t sll128 (const vect_t a)`
- `template<uint8_t s>`  
`static INLINE CONST vect_t srl128 (const vect_t a)`
- `static INLINE CONST vect_t vand (const vect_t a, const vect_t b)`
- `static INLINE CONST vect_t vor (const vect_t a, const vect_t b)`
- `static INLINE CONST vect_t vxor (const vect_t a, const vect_t b)`
- `static INLINE CONST vect_t vandnot (const vect_t a, const vect_t b)`

### Static Public Attributes

- `static const constexpr size_t vect_size = 4`
- `static const constexpr size_t alignment = 16`

## 12.287.1 Member Typedef Documentation

### 12.287.1.1 scalar\_t

```
using scalar_t = uint32_t
```

### 12.287.1.2 aligned\_allocator

```
using aligned_allocator = AlignedAllocator<scalar_t, Alignment(alignment)>
```

### 12.287.1.3 aligned\_vector

```
using aligned_vector = std::vector<scalar_t, aligned_allocator>
```

### 12.287.1.4 is\_same\_element

```
template<class Field>
using is_same_element = std::is_same<typename Field::Element, scalar_t>
```

### 12.287.1.5 vect\_t

```
using vect_t = __m128i [inherited]
```

## 12.287.2 Member Function Documentation

### 12.287.2.1 type\_string()

```
static const std::string type_string () [inline], [static]
```

### 12.287.2.2 set1() [1/2]

```
static INLINE CONST vect_t set1 (
    const scalar_t x) [inline], [static]
```

### 12.287.2.3 set() [1/2]

```
static INLINE CONST vect_t set (
    const scalar_t x0,
    const scalar_t x1,
    const scalar_t x2,
    const scalar_t x3) [inline], [static]
```

### 12.287.2.4 gather() [1/2]

```
template<class T>
static INLINE PURE vect_t gather (
    const scalar_t *const p,
    const T *const idx) [inline], [static]
```

### 12.287.2.5 load() [1/2]

```
static INLINE PURE vect_t load (
    const scalar_t *const p) [inline], [static]
```

### 12.287.2.6 loadu() [1/2]

```
static INLINE PURE vect_t loadu (
    const scalar_t *const p) [inline], [static]
```

### 12.287.2.7 store() [1/2]

```
static INLINE void store (
    scalar_t * p,
    vect_t v) [inline], [static]
```

### 12.287.2.8 storeu() [1/2]

```
static INLINE void storeu (
    scalar_t * p,
    vect_t v) [inline], [static]
```

### 12.287.2.9 stream() [1/2]

```
static INLINE void stream (
    scalar_t * p,
    const vect_t v) [inline], [static]
```

### 12.287.2.10 sra()

```
template<int s>
static INLINE CONST vect_t sra (
    const vect_t a) [inline], [static]
```

**12.287.2.11 greater()**

```
static INLINE CONST vect_t greater (  
    vect_t a,  
    vect_t b) [inline], [static]
```

**12.287.2.12 lesser()**

```
static INLINE CONST vect_t lesser (  
    vect_t a,  
    vect_t b) [inline], [static]
```

**12.287.2.13 greater\_eq()**

```
static INLINE CONST vect_t greater_eq (  
    const vect_t a,  
    const vect_t b) [inline], [static]
```

**12.287.2.14 lesser\_eq()**

```
static INLINE CONST vect_t lesser_eq (  
    const vect_t a,  
    const vect_t b) [inline], [static]
```

**12.287.2.15 mulhi()**

```
static INLINE CONST vect_t mulhi (  
    const vect_t a,  
    const vect_t b) [inline], [static]
```

**12.287.2.16 mulx()**

```
static INLINE CONST vect_t mulx (  
    const vect_t a,  
    const vect_t b) [inline], [static]
```

**12.287.2.17 fmaddx()**

```
static INLINE CONST vect_t fmaddx (  
    const vect_t c,  
    const vect_t a,  
    const vect_t b) [inline], [static]
```

**12.287.2.18 fmaddxin()**

```
static INLINE vect_t fmaddxin (  
    vect_t & c,  
    const vect_t a,  
    const vect_t b) [inline], [static]
```

**12.287.2.19 fnmaddx()**

```
static INLINE CONST vect_t fnmaddx (  
    const vect_t c,  
    const vect_t a,  
    const vect_t b) [inline], [static]
```

**12.287.2.20 fnmaddxin()**

```
static INLINE vect_t fnmaddxin (
    vect_t & c,
    const vect_t a,
    const vect_t b) [inline], [static]
```

**12.287.2.21 fmsubx()**

```
static INLINE CONST vect_t fmsubx (
    const vect_t c,
    const vect_t a,
    const vect_t b) [inline], [static]
```

**12.287.2.22 fmsubxin()**

```
static INLINE vect_t fmsubxin (
    vect_t & c,
    const vect_t a,
    const vect_t b) [inline], [static]
```

**12.287.2.23 hadd\_to\_scal()**

```
static INLINE CONST scalar_t hadd_to_scal (
    const vect_t a) [inline], [static]
```

**12.287.2.24 valid()**

```
template<class T>
static constexpr bool valid (
    T * p) [inline], [static], [constexpr], [inherited]
```

**12.287.2.25 compliant()**

```
template<class T>
static constexpr bool compliant (
    T n) [inline], [static], [constexpr], [inherited]
```

**12.287.2.26 set1() [2/2]**

```
static INLINE CONST vect_t set1 (
    const scalar_t x) [inline], [static], [inherited]
```

**12.287.2.27 set() [2/2]**

```
static INLINE CONST vect_t set (
    const scalar_t x0,
    const scalar_t x1,
    const scalar_t x2,
    const scalar_t x3) [inline], [static], [inherited]
```

**12.287.2.28 gather() [2/2]**

```
template<class T>
static INLINE PURE vect_t gather (
    const scalar_t *const p,
    const T *const idx) [inline], [static], [inherited]
```



**12.287.2.29 load()** [2/2]

```
static INLINE PURE vect_t load (  
    const scalar_t *const p) [inline], [static], [inherited]
```

**12.287.2.30 loadu()** [2/2]

```
static INLINE PURE vect_t loadu (  
    const scalar_t *const p) [inline], [static], [inherited]
```

**12.287.2.31 store()** [2/2]

```
static INLINE void store (  
    scalar_t * p,  
    vect_t v) [inline], [static], [inherited]
```

**12.287.2.32 storeu()** [2/2]

```
static INLINE void storeu (  
    scalar_t * p,  
    vect_t v) [inline], [static], [inherited]
```

**12.287.2.33 stream()** [2/2]

```
static INLINE void stream (  
    scalar_t * p,  
    const vect_t v) [inline], [static], [inherited]
```

**12.287.2.34 sll()**

```
template<int s>  
static INLINE CONST vect_t sll (  
    const vect_t a) [inline], [static], [inherited]
```

**12.287.2.35 srl()**

```
template<int s>  
static INLINE CONST vect_t srl (  
    const vect_t a) [inline], [static], [inherited]
```

**12.287.2.36 shuffle()**

```
template<uint8_t s>  
static INLINE CONST vect_t shuffle (  
    const vect_t a) [inline], [static], [inherited]
```

**12.287.2.37 unpacklo\_intrinsic()**

```
static INLINE CONST vect_t unpacklo_intrinsic (  
    const vect_t a,  
    const vect_t b) [inline], [static], [inherited]
```

**12.287.2.38 unpackhi\_intrinsic()**

```
static INLINE CONST vect_t unpackhi_intrinsic (  
    const vect_t a,  
    const vect_t b) [inline], [static], [inherited]
```

**12.287.2.39 unpacklo()**

```
static INLINE CONST vect_t unpacklo (  
    const vect_t a,  
    const vect_t b) [inline], [static], [inherited]
```

**12.287.2.40 unpackhi()**

```
static INLINE CONST vect_t unpackhi (  
    const vect_t a,  
    const vect_t b) [inline], [static], [inherited]
```

**12.287.2.41 unpacklohi()**

```
static INLINE void unpacklohi (  
    vect_t & lo,  
    vect_t & hi,  
    const vect_t a,  
    const vect_t b) [inline], [static], [inherited]
```

**12.287.2.42 pack\_even()**

```
static INLINE CONST vect_t pack_even (  
    const vect_t a,  
    const vect_t b) [inline], [static], [inherited]
```

**12.287.2.43 pack\_odd()**

```
static INLINE CONST vect_t pack_odd (  
    const vect_t a,  
    const vect_t b) [inline], [static], [inherited]
```

**12.287.2.44 pack()**

```
static INLINE void pack (  
    vect_t & even,  
    vect_t & odd,  
    const vect_t a,  
    const vect_t b) [inline], [static], [inherited]
```

**12.287.2.45 transpose()**

```
static INLINE void transpose (  
    vect_t & r0,  
    vect_t & r1,  
    vect_t & r2,  
    vect_t & r3) [inline], [static], [inherited]
```

**12.287.2.46 blend()**

```
template<uint8_t s>  
static INLINE CONST vect_t blend (  
    const vect_t a,  
    const vect_t b) [inline], [static], [inherited]
```

**12.287.2.47 add()**

```
static INLINE CONST vect_t add (  
    const vect_t a,  
    const vect_t b) [inline], [static], [inherited]
```

**12.287.2.48 addin()**

```
static INLINE vect_t addin (  
    vect_t & a,  
    const vect_t b) [inline], [static], [inherited]
```

**12.287.2.49 sub()**

```
static INLINE CONST vect_t sub (  
    const vect_t a,  
    const vect_t b) [inline], [static], [inherited]
```

**12.287.2.50 subin()**

```
static INLINE vect_t subin (  
    vect_t & a,  
    const vect_t b) [inline], [static], [inherited]
```

**12.287.2.51 mullo()**

```
static INLINE CONST vect_t mullo (  
    const vect_t a,  
    const vect_t b) [inline], [static], [inherited]
```

**12.287.2.52 mul()**

```
static INLINE CONST vect_t mul (  
    const vect_t a,  
    const vect_t b) [inline], [static], [inherited]
```

**12.287.2.53 fmadd()**

```
static INLINE CONST vect_t fmadd (  
    const vect_t c,  
    const vect_t a,  
    const vect_t b) [inline], [static], [inherited]
```

**12.287.2.54 fmaddin()**

```
static INLINE vect_t fmaddin (  
    vect_t & c,  
    const vect_t a,  
    const vect_t b) [inline], [static], [inherited]
```

**12.287.2.55 fnmadd()**

```
static INLINE CONST vect_t fnmadd (  
    const vect_t c,  
    const vect_t a,  
    const vect_t b) [inline], [static], [inherited]
```

**12.287.2.56 fnmaddin()**

```
static INLINE vect_t fnmaddin (  
    vect_t & c,  
    const vect_t a,  
    const vect_t b) [inline], [static], [inherited]
```

**12.287.2.57 fmsub()**

```
static INLINE CONST vect_t fmsub (
    const vect_t c,
    const vect_t a,
    const vect_t b) [inline], [static], [inherited]
```

**12.287.2.58 fmsubin()**

```
static INLINE vect_t fmsubin (
    vect_t & c,
    const vect_t a,
    const vect_t b) [inline], [static], [inherited]
```

**12.287.2.59 eq()**

```
static INLINE CONST vect_t eq (
    const vect_t a,
    const vect_t b) [inline], [static], [inherited]
```

**12.287.2.60 round()**

```
static INLINE CONST vect_t round (
    const vect_t a) [inline], [static], [inherited]
```

**12.287.2.61 mod()**

```
static INLINE vect_t mod (
    vect_t & C,
    const vect_t & P,
    const vect_t & INVP,
    const vect_t & NEGP,
    const vect_t & MIN,
    const vect_t & MAX,
    vect_t & Q,
    vect_t & T) [inline], [static], [inherited]
```

**12.287.2.62 zero()**

```
static INLINE CONST vect_t zero () [inline], [static], [inherited]
```

**12.287.2.63 sll128()**

```
template<uint8_t s>
static INLINE CONST vect_t sll128 (
    const vect_t a) [inline], [static], [inherited]
```

**12.287.2.64 srl128()**

```
template<uint8_t s>
static INLINE CONST vect_t srl128 (
    const vect_t a) [inline], [static], [inherited]
```

**12.287.2.65 vand()**

```
static INLINE CONST vect_t vand (
    const vect_t a,
    const vect_t b) [inline], [static], [inherited]
```

**12.287.2.66 vor()**

```
static INLINE CONST vect_t vor (
    const vect_t a,
    const vect_t b) [inline], [static], [inherited]
```

**12.287.2.67 vxor()**

```
static INLINE CONST vect_t vxor (
    const vect_t a,
    const vect_t b) [inline], [static], [inherited]
```

**12.287.2.68 vandnot()**

```
static INLINE CONST vect_t vandnot (
    const vect_t a,
    const vect_t b) [inline], [static], [inherited]
```

**12.287.3 Field Documentation****12.287.3.1 vect\_size**

```
const constexpr size_t vect_size = 4 [static], [constexpr], [inherited]
```

**12.287.3.2 alignment**

```
const constexpr size_t alignment = 16 [static], [constexpr], [inherited]
```

The documentation for this struct was generated from the following file:

- [simd128\\_int32.inl](#)

**12.288 Simd128\_impl< true, true, false, 8 > Struct Reference**

Inheritance diagram for Simd128\_impl< true, true, false, 8 >:

**Data Structures**

- union [Converter](#)

**Public Types**

- using [scalar\\_t](#) = uint64\_t
- using [aligned\\_allocator](#) = AlignedAllocator<[scalar\\_t](#), Alignment([alignment](#))>
- using [aligned\\_vector](#) = std::vector<[scalar\\_t](#), [aligned\\_allocator](#)>
- template<class [Field](#)>
  - using [is\\_same\\_element](#) = std::is\_same<typename [Field](#)::Element, [scalar\\_t](#)>
- using [vect\\_t](#) = \_\_m128i

## Static Public Member Functions

- static const std::string [type\\_string](#) ()
- static [INLINE CONST vect\\_t set1](#) (const [scalar\\_t](#) x)
- static [INLINE CONST vect\\_t set](#) (const [scalar\\_t](#) x0, const [scalar\\_t](#) x1)
- template<class T>
  - static [INLINE PURE vect\\_t gather](#) (const [scalar\\_t](#) \*const p, const T \*const idx)
- static [INLINE PURE vect\\_t load](#) (const [scalar\\_t](#) \*const p)
- static [INLINE PURE vect\\_t loadu](#) (const [scalar\\_t](#) \*const p)
- static [INLINE void store](#) ([scalar\\_t](#) \*p, [vect\\_t](#) v)
- static [INLINE void storeu](#) ([scalar\\_t](#) \*p, [vect\\_t](#) v)
- static [INLINE void stream](#) ([scalar\\_t](#) \*p, const [vect\\_t](#) v)
- template<int s>
  - static [INLINE CONST vect\\_t sra](#) (const [vect\\_t](#) a)
- static [INLINE CONST vect\\_t greater](#) ([vect\\_t](#) a, [vect\\_t](#) b)
- static [INLINE CONST vect\\_t lesser](#) ([vect\\_t](#) a, [vect\\_t](#) b)
- static [INLINE CONST vect\\_t greater\\_eq](#) (const [vect\\_t](#) a, const [vect\\_t](#) b)
- static [INLINE CONST vect\\_t lesser\\_eq](#) (const [vect\\_t](#) a, const [vect\\_t](#) b)
- static [INLINE CONST vect\\_t mullo](#) (const [vect\\_t](#) x0, const [vect\\_t](#) x1)
- static [INLINE CONST vect\\_t mulhi](#) (const [vect\\_t](#) a, const [vect\\_t](#) b)
- static [INLINE CONST vect\\_t mulx](#) (const [vect\\_t](#) a, const [vect\\_t](#) b)
- static [INLINE CONST vect\\_t fmaddx](#) (const [vect\\_t](#) c, const [vect\\_t](#) a, const [vect\\_t](#) b)
- static [INLINE vect\\_t fmaddxin](#) ([vect\\_t](#) &c, const [vect\\_t](#) a, const [vect\\_t](#) b)
- static [INLINE CONST vect\\_t fnmaddx](#) (const [vect\\_t](#) c, const [vect\\_t](#) a, const [vect\\_t](#) b)
- static [INLINE vect\\_t fnmaddxin](#) ([vect\\_t](#) &c, const [vect\\_t](#) a, const [vect\\_t](#) b)
- static [INLINE CONST vect\\_t fmsubx](#) (const [vect\\_t](#) c, const [vect\\_t](#) a, const [vect\\_t](#) b)
- static [INLINE vect\\_t fmsubxin](#) ([vect\\_t](#) &c, const [vect\\_t](#) a, const [vect\\_t](#) b)
- static [INLINE CONST scalar\\_t hadd\\_to\\_scal](#) (const [vect\\_t](#) a)
- template<class T>
  - static constexpr bool [valid](#) (T \*p)
- template<class T>
  - static constexpr bool [compliant](#) (T n)
- static [INLINE CONST vect\\_t set1](#) (const [scalar\\_t](#) x)
- static [INLINE CONST vect\\_t set](#) (const [scalar\\_t](#) x0, const [scalar\\_t](#) x1)
- template<class T>
  - static [INLINE PURE vect\\_t gather](#) (const [scalar\\_t](#) \*const p, const T \*const idx)
- template<int idx>
  - static [INLINE CONST scalar\\_t get](#) ([vect\\_t](#) v)
- static [INLINE PURE vect\\_t load](#) (const [scalar\\_t](#) \*const p)
- static [INLINE PURE vect\\_t loadu](#) (const [scalar\\_t](#) \*const p)
- static [INLINE void store](#) ([scalar\\_t](#) \*p, [vect\\_t](#) v)
- static [INLINE void storeu](#) ([scalar\\_t](#) \*p, [vect\\_t](#) v)
- static [INLINE void stream](#) ([scalar\\_t](#) \*p, const [vect\\_t](#) v)
- template<int s>
  - static [INLINE CONST vect\\_t sll](#) (const [vect\\_t](#) a)
- template<int s>
  - static [INLINE CONST vect\\_t srl](#) (const [vect\\_t](#) a)
- template<uint8\_t s>
  - static [INLINE CONST vect\\_t shuffle](#) (const [vect\\_t](#) a)
- static [INLINE CONST vect\\_t unpacklo\\_intrinsic](#) (const [vect\\_t](#) a, const [vect\\_t](#) b)
- static [INLINE CONST vect\\_t unpackhi\\_intrinsic](#) (const [vect\\_t](#) a, const [vect\\_t](#) b)
- static [INLINE CONST vect\\_t unpacklo](#) (const [vect\\_t](#) a, const [vect\\_t](#) b)
- static [INLINE CONST vect\\_t unpackhi](#) (const [vect\\_t](#) a, const [vect\\_t](#) b)
- static [INLINE void unpacklohi](#) ([vect\\_t](#) &lo, [vect\\_t](#) &hi, const [vect\\_t](#) a, const [vect\\_t](#) b)
- static [INLINE CONST vect\\_t pack\\_even](#) (const [vect\\_t](#) a, const [vect\\_t](#) b)
- static [INLINE CONST vect\\_t pack\\_odd](#) (const [vect\\_t](#) a, const [vect\\_t](#) b)

- static `INLINE` void `pack` (`vect_t` &even, `vect_t` &odd, const `vect_t` a, const `vect_t` b)
- static `INLINE` void `transpose` (`vect_t` &r0, `vect_t` &r1)
- template<uint8\_t s>
  - static `INLINE` `CONST` `vect_t` `blend` (const `vect_t` a, const `vect_t` b)
- static `INLINE` `CONST` `vect_t` `add` (const `vect_t` a, const `vect_t` b)
- static `INLINE` `vect_t` `addin` (`vect_t` &a, const `vect_t` b)
- static `INLINE` `CONST` `vect_t` `sub` (const `vect_t` a, const `vect_t` b)
- static `INLINE` `vect_t` `subin` (`vect_t` &a, const `vect_t` b)
- static `INLINE` `CONST` `vect_t` `mul` (const `vect_t` a, const `vect_t` b)
- static `INLINE` `CONST` `vect_t` `fmadd` (const `vect_t` c, const `vect_t` a, const `vect_t` b)
- static `INLINE` `vect_t` `fmaddin` (`vect_t` &c, const `vect_t` a, const `vect_t` b)
- static `INLINE` `CONST` `vect_t` `fnmadd` (const `vect_t` c, const `vect_t` a, const `vect_t` b)
- static `INLINE` `vect_t` `fnmaddin` (`vect_t` &c, const `vect_t` a, const `vect_t` b)
- static `INLINE` `CONST` `vect_t` `fmsub` (const `vect_t` c, const `vect_t` a, const `vect_t` b)
- static `INLINE` `vect_t` `fmsubin` (`vect_t` &c, const `vect_t` a, const `vect_t` b)
- static `INLINE` `CONST` `vect_t` `eq` (const `vect_t` a, const `vect_t` b)
- static `INLINE` `CONST` `vect_t` `round` (const `vect_t` a)
- static `INLINE` `CONST` `vect_t` `mask_high` ()
- static `INLINE` `CONST` `vect_t` `mulhi_fast` (`vect_t` x, `vect_t` y)
- static `INLINE` `vect_t` `mod` (`vect_t` &C, const \_\_m128d &P, const \_\_m128d &INVP, const \_\_m128d &NEGP, const `vect_t` &POW50REM, const \_\_m128d &MIN, const \_\_m128d &MAX, \_\_m128d &Q, \_\_m128d &T)
- static `INLINE` `CONST` `vect_t` `zero` ()
- template<uint8\_t s>
  - static `INLINE` `CONST` `vect_t` `sll128` (const `vect_t` a)
- template<uint8\_t s>
  - static `INLINE` `CONST` `vect_t` `srl128` (const `vect_t` a)
- static `INLINE` `CONST` `vect_t` `vand` (const `vect_t` a, const `vect_t` b)
- static `INLINE` `CONST` `vect_t` `vor` (const `vect_t` a, const `vect_t` b)
- static `INLINE` `CONST` `vect_t` `vxor` (const `vect_t` a, const `vect_t` b)
- static `INLINE` `CONST` `vect_t` `vandnot` (const `vect_t` a, const `vect_t` b)

### Static Public Attributes

- static const constexpr size\_t `vect_size` = 2
- static const constexpr size\_t `alignment` = 16

### Static Protected Member Functions

- static `INLINE` `CONST` `vect_t` `signbits` (const `vect_t` x)

## 12.288.1 Member Typedef Documentation

### 12.288.1.1 scalar\_t

```
using scalar_t = uint64_t
```

### 12.288.1.2 aligned\_allocator

```
using aligned_allocator = AlignedAllocator<scalar_t, Alignment(alignment)>
```

### 12.288.1.3 aligned\_vector

```
using aligned_vector = std::vector<scalar_t, aligned_allocator>
```

### 12.288.1.4 is\_same\_element

```
template<class Field>
using is_same_element = std::is_same<typename Field::Element, scalar_t>
```

**12.288.1.5 vect\_t**

```
using vect_t = __m128i [inherited]
```

**12.288.2 Member Function Documentation****12.288.2.1 type\_string()**

```
static const std::string type_string () [inline], [static]
```

**12.288.2.2 set1() [1/2]**

```
static INLINE CONST vect_t set1 (
    const scalar_t x) [inline], [static]
```

**12.288.2.3 set() [1/2]**

```
static INLINE CONST vect_t set (
    const scalar_t x0,
    const scalar_t x1) [inline], [static]
```

**12.288.2.4 gather() [1/2]**

```
template<class T>
static INLINE PURE vect_t gather (
    const scalar_t *const p,
    const T *const idx) [inline], [static]
```

**12.288.2.5 load() [1/2]**

```
static INLINE PURE vect_t load (
    const scalar_t *const p) [inline], [static]
```

**12.288.2.6 loadu() [1/2]**

```
static INLINE PURE vect_t loadu (
    const scalar_t *const p) [inline], [static]
```

**12.288.2.7 store() [1/2]**

```
static INLINE void store (
    scalar_t * p,
    vect_t v) [inline], [static]
```

**12.288.2.8 storeu() [1/2]**

```
static INLINE void storeu (
    scalar_t * p,
    vect_t v) [inline], [static]
```

**12.288.2.9 stream() [1/2]**

```
static INLINE void stream (
    scalar_t * p,
    const vect_t v) [inline], [static]
```

**12.288.2.10 sra()**

```
template<int s>
static INLINE CONST vect_t sra (
    const vect_t a) [inline], [static]
```



**12.288.2.11 greater()**

```
static INLINE CONST vect_t greater (  
    vect_t a,  
    vect_t b) [inline], [static]
```

**12.288.2.12 lesser()**

```
static INLINE CONST vect_t lesser (  
    vect_t a,  
    vect_t b) [inline], [static]
```

**12.288.2.13 greater\_eq()**

```
static INLINE CONST vect_t greater_eq (  
    const vect_t a,  
    const vect_t b) [inline], [static]
```

**12.288.2.14 lesser\_eq()**

```
static INLINE CONST vect_t lesser_eq (  
    const vect_t a,  
    const vect_t b) [inline], [static]
```

**12.288.2.15 mullo()**

```
static INLINE CONST vect_t mullo (  
    const vect_t x0,  
    const vect_t x1) [inline], [static]
```

**12.288.2.16 mulhi()**

```
static INLINE CONST vect_t mulhi (  
    const vect_t a,  
    const vect_t b) [inline], [static]
```

**12.288.2.17 mulx()**

```
static INLINE CONST vect_t mulx (  
    const vect_t a,  
    const vect_t b) [inline], [static]
```

**12.288.2.18 fmaddx()**

```
static INLINE CONST vect_t fmaddx (  
    const vect_t c,  
    const vect_t a,  
    const vect_t b) [inline], [static]
```

**12.288.2.19 fmaddxin()**

```
static INLINE vect_t fmaddxin (  
    vect_t & c,  
    const vect_t a,  
    const vect_t b) [inline], [static]
```

**12.288.2.20 fnmaddx()**

```
static INLINE CONST vect_t fnmaddx (
    const vect_t c,
    const vect_t a,
    const vect_t b) [inline], [static]
```

**12.288.2.21 fnmaddxin()**

```
static INLINE vect_t fnmaddxin (
    vect_t & c,
    const vect_t a,
    const vect_t b) [inline], [static]
```

**12.288.2.22 fmsubx()**

```
static INLINE CONST vect_t fmsubx (
    const vect_t c,
    const vect_t a,
    const vect_t b) [inline], [static]
```

**12.288.2.23 fmsubxin()**

```
static INLINE vect_t fmsubxin (
    vect_t & c,
    const vect_t a,
    const vect_t b) [inline], [static]
```

**12.288.2.24 hadd\_to\_scal()**

```
static INLINE CONST scalar_t hadd_to_scal (
    const vect_t a) [inline], [static]
```

**12.288.2.25 valid()**

```
template<class T>
static constexpr bool valid (
    T * p) [inline], [static], [constexpr], [inherited]
```

**12.288.2.26 compliant()**

```
template<class T>
static constexpr bool compliant (
    T n) [inline], [static], [constexpr], [inherited]
```

**12.288.2.27 set1() [2/2]**

```
static INLINE CONST vect_t set1 (
    const scalar_t x) [inline], [static], [inherited]
```

**12.288.2.28 set() [2/2]**

```
static INLINE CONST vect_t set (
    const scalar_t x0,
    const scalar_t x1) [inline], [static], [inherited]
```

**12.288.2.29 gather()** [2/2]

```
template<class T>
static INLINE PURE vect_t gather (
    const scalar_t *const p,
    const T *const idx) [inline], [static], [inherited]
```

**12.288.2.30 get()**

```
template<int idx>
static INLINE CONST scalar_t get (
    vect_t v) [inline], [static], [inherited]
```

**12.288.2.31 load()** [2/2]

```
static INLINE PURE vect_t load (
    const scalar_t *const p) [inline], [static], [inherited]
```

**12.288.2.32 loadu()** [2/2]

```
static INLINE PURE vect_t loadu (
    const scalar_t *const p) [inline], [static], [inherited]
```

**12.288.2.33 store()** [2/2]

```
static INLINE void store (
    scalar_t * p,
    vect_t v) [inline], [static], [inherited]
```

**12.288.2.34 storeu()** [2/2]

```
static INLINE void storeu (
    scalar_t * p,
    vect_t v) [inline], [static], [inherited]
```

**12.288.2.35 stream()** [2/2]

```
static INLINE void stream (
    scalar_t * p,
    const vect_t v) [inline], [static], [inherited]
```

**12.288.2.36 sll()**

```
template<int s>
static INLINE CONST vect_t sll (
    const vect_t a) [inline], [static], [inherited]
```

**12.288.2.37 srl()**

```
template<int s>
static INLINE CONST vect_t srl (
    const vect_t a) [inline], [static], [inherited]
```

**12.288.2.38 shuffle()**

```
template<uint8_t s>
static INLINE CONST vect_t shuffle (
    const vect_t a) [inline], [static], [inherited]
```

**12.288.2.39 unpacklo\_intrinsic()**

```
static INLINE CONST vect_t unpacklo_intrinsic (  
    const vect_t a,  
    const vect_t b) [inline], [static], [inherited]
```

**12.288.2.40 unpackhi\_intrinsic()**

```
static INLINE CONST vect_t unpackhi_intrinsic (  
    const vect_t a,  
    const vect_t b) [inline], [static], [inherited]
```

**12.288.2.41 unpacklo()**

```
static INLINE CONST vect_t unpacklo (  
    const vect_t a,  
    const vect_t b) [inline], [static], [inherited]
```

**12.288.2.42 unpackhi()**

```
static INLINE CONST vect_t unpackhi (  
    const vect_t a,  
    const vect_t b) [inline], [static], [inherited]
```

**12.288.2.43 unpacklohi()**

```
static INLINE void unpacklohi (  
    vect_t & lo,  
    vect_t & hi,  
    const vect_t a,  
    const vect_t b) [inline], [static], [inherited]
```

**12.288.2.44 pack\_even()**

```
static INLINE CONST vect_t pack_even (  
    const vect_t a,  
    const vect_t b) [inline], [static], [inherited]
```

**12.288.2.45 pack\_odd()**

```
static INLINE CONST vect_t pack_odd (  
    const vect_t a,  
    const vect_t b) [inline], [static], [inherited]
```

**12.288.2.46 pack()**

```
static INLINE void pack (  
    vect_t & even,  
    vect_t & odd,  
    const vect_t a,  
    const vect_t b) [inline], [static], [inherited]
```

**12.288.2.47 transpose()**

```
static INLINE void transpose (  
    vect_t & r0,  
    vect_t & r1) [inline], [static], [inherited]
```

**12.288.2.48 blend()**

```
template<uint8_t s>
static INLINE CONST vect_t blend (
    const vect_t a,
    const vect_t b) [inline], [static], [inherited]
```

**12.288.2.49 add()**

```
static INLINE CONST vect_t add (
    const vect_t a,
    const vect_t b) [inline], [static], [inherited]
```

**12.288.2.50 addin()**

```
static INLINE vect_t addin (
    vect_t & a,
    const vect_t b) [inline], [static], [inherited]
```

**12.288.2.51 sub()**

```
static INLINE CONST vect_t sub (
    const vect_t a,
    const vect_t b) [inline], [static], [inherited]
```

**12.288.2.52 subin()**

```
static INLINE vect_t subin (
    vect_t & a,
    const vect_t b) [inline], [static], [inherited]
```

**12.288.2.53 mul()**

```
static INLINE CONST vect_t mul (
    const vect_t a,
    const vect_t b) [inline], [static], [inherited]
```

**12.288.2.54 fmadd()**

```
static INLINE CONST vect_t fmadd (
    const vect_t c,
    const vect_t a,
    const vect_t b) [inline], [static], [inherited]
```

**12.288.2.55 fmaddin()**

```
static INLINE vect_t fmaddin (
    vect_t & c,
    const vect_t a,
    const vect_t b) [inline], [static], [inherited]
```

**12.288.2.56 fnmadd()**

```
static INLINE CONST vect_t fnmadd (
    const vect_t c,
    const vect_t a,
    const vect_t b) [inline], [static], [inherited]
```

**12.288.2.57 fnmaddin()**

```
static INLINE vect_t fnmaddin (
    vect_t & c,
    const vect_t a,
    const vect_t b) [inline], [static], [inherited]
```

**12.288.2.58 fmsub()**

```
static INLINE CONST vect_t fmsub (
    const vect_t c,
    const vect_t a,
    const vect_t b) [inline], [static], [inherited]
```

**12.288.2.59 fmsubin()**

```
static INLINE vect_t fmsubin (
    vect_t & c,
    const vect_t a,
    const vect_t b) [inline], [static], [inherited]
```

**12.288.2.60 eq()**

```
static INLINE CONST vect_t eq (
    const vect_t a,
    const vect_t b) [inline], [static], [inherited]
```

**12.288.2.61 round()**

```
static INLINE CONST vect_t round (
    const vect_t a) [inline], [static], [inherited]
```

**12.288.2.62 mask\_high()**

```
static INLINE CONST vect_t mask_high () [inline], [static], [inherited]
```

**12.288.2.63 mulhi\_fast()**

```
INLINE CONST vect_t mulhi_fast (
    vect_t x,
    vect_t y) [static], [inherited]
```

**12.288.2.64 mod()**

```
INLINE vect_t mod (
    vect_t & C,
    const __m128d & P,
    const __m128d & INVP,
    const __m128d & NEGP,
    const vect_t & POW50REM,
    const __m128d & MIN,
    const __m128d & MAX,
    __m128d & Q,
    __m128d & T) [static], [inherited]
```

**12.288.2.65 signbits()**

```
static INLINE CONST vect_t signbits (
    const vect_t x) [inline], [static], [protected], [inherited]
```

**12.288.2.66 zero()**

```
static INLINE CONST vect_t zero () [inline], [static], [inherited]
```

**12.288.2.67 sll128()**

```
template<uint8_t s>
static INLINE CONST vect_t sll128 (
    const vect_t a) [inline], [static], [inherited]
```

**12.288.2.68 srl128()**

```
template<uint8_t s>
static INLINE CONST vect_t srl128 (
    const vect_t a) [inline], [static], [inherited]
```

**12.288.2.69 vand()**

```
static INLINE CONST vect_t vand (
    const vect_t a,
    const vect_t b) [inline], [static], [inherited]
```

**12.288.2.70 vor()**

```
static INLINE CONST vect_t vor (
    const vect_t a,
    const vect_t b) [inline], [static], [inherited]
```

**12.288.2.71 vxor()**

```
static INLINE CONST vect_t vxor (
    const vect_t a,
    const vect_t b) [inline], [static], [inherited]
```

**12.288.2.72 vandnot()**

```
static INLINE CONST vect_t vandnot (
    const vect_t a,
    const vect_t b) [inline], [static], [inherited]
```

**12.288.3 Field Documentation****12.288.3.1 vect\_size**

```
const constexpr size_t vect_size = 2 [static], [constexpr], [inherited]
```

**12.288.3.2 alignment**

```
const constexpr size_t alignment = 16 [static], [constexpr], [inherited]
```

The documentation for this struct was generated from the following file:

- [simd128\\_int64.inl](#)

**12.289 Simd128\_impl< true, true, true, 2 > Struct Reference**

Inheritance diagram for Simd128\_impl< true, true, true, 2 >:



## Data Structures

- union [Converter](#)

## Public Types

- using [vect\\_t](#) = \_\_m128i
- using [scalar\\_t](#) = int16\_t
- using [aligned\\_allocator](#) = AlignedAllocator<[scalar\\_t](#), Alignment([alignment](#))>
- using [aligned\\_vector](#) = std::vector<[scalar\\_t](#), [aligned\\_allocator](#)>
- template<class [Field](#)>  
using [is\\_same\\_element](#) = std::is\_same<typename [Field::Element](#), [scalar\\_t](#)>

## Static Public Member Functions

- static const std::string [type\\_string](#) ()
- template<class T>  
static constexpr bool [valid](#) (T \*p)
- template<class T>  
static constexpr bool [compliant](#) (T n)
- static [INLINE CONST vect\\_t set1](#) (const [scalar\\_t](#) x)
- static [INLINE CONST vect\\_t set](#) (const [scalar\\_t](#) x0, const [scalar\\_t](#) x1, const [scalar\\_t](#) x2, const [scalar\\_t](#) x3, const [scalar\\_t](#) x4, const [scalar\\_t](#) x5, const [scalar\\_t](#) x6, const [scalar\\_t](#) x7)
- template<class T>  
static [INLINE PURE vect\\_t gather](#) (const [scalar\\_t](#) \*const p, const T \*const idx)
- static [INLINE PURE vect\\_t load](#) (const [scalar\\_t](#) \*const p)
- static [INLINE PURE vect\\_t loadu](#) (const [scalar\\_t](#) \*const p)
- static [INLINE void store](#) ([scalar\\_t](#) \*p, [vect\\_t](#) v)
- static [INLINE void storeu](#) ([scalar\\_t](#) \*p, [vect\\_t](#) v)
- static [INLINE void stream](#) ([scalar\\_t](#) \*p, const [vect\\_t](#) v)
- template<int s>  
static [INLINE CONST vect\\_t sll](#) (const [vect\\_t](#) a)
- template<int s>  
static [INLINE CONST vect\\_t srl](#) (const [vect\\_t](#) a)
- template<int s>  
static [INLINE CONST vect\\_t sra](#) (const [vect\\_t](#) a)
- template<uint32\_t s>  
static [INLINE CONST vect\\_t shuffle](#) (const [vect\\_t](#) a)
- static [INLINE CONST vect\\_t unpacklo\\_intrinsic](#) (const [vect\\_t](#) a, const [vect\\_t](#) b)
- static [INLINE CONST vect\\_t unpackhi\\_intrinsic](#) (const [vect\\_t](#) a, const [vect\\_t](#) b)
- static [INLINE CONST vect\\_t unpacklo](#) (const [vect\\_t](#) a, const [vect\\_t](#) b)
- static [INLINE CONST vect\\_t unpackhi](#) (const [vect\\_t](#) a, const [vect\\_t](#) b)
- static [INLINE void unpacklohi](#) ([vect\\_t](#) &lo, [vect\\_t](#) &hi, const [vect\\_t](#) a, const [vect\\_t](#) b)
- static [INLINE CONST vect\\_t pack\\_even](#) (const [vect\\_t](#) a, const [vect\\_t](#) b)
- static [INLINE CONST vect\\_t pack\\_odd](#) (const [vect\\_t](#) a, const [vect\\_t](#) b)
- static [INLINE void pack](#) ([vect\\_t](#) &even, [vect\\_t](#) &odd, const [vect\\_t](#) a, const [vect\\_t](#) b)
- static [INLINE void transpose](#) ([vect\\_t](#) &r0, [vect\\_t](#) &r1, [vect\\_t](#) &r2, [vect\\_t](#) &r3, [vect\\_t](#) &r4, [vect\\_t](#) &r5, [vect\\_t](#) &r6, [vect\\_t](#) &r7)



- `template<uint8_t s>`  
`static INLINE CONST vect_t blend (const vect_t a, const vect_t b)`
- `static INLINE CONST vect_t add (const vect_t a, const vect_t b)`
- `static INLINE vect_t addin (vect_t &a, const vect_t b)`
- `static INLINE CONST vect_t sub (const vect_t a, const vect_t b)`
- `static INLINE vect_t subin (vect_t &a, const vect_t b)`
- `static INLINE CONST vect_t mullo (const vect_t a, const vect_t b)`
- `static INLINE CONST vect_t mul (const vect_t a, const vect_t b)`
- `static INLINE CONST vect_t mulhi (const vect_t a, const vect_t b)`
- `static INLINE CONST vect_t mulx (const vect_t a, const vect_t b)`
- `static INLINE CONST vect_t fmaddd (const vect_t c, const vect_t a, const vect_t b)`
- `static INLINE vect_t fmadddin (vect_t &c, const vect_t a, const vect_t b)`
- `static INLINE CONST vect_t fmadddx (const vect_t c, const vect_t a, const vect_t b)`
- `static INLINE vect_t fmadddxin (vect_t &c, const vect_t a, const vect_t b)`
- `static INLINE CONST vect_t fnmadd (const vect_t c, const vect_t a, const vect_t b)`
- `static INLINE vect_t fnmaddin (vect_t &c, const vect_t a, const vect_t b)`
- `static INLINE CONST vect_t fnmaddx (const vect_t c, const vect_t a, const vect_t b)`
- `static INLINE vect_t fnmaddxin (vect_t &c, const vect_t a, const vect_t b)`
- `static INLINE CONST vect_t fmsub (const vect_t c, const vect_t a, const vect_t b)`
- `static INLINE vect_t fmsubin (vect_t &c, const vect_t a, const vect_t b)`
- `static INLINE CONST vect_t fmsubx (const vect_t c, const vect_t a, const vect_t b)`
- `static INLINE vect_t fmsubxin (vect_t &c, const vect_t a, const vect_t b)`
- `static INLINE CONST vect_t eq (const vect_t a, const vect_t b)`
- `static INLINE CONST vect_t greater (const vect_t a, const vect_t b)`
- `static INLINE CONST vect_t lesser (const vect_t a, const vect_t b)`
- `static INLINE CONST vect_t greater_eq (const vect_t a, const vect_t b)`
- `static INLINE CONST vect_t lesser_eq (const vect_t a, const vect_t b)`
- `static INLINE CONST scalar_t hadd_to_scal (const vect_t a)`
- `static INLINE CONST vect_t round (const vect_t a)`
- `static INLINE vect_t mod (vect_t &C, const vect_t &P, const __m64 &INVP, const vect_t &NEGP, const vect_t &MIN, const vect_t &MAX, vect_t &Q, vect_t &T)`
- `static INLINE CONST vect_t zero ()`
- `template<uint8_t s>`  
`static INLINE CONST vect_t sll128 (const vect_t a)`
- `template<uint8_t s>`  
`static INLINE CONST vect_t srl128 (const vect_t a)`
- `static INLINE CONST vect_t vand (const vect_t a, const vect_t b)`
- `static INLINE CONST vect_t vor (const vect_t a, const vect_t b)`
- `static INLINE CONST vect_t vxor (const vect_t a, const vect_t b)`
- `static INLINE CONST vect_t vandnot (const vect_t a, const vect_t b)`

### Static Public Attributes

- `static const constexpr size_t vect_size = 8`
- `static const constexpr size_t alignment = 16`

## 12.289.1 Member Typedef Documentation

### 12.289.1.1 vect\_t

```
using vect_t = __m128i
```

### 12.289.1.2 scalar\_t

```
using scalar_t = int16_t
```

**12.289.1.3 aligned\_allocator**

```
using aligned_allocator = AlignedAllocator<scalar_t, Alignment(alignment)>
```

**12.289.1.4 aligned\_vector**

```
using aligned_vector = std::vector<scalar_t, aligned_allocator>
```

**12.289.1.5 is\_same\_element**

```
template<class Field>
using is_same_element = std::is_same<typename Field::Element, scalar_t>
```

**12.289.2 Member Function Documentation****12.289.2.1 type\_string()**

```
static const std::string type_string () [inline], [static]
```

**12.289.2.2 valid()**

```
template<class T>
static constexpr bool valid (
    T * p) [inline], [static], [constexpr]
```

**12.289.2.3 compliant()**

```
template<class T>
static constexpr bool compliant (
    T n) [inline], [static], [constexpr]
```

**12.289.2.4 set1()**

```
static INLINE CONST vect_t set1 (
    const scalar_t x) [inline], [static]
```

**12.289.2.5 set()**

```
static INLINE CONST vect_t set (
    const scalar_t x0,
    const scalar_t x1,
    const scalar_t x2,
    const scalar_t x3,
    const scalar_t x4,
    const scalar_t x5,
    const scalar_t x6,
    const scalar_t x7) [inline], [static]
```

**12.289.2.6 gather()**

```
template<class T>
static INLINE PURE vect_t gather (
    const scalar_t *const p,
    const T *const idx) [inline], [static]
```

**12.289.2.7 load()**

```
static INLINE PURE vect_t load (
    const scalar_t *const p) [inline], [static]
```

**12.289.2.8 loadu()**

```
static INLINE PURE vect_t loadu (  
    const scalar_t *const p) [inline], [static]
```

**12.289.2.9 store()**

```
static INLINE void store (  
    scalar_t * p,  
    vect_t v) [inline], [static]
```

**12.289.2.10 storeu()**

```
static INLINE void storeu (  
    scalar_t * p,  
    vect_t v) [inline], [static]
```

**12.289.2.11 stream()**

```
static INLINE void stream (  
    scalar_t * p,  
    const vect_t v) [inline], [static]
```

**12.289.2.12 sll()**

```
template<int s>  
static INLINE CONST vect_t sll (  
    const vect_t a) [inline], [static]
```

**12.289.2.13 srl()**

```
template<int s>  
static INLINE CONST vect_t srl (  
    const vect_t a) [inline], [static]
```

**12.289.2.14 sra()**

```
template<int s>  
static INLINE CONST vect_t sra (  
    const vect_t a) [inline], [static]
```

**12.289.2.15 shuffle()**

```
template<uint32_t s>  
static INLINE CONST vect_t shuffle (  
    const vect_t a) [inline], [static]
```

**12.289.2.16 unpacklo\_intrinsic()**

```
static INLINE CONST vect_t unpacklo_intrinsic (  
    const vect_t a,  
    const vect_t b) [inline], [static]
```

**12.289.2.17 unpackhi\_intrinsic()**

```
static INLINE CONST vect_t unpackhi_intrinsic (  
    const vect_t a,  
    const vect_t b) [inline], [static]
```

**12.289.2.18 unpacklo()**

```
static INLINE CONST vect_t unpacklo (  
    const vect_t a,  
    const vect_t b) [inline], [static]
```

**12.289.2.19 unpackhi()**

```
static INLINE CONST vect_t unpackhi (  
    const vect_t a,  
    const vect_t b) [inline], [static]
```

**12.289.2.20 unpacklohi()**

```
static INLINE void unpacklohi (  
    vect_t & lo,  
    vect_t & hi,  
    const vect_t a,  
    const vect_t b) [inline], [static]
```

**12.289.2.21 pack\_even()**

```
static INLINE CONST vect_t pack_even (  
    const vect_t a,  
    const vect_t b) [inline], [static]
```

**12.289.2.22 pack\_odd()**

```
static INLINE CONST vect_t pack_odd (  
    const vect_t a,  
    const vect_t b) [inline], [static]
```

**12.289.2.23 pack()**

```
static INLINE void pack (  
    vect_t & even,  
    vect_t & odd,  
    const vect_t a,  
    const vect_t b) [inline], [static]
```

**12.289.2.24 transpose()**

```
static INLINE void transpose (  
    vect_t & r0,  
    vect_t & r1,  
    vect_t & r2,  
    vect_t & r3,  
    vect_t & r4,  
    vect_t & r5,  
    vect_t & r6,  
    vect_t & r7) [inline], [static]
```

**12.289.2.25 blend()**

```
template<uint8_t s>  
static INLINE CONST vect_t blend (  
    const vect_t a,  
    const vect_t b) [inline], [static]
```

**12.289.2.26 add()**

```
static INLINE CONST vect_t add (  
    const vect_t a,  
    const vect_t b) [inline], [static]
```

**12.289.2.27 addin()**

```
static INLINE vect_t addin (  
    vect_t & a,  
    const vect_t b) [inline], [static]
```

**12.289.2.28 sub()**

```
static INLINE CONST vect_t sub (  
    const vect_t a,  
    const vect_t b) [inline], [static]
```

**12.289.2.29 subin()**

```
static INLINE vect_t subin (  
    vect_t & a,  
    const vect_t b) [inline], [static]
```

**12.289.2.30 mullo()**

```
static INLINE CONST vect_t mullo (  
    const vect_t a,  
    const vect_t b) [inline], [static]
```

**12.289.2.31 mul()**

```
static INLINE CONST vect_t mul (  
    const vect_t a,  
    const vect_t b) [inline], [static]
```

**12.289.2.32 mulhi()**

```
static INLINE CONST vect_t mulhi (  
    const vect_t a,  
    const vect_t b) [inline], [static]
```

**12.289.2.33 mulx()**

```
static INLINE CONST vect_t mulx (  
    const vect_t a,  
    const vect_t b) [inline], [static]
```

**12.289.2.34 fmadd()**

```
static INLINE CONST vect_t fmadd (  
    const vect_t c,  
    const vect_t a,  
    const vect_t b) [inline], [static]
```

**12.289.2.35 fmaddin()**

```
static INLINE vect_t fmaddin (  
    vect_t & c,  
    const vect_t a,  
    const vect_t b) [inline], [static]
```

**12.289.2.36 fmaddx()**

```
static INLINE CONST vect_t fmaddx (  
    const vect_t c,  
    const vect_t a,  
    const vect_t b) [inline], [static]
```

**12.289.2.37 fmaddxin()**

```
static INLINE vect_t fmaddxin (  
    vect_t & c,  
    const vect_t a,  
    const vect_t b) [inline], [static]
```

**12.289.2.38 fnmadd()**

```
static INLINE CONST vect_t fnmadd (  
    const vect_t c,  
    const vect_t a,  
    const vect_t b) [inline], [static]
```

**12.289.2.39 fnmaddin()**

```
static INLINE vect_t fnmaddin (  
    vect_t & c,  
    const vect_t a,  
    const vect_t b) [inline], [static]
```

**12.289.2.40 fnmaddx()**

```
static INLINE CONST vect_t fnmaddx (  
    const vect_t c,  
    const vect_t a,  
    const vect_t b) [inline], [static]
```

**12.289.2.41 fnmaddxin()**

```
static INLINE vect_t fnmaddxin (  
    vect_t & c,  
    const vect_t a,  
    const vect_t b) [inline], [static]
```

**12.289.2.42 fmsub()**

```
static INLINE CONST vect_t fmsub (  
    const vect_t c,  
    const vect_t a,  
    const vect_t b) [inline], [static]
```

**12.289.2.43 fmsubin()**

```
static INLINE vect_t fmsubin (  
    vect_t & c,  
    const vect_t a,  
    const vect_t b) [inline], [static]
```

**12.289.2.44 fmsubx()**

```
static INLINE CONST vect_t fmsubx (  
    const vect_t c,
```

```
const vect_t a,  
const vect_t b) [inline], [static]
```

#### 12.289.2.45 fmsubxin()

```
static INLINE vect_t fmsubxin (  
    vect_t & c,  
    const vect_t a,  
    const vect_t b) [inline], [static]
```

#### 12.289.2.46 eq()

```
static INLINE CONST vect_t eq (  
    const vect_t a,  
    const vect_t b) [inline], [static]
```

#### 12.289.2.47 greater()

```
static INLINE CONST vect_t greater (  
    const vect_t a,  
    const vect_t b) [inline], [static]
```

#### 12.289.2.48 lesser()

```
static INLINE CONST vect_t lesser (  
    const vect_t a,  
    const vect_t b) [inline], [static]
```

#### 12.289.2.49 greater\_eq()

```
static INLINE CONST vect_t greater_eq (  
    const vect_t a,  
    const vect_t b) [inline], [static]
```

#### 12.289.2.50 lesser\_eq()

```
static INLINE CONST vect_t lesser_eq (  
    const vect_t a,  
    const vect_t b) [inline], [static]
```

#### 12.289.2.51 hadd\_to\_scal()

```
static INLINE CONST scalar_t hadd_to_scal (  
    const vect_t a) [inline], [static]
```

#### 12.289.2.52 round()

```
static INLINE CONST vect_t round (  
    const vect_t a) [inline], [static]
```

#### 12.289.2.53 mod()

```
static INLINE vect_t mod (  
    vect_t & C,  
    const vect_t & P,  
    const __m64 & INVP,  
    const vect_t & NEGP,  
    const vect_t & MIN,  
    const vect_t & MAX,
```

```
    vect_t & Q,
    vect_t & T) [inline], [static]
```

#### 12.289.2.54 zero()

```
static INLINE CONST vect_t zero () [inline], [static], [inherited]
```

#### 12.289.2.55 sll128()

```
template<uint8_t s>
static INLINE CONST vect_t sll128 (
    const vect_t a) [inline], [static], [inherited]
```

#### 12.289.2.56 srl128()

```
template<uint8_t s>
static INLINE CONST vect_t srl128 (
    const vect_t a) [inline], [static], [inherited]
```

#### 12.289.2.57 vand()

```
static INLINE CONST vect_t vand (
    const vect_t a,
    const vect_t b) [inline], [static], [inherited]
```

#### 12.289.2.58 vor()

```
static INLINE CONST vect_t vor (
    const vect_t a,
    const vect_t b) [inline], [static], [inherited]
```

#### 12.289.2.59 vxor()

```
static INLINE CONST vect_t vxor (
    const vect_t a,
    const vect_t b) [inline], [static], [inherited]
```

#### 12.289.2.60 vandnot()

```
static INLINE CONST vect_t vandnot (
    const vect_t a,
    const vect_t b) [inline], [static], [inherited]
```

### 12.289.3 Field Documentation

#### 12.289.3.1 vect\_size

```
const constexpr size_t vect_size = 8 [static], [constexpr]
```

#### 12.289.3.2 alignment

```
const constexpr size_t alignment = 16 [static], [constexpr]
```

The documentation for this struct was generated from the following file:

- [simd128\\_int16.inl](#)



## 12.290 Simd128\_impl< true, true, true, 4 > Struct Reference

Inheritance diagram for Simd128\_impl< true, true, true, 4 >:



### Data Structures

- union [Converter](#)

### Public Types

- using [vect\\_t](#) = \_\_m128i
- using [scalar\\_t](#) = int32\_t
- using [aligned\\_allocator](#) = AlignedAllocator<[scalar\\_t](#), Alignment([alignment](#))>
- using [aligned\\_vector](#) = std::vector<[scalar\\_t](#), [aligned\\_allocator](#)>
- template<class [Field](#)>
  - using [is\\_same\\_element](#) = std::is\_same<typename [Field::Element](#), [scalar\\_t](#)>

### Static Public Member Functions

- static const std::string [type\\_string](#) ()
- template<class T>
  - static constexpr bool [valid](#) (T \*p)
- template<class T>
  - static constexpr bool [compliant](#) (T n)
- static [INLINE CONST vect\\_t set1](#) (const [scalar\\_t](#) x)
- static [INLINE CONST vect\\_t set](#) (const [scalar\\_t](#) x0, const [scalar\\_t](#) x1, const [scalar\\_t](#) x2, const [scalar\\_t](#) x3)
- template<class T>
  - static [INLINE PURE vect\\_t gather](#) (const [scalar\\_t](#) \*const p, const T \*const idx)
- static [INLINE PURE vect\\_t load](#) (const [scalar\\_t](#) \*const p)
- static [INLINE PURE vect\\_t loadu](#) (const [scalar\\_t](#) \*const p)
- static [INLINE void store](#) ([scalar\\_t](#) \*p, [vect\\_t](#) v)
- static [INLINE void storeu](#) ([scalar\\_t](#) \*p, [vect\\_t](#) v)
- static [INLINE void stream](#) ([scalar\\_t](#) \*p, const [vect\\_t](#) v)
- template<int s>
  - static [INLINE CONST vect\\_t sll](#) (const [vect\\_t](#) a)
- template<int s>
  - static [INLINE CONST vect\\_t srl](#) (const [vect\\_t](#) a)
- template<int s>
  - static [INLINE CONST vect\\_t sra](#) (const [vect\\_t](#) a)
- template<uint8\_t s>
  - static [INLINE CONST vect\\_t shuffle](#) (const [vect\\_t](#) a)
- static [INLINE CONST vect\\_t unpacklo\\_intrinsic](#) (const [vect\\_t](#) a, const [vect\\_t](#) b)
- static [INLINE CONST vect\\_t unpackhi\\_intrinsic](#) (const [vect\\_t](#) a, const [vect\\_t](#) b)
- static [INLINE CONST vect\\_t unpacklo](#) (const [vect\\_t](#) a, const [vect\\_t](#) b)
- static [INLINE CONST vect\\_t unpackhi](#) (const [vect\\_t](#) a, const [vect\\_t](#) b)
- static [INLINE void unpacklohi](#) ([vect\\_t](#) &lo, [vect\\_t](#) &hi, const [vect\\_t](#) a, const [vect\\_t](#) b)
- static [INLINE CONST vect\\_t pack\\_even](#) (const [vect\\_t](#) a, const [vect\\_t](#) b)
- static [INLINE CONST vect\\_t pack\\_odd](#) (const [vect\\_t](#) a, const [vect\\_t](#) b)

- static `INLINE` void `pack` (`vect_t` &even, `vect_t` &odd, const `vect_t` a, const `vect_t` b)
- static `INLINE` void `transpose` (`vect_t` &r0, `vect_t` &r1, `vect_t` &r2, `vect_t` &r3)
- template<uint8\_t s>  
static `INLINE` `CONST` `vect_t` `blend` (const `vect_t` a, const `vect_t` b)
- static `INLINE` `CONST` `vect_t` `add` (const `vect_t` a, const `vect_t` b)
- static `INLINE` `vect_t` `addin` (`vect_t` &a, const `vect_t` b)
- static `INLINE` `CONST` `vect_t` `sub` (const `vect_t` a, const `vect_t` b)
- static `INLINE` `vect_t` `subin` (`vect_t` &a, const `vect_t` b)
- static `INLINE` `CONST` `vect_t` `mullo` (const `vect_t` a, const `vect_t` b)
- static `INLINE` `CONST` `vect_t` `mul` (const `vect_t` a, const `vect_t` b)
- static `INLINE` `CONST` `vect_t` `mulhi` (const `vect_t` a, const `vect_t` b)
- static `INLINE` `CONST` `vect_t` `mulx` (const `vect_t` a, const `vect_t` b)
- static `INLINE` `CONST` `vect_t` `fmadd` (const `vect_t` c, const `vect_t` a, const `vect_t` b)
- static `INLINE` `vect_t` `fmaddin` (`vect_t` &c, const `vect_t` a, const `vect_t` b)
- static `INLINE` `CONST` `vect_t` `fmaddx` (const `vect_t` c, const `vect_t` a, const `vect_t` b)
- static `INLINE` `vect_t` `fmaddxin` (`vect_t` &c, const `vect_t` a, const `vect_t` b)
- static `INLINE` `CONST` `vect_t` `fnmadd` (const `vect_t` c, const `vect_t` a, const `vect_t` b)
- static `INLINE` `vect_t` `fnmaddin` (`vect_t` &c, const `vect_t` a, const `vect_t` b)
- static `INLINE` `CONST` `vect_t` `fnmaddx` (const `vect_t` c, const `vect_t` a, const `vect_t` b)
- static `INLINE` `vect_t` `fnmaddxin` (`vect_t` &c, const `vect_t` a, const `vect_t` b)
- static `INLINE` `CONST` `vect_t` `fmsub` (const `vect_t` c, const `vect_t` a, const `vect_t` b)
- static `INLINE` `vect_t` `fmsubin` (`vect_t` &c, const `vect_t` a, const `vect_t` b)
- static `INLINE` `CONST` `vect_t` `fmsubx` (const `vect_t` c, const `vect_t` a, const `vect_t` b)
- static `INLINE` `vect_t` `fmsubxin` (`vect_t` &c, const `vect_t` a, const `vect_t` b)
- static `INLINE` `CONST` `vect_t` `eq` (const `vect_t` a, const `vect_t` b)
- static `INLINE` `CONST` `vect_t` `greater` (const `vect_t` a, const `vect_t` b)
- static `INLINE` `CONST` `vect_t` `lesser` (const `vect_t` a, const `vect_t` b)
- static `INLINE` `CONST` `vect_t` `greater_eq` (const `vect_t` a, const `vect_t` b)
- static `INLINE` `CONST` `vect_t` `lesser_eq` (const `vect_t` a, const `vect_t` b)
- static `INLINE` `CONST` `scalar_t` `hadd_to_scal` (const `vect_t` a)
- static `INLINE` `CONST` `vect_t` `round` (const `vect_t` a)
- static `INLINE` `vect_t` `mod` (`vect_t` &C, const `vect_t` &P, const `vect_t` &INVP, const `vect_t` &NEGP, const `vect_t` &MIN, const `vect_t` &MAX, `vect_t` &Q, `vect_t` &T)
- static `INLINE` `CONST` `vect_t` `zero` ()
- template<uint8\_t s>  
static `INLINE` `CONST` `vect_t` `sll128` (const `vect_t` a)
- template<uint8\_t s>  
static `INLINE` `CONST` `vect_t` `srl128` (const `vect_t` a)
- static `INLINE` `CONST` `vect_t` `vand` (const `vect_t` a, const `vect_t` b)
- static `INLINE` `CONST` `vect_t` `vor` (const `vect_t` a, const `vect_t` b)
- static `INLINE` `CONST` `vect_t` `vxor` (const `vect_t` a, const `vect_t` b)
- static `INLINE` `CONST` `vect_t` `vandnot` (const `vect_t` a, const `vect_t` b)

### Static Public Attributes

- static const constexpr size\_t `vect_size` = 4
- static const constexpr size\_t `alignment` = 16

## 12.290.1 Member Typedef Documentation

### 12.290.1.1 `vect_t`

```
using vect_t = __m128i
```

### 12.290.1.2 `scalar_t`

```
using scalar_t = int32_t
```

### 12.290.1.3 aligned\_allocator

```
using aligned_allocator = AlignedAllocator<scalar_t, Alignment(alignment)>
```

### 12.290.1.4 aligned\_vector

```
using aligned_vector = std::vector<scalar_t, aligned_allocator>
```

### 12.290.1.5 is\_same\_element

```
template<class Field>
using is_same_element = std::is_same<typename Field::Element, scalar_t>
```

## 12.290.2 Member Function Documentation

### 12.290.2.1 type\_string()

```
static const std::string type_string () [inline], [static]
```

### 12.290.2.2 valid()

```
template<class T>
static constexpr bool valid (
    T * p) [inline], [static], [constexpr]
```

### 12.290.2.3 compliant()

```
template<class T>
static constexpr bool compliant (
    T n) [inline], [static], [constexpr]
```

### 12.290.2.4 set1()

```
static INLINE CONST vect_t set1 (
    const scalar_t x) [inline], [static]
```

### 12.290.2.5 set()

```
static INLINE CONST vect_t set (
    const scalar_t x0,
    const scalar_t x1,
    const scalar_t x2,
    const scalar_t x3) [inline], [static]
```

### 12.290.2.6 gather()

```
template<class T>
static INLINE PURE vect_t gather (
    const scalar_t *const p,
    const T *const idx) [inline], [static]
```

### 12.290.2.7 load()

```
static INLINE PURE vect_t load (
    const scalar_t *const p) [inline], [static]
```

### 12.290.2.8 loadu()

```
static INLINE PURE vect_t loadu (
    const scalar_t *const p) [inline], [static]
```

#### 12.290.2.9 store()

```
static INLINE void store (  
    scalar_t * p,  
    vect_t v) [inline], [static]
```

#### 12.290.2.10 storeu()

```
static INLINE void storeu (  
    scalar_t * p,  
    vect_t v) [inline], [static]
```

#### 12.290.2.11 stream()

```
static INLINE void stream (  
    scalar_t * p,  
    const vect_t v) [inline], [static]
```

#### 12.290.2.12 sll()

```
template<int s>  
static INLINE CONST vect_t sll (  
    const vect_t a) [inline], [static]
```

#### 12.290.2.13 srl()

```
template<int s>  
static INLINE CONST vect_t srl (  
    const vect_t a) [inline], [static]
```

#### 12.290.2.14 sra()

```
template<int s>  
static INLINE CONST vect_t sra (  
    const vect_t a) [inline], [static]
```

#### 12.290.2.15 shuffle()

```
template<uint8_t s>  
static INLINE CONST vect_t shuffle (  
    const vect_t a) [inline], [static]
```

#### 12.290.2.16 unpacklo\_intrinsic()

```
static INLINE CONST vect_t unpacklo_intrinsic (  
    const vect_t a,  
    const vect_t b) [inline], [static]
```

#### 12.290.2.17 unpackhi\_intrinsic()

```
static INLINE CONST vect_t unpackhi_intrinsic (  
    const vect_t a,  
    const vect_t b) [inline], [static]
```

#### 12.290.2.18 unpacklo()

```
static INLINE CONST vect_t unpacklo (  
    const vect_t a,  
    const vect_t b) [inline], [static]
```

**12.290.2.19 unpackhi()**

```
static INLINE CONST vect_t unpackhi (  
    const vect_t a,  
    const vect_t b) [inline], [static]
```

**12.290.2.20 unpacklohi()**

```
static INLINE void unpacklohi (  
    vect_t & lo,  
    vect_t & hi,  
    const vect_t a,  
    const vect_t b) [inline], [static]
```

**12.290.2.21 pack\_even()**

```
static INLINE CONST vect_t pack_even (  
    const vect_t a,  
    const vect_t b) [inline], [static]
```

**12.290.2.22 pack\_odd()**

```
static INLINE CONST vect_t pack_odd (  
    const vect_t a,  
    const vect_t b) [inline], [static]
```

**12.290.2.23 pack()**

```
static INLINE void pack (  
    vect_t & even,  
    vect_t & odd,  
    const vect_t a,  
    const vect_t b) [inline], [static]
```

**12.290.2.24 transpose()**

```
static INLINE void transpose (  
    vect_t & r0,  
    vect_t & r1,  
    vect_t & r2,  
    vect_t & r3) [inline], [static]
```

**12.290.2.25 blend()**

```
template<uint8_t s>  
static INLINE CONST vect_t blend (  
    const vect_t a,  
    const vect_t b) [inline], [static]
```

**12.290.2.26 add()**

```
static INLINE CONST vect_t add (  
    const vect_t a,  
    const vect_t b) [inline], [static]
```

**12.290.2.27 addin()**

```
static INLINE vect_t addin (  
    vect_t & a,  
    const vect_t b) [inline], [static]
```

**12.290.2.28 sub()**

```
static INLINE CONST vect_t sub (  
    const vect_t a,  
    const vect_t b) [inline], [static]
```

**12.290.2.29 subin()**

```
static INLINE vect_t subin (  
    vect_t & a,  
    const vect_t b) [inline], [static]
```

**12.290.2.30 mullo()**

```
static INLINE CONST vect_t mullo (  
    const vect_t a,  
    const vect_t b) [inline], [static]
```

**12.290.2.31 mul()**

```
static INLINE CONST vect_t mul (  
    const vect_t a,  
    const vect_t b) [inline], [static]
```

**12.290.2.32 mulhi()**

```
static INLINE CONST vect_t mulhi (  
    const vect_t a,  
    const vect_t b) [inline], [static]
```

**12.290.2.33 mulx()**

```
static INLINE CONST vect_t mulx (  
    const vect_t a,  
    const vect_t b) [inline], [static]
```

**12.290.2.34 fmadd()**

```
static INLINE CONST vect_t fmadd (  
    const vect_t c,  
    const vect_t a,  
    const vect_t b) [inline], [static]
```

**12.290.2.35 fmaddin()**

```
static INLINE vect_t fmaddin (  
    vect_t & c,  
    const vect_t a,  
    const vect_t b) [inline], [static]
```

**12.290.2.36 fmaddx()**

```
static INLINE CONST vect_t fmaddx (  
    const vect_t c,  
    const vect_t a,  
    const vect_t b) [inline], [static]
```

**12.290.2.37 fmaddxin()**

```
static INLINE vect_t fmaddxin (  
    vect_t & c,  
    const vect_t a,  
    const vect_t b) [inline], [static]
```

**12.290.2.38 fnmadd()**

```
static INLINE CONST vect_t fnmadd (  
    const vect_t c,  
    const vect_t a,  
    const vect_t b) [inline], [static]
```

**12.290.2.39 fnmaddin()**

```
static INLINE vect_t fnmaddin (  
    vect_t & c,  
    const vect_t a,  
    const vect_t b) [inline], [static]
```

**12.290.2.40 fnmaddx()**

```
static INLINE CONST vect_t fnmaddx (  
    const vect_t c,  
    const vect_t a,  
    const vect_t b) [inline], [static]
```

**12.290.2.41 fnmaddxin()**

```
static INLINE vect_t fnmaddxin (  
    vect_t & c,  
    const vect_t a,  
    const vect_t b) [inline], [static]
```

**12.290.2.42 fmsub()**

```
static INLINE CONST vect_t fmsub (  
    const vect_t c,  
    const vect_t a,  
    const vect_t b) [inline], [static]
```

**12.290.2.43 fmsubin()**

```
static INLINE vect_t fmsubin (  
    vect_t & c,  
    const vect_t a,  
    const vect_t b) [inline], [static]
```

**12.290.2.44 fmsubx()**

```
static INLINE CONST vect_t fmsubx (  
    const vect_t c,  
    const vect_t a,  
    const vect_t b) [inline], [static]
```

**12.290.2.45 fmsubxin()**

```
static INLINE vect_t fmsubxin (  
    vect_t & c,
```

```

    const vect_t a,
    const vect_t b) [inline], [static]

```

#### 12.290.2.46 eq()

```

static INLINE CONST vect_t eq (
    const vect_t a,
    const vect_t b) [inline], [static]

```

#### 12.290.2.47 greater()

```

static INLINE CONST vect_t greater (
    const vect_t a,
    const vect_t b) [inline], [static]

```

#### 12.290.2.48 lesser()

```

static INLINE CONST vect_t lesser (
    const vect_t a,
    const vect_t b) [inline], [static]

```

#### 12.290.2.49 greater\_eq()

```

static INLINE CONST vect_t greater_eq (
    const vect_t a,
    const vect_t b) [inline], [static]

```

#### 12.290.2.50 lesser\_eq()

```

static INLINE CONST vect_t lesser_eq (
    const vect_t a,
    const vect_t b) [inline], [static]

```

#### 12.290.2.51 hadd\_to\_scal()

```

static INLINE CONST scalar_t hadd_to_scal (
    const vect_t a) [inline], [static]

```

#### 12.290.2.52 round()

```

static INLINE CONST vect_t round (
    const vect_t a) [inline], [static]

```

#### 12.290.2.53 mod()

```

static INLINE vect_t mod (
    vect_t & C,
    const vect_t & P,
    const vect_t & INVP,
    const vect_t & NEGP,
    const vect_t & MIN,
    const vect_t & MAX,
    vect_t & Q,
    vect_t & T) [inline], [static]

```

#### 12.290.2.54 zero()

```

static INLINE CONST vect_t zero () [inline], [static], [inherited]

```



**12.290.2.55 sll128()**

```
template<uint8_t s>
static INLINE CONST vect_t sll128 (
    const vect_t a) [inline], [static], [inherited]
```

**12.290.2.56 srl128()**

```
template<uint8_t s>
static INLINE CONST vect_t srl128 (
    const vect_t a) [inline], [static], [inherited]
```

**12.290.2.57 vand()**

```
static INLINE CONST vect_t vand (
    const vect_t a,
    const vect_t b) [inline], [static], [inherited]
```

**12.290.2.58 vor()**

```
static INLINE CONST vect_t vor (
    const vect_t a,
    const vect_t b) [inline], [static], [inherited]
```

**12.290.2.59 vxor()**

```
static INLINE CONST vect_t vxor (
    const vect_t a,
    const vect_t b) [inline], [static], [inherited]
```

**12.290.2.60 vandnot()**

```
static INLINE CONST vect_t vandnot (
    const vect_t a,
    const vect_t b) [inline], [static], [inherited]
```

**12.290.3 Field Documentation****12.290.3.1 vect\_size**

```
const constexpr size_t vect_size = 4 [static], [constexpr]
```

**12.290.3.2 alignment**

```
const constexpr size_t alignment = 16 [static], [constexpr]
```

The documentation for this struct was generated from the following file:

- [simd128\\_int32.inl](#)

**12.291 Simd128\_impl< true, true, true, 8 > Struct Reference**

Inheritance diagram for Simd128\_impl< true, true, true, 8 >:



## Data Structures

- union [Converter](#)

## Public Types

- using `vect_t` = `__m128i`
- using `scalar_t` = `int64_t`
- using `aligned_allocator` = `AlignedAllocator<scalar_t, Alignment(alignment)>`
- using `aligned_vector` = `std::vector<scalar_t, aligned_allocator>`
- template<class `Field`>  
using `is_same_element` = `std::is_same<typename Field::Element, scalar_t>`

## Static Public Member Functions

- static const std::string `type_string` ()
- template<class T>  
static constexpr bool `valid` (T \*p)
- template<class T>  
static constexpr bool `compliant` (T n)
- static `INLINE CONST vect_t set1` (const `scalar_t` x)
- static `INLINE CONST vect_t set` (const `scalar_t` x0, const `scalar_t` x1)
- template<class T>  
static `INLINE PURE vect_t gather` (const `scalar_t` \*const p, const T \*const idx)
- template<int idx>  
static `INLINE CONST scalar_t get` (`vect_t` v)
- static `INLINE PURE vect_t load` (const `scalar_t` \*const p)
- static `INLINE PURE vect_t loadu` (const `scalar_t` \*const p)
- static `INLINE void store` (`scalar_t` \*p, `vect_t` v)
- static `INLINE void storeu` (`scalar_t` \*p, `vect_t` v)
- static `INLINE void stream` (`scalar_t` \*p, const `vect_t` v)
- template<int s>  
static `INLINE CONST vect_t sll` (const `vect_t` a)
- template<int s>  
static `INLINE CONST vect_t srl` (const `vect_t` a)
- template<int s>  
static `INLINE CONST vect_t sra` (const `vect_t` a)
- template<uint8\_t s>  
static `INLINE CONST vect_t shuffle` (const `vect_t` a)
- static `INLINE CONST vect_t unpacklo_intrinsic` (const `vect_t` a, const `vect_t` b)
- static `INLINE CONST vect_t unpackhi_intrinsic` (const `vect_t` a, const `vect_t` b)
- static `INLINE CONST vect_t unpacklo` (const `vect_t` a, const `vect_t` b)
- static `INLINE CONST vect_t unpackhi` (const `vect_t` a, const `vect_t` b)
- static `INLINE void unpacklohi` (`vect_t` &lo, `vect_t` &hi, const `vect_t` a, const `vect_t` b)
- static `INLINE CONST vect_t pack_even` (const `vect_t` a, const `vect_t` b)
- static `INLINE CONST vect_t pack_odd` (const `vect_t` a, const `vect_t` b)
- static `INLINE void pack` (`vect_t` &even, `vect_t` &odd, const `vect_t` a, const `vect_t` b)
- static `INLINE void transpose` (`vect_t` &r0, `vect_t` &r1)

- `template<uint8_t s>`  
`static INLINE CONST vect_t blend (const vect_t a, const vect_t b)`
- `static INLINE CONST vect_t add (const vect_t a, const vect_t b)`
- `static INLINE vect_t addin (vect_t &a, const vect_t b)`
- `static INLINE CONST vect_t sub (const vect_t a, const vect_t b)`
- `static INLINE vect_t subin (vect_t &a, const vect_t b)`
- `static INLINE CONST vect_t mullo (const vect_t x0, const vect_t x1)`
- `static INLINE CONST vect_t mul (const vect_t a, const vect_t b)`
- `static INLINE CONST vect_t mulhi (const vect_t a, const vect_t b)`
- `static INLINE CONST vect_t mulx (const vect_t a, const vect_t b)`
- `static INLINE CONST vect_t fmadd (const vect_t c, const vect_t a, const vect_t b)`
- `static INLINE vect_t fmaddin (vect_t &c, const vect_t a, const vect_t b)`
- `static INLINE CONST vect_t fmadddx (const vect_t c, const vect_t a, const vect_t b)`
- `static INLINE vect_t fmadddxin (vect_t &c, const vect_t a, const vect_t b)`
- `static INLINE CONST vect_t fnmadd (const vect_t c, const vect_t a, const vect_t b)`
- `static INLINE vect_t fnmaddin (vect_t &c, const vect_t a, const vect_t b)`
- `static INLINE CONST vect_t fnmaddx (const vect_t c, const vect_t a, const vect_t b)`
- `static INLINE vect_t fnmaddxin (vect_t &c, const vect_t a, const vect_t b)`
- `static INLINE CONST vect_t fmsub (const vect_t c, const vect_t a, const vect_t b)`
- `static INLINE vect_t fmsubin (vect_t &c, const vect_t a, const vect_t b)`
- `static INLINE CONST vect_t fmsubx (const vect_t c, const vect_t a, const vect_t b)`
- `static INLINE vect_t fmsubxin (vect_t &c, const vect_t a, const vect_t b)`
- `static INLINE CONST vect_t eq (const vect_t a, const vect_t b)`
- `static INLINE CONST vect_t greater (const vect_t a, const vect_t b)`
- `static INLINE CONST vect_t lesser (const vect_t a, const vect_t b)`
- `static INLINE CONST vect_t greater_eq (const vect_t a, const vect_t b)`
- `static INLINE CONST vect_t lesser_eq (const vect_t a, const vect_t b)`
- `static INLINE CONST scalar_t hadd_to_scal (const vect_t a)`
- `static INLINE CONST vect_t round (const vect_t a)`
- `static INLINE CONST vect_t mask_high ()`
- `static INLINE CONST vect_t mulhi_fast (vect_t x, vect_t y)`
- `static INLINE vect_t mod (vect_t &C, const __m128d &P, const __m128d &INVP, const __m128d &NEGP, const vect_t &POW50REM, const __m128d &MIN, const __m128d &MAX, __m128d &Q, __m128d &T)`
- `static INLINE CONST vect_t zero ()`
- `template<uint8_t s>`  
`static INLINE CONST vect_t sll128 (const vect_t a)`
- `template<uint8_t s>`  
`static INLINE CONST vect_t srl128 (const vect_t a)`
- `static INLINE CONST vect_t vand (const vect_t a, const vect_t b)`
- `static INLINE CONST vect_t vor (const vect_t a, const vect_t b)`
- `static INLINE CONST vect_t vxor (const vect_t a, const vect_t b)`
- `static INLINE CONST vect_t vandnot (const vect_t a, const vect_t b)`

### Static Public Attributes

- `static const constexpr size_t vect_size = 2`
- `static const constexpr size_t alignment = 16`

### Static Protected Member Functions

- `static INLINE CONST vect_t signbits (const vect_t x)`

## 12.291.1 Member Typedef Documentation

### 12.291.1.1 vect\_t

```
using vect_t = __m128i
```

**12.291.1.2 scalar\_t**

```
using scalar_t = int64_t
```

**12.291.1.3 aligned\_allocator**

```
using aligned_allocator = AlignedAllocator<scalar_t, Alignment(alignment)>
```

**12.291.1.4 aligned\_vector**

```
using aligned_vector = std::vector<scalar_t, aligned_allocator>
```

**12.291.1.5 is\_same\_element**

```
template<class Field>
using is_same_element = std::is_same<typename Field::Element, scalar_t>
```

**12.291.2 Member Function Documentation****12.291.2.1 type\_string()**

```
static const std::string type_string () [inline], [static]
```

**12.291.2.2 valid()**

```
template<class T>
static constexpr bool valid (
    T * p) [inline], [static], [constexpr]
```

**12.291.2.3 compliant()**

```
template<class T>
static constexpr bool compliant (
    T n) [inline], [static], [constexpr]
```

**12.291.2.4 set1()**

```
static INLINE CONST vect_t set1 (
    const scalar_t x) [inline], [static]
```

**12.291.2.5 set()**

```
static INLINE CONST vect_t set (
    const scalar_t x0,
    const scalar_t x1) [inline], [static]
```

**12.291.2.6 gather()**

```
template<class T>
static INLINE PURE vect_t gather (
    const scalar_t *const p,
    const T *const idx) [inline], [static]
```

**12.291.2.7 get()**

```
template<int idx>
static INLINE CONST scalar_t get (
    vect_t v) [inline], [static]
```

**12.291.2.8 load()**

```
static INLINE PURE vect_t load (  
    const scalar_t *const p) [inline], [static]
```

**12.291.2.9 loadu()**

```
static INLINE PURE vect_t loadu (  
    const scalar_t *const p) [inline], [static]
```

**12.291.2.10 store()**

```
static INLINE void store (  
    scalar_t * p,  
    vect_t v) [inline], [static]
```

**12.291.2.11 storeu()**

```
static INLINE void storeu (  
    scalar_t * p,  
    vect_t v) [inline], [static]
```

**12.291.2.12 stream()**

```
static INLINE void stream (  
    scalar_t * p,  
    const vect_t v) [inline], [static]
```

**12.291.2.13 sll()**

```
template<int s>  
static INLINE CONST vect_t sll (  
    const vect_t a) [inline], [static]
```

**12.291.2.14 srl()**

```
template<int s>  
static INLINE CONST vect_t srl (  
    const vect_t a) [inline], [static]
```

**12.291.2.15 sra()**

```
template<int s>  
static INLINE CONST vect_t sra (  
    const vect_t a) [inline], [static]
```

**12.291.2.16 shuffle()**

```
template<uint8_t s>  
static INLINE CONST vect_t shuffle (  
    const vect_t a) [inline], [static]
```

**12.291.2.17 unpacklo\_intrinsic()**

```
static INLINE CONST vect_t unpacklo_intrinsic (  
    const vect_t a,  
    const vect_t b) [inline], [static]
```

**12.291.2.18 unpackhi\_intrinsic()**

```
static INLINE CONST vect_t unpackhi_intrinsic (
    const vect_t a,
    const vect_t b) [inline], [static]
```

**12.291.2.19 unpacklo()**

```
static INLINE CONST vect_t unpacklo (
    const vect_t a,
    const vect_t b) [inline], [static]
```

**12.291.2.20 unpackhi()**

```
static INLINE CONST vect_t unpackhi (
    const vect_t a,
    const vect_t b) [inline], [static]
```

**12.291.2.21 unpacklohi()**

```
static INLINE void unpacklohi (
    vect_t & lo,
    vect_t & hi,
    const vect_t a,
    const vect_t b) [inline], [static]
```

**12.291.2.22 pack\_even()**

```
static INLINE CONST vect_t pack_even (
    const vect_t a,
    const vect_t b) [inline], [static]
```

**12.291.2.23 pack\_odd()**

```
static INLINE CONST vect_t pack_odd (
    const vect_t a,
    const vect_t b) [inline], [static]
```

**12.291.2.24 pack()**

```
static INLINE void pack (
    vect_t & even,
    vect_t & odd,
    const vect_t a,
    const vect_t b) [inline], [static]
```

**12.291.2.25 transpose()**

```
static INLINE void transpose (
    vect_t & r0,
    vect_t & r1) [inline], [static]
```

**12.291.2.26 blend()**

```
template<uint8_t s>
static INLINE CONST vect_t blend (
    const vect_t a,
    const vect_t b) [inline], [static]
```

**12.291.2.27 add()**

```
static INLINE CONST vect_t add (  
    const vect_t a,  
    const vect_t b) [inline], [static]
```

**12.291.2.28 addin()**

```
static INLINE vect_t addin (  
    vect_t & a,  
    const vect_t b) [inline], [static]
```

**12.291.2.29 sub()**

```
static INLINE CONST vect_t sub (  
    const vect_t a,  
    const vect_t b) [inline], [static]
```

**12.291.2.30 subin()**

```
static INLINE vect_t subin (  
    vect_t & a,  
    const vect_t b) [inline], [static]
```

**12.291.2.31 mullo()**

```
static INLINE CONST vect_t mullo (  
    const vect_t x0,  
    const vect_t x1) [inline], [static]
```

**12.291.2.32 mul()**

```
static INLINE CONST vect_t mul (  
    const vect_t a,  
    const vect_t b) [inline], [static]
```

**12.291.2.33 mulhi()**

```
static INLINE CONST vect_t mulhi (  
    const vect_t a,  
    const vect_t b) [inline], [static]
```

**12.291.2.34 mulx()**

```
static INLINE CONST vect_t mulx (  
    const vect_t a,  
    const vect_t b) [inline], [static]
```

**12.291.2.35 fmadd()**

```
static INLINE CONST vect_t fmadd (  
    const vect_t c,  
    const vect_t a,  
    const vect_t b) [inline], [static]
```

**12.291.2.36 fmaddin()**

```
static INLINE vect_t fmaddin (  
    vect_t & c,  
    const vect_t a,  
    const vect_t b) [inline], [static]
```

**12.291.2.37 fmaddx()**

```
static INLINE CONST vect_t fmaddx (  
    const vect_t c,  
    const vect_t a,  
    const vect_t b) [inline], [static]
```

**12.291.2.38 fmaddxin()**

```
static INLINE vect_t fmaddxin (  
    vect_t & c,  
    const vect_t a,  
    const vect_t b) [inline], [static]
```

**12.291.2.39 fnmadd()**

```
static INLINE CONST vect_t fnmadd (  
    const vect_t c,  
    const vect_t a,  
    const vect_t b) [inline], [static]
```

**12.291.2.40 fnmaddin()**

```
static INLINE vect_t fnmaddin (  
    vect_t & c,  
    const vect_t a,  
    const vect_t b) [inline], [static]
```

**12.291.2.41 fnmaddx()**

```
static INLINE CONST vect_t fnmaddx (  
    const vect_t c,  
    const vect_t a,  
    const vect_t b) [inline], [static]
```

**12.291.2.42 fnmaddxin()**

```
static INLINE vect_t fnmaddxin (  
    vect_t & c,  
    const vect_t a,  
    const vect_t b) [inline], [static]
```

**12.291.2.43 fmsub()**

```
static INLINE CONST vect_t fmsub (  
    const vect_t c,  
    const vect_t a,  
    const vect_t b) [inline], [static]
```

**12.291.2.44 fmsubin()**

```
static INLINE vect_t fmsubin (  
    vect_t & c,  
    const vect_t a,  
    const vect_t b) [inline], [static]
```

**12.291.2.45 fmsubx()**

```
static INLINE CONST vect_t fmsubx (  
    const vect_t c,
```



```
const vect_t a,  
const vect_t b) [inline], [static]
```

#### 12.291.2.46 fmsubxin()

```
static INLINE vect_t fmsubxin (  
    vect_t & c,  
    const vect_t a,  
    const vect_t b) [inline], [static]
```

#### 12.291.2.47 eq()

```
static INLINE CONST vect_t eq (  
    const vect_t a,  
    const vect_t b) [inline], [static]
```

#### 12.291.2.48 greater()

```
static INLINE CONST vect_t greater (  
    const vect_t a,  
    const vect_t b) [inline], [static]
```

#### 12.291.2.49 lesser()

```
static INLINE CONST vect_t lesser (  
    const vect_t a,  
    const vect_t b) [inline], [static]
```

#### 12.291.2.50 greater\_eq()

```
static INLINE CONST vect_t greater_eq (  
    const vect_t a,  
    const vect_t b) [inline], [static]
```

#### 12.291.2.51 lesser\_eq()

```
static INLINE CONST vect_t lesser_eq (  
    const vect_t a,  
    const vect_t b) [inline], [static]
```

#### 12.291.2.52 hadd\_to\_scal()

```
static INLINE CONST scalar_t hadd_to_scal (  
    const vect_t a) [inline], [static]
```

#### 12.291.2.53 round()

```
static INLINE CONST vect_t round (  
    const vect_t a) [inline], [static]
```

#### 12.291.2.54 mask\_high()

```
static INLINE CONST vect_t mask_high () [inline], [static]
```

#### 12.291.2.55 mulhi\_fast()

```
INLINE CONST vect_t mulhi_fast (  
    vect_t x,  
    vect_t y) [static]
```

**12.291.2.56 mod()**

```

INLINE vect_t mod (
    vect_t & C,
    const __m128d & P,
    const __m128d & INVP,
    const __m128d & NEGP,
    const vect_t & POW50REM,
    const __m128d & MIN,
    const __m128d & MAX,
    __m128d & Q,
    __m128d & T) [static]

```

**12.291.2.57 signbits()**

```

static INLINE CONST vect_t signbits (
    const vect_t x) [inline], [static], [protected]

```

**12.291.2.58 zero()**

```

static INLINE CONST vect_t zero () [inline], [static], [inherited]

```

**12.291.2.59 sll128()**

```

template<uint8_t s>
static INLINE CONST vect_t sll128 (
    const vect_t a) [inline], [static], [inherited]

```

**12.291.2.60 srl128()**

```

template<uint8_t s>
static INLINE CONST vect_t srl128 (
    const vect_t a) [inline], [static], [inherited]

```

**12.291.2.61 vand()**

```

static INLINE CONST vect_t vand (
    const vect_t a,
    const vect_t b) [inline], [static], [inherited]

```

**12.291.2.62 vor()**

```

static INLINE CONST vect_t vor (
    const vect_t a,
    const vect_t b) [inline], [static], [inherited]

```

**12.291.2.63 vxor()**

```

static INLINE CONST vect_t vxor (
    const vect_t a,
    const vect_t b) [inline], [static], [inherited]

```

**12.291.2.64 vandnot()**

```

static INLINE CONST vect_t vandnot (
    const vect_t a,
    const vect_t b) [inline], [static], [inherited]

```

### 12.291.3 Field Documentation

#### 12.291.3.1 vect\_size

```
const constexpr size_t vect_size = 2 [static], [constexpr]
```

#### 12.291.3.2 alignment

```
const constexpr size_t alignment = 16 [static], [constexpr]
```

The documentation for this struct was generated from the following file:

- [simd128\\_int64.inl](#)

## 12.292 Simd128i\_base Struct Reference

Inheritance diagram for Simd128i\_base:



### Public Types

- using [vect\\_t](#) = \_\_m128i

### Static Public Member Functions

- static [INLINE CONST vect\\_t zero](#) ()
- [template<uint8\\_t s>](#)  
static [INLINE CONST vect\\_t sll128](#) (const [vect\\_t](#) a)
- [template<uint8\\_t s>](#)  
static [INLINE CONST vect\\_t srl128](#) (const [vect\\_t](#) a)
- static [INLINE CONST vect\\_t vand](#) (const [vect\\_t](#) a, const [vect\\_t](#) b)
- static [INLINE CONST vect\\_t vor](#) (const [vect\\_t](#) a, const [vect\\_t](#) b)
- static [INLINE CONST vect\\_t vxor](#) (const [vect\\_t](#) a, const [vect\\_t](#) b)
- static [INLINE CONST vect\\_t vandnot](#) (const [vect\\_t](#) a, const [vect\\_t](#) b)

### 12.292.1 Member Typedef Documentation

#### 12.292.1.1 vect\_t

```
using vect\_t = __m128i
```

### 12.292.2 Member Function Documentation

#### 12.292.2.1 zero()

```
static INLINE CONST vect\_t zero () [inline], [static]
```

#### 12.292.2.2 sll128()

```
template<uint8\_t s>
static INLINE CONST vect\_t sll128 (
    const vect\_t a) [inline], [static]
```

**12.292.2.3 srl128()**

```
template<uint8_t s>
static INLINE CONST vect_t srl128 (
    const vect_t a) [inline], [static]
```

**12.292.2.4 vand()**

```
static INLINE CONST vect_t vand (
    const vect_t a,
    const vect_t b) [inline], [static]
```

**12.292.2.5 vor()**

```
static INLINE CONST vect_t vor (
    const vect_t a,
    const vect_t b) [inline], [static]
```

**12.292.2.6 vxor()**

```
static INLINE CONST vect_t vxor (
    const vect_t a,
    const vect_t b) [inline], [static]
```

**12.292.2.7 vandnot()**

```
static INLINE CONST vect_t vandnot (
    const vect_t a,
    const vect_t b) [inline], [static]
```

The documentation for this struct was generated from the following file:

- [simd128.inl](#)

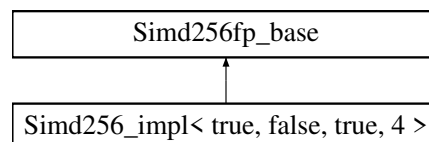
**12.293 Simd256\_impl< ArithType, Int, Signed, Size > Struct Template Reference**

The documentation for this struct was generated from the following file:

- [simd256.inl](#)

**12.294 Simd256\_impl< true, false, true, 4 > Struct Reference**

Inheritance diagram for Simd256\_impl< true, false, true, 4 >:



The documentation for this struct was generated from the following file:

- [simd256\\_float.inl](#)

## 12.295 Simd256\_impl< true, false, true, 8 > Struct Reference

Inheritance diagram for Simd256\_impl< true, false, true, 8 >:



### Data Structures

- union [Converter](#)

### Public Types

- using [vect\\_t](#) = \_\_m256d
- using [scalar\\_t](#) = double
- using [aligned\\_allocator](#) = AlignedAllocator<[scalar\\_t](#), Alignment([alignment](#))>
- using [aligned\\_vector](#) = std::vector<[scalar\\_t](#), [aligned\\_allocator](#)>
- template<class [Field](#)>
  - using [is\\_same\\_element](#) = std::is\_same<typename [Field::Element](#), [scalar\\_t](#)>

### Static Public Member Functions

- static const std::string [type\\_string](#) ()
- template<class T>
  - static constexpr bool [valid](#) (T \*p)
- template<class T>
  - static constexpr bool [compliant](#) (T n)
- static [INLINE CONST vect\\_t zero](#) ()
- static [INLINE CONST vect\\_t set1](#) (const [scalar\\_t](#) x)
- static [INLINE CONST vect\\_t set](#) (const [scalar\\_t](#) x1, const [scalar\\_t](#) x2, const [scalar\\_t](#) x3, const [scalar\\_t](#) x4)
- template<class T>
  - static [INLINE PURE vect\\_t gather](#) (const [scalar\\_t](#) \*const p, const T \*const idx)
- static [INLINE PURE vect\\_t load](#) (const [scalar\\_t](#) \*const p)
- static [INLINE PURE vect\\_t loadu](#) (const [scalar\\_t](#) \*const p)
- static [INLINE void store](#) (const [scalar\\_t](#) \*p, const [vect\\_t](#) v)
- static [INLINE void storeu](#) (const [scalar\\_t](#) \*p, const [vect\\_t](#) v)
- static [INLINE void stream](#) (const [scalar\\_t](#) \*p, const [vect\\_t](#) v)
- static [INLINE CONST vect\\_t unpacklo\\_intrinsic](#) (const [vect\\_t](#) a, const [vect\\_t](#) b)
- static [INLINE CONST vect\\_t unpackhi\\_intrinsic](#) (const [vect\\_t](#) a, const [vect\\_t](#) b)
- static [INLINE CONST vect\\_t unpacklo](#) (const [vect\\_t](#) a, const [vect\\_t](#) b)
- static [INLINE CONST vect\\_t unpackhi](#) (const [vect\\_t](#) a, const [vect\\_t](#) b)
- static [INLINE void unpacklohi](#) ([vect\\_t](#) &lo, [vect\\_t](#) &hi, const [vect\\_t](#) a, const [vect\\_t](#) b)
- static [INLINE CONST vect\\_t pack\\_even](#) (const [vect\\_t](#) a, const [vect\\_t](#) b)
- static [INLINE CONST vect\\_t pack\\_odd](#) (const [vect\\_t](#) a, const [vect\\_t](#) b)
- static [INLINE void pack](#) ([vect\\_t](#) &even, [vect\\_t](#) &odd, const [vect\\_t](#) a, const [vect\\_t](#) b)
- static [INLINE void transpose](#) ([vect\\_t](#) &r0, [vect\\_t](#) &r1, [vect\\_t](#) &r2, [vect\\_t](#) &r3)
- template<uint8\_t s>
  - static [INLINE CONST vect\\_t blend](#) (const [vect\\_t](#) a, const [vect\\_t](#) b)
  - static [INLINE CONST vect\\_t blendv](#) (const [vect\\_t](#) a, const [vect\\_t](#) b, const [vect\\_t](#) mask)
  - static [INLINE CONST vect\\_t add](#) (const [vect\\_t](#) a, const [vect\\_t](#) b)
  - static [INLINE vect\\_t addin](#) ([vect\\_t](#) &a, const [vect\\_t](#) b)
  - static [INLINE CONST vect\\_t sub](#) (const [vect\\_t](#) a, const [vect\\_t](#) b)
  - static [INLINE CONST vect\\_t subin](#) ([vect\\_t](#) &a, const [vect\\_t](#) b)

- static `INLINE CONST vect_t mul` (const `vect_t` a, const `vect_t` b)
- static `INLINE CONST vect_t mulin` (`vect_t` &a, const `vect_t` b)
- static `INLINE CONST vect_t div` (const `vect_t` a, const `vect_t` b)
- static `INLINE CONST vect_t fmadd` (const `vect_t` c, const `vect_t` a, const `vect_t` b)
- static `INLINE CONST vect_t fmaddin` (`vect_t` &c, const `vect_t` a, const `vect_t` b)
- static `INLINE CONST vect_t fnmadd` (const `vect_t` c, const `vect_t` a, const `vect_t` b)
- static `INLINE CONST vect_t fnmaddin` (`vect_t` &c, const `vect_t` a, const `vect_t` b)
- static `INLINE CONST vect_t fmsub` (const `vect_t` c, const `vect_t` a, const `vect_t` b)
- static `INLINE CONST vect_t fmsubin` (`vect_t` &c, const `vect_t` a, const `vect_t` b)
- static `INLINE CONST vect_t eq` (const `vect_t` a, const `vect_t` b)
- static `INLINE CONST vect_t lesser` (const `vect_t` a, const `vect_t` b)
- static `INLINE CONST vect_t lesser_eq` (const `vect_t` a, const `vect_t` b)
- static `INLINE CONST vect_t greater` (const `vect_t` a, const `vect_t` b)
- static `INLINE CONST vect_t greater_eq` (const `vect_t` a, const `vect_t` b)
- static `INLINE CONST vect_t vand` (const `vect_t` a, const `vect_t` b)
- static `INLINE CONST vect_t vor` (const `vect_t` a, const `vect_t` b)
- static `INLINE CONST vect_t vxor` (const `vect_t` a, const `vect_t` b)
- static `INLINE CONST vect_t vandnot` (const `vect_t` a, const `vect_t` b)
- static `INLINE CONST vect_t floor` (const `vect_t` a)
- static `INLINE CONST vect_t ceil` (const `vect_t` a)
- static `INLINE CONST vect_t round` (const `vect_t` a)
- static `INLINE CONST vect_t hadd` (const `vect_t` a, const `vect_t` b)
- static `INLINE CONST scalar_t hadd_to_scal` (const `vect_t` a)
- static `INLINE vect_t mod` (`vect_t` &C, const `vect_t` &P, const `vect_t` &INVP, const `vect_t` &NEGP, const `vect_t` &MIN, const `vect_t` &MAX, `vect_t` &Q, `vect_t` &T)

### Static Public Attributes

- static const constexpr size\_t `vect_size` = 4
- static const constexpr size\_t `alignment` = 32

## 12.295.1 Member Typedef Documentation

### 12.295.1.1 vect\_t

```
using vect_t = __m256d
```

### 12.295.1.2 scalar\_t

```
using scalar_t = double
```

### 12.295.1.3 aligned\_allocator

```
using aligned_allocator = AlignedAllocator<scalar_t, Alignment(alignment)>
```

### 12.295.1.4 aligned\_vector

```
using aligned_vector = std::vector<scalar_t, aligned_allocator>
```

### 12.295.1.5 is\_same\_element

```
template<class Field>
using is_same_element = std::is_same<typename Field::Element, scalar_t>
```

## 12.295.2 Member Function Documentation

### 12.295.2.1 type\_string()

```
static const std::string type_string () [inline], [static]
```

### 12.295.2.2 valid()

```
template<class T>
static constexpr bool valid (
    T * p) [inline], [static], [constexpr]
```

### 12.295.2.3 compliant()

```
template<class T>
static constexpr bool compliant (
    T n) [inline], [static], [constexpr]
```

### 12.295.2.4 zero()

```
static INLINE CONST vect_t zero () [inline], [static]
```

### 12.295.2.5 set1()

```
static INLINE CONST vect_t set1 (
    const scalar_t x) [inline], [static]
```

### 12.295.2.6 set()

```
static INLINE CONST vect_t set (
    const scalar_t x1,
    const scalar_t x2,
    const scalar_t x3,
    const scalar_t x4) [inline], [static]
```

### 12.295.2.7 gather()

```
template<class T>
static INLINE PURE vect_t gather (
    const scalar_t *const p,
    const T *const idx) [inline], [static]
```

### 12.295.2.8 load()

```
static INLINE PURE vect_t load (
    const scalar_t *const p) [inline], [static]
```

### 12.295.2.9 loadu()

```
static INLINE PURE vect_t loadu (
    const scalar_t *const p) [inline], [static]
```

### 12.295.2.10 store()

```
static INLINE void store (
    const scalar_t * p,
    const vect_t v) [inline], [static]
```

### 12.295.2.11 storeu()

```
static INLINE void storeu (
    const scalar_t * p,
    const vect_t v) [inline], [static]
```

**12.295.2.12 stream()**

```
static INLINE void stream (  
    const scalar_t * p,  
    const vect_t v) [inline], [static]
```

**12.295.2.13 unpacklo\_intrinsic()**

```
static INLINE CONST vect_t unpacklo_intrinsic (  
    const vect_t a,  
    const vect_t b) [inline], [static]
```

**12.295.2.14 unpackhi\_intrinsic()**

```
static INLINE CONST vect_t unpackhi_intrinsic (  
    const vect_t a,  
    const vect_t b) [inline], [static]
```

**12.295.2.15 unpacklo()**

```
static INLINE CONST vect_t unpacklo (  
    const vect_t a,  
    const vect_t b) [inline], [static]
```

**12.295.2.16 unpackhi()**

```
static INLINE CONST vect_t unpackhi (  
    const vect_t a,  
    const vect_t b) [inline], [static]
```

**12.295.2.17 unpacklohi()**

```
static INLINE void unpacklohi (  
    vect_t & lo,  
    vect_t & hi,  
    const vect_t a,  
    const vect_t b) [inline], [static]
```

**12.295.2.18 pack\_even()**

```
static INLINE CONST vect_t pack_even (  
    const vect_t a,  
    const vect_t b) [inline], [static]
```

**12.295.2.19 pack\_odd()**

```
static INLINE CONST vect_t pack_odd (  
    const vect_t a,  
    const vect_t b) [inline], [static]
```

**12.295.2.20 pack()**

```
static INLINE void pack (  
    vect_t & even,  
    vect_t & odd,  
    const vect_t a,  
    const vect_t b) [inline], [static]
```



### 12.295.2.21 transpose()

```
static INLINE void transpose (  
    vect_t & r0,  
    vect_t & r1,  
    vect_t & r2,  
    vect_t & r3) [inline], [static]
```

### 12.295.2.22 blend()

```
template<uint8_t s>  
static INLINE CONST vect_t blend (  
    const vect_t a,  
    const vect_t b) [inline], [static]
```

### 12.295.2.23 blendv()

```
static INLINE CONST vect_t blendv (  
    const vect_t a,  
    const vect_t b,  
    const vect_t mask) [inline], [static]
```

### 12.295.2.24 add()

```
static INLINE CONST vect_t add (  
    const vect_t a,  
    const vect_t b) [inline], [static]
```

### 12.295.2.25 addin()

```
static INLINE vect_t addin (  
    vect_t & a,  
    const vect_t b) [inline], [static]
```

### 12.295.2.26 sub()

```
static INLINE CONST vect_t sub (  
    const vect_t a,  
    const vect_t b) [inline], [static]
```

### 12.295.2.27 subin()

```
static INLINE CONST vect_t subin (  
    vect_t & a,  
    const vect_t b) [inline], [static]
```

### 12.295.2.28 mul()

```
static INLINE CONST vect_t mul (  
    const vect_t a,  
    const vect_t b) [inline], [static]
```

### 12.295.2.29 mulin()

```
static INLINE CONST vect_t mulin (  
    vect_t & a,  
    const vect_t b) [inline], [static]
```

**12.295.2.30 div()**

```
static INLINE CONST vect_t div (  
    const vect_t a,  
    const vect_t b) [inline], [static]
```

**12.295.2.31 fmadd()**

```
static INLINE CONST vect_t fmadd (  
    const vect_t c,  
    const vect_t a,  
    const vect_t b) [inline], [static]
```

**12.295.2.32 fmaddin()**

```
static INLINE CONST vect_t fmaddin (  
    vect_t & c,  
    const vect_t a,  
    const vect_t b) [inline], [static]
```

**12.295.2.33 fnmadd()**

```
static INLINE CONST vect_t fnmadd (  
    const vect_t c,  
    const vect_t a,  
    const vect_t b) [inline], [static]
```

**12.295.2.34 fnmaddin()**

```
static INLINE CONST vect_t fnmaddin (  
    vect_t & c,  
    const vect_t a,  
    const vect_t b) [inline], [static]
```

**12.295.2.35 fmsub()**

```
static INLINE CONST vect_t fmsub (  
    const vect_t c,  
    const vect_t a,  
    const vect_t b) [inline], [static]
```

**12.295.2.36 fmsubin()**

```
static INLINE CONST vect_t fmsubin (  
    vect_t & c,  
    const vect_t a,  
    const vect_t b) [inline], [static]
```

**12.295.2.37 eq()**

```
static INLINE CONST vect_t eq (  
    const vect_t a,  
    const vect_t b) [inline], [static]
```

**12.295.2.38 lesser()**

```
static INLINE CONST vect_t lesser (  
    const vect_t a,  
    const vect_t b) [inline], [static]
```

**12.295.2.39 lesser\_eq()**

```
static INLINE CONST vect_t lesser_eq (  
    const vect_t a,  
    const vect_t b) [inline], [static]
```

**12.295.2.40 greater()**

```
static INLINE CONST vect_t greater (  
    const vect_t a,  
    const vect_t b) [inline], [static]
```

**12.295.2.41 greater\_eq()**

```
static INLINE CONST vect_t greater_eq (  
    const vect_t a,  
    const vect_t b) [inline], [static]
```

**12.295.2.42 vand()**

```
static INLINE CONST vect_t vand (  
    const vect_t a,  
    const vect_t b) [inline], [static]
```

**12.295.2.43 vor()**

```
static INLINE CONST vect_t vor (  
    const vect_t a,  
    const vect_t b) [inline], [static]
```

**12.295.2.44 vxor()**

```
static INLINE CONST vect_t vxor (  
    const vect_t a,  
    const vect_t b) [inline], [static]
```

**12.295.2.45 vandnot()**

```
static INLINE CONST vect_t vandnot (  
    const vect_t a,  
    const vect_t b) [inline], [static]
```

**12.295.2.46 floor()**

```
static INLINE CONST vect_t floor (  
    const vect_t a) [inline], [static]
```

**12.295.2.47 ceil()**

```
static INLINE CONST vect_t ceil (  
    const vect_t a) [inline], [static]
```

**12.295.2.48 round()**

```
static INLINE CONST vect_t round (  
    const vect_t a) [inline], [static]
```

**12.295.2.49 hadd()**

```
static INLINE CONST vect_t hadd (
    const vect_t a,
    const vect_t b) [inline], [static]
```

**12.295.2.50 hadd\_to\_scal()**

```
static INLINE CONST scalar_t hadd_to_scal (
    const vect_t a) [inline], [static]
```

**12.295.2.51 mod()**

```
static INLINE vect_t mod (
    vect_t & C,
    const vect_t & P,
    const vect_t & INV_P,
    const vect_t & NEG_P,
    const vect_t & MIN,
    const vect_t & MAX,
    vect_t & Q,
    vect_t & T) [inline], [static]
```

**12.295.3 Field Documentation****12.295.3.1 vect\_size**

```
const constexpr size_t vect_size = 4 [static], [constexpr]
```

**12.295.3.2 alignment**

```
const constexpr size_t alignment = 32 [static], [constexpr]
```

The documentation for this struct was generated from the following file:

- [simd256\\_double.inl](#)

**12.296 Simd256\_impl< true, true, false, 2 > Struct Reference**

Inheritance diagram for Simd256\_impl< true, true, false, 2 >:

**Data Structures**

- union [Converter](#)

**Public Types**

- using [scalar\\_t](#) = uint16\_t
- using [aligned\\_allocator](#) = AlignedAllocator<[scalar\\_t](#), Alignment([alignment](#))>
- using [aligned\\_vector](#) = std::vector<[scalar\\_t](#), [aligned\\_allocator](#)>

- template<class Field>  
using is\_same\_element = std::is\_same<typename Field::Element, scalar\_t>
- using simdHalf = Simd128<scalar\_t>
- using vect\_t = \_\_m256i
- using half\_t = \_\_m128i

### Static Public Member Functions

- static const std::string type\_string ()
- static INLINE CONST vect\_t set1 (const scalar\_t x)
- static INLINE CONST vect\_t set (const scalar\_t x0, const scalar\_t x1, const scalar\_t x2, const scalar\_t x3, const scalar\_t x4, const scalar\_t x5, const scalar\_t x6, const scalar\_t x7, const scalar\_t x8, const scalar\_t x9, const scalar\_t x10, const scalar\_t x11, const scalar\_t x12, const scalar\_t x13, const scalar\_t x14, const scalar\_t x15)
- template<class T>  
static INLINE PURE vect\_t gather (const scalar\_t \*const p, const T \*const idx)
- static INLINE PURE vect\_t load (const scalar\_t \*const p)
- static INLINE PURE vect\_t loadu (const scalar\_t \*const p)
- static INLINE void store (scalar\_t \*p, vect\_t v)
- static INLINE void storeu (scalar\_t \*p, vect\_t v)
- static INLINE void stream (scalar\_t \*p, const vect\_t v)
- template<int s>  
static INLINE CONST vect\_t sra (const vect\_t a)
- static INLINE CONST vect\_t greater (vect\_t a, vect\_t b)
- static INLINE CONST vect\_t lesser (vect\_t a, vect\_t b)
- static INLINE CONST vect\_t greater\_eq (const vect\_t a, const vect\_t b)
- static INLINE CONST vect\_t lesser\_eq (const vect\_t a, const vect\_t b)
- static INLINE CONST vect\_t mulhi (const vect\_t a, const vect\_t b)
- static INLINE CONST vect\_t mulx (vect\_t a, vect\_t b)
- static INLINE CONST vect\_t fmaddx (const vect\_t c, const vect\_t a, const vect\_t b)
- static INLINE vect\_t fmaddxin (vect\_t &c, const vect\_t a, const vect\_t b)
- static INLINE CONST vect\_t fnmaddx (const vect\_t c, const vect\_t a, const vect\_t b)
- static INLINE vect\_t fnmaddxin (vect\_t &c, const vect\_t a, const vect\_t b)
- static INLINE CONST vect\_t fmsubx (const vect\_t c, const vect\_t a, const vect\_t b)
- static INLINE vect\_t fmsubxin (vect\_t &c, const vect\_t a, const vect\_t b)
- static INLINE CONST scalar\_t hadd\_to\_scal (const vect\_t a)
- template<class T>  
static constexpr bool valid (T \*p)
- template<class T>  
static constexpr bool compliant (T n)
- static INLINE CONST vect\_t set1 (const scalar\_t x)
- static INLINE CONST vect\_t set (const scalar\_t x0, const scalar\_t x1, const scalar\_t x2, const scalar\_t x3, const scalar\_t x4, const scalar\_t x5, const scalar\_t x6, const scalar\_t x7, const scalar\_t x8, const scalar\_t x9, const scalar\_t x10, const scalar\_t x11, const scalar\_t x12, const scalar\_t x13, const scalar\_t x14, const scalar\_t x15)
- template<class T>  
static INLINE PURE vect\_t gather (const scalar\_t \*const p, const T \*const idx)
- static INLINE PURE vect\_t load (const scalar\_t \*const p)
- static INLINE PURE vect\_t loadu (const scalar\_t \*const p)
- static INLINE void store (scalar\_t \*p, vect\_t v)
- static INLINE void storeu (scalar\_t \*p, vect\_t v)
- static INLINE void stream (scalar\_t \*p, const vect\_t v)
- template<int s>  
static INLINE CONST vect\_t sll (const vect\_t a)
- template<int s>  
static INLINE CONST vect\_t srl (const vect\_t a)

- `template<uint64_t s>`  
`static INLINE CONST vect_t shuffle (const vect_t a)`
- `static INLINE CONST vect_t unpacklo_intrinsic (const vect_t a, const vect_t b)`
- `static INLINE CONST vect_t unpackhi_intrinsic (const vect_t a, const vect_t b)`
- `static INLINE CONST vect_t unpacklo (const vect_t a, const vect_t b)`
- `static INLINE CONST vect_t unpackhi (const vect_t a, const vect_t b)`
- `static INLINE void unpacklohi (vect_t &lo, vect_t &hi, const vect_t a, const vect_t b)`
- `static INLINE CONST vect_t pack_even (const vect_t a, const vect_t b)`
- `static INLINE CONST vect_t pack_odd (const vect_t a, const vect_t b)`
- `static INLINE void pack (vect_t &even, vect_t &odd, const vect_t a, const vect_t b)`
- `static INLINE void transpose (vect_t &r0, vect_t &r1, vect_t &r2, vect_t &r3, vect_t &r4, vect_t &r5, vect_t &r6, vect_t &r7, vect_t &r8, vect_t &r9, vect_t &r10, vect_t &r11, vect_t &r12, vect_t &r13, vect_t &r14, vect_t &r15)`
- `template<uint16_t s, typename std::enable_if<(s & 0x00ff) == (s > > 8)>::type * = nullptr>`  
`static INLINE vect_t blend (const vect_t a, const vect_t b)`
- `template<uint16_t s, typename std::enable_if<(s & 0x00ff) != (s > > 8)>::type * = nullptr>`  
`static INLINE vect_t blend (const vect_t a, const vect_t b)`
- `static INLINE CONST vect_t add (const vect_t a, const vect_t b)`
- `static INLINE vect_t addin (vect_t &a, const vect_t b)`
- `static INLINE CONST vect_t sub (const vect_t a, const vect_t b)`
- `static INLINE vect_t subin (vect_t &a, const vect_t b)`
- `static INLINE CONST vect_t mullo (const vect_t a, const vect_t b)`
- `static INLINE CONST vect_t mul (const vect_t a, const vect_t b)`
- `static INLINE CONST vect_t fmadd (const vect_t c, const vect_t a, const vect_t b)`
- `static INLINE vect_t fmadin (vect_t &c, const vect_t a, const vect_t b)`
- `static INLINE CONST vect_t fnmadd (const vect_t c, const vect_t a, const vect_t b)`
- `static INLINE vect_t fnmadin (vect_t &c, const vect_t a, const vect_t b)`
- `static INLINE CONST vect_t fmsub (const vect_t c, const vect_t a, const vect_t b)`
- `static INLINE vect_t fmsubin (vect_t &c, const vect_t a, const vect_t b)`
- `static INLINE CONST vect_t eq (const vect_t a, const vect_t b)`
- `static INLINE CONST vect_t round (const vect_t a)`
- `static INLINE vect_t mod (vect_t &C, const vect_t &P, const vect_t &INVP, const vect_t &NEGP, const vect_t &MIN, const vect_t &MAX, vect_t &Q, vect_t &T)`
- `static INLINE CONST vect_t zero ()`

### Static Public Attributes

- `static const constexpr size_t vect_size = 16`
- `static const constexpr size_t alignment = 32`

## 12.296.1 Member Typedef Documentation

### 12.296.1.1 scalar\_t

```
using scalar_t = uint16_t
```

### 12.296.1.2 aligned\_allocator

```
using aligned_allocator = AlignedAllocator<scalar_t, Alignment(alignment)>
```

### 12.296.1.3 aligned\_vector

```
using aligned_vector = std::vector<scalar_t, aligned_allocator>
```

### 12.296.1.4 is\_same\_element

```
template<class Field>
using is_same_element = std::is_same<typename Field::Element, scalar_t>
```

### 12.296.1.5 simdHalf

```
using simdHalf = Simd128<scalar_t>
```

### 12.296.1.6 vect\_t

```
using vect_t = __m256i [inherited]
```

### 12.296.1.7 half\_t

```
using half_t = __m128i [inherited]
```

## 12.296.2 Member Function Documentation

### 12.296.2.1 type\_string()

```
static const std::string type_string () [inline], [static]
```

### 12.296.2.2 set1() [1/2]

```
static INLINE CONST vect_t set1 (
    const scalar_t x) [inline], [static]
```

### 12.296.2.3 set() [1/2]

```
static INLINE CONST vect_t set (
    const scalar_t x0,
    const scalar_t x1,
    const scalar_t x2,
    const scalar_t x3,
    const scalar_t x4,
    const scalar_t x5,
    const scalar_t x6,
    const scalar_t x7,
    const scalar_t x8,
    const scalar_t x9,
    const scalar_t x10,
    const scalar_t x11,
    const scalar_t x12,
    const scalar_t x13,
    const scalar_t x14,
    const scalar_t x15) [inline], [static]
```

### 12.296.2.4 gather() [1/2]

```
template<class T>
static INLINE PURE vect_t gather (
    const scalar_t *const p,
    const T *const idx) [inline], [static]
```

### 12.296.2.5 load() [1/2]

```
static INLINE PURE vect_t load (
    const scalar_t *const p) [inline], [static]
```

### 12.296.2.6 loadu() [1/2]

```
static INLINE PURE vect_t loadu (
    const scalar_t *const p) [inline], [static]
```

**12.296.2.7 store() [1/2]**

```
static INLINE void store (  
    scalar_t * p,  
    vect_t v) [inline], [static]
```

**12.296.2.8 storeu() [1/2]**

```
static INLINE void storeu (  
    scalar_t * p,  
    vect_t v) [inline], [static]
```

**12.296.2.9 stream() [1/2]**

```
static INLINE void stream (  
    scalar_t * p,  
    const vect_t v) [inline], [static]
```

**12.296.2.10 sra()**

```
template<int s>  
static INLINE CONST vect_t sra (  
    const vect_t a) [inline], [static]
```

**12.296.2.11 greater()**

```
static INLINE CONST vect_t greater (  
    vect_t a,  
    vect_t b) [inline], [static]
```

**12.296.2.12 lesser()**

```
static INLINE CONST vect_t lesser (  
    vect_t a,  
    vect_t b) [inline], [static]
```

**12.296.2.13 greater\_eq()**

```
static INLINE CONST vect_t greater_eq (  
    const vect_t a,  
    const vect_t b) [inline], [static]
```

**12.296.2.14 lesser\_eq()**

```
static INLINE CONST vect_t lesser_eq (  
    const vect_t a,  
    const vect_t b) [inline], [static]
```

**12.296.2.15 mulhi()**

```
static INLINE CONST vect_t mulhi (  
    const vect_t a,  
    const vect_t b) [inline], [static]
```

**12.296.2.16 mulx()**

```
static INLINE CONST vect_t mulx (  
    vect_t a,  
    vect_t b) [inline], [static]
```



**12.296.2.17 fmaddx()**

```
static INLINE CONST vect_t fmaddx (
    const vect_t c,
    const vect_t a,
    const vect_t b) [inline], [static]
```

**12.296.2.18 fmaddxin()**

```
static INLINE vect_t fmaddxin (
    vect_t & c,
    const vect_t a,
    const vect_t b) [inline], [static]
```

**12.296.2.19 fnmaddx()**

```
static INLINE CONST vect_t fnmaddx (
    const vect_t c,
    const vect_t a,
    const vect_t b) [inline], [static]
```

**12.296.2.20 fnmaddxin()**

```
static INLINE vect_t fnmaddxin (
    vect_t & c,
    const vect_t a,
    const vect_t b) [inline], [static]
```

**12.296.2.21 fmsubx()**

```
static INLINE CONST vect_t fmsubx (
    const vect_t c,
    const vect_t a,
    const vect_t b) [inline], [static]
```

**12.296.2.22 fmsubxin()**

```
static INLINE vect_t fmsubxin (
    vect_t & c,
    const vect_t a,
    const vect_t b) [inline], [static]
```

**12.296.2.23 hadd\_to\_scal()**

```
static INLINE CONST scalar_t hadd_to_scal (
    const vect_t a) [inline], [static]
```

**12.296.2.24 valid()**

```
template<class T>
static constexpr bool valid (
    T * p) [inline], [static], [constexpr], [inherited]
```

**12.296.2.25 compliant()**

```
template<class T>
static constexpr bool compliant (
    T n) [inline], [static], [constexpr], [inherited]
```

**12.296.2.26 set1() [2/2]**

```
static INLINE CONST vect_t set1 (
    const scalar_t x) [inline], [static], [inherited]
```

**12.296.2.27 set() [2/2]**

```
static INLINE CONST vect_t set (
    const scalar_t x0,
    const scalar_t x1,
    const scalar_t x2,
    const scalar_t x3,
    const scalar_t x4,
    const scalar_t x5,
    const scalar_t x6,
    const scalar_t x7,
    const scalar_t x8,
    const scalar_t x9,
    const scalar_t x10,
    const scalar_t x11,
    const scalar_t x12,
    const scalar_t x13,
    const scalar_t x14,
    const scalar_t x15) [inline], [static], [inherited]
```

**12.296.2.28 gather() [2/2]**

```
template<class T>
static INLINE PURE vect_t gather (
    const scalar_t *const p,
    const T *const idx) [inline], [static], [inherited]
```

**12.296.2.29 load() [2/2]**

```
static INLINE PURE vect_t load (
    const scalar_t *const p) [inline], [static], [inherited]
```

**12.296.2.30 loadu() [2/2]**

```
static INLINE PURE vect_t loadu (
    const scalar_t *const p) [inline], [static], [inherited]
```

**12.296.2.31 store() [2/2]**

```
static INLINE void store (
    scalar_t * p,
    vect_t v) [inline], [static], [inherited]
```

**12.296.2.32 storeu() [2/2]**

```
static INLINE void storeu (
    scalar_t * p,
    vect_t v) [inline], [static], [inherited]
```

**12.296.2.33 stream() [2/2]**

```
static INLINE void stream (
    scalar_t * p,
    const vect_t v) [inline], [static], [inherited]
```

**12.296.2.34 sll()**

```
template<int s>
static INLINE CONST vect_t sll (
    const vect_t a) [inline], [static], [inherited]
```

**12.296.2.35 srl()**

```
template<int s>
static INLINE CONST vect_t srl (
    const vect_t a) [inline], [static], [inherited]
```

**12.296.2.36 shuffle()**

```
template<uint64_t s>
static INLINE CONST vect_t shuffle (
    const vect_t a) [inline], [static], [inherited]
```

**12.296.2.37 unpacklo\_intrinsic()**

```
static INLINE CONST vect_t unpacklo_intrinsic (
    const vect_t a,
    const vect_t b) [inline], [static], [inherited]
```

**12.296.2.38 unpackhi\_intrinsic()**

```
static INLINE CONST vect_t unpackhi_intrinsic (
    const vect_t a,
    const vect_t b) [inline], [static], [inherited]
```

**12.296.2.39 unpacklo()**

```
static INLINE CONST vect_t unpacklo (
    const vect_t a,
    const vect_t b) [inline], [static], [inherited]
```

**12.296.2.40 unpackhi()**

```
static INLINE CONST vect_t unpackhi (
    const vect_t a,
    const vect_t b) [inline], [static], [inherited]
```

**12.296.2.41 unpacklohi()**

```
static INLINE void unpacklohi (
    vect_t & lo,
    vect_t & hi,
    const vect_t a,
    const vect_t b) [inline], [static], [inherited]
```

**12.296.2.42 pack\_even()**

```
static INLINE CONST vect_t pack_even (
    const vect_t a,
    const vect_t b) [inline], [static], [inherited]
```

**12.296.2.43 pack\_odd()**

```
static INLINE CONST vect_t pack_odd (
    const vect_t a,
    const vect_t b) [inline], [static], [inherited]
```

**12.296.2.44 pack()**

```
static INLINE void pack (
    vect_t & even,
    vect_t & odd,
    const vect_t a,
    const vect_t b) [inline], [static], [inherited]
```

**12.296.2.45 transpose()**

```
static INLINE void transpose (
    vect_t & r0,
    vect_t & r1,
    vect_t & r2,
    vect_t & r3,
    vect_t & r4,
    vect_t & r5,
    vect_t & r6,
    vect_t & r7,
    vect_t & r8,
    vect_t & r9,
    vect_t & r10,
    vect_t & r11,
    vect_t & r12,
    vect_t & r13,
    vect_t & r14,
    vect_t & r15) [inline], [static], [inherited]
```

**12.296.2.46 blend() [1/2]**

```
template<uint16_t s, typename std::enable_if<(s &0x00ff)==(s > > 8)>::type * = nullptr>
static INLINE vect_t blend (
    const vect_t a,
    const vect_t b) [inline], [static], [inherited]
```

**12.296.2.47 blend() [2/2]**

```
template<uint16_t s, typename std::enable_if<(s &0x00ff) !=(s > > 8)>::type * = nullptr>
static INLINE vect_t blend (
    const vect_t a,
    const vect_t b) [inline], [static], [inherited]
```

**12.296.2.48 add()**

```
static INLINE CONST vect_t add (
    const vect_t a,
    const vect_t b) [inline], [static], [inherited]
```

**12.296.2.49 addin()**

```
static INLINE vect_t addin (
    vect_t & a,
    const vect_t b) [inline], [static], [inherited]
```

**12.296.2.50 sub()**

```
static INLINE CONST vect_t sub (
    const vect_t a,
    const vect_t b) [inline], [static], [inherited]
```

**12.296.2.51 subin()**

```
static INLINE vect_t subin (  
    vect_t & a,  
    const vect_t b) [inline], [static], [inherited]
```

**12.296.2.52 mullo()**

```
static INLINE CONST vect_t mullo (  
    const vect_t a,  
    const vect_t b) [inline], [static], [inherited]
```

**12.296.2.53 mul()**

```
static INLINE CONST vect_t mul (  
    const vect_t a,  
    const vect_t b) [inline], [static], [inherited]
```

**12.296.2.54 fmadd()**

```
static INLINE CONST vect_t fmadd (  
    const vect_t c,  
    const vect_t a,  
    const vect_t b) [inline], [static], [inherited]
```

**12.296.2.55 fmaddin()**

```
static INLINE vect_t fmaddin (  
    vect_t & c,  
    const vect_t a,  
    const vect_t b) [inline], [static], [inherited]
```

**12.296.2.56 fnmadd()**

```
static INLINE CONST vect_t fnmadd (  
    const vect_t c,  
    const vect_t a,  
    const vect_t b) [inline], [static], [inherited]
```

**12.296.2.57 fnmaddin()**

```
static INLINE vect_t fnmaddin (  
    vect_t & c,  
    const vect_t a,  
    const vect_t b) [inline], [static], [inherited]
```

**12.296.2.58 fmsub()**

```
static INLINE CONST vect_t fmsub (  
    const vect_t c,  
    const vect_t a,  
    const vect_t b) [inline], [static], [inherited]
```

**12.296.2.59 fmsubin()**

```
static INLINE vect_t fmsubin (  
    vect_t & c,  
    const vect_t a,  
    const vect_t b) [inline], [static], [inherited]
```



- template<class Field>  
using is\_same\_element = std::is\_same<typename Field::Element, scalar\_t>
- using simdHalf = Simd128<scalar\_t>
- using scalar\_t = uint32\_t
- using aligned\_allocator = AlignedAllocator<scalar\_t, Alignment(alignment)>
- using aligned\_vector = std::vector<scalar\_t, aligned\_allocator>
- template<class Field>  
using is\_same\_element = std::is\_same<typename Field::Element, scalar\_t>
- using simdHalf = Simd128<scalar\_t>
- using vect\_t = \_\_m256i
- using vect\_t = \_\_m512i
- using half\_t = \_\_m128i
- using half\_t = \_\_m256i

### Static Public Member Functions

- static const std::string type\_string ()
- static INLINE CONST vect\_t set1 (const scalar\_t x)
- static INLINE CONST vect\_t set (const scalar\_t x0, const scalar\_t x1, const scalar\_t x2, const scalar\_t x3, const scalar\_t x4, const scalar\_t x5, const scalar\_t x6, const scalar\_t x7)
- template<class T>  
static INLINE PURE vect\_t gather (const scalar\_t \*const p, const T \*const idx)
- static INLINE PURE vect\_t load (const scalar\_t \*const p)
- static INLINE PURE vect\_t loadu (const scalar\_t \*const p)
- static INLINE void store (scalar\_t \*p, vect\_t v)
- static INLINE void storeu (scalar\_t \*p, vect\_t v)
- static INLINE void stream (scalar\_t \*p, const vect\_t v)
- template<int s>  
static INLINE CONST vect\_t sra (const vect\_t a)
- static INLINE CONST vect\_t greater (vect\_t a, vect\_t b)
- static INLINE CONST vect\_t lesser (vect\_t a, vect\_t b)
- static INLINE CONST vect\_t greater\_eq (const vect\_t a, const vect\_t b)
- static INLINE CONST vect\_t lesser\_eq (const vect\_t a, const vect\_t b)
- static INLINE CONST vect\_t mulhi (const vect\_t a, const vect\_t b)
- static INLINE CONST vect\_t mulx (vect\_t a, vect\_t b)
- static INLINE CONST vect\_t fmaddx (const vect\_t c, const vect\_t a, const vect\_t b)
- static INLINE vect\_t fmaddxin (vect\_t &c, const vect\_t a, const vect\_t b)
- static INLINE CONST vect\_t fnmaddx (const vect\_t c, const vect\_t a, const vect\_t b)
- static INLINE vect\_t fnmaddxin (vect\_t &c, const vect\_t a, const vect\_t b)
- static INLINE CONST vect\_t fmsubx (const vect\_t c, const vect\_t a, const vect\_t b)
- static INLINE vect\_t fmsubxin (vect\_t &c, const vect\_t a, const vect\_t b)
- static INLINE CONST scalar\_t hadd\_to\_scal (const vect\_t a)
- static const std::string type\_string ()
- static INLINE CONST vect\_t set1 (const scalar\_t x)
- static INLINE CONST vect\_t set (const scalar\_t x0, const scalar\_t x1, const scalar\_t x2, const scalar\_t x3, const scalar\_t x4, const scalar\_t x5, const scalar\_t x6, const scalar\_t x7)
- template<class T>  
static INLINE PURE vect\_t gather (const scalar\_t \*const p, const T \*const idx)
- static INLINE PURE vect\_t load (const scalar\_t \*const p)
- static INLINE PURE vect\_t loadu (const scalar\_t \*const p)
- static INLINE void store (scalar\_t \*p, vect\_t v)
- static INLINE void storeu (scalar\_t \*p, vect\_t v)
- static INLINE void stream (scalar\_t \*p, const vect\_t v)
- template<int s>  
static INLINE CONST vect\_t sra (const vect\_t a)

- static `INLINE CONST vect_t greater (vect_t a, vect_t b)`
- static `INLINE CONST vect_t lesser (vect_t a, vect_t b)`
- static `INLINE CONST vect_t greater_eq (const vect_t a, const vect_t b)`
- static `INLINE CONST vect_t lesser_eq (const vect_t a, const vect_t b)`
- static `INLINE CONST vect_t mulhi (const vect_t a, const vect_t b)`
- static `INLINE CONST vect_t mulx (vect_t a, vect_t b)`
- static `INLINE CONST vect_t fmaddx (const vect_t c, const vect_t a, const vect_t b)`
- static `INLINE vect_t fmaddxin (vect_t &c, const vect_t a, const vect_t b)`
- static `INLINE CONST vect_t fnmaddx (const vect_t c, const vect_t a, const vect_t b)`
- static `INLINE vect_t fnmaddxin (vect_t &c, const vect_t a, const vect_t b)`
- static `INLINE CONST vect_t fmsubx (const vect_t c, const vect_t a, const vect_t b)`
- static `INLINE vect_t fmsubxin (vect_t &c, const vect_t a, const vect_t b)`
- static `INLINE CONST scalar_t hadd_to_scal (const vect_t a)`
- `template<class T>`  
static constexpr bool `valid (T *p)`
- `template<class T>`  
static constexpr bool `valid (T *p)`
- `template<class T>`  
static constexpr bool `compliant (T n)`
- `template<class T>`  
static constexpr bool `compliant (T n)`
- static `INLINE CONST vect_t set1 (const scalar_t x)`
- static `INLINE CONST vect_t set (const scalar_t x0, const scalar_t x1, const scalar_t x2, const scalar_t x3, const scalar_t x4, const scalar_t x5, const scalar_t x6, const scalar_t x7)`
- static `INLINE CONST vect_t set (const scalar_t x0, const scalar_t x1, const scalar_t x2, const scalar_t x3, const scalar_t x4, const scalar_t x5, const scalar_t x6, const scalar_t x7, const scalar_t x8, const scalar_t x9, const scalar_t x10, const scalar_t x11, const scalar_t x12, const scalar_t x13, const scalar_t x14, const scalar_t x15)`
- `template<class T>`  
static `INLINE PURE vect_t gather (const scalar_t *const p, const T *const idx)`
- static `INLINE PURE vect_t load (const scalar_t *const p)`
- static `INLINE PURE vect_t loadu (const scalar_t *const p)`
- static `INLINE void store (scalar_t *p, vect_t v)`
- static `INLINE void storeu (scalar_t *p, vect_t v)`
- static `INLINE void stream (scalar_t *p, const vect_t v)`
- `template<int s>`  
static `INLINE CONST vect_t sll (const vect_t a)`
- `template<int s>`  
static `INLINE CONST vect_t sll (const vect_t a)`
- `template<int s>`  
static `INLINE CONST vect_t srl (const vect_t a)`
- `template<int s>`  
static `INLINE CONST vect_t srl (const vect_t a)`
- `template<uint8_t s>`  
static `INLINE CONST vect_t shuffle_twice (const vect_t a)`
- `template<uint8_t s>`  
static `INLINE CONST vect_t shuffle_twice (const vect_t a)`
- `template<uint32_t s>`  
static `INLINE CONST vect_t shuffle (const vect_t a)`
- `template<uint64_t s>`  
static `INLINE CONST vect_t shuffle (const vect_t a)`
- static `INLINE CONST vect_t unpacklo_intrinsic (const vect_t a, const vect_t b)`
- static `INLINE CONST vect_t unpacklo_intrinsic (const vect_t a, const vect_t b)`
- static `INLINE CONST vect_t unpackhi_intrinsic (const vect_t a, const vect_t b)`
- static `INLINE CONST vect_t unpackhi_intrinsic (const vect_t a, const vect_t b)`
- static `INLINE CONST vect_t unpacklo (const vect_t a, const vect_t b)`



- static [INLINE CONST vect\\_t unpacklo](#) (const [vect\\_t](#) a, const [vect\\_t](#) b)
- static [INLINE CONST vect\\_t unpackhi](#) (const [vect\\_t](#) a, const [vect\\_t](#) b)
- static [INLINE CONST vect\\_t unpackhi](#) (const [vect\\_t](#) a, const [vect\\_t](#) b)
- static [INLINE void unpacklohi](#) ([vect\\_t](#) &lo, [vect\\_t](#) &hi, const [vect\\_t](#) a, const [vect\\_t](#) b)
- static [INLINE void unpacklohi](#) ([vect\\_t](#) &lo, [vect\\_t](#) &hi, const [vect\\_t](#) a, const [vect\\_t](#) b)
- static [INLINE CONST vect\\_t pack\\_even](#) (const [vect\\_t](#) a, const [vect\\_t](#) b)
- static [INLINE CONST vect\\_t pack\\_even](#) (const [vect\\_t](#) a, const [vect\\_t](#) b)
- static [INLINE CONST vect\\_t pack\\_odd](#) (const [vect\\_t](#) a, const [vect\\_t](#) b)
- static [INLINE CONST vect\\_t pack\\_odd](#) (const [vect\\_t](#) a, const [vect\\_t](#) b)
- static [INLINE void pack](#) ([vect\\_t](#) &even, [vect\\_t](#) &odd, const [vect\\_t](#) a, const [vect\\_t](#) b)
- static [INLINE void pack](#) ([vect\\_t](#) &even, [vect\\_t](#) &odd, const [vect\\_t](#) a, const [vect\\_t](#) b)
- static [INLINE void transpose](#) ([vect\\_t](#) &r0, [vect\\_t](#) &r1, [vect\\_t](#) &r2, [vect\\_t](#) &r3, [vect\\_t](#) &r4, [vect\\_t](#) &r5, [vect\\_t](#) &r6, [vect\\_t](#) &r7)
- static [INLINE void transpose](#) ([vect\\_t](#) &r0, [vect\\_t](#) &r1, [vect\\_t](#) &r2, [vect\\_t](#) &r3, [vect\\_t](#) &r4, [vect\\_t](#) &r5, [vect\\_t](#) &r6, [vect\\_t](#) &r7, [vect\\_t](#) &r8, [vect\\_t](#) &r9, [vect\\_t](#) &r10, [vect\\_t](#) &r11, [vect\\_t](#) &r12, [vect\\_t](#) &r13, [vect\\_t](#) &r14, [vect\\_t](#) &r15)
- [template<uint8\\_t s>](#)  
static [INLINE CONST vect\\_t blend](#) (const [vect\\_t](#) a, const [vect\\_t](#) b)
- [template<uint16\\_t s>](#)  
static [INLINE CONST vect\\_t blend](#) (const [vect\\_t](#) a, const [vect\\_t](#) b)
- static [INLINE CONST vect\\_t add](#) (const [vect\\_t](#) a, const [vect\\_t](#) b)
- static [INLINE CONST vect\\_t add](#) (const [vect\\_t](#) a, const [vect\\_t](#) b)
- static [INLINE vect\\_t addin](#) ([vect\\_t](#) &a, const [vect\\_t](#) b)
- static [INLINE vect\\_t addin](#) ([vect\\_t](#) &a, const [vect\\_t](#) b)
- static [INLINE CONST vect\\_t sub](#) (const [vect\\_t](#) a, const [vect\\_t](#) b)
- static [INLINE CONST vect\\_t sub](#) (const [vect\\_t](#) a, const [vect\\_t](#) b)
- static [INLINE vect\\_t subin](#) ([vect\\_t](#) &a, const [vect\\_t](#) b)
- static [INLINE vect\\_t subin](#) ([vect\\_t](#) &a, const [vect\\_t](#) b)
- static [INLINE CONST vect\\_t mullo](#) (const [vect\\_t](#) a, const [vect\\_t](#) b)
- static [INLINE CONST vect\\_t mullo](#) (const [vect\\_t](#) a, const [vect\\_t](#) b)
- static [INLINE CONST vect\\_t mul](#) (const [vect\\_t](#) a, const [vect\\_t](#) b)
- static [INLINE CONST vect\\_t mul](#) (const [vect\\_t](#) a, const [vect\\_t](#) b)
- static [INLINE CONST vect\\_t fmadd](#) (const [vect\\_t](#) c, const [vect\\_t](#) a, const [vect\\_t](#) b)
- static [INLINE CONST vect\\_t fmadd](#) (const [vect\\_t](#) c, const [vect\\_t](#) a, const [vect\\_t](#) b)
- static [INLINE vect\\_t fmaddin](#) ([vect\\_t](#) &c, const [vect\\_t](#) a, const [vect\\_t](#) b)
- static [INLINE vect\\_t fmaddin](#) ([vect\\_t](#) &c, const [vect\\_t](#) a, const [vect\\_t](#) b)
- static [INLINE CONST vect\\_t fnmadd](#) (const [vect\\_t](#) c, const [vect\\_t](#) a, const [vect\\_t](#) b)
- static [INLINE CONST vect\\_t fnmadd](#) (const [vect\\_t](#) c, const [vect\\_t](#) a, const [vect\\_t](#) b)
- static [INLINE vect\\_t fnmaddin](#) ([vect\\_t](#) &c, const [vect\\_t](#) a, const [vect\\_t](#) b)
- static [INLINE vect\\_t fnmaddin](#) ([vect\\_t](#) &c, const [vect\\_t](#) a, const [vect\\_t](#) b)
- static [INLINE CONST vect\\_t fmsub](#) (const [vect\\_t](#) c, const [vect\\_t](#) a, const [vect\\_t](#) b)
- static [INLINE CONST vect\\_t fmsub](#) (const [vect\\_t](#) c, const [vect\\_t](#) a, const [vect\\_t](#) b)
- static [INLINE vect\\_t fmsubin](#) ([vect\\_t](#) &c, const [vect\\_t](#) a, const [vect\\_t](#) b)
- static [INLINE vect\\_t fmsubin](#) ([vect\\_t](#) &c, const [vect\\_t](#) a, const [vect\\_t](#) b)
- static [INLINE CONST vect\\_t eq](#) (const [vect\\_t](#) a, const [vect\\_t](#) b)
- static [INLINE CONST vect\\_t eq](#) (const [vect\\_t](#) a, const [vect\\_t](#) b)
- static [INLINE CONST vect\\_t round](#) (const [vect\\_t](#) a)
- static [INLINE CONST vect\\_t round](#) (const [vect\\_t](#) a)
- static [INLINE vect\\_t mod](#) ([vect\\_t](#) &C, const [vect\\_t](#) &P, const [vect\\_t](#) &INVP, const [vect\\_t](#) &NEGP, const [vect\\_t](#) &MIN, const [vect\\_t](#) &MAX, [vect\\_t](#) &Q, [vect\\_t](#) &T)
- static [INLINE vect\\_t mod](#) ([vect\\_t](#) &C, const [vect\\_t](#) &P, const [vect\\_t](#) &INVP, const [vect\\_t](#) &NEGP, const [vect\\_t](#) &MIN, const [vect\\_t](#) &MAX, [vect\\_t](#) &Q, [vect\\_t](#) &T)
- static [INLINE CONST vect\\_t zero](#) ()
- static [INLINE CONST vect\\_t zero](#) ()
- static [INLINE CONST vect\\_t vor](#) (const [vect\\_t](#) a, const [vect\\_t](#) b)
- static [INLINE CONST vect\\_t vxor](#) (const [vect\\_t](#) a, const [vect\\_t](#) b)
- static [INLINE CONST vect\\_t vand](#) (const [vect\\_t](#) a, const [vect\\_t](#) b)
- static [INLINE CONST vect\\_t vandnot](#) (const [vect\\_t](#) a, const [vect\\_t](#) b)

### Static Public Attributes

- static const constexpr size\_t `vect_size` = 8
- static const constexpr size\_t `alignment` = 32

## 12.297.1 Member Typedef Documentation

### 12.297.1.1 `scalar_t` [1/2]

```
using scalar_t = uint32_t
```

### 12.297.1.2 `aligned_allocator` [1/2]

```
using aligned_allocator = AlignedAllocator<scalar_t, Alignment(alignment)>
```

### 12.297.1.3 `aligned_vector` [1/2]

```
using aligned_vector = std::vector<scalar_t, aligned_allocator>
```

### 12.297.1.4 `is_same_element` [1/2]

```
template<class Field>
using is_same_element = std::is_same<typename Field::Element, scalar_t>
```

### 12.297.1.5 `simdHalf` [1/2]

```
using simdHalf = Simd128<scalar_t>
```

### 12.297.1.6 `scalar_t` [2/2]

```
using scalar_t = uint32_t
```

### 12.297.1.7 `aligned_allocator` [2/2]

```
using aligned_allocator = AlignedAllocator<scalar_t, Alignment(alignment)>
```

### 12.297.1.8 `aligned_vector` [2/2]

```
using aligned_vector = std::vector<scalar_t, aligned_allocator>
```

### 12.297.1.9 `is_same_element` [2/2]

```
template<class Field>
using is_same_element = std::is_same<typename Field::Element, scalar_t>
```

### 12.297.1.10 `simdHalf` [2/2]

```
using simdHalf = Simd128<scalar_t>
```

### 12.297.1.11 `vect_t` [1/2]

```
using vect_t = __m256i [inherited]
```

### 12.297.1.12 `vect_t` [2/2]

```
using vect_t = __m512i [inherited]
```

### 12.297.1.13 `half_t` [1/2]

```
using half_t = __m128i [inherited]
```

**12.297.1.14 half\_t [2/2]**

```
using half_t = __m256i [inherited]
```

**12.297.2 Member Function Documentation****12.297.2.1 type\_string() [1/2]**

```
static const std::string type_string () [inline], [static]
```

**12.297.2.2 set1() [1/3]**

```
static INLINE CONST vect_t set1 (
    const scalar_t x) [inline], [static]
```

**12.297.2.3 set() [1/4]**

```
static INLINE CONST vect_t set (
    const scalar_t x0,
    const scalar_t x1,
    const scalar_t x2,
    const scalar_t x3,
    const scalar_t x4,
    const scalar_t x5,
    const scalar_t x6,
    const scalar_t x7) [inline], [static]
```

**12.297.2.4 gather() [1/3]**

```
template<class T>
static INLINE PURE vect_t gather (
    const scalar_t *const p,
    const T *const idx) [inline], [static]
```

**12.297.2.5 load() [1/3]**

```
static INLINE PURE vect_t load (
    const scalar_t *const p) [inline], [static]
```

**12.297.2.6 loadu() [1/3]**

```
static INLINE PURE vect_t loadu (
    const scalar_t *const p) [inline], [static]
```

**12.297.2.7 store() [1/3]**

```
static INLINE void store (
    scalar_t * p,
    vect_t v) [inline], [static]
```

**12.297.2.8 storeu() [1/3]**

```
static INLINE void storeu (
    scalar_t * p,
    vect_t v) [inline], [static]
```

**12.297.2.9 stream() [1/3]**

```
static INLINE void stream (
    scalar_t * p,
    const vect_t v) [inline], [static]
```

**12.297.2.10 sra()** [1/2]

```
template<int s>
static INLINE CONST vect_t sra (
    const vect_t a) [inline], [static]
```

**12.297.2.11 greater()** [1/2]

```
static INLINE CONST vect_t greater (
    vect_t a,
    vect_t b) [inline], [static]
```

**12.297.2.12 lesser()** [1/2]

```
static INLINE CONST vect_t lesser (
    vect_t a,
    vect_t b) [inline], [static]
```

**12.297.2.13 greater\_eq()** [1/2]

```
static INLINE CONST vect_t greater_eq (
    const vect_t a,
    const vect_t b) [inline], [static]
```

**12.297.2.14 lesser\_eq()** [1/2]

```
static INLINE CONST vect_t lesser_eq (
    const vect_t a,
    const vect_t b) [inline], [static]
```

**12.297.2.15 mulhi()** [1/2]

```
static INLINE CONST vect_t mulhi (
    const vect_t a,
    const vect_t b) [inline], [static]
```

**12.297.2.16 mulx()** [1/2]

```
static INLINE CONST vect_t mulx (
    vect_t a,
    vect_t b) [inline], [static]
```

**12.297.2.17 fmaddx()** [1/2]

```
static INLINE CONST vect_t fmaddx (
    const vect_t c,
    const vect_t a,
    const vect_t b) [inline], [static]
```

**12.297.2.18 fmaddxin()** [1/2]

```
static INLINE vect_t fmaddxin (
    vect_t & c,
    const vect_t a,
    const vect_t b) [inline], [static]
```

**12.297.2.19 fnmaddx()** [1/2]

```
static INLINE CONST vect_t fnmaddx (
    const vect_t c,
    const vect_t a,
    const vect_t b) [inline], [static]
```

**12.297.2.20 fnmaddxin()** [1/2]

```
static INLINE vect_t fnmaddxin (
    vect_t & c,
    const vect_t a,
    const vect_t b) [inline], [static]
```

**12.297.2.21 fmsubx()** [1/2]

```
static INLINE CONST vect_t fmsubx (
    const vect_t c,
    const vect_t a,
    const vect_t b) [inline], [static]
```

**12.297.2.22 fmsubxin()** [1/2]

```
static INLINE vect_t fmsubxin (
    vect_t & c,
    const vect_t a,
    const vect_t b) [inline], [static]
```

**12.297.2.23 hadd\_to\_scal()** [1/2]

```
static INLINE CONST scalar_t hadd_to_scal (
    const vect_t a) [inline], [static]
```

**12.297.2.24 type\_string()** [2/2]

```
static const std::string type_string () [inline], [static]
```

**12.297.2.25 set1()** [2/3]

```
static INLINE CONST vect_t set1 (
    const scalar_t x) [inline], [static]
```

**12.297.2.26 set()** [2/4]

```
static INLINE CONST vect_t set (
    const scalar_t x0,
    const scalar_t x1,
    const scalar_t x2,
    const scalar_t x3,
    const scalar_t x4,
    const scalar_t x5,
    const scalar_t x6,
    const scalar_t x7) [inline], [static]
```

**12.297.2.27 gather()** [2/3]

```
template<class T>
static INLINE PURE vect_t gather (
    const scalar_t *const p,
    const T *const idx) [inline], [static]
```

**12.297.2.28 load()** [2/3]

```
static INLINE PURE vect_t load (  
    const scalar_t *const p) [inline], [static]
```

**12.297.2.29 loadu()** [2/3]

```
static INLINE PURE vect_t loadu (  
    const scalar_t *const p) [inline], [static]
```

**12.297.2.30 store()** [2/3]

```
static INLINE void store (  
    scalar_t * p,  
    vect_t v) [inline], [static]
```

**12.297.2.31 storeu()** [2/3]

```
static INLINE void storeu (  
    scalar_t * p,  
    vect_t v) [inline], [static]
```

**12.297.2.32 stream()** [2/3]

```
static INLINE void stream (  
    scalar_t * p,  
    const vect_t v) [inline], [static]
```

**12.297.2.33 sra()** [2/2]

```
template<int s>  
static INLINE CONST vect_t sra (  
    const vect_t a) [inline], [static]
```

**12.297.2.34 greater()** [2/2]

```
static INLINE CONST vect_t greater (  
    vect_t a,  
    vect_t b) [inline], [static]
```

**12.297.2.35 lesser()** [2/2]

```
static INLINE CONST vect_t lesser (  
    vect_t a,  
    vect_t b) [inline], [static]
```

**12.297.2.36 greater\_eq()** [2/2]

```
static INLINE CONST vect_t greater_eq (  
    const vect_t a,  
    const vect_t b) [inline], [static]
```

**12.297.2.37 lesser\_eq()** [2/2]

```
static INLINE CONST vect_t lesser_eq (  
    const vect_t a,  
    const vect_t b) [inline], [static]
```

**12.297.2.38 mulhi() [2/2]**

```
static INLINE CONST vect_t mulhi (  
    const vect_t a,  
    const vect_t b) [inline], [static]
```

**12.297.2.39 mulx() [2/2]**

```
static INLINE CONST vect_t mulx (  
    vect_t a,  
    vect_t b) [inline], [static]
```

**12.297.2.40 fmaddx() [2/2]**

```
static INLINE CONST vect_t fmaddx (  
    const vect_t c,  
    const vect_t a,  
    const vect_t b) [inline], [static]
```

**12.297.2.41 fmaddxin() [2/2]**

```
static INLINE vect_t fmaddxin (  
    vect_t & c,  
    const vect_t a,  
    const vect_t b) [inline], [static]
```

**12.297.2.42 fnmaddx() [2/2]**

```
static INLINE CONST vect_t fnmaddx (  
    const vect_t c,  
    const vect_t a,  
    const vect_t b) [inline], [static]
```

**12.297.2.43 fnmaddxin() [2/2]**

```
static INLINE vect_t fnmaddxin (  
    vect_t & c,  
    const vect_t a,  
    const vect_t b) [inline], [static]
```

**12.297.2.44 fmsubx() [2/2]**

```
static INLINE CONST vect_t fmsubx (  
    const vect_t c,  
    const vect_t a,  
    const vect_t b) [inline], [static]
```

**12.297.2.45 fmsubxin() [2/2]**

```
static INLINE vect_t fmsubxin (  
    vect_t & c,  
    const vect_t a,  
    const vect_t b) [inline], [static]
```

**12.297.2.46 hadd\_to\_scal() [2/2]**

```
static INLINE CONST scalar_t hadd_to_scal (  
    const vect_t a) [inline], [static]
```

**12.297.2.47 valid() [1/2]**

```
template<class T>
static constexpr bool valid (
    T * p) [inline], [static], [constexpr], [inherited]
```

**12.297.2.48 valid() [2/2]**

```
template<class T>
static constexpr bool valid (
    T * p) [inline], [static], [constexpr], [inherited]
```

**12.297.2.49 compliant() [1/2]**

```
template<class T>
static constexpr bool compliant (
    T n) [inline], [static], [constexpr], [inherited]
```

**12.297.2.50 compliant() [2/2]**

```
template<class T>
static constexpr bool compliant (
    T n) [inline], [static], [constexpr], [inherited]
```

**12.297.2.51 set1() [3/3]**

```
static INLINE CONST vect_t set1 (
    const scalar_t x) [inline], [static], [inherited]
```

**12.297.2.52 set() [3/4]**

```
static INLINE CONST vect_t set (
    const scalar_t x0,
    const scalar_t x1,
    const scalar_t x2,
    const scalar_t x3,
    const scalar_t x4,
    const scalar_t x5,
    const scalar_t x6,
    const scalar_t x7) [inline], [static], [inherited]
```

**12.297.2.53 set() [4/4]**

```
static INLINE CONST vect_t set (
    const scalar_t x0,
    const scalar_t x1,
    const scalar_t x2,
    const scalar_t x3,
    const scalar_t x4,
    const scalar_t x5,
    const scalar_t x6,
    const scalar_t x7,
    const scalar_t x8,
    const scalar_t x9,
    const scalar_t x10,
    const scalar_t x11,
    const scalar_t x12,
    const scalar_t x13,
    const scalar_t x14,
    const scalar_t x15) [inline], [static], [inherited]
```



**12.297.2.54 gather()** [3/3]

```
template<class T>
static INLINE PURE vect_t gather (
    const scalar_t *const p,
    const T *const idx) [inline], [static], [inherited]
```

**12.297.2.55 load()** [3/3]

```
static INLINE PURE vect_t load (
    const scalar_t *const p) [inline], [static], [inherited]
```

**12.297.2.56 loadu()** [3/3]

```
static INLINE PURE vect_t loadu (
    const scalar_t *const p) [inline], [static], [inherited]
```

**12.297.2.57 store()** [3/3]

```
static INLINE void store (
    scalar_t * p,
    vect_t v) [inline], [static], [inherited]
```

**12.297.2.58 storeu()** [3/3]

```
static INLINE void storeu (
    scalar_t * p,
    vect_t v) [inline], [static], [inherited]
```

**12.297.2.59 stream()** [3/3]

```
static INLINE void stream (
    scalar_t * p,
    const vect_t v) [inline], [static], [inherited]
```

**12.297.2.60 sll()** [1/2]

```
template<int s>
static INLINE CONST vect_t sll (
    const vect_t a) [inline], [static], [inherited]
```

**12.297.2.61 sll()** [2/2]

```
template<int s>
static INLINE CONST vect_t sll (
    const vect_t a) [inline], [static], [inherited]
```

**12.297.2.62 srl()** [1/2]

```
template<int s>
static INLINE CONST vect_t srl (
    const vect_t a) [inline], [static], [inherited]
```

**12.297.2.63 srl()** [2/2]

```
template<int s>
static INLINE CONST vect_t srl (
    const vect_t a) [inline], [static], [inherited]
```

**12.297.2.64 shuffle\_twice() [1/2]**

```
template<uint8_t s>
static INLINE CONST vect_t shuffle_twice (
    const vect_t a) [inline], [static], [inherited]
```

**12.297.2.65 shuffle\_twice() [2/2]**

```
template<uint8_t s>
static INLINE CONST vect_t shuffle_twice (
    const vect_t a) [inline], [static], [inherited]
```

**12.297.2.66 shuffle() [1/2]**

```
template<uint32_t s>
static INLINE CONST vect_t shuffle (
    const vect_t a) [inline], [static], [inherited]
```

**12.297.2.67 shuffle() [2/2]**

```
template<uint64_t s>
static INLINE CONST vect_t shuffle (
    const vect_t a) [inline], [static], [inherited]
```

**12.297.2.68 unpacklo\_intrinsic() [1/2]**

```
static INLINE CONST vect_t unpacklo_intrinsic (
    const vect_t a,
    const vect_t b) [inline], [static], [inherited]
```

**12.297.2.69 unpacklo\_intrinsic() [2/2]**

```
static INLINE CONST vect_t unpacklo_intrinsic (
    const vect_t a,
    const vect_t b) [inline], [static], [inherited]
```

**12.297.2.70 unpackhi\_intrinsic() [1/2]**

```
static INLINE CONST vect_t unpackhi_intrinsic (
    const vect_t a,
    const vect_t b) [inline], [static], [inherited]
```

**12.297.2.71 unpackhi\_intrinsic() [2/2]**

```
static INLINE CONST vect_t unpackhi_intrinsic (
    const vect_t a,
    const vect_t b) [inline], [static], [inherited]
```

**12.297.2.72 unpacklo() [1/2]**

```
static INLINE CONST vect_t unpacklo (
    const vect_t a,
    const vect_t b) [inline], [static], [inherited]
```

**12.297.2.73 unpacklo() [2/2]**

```
static INLINE CONST vect_t unpacklo (
    const vect_t a,
    const vect_t b) [inline], [static], [inherited]
```

**12.297.2.74 unpackhi() [1/2]**

```
static INLINE CONST vect_t unpackhi (  
    const vect_t a,  
    const vect_t b) [inline], [static], [inherited]
```

**12.297.2.75 unpackhi() [2/2]**

```
static INLINE CONST vect_t unpackhi (  
    const vect_t a,  
    const vect_t b) [inline], [static], [inherited]
```

**12.297.2.76 unpacklohi() [1/2]**

```
static INLINE void unpacklohi (  
    vect_t & lo,  
    vect_t & hi,  
    const vect_t a,  
    const vect_t b) [inline], [static], [inherited]
```

**12.297.2.77 unpacklohi() [2/2]**

```
static INLINE void unpacklohi (  
    vect_t & lo,  
    vect_t & hi,  
    const vect_t a,  
    const vect_t b) [inline], [static], [inherited]
```

**12.297.2.78 pack\_even() [1/2]**

```
static INLINE CONST vect_t pack_even (  
    const vect_t a,  
    const vect_t b) [inline], [static], [inherited]
```

**12.297.2.79 pack\_even() [2/2]**

```
static INLINE CONST vect_t pack_even (  
    const vect_t a,  
    const vect_t b) [inline], [static], [inherited]
```

**12.297.2.80 pack\_odd() [1/2]**

```
static INLINE CONST vect_t pack_odd (  
    const vect_t a,  
    const vect_t b) [inline], [static], [inherited]
```

**12.297.2.81 pack\_odd() [2/2]**

```
static INLINE CONST vect_t pack_odd (  
    const vect_t a,  
    const vect_t b) [inline], [static], [inherited]
```

**12.297.2.82 pack() [1/2]**

```
static INLINE void pack (  
    vect_t & even,  
    vect_t & odd,  
    const vect_t a,  
    const vect_t b) [inline], [static], [inherited]
```

**12.297.2.83 pack()** [2/2]

```
static INLINE void pack (
    vect_t & even,
    vect_t & odd,
    const vect_t a,
    const vect_t b) [inline], [static], [inherited]
```

**12.297.2.84 transpose()** [1/2]

```
static INLINE void transpose (
    vect_t & r0,
    vect_t & r1,
    vect_t & r2,
    vect_t & r3,
    vect_t & r4,
    vect_t & r5,
    vect_t & r6,
    vect_t & r7) [inline], [static], [inherited]
```

**12.297.2.85 transpose()** [2/2]

```
static INLINE void transpose (
    vect_t & r0,
    vect_t & r1,
    vect_t & r2,
    vect_t & r3,
    vect_t & r4,
    vect_t & r5,
    vect_t & r6,
    vect_t & r7,
    vect_t & r8,
    vect_t & r9,
    vect_t & r10,
    vect_t & r11,
    vect_t & r12,
    vect_t & r13,
    vect_t & r14,
    vect_t & r15) [inline], [static], [inherited]
```

**12.297.2.86 blend()** [1/2]

```
template<uint8_t s>
static INLINE CONST vect_t blend (
    const vect_t a,
    const vect_t b) [inline], [static], [inherited]
```

**12.297.2.87 blend()** [2/2]

```
template<uint16_t s>
static INLINE CONST vect_t blend (
    const vect_t a,
    const vect_t b) [inline], [static], [inherited]
```

**12.297.2.88 add()** [1/2]

```
static INLINE CONST vect_t add (
    const vect_t a,
    const vect_t b) [inline], [static], [inherited]
```

**12.297.2.89 add()** [2/2]

```
static INLINE CONST vect_t add (  
    const vect_t a,  
    const vect_t b) [inline], [static], [inherited]
```

**12.297.2.90 addin()** [1/2]

```
static INLINE vect_t addin (  
    vect_t & a,  
    const vect_t b) [inline], [static], [inherited]
```

**12.297.2.91 addin()** [2/2]

```
static INLINE vect_t addin (  
    vect_t & a,  
    const vect_t b) [inline], [static], [inherited]
```

**12.297.2.92 sub()** [1/2]

```
static INLINE CONST vect_t sub (  
    const vect_t a,  
    const vect_t b) [inline], [static], [inherited]
```

**12.297.2.93 sub()** [2/2]

```
static INLINE CONST vect_t sub (  
    const vect_t a,  
    const vect_t b) [inline], [static], [inherited]
```

**12.297.2.94 subin()** [1/2]

```
static INLINE vect_t subin (  
    vect_t & a,  
    const vect_t b) [inline], [static], [inherited]
```

**12.297.2.95 subin()** [2/2]

```
static INLINE vect_t subin (  
    vect_t & a,  
    const vect_t b) [inline], [static], [inherited]
```

**12.297.2.96 mullo()** [1/2]

```
static INLINE CONST vect_t mullo (  
    const vect_t a,  
    const vect_t b) [inline], [static], [inherited]
```

**12.297.2.97 mullo()** [2/2]

```
static INLINE CONST vect_t mullo (  
    const vect_t a,  
    const vect_t b) [inline], [static], [inherited]
```

**12.297.2.98 mul()** [1/2]

```
static INLINE CONST vect_t mul (  
    const vect_t a,  
    const vect_t b) [inline], [static], [inherited]
```

**12.297.2.99 mul()** [2/2]

```
static INLINE CONST vect_t mul (  
    const vect_t a,  
    const vect_t b) [inline], [static], [inherited]
```

**12.297.2.100 fmadd()** [1/2]

```
static INLINE CONST vect_t fmadd (  
    const vect_t c,  
    const vect_t a,  
    const vect_t b) [inline], [static], [inherited]
```

**12.297.2.101 fmadd()** [2/2]

```
static INLINE CONST vect_t fmadd (  
    const vect_t c,  
    const vect_t a,  
    const vect_t b) [inline], [static], [inherited]
```

**12.297.2.102 fmaddin()** [1/2]

```
static INLINE vect_t fmaddin (  
    vect_t & c,  
    const vect_t a,  
    const vect_t b) [inline], [static], [inherited]
```

**12.297.2.103 fmaddin()** [2/2]

```
static INLINE vect_t fmaddin (  
    vect_t & c,  
    const vect_t a,  
    const vect_t b) [inline], [static], [inherited]
```

**12.297.2.104 fnmadd()** [1/2]

```
static INLINE CONST vect_t fnmadd (  
    const vect_t c,  
    const vect_t a,  
    const vect_t b) [inline], [static], [inherited]
```

**12.297.2.105 fnmadd()** [2/2]

```
static INLINE CONST vect_t fnmadd (  
    const vect_t c,  
    const vect_t a,  
    const vect_t b) [inline], [static], [inherited]
```

**12.297.2.106 fnmaddin()** [1/2]

```
static INLINE vect_t fnmaddin (  
    vect_t & c,  
    const vect_t a,  
    const vect_t b) [inline], [static], [inherited]
```

**12.297.2.107 fnmaddin()** [2/2]

```
static INLINE vect_t fnmaddin (  
    vect_t & c,
```

```
const vect_t a,  
const vect_t b) [inline], [static], [inherited]
```

#### 12.297.2.108 fmsub() [1/2]

```
static INLINE CONST vect_t fmsub (  
    const vect_t c,  
    const vect_t a,  
    const vect_t b) [inline], [static], [inherited]
```

#### 12.297.2.109 fmsub() [2/2]

```
static INLINE CONST vect_t fmsub (  
    const vect_t c,  
    const vect_t a,  
    const vect_t b) [inline], [static], [inherited]
```

#### 12.297.2.110 fmsubin() [1/2]

```
static INLINE vect_t fmsubin (  
    vect_t & c,  
    const vect_t a,  
    const vect_t b) [inline], [static], [inherited]
```

#### 12.297.2.111 fmsubin() [2/2]

```
static INLINE vect_t fmsubin (  
    vect_t & c,  
    const vect_t a,  
    const vect_t b) [inline], [static], [inherited]
```

#### 12.297.2.112 eq() [1/2]

```
static INLINE CONST vect_t eq (  
    const vect_t a,  
    const vect_t b) [inline], [static], [inherited]
```

#### 12.297.2.113 eq() [2/2]

```
static INLINE CONST vect_t eq (  
    const vect_t a,  
    const vect_t b) [inline], [static], [inherited]
```

#### 12.297.2.114 round() [1/2]

```
static INLINE CONST vect_t round (  
    const vect_t a) [inline], [static], [inherited]
```

#### 12.297.2.115 round() [2/2]

```
static INLINE CONST vect_t round (  
    const vect_t a) [inline], [static], [inherited]
```

#### 12.297.2.116 mod() [1/2]

```
static INLINE vect_t mod (  
    vect_t & C,  
    const vect_t & P,  
    const vect_t & INVP,  
    const vect_t & NEGP,
```

```

const vect_t & MIN,
const vect_t & MAX,
vect_t & Q,
vect_t & T) [inline], [static], [inherited]

```

#### 12.297.2.117 mod() [2/2]

```

static INLINE vect_t mod (
    vect_t & C,
    const vect_t & P,
    const vect_t & INVP,
    const vect_t & NEGP,
    const vect_t & MIN,
    const vect_t & MAX,
    vect_t & Q,
    vect_t & T) [inline], [static], [inherited]

```

#### 12.297.2.118 zero() [1/2]

```

static INLINE CONST vect_t zero () [inline], [static], [inherited]

```

#### 12.297.2.119 zero() [2/2]

```

static INLINE CONST vect_t zero () [inline], [static], [inherited]

```

#### 12.297.2.120 vor()

```

static INLINE CONST vect_t vor (
    const vect_t a,
    const vect_t b) [inline], [static], [inherited]

```

#### 12.297.2.121 vxor()

```

static INLINE CONST vect_t vxor (
    const vect_t a,
    const vect_t b) [inline], [static], [inherited]

```

#### 12.297.2.122 vand()

```

static INLINE CONST vect_t vand (
    const vect_t a,
    const vect_t b) [inline], [static], [inherited]

```

#### 12.297.2.123 vandnot()

```

static INLINE CONST vect_t vandnot (
    const vect_t a,
    const vect_t b) [inline], [static], [inherited]

```

### 12.297.3 Field Documentation

#### 12.297.3.1 vect\_size

```

static const constexpr size_t vect_size = 8 [static], [constexpr], [inherited]

```

#### 12.297.3.2 alignment

```

static const constexpr size_t alignment = 32 [static], [constexpr], [inherited]

```

The documentation for this struct was generated from the following files:



- [simd256\\_int32.inl](#)
- [simd512\\_int32.inl](#)

## 12.298 Simd256\_impl< true, true, false, 8 > Struct Reference

Inheritance diagram for Simd256\_impl< true, true, false, 8 >:



### Data Structures

- union [Converter](#)

### Public Types

- using [scalar\\_t](#) = uint64\_t
- using [aligned\\_allocator](#) = AlignedAllocator<[scalar\\_t](#), Alignment([alignment](#))>
- using [aligned\\_vector](#) = std::vector<[scalar\\_t](#), [aligned\\_allocator](#)>
- template<class [Field](#)>
  - using [is\\_same\\_element](#) = std::is\_same<typename [Field::Element](#), [scalar\\_t](#)>
- using [simdHalf](#) = [Simd128](#)<[scalar\\_t](#)>
- using [vect\\_t](#) = \_\_m256i
- using [half\\_t](#) = \_\_m128i

### Static Public Member Functions

- static const std::string [type\\_string](#) ()
- static [INLINE CONST vect\\_t set1](#) (const [scalar\\_t](#) x)
- static [INLINE CONST vect\\_t set](#) (const [scalar\\_t](#) x0, const [scalar\\_t](#) x1, const [scalar\\_t](#) x2, const [scalar\\_t](#) x3)
- template<class T>
  - static [INLINE PURE vect\\_t gather](#) (const [scalar\\_t](#) \*const p, const T \*const idx)
- static [INLINE PURE vect\\_t load](#) (const [scalar\\_t](#) \*const p)
- static [INLINE PURE vect\\_t loadu](#) (const [scalar\\_t](#) \*const p)
- static [INLINE](#) void [store](#) ([scalar\\_t](#) \*p, [vect\\_t](#) v)
- static [INLINE](#) void [storeu](#) ([scalar\\_t](#) \*p, [vect\\_t](#) v)
- static [INLINE](#) void [stream](#) ([scalar\\_t](#) \*p, const [vect\\_t](#) v)
- template<int s>
  - static [INLINE CONST vect\\_t sra](#) (const [vect\\_t](#) a)
- static [INLINE CONST vect\\_t greater](#) ([vect\\_t](#) a, [vect\\_t](#) b)
- static [INLINE CONST vect\\_t lesser](#) ([vect\\_t](#) a, [vect\\_t](#) b)
- static [INLINE CONST vect\\_t greater\\_eq](#) (const [vect\\_t](#) a, const [vect\\_t](#) b)
- static [INLINE CONST vect\\_t lesser\\_eq](#) (const [vect\\_t](#) a, const [vect\\_t](#) b)
- static [INLINE CONST vect\\_t mullo](#) ([vect\\_t](#) a, [vect\\_t](#) b)
- static [INLINE CONST vect\\_t mulhi](#) ([vect\\_t](#) a, [vect\\_t](#) b)
- static [INLINE CONST vect\\_t mulx](#) (const [vect\\_t](#) a, const [vect\\_t](#) b)
- static [INLINE CONST vect\\_t fmaddx](#) (const [vect\\_t](#) c, const [vect\\_t](#) a, const [vect\\_t](#) b)
- static [INLINE vect\\_t fmaddxin](#) ([vect\\_t](#) &c, const [vect\\_t](#) a, const [vect\\_t](#) b)
- static [INLINE CONST vect\\_t fnmaddx](#) (const [vect\\_t](#) c, const [vect\\_t](#) a, const [vect\\_t](#) b)
- static [INLINE vect\\_t fnmaddxin](#) ([vect\\_t](#) &c, const [vect\\_t](#) a, const [vect\\_t](#) b)

- static `INLINE CONST vect_t fmsubx` (const `vect_t` c, const `vect_t` a, const `vect_t` b)
- static `INLINE vect_t fmsubxin` (`vect_t` &c, const `vect_t` a, const `vect_t` b)
- static `INLINE CONST scalar_t hadd_to_scal` (const `vect_t` a)
- template<class T>  
static constexpr bool `valid` (T \*p)
- template<class T>  
static constexpr bool `compliant` (T n)
- static `INLINE CONST vect_t set1` (const `scalar_t` x)
- static `INLINE CONST vect_t set` (const `scalar_t` x0, const `scalar_t` x1, const `scalar_t` x2, const `scalar_t` x3)
- template<class T>  
static `INLINE PURE vect_t gather` (const `scalar_t` \*const p, const T \*const idx)
- template<int idx>  
static `INLINE CONST scalar_t get` (`vect_t` v)
- static `INLINE PURE vect_t load` (const `scalar_t` \*const p)
- static `INLINE PURE vect_t loadu` (const `scalar_t` \*const p)
- static `INLINE void store` (`scalar_t` \*p, `vect_t` v)
- static `INLINE void storeu` (`scalar_t` \*p, `vect_t` v)
- static `INLINE void stream` (`scalar_t` \*p, const `vect_t` v)
- template<int s>  
static `INLINE CONST vect_t sll` (const `vect_t` a)
- template<int s>  
static `INLINE CONST vect_t srl` (const `vect_t` a)
- template<uint8\_t s>  
static `INLINE CONST vect_t shuffle` (const `vect_t` a)
- static `INLINE CONST vect_t unpacklo_intrinsic` (const `vect_t` a, const `vect_t` b)
- static `INLINE CONST vect_t unpackhi_intrinsic` (const `vect_t` a, const `vect_t` b)
- static `INLINE CONST vect_t unpacklo` (const `vect_t` a, const `vect_t` b)
- static `INLINE CONST vect_t unpackhi` (const `vect_t` a, const `vect_t` b)
- static `INLINE void unpacklohi` (`vect_t` &lo, `vect_t` &hi, const `vect_t` a, const `vect_t` b)
- static `INLINE CONST vect_t pack_even` (const `vect_t` a, const `vect_t` b)
- static `INLINE CONST vect_t pack_odd` (const `vect_t` a, const `vect_t` b)
- static `INLINE void pack` (`vect_t` &even, `vect_t` &odd, const `vect_t` a, const `vect_t` b)
- static `INLINE void transpose` (`vect_t` &r0, `vect_t` &r1, `vect_t` &r2, `vect_t` &r3)
- template<uint8\_t s>  
static `INLINE CONST vect_t blend` (const `vect_t` a, const `vect_t` b)
- static `INLINE CONST vect_t add` (const `vect_t` a, const `vect_t` b)
- static `INLINE vect_t addin` (`vect_t` &a, const `vect_t` b)
- static `INLINE CONST vect_t sub` (const `vect_t` a, const `vect_t` b)
- static `INLINE vect_t subin` (`vect_t` &a, const `vect_t` b)
- static `INLINE CONST vect_t mul` (const `vect_t` a, const `vect_t` b)
- static `INLINE CONST vect_t fmadd` (const `vect_t` c, const `vect_t` a, const `vect_t` b)
- static `INLINE vect_t fmadin` (`vect_t` &c, const `vect_t` a, const `vect_t` b)
- static `INLINE CONST vect_t fnmadd` (const `vect_t` c, const `vect_t` a, const `vect_t` b)
- static `INLINE vect_t fnmaddin` (`vect_t` &c, const `vect_t` a, const `vect_t` b)
- static `INLINE CONST vect_t fmsub` (const `vect_t` c, const `vect_t` a, const `vect_t` b)
- static `INLINE vect_t fmsubin` (`vect_t` &c, const `vect_t` a, const `vect_t` b)
- static `INLINE CONST vect_t eq` (const `vect_t` a, const `vect_t` b)
- static `INLINE CONST vect_t round` (const `vect_t` a)
- static `INLINE CONST vect_t mask_high` ()
- static `INLINE CONST vect_t mulhi_fast` (`vect_t` x, `vect_t` y)
- static `INLINE vect_t mod` (`vect_t` &C, const \_\_m256d &P, const \_\_m256d &INVP, const \_\_m256d &NEGP, const `vect_t` &POW50REM, const \_\_m256d &MIN, const \_\_m256d &MAX, \_\_m256d &Q, \_\_m256d &T)
- static `INLINE CONST vect_t zero` ()

**Static Public Attributes**

- static const constexpr size\_t `vect_size` = 4
- static const constexpr size\_t `alignment` = 32

**Static Protected Member Functions**

- static `INLINE CONST vect_t signbits` (const `vect_t` x)

**12.298.1 Member Typedef Documentation****12.298.1.1 scalar\_t**

```
using scalar_t = uint64_t
```

**12.298.1.2 aligned\_allocator**

```
using aligned_allocator = AlignedAllocator<scalar_t, Alignment(alignment)>
```

**12.298.1.3 aligned\_vector**

```
using aligned_vector = std::vector<scalar_t, aligned_allocator>
```

**12.298.1.4 is\_same\_element**

```
template<class Field>
using is_same_element = std::is_same<typename Field::Element, scalar_t>
```

**12.298.1.5 simdHalf**

```
using simdHalf = Simd128<scalar_t>
```

**12.298.1.6 vect\_t**

```
using vect_t = __m256i [inherited]
```

**12.298.1.7 half\_t**

```
using half_t = __m128i [inherited]
```

**12.298.2 Member Function Documentation****12.298.2.1 type\_string()**

```
static const std::string type_string () [inline], [static]
```

**12.298.2.2 set1() [1/2]**

```
static INLINE CONST vect_t set1 (
    const scalar_t x) [inline], [static]
```

**12.298.2.3 set() [1/2]**

```
static INLINE CONST vect_t set (
    const scalar_t x0,
    const scalar_t x1,
    const scalar_t x2,
    const scalar_t x3) [inline], [static]
```

**12.298.2.4 gather()** [1/2]

```
template<class T>
static INLINE PURE vect_t gather (
    const scalar_t *const p,
    const T *const idx) [inline], [static]
```

**12.298.2.5 load()** [1/2]

```
static INLINE PURE vect_t load (
    const scalar_t *const p) [inline], [static]
```

**12.298.2.6 loadu()** [1/2]

```
static INLINE PURE vect_t loadu (
    const scalar_t *const p) [inline], [static]
```

**12.298.2.7 store()** [1/2]

```
static INLINE void store (
    scalar_t * p,
    vect_t v) [inline], [static]
```

**12.298.2.8 storeu()** [1/2]

```
static INLINE void storeu (
    scalar_t * p,
    vect_t v) [inline], [static]
```

**12.298.2.9 stream()** [1/2]

```
static INLINE void stream (
    scalar_t * p,
    const vect_t v) [inline], [static]
```

**12.298.2.10 sra()**

```
template<int s>
static INLINE CONST vect_t sra (
    const vect_t a) [inline], [static]
```

**12.298.2.11 greater()**

```
static INLINE CONST vect_t greater (
    vect_t a,
    vect_t b) [inline], [static]
```

**12.298.2.12 lesser()**

```
static INLINE CONST vect_t lesser (
    vect_t a,
    vect_t b) [inline], [static]
```

**12.298.2.13 greater\_eq()**

```
static INLINE CONST vect_t greater_eq (
    const vect_t a,
    const vect_t b) [inline], [static]
```

**12.298.2.14 lesser\_eq()**

```
static INLINE CONST vect_t lesser_eq (  
    const vect_t a,  
    const vect_t b) [inline], [static]
```

**12.298.2.15 mullo()**

```
static INLINE CONST vect_t mullo (  
    vect_t a,  
    vect_t b) [inline], [static]
```

**12.298.2.16 mulhi()**

```
static INLINE CONST vect_t mulhi (  
    vect_t a,  
    vect_t b) [inline], [static]
```

**12.298.2.17 mulx()**

```
static INLINE CONST vect_t mulx (  
    const vect_t a,  
    const vect_t b) [inline], [static]
```

**12.298.2.18 fmaddx()**

```
static INLINE CONST vect_t fmaddx (  
    const vect_t c,  
    const vect_t a,  
    const vect_t b) [inline], [static]
```

**12.298.2.19 fmaddxin()**

```
static INLINE vect_t fmaddxin (  
    vect_t & c,  
    const vect_t a,  
    const vect_t b) [inline], [static]
```

**12.298.2.20 fnmaddx()**

```
static INLINE CONST vect_t fnmaddx (  
    const vect_t c,  
    const vect_t a,  
    const vect_t b) [inline], [static]
```

**12.298.2.21 fnmaddxin()**

```
static INLINE vect_t fnmaddxin (  
    vect_t & c,  
    const vect_t a,  
    const vect_t b) [inline], [static]
```

**12.298.2.22 fmsubx()**

```
static INLINE CONST vect_t fmsubx (  
    const vect_t c,  
    const vect_t a,  
    const vect_t b) [inline], [static]
```

**12.298.2.23 fmsubxin()**

```
static INLINE vect_t fmsubxin (
    vect_t & c,
    const vect_t a,
    const vect_t b) [inline], [static]
```

**12.298.2.24 hadd\_to\_scal()**

```
static INLINE CONST scalar_t hadd_to_scal (
    const vect_t a) [inline], [static]
```

**12.298.2.25 valid()**

```
template<class T>
static constexpr bool valid (
    T * p) [inline], [static], [constexpr], [inherited]
```

**12.298.2.26 compliant()**

```
template<class T>
static constexpr bool compliant (
    T n) [inline], [static], [constexpr], [inherited]
```

**12.298.2.27 set1() [2/2]**

```
static INLINE CONST vect_t set1 (
    const scalar_t x) [inline], [static], [inherited]
```

**12.298.2.28 set() [2/2]**

```
static INLINE CONST vect_t set (
    const scalar_t x0,
    const scalar_t x1,
    const scalar_t x2,
    const scalar_t x3) [inline], [static], [inherited]
```

**12.298.2.29 gather() [2/2]**

```
template<class T>
static INLINE PURE vect_t gather (
    const scalar_t *const p,
    const T *const idx) [inline], [static], [inherited]
```

**12.298.2.30 get()**

```
template<int idx>
static INLINE CONST scalar_t get (
    vect_t v) [inline], [static], [inherited]
```

**12.298.2.31 load() [2/2]**

```
static INLINE PURE vect_t load (
    const scalar_t *const p) [inline], [static], [inherited]
```

**12.298.2.32 loadu() [2/2]**

```
static INLINE PURE vect_t loadu (
    const scalar_t *const p) [inline], [static], [inherited]
```

**12.298.2.33 store()** [2/2]

```
static INLINE void store (  
    scalar_t * p,  
    vect_t v) [inline], [static], [inherited]
```

**12.298.2.34 storeu()** [2/2]

```
static INLINE void storeu (  
    scalar_t * p,  
    vect_t v) [inline], [static], [inherited]
```

**12.298.2.35 stream()** [2/2]

```
static INLINE void stream (  
    scalar_t * p,  
    const vect_t v) [inline], [static], [inherited]
```

**12.298.2.36 sll()**

```
template<int s>  
static INLINE CONST vect_t sll (  
    const vect_t a) [inline], [static], [inherited]
```

**12.298.2.37 srl()**

```
template<int s>  
static INLINE CONST vect_t srl (  
    const vect_t a) [inline], [static], [inherited]
```

**12.298.2.38 shuffle()**

```
template<uint8_t s>  
static INLINE CONST vect_t shuffle (  
    const vect_t a) [inline], [static], [inherited]
```

**12.298.2.39 unpacklo\_intrinsic()**

```
static INLINE CONST vect_t unpacklo_intrinsic (  
    const vect_t a,  
    const vect_t b) [inline], [static], [inherited]
```

**12.298.2.40 unpackhi\_intrinsic()**

```
static INLINE CONST vect_t unpackhi_intrinsic (  
    const vect_t a,  
    const vect_t b) [inline], [static], [inherited]
```

**12.298.2.41 unpacklo()**

```
static INLINE CONST vect_t unpacklo (  
    const vect_t a,  
    const vect_t b) [inline], [static], [inherited]
```

**12.298.2.42 unpackhi()**

```
static INLINE CONST vect_t unpackhi (  
    const vect_t a,  
    const vect_t b) [inline], [static], [inherited]
```

**12.298.2.43 unpacklohi()**

```
static INLINE void unpacklohi (
    vect_t & lo,
    vect_t & hi,
    const vect_t a,
    const vect_t b) [inline], [static], [inherited]
```

**12.298.2.44 pack\_even()**

```
static INLINE CONST vect_t pack_even (
    const vect_t a,
    const vect_t b) [inline], [static], [inherited]
```

**12.298.2.45 pack\_odd()**

```
static INLINE CONST vect_t pack_odd (
    const vect_t a,
    const vect_t b) [inline], [static], [inherited]
```

**12.298.2.46 pack()**

```
static INLINE void pack (
    vect_t & even,
    vect_t & odd,
    const vect_t a,
    const vect_t b) [inline], [static], [inherited]
```

**12.298.2.47 transpose()**

```
static INLINE void transpose (
    vect_t & r0,
    vect_t & r1,
    vect_t & r2,
    vect_t & r3) [inline], [static], [inherited]
```

**12.298.2.48 blend()**

```
template<uint8_t s>
static INLINE CONST vect_t blend (
    const vect_t a,
    const vect_t b) [inline], [static], [inherited]
```

**12.298.2.49 add()**

```
static INLINE CONST vect_t add (
    const vect_t a,
    const vect_t b) [inline], [static], [inherited]
```

**12.298.2.50 addin()**

```
static INLINE vect_t addin (
    vect_t & a,
    const vect_t b) [inline], [static], [inherited]
```

**12.298.2.51 sub()**

```
static INLINE CONST vect_t sub (
    const vect_t a,
    const vect_t b) [inline], [static], [inherited]
```



**12.298.2.52 subin()**

```
static INLINE vect_t subin (  
    vect_t & a,  
    const vect_t b) [inline], [static], [inherited]
```

**12.298.2.53 mul()**

```
static INLINE CONST vect_t mul (  
    const vect_t a,  
    const vect_t b) [inline], [static], [inherited]
```

**12.298.2.54 fmadd()**

```
static INLINE CONST vect_t fmadd (  
    const vect_t c,  
    const vect_t a,  
    const vect_t b) [inline], [static], [inherited]
```

**12.298.2.55 fmaddin()**

```
static INLINE vect_t fmaddin (  
    vect_t & c,  
    const vect_t a,  
    const vect_t b) [inline], [static], [inherited]
```

**12.298.2.56 fnmadd()**

```
static INLINE CONST vect_t fnmadd (  
    const vect_t c,  
    const vect_t a,  
    const vect_t b) [inline], [static], [inherited]
```

**12.298.2.57 fnmaddin()**

```
static INLINE vect_t fnmaddin (  
    vect_t & c,  
    const vect_t a,  
    const vect_t b) [inline], [static], [inherited]
```

**12.298.2.58 fmsub()**

```
static INLINE CONST vect_t fmsub (  
    const vect_t c,  
    const vect_t a,  
    const vect_t b) [inline], [static], [inherited]
```

**12.298.2.59 fmsubin()**

```
static INLINE vect_t fmsubin (  
    vect_t & c,  
    const vect_t a,  
    const vect_t b) [inline], [static], [inherited]
```

**12.298.2.60 eq()**

```
static INLINE CONST vect_t eq (  
    const vect_t a,  
    const vect_t b) [inline], [static], [inherited]
```

**12.298.2.61 round()**

```
static INLINE CONST vect_t round (
    const vect_t a) [inline], [static], [inherited]
```

**12.298.2.62 mask\_high()**

```
static INLINE CONST vect_t mask_high () [inline], [static], [inherited]
```

**12.298.2.63 mulhi\_fast()**

```
INLINE CONST vect_t mulhi_fast (
    vect_t x,
    vect_t y) [static], [inherited]
```

**12.298.2.64 mod()**

```
INLINE vect_t mod (
    vect_t & C,
    const __m256d & P,
    const __m256d & INV_P,
    const __m256d & NEG_P,
    const vect_t & POW50REM,
    const __m256d & MIN,
    const __m256d & MAX,
    __m256d & Q,
    __m256d & T) [static], [inherited]
```

**12.298.2.65 signbits()**

```
static INLINE CONST vect_t signbits (
    const vect_t x) [inline], [static], [protected], [inherited]
```

**12.298.2.66 zero()**

```
static INLINE CONST vect_t zero () [inline], [static], [inherited]
```

**12.298.3 Field Documentation****12.298.3.1 vect\_size**

```
const constexpr size_t vect_size = 4 [static], [constexpr], [inherited]
```

**12.298.3.2 alignment**

```
const constexpr size_t alignment = 32 [static], [constexpr], [inherited]
```

The documentation for this struct was generated from the following file:

- [simd256\\_int64.inl](#)

**12.299 Simd256\_impl< true, true, true, 2 > Struct Reference**

Inheritance diagram for Simd256\_impl< true, true, true, 2 >:



## Data Structures

- union [Converter](#)

## Public Types

- using [vect\\_t](#) = \_\_m256i
- using [half\\_t](#) = \_\_m128i
- using [scalar\\_t](#) = int16\_t
- using [simdHalf](#) = [Simd128](#)<[scalar\\_t](#)>
- using [aligned\\_allocator](#) = [AlignedAllocator](#)<[scalar\\_t](#), [Alignment](#)([alignment](#))>
- using [aligned\\_vector](#) = std::vector<[scalar\\_t](#), [aligned\\_allocator](#)>
- template<class [Field](#)>
  - using [is\\_same\\_element](#) = std::is\_same<typename [Field::Element](#), [scalar\\_t](#)>

## Static Public Member Functions

- static const std::string [type\\_string](#) ()
- template<class T>
  - static constexpr bool [valid](#) (T \*p)
- template<class T>
  - static constexpr bool [compliant](#) (T n)
- static [INLINE CONST vect\\_t set1](#) (const [scalar\\_t](#) x)
- static [INLINE CONST vect\\_t set](#) (const [scalar\\_t](#) x0, const [scalar\\_t](#) x1, const [scalar\\_t](#) x2, const [scalar\\_t](#) x3, const [scalar\\_t](#) x4, const [scalar\\_t](#) x5, const [scalar\\_t](#) x6, const [scalar\\_t](#) x7, const [scalar\\_t](#) x8, const [scalar\\_t](#) x9, const [scalar\\_t](#) x10, const [scalar\\_t](#) x11, const [scalar\\_t](#) x12, const [scalar\\_t](#) x13, const [scalar\\_t](#) x14, const [scalar\\_t](#) x15)
- template<class T>
  - static [INLINE PURE vect\\_t gather](#) (const [scalar\\_t](#) \*const p, const T \*const idx)
- static [INLINE PURE vect\\_t load](#) (const [scalar\\_t](#) \*const p)
- static [INLINE PURE vect\\_t loadu](#) (const [scalar\\_t](#) \*const p)
- static [INLINE void store](#) ([scalar\\_t](#) \*p, [vect\\_t](#) v)
- static [INLINE void storeu](#) ([scalar\\_t](#) \*p, [vect\\_t](#) v)
- static [INLINE void stream](#) ([scalar\\_t](#) \*p, const [vect\\_t](#) v)
- template<int s>
  - static [INLINE CONST vect\\_t sll](#) (const [vect\\_t](#) a)
- template<int s>
  - static [INLINE CONST vect\\_t srl](#) (const [vect\\_t](#) a)
- template<int s>
  - static [INLINE CONST vect\\_t sra](#) (const [vect\\_t](#) a)
- template<uint64\_t s>
  - static [INLINE CONST vect\\_t shuffle](#) (const [vect\\_t](#) a)
- static [INLINE CONST vect\\_t unpacklo\\_intrinsic](#) (const [vect\\_t](#) a, const [vect\\_t](#) b)
- static [INLINE CONST vect\\_t unpackhi\\_intrinsic](#) (const [vect\\_t](#) a, const [vect\\_t](#) b)
- static [INLINE CONST vect\\_t unpacklo](#) (const [vect\\_t](#) a, const [vect\\_t](#) b)
- static [INLINE CONST vect\\_t unpackhi](#) (const [vect\\_t](#) a, const [vect\\_t](#) b)
- static [INLINE void unpacklohi](#) ([vect\\_t](#) &lo, [vect\\_t](#) &hi, const [vect\\_t](#) a, const [vect\\_t](#) b)
- static [INLINE CONST vect\\_t pack\\_even](#) (const [vect\\_t](#) a, const [vect\\_t](#) b)

- static `INLINE CONST vect_t pack_odd` (const `vect_t` a, const `vect_t` b)
- static `INLINE void pack` (`vect_t` &even, `vect_t` &odd, const `vect_t` a, const `vect_t` b)
- static `INLINE void transpose` (`vect_t` &r0, `vect_t` &r1, `vect_t` &r2, `vect_t` &r3, `vect_t` &r4, `vect_t` &r5, `vect_t` &r6, `vect_t` &r7, `vect_t` &r8, `vect_t` &r9, `vect_t` &r10, `vect_t` &r11, `vect_t` &r12, `vect_t` &r13, `vect_t` &r14, `vect_t` &r15)
- `template<uint16_t s, typename std::enable_if<(s & 0x00ff) == (s > > 8)>::type * = nullptr>`  
static `INLINE vect_t blend` (const `vect_t` a, const `vect_t` b)
- `template<uint16_t s, typename std::enable_if<(s & 0x00ff) != (s > > 8)>::type * = nullptr>`  
static `INLINE vect_t blend` (const `vect_t` a, const `vect_t` b)
- static `INLINE CONST vect_t add` (const `vect_t` a, const `vect_t` b)
- static `INLINE vect_t addin` (`vect_t` &a, const `vect_t` b)
- static `INLINE CONST vect_t sub` (const `vect_t` a, const `vect_t` b)
- static `INLINE vect_t subin` (`vect_t` &a, const `vect_t` b)
- static `INLINE CONST vect_t mullo` (const `vect_t` a, const `vect_t` b)
- static `INLINE CONST vect_t mul` (const `vect_t` a, const `vect_t` b)
- static `INLINE CONST vect_t mulhi` (const `vect_t` a, const `vect_t` b)
- static `INLINE CONST vect_t mulx` (`vect_t` a, `vect_t` b)
- static `INLINE CONST vect_t fmadd` (const `vect_t` c, const `vect_t` a, const `vect_t` b)
- static `INLINE vect_t fmaddin` (`vect_t` &c, const `vect_t` a, const `vect_t` b)
- static `INLINE CONST vect_t fmaddx` (const `vect_t` c, const `vect_t` a, const `vect_t` b)
- static `INLINE vect_t fmaddxin` (`vect_t` &c, const `vect_t` a, const `vect_t` b)
- static `INLINE CONST vect_t fnmadd` (const `vect_t` c, const `vect_t` a, const `vect_t` b)
- static `INLINE vect_t fnmaddin` (`vect_t` &c, const `vect_t` a, const `vect_t` b)
- static `INLINE CONST vect_t fnmaddx` (const `vect_t` c, const `vect_t` a, const `vect_t` b)
- static `INLINE vect_t fnmaddxin` (`vect_t` &c, const `vect_t` a, const `vect_t` b)
- static `INLINE CONST vect_t fmsub` (const `vect_t` c, const `vect_t` a, const `vect_t` b)
- static `INLINE vect_t fmsubin` (`vect_t` &c, const `vect_t` a, const `vect_t` b)
- static `INLINE CONST vect_t fmsubx` (const `vect_t` c, const `vect_t` a, const `vect_t` b)
- static `INLINE vect_t fmsubxin` (`vect_t` &c, const `vect_t` a, const `vect_t` b)
- static `INLINE CONST vect_t eq` (const `vect_t` a, const `vect_t` b)
- static `INLINE CONST vect_t greater` (const `vect_t` a, const `vect_t` b)
- static `INLINE CONST vect_t lesser` (const `vect_t` a, const `vect_t` b)
- static `INLINE CONST vect_t greater_eq` (const `vect_t` a, const `vect_t` b)
- static `INLINE CONST vect_t lesser_eq` (const `vect_t` a, const `vect_t` b)
- static `INLINE CONST scalar_t hadd_to_scal` (const `vect_t` a)
- static `INLINE CONST vect_t round` (const `vect_t` a)
- static `INLINE vect_t mod` (`vect_t` &C, const `vect_t` &P, const `vect_t` &INVP, const `vect_t` &NEGP, const `vect_t` &MIN, const `vect_t` &MAX, `vect_t` &Q, `vect_t` &T)
- static `INLINE CONST vect_t zero` ()

## Static Public Attributes

- static const constexpr size\_t `vect_size` = 16
- static const constexpr size\_t `alignment` = 32

## 12.299.1 Member Typedef Documentation

### 12.299.1.1 vect\_t

using `vect_t` = \_\_m256i

### 12.299.1.2 half\_t

using `half_t` = \_\_m128i

### 12.299.1.3 scalar\_t

using `scalar_t` = int16\_t

**12.299.1.4 simdHalf**

```
using simdHalf = Simd128<scalar_t>
```

**12.299.1.5 aligned\_allocator**

```
using aligned_allocator = AlignedAllocator<scalar_t, Alignment(alignment)>
```

**12.299.1.6 aligned\_vector**

```
using aligned_vector = std::vector<scalar_t, aligned_allocator>
```

**12.299.1.7 is\_same\_element**

```
template<class Field>
using is_same_element = std::is_same<typename Field::Element, scalar_t>
```

**12.299.2 Member Function Documentation****12.299.2.1 type\_string()**

```
static const std::string type_string () [inline], [static]
```

**12.299.2.2 valid()**

```
template<class T>
static constexpr bool valid (
    T * p) [inline], [static], [constexpr]
```

**12.299.2.3 compliant()**

```
template<class T>
static constexpr bool compliant (
    T n) [inline], [static], [constexpr]
```

**12.299.2.4 set1()**

```
static INLINE CONST vect_t set1 (
    const scalar_t x) [inline], [static]
```

**12.299.2.5 set()**

```
static INLINE CONST vect_t set (
    const scalar_t x0,
    const scalar_t x1,
    const scalar_t x2,
    const scalar_t x3,
    const scalar_t x4,
    const scalar_t x5,
    const scalar_t x6,
    const scalar_t x7,
    const scalar_t x8,
    const scalar_t x9,
    const scalar_t x10,
    const scalar_t x11,
    const scalar_t x12,
    const scalar_t x13,
    const scalar_t x14,
    const scalar_t x15) [inline], [static]
```

#### 12.299.2.6 gather()

```
template<class T>
static INLINE PURE vect_t gather (
    const scalar_t *const p,
    const T *const idx) [inline], [static]
```

#### 12.299.2.7 load()

```
static INLINE PURE vect_t load (
    const scalar_t *const p) [inline], [static]
```

#### 12.299.2.8 loadu()

```
static INLINE PURE vect_t loadu (
    const scalar_t *const p) [inline], [static]
```

#### 12.299.2.9 store()

```
static INLINE void store (
    scalar_t * p,
    vect_t v) [inline], [static]
```

#### 12.299.2.10 storeu()

```
static INLINE void storeu (
    scalar_t * p,
    vect_t v) [inline], [static]
```

#### 12.299.2.11 stream()

```
static INLINE void stream (
    scalar_t * p,
    const vect_t v) [inline], [static]
```

#### 12.299.2.12 sll()

```
template<int s>
static INLINE CONST vect_t sll (
    const vect_t a) [inline], [static]
```

#### 12.299.2.13 srl()

```
template<int s>
static INLINE CONST vect_t srl (
    const vect_t a) [inline], [static]
```

#### 12.299.2.14 sra()

```
template<int s>
static INLINE CONST vect_t sra (
    const vect_t a) [inline], [static]
```

#### 12.299.2.15 shuffle()

```
template<uint64_t s>
static INLINE CONST vect_t shuffle (
    const vect_t a) [inline], [static]
```

**12.299.2.16 unpacklo\_intrinsic()**

```
static INLINE CONST vect_t unpacklo_intrinsic (  
    const vect_t a,  
    const vect_t b) [inline], [static]
```

**12.299.2.17 unpackhi\_intrinsic()**

```
static INLINE CONST vect_t unpackhi_intrinsic (  
    const vect_t a,  
    const vect_t b) [inline], [static]
```

**12.299.2.18 unpacklo()**

```
static INLINE CONST vect_t unpacklo (  
    const vect_t a,  
    const vect_t b) [inline], [static]
```

**12.299.2.19 unpackhi()**

```
static INLINE CONST vect_t unpackhi (  
    const vect_t a,  
    const vect_t b) [inline], [static]
```

**12.299.2.20 unpacklohi()**

```
static INLINE void unpacklohi (  
    vect_t & lo,  
    vect_t & hi,  
    const vect_t a,  
    const vect_t b) [inline], [static]
```

**12.299.2.21 pack\_even()**

```
static INLINE CONST vect_t pack_even (  
    const vect_t a,  
    const vect_t b) [inline], [static]
```

**12.299.2.22 pack\_odd()**

```
static INLINE CONST vect_t pack_odd (  
    const vect_t a,  
    const vect_t b) [inline], [static]
```

**12.299.2.23 pack()**

```
static INLINE void pack (  
    vect_t & even,  
    vect_t & odd,  
    const vect_t a,  
    const vect_t b) [inline], [static]
```

**12.299.2.24 transpose()**

```
static INLINE void transpose (  
    vect_t & r0,  
    vect_t & r1,  
    vect_t & r2,  
    vect_t & r3,  
    vect_t & r4,
```

```

    vect_t & r5,
    vect_t & r6,
    vect_t & r7,
    vect_t & r8,
    vect_t & r9,
    vect_t & r10,
    vect_t & r11,
    vect_t & r12,
    vect_t & r13,
    vect_t & r14,
    vect_t & r15) [inline], [static]

```

#### 12.299.2.25 blend() [1/2]

```

template<uint16_t s, typename std::enable_if<(s &0x00ff)==(s > > 8)>::type * = nullptr>
static INLINE vect_t blend (
    const vect_t a,
    const vect_t b) [inline], [static]

```

#### 12.299.2.26 blend() [2/2]

```

template<uint16_t s, typename std::enable_if<(s &0x00ff) !=(s > > 8)>::type * = nullptr>
static INLINE vect_t blend (
    const vect_t a,
    const vect_t b) [inline], [static]

```

#### 12.299.2.27 add()

```

static INLINE CONST vect_t add (
    const vect_t a,
    const vect_t b) [inline], [static]

```

#### 12.299.2.28 addin()

```

static INLINE vect_t addin (
    vect_t & a,
    const vect_t b) [inline], [static]

```

#### 12.299.2.29 sub()

```

static INLINE CONST vect_t sub (
    const vect_t a,
    const vect_t b) [inline], [static]

```

#### 12.299.2.30 subin()

```

static INLINE vect_t subin (
    vect_t & a,
    const vect_t b) [inline], [static]

```

#### 12.299.2.31 mullo()

```

static INLINE CONST vect_t mullo (
    const vect_t a,
    const vect_t b) [inline], [static]

```



**12.299.2.32 mul()**

```
static INLINE CONST vect_t mul (  
    const vect_t a,  
    const vect_t b) [inline], [static]
```

**12.299.2.33 mulhi()**

```
static INLINE CONST vect_t mulhi (  
    const vect_t a,  
    const vect_t b) [inline], [static]
```

**12.299.2.34 mulx()**

```
static INLINE CONST vect_t mulx (  
    vect_t a,  
    vect_t b) [inline], [static]
```

**12.299.2.35 fmadd()**

```
static INLINE CONST vect_t fmadd (  
    const vect_t c,  
    const vect_t a,  
    const vect_t b) [inline], [static]
```

**12.299.2.36 fmaddin()**

```
static INLINE vect_t fmaddin (  
    vect_t & c,  
    const vect_t a,  
    const vect_t b) [inline], [static]
```

**12.299.2.37 fmaddx()**

```
static INLINE CONST vect_t fmaddx (  
    const vect_t c,  
    const vect_t a,  
    const vect_t b) [inline], [static]
```

**12.299.2.38 fmaddxin()**

```
static INLINE vect_t fmaddxin (  
    vect_t & c,  
    const vect_t a,  
    const vect_t b) [inline], [static]
```

**12.299.2.39 fnmadd()**

```
static INLINE CONST vect_t fnmadd (  
    const vect_t c,  
    const vect_t a,  
    const vect_t b) [inline], [static]
```

**12.299.2.40 fnmaddin()**

```
static INLINE vect_t fnmaddin (  
    vect_t & c,  
    const vect_t a,  
    const vect_t b) [inline], [static]
```

**12.299.2.41 fnmaddx()**

```
static INLINE CONST vect_t fnmaddx (  
    const vect_t c,  
    const vect_t a,  
    const vect_t b) [inline], [static]
```

**12.299.2.42 fnmaddxin()**

```
static INLINE vect_t fnmaddxin (  
    vect_t & c,  
    const vect_t a,  
    const vect_t b) [inline], [static]
```

**12.299.2.43 fmsub()**

```
static INLINE CONST vect_t fmsub (  
    const vect_t c,  
    const vect_t a,  
    const vect_t b) [inline], [static]
```

**12.299.2.44 fmsubin()**

```
static INLINE vect_t fmsubin (  
    vect_t & c,  
    const vect_t a,  
    const vect_t b) [inline], [static]
```

**12.299.2.45 fmsubx()**

```
static INLINE CONST vect_t fmsubx (  
    const vect_t c,  
    const vect_t a,  
    const vect_t b) [inline], [static]
```

**12.299.2.46 fmsubxin()**

```
static INLINE vect_t fmsubxin (  
    vect_t & c,  
    const vect_t a,  
    const vect_t b) [inline], [static]
```

**12.299.2.47 eq()**

```
static INLINE CONST vect_t eq (  
    const vect_t a,  
    const vect_t b) [inline], [static]
```

**12.299.2.48 greater()**

```
static INLINE CONST vect_t greater (  
    const vect_t a,  
    const vect_t b) [inline], [static]
```

**12.299.2.49 lesser()**

```
static INLINE CONST vect_t lesser (  
    const vect_t a,  
    const vect_t b) [inline], [static]
```

**12.299.2.50 greater\_eq()**

```
static INLINE CONST vect_t greater_eq (
    const vect_t a,
    const vect_t b) [inline], [static]
```

**12.299.2.51 lesser\_eq()**

```
static INLINE CONST vect_t lesser_eq (
    const vect_t a,
    const vect_t b) [inline], [static]
```

**12.299.2.52 hadd\_to\_scal()**

```
static INLINE CONST scalar_t hadd_to_scal (
    const vect_t a) [inline], [static]
```

**12.299.2.53 round()**

```
static INLINE CONST vect_t round (
    const vect_t a) [inline], [static]
```

**12.299.2.54 mod()**

```
static INLINE vect_t mod (
    vect_t & C,
    const vect_t & P,
    const vect_t & INVP,
    const vect_t & NEGP,
    const vect_t & MIN,
    const vect_t & MAX,
    vect_t & Q,
    vect_t & T) [inline], [static]
```

**12.299.2.55 zero()**

```
static INLINE CONST vect_t zero () [inline], [static], [inherited]
```

**12.299.3 Field Documentation****12.299.3.1 vect\_size**

```
const constexpr size_t vect_size = 16 [static], [constexpr]
```

**12.299.3.2 alignment**

```
const constexpr size_t alignment = 32 [static], [constexpr]
```

The documentation for this struct was generated from the following file:

- [simd256\\_int16.inl](#)

**12.300 Simd256\_impl< true, true, true, 4 > Struct Reference**

Inheritance diagram for Simd256\_impl< true, true, true, 4 >:



## Data Structures

- union [Converter](#)

## Public Types

- using [vect\\_t](#) = \_\_m256i
- using [half\\_t](#) = \_\_m128i
- using [scalar\\_t](#) = int32\_t
- using [simdHalf](#) = [Simd128](#)<[scalar\\_t](#)>
- using [aligned\\_allocator](#) = [AlignedAllocator](#)<[scalar\\_t](#), [Alignment](#)([alignment](#))>
- using [aligned\\_vector](#) = std::vector<[scalar\\_t](#), [aligned\\_allocator](#)>
- template<class [Field](#)>
  - using [is\\_same\\_element](#) = std::is\_same<typename [Field](#)::Element, [scalar\\_t](#)>
- using [vect\\_t](#) = \_\_m512i
- using [half\\_t](#) = \_\_m256i
- using [scalar\\_t](#) = int32\_t
- using [simdHalf](#) = [Simd256](#)<[scalar\\_t](#)>
- using [aligned\\_allocator](#) = [AlignedAllocator](#)<[scalar\\_t](#), [Alignment](#)([alignment](#))>
- using [aligned\\_vector](#) = std::vector<[scalar\\_t](#), [aligned\\_allocator](#)>
- template<class [Field](#)>
  - using [is\\_same\\_element](#) = std::is\_same<typename [Field](#)::Element, [scalar\\_t](#)>

## Static Public Member Functions

- static const std::string [type\\_string](#) ()
- template<class T>
  - static constexpr bool [valid](#) (T \*p)
- template<class T>
  - static constexpr bool [compliant](#) (T n)
- static [INLINE CONST](#) [vect\\_t set1](#) (const [scalar\\_t](#) x)
- static [INLINE CONST](#) [vect\\_t set](#) (const [scalar\\_t](#) x0, const [scalar\\_t](#) x1, const [scalar\\_t](#) x2, const [scalar\\_t](#) x3, const [scalar\\_t](#) x4, const [scalar\\_t](#) x5, const [scalar\\_t](#) x6, const [scalar\\_t](#) x7)
- template<class T>
  - static [INLINE PURE](#) [vect\\_t gather](#) (const [scalar\\_t](#) \*const p, const T \*const idx)
- static [INLINE PURE](#) [vect\\_t load](#) (const [scalar\\_t](#) \*const p)
- static [INLINE PURE](#) [vect\\_t loadu](#) (const [scalar\\_t](#) \*const p)
- static [INLINE](#) void [store](#) ([scalar\\_t](#) \*p, [vect\\_t](#) v)
- static [INLINE](#) void [storeu](#) ([scalar\\_t](#) \*p, [vect\\_t](#) v)
- static [INLINE](#) void [stream](#) ([scalar\\_t](#) \*p, const [vect\\_t](#) v)
- template<int s>
  - static [INLINE CONST](#) [vect\\_t sll](#) (const [vect\\_t](#) a)
- template<int s>
  - static [INLINE CONST](#) [vect\\_t srl](#) (const [vect\\_t](#) a)
- template<int s>
  - static [INLINE CONST](#) [vect\\_t sra](#) (const [vect\\_t](#) a)
- template<uint8\_t s>
  - static [INLINE CONST](#) [vect\\_t shuffle\\_twice](#) (const [vect\\_t](#) a)

- template<uint32\_t s>
  - static **INLINE CONST** vect\_t shuffle (const vect\_t a)
- static **INLINE CONST** vect\_t unpacklo\_intrinsic (const vect\_t a, const vect\_t b)
- static **INLINE CONST** vect\_t unpackhi\_intrinsic (const vect\_t a, const vect\_t b)
- static **INLINE CONST** vect\_t unpacklo (const vect\_t a, const vect\_t b)
- static **INLINE CONST** vect\_t unpackhi (const vect\_t a, const vect\_t b)
- static **INLINE** void unpacklohi (vect\_t &lo, vect\_t &hi, const vect\_t a, const vect\_t b)
- static **INLINE CONST** vect\_t pack\_even (const vect\_t a, const vect\_t b)
- static **INLINE CONST** vect\_t pack\_odd (const vect\_t a, const vect\_t b)
- static **INLINE** void pack (vect\_t &even, vect\_t &odd, const vect\_t a, const vect\_t b)
- static **INLINE** void transpose (vect\_t &r0, vect\_t &r1, vect\_t &r2, vect\_t &r3, vect\_t &r4, vect\_t &r5, vect\_t &r6, vect\_t &r7)
- template<uint8\_t s>
  - static **INLINE CONST** vect\_t blend (const vect\_t a, const vect\_t b)
  - static **INLINE CONST** vect\_t add (const vect\_t a, const vect\_t b)
  - static **INLINE** vect\_t addin (vect\_t &a, const vect\_t b)
  - static **INLINE CONST** vect\_t sub (const vect\_t a, const vect\_t b)
  - static **INLINE** vect\_t subin (vect\_t &a, const vect\_t b)
  - static **INLINE CONST** vect\_t mullo (const vect\_t a, const vect\_t b)
  - static **INLINE CONST** vect\_t mul (const vect\_t a, const vect\_t b)
  - static **INLINE CONST** vect\_t mulhi (const vect\_t a, const vect\_t b)
  - static **INLINE CONST** vect\_t mulx (vect\_t a, vect\_t b)
  - static **INLINE CONST** vect\_t fmadd (const vect\_t c, const vect\_t a, const vect\_t b)
  - static **INLINE** vect\_t fmadin (vect\_t &c, const vect\_t a, const vect\_t b)
  - static **INLINE CONST** vect\_t fmadx (const vect\_t c, const vect\_t a, const vect\_t b)
  - static **INLINE** vect\_t fmadxin (vect\_t &c, const vect\_t a, const vect\_t b)
  - static **INLINE CONST** vect\_t fnmadd (const vect\_t c, const vect\_t a, const vect\_t b)
  - static **INLINE** vect\_t fnmadin (vect\_t &c, const vect\_t a, const vect\_t b)
  - static **INLINE CONST** vect\_t fnmaddx (const vect\_t c, const vect\_t a, const vect\_t b)
  - static **INLINE** vect\_t fnmaddxin (vect\_t &c, const vect\_t a, const vect\_t b)
  - static **INLINE CONST** vect\_t fmsub (const vect\_t c, const vect\_t a, const vect\_t b)
  - static **INLINE** vect\_t fmsubin (vect\_t &c, const vect\_t a, const vect\_t b)
  - static **INLINE CONST** vect\_t fmsubx (const vect\_t c, const vect\_t a, const vect\_t b)
  - static **INLINE** vect\_t fmsubxin (vect\_t &c, const vect\_t a, const vect\_t b)
  - static **INLINE CONST** vect\_t eq (const vect\_t a, const vect\_t b)
  - static **INLINE CONST** vect\_t greater (const vect\_t a, const vect\_t b)
  - static **INLINE CONST** vect\_t lesser (const vect\_t a, const vect\_t b)
  - static **INLINE CONST** vect\_t greater\_eq (const vect\_t a, const vect\_t b)
  - static **INLINE CONST** vect\_t lesser\_eq (const vect\_t a, const vect\_t b)
  - static **INLINE CONST** scalar\_t hadd\_to\_scal (const vect\_t a)
  - static **INLINE CONST** vect\_t round (const vect\_t a)
  - static **INLINE** vect\_t mod (vect\_t &C, const vect\_t &P, const vect\_t &INVP, const vect\_t &NEGP, const vect\_t &MIN, const vect\_t &MAX, vect\_t &Q, vect\_t &T)
  - static const std::string type\_string ()
- template<class T>
  - static constexpr bool valid (T \*p)
- template<class T>
  - static constexpr bool compliant (T n)
- static **INLINE CONST** vect\_t set1 (const scalar\_t x)
- static **INLINE CONST** vect\_t set (const scalar\_t x0, const scalar\_t x1, const scalar\_t x2, const scalar\_t x3, const scalar\_t x4, const scalar\_t x5, const scalar\_t x6, const scalar\_t x7, const scalar\_t x8, const scalar\_t x9, const scalar\_t x10, const scalar\_t x11, const scalar\_t x12, const scalar\_t x13, const scalar\_t x14, const scalar\_t x15)
- template<class T>
  - static **INLINE PURE** vect\_t gather (const scalar\_t \*const p, const T \*const idx)

- static `INLINE PURE vect_t load` (const `scalar_t` \*const p)
- static `INLINE PURE vect_t loadu` (const `scalar_t` \*const p)
- static `INLINE void store` (`scalar_t` \*p, `vect_t` v)
- static `INLINE void storeu` (`scalar_t` \*p, `vect_t` v)
- static `INLINE void stream` (`scalar_t` \*p, const `vect_t` v)
- template<int s>  
static `INLINE CONST vect_t sll` (const `vect_t` a)
- template<int s>  
static `INLINE CONST vect_t srl` (const `vect_t` a)
- template<int s>  
static `INLINE CONST vect_t sra` (const `vect_t` a)
- template<uint8\_t s>  
static `INLINE CONST vect_t shuffle_twice` (const `vect_t` a)
- template<uint64\_t s>  
static `INLINE CONST vect_t shuffle` (const `vect_t` a)
- static `INLINE CONST vect_t unpacklo_intrinsic` (const `vect_t` a, const `vect_t` b)
- static `INLINE CONST vect_t unpackhi_intrinsic` (const `vect_t` a, const `vect_t` b)
- static `INLINE CONST vect_t unpacklo` (const `vect_t` a, const `vect_t` b)
- static `INLINE CONST vect_t unpackhi` (const `vect_t` a, const `vect_t` b)
- static `INLINE void unpacklohi` (`vect_t` &lo, `vect_t` &hi, const `vect_t` a, const `vect_t` b)
- static `INLINE CONST vect_t pack_even` (const `vect_t` a, const `vect_t` b)
- static `INLINE CONST vect_t pack_odd` (const `vect_t` a, const `vect_t` b)
- static `INLINE void pack` (`vect_t` &even, `vect_t` &odd, const `vect_t` a, const `vect_t` b)
- static `INLINE void transpose` (`vect_t` &r0, `vect_t` &r1, `vect_t` &r2, `vect_t` &r3, `vect_t` &r4, `vect_t` &r5, `vect_t` &r6, `vect_t` &r7, `vect_t` &r8, `vect_t` &r9, `vect_t` &r10, `vect_t` &r11, `vect_t` &r12, `vect_t` &r13, `vect_t` &r14, `vect_t` &r15)
- template<uint16\_t s>  
static `INLINE CONST vect_t blend` (const `vect_t` a, const `vect_t` b)
- static `INLINE CONST vect_t add` (const `vect_t` a, const `vect_t` b)
- static `INLINE vect_t addin` (`vect_t` &a, const `vect_t` b)
- static `INLINE CONST vect_t sub` (const `vect_t` a, const `vect_t` b)
- static `INLINE vect_t subin` (`vect_t` &a, const `vect_t` b)
- static `INLINE CONST vect_t mullo` (const `vect_t` a, const `vect_t` b)
- static `INLINE CONST vect_t mul` (const `vect_t` a, const `vect_t` b)
- static `INLINE CONST vect_t mulhi` (const `vect_t` a, const `vect_t` b)
- static `INLINE CONST vect_t mulx` (`vect_t` a, `vect_t` b)
- static `INLINE CONST vect_t fmadd` (const `vect_t` c, const `vect_t` a, const `vect_t` b)
- static `INLINE vect_t fmaddin` (`vect_t` &c, const `vect_t` a, const `vect_t` b)
- static `INLINE CONST vect_t fmadddx` (const `vect_t` c, const `vect_t` a, const `vect_t` b)
- static `INLINE vect_t fmadddxin` (`vect_t` &c, const `vect_t` a, const `vect_t` b)
- static `INLINE CONST vect_t fnmadd` (const `vect_t` c, const `vect_t` a, const `vect_t` b)
- static `INLINE vect_t fnmaddin` (`vect_t` &c, const `vect_t` a, const `vect_t` b)
- static `INLINE CONST vect_t fnmaddx` (const `vect_t` c, const `vect_t` a, const `vect_t` b)
- static `INLINE vect_t fnmaddxin` (`vect_t` &c, const `vect_t` a, const `vect_t` b)
- static `INLINE CONST vect_t fmsub` (const `vect_t` c, const `vect_t` a, const `vect_t` b)
- static `INLINE vect_t fmsubin` (`vect_t` &c, const `vect_t` a, const `vect_t` b)
- static `INLINE CONST vect_t fmsubx` (const `vect_t` c, const `vect_t` a, const `vect_t` b)
- static `INLINE vect_t fmsubxin` (`vect_t` &c, const `vect_t` a, const `vect_t` b)
- static `INLINE CONST vect_t eq` (const `vect_t` a, const `vect_t` b)
- static `INLINE CONST vect_t greater` (const `vect_t` a, const `vect_t` b)
- static `INLINE CONST vect_t lesser` (const `vect_t` a, const `vect_t` b)
- static `INLINE CONST vect_t greater_eq` (const `vect_t` a, const `vect_t` b)
- static `INLINE CONST vect_t lesser_eq` (const `vect_t` a, const `vect_t` b)
- static `INLINE CONST scalar_t hadd_to_scal` (const `vect_t` a)
- static `INLINE CONST vect_t round` (const `vect_t` a)

- static `INLINE vect_t mod (vect_t &C, const vect_t &P, const vect_t &INVP, const vect_t &NEGP, const vect_t &MIN, const vect_t &MAX, vect_t &Q, vect_t &T)`
- static `INLINE CONST vect_t zero ()`
- static `INLINE CONST vect_t zero ()`
- static `INLINE CONST vect_t vor (const vect_t a, const vect_t b)`
- static `INLINE CONST vect_t vxor (const vect_t a, const vect_t b)`
- static `INLINE CONST vect_t vand (const vect_t a, const vect_t b)`
- static `INLINE CONST vect_t vandnot (const vect_t a, const vect_t b)`

### Static Public Attributes

- static const constexpr size\_t `vect_size` = 8
- static const constexpr size\_t `alignment` = 32

## 12.300.1 Member Typedef Documentation

### 12.300.1.1 vect\_t [1/2]

```
using vect_t = __m256i
```

### 12.300.1.2 half\_t [1/2]

```
using half_t = __m128i
```

### 12.300.1.3 scalar\_t [1/2]

```
using scalar_t = int32_t
```

### 12.300.1.4 simdHalf [1/2]

```
using simdHalf = Simd128<scalar_t>
```

### 12.300.1.5 aligned\_allocator [1/2]

```
using aligned_allocator = AlignedAllocator<scalar_t, Alignment(alignment)>
```

### 12.300.1.6 aligned\_vector [1/2]

```
using aligned_vector = std::vector<scalar_t, aligned_allocator>
```

### 12.300.1.7 is\_same\_element [1/2]

```
template<class Field>
using is_same_element = std::is_same<typename Field::Element, scalar_t>
```

### 12.300.1.8 vect\_t [2/2]

```
using vect_t = __m512i
```

### 12.300.1.9 half\_t [2/2]

```
using half_t = __m256i
```

### 12.300.1.10 scalar\_t [2/2]

```
using scalar_t = int32_t
```

### 12.300.1.11 simdHalf [2/2]

```
using simdHalf = Simd256<scalar_t>
```

**12.300.1.12 aligned\_allocator [2/2]**

```
using aligned_allocator = AlignedAllocator<scalar_t, Alignment(alignment)>
```

**12.300.1.13 aligned\_vector [2/2]**

```
using aligned_vector = std::vector<scalar_t, aligned_allocator>
```

**12.300.1.14 is\_same\_element [2/2]**

```
template<class Field>
using is_same_element = std::is_same<typename Field::Element, scalar_t>
```

**12.300.2 Member Function Documentation****12.300.2.1 type\_string() [1/2]**

```
static const std::string type_string () [inline], [static]
```

**12.300.2.2 valid() [1/2]**

```
template<class T>
static constexpr bool valid (
    T * p) [inline], [static], [constexpr]
```

**12.300.2.3 compliant() [1/2]**

```
template<class T>
static constexpr bool compliant (
    T n) [inline], [static], [constexpr]
```

**12.300.2.4 set1() [1/2]**

```
static INLINE CONST vect_t set1 (
    const scalar_t x) [inline], [static]
```

**12.300.2.5 set() [1/2]**

```
static INLINE CONST vect_t set (
    const scalar_t x0,
    const scalar_t x1,
    const scalar_t x2,
    const scalar_t x3,
    const scalar_t x4,
    const scalar_t x5,
    const scalar_t x6,
    const scalar_t x7) [inline], [static]
```

**12.300.2.6 gather() [1/2]**

```
template<class T>
static INLINE PURE vect_t gather (
    const scalar_t *const p,
    const T *const idx) [inline], [static]
```

**12.300.2.7 load() [1/2]**

```
static INLINE PURE vect_t load (
    const scalar_t *const p) [inline], [static]
```



**12.300.2.8 loadu() [1/2]**

```
static INLINE PURE vect_t loadu (  
    const scalar_t *const p) [inline], [static]
```

**12.300.2.9 store() [1/2]**

```
static INLINE void store (  
    scalar_t * p,  
    vect_t v) [inline], [static]
```

**12.300.2.10 storeu() [1/2]**

```
static INLINE void storeu (  
    scalar_t * p,  
    vect_t v) [inline], [static]
```

**12.300.2.11 stream() [1/2]**

```
static INLINE void stream (  
    scalar_t * p,  
    const vect_t v) [inline], [static]
```

**12.300.2.12 sll() [1/2]**

```
template<int s>  
static INLINE CONST vect_t sll (  
    const vect_t a) [inline], [static]
```

**12.300.2.13 srl() [1/2]**

```
template<int s>  
static INLINE CONST vect_t srl (  
    const vect_t a) [inline], [static]
```

**12.300.2.14 sra() [1/2]**

```
template<int s>  
static INLINE CONST vect_t sra (  
    const vect_t a) [inline], [static]
```

**12.300.2.15 shuffle\_twice() [1/2]**

```
template<uint8_t s>  
static INLINE CONST vect_t shuffle_twice (  
    const vect_t a) [inline], [static]
```

**12.300.2.16 shuffle() [1/2]**

```
template<uint32_t s>  
static INLINE CONST vect_t shuffle (  
    const vect_t a) [inline], [static]
```

**12.300.2.17 unpacklo\_intrinsic() [1/2]**

```
static INLINE CONST vect_t unpacklo_intrinsic (  
    const vect_t a,  
    const vect_t b) [inline], [static]
```

**12.300.2.18 unpackhi\_intrinsic() [1/2]**

```
static INLINE CONST vect_t unpackhi_intrinsic (  
    const vect_t a,  
    const vect_t b) [inline], [static]
```

**12.300.2.19 unpacklo() [1/2]**

```
static INLINE CONST vect_t unpacklo (  
    const vect_t a,  
    const vect_t b) [inline], [static]
```

**12.300.2.20 unpackhi() [1/2]**

```
static INLINE CONST vect_t unpackhi (  
    const vect_t a,  
    const vect_t b) [inline], [static]
```

**12.300.2.21 unpacklohi() [1/2]**

```
static INLINE void unpacklohi (  
    vect_t & lo,  
    vect_t & hi,  
    const vect_t a,  
    const vect_t b) [inline], [static]
```

**12.300.2.22 pack\_even() [1/2]**

```
static INLINE CONST vect_t pack_even (  
    const vect_t a,  
    const vect_t b) [inline], [static]
```

**12.300.2.23 pack\_odd() [1/2]**

```
static INLINE CONST vect_t pack_odd (  
    const vect_t a,  
    const vect_t b) [inline], [static]
```

**12.300.2.24 pack() [1/2]**

```
static INLINE void pack (  
    vect_t & even,  
    vect_t & odd,  
    const vect_t a,  
    const vect_t b) [inline], [static]
```

**12.300.2.25 transpose() [1/2]**

```
static INLINE void transpose (  
    vect_t & r0,  
    vect_t & r1,  
    vect_t & r2,  
    vect_t & r3,  
    vect_t & r4,  
    vect_t & r5,  
    vect_t & r6,  
    vect_t & r7) [inline], [static]
```

**12.300.2.26 blend()** [1/2]

```
template<uint8_t s>
static INLINE CONST vect_t blend (
    const vect_t a,
    const vect_t b)  [inline], [static]
```

**12.300.2.27 add()** [1/2]

```
static INLINE CONST vect_t add (
    const vect_t a,
    const vect_t b)  [inline], [static]
```

**12.300.2.28 addin()** [1/2]

```
static INLINE vect_t addin (
    vect_t & a,
    const vect_t b)  [inline], [static]
```

**12.300.2.29 sub()** [1/2]

```
static INLINE CONST vect_t sub (
    const vect_t a,
    const vect_t b)  [inline], [static]
```

**12.300.2.30 subin()** [1/2]

```
static INLINE vect_t subin (
    vect_t & a,
    const vect_t b)  [inline], [static]
```

**12.300.2.31 mullo()** [1/2]

```
static INLINE CONST vect_t mullo (
    const vect_t a,
    const vect_t b)  [inline], [static]
```

**12.300.2.32 mul()** [1/2]

```
static INLINE CONST vect_t mul (
    const vect_t a,
    const vect_t b)  [inline], [static]
```

**12.300.2.33 mulhi()** [1/2]

```
static INLINE CONST vect_t mulhi (
    const vect_t a,
    const vect_t b)  [inline], [static]
```

**12.300.2.34 mulx()** [1/2]

```
static INLINE CONST vect_t mulx (
    vect_t a,
    vect_t b)  [inline], [static]
```

**12.300.2.35 fmadd()** [1/2]

```
static INLINE CONST vect_t fmadd (
    const vect_t c,
    const vect_t a,
    const vect_t b)  [inline], [static]
```

**12.300.2.36 fmaddin()** [1/2]

```
static INLINE vect_t fmaddin (  
    vect_t & c,  
    const vect_t a,  
    const vect_t b) [inline], [static]
```

**12.300.2.37 fmaddx()** [1/2]

```
static INLINE CONST vect_t fmaddx (  
    const vect_t c,  
    const vect_t a,  
    const vect_t b) [inline], [static]
```

**12.300.2.38 fmaddxin()** [1/2]

```
static INLINE vect_t fmaddxin (  
    vect_t & c,  
    const vect_t a,  
    const vect_t b) [inline], [static]
```

**12.300.2.39 fnmadd()** [1/2]

```
static INLINE CONST vect_t fnmadd (  
    const vect_t c,  
    const vect_t a,  
    const vect_t b) [inline], [static]
```

**12.300.2.40 fnmaddin()** [1/2]

```
static INLINE vect_t fnmaddin (  
    vect_t & c,  
    const vect_t a,  
    const vect_t b) [inline], [static]
```

**12.300.2.41 fnmaddx()** [1/2]

```
static INLINE CONST vect_t fnmaddx (  
    const vect_t c,  
    const vect_t a,  
    const vect_t b) [inline], [static]
```

**12.300.2.42 fnmaddxin()** [1/2]

```
static INLINE vect_t fnmaddxin (  
    vect_t & c,  
    const vect_t a,  
    const vect_t b) [inline], [static]
```

**12.300.2.43 fmsub()** [1/2]

```
static INLINE CONST vect_t fmsub (  
    const vect_t c,  
    const vect_t a,  
    const vect_t b) [inline], [static]
```

**12.300.2.44 fmsubin()** [1/2]

```
static INLINE vect_t fmsubin (  
    vect_t & c,
```

```
const vect_t a,  
const vect_t b) [inline], [static]
```

#### 12.300.2.45 fmsubx() [1/2]

```
static INLINE CONST vect_t fmsubx (  
    const vect_t c,  
    const vect_t a,  
    const vect_t b) [inline], [static]
```

#### 12.300.2.46 fmsubxin() [1/2]

```
static INLINE vect_t fmsubxin (  
    vect_t & c,  
    const vect_t a,  
    const vect_t b) [inline], [static]
```

#### 12.300.2.47 eq() [1/2]

```
static INLINE CONST vect_t eq (  
    const vect_t a,  
    const vect_t b) [inline], [static]
```

#### 12.300.2.48 greater() [1/2]

```
static INLINE CONST vect_t greater (  
    const vect_t a,  
    const vect_t b) [inline], [static]
```

#### 12.300.2.49 lesser() [1/2]

```
static INLINE CONST vect_t lesser (  
    const vect_t a,  
    const vect_t b) [inline], [static]
```

#### 12.300.2.50 greater\_eq() [1/2]

```
static INLINE CONST vect_t greater_eq (  
    const vect_t a,  
    const vect_t b) [inline], [static]
```

#### 12.300.2.51 lesser\_eq() [1/2]

```
static INLINE CONST vect_t lesser_eq (  
    const vect_t a,  
    const vect_t b) [inline], [static]
```

#### 12.300.2.52 hadd\_to\_scal() [1/2]

```
static INLINE CONST scalar_t hadd_to_scal (  
    const vect_t a) [inline], [static]
```

#### 12.300.2.53 round() [1/2]

```
static INLINE CONST vect_t round (  
    const vect_t a) [inline], [static]
```

**12.300.2.54 mod()** [1/2]

```
static INLINE vect_t mod (
    vect_t & C,
    const vect_t & P,
    const vect_t & INVP,
    const vect_t & NEGP,
    const vect_t & MIN,
    const vect_t & MAX,
    vect_t & Q,
    vect_t & T) [inline], [static]
```

**12.300.2.55 type\_string()** [2/2]

```
static const std::string type_string () [inline], [static]
```

**12.300.2.56 valid()** [2/2]

```
template<class T>
static constexpr bool valid (
    T * p) [inline], [static], [constexpr]
```

**12.300.2.57 compliant()** [2/2]

```
template<class T>
static constexpr bool compliant (
    T n) [inline], [static], [constexpr]
```

**12.300.2.58 set1()** [2/2]

```
static INLINE CONST vect_t set1 (
    const scalar_t x) [inline], [static]
```

**12.300.2.59 set()** [2/2]

```
static INLINE CONST vect_t set (
    const scalar_t x0,
    const scalar_t x1,
    const scalar_t x2,
    const scalar_t x3,
    const scalar_t x4,
    const scalar_t x5,
    const scalar_t x6,
    const scalar_t x7,
    const scalar_t x8,
    const scalar_t x9,
    const scalar_t x10,
    const scalar_t x11,
    const scalar_t x12,
    const scalar_t x13,
    const scalar_t x14,
    const scalar_t x15) [inline], [static]
```

**12.300.2.60 gather()** [2/2]

```
template<class T>
static INLINE PURE vect_t gather (
    const scalar_t *const p,
    const T *const idx) [inline], [static]
```

**12.300.2.61 load()** [2/2]

```
static INLINE PURE vect_t load (  
    const scalar_t *const p) [inline], [static]
```

**12.300.2.62 loadu()** [2/2]

```
static INLINE PURE vect_t loadu (  
    const scalar_t *const p) [inline], [static]
```

**12.300.2.63 store()** [2/2]

```
static INLINE void store (  
    scalar_t * p,  
    vect_t v) [inline], [static]
```

**12.300.2.64 storeu()** [2/2]

```
static INLINE void storeu (  
    scalar_t * p,  
    vect_t v) [inline], [static]
```

**12.300.2.65 stream()** [2/2]

```
static INLINE void stream (  
    scalar_t * p,  
    const vect_t v) [inline], [static]
```

**12.300.2.66 sll()** [2/2]

```
template<int s>  
static INLINE CONST vect_t sll (  
    const vect_t a) [inline], [static]
```

**12.300.2.67 srl()** [2/2]

```
template<int s>  
static INLINE CONST vect_t srl (  
    const vect_t a) [inline], [static]
```

**12.300.2.68 sra()** [2/2]

```
template<int s>  
static INLINE CONST vect_t sra (  
    const vect_t a) [inline], [static]
```

**12.300.2.69 shuffle\_twice()** [2/2]

```
template<uint8_t s>  
static INLINE CONST vect_t shuffle_twice (  
    const vect_t a) [inline], [static]
```

**12.300.2.70 shuffle()** [2/2]

```
template<uint64_t s>  
static INLINE CONST vect_t shuffle (  
    const vect_t a) [inline], [static]
```

**12.300.2.71 unpacklo\_intrinsic() [2/2]**

```
static INLINE CONST vect_t unpacklo_intrinsic (  
    const vect_t a,  
    const vect_t b) [inline], [static]
```

**12.300.2.72 unpackhi\_intrinsic() [2/2]**

```
static INLINE CONST vect_t unpackhi_intrinsic (  
    const vect_t a,  
    const vect_t b) [inline], [static]
```

**12.300.2.73 unpacklo() [2/2]**

```
static INLINE CONST vect_t unpacklo (  
    const vect_t a,  
    const vect_t b) [inline], [static]
```

**12.300.2.74 unpackhi() [2/2]**

```
static INLINE CONST vect_t unpackhi (  
    const vect_t a,  
    const vect_t b) [inline], [static]
```

**12.300.2.75 unpacklohi() [2/2]**

```
static INLINE void unpacklohi (  
    vect_t & lo,  
    vect_t & hi,  
    const vect_t a,  
    const vect_t b) [inline], [static]
```

**12.300.2.76 pack\_even() [2/2]**

```
static INLINE CONST vect_t pack_even (  
    const vect_t a,  
    const vect_t b) [inline], [static]
```

**12.300.2.77 pack\_odd() [2/2]**

```
static INLINE CONST vect_t pack_odd (  
    const vect_t a,  
    const vect_t b) [inline], [static]
```

**12.300.2.78 pack() [2/2]**

```
static INLINE void pack (  
    vect_t & even,  
    vect_t & odd,  
    const vect_t a,  
    const vect_t b) [inline], [static]
```

**12.300.2.79 transpose() [2/2]**

```
static INLINE void transpose (  
    vect_t & r0,  
    vect_t & r1,  
    vect_t & r2,  
    vect_t & r3,  
    vect_t & r4,
```



```
vect_t & r5,  
vect_t & r6,  
vect_t & r7,  
vect_t & r8,  
vect_t & r9,  
vect_t & r10,  
vect_t & r11,  
vect_t & r12,  
vect_t & r13,  
vect_t & r14,  
vect_t & r15) [inline], [static]
```

#### 12.300.2.80 blend() [2/2]

```
template<uint16_t s>  
static INLINE CONST vect_t blend (  
    const vect_t a,  
    const vect_t b) [inline], [static]
```

#### 12.300.2.81 add() [2/2]

```
static INLINE CONST vect_t add (  
    const vect_t a,  
    const vect_t b) [inline], [static]
```

#### 12.300.2.82 addin() [2/2]

```
static INLINE vect_t addin (  
    vect_t & a,  
    const vect_t b) [inline], [static]
```

#### 12.300.2.83 sub() [2/2]

```
static INLINE CONST vect_t sub (  
    const vect_t a,  
    const vect_t b) [inline], [static]
```

#### 12.300.2.84 subin() [2/2]

```
static INLINE vect_t subin (  
    vect_t & a,  
    const vect_t b) [inline], [static]
```

#### 12.300.2.85 mullo() [2/2]

```
static INLINE CONST vect_t mullo (  
    const vect_t a,  
    const vect_t b) [inline], [static]
```

#### 12.300.2.86 mul() [2/2]

```
static INLINE CONST vect_t mul (  
    const vect_t a,  
    const vect_t b) [inline], [static]
```

#### 12.300.2.87 mulhi() [2/2]

```
static INLINE CONST vect_t mulhi (  
    const vect_t a,  
    const vect_t b) [inline], [static]
```

**12.300.2.88 mulx() [2/2]**

```
static INLINE CONST vect_t mulx (  
    vect_t a,  
    vect_t b) [inline], [static]
```

**12.300.2.89 fmadd() [2/2]**

```
static INLINE CONST vect_t fmadd (  
    const vect_t c,  
    const vect_t a,  
    const vect_t b) [inline], [static]
```

**12.300.2.90 fmaddin() [2/2]**

```
static INLINE vect_t fmaddin (  
    vect_t & c,  
    const vect_t a,  
    const vect_t b) [inline], [static]
```

**12.300.2.91 fmaddx() [2/2]**

```
static INLINE CONST vect_t fmaddx (  
    const vect_t c,  
    const vect_t a,  
    const vect_t b) [inline], [static]
```

**12.300.2.92 fmaddxin() [2/2]**

```
static INLINE vect_t fmaddxin (  
    vect_t & c,  
    const vect_t a,  
    const vect_t b) [inline], [static]
```

**12.300.2.93 fnmadd() [2/2]**

```
static INLINE CONST vect_t fnmadd (  
    const vect_t c,  
    const vect_t a,  
    const vect_t b) [inline], [static]
```

**12.300.2.94 fnmaddin() [2/2]**

```
static INLINE vect_t fnmaddin (  
    vect_t & c,  
    const vect_t a,  
    const vect_t b) [inline], [static]
```

**12.300.2.95 fnmaddx() [2/2]**

```
static INLINE CONST vect_t fnmaddx (  
    const vect_t c,  
    const vect_t a,  
    const vect_t b) [inline], [static]
```

**12.300.2.96 fnmaddxin() [2/2]**

```
static INLINE vect_t fnmaddxin (  
    vect_t & c,
```

```
const vect_t a,  
const vect_t b) [inline], [static]
```

#### 12.300.2.97 fmsub() [2/2]

```
static INLINE CONST vect_t fmsub (  
    const vect_t c,  
    const vect_t a,  
    const vect_t b) [inline], [static]
```

#### 12.300.2.98 fmsubin() [2/2]

```
static INLINE vect_t fmsubin (  
    vect_t & c,  
    const vect_t a,  
    const vect_t b) [inline], [static]
```

#### 12.300.2.99 fmsubx() [2/2]

```
static INLINE CONST vect_t fmsubx (  
    const vect_t c,  
    const vect_t a,  
    const vect_t b) [inline], [static]
```

#### 12.300.2.100 fmsubxin() [2/2]

```
static INLINE vect_t fmsubxin (  
    vect_t & c,  
    const vect_t a,  
    const vect_t b) [inline], [static]
```

#### 12.300.2.101 eq() [2/2]

```
static INLINE CONST vect_t eq (  
    const vect_t a,  
    const vect_t b) [inline], [static]
```

#### 12.300.2.102 greater() [2/2]

```
static INLINE CONST vect_t greater (  
    const vect_t a,  
    const vect_t b) [inline], [static]
```

#### 12.300.2.103 lesser() [2/2]

```
static INLINE CONST vect_t lesser (  
    const vect_t a,  
    const vect_t b) [inline], [static]
```

#### 12.300.2.104 greater\_eq() [2/2]

```
static INLINE CONST vect_t greater_eq (  
    const vect_t a,  
    const vect_t b) [inline], [static]
```

#### 12.300.2.105 lesser\_eq() [2/2]

```
static INLINE CONST vect_t lesser_eq (  
    const vect_t a,  
    const vect_t b) [inline], [static]
```

**12.300.2.106 hadd\_to\_scal()** [2/2]

```
static INLINE CONST scalar_t hadd_to_scal (
    const vect_t a) [inline], [static]
```

**12.300.2.107 round()** [2/2]

```
static INLINE CONST vect_t round (
    const vect_t a) [inline], [static]
```

**12.300.2.108 mod()** [2/2]

```
static INLINE vect_t mod (
    vect_t & C,
    const vect_t & P,
    const vect_t & INVP,
    const vect_t & NEGP,
    const vect_t & MIN,
    const vect_t & MAX,
    vect_t & Q,
    vect_t & T) [inline], [static]
```

**12.300.2.109 zero()** [1/2]

```
static INLINE CONST vect_t zero () [inline], [static], [inherited]
```

**12.300.2.110 zero()** [2/2]

```
static INLINE CONST vect_t zero () [inline], [static], [inherited]
```

**12.300.2.111 vor()**

```
static INLINE CONST vect_t vor (
    const vect_t a,
    const vect_t b) [inline], [static], [inherited]
```

**12.300.2.112 vxor()**

```
static INLINE CONST vect_t vxor (
    const vect_t a,
    const vect_t b) [inline], [static], [inherited]
```

**12.300.2.113 vand()**

```
static INLINE CONST vect_t vand (
    const vect_t a,
    const vect_t b) [inline], [static], [inherited]
```

**12.300.2.114 vandnot()**

```
static INLINE CONST vect_t vandnot (
    const vect_t a,
    const vect_t b) [inline], [static], [inherited]
```

**12.300.3 Field Documentation****12.300.3.1 vect\_size**

```
static const constexpr size_t vect_size = 8 [static], [constexpr]
```

### 12.300.3.2 alignment

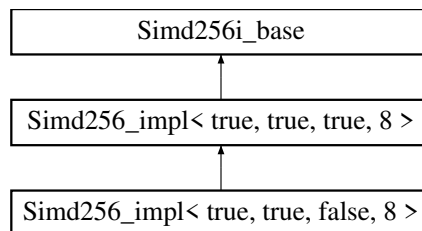
```
static const constexpr size_t alignment = 32 [static], [constexpr]
```

The documentation for this struct was generated from the following files:

- [simd256\\_int32.inl](#)
- [simd512\\_int32.inl](#)

## 12.301 Simd256\_impl< true, true, true, 8 > Struct Reference

Inheritance diagram for Simd256\_impl< true, true, true, 8 >:



### Data Structures

- union [Converter](#)

### Public Types

- using [vect\\_t](#) = \_\_m256i
- using [half\\_t](#) = \_\_m128i
- using [scalar\\_t](#) = int64\_t
- using [simdHalf](#) = [Simd128](#)<[scalar\\_t](#)>
- using [aligned\\_allocator](#) = [AlignedAllocator](#)<[scalar\\_t](#), [Alignment](#)([alignment](#))>
- using [aligned\\_vector](#) = std::vector<[scalar\\_t](#), [aligned\\_allocator](#)>
- template<class [Field](#)>  
using [is\\_same\\_element](#) = std::is\_same<typename [Field](#)::Element, [scalar\\_t](#)>

### Static Public Member Functions

- static const std::string [type\\_string](#) ()
- template<class T>  
static constexpr bool [valid](#) (T \*p)
- template<class T>  
static constexpr bool [compliant](#) (T n)
- static [INLINE CONST vect\\_t set1](#) (const [scalar\\_t](#) x)
- static [INLINE CONST vect\\_t set](#) (const [scalar\\_t](#) x0, const [scalar\\_t](#) x1, const [scalar\\_t](#) x2, const [scalar\\_t](#) x3)
- template<class T>  
static [INLINE PURE vect\\_t gather](#) (const [scalar\\_t](#) \*const p, const T \*const idx)
- template<int idx>  
static [INLINE CONST scalar\\_t get](#) ([vect\\_t](#) v)
- static [INLINE PURE vect\\_t load](#) (const [scalar\\_t](#) \*const p)
- static [INLINE PURE vect\\_t loadu](#) (const [scalar\\_t](#) \*const p)
- static [INLINE void store](#) ([scalar\\_t](#) \*p, [vect\\_t](#) v)
- static [INLINE void storeu](#) ([scalar\\_t](#) \*p, [vect\\_t](#) v)
- static [INLINE void stream](#) ([scalar\\_t](#) \*p, const [vect\\_t](#) v)
- template<int s>  
static [INLINE CONST vect\\_t sll](#) (const [vect\\_t](#) a)

- `template<int s>`  
static `INLINE CONST vect_t srl` (const `vect_t` a)
- `template<int s>`  
static `INLINE CONST vect_t sra` (const `vect_t` a)
- `template<uint8_t s>`  
static `INLINE CONST vect_t shuffle` (const `vect_t` a)
- static `INLINE CONST vect_t unpacklo_intrinsic` (const `vect_t` a, const `vect_t` b)
- static `INLINE CONST vect_t unpackhi_intrinsic` (const `vect_t` a, const `vect_t` b)
- static `INLINE CONST vect_t unpacklo` (const `vect_t` a, const `vect_t` b)
- static `INLINE CONST vect_t unpackhi` (const `vect_t` a, const `vect_t` b)
- static `INLINE void unpacklohi` (`vect_t` &lo, `vect_t` &hi, const `vect_t` a, const `vect_t` b)
- static `INLINE CONST vect_t pack_even` (const `vect_t` a, const `vect_t` b)
- static `INLINE CONST vect_t pack_odd` (const `vect_t` a, const `vect_t` b)
- static `INLINE void pack` (`vect_t` &even, `vect_t` &odd, const `vect_t` a, const `vect_t` b)
- static `INLINE void transpose` (`vect_t` &r0, `vect_t` &r1, `vect_t` &r2, `vect_t` &r3)
- `template<uint8_t s>`  
static `INLINE CONST vect_t blend` (const `vect_t` a, const `vect_t` b)
- static `INLINE CONST vect_t add` (const `vect_t` a, const `vect_t` b)
- static `INLINE vect_t addin` (`vect_t` &a, const `vect_t` b)
- static `INLINE CONST vect_t sub` (const `vect_t` a, const `vect_t` b)
- static `INLINE vect_t subin` (`vect_t` &a, const `vect_t` b)
- static `INLINE CONST vect_t mullo` (`vect_t` a, `vect_t` b)
- static `INLINE CONST vect_t mul` (const `vect_t` a, const `vect_t` b)
- static `INLINE CONST vect_t mulhi` (`vect_t` a, `vect_t` b)
- static `INLINE CONST vect_t mulx` (const `vect_t` a, const `vect_t` b)
- static `INLINE CONST vect_t fmadd` (const `vect_t` c, const `vect_t` a, const `vect_t` b)
- static `INLINE vect_t fmaddin` (`vect_t` &c, const `vect_t` a, const `vect_t` b)
- static `INLINE CONST vect_t fmadddx` (const `vect_t` c, const `vect_t` a, const `vect_t` b)
- static `INLINE vect_t fmadddxin` (`vect_t` &c, const `vect_t` a, const `vect_t` b)
- static `INLINE CONST vect_t fnmadd` (const `vect_t` c, const `vect_t` a, const `vect_t` b)
- static `INLINE vect_t fnmaddin` (`vect_t` &c, const `vect_t` a, const `vect_t` b)
- static `INLINE CONST vect_t fnmaddx` (const `vect_t` c, const `vect_t` a, const `vect_t` b)
- static `INLINE vect_t fnmaddxin` (`vect_t` &c, const `vect_t` a, const `vect_t` b)
- static `INLINE CONST vect_t fmsub` (const `vect_t` c, const `vect_t` a, const `vect_t` b)
- static `INLINE vect_t fmsubin` (`vect_t` &c, const `vect_t` a, const `vect_t` b)
- static `INLINE CONST vect_t fmsubx` (const `vect_t` c, const `vect_t` a, const `vect_t` b)
- static `INLINE vect_t fmsubxin` (`vect_t` &c, const `vect_t` a, const `vect_t` b)
- static `INLINE CONST vect_t eq` (const `vect_t` a, const `vect_t` b)
- static `INLINE CONST vect_t greater` (const `vect_t` a, const `vect_t` b)
- static `INLINE CONST vect_t lesser` (const `vect_t` a, const `vect_t` b)
- static `INLINE CONST vect_t greater_eq` (const `vect_t` a, const `vect_t` b)
- static `INLINE CONST vect_t lesser_eq` (const `vect_t` a, const `vect_t` b)
- static `INLINE CONST scalar_t hadd_to_scal` (const `vect_t` a)
- static `INLINE CONST vect_t round` (const `vect_t` a)
- static `INLINE CONST vect_t mask_high` ()
- static `INLINE CONST vect_t mulhi_fast` (`vect_t` x, `vect_t` y)
- static `INLINE vect_t mod` (`vect_t` &C, const `__m256d` &P, const `__m256d` &INVP, const `__m256d` &NEGP, const `vect_t` &POW50REM, const `__m256d` &MIN, const `__m256d` &MAX, `__m256d` &Q, `__m256d` &T)
- static `INLINE CONST vect_t zero` ()

### Static Public Attributes

- static const constexpr `size_t vect_size` = 4
- static const constexpr `size_t alignment` = 32

**Static Protected Member Functions**

- static `INLINE CONST vect_t signbits` (const `vect_t` x)

**12.301.1 Member Typedef Documentation****12.301.1.1 vect\_t**

```
using vect_t = __m256i
```

**12.301.1.2 half\_t**

```
using half_t = __m128i
```

**12.301.1.3 scalar\_t**

```
using scalar_t = int64_t
```

**12.301.1.4 simdHalf**

```
using simdHalf = Simd128<scalar_t>
```

**12.301.1.5 aligned\_allocator**

```
using aligned_allocator = AlignedAllocator<scalar_t, Alignment(alignment)>
```

**12.301.1.6 aligned\_vector**

```
using aligned_vector = std::vector<scalar_t, aligned_allocator>
```

**12.301.1.7 is\_same\_element**

```
template<class Field>
using is_same_element = std::is_same<typename Field::Element, scalar_t>
```

**12.301.2 Member Function Documentation****12.301.2.1 type\_string()**

```
static const std::string type_string () [inline], [static]
```

**12.301.2.2 valid()**

```
template<class T>
static constexpr bool valid (
    T * p) [inline], [static], [constexpr]
```

**12.301.2.3 compliant()**

```
template<class T>
static constexpr bool compliant (
    T n) [inline], [static], [constexpr]
```

**12.301.2.4 set1()**

```
static INLINE CONST vect_t set1 (
    const scalar_t x) [inline], [static]
```

**12.301.2.5 set()**

```
static INLINE CONST vect_t set (
    const scalar_t x0,
    const scalar_t x1,
    const scalar_t x2,
    const scalar_t x3) [inline], [static]
```

**12.301.2.6 gather()**

```
template<class T>
static INLINE PURE vect_t gather (
    const scalar_t *const p,
    const T *const idx) [inline], [static]
```

**12.301.2.7 get()**

```
template<int idx>
static INLINE CONST scalar_t get (
    vect_t v) [inline], [static]
```

**12.301.2.8 load()**

```
static INLINE PURE vect_t load (
    const scalar_t *const p) [inline], [static]
```

**12.301.2.9 loadu()**

```
static INLINE PURE vect_t loadu (
    const scalar_t *const p) [inline], [static]
```

**12.301.2.10 store()**

```
static INLINE void store (
    scalar_t * p,
    vect_t v) [inline], [static]
```

**12.301.2.11 storeu()**

```
static INLINE void storeu (
    scalar_t * p,
    vect_t v) [inline], [static]
```

**12.301.2.12 stream()**

```
static INLINE void stream (
    scalar_t * p,
    const vect_t v) [inline], [static]
```

**12.301.2.13 sll()**

```
template<int s>
static INLINE CONST vect_t sll (
    const vect_t a) [inline], [static]
```

**12.301.2.14 srl()**

```
template<int s>
static INLINE CONST vect_t srl (
    const vect_t a) [inline], [static]
```



**12.301.2.15 sra()**

```
template<int s>
static INLINE CONST vect_t sra (
    const vect_t a) [inline], [static]
```

**12.301.2.16 shuffle()**

```
template<uint8_t s>
static INLINE CONST vect_t shuffle (
    const vect_t a) [inline], [static]
```

**12.301.2.17 unpacklo\_intrinsic()**

```
static INLINE CONST vect_t unpacklo_intrinsic (
    const vect_t a,
    const vect_t b) [inline], [static]
```

**12.301.2.18 unpackhi\_intrinsic()**

```
static INLINE CONST vect_t unpackhi_intrinsic (
    const vect_t a,
    const vect_t b) [inline], [static]
```

**12.301.2.19 unpacklo()**

```
static INLINE CONST vect_t unpacklo (
    const vect_t a,
    const vect_t b) [inline], [static]
```

**12.301.2.20 unpackhi()**

```
static INLINE CONST vect_t unpackhi (
    const vect_t a,
    const vect_t b) [inline], [static]
```

**12.301.2.21 unpacklohi()**

```
static INLINE void unpacklohi (
    vect_t & lo,
    vect_t & hi,
    const vect_t a,
    const vect_t b) [inline], [static]
```

**12.301.2.22 pack\_even()**

```
static INLINE CONST vect_t pack_even (
    const vect_t a,
    const vect_t b) [inline], [static]
```

**12.301.2.23 pack\_odd()**

```
static INLINE CONST vect_t pack_odd (
    const vect_t a,
    const vect_t b) [inline], [static]
```

#### 12.301.2.24 pack()

```
static INLINE void pack (  
    vect_t & even,  
    vect_t & odd,  
    const vect_t a,  
    const vect_t b) [inline], [static]
```

#### 12.301.2.25 transpose()

```
static INLINE void transpose (  
    vect_t & r0,  
    vect_t & r1,  
    vect_t & r2,  
    vect_t & r3) [inline], [static]
```

#### 12.301.2.26 blend()

```
template<uint8_t s>  
static INLINE CONST vect_t blend (  
    const vect_t a,  
    const vect_t b) [inline], [static]
```

#### 12.301.2.27 add()

```
static INLINE CONST vect_t add (  
    const vect_t a,  
    const vect_t b) [inline], [static]
```

#### 12.301.2.28 addin()

```
static INLINE vect_t addin (  
    vect_t & a,  
    const vect_t b) [inline], [static]
```

#### 12.301.2.29 sub()

```
static INLINE CONST vect_t sub (  
    const vect_t a,  
    const vect_t b) [inline], [static]
```

#### 12.301.2.30 subin()

```
static INLINE vect_t subin (  
    vect_t & a,  
    const vect_t b) [inline], [static]
```

#### 12.301.2.31 mullo()

```
static INLINE CONST vect_t mullo (  
    vect_t a,  
    vect_t b) [inline], [static]
```

#### 12.301.2.32 mul()

```
static INLINE CONST vect_t mul (  
    const vect_t a,  
    const vect_t b) [inline], [static]
```

**12.301.2.33 mulhi()**

```
static INLINE CONST vect_t mulhi (  
    vect_t a,  
    vect_t b) [inline], [static]
```

**12.301.2.34 mulx()**

```
static INLINE CONST vect_t mulx (  
    const vect_t a,  
    const vect_t b) [inline], [static]
```

**12.301.2.35 fmadd()**

```
static INLINE CONST vect_t fmadd (  
    const vect_t c,  
    const vect_t a,  
    const vect_t b) [inline], [static]
```

**12.301.2.36 fmaddin()**

```
static INLINE vect_t fmaddin (  
    vect_t & c,  
    const vect_t a,  
    const vect_t b) [inline], [static]
```

**12.301.2.37 fmaddx()**

```
static INLINE CONST vect_t fmaddx (  
    const vect_t c,  
    const vect_t a,  
    const vect_t b) [inline], [static]
```

**12.301.2.38 fmaddxin()**

```
static INLINE vect_t fmaddxin (  
    vect_t & c,  
    const vect_t a,  
    const vect_t b) [inline], [static]
```

**12.301.2.39 fnmadd()**

```
static INLINE CONST vect_t fnmadd (  
    const vect_t c,  
    const vect_t a,  
    const vect_t b) [inline], [static]
```

**12.301.2.40 fnmaddin()**

```
static INLINE vect_t fnmaddin (  
    vect_t & c,  
    const vect_t a,  
    const vect_t b) [inline], [static]
```

**12.301.2.41 fnmaddx()**

```
static INLINE CONST vect_t fnmaddx (  
    const vect_t c,  
    const vect_t a,  
    const vect_t b) [inline], [static]
```

**12.301.2.42 fnmaddxin()**

```
static INLINE vect_t fnmaddxin (  
    vect_t & c,  
    const vect_t a,  
    const vect_t b) [inline], [static]
```

**12.301.2.43 fmsub()**

```
static INLINE CONST vect_t fmsub (  
    const vect_t c,  
    const vect_t a,  
    const vect_t b) [inline], [static]
```

**12.301.2.44 fmsubin()**

```
static INLINE vect_t fmsubin (  
    vect_t & c,  
    const vect_t a,  
    const vect_t b) [inline], [static]
```

**12.301.2.45 fmsubx()**

```
static INLINE CONST vect_t fmsubx (  
    const vect_t c,  
    const vect_t a,  
    const vect_t b) [inline], [static]
```

**12.301.2.46 fmsubxin()**

```
static INLINE vect_t fmsubxin (  
    vect_t & c,  
    const vect_t a,  
    const vect_t b) [inline], [static]
```

**12.301.2.47 eq()**

```
static INLINE CONST vect_t eq (  
    const vect_t a,  
    const vect_t b) [inline], [static]
```

**12.301.2.48 greater()**

```
static INLINE CONST vect_t greater (  
    const vect_t a,  
    const vect_t b) [inline], [static]
```

**12.301.2.49 lesser()**

```
static INLINE CONST vect_t lesser (  
    const vect_t a,  
    const vect_t b) [inline], [static]
```

**12.301.2.50 greater\_eq()**

```
static INLINE CONST vect_t greater_eq (  
    const vect_t a,  
    const vect_t b) [inline], [static]
```

**12.301.2.51 lesser\_eq()**

```
static INLINE CONST vect_t lesser_eq (
    const vect_t a,
    const vect_t b) [inline], [static]
```

**12.301.2.52 hadd\_to\_scal()**

```
static INLINE CONST scalar_t hadd_to_scal (
    const vect_t a) [inline], [static]
```

**12.301.2.53 round()**

```
static INLINE CONST vect_t round (
    const vect_t a) [inline], [static]
```

**12.301.2.54 mask\_high()**

```
static INLINE CONST vect_t mask_high () [inline], [static]
```

**12.301.2.55 mulhi\_fast()**

```
INLINE CONST vect_t mulhi_fast (
    vect_t x,
    vect_t y) [static]
```

**12.301.2.56 mod()**

```
INLINE vect_t mod (
    vect_t & C,
    const __m256d & P,
    const __m256d & INVP,
    const __m256d & NEGP,
    const vect_t & POW5OREM,
    const __m256d & MIN,
    const __m256d & MAX,
    __m256d & Q,
    __m256d & T) [static]
```

**12.301.2.57 signbits()**

```
static INLINE CONST vect_t signbits (
    const vect_t x) [inline], [static], [protected]
```

**12.301.2.58 zero()**

```
static INLINE CONST vect_t zero () [inline], [static], [inherited]
```

**12.301.3 Field Documentation****12.301.3.1 vect\_size**

```
const constexpr size_t vect_size = 4 [static], [constexpr]
```

**12.301.3.2 alignment**

```
const constexpr size_t alignment = 32 [static], [constexpr]
```

The documentation for this struct was generated from the following file:

- [simd256\\_int64.inl](#)

## 12.302 Simd256fp\_base Struct Reference

Inheritance diagram for Simd256fp\_base:



The documentation for this struct was generated from the following file:

- [simd256.inl](#)

## 12.303 Simd256i\_base Struct Reference

Inheritance diagram for Simd256i\_base:



### Public Types

- using [vect\\_t](#) = \_\_m256i

### Static Public Member Functions

- static [INLINE CONST vect\\_t zero](#) ()

### 12.303.1 Member Typedef Documentation

#### 12.303.1.1 vect\_t

using [vect\\_t](#) = \_\_m256i

### 12.303.2 Member Function Documentation

#### 12.303.2.1 zero()

static [INLINE CONST vect\\_t zero](#) () [inline], [static]

The documentation for this struct was generated from the following file:

- [simd256.inl](#)

## 12.304 Simd512\_impl< ArithType, Int, Signed, Size > Struct Template Reference

The documentation for this struct was generated from the following file:

- [simd512.inl](#)

## 12.305 Simd512\_impl< true, false, true, 4 > Struct Reference

The documentation for this struct was generated from the following file:

- [simd512\\_float.inl](#)

## 12.306 Simd512\_impl< true, false, true, 8 > Struct Reference

### Public Types

- using `vect_t` = `__m512d`
- using `scalar_t` = `double`
- using `aligned_allocator` = `AlignedAllocator<scalar_t, Alignment(alignment)>`
- using `aligned_vector` = `std::vector<scalar_t, aligned_allocator>`
- template<class `Field`>  
using `is_same_element` = `std::is_same<typename Field::Element, scalar_t>`

### Static Public Member Functions

- static const std::string `type_string` ()
- template<class `T`>  
static constexpr bool `valid` (`T *p`)
- template<class `T`>  
static constexpr bool `compliant` (`T n`)
- static `INLINE CONST vect_t zero` ()
- static `INLINE CONST vect_t set1` (const `scalar_t x`)
- static `INLINE CONST vect_t set` (const `scalar_t x1`, const `scalar_t x2`, const `scalar_t x3`, const `scalar_t x4`, const `scalar_t x5`, const `scalar_t x6`, const `scalar_t x7`, const `scalar_t x8`)
- template<class `T`>  
static `INLINE PURE vect_t gather` (const `scalar_t *const p`, const `T *const idx`)
- static `INLINE PURE vect_t load` (const `scalar_t *const p`)
- static `INLINE PURE vect_t loadu` (const `scalar_t *const p`)
- static `INLINE void store` (const `scalar_t *p`, const `vect_t v`)
- static `INLINE void storeu` (const `scalar_t *p`, const `vect_t v`)
- static `INLINE void stream` (const `scalar_t *p`, const `vect_t v`)
- template<uint8\_t `s`>  
static `INLINE CONST vect_t shuffle` (const `vect_t a`)
- static `INLINE CONST vect_t unpacklo_intrinsic` (const `vect_t a`, const `vect_t b`)
- static `INLINE CONST vect_t unpackhi_intrinsic` (const `vect_t a`, const `vect_t b`)
- static `INLINE CONST vect_t unpacklo` (const `vect_t a`, const `vect_t b`)
- static `INLINE CONST vect_t unpackhi` (const `vect_t a`, const `vect_t b`)
- static `INLINE void unpacklohi` (`vect_t &lo`, `vect_t &hi`, const `vect_t a`, const `vect_t b`)
- static `INLINE CONST vect_t pack_even` (const `vect_t a`, const `vect_t b`)
- static `INLINE CONST vect_t pack_odd` (const `vect_t a`, const `vect_t b`)
- static `INLINE void pack` (`vect_t &even`, `vect_t &odd`, const `vect_t a`, const `vect_t b`)
- static `INLINE void transpose` (`vect_t &r0`, `vect_t &r1`, `vect_t &r2`, `vect_t &r3`, `vect_t &r4`, `vect_t &r5`, `vect_t &r6`, `vect_t &r7`)
- template<uint8\_t `s`>  
static `INLINE CONST vect_t blend` (const `vect_t a`, const `vect_t b`)
- static `INLINE CONST vect_t blendv` (const `vect_t a`, const `vect_t b`, const `vect_t mask`)
- static `INLINE CONST vect_t add` (const `vect_t a`, const `vect_t b`)
- static `INLINE vect_t addin` (`vect_t &a`, const `vect_t b`)
- static `INLINE CONST vect_t sub` (const `vect_t a`, const `vect_t b`)
- static `INLINE CONST vect_t subin` (`vect_t &a`, const `vect_t b`)
- static `INLINE CONST vect_t mul` (const `vect_t a`, const `vect_t b`)
- static `INLINE CONST vect_t mulin` (`vect_t &a`, const `vect_t b`)
- static `INLINE CONST vect_t div` (const `vect_t a`, const `vect_t b`)
- static `INLINE CONST vect_t fmadd` (const `vect_t c`, const `vect_t a`, const `vect_t b`)
- static `INLINE CONST vect_t fmaddin` (`vect_t &c`, const `vect_t a`, const `vect_t b`)
- static `INLINE CONST vect_t fnmadd` (const `vect_t c`, const `vect_t a`, const `vect_t b`)
- static `INLINE CONST vect_t fnmaddin` (`vect_t &c`, const `vect_t a`, const `vect_t b`)
- static `INLINE CONST vect_t fmsub` (const `vect_t c`, const `vect_t a`, const `vect_t b`)

- static `INLINE CONST vect_t fmsubin (vect_t &c, const vect_t a, const vect_t b)`
- static `INLINE CONST vect_t eq (const vect_t a, const vect_t b)`
- static `INLINE CONST vect_t lesser (const vect_t a, const vect_t b)`
- static `INLINE CONST vect_t lesser_eq (const vect_t a, const vect_t b)`
- static `INLINE CONST vect_t greater (const vect_t a, const vect_t b)`
- static `INLINE CONST vect_t greater_eq (const vect_t a, const vect_t b)`
- static `INLINE CONST vect_t floor (const vect_t a)`
- static `INLINE CONST vect_t ceil (const vect_t a)`
- static `INLINE CONST vect_t round (const vect_t a)`
- static `INLINE CONST vect_t hadd (const vect_t a, const vect_t b)`
- static `INLINE CONST scalar_t hadd_to_scal (const vect_t a)`

### Static Public Attributes

- static const constexpr size\_t `vect_size` = 8
- static const constexpr size\_t `alignment` = 64

## 12.306.1 Member Typedef Documentation

### 12.306.1.1 vect\_t

```
using vect_t = __m512d
```

### 12.306.1.2 scalar\_t

```
using scalar_t = double
```

### 12.306.1.3 aligned\_allocator

```
using aligned_allocator = AlignedAllocator<scalar_t, Alignment(alignment)>
```

### 12.306.1.4 aligned\_vector

```
using aligned_vector = std::vector<scalar_t, aligned_allocator>
```

### 12.306.1.5 is\_same\_element

```
template<class Field>
using is_same_element = std::is_same<typename Field::Element, scalar_t>
```

## 12.306.2 Member Function Documentation

### 12.306.2.1 type\_string()

```
static const std::string type_string () [inline], [static]
```

### 12.306.2.2 valid()

```
template<class T>
static constexpr bool valid (
    T * p) [inline], [static], [constexpr]
```

### 12.306.2.3 compliant()

```
template<class T>
static constexpr bool compliant (
    T n) [inline], [static], [constexpr]
```



**12.306.2.4 zero()**

```
static INLINE CONST vect_t zero () [inline], [static]
```

**12.306.2.5 set1()**

```
static INLINE CONST vect_t set1 (  
    const scalar_t x) [inline], [static]
```

**12.306.2.6 set()**

```
static INLINE CONST vect_t set (  
    const scalar_t x1,  
    const scalar_t x2,  
    const scalar_t x3,  
    const scalar_t x4,  
    const scalar_t x5,  
    const scalar_t x6,  
    const scalar_t x7,  
    const scalar_t x8) [inline], [static]
```

**12.306.2.7 gather()**

```
template<class T>  
static INLINE PURE vect_t gather (  
    const scalar_t *const p,  
    const T *const idx) [inline], [static]
```

**12.306.2.8 load()**

```
static INLINE PURE vect_t load (  
    const scalar_t *const p) [inline], [static]
```

**12.306.2.9 loadu()**

```
static INLINE PURE vect_t loadu (  
    const scalar_t *const p) [inline], [static]
```

**12.306.2.10 store()**

```
static INLINE void store (  
    const scalar_t * p,  
    const vect_t v) [inline], [static]
```

**12.306.2.11 storeu()**

```
static INLINE void storeu (  
    const scalar_t * p,  
    const vect_t v) [inline], [static]
```

**12.306.2.12 stream()**

```
static INLINE void stream (  
    const scalar_t * p,  
    const vect_t v) [inline], [static]
```

**12.306.2.13 shuffle()**

```
template<uint8_t s>  
static INLINE CONST vect_t shuffle (  
    const vect_t a) [inline], [static]
```

**12.306.2.14 unpacklo\_intrinsic()**

```
static INLINE CONST vect_t unpacklo_intrinsic (  
    const vect_t a,  
    const vect_t b) [inline], [static]
```

**12.306.2.15 unpackhi\_intrinsic()**

```
static INLINE CONST vect_t unpackhi_intrinsic (  
    const vect_t a,  
    const vect_t b) [inline], [static]
```

**12.306.2.16 unpacklo()**

```
static INLINE CONST vect_t unpacklo (  
    const vect_t a,  
    const vect_t b) [inline], [static]
```

**12.306.2.17 unpackhi()**

```
static INLINE CONST vect_t unpackhi (  
    const vect_t a,  
    const vect_t b) [inline], [static]
```

**12.306.2.18 unpacklohi()**

```
static INLINE void unpacklohi (  
    vect_t & lo,  
    vect_t & hi,  
    const vect_t a,  
    const vect_t b) [inline], [static]
```

**12.306.2.19 pack\_even()**

```
static INLINE CONST vect_t pack_even (  
    const vect_t a,  
    const vect_t b) [inline], [static]
```

**12.306.2.20 pack\_odd()**

```
static INLINE CONST vect_t pack_odd (  
    const vect_t a,  
    const vect_t b) [inline], [static]
```

**12.306.2.21 pack()**

```
static INLINE void pack (  
    vect_t & even,  
    vect_t & odd,  
    const vect_t a,  
    const vect_t b) [inline], [static]
```

**12.306.2.22 transpose()**

```
static INLINE void transpose (  
    vect_t & r0,  
    vect_t & r1,  
    vect_t & r2,  
    vect_t & r3,  
    vect_t & r4,
```

```
    vect_t & r5,  
    vect_t & r6,  
    vect_t & r7) [inline], [static]
```

#### 12.306.2.23 blend()

```
template<uint8_t s>  
static INLINE CONST vect_t blend (  
    const vect_t a,  
    const vect_t b) [inline], [static]
```

#### 12.306.2.24 blendv()

```
static INLINE CONST vect_t blendv (  
    const vect_t a,  
    const vect_t b,  
    const vect_t mask) [inline], [static]
```

#### 12.306.2.25 add()

```
static INLINE CONST vect_t add (  
    const vect_t a,  
    const vect_t b) [inline], [static]
```

#### 12.306.2.26 addin()

```
static INLINE vect_t addin (  
    vect_t & a,  
    const vect_t b) [inline], [static]
```

#### 12.306.2.27 sub()

```
static INLINE CONST vect_t sub (  
    const vect_t a,  
    const vect_t b) [inline], [static]
```

#### 12.306.2.28 subin()

```
static INLINE CONST vect_t subin (  
    vect_t & a,  
    const vect_t b) [inline], [static]
```

#### 12.306.2.29 mul()

```
static INLINE CONST vect_t mul (  
    const vect_t a,  
    const vect_t b) [inline], [static]
```

#### 12.306.2.30 mulin()

```
static INLINE CONST vect_t mulin (  
    vect_t & a,  
    const vect_t b) [inline], [static]
```

#### 12.306.2.31 div()

```
static INLINE CONST vect_t div (  
    const vect_t a,  
    const vect_t b) [inline], [static]
```

**12.306.2.32 fmall()**

```
static INLINE CONST vect_t fmall (  
    const vect_t c,  
    const vect_t a,  
    const vect_t b) [inline], [static]
```

**12.306.2.33 fmallin()**

```
static INLINE CONST vect_t fmallin (  
    vect_t & c,  
    const vect_t a,  
    const vect_t b) [inline], [static]
```

**12.306.2.34 fmmall()**

```
static INLINE CONST vect_t fmmall (  
    const vect_t c,  
    const vect_t a,  
    const vect_t b) [inline], [static]
```

**12.306.2.35 fmmallin()**

```
static INLINE CONST vect_t fmmallin (  
    vect_t & c,  
    const vect_t a,  
    const vect_t b) [inline], [static]
```

**12.306.2.36 fmsub()**

```
static INLINE CONST vect_t fmsub (  
    const vect_t c,  
    const vect_t a,  
    const vect_t b) [inline], [static]
```

**12.306.2.37 fmsubin()**

```
static INLINE CONST vect_t fmsubin (  
    vect_t & c,  
    const vect_t a,  
    const vect_t b) [inline], [static]
```

**12.306.2.38 eq()**

```
static INLINE CONST vect_t eq (  
    const vect_t a,  
    const vect_t b) [inline], [static]
```

**12.306.2.39 lesser()**

```
static INLINE CONST vect_t lesser (  
    const vect_t a,  
    const vect_t b) [inline], [static]
```

**12.306.2.40 lesser\_eq()**

```
static INLINE CONST vect_t lesser_eq (  
    const vect_t a,  
    const vect_t b) [inline], [static]
```

**12.306.2.41 greater()**

```
static INLINE CONST vect_t greater (
    const vect_t a,
    const vect_t b) [inline], [static]
```

**12.306.2.42 greater\_eq()**

```
static INLINE CONST vect_t greater_eq (
    const vect_t a,
    const vect_t b) [inline], [static]
```

**12.306.2.43 floor()**

```
static INLINE CONST vect_t floor (
    const vect_t a) [inline], [static]
```

**12.306.2.44 ceil()**

```
static INLINE CONST vect_t ceil (
    const vect_t a) [inline], [static]
```

**12.306.2.45 round()**

```
static INLINE CONST vect_t round (
    const vect_t a) [inline], [static]
```

**12.306.2.46 hadd()**

```
static INLINE CONST vect_t hadd (
    const vect_t a,
    const vect_t b) [inline], [static]
```

**12.306.2.47 hadd\_to\_scal()**

```
static INLINE CONST scalar_t hadd_to_scal (
    const vect_t a) [inline], [static]
```

**12.306.3 Field Documentation****12.306.3.1 vect\_size**

```
const constexpr size_t vect_size = 8 [static], [constexpr]
```

**12.306.3.2 alignment**

```
const constexpr size_t alignment = 64 [static], [constexpr]
```

The documentation for this struct was generated from the following file:

- [simd512\\_double.inl](#)

**12.307 Simd512\_impl< true, true, false, 8 > Struct Reference**

Inheritance diagram for Simd512\_impl< true, true, false, 8 >:



## Data Structures

- union [Converter](#)

## Public Types

- using [scalar\\_t](#) = uint64\_t
- using [aligned\\_allocator](#) = AlignedAllocator<[scalar\\_t](#), Alignment([alignment](#))>
- using [aligned\\_vector](#) = std::vector<[scalar\\_t](#), [aligned\\_allocator](#)>
- template<class [Field](#)>
  - using [is\\_same\\_element](#) = std::is\_same<typename [Field::Element](#), [scalar\\_t](#)>
- using [simdHalf](#) = [Simd256](#)<[scalar\\_t](#)>
- using [vect\\_t](#) = \_\_m512i
- using [half\\_t](#) = \_\_m256i

## Static Public Member Functions

- static const std::string [type\\_string](#) ()
- static [INLINE CONST vect\\_t set1](#) (const [scalar\\_t](#) x)
- static [INLINE CONST vect\\_t set](#) (const [scalar\\_t](#) x0, const [scalar\\_t](#) x1, const [scalar\\_t](#) x2, const [scalar\\_t](#) x3, const [scalar\\_t](#) x4, const [scalar\\_t](#) x5, const [scalar\\_t](#) x6, const [scalar\\_t](#) x7)
- template<class T>
  - static [INLINE PURE vect\\_t gather](#) (const [scalar\\_t](#) \*const p, const T \*const idx)
- static [INLINE PURE vect\\_t load](#) (const [scalar\\_t](#) \*const p)
- static [INLINE PURE vect\\_t loadu](#) (const [scalar\\_t](#) \*const p)
- static [INLINE void store](#) ([scalar\\_t](#) \*p, [vect\\_t](#) v)
- template<uint8\_t k>
  - static [INLINE void maskstore](#) ([scalar\\_t](#) \*p, [vect\\_t](#) v)
- static [INLINE void storeu](#) ([scalar\\_t](#) \*p, [vect\\_t](#) v)
- static [INLINE void stream](#) ([scalar\\_t](#) \*p, const [vect\\_t](#) v)
- template<int s>
  - static [INLINE CONST vect\\_t sra](#) (const [vect\\_t](#) a)
- static [INLINE CONST vect\\_t greater](#) ([vect\\_t](#) a, [vect\\_t](#) b)
- static [INLINE CONST vect\\_t lesser](#) ([vect\\_t](#) a, [vect\\_t](#) b)
- static [INLINE CONST vect\\_t greater\\_eq](#) (const [vect\\_t](#) a, const [vect\\_t](#) b)
- static [INLINE CONST vect\\_t lesser\\_eq](#) (const [vect\\_t](#) a, const [vect\\_t](#) b)
- static [INLINE CONST vect\\_t mullo](#) ([vect\\_t](#) a, [vect\\_t](#) b)
- static [INLINE CONST vect\\_t mulhi](#) ([vect\\_t](#) a, [vect\\_t](#) b)
- static [INLINE CONST vect\\_t mulx](#) (const [vect\\_t](#) a, const [vect\\_t](#) b)
- static [INLINE CONST vect\\_t fmaddx](#) (const [vect\\_t](#) c, const [vect\\_t](#) a, const [vect\\_t](#) b)
- static [INLINE vect\\_t fmaddxin](#) ([vect\\_t](#) &c, const [vect\\_t](#) a, const [vect\\_t](#) b)
- static [INLINE CONST vect\\_t fnmaddx](#) (const [vect\\_t](#) c, const [vect\\_t](#) a, const [vect\\_t](#) b)
- static [INLINE vect\\_t fnmaddxin](#) ([vect\\_t](#) &c, const [vect\\_t](#) a, const [vect\\_t](#) b)
- static [INLINE CONST vect\\_t fmsubx](#) (const [vect\\_t](#) c, const [vect\\_t](#) a, const [vect\\_t](#) b)
- static [INLINE vect\\_t fmsubxin](#) ([vect\\_t](#) &c, const [vect\\_t](#) a, const [vect\\_t](#) b)
- static [INLINE CONST scalar\\_t hadd\\_to\\_scal](#) (const [vect\\_t](#) a)
- template<class T>
  - static constexpr bool [valid](#) (T \*p)

- `template<class T>`  
`static constexpr bool compliant (T n)`
- `static INLINE CONST vect_t set1 (const scalar_t x)`
- `static INLINE CONST vect_t set (const scalar_t x0, const scalar_t x1, const scalar_t x2, const scalar_t x3, const scalar_t x4, const scalar_t x5, const scalar_t x6, const scalar_t x7)`
- `static INLINE CONST vect_t set (const scalar_t x0, const scalar_t x1, const scalar_t x2, const scalar_t x3)`
- `template<class T>`  
`static INLINE PURE vect_t gather (const scalar_t *const p, const T *const idx)`
- `static INLINE PURE vect_t load (const scalar_t *const p)`
- `static INLINE PURE vect_t loadu (const scalar_t *const p)`
- `static INLINE void store (scalar_t *p, vect_t v)`
- `template<uint8_t k>`  
`static INLINE void maskstore (scalar_t *p, vect_t v)`
- `static INLINE void storeu (scalar_t *p, vect_t v)`
- `static INLINE void stream (scalar_t *p, const vect_t v)`
- `template<int s>`  
`static INLINE CONST vect_t sll (const vect_t a)`
- `template<int s>`  
`static INLINE CONST vect_t srl (const vect_t a)`
- `template<uint8_t s>`  
`static INLINE CONST vect_t shuffle (const vect_t a)`
- `static INLINE CONST vect_t unpacklo_intrinsic (const vect_t a, const vect_t b)`
- `static INLINE CONST vect_t unpackhi_intrinsic (const vect_t a, const vect_t b)`
- `static INLINE CONST vect_t unpacklo (const vect_t a, const vect_t b)`
- `static INLINE CONST vect_t unpackhi (const vect_t a, const vect_t b)`
- `static INLINE void unpacklohi (vect_t &lo, vect_t &hi, const vect_t a, const vect_t b)`
- `static INLINE CONST vect_t pack_even (const vect_t a, const vect_t b)`
- `static INLINE CONST vect_t pack_odd (const vect_t a, const vect_t b)`
- `static INLINE void pack (vect_t &even, vect_t &odd, const vect_t a, const vect_t b)`
- `static INLINE void transpose (vect_t &r0, vect_t &r1, vect_t &r2, vect_t &r3, vect_t &r4, vect_t &r5, vect_t &r6, vect_t &r7)`
- `template<uint8_t s>`  
`static INLINE CONST vect_t blend (const vect_t a, const vect_t b)`
- `static INLINE CONST vect_t add (const vect_t a, const vect_t b)`
- `static INLINE vect_t addin (vect_t &a, const vect_t b)`
- `static INLINE CONST vect_t sub (const vect_t a, const vect_t b)`
- `static INLINE vect_t subin (vect_t &a, const vect_t b)`
- `static INLINE CONST vect_t mul (const vect_t a, const vect_t b)`
- `static INLINE CONST vect_t fmadd (const vect_t c, const vect_t a, const vect_t b)`
- `static INLINE vect_t fmaddin (vect_t &c, const vect_t a, const vect_t b)`
- `static INLINE CONST vect_t fnmadd (const vect_t c, const vect_t a, const vect_t b)`
- `static INLINE vect_t fnmaddin (vect_t &c, const vect_t a, const vect_t b)`
- `static INLINE CONST vect_t fmsub (const vect_t c, const vect_t a, const vect_t b)`
- `static INLINE vect_t fmsubin (vect_t &c, const vect_t a, const vect_t b)`
- `static INLINE CONST vect_t eq (const vect_t a, const vect_t b)`
- `static INLINE CONST vect_t round (const vect_t a)`
- `static INLINE CONST vect_t mask_high ()`
- `static INLINE CONST vect_t mulhi_fast (vect_t x, vect_t y)`
- `static INLINE vect_t mod (vect_t &C, const __m512d &P, const __m512d &INVP, const __m512d &NEGP, const vect_t &POW50REM, const __m512d &MIN, const __m512d &MAX, __m512d &Q, __m512d &T)`
- `static INLINE CONST vect_t zero ()`
- `static INLINE CONST vect_t vor (const vect_t a, const vect_t b)`
- `static INLINE CONST vect_t vxor (const vect_t a, const vect_t b)`
- `static INLINE CONST vect_t vand (const vect_t a, const vect_t b)`
- `static INLINE CONST vect_t vandnot (const vect_t a, const vect_t b)`

**Static Public Attributes**

- static const constexpr size\_t `vect_size` = 8
- static const constexpr size\_t `alignment` = 64

**Static Protected Member Functions**

- static `INLINE CONST vect_t signbits` (const `vect_t` x)

**12.307.1 Member Typedef Documentation****12.307.1.1 scalar\_t**

```
using scalar_t = uint64_t
```

**12.307.1.2 aligned\_allocator**

```
using aligned_allocator = AlignedAllocator<scalar_t, Alignment(alignment)>
```

**12.307.1.3 aligned\_vector**

```
using aligned_vector = std::vector<scalar_t, aligned_allocator>
```

**12.307.1.4 is\_same\_element**

```
template<class Field>
using is_same_element = std::is_same<typename Field::Element, scalar_t>
```

**12.307.1.5 simdHalf**

```
using simdHalf = Simd256<scalar_t>
```

**12.307.1.6 vect\_t**

```
using vect_t = __m512i [inherited]
```

**12.307.1.7 half\_t**

```
using half_t = __m256i [inherited]
```

**12.307.2 Member Function Documentation****12.307.2.1 type\_string()**

```
static const std::string type_string () [inline], [static]
```

**12.307.2.2 set1() [1/2]**

```
static INLINE CONST vect_t set1 (
    const scalar_t x) [inline], [static]
```

**12.307.2.3 set() [1/3]**

```
static INLINE CONST vect_t set (
    const scalar_t x0,
    const scalar_t x1,
    const scalar_t x2,
    const scalar_t x3,
    const scalar_t x4,
    const scalar_t x5,
    const scalar_t x6,
    const scalar_t x7) [inline], [static]
```



**12.307.2.4 gather()** [1/2]

```
template<class T>
static INLINE PURE vect_t gather (
    const scalar_t *const p,
    const T *const idx) [inline], [static]
```

**12.307.2.5 load()** [1/2]

```
static INLINE PURE vect_t load (
    const scalar_t *const p) [inline], [static]
```

**12.307.2.6 loadu()** [1/2]

```
static INLINE PURE vect_t loadu (
    const scalar_t *const p) [inline], [static]
```

**12.307.2.7 store()** [1/2]

```
static INLINE void store (
    scalar_t * p,
    vect_t v) [inline], [static]
```

**12.307.2.8 maskstore()** [1/2]

```
template<uint8_t k>
static INLINE void maskstore (
    scalar_t * p,
    vect_t v) [inline], [static]
```

**12.307.2.9 storeu()** [1/2]

```
static INLINE void storeu (
    scalar_t * p,
    vect_t v) [inline], [static]
```

**12.307.2.10 stream()** [1/2]

```
static INLINE void stream (
    scalar_t * p,
    const vect_t v) [inline], [static]
```

**12.307.2.11 sra()**

```
template<int s>
static INLINE CONST vect_t sra (
    const vect_t a) [inline], [static]
```

**12.307.2.12 greater()**

```
static INLINE CONST vect_t greater (
    vect_t a,
    vect_t b) [inline], [static]
```

**12.307.2.13 lesser()**

```
static INLINE CONST vect_t lesser (
    vect_t a,
    vect_t b) [inline], [static]
```

**12.307.2.14 greater\_eq()**

```
static INLINE CONST vect_t greater_eq (  
    const vect_t a,  
    const vect_t b) [inline], [static]
```

**12.307.2.15 lesser\_eq()**

```
static INLINE CONST vect_t lesser_eq (  
    const vect_t a,  
    const vect_t b) [inline], [static]
```

**12.307.2.16 mullo()**

```
static INLINE CONST vect_t mullo (  
    vect_t a,  
    vect_t b) [inline], [static]
```

**12.307.2.17 mulhi()**

```
static INLINE CONST vect_t mulhi (  
    vect_t a,  
    vect_t b) [inline], [static]
```

**12.307.2.18 mulx()**

```
static INLINE CONST vect_t mulx (  
    const vect_t a,  
    const vect_t b) [inline], [static]
```

**12.307.2.19 fmaddx()**

```
static INLINE CONST vect_t fmaddx (  
    const vect_t c,  
    const vect_t a,  
    const vect_t b) [inline], [static]
```

**12.307.2.20 fmaddxin()**

```
static INLINE vect_t fmaddxin (  
    vect_t & c,  
    const vect_t a,  
    const vect_t b) [inline], [static]
```

**12.307.2.21 fnmaddx()**

```
static INLINE CONST vect_t fnmaddx (  
    const vect_t c,  
    const vect_t a,  
    const vect_t b) [inline], [static]
```

**12.307.2.22 fnmaddxin()**

```
static INLINE vect_t fnmaddxin (  
    vect_t & c,  
    const vect_t a,  
    const vect_t b) [inline], [static]
```

**12.307.2.23 fmsubx()**

```
static INLINE CONST vect_t fmsubx (
    const vect_t c,
    const vect_t a,
    const vect_t b) [inline], [static]
```

**12.307.2.24 fmsubxin()**

```
static INLINE vect_t fmsubxin (
    vect_t & c,
    const vect_t a,
    const vect_t b) [inline], [static]
```

**12.307.2.25 hadd\_to\_scal()**

```
static INLINE CONST scalar_t hadd_to_scal (
    const vect_t a) [inline], [static]
```

**12.307.2.26 valid()**

```
template<class T>
static constexpr bool valid (
    T * p) [inline], [static], [constexpr], [inherited]
```

**12.307.2.27 compliant()**

```
template<class T>
static constexpr bool compliant (
    T n) [inline], [static], [constexpr], [inherited]
```

**12.307.2.28 set1() [2/2]**

```
static INLINE CONST vect_t set1 (
    const scalar_t x) [inline], [static], [inherited]
```

**12.307.2.29 set() [2/3]**

```
static INLINE CONST vect_t set (
    const scalar_t x0,
    const scalar_t x1,
    const scalar_t x2,
    const scalar_t x3,
    const scalar_t x4,
    const scalar_t x5,
    const scalar_t x6,
    const scalar_t x7) [inline], [static], [inherited]
```

**12.307.2.30 set() [3/3]**

```
static INLINE CONST vect_t set (
    const scalar_t x0,
    const scalar_t x1,
    const scalar_t x2,
    const scalar_t x3) [inline], [static], [inherited]
```

**12.307.2.31 gather() [2/2]**

```
template<class T>
static INLINE PURE vect_t gather (
```

```
const scalar_t *const p,
const T *const idx) [inline], [static], [inherited]
```

#### 12.307.2.32 load() [2/2]

```
static INLINE PURE vect_t load (
const scalar_t *const p) [inline], [static], [inherited]
```

#### 12.307.2.33 loadu() [2/2]

```
static INLINE PURE vect_t loadu (
const scalar_t *const p) [inline], [static], [inherited]
```

#### 12.307.2.34 store() [2/2]

```
static INLINE void store (
scalar_t * p,
vect_t v) [inline], [static], [inherited]
```

#### 12.307.2.35 maskstore() [2/2]

```
template<uint8_t k>
static INLINE void maskstore (
scalar_t * p,
vect_t v) [inline], [static], [inherited]
```

#### 12.307.2.36 storeu() [2/2]

```
static INLINE void storeu (
scalar_t * p,
vect_t v) [inline], [static], [inherited]
```

#### 12.307.2.37 stream() [2/2]

```
static INLINE void stream (
scalar_t * p,
const vect_t v) [inline], [static], [inherited]
```

#### 12.307.2.38 sll()

```
template<int s>
static INLINE CONST vect_t sll (
const vect_t a) [inline], [static], [inherited]
```

#### 12.307.2.39 srl()

```
template<int s>
static INLINE CONST vect_t srl (
const vect_t a) [inline], [static], [inherited]
```

#### 12.307.2.40 shuffle()

```
template<uint8_t s>
static INLINE CONST vect_t shuffle (
const vect_t a) [inline], [static], [inherited]
```

**12.307.2.41 unpacklo\_intrinsic()**

```
static INLINE CONST vect_t unpacklo_intrinsic (  
    const vect_t a,  
    const vect_t b) [inline], [static], [inherited]
```

**12.307.2.42 unpackhi\_intrinsic()**

```
static INLINE CONST vect_t unpackhi_intrinsic (  
    const vect_t a,  
    const vect_t b) [inline], [static], [inherited]
```

**12.307.2.43 unpacklo()**

```
static INLINE CONST vect_t unpacklo (  
    const vect_t a,  
    const vect_t b) [inline], [static], [inherited]
```

**12.307.2.44 unpackhi()**

```
static INLINE CONST vect_t unpackhi (  
    const vect_t a,  
    const vect_t b) [inline], [static], [inherited]
```

**12.307.2.45 unpacklohi()**

```
static INLINE void unpacklohi (  
    vect_t & lo,  
    vect_t & hi,  
    const vect_t a,  
    const vect_t b) [inline], [static], [inherited]
```

**12.307.2.46 pack\_even()**

```
static INLINE CONST vect_t pack_even (  
    const vect_t a,  
    const vect_t b) [inline], [static], [inherited]
```

**12.307.2.47 pack\_odd()**

```
static INLINE CONST vect_t pack_odd (  
    const vect_t a,  
    const vect_t b) [inline], [static], [inherited]
```

**12.307.2.48 pack()**

```
static INLINE void pack (  
    vect_t & even,  
    vect_t & odd,  
    const vect_t a,  
    const vect_t b) [inline], [static], [inherited]
```

**12.307.2.49 transpose()**

```
static INLINE void transpose (  
    vect_t & r0,  
    vect_t & r1,  
    vect_t & r2,  
    vect_t & r3,  
    vect_t & r4,
```

```
    vect_t & r5,  
    vect_t & r6,  
    vect_t & r7) [inline], [static], [inherited]
```

#### 12.307.2.50 blend()

```
template<uint8_t s>  
static INLINE CONST vect_t blend (  
    const vect_t a,  
    const vect_t b) [inline], [static], [inherited]
```

#### 12.307.2.51 add()

```
static INLINE CONST vect_t add (  
    const vect_t a,  
    const vect_t b) [inline], [static], [inherited]
```

#### 12.307.2.52 addin()

```
static INLINE vect_t addin (  
    vect_t & a,  
    const vect_t b) [inline], [static], [inherited]
```

#### 12.307.2.53 sub()

```
static INLINE CONST vect_t sub (  
    const vect_t a,  
    const vect_t b) [inline], [static], [inherited]
```

#### 12.307.2.54 subin()

```
static INLINE vect_t subin (  
    vect_t & a,  
    const vect_t b) [inline], [static], [inherited]
```

#### 12.307.2.55 mul()

```
static INLINE CONST vect_t mul (  
    const vect_t a,  
    const vect_t b) [inline], [static], [inherited]
```

#### 12.307.2.56 fmadd()

```
static INLINE CONST vect_t fmadd (  
    const vect_t c,  
    const vect_t a,  
    const vect_t b) [inline], [static], [inherited]
```

#### 12.307.2.57 fmaddin()

```
static INLINE vect_t fmaddin (  
    vect_t & c,  
    const vect_t a,  
    const vect_t b) [inline], [static], [inherited]
```

#### 12.307.2.58 fnmadd()

```
static INLINE CONST vect_t fnmadd (  
    const vect_t c,
```

```
const vect_t a,
const vect_t b) [inline], [static], [inherited]
```

#### 12.307.2.59 fnmaddin()

```
static INLINE vect_t fnmaddin (
    vect_t & c,
    const vect_t a,
    const vect_t b) [inline], [static], [inherited]
```

#### 12.307.2.60 fmsub()

```
static INLINE CONST vect_t fmsub (
    const vect_t c,
    const vect_t a,
    const vect_t b) [inline], [static], [inherited]
```

#### 12.307.2.61 fmsubin()

```
static INLINE vect_t fmsubin (
    vect_t & c,
    const vect_t a,
    const vect_t b) [inline], [static], [inherited]
```

#### 12.307.2.62 eq()

```
static INLINE CONST vect_t eq (
    const vect_t a,
    const vect_t b) [inline], [static], [inherited]
```

#### 12.307.2.63 round()

```
static INLINE CONST vect_t round (
    const vect_t a) [inline], [static], [inherited]
```

#### 12.307.2.64 mask\_high()

```
static INLINE CONST vect_t mask_high () [inline], [static], [inherited]
```

#### 12.307.2.65 mulhi\_fast()

```
INLINE CONST vect_t mulhi_fast (
    vect_t x,
    vect_t y) [static], [inherited]
```

#### 12.307.2.66 mod()

```
INLINE vect_t mod (
    vect_t & C,
    const __m512d & P,
    const __m512d & INV_P,
    const __m512d & NEG_P,
    const vect_t & POW50REM,
    const __m512d & MIN,
    const __m512d & MAX,
    __m512d & Q,
    __m512d & T) [static], [inherited]
```

**12.307.2.67 signbits()**

```
static INLINE CONST vect_t signbits (
    const vect_t x)  [inline], [static], [protected], [inherited]
```

**12.307.2.68 zero()**

```
static INLINE CONST vect_t zero ()  [inline], [static], [inherited]
```

**12.307.2.69 vor()**

```
static INLINE CONST vect_t vor (
    const vect_t a,
    const vect_t b)  [inline], [static], [inherited]
```

**12.307.2.70 vxor()**

```
static INLINE CONST vect_t vxor (
    const vect_t a,
    const vect_t b)  [inline], [static], [inherited]
```

**12.307.2.71 vand()**

```
static INLINE CONST vect_t vand (
    const vect_t a,
    const vect_t b)  [inline], [static], [inherited]
```

**12.307.2.72 vandnot()**

```
static INLINE CONST vect_t vandnot (
    const vect_t a,
    const vect_t b)  [inline], [static], [inherited]
```

**12.307.3 Field Documentation****12.307.3.1 vect\_size**

```
const constexpr size_t vect_size = 8  [static], [constexpr], [inherited]
```

**12.307.3.2 alignment**

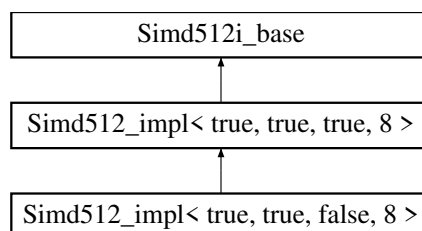
```
const constexpr size_t alignment = 64  [static], [constexpr], [inherited]
```

The documentation for this struct was generated from the following file:

- [simd512\\_int64.inl](#)

**12.308 Simd512\_impl< true, true, true, 8 > Struct Reference**

Inheritance diagram for Simd512\_impl< true, true, true, 8 >:





## Data Structures

- union [Converter](#)

## Public Types

- using [vect\\_t](#) = \_\_m512i
- using [half\\_t](#) = \_\_m256i
- using [scalar\\_t](#) = int64\_t
- using [simdHalf](#) = [Simd256](#)<[scalar\\_t](#)>
- using [aligned\\_allocator](#) = [AlignedAllocator](#)<[scalar\\_t](#), [Alignment](#)([alignment](#))>
- using [aligned\\_vector](#) = std::vector<[scalar\\_t](#), [aligned\\_allocator](#)>
- template<class [Field](#)>
  - using [is\\_same\\_element](#) = std::is\_same<typename [Field::Element](#), [scalar\\_t](#)>

## Static Public Member Functions

- static const std::string [type\\_string](#) ()
- template<class T>
  - static constexpr bool [valid](#) (T \*p)
- template<class T>
  - static constexpr bool [compliant](#) (T n)
- static [INLINE CONST vect\\_t set1](#) (const [scalar\\_t](#) x)
- static [INLINE CONST vect\\_t set](#) (const [scalar\\_t](#) x0, const [scalar\\_t](#) x1, const [scalar\\_t](#) x2, const [scalar\\_t](#) x3, const [scalar\\_t](#) x4, const [scalar\\_t](#) x5, const [scalar\\_t](#) x6, const [scalar\\_t](#) x7)
- static [INLINE CONST vect\\_t set](#) (const [scalar\\_t](#) x0, const [scalar\\_t](#) x1, const [scalar\\_t](#) x2, const [scalar\\_t](#) x3)
- template<class T>
  - static [INLINE PURE vect\\_t gather](#) (const [scalar\\_t](#) \*const p, const T \*const idx)
- static [INLINE PURE vect\\_t load](#) (const [scalar\\_t](#) \*const p)
- static [INLINE PURE vect\\_t loadu](#) (const [scalar\\_t](#) \*const p)
- static [INLINE void store](#) ([scalar\\_t](#) \*p, [vect\\_t](#) v)
- template<uint8\_t k>
  - static [INLINE void maskstore](#) ([scalar\\_t](#) \*p, [vect\\_t](#) v)
- static [INLINE void storeu](#) ([scalar\\_t](#) \*p, [vect\\_t](#) v)
- static [INLINE void stream](#) ([scalar\\_t](#) \*p, const [vect\\_t](#) v)
- template<int s>
  - static [INLINE CONST vect\\_t sll](#) (const [vect\\_t](#) a)
- template<int s>
  - static [INLINE CONST vect\\_t srl](#) (const [vect\\_t](#) a)
- template<int s>
  - static [INLINE CONST vect\\_t sra](#) (const [vect\\_t](#) a)
- template<uint8\_t s>
  - static [INLINE CONST vect\\_t shuffle](#) (const [vect\\_t](#) a)
- static [INLINE CONST vect\\_t unpacklo\\_intrinsic](#) (const [vect\\_t](#) a, const [vect\\_t](#) b)
- static [INLINE CONST vect\\_t unpackhi\\_intrinsic](#) (const [vect\\_t](#) a, const [vect\\_t](#) b)
- static [INLINE CONST vect\\_t unpacklo](#) (const [vect\\_t](#) a, const [vect\\_t](#) b)
- static [INLINE CONST vect\\_t unpackhi](#) (const [vect\\_t](#) a, const [vect\\_t](#) b)
- static [INLINE void unpacklohi](#) ([vect\\_t](#) &lo, [vect\\_t](#) &hi, const [vect\\_t](#) a, const [vect\\_t](#) b)
- static [INLINE CONST vect\\_t pack\\_even](#) (const [vect\\_t](#) a, const [vect\\_t](#) b)
- static [INLINE CONST vect\\_t pack\\_odd](#) (const [vect\\_t](#) a, const [vect\\_t](#) b)
- static [INLINE void pack](#) ([vect\\_t](#) &even, [vect\\_t](#) &odd, const [vect\\_t](#) a, const [vect\\_t](#) b)
- static [INLINE void transpose](#) ([vect\\_t](#) &r0, [vect\\_t](#) &r1, [vect\\_t](#) &r2, [vect\\_t](#) &r3, [vect\\_t](#) &r4, [vect\\_t](#) &r5, [vect\\_t](#) &r6, [vect\\_t](#) &r7)
- template<uint8\_t s>
  - static [INLINE CONST vect\\_t blend](#) (const [vect\\_t](#) a, const [vect\\_t](#) b)
- static [INLINE CONST vect\\_t add](#) (const [vect\\_t](#) a, const [vect\\_t](#) b)
- static [INLINE vect\\_t addin](#) ([vect\\_t](#) &a, const [vect\\_t](#) b)

- static `INLINE CONST vect_t sub` (const `vect_t` a, const `vect_t` b)
- static `INLINE vect_t subin` (`vect_t` &a, const `vect_t` b)
- static `INLINE CONST vect_t mullo` (`vect_t` a, `vect_t` b)
- static `INLINE CONST vect_t mul` (const `vect_t` a, const `vect_t` b)
- static `INLINE CONST vect_t mulhi` (`vect_t` a, `vect_t` b)
- static `INLINE CONST vect_t mulx` (const `vect_t` a, const `vect_t` b)
- static `INLINE CONST vect_t fmadd` (const `vect_t` c, const `vect_t` a, const `vect_t` b)
- static `INLINE vect_t fmaddin` (`vect_t` &c, const `vect_t` a, const `vect_t` b)
- static `INLINE CONST vect_t fmaddx` (const `vect_t` c, const `vect_t` a, const `vect_t` b)
- static `INLINE vect_t fmaddxin` (`vect_t` &c, const `vect_t` a, const `vect_t` b)
- static `INLINE CONST vect_t fnmadd` (const `vect_t` c, const `vect_t` a, const `vect_t` b)
- static `INLINE vect_t fnmaddin` (`vect_t` &c, const `vect_t` a, const `vect_t` b)
- static `INLINE CONST vect_t fnmaddx` (const `vect_t` c, const `vect_t` a, const `vect_t` b)
- static `INLINE vect_t fnmaddxin` (`vect_t` &c, const `vect_t` a, const `vect_t` b)
- static `INLINE CONST vect_t fmsub` (const `vect_t` c, const `vect_t` a, const `vect_t` b)
- static `INLINE vect_t fmsubin` (`vect_t` &c, const `vect_t` a, const `vect_t` b)
- static `INLINE CONST vect_t fmsubx` (const `vect_t` c, const `vect_t` a, const `vect_t` b)
- static `INLINE vect_t fmsubxin` (`vect_t` &c, const `vect_t` a, const `vect_t` b)
- static `INLINE CONST vect_t eq` (const `vect_t` a, const `vect_t` b)
- static `INLINE CONST vect_t greater` (const `vect_t` a, const `vect_t` b)
- static `INLINE CONST vect_t lesser` (const `vect_t` a, const `vect_t` b)
- static `INLINE CONST vect_t greater_eq` (const `vect_t` a, const `vect_t` b)
- static `INLINE CONST vect_t lesser_eq` (const `vect_t` a, const `vect_t` b)
- static `INLINE CONST scalar_t hadd_to_scal` (const `vect_t` a)
- static `INLINE CONST vect_t round` (const `vect_t` a)
- static `INLINE CONST vect_t mask_high` ()
- static `INLINE CONST vect_t mulhi_fast` (`vect_t` x, `vect_t` y)
- static `INLINE vect_t mod` (`vect_t` &C, const `__m512d` &P, const `__m512d` &INVP, const `__m512d` &NEGP, const `vect_t` &POW50REM, const `__m512d` &MIN, const `__m512d` &MAX, `__m512d` &Q, `__m512d` &T)
- static `INLINE CONST vect_t zero` ()
- static `INLINE CONST vect_t vor` (const `vect_t` a, const `vect_t` b)
- static `INLINE CONST vect_t vxor` (const `vect_t` a, const `vect_t` b)
- static `INLINE CONST vect_t vand` (const `vect_t` a, const `vect_t` b)
- static `INLINE CONST vect_t vandnot` (const `vect_t` a, const `vect_t` b)

### Static Public Attributes

- static const constexpr size\_t `vect_size` = 8
- static const constexpr size\_t `alignment` = 64

### Static Protected Member Functions

- static `INLINE CONST vect_t signbits` (const `vect_t` x)

## 12.308.1 Member Typedef Documentation

### 12.308.1.1 `vect_t`

```
using vect_t = __m512i
```

### 12.308.1.2 `half_t`

```
using half_t = __m256i
```

### 12.308.1.3 `scalar_t`

```
using scalar_t = int64_t
```

**12.308.1.4 simdHalf**

```
using simdHalf = Simd256<scalar_t>
```

**12.308.1.5 aligned\_allocator**

```
using aligned_allocator = AlignedAllocator<scalar_t, Alignment(alignment)>
```

**12.308.1.6 aligned\_vector**

```
using aligned_vector = std::vector<scalar_t, aligned_allocator>
```

**12.308.1.7 is\_same\_element**

```
template<class Field>
using is_same_element = std::is_same<typename Field::Element, scalar_t>
```

**12.308.2 Member Function Documentation****12.308.2.1 type\_string()**

```
static const std::string type_string () [inline], [static]
```

**12.308.2.2 valid()**

```
template<class T>
static constexpr bool valid (
    T * p) [inline], [static], [constexpr]
```

**12.308.2.3 compliant()**

```
template<class T>
static constexpr bool compliant (
    T n) [inline], [static], [constexpr]
```

**12.308.2.4 set1()**

```
static INLINE CONST vect_t set1 (
    const scalar_t x) [inline], [static]
```

**12.308.2.5 set() [1/2]**

```
static INLINE CONST vect_t set (
    const scalar_t x0,
    const scalar_t x1,
    const scalar_t x2,
    const scalar_t x3,
    const scalar_t x4,
    const scalar_t x5,
    const scalar_t x6,
    const scalar_t x7) [inline], [static]
```

**12.308.2.6 set() [2/2]**

```
static INLINE CONST vect_t set (
    const scalar_t x0,
    const scalar_t x1,
    const scalar_t x2,
    const scalar_t x3) [inline], [static]
```

#### 12.308.2.7 gather()

```
template<class T>
static INLINE PURE vect_t gather (
    const scalar_t *const p,
    const T *const idx) [inline], [static]
```

#### 12.308.2.8 load()

```
static INLINE PURE vect_t load (
    const scalar_t *const p) [inline], [static]
```

#### 12.308.2.9 loadu()

```
static INLINE PURE vect_t loadu (
    const scalar_t *const p) [inline], [static]
```

#### 12.308.2.10 store()

```
static INLINE void store (
    scalar_t * p,
    vect_t v) [inline], [static]
```

#### 12.308.2.11 maskstore()

```
template<uint8_t k>
static INLINE void maskstore (
    scalar_t * p,
    vect_t v) [inline], [static]
```

#### 12.308.2.12 storeu()

```
static INLINE void storeu (
    scalar_t * p,
    vect_t v) [inline], [static]
```

#### 12.308.2.13 stream()

```
static INLINE void stream (
    scalar_t * p,
    const vect_t v) [inline], [static]
```

#### 12.308.2.14 sll()

```
template<int s>
static INLINE CONST vect_t sll (
    const vect_t a) [inline], [static]
```

#### 12.308.2.15 srl()

```
template<int s>
static INLINE CONST vect_t srl (
    const vect_t a) [inline], [static]
```

#### 12.308.2.16 sra()

```
template<int s>
static INLINE CONST vect_t sra (
    const vect_t a) [inline], [static]
```

**12.308.2.17 shuffle()**

```
template<uint8_t s>
static INLINE CONST vect_t shuffle (
    const vect_t a) [inline], [static]
```

**12.308.2.18 unpacklo\_intrinsic()**

```
static INLINE CONST vect_t unpacklo_intrinsic (
    const vect_t a,
    const vect_t b) [inline], [static]
```

**12.308.2.19 unpackhi\_intrinsic()**

```
static INLINE CONST vect_t unpackhi_intrinsic (
    const vect_t a,
    const vect_t b) [inline], [static]
```

**12.308.2.20 unpacklo()**

```
static INLINE CONST vect_t unpacklo (
    const vect_t a,
    const vect_t b) [inline], [static]
```

**12.308.2.21 unpackhi()**

```
static INLINE CONST vect_t unpackhi (
    const vect_t a,
    const vect_t b) [inline], [static]
```

**12.308.2.22 unpacklohi()**

```
static INLINE void unpacklohi (
    vect_t & lo,
    vect_t & hi,
    const vect_t a,
    const vect_t b) [inline], [static]
```

**12.308.2.23 pack\_even()**

```
static INLINE CONST vect_t pack_even (
    const vect_t a,
    const vect_t b) [inline], [static]
```

**12.308.2.24 pack\_odd()**

```
static INLINE CONST vect_t pack_odd (
    const vect_t a,
    const vect_t b) [inline], [static]
```

**12.308.2.25 pack()**

```
static INLINE void pack (
    vect_t & even,
    vect_t & odd,
    const vect_t a,
    const vect_t b) [inline], [static]
```

**12.308.2.26 transpose()**

```
static INLINE void transpose (  
    vect_t & r0,  
    vect_t & r1,  
    vect_t & r2,  
    vect_t & r3,  
    vect_t & r4,  
    vect_t & r5,  
    vect_t & r6,  
    vect_t & r7) [inline], [static]
```

**12.308.2.27 blend()**

```
template<uint8_t s>  
static INLINE CONST vect_t blend (  
    const vect_t a,  
    const vect_t b) [inline], [static]
```

**12.308.2.28 add()**

```
static INLINE CONST vect_t add (  
    const vect_t a,  
    const vect_t b) [inline], [static]
```

**12.308.2.29 addin()**

```
static INLINE vect_t addin (  
    vect_t & a,  
    const vect_t b) [inline], [static]
```

**12.308.2.30 sub()**

```
static INLINE CONST vect_t sub (  
    const vect_t a,  
    const vect_t b) [inline], [static]
```

**12.308.2.31 subin()**

```
static INLINE vect_t subin (  
    vect_t & a,  
    const vect_t b) [inline], [static]
```

**12.308.2.32 mullo()**

```
static INLINE CONST vect_t mullo (  
    vect_t a,  
    vect_t b) [inline], [static]
```

**12.308.2.33 mul()**

```
static INLINE CONST vect_t mul (  
    const vect_t a,  
    const vect_t b) [inline], [static]
```

**12.308.2.34 mulhi()**

```
static INLINE CONST vect_t mulhi (  
    vect_t a,  
    vect_t b) [inline], [static]
```

**12.308.2.35 mulx()**

```
static INLINE CONST vect_t mulx (  
    const vect_t a,  
    const vect_t b) [inline], [static]
```

**12.308.2.36 fmadd()**

```
static INLINE CONST vect_t fmadd (  
    const vect_t c,  
    const vect_t a,  
    const vect_t b) [inline], [static]
```

**12.308.2.37 fmaddin()**

```
static INLINE vect_t fmaddin (  
    vect_t & c,  
    const vect_t a,  
    const vect_t b) [inline], [static]
```

**12.308.2.38 fmaddx()**

```
static INLINE CONST vect_t fmaddx (  
    const vect_t c,  
    const vect_t a,  
    const vect_t b) [inline], [static]
```

**12.308.2.39 fmaddxin()**

```
static INLINE vect_t fmaddxin (  
    vect_t & c,  
    const vect_t a,  
    const vect_t b) [inline], [static]
```

**12.308.2.40 fnmadd()**

```
static INLINE CONST vect_t fnmadd (  
    const vect_t c,  
    const vect_t a,  
    const vect_t b) [inline], [static]
```

**12.308.2.41 fnmaddin()**

```
static INLINE vect_t fnmaddin (  
    vect_t & c,  
    const vect_t a,  
    const vect_t b) [inline], [static]
```

**12.308.2.42 fnmaddx()**

```
static INLINE CONST vect_t fnmaddx (  
    const vect_t c,  
    const vect_t a,  
    const vect_t b) [inline], [static]
```

**12.308.2.43 fnmaddxin()**

```
static INLINE vect_t fnmaddxin (  
    vect_t & c,
```

```
const vect_t a,  
const vect_t b) [inline], [static]
```

#### 12.308.2.44 fmsub()

```
static INLINE CONST vect_t fmsub (  
    const vect_t c,  
    const vect_t a,  
    const vect_t b) [inline], [static]
```

#### 12.308.2.45 fmsubin()

```
static INLINE vect_t fmsubin (  
    vect_t & c,  
    const vect_t a,  
    const vect_t b) [inline], [static]
```

#### 12.308.2.46 fmsubx()

```
static INLINE CONST vect_t fmsubx (  
    const vect_t c,  
    const vect_t a,  
    const vect_t b) [inline], [static]
```

#### 12.308.2.47 fmsubxin()

```
static INLINE vect_t fmsubxin (  
    vect_t & c,  
    const vect_t a,  
    const vect_t b) [inline], [static]
```

#### 12.308.2.48 eq()

```
static INLINE CONST vect_t eq (  
    const vect_t a,  
    const vect_t b) [inline], [static]
```

#### 12.308.2.49 greater()

```
static INLINE CONST vect_t greater (  
    const vect_t a,  
    const vect_t b) [inline], [static]
```

#### 12.308.2.50 lesser()

```
static INLINE CONST vect_t lesser (  
    const vect_t a,  
    const vect_t b) [inline], [static]
```

#### 12.308.2.51 greater\_eq()

```
static INLINE CONST vect_t greater_eq (  
    const vect_t a,  
    const vect_t b) [inline], [static]
```

#### 12.308.2.52 lesser\_eq()

```
static INLINE CONST vect_t lesser_eq (  
    const vect_t a,  
    const vect_t b) [inline], [static]
```



**12.308.2.53 hadd\_to\_scal()**

```
static INLINE CONST scalar_t hadd_to_scal (
    const vect_t a) [inline], [static]
```

**12.308.2.54 round()**

```
static INLINE CONST vect_t round (
    const vect_t a) [inline], [static]
```

**12.308.2.55 mask\_high()**

```
static INLINE CONST vect_t mask_high () [inline], [static]
```

**12.308.2.56 mulhi\_fast()**

```
INLINE CONST vect_t mulhi_fast (
    vect_t x,
    vect_t y) [static]
```

**12.308.2.57 mod()**

```
INLINE vect_t mod (
    vect_t & C,
    const __m512d & P,
    const __m512d & INV_P,
    const __m512d & NEG_P,
    const vect_t & POW50REM,
    const __m512d & MIN,
    const __m512d & MAX,
    __m512d & Q,
    __m512d & T) [static]
```

**12.308.2.58 signbits()**

```
static INLINE CONST vect_t signbits (
    const vect_t x) [inline], [static], [protected]
```

**12.308.2.59 zero()**

```
static INLINE CONST vect_t zero () [inline], [static], [inherited]
```

**12.308.2.60 vor()**

```
static INLINE CONST vect_t vor (
    const vect_t a,
    const vect_t b) [inline], [static], [inherited]
```

**12.308.2.61 vxor()**

```
static INLINE CONST vect_t vxor (
    const vect_t a,
    const vect_t b) [inline], [static], [inherited]
```

**12.308.2.62 vand()**

```
static INLINE CONST vect_t vand (
    const vect_t a,
    const vect_t b) [inline], [static], [inherited]
```

### 12.308.2.63 vandnot()

```
static INLINE CONST vect_t vandnot (
    const vect_t a,
    const vect_t b) [inline], [static], [inherited]
```

## 12.308.3 Field Documentation

### 12.308.3.1 vect\_size

```
const constexpr size_t vect_size = 8 [static], [constexpr]
```

### 12.308.3.2 alignment

```
const constexpr size_t alignment = 64 [static], [constexpr]
```

The documentation for this struct was generated from the following file:

- [simd512\\_int64.inl](#)

## 12.309 Simd512i\_base Struct Reference

Inheritance diagram for Simd512i\_base:



### Public Types

- using `vect_t` = `__m512i`

### Static Public Member Functions

- static `INLINE CONST vect_t zero ()`
- static `INLINE CONST vect_t vor (const vect_t a, const vect_t b)`
- static `INLINE CONST vect_t vxor (const vect_t a, const vect_t b)`
- static `INLINE CONST vect_t vand (const vect_t a, const vect_t b)`
- static `INLINE CONST vect_t vandnot (const vect_t a, const vect_t b)`

## 12.309.1 Member Typedef Documentation

### 12.309.1.1 vect\_t

```
using vect_t = __m512i
```

## 12.309.2 Member Function Documentation

### 12.309.2.1 zero()

```
static INLINE CONST vect_t zero () [inline], [static]
```

### 12.309.2.2 vor()

```
static INLINE CONST vect_t vor (
    const vect_t a,
    const vect_t b) [inline], [static]
```

**12.309.2.3 vxor()**

```
static INLINE CONST vect_t vxor (
    const vect_t a,
    const vect_t b) [inline], [static]
```

**12.309.2.4 vand()**

```
static INLINE CONST vect_t vand (
    const vect_t a,
    const vect_t b) [inline], [static]
```

**12.309.2.5 vandnot()**

```
static INLINE CONST vect_t vandnot (
    const vect_t a,
    const vect_t b) [inline], [static]
```

The documentation for this struct was generated from the following file:

- [simd512.inl](#)

**12.310 SimdChooser< T, bool, bool > Struct Template Reference**

```
#include <fflas_simd.h>
```

The documentation for this struct was generated from the following file:

- [fflas\\_simd.h](#)

**12.311 SimdChooser< T, false, b > Struct Template Reference**

```
#include <fflas_simd.h>
```

**Public Types**

- using [value](#) = [NoSimd](#)<T>

**12.311.1 Member Typedef Documentation****12.311.1.1 value**

```
template<class T, bool b>
using value = NoSimd<T>
```

The documentation for this struct was generated from the following file:

- [fflas\\_simd.h](#)

**12.312 SimdChooser< T, true, false > Struct Template Reference**

```
#include <fflas_simd.h>
```

**Public Types**

- using [value](#) = [NoSimd](#)<T>

### 12.312.1 Member Typedef Documentation

#### 12.312.1.1 value

```
template<class T>
using value = NoSimd<T>
```

The documentation for this struct was generated from the following file:

- [fflas\\_simd.h](#)

### 12.313 SimdChooser< T, true, true > Struct Template Reference

```
#include <fflas_simd.h>
```

#### Public Types

- using [value](#) = [NoSimd](#)<T>

### 12.313.1 Member Typedef Documentation

#### 12.313.1.1 value

```
template<class T>
using value = NoSimd<T>
```

The documentation for this struct was generated from the following file:

- [fflas\\_simd.h](#)

### 12.314 simdToType< T > Struct Template Reference

The documentation for this struct was generated from the following file:

- [fflas\\_simd.h](#)

### 12.315 Single Struct Reference

The documentation for this struct was generated from the following file:

- [blockcuts.inl](#)

### 12.316 Sparse< Field, SparseMatrix\_t, IdxT, PtrT > Struct Template Reference

The documentation for this struct was generated from the following file:

- [fflas\\_sparse.h](#)

### 12.317 Sparse< \_Field, SparseMatrix\_t::COO > Struct Template Reference

```
#include <coo.h>
```

Inheritance diagram for Sparse< \_Field, SparseMatrix\_t::COO >:



## Public Types

- using [Field](#) = \_Field

## Data Fields

- [index\\_t](#) \* [col](#) = nullptr
- [index\\_t](#) \* [row](#) = nullptr
- \_Field::Element\_ptr [dat](#)
- bool [delayed](#) = false
- uint64\_t [kmax](#) = 0
- [index\\_t](#) [m](#) = 0
- [index\\_t](#) [n](#) = 0
- uint64\_t [nnz](#) = 0
- uint64\_t [nElements](#) = 0
- uint64\_t [maxrow](#) = 0

## 12.317.1 Member Typedef Documentation

### 12.317.1.1 Field

```
template<class _Field>
using Field = _Field
```

## 12.317.2 Field Documentation

### 12.317.2.1 col

```
template<class _Field>
index\_t* col = nullptr
```

### 12.317.2.2 row

```
template<class _Field>
index\_t* row = nullptr
```

### 12.317.2.3 dat

```
template<class _Field>
_Field::Element_ptr dat
```

### 12.317.2.4 delayed

```
template<class _Field>
bool delayed = false
```

### 12.317.2.5 kmax

```
template<class _Field>
uint64_t kmax = 0
```

### 12.317.2.6 m

```
template<class _Field>
index\_t m = 0
```

### 12.317.2.7 n

```
template<class _Field>
index\_t n = 0
```

**12.317.2.8 nnz**

```
template<class _Field>
uint64_t nnz = 0
```

**12.317.2.9 nElements**

```
template<class _Field>
uint64_t nElements = 0
```

**12.317.2.10 maxrow**

```
template<class _Field>
uint64_t maxrow = 0
```

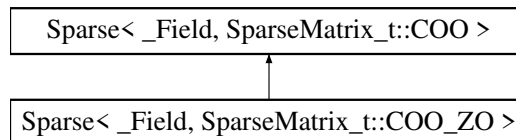
The documentation for this struct was generated from the following file:

- [coo.h](#)

## 12.318 Sparse<\_Field, SparseMatrix\_t::COO\_ZO > Struct Template Reference

```
#include <coo.h>
```

Inheritance diagram for Sparse<\_Field, SparseMatrix\_t::COO\_ZO >:

**Public Types**

- using [Field](#) = \_Field

**Data Fields**

- \_Field::Element [cst](#) = 1
- [index\\_t](#) \* [col](#) = nullptr
- [index\\_t](#) \* [row](#) = nullptr
- \_Field::Element\_ptr [dat](#)
- bool [delayed](#) = false
- uint64\_t [kmax](#) = 0
- [index\\_t](#) [m](#) = 0
- [index\\_t](#) [n](#) = 0
- uint64\_t [nnz](#) = 0
- uint64\_t [nElements](#) = 0
- uint64\_t [maxrow](#) = 0

**12.318.1 Member Typedef Documentation****12.318.1.1 Field**

```
template<class _Field>
using Field = _Field
```

## 12.318.2 Field Documentation

### 12.318.2.1 cst

```
template<class _Field>
_Field::Element cst = 1
```

### 12.318.2.2 col

```
template<class _Field>
index_t* col = nullptr [inherited]
```

### 12.318.2.3 row

```
template<class _Field>
index_t* row = nullptr [inherited]
```

### 12.318.2.4 dat

```
template<class _Field>
_Field::Element_ptr dat [inherited]
```

### 12.318.2.5 delayed

```
template<class _Field>
bool delayed = false [inherited]
```

### 12.318.2.6 kmax

```
template<class _Field>
uint64_t kmax = 0 [inherited]
```

### 12.318.2.7 m

```
template<class _Field>
index_t m = 0 [inherited]
```

### 12.318.2.8 n

```
template<class _Field>
index_t n = 0 [inherited]
```

### 12.318.2.9 nnz

```
template<class _Field>
uint64_t nnz = 0 [inherited]
```

### 12.318.2.10 nElements

```
template<class _Field>
uint64_t nElements = 0 [inherited]
```

### 12.318.2.11 maxrow

```
template<class _Field>
uint64_t maxrow = 0 [inherited]
```

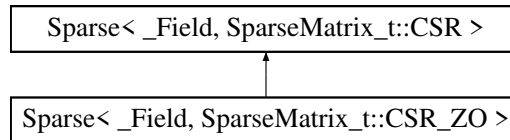
The documentation for this struct was generated from the following file:

- [coo.h](#)

## 12.319 Sparse< \_Field, SparseMatrix\_t::CSR > Struct Template Reference

```
#include <csr.h>
```

Inheritance diagram for Sparse< \_Field, SparseMatrix\_t::CSR >:



### Public Types

- using [Field](#) = \_Field

### Data Fields

- bool [delayed](#) = false
- uint64\_t [kmax](#) = 0
- [index\\_t](#) [m](#) = 0
- [index\\_t](#) [n](#) = 0
- uint64\_t [nnz](#) = 0
- uint64\_t [nElements](#) = 0
- uint64\_t [maxrow](#) = 0
- [index\\_t](#) \* [col](#) = nullptr
- [index\\_t](#) \* [st](#) = nullptr
- [index\\_t](#) \* [stend](#) = nullptr
- \_Field::Element\_ptr [dat](#)

### 12.319.1 Member Typedef Documentation

#### 12.319.1.1 Field

```
template<class _Field>
using Field = _Field
```

### 12.319.2 Field Documentation

#### 12.319.2.1 delayed

```
template<class _Field>
bool delayed = false
```

#### 12.319.2.2 kmax

```
template<class _Field>
uint64_t kmax = 0
```

#### 12.319.2.3 m

```
template<class _Field>
index\_t m = 0
```

#### 12.319.2.4 n

```
template<class _Field>
index\_t n = 0
```



**12.319.2.5 nnz**

```
template<class _Field>
uint64_t nnz = 0
```

**12.319.2.6 nElements**

```
template<class _Field>
uint64_t nElements = 0
```

**12.319.2.7 maxrow**

```
template<class _Field>
uint64_t maxrow = 0
```

**12.319.2.8 col**

```
template<class _Field>
index_t* col = nullptr
```

**12.319.2.9 st**

```
template<class _Field>
index_t* st = nullptr
```

**12.319.2.10 stend**

```
template<class _Field>
index_t* stend = nullptr
```

**12.319.2.11 dat**

```
template<class _Field>
_Field::Element_ptr dat
```

The documentation for this struct was generated from the following file:

- [csr.h](#)

## 12.320 Sparse< \_Field, SparseMatrix\_t::CSR\_HYB > Struct Template Reference

```
#include <csr_hyb.h>
```

**Public Types**

- using [Field](#) = \_Field

**Data Fields**

- bool [delayed](#) = false
- [index\\_t](#) \* [col](#) = nullptr
- [index\\_t](#) \* [st](#) = nullptr
- \_Field::Element\_ptr [dat](#)
- uint64\_t [kmax](#) = 0
- [index\\_t](#) [m](#) = 0
- [index\\_t](#) [n](#) = 0
- uint64\_t [nnz](#) = 0
- uint64\_t [nElements](#) = 0

- uint64\_t `maxrow` = 0
- uint64\_t `nOnes` = 0
- uint64\_t `nMOnes` = 0
- uint64\_t `nOthers` = 0

## 12.320.1 Member Typedef Documentation

### 12.320.1.1 Field

```
template<class _Field>
using Field = _Field
```

## 12.320.2 Field Documentation

### 12.320.2.1 delayed

```
template<class _Field>
bool delayed = false
```

### 12.320.2.2 col

```
template<class _Field>
index_t* col = nullptr
```

### 12.320.2.3 st

```
template<class _Field>
index_t* st = nullptr
```

### 12.320.2.4 dat

```
template<class _Field>
_Field::Element_ptr dat
```

### 12.320.2.5 kmax

```
template<class _Field>
uint64_t kmax = 0
```

### 12.320.2.6 m

```
template<class _Field>
index_t m = 0
```

### 12.320.2.7 n

```
template<class _Field>
index_t n = 0
```

### 12.320.2.8 nnz

```
template<class _Field>
uint64_t nnz = 0
```

### 12.320.2.9 nElements

```
template<class _Field>
uint64_t nElements = 0
```

**12.320.2.10 maxrow**

```
template<class _Field>
uint64_t maxrow = 0
```

**12.320.2.11 nOnes**

```
template<class _Field>
uint64_t nOnes = 0
```

**12.320.2.12 nMOnes**

```
template<class _Field>
uint64_t nMOnes = 0
```

**12.320.2.13 nOthers**

```
template<class _Field>
uint64_t nOthers = 0
```

The documentation for this struct was generated from the following file:

- [csr\\_hyb.h](#)

## 12.321 Sparse< \_Field, SparseMatrix\_t::CSR\_ZO > Struct Template Reference

```
#include <csr.h>
```

Inheritance diagram for Sparse< \_Field, SparseMatrix\_t::CSR\_ZO >:

**Public Types**

- using [Field](#) = \_Field

**Data Fields**

- int64\_t [cst](#) = 1
- bool [delayed](#) = false
- uint64\_t [kmax](#) = 0
- [index\\_t](#) [m](#) = 0
- [index\\_t](#) [n](#) = 0
- uint64\_t [nnz](#) = 0
- uint64\_t [nElements](#) = 0
- uint64\_t [maxrow](#) = 0
- [index\\_t](#) \* [col](#) = nullptr
- [index\\_t](#) \* [st](#) = nullptr
- [index\\_t](#) \* [stend](#) = nullptr
- \_Field::Element\_ptr [dat](#)

## 12.321.1 Member Typedef Documentation

### 12.321.1.1 Field

```
template<class _Field>
using Field = _Field
```

## 12.321.2 Field Documentation

### 12.321.2.1 cst

```
template<class _Field>
int64_t cst = 1
```

### 12.321.2.2 delayed

```
template<class _Field>
bool delayed = false
```

### 12.321.2.3 kmax

```
template<class _Field>
uint64_t kmax = 0 [inherited]
```

### 12.321.2.4 m

```
template<class _Field>
index_t m = 0 [inherited]
```

### 12.321.2.5 n

```
template<class _Field>
index_t n = 0 [inherited]
```

### 12.321.2.6 nnz

```
template<class _Field>
uint64_t nnz = 0 [inherited]
```

### 12.321.2.7 nElements

```
template<class _Field>
uint64_t nElements = 0 [inherited]
```

### 12.321.2.8 maxrow

```
template<class _Field>
uint64_t maxrow = 0 [inherited]
```

### 12.321.2.9 col

```
template<class _Field>
index_t* col = nullptr [inherited]
```

### 12.321.2.10 st

```
template<class _Field>
index_t* st = nullptr [inherited]
```

**12.321.2.11 stend**

```
template<class _Field>
index_t* stend = nullptr [inherited]
```

**12.321.2.12 dat**

```
template<class _Field>
_Field::Element_ptr dat [inherited]
```

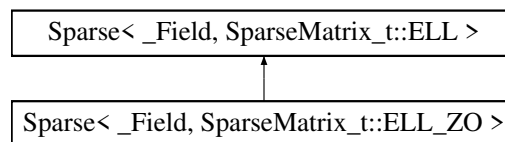
The documentation for this struct was generated from the following file:

- [csr.h](#)

## 12.322 Sparse< \_Field, SparseMatrix\_t::ELL > Struct Template Reference

```
#include <ell.h>
```

Inheritance diagram for Sparse< \_Field, SparseMatrix\_t::ELL >:

**Public Types**

- using [Field](#) = \_Field

**Data Fields**

- bool [delayed](#) = false
- uint64\_t [kmax](#) = 0
- [index\\_t](#) [m](#) = 0
- [index\\_t](#) [n](#) = 0
- [index\\_t](#) [ld](#) = 0
- uint64\_t [nnz](#) = 0
- uint64\_t [nElements](#) = 0
- uint64\_t [maxrow](#) = 0
- [index\\_t](#) \* [col](#) = nullptr
- \_Field::Element\_ptr [dat](#)

**12.322.1 Member Typedef Documentation****12.322.1.1 Field**

```
template<class _Field>
using Field = _Field
```

**12.322.2 Field Documentation****12.322.2.1 delayed**

```
template<class _Field>
bool delayed = false
```

**12.322.2.2 kmax**

```
template<class _Field>
uint64_t kmax = 0
```

**12.322.2.3 m**

```
template<class _Field>
index_t m = 0
```

**12.322.2.4 n**

```
template<class _Field>
index_t n = 0
```

**12.322.2.5 ld**

```
template<class _Field>
index_t ld = 0
```

**12.322.2.6 nnz**

```
template<class _Field>
uint64_t nnz = 0
```

**12.322.2.7 nElements**

```
template<class _Field>
uint64_t nElements = 0
```

**12.322.2.8 maxrow**

```
template<class _Field>
uint64_t maxrow = 0
```

**12.322.2.9 col**

```
template<class _Field>
index_t* col = nullptr
```

**12.322.2.10 dat**

```
template<class _Field>
_Field::Element_ptr dat
```

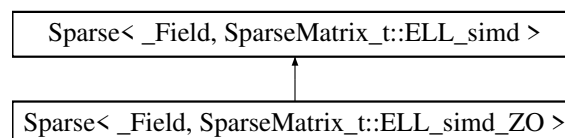
The documentation for this struct was generated from the following file:

- [ell.h](#)

## 12.323 Sparse< \_Field, SparseMatrix\_t::ELL\_simd > Struct Template Reference

```
#include <ell_simd.h>
```

Inheritance diagram for Sparse< \_Field, SparseMatrix\_t::ELL\_simd >:



## Data Fields

- bool `delayed` = false
- int `chunk` = 0
- `index_t` `m` = 0
- `index_t` `n` = 0
- `index_t` `ld` = 0
- `uint64_t` `kmax` = 0
- `uint64_t` `nnz` = 0
- `uint64_t` `nElements` = 0
- `uint64_t` `maxrow` = 0
- `uint64_t` `nChunks` = 0
- `index_t` \* `col` = nullptr
- `_Field::Element_ptr` `dat`

## 12.323.1 Field Documentation

### 12.323.1.1 `delayed`

```
template<class _Field>
bool delayed = false
```

### 12.323.1.2 `chunk`

```
template<class _Field>
int chunk = 0
```

### 12.323.1.3 `m`

```
template<class _Field>
index_t m = 0
```

### 12.323.1.4 `n`

```
template<class _Field>
index_t n = 0
```

### 12.323.1.5 `ld`

```
template<class _Field>
index_t ld = 0
```

### 12.323.1.6 `kmax`

```
template<class _Field>
uint64_t kmax = 0
```

### 12.323.1.7 `nnz`

```
template<class _Field>
uint64_t nnz = 0
```

### 12.323.1.8 `nElements`

```
template<class _Field>
uint64_t nElements = 0
```

**12.323.1.9 maxrow**

```
template<class _Field>
uint64_t maxrow = 0
```

**12.323.1.10 nChunks**

```
template<class _Field>
uint64_t nChunks = 0
```

**12.323.1.11 col**

```
template<class _Field>
index_t* col = nullptr
```

**12.323.1.12 dat**

```
template<class _Field>
_Field::Element_ptr dat
```

The documentation for this struct was generated from the following file:

- [ell\\_simd.h](#)

## 12.324 Sparse< \_Field, SparseMatrix\_t::ELL\_simd\_ZO > Struct Template Reference

```
#include <ell_simd.h>
```

Inheritance diagram for Sparse< \_Field, SparseMatrix\_t::ELL\_simd\_ZO >:

**Data Fields**

- \_Field::Element [cst](#) = 1
- bool [delayed](#) = false
- int [chunk](#) = 0
- [index\\_t](#) [m](#) = 0
- [index\\_t](#) [n](#) = 0
- [index\\_t](#) [ld](#) = 0
- uint64\_t [kmax](#) = 0
- uint64\_t [nnz](#) = 0
- uint64\_t [nElements](#) = 0
- uint64\_t [maxrow](#) = 0
- uint64\_t [nChunks](#) = 0
- [index\\_t](#) \* [col](#) = nullptr
- \_Field::Element\_ptr [dat](#)

**12.324.1 Field Documentation****12.324.1.1 cst**

```
template<class _Field>
_Field::Element cst = 1
```



### 12.324.1.2 delayed

```
template<class _Field>
bool delayed = false [inherited]
```

### 12.324.1.3 chunk

```
template<class _Field>
int chunk = 0 [inherited]
```

### 12.324.1.4 m

```
template<class _Field>
index_t m = 0 [inherited]
```

### 12.324.1.5 n

```
template<class _Field>
index_t n = 0 [inherited]
```

### 12.324.1.6 ld

```
template<class _Field>
index_t ld = 0 [inherited]
```

### 12.324.1.7 kmax

```
template<class _Field>
uint64_t kmax = 0 [inherited]
```

### 12.324.1.8 nnz

```
template<class _Field>
uint64_t nnz = 0 [inherited]
```

### 12.324.1.9 nElements

```
template<class _Field>
uint64_t nElements = 0 [inherited]
```

### 12.324.1.10 maxrow

```
template<class _Field>
uint64_t maxrow = 0 [inherited]
```

### 12.324.1.11 nChunks

```
template<class _Field>
uint64_t nChunks = 0 [inherited]
```

### 12.324.1.12 col

```
template<class _Field>
index_t* col = nullptr [inherited]
```

### 12.324.1.13 dat

```
template<class _Field>
_Field::Element_ptr dat [inherited]
```

The documentation for this struct was generated from the following file:

- [ell\\_simd.h](#)

## 12.325 Sparse< \_Field, SparseMatrix\_t::ELL\_ZO > Struct Template Reference

```
#include <ell.h>
```

Inheritance diagram for Sparse< \_Field, SparseMatrix\_t::ELL\_ZO >:



### Public Types

- using [Field](#) = \_Field

### Data Fields

- \_Field::Element [cst](#) = 1
- bool [delayed](#) = false
- uint64\_t [kmax](#) = 0
- [index\\_t](#) [m](#) = 0
- [index\\_t](#) [n](#) = 0
- [index\\_t](#) [ld](#) = 0
- uint64\_t [nnz](#) = 0
- uint64\_t [nElements](#) = 0
- uint64\_t [maxrow](#) = 0
- [index\\_t](#) \* [col](#) = nullptr
- \_Field::Element\_ptr [dat](#)

### 12.325.1 Member Typedef Documentation

#### 12.325.1.1 Field

```
template<class _Field>
using Field = _Field
```

### 12.325.2 Field Documentation

#### 12.325.2.1 cst

```
template<class _Field>
_Field::Element cst = 1
```

#### 12.325.2.2 delayed

```
template<class _Field>
bool delayed = false [inherited]
```

#### 12.325.2.3 kmax

```
template<class _Field>
uint64_t kmax = 0 [inherited]
```

#### 12.325.2.4 m

```
template<class _Field>
index\_t m = 0 [inherited]
```

**12.325.2.5 n**

```
template<class _Field>
index_t n = 0 [inherited]
```

**12.325.2.6 ld**

```
template<class _Field>
index_t ld = 0 [inherited]
```

**12.325.2.7 nnz**

```
template<class _Field>
uint64_t nnz = 0 [inherited]
```

**12.325.2.8 nElements**

```
template<class _Field>
uint64_t nElements = 0 [inherited]
```

**12.325.2.9 maxrow**

```
template<class _Field>
uint64_t maxrow = 0 [inherited]
```

**12.325.2.10 col**

```
template<class _Field>
index_t* col = nullptr [inherited]
```

**12.325.2.11 dat**

```
template<class _Field>
_Field::Element_ptr dat [inherited]
```

The documentation for this struct was generated from the following file:

- [ell.h](#)

## 12.326 Sparse< \_Field, SparseMatrix\_t::SELL > Struct Template Reference

```
#include <sell.h>
```

Inheritance diagram for Sparse< \_Field, SparseMatrix\_t::SELL >:

**Public Types**

- using [Field](#) = \_Field

## Data Fields

- bool `delayed` = false
- int `chunk` = 0
- `index_t` `kmax` = 0
- `index_t` `m` = 0
- `index_t` `n` = 0
- `index_t` `maxrow` = 0
- `index_t` `sigma` = 0
- `index_t` `nChunks` = 0
- `uint64_t` `nnz` = 0
- `uint64_t` `nElements` = 0
- `index_t` \* `perm` = nullptr
- `uint64_t` \* `st` = nullptr
- `index_t` \* `chunkSize` = nullptr
- `index_t` \* `col` = nullptr
- `_Field::Element_ptr` `dat`

## 12.326.1 Member Typedef Documentation

### 12.326.1.1 Field

```
template<class _Field>
using Field = _Field
```

## 12.326.2 Field Documentation

### 12.326.2.1 `delayed`

```
template<class _Field>
bool delayed = false
```

### 12.326.2.2 `chunk`

```
template<class _Field>
int chunk = 0
```

### 12.326.2.3 `kmax`

```
template<class _Field>
index_t kmax = 0
```

### 12.326.2.4 `m`

```
template<class _Field>
index_t m = 0
```

### 12.326.2.5 `n`

```
template<class _Field>
index_t n = 0
```

### 12.326.2.6 `maxrow`

```
template<class _Field>
index_t maxrow = 0
```

**12.326.2.7 sigma**

```
template<class _Field>
index_t sigma = 0
```

**12.326.2.8 nChunks**

```
template<class _Field>
index_t nChunks = 0
```

**12.326.2.9 nnz**

```
template<class _Field>
uint64_t nnz = 0
```

**12.326.2.10 nElements**

```
template<class _Field>
uint64_t nElements = 0
```

**12.326.2.11 perm**

```
template<class _Field>
index_t* perm = nullptr
```

**12.326.2.12 st**

```
template<class _Field>
uint64_t* st = nullptr
```

**12.326.2.13 chunkSize**

```
template<class _Field>
index_t* chunkSize = nullptr
```

**12.326.2.14 col**

```
template<class _Field>
index_t* col = nullptr
```

**12.326.2.15 dat**

```
template<class _Field>
_Field::Element_ptr dat
```

The documentation for this struct was generated from the following file:

- [sell.h](#)

## 12.327 Sparse< \_Field, SparseMatrix\_t::SELL\_ZO > Struct Template Reference

```
#include <sell.h>
```

Inheritance diagram for Sparse< \_Field, SparseMatrix\_t::SELL\_ZO >:



## Public Types

- using `Field` = `_Field`

## Data Fields

- `_Field::Element` `cst` = 1
- bool `delayed` = false
- int `chunk` = 0
- `index_t` `kmax` = 0
- `index_t` `m` = 0
- `index_t` `n` = 0
- `index_t` `maxrow` = 0
- `index_t` `sigma` = 0
- `index_t` `nChunks` = 0
- `uint64_t` `nnz` = 0
- `uint64_t` `nElements` = 0
- `index_t` \* `perm` = nullptr
- `uint64_t` \* `st` = nullptr
- `index_t` \* `chunkSize` = nullptr
- `index_t` \* `col` = nullptr
- `_Field::Element_ptr` `dat`

## 12.327.1 Member Typedef Documentation

### 12.327.1.1 Field

```
template<class _Field>
using Field = _Field
```

## 12.327.2 Field Documentation

### 12.327.2.1 cst

```
template<class _Field>
_Field::Element cst = 1
```

### 12.327.2.2 delayed

```
template<class _Field>
bool delayed = false [inherited]
```

### 12.327.2.3 chunk

```
template<class _Field>
int chunk = 0 [inherited]
```

### 12.327.2.4 kmax

```
template<class _Field>
index_t kmax = 0 [inherited]
```

### 12.327.2.5 m

```
template<class _Field>
index_t m = 0 [inherited]
```

**12.327.2.6 n**

```
template<class _Field>
index_t n = 0 [inherited]
```

**12.327.2.7 maxrow**

```
template<class _Field>
index_t maxrow = 0 [inherited]
```

**12.327.2.8 sigma**

```
template<class _Field>
index_t sigma = 0 [inherited]
```

**12.327.2.9 nChunks**

```
template<class _Field>
index_t nChunks = 0 [inherited]
```

**12.327.2.10 nnz**

```
template<class _Field>
uint64_t nnz = 0 [inherited]
```

**12.327.2.11 nElements**

```
template<class _Field>
uint64_t nElements = 0 [inherited]
```

**12.327.2.12 perm**

```
template<class _Field>
index_t* perm = nullptr [inherited]
```

**12.327.2.13 st**

```
template<class _Field>
uint64_t* st = nullptr [inherited]
```

**12.327.2.14 chunkSize**

```
template<class _Field>
index_t* chunkSize = nullptr [inherited]
```

**12.327.2.15 col**

```
template<class _Field>
index_t* col = nullptr [inherited]
```

**12.327.2.16 dat**

```
template<class _Field>
_Field::Element_ptr dat [inherited]
```

The documentation for this struct was generated from the following file:

- [sell.h](#)

**12.328 SpMat< Field, flag > Struct Template Reference**

```
#include <fflas_sparse.h>
```

**Data Fields**

- `FFLAS::CooMat< Field > * _coo = nullptr`
- `FFLAS::CsrMat< Field > * _csr = nullptr`
- `FFLAS::EllMat< Field > * _ell = nullptr`

**12.328.1 Field Documentation****12.328.1.1 \_coo**

```
template<class Field, int flag = HelperFlag::none>
FFLAS::CooMat<Field>* _coo = nullptr
```

**12.328.1.2 \_csr**

```
template<class Field, int flag = HelperFlag::none>
FFLAS::CsrMat<Field>* _csr = nullptr
```

**12.328.1.3 \_ell**

```
template<class Field, int flag = HelperFlag::none>
FFLAS::EllMat<Field>* _ell = nullptr
```

The documentation for this struct was generated from the following file:

- `fflas_sparse.h`

**12.329 StatsMatrix Struct Reference**

```
#include <utils.h>
```

**Data Fields**

- `uint64_t rowdim = 0`
- `uint64_t coldim = 0`
- `uint64_t nOnes = 0`
- `uint64_t nMOnes = 0`
- `uint64_t nOthers = 0`
- `uint64_t nnz = 0`
- `uint64_t maxRow = 0`
- `uint64_t minRow = 0`
- `uint64_t averageRow = 0`
- `uint64_t deviationRow = 0`
- `uint64_t maxCol = 0`
- `uint64_t minCol = 0`
- `uint64_t averageCol = 0`
- `uint64_t deviationCol = 0`
- `uint64_t minColDifference = 0`
- `uint64_t maxColDifference = 0`
- `uint64_t averageColDifference = 0`
- `uint64_t deviationColDifference = 0`
- `uint64_t minRowDifference = 0`
- `uint64_t maxRowDifference = 0`
- `uint64_t averageRowDifference = 0`
- `uint64_t deviationRowDifference = 0`
- `uint64_t nDenseRows = 0`
- `uint64_t nDenseCols = 0`
- `uint64_t nEmptyRows = 0`



- `uint64_t nEmptyCols = 0`
- `uint64_t nEmptyColsEnd = 0`
- `std::vector< uint64_t > denseRows`
- `std::vector< uint64_t > denseCols`

## 12.329.1 Field Documentation

### 12.329.1.1 rowdim

`uint64_t rowdim = 0`

### 12.329.1.2 coldim

`uint64_t coldim = 0`

### 12.329.1.3 nOnes

`uint64_t nOnes = 0`

### 12.329.1.4 nMOnes

`uint64_t nMOnes = 0`

### 12.329.1.5 nOthers

`uint64_t nOthers = 0`

### 12.329.1.6 nnz

`uint64_t nnz = 0`

### 12.329.1.7 maxRow

`uint64_t maxRow = 0`

### 12.329.1.8 minRow

`uint64_t minRow = 0`

### 12.329.1.9 averageRow

`uint64_t averageRow = 0`

### 12.329.1.10 deviationRow

`uint64_t deviationRow = 0`

### 12.329.1.11 maxCol

`uint64_t maxCol = 0`

### 12.329.1.12 minCol

`uint64_t minCol = 0`

### 12.329.1.13 averageCol

`uint64_t averageCol = 0`

**12.329.1.14 deviationCol**

```
uint64_t deviationCol = 0
```

**12.329.1.15 minColDifference**

```
uint64_t minColDifference = 0
```

**12.329.1.16 maxColDifference**

```
uint64_t maxColDifference = 0
```

**12.329.1.17 averageColDifference**

```
uint64_t averageColDifference = 0
```

**12.329.1.18 deviationColDifference**

```
uint64_t deviationColDifference = 0
```

**12.329.1.19 minRowDifference**

```
uint64_t minRowDifference = 0
```

**12.329.1.20 maxRowDifference**

```
uint64_t maxRowDifference = 0
```

**12.329.1.21 averageRowDifference**

```
uint64_t averageRowDifference = 0
```

**12.329.1.22 deviationRowDifference**

```
uint64_t deviationRowDifference = 0
```

**12.329.1.23 nDenseRows**

```
uint64_t nDenseRows = 0
```

**12.329.1.24 nDenseCols**

```
uint64_t nDenseCols = 0
```

**12.329.1.25 nEmptyRows**

```
uint64_t nEmptyRows = 0
```

**12.329.1.26 nEmptyCols**

```
uint64_t nEmptyCols = 0
```

**12.329.1.27 nEmptyColsEnd**

```
uint64_t nEmptyColsEnd = 0
```

**12.329.1.28 denseRows**

```
std::vector<uint64_t> denseRows
```

**12.329.1.29 denseCols**

```
std::vector<uint64_t> denseCols
```

The documentation for this struct was generated from the following file:

- [utils.h](#)

**12.330 string Class Reference**

STL class.

**Data Structures**

- class [const\\_iterator](#)  
*STL iterator class.*
- class [const\\_reverse\\_iterator](#)  
*STL iterator class.*
- class [iterator](#)  
*STL iterator class.*
- class [reverse\\_iterator](#)  
*STL iterator class.*

**12.330.1 Detailed Description**

STL class.

The documentation for this class was generated from the following files:

**12.331 support\_fast\_mod< T > Struct Template Reference**

```
#include <fflas_freduce.h>
```

Inheritance diagram for support\_fast\_mod< T >:



The documentation for this struct was generated from the following file:

- [fflas\\_freduce.h](#)

**12.332 support\_fast\_mod< double > Struct Reference**

```
#include <fflas_freduce.h>
```

Inheritance diagram for support\_fast\_mod< double >:



The documentation for this struct was generated from the following file:

- [fflas\\_freduce.h](#)

### 12.333 `support_fast_mod< float >` Struct Reference

```
#include <fflas_freduce.h>
```

Inheritance diagram for `support_fast_mod< float >`:



The documentation for this struct was generated from the following file:

- [fflas\\_freduce.h](#)

### 12.334 `support_fast_mod< int64_t >` Struct Reference

```
#include <fflas_freduce.h>
```

Inheritance diagram for `support_fast_mod< int64_t >`:



The documentation for this struct was generated from the following file:

- [fflas\\_freduce.h](#)

### 12.335 `support_simd< T >` Struct Template Reference

```
#include <fflas_simd.h>
```

Inheritance diagram for `support_simd< T >`:



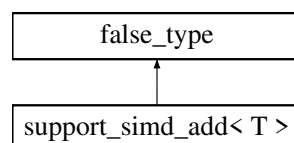
The documentation for this struct was generated from the following file:

- [fflas\\_simd.h](#)

### 12.336 `support_simd_add< T >` Struct Template Reference

```
#include <fflas_fadd.h>
```

Inheritance diagram for `support_simd_add< T >`:



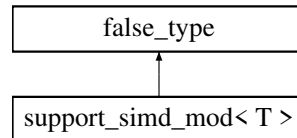
The documentation for this struct was generated from the following file:

- [fflas\\_fadd.h](#)

## 12.337 support\_simd\_mod< T > Struct Template Reference

```
#include <fflas_freduce.h>
```

Inheritance diagram for support\_simd\_mod< T >:



The documentation for this struct was generated from the following file:

- [fflas\\_freduce.h](#)

## 12.338 Test< Elt > Class Template Reference

### Public Types

- using [Field](#) = Modular<Elt>
- using [Elt\\_ptr](#) = typename [Field::Element\\_ptr](#)
- using [Residu](#) = typename [Field::Residu\\_t](#)
- template<bool B, class T = void>  
using [enable\\_if\\_t](#) = typename std::enable\_if<B, T>::type
- template<typename [Simd](#)>  
using [is\\_same\\_element](#) = typename [Simd::template is\\_same\\_element](#)<[Field](#)>
- template<typename E>  
using [enable\\_if\\_no\\_simd\\_t](#) = [enable\\_if\\_t](#)<[Simd](#)<E>::vect\_size == 1>
- template<typename E>  
using [enable\\_if\\_simd128\\_t](#) = [enable\\_if\\_t](#)<sizeof(E)\*[Simd](#)<E>::vect\_size == 16>
- template<typename E>  
using [enable\\_if\\_simd256\\_t](#) = [enable\\_if\\_t](#)<sizeof(E)\*[Simd](#)<E>::vect\_size == 32>
- template<typename E>  
using [enable\\_if\\_simd512\\_t](#) = [enable\\_if\\_t](#)<sizeof(E)\*[Simd](#)<E>::vect\_size == 64>

### Public Member Functions

- [Test](#) (size\_t mm, size\_t nn)
- template<typename [Simd](#) = NoSimd<Elt>, [enable\\_if\\_t](#)<[is\\_same\\_element](#)< [Simd](#) >::value > \* = nullptr>  
bool [test\\_ftranspose](#) (size\_t m, size\_t n, [Elt\\_ptr](#) A, size\_t lda, [Elt\\_ptr](#) B, size\_t ldb)
- template<typename [Simd](#) = NoSimd<Elt>, [enable\\_if\\_t](#)<[is\\_same\\_element](#)< [Simd](#) >::value > \* = nullptr>  
bool [doTests](#) ()
- template<typename \_E = Elt, [enable\\_if\\_t](#)<[is\\_same](#)< \_E, Elt >::value > \* = nullptr, [enable\\_if\\_no\\_simd\\_t](#)< \_E > \* = nullptr>  
bool [run](#) ()

### Static Public Member Functions

- template<typename \_E = Elt, [enable\\_if\\_t](#)<[is\\_same](#)< \_E, Givaro::Integer >::value > \* = nullptr>  
static [Residu cardinality](#) ()
- template<typename \_E = Elt, [enable\\_if\\_t](#)<[is\\_same](#)< \_E, Givaro::Integer >::value > \* = nullptr>  
static [Residu cardinality](#) ()

## Protected Attributes

- [Field F](#)
- [size\\_t \\_mm](#)
- [size\\_t \\_nn](#)

## 12.338.1 Member Typedef Documentation

### 12.338.1.1 Field

```
template<typename Elt>
using Field = Modular<Elt>
```

### 12.338.1.2 Elt\_ptr

```
template<typename Elt>
using Elt\_ptr = typename Field::Element\_ptr
```

### 12.338.1.3 Residu

```
template<typename Elt>
using Residu = typename Field::Residu\_t
```

### 12.338.1.4 enable\_if\_t

```
template<typename Elt>
template<bool B, class T = void>
using enable\_if\_t = typename std::enable_if<B, T>::type
```

### 12.338.1.5 is\_same\_element

```
template<typename Elt>
template<typename Simd>
using is\_same\_element = typename Simd::template is\_same\_element<Field>
```

### 12.338.1.6 enable\_if\_no\_simd\_t

```
template<typename Elt>
template<typename E>
using enable\_if\_no\_simd\_t = enable\_if\_t<Simd<E>::vect_size == 1>
```

### 12.338.1.7 enable\_if\_simd128\_t

```
template<typename Elt>
template<typename E>
using enable\_if\_simd128\_t = enable\_if\_t<sizeof(E)*Simd<E>::vect_size == 16>
```

### 12.338.1.8 enable\_if\_simd256\_t

```
template<typename Elt>
template<typename E>
using enable\_if\_simd256\_t = enable\_if\_t<sizeof(E)*Simd<E>::vect_size == 32>
```

### 12.338.1.9 enable\_if\_simd512\_t

```
template<typename Elt>
template<typename E>
using enable\_if\_simd512\_t = enable\_if\_t<sizeof(E)*Simd<E>::vect_size == 64>
```

## 12.338.2 Constructor & Destructor Documentation

### 12.338.2.1 Test()

```
template<typename Elt>
Test (
    size_t mm,
    size_t nn) [inline]
```

## 12.338.3 Member Function Documentation

### 12.338.3.1 cardinality() [1/2]

```
template<typename Elt>
template<typename _E = Elt, enable_if_t<!is_same< _E, Givaro::Integer >::value > * = nullptr>
static Residu cardinality () [inline], [static]
```

### 12.338.3.2 cardinality() [2/2]

```
template<typename Elt>
template<typename _E = Elt, enable_if_t< is_same< _E, Givaro::Integer >::value > * = nullptr>
static Residu cardinality () [inline], [static]
```

### 12.338.3.3 test\_ftranspose()

```
template<typename Elt>
template<typename Simd = NoSimd<Elt>, enable_if_t< is_same_element< Simd >::value > * =
nullptr>
bool test_ftranspose (
    size_t m,
    size_t n,
    Elt_ptr A,
    size_t lda,
    Elt_ptr B,
    size_t ldb) [inline]
```

### 12.338.3.4 doTests()

```
template<typename Elt>
template<typename Simd = NoSimd<Elt>, enable_if_t< is_same_element< Simd >::value > * =
nullptr>
bool doTests () [inline]
```

### 12.338.3.5 run()

```
template<typename Elt>
template<typename _E = Elt, enable_if_t< is_same< _E, Elt >::value > * = nullptr, enable_if_no_simd_t<
_E > * = nullptr>
bool run () [inline]
```

## 12.338.4 Field Documentation

### 12.338.4.1 F

```
template<typename Elt>
Field F [protected]
```

### 12.338.4.2 \_mm

```
template<typename Elt>
size_t _mm [protected]
```

### 12.338.4.3 `_nn`

```
template<typename Elt>
size_t _nn [protected]
```

The documentation for this class was generated from the following file:

- [test-storage-transpose.C](#)

## 12.339 `TestOneMethod< Simd >` Class Template Reference

### Public Types

- using [Element](#) = typename `Simd::scalar_t`
- using [vect\\_t](#) = typename `Simd::vect_t`
- using [vectElt](#) = [vector](#)<[Element](#)>
- template<bool B, typename T = void>  
using [enable\\_if\\_t](#) = typename `enable_if<B, T>::type`

### Public Member Functions

- template<typename... AScal, typename RScal, typename... ASimd, typename RSimd, [enable\\_if\\_t](#)< sizeof...(AScal)==sizeof...(ASimd)>  
\* = nullptr, [enable\\_if\\_t](#)< [count\\_nonconst\\_lvalue\\_reference](#)< AScal... >::n==[count\\_nonconst\\_lvalue\\_reference](#)< ASimd... >::n > \*  
= nullptr, [enable\\_if\\_t](#)< [is\\_all\\_same](#)< AScal... >::value > \* = nullptr, [enable\\_if\\_t](#)< [is\\_all\\_same](#)< [vect\\_t](#), ASimd... >::value > \* =  
nullptr>  
[TestOneMethod](#) (function< RSimd(ASimd...)> fsimd, function< RScal(AScal...)> fscal, function<  
void([vector](#)< [vectElt](#) > &)> genInputs, [string](#) fname)
- template<typename Ret, typename... AScal>  
[enable\\_if\\_t](#)< [is\\_all\\_same](#)< [Element](#), AScal... >::value &&std::is\_convertible< Ret, [Element](#) >::value, void >  
> [evaluate\\_scalar\\_method](#) (function< Ret(AScal...)> fscal)
- template<typename... AScal>  
[enable\\_if\\_t](#)< [is\\_all\\_same](#)< [vectElt](#), AScal... >::value, void > [evaluate\\_scalar\\_method](#) (function<  
[vectElt](#)(AScal...)> fscal)
- template<typename... AScal>  
[enable\\_if\\_t](#)< [is\\_all\\_same](#)< [vectElt](#), AScal... >::value, void > [evaluate\\_scalar\\_method](#) (function<  
void(AScal...)> fscal)
- template<typename Ret, typename... ASimd>  
[enable\\_if\\_t](#)< [is\\_all\\_same](#)< [vect\\_t](#), ASimd... >::value &&std::is\_convertible< Ret, [vect\\_t](#) >::value, void >  
> [evaluate\\_simd\\_method](#) (function< Ret(ASimd...)> fsimd, [array](#)< [vect\\_t](#), sizeof...(ASimd)> &simd\_in)
- template<typename... ASimd>  
[enable\\_if\\_t](#)< [is\\_all\\_same](#)< [vect\\_t](#), ASimd... >::value, void > [evaluate\\_simd\\_method](#) (function<  
void(ASimd...)> fsimd, [array](#)< [vect\\_t](#), sizeof...(ASimd)> &simd\_in)
- bool [getStatus](#) () const
- [string](#) [getTestName](#) () const
- bool [writeResultLine](#) () const
- void [writeDebugData](#) () const

### Static Public Attributes

- static constexpr size\_t [vect\\_size](#) = `Simd::vect_size`

### Protected Attributes

- size\_t [nb\\_lref](#)
- [string](#) [name](#)
- [vector](#)< [vectElt](#) > [inputs](#)
- [vector](#)< [vectElt](#) > [outputs\\_simd](#)
- [vector](#)< [vectElt](#) > [outputs\\_scalar](#)



## 12.339.1 Member Typedef Documentation

### 12.339.1.1 Element

```
template<typename Simd>
using Element = typename Simd::scalar_t
```

### 12.339.1.2 vect\_t

```
template<typename Simd>
using vect_t = typename Simd::vect_t
```

### 12.339.1.3 vectElt

```
template<typename Simd>
using vectElt = vector<Element>
```

### 12.339.1.4 enable\_if\_t

```
template<typename Simd>
template<bool B, typename T = void>
using enable_if_t = typename enable_if<B, T>::type
```

## 12.339.2 Constructor & Destructor Documentation

### 12.339.2.1 TestOneMethod()

```
template<typename Simd>
template<typename... AScal, typename RScal, typename... ASimd, typename RSimd, enable_if_t<
sizeof...(AScal)==sizeof...(ASimd)> * = nullptr, enable_if_t< count_nonconst_lvalue_reference<
AScal... >::n==count_nonconst_lvalue_reference< ASimd... >::n > * = nullptr, enable_if_t<
is_all_same< AScal... >::value > * = nullptr, enable_if_t< is_all_same< vect_t, ASimd...
>::value > * = nullptr>
TestOneMethod (
    function< RSimd(ASimd...)> fsimd,
    function< RScal(AScal...)> fscal,
    function< void(vector< vectElt > &)> genInputs,
    string fname) [inline]
```

## 12.339.3 Member Function Documentation

### 12.339.3.1 evaluate\_scalar\_method() [1/3]

```
template<typename Simd>
template<typename Ret, typename... AScal>
enable_if_t< is_all_same< Element, AScal... >::value &&std::is_convertible< Ret, Element >↔
::value, void > evaluate_scalar_method (
    function< Ret(AScal...)> fscal) [inline]
```

### 12.339.3.2 evaluate\_scalar\_method() [2/3]

```
template<typename Simd>
template<typename... AScal>
enable_if_t< is_all_same< vectElt, AScal... >::value, void > evaluate_scalar_method (
    function< vectElt(AScal...)> fscal) [inline]
```

### 12.339.3.3 evaluate\_scalar\_method() [3/3]

```
template<typename Simd>
template<typename... AScal>
```

```
enable_if_t< is_all_same< vectElt, AScal... >::value, void > evaluate_scalar_method (
    function< void(AScal...)> fscal) [inline]
```

#### 12.339.3.4 evaluate\_simd\_method() [1/2]

```
template<typename Simd>
template<typename Ret, typename... ASimd>
enable_if_t< is_all_same< vect_t, ASimd... >::value &&std::is_convertible< Ret, vect_t >←
::value, void > evaluate_simd_method (
    function< Ret(ASimd...)> fsimd,
    array< vect_t, sizeof...(ASimd)> & simd_in) [inline]
```

#### 12.339.3.5 evaluate\_simd\_method() [2/2]

```
template<typename Simd>
template<typename... ASimd>
enable_if_t< is_all_same< vect_t, ASimd... >::value, void > evaluate_simd_method (
    function< void(ASimd...)> fsimd,
    array< vect_t, sizeof...(ASimd)> & simd_in) [inline]
```

#### 12.339.3.6 getStatus()

```
template<typename Simd>
bool getStatus () const [inline]
```

#### 12.339.3.7 getTestName()

```
template<typename Simd>
string getTestName () const [inline]
```

#### 12.339.3.8 writeResultLine()

```
template<typename Simd>
bool writeResultLine () const [inline]
```

#### 12.339.3.9 writeDebugData()

```
template<typename Simd>
void writeDebugData () const [inline]
```

### 12.339.4 Field Documentation

#### 12.339.4.1 vect\_size

```
template<typename Simd>
size_t vect_size = Simd::vect_size [static], [constexpr]
```

#### 12.339.4.2 nb\_lref

```
template<typename Simd>
size_t nb_lref [protected]
```

#### 12.339.4.3 name

```
template<typename Simd>
string name [protected]
```

#### 12.339.4.4 inputs

```
template<typename Simd>
vector<vectElt> inputs [protected]
```

**12.339.4.5 outputs\_simd**

```
template<typename Simd>
vector<vectElt> outputs_simd [protected]
```

**12.339.4.6 outputs\_scalar**

```
template<typename Simd>
vector<vectElt> outputs_scalar [protected]
```

The documentation for this class was generated from the following file:

- [test-simd.C](#)

**12.340 tfn\_minus Struct Reference**

```
#include <sparse_matrix_traits.h>
```

**Public Member Functions**

- `template<typename... Args>`  
`auto operator() (Args &&... args) const -> decltype(operator+(std::forward< Args >(args)...))`

**12.340.1 Member Function Documentation****12.340.1.1 operator>()()**

```
template<typename... Args>
auto operator() (
    Args &&... args) const -> decltype(operator+(std::forward<Args>(args)...))
[inline]
```

The documentation for this struct was generated from the following file:

- [sparse\\_matrix\\_traits.h](#)

**12.341 tfn\_minus\_eq Struct Reference**

```
#include <sparse_matrix_traits.h>
```

**Public Member Functions**

- `template<typename... Args>`  
`auto operator() (Args &&... args) const -> decltype(operator+(std::forward< Args >(args)...))`

**12.341.1 Member Function Documentation****12.341.1.1 operator>()()**

```
template<typename... Args>
auto operator() (
    Args &&... args) const -> decltype(operator+(std::forward<Args>(args)...))
[inline]
```

The documentation for this struct was generated from the following file:

- [sparse\\_matrix\\_traits.h](#)

**12.342 tfn\_mul Struct Reference**

```
#include <sparse_matrix_traits.h>
```

## Public Member Functions

- `template<typename... Args>`  
`auto operator\(\) (Args &&... args) const -> decltype(operator+(std::forward< Args >(args)...))`

### 12.342.1 Member Function Documentation

#### 12.342.1.1 `operator>()`

```
template<typename... Args>
auto operator() (
    Args &&... args) const -> decltype(operator+(std::forward<Args>(args)...))
[inline]
```

The documentation for this struct was generated from the following file:

- [sparse\\_matrix\\_traits.h](#)

## 12.343 tfn\_mul\_eq Struct Reference

```
#include <sparse_matrix_traits.h>
```

## Public Member Functions

- `template<typename... Args>`  
`auto operator\(\) (Args &&... args) const -> decltype(operator+(std::forward< Args >(args)...))`

### 12.343.1 Member Function Documentation

#### 12.343.1.1 `operator>()`

```
template<typename... Args>
auto operator() (
    Args &&... args) const -> decltype(operator+(std::forward<Args>(args)...))
[inline]
```

The documentation for this struct was generated from the following file:

- [sparse\\_matrix\\_traits.h](#)

## 12.344 tfn\_plus Struct Reference

```
#include <sparse_matrix_traits.h>
```

## Public Member Functions

- `template<typename... Args>`  
`auto operator\(\) (Args &&... args) const -> decltype(operator+(std::forward< Args >(args)...))`

### 12.344.1 Member Function Documentation

#### 12.344.1.1 `operator>()`

```
template<typename... Args>
auto operator() (
    Args &&... args) const -> decltype(operator+(std::forward<Args>(args)...))
[inline]
```

The documentation for this struct was generated from the following file:

- [sparse\\_matrix\\_traits.h](#)

## 12.345 tfn\_plus\_eq Struct Reference

```
#include <sparse_matrix_traits.h>
```

### Public Member Functions

- `template<typename... Args>`  
`auto operator() (Args &&... args) const -> decltype(operator+(std::forward< Args >(args)...))`

### 12.345.1 Member Function Documentation

#### 12.345.1.1 operator>()()

```
template<typename... Args>
auto operator() (
    Args &&... args) const -> decltype(operator+(std::forward<Args>(args)...))
[inline]
```

The documentation for this struct was generated from the following file:

- [sparse\\_matrix\\_traits.h](#)

## 12.346 Threads Struct Reference

The documentation for this struct was generated from the following file:

- [blockcuts.inl](#)

## 12.347 ThreeD Struct Reference

The documentation for this struct was generated from the following file:

- [blockcuts.inl](#)

## 12.348 ThreeDAdaptive Struct Reference

The documentation for this struct was generated from the following file:

- [blockcuts.inl](#)

## 12.349 ThreeDInPlace Struct Reference

The documentation for this struct was generated from the following file:

- [blockcuts.inl](#)

## 12.350 TRSMHelper< ReclterTrait, ParSeqTrait > Struct Template Reference

TRSM Helper.

### Public Member Functions

- `template<class Cut, class Param>`  
`TRSMHelper (ParSeqHelper::Parallel< Cut, Param > _PS)`
- `TRSMHelper (ParSeqHelper::Sequential _PS)`
- `template<typename RIT, typename PST>`  
`TRSMHelper (TRSMHelper< RIT, PST > &_TH)`

- `template<class Dom, class Algo = FFLAS::MMHelperAlgo::Winograd, class ModeT = typename FFLAS::ModeTraits<Dom>::value> FFLAS::MMHelper< Dom, Algo, ModeT, ParSeqTrait > pMMH (Dom &D, size_t m, size_t k, size_t n, ParSeqTrait p) const`
- `template<class Dom, class Algo = FFLAS::MMHelperAlgo::Winograd, class ModeT = typename FFLAS::ModeTraits<Dom>::value> FFLAS::MMHelper< Dom, Algo, ModeT, ParSeqTrait > pMMH (Dom &D, size_t m, size_t k, size_t n) const`

## Data Fields

- ParSeqTrait `parseq`

## 12.350.1 Detailed Description

```
template<typename RecIterTrait = StructureHelper::Recursive, typename ParSeqTrait = ParSeqHelper::Sequential>
```

```
struct FFLAS::TRSMHelper< RecIterTrait, ParSeqTrait >
```

TRSM Helper.

## 12.350.2 Constructor & Destructor Documentation

### 12.350.2.1 TRSMHelper() [1/3]

```
template<typename RecIterTrait = StructureHelper::Recursive, typename ParSeqTrait = ParSeqHelper::Sequential>
template<class Cut, class Param>
TRSMHelper (
    ParSeqHelper::Parallel< Cut, Param > _PS) [inline]
```

### 12.350.2.2 TRSMHelper() [2/3]

```
template<typename RecIterTrait = StructureHelper::Recursive, typename ParSeqTrait = ParSeqHelper::Sequential>
TRSMHelper (
    ParSeqHelper::Sequential _PS) [inline]
```

### 12.350.2.3 TRSMHelper() [3/3]

```
template<typename RecIterTrait = StructureHelper::Recursive, typename ParSeqTrait = ParSeqHelper::Sequential>
template<typename RIT, typename PST>
TRSMHelper (
    TRSMHelper< RIT, PST > & _TH) [inline]
```

## 12.350.3 Member Function Documentation

### 12.350.3.1 pMMH() [1/2]

```
template<typename RecIterTrait = StructureHelper::Recursive, typename ParSeqTrait = ParSeqHelper::Sequential>
template<class Dom, class Algo = FFLAS::MMHelperAlgo::Winograd, class ModeT = typename FFLAS::ModeTraits<Dom>::value>
FFLAS::MMHelper< Dom, Algo, ModeT, ParSeqTrait > pMMH (
    Dom & D,
    size_t m,
    size_t k,
    size_t n,
    ParSeqTrait p) const [inline]
```

**12.350.3.2 pMMH() [2/2]**

```
template<typename RecIterTrait = StructureHelper::Recursive, typename ParSeqTrait = ParSeq↵
Helper::Sequential>
template<class Dom, class Algo = FFLAS::MMHelperAlgo::Winograd, class ModeT = typename FFLAS↵
::ModeTraits<Dom>::value>
FFLAS::MMHelper< Dom, Algo, ModeT, ParSeqTrait > pMMH (
    Dom & D,
    size_t m,
    size_t k,
    size_t n) const [inline]
```

**12.350.4 Field Documentation****12.350.4.1 parseq**

```
template<typename RecIterTrait = StructureHelper::Recursive, typename ParSeqTrait = ParSeq↵
Helper::Sequential>
ParSeqTrait parseq
```

The documentation for this struct was generated from the following file:

- [fflas\\_helpers.inl](#)

**12.351 TwoD Struct Reference**

The documentation for this struct was generated from the following file:

- [blockcuts.inl](#)

**12.352 TwoDAdaptive Struct Reference**

The documentation for this struct was generated from the following file:

- [blockcuts.inl](#)

**12.353 UnparametricTag Struct Reference**

If the field uses a representation with infix operators.

```
#include <field-traits.h>
```

**12.353.1 Detailed Description**

If the field uses a representation with infix operators.

The documentation for this struct was generated from the following file:

- [field-traits.h](#)

**12.354 vector< T > Class Template Reference**

STL class.

**Data Structures**

- class [const\\_iterator](#)  
*STL iterator class.*
- class [const\\_reverse\\_iterator](#)  
*STL iterator class.*

- class [iterator](#)  
*STL iterator class.*
- class [reverse\\_iterator](#)  
*STL iterator class.*

## Data Fields

- T [elements](#)  
*STL member.*

### 12.354.1 Detailed Description

STL class.

### 12.354.2 Field Documentation

#### 12.354.2.1 elements

T [elements](#)

STL member.

The documentation for this class was generated from the following files:

## 12.355 `width< T >` Struct Template Reference

### Static Public Attributes

- static constexpr `size_t` [value](#) = 2+2\*sizeof(T)

### 12.355.1 Field Documentation

#### 12.355.1.1 value

```
template<typename T>
```

```
size_t value = 2+2*sizeof(T) [static], [constexpr]
```

The documentation for this struct was generated from the following file:

- [test-simd.C](#)

## 12.356 `width< double >` Struct Reference

### Static Public Attributes

- static constexpr `size_t` [value](#) = 24
- static constexpr `size_t` [value](#)

### 12.356.1 Field Documentation

#### 12.356.1.1 value [1/2]

```
size_t value = 24 [static], [constexpr]
```

#### 12.356.1.2 value [2/2]

```
size_t value [static], [constexpr]
```

The documentation for this struct was generated from the following file:

- [test-simd.C](#)



## 12.357 width< float > Struct Reference

### Static Public Attributes

- static constexpr size\_t [value](#) = 16
- static constexpr size\_t [value](#)

### 12.357.1 Field Documentation

#### 12.357.1.1 value [1/2]

size\_t value = 16 [static], [constexpr]

#### 12.357.1.2 value [2/2]

size\_t value [static], [constexpr]

The documentation for this struct was generated from the following file:

- [test-simd.C](#)

## 12.358 Winograd Struct Reference

The documentation for this struct was generated from the following file:

- [fflas\\_helpers.inl](#)

## 12.359 WinogradPar Struct Reference

The documentation for this struct was generated from the following file:

- [fflas\\_helpers.inl](#)



# Chapter 13

## File Documentation

### 13.1 arithprog.C File Reference

```
#include "fflas-ffpack/fflas-ffpack-config.h"
#include "fflas-ffpack/utils/fflas_randommatrix.h"
```

#### Typedefs

- typedef Givaro::OMPTimer [TTimer](#)

#### Functions

- int [main](#) (int argc, char \*\*argv)

#### 13.1.1 Typedef Documentation

##### 13.1.1.1 TTimer

```
typedef Givaro::Timer TTimer
```

#### 13.1.2 Function Documentation

##### 13.1.2.1 main()

```
int main (
    int argc,
    char ** argv)
```

### 13.2 autotune/charpoly.C File Reference

```
#include "fflas-ffpack/fflas-ffpack-config.h"
#include "fflas-ffpack/utils/fflas_randommatrix.h"
#include <iostream>
#include <givaro/modular-balanced.h>
#include "fflas-ffpack/utils/timer.h"
#include "fflas-ffpack/ffpack/ffpack.h"
#include <ctime>
```

#### Macros

- #define [CUBE](#)(x)
- #define [GFOPS](#)(m, n, r, t)

## Typedefs

- typedef Givaro::Timer [TTimer](#)

## Functions

- int [main](#) ()

## 13.2.1 Macro Definition Documentation

### 13.2.1.1 CUBE

```
#define CUBE(
                x)
```

#### Value:

```
((x)*(x)*(x))
```

### 13.2.1.2 GFOPS

```
#define GFOPS(
                m,
                n,
                r,
                t)
```

#### Value:

```
(2.7*CUBE(double(n)/1000.0))/t
```

## 13.2.2 Typedef Documentation

### 13.2.2.1 TTimer

```
typedef Givaro::Timer TTimer
```

## 13.2.3 Function Documentation

### 13.2.3.1 main()

```
int main (
        void )
```

## 13.3 examples/charpoly.C File Reference

```
#include <iostream>
#include "fflas-ffpack/fflas-ffpack.h"
```

## Functions

- int [main](#) (int argc, char \*\*argv)

*This example computes the characteristic polynomial of a matrix over a defined finite field.*

## 13.3.1 Function Documentation

### 13.3.1.1 main()

```
int main (
        int argc,
        char ** argv)
```

This example computes the characteristic polynomial of a matrix over a defined finite field.  
Outputs the characteristic polynomial.

## 13.4 fsyrk.C File Reference

```
#include "fflas-ffpack/fflas-ffpack-config.h"
#include <iostream>
#include <givaro/modular-balanced.h>
#include "fflas-ffpack/utils/timer.h"
#include "fflas-ffpack/ffpack/ffpack.h"
#include "fflas-ffpack/utils/fflas_randommatrix.h"
#include <ctime>
```

### Macros

- #define CUBE(x)
- #define GFOPS(n, t)

### Functions

- int main ()

### 13.4.1 Macro Definition Documentation

#### 13.4.1.1 CUBE

```
#define CUBE(  
            x)
```

##### Value:

```
((x) * (x) * (x))
```

#### 13.4.1.2 GFOPS

```
#define GFOPS(  
            n,  
            t)
```

##### Value:

```
(CUBE(double(n) / 1000.0) / (3.0 * t))
```

### 13.4.2 Function Documentation

#### 13.4.2.1 main()

```
int main (  
        void )
```

## 13.5 fsytrf.C File Reference

```
#include "fflas-ffpack/fflas-ffpack-config.h"
#include <iostream>
#include <givaro/modular-balanced.h>
#include "fflas-ffpack/utils/timer.h"
#include "fflas-ffpack/ffpack/ffpack.h"
#include "fflas-ffpack/utils/fflas_randommatrix.h"
#include <ctime>
```

### Macros

- #define CUBE(x)
- #define GFOPS(n, t)

## Functions

- int [main](#) ()

## 13.5.1 Macro Definition Documentation

### 13.5.1.1 CUBE

```
#define CUBE(  
                x)
```

#### Value:

```
((x) * (x) * (x))
```

### 13.5.1.2 GFOPS

```
#define GFOPS(  
                n,  
                t)
```

#### Value:

```
(CUBE(double(n) / 1000.0) / (3.0 * t))
```

## 13.5.2 Function Documentation

### 13.5.2.1 main()

```
int main (  
            void )
```

## 13.6 ftrtri.C File Reference

```
#include "fflas-ffpack/fflas-ffpack-config.h"  
#include "fflas-ffpack/utils/fflas_randommatrix.h"  
#include <iostream>  
#include <givaro/modular-balanced.h>  
#include "fflas-ffpack/utils/timer.h"  
#include "fflas-ffpack/ffpack/ffpack.h"  
#include <ctime>
```

## Macros

- #define [CUBE](#)(x)
- #define [GFOPS](#)(n, t)

## Functions

- int [main](#) ()

## 13.6.1 Macro Definition Documentation

### 13.6.1.1 CUBE

```
#define CUBE(  
                x)
```

#### Value:

```
((x) * (x) * (x))
```

### 13.6.1.2 GFOPS

```
#define GFOPS(
    n,
    t)
```

**Value:**

```
(CUBE(double(n)/1000.0)/(3.0*t))
```

## 13.6.2 Function Documentation

### 13.6.2.1 main()

```
int main (
    void )
```

## 13.7 autotune/pluq.C File Reference

```
#include "fflas-ffpack/fflas-ffpack-config.h"
#include "fflas-ffpack/utils/fflas_randommatrix.h"
#include <iostream>
#include <givaro/modular-balanced.h>
#include "fflas-ffpack/utils/timer.h"
#include "fflas-ffpack/ffpack/ffpack.h"
#include <ctime>
```

### Macros

- #define CUBE(x)
- #define GFOPS(m, n, r, t)

### Functions

- int main ()

## 13.7.1 Macro Definition Documentation

### 13.7.1.1 CUBE

```
#define CUBE(
    x)
```

**Value:**

```
((x)*(x)*(x))
```

### 13.7.1.2 GFOPS

```
#define GFOPS(
    m,
    n,
    r,
    t)
```

**Value:**

```
(2.0/3.0*CUBE(double(n)/1000.0) + 2*m/1000.0*n/1000.0*double(r)/1000.0 -
double(r)/1000.0*double(r)/1000.0*(m+n)/1000)/t
```

## 13.7.2 Function Documentation

### 13.7.2.1 main()

```
int main (
    void )
```

## 13.8 examples/pluq.C File Reference

```
#include <iostream>
#include <givaro/modular.h>
#include "fflas-ffpack/fflas-ffpack-config.h"
#include "fflas-ffpack/fflas-ffpack.h"
#include "fflas-ffpack/utils/fflas_io.h"
```

### Functions

- int [main](#) (int argc, char \*\*argv)

## 13.8.1 Function Documentation

### 13.8.1.1 main()

```
int main (
    int argc,
    char ** argv)
```

## 13.9 winograd.C File Reference

```
#include "fflas-ffpack/fflas-ffpack-config.h"
#include "fflas-ffpack/utils/fflas_randommatrix.h"
#include <iostream>
#include <fstream>
#include <givaro/modular.h>
#include <givaro/modular-balanced.h>
#include "fflas-ffpack/utils/timer.h"
#include "fflas-ffpack/fflas/fflas.h"
#include <ctime>
```

### Macros

- #define [DOUBLE\\_TO\\_FLOAT\\_CROSSOVER](#) 0
- #define [GFOPS](#)(n, t)

### Functions

- template<class [Field](#)>  
bool [balanced](#) (const [Field](#) &)
- template<class T>  
bool [balanced](#) (const [Givaro::ModularBalanced](#)< T > &)
- int [main](#) ()

## 13.9.1 Macro Definition Documentation

### 13.9.1.1 DOUBLE\_TO\_FLOAT\_CROSSOVER

```
#define DOUBLE_TO_FLOAT_CROSSOVER 0
```



### 13.9.1.2 GFOPS

```
#define GFOPS(
    n,
    t)
```

**Value:**

```
(2.0/t*(double)n/1000.0*(double)n/1000.0*(double)n/1000.0)
```

## 13.9.2 Function Documentation

### 13.9.2.1 balanced() [1/2]

```
template<class Field>
bool balanced (
    const Field & )
```

### 13.9.2.2 balanced() [2/2]

```
template<class T>
bool balanced (
    const Givaro::ModularBalanced< T > & )
```

### 13.9.2.3 main()

```
int main (
    void )
```

## 13.10 benchmark-charpoly-mp.C File Reference

```
#include "fflas-ffpack/fflas-ffpack-config.h"
#include <iostream>
#include <givaro/modular.h>
#include "fflas-ffpack/fflas-ffpack.h"
#include "fflas-ffpack/utils/timer.h"
#include "fflas-ffpack/utils/test-utils.h"
#include "fflas-ffpack/utils/Matio.h"
#include "fflas-ffpack/utils/args-parser.h"
```

### Macros

- `#define __FFLASFFPACK_FORCE_SEQ`

### Functions

- `int main (int argc, char **argv)`

## 13.10.1 Macro Definition Documentation

### 13.10.1.1 \_\_FFLASFFPACK\_FORCE\_SEQ

```
#define __FFLASFFPACK_FORCE_SEQ
```

## 13.10.2 Function Documentation

### 13.10.2.1 main()

```
int main (
    int argc,
    char ** argv)
```

## 13.11 benchmark-charpoly.C File Reference

```
#include "fflas-ffpack/fflas-ffpack-config.h"
#include <iostream>
#include <givaro/modular.h>
#include <givaro/givpoly1.h>
#include "fflas-ffpack/fflas-ffpack.h"
#include "fflas-ffpack/utils/timer.h"
#include "fflas-ffpack/utils/test-utils.h"
#include "fflas-ffpack/utils/fflas_randommatrix.h"
#include "fflas-ffpack/utils/fflas_io.h"
#include "fflas-ffpack/utils/args-parser.h"
```

### Macros

- `#define __FFLASFFPACK_OPENBLAS_NT_ALREADY_SET 1`

### Functions

- `template<class Field>`  
`void run_with_field (int q, uint64_t bits, size_t n, size_t d, size_t iter, std::string file, int variant, uint64_t seed)`
- `int main (int argc, char **argv)`

### 13.11.1 Macro Definition Documentation

#### 13.11.1.1 \_\_FFLASFFPACK\_OPENBLAS\_NT\_ALREADY\_SET

```
#define __FFLASFFPACK_OPENBLAS_NT_ALREADY_SET 1
```

### 13.11.2 Function Documentation

#### 13.11.2.1 run\_with\_field()

```
template<class Field>
void run_with_field (
    int q,
    uint64_t bits,
    size_t n,
    size_t d,
    size_t iter,
    std::string file,
    int variant,
    uint64_t seed)
```

#### 13.11.2.2 main()

```
int main (
    int argc,
    char ** argv)
```

## 13.12 benchmark-checkers.C File Reference

```
#include "fflas-ffpack/fflas-ffpack-config.h"
#include <iostream>
#include <stdlib.h>
#include <time.h>
#include "fflas-ffpack/fflas-ffpack.h"
#include "fflas-ffpack/utils/args-parser.h"
```

```
#include "fflas-ffpack/utils/fflas_randommatrix.h"
#include "fflas-ffpack/utils/timer.h"
#include "fflas-ffpack/fflas/fflas.h"
#include "fflas-ffpack/checkers/checkers_fflas.h"
#include "fflas-ffpack/checkers/checkers_ffpack.h"
#include <fstream>
```

### Macros

- #define [ENABLE\\_ALL\\_CHECKINGS](#) 1
- #define [\\_NR\\_TESTS](#) 5
- #define [\\_MAX\\_SIZE\\_MATRICES](#) 1000
- #define [CUBE](#)(x)

### Functions

- int [main](#) (int argc, char \*\*argv)

## 13.12.1 Macro Definition Documentation

### 13.12.1.1 [ENABLE\\_ALL\\_CHECKINGS](#)

```
#define ENABLE_ALL_CHECKINGS 1
```

### 13.12.1.2 [\\_NR\\_TESTS](#)

```
#define _NR_TESTS 5
```

### 13.12.1.3 [\\_MAX\\_SIZE\\_MATRICES](#)

```
#define _MAX_SIZE_MATRICES 1000
```

### 13.12.1.4 [CUBE](#)

```
#define CUBE(  
    x)
```

#### Value:

```
((x) * (x) * (x))
```

## 13.12.2 Function Documentation

### 13.12.2.1 [main\(\)](#)

```
int main (  
    int argc,  
    char ** argv)
```

## 13.13 benchmark-dgemm.C File Reference

```
#include "fflas-ffpack/fflas-ffpack-config.h"
#include <iostream>
#include <givaro/modular.h>
#include "fflas-ffpack/config-blas.h"
#include "fflas-ffpack/fflas/fflas.h"
#include "fflas-ffpack/utils/timer.h"
#include "fflas-ffpack/utils/fflas_io.h"
#include "fflas-ffpack/utils/args-parser.h"
```

**Macros**

- `#define CBLAS_GEMM` `cblas_dgemm`

**Typedefs**

- `typedef FFLAS::Timer TTimer`
- `typedef double Floats`

**Functions**

- `int main` (`int argc`, `char **argv`)

**13.13.1 Macro Definition Documentation****13.13.1.1 CBLAS\_GEMM**

```
#define CBLAS_GEMM cblas_dgemm
```

**13.13.2 Typedef Documentation****13.13.2.1 TTimer**

```
typedef FFLAS::Timer TTimer
```

**13.13.2.2 Floats**

```
typedef double Floats
```

**13.13.3 Function Documentation****13.13.3.1 main()**

```
int main (
    int argc,
    char ** argv)
```

**13.14 benchmark-dgetrf.C File Reference**

```
#include "fflas-ffpack/fflas-ffpack-config.h"
#include <iostream>
#include <vector>
#include <givaro/modular.h>
#include "fflas-ffpack/fflas-ffpack.h"
#include "fflas-ffpack/utils/timer.h"
#include "fflas-ffpack/utils/fflas_io.h"
#include "fflas-ffpack/utils/args-parser.h"
```

**Macros**

- `#define __FFLASFFPACK_HAVE_DGETRF` 1

**Functions**

- `int main` (`int argc`, `char **argv`)

## 13.14.1 Macro Definition Documentation

### 13.14.1.1 \_\_FFLASFFPACK\_HAVE\_DGETRF

```
#define __FFLASFFPACK_HAVE_DGETRF 1
```

## 13.14.2 Function Documentation

### 13.14.2.1 main()

```
int main (  
    int argc,  
    char ** argv)
```

## 13.15 benchmark-dgetri.C File Reference

```
#include "fflas-ffpack/fflas-ffpack-config.h"  
#include <iostream>  
#include <vector>  
#include <givaro/modular.h>  
#include "fflas-ffpack/fflas-ffpack.h"  
#include "fflas-ffpack/utils/timer.h"  
#include "fflas-ffpack/utils/fflas_io.h"  
#include "fflas-ffpack/utils/args-parser.h"
```

### Functions

- int [main](#) (int argc, char \*\*argv)

## 13.15.1 Function Documentation

### 13.15.1.1 main()

```
int main (  
    int argc,  
    char ** argv)
```

## 13.16 benchmark-dsytrf.C File Reference

```
#include "fflas-ffpack/fflas-ffpack-config.h"  
#include <iostream>  
#include <vector>  
#include <givaro/modular.h>  
#include "fflas-ffpack/fflas-ffpack.h"  
#include "fflas-ffpack/utils/timer.h"  
#include "fflas-ffpack/utils/fflas_io.h"  
#include "fflas-ffpack/utils/args-parser.h"
```

### Macros

- #define [EFGFF](#)(n, t, i)

### Functions

- int [main](#) (int argc, char \*\*argv)

## 13.16.1 Macro Definition Documentation

### 13.16.1.1 EFFGFF

```
#define EFFGFF(
    n,
    t,
    i)
```

#### Value:

```
( (double(n)/1000.*double(n)/1000.*double(n)/1000.0) / double(t) * double(i) / 3.)
```

## 13.16.2 Function Documentation

### 13.16.2.1 main()

```
int main (
    int argc,
    char ** argv)
```

## 13.17 benchmark-dtrsm.C File Reference

```
#include "fflas-ffpack/fflas-ffpack-config.h"
#include <iostream>
#include <givaro/modular.h>
#include "fflas-ffpack/fflas-ffpack.h"
#include "fflas-ffpack/utils/timer.h"
#include "fflas-ffpack/utils/fflas_io.h"
#include "fflas-ffpack/utils/args-parser.h"
```

### Functions

- int [main](#) (int argc, char \*\*argv)

## 13.17.1 Function Documentation

### 13.17.1.1 main()

```
int main (
    int argc,
    char ** argv)
```

## 13.18 benchmark-dtrtri.C File Reference

```
#include "fflas-ffpack/fflas-ffpack-config.h"
#include <iostream>
#include <givaro/modular.h>
#include "fflas-ffpack/fflas-ffpack.h"
#include "fflas-ffpack/utils/timer.h"
#include "fflas-ffpack/utils/fflas_io.h"
#include "fflas-ffpack/utils/args-parser.h"
```

### Macros

- #define [\\_\\_FFLASFFPACK\\_HAVE\\_DTRTRI](#) 1

**Functions**

- int [main](#) (int argc, char \*\*argv)

**13.18.1 Macro Definition Documentation****13.18.1.1 \_\_FFLASFFPACK\_HAVE\_DTRTRI**

```
#define __FFLASFFPACK_HAVE_DTRTRI 1
```

**13.18.2 Function Documentation****13.18.2.1 main()**

```
int main (
    int argc,
    char ** argv)
```

**13.19 benchmark-fadd-lvl2.C File Reference**

```
#include "fflas-ffpack/fflas-ffpack-config.h"
#include <iostream>
#include <givaro/modular.h>
#include "fflas-ffpack/fflas-ffpack.h"
#include "fflas-ffpack/utils/timer.h"
#include "fflas-ffpack/utils/fflas_io.h"
#include "fflas-ffpack/utils/args-parser.h"
```

**Macros**

- #define [\\_\\_FFLASFFPACK\\_OPENBLAS\\_NT\\_ALREADY\\_SET](#) 1

**Functions**

- int [main](#) (int argc, char \*\*argv)

**13.19.1 Macro Definition Documentation****13.19.1.1 \_\_FFLASFFPACK\_OPENBLAS\_NT\_ALREADY\_SET**

```
#define __FFLASFFPACK_OPENBLAS_NT_ALREADY_SET 1
```

**13.19.2 Function Documentation****13.19.2.1 main()**

```
int main (
    int argc,
    char ** argv)
```

**13.20 benchmark-fdot.C File Reference**

```
#include "fflas-ffpack/fflas-ffpack-config.h"
#include <iostream>
#include <givaro/modular.h>
#include <givaro/givrational.h>
#include "fflas-ffpack/fflas-ffpack.h"
#include "fflas-ffpack/utils/timer.h"
```

```
#include "fflas-ffpack/utils/test-utils.h"
#include "fflas-ffpack/utils/fflas_io.h"
#include "fflas-ffpack/paladin/parallel.h"
#include "fflas-ffpack/paladin/fflas_plevel1.h"
#include "fflas-ffpack/utils/args-parser.h"
```

## Macros

- `#define __FFLASFFPACK_OPENBLAS_NT_ALREADY_SET 1`

## Functions

- `template<class Field>`  
`Field::Element run_with_field` (int q, size\_t iter, size\_t N, const uint64\_t BS, const size\_t p, const size\_t threads, uint64\_t seed)
- `int main` (int argc, char \*\*argv)

## 13.20.1 Macro Definition Documentation

### 13.20.1.1 \_\_FFLASFFPACK\_OPENBLAS\_NT\_ALREADY\_SET

```
#define __FFLASFFPACK_OPENBLAS_NT_ALREADY_SET 1
```

## 13.20.2 Function Documentation

### 13.20.2.1 run\_with\_field()

```
template<class Field>
Field::Element run_with_field (
    int q,
    size_t iter,
    size_t N,
    const uint64_t BS,
    const size_t p,
    const size_t threads,
    uint64_t seed)
```

### 13.20.2.2 main()

```
int main (
    int argc,
    char ** argv)
```

## 13.21 benchmark-fgemm-mp.C File Reference

```
#include "fflas-ffpack/fflas-ffpack-config.h"
#include <iostream>
#include <typeinfo>
#include <vector>
#include <string>
#include "fflas-ffpack/fflas/fflas.h"
#include "fflas-ffpack/utils/fflas_io.h"
#include "fflas-ffpack/utils/timer.h"
#include "fflas-ffpack/utils/args-parser.h"
#include "givaro/modular-integer.h"
#include "givaro/givcaster.h"
#include "fflas-ffpack/paladin/parallel.h"
```



## Macros

- `#define __FFLASFFPACK_OPENBLAS_NT_ALREADY_SET 1`
- `#define MG_DEFAULT MG_ACTIVE`
- `#define STD_RECINT_SIZE 8`

## Functions

- `template<typename Ints>`  
`int tmain ()`
- `int main (int argc, char **argv)`

### 13.21.1 Macro Definition Documentation

#### 13.21.1.1 \_\_FFLASFFPACK\_OPENBLAS\_NT\_ALREADY\_SET

```
#define __FFLASFFPACK_OPENBLAS_NT_ALREADY_SET 1
```

#### 13.21.1.2 MG\_DEFAULT

```
#define MG_DEFAULT MG_ACTIVE
```

#### 13.21.1.3 STD\_RECINT\_SIZE

```
#define STD_RECINT_SIZE 8
```

### 13.21.2 Function Documentation

#### 13.21.2.1 tmain()

```
template<typename Ints>
int tmain ()
```

#### 13.21.2.2 main()

```
int main (
    int argc,
    char ** argv)
```

## 13.22 benchmark-fgemm-rns.C File Reference

```
#include "fflas-ffpack/fflas/fflas.h"
#include <iostream>
#include "fflas-ffpack/utils/timer.h"
#include "fflas-ffpack/utils/args-parser.h"
```

## Macros

- `#define __FFLASFFPACK_OPENBLAS_NT_ALREADY_SET 1`

## Typedefs

- `typedef FFPACK::rns_double RNS`
- `typedef FFPACK::RNSInteger< RNS > Field`
- `typedef Field::Element_ptr Element_ptr`
- `typedef Field::ConstElement_ptr ConstElement_ptr`
- `typedef StrategyParameter::Threads THREADS`
- `typedef StrategyParameter::Grain GRAIN`

- typedef [StrategyParameter::TwoD](#) TWOD
- typedef [StrategyParameter::TwoDAdaptive](#) TWODA
- typedef [StrategyParameter::ThreeD](#) THREED
- typedef [StrategyParameter::ThreeDAdaptive](#) THREEDA
- typedef [StrategyParameter::ThreeDInPlace](#) THREEDIP
- typedef [ParSeqHelper::Sequential](#) PSeq

## Functions

- int [main](#) (int argc, char \*argv[])

## 13.22.1 Macro Definition Documentation

### 13.22.1.1 \_\_FFLASFFPACK\_OPENBLAS\_NT\_ALREADY\_SET

```
#define __FFLASFFPACK_OPENBLAS_NT_ALREADY_SET 1
```

## 13.22.2 Typedef Documentation

### 13.22.2.1 RNS

```
typedef FFPACK::rns\_double RNS
```

### 13.22.2.2 Field

```
typedef FFPACK::RNSInteger<RNS> Field
```

### 13.22.2.3 Element\_ptr

```
typedef Field::Element\_ptr Element_ptr
```

### 13.22.2.4 ConstElement\_ptr

```
typedef Field::ConstElement\_ptr ConstElement_ptr
```

### 13.22.2.5 THREADS

```
typedef StrategyParameter::Threads THREADS
```

### 13.22.2.6 GRAIN

```
typedef StrategyParameter::Grain GRAIN
```

### 13.22.2.7 TWOD

```
typedef StrategyParameter::TwoD TWOD
```

### 13.22.2.8 TWODA

```
typedef StrategyParameter::TwoDAdaptive TWODA
```

### 13.22.2.9 THREED

```
typedef StrategyParameter::ThreeD THREED
```

### 13.22.2.10 THREEDA

```
typedef StrategyParameter::ThreeDAdaptive THREEDA
```

**13.22.2.11 THREEDIP**

```
typedef StrategyParameter::ThreeDInPlace THREEDIP
```

**13.22.2.12 PSeq**

```
typedef ParSeqHelper::Sequential PSeq
```

**13.22.3 Function Documentation****13.22.3.1 main()**

```
int main (
    int argc,
    char * argv[])
```

**13.23 benchmark-fgemm.C File Reference**

```
#include "fflas-ffpack/fflas-ffpack-config.h"
#include <iostream>
#include <givaro/modular-balanced.h>
#include "fflas-ffpack/config-blas.h"
#include "fflas-ffpack/fflas/fflas.h"
#include "fflas-ffpack/utils/timer.h"
#include "fflas-ffpack/utils/args-parser.h"
```

**Macros**

- #define CLASSIC\_HYBRID

**Functions**

- int main (int argc, char \*\*argv)

**13.23.1 Macro Definition Documentation****13.23.1.1 CLASSIC\_HYBRID**

```
#define CLASSIC_HYBRID
```

**13.23.2 Function Documentation****13.23.2.1 main()**

```
int main (
    int argc,
    char ** argv)
```

**13.24 benchmark-fgemv-mp.C File Reference**

```
#include "fflas-ffpack/fflas-ffpack-config.h"
#include <iostream>
#include <typeinfo>
#include <vector>
#include <string>
#include "fflas-ffpack/utils/timer.h"
#include "fflas-ffpack/fflas/fflas.h"
#include "fflas-ffpack/utils/args-parser.h"
```

```
#include "givaro/modular-integer.h"
#include "givaro/givcaster.h"
#include "fflas-ffpack/paladin/parallel.h"
```

## Macros

- `#define __FFLASFFPACK_OPENBLAS_NT_ALREADY_SET 1`
- `#define MG_DEFAULT MG_ACTIVE`
- `#define STD_RECINT_SIZE 8`

## Functions

- `template<typename T>`  
`std::ostream & write_matrix (std::ostream &out, Givaro::Integer p, size_t m, size_t n, T *C, size_t ldc)`
- `template<typename Ints>`  
`int tmain ()`
- `int main (int argc, char **argv)`

## 13.24.1 Macro Definition Documentation

### 13.24.1.1 \_\_FFLASFFPACK\_OPENBLAS\_NT\_ALREADY\_SET

```
#define __FFLASFFPACK_OPENBLAS_NT_ALREADY_SET 1
```

### 13.24.1.2 MG\_DEFAULT

```
#define MG_DEFAULT MG_ACTIVE
```

### 13.24.1.3 STD\_RECINT\_SIZE

```
#define STD_RECINT_SIZE 8
```

## 13.24.2 Function Documentation

### 13.24.2.1 write\_matrix()

```
template<typename T>
std::ostream & write_matrix (
    std::ostream & out,
    Givaro::Integer p,
    size_t m,
    size_t n,
    T * C,
    size_t ldc)
```

### 13.24.2.2 tmain()

```
template<typename Ints>
int tmain ()
```

### 13.24.2.3 main()

```
int main (
    int argc,
    char ** argv)
```

## 13.25 benchmark-fgemv.C File Reference

```
#include "fflas-ffpack/fflas-ffpack-config.h"
#include <iostream>
#include <givaro/modular-balanced.h>
#include "fflas-ffpack/config-blas.h"
#include "fflas-ffpack/fflas/fflas.h"
#include "fflas-ffpack/utils/timer.h"
#include "fflas-ffpack/utils/args-parser.h"
#include "fflas-ffpack/utils/fflas_io.h"
#include "fflas-ffpack/utils/test-utils.h"
#include "givaro/modular-integer.h"
#include "givaro/givcaster.h"
```

### Data Structures

- struct [need\\_field\\_characteristic](#)< Field >
- struct [need\\_field\\_characteristic](#)< Givaro::Modular< Field > >
- struct [need\\_field\\_characteristic](#)< Givaro::ModularBalanced< Field > >
- struct [compatible\\_data\\_type](#)< Field >
- struct [compatible\\_data\\_type](#)< Givaro::ZRing< float > >
- struct [compatible\\_data\\_type](#)< Givaro::ZRing< double > >

### Macros

- #define [\\_\\_FFLASFFPACK\\_OPENBLAS\\_NT\\_ALREADY\\_SET](#) 1

### Functions

- template<class [Field](#), class RandIter, class Matrix, class Vector>  
void [fill\\_value](#) ([Field](#) &F, RandIter &Rand, Matrix &A, Vector &X, Vector &Y, size\_t m, size\_t k, size\_t incX, size\_t incY, size\_t lda, int NBK)
- template<class [Field](#), class Matrix, class Vector>  
void [genData](#) ([Field](#) &F, Matrix &A, Vector &X, Vector &Y, size\_t m, size\_t k, size\_t incX, size\_t incY, size\_t lda, int NBK, uint64\_t bitsize, uint64\_t seed)
- template<class [Field](#), class Matrix, class Vector>  
bool [check\\_result](#) ([Field](#) &F, size\_t m, size\_t lda, Matrix &A, Vector &X, size\_t incX, Vector &Y, size\_t incY)
- template<class [Field](#), class Matrix, class Vector>  
bool [benchmark\\_with\\_timer](#) ([Field](#) &F, int p, Matrix &A, Vector &X, Vector &Y, size\_t m, size\_t k, size\_t incX, size\_t incY, size\_t lda, size\_t iters, int t, double &time, size\_t GrainSize)
- template<class [Field](#), class arg>  
void [benchmark\\_disp](#) ([Field](#) &F, bool pass, double &time, size\_t iters, int p, size\_t m, size\_t k, arg &as)
- template<class [Field](#), class arg>  
void [benchmark\\_in\\_Field](#) ([Field](#) &F, int p, size\_t m, size\_t k, int NBK, uint64\_t bitsize, uint64\_t seed, size\_t iters, int t, arg &as, size\_t GrainSize)
- template<class [Field](#), class arg>  
void [benchmark\\_with\\_field](#) (int p, size\_t m, size\_t k, int NBK, uint64\_t bitsize, uint64\_t seed, size\_t iters, int t, arg &as, size\_t GrainSize)
- template<class [Field](#), class arg>  
void [benchmark\\_with\\_field](#) (const Givaro::Integer &q, int p, size\_t m, size\_t k, int NBK, uint64\_t bitsize, uint64\_t seed, size\_t iters, int t, arg &as, size\_t GrainSize)
- int [main](#) (int argc, char \*\*argv)

### 13.25.1 Macro Definition Documentation

#### 13.25.1.1 \_\_FFLASFFPACK\_OPENBLAS\_NT\_ALREADY\_SET

```
#define __FFLASFFPACK_OPENBLAS_NT_ALREADY_SET 1
```

## 13.25.2 Function Documentation

### 13.25.2.1 fill\_value()

```
template<class Field, class RandIter, class Matrix, class Vector>
void fill_value (
    Field & F,
    RandIter & Rand,
    Matrix & A,
    Vector & X,
    Vector & Y,
    size_t m,
    size_t k,
    size_t incX,
    size_t incY,
    size_t lda,
    int NBK)
```

### 13.25.2.2 genData()

```
template<class Field, class Matrix, class Vector>
void genData (
    Field & F,
    Matrix & A,
    Vector & X,
    Vector & Y,
    size_t m,
    size_t k,
    size_t incX,
    size_t incY,
    size_t lda,
    int NBK,
    uint64_t bitsize,
    uint64_t seed)
```

### 13.25.2.3 check\_result()

```
template<class Field, class Matrix, class Vector>
bool check_result (
    Field & F,
    size_t m,
    size_t lda,
    Matrix & A,
    Vector & X,
    size_t incX,
    Vector & Y,
    size_t incY)
```

### 13.25.2.4 benchmark\_with\_timer()

```
template<class Field, class Matrix, class Vector>
bool benchmark_with_timer (
    Field & F,
    int p,
    Matrix & A,
    Vector & X,
    Vector & Y,
    size_t m,
    size_t k,
    size_t incX,
```

```

    size_t incY,
    size_t lda,
    size_t iters,
    int t,
    double & time,
    size_t GrainSize)

```

### 13.25.2.5 benchmark\_disp()

```

template<class Field, class arg>
void benchmark_disp (
    Field & F,
    bool pass,
    double & time,
    size_t iters,
    int p,
    size_t m,
    size_t k,
    arg & as)

```

### 13.25.2.6 benchmark\_in\_Field()

```

template<class Field, class arg>
void benchmark_in_Field (
    Field & F,
    int p,
    size_t m,
    size_t k,
    int NBK,
    uint64_t bitsize,
    uint64_t seed,
    size_t iters,
    int t,
    arg & as,
    size_t GrainSize)

```

### 13.25.2.7 benchmark\_with\_field() [1/2]

```

template<class Field, class arg>
void benchmark_with_field (
    int p,
    size_t m,
    size_t k,
    int NBK,
    uint64_t bitsize,
    uint64_t seed,
    size_t iters,
    int t,
    arg & as,
    size_t GrainSize)

```

### 13.25.2.8 benchmark\_with\_field() [2/2]

```

template<class Field, class arg>
void benchmark_with_field (
    const Givaro::Integer & q,
    int p,
    size_t m,
    size_t k,

```

```

    int NBK,
    uint64_t bitsize,
    uint64_t seed,
    size_t iters,
    int t,
    arg & as,
    size_t GrainSize)

```

### 13.25.2.9 main()

```

int main (
    int argc,
    char ** argv)

```

## 13.26 benchmark-fgesv.C File Reference

```

#include "fflas-ffpack/fflas-ffpack-config.h"
#include <iostream>
#include <givaro/modular.h>
#include "fflas-ffpack/fflas-ffpack.h"
#include "fflas-ffpack/utils/timer.h"
#include "fflas-ffpack/utils/fflas_io.h"
#include "fflas-ffpack/utils/args-parser.h"

```

### Macros

- `#define __FFLASFFPACK_OPENBLAS_NT_ALREADY_SET 1`

### Functions

- `int main (int argc, char **argv)`

## 13.26.1 Macro Definition Documentation

### 13.26.1.1 \_\_FFLASFFPACK\_OPENBLAS\_NT\_ALREADY\_SET

```
#define __FFLASFFPACK_OPENBLAS_NT_ALREADY_SET 1
```

## 13.26.2 Function Documentation

### 13.26.2.1 main()

```

int main (
    int argc,
    char ** argv)

```

## 13.27 benchmark-fsyr2k.C File Reference

```

#include "fflas-ffpack/fflas-ffpack-config.h"
#include <iostream>
#include <givaro/modular-balanced.h>
#include "fflas-ffpack/config-blas.h"
#include "fflas-ffpack/fflas/fflas.h"
#include "fflas-ffpack/utils/timer.h"
#include "fflas-ffpack/utils/args-parser.h"

```



**Functions**

- int [main](#) (int argc, char \*\*argv)

**13.27.1 Function Documentation****13.27.1.1 main()**

```
int main (
    int argc,
    char ** argv)
```

**13.28 benchmark-fsyrrk.C File Reference**

```
#include "fflas-ffpack/fflas-ffpack-config.h"
#include <iostream>
#include <givaro/modular.h>
#include "fflas-ffpack/fflas-ffpack.h"
#include "fflas-ffpack/utils/timer.h"
#include "fflas-ffpack/utils/args-parser.h"
```

**Macros**

- #define [\\_\\_FFLASFFPACK\\_OPENBLAS\\_NT\\_ALREADY\\_SET](#) 1

**Functions**

- int [main](#) (int argc, char \*\*argv)

**13.28.1 Macro Definition Documentation****13.28.1.1 \_\_FFLASFFPACK\_OPENBLAS\_NT\_ALREADY\_SET**

```
#define __FFLASFFPACK_OPENBLAS_NT_ALREADY_SET 1
```

**13.28.2 Function Documentation****13.28.2.1 main()**

```
int main (
    int argc,
    char ** argv)
```

**13.29 benchmark-fsytrf.C File Reference**

```
#include "fflas-ffpack/fflas-ffpack-config.h"
#include <iostream>
#include <givaro/modular.h>
#include "fflas-ffpack/fflas-ffpack.h"
#include "fflas-ffpack/utils/timer.h"
#include "fflas-ffpack/utils/fflas_io.h"
#include "fflas-ffpack/utils/args-parser.h"
```

**Macros**

- #define [\\_\\_FFPACK\\_FSYTRF\\_BC\\_CROUT](#)
- #define [\\_\\_FFLASFFPACK\\_OPENBLAS\\_NT\\_ALREADY\\_SET](#) 1

- `#define CUBE(x)`

## Functions

- `int main (int argc, char **argv)`

## 13.29.1 Macro Definition Documentation

### 13.29.1.1 \_\_FFPACK\_FSYTRF\_BC\_CROUT

```
#define __FFPACK_FSYTRF_BC_CROUT
```

### 13.29.1.2 \_\_FFLASFFPACK\_OPENBLAS\_NT\_ALREADY\_SET

```
#define __FFLASFFPACK_OPENBLAS_NT_ALREADY_SET 1
```

### 13.29.1.3 CUBE

```
#define CUBE(  
            x)
```

#### Value:

```
((x) * (x) * (x))
```

## 13.29.2 Function Documentation

### 13.29.2.1 main()

```
int main (  
        int argc,  
        char ** argv)
```

## 13.30 benchmark-ftsrm-mp.C File Reference

```
#include "fflas-ffpack/fflas-ffpack-config.h"  
#include <iostream>  
#include <vector>  
#include <string>  
#include "fflas-ffpack/utils/timer.h"  
#include "fflas-ffpack/fflas/fflas.h"  
#include "fflas-ffpack/utils/args-parser.h"  
#include "givaro/modular-integer.h"
```

## Macros

- `#define __FFLASFFPACK_OPENBLAS_NT_ALREADY_SET 1`

## Functions

- `int main (int argc, char **argv)`

## 13.30.1 Macro Definition Documentation

### 13.30.1.1 \_\_FFLASFFPACK\_OPENBLAS\_NT\_ALREADY\_SET

```
#define __FFLASFFPACK_OPENBLAS_NT_ALREADY_SET 1
```

## 13.30.2 Function Documentation

### 13.30.2.1 main()

```
int main (
    int argc,
    char ** argv)
```

## 13.31 benchmark-fftrsm.C File Reference

```
#include "fflas-ffpack/fflas-ffpack-config.h"
#include <iostream>
#include <givaro/modular.h>
#include "fflas-ffpack/fflas-ffpack.h"
#include "fflas-ffpack/utils/timer.h"
#include "fflas-ffpack/utils/fflas_io.h"
#include "fflas-ffpack/utils/args-parser.h"
```

### Macros

- `#define __FFLASFFPACK_OPENBLAS_NT_ALREADY_SET 1`

### Functions

- `int main (int argc, char **argv)`

## 13.31.1 Macro Definition Documentation

### 13.31.1.1 \_\_FFLASFFPACK\_OPENBLAS\_NT\_ALREADY\_SET

```
#define __FFLASFFPACK_OPENBLAS_NT_ALREADY_SET 1
```

## 13.31.2 Function Documentation

### 13.31.2.1 main()

```
int main (
    int argc,
    char ** argv)
```

## 13.32 benchmark-fftrsv.C File Reference

```
#include "fflas-ffpack/fflas-ffpack-config.h"
#include <iostream>
#include <givaro/modular.h>
#include "fflas-ffpack/fflas-ffpack.h"
#include "fflas-ffpack/utils/timer.h"
#include "fflas-ffpack/utils/args-parser.h"
```

### Macros

- `#define __FFLASFFPACK_OPENBLAS_NT_ALREADY_SET 1`

### Functions

- `int main (int argc, char **argv)`

### 13.32.1 Macro Definition Documentation

#### 13.32.1.1 \_\_FFLASFFPACK\_OPENBLAS\_NT\_ALREADY\_SET

```
#define __FFLASFFPACK_OPENBLAS_NT_ALREADY_SET 1
```

### 13.32.2 Function Documentation

#### 13.32.2.1 main()

```
int main (
    int argc,
    char ** argv)
```

## 13.33 benchmark-fttrtri.C File Reference

```
#include "fflas-ffpack/fflas-ffpack-config.h"
#include <iostream>
#include <givaro/modular.h>
#include "fflas-ffpack/fflas-ffpack.h"
#include "fflas-ffpack/utils/timer.h"
#include "fflas-ffpack/utils/fflas_io.h"
#include "fflas-ffpack/utils/args-parser.h"
```

### Macros

- `#define __FFLASFFPACK_OPENBLAS_NT_ALREADY_SET 1`
- `#define CUBE(x)`

### Functions

- `int main (int argc, char **argv)`

### 13.33.1 Macro Definition Documentation

#### 13.33.1.1 \_\_FFLASFFPACK\_OPENBLAS\_NT\_ALREADY\_SET

```
#define __FFLASFFPACK_OPENBLAS_NT_ALREADY_SET 1
```

#### 13.33.1.2 CUBE

```
#define CUBE(
    x)
```

### Value:

```
((x) * (x) * (x))
```

### 13.33.2 Function Documentation

#### 13.33.2.1 main()

```
int main (
    int argc,
    char ** argv)
```

## 13.34 benchmark-inverse.C File Reference

```
#include "fflas-ffpack/fflas-ffpack-config.h"
#include <iostream>
```

```
#include <givaro/modular.h>
#include "fflas-ffpack/fflas-ffpack.h"
#include "fflas-ffpack/utils/timer.h"
#include "fflas-ffpack/utils/fflas_io.h"
#include "fflas-ffpack/utils/args-parser.h"
```

## Macros

- `#define CUBE(x)`

## Functions

- `int main (int argc, char **argv)`

### 13.34.1 Macro Definition Documentation

#### 13.34.1.1 CUBE

```
#define CUBE(  
    x)
```

#### Value:

```
((x) * (x) * (x))
```

### 13.34.2 Function Documentation

#### 13.34.2.1 main()

```
int main (  
    int argc,  
    char ** argv)
```

## 13.35 benchmark-lqup-mp.C File Reference

```
#include "fflas-ffpack/fflas-ffpack-config.h"
#include <iostream>
#include <vector>
#include <string>
#include "fflas-ffpack/utils/timer.h"
#include "fflas-ffpack/ffpack/ffpack.h"
#include "fflas-ffpack/utils/args-parser.h"
#include "givaro/modular-integer.h"
```

## Functions

- `int main (int argc, char **argv)`

### 13.35.1 Function Documentation

#### 13.35.1.1 main()

```
int main (  
    int argc,  
    char ** argv)
```

## 13.36 benchmark-lqup.C File Reference

```
#include "fflas-ffpack/fflas-ffpack-config.h"
#include <iostream>
#include <givaro/modular.h>
#include "fflas-ffpack/fflas-ffpack.h"
#include "fflas-ffpack/utils/timer.h"
#include "fflas-ffpack/utils/fflas_io.h"
#include "fflas-ffpack/utils/args-parser.h"
```

### Macros

- #define [CUBE](#)(x)

### Functions

- int [main](#) (int argc, char \*\*argv)

## 13.36.1 Macro Definition Documentation

### 13.36.1.1 CUBE

```
#define CUBE(  
            x)
```

#### Value:

```
((x) * (x) * (x))
```

## 13.36.2 Function Documentation

### 13.36.2.1 main()

```
int main (  
        int argc,  
        char ** argv)
```

## 13.37 benchmark-pluq.C File Reference

```
#include "fflas-ffpack/fflas-ffpack-config.h"
#include <givaro/modular.h>
#include <givaro/givranditer.h>
#include <iostream>
#include "fflas-ffpack/config-blas.h"
#include "fflas-ffpack/fflas/fflas.h"
#include "fflas-ffpack/utils/timer.h"
#include "fflas-ffpack/utils/fflas_randommatrix.h"
#include "fflas-ffpack/utils/args-parser.h"
#include "fflas-ffpack/ffpack/ffpack.h"
```

### Macros

- #define [\\_FFLASFFPACK\\_OPENBLAS\\_NT\\_ALREADY\\_SET](#) 1
- #define [CUBE](#)(x)

### Typedefs

- typedef [Givaro::ModularBalanced](#)< double > [Field](#)

## Functions

- void `verification_PLUQ` (const `Field` &`F`, typename `Field::Element` \*`B`, typename `Field::Element` \*`A`, `size_t` \*`P`, `size_t` \*`Q`, `size_t` `m`, `size_t` `n`, `size_t` `R`)
- void `Rec_Initialize` (`Field` &`F`, `Field::Element` \*`C`, `size_t` `m`, `size_t` `n`, `size_t` `ldc`)
- int `main` (int `argc`, char \*\*`argv`)

## 13.37.1 Macro Definition Documentation

### 13.37.1.1 \_\_FFLASFFPACK\_OPENBLAS\_NT\_ALREADY\_SET

```
#define __FFLASFFPACK_OPENBLAS_NT_ALREADY_SET 1
```

### 13.37.1.2 CUBE

```
#define CUBE(  
            x)
```

#### Value:

```
((x) * (x) * (x))
```

## 13.37.2 Typedef Documentation

### 13.37.2.1 Field

```
typedef Givaro::ModularBalanced<double> Field
```

## 13.37.3 Function Documentation

### 13.37.3.1 verification\_PLUQ()

```
void verification_PLUQ (  
    const Field & F,  
    typename Field::Element * B,  
    typename Field::Element * A,  
    size_t * P,  
    size_t * Q,  
    size_t m,  
    size_t n,  
    size_t R)
```

### 13.37.3.2 Rec\_Initialize()

```
void Rec_Initialize (  
    Field & F,  
    Field::Element * C,  
    size_t m,  
    size_t n,  
    size_t ldc)
```

### 13.37.3.3 main()

```
int main (  
    int argc,  
    char ** argv)
```

## 13.38 benchmark-quasisep.C File Reference

```
#include "fflas-ffpack/fflas-ffpack-config.h"  
#include <iostream>
```

```
#include <givaro/modular.h>
#include <givaro/givpoly1.h>
#include "fflas-ffpack/fflas-ffpack.h"
#include "fflas-ffpack/utils/timer.h"
#include "fflas-ffpack/utils/test-utils.h"
#include "fflas-ffpack/utils/fflas_randommatrix.h"
#include "fflas-ffpack/utils/fflas_io.h"
#include "fflas-ffpack/utils/args-parser.h"
```

## Macros

- `#define __FFLASFFPACK_OPENBLAS_NT_ALREADY_SET 1`

## Functions

- `template<class Field>`  
`void run_with_field (int q, size_t n, size_t m, size_t t, size_t r, size_t iter, uint64_t seed)`
- `int main (int argc, char **argv)`

## 13.38.1 Macro Definition Documentation

### 13.38.1.1 \_\_FFLASFFPACK\_OPENBLAS\_NT\_ALREADY\_SET

```
#define __FFLASFFPACK_OPENBLAS_NT_ALREADY_SET 1
```

## 13.38.2 Function Documentation

### 13.38.2.1 run\_with\_field()

```
template<class Field>
void run_with_field (
    int q,
    size_t n,
    size_t m,
    size_t t,
    size_t r,
    size_t iter,
    uint64_t seed)
```

### 13.38.2.2 main()

```
int main (
    int argc,
    char ** argv)
```

## 13.39 benchmark-storage-transpose.C File Reference

```
#include <iomanip>
#include <iostream>
#include <random>
#include "fflas-ffpack/utils/args-parser.h"
#include "fflas-ffpack/utils/test-utils.h"
#include "fflas-ffpack/utils/fflas_io.h"
#include "fflas-ffpack/utils/fflas_memory.h"
#include <givaro/modular.h>
#include <recint/rint.h>
#include "fflas-ffpack/fflas/fflas_transpose.h"
```



**Data Structures**

- class [Bench<Elt>](#)
- class [ModularBalanced<T>](#)

**Functions**

- int [main](#) (int argc, char \*\*argv)

**13.39.1 Function Documentation****13.39.1.1 main()**

```
int main (
    int argc,
    char ** argv)
```

**13.40 benchmark-wino.C File Reference**

```
#include "fflas-ffpack/fflas-ffpack-config.h"
#include <iostream>
#include <fstream>
#include <givaro/modular.h>
#include "fflas-ffpack/fflas/fflas.h"
#include "fflas-ffpack/utils/timer.h"
#include "fflas-ffpack/utils/args-parser.h"
```

**Macros**

- #define [CUBE](#)(x)

**Functions**

- template<class [Field](#)>  
void [launch\\_wino](#) (const [Field](#) &F, const size\_t &n, const size\_t &NB, const size\_t &wino, const bool &asmax, const size\_t &seed, const bool compare)
- int [main](#) (int argc, char \*\*argv)

**13.40.1 Macro Definition Documentation****13.40.1.1 CUBE**

```
#define CUBE(
    x)
```

**Value:**

```
((x) * (x) * (x))
```

**13.40.2 Function Documentation****13.40.2.1 launch\_wino()**

```
template<class Field>
void launch_wino (
    const Field & F,
    const size_t & n,
    const size_t & NB,
    const size_t & wino,
    const bool & asmax,
```

```
const size_t & seed,
const bool compare)
```

### 13.40.2.2 main()

```
int main (
    int argc,
    char ** argv)
```

## 13.41 mainpage.doxy File Reference

## 13.42 det.C File Reference

```
#include <givaro/modular.h>
#include <iostream>
#include "fflas-ffpack/fflas-ffpack-config.h"
#include "fflas-ffpack/fflas-ffpack.h"
#include "fflas-ffpack/utils/fflas_io.h"
```

### Functions

- int [main](#) (int argc, char \*\*argv)

*This example computes the determinant of a matrix over a defined finite field.*

### 13.42.1 Function Documentation

#### 13.42.1.1 main()

```
int main (
    int argc,
    char ** argv)
```

This example computes the determinant of a matrix over a defined finite field.  
Outputs the determinant.

## 13.43 matmul.C File Reference

```
#include <iostream>
#include "fflas-ffpack/fflas-ffpack.h"
```

### Functions

- int [main](#) (int argc, char \*\*argv)

*This example computes the matrix multiplication over a defined finite field.*

### 13.43.1 Function Documentation

#### 13.43.1.1 main()

```
int main (
    int argc,
    char ** argv)
```

This example computes the matrix multiplication over a defined finite field.  
Outputs the product of the matrix given as input.

## 13.44 rank.C File Reference

```
#include <iostream>
#include "fflas-ffpack/fflas-ffpack.h"
```

### Functions

- int [main](#) (int argc, char \*\*argv)

*This example computes the rank of a matrix over a defined finite field.*

### 13.44.1 Function Documentation

#### 13.44.1.1 main()

```
int main (
    int argc,
    char ** argv)
```

This example computes the rank of a matrix over a defined finite field.  
Outputs the rank.

## 13.45 solve.C File Reference

```
#include <iostream>
#include "fflas-ffpack/fflas-ffpack.h"
```

### Functions

- int [main](#) (int argc, char \*\*argv)

*This example solve the quare system defined by the input over a defined finite field.*

### 13.45.1 Function Documentation

#### 13.45.1.1 main()

```
int main (
    int argc,
    char ** argv)
```

This example solve the quare system defined by the input over a defined finite field.

## 13.46 checker\_charpoly.inl File Reference

```
#include "fflas-ffpack/ffpack/ffpack.h"
```

### Data Structures

- class [CheckerImplem\\_charpoly](#)< Field, Polynomial >
- class [CheckerImplem\\_charpoly](#)< Givaro::ZRing< Givaro::Integer >, Polynomial >

### Namespaces

- namespace [FFPACK](#)

*Finite Field **PACK** Set of elimination based routines for dense linear algebra.*

**Macros**

- `#define` [\\_\\_FFLASFFPACK\\_checker\\_charpoly\\_INL](#)

**13.46.1 Macro Definition Documentation****13.46.1.1 \_\_FFLASFFPACK\_checker\_charpoly\_INL**

```
#define __FFLASFFPACK_checker_charpoly_INL
```

**13.47 checker\_det.inl File Reference**

```
#include "fflas-ffpack/ffpack/ffpack.h"
```

**Data Structures**

- class [CheckerImplem\\_Det< Field >](#)

**Namespaces**

- namespace [FFPACK](#)  
*Finite Field **PACK** Set of elimination based routines for dense linear algebra.*

**Macros**

- `#define` [\\_\\_FFLASFFPACK\\_checker\\_det\\_INL](#)

**13.47.1 Macro Definition Documentation****13.47.1.1 \_\_FFLASFFPACK\_checker\_det\_INL**

```
#define __FFLASFFPACK_checker_det_INL
```

**13.48 checker\_empty.h File Reference**

```
#include "fflas-ffpack/fflas-ffpack-config.h"
```

**Data Structures**

- struct [Checker\\_Empty< Field >](#)

**Namespaces**

- namespace [FFLAS](#)

**13.49 checker\_fgemm.inl File Reference****Data Structures**

- class [CheckerImplem\\_fgemm< Field >](#)

**Namespaces**

- namespace [FFLAS](#)

**Macros**

- #define [\\_\\_FFLASFFPACK\\_checker\\_fgemm\\_INL](#)

**13.49.1 Macro Definition Documentation****13.49.1.1 \_\_FFLASFFPACK\_checker\_fgemm\_INL**

```
#define __FFLASFFPACK_checker_fgemm_INL
```

**13.50 checker\_ftsm.inl File Reference****Data Structures**

- class [CheckerImplem\\_ftsm< Field >](#)

**Namespaces**

- namespace [FFLAS](#)

**Macros**

- #define [\\_\\_FFLASFFPACK\\_checker\\_ftsm\\_INL](#)

**13.50.1 Macro Definition Documentation****13.50.1.1 \_\_FFLASFFPACK\_checker\_ftsm\_INL**

```
#define __FFLASFFPACK_checker_ftsm_INL
```

**13.51 checker\_invert.inl File Reference****Data Structures**

- class [CheckerImplem\\_invert< Field >](#)

**Namespaces**

- namespace [FFPACK](#)

*Finite Field **PACK** Set of elimination based routines for dense linear algebra.*

**Macros**

- #define [\\_\\_FFLASFFPACK\\_checker\\_invert\\_INL](#)

**13.51.1 Macro Definition Documentation****13.51.1.1 \_\_FFLASFFPACK\_checker\_invert\_INL**

```
#define __FFLASFFPACK_checker_invert_INL
```

**13.52 checker\_pluq.inl File Reference**

```
#include "fflas-ffpack/ffpack/ffpack.h"
#include "fflas-ffpack/utils/fflas_io.h"
```

## Data Structures

- class [CheckerImplem\\_PLUQ<Field>](#)

## Namespaces

- namespace [FFPACK](#)

*Finite **Field** **PACK** Set of elimination based routines for dense linear algebra.*

## Macros

- `#define` [\\_\\_FFLASFFPACK\\_checker\\_pluq\\_INL](#)

## 13.52.1 Macro Definition Documentation

### 13.52.1.1 [\\_\\_FFLASFFPACK\\_checker\\_pluq\\_INL](#)

```
#define __FFLASFFPACK_checker_pluq_INL
```

## 13.53 checkers.doxy File Reference

## 13.54 checkers\_fflas.h File Reference

```
#include "fflas-ffpack/fflas-ffpack-config.h"
#include "checker_empty.h"
#include "fflas-ffpack/fflas/fflas.h"
#include "fflas-ffpack/fflas/fflas_enum.h"
#include "fflas-ffpack/fflas/fflas_memory.h"
```

## Data Structures

- class [FailureFgemmCheck](#)
- class [FailureTrsmCheck](#)

## Namespaces

- namespace [FFLAS](#)

## Typedefs

- `template<class Field>`  
using [Checker\\_fgemm](#) = [FFLAS::Checker\\_Empty<Field>](#)
- `template<class Field>`  
using [Checker\\_ftrsm](#) = [FFLAS::Checker\\_Empty<Field>](#)

## 13.55 checkers\_fflas.inl File Reference

```
#include "checker_fgemm.inl"
#include "checker_ftrsm.inl"
```

## Namespaces

- namespace [FFLAS](#)

**Macros**

- `#define FFLASFFPACK_checkers_fflas_inl_H`

**Typedefs**

- `template<class Field>`  
`using ForceCheck_fgemm = CheckerImplem_fgemm<Field>`
- `template<class Field>`  
`using ForceCheck_ftrsm = CheckerImplem_ftrsm<Field>`

**13.55.1 Macro Definition Documentation****13.55.1.1 FFLASFFPACK\_checkers\_fflas\_inl\_H**

```
#define FFLASFFPACK_checkers_fflas_inl_H
```

**13.56 checkers\_ffpack.h File Reference**

```
#include "fflas-ffpack/fflas-ffpack-config.h"
#include "checker_empty.h"
#include "fflas-ffpack/ffpack/ffpack.h"
```

**Data Structures**

- class [FailurePLUQCheck](#)
- class [FailureDetCheck](#)
- class [FailureInvertCheck](#)
- class [FailureCharpolyCheck](#)

**Namespaces**

- namespace [FFPACK](#)

*Finite Field **PACK** Set of elimination based routines for dense linear algebra.*

**Typedefs**

- `template<class Field>`  
`using Checker_PLUQ = FFLAS::Checker_Empty<Field>`
- `template<class Field>`  
`using Checker_Det = FFLAS::Checker_Empty<Field>`
- `template<class Field>`  
`using Checker_invert = FFLAS::Checker_Empty<Field>`
- `template<class Field, class Polynomial>`  
`using Checker_charpoly = FFLAS::Checker_Empty<Field>`

**13.57 checkers\_ffpack.inl File Reference**

```
#include "checker_pluq.inl"
#include "checker_det.inl"
#include "checker_invert.inl"
#include "checker_charpoly.inl"
```

## Namespaces

- namespace [FFPACK](#)

*Finite Field **PACK** Set of elimination based routines for dense linear algebra.*

## Macros

- `#define` [FFLASFFPACK\\_checkers\\_ffpack\\_inl\\_H](#)

## Typedefs

- `template<class Field>`  
using [ForceCheck\\_PLUQ](#) = [CheckerImplem\\_PLUQ](#)<[Field](#)>
- `template<class Field>`  
using [ForceCheck\\_Det](#) = [CheckerImplem\\_Det](#)<[Field](#)>
- `template<class Field>`  
using [ForceCheck\\_invert](#) = [CheckerImplem\\_invert](#)<[Field](#)>
- `template<class Field, class Polynomial>`  
using [ForceCheck\\_charpoly](#) = [CheckerImplem\\_charpoly](#)<[Field](#),Polynomial>

## 13.57.1 Macro Definition Documentation

### 13.57.1.1 FFLASFFPACK\_checkers\_ffpack\_inl\_H

```
#define FFLASFFPACK_checkers_ffpack_inl_H
```

## 13.58 config-blas.h File Reference

### Macros

- `#define` [CBLAS\\_INT](#) int
- `#define` [CBLAS\\_ENUM\\_DEFINED\\_H](#)
- `#define` [CBLAS\\_EXTERNALS](#)
- `#define` [blas\\_enum](#) enum

### Enumerations

- enum [CBLAS\\_ORDER](#) { [CblasRowMajor](#) =101 , [CblasColMajor](#) =102 }
- enum [CBLAS\\_TRANSPOSE](#) { [CblasNoTrans](#) =111 , [CblasTrans](#) =112 , [CblasConjTrans](#) =113 , [AtlasConj](#) =114 }
- enum [CBLAS\\_UPLO](#) { [CblasUpper](#) =121 , [CblasLower](#) =122 }
- enum [CBLAS\\_DIAG](#) { [CblasNonUnit](#) =131 , [CblasUnit](#) =132 }
- enum [CBLAS\\_SIDE](#) { [CblasLeft](#) =141 , [CblasRight](#) =142 }

### Functions

- void [daxpy\\_](#) (const int \*, const double \*, const double \*, const int \*, double \*, const int \*)
- void [saxpy\\_](#) (const int \*, const float \*, const float \*, const int \*, float \*, const int \*)
- double [ddot\\_](#) (const int \*, const double \*, const int \*, const double \*, const int \*)
- float [sdot\\_](#) (const int \*, const float \*, const int \*, const float \*, const int \*)
- double [dasum\\_](#) (const int \*, const double \*, const int \*)
- int [idamax\\_](#) (const int \*, const double \*, const int \*)
- double [dnrm2\\_](#) (const int \*, const double \*, const int \*)
- void [dgemv\\_](#) (const char \*, const int \*, const int \*, const double \*, const double \*, const int \*, const double \*, const int \*, const double \*, double \*, const int \*)
- void [sgemv\\_](#) (const char \*, const int \*, const int \*, const float \*, const float \*, const int \*, const float \*, const int \*, const float \*, float \*, const int \*)



- void [dger\\_](#) (const int \*, const int \*, const double \*, const double \*, const int \*, const double \*, const int \*, double \*, const int \*)
- void [sger\\_](#) (const int \*, const int \*, const float \*, const float \*, const int \*, const float \*, const int \*, float \*, const int \*)
- void [dcopy\\_](#) (const int \*, const double \*, const int \*, double \*, const int \*)
- void [scopy\\_](#) (const int \*, const float \*, const int \*, float \*, const int \*)
- void [dscal\\_](#) (const int \*, const double \*, double \*, const int \*)
- void [sscal\\_](#) (const int \*, const float \*, float \*, const int \*)
- void [dtrsm\\_](#) (const char \*, const char \*, const char \*, const char \*, const int \*, const int \*, const double \*, const double \*, const int \*, double \*, const int \*)
- void [strsm\\_](#) (const char \*, const char \*, const char \*, const char \*, const int \*, const int \*, const float \*, const float \*, const int \*, float \*, const int \*)
- void [dtrmm\\_](#) (const char \*, const char \*, const char \*, const char \*, const int \*, const int \*, const double \*, const double \*, const int \*, double \*, const int \*)
- void [strmm\\_](#) (const char \*, const char \*, const char \*, const char \*, const int \*, const int \*, const float \*, const float \*, const int \*, float \*, const int \*)
- void [sgemm\\_](#) (const char \*, const char \*, const int \*, const int \*, const int \*, const float \*, const float \*, const int \*, const float \*, const int \*, const float \*, float \*, const int \*)
- void [dgemm\\_](#) (const char \*, const char \*, const int \*, const int \*, const int \*, const double \*, const double \*, const int \*, const double \*, const int \*, const double \*, double \*, const int \*)
- void [cblas\\_dsyrk](#) (const enum [CBLAS\\_ORDER](#) Order, const enum [CBLAS\\_UPLO](#) Uplo, const enum [CBLAS\\_TRANSPOSE](#) Trans, const int N, const int K, const double alpha, const double \*A, const int lda, const double beta, double \*C, const int ldc)

## 13.58.1 Macro Definition Documentation

### 13.58.1.1 CBLAS\_INT

```
#define CBLAS_INT int
```

### 13.58.1.2 CBLAS\_ENUM\_DEFINED\_H

```
#define CBLAS_ENUM_DEFINED_H
```

### 13.58.1.3 CBLAS\_EXTERNALS

```
#define CBLAS_EXTERNALS
```

### 13.58.1.4 blas\_enum

```
#define blas_enum enum
```

## 13.58.2 Enumeration Type Documentation

### 13.58.2.1 CBLAS\_ORDER

```
enum CBLAS\_ORDER
```

Enumerator

CblasRowMajor	
CblasColMajor	

### 13.58.2.2 CBLAS\_TRANSPOSE

```
enum CBLAS\_TRANSPOSE
```

**Enumerator**

CblasNoTrans	
CblasTrans	
CblasConjTrans	
AtlasConj	

**13.58.2.3 CBLAS\_UPLO**

enum [CBLAS\\_UPLO](#)

**Enumerator**

CblasUpper	
CblasLower	

**13.58.2.4 CBLAS\_DIAG**

enum [CBLAS\\_DIAG](#)

**Enumerator**

CblasNonUnit	
CblasUnit	

**13.58.2.5 CBLAS\_SIDE**

enum [CBLAS\\_SIDE](#)

**Enumerator**

CblasLeft	
CblasRight	

**13.58.3 Function Documentation****13.58.3.1 daxpy\_()**

```
void daxpy_ (
    const int * ,
    const double * ,
    const double * ,
    const int * ,
    double * ,
    const int * )
```

**13.58.3.2 saxpy\_()**

```
void saxpy_ (
    const int * ,
    const float * ,
    const float * ,
    const int * ,
    float * ,
    const int * )
```

### 13.58.3.3 ddot\_()

```
double ddot_ (
    const int * ,
    const double * ,
    const int * ,
    const double * ,
    const int * )
```

### 13.58.3.4 sdot\_()

```
float sdot_ (
    const int * ,
    const float * ,
    const int * ,
    const float * ,
    const int * )
```

### 13.58.3.5 dasum\_()

```
double dasum_ (
    const int * ,
    const double * ,
    const int * )
```

### 13.58.3.6 idamax\_()

```
int idamax_ (
    const int * ,
    const double * ,
    const int * )
```

### 13.58.3.7 dnrm2\_()

```
double dnrm2_ (
    const int * ,
    const double * ,
    const int * )
```

### 13.58.3.8 dgemv\_()

```
void dgemv_ (
    const char * ,
    const int * ,
    const int * ,
    const double * ,
    const double * ,
    const int * ,
    const double * ,
    const int * ,
    const double * ,
    double * ,
    const int * )
```

### 13.58.3.9 sgemv\_()

```
void sgemv_ (
    const char * ,
    const int * ,
    const int * ,
```

```
    const float * ,  
    const float * ,  
    const int * ,  
    const float * ,  
    const int * ,  
    const float * ,  
    float * ,  
    const int * )
```

#### 13.58.3.10 dger\_()

```
void dger_ (  
    const int * ,  
    const int * ,  
    const double * ,  
    const double * ,  
    const int * ,  
    const double * ,  
    const int * ,  
    double * ,  
    const int * )
```

#### 13.58.3.11 sger\_()

```
void sger_ (  
    const int * ,  
    const int * ,  
    const float * ,  
    const float * ,  
    const int * ,  
    const float * ,  
    const int * ,  
    float * ,  
    const int * )
```

#### 13.58.3.12 dcopy\_()

```
void dcopy_ (  
    const int * ,  
    const double * ,  
    const int * ,  
    double * ,  
    const int * )
```

#### 13.58.3.13 scopy\_()

```
void scopy_ (  
    const int * ,  
    const float * ,  
    const int * ,  
    float * ,  
    const int * )
```

#### 13.58.3.14 dscal\_()

```
void dscal_ (  
    const int * ,  
    const double * ,
```

```
double * ,  
const int * )
```

#### 13.58.3.15 sscal\_()

```
void sscal_ (  
    const int * ,  
    const float * ,  
    float * ,  
    const int * )
```

#### 13.58.3.16 dtrsm\_()

```
void dtrsm_ (  
    const char * ,  
    const char * ,  
    const char * ,  
    const char * ,  
    const int * ,  
    const int * ,  
    const double * ,  
    const double * ,  
    const int * ,  
    double * ,  
    const int * )
```

#### 13.58.3.17 strsm\_()

```
void strsm_ (  
    const char * ,  
    const char * ,  
    const char * ,  
    const char * ,  
    const int * ,  
    const int * ,  
    const float * ,  
    const float * ,  
    const int * ,  
    float * ,  
    const int * )
```

#### 13.58.3.18 dtrmm\_()

```
void dtrmm_ (  
    const char * ,  
    const char * ,  
    const char * ,  
    const char * ,  
    const int * ,  
    const int * ,  
    const double * ,  
    const double * ,  
    const int * ,  
    double * ,  
    const int * )
```

#### 13.58.3.19 strmm\_()

```
void strmm_ (  

```

```
    const char * ,  
    const char * ,  
    const char * ,  
    const char * ,  
    const int * ,  
    const int * ,  
    const float * ,  
    const float * ,  
    const int * ,  
    float * ,  
    const int * )
```

#### 13.58.3.20 sgemm\_()

```
void sgemm_ (  
    const char * ,  
    const char * ,  
    const int * ,  
    const int * ,  
    const int * ,  
    const float * ,  
    const float * ,  
    const int * ,  
    const float * ,  
    const int * ,  
    const float * ,  
    float * ,  
    const int * )
```

#### 13.58.3.21 dgemm\_()

```
void dgemm_ (  
    const char * ,  
    const char * ,  
    const int * ,  
    const int * ,  
    const int * ,  
    const double * ,  
    const double * ,  
    const int * ,  
    const double * ,  
    const int * ,  
    const double * ,  
    double * ,  
    const int * )
```

#### 13.58.3.22 cblas\_dsyrk()

```
void cblas_dsyrk (  
    const enum CBLAS_ORDER Order,  
    const enum CBLAS_UPLO Uplo,  
    const enum CBLAS_TRANSPOSE Trans,  
    const int N,  
    const int K,  
    const double alpha,  
    const double * A,  
    const int lda,  
    const double beta,
```

```
double * C,
const int ldc)
```

## 13.59 config.h File Reference

### Macros

- #define [HAVE\\_BLAS](#) 1
- #define [HAVE\\_CBLAS](#) 1
- #define [HAVE\\_CXX11](#) 1
- #define [HAVE\\_DLFCN\\_H](#) 1
- #define [HAVE\\_FLOAT\\_H](#) 1
- #define [HAVE\\_INT128](#) 1
- #define [HAVE\\_INTPYPES\\_H](#) 1
- #define [HAVE\\_LAPACK](#) 1
- #define [HAVE\\_LIMITS\\_H](#) 1
- #define [HAVE\\_LITTLE\\_ENDIAN](#) 1
- #define [HAVE\\_PTHREAD\\_H](#) 1
- #define [HAVE\\_STDDEF\\_H](#) 1
- #define [HAVE\\_STDINT\\_H](#) 1
- #define [HAVE\\_STDIO\\_H](#) 1
- #define [HAVE\\_STDLIB\\_H](#) 1
- #define [HAVE\\_STRINGS\\_H](#) 1
- #define [HAVE\\_STRING\\_H](#) 1
- #define [HAVE\\_SYS\\_STAT\\_H](#) 1
- #define [HAVE\\_SYS\\_TIME\\_H](#) 1
- #define [HAVE\\_SYS\\_TYPES\\_H](#) 1
- #define [HAVE\\_UNISTD\\_H](#) 1
- #define [LT\\_OBJDIR](#) ".libs/"
- #define [OPENBLAS\\_NUM\\_THREADS](#) 1
- #define [PACKAGE](#) "fflas-ffpack"
- #define [PACKAGE\\_BUGREPORT](#) "ffpack-devel@googlegroups.com"
- #define [PACKAGE\\_NAME](#) "FFLAS-FFPACK"
- #define [PACKAGE\\_STRING](#) "FFLAS-FFPACK 2.5.0"
- #define [PACKAGE\\_TARNAME](#) "fflas-ffpack"
- #define [PACKAGE\\_URL](#) "https://github.com/linbox-team/fflas-ffpack"
- #define [PACKAGE\\_VERSION](#) "2.5.0"
- #define [SIZEOF\\_CHAR](#) 1
- #define [SIZEOF\\_INT](#) 4
- #define [SIZEOF\\_LONG](#) 8
- #define [SIZEOF\\_LONG\\_LONG](#) 8
- #define [SIZEOF\\_SHORT](#) 2
- #define [SIZEOF\\_\\_\\_INT64\\_T](#) 8
- #define [STDC\\_HEADERS](#) 1
- #define [USE\\_OPENMP](#) 1
- #define [VERSION](#) "2.5.0"

### 13.59.1 Macro Definition Documentation

#### 13.59.1.1 HAVE\_BLAS

```
#define HAVE_BLAS 1
```

#### 13.59.1.2 HAVE\_CBLAS

```
#define HAVE_CBLAS 1
```

**13.59.1.3 HAVE\_CXX11**

```
#define HAVE_CXX11 1
```

**13.59.1.4 HAVE\_DLFCN\_H**

```
#define HAVE_DLFCN_H 1
```

**13.59.1.5 HAVE\_FLOAT\_H**

```
#define HAVE_FLOAT_H 1
```

**13.59.1.6 HAVE\_INT128**

```
#define HAVE_INT128 1
```

**13.59.1.7 HAVE\_INTTYPES\_H**

```
#define HAVE_INTTYPES_H 1
```

**13.59.1.8 HAVE\_LAPACK**

```
#define HAVE_LAPACK 1
```

**13.59.1.9 HAVE\_LIMITS\_H**

```
#define HAVE_LIMITS_H 1
```

**13.59.1.10 HAVE\_LITTLE\_ENDIAN**

```
#define HAVE_LITTLE_ENDIAN 1
```

**13.59.1.11 HAVE\_PTHREAD\_H**

```
#define HAVE_PTHREAD_H 1
```

**13.59.1.12 HAVE\_STDDEF\_H**

```
#define HAVE_STDDEF_H 1
```

**13.59.1.13 HAVE\_STDINT\_H**

```
#define HAVE_STDINT_H 1
```

**13.59.1.14 HAVE\_STDIO\_H**

```
#define HAVE_STDIO_H 1
```

**13.59.1.15 HAVE\_STDLIB\_H**

```
#define HAVE_STDLIB_H 1
```

**13.59.1.16 HAVE\_STRINGS\_H**

```
#define HAVE_STRINGS_H 1
```

**13.59.1.17 HAVE\_STRING\_H**

```
#define HAVE_STRING_H 1
```



**13.59.1.18 HAVE\_SYS\_STAT\_H**

```
#define HAVE_SYS_STAT_H 1
```

**13.59.1.19 HAVE\_SYS\_TIME\_H**

```
#define HAVE_SYS_TIME_H 1
```

**13.59.1.20 HAVE\_SYS\_TYPES\_H**

```
#define HAVE_SYS_TYPES_H 1
```

**13.59.1.21 HAVE\_UNISTD\_H**

```
#define HAVE_UNISTD_H 1
```

**13.59.1.22 LT\_OBJDIR**

```
#define LT_OBJDIR ".libs/"
```

**13.59.1.23 OPENBLAS\_NUM\_THREADS**

```
#define OPENBLAS_NUM_THREADS 1
```

**13.59.1.24 PACKAGE**

```
#define PACKAGE "fflas-ffpack"
```

**13.59.1.25 PACKAGE\_BUGREPORT**

```
#define PACKAGE_BUGREPORT "ffpack-devel@googlegroups.com"
```

**13.59.1.26 PACKAGE\_NAME**

```
#define PACKAGE_NAME "FFLAS-FFPACK"
```

**13.59.1.27 PACKAGE\_STRING**

```
#define PACKAGE_STRING "FFLAS-FFPACK 2.5.0"
```

**13.59.1.28 PACKAGE\_TARNAME**

```
#define PACKAGE_TARNAME "fflas-ffpack"
```

**13.59.1.29 PACKAGE\_URL**

```
#define PACKAGE_URL "https://github.com/linbox-team/fflas-ffpack"
```

**13.59.1.30 PACKAGE\_VERSION**

```
#define PACKAGE_VERSION "2.5.0"
```

**13.59.1.31 SIZEOF\_CHAR**

```
#define SIZEOF_CHAR 1
```

**13.59.1.32 SIZEOF\_INT**

```
#define SIZEOF_INT 4
```

**13.59.1.33    `SIZEOF_LONG`**

```
#define SIZEOF_LONG 8
```

**13.59.1.34    `SIZEOF_LONG_LONG`**

```
#define SIZEOF_LONG_LONG 8
```

**13.59.1.35    `SIZEOF_SHORT`**

```
#define SIZEOF_SHORT 2
```

**13.59.1.36    `SIZEOF___INT64_T`**

```
#define SIZEOF___INT64_T 8
```

**13.59.1.37    `STDC_HEADERS`**

```
#define STDC_HEADERS 1
```

**13.59.1.38    `USE_OPENMP`**

```
#define USE_OPENMP 1
```

**13.59.1.39    `VERSION`**

```
#define VERSION "2.5.0"
```

**13.60    `fflas-ffpack/config.h` File Reference****Macros**

- `#define __FFLASFFPACK_HAVE_BLAS 1`
- `#define __FFLASFFPACK_HAVE_CBLAS 1`
- `#define __FFLASFFPACK_HAVE_CXX11 1`
- `#define __FFLASFFPACK_HAVE_DLFCN_H 1`
- `#define __FFLASFFPACK_HAVE_FLOAT_H 1`
- `#define __FFLASFFPACK_HAVE_INT128 1`
- `#define __FFLASFFPACK_HAVE_INTTYPES_H 1`
- `#define __FFLASFFPACK_HAVE_LAPACK 1`
- `#define __FFLASFFPACK_HAVE_LIMITS_H 1`
- `#define __FFLASFFPACK_HAVE_LITTLE_ENDIAN 1`
- `#define __FFLASFFPACK_HAVE_PTHREAD_H 1`
- `#define __FFLASFFPACK_HAVE_STDDEF_H 1`
- `#define __FFLASFFPACK_HAVE_STDINT_H 1`
- `#define __FFLASFFPACK_HAVE_STDIO_H 1`
- `#define __FFLASFFPACK_HAVE_STDLIB_H 1`
- `#define __FFLASFFPACK_HAVE_STRINGS_H 1`
- `#define __FFLASFFPACK_HAVE_STRING_H 1`
- `#define __FFLASFFPACK_HAVE_SYS_STAT_H 1`
- `#define __FFLASFFPACK_HAVE_SYS_TIME_H 1`
- `#define __FFLASFFPACK_HAVE_SYS_TYPES_H 1`
- `#define __FFLASFFPACK_HAVE_UNISTD_H 1`
- `#define __FFLASFFPACK_LT_OBJDIR ".libs/"`
- `#define __FFLASFFPACK_OPENBLAS_NUM_THREADS 1`
- `#define __FFLASFFPACK_PACKAGE "fflas-ffpack"`
- `#define __FFLASFFPACK_PACKAGE_BUGREPORT "ffpack-devel@googlegroups.com"`

- `#define __FFLASFFPACK_PACKAGE_NAME "FFLAS-FFPACK"`
- `#define __FFLASFFPACK_PACKAGE_STRING "FFLAS-FFPACK 2.5.0"`
- `#define __FFLASFFPACK_PACKAGE_TARNAME "fflas-ffpack"`
- `#define __FFLASFFPACK_PACKAGE_URL "https://github.com/linbox-team/fflas-ffpack"`
- `#define __FFLASFFPACK_PACKAGE_VERSION "2.5.0"`
- `#define __FFLASFFPACK_SIZEOF_CHAR 1`
- `#define __FFLASFFPACK_SIZEOF_INT 4`
- `#define __FFLASFFPACK_SIZEOF_LONG 8`
- `#define __FFLASFFPACK_SIZEOF_LONG_LONG 8`
- `#define __FFLASFFPACK_SIZEOF_SHORT 2`
- `#define __FFLASFFPACK_SIZEOF__INT64_T 8`
- `#define __FFLASFFPACK_STDC_HEADERS 1`
- `#define __FFLASFFPACK_USE_OPENMP 1`
- `#define __FFLASFFPACK_VERSION "2.5.0"`

### 13.60.1 Macro Definition Documentation

#### 13.60.1.1 \_\_FFLASFFPACK\_HAVE\_BLAS

```
#define __FFLASFFPACK_HAVE_BLAS 1
```

#### 13.60.1.2 \_\_FFLASFFPACK\_HAVE\_CBLAS

```
#define __FFLASFFPACK_HAVE_CBLAS 1
```

#### 13.60.1.3 \_\_FFLASFFPACK\_HAVE\_CXX11

```
#define __FFLASFFPACK_HAVE_CXX11 1
```

#### 13.60.1.4 \_\_FFLASFFPACK\_HAVE\_DLFCN\_H

```
#define __FFLASFFPACK_HAVE_DLFCN_H 1
```

#### 13.60.1.5 \_\_FFLASFFPACK\_HAVE\_FLOAT\_H

```
#define __FFLASFFPACK_HAVE_FLOAT_H 1
```

#### 13.60.1.6 \_\_FFLASFFPACK\_HAVE\_INT128

```
#define __FFLASFFPACK_HAVE_INT128 1
```

#### 13.60.1.7 \_\_FFLASFFPACK\_HAVE\_INTPYPES\_H

```
#define __FFLASFFPACK_HAVE_INTPYPES_H 1
```

#### 13.60.1.8 \_\_FFLASFFPACK\_HAVE\_LAPACK

```
#define __FFLASFFPACK_HAVE_LAPACK 1
```

#### 13.60.1.9 \_\_FFLASFFPACK\_HAVE\_LIMITS\_H

```
#define __FFLASFFPACK_HAVE_LIMITS_H 1
```

#### 13.60.1.10 \_\_FFLASFFPACK\_HAVE\_LITTLE\_ENDIAN

```
#define __FFLASFFPACK_HAVE_LITTLE_ENDIAN 1
```

#### 13.60.1.11 \_\_FFLASFFPACK\_HAVE\_PTHREAD\_H

```
#define __FFLASFFPACK_HAVE_PTHREAD_H 1
```

**13.60.1.12 \_\_FFLASFFPACK\_HAVE\_STDDEF\_H**

```
#define __FFLASFFPACK_HAVE_STDDEF_H 1
```

**13.60.1.13 \_\_FFLASFFPACK\_HAVE\_STDINT\_H**

```
#define __FFLASFFPACK_HAVE_STDINT_H 1
```

**13.60.1.14 \_\_FFLASFFPACK\_HAVE\_STDIO\_H**

```
#define __FFLASFFPACK_HAVE_STDIO_H 1
```

**13.60.1.15 \_\_FFLASFFPACK\_HAVE\_STDLIB\_H**

```
#define __FFLASFFPACK_HAVE_STDLIB_H 1
```

**13.60.1.16 \_\_FFLASFFPACK\_HAVE\_STRINGS\_H**

```
#define __FFLASFFPACK_HAVE_STRINGS_H 1
```

**13.60.1.17 \_\_FFLASFFPACK\_HAVE\_STRING\_H**

```
#define __FFLASFFPACK_HAVE_STRING_H 1
```

**13.60.1.18 \_\_FFLASFFPACK\_HAVE\_SYS\_STAT\_H**

```
#define __FFLASFFPACK_HAVE_SYS_STAT_H 1
```

**13.60.1.19 \_\_FFLASFFPACK\_HAVE\_SYS\_TIME\_H**

```
#define __FFLASFFPACK_HAVE_SYS_TIME_H 1
```

**13.60.1.20 \_\_FFLASFFPACK\_HAVE\_SYS\_TYPES\_H**

```
#define __FFLASFFPACK_HAVE_SYS_TYPES_H 1
```

**13.60.1.21 \_\_FFLASFFPACK\_HAVE\_UNISTD\_H**

```
#define __FFLASFFPACK_HAVE_UNISTD_H 1
```

**13.60.1.22 \_\_FFLASFFPACK\_LT\_OBJDIR**

```
#define __FFLASFFPACK_LT_OBJDIR ".libs/"
```

**13.60.1.23 \_\_FFLASFFPACK\_OPENBLAS\_NUM\_THREADS**

```
#define __FFLASFFPACK_OPENBLAS_NUM_THREADS 1
```

**13.60.1.24 \_\_FFLASFFPACK\_PACKAGE**

```
#define __FFLASFFPACK_PACKAGE "fflas-ffpack"
```

**13.60.1.25 \_\_FFLASFFPACK\_PACKAGE\_BUGREPORT**

```
#define __FFLASFFPACK_PACKAGE_BUGREPORT "ffpack-devel@googlegroups.com"
```

**13.60.1.26 \_\_FFLASFFPACK\_PACKAGE\_NAME**

```
#define __FFLASFFPACK_PACKAGE_NAME "FFLAS-FFPACK"
```

**13.60.1.27 \_\_FFLASFFPACK\_PACKAGE\_STRING**

```
#define __FFLASFFPACK_PACKAGE_STRING "FFLAS-FFPACK 2.5.0"
```

**13.60.1.28 \_\_FFLASFFPACK\_PACKAGE\_TARNAME**

```
#define __FFLASFFPACK_PACKAGE_TARNAME "fflas-ffpack"
```

**13.60.1.29 \_\_FFLASFFPACK\_PACKAGE\_URL**

```
#define __FFLASFFPACK_PACKAGE_URL "https://github.com/linbox-team/fflas-ffpack"
```

**13.60.1.30 \_\_FFLASFFPACK\_PACKAGE\_VERSION**

```
#define __FFLASFFPACK_PACKAGE_VERSION "2.5.0"
```

**13.60.1.31 \_\_FFLASFFPACK\_SIZEOF\_CHAR**

```
#define __FFLASFFPACK_SIZEOF_CHAR 1
```

**13.60.1.32 \_\_FFLASFFPACK\_SIZEOF\_INT**

```
#define __FFLASFFPACK_SIZEOF_INT 4
```

**13.60.1.33 \_\_FFLASFFPACK\_SIZEOF\_LONG**

```
#define __FFLASFFPACK_SIZEOF_LONG 8
```

**13.60.1.34 \_\_FFLASFFPACK\_SIZEOF\_LONG\_LONG**

```
#define __FFLASFFPACK_SIZEOF_LONG_LONG 8
```

**13.60.1.35 \_\_FFLASFFPACK\_SIZEOF\_SHORT**

```
#define __FFLASFFPACK_SIZEOF_SHORT 2
```

**13.60.1.36 \_\_FFLASFFPACK\_SIZEOF\_\_INT64\_T**

```
#define __FFLASFFPACK_SIZEOF__INT64_T 8
```

**13.60.1.37 \_\_FFLASFFPACK\_STDC\_HEADERS**

```
#define __FFLASFFPACK_STDC_HEADERS 1
```

**13.60.1.38 \_\_FFLASFFPACK\_USE\_OPENMP**

```
#define __FFLASFFPACK_USE_OPENMP 1
```

**13.60.1.39 \_\_FFLASFFPACK\_VERSION**

```
#define __FFLASFFPACK_VERSION "2.5.0"
```

**13.61 fflas-ffpack-config.h File Reference**

Defaults for optimised values.

```
#include "fflas-ffpack/config.h"
#include "fflas-ffpack/fflas-ffpack-thresholds.h"
#include "fflas-ffpack/fflas-ffpack-default-thresholds.h"
#include "givaro/givconfig.h"
```

**Macros**

- `#define GCC_VERSION (__GNUC__ * 10000 + __GNUC_MINOR__ * 100 + __GNUC_PATCHLEVEL__)`

**13.61.1 Detailed Description**

Defaults for optimised values.

While `fflas-ffpack-optimise.h` is created by `configure` script, (either left blank or filled by optimiser), this file produces the defaults for the optimised values. If `fflas-ffpack-optimise.h` is not empty, then its values preceeds the defaults here.

**13.61.2 Macro Definition Documentation****13.61.2.1 GCC\_VERSION**

```
#define GCC_VERSION (__GNUC__ * 10000 + __GNUC_MINOR__ * 100 + __GNUC_PATCHLEVEL__)
```

**13.62 fflas-ffpack-default-thresholds.h File Reference****Macros**

- `#define __FFLASFFPACK_WINOTHRESHOLD 1000`
- `#define __FFLASFFPACK_WINOTHRESHOLD_FLT 2000`
- `#define __FFLASFFPACK_WINOTHRESHOLD_BAL 1000`
- `#define __FFLASFFPACK_WINOTHRESHOLD_BAL_FLT 2000`
- `#define __FFLASFFPACK_PLUQ_THRESHOLD 256`
- `#define __FFLASFFPACK_CHARPOLY_LUKrylov_ArithProg_THRESHOLD 1000`
- `#define __FFLASFFPACK_CHARPOLY_Danilevskii_LUKrylov_THRESHOLD 16`
- `#define __FFLASFFPACK_ARITHPROG_THRESHOLD 30`
- `#define __FFLASFFPACK_FTRTRI_THRESHOLD 32`
- `#define __FFLASFFPACK_FSYTRF_THRESHOLD 64`
- `#define __FFLASFFPACK_FSYRK_THRESHOLD 3000`

**13.62.1 Macro Definition Documentation****13.62.1.1 \_\_FFLASFFPACK\_WINOTHRESHOLD**

```
#define __FFLASFFPACK_WINOTHRESHOLD 1000
```

**13.62.1.2 \_\_FFLASFFPACK\_WINOTHRESHOLD\_FLT**

```
#define __FFLASFFPACK_WINOTHRESHOLD_FLT 2000
```

**13.62.1.3 \_\_FFLASFFPACK\_WINOTHRESHOLD\_BAL**

```
#define __FFLASFFPACK_WINOTHRESHOLD_BAL 1000
```

**13.62.1.4 \_\_FFLASFFPACK\_WINOTHRESHOLD\_BAL\_FLT**

```
#define __FFLASFFPACK_WINOTHRESHOLD_BAL_FLT 2000
```

**13.62.1.5 \_\_FFLASFFPACK\_PLUQ\_THRESHOLD**

```
#define __FFLASFFPACK_PLUQ_THRESHOLD 256
```

**13.62.1.6 \_\_FFLASFFPACK\_CHARPOLY\_LUKrylov\_ArithProg\_THRESHOLD**

```
#define __FFLASFFPACK_CHARPOLY_LUKrylov_ArithProg_THRESHOLD 1000
```

**13.62.1.7 \_\_FFLASFFPACK\_CHARPOLY\_Danilevskii\_LUKrylov\_THRESHOLD**

```
#define __FFLASFFPACK_CHARPOLY_Danilevskii_LUKrylov_THRESHOLD 16
```

**13.62.1.8 \_\_FFLASFFPACK\_ARITHPROG\_THRESHOLD**

```
#define __FFLASFFPACK_ARITHPROG_THRESHOLD 30
```

**13.62.1.9 \_\_FFLASFFPACK\_FTRTRI\_THRESHOLD**

```
#define __FFLASFFPACK_FTRTRI_THRESHOLD 32
```

**13.62.1.10 \_\_FFLASFFPACK\_FSYTRF\_THRESHOLD**

```
#define __FFLASFFPACK_FSYTRF_THRESHOLD 64
```

**13.62.1.11 \_\_FFLASFFPACK\_FSYRK\_THRESHOLD**

```
#define __FFLASFFPACK_FSYRK_THRESHOLD 3000
```

**13.63 fflas-ffpack-thresholds.h File Reference****13.64 fflas-ffpack.doxy File Reference****13.65 fflas-ffpack.h File Reference**

Includes [FFLAS](#) and [FFPACK](#).

```
#include "fflas-ffpack/fflas-ffpack-config.h"
#include "fflas/fflas.h"
#include "ffpack/ffpack.h"
```

**13.65.1 Detailed Description**

Includes [FFLAS](#) and [FFPACK](#).

**13.66 fflas.doxy File Reference****13.67 fflas.h File Reference**

**Finite Field Linear Algebra Subroutines**

```
#include "fflas-ffpack/fflas-ffpack-config.h"
#include "fflas-ffpack/config.h"
#include "fflas-ffpack/config-blas.h"
#include <cmath>
#include <cstring>
#include <float.h>
#include <algorithm>
#include "fflas_enum.h"
#include "fflas-ffpack/utils/fflas_memory.h"
#include "fflas-ffpack/paladin/parallel.h"
#include "fflas_level1.inl"
#include "fflas_level2.inl"
#include "fflas_level3.inl"
#include "fflas-ffpack/checkers/checkers_fflas.h"
#include "fflas_freduce.h"
#include "fflas_fadd.h"
```

```
#include "fflas_fscal.h"
#include "fflas_fassign.h"
#include "fflas_fgemm.inl"
#include "fflas_pfgemm.inl"
#include "fflas_fgemv.inl"
#include "fflas-ffpack/paladin/pfgemv.inl"
#include "fflas_freivalds.inl"
#include "fflas_fger.inl"
#include "fflas_fsyrk.inl"
#include "fflas_fsyrk_strassen.inl"
#include "fflas_fsyr2k.inl"
#include "fflas_ftrsm.inl"
#include "fflas_pftsm.inl"
#include "fflas_ftrmm.inl"
#include "fflas_ftrsv.inl"
#include "fflas_faxpy.inl"
#include "fflas_fdot.inl"
#include "fflas-ffpack/field/rns.h"
#include "fflas_fscal_mp.inl"
#include "fflas_freduce_mp.inl"
#include "fflas-ffpack/fflas/fflas_fger_mp.inl"
#include "fflas_fgemm/fgemm_classical_mp.inl"
#include "fflas_ftrsm_mp.inl"
#include "fflas_fgemv_mp.inl"
#include "fflas-ffpack/field/rns.inl"
#include "fflas-ffpack/paladin/fflas_plevell.h"
#include "fflas_sparse.h"
#include "fflas-ffpack/checkers/checkers_fflas.inl"
```

## Macros

- `#define WINOTHRESHOLD __FFLASFFPACK_WINOTHRESHOLD`
- `#define DOUBLE_TO_FLOAT_CROSSOVER 800`

*Thresholds determining which floating point representation to use, depending on the cardinality of the finite field.*

## 13.67.1 Detailed Description

### Finite Field Linear Algebra Subroutines

#### Author

Clément Pernet.

## 13.67.2 Macro Definition Documentation

### 13.67.2.1 WINOTHRESHOLD

```
#define WINOTHRESHOLD __FFLASFFPACK_WINOTHRESHOLD
```

### 13.67.2.2 DOUBLE\_TO\_FLOAT\_CROSSOVER

```
#define DOUBLE_TO_FLOAT_CROSSOVER 800
```

Thresholds determining which floating point representation to use, depending on the cardinality of the finite field. This is only used when the element representation is not a floating point type.

**Bug** to be benchmarked.



## 13.68 fflas\_bounds.inl File Reference

```
#include "fflas-ffpack/fflas-ffpack-config.h"
#include "fflas-ffpack/utils/flimits.h"
#include <givaro/udl.h>
#include <givaro/modular.h>
#include <givaro/modular-balanced.h>
```

### Namespaces

- namespace [FFLAS](#)
- namespace [FFLAS::Protected](#)

### Macros

- `#define` [\\_\\_FFLASFFPACK\\_fflas\\_bounds\\_INL](#)
- `#define` [FFLAS\\_INT\\_TYPE](#) `uint64_t`

### Functions

- `template<class Field>`  
`double computeFactorClassic (const Field &F)`
- `template<> double computeFactorClassic (const Givaro::ModularBalanced< double > &F)`
- `template<> double computeFactorClassic (const Givaro::ModularBalanced< float > &F)`
- `template<class Field>`  
`size_t DotProdBoundClassic (const Field &F, const typename Field::Element &beta)`
- `Givaro::Integer InfNorm (const size_t M, const size_t N, const Givaro::Integer *A, const size_t lda)`
- `template<class Field>`  
`size_t TRSMBound (const Field &)`  
*TRSMBound.*
- `template<class Element>`  
`size_t TRSMBound (const Givaro::Modular< Element > &F)`  
*Specialization for positive modular representation over double Computes nmax s.t.*
- `template<class Element>`  
`size_t TRSMBound (const Givaro::ModularBalanced< Element > &F)`  
*Specialization for balanced modular representation over double.*

### 13.68.1 Macro Definition Documentation

#### 13.68.1.1 [\\_\\_FFLASFFPACK\\_fflas\\_bounds\\_INL](#)

```
#define __FFLASFFPACK_fflas_bounds_INL
```

#### 13.68.1.2 [FFLAS\\_INT\\_TYPE](#)

```
#define FFLAS_INT_TYPE uint64_t
```

## 13.69 fflas\_enum.h File Reference

```
#include <algorithm>
```

### Data Structures

- class [AreEqual](#)< X, Y >
- class [AreEqual](#)< X, X >

## Namespaces

- namespace [FFLAS](#)
- namespace [FFLAS::Protected](#)

## Enumerations

- enum [FFLAS\\_ORDER](#) { [FflasRowMajor](#) =101 , [FflasColMajor](#) =102 }  
*Storage by row or col ?*
- enum [FFLAS\\_TRANSPOSE](#) { [FflasNoTrans](#) = 111 , [FflasTrans](#) = 112 }  
*Is matrix transposed ?*
- enum [FFLAS\\_UPLO](#) { [FflasUpper](#) = 121 , [FflasLower](#) = 122 , [FflasLeftTri](#) = 123 , [FflasRightTri](#) = 124 }  
*Is triangular matrix's shape upper ?*
- enum [FFLAS\\_DIAG](#) { [FflasNonUnit](#) = 131 , [FflasUnit](#) = 132 }  
*Is the triangular matrix implicitly unit diagonal ?*
- enum [FFLAS\\_SIDE](#) { [FflasLeft](#) = 141 , [FflasRight](#) = 142 }  
*On what side ?*
- enum [FFLAS\\_BASE](#) { [FflasDouble](#) = 151 , [FflasFloat](#) = 152 , [FflasGeneric](#) = 153 }  
*FFLAS\_BASE determines the type of the element representation for Matrix Mult kernel.*

## Functions

- template<class T>  
const T & [min3](#) (const T &m, const T &n, const T &k)
- template<class T>  
const T & [max3](#) (const T &m, const T &n, const T &k)
- template<class T>  
const T & [min4](#) (const T &m, const T &n, const T &k, const T &l)
- template<class T>  
const T & [max4](#) (const T &m, const T &n, const T &k, const T &l)

## 13.70 fflas\_fadd.h File Reference

```
#include "fflas-ffpack/fflas/fflas_simd.h"
#include "fflas_fadd.inl"
```

## Data Structures

- struct [support\\_simd\\_add< T >](#)

## Namespaces

- namespace [FFLAS](#)

## Functions

- template<class [Field](#)>  
void [fadd](#) (const [Field](#) &F, const size\_t N, typename [Field::ConstElement\\_ptr](#) A, const size\_t inca, typename [Field::ConstElement\\_ptr](#) B, const size\_t incb, typename [Field::Element\\_ptr](#) C, const size\_t incc)
- template<class [Field](#)>  
void [faddin](#) (const [Field](#) &F, const size\_t N, typename [Field::ConstElement\\_ptr](#) B, const size\_t incb, typename [Field::Element\\_ptr](#) C, const size\_t incc)
- template<class [Field](#)>  
void [fsub](#) (const [Field](#) &F, const size\_t N, typename [Field::ConstElement\\_ptr](#) A, const size\_t inca, typename [Field::ConstElement\\_ptr](#) B, const size\_t incb, typename [Field::Element\\_ptr](#) C, const size\_t incc)

- `template<class Field>`  
`void fsubin (const Field &F, const size_t N, typename Field::ConstElement_ptr B, const size_t incb, typename Field::Element_ptr C, const size_t incc)`
- `template<class Field>`  
`void fadd (const Field &F, const size_t N, typename Field::ConstElement_ptr A, const size_t inca, const typename Field::Element alpha, typename Field::ConstElement_ptr B, const size_t incb, typename Field::Element_ptr C, const size_t incc)`
- `template<class Field>`  
`void pfadd (const Field &F, const size_t M, const size_t N, typename Field::ConstElement_ptr A, const size_t lda, typename Field::ConstElement_ptr B, const size_t ldb, typename Field::Element_ptr C, const size_t ldc, const size_t numths)`
- `template<class Field>`  
`void pfsub (const Field &F, const size_t M, const size_t N, typename Field::ConstElement_ptr A, const size_t lda, typename Field::ConstElement_ptr B, const size_t ldb, typename Field::Element_ptr C, const size_t ldc, const size_t numths)`
- `template<class Field>`  
`void pfaddin (const Field &F, const size_t M, const size_t N, typename Field::ConstElement_ptr B, const size_t ldb, typename Field::Element_ptr C, const size_t ldc, size_t numths)`
- `template<class Field>`  
`void pfsubin (const Field &F, const size_t M, const size_t N, typename Field::ConstElement_ptr B, const size_t ldb, typename Field::Element_ptr C, const size_t ldc, size_t numths)`
- `template<class Field>`  
`void fadd (const Field &F, const size_t M, const size_t N, typename Field::ConstElement_ptr A, const size_t lda, typename Field::ConstElement_ptr B, const size_t ldb, typename Field::Element_ptr C, const size_t ldc)`  
*fadd : matrix addition.*
- `template<class Field>`  
`void fsub (const Field &F, const size_t M, const size_t N, typename Field::ConstElement_ptr A, const size_t lda, typename Field::ConstElement_ptr B, const size_t ldb, typename Field::Element_ptr C, const size_t ldc)`  
*fsub : matrix subtraction.*
- `template<class Field>`  
`void faddin (const Field &F, const size_t M, const size_t N, typename Field::ConstElement_ptr B, const size_t ldb, typename Field::Element_ptr C, const size_t ldc)`  
*faddin*
- `template<class Field>`  
`void faddin (const Field &F, const FFLAS_UPLO uplo, const size_t N, typename Field::ConstElement_ptr B, const size_t ldb, typename Field::Element_ptr C, const size_t ldc)`  
*fadding for symmetric matrices*
- `template<class Field>`  
`void fsubin (const Field &F, const size_t M, const size_t N, typename Field::ConstElement_ptr B, const size_t ldb, typename Field::Element_ptr C, const size_t ldc)`  
*fsubin  $C = C - B$*
- `template<class Field>`  
`void fadd (const Field &F, const size_t M, const size_t N, typename Field::ConstElement_ptr A, const size_t lda, const typename Field::Element alpha, typename Field::ConstElement_ptr B, const size_t ldb, typename Field::Element_ptr C, const size_t ldc)`  
*fadd : matrix addition with scaling.*

## 13.71 fflas\_fadd.inl File Reference

```
#include "fflas-ffpack/fflas/fflas_simd.h"
```

### Namespaces

- namespace `FFLAS`
- namespace `FFLAS::vectorised`
- namespace `FFLAS::details`

## Macros

- `#define __FFLASFFPACK_fadd_INL`

## Functions

- `template<class SimdT, class Element, bool positive>`  
`std::enable_if< is_simd< SimdT >::value, void >::type VEC_ADD (SimdT &C, SimdT &A, SimdT &B, SimdT &Q, SimdT &T, SimdT &P, SimdT &NEGP, SimdT &MIN, SimdT &MAX)`
- `template<bool positive, class Element, class T1, class T2>`  
`std::enable_if< FFLAS::support_simd_add< Element >::value, void >::type addp (Element *T, const Element *TA, const Element *TB, size_t n, Element p, T1 min_, T2 max_)`
- `template<class SimdT, class Element, bool positive>`  
`std::enable_if< is_simd< SimdT >::value, void >::type VEC_SUB (SimdT &C, SimdT &A, SimdT &B, SimdT &Q, SimdT &T, SimdT &P, SimdT &NEGP, SimdT &MIN, SimdT &MAX)`
- `template<bool positive, class Element, class T1, class T2>`  
`std::enable_if< FFLAS::support_simd_add< Element >::value, void >::type subp (Element *T, const Element *TA, const Element *TB, const size_t n, const Element p, const T1 min_, const T2 max_)`
- `template<class Element>`  
`std::enable_if< FFLAS::support_simd_add< Element >::value, void >::type add (Element *T, const Element *TA, const Element *TB, size_t n)`
- `template<class Element>`  
`std::enable_if< FFLAS::support_simd_add< Element >::value, void >::type sub (Element *T, const Element *TA, const Element *TB, size_t n)`
- `template<class Field, bool ADD>`  
`std::enable_if< FFLAS::support_simd_add< typenameField::Element >::value, void >::type fadd (const Field &F, const size_t N, typename Field::ConstElement_ptr A, const size_t inca, typename Field::ConstElement_ptr B, const size_t incb, typename Field::Element_ptr C, const size_t incc, FieldCategories::ModularTag)`
- `template<class Field, bool ADD>`  
`std::enable_if< !FFLAS::support_simd_add< typenameField::Element >::value, void >::type fadd (const Field &F, const size_t N, typename Field::ConstElement_ptr A, const size_t inca, typename Field::ConstElement_ptr B, const size_t incb, typename Field::Element_ptr C, const size_t incc, FieldCategories::ModularTag)`
- `template<class Field, bool ADD>`  
`void fadd (const Field &F, const size_t N, typename Field::ConstElement_ptr A, const size_t inca, typename Field::ConstElement_ptr B, const size_t incb, typename Field::Element_ptr C, const size_t incc, FieldCategories::GenericTag)`
- `template<class Field, bool ADD>`  
`std::enable_if< !FFLAS::support_simd_add< typenameField::Element >::value, void >::type fadd (const Field &F, const size_t N, typename Field::ConstElement_ptr A, const size_t inca, typename Field::ConstElement_ptr B, const size_t incb, typename Field::Element_ptr C, const size_t incc, FieldCategories::UnparametricTag)`
- `template<class Field, bool ADD>`  
`std::enable_if< FFLAS::support_simd_add< typenameField::Element >::value, void >::type fadd (const Field &F, const size_t N, typename Field::ConstElement_ptr A, const size_t inca, typename Field::ConstElement_ptr B, const size_t incb, typename Field::Element_ptr C, const size_t incc, FieldCategories::UnparametricTag)`

## 13.71.1 Macro Definition Documentation

### 13.71.1.1 \_\_FFLASFFPACK\_fadd\_INL

```
#define __FFLASFFPACK_fadd_INL
```

## 13.72 fflas\_fassign.h File Reference

```
#include "fflas_fassign.inl"
```

## 13.73 fflas\_fassign.inl File Reference

```
#include <string.h>
#include <givaro/modular.h>
#include <givaro/modular-balanced.h>
#include <givaro/zring.h>
#include "fflas-ffpack/utils/debug.h"
```

### Namespaces

- namespace [FFLAS](#)

### Macros

- #define [\\_\\_FFLASFFPACK\\_fassign\\_INL](#)

### Functions

- template<class [Field](#)>  
void [fassign](#) (const [Field](#) &F, const size\_t N, typename [Field::ConstElement\\_ptr](#) Y, const size\_t incY, typename [Field::Element\\_ptr](#) X, const size\_t incX)  
 $fassign : x \leftarrow y.$
- template<> void [fassign](#) (const Givaro::Modular< float > &F, const size\_t N, const float \*Y, const size\_t incY, float \*X, const size\_t incX)
- template<> void [fassign](#) (const Givaro::ModularBalanced< float > &F, const size\_t N, const float \*Y, const size\_t incY, float \*X, const size\_t incX)
- template<> void [fassign](#) (const Givaro::ZRing< float > &F, const size\_t N, const float \*Y, const size\_t incY, float \*X, const size\_t incX)
- template<> void [fassign](#) (const Givaro::Modular< double > &F, const size\_t N, const double \*Y, const size\_t incY, double \*X, const size\_t incX)
- template<> void [fassign](#) (const Givaro::ModularBalanced< double > &F, const size\_t N, const double \*Y, const size\_t incY, double \*X, const size\_t incX)
- template<> void [fassign](#) (const Givaro::ZRing< double > &F, const size\_t N, const double \*Y, const size\_t incY, double \*X, const size\_t incX)
- template<class [Field](#)>  
void [fassign](#) (const [Field](#) &F, const size\_t m, const size\_t n, typename [Field::ConstElement\\_ptr](#) B, const size\_t ldb, typename [Field::Element\\_ptr](#) A, const size\_t lda)  
 $fassign : A \leftarrow B.$

### 13.73.1 Macro Definition Documentation

#### 13.73.1.1 \_\_FFLASFFPACK\_fassign\_INL

```
#define __FFLASFFPACK_fassign_INL
```

## 13.74 fflas\_faxpy.inl File Reference

### Namespaces

- namespace [FFLAS](#)
- namespace [FFLAS::vectorised](#)
- namespace [FFLAS::vectorised::unswitch](#)
- namespace [FFLAS::details](#)

### Macros

- #define [\\_\\_FFLASFFPACK\\_faxpy\\_INL](#)

## Functions

- `template<class Field>`  
`std::enable_if<!FFLAS::support_simd_mod< typenameField::Element >::value &&FFLAS::support_fast_mod<`  
`typenameField::Element >::value, void >::type axpyp (const Field &F, const typename Field::Element a,`  
`typename Field::ConstElement_ptr X, typename Field::Element_ptr Y, const size_t n, HelperMod< Field >`  
`&H)`
- `template<class Field>`  
`std::enable_if< FFLAS::support_fast_mod< typenameField::Element >::value, void >::type axpyp`  
`(const Field &F, const typename Field::Element a, typename Field::ConstElement_ptr X, typename`  
`Field::Element_ptr Y, const size_t n, const size_t incX, const size_t incY, HelperMod< Field > &H)`
- `template<class Field>`  
`std::enable_if< FFLAS::support_fast_mod< typenameField::Element >::value, void >::type axpyp`  
`(const Field &F, const typename Field::Element a, typename Field::ConstElement_ptr X, typename`  
`Field::Element_ptr Y, const size_t n)`
- `template<class Field>`  
`std::enable_if< FFLAS::support_fast_mod< typenameField::Element >::value, void >::type axpyp`  
`(const Field &F, const typename Field::Element a, typename Field::ConstElement_ptr X, typename`  
`Field::Element_ptr Y, const size_t n, const size_t incX, const size_t incY)`
- `template<class Field>`  
`std::enable_if< FFLAS::support_fast_mod< typenameField::Element >::value, void >::type faxpy (const`  
`Field &F, const size_t N, const typename Field::Element a, typename Field::ConstElement_ptr X, const size_t`  
`incX, typename Field::Element_ptr Y, const size_t incY, FieldCategories::ModularTag)`
- `template<class Field, class FC>`  
`void faxpy (const Field &F, const size_t N, const typename Field::Element a, typename Field::ConstElement_ptr`  
`X, const size_t incX, typename Field::Element_ptr Y, const size_t incY, FC)`
- `template<class Field>`  
`void faxpy (const Field &F, const size_t N, const typename Field::Element alpha, typename Field::ConstElement_ptr`  
`X, const size_t incX, typename Field::Element_ptr Y, const size_t incY)`  

$$faxpy : y \leftarrow \alpha \cdot x + y.$$
- `template<> void faxpy (const Givaro::DoubleDomain &, const size_t N, const Givaro::DoubleDomain::Element a,`  
`Givaro::DoubleDomain::ConstElement_ptr x, const size_t incx, Givaro::DoubleDomain::Element_ptr y,`  
`const size_t incy)`
- `template<> void faxpy (const Givaro::FloatDomain &, const size_t N, const Givaro::FloatDomain::Element`  
`a, Givaro::FloatDomain::ConstElement_ptr x, const size_t incx, Givaro::FloatDomain::Element_ptr y, const`  
`size_t incy)`
- `template<class Field>`  
`void faxpy (const Field &F, const size_t m, const size_t n, const typename Field::Element alpha, typename`  
`Field::ConstElement_ptr X, const size_t idx, typename Field::Element_ptr Y, const size_t ldy)`  

$$faxpy : y \leftarrow \alpha \cdot x + y.$$

## 13.74.1 Macro Definition Documentation

### 13.74.1.1 \_\_FFLASFFPACK\_faxpy\_INL

```
#define __FFLASFFPACK_faxpy_INL
```

## 13.75 fflas\_fdot.inl File Reference

```
#include "fflas-ffpack/fflas/fflas_helpers.inl"
```

## Namespaces

- namespace [FFLAS](#)

## Macros

- `#define __FFLASFFPACK_fdot_INL`

## Functions

- `template<class Field>`  
`Field::Element fdot` (const `Field` &F, const `size_t` N, typename `Field::ConstElement_ptr` x, const `size_t` incx, typename `Field::ConstElement_ptr` y, const `size_t` incy, `ModeCategories::DefaultTag` &MT)
- `template<class Field>`  
`Field::Element fdot` (const `Field` &F, const `size_t` N, typename `Field::ConstElement_ptr` x, const `size_t` incx, typename `Field::ConstElement_ptr` y, const `size_t` incy, `ModeCategories::DelayedTag` &MT)
- `template<>` `Givaro::DoubleDomain::Element fdot` (const `Givaro::DoubleDomain` &, const `size_t` N, `Givaro::DoubleDomain::ConstElement_ptr` x, const `size_t` incx, `Givaro::DoubleDomain::ConstElement_ptr` y, const `size_t` incy, `ModeCategories::DefaultTag` &MT)
- `template<>` `Givaro::FloatDomain::Element fdot` (const `Givaro::FloatDomain` &, const `size_t` N, `Givaro::FloatDomain::ConstElement_ptr` x, const `size_t` incx, `Givaro::FloatDomain::ConstElement_ptr` y, const `size_t` incy, `ModeCategories::DefaultTag` &MT)
- `template<class Field, class T>`  
`Field::Element fdot` (const `Field` &F, const `size_t` N, typename `Field::ConstElement_ptr` x, const `size_t` incx, typename `Field::ConstElement_ptr` y, const `size_t` incy, `ModeCategories::ConvertTo`< T > &MT)
- `template<class Field>`  
`Field::Element fdot` (const `Field` &F, const `size_t` N, typename `Field::ConstElement_ptr` x, const `size_t` incx, typename `Field::ConstElement_ptr` y, const `size_t` incy, `ModeCategories::DefaultBoundedTag` &dbt)
- `template<class Field>`  
`Field::Element fdot` (const `Field` &F, const `size_t` N, typename `Field::ConstElement_ptr` x, const `size_t` incx, typename `Field::ConstElement_ptr` y, const `size_t` incy, const `ParSeqHelper::Sequential` seq)
- `template<class Field>`  
`Field::Element fdot` (const `Field` &F, const `size_t` N, typename `Field::ConstElement_ptr` X, const `size_t` incX, typename `Field::ConstElement_ptr` Y, const `size_t` incY)  

$$fdot: \text{dot product } x^T y.$$

## 13.75.1 Macro Definition Documentation

### 13.75.1.1 \_\_FFLASFFPACK\_fdot\_INL

```
#define __FFLASFFPACK_fdot_INL
```

## 13.76 fflas\_fgemm.inl File Reference

```
#include <givaro/modular.h>
#include <givaro/modular-balanced.h>
#include "fflas-ffpack/utils/debug.h"
#include "fflas_fgemm/fgemm_classical.inl"
#include "fflas_fgemm/fgemm_winograd.inl"
```

## Namespaces

- namespace `FFLAS`
- namespace `FFLAS::Protected`

## Macros

- `#define __FFLASFFPACK_fgemm_INL`

## Functions

- `template<class NewField, class Field, class FieldMode>`  
`Field::Element_ptr fgemm_convert` (const `Field` &F, const `FFLAS_TRANSPOSE` ta, const `FFLAS_TRANSPOSE` tb, const `size_t` m, const `size_t` n, const `size_t` k, const typename `Field::Element` alpha, typename `Field::ConstElement_ptr` A, const `size_t` lda, typename `Field::ConstElement_ptr` B, const `size_t` ldb, const typename `Field::Element` beta, typename `Field::Element_ptr` C, const `size_t` ldc, `MMHelper`< `Field`, `MMHelperAlgo::Winograd`, `FieldMode` > &H)
- `template<class Field, class Element, class AlgoT, class ParSeqTrait>`  
`bool NeedPreAddReduction` (`Element` &Outmin, `Element` &Outmax, `Element` &Op1min, `Element` &Op1max, `Element` &Op2min, `Element` &Op2max, `MMHelper`< `Field`, `AlgoT`, `ModeCategories::LazyTag`, `ParSeqTrait` > &WH)
- `template<class Field, class Element, class AlgoT, class ModeT, class ParSeqTrait>`  
`bool NeedPreAddReduction` (`Element` &Outmin, `Element` &Outmax, `Element` &Op1min, `Element` &Op1max, `Element` &Op2min, `Element` &Op2max, `MMHelper`< `Field`, `AlgoT`, `ModeT`, `ParSeqTrait` > &WH)
- `template<class Field, class Element, class AlgoT, class ParSeqTrait>`  
`bool NeedPreSubReduction` (`Element` &Outmin, `Element` &Outmax, `Element` &Op1min, `Element` &Op1max, `Element` &Op2min, `Element` &Op2max, `MMHelper`< `Field`, `AlgoT`, `ModeCategories::LazyTag`, `ParSeqTrait` > &WH)
- `template<class Field, class Element, class AlgoT, class ModeT, class ParSeqTrait>`  
`bool NeedPreSubReduction` (`Element` &Outmin, `Element` &Outmax, `Element` &Op1min, `Element` &Op1max, `Element` &Op2min, `Element` &Op2max, `MMHelper`< `Field`, `AlgoT`, `ModeT`, `ParSeqTrait` > &WH)
- `template<class Field, class Element, class AlgoT, class ParSeqTrait>`  
`bool NeedDoublePreAddReduction` (`Element` &Outmin, `Element` &Outmax, `Element` &Op1min, `Element` &Op1max, `Element` &Op2min, `Element` &Op2max, `Element` beta, `MMHelper`< `Field`, `AlgoT`, `ModeCategories::LazyTag`, `ParSeqTrait` > &WH)
- `template<class Field, class Element, class AlgoT, class ModeT, class ParSeqTrait>`  
`bool NeedDoublePreAddReduction` (`Element` &Outmin, `Element` &Outmax, `Element` &Op1min, `Element` &Op1max, `Element` &Op2min, `Element` &Op2max, `Element` beta, `MMHelper`< `Field`, `AlgoT`, `ModeT`, `ParSeqTrait` > &WH)
- `template<class Field, class AlgoT, class ParSeqTrait>`  
`void ScalAndReduce` (const `Field` &F, const `size_t` N, const typename `Field::Element` alpha, typename `Field::Element_ptr` X, const `size_t` incX, const `MMHelper`< `Field`, `AlgoT`, `ModeCategories::LazyTag`, `ParSeqTrait` > &H)
- `template<class Field, class AlgoT, class ParSeqTrait>`  
`void ScalAndReduce` (const `Field` &F, const `size_t` M, const `size_t` N, const typename `Field::Element` alpha, typename `Field::Element_ptr` A, const `size_t` lda, const `MMHelper`< `Field`, `AlgoT`, `ModeCategories::LazyTag`, `ParSeqTrait` > &H)
- `template<class Field>`  
`Field::Element_ptr fgemm` (const `Field` &F, const `FFLAS_TRANSPOSE` ta, const `FFLAS_TRANSPOSE` tb, const `size_t` m, const `size_t` n, const `size_t` k, const typename `Field::Element` alpha, typename `Field::ConstElement_ptr` A, const `size_t` lda, typename `Field::ConstElement_ptr` B, const `size_t` ldb, const typename `Field::Element` beta, typename `Field::Element_ptr` C, const `size_t` ldc, `MMHelper`< `Field`, `MMHelperAlgo::Winograd`, `ModeCategories::ConvertTo`< `ElementCategories::MachineFloatTag` >, `ParSeqHelper::Sequential` > &H)
- `template<typename Field>`  
`Field::Element_ptr fgemm` (const `Field` &F, const `FFLAS_TRANSPOSE` ta, const `FFLAS_TRANSPOSE` tb, const `size_t` m, const `size_t` n, const `size_t` k, const typename `Field::Element` alpha, typename `Field::ConstElement_ptr` A, const `size_t` lda, typename `Field::ConstElement_ptr` B, const `size_t` ldb, const typename `Field::Element` beta, typename `Field::Element_ptr` C, const `size_t` ldc, const `ParSeqHelper::Sequential` seq)
- `template<typename Field, class Cut, class Param>`  
`Field::Element_ptr fgemm` (const `Field` &F, const `FFLAS_TRANSPOSE` ta, const `FFLAS_TRANSPOSE` tb, const `size_t` m, const `size_t` n, const `size_t` k, const typename `Field::Element` alpha, typename `Field::ConstElement_ptr` A, const `size_t` lda, typename `Field::ConstElement_ptr` B, const `size_t` ldb, const typename `Field::Element` beta, typename `Field::Element_ptr` C, const `size_t` ldc, const `ParSeqHelper::Parallel`< `Cut`, `Param` > par)



- `template<typename Field>`  
`Field::Element_ptr fgemm (const Field &F, const FFLAS_TRANSPOSE ta, const FFLAS_TRANSPOSE tb, const size_t m, const size_t n, const size_t k, const typename Field::Element alpha, typename Field::ConstElement_ptr A, const size_t lda, typename Field::ConstElement_ptr B, const size_t ldb, const typename Field::Element beta, typename Field::Element_ptr C, const size_t ldc)`  
*fgemm: Field GEneral Matrix Multiply.*
- `template<typename Field, class ModeT, class ParSeq>`  
`Field::Element_ptr fgemm (const Field &F, const FFLAS_TRANSPOSE ta, const FFLAS_TRANSPOSE tb, const size_t m, const size_t n, const size_t k, const typename Field::Element alpha, typename Field::ConstElement_ptr A, const size_t lda, typename Field::ConstElement_ptr B, const size_t ldb, const typename Field::Element beta, typename Field::Element_ptr C, const size_t ldc, MMHelper< Field, MMHelperAlgo::Auto, ModeT, ParSeq > &H)`
- `template<class Field>`  
`Field::Element_ptr fgemm (const Field &F, const FFLAS_TRANSPOSE ta, const FFLAS_TRANSPOSE tb, const size_t m, const size_t n, const size_t k, const typename Field::Element alpha, typename Field::ConstElement_ptr A, const size_t lda, typename Field::ConstElement_ptr B, const size_t ldb, const typename Field::Element beta, typename Field::Element_ptr C, const size_t ldc, MMHelper< Field, MMHelperAlgo::Winograd, ModeCategories::DelayedTag, ParSeqHelper::Sequential > &H)`
- `template<class Field>`  
`Field::Element_ptr fsquare (const Field &F, const FFLAS_TRANSPOSE ta, const size_t n, const typename Field::Element alpha, typename Field::ConstElement_ptr A, const size_t lda, const typename Field::Element beta, typename Field::Element_ptr C, const size_t ldc)`  
*fsquare: Squares a matrix.*
- `template<class Field>`  
`Field::Element_ptr fsquareCommon (const Field &F, const FFLAS_TRANSPOSE ta, const size_t n, const typename Field::Element alpha, typename Field::ConstElement_ptr A, const size_t lda, const typename Field::Element beta, typename Field::Element_ptr C, const size_t ldc)`
- `template<> double * fsquare (const Givaro::ModularBalanced< double > &F, const FFLAS_TRANSPOSE ta, const size_t n, const double alpha, const double *A, const size_t lda, const double beta, double *C, const size_t ldc)`
- `template<> float * fsquare (const Givaro::ModularBalanced< float > &F, const FFLAS_TRANSPOSE ta, const size_t n, const float alpha, const float *A, const size_t lda, const float beta, float *C, const size_t ldc)`
- `template<> double * fsquare (const Givaro::Modular< double > &F, const FFLAS_TRANSPOSE ta, const size_t n, const double alpha, const double *A, const size_t lda, const double beta, double *C, const size_t ldc)`
- `template<> float * fsquare (const Givaro::Modular< float > &F, const FFLAS_TRANSPOSE ta, const size_t n, const float alpha, const float *A, const size_t lda, const float beta, float *C, const size_t ldc)`

## 13.76.1 Macro Definition Documentation

### 13.76.1.1 \_\_FFLASFFPACK\_fgemm\_INL

```
#define __FFLASFFPACK_fgemm_INL
```

## 13.77 fgemm\_classical.inl File Reference

## 13.78 fgemm\_classical\_mp.inl File Reference

matrix multiplication with multiprecision input (either over Z or over Z/pZ)

```
#include <givaro/modular-integer.h>
#include <givaro/zring.h>
#include "fflas-ffpack/field/rns-double.h"
#include "fflas-ffpack/field/rns-integer.h"
#include "fflas-ffpack/field/rns-integer-mod.h"
#include "fflas-ffpack/field/field-traits.h"
#include "fflas-ffpack/fflas/fflas_helpers.inl"
```

```
#include "fflas-ffpack/fflas/fflas_bounds.inl"
```

## Namespaces

- namespace `FFLAS`

## Macros

- `#define __FFPACK_fgemm_classical_INL`

## Functions

- `template<typename RNS, typename ParSeqTrait>`  
`FFPACK::RNSInteger< RNS >::Element_ptr fgemm (const FFPACK::RNSInteger< RNS > &F, const FFLAS_TRANSPOSE ta, const FFLAS_TRANSPOSE tb, const size_t m, const size_t n, const size_t k, const typename FFPACK::RNSInteger< RNS >::Element alpha, typename FFPACK::RNSInteger< RNS >::ConstElement_ptr Ad, const size_t lda, typename FFPACK::RNSInteger< RNS >::ConstElement_ptr Bd, const size_t ldb, const typename FFPACK::RNSInteger< RNS >::Element beta, typename FFPACK::RNSInteger< RNS >::Element_ptr Cd, const size_t ldc, MMHelper< FFPACK::RNSInteger< RNS >, MMHelperAlgo::Classic, ModeCategories::DefaultTag, ParSeqHelper::Compose< ParSeqHelper::Sequential, ParSeqTrait > > &H)`
- `template<typename RNS>`  
`FFPACK::RNSInteger< RNS >::Element_ptr fgemm (const FFPACK::RNSInteger< RNS > &F, const FFLAS_TRANSPOSE ta, const FFLAS_TRANSPOSE tb, const size_t m, const size_t n, const size_t k, const typename FFPACK::RNSInteger< RNS >::Element alpha, typename FFPACK::RNSInteger< RNS >::ConstElement_ptr Ad, const size_t lda, typename FFPACK::RNSInteger< RNS >::ConstElement_ptr Bd, const size_t ldb, const typename FFPACK::RNSInteger< RNS >::Element beta, typename FFPACK::RNSInteger< RNS >::Element_ptr Cd, const size_t ldc, MMHelper< FFPACK::RNSInteger< RNS >, MMHelperAlgo::Classic, ModeCategories::DefaultTag, ParSeqHelper::Sequential > &H)`
- `template<typename RNS, typename ParSeqTrait>`  
`FFPACK::RNSInteger< RNS >::Element_ptr fgemm (const FFPACK::RNSInteger< RNS > &F, const FFLAS_TRANSPOSE ta, const FFLAS_TRANSPOSE tb, const size_t m, const size_t n, const size_t k, const typename FFPACK::RNSInteger< RNS >::Element alpha, typename FFPACK::RNSInteger< RNS >::ConstElement_ptr Ad, const size_t lda, typename FFPACK::RNSInteger< RNS >::ConstElement_ptr Bd, const size_t ldb, const typename FFPACK::RNSInteger< RNS >::Element beta, typename FFPACK::RNSInteger< RNS >::Element_ptr Cd, const size_t ldc, MMHelper< FFPACK::RNSInteger< RNS >, MMHelperAlgo::Classic, ModeCategories::DefaultTag, ParSeqHelper::Compose< ParSeqHelper::Parallel< CuttingStrategy::RNSModulus, StrategyParameter::Threads >, ParSeqTrait > > &H)`
- `template<typename RNS, typename Cut, typename Param>`  
`FFPACK::RNSInteger< RNS >::Element_ptr fgemm (const FFPACK::RNSInteger< RNS > &F, const FFLAS_TRANSPOSE ta, const FFLAS_TRANSPOSE tb, const size_t m, const size_t n, const size_t k, const typename FFPACK::RNSInteger< RNS >::Element alpha, typename FFPACK::RNSInteger< RNS >::ConstElement_ptr Ad, const size_t lda, typename FFPACK::RNSInteger< RNS >::ConstElement_ptr Bd, const size_t ldb, const typename FFPACK::RNSInteger< RNS >::Element beta, typename FFPACK::RNSInteger< RNS >::Element_ptr Cd, const size_t ldc, MMHelper< FFPACK::RNSInteger< RNS >, MMHelperAlgo::Classic, ModeCategories::DefaultTag, ParSeqHelper::Parallel< Cut, Param > > &H)`
- `template<class ParSeq>`  
`Givaro::Integer * fgemm (const Givaro::ZRing< Givaro::Integer > &F, const FFLAS_TRANSPOSE ta, const FFLAS_TRANSPOSE tb, const size_t m, const size_t n, const size_t k, const Givaro::Integer alpha, const Givaro::Integer *A, const size_t lda, const Givaro::Integer *B, const size_t ldb, Givaro::Integer beta, Givaro::Integer *C, const size_t ldc, MMHelper< Givaro::ZRing< Givaro::Integer >, MMHelperAlgo::Classic, ModeCategories::ConvertTo< ElementCategories::RNSElementTag >, ParSeq > &H)`
- `template<typename RNS, class ModeT>`  
`RNS::Element_ptr fgemm (const FFPACK::RNSInteger< RNS > &F, const FFLAS_TRANSPOSE ta, const FFLAS_TRANSPOSE tb, const size_t m, const size_t n, const size_t k, const typename RNS::Element alpha,`

- ```

typename RNS::ConstElement_ptr Ad, const size_t lda, typename RNS::ConstElement_ptr Bd, const size_t ldb, const typename RNS::Element beta, typename RNS::Element_ptr Cd, const size_t ldc, MMHelper<FFPACK::RNSInteger< RNS >, MMHelperAlgo::Winograd, ModeT, ParSeqHelper::Sequential > &H)

```
- `template<typename RNS>`  
`RNS::Element_ptr fgemm (const FFPACK::RNSIntegerMod< RNS > &F, const FFLAS_TRANSPOSE ta, const FFLAS_TRANSPOSE tb, const size_t m, const size_t n, const size_t k, const typename RNS::Element alpha, typename RNS::ConstElement_ptr Ad, const size_t lda, typename RNS::ConstElement_ptr Bd, const size_t ldb, const typename RNS::Element beta, typename RNS::Element_ptr Cd, const size_t ldc, MMHelper< FFPACK::RNSIntegerMod< RNS >, MMHelperAlgo::Winograd > &H)`
  - `Givaro::Integer * fgemm (const Givaro::Modular< Givaro::Integer > &F, const FFLAS_TRANSPOSE ta, const FFLAS_TRANSPOSE tb, const size_t m, const size_t n, const size_t k, const Givaro::Integer alpha, const Givaro::Integer *A, const size_t lda, const Givaro::Integer *B, const size_t ldb, const Givaro::Integer beta, Givaro::Integer *C, const size_t ldc, MMHelper< Givaro::Modular< Givaro::Integer >, MMHelperAlgo::Classic, ModeCategories::ConvertTo< ElementCategories::RNSElementTag > > &H)`
  - `template<class ParSeq>`  
`Givaro::Integer * fgemm (const Givaro::Modular< Givaro::Integer > &F, const FFLAS_TRANSPOSE ta, const FFLAS_TRANSPOSE tb, const size_t m, const size_t n, const size_t k, const Givaro::Integer alpha, const Givaro::Integer *A, const size_t lda, const Givaro::Integer *B, const size_t ldb, const Givaro::Integer beta, Givaro::Integer *C, const size_t ldc, MMHelper< Givaro::Modular< Givaro::Integer >, MMHelperAlgo::Auto, ModeCategories::ConvertTo< ElementCategories::RNSElementTag >, ParSeq > &H)`
  - `template<size_t K1, size_t K2, class ParSeq>`  
`Reclnt::ruint< K1 > * fgemm (const Givaro::Modular< Reclnt::ruint< K1 >, Reclnt::ruint< K2 > > &F, const FFLAS_TRANSPOSE ta, const FFLAS_TRANSPOSE tb, const size_t m, const size_t n, const size_t k, const Reclnt::ruint< K1 > alpha, const Reclnt::ruint< K1 > *A, const size_t lda, const Reclnt::ruint< K1 > *B, const size_t ldb, Reclnt::ruint< K1 > beta, Reclnt::ruint< K1 > *C, const size_t ldc, MMHelper< Givaro::Modular< Reclnt::ruint< K1 >, Reclnt::ruint< K2 > >, MMHelperAlgo::Classic, ModeCategories::ConvertTo< ElementCategories::RNSElementTag >, ParSeq > &H)`

### 13.78.1 Detailed Description

matrix multiplication with multiprecision input (either over Z or over Z/pZ)

### 13.78.2 Macro Definition Documentation

#### 13.78.2.1 \_\_FFPACK\_fgemm\_classical\_INL

```
#define __FFPACK_fgemm_classical_INL
```

## 13.79 fgemm\_winograd.inl File Reference

```

#include <stdint.h>
#include <givaro/modular.h>
#include <givaro/zring.h>
#include "fgemm_classical.inl"
#include "schedule_winograd.inl"
#include "schedule_winograd_acc.inl"
#include "schedule_winograd_acc_ip.inl"
#include "schedule_winograd_ip.inl"
#include "fflas-ffpack/fflas-ffpack-config.h"

```

### Namespaces

- namespace `FFLAS`
- namespace `FFLAS::Protected`

## Macros

- #define `__FFLASFFPACK_fflas_fflas_fgemm_winograd_INL`
- #define `NEWWINO`

## Functions

- template<class `Field`>  
int `WinogradThreshold` (const `Field` &F)  
*Computes the number of recursive levels to perform.*
- template<> int `WinogradThreshold` (const `Givaro::Modular`< float > &F)
- template<> int `WinogradThreshold` (const `Givaro::ModularBalanced`< double > &F)
- template<> int `WinogradThreshold` (const `Givaro::ModularBalanced`< float > &F)
- template<class `Field`>  
int `WinogradSteps` (const `Field` &F, const size\_t &m)  
*Computes the number of recursive levels to perform.*
- template<class `Field`, class `FieldMode`>  
void `DynamicPeeling` (const `Field` &F, const `FFLAS_TRANSPOSE` ta, const `FFLAS_TRANSPOSE` tb, const size\_t m, const size\_t n, const size\_t k, const size\_t mr, const size\_t nr, const size\_t kr, const typename `Field::Element` alpha, typename `Field::ConstElement_ptr` A, const size\_t lda, typename `Field::ConstElement_ptr` B, const size\_t ldb, const typename `Field::Element` beta, typename `Field::Element_ptr` C, const size\_t ldc, `MMHelper`< `Field`, `MMHelperAlgo::Winograd`, `FieldMode` > &H, const typename `MMHelper`< `Field`, `MMHelperAlgo::Winograd`, `FieldMode` >::`DelayedField::Element` Cmin, const typename `MMHelper`< `Field`, `MMHelperAlgo::Winograd`, `FieldMode` >::`DelayedField::Element` Cmax)
- template<class `Field`, class `FieldMode`>  
void `DynamicPeeling2` (const `Field` &F, const `FFLAS_TRANSPOSE` ta, const `FFLAS_TRANSPOSE` tb, const size\_t m, const size\_t n, const size\_t k, const size\_t mr, const size\_t nr, const size\_t kr, const typename `Field::Element` alpha, typename `Field::ConstElement_ptr` A, const size\_t lda, typename `Field::ConstElement_ptr` B, const size\_t ldb, const typename `Field::Element` beta, typename `Field::Element_ptr` C, const size\_t ldc, `MMHelper`< `Field`, `MMHelperAlgo::Winograd`, `FieldMode` > &H, const typename `MMHelper`< `Field`, `MMHelperAlgo::Winograd`, `FieldMode` >::`DelayedField::Element` Cmin, const typename `MMHelper`< `Field`, `MMHelperAlgo::Winograd`, `FieldMode` >::`DelayedField::Element` Cmax)
- template<class `Field`, class `FieldMode`>  
void `WinogradCalc` (const `Field` &F, const `FFLAS_TRANSPOSE` ta, const `FFLAS_TRANSPOSE` tb, const size\_t mr, const size\_t nr, const size\_t kr, const typename `Field::Element` alpha, typename `Field::ConstElement_ptr` A, const size\_t lda, typename `Field::ConstElement_ptr` B, const size\_t ldb, const typename `Field::Element` beta, typename `Field::Element_ptr` C, const size\_t ldc, `MMHelper`< `Field`, `MMHelperAlgo::Winograd`, `FieldMode` > &H)
- template<class `Field`, class `ModeT`>  
`Field::Element_ptr` `fgemm` (const `Field` &F, const `FFLAS_TRANSPOSE` ta, const `FFLAS_TRANSPOSE` tb, const size\_t m, const size\_t n, const size\_t k, const typename `Field::Element` alpha, typename `Field::ConstElement_ptr` A, const size\_t lda, typename `Field::ConstElement_ptr` B, const size\_t ldb, const typename `Field::Element` beta, typename `Field::Element_ptr` C, const size\_t ldc, `MMHelper`< `Field`, `MMHelperAlgo::Winograd`, `ModeT` > &H)
- template<class `Field`, class `ModeT`, class `Cut`, class `Param`>  
`Field::Element_ptr` `fgemm` (const `Field` &F, const `FFLAS_TRANSPOSE` ta, const `FFLAS_TRANSPOSE` tb, const size\_t m, const size\_t n, const size\_t k, const typename `Field::Element` alpha, typename `Field::ConstElement_ptr` A, const size\_t lda, typename `Field::ConstElement_ptr` B, const size\_t ldb, const typename `Field::Element` beta, typename `Field::Element_ptr` C, const size\_t ldc, `MMHelper`< `Field`, `MMHelperAlgo::WinogradPar`, `ModeT`, `ParSeqHelper::Parallel`< `Cut`, `Param` > > &H)

## 13.79.1 Macro Definition Documentation

### 13.79.1.1 `__FFLASFFPACK_fflas_fflas_fgemm_winograd_INL`

```
#define __FFLASFFPACK_fflas_fflas_fgemm_winograd_INL
```

### 13.79.1.2 NEWWINO

```
#define NEWWINO
```

## 13.80 matmul.doxy File Reference

### 13.81 schedule\_bini.inl File Reference

Bini implementation.

#### Namespaces

- namespace [FFLAS](#)
- namespace [FFLAS::BLAS3](#)

#### Macros

- #define [\\_\\_FFLASFFPACK\\_fgemm\\_bini\\_INL](#)

#### Functions

- template<class [Field](#)>  
void [Bini](#) (const [Field](#) &F, const [FFLAS\\_TRANSPOSE](#) ta, const [FFLAS\\_TRANSPOSE](#) tb, const size\_t mr, const size\_t nr, const size\_t kr, const typename [Field::Element](#) alpha, const typename [Field::Element\\_ptr](#) A, const size\_t lda, const typename [Field::Element\\_ptr](#) B, const size\_t ldb, const typename [Field::Element](#) beta, typename [Field::Element\\_ptr](#) C, const size\_t ldc, const size\_t kmax, const size\_t w, const [FFLAS\\_BASE](#) base, const size\_t rec\_level)

#### 13.81.1 Detailed Description

Bini implementation.

#### 13.81.2 Macro Definition Documentation

##### 13.81.2.1 [\\_\\_FFLASFFPACK\\_fgemm\\_bini\\_INL](#)

```
#define __FFLASFFPACK_fgemm_bini_INL
```

### 13.82 schedule\_winograd.inl File Reference

#### Namespaces

- namespace [FFLAS](#)
- namespace [FFLAS::BLAS3](#)

#### Macros

- #define [\\_\\_FFLASFFPACK\\_fgemm\\_winograd\\_INL](#)

#### Functions

- template<class [Field](#), class [FieldTrait](#), class [Strat](#), class [Param](#)>  
[Field::Element\\_ptr](#) [WinoPar](#) (const [Field](#) &F, const [FFLAS\\_TRANSPOSE](#) ta, const [FFLAS\\_TRANSPOSE](#) tb, const size\_t mr, const size\_t nr, const size\_t kr, const typename [Field::Element](#) alpha, typename [Field::ConstElement\\_ptr](#) A, const size\_t lda, typename [Field::ConstElement\\_ptr](#) B, const size\_t ldb, const typename [Field::Element](#) beta, typename [Field::Element\\_ptr](#) C, const size\_t ldc, [MMHelper](#)< [Field](#), [MMHelperAlgo::WinogradPar](#), [FieldTrait](#), [ParSeqHelper::Parallel](#)< [Strat](#), [Param](#) > > &WH)

- `template<class Field, class FieldTrait>`  
`void Winograd (const Field &F, const FFLAS_TRANSPOSE ta, const FFLAS_TRANSPOSE tb, const size_t`  
`mr, const size_t nr, const size_t kr, const typename Field::Element alpha, typename Field::ConstElement_ptr`  
`A, const size_t lda, typename Field::ConstElement_ptr B, const size_t ldb, const typename Field::Element`  
`beta, typename Field::Element_ptr C, const size_t ldc, MMHelper< Field, MMHelperAlgo::Winograd, Field↵`  
`Trait > &WH)`

## 13.82.1 Macro Definition Documentation

### 13.82.1.1 \_\_FFLASFFPACK\_fgemm\_winograd\_INL

```
#define __FFLASFFPACK_fgemm_winograd_INL
```

## 13.83 schedule\_winograd\_acc.inl File Reference

### Namespaces

- namespace `FFLAS`
- namespace `FFLAS::BLAS3`

### Macros

- `#define __FFLASFFPACK_fgemm_winograd_acc_INL`

### Functions

- `template<class Field, class FieldTrait>`  
`void WinogradAcc_3_23 (const Field &F, const FFLAS_TRANSPOSE ta, const FFLAS_TRANSPOSE`  
`tb, const size_t mr, const size_t nr, const size_t kr, const typename Field::Element alpha, typename`  
`Field::ConstElement_ptr A, const size_t lda, typename Field::ConstElement_ptr B, const size_t ldb,`  
`const typename Field::Element beta, typename Field::Element_ptr C, const size_t ldc, MMHelper< Field,`  
`MMHelperAlgo::Winograd, FieldTrait > &WH)`
- `template<class Field, class FieldTrait>`  
`void WinogradAcc_3_21 (const Field &F, const FFLAS_TRANSPOSE ta, const FFLAS_TRANSPOSE`  
`tb, const size_t mr, const size_t nr, const size_t kr, const typename Field::Element alpha, typename`  
`Field::ConstElement_ptr A, const size_t lda, typename Field::ConstElement_ptr B, const size_t ldb,`  
`const typename Field::Element beta, typename Field::Element_ptr C, const size_t ldc, MMHelper< Field,`  
`MMHelperAlgo::Winograd, FieldTrait > &WH)`
- `template<class Field, class FieldTrait>`  
`void WinogradAcc_2_24 (const Field &F, const FFLAS_TRANSPOSE ta, const FFLAS_TRANSPOSE`  
`tb, const size_t mr, const size_t nr, const size_t kr, const typename Field::Element alpha, const type-`  
`name Field::Element_ptr A, const size_t lda, const typename Field::Element_ptr B, const size_t ldb,`  
`const typename Field::Element beta, typename Field::Element_ptr C, const size_t ldc, MMHelper< Field,`  
`MMHelperAlgo::Winograd, FieldTrait > &WH)`
- `template<class Field, class FieldTrait>`  
`void WinogradAcc_2_27 (const Field &F, const FFLAS_TRANSPOSE ta, const FFLAS_TRANSPOSE`  
`tb, const size_t mr, const size_t nr, const size_t kr, const typename Field::Element alpha, const type-`  
`name Field::Element_ptr A, const size_t lda, const typename Field::Element_ptr B, const size_t ldb,`  
`const typename Field::Element beta, typename Field::Element_ptr C, const size_t ldc, MMHelper< Field,`  
`MMHelperAlgo::Winograd, FieldTrait > &WH)`

## 13.83.1 Macro Definition Documentation

### 13.83.1.1 \_\_FFLASFFPACK\_fgemm\_winograd\_acc\_INL

```
#define __FFLASFFPACK_fgemm_winograd_acc_INL
```

## 13.84 schedule\_winograd\_acc\_ip.inl File Reference

### Namespaces

- namespace [FFLAS](#)
- namespace [FFLAS::BLAS3](#)

### Macros

- `#define` [\\_\\_FFLASFFPACK\\_fgemm\\_winograd\\_acc\\_ip\\_INL](#)

### Functions

- `template<class Field, class FieldTrait>`  
void [WinogradAcc\\_LR](#) (const [Field](#) &F, const [FFLAS\\_TRANSPOSE](#) ta, const [FFLAS\\_TRANSPOSE](#) tb, const [size\\_t](#) mr, const [size\\_t](#) nr, const [size\\_t](#) kr, const typename [Field::Element](#) alpha, typename [Field::Element\\_ptr](#) A, const [size\\_t](#) lda, typename [Field::Element\\_ptr](#) B, const [size\\_t](#) ldb, const typename [Field::Element](#) beta, typename [Field::Element\\_ptr](#) C, const [size\\_t](#) ldc, const [MMHelper](#)< [Field](#), [MMHelperAlgo::Winograd](#), [FieldTrait](#) > &WH)
- `template<class Field, class FieldTrait>`  
void [WinogradAcc\\_R\\_S](#) (const [Field](#) &F, const [FFLAS\\_TRANSPOSE](#) ta, const [FFLAS\\_TRANSPOSE](#) tb, const [size\\_t](#) mr, const [size\\_t](#) nr, const [size\\_t](#) kr, const typename [Field::Element](#) alpha, const typename [Field::Element\\_ptr](#) A, const [size\\_t](#) lda, typename [Field::Element\\_ptr](#) B, const [size\\_t](#) ldb, const typename [Field::Element](#) beta, typename [Field::Element\\_ptr](#) C, const [size\\_t](#) ldc, const [MMHelper](#)< [Field](#), [MMHelperAlgo::Winograd](#), [FieldTrait](#) > &WH)
- `template<class Field, class FieldTrait>`  
void [WinogradAcc\\_L\\_S](#) (const [Field](#) &F, const [FFLAS\\_TRANSPOSE](#) ta, const [FFLAS\\_TRANSPOSE](#) tb, const [size\\_t](#) mr, const [size\\_t](#) nr, const [size\\_t](#) kr, const typename [Field::Element](#) alpha, typename [Field::Element\\_ptr](#) A, const [size\\_t](#) lda, const typename [Field::Element\\_ptr](#) B, const [size\\_t](#) ldb, const typename [Field::Element](#) beta, typename [Field::Element\\_ptr](#) C, const [size\\_t](#) ldc, const [MMHelper](#)< [Field](#), [MMHelperAlgo::Winograd](#), [FieldTrait](#) > &WH)

### 13.84.1 Macro Definition Documentation

#### 13.84.1.1 [\\_\\_FFLASFFPACK\\_fgemm\\_winograd\\_acc\\_ip\\_INL](#)

```
#define __FFLASFFPACK_fgemm_winograd_acc_ip_INL
```

## 13.85 schedule\_winograd\_ip.inl File Reference

### Namespaces

- namespace [FFLAS](#)
- namespace [FFLAS::BLAS3](#)

### Macros

- `#define` [\\_\\_FFLASFFPACK\\_fgemm\\_winograd\\_ip\\_INL](#)

### Functions

- `template<class Field, class FieldTrait>`  
void [Winograd\\_LR\\_S](#) (const [Field](#) &F, const [FFLAS\\_TRANSPOSE](#) ta, const [FFLAS\\_TRANSPOSE](#) tb, const [size\\_t](#) mr, const [size\\_t](#) nr, const [size\\_t](#) kr, const typename [Field::Element](#) alpha, typename [Field::Element\\_ptr](#) A, const [size\\_t](#) lda, typename [Field::Element\\_ptr](#) B, const [size\\_t](#) ldb, const typename [Field::Element](#) beta, typename [Field::Element\\_ptr](#) C, const [size\\_t](#) ldc, const [MMHelper](#)< [Field](#), [MMHelperAlgo::Winograd](#), [FieldTrait](#) > &WH)



- `template<class Field, class FieldTrait>`  
`void Winograd_L_S (const Field &F, const FFLAS_TRANSPOSE ta, const FFLAS_TRANSPOSE tb, const size_t mr, const size_t nr, const size_t kr, const typename Field::Element alpha, typename Field::Element_ptr A, const size_t lda, const typename Field::Element_ptr B, const size_t ldb, const typename Field::Element beta, typename Field::Element_ptr C, const size_t ldc, const MMHelper< Field, MMHelperAlgo::Winograd, FieldTrait > &WH)`
- `template<class Field, class FieldTrait>`  
`void Winograd_R_S (const Field &F, const FFLAS_TRANSPOSE ta, const FFLAS_TRANSPOSE tb, const size_t mr, const size_t nr, const size_t kr, const typename Field::Element alpha, const typename Field::Element_ptr A, const size_t lda, typename Field::Element_ptr B, const size_t ldb, const typename Field::Element beta, typename Field::Element_ptr C, const size_t ldc, const MMHelper< Field, MMHelperAlgo::Winograd, FieldTrait > &WH)`

## 13.85.1 Macro Definition Documentation

### 13.85.1.1 \_\_FFLASFFPACK\_fgemm\_winograd\_ip\_INL

```
#define __FFLASFFPACK_fgemm_winograd_ip_INL
```

## 13.86 fflas\_fgemv.inl File Reference

```
#include <givaro/zring.h>
```

### Namespaces

- namespace FFLAS
- namespace FFLAS::Protected

### Macros

- #define \_\_FFLASFFPACK\_fgemv\_INL

### Functions

- `template<typename FloatElement, class Field>`  
`Field::Element_ptr fgemv_convert (const Field &F, const FFLAS_TRANSPOSE ta, const size_t M, const size_t N, const typename Field::Element alpha, typename Field::ConstElement_ptr A, const size_t lda, typename Field::ConstElement_ptr X, const size_t incX, const typename Field::Element beta, typename Field::Element_ptr Y, const size_t incY)`
- `template<class Field>`  
`Field::Element_ptr fgemv (const Field &F, const FFLAS_TRANSPOSE ta, const size_t M, const size_t N, const typename Field::Element alpha, typename Field::ConstElement_ptr A, const size_t lda, typename Field::ConstElement_ptr X, const size_t incX, const typename Field::Element beta, typename Field::Element_ptr Y, const size_t incY, MMHelper< Field, MMHelperAlgo::Classic, ModeCategories::ConvertTo< ElementCategories::MachineFloatTag > > &H)`
- `template<class Field>`  
`Field::Element_ptr fgemv (const Field &F, const FFLAS_TRANSPOSE ta, const size_t M, const size_t N, const typename Field::Element alpha, typename Field::ConstElement_ptr A, const size_t lda, typename Field::ConstElement_ptr X, const size_t incX, const typename Field::Element beta, typename Field::Element_ptr Y, const size_t incY, MMHelper< Field, MMHelperAlgo::Classic, ModeCategories::DelayedTag > &H)`
- `template<class Field>`  
`Field::Element_ptr fgemv (const Field &F, const FFLAS_TRANSPOSE ta, const size_t M, const size_t N, const typename Field::Element alpha, typename Field::ConstElement_ptr A, const size_t lda, typename Field::ConstElement_ptr X, const size_t incX, const typename Field::Element beta, typename Field::Element_ptr Y, const size_t incY, MMHelper< Field, MMHelperAlgo::Classic, ModeCategories::DefaultTag > &H)`



- `template<class Field>`  
`Field::Element_ptr fgmv (const Field &F, const FFLAS_TRANSPOSE ta, const size_t M, const size_t N, const typename Field::Element alpha, typename Field::ConstElement_ptr A, const size_t lda, typename Field::ConstElement_ptr X, const size_t incX, const typename Field::Element beta, typename Field::Element_ptr Y, const size_t incY, MMHelper< Field, MMHelperAlgo::Classic, ModeCategories::LazyTag > &H)`
- `template<class Field>`  
`Field::Element_ptr fgmv (const Field &F, const FFLAS_TRANSPOSE TransA, const size_t M, const size_t N, const typename Field::Element alpha, typename Field::ConstElement_ptr A, const size_t lda, typename Field::ConstElement_ptr X, const size_t incX, const typename Field::Element beta, typename Field::Element_ptr Y, const size_t incY)`  
*finite prime Field GEneral Matrix Vector multiplication.*
- `Givaro::ZRing< int64_t >::Element_ptr fgmv (const Givaro::ZRing< int64_t > &F, const FFLAS_TRANSPOSE ta, const size_t M, const size_t N, const int64_t alpha, const int64_t *A, const size_t lda, const int64_t *X, const size_t incX, const int64_t beta, int64_t *Y, const size_t incY, MMHelper< Givaro::ZRing< int64_t >, MMHelperAlgo::Classic, ModeCategories::DefaultTag > &H)`
- `Givaro::DoubleDomain::Element_ptr fgmv (const Givaro::DoubleDomain &F, const FFLAS_TRANSPOSE ta, const size_t M, const size_t N, const Givaro::DoubleDomain::Element alpha, const Givaro::DoubleDomain::ConstElement_ptr A, const size_t lda, const Givaro::DoubleDomain::ConstElement_ptr X, const size_t incX, const Givaro::DoubleDomain::Element beta, Givaro::DoubleDomain::Element_ptr Y, const size_t incY, MMHelper< Givaro::DoubleDomain, MMHelperAlgo::Classic, ModeCategories::DefaultTag > &H)`
- `template<class Field>`  
`Field::Element_ptr fgmv (const Field &F, const FFLAS_TRANSPOSE ta, const size_t M, const size_t N, const typename Field::Element alpha, const typename Field::ConstElement_ptr A, const size_t lda, const typename Field::ConstElement_ptr X, const size_t incX, const typename Field::Element beta, typename Field::Element_ptr Y, const size_t incY, MMHelper< Field, MMHelperAlgo::Classic, ModeCategories::DefaultBoundedTag > &H)`
- `Givaro::FloatDomain::Element_ptr fgmv (const Givaro::FloatDomain &F, const FFLAS_TRANSPOSE ta, const size_t M, const size_t N, const Givaro::FloatDomain::Element alpha, const Givaro::FloatDomain::ConstElement_ptr A, const size_t lda, const Givaro::FloatDomain::ConstElement_ptr X, const size_t incX, const Givaro::FloatDomain::Element beta, Givaro::FloatDomain::Element_ptr Y, const size_t incY, MMHelper< Givaro::FloatDomain, MMHelperAlgo::Classic, ModeCategories::DefaultTag > &H)`
- `template<class Field, class Cut, class Param>`  
`Field::Element_ptr fgmv (const Field &F, const FFLAS_TRANSPOSE ta, const size_t m, const size_t n, const typename Field::Element alpha, const typename Field::ConstElement_ptr A, const size_t lda, const typename Field::ConstElement_ptr X, const size_t incX, const typename Field::Element beta, typename Field::Element_ptr Y, const size_t incY, ParSeqHelper::Parallel< Cut, Param > &parH)`
- `template<class Field>`  
`Field::Element_ptr fgmv (const Field &F, const FFLAS_TRANSPOSE ta, const size_t m, const size_t n, const typename Field::Element alpha, const typename Field::ConstElement_ptr A, const size_t lda, const typename Field::ConstElement_ptr X, const size_t incX, const typename Field::Element beta, typename Field::Element_ptr Y, const size_t incY, ParSeqHelper::Sequential &seqH)`

## 13.86.1 Macro Definition Documentation

### 13.86.1.1 \_\_FFLASFFPACK\_fgmv\_INL

```
#define __FFLASFFPACK_fgmv_INL
```

## 13.87 fflas\_fgmv\_mp.inl File Reference

```
#include "fflas-ffpack/field/rns-integer-mod.h"
```

### Namespaces

- namespace `FFLAS`

## Macros

- `#define __FFLASFFPACK_fgemv_mp_INL`

## Functions

- `FFPACK::rns_double::Element_ptr fgemv` (const `FFPACK::RNSInteger< FFPACK::rns_double >` &F, const `FFLAS_TRANSPOSE` ta, const `size_t` M, const `size_t` N, const `FFPACK::rns_double::Element` alpha, `FFPACK::rns_double::ConstElement_ptr` A, const `size_t` lda, `FFPACK::rns_double::ConstElement_ptr` X, const `size_t` incX, const `FFPACK::rns_double::Element` beta, `FFPACK::rns_double::Element_ptr` Y, const `size_t` incY, `MMHelper< FFPACK::RNSInteger< FFPACK::rns_double >`, `MMHelperAlgo::Classic`, `ModeCategories::DefaultTag` > &H)
- `FFPACK::rns_double::Element_ptr fgemv` (const `FFPACK::RNSIntegerMod< FFPACK::rns_double >` &F, const `FFLAS_TRANSPOSE` ta, const `size_t` M, const `size_t` N, const `FFPACK::rns_double::Element` alpha, `FFPACK::rns_double::ConstElement_ptr` A, const `size_t` lda, `FFPACK::rns_double::ConstElement_ptr` X, const `size_t` incX, const `FFPACK::rns_double::Element` beta, `FFPACK::rns_double::Element_ptr` Y, const `size_t` incY, `MMHelper< FFPACK::RNSIntegerMod< FFPACK::rns_double >`, `MMHelperAlgo::Classic`, `ModeCategories::DefaultTag` > &H)
- `Givaro::Integer * fgemv` (const `Givaro::ZRing< Givaro::Integer >` &F, const `FFLAS_TRANSPOSE` ta, const `size_t` m, const `size_t` n, const `Givaro::Integer` alpha, `Givaro::Integer *A`, const `size_t` lda, `Givaro::Integer *X`, const `size_t` ldx, `Givaro::Integer` beta, `Givaro::Integer *Y`, const `size_t` ldy, `MMHelper< Givaro::ZRing< Givaro::Integer >`, `MMHelperAlgo::Classic`, `ModeCategories::ConvertTo< ElementCategories::RNSElementTag >` > &H)
- `Givaro::Integer * fgemv` (const `Givaro::Modular< Givaro::Integer >` &F, const `FFLAS_TRANSPOSE` ta, const `size_t` m, const `size_t` n, const `Givaro::Integer` alpha, `Givaro::Integer *A`, const `size_t` lda, `Givaro::Integer *X`, const `size_t` ldx, `Givaro::Integer` beta, `Givaro::Integer *Y`, const `size_t` ldy, `MMHelper< Givaro::Modular< Givaro::Integer >`, `MMHelperAlgo::Classic`, `ModeCategories::ConvertTo< ElementCategories::RNSElementTag >` > &H)
- `template<size_t K1, size_t K2, class ParSeq>`  
`RecInt::ruint< K1 > * fgemv` (const `Givaro::Modular< RecInt::ruint< K1 >`, `RecInt::ruint< K2 >` > &F, const `FFLAS_TRANSPOSE` ta, const `size_t` m, const `size_t` n, const `RecInt::ruint< K1 >` alpha, const `RecInt::ruint< K1 > *A`, const `size_t` lda, const `RecInt::ruint< K1 > *X`, const `size_t` incx, `RecInt::ruint< K1 >` beta, `RecInt::ruint< K1 > *Y`, const `size_t` incy, `MMHelper< Givaro::Modular< RecInt::ruint< K1 >`, `RecInt::ruint< K2 >` >, `MMHelperAlgo::Classic`, `ModeCategories::ConvertTo< ElementCategories::RNSElementTag >`, `ParSeq` > &H)

## 13.87.1 Macro Definition Documentation

### 13.87.1.1 \_\_FFLASFFPACK\_fgemv\_mp\_INL

```
#define __FFLASFFPACK_fgemv_mp_INL
```

## 13.88 fflas\_fger.inl File Reference

### Namespaces

- namespace `FFLAS`
- namespace `FFLAS::Protected`

### Macros

- `#define __FFLASFFPACK_fger_INL`

### Functions

- `template<class Field>`  
`void fger` (const `Field` &F, const `size_t` M, const `size_t` N, const typename `Field::Element` alpha, typename `Field::ConstElement_ptr` x, const `size_t` incx, typename `Field::ConstElement_ptr` y, const `size_t` incy, typename `Field::Element_ptr` A, const `size_t` lda)

*fger*: rank one update of a general matrix

- `template<class FloatElement, class Field>`  
`void fger_convert (const Field &F, const size_t M, const size_t N, const typename Field::Element alpha,`  
`typename Field::ConstElement_ptr x, const size_t incx, typename Field::ConstElement_ptr y, const size_t`  
`incy, typename Field::Element_ptr A, const size_t lda)`
- `template<class Field>`  
`void fger (const Field &F, const size_t M, const size_t N, const typename Field::Element alpha, type-`  
`name Field::ConstElement_ptr x, const size_t incx, typename Field::ConstElement_ptr y, const size_t`  
`incy, typename Field::Element_ptr A, const size_t lda, MMHelper< Field, MMHelperAlgo::Classic,`  
`ModeCategories::ConvertTo< ElementCategories::MachineFloatTag > > &H)`
- `template<class Field, class AnyTag>`  
`void fger (const Field &F, const size_t M, const size_t N, const typename Field::Element alpha, typename`  
`Field::ConstElement_ptr x, const size_t incx, typename Field::ConstElement_ptr y, const size_t incy, type-`  
`name Field::Element_ptr A, const size_t lda, MMHelper< Field, MMHelperAlgo::Classic, AnyTag > &H)`
- `void fger (const Givaro::DoubleDomain &F, const size_t M, const size_t N, const Givaro::DoubleDomain::E-`  
`lement alpha, const Givaro::DoubleDomain::ConstElement_ptr x, const size_t incx, const Givaro::Double-`  
`Domain::ConstElement_ptr y, const size_t incy, Givaro::DoubleDomain::Element_ptr A, const size_t lda,`  
`MMHelper< Givaro::DoubleDomain, MMHelperAlgo::Classic, ModeCategories::DefaultTag > &H)`
- `template<class Field>`  
`void fger (const Field &F, const size_t M, const size_t N, const typename Field::Element alpha, const`  
`typename Field::ConstElement_ptr x, const size_t incx, const typename Field::ConstElement_ptr y, const`  
`size_t incy, typename Field::Element_ptr A, const size_t lda, MMHelper< Field, MMHelperAlgo::Classic,`  
`ModeCategories::DefaultBoundedTag > &H)`
- `void fger (const Givaro::FloatDomain &F, const size_t M, const size_t N, const Givaro::FloatDomain::Element`  
`alpha, const Givaro::FloatDomain::ConstElement_ptr x, const size_t incx, const Givaro::FloatDomain::E-`  
`lement_ptr y, const size_t incy, Givaro::FloatDomain::Element_ptr A, const size_t lda, MMHelper<`  
`Givaro::FloatDomain, MMHelperAlgo::Classic, ModeCategories::DefaultTag > &H)`
- `template<class Field>`  
`void fger (const Field &F, const size_t M, const size_t N, const typename Field::Element alpha, type-`  
`name Field::ConstElement_ptr x, const size_t incx, typename Field::ConstElement_ptr y, const size_t`  
`incy, typename Field::Element_ptr A, const size_t lda, MMHelper< Field, MMHelperAlgo::Classic,`  
`ModeCategories::LazyTag > &H)`
- `template<class Field>`  
`void fger (const Field &F, const size_t M, const size_t N, const typename Field::Element alpha, type-`  
`name Field::ConstElement_ptr x, const size_t incx, typename Field::ConstElement_ptr y, const size_t`  
`incy, typename Field::Element_ptr A, const size_t lda, MMHelper< Field, MMHelperAlgo::Classic,`  
`ModeCategories::DelayedTag > &H)`

## 13.88.1 Macro Definition Documentation

### 13.88.1.1 \_\_FFLASFFPACK\_fger\_INL

```
#define __FFLASFFPACK_fger_INL
```

## 13.89 fflas\_fger\_mp.inl File Reference

```
#include <givaro/modular-integer.h>
#include <givaro/zring.h>
#include "fflas-ffpack/fflas/fflas_helpers.inl"
#include "fflas-ffpack/fflas/fflas_fgemm/fgemm_classical_mp.inl"
#include "fflas-ffpack/field/rns-integer.h"
#include "fflas-ffpack/field/rns-integer-mod.h"
```

### Namespaces

- namespace [FFLAS](#)

## Macros

- `#define __FFPACK_fger_mp_INL`

## Functions

- void `fger` (const Givaro::Modular< Givaro::Integer > &F, const size\_t M, const size\_t N, const typename Givaro::Integer alpha, typename Givaro::Integer \*x, const size\_t incx, typename Givaro::Integer \*y, const size\_t incy, typename Givaro::Integer \*A, const size\_t lda, `MMHelper`< Givaro::Modular< Givaro::Integer >, `MMHelperAlgo::Classic`, `ModeCategories::ConvertTo`< `ElementCategories::RNSElementTag` > > &H)
- template<typename `RNS`>  
void `fger` (const `FFPACK::RNSInteger`< `RNS` > &F, const size\_t M, const size\_t N, const typename `FFPACK::RNSInteger`< `RNS` >::Element alpha, typename `FFPACK::RNSInteger`< `RNS` >::Element\_ptr x, const size\_t incx, typename `FFPACK::RNSInteger`< `RNS` >::Element\_ptr y, const size\_t incy, typename `FFPACK::RNSInteger`< `RNS` >::Element\_ptr A, const size\_t lda, `MMHelper`< `FFPACK::RNSInteger`< `RNS` >, `MMHelperAlgo::Classic`, `ModeCategories::DefaultTag` > &H)
- template<typename `RNS`>  
void `fger` (const `FFPACK::RNSIntegerMod`< `RNS` > &F, const size\_t M, const size\_t N, const type-name `FFPACK::RNSIntegerMod`< `RNS` >::Element alpha, typename `FFPACK::RNSIntegerMod`< `RNS` >::Element\_ptr x, const size\_t incx, typename `FFPACK::RNSIntegerMod`< `RNS` >::Element\_ptr y, const size\_t incy, typename `FFPACK::RNSIntegerMod`< `RNS` >::Element\_ptr A, const size\_t lda, `MMHelper`< `FFPACK::RNSIntegerMod`< `RNS` >, `MMHelperAlgo::Classic` > &H)

## 13.89.1 Macro Definition Documentation

### 13.89.1.1 \_\_FFPACK\_fger\_mp\_INL

```
#define __FFPACK_fger_mp_INL
```

## 13.90 fflas\_freduce.h File Reference

```
#include "fflas-ffpack/fflas/fflas_simd.h"
#include "fflas-ffpack/field/field_traits.h"
#include "fflas-ffpack/utils/cast.h"
#include "fflas-ffpack/fflas/fflas_freduce.inl"
```

## Data Structures

- struct `support_simd_mod`< T >
- struct `support_fast_mod`< T >
- struct `support_fast_mod`< float >
- struct `support_fast_mod`< double >
- struct `support_fast_mod`< int64\_t >

## Namespaces

- namespace `FFLAS`

## Functions

- template<class `Field`>  
void `freduce` (const `Field` &F, const size\_t n, typename `Field::ConstElement_ptr` Y, const size\_t incY, typename `Field::Element_ptr` X, const size\_t incX)  
$$freduce\ x \leftarrow ymodF.$$
- template<class `Field`>  
void `freduce` (const `Field` &F, const size\_t n, typename `Field::Element_ptr` X, const size\_t incX)  
$$freduce\ x \leftarrow xmodF.$$

- template<class [Field](#)>  
void [freduce\\_constoverride](#) (const [Field](#) &F, const size\_t m, typename [Field::ConstElement\\_ptr](#) A, const size\_t incX)
- template<class [Field](#), class ConstOtherElement\_ptr>  
void [finit](#) (const [Field](#) &F, const size\_t n, ConstOtherElement\_ptr Y, const size\_t incY, typename [Field::Element\\_ptr](#) X, const size\_t incX)
- template<class [Field](#)>  
void [finit](#) (const [Field](#) &F, const size\_t n, typename [Field::Element\\_ptr](#) X, const size\_t incX)  
*finit initializes  $X$  in  $F^{\mathbb{S}}$ .*
- template<class [Field](#)>  
void [freduce](#) (const [Field](#) &F, const size\_t m, const size\_t n, typename [Field::Element\\_ptr](#) A, const size\_t lda)  
*freduce  $A \leftarrow A \bmod F$ .*
- template<class [Field](#)>  
void [freduce](#) (const [Field](#) &F, const [FFLAS\\_UPLO](#) uplo, const size\_t N, typename [Field::Element\\_ptr](#) A, const size\_t lda)  
*freduce for square symmetric matrices*
- template<class [Field](#)>  
void [pfreduce](#) (const [Field](#) &F, const size\_t m, const size\_t n, typename [Field::Element\\_ptr](#) A, const size\_t lda, const size\_t numths)
- template<class [Field](#)>  
void [freduce](#) (const [Field](#) &F, const size\_t m, const size\_t n, typename [Field::ConstElement\\_ptr](#) B, const size\_t ldb, typename [Field::Element\\_ptr](#) A, const size\_t lda)  
*freduce  $A \leftarrow B \bmod F$ .*
- template<class [Field](#)>  
void [freduce\\_constoverride](#) (const [Field](#) &F, const size\_t m, const size\_t n, typename [Field::ConstElement\\_ptr](#) A, const size\_t lda)
- template<class [Field](#), class OtherElement\_ptr>  
void [finit](#) (const [Field](#) &F, const size\_t m, const size\_t n, const OtherElement\_ptr B, const size\_t ldb, typename [Field::Element\\_ptr](#) A, const size\_t lda)  
*finit  $A \leftarrow B \bmod F$ .*
- template<class [Field](#)>  
void [finit](#) (const [Field](#) &F, const size\_t m, const size\_t n, typename [Field::Element\\_ptr](#) A, const size\_t lda)

## 13.91 fflas\_freduce.inl File Reference

```
#include <givaro/udl.h>
#include "fflas-ffpack/fflas/fflas_fassign.h"
```

### Data Structures

- struct [HelperMod](#)< [Field](#), [ElementCategories::MachineIntTag](#) >
- struct [HelperMod](#)< [Field](#), [FFLAS::ElementCategories::MachineFloatTag](#) >
- struct [HelperMod](#)< [Field](#), [FFLAS::ElementCategories::ArbitraryPrecIntTag](#) >
- struct [HelperMod](#)< [Field](#), [FFLAS::ElementCategories::FixedPrecIntTag](#) >

### Namespaces

- namespace [FFLAS](#)
- namespace [FFLAS::vectorised](#)
- namespace [FFLAS::vectorised::unswitch](#)
- namespace [FFLAS::details](#)

### Macros

- #define [\\_\\_FFLASFFPACK\\_fflas\\_freduce\\_INL](#)
- #define [FFLASFFPACK\\_COPY\\_REDUCE](#) 32 /\* TODO TO BENCHMARK LATER \*/

## Functions

- `template<class T>`  
`std::enable_if<!std::is_integral< T >::value, T >::type` `reduce` (T A, T B)
- `template<class T>`  
`std::enable_if< std::is_integral< T >::value, T >::type` `reduce` (T A, T B)
- `template<>` `Givaro::Integer` `reduce` (Givaro::Integer A, Givaro::Integer B)
- `float` `reduce` (float A, float B, float invB, float min, float max)
- `double` `reduce` (double A, double B, double invB, double min, double max)
- `int64_t` `reduce` (int64\_t A, int64\_t p, double invp, double min, double max, int64\_t pow50rem)
- `template<class Field>`  
`Field::Element` `reduce` (typename `Field::Element` A, `HelperMod`< `Field`, `ElementCategories::MachineIntTag` > &H)
- `template<class Field>`  
`Field::Element` `reduce` (typename `Field::Element` A, `HelperMod`< `Field`, `ElementCategories::MachineFloatTag` > &H)
- `template<class Field>`  
`Field::Element` `reduce` (typename `Field::Element` A, `HelperMod`< `Field`, `ElementCategories::ArbitraryPrecIntTag` > &H)
- `template<class Field>`  
`std::enable_if< !FFLAS::support_simd_mod< typenameField::Element >::value &&FFLAS::support_fast_mod< typenameField::Element >::value, void >::type` `modp` (const `Field` &F, typename `Field::ConstElement_ptr` U, const size\_t &n, typename `Field::Element_ptr` T, `HelperMod`< `Field` > &H)
- `template<class Field>`  
`std::enable_if< FFLAS::support_fast_mod< typenameField::Element >::value, void >::type` `modp` (const `Field` &F, typename `Field::ConstElement_ptr` U, const size\_t &n, const size\_t &incX, typename `Field::Element_ptr` T, `HelperMod`< `Field` > &H)
- `template<class Field>`  
`std::enable_if< FFLAS::support_fast_mod< typenameField::Element >::value, void >::type` `modp` (const `Field` &F, typename `Field::ConstElement_ptr` U, const size\_t &n, const size\_t &incX, typename `Field::Element_ptr` T)
- `template<class Field>`  
`std::enable_if< FFLAS::support_fast_mod< typenameField::Element >::value, void >::type` `modp` (const `Field` &F, typename `Field::ConstElement_ptr` U, const size\_t &n, const size\_t &incX, typename `Field::Element_ptr` T)
- `template<class Field>`  
`std::enable_if< FFLAS::support_fast_mod< typenameField::Element >::value, void >::type` `freduce` (const `Field` &F, const size\_t m, typename `Field::Element_ptr` A, const size\_t incX, `FieldCategories::ModularTag`)
- `template<class Field>`  
`std::enable_if< FFLAS::support_fast_mod< typenameField::Element >::value, void >::type` `freduce` (const `Field` &F, const size\_t m, typename `Field::ConstElement_ptr` B, const size\_t incY, typename `Field::Element_ptr` A, const size\_t incX, `FieldCategories::ModularTag`)
- `template<class Field, class FC>`  
`void` `freduce` (const `Field` &F, const size\_t m, typename `Field::Element_ptr` A, const size\_t incX, FC)
- `template<class Field, class FC>`  
`void` `freduce` (const `Field` &F, const size\_t m, typename `Field::ConstElement_ptr` B, const size\_t incY, typename `Field::Element_ptr` A, const size\_t incX, FC)

### 13.91.1 Macro Definition Documentation

#### 13.91.1.1 \_\_FFLASFFPACK\_fflas\_freduce\_INL

```
#define __FFLASFFPACK_fflas_freduce_INL
```

#### 13.91.1.2 FFLASFFPACK\_COPY\_REDUCE

```
#define FFLASFFPACK_COPY_REDUCE 32 /* TODO TO BENCHMARK LATER */
```

## 13.92 fflas\_freduce\_mp.inl File Reference

```
#include "fflas-ffpack/field/rns-integer-mod.h"
```

### Namespaces

- namespace [FFLAS](#)

### Macros

- #define [\\_\\_FFLASFFPACK\\_fflas\\_freduce\\_mp\\_INL](#)

### Functions

- template<> void [freduce](#) (const [FFPACK::RNSIntegerMod](#)< [FFPACK::rns\\_double](#) > &F, const size\_t n, [FFPACK::RNSIntegerMod](#)< [FFPACK::rns\\_double](#) >::Element\_ptr A, size\_t inc)
- template<> void [freduce](#) (const [FFPACK::RNSIntegerMod](#)< [FFPACK::rns\\_double](#) > &F, const size\_t m, const size\_t n, [FFPACK::rns\\_double::Element\\_ptr](#) A, size\_t lda)

### 13.92.1 Macro Definition Documentation

#### 13.92.1.1 \_\_FFLASFFPACK\_fflas\_freduce\_mp\_INL

```
#define __FFLASFFPACK_fflas_freduce_mp_INL
```

## 13.93 fflas\_freivalds.inl File Reference

### Namespaces

- namespace [FFLAS](#)

### Macros

- #define [\\_\\_FFLASFFPACK\\_freivalds\\_INL](#)

### Functions

- template<class [Field](#)>  
bool [freivalds](#) (const [Field](#) &F, const [FFLAS\\_TRANSPOSE](#) ta, const [FFLAS\\_TRANSPOSE](#) tb, const size\_t m, const size\_t n, const size\_t k, const typename [Field::Element](#) alpha, typename [Field::ConstElement\\_ptr](#) A, const size\_t lda, typename [Field::ConstElement\\_ptr](#) B, const size\_t ldb, typename [Field::ConstElement\\_ptr](#) C, const size\_t ldc)

*freivalds: Freivalds **GE**neral **M**atrix **M**ultiply **R**andom **C**heck.*

### 13.93.1 Macro Definition Documentation

#### 13.93.1.1 \_\_FFLASFFPACK\_freivalds\_INL

```
#define __FFLASFFPACK_freivalds_INL
```

## 13.94 fflas\_fscal.h File Reference

```
#include "fflas_fscal.inl"
```



## 13.95 fflas\_fscal.inl File Reference

### Namespaces

- namespace [FFLAS](#)
- namespace [FFLAS::vectorised](#)
- namespace [FFLAS::vectorised::unswitch](#)
- namespace [FFLAS::details](#)

### Macros

- `#define` [\\_\\_FFLASFFPACK\\_fscal\\_INL](#)

### Functions

- `template<class Field>`  
`std::enable_if<!FFLAS::support_simd_mod< typenameField::Element >::value &&FFLAS::support_fast_mod<`  
`typenameField::Element >::value, void >::type` [scalp](#) (const [Field](#) &F, typename [Field::Element\\_ptr](#) T, const  
 typename [Field::Element](#) alpha, typename [Field::ConstElement\\_ptr](#) U, const size\_t n, [HelperMod](#)< [Field](#) >  
 &H)
- `template<class Field>`  
`std::enable_if< FFLAS::support_fast_mod< typenameField::Element >::value, void >::type` [scalp](#)  
 (const [Field](#) &F, typename [Field::Element\\_ptr](#) T, const typename [Field::Element](#) alpha, typename  
[Field::ConstElement\\_ptr](#) U, const size\_t n, const size\_t &incX, [HelperMod](#)< [Field](#) > &H)
- `template<class Field>`  
`std::enable_if< FFLAS::support_fast_mod< typenameField::Element >::value, void >::type` [scalp](#)  
 (const [Field](#) &F, typename [Field::Element\\_ptr](#) T, const typename [Field::Element](#) alpha, typename  
[Field::ConstElement\\_ptr](#) U, const size\_t n, const size\_t &incX, const size\_t &incY, [HelperMod](#)< [Field](#) >  
 &H)
- `template<class Field>`  
`std::enable_if< FFLAS::support_fast_mod< typenameField::Element >::value, void >::type` [scalp](#)  
 (const [Field](#) &F, typename [Field::Element\\_ptr](#) T, const typename [Field::Element](#) alpha, typename  
[Field::ConstElement\\_ptr](#) U, const size\_t n)
- `template<class Field>`  
`std::enable_if< FFLAS::support_fast_mod< typenameField::Element >::value, void >::type` [scalp](#)  
 (const [Field](#) &F, typename [Field::Element\\_ptr](#) T, const typename [Field::Element](#) alpha, typename  
[Field::ConstElement\\_ptr](#) U, const size\_t n, const size\_t &incX)
- `template<class Field>`  
`std::enable_if< FFLAS::support_fast_mod< typenameField::Element >::value, void >::type` [scalp](#)  
 (const [Field](#) &F, typename [Field::Element\\_ptr](#) T, const typename [Field::Element](#) alpha, typename  
[Field::ConstElement\\_ptr](#) U, const size\_t n, const size\_t &incX, const size\_t &incY)
- `template<class Field>`  
`std::enable_if< FFLAS::support_fast_mod< typenameField::Element >::value, void >::type` [fscal](#) (const  
[Field](#) &F, const size\_t N, const typename [Field::Element](#) a, typename [Field::Element\\_ptr](#) X, const size\_t incX,  
[FieldCategories::ModularTag](#))
- `template<class Field>`  
`std::enable_if< FFLAS::support_fast_mod< typenameField::Element >::value, void >::type` [fscal](#) (const  
[Field](#) &F, const size\_t N, const typename [Field::Element](#) a, typename [Field::ConstElement\\_ptr](#) X, const size\_t  
 incX, typename [Field::Element\\_ptr](#) Y, const size\_t incY, [FieldCategories::ModularTag](#))
- `template<class Field, class FC>`  
 void [fscal](#) (const [Field](#) &F, const size\_t n, const typename [Field::Element](#) a, typename [Field::Element\\_ptr](#) X,  
 const size\_t incX, FC)
- `template<class Field, class FC>`  
 void [fscal](#) (const [Field](#) &F, const size\_t N, const typename [Field::Element](#) a, typename [Field::ConstElement\\_ptr](#)  
 X, const size\_t incX, typename [Field::Element\\_ptr](#) Y, const size\_t incY, FC)
- `template<class Field>`  
 void [fscal](#) (const [Field](#) &F, const size\_t n, const typename [Field::Element](#) alpha, typename [Field::Element\\_ptr](#)  
 X, const size\_t incX)



- $fscal_{in} x \leftarrow \alpha \cdot x.$
- template<class [Field](#)>  
void [fscal](#) (const [Field](#) &F, const size\_t n, const typename [Field::Element](#) alpha, typename [Field::ConstElement\\_ptr](#) X, const size\_t incX, typename [Field::Element\\_ptr](#) Y, const size\_t incY)  
 $fscal y \leftarrow \alpha \cdot x.$
- template<> void [fscal](#) (const Givaro::DoubleDomain &, const size\_t N, const Givaro::DoubleDomain::Element a, Givaro::DoubleDomain::ConstElement\_ptr x, const size\_t incx, Givaro::DoubleDomain::Element\_ptr y, const size\_t incy)
- template<> void [fscal](#) (const Givaro::FloatDomain &, const size\_t N, const Givaro::FloatDomain::Element a, Givaro::FloatDomain::ConstElement\_ptr x, const size\_t incx, Givaro::FloatDomain::Element\_ptr y, const size\_t incy)
- template<> void [fscal\\_{in}](#) (const Givaro::DoubleDomain &, const size\_t N, const Givaro::DoubleDomain::Element a, Givaro::DoubleDomain::Element\_ptr y, const size\_t incy)
- template<> void [fscal\\_{in}](#) (const Givaro::FloatDomain &, const size\_t N, const Givaro::FloatDomain::Element a, Givaro::FloatDomain::Element\_ptr y, const size\_t incy)
- template<class [Field](#)>  
void [fscal\\_{in}](#) (const [Field](#) &F, const size\_t m, const size\_t n, const typename [Field::Element](#) alpha, typename [Field::Element\\_ptr](#) A, const size\_t lda)  
 $fscal_{in} A \leftarrow a \cdot A.$
- template<class [Field](#)>  
void [fscal](#) (const [Field](#) &F, const size\_t m, const size\_t n, const typename [Field::Element](#) alpha, typename [Field::ConstElement\\_ptr](#) A, const size\_t lda, typename [Field::Element\\_ptr](#) B, const size\_t ldb)  
 $fscal B \leftarrow a \cdot A.$

## 13.95.1 Macro Definition Documentation

### 13.95.1.1 \_\_FFLASFFPACK\_fscal\_INL

```
#define __FFLASFFPACK_fscal_INL
```

## 13.96 fflas\_fscal\_mp.inl File Reference

```
#include "fflas-ffpack/field/rns-integer.h"
#include "fflas_fscal.h"
#include "fflas_fgemm.inl"
#include "fflas-ffpack/fflas/fflas_freduce_mp.inl"
```

### Namespaces

- namespace [FFLAS](#)

### Macros

- #define [\\_\\_FFLASFFPACK\\_fscal\\_mp\\_INL](#)

### Functions

- template<> void [fscal\\_{in}](#) (const [FFPACK::RNSInteger](#)< [FFPACK::rns\\_double](#) > &F, const size\_t n, const [FFPACK::rns\\_double::Element](#) alpha, [FFPACK::rns\\_double::Element\\_ptr](#) A, const size\_t inc)
- template<> void [fscal](#) (const [FFPACK::RNSInteger](#)< [FFPACK::rns\\_double](#) > &F, const size\_t n, const [FFPACK::rns\\_double::Element](#) alpha, [FFPACK::rns\\_double::ConstElement\\_ptr](#) A, const size\_t Ainc, [FFPACK::rns\\_double::Element\\_ptr](#) B, const size\_t Binc)
- template<> void [fscal\\_{in}](#) (const [FFPACK::RNSInteger](#)< [FFPACK::rns\\_double](#) > &F, const size\_t m, const size\_t n, const [FFPACK::rns\\_double::Element](#) alpha, [FFPACK::rns\\_double::Element\\_ptr](#) A, const size\_t lda)

- `template<> void fscal (const FFPACK::RNSInteger< FFPACK::rns_double > &F, const size_t m, const size_t n, const FFPACK::rns_double::Element alpha, FFPACK::rns_double::ConstElement_ptr A, const size_t lda, FFPACK::rns_double::Element_ptr B, const size_t ldb)`
- `template<> void fscaln (const FFPACK::RNSIntegerMod< FFPACK::rns_double > &F, const size_t n, const typename FFPACK::RNSIntegerMod< FFPACK::rns_double >::Element alpha, typename FFPACK::RNSIntegerMod< FFPACK::rns_double >::Element_ptr A, const size_t inc)`
- `template<> void fscal (const FFPACK::RNSIntegerMod< FFPACK::rns_double > &F, const size_t n, const FFPACK::rns_double::Element alpha, FFPACK::rns_double::ConstElement_ptr A, const size_t Ainc, FFPACK::rns_double::Element_ptr B, const size_t Binc)`
- `template<> void fscaln (const FFPACK::RNSIntegerMod< FFPACK::rns_double > &F, const size_t m, const size_t n, const FFPACK::rns_double::Element alpha, FFPACK::rns_double::Element_ptr A, const size_t lda)`
- `template<> void fscal (const FFPACK::RNSIntegerMod< FFPACK::rns_double > &F, const size_t m, const size_t n, const FFPACK::rns_double::Element alpha, FFPACK::rns_double::ConstElement_ptr A, const size_t lda, FFPACK::rns_double::Element_ptr B, const size_t ldb)`

### 13.96.1 Macro Definition Documentation

#### 13.96.1.1 \_\_FFLASFFPACK\_fscal\_mp\_INL

```
#define __FFLASFFPACK_fscal_mp_INL
```

## 13.97 fflas\_fsy2k.inl File Reference

```
#include <fflas-ffpack/utils/fflas_io.h>
```

### Namespaces

- namespace [FFLAS](#)

### Macros

- `#define __FFLASFFPACK_fflas_fsy2k_INL`

### Functions

- `template<class Field> Field::Element_ptr fsy2k (const Field &F, const FFLAS_UPLO UpLo, const FFLAS_TRANSPOSE trans, const size_t n, const size_t k, const typename Field::Element alpha, typename Field::ConstElement_ptr A, const size_t lda, typename Field::ConstElement_ptr B, const size_t ldb, const typename Field::Element beta, typename Field::Element_ptr C, const size_t ldc)`

*fsy2k: Symmetric Rank 2K update*

### 13.97.1 Macro Definition Documentation

#### 13.97.1.1 \_\_FFLASFFPACK\_fflas\_fsy2k\_INL

```
#define __FFLASFFPACK_fflas_fsy2k_INL
```

## 13.98 fflas\_fsyrk.inl File Reference

### Namespaces

- namespace [FFLAS](#)
- namespace [FFLAS::Protected](#)

### Macros

- `#define __FFLASFFPACK_fflas_fsyrk_INL`

## Functions

- template<class NewField, class Field, class FieldMode>  
 Field::Element\_ptr fsyrk\_convert (const Field &F, const FFLAS\_UPLO UpLo, const FFLAS\_TRANSPOSE trans, const size\_t N, const size\_t K, const typename Field::Element alpha, typename Field::ConstElement\_ptr A, const size\_t lda, const typename Field::Element beta, typename Field::Element\_ptr C, const size\_t ldc, MMHelper< Field, MMHelperAlgo::Classic, FieldMode > &H)
- template<class Field>  
 Field::Element\_ptr fsyrk (const Field &F, const FFLAS\_UPLO UpLo, const FFLAS\_TRANSPOSE trans, const size\_t n, const size\_t k, const typename Field::Element alpha, typename Field::ConstElement\_ptr A, const size\_t lda, const typename Field::Element beta, typename Field::Element\_ptr C, const size\_t ldc)  
*fsyrk: Symmetric Rank K update*
- template<class Field>  
 Field::Element\_ptr fsyrk (const Field &F, const FFLAS\_UPLO UpLo, const FFLAS\_TRANSPOSE trans, const size\_t N, const size\_t K, const typename Field::Element alpha, typename Field::ConstElement\_ptr A, const size\_t lda, const typename Field::Element beta, typename Field::Element\_ptr C, const size\_t ldc, const ParSeqHelper::Sequential seq)
- template<class Field>  
 Field::Element\_ptr fsyrk (const Field &F, const FFLAS\_UPLO UpLo, const FFLAS\_TRANSPOSE trans, const size\_t N, const size\_t K, const typename Field::Element alpha, typename Field::ConstElement\_ptr A, const size\_t lda, const typename Field::Element beta, typename Field::Element\_ptr C, const size\_t ldc, MMHelper< Field, MMHelperAlgo::Classic, ModeCategories::DefaultTag > &H)
- template<class Field>  
 Field::Element\_ptr fsyrk (const Field &F, const FFLAS\_UPLO UpLo, const FFLAS\_TRANSPOSE trans, const size\_t N, const size\_t K, const typename Field::Element alpha, typename Field::ConstElement\_ptr A, const size\_t lda, const typename Field::Element beta, typename Field::Element\_ptr C, const size\_t ldc, MMHelper< Field, MMHelperAlgo::Classic, ModeCategories::ConvertTo< ElementCategories::MachineFloatTag >, ParSeqHelper::Sequential > &H)
- template<class Field, class AlgoT, class ParSeqTrait>  
 void ScalAndReduce (const Field &F, const FFLAS\_UPLO UpLo, const size\_t N, const typename Field::Element alpha, typename Field::Element\_ptr A, const size\_t lda, const MMHelper< Field, AlgoT, ModeCategories::LazyTag, ParSeqTrait > &H)
- template<class Field>  
 Field::Element\_ptr fsyrk (const Field &F, const FFLAS\_UPLO UpLo, const FFLAS\_TRANSPOSE trans, const size\_t N, const size\_t K, const typename Field::Element alpha, typename Field::ConstElement\_ptr A, const size\_t lda, const typename Field::Element beta, typename Field::Element\_ptr C, const size\_t ldc, MMHelper< Field, MMHelperAlgo::Classic, ModeCategories::DelayedTag > &H)
- template<class Field>  
 Field::Element\_ptr fsyrk (const Field &F, const FFLAS\_UPLO UpLo, const FFLAS\_TRANSPOSE trans, const size\_t N, const size\_t K, const typename Field::Element alpha, typename Field::ConstElement\_ptr A, const size\_t lda, const typename Field::Element beta, typename Field::Element\_ptr C, const size\_t ldc, MMHelper< Field, MMHelperAlgo::Classic, ModeCategories::LazyTag > &H)
- template<class Field, typename Mode>  
 Field::Element\_ptr fsyrk (const Field &F, const FFLAS\_UPLO UpLo, const FFLAS\_TRANSPOSE trans, const size\_t N, const size\_t K, const typename Field::Element alpha, typename Field::ConstElement\_ptr A, const size\_t lda, const typename Field::Element beta, typename Field::Element\_ptr C, const size\_t ldc, MMHelper< Field, MMHelperAlgo::DivideAndConquer, Mode > &H)
- template<class Field>  
 Field::Element\_ptr fsyrk (const Field &F, const FFLAS\_UPLO UpLo, const FFLAS\_TRANSPOSE trans, const size\_t N, const size\_t K, const typename Field::Element alpha, typename Field::ConstElement\_ptr A, const size\_t lda, const typename Field::Element beta, typename Field::Element\_ptr C, const size\_t ldc, MMHelper< Field, MMHelperAlgo::Classic, ModeCategories::DefaultBoundedTag > &H)
- Givaro::FloatDomain::Element\_ptr fsyrk (const Givaro::FloatDomain &F, const FFLAS\_UPLO UpLo, const FFLAS\_TRANSPOSE trans, const size\_t N, const size\_t K, const Givaro::FloatDomain::Element alpha, Givaro::FloatDomain::ConstElement\_ptr A, const size\_t lda, const Givaro::FloatDomain::Element beta, Givaro::FloatDomain::Element\_ptr C, const size\_t ldc, MMHelper< Givaro::FloatDomain, MMHelperAlgo::Classic, ModeCategories::DefaultTag > &H)

- Givaro::DoubleDomain::Element\_ptr [fsyrk](#) (const Givaro::DoubleDomain &F, const [FFLAS\\_UPLO](#) UpLo, const [FFLAS\\_TRANSPOSE](#) trans, const size\_t N, const size\_t K, const Givaro::DoubleDomain::Element alpha, Givaro::DoubleDomain::ConstElement\_ptr A, const size\_t lda, const Givaro::DoubleDomain::Element beta, Givaro::DoubleDomain::Element\_ptr C, const size\_t ldc, [MMHelper](#)< Givaro::DoubleDomain, [MMHelperAlgo::Classic](#), [ModeCategories::DefaultTag](#) > &H)
- template<class [Field](#)>  
[Field::Element\\_ptr fsyrk](#) (const [Field](#) &F, const [FFLAS\\_UPLO](#) UpLo, const [FFLAS\\_TRANSPOSE](#) trans, const size\_t n, const size\_t k, const typename [Field::Element](#) alpha, typename [Field::Element\\_ptr](#) A, const size\_t lda, typename [Field::ConstElement\\_ptr](#) D, const size\_t incD, const typename [Field::Element](#) beta, typename [Field::Element\\_ptr](#) C, const size\_t ldc, const size\_t threshold=[\\_\\_FFLASFFPACK\\_FSYRK\\_THRESHOLD](#))  
*fsyrk: Symmetric Rank K update with diagonal scaling*
- template<class [Field](#)>  
[Field::Element\\_ptr fsyrk](#) (const [Field](#) &F, const [FFLAS\\_UPLO](#) UpLo, const [FFLAS\\_TRANSPOSE](#) trans, const size\_t N, const size\_t K, const typename [Field::Element](#) alpha, typename [Field::Element\\_ptr](#) A, const size\_t lda, typename [Field::ConstElement\\_ptr](#) D, const size\_t incD, const typename [Field::Element](#) beta, typename [Field::Element\\_ptr](#) C, const size\_t ldc, const [ParSeqHelper::Sequential](#) seq, const size\_t threshold)
- template<class [Field](#), class Cut, class Param>  
[Field::Element\\_ptr fsyrk](#) (const [Field](#) &F, const [FFLAS\\_UPLO](#) UpLo, const [FFLAS\\_TRANSPOSE](#) trans, const size\_t N, const size\_t K, const typename [Field::Element](#) alpha, typename [Field::Element\\_ptr](#) A, const size\_t lda, typename [Field::ConstElement\\_ptr](#) D, const size\_t incD, const typename [Field::Element](#) beta, typename [Field::Element\\_ptr](#) C, const size\_t ldc, const [ParSeqHelper::Parallel](#)< Cut, Param > par, const size\_t threshold)
- template<class [Field](#)>  
[Field::Element\\_ptr fsyrk](#) (const [Field](#) &F, const [FFLAS\\_UPLO](#) UpLo, const [FFLAS\\_TRANSPOSE](#) trans, const size\_t n, const size\_t k, const typename [Field::Element](#) alpha, typename [Field::Element\\_ptr](#) A, const size\_t lda, typename [Field::ConstElement\\_ptr](#) D, const size\_t incD, const std::vector< bool > &two←Block, const typename [Field::Element](#) beta, typename [Field::Element\\_ptr](#) C, const size\_t ldc, const size\_t threshold=[\\_\\_FFLASFFPACK\\_FSYRK\\_THRESHOLD](#))  
*fsyrk: Symmetric Rank K update with diagonal scaling*

## 13.98.1 Macro Definition Documentation

### 13.98.1.1 [\\_\\_FFLASFFPACK\\_fflas\\_fsyk\\_INL](#)

```
#define \_\_FFLASFFPACK\_fflas\_fsyk\_INL
```

## 13.99 [fflas\\_fsyk\\_strassen.inl](#) File Reference

```
#include <givaro/givintsqrootmod.h>
```

### Namespaces

- namespace [FFLAS](#)
- namespace [FFLAS::Protected](#)

### Macros

- #define [\\_\\_FFLASFFPACK\\_fflas\\_fsyk\\_strassen\\_INL](#)

### Functions

- template<class [Field](#), class Element, class AlgoT, class ParSeqTrait>  
bool [NeedPreScalReduction](#) (Element &Outmin, Element &Outmax, Element &Op1min, Element &Op1max, const Element &x, [MMHelper](#)< [Field](#), AlgoT, [ModeCategories::LazyTag](#), ParSeqTrait > &WH)
- template<class [Field](#), class Element, class AlgoT, class ModeT, class ParSeqTrait>  
bool [NeedPreScalReduction](#) (Element &Outmin, Element &Outmax, Element &Op1min, Element &Op1max, const Element &x, [MMHelper](#)< [Field](#), AlgoT, ModeT, ParSeqTrait > &WH)

- template<class [Field](#), class Element, class AlgoT, class ParSeqTrait>  
bool [NeedPreAxyReduction](#) (Element &Outmin, Element &Outmax, Element &Op1min, Element &Op1max, Element &Op2min, Element &Op2max, const Element &x, [MMHelper](#)< [Field](#), AlgoT, [ModeCategories::LazyTag](#), ParSeqTrait > &WH)
- template<class [Field](#), class Element, class AlgoT, class ModeT, class ParSeqTrait>  
bool [NeedPreAxyReduction](#) (Element &Outmin, Element &Outmax, Element &Op1min, Element &Op1max, Element &Op2min, Element &Op2max, const Element &x, [MMHelper](#)< [Field](#), AlgoT, ModeT, ParSeqTrait > &WH)
- template<class [Field](#), class FieldTrait>  
void [computeS1S2](#) (const [Field](#) &F, const [FFLAS\\_TRANSPOSE](#) trans, const size\_t N, const size\_t K, const typename [Field::Element](#) x, const typename [Field::Element](#) y, typename [Field::Element\\_ptr](#) A, const size\_t lda, typename [Field::Element\\_ptr](#) S, const size\_t lds, typename [Field::Element\\_ptr](#) T, const size\_t ldt, [MMHelper](#)< [Field](#), [MMHelperAlgo::Winograd](#), FieldTrait > &WH)
- template<class [Field](#)>  
[Field::Element\\_ptr](#) [fsyrk](#) (const [Field](#) &F, const [FFLAS\\_UPLO](#) UpLo, const [FFLAS\\_TRANSPOSE](#) trans, const size\_t N, const size\_t K, const typename [Field::Element](#) alpha, typename [Field::ConstElement\\_ptr](#) A, const size\_t lda, const typename [Field::Element](#) beta, typename [Field::Element\\_ptr](#) C, const size\_t ldc, [MMHelper](#)< [Field](#), [MMHelperAlgo::Winograd](#), [ModeCategories::DelayedTag](#), [ParSeqHelper::Sequential](#) > &H)
- template<class [Field](#), class Mode>  
[Field::Element\\_ptr](#) [fsyrk](#) (const [Field](#) &F, const [FFLAS\\_UPLO](#) UpLo, const [FFLAS\\_TRANSPOSE](#) trans, const size\_t N, const size\_t K, const typename [Field::Element](#) alpha, typename [Field::ConstElement\\_ptr](#) A, const size\_t lda, const typename [Field::Element](#) beta, typename [Field::Element\\_ptr](#) C, const size\_t ldc, [MMHelper](#)< [Field](#), [MMHelperAlgo::Winograd](#), Mode > &H)
- template<class [Field](#), class FieldTrait>  
[Field::Element\\_ptr](#) [fsyrk\\_strassen](#) (const [Field](#) &F, const [FFLAS\\_UPLO](#) uplo, const [FFLAS\\_TRANSPOSE](#) trans, const size\_t N, const size\_t K, const typename [Field::Element](#) y1, const typename [Field::Element](#) y2, const typename [Field::Element](#) alpha, typename [Field::Element\\_ptr](#) A, const size\_t lda, const typename [Field::Element](#) beta, typename [Field::Element\\_ptr](#) C, const size\_t ldc, [MMHelper](#)< [Field](#), [MMHelperAlgo::Winograd](#), FieldTrait > &WH)

### 13.99.1 Macro Definition Documentation

#### 13.99.1.1 \_\_FFLASFFPACK\_fflas\_fsyk\_strassen\_INL

```
#define __FFLASFFPACK_fflas_fsyk_strassen_INL
```

## 13.100 fflas\_ftmm.inl File Reference

### Namespaces

- namespace [FFLAS](#)

### Macros

- #define [\\_\\_FFLASFFPACK\\_ftmm\\_INL](#)

### Functions

- template<class [Field](#)>  
void [ftmm](#) (const [Field](#) &F, const [FFLAS\\_SIDE](#) Side, const [FFLAS\\_UPLO](#) Uplo, const [FFLAS\\_TRANSPOSE](#) TransA, const [FFLAS\\_DIAG](#) Diag, const size\_t M, const size\_t N, const typename [Field::Element](#) alpha, typename [Field::ConstElement\\_ptr](#) A, const size\_t lda, typename [Field::Element\\_ptr](#) B, const size\_t ldb)  
*ftmm: **TRI**angular **M**atrix **M**ultiply.*
- template<class [Field](#)>  
void [ftmm](#) (const [Field](#) &F, const [FFLAS\\_SIDE](#) Side, const [FFLAS\\_UPLO](#) Uplo, const [FFLAS\\_TRANSPOSE](#) TransA, const [FFLAS\\_DIAG](#) Diag, const size\_t M, const size\_t N, const typename [Field::Element](#) alpha, typename [Field::ConstElement\\_ptr](#) A, const size\_t lda, typename [Field::ConstElement\\_ptr](#) B, const size\_t ldb, const typename [Field::Element](#) beta, typename [Field::Element\\_ptr](#) C, const size\_t ldc)

*ftmm: **TR**iangular **M**atrix **M**ultiply with 3 operands Computes  $C \leftarrow \alpha \text{op}(A)B + \text{beta}C$  or  $C \leftarrow \alpha B \text{op}(A) + \text{beta}C$ .*

### 13.100.1 Macro Definition Documentation

#### 13.100.1.1 \_\_FFLASFFPACK\_ftmm\_INL

```
#define __FFLASFFPACK_ftmm_INL
```

## 13.101 fflas\_ftsm.inl File Reference

### Namespaces

- namespace [FFLAS](#)

### Macros

- #define [\\_\\_FFLASFFPACK\\_ftsm\\_INL](#)

### Functions

- template<class [Field](#)>  
void [ftsm](#) (const [Field](#) &F, const [FFLAS\\_SIDE](#) Side, const [FFLAS\\_UPLO](#) Uplo, const [FFLAS\\_TRANSPOSE](#) TransA, const [FFLAS\\_DIAG](#) Diag, const size\_t M, const size\_t N, const typename [Field::Element](#) alpha, typename [Field::Element\\_ptr](#) A, const size\_t lda, typename [Field::Element\\_ptr](#) B, const size\_t ldb)
- template<class [Field](#)>  
void [ftsm](#) (const [Field](#) &F, const [FFLAS\\_SIDE](#) Side, const [FFLAS\\_UPLO](#) Uplo, const [FFLAS\\_TRANSPOSE](#) TransA, const [FFLAS\\_DIAG](#) Diag, const size\_t M, const size\_t N, const typename [Field::Element](#) alpha, typename [Field::Element\\_ptr](#) A, const size\_t lda, typename [Field::Element\\_ptr](#) B, const size\_t ldb, const [ParSeqHelper::Sequential](#) &PSH)
- template<class [Field](#), class Cut, class Param>  
void [ftsm](#) (const [Field](#) &F, const [FFLAS\\_SIDE](#) Side, const [FFLAS\\_UPLO](#) Uplo, const [FFLAS\\_TRANSPOSE](#) TransA, const [FFLAS\\_DIAG](#) Diag, const size\_t M, const size\_t N, const typename [Field::Element](#) alpha, typename [Field::Element\\_ptr](#) A, const size\_t lda, typename [Field::Element\\_ptr](#) B, const size\_t ldb, const [ParSeqHelper::Parallel](#)< Cut, Param > &PSH)
- template<class [Field](#), class ParSeqTrait = [ParSeqHelper::Sequential](#)>  
void [ftsm](#) (const [Field](#) &F, const [FFLAS\\_SIDE](#) Side, const [FFLAS\\_UPLO](#) Uplo, const [FFLAS\\_TRANSPOSE](#) TransA, const [FFLAS\\_DIAG](#) Diag, const size\_t M, const size\_t N, const typename [Field::Element](#) alpha, typename [Field::Element\\_ptr](#) A, const size\_t lda, typename [Field::Element\\_ptr](#) B, const size\_t ldb, [TRSMHelper](#)< [StructureHelper::Recursive](#), ParSeqTrait > &H)

### 13.101.1 Macro Definition Documentation

#### 13.101.1.1 \_\_FFLASFFPACK\_ftsm\_INL

```
#define __FFLASFFPACK_ftsm_INL
```

## 13.102 fflas\_ftsm\_mp.inl File Reference

triangular system with matrix right hand side over multiprecision domain (either over Z or over Z/pZ)

```
#include <cmath>
#include <givaro/modular-integer.h>
#include <givaro/givinteger.h>
#include "fflas-ffpack/fflas/fflas_bounds.inl"
#include "fflas-ffpack/fflas/fflas_level3.inl"
#include "fflas-ffpack/field/rns-integer-mod.h"
#include "fflas-ffpack/field/rns-integer.h"
```

**Namespaces**

- namespace [FFLAS](#)

**Macros**

- #define [\\_\\_FFPACK\\_ftrsm\\_mp\\_INL](#)

**Functions**

- void [ftrsm](#) (const Givaro::Modular< Givaro::Integer > &F, const [FFLAS\\_SIDE](#) Side, const [FFLAS\\_UPLO](#) Uplo, const [FFLAS\\_TRANSPOSE](#) TransA, const [FFLAS\\_DIAG](#) Diag, const size\_t M, const size\_t N, const Givaro::Integer alpha, const Givaro::Integer \*A, const size\_t lda, Givaro::Integer \*B, const size\_t ldb)
- void [cblas\\_impftrsm](#) (const enum [FFLAS\\_ORDER](#) Order, const enum [FFLAS\\_SIDE](#) Side, const enum [FFLAS\\_UPLO](#) Uplo, const enum [FFLAS\\_TRANSPOSE](#) TransA, const enum [FFLAS\\_DIAG](#) Diag, const int M, const int N, const [FFPACK::rns\\_double\\_elt](#) alpha, [FFPACK::rns\\_double\\_elt\\_cstptr](#) A, const int lda, [FFPACK::rns\\_double\\_elt\\_ptr](#) B, const int ldb)

**13.102.1 Detailed Description**

triangular system with matrix right hand side over multiprecision domain (either over Z or over Z/pZ)

**13.102.2 Macro Definition Documentation****13.102.2.1 \_\_FFPACK\_ftrsm\_mp\_INL**

```
#define __FFPACK_ftrsm_mp_INL
```

**13.103 fflas\_ftrsv.inl File Reference****Namespaces**

- namespace [FFLAS](#)

**Macros**

- #define [\\_\\_FFLASFFPACK\\_ftrsv\\_INL](#)

**Functions**

- template<class [Field](#)>  
void [ftrsv](#) (const [Field](#) &F, const [FFLAS\\_UPLO](#) Uplo, const [FFLAS\\_TRANSPOSE](#) TransA, const [FFLAS\\_DIAG](#) Diag, const size\_t N, typename [Field::ConstElement\\_ptr](#) A, const size\_t lda, typename [Field::Element\\_ptr](#) X, int incX)

*ftrsv: TRIangular System solve with Vector Computes  $X \leftarrow \text{op}(A^{-1})X$*

**13.103.1 Macro Definition Documentation****13.103.1.1 \_\_FFLASFFPACK\_ftrsv\_INL**

```
#define __FFLASFFPACK_ftrsv_INL
```

**13.104 fflas\_helpers.inl File Reference**

```
#include "fflas-ffpack/field/field-traits.h"
#include "fflas-ffpack/paladin/parallel.h"
#include "fflas-ffpack/utils/flimits.h"
#include <algorithm>
```

## Data Structures

- struct [Auto](#)
- struct [Classic](#)
- struct [DivideAndConquer](#)
- struct [Winograd](#)
- struct [WinogradPar](#)
- struct [Bini](#)
- struct [AlgoChooser](#)< [ModeT](#), [ParSeq](#) >
- struct [AlgoChooser](#)< [ModeCategories::ConvertTo](#)< [ElementCategories::RNSElementTag](#) >, [ParSeq](#) >
- struct [MMHelper](#)< [Field](#), [AlgoTrait](#), [ModeTrait](#), [ParSeqTrait](#) >
- struct [Recursive](#)
- struct [Iterative](#)
- struct [Hybrid](#)
- struct [TRSMHelper](#)< [ReclterTrait](#), [ParSeqTrait](#) >

*TRSM Helper.*

## Namespaces

- namespace [FFLAS](#)
- namespace [FFLAS::Protected](#)
- namespace [FFLAS::MMHelperAlgo](#)
- namespace [FFLAS::StructureHelper](#)

*StructureHelper for ftrsm.*

## Macros

- #define [\\_\\_FFLASFFPACK\\_fflas\\_fflas\\_mmhelper\\_INL](#)

## Functions

- template<class [Field](#)>  
int [WinogradSteps](#) (const [Field](#) &F, const size\_t &m)  
*Computes the number of recursive levels to perform.*
- template<class DFE>  
size\_t [min\\_types](#) (const DFE &k)
- template<> size\_t [min\\_types](#) (const [Reclnt::rint](#)< 6 > &k)
- template<> size\_t [min\\_types](#) (const [Reclnt::rint](#)< 7 > &k)
- template<> size\_t [min\\_types](#) (const [Reclnt::rint](#)< 8 > &k)
- template<> size\_t [min\\_types](#) (const [Reclnt::rint](#)< 9 > &k)
- template<> size\_t [min\\_types](#) (const [Reclnt::rint](#)< 10 > &k)
- template<> size\_t [min\\_types](#) (const [Givaro::Integer](#) &k)
- template<class T>  
bool [unfit](#) (T x)
- template<> bool [unfit](#) (int64\_t x)
- template<size\_t K>  
bool [unfit](#) ([Reclnt::rint](#)< K > x)
- template<> bool [unfit](#) ([Reclnt::rint](#)< 6 > x)

## 13.104.1 Macro Definition Documentation

### 13.104.1.1 [\\_\\_FFLASFFPACK\\_fflas\\_fflas\\_mmhelper\\_INL](#)

```
#define __FFLASFFPACK_fflas_fflas_mmhelper_INL
```



## 13.105 igemm.doxy File Reference

## 13.106 igemm.h File Reference

```
#include "igemm_kernels.h"
#include "igemm_tools.h"
#include "fflas-ffpack/utils/fflas_memory.h"
#include "igemm.inl"
```

### Namespaces

- namespace [FFLAS](#)
- namespace [FFLAS::Protected](#)

### Enumerations

- enum [number\\_kind](#) { [zero](#) =0 , [one](#) =1 , [mone](#) =-1 , [other](#) =2 }

### Functions

- template<enum [FFLAS\\_TRANSPOSE](#) tA, enum [FFLAS\\_TRANSPOSE](#) tB>  
void [igemm\\_colmajor](#) (size\_t rows, size\_t cols, size\_t depth, const int64\_t alpha, const int64\_t \*A, size\_t lda, const int64\_t \*B, size\_t ldb, int64\_t \*C, size\_t ldc)
- template<enum [FFLAS\\_TRANSPOSE](#) tA, enum [FFLAS\\_TRANSPOSE](#) tB, enum [number\\_kind](#) alpha\_kind>  
void [igemm\\_colmajor](#) (size\_t rows, size\_t cols, size\_t depth, const int64\_t alpha, const int64\_t \*A, size\_t lda, const int64\_t \*B, size\_t ldb, int64\_t \*C, size\_t ldc)
- void [igemm](#) (const enum [FFLAS\\_TRANSPOSE](#) TransA, const enum [FFLAS\\_TRANSPOSE](#) TransB, size\_t rows, size\_t cols, size\_t depth, const int64\_t alpha, const int64\_t \*A, size\_t lda, const int64\_t \*B, size\_t ldb, const int64\_t beta, int64\_t \*C, size\_t ldc)
- void [igemm\\_](#) (const enum [FFLAS\\_ORDER](#) Order, const enum [FFLAS\\_TRANSPOSE](#) TransA, const enum [FFLAS\\_TRANSPOSE](#) TransB, const size\_t M, const size\_t N, const size\_t K, const int64\_t alpha, const int64\_t \*A, const size\_t lda, const int64\_t \*B, const size\_t ldb, const int64\_t beta, int64\_t \*C, const size\_t ldc)

## 13.107 igemm.inl File Reference

```
#include "fflas-ffpack/utils/fflas_memory.h"
```

### Namespaces

- namespace [FFLAS](#)
- namespace [FFLAS::Protected](#)

### Macros

- #define [\\_\\_FFLASFFPACK\\_fflas\\_igemm\\_igemm\\_INL](#)

### Functions

- template<enum [FFLAS\\_TRANSPOSE](#) tA, enum [FFLAS\\_TRANSPOSE](#) tB>  
void [igemm\\_colmajor](#) (size\_t rows, size\_t cols, size\_t depth, const int64\_t alpha, const int64\_t \*A, size\_t lda, const int64\_t \*B, size\_t ldb, int64\_t \*C, size\_t ldc)
- template<enum [FFLAS\\_TRANSPOSE](#) tA, enum [FFLAS\\_TRANSPOSE](#) tB, enum [number\\_kind](#) alpha\_kind>  
void [igemm\\_colmajor](#) (size\_t rows, size\_t cols, size\_t depth, const int64\_t alpha, const int64\_t \*A, size\_t lda, const int64\_t \*B, size\_t ldb, int64\_t \*C, size\_t ldc)

- void [igemm](#) (const enum [FFLAS\\_TRANSPOSE](#) TransA, const enum [FFLAS\\_TRANSPOSE](#) TransB, size\_t rows, size\_t cols, size\_t depth, const int64\_t alpha, const int64\_t \*A, size\_t lda, const int64\_t \*B, size\_t ldb, const int64\_t beta, int64\_t \*C, size\_t ldc)
- void [igemm\\_](#) (const enum [FFLAS\\_ORDER](#) Order, const enum [FFLAS\\_TRANSPOSE](#) TransA, const enum [FFLAS\\_TRANSPOSE](#) TransB, const size\_t M, const size\_t N, const size\_t K, const int64\_t alpha, const int64\_t \*A, const size\_t lda, const int64\_t \*B, const size\_t ldb, const int64\_t beta, int64\_t \*C, const size\_t ldc)

### 13.107.1 Macro Definition Documentation

#### 13.107.1.1 `__FFLASFFPACK_fflas_igemm_igemm_INL`

```
#define __FFLASFFPACK_fflas_igemm_igemm_INL
```

## 13.108 `igemm_kernels.h` File Reference

```
#include "igemm_kernels.inl"
```

### Namespaces

- namespace [FFLAS](#)
- namespace [FFLAS::details](#)

### Functions

- template<enum [number\\_kind](#) K>  
void [igebb44](#) (size\_t i, size\_t j, size\_t depth, size\_t pdeth, const int64\_t alpha, const int64\_t \*bIA, const int64\_t \*bIB, int64\_t \*C, size\_t ldc)
- template<enum [number\\_kind](#) K>  
void [igebb24](#) (size\_t i, size\_t j, size\_t depth, size\_t pdeth, const int64\_t alpha, const int64\_t \*bIA, const int64\_t \*bIB, int64\_t \*C, size\_t ldc)
- template<enum [number\\_kind](#) K>  
void [igebb14](#) (size\_t i, size\_t j, size\_t depth, size\_t pdeth, const int64\_t alpha, const int64\_t \*bIA, const int64\_t \*bIB, int64\_t \*C, size\_t ldc)
- template<enum [number\\_kind](#) K>  
void [igebb41](#) (size\_t i, size\_t j, size\_t depth, size\_t pdeth, const int64\_t alpha, const int64\_t \*bIA, const int64\_t \*bIB, int64\_t \*C, size\_t ldc)
- template<enum [number\\_kind](#) K>  
void [igebb21](#) (size\_t i, size\_t j, size\_t depth, size\_t pdeth, const int64\_t alpha, const int64\_t \*bIA, const int64\_t \*bIB, int64\_t \*C, size\_t ldc)
- template<enum [number\\_kind](#) K>  
void [igebb11](#) (size\_t i, size\_t j, size\_t depth, size\_t pdeth, const int64\_t alpha, const int64\_t \*bIA, const int64\_t \*bIB, int64\_t \*C, size\_t ldc)
- template<enum [number\\_kind](#) K>  
void [igebp](#) (size\_t rows, size\_t cols, size\_t depth, const int64\_t alpha, const int64\_t \*blockA, size\_t lda, const int64\_t \*blockB, size\_t ldb, int64\_t \*C, size\_t ldc)

## 13.109 `igemm_kernels.inl` File Reference

```
#include "fflas-ffpack/utils/fflas_memory.h"
```

```
#include "igemm_tools.h"
```

### Namespaces

- namespace [FFLAS](#)
- namespace [FFLAS::details](#)

## Macros

- `#define \_\_FFLASFFPACK\_fflas\_igemm\_igemm\_kernels\_INL`

## Functions

- `template<enum number\_kind K>`  
`void igebb44 (size_t i, size_t j, size_t depth, size_t pdeth, const int64_t alpha, const int64_t *bIA, const int64_t *bIB, int64_t *C, size_t ldc)`
- `template<enum number\_kind K>`  
`void igebb24 (size_t i, size_t j, size_t depth, size_t pdeth, const int64_t alpha, const int64_t *bIA, const int64_t *bIB, int64_t *C, size_t ldc)`
- `template<enum number\_kind K>`  
`void igebb14 (size_t i, size_t j, size_t depth, size_t pdeth, const int64_t alpha, const int64_t *bIA, const int64_t *bIB, int64_t *C, size_t ldc)`
- `template<enum number\_kind K>`  
`void igebb41 (size_t i, size_t j, size_t depth, size_t pdeth, const int64_t alpha, const int64_t *bIA, const int64_t *bIB, int64_t *C, size_t ldc)`
- `template<enum number\_kind K>`  
`void igebb21 (size_t i, size_t j, size_t depth, size_t pdeth, const int64_t alpha, const int64_t *bIA, const int64_t *bIB, int64_t *C, size_t ldc)`
- `template<enum number\_kind K>`  
`void igebb11 (size_t i, size_t j, size_t depth, size_t pdeth, const int64_t alpha, const int64_t *bIA, const int64_t *bIB, int64_t *C, size_t ldc)`
- `template<enum number\_kind K>`  
`void igebp (size_t rows, size_t cols, size_t depth, const int64_t alpha, const int64_t *blockA, size_t lda, const int64_t *blockB, size_t ldb, int64_t *C, size_t ldc)`

### 13.109.1 Macro Definition Documentation

#### 13.109.1.1 [\\_\\_FFLASFFPACK\\_fflas\\_igemm\\_igemm\\_kernels\\_INL](#)

```
#define __FFLASFFPACK_fflas_igemm_igemm_kernels_INL
```

## 13.110 igemm\_tools.h File Reference

```
#include "igemm_tools.inl"
```

## Namespaces

- namespace [FFLAS](#)
- namespace [FFLAS::details](#)

## Functions

- `template<size_t k, bool transpose>`  
`void pack\_lhs (int64_t *XX, const int64_t *X, size_t ldx, size_t rows, size_t cols)`
- `template<size_t k, bool transpose>`  
`void pack\_rhs (int64_t *XX, const int64_t *X, size_t ldx, size_t rows, size_t cols)`
- `void gebp (size_t rows, size_t cols, size_t depth, int64_t *C, size_t ldc, const int64_t *blockA, size_t lda, const int64_t *BlockB, size_t ldb, int64_t *BlockW)`
- `void BlockingFactor (size_t &m, size_t &n, size_t &k)`

### 13.111 igemm\_tools.inl File Reference

```
#include "fflas-ffpack/fflas/fflas_simd.h"
```

## Namespaces

- namespace [FFLAS](#)
- namespace [FFLAS::details](#)

## Macros

- `#define __FFLASFFPACK_fflas_igemm_igemm_tools_INL`

## Functions

- `template<size_t k, bool transpose>`  
void [pack\\_rhs](#) (int64\_t \*XX, const int64\_t \*X, size\_t ldx, size\_t rows, size\_t cols)
- `template<size_t k, bool transpose>`  
void [pack\\_lhs](#) (int64\_t \*XX, const int64\_t \*X, size\_t ldx, size\_t rows, size\_t cols)
- void [BlockingFactor](#) (size\_t &m, size\_t &n, size\_t &k)

### 13.111.1 Macro Definition Documentation

#### 13.111.1.1 \_\_FFLASFFPACK\_fflas\_igemm\_igemm\_tools\_INL

```
#define __FFLASFFPACK_fflas_igemm_igemm_tools_INL
```

## 13.112 fflas\_level1.inl File Reference

## Namespaces

- namespace [FFLAS](#)

## Macros

- `#define __FFLASFFPACK_fflas_fflas_level1_INL`

## Functions

- `template<class Field>`  
void [freduce](#) (const [Field](#) &F, const size\_t n, typename [Field::Element\\_ptr](#) X, const size\_t incX)  
 $freduce\ x \leftarrow x \bmod F.$
- `template<class Field>`  
void [freduce](#) (const [Field](#) &F, const size\_t n, typename [Field::ConstElement\\_ptr](#) Y, const size\_t incY, typename [Field::Element\\_ptr](#) X, const size\_t incX)  
 $freduce\ x \leftarrow y \bmod F.$
- `template<class Field, class OtherElement_ptr>`  
void [finit](#) (const [Field](#) &F, const size\_t n, const OtherElement\_ptr Y, const size\_t incY, typename [Field::Element\\_ptr](#) X, const size\_t incX)  
 $finit\ x \leftarrow y \bmod F.$
- `template<class Field>`  
void [finit](#) (const [Field](#) &F, const size\_t n, typename [Field::Element\\_ptr](#) X, const size\_t incX)  
 $finit\ \text{Initializes } X \text{ in } F\$.$
- `template<class Field, class OtherElement_ptr>`  
void [fconvert](#) (const [Field](#) &F, const size\_t n, OtherElement\_ptr X, const size\_t incX, typename [Field::ConstElement\\_ptr](#) Y, const size\_t incY)  
 $fconvert\ x \leftarrow y \bmod F.$
- `template<class Field>`  
void [fnegin](#) (const [Field](#) &F, const size\_t n, typename [Field::Element\\_ptr](#) X, const size\_t incX)  
 $fnegin\ x \leftarrow -x.$

- `template<class Field>`  
`void fneg (const Field &F, const size_t n, typename Field::ConstElement_ptr Y, const size_t incY, typename Field::Element_ptr X, const size_t incX)`  

$$fneg\ x \leftarrow -y.$$
- `template<class Field>`  
`void fzero (const Field &F, const size_t n, typename Field::Element_ptr X, const size_t incX)`  

$$fzero : A \leftarrow 0.$$
- `template<class Field, class RandIter>`  
`void frand (const Field &F, RandIter &G, const size_t n, typename Field::Element_ptr X, const size_t incX)`  

$$frand : A \leftarrow random.$$
- `template<class Field>`  
`bool fiszero (const Field &F, const size_t n, typename Field::ConstElement_ptr X, const size_t incX)`  

$$fiszero : test\ X = 0.$$
- `template<class Field>`  
`bool fequal (const Field &F, const size_t n, typename Field::ConstElement_ptr X, const size_t incX, typename Field::ConstElement_ptr Y, const size_t incY)`  

$$fequal : test\ X = Y.$$
- `template<class Field>`  
`void fassign (const Field &F, const size_t N, typename Field::ConstElement_ptr Y, const size_t incY, typename Field::Element_ptr X, const size_t incX)`  

$$fassign : x \leftarrow y.$$
- `template<class Field>`  
`void fscaln (const Field &F, const size_t n, const typename Field::Element alpha, typename Field::Element_ptr X, const size_t incX)`  

$$fscaln\ x \leftarrow \alpha \cdot x.$$
- `template<class Field>`  
`void fscale (const Field &F, const size_t n, const typename Field::Element alpha, typename Field::ConstElement_ptr X, const size_t incX, typename Field::Element_ptr Y, const size_t incY)`  

$$fscale\ y \leftarrow \alpha \cdot x.$$
- `template<class Field>`  
`void faxpy (const Field &F, const size_t N, const typename Field::Element alpha, typename Field::ConstElement_ptr X, const size_t incX, typename Field::Element_ptr Y, const size_t incY)`  

$$faxpy : y \leftarrow \alpha \cdot x + y.$$
- `template<class Field>`  
`void faxpby (const Field &F, const size_t N, const typename Field::Element alpha, typename Field::ConstElement_ptr X, const size_t incX, const typename Field::Element beta, typename Field::Element_ptr Y, const size_t incY)`  

$$faxpby : y \leftarrow \alpha \cdot x + \beta \cdot y.$$
- `template<class Field>`  
`Field::Element fdot (const Field &F, const size_t N, typename Field::ConstElement_ptr X, const size_t incX, typename Field::ConstElement_ptr Y, const size_t incY)`  

$$fdot: dot\ product\ x^T y.$$
- `template<class Field>`  
`Field::Element fdot (const Field &F, const size_t N, typename Field::ConstElement_ptr x, const size_t incx, typename Field::ConstElement_ptr y, const size_t incy, const ParSeqHelper::Sequential seq)`
- `template<typename Field, class Cut, class Param>`  
`Field::Element fdot (const Field &F, const size_t N, typename Field::ConstElement_ptr X, const size_t incX, typename Field::ConstElement_ptr Y, const size_t incY, const ParSeqHelper::Parallel< Cut, Param > par)`
- `template<class Field>`  
`void fswap (const Field &F, const size_t N, typename Field::Element_ptr X, const size_t incX, typename Field::Element_ptr Y, const size_t incY)`  

$$fswap: X \leftrightarrow Y.$$

- `template<class Field>`  
`void pfadd (const Field &F, const size_t M, const size_t N, typename Field::ConstElement_ptr A, const size_t lda, typename Field::ConstElement_ptr B, const size_t ldb, typename Field::Element_ptr C, const size_t ldc, const size_t numths)`
- `template<class Field>`  
`void pfsub (const Field &F, const size_t M, const size_t N, typename Field::ConstElement_ptr A, const size_t lda, typename Field::ConstElement_ptr B, const size_t ldb, typename Field::Element_ptr C, const size_t ldc, const size_t numths)`
- `template<class Field>`  
`void pfaddin (const Field &F, const size_t M, const size_t N, typename Field::ConstElement_ptr B, const size_t ldb, typename Field::Element_ptr C, const size_t ldc, size_t numths)`
- `template<class Field>`  
`void pfsubin (const Field &F, const size_t M, const size_t N, typename Field::ConstElement_ptr B, const size_t ldb, typename Field::Element_ptr C, const size_t ldc, size_t numths)`
- `template<class Field>`  
`void fadd (const Field &F, const size_t N, typename Field::ConstElement_ptr A, const size_t inca, typename Field::ConstElement_ptr B, const size_t incb, typename Field::Element_ptr C, const size_t incc)`
- `template<class Field>`  
`void fsub (const Field &F, const size_t N, typename Field::ConstElement_ptr A, const size_t inca, typename Field::ConstElement_ptr B, const size_t incb, typename Field::Element_ptr C, const size_t incc)`
- `template<class Field>`  
`void faddin (const Field &F, const size_t N, typename Field::ConstElement_ptr B, const size_t incb, typename Field::Element_ptr C, const size_t incc)`
- `template<class Field>`  
`void fsubin (const Field &F, const size_t N, typename Field::ConstElement_ptr B, const size_t incb, typename Field::Element_ptr C, const size_t incc)`
- `template<class Field>`  
`void fadd (const Field &F, const size_t N, typename Field::ConstElement_ptr A, const size_t inca, const typename Field::Element_ptr alpha, typename Field::ConstElement_ptr B, const size_t incb, typename Field::Element_ptr C, const size_t incc)`

### 13.112.1 Macro Definition Documentation

#### 13.112.1.1 \_\_FFLASFFPACK\_fflas\_fflas\_level1\_INL

```
#define __FFLASFFPACK_fflas_fflas_level1_INL
```

### 13.113 fflas\_level2.inl File Reference

```
#include "givaro/zring.h"
```

#### Namespaces

- namespace `FFLAS`

#### Macros

- `#define __FFLASFFPACK_fflas_fflas_level2_INL`

#### Functions

- `template<class Field>`  
`void fassign (const Field &F, const size_t m, const size_t n, typename Field::ConstElement_ptr B, const size_t ldb, typename Field::Element_ptr A, const size_t lda)`  

$$fassign : A \leftarrow B.$$
- `template<class Field>`  
`void fzero (const Field &F, const size_t m, const size_t n, typename Field::Element_ptr A, const size_t lda)`

- $fzero : A \leftarrow 0.$ 
  - template<class [Field](#)>  
void [fzero](#) (const [Field](#) &F, const [FFLAS\\_UPLO](#) shape, const [FFLAS\\_DIAG](#) diag, const size\_t n, typename [Field::Element\\_ptr](#) A, const size\_t lda)  
 $fzero : A \leftarrow 0 \text{ for a triangular matrix.}$
- template<class [Field](#), class RandIter>  
void [frand](#) (const [Field](#) &F, RandIter &G, const size\_t m, const size\_t n, typename [Field::Element\\_ptr](#) A, const size\_t lda)  
 $frand : A \leftarrow \text{random.}$
- template<class [Field](#)>  
bool [fequal](#) (const [Field](#) &F, const size\_t m, const size\_t n, typename [Field::ConstElement\\_ptr](#) A, const size\_t lda, typename [Field::ConstElement\\_ptr](#) B, const size\_t ldb)  
 $fequal : \text{test } A = B.$
- template<class [Field](#)>  
bool [fiszero](#) (const [Field](#) &F, const size\_t m, const size\_t n, typename [Field::ConstElement\\_ptr](#) A, const size\_t lda)  
 $fiszero : \text{test } A = 0.$
- template<class [Field](#)>  
void [fidentity](#) (const [Field](#) &F, const size\_t m, const size\_t n, typename [Field::Element\\_ptr](#) A, const size\_t lda, const typename [Field::Element](#) &d)  
 $\text{creates a diagonal matrix}$
- template<class [Field](#)>  
void [fidentity](#) (const [Field](#) &F, const size\_t m, const size\_t n, typename [Field::Element\\_ptr](#) A, const size\_t lda)  
 $\text{creates a diagonal matrix}$
- template<class [Field](#)>  
void [freduce](#) (const [Field](#) &F, const size\_t m, const size\_t n, typename [Field::Element\\_ptr](#) A, const size\_t lda)  
 $freduce \ A \leftarrow A \bmod F.$
- template<class [Field](#)>  
void [freduce](#) (const [Field](#) &F, const [FFLAS\\_UPLO](#) uplo, const size\_t N, typename [Field::Element\\_ptr](#) A, const size\_t lda)  
 $freduce \text{ for square symmetric matrices}$
- template<class [Field](#)>  
void [freduce](#) (const [Field](#) &F, const size\_t m, const size\_t n, typename [Field::ConstElement\\_ptr](#) B, const size\_t ldb, typename [Field::Element\\_ptr](#) A, const size\_t lda)  
 $freduce \ A \leftarrow B \bmod F.$
- template<class [Field](#), class OtherElement\_ptr>  
void [finit](#) (const [Field](#) &F, const size\_t m, const size\_t n, const OtherElement\_ptr B, const size\_t ldb, typename [Field::Element\\_ptr](#) A, const size\_t lda)  
 $finit \ A \leftarrow B \bmod F.$
- template<class [Field](#), class OtherElement\_ptr>  
void [finit](#) (const [Field](#) &F, const size\_t m, const size\_t n, typename [Field::Element\\_ptr](#) A, const size\_t lda)  
 $finit \text{ Initializes } A \text{ in } F^{\$}.$
- template<class [Field](#), class OtherElement\_ptr>  
void [fconvert](#) (const [Field](#) &F, const size\_t m, const size\_t n, OtherElement\_ptr A, const size\_t lda, typename [Field::ConstElement\\_ptr](#) B, const size\_t ldb)  
 $fconvert \ A \leftarrow B \bmod F.$
- template<class [Field](#)>  
void [fnegin](#) (const [Field](#) &F, const size\_t m, const size\_t n, typename [Field::Element\\_ptr](#) A, const size\_t lda)  
 $fnegin \ A \leftarrow -A.$
- template<class [Field](#)>  
void [fneg](#) (const [Field](#) &F, const size\_t m, const size\_t n, typename [Field::ConstElement\\_ptr](#) B, const size\_t ldb, typename [Field::Element\\_ptr](#) A, const size\_t lda)  
 $fneg \ A \leftarrow -B.$

- template<class [Field](#)>  
void [fscal](#) (const [Field](#) &F, const size\_t m, const size\_t n, const typename [Field::Element](#) alpha, typename [Field::Element\\_ptr](#) A, const size\_t lda)  
 $fscal\ A \leftarrow a \cdot A.$
- template<class [Field](#)>  
void [fscal](#) (const [Field](#) &F, const size\_t m, const size\_t n, const typename [Field::Element](#) alpha, typename [Field::ConstElement\\_ptr](#) A, const size\_t lda, typename [Field::Element\\_ptr](#) B, const size\_t ldb)  
 $fscal\ B \leftarrow a \cdot A.$
- template<class [Field](#)>  
void [faxpy](#) (const [Field](#) &F, const size\_t m, const size\_t n, const typename [Field::Element](#) alpha, typename [Field::ConstElement\\_ptr](#) X, const size\_t ldx, typename [Field::Element\\_ptr](#) Y, const size\_t ldy)  
 $faxpy : y \leftarrow \alpha \cdot x + y.$
- template<class [Field](#)>  
void [faxpby](#) (const [Field](#) &F, const size\_t m, const size\_t n, const typename [Field::Element](#) alpha, typename [Field::ConstElement\\_ptr](#) X, const size\_t ldx, const typename [Field::Element](#) beta, typename [Field::Element\\_ptr](#) Y, const size\_t ldy)  
 $faxpby : y \leftarrow \alpha \cdot x + \beta \cdot y.$
- template<class [Field](#)>  
void [fmove](#) (const [Field](#) &F, const size\_t m, const size\_t n, typename [Field::Element\\_ptr](#) A, const size\_t lda, typename [Field::Element\\_ptr](#) B, const size\_t ldb)  
 $fmove : A \leftarrow B\ and\ B \leftarrow 0.$
- template<class [Field](#)>  
void [fadd](#) (const [Field](#) &F, const size\_t M, const size\_t N, typename [Field::ConstElement\\_ptr](#) A, const size\_t lda, typename [Field::ConstElement\\_ptr](#) B, const size\_t ldb, typename [Field::Element\\_ptr](#) C, const size\_t ldc)  
 $fadd : matrix\ addition.$
- template<class [Field](#)>  
void [fsub](#) (const [Field](#) &F, const size\_t M, const size\_t N, typename [Field::ConstElement\\_ptr](#) A, const size\_t lda, typename [Field::ConstElement\\_ptr](#) B, const size\_t ldb, typename [Field::Element\\_ptr](#) C, const size\_t ldc)  
 $fsub : matrix\ subtraction.$
- template<class [Field](#)>  
void [fsubin](#) (const [Field](#) &F, const size\_t M, const size\_t N, typename [Field::ConstElement\\_ptr](#) B, const size\_t ldb, typename [Field::Element\\_ptr](#) C, const size\_t ldc)  
 $fsubin\ C = C - B$
- template<class [Field](#)>  
void [fadd](#) (const [Field](#) &F, const size\_t M, const size\_t N, typename [Field::ConstElement\\_ptr](#) A, const size\_t lda, const typename [Field::Element](#) alpha, typename [Field::ConstElement\\_ptr](#) B, const size\_t ldb, typename [Field::Element\\_ptr](#) C, const size\_t ldc)  
 $fadd : matrix\ addition\ with\ scaling.$
- template<class [Field](#)>  
void [faddin](#) (const [Field](#) &F, const size\_t M, const size\_t N, typename [Field::ConstElement\\_ptr](#) B, const size\_t ldb, typename [Field::Element\\_ptr](#) C, const size\_t ldc)  
 $faddin$
- template<class [Field](#)>  
void [faddin](#) (const [Field](#) &F, const [FFLAS\\_UPLO](#) uplo, const size\_t N, typename [Field::ConstElement\\_ptr](#) B, const size\_t ldb, typename [Field::Element\\_ptr](#) C, const size\_t ldc)  
 $fadding\ for\ symmetric\ matrices$
- template<class [Field](#)>  
[Field::Element\\_ptr](#) [fgemv](#) (const [Field](#) &F, const [FFLAS\\_TRANSPOSE](#) TransA, const size\_t M, const size\_t N, const typename [Field::Element](#) alpha, typename [Field::ConstElement\\_ptr](#) A, const size\_t lda, typename [Field::ConstElement\\_ptr](#) X, const size\_t incX, const typename [Field::Element](#) beta, typename [Field::Element\\_ptr](#) Y, const size\_t incY)  
 $finite\ prime\ Field\ GEneral\ Matrix\ Vector\ multiplication.$
- template<class [Field](#)>  
void [fger](#) (const [Field](#) &F, const size\_t M, const size\_t N, const typename [Field::Element](#) alpha, typename [Field::ConstElement\\_ptr](#) x, const size\_t incx, typename [Field::ConstElement\\_ptr](#) y, const size\_t incy, typename [Field::Element\\_ptr](#) A, const size\_t lda)



*fgcr: rank one update of a general matrix*

- template<class [Field](#)>  
void [ftrsv](#) (const [Field](#) &F, const [FFLAS\\_UPLO](#) Uplo, const [FFLAS\\_TRANSPOSE](#) TransA, const [FFLAS\\_DIAG](#) Diag, const size\_t N, typename [Field::ConstElement\\_ptr](#) A, const size\_t lda, typename [Field::Element\\_ptr](#) X, int incX)

*ftrsv: TRIangular System solve with Vector Computes  $X \leftarrow \text{op}(A^{-1})X$*

- template<class [Field](#)>  
size\_t [bitsize](#) (const [Field](#) &F, size\_t M, size\_t N, const typename [Field::ConstElement\\_ptr](#) A, size\_t lda)  
*bitsize: Computes the largest bitsize of the matrix' coefficients.*
- template<> size\_t [bitsize](#)< [Givaro::ZRing](#)< [Givaro::Integer](#) > > (const [Givaro::ZRing](#)< [Givaro::Integer](#) > &F, size\_t M, size\_t N, const [Givaro::Integer](#) \*A, size\_t lda)
- template<class [Field](#)>  
void [ftrmv](#) (const [Field](#) &F, const [FFLAS\\_UPLO](#) Uplo, const [FFLAS\\_TRANSPOSE](#) TransA, const [FFLAS\\_DIAG](#) Diag, const size\_t N, typename [Field::ConstElement\\_ptr](#) A, const size\_t lda, typename [Field::Element\\_ptr](#) X, int incX)

*ftrsm: TRIangular Matrix Vector prodcut Computes  $X \leftarrow \text{op}(A)X$*

### 13.113.1 Macro Definition Documentation

#### 13.113.1.1 \_\_FFLASFFPACK\_fflas\_fflas\_level2\_INL

```
#define __FFLASFFPACK_fflas_fflas_level2_INL
```

## 13.114 fflas\_level3.inl File Reference

```
#include "fflas_bounds.inl"
#include "fflas_helpers.inl"
#include "fflas-ffpack/paladin/parallel.h"
```

### Namespaces

- namespace [FFLAS](#)
- namespace [FFLAS::Protected](#)

### Macros

- #define [\\_\\_FFLASFFPACK\\_fflas\\_fflas\\_level3\\_INL](#)
- #define [\\_\\_FFLAS\\_\\_TRSM\\_READONLY](#)

### Functions

- template<class [Field](#)>  
void [MatF2MatD\\_Triangular](#) (const [Field](#) &F, [Givaro::DoubleDomain::Element\\_ptr](#) S, const size\_t lds, type-  
name [Field::ConstElement\\_ptr](#) const E, const size\_t lde, const size\_t m, const size\_t n)
- template<class [Field](#)>  
void [MatF2MatFI\\_Triangular](#) (const [Field](#) &F, [Givaro::FloatDomain::Element\\_ptr](#) S, const size\_t lds, typename  
[Field::ConstElement\\_ptr](#) const E, const size\_t lde, const size\_t m, const size\_t n)
- template<class [Field](#)>  
void [ftrsm](#) (const [Field](#) &F, const [FFLAS\\_SIDE](#) Side, const [FFLAS\\_UPLO](#) Uplo, const [FFLAS\\_TRANSPOSE](#)  
TransA, const [FFLAS\\_DIAG](#) Diag, const size\_t M, const size\_t N, const typename [Field::Element](#) alpha,  
typename [Field::ConstElement\\_ptr](#) A, const size\_t lda, typename [Field::Element\\_ptr](#) B, const size\_t ldb)  
*ftrsm: TRIangular System solve with Matrix.*
- template<class [Field](#)>  
void [ftrmm](#) (const [Field](#) &F, const [FFLAS\\_SIDE](#) Side, const [FFLAS\\_UPLO](#) Uplo, const [FFLAS\\_TRANSPOSE](#)  
TransA, const [FFLAS\\_DIAG](#) Diag, const size\_t M, const size\_t N, const typename [Field::Element](#) alpha,  
typename [Field::ConstElement\\_ptr](#) A, const size\_t lda, typename [Field::Element\\_ptr](#) B, const size\_t ldb)

*ftmm: **TRI**angular **M**atrix **M**ultiply.*

- template<class Field>  
void **ftmm** (const Field &F, const FFLAS\_SIDE Side, const FFLAS\_UPLO Uplo, const FFLAS\_TRANSPOSE TransA, const FFLAS\_DIAG Diag, const size\_t M, const size\_t N, const typename Field::Element alpha, typename Field::ConstElement\_ptr A, const size\_t lda, typename Field::ConstElement\_ptr B, const size\_t ldb, const typename Field::Element beta, typename Field::Element\_ptr C, const size\_t ldc)  
  
*ftmm: **TRI**angular **M**atrix **M**ultiply with 3 operands Computes  $C \leftarrow \alpha \text{op}(A)B + \text{beta}C$  or  $C \leftarrow \alpha \text{Bop}(A) + \text{beta}C$ .*
- template<class Field>  
Field::Element\_ptr **fsyrk** (const Field &F, const FFLAS\_UPLO UpLo, const FFLAS\_TRANSPOSE trans, const size\_t n, const size\_t k, const typename Field::Element alpha, typename Field::ConstElement\_ptr A, const size\_t lda, const typename Field::Element beta, typename Field::Element\_ptr C, const size\_t ldc)  
  
*fsyrk: Symmetric Rank K update*
- template<class Field, typename FieldTrait>  
Field::Element\_ptr **fsyrk\_strassen** (const Field &F, const FFLAS\_UPLO UpLo, const FFLAS\_TRANSPOSE trans, const size\_t N, const size\_t K, const typename Field::Element y1, const typename Field::Element y2, const typename Field::Element alpha, typename Field::ConstElement\_ptr A, const size\_t lda, const typename Field::Element beta, typename Field::Element\_ptr C, const size\_t ldc, MMHelper< Field, MMHelperAlgo::Winograd, FieldTrait > &H)
- template<class Field>  
Field::Element\_ptr **fsyr2k** (const Field &F, const FFLAS\_UPLO UpLo, const FFLAS\_TRANSPOSE trans, const size\_t n, const size\_t k, const typename Field::Element alpha, typename Field::ConstElement\_ptr A, const size\_t lda, typename Field::ConstElement\_ptr B, const size\_t ldb, const typename Field::Element beta, typename Field::Element\_ptr C, const size\_t ldc)  
  
*fsyr2k: Symmetric Rank 2K update*
- template<class Field>  
Field::Element\_ptr **fsyrk** (const Field &F, const FFLAS\_UPLO UpLo, const FFLAS\_TRANSPOSE trans, const size\_t n, const size\_t k, const typename Field::Element alpha, typename Field::Element\_ptr A, const size\_t lda, typename Field::ConstElement\_ptr D, const size\_t incD, const typename Field::Element beta, typename Field::Element\_ptr C, const size\_t ldc, const size\_t threshold=\_\_FFLASFFPACK\_FSYRK\_THRESHOLD)  
  
*fsyrk: Symmetric Rank K update with diagonal scaling*
- template<class Field>  
Field::Element\_ptr **fsyrk** (const Field &F, const FFLAS\_UPLO UpLo, const FFLAS\_TRANSPOSE trans, const size\_t N, const size\_t K, const typename Field::Element alpha, typename Field::Element\_ptr A, const size\_t lda, typename Field::ConstElement\_ptr D, const size\_t incD, const typename Field::Element beta, typename Field::Element\_ptr C, const size\_t ldc, const ParSeqHelper::Sequential seq, const size\_t threshold)
- template<class Field, class Cut, class Param>  
Field::Element\_ptr **fsyrk** (const Field &F, const FFLAS\_UPLO UpLo, const FFLAS\_TRANSPOSE trans, const size\_t N, const size\_t K, const typename Field::Element alpha, typename Field::Element\_ptr A, const size\_t lda, typename Field::ConstElement\_ptr D, const size\_t incD, const typename Field::Element beta, typename Field::Element\_ptr C, const size\_t ldc, const ParSeqHelper::Parallel< Cut, Param > par, const size\_t threshold)
- template<class Field>  
Field::Element\_ptr **fsyrk** (const Field &F, const FFLAS\_UPLO UpLo, const FFLAS\_TRANSPOSE trans, const size\_t n, const size\_t k, const typename Field::Element alpha, typename Field::Element\_ptr A, const size\_t lda, typename Field::ConstElement\_ptr D, const size\_t incD, const std::vector< bool > &two← Block, const typename Field::Element beta, typename Field::Element\_ptr C, const size\_t ldc, const size\_t threshold=\_\_FFLASFFPACK\_FSYRK\_THRESHOLD)  
  
*fsyrk: Symmetric Rank K update with diagonal scaling*
- template<typename Field>  
Field::Element\_ptr **fgemm** (const Field &F, const FFLAS\_TRANSPOSE ta, const FFLAS\_TRANSPOSE tb, const size\_t m, const size\_t n, const size\_t k, const typename Field::Element alpha, typename Field::ConstElement\_ptr A, const size\_t lda, typename Field::ConstElement\_ptr B, const size\_t ldb, const typename Field::Element beta, typename Field::Element\_ptr C, const size\_t ldc)  
  
*fgemm: **F**ield **G**eneral **M**atrix **M**ultiply.*
- template<typename Field>  
Field::Element\_ptr **fgemm** (const Field &F, const FFLAS\_TRANSPOSE ta, const FFLAS\_TRANSPOSE

tb, const size\_t m, const size\_t n, const size\_t k, const typename Field::Element alpha, typename Field::ConstElement\_ptr A, const size\_t lda, typename Field::ConstElement\_ptr B, const size\_t ldb, const typename Field::Element beta, typename Field::Element\_ptr C, const size\_t ldc, const ParSeqHelper::Sequential seq)

- template<typename Field, class Cut, class Param>  
Field::Element\_ptr fgemm (const Field &F, const FFLAS\_TRANSPOSE ta, const FFLAS\_TRANSPOSE tb, const size\_t m, const size\_t n, const size\_t k, const typename Field::Element alpha, typename Field::ConstElement\_ptr A, const size\_t lda, typename Field::ConstElement\_ptr B, const size\_t ldb, const typename Field::Element beta, typename Field::Element\_ptr C, const size\_t ldc, const ParSeqHelper::Parallel< Cut, Param > par)
- template<typename Field>  
Field::Element\_ptr pfgemm (const Field &F, const FFLAS\_TRANSPOSE ta, const FFLAS\_TRANSPOSE tb, const size\_t m, const size\_t n, const size\_t k, const typename Field::Element alpha, typename Field::ConstElement\_ptr A, const size\_t lda, typename Field::ConstElement\_ptr B, const size\_t ldb, const typename Field::Element beta, typename Field::Element\_ptr C, const size\_t ldc, size\_t numthreads=0)
- template<class Field>  
Field::Element \* pfgemm\_1D\_rec (const Field &F, const FFLAS\_TRANSPOSE ta, const FFLAS\_TRANSPOSE tb, const size\_t m, const size\_t n, const size\_t k, const typename Field::Element alpha, const typename Field::Element\_ptr A, const size\_t lda, const typename Field::Element\_ptr B, const size\_t ldb, const typename Field::Element beta, typename Field::Element \*C, const size\_t ldc, size\_t seuil)
- template<class Field>  
Field::Element \* pfgemm\_2D\_rec (const Field &F, const FFLAS\_TRANSPOSE ta, const FFLAS\_TRANSPOSE tb, const size\_t m, const size\_t n, const size\_t k, const typename Field::Element alpha, const typename Field::Element\_ptr A, const size\_t lda, const typename Field::Element\_ptr B, const size\_t ldb, const typename Field::Element beta, typename Field::Element \*C, const size\_t ldc, size\_t seuil)
- template<class Field>  
Field::Element \* pfgemm\_3D\_rec (const Field &F, const FFLAS\_TRANSPOSE ta, const FFLAS\_TRANSPOSE tb, const size\_t m, const size\_t n, const size\_t k, const typename Field::Element alpha, const typename Field::Element\_ptr A, const size\_t lda, const typename Field::Element\_ptr B, const size\_t ldb, const typename Field::Element beta, typename Field::Element\_ptr C, const size\_t ldc, size\_t seuil, size\_t \*x)
- template<class Field>  
Field::Element\_ptr pfgemm\_3D\_rec2 (const Field &F, const FFLAS\_TRANSPOSE ta, const FFLAS\_TRANSPOSE tb, const size\_t m, const size\_t n, const size\_t k, const typename Field::Element alpha, const typename Field::Element\_ptr A, const size\_t lda, const typename Field::Element\_ptr B, const size\_t ldb, const typename Field::Element beta, typename Field::Element\_ptr C, const size\_t ldc, size\_t seuil, size\_t \*x)
- template<class Field>  
Field::Element\_ptr fsquare (const Field &F, const FFLAS\_TRANSPOSE ta, const size\_t n, const typename Field::Element alpha, typename Field::ConstElement\_ptr A, const size\_t lda, const typename Field::Element beta, typename Field::Element\_ptr C, const size\_t ldc)

*fsquare: Squares a matrix.*

### 13.114.1 Macro Definition Documentation

#### 13.114.1.1 \_\_FFLASFFPACK\_fflas\_fflas\_level3\_INL

```
#define __FFLASFFPACK_fflas_fflas_level3_INL
```

#### 13.114.1.2 \_\_FFLAS\_TRSM\_READONLY

```
#define __FFLAS_TRSM_READONLY
```

## 13.115 fflas\_pfgemm.inl File Reference

```
#include "fflas-ffpack/paladin/blockcuts.inl"
#include "fflas-ffpack/paladin/parallel.h"
#include "fflas-ffpack/utils/timer.h"
#include "fflas-ffpack/paladin/pfgemm_variants.inl"
```

## Namespaces

- namespace [FFLAS](#)

## Macros

- `#define __FFLASFFPACK_fflas_pfgemm_INL`
- `#define __FFLASFFPACK_SEQPARTHRESHOLD 220`
- `#define __FFLASFFPACK_DIMKPENALTY 1`

## Functions

- `template<class Field, class ModeTrait, class Strat, class Param>`  
`std::enable_if<!std::is_same< ModeTrait, ModeCategories::ConvertTo< ElementCategories::RNSElementTag`  
`>::value, typename Field::Element\_ptr >::type fgemm (const Field &F, const FFLAS::FFLAS\_TRANSPOSE`  
`ta, const FFLAS::FFLAS\_TRANSPOSE tb, const size_t m, const size_t n, const size_t k, const`  
`typename Field::Element alpha, typename Field::ConstElement\_ptr A, const size_t lda, typename`  
`Field::ConstElement\_ptr B, const size_t ldb, const typename Field::Element beta, typename Field::Element\_ptr`  
`C, const size_t ldc, MMHelper< Field, MMHelperAlgo::Winograd, ModeTrait, ParSeqHelper::Parallel< Strat,`  
`Param > > &H)`

## 13.115.1 Macro Definition Documentation

### 13.115.1.1 \_\_FFLASFFPACK\_fflas\_pfgemm\_INL

```
#define __FFLASFFPACK_fflas_pfgemm_INL
```

### 13.115.1.2 \_\_FFLASFFPACK\_SEQPARTHRESHOLD

```
#define __FFLASFFPACK_SEQPARTHRESHOLD 220
```

### 13.115.1.3 \_\_FFLASFFPACK\_DIMKPENALTY

```
#define __FFLASFFPACK_DIMKPENALTY 1
```

## 13.116 fflas\_pftsm.inl File Reference

```
#include "fflas-ffpack/paladin/parallel.h"
```

## Namespaces

- namespace [FFLAS](#)

## Macros

- `#define __FFLASFFPACK_fflas_pftsm_INL`
- `#define PTRSM_HYBRID_THRESHOLD 256`

## Functions

- `template<class Field, class Cut, class Param>`  
`Field::Element\_ptr ftrsm (const Field &F, const FFLAS::FFLAS\_SIDE Side, const FFLAS::FFLAS\_UPLO`  
`UpLo, const FFLAS::FFLAS\_TRANSPOSE TA, const FFLAS::FFLAS\_DIAG Diag, const size_t m, const`  
`size_t n, const typename Field::Element alpha, typename Field::Element\_ptr A, const size_t lda, typename`  
`Field::Element\_ptr B, const size_t ldb, TRSMHelper< StructureHelper::Iterative, ParSeqHelper::Parallel<`  
`Cut, Param > > &H)`

- template<class [Field](#), class Cut, class Param>  
[Field::Element\\_ptr](#) ftrsm (const [Field](#) &F, const [FFLAS::FFLAS\\_SIDE](#) Side, const [FFLAS::FFLAS\\_UPLO](#) UpLo, const [FFLAS::FFLAS\\_TRANSPOSE](#) TA, const [FFLAS::FFLAS\\_DIAG](#) Diag, const size\_t m, const size\_t n, const typename [Field::Element](#) alpha, typename [Field::Element\\_ptr](#) A, const size\_t lda, typename [Field::Element\\_ptr](#) B, const size\_t ldb, [TRSMHelper](#)< [StructureHelper::Hybrid](#), [ParSeqHelper::Parallel](#)< Cut, Param > > &H)

## 13.116.1 Macro Definition Documentation

### 13.116.1.1 \_\_FFLASFFPACK\_fflas\_pftrsm\_INL

```
#define __FFLASFFPACK_fflas_pftrsm_INL
```

### 13.116.1.2 PTRSM\_HYBRID\_THRESHOLD

```
#define PTRSM_HYBRID_THRESHOLD 256
```

## 13.117 fflas\_simd.h File Reference

```
#include "fflas-ffpack/utils/fflas_intrinsic.h"
#include <iostream>
#include <type_traits>
#include <limits>
#include "fflas-ffpack/fflas-ffpack-config.h"
#include "fflas-ffpack/utils/debug.h"
#include "fflas-ffpack/utils/align-allocator.h"
#include <vector>
#include "givaro/givtypestring.h"
#include <fflas-ffpack/fflas/fflas_simd/simd_modular.inl>
```

### Data Structures

- struct [support\\_simd](#)< T >
- struct [is\\_simd](#)< T >
- struct [NoSimd](#)< T >
- struct [SimdChooser](#)< T, bool, bool >
- struct [SimdChooser](#)< T, false, b >
- struct [SimdChooser](#)< T, true, false >
- struct [SimdChooser](#)< T, true, true >

### Namespaces

- namespace [FFLAS](#)

### Macros

- #define [SIMD\\_INT](#) 1
- #define [INLINE](#) inline
- #define [CONST](#)
- #define [PURE](#)
- #define [NORML\\_MOD](#)(C, P, NEGP, MIN, MAX, Q, T)
- #define [FLOAT\\_MOD](#)(C, P, INVP, Q)

### Typedefs

- template<class T>  
using [Simd](#) = typename [SimdChooser](#)<T>::value

## 13.117.1 Macro Definition Documentation

### 13.117.1.1 SIMD\_INT

```
#define SIMD_INT 1
```

### 13.117.1.2 INLINE

```
#define INLINE inline
```

### 13.117.1.3 CONST

```
#define CONST
```

### 13.117.1.4 PURE

```
#define PURE
```

### 13.117.1.5 NORML\_MOD

```
#define NORML_MOD(  
    C,  
    P,  
    NEGP,  
    MIN,  
    MAX,  
    Q,  
    T)
```

**Value:**

```
{  
    \  
    Q = greater(C, MAX);  
    \  
    T = lesser(C, MIN);  
    \  
    Q = vand(Q, NEGP);  
    \  
    T = vand(T, P);  
    \  
    Q = vor(Q, T);  
    \  
    C = add(C, Q);  
    \  
}
```

### 13.117.1.6 FLOAT\_MOD

```
#define FLOAT_MOD(  
    C,  
    P,  
    INVP,  
    Q)
```

**Value:**

```
{  
    \  
    Q = mul(C, INVP);  
    \  
    Q = floor(Q);  
    \  
    C = fnmadd(C, Q, P);  
    \  
}
```

## 13.117.2 Typedef Documentation

### 13.117.2.1 Simd

```
template<class T>
```

```
using Simd = typename SimdChooser<T>::value
```

## 13.118 simd.dox File Reference

## 13.119 simd128.inl File Reference

```
#include "simd128_float.inl"
#include "simd128_double.inl"
```

### Data Structures

- struct [Simd128i\\_base](#)

### Macros

- #define [\\_\\_FFLASFFPACK\\_fflas\\_ffpack\\_utils\\_simd128\\_INL](#)

### Typedefs

- template<class T>  
using [Simd128](#)

### 13.119.1 Macro Definition Documentation

#### 13.119.1.1 \_\_FFLASFFPACK\_fflas\_ffpack\_utils\_simd128\_INL

```
#define __FFLASFFPACK_fflas_ffpack_utils_simd128_INL
```

### 13.119.2 Typedef Documentation

#### 13.119.2.1 Simd128

```
template<class T>
using Simd128
```

#### Initial value:

```
Simd128_impl<std::is_arithmetic<T>::value, std::is_integral<T>::value, std::is_signed<T>::value, sizeof(T)>
```

## 13.120 simd128\_double.inl File Reference

```
#include "givaro/givtypestring.h"
#include "fflas-ffpack/utils/align-allocator.h"
#include <vector>
#include <type_traits>
```

### Data Structures

- struct [Simd128\\_impl< true, false, true, 8 >](#)

### Macros

- #define [\\_\\_FFLASFFPACK\\_fflas\\_ffpack\\_utils\\_simd128\\_double\\_INL](#)

### 13.120.1 Macro Definition Documentation

#### 13.120.1.1 \_\_FFLASFFPACK\_fflas\_ffpack\_utils\_simd128\_double\_INL

```
#define __FFLASFFPACK_fflas_ffpack_utils_simd128_double_INL
```

### 13.121 simd128\_float.inl File Reference

```
#include "givaro/givtypestring.h"
#include "fflas-ffpack/utils/align-allocator.h"
#include <vector>
#include <type_traits>
```

#### Data Structures

- struct [Simd128\\_impl](#)< true, false, true, 4 >

#### Macros

- #define [\\_\\_FFLASFFPACK\\_fflas\\_ffpack\\_utils\\_simd128\\_float\\_INL](#)

### 13.121.1 Macro Definition Documentation

#### 13.121.1.1 \_\_FFLASFFPACK\_fflas\_ffpack\_utils\_simd128\_float\_INL

```
#define __FFLASFFPACK_fflas_ffpack_utils_simd128_float_INL
```

### 13.122 simd128\_int16.inl File Reference

```
#include "givaro/givtypestring.h"
#include "fflas-ffpack/utils/align-allocator.h"
#include <vector>
#include <type_traits>
```

#### Data Structures

- struct [Simd128\\_impl](#)< true, true, true, 2 >
- union [Simd128\\_impl](#)< true, true, true, 2 >::Converter
- struct [Simd128\\_impl](#)< true, true, false, 2 >
- union [Simd128\\_impl](#)< true, true, false, 2 >::Converter

#### Macros

- #define [\\_\\_FFLASFFPACK\\_fflas\\_ffpack\\_utils\\_simd128\\_int16\\_INL](#)

### 13.122.1 Macro Definition Documentation

#### 13.122.1.1 \_\_FFLASFFPACK\_fflas\_ffpack\_utils\_simd128\_int16\_INL

```
#define __FFLASFFPACK_fflas_ffpack_utils_simd128_int16_INL
```

### 13.123 simd128\_int32.inl File Reference

```
#include "givaro/givtypestring.h"
#include "fflas-ffpack/utils/align-allocator.h"
#include <vector>
```



```
#include <type_traits>
```

### Data Structures

- struct [Simd128\\_impl< true, true, true, 4 >](#)
- union [Simd128\\_impl< true, true, true, 4 >::Converter](#)
- struct [Simd128\\_impl< true, true, false, 4 >](#)
- union [Simd128\\_impl< true, true, false, 4 >::Converter](#)

### Macros

- #define [\\_\\_FFLASFFPACK\\_fflas\\_ffpack\\_utils\\_simd128\\_int32\\_INL](#)

## 13.123.1 Macro Definition Documentation

### 13.123.1.1 \_\_FFLASFFPACK\_fflas\_ffpack\_utils\_simd128\_int32\_INL

```
#define __FFLASFFPACK_fflas_ffpack_utils_simd128_int32_INL
```

## 13.124 simd128\_int64.inl File Reference

```
#include "givaro/givtypestring.h"
#include "fflas-ffpack/utils/align-allocator.h"
#include "fflas-ffpack/utils/bit_manipulation.h"
#include <vector>
#include <type_traits>
```

### Data Structures

- struct [Simd128\\_impl< true, true, true, 8 >](#)
- union [Simd128\\_impl< true, true, true, 8 >::Converter](#)
- struct [Simd128\\_impl< true, true, false, 8 >](#)
- union [Simd128\\_impl< true, true, false, 8 >::Converter](#)

### Macros

- #define [\\_\\_FFLASFFPACK\\_fflas\\_ffpack\\_utils\\_simd128\\_int64\\_INL](#)
- #define [vect\\_t Simd128\\_impl<true,true,true,8>::vect\\_t](#)

## 13.124.1 Macro Definition Documentation

### 13.124.1.1 \_\_FFLASFFPACK\_fflas\_ffpack\_utils\_simd128\_int64\_INL

```
#define __FFLASFFPACK_fflas_ffpack_utils_simd128_int64_INL
```

### 13.124.1.2 vect\_t

```
#define vect_t Simd128_impl<true,true,true,8>::vect_t
```

## 13.125 simd256.inl File Reference

```
#include "simd256_float.inl"
#include "simd256_double.inl"
```

**Data Structures**

- struct [Simd256fp\\_base](#)
- struct [Simd256i\\_base](#)

**Macros**

- `#define __FFLASFFPACK_fflas_ffpack_utils_simd256_INL`

**Typedefs**

- `template<class T>`  
using [Simd256](#)

**13.125.1 Macro Definition Documentation****13.125.1.1 \_\_FFLASFFPACK\_fflas\_ffpack\_utils\_simd256\_INL**

```
#define __FFLASFFPACK_fflas_ffpack_utils_simd256_INL
```

**13.125.2 Typedef Documentation****13.125.2.1 Simd256**

```
template<class T>
using Simd256
```

**Initial value:**

```
Simd256\_impl<std::is_arithmetic<T>::value, std::is_integral<T>::value, std::is_signed<T>::value, sizeof(T)>
```

**13.126 simd256\_double.inl File Reference**

```
#include "givaro/givtypestring.h"
#include "fflas-ffpack/utils/align-allocator.h"
#include <vector>
#include <type_traits>
```

**Data Structures**

- struct [Simd256\\_impl](#)< true, false, true, 8 >
- union [Simd256\\_impl](#)< true, false, true, 8 >::Converter

**Macros**

- `#define __FFLASFFPACK_fflas_ffpack_utils_simd256_double_INL`

**13.126.1 Macro Definition Documentation****13.126.1.1 \_\_FFLASFFPACK\_fflas\_ffpack\_utils\_simd256\_double\_INL**

```
#define __FFLASFFPACK_fflas_ffpack_utils_simd256_double_INL
```

**13.127 simd256\_float.inl File Reference**

```
#include "givaro/givtypestring.h"
#include "fflas-ffpack/utils/align-allocator.h"
#include <vector>
#include <type_traits>
```

## Data Structures

- struct [Simd256\\_impl< true, false, true, 4 >](#)

## Macros

- `#define __FFLASFFPACK_fflas_ffpack_utils_simd256_float_INL`

## 13.127.1 Macro Definition Documentation

### 13.127.1.1 \_\_FFLASFFPACK\_fflas\_ffpack\_utils\_simd256\_float\_INL

```
#define __FFLASFFPACK_fflas_ffpack_utils_simd256_float_INL
```

## 13.128 simd256\_int16.inl File Reference

```
#include "givaro/givtypestring.h"
#include "fflas-ffpack/utils/align-allocator.h"
#include <vector>
#include <type_traits>
```

## Data Structures

- struct [Simd256\\_impl< true, true, true, 2 >](#)
- union [Simd256\\_impl< true, true, true, 2 >::Converter](#)
- struct [Simd256\\_impl< true, true, false, 2 >](#)
- union [Simd256\\_impl< true, true, false, 2 >::Converter](#)

## Macros

- `#define __FFLASFFPACK_fflas_ffpack_utils_simd256_int16_INL`

## 13.128.1 Macro Definition Documentation

### 13.128.1.1 \_\_FFLASFFPACK\_fflas\_ffpack\_utils\_simd256\_int16\_INL

```
#define __FFLASFFPACK_fflas_ffpack_utils_simd256_int16_INL
```

## 13.129 simd256\_int32.inl File Reference

```
#include "givaro/givtypestring.h"
#include "fflas-ffpack/utils/align-allocator.h"
#include <vector>
#include <type_traits>
```

## Data Structures

- struct [Simd256\\_impl< true, true, true, 4 >](#)
- union [Simd256\\_impl< true, true, true, 4 >::Converter](#)
- struct [Simd256\\_impl< true, true, false, 4 >](#)
- union [Simd256\\_impl< true, true, false, 4 >::Converter](#)

## Macros

- `#define __FFLASFFPACK_fflas_ffpack_utils_simd256_int32_INL`

### 13.129.1 Macro Definition Documentation

#### 13.129.1.1 \_\_FFLASFFPACK\_fflas\_ffpack\_utils\_simd256\_int32\_INL

```
#define __FFLASFFPACK_fflas_ffpack_utils_simd256_int32_INL
```

### 13.130 simd256\_int64.inl File Reference

```
#include "givaro/givtypestring.h"
#include "fflas-ffpack/utils/align-allocator.h"
#include "fflas-ffpack/utils/bit_manipulation.h"
#include <vector>
#include <type_traits>
```

#### Data Structures

- struct [Simd256\\_impl< true, true, true, 8 >](#)
- union [Simd256\\_impl< true, true, true, 8 >::Converter](#)
- struct [Simd256\\_impl< true, true, false, 8 >](#)
- union [Simd256\\_impl< true, true, false, 8 >::Converter](#)

#### Macros

- #define [\\_\\_FFLASFFPACK\\_fflas\\_ffpack\\_utils\\_simd256\\_int64\\_INL](#)
- #define [vect\\_t Simd256\\_impl<true, true, true, 8>::vect\\_t](#)

### 13.130.1 Macro Definition Documentation

#### 13.130.1.1 \_\_FFLASFFPACK\_fflas\_ffpack\_utils\_simd256\_int64\_INL

```
#define __FFLASFFPACK_fflas_ffpack_utils_simd256_int64_INL
```

#### 13.130.1.2 vect\_t

```
#define vect_t Simd256\_impl<true, true, true, 8>::vect\_t
```

### 13.131 simd512.inl File Reference

```
#include "simd512_float.inl"
#include "simd512_double.inl"
#include "simd512_int64.inl"
```

#### Data Structures

- struct [Simd512i\\_base](#)

#### Macros

- #define [\\_\\_FFLASFFPACK\\_simd512\\_INL](#)

#### Typedefs

- template<class T>  
using [Simd512](#)

### 13.131.1 Macro Definition Documentation

#### 13.131.1.1 \_\_FFLASFFPACK\_simd512\_INL

```
#define __FFLASFFPACK_simd512_INL
```

### 13.131.2 Typedef Documentation

#### 13.131.2.1 Simd512

```
template<class T>  
using Simd512
```

Initial value:

```
Simd512_impl<std::is_arithmetic<T>::value, std::is_integral<T>::value, std::is_signed<T>::value, sizeof(T)>
```

## 13.132 simd512\_double.inl File Reference

```
#include "givaro/givtypestring.h"  
#include "fflas-ffpack/utils/align-allocator.h"  
#include <vector>  
#include <type_traits>
```

### Data Structures

- struct [Simd512\\_impl](#)< true, false, true, 8 >

### Macros

- #define [\\_\\_FFLASFFPACK\\_simd512\\_double\\_INL](#)

### 13.132.1 Macro Definition Documentation

#### 13.132.1.1 \_\_FFLASFFPACK\_simd512\_double\_INL

```
#define __FFLASFFPACK_simd512_double_INL
```

## 13.133 simd512\_float.inl File Reference

```
#include "givaro/givtypestring.h"  
#include "fflas-ffpack/utils/align-allocator.h"  
#include <vector>  
#include <type_traits>
```

### Data Structures

- struct [Simd512\\_impl](#)< true, false, true, 4 >

### Macros

- #define [\\_\\_FFLASFFPACK\\_simd512\\_float\\_INL](#)

### 13.133.1 Macro Definition Documentation

#### 13.133.1.1 \_\_FFLASFFPACK\_simd512\_float\_INL

```
#define __FFLASFFPACK_simd512_float_INL
```

## 13.134 simd512\_int32.inl File Reference

```
#include "fflas-ffpack/fflas/fflas_simd/simd512_int64.inl"
#include "givaro/givtypestring.h"
#include "fflas-ffpack/utils/align-allocator.h"
#include <vector>
#include <type_traits>
```

### Data Structures

- struct [Simd256\\_impl< true, true, true, 4 >](#)
- union [Simd256\\_impl< true, true, true, 4 >::Converter](#)
- struct [Simd256\\_impl< true, true, false, 4 >](#)
- union [Simd256\\_impl< true, true, false, 4 >::Converter](#)

### Macros

- `#define \_\_FFLASFFPACK\_simd512\_int32\_INL`

### 13.134.1 Macro Definition Documentation

#### 13.134.1.1 [\\_\\_FFLASFFPACK\\_simd512\\_int32\\_INL](#)

```
#define \_\_FFLASFFPACK\_simd512\_int32\_INL
```

## 13.135 simd512\_int64.inl File Reference

```
#include "givaro/givtypestring.h"
#include "fflas-ffpack/utils/align-allocator.h"
#include "fflas-ffpack/utils/bit_manipulation.h"
#include <vector>
#include <type_traits>
```

### Data Structures

- struct [Simd512\\_impl< true, true, true, 8 >](#)
- union [Simd512\\_impl< true, true, true, 8 >::Converter](#)
- struct [Simd512\\_impl< true, true, false, 8 >](#)
- union [Simd512\\_impl< true, true, false, 8 >::Converter](#)

### Macros

- `#define \_simd512\_int64\_INL`
- `#define vect\_t Simd512\_impl<true, true, true, 8>::vect\_t`

### 13.135.1 Macro Definition Documentation

#### 13.135.1.1 [\\_simd512\\_int64\\_INL](#)

```
#define \_simd512\_int64\_INL
```

#### 13.135.1.2 [vect\\_t](#)

```
#define vect\_t Simd512\_impl<true, true, true, 8>::vect\_t
```

## 13.136 simd\_modular.inl File Reference

### Data Structures

- class [FieldSimd< \\_Field >](#)

## 13.137 fflas\_sparse.h File Reference

```
#include "fflas-ffpack/fflas-ffpack-config.h"
#include "fflas-ffpack/config.h"
#include "fflas-ffpack/config-blas.h"
#include "fflas-ffpack/paladin/parallel.h"
#include <recint/recint.h>
#include <givaro/udl.h>
#include "fflas-ffpack/fflas/fflas.h"
#include "fflas-ffpack/field/field-traits.h"
#include "fflas-ffpack/fflas/fflas_bounds.inl"
#include "fflas-ffpack/utils/fflas_memory.h"
#include <type_traits>
#include <vector>
#include <iostream>
#include "fflas-ffpack/fflas/fflas_sparse/sparse_matrix_traits.h"
#include "fflas-ffpack/fflas/fflas_sparse/utils.h"
#include "fflas-ffpack/fflas/fflas_sparse/csr.h"
#include "fflas-ffpack/fflas/fflas_sparse/coo.h"
#include "fflas-ffpack/fflas/fflas_sparse/ell.h"
#include "fflas-ffpack/fflas/fflas_sparse/sell.h"
#include "fflas-ffpack/fflas/fflas_sparse/csr_hyb.h"
#include "fflas-ffpack/fflas/fflas_sparse/ell_simd.h"
#include "fflas-ffpack/fflas/fflas_sparse/hyb_zo.h"
#include "fflas-ffpack/fflas/fflas_sparse.inl"
#include "fflas-ffpack/fflas/fflas_sparse/read_sparse.h"
```

### Data Structures

- struct [HelperFlag](#)
- struct [CsrMat< Field >](#)
- struct [CooMat< Field >](#)
- struct [EllMat< Field >](#)
- struct [SpMat< Field, flag >](#)

### Namespaces

- namespace [MKL\\_CONFIG](#)
- namespace [FFLAS](#)
- namespace [FFLAS::sparse\\_details](#)

### Macros

- #define [index\\_t](#) uint32\_t
- #define [ROUND\\_DOWN](#)(x, s)
- #define [\\_\\_FFLASFFPACK\\_CACHE\\_LINE\\_SIZE](#) 64
- #define [assume\\_aligned](#)(pout, pin, v)
- #define [DENSE\\_THRESHOLD](#) 0.5

## Enumerations

- enum class [SparseMatrix\\_t](#) {  
[CSR](#) , [CSR\\_ZO](#) , [CSC](#) , [CSC\\_ZO](#) ,  
[COO](#) , [COO\\_ZO](#) , [ELL](#) , [ELL\\_ZO](#) ,  
[SELL](#) , [SELL\\_ZO](#) , [ELL\\_simd](#) , [ELL\\_simd\\_ZO](#) ,  
[CSR\\_HYB](#) , [HYB\\_ZO](#) }

## Functions

- template<class [Field](#)>  
void [init\\_y](#) (const [Field](#) &F, const size\_t m, const typename [Field::Element](#) b, typename [Field::Element\\_ptr](#) y)
- template<class [Field](#)>  
void [init\\_y](#) (const [Field](#) &F, const size\_t m, const size\_t n, const typename [Field::Element](#) b, typename [Field::Element\\_ptr](#) y, const int ldy)
- template<class [Field](#), class SM, class FC, class MZO>  
std::enable\_if<!std::is\_same< typenameElementTraits< typenameField::Element >::value, [ElementCategories::MachineFloat](#) >::value||std::is\_same< typenameElementTraits< typenameField::Element >::value, [ElementCategories::MachineIntTag](#) >::value>>::type [fspmv\\_dispatch](#) (const [Field](#) &F, const SM &A, typename [Field::ConstElement\\_ptr](#) x, typename [Field::Element\\_ptr](#) y, FC fc, MZO mzo)
- template<class [Field](#), class SM, class FC, class MZO>  
std::enable\_if< std::is\_same< typenameElementTraits< typenameField::Element >::value, [ElementCategories::MachineFloat](#) >::value||std::is\_same< typenameElementTraits< typenameField::Element >::value, [ElementCategories::MachineIntTag](#) >::value >>::type [fspmv\\_dispatch](#) (const [Field](#) &F, const SM &A, typename [Field::ConstElement\\_ptr](#) x, typename [Field::Element\\_ptr](#) y, FC fc, MZO mzo)
- template<class [Field](#), class SM>  
void [fspmv](#) (const [Field](#) &F, const SM &A, typename [Field::ConstElement\\_ptr](#) x, typename [Field::Element\\_ptr](#) y, [FieldCategories::GenericTag](#), [NotZOSparseMatrix](#))
- template<class [Field](#), class SM>  
std::enable\_if<![isSparseMatrixSimdFormat](#)< [Field](#), SM >::value >>::type [fspmv](#) (const [Field](#) &F, const SM &A, typename [Field::ConstElement\\_ptr](#) x, typename [Field::Element\\_ptr](#) y, [FieldCategories::UnparametricTag](#), [NotZOSparseMatrix](#))
- template<class [Field](#), class SM>  
std::enable\_if< [isSparseMatrixSimdFormat](#)< [Field](#), SM >::value >>::type [fspmv](#) (const [Field](#) &F, const SM &A, typename [Field::ConstElement\\_ptr](#) x, typename [Field::Element\\_ptr](#) y, [FieldCategories::UnparametricTag](#), [NotZOSparseMatrix](#))
- template<class [Field](#), class SM>  
std::enable\_if<![isSparseMatrixSimdFormat](#)< [Field](#), SM >::value >>::type [fspmv](#) (const [Field](#) &F, const SM &A, typename [Field::ConstElement\\_ptr](#) x, typename [Field::Element\\_ptr](#) y, [FieldCategories::ModularTag](#), [NotZOSparseMatrix](#))
- template<class [Field](#), class SM>  
std::enable\_if< [isSparseMatrixSimdFormat](#)< [Field](#), SM >::value >>::type [fspmv](#) (const [Field](#) &F, const SM &A, typename [Field::ConstElement\\_ptr](#) x, typename [Field::Element\\_ptr](#) y, [FieldCategories::ModularTag](#), [NotZOSparseMatrix](#))
- template<class [Field](#), class SM>  
void [fspmv](#) (const [Field](#) &F, const SM &A, typename [Field::ConstElement\\_ptr](#) x, typename [Field::Element\\_ptr](#) y, [FieldCategories::GenericTag](#), [ZOSparseMatrix](#))
- template<class [Field](#), class SM>  
std::enable\_if<![isSparseMatrixSimdFormat](#)< [Field](#), SM >::value >>::type [fspmv](#) (const [Field](#) &F, const SM &A, typename [Field::ConstElement\\_ptr](#) x, typename [Field::Element\\_ptr](#) y, [FieldCategories::UnparametricTag](#), [ZOSparseMatrix](#))
- template<class [Field](#), class SM>  
std::enable\_if< [isSparseMatrixSimdFormat](#)< [Field](#), SM >::value >>::type [fspmv](#) (const [Field](#) &F, const SM &A, typename [Field::ConstElement\\_ptr](#) x, typename [Field::Element\\_ptr](#) y, [FieldCategories::UnparametricTag](#), [ZOSparseMatrix](#))
- template<class [Field](#), class SM>  
void [fspmv](#) (const [Field](#) &F, const SM &A, typename [Field::ConstElement\\_ptr](#) x, typename [Field::Element\\_ptr](#) y, [FieldCategories::ModularTag](#), std::true\_type)



- `template<class Field, class SM, class FCat, class MZO>`  
`std::enable_if<!(std::is_same< typenameElementTraits< typenameField::Element >::value, ElementCategories::MachineFloat >::value)||std::is_same< typenameElementTraits< typenameField::Element >::value, ElementCategories::MachineIntTag >::value)>::type fspmm_dispatch (const Field &F, const SM &A, size_t blockSize, typename Field::ConstElement_ptr x, int ldx, typename Field::Element_ptr y, int ldy, FCat, MZO)`
- `template<class Field, class SM, class FCat, class MZO>`  
`std::enable_if< std::is_same< typenameElementTraits< typenameField::Element >::value, ElementCategories::MachineFloat >::value)||std::is_same< typenameElementTraits< typenameField::Element >::value, ElementCategories::MachineIntTag >::value >::type fspmm_dispatch (const Field &F, const SM &A, size_t blockSize, typename Field::ConstElement_ptr x, int ldx, typename Field::Element_ptr y, int ldy, FCat, MZO)`
- `template<class Field, class SM>`  
`void fspmm (const Field &F, const SM &A, size_t blockSize, typename Field::ConstElement_ptr x, int ldx, typename Field::Element_ptr y, int ldy, FieldCategories::GenericTag, NotZOSparseMatrix)`
- `template<class Field, class SM>`  
`std::enable_if< support_simd< typenameField::Element >::value >::type fspmm (const Field &F, const SM &A, size_t blockSize, typename Field::ConstElement_ptr x, int ldx, typename Field::Element_ptr y, int ldy, FieldCategories::UnparametricTag, NotZOSparseMatrix)`
- `template<class Field, class SM>`  
`std::enable_if<!support_simd< typenameField::Element >::value >::type fspmm (const Field &F, const SM &A, size_t blockSize, typename Field::ConstElement_ptr x, int ldx, typename Field::Element_ptr y, int ldy, FieldCategories::UnparametricTag, NotZOSparseMatrix)`
- `template<class Field, class SM>`  
`std::enable_if< support_simd< typenameField::Element >::value >::type fspmm (const Field &F, const SM &A, size_t blockSize, typename Field::ConstElement_ptr x, int ldx, typename Field::Element_ptr y, int ldy, FieldCategories::ModularTag, NotZOSparseMatrix)`
- `template<class Field, class SM>`  
`std::enable_if<!support_simd< typenameField::Element >::value >::type fspmm (const Field &F, const SM &A, size_t blockSize, typename Field::ConstElement_ptr x, int ldx, typename Field::Element_ptr y, int ldy, FieldCategories::ModularTag, NotZOSparseMatrix)`
- `template<class Field, class SM>`  
`void fspmm (const Field &F, const SM &A, size_t blockSize, typename Field::ConstElement_ptr x, int ldx, typename Field::Element_ptr y, int ldy, FieldCategories::GenericTag, ZOSparseMatrix)`
- `template<class Field, class SM>`  
`std::enable_if< support_simd< typenameField::Element >::value >::type fspmm (const Field &F, const SM &A, size_t blockSize, typename Field::ConstElement_ptr x, int ldx, typename Field::Element_ptr y, int ldy, FieldCategories::UnparametricTag, ZOSparseMatrix)`
- `template<class Field, class SM>`  
`std::enable_if<!support_simd< typenameField::Element >::value >::type fspmm (const Field &F, const SM &A, size_t blockSize, typename Field::ConstElement_ptr x, int ldx, typename Field::Element_ptr y, int ldy, FieldCategories::UnparametricTag, ZOSparseMatrix)`
- `template<class Field, class SM>`  
`void fspmm (const Field &F, const SM &A, size_t blockSize, typename Field::ConstElement_ptr x, int ldx, typename Field::Element_ptr y, int ldy, FieldCategories::ModularTag, ZOSparseMatrix)`
- `template<class Field, class SM, class FCat, class MZO>`  
`std::enable_if<!(std::is_same< typenameElementTraits< typenameField::Element >::value, ElementCategories::MachineFloat >::value)||std::is_same< typenameElementTraits< typenameField::Element >::value, ElementCategories::MachineIntTag >::value)>::type pfspmm_dispatch (const Field &F, const SM &A, size_t blockSize, typename Field::ConstElement_ptr x, int ldx, typename Field::Element_ptr y, int ldy, FCat, MZO)`
- `template<class Field, class SM, class FCat, class MZO>`  
`std::enable_if< std::is_same< typenameElementTraits< typenameField::Element >::value, ElementCategories::MachineFloat >::value)||std::is_same< typenameElementTraits< typenameField::Element >::value, ElementCategories::MachineIntTag >::value >::type pfspmm_dispatch (const Field &F, const SM &A, size_t blockSize, typename Field::ConstElement_ptr x, int ldx, typename Field::Element_ptr y, int ldy, FCat, MZO)`
- `template<class Field, class SM>`  
`void pfspmm (const Field &F, const SM &A, size_t blockSize, typename Field::ConstElement_ptr x, int ldx, typename Field::Element_ptr y, int ldy, FieldCategories::GenericTag, NotZOSparseMatrix)`

- `template<class Field, class SM>`  
`std::enable_if< support_simd< typenameField::Element >::value >::type pfspmm (const Field &F, const SM &A, size_t blockSize, typename Field::ConstElement_ptr x, int ldx, typename Field::Element_ptr y, int ldy, FieldCategories::UnparametricTag, NotZOSparseMatrix)`
- `template<class Field, class SM>`  
`std::enable_if< !support_simd< typenameField::Element >::value >::type pfspmm (const Field &F, const SM &A, size_t blockSize, typename Field::ConstElement_ptr x, int ldx, typename Field::Element_ptr y, int ldy, FieldCategories::UnparametricTag, NotZOSparseMatrix)`
- `template<class Field, class SM>`  
`std::enable_if< support_simd< typenameField::Element >::value >::type pfspmm (const Field &F, const SM &A, size_t blockSize, typename Field::ConstElement_ptr x, int ldx, typename Field::Element_ptr y, int ldy, FieldCategories::ModularTag, NotZOSparseMatrix)`
- `template<class Field, class SM>`  
`std::enable_if< !support_simd< typenameField::Element >::value >::type pfspmm (const Field &F, const SM &A, size_t blockSize, typename Field::ConstElement_ptr x, int ldx, typename Field::Element_ptr y, int ldy, FieldCategories::ModularTag, NotZOSparseMatrix)`
- `template<class Field, class SM>`  
`void pfspmm (const Field &F, const SM &A, size_t blockSize, typename Field::ConstElement_ptr x, int ldx, typename Field::Element_ptr y, int ldy, FieldCategories::GenericTag, ZOSparseMatrix)`
- `template<class Field, class SM>`  
`std::enable_if< support_simd< typenameField::Element >::value >::type pfspmm (const Field &F, const SM &A, size_t blockSize, typename Field::ConstElement_ptr x, int ldx, typename Field::Element_ptr y, int ldy, FieldCategories::UnparametricTag, ZOSparseMatrix)`
- `template<class Field, class SM>`  
`std::enable_if< !support_simd< typenameField::Element >::value >::type pfspmm (const Field &F, const SM &A, size_t blockSize, typename Field::ConstElement_ptr x, int ldx, typename Field::Element_ptr y, int ldy, FieldCategories::UnparametricTag, ZOSparseMatrix)`
- `template<class Field, class SM>`  
`void pfspmm (const Field &F, const SM &A, size_t blockSize, typename Field::ConstElement_ptr x, int ldx, typename Field::Element_ptr y, int ldy, FieldCategories::ModularTag, ZOSparseMatrix)`
- `template<class Field, class SM>`  
`void pfspmv (const Field &F, const SM &A, typename Field::ConstElement_ptr x, typename Field::Element_ptr y, FieldCategories::GenericTag, std::false_type)`
- `template<class Field, class SM>`  
`void pfspmv (const Field &F, const SM &A, typename Field::ConstElement_ptr x, typename Field::Element_ptr y, FieldCategories::UnparametricTag, std::false_type)`
- `template<class Field, class SM>`  
`void pfspmv (const Field &F, const SM &A, typename Field::ConstElement_ptr x, typename Field::Element_ptr y, FieldCategories::ModularTag, std::false_type)`
- `template<class Field, class SM>`  
`void pfspmv (const Field &F, const SM &A, typename Field::ConstElement_ptr x, typename Field::Element_ptr y, FieldCategories::GenericTag, std::true_type)`
- `template<class Field, class SM>`  
`void pfspmv (const Field &F, const SM &A, typename Field::ConstElement_ptr x, typename Field::Element_ptr y, FieldCategories::UnparametricTag, std::true_type)`
- `template<class Field, class SM>`  
`void pfspmv (const Field &F, const SM &A, typename Field::ConstElement_ptr x, typename Field::Element_ptr y, FieldCategories::ModularTag, std::true_type)`
- `template<class Field, class SM>`  
`void fspmv (const Field &F, const SM &A, typename Field::ConstElement_ptr x, const typename Field::Element &beta, typename Field::Element_ptr y)`
- `template<class Field, class SM>`  
`void fspmm (const Field &F, const SM &A, size_t blockSize, typename Field::ConstElement_ptr x, int ldx, const typename Field::Element &beta, typename Field::Element_ptr y, int ldy)`

## 13.137.1 Macro Definition Documentation

### 13.137.1.1 `index_t`

```
#define index_t uint32_t
```

### 13.137.1.2 `ROUND_DOWN`

```
#define ROUND_DOWN(  
    x,  
    s)
```

**Value:**

```
((x) & ~((s)-1))
```

### 13.137.1.3 `__FFLASFFPACK_CACHE_LINE_SIZE`

```
#define __FFLASFFPACK_CACHE_LINE_SIZE 64
```

### 13.137.1.4 `assume_aligned`

```
#define assume_aligned(  
    pout,  
    pin,  
    v)
```

**Value:**

```
decltype(pin) pout = pin;
```

### 13.137.1.5 `DENSE_THRESHOLD`

```
#define DENSE_THRESHOLD 0.5
```

## 13.138 fflas\_sparse.inl File Reference

### Namespaces

- namespace [FFLAS](#)
- namespace [FFLAS::sparse\\_details](#)

### Macros

- #define [\\_\\_FFLASFFPACK\\_fflas\\_fflas\\_sparse\\_INL](#)

### Functions

- template<class [Field](#)>  
void [init\\_y](#) (const [Field](#) &F, const size\_t m, const typename [Field::Element](#) b, typename [Field::Element\\_ptr](#) y)
- template<class [Field](#)>  
void [init\\_y](#) (const [Field](#) &F, const size\_t m, const size\_t n, const typename [Field::Element](#) b, typename [Field::Element\\_ptr](#) y, const int ldy)
- template<class [Field](#), class SM, class FC, class MZO>  
std::enable\_if<!(std::is\_same< typenameElementTraits< typenameField::Element >::value, [ElementCategories::MachineFloat](#)>::value||std::is\_same< typenameElementTraits< typenameField::Element >::value, [ElementCategories::MachineIntTag](#)>::value)>::type [fspmv\\_dispatch](#) (const [Field](#) &F, const SM &A, typename [Field::ConstElement\\_ptr](#) x, typename [Field::Element\\_ptr](#) y, FC fc, MZO mzo)
- template<class [Field](#), class SM, class FC, class MZO>  
std::enable\_if< std::is\_same< typenameElementTraits< typenameField::Element >::value, [ElementCategories::MachineFloat](#)>::value||std::is\_same< typenameElementTraits< typenameField::Element >::value, [ElementCategories::MachineIntTag](#)>::value >::type [fspmv\\_dispatch](#) (const [Field](#) &F, const SM &A, typename [Field::ConstElement\\_ptr](#) x, typename [Field::Element\\_ptr](#) y, FC fc, MZO mzo)

- `template<class Field, class SM>`  
`void fspmv (const Field &F, const SM &A, typename Field::ConstElement_ptr x, typename Field::Element_ptr y, FieldCategories::GenericTag, NotZOSparseMatrix)`
- `template<class Field, class SM>`  
`std::enable_if<!isSparseMatrixSimdFormat< Field, SM >::value >::type fspmv (const Field &F, const SM &A, typename Field::ConstElement_ptr x, typename Field::Element_ptr y, FieldCategories::UnparametricTag, NotZOSparseMatrix)`
- `template<class Field, class SM>`  
`std::enable_if< isSparseMatrixSimdFormat< Field, SM >::value &&support_simd< typenameField::Element >::value >::type fspmv (const Field &F, const SM &A, typename Field::ConstElement_ptr x, typename Field::Element_ptr y, FieldCategories::UnparametricTag, NotZOSparseMatrix)`
- `template<class Field, class SM>`  
`std::enable_if<!isSparseMatrixSimdFormat< Field, SM >::value >::type fspmv (const Field &F, const SM &A, typename Field::ConstElement_ptr x, typename Field::Element_ptr y, FieldCategories::ModularTag, NotZOSparseMatrix)`
- `template<class Field, class SM>`  
`std::enable_if< isSparseMatrixSimdFormat< Field, SM >::value &&support_simd< typenameField::Element >::value >::type fspmv (const Field &F, const SM &A, typename Field::ConstElement_ptr x, typename Field::Element_ptr y, FieldCategories::ModularTag, NotZOSparseMatrix)`
- `template<class Field, class SM>`  
`void fspmv (const Field &F, const SM &A, typename Field::ConstElement_ptr x, typename Field::Element_ptr y, FieldCategories::GenericTag, ZOSparseMatrix)`
- `template<class Field, class SM>`  
`std::enable_if<!isSparseMatrixSimdFormat< Field, SM >::value >::type fspmv (const Field &F, const SM &A, typename Field::ConstElement_ptr x, typename Field::Element_ptr y, FieldCategories::UnparametricTag, ZOSparseMatrix)`
- `template<class Field, class SM>`  
`std::enable_if< isSparseMatrixSimdFormat< Field, SM >::value &&support_simd< typenameField::Element >::value >::type fspmv (const Field &F, const SM &A, typename Field::ConstElement_ptr x, typename Field::Element_ptr y, FieldCategories::UnparametricTag, ZOSparseMatrix)`
- `template<class Field, class SM>`  
`void fspmv (const Field &F, const SM &A, typename Field::ConstElement_ptr x, typename Field::Element_ptr y, FieldCategories::ModularTag, std::true_type)`
- `template<class Field, class SM, class FCat, class MZO>`  
`std::enable_if<!(std::is_same< typenameElementTraits< typenameField::Element >::value, ElementCategories::MachineFloat >::value)|std::is_same< typenameElementTraits< typenameField::Element >::value, ElementCategories::MachineIntTag >::value)>::type fspmm_dispatch (const Field &F, const SM &A, size_t blockSize, typename Field::ConstElement_ptr x, int ldx, typename Field::Element_ptr y, int ldy, FCat, MZO)`
- `template<class Field, class SM, class FCat, class MZO>`  
`std::enable_if< std::is_same< typenameElementTraits< typenameField::Element >::value, ElementCategories::MachineFloat >::value)|std::is_same< typenameElementTraits< typenameField::Element >::value, ElementCategories::MachineIntTag >::value >::type fspmm_dispatch (const Field &F, const SM &A, size_t blockSize, typename Field::ConstElement_ptr x, int ldx, typename Field::Element_ptr y, int ldy, FCat, MZO)`
- `template<class Field, class SM>`  
`void fspmm (const Field &F, const SM &A, size_t blockSize, typename Field::ConstElement_ptr x, int ldx, typename Field::Element_ptr y, int ldy, FieldCategories::GenericTag, NotZOSparseMatrix)`
- `template<class Field, class SM>`  
`std::enable_if< support_simd< typenameField::Element >::value >::type fspmm (const Field &F, const SM &A, size_t blockSize, typename Field::ConstElement_ptr x, int ldx, typename Field::Element_ptr y, int ldy, FieldCategories::UnparametricTag, NotZOSparseMatrix)`
- `template<class Field, class SM>`  
`std::enable_if<!support_simd< typenameField::Element >::value >::type fspmm (const Field &F, const SM &A, size_t blockSize, typename Field::ConstElement_ptr x, int ldx, typename Field::Element_ptr y, int ldy, FieldCategories::UnparametricTag, NotZOSparseMatrix)`
- `template<class Field, class SM>`  
`std::enable_if< support_simd< typenameField::Element >::value >::type fspmm (const Field &F, const SM &A, size_t blockSize, typename Field::ConstElement_ptr x, int ldx, typename Field::Element_ptr y, int ldy, FieldCategories::ModularTag, NotZOSparseMatrix)`

- `template<class Field, class SM>`  
`std::enable_if<!support\_simd< typenameField::Element >::value >::type fspmm (const Field &F, const SM &A, size_t blockSize, typename Field::ConstElement_ptr x, int ldx, typename Field::Element_ptr y, int ldy, FieldCategories::ModularTag, NotZOSparseMatrix)`
- `template<class Field, class SM>`  
`void fspmm (const Field &F, const SM &A, size_t blockSize, typename Field::ConstElement_ptr x, int ldx, typename Field::Element_ptr y, int ldy, FieldCategories::GenericTag, ZOSparseMatrix)`
- `template<class Field, class SM>`  
`std::enable_if< support\_simd< typenameField::Element >::value >::type fspmm (const Field &F, const SM &A, size_t blockSize, typename Field::ConstElement_ptr x, int ldx, typename Field::Element_ptr y, int ldy, FieldCategories::UnparametricTag, ZOSparseMatrix)`
- `template<class Field, class SM>`  
`std::enable_if<!support\_simd< typenameField::Element >::value >::type fspmm (const Field &F, const SM &A, size_t blockSize, typename Field::ConstElement_ptr x, int ldx, typename Field::Element_ptr y, int ldy, FieldCategories::UnparametricTag, ZOSparseMatrix)`
- `template<class Field, class SM>`  
`void fspmm (const Field &F, const SM &A, size_t blockSize, typename Field::ConstElement_ptr x, int ldx, typename Field::Element_ptr y, int ldy, FieldCategories::ModularTag, ZOSparseMatrix)`
- `template<class Field, class SM>`  
`void fspmv (const Field &F, const SM &A, typename Field::ConstElement_ptr x, const typename Field::Element &beta, typename Field::Element_ptr y)`
- `template<class Field, class SM>`  
`void fspmm (const Field &F, const SM &A, size_t blockSize, typename Field::ConstElement_ptr x, int ldx, const typename Field::Element &beta, typename Field::Element_ptr y, int ldy)`

## 13.138.1 Macro Definition Documentation

### 13.138.1.1 \_\_FFLASFFPACK\_fflas\_fflas\_sparse\_INL

```
#define __FFLASFFPACK_fflas_fflas_sparse_INL
```

## 13.139 coo.h File Reference

```
#include "fflas-ffpack/fflas/fflas_sparse/coo/coo_utils.inl"
#include "fflas-ffpack/fflas/fflas_sparse/coo/coo_spmv.inl"
#include "fflas-ffpack/fflas/fflas_sparse/coo/coo_spmmm.inl"
```

### Data Structures

- struct [Sparse< \\_Field, SparseMatrix\\_t::COO >](#)
- struct [Sparse< \\_Field, SparseMatrix\\_t::COO\\_ZO >](#)

### Namespaces

- namespace [FFLAS](#)

### Functions

- `template<class Field, class IndexT>`  
`void sparse_init (const Field &F, Sparse< Field, SparseMatrix\_t::COO > &A, const IndexT *row, const IndexT *col, typename Field::ConstElement_ptr dat, uint64_t rowdim, uint64_t coldim, uint64_t nnz)`
- `template<class Field, class IndexT>`  
`void sparse_init (const Field &F, Sparse< Field, SparseMatrix\_t::COO\_ZO > &A, const IndexT *row, const IndexT *col, typename Field::ConstElement_ptr dat, uint64_t rowdim, uint64_t coldim, uint64_t nnz)`
- `template<class Field>`  
`void sparse_delete (const Sparse< Field, SparseMatrix\_t::COO > &A)`
- `template<class Field>`  
`void sparse_delete (const Sparse< Field, SparseMatrix\_t::COO\_ZO > &A)`

## 13.140 coo\_spmv.inl File Reference

### Namespaces

- namespace [FFLAS](#)
- namespace [FFLAS::sparse\\_details\\_impl](#)

### Macros

- `#define` [\\_\\_FFLASFFPACK\\_fflas\\_sparse\\_coo\\_spmv\\_INL](#)

### Functions

- `template<class Field>`  
void [fspmv](#) (const [Field](#) &F, const [Sparse](#)< [Field](#), [SparseMatrix\\_t::COO](#) > &A, [size\\_t](#) blockSize, typename [Field::ConstElement\\_ptr](#) x\_, int ldx, typename [Field::Element\\_ptr](#) y\_, int ldy, [FieldCategories::GenericTag](#))
- `template<class Field>`  
void [fspmv](#) (const [Field](#) &F, const [Sparse](#)< [Field](#), [SparseMatrix\\_t::COO](#) > &A, [size\\_t](#) blockSize, typename [Field::ConstElement\\_ptr](#) x\_, int ldx, typename [Field::Element\\_ptr](#) y\_, int ldy, [FieldCategories::UnparametricTag](#))
- `template<class Field>`  
void [fspmv](#) (const [Field](#) &F, const [Sparse](#)< [Field](#), [SparseMatrix\\_t::COO](#) > &A, [size\\_t](#) blockSize, typename [Field::ConstElement\\_ptr](#) x\_, int ldx, typename [Field::Element\\_ptr](#) y\_, int ldy, const [int64\\_t](#) kmax)
- `template<class Field>`  
void [fspmv\\_simd\\_aligned](#) (const [Field](#) &F, const [Sparse](#)< [Field](#), [SparseMatrix\\_t::COO](#) > &A, [size\\_t](#) blockSize, typename [Field::ConstElement\\_ptr](#) x\_, int ldx, typename [Field::Element\\_ptr](#) y\_, int ldy, const [int64\\_t](#) kmax)
- `template<class Field>`  
void [fspmv\\_simd\\_unaligned](#) (const [Field](#) &F, const [Sparse](#)< [Field](#), [SparseMatrix\\_t::COO](#) > &A, [size\\_t](#) blockSize, typename [Field::ConstElement\\_ptr](#) x\_, int ldx, typename [Field::Element\\_ptr](#) y\_, int ldy, const [int64\\_t](#) kmax)
- `template<class Field>`  
void [fspmv\\_one](#) (const [Field](#) &F, const [Sparse](#)< [Field](#), [SparseMatrix\\_t::COO\\_ZO](#) > &A, [size\\_t](#) blockSize, typename [Field::ConstElement\\_ptr](#) x\_, int ldx, typename [Field::Element\\_ptr](#) y\_, int ldy, [FieldCategories::GenericTag](#))
- `template<class Field>`  
void [fspmv\\_mone](#) (const [Field](#) &F, const [Sparse](#)< [Field](#), [SparseMatrix\\_t::COO\\_ZO](#) > &A, [size\\_t](#) blockSize, typename [Field::ConstElement\\_ptr](#) x\_, int ldx, typename [Field::Element\\_ptr](#) y\_, int ldy, [FieldCategories::GenericTag](#))
- `template<class Field>`  
void [fspmv\\_one\\_simd\\_aligned](#) (const [Field](#) &F, const [Sparse](#)< [Field](#), [SparseMatrix\\_t::COO\\_ZO](#) > &A, [size\\_t](#) blockSize, typename [Field::ConstElement\\_ptr](#) x\_, int ldx, typename [Field::Element\\_ptr](#) y\_, int ldy, [FieldCategories::UnparametricTag](#))
- `template<class Field>`  
void [fspmv\\_one\\_simd\\_unaligned](#) (const [Field](#) &F, const [Sparse](#)< [Field](#), [SparseMatrix\\_t::COO\\_ZO](#) > &A, [size\\_t](#) blockSize, typename [Field::ConstElement\\_ptr](#) x\_, int ldx, typename [Field::Element\\_ptr](#) y\_, int ldy, [FieldCategories::UnparametricTag](#))
- `template<class Field>`  
void [fspmv\\_mone\\_simd\\_aligned](#) (const [Field](#) &F, const [Sparse](#)< [Field](#), [SparseMatrix\\_t::COO\\_ZO](#) > &A, [size\\_t](#) blockSize, typename [Field::ConstElement\\_ptr](#) x\_, int ldx, typename [Field::Element\\_ptr](#) y\_, int ldy, [FieldCategories::UnparametricTag](#))
- `template<class Field>`  
void [fspmv\\_mone\\_simd\\_unaligned](#) (const [Field](#) &F, const [Sparse](#)< [Field](#), [SparseMatrix\\_t::COO\\_ZO](#) > &A, [size\\_t](#) blockSize, typename [Field::ConstElement\\_ptr](#) x\_, int ldx, typename [Field::Element\\_ptr](#) y\_, int ldy, [FieldCategories::UnparametricTag](#))

### 13.140.1 Macro Definition Documentation

#### 13.140.1.1 \_\_FFLASFFPACK\_fflas\_sparse\_coo\_spmv\_INL

```
#define __FFLASFFPACK_fflas_sparse_coo_spmv_INL
```

## 13.141 coo\_spmv.inl File Reference

### Namespaces

- namespace [FFLAS](#)
- namespace [FFLAS::sparse\\_details\\_impl](#)

### Macros

- `#define __FFLASFFPACK_fflas_sparse_coo_spmv_INL`

### Functions

- `template<class Field>`  
void [fspm](#)(const [Field](#) &F, const [Sparse](#)< [Field](#), [SparseMatrix\\_t::COO](#) > &A, typename [Field::ConstElement\\_ptr](#) x\_, typename [Field::Element\\_ptr](#) y\_, [FieldCategories::GenericTag](#))
- `template<class Field>`  
void [fspm](#)(const [Field](#) &F, const [Sparse](#)< [Field](#), [SparseMatrix\\_t::COO](#) > &A, typename [Field::ConstElement\\_ptr](#) x\_, typename [Field::Element\\_ptr](#) y\_, [FieldCategories::UnparametricTag](#))
- `template<class Field>`  
void [fspm](#)(const [Field](#) &F, const [Sparse](#)< [Field](#), [SparseMatrix\\_t::COO](#) > &A, typename [Field::ConstElement\\_ptr](#) x\_, typename [Field::Element\\_ptr](#) y\_, const [uint64\\_t](#) kmax)
- `template<class Field>`  
void [fspm\\_one](#)(const [Field](#) &F, const [Sparse](#)< [Field](#), [SparseMatrix\\_t::COO\\_ZO](#) > &A, typename [Field::ConstElement\\_ptr](#) x\_, typename [Field::Element\\_ptr](#) y\_, [FieldCategories::GenericTag](#))
- `template<class Field>`  
void [fspm\\_mone](#)(const [Field](#) &F, const [Sparse](#)< [Field](#), [SparseMatrix\\_t::COO\\_ZO](#) > &A, typename [Field::ConstElement\\_ptr](#) x\_, typename [Field::Element\\_ptr](#) y\_, [FieldCategories::GenericTag](#))
- `template<class Field>`  
void [fspm\\_one](#)(const [Field](#) &F, const [Sparse](#)< [Field](#), [SparseMatrix\\_t::COO\\_ZO](#) > &A, typename [Field::ConstElement\\_ptr](#) x\_, typename [Field::Element\\_ptr](#) y\_, [FieldCategories::UnparametricTag](#))
- `template<class Field>`  
void [fspm\\_mone](#)(const [Field](#) &F, const [Sparse](#)< [Field](#), [SparseMatrix\\_t::COO\\_ZO](#) > &A, typename [Field::ConstElement\\_ptr](#) x\_, typename [Field::Element\\_ptr](#) y\_, [FieldCategories::UnparametricTag](#))

### 13.141.1 Macro Definition Documentation

#### 13.141.1.1 \_\_FFLASFFPACK\_fflas\_sparse\_coo\_spmv\_INL

```
#define __FFLASFFPACK_fflas_sparse_coo_spmv_INL
```

## 13.142 coo\_utils.inl File Reference

### Namespaces

- namespace [FFLAS](#)

### Macros

- `#define __FFLASFFPACK_fflas_sparse_coo_utils_INL`

### Functions

- `template<class Field>`  
void [sparse\\_delete](#)(const [Sparse](#)< [Field](#), [SparseMatrix\\_t::COO](#) > &A)
- `template<class Field>`  
void [sparse\\_delete](#)(const [Sparse](#)< [Field](#), [SparseMatrix\\_t::COO\\_ZO](#) > &A)



- `template<class Field, class IndexT>`  
`void sparse_init (const Field &F, Sparse< Field, SparseMatrix_t::COO > &A, const IndexT *row, const IndexT *col, typename Field::ConstElement_ptr dat, uint64_t rowdim, uint64_t coldim, uint64_t nnz)`
- `template<class Field, class IndexT>`  
`void sparse_init (const Field &F, Sparse< Field, SparseMatrix_t::COO_ZO > &A, const IndexT *row, const IndexT *col, typename Field::ConstElement_ptr dat, uint64_t rowdim, uint64_t coldim, uint64_t nnz)`

### 13.142.1 Macro Definition Documentation

#### 13.142.1.1 \_\_FFLASFFPACK\_fflas\_sparse\_coo\_utils\_INL

```
#define __FFLASFFPACK_fflas_sparse_coo_utils_INL
```

## 13.143 csr.h File Reference

```
#include "fflas-ffpack/fflas/fflas_sparse/csr/csr_utils.inl"
#include "fflas-ffpack/fflas/fflas_sparse/csr/csr_spmv.inl"
#include "fflas-ffpack/fflas/fflas_sparse/csr/csr_spmmm.inl"
```

### Data Structures

- struct `Sparse< _Field, SparseMatrix_t::CSR >`
- struct `Sparse< _Field, SparseMatrix_t::CSR_ZO >`

### Namespaces

- namespace `FFLAS`

### Functions

- `template<class Field, class IndexT>`  
`void sparse_init (const Field &F, Sparse< Field, SparseMatrix_t::CSR > &A, const IndexT *row, const IndexT *col, typename Field::ConstElement_ptr dat, uint64_t rowdim, uint64_t coldim, uint64_t nnz)`
- `template<class Field, class IndexT>`  
`void sparse_init (const Field &F, Sparse< Field, SparseMatrix_t::CSR_ZO > &A, const IndexT *row, const IndexT *col, typename Field::ConstElement_ptr dat, uint64_t rowdim, uint64_t coldim, uint64_t nnz)`
- `template<class Field>`  
`void sparse_delete (const Sparse< Field, SparseMatrix_t::CSR > &A)`
- `template<class Field>`  
`void sparse_delete (const Sparse< Field, SparseMatrix_t::CSR_ZO > &A)`

## 13.144 csr\_pspmm.inl File Reference

### Namespaces

- namespace `FFLAS`
- namespace `FFLAS::sparse_details_impl`

### Macros

- `#define __FFLASFFPACK_fflas_sparse_CSR_pspmm_INL`



## Functions

- `template<class Field>`  
`void pfspmm (const Field &F, const Sparse< Field, SparseMatrix_t::CSR > &A, size_t blockSize, typename Field::ConstElement_ptr x_, int ldx, typename Field::Element_ptr y_, int ldy, FieldCategories::GenericTag)`
- `template<class Field>`  
`void pfspmm (const Field &F, const Sparse< Field, SparseMatrix_t::CSR > &A, size_t blockSize, typename Field::ConstElement_ptr x_, int ldx, typename Field::Element_ptr y_, int ldy, FieldCategories::UnparametricTag)`
- `template<class Field>`  
`void pfspmm (const Field &F, const Sparse< Field, SparseMatrix_t::CSR > &A, size_t blockSize, typename Field::ConstElement_ptr x_, int ldx, typename Field::Element_ptr y_, int ldy, const int64_t kmax)`
- `template<class Field>`  
`void pfspmm_one (const Field &F, const Sparse< Field, SparseMatrix_t::CSR_ZO > &A, size_t blockSize, typename Field::ConstElement_ptr x_, int ldx, typename Field::Element_ptr y_, int ldy, FieldCategories::GenericTag)`
- `template<class Field>`  
`void pfspmm_mone (const Field &F, const Sparse< Field, SparseMatrix_t::CSR_ZO > &A, size_t blockSize, typename Field::ConstElement_ptr x_, int ldx, typename Field::Element_ptr y_, int ldy, FieldCategories::GenericTag)`
- `template<class Field>`  
`void pfspmm_one (const Field &F, const Sparse< Field, SparseMatrix_t::CSR_ZO > &A, size_t blockSize, typename Field::ConstElement_ptr x_, int ldx, typename Field::Element_ptr y_, int ldy, FieldCategories::UnparametricTag)`
- `template<class Field>`  
`void pfspmm_mone (const Field &F, const Sparse< Field, SparseMatrix_t::CSR_ZO > &A, size_t blockSize, typename Field::ConstElement_ptr x_, int ldx, typename Field::Element_ptr y_, int ldy, FieldCategories::UnparametricTag)`

### 13.144.1 Macro Definition Documentation

#### 13.144.1.1 \_\_FFLASFFPACK\_fflas\_sparse\_CSR\_pspmm\_INL

```
#define __FFLASFFPACK_fflas_sparse_CSR_pspmm_INL
```

## 13.145 csr\_pspmv.inl File Reference

```
#include <thread>
```

## Namespaces

- namespace `FFLAS`
- namespace `FFLAS::sparse_details_impl`

## Macros

- `#define __FFLASFFPACK_fflas_sparse_CSR_pspmv_INL`

## Functions

- `template<class Field>`  
`void pspmv (const Field &F, const Sparse< Field, SparseMatrix_t::CSR > &A, typename Field::ConstElement_ptr x_, typename Field::Element_ptr y_, FieldCategories::GenericTag)`
- `template<class Field>`  
`void pspmv_task (const Field &F, const Sparse< Field, SparseMatrix_t::CSR > &A, typename Field::ConstElement_ptr x_, typename Field::Element_ptr y_, const index_t iStart, const index_t iStop, FieldCategories::UnparametricTag)`

- `template<class Field>`  
`void pfspmv (const Field &F, const Sparse< Field, SparseMatrix_t::CSR > &A, typename Field::ConstElement_ptr x_, typename Field::Element_ptr y_, FieldCategories::UnparametricTag)`
- `template<class Field>`  
`void pfspmv (const Field &F, const Sparse< Field, SparseMatrix_t::CSR > &A, typename Field::ConstElement_ptr x_, typename Field::Element_ptr y_, const int64_t kmax)`
- `template<class Field>`  
`void pfspmv_one (const Field &F, const Sparse< Field, SparseMatrix_t::CSR_ZO > &A, typename Field::ConstElement_ptr x_, typename Field::Element_ptr y_, FieldCategories::GenericTag)`
- `template<class Field>`  
`void pfspmv_mone (const Field &F, const Sparse< Field, SparseMatrix_t::CSR_ZO > &A, typename Field::ConstElement_ptr x_, typename Field::Element_ptr y_, FieldCategories::GenericTag)`
- `template<class Field>`  
`void pfspmv_one (const Field &F, const Sparse< Field, SparseMatrix_t::CSR_ZO > &A, typename Field::ConstElement_ptr x_, typename Field::Element_ptr y_, FieldCategories::UnparametricTag)`
- `template<class Field>`  
`void pfspmv_mone (const Field &F, const Sparse< Field, SparseMatrix_t::CSR_ZO > &A, typename Field::ConstElement_ptr x_, typename Field::Element_ptr y_, FieldCategories::UnparametricTag)`

### 13.145.1 Macro Definition Documentation

#### 13.145.1.1 \_\_FFLASFFPACK\_fflas\_sparse\_CSR\_pspmv\_INL

```
#define __FFLASFFPACK_fflas_sparse_CSR_pspmv_INL
```

## 13.146 csr\_spmv.inl File Reference

### Namespaces

- namespace `FFLAS`
- namespace `FFLAS::sparse_details_impl`

### Macros

- `#define __FFLASFFPACK_fflas_sparse_CSR_spmv_INL`

### Functions

- `template<class Field>`  
`void fspmv (const Field &F, const Sparse< Field, SparseMatrix_t::CSR > &A, size_t blockSize, typename Field::ConstElement_ptr x_, int ldx, typename Field::Element_ptr y_, int ldy, FieldCategories::GenericTag)`
- `template<class Field>`  
`void fspmv (const Field &F, const Sparse< Field, SparseMatrix_t::CSR > &A, index_t blockSize, typename Field::ConstElement_ptr x_, index_t ldx, typename Field::Element_ptr y_, index_t ldy, FieldCategories::UnparametricTag)`
- `template<class Field>`  
`void fspmv_simd_aligned (const Field &F, const Sparse< Field, SparseMatrix_t::CSR > &A, size_t blockSize, typename Field::ConstElement_ptr x_, int ldx, typename Field::Element_ptr y_, int ldy, FieldCategories::UnparametricTag)`
- `template<class Field>`  
`void fspmv_simd_unaligned (const Field &F, const Sparse< Field, SparseMatrix_t::CSR > &A, size_t blockSize, typename Field::ConstElement_ptr x_, int ldx, typename Field::Element_ptr y_, int ldy, FieldCategories::UnparametricTag)`
- `template<class Field>`  
`void fspmv (const Field &F, const Sparse< Field, SparseMatrix_t::CSR > &A, size_t blockSize, typename Field::ConstElement_ptr x_, int ldx, typename Field::Element_ptr y_, int ldy, const int64_t kmax)`

- `template<class Field>`  
`void fspmm_one (const Field &F, const Sparse< Field, SparseMatrix_t::CSR_ZO > &A, size_t blockSize, typename Field::ConstElement_ptr x_, int ldx, typename Field::Element_ptr y_, int ldy, FieldCategories::GenericTag)`
- `template<class Field>`  
`void fspmm_mone (const Field &F, const Sparse< Field, SparseMatrix_t::CSR_ZO > &A, size_t blockSize, typename Field::ConstElement_ptr x_, int ldx, typename Field::Element_ptr y_, int ldy, FieldCategories::GenericTag)`
- `template<class Field>`  
`void fspmm_one_simd_aligned (const Field &F, const Sparse< Field, SparseMatrix_t::CSR_ZO > &A, size_t blockSize, typename Field::ConstElement_ptr x_, int ldx, typename Field::Element_ptr y_, int ldy, FieldCategories::UnparametricTag)`
- `template<class Field>`  
`void fspmm_one_simd_unaligned (const Field &F, const Sparse< Field, SparseMatrix_t::CSR_ZO > &A, size_t blockSize, typename Field::ConstElement_ptr x_, int ldx, typename Field::Element_ptr y_, int ldy, FieldCategories::UnparametricTag)`
- `template<class Field>`  
`void fspmm_mone_simd_aligned (const Field &F, const Sparse< Field, SparseMatrix_t::CSR_ZO > &A, size_t blockSize, typename Field::ConstElement_ptr x_, int ldx, typename Field::Element_ptr y_, int ldy, FieldCategories::UnparametricTag)`
- `template<class Field>`  
`void fspmm_mone_simd_unaligned (const Field &F, const Sparse< Field, SparseMatrix_t::CSR_ZO > &A, size_t blockSize, typename Field::ConstElement_ptr x_, int ldx, typename Field::Element_ptr y_, int ldy, FieldCategories::UnparametricTag)`

## 13.146.1 Macro Definition Documentation

### 13.146.1.1 \_\_FflasFfpack\_fflas\_sparse\_CSR\_spmv\_INL

```
#define __FflasFfpack_fflas_sparse_CSR_spmv_INL
```

## 13.147 csr\_spmv.inl File Reference

### Namespaces

- namespace `FFLAS`
- namespace `FFLAS::sparse_details_impl`

### Macros

- `#define __FflasFfpack_fflas_sparse_CSR_spmv_INL`

### Functions

- `template<class Field>`  
`void fspmv (const Field &F, const Sparse< Field, SparseMatrix_t::CSR > &A, typename Field::ConstElement_ptr x_, typename Field::Element_ptr y_, FieldCategories::GenericTag)`
- `template<class Field>`  
`void fspmv (const Field &F, const Sparse< Field, SparseMatrix_t::CSR > &A, typename Field::ConstElement_ptr x_, typename Field::Element_ptr y_, FieldCategories::UnparametricTag)`
- `template<class Field>`  
`void fspmv (const Field &F, const Sparse< Field, SparseMatrix_t::CSR > &A, typename Field::ConstElement_ptr x_, typename Field::Element_ptr y_, const int64_t kmax)`
- `template<class Field>`  
`void fspmv_one (const Field &F, const Sparse< Field, SparseMatrix_t::CSR_ZO > &A, typename Field::ConstElement_ptr x_, typename Field::Element_ptr y_, FieldCategories::GenericTag)`

- `template<class Field>`  
`void fspmv_mone (const Field &F, const Sparse< Field, SparseMatrix_t::CSR_ZO > &A, typename Field::ConstElement_ptr x_, typename Field::Element_ptr y_, FieldCategories::GenericTag)`
- `template<class Field>`  
`void fspmv_one (const Field &F, const Sparse< Field, SparseMatrix_t::CSR_ZO > &A, typename Field::ConstElement_ptr x_, typename Field::Element_ptr y_, FieldCategories::UnparametricTag)`
- `template<class Field>`  
`void fspmv_mone (const Field &F, const Sparse< Field, SparseMatrix_t::CSR_ZO > &A, typename Field::ConstElement_ptr x_, typename Field::Element_ptr y_, FieldCategories::UnparametricTag)`

### 13.147.1 Macro Definition Documentation

#### 13.147.1.1 \_\_FFLASFFPACK\_fflas\_sparse\_CSR\_spmv\_INL

```
#define __FFLASFFPACK_fflas_sparse_CSR_spmv_INL
```

## 13.148 csr\_utils.inl File Reference

### Namespaces

- namespace [FFLAS](#)

### Functions

- `template<class Field>`  
`void sparse_delete (const Sparse< Field, SparseMatrix_t::CSR > &A)`
- `template<class Field>`  
`void sparse_delete (const Sparse< Field, SparseMatrix_t::CSR_ZO > &A)`
- `template<class Field>`  
`std::ostream & sparse_print (std::ostream &os, const Sparse< Field, SparseMatrix_t::CSR > &A)`
- `template<class IndexT>`  
`void sparse_init (const Givaro::Modular< Givaro::Integer > &F, Sparse< Givaro::Modular< Givaro::Integer >, SparseMatrix_t::CSR > &A, const IndexT *row, const IndexT *col, Givaro::Integer *dat, uint64_t rowdim, uint64_t coldim, uint64_t nnz)`
- `template<class IndexT>`  
`void sparse_init (const Givaro::ZRing< Givaro::Integer > &F, Sparse< Givaro::ZRing< Givaro::Integer >, SparseMatrix_t::CSR_ZO > &A, const IndexT *row, const IndexT *col, Givaro::Integer *dat, uint64_t rowdim, uint64_t coldim, uint64_t nnz)`
- `template<class IndexT, size_t RECINT_SIZE>`  
`void sparse_init (const Givaro::ZRing< RecInt::rmint< RECINT_SIZE > > &F, Sparse< Givaro::ZRing< RecInt::rmint< RECINT_SIZE >, SparseMatrix_t::CSR_ZO > &A, const IndexT *row, const IndexT *col, typename Givaro::ZRing< RecInt::rmint< RECINT_SIZE >>::Element_ptr dat, uint64_t rowdim, uint64_t coldim, uint64_t nnz)`
- `template<class IndexT, size_t RECINT_SIZE>`  
`void sparse_init (const Givaro::ZRing< RecInt::rmint< RECINT_SIZE > > &F, Sparse< Givaro::ZRing< RecInt::rmint< RECINT_SIZE >, SparseMatrix_t::CSR > &A, const IndexT *row, const IndexT *col, typename Givaro::ZRing< RecInt::rmint< RECINT_SIZE >>::Element_ptr dat, uint64_t rowdim, uint64_t coldim, uint64_t nnz)`
- `template<class Field, class IndexT>`  
`void sparse_init (const Field &F, Sparse< Field, SparseMatrix_t::CSR > &A, const IndexT *row, const IndexT *col, typename Field::ConstElement_ptr dat, uint64_t rowdim, uint64_t coldim, uint64_t nnz)`
- `template<class Field, class IndexT>`  
`void sparse_init (const Field &F, Sparse< Field, SparseMatrix_t::CSR_ZO > &A, const IndexT *row, const IndexT *col, typename Field::ConstElement_ptr dat, uint64_t rowdim, uint64_t coldim, uint64_t nnz)`

## 13.149 csr\_hyb.h File Reference

```
#include "fflas-ffpack/fflas/fflas_sparse/csr_hyb/csr_hyb_utils.inl"
#include "fflas-ffpack/fflas/fflas_sparse/csr_hyb/csr_hyb_spmv.inl"
#include "fflas-ffpack/fflas/fflas_sparse/csr_hyb/csr_hyb_spmmm.inl"
```

### Data Structures

- struct [Sparse< \\_Field, SparseMatrix\\_t::CSR\\_HYB >](#)

### Namespaces

- namespace [FFLAS](#)

### Functions

- template<class [Field](#)>  
void [sparse\\_delete](#) (const [Sparse< Field, SparseMatrix\\_t::CSR\\_HYB >](#) &A)
- template<class [Field](#), class IndexT>  
void [sparse\\_init](#) (const [Field](#) &F, [Sparse< Field, SparseMatrix\\_t::CSR\\_HYB >](#) &A, const IndexT \*row, const IndexT \*col, typename [Field::ConstElement\\_ptr](#) dat, uint64\_t rowdim, uint64\_t coldim, uint64\_t nnz)

## 13.150 csr\_hyb\_pspmm.inl File Reference

### Namespaces

- namespace [FFLAS](#)
- namespace [FFLAS::sparse\\_details\\_impl](#)

### Macros

- #define [\\_\\_FFLASFFPACK\\_fflas\\_sparse\\_CSR\\_HYB\\_pspmm\\_INL](#)

### Functions

- template<class [Field](#)>  
void [pfspmm](#) (const [Field](#) &F, const [Sparse< Field, SparseMatrix\\_t::CSR\\_HYB >](#) &A, size\_t blockSize, typename [Field::ConstElement\\_ptr](#) x, typename [Field::Element\\_ptr](#) y, [FieldCategories::GenericTag](#))
- template<class [Field](#)>  
void [pfspmm](#) (const [Field](#) &F, const [Sparse< Field, SparseMatrix\\_t::CSR\\_HYB >](#) &A, size\_t blockSize, typename [Field::ConstElement\\_ptr](#) x, int ldx, typename [Field::Element\\_ptr](#) y, int ldy, [FieldCategories::GenericTag](#))
- template<class [Field](#)>  
void [pfspmm](#) (const [Field](#) &F, const [Sparse< Field, SparseMatrix\\_t::CSR\\_HYB >](#) &A, size\_t blockSize, typename [Field::ConstElement\\_ptr](#) x, typename [Field::Element\\_ptr](#) y, [FieldCategories::UnparametricTag](#))
- template<class [Field](#)>  
void [pfspmm](#) (const [Field](#) &F, const [Sparse< Field, SparseMatrix\\_t::CSR\\_HYB >](#) &A, size\_t blockSize, typename [Field::ConstElement\\_ptr](#) x, int ldx, typename [Field::Element\\_ptr](#) y, int ldy, [FieldCategories::UnparametricTag](#))
- template<class [Field](#)>  
void [pfspmm](#) (const [Field](#) &F, const [Sparse< Field, SparseMatrix\\_t::CSR\\_HYB >](#) &A, size\_t blockSize, typename [Field::ConstElement\\_ptr](#) x, typename [Field::Element\\_ptr](#) y, const int64\_t kmax)
- template<class [Field](#)>  
void [pfspmm](#) (const [Field](#) &F, const [Sparse< Field, SparseMatrix\\_t::CSR\\_HYB >](#) &A, size\_t blockSize, typename [Field::ConstElement\\_ptr](#) x, int ldx, typename [Field::Element\\_ptr](#) y, int ldy, const int64\_t kmax)

### 13.150.1 Macro Definition Documentation

#### 13.150.1.1 \_\_FFLASFFPACK\_fflas\_sparse\_CSR\_HYB\_pspmm\_INL

```
#define __FFLASFFPACK_fflas_sparse_CSR_HYB_pspmm_INL
```

## 13.151 csr\_hyb\_pspmv.inl File Reference

### Namespaces

- namespace [FFLAS](#)
- namespace [FFLAS::sparse\\_details\\_impl](#)

### Macros

- #define [\\_\\_FFLASFFPACK\\_fflas\\_sparse\\_CSR\\_HYB\\_pspmv\\_INL](#)

### Functions

- template<class [Field](#)>  
void [pfspmv](#) (const [Field](#) &F, const [Sparse](#)< [Field](#), [SparseMatrix\\_t::CSR\\_HYB](#) > &A, typename [Field::ConstElement\\_ptr](#) x\_, typename [Field::Element\\_ptr](#) y\_, [FieldCategories::GenericTag](#))
- template<class [Field](#)>  
void [pfspmv](#) (const [Field](#) &F, const [Sparse](#)< [Field](#), [SparseMatrix\\_t::CSR\\_HYB](#) > &A, typename [Field::ConstElement\\_ptr](#) x\_, typename [Field::Element\\_ptr](#) y\_, [FieldCategories::UnparametricTag](#))
- template<class [Field](#)>  
void [pfspmv](#) (const [Field](#) &F, const [Sparse](#)< [Field](#), [SparseMatrix\\_t::CSR\\_HYB](#) > &A, typename [Field::ConstElement\\_ptr](#) x\_, typename [Field::Element\\_ptr](#) y\_, const int64\_t kmax)

### 13.151.1 Macro Definition Documentation

#### 13.151.1.1 \_\_FFLASFFPACK\_fflas\_sparse\_CSR\_HYB\_pspmv\_INL

```
#define __FFLASFFPACK_fflas_sparse_CSR_HYB_pspmv_INL
```

## 13.152 csr\_hyb\_spmv.inl File Reference

### Namespaces

- namespace [FFLAS](#)
- namespace [FFLAS::sparse\\_details\\_impl](#)

### Macros

- #define [\\_\\_FFLASFFPACK\\_fflas\\_sparse\\_CSR\\_HYB\\_spmv\\_INL](#)

### Functions

- template<class [Field](#)>  
void [fspmv](#) (const [Field](#) &F, const [Sparse](#)< [Field](#), [SparseMatrix\\_t::CSR\\_HYB](#) > &A, size\_t blockSize, type-  
name [Field::ConstElement\\_ptr](#) x\_, int ldx, typename [Field::Element\\_ptr](#) y\_, int ldy, [FieldCategories::GenericTag](#))
- template<class [Field](#)>  
void [fspmv](#) (const [Field](#) &F, const [Sparse](#)< [Field](#), [SparseMatrix\\_t::CSR\\_HYB](#) > &A, size\_t blockSize, type-  
name [Field::ConstElement\\_ptr](#) x\_, int ldx, typename [Field::Element\\_ptr](#) y\_, int ldy, [FieldCategories::UnparametricTag](#))
- template<class [Field](#)>  
void [fspmv](#) (const [Field](#) &F, const [Sparse](#)< [Field](#), [SparseMatrix\\_t::CSR\\_HYB](#) > &A, size\_t blockSize, type-  
name [Field::ConstElement\\_ptr](#) x\_, int ldx, typename [Field::Element\\_ptr](#) y\_, int ldy, const int64\_t kmax)

## 13.152.1 Macro Definition Documentation

### 13.152.1.1 \_\_FFLASFFPACK\_fflas\_sparse\_CSR\_HYB\_spmv\_INL

```
#define __FFLASFFPACK_fflas_sparse_CSR_HYB_spmv_INL
```

## 13.153 csr\_hyb\_spmv.inl File Reference

### Namespaces

- namespace [FFLAS](#)
- namespace [FFLAS::sparse\\_details\\_impl](#)

### Macros

- #define [\\_\\_FFLASFFPACK\\_fflas\\_sparse\\_CSR\\_HYB\\_spmv\\_INL](#)

### Functions

- template<class [Field](#)>  
void [fspmv](#) (const [Field](#) &F, const [Sparse](#)< [Field](#), [SparseMatrix\\_t::CSR\\_HYB](#) > &A, typename [Field::ConstElement\\_ptr](#) x\_, typename [Field::Element\\_ptr](#) y\_, [FieldCategories::GenericTag](#))
- template<class [Field](#)>  
void [fspmv](#) (const [Field](#) &F, const [Sparse](#)< [Field](#), [SparseMatrix\\_t::CSR\\_HYB](#) > &A, typename [Field::ConstElement\\_ptr](#) x\_, typename [Field::Element\\_ptr](#) y\_, [FieldCategories::UnparametricTag](#))
- template<class [Field](#)>  
void [fspmv](#) (const [Field](#) &F, const [Sparse](#)< [Field](#), [SparseMatrix\\_t::CSR\\_HYB](#) > &A, typename [Field::ConstElement\\_ptr](#) x\_, typename [Field::Element\\_ptr](#) y\_, const uint64\_t kmax)

## 13.153.1 Macro Definition Documentation

### 13.153.1.1 \_\_FFLASFFPACK\_fflas\_sparse\_CSR\_HYB\_spmv\_INL

```
#define __FFLASFFPACK_fflas_sparse_CSR_HYB_spmv_INL
```

## 13.154 csr\_hyb\_utils.inl File Reference

### Data Structures

- struct [Info](#)
- struct [Coo](#)< [ValT](#), [IdxT](#) >

### Namespaces

- namespace [FFLAS](#)
- namespace [FFLAS::csr\\_hyb\\_details](#)

### Macros

- #define [\\_\\_FFLASFFPACK\\_fflas\\_sparse\\_CSR\\_HYB\\_utils\\_INL](#)

### Functions

- template<class [Field](#)>  
void [sparse\\_delete](#) (const [Sparse](#)< [Field](#), [SparseMatrix\\_t::CSR\\_HYB](#) > &A)
- template<class [Field](#), class [IndexT](#)>  
void [sparse\\_init](#) (const [Field](#) &F, [Sparse](#)< [Field](#), [SparseMatrix\\_t::CSR\\_HYB](#) > &A, const [IndexT](#) \*row, const [IndexT](#) \*col, typename [Field::ConstElement\\_ptr](#) dat, uint64\_t rowdim, uint64\_t coldim, uint64\_t nnz)

### 13.154.1 Macro Definition Documentation

#### 13.154.1.1 \_\_FFLASFFPACK\_fflas\_sparse\_CSR\_HYB\_utils\_INL

```
#define __FFLASFFPACK_fflas_sparse_CSR_HYB_utils_INL
```

## 13.155 ell.h File Reference

```
#include "fflas-ffpack/fflas/fflas_sparse/ell/ell_utils.inl"
#include "fflas-ffpack/fflas/fflas_sparse/ell/ell_spmv.inl"
#include "fflas-ffpack/fflas/fflas_sparse/ell/ell_spmmm.inl"
```

### Data Structures

- struct [Sparse< \\_Field, SparseMatrix\\_t::ELL >](#)
- struct [Sparse< \\_Field, SparseMatrix\\_t::ELL\\_ZO >](#)

### Namespaces

- namespace [FFLAS](#)

### Functions

- template<class [Field](#), class IndexT>  
void [sparse\\_init](#) (const [Field](#) &F, [Sparse< Field, SparseMatrix\\_t::ELL >](#) &A, const IndexT \*row, const IndexT \*col, typename [Field::ConstElement\\_ptr](#) dat, uint64\_t rowdim, uint64\_t coldim, uint64\_t nnz)
- template<class [Field](#), class IndexT>  
void [sparse\\_init](#) (const [Field](#) &F, [Sparse< Field, SparseMatrix\\_t::ELL\\_ZO >](#) &A, const IndexT \*row, const IndexT \*col, typename [Field::ConstElement\\_ptr](#) dat, uint64\_t rowdim, uint64\_t coldim, uint64\_t nnz)
- template<class [Field](#)>  
void [sparse\\_delete](#) (const [Sparse< Field, SparseMatrix\\_t::ELL >](#) &A)
- template<class [Field](#)>  
void [sparse\\_delete](#) (const [Sparse< Field, SparseMatrix\\_t::ELL\\_ZO >](#) &A)

## 13.156 ell\_pspmm.inl File Reference

### Namespaces

- namespace [FFLAS](#)
- namespace [FFLAS::sparse\\_details\\_impl](#)

### Macros

- #define [\\_\\_FFLASFFPACK\\_fflas\\_sparse\\_ELL\\_pspmm\\_INL](#)

### Functions

- template<class [Field](#)>  
void [pfsppmm](#) (const [Field](#) &F, const [Sparse< Field, SparseMatrix\\_t::ELL >](#) &A, size\_t blockSize, typename [Field::ConstElement\\_ptr](#) x, typename [Field::Element\\_ptr](#) y, [FieldCategories::GenericTag](#))
- template<class [Field](#)>  
void [pfsppmm](#) (const [Field](#) &F, const [Sparse< Field, SparseMatrix\\_t::ELL >](#) &A, size\_t blockSize, typename [Field::ConstElement\\_ptr](#) x, int ldx, typename [Field::Element\\_ptr](#) y, int ldy, [FieldCategories::GenericTag](#))
- template<class [Field](#)>  
void [pfsppmm](#) (const [Field](#) &F, const [Sparse< Field, SparseMatrix\\_t::ELL >](#) &A, size\_t blockSize, typename [Field::ConstElement\\_ptr](#) x, typename [Field::Element\\_ptr](#) y, [FieldCategories::UnparametricTag](#))



- `template<class Field>`  
`void pfspmm (const Field &F, const Sparse< Field, SparseMatrix_t::ELL > &A, size_t blockSize, typename Field::ConstElement_ptr x, int ldx, typename Field::Element_ptr y, int ldy, FieldCategories::UnparametricTag)`
- `template<class Field>`  
`void pfspmm (const Field &F, const Sparse< Field, SparseMatrix_t::ELL > &A, size_t blockSize, typename Field::ConstElement_ptr x, typename Field::Element_ptr y, const int64_t kmax)`
- `template<class Field>`  
`void pfspmm (const Field &F, const Sparse< Field, SparseMatrix_t::ELL > &A, size_t blockSize, typename Field::ConstElement_ptr x, int ldx, typename Field::Element_ptr y, int ldy, const int64_t kmax)`
- `template<class Field, class Func>`  
`void pfspmm_zo (const Field &F, const Sparse< Field, SparseMatrix_t::ELL_ZO > &A, size_t blockSize, typename Field::ConstElement_ptr x, typename Field::Element_ptr y, Func &&func)`
- `template<class Field, class Func>`  
`void pfspmm_zo (const Field &F, const Sparse< Field, SparseMatrix_t::ELL_ZO > &A, size_t blockSize, typename Field::ConstElement_ptr x, int ldx, typename Field::Element_ptr y, int ldy, Func &&func)`

## 13.156.1 Macro Definition Documentation

### 13.156.1.1 \_\_FFLASFFPACK\_fflas\_sparse\_ELL\_pspmm\_INL

```
#define __FFLASFFPACK_fflas_sparse_ELL_pspmm_INL
```

## 13.157 ell\_pspmv.inl File Reference

### Namespaces

- namespace [FFLAS](#)
- namespace [FFLAS::sparse\\_details\\_impl](#)

### Macros

- `#define` [\\_\\_FFLASFFPACK\\_fflas\\_sparse\\_ELL\\_pspmv\\_INL](#)

### Functions

- `template<class Field>`  
`void pfspmv (const Field &F, const Sparse< Field, SparseMatrix_t::ELL > &A, typename Field::ConstElement_ptr x_, typename Field::Element_ptr y_, FieldCategories::GenericTag)`
- `template<class Field>`  
`void pfspmv (const Field &F, const Sparse< Field, SparseMatrix_t::ELL > &A, typename Field::ConstElement_ptr x_, typename Field::Element_ptr y_, FieldCategories::UnparametricTag)`
- `template<class Field>`  
`void pfspmv (const Field &F, const Sparse< Field, SparseMatrix_t::ELL > &A, typename Field::ConstElement_ptr x_, typename Field::Element_ptr y_, const int64_t kmax)`
- `template<class Field>`  
`void pfspmv_one (const Field &F, const Sparse< Field, SparseMatrix_t::ELL_ZO > &A, typename Field::ConstElement_ptr x_, typename Field::Element_ptr y_, FieldCategories::GenericTag)`
- `template<class Field>`  
`void pfspmv_mone (const Field &F, const Sparse< Field, SparseMatrix_t::ELL_ZO > &A, typename Field::ConstElement_ptr x_, typename Field::Element_ptr y_, FieldCategories::GenericTag)`
- `template<class Field>`  
`void pfspmv_one (const Field &F, const Sparse< Field, SparseMatrix_t::ELL_ZO > &A, typename Field::ConstElement_ptr x_, typename Field::Element_ptr y_, FieldCategories::UnparametricTag)`
- `template<class Field>`  
`void pfspmv_mone (const Field &F, const Sparse< Field, SparseMatrix_t::ELL_ZO > &A, typename Field::ConstElement_ptr x_, typename Field::Element_ptr y_, FieldCategories::UnparametricTag)`

## 13.157.1 Macro Definition Documentation

### 13.157.1.1 \_\_FFLASFFPACK\_fflas\_sparse\_ELL\_pspmv\_INL

```
#define __FFLASFFPACK_fflas_sparse_ELL_pspmv_INL
```

## 13.158 ell\_spmmm.inl File Reference

### Namespaces

- namespace [FFLAS](#)
- namespace [FFLAS::sparse\\_details\\_impl](#)

### Macros

- #define [\\_\\_FFLASFFPACK\\_fflas\\_sparse\\_ELL\\_spmmm\\_INL](#)

### Functions

- [template<class Field>](#)  
void [fspmm](#) (const [Field](#) &F, const [Sparse](#)< [Field](#), [SparseMatrix\\_t::ELL](#) > &A, [size\\_t](#) blockSize, [typename](#) [Field::ConstElement\\_ptr](#) x\_, [int](#) ldx, [typename](#) [Field::Element\\_ptr](#) y\_, [int](#) ldy, [FieldCategories::GenericTag](#))
- [template<class Field>](#)  
void [fspmm](#) (const [Field](#) &F, const [Sparse](#)< [Field](#), [SparseMatrix\\_t::ELL](#) > &A, [size\\_t](#) blockSize, [typename](#) [Field::ConstElement\\_ptr](#) x\_, [int](#) ldx, [typename](#) [Field::Element\\_ptr](#) y\_, [int](#) ldy, [FieldCategories::UnparametricTag](#))
- [template<class Field>](#)  
void [fspmm](#) (const [Field](#) &F, const [Sparse](#)< [Field](#), [SparseMatrix\\_t::ELL](#) > &A, [size\\_t](#) blockSize, [typename](#) [Field::ConstElement\\_ptr](#) x\_, [int](#) ldx, [typename](#) [Field::Element\\_ptr](#) y\_, [int](#) ldy, [const int64\\_t](#) kmax)
- [template<class Field>](#)  
void [fspmm\\_mone](#) (const [Field](#) &F, const [Sparse](#)< [Field](#), [SparseMatrix\\_t::ELL\\_ZO](#) > &A, [size\\_t](#) blockSize, [typename](#) [Field::ConstElement\\_ptr](#) x\_, [int](#) ldx, [typename](#) [Field::Element\\_ptr](#) y\_, [int](#) ldy, [FieldCategories::GenericTag](#))
- [template<class Field>](#)  
void [fspmm\\_one](#) (const [Field](#) &F, const [Sparse](#)< [Field](#), [SparseMatrix\\_t::ELL\\_ZO](#) > &A, [size\\_t](#) blockSize, [typename](#) [Field::ConstElement\\_ptr](#) x\_, [int](#) ldx, [typename](#) [Field::Element\\_ptr](#) y\_, [int](#) ldy, [FieldCategories::GenericTag](#))
- [template<class Field>](#)  
void [fspmm\\_mone](#) (const [Field](#) &F, const [Sparse](#)< [Field](#), [SparseMatrix\\_t::ELL\\_ZO](#) > &A, [size\\_t](#) blockSize, [typename](#) [Field::ConstElement\\_ptr](#) x\_, [int](#) ldx, [typename](#) [Field::Element\\_ptr](#) y\_, [int](#) ldy, [FieldCategories::UnparametricTag](#))
- [template<class Field>](#)  
void [fspmm\\_one](#) (const [Field](#) &F, const [Sparse](#)< [Field](#), [SparseMatrix\\_t::ELL\\_ZO](#) > &A, [size\\_t](#) blockSize, [typename](#) [Field::ConstElement\\_ptr](#) x\_, [int](#) ldx, [typename](#) [Field::Element\\_ptr](#) y\_, [int](#) ldy, [FieldCategories::UnparametricTag](#))
- [template<class Field>](#)  
void [fspmm\\_one\\_simd\\_aligned](#) (const [Field](#) &F, const [Sparse](#)< [Field](#), [SparseMatrix\\_t::ELL\\_ZO](#) > &A, [size\\_t](#) blockSize, [typename](#) [Field::ConstElement\\_ptr](#) x\_, [int](#) ldx, [typename](#) [Field::Element\\_ptr](#) y\_, [int](#) ldy, [FieldCategories::UnparametricTag](#))
- [template<class Field>](#)  
void [fspmm\\_one\\_simd\\_unaligned](#) (const [Field](#) &F, const [Sparse](#)< [Field](#), [SparseMatrix\\_t::ELL\\_ZO](#) > &A, [size\\_t](#) blockSize, [typename](#) [Field::ConstElement\\_ptr](#) x\_, [int](#) ldx, [typename](#) [Field::Element\\_ptr](#) y\_, [int](#) ldy, [FieldCategories::UnparametricTag](#))
- [template<class Field>](#)  
void [fspmm\\_mone\\_simd\\_aligned](#) (const [Field](#) &F, const [Sparse](#)< [Field](#), [SparseMatrix\\_t::ELL\\_ZO](#) > &A, [size\\_t](#) blockSize, [typename](#) [Field::ConstElement\\_ptr](#) x\_, [int](#) ldx, [typename](#) [Field::Element\\_ptr](#) y\_, [int](#) ldy, [FieldCategories::UnparametricTag](#))

- template<class [Field](#)>  
void [fspmm\\_mone\\_simd\\_unaligned](#) (const [Field](#) &F, const [Sparse](#)< [Field](#), [SparseMatrix\\_t::ELL\\_ZO](#) > &A, size\_t blockSize, typename [Field::ConstElement\\_ptr](#) x\_, int ldx, typename [Field::Element\\_ptr](#) y\_, int ldy, [FieldCategories::UnparametricTag](#))

### 13.158.1 Macro Definition Documentation

#### 13.158.1.1 \_\_FFLASFFPACK\_fflas\_sparse\_ELL\_spmv\_INL

```
#define __FFLASFFPACK_fflas_sparse_ELL_spmv_INL
```

## 13.159 ell\_spmv.inl File Reference

### Namespaces

- namespace [FFLAS](#)
- namespace [FFLAS::sparse\\_details\\_impl](#)

### Macros

- #define [\\_\\_FFLASFFPACK\\_fflas\\_sparse\\_ELL\\_spmv\\_INL](#)

### Functions

- template<class [Field](#)>  
void [fspmv](#) (const [Field](#) &F, const [Sparse](#)< [Field](#), [SparseMatrix\\_t::ELL](#) > &A, typename [Field::ConstElement\\_ptr](#) x\_, typename [Field::Element\\_ptr](#) y\_, [FieldCategories::GenericTag](#))
- template<class [Field](#)>  
void [fspmv](#) (const [Field](#) &F, const [Sparse](#)< [Field](#), [SparseMatrix\\_t::ELL](#) > &A, typename [Field::ConstElement\\_ptr](#) x\_, typename [Field::Element\\_ptr](#) y\_, [FieldCategories::UnparametricTag](#))
- template<class [Field](#)>  
void [fspmv](#) (const [Field](#) &F, const [Sparse](#)< [Field](#), [SparseMatrix\\_t::ELL](#) > &A, typename [Field::ConstElement\\_ptr](#) x\_, typename [Field::Element\\_ptr](#) y\_, const uint64\_t kmax)
- template<class [Field](#)>  
void [fspmv\\_one](#) (const [Field](#) &F, const [Sparse](#)< [Field](#), [SparseMatrix\\_t::ELL\\_ZO](#) > &A, typename [Field::ConstElement\\_ptr](#) x\_, typename [Field::Element\\_ptr](#) y\_, [FieldCategories::GenericTag](#))
- template<class [Field](#)>  
void [fspmv\\_mone](#) (const [Field](#) &F, const [Sparse](#)< [Field](#), [SparseMatrix\\_t::ELL\\_ZO](#) > &A, typename [Field::ConstElement\\_ptr](#) x\_, typename [Field::Element\\_ptr](#) y\_, [FieldCategories::GenericTag](#))
- template<class [Field](#)>  
void [fspmv\\_one](#) (const [Field](#) &F, const [Sparse](#)< [Field](#), [SparseMatrix\\_t::ELL\\_ZO](#) > &A, typename [Field::ConstElement\\_ptr](#) x\_, typename [Field::Element\\_ptr](#) y\_, [FieldCategories::UnparametricTag](#))
- template<class [Field](#)>  
void [fspmv\\_mone](#) (const [Field](#) &F, const [Sparse](#)< [Field](#), [SparseMatrix\\_t::ELL\\_ZO](#) > &A, typename [Field::ConstElement\\_ptr](#) x\_, typename [Field::Element\\_ptr](#) y\_, [FieldCategories::UnparametricTag](#))

### 13.159.1 Macro Definition Documentation

#### 13.159.1.1 \_\_FFLASFFPACK\_fflas\_sparse\_ELL\_spmv\_INL

```
#define __FFLASFFPACK_fflas_sparse_ELL_spmv_INL
```

## 13.160 ell\_utils.inl File Reference

```
#include <vector>
```

## Namespaces

- namespace [FFLAS](#)

## Macros

- `#define` [\\_\\_FFLASFFPACK\\_fflas\\_sparse\\_ELL\\_utils\\_INL](#)

## Functions

- `template<class Field>`  
void [sparse\\_delete](#) (const [Sparse](#)< [Field](#), [SparseMatrix\\_t::ELL](#) > &A)
- `template<class Field>`  
void [sparse\\_delete](#) (const [Sparse](#)< [Field](#), [SparseMatrix\\_t::ELL\\_ZO](#) > &A)
- `template<class Field, class IndexT>`  
void [sparse\\_init](#) (const [Field](#) &F, [Sparse](#)< [Field](#), [SparseMatrix\\_t::ELL](#) > &A, const IndexT \*row, const IndexT \*col, typename [Field::ConstElement\\_ptr](#) dat, uint64\_t rowdim, uint64\_t coldim, uint64\_t nnz)
- `template<class Field, class IndexT>`  
void [sparse\\_init](#) (const [Field](#) &F, [Sparse](#)< [Field](#), [SparseMatrix\\_t::ELL\\_ZO](#) > &A, const IndexT \*row, const IndexT \*col, typename [Field::ConstElement\\_ptr](#) dat, uint64\_t rowdim, uint64\_t coldim, uint64\_t nnz)

### 13.160.1 Macro Definition Documentation

#### 13.160.1.1 [\\_\\_FFLASFFPACK\\_fflas\\_sparse\\_ELL\\_utils\\_INL](#)

```
#define __FFLASFFPACK_fflas_sparse_ELL_utils_INL
```

## 13.161 [ell\\_simd.h](#) File Reference

```
#include "fflas-ffpack/fflas/fflas_sparse/ell_simd/ell_simd_utils.inl"
#include "fflas-ffpack/fflas/fflas_sparse/ell_simd/ell_simd_spmv.inl"
```

## Data Structures

- struct [Sparse](#)< [\\_Field](#), [SparseMatrix\\_t::ELL\\_simd](#) >
- struct [Sparse](#)< [\\_Field](#), [SparseMatrix\\_t::ELL\\_simd\\_ZO](#) >

## Namespaces

- namespace [FFLAS](#)

## Functions

- `template<class Field, class IndexT>`  
void [sparse\\_init](#) (const [Field](#) &F, [Sparse](#)< [Field](#), [SparseMatrix\\_t::ELL\\_simd](#) > &A, const IndexT \*row, const IndexT \*col, typename [Field::ConstElement\\_ptr](#) dat, uint64\_t rowdim, uint64\_t coldim, uint64\_t nnz)
- `template<class Field, class IndexT>`  
void [sparse\\_init](#) (const [Field](#) &F, [Sparse](#)< [Field](#), [SparseMatrix\\_t::ELL\\_simd\\_ZO](#) > &A, const IndexT \*row, const IndexT \*col, typename [Field::ConstElement\\_ptr](#) dat, uint64\_t rowdim, uint64\_t coldim, uint64\_t nnz)
- `template<class Field>`  
void [sparse\\_delete](#) (const [Sparse](#)< [Field](#), [SparseMatrix\\_t::ELL\\_simd](#) > &A)
- `template<class Field>`  
void [sparse\\_delete](#) (const [Sparse](#)< [Field](#), [SparseMatrix\\_t::ELL\\_simd\\_ZO](#) > &A)

## 13.162 ell\_simd\_pspmv.inl File Reference

### Namespaces

- namespace [FFLAS](#)
- namespace [FFLAS::sparse\\_details\\_impl](#)

### Macros

- `#define` [\\_\\_FFLASFFPACK\\_fflas\\_sparse\\_ELL\\_simd\\_pspmv\\_INL](#)

### Functions

- `template<class Field>`  
void [pfspmv](#) (const [Field](#) &F, const [Sparse](#)< [Field](#), [SparseMatrix\\_t::ELL\\_simd](#) > &A, typename [Field::ConstElement\\_ptr](#) x\_, typename [Field::Element\\_ptr](#) y\_, [FieldCategories::GenericTag](#))
- `template<class Field>`  
void [pfspmv](#) (const [Field](#) &F, const [Sparse](#)< [Field](#), [SparseMatrix\\_t::ELL\\_simd](#) > &A, typename [Field::ConstElement\\_ptr](#) x\_, typename [Field::Element\\_ptr](#) y\_, [FieldCategories::UnparametricTag](#))
- `template<class Field>`  
void [pfspmv](#) (const [Field](#) &F, const [Sparse](#)< [Field](#), [SparseMatrix\\_t::ELL\\_simd](#) > &A, typename [Field::ConstElement\\_ptr](#) x\_, typename [Field::Element\\_ptr](#) y\_, const uint64\_t kmax)
- `template<class Field>`  
void [pfspmv\\_one](#) (const [Field](#) &F, const [Sparse](#)< [Field](#), [SparseMatrix\\_t::ELL\\_simd\\_ZO](#) > &A, typename [Field::ConstElement\\_ptr](#) x\_, typename [Field::Element\\_ptr](#) y\_, [FieldCategories::GenericTag](#))
- `template<class Field>`  
void [pfspmv\\_mone](#) (const [Field](#) &F, const [Sparse](#)< [Field](#), [SparseMatrix\\_t::ELL\\_simd\\_ZO](#) > &A, typename [Field::ConstElement\\_ptr](#) x\_, typename [Field::Element\\_ptr](#) y\_, [FieldCategories::GenericTag](#))
- `template<class Field>`  
void [pfspmv\\_one](#) (const [Field](#) &F, const [Sparse](#)< [Field](#), [SparseMatrix\\_t::ELL\\_simd\\_ZO](#) > &A, typename [Field::ConstElement\\_ptr](#) x\_, typename [Field::Element\\_ptr](#) y\_, [FieldCategories::UnparametricTag](#))
- `template<class Field>`  
void [pfspmv\\_mone](#) (const [Field](#) &F, const [Sparse](#)< [Field](#), [SparseMatrix\\_t::ELL\\_simd\\_ZO](#) > &A, typename [Field::ConstElement\\_ptr](#) x\_, typename [Field::Element\\_ptr](#) y\_, [FieldCategories::UnparametricTag](#))

### 13.162.1 Macro Definition Documentation

#### 13.162.1.1 \_\_FFLASFFPACK\_fflas\_sparse\_ELL\_simd\_pspmv\_INL

```
#define __FFLASFFPACK_fflas_sparse_ELL_simd_pspmv_INL
```

## 13.163 ell\_simd\_spmv.inl File Reference

### Namespaces

- namespace [FFLAS](#)
- namespace [FFLAS::sparse\\_details\\_impl](#)

### Macros

- `#define` [\\_\\_FFLASFFPACK\\_fflas\\_sparse\\_ELL\\_simd\\_spmv\\_INL](#)

### Functions

- `template<class Field>`  
void [fspmv](#) (const [Field](#) &F, const [Sparse](#)< [Field](#), [SparseMatrix\\_t::ELL\\_simd](#) > &A, typename [Field::ConstElement\\_ptr](#) x\_, typename [Field::Element\\_ptr](#) y\_, [FieldCategories::GenericTag](#))

- `template<class Field>`  
`void fspmv_simd (const Field &F, const Sparse< Field, SparseMatrix_t::ELL_simd > &A, typename Field::ConstElement_ptr x_, typename Field::Element_ptr y_, FieldCategories::UnparametricTag)`
- `template<class Field>`  
`void fspmv (const Field &F, const Sparse< Field, SparseMatrix_t::ELL_simd > &A, typename Field::ConstElement_ptr x_, typename Field::Element_ptr y_, FieldCategories::UnparametricTag)`
- `template<class Field>`  
`void fspmv_simd (const Field &F, const Sparse< Field, SparseMatrix_t::ELL_simd > &A, typename Field::ConstElement_ptr x_, typename Field::Element_ptr y_, const uint64_t kmax)`
- `template<class Field>`  
`void fspmv (const Field &F, const Sparse< Field, SparseMatrix_t::ELL_simd > &A, typename Field::ConstElement_ptr x_, typename Field::Element_ptr y_, const uint64_t kmax)`
- `template<class Field>`  
`void fspmv_one (const Field &F, const Sparse< Field, SparseMatrix_t::ELL_simd_ZO > &A, typename Field::ConstElement_ptr x_, typename Field::Element_ptr y_, FieldCategories::GenericTag)`
- `template<class Field>`  
`void fspmv_mone (const Field &F, const Sparse< Field, SparseMatrix_t::ELL_simd_ZO > &A, typename Field::ConstElement_ptr x_, typename Field::Element_ptr y_, FieldCategories::GenericTag)`
- `template<class Field>`  
`void fspmv_one (const Field &F, const Sparse< Field, SparseMatrix_t::ELL_simd_ZO > &A, typename Field::ConstElement_ptr x_, typename Field::Element_ptr y_, FieldCategories::UnparametricTag)`
- `template<class Field>`  
`void fspmv_mone (const Field &F, const Sparse< Field, SparseMatrix_t::ELL_simd_ZO > &A, typename Field::ConstElement_ptr x_, typename Field::Element_ptr y_, FieldCategories::UnparametricTag)`
- `template<class Field>`  
`void fspmv_one_simd (const Field &F, const Sparse< Field, SparseMatrix_t::ELL_simd_ZO > &A, typename Field::ConstElement_ptr x_, typename Field::Element_ptr y_, FieldCategories::UnparametricTag)`
- `template<class Field>`  
`void fspmv_mone_simd (const Field &F, const Sparse< Field, SparseMatrix_t::ELL_simd_ZO > &A, typename Field::ConstElement_ptr x_, typename Field::Element_ptr y_, FieldCategories::UnparametricTag)`

### 13.163.1 Macro Definition Documentation

#### 13.163.1.1 \_\_FFLASFFPACK\_fflas\_sparse\_ELL\_simd\_spmv\_INL

```
#define __FFLASFFPACK_fflas_sparse_ELL_simd_spmv_INL
```

## 13.164 ell\_simd\_utils.inl File Reference

### Namespaces

- namespace [FFLAS](#)

### Macros

- `#define __FFLASFFPACK_fflas_sparse_ELL_simd_utils_INL`

### Functions

- `template<class Field>`  
`void sparse_delete (const Sparse< Field, SparseMatrix_t::ELL_simd > &A)`
- `template<class Field>`  
`void sparse_delete (const Sparse< Field, SparseMatrix_t::ELL_simd_ZO > &A)`
- `template<class Field>`  
`void sparse_print (const Sparse< Field, SparseMatrix_t::ELL_simd > &A)`
- `template<class Field, class IndexT>`  
`void sparse_init (const Field &F, Sparse< Field, SparseMatrix_t::ELL_simd > &A, const IndexT *row, const IndexT *col, typename Field::ConstElement_ptr dat, uint64_t rowdim, uint64_t coldim, uint64_t nnz)`

- `template<class Field, class IndexT>`  
`void sparse_init (const Field &F, Sparse< Field, SparseMatrix_t::ELL_simd_ZO > &A, const IndexT *row,`  
`const IndexT *col, typename Field::ConstElement_ptr dat, uint64_t rowdim, uint64_t coldim, uint64_t nnz)`

### 13.164.1 Macro Definition Documentation

#### 13.164.1.1 \_\_FFLASFFPACK\_fflas\_sparse\_ELL\_simd\_utils\_INL

```
#define __FFLASFFPACK_fflas_sparse_ELL_simd_utils_INL
```

## 13.165 hyb\_zo.h File Reference

```
#include "fflas-ffpack/fflas/fflas_sparse/hyb_zo/hyb_zo_utils.inl"
#include "fflas-ffpack/fflas/fflas_sparse/hyb_zo/hyb_zo_spmv.inl"
#include "fflas-ffpack/fflas/fflas_sparse/hyb_zo/hyb_zo_spmmm.inl"
```

### Namespaces

- namespace [FFLAS](#)

## 13.166 hyb\_zo\_pspmm.inl File Reference

### Namespaces

- namespace [FFLAS](#)
- namespace [FFLAS::sparse\\_details\\_impl](#)

### Macros

- `#define __FFLASFFPACK_fflas_sparse_HYB_ZO_pspmm_INL`

### Functions

- `template<class Field>`  
`void pfspmm (const Field &F, const Sparse< Field, SparseMatrix_t::HYB_ZO > &A, size_t blockSize, type-`  
`name Field::ConstElement_ptr x, int ldx, typename Field::Element_ptr y, int ldy, FieldCategories::GenericTag)`
- `template<class Field>`  
`void pfspmm (const Field &F, const Sparse< Field, SparseMatrix_t::HYB_ZO > &A, size_t blockSize, type-`  
`name Field::ConstElement_ptr x, int ldx, typename Field::Element_ptr y, int ldy, FieldCategories::UnparametricTag)`
- `template<class Field>`  
`void pfspmm (const Field &F, const Sparse< Field, SparseMatrix_t::HYB_ZO > &A, size_t blockSize, type-`  
`name Field::ConstElement_ptr x, int ldx, typename Field::Element_ptr y, int ldy, uint64_t kmax)`

### 13.166.1 Macro Definition Documentation

#### 13.166.1.1 \_\_FFLASFFPACK\_fflas\_sparse\_HYB\_ZO\_pspmm\_INL

```
#define __FFLASFFPACK_fflas_sparse_HYB_ZO_pspmm_INL
```

## 13.167 hyb\_zo\_pspmv.inl File Reference

### Namespaces

- namespace [FFLAS](#)
- namespace [FFLAS::sparse\\_details\\_impl](#)

## Macros

- `#define __FFLASFFPACK_fflas_sparse_HYB_ZO_pspmv_INL`

## Functions

- `template<class Field>`  
`void pfspmv (const Field &F, const Sparse< Field, SparseMatrix_t::HYB_ZO > &A, typename Field::ConstElement_ptr x, typename Field::Element_ptr y, FieldCategories::GenericTag)`
- `template<class Field>`  
`void pfspmv (const Field &F, const Sparse< Field, SparseMatrix_t::HYB_ZO > &A, typename Field::ConstElement_ptr x, typename Field::Element_ptr y, FieldCategories::UnparametricTag)`
- `template<class Field>`  
`void pfspmv (const Field &F, const Sparse< Field, SparseMatrix_t::HYB_ZO > &A, typename Field::ConstElement_ptr x, typename Field::Element_ptr y, uint64_t kmax)`

### 13.167.1 Macro Definition Documentation

#### 13.167.1.1 \_\_FFLASFFPACK\_fflas\_sparse\_HYB\_ZO\_pspmv\_INL

```
#define __FFLASFFPACK_fflas_sparse_HYB_ZO_pspmv_INL
```

## 13.168 hyb\_zo\_spmv.inl File Reference

### Namespaces

- namespace `FFLAS`
- namespace `FFLAS::sparse_details_impl`

### Macros

- `#define __FFLASFFPACK_fflas_sparse_HYB_ZO_spmv_INL`

### Functions

- `template<class Field>`  
`void fspmv (const Field &F, const Sparse< Field, SparseMatrix_t::HYB_ZO > &A, size_t blockSize, typename Field::ConstElement_ptr x, int ldx, typename Field::Element_ptr y, int ldy, FieldCategories::GenericTag)`
- `template<class Field>`  
`void fspmv (const Field &F, const Sparse< Field, SparseMatrix_t::HYB_ZO > &A, size_t blockSize, typename Field::ConstElement_ptr x, int ldx, typename Field::Element_ptr y, int ldy, FieldCategories::UnparametricTag)`
- `template<class Field>`  
`void fspmv (const Field &F, const Sparse< Field, SparseMatrix_t::HYB_ZO > &A, size_t blockSize, typename Field::ConstElement_ptr x, int ldx, typename Field::Element_ptr y, int ldy, uint64_t kmax)`

### 13.168.1 Macro Definition Documentation

#### 13.168.1.1 \_\_FFLASFFPACK\_fflas\_sparse\_HYB\_ZO\_spmv\_INL

```
#define __FFLASFFPACK_fflas_sparse_HYB_ZO_spmv_INL
```

## 13.169 hyb\_zo\_spmv.inl File Reference

### Namespaces

- namespace `FFLAS`
- namespace `FFLAS::sparse_details_impl`



**Macros**

- `#define __FFLASFFPACK_fflas_sparse_HYB_ZO_spmv_INL`

**Functions**

- `template<class Field>`  
`void fspmv (const Field &F, const Sparse< Field, SparseMatrix_t::HYB_ZO > &A, typename Field::ConstElement_ptr x, typename Field::Element_ptr y, FieldCategories::GenericTag)`
- `template<class Field>`  
`void fspmv (const Field &F, const Sparse< Field, SparseMatrix_t::HYB_ZO > &A, typename Field::ConstElement_ptr x, typename Field::Element_ptr y, FieldCategories::UnparametricTag)`
- `template<class Field>`  
`void fspmv (const Field &F, const Sparse< Field, SparseMatrix_t::HYB_ZO > &A, typename Field::ConstElement_ptr x, typename Field::Element_ptr y, uint64_t kmax)`

**13.169.1 Macro Definition Documentation****13.169.1.1 \_\_FFLASFFPACK\_fflas\_sparse\_HYB\_ZO\_spmv\_INL**

```
#define __FFLASFFPACK_fflas_sparse_HYB_ZO_spmv_INL
```

**13.170 hyb\_zo\_utils.inl File Reference****Namespaces**

- namespace `FFLAS`

**Macros**

- `#define __FFLASFFPACK_fflas_sparse_HYB_ZO_utils_INL`

**Functions**

- `template<class Field>`  
`void sparse_delete (const Sparse< Field, SparseMatrix_t::HYB_ZO > &A)`
- `template<class Field, class IndexT>`  
`void sparse_init (const Field &F, Sparse< Field, SparseMatrix_t::HYB_ZO > &A, const IndexT *row, const IndexT *col, typename Field::ConstElement_ptr dat, uint64_t rowdim, uint64_t coldim, uint64_t nnz)`
- `template<typename _Field>`  
`std::ostream & operator<< (std::ostream &os, const Sparse< _Field, SparseMatrix_t::HYB_ZO > &A)`

**13.170.1 Macro Definition Documentation****13.170.1.1 \_\_FFLASFFPACK\_fflas\_sparse\_HYB\_ZO\_utils\_INL**

```
#define __FFLASFFPACK_fflas_sparse_HYB_ZO_utils_INL
```

**13.171 read\_sparse.h File Reference**

```
#include "fflas-ffpack/fflas-ffpack-config.h"
#include <fstream>
#include <string>
#include <cstdlib>
#include <iterator>
```

## Data Structures

- struct [Coo< Field >](#)
- struct [readMyMachineType< Field, T >](#)
- struct [readMyMachineType< Field, mpz\\_t >](#)

## Namespaces

- namespace [FFLAS](#)
- namespace [FFLAS::details\\_spmv](#)

## Macros

- `#define` [DNS\\_BIN\\_VER](#) 0
- `#define` [mask\\_t](#) uint64\_t

## Functions

- `template<class Field, bool sorted = true, bool read_integer = false>`  
void [readSmsFormat](#) (const std::string &path, const [Field](#) &f, [index\\_t](#) \*&row, [index\\_t](#) \*&col, typename [Field::Element\\_ptr](#) &val, [index\\_t](#) &rowdim, [index\\_t](#) &coldim, uint64\_t &n nz)
- `template<class Field>`  
void [readSprFormat](#) (const std::string &path, const [Field](#) &f, [index\\_t](#) \*&row, [index\\_t](#) \*&col, typename [Field::Element\\_ptr](#) &val, [index\\_t](#) &rowdim, [index\\_t](#) &coldim, uint64\_t &n nz)
- `template<class T>`  
std::enable\_if< std::is\_integral< T >::value, int > [getDataType](#) ()
- `template<class T>`  
std::enable\_if< std::is\_floating\_point< T >::value, int > [getDataType](#) ()
- `template<class T>`  
std::enable\_if< std::is\_same< T, mpz\_t >::value, int > [getDataType](#) ()
- `template<class T>`  
int [getDataType](#) ()
- `template<class Field>`  
void [readMachineType](#) (const [Field](#) &F, typename [Field::Element](#) &modulo, typename [Field::Element\\_ptr](#) val, std::ifstream &file, const uint64\_t dims, const [mask\\_t](#) data\_type, const [mask\\_t](#) field\_desc)
- `template<class Field>`  
void [readDnsFormat](#) (const std::string &path, const [Field](#) &F, [index\\_t](#) &rowdim, [index\\_t](#) &coldim, typename [Field::Element\\_ptr](#) &val)
- `template<class Field>`  
void [writeDnsFormat](#) (const std::string &path, const [Field](#) &F, const [index\\_t](#) &rowdim, const [index\\_t](#) &coldim, typename [Field::Element\\_ptr](#) A, [index\\_t](#) ldA)

## 13.171.1 Macro Definition Documentation

### 13.171.1.1 DNS\_BIN\_VER

```
#define DNS_BIN_VER 0
```

### 13.171.1.2 mask\_t

```
#define mask_t uint64_t
```

## 13.172 sell.h File Reference

```
#include "fflas-ffpack/fflas/fflas_sparse/sell/sell_utils.inl"
#include "fflas-ffpack/fflas/fflas_sparse/sell/sell_spmv.inl"
```

**Data Structures**

- struct [Sparse<\\_Field, SparseMatrix\\_t::SELL >](#)
- struct [Sparse<\\_Field, SparseMatrix\\_t::SELL\\_ZO >](#)

**Namespaces**

- namespace [FFLAS](#)

**13.173 sell\_pspmv.inl File Reference****Namespaces**

- namespace [FFLAS](#)
- namespace [FFLAS::sparse\\_details\\_impl](#)

**Macros**

- `#define` [\\_\\_FFLASFFPACK\\_fflas\\_sparse\\_sell\\_pspmv\\_INL](#)

**Functions**

- `template<class Field>`  
void [pfpsmv](#) (const [Field](#) &F, const [Sparse<Field, SparseMatrix\\_t::SELL >](#) &A, typename [Field::ConstElement\\_ptr](#) x\_, typename [Field::Element\\_ptr](#) y\_, [FieldCategories::GenericTag](#))
- `template<class Field>`  
void [pfpsmv](#) (const [Field](#) &F, const [Sparse<Field, SparseMatrix\\_t::SELL >](#) &A, typename [Field::ConstElement\\_ptr](#) x\_, typename [Field::Element\\_ptr](#) y\_, [FieldCategories::UnparametricTag](#))
- `template<class Field>`  
void [pfpsmv](#) (const [Field](#) &F, const [Sparse<Field, SparseMatrix\\_t::SELL >](#) &A, typename [Field::ConstElement\\_ptr](#) x\_, typename [Field::Element\\_ptr](#) y\_, const int64\_t kmax)
- `template<class Field>`  
void [pfpsmv\\_one](#) (const [Field](#) &F, const [Sparse<Field, SparseMatrix\\_t::SELL\\_ZO >](#) &A, typename [Field::ConstElement\\_ptr](#) x\_, typename [Field::Element\\_ptr](#) y\_, [FieldCategories::GenericTag](#))
- `template<class Field>`  
void [pfpsmv\\_mone](#) (const [Field](#) &F, const [Sparse<Field, SparseMatrix\\_t::SELL\\_ZO >](#) &A, typename [Field::ConstElement\\_ptr](#) x\_, typename [Field::Element\\_ptr](#) y\_, [FieldCategories::GenericTag](#))
- `template<class Field>`  
void [pfpsmv\\_one](#) (const [Field](#) &F, const [Sparse<Field, SparseMatrix\\_t::SELL\\_ZO >](#) &A, typename [Field::ConstElement\\_ptr](#) x\_, typename [Field::Element\\_ptr](#) y\_, [FieldCategories::UnparametricTag](#))
- `template<class Field>`  
void [pfpsmv\\_mone](#) (const [Field](#) &F, const [Sparse<Field, SparseMatrix\\_t::SELL\\_ZO >](#) &A, typename [Field::ConstElement\\_ptr](#) x\_, typename [Field::Element\\_ptr](#) y\_, [FieldCategories::UnparametricTag](#))

**13.173.1 Macro Definition Documentation****13.173.1.1 \_\_FFLASFFPACK\_fflas\_sparse\_sell\_pspmv\_INL**

```
#define __FFLASFFPACK_fflas_sparse_sell_pspmv_INL
```

**13.174 sell\_spmv.inl File Reference****Namespaces**

- namespace [FFLAS](#)
- namespace [FFLAS::sparse\\_details\\_impl](#)

## Macros

- `#define __FFLASFFPACK_fflas_sparse_sell_spmv_INL`

## Functions

- `template<class Field>`  
`void fspmv (const Field &F, const Sparse< Field, SparseMatrix_t::SELL > &A, typename Field::ConstElement_ptr x_, typename Field::Element_ptr y_, FieldCategories::GenericTag)`
- `template<class Field>`  
`void fspmv_simd (const Field &F, const Sparse< Field, SparseMatrix_t::SELL > &A, typename Field::ConstElement_ptr x_, typename Field::Element_ptr y_, FieldCategories::UnparametricTag)`
- `template<class Field>`  
`void fspmv (const Field &F, const Sparse< Field, SparseMatrix_t::SELL > &A, typename Field::ConstElement_ptr x_, typename Field::Element_ptr y_, FieldCategories::UnparametricTag)`
- `template<class Field>`  
`void fspmv_simd (const Field &F, const Sparse< Field, SparseMatrix_t::SELL > &A, typename Field::ConstElement_ptr x_, typename Field::Element_ptr y_, const uint64_t kmax)`
- `template<class Field>`  
`void fspmv (const Field &F, const Sparse< Field, SparseMatrix_t::SELL > &A, typename Field::ConstElement_ptr x_, typename Field::Element_ptr y_, const uint64_t kmax)`
- `template<class Field>`  
`void fspmv_one (const Field &F, const Sparse< Field, SparseMatrix_t::SELL_ZO > &A, typename Field::ConstElement_ptr x_, typename Field::Element_ptr y_, FieldCategories::GenericTag)`
- `template<class Field>`  
`void fspmv_mone (const Field &F, const Sparse< Field, SparseMatrix_t::SELL_ZO > &A, typename Field::ConstElement_ptr x_, typename Field::Element_ptr y_, FieldCategories::GenericTag)`
- `template<class Field>`  
`void fspmv_one_simd (const Field &F, const Sparse< Field, SparseMatrix_t::SELL_ZO > &A, typename Field::ConstElement_ptr x_, typename Field::Element_ptr y_, FieldCategories::UnparametricTag)`
- `template<class Field>`  
`void fspmv_mone_simd (const Field &F, const Sparse< Field, SparseMatrix_t::SELL_ZO > &A, typename Field::ConstElement_ptr x_, typename Field::Element_ptr y_, FieldCategories::UnparametricTag)`
- `template<class Field>`  
`void fspmv_one (const Field &F, const Sparse< Field, SparseMatrix_t::SELL_ZO > &A, typename Field::ConstElement_ptr x_, typename Field::Element_ptr y_, FieldCategories::UnparametricTag)`
- `template<class Field>`  
`void fspmv_mone (const Field &F, const Sparse< Field, SparseMatrix_t::SELL_ZO > &A, typename Field::ConstElement_ptr x_, typename Field::Element_ptr y_, FieldCategories::UnparametricTag)`

## 13.174.1 Macro Definition Documentation

### 13.174.1.1 \_\_FFLASFFPACK\_fflas\_sparse\_sell\_spmv\_INL

```
#define __FFLASFFPACK_fflas_sparse_sell_spmv_INL
```

## 13.175 sell\_utils.inl File Reference

### Data Structures

- struct [Info](#)
- struct [Coo< ValT, IdxT >](#)

### Namespaces

- namespace [FFLAS](#)
- namespace [FFLAS::sell\\_details](#)

## Macros

- `#define __FFLASFFPACK_fflas_sparse_sell_utils_INL`

## Functions

- `template<class Field>`  
`void fspmv (const Field &F, const Sparse< Field, SparseMatrix_t::SELL_ZO > &A, typename Field::ConstElement_ptr x, typename Field::Element_ptr y, FieldCategories::ModularTag)`
- `template<class Field>`  
`void sparse_delete (const Sparse< Field, SparseMatrix_t::SELL > &A)`
- `template<class Field>`  
`void sparse_delete (const Sparse< Field, SparseMatrix_t::SELL_ZO > &A)`
- `template<class Field>`  
`void sparse_print (const Sparse< Field, SparseMatrix_t::SELL > &A)`
- `template<class Field, class IndexT>`  
`void sparse_init (const Field &F, Sparse< Field, SparseMatrix_t::SELL > &A, const IndexT *row, const IndexT *col, typename Field::ConstElement_ptr dat, uint64_t rowdim, uint64_t coldim, uint64_t nnz, uint64_t sigma=0)`
- `template<class Field, class IndexT>`  
`void sparse_init (const Field &F, Sparse< Field, SparseMatrix_t::SELL_ZO > &A, const IndexT *row, const IndexT *col, typename Field::ConstElement_ptr dat, uint64_t rowdim, uint64_t coldim, uint64_t nnz)`

## 13.175.1 Macro Definition Documentation

### 13.175.1.1 \_\_FFLASFFPACK\_fflas\_sparse\_sell\_utils\_INL

```
#define __FFLASFFPACK_fflas_sparse_sell_utils_INL
```

## 13.176 sparse\_matrix\_traits.h File Reference

```
#include <type_traits>
```

## Data Structures

- `struct isSparseMatrix< Field, M >`
- `struct isSparseMatrix< Field, Sparse< Field, SparseMatrix_t::CSR > >`
- `struct isSparseMatrix< Field, Sparse< Field, SparseMatrix_t::CSR_ZO > >`
- `struct isSparseMatrix< Field, Sparse< Field, SparseMatrix_t::COO > >`
- `struct isSparseMatrix< Field, Sparse< Field, SparseMatrix_t::COO_ZO > >`
- `struct isSparseMatrix< Field, Sparse< Field, SparseMatrix_t::ELL > >`
- `struct isSparseMatrix< Field, Sparse< Field, SparseMatrix_t::ELL_ZO > >`
- `struct isSparseMatrix< Field, Sparse< Field, SparseMatrix_t::SELL > >`
- `struct isSparseMatrix< Field, Sparse< Field, SparseMatrix_t::SELL_ZO > >`
- `struct isSparseMatrix< Field, Sparse< Field, SparseMatrix_t::ELL_simd > >`
- `struct isSparseMatrix< Field, Sparse< Field, SparseMatrix_t::ELL_simd_ZO > >`
- `struct isSparseMatrix< Field, Sparse< Field, SparseMatrix_t::CSR_HYB > >`
- `struct isSparseMatrix< Field, Sparse< Field, SparseMatrix_t::HYB_ZO > >`
- `struct isZOSparseMatrix< F, M >`
- `struct isZOSparseMatrix< Field, Sparse< Field, SparseMatrix_t::CSR_ZO > >`
- `struct isZOSparseMatrix< Field, Sparse< Field, SparseMatrix_t::COO_ZO > >`
- `struct isZOSparseMatrix< Field, Sparse< Field, SparseMatrix_t::ELL_ZO > >`
- `struct isZOSparseMatrix< Field, Sparse< Field, SparseMatrix_t::SELL_ZO > >`
- `struct isZOSparseMatrix< Field, Sparse< Field, SparseMatrix_t::ELL_simd_ZO > >`
- `struct isSparseMatrixSimdFormat< F, M >`
- `struct isSparseMatrixMKLFormat< F, M >`

- struct [tfn\\_plus](#)
- struct [tfn\\_mul](#)
- struct [tfn\\_mul\\_eq](#)
- struct [tfn\\_minus](#)
- struct [tfn\\_plus\\_eq](#)
- struct [tfn\\_minus\\_eq](#)
- struct [has\\_plus\\_impl](#)< C >
- struct [has\\_mul\\_impl](#)< C >
- struct [has\\_mul\\_eq\\_impl](#)< C >
- struct [has\\_plus\\_eq\\_impl](#)< C >
- struct [has\\_minus\\_eq\\_impl](#)< C >
- struct [has\\_minus\\_impl](#)< C >
- struct [has\\_operation](#)< T >

## Namespaces

- namespace [FFLAS](#)

## Typedefs

- using [ZOSparseMatrix](#) = std::true\_type
- using [NotZOSparseMatrix](#) = std::false\_type
- using [SimdSparseMatrix](#) = std::true\_type
- using [NoSimdSparseMatrix](#) = std::false\_type
- using [MKLSparseMatrixFormat](#) = std::true\_type
- using [NotMKLSparseMatrixFormat](#) = std::false\_type
- template<class T>  
using [has\\_plus](#) = typename std::conditional<std::is\_arithmetic<T>::value, std::true\_type, [has\\_plus\\_impl](#)<T>>::type
- template<class T>  
using [has\\_minus](#) = typename std::conditional<std::is\_arithmetic<T>::value, std::true\_type, [has\\_minus\\_impl](#)<T>>::type
- template<class T>  
using [has\\_equal](#) = typename std::conditional<std::is\_arithmetic<T>::value, std::true\_type, std::is\_copy\_assignable<T>>::type
- template<class T>  
using [has\\_plus\\_eq](#) = typename std::conditional<std::is\_arithmetic<T>::value, std::true\_type, [has\\_plus\\_eq\\_impl](#)<T>>::type
- template<class T>  
using [has\\_minus\\_eq](#) = typename std::conditional<std::is\_arithmetic<T>::value, std::true\_type, [has\\_minus\\_eq\\_impl](#)<T>>::type
- template<class T>  
using [has\\_mul](#) = typename std::conditional<std::is\_arithmetic<T>::value, std::true\_type, [has\\_mul\\_impl](#)<T>>::type
- template<class T>  
using [has\\_mul\\_eq](#) = typename std::conditional<std::is\_arithmetic<T>::value, std::true\_type, [has\\_mul\\_eq\\_impl](#)<T>>::type

## 13.177 utils.h File Reference

```
#include <algorithm>
#include <numeric>
#include <vector>
```

## Data Structures

- struct [StatsMatrix](#)

## Namespaces

- namespace [FFLAS](#)

## Functions

- template<class It>  
double [computeDeviation](#) (It begin, It end)
- template<class Field>  
[StatsMatrix](#) [getStat](#) (const [Field](#) &F, const [index\\_t](#) \*row, const [index\\_t](#) \*col, typename [Field::ConstElement\\_ptr](#) val, uint64\_t rowdim, uint64\_t coldim, uint64\_t nnz)

## 13.178 fflas\_transpose.h File Reference

transpose the storage of the matrix (switch between row and col major mode)

```
#include "fflas-ffpack/utils/debug.h"
#include "fflas-ffpack/fflas/fflas.h"
#include "fflas-ffpack/utils/fflas_memory.h"
#include "fflas-ffpack/fflas/fflas_simd.h"
```

## Data Structures

- struct [BlockTransposeSIMD](#)< [Field](#), [Simd](#), >

## Namespaces

- namespace [FFLAS](#)
- namespace [FFLAS::\\_fttranspose\\_impl](#)

## Macros

- #define [FFLAS\\_TRANSPOSE\\_BLOCKSIZE](#) 32
- #define [LD](#)(i)
- #define [ST](#)(i)

## Functions

- template<size\_t bs, typename [Field](#), typename BTSimd>  
void [not\\_inplace](#) (const [Field](#) &F, const BTSimd &BTS, const size\_t m, const size\_t n, typename [Field::ConstElement\\_ptr](#) A, const size\_t lda, typename [Field::Element\\_ptr](#) B, const size\_t ldb)
- template<size\_t bs, typename [Field](#), typename BTSimd>  
void [square\\_inplace](#) (const [Field](#) &F, const BTSimd &BTS, const size\_t m, typename [Field::Element\\_ptr](#) A, const size\_t lda)
- template<size\_t bs, typename [Field](#), typename BTSimd>  
void [nonsquare\\_inplace\\_v1](#) (const [Field](#) &F, const BTSimd &BTS, const size\_t m, const size\_t n, typename [Field::Element\\_ptr](#) A)
- template<size\_t bs, typename [Field](#), typename BTSimd>  
void [nonsquare\\_inplace\\_v2](#) (const [Field](#) &F, const BTSimd &BTS, const size\_t m, const size\_t n, typename [Field::Element\\_ptr](#) A)
- template<typename [Field](#), typename [Simd](#) = Simd<typename [Field::Element](#)>, size\_t bs = FFLAS\_TRANSPOSE\_BLOCKSIZE, typename std::enable\_if< Simd::template is\_same\_element< [Field](#) >::value >::type \* = nullptr, typename std::enable\_if< bs > = 1 && bs % Simd::vect\_size == 0, ::type \* = nullptr>  
[Field::Element\\_ptr](#) [transpose](#) (const [Field](#) &F, const size\_t m, const size\_t n, typename [Field::ConstElement\\_ptr](#) A, const size\_t lda, typename [Field::Element\\_ptr](#) B, const size\_t ldb)

### 13.178.1 Detailed Description

transpose the storage of the matrix (switch between row and col major mode)

### 13.178.2 Macro Definition Documentation

#### 13.178.2.1 FFLAS\_TRANSPOSE\_BLOCKSIZE

```
#define FFLAS_TRANSPOSE_BLOCKSIZE 32
```

#### 13.178.2.2 LD

```
#define LD(  
    i)
```

**Value:**

```
R##i=Simd::loadu(A+lda*i)
```

#### 13.178.2.3 ST

```
#define ST(  
    i)
```

**Value:**

```
Simd::storeu(B+ldb*i,R##i)
```

## 13.179 ffpack.dox File Reference

## 13.180 ffpack.h File Reference

Set of elimination based routines for dense linear algebra.

```
#include "givaro/givpoly1.h"  
#include <fflas-ffpack/fflas-ffpack-config.h>  
#include "fflas-ffpack/fflas/fflas.h"  
#include "fflas-ffpack/fflas/fflas_helpers.inl"  
#include <list>  
#include <vector>  
#include <iostream>  
#include <algorithm>  
#include "fflas-ffpack/checkers/checkers_ffpack.h"  
#include "ffpack_fgesv.inl"  
#include "ffpack_fgetrs.inl"  
#include "fflas-ffpack/checkers/checkers_ffpack.inl"  
#include "ffpack_pluq.inl"  
#include "ffpack_pluq_mp.inl"  
#include "ffpack_ppluq.inl"  
#include "ffpack_ludivine.inl"  
#include "ffpack_ludivine_mp.inl"  
#include "ffpack_echelonforms.inl"  
#include "ffpack_fsytrf.inl"  
#include "ffpack_invert.inl"  
#include "ffpack_ftrtr.inl"  
#include "ffpack_ftrstr.inl"  
#include "ffpack_ftrssyr2k.inl"  
#include "ffpack_charpoly_kglu.inl"  
#include "ffpack_charpoly_kgfast.inl"  
#include "ffpack_charpoly_kgfastgeneralized.inl"  
#include "ffpack_charpoly_danilevski.inl"  
#include "ffpack_charpoly.inl"  
#include "ffpack_frobenius.inl"
```



```
#include "ffpack_minpoly.inl"
#include "ffpack_krylovelim.inl"
#include "ffpack_permutation.inl"
#include "ffpack_rankprofiles.inl"
#include "ffpack_det_mp.inl"
#include "ffpack_bruhatgen.inl"
#include "ffpack.inl"
```

## Data Structures

- class [CharpolyFailed](#)

## Namespaces

- namespace [FFPACK](#)  
*Finite Field PACK Set of elimination based routines for dense linear algebra.*
- namespace [FFPACK::Protected](#)

## Macros

- `#define __FFLASFFPACK_FTRSTR_THRESHOLD 64`
- `#define __FFLASFFPACK_FTRSSYR2K_THRESHOLD 64`

## Functions

- void [LAPACKPerm2MathPerm](#) (size\_t \*MathP, const size\_t \*LapackP, const size\_t N)  
*Conversion of a permutation from LAPACK format to Math format.*
- void [MathPerm2LAPACKPerm](#) (size\_t \*LapackP, const size\_t \*MathP, const size\_t N)  
*Conversion of a permutation from Maths format to LAPACK format.*
- template<class [Field](#)>  
void [applyP](#) (const [Field](#) &F, const [FFLAS::FFLAS\\_SIDE](#) Side, const [FFLAS::FFLAS\\_TRANSPOSE](#) Trans, const size\_t M, const size\_t ibeg, const size\_t iend, typename [Field::Element\\_ptr](#) A, const size\_t lda, const size\_t \*P)  
*Computes  $P1 \times \text{Diag}(I_R, P2)$  where  $P1$  is a LAPACK and  $P2$  a LAPACK permutation and store the result in  $P1$  as a LAPACK permutation.*
- template<class [Field](#)>  
void [applyP](#) (const [Field](#) &F, const [FFLAS::FFLAS\\_SIDE](#) Side, const [FFLAS::FFLAS\\_TRANSPOSE](#) Trans, const size\_t m, const size\_t ibeg, const size\_t iend, typename [Field::Element\\_ptr](#) A, const size\_t lda, const size\_t \*P, const [FFLAS::ParSeqHelper::Sequential](#) seq)
- template<class [Field](#), class Cut, class Param>  
void [applyP](#) (const [Field](#) &F, const [FFLAS::FFLAS\\_SIDE](#) Side, const [FFLAS::FFLAS\\_TRANSPOSE](#) Trans, const size\_t m, const size\_t ibeg, const size\_t iend, typename [Field::Element\\_ptr](#) A, const size\_t lda, const size\_t \*P, const [FFLAS::ParSeqHelper::Parallel](#)< Cut, Param > par)
- template<class [Field](#)>  
void [MonotonicApplyP](#) (const [Field](#) &F, const [FFLAS::FFLAS\\_SIDE](#) Side, const [FFLAS::FFLAS\\_TRANSPOSE](#) Trans, const size\_t M, const size\_t ibeg, const size\_t iend, typename [Field::Element\\_ptr](#) A, const size\_t lda, const size\_t \*P, const size\_t R)  
*Apply a R-monotonically increasing permutation P, to the matrix A.*
- template<class [Field](#)>  
void [fgetrs](#) (const [Field](#) &F, const [FFLAS::FFLAS\\_SIDE](#) Side, const size\_t M, const size\_t N, const size\_t R, typename [Field::Element\\_ptr](#) A, const size\_t lda, const size\_t \*P, const size\_t \*Q, typename [Field::Element\\_ptr](#) B, const size\_t ldb, int \*info)  
*Solve the system  $AX = B$  or  $XA = B$ .*

- `template<class Field>`  
`Field::Element_ptr fgetrs (const Field &F, const FFLAS::FFLAS_SIDE Side, const size_t M, const size_t N, const size_t NRHS, const size_t R, typename Field::Element_ptr A, const size_t lda, const size_t *P, const size_t *Q, typename Field::Element_ptr X, const size_t ldx, typename Field::ConstElement_ptr B, const size_t ldb, int *info)`  
*Solve the system  $A X = B$  or  $X A = B$ .*
- `template<class Field>`  
`size_t fgesv (const Field &F, const FFLAS::FFLAS_SIDE Side, const size_t M, const size_t N, typename Field::Element_ptr A, const size_t lda, typename Field::Element_ptr B, const size_t ldb, int *info)`  
*Square system solver.*
- `template<class Field>`  
`size_t fgesv (const Field &F, const FFLAS::FFLAS_SIDE Side, const size_t M, const size_t N, const size_t NRHS, typename Field::Element_ptr A, const size_t lda, typename Field::Element_ptr X, const size_t ldx, typename Field::ConstElement_ptr B, const size_t ldb, int *info)`  
*Rectangular system solver.*
- `template<class Field>`  
`void ftrtri (const Field &F, const FFLAS::FFLAS_UPLO Uplo, const FFLAS::FFLAS_DIAG Diag, const size_t N, typename Field::Element_ptr A, const size_t lda, const size_t threshold=__FFLASFFPACK_FTRTRI_THRESHOLD)`  
*Compute the inverse of a triangular matrix.*
- `template<class Field>`  
`void trinv_left (const Field &F, const size_t N, typename Field::ConstElement_ptr L, const size_t ldl, typename Field::Element_ptr X, const size_t ldx)`
- `template<class Field>`  
`void ftrtrm (const Field &F, const FFLAS::FFLAS_SIDE side, const FFLAS::FFLAS_DIAG diag, const size_t N, typename Field::Element_ptr A, const size_t lda)`  
*Compute the product of two triangular matrices of opposite shape.*
- `template<class Field>`  
`void ftrstr (const Field &F, const FFLAS::FFLAS_SIDE side, const FFLAS::FFLAS_UPLO Uplo, const FFLAS::FFLAS_DIAG diagA, const FFLAS::FFLAS_DIAG diagB, const size_t N, typename Field::ConstElement_ptr A, const size_t lda, typename Field::Element_ptr B, const size_t ldb, const size_t threshold=__FFLASFFPACK_FTRSTR_THRESHOLD)`  
*Solve a triangular system with a triangular right hand side of the same shape.*
- `template<class Field>`  
`void ftrssyr2k (const Field &F, const FFLAS::FFLAS_UPLO Uplo, const FFLAS::FFLAS_DIAG diagA, const size_t N, typename Field::ConstElement_ptr A, const size_t lda, typename Field::Element_ptr B, const size_t ldb, const size_t threshold=__FFLASFFPACK_FTRSSYR2K_THRESHOLD)`  
*Solve a triangular system in a symmetric sum: find  $B$  upper/lower triangular such that  $A^T B + B^T A = C$  where  $C$  is symmetric.*
- `template<class Field>`  
`bool fsytrf (const Field &F, const FFLAS::FFLAS_UPLO UpLo, const size_t N, typename Field::Element_ptr A, const size_t lda, const size_t threshold=__FFLASFFPACK_FSYTRF_THRESHOLD)`  
*Triangular factorization of symmetric matrices.*
- `template<class Field>`  
`bool fsytrf (const Field &F, const FFLAS::FFLAS_UPLO UpLo, const size_t N, typename Field::Element_ptr A, const size_t lda, const FFLAS::ParSeqHelper::Sequential seq, const size_t threshold=__FFLASFFPACK_FSYTRF_THRESHOLD)`
- `template<class Field, class Cut, class Param>`  
`bool fsytrf (const Field &F, const FFLAS::FFLAS_UPLO UpLo, const size_t N, typename Field::Element_ptr A, const size_t lda, const FFLAS::ParSeqHelper::Parallel< Cut, Param > par, const size_t threshold=__FFLASFFPACK_FSYTRF_THRESHOLD)`
- `template<class Field>`  
`bool fsytrf_nonunit (const Field &F, const FFLAS::FFLAS_UPLO UpLo, const size_t N, typename Field::Element_ptr A, const size_t lda, typename Field::Element_ptr D, const size_t incD, const size_t threshold=__FFLASFFPACK_FSYTRF_THRESHOLD)`  
*Triangular factorization of symmetric matrices.*
- `template<class Field>`  
`size_t PLUQ (const Field &F, const FFLAS::FFLAS_DIAG Diag, const size_t M, const size_t N, typename Field::Element_ptr A, const size_t lda, size_t *P, size_t *Q)`

*Compute a PLUQ factorization of the given matrix.*

- `template<class Field>`  
`size_t pPLUQ (const Field &F, const FFLAS::FFLAS_DIAG Diag, const size_t M, const size_t N, typename Field::Element_ptr A, const size_t lda, size_t *P, size_t *Q)`
- `template<class Field>`  
`size_t PLUQ (const Field &F, const FFLAS::FFLAS_DIAG Diag, const size_t M, const size_t N, typename Field::Element_ptr A, const size_t lda, size_t *P, size_t *Q, const FFLAS::ParSeqHelper::Sequential &PSHelper, size_t BCThreshold=__FFLASFFPACK_PLUQ_THRESHOLD)`
- `template<class Field, class Cut, class Param>`  
`size_t PLUQ (const Field &F, const FFLAS::FFLAS_DIAG Diag, const size_t M, const size_t N, typename Field::Element_ptr A, const size_t lda, size_t *P, size_t *Q, const FFLAS::ParSeqHelper::Parallel< Cut, Param > &PSHelper)`
- `template<class Field>`  
`size_t LUdivine (const Field &F, const FFLAS::FFLAS_DIAG Diag, const FFLAS::FFLAS_TRANSPOSE trans, const size_t M, const size_t N, typename Field::Element_ptr A, const size_t lda, size_t *P, size_t *Qt, const FFPACK_LU_TAG LuTag=FfpackSlabRecursive, const size_t cutoff=__FFLASFFPACK_LUDIVINE_THRESHOLD)`

*Compute the CUP or PLE factorization of the given matrix.*

- `template<class Field>`  
`size_t LUdivine_construct (const Field &F, const FFLAS::FFLAS_DIAG Diag, const size_t M, const size_t N, typename Field::ConstElement_ptr A, const size_t lda, typename Field::Element_ptr X, const size_t ldx, typename Field::Element_ptr u, const size_t incu, size_t *P, bool computeX, const FFPACK_MINPOLY_TAG MinTag=FfpackDense, const size_t kg_mc=0, const size_t kg_mb=0, const size_t kg_j=0)`
- `template<class Field>`  
`size_t ColumnEchelonForm (const Field &F, const size_t M, const size_t N, typename Field::Element_ptr A, const size_t lda, size_t *P, size_t *Qt, bool transform=false, const FFPACK_LU_TAG LuTag=FfpackSlabRecursive)`

*Compute the Column Echelon form of the input matrix in-place.*

- `template<class Field>`  
`size_t pColumnEchelonForm (const Field &F, const size_t M, const size_t N, typename Field::Element_ptr A, const size_t lda, size_t *P, size_t *Qt, bool transform=false, size_t numthreads=0, const FFPACK_LU_TAG LuTag=FfpackTileRecursive)`
- `template<class Field, class PSHelper>`  
`size_t ColumnEchelonForm (const Field &F, const size_t M, const size_t N, typename Field::Element_ptr A, const size_t lda, size_t *P, size_t *Qt, const bool transform, const FFPACK_LU_TAG LuTag, const PSHelper &psH)`
- `template<class Field>`  
`size_t RowEchelonForm (const Field &F, const size_t M, const size_t N, typename Field::Element_ptr A, const size_t lda, size_t *P, size_t *Qt, const bool transform=false, const FFPACK_LU_TAG LuTag=FfpackSlabRecursive)`

*Compute the Row Echelon form of the input matrix in-place.*

- `template<class Field>`  
`size_t pRowEchelonForm (const Field &F, const size_t M, const size_t N, typename Field::Element_ptr A, const size_t lda, size_t *P, size_t *Qt, const bool transform=false, size_t numthreads=0, const FFPACK_LU_TAG LuTag=FfpackTileRecursive)`
- `template<class Field, class PSHelper>`  
`size_t RowEchelonForm (const Field &F, const size_t M, const size_t N, typename Field::Element_ptr A, const size_t lda, size_t *P, size_t *Qt, const bool transform, const FFPACK_LU_TAG LuTag, const PSHelper &psH)`
- `template<class Field>`  
`size_t ReducedColumnEchelonForm (const Field &F, const size_t M, const size_t N, typename Field::Element_ptr A, const size_t lda, size_t *P, size_t *Qt, const bool transform=false, const FFPACK_LU_TAG LuTag=FfpackSlabRecursive)`

*Compute the Reduced Column Echelon form of the input matrix in-place.*

- `template<class Field>`  
`size_t pReducedColumnEchelonForm (const Field &F, const size_t M, const size_t N, typename`

- `Field::Element_ptr A, const size_t lda, size_t *P, size_t *Qt, const bool transform=false, size_t numthreads=0, const FFPACK_LU_TAG LuTag=FfpackTileRecursive)`
- `template<class Field, class PSHelper>`  
`size_t ReducedColumnEchelonForm (const Field &F, const size_t M, const size_t N, typename Field::Element_ptr A, const size_t lda, size_t *P, size_t *Qt, const bool transform, const FFPACK_LU_TAG LuTag, const PSHelper &psH)`
  - `template<class Field>`  
`size_t ReducedRowEchelonForm (const Field &F, const size_t M, const size_t N, typename Field::Element_ptr A, const size_t lda, size_t *P, size_t *Qt, const bool transform=false, const FFPACK_LU_TAG LuTag=FfpackSlabRecursive)`  
*Compute the Reduced Row Echelon form of the input matrix in-place.*
  - `template<class Field>`  
`size_t pReducedRowEchelonForm (const Field &F, const size_t M, const size_t N, typename Field::Element_ptr A, const size_t lda, size_t *P, size_t *Qt, const bool transform=false, size_t numthreads=0, const FFPACK_LU_TAG LuTag=FfpackTileRecursive)`
  - `template<class Field, class PSHelper>`  
`size_t ReducedRowEchelonForm (const Field &F, const size_t M, const size_t N, typename Field::Element_ptr A, const size_t lda, size_t *P, size_t *Qt, const bool transform, const FFPACK_LU_TAG LuTag, const PSHelper &psH)`
  - `template<class Field>`  
`size_t GaussJordan (const Field &F, const size_t M, const size_t N, typename Field::Element_ptr A, const size_t lda, const size_t colbeg, const size_t rowbeg, const size_t colsize, size_t *P, size_t *Q, const FFPACK::FFPACK_LU_TAG LuTag)`  
*Gauss-Jordan algorithm computing the Reduced Row echelon form and its transform matrix.*
  - `template<class Field>`  
`Field::Element_ptr Invert (const Field &F, const size_t M, typename Field::Element_ptr A, const size_t lda, int &>nullity)`  
*Invert the given matrix in place or computes its nullity if it is singular.*
  - `template<class Field>`  
`Field::Element_ptr Invert (const Field &F, const size_t M, typename Field::ConstElement_ptr A, const size_t lda, typename Field::Element_ptr X, const size_t ldx, int &>nullity)`  
*Invert the given matrix or computes its nullity if it is singular.*
  - `template<class Field>`  
`Field::Element_ptr Invert2 (const Field &F, const size_t M, typename Field::Element_ptr A, const size_t lda, typename Field::Element_ptr X, const size_t ldx, int &>nullity)`  
*Invert the given matrix or computes its nullity if it is singular.*
  - `template<class PolRing>`  
`std::list< typename PolRing::Element > & CharPoly (const PolRing &R, std::list< typename PolRing::Element > &charp, const size_t N, typename PolRing::Domain_t::Element_ptr A, const size_t lda, typename PolRing::Domain_t::RandIter &G, const FFPACK_CHARPOLY_TAG CharpTag=FfpackAuto, const size_t degree=__FFLASFFPACK_ARITHPROG_THRESHOLD)`  
*Compute the characteristic polynomial of the matrix A.*
  - `template<class PolRing>`  
`PolRing::Element & CharPoly (const PolRing &R, typename PolRing::Element &charp, const size_t N, typename PolRing::Domain_t::Element_ptr A, const size_t lda, typename PolRing::Domain_t::RandIter &G, const FFPACK_CHARPOLY_TAG CharpTag=FfpackAuto, const size_t degree=__FFLASFFPACK_ARITHPROG_THRESHOLD)`  
*Compute the characteristic polynomial of the matrix A.*
  - `template<class PolRing>`  
`PolRing::Element & CharPoly (const PolRing &R, typename PolRing::Element &charp, const size_t N, typename PolRing::Domain_t::Element_ptr A, const size_t lda, const FFPACK_CHARPOLY_TAG CharpTag=FfpackAuto, const size_t degree=__FFLASFFPACK_ARITHPROG_THRESHOLD)`  
*Compute the characteristic polynomial of the matrix A.*
  - `template<class Field, class Polynomial>`  
`std::list< Polynomial > & KellerGehrig (const Field &F, std::list< Polynomial > &charp, const size_t N, typename Field::ConstElement_ptr A, const size_t lda)`

- template<class [Field](#), class Polynomial>  
int [KGFast](#) (const [Field](#) &F, std::list< Polynomial > &charp, const size\_t N, typename [Field::Element\\_ptr](#) A, const size\_t lda, size\_t \*kg\_mc, size\_t \*kg\_mb, size\_t \*kg\_j)
- template<class [Field](#), class Polynomial>  
std::list< Polynomial > & [KGFast\\_generalized](#) (const [Field](#) &F, std::list< Polynomial > &charp, const size\_t N, typename [Field::Element\\_ptr](#) A, const size\_t lda)
- template<class [Field](#)>  
void [fgemv\\_kgf](#) (const [Field](#) &F, const size\_t N, typename [Field::ConstElement\\_ptr](#) A, const size\_t lda, typename [Field::ConstElement\\_ptr](#) X, const size\_t incX, typename [Field::Element\\_ptr](#) Y, const size\_t incY, const size\_t kg\_mc, const size\_t kg\_mb, const size\_t kg\_j)
- template<class [Field](#), class Polynomial, class RandIter>  
std::list< Polynomial > & [LUKrylov](#) (const [Field](#) &F, std::list< Polynomial > &charp, const size\_t N, typename [Field::Element\\_ptr](#) A, const size\_t lda, typename [Field::Element\\_ptr](#) U, const size\_t ldu, RandIter &G)
- template<class [Field](#), class Polynomial>  
std::list< Polynomial > & [Danilevski](#) (const [Field](#) &F, std::list< Polynomial > &charp, const size\_t N, typename [Field::Element\\_ptr](#) A, const size\_t lda)
- template<class PolRing>  
void [RandomKrylovPrecond](#) (const PolRing &PR, std::list< typename PolRing::Element > &completed, Factors, const size\_t N, typename PolRing::Domain\_t::Element\_ptr A, const size\_t lda, size\_t &Nb, typename PolRing::Domain\_t::Element\_ptr &B, size\_t &ldb, typename PolRing::Domain\_t::RandIter &g, const size\_t degree=\_\_FFLASFFPACK\_ARITHPROG\_THRESHOLD)
- template<class PolRing>  
std::list< typename PolRing::Element > & [ArithProg](#) (const PolRing &PR, std::list< typename PolRing::Element > &frobeniusForm, const size\_t N, typename PolRing::Domain\_t::Element\_ptr A, const size\_t lda, const size\_t degree)
- template<class [Field](#), class Polynomial>  
std::list< Polynomial > & [LUKrylov\\_KGFast](#) (const [Field](#) &F, std::list< Polynomial > &charp, const size\_t N, typename [Field::Element\\_ptr](#) A, const size\_t lda, typename [Field::Element\\_ptr](#) X, const size\_t ldx)
- template<class [Field](#), class Polynomial>  
Polynomial & [MinPoly](#) (const [Field](#) &F, Polynomial &minP, const size\_t N, typename [Field::ConstElement\\_ptr](#) A, const size\_t lda)  
*Compute the minimal polynomial of the matrix A.*
- template<class [Field](#), class Polynomial, class RandIter>  
Polynomial & [MinPoly](#) (const [Field](#) &F, Polynomial &minP, const size\_t N, typename [Field::ConstElement\\_ptr](#) A, const size\_t lda, RandIter &G)  
*Compute the minimal polynomial of the matrix A.*
- template<class [Field](#), class Polynomial>  
Polynomial & [MatVecMinPoly](#) (const [Field](#) &F, Polynomial &minP, const size\_t N, typename [Field::ConstElement\\_ptr](#) A, const size\_t lda, typename [Field::ConstElement\\_ptr](#) v, const size\_t incv)  
*Compute the minimal polynomial of the matrix A and a vector v, namely the first linear dependency relation in the Krylov basis  $(v, Av, \dots, A^N v)$ .*
- template<class [Field](#), class Polynomial>  
Polynomial & [MatVecMinPoly](#) (const [Field](#) &F, Polynomial &minP, const size\_t N, typename [Field::ConstElement\\_ptr](#) A, const size\_t lda, typename [Field::Element\\_ptr](#) v, const size\_t incv, typename [Field::Element\\_ptr](#) K, const size\_t ldk, size\_t \*P)
- template<class [Field](#), class Polynomial>  
Polynomial & [Hybrid\\_KGF\\_LUK\\_MinPoly](#) (const [Field](#) &F, Polynomial &minP, const size\_t N, typename [Field::ConstElement\\_ptr](#) A, const size\_t lda, typename [Field::Element\\_ptr](#) X, const size\_t ldx, size\_t \*P, const FFPACK\_MINPOLY\_TAG MinTag=FFPACK::FpackDense, const size\_t kg\_mc=0, const size\_t kg\_mb=0, const size\_t kg\_j=0)
- template<class [Field](#)>  
size\_t [Rank](#) (const [Field](#) &F, const size\_t M, const size\_t N, typename [Field::Element\\_ptr](#) A, const size\_t lda)  
*Computes the rank of the given matrix using a PLUQ factorization.*
- template<class [Field](#)>  
size\_t [pRank](#) (const [Field](#) &F, const size\_t M, const size\_t N, typename [Field::Element\\_ptr](#) A, const size\_t lda, size\_t numthreads=0)

- `template<class Field, class PSHelper>`  
`size_t Rank (const Field &F, const size_t M, const size_t N, typename Field::Element_ptr A, const size_t lda, const PSHelper &psH)`
- `template<class Field>`  
`bool IsSingular (const Field &F, const size_t M, const size_t N, typename Field::Element_ptr A, const size_t lda)`  
*Returns true if the given matrix is singular.*
- `template<class Field>`  
`Field::Element & Det (const Field &F, typename Field::Element &det, const size_t N, typename Field::Element_ptr A, const size_t lda, size_t *P=NULL, size_t *Q=NULL)`  
*Returns the determinant of the given square matrix.*
- `template<class Field>`  
`Field::Element & pDet (const Field &F, typename Field::Element &det, const size_t N, typename Field::Element_ptr A, const size_t lda, size_t numthreads=0, size_t *P=NULL, size_t *Q=NULL)`
- `template<class Field, class PSHelper>`  
`Field::Element & Det (const Field &F, typename Field::Element &det, const size_t N, typename Field::Element_ptr A, const size_t lda, const PSHelper &psH, size_t *P=NULL, size_t *Q=NULL)`
- `template<class Field>`  
`Field::Element_ptr Solve (const Field &F, const size_t M, typename Field::Element_ptr A, const size_t lda, typename Field::Element_ptr x, const int incx, typename Field::ConstElement_ptr b, const int incb)`  
*Solves a linear system  $AX = b$  using PLUQ factorization.*
- `template<class Field, class PSHelper>`  
`Field::Element_ptr Solve (const Field &F, const size_t M, typename Field::Element_ptr A, const size_t lda, typename Field::Element_ptr x, const int incx, typename Field::ConstElement_ptr b, const int incb, PSHelper &psH)`
- `template<class Field>`  
`Field::Element_ptr pSolve (const Field &F, const size_t M, typename Field::Element_ptr A, const size_t lda, typename Field::Element_ptr x, const int incx, typename Field::ConstElement_ptr b, const int incb, size_t numthreads=0)`
- `template<class Field>`  
`*void RandomNullSpaceVector (const Field &F, const FFLAS::FFLAS_SIDE Side, const size_t M, const size_t N, typename Field::Element_ptr A, const size_t lda, typename Field::Element_ptr X, const size_t incX)`  
*Solve  $LX = B$  or  $XL = B$  in place.*
- `template<class Field>`  
`size_t NullSpaceBasis (const Field &F, const FFLAS::FFLAS_SIDE Side, const size_t M, const size_t N, typename Field::Element_ptr A, const size_t lda, typename Field::Element_ptr &NS, size_t &ldn, size_t &NSdim)`  
*Computes a basis of the Left/Right nullspace of the matrix A.*
- `template<class Field>`  
`size_t RowRankProfile (const Field &F, const size_t M, const size_t N, typename Field::Element_ptr A, const size_t lda, size_t *&rkprofile, const FFPACK_LU_TAG LuTag=FpackSlabRecursive)`  
*Computes the row rank profile of A.*
- `template<class Field>`  
`size_t pRowRankProfile (const Field &F, const size_t M, const size_t N, typename Field::Element_ptr A, const size_t lda, size_t *&rkprofile, size_t numthreads=0, const FFPACK_LU_TAG LuTag=FpackTileRecursive)`
- `template<class Field, class PSHelper>`  
`size_t RowRankProfile (const Field &F, const size_t M, const size_t N, typename Field::Element_ptr A, const size_t lda, size_t *&rkprofile, const FFPACK_LU_TAG LuTag, PSHelper &psH)`
- `template<class Field>`  
`size_t ColumnRankProfile (const Field &F, const size_t M, const size_t N, typename Field::Element_ptr A, const size_t lda, size_t *&rkprofile, const FFPACK_LU_TAG LuTag=FpackSlabRecursive)`  
*Computes the column rank profile of A.*
- `template<class Field>`  
`size_t pColumnRankProfile (const Field &F, const size_t M, const size_t N, typename Field::Element_ptr A, const size_t lda, size_t *&rkprofile, size_t numthreads=0, const FFPACK_LU_TAG LuTag=FpackTileRecursive)`



- template<class [Field](#), class PSHelper>  
size\_t [ColumnRankProfile](#) (const [Field](#) &F, const size\_t M, const size\_t N, typename [Field::Element\\_ptr](#) A, const size\_t lda, size\_t \*rkprofile, const FFPACK\_LU\_TAG LuTag, PSHelper &psH)
- void [RankProfileFromLU](#) (const size\_t \*P, const size\_t N, const size\_t R, size\_t \*rkprofile, const FFPACK\_LU\_TAG LuTag)  
*Recovers the column/row rank profile from the permutation of an LU decomposition.*
- size\_t [LeadingSubmatrixRankProfiles](#) (const size\_t M, const size\_t N, const size\_t R, const size\_t LSm, const size\_t LSn, const size\_t \*P, const size\_t \*Q, size\_t \*RRP, size\_t \*CRP)  
*Recovers the row and column rank profiles of any leading submatrix from the PLUQ decomposition.*
- template<class [Field](#)>  
size\_t [RowRankProfileSubmatrixIndices](#) (const [Field](#) &F, const size\_t M, const size\_t N, typename [Field::Element\\_ptr](#) A, const size\_t lda, size\_t \*rowindices, size\_t \*colindices, size\_t &R)  
*RowRankProfileSubmatrixIndices.*
- template<class [Field](#)>  
size\_t [ColRankProfileSubmatrixIndices](#) (const [Field](#) &F, const size\_t M, const size\_t N, typename [Field::Element\\_ptr](#) A, const size\_t lda, size\_t \*rowindices, size\_t \*colindices, size\_t &R)  
*Computes the indices of the submatrix  $r \times r$  X of A whose columns correspond to the column rank profile of A.*
- template<class [Field](#)>  
size\_t [RowRankProfileSubmatrix](#) (const [Field](#) &F, const size\_t M, const size\_t N, typename [Field::Element\\_ptr](#) A, const size\_t lda, typename [Field::Element\\_ptr](#) &X, size\_t &R)  
*Computes the  $r \times r$  submatrix X of A, by picking the row rank profile rows of A.*
- template<class [Field](#)>  
size\_t [ColRankProfileSubmatrix](#) (const [Field](#) &F, const size\_t M, const size\_t N, typename [Field::Element\\_ptr](#) A, const size\_t lda, typename [Field::Element\\_ptr](#) &X, size\_t &R)  
*Compute the  $r \times r$  submatrix X of A, by picking the row rank profile rows of A.*
- template<class [Field](#)>  
void [getTriangular](#) (const [Field](#) &F, const FFLAS::FFLAS\_UPLO Uplo, const FFLAS::FFLAS\_DIAG diag, const size\_t M, const size\_t N, const size\_t R, typename [Field::ConstElement\\_ptr](#) A, const size\_t lda, typename [Field::Element\\_ptr](#) T, const size\_t ldt, const bool OnlyNonZeroVectors=false)  
*Extracts a triangular matrix from a compact storage  $A=L\backslash U$  of rank R.*
- template<class [Field](#)>  
void [getTriangular](#) (const [Field](#) &F, const FFLAS::FFLAS\_UPLO Uplo, const FFLAS::FFLAS\_DIAG diag, const size\_t M, const size\_t N, const size\_t R, typename [Field::Element\\_ptr](#) A, const size\_t lda)  
*Cleans up a compact storage  $A=L\backslash U$  to reveal a triangular matrix of rank R.*
- template<class [Field](#)>  
void [getEchelonForm](#) (const [Field](#) &F, const FFLAS::FFLAS\_UPLO Uplo, const FFLAS::FFLAS\_DIAG diag, const size\_t M, const size\_t N, const size\_t R, const size\_t \*P, typename [Field::ConstElement\\_ptr](#) A, const size\_t lda, typename [Field::Element\\_ptr](#) T, const size\_t ldt, const bool OnlyNonZeroVectors=false, const FFPACK\_LU\_TAG LuTag=[FfpackSlabRecursive](#))  
*Extracts a matrix in echelon form from a compact storage  $A=L\backslash U$  of rank R obtained by RowEchelonForm or ColumnEchelonForm.*
- template<class [Field](#)>  
void [getEchelonForm](#) (const [Field](#) &F, const FFLAS::FFLAS\_UPLO Uplo, const FFLAS::FFLAS\_DIAG diag, const size\_t M, const size\_t N, const size\_t R, const size\_t \*P, typename [Field::Element\\_ptr](#) A, const size\_t lda, const FFPACK\_LU\_TAG LuTag=[FfpackSlabRecursive](#))  
*Cleans up a compact storage  $A=L\backslash U$  obtained by RowEchelonForm or ColumnEchelonForm to reveal an echelon form of rank R.*
- template<class [Field](#)>  
void [getEchelonTransform](#) (const [Field](#) &F, const FFLAS::FFLAS\_UPLO Uplo, const FFLAS::FFLAS\_DIAG diag, const size\_t M, const size\_t N, const size\_t R, const size\_t \*P, const size\_t \*Q, typename [Field::ConstElement\\_ptr](#) A, const size\_t lda, typename [Field::Element\\_ptr](#) T, const size\_t ldt, const FFPACK\_LU\_TAG LuTag=[FfpackSlabRecursive](#))  
*Extracts a transformation matrix to echelon form from a compact storage  $A=L\backslash U$  of rank R obtained by RowEchelonForm or ColumnEchelonForm.*

- `template<class Field>`  
`void getReducedEchelonForm (const Field &F, const FFLAS::FFLAS_UPLO Uplo, const size_t M, const size_t N, const size_t R, const size_t *P, typename Field::ConstElement_ptr A, const size_t Ida, typename Field::Element_ptr T, const size_t ldt, const bool OnlyNonZeroVectors=false, const FFPACK_LU_TAG LuTag=FFpackSlabRecursive)`  
*Extracts a matrix in echelon form from a compact storage  $A=L\backslash U$  of rank  $R$  obtained by `ReducedRowEchelonForm` or `ReducedColumnEchelonForm` with `transform = true`.*
- `template<class Field>`  
`void getReducedEchelonForm (const Field &F, const FFLAS::FFLAS_UPLO Uplo, const size_t M, const size_t N, const size_t R, const size_t *P, typename Field::Element_ptr A, const size_t Ida, const FFPACK_LU_TAG LuTag=FFpackSlabRecursive)`  
*Cleans up a compact storage  $A=L\backslash U$  of rank  $R$  obtained by `ReducedRowEchelonForm` or `ReducedColumnEchelonForm` with `transform = true`.*
- `template<class Field>`  
`void getReducedEchelonTransform (const Field &F, const FFLAS::FFLAS_UPLO Uplo, const size_t M, const size_t N, const size_t R, const size_t *P, const size_t *Q, typename Field::ConstElement_ptr A, const size_t Ida, typename Field::Element_ptr T, const size_t ldt, const FFPACK_LU_TAG LuTag=FFpackSlabRecursive)`  
*Extracts a transformation matrix to echelon form from a compact storage  $A=L\backslash U$  of rank  $R$  obtained by `RowEchelonForm` or `ColumnEchelonForm`.*
- `void PLUQtoEchelonPermutation (const size_t N, const size_t R, const size_t *P, size_t *outPerm)`  
*Auxiliary routine: determines the permutation that changes a PLUQ decomposition into a echelon form revealing PLUQ decomposition.*
- `template<class Field>`  
`size_t LTBruhatGen (const Field &Fi, const FFLAS::FFLAS_DIAG diag, const size_t N, typename Field::Element_ptr A, const size_t Ida, size_t *P, size_t *Q)`  
*LTBruhatGen Suppose  $A$  is Left Triangular Matrix This procedure computes the Bruhat Representation of  $A$  and return the rank of  $A$ .*
- `template<class Field>`  
`void getLTBruhatGen (const Field &Fi, const size_t N, const size_t r, const size_t *P, const size_t *Q, typename Field::Element_ptr R, const size_t ldr)`  
*GetLTBruhatGen This procedure Computes the Rank Revealing Matrix based on the Bruhta representation of a Matrix.*
- `template<class Field>`  
`void getLTBruhatGen (const Field &Fi, const FFLAS::FFLAS_UPLO Uplo, const FFLAS::FFLAS_DIAG diag, const size_t N, const size_t r, const size_t *P, const size_t *Q, typename Field::ConstElement_ptr A, const size_t Ida, typename Field::Element_ptr T, const size_t ldt)`  
*GetLTBruhatGen This procedure computes the matrix  $L$  or  $U$  f the Bruhat Representation Suppose that  $A$  is the bruhat representation of a matrix.*
- `size_t LTQSorder (const size_t N, const size_t r, const size_t *P, const size_t *Q)`  
*LTQSorder This procedure computes the order of quasiseparability of a matrix.*
- `template<class Field>`  
`size_t CompressToBlockBiDiagonal (const Field &Fi, const FFLAS::FFLAS_UPLO Uplo, size_t N, size_t s, size_t r, const size_t *P, const size_t *Q, typename Field::Element_ptr A, size_t Ida, typename Field::Element_ptr X, size_t ldx, size_t *K, size_t *M, size_t *T)`  
*CompressToBlockBiDiagonal This procedure compress a compact representation of a row echelon form or column echelon form.*
- `template<class Field>`  
`void ExpandBlockBiDiagonalToBruhat (const Field &Fi, const FFLAS::FFLAS_UPLO Uplo, size_t N, size_t s, size_t r, typename Field::Element_ptr A, size_t Ida, typename Field::Element_ptr X, size_t ldx, size_t NbBlocks, size_t *K, size_t *M, size_t *T)`  
*ExpandBlockBiDiagonal This procedure expand a compact representation of a row echelon form or column echelon form.*
- `void Bruhat2EchelonPermutation (size_t N, size_t R, const size_t *P, const size_t *Q, size_t *M)`  
*Bruhat2EchelonPermutation ( $N, R, P, Q$ ) Compute  $M$  such that  $LM$  or  $MU$  is in echelon form where  $L$  or  $U$  are factors of the Bruhat Representation.*
- `size_t * Tinverter (size_t *T, size_t r)`



- template<class [Field](#)>  
void [ComputeRPermutation](#) (const [Field](#) &Fi, size\_t N, size\_t r, const size\_t \*P, const size\_t \*Q, size\_t \*R, size\_t \*MU, size\_t \*ML)
- template<class [Field](#)>  
void [productBruhatxTS](#) (const [Field](#) &Fi, size\_t N, size\_t s, size\_t r, const size\_t \*P, const size\_t \*Q, const typename [Field::Element\\_ptr](#) Xu, size\_t ldu, size\_t NbBlocksU, size\_t \*Ku, size\_t \*Tu, size\_t \*MU, const typename [Field::Element\\_ptr](#) XI, size\_t ldl, size\_t NbBlocksL, size\_t \*KI, size\_t \*TI, size\_t \*ML, typename [Field::Element\\_ptr](#) B, size\_t t, size\_t ldb, typename [Field::Element\\_ptr](#) C, size\_t ldc)  
*productBruhatxTS Compute the product between the CRE compact representation of a matrix A and B a tall matrix*
- template<class [Field](#)>  
[Field::Element\\_ptr](#) [LQUPtoInverseOfFullRankMinor](#) (const [Field](#) &F, const size\_t rank, typename [Field::Element\\_ptr](#) A\_factors, const size\_t lda, const size\_t \*QtPointer, typename [Field::Element\\_ptr](#) X, const size\_t ldx)  
*LQUPtoInverseOfFullRankMinor.*

### 13.180.1 Detailed Description

Set of elimination based routines for dense linear algebra.

Matrices are supposed over finite prime field of characteristic less than  $2^{26}$ .

### 13.180.2 Macro Definition Documentation

#### 13.180.2.1 \_\_FFLASFFPACK\_FTRSTR\_THRESHOLD

```
#define __FFLASFFPACK_FTRSTR_THRESHOLD 64
```

#### 13.180.2.2 \_\_FFLASFFPACK\_FTRSSYR2K\_THRESHOLD

```
#define __FFLASFFPACK_FTRSSYR2K_THRESHOLD 64
```

## 13.181 ffpack.inl File Reference

### Namespaces

- namespace [FFPACK](#)  
*Finite Field **PACK** Set of elimination based routines for dense linear algebra.*

### Macros

- #define [\\_\\_FFLASFFPACK\\_ffpack\\_INL](#)

### Functions

- template<class [Field](#)>  
size\_t [Rank](#) (const [Field](#) &F, const size\_t M, const size\_t N, typename [Field::Element\\_ptr](#) A, const size\_t lda)  
*Computes the rank of the given matrix using a PLUQ factorization.*
- template<class [Field](#)>  
size\_t [pRank](#) (const [Field](#) &F, const size\_t M, const size\_t N, typename [Field::Element\\_ptr](#) A, const size\_t lda, size\_t numthreads=0)
- template<class [Field](#), class PSHelper>  
size\_t [Rank](#) (const [Field](#) &F, const size\_t M, const size\_t N, typename [Field::Element\\_ptr](#) A, const size\_t lda, const PSHelper &psH)
- template<class [Field](#)>  
bool [IsSingular](#) (const [Field](#) &F, const size\_t M, const size\_t N, typename [Field::Element\\_ptr](#) A, const size\_t lda)  
*Returns true if the given matrix is singular.*

- `template<class Field>`  
`Field::Element & Det (const Field &F, typename Field::Element &det, const size_t N, typename Field::Element_ptr A, const size_t lda, size_t *P=NULL, size_t *Q=NULL)`  
*Returns the determinant of the given square matrix.*
- `template<class Field>`  
`Field::Element & pDet (const Field &F, typename Field::Element &det, const size_t N, typename Field::Element_ptr A, const size_t lda, size_t numthreads=0, size_t *P=NULL, size_t *Q=NULL)`
- `template<class Field, class PSHelper>`  
`Field::Element & Det (const Field &F, typename Field::Element &det, const size_t N, typename Field::Element_ptr A, const size_t lda, const PSHelper &psH, size_t *P=NULL, size_t *Q=NULL)`
- `template<class Field>`  
`Field::Element_ptr Solve (const Field &F, const size_t M, typename Field::Element_ptr A, const size_t lda, typename Field::Element_ptr x, const int incx, typename Field::ConstElement_ptr b, const int incb)`  
*Solves a linear system  $AX = b$  using PLUQ factorization.*
- `template<class Field, class PSHelper>`  
`Field::Element_ptr Solve (const Field &F, const size_t M, typename Field::Element_ptr A, const size_t lda, typename Field::Element_ptr x, const int incx, typename Field::ConstElement_ptr b, const int incb, PSHelper &psH)`
- `template<class Field>`  
`Field::Element_ptr pSolve (const Field &F, const size_t M, typename Field::Element_ptr A, const size_t lda, typename Field::Element_ptr x, const int incx, typename Field::ConstElement_ptr b, const int incb, size_t numthreads=0)`
- `template<class Field>`  
`void RandomNullSpaceVector (const Field &F, const FFLAS::FFLAS_SIDE Side, const size_t M, const size_t N, typename Field::Element_ptr A, const size_t lda, typename Field::Element_ptr X, const size_t incX)`  
*Solve  $LX = B$  or  $XL = B$  in place.*
- `template<class Field>`  
`size_t NullSpaceBasis (const Field &F, const FFLAS::FFLAS_SIDE Side, const size_t M, const size_t N, typename Field::Element_ptr A, const size_t lda, typename Field::Element_ptr &NS, size_t &ldn, size_t &NSdim)`  
*Computes a basis of the Left/Right nullspace of the matrix A.*
- `template<class Field>`  
`void solveLB (const Field &F, const FFLAS::FFLAS_SIDE Side, const size_t M, const size_t N, const size_t R, typename Field::Element_ptr L, const size_t ldl, const size_t *Q, typename Field::Element_ptr B, const size_t ldb)`
- `template<class Field>`  
`void solveLB2 (const Field &F, const FFLAS::FFLAS_SIDE Side, const size_t M, const size_t N, const size_t R, typename Field::Element_ptr L, const size_t ldl, const size_t *Q, typename Field::Element_ptr B, const size_t ldb)`

## 13.181.1 Macro Definition Documentation

### 13.181.1.1 \_\_FFLASFFPACK\_ffpack\_INL

```
#define __FFLASFFPACK_ffpack_INL
```

## 13.182 ffpack\_bruhatgen.inl File Reference

### Namespaces

- namespace `FFPACK`  
*Finite Field PACK Set of elimination based routines for dense linear algebra.*

### Macros

- `#define __FFLASFFPACK_ffpack_bruhatgen_inl`

## Functions

- `template<class Field>`  
`size_t LTBruhatGen (const Field &Fi, const FFLAS::FFLAS_DIAG diag, const size_t N, typename Field::Element_ptr A, const size_t lda, size_t *P, size_t *Q)`  
*LTBruhatGen Suppose A is Left Triangular Matrix This procedure computes the Bruhat Representation of A and return the rank of A.*
- `template<class Field>`  
`void getLTBruhatGen (const Field &Fi, const size_t N, const size_t r, const size_t *P, const size_t *Q, type-name Field::Element_ptr R, const size_t ldr)`  
*GetLTBruhatGen This procedure Computes the Rank Revealing Matrix based on the Bruhta representation of a Matrix.*
- `template<class Field>`  
`void getLTBruhatGen (const Field &Fi, const FFLAS::FFLAS_UPLO Uplo, const FFLAS::FFLAS_DIAG diag, const size_t N, const size_t r, const size_t *P, const size_t *Q, typename Field::ConstElement_ptr A, const size_t lda, typename Field::Element_ptr T, const size_t ldt)`  
*GetLTBruhatGen This procedure computes the matrix L or U f the Bruhat Representation Suppose that A is the bruhat representation of a matrix.*
- `size_t LTQSorder (const size_t N, const size_t r, const size_t *P, const size_t *Q)`  
*LTQSorder This procedure computes the order of quasiseparability of a matrix.*
- `template<class Field>`  
`size_t CompressToBlockBiDiagonal (const Field &Fi, const FFLAS::FFLAS_UPLO Uplo, size_t N, size_t s, size_t r, const size_t *P, const size_t *Q, typename Field::Element_ptr A, size_t lda, typename Field::Element_ptr X, size_t ldx, size_t *K, size_t *M, size_t *T)`  
*CompressToBlockBiDiagonal This procedure compress a compact representation of a row echelon form or column echelon form.*
- `template<class Field>`  
`void ExpandBlockBiDiagonalToBruhat (const Field &Fi, const FFLAS::FFLAS_UPLO Uplo, size_t N, size_t s, size_t r, typename Field::Element_ptr A, size_t lda, typename Field::Element_ptr X, size_t ldx, size_t NbBlocks, size_t *K, size_t *M, size_t *T)`  
*ExpandBlockBiDiagonal This procedure expand a compact representation of a row echelon form or column echelon form.*
- `void Bruhat2EchelonPermutation (size_t N, size_t R, const size_t *P, const size_t *Q, size_t *M)`  
*Bruhat2EchelonPermutation (N,R,P,Q) Compute M such that LM or MU is in echelon form where L or U are factors of the Bruhat Rpresentation.*
- `size_t * TInverter (const size_t *T, size_t r)`
- `template<class Field>`  
`void ComputeRPermutation (const Field &Fi, size_t N, size_t r, const size_t *P, const size_t *Q, size_t *R, const size_t *MU, const size_t *ML)`
- `template<class Field>`  
`Field::Element_ptr expandLCRE (const Field &Fi, size_t N, size_t s, size_t r, size_t *R, size_t i, typename Field::ConstElement_ptr Xu, size_t ldu, size_t NbBlocksU, const size_t *Ku, const size_t *Tuinv, typename Field::ConstElement_ptr Xl, size_t ldl, size_t NbBlocksL, const size_t *Kl, const size_t *Tlinv, typename Field::Element_ptr CRE, size_t ldcre)`  
*Expands an anti-diagonal block of a left triangular matrix from its compact Bruhat representation.*
- `template<class Field>`  
`void productBruhatxTS (const Field &Fi, size_t N, size_t s, size_t r, size_t t, const size_t *P, const size_t *Q, typename Field::ConstElement_ptr Xu, size_t ldu, size_t NbBlocksU, const size_t *Ku, const size_t *Tu, const size_t *MU, typename Field::ConstElement_ptr Xl, size_t ldl, size_t NbBlocksL, const size_t *Kl, const size_t *Tl, const size_t *ML, typename Field::Element_ptr B, size_t ldb, const typename Field::Element beta, typename Field::Element_ptr D, size_t ldd)`  
*Compute the product of a left-triangular quasi-separable matrix A, represented by a compact Bruhat generator, with a dense rectangular matrix B:  $C \leftarrow A \times B + \text{beta}C$ .*

### 13.182.1 Macro Definition Documentation

#### 13.182.1.1 \_\_FFLASFFPACK\_ffpack\_bruhatgen\_inl

```
#define __FFLASFFPACK_ffpack_bruhatgen_inl
```

## 13.183 ffpack\_charpoly.inl File Reference

```
#include "fflas-ffpack/utils/fflas_randommatrix.h"
#include "ffpack_charpoly_mp.inl"
```

### Namespaces

- namespace [FFPACK](#)  
*Finite Field **PACK** Set of elimination based routines for dense linear algebra.*
- namespace [FFPACK::Protected](#)

### Macros

- #define [\\_\\_FFLASFFPACK\\_charpoly\\_INL](#)

### Functions

- template<class PolRing>  
std::list< typename PolRing::Element > & [CharPoly](#) (const PolRing &R, std::list< typename PolRing::Element > &charp, const size\_t N, typename PolRing::Domain\_t::Element\_ptr A, const size\_t lda, typename PolRing::Domain\_t::RandIter &G, const FFPACK\_CHARPOLY\_TAG CharpTag=FpackAuto, const size\_t degree=\_\_FFLASFFPACK\_ARITHPROG\_THRESHOLD)  
*Compute the characteristic polynomial of the matrix A.*
- template<class PolRing>  
PolRing::Element & [CharPoly](#) (const PolRing &R, typename PolRing::Element &charp, const size\_t N, typename PolRing::Domain\_t::Element\_ptr A, const size\_t lda, typename PolRing::Domain\_t::RandIter &G, const FFPACK\_CHARPOLY\_TAG CharpTag=FpackAuto, const size\_t degree=\_\_FFLASFFPACK\_ARITHPROG\_THRESHOLD)  
*Compute the characteristic polynomial of the matrix A.*
- template<class Field, class Polynomial, class RandIter>  
std::list< Polynomial > & [LUKrylov](#) (const Field &F, std::list< Polynomial > &charp, const size\_t N, typename Field::Element\_ptr A, const size\_t lda, typename Field::Element\_ptr U, const size\_t ldu, RandIter &G)
- template<class Field, class Polynomial>  
std::list< Polynomial > & [LUKrylov\\_KGFast](#) (const Field &F, std::list< Polynomial > &charp, const size\_t N, typename Field::Element\_ptr A, const size\_t lda, typename Field::Element\_ptr X, const size\_t ldx)

### 13.183.1 Macro Definition Documentation

#### 13.183.1.1 \_\_FFLASFFPACK\_charpoly\_INL

```
#define __FFLASFFPACK_charpoly_INL
```

## 13.184 ffpack\_charpoly\_danilevski.inl File Reference

### Namespaces

- namespace [FFPACK](#)  
*Finite Field **PACK** Set of elimination based routines for dense linear algebra.*

### Macros

- #define [\\_\\_FFLASFFPACK\\_ffpack\\_charpoly\\_danilveski\\_INL](#)

## Functions

- `template<class Field, class Polynomial>`  
`std::list< Polynomial > & Danilevski (const Field &F, std::list< Polynomial > &charp, const size_t N, type-`  
`name Field::Element\_ptr A, const size_t lda)`

## 13.184.1 Macro Definition Documentation

### 13.184.1.1 \_\_FflasFFPACK\_ffpack\_charpoly\_danilveski\_INL

```
#define __FflasFFPACK_ffpack_charpoly_danilveski_INL
```

## 13.185 ffpack\_charpoly\_kgfast.inl File Reference

### Namespaces

- namespace [FFPACK](#)  
*Finite Field PACK Set of elimination based routines for dense linear algebra.*
- namespace [FFPACK::Protected](#)

### Macros

- `#define \_\_FflasFFPACK\_ffpack\_charpoly\_kgfast\_INL`

## Functions

- `template<class Field, class Polynomial>`  
`int KGFast (const Field &F, std::list< Polynomial > &charp, const size_t N, typename Field::Element\_ptr A,`  
`const size_t lda, size_t *kg_mc, size_t *kg_mb, size_t *kg_j)`
- `template<class Field>`  
`void fgemv\_kgf (const Field &F, const size_t N, typename Field::ConstElement\_ptr A, const size_t lda, type-`  
`name Field::ConstElement\_ptr X, const size_t incX, typename Field::Element\_ptr Y, const size_t incY, const`  
`size_t kg_mc, const size_t kg_mb, const size_t kg_j)`

## 13.185.1 Macro Definition Documentation

### 13.185.1.1 \_\_FflasFFPACK\_ffpack\_charpoly\_kgfast\_INL

```
#define __FflasFFPACK_ffpack_charpoly_kgfast_INL
```

## 13.186 ffpack\_charpoly\_kgfastgeneralized.inl File Reference

```
#include <iostream>
#include "fflas-ffpack/utils/fflas_io.h"
```

### Namespaces

- namespace [FFPACK](#)  
*Finite Field PACK Set of elimination based routines for dense linear algebra.*
- namespace [FFPACK::Protected](#)

### Macros

- `#define \_\_FflasFFPACK\_ffpack\_charpoly\_kgfastgeneralized\_INL`

## Functions

- template<class [Field](#)>  
[Field::Element\\_ptr](#) buildMatrix (const [Field](#) &F, typename [Field::ConstElement\\_ptr](#) E, typename [Field::ConstElement\\_ptr](#) C, const size\_t lda, const size\_t \*B, const size\_t \*T, const size\_t me, const size\_t mc, const size\_t lambda, const size\_t mu)
- template<class [Field](#), class Polynomial>  
std::list< Polynomial > & [KGFast\\_generalized](#) (const [Field](#) &F, std::list< Polynomial > &charp, const size\_t N, typename [Field::Element\\_ptr](#) A, const size\_t lda)

## 13.186.1 Macro Definition Documentation

### 13.186.1.1 \_\_FFLASFFPACK\_ffpack\_charpoly\_kgfastgeneralized\_INL

```
#define __FFLASFFPACK_ffpack_charpoly_kgfastgeneralized_INL
```

## 13.187 ffpack\_charpoly\_kglu.inl File Reference

### Namespaces

- namespace [FFPACK](#)  
*Finite Field **PACK** Set of elimination based routines for dense linear algebra.*
- namespace [FFPACK::Protected](#)

### Macros

- #define [\\_\\_FFLASFFPACK\\_ffpack\\_charpoly\\_kglu\\_INL](#)

## Functions

- template<class [Field](#)>  
size\_t [updated](#) (const [Field](#) &F, size\_t \*d, size\_t k, std::vector< std::vector< typename [Field::Element](#) > > &minpt)
- template<class [Field](#)>  
size\_t [newD](#) (const [Field](#) &F, size\_t \*d, bool &KeepOn, const size\_t l, const size\_t N, typename [Field::Element\\_ptr](#) X, const size\_t \*Q, std::vector< std::vector< typename [Field::Element](#) > > &minpt)
- template<class [Field](#), class Polynomial>  
std::list< Polynomial > & [KellerGehrig](#) (const [Field](#) &F, std::list< Polynomial > &charp, const size\_t N, typename [Field::ConstElement\\_ptr](#) A, const size\_t lda)

## 13.187.1 Macro Definition Documentation

### 13.187.1.1 \_\_FFLASFFPACK\_ffpack\_charpoly\_kglu\_INL

```
#define __FFLASFFPACK_ffpack_charpoly_kglu_INL
```

## 13.188 ffpack\_charpoly\_mp.inl File Reference

```
#include <givaro/zring.h>
#include "givaro/givinteger.h"
#include "givaro/givpoly1.h"
#include "fflas-ffpack/field/rns-integer.h"
#include "fflas-ffpack/fflas-ffpack.h"
```

### Namespaces

- namespace [FFPACK](#)  
*Finite Field **PACK** Set of elimination based routines for dense linear algebra.*

## Macros

- `#define __FFPACK_charpoly_mp_INL`

## Functions

- `FFPACK::RNSInteger< FFPACK::rns_double >::Element_ptr CharPoly` (const `FFPACK::RNSInteger< FFPACK::rns_double > &F`, typename `FFPACK::RNSInteger< FFPACK::rns_double >::Element_ptr` charp, const size\_t N, typename `FFPACK::RNSInteger< FFPACK::rns_double >::Element_ptr` A, const size\_t lda, `Givaro::ZRing< Givaro::Integer >::RandIter &G`, const `FFPACK_CHARPOLY_TAG` CharpTag, size\_t degree)
- `template<> Givaro::Poly1Dom< Givaro::ZRing< Givaro::Integer > >::Element & CharPoly` (const `Givaro::Poly1Dom< Givaro::ZRing< Givaro::Integer > > &R`, `Givaro::Poly1Dom< Givaro::ZRing< Givaro::Integer > >::Element` &charp, const size\_t N, `Givaro::Integer *A`, const size\_t lda, `Givaro::ZRing< Givaro::Integer >::RandIter &G`, const `FFPACK_CHARPOLY_TAG` CharpTag, size\_t degree)

## 13.188.1 Macro Definition Documentation

### 13.188.1.1 \_\_FFPACK\_charpoly\_mp\_INL

```
#define __FFPACK_charpoly_mp_INL
```

## 13.189 ffpack\_det\_mp.inl File Reference

```
#include <givaro/zring.h>
#include "givaro/givinteger.h"
#include "fflas-ffpack/field/rns-integer.h"
#include "fflas-ffpack/fflas-ffpack.h"
```

## Namespaces

- namespace `FFPACK`  
*Finite Field PACK Set of elimination based routines for dense linear algebra.*

## Macros

- `#define __FFPACK_det_mp_INL`

## Functions

- `template<class PSHelper>`  
`FFPACK::RNSInteger< FFPACK::rns_double >::Element_ptr & Det` (const `FFPACK::RNSInteger< FFPACK::rns_double > &F`, typename `FFPACK::RNSInteger< FFPACK::rns_double >::Element_ptr` &det, const size\_t N, typename `FFPACK::RNSInteger< FFPACK::rns_double >::Element_ptr` A, const size\_t lda, const `PSHelper &psH`)
- `template<class PSHelper>`  
`Givaro::Integer & Det` (const `Givaro::ZRing< Givaro::Integer > &F`, `Givaro::Integer &det`, const size\_t N, `Givaro::Integer *A`, const size\_t lda, const `PSHelper &psH`, size\_t \*P, size\_t \*Q)

## 13.189.1 Macro Definition Documentation

### 13.189.1.1 \_\_FFPACK\_det\_mp\_INL

```
#define __FFPACK_det_mp_INL
```

## 13.190 ffpack\_echelonforms.inl File Reference

### Namespaces

- namespace [FFPACK](#)  
*Finite Field PACK Set of elimination based routines for dense linear algebra.*

### Macros

- #define [\\_\\_FFLASFFPACK\\_ffpack\\_echelon\\_forms\\_INL](#)
- #define [\\_\\_FFLASFFPACK\\_GAUSSJORDAN\\_BASECASE](#) 256

### Functions

- template<class [Field](#)>  
void [getTriangular](#) (const [Field](#) &F, const [FFLAS::FFLAS\\_UPLO](#) Uplo, const [FFLAS::FFLAS\\_DIAG](#) diag, const size\_t M, const size\_t N, const size\_t R, typename [Field::ConstElement\\_ptr](#) A, const size\_t lda, typename [Field::Element\\_ptr](#) T, const size\_t ldt, const bool OnlyNonZeroVectors=false)  
*Extracts a triangular matrix from a compact storage  $A=L\backslash U$  of rank  $R$ .*
- template<class [Field](#)>  
void [getTriangular](#) (const [Field](#) &F, const [FFLAS::FFLAS\\_UPLO](#) Uplo, const [FFLAS::FFLAS\\_DIAG](#) diag, const size\_t M, const size\_t N, const size\_t R, typename [Field::Element\\_ptr](#) A, const size\_t lda)  
*Cleans up a compact storage  $A=L\backslash U$  to reveal a triangular matrix of rank  $R$ .*
- void [PLUQtoEchelonPermutation](#) (const size\_t N, const size\_t R, const size\_t \*P, size\_t \*outPerm)  
*Auxiliary routine: determines the permutation that changes a PLUQ decomposition into a echelon form revealing PLUQ decomposition.*
- template<class [Field](#)>  
void [getEchelonForm](#) (const [Field](#) &F, const [FFLAS::FFLAS\\_UPLO](#) Uplo, const [FFLAS::FFLAS\\_DIAG](#) diag, const size\_t M, const size\_t N, const size\_t R, const size\_t \*P, typename [Field::ConstElement\\_ptr](#) A, const size\_t lda, typename [Field::Element\\_ptr](#) T, const size\_t ldt, const bool OnlyNonZeroVectors=false, const [FFPACK\\_LU\\_TAG](#) LuTag=[FfpackSlabRecursive](#))  
*Extracts a matrix in echelon form from a compact storage  $A=L\backslash U$  of rank  $R$  obtained by RowEchelonForm or Column↔EchelonForm.*
- template<class [Field](#)>  
void [getEchelonForm](#) (const [Field](#) &F, const [FFLAS::FFLAS\\_UPLO](#) Uplo, const [FFLAS::FFLAS\\_DIAG](#) diag, const size\_t M, const size\_t N, const size\_t R, const size\_t \*P, typename [Field::Element\\_ptr](#) A, const size\_t lda, const [FFPACK\\_LU\\_TAG](#) LuTag=[FfpackSlabRecursive](#))  
*Cleans up a compact storage  $A=L\backslash U$  obtained by RowEchelonForm or ColumnEchelonForm to reveal an echelon form of rank  $R$ .*
- template<class [Field](#)>  
void [getEchelonTransform](#) (const [Field](#) &F, const [FFLAS::FFLAS\\_UPLO](#) Uplo, const [FFLAS::FFLAS\\_DIAG](#) diag, const size\_t M, const size\_t N, const size\_t R, const size\_t \*P, const size\_t \*Q, typename [Field::ConstElement\\_ptr](#) A, const size\_t lda, typename [Field::Element\\_ptr](#) T, const size\_t ldt, const [FFPACK\\_LU\\_TAG](#) LuTag=[FfpackSlabRecursive](#))  
*Extracts a transformation matrix to echelon form from a compact storage  $A=L\backslash U$  of rank  $R$  obtained by RowEchelon↔Form or ColumnEchelonForm.*
- template<class [Field](#)>  
void [getReducedEchelonForm](#) (const [Field](#) &F, const [FFLAS::FFLAS\\_UPLO](#) Uplo, const size\_t M, const size\_t N, const size\_t R, const size\_t \*P, typename [Field::ConstElement\\_ptr](#) A, const size\_t lda, typename [Field::Element\\_ptr](#) T, const size\_t ldt, const bool OnlyNonZeroVectors=false, const [FFPACK\\_LU\\_TAG](#) LuTag=[FfpackSlabRecursive](#))  
*Extracts a matrix in echelon form from a compact storage  $A=L\backslash U$  of rank  $R$  obtained by ReducedRowEchelonForm or ReducedColumnEchelonForm with transform = true.*
- template<class [Field](#)>  
void [getReducedEchelonForm](#) (const [Field](#) &F, const [FFLAS::FFLAS\\_UPLO](#) Uplo, const size\_t M, const size\_t N, const size\_t R, const size\_t \*P, typename [Field::Element\\_ptr](#) A, const size\_t lda, const [FFPACK\\_LU\\_TAG](#) LuTag=[FfpackSlabRecursive](#))



*Cleans up a compact storage  $A=LU$  of rank  $R$  obtained by `ReducedRowEchelonForm` or `ReducedColumnEchelonForm` with `transform = true`.*

- `template<class Field>`  
`void getReducedEchelonTransform` (const `Field` &F, const `FFLAS::FFLAS_UPLO` Uplo, const `size_t` M, const `size_t` N, const `size_t` R, const `size_t` \*P, const `size_t` \*Q, typename `Field::ConstElement_ptr` A, const `size_t` lda, typename `Field::Element_ptr` T, const `size_t` ldt, const `FFPACK_LU_TAG` LuTag=`FfpackSlabRecursive`)

*Extracts a transformation matrix to echelon form from a compact storage  $A=LU$  of rank  $R$  obtained by `RowEchelonForm` or `ColumnEchelonForm`.*

## 13.190.1 Macro Definition Documentation

### 13.190.1.1 \_\_FFLASFFPACK\_ffpack\_echelon\_forms\_INL

```
#define __FFLASFFPACK_ffpack_echelon_forms_INL
```

### 13.190.1.2 \_\_FFLASFFPACK\_GAUSSJORDAN\_BASECASE

```
#define __FFLASFFPACK_GAUSSJORDAN_BASECASE 256
```

## 13.191 ffpack\_fgesv.inl File Reference

### Namespaces

- namespace `FFPACK`  
*Finite Field **PACK** Set of elimination based routines for dense linear algebra.*

### Macros

- `#define __FFLASFFPACK_ffpack_fgesv_INL`

### Functions

- `template<class Field>`  
`size_t fgesv` (const `Field` &F, const `FFLAS::FFLAS_SIDE` Side, const `size_t` M, const `size_t` N, typename `Field::Element_ptr` A, const `size_t` lda, typename `Field::Element_ptr` B, const `size_t` ldb, int \*info)  
*Square system solver.*
- `template<class Field>`  
`size_t fgesv` (const `Field` &F, const `FFLAS::FFLAS_SIDE` Side, const `size_t` M, const `size_t` N, const `size_t` NRHS, typename `Field::Element_ptr` A, const `size_t` lda, typename `Field::Element_ptr` X, const `size_t` ldx, typename `Field::ConstElement_ptr` B, const `size_t` ldb, int \*info)  
*Rectangular system solver.*

## 13.191.1 Macro Definition Documentation

### 13.191.1.1 \_\_FFLASFFPACK\_ffpack\_fgesv\_INL

```
#define __FFLASFFPACK_ffpack_fgesv_INL
```

## 13.192 ffpack\_fgetrs.inl File Reference

### Namespaces

- namespace `FFPACK`  
*Finite Field **PACK** Set of elimination based routines for dense linear algebra.*

### Macros

- `#define __FFLASFFPACK_ffpack_fgetrs_INL`

## Functions

- template<class [Field](#)>  
void [fgetrs](#) (const [Field](#) &F, const [FFLAS::FFLAS\\_SIDE](#) Side, const size\_t M, const size\_t N, const size\_t R, typename [Field::Element\\_ptr](#) A, const size\_t lda, const size\_t \*P, const size\_t \*Q, typename [Field::Element\\_ptr](#) B, const size\_t ldb, int \*info)  
*Solve the system  $AX = B$  or  $XA = B$ .*
- template<class [Field](#)>  
[Field::Element\\_ptr](#) [fgetrs](#) (const [Field](#) &F, const [FFLAS::FFLAS\\_SIDE](#) Side, const size\_t M, const size\_t N, const size\_t NRHS, const size\_t R, typename [Field::Element\\_ptr](#) A, const size\_t lda, const size\_t \*P, const size\_t \*Q, typename [Field::Element\\_ptr](#) X, const size\_t idx, typename [Field::ConstElement\\_ptr](#) B, const size\_t ldb, int \*info)  
*Solve the system  $A X = B$  or  $X A = B$ .*

## 13.192.1 Macro Definition Documentation

### 13.192.1.1 `__FFLASFFPACK_ffpack_fgetrs_INL`

```
#define __FFLASFFPACK_ffpack_fgetrs_INL
```

## 13.193 `ffpack_frobenius.inl` File Reference

```
#include <givaro/givranditer.h>
```

## Namespaces

- namespace [FFPACK](#)  
*Finite **Field** **PACK** Set of elimination based routines for dense linear algebra.*
- namespace [FFPACK::Protected](#)

## Functions

- template<class [Field](#)>  
void [CompressRows](#) ([Field](#) &F, const size\_t M, typename [Field::Element\\_ptr](#) A, const size\_t lda, typename [Field::Element\\_ptr](#) tmp, const size\_t ldtmp, const size\_t \*d, const size\_t nb\_blocs)
- template<class [Field](#)>  
void [CompressRowsQK](#) ([Field](#) &F, const size\_t M, typename [Field::Element\\_ptr](#) A, const size\_t lda, typename [Field::Element\\_ptr](#) tmp, const size\_t ldtmp, const size\_t \*d, const size\_t deg, const size\_t nb\_blocs)
- template<class [Field](#)>  
void [DeCompressRows](#) ([Field](#) &F, const size\_t M, const size\_t N, typename [Field::Element\\_ptr](#) A, const size\_t lda, typename [Field::Element\\_ptr](#) tmp, const size\_t ldtmp, const size\_t \*d, const size\_t nb\_blocs)
- template<class [Field](#)>  
void [DeCompressRowsQK](#) ([Field](#) &F, const size\_t M, const size\_t N, typename [Field::Element\\_ptr](#) A, const size\_t lda, typename [Field::Element\\_ptr](#) tmp, const size\_t ldtmp, const size\_t \*d, const size\_t deg, const size\_t nb\_blocs)
- template<class [Field](#)>  
void [CompressRowsQA](#) ([Field](#) &F, const size\_t M, typename [Field::Element\\_ptr](#) A, const size\_t lda, typename [Field::Element\\_ptr](#) tmp, const size\_t ldtmp, const size\_t \*d, const size\_t nb\_blocs)
- template<class [Field](#)>  
void [DeCompressRowsQA](#) ([Field](#) &F, const size\_t M, const size\_t N, typename [Field::Element\\_ptr](#) A, const size\_t lda, typename [Field::Element\\_ptr](#) tmp, const size\_t ldtmp, const size\_t \*d, const size\_t nb\_blocs)
- template<class [PolRing](#)>  
void [RandomKrylovPrecond](#) (const [PolRing](#) &PR, std::list< typename [PolRing::Element](#) > &completedFactors, const size\_t N, typename [PolRing::Domain\\_t::Element\\_ptr](#) A, const size\_t lda, size\_t &Nb, typename [PolRing::Domain\\_t::Element\\_ptr](#) &B, size\_t &ldb, typename [PolRing::Domain\\_t::RandIter](#) &g, const size\_t degree=[\\_\\_FFLASFFPACK\\_ARITHPROG\\_THRESHOLD](#))

- `template<class PolRing>`  
`std::list< typename PolRing::Element > & ArithProg (const PolRing &PR, std::list< typename PolRing::Element > &frobeniusForm, const size_t N, typename PolRing::Domain_t::Element_ptr A, const size_t lda, const size_t degree)`

## 13.194 ffpack\_fsytrf.inl File Reference

```
#include "fflas-ffpack/utils/fflas_io.h"
```

### Namespaces

- namespace `FFPACK`  
*Finite Field **PACK** Set of elimination based routines for dense linear algebra.*

### Macros

- `#define __FFLASFFPACK_ffpack_fsytrf_INL`

### Functions

- `template<class Field>`  
`bool fsytrf_BC_Crout (const Field &F, const FFLAS::FFLAS_UPLO UpLo, const size_t N, typename Field::Element_ptr A, const size_t lda, typename Field::Element_ptr Dinv, const size_t incDinv)`
- `template<class Field>`  
`size_t fsytrf_BC_RL (const Field &F, const FFLAS::FFLAS_UPLO UpLo, const size_t N, typename Field::Element_ptr A, const size_t lda, typename Field::Element_ptr Dinv, const size_t incDinv)`
- `template<class Field>`  
`size_t fsytrf_UP_RPM_BC_RL (const Field &F, const size_t N, typename Field::Element_ptr A, const size_t lda, typename Field::Element_ptr Dinv, const size_t incDinv, size_t *P)`
- `template<class Field>`  
`size_t fsytrf_LOW_RPM_BC_Crout (const Field &F, const size_t N, typename Field::Element_ptr A, const size_t lda, typename Field::Element_ptr Dinv, const size_t incDinv, size_t *P)`
- `template<class Field>`  
`size_t fsytrf_UP_RPM_BC_Crout (const Field &F, const size_t N, typename Field::Element_ptr A, const size_t lda, typename Field::Element_ptr Dinv, const size_t incDinv, size_t *P)`
- `template<class Field>`  
`size_t fsytrf_UP_RPM (const Field &Fi, const size_t N, typename Field::Element_ptr A, const size_t lda, typename Field::Element_ptr Dinv, const size_t incDinv, size_t *P, size_t BCThreshold)`
- `template<class Field>`  
`bool fsytrf_nonunit (const Field &F, const FFLAS::FFLAS_UPLO UpLo, const size_t N, typename Field::Element_ptr A, const size_t lda, typename Field::Element_ptr Dinv, const size_t incDinv, FFLAS::ParSeqHelper::Sequential seq, size_t threshold)`
- `template<class Field, class Cut, class Param>`  
`bool fsytrf_nonunit (const Field &F, const FFLAS::FFLAS_UPLO UpLo, const size_t N, typename Field::Element_ptr A, const size_t lda, typename Field::Element_ptr Dinv, const size_t incDinv, FFLAS::ParSeqHelper::Parallel< Cut, Param > par, size_t threshold)`
- `template<class Field>`  
`bool fsytrf (const Field &F, const FFLAS::FFLAS_UPLO UpLo, const size_t N, typename Field::Element_ptr A, const size_t lda, const size_t threshold=__FFLASFFPACK_FSYTRF_THRESHOLD)`  
*Triangular factorization of symmetric matrices.*
- `template<class Field>`  
`bool fsytrf (const Field &F, const FFLAS::FFLAS_UPLO UpLo, const size_t N, typename Field::Element_ptr A, const size_t lda, const FFLAS::ParSeqHelper::Sequential seq, const size_t threshold=__FFLASFFPACK_FSYTRF_THRESHOLD)`
- `template<class Field, class Cut, class Param>`  
`bool fsytrf (const Field &F, const FFLAS::FFLAS_UPLO UpLo, const size_t N, typename Field::Element_ptr A, const size_t lda, const FFLAS::ParSeqHelper::Parallel< Cut, Param > par, const size_t threshold=__FFLASFFPACK_FSYTRF_THRESHOLD)`

- template<class [Field](#)>  
size\_t [fsytrf\\_RPM](#) (const [Field](#) &F, const [FFLAS::FFLAS\\_UPLO](#) UpLo, const size\_t N, typename [Field::Element\\_ptr](#) A, const size\_t lda, size\_t \*P, size\_t threshold)
- template<class [Field](#)>  
void [getTridiagonal](#) (const [Field](#) &F, const size\_t N, const size\_t R, typename [Field::ConstElement\\_ptr](#) A, const size\_t lda, size\_t \*P, typename [Field::Element\\_ptr](#) T, const size\_t ldt)

### 13.194.1 Macro Definition Documentation

#### 13.194.1.1 [\\_\\_FFLASFFPACK\\_ffpack\\_fsytrf\\_INL](#)

```
#define __FFLASFFPACK_ffpack_fsytrf_INL
```

## 13.195 [ffpack\\_ftrssyr2k.inl](#) File Reference

```
#include "fflas-ffpack/utils/fflas_io.h"
```

### Namespaces

- namespace [FFPACK](#)  
*Finite **Field** **PACK** Set of elimination based routines for dense linear algebra.*

### Macros

- #define [\\_\\_FFLASFFPACK\\_ffpack\\_ftrssyr2k\\_INL](#)

### Functions

- template<class [Field](#)>  
void [ftrssyr2k](#) (const [Field](#) &F, const [FFLAS::FFLAS\\_UPLO](#) Uplo, const [FFLAS::FFLAS\\_DIAG](#) diagA, const size\_t N, typename [Field::ConstElement\\_ptr](#) A, const size\_t lda, typename [Field::Element\\_ptr](#) B, const size\_t ldb, const size\_t threshold=[\\_\\_FFLASFFPACK\\_FTRSSYR2K\\_THRESHOLD](#))  
*Solve a triangular system in a symmetric sum: find B upper/lower triangular such that  $A^T B + B^T A = C$  where C is symmetric.*

### 13.195.1 Macro Definition Documentation

#### 13.195.1.1 [\\_\\_FFLASFFPACK\\_ffpack\\_ftrssyr2k\\_INL](#)

```
#define __FFLASFFPACK_ffpack_ftrssyr2k_INL
```

## 13.196 [ffpack\\_ftrstr.inl](#) File Reference

```
#include "fflas-ffpack/utils/fflas_io.h"
```

### Namespaces

- namespace [FFPACK](#)  
*Finite **Field** **PACK** Set of elimination based routines for dense linear algebra.*

### Macros

- #define [\\_\\_FFLASFFPACK\\_ffpack\\_ftrstr\\_INL](#)

## Functions

- `template<class Field>`  
`void ftrstr (const Field &F, const FFLAS::FFLAS_SIDE side, const FFLAS::FFLAS_UPLO Uplo, const FFLAS::FFLAS_DIAG diagA, const FFLAS::FFLAS_DIAG diagB, const size_t N, typename Field::ConstElement_ptr A, const size_t lda, typename Field::Element_ptr B, const size_t ldb, const size_t threshold=__FFLASFFPACK_FTRSTR_THRESHOLD)`

*Solve a triangular system with a triangular right hand side of the same shape.*

## 13.196.1 Macro Definition Documentation

### 13.196.1.1 \_\_FFLASFFPACK\_ffpack\_ftrstr\_INL

```
#define __FFLASFFPACK_ffpack_ftrstr_INL
```

## 13.197 ffpack\_ftrtr.inl File Reference

### Namespaces

- namespace `FFPACK`  
*Finite Field PACK Set of elimination based routines for dense linear algebra.*

### Macros

- `#define ENABLE_ALL_CHECKINGS 1`
- `#define __FFLASFFPACK_ffpack_ftrtr_INL`

## Functions

- `template<class Field>`  
`void ftrtri (const Field &F, const FFLAS::FFLAS_UPLO Uplo, const FFLAS::FFLAS_DIAG Diag, const size_t N, typename Field::Element_ptr A, const size_t lda, const size_t threshold=__FFLASFFPACK_FTRTRI_THRESHOLD)`  
*Compute the inverse of a triangular matrix.*
- `template<class Field>`  
`void ftrtrm (const Field &F, const FFLAS::FFLAS_SIDE side, const FFLAS::FFLAS_DIAG diag, const size_t N, typename Field::Element_ptr A, const size_t lda)`  
*Compute the product of two triangular matrices of opposite shape.*
- `template<class Field>`  
`void trinv_left (const Field &F, const size_t N, typename Field::ConstElement_ptr L, const size_t ldl, typename Field::Element_ptr X, const size_t idx)`

## 13.197.1 Macro Definition Documentation

### 13.197.1.1 ENABLE\_ALL\_CHECKINGS

```
#define ENABLE_ALL_CHECKINGS 1
```

### 13.197.1.2 \_\_FFLASFFPACK\_ffpack\_ftrtr\_INL

```
#define __FFLASFFPACK_ffpack_ftrtr_INL
```

## 13.198 ffpack\_invert.inl File Reference

### Namespaces

- namespace `FFPACK`  
*Finite Field PACK Set of elimination based routines for dense linear algebra.*

## Macros

- `#define __FFLASFFPACK_ffpack_invert_INL`

## Functions

- `template<class Field>`  
`Field::Element_ptr Invert` (const `Field` &F, const `size_t` M, typename `Field::Element_ptr` A, const `size_t` lda, int &>nullity)  
*Invert the given matrix in place or computes its nullity if it is singular.*
- `template<class Field>`  
`Field::Element_ptr Invert` (const `Field` &F, const `size_t` M, typename `Field::ConstElement_ptr` A, const `size_t` lda, typename `Field::Element_ptr` X, const `size_t` ldx, int &>nullity)  
*Invert the given matrix or computes its nullity if it is singular.*
- `template<class Field>`  
`Field::Element_ptr Invert2` (const `Field` &F, const `size_t` M, typename `Field::Element_ptr` A, const `size_t` lda, typename `Field::Element_ptr` X, const `size_t` ldx, int &>nullity)  
*Invert the given matrix or computes its nullity if it is singular.*

## 13.198.1 Macro Definition Documentation

### 13.198.1.1 \_\_FFLASFFPACK\_ffpack\_invert\_INL

```
#define __FFLASFFPACK_ffpack_invert_INL
```

## 13.199 fpack\_krylovelim.inl File Reference

### Macros

- `#define __FFLASFFPACK_ffpack_krylovelim_INL`

## 13.199.1 Macro Definition Documentation

### 13.199.1.1 \_\_FFLASFFPACK\_ffpack\_krylovelim\_INL

```
#define __FFLASFFPACK_ffpack_krylovelim_INL
```

## 13.200 fpack\_ludivine.inl File Reference

```
#include "fflas-ffpack/fflas/fflas_bounds.inl"
```

### Data Structures

- class `callLUdivine_small< Element >`
- class `callLUdivine_small< double >`
- class `callLUdivine_small< float >`

### Namespaces

- namespace `FFPACK`  
*Finite Field **PACK** Set of elimination based routines for dense linear algebra.*
- namespace `FFPACK::Protected`

### Macros

- `#define __FFLASFFPACK_ffpack_ludivine_INL`

## Functions

- template<class [Field](#)>  
size\_t [LUdivine\\_gauss](#) (const [Field](#) &F, const [FFLAS::FFLAS\\_DIAG](#) Diag, const size\_t M, const size\_t N, typename [Field::Element\\_ptr](#) A, const size\_t lda, size\_t \*P, size\_t \*Q, const [FFPACK::FFPACK\\_LU\\_TAG](#) LuTag)
- template<class [Field](#)>  
size\_t [LUdivine\\_small](#) (const [Field](#) &F, const [FFLAS::FFLAS\\_DIAG](#) Diag, const [FFLAS::FFLAS\\_TRANSPOSE](#) trans, const size\_t M, const size\_t N, typename [Field::Element\\_ptr](#) A, const size\_t lda, size\_t \*P, size\_t \*Q, const [FFPACK::FFPACK\\_LU\\_TAG](#) LuTag)
- template<class [Field](#)>  
size\_t [LUdivine](#) (const [Field](#) &F, const [FFLAS::FFLAS\\_DIAG](#) Diag, const [FFLAS::FFLAS\\_TRANSPOSE](#) trans, const size\_t M, const size\_t N, typename [Field::Element\\_ptr](#) A, const size\_t lda, size\_t \*P, size\_t \*Q, const [FFPACK::FFPACK\\_LU\\_TAG](#) LuTag, const size\_t cutoff)
- template<class [Field](#)>  
size\_t [LUdivine\\_construct](#) (const [Field](#) &F, const [FFLAS::FFLAS\\_DIAG](#) Diag, const size\_t M, const size\_t N, typename [Field::ConstElement\\_ptr](#) A, const size\_t lda, typename [Field::Element\\_ptr](#) X, const size\_t idx, typename [Field::Element\\_ptr](#) u, const size\_t incu, size\_t \*P, bool computeX, const [FFPACK::FFPACK\\_MINPOLY\\_TAG](#) MinTag, const size\_t kg\_mc, const size\_t kg\_mb, const size\_t kg\_j)

### 13.200.1 Macro Definition Documentation

#### 13.200.1.1 [\\_\\_FFLASFFPACK\\_ffpack\\_ludivine\\_INL](#)

```
#define __FFLASFFPACK_ffpack_ludivine_INL
```

## 13.201 ffpack\_ludivine\_mp.inl File Reference

```
#include <givaro/modular-integer.h>
#include <givaro/givinteger.h>
#include "fflas-ffpack/field/rns-integer-mod.h"
#include "fflas-ffpack/field/rns-integer.h"
#include "fflas-ffpack/fflas/fflas.h"
#include "fflas-ffpack/ffpack/ffpack_ludivine.inl"
```

## Namespaces

- namespace [FFPACK](#)  
*Finite Field **PACK** Set of elimination based routines for dense linear algebra.*

## Macros

- #define [\\_\\_FFPACK\\_ludivine\\_mp\\_INL](#)

## Functions

- template<> size\_t [LUdivine](#) (const Givaro::Modular< Givaro::Integer > &F, const [FFLAS::FFLAS\\_DIAG](#) Diag, const [FFLAS::FFLAS\\_TRANSPOSE](#) trans, const size\_t M, const size\_t N, typename Givaro::Integer \*A, const size\_t lda, size\_t \*P, size\_t \*Q, const [FFPACK::FFPACK\\_LU\\_TAG](#) LuTag, const size\_t cutoff)

### 13.201.1 Macro Definition Documentation

#### 13.201.1.1 [\\_\\_FFPACK\\_ludivine\\_mp\\_INL](#)

```
#define __FFPACK_ludivine_mp_INL
```

## 13.202 ffpack\_minpoly.inl File Reference

### Namespaces

- namespace [FFPACK](#)  
*Finite Field **PACK** Set of elimination based routines for dense linear algebra.*
- namespace [FFPACK::Protected](#)

### Macros

- `#define` [\\_\\_FFLASFFPACK\\_ffpack\\_minpoly\\_INL](#)

### Functions

- `template<class Field, class Polynomial>`  
Polynomial & [MinPoly](#) (const [Field](#) &F, Polynomial &minP, const size\_t N, typename [Field::ConstElement\\_ptr](#) A, const size\_t lda)  
*Compute the minimal polynomial of the matrix A.*
- `template<class Field, class Polynomial, class RandIter>`  
Polynomial & [MinPoly](#) (const [Field](#) &F, Polynomial &minP, const size\_t N, typename [Field::ConstElement\\_ptr](#) A, const size\_t lda, RandIter &G)  
*Compute the minimal polynomial of the matrix A.*
- `template<class Field, class Polynomial>`  
Polynomial & [MatVecMinPoly](#) (const [Field](#) &F, Polynomial &minP, const size\_t N, typename [Field::ConstElement\\_ptr](#) A, const size\_t lda, typename [Field::ConstElement\\_ptr](#) v, const size\_t incv)  
*Compute the minimal polynomial of the matrix A and a vector v, namely the first linear dependency relation in the Krylov basis  $(v, Av, \dots, A^N v)$ .*
- `template<class Field, class Polynomial>`  
Polynomial & [MatVecMinPoly](#) (const [Field](#) &F, Polynomial &minP, const size\_t N, typename [Field::ConstElement\\_ptr](#) A, const size\_t lda, typename [Field::Element\\_ptr](#) v, const size\_t incv, typename [Field::Element\\_ptr](#) K, const size\_t ldk, size\_t \*P)  
*Compute the minimal polynomial of the matrix A and a vector v, namely the first linear dependency relation in the Krylov basis  $(v, Av, \dots, A^N v)$ .*
- `template<class Field, class Polynomial>`  
Polynomial & [Hybrid\\_KGF\\_LUK\\_MinPoly](#) (const [Field](#) &F, Polynomial &minP, const size\_t N, typename [Field::ConstElement\\_ptr](#) A, const size\_t lda, typename [Field::Element\\_ptr](#) X, const size\_t ldx, size\_t \*P, const FFPACK\_MINPOLY\_TAG MinTag=FFPACK::FfpackDense, const size\_t kg\_mc=0, const size\_t kg\_↔ mb=0, const size\_t kg\_j=0)

### 13.202.1 Macro Definition Documentation

#### 13.202.1.1 \_\_FFLASFFPACK\_ffpack\_minpoly\_INL

```
#define __FFLASFFPACK_ffpack_minpoly_INL
```

## 13.203 ffpack\_permutation.inl File Reference

```
#include <givar/zring.h>
#include "fflas-ffpack/fflas/fflas_fassign.h"
```

### Namespaces

- namespace [FFPACK](#)  
*Finite Field **PACK** Set of elimination based routines for dense linear algebra.*

### Macros

- `#define` [\\_\\_FFLASFFPACK\\_ffpack\\_permutation\\_INL](#)
- `#define` [FFLASFFPACK\\_PERM\\_BKSIZE](#) 32



## Functions

- template<class [Field](#)>  
void [MonotonicApplyP](#) (const [Field](#) &F, const [FFLAS::FFLAS\\_SIDE](#) Side, const [FFLAS::FFLAS\\_TRANSPOSE](#) Trans, const size\_t M, const size\_t ibeg, const size\_t iend, typename [Field::Element\\_ptr](#) A, const size\_t lda, const size\_t \*P, const size\_t R)  
*Apply a R-monotonically increasing permutation P, to the matrix A.*
- template<class [Field](#)>  
void [MonotonicCompress](#) (const [Field](#) &F, const [FFLAS::FFLAS\\_SIDE](#) Side, const size\_t M, typename [Field::Element\\_ptr](#) A, const size\_t lda, const size\_t incA, const size\_t \*MathP, const size\_t R, const size\_t maxpiv, const size\_t rowstomove, const std::vector< bool > &ispiv)
- template<class [Field](#)>  
void [MonotonicCompressMorePivots](#) (const [Field](#) &F, const [FFLAS::FFLAS\\_SIDE](#) Side, const size\_t M, type-name [Field::Element\\_ptr](#) A, const size\_t lda, const size\_t incA, const size\_t \*MathP, const size\_t R, const size\_t rowstomove, const size\_t lenP)
- template<class [Field](#)>  
void [MonotonicCompressCycles](#) (const [Field](#) &F, const [FFLAS::FFLAS\\_SIDE](#) Side, const size\_t M, typename [Field::Element\\_ptr](#) A, const size\_t lda, const size\_t incA, const size\_t \*MathP, const size\_t lenP)
- template<class [Field](#)>  
void [MonotonicExpand](#) (const [Field](#) &F, const [FFLAS::FFLAS\\_SIDE](#) Side, const size\_t M, typename [Field::Element\\_ptr](#) A, const size\_t lda, const size\_t incA, const size\_t \*MathP, const size\_t R, const size\_t maxpiv, const size\_t rowstomove, const std::vector< bool > &ispiv)
- template<class [Field](#)>  
void [applyP\\_block](#) (const [Field](#) &F, const [FFLAS::FFLAS\\_SIDE](#) Side, const [FFLAS::FFLAS\\_TRANSPOSE](#) Trans, const size\_t M, const size\_t ibeg, const size\_t iend, typename [Field::Element\\_ptr](#) A, const size\_t lda, const size\_t \*P)
- template<class [Field](#)>  
void [applyP](#) (const [Field](#) &F, const [FFLAS::FFLAS\\_SIDE](#) Side, const [FFLAS::FFLAS\\_TRANSPOSE](#) Trans, const size\_t m, const size\_t ibeg, const size\_t iend, typename [Field::Element\\_ptr](#) A, const size\_t lda, const size\_t \*P, const [FFLAS::ParSeqHelper::Sequential](#) seq)
- template<class [Field](#)>  
void [doApplyS](#) (const [Field](#) &F, typename [Field::Element\\_ptr](#) A, const size\_t lda, typename [Field::Element\\_ptr](#) tmp, const size\_t width, const size\_t M2, const size\_t R1, const size\_t R2, const size\_t R3, const size\_t R4)
- template<class [Field](#)>  
void [MatrixApplyS](#) (const [Field](#) &F, typename [Field::Element\\_ptr](#) A, const size\_t lda, const size\_t width, const size\_t M2, const size\_t R1, const size\_t R2, const size\_t R3, const size\_t R4)
- template<class [Field](#)>  
void [MatrixApplyS](#) (const [Field](#) &F, typename [Field::Element\\_ptr](#) A, const size\_t lda, const size\_t width, const size\_t M2, const size\_t R1, const size\_t R2, const size\_t R3, const size\_t R4, const [FFLAS::ParSeqHelper::Sequential](#) seq)
- template<class [Field](#), class Cut, class Param>  
void [MatrixApplyS](#) (const [Field](#) &F, typename [Field::Element\\_ptr](#) A, const size\_t lda, const size\_t width, const size\_t M2, const size\_t R1, const size\_t R2, const size\_t R3, const size\_t R4, const [FFLAS::ParSeqHelper::Parallel](#)< Cut, Param > par)
- template<class T>  
void [PermApplyS](#) (T \*A, const size\_t lda, const size\_t width, const size\_t M2, const size\_t R1, const size\_t R2, const size\_t R3, const size\_t R4)
- template<class [Field](#)>  
void [doApplyT](#) (const [Field](#) &F, typename [Field::Element\\_ptr](#) A, const size\_t lda, typename [Field::Element\\_ptr](#) tmp, const size\_t width, const size\_t N2, const size\_t R1, const size\_t R2, const size\_t R3, const size\_t R4)
- template<class [Field](#)>  
void [MatrixApplyT](#) (const [Field](#) &F, typename [Field::Element\\_ptr](#) A, const size\_t lda, const size\_t width, const size\_t N2, const size\_t R1, const size\_t R2, const size\_t R3, const size\_t R4)
- template<class [Field](#)>  
void [MatrixApplyT](#) (const [Field](#) &F, typename [Field::Element\\_ptr](#) A, const size\_t lda, const size\_t width, const size\_t N2, const size\_t R1, const size\_t R2, const size\_t R3, const size\_t R4, const [FFLAS::ParSeqHelper::Sequential](#) seq)

- `template<class Field, class Cut, class Param>`  
`void MatrixApplyT (const Field &F, typename Field::Element_ptr A, const size_t lda, const size_t width, const size_t N2, const size_t R1, const size_t R2, const size_t R3, const size_t R4, const FFLAS::ParSeqHelper::Parallel< Cut, Param > par)`
- `template<class T>`  
`void PermApplyT (T *A, const size_t lda, const size_t width, const size_t N2, const size_t R1, const size_t R2, const size_t R3, const size_t R4)`
- `void LAPACKPerm2MathPerm (size_t *MathP, const size_t *LapackP, const size_t N)`  
*Conversion of a permutation from LAPACK format to Math format.*
- `void MathPerm2LAPACKPerm (size_t *LapackP, const size_t *MathP, const size_t N)`  
*Conversion of a permutation from Maths format to LAPACK format.*
- `void composePermutationsLLL (size_t *P1, const size_t *P2, const size_t R, const size_t N)`  
*Computes  $P1 \times \text{Diag}(I_R, P2)$  where  $P1$  is a LAPACK and  $P2$  a LAPACK permutation and store the result in  $P1$  as a LAPACK permutation.*
- `void composePermutationsLLM (size_t *MathP, const size_t *P1, const size_t *P2, const size_t R, const size_t N)`  
*Computes  $P1 \times \text{Diag}(I_R, P2)$  where  $P1$  is a LAPACK and  $P2$  a LAPACK permutation and store the result in  $MathP$  as a MathPermutation format.*
- `void composePermutationsMLM (size_t *MathP1, const size_t *P2, const size_t R, const size_t N)`  
*Computes  $MathP1 \times \text{Diag}(I_R, P2)$  where  $MathP1$  is a MathPermutation and  $P2$  a LAPACK permutation and store the result in  $MathP1$  as a MathPermutation format.*
- `void cyclic_shift_mathPerm (size_t *P, const size_t s)`
- `template<class Field>`  
`void cyclic_shift_row_col (const Field &F, typename Field::Element_ptr A, size_t m, size_t n, size_t lda)`
- `template<class Field>`  
`void cyclic_shift_row (const Field &F, typename Field::Element_ptr A, size_t m, size_t n, size_t lda)`
- `template<typename T>`  
`void cyclic_shift_row (const RNSIntegerMod< T > &F, typename T::Element_ptr A, size_t m, size_t n, size_t lda)`
- `template<class Field>`  
`void cyclic_shift_col (const Field &F, typename Field::Element_ptr A, size_t m, size_t n, size_t lda)`
- `template<typename T>`  
`void cyclic_shift_col (const RNSIntegerMod< T > &F, typename T::Element_ptr A, size_t m, size_t n, size_t lda)`
- `template<class Field>`  
`void applyP (const Field &F, const FFLAS::FFLAS_SIDE Side, const FFLAS::FFLAS_TRANSPOSE Trans, const size_t M, const size_t ibeg, const size_t iend, typename Field::Element_ptr A, const size_t lda, const size_t *P)`  
*Computes  $P1 \times \text{Diag}(I_R, P2)$  where  $P1$  is a LAPACK and  $P2$  a LAPACK permutation and store the result in  $P1$  as a LAPACK permutation.*
- `template<class Field, class Cut, class Param>`  
`void applyP (const Field &F, const FFLAS::FFLAS_SIDE Side, const FFLAS::FFLAS_TRANSPOSE Trans, const size_t m, const size_t ibeg, const size_t iend, typename Field::Element_ptr A, const size_t lda, const size_t *P, const FFLAS::ParSeqHelper::Parallel< Cut, Param > par)`

### 13.203.1 Macro Definition Documentation

#### 13.203.1.1 \_\_FFLASFFPACK\_ffpack\_permutation\_INL

```
#define __FFLASFFPACK_ffpack_permutation_INL
```

#### 13.203.1.2 FFLASFFPACK\_PERM\_BKSIZE

```
#define FFLASFFPACK_PERM_BKSIZE 32
```

## 13.204 ffpack\_pluq.inl File Reference

### Namespaces

- namespace [FFPACK](#)  
*Finite Field **PACK** Set of elimination based routines for dense linear algebra.*

### Macros

- #define [\\_\\_FFLASFFPACK\\_ffpack\\_pluq\\_INL](#)
- #define [CROUT](#)

### Functions

- template<class [Field](#)>  
size\_t [PLUQ\\_basecaseV3](#) (const [Field](#) &Fi, const [FFLAS::FFLAS\\_DIAG](#) Diag, const size\_t M, const size\_t N, typename [Field::Element](#) \*A, const size\_t lda, size\_t \*P, size\_t \*Q)
- template<class [Field](#)>  
size\_t [PLUQ\\_basecaseV2](#) (const [Field](#) &Fi, const [FFLAS::FFLAS\\_DIAG](#) Diag, const size\_t M, const size\_t N, typename [Field::Element](#) \*A, const size\_t lda, size\_t \*P, size\_t \*Q)
- template<class [Field](#)>  
size\_t [PLUQ\\_basecaseCrout](#) (const [Field](#) &Fi, const [FFLAS::FFLAS\\_DIAG](#) Diag, const size\_t M, const size\_t N, typename [Field::Element\\_ptr](#) A, const size\_t lda, size\_t \*P, size\_t \*Q)
- template<class [Field](#)>  
size\_t [\\_PLUQ](#) (const [Field](#) &Fi, const [FFLAS::FFLAS\\_DIAG](#) Diag, const size\_t M, const size\_t N, typename [Field::Element\\_ptr](#) A, const size\_t lda, size\_t \*P, size\_t \*Q, size\_t BCThreshold)
- template<class [Field](#)>  
size\_t [PLUQ](#) (const [Field](#) &F, const [FFLAS::FFLAS\\_DIAG](#) Diag, const size\_t M, const size\_t N, typename [Field::Element\\_ptr](#) A, const size\_t lda, size\_t \*P, size\_t \*Q, const [FFLAS::ParSeqHelper::Sequential](#) &PHelper, size\_t BCThreshold=[\\_\\_FFLASFFPACK\\_PLUQ\\_THRESHOLD](#))
- template<class [Field](#)>  
size\_t [PLUQ](#) (const [Field](#) &F, const [FFLAS::FFLAS\\_DIAG](#) Diag, const size\_t M, const size\_t N, typename [Field::Element\\_ptr](#) A, const size\_t lda, size\_t \*P, size\_t \*Q)

*Compute a PLUQ factorization of the given matrix.*

### 13.204.1 Macro Definition Documentation

#### 13.204.1.1 [\\_\\_FFLASFFPACK\\_ffpack\\_pluq\\_INL](#)

```
#define __FFLASFFPACK_ffpack_pluq_INL
```

#### 13.204.1.2 [CROUT](#)

```
#define CROUT
```

## 13.205 ffpack\_pluq\_mp.inl File Reference

```
#include "fflas-ffpack/field/rns-integer-mod.h"
#include "fflas-ffpack/field/rns-integer.h"
#include "fflas-ffpack/fflas-ffpack.h"
#include "givaro/givinteger.h"
#include "givaro/modular-integer.h"
```

### Namespaces

- namespace [FFPACK](#)  
*Finite Field **PACK** Set of elimination based routines for dense linear algebra.*

## Macros

- `#define __FFPACK_pluq_mp_INL`

## Functions

- `template<class Cut, class Param>`  
`size_t PLUQ (const Givaro::Modular< Givaro::Integer > &F, const FFLAS::FFLAS_DIAG Diag, const size_t M, const size_t N, typename Givaro::Integer *A, const size_t lda, size_t *P, size_t *Q, size_t BCThreshold, FFLAS::ParSeqHelper::Parallel< Cut, Param > &PSHelper)`

## 13.205.1 Macro Definition Documentation

### 13.205.1.1 \_\_FFPACK\_pluq\_mp\_INL

```
#define __FFPACK_pluq_mp_INL
```

## 13.206 ffpack\_ppluq.inl File Reference

## Namespaces

- namespace `FFPACK`  
*Finite Field **PACK** Set of elimination based routines for dense linear algebra.*

## Macros

- `#define __FFLASFFPACK_ffpack_ppluq_INL`
- `#define __FFLAS__TRSM_READONLY`
- `#define PBASECASE_K 256`

## Functions

- `template<class Field>`  
`void threads_fgemm (const size_t m, const size_t n, const size_t r, int nbthreads, size_t *W1, size_t *W2, size_t *W3, size_t gamma)`
- `template<class Field>`  
`void threads_ftrsm (const size_t m, const size_t n, int nbthreads, size_t *t1, size_t *t2)`
- `template<class Field>`  
`size_t PLUQ (const Field &Fi, const FFLAS::FFLAS_DIAG Diag, const size_t M, const size_t N, typename Field::Element_ptr A, const size_t lda, size_t *P, size_t *Q, const FFLAS::ParSeqHelper::Parallel< FFLAS::CuttingStrategy::Recursive, FFLAS::StrategyParameter::Threads > &PSHelper)`
- `template<class Field>`  
`size_t pPLUQ (const Field &F, const FFLAS::FFLAS_DIAG Diag, const size_t M, const size_t N, typename Field::Element_ptr A, const size_t lda, size_t *P, size_t *Q)`

## 13.206.1 Macro Definition Documentation

### 13.206.1.1 \_\_FFLASFFPACK\_ffpack\_ppluq\_INL

```
#define __FFLASFFPACK_ffpack_ppluq_INL
```

### 13.206.1.2 \_\_FFLAS\_\_TRSM\_READONLY

```
#define __FFLAS__TRSM_READONLY
```

### 13.206.1.3 PBASECASE\_K

```
#define PBASECASE_K 256
```

## 13.207 ffpack\_rankprofiles.inl File Reference

### Namespaces

- namespace [FFPACK](#)  
*Finite Field PACK Set of elimination based routines for dense linear algebra.*

### Macros

- #define [\\_\\_FFLASFFPACK\\_ffpack\\_rank\\_profiles\\_INL](#)

### Functions

- template<class [Field](#)>  
size\_t [RowRankProfile](#) (const [Field](#) &F, const size\_t M, const size\_t N, typename [Field::Element\\_ptr](#) A, const size\_t lda, size\_t \*rkprofile, const FFPACK\_LU\_TAG LuTag=[FfpackSlabRecursive](#))  
*Computes the row rank profile of A.*
- template<class [Field](#)>  
size\_t [pRowRankProfile](#) (const [Field](#) &F, const size\_t M, const size\_t N, typename [Field::Element\\_ptr](#) A, const size\_t lda, size\_t \*rkprofile, size\_t numthreads=0, const FFPACK\_LU\_TAG LuTag=[FfpackTileRecursive](#))
- template<class [Field](#), class PSHelper>  
size\_t [RowRankProfile](#) (const [Field](#) &F, const size\_t M, const size\_t N, typename [Field::Element\\_ptr](#) A, const size\_t lda, size\_t \*rkprofile, const FFPACK\_LU\_TAG LuTag, PSHelper &psH)
- template<class [Field](#)>  
size\_t [ColumnRankProfile](#) (const [Field](#) &F, const size\_t M, const size\_t N, typename [Field::Element\\_ptr](#) A, const size\_t lda, size\_t \*rkprofile, const FFPACK\_LU\_TAG LuTag=[FfpackSlabRecursive](#))  
*Computes the column rank profile of A.*
- template<class [Field](#)>  
size\_t [pColumnRankProfile](#) (const [Field](#) &F, const size\_t M, const size\_t N, typename [Field::Element\\_ptr](#) A, const size\_t lda, size\_t \*rkprofile, size\_t numthreads=0, const FFPACK\_LU\_TAG LuTag=[FfpackTileRecursive](#))
- template<class [Field](#), class PSHelper>  
size\_t [ColumnRankProfile](#) (const [Field](#) &F, const size\_t M, const size\_t N, typename [Field::Element\\_ptr](#) A, const size\_t lda, size\_t \*rkprofile, const FFPACK\_LU\_TAG LuTag, PSHelper &psH)
- void [RankProfileFromLU](#) (const size\_t \*P, const size\_t N, const size\_t R, size\_t \*rkprofile, const FFPACK\_LU\_TAG LuTag)  
*Recovers the column/row rank profile from the permutation of an LU decomposition.*
- size\_t [LeadingSubmatrixRankProfiles](#) (const size\_t M, const size\_t N, const size\_t R, const size\_t LSm, const size\_t LSn, const size\_t \*P, const size\_t \*Q, size\_t \*RRP, size\_t \*CRP)  
*Recovers the row and column rank profiles of any leading submatrix from the PLUQ decomposition.*
- template<class [Field](#)>  
size\_t [RowRankProfileSubmatrixIndices](#) (const [Field](#) &F, const size\_t M, const size\_t N, typename [Field::Element\\_ptr](#) A, const size\_t lda, size\_t \*&rowindices, size\_t \*&colindices, size\_t &R)  
*RowRankProfileSubmatrixIndices.*
- template<class [Field](#)>  
size\_t [ColRankProfileSubmatrixIndices](#) (const [Field](#) &F, const size\_t M, const size\_t N, typename [Field::Element\\_ptr](#) A, const size\_t lda, size\_t \*&rowindices, size\_t \*&colindices, size\_t &R)  
*Computes the indices of the submatrix  $r \times r$  X of A whose columns correspond to the column rank profile of A.*
- template<class [Field](#)>  
size\_t [RowRankProfileSubmatrix](#) (const [Field](#) &F, const size\_t M, const size\_t N, typename [Field::Element\\_ptr](#) A, const size\_t lda, typename [Field::Element\\_ptr](#) &X, size\_t &R)  
*Computes the  $r \times r$  submatrix X of A, by picking the row rank profile rows of A.*
- template<class [Field](#)>  
size\_t [ColRankProfileSubmatrix](#) (const [Field](#) &F, const size\_t M, const size\_t N, typename [Field::Element\\_ptr](#) A, const size\_t lda, typename [Field::Element\\_ptr](#) &X, size\_t &R)  
*Compute the  $r \times r$  submatrix X of A, by picking the row rank profile rows of A.*

- `template<class Field>`  
`Field::Element_ptr LQUPtoInverseOfFullRankMinor (const Field &F, const size_t rank, typename`  
`Field::Element_ptr A_factors, const size_t lda, const size_t *QtPointer, typename Field::Element_ptr X,`  
`const size_t ldx)`  
`LQUPtoInverseOfFullRankMinor.`

## 13.207.1 Macro Definition Documentation

### 13.207.1.1 \_\_FFLASFFPACK\_ffpack\_rank\_profiles\_INL

```
#define __FFLASFFPACK_ffpack_rank_profiles_INL
```

## 13.208 field-traits.h File Reference

Field Traits.

```
#include <type_traits>
#include "fflas-ffpack/field/rns-double-elt.h"
#include "recint/rmint.h"
#include "givaro/modular-general.h"
#include "givaro/zring.h"
```

### Data Structures

- struct [GenericTag](#)  
*generic ring.*
- struct [ModularTag](#)  
*This is a modular field like e.g. `Modular<T>` or `ModularBalanced<T>`*
- struct [UnparametricTag](#)  
*If the field uses a representation with infix operators.*
- struct [DefaultTag](#)  
*No specific mode of action: use standard field operations.*
- struct [DefaultBoundedTag](#)  
*Use standard field operations, but keeps track of bounds on input and output.*
- struct [ConvertTo< T >](#)  
*Force conversion to appropriate element type of `ElementCategory T`.*
- struct [DelayedTag](#)  
*Performs field operations with delayed mod reductions. Ensures result is reduced.*
- struct [LazyTag](#)  
*Performs field operations with delayed mod only when necessary. Result may not be reduced.*
- struct [GenericTag](#)  
*default is generic*
- struct [MachineFloatTag](#)  
*float or double*
- struct [MachineIntTag](#)  
*short, int, long, long long, and unsigned variants*
- struct [FixedPrecIntTag](#)  
*Fixed precision integers above machine precision: `Givaro::recInt`.*
- struct [ArbitraryPrecIntTag](#)  
*Arbitrary precision integers: `GMP`.*
- struct [RNSElementTag](#)  
*Representation in a Residue Number System.*
- struct [ElementTraits< Element >](#)

*ElementTraits.*

- struct [ElementTraits](#)< float >
- struct [ElementTraits](#)< double >
- struct [ElementTraits](#)< int8\_t >
- struct [ElementTraits](#)< int16\_t >
- struct [ElementTraits](#)< int32\_t >
- struct [ElementTraits](#)< int64\_t >
- struct [ElementTraits](#)< uint8\_t >
- struct [ElementTraits](#)< uint16\_t >
- struct [ElementTraits](#)< uint32\_t >
- struct [ElementTraits](#)< uint64\_t >
- struct [ElementTraits](#)< Givaro::Integer >
- struct [ElementTraits](#)< Reclnt::rint< K > >
- struct [ElementTraits](#)< Reclnt::ruint< K > >
- struct [ElementTraits](#)< Reclnt::rmint< K, MG > >
- struct [ElementTraits](#)< FFPACK::rns\_double\_elt >
- struct [ModeTraits](#)< Field >

*ModeTraits.*

- struct [ModeTraits](#)< Givaro::Modular< Element, Compute > >
- struct [ModeTraits](#)< Givaro::Modular< int64\_t, uint64\_t > >
- struct [ModeTraits](#)< Givaro::Modular< int8\_t, Compute > >
- struct [ModeTraits](#)< Givaro::Modular< int16\_t, Compute > >
- struct [ModeTraits](#)< Givaro::Modular< int32\_t, Compute > >
- struct [ModeTraits](#)< Givaro::Modular< uint8\_t, Compute > >
- struct [ModeTraits](#)< Givaro::Modular< uint16\_t, Compute > >
- struct [ModeTraits](#)< Givaro::Modular< uint32\_t, Compute > >
- struct [ModeTraits](#)< Givaro::Modular< Givaro::Integer, Compute > >
- struct [ModeTraits](#)< Givaro::Modular< Reclnt::ruint< K >, Compute > >
- struct [ModeTraits](#)< Givaro::ModularBalanced< Element > >
- struct [ModeTraits](#)< Givaro::ModularBalanced< int8\_t > >
- struct [ModeTraits](#)< Givaro::ModularBalanced< int16\_t > >
- struct [ModeTraits](#)< Givaro::ModularBalanced< int32\_t > >
- struct [ModeTraits](#)< Givaro::ModularBalanced< Givaro::Integer > >
- struct [ModeTraits](#)< Givaro::ZRing< Givaro::Integer > >
- struct [ModeTraits](#)< Givaro::ZRing< float > >
- struct [ModeTraits](#)< Givaro::ZRing< double > >
- struct [ModeTraits](#)< Givaro::Montgomery< T > >
- struct [FieldTraits](#)< Field >

*FieldTrait.*

- struct [FieldTraits](#)< Givaro::ZRing< Reclnt::ruint< K > > >
- struct [FieldTraits](#)< Givaro::Modular< Element > >
- struct [FieldTraits](#)< Givaro::ModularBalanced< Element > >
- struct [FieldTraits](#)< Givaro::ZRing< double > >
- struct [FieldTraits](#)< Givaro::ZRing< float > >
- struct [FieldTraits](#)< Givaro::ZRing< int16\_t > >
- struct [FieldTraits](#)< Givaro::ZRing< uint16\_t > >
- struct [FieldTraits](#)< Givaro::ZRing< int32\_t > >
- struct [FieldTraits](#)< Givaro::ZRing< uint32\_t > >
- struct [FieldTraits](#)< Givaro::ZRing< int64\_t > >
- struct [FieldTraits](#)< Givaro::ZRing< uint64\_t > >
- struct [FieldTraits](#)< Givaro::ZRing< Givaro::Integer > >
- struct [FieldTraits](#)< FFPACK::RNSInteger< T > >
- struct [FieldTraits](#)< FFPACK::RNSIntegerMod< T > >
- struct [associatedDelayedField](#)< Field >
- struct [associatedDelayedField](#)< const Givaro::Modular< T, X > >
- struct [associatedDelayedField](#)< const Givaro::ModularBalanced< T > >
- struct [associatedDelayedField](#)< const Givaro::ZRing< T > >
- struct [associatedDelayedField](#)< const FFPACK::RNSIntegerMod< RNS > >

## Namespaces

- namespace [Reclnt](#)
- namespace [Givaro](#)
- namespace [FFPACK](#)

*Finite Field **PACK** Set of elimination based routines for dense linear algebra.*

- namespace [FFLAS](#)
- namespace [FFLAS::FieldCategories](#)

*Traits and categories will need to be placed in a proper file later.*

- namespace [FFLAS::ModeCategories](#)
- namespace [FFLAS::ElementCategories](#)

*Specifies the mode of action for an algorithm w.r.t.*

## Functions

- template<class [Field](#), class enable = void>  
Field::Residu\_t [maxCardinality](#) ()
- template<> uint64\_t [maxCardinality](#)< [Givaro::Modular](#)< int64\_t > > ()
- template<> uint32\_t [maxCardinality](#)< [Givaro::Modular](#)< int32\_t > > ()
- template<class [Field](#)>  
Field::Residu\_t [minCardinality](#) ()

### 13.208.1 Detailed Description

[Field](#) Traits.

## 13.209 field.doxy File Reference

### 13.210 rns-double-elt.h File Reference

rns elt structure with double support

```
#include "fflas-ffpack/utils/fflas_memory.h"
#include "fflas-ffpack/utils/cast.h"
```

## Data Structures

- struct [rns\\_double\\_elt](#)
- struct [rns\\_double\\_elt\\_ptr](#)
- struct [rns\\_double\\_elt\\_cstptr](#)

## Namespaces

- namespace [FFPACK](#)

*Finite Field **PACK** Set of elimination based routines for dense linear algebra.*

## Functions

- template<> [rns\\_double\\_elt\\_ptr](#) fflas\_const\_cast ([rns\\_double\\_elt\\_cstptr](#) x)
- template<> [rns\\_double\\_elt\\_cstptr](#) fflas\_const\_cast ([rns\\_double\\_elt\\_ptr](#) x)

### 13.210.1 Detailed Description

rns elt structure with double support



## 13.211 rns-double-recint.inl File Reference

```
#include "fflas-ffpack/fflas/fflas_freduce.h"
```

### Namespaces

- namespace [FFPACK](#)  
*Finite Field **PACK** Set of elimination based routines for dense linear algebra.*

### Macros

- #define [\\_\\_FFLASFFPACK\\_field\\_rns\\_double\\_recint\\_INL](#)

### 13.211.1 Macro Definition Documentation

#### 13.211.1.1 [\\_\\_FFLASFFPACK\\_field\\_rns\\_double\\_recint\\_INL](#)

```
#define __FFLASFFPACK_field_rns_double_recint_INL
```

## 13.212 rns-double.h File Reference

rns structure with double support

```
#include <iterator>
#include <vector>
#include <givaro/modular-floating.h>
#include <givaro/givinteger.h>
#include <givaro/givintprime.h>
#include "givaro/modular-extended.h"
#include <recint/ruint.h>
#include "fflas-ffpack/config-blas.h"
#include "fflas-ffpack/utils/fflas_memory.h"
#include "fflas-ffpack/utils/align-allocator.h"
#include "fflas-ffpack/field/rns-double-elt.h"
#include "rns-double.inl"
#include "rns-double-recint.inl"
```

### Data Structures

- struct [rns\\_double](#)
- struct [rns\\_double\\_extended](#)
- class [rnsRandIter](#)< [RNS](#) >

### Namespaces

- namespace [FFPACK](#)  
*Finite Field **PACK** Set of elimination based routines for dense linear algebra.*
- namespace [FFLAS](#)

### Macros

- #define [ROUND\\_DOWN](#)(x, s)

### Functions

- template<> void [fflas\\_delete](#) (FFPACK::rns\_double\_elt\_ptr A)
- template<> void [fflas\\_delete](#) (FFPACK::rns\_double\_elt\_cstptr A)

### 13.212.1 Detailed Description

rns structure with double support

### 13.212.2 Macro Definition Documentation

#### 13.212.2.1 ROUND\_DOWN

```
#define ROUND_DOWN(  
    x,  
    s)
```

**Value:**

```
((x) & ~((s)-1))
```

## 13.213 rns-double.inl File Reference

```
#include "fflas-ffpack/fflas/fflas_freduce.h"
```

### Namespaces

- namespace [FFPACK](#)

*Finite Field **PACK** Set of elimination based routines for dense linear algebra.*

### Macros

- #define [\\_\\_FFLASFFPACK\\_field\\_rns\\_double\\_INL](#)

### 13.213.1 Macro Definition Documentation

#### 13.213.1.1 \_\_FFLASFFPACK\_field\_rns\_double\_INL

```
#define __FFLASFFPACK_field_rns_double_INL
```

## 13.214 rns-integer-mod.h File Reference

representation of  $\mathbb{Z}/p\mathbb{Z}$  using [RNS](#) representation (note: fixed precision)

```
#include <vector>  
#include <cmath>  
#include <recint/recint.h>  
#include <givaro/modular-integer.h>  
#include <givaro/givinteger.h>  
#include <givaro/udl.h>  
#include "givaro/modular-extended.h"  
#include "fflas-ffpack/field/rns-double.h"  
#include "fflas-ffpack/field/rns-integer.h"  
#include "fflas-ffpack/fflas/fflas_level1.inl"  
#include "fflas-ffpack/fflas/fflas_level2.inl"  
#include "fflas-ffpack/fflas/fflas_level3.inl"  
#include "fflas-ffpack/fflas/fflas_enum.h"  
#include "fflas-ffpack/fflas/fflas_fscal_mp.inl"
```

### Data Structures

- class [RNSIntegerMod< RNS >](#)
- class [RNSIntegerMod< RNS >::RandIter](#)

## Namespaces

- namespace [FFPACK](#)  
*Finite Field **PACK** Set of elimination based routines for dense linear algebra.*
- namespace [FFLAS](#)

## Functions

- `template<> FFPACK::rns\_double\_elt\_ptr fflas\_new (const FFPACK::RNSIntegerMod< FFPACK::rns\_double > &F, const size_t m, const Alignment align)`
- `template<> FFPACK::rns\_double\_elt\_ptr fflas\_new (const FFPACK::RNSIntegerMod< FFPACK::rns\_double > &F, const size_t m, const size_t n, const Alignment align)`
- `template<typename RNS>  
void finit\_rns (const FFPACK::RNSIntegerMod< RNS > &F, const size_t m, const size_t n, size_t k, const Givaro::Integer *B, const size_t ldb, typename RNS::Element\_ptr A)`
- `template<typename RNS>  
void finit\_trans\_rns (const FFPACK::RNSIntegerMod< RNS > &F, const size_t m, const size_t n, size_t k, const Givaro::Integer *B, const size_t ldb, typename RNS::Element\_ptr A)`
- `template<typename RNS>  
void fconvert\_rns (const FFPACK::RNSIntegerMod< RNS > &F, const size_t m, const size_t n, Givaro::Integer alpha, Givaro::Integer *B, const size_t ldb, typename RNS::ConstElement\_ptr A)`
- `template<typename RNS>  
void fconvert\_trans\_rns (const FFPACK::RNSIntegerMod< RNS > &F, const size_t m, const size_t n, Givaro::Integer alpha, Givaro::Integer *B, const size_t ldb, typename RNS::ConstElement\_ptr A)`

### 13.214.1 Detailed Description

representation of  $\mathbb{Z}/p\mathbb{Z}$  using [RNS](#) representation (note: fixed precision)

## 13.215 rns-integer.h File Reference

representation of  $\mathbb{Z}$  using [RNS](#) representation (note: fixed precision)

```
#include <givaro/givinteger.h>
#include "fflas-ffpack/field/rns-double.h"
```

## Data Structures

- class [RNSInteger](#)< [RNS](#) >
- class [RNSInteger](#)< [RNS](#) >::RandIter

## Namespaces

- namespace [FFPACK](#)  
*Finite Field **PACK** Set of elimination based routines for dense linear algebra.*
- namespace [FFLAS](#)

## Functions

- `template<> FFPACK::rns\_double\_elt\_ptr fflas\_new (const FFPACK::RNSInteger< FFPACK::rns\_double > &F, const size_t m, const Alignment align)`
- `template<> FFPACK::rns\_double\_elt\_ptr fflas\_new (const FFPACK::RNSInteger< FFPACK::rns\_double > &F, const size_t m, const size_t n, const Alignment align)`
- `template<typename RNS>  
void finit\_rns (const FFPACK::RNSInteger< RNS > &F, const size_t m, const size_t n, size_t k, const Givaro::Integer *B, const size_t ldb, typename FFPACK::RNSInteger< RNS >::Element_ptr A)`
- `template<typename RNS>  
void fconvert\_rns (const FFPACK::RNSInteger< RNS > &F, const size_t m, const size_t n, Givaro::Integer alpha, Givaro::Integer *B, const size_t ldb, typename FFPACK::RNSInteger< RNS >::ConstElement_ptr A)`

### 13.215.1 Detailed Description

representation of  $\mathbb{Z}$  using [RNS](#) representation (note: fixed precision)

## 13.216 rns.h File Reference

### Namespaces

- namespace [FFPACK](#)  
*Finite Field **PACK** Set of elimination based routines for dense linear algebra.*

## 13.217 rns.inl File Reference

```
#include "rns-double.h"
#include "rns-integer.h"
#include "rns-integer-mod.h"
```

### Macros

- #define [\\_\\_FFLASFFPACK\\_field\\_rns\\_INL](#)

### 13.217.1 Macro Definition Documentation

#### 13.217.1.1 \_\_FFLASFFPACK\_field\_rns\_INL

```
#define __FFLASFFPACK_field_rns_INL
```

## 13.218 interfaces.doxy File Reference

## 13.219 fflas\_c.h File Reference

```
#include <stdbool.h>
#include <stdlib.h>
#include <inttypes.h>
```

### Macros

- #define [FFLAS\\_COMPILED](#)

### Enumerations

- enum [FFLAS\\_C\\_ORDER](#) { [FflasRowMajor](#) = 101 , [FflasColMajor](#) = 102 }  
*Storage by row or col ?*
- enum [FFLAS\\_C\\_TRANSPOSE](#) { [FflasNoTrans](#) = 111 , [FflasTrans](#) = 112 }  
*Is matrix transposed ?*
- enum [FFLAS\\_C\\_UPLO](#) { [FflasUpper](#) = 121 , [FflasLower](#) = 122 }  
*Is triangular matrix's shape upper ?*
- enum [FFLAS\\_C\\_DIAG](#) { [FflasNonUnit](#) = 131 , [FflasUnit](#) = 132 }  
*Is the triangular matrix implicitly unit diagonal ?*
- enum [FFLAS\\_C\\_SIDE](#) { [FflasLeft](#) = 141 , [FflasRight](#) = 142 }  
*On what side ?*
- enum [FFLAS\\_C\\_BASE](#) { [FflasDouble](#) = 151 , [FflasFloat](#) = 152 , [FflasGeneric](#) = 153 }  
*[FFLAS\\_C\\_BASE](#) determines the type of the element representation for Matrix Mult kernel.*

## Functions

- void [freducein\\_1\\_modular\\_double](#) (const double p, const size\_t n, double \*X, const size\_t incX, bool positive)
- void [freduce\\_1\\_modular\\_double](#) (const double F, const size\_t n, const double \*Y, const size\_t incY, double \*X, const size\_t incX, bool positive)
- void [fnegin\\_1\\_modular\\_double](#) (const double F, const size\_t n, double \*X, const size\_t incX, bool positive)
- void [fneg\\_1\\_modular\\_double](#) (const double p, const size\_t n, const double \*Y, const size\_t incY, double \*X, const size\_t incX, bool positive)
- void [fzero\\_1\\_modular\\_double](#) (const double p, const size\_t n, double \*X, const size\_t incX, bool positive)
- bool [fiszero\\_1\\_modular\\_double](#) (const double p, const size\_t n, const double \*X, const size\_t incX, bool positive)
- bool [fequal\\_1\\_modular\\_double](#) (const double p, const size\_t n, const double \*X, const size\_t incX, const double \*Y, const size\_t incY, bool positive)
- void [fassign\\_1\\_modular\\_double](#) (const double p, const size\_t n, const double \*Y, const size\_t incY, double \*X, const size\_t incX, bool positive)
- void [fscal\\_1\\_modular\\_double](#) (const double p, const size\_t n, const double alpha, double \*X, const size\_t incX, bool positive)
- void [fscal\\_1\\_modular\\_double](#) (const double p, const size\_t n, const double alpha, const double \*X, const size\_t incX, double \*Y, const size\_t incY, bool positive)
- void [faxpy\\_1\\_modular\\_double](#) (const double p, const size\_t n, const double alpha, const double \*X, const size\_t incX, double \*Y, const size\_t incY, bool positive)
- double [fdot\\_1\\_modular\\_double](#) (const double p, const size\_t n, const double \*X, const size\_t incX, const double \*Y, const size\_t incY, bool positive)
- void [fswap\\_1\\_modular\\_double](#) (const double p, const size\_t n, double \*X, const size\_t incX, double \*Y, const size\_t incY, bool positive)
- void [fadd\\_1\\_modular\\_double](#) (const double p, const size\_t n, const double \*A, const size\_t incA, const double \*B, const size\_t incB, double \*C, const size\_t incC, bool positive)
- void [fsub\\_1\\_modular\\_double](#) (const double p, const size\_t n, const double \*A, const size\_t incA, const double \*B, const size\_t incB, double \*C, const size\_t incC, bool positive)
- void [faddin\\_1\\_modular\\_double](#) (const double p, const size\_t n, const double \*B, const size\_t incB, double \*C, const size\_t incC, bool positive)
- void [fsubin\\_1\\_modular\\_double](#) (const double p, const size\_t n, const double \*B, const size\_t incB, double \*C, const size\_t incC, bool positive)
- void [fassign\\_2\\_modular\\_double](#) (const double p, const size\_t m, const size\_t n, const double \*B, const size\_t incB, double \*A, const size\_t incA, bool positive)
- void [fzero\\_2\\_modular\\_double](#) (const double p, const size\_t m, const size\_t n, double \*A, const size\_t incA, bool positive)
- bool [fequal\\_2\\_modular\\_double](#) (const double p, const size\_t m, const size\_t n, const double \*A, const size\_t incA, const double \*B, const size\_t incB, bool positive)
- bool [fiszero\\_2\\_modular\\_double](#) (const double p, const size\_t m, const size\_t n, const double \*A, const size\_t incA, bool positive)
- void [fidentity\\_2\\_modular\\_double](#) (const double p, const size\_t m, const size\_t n, double \*A, const size\_t incA, const double d, bool positive)
- void [freducein\\_2\\_modular\\_double](#) (const double p, const size\_t m, const size\_t n, double \*A, const size\_t incA, bool positive)
- void [freduce\\_2\\_modular\\_double](#) (const double p, const size\_t m, const size\_t n, const double \*B, const size\_t incB, double \*A, const size\_t incA, bool positive)
- void [fnegin\\_2\\_modular\\_double](#) (const double p, const size\_t m, const size\_t n, double \*A, const size\_t incA, bool positive)
- void [fneg\\_2\\_modular\\_double](#) (const double p, const size\_t m, const size\_t n, const double \*B, const size\_t incB, double \*A, const size\_t incA, bool positive)
- void [fscal\\_2\\_modular\\_double](#) (const double p, const size\_t m, const size\_t n, const double alpha, double \*A, const size\_t incA, bool positive)
- void [fscal\\_2\\_modular\\_double](#) (const double p, const size\_t m, const size\_t n, const double alpha, const double \*A, const size\_t incA, double \*B, const size\_t incB, bool positive)
- void [faxpy\\_2\\_modular\\_double](#) (const double p, const size\_t m, const size\_t n, const double alpha, const double \*X, const size\_t incX, double \*Y, const size\_t incY, bool positive)

- void [fmove\\_2\\_modular\\_double](#) (const double p, const size\_t m, const size\_t n, double \*A, const size\_t ldA, double \*B, const size\_t ldB, bool positive)
- void [fadd\\_2\\_modular\\_double](#) (const double p, const size\_t m, const size\_t n, const double \*A, const size\_t ldA, const double \*B, const size\_t ldB, double \*C, const size\_t ldC, bool positive)
- void [fsub\\_2\\_modular\\_double](#) (const double p, const size\_t m, const size\_t n, const double \*A, const size\_t ldA, const double \*B, const size\_t ldB, double \*C, const size\_t ldC, bool positive)
- void [fsubin\\_2\\_modular\\_double](#) (const double p, const size\_t m, const size\_t n, const double \*B, const size\_t ldB, double \*C, const size\_t ldC, bool positive)
- void [faddin\\_2\\_modular\\_double](#) (const double p, const size\_t m, const size\_t n, const double \*B, const size\_t ldB, double \*C, const size\_t ldC, bool positive)
- double \* [fgemv\\_2\\_modular\\_double](#) (const double p, const enum [FFLAS\\_C\\_TRANSPOSE](#) TransA, const size\_t m, const size\_t n, const double alpha, const double \*A, const size\_t ldA, const double \*X, const size\_t incX, const double betA, double \*Y, const size\_t incY, bool positive)
- void [fger\\_2\\_modular\\_double](#) (const double p, const size\_t m, const size\_t n, const double alpha, const double \*x, const size\_t incX, const double \*y, const size\_t incY, double \*A, const size\_t ldA, bool positive)
- void [ftrsv\\_2\\_modular\\_double](#) (const double p, const enum [FFLAS\\_C\\_UPLO](#) Uplo, const enum [FFLAS\\_C\\_TRANSPOSE](#) TransA, const enum [FFLAS\\_C\\_DIAG](#) Diag, const size\_t n, const double \*A, const size\_t ldA, double \*X, int incX, bool positive)
- void [ftrsm\\_3\\_modular\\_double](#) (const double p, const enum [FFLAS\\_C\\_SIDE](#) Side, const enum [FFLAS\\_C\\_UPLO](#) Uplo, const enum [FFLAS\\_C\\_TRANSPOSE](#) TransA, const enum [FFLAS\\_C\\_DIAG](#) Diag, const size\_t m, const size\_t n, const double alpha, const double \*A, const size\_t ldA, double \*B, const size\_t ldB, bool positive)
- void [ftrmm\\_3\\_modular\\_double](#) (const double p, const enum [FFLAS\\_C\\_SIDE](#) Side, const enum [FFLAS\\_C\\_UPLO](#) Uplo, const enum [FFLAS\\_C\\_TRANSPOSE](#) TransA, const enum [FFLAS\\_C\\_DIAG](#) Diag, const size\_t m, const size\_t n, const double alpha, double \*A, const size\_t ldA, double \*B, const size\_t ldB, bool positive)
- double \* [fgemm\\_3\\_modular\\_double](#) (const double p, const enum [FFLAS\\_C\\_TRANSPOSE](#) tA, const enum [FFLAS\\_C\\_TRANSPOSE](#) tB, const size\_t m, const size\_t n, const size\_t k, const double alpha, const double \*A, const size\_t ldA, const double \*B, const size\_t ldB, const double betA, double \*C, const size\_t ldC, bool positive)
- double \* [fsquare\\_3\\_modular\\_double](#) (const double p, const enum [FFLAS\\_C\\_TRANSPOSE](#) tA, const size\_t n, const double alpha, const double \*A, const size\_t ldA, const double betA, double \*C, const size\_t ldC, bool positive)

### 13.219.1 Macro Definition Documentation

#### 13.219.1.1 FFLAS\_COMPILED

```
#define FFLAS_COMPILED
```

### 13.219.2 Enumeration Type Documentation

#### 13.219.2.1 FFLAS\_C\_ORDER

```
enum FFLAS\_C\_ORDER
```

Storage by row or col ?

Enumerator

|                               |           |
|-------------------------------|-----------|
| <a href="#">FflasRowMajor</a> | row major |
| <a href="#">FflasColMajor</a> | col major |

#### 13.219.2.2 FFLAS\_C\_TRANSPOSE

```
enum FFLAS\_C\_TRANSPOSE
```

Is matrix transposed ?

## Enumerator

|              |                           |
|--------------|---------------------------|
| FflasNoTrans | Matrix is not transposed. |
| FflasTrans   | Matrix is transposed.     |

**13.219.2.3 FFLAS\_C\_UPLO**enum [FFLAS\\_C\\_UPLO](#)

Is triangular matrix's shape upper ?

## Enumerator

|            |                                                                        |
|------------|------------------------------------------------------------------------|
| FflasUpper | Triangular matrix is Upper triangular (if $i > j$ then $T_{i,j} = 0$ ) |
| FflasLower | Triangular matrix is Lower triangular (if $i < j$ then $T_{i,j} = 0$ ) |

**13.219.2.4 FFLAS\_C\_DIAG**enum [FFLAS\\_C\\_DIAG](#)

Is the triangular matrix implicitly unit diagonal ?

## Enumerator

|              |                                                                   |
|--------------|-------------------------------------------------------------------|
| FflasNonUnit | Triangular matrix has an explicit arbitrary diagonal.             |
| FflasUnit    | Triangular matrix has an implicit unit diagonal ( $T_{i,i} = 1$ ) |

**13.219.2.5 FFLAS\_C\_SIDE**enum [FFLAS\\_C\\_SIDE](#)

On what side ?

## Enumerator

|            |                                 |
|------------|---------------------------------|
| FflasLeft  | Operator applied on the left.   |
| FflasRight | Operator applied on the righth. |

**13.219.2.6 FFLAS\_C\_BASE**enum [FFLAS\\_C\\_BASE](#)

[FFLAS\\_C\\_BASE](#) determines the type of the element representation for Matrix Mult kernel.  
(deprecated, should not be used)

## Enumerator

|              |                                                                            |
|--------------|----------------------------------------------------------------------------|
| FflasDouble  | to use the double precision BLAS                                           |
| FflasFloat   | to use the single precision BLAS                                           |
| FflasGeneric | for any other domain, that can not be converted to floating point integers |

### 13.219.3 Function Documentation

#### 13.219.3.1 `freducein_1_modular_double()`

```
void freducein_1_modular_double (
    const double p,
    const size_t n,
    double * X,
    const size_t incX,
    bool positive)
```

#### 13.219.3.2 `freduce_1_modular_double()`

```
void freduce_1_modular_double (
    const double F,
    const size_t n,
    const double * Y,
    const size_t incY,
    double * X,
    const size_t incX,
    bool positive)
```

#### 13.219.3.3 `fnegin_1_modular_double()`

```
void fnegin_1_modular_double (
    const double F,
    const size_t n,
    double * X,
    const size_t incX,
    bool positive)
```

#### 13.219.3.4 `fneg_1_modular_double()`

```
void fneg_1_modular_double (
    const double p,
    const size_t n,
    const double * Y,
    const size_t incY,
    double * X,
    const size_t incX,
    bool positive)
```

#### 13.219.3.5 `fzero_1_modular_double()`

```
void fzero_1_modular_double (
    const double p,
    const size_t n,
    double * X,
    const size_t incX,
    bool positive)
```

#### 13.219.3.6 `fiszero_1_modular_double()`

```
bool fiszero_1_modular_double (
    const double p,
    const size_t n,
    const double * X,
    const size_t incX,
    bool positive)
```



**13.219.3.7 fequal\_1\_modular\_double()**

```
bool fequal_1_modular_double (
    const double p,
    const size_t n,
    const double * X,
    const size_t incX,
    const double * Y,
    const size_t incY,
    bool positive)
```

**13.219.3.8 fassign\_1\_modular\_double()**

```
void fassign_1_modular_double (
    const double p,
    const size_t n,
    const double * Y,
    const size_t incY,
    double * X,
    const size_t incX,
    bool positive)
```

**13.219.3.9 fscal\_1\_modular\_double()**

```
void fscal_1_modular_double (
    const double p,
    const size_t n,
    const double alpha,
    double * X,
    const size_t incX,
    bool positive)
```

**13.219.3.10 fscale\_1\_modular\_double()**

```
void fscale_1_modular_double (
    const double p,
    const size_t n,
    const double alpha,
    const double * X,
    const size_t incX,
    double * Y,
    const size_t incY,
    bool positive)
```

**13.219.3.11 faxpy\_1\_modular\_double()**

```
void faxpy_1_modular_double (
    const double p,
    const size_t n,
    const double alpha,
    const double * X,
    const size_t incX,
    double * Y,
    const size_t incY,
    bool positive)
```

**13.219.3.12 fdot\_1\_modular\_double()**

```
double fdot_1_modular_double (
    const double p,
```

```
    const size_t n,  
    const double * X,  
    const size_t incX,  
    const double * Y,  
    const size_t incY,  
    bool positive)
```

#### 13.219.3.13 fswap\_1\_modular\_double()

```
void fswap_1_modular_double (  
    const double p,  
    const size_t n,  
    double * X,  
    const size_t incX,  
    double * Y,  
    const size_t incY,  
    bool positive)
```

#### 13.219.3.14 fadd\_1\_modular\_double()

```
void fadd_1_modular_double (  
    const double p,  
    const size_t n,  
    const double * A,  
    const size_t incA,  
    const double * B,  
    const size_t incB,  
    double * C,  
    const size_t incC,  
    bool positive)
```

#### 13.219.3.15 fsub\_1\_modular\_double()

```
void fsub_1_modular_double (  
    const double p,  
    const size_t n,  
    const double * A,  
    const size_t incA,  
    const double * B,  
    const size_t incB,  
    double * C,  
    const size_t incC,  
    bool positive)
```

#### 13.219.3.16 faddin\_1\_modular\_double()

```
void faddin_1_modular_double (  
    const double p,  
    const size_t n,  
    const double * B,  
    const size_t incB,  
    double * C,  
    const size_t incC,  
    bool positive)
```

#### 13.219.3.17 fsubin\_1\_modular\_double()

```
void fsubin_1_modular_double (  
    const double p,
```

```
    const size_t n,  
    const double * B,  
    const size_t incB,  
    double * C,  
    const size_t incC,  
    bool positive)
```

#### 13.219.3.18 fassign\_2\_modular\_double()

```
void fassign_2_modular_double (  
    const double p,  
    const size_t m,  
    const size_t n,  
    const double * B,  
    const size_t ldB,  
    double * A,  
    const size_t ldA,  
    bool positive)
```

#### 13.219.3.19 fzero\_2\_modular\_double()

```
void fzero_2_modular_double (  
    const double p,  
    const size_t m,  
    const size_t n,  
    double * A,  
    const size_t ldA,  
    bool positive)
```

#### 13.219.3.20 fequal\_2\_modular\_double()

```
bool fequal_2_modular_double (  
    const double p,  
    const size_t m,  
    const size_t n,  
    const double * A,  
    const size_t ldA,  
    const double * B,  
    const size_t ldB,  
    bool positive)
```

#### 13.219.3.21 fiszero\_2\_modular\_double()

```
bool fiszero_2_modular_double (  
    const double p,  
    const size_t m,  
    const size_t n,  
    const double * A,  
    const size_t ldA,  
    bool positive)
```

#### 13.219.3.22 fidentity\_2\_modular\_double()

```
void fidentity_2_modular_double (  
    const double p,  
    const size_t m,  
    const size_t n,  
    double * A,  
    const size_t ldA,
```

```
    const double d,  
    bool positive)
```

#### 13.219.3.23 **freducein\_2\_modular\_double()**

```
void frducein_2_modular_double (  
    const double p,  
    const size_t m,  
    const size_t n,  
    double * A,  
    const size_t ldA,  
    bool positive)
```

#### 13.219.3.24 **freduce\_2\_modular\_double()**

```
void frduce_2_modular_double (  
    const double p,  
    const size_t m,  
    const size_t n,  
    const double * B,  
    const size_t ldB,  
    double * A,  
    const size_t ldA,  
    bool positive)
```

#### 13.219.3.25 **fnegin\_2\_modular\_double()**

```
void fnegin_2_modular_double (  
    const double p,  
    const size_t m,  
    const size_t n,  
    double * A,  
    const size_t ldA,  
    bool positive)
```

#### 13.219.3.26 **fneg\_2\_modular\_double()**

```
void fneg_2_modular_double (  
    const double p,  
    const size_t m,  
    const size_t n,  
    const double * B,  
    const size_t ldB,  
    double * A,  
    const size_t ldA,  
    bool positive)
```

#### 13.219.3.27 **fscaln\_2\_modular\_double()**

```
void fscaln_2_modular_double (  
    const double p,  
    const size_t m,  
    const size_t n,  
    const double alpha,  
    double * A,  
    const size_t ldA,  
    bool positive)
```

**13.219.3.28 fscal\_2\_modular\_double()**

```
void fscal_2_modular_double (
    const double p,
    const size_t m,
    const size_t n,
    const double alpha,
    const double * A,
    const size_t ldA,
    double * B,
    const size_t ldB,
    bool positive)
```

**13.219.3.29 faxpy\_2\_modular\_double()**

```
void faxpy_2_modular_double (
    const double p,
    const size_t m,
    const size_t n,
    const double alpha,
    const double * X,
    const size_t ldX,
    double * Y,
    const size_t ldY,
    bool positive)
```

**13.219.3.30 fmove\_2\_modular\_double()**

```
void fmove_2_modular_double (
    const double p,
    const size_t m,
    const size_t n,
    double * A,
    const size_t ldA,
    double * B,
    const size_t ldB,
    bool positive)
```

**13.219.3.31 fadd\_2\_modular\_double()**

```
void fadd_2_modular_double (
    const double p,
    const size_t m,
    const size_t n,
    const double * A,
    const size_t ldA,
    const double * B,
    const size_t ldB,
    double * C,
    const size_t ldC,
    bool positive)
```

**13.219.3.32 fsub\_2\_modular\_double()**

```
void fsub_2_modular_double (
    const double p,
    const size_t m,
    const size_t n,
    const double * A,
```

```

    const size_t ldA,
    const double * B,
    const size_t ldB,
    double * C,
    const size_t ldC,
    bool positive)

```

#### 13.219.3.33 fsubin\_2\_modular\_double()

```

void fsubin_2_modular_double (
    const double p,
    const size_t m,
    const size_t n,
    const double * B,
    const size_t ldB,
    double * C,
    const size_t ldC,
    bool positive)

```

#### 13.219.3.34 faddin\_2\_modular\_double()

```

void faddin_2_modular_double (
    const double p,
    const size_t m,
    const size_t n,
    const double * B,
    const size_t ldB,
    double * C,
    const size_t ldC,
    bool positive)

```

#### 13.219.3.35 fgemv\_2\_modular\_double()

```

double * fgemv_2_modular_double (
    const double p,
    const enum FFLAS_C_TRANSPOSE TransA,
    const size_t m,
    const size_t n,
    const double alpha,
    const double * A,
    const size_t ldA,
    const double * X,
    const size_t incX,
    const double betA,
    double * Y,
    const size_t incY,
    bool positive)

```

#### 13.219.3.36 fger\_2\_modular\_double()

```

void fger_2_modular_double (
    const double p,
    const size_t m,
    const size_t n,
    const double alpha,
    const double * x,
    const size_t incX,
    const double * y,
    const size_t incY,

```

```
double * A,  
const size_t ldA,  
bool positive)
```

### 13.219.3.37 ftrsv\_2\_modular\_double()

```
void ftrsv_2_modular_double (  
    const double p,  
    const enum FFLAS_C_UPLO Uplo,  
    const enum FFLAS_C_TRANSPOSE TransA,  
    const enum FFLAS_C_DIAG Diag,  
    const size_t n,  
    const double * A,  
    const size_t ldA,  
    double * X,  
    int incX,  
    bool positive)
```

### 13.219.3.38 ftrsm\_3\_modular\_double()

```
void ftrsm_3_modular_double (  
    const double p,  
    const enum FFLAS_C_SIDE Side,  
    const enum FFLAS_C_UPLO Uplo,  
    const enum FFLAS_C_TRANSPOSE TransA,  
    const enum FFLAS_C_DIAG Diag,  
    const size_t m,  
    const size_t n,  
    const double alpha,  
    const double * A,  
    const size_t ldA,  
    double * B,  
    const size_t ldB,  
    bool positive)
```

### 13.219.3.39 ftrmm\_3\_modular\_double()

```
void ftrmm_3_modular_double (  
    const double p,  
    const enum FFLAS_C_SIDE Side,  
    const enum FFLAS_C_UPLO Uplo,  
    const enum FFLAS_C_TRANSPOSE TransA,  
    const enum FFLAS_C_DIAG Diag,  
    const size_t m,  
    const size_t n,  
    const double alpha,  
    double * A,  
    const size_t ldA,  
    double * B,  
    const size_t ldB,  
    bool positive)
```

### 13.219.3.40 fgemm\_3\_modular\_double()

```
double * fgemm_3_modular_double (  
    const double p,  
    const enum FFLAS_C_TRANSPOSE tA,  
    const enum FFLAS_C_TRANSPOSE tB,  
    const size_t m,
```

```

    const size_t n,
    const size_t k,
    const double alpha,
    const double * A,
    const size_t ldA,
    const double * B,
    const size_t ldB,
    const double betA,
    double * C,
    const size_t ldC,
    bool positive)

```

#### 13.219.3.41 fsquare\_3\_modular\_double()

```

double * fsquare_3_modular_double (
    const double p,
    const enum FFLAS_C_TRANSPOSE tA,
    const size_t n,
    const double alpha,
    const double * A,
    const size_t ldA,
    const double betA,
    double * C,
    const size_t ldC,
    bool positive)

```

## 13.220 fflas\_L1\_inst.C File Reference

```

#include "fflas-ffpack/fflas-ffpack-config.h"
#include "givaro/modular.h"
#include "givaro/modular-balanced.h"
#include "fflas-ffpack/fflas/fflas.h"
#include "fflas-ffpack/fflas/fflas_helpers.inl"
#include "fflas_L1_inst_implem.inl"

```

### Macros

- #define `__FFLAS_L1_INST_C`
- #define `INST_OR_DECL`
- #define `FFLAS_FIELD Givaro::ModularBalanced`
- #define `FFLAS_ELT` double
- #define `FFLAS_ELT` float
- #define `FFLAS_ELT` int64\_t
- #define `FFLAS_FIELD` Givaro::Modular
- #define `FFLAS_ELT` double
- #define `FFLAS_ELT` float
- #define `FFLAS_ELT` int64\_t

### 13.220.1 Macro Definition Documentation

#### 13.220.1.1 \_\_FFLAS\_L1\_INST\_C

```
#define __FFLAS_L1_INST_C
```

#### 13.220.1.2 INST\_OR\_DECL

```
#define INST_OR_DECL
```



**13.220.1.3 FFLAS\_FIELD [1/2]**

```
#define FFLAS_FIELD Givaro::ModularBalanced
```

**13.220.1.4 FFLAS\_ELT [1/6]**

```
#define FFLAS_ELT double
```

**13.220.1.5 FFLAS\_ELT [2/6]**

```
#define FFLAS_ELT float
```

**13.220.1.6 FFLAS\_ELT [3/6]**

```
#define FFLAS_ELT int64_t
```

**13.220.1.7 FFLAS\_FIELD [2/2]**

```
#define FFLAS_FIELD Givaro::Modular
```

**13.220.1.8 FFLAS\_ELT [4/6]**

```
#define FFLAS_ELT double
```

**13.220.1.9 FFLAS\_ELT [5/6]**

```
#define FFLAS_ELT float
```

**13.220.1.10 FFLAS\_ELT [6/6]**

```
#define FFLAS_ELT int64_t
```

**13.221 fflas\_L1\_inst.h File Reference**

```
#include "givaro/modular.h"
#include "givaro/modular-balanced.h"
#include "fflas-ffpack/fflas/fflas.h"
#include "fflas-ffpack/fflas/fflas_helpers.inl"
#include "fflas_L1_inst_implem.inl"
```

**Macros**

- #define [INST\\_OR\\_DECL](#) <>
- #define [FFLAS\\_FIELD](#) Givaro::ModularBalanced
- #define [FFLAS\\_ELT](#) double
- #define [FFLAS\\_ELT](#) float
- #define [FFLAS\\_ELT](#) int64\_t
- #define [FFLAS\\_FIELD](#) Givaro::Modular
- #define [FFLAS\\_ELT](#) double
- #define [FFLAS\\_ELT](#) float
- #define [FFLAS\\_ELT](#) int64\_t

**13.221.1 Macro Definition Documentation****13.221.1.1 INST\_OR\_DECL**

```
#define INST_OR_DECL <>
```

**13.221.1.2 FFLAS\_FIELD [1/2]**

```
#define FFLAS_FIELD Givaro::ModularBalanced
```

**13.221.1.3 FFLAS\_ELT [1/6]**

```
#define FFLAS_ELT double
```

**13.221.1.4 FFLAS\_ELT [2/6]**

```
#define FFLAS_ELT float
```

**13.221.1.5 FFLAS\_ELT [3/6]**

```
#define FFLAS_ELT int64_t
```

**13.221.1.6 FFLAS\_FIELD [2/2]**

```
#define FFLAS_FIELD Givaro::Modular
```

**13.221.1.7 FFLAS\_ELT [4/6]**

```
#define FFLAS_ELT double
```

**13.221.1.8 FFLAS\_ELT [5/6]**

```
#define FFLAS_ELT float
```

**13.221.1.9 FFLAS\_ELT [6/6]**

```
#define FFLAS_ELT int64_t
```

**13.222 fflas\_L1\_inst\_implem.inl File Reference****Namespaces**

- namespace [FFLAS](#)

**Functions**

- template [INST\\_OR\\_DECL](#) void [freduce](#) (const [FFLAS\\_FIELD](#)< [FFLAS\\_ELT](#) > &F, const size\_t n, [FFLAS\\_ELT](#) \*X, const size\_t incX)  

$$\text{freduce } x \leftarrow x \bmod F.$$
- template [INST\\_OR\\_DECL](#) void [freduce](#) (const [FFLAS\\_FIELD](#)< [FFLAS\\_ELT](#) > &F, const size\_t n, const [FFLAS\\_ELT](#) \*Y, const size\_t incY, [FFLAS\\_ELT](#) \*X, const size\_t incX)  

$$\text{freduce } x \leftarrow y \bmod F.$$
- template [INST\\_OR\\_DECL](#) void [finit](#) (const [FFLAS\\_FIELD](#)< [FFLAS\\_ELT](#) > &F, const size\_t n, const [FFLAS\\_ELT](#) \*Y, const size\_t incY, [FFLAS\\_ELT](#) \*X, const size\_t incX)  

$$\text{finit } x \leftarrow y \bmod F.$$
- template [INST\\_OR\\_DECL](#) void [fconvert](#) (const [FFLAS\\_FIELD](#)< [FFLAS\\_ELT](#) > &F, const size\_t n, [FFLAS\\_ELT](#) \*X, const size\_t incX, const [FFLAS\\_ELT](#) \*Y, const size\_t incY)  

$$\text{fconvert } x \leftarrow y \bmod F.$$
- template [INST\\_OR\\_DECL](#) void [fnegin](#) (const [FFLAS\\_FIELD](#)< [FFLAS\\_ELT](#) > &F, const size\_t n, [FFLAS\\_ELT](#) \*X, const size\_t incX)  

$$\text{fnegin } x \leftarrow -x.$$
- template [INST\\_OR\\_DECL](#) void [fneg](#) (const [FFLAS\\_FIELD](#)< [FFLAS\\_ELT](#) > &F, const size\_t n, const [FFLAS\\_ELT](#) \*Y, const size\_t incY, [FFLAS\\_ELT](#) \*X, const size\_t incX)  

$$\text{fneg } x \leftarrow -y.$$

- template `INST_OR_DECL` void `fzero` (const `FFLAS_FIELD`< `FFLAS_ELT` > &F, const `size_t` n, `FFLAS_ELT` \*X, const `size_t` incX)  
 $fzero : A \leftarrow 0.$
- template `INST_OR_DECL` bool `fiszero` (const `FFLAS_FIELD`< `FFLAS_ELT` > &F, const `size_t` n, const `FFLAS_ELT` \*X, const `size_t` incX)  
 $fiszero : test\ X = 0.$
- template `INST_OR_DECL` bool `fequal` (const `FFLAS_FIELD`< `FFLAS_ELT` > &F, const `size_t` n, const `FFLAS_ELT` \*X, const `size_t` incX, const `FFLAS_ELT` \*Y, const `size_t` incY)  
 $fequal : test\ X = Y.$
- template `INST_OR_DECL` void `fassign` (const `FFLAS_FIELD`< `FFLAS_ELT` > &F, const `size_t` N, const `FFLAS_ELT` \*Y, const `size_t` incY, `FFLAS_ELT` \*X, const `size_t` incX)  
 $fassign : x \leftarrow y.$
- template `INST_OR_DECL` void `fscal` (const `FFLAS_FIELD`< `FFLAS_ELT` > &F, const `size_t` n, const `FFLAS_ELT` alpha, `FFLAS_ELT` \*X, const `size_t` incX)  
 $fscal\ x \leftarrow \alpha \cdot x.$
- template `INST_OR_DECL` void `fscal` (const `FFLAS_FIELD`< `FFLAS_ELT` > &F, const `size_t` n, const `FFLAS_ELT` alpha, const `FFLAS_ELT` \*X, const `size_t` incX, `FFLAS_ELT` \*Y, const `size_t` incY)  
 $fscal\ y \leftarrow \alpha \cdot x.$
- template `INST_OR_DECL` void `faxpy` (const `FFLAS_FIELD`< `FFLAS_ELT` > &F, const `size_t` N, const `FFLAS_ELT` alpha, const `FFLAS_ELT` \*X, const `size_t` incX, `FFLAS_ELT` \*Y, const `size_t` incY)  
 $faxpy : y \leftarrow \alpha \cdot x + y.$
- template `INST_OR_DECL` `FFLAS_ELT` `fdot` (const `FFLAS_FIELD`< `FFLAS_ELT` > &F, const `size_t` N, const `FFLAS_ELT` \*X, const `size_t` incX, const `FFLAS_ELT` \*Y, const `size_t` incY)  
 $faxpy : y \leftarrow \alpha \cdot x + \beta \cdot y.$
- template `INST_OR_DECL` void `fswap` (const `FFLAS_FIELD`< `FFLAS_ELT` > &F, const `size_t` N, `FFLAS_ELT` \*X, const `size_t` incX, `FFLAS_ELT` \*Y, const `size_t` incY)  
 $fswap : X \leftrightarrow Y.$
- template `INST_OR_DECL` void `fadd` (const `FFLAS_FIELD`< `FFLAS_ELT` > &F, const `size_t` N, const `FFLAS_ELT` \*A, const `size_t` inca, const `FFLAS_ELT` \*B, const `size_t` incb, `FFLAS_ELT` \*C, const `size_t` incc)
- template `INST_OR_DECL` void `fsub` (const `FFLAS_FIELD`< `FFLAS_ELT` > &F, const `size_t` N, const `FFLAS_ELT` \*A, const `size_t` inca, const `FFLAS_ELT` \*B, const `size_t` incb, `FFLAS_ELT` \*C, const `size_t` incc)
- template `INST_OR_DECL` void `faddin` (const `FFLAS_FIELD`< `FFLAS_ELT` > &F, const `size_t` N, const `FFLAS_ELT` \*B, const `size_t` incb, `FFLAS_ELT` \*C, const `size_t` incc)
- template `INST_OR_DECL` void `fadd` (const `FFLAS_FIELD`< `FFLAS_ELT` > &F, const `size_t` N, const `FFLAS_ELT` \*A, const `size_t` inca, const `FFLAS_ELT` alpha, const `FFLAS_ELT` \*B, const `size_t` incb, `FFLAS_ELT` \*C, const `size_t` incc)

## 13.223 fflas\_L2\_inst.C File Reference

```
#include "fflas-ffpack/fflas-ffpack-config.h"
#include "givaro/modular.h"
#include "givaro/modular-balanced.h"
#include "fflas-ffpack/fflas/fflas.h"
#include "fflas-ffpack/fflas/fflas_helpers.inl"
#include "fflas_L2_inst_implem.inl"
```

### Macros

- `#define` `__FFLAS_L2_INST_C`
- `#define` `INST_OR_DECL`
- `#define` `FFLAS_FIELD` `Givaro::ModularBalanced`

- `#define FFLAS_ELT double`
- `#define FFLAS_ELT float`
- `#define FFLAS_ELT int64_t`
- `#define FFLAS_FIELD Givaro::Modular`
- `#define FFLAS_ELT double`
- `#define FFLAS_ELT float`
- `#define FFLAS_ELT int64_t`

### 13.223.1 Macro Definition Documentation

#### 13.223.1.1 `__FFLAS_L2_INST_C`

```
#define __FFLAS_L2_INST_C
```

#### 13.223.1.2 `INST_OR_DECL`

```
#define INST_OR_DECL
```

#### 13.223.1.3 `FFLAS_FIELD` [1/2]

```
#define FFLAS_FIELD Givaro::ModularBalanced
```

#### 13.223.1.4 `FFLAS_ELT` [1/6]

```
#define FFLAS_ELT double
```

#### 13.223.1.5 `FFLAS_ELT` [2/6]

```
#define FFLAS_ELT float
```

#### 13.223.1.6 `FFLAS_ELT` [3/6]

```
#define FFLAS_ELT int64_t
```

#### 13.223.1.7 `FFLAS_FIELD` [2/2]

```
#define FFLAS_FIELD Givaro::Modular
```

#### 13.223.1.8 `FFLAS_ELT` [4/6]

```
#define FFLAS_ELT double
```

#### 13.223.1.9 `FFLAS_ELT` [5/6]

```
#define FFLAS_ELT float
```

#### 13.223.1.10 `FFLAS_ELT` [6/6]

```
#define FFLAS_ELT int64_t
```

## 13.224 `fflas_L2_inst.h` File Reference

```
#include "givaro/modular.h"
#include "givaro/modular-balanced.h"
#include "fflas-ffpack/fflas/fflas.h"
#include "fflas-ffpack/fflas/fflas_helpers.inl"
#include "fflas_L2_inst_implem.inl"
```

## Macros

- `#define INST_OR_DECL <>`
- `#define FFLAS_FIELD Givaro::ModularBalanced`
- `#define FFLAS_ELT double`
- `#define FFLAS_ELT float`
- `#define FFLAS_ELT int64_t`
- `#define FFLAS_FIELD Givaro::Modular`
- `#define FFLAS_ELT double`
- `#define FFLAS_ELT float`
- `#define FFLAS_ELT int64_t`

## 13.224.1 Macro Definition Documentation

### 13.224.1.1 INST\_OR\_DECL

```
#define INST_OR_DECL <>
```

### 13.224.1.2 FFLAS\_FIELD [1/2]

```
#define FFLAS_FIELD Givaro::ModularBalanced
```

### 13.224.1.3 FFLAS\_ELT [1/6]

```
#define FFLAS_ELT double
```

### 13.224.1.4 FFLAS\_ELT [2/6]

```
#define FFLAS_ELT float
```

### 13.224.1.5 FFLAS\_ELT [3/6]

```
#define FFLAS_ELT int64_t
```

### 13.224.1.6 FFLAS\_FIELD [2/2]

```
#define FFLAS_FIELD Givaro::Modular
```

### 13.224.1.7 FFLAS\_ELT [4/6]

```
#define FFLAS_ELT double
```

### 13.224.1.8 FFLAS\_ELT [5/6]

```
#define FFLAS_ELT float
```

### 13.224.1.9 FFLAS\_ELT [6/6]

```
#define FFLAS_ELT int64_t
```

## 13.225 fflas\_L2\_inst\_implem.inl File Reference

## Namespaces

- namespace [FFLAS](#)

## Functions

- template `INST_OR_DECL` void `fassign` (const `FFLAS_FIELD`< `FFLAS_ELT` > &F, const size\_t m, const size\_t n, const `FFLAS_ELT` \*B, const size\_t ldb, `FFLAS_ELT` \*A, const size\_t lda)  
 $fassign : A \leftarrow B.$
- template `INST_OR_DECL` void `fzero` (const `FFLAS_FIELD`< `FFLAS_ELT` > &F, const size\_t m, const size\_t n, `FFLAS_ELT` \*A, const size\_t lda)  
 $fzero : A \leftarrow 0.$
- template `INST_OR_DECL` bool `fequal` (const `FFLAS_FIELD`< `FFLAS_ELT` > &F, const size\_t m, const size\_t n, const `FFLAS_ELT` \*A, const size\_t lda, const `FFLAS_ELT` \*B, const size\_t ldb)  
 $fequal : test A = B.$
- template `INST_OR_DECL` bool `fiszero` (const `FFLAS_FIELD`< `FFLAS_ELT` > &F, const size\_t m, const size\_t n, const `FFLAS_ELT` \*A, const size\_t lda)  
 $fiszero : test A = 0.$
- template `INST_OR_DECL` void `fidentity` (const `FFLAS_FIELD`< `FFLAS_ELT` > &F, const size\_t m, const size\_t n, `FFLAS_ELT` \*A, const size\_t lda, const `FFLAS_ELT` &d)  
 $creates a diagonal matrix$
- template `INST_OR_DECL` void `fidentity` (const `FFLAS_FIELD`< `FFLAS_ELT` > &F, const size\_t m, const size\_t n, `FFLAS_ELT` \*A, const size\_t lda)  
 $creates a diagonal matrix$
- template `INST_OR_DECL` void `freduce` (const `FFLAS_FIELD`< `FFLAS_ELT` > &F, const size\_t m, const size\_t n, `FFLAS_ELT` \*A, const size\_t lda)  
 $freduce A \leftarrow A mod F.$
- template `INST_OR_DECL` void `freduce` (const `FFLAS_FIELD`< `FFLAS_ELT` > &F, const size\_t m, const size\_t n, const `FFLAS_ELT` \*B, const size\_t ldb, `FFLAS_ELT` \*A, const size\_t lda)  
 $freduce A \leftarrow B mod F.$
- template `INST_OR_DECL` void `finit` (const `FFLAS_FIELD`< `FFLAS_ELT` > &F, const size\_t m, const size\_t n, const `FFLAS_ELT` \*B, const size\_t ldb, `FFLAS_ELT` \*A, const size\_t lda)  
 $finit A \leftarrow B mod F.$
- template `INST_OR_DECL` void `fnegin` (const `FFLAS_FIELD`< `FFLAS_ELT` > &F, const size\_t m, const size\_t n, `FFLAS_ELT` \*A, const size\_t lda)  
 $fnegin A \leftarrow -A.$
- template `INST_OR_DECL` void `fneg` (const `FFLAS_FIELD`< `FFLAS_ELT` > &F, const size\_t m, const size\_t n, const `FFLAS_ELT` \*B, const size\_t ldb, `FFLAS_ELT` \*A, const size\_t lda)  
 $fneg A \leftarrow -B.$
- template `INST_OR_DECL` void `fscaln` (const `FFLAS_FIELD`< `FFLAS_ELT` > &F, const size\_t m, const size\_t n, const `FFLAS_ELT` alpha, `FFLAS_ELT` \*A, const size\_t lda)  
 $fscaln A \leftarrow a \cdot A.$
- template `INST_OR_DECL` void `fscal` (const `FFLAS_FIELD`< `FFLAS_ELT` > &F, const size\_t m, const size\_t n, const `FFLAS_ELT` alpha, const `FFLAS_ELT` \*A, const size\_t lda, `FFLAS_ELT` \*B, const size\_t ldb)  
 $fscal B \leftarrow a \cdot A.$
- template `INST_OR_DECL` void `faxpy` (const `FFLAS_FIELD`< `FFLAS_ELT` > &F, const size\_t m, const size\_t n, const `FFLAS_ELT` alpha, const `FFLAS_ELT` \*X, const size\_t ldx, `FFLAS_ELT` \*Y, const size\_t ldy)  
 $faxpy : y \leftarrow \alpha \cdot x + y.$
- template `INST_OR_DECL` void `fmove` (const `FFLAS_FIELD`< `FFLAS_ELT` > &F, const size\_t m, const size\_t n, `FFLAS_ELT` \*A, const size\_t lda, `FFLAS_ELT` \*B, const size\_t ldb)  
 $faxpy : y \leftarrow \alpha \cdot x + \beta \cdot y.$
- template `INST_OR_DECL` void `fadd` (const `FFLAS_FIELD`< `FFLAS_ELT` > &F, const size\_t M, const size\_t N, const `FFLAS_ELT` \*A, const size\_t lda, const `FFLAS_ELT` \*B, const size\_t ldb, `FFLAS_ELT` \*C, const size\_t ldc)  
 $fadd : matrix addition.$
- template `INST_OR_DECL` void `fsub` (const `FFLAS_FIELD`< `FFLAS_ELT` > &F, const size\_t M, const size\_t N, const `FFLAS_ELT` \*A, const size\_t lda, const `FFLAS_ELT` \*B, const size\_t ldb, `FFLAS_ELT` \*C, const size\_t ldc)

*fsub* : matrix subtraction.

- template `INST_OR_DECL` void `fsubin` (const `FFLAS_FIELD`< `FFLAS_ELT` > &F, const size\_t M, const size\_t N, const `FFLAS_ELT` \*B, const size\_t ldb, `FFLAS_ELT` \*C, const size\_t ldc)

*fsubin*  $C = C - B$

- template `INST_OR_DECL` void `fadd` (const `FFLAS_FIELD`< `FFLAS_ELT` > &F, const size\_t M, const size\_t N, const `FFLAS_ELT` \*A, const size\_t lda, const `FFLAS_ELT` alpha, const `FFLAS_ELT` \*B, const size\_t ldb, `FFLAS_ELT` \*C, const size\_t ldc)

*fadd* : matrix addition with scaling.

- template `INST_OR_DECL` void `faddin` (const `FFLAS_FIELD`< `FFLAS_ELT` > &F, const size\_t M, const size\_t N, const `FFLAS_ELT` \*B, const size\_t ldb, `FFLAS_ELT` \*C, const size\_t ldc)

*faddin*

- template `INST_OR_DECL` `FFLAS_ELT` \* `fgemv` (const `FFLAS_FIELD`< `FFLAS_ELT` > &F, const `FFLAS_TRANSPOSE` TransA, const size\_t M, const size\_t N, const `FFLAS_ELT` alpha, const `FFLAS_ELT` \*A, const size\_t lda, const `FFLAS_ELT` \*X, const size\_t incX, const `FFLAS_ELT` beta, `FFLAS_ELT` \*Y, const size\_t incY)

*finite prime* `FFLAS_FIELD`<`FFLAS_ELT`> *GEneral Matrix Vector multiplication.*

- template `INST_OR_DECL` void `fger` (const `FFLAS_FIELD`< `FFLAS_ELT` > &F, const size\_t M, const size\_t N, const `FFLAS_ELT` alpha, const `FFLAS_ELT` \*x, const size\_t incx, const `FFLAS_ELT` \*y, const size\_t incy, `FFLAS_ELT` \*A, const size\_t lda)

*fger*: rank one update of a general matrix

- template `INST_OR_DECL` void `ftsv` (const `FFLAS_FIELD`< `FFLAS_ELT` > &F, const `FFLAS_UPLO` Uplo, const `FFLAS_TRANSPOSE` TransA, const `FFLAS_DIAG` Diag, const size\_t N, const `FFLAS_ELT` \*A, const size\_t lda, `FFLAS_ELT` \*X, int incX)

*ftsv*: *TRI*angular System solve with Vector Computes  $X \leftarrow \text{op}(A^{-1})X$

## 13.226 fflas\_L3\_inst.C File Reference

```
#include "fflas-ffpack/fflas-ffpack-config.h"
#include "givaro/modular.h"
#include "givaro/modular-balanced.h"
#include "fflas-ffpack/fflas/fflas.h"
#include "fflas-ffpack/fflas/fflas_helpers.inl"
#include "fflas_L3_inst_implem.inl"
```

### Macros

- #define `__FFLAS_L3_INST_C`
- #define `INST_OR_DECL`
- #define `FFLAS_FIELD` Givaro::ModularBalanced
- #define `FFLAS_ELT` double
- #define `FFLAS_ELT` float
- #define `FFLAS_ELT` int64\_t
- #define `FFLAS_FIELD` Givaro::Modular
- #define `FFLAS_ELT` double
- #define `FFLAS_ELT` float
- #define `FFLAS_ELT` int64\_t

### 13.226.1 Macro Definition Documentation

#### 13.226.1.1 \_\_FFLAS\_L3\_INST\_C

```
#define __FFLAS_L3_INST_C
```

**13.226.1.2 INST\_OR\_DECL**

```
#define INST_OR_DECL
```

**13.226.1.3 FFLAS\_FIELD [1/2]**

```
#define FFLAS_FIELD Givaro::ModularBalanced
```

**13.226.1.4 FFLAS\_ELT [1/6]**

```
#define FFLAS_ELT double
```

**13.226.1.5 FFLAS\_ELT [2/6]**

```
#define FFLAS_ELT float
```

**13.226.1.6 FFLAS\_ELT [3/6]**

```
#define FFLAS_ELT int64_t
```

**13.226.1.7 FFLAS\_FIELD [2/2]**

```
#define FFLAS_FIELD Givaro::Modular
```

**13.226.1.8 FFLAS\_ELT [4/6]**

```
#define FFLAS_ELT double
```

**13.226.1.9 FFLAS\_ELT [5/6]**

```
#define FFLAS_ELT float
```

**13.226.1.10 FFLAS\_ELT [6/6]**

```
#define FFLAS_ELT int64_t
```

**13.227 fflas\_L3\_inst.h File Reference**

```
#include "givaro/modular.h"
#include "givaro/modular-balanced.h"
#include "fflas-ffpack/fflas/fflas.h"
#include "fflas-ffpack/fflas/fflas_helpers.inl"
#include "fflas_L3_inst_implem.inl"
```

**Macros**

- #define [INST\\_OR\\_DECL](#) <>
- #define [FFLAS\\_FIELD](#) [Givaro::ModularBalanced](#)
- #define [FFLAS\\_ELT](#) double
- #define [FFLAS\\_ELT](#) float
- #define [FFLAS\\_ELT](#) int64\_t
- #define [FFLAS\\_FIELD](#) [Givaro::Modular](#)
- #define [FFLAS\\_ELT](#) double
- #define [FFLAS\\_ELT](#) float
- #define [FFLAS\\_ELT](#) int64\_t



## 13.227.1 Macro Definition Documentation

### 13.227.1.1 INST\_OR\_DECL

```
#define INST_OR_DECL <>
```

### 13.227.1.2 FFLAS\_FIELD [1/2]

```
#define FFLAS_FIELD Givaro::ModularBalanced
```

### 13.227.1.3 FFLAS\_ELT [1/6]

```
#define FFLAS_ELT double
```

### 13.227.1.4 FFLAS\_ELT [2/6]

```
#define FFLAS_ELT float
```

### 13.227.1.5 FFLAS\_ELT [3/6]

```
#define FFLAS_ELT int64_t
```

### 13.227.1.6 FFLAS\_FIELD [2/2]

```
#define FFLAS_FIELD Givaro::Modular
```

### 13.227.1.7 FFLAS\_ELT [4/6]

```
#define FFLAS_ELT double
```

### 13.227.1.8 FFLAS\_ELT [5/6]

```
#define FFLAS_ELT float
```

### 13.227.1.9 FFLAS\_ELT [6/6]

```
#define FFLAS_ELT int64_t
```

## 13.228 fflas\_L3\_inst\_implem.inl File Reference

### Namespaces

- namespace [FFLAS](#)

### Macros

- #define [\\_\\_FFLAS\\_TRSM\\_READONLY](#)

### Functions

- template [INST\\_OR\\_DECL](#) void [ftrsm](#) (const [FFLAS\\_FIELD](#)< [FFLAS\\_ELT](#) > &F, const [FFLAS\\_SIDE](#) Side, const [FFLAS\\_UPLO](#) Uplo, const [FFLAS\\_TRANSPOSE](#) TransA, const [FFLAS\\_DIAG](#) Diag, const size\_t M, const size\_t N, const [FFLAS\\_ELT](#) alpha, const [FFLAS\\_ELT](#) \*A, const size\_t lda, [FFLAS\\_ELT](#) \*B, const size\_t ldb)  
*ftrsm: **TR**angular **S**ystem solve with **M**atrix.*
- template [INST\\_OR\\_DECL](#) void [ftrmm](#) (const [FFLAS\\_FIELD](#)< [FFLAS\\_ELT](#) > &F, const [FFLAS\\_SIDE](#) Side, const [FFLAS\\_UPLO](#) Uplo, const [FFLAS\\_TRANSPOSE](#) TransA, const [FFLAS\\_DIAG](#) Diag, const size\_t M, const size\_t N, const [FFLAS\\_ELT](#) alpha, const [FFLAS\\_ELT](#) \*A, const size\_t lda, [FFLAS\\_ELT](#) \*B, const size\_t ldb)  
*ftrmm: **TR**angular **M**atrix **M**ultiply.*

- template `INST_OR_DECL FFLAS_ELT * fgemm` (const `FFLAS_FIELD< FFLAS_ELT >` &F, const `FFLAS_TRANSPOSE` ta, const `FFLAS_TRANSPOSE` tb, const `size_t` m, const `size_t` n, const `size_t` k, const `FFLAS_ELT` alpha, const `FFLAS_ELT` \*A, const `size_t` lda, const `FFLAS_ELT` \*B, const `size_t` ldb, const `FFLAS_ELT` beta, `FFLAS_ELT` \*C, const `size_t` ldc)

*fgemm: Field **GE**neral **M**atrix **M**ultiply.*

- template `INST_OR_DECL FFLAS_ELT * fgemm` (const `FFLAS_FIELD< FFLAS_ELT >` &F, const `FFLAS_TRANSPOSE` ta, const `FFLAS_TRANSPOSE` tb, const `size_t` m, const `size_t` n, const `size_t` k, const `FFLAS_ELT` alpha, const `FFLAS_ELT` \*A, const `size_t` lda, const `FFLAS_ELT` \*B, const `size_t` ldb, const `FFLAS_ELT` beta, `FFLAS_ELT` \*C, const `size_t` ldc, const `ParSeqHelper::Sequential` seq)
- template `INST_OR_DECL FFLAS_ELT * fgemm` (const `FFLAS_FIELD< FFLAS_ELT >` &F, const `FFLAS_TRANSPOSE` ta, const `FFLAS_TRANSPOSE` tb, const `size_t` m, const `size_t` n, const `size_t` k, const `FFLAS_ELT` alpha, const `FFLAS_ELT` \*A, const `size_t` lda, const `FFLAS_ELT` \*B, const `size_t` ldb, const `FFLAS_ELT` beta, `FFLAS_ELT` \*C, const `size_t` ldc, const `ParSeqHelper::Parallel< CuttingStrategy::Recursive, StrategyParameter::TwoDAdaptive >` par)
- template `INST_OR_DECL FFLAS_ELT * fgemm` (const `FFLAS_FIELD< FFLAS_ELT >` &F, const `FFLAS_TRANSPOSE` ta, const `FFLAS_TRANSPOSE` tb, const `size_t` m, const `size_t` n, const `size_t` k, const `FFLAS_ELT` alpha, const `FFLAS_ELT` \*A, const `size_t` lda, const `FFLAS_ELT` \*B, const `size_t` ldb, const `FFLAS_ELT` beta, `FFLAS_ELT` \*C, const `size_t` ldc, const `ParSeqHelper::Parallel< CuttingStrategy::Block, StrategyParameter::Threads >` par)
- template `INST_OR_DECL FFLAS_ELT * fsquare` (const `FFLAS_FIELD< FFLAS_ELT >` &F, const `FFLAS_TRANSPOSE` ta, const `size_t` n, const `FFLAS_ELT` alpha, const `FFLAS_ELT` \*A, const `size_t` lda, const `FFLAS_ELT` beta, `FFLAS_ELT` \*C, const `size_t` ldc)

*fsquare: Squares a matrix.*

## 13.228.1 Macro Definition Documentation

### 13.228.1.1 \_\_FFLAS\_TRSM\_READONLY

```
#define __FFLAS_TRSM_READONLY
```

## 13.229 fflas\_lvl1.C File Reference

C functions calls for level 1 `FFLAS` in `fflas-c.h`.

```
#include "fflas-ffpack/interfaces/libs/fflas_c.h"
#include "fflas-ffpack/fflas/fflas.h"
#include "givaro/modular-balanced.h"
#include "givaro/modular.h"
```

## Functions

- void `freducein_1_modular_double` (const double p, const `size_t` n, double \*X, const `size_t` incX, bool positive)
- void `freduce_1_modular_double` (const double p, const `size_t` n, const double \*Y, const `size_t` incY, double \*X, const `size_t` incX, bool positive)
- void `fnegin_1_modular_double` (const double p, const `size_t` n, double \*X, const `size_t` incX, bool positive)
- void `fneg_1_modular_double` (const double p, const `size_t` n, const double \*Y, const `size_t` incY, double \*X, const `size_t` incX, bool positive)
- void `fzero_1_modular_double` (const double p, const `size_t` n, double \*X, const `size_t` incX, bool positive)
- bool `fiszero_1_modular_double` (const double p, const `size_t` n, const double \*X, const `size_t` incX, bool positive)
- bool `fequal_1_modular_double` (const double p, const `size_t` n, const double \*X, const `size_t` incX, const double \*Y, const `size_t` incY, bool positive)
- void `fassign_1_modular_double` (const double p, const `size_t` n, const double \*Y, const `size_t` incY, double \*X, const `size_t` incX, bool positive)
- void `fscaln_1_modular_double` (const double p, const `size_t` n, const double alpha, double \*X, const `size_t` incX, bool positive)

- void [fscal\\_1\\_modular\\_double](#) (const double p, const size\_t n, const double alpha, const double \*X, const size\_t incX, double \*Y, const size\_t incY, bool positive)
- void [faxpy\\_1\\_modular\\_double](#) (const double p, const size\_t n, const double alpha, const double \*X, const size\_t incX, double \*Y, const size\_t incY, bool positive)
- double [fdot\\_1\\_modular\\_double](#) (const double p, const size\_t n, const double \*X, const size\_t incX, const double \*Y, const size\_t incY, bool positive)
- void [fswap\\_1\\_modular\\_double](#) (const double p, const size\_t n, double \*X, const size\_t incX, double \*Y, const size\_t incY, bool positive)
- void [fadd\\_1\\_modular\\_double](#) (const double p, const size\_t n, const double \*A, const size\_t incA, const double \*B, const size\_t incB, double \*C, const size\_t incC, bool positive)
- void [fsub\\_1\\_modular\\_double](#) (const double p, const size\_t n, const double \*A, const size\_t incA, const double \*B, const size\_t incB, double \*C, const size\_t incC, bool positive)
- void [faddin\\_1\\_modular\\_double](#) (const double p, const size\_t n, const double \*B, const size\_t incB, double \*C, const size\_t incC, bool positive)
- void [fsubin\\_1\\_modular\\_double](#) (const double p, const size\_t n, const double \*B, const size\_t incB, double \*C, const size\_t incC, bool positive)

### 13.229.1 Detailed Description

C functions calls for level 1 [FFLAS](#) in `fflas-c.h`.

Author

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See also

[fflas/fflas\\_level1.inl](#)

### 13.229.2 Function Documentation

#### 13.229.2.1 `freducein_1_modular_double()`

```
void freducein_1_modular_double (
    const double p,
    const size_t n,
    double * X,
    const size_t incX,
    bool positive)
```

#### 13.229.2.2 `freduce_1_modular_double()`

```
void freduce_1_modular_double (
    const double p,
    const size_t n,
    const double * Y,
    const size_t incY,
    double * X,
    const size_t incX,
    bool positive)
```

#### 13.229.2.3 `fnegin_1_modular_double()`

```
void fnegin_1_modular_double (
    const double p,
    const size_t n,
    double * X,
    const size_t incX,
    bool positive)
```

**13.229.2.4 fneg\_1\_modular\_double()**

```
void fneg_1_modular_double (
    const double p,
    const size_t n,
    const double * Y,
    const size_t incY,
    double * X,
    const size_t incX,
    bool positive)
```

**13.229.2.5 fzero\_1\_modular\_double()**

```
void fzero_1_modular_double (
    const double p,
    const size_t n,
    double * X,
    const size_t incX,
    bool positive)
```

**13.229.2.6 fiszero\_1\_modular\_double()**

```
bool fiszero_1_modular_double (
    const double p,
    const size_t n,
    const double * X,
    const size_t incX,
    bool positive)
```

**13.229.2.7 fequal\_1\_modular\_double()**

```
bool fequal_1_modular_double (
    const double p,
    const size_t n,
    const double * X,
    const size_t incX,
    const double * Y,
    const size_t incY,
    bool positive)
```

**13.229.2.8 fassign\_1\_modular\_double()**

```
void fassign_1_modular_double (
    const double p,
    const size_t n,
    const double * Y,
    const size_t incY,
    double * X,
    const size_t incX,
    bool positive)
```

**13.229.2.9 fscaln\_1\_modular\_double()**

```
void fscaln_1_modular_double (
    const double p,
    const size_t n,
    const double alpha,
    double * X,
    const size_t incX,
    bool positive)
```

**13.229.2.10 fscal\_1\_modular\_double()**

```
void fscal_1_modular_double (
    const double p,
    const size_t n,
    const double alpha,
    const double * X,
    const size_t incX,
    double * Y,
    const size_t incY,
    bool positive)
```

**13.229.2.11 faxpy\_1\_modular\_double()**

```
void faxpy_1_modular_double (
    const double p,
    const size_t n,
    const double alpha,
    const double * X,
    const size_t incX,
    double * Y,
    const size_t incY,
    bool positive)
```

**13.229.2.12 fdot\_1\_modular\_double()**

```
double fdot_1_modular_double (
    const double p,
    const size_t n,
    const double * X,
    const size_t incX,
    const double * Y,
    const size_t incY,
    bool positive)
```

**13.229.2.13 fswap\_1\_modular\_double()**

```
void fswap_1_modular_double (
    const double p,
    const size_t n,
    double * X,
    const size_t incX,
    double * Y,
    const size_t incY,
    bool positive)
```

**13.229.2.14 fadd\_1\_modular\_double()**

```
void fadd_1_modular_double (
    const double p,
    const size_t n,
    const double * A,
    const size_t incA,
    const double * B,
    const size_t incB,
    double * C,
    const size_t incC,
    bool positive)
```

**13.229.2.15 fsub\_1\_modular\_double()**

```
void fsub_1_modular_double (
    const double p,
    const size_t n,
    const double * A,
    const size_t incA,
    const double * B,
    const size_t incB,
    double * C,
    const size_t incC,
    bool positive)
```

**13.229.2.16 faddin\_1\_modular\_double()**

```
void faddin_1_modular_double (
    const double p,
    const size_t n,
    const double * B,
    const size_t incB,
    double * C,
    const size_t incC,
    bool positive)
```

**13.229.2.17 fsubin\_1\_modular\_double()**

```
void fsubin_1_modular_double (
    const double p,
    const size_t n,
    const double * B,
    const size_t incB,
    double * C,
    const size_t incC,
    bool positive)
```

**13.230 fflas\_lvl2.C File Reference**

C functions calls for level 2 [FFLAS](#) in fflas-c.h.

```
#include "fflas-ffpack/interfaces/libs/fflas_c.h"
#include "fflas-ffpack/fflas/fflas.h"
#include "givaro//modular-balanced.h"
#include "givaro//modular.h"
```

**Functions**

- void [fassign\\_2\\_modular\\_double](#) (const double p, const size\_t m, const size\_t n, const double \*A, const size\_t lda, double \*B, const size\_t ldb, bool positive)
- void [fzero\\_2\\_modular\\_double](#) (const double p, const size\_t m, const size\_t n, double \*A, const size\_t lda, bool positive)
- bool [fequal\\_2\\_modular\\_double](#) (const double p, const size\_t m, const size\_t n, const double \*A, const size\_t lda, const double \*B, const size\_t ldb, bool positive)
- bool [fiszero\\_2\\_modular\\_double](#) (const double p, const size\_t m, const size\_t n, const double \*A, const size\_t lda, bool positive)
- void [fidentity\\_2\\_modular\\_double](#) (const double p, const size\_t m, const size\_t n, double \*A, const size\_t lda, const double d, bool positive)
- void [freducein\\_2\\_modular\\_double](#) (const double p, const size\_t m, const size\_t n, double \*A, const size\_t lda, bool positive)

- void [freduce\\_2\\_modular\\_double](#) (const double p, const size\_t m, const size\_t n, const double \*A, const size\_t lda, double \*B, const size\_t ldb, bool positive)
- void [fnegin\\_2\\_modular\\_double](#) (const double p, const size\_t m, const size\_t n, double \*A, const size\_t lda, bool positive)
- void [fneg\\_2\\_modular\\_double](#) (const double p, const size\_t m, const size\_t n, const double \*A, const size\_t lda, double \*B, const size\_t ldb, bool positive)
- void [fscaln\\_2\\_modular\\_double](#) (const double p, const size\_t m, const size\_t n, const double alpha, double \*A, const size\_t lda, bool positive)
- void [fscal\\_2\\_modular\\_double](#) (const double p, const size\_t m, const size\_t n, const double alpha, const double \*A, const size\_t lda, double \*B, const size\_t ldb, bool positive)
- void [faxpy\\_2\\_modular\\_double](#) (const double p, const size\_t m, const size\_t n, const double alpha, const double \*A, const size\_t lda, double \*B, const size\_t ldb, bool positive)
- void [fmove\\_2\\_modular\\_double](#) (const double p, const size\_t m, const size\_t n, double \*A, const size\_t lda, double \*B, const size\_t ldb, bool positive)
- void [fadd\\_2\\_modular\\_double](#) (const double p, const size\_t m, const size\_t n, const double \*A, const size\_t lda, const double \*B, const size\_t ldb, double \*C, const size\_t ldc, bool positive)
- void [fsub\\_2\\_modular\\_double](#) (const double p, const size\_t m, const size\_t n, const double \*A, const size\_t lda, const double \*B, const size\_t ldb, double \*C, const size\_t ldc, bool positive)
- void [fsubin\\_2\\_modular\\_double](#) (const double p, const size\_t m, const size\_t n, const double \*B, const size\_t ldb, double \*C, const size\_t ldc, bool positive)
- void [faddin\\_2\\_modular\\_double](#) (const double p, const size\_t m, const size\_t n, const double \*B, const size\_t ldb, double \*C, const size\_t ldc, bool positive)
- double \* [fgemv\\_2\\_modular\\_double](#) (const double p, const enum [FFLAS\\_C\\_TRANSPOSE](#) TransA, const size\_t m, const size\_t n, const double alpha, const double \*A, const size\_t lda, const double \*X, const size\_t incX, const double beta, double \*Y, const size\_t incY, bool positive)
- void [fger\\_2\\_modular\\_double](#) (const double p, const size\_t m, const size\_t n, const double alpha, const double \*X, const size\_t incX, const double \*Y, const size\_t incY, double \*A, const size\_t lda, bool positive)
- void [ftrsv\\_2\\_modular\\_double](#) (const double p, const enum [FFLAS\\_C\\_UPLO](#) Uplo, const enum [FFLAS\\_C\\_TRANSPOSE](#) TransA, const enum [FFLAS\\_C\\_DIAG](#) Diag, const size\_t n, const double \*A, const size\_t lda, double \*X, int incX, bool positive)

### 13.230.1 Detailed Description

C functions calls for level 2 [FFLAS](#) in `fflas-c.h`.

Author

Brice Boyer

See also

[fflas/fflas\\_level2.inl](#)

### 13.230.2 Function Documentation

#### 13.230.2.1 `fassign_2_modular_double()`

```
void fassign_2_modular_double (
    const double p,
    const size_t m,
    const size_t n,
    const double * A,
    const size_t lda,
    double * B,
    const size_t ldb,
    bool positive)
```

**13.230.2.2 fzero\_2\_modular\_double()**

```
void fzero_2_modular_double (
    const double p,
    const size_t m,
    const size_t n,
    double * A,
    const size_t lda,
    bool positive)
```

**13.230.2.3 fequal\_2\_modular\_double()**

```
bool fequal_2_modular_double (
    const double p,
    const size_t m,
    const size_t n,
    const double * A,
    const size_t lda,
    const double * B,
    const size_t ldb,
    bool positive)
```

**13.230.2.4 fiszero\_2\_modular\_double()**

```
bool fiszero_2_modular_double (
    const double p,
    const size_t m,
    const size_t n,
    const double * A,
    const size_t lda,
    bool positive)
```

**13.230.2.5 fidentity\_2\_modular\_double()**

```
void fidentity_2_modular_double (
    const double p,
    const size_t m,
    const size_t n,
    double * A,
    const size_t lda,
    const double d,
    bool positive)
```

**13.230.2.6 freducein\_2\_modular\_double()**

```
void freducein_2_modular_double (
    const double p,
    const size_t m,
    const size_t n,
    double * A,
    const size_t lda,
    bool positive)
```

**13.230.2.7 freduce\_2\_modular\_double()**

```
void freduce_2_modular_double (
    const double p,
    const size_t m,
    const size_t n,
```



```
    const double * A,  
    const size_t lda,  
    double * B,  
    const size_t ldb,  
    bool positive)
```

#### 13.230.2.8 fnegin\_2\_modular\_double()

```
void fnegin_2_modular_double (  
    const double p,  
    const size_t m,  
    const size_t n,  
    double * A,  
    const size_t lda,  
    bool positive)
```

#### 13.230.2.9 fneg\_2\_modular\_double()

```
void fneg_2_modular_double (  
    const double p,  
    const size_t m,  
    const size_t n,  
    const double * A,  
    const size_t lda,  
    double * B,  
    const size_t ldb,  
    bool positive)
```

#### 13.230.2.10 fscaln\_2\_modular\_double()

```
void fscaln_2_modular_double (  
    const double p,  
    const size_t m,  
    const size_t n,  
    const double alpha,  
    double * A,  
    const size_t lda,  
    bool positive)
```

#### 13.230.2.11 fscal\_2\_modular\_double()

```
void fscal_2_modular_double (  
    const double p,  
    const size_t m,  
    const size_t n,  
    const double alpha,  
    const double * A,  
    const size_t lda,  
    double * B,  
    const size_t ldb,  
    bool positive)
```

#### 13.230.2.12 faxpy\_2\_modular\_double()

```
void faxpy_2_modular_double (  
    const double p,  
    const size_t m,  
    const size_t n,  
    const double alpha,
```

```
    const double * A,  
    const size_t lda,  
    double * B,  
    const size_t ldb,  
    bool positive)
```

#### 13.230.2.13 fmove\_2\_modular\_double()

```
void fmove_2_modular_double (  
    const double p,  
    const size_t m,  
    const size_t n,  
    double * A,  
    const size_t lda,  
    double * B,  
    const size_t ldb,  
    bool positive)
```

#### 13.230.2.14 fadd\_2\_modular\_double()

```
void fadd_2_modular_double (  
    const double p,  
    const size_t m,  
    const size_t n,  
    const double * A,  
    const size_t lda,  
    const double * B,  
    const size_t ldb,  
    double * C,  
    const size_t ldc,  
    bool positive)
```

#### 13.230.2.15 fsub\_2\_modular\_double()

```
void fsub_2_modular_double (  
    const double p,  
    const size_t m,  
    const size_t n,  
    const double * A,  
    const size_t lda,  
    const double * B,  
    const size_t ldb,  
    double * C,  
    const size_t ldc,  
    bool positive)
```

#### 13.230.2.16 fsubin\_2\_modular\_double()

```
void fsubin_2_modular_double (  
    const double p,  
    const size_t m,  
    const size_t n,  
    const double * B,  
    const size_t ldb,  
    double * C,  
    const size_t ldc,  
    bool positive)
```

**13.230.2.17 faddin\_2\_modular\_double()**

```
void faddin_2_modular_double (
    const double p,
    const size_t m,
    const size_t n,
    const double * B,
    const size_t ldb,
    double * C,
    const size_t ldc,
    bool positive)
```

**13.230.2.18 fgemv\_2\_modular\_double()**

```
double * fgemv_2_modular_double (
    const double p,
    const enum FFLAS_C_TRANSPOSE TransA,
    const size_t m,
    const size_t n,
    const double alpha,
    const double * A,
    const size_t lda,
    const double * X,
    const size_t incX,
    const double beta,
    double * Y,
    const size_t incY,
    bool positive)
```

**13.230.2.19 fger\_2\_modular\_double()**

```
void fger_2_modular_double (
    const double p,
    const size_t m,
    const size_t n,
    const double alpha,
    const double * X,
    const size_t incX,
    const double * Y,
    const size_t incY,
    double * A,
    const size_t lda,
    bool positive)
```

**13.230.2.20 ftrsv\_2\_modular\_double()**

```
void ftrsv_2_modular_double (
    const double p,
    const enum FFLAS_C_UPLO Uplo,
    const enum FFLAS_C_TRANSPOSE TransA,
    const enum FFLAS_C_DIAG Diag,
    const size_t n,
    const double * A,
    const size_t lda,
    double * X,
    int incX,
    bool positive)
```

## 13.231 fflas\_lvl3.C File Reference

C functions calls for level 3 [FFLAS](#) in fflas-c.h.

```
#include "fflas-ffpack/interfaces/libs/fflas_c.h"
#include "fflas-ffpack/fflas/fflas.h"
#include "givaro//modular-balanced.h"
#include "givaro//modular.h"
```

### Functions

- void [ftrsm\\_3\\_modular\\_double](#) (const double p, const enum [FFLAS\\_C\\_SIDE](#) Side, const enum [FFLAS\\_C\\_UPLO](#) Uplo, const enum [FFLAS\\_C\\_TRANSPOSE](#) tA, const enum [FFLAS\\_C\\_DIAG](#) Diag, const size\_t m, const size\_t n, const double alpha, const double \*A, const size\_t ldA, double \*B, const size\_t ldB, bool positive)
- void [ftrmm\\_3\\_modular\\_double](#) (const double p, const enum [FFLAS\\_C\\_SIDE](#) Side, const enum [FFLAS\\_C\\_UPLO](#) Uplo, const enum [FFLAS\\_C\\_TRANSPOSE](#) tA, const enum [FFLAS\\_C\\_DIAG](#) Diag, const size\_t m, const size\_t n, const double alpha, double \*A, const size\_t ldA, double \*B, const size\_t ldB, bool positive)
- double \* [fgemm\\_3\\_modular\\_double](#) (const double p, const enum [FFLAS\\_C\\_TRANSPOSE](#) tA, const enum [FFLAS\\_C\\_TRANSPOSE](#) tB, const size\_t m, const size\_t n, const size\_t k, const double alpha, const double \*A, const size\_t ldA, const double \*B, const size\_t ldB, const double betA, double \*C, const size\_t ldC, bool positive)
- double \* [fsquare\\_3\\_modular\\_double](#) (const double p, const enum [FFLAS\\_C\\_TRANSPOSE](#) tA, const size\_t n, const double alpha, const double \*A, const size\_t ldA, const double betA, double \*C, const size\_t ldC, bool positive)

### 13.231.1 Detailed Description

C functions calls for level 3 [FFLAS](#) in fflas-c.h.

Author

Brice Boyer

See also

[fflas/fflas\\_level3.inl](#)

### 13.231.2 Function Documentation

#### 13.231.2.1 ftrsm\_3\_modular\_double()

```
void ftrsm_3_modular_double (
    const double p,
    const enum FFLAS\_C\_SIDE Side,
    const enum FFLAS\_C\_UPLO Uplo,
    const enum FFLAS\_C\_TRANSPOSE tA,
    const enum FFLAS\_C\_DIAG Diag,
    const size_t m,
    const size_t n,
    const double alpha,
    const double * A,
    const size_t ldA,
    double * B,
    const size_t ldB,
    bool positive)
```

**13.231.2.2 ftrmm\_3\_modular\_double()**

```
void ftrmm_3_modular_double (
    const double p,
    const enum FFLAS_C_SIDE Side,
    const enum FFLAS_C_UPLO Uplo,
    const enum FFLAS_C_TRANSPOSE tA,
    const enum FFLAS_C_DIAG Diag,
    const size_t m,
    const size_t n,
    const double alpha,
    double * A,
    const size_t ldA,
    double * B,
    const size_t ldB,
    bool positive)
```

**13.231.2.3 fgemv\_3\_modular\_double()**

```
double * fgemv_3_modular_double (
    const double p,
    const enum FFLAS_C_TRANSPOSE tA,
    const enum FFLAS_C_TRANSPOSE tB,
    const size_t m,
    const size_t n,
    const size_t k,
    const double alpha,
    const double * A,
    const size_t ldA,
    const double * B,
    const size_t ldB,
    const double betA,
    double * C,
    const size_t ldC,
    bool positive)
```

**13.231.2.4 fsquare\_3\_modular\_double()**

```
double * fsquare_3_modular_double (
    const double p,
    const enum FFLAS_C_TRANSPOSE tA,
    const size_t n,
    const double alpha,
    const double * A,
    const size_t ldA,
    const double betA,
    double * C,
    const size_t ldC,
    bool positive)
```

**13.232 fflas\_sparse.C File Reference**

C functions calls for level 1.5 and 2.5 [FFLAS](#) in fflas-c.h.

**13.232.1 Detailed Description**

C functions calls for level 1.5 and 2.5 [FFLAS](#) in fflas-c.h.

## Author

Brice Boyer

## See also

[fflas/fflas\\_sparse.h](#)

## 13.233 ffpack.C File Reference

C functions calls for [FFPACK](#) in `ffpack-c.h`.

```
#include "fflas-ffpack/interfaces/libs/ffpack_c.h"
#include "fflas-ffpack/fflas/fflas.h"
#include "fflas-ffpack/ffpack/ffpack.h"
#include "givaro//modular-balanced.h"
#include "givaro//modular.h"
```

### Functions

- void [LAPACKPerm2MathPerm](#) (size\_t \*MathP, const size\_t \*LapackP, const size\_t N)
- void [MathPerm2LAPACKPerm](#) (size\_t \*LapackP, const size\_t \*MathP, const size\_t N)
- void [MatrixApplyS\\_modular\\_double](#) (const double p, double \*A, const size\_t lda, const size\_t width, const size\_t M2, const size\_t R1, const size\_t R2, const size\_t R3, const size\_t R4, bool positive)
- void [PermApplyS\\_double](#) (double \*A, const size\_t lda, const size\_t width, const size\_t M2, const size\_t R1, const size\_t R2, const size\_t R3, const size\_t R4)
- void [MatrixApplyT\\_modular\\_double](#) (const double p, double \*A, const size\_t lda, const size\_t width, const size\_t N2, const size\_t R1, const size\_t R2, const size\_t R3, const size\_t R4, bool positive)
- void [PermApplyT\\_double](#) (double \*A, const size\_t lda, const size\_t width, const size\_t N2, const size\_t R1, const size\_t R2, const size\_t R3, const size\_t R4)
- void [composePermutationsLLM](#) (size\_t \*MathP, const size\_t \*P1, const size\_t \*P2, const size\_t R, const size\_t N)
- void [composePermutationsLLL](#) (size\_t \*P1, const size\_t \*P2, const size\_t R, const size\_t N)
- void [composePermutationsMLM](#) (size\_t \*MathP1, const size\_t \*P2, const size\_t R, const size\_t N)
- void [cyclic\\_shift\\_mathPerm](#) (size\_t \*P, const size\_t s)
- void [cyclic\\_shift\\_row\\_modular\\_double](#) (const double p, double \*A, size\_t m, size\_t n, size\_t lda, bool positive)
- void [cyclic\\_shift\\_col\\_modular\\_double](#) (const double p, double \*A, size\_t m, size\_t n, size\_t lda, bool positive)
- void [applyP\\_modular\\_double](#) (const double p, const enum [FFLAS::FFLAS\\_SIDE](#) Side, const enum [FFLAS::FFLAS\\_TRANSPOSE](#) Trans, const size\_t M, const size\_t ibeg, const size\_t iend, double \*A, const size\_t lda, const size\_t \*P, bool positive)
- void [fgetrsin\\_modular\\_double](#) (const double p, const enum [FFLAS::FFLAS\\_SIDE](#) Side, const size\_t M, const size\_t N, const size\_t R, double \*A, const size\_t lda, const size\_t \*P, const size\_t \*Q, double \*B, const size\_t ldb, int \*info, bool positive)
- double \* [fgetrsv\\_modular\\_double](#) (const double p, const enum [FFLAS::FFLAS\\_SIDE](#) Side, const size\_t M, const size\_t N, const size\_t NRHS, const size\_t R, double \*A, const size\_t lda, const size\_t \*P, const size\_t \*Q, double \*X, const size\_t ldx, const double \*B, const size\_t ldb, int \*info, bool positive)
- size\_t [fgesvin\\_modular\\_double](#) (const double p, const enum [FFLAS::FFLAS\\_SIDE](#) Side, const size\_t M, const size\_t N, double \*A, const size\_t lda, double \*B, const size\_t ldb, int \*info, bool positive)
- size\_t [fgesv\\_modular\\_double](#) (const double p, const enum [FFLAS::FFLAS\\_SIDE](#) Side, const size\_t M, const size\_t N, const size\_t NRHS, double \*A, const size\_t lda, double \*X, const size\_t ldx, const double \*B, const size\_t ldb, int \*info, bool positive)
- void [ftrtri\\_modular\\_double](#) (const double p, const enum [FFLAS::FFLAS\\_UPLO](#) Uplo, const enum [FFLAS::FFLAS\\_DIAG](#) Diag, const size\_t N, double \*A, const size\_t lda, bool positive)
- void [trinv\\_left\\_modular\\_double](#) (const double p, const size\_t N, const double \*L, const size\_t ldl, double \*X, const size\_t ldx, bool positive)
- void [ftrtrm\\_modular\\_double](#) (const double p, const [FFLAS::FFLAS\\_SIDE](#) side, const enum [FFLAS::FFLAS\\_DIAG](#) Diag, const size\_t N, double \*A, const size\_t lda, bool positive)

- [illegible]

- `size_t pReducedColumnEchelonForm_modular_int32_t` (const int32\_t p, const size\_t M, const size\_t N, int32\_t \*A, const size\_t lda, size\_t \*P, size\_t \*Qt, const bool transform, const enum [FFPACK\\_C\\_LU\\_TAG](#) LuTag, bool positive)
- `size_t pReducedRowEchelonForm_modular_int32_t` (const int32\_t p, const size\_t M, const size\_t N, int32\_t \*A, const size\_t lda, size\_t \*P, size\_t \*Qt, const bool transform, const enum [FFPACK\\_C\\_LU\\_TAG](#) LuTag, bool positive)
- `double * Invertin_modular_double` (const double p, const size\_t M, double \*A, const size\_t lda, int \*nullity, bool positive)
- `double * Invert_modular_double` (const double p, const size\_t M, const double \*A, const size\_t lda, double \*X, const size\_t idx, int \*nullity, bool positive)
- `double * Invert2_modular_double` (const double p, const size\_t M, double \*A, const size\_t lda, double \*X, const size\_t idx, int \*nullity, bool positive)
- `size_t KrylovElim_modular_double` (const double p, const size\_t M, const size\_t N, double \*A, const size\_t lda, size\_t \*P, size\_t \*Q, const size\_t deg, size\_t \*iterates, size\_t \*inviterates, const size\_t maxit, size\_t virt, bool positive)
- `size_t SpecRankProfile_modular_double` (const double p, const size\_t M, const size\_t N, double \*A, const size\_t lda, const size\_t deg, size\_t \*rankProfile, bool positive)
- `size_t Rank_modular_double` (const double p, const size\_t M, const size\_t N, double \*A, const size\_t lda, bool positive)
- `bool IsSingular_modular_double` (const double p, const size\_t M, const size\_t N, double \*A, const size\_t lda, bool positive)
- `double Det_modular_double` (const double p, const size\_t N, double \*A, const size\_t lda, bool positive)
- `double * Solve_modular_double` (const double p, const size\_t M, double \*A, const size\_t lda, double \*x, const int incx, const double \*b, const int incb, bool positive)
- `void solveLB_modular_double` (const double p, const enum [FFLAS::FFLAS\\_SIDE](#) Side, const size\_t M, const size\_t N, const size\_t R, double \*L, const size\_t ldl, const size\_t \*Q, double \*B, const size\_t ldb, bool positive)
- `void solveLB2_modular_double` (const double p, const enum [FFLAS::FFLAS\\_SIDE](#) Side, const size\_t M, const size\_t N, const size\_t R, double \*L, const size\_t ldl, const size\_t \*Q, double \*B, const size\_t ldb, bool positive)
- `void RandomNullSpaceVector_modular_double` (const double p, const enum [FFLAS::FFLAS\\_SIDE](#) Side, const size\_t M, const size\_t N, double \*A, const size\_t lda, double \*X, const size\_t incX, bool positive)
- `size_t NullSpaceBasis_modular_double` (const double p, const enum [FFLAS::FFLAS\\_SIDE](#) Side, const size\_t M, const size\_t N, double \*A, const size\_t lda, double \*\*NS, size\_t \*ldn, size\_t \*NSdim, bool positive)
- `size_t RowRankProfile_modular_double` (const double p, const size\_t M, const size\_t N, double \*A, const size\_t lda, size\_t \*\*rkprofile, const enum [FFPACK\\_C\\_LU\\_TAG](#) LuTag, bool positive)
- `size_t ColumnRankProfile_modular_double` (const double p, const size\_t M, const size\_t N, double \*A, const size\_t lda, size\_t \*\*rkprofile, const enum [FFPACK\\_C\\_LU\\_TAG](#) LuTag, bool positive)
- `void RankProfileFromLU` (const size\_t \*P, const size\_t N, const size\_t R, size\_t \*rkprofile, const enum [FFPACK\\_C\\_LU\\_TAG](#) LuTag)
- `size_t LeadingSubmatrixRankProfiles` (const size\_t M, const size\_t N, const size\_t R, const size\_t LSm, const size\_t LSn, const size\_t \*P, const size\_t \*Q, size\_t \*RRP, size\_t \*CRP)
- `size_t RowRankProfileSubmatrixIndices_modular_double` (const double p, const size\_t M, const size\_t N, double \*A, const size\_t lda, size\_t \*\*rowindices, size\_t \*\*colindices, size\_t \*R, bool positive)
- `size_t ColRankProfileSubmatrixIndices_modular_double` (const double p, const size\_t M, const size\_t N, double \*A, const size\_t lda, size\_t \*\*rowindices, size\_t \*\*colindices, size\_t \*R, bool positive)
- `size_t RowRankProfileSubmatrix_modular_double` (const double p, const size\_t M, const size\_t N, double \*A, const size\_t lda, double \*\*X, size\_t \*R, bool positive)
- `size_t ColRankProfileSubmatrix_modular_double` (const double p, const size\_t M, const size\_t N, double \*A, const size\_t lda, double \*\*X, size\_t \*R, bool positive)
- `void getTriangular_modular_double` (const double p, const enum [FFLAS::FFLAS\\_UPLO](#) Uplo, const enum [FFLAS::FFLAS\\_DIAG](#) Diag, const size\_t M, const size\_t N, const size\_t R, const double \*A, const size\_t lda, double \*T, const size\_t ldt, const bool OnlyNonZeroVectors, bool positive)
- `void getTriangularin_modular_double` (const double p, const enum [FFLAS::FFLAS\\_UPLO](#) Uplo, const enum [FFLAS::FFLAS\\_DIAG](#) Diag, const size\_t M, const size\_t N, const size\_t R, double \*A, const size\_t lda, bool positive)



- void [getEchelonForm\\_modular\\_double](#) (const double p, const enum [FFLAS::FFLAS\\_UPLO](#) Uplo, const enum [FFLAS::FFLAS\\_DIAG](#) Diag, const size\_t M, const size\_t N, const size\_t R, const size\_t \*P, const double \*A, const size\_t lda, double \*T, const size\_t ldt, const bool OnlyNonZeroVectors, const enum [FFPACK\\_C\\_LU\\_TAG](#) LuTag, bool positive)
- void [getEchelonFormin\\_modular\\_double](#) (const double p, const enum [FFLAS::FFLAS\\_UPLO](#) Uplo, const enum [FFLAS::FFLAS\\_DIAG](#) Diag, const size\_t M, const size\_t N, const size\_t R, const size\_t \*P, double \*A, const size\_t lda, const enum [FFPACK\\_C\\_LU\\_TAG](#) LuTag, bool positive)
- void [getEchelonTransform\\_modular\\_double](#) (const double p, const enum [FFLAS::FFLAS\\_UPLO](#) Uplo, const enum [FFLAS::FFLAS\\_DIAG](#) Diag, const size\_t M, const size\_t N, const size\_t R, const size\_t \*P, const size\_t \*Q, const double \*A, const size\_t lda, double \*T, const size\_t ldt, const enum [FFPACK\\_C\\_LU\\_TAG](#) LuTag, bool positive)
- void [getReducedEchelonForm\\_modular\\_double](#) (const double p, const enum [FFLAS::FFLAS\\_UPLO](#) Uplo, const size\_t M, const size\_t N, const size\_t R, const size\_t \*P, const double \*A, const size\_t lda, double \*T, const size\_t ldt, const bool OnlyNonZeroVectors, const enum [FFPACK\\_C\\_LU\\_TAG](#) LuTag, bool positive)
- void [getReducedEchelonFormin\\_modular\\_double](#) (const double p, const enum [FFLAS::FFLAS\\_UPLO](#) Uplo, const size\_t M, const size\_t N, const size\_t R, const size\_t \*P, double \*A, const size\_t lda, const enum [FFPACK\\_C\\_LU\\_TAG](#) LuTag, bool positive)
- void [getReducedEchelonTransform\\_modular\\_double](#) (const double p, const enum [FFLAS::FFLAS\\_UPLO](#) Uplo, const size\_t M, const size\_t N, const size\_t R, const size\_t \*P, const size\_t \*Q, const double \*A, const size\_t lda, double \*T, const size\_t ldt, const enum [FFPACK\\_C\\_LU\\_TAG](#) LuTag, bool positive)
- void [PLUQtoEchelonPermutation](#) (const size\_t N, const size\_t R, const size\_t \*P, size\_t \*outPerm)

### 13.233.1 Detailed Description

C functions calls for [FFPACK](#) in ffpack-c.h.

Author

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See also

[ffpack/ffpack.h](#)

### 13.233.2 Function Documentation

#### 13.233.2.1 LAPACKPerm2MathPerm()

```
void LAPACKPerm2MathPerm (
    size_t * MathP,
    const size_t * LapackP,
    const size_t N)
```

#### 13.233.2.2 MathPerm2LAPACKPerm()

```
void MathPerm2LAPACKPerm (
    size_t * LapackP,
    const size_t * MathP,
    const size_t N)
```

#### 13.233.2.3 MatrixApplyS\_modular\_double()

```
void MatrixApplyS_modular_double (
    const double p,
    double * A,
    const size_t lda,
    const size_t width,
    const size_t M2,
    const size_t R1,
    const size_t R2,
```

```

    const size_t R3,
    const size_t R4,
    bool positive)

```

#### 13.233.2.4 PermApplyS\_double()

```

void PermApplyS_double (
    double * A,
    const size_t lda,
    const size_t width,
    const size_t M2,
    const size_t R1,
    const size_t R2,
    const size_t R3,
    const size_t R4)

```

#### 13.233.2.5 MatrixApplyT\_modular\_double()

```

void MatrixApplyT_modular_double (
    const double p,
    double * A,
    const size_t lda,
    const size_t width,
    const size_t N2,
    const size_t R1,
    const size_t R2,
    const size_t R3,
    const size_t R4,
    bool positive)

```

#### 13.233.2.6 PermApplyT\_double()

```

void PermApplyT_double (
    double * A,
    const size_t lda,
    const size_t width,
    const size_t N2,
    const size_t R1,
    const size_t R2,
    const size_t R3,
    const size_t R4)

```

#### 13.233.2.7 composePermutationsLLM()

```

void composePermutationsLLM (
    size_t * MathP,
    const size_t * P1,
    const size_t * P2,
    const size_t R,
    const size_t N)

```

#### 13.233.2.8 composePermutationsLLL()

```

void composePermutationsLLL (
    size_t * P1,
    const size_t * P2,
    const size_t R,
    const size_t N)

```

**13.233.2.9 composePermutationsMLM()**

```
void composePermutationsMLM (
    size_t * MathP1,
    const size_t * P2,
    const size_t R,
    const size_t N)
```

**13.233.2.10 cyclic\_shift\_mathPerm()**

```
void cyclic_shift_mathPerm (
    size_t * P,
    const size_t s)
```

**13.233.2.11 cyclic\_shift\_row\_modular\_double()**

```
void cyclic_shift_row_modular_double (
    const double p,
    double * A,
    size_t m,
    size_t n,
    size_t lda,
    bool positive)
```

**13.233.2.12 cyclic\_shift\_col\_modular\_double()**

```
void cyclic_shift_col_modular_double (
    const double p,
    double * A,
    size_t m,
    size_t n,
    size_t lda,
    bool positive)
```

**13.233.2.13 applyP\_modular\_double()**

```
void applyP_modular_double (
    const double p,
    const enum FFLAS::FFLAS_SIDE Side,
    const enum FFLAS::FFLAS_TRANSPOSE Trans,
    const size_t M,
    const size_t ibeg,
    const size_t iend,
    double * A,
    const size_t lda,
    const size_t * P,
    bool positive)
```

**13.233.2.14 fgetrsin\_modular\_double()**

```
void fgetrsin_modular_double (
    const double p,
    const enum FFLAS::FFLAS_SIDE Side,
    const size_t M,
    const size_t N,
    const size_t R,
    double * A,
    const size_t lda,
    const size_t * P,
```

```

    const size_t * Q,
    double * B,
    const size_t ldb,
    int * info,
    bool positive)

```

#### 13.233.2.15 fgetrsv\_modular\_double()

```

double * fgetrsv_modular_double (
    const double p,
    const enum FFLAS::FFLAS_SIDE Side,
    const size_t M,
    const size_t N,
    const size_t NRHS,
    const size_t R,
    double * A,
    const size_t lda,
    const size_t * P,
    const size_t * Q,
    double * X,
    const size_t ldx,
    const double * B,
    const size_t ldb,
    int * info,
    bool positive)

```

#### 13.233.2.16 fgesvin\_modular\_double()

```

size_t fgesvin_modular_double (
    const double p,
    const enum FFLAS::FFLAS_SIDE Side,
    const size_t M,
    const size_t N,
    double * A,
    const size_t lda,
    double * B,
    const size_t ldb,
    int * info,
    bool positive)

```

#### 13.233.2.17 fgesv\_modular\_double()

```

size_t fgesv_modular_double (
    const double p,
    const enum FFLAS::FFLAS_SIDE Side,
    const size_t M,
    const size_t N,
    const size_t NRHS,
    double * A,
    const size_t lda,
    double * X,
    const size_t ldx,
    const double * B,
    const size_t ldb,
    int * info,
    bool positive)

```

**13.233.2.18 ftrtri\_modular\_double()**

```
void ftrtri_modular_double (
    const double p,
    const enum FFLAS::FFLAS_UPLO Uplo,
    const enum FFLAS::FFLAS_DIAG Diag,
    const size_t N,
    double * A,
    const size_t lda,
    bool positive)
```

**13.233.2.19 trinv\_left\_modular\_double()**

```
void trinv_left_modular_double (
    const double p,
    const size_t N,
    const double * L,
    const size_t ldl,
    double * X,
    const size_t ldx,
    bool positive)
```

**13.233.2.20 ftrtrm\_modular\_double()**

```
void ftrtrm_modular_double (
    const double p,
    const FFLAS::FFLAS_SIDE side,
    const enum FFLAS::FFLAS_DIAG Diag,
    const size_t N,
    double * A,
    const size_t lda,
    bool positive)
```

**13.233.2.21 PLUQ\_modular\_double()**

```
size_t PLUQ_modular_double (
    const double p,
    const enum FFLAS::FFLAS_DIAG Diag,
    const size_t M,
    const size_t N,
    double * A,
    const size_t lda,
    size_t * P,
    size_t * Q,
    bool positive)
```

**13.233.2.22 LUdivine\_modular\_double()**

```
size_t LUdivine_modular_double (
    const double p,
    const enum FFLAS::FFLAS_DIAG Diag,
    const enum FFLAS::FFLAS_TRANSPOSE Trans,
    const size_t M,
    const size_t N,
    double * A,
    const size_t lda,
    size_t * P,
    size_t * Qt,
    const enum FFPACK_C_LU_TAG LuTag,
```

```
    const size_t cutoff,
    bool positive)
```

#### 13.233.2.23 ColumnEchelonForm\_modular\_double()

```
size_t ColumnEchelonForm_modular_double (
    const double p,
    const size_t M,
    const size_t N,
    double * A,
    const size_t lda,
    size_t * P,
    size_t * Qt,
    bool transform,
    const enum FFPACK_C_LU_TAG LuTag,
    bool positive)
```

#### 13.233.2.24 RowEchelonForm\_modular\_double()

```
size_t RowEchelonForm_modular_double (
    const double p,
    const size_t M,
    const size_t N,
    double * A,
    const size_t lda,
    size_t * P,
    size_t * Qt,
    const bool transform,
    const enum FFPACK_C_LU_TAG LuTag,
    bool positive)
```

#### 13.233.2.25 ReducedColumnEchelonForm\_modular\_double()

```
size_t ReducedColumnEchelonForm_modular_double (
    const double p,
    const size_t M,
    const size_t N,
    double * A,
    const size_t lda,
    size_t * P,
    size_t * Qt,
    const bool transform,
    const enum FFPACK_C_LU_TAG LuTag,
    bool positive)
```

#### 13.233.2.26 ReducedRowEchelonForm\_modular\_double()

```
size_t ReducedRowEchelonForm_modular_double (
    const double p,
    const size_t M,
    const size_t N,
    double * A,
    const size_t lda,
    size_t * P,
    size_t * Qt,
    const bool transform,
    const enum FFPACK_C_LU_TAG LuTag,
    bool positive)
```

**13.233.2.27 ColumnEchelonForm\_modular\_float()**

```
size_t ColumnEchelonForm_modular_float (  
    const float p,  
    const size_t M,  
    const size_t N,  
    float * A,  
    const size_t lda,  
    size_t * P,  
    size_t * Qt,  
    bool transform,  
    const enum FFPACK_C_LU_TAG LuTag,  
    bool positive)
```

**13.233.2.28 RowEchelonForm\_modular\_float()**

```
size_t RowEchelonForm_modular_float (  
    const float p,  
    const size_t M,  
    const size_t N,  
    float * A,  
    const size_t lda,  
    size_t * P,  
    size_t * Qt,  
    const bool transform,  
    const enum FFPACK_C_LU_TAG LuTag,  
    bool positive)
```

**13.233.2.29 ReducedColumnEchelonForm\_modular\_float()**

```
size_t ReducedColumnEchelonForm_modular_float (  
    const float p,  
    const size_t M,  
    const size_t N,  
    float * A,  
    const size_t lda,  
    size_t * P,  
    size_t * Qt,  
    const bool transform,  
    const enum FFPACK_C_LU_TAG LuTag,  
    bool positive)
```

**13.233.2.30 ReducedRowEchelonForm\_modular\_float()**

```
size_t ReducedRowEchelonForm_modular_float (  
    const float p,  
    const size_t M,  
    const size_t N,  
    float * A,  
    const size_t lda,  
    size_t * P,  
    size_t * Qt,  
    const bool transform,  
    const enum FFPACK_C_LU_TAG LuTag,  
    bool positive)
```

**13.233.2.31 ColumnEchelonForm\_modular\_int32\_t()**

```
size_t ColumnEchelonForm_modular_int32_t (  
    const int32_t p,
```

```

    const size_t M,
    const size_t N,
    int32_t * A,
    const size_t lda,
    size_t * P,
    size_t * Qt,
    bool transform,
    const enum FFPACK_C_LU_TAG LuTag,
    bool positive)

```

#### 13.233.2.32 RowEchelonForm\_modular\_int32\_t()

```

size_t RowEchelonForm_modular_int32_t (
    const int32_t p,
    const size_t M,
    const size_t N,
    int32_t * A,
    const size_t lda,
    size_t * P,
    size_t * Qt,
    const bool transform,
    const enum FFPACK_C_LU_TAG LuTag,
    bool positive)

```

#### 13.233.2.33 ReducedColumnEchelonForm\_modular\_int32\_t()

```

size_t ReducedColumnEchelonForm_modular_int32_t (
    const int32_t p,
    const size_t M,
    const size_t N,
    int32_t * A,
    const size_t lda,
    size_t * P,
    size_t * Qt,
    const bool transform,
    const enum FFPACK_C_LU_TAG LuTag,
    bool positive)

```

#### 13.233.2.34 ReducedRowEchelonForm\_modular\_int32\_t()

```

size_t ReducedRowEchelonForm_modular_int32_t (
    const int32_t p,
    const size_t M,
    const size_t N,
    int32_t * A,
    const size_t lda,
    size_t * P,
    size_t * Qt,
    const bool transform,
    const enum FFPACK_C_LU_TAG LuTag,
    bool positive)

```

#### 13.233.2.35 pColumnEchelonForm\_modular\_double()

```

size_t pColumnEchelonForm_modular_double (
    const double p,
    const size_t M,
    const size_t N,
    double * A,

```



```

    const size_t lda,
    size_t * P,
    size_t * Qt,
    bool transform,
    const enum FFPACK_C_LU_TAG LuTag,
    bool positive)

```

#### 13.233.2.36 pRowEchelonForm\_modular\_double()

```

size_t pRowEchelonForm_modular_double (
    const double p,
    const size_t M,
    const size_t N,
    double * A,
    const size_t lda,
    size_t * P,
    size_t * Qt,
    const bool transform,
    const enum FFPACK_C_LU_TAG LuTag,
    bool positive)

```

#### 13.233.2.37 pReducedColumnEchelonForm\_modular\_double()

```

size_t pReducedColumnEchelonForm_modular_double (
    const double p,
    const size_t M,
    const size_t N,
    double * A,
    const size_t lda,
    size_t * P,
    size_t * Qt,
    const bool transform,
    const enum FFPACK_C_LU_TAG LuTag,
    bool positive)

```

#### 13.233.2.38 pReducedRowEchelonForm\_modular\_double()

```

size_t pReducedRowEchelonForm_modular_double (
    const double p,
    const size_t M,
    const size_t N,
    double * A,
    const size_t lda,
    size_t * P,
    size_t * Qt,
    const bool transform,
    const enum FFPACK_C_LU_TAG LuTag,
    bool positive)

```

#### 13.233.2.39 pColumnEchelonForm\_modular\_float()

```

size_t pColumnEchelonForm_modular_float (
    const float p,
    const size_t M,
    const size_t N,
    float * A,
    const size_t lda,
    size_t * P,
    size_t * Qt,

```

```

    bool transform,
    const enum FFPACK_C_LU_TAG LuTag,
    bool positive)

```

#### 13.233.2.40 pRowEchelonForm\_modular\_float()

```

size_t pRowEchelonForm_modular_float (
    const float p,
    const size_t M,
    const size_t N,
    float * A,
    const size_t lda,
    size_t * P,
    size_t * Qt,
    const bool transform,
    const enum FFPACK_C_LU_TAG LuTag,
    bool positive)

```

#### 13.233.2.41 pReducedColumnEchelonForm\_modular\_float()

```

size_t pReducedColumnEchelonForm_modular_float (
    const float p,
    const size_t M,
    const size_t N,
    float * A,
    const size_t lda,
    size_t * P,
    size_t * Qt,
    const bool transform,
    const enum FFPACK_C_LU_TAG LuTag,
    bool positive)

```

#### 13.233.2.42 pReducedRowEchelonForm\_modular\_float()

```

size_t pReducedRowEchelonForm_modular_float (
    const float p,
    const size_t M,
    const size_t N,
    float * A,
    const size_t lda,
    size_t * P,
    size_t * Qt,
    const bool transform,
    const enum FFPACK_C_LU_TAG LuTag,
    bool positive)

```

#### 13.233.2.43 pColumnEchelonForm\_modular\_int32\_t()

```

size_t pColumnEchelonForm_modular_int32_t (
    const int32_t p,
    const size_t M,
    const size_t N,
    int32_t * A,
    const size_t lda,
    size_t * P,
    size_t * Qt,
    bool transform,
    const enum FFPACK_C_LU_TAG LuTag,
    bool positive)

```

**13.233.2.44 pRowEchelonForm\_modular\_int32\_t()**

```
size_t pRowEchelonForm_modular_int32_t (  
    const int32_t p,  
    const size_t M,  
    const size_t N,  
    int32_t * A,  
    const size_t lda,  
    size_t * P,  
    size_t * Qt,  
    const bool transform,  
    const enum FFPACK_C_LU_TAG LuTag,  
    bool positive)
```

**13.233.2.45 pReducedColumnEchelonForm\_modular\_int32\_t()**

```
size_t pReducedColumnEchelonForm_modular_int32_t (  
    const int32_t p,  
    const size_t M,  
    const size_t N,  
    int32_t * A,  
    const size_t lda,  
    size_t * P,  
    size_t * Qt,  
    const bool transform,  
    const enum FFPACK_C_LU_TAG LuTag,  
    bool positive)
```

**13.233.2.46 pReducedRowEchelonForm\_modular\_int32\_t()**

```
size_t pReducedRowEchelonForm_modular_int32_t (  
    const int32_t p,  
    const size_t M,  
    const size_t N,  
    int32_t * A,  
    const size_t lda,  
    size_t * P,  
    size_t * Qt,  
    const bool transform,  
    const enum FFPACK_C_LU_TAG LuTag,  
    bool positive)
```

**13.233.2.47 Invertin\_modular\_double()**

```
double * Invertin_modular_double (  
    const double p,  
    const size_t M,  
    double * A,  
    const size_t lda,  
    int * nullity,  
    bool positive)
```

**13.233.2.48 Invert\_modular\_double()**

```
double * Invert_modular_double (  
    const double p,  
    const size_t M,  
    const double * A,  
    const size_t lda,
```

```
double * X,
const size_t ldx,
int * nullity,
bool positive)
```

#### 13.233.2.49 Invert2\_modular\_double()

```
double * Invert2_modular_double (
    const double p,
    const size_t M,
    double * A,
    const size_t lda,
    double * X,
    const size_t ldx,
    int * nullity,
    bool positive)
```

#### 13.233.2.50 KrylovElim\_modular\_double()

```
size_t KrylovElim_modular_double (
    const double p,
    const size_t M,
    const size_t N,
    double * A,
    const size_t lda,
    size_t * P,
    size_t * Q,
    const size_t deg,
    size_t * iterates,
    size_t * inviterates,
    const size_t maxit,
    size_t virt,
    bool positive)
```

#### 13.233.2.51 SpecRankProfile\_modular\_double()

```
size_t SpecRankProfile_modular_double (
    const double p,
    const size_t M,
    const size_t N,
    double * A,
    const size_t lda,
    const size_t deg,
    size_t * rankProfile,
    bool positive)
```

#### 13.233.2.52 Rank\_modular\_double()

```
size_t Rank_modular_double (
    const double p,
    const size_t M,
    const size_t N,
    double * A,
    const size_t lda,
    bool positive)
```

#### 13.233.2.53 IsSingular\_modular\_double()

```
bool IsSingular_modular_double (
```

```
    const double p,  
    const size_t M,  
    const size_t N,  
    double * A,  
    const size_t lda,  
    bool positive)
```

#### 13.233.2.54 Det\_modular\_double()

```
double Det_modular_double (  
    const double p,  
    const size_t N,  
    double * A,  
    const size_t lda,  
    bool positive)
```

#### 13.233.2.55 Solve\_modular\_double()

```
double * Solve_modular_double (  
    const double p,  
    const size_t M,  
    double * A,  
    const size_t lda,  
    double * x,  
    const int incx,  
    const double * b,  
    const int incb,  
    bool positive)
```

#### 13.233.2.56 solveLB\_modular\_double()

```
void solveLB_modular_double (  
    const double p,  
    const enum FFLAS::FFLAS_SIDE Side,  
    const size_t M,  
    const size_t N,  
    const size_t R,  
    double * L,  
    const size_t ldl,  
    const size_t * Q,  
    double * B,  
    const size_t ldb,  
    bool positive)
```

#### 13.233.2.57 solveLB2\_modular\_double()

```
void solveLB2_modular_double (  
    const double p,  
    const enum FFLAS::FFLAS_SIDE Side,  
    const size_t M,  
    const size_t N,  
    const size_t R,  
    double * L,  
    const size_t ldl,  
    const size_t * Q,  
    double * B,  
    const size_t ldb,  
    bool positive)
```

**13.233.2.58 RandomNullSpaceVector\_modular\_double()**

```
void RandomNullSpaceVector_modular_double (
    const double p,
    const enum FFLAS::FFLAS_SIDE Side,
    const size_t M,
    const size_t N,
    double * A,
    const size_t lda,
    double * X,
    const size_t incX,
    bool positive)
```

**13.233.2.59 NullSpaceBasis\_modular\_double()**

```
size_t NullSpaceBasis_modular_double (
    const double p,
    const enum FFLAS::FFLAS_SIDE Side,
    const size_t M,
    const size_t N,
    double * A,
    const size_t lda,
    double ** NS,
    size_t * ldn,
    size_t * NSdim,
    bool positive)
```

**13.233.2.60 RowRankProfile\_modular\_double()**

```
size_t RowRankProfile_modular_double (
    const double p,
    const size_t M,
    const size_t N,
    double * A,
    const size_t lda,
    size_t ** rkprofile,
    const enum FFPACK_C_LU_TAG LuTag,
    bool positive)
```

**13.233.2.61 ColumnRankProfile\_modular\_double()**

```
size_t ColumnRankProfile_modular_double (
    const double p,
    const size_t M,
    const size_t N,
    double * A,
    const size_t lda,
    size_t ** rkprofile,
    const enum FFPACK_C_LU_TAG LuTag,
    bool positive)
```

**13.233.2.62 RankProfileFromLU()**

```
void RankProfileFromLU (
    const size_t * P,
    const size_t N,
    const size_t R,
    size_t * rkprofile,
    const enum FFPACK_C_LU_TAG LuTag)
```

**13.233.2.63 LeadingSubmatrixRankProfiles()**

```
size_t LeadingSubmatrixRankProfiles (
    const size_t M,
    const size_t N,
    const size_t R,
    const size_t LSm,
    const size_t LSn,
    const size_t * P,
    const size_t * Q,
    size_t * RRP,
    size_t * CRP)
```

**13.233.2.64 RowRankProfileSubmatrixIndices\_modular\_double()**

```
size_t RowRankProfileSubmatrixIndices_modular_double (
    const double p,
    const size_t M,
    const size_t N,
    double * A,
    const size_t lda,
    size_t ** rowindices,
    size_t ** colindices,
    size_t * R,
    bool positive)
```

**13.233.2.65 ColRankProfileSubmatrixIndices\_modular\_double()**

```
size_t ColRankProfileSubmatrixIndices_modular_double (
    const double p,
    const size_t M,
    const size_t N,
    double * A,
    const size_t lda,
    size_t ** rowindices,
    size_t ** colindices,
    size_t * R,
    bool positive)
```

**13.233.2.66 RowRankProfileSubmatrix\_modular\_double()**

```
size_t RowRankProfileSubmatrix_modular_double (
    const double p,
    const size_t M,
    const size_t N,
    double * A,
    const size_t lda,
    double ** X,
    size_t * R,
    bool positive)
```

**13.233.2.67 ColRankProfileSubmatrix\_modular\_double()**

```
size_t ColRankProfileSubmatrix_modular_double (
    const double p,
    const size_t M,
    const size_t N,
    double * A,
    const size_t lda,
```

```
double ** X,
size_t * R,
bool positive)
```

### 13.233.2.68 getTriangular\_modular\_double()

```
void getTriangular_modular_double (
    const double p,
    const enum FFLAS::FFLAS_UPLO Uplo,
    const enum FFLAS::FFLAS_DIAG Diag,
    const size_t M,
    const size_t N,
    const size_t R,
    const double * A,
    const size_t lda,
    double * T,
    const size_t ldt,
    const bool OnlyNonZeroVectors,
    bool positive)
```

### 13.233.2.69 getTriangularin\_modular\_double()

```
void getTriangularin_modular_double (
    const double p,
    const enum FFLAS::FFLAS_UPLO Uplo,
    const enum FFLAS::FFLAS_DIAG Diag,
    const size_t M,
    const size_t N,
    const size_t R,
    double * A,
    const size_t lda,
    bool positive)
```

### 13.233.2.70 getEchelonForm\_modular\_double()

```
void getEchelonForm_modular_double (
    const double p,
    const enum FFLAS::FFLAS_UPLO Uplo,
    const enum FFLAS::FFLAS_DIAG Diag,
    const size_t M,
    const size_t N,
    const size_t R,
    const size_t * P,
    const double * A,
    const size_t lda,
    double * T,
    const size_t ldt,
    const bool OnlyNonZeroVectors,
    const enum FFPACK_C_LU_TAG LuTag,
    bool positive)
```

### 13.233.2.71 getEchelonFormin\_modular\_double()

```
void getEchelonFormin_modular_double (
    const double p,
    const enum FFLAS::FFLAS_UPLO Uplo,
    const enum FFLAS::FFLAS_DIAG Diag,
    const size_t M,
    const size_t N,
```



```

    const size_t R,
    const size_t * P,
    double * A,
    const size_t lda,
    const enum FFPACK_C_LU_TAG LuTag,
    bool positive)

```

#### 13.233.2.72 getEchelonTransform\_modular\_double()

```

void getEchelonTransform_modular_double (
    const double p,
    const enum FFLAS::FFLAS_UPLO Uplo,
    const enum FFLAS::FFLAS_DIAG Diag,
    const size_t M,
    const size_t N,
    const size_t R,
    const size_t * P,
    const size_t * Q,
    const double * A,
    const size_t lda,
    double * T,
    const size_t ldt,
    const enum FFPACK_C_LU_TAG LuTag,
    bool positive)

```

#### 13.233.2.73 getReducedEchelonForm\_modular\_double()

```

void getReducedEchelonForm_modular_double (
    const double p,
    const enum FFLAS::FFLAS_UPLO Uplo,
    const size_t M,
    const size_t N,
    const size_t R,
    const size_t * P,
    const double * A,
    const size_t lda,
    double * T,
    const size_t ldt,
    const bool OnlyNonZeroVectors,
    const enum FFPACK_C_LU_TAG LuTag,
    bool positive)

```

#### 13.233.2.74 getReducedEchelonFormin\_modular\_double()

```

void getReducedEchelonFormin_modular_double (
    const double p,
    const enum FFLAS::FFLAS_UPLO Uplo,
    const size_t M,
    const size_t N,
    const size_t R,
    const size_t * P,
    double * A,
    const size_t lda,
    const enum FFPACK_C_LU_TAG LuTag,
    bool positive)

```

#### 13.233.2.75 getReducedEchelonTransform\_modular\_double()

```

void getReducedEchelonTransform_modular_double (

```

```

const double p,
const enum FFLAS::FFLAS_UPLO Uplo,
const size_t M,
const size_t N,
const size_t R,
const size_t * P,
const size_t * Q,
const double * A,
const size_t lda,
double * T,
const size_t ldt,
const enum FFPACK_C_LU_TAG LuTag,
bool positive)

```

### 13.233.2.76 PLUQtoEchelonPermutation()

```

void PLUQtoEchelonPermutation (
    const size_t N,
    const size_t R,
    const size_t * P,
    size_t * outPerm)

```

## 13.234 ffpack\_c.h File Reference

```

#include <stdbool.h>
#include <stdlib.h>
#include <inttypes.h>

```

### Macros

- `#define FFPACK_COMPILED`

### Enumerations

- enum `FFLAS_C_ORDER` { `FflasRowMajor` =101 , `FflasColMajor` =102 }
- enum `FFLAS_C_TRANSPOSE` { `FflasNoTrans` = 111 , `FflasTrans` = 112 }
- enum `FFLAS_C_UPLO` { `FflasUpper` = 121 , `FflasLower` = 122 }
- enum `FFLAS_C_DIAG` { `FflasNonUnit` = 131 , `FflasUnit` = 132 }
- enum `FFLAS_C_SIDE` { `FflasLeft` = 141 , `FflasRight` = 142 }
- enum `FFPACK_C_LU_TAG` { `FfpackSlabRecursive` = 1 , `FfpackTileRecursive` = 2 , `FfpackSingular` = 3 }
- enum `FFPACK_C_CHARPOLY_TAG` {  
`FfpackLUK` =1 , `FfpackKG` =2 , `FfpackHybrid` =3 , `FfpackKGFast` =4 ,  
`FfpackDanilevski` =5 , `FfpackArithProg` =6 , `FfpackKGFastG` =7 }
- enum `FFPACK_C_MINPOLY_TAG` { `FfpackDense` =1 , `FfpackKGF` =2 }

### Functions

- void `LAPACKPerm2MathPerm` (size\_t \*MathP, const size\_t \*LapackP, const size\_t N)
- void `MathPerm2LAPACKPerm` (size\_t \*LapackP, const size\_t \*MathP, const size\_t N)
- void `MatrixApplyS_modular_double` (const double p, double \*A, const size\_t lda, const size\_t width, const size\_t M2, const size\_t R1, const size\_t R2, const size\_t R3, const size\_t R4, bool positive)
- void `PermApplyS_double` (double \*A, const size\_t lda, const size\_t width, const size\_t M2, const size\_t R1, const size\_t R2, const size\_t R3, const size\_t R4)
- void `MatrixApplyT_modular_double` (const double p, double \*A, const size\_t lda, const size\_t width, const size\_t N2, const size\_t R1, const size\_t R2, const size\_t R3, const size\_t R4, bool positive)
- void `PermApplyT_double` (double \*A, const size\_t lda, const size\_t width, const size\_t N2, const size\_t R1, const size\_t R2, const size\_t R3, const size\_t R4)

- void [composePermutationsLLM](#) (size\_t \*MathP, const size\_t \*P1, const size\_t \*P2, const size\_t R, const size\_t N)
- void [composePermutationsLLL](#) (size\_t \*P1, const size\_t \*P2, const size\_t R, const size\_t N)
- void [composePermutationsMLM](#) (size\_t \*MathP1, const size\_t \*P2, const size\_t R, const size\_t N)
- void [cyclic\\_shift\\_mathPerm](#) (size\_t \*P, const size\_t s)
- void [cyclic\\_shift\\_row\\_modular\\_double](#) (const double p, double \*A, size\_t m, size\_t n, size\_t lda, bool positive)
- void [cyclic\\_shift\\_col\\_modular\\_double](#) (const double p, double \*A, size\_t m, size\_t n, size\_t lda, bool positive)
- void [applyP\\_modular\\_double](#) (const double p, const enum [FFLAS\\_C\\_SIDE](#) Side, const enum [FFLAS\\_C\\_TRANSPOSE](#) Trans, const size\_t M, const size\_t ibeg, const size\_t iend, double \*A, const size\_t lda, const size\_t \*P, bool positive)
- void [fgetrsin\\_modular\\_double](#) (const double p, const enum [FFLAS\\_C\\_SIDE](#) Side, const size\_t M, const size\_t N, const size\_t R, double \*A, const size\_t lda, const size\_t \*P, const size\_t \*Q, double \*B, const size\_t ldb, int \*info, bool positive)
- double \* [fgetrs\\_modular\\_double](#) (const double p, const enum [FFLAS\\_C\\_SIDE](#) Side, const size\_t M, const size\_t N, const size\_t NRHS, const size\_t R, double \*A, const size\_t lda, const size\_t \*P, const size\_t \*Q, double \*X, const size\_t ldx, const double \*B, const size\_t ldb, int \*info, bool positive)
- size\_t [fgesvin\\_modular\\_double](#) (const double p, const enum [FFLAS\\_C\\_SIDE](#) Side, const size\_t M, const size\_t N, double \*A, const size\_t lda, double \*B, const size\_t ldb, int \*info, bool positive)
- size\_t [fgesv\\_modular\\_double](#) (const double p, const enum [FFLAS\\_C\\_SIDE](#) Side, const size\_t M, const size\_t N, const size\_t NRHS, double \*A, const size\_t lda, double \*X, const size\_t ldx, const double \*B, const size\_t ldb, int \*info)
- void [ftrtri\\_modular\\_double](#) (const double p, const enum [FFLAS\\_C\\_UPLO](#) Uplo, const enum [FFLAS\\_C\\_DIAG](#) Diag, const size\_t N, double \*A, const size\_t lda, bool positive)
- void [trinv\\_left\\_modular\\_double](#) (const double p, const size\_t N, const double \*L, const size\_t ldl, double \*X, const size\_t ldx, bool positive)
- void [ftrtrm\\_modular\\_double](#) (const double p, const enum [FFLAS\\_C\\_DIAG](#) diag, const size\_t N, double \*A, const size\_t lda, bool positive)
- size\_t [PLUQ\\_modular\\_double](#) (const double p, const enum [FFLAS\\_C\\_DIAG](#) Diag, const size\_t M, const size\_t N, double \*A, const size\_t lda, size\_t \*P, size\_t \*Q, bool positive)
- size\_t [LUdivine\\_modular\\_double](#) (const double p, const enum [FFLAS\\_C\\_DIAG](#) Diag, const enum [FFLAS\\_C\\_TRANSPOSE](#) trans, const size\_t M, const size\_t N, double \*A, const size\_t lda, size\_t \*P, size\_t \*Qt, const enum [FFPACK\\_C\\_LU\\_TAG](#) LuTag, const size\_t cutoff, bool positive)
- size\_t [LUdivine\\_small\\_modular\\_double](#) (const double p, const enum [FFLAS\\_C\\_DIAG](#) Diag, const enum [FFLAS\\_C\\_TRANSPOSE](#) trans, const size\_t M, const size\_t N, double \*A, const size\_t lda, size\_t \*P, size\_t \*Q, const enum [FFPACK\\_C\\_LU\\_TAG](#) LuTag, bool positive)
- size\_t [LUdivine\\_gauss\\_modular\\_double](#) (const double p, const enum [FFLAS\\_C\\_DIAG](#) Diag, const size\_t M, const size\_t N, double \*A, const size\_t lda, size\_t \*P, size\_t \*Q, const enum [FFPACK\\_C\\_LU\\_TAG](#) LuTag, bool positive)
- size\_t [ColumnEchelonForm\\_modular\\_double](#) (const double p, const size\_t M, const size\_t N, double \*A, const size\_t lda, size\_t \*P, size\_t \*Qt, bool transform, const enum [FFPACK\\_C\\_LU\\_TAG](#) LuTag, bool positive)
- size\_t [RowEchelonForm\\_modular\\_double](#) (const double p, const size\_t M, const size\_t N, double \*A, const size\_t lda, size\_t \*P, size\_t \*Qt, const bool transform, const enum [FFPACK\\_C\\_LU\\_TAG](#) LuTag, bool positive)
- size\_t [ColumnEchelonForm\\_modular\\_float](#) (const float p, const size\_t M, const size\_t N, float \*A, const size\_t lda, size\_t \*P, size\_t \*Qt, bool transform, const enum [FFPACK\\_C\\_LU\\_TAG](#) LuTag, bool positive)
- size\_t [RowEchelonForm\\_modular\\_float](#) (const float p, const size\_t M, const size\_t N, float \*A, const size\_t lda, size\_t \*P, size\_t \*Qt, const bool transform, const enum [FFPACK\\_C\\_LU\\_TAG](#) LuTag, bool positive)
- size\_t [ColumnEchelonForm\\_modular\\_int32\\_t](#) (const int32\_t p, const size\_t M, const size\_t N, int32\_t \*A, const size\_t lda, size\_t \*P, size\_t \*Qt, bool transform, const enum [FFPACK\\_C\\_LU\\_TAG](#) LuTag, bool positive)
- size\_t [RowEchelonForm\\_modular\\_int32\\_t](#) (const int32\_t p, const size\_t M, const size\_t N, int32\_t \*A, const size\_t lda, size\_t \*P, size\_t \*Qt, const bool transform, const enum [FFPACK\\_C\\_LU\\_TAG](#) LuTag, bool positive)
- size\_t [ReducedColumnEchelonForm\\_modular\\_double](#) (const double p, const size\_t M, const size\_t N, double \*A, const size\_t lda, size\_t \*P, size\_t \*Qt, const bool transform, const enum [FFPACK\\_C\\_LU\\_TAG](#) LuTag, bool positive)
- size\_t [ReducedRowEchelonForm\\_modular\\_double](#) (const double p, const size\_t M, const size\_t N, double \*A, const size\_t lda, size\_t \*P, size\_t \*Qt, const bool transform, const enum [FFPACK\\_C\\_LU\\_TAG](#) LuTag, bool positive)

- `size_t ReducedColumnEchelonForm_modular_float` (const float p, const size\_t M, const size\_t N, float \*A, const size\_t lda, size\_t \*P, size\_t \*Qt, const bool transform, const enum `FFPACK_C_LU_TAG` LuTag, bool positive)
- `size_t ReducedRowEchelonForm_modular_float` (const float p, const size\_t M, const size\_t N, float \*A, const size\_t lda, size\_t \*P, size\_t \*Qt, const bool transform, const enum `FFPACK_C_LU_TAG` LuTag, bool positive)
- `size_t ReducedColumnEchelonForm_modular_int32_t` (const int32\_t p, const size\_t M, const size\_t N, int32\_t \*A, const size\_t lda, size\_t \*P, size\_t \*Qt, const bool transform, const enum `FFPACK_C_LU_TAG` LuTag, bool positive)
- `size_t ReducedRowEchelonForm_modular_int32_t` (const int32\_t p, const size\_t M, const size\_t N, int32\_t \*A, const size\_t lda, size\_t \*P, size\_t \*Qt, const bool transform, const enum `FFPACK_C_LU_TAG` LuTag, bool positive)
- `size_t ReducedRowEchelonForm2_modular_double` (const double p, const size\_t M, const size\_t N, double \*A, const size\_t lda, size\_t \*P, size\_t \*Qt, const bool transform, bool positive)
- `size_t REF_modular_double` (const double p, const size\_t M, const size\_t N, double \*A, const size\_t lda, const size\_t colbeg, const size\_t rowbeg, const size\_t colsize, size\_t \*Qt, size\_t \*P, bool positive)
- `double * Invertin_modular_double` (const double p, const size\_t M, double \*A, const size\_t lda, int \*nullity, bool positive)
- `double * Invert_modular_double` (const double p, const size\_t M, const double \*A, const size\_t lda, double \*X, const size\_t ldx, int \*nullity, bool positive)
- `double * Invert2_modular_double` (const double p, const size\_t M, double \*A, const size\_t lda, double \*X, const size\_t ldx, int \*nullity, bool positive)
- `size_t KrylovElim_modular_double` (const double p, const size\_t M, const size\_t N, double \*A, const size\_t lda, size\_t \*P, size\_t \*Q, const size\_t deg, size\_t \*iterates, size\_t \*inviterates, const size\_t maxit, size\_t virt, bool positive)
- `size_t SpecRankProfile_modular_double` (const double p, const size\_t M, const size\_t N, double \*A, const size\_t lda, const size\_t deg, size\_t \*rankProfile, bool positive)
- `size_t Rank_modular_double` (const double p, const size\_t M, const size\_t N, double \*A, const size\_t lda, bool positive)
- `bool IsSingular_modular_double` (const double p, const size\_t M, const size\_t N, double \*A, const size\_t lda, bool positive)
- `double Det_modular_double` (const double p, const size\_t N, double \*A, const size\_t lda, bool positive)
- `double * Solve_modular_double` (const double p, const size\_t M, double \*A, const size\_t lda, double \*x, const int incx, const double \*b, const int incb, bool positive)
- `void solveLB_modular_double` (const double p, const enum `FFLAS_C_SIDE` Side, const size\_t M, const size\_t N, const size\_t R, double \*L, const size\_t ldl, const size\_t \*Q, double \*B, const size\_t ldb)
- `void solveLB2_modular_double` (const double p, const enum `FFLAS_C_SIDE` Side, const size\_t M, const size\_t N, const size\_t R, double \*L, const size\_t ldl, const size\_t \*Q, double \*B, const size\_t ldb, bool positive)
- `void RandomNullSpaceVector_modular_double` (const double p, const enum `FFLAS_C_SIDE` Side, const size\_t M, const size\_t N, double \*A, const size\_t lda, double \*X, const size\_t incX, bool positive)
- `size_t NullSpaceBasis_modular_double` (const double p, const enum `FFLAS_C_SIDE` Side, const size\_t M, const size\_t N, double \*A, const size\_t lda, double \*\*NS, size\_t \*ldn, size\_t \*NSdim, bool positive)
- `size_t RowRankProfile_modular_double` (const double p, const size\_t M, const size\_t N, double \*A, const size\_t lda, size\_t \*\*rkprofile, const enum `FFPACK_C_LU_TAG` LuTag, bool positive)
- `size_t ColumnRankProfile_modular_double` (const double p, const size\_t M, const size\_t N, double \*A, const size\_t lda, size\_t \*\*rkprofile, const enum `FFPACK_C_LU_TAG` LuTag, bool positive)
- `void RankProfileFromLU` (const size\_t \*P, const size\_t N, const size\_t R, size\_t \*rkprofile, const enum `FFPACK_C_LU_TAG` LuTag)
- `size_t LeadingSubmatrixRankProfiles` (const size\_t M, const size\_t N, const size\_t R, const size\_t LSm, const size\_t LSn, const size\_t \*P, const size\_t \*Q, size\_t \*RRP, size\_t \*CRP)
- `size_t RowRankProfileSubmatrixIndices_modular_double` (const double p, const size\_t M, const size\_t N, double \*A, const size\_t lda, size\_t \*\*rowindices, size\_t \*\*colindices, size\_t \*R, bool positive)
- `size_t ColRankProfileSubmatrixIndices_modular_double` (const double p, const size\_t M, const size\_t N, double \*A, const size\_t lda, size\_t \*\*rowindices, size\_t \*\*colindices, size\_t \*R, bool positive)
- `size_t RowRankProfileSubmatrix_modular_double` (const double p, const size\_t M, const size\_t N, double \*A, const size\_t lda, double \*\*X, size\_t \*R, bool positive)
- `size_t ColRankProfileSubmatrix_modular_double` (const double p, const size\_t M, const size\_t N, double \*A, const size\_t lda, double \*\*X, size\_t \*R, bool positive)

- void [getTriangular\\_modular\\_double](#) (const double p, const enum [FFLAS\\_C\\_UPLO](#) Uplo, const enum [FFLAS\\_C\\_DIAG](#) diag, const size\_t M, const size\_t N, const size\_t R, const double \*A, const size\_t lda, double \*T, const size\_t ldt, const bool OnlyNonZeroVectors, bool positive)
- void [getTriangularin\\_modular\\_double](#) (const double p, const enum [FFLAS\\_C\\_UPLO](#) Uplo, const enum [FFLAS\\_C\\_DIAG](#) diag, const size\_t M, const size\_t N, const size\_t R, double \*A, const size\_t lda, bool positive)
- void [getEchelonForm\\_modular\\_double](#) (const double p, const enum [FFLAS\\_C\\_UPLO](#) Uplo, const enum [FFLAS\\_C\\_DIAG](#) diag, const size\_t M, const size\_t N, const size\_t R, const size\_t \*P, const double \*A, const size\_t lda, double \*T, const size\_t ldt, const bool OnlyNonZeroVectors, const enum [FFPACK\\_C\\_LU\\_TAG](#) LuTag, bool positive)
- void [getEchelonFormin\\_modular\\_double](#) (const double p, const enum [FFLAS\\_C\\_UPLO](#) Uplo, const enum [FFLAS\\_C\\_DIAG](#) diag, const size\_t M, const size\_t N, const size\_t R, const size\_t \*P, double \*A, const size\_t lda, const enum [FFPACK\\_C\\_LU\\_TAG](#) LuTag, bool positive)
- void [getEchelonTransform\\_modular\\_double](#) (const double p, const enum [FFLAS\\_C\\_UPLO](#) Uplo, const enum [FFLAS\\_C\\_DIAG](#) diag, const size\_t M, const size\_t N, const size\_t R, const size\_t \*P, const size\_t \*Q, const double \*A, const size\_t lda, double \*T, const size\_t ldt, const enum [FFPACK\\_C\\_LU\\_TAG](#) LuTag, bool positive)
- void [getReducedEchelonForm\\_modular\\_double](#) (const double p, const enum [FFLAS\\_C\\_UPLO](#) Uplo, const size\_t M, const size\_t N, const size\_t R, const size\_t \*P, const double \*A, const size\_t lda, double \*T, const size\_t ldt, const bool OnlyNonZeroVectors, const enum [FFPACK\\_C\\_LU\\_TAG](#) LuTag, bool positive)
- void [getReducedEchelonFormin\\_modular\\_double](#) (const double p, const enum [FFLAS\\_C\\_UPLO](#) Uplo, const size\_t M, const size\_t N, const size\_t R, const size\_t \*P, double \*A, const size\_t lda, const enum [FFPACK\\_C\\_LU\\_TAG](#) LuTag, bool positive)
- void [getReducedEchelonTransform\\_modular\\_double](#) (const double p, const enum [FFLAS\\_C\\_UPLO](#) Uplo, const size\_t M, const size\_t N, const size\_t R, const size\_t \*P, const size\_t \*Q, const double \*A, const size\_t lda, double \*T, const size\_t ldt, const enum [FFPACK\\_C\\_LU\\_TAG](#) LuTag, bool positive)
- void [PLUQtoEchelonPermutation](#) (const size\_t N, const size\_t R, const size\_t \*P, size\_t \*outPerm)

## 13.234.1 Macro Definition Documentation

### 13.234.1.1 FFPACK\_COMPILED

```
#define FFPACK_COMPILED
```

## 13.234.2 Enumeration Type Documentation

### 13.234.2.1 FFLAS\_C\_ORDER

```
enum FFLAS\_C\_ORDER
```

Enumerator

|                               |  |
|-------------------------------|--|
| <a href="#">FflasRowMajor</a> |  |
| <a href="#">FflasColMajor</a> |  |

### 13.234.2.2 FFLAS\_C\_TRANSPOSE

```
enum FFLAS\_C\_TRANSPOSE
```

Enumerator

|                              |  |
|------------------------------|--|
| <a href="#">FflasNoTrans</a> |  |
| <a href="#">FflasTrans</a>   |  |

### 13.234.2.3 FFLAS\_C\_UPLO

```
enum FFLAS\_C\_UPLO
```

**Enumerator**

|            |  |
|------------|--|
| FflasUpper |  |
| FflasLower |  |

**13.234.2.4 FFLAS\_C\_DIAG**

enum [FFLAS\\_C\\_DIAG](#)

**Enumerator**

|              |  |
|--------------|--|
| FflasNonUnit |  |
| FflasUnit    |  |

**13.234.2.5 FFLAS\_C\_SIDE**

enum [FFLAS\\_C\\_SIDE](#)

**Enumerator**

|            |  |
|------------|--|
| FflasLeft  |  |
| FflasRight |  |

**13.234.2.6 FFPACK\_C\_LU\_TAG**

enum [FFPACK\\_C\\_LU\\_TAG](#)

**Enumerator**

|                     |  |
|---------------------|--|
| FfpackSlabRecursive |  |
| FfpackTileRecursive |  |
| FfpackSingular      |  |

**13.234.2.7 FFPACK\_C\_CHARPOLY\_TAG**

enum [FFPACK\\_C\\_CHARPOLY\\_TAG](#)

**Enumerator**

|                  |  |
|------------------|--|
| FfpackLUK        |  |
| FfpackKG         |  |
| FfpackHybrid     |  |
| FfpackKGFast     |  |
| FfpackDanilevski |  |
| FfpackArithProg  |  |
| FfpackKGFastG    |  |

**13.234.2.8 FFPACK\_C\_MINPOLY\_TAG**

enum [FFPACK\\_C\\_MINPOLY\\_TAG](#)

## Enumerator

|             |  |
|-------------|--|
| FfpackDense |  |
| FfpackKGF   |  |

### 13.234.3 Function Documentation

#### 13.234.3.1 LAPACKPerm2MathPerm()

```
void LAPACKPerm2MathPerm (
    size_t * MathP,
    const size_t * LapackP,
    const size_t N)
```

#### 13.234.3.2 MathPerm2LAPACKPerm()

```
void MathPerm2LAPACKPerm (
    size_t * LapackP,
    const size_t * MathP,
    const size_t N)
```

#### 13.234.3.3 MatrixApplyS\_modular\_double()

```
void MatrixApplyS_modular_double (
    const double p,
    double * A,
    const size_t lda,
    const size_t width,
    const size_t M2,
    const size_t R1,
    const size_t R2,
    const size_t R3,
    const size_t R4,
    bool positive)
```

#### 13.234.3.4 PermApplyS\_double()

```
void PermApplyS_double (
    double * A,
    const size_t lda,
    const size_t width,
    const size_t M2,
    const size_t R1,
    const size_t R2,
    const size_t R3,
    const size_t R4)
```

#### 13.234.3.5 MatrixApplyT\_modular\_double()

```
void MatrixApplyT_modular_double (
    const double p,
    double * A,
    const size_t lda,
    const size_t width,
    const size_t N2,
    const size_t R1,
    const size_t R2,
    const size_t R3,
```

```
    const size_t R4,
    bool positive)
```

#### 13.234.3.6 PermApplyT\_double()

```
void PermApplyT_double (
    double * A,
    const size_t lda,
    const size_t width,
    const size_t N2,
    const size_t R1,
    const size_t R2,
    const size_t R3,
    const size_t R4)
```

#### 13.234.3.7 composePermutationsLLM()

```
void composePermutationsLLM (
    size_t * MathP,
    const size_t * P1,
    const size_t * P2,
    const size_t R,
    const size_t N)
```

#### 13.234.3.8 composePermutationsLLL()

```
void composePermutationsLLL (
    size_t * P1,
    const size_t * P2,
    const size_t R,
    const size_t N)
```

#### 13.234.3.9 composePermutationsMLM()

```
void composePermutationsMLM (
    size_t * MathP1,
    const size_t * P2,
    const size_t R,
    const size_t N)
```

#### 13.234.3.10 cyclic\_shift\_mathPerm()

```
void cyclic_shift_mathPerm (
    size_t * P,
    const size_t s)
```

#### 13.234.3.11 cyclic\_shift\_row\_modular\_double()

```
void cyclic_shift_row_modular_double (
    const double p,
    double * A,
    size_t m,
    size_t n,
    size_t lda,
    bool positive)
```

#### 13.234.3.12 cyclic\_shift\_col\_modular\_double()

```
void cyclic_shift_col_modular_double (
    const double p,
```



```
double * A,  
size_t m,  
size_t n,  
size_t lda,  
bool positive)
```

#### 13.234.3.13 applyP\_modular\_double()

```
void applyP_modular_double (  
    const double p,  
    const enum FFLAS_C_SIDE Side,  
    const enum FFLAS_C_TRANSPOSE Trans,  
    const size_t M,  
    const size_t ibeg,  
    const size_t iend,  
    double * A,  
    const size_t lda,  
    const size_t * P,  
    bool positive)
```

#### 13.234.3.14 fgetrsin\_modular\_double()

```
void fgetrsin_modular_double (  
    const double p,  
    const enum FFLAS_C_SIDE Side,  
    const size_t M,  
    const size_t N,  
    const size_t R,  
    double * A,  
    const size_t lda,  
    const size_t * P,  
    const size_t * Q,  
    double * B,  
    const size_t ldb,  
    int * info,  
    bool positive)
```

#### 13.234.3.15 fgetrs\_modular\_double()

```
double * fgetrs_modular_double (  
    const double p,  
    const enum FFLAS_C_SIDE Side,  
    const size_t M,  
    const size_t N,  
    const size_t NRHS,  
    const size_t R,  
    double * A,  
    const size_t lda,  
    const size_t * P,  
    const size_t * Q,  
    double * X,  
    const size_t ldx,  
    const double * B,  
    const size_t ldb,  
    int * info,  
    bool positive)
```

**13.234.3.16 fgesvin\_modular\_double()**

```
size_t fgesvin_modular_double (
    const double p,
    const enum FFLAS_C_SIDE Side,
    const size_t M,
    const size_t N,
    double * A,
    const size_t lda,
    double * B,
    const size_t ldb,
    int * info,
    bool positive)
```

**13.234.3.17 fgesv\_modular\_double()**

```
size_t fgesv_modular_double (
    const double p,
    const enum FFLAS_C_SIDE Side,
    const size_t M,
    const size_t N,
    const size_t NRHS,
    double * A,
    const size_t lda,
    double * X,
    const size_t ldx,
    const double * B,
    const size_t ldb,
    int * info)
```

**13.234.3.18 ftrtri\_modular\_double()**

```
void ftrtri_modular_double (
    const double p,
    const enum FFLAS_C_UPLO Uplo,
    const enum FFLAS_C_DIAG Diag,
    const size_t N,
    double * A,
    const size_t lda,
    bool positive)
```

**13.234.3.19 trinv\_left\_modular\_double()**

```
void trinv_left_modular_double (
    const double p,
    const size_t N,
    const double * L,
    const size_t ldl,
    double * X,
    const size_t ldx,
    bool positive)
```

**13.234.3.20 ftrtrm\_modular\_double()**

```
void ftrtrm_modular_double (
    const double p,
    const enum FFLAS_C_DIAG diag,
    const size_t N,
    double * A,
```

```
    const size_t lda,  
    bool positive)
```

#### 13.234.3.21 PLUQ\_modular\_double()

```
size_t PLUQ_modular_double (  
    const double p,  
    const enum FFLAS_C_DIAG Diag,  
    const size_t M,  
    const size_t N,  
    double * A,  
    const size_t lda,  
    size_t * P,  
    size_t * Q,  
    bool positive)
```

#### 13.234.3.22 LUdivine\_modular\_double()

```
size_t LUdivine_modular_double (  
    const double p,  
    const enum FFLAS_C_DIAG Diag,  
    const enum FFLAS_C_TRANSPOSE trans,  
    const size_t M,  
    const size_t N,  
    double * A,  
    const size_t lda,  
    size_t * P,  
    size_t * Qt,  
    const enum FFPACK_C_LU_TAG LuTag,  
    const size_t cutoff,  
    bool positive)
```

#### 13.234.3.23 LUdivine\_small\_modular\_double()

```
size_t LUdivine_small_modular_double (  
    const double p,  
    const enum FFLAS_C_DIAG Diag,  
    const enum FFLAS_C_TRANSPOSE trans,  
    const size_t M,  
    const size_t N,  
    double * A,  
    const size_t lda,  
    size_t * P,  
    size_t * Q,  
    const enum FFPACK_C_LU_TAG LuTag,  
    bool positive)
```

#### 13.234.3.24 LUdivine\_gauss\_modular\_double()

```
size_t LUdivine_gauss_modular_double (  
    const double p,  
    const enum FFLAS_C_DIAG Diag,  
    const size_t M,  
    const size_t N,  
    double * A,  
    const size_t lda,  
    size_t * P,  
    size_t * Q,
```

```
const enum FFPACK_C_LU_TAG LuTag,
bool positive)
```

#### 13.234.3.25 ColumnEchelonForm\_modular\_double()

```
size_t ColumnEchelonForm_modular_double (
    const double p,
    const size_t M,
    const size_t N,
    double * A,
    const size_t lda,
    size_t * P,
    size_t * Qt,
    bool transform,
    const enum FFPACK_C_LU_TAG LuTag,
    bool positive)
```

#### 13.234.3.26 RowEchelonForm\_modular\_double()

```
size_t RowEchelonForm_modular_double (
    const double p,
    const size_t M,
    const size_t N,
    double * A,
    const size_t lda,
    size_t * P,
    size_t * Qt,
    const bool transform,
    const enum FFPACK_C_LU_TAG LuTag,
    bool positive)
```

#### 13.234.3.27 ColumnEchelonForm\_modular\_float()

```
size_t ColumnEchelonForm_modular_float (
    const float p,
    const size_t M,
    const size_t N,
    float * A,
    const size_t lda,
    size_t * P,
    size_t * Qt,
    bool transform,
    const enum FFPACK_C_LU_TAG LuTag,
    bool positive)
```

#### 13.234.3.28 RowEchelonForm\_modular\_float()

```
size_t RowEchelonForm_modular_float (
    const float p,
    const size_t M,
    const size_t N,
    float * A,
    const size_t lda,
    size_t * P,
    size_t * Qt,
    const bool transform,
    const enum FFPACK_C_LU_TAG LuTag,
    bool positive)
```

**13.234.3.29 ColumnEchelonForm\_modular\_int32\_t()**

```
size_t ColumnEchelonForm_modular_int32_t (
    const int32_t p,
    const size_t M,
    const size_t N,
    int32_t * A,
    const size_t lda,
    size_t * P,
    size_t * Qt,
    bool transform,
    const enum FFPACK_C_LU_TAG LuTag,
    bool positive)
```

**13.234.3.30 RowEchelonForm\_modular\_int32\_t()**

```
size_t RowEchelonForm_modular_int32_t (
    const int32_t p,
    const size_t M,
    const size_t N,
    int32_t * A,
    const size_t lda,
    size_t * P,
    size_t * Qt,
    const bool transform,
    const enum FFPACK_C_LU_TAG LuTag,
    bool positive)
```

**13.234.3.31 ReducedColumnEchelonForm\_modular\_double()**

```
size_t ReducedColumnEchelonForm_modular_double (
    const double p,
    const size_t M,
    const size_t N,
    double * A,
    const size_t lda,
    size_t * P,
    size_t * Qt,
    const bool transform,
    const enum FFPACK_C_LU_TAG LuTag,
    bool positive)
```

**13.234.3.32 ReducedRowEchelonForm\_modular\_double()**

```
size_t ReducedRowEchelonForm_modular_double (
    const double p,
    const size_t M,
    const size_t N,
    double * A,
    const size_t lda,
    size_t * P,
    size_t * Qt,
    const bool transform,
    const enum FFPACK_C_LU_TAG LuTag,
    bool positive)
```

**13.234.3.33 ReducedColumnEchelonForm\_modular\_float()**

```
size_t ReducedColumnEchelonForm_modular_float (
    const float p,
```

```

    const size_t M,
    const size_t N,
    float * A,
    const size_t lda,
    size_t * P,
    size_t * Qt,
    const bool transform,
    const enum FFPACK_C_LU_TAG LuTag,
    bool positive)

```

#### 13.234.3.34 ReducedRowEchelonForm\_modular\_float()

```

size_t ReducedRowEchelonForm_modular_float (
    const float p,
    const size_t M,
    const size_t N,
    float * A,
    const size_t lda,
    size_t * P,
    size_t * Qt,
    const bool transform,
    const enum FFPACK_C_LU_TAG LuTag,
    bool positive)

```

#### 13.234.3.35 ReducedColumnEchelonForm\_modular\_int32\_t()

```

size_t ReducedColumnEchelonForm_modular_int32_t (
    const int32_t p,
    const size_t M,
    const size_t N,
    int32_t * A,
    const size_t lda,
    size_t * P,
    size_t * Qt,
    const bool transform,
    const enum FFPACK_C_LU_TAG LuTag,
    bool positive)

```

#### 13.234.3.36 ReducedRowEchelonForm\_modular\_int32\_t()

```

size_t ReducedRowEchelonForm_modular_int32_t (
    const int32_t p,
    const size_t M,
    const size_t N,
    int32_t * A,
    const size_t lda,
    size_t * P,
    size_t * Qt,
    const bool transform,
    const enum FFPACK_C_LU_TAG LuTag,
    bool positive)

```

#### 13.234.3.37 ReducedRowEchelonForm2\_modular\_double()

```

size_t ReducedRowEchelonForm2_modular_double (
    const double p,
    const size_t M,
    const size_t N,
    double * A,

```

```
    const size_t lda,  
    size_t * P,  
    size_t * Qt,  
    const bool transform,  
    bool positive)
```

#### 13.234.3.38 REF\_modular\_double()

```
size_t REF_modular_double (  
    const double p,  
    const size_t M,  
    const size_t N,  
    double * A,  
    const size_t lda,  
    const size_t colbeg,  
    const size_t rowbeg,  
    const size_t colsize,  
    size_t * Qt,  
    size_t * P,  
    bool positive)
```

#### 13.234.3.39 Invertin\_modular\_double()

```
double * Invertin_modular_double (  
    const double p,  
    const size_t M,  
    double * A,  
    const size_t lda,  
    int * nullity,  
    bool positive)
```

#### 13.234.3.40 Invert\_modular\_double()

```
double * Invert_modular_double (  
    const double p,  
    const size_t M,  
    const double * A,  
    const size_t lda,  
    double * X,  
    const size_t ldx,  
    int * nullity,  
    bool positive)
```

#### 13.234.3.41 Invert2\_modular\_double()

```
double * Invert2_modular_double (  
    const double p,  
    const size_t M,  
    double * A,  
    const size_t lda,  
    double * X,  
    const size_t ldx,  
    int * nullity,  
    bool positive)
```

#### 13.234.3.42 KrylovElim\_modular\_double()

```
size_t KrylovElim_modular_double (  
    const double p,
```

```

    const size_t M,
    const size_t N,
    double * A,
    const size_t lda,
    size_t * P,
    size_t * Q,
    const size_t deg,
    size_t * iterates,
    size_t * inviterates,
    const size_t maxit,
    size_t virt,
    bool positive)

```

#### 13.234.3.43 SpecRankProfile\_modular\_double()

```

size_t SpecRankProfile_modular_double (
    const double p,
    const size_t M,
    const size_t N,
    double * A,
    const size_t lda,
    const size_t deg,
    size_t * rankProfile,
    bool positive)

```

#### 13.234.3.44 Rank\_modular\_double()

```

size_t Rank_modular_double (
    const double p,
    const size_t M,
    const size_t N,
    double * A,
    const size_t lda,
    bool positive)

```

#### 13.234.3.45 IsSingular\_modular\_double()

```

bool IsSingular_modular_double (
    const double p,
    const size_t M,
    const size_t N,
    double * A,
    const size_t lda,
    bool positive)

```

#### 13.234.3.46 Det\_modular\_double()

```

double Det_modular_double (
    const double p,
    const size_t N,
    double * A,
    const size_t lda,
    bool positive)

```

#### 13.234.3.47 Solve\_modular\_double()

```

double * Solve_modular_double (
    const double p,
    const size_t M,

```



```
double * A,  
const size_t lda,  
double * x,  
const int incx,  
const double * b,  
const int incb,  
bool positive)
```

#### 13.234.3.48 solveLB\_modular\_double()

```
void solveLB_modular_double (  
    const double p,  
    const enum FFLAS_C_SIDE Side,  
    const size_t M,  
    const size_t N,  
    const size_t R,  
    double * L,  
    const size_t ldl,  
    const size_t * Q,  
    double * B,  
    const size_t ldb)
```

#### 13.234.3.49 solveLB2\_modular\_double()

```
void solveLB2_modular_double (  
    const double p,  
    const enum FFLAS_C_SIDE Side,  
    const size_t M,  
    const size_t N,  
    const size_t R,  
    double * L,  
    const size_t ldl,  
    const size_t * Q,  
    double * B,  
    const size_t ldb,  
    bool positive)
```

#### 13.234.3.50 RandomNullSpaceVector\_modular\_double()

```
void RandomNullSpaceVector_modular_double (  
    const double p,  
    const enum FFLAS_C_SIDE Side,  
    const size_t M,  
    const size_t N,  
    double * A,  
    const size_t lda,  
    double * X,  
    const size_t incX,  
    bool positive)
```

#### 13.234.3.51 NullSpaceBasis\_modular\_double()

```
size_t NullSpaceBasis_modular_double (  
    const double p,  
    const enum FFLAS_C_SIDE Side,  
    const size_t M,  
    const size_t N,  
    double * A,  
    const size_t lda,
```

```
double ** NS,
size_t * ldn,
size_t * NSdim,
bool positive)
```

#### 13.234.3.52 RowRankProfile\_modular\_double()

```
size_t RowRankProfile_modular_double (
    const double p,
    const size_t M,
    const size_t N,
    double * A,
    const size_t lda,
    size_t ** rkprofile,
    const enum FFPACK_C_LU_TAG LuTag,
    bool positive)
```

#### 13.234.3.53 ColumnRankProfile\_modular\_double()

```
size_t ColumnRankProfile_modular_double (
    const double p,
    const size_t M,
    const size_t N,
    double * A,
    const size_t lda,
    size_t ** rkprofile,
    const enum FFPACK_C_LU_TAG LuTag,
    bool positive)
```

#### 13.234.3.54 RankProfileFromLU()

```
void RankProfileFromLU (
    const size_t * P,
    const size_t N,
    const size_t R,
    size_t * rkprofile,
    const enum FFPACK_C_LU_TAG LuTag)
```

#### 13.234.3.55 LeadingSubmatrixRankProfiles()

```
size_t LeadingSubmatrixRankProfiles (
    const size_t M,
    const size_t N,
    const size_t R,
    const size_t LSm,
    const size_t LSn,
    const size_t * P,
    const size_t * Q,
    size_t * RRP,
    size_t * CRP)
```

#### 13.234.3.56 RowRankProfileSubmatrixIndices\_modular\_double()

```
size_t RowRankProfileSubmatrixIndices_modular_double (
    const double p,
    const size_t M,
    const size_t N,
    double * A,
    const size_t lda,
```

```

    size_t ** rowindices,
    size_t ** colindices,
    size_t * R,
    bool positive)

```

#### 13.234.3.57 ColRankProfileSubmatrixIndices\_modular\_double()

```

size_t ColRankProfileSubmatrixIndices_modular_double (
    const double p,
    const size_t M,
    const size_t N,
    double * A,
    const size_t lda,
    size_t ** rowindices,
    size_t ** colindices,
    size_t * R,
    bool positive)

```

#### 13.234.3.58 RowRankProfileSubmatrix\_modular\_double()

```

size_t RowRankProfileSubmatrix_modular_double (
    const double p,
    const size_t M,
    const size_t N,
    double * A,
    const size_t lda,
    double ** X,
    size_t * R,
    bool positive)

```

#### 13.234.3.59 ColRankProfileSubmatrix\_modular\_double()

```

size_t ColRankProfileSubmatrix_modular_double (
    const double p,
    const size_t M,
    const size_t N,
    double * A,
    const size_t lda,
    double ** X,
    size_t * R,
    bool positive)

```

#### 13.234.3.60 getTriangular\_modular\_double()

```

void getTriangular_modular_double (
    const double p,
    const enum FFLAS_C_UPLO Uplo,
    const enum FFLAS_C_DIAG diag,
    const size_t M,
    const size_t N,
    const size_t R,
    const double * A,
    const size_t lda,
    double * T,
    const size_t ldt,
    const bool OnlyNonZeroVectors,
    bool positive)

```

**13.234.3.61 getTriangularin\_modular\_double()**

```
void getTriangularin_modular_double (
    const double p,
    const enum FFLAS_C_UPLO Uplo,
    const enum FFLAS_C_DIAG diag,
    const size_t M,
    const size_t N,
    const size_t R,
    double * A,
    const size_t lda,
    bool positive)
```

**13.234.3.62 getEchelonForm\_modular\_double()**

```
void getEchelonForm_modular_double (
    const double p,
    const enum FFLAS_C_UPLO Uplo,
    const enum FFLAS_C_DIAG diag,
    const size_t M,
    const size_t N,
    const size_t R,
    const size_t * P,
    const double * A,
    const size_t lda,
    double * T,
    const size_t ldt,
    const bool OnlyNonZeroVectors,
    const enum FFPACK_C_LU_TAG LuTag,
    bool positive)
```

**13.234.3.63 getEchelonFormin\_modular\_double()**

```
void getEchelonFormin_modular_double (
    const double p,
    const enum FFLAS_C_UPLO Uplo,
    const enum FFLAS_C_DIAG diag,
    const size_t M,
    const size_t N,
    const size_t R,
    const size_t * P,
    double * A,
    const size_t lda,
    const enum FFPACK_C_LU_TAG LuTag,
    bool positive)
```

**13.234.3.64 getEchelonTransform\_modular\_double()**

```
void getEchelonTransform_modular_double (
    const double p,
    const enum FFLAS_C_UPLO Uplo,
    const enum FFLAS_C_DIAG diag,
    const size_t M,
    const size_t N,
    const size_t R,
    const size_t * P,
    const size_t * Q,
    const double * A,
    const size_t lda,
```

```
double * T,
const size_t ldt,
const enum FFPACK_C_LU_TAG LuTag,
bool positive)
```

#### 13.234.3.65 getReducedEchelonForm\_modular\_double()

```
void getReducedEchelonForm_modular_double (
    const double p,
    const enum FFLAS_C_UPLO Uplo,
    const size_t M,
    const size_t N,
    const size_t R,
    const size_t * P,
    const double * A,
    const size_t lda,
    double * T,
    const size_t ldt,
    const bool OnlyNonZeroVectors,
    const enum FFPACK_C_LU_TAG LuTag,
    bool positive)
```

#### 13.234.3.66 getReducedEchelonFormin\_modular\_double()

```
void getReducedEchelonFormin_modular_double (
    const double p,
    const enum FFLAS_C_UPLO Uplo,
    const size_t M,
    const size_t N,
    const size_t R,
    const size_t * P,
    double * A,
    const size_t lda,
    const enum FFPACK_C_LU_TAG LuTag,
    bool positive)
```

#### 13.234.3.67 getReducedEchelonTransform\_modular\_double()

```
void getReducedEchelonTransform_modular_double (
    const double p,
    const enum FFLAS_C_UPLO Uplo,
    const size_t M,
    const size_t N,
    const size_t R,
    const size_t * P,
    const size_t * Q,
    const double * A,
    const size_t lda,
    double * T,
    const size_t ldt,
    const enum FFPACK_C_LU_TAG LuTag,
    bool positive)
```

#### 13.234.3.68 PLUQtoEchelonPermutation()

```
void PLUQtoEchelonPermutation (
    const size_t N,
    const size_t R,
```

```
const size_t * P,
size_t * outPerm)
```

## 13.235 ffpack\_inst.C File Reference

```
#include "fflas-ffpack/fflas-ffpack-config.h"
#include "givaro/modular.h"
#include "givaro/modular-balanced.h"
#include "fflas-ffpack/ffpack/ffpack.h"
#include "ffpack_inst_implem.inl"
```

### Macros

- `#define __FFPACK_INST_C`
- `#define FFLAS_COMPILED`
- `#define INST_OR_DECL`
- `#define FFLAS_FIELD Givaro::ModularBalanced`
- `#define FFLAS_ELT double`
- `#define FFLAS_ELT float`
- `#define FFLAS_ELT int64_t`
- `#define FFLAS_FIELD Givaro::Modular`
- `#define FFLAS_ELT double`
- `#define FFLAS_ELT float`
- `#define FFLAS_ELT int64_t`

### 13.235.1 Macro Definition Documentation

#### 13.235.1.1 \_\_FFPACK\_INST\_C

```
#define __FFPACK_INST_C
```

#### 13.235.1.2 FFLAS\_COMPILED

```
#define FFLAS_COMPILED
```

#### 13.235.1.3 INST\_OR\_DECL

```
#define INST_OR_DECL
```

#### 13.235.1.4 FFLAS\_FIELD [1/2]

```
#define FFLAS_FIELD Givaro::ModularBalanced
```

#### 13.235.1.5 FFLAS\_ELT [1/6]

```
#define FFLAS_ELT double
```

#### 13.235.1.6 FFLAS\_ELT [2/6]

```
#define FFLAS_ELT float
```

#### 13.235.1.7 FFLAS\_ELT [3/6]

```
#define FFLAS_ELT int64_t
```

#### 13.235.1.8 FFLAS\_FIELD [2/2]

```
#define FFLAS_FIELD Givaro::Modular
```

**13.235.1.9 FFLAS\_ELT [4/6]**

```
#define FFLAS_ELT double
```

**13.235.1.10 FFLAS\_ELT [5/6]**

```
#define FFLAS_ELT float
```

**13.235.1.11 FFLAS\_ELT [6/6]**

```
#define FFLAS_ELT int64_t
```

## 13.236 ffpack\_inst.h File Reference

```
#include "givaro/modular.h"  
#include "givaro/modular-balanced.h"  
#include "fflas-ffpack/ffpack/ffpack.h"  
#include "ffpack_inst_implem.inl"
```

### Macros

- `#define FFLAS_COMPILED`
- `#define INST_OR_DECL <>`
- `#define FFLAS_FIELD Givaro::ModularBalanced`
- `#define FFLAS_ELT double`
- `#define FFLAS_ELT float`
- `#define FFLAS_ELT int64_t`
- `#define FFLAS_FIELD Givaro::Modular`
- `#define FFLAS_ELT double`
- `#define FFLAS_ELT float`
- `#define FFLAS_ELT int64_t`

### 13.236.1 Macro Definition Documentation

**13.236.1.1 FFLAS\_COMPILED**

```
#define FFLAS_COMPILED
```

**13.236.1.2 INST\_OR\_DECL**

```
#define INST_OR_DECL <>
```

**13.236.1.3 FFLAS\_FIELD [1/2]**

```
#define FFLAS_FIELD Givaro::ModularBalanced
```

**13.236.1.4 FFLAS\_ELT [1/6]**

```
#define FFLAS_ELT double
```

**13.236.1.5 FFLAS\_ELT [2/6]**

```
#define FFLAS_ELT float
```

**13.236.1.6 FFLAS\_ELT [3/6]**

```
#define FFLAS_ELT int64_t
```

**13.236.1.7 FFLAS\_FIELD [2/2]**

```
#define FFLAS_FIELD Givaro::Modular
```

**13.236.1.8 FFLAS\_ELT [4/6]**

```
#define FFLAS_ELT double
```

**13.236.1.9 FFLAS\_ELT [5/6]**

```
#define FFLAS_ELT float
```

**13.236.1.10 FFLAS\_ELT [6/6]**

```
#define FFLAS_ELT int64_t
```

**13.237 ffpack\_inst\_implem.inl File Reference****Namespaces**

- namespace [FFPACK](#)  
*Finite Field **PACK** Set of elimination based routines for dense linear algebra.*

**Functions**

- void [composePermutationsLLM](#) (size\_t \*MathP, const size\_t \*P1, const size\_t \*P2, const size\_t R, const size\_t N)  
*Computes  $P1 \times \text{Diag}(I_R, P2)$  where  $P1$  is a LAPACK and  $P2$  a LAPACK permutation and store the result in  $\text{MathP}$  as a  $\text{MathPermutation}$  format.*
- void [composePermutationsLLL](#) (size\_t \*P1, const size\_t \*P2, const size\_t R, const size\_t N)  
*Computes  $P1 \times \text{Diag}(I_R, P2)$  where  $P1$  is a LAPACK and  $P2$  a LAPACK permutation and store the result in  $P1$  as a LAPACK permutation.*
- void [composePermutationsMLM](#) (size\_t \*MathP1, const size\_t \*P2, const size\_t R, const size\_t N)  
*Computes  $\text{MathP1} \times \text{Diag}(I_R, P2)$  where  $\text{MathP1}$  is a  $\text{MathPermutation}$  and  $P2$  a LAPACK permutation and store the result in  $\text{MathP1}$  as a  $\text{MathPermutation}$  format.*
- void [cyclic\\_shift\\_mathPerm](#) (size\_t \*P, const size\_t s)
- template<typename Base\_t>  
void [cyclic\\_shift\\_row\\_col](#) (Base\_t \*A, size\_t m, size\_t n, size\_t lda)
- template [INST\\_OR\\_DECL](#) void [cyclic\\_shift\\_row](#) (const [FFLAS\\_FIELD](#)< [FFLAS\\_ELT](#) > &F, [FFLAS\\_ELT](#) \*A, size\_t m, size\_t n, size\_t lda)
- template [INST\\_OR\\_DECL](#) void [cyclic\\_shift\\_col](#) (const [FFLAS\\_FIELD](#)< [FFLAS\\_ELT](#) > &F, [FFLAS\\_ELT](#) \*A, size\_t m, size\_t n, size\_t lda)
- template [INST\\_OR\\_DECL](#) void [applyP](#) (const [FFLAS\\_FIELD](#)< [FFLAS\\_ELT](#) > &F, const [FFLAS::FFLAS\\_SIDE](#) Side, const [FFLAS::FFLAS\\_TRANSPOSE](#) Trans, const size\_t M, const size\_t ibeg, const size\_t iend, [FFLAS\\_ELT](#) \*A, const size\_t lda, const size\_t \*P)
- template [INST\\_OR\\_DECL](#) void [fgetrs](#) (const [FFLAS\\_FIELD](#)< [FFLAS\\_ELT](#) > &F, const [FFLAS::FFLAS\\_SIDE](#) Side, const size\_t M, const size\_t N, const size\_t R, [FFLAS\\_ELT](#) \*A, const size\_t lda, const size\_t \*P, const size\_t \*Q, [FFLAS\\_ELT](#) \*B, const size\_t ldb, int \*info)
- template [INST\\_OR\\_DECL](#) [FFLAS\\_ELT](#) \* [fgetrs](#) (const [FFLAS\\_FIELD](#)< [FFLAS\\_ELT](#) > &F, const [FFLAS::FFLAS\\_SIDE](#) Side, const size\_t M, const size\_t N, const size\_t NRHS, const size\_t R, [FFLAS\\_ELT](#) \*A, const size\_t lda, const size\_t \*P, const size\_t \*Q, [FFLAS\\_ELT](#) \*X, const size\_t ldx, const [FFLAS\\_ELT](#) \*B, const size\_t ldb, int \*info)
- template [INST\\_OR\\_DECL](#) size\_t [fgesv](#) (const [FFLAS\\_FIELD](#)< [FFLAS\\_ELT](#) > &F, const [FFLAS::FFLAS\\_SIDE](#) Side, const size\_t M, const size\_t N, [FFLAS\\_ELT](#) \*A, const size\_t lda, [FFLAS\\_ELT](#) \*B, const size\_t ldb, int \*info)
- template [INST\\_OR\\_DECL](#) size\_t [fgesv](#) (const [FFLAS\\_FIELD](#)< [FFLAS\\_ELT](#) > &F, const [FFLAS::FFLAS\\_SIDE](#) Side, const size\_t M, const size\_t N, const size\_t NRHS, [FFLAS\\_ELT](#) \*A, const size\_t lda, [FFLAS\\_ELT](#) \*X, const size\_t ldx, const [FFLAS\\_ELT](#) \*B, const size\_t ldb, int \*info)



- template `INST_OR_DECL` void `fttri` (const `FFLAS_FIELD`< `FFLAS_ELT` > &F, const `FFLAS::FFLAS_UPLO` Uplo, const `FFLAS::FFLAS_DIAG` Diag, const size\_t N, `FFLAS_ELT` \*A, const size\_t lda, const size\_t threshold)
- template `INST_OR_DECL` void `trinv_left` (const `FFLAS_FIELD`< `FFLAS_ELT` > &F, const size\_t N, const `FFLAS_ELT` \*L, const size\_t ldl, `FFLAS_ELT` \*X, const size\_t ldx)
- template `INST_OR_DECL` void `fttrm` (const `FFLAS_FIELD`< `FFLAS_ELT` > &F, const `FFLAS::FFLAS_SIDE` side, const `FFLAS::FFLAS_DIAG` diag, const size\_t N, `FFLAS_ELT` \*A, const size\_t lda)
- template `INST_OR_DECL` size\_t `PLUQ` (const `FFLAS_FIELD`< `FFLAS_ELT` > &F, const `FFLAS::FFLAS_DIAG` Diag, const size\_t M, const size\_t N, `FFLAS_ELT` \*A, const size\_t lda, size\_t \*P, size\_t \*Q)
- template `INST_OR_DECL` size\_t `LUdivine` (const `FFLAS_FIELD`< `FFLAS_ELT` > &F, const `FFLAS::FFLAS_DIAG` Diag, const `FFLAS::FFLAS_TRANSPOSE` trans, const size\_t M, const size\_t N, `FFLAS_ELT` \*A, const size\_t lda, size\_t \*P, size\_t \*Qt, const `FFPACK_LU_TAG` LuTag, const size\_t cutoff)
- template `INST_OR_DECL` size\_t `LUdivine_small` (const `FFLAS_FIELD`< `FFLAS_ELT` > &F, const `FFLAS::FFLAS_DIAG` Diag, const `FFLAS::FFLAS_TRANSPOSE` trans, const size\_t M, const size\_t N, `FFLAS_ELT` \*A, const size\_t lda, size\_t \*P, size\_t \*Q, const `FFPACK_LU_TAG` LuTag)
- template `INST_OR_DECL` size\_t `LUdivine_gauss` (const `FFLAS_FIELD`< `FFLAS_ELT` > &F, const `FFLAS::FFLAS_DIAG` Diag, const size\_t M, const size\_t N, `FFLAS_ELT` \*A, const size\_t lda, size\_t \*P, size\_t \*Q, const `FFPACK_LU_TAG` LuTag)
- template `INST_OR_DECL` size\_t `RowEchelonForm` (const `FFLAS_FIELD`< `FFLAS_ELT` > &F, const size\_t M, const size\_t N, `FFLAS_ELT` \*A, const size\_t lda, size\_t \*P, size\_t \*Qt, const bool transform, const `FFPACK_LU_TAG` LuTag)
- template `INST_OR_DECL` size\_t `ReducedRowEchelonForm` (const `FFLAS_FIELD`< `FFLAS_ELT` > &F, const size\_t M, const size\_t N, `FFLAS_ELT` \*A, const size\_t lda, size\_t \*P, size\_t \*Qt, const bool transform, const `FFPACK_LU_TAG` LuTag)
- template `INST_OR_DECL` size\_t `ColumnEchelonForm` (const `FFLAS_FIELD`< `FFLAS_ELT` > &F, const size\_t M, const size\_t N, `FFLAS_ELT` \*A, const size\_t lda, size\_t \*P, size\_t \*Qt, const bool transform, const `FFPACK_LU_TAG` LuTag)
- template `INST_OR_DECL` size\_t `ReducedColumnEchelonForm` (const `FFLAS_FIELD`< `FFLAS_ELT` > &F, const size\_t M, const size\_t N, `FFLAS_ELT` \*A, const size\_t lda, size\_t \*P, size\_t \*Qt, const bool transform, const `FFPACK_LU_TAG` LuTag)
- template `INST_OR_DECL` `FFLAS_ELT` \* `Invert` (const `FFLAS_FIELD`< `FFLAS_ELT` > &F, const size\_t M, `FFLAS_ELT` \*A, const size\_t lda, int &nullity)
- template `INST_OR_DECL` `FFLAS_ELT` \* `Invert` (const `FFLAS_FIELD`< `FFLAS_ELT` > &F, const size\_t M, const `FFLAS_ELT` \*A, const size\_t lda, `FFLAS_ELT` \*X, const size\_t ldx, int &nullity)
- template `INST_OR_DECL` `FFLAS_ELT` \* `Invert2` (const `FFLAS_FIELD`< `FFLAS_ELT` > &F, const size\_t M, `FFLAS_ELT` \*A, const size\_t lda, `FFLAS_ELT` \*X, const size\_t ldx, int &nullity)
- template `INST_OR_DECL` std::list< Givaro::Poly1Dom< `FFLAS_FIELD`< `FFLAS_ELT` > >::Element > & `CharPoly` (const Givaro::Poly1Dom< `FFLAS_FIELD`< `FFLAS_ELT` > > &R, std::list< Givaro::Poly1Dom< `FFLAS_FIELD`< `FFLAS_ELT` > >::Element > &charp, const size\_t N, `FFLAS_ELT` \*A, const size\_t lda, `FFLAS_FIELD`< `FFLAS_ELT` >::RandIter &G, const `FFPACK_CHARPOLY_TAG` CharpTag, const size\_t degree)
- template `INST_OR_DECL` Givaro::Poly1Dom< `FFLAS_FIELD`< `FFLAS_ELT` > >::Element & `CharPoly` (const Givaro::Poly1Dom< `FFLAS_FIELD`< `FFLAS_ELT` > > &R, Givaro::Poly1Dom< `FFLAS_FIELD`< `FFLAS_ELT` > >::Element &charp, const size\_t N, `FFLAS_ELT` \*A, const size\_t lda, `FFLAS_FIELD`< `FFLAS_ELT` >::RandIter &G, const `FFPACK_CHARPOLY_TAG` CharpTag, const size\_t degree)
- template `INST_OR_DECL` Givaro::Poly1Dom< `FFLAS_FIELD`< `FFLAS_ELT` > >::Element & `CharPoly` (const Givaro::Poly1Dom< `FFLAS_FIELD`< `FFLAS_ELT` > > &R, Givaro::Poly1Dom< `FFLAS_FIELD`< `FFLAS_ELT` > >::Element &charp, const size\_t N, `FFLAS_ELT` \*A, const size\_t lda, const `FFPACK_CHARPOLY_TAG` CharpTag, const size\_t degree)
- template `INST_OR_DECL` std::vector< `FFLAS_ELT` > & `MinPoly` (const `FFLAS_FIELD`< `FFLAS_ELT` > &F, std::vector< `FFLAS_ELT` > &minP, const size\_t N, const `FFLAS_ELT` \*A, const size\_t lda, `FFLAS_FIELD`< `FFLAS_ELT` >::RandIter &G)
- template `INST_OR_DECL` std::vector< `FFLAS_ELT` > & `MinPoly` (const `FFLAS_FIELD`< `FFLAS_ELT` > &F, std::vector< `FFLAS_ELT` > &minP, const size\_t N, const `FFLAS_ELT` \*A, const size\_t lda)
- template `INST_OR_DECL` std::vector< `FFLAS_ELT` > & `MatVecMinPoly` (const `FFLAS_FIELD`< `FFLAS_ELT` > &F, std::vector< `FFLAS_ELT` > &minP, const size\_t N, const `FFLAS_ELT` \*A, const size\_t lda, const `FFLAS_ELT` \*V, const size\_t incv)

- template `INST_OR_DECL` `size_t KrylovElim` (const `FFLAS_FIELD`< `FFLAS_ELT` > &F, const `size_t` M, const `size_t` N, `FFLAS_ELT` \*A, const `size_t` lda, `size_t` \*P, `size_t` \*Q, const `size_t` deg, `size_t` \*iterates, `size_t` \*inviterates, const `size_t` maxit, `size_t` virt)
- template `INST_OR_DECL` `size_t SpecRankProfile` (const `FFLAS_FIELD`< `FFLAS_ELT` > &F, const `size_t` M, const `size_t` N, `FFLAS_ELT` \*A, const `size_t` lda, const `size_t` deg, `size_t` \*rankProfile)
- template `INST_OR_DECL` `size_t Rank` (const `FFLAS_FIELD`< `FFLAS_ELT` > &F, const `size_t` M, const `size_t` N, `FFLAS_ELT` \*A, const `size_t` lda)
- template `INST_OR_DECL` `bool IsSingular` (const `FFLAS_FIELD`< `FFLAS_ELT` > &F, const `size_t` M, const `size_t` N, `FFLAS_ELT` \*A, const `size_t` lda)
- template `INST_OR_DECL` `FFLAS_ELT & Det` (const `FFLAS_FIELD`< `FFLAS_ELT` > &F, `FFLAS_ELT` &det, const `size_t` N, `FFLAS_ELT` \*A, const `size_t` lda, `size_t` \*P, `size_t` \*Q)
- template `INST_OR_DECL` `FFLAS_ELT & Det` (const `FFLAS_FIELD`< `FFLAS_ELT` > &F, `FFLAS_ELT` &det, const `size_t` N, `FFLAS_ELT` \*A, const `size_t` lda, const `FFLAS::ParSeqHelper::Parallel`< `FFLAS::CuttingStrategy::Recursive`, `FFLAS::StrategyParameter::Threads` > &parH, `size_t` \*P, `size_t` \*Q)
- template `INST_OR_DECL` `FFLAS_ELT * Solve` (const `FFLAS_FIELD`< `FFLAS_ELT` > &F, const `size_t` M, `FFLAS_ELT` \*A, const `size_t` lda, `FFLAS_ELT` \*x, const `int` incx, const `FFLAS_ELT` \*b, const `int` incb)
- template `INST_OR_DECL` `void solveLB` (const `FFLAS_FIELD`< `FFLAS_ELT` > &F, const `FFLAS::FFLAS_SIDE` Side, const `size_t` M, const `size_t` N, const `size_t` R, `FFLAS_ELT` \*L, const `size_t` ldl, const `size_t` \*Q, `FFLAS_ELT` \*B, const `size_t` ldb)
- template `INST_OR_DECL` `void solveLB2` (const `FFLAS_FIELD`< `FFLAS_ELT` > &F, const `FFLAS::FFLAS_SIDE` Side, const `size_t` M, const `size_t` N, const `size_t` R, `FFLAS_ELT` \*L, const `size_t` ldl, const `size_t` \*Q, `FFLAS_ELT` \*B, const `size_t` ldb)
- template `INST_OR_DECL` `void RandomNullSpaceVector` (const `FFLAS_FIELD`< `FFLAS_ELT` > &F, const `FFLAS::FFLAS_SIDE` Side, const `size_t` M, const `size_t` N, `FFLAS_ELT` \*A, const `size_t` lda, `FFLAS_ELT` \*X, const `size_t` incX)
- template `INST_OR_DECL` `size_t NullSpaceBasis` (const `FFLAS_FIELD`< `FFLAS_ELT` > &F, const `FFLAS::FFLAS_SIDE` Side, const `size_t` M, const `size_t` N, `FFLAS_ELT` \*A, const `size_t` lda, `FFLAS_ELT` \*&NS, `size_t` &ldn, `size_t` &NSdim)
- template `INST_OR_DECL` `size_t RowRankProfile` (const `FFLAS_FIELD`< `FFLAS_ELT` > &F, const `size_t` M, const `size_t` N, `FFLAS_ELT` \*A, const `size_t` lda, `size_t` \*rkprofile, const `FFPACK_LU_TAG` LuTag)
- template `INST_OR_DECL` `size_t ColumnRankProfile` (const `FFLAS_FIELD`< `FFLAS_ELT` > &F, const `size_t` M, const `size_t` N, `FFLAS_ELT` \*A, const `size_t` lda, `size_t` \*rkprofile, const `FFPACK_LU_TAG` LuTag)
- `void RankProfileFromLU` (const `size_t` \*P, const `size_t` N, const `size_t` R, `size_t` \*rkprofile, const `FFPACK_LU_TAG` LuTag)

*Recovers the column/row rank profile from the permutation of an LU decomposition.*

- `size_t LeadingSubmatrixRankProfiles` (const `size_t` M, const `size_t` N, const `size_t` R, const `size_t` LSm, const `size_t` LSn, const `size_t` \*P, const `size_t` \*Q, `size_t` \*RRP, `size_t` \*CRP)

*Recovers the row and column rank profiles of any leading submatrix from the PLUQ decomposition.*

- template `INST_OR_DECL` `size_t RowRankProfileSubmatrixIndices` (const `FFLAS_FIELD`< `FFLAS_ELT` > &F, const `size_t` M, const `size_t` N, `FFLAS_ELT` \*A, const `size_t` lda, `size_t` \*rowindices, `size_t` \*colindices, `size_t` &R)
- template `INST_OR_DECL` `size_t ColRankProfileSubmatrixIndices` (const `FFLAS_FIELD`< `FFLAS_ELT` > &F, const `size_t` M, const `size_t` N, `FFLAS_ELT` \*A, const `size_t` lda, `size_t` \*rowindices, `size_t` \*colindices, `size_t` &R)
- template `INST_OR_DECL` `size_t RowRankProfileSubmatrix` (const `FFLAS_FIELD`< `FFLAS_ELT` > &F, const `size_t` M, const `size_t` N, `FFLAS_ELT` \*A, const `size_t` lda, `FFLAS_ELT` \*&X, `size_t` &R)
- template `INST_OR_DECL` `size_t ColRankProfileSubmatrix` (const `FFLAS_FIELD`< `FFLAS_ELT` > &F, const `size_t` M, const `size_t` N, `FFLAS_ELT` \*A, const `size_t` lda, `FFLAS_ELT` \*&X, `size_t` &R)
- template `INST_OR_DECL` `void getTriangular`< `FFLAS_FIELD`< `FFLAS_ELT` > > (const `FFLAS_FIELD`< `FFLAS_ELT` > &F, const `FFLAS::FFLAS_UPLO` Uplo, const `FFLAS::FFLAS_DIAG` diag, const `size_t` M, const `size_t` N, const `size_t` R, const `FFLAS_ELT` \*A, const `size_t` lda, `FFLAS_ELT` \*T, const `size_t` ldt, const `bool` OnlyNonZeroVectors)
- template `INST_OR_DECL` `void getTriangular`< `FFLAS_FIELD`< `FFLAS_ELT` > > (const `FFLAS_FIELD`< `FFLAS_ELT` > &F, const `FFLAS::FFLAS_UPLO` Uplo, const `FFLAS::FFLAS_DIAG` diag, const `size_t` M, const `size_t` N, const `size_t` R, `FFLAS_ELT` \*A, const `size_t` lda)

- template [INST\\_OR\\_DECL](#) void [getEchelonForm](#)< [FFLAS\\_FIELD](#)< [FFLAS\\_ELT](#) > > (const [FFLAS\\_FIELD](#)< [FFLAS\\_ELT](#) > &F, const [FFLAS::FFLAS\\_UPLO](#) Uplo, const [FFLAS::FFLAS\\_DIAG](#) diag, const size\_t M, const size\_t N, const size\_t R, const size\_t \*P, const [FFLAS\\_ELT](#) \*A, const size\_t lda, [FFLAS\\_ELT](#) \*T, const size\_t ldt, const bool OnlyNonZeroVectors, const [FFPACK\\_LU\\_TAG](#) LuTag)
- template [INST\\_OR\\_DECL](#) void [getEchelonForm](#)< [FFLAS\\_FIELD](#)< [FFLAS\\_ELT](#) > > (const [FFLAS\\_FIELD](#)< [FFLAS\\_ELT](#) > &F, const [FFLAS::FFLAS\\_UPLO](#) Uplo, const [FFLAS::FFLAS\\_DIAG](#) diag, const size\_t M, const size\_t N, const size\_t R, const size\_t \*P, [FFLAS\\_ELT](#) \*A, const size\_t lda, const [FFPACK\\_LU\\_TAG](#) LuTag)
- template [INST\\_OR\\_DECL](#) void [getEchelonTransform](#)< [FFLAS\\_FIELD](#)< [FFLAS\\_ELT](#) > > (const [FFLAS\\_FIELD](#)< [FFLAS\\_ELT](#) > &F, const [FFLAS::FFLAS\\_UPLO](#) Uplo, const [FFLAS::FFLAS\\_DIAG](#) diag, const size\_t M, const size\_t N, const size\_t R, const size\_t \*P, const size\_t \*Q, const [FFLAS\\_ELT](#) \*A, const size\_t lda, [FFLAS\\_ELT](#) \*T, const size\_t ldt, const [FFPACK\\_LU\\_TAG](#) LuTag)
- template [INST\\_OR\\_DECL](#) void [getReducedEchelonForm](#)< [FFLAS\\_FIELD](#)< [FFLAS\\_ELT](#) > > (const [FFLAS\\_FIELD](#)< [FFLAS\\_ELT](#) > &F, const [FFLAS::FFLAS\\_UPLO](#) Uplo, const size\_t M, const size\_t N, const size\_t R, const size\_t \*P, const [FFLAS\\_ELT](#) \*A, const size\_t lda, [FFLAS\\_ELT](#) \*T, const size\_t ldt, const bool OnlyNonZeroVectors, const [FFPACK\\_LU\\_TAG](#) LuTag)
- template [INST\\_OR\\_DECL](#) void [getReducedEchelonForm](#)< [FFLAS\\_FIELD](#)< [FFLAS\\_ELT](#) > > (const [FFLAS\\_FIELD](#)< [FFLAS\\_ELT](#) > &F, const [FFLAS::FFLAS\\_UPLO](#) Uplo, const size\_t M, const size\_t N, const size\_t R, const size\_t \*P, [FFLAS\\_ELT](#) \*A, const size\_t lda, const [FFPACK\\_LU\\_TAG](#) LuTag)
- template [INST\\_OR\\_DECL](#) void [getReducedEchelonTransform](#)< [FFLAS\\_FIELD](#)< [FFLAS\\_ELT](#) > > (const [FFLAS\\_FIELD](#)< [FFLAS\\_ELT](#) > &F, const [FFLAS::FFLAS\\_UPLO](#) Uplo, const size\_t M, const size\_t N, const size\_t R, const size\_t \*P, const size\_t \*Q, const [FFLAS\\_ELT](#) \*A, const size\_t lda, [FFLAS\\_ELT](#) \*T, const size\_t ldt, const [FFPACK\\_LU\\_TAG](#) LuTag)
- void [PLUQtoEchelonPermutation](#) (const size\_t N, const size\_t R, const size\_t \*P, size\_t \*outPerm)  
*Auxiliary routine: determines the permutation that changes a PLUQ decomposition into a echelon form revealing PLUQ decomposition.*
- template [INST\\_OR\\_DECL](#) [FFLAS\\_ELT](#) \* [LQUptInverseOfFullRankMinor](#) (const [FFLAS\\_FIELD](#)< [FFLAS\\_ELT](#) > &F, const size\_t rank, [FFLAS\\_ELT](#) \*A\_factors, const size\_t lda, const size\_t \*QtPointer, [FFLAS\\_ELT](#) \*X, const size\_t ldx)

## 13.238 blockcuts.inl File Reference

```
#include <fflas-ffpack/fflas/fflas_enum.h>
#include <math.h>
#include <cassert>
```

### Data Structures

- struct [Single](#)
- struct [Row](#)
- struct [Column](#)
- struct [Block](#)
- struct [Recursive](#)
- struct [Fixed](#)
- struct [Threads](#)
- struct [Grain](#)
- struct [TwoD](#)
- struct [TwoDAdaptive](#)
- struct [ThreeD](#)
- struct [ThreeDInPlace](#)
- struct [ThreeDAdaptive](#)
- struct [Parallel](#)< C, P >
- struct [Sequential](#)
- struct [Compose](#)< H1, H2 >
- struct [ForStrategy1D](#)< blocksize\_t, Cut, Param >
- struct [ForStrategy2D](#)< blocksize\_t, Cut, Param >

## Namespaces

- namespace [FFLAS](#)
- namespace [FFLAS::CuttingStrategy](#)
- namespace [FFLAS::StrategyParameter](#)
- namespace [FFLAS::ParSeqHelper](#)

*[ParSeqHelper](#) for both *fgemm* and *ftrsm*.*

## Macros

- `#define \_\_FFLASFFPACK\_fflas\_blockcuts\_INL`
- `#define \_\_FFLASFFPACK\_MINBLOCKCUTS ((size_t)256)`

## Typedefs

- typedef [Row](#) [RNSModulus](#)

## Functions

- `template<class Cut = CuttingStrategy::Block, class Strat = StrategyParameter::Threads>  
void BlockCuts (size_t &RBLOCKSIZE, size_t &CBLOCKSIZE, const size_t m, const size_t n, const size_t numthreads)`
- `template<> void BlockCuts< CuttingStrategy::Single, StrategyParameter::Threads > (size_t &RBLOCKSIZE, size_t &CBLOCKSIZE, const size_t m, const size_t n, const size_t numthreads)`
- `template<> void BlockCuts< CuttingStrategy::Row, StrategyParameter::Fixed > (size_t &RBLOCKSIZE, size_t &CBLOCKSIZE, const size_t m, const size_t n, const size_t numthreads)`
- `template<> void BlockCuts< CuttingStrategy::Row, StrategyParameter::Grain > (size_t &RBLOCKSIZE, size_t &CBLOCKSIZE, const size_t m, const size_t n, const size_t grainsize)`
- `template<> void BlockCuts< CuttingStrategy::Block, StrategyParameter::Grain > (size_t &RBLOCKSIZE, size_t &CBLOCKSIZE, const size_t m, const size_t n, const size_t grainsize)`
- `template<> void BlockCuts< CuttingStrategy::Column, StrategyParameter::Fixed > (size_t &RBLOCKSIZE, size_t &CBLOCKSIZE, const size_t m, const size_t n, const size_t numthreads)`
- `template<> void BlockCuts< CuttingStrategy::Column, StrategyParameter::Grain > (size_t &RBLOCKSIZE, size_t &CBLOCKSIZE, const size_t m, const size_t n, const size_t grainsize)`
- `template<> void BlockCuts< CuttingStrategy::Block, StrategyParameter::Fixed > (size_t &RBLOCKSIZE, size_t &CBLOCKSIZE, const size_t m, const size_t n, const size_t numthreads)`
- `template<> void BlockCuts< CuttingStrategy::Row, StrategyParameter::Threads > (size_t &RBLOCKSIZE, size_t &CBLOCKSIZE, const size_t m, const size_t n, const size_t numthreads)`
- `template<> void BlockCuts< CuttingStrategy::Column, StrategyParameter::Threads > (size_t &RBLOCKSIZE, size_t &CBLOCKSIZE, const size_t m, const size_t n, const size_t numthreads)`
- `template<> void BlockCuts< CuttingStrategy::Block, StrategyParameter::Threads > (size_t &RBLOCKSIZE, size_t &CBLOCKSIZE, const size_t m, const size_t n, const size_t numthreads)`
- `template<class Cut = CuttingStrategy::Block, class Param = StrategyParameter::Threads>  
void BlockCuts (size_t &rowBlockSize, size_t &colBlockSize, size_t &lastRBS, size_t &lastCBS, size_t &changeRBS, size_t &changeCBS, size_t &numRowBlock, size_t &numColBlock, size_t m, size_t n, const size_t numthreads)`

## 13.238.1 Macro Definition Documentation

### 13.238.1.1 [\\_\\_FFLASFFPACK\\_fflas\\_blockcuts\\_INL](#)

```
#define \_\_FFLASFFPACK\_fflas\_blockcuts\_INL
```

### 13.238.1.2 [\\_\\_FFLASFFPACK\\_MINBLOCKCUTS](#)

```
#define \_\_FFLASFFPACK\_MINBLOCKCUTS ((size_t)256)
```

## 13.239 fflas\_plevel1.h File Reference

```
#include "fflas-ffpack/paladin/parallel.h"
```

### Namespaces

- namespace [FFLAS](#)

### Functions

- template<class [Field](#)>  
void [pfzero](#) (const [Field](#) &F, size\_t m, size\_t n, typename [Field::Element\\_ptr](#) C, size\_t BS=0)
- template<class [Field](#), class RandIter>  
void [pfrand](#) (const [Field](#) &F, RandIter &G, size\_t m, size\_t n, typename [Field::Element\\_ptr](#) C, size\_t BS=0)
- template<class [Field](#), class Cut, class Param>  
[Field::Element](#) & [fdot](#) (const [Field](#) &F, const size\_t N, typename [Field::ConstElement\\_ptr](#) x, const size\_t incx, typename [Field::ConstElement\\_ptr](#) y, const size\_t incy, typename [Field::Element](#) &d, const [ParSeqHelper::Parallel](#)< Cut, Param > par)
- template<typename [Field](#), class Cut, class Param>  
[Field::Element](#) [fdot](#) (const [Field](#) &F, const size\_t N, typename [Field::ConstElement\\_ptr](#) X, const size\_t incX, typename [Field::ConstElement\\_ptr](#) Y, const size\_t incY, const [ParSeqHelper::Parallel](#)< Cut, Param > par)

## 13.240 kaapi\_routines.inl File Reference

### Macros

- #define [\\_\\_FFLASFFPACK\\_KAAPI\\_ROUTINES\\_INL](#)

### 13.240.1 Macro Definition Documentation

#### 13.240.1.1 \_\_FFLASFFPACK\_KAAPI\_ROUTINES\_INL

```
#define __FFLASFFPACK_KAAPI_ROUTINES_INL
```

## 13.241 parallel.h File Reference

```
#include "fflas-ffpack/config.h"
#include "fflas-ffpack/paladin/blockcuts.inl"
```

### Macros

- #define [\\_\\_FFLASFFPACK\\_SEQUENTIAL](#)
- #define [index\\_t](#) size\_t
- #define [TASK](#)(M, I)
- #define [WAIT](#)
- #define [CHECK\\_DEPENDENCIES](#)
- #define [BARRIER](#)
- #define [PAR\\_BLOCK](#)
- #define [SYNCH\\_GROUP](#)(Args...)
- #define [THREAD\\_INDEX](#) 0
- #define [NUM\\_THREADS](#) 1
- #define [SET\\_THREADS](#)(num\_threads)
- #define [MAX\\_THREADS](#) 1
- #define [READ](#)(Args...)
- #define [WRITE](#)(Args...)

- #define `READWRITE`(Args...)
- #define `CONSTREFERENCE`(...)
- #define `VALUE`(...)
- #define `BEGIN_PARALLEL_MAIN`(Args...)
- #define `END_PARALLEL_MAIN`(void)
- #define `FORBLOCK1D`(iter, m, Helper, Args...)
- #define `FOR1D`(i, m, Helper, Args...)
- #define `PARFORBLOCK1D`(iter, m, Helper, Args...)
- #define `PARFOR1D`(iter, m, Helper, Args...)
- #define `FORBLOCK2D`(iter, m, n, Helper, Args...)
- #define `FOR2D`(i, j, m, n, Helper, Args...)
- #define `PARFORBLOCK2D`(iter, m, n, Helper, Args...)
- #define `PARFOR2D`(i, j, m, n, Helper, Args...)
- #define `COMMA` ,
- #define `MODE`(...)
- #define `RETURNPARAM`(f, P1, Args...)
- #define `NUMARGS`(...)
- #define `PP_NARG`(...)
- #define `PP_ARG_N`( \_1, \_2, \_3, \_4, \_5, \_6, \_7, \_8, \_9, \_10, \_11, \_12, \_13, \_14, \_15, \_16, \_17, \_18, \_19, \_20, \_21, \_22, \_23, \_24, \_25, \_26, \_27, \_28, \_29, \_30, \_31, \_32, \_33, \_34, \_35, \_36, \_37, \_38, \_39, \_40, \_41, \_42, \_43, \_44, \_45, \_46, \_47, \_48, \_49, \_50, \_51, \_52, \_53, \_54, \_55, \_56, \_57, \_58, \_59, \_60, \_61, \_62, \_63, N, ...)
- #define `PP_RSEQ_N`()
- #define `NOSPLIT`()
- #define `splitting_0`()
- #define `splitting_1`(a)
- #define `splitting_2`(a, c)
- #define `splitting_3`(a, b, c)
- #define `splitt`(\_1, \_2, \_3, NAME, ...)
- #define `SPLITTER`(...)

## 13.241.1 Macro Definition Documentation

### 13.241.1.1 `__FFLASFFPACK_SEQUENTIAL`

```
#define __FFLASFFPACK_SEQUENTIAL
```

### 13.241.1.2 `index_t`

```
#define index_t size_t
```

### 13.241.1.3 `TASK`

```
#define TASK(  
    M,  
    I)
```

**Value:**

```
{I;}
```

### 13.241.1.4 `WAIT`

```
#define WAIT
```

### 13.241.1.5 `CHECK_DEPENDENCIES`

```
#define CHECK_DEPENDENCIES
```

#### 13.241.1.6 BARRIER

```
#define BARRIER
```

#### 13.241.1.7 PAR\_BLOCK

```
#define PAR_BLOCK
```

#### 13.241.1.8 SYNCH\_GROUP

```
#define SYNCH_GROUP(  
    Args...)
```

**Value:**

```
{{Args}};
```

#### 13.241.1.9 THREAD\_INDEX

```
#define THREAD_INDEX 0
```

#### 13.241.1.10 NUM\_THREADS

```
#define NUM_THREADS 1
```

#### 13.241.1.11 SET\_THREADS

```
#define SET_THREADS(  
    num_threads)
```

**Value:**

```
{}
```

#### 13.241.1.12 MAX\_THREADS

```
#define MAX_THREADS 1
```

#### 13.241.1.13 READ

```
#define READ(  
    Args...)
```

#### 13.241.1.14 WRITE

```
#define WRITE(  
    Args...)
```

#### 13.241.1.15 READWRITE

```
#define READWRITE(  
    Args...)
```

#### 13.241.1.16 CONSTREFERENCE

```
#define CONSTREFERENCE(  
    ...)
```

#### 13.241.1.17 VALUE

```
#define VALUE(  
    ...)
```

**13.241.1.18 BEGIN\_PARALLEL\_MAIN**

```
#define BEGIN_PARALLEL_MAIN(
    Args...)
```

**Value:**

```
int main(Args) {
```

**13.241.1.19 END\_PARALLEL\_MAIN**

```
#define END_PARALLEL_MAIN(
    void)
```

**Value:**

```
return 0; }
```

**13.241.1.20 FORBLOCK1D**

```
#define FORBLOCK1D(
    iter,
    m,
    Helper,
    Args...)
```

**Value:**

```
{ FFLAS::ForStrategy1D<std::remove_const<decltype(m)>::type, typename decltype(Helper)::Cut, typename
  decltype(Helper)::Param> iter(m, Helper); \
  for(iter.initialize(); !iter.isTerminated(); ++iter) \
  {Args;} }
```

**13.241.1.21 FOR1D**

```
#define FOR1D(
    i,
    m,
    Helper,
    Args...)
```

**Value:**

```
FORBLOCK1D(_internal_iterator, m, Helper, \
    for(auto i=_internal_iterator.begin(); i!=_internal_iterator.end(); ++i) \
    { Args; })
```

**13.241.1.22 PARFORBLOCK1D**

```
#define PARFORBLOCK1D(
    iter,
    m,
    Helper,
    Args...)
```

**Value:**

```
for(std::remove_const<decltype(m)>::type iter=0; iter<m; ++iter) \
{ Args; }
```

**13.241.1.23 PARFOR1D**

```
#define PARFOR1D(
    iter,
    m,
    Helper,
    Args...)
```

**Value:**

```
for(std::remove_const<decltype(m)>::type iter=0; iter<m; ++iter) \
{ Args; }
```



**13.241.1.24 FORBLOCK2D**

```
#define FORBLOCK2D(
    iter,
    m,
    n,
    Helper,
    Args...)

```

**Value:**

```
{ FFLAS::ForStrategy2D<std::remove_const<decltype(m)>::type, typename decltype(Helper)::Cut, typename
    decltype(Helper)::Param> iter(m,n,Helper); \
    for(iter.initialize(); !iter.isTerminated(); ++iter) \
    { Args; } }

```

**13.241.1.25 FOR2D**

```
#define FOR2D(
    i,
    j,
    m,
    n,
    Helper,
    Args...)

```

**Value:**

```
FORBLOCK2D(_internal_iterator, m, n, Helper, \
    for(auto i=_internal_iterator.ibegin(); i!=_internal_iterator.iend(); ++i) \
    for(auto j=_internal_iterator.jbegin(); j!=_internal_iterator.jend(); ++j) \
    { Args; })

```

**13.241.1.26 PARFORBLOCK2D**

```
#define PARFORBLOCK2D(
    iter,
    m,
    n,
    Helper,
    Args...)

```

**Value:**

```
FORBLOCK2D(iter, m, n, Helper, Args)

```

**13.241.1.27 PARFOR2D**

```
#define PARFOR2D(
    i,
    j,
    m,
    n,
    Helper,
    Args...)

```

**Value:**

```
FOR2D(i, j, m, n, Helper, Args)

```

**13.241.1.28 COMMA**

```
#define COMMA ,

```

**13.241.1.29 MODE**

```
#define MODE(
    ...)

```

**Value:**

```
__VA_ARGS__

```

### 13.241.1.30 RETURNPARAM

```
#define RETURNPARAM(  
    f,  
    Pl,  
    Args...)
```

**Value:**

Pl=f(Args)

### 13.241.1.31 NUMARGS

```
#define NUMARGS(  
    ...)
```

**Value:**

[PP\\_NARG\\_](#)([\\_\\_VA\\_ARGS\\_\\_](#), [PP\\_RSEQ\\_N\(\)](#))

### 13.241.1.32 PP\_NARG\_

```
#define PP_NARG_  
    ...)
```

**Value:**

[PP\\_ARG\\_N](#)([\\_\\_VA\\_ARGS\\_\\_](#))

### 13.241.1.33 PP\_ARG\_N

```
#define PP_ARG_N(  
    _1,  
    _2,  
    _3,  
    _4,  
    _5,  
    _6,  
    _7,  
    _8,  
    _9,  
    _10,  
    _11,  
    _12,  
    _13,  
    _14,  
    _15,  
    _16,  
    _17,  
    _18,  
    _19,  
    _20,  
    _21,  
    _22,  
    _23,  
    _24,  
    _25,  
    _26,  
    _27,  
    _28,  
    _29,  
    _30,  
    _31,  
    _32,  
    _33,
```

```

    _34,
    _35,
    _36,
    _37,
    _38,
    _39,
    _40,
    _41,
    _42,
    _43,
    _44,
    _45,
    _46,
    _47,
    _48,
    _49,
    _50,
    _51,
    _52,
    _53,
    _54,
    _55,
    _56,
    _57,
    _58,
    _59,
    _60,
    _61,
    _62,
    _63,
    N,
    ... )

```

**Value:**

N

#### 13.241.1.34 PP\_RSEQ\_N

```
#define PP_RSEQ_N()
```

**Value:**

```

63, 62, 61, 60, \
59, 58, 57, 56, 55, 54, 53, 52, 51, 50, \
49, 48, 47, 46, 45, 44, 43, 42, 41, 40, \
39, 38, 37, 36, 35, 34, 33, 32, 31, 30, \
29, 28, 27, 26, 25, 24, 23, 22, 21, 20, \
19, 18, 17, 16, 15, 14, 13, 12, 11, 10, \
9, 8, 7, 6, 5, 4, 3, 2, 1, 0

```

#### 13.241.1.35 NOSPLIT

```
#define NOSPLIT()
```

**Value:**

```
FFLAS::ParSeqHelper::Sequential()
```

#### 13.241.1.36 splitting\_0

```
#define splitting_0()
```

**Value:**

```
FFLAS::ParSeqHelper::Parallel<FFLAS::CuttingStrategy::Block, FFLAS::StrategyParameter::Threads>()
```

**13.241.1.37 splitting\_1**

```
#define splitting_1(
    a)
```

**Value:**

`FFLAS::ParSeqHelper::Parallel<FFLAS::CuttingStrategy::Block, FFLAS::StrategyParameter::Threads>(a)`

**13.241.1.38 splitting\_2**

```
#define splitting_2(
    a,
    c)
```

**Value:**

`FFLAS::ParSeqHelper::Parallel<FFLAS::CuttingStrategy::Block, c>(a)`

**13.241.1.39 splitting\_3**

```
#define splitting_3(
    a,
    b,
    c)
```

**Value:**

`FFLAS::ParSeqHelper::Parallel<b, c>(a)`

**13.241.1.40 splitt**

```
#define splitt(
    _1,
    _2,
    _3,
    NAME,
    ...)
```

**Value:**

NAME

**13.241.1.41 SPLITTER**

```
#define SPLITTER(
    ...)
```

**Value:**

`splitt(__VA_ARGS__, splitting_3, splitting_2, splitting_1, splitting_0)(__VA_ARGS__)`

**13.242 pfgemm\_variants.inl File Reference****Namespaces**

- namespace `FFLAS`

**Functions**

- template<class `Field`, class `AlgoT`, class `FieldTrait`>  
`Field::Element * pfgemm` (const `Field` &F, const `FFLAS_TRANSPOSE` ta, const `FFLAS_TRANSPOSE` tb, const `size_t` m, const `size_t` n, const `size_t` k, const typename `Field::Element` alpha, const typename `Field::ConstElement_ptr` A, const `size_t` lda, const typename `Field::ConstElement_ptr` B, const `size_t` ldb, const typename `Field::Element` beta, typename `Field::Element` \*C, const `size_t` ldc, `MMHelper`< `Field`, `AlgoT`, `FieldTrait`, `ParSeqHelper::Parallel`< `CuttingStrategy::Block`, `StrategyParameter::Threads` > > &H)
- template<class `Field`, class `AlgoT`, class `FieldTrait`>  
`Field::Element * pfgemm` (const `Field` &F, const `FFLAS_TRANSPOSE` ta, const `FFLAS_TRANSPOSE` tb, const `size_t` m, const `size_t` n, const `size_t` k, const typename `Field::Element` alpha, const typename

- ```
Field::ConstElement_ptr AA, const size_t lda, const typename Field::ConstElement_ptr BB, const size_t
ldb, const typename Field::Element beta, typename Field::Element *C, const size_t ldc, MMHelper< Field,
AlgoT, FieldTrait, ParSeqHelper::Parallel< CuttingStrategy::Recursive, StrategyParameter::ThreeDAdaptive
> > &H)
> > &H)
• template<class Field, class AlgoT, class FieldTrait>
Field::Element * pfgemm (const Field &F, const FFLAS_TRANSPOSE ta, const FFLAS_TRANSPOSE tb,
const size_t m, const size_t n, const size_t k, const typename Field::Element alpha, const typename
Field::ConstElement_ptr AA, const size_t lda, const typename Field::ConstElement_ptr BB, const size_t
ldb, const typename Field::Element beta, typename Field::Element *C, const size_t ldc, MMHelper< Field,
AlgoT, FieldTrait, ParSeqHelper::Parallel< CuttingStrategy::Recursive, StrategyParameter::TwoDAdaptive >
> &H)
> &H)
• template<class Field, class AlgoT, class FieldTrait>
Field::Element * pfgemm (const Field &F, const FFLAS_TRANSPOSE ta, const FFLAS_TRANSPOSE tb,
const size_t m, const size_t n, const size_t k, const typename Field::Element alpha, const typename
Field::ConstElement_ptr AA, const size_t lda, const typename Field::ConstElement_ptr BB, const size_t
ldb, const typename Field::Element beta, typename Field::Element *C, const size_t ldc, MMHelper< Field,
AlgoT, FieldTrait, ParSeqHelper::Parallel< CuttingStrategy::Recursive, StrategyParameter::TwoD > > &H)
> &H)
• template<class Field, class AlgoT, class FieldTrait>
Field::Element_ptr pfgemm (const Field &F, const FFLAS_TRANSPOSE ta, const FFLAS_TRANSPOSE
tb, const size_t m, const size_t n, const size_t k, const typename Field::Element alpha, const typename
Field::ConstElement_ptr A, const size_t lda, const typename Field::ConstElement_ptr B, const size_t ldb,
const typename Field::Element beta, typename Field::Element_ptr C, const size_t ldc, MMHelper< Field,
AlgoT, FieldTrait, ParSeqHelper::Parallel< CuttingStrategy::Recursive, StrategyParameter::ThreeD > > &H)
> &H)
• template<class Field, class AlgoT, class FieldTrait>
Field::Element * pfgemm (const Field &F, const FFLAS_TRANSPOSE ta, const FFLAS_TRANSPOSE tb,
const size_t m, const size_t n, const size_t k, const typename Field::Element alpha, const typename
Field::ConstElement_ptr A, const size_t lda, const typename Field::ConstElement_ptr B, const size_t ldb,
const typename Field::Element beta, typename Field::Element_ptr C, const size_t ldc, MMHelper< Field, Al-
goT, FieldTrait, ParSeqHelper::Parallel< CuttingStrategy::Recursive, StrategyParameter::ThreeDInPlace >
> &H)
> &H)
```

## 13.243 pfgemv.inl File Reference

### Namespaces

- namespace [FFLAS](#)

### Functions

- template<class Field, class AlgoT, class FieldTrait>
[Field::Element\\_ptr fgemv](#) (const Field &F, const FFLAS\_TRANSPOSE ta, const size\_t m, const size\_t
n, const typename Field::Element alpha, const typename Field::ConstElement\_ptr A, const size\_t lda,
const typename Field::ConstElement\_ptr X, const size\_t incX, const typename Field::Element beta, type-
name Field::Element\_ptr Y, const size\_t incY, MMHelper< Field, AlgoT, FieldTrait, ParSeqHelper::Parallel<
CuttingStrategy::Recursive, StrategyParameter::Threads > > &H)
> &H)
• template<class Field, class AlgoT, class FieldTrait, class Cut>
[Field::Element\\_ptr fgemv](#) (const Field &F, const FFLAS\_TRANSPOSE ta, const size\_t m, const size\_t
n, const typename Field::Element alpha, const typename Field::ConstElement\_ptr A, const size\_t lda,
const typename Field::ConstElement\_ptr X, const size\_t incX, const typename Field::Element beta, type-
name Field::Element\_ptr Y, const size\_t incY, MMHelper< Field, AlgoT, FieldTrait, ParSeqHelper::Parallel<
CuttingStrategy::Row, Cut > > &H)
> &H)

## 13.244 align-allocator.h File Reference

```
#include "fflas-ffpack/config.h"
```

## 13.245 args-parser.h File Reference

```
#include <fflas-ffpack/fflas-ffpack-config.h>
#include <givaro/givinteger.h>
#include <givaro/givprint.h>
#include <iostream>
#include <fstream>
#include <vector>
#include <string>
#include <cstring>
#include <list>
#include <stdlib.h>
```

### Data Structures

- struct [Argument](#)

### Namespaces

- namespace [FFLAS](#)

### Macros

- #define [TYPE\\_BOOL](#) [TYPE\\_NONE](#)
- #define [END\\_OF\\_ARGUMENTS](#) { '\0', "\0", "\0", [TYPE\\_NONE](#), NULL }
- #define [type\\_integer](#) long int

### Enumerations

- enum [ArgumentType](#) {  
[TYPE\\_NONE](#) , [TYPE\\_INT](#) , [TYPE\\_UINT64](#) , [TYPE\\_LONGLONG](#) ,  
[TYPE\\_INTEGER](#) , [TYPE\\_DOUBLE](#) , [TYPE\\_INTLIST](#) , [TYPE\\_STR](#) }

### Functions

- void [parseArguments](#) (int argc, char \*\*argv, [Argument](#) \*args, bool printDefaults=true)
- void [printHelpMessage](#) (const char \*program, [Argument](#) \*args, bool printDefaults=false)
- [Argument](#) \* [findArgument](#) ([Argument](#) \*args, char c)
- int [getListArgs](#) (std::list< int > &outlist, std::string &instring)  
*transforms a string list of ints to a list of int string "12,13,15" is turned into list of ints {12,13,15}*
- char \* [getArgumentValue](#) (int argc, char \*\*argv, int i)  
*Get the value of an argument and avoid core dump when no value was given after an argument.*
- std::ostream & [writeCommandString](#) (std::ostream &os, [Argument](#) \*args, const char \*programName=nullptr)  
*writes the values of all arguments, preceded by the programName*

## 13.245.1 Macro Definition Documentation

### 13.245.1.1 TYPE\_BOOL

```
#define TYPE_BOOL TYPE\_NONE
```

### 13.245.1.2 END\_OF\_ARGUMENTS

```
#define END_OF_ARGUMENTS { '\0', "\0", "\0", TYPE\_NONE, NULL }
```

### 13.245.1.3 type\_integer

```
#define type_integer long int
```

## 13.245.2 Enumeration Type Documentation

### 13.245.2.1 ArgumentType

enum [ArgumentType](#)

#### Enumerator

TYPE_NONE	
TYPE_INT	
TYPE_UINT64	
TYPE_LONGLONG	
TYPE_INTEGER	
TYPE_DOUBLE	
TYPE_INTLIST	
TYPE_STR	

## 13.245.3 Function Documentation

### 13.245.3.1 printHelpMessage()

```
void printHelpMessage (
    const char * program,
    Argument * args,
    bool printDefaults = false)
```

### 13.245.3.2 findArgument()

```
Argument * findArgument (
    Argument * args,
    char c)
```

### 13.245.3.3 getListArgs()

```
int getListArgs (
    std::list< int > & outlist,
    std::string & instring)
```

transforms a string list of ints to a list of int string "12,13,15" is turned into list of ints {12,13,15}

#### Parameters

<i>outlist</i>	list once converted
<i>instring</i>	list to be converted

#### Returns

status message.

## 13.246 bit\_manipulation.h File Reference

```
#include <givaro/udl.h>
#include "fflas-ffpack/fflas-ffpack-config.h"
```

#### Macros

- #define [\\_\\_has\\_builtin](#)(x)

## Functions

- `int32_t clz (uint64_t val)`
- `int32_t clz (uint32_t val)`
- `int32_t ctz (uint32_t val)`
- `int32_t ctz (uint64_t val)`

## 13.246.1 Macro Definition Documentation

### 13.246.1.1 `__has_builtin`

```
#define __has_builtin(  
    x)
```

**Value:**

0

## 13.246.2 Function Documentation

### 13.246.2.1 `clz()` [1/2]

```
int32_t clz (  
    uint64_t val) [inline]
```

### 13.246.2.2 `clz()` [2/2]

```
int32_t clz (  
    uint32_t val) [inline]
```

### 13.246.2.3 `ctz()` [1/2]

```
int32_t ctz (  
    uint32_t val) [inline]
```

### 13.246.2.4 `ctz()` [2/2]

```
int32_t ctz (  
    uint64_t val) [inline]
```

## 13.247 `cast.h` File Reference

### Namespaces

- namespace [FFPACK](#)  
*Finite Field **PACK** Set of elimination based routines for dense linear algebra.*

### Functions

- `template<class T, class CT = const T>`  
`T fflas_const_cast (CT x)`

## 13.248 `debug.h` File Reference

Various utilities for debugging.

```
#include <fflas-ffpack/fflas-ffpack-config.h>  
#include <iostream>  
#include <sstream>  
#include <cmath>  
#include <stdexcept>
```



## Data Structures

- class [Failure](#)

*A precondition failed.*

## Namespaces

- namespace [FFPACK](#)

*Finite Field **PACK** Set of elimination based routines for dense linear algebra.*

## Macros

- `#define FFLASFFPACK_check(check)`
- `#define FFLASFFPACK_abort(msg)`

## Functions

- [Failure](#) & [failure](#) ()
- `template<class T>`  
`bool isOdd (const T &a)`
- `bool isOdd (const float &a)`
- `bool isOdd (const double &a)`

### 13.248.1 Detailed Description

Various utilities for debugging.

**Todo** we should put vector printing elsewhere.

### 13.248.2 Macro Definition Documentation

#### 13.248.2.1 FFLASFFPACK\_check

```
#define FFLASFFPACK_check(  
    check)
```

**Value:**

```
if (!(check)) {\n    FFPACK::failure() (__func__, __FILE__, __LINE__, #check); \n    throw std::runtime_error(#check); \n}
```

#### 13.248.2.2 FFLASFFPACK\_abort

```
#define FFLASFFPACK_abort(  
    msg)
```

**Value:**

```
{\n    FFPACK::failure() (__func__, __FILE__, __LINE__, msg); \n    throw std::runtime_error(msg); \n}
```

## 13.249 fflas\_intrinsic.h File Reference

## 13.250 fflas\_io.h File Reference

```
#include <cstring>\n#include <stdio.h>\n#include <stdlib.h>\n#include <fstream>\n#include "fflas-ffpack/fflas/fflas.h"
```

```
#include "fflas_memory.h"
```

## Namespaces

- namespace [FFLAS](#)

## Enumerations

- enum [FFLAS\\_FORMAT](#) {  
[FflasAuto](#) = 0 , [FflasDense](#) = 1 , [FflasSMS](#) = 2 , [FflasBinary](#) = 3 ,  
[FflasMath](#) = 4 , [FflasMaple](#) = 5 , [FflasSageMath](#) = 6 }

## Functions

- template<class [Field](#)>  
std::ostream & [WriteMatrix](#) (std::ostream &c, const [Field](#) &F, size\_t m, size\_t n, typename [Field::ConstElement\\_ptr](#) A, size\_t lda, [FFLAS\\_FORMAT](#) format, bool column\_major)  
*WriteMatrix: write a matrix to an output stream.*
- void [preamble](#) (std::ifstream &ifs, [FFLAS\\_FORMAT](#) &format)
- template<class [Field](#)>  
[Field::Element\\_ptr](#) [ReadMatrix](#) (std::ifstream &ifs, [Field](#) &F, size\_t &m, size\_t &n, typename [Field::Element\\_ptr](#) &A, [FFLAS\\_FORMAT](#) format=[FflasAuto](#))  
*ReadMatrix: read a matrix from an input stream.*
- template<class [Field](#)>  
[Field::Element\\_ptr](#) [ReadMatrix](#) (const std::string &matrix\_file, [Field](#) &F, size\_t &m, size\_t &n, typename [Field::Element\\_ptr](#) &A, [FFLAS\\_FORMAT](#) format=[FflasAuto](#))  
*ReadMatrix: read a matrix from a file.*
- template<class [Field](#)>  
void [WriteMatrix](#) (std::string &matrix\_file, const [Field](#) &F, int m, int n, typename [Field::ConstElement\\_ptr](#) A, size\_t lda, [FFLAS\\_FORMAT](#) format=[FflasDense](#), bool column\_major=false)  
*WriteMatrix: write a matrix to a file.*
- std::ostream & [WritePermutation](#) (std::ostream &c, const size\_t \*P, size\_t N)  
*WritePermutation: write a permutation matrix to an output stream.*

## 13.251 fflas\_memory.h File Reference

```
#include "fflas-ffpack/utils/align-allocator.h"
#include <givaro/givinteger.h>
```

## Namespaces

- namespace [FFLAS](#)

## Functions

- template<class [Element](#)>  
bool [alignable](#) ()
- template<> bool [alignable](#)< [Givaro::Integer](#) \* > ()
- template<class [Field](#)>  
[Field::Element\\_ptr](#) [fflas\\_new](#) (const [Field](#) &F, const size\_t m, const Alignment align=[Alignment::DEFAULT](#))
- template<class [Field](#)>  
[Field::Element\\_ptr](#) [fflas\\_new](#) (const [Field](#) &F, const size\_t m, const size\_t n, const Alignment align=[Alignment::DEFAULT](#))
- template<class [Element](#)>  
[Element](#) \* [fflas\\_new](#) (const size\_t m, const Alignment align=[Alignment::DEFAULT](#))

- template<class [Element\\_ptr](#)>  
void [fflas\\_delete](#) ([Element\\_ptr](#) A)
- template<class Ptr, class ... Args>  
void [fflas\\_delete](#) (Ptr p, Args ... args)
- void [prefetch](#) (const int64\_t \*)
- void [getTLBSize](#) (int &tlb)
- void [queryCacheSizes](#) (int &l1, int &l2, int &l3)
- int [queryL1CacheSize](#) ()
- int [queryTopLevelCacheSize](#) ()

## 13.252 fflas\_randommatrix.h File Reference

```
#include "fflas-ffpack/fflas-ffpack-config.h"
#include "fflas-ffpack/utils/debug.h"
#include "fflas-ffpack/fflas/fflas.h"
#include <givaro/givinteger.h>
#include <givaro/givintprime.h>
#include <givaro/givranditer.h>
#include "fflas-ffpack/ffpack/ffpack.h"
```

### Namespaces

- namespace [FFPACK](#)  
*Finite Field **PACK** Set of elimination based routines for dense linear algebra.*

### Functions

- template<class [Field](#), class RandIter>  
[Field::Element\\_ptr NonZeroRandomMatrix](#) (const [Field](#) &F, size\_t m, size\_t n, typename [Field::Element\\_ptr](#) A, size\_t lda, RandIter &G)  
*Random non-zero Matrix.*
- template<class [Field](#), class RandIter>  
[Field::Element\\_ptr NonZeroRandomMatrix](#) (const [Field](#) &F, size\_t m, size\_t n, typename [Field::Element\\_ptr](#) A, size\_t lda)  
*Random non-zero Matrix.*
- template<class [Field](#), class RandIter>  
[Field::Element\\_ptr RandomMatrix](#) (const [Field](#) &F, size\_t m, size\_t n, typename [Field::Element\\_ptr](#) A, size\_t lda, RandIter &G)  
*Random Matrix.*
- template<class [Field](#)>  
[Field::Element\\_ptr RandomMatrix](#) (const [Field](#) &F, size\_t m, size\_t n, typename [Field::Element\\_ptr](#) A, size\_t lda)  
*Random Matrix.*
- template<class [Field](#), class RandIter>  
[Field::Element\\_ptr RandomTriangularMatrix](#) (const [Field](#) &F, size\_t m, size\_t n, const [FFLAS::FFLAS\\_UPLO](#) UpLo, const [FFLAS::FFLAS\\_DIAG](#) Diag, bool nonsingular, typename [Field::Element\\_ptr](#) A, size\_t lda, RandIter &G)  
*Random Triangular Matrix.*
- template<class [Field](#)>  
[Field::Element\\_ptr RandomTriangularMatrix](#) (const [Field](#) &F, size\_t m, size\_t n, const [FFLAS::FFLAS\\_UPLO](#) UpLo, const [FFLAS::FFLAS\\_DIAG](#) Diag, bool nonsingular, typename [Field::Element\\_ptr](#) A, size\_t lda)  
*Random Triangular Matrix.*
- size\_t [RandInt](#) (size\_t a, size\_t b)

- `template<class Field, class RandIter>`  
`Field::Element_ptr RandomSymmetricMatrix` (const `Field` &F, `size_t` n, bool nonsingular, typename `Field::Element_ptr` A, `size_t` lda, `RandIter` &G)  
*Random Symmetric Matrix.*
- `template<class Field, class RandIter>`  
`Field::Element_ptr RandomMatrixWithRank` (const `Field` &F, `size_t` m, `size_t` n, `size_t` r, typename `Field::Element_ptr` A, `size_t` lda, `RandIter` &G)  
*Random Matrix with prescribed rank.*
- `template<class Field>`  
`Field::Element_ptr RandomMatrixWithRank` (const `Field` &F, `size_t` m, `size_t` n, `size_t` r, typename `Field::Element_ptr` A, `size_t` lda)  
*Random Matrix with prescribed rank.*
- `size_t * RandomIndexSubset` (`size_t` N, `size_t` R, `size_t` \*P)  
*Pick uniformly at random a sequence of  $R$  distinct elements from the set  $\{0, \dots, N - 1\}$  using Knuth's shuffle.*
- `size_t * RandomPermutation` (`size_t` N, `size_t` \*P)  
*Pick uniformly at random a permutation of size  $N$  stored in LAPACK format using Knuth's shuffle.*
- `void RandomRankProfileMatrix` (`size_t` M, `size_t` N, `size_t` R, `size_t` \*rows, `size_t` \*cols)  
*Pick uniformly at random an  $R$ -subpermutation of dimension  $M \times N$  : a matrix with only  $R$  non-zeros equal to one, in a random rook placement.*
- `void swapval` (`size_t` k, `size_t` N, `size_t` \*P, `size_t` val)
- `void RandomSymmetricRankProfileMatrix` (`size_t` N, `size_t` R, `size_t` \*rows, `size_t` \*cols)  
*Pick uniformly at random a symmetric  $R$ -subpermutation of dimension  $N \times N$  : a symmetric matrix with only  $R$  non-zeros, all equal to one, in a random rook placement.*
- `void RandomLTQSRankProfileMatrix` (`size_t` n, `size_t` r, `size_t` t, `size_t` \*rows, `size_t` \*cols)
- `template<class Field, class RandIter>`  
`Field::Element_ptr RandomMatrixWithRankandRPM` (const `Field` &F, `size_t` M, `size_t` N, `size_t` R, typename `Field::Element_ptr` A, `size_t` lda, const `size_t` \*RRP, const `size_t` \*CRP, `RandIter` &G)  
*Random Matrix with prescribed rank and rank profile matrix Creates an  $m \times n$  matrix with random entries and rank  $r$ .*
- `template<class Field>`  
`Field::Element_ptr RandomMatrixWithRankandRPM` (const `Field` &F, `size_t` M, `size_t` N, `size_t` R, typename `Field::Element_ptr` A, `size_t` lda, const `size_t` \*RRP, const `size_t` \*CRP)  
*Random Matrix with prescribed rank and rank profile matrix Creates an  $m \times n$  matrix with random entries and rank  $r$ .*
- `template<class Field, class RandIter>`  
`Field::Element_ptr RandomSymmetricMatrixWithRankandRPM` (const `Field` &F, `size_t` N, `size_t` R, typename `Field::Element_ptr` A, `size_t` lda, const `size_t` \*RRP, const `size_t` \*CRP, `RandIter` &G)  
*Random Symmetric Matrix with prescribed rank and rank profile matrix Creates an  $n \times n$  symmetric matrix with random entries and rank  $r$ .*
- `template<class Field>`  
`Field::Element_ptr RandomSymmetricMatrixWithRankandRPM` (const `Field` &F, `size_t` M, `size_t` N, `size_t` R, typename `Field::Element_ptr` A, `size_t` lda, const `size_t` \*RRP, const `size_t` \*CRP)  
*Random Symmetric Matrix with prescribed rank and rank profile matrix Creates an  $n \times n$  symmetric matrix with random entries and rank  $r$ .*
- `template<class Field, class RandIter>`  
`Field::Element_ptr RandomMatrixWithRankandRandomRPM` (const `Field` &F, `size_t` M, `size_t` N, `size_t` R, typename `Field::Element_ptr` A, `size_t` lda, `RandIter` &G)  
*Random Matrix with prescribed rank, with random rank profile matrix Creates an  $m \times n$  matrix with random entries, rank  $r$  and with a rank profile matrix chosen uniformly at random.*
- `template<class Field>`  
`Field::Element_ptr RandomMatrixWithRankandRandomRPM` (const `Field` &F, `size_t` M, `size_t` N, `size_t` R, typename `Field::Element_ptr` A, `size_t` lda)  
*Random Matrix with prescribed rank, with random rank profile matrix Creates an  $m \times n$  matrix with random entries, rank  $r$  and with a rank profile matrix chosen uniformly at random.*
- `template<class Field, class RandIter>`  
`Field::Element_ptr RandomSymmetricMatrixWithRankandRandomRPM` (const `Field` &F, `size_t` N, `size_t` R, typename `Field::Element_ptr` A, `size_t` lda, `RandIter` &G)

*Random Symmetric Matrix with prescribed rank, with random rank profile matrix Creates an  $n \times n$  matrix with random entries, rank  $r$  and with a rank profile matrix chosen uniformly at random.*

- `template<class Field>`  
`Field::Element_ptr RandomSymmetricMatrixWithRankandRandomRPM (const Field &F, size_t N, size_t R, typename Field::Element_ptr A, size_t lda)`  
*Random Symmetric Matrix with prescribed rank, with random rank profile matrix Creates an  $n \times n$  matrix with random entries, rank  $r$  and with a rank profile matrix chosen uniformly at random.*
- `template<class Field>`  
`Field::Element_ptr RandomMatrixWithDet (const Field &F, size_t n, const typename Field::Element d, typename Field::Element_ptr A, size_t lda)`  
*Random Matrix with prescribed det.*
- `template<class Field, class RandIter>`  
`Field::Element_ptr RandomMatrixWithDet (const Field &F, size_t n, const typename Field::Element d, typename Field::Element_ptr A, size_t lda, RandIter &G)`  
*Random Matrix with prescribed det.*
- `template<class Field, class RandIter>`  
`Field::Element_ptr RandomLTQSMMatrixWithRankandQSorder (Field &F, size_t n, size_t r, size_t t, typename Field::Element_ptr A, size_t lda, RandIter &G)`

## 13.253 flimits.h File Reference

```
#include <climits>
#include <limits>
#include <type_traits>
#include <givaro/givinteger.h>
```

### Data Structures

- `struct limits< unsigned char >`
- `struct limits< signed char >`
- `struct limits< char >`
- `struct limits< unsigned short int >`
- `struct limits< short int >`
- `struct limits< unsigned int >`
- `struct limits< int >`
- `struct limits< unsigned long >`
- `struct limits< long >`
- `struct limits< unsigned long long >`
- `struct limits< long long >`
- `struct limits< float >`
- `struct limits< double >`
- `struct limits< Givaro::Integer >`
- `struct limits< Reclnt::ruint< K > >`
- `struct limits< Reclnt::rint< K > >`

### Functions

- `template<class T, class E>`  
`std::enable_if< std::is_signed< T >::value==std::is_signed< E >::value, bool >::type in_range (E e)`
- `template<class T, class E>`  
`std::enable_if<(std::is_signed< T >::value)&&! (std::is_signed< E >::value), bool >::type in_range (E e)`
- `template<class T, class E>`  
`std::enable_if<! (std::is_signed< T >::value)&&(std::is_signed< E >::value), bool >::type in_range (E e)`

### 13.253.1 Function Documentation

#### 13.253.1.1 `in_range()` [1/3]

```
template<class T, class E>
std::enable_if< std::is_signed< T >::value==std::is_signed< E >::value, bool >::type in_↵
range (
    E e)
```

#### 13.253.1.2 `in_range()` [2/3]

```
template<class T, class E>
std::enable_if<(std::is_signed< T >::value)&&!(std::is_signed< E >::value), bool >::type
in_range (
    E e)
```

#### 13.253.1.3 `in_range()` [3/3]

```
template<class T, class E>
std::enable_if<!(std::is_signed< T >::value)&&(std::is_signed< E >::value), bool >::type
in_range (
    E e)
```

## 13.254 Matio.h File Reference

```
#include <cstring>
#include <stdio.h>
#include <stdlib.h>
#include "fflas_memory.h"
```

### Functions

- template<class [Field](#)>  
[Field::Element\\_ptr read\\_field](#) (const [Field](#) &F, const char \*mat\_file, size\_t \*tni, size\_t \*tnj)
- template<class [Field](#)>  
std::ostream & [write\\_field](#) (const [Field](#) &F, std::ostream &c, typename [Field::ConstElement\\_ptr](#) E, int n, int m, int id, bool mapleFormat=false, bool column\_major=false)

### 13.254.1 Function Documentation

#### 13.254.1.1 `read_field()`

```
template<class Field>
Field::Element\_ptr read\_field (
    const Field & F,
    const char * mat_file,
    size_t * tni,
    size_t * tnj)
```

#### 13.254.1.2 `write_field()`

```
template<class Field>
std::ostream & write\_field (
    const Field & F,
    std::ostream & c,
    typename Field::ConstElement\_ptr E,
    int n,
    int m,
```

```

    int id,
    bool mapleFormat = false,
    bool column_major = false)

```

## 13.255 test-utils.h File Reference

```

#include "fflas-ffpack/fflas-ffpack-config.h"
#include "fflas-ffpack/utils/debug.h"
#include "fflas-ffpack/ffpack/ffpack.h"
#include "fflas-ffpack/utils/fflas_randommatrix.h"
#include <givaro/givinteger.h>
#include <givaro/givintprime.h>
#include <givaro/givranditer.h>
#include <givaro/givtimer.h>
#include <random>
#include <functional>

```

### Namespaces

- namespace [FFLAS](#)
- namespace [FFPACK](#)

*Finite Field **PACK** Set of elimination based routines for dense linear algebra.*

### Functions

- uint64\_t [getSeed](#) ()
- template<typename [Field](#)>  
[Field](#) \* [chooseField](#) (Givaro::Integer q, uint64\_t b, uint64\_t seed)
- template<> Givaro::ZRing< int32\_t > \* [chooseField](#)< Givaro::ZRing< int32\_t > > (Givaro::Integer q, uint64\_t b, uint64\_t seed)
- template<> Givaro::ZRing< int64\_t > \* [chooseField](#)< Givaro::ZRing< int64\_t > > (Givaro::Integer q, uint64\_t b, uint64\_t seed)
- template<> Givaro::ZRing< float > \* [chooseField](#)< Givaro::ZRing< float > > (Givaro::Integer q, uint64\_t b, uint64\_t seed)
- template<> Givaro::ZRing< double > \* [chooseField](#)< Givaro::ZRing< double > > (Givaro::Integer q, uint64\_t b, uint64\_t seed)

## 13.256 timer.h File Reference

```

#include <time.h>
#include <givaro/givtimer.h>

```

### Namespaces

- namespace [FFLAS](#)

### Typedefs

- typedef Givaro::Timer [Timer](#)
- typedef Givaro::BaseTimer [BaseTimer](#)
- typedef Givaro::UserTimer [UserTimer](#)
- typedef Givaro::SysTimer [SysTimer](#)

## 13.257 cblas.C File Reference

```
#include "fflas-ffpack/config-blas.h"
```

### Macros

- #define [\\_\\_FFLASFFPACK\\_CONFIGURATION](#)
- #define [\\_\\_FFLASFFPACK\\_HAVE\\_CBLAS](#) 1

### Functions

- int [main](#) ()

### 13.257.1 Macro Definition Documentation

#### 13.257.1.1 \_\_FFLASFFPACK\_CONFIGURATION

```
#define __FFLASFFPACK_CONFIGURATION
```

#### 13.257.1.2 \_\_FFLASFFPACK\_HAVE\_CBLAS

```
#define __FFLASFFPACK_HAVE_CBLAS 1
```

### 13.257.2 Function Documentation

#### 13.257.2.1 main()

```
int main (  
    void )
```

## 13.258 clapack.C File Reference

```
#include "fflas-ffpack/config-blas.h"
```

### Macros

- #define [\\_\\_FFLASFFPACK\\_CONFIGURATION](#)
- #define [\\_\\_FFLASFFPACK\\_HAVE\\_LAPACK](#) 1
- #define [\\_\\_FFLASFFPACK\\_HAVE\\_CLAPACK](#) 1

### Functions

- int [main](#) ()

### 13.258.1 Macro Definition Documentation

#### 13.258.1.1 \_\_FFLASFFPACK\_CONFIGURATION

```
#define __FFLASFFPACK_CONFIGURATION
```

#### 13.258.1.2 \_\_FFLASFFPACK\_HAVE\_LAPACK

```
#define __FFLASFFPACK_HAVE_LAPACK 1
```

#### 13.258.1.3 \_\_FFLASFFPACK\_HAVE\_CLAPACK

```
#define __FFLASFFPACK_HAVE_CLAPACK 1
```



## 13.258.2 Function Documentation

### 13.258.2.1 main()

```
int main (
    void )
```

## 13.259 cuda.C File Reference

```
#include <stdio.h>
#include <cuda_runtime.h>
#include <cusparse.h>
```

### Functions

- int [main](#) ()

## 13.259.1 Function Documentation

### 13.259.1.1 main()

```
int main (
    void )
```

## 13.260 fblas.C File Reference

```
#include "fflas-ffpack/config-blas.h"
```

### Macros

- #define [\\_\\_FFLASFFPACK\\_CONFIGURATION](#)

### Functions

- void [dgemm\\_](#) (const char \*, const char \*, const int \*, const int \*, const int \*, const double \*, const double \*, const int \*, const double \*, const int \*, const double \*, double \*, const int \*)
- int [main](#) ()

## 13.260.1 Macro Definition Documentation

### 13.260.1.1 \_\_FFLASFFPACK\_CONFIGURATION

```
#define __FFLASFFPACK_CONFIGURATION
```

## 13.260.2 Function Documentation

### 13.260.2.1 dgemm\_()

```
void dgemm_ (
    const char * ,
    const char * ,
    const int * ,
    const int * ,
    const int * ,
    const double * ,
    const double * ,
    const int * ,
```

```

    const double * ,
    const int * ,
    const double * ,
    double * ,
    const int * )

```

### 13.260.2.2 main()

```

int main (
    void )

```

## 13.261 lapack.C File Reference

```
#include "fflas-ffpack/config-blas.h"
```

### Macros

- `#define __FFLASFFPACK_CONFIGURATION`
- `#define __FFLASFFPACK_HAVE_LAPACK 1`

### Functions

- int [main](#) ()

### 13.261.1 Macro Definition Documentation

#### 13.261.1.1 \_\_FFLASFFPACK\_CONFIGURATION

```
#define __FFLASFFPACK_CONFIGURATION
```

#### 13.261.1.2 \_\_FFLASFFPACK\_HAVE\_LAPACK

```
#define __FFLASFFPACK_HAVE_LAPACK 1
```

### 13.261.2 Function Documentation

#### 13.261.2.1 main()

```

int main (
    void )

```

## 13.262 regression-check.C File Reference

```

#include "fflas-ffpack/fflas-ffpack-config.h"
#include <givaro/modular.h>
#include "fflas-ffpack/fflas-ffpack.h"

```

### Functions

- bool [check1](#) ()
- bool [check2](#) ()
- bool [check3](#) ()
- bool [check4](#) ()
- bool [checkZeroDimCharpoly](#) ()
- bool [checkZeroDimMinPoly](#) ()
- bool [gf2ModularBalanced](#) ()
- int [main](#) ()

## 13.262.1 Function Documentation

### 13.262.1.1 check1()

```
bool check1 ()
```

### 13.262.1.2 check2()

```
bool check2 ()
```

### 13.262.1.3 check3()

```
bool check3 ()
```

### 13.262.1.4 check4()

```
bool check4 ()
```

### 13.262.1.5 checkZeroDimCharpoly()

```
bool checkZeroDimCharpoly ()
```

### 13.262.1.6 checkZeroDimMinPoly()

```
bool checkZeroDimMinPoly ()
```

### 13.262.1.7 gf2ModularBalanced()

```
bool gf2ModularBalanced ()
```

### 13.262.1.8 main()

```
int main (
    void )
```

## 13.263 test-charpoly-check.C File Reference

```
#include <iostream>
#include <stdlib.h>
#include <time.h>
#include "fflas-ffpack/fflas-ffpack.h"
#include "fflas-ffpack/utils/args-parser.h"
#include "fflas-ffpack/utils/test-utils.h"
#include "fflas-ffpack/utils/fflas_io.h"
```

### Macros

- `#define ENABLE_CHECKER_charpoly 1`
- `#define TIME_CHECKER_CHARPOLY 1`

### Functions

- `template<class Field, class Polynomial>`  
`void printPolynomial (const Field &F, Polynomial &v)`
- `int main (int argc, char **argv)`

### 13.263.1 Macro Definition Documentation

#### 13.263.1.1 ENABLE\_CHECKER\_charpoly

```
#define ENABLE_CHECKER_charpoly 1
```

#### 13.263.1.2 TIME\_CHECKER\_CHARPOLY

```
#define TIME_CHECKER_CHARPOLY 1
```

### 13.263.2 Function Documentation

#### 13.263.2.1 printPolynomial()

```
template<class Field, class Polynomial>
void printPolynomial (
    const Field & F,
    Polynomial & v)
```

#### 13.263.2.2 main()

```
int main (
    int argc,
    char ** argv)
```

## 13.264 test-charpoly.C File Reference

```
#include <iostream>
#include <iomanip>
#include "givaro/modular.h"
#include "fflas-ffpack/utils/fflas_io.h"
#include "fflas-ffpack/utils/fflas_randommatrix.h"
#include "fflas-ffpack/ffpack/ffpack.h"
#include "fflas-ffpack/utils/args-parser.h"
#include "fflas-ffpack/utils/test-utils.h"
#include <random>
#include <chrono>
```

### Functions

- template<class Field, class RandIter>  
bool **launch\_test** (const Field &F, size\_t n, typename Field::Element \*A, size\_t lda, size\_t nbit, RandIter &G, FFPACK::FFPACK\_CHARPOLY\_TAG CT)
- template<class Field>  
bool **run\_with\_field** (const Givaro::Integer p, uint64\_t bits, size\_t n, std::string file, int variant, size\_t iter, uint64\_t seed)
- int **main** (int argc, char \*\*argv)

### 13.264.1 Function Documentation

#### 13.264.1.1 launch\_test()

```
template<class Field, class RandIter>
bool launch_test (
    const Field & F,
    size_t n,
    typename Field::Element * A,
    size_t lda,
```

```

    size_t nbit,
    RandIter & G,
    FFPACK::FFPACK_CHARPOLY_TAG CT)

```

### 13.264.1.2 run\_with\_field()

```

template<class Field>
bool run_with_field (
    const Givaro::Integer p,
    uint64_t bits,
    size_t n,
    std::string file,
    int variant,
    size_t iter,
    uint64_t seed)

```

### 13.264.1.3 main()

```

int main (
    int argc,
    char ** argv)

```

## 13.265 test-compressQ.C File Reference

```

#include "fflas-ffpack/fflas-ffpack-config.h"
#include <iostream>
#include <list>
#include <vector>
#include <givaro/modular-balanced.h>
#include "fflas-ffpack/utils/timer.h"
#include "fflas-ffpack/ffpack/ffpack.h"
#include "fflas-ffpack/utils/args-parser.h"

```

### Typedefs

- typedef Givaro::Modular< double > [Field](#)

### Functions

- template<class T>  
std::ostream & [printvect](#) (std::ostream &o, [vector](#)< T > &vect)
- int [main](#) (int argc, char \*\*argv)

## 13.265.1 Typedef Documentation

### 13.265.1.1 Field

```

typedef Givaro::Modular<double> Field

```

## 13.265.2 Function Documentation

### 13.265.2.1 printvect()

```

template<class T>
std::ostream & printvect (
    std::ostream & o,
    vector< T > & vect)

```

**Bug** does not belong here

### 13.265.2.2 main()

```
int main (  
    int argc,  
    char ** argv)
```

## 13.266 test-det-check.C File Reference

```
#include <iostream>  
#include <stdlib.h>  
#include <time.h>  
#include "fflas-ffpack/fflas-ffpack.h"  
#include "fflas-ffpack/utils/args-parser.h"  
#include "fflas-ffpack/utils/test-utils.h"  
#include "fflas-ffpack/checkers/checkers_ffpack.h"  
#include "fflas-ffpack/checkers/checkers_ffpack.inl"
```

### Macros

- `#define ENABLE_CHECKER_Det 1`
- `#define TIME_CHECKER_Det 1`

### Functions

- `int main (int argc, char **argv)`

## 13.266.1 Macro Definition Documentation

### 13.266.1.1 ENABLE\_CHECKER\_Det

```
#define ENABLE_CHECKER_Det 1
```

### 13.266.1.2 TIME\_CHECKER\_Det

```
#define TIME_CHECKER_Det 1
```

## 13.266.2 Function Documentation

### 13.266.2.1 main()

```
int main (  
    int argc,  
    char ** argv)
```

## 13.267 test-det.C File Reference

```
#include "fflas-ffpack/fflas-ffpack-config.h"  
#include <iomanip>  
#include <iostream>  
#include <givaro/modular-balanced.h>  
#include "fflas-ffpack/utils/timer.h"  
#include "fflas-ffpack/ffpack/ffpack.h"  
#include "fflas-ffpack/utils/args-parser.h"  
#include "fflas-ffpack/utils/test-utils.h"
```

## Functions

- template<class [Field](#), class RandIter>  
bool [test\\_det](#) ([Field](#) &F, size\_t n, int iter, RandIter &G)
- int [main](#) (int argc, char \*\*argv)

### 13.267.1 Function Documentation

#### 13.267.1.1 test\_det()

```
template<class Field, class RandIter>
bool test_det (
    Field & F,
    size_t n,
    int iter,
    RandIter & G)
```

[Todo](#) test with stride

#### 13.267.1.2 main()

```
int main (
    int argc,
    char ** argv)
```

## 13.268 test-echelon.C File Reference

```
#include "fflas-ffpack/fflas-ffpack-config.h"
#include <iostream>
#include <iomanip>
#include <givaro/modular-balanced.h>
#include <givaro/udl.h>
#include "fflas-ffpack/utils/timer.h"
#include "fflas-ffpack/ffpack/ffpack.h"
#include "fflas-ffpack/utils/args-parser.h"
#include "fflas-ffpack/utils/test-utils.h"
#include "fflas-ffpack/utils/fflas_io.h"
#include <random>
#include <chrono>
```

## Macros

- #define [\\_\\_FFLASFFPACK\\_SEQUENTIAL](#)
- #define [\\_\\_FFLASFFPACK\\_GAUSSJORDAN\\_BASECASE](#) 25
- #define [\\_\\_FFLASFFPACK\\_PLUQ\\_THRESHOLD](#) 25

## Functions

- template<class [Field](#), class RandIter>  
bool [test\\_colechelon](#) ([Field](#) &F, size\_t m, size\_t n, size\_t r, size\_t iters, FFPACK::FFPACK\_LU\_TAG LuTag, RandIter &G, bool par)
- template<class [Field](#), class RandIter>  
bool [test\\_rowechelon](#) ([Field](#) &F, size\_t m, size\_t n, size\_t r, size\_t iters, FFPACK::FFPACK\_LU\_TAG LuTag, RandIter &G, bool par)
- template<class [Field](#), class RandIter>  
bool [test\\_redcoechelon](#) ([Field](#) &F, size\_t m, size\_t n, size\_t r, size\_t iters, FFPACK::FFPACK\_LU\_TAG LuTag, RandIter &G, bool par)

- template<class [Field](#), class RandIter>  
bool [test\\_redrowechelon](#) ([Field](#) &F, size\_t m, size\_t n, size\_t r, size\_t iters, FFPACK::FFPACK\_LU\_TAG LuTag, RandIter &G, bool par)
- template<class [Field](#)>  
bool [run\\_with\\_field](#) (Givaro::Integer q, uint64\_t b, size\_t m, size\_t n, size\_t r, size\_t iters, uint64\_t seed)
- int [main](#) (int argc, char \*\*argv)

## 13.268.1 Macro Definition Documentation

### 13.268.1.1 \_\_FFLASFFPACK\_SEQUENTIAL

```
#define __FFLASFFPACK_SEQUENTIAL
```

### 13.268.1.2 \_\_FFLASFFPACK\_GAUSSJORDAN\_BASECASE

```
#define __FFLASFFPACK_GAUSSJORDAN_BASECASE 25
```

### 13.268.1.3 \_\_FFLASFFPACK\_PLUQ\_THRESHOLD

```
#define __FFLASFFPACK_PLUQ_THRESHOLD 25
```

## 13.268.2 Function Documentation

### 13.268.2.1 test\_colechelon()

```
template<class Field, class RandIter>
bool test_colechelon (
    Field & F,
    size_t m,
    size_t n,
    size_t r,
    size_t iters,
    FFPACK::FFPACK_LU_TAG LuTag,
    RandIter & G,
    bool par)
```

[Todo](#) check Ida

### 13.268.2.2 test\_rowechelon()

```
template<class Field, class RandIter>
bool test_rowechelon (
    Field & F,
    size_t m,
    size_t n,
    size_t r,
    size_t iters,
    FFPACK::FFPACK_LU_TAG LuTag,
    RandIter & G,
    bool par)
```

[Todo](#) check Ida

### 13.268.2.3 test\_redcolechelon()

```
template<class Field, class RandIter>
bool test_redcolechelon (
    Field & F,
```



```

    size_t m,
    size_t n,
    size_t r,
    size_t iters,
    FFPACK::FFPACK_LU_TAG LuTag,
    RandIter & G,
    bool par)

```

**Todo** check Ida

#### 13.268.2.4 test\_redrowechelon()

```

template<class Field, class RandIter>
bool test_redrowechelon (
    Field & F,
    size_t m,
    size_t n,
    size_t r,
    size_t iters,
    FFPACK::FFPACK_LU_TAG LuTag,
    RandIter & G,
    bool par)

```

**Todo** check Ida

#### 13.268.2.5 run\_with\_field()

```

template<class Field>
bool run_with_field (
    Givaro::Integer q,
    uint64_t b,
    size_t m,
    size_t n,
    size_t r,
    size_t iters,
    uint64_t seed)

```

#### 13.268.2.6 main()

```

int main (
    int argc,
    char ** argv)

```

## 13.269 test-fadd.C File Reference

```

#include "fflas-ffpack/fflas-ffpack-config.h"
#include <typeinfo>
#include <givaro/modular-balanced.h>
#include "fflas-ffpack/utils/timer.h"
#include "fflas-ffpack/fflas/fflas.h"
#include "fflas-ffpack/utils/args-parser.h"
#include "fflas-ffpack/utils/test-utils.h"
#include "assert.h"

```

## Functions

- `template<class Field>`  
`bool test_fadd (const Field &F, size_t m, size_t k, size_t n, bool timing, uint64_t seed)`
- `template<class Field>`  
`bool test_faddin (const Field &F, size_t m, size_t k, size_t n, bool timing, uint64_t seed)`
- `template<class Field>`  
`bool test_fsub (const Field &F, size_t m, size_t k, size_t n, bool timing, uint64_t seed)`
- `template<class Field>`  
`bool test_fsubin (const Field &F, size_t m, size_t k, size_t n, bool timing, uint64_t seed)`
- `int main (int ac, char **av)`

## 13.269.1 Function Documentation

### 13.269.1.1 test\_fadd()

```
template<class Field>
bool test_fadd (
    const Field & F,
    size_t m,
    size_t k,
    size_t n,
    bool timing,
    uint64_t seed)
```

### 13.269.1.2 test\_faddin()

```
template<class Field>
bool test_faddin (
    const Field & F,
    size_t m,
    size_t k,
    size_t n,
    bool timing,
    uint64_t seed)
```

### 13.269.1.3 test\_fsub()

```
template<class Field>
bool test_fsub (
    const Field & F,
    size_t m,
    size_t k,
    size_t n,
    bool timing,
    uint64_t seed)
```

### 13.269.1.4 test\_fsubin()

```
template<class Field>
bool test_fsubin (
    const Field & F,
    size_t m,
    size_t k,
    size_t n,
    bool timing,
    uint64_t seed)
```

### 13.269.1.5 main()

```
int main (
    int ac,
    char ** av)
```

## 13.270 test-fdot.C File Reference

```
#include "fflas-ffpack/fflas-ffpack-config.h"
#include <iomanip>
#include <iostream>
#include "fflas-ffpack/fflas/fflas.h"
#include "fflas-ffpack/utils/args-parser.h"
#include "fflas-ffpack/utils/test-utils.h"
#include "fflas-ffpack/paladin/parallel.h"
#include "fflas-ffpack/paladin/fflas_plevel1.h"
#include <givaro/zring.h>
#include <givaro/modular.h>
#include <random>
#include <chrono>
```

### Macros

- `#define ENABLE\_ALL\_CHECKINGS 1`

### Functions

- `template<typename Field>`  
`bool check\_fdot (const Field &F, size_t n, typename Field::ConstElement\_ptr a, size_t inca, typename Field::ConstElement\_ptr b, size_t incb)`
- `template<class Field>`  
`bool run\_with\_field (Givaro::Integer q, size_t BS, size_t n, size_t iters, uint64_t seed)`
- `bool run\_with\_Integer (size_t BS, size_t n, size_t iters, uint64_t seed)`
- `int main (int argc, char **argv)`

## 13.270.1 Macro Definition Documentation

### 13.270.1.1 [ENABLE\\_ALL\\_CHECKINGS](#)

```
#define ENABLE\_ALL\_CHECKINGS 1
```

## 13.270.2 Function Documentation

### 13.270.2.1 [check\\_fdot\(\)](#)

```
template<typename Field>
bool check\_fdot (
    const Field & F,
    size_t n,
    typename Field::ConstElement\_ptr a,
    size_t inca,
    typename Field::ConstElement\_ptr b,
    size_t incb)
```

### 13.270.2.2 [run\\_with\\_field\(\)](#)

```
template<class Field>
bool run\_with\_field (
```

```
Givaro::Integer q,
size_t BS,
size_t n,
size_t iters,
uint64_t seed)
```

### 13.270.2.3 run\_with\_Integer()

```
bool run_with_Integer (
    size_t BS,
    size_t n,
    size_t iters,
    uint64_t seed)
```

### 13.270.2.4 main()

```
int main (
    int argc,
    char ** argv)
```

## 13.271 test-fgemm-check.C File Reference

```
#include <iostream>
#include <stdlib.h>
#include <time.h>
#include "fflas-ffpack/fflas-ffpack.h"
#include "fflas-ffpack/utils/args-parser.h"
#include "fflas-ffpack/utils/test-utils.h"
```

### Macros

- #define [ENABLE\\_ALL\\_CHECKINGS](#) 1

### Functions

- template<class [Field](#), class RandIter>  
bool [launch\\_MM\\_dispatch](#) (const [Field](#) &F, const int mm, const int nn, const int kk, const typename [Field::Element](#) alpha, const typename [Field::Element](#) beta, const size\_t iters, RandIter &G)
- template<class [Field](#)>  
bool [run\\_with\\_field](#) (Givaro::Integer q, uint64\_t b, int m, int n, int k, size\_t iters, uint64\_t seed)
- int [main](#) (int argc, char \*\*argv)

## 13.271.1 Macro Definition Documentation

### 13.271.1.1 ENABLE\_ALL\_CHECKINGS

```
#define ENABLE_ALL_CHECKINGS 1
```

## 13.271.2 Function Documentation

### 13.271.2.1 launch\_MM\_dispatch()

```
template<class Field, class RandIter>
bool launch_MM_dispatch (
    const Field & F,
    const int mm,
    const int nn,
    const int kk,
```

```
const typename Field::Element alpha,
const typename Field::Element beta,
const size_t iters,
RandIter & G)
```

**Bug** test for ldX equal

**Bug**

**Bug** test for transpo

**Bug**

**Todo** does nbw actually do nbw recursive calls and then call blas (check ?) ?

### 13.271.2.2 run\_with\_field()

```
template<class Field>
bool run_with_field (
    Givaro::Integer q,
    uint64_t b,
    int m,
    int n,
    int k,
    size_t iters,
    uint64_t seed)
```

### 13.271.2.3 main()

```
int main (
    int argc,
    char ** argv)
```

## 13.272 test-fgemm.C File Reference

```
#include "fflas-ffpack/fflas-ffpack-config.h"
#include "fflas-ffpack/utils/fflas_io.h"
#include <iomanip>
#include <iostream>
#include <givaro/modular.h>
#include <recint/rint.h>
#include "fflas-ffpack/utils/timer.h"
#include "fflas-ffpack/fflas/fflas.h"
#include "fflas-ffpack/utils/args-parser.h"
#include "fflas-ffpack/utils/test-utils.h"
#include <random>
```

### Macros

- `#define ENABLE_CHECKER_fgemm 1`

### Functions

- `template<class Field>`  
`bool check_MM (const Field &F, const typename Field::Element_ptr Cd, enum FFLAS_TRANSPOSE &ta, enum FFLAS_TRANSPOSE &tb, const size_t m, const size_t n, const size_t k, const typename Field::Element &alpha, const typename Field::Element_ptr A, size_t lda, const typename Field::Element_ptr B, size_t ldb, const typename Field::Element &beta, const typename Field::Element_ptr C, size_t ldc)`

- `template<class Field, class RandIter>`  
`bool launch_MM (const Field &F, const size_t m, const size_t n, const size_t k, const typename Field::Element`  
`alpha, const typename Field::Element beta, const size_t ldc, const size_t lda, enum FFLAS_TRANSPOSE`  
`ta, const size_t ldb, enum FFLAS_TRANSPOSE tb, size_t iters, int nbw, bool par, RandIter &G)`
- `template<class Field, class RandIter>`  
`bool launch_MM_dispatch (const Field &F, const int mm, const int nn, const int kk, const typename`  
`Field::Element alpha, const typename Field::Element beta, const size_t iters, const int nbw, const bool par,`  
`RandIter &G)`
- `template<class Field>`  
`bool run_with_field (Givaro::Integer q, uint64_t b, int m, int n, int k, int nbw, size_t iters, bool par, size_t seed)`
- `int main (int argc, char **argv)`

## 13.272.1 Macro Definition Documentation

### 13.272.1.1 ENABLE\_CHECKER\_fgemm

```
#define ENABLE_CHECKER_fgemm 1
```

## 13.272.2 Function Documentation

### 13.272.2.1 check\_MM()

```
template<class Field>
bool check_MM (
    const Field & F,
    const typename Field::Element_ptr Cd,
    enum FFLAS_TRANSPOSE & ta,
    enum FFLAS_TRANSPOSE & tb,
    const size_t m,
    const size_t n,
    const size_t k,
    const typename Field::Element & alpha,
    const typename Field::Element_ptr A,
    size_t lda,
    const typename Field::Element_ptr B,
    size_t ldb,
    const typename Field::Element & beta,
    const typename Field::Element_ptr C,
    size_t ldc)
```

### 13.272.2.2 launch\_MM()

```
template<class Field, class RandIter>
bool launch_MM (
    const Field & F,
    const size_t m,
    const size_t n,
    const size_t k,
    const typename Field::Element alpha,
    const typename Field::Element beta,
    const size_t ldc,
    const size_t lda,
    enum FFLAS_TRANSPOSE ta,
    const size_t ldb,
    enum FFLAS_TRANSPOSE tb,
    size_t iters,
    int nbw,
    bool par,
    RandIter & G)
```

**13.272.2.3 launch\_MM\_dispatch()**

```
template<class Field, class RandIter>
bool launch_MM_dispatch (
    const Field & F,
    const int mm,
    const int nn,
    const int kk,
    const typename Field::Element alpha,
    const typename Field::Element beta,
    const size_t iters,
    const int nbw,
    const bool par,
    RandIter & G)
```

**Bug** test for ldX equal

**Bug**

**Bug** test for transpo

**Bug**

**Todo** does nbw actually do nbw recursive calls and then call blas (check ?) ?

**13.272.2.4 run\_with\_field()**

```
template<class Field>
bool run_with_field (
    Givaro::Integer q,
    uint64_t b,
    int m,
    int n,
    int k,
    int nbw,
    size_t iters,
    bool par,
    size_t seed)
```

**13.272.2.5 main()**

```
int main (
    int argc,
    char ** argv)
```

**13.273 test-fgemv.C File Reference**

```
#include "fflas-ffpack/fflas-ffpack-config.h"
#include <iomanip>
#include <iostream>
#include <givaro/modular.h>
#include <recint/rint.h>
#include "fflas-ffpack/utils/timer.h"
#include "fflas-ffpack/fflas/fflas.h"
#include "fflas-ffpack/utils/args-parser.h"
#include "fflas-ffpack/utils/test-utils.h"
```

## Functions

- `template<class Field>`  
`bool check_MV (const Field &F, const typename Field::Element_ptr Cd, enum FFLAS_TRANSPOSE &ta, const size_t m, const size_t k, const typename Field::Element &alpha, const typename Field::Element_ptr A, size_t lda, const typename Field::Element_ptr X, size_t incX, const typename Field::Element &beta, const typename Field::Element_ptr Y, size_t incY)`
- `template<class Field, class RandIter>`  
`bool launch_MV (const Field &F, const size_t m, const size_t k, const typename Field::Element alpha, const typename Field::Element beta, const size_t lda, enum FFLAS_TRANSPOSE ta, const size_t incX, const size_t incY, size_t iters, bool par, RandIter &G)`
- `template<class Field, class RandIter>`  
`bool launch_MV_dispatch (const Field &F, const int mm, const int kk, const typename Field::Element alpha, const typename Field::Element beta, const size_t iters, const bool par, RandIter &G)`
- `template<class Field>`  
`bool run_with_field (Givaro::Integer q, uint64_t b, int m, int k, size_t iters, bool par, uint64_t seed)`
- `int main (int argc, char **argv)`

## 13.273.1 Function Documentation

### 13.273.1.1 check\_MV()

```
template<class Field>
bool check_MV (
    const Field & F,
    const typename Field::Element_ptr Cd,
    enum FFLAS_TRANSPOSE & ta,
    const size_t m,
    const size_t k,
    const typename Field::Element & alpha,
    const typename Field::Element_ptr A,
    size_t lda,
    const typename Field::Element_ptr X,
    size_t incX,
    const typename Field::Element & beta,
    const typename Field::Element_ptr Y,
    size_t incY)
```

### 13.273.1.2 launch\_MV()

```
template<class Field, class RandIter>
bool launch_MV (
    const Field & F,
    const size_t m,
    const size_t k,
    const typename Field::Element alpha,
    const typename Field::Element beta,
    const size_t lda,
    enum FFLAS_TRANSPOSE ta,
    const size_t incX,
    const size_t incY,
    size_t iters,
    bool par,
    RandIter & G)
```

### 13.273.1.3 launch\_MV\_dispatch()

```
template<class Field, class RandIter>
bool launch_MV_dispatch (
```



```

    const Field & F,
    const int mm,
    const int kk,
    const typename Field::Element alpha,
    const typename Field::Element beta,
    const size_t iters,
    const bool par,
    RandIter & G)

```

#### 13.273.1.4 run\_with\_field()

```

template<class Field>
bool run_with_field (
    Givaro::Integer q,
    uint64_t b,
    int m,
    int k,
    size_t iters,
    bool par,
    uint64_t seed)

```

#### 13.273.1.5 main()

```

int main (
    int argc,
    char ** argv)

```

## 13.274 test-fger.C File Reference

```

#include "fflas-ffpack/fflas-ffpack-config.h"
#include <iomanip>
#include <iostream>
#include <givaro/modular-integral.h>
#include <givaro/modular-balanced.h>
#include <givaro/givintprime.h>
#include "fflas-ffpack/utils/timer.h"
#include "fflas-ffpack/fflas/fflas.h"
#include "fflas-ffpack/utils/args-parser.h"
#include "fflas-ffpack/utils/test-utils.h"
#include "fflas-ffpack/utils/fflas_io.h"

```

### Macros

- #define `TIME` 1

### Functions

- template<class `Field`>  
bool `check_fger` (const `Field` &F, const typename `Field::Element_ptr` Cd, const size\_t m, const size\_t n, const typename `Field::Element` &alpha, const typename `Field::Element_ptr` x, const size\_t incx, const typename `Field::Element_ptr` y, const size\_t incy, const typename `Field::Element_ptr` C, const size\_t ldc)
- template<class `Field`, class `RandIter`>  
bool `launch_fger` (const `Field` &F, const size\_t m, const size\_t n, const typename `Field::Element` alpha, const size\_t ldc, const size\_t inca, const size\_t incb, size\_t iters, `RandIter` &G)
- template<class `Field`, class `RandIter`>  
bool `launch_fger_dispatch` (const `Field` &F, const size\_t nn, const typename `Field::Element` alpha, const size\_t iters, `RandIter` &G)

- `template<class Field>`  
`bool run_with_field (int64_t q, uint64_t b, size_t n, size_t iters, uint64_t seed)`
- `int main (int argc, char **argv)`

## 13.274.1 Macro Definition Documentation

### 13.274.1.1 TIME

```
#define TIME 1
```

## 13.274.2 Function Documentation

### 13.274.2.1 check\_fger()

```
template<class Field>
bool check_fger (
    const Field & F,
    const typename Field::Element_ptr Cd,
    const size_t m,
    const size_t n,
    const typename Field::Element & alpha,
    const typename Field::Element_ptr x,
    const size_t incx,
    const typename Field::Element_ptr y,
    const size_t incy,
    const typename Field::Element_ptr C,
    const size_t ldc)
```

### 13.274.2.2 launch\_fger()

```
template<class Field, class RandIter>
bool launch_fger (
    const Field & F,
    const size_t m,
    const size_t n,
    const typename Field::Element alpha,
    const size_t ldc,
    const size_t inca,
    const size_t incb,
    size_t iters,
    RandIter & G)
```

### 13.274.2.3 launch\_fger\_dispatch()

```
template<class Field, class RandIter>
bool launch_fger_dispatch (
    const Field & F,
    const size_t nn,
    const typename Field::Element alpha,
    const size_t iters,
    RandIter & G)
```

**Bug** test for incx equal

**Bug**

**Bug** test for transpo

**Bug**

**Todo** does nbw actually do nbw recursive calls and then call blas (check ?) ?

#### 13.274.2.4 run\_with\_field()

```
template<class Field>
bool run_with_field (
    int64_t q,
    uint64_t b,
    size_t n,
    size_t iters,
    uint64_t seed)
```

#### 13.274.2.5 main()

```
int main (
    int argc,
    char ** argv)
```

## 13.275 test-fgesv.C File Reference

```
#include <iostream>
#include <iomanip>
#include "fflas-ffpack/utils/fflas_io.h"
#include "fflas-ffpack/fflas-ffpack.h"
#include "fflas-ffpack/utils/args-parser.h"
#include "fflas-ffpack/utils/test-utils.h"
#include <givaro/modular.h>
```

### Functions

- template<class Field, class RandIter>  
bool test\_square\_fgesv (Field &F, FFLAS\_SIDE side, string fileA, string fileB, size\_t m, size\_t k, size\_t r, RandIter &G)
- template<class Field, class RandIter>  
bool test\_rect\_fgesv (Field &F, FFLAS\_SIDE side, string fileA, string fileB, size\_t m, size\_t n, size\_t k, size\_t r, RandIter &G)
- template<class Field>  
bool run\_with\_field (Givaro::Integer q, uint64\_t b, size\_t m, size\_t n, size\_t k, size\_t r, size\_t iters, string fileA, string fileB, uint64\_t &seed)
- int main (int argc, char \*\*argv)

### 13.275.1 Function Documentation

#### 13.275.1.1 test\_square\_fgesv()

```
template<class Field, class RandIter>
bool test_square_fgesv (
    Field & F,
    FFLAS_SIDE side,
    string fileA,
    string fileB,
    size_t m,
    size_t k,
    size_t r,
    RandIter & G)
```

#### 13.275.1.2 test\_rect\_fgesv()

```
template<class Field, class RandIter>
bool test_rect_fgesv (
```

```

    Field & F,
    FFLAS_SIDE side,
    string fileA,
    string fileB,
    size_t m,
    size_t n,
    size_t k,
    size_t r,
    RandIter & G)

```

### 13.275.1.3 run\_with\_field()

```

template<class Field>
bool run_with_field (
    Givaro::Integer q,
    uint64_t b,
    size_t m,
    size_t n,
    size_t k,
    size_t r,
    size_t iters,
    string fileA,
    string fileB,
    uint64_t & seed)

```

### 13.275.1.4 main()

```

int main (
    int argc,
    char ** argv)

```

## 13.276 test-finit.C File Reference

```

#include "fflas-ffpack/fflas-ffpack-config.h"
#include <typeinfo>
#include <givaro/modular.h>
#include <givaro/modular-balanced.h>
#include "fflas-ffpack/utils/timer.h"
#include "fflas-ffpack/fflas/fflas.h"
#include "fflas-ffpack/utils/args-parser.h"
#include "fflas-ffpack/utils/test-utils.h"
#include "assert.h"
#include <random>
#include <chrono>

```

### Functions

- template<class Field>  
bool **test\_reduce** (const Field &F, size\_t m, size\_t k, size\_t n, bool timing, uint64\_t seed)
- template<class Field>  
bool **run\_with\_field** (Givaro::Integer q, size\_t b, size\_t m, size\_t k, size\_t n, size\_t iters, bool timing, uint64\_t seed)
- int **main** (int ac, char \*\*av)

## 13.276.1 Function Documentation

### 13.276.1.1 test\_freduce()

```
template<class Field>
bool test_freduce (
    const Field & F,
    size_t m,
    size_t k,
    size_t n,
    bool timing,
    uint64_t seed)
```

### 13.276.1.2 run\_with\_field()

```
template<class Field>
bool run_with_field (
    Givaro::Integer q,
    size_t b,
    size_t m,
    size_t k,
    size_t n,
    size_t iters,
    bool timing,
    uint64_t seed)
```

### 13.276.1.3 main()

```
int main (
    int ac,
    char ** av)
```

## 13.277 test-fscal.C File Reference

```
#include "fflas-ffpack/fflas-ffpack-config.h"
#include <typeinfo>
#include <givaro/modular-balanced.h>
#include "fflas-ffpack/utils/timer.h"
#include "fflas-ffpack/fflas/fflas.h"
#include "fflas-ffpack/utils/args-parser.h"
#include "fflas-ffpack/utils/test-utils.h"
#include "assert.h"
```

### Functions

- template<class Field, class RandIter>  
bool test\_fscal (const Field &F, const typename Field::Element &alpha, size\_t m, size\_t k, size\_t n, bool timing, RandIter &G)
- template<class Field>  
bool test\_fscal (const Field &F, size\_t m, size\_t k, size\_t n, bool timing, uint64\_t seed)
- template<class Field, class RandIter>  
bool test\_fscal\_in (const Field &F, const typename Field::Element &alpha, size\_t m, size\_t k, size\_t n, bool timing, RandIter &G)
- template<class Field>  
bool test\_fscal\_in (const Field &F, size\_t m, size\_t k, size\_t n, bool timing, uint64\_t seed)
- int main (int ac, char \*\*av)

- `template<class Field, class RandIter>`  
`Field::Element_ptr RandomMatrix` (const `Field` &F, `size_t` m, `size_t` n, `typename Field::Element_ptr` A, `size_t` lda, `RandIter` &G)  
*Random Matrix.*

## 13.277.1 Function Documentation

### 13.277.1.1 `test_fscal()` [1/2]

```
template<class Field, class RandIter>
bool test_fscal (
    const Field & F,
    const typename Field::Element & alpha,
    size_t m,
    size_t k,
    size_t n,
    bool timing,
    RandIter & G)
```

### 13.277.1.2 `test_fscal()` [2/2]

```
template<class Field>
bool test_fscal (
    const Field & F,
    size_t m,
    size_t k,
    size_t n,
    bool timing,
    uint64_t seed)
```

### 13.277.1.3 `test_fscalin()` [1/2]

```
template<class Field, class RandIter>
bool test_fscalin (
    const Field & F,
    const typename Field::Element & alpha,
    size_t m,
    size_t k,
    size_t n,
    bool timing,
    RandIter & G)
```

### 13.277.1.4 `test_fscalin()` [2/2]

```
template<class Field>
bool test_fscalin (
    const Field & F,
    size_t m,
    size_t k,
    size_t n,
    bool timing,
    uint64_t seed)
```

### 13.277.1.5 `main()`

```
int main (
    int ac,
    char ** av)
```

### 13.277.1.6 RandomMatrix()

```
template<class Field, class RandIter>
Field::Element_ptr RandomMatrix (
    const Field & F,
    size_t m,
    size_t n,
    typename Field::Element_ptr A,
    size_t lda,
    RandIter & G) [inline]
```

Random Matrix.

Creates a  $m \times n$  matrix with random entries.

#### Parameters

	$F$	field
	$m$	number of rows in A
	$n$	number of cols in A
out	$A$	the matrix (preallocated to at least $m \times lda$ field elements)
	$lda$	leading dimension of A
	$G$	a random iterator

#### Returns

A.

## 13.278 test-fsyr2k.C File Reference

```
#include "fflas-ffpack/fflas-ffpack-config.h"
#include <iomanip>
#include <iostream>
#include <random>
#include "fflas-ffpack/utils/timer.h"
#include "fflas-ffpack/fflas/fflas.h"
#include "fflas-ffpack/utils/args-parser.h"
#include "fflas-ffpack/utils/test-utils.h"
#include <givaro/modular.h>
```

#### Macros

- #define `ENABLE_ALL_CHECKINGS` 1

#### Functions

- template<typename `Field`, class `RandIter`>  
bool `check_fsyr2k` (const `Field` &F, size\_t n, size\_t k, const typename `Field::Element` &alpha, const typename `Field::Element` &beta, `FFLAS::FFLAS_UPLO` uplo, `FFLAS::FFLAS_TRANSPOSE` trans, `RandIter` &Rand)
- template<class `Field`>  
bool `run_with_field` (`Givaro::Integer` q, size\_t b, size\_t n, size\_t k, int a, int c, size\_t iters, uint64\_t seed)
- int `main` (int argc, char \*\*argv)

### 13.278.1 Macro Definition Documentation

#### 13.278.1.1 ENABLE\_ALL\_CHECKINGS

```
#define ENABLE_ALL_CHECKINGS 1
```

## 13.278.2 Function Documentation

### 13.278.2.1 check\_fsyr2k()

```
template<typename Field, class RandIter>
bool check_fsyr2k (
    const Field & F,
    size_t n,
    size_t k,
    const typename Field::Element & alpha,
    const typename Field::Element & beta,
    FFLAS::FFLAS_UPLO uplo,
    FFLAS::FFLAS_TRANSPOSE trans,
    RandIter & Rand)
```

### 13.278.2.2 run\_with\_field()

```
template<class Field>
bool run_with_field (
    Givaro::Integer q,
    size_t b,
    size_t n,
    size_t k,
    int a,
    int c,
    size_t iters,
    uint64_t seed)
```

### 13.278.2.3 main()

```
int main (
    int argc,
    char ** argv)
```

## 13.279 test-fsyk.C File Reference

```
#include "fflas-ffpack/fflas-ffpack-config.h"
#include <iomanip>
#include <iostream>
#include <random>
#include "fflas-ffpack/utils/fflas_io.h"
#include "fflas-ffpack/utils/timer.h"
#include "fflas-ffpack/fflas/fflas.h"
#include "fflas-ffpack/utils/args-parser.h"
#include "fflas-ffpack/utils/test-utils.h"
#include <givaro/modular.h>
```

### Macros

- #define `ENABLE_ALL_CHECKINGS` 1

### Functions

- template<typename `Field`, class `RandIter`>  
bool `check_fsyk` (const `Field` &F, size\_t n, size\_t k, size\_t w, const typename `Field::Element` &alpha, const typename `Field::Element` &beta, `FFLAS::FFLAS_UPLO` uplo, `FFLAS::FFLAS_TRANSPOSE` trans, `RandIter` &Rand)



- `template<typename Field, class RandIter>`  
`bool check_fsyrc_diag (const Field &F, size_t n, size_t k, const typename Field::Element &alpha, const`  
`typename Field::Element &beta, FFLAS::FFLAS_UPLO uplo, FFLAS::FFLAS_TRANSPOSE trans, RandIter`  
`&Rand)`
- `template<typename Field, class RandIter>`  
`bool check_fsyrc_bkdiag (const Field &F, size_t n, size_t k, const typename Field::Element &alpha, const`  
`typename Field::Element &beta, FFLAS_UPLO uplo, FFLAS_TRANSPOSE trans, RandIter &Rand)`
- `template<class Field, class RandIter>`  
`bool check_computeS1S2 (const Field &F, size_t N, size_t K, FFLAS_TRANSPOSE trans, RandIter &G)`
- `template<class Field>`  
`bool run_with_field (Givaro::Integer q, size_t b, size_t n, size_t k, size_t w, int a, int c, size_t iters, uint64_t`  
`seed)`
- `int main (int argc, char **argv)`

## 13.279.1 Macro Definition Documentation

### 13.279.1.1 ENABLE\_ALL\_CHECKINGS

```
#define ENABLE_ALL_CHECKINGS 1
```

## 13.279.2 Function Documentation

### 13.279.2.1 check\_fsyrc()

```
template<typename Field, class RandIter>
bool check_fsyrc (
    const Field & F,
    size_t n,
    size_t k,
    size_t w,
    const typename Field::Element & alpha,
    const typename Field::Element & beta,
    FFLAS::FFLAS_UPLO uplo,
    FFLAS::FFLAS_TRANSPOSE trans,
    RandIter & Rand)
```

### 13.279.2.2 check\_fsyrc\_diag()

```
template<typename Field, class RandIter>
bool check_fsyrc_diag (
    const Field & F,
    size_t n,
    size_t k,
    const typename Field::Element & alpha,
    const typename Field::Element & beta,
    FFLAS::FFLAS_UPLO uplo,
    FFLAS::FFLAS_TRANSPOSE trans,
    RandIter & Rand)
```

### 13.279.2.3 check\_fsyrc\_bkdiag()

```
template<typename Field, class RandIter>
bool check_fsyrc_bkdiag (
    const Field & F,
    size_t n,
    size_t k,
    const typename Field::Element & alpha,
    const typename Field::Element & beta,
    FFLAS_UPLO uplo,
```

```

    FFLAS_TRANSPOSE trans,
    RandIter & Rand)

```

#### 13.279.2.4 check\_computeS1S2()

```

template<class Field, class RandIter>
bool check_computeS1S2 (
    const Field & F,
    size_t N,
    size_t K,
    FFLAS_TRANSPOSE trans,
    RandIter & G)

```

#### 13.279.2.5 run\_with\_field()

```

template<class Field>
bool run_with_field (
    Givaro::Integer q,
    size_t b,
    size_t n,
    size_t k,
    size_t w,
    int a,
    int c,
    size_t iters,
    uint64_t seed)

```

#### 13.279.2.6 main()

```

int main (
    int argc,
    char ** argv)

```

## 13.280 test-fsytrf.C File Reference

```

#include <iostream>
#include <iterator>
#include <vector>
#include "fflas-ffpack/fflas-ffpack-config.h"
#include "fflas-ffpack/ffpack/ffpack.h"
#include "fflas-ffpack/utils/args-parser.h"
#include <iomanip>
#include <random>
#include <chrono>
#include <givaro/modular.h>
#include "fflas-ffpack/utils/test-utils.h"

```

### Functions

- template<typename T>  
std::ostream & [operator<<](#) (std::ostream &os, const std::vector< T > &x)
- template<class Field, class RandIter>  
bool [test\\_RPM\\_fsytrf](#) (Field &F, FFLAS\_UPLO uplo, [string](#) file, size\_t n, size\_t r, RandIter &G, size\_t threshold)
- template<class Field, class RandIter>  
bool [test\\_generic\\_fsytrf](#) (Field &F, FFLAS\_UPLO uplo, [string](#) file, size\_t n, RandIter &G, size\_t threshold)

- `template<class Field>`  
`bool run_with_field` (Givaro::Integer q, uint64\_t b, size\_t n, size\_t r, size\_t iters, `string` file, size\_t threshold, uint64\_t &seed)
- `int main` (int argc, char \*\*argv)

## 13.280.1 Function Documentation

### 13.280.1.1 `operator<<()`

```
template<typename T>
std::ostream & operator<< (
    std::ostream & os,
    const std::vector< T > & x)
```

### 13.280.1.2 `test_RPM_fsytrf()`

```
template<class Field, class RandIter>
bool test_RPM_fsytrf (
    Field & F,
    FFLAS_UPLO uplo,
    string file,
    size_t n,
    size_t r,
    RandIter & G,
    size_t threshold)
```

### 13.280.1.3 `test_generic_fsytrf()`

```
template<class Field, class RandIter>
bool test_generic_fsytrf (
    Field & F,
    FFLAS_UPLO uplo,
    string file,
    size_t n,
    RandIter & G,
    size_t threshold)
```

### 13.280.1.4 `run_with_field()`

```
template<class Field>
bool run_with_field (
    Givaro::Integer q,
    uint64_t b,
    size_t n,
    size_t r,
    size_t iters,
    string file,
    size_t threshold,
    uint64_t & seed)
```

### 13.280.1.5 `main()`

```
int main (
    int argc,
    char ** argv)
```

## 13.281 test-ffrmm.C File Reference

```
#include "fflas-ffpack/fflas-ffpack-config.h"
```

```
#include <givaro/modular-integer.h>
#include <iomanip>
#include <iostream>
#include <random>
#include "fflas-ffpack/utils/timer.h"
#include "fflas-ffpack/fflas/fflas.h"
#include "fflas-ffpack/utils/args-parser.h"
#include "fflas-ffpack/utils/test-utils.h"
#include <givaro/modular.h>
#include <givaro/modular-balanced.h>
```

## Macros

- `#define __FFLASFFPACK_SEQUENTIAL`

## Functions

- `template<typename Field, class RandIter>`  
`bool check_ftrmm (const Field &F, size_t m, size_t n, const typename Field::Element &alpha,`  
`FFLAS::FFLAS_SIDE side, FFLAS::FFLAS_UPLO uplo, FFLAS::FFLAS_TRANSPOSE trans, FFLAS::FFLAS_DIAG`  
`diag, RandIter &Rand)`
- `template<class Field>`  
`bool run_with_field (Givaro::Integer q, size_t b, size_t m, size_t n, uint64_t a, size_t iters, uint64_t seed)`
- `int main (int argc, char **argv)`

## 13.281.1 Macro Definition Documentation

### 13.281.1.1 \_\_FFLASFFPACK\_SEQUENTIAL

```
#define __FFLASFFPACK_SEQUENTIAL
```

## 13.281.2 Function Documentation

### 13.281.2.1 check\_ftrmm()

```
template<typename Field, class RandIter>
bool check_ftrmm (
    const Field & F,
    size_t m,
    size_t n,
    const typename Field::Element & alpha,
    FFLAS::FFLAS_SIDE side,
    FFLAS::FFLAS_UPLO uplo,
    FFLAS::FFLAS_TRANSPOSE trans,
    FFLAS::FFLAS_DIAG diag,
    RandIter & Rand)
```

### 13.281.2.2 run\_with\_field()

```
template<class Field>
bool run_with_field (
    Givaro::Integer q,
    size_t b,
    size_t m,
    size_t n,
    uint64_t a,
    size_t iters,
    uint64_t seed)
```

**13.281.2.3 main()**

```
int main (
    int argc,
    char ** argv)
```

**13.282 test-ffrmv.C File Reference**

```
#include "fflas-ffpack/fflas-ffpack-config.h"
#include <iomanip>
#include <iostream>
#include <chrono>
#include <random>
#include "fflas-ffpack/utils/timer.h"
#include "fflas-ffpack/fflas/fflas.h"
#include "fflas-ffpack/utils/args-parser.h"
#include "fflas-ffpack/utils/test-utils.h"
#include <givaro/modular.h>
```

**Macros**

- `#define __FFLASFFPACK_SEQUENTIAL`
- `#define ENABLE_ALL_CHECKINGS 1`

**Functions**

- `template<typename Field, class RandIter>`  
`bool check_ffrmv (const Field &F, size_t n, FFLAS_UPLO uplo, FFLAS_TRANSPOSE trans, FFLAS_DIAG diag, RandIter &Rand)`
- `template<class Field>`  
`bool run_with_field (Givaro::Integer q, size_t b, size_t n, size_t iters, uint64_t seed)`
- `int main (int argc, char **argv)`

**13.282.1 Macro Definition Documentation****13.282.1.1 \_\_FFLASFFPACK\_SEQUENTIAL**

```
#define __FFLASFFPACK_SEQUENTIAL
```

**13.282.1.2 ENABLE\_ALL\_CHECKINGS**

```
#define ENABLE_ALL_CHECKINGS 1
```

**13.282.2 Function Documentation****13.282.2.1 check\_ffrmv()**

```
template<typename Field, class RandIter>
bool check_ffrmv (
    const Field & F,
    size_t n,
    FFLAS_UPLO uplo,
    FFLAS_TRANSPOSE trans,
    FFLAS_DIAG diag,
    RandIter & Rand)
```

### 13.282.2.2 run\_with\_field()

```
template<class Field>
bool run_with_field (
    Givaro::Integer q,
    size_t b,
    size_t n,
    size_t iters,
    uint64_t seed)
```

### 13.282.2.3 main()

```
int main (
    int argc,
    char ** argv)
```

## 13.283 test-ftrsm-check.C File Reference

```
#include <iostream>
#include <stdlib.h>
#include <time.h>
#include "fflas-ffpack/fflas-ffpack.h"
#include "fflas-ffpack/utils/args-parser.h"
#include "fflas-ffpack/utils/test-utils.h"
#include "fflas-ffpack/utils/fflas_io.h"
```

### Macros

- #define [ENABLE\\_ALL\\_CHECKINGS](#) 1

### Functions

- int [main](#) (int argc, char \*\*argv)

## 13.283.1 Macro Definition Documentation

### 13.283.1.1 ENABLE\_ALL\_CHECKINGS

```
#define ENABLE_ALL_CHECKINGS 1
```

## 13.283.2 Function Documentation

### 13.283.2.1 main()

```
int main (
    int argc,
    char ** argv)
```

## 13.284 test-ftrsm.C File Reference

```
#include "fflas-ffpack/fflas-ffpack-config.h"
#include <givaro/modular-integer.h>
#include <iomanip>
#include <iostream>
#include "fflas-ffpack/utils/timer.h"
#include "fflas-ffpack/fflas/fflas.h"
#include "fflas-ffpack/utils/args-parser.h"
```

```
#include "fflas-ffpack/utils/test-utils.h"
#include <givaro/modular.h>
#include <givaro/modular-balanced.h>
#include <random>
```

## Macros

- `#define __FFLASFFPACK_SEQUENTIAL`
- `#define ENABLE_ALL_CHECKINGS 1`

## Functions

- `template<typename Field, class RandIter>`  
`bool check_ffrsm (const Field &F, size_t m, size_t n, const typename Field::Element &alpha,`  
`FFLAS::FFLAS_SIDE side, FFLAS::FFLAS_UPLO uplo, FFLAS::FFLAS_TRANSPOSE trans, FFLAS::FFLAS_DIAG`  
`diag, RandIter &Rand)`
- `template<class Field>`  
`bool run_with_field (Givaro::Integer q, size_t b, size_t m, size_t n, uint64_t a, size_t iters, uint64_t seed)`
- `int main (int argc, char **argv)`

## 13.284.1 Macro Definition Documentation

### 13.284.1.1 \_\_FFLASFFPACK\_SEQUENTIAL

```
#define __FFLASFFPACK_SEQUENTIAL
```

### 13.284.1.2 ENABLE\_ALL\_CHECKINGS

```
#define ENABLE_ALL_CHECKINGS 1
```

## 13.284.2 Function Documentation

### 13.284.2.1 check\_ffrsm()

```
template<typename Field, class RandIter>
bool check_ffrsm (
    const Field & F,
    size_t m,
    size_t n,
    const typename Field::Element & alpha,
    FFLAS::FFLAS_SIDE side,
    FFLAS::FFLAS_UPLO uplo,
    FFLAS::FFLAS_TRANSPOSE trans,
    FFLAS::FFLAS_DIAG diag,
    RandIter & Rand)
```

### 13.284.2.2 run\_with\_field()

```
template<class Field>
bool run_with_field (
    Givaro::Integer q,
    size_t b,
    size_t m,
    size_t n,
    uint64_t a,
    size_t iters,
    uint64_t seed)
```

### 13.284.2.3 main()

```
int main (
    int argc,
    char ** argv)
```

## 13.285 test-fftrssyr2k.C File Reference

```
#include "fflas-ffpack/utils/fflas_io.h"
#include "fflas-ffpack/fflas-ffpack-config.h"
#include <givaro/modular-integer.h>
#include <iomanip>
#include <iostream>
#include "fflas-ffpack/utils/timer.h"
#include "fflas-ffpack/ffpack/ffpack.h"
#include "fflas-ffpack/utils/args-parser.h"
#include "fflas-ffpack/utils/test-utils.h"
#include <givaro/modular.h>
#include <givaro/modular-balanced.h>
#include <random>
```

### Macros

- `#define` [ENABLE\\_ALL\\_CHECKINGS](#) 1

### Functions

- `template<typename Field, class RandIter>`  
`bool check\_fftrssyr2k (const Field &F, size_t n, FFLAS::FFLAS\_UPLO uplo, FFLAS::FFLAS\_DIAG diagA, RandIter &Rand)`
- `template<class Field>`  
`bool run\_with\_field (Givaro::Integer q, size_t b, size_t n, size_t iters, uint64_t seed)`
- `int main (int argc, char **argv)`

## 13.285.1 Macro Definition Documentation

### 13.285.1.1 ENABLE\_ALL\_CHECKINGS

```
#define ENABLE_ALL_CHECKINGS 1
```

## 13.285.2 Function Documentation

### 13.285.2.1 check\_fftrssyr2k()

```
template<typename Field, class RandIter>
bool check\_fftrssyr2k (
    const Field & F,
    size_t n,
    FFLAS::FFLAS\_UPLO uplo,
    FFLAS::FFLAS\_DIAG diagA,
    RandIter & Rand)
```

### 13.285.2.2 run\_with\_field()

```
template<class Field>
bool run\_with\_field (
    Givaro::Integer q,
    size_t b,
```



```

    size_t n,
    size_t iters,
    uint64_t seed)

```

### 13.285.2.3 main()

```

int main (
    int argc,
    char ** argv)

```

## 13.286 test-fftrstr.C File Reference

```

#include "fflas-ffpack/utils/fflas_io.h"
#include "fflas-ffpack/fflas-ffpack-config.h"
#include <givaro/modular-integer.h>
#include <iomanip>
#include <iostream>
#include "fflas-ffpack/utils/timer.h"
#include "fflas-ffpack/ffpack/ffpack.h"
#include "fflas-ffpack/utils/args-parser.h"
#include "fflas-ffpack/utils/test-utils.h"
#include <givaro/modular.h>
#include <givaro/modular-balanced.h>
#include <random>

```

### Macros

- #define [ENABLE\\_ALL\\_CHECKINGS](#) 1

### Functions

- template<typename [Field](#), class RandIter>  
 bool [check\\_fftrstr](#) (const [Field](#) &F, size\_t n, [FFLAS::FFLAS\\_SIDE](#) side, [FFLAS::FFLAS\\_UPLO](#) uplo, [FFLAS::FFLAS\\_DIAG](#) diagA, [FFLAS::FFLAS\\_DIAG](#) diagB, RandIter &Rand)
- template<class [Field](#)>  
 bool [run\\_with\\_field](#) (Givaro::Integer q, size\_t b, size\_t n, size\_t iters, uint64\_t seed)
- int [main](#) (int argc, char \*\*argv)

## 13.286.1 Macro Definition Documentation

### 13.286.1.1 ENABLE\_ALL\_CHECKINGS

```
#define ENABLE_ALL_CHECKINGS 1
```

## 13.286.2 Function Documentation

### 13.286.2.1 check\_fftrstr()

```

template<typename Field, class RandIter>
bool check\_fftrstr (
    const Field & F,
    size_t n,
    FFLAS::FFLAS\_SIDE side,
    FFLAS::FFLAS\_UPLO uplo,
    FFLAS::FFLAS\_DIAG diagA,
    FFLAS::FFLAS\_DIAG diagB,
    RandIter & Rand)

```

### 13.286.2.2 run\_with\_field()

```
template<class Field>
bool run_with_field (
    Givaro::Integer q,
    size_t b,
    size_t n,
    size_t iters,
    uint64_t seed)
```

### 13.286.2.3 main()

```
int main (
    int argc,
    char ** argv)
```

## 13.287 test-fftrsv.C File Reference

```
#include "fflas-ffpack/fflas-ffpack-config.h"
#include <iomanip>
#include <iostream>
#include <random>
#include "fflas-ffpack/utils/timer.h"
#include "fflas-ffpack/fflas/fflas.h"
#include "fflas-ffpack/utils/args-parser.h"
#include "fflas-ffpack/utils/test-utils.h"
#include <givaro/modular.h>
```

### Macros

- `#define __FFLASFFPACK_SEQUENTIAL`
- `#define ENABLE_ALL_CHECKINGS 1`

### Functions

- `template<typename Field, class RandIter>`  
`bool check_fftrsv (const Field &F, size_t n, FFLAS_UPLO uplo, FFLAS_TRANSPOSE trans, FFLAS_DIAG diag, RandIter &Rand)`
- `template<class Field>`  
`bool run_with_field (Givaro::Integer q, size_t b, size_t n, size_t iters, uint64_t seed)`
- `int main (int argc, char **argv)`

## 13.287.1 Macro Definition Documentation

### 13.287.1.1 \_\_FFLASFFPACK\_SEQUENTIAL

```
#define __FFLASFFPACK_SEQUENTIAL
```

### 13.287.1.2 ENABLE\_ALL\_CHECKINGS

```
#define ENABLE_ALL_CHECKINGS 1
```

## 13.287.2 Function Documentation

### 13.287.2.1 check\_fftrsv()

```
template<typename Field, class RandIter>
bool check_fftrsv (
```

```

    const Field & F,
    size_t n,
    FFLAS_UPLO uplo,
    FFLAS_TRANSPOSE trans,
    FFLAS_DIAG diag,
    RandIter & Rand)

```

### 13.287.2.2 run\_with\_field()

```

template<class Field>
bool run_with_field (
    Givaro::Integer q,
    size_t b,
    size_t n,
    size_t iters,
    uint64_t seed)

```

### 13.287.2.3 main()

```

int main (
    int argc,
    char ** argv)

```

## 13.288 test-fftrtri.C File Reference

```

#include "fflas-ffpack/fflas-ffpack-config.h"
#include <iomanip>
#include <iostream>
#include <random>
#include "fflas-ffpack/utils/timer.h"
#include "fflas-ffpack/fflas/fflas.h"
#include "fflas-ffpack/utils/args-parser.h"
#include "fflas-ffpack/utils/test-utils.h"
#include <givaro/modular.h>
#include "fflas-ffpack/utils/fflas_io.h"
#include "fflas-ffpack/ffpack/ffpack.h"

```

### Macros

- #define [\\_\\_FFLASFFPACK\\_SEQUENTIAL](#)
- #define [ENABLE\\_ALL\\_CHECKINGS](#) 1

### Functions

- template<typename [Field](#), class RandIter>  
bool [check\\_fftrtri](#) (const [Field](#) &F, size\_t n, [FFLAS\\_UPLO](#) uplo, [FFLAS\\_DIAG](#) diag, RandIter &Rand)
- template<class [Field](#)>  
bool [run\\_with\\_field](#) (Givaro::Integer q, size\_t b, size\_t n, size\_t iters, uint64\_t seed)
- int [main](#) (int argc, char \*\*argv)

## 13.288.1 Macro Definition Documentation

### 13.288.1.1 \_\_FFLASFFPACK\_SEQUENTIAL

```

#define __FFLASFFPACK_SEQUENTIAL

```

### 13.288.1.2 ENABLE\_ALL\_CHECKINGS

```
#define ENABLE_ALL_CHECKINGS 1
```

## 13.288.2 Function Documentation

### 13.288.2.1 check\_ftrtri()

```
template<typename Field, class RandIter>
bool check_ftrtri (
    const Field & F,
    size_t n,
    FFLAS_UPLO uplo,
    FFLAS_DIAG diag,
    RandIter & Rand)
```

### 13.288.2.2 run\_with\_field()

```
template<class Field>
bool run_with_field (
    Givaro::Integer q,
    size_t b,
    size_t n,
    size_t iters,
    uint64_t seed)
```

### 13.288.2.3 main()

```
int main (
    int argc,
    char ** argv)
```

## 13.289 test-interfaces-c.c File Reference

```
#include <fflas-ffpack/interfaces/libs/fflas_c.h>
#include <fflas-ffpack/interfaces/libs/ffpack_c.h>
#include <stdlib.h>
#include <stdio.h>
```

### Functions

- int [main](#) ()

## 13.289.1 Function Documentation

### 13.289.1.1 main()

```
int main (
    void )
```

## 13.290 test-invert-check.C File Reference

```
#include <iostream>
#include <stdlib.h>
#include "fflas-ffpack/fflas-ffpack.h"
#include "fflas-ffpack/utils/args-parser.h"
#include "fflas-ffpack/utils/test-utils.h"
```

```
#include "fflas-ffpack/utils/fflas_randommatrix.h"
```

## Macros

- #define [ENABLE\\_ALL\\_CHECKINGS](#) 1

## Functions

- int [main](#) (int argc, char \*\*argv)

## 13.290.1 Macro Definition Documentation

### 13.290.1.1 ENABLE\_ALL\_CHECKINGS

```
#define ENABLE_ALL_CHECKINGS 1
```

## 13.290.2 Function Documentation

### 13.290.2.1 main()

```
int main (
    int argc,
    char ** argv)
```

## 13.291 test-io.C File Reference

```
#include "fflas-ffpack/fflas-ffpack-config.h"
#include <iostream>
#include <random>
#include <givaro/modular.h>
#include <givaro/zring.h>
#include "fflas-ffpack/utils/test-utils.h"
#include "fflas-ffpack/utils/fflas_io.h"
#include "fflas-ffpack/utils/args-parser.h"
```

## Data Structures

- struct [CompactElement](#)< [Element](#) >
- struct [CompactElement](#)< [double](#) >
- struct [CompactElement](#)< [float](#) >
- struct [CompactElement](#)< [int64\\_t](#) >
- struct [CompactElement](#)< [int32\\_t](#) >
- struct [CompactElement](#)< [int16\\_t](#) >

## Functions

- template<class [Field](#)>  
bool [run\\_with\\_field](#) (Givaro::Integer q, uint64\_t b, size\_t m, size\_t n, size\_t iters, uint64\_t seed)
- int [main](#) (int argc, char \*\*argv)

## 13.291.1 Function Documentation

### 13.291.1.1 run\_with\_field()

```
template<class Field>
bool run_with_field (
    Givaro::Integer q,
```

```

uint64_t b,
size_t m,
size_t n,
size_t iters,
uint64_t seed)

```

### 13.291.1.2 main()

```

int main (
    int argc,
    char ** argv)

```

## 13.292 test-lu.C File Reference

```

#include "fflas-ffpack/fflas-ffpack-config.h"
#include <givaro/modular-balanced.h>
#include <iostream>
#include <iomanip>
#include "fflas-ffpack/utils/timer.h"
#include "fflas-ffpack/fflas/fflas.h"
#include "fflas-ffpack/ffpack/ffpack.h"
#include "fflas-ffpack/utils/test-utils.h"
#include "fflas-ffpack/utils/args-parser.h"
#include <random>

```

### Macros

- #define [BASECASE\\_K](#) 37
- #define [\\_\\_FFLASFFPACK\\_SEQUENTIAL](#)
- #define [\\_\\_LUDIVINE\\_CUTOFF](#) 1

### Functions

- template<class [Field](#), [FFLAS\\_DIAG](#) diag, [FFLAS\\_TRANSPOSE](#) trans>  
 bool [test\\_LUdivine](#) (const [Field](#) &F, typename [Field::ConstElement\\_ptr](#) A, size\_t lda, size\_t r, size\_t m, size\_t n)  
*Tests the LUdivine routine.*
- template<class [Field](#), [FFLAS\\_DIAG](#) diag>  
 bool [verifPLUQ](#) (const [Field](#) &F, typename [Field::ConstElement\\_ptr](#) A, size\_t lda, typename [Field::Element\\_ptr](#) PLUQ, size\_t ldpluq, size\_t \*P, size\_t \*Q, size\_t m, size\_t n, size\_t R)  
*Verifies that  $B = PLUQ$  where A stores  $[L|U]$ .*
- template<class [Field](#), [FFLAS\\_DIAG](#) diag, class RandIter>  
 bool [test\\_pluq](#) (const [Field](#) &F, typename [Field::ConstElement\\_ptr](#) A, size\_t r, size\_t m, size\_t n, size\_t lda, RandIter &G)  
*Tests the LUdivine routine.*
- template<class [Field](#), [FFLAS\\_DIAG](#) diag, [FFLAS\\_TRANSPOSE](#) trans, class RandIter>  
 bool [launch\\_test](#) (const [Field](#) &F, size\_t r, size\_t m, size\_t n, RandIter &G)
- template<class [Field](#)>  
 bool [run\\_with\\_field](#) (Givaro::Integer q, uint64\_t b, size\_t m, size\_t n, size\_t r, size\_t iters, uint64\_t seed)
- int [main](#) (int argc, char \*\*argv)

### Variables

- Givaro::Timer [tperm](#)
- Givaro::Timer [tgemm](#)
- Givaro::Timer [tBC](#)

- Givaro::Timer [ttrsm](#)
- Givaro::Timer [trest](#)
- Givaro::Timer [timtot](#)
- `size_t mvcnt` = 0

## 13.292.1 Macro Definition Documentation

### 13.292.1.1 BASECASE\_K

```
#define BASECASE_K 37
```

### 13.292.1.2 \_\_FFLASFFPACK\_SEQUENTIAL

```
#define __FFLASFFPACK_SEQUENTIAL
```

### 13.292.1.3 \_\_LUDIVINE\_CUTOFF

```
#define __LUDIVINE_CUTOFF 1
```

## 13.292.2 Function Documentation

### 13.292.2.1 test\_LUdivine()

```
template<class Field, FFLAS::FFLAS_DIAG diag, FFLAS_TRANSPOSE trans>
bool test_LUdivine (
    const Field & F,
    typename Field::ConstElement_ptr A,
    size_t lda,
    size_t r,
    size_t m,
    size_t n)
    Tests the LUdivine routine.
```

Tests the LUdivine routine.

#### Template Parameters

<i>Field</i>	<a href="#">Field</a>
<i>Diag</i>	Unit diagonal in U
<i>Trans</i>	

#### Parameters

<i>F</i>	field
<i>A</i>	Matrix (preallocated)
<i>r</i>	rank of A
<i>m</i>	rows
<i>n</i>	cols
<i>lda</i>	leading dim of A

#### Returns

0 iff correct, 1 otherwise

### 13.292.2.2 `verifPLUQ()`

```
template<class Field, FFLAS_DIAG diag>
bool verifPLUQ (
    const Field & F,
    typename Field::ConstElement_ptr A,
    size_t lda,
    typename Field::Element_ptr PLUQ,
    size_t ldpluq,
    size_t * P,
    size_t * Q,
    size_t m,
    size_t n,
    size_t R)

```

Verifies that  $B = PLUQ$  where  $A$  stores  $[L\backslash U]$ .

#### Template Parameters

<i>Field</i>	Field
<i>Diag</i>	Unit diagonal in U

#### Parameters

<i>F</i>	field
<i>A</i>	Matrix (preallocated)
<i>r</i>	rank of A
<i>m</i>	rows
<i>n</i>	cols
<i>lda</i>	leading dim of A

#### Returns

0 iff correct, 1 otherwise

### 13.292.2.3 `test_pluq()`

```
template<class Field, FFLAS_DIAG diag, class RandIter>
bool test_pluq (
    const Field & F,
    typename Field::ConstElement_ptr A,
    size_t r,
    size_t m,
    size_t n,
    size_t lda,
    RandIter & G)

```

Tests the LUdivine routine.

#### Template Parameters

<i>Field</i>	Field
<i>Diag</i>	Unit diagonal in U
<i>Trans</i>	



## Parameters

<i>F</i>	field
<i>A</i>	Matrix (preallocated)
<i>r</i>	rank of A
<i>m</i>	rows
<i>n</i>	cols
<i>lda</i>	leading dim of A

## Returns

0 iff correct, 1 otherwise

**13.292.2.4 launch\_test()**

```
template<class Field, FFLAS_DIAG diag, FFLAS_TRANSPOSE trans, class RandIter>
bool launch_test (
    const Field & F,
    size_t r,
    size_t m,
    size_t n,
    RandIter & G)
```

**13.292.2.5 run\_with\_field()**

```
template<class Field>
bool run_with_field (
    Givaro::Integer q,
    uint64_t b,
    size_t m,
    size_t n,
    size_t r,
    size_t iters,
    uint64_t seed)
```

**13.292.2.6 main()**

```
int main (
    int argc,
    char ** argv)
```

**13.292.3 Variable Documentation****13.292.3.1 tperm**

Givaro::Timer tperm

**13.292.3.2 tgemm**

Givaro::Timer tgemm

**13.292.3.3 tBC**

Givaro::Timer tBC

**13.292.3.4 ttrsm**

Givaro::Timer ttrsm

### 13.292.3.5 trest

```
Givaro::Timer trest
```

### 13.292.3.6 timtot

```
Givaro::Timer timtot
```

### 13.292.3.7 mvcnt

```
size_t mvcnt = 0
```

## 13.293 test-maxdelayeddim.C File Reference

```
#include <givaro/modular.h>
#include <recint/rint.h>
#include "fflas-ffpack/fflas-ffpack.h"
#include <stdlib.h>
#include <stdio.h>
```

### Macros

- #define [MAX\\_WITH\\_SIZE\\_T](#)(x)

### Functions

- template<class [Field](#)>  
bool [test](#) (Givaro::Integer p, size\_t kmax)
- int [main](#) ()

## 13.293.1 Macro Definition Documentation

### 13.293.1.1 MAX\_WITH\_SIZE\_T

```
#define MAX_WITH_SIZE_T(  
    x)
```

#### Value:

```
( (static_cast<uint64_t>(std::numeric_limits<size_t>::max()) < x)? std::numeric_limits<size_t>::max() : x )
```

## 13.293.2 Function Documentation

### 13.293.2.1 test()

```
template<class Field>
bool test (
    Givaro::Integer p,
    size_t kmax)
```

### 13.293.2.2 main()

```
int main (
    void )
```

## 13.294 test-minpoly.C File Reference

```
#include <iomanip>
#include <iostream>
#include <random>
```

```
#include <chrono>
#include "fflas-ffpack/fflas-ffpack-config.h"
#include "fflas-ffpack/fflas/fflas.h"
#include "fflas-ffpack/ffpack/ffpack.h"
#include "fflas-ffpack/utils/args-parser.h"
#include "fflas-ffpack/utils/fflas_randommatrix.h"
#include "fflas-ffpack/utils/test-utils.h"
#include <givaro/modular.h>
#include <givaro/modular-balanced.h>
#include <givaro/modular-integer.h>
#include <givaro/givpoly1factor.h>
#include <givaro/givpoly1.h>
```

## Functions

- template<typename [Field](#), class RandIter>  
bool [check\\_minpoly](#) (const [Field](#) &F, size\_t n, RandIter &G)
- template<class [Field](#)>  
bool [run\\_with\\_field](#) (Givaro::Integer q, size\_t b, size\_t n, size\_t iters, uint64\_t seed)
- int [main](#) (int argc, char \*\*argv)

## 13.294.1 Function Documentation

### 13.294.1.1 [check\\_minpoly\(\)](#)

```
template<typename Field, class RandIter>
bool check\_minpoly (
    const Field & F,
    size_t n,
    RandIter & G)
```

### 13.294.1.2 [run\\_with\\_field\(\)](#)

```
template<class Field>
bool run\_with\_field (
    Givaro::Integer q,
    size_t b,
    size_t n,
    size_t iters,
    uint64_t seed)
```

### 13.294.1.3 [main\(\)](#)

```
int main (
    int argc,
    char ** argv)
```

## 13.295 test-multifile1.C File Reference

```
#include "fflas-ffpack/fflas-ffpack.h"
```

## 13.296 test-multifile2.C File Reference

```
#include "fflas-ffpack/fflas-ffpack.h"
```

## Functions

- int [main](#) (void)

### 13.296.1 Function Documentation

#### 13.296.1.1 main()

```
int main (
    void )
```

## 13.297 test-nullspace.C File Reference

```
#include <iomanip>
#include <iostream>
#include "fflas-ffpack/ffpack/ffpack.h"
#include "fflas-ffpack/utils/args-parser.h"
#include "fflas-ffpack/utils/fflas_io.h"
#include "fflas-ffpack/utils/fflas_randommatrix.h"
#include "fflas-ffpack/utils/test-utils.h"
#include "fflas-ffpack/utils/timer.h"
```

## Functions

- template<class [Field](#)>  
std::string [checkingMessage](#) (const [Field](#) &F)
- template<class [Field](#)>  
[Field::Element\\_ptr](#) [readOrRandomMatrixWithRankAndRandomRPM](#) (const [Field](#) &F, std::string file, size\_t  $\leftrightarrow$  t &m, size\_t &n, size\_t &lda, size\_t &r, uint64\_t seed)  
*If file is not empty, read it and set m, n, lda and r.*
- template<class [Field](#)>  
bool [test\\_nullspace](#) ([Field](#) &F, [FFLAS::FFLAS\\_SIDE](#) side, size\_t m, size\_t n, size\_t r, typename [Field::Element\\_ptr](#) A, size\_t lda)
- template<class [Field](#)>  
bool [run\\_with\\_field](#) (Givaro::Integer q, uint64\_t b, size\_t m, size\_t n, size\_t r, size\_t iters, std::string file, uint64\_t &seed)
- int [main](#) (int argc, char \*\*argv)

### 13.297.1 Function Documentation

#### 13.297.1.1 checkingMessage()

```
template<class Field>
std::string checkingMessage (
    const Field & F)
```

#### 13.297.1.2 readOrRandomMatrixWithRankAndRandomRPM()

```
template<class Field>
Field::Element\_ptr readOrRandomMatrixWithRankAndRandomRPM (
    const Field & F,
    std::string file,
    size_t & m,
    size_t & n,
    size_t & lda,
    size_t & r,
    uint64_t seed)
```

If file is not empty, read it and set m, n, lda and r.

Otherwise, generate a random matrix of size  $m \times n$  with random `lda`.

### 13.297.1.3 test\_nullspace()

```
template<class Field>
bool test_nullspace (
    Field & F,
    FFLAS::FFLAS_SIDE side,
    size_t m,
    size_t n,
    size_t r,
    typename Field::Element_ptr A,
    size_t lda)
```

### 13.297.1.4 run\_with\_field()

```
template<class Field>
bool run_with_field (
    Givaro::Integer q,
    uint64_t b,
    size_t m,
    size_t n,
    size_t r,
    size_t iters,
    std::string file,
    uint64_t & seed)
```

### 13.297.1.5 main()

```
int main (
    int argc,
    char ** argv)
```

## 13.298 test-permutations.C File Reference

```
#include "fflas-ffpack/fflas-ffpack-config.h"
#include <iostream>
#include <givaro/modular.h>
#include "fflas-ffpack/ffpack/ffpack.h"
```

### Functions

- bool [checkMonotonicApplyP](#) (FFLAS\_SIDE Side, FFLAS\_TRANSPOSE trans, size\_t \*P, size\_t N, size\_t R)
- int [main](#) ()

### Variables

- Givaro::Timer [tperm](#)
- Givaro::Timer [tgemm](#)
- Givaro::Timer [tBC](#)
- Givaro::Timer [ttrsm](#)
- Givaro::Timer [trest](#)
- Givaro::Timer [timtot](#)

## 13.298.1 Function Documentation

### 13.298.1.1 checkMonotonicApplyP()

```
bool checkMonotonicApplyP (
    FFLAS_SIDE Side,
    FFLAS_TRANSPOSE trans,
    size_t * P,
    size_t N,
    size_t R)
```

### 13.298.1.2 main()

```
int main (
    void )
```

## 13.298.2 Variable Documentation

### 13.298.2.1 tperm

```
Givaro::Timer tperm
```

### 13.298.2.2 tgemm

```
Givaro::Timer tgemm
```

### 13.298.2.3 tBC

```
Givaro::Timer tBC
```

### 13.298.2.4 ttrsm

```
Givaro::Timer ttrsm
```

### 13.298.2.5 trest

```
Givaro::Timer trest
```

### 13.298.2.6 timtot

```
Givaro::Timer timtot
```

## 13.299 test-pluq-check.C File Reference

```
#include <iostream>
#include <stdlib.h>
#include <time.h>
#include "fflas-ffpack/fflas-ffpack.h"
#include "fflas-ffpack/utils/args-parser.h"
#include "fflas-ffpack/utils/test-utils.h"
```

### Macros

- #define `ENABLE_ALL_CHECKINGS` 1

### Functions

- int `main` (int argc, char \*\*argv)

### 13.299.1 Macro Definition Documentation

### 13.299.1.1 ENABLE\_ALL\_CHECKINGS

```
#define ENABLE_ALL_CHECKINGS 1
```

### 13.299.2 Function Documentation

### 13.299.2.1 main()

```
int main (
    int argc,
    char ** argv)
```

### 13.300 test-quasisep.C File Reference

```
#include "fflas-ffpack/fflas-ffpack-config.h"
#include <givaro/modular-balanced.h>
#include <iostream>
#include <iomanip>
#include "fflas-ffpack/fflas/fflas.h"
#include "fflas-ffpack/ffpack/ffpack.h"
#include "fflas-ffpack/utils/test-utils.h"
#include "fflas-ffpack/utils/args-parser.h"
#include <random>
```

## Functions

- template<class [Field](#), [FFLAS\\_DIAG](#) diag, class RandIter>  
bool [test\\_BruhatGenerator](#) (const [Field](#) &F, size\_t n, size\_t r, size\_t t, typename [Field::ConstElement\\_ptr](#) A, size\_t lda, typename [Field::Element\\_ptr](#) TS, size\_t l, RandIter &G)
- template<class [Field](#), [FFLAS\\_DIAG](#) diag, class RandIter>  
bool [launch\\_test](#) (const [Field](#) &F, size\_t n, size\_t r, size\_t t, size\_t l, RandIter &G)
- template<class [Field](#), class RandGen>  
bool [testLTQSRPM](#) (const [Field](#) &F, size\_t n, size\_t r, size\_t t, RandGen &G)
- template<class [Field](#)>  
bool [run\\_with\\_field](#) (Givaro::Integer q, uint64\_t b, size\_t n, size\_t r, size\_t t, size\_t l, size\_t iters, uint64\_t seed)
- int [main](#) (int argc, char \*\*argv)

### 13.300.1 Function Documentation

### 13.300.1.1 test\_BruhatGenerator()

```
template<class Field, FFLAS_DIAG diag, class RandIter>
bool test_BruhatGenerator (
    const Field & F,
    size_t n,
    size_t r,
    size_t t,
    typename Field::ConstElement_ptr A,
    size_t lda,
    typename Field::Element_ptr TS,
    size_t l,
    RandIter & G)
```

**13.300.1.2 launch\_test()**

```
template<class Field, FFLAS_DIAG diag, class RandIter>
bool launch_test (
    const Field & F,
    size_t n,
    size_t r,
    size_t t,
    size_t l,
    RandIter & G)
```

**13.300.1.3 testLTQSRPM()**

```
template<class Field, class RandGen>
bool testLTQSRPM (
    const Field & F,
    size_t n,
    size_t r,
    size_t t,
    RandGen & G)
```

**13.300.1.4 run\_with\_field()**

```
template<class Field>
bool run_with_field (
    Givaro::Integer q,
    uint64_t b,
    size_t n,
    size_t r,
    size_t t,
    size_t l,
    size_t iters,
    uint64_t seed)
```

**13.300.1.5 main()**

```
int main (
    int argc,
    char ** argv)
```

**13.301 test-rankprofiles.C File Reference**

```
#include "fflas-ffpack/fflas-ffpack-config.h"
#include "fflas-ffpack/ffpack/ffpack.h"
#include "fflas-ffpack/utils/args-parser.h"
#include "fflas-ffpack/utils/test-utils.h"
#include <givaro/modular.h>
#include <iostream>
#include <iomanip>
#include <random>
#include <chrono>
```

**Macros**

- #define `__FFLASFFPACK_SEQUENTIAL`



## Functions

- template<class [Field](#)>  
bool [run\\_with\\_field](#) (Givaro::Integer q, uint64\_t b, size\_t m, size\_t n, size\_t r, size\_t iters, uint64\_t seed, bool par)
- int [main](#) (int argc, char \*\*argv)

### 13.301.1 Macro Definition Documentation

#### 13.301.1.1 \_\_FFLASFFPACK\_SEQUENTIAL

```
#define __FFLASFFPACK_SEQUENTIAL
```

### 13.301.2 Function Documentation

#### 13.301.2.1 run\_with\_field()

```
template<class Field>
bool run_with_field (
    Givaro::Integer q,
    uint64_t b,
    size_t m,
    size_t n,
    size_t r,
    size_t iters,
    uint64_t seed,
    bool par)
```

#### 13.301.2.2 main()

```
int main (
    int argc,
    char ** argv)
```

## 13.302 test-rpm.C File Reference

```
#include <iostream>
#include "givaro/modular.h"
#include "fflas-ffpack/fflas-ffpack-config.h"
#include "fflas-ffpack/utils/test-utils.h"
#include "fflas-ffpack/utils/args-parser.h"
#include "fflas-ffpack/ffpack/ffpack.h"
```

## Functions

- bool [checkRPM](#) (size\_t M, size\_t N, size\_t R)
- bool [checkSymmetricRPM](#) (size\_t N, size\_t R)
- int [main](#) (int argc, char \*\*argv)

### 13.302.1 Function Documentation

#### 13.302.1.1 checkRPM()

```
bool checkRPM (
    size_t M,
    size_t N,
    size_t R)
```

### 13.302.1.2 checkSymmetricRPM()

```
bool checkSymmetricRPM (
    size_t N,
    size_t R)
```

### 13.302.1.3 main()

```
int main (
    int argc,
    char ** argv)
```

## 13.303 test-simd.C File Reference

```
#include "givaro/givinteger.h"
#include "givaro/modular.h"
#include "fflas-ffpack/fflas-ffpack-config.h"
#include "fflas-ffpack/fflas/fflas_simd.h"
#include "fflas-ffpack/utils/args-parser.h"
#include "fflas-ffpack/utils/test-utils.h"
#include "fflas-ffpack/utils/align-allocator.h"
#include <array>
#include <vector>
#include <random>
#include <string>
#include <functional>
#include <limits>
#include <type_traits>
#include <algorithm>
```

### Data Structures

- struct [ALL< true, v... >](#)
- struct [ALL< false, v... >](#)
- struct [ALL<>](#)
- struct [count\\_nonconst\\_lvalue\\_reference< T, O... >](#)
- struct [count\\_nonconst\\_lvalue\\_reference< T &, O... >](#)
- struct [count\\_nonconst\\_lvalue\\_reference< const T &, O... >](#)
- struct [count\\_nonconst\\_lvalue\\_reference<>](#)
- struct [is\\_all\\_same< T, Args... >](#)
- struct [is\\_all\\_same<>](#)
- struct [width< T >](#)
- struct [width< float >](#)
- struct [width< double >](#)
- class [TestOneMethod< Simd >](#)
- struct [ScalFunctionsBase< Element, typename enable\\_if< is\\_floating\\_point< Element >::value >::type >](#)
- class [ScalFunctionsBase< Element, typename enable\\_if< is\\_floating\\_point< Element >::value >::type >::FloatingPointTestD](#)
- struct [ScalFunctionsBase< Element, typename enable\\_if< is\\_integral< Element >::value >::type >](#)
- struct [ScalFunctions< Element >](#)
- class [string](#)  
*STL class.*
- class [vector< T >](#)  
*STL class.*
- class [array< T >](#)  
*STL class.*

## Macros

- `#define _TEST_ONE(K, f1, f2, r, n)`
- `#define TEST_ONE_OP(f)`
- `#define TEST_ONE_OP_WZ(f)`
- `#define TEST_IMPL(SIZE, Elt)`

## Functions

- `template<typename Element>`  
`enable_if< is_integral< Element >::value, bool >::type check_eq (Element x, Element y)`
- `template<typename Element>`  
`enable_if< is_floating_point< Element >::value, bool >::type check_eq (Element x, Element y)`
- `template<typename Element>`  
`bool cmp (vector< Element > out_scal, vector< Element > out_simd)`
- `template<typename Ret, typename T>`  
`Ret eval_func_on_array (function< Ret()> f, array< T, 0 > &arr)`
- `template<typename T, typename... TArgs>`  
`void eval_func_on_array (function< void(T, TArgs...)> f, array< typename decay< T >::type, sizeof...(TArgs)+1 > &arr)`
- `template<typename Ret, typename T, typename... TArgs>`  
`Ret eval_func_on_array (function< Ret(T, TArgs...)> f, array< typename decay< T >::type, sizeof...(TArgs)+1 > &arr)`
- `template<typename E>`  
`std::ostream & operator<< (std::ostream &o, const vector< E > &V)`
- `template<typename Simd, typename Element>`  
`enable_if< is_floating_point< Element >::value, bool >::type test_impl_base ()`
- `template<typename Simd, typename Element>`  
`enable_if< is_integral< Element >::value, bool >::type test_impl_base ()`
- `template<typename Simd, typename Element>`  
`bool test_impl ()`
- `int main (int argc, char *argv[])`

## 13.303.1 Macro Definition Documentation

### 13.303.1.1 \_TEST\_ONE

```
#define _TEST_ONE(
    K,
    f1,
    f2,
    r,
    n)
```

#### Value:

```
do {
    K T(f1, f2, r, n);
    bool b = T.writeResultLine();
    if (b == false)
        T.writeDebugData();
    btest &= b;
} while (0)
```

### 13.303.1.2 TEST\_ONE\_OP

```
#define TEST_ONE_OP(
    f)
```

#### Value:

```
_TEST_ONE(TestOneMethod<Simd>,
function<decltype(Simd::f)>(Simd::f),
function<decltype(Scal::f)>(Scal::f),
function<decltype(Scal::genInputs)>(Scal::genInputs), #f)
```

### 13.303.1.3 TEST\_ONE\_OP\_WZ

```
#define TEST_ONE_OP_WZ (
    f)
```

Value:

```
_TEST_ONE(TestOneMethod<Simd>,
function<decltype(Simd::f)>(Simd::f),
function<decltype(Scal::f)>(Scal::f),
function<decltype(Scal::genInputsWithZero)>(Scal::genInputsWithZero),
#f " test with zero")
```

### 13.303.1.4 TEST\_IMPL

```
#define TEST_IMPL(
    SIZE,
    Elt)
```

Value:

```
do {
    pass &= test_impl<Simd##SIZE<Elt>, Elt>();
    cout << endl;
} while (0)
```

## 13.303.2 Function Documentation

### 13.303.2.1 check\_eq() [1/2]

```
template<typename Element>
enable_if< is_integral< Element >::value, bool >::type check_eq (
    Element x,
    Element y)
```

### 13.303.2.2 check\_eq() [2/2]

```
template<typename Element>
enable_if< is_floating_point< Element >::value, bool >::type check_eq (
    Element x,
    Element y)
```

### 13.303.2.3 cmp()

```
template<typename Element>
bool cmp (
    vector< Element > out_scal,
    vector< Element > out_simd)
```

### 13.303.2.4 eval\_func\_on\_array() [1/3]

```
template<typename Ret, typename T>
Ret eval_func_on_array (
    function< Ret()> f,
    array< T, 0 > & arr)
```

### 13.303.2.5 eval\_func\_on\_array() [2/3]

```
template<typename T, typename... TArgs>
void eval_func_on_array (
    function< void(T, TArgs...)> f,
    array< typename decay< T >::type, sizeof...(TArgs)+1 > & arr)
```

### 13.303.2.6 eval\_func\_on\_array() [3/3]

```
template<typename Ret, typename T, typename... TArgs>
Ret eval_func_on_array (
```

```
function< Ret(T, TArgs...)> f,
array< typename decay< T >::type, sizeof...(TArgs)+1 > & arr)
```

### 13.303.2.7 operator<<()

```
template<typename E>
std::ostream & operator<< (
    std::ostream & o,
    const vector< E > & V)
```

### 13.303.2.8 test\_impl\_base() [1/2]

```
template<typename Simd, typename Element>
enable_if< is_floating_point< Element >::value, bool >::type test_impl_base ()
```

### 13.303.2.9 test\_impl\_base() [2/2]

```
template<typename Simd, typename Element>
enable_if< is_integral< Element >::value, bool >::type test_impl_base ()
```

### 13.303.2.10 test\_impl()

```
template<typename Simd, typename Element>
bool test_impl ()
```

### 13.303.2.11 main()

```
int main (
    int argc,
    char * argv[])
```

## 13.304 test-solve.C File Reference

```
#include <givaro/modular-integer.h>
#include <iomanip>
#include <iostream>
#include "fflas-ffpack/utils/timer.h"
#include "fflas-ffpack/fflas/fflas.h"
#include "fflas-ffpack/utils/args-parser.h"
#include "fflas-ffpack/utils/test-utils.h"
#include <givaro/modular.h>
#include <givaro/modular-balanced.h>
```

### Functions

- template<typename Field, class RandIter>  
bool [check\\_solve](#) (const Field &F, size\_t m, RandIter &Rand, bool isParallel)
- template<class Field>  
bool [run\\_with\\_field](#) (Givaro::Integer q, size\_t b, size\_t m, size\_t iters, uint64\_t seed)
- int [main](#) (int argc, char \*\*argv)

## 13.304.1 Function Documentation

### 13.304.1.1 check\_solve()

```
template<typename Field, class RandIter>
bool check_solve (
    const Field & F,
```

```

        size_t m,
        RandIter & Rand,
        bool isParallel)

```

#### 13.304.1.2 run\_with\_field()

```

template<class Field>
bool run_with_field (
    Givaro::Integer q,
    size_t b,
    size_t m,
    size_t iters,
    uint64_t seed)

```

#### 13.304.1.3 main()

```

int main (
    int argc,
    char ** argv)

```

### 13.305 test-storage-transpose.C File Reference

```

#include <iomanip>
#include <iostream>
#include <random>
#include "fflas-ffpack/utils/args-parser.h"
#include "fflas-ffpack/utils/test-utils.h"
#include "fflas-ffpack/utils/fflas_io.h"
#include "fflas-ffpack/utils/fflas_memory.h"
#include <givaro/modular.h>
#include <recint/rint.h>
#include "fflas-ffpack/fflas/fflas_transpose.h"

```

#### Data Structures

- class [Test< Elt >](#)

#### Functions

- int [main](#) (int argc, char \*\*argv)

#### 13.305.1 Function Documentation

##### 13.305.1.1 main()

```

int main (
    int argc,
    char ** argv)

```

### 13.306 101-fgemm.C File Reference

```

#include <fflas-ffpack/fflas-ffpack-config.h>
#include <givaro/modular-balanced.h>
#include <fflas-ffpack/fflas/fflas.h>
#include <fflas-ffpack/utils/timer.h>
#include <fflas-ffpack/utils/fflas_io.h>
#include <fflas-ffpack/utils/args-parser.h>

```

```
#include <iostream>
```

## Functions

- int [main](#) (int argc, char \*\*argv)

### 13.306.1 Function Documentation

#### 13.306.1.1 main()

```
int main (  
    int argc,  
    char ** argv)
```

## 13.307 2x2-fgemm.C File Reference

```
#include <fflas-ffpack/fflas-ffpack-config.h>  
#include <givaro/modular-balanced.h>  
#include <fflas-ffpack/fflas/fflas.h>  
#include <fflas-ffpack/utils/timer.h>  
#include <fflas-ffpack/utils/fflas_io.h>  
#include <fflas-ffpack/utils/args-parser.h>  
#include <iostream>
```

## Functions

- int [main](#) (int argc, char \*\*argv)

### 13.307.1 Function Documentation

#### 13.307.1.1 main()

```
int main (  
    int argc,  
    char ** argv)
```

## 13.308 2x2-ftsrv.C File Reference

```
#include <fflas-ffpack/fflas-ffpack-config.h>  
#include <givaro/modular-balanced.h>  
#include <fflas-ffpack/fflas/fflas.h>  
#include <fflas-ffpack/utils/timer.h>  
#include <fflas-ffpack/utils/fflas_io.h>  
#include <fflas-ffpack/utils/args-parser.h>  
#include <iostream>  
#include <array>
```

## Functions

- int [main](#) (int argc, char \*\*argv)

### 13.308.1 Function Documentation

#### 13.308.1.1 main()

```
int main (  
    int argc,  
    char ** argv)
```

## 13.309 2x2-pluq.C File Reference

```
#include <iostream>  
#include <vector>  
#include <givaro/modular.h>  
#include "fflas-ffpack/fflas-ffpack-config.h"  
#include "fflas-ffpack/fflas-ffpack.h"  
#include "fflas-ffpack/utils/fflas_io.h"
```

### Functions

- int [main](#) (int argc, char \*\*argv)

### 13.309.1 Function Documentation

#### 13.309.1.1 main()

```
int main (  
    int argc,  
    char ** argv)
```

## 13.310 fflas-101\_1.C File Reference

```
#include <fflas-ffpack/fflas/fflas.h>  
#include <givaro/modular.h>  
#include <givaro/modular-balanced.h>  
#include "fflas-ffpack/utils/fflas_io.h"  
#include <iostream>
```

### Functions

- int [main](#) (int argc, char \*\*argv)

### 13.310.1 Function Documentation

#### 13.310.1.1 main()

```
int main (  
    int argc,  
    char ** argv)
```

## 13.311 fflas-101\_3.C File Reference

```
#include <fflas-ffpack/fflas/fflas.h>  
#include <givaro/modular.h>  
#include <givaro/modular-balanced.h>  
#include "fflas-ffpack/utils/fflas_io.h"  
#include "fflas-ffpack/utils/fflas_randommatrix.h"
```



```
#include <iostream>
```

## Functions

- int [main](#) (int argc, char \*\*argv)

### 13.311.1 Function Documentation

#### 13.311.1.1 main()

```
int main (  
    int argc,  
    char ** argv)
```

## 13.312 fflas\_101.C File Reference

```
#include <fflas-ffpack/fflas/fflas.h>  
#include <givaro/modular.h>  
#include <givaro/modular-balanced.h>  
#include <iostream>
```

## Functions

- int [main](#) (int argc, char \*\*argv)

### 13.312.1 Function Documentation

#### 13.312.1.1 main()

```
int main (  
    int argc,  
    char ** argv)
```

## 13.313 fflas\_101\_lvl1.C File Reference

```
#include <fflas-ffpack/fflas/fflas.h>  
#include <givaro/modular.h>  
#include <givaro/modular-balanced.h>  
#include <iostream>  
#include "fflas-ffpack/utils/fflas_io.h"
```

## Functions

- int [main](#) (int argc, char \*\*argv)

### 13.313.1 Function Documentation

#### 13.313.1.1 main()

```
int main (  
    int argc,  
    char ** argv)
```

## 13.314 ffpack-fgesv.C File Reference

```
#include <fflas-ffpack/fflas/fflas.h>
#include <givaro/modular.h>
#include <givaro/modular-balanced.h>
#include "fflas-ffpack/utils/fflas_io.h"
#include <fflas-ffpack/ffpack/ffpack.h>
#include <iostream>
```

### Functions

- int [main](#) (int argc, char \*\*argv)

### 13.314.1 Function Documentation

#### 13.314.1.1 main()

```
int main (
    int argc,
    char ** argv)
```

## 13.315 ffpack-solve.C File Reference

```
#include <fflas-ffpack/fflas/fflas.h>
#include <givaro/modular.h>
#include <givaro/modular-balanced.h>
#include "fflas-ffpack/utils/fflas_io.h"
#include <fflas-ffpack/ffpack/ffpack.h>
#include <iostream>
```

### Functions

- int [main](#) (int argc, char \*\*argv)

### 13.315.1 Function Documentation

#### 13.315.1.1 main()

```
int main (
    int argc,
    char ** argv)
```

PS: the function Solve will modify the matrix A so here we used a duplicate matrix A2 otherwise  $A*x$  will not be equal to b for the later verification stage

# Index

**\_F**  
RNSIntegerMod< RNS >, [548](#)

**\_M**  
rns\_double, [527](#)  
rns\_double\_extended, [538](#)

**\_MAX\_SIZE\_MATRICES**  
benchmark-checkers.C, [779](#)

**\_MMi**  
rns\_double, [527](#)  
rns\_double\_extended, [538](#)

**\_Mi**  
rns\_double, [527](#)  
rns\_double\_extended, [538](#)

**\_Mi\_modp\_rns**  
RNSIntegerMod< RNS >, [548](#)

**\_NR\_TESTS**  
benchmark-checkers.C, [779](#)

**\_PLUQ**  
FFPACK, [361](#)

**\_RNSdelayed**  
RNSIntegerMod< RNS >, [548](#)

**\_TEST\_ONE**  
test-simd.C, [1099](#)

**\_\_FFLASFFPACK\_ARITHPROG\_THRESHOLD**  
fflas-ffpack-default-thresholds.h, [823](#)

**\_\_FFLASFFPACK\_CACHE\_LINE\_SIZE**  
fflas\_sparse.h, [883](#)

**\_\_FFLASFFPACK\_CHARPOLY\_Danilevskii\_LUKrylov\_THRESHOLD**  
fflas-ffpack-default-thresholds.h, [822](#)

**\_\_FFLASFFPACK\_CHARPOLY\_LUKrylov\_ArithProg\_THRESHOLD**  
fflas-ffpack-default-thresholds.h, [822](#)

**\_\_FFLASFFPACK\_CONFIGURATION**  
cblas.C, [1048](#)  
clapack.C, [1048](#)  
fblas.C, [1049](#)  
lapack.C, [1050](#)

**\_\_FFLASFFPACK\_DIMKPENALTY**  
fflas\_pfgemm.inl, [868](#)

**\_\_FFLASFFPACK\_FORCE\_SEQ**  
benchmark-charpoly-mp.C, [777](#)

**\_\_FFLASFFPACK\_FSYRK\_THRESHOLD**  
fflas-ffpack-default-thresholds.h, [823](#)

**\_\_FFLASFFPACK\_FSYTRF\_THRESHOLD**  
fflas-ffpack-default-thresholds.h, [823](#)

**\_\_FFLASFFPACK\_FTRSSYR2K\_THRESHOLD**  
ffpack.h, [921](#)

**\_\_FFLASFFPACK\_FTRSTR\_THRESHOLD**  
ffpack.h, [921](#)

**\_\_FFLASFFPACK\_FTRTRI\_THRESHOLD**  
fflas-ffpack-default-thresholds.h, [823](#)

**\_\_FFLASFFPACK\_GAUSSJORDAN\_BASECASE**  
ffpack\_echelonforms.inl, [929](#)  
test-echelon.C, [1056](#)

**\_\_FFLASFFPACK\_HAVE\_BLAS**  
config.h, [819](#)

**\_\_FFLASFFPACK\_HAVE\_CBLAS**  
cblas.C, [1048](#)  
config.h, [819](#)

**\_\_FFLASFFPACK\_HAVE\_CLAPACK**  
clapack.C, [1048](#)

**\_\_FFLASFFPACK\_HAVE\_CXX11**  
config.h, [819](#)

**\_\_FFLASFFPACK\_HAVE\_DGETRF**  
benchmark-dgetrf.C, [781](#)

**\_\_FFLASFFPACK\_HAVE\_DLFCN\_H**  
config.h, [819](#)

**\_\_FFLASFFPACK\_HAVE\_DTRTRI**  
benchmark-dtrtri.C, [783](#)

**\_\_FFLASFFPACK\_HAVE\_FLOAT\_H**  
config.h, [819](#)

**\_\_FFLASFFPACK\_HAVE\_INT128**  
config.h, [819](#)

**\_\_FFLASFFPACK\_HAVE\_INTTYPES\_H**  
config.h, [819](#)

**\_\_FFLASFFPACK\_HAVE\_LAPACK**  
clapack.C, [1048](#)  
lapack.C, [1050](#)

**\_\_FFLASFFPACK\_HAVE\_LIMITS\_H**  
config.h, [819](#)

**\_\_FFLASFFPACK\_HAVE\_LITTLE\_ENDIAN**  
config.h, [819](#)

**\_\_FFLASFFPACK\_HAVE\_PTHREAD\_H**  
config.h, [819](#)

**\_\_FFLASFFPACK\_HAVE\_STDDEF\_H**  
config.h, [819](#)

**\_\_FFLASFFPACK\_HAVE\_STDINT\_H**  
config.h, [820](#)

**\_\_FFLASFFPACK\_HAVE\_STDIO\_H**  
config.h, [820](#)

**\_\_FFLASFFPACK\_HAVE\_STDLIB\_H**  
config.h, [820](#)

**\_\_FFLASFFPACK\_HAVE\_STRINGS\_H**  
config.h, [820](#)

**\_\_FFLASFFPACK\_HAVE\_STRING\_H**  
config.h, [820](#)

**\_\_FFLASFFPACK\_HAVE\_SYS\_STAT\_H**  
config.h, [820](#)

- \_\_FFLASFFPACK\_HAVE\_SYS\_TIME\_H
  - config.h, [820](#)
- \_\_FFLASFFPACK\_HAVE\_SYS\_TYPES\_H
  - config.h, [820](#)
- \_\_FFLASFFPACK\_HAVE\_UNISTD\_H
  - config.h, [820](#)
- \_\_FFLASFFPACK\_KAAPI\_ROUTINES\_INL
  - kaapi\_routines.inl, [1029](#)
- \_\_FFLASFFPACK\_LT\_OBJDIR
  - config.h, [820](#)
- \_\_FFLASFFPACK\_MINBLOCKCUTS
  - blockcuts.inl, [1028](#)
- \_\_FFLASFFPACK\_OPENBLAS\_NT\_ALREADY\_SET
  - benchmark-charpoly.C, [778](#)
  - benchmark-fadd-lvl2.C, [783](#)
  - benchmark-fdot.C, [784](#)
  - benchmark-fgemm-mp.C, [785](#)
  - benchmark-fgemm-rns.C, [786](#)
  - benchmark-fgemv-mp.C, [788](#)
  - benchmark-fgemv.C, [789](#)
  - benchmark-fgesv.C, [792](#)
  - benchmark-fsyrc.C, [793](#)
  - benchmark-fsytrf.C, [794](#)
  - benchmark-ftrsm-mp.C, [794](#)
  - benchmark-ftrsm.C, [795](#)
  - benchmark-ftrsv.C, [796](#)
  - benchmark-ftrtri.C, [796](#)
  - benchmark-pluq.C, [799](#)
  - benchmark-quasisep.C, [800](#)
- \_\_FFLASFFPACK\_OPENBLAS\_NUM\_THREADS
  - config.h, [820](#)
- \_\_FFLASFFPACK\_PACKAGE
  - config.h, [820](#)
- \_\_FFLASFFPACK\_PACKAGE\_BUGREPORT
  - config.h, [820](#)
- \_\_FFLASFFPACK\_PACKAGE\_NAME
  - config.h, [820](#)
- \_\_FFLASFFPACK\_PACKAGE\_STRING
  - config.h, [820](#)
- \_\_FFLASFFPACK\_PACKAGE\_TARNAME
  - config.h, [821](#)
- \_\_FFLASFFPACK\_PACKAGE\_URL
  - config.h, [821](#)
- \_\_FFLASFFPACK\_PACKAGE\_VERSION
  - config.h, [821](#)
- \_\_FFLASFFPACK\_PLUQ\_THRESHOLD
  - fflas-ffpack-default-thresholds.h, [822](#)
  - test-echelon.C, [1056](#)
- \_\_FFLASFFPACK\_SEQPARTHRESHOLD
  - fflas\_pfgemm.inl, [868](#)
- \_\_FFLASFFPACK\_SEQUENTIAL
  - parallel.h, [1030](#)
  - test-echelon.C, [1056](#)
  - test-ftrmm.C, [1076](#)
  - test-ftrmv.C, [1077](#)
  - test-ftrsm.C, [1079](#)
  - test-ftrsv.C, [1082](#)
  - test-ftrtri.C, [1083](#)
  - test-lu.C, [1087](#)
  - test-rankprofiles.C, [1097](#)
- \_\_FFLASFFPACK\_SIZEOF\_CHAR
  - config.h, [821](#)
- \_\_FFLASFFPACK\_SIZEOF\_INT
  - config.h, [821](#)
- \_\_FFLASFFPACK\_SIZEOF\_LONG
  - config.h, [821](#)
- \_\_FFLASFFPACK\_SIZEOF\_LONG\_LONG
  - config.h, [821](#)
- \_\_FFLASFFPACK\_SIZEOF\_SHORT
  - config.h, [821](#)
- \_\_FFLASFFPACK\_SIZEOF\_\_\_INT64\_T
  - config.h, [821](#)
- \_\_FFLASFFPACK\_STDC\_HEADERS
  - config.h, [821](#)
- \_\_FFLASFFPACK\_USE\_OPENMP
  - config.h, [821](#)
- \_\_FFLASFFPACK\_VERSION
  - config.h, [821](#)
- \_\_FFLASFFPACK\_WINOTHRESHOLD
  - fflas-ffpack-default-thresholds.h, [822](#)
- \_\_FFLASFFPACK\_WINOTHRESHOLD\_BAL
  - fflas-ffpack-default-thresholds.h, [822](#)
- \_\_FFLASFFPACK\_WINOTHRESHOLD\_BAL\_FLT
  - fflas-ffpack-default-thresholds.h, [822](#)
- \_\_FFLASFFPACK\_WINOTHRESHOLD\_FLT
  - fflas-ffpack-default-thresholds.h, [822](#)
- \_\_FFLASFFPACK\_charpoly\_INL
  - ffpack\_charpoly.inl, [924](#)
- \_\_FFLASFFPACK\_checker\_charpoly\_INL
  - checker\_charpoly.inl, [804](#)
- \_\_FFLASFFPACK\_checker\_det\_INL
  - checker\_det.inl, [804](#)
- \_\_FFLASFFPACK\_checker\_fgemm\_INL
  - checker\_fgemm.inl, [805](#)
- \_\_FFLASFFPACK\_checker\_ftrsm\_INL
  - checker\_ftrsm.inl, [805](#)
- \_\_FFLASFFPACK\_checker\_invert\_INL
  - checker\_invert.inl, [805](#)
- \_\_FFLASFFPACK\_checker\_pluq\_INL
  - checker\_pluq.inl, [806](#)
- \_\_FFLASFFPACK\_fadd\_INL
  - fflas\_fadd.inl, [828](#)
- \_\_FFLASFFPACK\_fassign\_INL
  - fflas\_fassign.inl, [829](#)
- \_\_FFLASFFPACK\_faxpy\_INL
  - fflas\_faxpy.inl, [830](#)
- \_\_FFLASFFPACK\_fdot\_INL
  - fflas\_fdot.inl, [831](#)
- \_\_FFLASFFPACK\_fflas\_blockcuts\_INL
  - blockcuts.inl, [1028](#)
- \_\_FFLASFFPACK\_fflas\_bounds\_INL
  - fflas\_bounds.inl, [825](#)
- \_\_FFLASFFPACK\_fflas\_fflas\_fgemm\_winograd\_INL
  - fgemm\_winograd.inl, [836](#)
- \_\_FFLASFFPACK\_fflas\_fflas\_level1\_INL
  - fflas\_level1.inl, [862](#)

- \_\_FFLASFFPACK\_fflas\_fflas\_level2\_INL  
fflas\_level2.inl, [865](#)
- \_\_FFLASFFPACK\_fflas\_fflas\_level3\_INL  
fflas\_level3.inl, [867](#)
- \_\_FFLASFFPACK\_fflas\_fflas\_mmhelper\_INL  
fflas\_helpers.inl, [856](#)
- \_\_FFLASFFPACK\_fflas\_fflas\_sparse\_INL  
fflas\_sparse.inl, [885](#)
- \_\_FFLASFFPACK\_fflas\_ffpack\_utils\_simd128\_INL  
simd128.inl, [871](#)
- \_\_FFLASFFPACK\_fflas\_ffpack\_utils\_simd128\_double\_INL  
simd128\_double.inl, [872](#)
- \_\_FFLASFFPACK\_fflas\_ffpack\_utils\_simd128\_float\_INL  
simd128\_float.inl, [872](#)
- \_\_FFLASFFPACK\_fflas\_ffpack\_utils\_simd128\_int16\_INL  
simd128\_int16.inl, [872](#)
- \_\_FFLASFFPACK\_fflas\_ffpack\_utils\_simd128\_int32\_INL  
simd128\_int32.inl, [873](#)
- \_\_FFLASFFPACK\_fflas\_ffpack\_utils\_simd128\_int64\_INL  
simd128\_int64.inl, [873](#)
- \_\_FFLASFFPACK\_fflas\_ffpack\_utils\_simd256\_INL  
simd256.inl, [874](#)
- \_\_FFLASFFPACK\_fflas\_ffpack\_utils\_simd256\_double\_INL  
simd256\_double.inl, [874](#)
- \_\_FFLASFFPACK\_fflas\_ffpack\_utils\_simd256\_float\_INL  
simd256\_float.inl, [875](#)
- \_\_FFLASFFPACK\_fflas\_ffpack\_utils\_simd256\_int16\_INL  
simd256\_int16.inl, [875](#)
- \_\_FFLASFFPACK\_fflas\_ffpack\_utils\_simd256\_int32\_INL  
simd256\_int32.inl, [876](#)
- \_\_FFLASFFPACK\_fflas\_ffpack\_utils\_simd256\_int64\_INL  
simd256\_int64.inl, [876](#)
- \_\_FFLASFFPACK\_fflas\_freduce\_INL  
fflas\_freduce.inl, [846](#)
- \_\_FFLASFFPACK\_fflas\_freduce\_mp\_INL  
fflas\_freduce\_mp.inl, [847](#)
- \_\_FFLASFFPACK\_fflas\_fsy2k\_INL  
fflas\_fsy2k.inl, [850](#)
- \_\_FFLASFFPACK\_fflas\_fsyk\_INL  
fflas\_fsyk.inl, [852](#)
- \_\_FFLASFFPACK\_fflas\_fsyk\_strassen\_INL  
fflas\_fsyk\_strassen.inl, [853](#)
- \_\_FFLASFFPACK\_fflas\_igemm\_igemm\_INL  
igemm.inl, [858](#)
- \_\_FFLASFFPACK\_fflas\_igemm\_igemm\_kernels\_INL  
igemm\_kernels.inl, [859](#)
- \_\_FFLASFFPACK\_fflas\_igemm\_igemm\_tools\_INL  
igemm\_tools.inl, [860](#)
- \_\_FFLASFFPACK\_fflas\_pfgemm\_INL  
fflas\_pfgemm.inl, [868](#)
- \_\_FFLASFFPACK\_fflas\_pftsrsm\_INL  
fflas\_pftsrsm.inl, [869](#)
- \_\_FFLASFFPACK\_fflas\_sparse\_CSR\_HYB\_pspmm\_INL  
csr\_hyb\_pspmm.inl, [894](#)
- \_\_FFLASFFPACK\_fflas\_sparse\_CSR\_HYB\_pspmv\_INL  
csr\_hyb\_pspmv.inl, [894](#)
- \_\_FFLASFFPACK\_fflas\_sparse\_CSR\_HYB\_spm INL  
csr\_hyb\_spm.inl, [895](#)
- \_\_FFLASFFPACK\_fflas\_sparse\_CSR\_HYB\_spmv\_INL  
csr\_hyb\_spmv.inl, [895](#)
- \_\_FFLASFFPACK\_fflas\_sparse\_CSR\_HYB\_utils\_INL  
csr\_hyb\_utils.inl, [896](#)
- \_\_FFLASFFPACK\_fflas\_sparse\_CSR\_pspmm\_INL  
csr\_pspmm.inl, [889](#)
- \_\_FFLASFFPACK\_fflas\_sparse\_CSR\_pspmv\_INL  
csr\_pspmv.inl, [890](#)
- \_\_FFLASFFPACK\_fflas\_sparse\_CSR\_spm INL  
csr\_spm.inl, [891](#)
- \_\_FFLASFFPACK\_fflas\_sparse\_CSR\_spmv\_INL  
csr\_spmv.inl, [892](#)
- \_\_FFLASFFPACK\_fflas\_sparse\_ELL\_pspmm\_INL  
ell\_pspmm.inl, [897](#)
- \_\_FFLASFFPACK\_fflas\_sparse\_ELL\_pspmv\_INL  
ell\_pspmv.inl, [898](#)
- \_\_FFLASFFPACK\_fflas\_sparse\_ELL\_simd\_pspmv\_INL  
ell\_simd\_pspmv.inl, [901](#)
- \_\_FFLASFFPACK\_fflas\_sparse\_ELL\_simd\_spmv\_INL  
ell\_simd\_spmv.inl, [902](#)
- \_\_FFLASFFPACK\_fflas\_sparse\_ELL\_simd\_utils\_INL  
ell\_simd\_utils.inl, [903](#)
- \_\_FFLASFFPACK\_fflas\_sparse\_ELL\_spm INL  
ell\_spm.inl, [899](#)
- \_\_FFLASFFPACK\_fflas\_sparse\_ELL\_spmv\_INL  
ell\_spmv.inl, [899](#)
- \_\_FFLASFFPACK\_fflas\_sparse\_ELL\_utils\_INL  
ell\_utils.inl, [900](#)
- \_\_FFLASFFPACK\_fflas\_sparse\_HYB\_ZO\_pspmm\_INL  
hyb\_zo\_pspmm.inl, [903](#)
- \_\_FFLASFFPACK\_fflas\_sparse\_HYB\_ZO\_pspmv\_INL  
hyb\_zo\_pspmv.inl, [904](#)
- \_\_FFLASFFPACK\_fflas\_sparse\_HYB\_ZO\_spm INL  
hyb\_zo\_spm.inl, [904](#)
- \_\_FFLASFFPACK\_fflas\_sparse\_HYB\_ZO\_spmv\_INL  
hyb\_zo\_spmv.inl, [905](#)
- \_\_FFLASFFPACK\_fflas\_sparse\_HYB\_ZO\_utils\_INL  
hyb\_zo\_utils.inl, [905](#)
- \_\_FFLASFFPACK\_fflas\_sparse\_coo\_spm INL  
coo\_spm.inl, [886](#)
- \_\_FFLASFFPACK\_fflas\_sparse\_coo\_spmv\_INL  
coo\_spmv.inl, [887](#)
- \_\_FFLASFFPACK\_fflas\_sparse\_coo\_utils\_INL  
coo\_utils.inl, [888](#)
- \_\_FFLASFFPACK\_fflas\_sparse\_sell\_pspmv\_INL  
sell\_pspmv.inl, [907](#)
- \_\_FFLASFFPACK\_fflas\_sparse\_sell\_spmv\_INL  
sell\_spmv.inl, [908](#)
- \_\_FFLASFFPACK\_fflas\_sparse\_sell\_utils\_INL  
sell\_utils.inl, [909](#)
- \_\_FFLASFFPACK\_ffpack\_INL  
ffpack.inl, [922](#)
- \_\_FFLASFFPACK\_ffpack\_bruhatgen\_inl  
ffpack\_bruhatgen.inl, [924](#)
- \_\_FFLASFFPACK\_ffpack\_charpoly\_danilveski\_INL  
ffpack\_charpoly\_danilevski.inl, [925](#)
- \_\_FFLASFFPACK\_ffpack\_charpoly\_kgfast\_INL  
ffpack\_charpoly\_kgfast.inl, [925](#)

- \_\_FFLASFFPACK\_ffpack\_charpoly\_kgfastgeneralized\_INL
  - ffpack\_charpoly\_kgfastgeneralized.inl, [926](#)
- \_\_FFLASFFPACK\_ffpack\_charpoly\_kglu\_INL
  - ffpack\_charpoly\_kglu.inl, [926](#)
- \_\_FFLASFFPACK\_ffpack\_echelon\_forms\_INL
  - ffpack\_echelonforms.inl, [929](#)
- \_\_FFLASFFPACK\_ffpack\_fgesv\_INL
  - ffpack\_fgesv.inl, [929](#)
- \_\_FFLASFFPACK\_ffpack\_fgetrs\_INL
  - ffpack\_fgetrs.inl, [930](#)
- \_\_FFLASFFPACK\_ffpack\_fsytrf\_INL
  - ffpack\_fsytrf.inl, [932](#)
- \_\_FFLASFFPACK\_ffpack\_ftrssyr2k\_INL
  - ffpack\_ftrssyr2k.inl, [932](#)
- \_\_FFLASFFPACK\_ffpack\_ftrstr\_INL
  - ffpack\_ftrstr.inl, [933](#)
- \_\_FFLASFFPACK\_ffpack\_ftrtr\_INL
  - ffpack\_ftrtr.inl, [933](#)
- \_\_FFLASFFPACK\_ffpack\_invert\_INL
  - ffpack\_invert.inl, [934](#)
- \_\_FFLASFFPACK\_ffpack\_krylovelim\_INL
  - ffpack\_krylovelim.inl, [934](#)
- \_\_FFLASFFPACK\_ffpack\_ludivine\_INL
  - ffpack\_ludivine.inl, [935](#)
- \_\_FFLASFFPACK\_ffpack\_minpoly\_INL
  - ffpack\_minpoly.inl, [936](#)
- \_\_FFLASFFPACK\_ffpack\_permutation\_INL
  - ffpack\_permutation.inl, [938](#)
- \_\_FFLASFFPACK\_ffpack\_pluq\_INL
  - ffpack\_pluq.inl, [939](#)
- \_\_FFLASFFPACK\_ffpack\_ppluq\_INL
  - ffpack\_ppluq.inl, [940](#)
- \_\_FFLASFFPACK\_ffpack\_rank\_profiles\_INL
  - ffpack\_rankprofiles.inl, [942](#)
- \_\_FFLASFFPACK\_ffgemm\_INL
  - fflas\_fgemm.inl, [833](#)
- \_\_FFLASFFPACK\_ffgemm\_bini\_INL
  - schedule\_bini.inl, [837](#)
- \_\_FFLASFFPACK\_ffgemm\_winograd\_INL
  - schedule\_winograd.inl, [838](#)
- \_\_FFLASFFPACK\_ffgemm\_winograd\_acc\_INL
  - schedule\_winograd\_acc.inl, [838](#)
- \_\_FFLASFFPACK\_ffgemm\_winograd\_acc\_ip\_INL
  - schedule\_winograd\_acc\_ip.inl, [839](#)
- \_\_FFLASFFPACK\_ffgemm\_winograd\_ip\_INL
  - schedule\_winograd\_ip.inl, [840](#)
- \_\_FFLASFFPACK\_ffgemv\_INL
  - fflas\_ffgemv.inl, [841](#)
- \_\_FFLASFFPACK\_ffgemv\_mp\_INL
  - fflas\_ffgemv\_mp.inl, [842](#)
- \_\_FFLASFFPACK\_fger\_INL
  - fflas\_fger.inl, [843](#)
- \_\_FFLASFFPACK\_field\_rns\_INL
  - rns.inl, [948](#)
- \_\_FFLASFFPACK\_field\_rns\_double\_INL
  - rns-double.inl, [946](#)
- \_\_FFLASFFPACK\_field\_rns\_double\_recint\_INL
  - rns-double-recint.inl, [945](#)
- \_\_FFLASFFPACK\_freivalds\_INL
  - fflas\_freivalds.inl, [847](#)
- \_\_FFLASFFPACK\_fscal\_INL
  - fflas\_fscal.inl, [849](#)
- \_\_FFLASFFPACK\_fscal\_mp\_INL
  - fflas\_fscal\_mp.inl, [850](#)
- \_\_FFLASFFPACK\_ftrmm\_INL
  - fflas\_ftrmm.inl, [854](#)
- \_\_FFLASFFPACK\_ftrsm\_INL
  - fflas\_ftrsm.inl, [854](#)
- \_\_FFLASFFPACK\_ftrsv\_INL
  - fflas\_ftrsv.inl, [855](#)
- \_\_FFLASFFPACK\_simd512\_INL
  - simd512.inl, [877](#)
- \_\_FFLASFFPACK\_simd512\_double\_INL
  - simd512\_double.inl, [877](#)
- \_\_FFLASFFPACK\_simd512\_float\_INL
  - simd512\_float.inl, [877](#)
- \_\_FFLASFFPACK\_simd512\_int32\_INL
  - simd512\_int32.inl, [878](#)
- \_\_FFLAS\_L1\_INST\_C
  - fflas\_L1\_inst.C, [960](#)
- \_\_FFLAS\_L2\_INST\_C
  - fflas\_L2\_inst.C, [964](#)
- \_\_FFLAS\_L3\_INST\_C
  - fflas\_L3\_inst.C, [967](#)
- \_\_FFLAS\_\_TRSM\_READONLY
  - fflas\_L3\_inst\_implem.inl, [970](#)
  - fflas\_level3.inl, [867](#)
  - ffpack\_ppluq.inl, [940](#)
- \_\_FFPACK\_FSYTRF\_BC\_CROUT
  - benchmark-fsytrf.C, [794](#)
- \_\_FFPACK\_INST\_C
  - ffpack\_inst.C, [1022](#)
- \_\_FFPACK\_charpoly\_mp\_INL
  - ffpack\_charpoly\_mp.inl, [927](#)
- \_\_FFPACK\_det\_mp\_INL
  - ffpack\_det\_mp.inl, [927](#)
- \_\_FFPACK\_ffgemm\_classical\_INL
  - ffgemm\_classical\_mp.inl, [835](#)
- \_\_FFPACK\_fger\_mp\_INL
  - fflas\_fger\_mp.inl, [844](#)
- \_\_FFPACK\_ftrsm\_mp\_INL
  - fflas\_ftrsm\_mp.inl, [855](#)
- \_\_FFPACK\_ludivine\_mp\_INL
  - ffpack\_ludivine\_mp.inl, [935](#)
- \_\_FFPACK\_pluq\_mp\_INL
  - ffpack\_pluq\_mp.inl, [940](#)
- \_\_LUDIVINE\_CUTOFF
  - test-lu.C, [1087](#)
- \_\_has\_builtin
  - bit\_manipulation.h, [1040](#)
- \_\_alloc
  - rns\_double\_elt, [529](#)
  - rns\_double\_elt\_cstptr, [532](#)
  - rns\_double\_elt\_ptr, [534](#)
- \_\_basis
  - rns\_double, [527](#)

- rns\_double\_extended, [537](#)
- \_basisMax
  - rns\_double, [527](#)
  - rns\_double\_extended, [537](#)
- \_coo
  - SpMat< Field, flag >, [752](#)
- \_coo16
  - CooMat< Field >, [434](#)
- \_coo16\_zo
  - CooMat< Field >, [434](#)
- \_coo32
  - CooMat< Field >, [434](#)
- \_coo32\_zo
  - CooMat< Field >, [434](#)
- \_coo64
  - CooMat< Field >, [434](#)
- \_coo64\_zo
  - CooMat< Field >, [434](#)
- \_crt\_in
  - rns\_double, [527](#)
  - rns\_double\_extended, [538](#)
- \_crt\_out
  - rns\_double, [527](#)
  - rns\_double\_extended, [538](#)
- \_csr
  - SpMat< Field, flag >, [752](#)
- \_csr16
  - CsrMat< Field >, [436](#)
- \_csr16\_zo
  - CsrMat< Field >, [436](#)
- \_csr32
  - CsrMat< Field >, [436](#)
- \_csr32\_zo
  - CsrMat< Field >, [436](#)
- \_csr64
  - CsrMat< Field >, [436](#)
- \_csr64\_zo
  - CsrMat< Field >, [436](#)
- \_ell
  - SpMat< Field, flag >, [752](#)
- \_ell16
  - EllMat< Field >, [444](#)
- \_ell16\_zo
  - EllMat< Field >, [444](#)
- \_ell32
  - EllMat< Field >, [444](#)
- \_ell32\_zo
  - EllMat< Field >, [444](#)
- \_ell64
  - EllMat< Field >, [444](#)
- \_ell64\_zo
  - EllMat< Field >, [444](#)
- \_errorStream
  - Failure, [446](#)
- \_field\_rns
  - rns\_double, [527](#)
  - rns\_double\_extended, [538](#)
- \_iM\_modp\_rns
  - RNSIntegerMod< RNS >, [548](#)
- \_ibeg
  - ForStrategy2D< blocksize\_t, Cut, Param >, [468](#)
- \_iend
  - ForStrategy2D< blocksize\_t, Cut, Param >, [468](#)
- \_invbasis
  - rns\_double, [527](#)
  - rns\_double\_extended, [537](#)
- \_jbeg
  - ForStrategy2D< blocksize\_t, Cut, Param >, [468](#)
- \_jend
  - ForStrategy2D< blocksize\_t, Cut, Param >, [468](#)
- \_ldm
  - rns\_double, [528](#)
  - rns\_double\_extended, [538](#)
- \_mi\_sum
  - rns\_double, [528](#)
- \_mm
  - Test< Elt >, [759](#)
- \_negbasis
  - rns\_double, [527](#)
  - rns\_double\_extended, [537](#)
- \_nn
  - Test< Elt >, [759](#)
- \_p
  - RNSIntegerMod< RNS >, [548](#)
- \_pbits
  - rns\_double, [528](#)
  - rns\_double\_extended, [538](#)
- \_ptr
  - rns\_double\_elt, [529](#)
  - rns\_double\_elt\_cstptr, [532](#)
  - rns\_double\_elt\_ptr, [534](#)
- \_rns
  - RNSInteger< RNS >, [542](#)
  - RNSIntegerMod< RNS >, [548](#)
- \_simd512\_int64\_INL
  - simd512\_int64.inl, [878](#)
- \_size
  - rns\_double, [527](#)
  - rns\_double\_extended, [538](#)
- \_stride
  - rns\_double\_elt, [529](#)
  - rns\_double\_elt\_cstptr, [532](#)
  - rns\_double\_elt\_ptr, [534](#)
- \_zero
  - ScalFunctionsBase< Element, typename enable\_if< is\_floating\_point< Element >::value >::type >, [557](#)
  - ScalFunctionsBase< Element, typename enable\_if< is\_integral< Element >::value >::type >, [559](#)
- ~CheckerImplem\_Det
  - CheckerImplem\_Det< Field >, [414](#)
- ~CheckerImplem\_PLUQ
  - CheckerImplem\_PLUQ< Field >, [418](#)
- ~CheckerImplem\_charpoly
  - CheckerImplem\_charpoly< Field, Polynomial >, [411](#)



- CheckerImplem\_charpoly< Givaro::ZRing< Givaro::Integer >, Polynomial >, 413
- ~CheckerImplem\_fgemm
  - CheckerImplem\_fgemm< Field >, 415
- ~CheckerImplem\_ftsm
  - CheckerImplem\_ftsm< Field >, 416
- ~CheckerImplem\_invert
  - CheckerImplem\_invert< Field >, 417
- ~rns\_double\_elt
  - rns\_double\_elt, 528
- 101-fgemm.C, 1102
  - main, 1103
- 2x2-fgemm.C, 1103
  - main, 1103
- 2x2-ftsv.C, 1103
  - main, 1104
- 2x2-pluq.C, 1104
  - main, 1104
- add
  - FFLAS::vectorised, 280
  - FieldSimd< \_Field >, 449
  - RNSIntegerMod< RNS >, 546
  - ScalFunctions< Element >, 552
  - Simd128\_impl< true, true, false, 2 >, 568
  - Simd128\_impl< true, true, false, 4 >, 578
  - Simd128\_impl< true, true, false, 8 >, 589
  - Simd128\_impl< true, true, true, 2 >, 596
  - Simd128\_impl< true, true, true, 4 >, 605
  - Simd128\_impl< true, true, true, 8 >, 614
  - Simd256\_impl< true, false, true, 8 >, 625
  - Simd256\_impl< true, true, false, 2 >, 636
  - Simd256\_impl< true, true, false, 4 >, 652
  - Simd256\_impl< true, true, false, 8 >, 664
  - Simd256\_impl< true, true, true, 2 >, 672
  - Simd256\_impl< true, true, true, 4 >, 683, 689
  - Simd256\_impl< true, true, true, 8 >, 698
  - Simd512\_impl< true, false, true, 8 >, 707
  - Simd512\_impl< true, true, false, 8 >, 718
  - Simd512\_impl< true, true, true, 8 >, 726
- add\_r
  - FieldSimd< \_Field >, 449
- addin
  - FieldSimd< \_Field >, 449
  - ScalFunctions< Element >, 552
  - Simd128\_impl< true, true, false, 2 >, 568
  - Simd128\_impl< true, true, false, 4 >, 578
  - Simd128\_impl< true, true, false, 8 >, 589
  - Simd128\_impl< true, true, true, 2 >, 597
  - Simd128\_impl< true, true, true, 4 >, 605
  - Simd128\_impl< true, true, true, 8 >, 615
  - Simd256\_impl< true, false, true, 8 >, 625
  - Simd256\_impl< true, true, false, 2 >, 636
  - Simd256\_impl< true, true, false, 4 >, 653
  - Simd256\_impl< true, true, false, 8 >, 664
  - Simd256\_impl< true, true, true, 2 >, 672
  - Simd256\_impl< true, true, true, 4 >, 683, 689
  - Simd256\_impl< true, true, true, 8 >, 698
  - Simd512\_impl< true, false, true, 8 >, 707
- Simd512\_impl< true, true, false, 8 >, 718
- Simd512\_impl< true, true, true, 8 >, 726
- addin\_r
  - FieldSimd< \_Field >, 449
- addp
  - FFLAS::vectorised, 279
- AlgoChooser< ModeCategories::ConvertTo< ElementCategories::RNSElementTag >, ParSeq >, 397
  - value, 397
- AlgoChooser< ModeT, ParSeq >, 397
  - value, 397
- align-allocator.h, 1037
- alignable
  - FFLAS, 188
- alignable< Givaro::Integer \* >
  - FFLAS, 188
- aligned\_allocator
  - NoSimd< T >, 516
  - Simd128\_impl< true, true, false, 2 >, 563
  - Simd128\_impl< true, true, false, 4 >, 573
  - Simd128\_impl< true, true, false, 8 >, 583
  - Simd128\_impl< true, true, true, 2 >, 593
  - Simd128\_impl< true, true, true, 4 >, 602
  - Simd128\_impl< true, true, true, 8 >, 612
  - Simd256\_impl< true, false, true, 8 >, 622
  - Simd256\_impl< true, true, false, 2 >, 630
  - Simd256\_impl< true, true, false, 4 >, 642
  - Simd256\_impl< true, true, false, 8 >, 659
  - Simd256\_impl< true, true, true, 2 >, 669
  - Simd256\_impl< true, true, true, 4 >, 679
  - Simd256\_impl< true, true, true, 8 >, 695
  - Simd512\_impl< true, false, true, 8 >, 704
  - Simd512\_impl< true, true, false, 8 >, 712
  - Simd512\_impl< true, true, true, 8 >, 723
- aligned\_vector
  - NoSimd< T >, 516
  - Simd128\_impl< true, true, false, 2 >, 563
  - Simd128\_impl< true, true, false, 4 >, 573
  - Simd128\_impl< true, true, false, 8 >, 583
  - Simd128\_impl< true, true, true, 2 >, 594
  - Simd128\_impl< true, true, true, 4 >, 603
  - Simd128\_impl< true, true, true, 8 >, 612
  - Simd256\_impl< true, false, true, 8 >, 622
  - Simd256\_impl< true, true, false, 2 >, 630
  - Simd256\_impl< true, true, false, 4 >, 642
  - Simd256\_impl< true, true, false, 8 >, 659
  - Simd256\_impl< true, true, true, 2 >, 669
  - Simd256\_impl< true, true, true, 4 >, 679, 680
  - Simd256\_impl< true, true, true, 8 >, 695
  - Simd512\_impl< true, false, true, 8 >, 704
  - Simd512\_impl< true, true, false, 8 >, 712
  - Simd512\_impl< true, true, true, 8 >, 723
- alignment
  - FieldSimd< \_Field >, 452
  - NoSimd< T >, 517
  - Simd128\_impl< true, true, false, 2 >, 571
  - Simd128\_impl< true, true, false, 4 >, 581



- Simd128\_impl< true, true, false, 8 >, [591](#)
- Simd128\_impl< true, true, true, 2 >, [600](#)
- Simd128\_impl< true, true, true, 4 >, [609](#)
- Simd128\_impl< true, true, true, 8 >, [619](#)
- Simd256\_impl< true, false, true, 8 >, [628](#)
- Simd256\_impl< true, true, false, 2 >, [638](#)
- Simd256\_impl< true, true, false, 4 >, [656](#)
- Simd256\_impl< true, true, false, 8 >, [666](#)
- Simd256\_impl< true, true, true, 2 >, [675](#)
- Simd256\_impl< true, true, true, 4 >, [692](#)
- Simd256\_impl< true, true, true, 8 >, [701](#)
- Simd512\_impl< true, false, true, 8 >, [709](#)
- Simd512\_impl< true, true, false, 8 >, [720](#)
- Simd512\_impl< true, true, true, 8 >, [730](#)
- ALL< false, v... >, [398](#)
  - value, [398](#)
- ALL< true, v... >, [398](#)
  - value, [398](#)
- ALL< v >, [397](#)
- ALL<>, [398](#)
  - value, [398](#)
- Amax
  - MMHelper< Field, AlgoTrait, ModeTrait, ParSeq-Trait >, [505](#)
- Amin
  - MMHelper< Field, AlgoTrait, ModeTrait, ParSeq-Trait >, [505](#)
- applyP
  - FFPACK, [304](#), [305](#), [363](#)
- applyP\_block
  - FFPACK, [355](#)
- applyP\_modular\_double
  - ffpack.C, [987](#)
  - ffpack\_c.h, [1009](#)
- ArbitraryPrecIntTag, [398](#)
- Architecture of the library., [2](#)
- areEqual
  - RNSIntegerMod< RNS >, [547](#)
- AreEqual< X, X >, [399](#)
  - value, [399](#)
- AreEqual< X, Y >, [399](#)
  - value, [399](#)
- args-parser.h, [1038](#)
  - ArgumentType, [1039](#)
  - END\_OF\_ARGUMENTS, [1038](#)
  - findArgument, [1039](#)
  - getListArgs, [1039](#)
  - printHelpMessage, [1039](#)
  - TYPE\_BOOL, [1038](#)
  - TYPE\_DOUBLE, [1039](#)
  - TYPE\_INT, [1039](#)
  - TYPE\_INTEGER, [1039](#)
  - type\_integer, [1038](#)
  - TYPE\_INTLIST, [1039](#)
  - TYPE\_LONGLONG, [1039](#)
  - TYPE\_NONE, [1039](#)
  - TYPE\_STR, [1039](#)
  - TYPE\_UINT64, [1039](#)
- Argument, [399](#)
  - c, [399](#)
  - data, [400](#)
  - example, [399](#)
  - helpString, [400](#)
  - type, [400](#)
- ArgumentType
  - args-parser.h, [1039](#)
- ArithProg
  - FFPACK::Protected, [393](#)
- arithprog.C, [771](#)
  - main, [771](#)
  - TTimer, [771](#)
- array< T >, [400](#)
  - elements, [400](#)
- array< T >::const\_iterator, [423](#)
- array< T >::const\_reverse\_iterator, [423](#)
- array< T >::iterator, [490](#)
- array< T >::reverse\_iterator, [522](#)
- assign
  - RNSInteger< RNS >, [541](#)
  - RNSIntegerMod< RNS >, [546](#)
- associatedDelayedField< const FFPACK::RNSIntegerMod< RNS > >, [401](#)
  - field, [401](#)
  - type, [401](#)
- associatedDelayedField< const Givaro::Modular< T, X > >, [401](#)
  - field, [402](#)
  - type, [402](#)
- associatedDelayedField< const Givaro::ModularBalanced< T > >, [402](#)
  - field, [402](#)
  - type, [402](#)
- associatedDelayedField< const Givaro::ZRing< T > >, [403](#)
  - field, [403](#)
  - type, [403](#)
- associatedDelayedField< Field >, [400](#)
  - field, [401](#)
  - type, [401](#)
- assume\_aligned
  - fflas\_sparse.h, [883](#)
- AtlasConj
  - config-blas.h, [810](#)
- Aunfit
  - MMHelper< Field, AlgoTrait, ModeTrait, ParSeq-Trait >, [504](#)
- aut
  - HelperFlag, [477](#)
- Auto, [403](#)
- averageCol
  - StatsMatrix, [753](#)
- averageColDifference
  - StatsMatrix, [754](#)
- averageRow
  - StatsMatrix, [753](#)
- averageRowDifference

- StatsMatrix, [754](#)
- axpy
  - FieldSimd< \_Field >, [451](#)
- axpy\_r
  - FieldSimd< \_Field >, [452](#)
- axpyin
  - FieldSimd< \_Field >, [451](#)
  - RNSIntegerMod< RNS >, [546](#)
- axpyin\_r
  - FieldSimd< \_Field >, [452](#)
- axpyp
  - FFLAS::vectorised, [280](#)
  - FFLAS::vectorised::unswitch, [284](#)
- balanced
  - FieldTraits< FFPACK::RNSInteger< T > >, [454](#)
  - FieldTraits< FFPACK::RNSIntegerMod< T > >, [454](#)
  - FieldTraits< Field >, [453](#)
  - FieldTraits< Givaro::Modular< Element > >, [455](#)
  - FieldTraits< Givaro::ModularBalanced< Element > >, [456](#)
  - FieldTraits< Givaro::ZRing< double > >, [456](#)
  - FieldTraits< Givaro::ZRing< float > >, [457](#)
  - FieldTraits< Givaro::ZRing< Givaro::Integer > >, [458](#)
  - FieldTraits< Givaro::ZRing< int16\_t > >, [458](#)
  - FieldTraits< Givaro::ZRing< int32\_t > >, [459](#)
  - FieldTraits< Givaro::ZRing< int64\_t > >, [460](#)
  - FieldTraits< Givaro::ZRing< Reclnt::ruint< K > >, [460](#)
  - FieldTraits< Givaro::ZRing< uint16\_t > >, [461](#)
  - FieldTraits< Givaro::ZRing< uint32\_t > >, [462](#)
  - FieldTraits< Givaro::ZRing< uint64\_t > >, [462](#)
  - winograd.C, [777](#)
- BARRIER
  - parallel.h, [1030](#)
- BASECASE\_K
  - test-lu.C, [1087](#)
- BaseTimer
  - FFLAS, [74](#)
- BasisElement
  - rns\_double, [524](#)
  - rns\_double\_extended, [535](#)
  - RNSInteger< RNS >, [539](#)
  - RNSIntegerMod< RNS >, [544](#)
- begin
  - ForStrategy1D< blocksize\_t, Cut, Param >, [464](#)
  - Info, [482](#), [483](#)
- BEGIN\_PARALLEL\_MAIN
  - parallel.h, [1031](#)
- Bench
  - Bench< Elt >, [405](#)
- Bench< Elt >, [403](#)
  - Bench, [405](#)
  - cardinality, [405](#)
  - doBenchs, [405](#)
  - Elt\_ptr, [404](#)
  - enable\_if\_no\_simd\_t, [405](#)
  - enable\_if\_simd128\_t, [405](#)
  - enable\_if\_simd256\_t, [405](#)
  - enable\_if\_simd512\_t, [405](#)
  - enable\_if\_t, [404](#)
  - F, [406](#)
  - Field, [404](#)
  - inplace, [406](#)
  - is\_same\_element, [404](#)
  - iters, [406](#)
  - m, [406](#)
  - n, [406](#)
  - Residu, [404](#)
  - run, [405](#)
- benchmark-charpoly-mp.C, [777](#)
  - \_\_FFLASFFPACK\_FORCE\_SEQ, [777](#)
  - main, [777](#)
- benchmark-charpoly.C, [778](#)
  - \_\_FFLASFFPACK\_OPENBLAS\_NT\_ALREADY\_SET, [778](#)
  - main, [778](#)
  - run\_with\_field, [778](#)
- benchmark-checkers.C, [778](#)
  - \_MAX\_SIZE\_MATRICES, [779](#)
  - \_NR\_TESTS, [779](#)
  - CUBE, [779](#)
  - ENABLE\_ALL\_CHECKINGS, [779](#)
  - main, [779](#)
- benchmark-dgemm.C, [779](#)
  - CBLAS\_GEMM, [780](#)
  - Floats, [780](#)
  - main, [780](#)
  - TTimer, [780](#)
- benchmark-dgetrf.C, [780](#)
  - \_\_FFLASFFPACK\_HAVE\_DGETRF, [781](#)
  - main, [781](#)
- benchmark-dgetri.C, [781](#)
  - main, [781](#)
- benchmark-dsytrf.C, [781](#)
  - EFFGFF, [782](#)
  - main, [782](#)
- benchmark-dtrsm.C, [782](#)
  - main, [782](#)
- benchmark-dtrtri.C, [782](#)
  - \_\_FFLASFFPACK\_HAVE\_DTRTRI, [783](#)
  - main, [783](#)
- benchmark-fadd-lvl2.C, [783](#)
  - \_\_FFLASFFPACK\_OPENBLAS\_NT\_ALREADY\_SET, [783](#)
  - main, [783](#)
- benchmark-fdot.C, [783](#)
  - \_\_FFLASFFPACK\_OPENBLAS\_NT\_ALREADY\_SET, [784](#)
  - main, [784](#)
  - run\_with\_field, [784](#)
- benchmark-fgemm-mp.C, [784](#)
  - \_\_FFLASFFPACK\_OPENBLAS\_NT\_ALREADY\_SET, [785](#)
  - main, [785](#)

- MG\_DEFAULT, [785](#)
- STD\_RECINT\_SIZE, [785](#)
- tmain, [785](#)
- benchmark-fgemmm-rns.C, [785](#)
  - \_\_FFLASFFPACK\_OPENBLAS\_NT\_ALREADY\_SET, [786](#)
  - ConstElement\_ptr, [786](#)
  - Element\_ptr, [786](#)
  - Field, [786](#)
  - GRAIN, [786](#)
  - main, [787](#)
  - PSeq, [787](#)
  - RNS, [786](#)
  - THREADS, [786](#)
  - THREED, [786](#)
  - THREEDA, [786](#)
  - THREEDIP, [786](#)
  - TWOD, [786](#)
  - TWODA, [786](#)
- benchmark-fgemmm.C, [787](#)
  - CLASSIC\_HYBRID, [787](#)
  - main, [787](#)
- benchmark-fgemv-mp.C, [787](#)
  - \_\_FFLASFFPACK\_OPENBLAS\_NT\_ALREADY\_SET, [788](#)
  - main, [788](#)
  - MG\_DEFAULT, [788](#)
  - STD\_RECINT\_SIZE, [788](#)
  - tmain, [788](#)
  - write\_matrix, [788](#)
- benchmark-fgemv.C, [789](#)
  - \_\_FFLASFFPACK\_OPENBLAS\_NT\_ALREADY\_SET, [789](#)
  - benchmark\_disp, [791](#)
  - benchmark\_in\_Field, [791](#)
  - benchmark\_with\_field, [791](#)
  - benchmark\_with\_timer, [790](#)
  - check\_result, [790](#)
  - fill\_value, [790](#)
  - genData, [790](#)
  - main, [792](#)
- benchmark-fgesv.C, [792](#)
  - \_\_FFLASFFPACK\_OPENBLAS\_NT\_ALREADY\_SET, [792](#)
  - main, [792](#)
- benchmark-fsyr2k.C, [792](#)
  - main, [793](#)
- benchmark-fsyrk.C, [793](#)
  - \_\_FFLASFFPACK\_OPENBLAS\_NT\_ALREADY\_SET, [793](#)
  - main, [793](#)
- benchmark-fsytrf.C, [793](#)
  - \_\_FFLASFFPACK\_OPENBLAS\_NT\_ALREADY\_SET, [794](#)
  - \_\_FFPACK\_FSYTRF\_BC\_CROUT, [794](#)
  - CUBE, [794](#)
  - main, [794](#)
- benchmark-fttrsm-mp.C, [794](#)
  - \_\_FFLASFFPACK\_OPENBLAS\_NT\_ALREADY\_SET, [794](#)
  - main, [795](#)
- benchmark-fttrsm.C, [795](#)
  - \_\_FFLASFFPACK\_OPENBLAS\_NT\_ALREADY\_SET, [795](#)
  - main, [795](#)
- benchmark-fttrsv.C, [795](#)
  - \_\_FFLASFFPACK\_OPENBLAS\_NT\_ALREADY\_SET, [796](#)
  - main, [796](#)
- benchmark-fttrtri.C, [796](#)
  - \_\_FFLASFFPACK\_OPENBLAS\_NT\_ALREADY\_SET, [796](#)
  - CUBE, [796](#)
  - main, [796](#)
- benchmark-inverse.C, [796](#)
  - CUBE, [797](#)
  - main, [797](#)
- benchmark-lqup-mp.C, [797](#)
  - main, [797](#)
- benchmark-lqup.C, [798](#)
  - CUBE, [798](#)
  - main, [798](#)
- benchmark-pluq.C, [798](#)
  - \_\_FFLASFFPACK\_OPENBLAS\_NT\_ALREADY\_SET, [799](#)
  - CUBE, [799](#)
  - Field, [799](#)
  - main, [799](#)
  - Rec\_Initialize, [799](#)
  - verification\_PLUQ, [799](#)
- benchmark-quasisep.C, [799](#)
  - \_\_FFLASFFPACK\_OPENBLAS\_NT\_ALREADY\_SET, [800](#)
  - main, [800](#)
  - run\_with\_field, [800](#)
- benchmark-storage-transpose.C, [800](#)
  - main, [801](#)
- benchmark-wino.C, [801](#)
  - CUBE, [801](#)
  - launch\_wino, [801](#)
  - main, [802](#)
- benchmark\_disp
  - benchmark-fgemv.C, [791](#)
- benchmark\_in\_Field
  - benchmark-fgemv.C, [791](#)
- benchmark\_with\_field
  - benchmark-fgemv.C, [791](#)
- benchmark\_with\_timer
  - benchmark-fgemv.C, [790](#)
- Bibliography, [7](#)
- Bini, [406](#)
  - FFLAS::BLAS3, [192](#)
- bit\_manipulation.h, [1039](#)
  - \_\_has\_builtin, [1040](#)
  - clz, [1040](#)
  - ctz, [1040](#)

- bitsize
  - FFLAS, [140](#)
- bitsize< Givaro::ZRing< Givaro::Integer > >
  - FFLAS, [140](#)
- blas\_enum
  - config-blas.h, [809](#)
- blend
  - ScalFunctions< Element >, [555](#)
  - Simd128\_impl< true, true, false, 2 >, [568](#)
  - Simd128\_impl< true, true, false, 4 >, [578](#)
  - Simd128\_impl< true, true, false, 8 >, [588](#)
  - Simd128\_impl< true, true, true, 2 >, [596](#)
  - Simd128\_impl< true, true, true, 4 >, [605](#)
  - Simd128\_impl< true, true, true, 8 >, [614](#)
  - Simd256\_impl< true, false, true, 8 >, [625](#)
  - Simd256\_impl< true, true, false, 2 >, [636](#)
  - Simd256\_impl< true, true, false, 4 >, [652](#)
  - Simd256\_impl< true, true, false, 8 >, [664](#)
  - Simd256\_impl< true, true, true, 2 >, [672](#)
  - Simd256\_impl< true, true, true, 4 >, [682](#), [689](#)
  - Simd256\_impl< true, true, true, 8 >, [698](#)
  - Simd512\_impl< true, false, true, 8 >, [707](#)
  - Simd512\_impl< true, true, false, 8 >, [718](#)
  - Simd512\_impl< true, true, true, 8 >, [726](#)
- blendv
  - ScalFunctionsBase< Element, typename enable\_if< is\_floating\_point< Element >::value >::type >, [556](#)
  - Simd256\_impl< true, false, true, 8 >, [625](#)
  - Simd512\_impl< true, false, true, 8 >, [707](#)
- Block, [406](#)
- BlockCuts
  - FFLAS, [179](#), [181](#)
- BlockCuts< CuttingStrategy::Block, StrategyParameter::Fixed >
  - FFLAS, [180](#)
- BlockCuts< CuttingStrategy::Block, StrategyParameter::Grain >
  - FFLAS, [179](#)
- BlockCuts< CuttingStrategy::Block, StrategyParameter::Threads >
  - FFLAS, [181](#)
- BlockCuts< CuttingStrategy::Column, StrategyParameter::Fixed >
  - FFLAS, [180](#)
- BlockCuts< CuttingStrategy::Column, StrategyParameter::Grain >
  - FFLAS, [180](#)
- BlockCuts< CuttingStrategy::Column, StrategyParameter::Threads >
  - FFLAS, [180](#)
- BlockCuts< CuttingStrategy::Row, StrategyParameter::Fixed >
  - FFLAS, [179](#)
- BlockCuts< CuttingStrategy::Row, StrategyParameter::Grain >
  - FFLAS, [179](#)
- BlockCuts< CuttingStrategy::Row, StrategyParameter::Threads >
  - FFLAS, [180](#)
- BlockCuts< CuttingStrategy::Single, StrategyParameter::Threads >
  - FFLAS, [179](#)
- blockcuts.inl, [1027](#)
  - \_\_FFLASFFPACK\_MINBLOCKCUTS, [1028](#)
  - \_\_FFLASFFPACK\_fflas\_blockcuts\_INL, [1028](#)
- blockindex
  - ForStrategy1D< blocksize\_t, Cut, Param >, [465](#)
  - ForStrategy2D< blocksize\_t, Cut, Param >, [468](#)
- BlockingFactor
  - FFLAS::details, [206](#)
- BLOCKS
  - ForStrategy2D< blocksize\_t, Cut, Param >, [469](#)
- BlockTransposeSIMD< Field, Simd, >, [406](#)
  - info, [407](#)
  - size, [407](#)
  - transpose, [407](#), [408](#)
- Bmax
  - MMHelper< Field, AlgoTrait, ModeTrait, ParSeqTrait >, [505](#)
- Bmin
  - MMHelper< Field, AlgoTrait, ModeTrait, ParSeqTrait >, [505](#)
- Bruhat2EchelonPermutation
  - FFPACK, [343](#)
- Bug List, [3](#)
- build
  - ForStrategy1D< blocksize\_t, Cut, Param >, [464](#)
- buildMatrix
  - FFPACK, [349](#)
- Bunfit
  - MMHelper< Field, AlgoTrait, ModeTrait, ParSeqTrait >, [504](#)
- c
  - Argument, [399](#)
- callLUdivine\_small< double >, [409](#)
  - operator(), [409](#)
- callLUdivine\_small< Element >, [408](#)
  - operator(), [408](#)
- callLUdivine\_small< float >, [410](#)
  - operator(), [410](#)
- cardinality
  - Bench< Elt >, [405](#)
  - RNSInteger< RNS >, [541](#)
  - RNSIntegerMod< RNS >, [545](#)
  - Test< Elt >, [759](#)
- cast.h, [1040](#)
- category
  - FieldTraits< FFPACK::RNSInteger< T > >, [454](#)
  - FieldTraits< FFPACK::RNSIntegerMod< T > >, [454](#)
  - FieldTraits< Field >, [453](#)
  - FieldTraits< Givaro::Modular< Element > >, [455](#)
  - FieldTraits< Givaro::ModularBalanced< Element > >, [456](#)

- FieldTraits< Givaro::ZRing< double > >, [456](#)
- FieldTraits< Givaro::ZRing< float > >, [457](#)
- FieldTraits< Givaro::ZRing< Givaro::Integer > >, [458](#)
- FieldTraits< Givaro::ZRing< int16\_t > >, [458](#)
- FieldTraits< Givaro::ZRing< int32\_t > >, [459](#)
- FieldTraits< Givaro::ZRing< int64\_t > >, [459](#)
- FieldTraits< Givaro::ZRing< Reclnt::ruint< K > >, [460](#)
- FieldTraits< Givaro::ZRing< uint16\_t > >, [461](#)
- FieldTraits< Givaro::ZRing< uint32\_t > >, [461](#)
- FieldTraits< Givaro::ZRing< uint64\_t > >, [462](#)
- cblas.C, [1048](#)
  - \_\_FFLASFFPACK\_CONFIGURATION, [1048](#)
  - \_\_FFLASFFPACK\_HAVE\_CBLAS, [1048](#)
  - main, [1048](#)
- CBLAS\_DIAG
  - config-blas.h, [810](#)
- cblas\_dsyrk
  - config-blas.h, [814](#)
- CBLAS\_ENUM\_DEFINED\_H
  - config-blas.h, [809](#)
- CBLAS\_EXTERNALS
  - config-blas.h, [809](#)
- CBLAS\_GEMM
  - benchmark-dgemm.C, [780](#)
- cblas\_imptrsm
  - FFLAS, [127](#)
- CBLAS\_INT
  - config-blas.h, [809](#)
- CBLAS\_ORDER
  - config-blas.h, [809](#)
- CBLAS\_SIDE
  - config-blas.h, [810](#)
- CBLAS\_TRANSPOSE
  - config-blas.h, [809](#)
- CBLAS\_UPLO
  - config-blas.h, [810](#)
- CblasColMajor
  - config-blas.h, [809](#)
- CblasConjTrans
  - config-blas.h, [810](#)
- CblasLeft
  - config-blas.h, [810](#)
- CblasLower
  - config-blas.h, [810](#)
- CblasNonUnit
  - config-blas.h, [810](#)
- CblasNoTrans
  - config-blas.h, [810](#)
- CblasRight
  - config-blas.h, [810](#)
- CblasRowMajor
  - config-blas.h, [809](#)
- CblasTrans
  - config-blas.h, [810](#)
- CblasUnit
  - config-blas.h, [810](#)
- CblasUpper
  - config-blas.h, [810](#)
- ceil
  - ScalFunctionsBase< Element, typename enable\_if< is\_floating\_point< Element >::value >::type >, [556](#)
  - Simd256\_impl< true, false, true, 8 >, [627](#)
  - Simd512\_impl< true, false, true, 8 >, [709](#)
- changeBS
  - ForStrategy1D< blocksize\_t, Cut, Param >, [465](#)
- changeCBS
  - ForStrategy2D< blocksize\_t, Cut, Param >, [469](#)
- changeRBS
  - ForStrategy2D< blocksize\_t, Cut, Param >, [469](#)
- characteristic
  - RNSInteger< RNS >, [540](#)
  - RNSIntegerMod< RNS >, [545](#)
- CharPoly
  - FFPACK, [321](#), [322](#), [349](#), [367](#), [368](#)
- charpoly.C, [771](#), [772](#)
  - CUBE, [772](#)
  - GFOPS, [772](#)
  - main, [772](#)
  - TTimer, [772](#)
- CharpolyFailed, [410](#)
- check
  - Checker\_Empty< Field >, [411](#)
  - CheckerImplem\_charpoly< Field, Polynomial >, [412](#)
  - CheckerImplem\_charpoly< Givaro::ZRing< Givaro::Integer >, Polynomial >, [413](#)
  - CheckerImplem\_Det< Field >, [414](#)
  - CheckerImplem\_fgmm< Field >, [415](#)
  - CheckerImplem\_ftsm< Field >, [416](#)
  - CheckerImplem\_invert< Field >, [417](#)
  - CheckerImplem\_PLUQ< Field >, [418](#)
- check1
  - regression-check.C, [1051](#)
- check2
  - regression-check.C, [1051](#)
- check3
  - regression-check.C, [1051](#)
- check4
  - regression-check.C, [1051](#)
- check\_computeS1S2
  - test-fsyrk.C, [1074](#)
- CHECK\_DEPENDENCIES
  - parallel.h, [1030](#)
- check\_eq
  - test-simd.C, [1100](#)
- check\_fdot
  - test-fdot.C, [1059](#)
- check\_fger
  - test-fger.C, [1066](#)
- check\_fsyr2k
  - test-fsyr2k.C, [1072](#)
- check\_fsyrk
  - test-fsyrk.C, [1073](#)

- check\_fsyrk\_bkdiag
  - test-fsyrk.C, [1073](#)
- check\_fsyrk\_diag
  - test-fsyrk.C, [1073](#)
- check\_ftrmm
  - test-ftrmm.C, [1076](#)
- check\_ftrmv
  - test-ftrmv.C, [1077](#)
- check\_ftrsm
  - test-ftrsm.C, [1079](#)
- check\_ftrssyr2k
  - test-ftrssyr2k.C, [1080](#)
- check\_ftrstr
  - test-ftrstr.C, [1081](#)
- check\_ftrsv
  - test-ftrsv.C, [1082](#)
- check\_ftrtri
  - test-ftrtri.C, [1084](#)
- check\_minpoly
  - test-minpoly.C, [1091](#)
- check\_MM
  - test-fgemm.C, [1062](#)
- check\_MV
  - test-fgemv.C, [1064](#)
- check\_result
  - benchmark-fgemv.C, [790](#)
- check\_solve
  - test-solve.C, [1101](#)
- checkA
  - MMHelper< Field, AlgoTrait, ModeTrait, ParSeq-Trait >, [504](#)
- checkB
  - MMHelper< Field, AlgoTrait, ModeTrait, ParSeq-Trait >, [504](#)
- CHECKER, [41](#)
- Checker\_charpoly
  - FFPACK, [303](#)
- checker\_charpoly.inl, [803](#)
  - \_\_FFLASFFPACK\_checker\_charpoly\_INL, [804](#)
- Checker\_Det
  - FFPACK, [302](#)
- checker\_det.inl, [804](#)
  - \_\_FFLASFFPACK\_checker\_det\_INL, [804](#)
- Checker\_Empty
  - Checker\_Empty< Field >, [411](#)
- Checker\_Empty< Field >, [410](#)
  - check, [411](#)
  - Checker\_Empty, [411](#)
- checker\_empty.h, [804](#)
- Checker\_fgemm
  - FFLAS, [72](#)
- checker\_fgemm.inl, [804](#)
  - \_\_FFLASFFPACK\_checker\_fgemm\_INL, [805](#)
- Checker\_ftrsm
  - FFLAS, [72](#)
- checker\_ftrsm.inl, [805](#)
  - \_\_FFLASFFPACK\_checker\_ftrsm\_INL, [805](#)
- Checker\_invert
  - FFPACK, [303](#)
- checker\_invert.inl, [805](#)
  - \_\_FFLASFFPACK\_checker\_invert\_INL, [805](#)
- Checker\_PLUQ
  - FFPACK, [302](#)
- checker\_pluq.inl, [805](#)
  - \_\_FFLASFFPACK\_checker\_pluq\_INL, [806](#)
- CheckerImplem\_charpoly
  - CheckerImplem\_charpoly< Field, Polynomial >, [411](#)
  - CheckerImplem\_charpoly< Givaro::ZRing< Givaro::Integer >, Polynomial >, [412](#), [413](#)
- CheckerImplem\_charpoly< Field, Polynomial >, [411](#)
  - ~CheckerImplem\_charpoly, [411](#)
  - check, [412](#)
  - CheckerImplem\_charpoly, [411](#)
- CheckerImplem\_charpoly< Givaro::ZRing< Givaro::Integer >, Polynomial >, [412](#)
  - ~CheckerImplem\_charpoly, [413](#)
  - check, [413](#)
  - CheckerImplem\_charpoly, [412](#), [413](#)
  - Ring, [412](#)
- CheckerImplem\_Det
  - CheckerImplem\_Det< Field >, [414](#)
- CheckerImplem\_Det< Field >, [413](#)
  - ~CheckerImplem\_Det, [414](#)
  - check, [414](#)
  - CheckerImplem\_Det, [414](#)
- CheckerImplem\_fgemm
  - CheckerImplem\_fgemm< Field >, [415](#)
- CheckerImplem\_fgemm< Field >, [414](#)
  - ~CheckerImplem\_fgemm, [415](#)
  - check, [415](#)
  - CheckerImplem\_fgemm, [415](#)
- CheckerImplem\_ftrsm
  - CheckerImplem\_ftrsm< Field >, [416](#)
- CheckerImplem\_ftrsm< Field >, [416](#)
  - ~CheckerImplem\_ftrsm, [416](#)
  - check, [416](#)
  - CheckerImplem\_ftrsm, [416](#)
- CheckerImplem\_invert
  - CheckerImplem\_invert< Field >, [417](#)
- CheckerImplem\_invert< Field >, [417](#)
  - ~CheckerImplem\_invert, [417](#)
  - check, [417](#)
  - CheckerImplem\_invert, [417](#)
- CheckerImplem\_PLUQ
  - CheckerImplem\_PLUQ< Field >, [418](#)
- CheckerImplem\_PLUQ< Field >, [417](#)
  - ~CheckerImplem\_PLUQ, [418](#)
  - check, [418](#)
  - CheckerImplem\_PLUQ, [418](#)
- checkers.doxy, [806](#)
- checkers\_fflas.h, [806](#)
- checkers\_fflas.inl, [806](#)
  - FFLASFFPACK\_checkers\_fflas\_inl\_H, [807](#)
- checkers\_ffpack.h, [807](#)
- checkers\_ffpack.inl, [807](#)

- FFLASFFPACK\_checkers\_ffpack\_inl\_H, [808](#)
- checkingMessage
  - test-nullspace.C, [1092](#)
- checkMonotonicApplyP
  - test-permutations.C, [1094](#)
- checkOut
  - MMHelper< Field, AlgoTrait, ModeTrait, ParSeq-Trait >, [504](#)
- checkRPM
  - test-rpm.C, [1097](#)
- checkSymmetricRPM
  - test-rpm.C, [1097](#)
- checkZeroDimCharpoly
  - regression-check.C, [1051](#)
- checkZeroDimMinPoly
  - regression-check.C, [1051](#)
- chooseField
  - FFPACK, [388](#)
- chooseField< Givaro::ZRing< double > >
  - FFPACK, [389](#)
- chooseField< Givaro::ZRing< float > >
  - FFPACK, [388](#)
- chooseField< Givaro::ZRing< int32\_t > >
  - FFPACK, [388](#)
- chooseField< Givaro::ZRing< int64\_t > >
  - FFPACK, [388](#)
- chunk
  - Sparse< \_Field, SparseMatrix\_t::ELL\_simd >, [743](#)
  - Sparse< \_Field, SparseMatrix\_t::ELL\_simd\_ZO >, [745](#)
  - Sparse< \_Field, SparseMatrix\_t::SELL >, [748](#)
  - Sparse< \_Field, SparseMatrix\_t::SELL\_ZO >, [750](#)
- chunkSize
  - Sparse< \_Field, SparseMatrix\_t::SELL >, [749](#)
  - Sparse< \_Field, SparseMatrix\_t::SELL\_ZO >, [751](#)
- clapack.C, [1048](#)
  - \_\_FFLASFFPACK\_CONFIGURATION, [1048](#)
  - \_\_FFLASFFPACK\_HAVE\_CLAPACK, [1048](#)
  - \_\_FFLASFFPACK\_HAVE\_LAPACK, [1048](#)
  - main, [1049](#)
- Classic, [418](#)
- CLASSIC\_HYBRID
  - benchmark-fgemm.C, [787](#)
- clz
  - bit\_manipulation.h, [1040](#)
- Cmax
  - MMHelper< Field, AlgoTrait, ModeTrait, ParSeq-Trait >, [505](#)
- Cmin
  - MMHelper< Field, AlgoTrait, ModeTrait, ParSeq-Trait >, [505](#)
- cmp
  - test-simd.C, [1100](#)
- cmp\_false
  - ScalFunctionsBase< Element, typename enable\_if< is\_floating\_point< Element >::value >::type >, [557](#)
- ScalFunctionsBase< Element, typename enable\_if< is\_integral< Element >::value >::type >, [560](#)
- cmp\_true
  - ScalFunctionsBase< Element, typename enable\_if< is\_floating\_point< Element >::value >::type >, [557](#)
  - ScalFunctionsBase< Element, typename enable\_if< is\_integral< Element >::value >::type >, [559](#)
- col
  - Coo< Field >, [432](#)
  - Coo< ValT, IdxT >, [430](#), [433](#)
  - Sparse< \_Field, SparseMatrix\_t::COO >, [733](#)
  - Sparse< \_Field, SparseMatrix\_t::COO\_ZO >, [735](#)
  - Sparse< \_Field, SparseMatrix\_t::CSR >, [737](#)
  - Sparse< \_Field, SparseMatrix\_t::CSR\_HYB >, [738](#)
  - Sparse< \_Field, SparseMatrix\_t::CSR\_ZO >, [740](#)
  - Sparse< \_Field, SparseMatrix\_t::ELL >, [742](#)
  - Sparse< \_Field, SparseMatrix\_t::ELL\_simd >, [744](#)
  - Sparse< \_Field, SparseMatrix\_t::ELL\_simd\_ZO >, [745](#)
  - Sparse< \_Field, SparseMatrix\_t::ELL\_ZO >, [747](#)
  - Sparse< \_Field, SparseMatrix\_t::SELL >, [749](#)
  - Sparse< \_Field, SparseMatrix\_t::SELL\_ZO >, [751](#)
- colblockindex
  - ForStrategy2D< blocksize\_t, Cut, Param >, [468](#)
- colBlockSize
  - ForStrategy2D< blocksize\_t, Cut, Param >, [469](#)
- coldim
  - StatsMatrix, [753](#)
- colnumblocks
  - ForStrategy2D< blocksize\_t, Cut, Param >, [467](#)
- ColRankProfileSubmatrix
  - FFPACK, [334](#), [372](#)
- ColRankProfileSubmatrix\_modular\_double
  - ffpack.C, [999](#)
  - ffpack\_c.h, [1019](#)
- ColRankProfileSubmatrixIndices
  - FFPACK, [333](#), [372](#)
- ColRankProfileSubmatrixIndices\_modular\_double
  - ffpack.C, [999](#)
  - ffpack\_c.h, [1019](#)
- Column, [419](#)
- ColumnEchelonForm
  - FFPACK, [315](#), [316](#), [366](#)
- ColumnEchelonForm\_modular\_double
  - ffpack.C, [990](#)
  - ffpack\_c.h, [1012](#)
- ColumnEchelonForm\_modular\_float
  - ffpack.C, [990](#)
  - ffpack\_c.h, [1012](#)
- ColumnEchelonForm\_modular\_int32\_t
  - ffpack.C, [991](#)
  - ffpack\_c.h, [1012](#)
- ColumnRankProfile
  - FFPACK, [330](#), [331](#), [371](#)
- ColumnRankProfile\_modular\_double
  - ffpack.C, [998](#)



- ffpack\_c.h, [1018](#)
- COMMA
  - parallel.h, [1033](#)
- CompactElement< double >, [419](#)
  - type, [419](#)
- CompactElement< Element >, [419](#)
  - type, [419](#)
- CompactElement< float >, [419](#)
  - type, [419](#)
- CompactElement< int16\_t >, [420](#)
  - type, [420](#)
- CompactElement< int32\_t >, [420](#)
  - type, [420](#)
- CompactElement< int64\_t >, [420](#)
  - type, [420](#)
- compatible\_data\_type< Field >, [421](#)
  - value, [421](#)
- compatible\_data\_type< Givaro::ZRing< double > >, [421](#)
  - value, [421](#)
- compatible\_data\_type< Givaro::ZRing< float > >, [421](#)
  - value, [421](#)
- compliant
  - NoSimd< T >, [517](#)
  - Simd128\_impl< true, true, false, 2 >, [566](#)
  - Simd128\_impl< true, true, false, 4 >, [576](#)
  - Simd128\_impl< true, true, false, 8 >, [586](#)
  - Simd128\_impl< true, true, true, 2 >, [594](#)
  - Simd128\_impl< true, true, true, 4 >, [603](#)
  - Simd128\_impl< true, true, true, 8 >, [612](#)
  - Simd256\_impl< true, false, true, 8 >, [623](#)
  - Simd256\_impl< true, true, false, 2 >, [633](#)
  - Simd256\_impl< true, true, false, 4 >, [648](#)
  - Simd256\_impl< true, true, false, 8 >, [662](#)
  - Simd256\_impl< true, true, true, 2 >, [669](#)
  - Simd256\_impl< true, true, true, 4 >, [680](#), [686](#)
  - Simd256\_impl< true, true, true, 8 >, [695](#)
  - Simd512\_impl< true, false, true, 8 >, [704](#)
  - Simd512\_impl< true, true, false, 8 >, [715](#)
  - Simd512\_impl< true, true, true, 8 >, [723](#)
- Compose
  - Compose< H1, H2 >, [422](#)
- Compose< H1, H2 >, [422](#)
  - Compose, [422](#)
  - first\_component, [422](#)
  - operator<<, [423](#)
  - second\_component, [422](#)
- composePermutationsLLL
  - FFPACK, [358](#)
  - ffpack.C, [986](#)
  - ffpack\_c.h, [1008](#)
- composePermutationsLLM
  - FFPACK, [358](#)
  - ffpack.C, [986](#)
  - ffpack\_c.h, [1008](#)
- composePermutationsMLM
  - FFPACK, [359](#)
  - ffpack.C, [986](#)
- ffpack\_c.h, [1008](#)
- CompressRows
  - FFPACK::Protected, [394](#)
- CompressRowsQA
  - FFPACK::Protected, [395](#)
- CompressRowsQK
  - FFPACK::Protected, [395](#)
- CompressToBlockBiDiagonal
  - FFPACK, [342](#)
- computeDeviation
  - FFLAS, [153](#)
- computeFactorClassic
  - FFLAS::Protected, [211](#)
- ComputeRPermutation
  - FFPACK, [344](#), [347](#)
- computeS1S2
  - FFLAS, [123](#)
- config-blas.h, [808](#)
  - AtlasConj, [810](#)
  - blas\_enum, [809](#)
  - CBLAS\_DIAG, [810](#)
  - cblas\_dsyrk, [814](#)
  - CBLAS\_ENUM\_DEFINED\_H, [809](#)
  - CBLAS\_EXTERNALS, [809](#)
  - CBLAS\_INT, [809](#)
  - CBLAS\_ORDER, [809](#)
  - CBLAS\_SIDE, [810](#)
  - CBLAS\_TRANSPOSE, [809](#)
  - CBLAS\_UPLO, [810](#)
  - CblasColMajor, [809](#)
  - CblasConjTrans, [810](#)
  - CblasLeft, [810](#)
  - CblasLower, [810](#)
  - CblasNonUnit, [810](#)
  - CblasNoTrans, [810](#)
  - CblasRight, [810](#)
  - CblasRowMajor, [809](#)
  - CblasTrans, [810](#)
  - CblasUnit, [810](#)
  - CblasUpper, [810](#)
  - dasum\_, [811](#)
  - daxpy\_, [810](#)
  - dcopy\_, [812](#)
  - ddot\_, [810](#)
  - dgemm\_, [814](#)
  - dgemv\_, [811](#)
  - dger\_, [812](#)
  - dnrm2\_, [811](#)
  - dscal\_, [812](#)
  - dtrmm\_, [813](#)
  - dtrsm\_, [813](#)
  - idamax\_, [811](#)
  - saxpy\_, [810](#)
  - scopy\_, [812](#)
  - sdot\_, [811](#)
  - sgemm\_, [814](#)
  - sgemv\_, [811](#)
  - sger\_, [812](#)



- sscal\_, [813](#)
- strmm\_, [813](#)
- strsm\_, [813](#)
- config.h, [815](#), [818](#)
  - \_\_FFLASFFPACK\_HAVE\_BLAS, [819](#)
  - \_\_FFLASFFPACK\_HAVE\_CBLAS, [819](#)
  - \_\_FFLASFFPACK\_HAVE\_CXX11, [819](#)
  - \_\_FFLASFFPACK\_HAVE\_DLFCN\_H, [819](#)
  - \_\_FFLASFFPACK\_HAVE\_FLOAT\_H, [819](#)
  - \_\_FFLASFFPACK\_HAVE\_INT128, [819](#)
  - \_\_FFLASFFPACK\_HAVE\_INTPTR\_T, [819](#)
  - \_\_FFLASFFPACK\_HAVE\_INTTYPES\_H, [819](#)
  - \_\_FFLASFFPACK\_HAVE\_LAPACK, [819](#)
  - \_\_FFLASFFPACK\_HAVE\_LIMITS\_H, [819](#)
  - \_\_FFLASFFPACK\_HAVE\_LITTLE\_ENDIAN, [819](#)
  - \_\_FFLASFFPACK\_HAVE\_PTHREAD\_H, [819](#)
  - \_\_FFLASFFPACK\_HAVE\_STDDEF\_H, [819](#)
  - \_\_FFLASFFPACK\_HAVE\_STDINT\_H, [820](#)
  - \_\_FFLASFFPACK\_HAVE\_STDIO\_H, [820](#)
  - \_\_FFLASFFPACK\_HAVE\_STDLIB\_H, [820](#)
  - \_\_FFLASFFPACK\_HAVE\_STRINGS\_H, [820](#)
  - \_\_FFLASFFPACK\_HAVE\_STRING\_H, [820](#)
  - \_\_FFLASFFPACK\_HAVE\_SYS\_STAT\_H, [820](#)
  - \_\_FFLASFFPACK\_HAVE\_SYS\_TIME\_H, [820](#)
  - \_\_FFLASFFPACK\_HAVE\_SYS\_TYPES\_H, [820](#)
  - \_\_FFLASFFPACK\_HAVE\_UNISTD\_H, [820](#)
  - \_\_FFLASFFPACK\_LT\_OBJDIR, [820](#)
  - \_\_FFLASFFPACK\_OPENBLAS\_NUM\_THREADS, [820](#)
  - \_\_FFLASFFPACK\_PACKAGE, [820](#)
  - \_\_FFLASFFPACK\_PACKAGE\_BUGREPORT, [820](#)
  - \_\_FFLASFFPACK\_PACKAGE\_NAME, [820](#)
  - \_\_FFLASFFPACK\_PACKAGE\_STRING, [820](#)
  - \_\_FFLASFFPACK\_PACKAGE\_TARNAME, [821](#)
  - \_\_FFLASFFPACK\_PACKAGE\_URL, [821](#)
  - \_\_FFLASFFPACK\_PACKAGE\_VERSION, [821](#)
  - \_\_FFLASFFPACK\_SIZEOF\_CHAR, [821](#)
  - \_\_FFLASFFPACK\_SIZEOF\_INT, [821](#)
  - \_\_FFLASFFPACK\_SIZEOF\_LONG, [821](#)
  - \_\_FFLASFFPACK\_SIZEOF\_LONG\_LONG, [821](#)
  - \_\_FFLASFFPACK\_SIZEOF\_SHORT, [821](#)
  - \_\_FFLASFFPACK\_SIZEOF\_\_INT64\_T, [821](#)
  - \_\_FFLASFFPACK\_STDC\_HEADERS, [821](#)
  - \_\_FFLASFFPACK\_USE\_OPENMP, [821](#)
  - \_\_FFLASFFPACK\_VERSION, [821](#)
- HAVE\_BLAS, [815](#)
- HAVE\_CBLAS, [815](#)
- HAVE\_CXX11, [815](#)
- HAVE\_DLFCN\_H, [816](#)
- HAVE\_FLOAT\_H, [816](#)
- HAVE\_INT128, [816](#)
- HAVE\_INTPTR\_T, [816](#)
- HAVE\_LAPACK, [816](#)
- HAVE\_LIMITS\_H, [816](#)
- HAVE\_LITTLE\_ENDIAN, [816](#)
- HAVE\_PTHREAD\_H, [816](#)
- HAVE\_STDDEF\_H, [816](#)
- HAVE\_STDINT\_H, [816](#)
- HAVE\_STDIO\_H, [816](#)
- HAVE\_STDLIB\_H, [816](#)
- HAVE\_STRING\_H, [816](#)
- HAVE\_STRINGS\_H, [816](#)
- HAVE\_SYS\_STAT\_H, [816](#)
- HAVE\_SYS\_TIME\_H, [817](#)
- HAVE\_SYS\_TYPES\_H, [817](#)
- HAVE\_UNISTD\_H, [817](#)
- LT\_OBJDIR, [817](#)
- OPENBLAS\_NUM\_THREADS, [817](#)
- PACKAGE, [817](#)
- PACKAGE\_BUGREPORT, [817](#)
- PACKAGE\_NAME, [817](#)
- PACKAGE\_STRING, [817](#)
- PACKAGE\_TARNAME, [817](#)
- PACKAGE\_URL, [817](#)
- PACKAGE\_VERSION, [817](#)
- SIZEOF\_\_INT64\_T, [818](#)
- SIZEOF\_CHAR, [817](#)
- SIZEOF\_INT, [817](#)
- SIZEOF\_LONG, [817](#)
- SIZEOF\_LONG\_LONG, [818](#)
- SIZEOF\_SHORT, [818](#)
- STDC\_HEADERS, [818](#)
- USE\_OPENMP, [818](#)
- VERSION, [818](#)
- Configuring and Installing FFLAS-FFPACK, [2](#)
- CONST
  - fflas\_simd.h, [870](#)
- ConstElement\_ptr
  - benchmark-fgemv-rns.C, [786](#)
  - rns\_double, [524](#)
  - rns\_double\_extended, [536](#)
  - RNSInteger< RNS >, [540](#)
  - RNSIntegerMod< RNS >, [543](#)
- CONSTREFERENCE
  - parallel.h, [1031](#)
- convert
  - rns\_double, [526](#), [527](#)
  - rns\_double\_extended, [537](#)
  - RNSInteger< RNS >, [541](#)
  - RNSIntegerMod< RNS >, [546](#)
- convert\_transpose
  - rns\_double, [526](#)
- ConvertTo< T >, [429](#)
- COO
  - FFLAS, [76](#)
- Coo
  - Coo< Field >, [431](#)
  - Coo< ValT, IdxT >, [430](#), [433](#)
- coo
  - HelperFlag, [477](#)
- Coo< Field >, [431](#)
  - col, [432](#)
  - Coo, [431](#)
  - deleted, [432](#)
  - operator=, [432](#)
  - row, [432](#)
  - val, [432](#)

- Coo< ValT, IdxT >, [429](#), [432](#)
  - col, [430](#), [433](#)
  - Coo, [430](#), [433](#)
  - operator=, [430](#), [433](#)
  - row, [430](#), [433](#)
  - Self, [430](#), [433](#)
  - val, [430](#), [433](#)
- coo.h, [885](#)
- coo\_spmmm.inl, [886](#)
  - \_\_FFLASFFPACK\_fflas\_sparse\_coo\_spmmm\_INL, [886](#)
- coo\_spmv.inl, [887](#)
  - \_\_FFLASFFPACK\_fflas\_sparse\_coo\_spmv\_INL, [887](#)
- coo\_utils.inl, [887](#)
  - \_\_FFLASFFPACK\_fflas\_sparse\_coo\_utils\_INL, [888](#)
- COO\_ZO
  - FFLAS, [76](#)
- CooMat< Field >, [434](#)
  - \_coo16, [434](#)
  - \_coo16\_zo, [434](#)
  - \_coo32, [434](#)
  - \_coo32\_zo, [434](#)
  - \_coo64, [434](#)
  - \_coo64\_zo, [434](#)
- Copying and Licence, [2](#)
- count\_nonconst\_lvalue\_reference< const T &, O... >, [435](#)
  - n, [435](#)
- count\_nonconst\_lvalue\_reference< T >, [435](#)
- count\_nonconst\_lvalue\_reference< T &, O... >, [435](#)
  - n, [435](#)
- count\_nonconst\_lvalue\_reference< T, O... >, [435](#)
  - n, [435](#)
- count\_nonconst\_lvalue\_reference<>, [436](#)
  - n, [436](#)
- CROUT
  - ffpack\_pluq.inl, [939](#)
- CSC
  - FFLAS, [76](#)
- CSC\_ZO
  - FFLAS, [76](#)
- CSR
  - FFLAS, [76](#)
- csr
  - HelperFlag, [477](#)
- csr.h, [888](#)
- CSR\_HYB
  - FFLAS, [76](#)
- csr\_hyb.h, [893](#)
- csr\_hyb\_pspmm.inl, [893](#)
  - \_\_FFLASFFPACK\_fflas\_sparse\_CSR\_HYB\_pspmm\_INL, [894](#)
- csr\_hyb\_pspmv.inl, [894](#)
  - \_\_FFLASFFPACK\_fflas\_sparse\_CSR\_HYB\_pspmv\_INL, [894](#)
- csr\_hyb\_spmmm.inl, [894](#)
  - \_\_FFLASFFPACK\_fflas\_sparse\_CSR\_HYB\_spmmm\_INL, [895](#)
- csr\_hyb\_spmv.inl, [895](#)
  - \_\_FFLASFFPACK\_fflas\_sparse\_CSR\_HYB\_spmv\_INL, [895](#)
- csr\_hyb\_utils.inl, [895](#)
  - \_\_FFLASFFPACK\_fflas\_sparse\_CSR\_HYB\_utils\_INL, [896](#)
- csr\_pspmm.inl, [888](#)
  - \_\_FFLASFFPACK\_fflas\_sparse\_CSR\_pspmm\_INL, [889](#)
- csr\_pspmv.inl, [889](#)
  - \_\_FFLASFFPACK\_fflas\_sparse\_CSR\_pspmv\_INL, [890](#)
- csr\_spmmm.inl, [890](#)
  - \_\_FFLASFFPACK\_fflas\_sparse\_CSR\_spmmm\_INL, [891](#)
- csr\_spmv.inl, [891](#)
  - \_\_FFLASFFPACK\_fflas\_sparse\_CSR\_spmv\_INL, [892](#)
- csr\_utils.inl, [892](#)
- CSR\_ZO
  - FFLAS, [76](#)
- CsrMat< Field >, [436](#)
  - \_csr16, [436](#)
  - \_csr16\_zo, [436](#)
  - \_csr32, [436](#)
  - \_csr32\_zo, [436](#)
  - \_csr64, [436](#)
  - \_csr64\_zo, [436](#)
- cst
  - Sparse< \_Field, SparseMatrix\_t::COO\_ZO >, [735](#)
  - Sparse< \_Field, SparseMatrix\_t::CSR\_ZO >, [740](#)
  - Sparse< \_Field, SparseMatrix\_t::ELL\_simd\_ZO >, [744](#)
  - Sparse< \_Field, SparseMatrix\_t::ELL\_ZO >, [746](#)
  - Sparse< \_Field, SparseMatrix\_t::SELL\_ZO >, [750](#)
- ctz
  - bit\_manipulation.h, [1040](#)
- CUBE
  - benchmark-checkers.C, [779](#)
  - benchmark-fsytrf.C, [794](#)
  - benchmark-fttri.C, [796](#)
  - benchmark-inverse.C, [797](#)
  - benchmark-lqup.C, [798](#)
  - benchmark-pluq.C, [799](#)
  - benchmark-wino.C, [801](#)
  - charpoly.C, [772](#)
  - fsyrk.C, [773](#)
  - fsytrf.C, [774](#)
  - fttri.C, [774](#)
  - pluq.C, [775](#)
  - na.C, [1049](#)
  - main, [1049](#)
- current
  - ForStrategy1D< blocksize\_t, Cut, Param >, [465](#)
  - ForStrategy2D< blocksize\_t, Cut, Param >, [469](#)
- Cut

- Parallel< C, P >, 517
- cyclic\_shift\_col
  - FFPACK, 360, 363
- cyclic\_shift\_col\_modular\_double
  - ffpack.C, 987
  - ffpack\_c.h, 1008
- cyclic\_shift\_mathPerm
  - FFPACK, 359
  - ffpack.C, 987
  - ffpack\_c.h, 1008
- cyclic\_shift\_row
  - FFPACK, 359, 362
- cyclic\_shift\_row\_col
  - FFPACK, 359, 362
- cyclic\_shift\_row\_modular\_double
  - ffpack.C, 987
  - ffpack\_c.h, 1008
- Danilevski
  - FFPACK, 349
  - FFPACK::Protected, 393
- dasum\_
  - config-blas.h, 811
- dat
  - Sparse< \_Field, SparseMatrix\_t::COO >, 733
  - Sparse< \_Field, SparseMatrix\_t::COO\_ZO >, 735
  - Sparse< \_Field, SparseMatrix\_t::CSR >, 737
  - Sparse< \_Field, SparseMatrix\_t::CSR\_HYB >, 738
  - Sparse< \_Field, SparseMatrix\_t::CSR\_ZO >, 741
  - Sparse< \_Field, SparseMatrix\_t::ELL >, 742
  - Sparse< \_Field, SparseMatrix\_t::ELL\_simd >, 744
  - Sparse< \_Field, SparseMatrix\_t::ELL\_simd\_ZO >, 745
  - Sparse< \_Field, SparseMatrix\_t::ELL\_ZO >, 747
  - Sparse< \_Field, SparseMatrix\_t::SELL >, 749
  - Sparse< \_Field, SparseMatrix\_t::SELL\_ZO >, 751
- data
  - Argument, 400
- daxpy\_
  - config-blas.h, 810
- dcopy\_
  - config-blas.h, 812
- ddot\_
  - config-blas.h, 810
- debug.h, 1040
  - FFLASFFPACK\_abort, 1041
  - FFLASFFPACK\_check, 1041
- DeCompressRows
  - FFPACK::Protected, 395
- DeCompressRowsQA
  - FFPACK::Protected, 396
- DeCompressRowsQK
  - FFPACK::Protected, 395
- DefaultBoundedTag, 437
- DefaultTag, 437
- delayed
  - RNSIntegerMod< RNS >, 544
  - Sparse< \_Field, SparseMatrix\_t::COO >, 733
  - Sparse< \_Field, SparseMatrix\_t::COO\_ZO >, 735
  - Sparse< \_Field, SparseMatrix\_t::CSR >, 736
  - Sparse< \_Field, SparseMatrix\_t::CSR\_HYB >, 738
  - Sparse< \_Field, SparseMatrix\_t::CSR\_ZO >, 740
  - Sparse< \_Field, SparseMatrix\_t::ELL >, 741
  - Sparse< \_Field, SparseMatrix\_t::ELL\_simd >, 743
  - Sparse< \_Field, SparseMatrix\_t::ELL\_simd\_ZO >, 744
  - Sparse< \_Field, SparseMatrix\_t::ELL\_ZO >, 746
  - Sparse< \_Field, SparseMatrix\_t::SELL >, 748
  - Sparse< \_Field, SparseMatrix\_t::SELL\_ZO >, 750
- DelayedField
  - MMHelper< Field, AlgoTrait, ModeTrait, ParSeq-Trait >, 502
- delayedField
  - MMHelper< Field, AlgoTrait, ModeTrait, ParSeq-Trait >, 506
- DelayedField\_t
  - MMHelper< Field, AlgoTrait, ModeTrait, ParSeq-Trait >, 502
- DelayedTag, 437
- deleted
  - Coo< Field >, 432
- DENSE\_THRESHOLD
  - fflas\_sparse.h, 883
- denseCols
  - StatsMatrix, 754
- denseRows
  - StatsMatrix, 754
- Det
  - FFPACK, 326, 327, 350, 369, 370
- det.C, 802
  - main, 802
- Det\_modular\_double
  - ffpack.C, 997
  - ffpack\_c.h, 1016
- deviationCol
  - StatsMatrix, 753
- deviationColDifference
  - StatsMatrix, 754
- deviationRow
  - StatsMatrix, 753
- deviationRowDifference
  - StatsMatrix, 754
- DFelt
  - MMHelper< Field, AlgoTrait, ModeTrait, ParSeq-Trait >, 502
- dgemm\_
  - config-blas.h, 814
  - fblas.C, 1049
- dgemv\_
  - config-blas.h, 811
- dger\_
  - config-blas.h, 812
- digits
  - limits< char >, 491
  - limits< double >, 492

- limits< float >, [492](#)
  - limits< int >, [494](#)
  - limits< long >, [494](#)
  - limits< long long >, [495](#)
  - limits< short int >, [497](#)
  - limits< signed char >, [497](#)
  - limits< unsigned char >, [498](#)
  - limits< unsigned int >, [499](#)
  - limits< unsigned long >, [499](#)
  - limits< unsigned long long >, [500](#)
  - limits< unsigned short int >, [500](#)
  - div
    - ScalFunctions< Element >, [553](#)
    - Simd256\_impl< true, false, true, 8 >, [625](#)
    - Simd512\_impl< true, false, true, 8 >, [707](#)
  - DivideAndConquer, [437](#)
  - dnrm2\_
    - config-blas.h, [811](#)
  - DNS\_BIN\_VER
    - read\_sparse.h, [906](#)
  - doApplyS
    - FFPACK, [355](#)
  - doApplyT
    - FFPACK, [356](#)
  - doBenchs
    - Bench< Elt >, [405](#)
  - doTests
    - Test< Elt >, [759](#)
  - DotProdBoundClassic
    - FFLAS::Protected, [212](#)
  - DOUBLE\_TO\_FLOAT\_CROSSOVER
    - fflas.h, [824](#)
    - winograd.C, [776](#)
  - dscal\_
    - config-blas.h, [812](#)
  - dtrmm\_
    - config-blas.h, [813](#)
  - dtrsm\_
    - config-blas.h, [813](#)
  - DynamicPeeling
    - FFLAS::Protected, [216](#)
  - DynamicPeeling2
    - FFLAS::Protected, [216](#)
  - EFFGFF
    - benchmark-dsytrf.C, [782](#)
  - Element
    - FieldSimd< \_Field >, [448](#)
    - readMyMachineType< Field, mpz\_t >, [521](#), [522](#)
    - readMyMachineType< Field, T >, [521](#)
    - rns\_double, [524](#)
    - rns\_double\_extended, [536](#)
    - RNSInteger< RNS >, [539](#)
    - RNSIntegerMod< RNS >, [543](#)
    - TestOneMethod< Simd >, [761](#)
  - Element\_ptr
    - benchmark-fgemm-rns.C, [786](#)
    - readMyMachineType< Field, mpz\_t >, [521](#), [522](#)
    - readMyMachineType< Field, T >, [521](#)
  - rns\_double, [524](#)
  - rns\_double\_extended, [536](#)
  - RNSInteger< RNS >, [540](#)
  - RNSIntegerMod< RNS >, [543](#)
  - elements
    - array< T >, [400](#)
    - vector< T >, [768](#)
  - ElementTraits< double >, [438](#)
    - value, [438](#)
  - ElementTraits< Element >, [437](#)
    - value, [438](#)
  - ElementTraits< FFPACK::rns\_double\_elt >, [438](#)
    - value, [438](#)
  - ElementTraits< float >, [438](#)
    - value, [439](#)
  - ElementTraits< Givaro::Integer >, [439](#)
    - value, [439](#)
  - ElementTraits< int16\_t >, [439](#)
    - value, [439](#)
  - ElementTraits< int32\_t >, [440](#)
    - value, [440](#)
  - ElementTraits< int64\_t >, [440](#)
    - value, [440](#)
  - ElementTraits< int8\_t >, [440](#)
    - value, [440](#)
  - ElementTraits< Reclnt::rint< K > >, [441](#)
    - value, [441](#)
  - ElementTraits< Reclnt::rmint< K, MG > >, [441](#)
    - value, [441](#)
  - ElementTraits< Reclnt::ruint< K > >, [441](#)
    - value, [442](#)
  - ElementTraits< uint16\_t >, [442](#)
    - value, [442](#)
  - ElementTraits< uint32\_t >, [442](#)
    - value, [442](#)
  - ElementTraits< uint64\_t >, [443](#)
    - value, [443](#)
  - ElementTraits< uint8\_t >, [443](#)
    - value, [443](#)
- ELL
  - FFLAS, [76](#)
- ell
  - HelperFlag, [477](#)
- ell.h, [896](#)
- ell\_pspmm.inl, [896](#)
  - \_\_FFLASFFPACK\_fflas\_sparse\_ELL\_pspmm\_INL, [897](#)
- ell\_pspmv.inl, [897](#)
  - \_\_FFLASFFPACK\_fflas\_sparse\_ELL\_pspmv\_INL, [898](#)
- ELL\_simd
  - FFLAS, [76](#)
- ell\_simd.h, [900](#)
- ell\_simd\_pspmv.inl, [901](#)
  - \_\_FFLASFFPACK\_fflas\_sparse\_ELL\_simd\_pspmv\_INL, [901](#)
- ell\_simd\_spmv.inl, [901](#)

- \_\_FFLASFFPACK\_fflas\_sparse\_ELL\_simd\_spmv\_INL, 902
- ell\_simd\_utils.inl, 902
  - \_\_FFLASFFPACK\_fflas\_sparse\_ELL\_simd\_utils\_INL, 903
- ELL\_simd\_ZO
  - FFLAS, 76
- ell\_spmv.inl, 898
  - \_\_FFLASFFPACK\_fflas\_sparse\_ELL\_spmv\_INL, 899
- ell\_spmv.inl, 899
  - \_\_FFLASFFPACK\_fflas\_sparse\_ELL\_spmv\_INL, 899
- ell\_utils.inl, 899
  - \_\_FFLASFFPACK\_fflas\_sparse\_ELL\_utils\_INL, 900
- ELL\_ZO
  - FFLAS, 76
- ElIMat< Field >, 443
  - \_ell16, 444
  - \_ell16\_zo, 444
  - \_ell32, 444
  - \_ell32\_zo, 444
  - \_ell64, 444
  - \_ell64\_zo, 444
- Elt\_ptr
  - Bench< Elt >, 404
  - Test< Elt >, 758
- ENABLE\_ALL\_CHECKINGS
  - benchmark-checkers.C, 779
  - ffpack\_fttr.inl, 933
  - test-fdot.C, 1059
  - test-fgemv-check.C, 1060
  - test-fsyr2k.C, 1071
  - test-fsyrk.C, 1073
  - test-ftmv.C, 1077
  - test-ftsm-check.C, 1078
  - test-ftsm.C, 1079
  - test-ftssyr2k.C, 1080
  - test-ftstr.C, 1081
  - test-ftsv.C, 1082
  - test-fttri.C, 1083
  - test-invert-check.C, 1085
  - test-pluq-check.C, 1095
- ENABLE\_CHECKER\_charpoly
  - test-charpoly-check.C, 1052
- ENABLE\_CHECKER\_Det
  - test-det-check.C, 1054
- ENABLE\_CHECKER\_fgemv
  - test-fgemv.C, 1062
- enable\_if\_no\_simd\_t
  - Bench< Elt >, 405
  - Test< Elt >, 758
- enable\_if\_simd128\_t
  - Bench< Elt >, 405
  - Test< Elt >, 758
- enable\_if\_simd256\_t
  - Bench< Elt >, 405
- Test< Elt >, 758
  - enable\_if\_simd512\_t
    - Bench< Elt >, 405
    - Test< Elt >, 758
    - TestOneMethod< Simd >, 761
- end
  - ForStrategy1D< blocksize\_t, Cut, Param >, 465
- END\_OF\_ARGUMENTS
  - args-parser.h, 1038
- END\_PARALLEL\_MAIN
  - parallel.h, 1032
- eq
  - ScalFunctions< Element >, 554
  - Simd128\_impl< true, true, false, 2 >, 570
  - Simd128\_impl< true, true, false, 4 >, 580
  - Simd128\_impl< true, true, false, 8 >, 590
  - Simd128\_impl< true, true, true, 2 >, 599
  - Simd128\_impl< true, true, true, 4 >, 608
  - Simd128\_impl< true, true, true, 8 >, 617
  - Simd256\_impl< true, false, true, 8 >, 626
  - Simd256\_impl< true, true, false, 2 >, 637
  - Simd256\_impl< true, true, false, 4 >, 655
  - Simd256\_impl< true, true, false, 8 >, 665
  - Simd256\_impl< true, true, true, 2 >, 674
  - Simd256\_impl< true, true, true, 4 >, 685, 691
  - Simd256\_impl< true, true, true, 8 >, 700
  - Simd512\_impl< true, false, true, 8 >, 708
  - Simd512\_impl< true, true, false, 8 >, 719
  - Simd512\_impl< true, true, true, 8 >, 728
- eval\_func\_on\_array
  - test-simd.C, 1100
- evaluate\_scalar\_method
  - TestOneMethod< Simd >, 761
- evaluate\_simd\_method
  - TestOneMethod< Simd >, 762
- example
  - Argument, 399
- ExpandBlockBiDiagonalToBruhat
  - FFPACK, 343
- expandLCRE
  - FFPACK, 347
- F
  - Bench< Elt >, 406
  - Test< Elt >, 759
- fadd
  - FFLAS, 77–79, 81, 164, 171, 172
  - FFLAS::details, 199, 200
- fadd\_1\_modular\_double
  - fflas\_c.h, 954
  - fflas\_lvl1.C, 973
- fadd\_2\_modular\_double
  - fflas\_c.h, 957
  - fflas\_lvl2.C, 978
- faddin
  - FFLAS, 77, 81, 164, 172

- faddin\_1\_modular\_double
  - fflas\_c.h, [954](#)
  - fflas\_lvl1.C, [974](#)
- faddin\_2\_modular\_double
  - fflas\_c.h, [958](#)
  - fflas\_lvl2.C, [978](#)
- Failure, [444](#)
  - \_errorStream, [446](#)
  - Failure, [445](#)
  - operator(), [445](#)
  - print, [445](#)
  - setErrorStream, [445](#)
- failure
  - FFPACK, [375](#)
- FailureCharpolyCheck, [446](#)
- FailureDetCheck, [446](#)
- FailureFgemmCheck, [446](#)
- FailureInvertCheck, [446](#)
- FailurePLUQCheck, [446](#)
- FailureTrsmCheck, [446](#)
- fassign
  - FFLAS, [82–84](#), [160](#), [164](#)
- fassign\_1\_modular\_double
  - fflas\_c.h, [953](#)
  - fflas\_lvl1.C, [972](#)
- fassign\_2\_modular\_double
  - fflas\_c.h, [955](#)
  - fflas\_lvl2.C, [975](#)
- faxpby
  - FFLAS, [132](#), [139](#)
- faxpy
  - FFLAS, [84](#), [85](#), [162](#), [169](#)
  - FFLAS::details, [201](#)
- faxpy\_1\_modular\_double
  - fflas\_c.h, [953](#)
  - fflas\_lvl1.C, [973](#)
- faxpy\_2\_modular\_double
  - fflas\_c.h, [957](#)
  - fflas\_lvl2.C, [977](#)
- fblas.C, [1049](#)
  - \_\_FFLASFFPACK\_CONFIGURATION, [1049](#)
  - dgemm\_, [1049](#)
  - main, [1050](#)
- fconvert
  - FFLAS, [129](#), [137](#), [158](#)
- fconvert\_rns
  - FFLAS, [156](#), [157](#)
- fconvert\_trans\_rns
  - FFLAS, [156](#)
- fdot
  - FFLAS, [86](#), [87](#), [133](#), [162](#), [181](#)
- fdot\_1\_modular\_double
  - fflas\_c.h, [953](#)
  - fflas\_lvl1.C, [973](#)
- fequal
  - FFLAS, [132](#), [136](#), [160](#), [165](#)
- fequal\_1\_modular\_double
  - fflas\_c.h, [952](#)
- fflas\_lvl1.C, [972](#)
- fequal\_2\_modular\_double
  - fflas\_c.h, [955](#)
  - fflas\_lvl2.C, [976](#)
- FFLAS, [42](#), [45](#)
  - alignable, [188](#)
  - alignable< Givaro::Integer \* >, [188](#)
  - BaseTimer, [74](#)
  - bitsize, [140](#)
  - bitsize< Givaro::ZRing< Givaro::Integer > >, [140](#)
  - BlockCuts, [179](#), [181](#)
  - BlockCuts< CuttingStrategy::Block, StrategyParameter::Fixed >, [180](#)
  - BlockCuts< CuttingStrategy::Block, StrategyParameter::Grain >, [179](#)
  - BlockCuts< CuttingStrategy::Block, StrategyParameter::Threads >, [181](#)
  - BlockCuts< CuttingStrategy::Column, StrategyParameter::Fixed >, [180](#)
  - BlockCuts< CuttingStrategy::Column, StrategyParameter::Grain >, [180](#)
  - BlockCuts< CuttingStrategy::Column, StrategyParameter::Threads >, [180](#)
  - BlockCuts< CuttingStrategy::Row, StrategyParameter::Fixed >, [179](#)
  - BlockCuts< CuttingStrategy::Row, StrategyParameter::Grain >, [179](#)
  - BlockCuts< CuttingStrategy::Row, StrategyParameter::Threads >, [180](#)
  - BlockCuts< CuttingStrategy::Single, StrategyParameter::Threads >, [179](#)
- cblas\_imprsm, [127](#)
- Checker\_fgemm, [72](#)
- Checker\_frsm, [72](#)
- computeDeviation, [153](#)
- computeS1S2, [123](#)
- COO, [76](#)
- COO\_ZO, [76](#)
- CSC, [76](#)
- CSC\_ZO, [76](#)
- CSR, [76](#)
- CSR\_HYB, [76](#)
- CSR\_ZO, [76](#)
- ELL, [76](#)
- ELL\_simd, [76](#)
- ELL\_simd\_ZO, [76](#)
- ELL\_ZO, [76](#)
- fadd, [77–79](#), [81](#), [164](#), [171](#), [172](#)
- faddin, [77](#), [81](#), [164](#), [172](#)
- fassign, [82–84](#), [160](#), [164](#)
- faxpby, [132](#), [139](#)
- faxpy, [84](#), [85](#), [162](#), [169](#)
- fconvert, [129](#), [137](#), [158](#)
- fconvert\_rns, [156](#), [157](#)
- fconvert\_trans\_rns, [156](#)
- fdot, [86](#), [87](#), [133](#), [162](#), [181](#)
- fequal, [132](#), [136](#), [160](#), [165](#)
- FFLAS\_BASE, [75](#)

- [fflas\\_delete](#), 155, 188
- [FFLAS\\_DIAG](#), 75
- [FFLAS\\_FORMAT](#), 76
- [fflas\\_new](#), 155, 156, 188
- [FFLAS\\_ORDER](#), 74
- [FFLAS\\_SIDE](#), 75
- [FFLAS\\_TRANSPOSE](#), 74
- [FFLAS\\_UPLO](#), 74
- [FflasAuto](#), 76
- [FflasBinary](#), 76
- [FflasColMajor](#), 74
- [FflasDense](#), 76
- [FflasDouble](#), 75
- [FflasFloat](#), 75
- [FflasGeneric](#), 75
- [FflasLeft](#), 75
- [FflasLeftTri](#), 75
- [FflasLower](#), 75
- [FflasMaple](#), 76
- [FflasMath](#), 76
- [FflasNonUnit](#), 75
- [FflasNoTrans](#), 74
- [FflasRight](#), 75
- [FflasRightTri](#), 75
- [FflasRowMajor](#), 74
- [FflasSageMath](#), 76
- [FflasSMS](#), 76
- [FflasTrans](#), 74
- [FflasUnit](#), 75
- [FflasUpper](#), 75
- [fgemm](#), 88–90, 92–97, 144, 176–178
- [fgemv](#), 97–102, 173, 184
- [fger](#), 103–106, 173
- [fidentity](#), 136, 137, 166
- [finit](#), 108, 110, 129, 137, 158, 167
- [finit\\_rns](#), 155, 156
- [finit\\_trans\\_rns](#), 155
- [fiszero](#), 131, 136, 160, 166
- [fmove](#), 139, 170
- [fneg](#), 130, 138, 159, 168
- [fnegin](#), 130, 138, 159, 168
- [ForceCheck\\_fgemm](#), 72
- [ForceCheck\\_ftrsm](#), 72
- [frand](#), 131, 135
- [freduce](#), 107–111, 157, 167
- [freduce\\_constoverride](#), 108, 110
- [freivalds](#), 111
- [fscal](#), 112–116, 161, 169
- [fscaln](#), 111, 113–116, 161, 169
- [fspmm](#), 145
- [fspmv](#), 145, 152
- [fsquare](#), 91, 92, 178
- [fsub](#), 78, 80, 164, 171
- [fsubin](#), 78, 81, 172
- [fswap](#), 133, 163
- [fsyr2k](#), 116
- [fsyrk](#), 117–124
- [fsyrk\\_strassen](#), 124, 142
- [ftranspose](#), 154
- [ftrmm](#), 124, 125, 175
- [ftrmv](#), 140
- [ftrsm](#), 126, 127, 141, 144, 145, 175
- [ftrsv](#), 128, 174
- [fzero](#), 130, 133, 135, 159, 165
- [getArgumentValue](#), 185
- [getDataType](#), 151, 152
- [getSeed](#), 189
- [getStat](#), 154
- [getTLBSize](#), 189
- [has\\_equal](#), 73
- [has\\_minus](#), 73
- [has\\_minus\\_eq](#), 73
- [has\\_mul](#), 73
- [has\\_mul\\_eq](#), 73
- [has\\_plus](#), 73
- [has\\_plus\\_eq](#), 73
- [HYB\\_ZO](#), 76
- [igemm\\_](#), 128
- [InfNorm](#), 76
- [max3](#), 77
- [max4](#), 77
- [maxCardinality](#), 154
- [maxCardinality< Givaro::Modular< int32\\_t > >](#), 154
- [maxCardinality< Givaro::Modular< int64\\_t > >](#), 154
- [min3](#), 76
- [min4](#), 77
- [minCardinality](#), 154
- [MKLSparseMatrixFormat](#), 72
- [mone](#), 76
- [NoSimdSparseMatrix](#), 72
- [NotMKLSparseMatrixFormat](#), 72
- [NotZOSparseMatrix](#), 72
- [number\\_kind](#), 75
- [one](#), 76
- [operator<<](#), 151
- [other](#), 76
- [parseArguments](#), 185
- [pfadd](#), 78
- [pfaddin](#), 79
- [pfgemm](#), 142, 182–184
- [pfgemm\\_1D\\_rec](#), 142
- [pfgemm\\_2D\\_rec](#), 143
- [pfgemm\\_3D\\_rec](#), 143
- [pfgemm\\_3D\\_rec2](#), 144
- [pfrand](#), 181
- [pfreduce](#), 109
- [pfsub](#), 79
- [pfsubin](#), 79
- [pfzero](#), 181
- [preamble](#), 186
- [prefetch](#), 189
- [queryCacheSizes](#), 189
- [queryL1CacheSize](#), 189
- [queryTopLevelCacheSize](#), 189



- readDnsFormat, [152](#)
- readMachineType, [152](#)
- ReadMatrix, [186](#)
- readSmsFormat, [151](#)
- readSprFormat, [151](#)
- SELL, [76](#)
- SELL\_ZO, [76](#)
- SimdSparseMatrix, [72](#)
- sparse\_delete, [146–150](#), [153](#)
- sparse\_init, [145–150](#), [153](#)
- sparse\_print, [147](#), [150](#), [153](#)
- SparseMatrix\_t, [76](#)
- SysTimer, [74](#)
- Timer, [73](#)
- UserTimer, [74](#)
- writeCommandString, [185](#)
- writeDnsFormat, [152](#)
- WriteMatrix, [185](#), [187](#)
- WritePermutation, [187](#)
- zero, [76](#)
- ZOSparseMatrix, [72](#)
- fflas-101\_1.C, [1104](#)
  - main, [1104](#)
- fflas-101\_3.C, [1104](#)
  - main, [1105](#)
- FFLAS-FFPACK, [41](#)
- FFLAS-FFPACK Documentation., [1](#)
- FFLAS-FFPACK fields, [43](#)
- fflas-ffpack-config.h, [821](#)
  - GCC\_VERSION, [822](#)
- fflas-ffpack-default-thresholds.h, [822](#)
  - \_\_FFLASFFPACK\_ARITHPROG\_THRESHOLD, [823](#)
  - \_\_FFLASFFPACK\_CHARPOLY\_Danilevskii\_LUKrylov\_THRESHOLD, [822](#)
  - \_\_FFLASFFPACK\_CHARPOLY\_LUKrylov\_ArithProg\_THRESHOLD, [822](#)
  - \_\_FFLASFFPACK\_FSYRK\_THRESHOLD, [823](#)
  - \_\_FFLASFFPACK\_FSYTRF\_THRESHOLD, [823](#)
  - \_\_FFLASFFPACK\_FTRTRI\_THRESHOLD, [823](#)
  - \_\_FFLASFFPACK\_PLUQ\_THRESHOLD, [822](#)
  - \_\_FFLASFFPACK\_WINOTHRESHOLD, [822](#)
  - \_\_FFLASFFPACK\_WINOTHRESHOLD\_BAL, [822](#)
  - \_\_FFLASFFPACK\_WINOTHRESHOLD\_BAL\_FLT, [822](#)
  - \_\_FFLASFFPACK\_WINOTHRESHOLD\_FLT, [822](#)
- fflas-ffpack-thresholds.h, [823](#)
- fflas-ffpack.dox, [823](#)
- fflas-ffpack.h, [823](#)
- fflas.dox, [823](#)
- fflas.h, [823](#)
  - DOUBLE\_TO\_FLOAT\_CROSSOVER, [824](#)
  - WINOTHRESHOLD, [824](#)
- FFLAS::\_ftranspose\_impl, [190](#)
  - nonsquare\_inplace\_v1, [190](#)
  - nonsquare\_inplace\_v2, [190](#)
  - not\_inplace, [190](#)
  - square\_inplace, [190](#)
- FFLAS::BLAS3, [191](#)
  - Bini, [192](#)
  - Winograd, [193](#)
  - Winograd\_L\_S, [196](#)
  - Winograd\_LR\_S, [196](#)
  - Winograd\_R\_S, [197](#)
  - WinogradAcc\_2\_24, [194](#)
  - WinogradAcc\_2\_27, [194](#)
  - WinogradAcc\_3\_21, [194](#)
  - WinogradAcc\_3\_23, [193](#)
  - WinogradAcc\_L\_S, [196](#)
  - WinogradAcc\_LR, [195](#)
  - WinogradAcc\_R\_S, [195](#)
  - WinoPar, [193](#)
- FFLAS::csr\_hyb\_details, [197](#)
- FFLAS::CuttingStrategy, [197](#)
  - RNSModulus, [198](#)
- FFLAS::details, [198](#)
  - BlockingFactor, [206](#)
  - fadd, [199](#), [200](#)
  - faxpy, [201](#)
  - freduce, [201](#), [202](#)
  - fscale, [202](#), [203](#)
  - fscalein, [202](#), [203](#)
  - gebp, [205](#)
  - igebb11, [204](#)
  - igebb14, [204](#)
  - igebb21, [204](#)
  - igebb24, [203](#)
  - igebb41, [204](#)
  - igebb44, [203](#)
  - igebp, [205](#)
  - pack\_lhs, [205](#)
  - pack\_rhs, [205](#)
- FFLAS::details\_spmv, [206](#)
- FFLAS::ElementCategories, [206](#)
- FFLAS::FieldCategories, [206](#)
- FFLAS::MMHelperAlgo, [207](#)
- FFLAS::ModeCategories, [207](#)
- FFLAS::ParSeqHelper, [208](#)
- FFLAS::Protected, [208](#)
  - computeFactorClassic, [211](#)
  - DotProdBoundClassic, [212](#)
  - DynamicPeeling, [216](#)
  - DynamicPeeling2, [216](#)
  - fgemm\_convert, [212](#)
  - fgemv\_convert, [217](#)
  - fger\_convert, [218](#)
  - fsquareCommon, [215](#)
  - fsyrk\_convert, [218](#)
  - igemm, [221](#)
  - igemm\_colmajor, [221](#)
  - MatF2MatD\_Triangular, [222](#)
  - MatF2MatFI\_Triangular, [222](#)
  - min\_types, [219](#), [220](#)
  - NeedDoublePreAddReduction, [214](#)
  - NeedPreAddReduction, [213](#)
  - NeedPreAxyReduction, [219](#)



- NeedPreScalReduction, [218](#), [219](#)
- NeedPreSubReduction, [213](#)
- ScalAndReduce, [214](#), [218](#)
- TRSMBound, [212](#)
- unfit, [220](#), [221](#)
- WinogradCalc, [217](#)
- WinogradSteps, [216](#)
- WinogradThreshold, [215](#)
- FFLAS::sell\_details, [222](#)
- FFLAS::sparse\_details, [223](#)
  - fspmm, [229–231](#)
  - fspmm\_dispatch, [228](#), [229](#)
  - fspmv, [226–228](#), [236](#)
  - fspmv\_dispatch, [226](#)
  - init\_y, [226](#)
  - pfspmm, [232–234](#)
  - pfspmm\_dispatch, [231](#), [232](#)
  - pfspmv, [234](#), [235](#)
- FFLAS::sparse\_details\_impl, [237](#)
  - fspmm, [245](#), [252](#), [253](#), [258](#), [259](#), [263](#), [272](#)
  - fspmm\_mone, [246](#), [254](#), [264](#)
  - fspmm\_mone\_simd\_aligned, [247](#), [254](#), [265](#)
  - fspmm\_mone\_simd\_unaligned, [247](#), [255](#), [265](#)
  - fspmm\_one, [246](#), [253](#), [264](#)
  - fspmm\_one\_simd\_aligned, [247](#), [254](#), [265](#)
  - fspmm\_one\_simd\_unaligned, [247](#), [254](#), [265](#)
  - fspmm\_simd\_aligned, [246](#), [253](#)
  - fspmm\_simd\_unaligned, [246](#), [253](#)
  - fspmv, [248](#), [255](#), [259](#), [266](#), [268](#), [269](#), [273](#), [275](#)
  - fspmv\_mone, [248](#), [249](#), [256](#), [266](#), [267](#), [270](#), [276](#), [277](#)
  - fspmv\_mone\_simd, [270](#), [276](#)
  - fspmv\_one, [248](#), [249](#), [255](#), [256](#), [266](#), [267](#), [269](#), [270](#), [276](#)
  - fspmv\_one\_simd, [270](#), [276](#)
  - fspmv\_simd, [269](#), [275](#)
  - pfspmm, [249](#), [256](#), [257](#), [259–261](#), [271](#)
  - pfspmm\_mone, [250](#)
  - pfspmm\_one, [250](#)
  - pfspmm\_zo, [261](#)
  - pfspmv, [251](#), [258](#), [261](#), [262](#), [267](#), [271–274](#)
  - pfspmv\_mone, [252](#), [262](#), [263](#), [268](#), [274](#)
  - pfspmv\_one, [251](#), [252](#), [262](#), [268](#), [274](#)
  - pfspmv\_task, [251](#)
- FFLAS::StrategyParameter, [277](#)
- FFLAS::StructureHelper, [277](#)
- FFLAS::vectorised, [278](#)
  - add, [280](#)
  - addp, [279](#)
  - axpyp, [280](#)
  - modp, [282](#)
  - reduce, [281](#), [282](#)
  - scalp, [282](#), [283](#)
  - sub, [280](#)
  - subp, [280](#)
  - VEC\_ADD, [279](#)
  - VEC\_SUB, [279](#)
- FFLAS::vectorised::unswitch, [283](#)
  - axpyp, [284](#)
  - modp, [284](#), [285](#)
  - scalp, [285](#)
- fflas\_101.C, [1105](#)
  - main, [1105](#)
- fflas\_101\_lvl1.C, [1105](#)
  - main, [1105](#)
- FFLAS\_BASE
  - FFLAS, [75](#)
- fflas\_bounds.inl, [825](#)
  - \_\_FFLASFFPACK\_fflas\_bounds\_INL, [825](#)
  - FFLAS\_INT\_TYPE, [825](#)
- fflas\_c.h, [948](#)
  - fadd\_1\_modular\_double, [954](#)
  - fadd\_2\_modular\_double, [957](#)
  - faddin\_1\_modular\_double, [954](#)
  - faddin\_2\_modular\_double, [958](#)
  - fassign\_1\_modular\_double, [953](#)
  - fassign\_2\_modular\_double, [955](#)
  - faxpy\_1\_modular\_double, [953](#)
  - faxpy\_2\_modular\_double, [957](#)
  - fdot\_1\_modular\_double, [953](#)
  - fequal\_1\_modular\_double, [952](#)
  - fequal\_2\_modular\_double, [955](#)
  - FFLAS\_C\_BASE, [951](#)
  - FFLAS\_C\_DIAG, [951](#)
  - FFLAS\_C\_ORDER, [950](#)
  - FFLAS\_C\_SIDE, [951](#)
  - FFLAS\_C\_TRANSPOSE, [950](#)
  - FFLAS\_C\_UPLO, [951](#)
  - FFLAS\_COMPILED, [950](#)
  - FflasColMajor, [950](#)
  - FflasDouble, [951](#)
  - FflasFloat, [951](#)
  - FflasGeneric, [951](#)
  - FflasLeft, [951](#)
  - FflasLower, [951](#)
  - FflasNonUnit, [951](#)
  - FflasNoTrans, [951](#)
  - FflasRight, [951](#)
  - FflasRowMajor, [950](#)
  - FflasTrans, [951](#)
  - FflasUnit, [951](#)
  - FflasUpper, [951](#)
  - fgemm\_3\_modular\_double, [959](#)
  - fgemv\_2\_modular\_double, [958](#)
  - fger\_2\_modular\_double, [958](#)
  - fidentity\_2\_modular\_double, [955](#)
  - fiszero\_1\_modular\_double, [952](#)
  - fiszero\_2\_modular\_double, [955](#)
  - fmove\_2\_modular\_double, [957](#)
  - fneg\_1\_modular\_double, [952](#)
  - fneg\_2\_modular\_double, [956](#)
  - fnegin\_1\_modular\_double, [952](#)
  - fnegin\_2\_modular\_double, [956](#)
  - freduce\_1\_modular\_double, [952](#)
  - freduce\_2\_modular\_double, [956](#)
  - freducein\_1\_modular\_double, [952](#)

- freduein\_2\_modular\_double, 956
- fscal\_1\_modular\_double, 953
- fscal\_2\_modular\_double, 956
- fscalin\_1\_modular\_double, 953
- fscalin\_2\_modular\_double, 956
- fsquare\_3\_modular\_double, 960
- fsub\_1\_modular\_double, 954
- fsub\_2\_modular\_double, 957
- fsubin\_1\_modular\_double, 954
- fsubin\_2\_modular\_double, 958
- fswap\_1\_modular\_double, 954
- ftmm\_3\_modular\_double, 959
- ftsm\_3\_modular\_double, 959
- ftsv\_2\_modular\_double, 959
- fzero\_1\_modular\_double, 952
- fzero\_2\_modular\_double, 955
- FFLAS\_C\_BASE
  - fflas\_c.h, 951
- FFLAS\_C\_DIAG
  - fflas\_c.h, 951
  - ffpack\_c.h, 1006
- FFLAS\_C\_ORDER
  - fflas\_c.h, 950
  - ffpack\_c.h, 1005
- FFLAS\_C\_SIDE
  - fflas\_c.h, 951
  - ffpack\_c.h, 1006
- FFLAS\_C\_TRANSPOSE
  - fflas\_c.h, 950
  - ffpack\_c.h, 1005
- FFLAS\_C\_UPLO
  - fflas\_c.h, 951
  - ffpack\_c.h, 1005
- FFLAS\_COMPILED
  - fflas\_c.h, 950
  - ffpack\_inst.C, 1022
  - ffpack\_inst.h, 1023
- fflas\_const\_cast
  - FFPACK, 362, 375
- fflas\_delete
  - FFLAS, 155, 188
- FFLAS\_DIAG
  - FFLAS, 75
- FFLAS\_ELT
  - fflas\_L1\_inst.C, 961
  - fflas\_L1\_inst.h, 962
  - fflas\_L2\_inst.C, 964
  - fflas\_L2\_inst.h, 965
  - fflas\_L3\_inst.C, 968
  - fflas\_L3\_inst.h, 969
  - ffpack\_inst.C, 1022, 1023
  - ffpack\_inst.h, 1023, 1024
- fflas\_enum.h, 825
- fflas\_fadd.h, 826
- fflas\_fadd.inl, 827
  - \_\_FFLASFFPACK\_fadd\_INL, 828
- fflas\_fassign.h, 828
- fflas\_fassign.inl, 829
  - \_\_FFLASFFPACK\_fassign\_INL, 829
- fflas\_faxpy.inl, 829
  - \_\_FFLASFFPACK\_faxpy\_INL, 830
- fflas\_fdot.inl, 830
  - \_\_FFLASFFPACK\_fdot\_INL, 831
- fflas\_fgemm.inl, 831
  - \_\_FFLASFFPACK\_fgemm\_INL, 833
- fflas\_fgenv.inl, 840
  - \_\_FFLASFFPACK\_fgenv\_INL, 841
- fflas\_fgenv\_mp.inl, 841
  - \_\_FFLASFFPACK\_fgenv\_mp\_INL, 842
- fflas\_fger.inl, 842
  - \_\_FFLASFFPACK\_fger\_INL, 843
- fflas\_fger\_mp.inl, 843
  - \_\_FFPACK\_fger\_mp\_INL, 844
- FFLAS\_FIELD
  - fflas\_L1\_inst.C, 960, 961
  - fflas\_L1\_inst.h, 961, 962
  - fflas\_L2\_inst.C, 964
  - fflas\_L2\_inst.h, 965
  - fflas\_L3\_inst.C, 968
  - fflas\_L3\_inst.h, 969
  - ffpack\_inst.C, 1022
  - ffpack\_inst.h, 1023
- FFLAS\_FORMAT
  - FFLAS, 76
- fflas\_freduce.h, 844
- fflas\_freduce.inl, 845
  - \_\_FFLASFFPACK\_fflas\_freduce\_INL, 846
  - FFLASFFPACK\_COPY\_REDUCE, 846
- fflas\_freduce\_mp.inl, 847
  - \_\_FFLASFFPACK\_fflas\_freduce\_mp\_INL, 847
- fflas\_freivalds.inl, 847
  - \_\_FFLASFFPACK\_freivalds\_INL, 847
- fflas\_fscal.h, 847
- fflas\_fscal.inl, 848
  - \_\_FFLASFFPACK\_fscal\_INL, 849
- fflas\_fscal\_mp.inl, 849
  - \_\_FFLASFFPACK\_fscal\_mp\_INL, 850
- fflas\_fsyr2k.inl, 850
  - \_\_FFLASFFPACK\_fflas\_fsyr2k\_INL, 850
- fflas\_fsyrk.inl, 850
  - \_\_FFLASFFPACK\_fflas\_fsyrk\_INL, 852
- fflas\_fsyrk\_strassen.inl, 852
  - \_\_FFLASFFPACK\_fflas\_fsyrk\_strassen\_INL, 853
- fflas\_ftmm.inl, 853
  - \_\_FFLASFFPACK\_ftmm\_INL, 854
- fflas\_ftsm.inl, 854
  - \_\_FFLASFFPACK\_ftsm\_INL, 854
- fflas\_ftsm\_mp.inl, 854
  - \_\_FFPACK\_ftsm\_mp\_INL, 855
- fflas\_ftsv.inl, 855
  - \_\_FFLASFFPACK\_ftsv\_INL, 855
- fflas\_helpers.inl, 855
  - \_\_FFLASFFPACK\_fflas\_fflas\_mmhelper\_INL, 856
- FFLAS\_INT\_TYPE
  - fflas\_bounds.inl, 825
- fflas\_intrinsic.h, 1041

fflas\_io.h, 1041  
 fflas\_L1\_inst.C, 960  
     \_\_FFLAS\_L1\_INST\_C, 960  
     FFLAS\_ELT, 961  
     FFLAS\_FIELD, 960, 961  
     INST\_OR\_DECL, 960  
 fflas\_L1\_inst.h, 961  
     FFLAS\_ELT, 962  
     FFLAS\_FIELD, 961, 962  
     INST\_OR\_DECL, 961  
 fflas\_L1\_inst\_implement.inl, 962  
 fflas\_L2\_inst.C, 963  
     \_\_FFLAS\_L2\_INST\_C, 964  
     FFLAS\_ELT, 964  
     FFLAS\_FIELD, 964  
     INST\_OR\_DECL, 964  
 fflas\_L2\_inst.h, 964  
     FFLAS\_ELT, 965  
     FFLAS\_FIELD, 965  
     INST\_OR\_DECL, 965  
 fflas\_L2\_inst\_implement.inl, 965  
 fflas\_L3\_inst.C, 967  
     \_\_FFLAS\_L3\_INST\_C, 967  
     FFLAS\_ELT, 968  
     FFLAS\_FIELD, 968  
     INST\_OR\_DECL, 967  
 fflas\_L3\_inst.h, 968  
     FFLAS\_ELT, 969  
     FFLAS\_FIELD, 969  
     INST\_OR\_DECL, 969  
 fflas\_L3\_inst\_implement.inl, 969  
     \_\_FFLAS\_\_TRSM\_READONLY, 970  
 fflas\_level1.inl, 860  
     \_\_FFLASFFPACK\_fflas\_fflas\_level1\_INL, 862  
 fflas\_level2.inl, 862  
     \_\_FFLASFFPACK\_fflas\_fflas\_level2\_INL, 865  
 fflas\_level3.inl, 865  
     \_\_FFLASFFPACK\_fflas\_fflas\_level3\_INL, 867  
     \_\_FFLAS\_\_TRSM\_READONLY, 867  
 fflas\_lvl1.C, 970  
     fadd\_1\_modular\_double, 973  
     faddin\_1\_modular\_double, 974  
     fassign\_1\_modular\_double, 972  
     faxpy\_1\_modular\_double, 973  
     fdot\_1\_modular\_double, 973  
     fequal\_1\_modular\_double, 972  
     fiszero\_1\_modular\_double, 972  
     fneg\_1\_modular\_double, 971  
     fnegin\_1\_modular\_double, 971  
     freduce\_1\_modular\_double, 971  
     freducein\_1\_modular\_double, 971  
     fscal\_1\_modular\_double, 972  
     fscaln\_1\_modular\_double, 972  
     fsub\_1\_modular\_double, 973  
     fsubin\_1\_modular\_double, 974  
     fswap\_1\_modular\_double, 973  
     fzero\_1\_modular\_double, 972  
 fflas\_lvl2.C, 974  
     fadd\_2\_modular\_double, 978  
     faddin\_2\_modular\_double, 978  
     fassign\_2\_modular\_double, 975  
     faxpy\_2\_modular\_double, 977  
     fequal\_2\_modular\_double, 976  
     fgemv\_2\_modular\_double, 979  
     fger\_2\_modular\_double, 979  
     fidentity\_2\_modular\_double, 976  
     fiszero\_2\_modular\_double, 976  
     fmove\_2\_modular\_double, 978  
     fneg\_2\_modular\_double, 977  
     fnegin\_2\_modular\_double, 977  
     freduce\_2\_modular\_double, 976  
     freducein\_2\_modular\_double, 976  
     fscal\_2\_modular\_double, 977  
     fscaln\_2\_modular\_double, 977  
     fsub\_2\_modular\_double, 978  
     fsubin\_2\_modular\_double, 978  
     ftrsv\_2\_modular\_double, 979  
     fzero\_2\_modular\_double, 975  
 fflas\_lvl3.C, 980  
     fgemm\_3\_modular\_double, 981  
     fsquare\_3\_modular\_double, 981  
     ftrmm\_3\_modular\_double, 980  
     ftrsm\_3\_modular\_double, 980  
 fflas\_memory.h, 1042  
 fflas\_new  
     FFLAS, 155, 156, 188  
 FFLAS\_ORDER  
     FFLAS, 74  
 fflas\_pfgemm.inl, 867  
     \_\_FFLASFFPACK\_DIMKPENALTY, 868  
     \_\_FFLASFFPACK\_SEQPARTHRESHOLD, 868  
     \_\_FFLASFFPACK\_fflas\_pfgemm\_INL, 868  
 fflas\_pftrsm.inl, 868  
     \_\_FFLASFFPACK\_fflas\_pftrsm\_INL, 869  
     PTRSM\_HYBRID\_THRESHOLD, 869  
 fflas\_plevel1.h, 1029  
 fflas\_randommatrix.h, 1043  
 FFLAS\_SIDE  
     FFLAS, 75  
 fflas\_simd.h, 869  
     CONST, 870  
     FLOAT\_MOD, 870  
     INLINE, 870  
     NORML\_MOD, 870  
     PURE, 870  
     Simd, 870  
     SIMD\_INT, 870  
 fflas\_sparse.C, 981  
 fflas\_sparse.h, 879  
     \_\_FFLASFFPACK\_CACHE\_LINE\_SIZE, 883  
     assume\_aligned, 883  
     DENSE\_THRESHOLD, 883  
     index\_t, 883  
     ROUND\_DOWN, 883  
 fflas\_sparse.inl, 883  
     \_\_FFLASFFPACK\_fflas\_fflas\_sparse\_INL, 885

- FFLAS\_TRANSPOSE
  - FFLAS, [74](#)
- fflas\_transpose.h, [911](#)
  - FFLAS\_TRANSPOSE\_BLOCKSIZE, [912](#)
  - LD, [912](#)
  - ST, [912](#)
- FFLAS\_TRANSPOSE\_BLOCKSIZE
  - fflas\_transpose.h, [912](#)
- FFLAS\_UPLO
  - FFLAS, [74](#)
- FflasAuto
  - FFLAS, [76](#)
- FflasBinary
  - FFLAS, [76](#)
- FflasColMajor
  - FFLAS, [74](#)
  - fflas\_c.h, [950](#)
  - ffpack\_c.h, [1005](#)
- FflasDense
  - FFLAS, [76](#)
- FflasDouble
  - FFLAS, [75](#)
  - fflas\_c.h, [951](#)
- FFLASFFPACK\_abort
  - debug.h, [1041](#)
- FFLASFFPACK\_check
  - debug.h, [1041](#)
- FFLASFFPACK\_checkers\_fflas\_inl\_H
  - checkers\_fflas.inl, [807](#)
- FFLASFFPACK\_checkers\_ffpack\_inl\_H
  - checkers\_ffpack.inl, [808](#)
- FFLASFFPACK\_COPY\_REDUCE
  - fflas\_freduce.inl, [846](#)
- FFLASFFPACK\_PERM\_BKSIZE
  - ffpack\_permutation.inl, [938](#)
- FflasFloat
  - FFLAS, [75](#)
  - fflas\_c.h, [951](#)
- FflasGeneric
  - FFLAS, [75](#)
  - fflas\_c.h, [951](#)
- FflasLeft
  - FFLAS, [75](#)
  - fflas\_c.h, [951](#)
  - ffpack\_c.h, [1006](#)
- FflasLeftTri
  - FFLAS, [75](#)
- FflasLower
  - FFLAS, [75](#)
  - fflas\_c.h, [951](#)
  - ffpack\_c.h, [1006](#)
- FflasMaple
  - FFLAS, [76](#)
- FflasMath
  - FFLAS, [76](#)
- FflasNonUnit
  - FFLAS, [75](#)
  - fflas\_c.h, [951](#)
- ffpack\_c.h, [1006](#)
- FflasNoTrans
  - FFLAS, [74](#)
  - fflas\_c.h, [951](#)
  - ffpack\_c.h, [1005](#)
- FflasRight
  - FFLAS, [75](#)
  - fflas\_c.h, [951](#)
  - ffpack\_c.h, [1006](#)
- FflasRightTri
  - FFLAS, [75](#)
- FflasRowMajor
  - FFLAS, [74](#)
  - fflas\_c.h, [950](#)
  - ffpack\_c.h, [1005](#)
- FflasSageMath
  - FFLAS, [76](#)
- FflasSMS
  - FFLAS, [76](#)
- FflasTrans
  - FFLAS, [74](#)
  - fflas\_c.h, [951](#)
  - ffpack\_c.h, [1005](#)
- FflasUnit
  - FFLAS, [75](#)
  - fflas\_c.h, [951](#)
  - ffpack\_c.h, [1006](#)
- FflasUpper
  - FFLAS, [75](#)
  - fflas\_c.h, [951](#)
  - ffpack\_c.h, [1006](#)
- FFPACK, [43](#), [286](#)
  - \_PLUQ, [361](#)
  - applyP, [304](#), [305](#), [363](#)
  - applyP\_block, [355](#)
  - Bruhat2EchelonPermutation, [343](#)
  - buildMatrix, [349](#)
  - CharPoly, [321](#), [322](#), [349](#), [367](#), [368](#)
  - Checker\_charpoly, [303](#)
  - Checker\_Det, [302](#)
  - Checker\_invert, [303](#)
  - Checker\_PLUQ, [302](#)
  - chooseField, [388](#)
  - chooseField< Givaro::ZRing< double > >, [389](#)
  - chooseField< Givaro::ZRing< float > >, [388](#)
  - chooseField< Givaro::ZRing< int32\_t > >, [388](#)
  - chooseField< Givaro::ZRing< int64\_t > >, [388](#)
  - ColRankProfileSubmatrix, [334](#), [372](#)
  - ColRankProfileSubmatrixIndices, [333](#), [372](#)
  - ColumnEchelonForm, [315](#), [316](#), [366](#)
  - ColumnRankProfile, [330](#), [331](#), [371](#)
  - composePermutationsLLL, [358](#)
  - composePermutationsLLM, [358](#)
  - composePermutationsMLM, [359](#)
  - CompressToBlockBiDiagonal, [342](#)
  - ComputeRPermutation, [344](#), [347](#)
  - cyclic\_shift\_col, [360](#), [363](#)
  - cyclic\_shift\_mathPerm, [359](#)

- cyclic\_shift\_row, [359](#), [362](#)
- cyclic\_shift\_row\_col, [359](#), [362](#)
- Danilevski, [349](#)
- Det, [326](#), [327](#), [350](#), [369](#), [370](#)
- doApplyS, [355](#)
- doApplyT, [356](#)
- ExpandBlockBiDiagonalToBruhat, [343](#)
- expandLCRE, [347](#)
- failure, [375](#)
- fflas\_const\_cast, [362](#), [375](#)
- fgesv, [307](#), [308](#), [364](#)
- fgetrs, [306](#), [363](#)
- ForceCheck\_charpoly, [303](#)
- ForceCheck\_Det, [303](#)
- ForceCheck\_invert, [303](#)
- ForceCheck\_PLUQ, [303](#)
- fsytrf, [311](#), [312](#)
- fsytrf\_BC\_Crout, [350](#)
- fsytrf\_BC\_RL, [350](#)
- fsytrf\_LOW\_RPM\_BC\_Crout, [351](#)
- fsytrf\_nonunit, [312](#), [352](#)
- fsytrf\_RPM, [352](#)
- fsytrf\_UP\_RPM, [351](#)
- fsytrf\_UP\_RPM\_BC\_Crout, [351](#)
- fsytrf\_UP\_RPM\_BC\_RL, [351](#)
- ftssyr2k, [310](#)
- ftstr, [310](#)
- fttri, [309](#), [364](#)
- fttrm, [309](#), [365](#)
- getEchelonForm, [336](#)
- getEchelonForm< FFLAS\_FIELD< FFLAS\_ELT >  
>, [373](#)
- getEchelonTransform, [337](#)
- getEchelonTransform< FFLAS\_FIELD< FFLAS\_ELT  
> >, [373](#)
- getLTBruhatGen, [341](#)
- getReducedEchelonForm, [338](#), [339](#)
- getReducedEchelonForm< FFLAS\_FIELD<  
FFLAS\_ELT > >, [374](#)
- getReducedEchelonTransform, [339](#)
- getReducedEchelonTransform< FFLAS\_FIELD<  
FFLAS\_ELT > >, [374](#)
- getTriangular, [335](#)
- getTriangular< FFLAS\_FIELD< FFLAS\_ELT > >,  
[372](#), [373](#)
- getTridiagonal, [352](#)
- Invert, [320](#), [367](#)
- Invert2, [321](#), [367](#)
- isOdd, [375](#)
- IsSingular, [325](#), [369](#)
- KrylovElim, [369](#)
- LAPACKPerm2MathPerm, [303](#)
- LeadingSubmatrixRankProfiles, [331](#)
- LQUPtoInverseOfFullRankMinor, [345](#), [375](#)
- LTBruhatGen, [340](#)
- LTQSorter, [342](#)
- LUdivine, [314](#), [353](#), [354](#), [365](#)
- LUdivine\_gauss, [353](#), [366](#)
- LUdivine\_small, [353](#), [365](#)
- MathPerm2LAPACKPerm, [303](#)
- MatrixApplyS, [355](#), [356](#)
- MatrixApplyT, [357](#)
- MatVecMinPoly, [324](#), [368](#)
- MinPoly, [323](#), [368](#)
- MonotonicApplyP, [305](#)
- MonotonicCompress, [354](#)
- MonotonicCompressCycles, [354](#)
- MonotonicCompressMorePivots, [354](#)
- MonotonicExpand, [355](#)
- NonZeroRandomMatrix, [375](#), [376](#)
- NullSpaceBasis, [328](#), [371](#)
- pColumnEchelonForm, [316](#)
- pColumnRankProfile, [331](#)
- pDet, [326](#)
- PermApplyS, [356](#)
- PermApplyT, [358](#)
- PLUQ, [313](#), [314](#), [361](#), [362](#), [365](#)
- PLUQ\_basecaseCrout, [360](#)
- PLUQ\_basecaseV2, [360](#)
- PLUQ\_basecaseV3, [360](#)
- PLUQtoEchelonPermutation, [340](#)
- pPLUQ, [313](#)
- pRank, [325](#)
- pReducedColumnEchelonForm, [318](#)
- pReducedRowEchelonForm, [319](#)
- productBruhatxTS, [344](#), [347](#)
- pRowEchelonForm, [317](#)
- pRowRankProfile, [330](#)
- pSolve, [328](#)
- RandInt, [379](#)
- RandomIndexSubset, [380](#)
- RandomLTQSMatixWithRankandQSorter, [388](#)
- RandomLTQSRankProfileMatrix, [382](#)
- RandomMatrix, [376](#), [377](#)
- RandomMatrixWithDet, [387](#)
- RandomMatrixWithRank, [379](#), [380](#)
- RandomMatrixWithRankandRandomRPM, [385](#)
- RandomMatrixWithRankandRPM, [382](#), [383](#)
- RandomNullSpaceVector, [328](#), [345](#), [371](#)
- RandomPermutation, [381](#)
- RandomRankProfileMatrix, [381](#)
- RandomSymmetricMatrix, [379](#)
- RandomSymmetricMatrixWithRankandRandom-  
RPM, [386](#)
- RandomSymmetricMatrixWithRankandRPM, [383](#),  
[384](#)
- RandomSymmetricRankProfileMatrix, [382](#)
- RandomTriangularMatrix, [377](#), [378](#)
- Rank, [324](#), [325](#), [369](#)
- RankProfileFromLU, [331](#)
- ReducedColumnEchelonForm, [317](#), [318](#), [367](#)
- ReducedRowEchelonForm, [319](#), [366](#)
- RowEchelonForm, [316](#), [317](#), [366](#)
- RowRankProfile, [329](#), [330](#), [371](#)
- RowRankProfileSubmatrix, [333](#), [372](#)
- RowRankProfileSubmatrixIndices, [332](#), [372](#)

- Solve, [327](#), [370](#)
- solveLB, [346](#), [370](#)
- solveLB2, [346](#), [370](#)
- SpecRankProfile, [369](#)
- swapval, [381](#)
- threads\_fgemm, [361](#)
- threads\_ftrsm, [361](#)
- TInverter, [344](#), [347](#)
- trinv\_left, [309](#), [365](#)
- ffpack-fgesv.C, [1106](#)
  - main, [1106](#)
- ffpack-solve.C, [1106](#)
  - main, [1106](#)
- ffpack.C, [982](#)
  - applyP\_modular\_double, [987](#)
  - ColRankProfileSubmatrix\_modular\_double, [999](#)
  - ColRankProfileSubmatrixIndices\_modular\_double, [999](#)
  - ColumnEchelonForm\_modular\_double, [990](#)
  - ColumnEchelonForm\_modular\_float, [990](#)
  - ColumnEchelonForm\_modular\_int32\_t, [991](#)
  - ColumnRankProfile\_modular\_double, [998](#)
  - composePermutationsLLL, [986](#)
  - composePermutationsLLM, [986](#)
  - composePermutationsMLM, [986](#)
  - cyclic\_shift\_col\_modular\_double, [987](#)
  - cyclic\_shift\_mathPerm, [987](#)
  - cyclic\_shift\_row\_modular\_double, [987](#)
  - Det\_modular\_double, [997](#)
  - fgesv\_modular\_double, [988](#)
  - fgesvin\_modular\_double, [988](#)
  - fgetrsin\_modular\_double, [987](#)
  - fgetrsv\_modular\_double, [988](#)
  - ftrtri\_modular\_double, [988](#)
  - ftrtrm\_modular\_double, [989](#)
  - getEchelonForm\_modular\_double, [1000](#)
  - getEchelonFormin\_modular\_double, [1000](#)
  - getEchelonTransform\_modular\_double, [1001](#)
  - getReducedEchelonForm\_modular\_double, [1001](#)
  - getReducedEchelonFormin\_modular\_double, [1001](#)
  - getReducedEchelonTransform\_modular\_double, [1001](#)
  - getTriangular\_modular\_double, [1000](#)
  - getTriangularin\_modular\_double, [1000](#)
  - Invert2\_modular\_double, [996](#)
  - Invert\_modular\_double, [995](#)
  - Invertin\_modular\_double, [995](#)
  - IsSingular\_modular\_double, [996](#)
  - KrylovElim\_modular\_double, [996](#)
  - LAPACKPerm2MathPerm, [985](#)
  - LeadingSubmatrixRankProfiles, [998](#)
  - LUdivine\_modular\_double, [989](#)
  - MathPerm2LAPACKPerm, [985](#)
  - MatrixApplyS\_modular\_double, [985](#)
  - MatrixApplyT\_modular\_double, [986](#)
  - NullSpaceBasis\_modular\_double, [998](#)
  - pColumnEchelonForm\_modular\_double, [992](#)
  - pColumnEchelonForm\_modular\_float, [993](#)
  - pColumnEchelonForm\_modular\_int32\_t, [994](#)
  - PermApplyS\_double, [986](#)
  - PermApplyT\_double, [986](#)
  - PLUQ\_modular\_double, [989](#)
  - PLUQtoEchelonPermutation, [1002](#)
  - pReducedColumnEchelonForm\_modular\_double, [993](#)
  - pReducedColumnEchelonForm\_modular\_float, [994](#)
  - pReducedColumnEchelonForm\_modular\_int32\_t, [995](#)
  - pReducedRowEchelonForm\_modular\_double, [993](#)
  - pReducedRowEchelonForm\_modular\_float, [994](#)
  - pReducedRowEchelonForm\_modular\_int32\_t, [995](#)
  - pRowEchelonForm\_modular\_double, [993](#)
  - pRowEchelonForm\_modular\_float, [994](#)
  - pRowEchelonForm\_modular\_int32\_t, [994](#)
  - RandomNullSpaceVector\_modular\_double, [997](#)
  - Rank\_modular\_double, [996](#)
  - RankProfileFromLU, [998](#)
  - ReducedColumnEchelonForm\_modular\_double, [990](#)
  - ReducedColumnEchelonForm\_modular\_float, [991](#)
  - ReducedColumnEchelonForm\_modular\_int32\_t, [992](#)
  - ReducedRowEchelonForm\_modular\_double, [990](#)
  - ReducedRowEchelonForm\_modular\_float, [991](#)
  - ReducedRowEchelonForm\_modular\_int32\_t, [992](#)
  - RowEchelonForm\_modular\_double, [990](#)
  - RowEchelonForm\_modular\_float, [991](#)
  - RowEchelonForm\_modular\_int32\_t, [992](#)
  - RowRankProfile\_modular\_double, [998](#)
  - RowRankProfileSubmatrix\_modular\_double, [999](#)
  - RowRankProfileSubmatrixIndices\_modular\_double, [999](#)
  - Solve\_modular\_double, [997](#)
  - solveLB2\_modular\_double, [997](#)
  - solveLB\_modular\_double, [997](#)
  - SpecRankProfile\_modular\_double, [996](#)
  - trinv\_left\_modular\_double, [989](#)
  - ffpack.doxy, [912](#)
  - ffpack.h, [912](#)
    - \_\_FFLASFFPACK\_FTRSSYR2K\_THRESHOLD, [921](#)
    - \_\_FFLASFFPACK\_FTRSTR\_THRESHOLD, [921](#)
  - ffpack.inl, [921](#)
    - \_\_FFLASFFPACK\_ffpack\_INL, [922](#)
  - FFPACK::Protected, [389](#)
    - ArithProg, [393](#)
    - CompressRows, [394](#)
    - CompressRowsQA, [395](#)
    - CompressRowsQK, [395](#)
    - Danilevski, [393](#)
    - DeCompressRows, [395](#)
    - DeCompressRowsQA, [396](#)
    - DeCompressRowsQK, [395](#)
    - fgemv\_kgf, [392](#)



- GaussJordan, 391
- Hybrid\_KGF\_LUK\_MinPoly, 394
- KellerGehrig, 391
- KGFast, 392
- KGFast\_generalized, 392
- LUdivine\_construct, 390, 396
- LUKrylov, 392
- LUKrylov\_KGFast, 393
- MatVecMinPoly, 393
- newD, 394
- RandomKrylovPrecond, 393
- updatedD, 394
- ffpack\_bruhatgen.inl, 922
- \_\_FFLASFFPACK\_ffpack\_bruhatgen\_inl, 924
- ffpack\_c.h, 1002
- applyP\_modular\_double, 1009
- ColRankProfileSubmatrix\_modular\_double, 1019
- ColRankProfileSubmatrixIndices\_modular\_double, 1019
- ColumnEchelonForm\_modular\_double, 1012
- ColumnEchelonForm\_modular\_float, 1012
- ColumnEchelonForm\_modular\_int32\_t, 1012
- ColumnRankProfile\_modular\_double, 1018
- composePermutationsLLL, 1008
- composePermutationsLLM, 1008
- composePermutationsMLM, 1008
- cyclic\_shift\_col\_modular\_double, 1008
- cyclic\_shift\_mathPerm, 1008
- cyclic\_shift\_row\_modular\_double, 1008
- Det\_modular\_double, 1016
- FFLAS\_C\_DIAG, 1006
- FFLAS\_C\_ORDER, 1005
- FFLAS\_C\_SIDE, 1006
- FFLAS\_C\_TRANSPOSE, 1005
- FFLAS\_C\_UPLO, 1005
- FflasColMajor, 1005
- FflasLeft, 1006
- FflasLower, 1006
- FflasNonUnit, 1006
- FflasNoTrans, 1005
- FflasRight, 1006
- FflasRowMajor, 1005
- FflasTrans, 1005
- FflasUnit, 1006
- FflasUpper, 1006
- FFPACK\_C\_CHARPOLY\_TAG, 1006
- FFPACK\_C\_LU\_TAG, 1006
- FFPACK\_C\_MINPOLY\_TAG, 1006
- FFPACK\_COMPILED, 1005
- FfpackArithProg, 1006
- FfpackDanilevski, 1006
- FfpackDense, 1007
- FfpackHybrid, 1006
- FfpackKG, 1006
- FfpackKGF, 1007
- FfpackKGFast, 1006
- FfpackKGFastG, 1006
- FfpackLUK, 1006
- FfpackSingular, 1006
- FfpackSlabRecursive, 1006
- FfpackTileRecursive, 1006
- fgesv\_modular\_double, 1010
- fgesvin\_modular\_double, 1009
- fgetrs\_modular\_double, 1009
- fgetrsin\_modular\_double, 1009
- ftrtri\_modular\_double, 1010
- ftrtrm\_modular\_double, 1010
- getEchelonForm\_modular\_double, 1020
- getEchelonFormin\_modular\_double, 1020
- getEchelonTransform\_modular\_double, 1020
- getReducedEchelonForm\_modular\_double, 1021
- getReducedEchelonFormin\_modular\_double, 1021
- getReducedEchelonTransform\_modular\_double, 1021
- getTriangular\_modular\_double, 1019
- getTriangularin\_modular\_double, 1019
- Invert2\_modular\_double, 1015
- Invert\_modular\_double, 1015
- Invertin\_modular\_double, 1015
- IsSingular\_modular\_double, 1016
- KrylovElim\_modular\_double, 1015
- LAPACKPerm2MathPerm, 1007
- LeadingSubmatrixRankProfiles, 1018
- LUdivine\_gauss\_modular\_double, 1011
- LUdivine\_modular\_double, 1011
- LUdivine\_small\_modular\_double, 1011
- MathPerm2LAPACKPerm, 1007
- MatrixApplyS\_modular\_double, 1007
- MatrixApplyT\_modular\_double, 1007
- NullSpaceBasis\_modular\_double, 1017
- PermApplyS\_double, 1007
- PermApplyT\_double, 1008
- PLUQ\_modular\_double, 1011
- PLUQtoEchelonPermutation, 1021
- RandomNullSpaceVector\_modular\_double, 1017
- Rank\_modular\_double, 1016
- RankProfileFromLU, 1018
- ReducedColumnEchelonForm\_modular\_double, 1013
- ReducedColumnEchelonForm\_modular\_float, 1013
- ReducedColumnEchelonForm\_modular\_int32\_t, 1014
- ReducedRowEchelonForm2\_modular\_double, 1014
- ReducedRowEchelonForm\_modular\_double, 1013
- ReducedRowEchelonForm\_modular\_float, 1014
- ReducedRowEchelonForm\_modular\_int32\_t, 1014
- REF\_modular\_double, 1015
- RowEchelonForm\_modular\_double, 1012
- RowEchelonForm\_modular\_float, 1012
- RowEchelonForm\_modular\_int32\_t, 1013
- RowRankProfile\_modular\_double, 1018
- RowRankProfileSubmatrix\_modular\_double, 1019

- RowRankProfileSubmatrixIndices\_modular\_double, 1018
- Solve\_modular\_double, 1016
- solveLB2\_modular\_double, 1017
- solveLB\_modular\_double, 1017
- SpecRankProfile\_modular\_double, 1016
- trinv\_left\_modular\_double, 1010
- FFPACK\_C\_CHARPOLY\_TAG
  - ffpack\_c.h, 1006
- FFPACK\_C\_LU\_TAG
  - ffpack\_c.h, 1006
- FFPACK\_C\_MINPOLY\_TAG
  - ffpack\_c.h, 1006
- ffpack\_charpoly.inl, 924
  - \_\_FFLASFFPACK\_charpoly\_INL, 924
- ffpack\_charpoly\_danilevski.inl, 924
  - \_\_FFLASFFPACK\_ffpack\_charpoly\_danilveski\_INL, 925
- ffpack\_charpoly\_kgfast.inl, 925
  - \_\_FFLASFFPACK\_ffpack\_charpoly\_kgfast\_INL, 925
- ffpack\_charpoly\_kgfastgeneralized.inl, 925
  - \_\_FFLASFFPACK\_ffpack\_charpoly\_kgfastgeneralized\_INL, 926
- ffpack\_charpoly\_kglu.inl, 926
  - \_\_FFLASFFPACK\_ffpack\_charpoly\_kglu\_INL, 926
- ffpack\_charpoly\_mp.inl, 926
  - \_\_FFPACK\_charpoly\_mp\_INL, 927
- FFPACK\_COMPILED
  - ffpack\_c.h, 1005
- ffpack\_det\_mp.inl, 927
  - \_\_FFPACK\_det\_mp\_INL, 927
- ffpack\_echelonforms.inl, 928
  - \_\_FFLASFFPACK\_GAUSSJORDAN\_BASECASE, 929
  - \_\_FFLASFFPACK\_ffpack\_echelon\_forms\_INL, 929
- ffpack\_fgesv.inl, 929
  - \_\_FFLASFFPACK\_ffpack\_fgesv\_INL, 929
- ffpack\_fgetrs.inl, 929
  - \_\_FFLASFFPACK\_ffpack\_fgetrs\_INL, 930
- ffpack\_frobenius.inl, 930
- ffpack\_fsytrf.inl, 931
  - \_\_FFLASFFPACK\_ffpack\_fsytrf\_INL, 932
- ffpack\_ftrssyr2k.inl, 932
  - \_\_FFLASFFPACK\_ffpack\_ftrssyr2k\_INL, 932
- ffpack\_ftrstr.inl, 932
  - \_\_FFLASFFPACK\_ffpack\_ftrstr\_INL, 933
- ffpack\_ftrtr.inl, 933
  - \_\_FFLASFFPACK\_ffpack\_ftrtr\_INL, 933
- ENABLE\_ALL\_CHECKINGS, 933
- ffpack\_inst.C, 1022
  - \_\_FFPACK\_INST\_C, 1022
  - FFLAS\_COMPILED, 1022
  - FFLAS\_ELT, 1022, 1023
  - FFLAS\_FIELD, 1022
  - INST\_OR\_DECL, 1022
- ffpack\_inst.h, 1023
- FFLAS\_COMPILED, 1023
- FFLAS\_ELT, 1023, 1024
- FFLAS\_FIELD, 1023
- INST\_OR\_DECL, 1023
- ffpack\_inst\_implem.inl, 1024
- ffpack\_invert.inl, 933
  - \_\_FFLASFFPACK\_ffpack\_invert\_INL, 934
- ffpack\_krylovelim.inl, 934
  - \_\_FFLASFFPACK\_ffpack\_krylovelim\_INL, 934
- ffpack\_ludivine.inl, 934
  - \_\_FFLASFFPACK\_ffpack\_ludivine\_INL, 935
- ffpack\_ludivine\_mp.inl, 935
  - \_\_FFPACK\_ludivine\_mp\_INL, 935
- ffpack\_minpoly.inl, 936
  - \_\_FFLASFFPACK\_ffpack\_minpoly\_INL, 936
- ffpack\_permutation.inl, 936
  - \_\_FFLASFFPACK\_ffpack\_permutation\_INL, 938
- FFLASFFPACK\_PERM\_BKSIZE, 938
- ffpack\_pluq.inl, 939
  - \_\_FFLASFFPACK\_ffpack\_pluq\_INL, 939
- CROUT, 939
- ffpack\_pluq\_mp.inl, 939
- FFPACK\_pluq\_mp\_INL, 940
- ffpack\_ppluq.inl, 940
  - \_\_FFLASFFPACK\_ffpack\_ppluq\_INL, 940
- \_\_FFLAS\_\_TRSM\_READONLY, 940
- PBASECASE\_K, 940
- ffpack\_rankprofiles.inl, 941
  - \_\_FFLASFFPACK\_ffpack\_rank\_profiles\_INL, 942
- FpackArithProg
  - ffpack\_c.h, 1006
- FpackDanilevski
  - ffpack\_c.h, 1006
- FpackDense
  - ffpack\_c.h, 1007
- FpackHybrid
  - ffpack\_c.h, 1006
- FpackKG
  - ffpack\_c.h, 1006
- FpackKGF
  - ffpack\_c.h, 1007
- FpackKGFast
  - ffpack\_c.h, 1006
- FpackKGFastG
  - ffpack\_c.h, 1006
- FpackLUK
  - ffpack\_c.h, 1006
- FpackSingular
  - ffpack\_c.h, 1006
- FpackSlabRecursive
  - ffpack\_c.h, 1006
- FpackTileRecursive
  - ffpack\_c.h, 1006
- fgemm
  - FFLAS, 88–90, 92–97, 144, 176–178
- fgemm\_3\_modular\_double
  - fflas\_c.h, 959
  - fflas\_lvl3.C, 981



- fgemm\_classical.inl, [833](#)
- fgemm\_classical\_mp.inl, [833](#)
  - \_\_FFPACK\_fgemm\_classical\_INL, [835](#)
- fgemm\_convert
  - FFLAS::Protected, [212](#)
- fgemm\_winograd.inl, [835](#)
  - \_\_FFLASFFPACK\_fflas\_fflas\_fgemm\_winograd\_INL, field [836](#)
  - NEWWINO, [836](#)
- fgemv
  - FFLAS, [97–102](#), [173](#), [184](#)
- fgemv\_2\_modular\_double
  - fflas\_c.h, [958](#)
  - fflas\_lvl2.C, [979](#)
- fgemv\_convert
  - FFLAS::Protected, [217](#)
- fgemv\_kgf
  - FFPACK::Protected, [392](#)
- fger
  - FFLAS, [103–106](#), [173](#)
- fger\_2\_modular\_double
  - fflas\_c.h, [958](#)
  - fflas\_lvl2.C, [979](#)
- fger\_convert
  - FFLAS::Protected, [218](#)
- fgesv
  - FFPACK, [307](#), [308](#), [364](#)
- fgesv\_modular\_double
  - ffpack.C, [988](#)
  - ffpack\_c.h, [1010](#)
- fgesvin\_modular\_double
  - ffpack.C, [988](#)
  - ffpack\_c.h, [1009](#)
- fgetrs
  - FFPACK, [306](#), [363](#)
- fgetrs\_modular\_double
  - ffpack\_c.h, [1009](#)
- fgetrsin\_modular\_double
  - ffpack.C, [987](#)
  - ffpack\_c.h, [1009](#)
- fgetrsv\_modular\_double
  - ffpack.C, [988](#)
- fidentity
  - FFLAS, [136](#), [137](#), [166](#)
- fidentity\_2\_modular\_double
  - fflas\_c.h, [955](#)
  - fflas\_lvl2.C, [976](#)
- Field
  - Bench< Elt >, [404](#)
  - benchmark-fgemm-rns.C, [786](#)
  - benchmark-pluq.C, [799](#)
  - FieldSimd< \_Field >, [448](#)
  - Sparse< \_Field, SparseMatrix\_t::COO >, [733](#)
  - Sparse< \_Field, SparseMatrix\_t::COO\_ZO >, [734](#)
  - Sparse< \_Field, SparseMatrix\_t::CSR >, [736](#)
  - Sparse< \_Field, SparseMatrix\_t::CSR\_HYB >, [738](#)
  - Sparse< \_Field, SparseMatrix\_t::CSR\_ZO >, [740](#)
  - Sparse< \_Field, SparseMatrix\_t::ELL >, [741](#)
  - Sparse< \_Field, SparseMatrix\_t::ELL\_ZO >, [746](#)
  - Sparse< \_Field, SparseMatrix\_t::SELL >, [748](#)
  - Sparse< \_Field, SparseMatrix\_t::SELL\_ZO >, [750](#)
  - Test< Elt >, [758](#)
  - test-compressQ.C, [1053](#)
  - associatedDelayedField< const FFPACK::RNSIntegerMod< RNS > >, [401](#)
  - associatedDelayedField< const Givaro::Modular< T, X > >, [402](#)
  - associatedDelayedField< const Givaro::ModularBalanced< T > >, [402](#)
  - associatedDelayedField< const Givaro::ZRing< T > >, [403](#)
  - associatedDelayedField< Field >, [401](#)
- field-traits.h, [942](#)
- field.doxy, [944](#)
- FieldMax
  - MMHelper< Field, AlgoTrait, ModeTrait, ParSeq-Trait >, [505](#)
- FieldMin
  - MMHelper< Field, AlgoTrait, ModeTrait, ParSeq-Trait >, [505](#)
- FieldSimd
  - FieldSimd< \_Field >, [448](#)
- FieldSimd< \_Field >, [447](#)
  - add, [449](#)
  - add\_r, [449](#)
  - addin, [449](#)
  - addin\_r, [449](#)
  - alignment, [452](#)
  - axpy, [451](#)
  - axpy\_r, [452](#)
  - axpyin, [451](#)
  - axpyin\_r, [452](#)
  - Element, [448](#)
  - Field, [448](#)
  - FieldSimd, [448](#)
  - init, [448](#), [449](#)
  - maxpy, [452](#)
  - maxpyin, [452](#)
  - mod, [450](#)
  - mul, [450](#), [451](#)
  - mul\_r, [451](#)
  - mulin, [451](#)
  - operator=, [448](#)
  - scalar\_t, [448](#)
  - simd, [448](#)
  - sub, [449](#), [450](#)
  - sub\_r, [450](#)
  - subin, [450](#)
  - subin\_r, [450](#)
  - vect\_size, [452](#)
  - vect\_t, [448](#)
  - zero, [450](#)
- FieldTraits< FFPACK::RNSInteger< T > >, [453](#)
  - balanced, [454](#)

- category, [454](#)
- FieldTraits< FFPACK::RNSIntegerMod< T > >, [454](#)
  - balanced, [454](#)
  - category, [454](#)
- FieldTraits< Field >, [453](#)
  - balanced, [453](#)
  - category, [453](#)
- FieldTraits< Givaro::Modular< Element > >, [455](#)
  - balanced, [455](#)
  - category, [455](#)
- FieldTraits< Givaro::ModularBalanced< Element > >, [455](#)
  - balanced, [456](#)
  - category, [456](#)
- FieldTraits< Givaro::ZRing< double > >, [456](#)
  - balanced, [456](#)
  - category, [456](#)
- FieldTraits< Givaro::ZRing< float > >, [457](#)
  - balanced, [457](#)
  - category, [457](#)
- FieldTraits< Givaro::ZRing< Givaro::Integer > >, [457](#)
  - balanced, [458](#)
  - category, [458](#)
- FieldTraits< Givaro::ZRing< int16\_t > >, [458](#)
  - balanced, [458](#)
  - category, [458](#)
- FieldTraits< Givaro::ZRing< int32\_t > >, [459](#)
  - balanced, [459](#)
  - category, [459](#)
- FieldTraits< Givaro::ZRing< int64\_t > >, [459](#)
  - balanced, [460](#)
  - category, [459](#)
- FieldTraits< Givaro::ZRing< Reclnt::ruint< K > > >, [460](#)
  - balanced, [460](#)
  - category, [460](#)
- FieldTraits< Givaro::ZRing< uint16\_t > >, [460](#)
  - balanced, [461](#)
  - category, [461](#)
- FieldTraits< Givaro::ZRing< uint32\_t > >, [461](#)
  - balanced, [462](#)
  - category, [461](#)
- FieldTraits< Givaro::ZRing< uint64\_t > >, [462](#)
  - balanced, [462](#)
  - category, [462](#)
- fill\_value
  - benchmark-fgemv.C, [790](#)
- findArgument
  - args-parser.h, [1039](#)
- finit
  - FFLAS, [108](#), [110](#), [129](#), [137](#), [158](#), [167](#)
- finit\_rns
  - FFLAS, [155](#), [156](#)
- finit\_trans\_rns
  - FFLAS, [155](#)
- first\_component
  - Compose< H1, H2 >, [422](#)
- firstBlockSize
  - ForStrategy1D< blocksize\_t, Cut, Param >, [465](#)
- fiszero
  - FFLAS, [131](#), [136](#), [160](#), [166](#)
- fiszero\_1\_modular\_double
  - fflas\_c.h, [952](#)
  - fflas\_lvl1.C, [972](#)
- fiszero\_2\_modular\_double
  - fflas\_c.h, [955](#)
  - fflas\_lvl2.C, [976](#)
- Fixed, [462](#)
- FixedPrecIntTag, [462](#)
- flimits.h, [1045](#)
  - in\_range, [1046](#)
- FLOAT\_MOD
  - fflas\_simd.h, [870](#)
- FloatingPointTestDistribution
  - ScalFunctionsBase< Element, typename enable\_if< is\_floating\_point< Element >::value >::type >::FloatingPointTestDistribution, [463](#)
- Floats
  - benchmark-dgemm.C, [780](#)
- floor
  - ScalFunctionsBase< Element, typename enable\_if< is\_floating\_point< Element >::value >::type >, [556](#)
  - Simd256\_impl< true, false, true, 8 >, [627](#)
  - Simd512\_impl< true, false, true, 8 >, [709](#)
- fma
  - ScalFunctionsBase< Element, typename enable\_if< is\_floating\_point< Element >::value >::type >, [556](#)
  - ScalFunctionsBase< Element, typename enable\_if< is\_integral< Element >::value >::type >, [558](#)
- fmadd
  - ScalFunctions< Element >, [553](#)
  - Simd128\_impl< true, true, false, 2 >, [569](#)
  - Simd128\_impl< true, true, false, 4 >, [579](#)
  - Simd128\_impl< true, true, false, 8 >, [589](#)
  - Simd128\_impl< true, true, true, 2 >, [597](#)
  - Simd128\_impl< true, true, true, 4 >, [606](#)
  - Simd128\_impl< true, true, true, 8 >, [615](#)
  - Simd256\_impl< true, false, true, 8 >, [626](#)
  - Simd256\_impl< true, true, false, 2 >, [637](#)
  - Simd256\_impl< true, true, false, 4 >, [654](#)
  - Simd256\_impl< true, true, false, 8 >, [665](#)
  - Simd256\_impl< true, true, true, 2 >, [673](#)
  - Simd256\_impl< true, true, true, 4 >, [683](#), [690](#)
  - Simd256\_impl< true, true, true, 8 >, [699](#)
  - Simd512\_impl< true, false, true, 8 >, [707](#)
  - Simd512\_impl< true, true, false, 8 >, [718](#)
  - Simd512\_impl< true, true, true, 8 >, [727](#)
- fmaddin
  - ScalFunctions< Element >, [553](#)
  - Simd128\_impl< true, true, false, 2 >, [569](#)
  - Simd128\_impl< true, true, false, 4 >, [579](#)
  - Simd128\_impl< true, true, false, 8 >, [589](#)
  - Simd128\_impl< true, true, true, 2 >, [597](#)
  - Simd128\_impl< true, true, true, 4 >, [606](#)

- Simd128\_impl< true, true, true, 8 >, [615](#)
- Simd256\_impl< true, false, true, 8 >, [626](#)
- Simd256\_impl< true, true, false, 2 >, [637](#)
- Simd256\_impl< true, true, false, 4 >, [654](#)
- Simd256\_impl< true, true, false, 8 >, [665](#)
- Simd256\_impl< true, true, true, 2 >, [673](#)
- Simd256\_impl< true, true, true, 4 >, [683](#), [690](#)
- Simd256\_impl< true, true, true, 8 >, [699](#)
- Simd512\_impl< true, false, true, 8 >, [708](#)
- Simd512\_impl< true, true, false, 8 >, [718](#)
- Simd512\_impl< true, true, true, 8 >, [727](#)
- fmadddx
  - ScalFunctionsBase< Element, typename enable\_if< is\_integral< Element >::value >::type >, [558](#)
  - Simd128\_impl< true, true, false, 2 >, [565](#)
  - Simd128\_impl< true, true, false, 4 >, [575](#)
  - Simd128\_impl< true, true, false, 8 >, [585](#)
  - Simd128\_impl< true, true, true, 2 >, [597](#)
  - Simd128\_impl< true, true, true, 4 >, [606](#)
  - Simd128\_impl< true, true, true, 8 >, [615](#)
  - Simd256\_impl< true, true, false, 2 >, [632](#)
  - Simd256\_impl< true, true, false, 4 >, [644](#), [647](#)
  - Simd256\_impl< true, true, false, 8 >, [661](#)
  - Simd256\_impl< true, true, true, 2 >, [673](#)
  - Simd256\_impl< true, true, true, 4 >, [684](#), [690](#)
  - Simd256\_impl< true, true, true, 8 >, [699](#)
  - Simd512\_impl< true, true, false, 8 >, [714](#)
  - Simd512\_impl< true, true, true, 8 >, [727](#)
- fmadddxin
  - ScalFunctionsBase< Element, typename enable\_if< is\_integral< Element >::value >::type >, [558](#)
  - Simd128\_impl< true, true, false, 2 >, [565](#)
  - Simd128\_impl< true, true, false, 4 >, [575](#)
  - Simd128\_impl< true, true, false, 8 >, [585](#)
  - Simd128\_impl< true, true, true, 2 >, [598](#)
  - Simd128\_impl< true, true, true, 4 >, [606](#)
  - Simd128\_impl< true, true, true, 8 >, [616](#)
  - Simd256\_impl< true, true, false, 2 >, [633](#)
  - Simd256\_impl< true, true, false, 4 >, [644](#), [647](#)
  - Simd256\_impl< true, true, false, 8 >, [661](#)
  - Simd256\_impl< true, true, true, 2 >, [673](#)
  - Simd256\_impl< true, true, true, 4 >, [684](#), [690](#)
  - Simd256\_impl< true, true, true, 8 >, [699](#)
  - Simd512\_impl< true, true, false, 8 >, [714](#)
  - Simd512\_impl< true, true, true, 8 >, [727](#)
- fmove
  - FFLAS, [139](#), [170](#)
- fmove\_2\_modular\_double
  - fflas\_c.h, [957](#)
  - fflas\_lvl2.C, [978](#)
- fmsub
  - ScalFunctions< Element >, [553](#)
  - Simd128\_impl< true, true, false, 2 >, [569](#)
  - Simd128\_impl< true, true, false, 4 >, [579](#)
  - Simd128\_impl< true, true, false, 8 >, [590](#)
  - Simd128\_impl< true, true, true, 2 >, [598](#)
  - Simd128\_impl< true, true, true, 4 >, [607](#)
  - Simd128\_impl< true, true, true, 8 >, [616](#)
- Simd256\_impl< true, false, true, 8 >, [626](#)
- Simd256\_impl< true, true, false, 2 >, [637](#)
- Simd256\_impl< true, true, false, 4 >, [655](#)
- Simd256\_impl< true, true, false, 8 >, [665](#)
- Simd256\_impl< true, true, true, 2 >, [674](#)
- Simd256\_impl< true, true, true, 4 >, [684](#), [691](#)
- Simd256\_impl< true, true, true, 8 >, [700](#)
- Simd512\_impl< true, false, true, 8 >, [708](#)
- Simd512\_impl< true, true, false, 8 >, [719](#)
- Simd512\_impl< true, true, true, 8 >, [728](#)
- fmsubbin
  - ScalFunctions< Element >, [553](#)
  - Simd128\_impl< true, true, false, 2 >, [570](#)
  - Simd128\_impl< true, true, false, 4 >, [580](#)
  - Simd128\_impl< true, true, false, 8 >, [590](#)
  - Simd128\_impl< true, true, true, 2 >, [598](#)
  - Simd128\_impl< true, true, true, 4 >, [607](#)
  - Simd128\_impl< true, true, true, 8 >, [616](#)
  - Simd256\_impl< true, false, true, 8 >, [626](#)
  - Simd256\_impl< true, true, false, 2 >, [637](#)
  - Simd256\_impl< true, true, false, 4 >, [655](#)
  - Simd256\_impl< true, true, false, 8 >, [665](#)
  - Simd256\_impl< true, true, true, 2 >, [674](#)
  - Simd256\_impl< true, true, true, 4 >, [684](#), [691](#)
  - Simd256\_impl< true, true, true, 8 >, [700](#)
  - Simd512\_impl< true, false, true, 8 >, [708](#)
  - Simd512\_impl< true, true, false, 8 >, [719](#)
  - Simd512\_impl< true, true, true, 8 >, [728](#)
- fmsubx
  - ScalFunctionsBase< Element, typename enable\_if< is\_integral< Element >::value >::type >, [558](#)
  - Simd128\_impl< true, true, false, 2 >, [565](#)
  - Simd128\_impl< true, true, false, 4 >, [576](#)
  - Simd128\_impl< true, true, false, 8 >, [586](#)
  - Simd128\_impl< true, true, true, 2 >, [598](#)
  - Simd128\_impl< true, true, true, 4 >, [607](#)
  - Simd128\_impl< true, true, true, 8 >, [616](#)
  - Simd256\_impl< true, true, false, 2 >, [633](#)
  - Simd256\_impl< true, true, false, 4 >, [645](#), [647](#)
  - Simd256\_impl< true, true, false, 8 >, [661](#)
  - Simd256\_impl< true, true, true, 2 >, [674](#)
  - Simd256\_impl< true, true, true, 4 >, [685](#), [691](#)
  - Simd256\_impl< true, true, true, 8 >, [700](#)
  - Simd512\_impl< true, true, false, 8 >, [714](#)
  - Simd512\_impl< true, true, true, 8 >, [728](#)
- fmsubxin
  - ScalFunctionsBase< Element, typename enable\_if< is\_integral< Element >::value >::type >, [559](#)
  - Simd128\_impl< true, true, false, 2 >, [566](#)
  - Simd128\_impl< true, true, false, 4 >, [576](#)
  - Simd128\_impl< true, true, false, 8 >, [586](#)
  - Simd128\_impl< true, true, true, 2 >, [599](#)
  - Simd128\_impl< true, true, true, 4 >, [607](#)
  - Simd128\_impl< true, true, true, 8 >, [617](#)
  - Simd256\_impl< true, true, false, 2 >, [633](#)
  - Simd256\_impl< true, true, false, 4 >, [645](#), [647](#)
  - Simd256\_impl< true, true, false, 8 >, [661](#)
  - Simd256\_impl< true, true, true, 2 >, [674](#)

- Simd256\_impl< true, true, true, 4 >, [685](#), [691](#)
  - Simd256\_impl< true, true, true, 8 >, [700](#)
  - Simd512\_impl< true, true, false, 8 >, [715](#)
  - Simd512\_impl< true, true, true, 8 >, [728](#)
- fneg
  - FFLAS, [130](#), [138](#), [159](#), [168](#)
- fneg\_1\_modular\_double
  - fflas\_c.h, [952](#)
  - fflas\_lvl1.C, [971](#)
- fneg\_2\_modular\_double
  - fflas\_c.h, [956](#)
  - fflas\_lvl2.C, [977](#)
- fnegin
  - FFLAS, [130](#), [138](#), [159](#), [168](#)
- fnegin\_1\_modular\_double
  - fflas\_c.h, [952](#)
  - fflas\_lvl1.C, [971](#)
- fnegin\_2\_modular\_double
  - fflas\_c.h, [956](#)
  - fflas\_lvl2.C, [977](#)
- fnmadd
  - ScalFunctions< Element >, [553](#)
  - Simd128\_impl< true, true, false, 2 >, [569](#)
  - Simd128\_impl< true, true, false, 4 >, [579](#)
  - Simd128\_impl< true, true, false, 8 >, [589](#)
  - Simd128\_impl< true, true, true, 2 >, [598](#)
  - Simd128\_impl< true, true, true, 4 >, [607](#)
  - Simd128\_impl< true, true, true, 8 >, [616](#)
  - Simd256\_impl< true, false, true, 8 >, [626](#)
  - Simd256\_impl< true, true, false, 2 >, [637](#)
  - Simd256\_impl< true, true, false, 4 >, [654](#)
  - Simd256\_impl< true, true, false, 8 >, [665](#)
  - Simd256\_impl< true, true, true, 2 >, [673](#)
  - Simd256\_impl< true, true, true, 4 >, [684](#), [690](#)
  - Simd256\_impl< true, true, true, 8 >, [699](#)
  - Simd512\_impl< true, false, true, 8 >, [708](#)
  - Simd512\_impl< true, true, false, 8 >, [718](#)
  - Simd512\_impl< true, true, true, 8 >, [727](#)
- fnmaddin
  - ScalFunctions< Element >, [553](#)
  - Simd128\_impl< true, true, false, 2 >, [569](#)
  - Simd128\_impl< true, true, false, 4 >, [579](#)
  - Simd128\_impl< true, true, false, 8 >, [589](#)
  - Simd128\_impl< true, true, true, 2 >, [598](#)
  - Simd128\_impl< true, true, true, 4 >, [607](#)
  - Simd128\_impl< true, true, true, 8 >, [616](#)
  - Simd256\_impl< true, false, true, 8 >, [626](#)
  - Simd256\_impl< true, true, false, 2 >, [637](#)
  - Simd256\_impl< true, true, false, 4 >, [654](#)
  - Simd256\_impl< true, true, false, 8 >, [665](#)
  - Simd256\_impl< true, true, true, 2 >, [673](#)
  - Simd256\_impl< true, true, true, 4 >, [684](#), [690](#)
  - Simd256\_impl< true, true, true, 8 >, [699](#)
  - Simd512\_impl< true, false, true, 8 >, [708](#)
  - Simd512\_impl< true, true, false, 8 >, [719](#)
  - Simd512\_impl< true, true, true, 8 >, [727](#)
- fnmaddx
  - ScalFunctionsBase< Element, typename enable\_if< is\_integral< Element >::value >::type >, [559](#)
  - Simd128\_impl< true, true, false, 2 >, [565](#)
  - Simd128\_impl< true, true, false, 4 >, [575](#)
  - Simd128\_impl< true, true, false, 8 >, [585](#)
  - Simd128\_impl< true, true, true, 2 >, [598](#)
  - Simd128\_impl< true, true, true, 4 >, [607](#)
  - Simd128\_impl< true, true, true, 8 >, [616](#)
  - Simd256\_impl< true, true, false, 2 >, [633](#)
  - Simd256\_impl< true, true, false, 4 >, [644](#), [647](#)
  - Simd256\_impl< true, true, false, 8 >, [661](#)
  - Simd256\_impl< true, true, true, 2 >, [673](#)
  - Simd256\_impl< true, true, true, 4 >, [684](#), [690](#)
  - Simd256\_impl< true, true, true, 8 >, [699](#)
  - Simd512\_impl< true, true, false, 8 >, [714](#)
  - Simd512\_impl< true, true, true, 8 >, [727](#)
- fnmaddxin
  - ScalFunctionsBase< Element, typename enable\_if< is\_integral< Element >::value >::type >, [559](#)
  - Simd128\_impl< true, true, false, 2 >, [565](#)
  - Simd128\_impl< true, true, false, 4 >, [575](#)
  - Simd128\_impl< true, true, false, 8 >, [586](#)
  - Simd128\_impl< true, true, true, 2 >, [598](#)
  - Simd128\_impl< true, true, true, 4 >, [607](#)
  - Simd128\_impl< true, true, true, 8 >, [616](#)
  - Simd256\_impl< true, true, false, 2 >, [633](#)
  - Simd256\_impl< true, true, false, 4 >, [645](#), [647](#)
  - Simd256\_impl< true, true, false, 8 >, [661](#)
  - Simd256\_impl< true, true, true, 2 >, [674](#)
  - Simd256\_impl< true, true, true, 4 >, [684](#), [690](#)
  - Simd256\_impl< true, true, true, 8 >, [699](#)
  - Simd512\_impl< true, true, false, 8 >, [714](#)
  - Simd512\_impl< true, true, true, 8 >, [727](#)
- FOR1D
  - parallel.h, [1032](#)
- FOR2D
  - parallel.h, [1033](#)
- FORBLOCK1D
  - parallel.h, [1032](#)
- FORBLOCK2D
  - parallel.h, [1032](#)
- ForceCheck\_charpoly
  - FFPACK, [303](#)
- ForceCheck\_Det
  - FFPACK, [303](#)
- ForceCheck\_fgemm
  - FFLAS, [72](#)
- ForceCheck\_ftsrsm
  - FFLAS, [72](#)
- ForceCheck\_invert
  - FFPACK, [303](#)
- ForceCheck\_PLUQ
  - FFPACK, [303](#)
- ForStrategy1D
  - ForStrategy1D< blocksize\_t, Cut, Param >, [464](#)
- ForStrategy1D< blocksize\_t, Cut, Param >, [463](#)
  - begin, [464](#)
  - blockindex, [465](#)

- build, [464](#)
- changeBS, [465](#)
- current, [465](#)
- end, [465](#)
- firstBlockSize, [465](#)
- ForStrategy1D, [464](#)
- ibeg, [465](#)
- iend, [465](#)
- initialize, [464](#)
- isTerminated, [464](#)
- lastBlockSize, [465](#)
- numBlock, [466](#)
- numblocks, [465](#)
- operator++, [465](#)
- ForStrategy2D
  - ForStrategy2D< blocksize\_t, Cut, Param >, [467](#)
- ForStrategy2D< blocksize\_t, Cut, Param >, [466](#)
  - \_ibeg, [468](#)
  - \_iend, [468](#)
  - \_jbeg, [468](#)
  - \_jend, [468](#)
  - blockindex, [468](#)
  - BLOCKS, [469](#)
  - changeCBS, [469](#)
  - changeRBS, [469](#)
  - colblockindex, [468](#)
  - colBlockSize, [469](#)
  - colnumblocks, [467](#)
  - current, [469](#)
  - ForStrategy2D, [467](#)
  - ibegin, [467](#)
  - iend, [467](#)
  - initialize, [467](#)
  - isTerminated, [467](#)
  - jbegin, [467](#)
  - jend, [467](#)
  - lastCBS, [469](#)
  - lastRBS, [469](#)
  - numColBlock, [469](#)
  - numRowBlock, [469](#)
  - operator<<, [468](#)
  - operator++, [467](#)
  - rowblockindex, [468](#)
  - rowBlockSize, [468](#)
  - rownumblocks, [467](#)
- frand
  - FFLAS, [131](#), [135](#)
- freduce
  - FFLAS, [107–111](#), [157](#), [167](#)
  - FFLAS::details, [201](#), [202](#)
- freduce\_1\_modular\_double
  - fflas\_c.h, [952](#)
  - fflas\_lvl1.C, [971](#)
- freduce\_2\_modular\_double
  - fflas\_c.h, [956](#)
  - fflas\_lvl2.C, [976](#)
- freduce\_constoverride
  - FFLAS, [108](#), [110](#)
- freducein\_1\_modular\_double
  - fflas\_c.h, [952](#)
  - fflas\_lvl1.C, [971](#)
- freducein\_2\_modular\_double
  - fflas\_c.h, [956](#)
  - fflas\_lvl2.C, [976](#)
- freivalds
  - FFLAS, [111](#)
- fscal
  - FFLAS, [112–116](#), [161](#), [169](#)
  - FFLAS::details, [202](#), [203](#)
- fscal\_1\_modular\_double
  - fflas\_c.h, [953](#)
  - fflas\_lvl1.C, [972](#)
- fscal\_2\_modular\_double
  - fflas\_c.h, [956](#)
  - fflas\_lvl2.C, [977](#)
- fscalin
  - FFLAS, [111](#), [113–116](#), [161](#), [169](#)
  - FFLAS::details, [202](#), [203](#)
- fscalin\_1\_modular\_double
  - fflas\_c.h, [953](#)
  - fflas\_lvl1.C, [972](#)
- fscalin\_2\_modular\_double
  - fflas\_c.h, [956](#)
  - fflas\_lvl2.C, [977](#)
- fspmm
  - FFLAS, [145](#)
  - FFLAS::sparse\_details, [229–231](#)
  - FFLAS::sparse\_details\_impl, [245](#), [252](#), [253](#), [258](#), [259](#), [263](#), [272](#)
- fspmm\_dispatch
  - FFLAS::sparse\_details, [228](#), [229](#)
- fspmm\_mone
  - FFLAS::sparse\_details\_impl, [246](#), [254](#), [264](#)
- fspmm\_mone\_simd\_aligned
  - FFLAS::sparse\_details\_impl, [247](#), [254](#), [265](#)
- fspmm\_mone\_simd\_unaligned
  - FFLAS::sparse\_details\_impl, [247](#), [255](#), [265](#)
- fspmm\_one
  - FFLAS::sparse\_details\_impl, [246](#), [253](#), [264](#)
- fspmm\_one\_simd\_aligned
  - FFLAS::sparse\_details\_impl, [247](#), [254](#), [265](#)
- fspmm\_one\_simd\_unaligned
  - FFLAS::sparse\_details\_impl, [247](#), [254](#), [265](#)
- fspmm\_simd\_aligned
  - FFLAS::sparse\_details\_impl, [246](#), [253](#)
- fspmm\_simd\_unaligned
  - FFLAS::sparse\_details\_impl, [246](#), [253](#)
- fspmv
  - FFLAS, [145](#), [152](#)
  - FFLAS::sparse\_details, [226–228](#), [236](#)
  - FFLAS::sparse\_details\_impl, [248](#), [255](#), [259](#), [266](#), [268](#), [269](#), [273](#), [275](#)
- fspmv\_dispatch
  - FFLAS::sparse\_details, [226](#)
- fspmv\_mone

- FFLAS::sparse\_details\_impl, 248, 249, 256, 266, 267, 270, 276, 277
- fspmv\_mone\_simd
  - FFLAS::sparse\_details\_impl, 270, 276
- fspmv\_one
  - FFLAS::sparse\_details\_impl, 248, 249, 255, 256, 266, 267, 269, 270, 276
- fspmv\_one\_simd
  - FFLAS::sparse\_details\_impl, 270, 276
- fspmv\_simd
  - FFLAS::sparse\_details\_impl, 269, 275
- fsquare
  - FFLAS, 91, 92, 178
- fsquare\_3\_modular\_double
  - fflas\_c.h, 960
  - fflas\_lvl3.C, 981
- fsquareCommon
  - FFLAS::Protected, 215
- fsub
  - FFLAS, 78, 80, 164, 171
- fsub\_1\_modular\_double
  - fflas\_c.h, 954
  - fflas\_lvl1.C, 973
- fsub\_2\_modular\_double
  - fflas\_c.h, 957
  - fflas\_lvl2.C, 978
- fsubin
  - FFLAS, 78, 81, 172
- fsubin\_1\_modular\_double
  - fflas\_c.h, 954
  - fflas\_lvl1.C, 974
- fsubin\_2\_modular\_double
  - fflas\_c.h, 958
  - fflas\_lvl2.C, 978
- fswap
  - FFLAS, 133, 163
- fswap\_1\_modular\_double
  - fflas\_c.h, 954
  - fflas\_lvl1.C, 973
- fsyr2k
  - FFLAS, 116
- fsyrk
  - FFLAS, 117–124
- fsyrk.C, 773
  - CUBE, 773
  - GFOPS, 773
  - main, 773
- fsyrk\_convert
  - FFLAS::Protected, 218
- fsyrk\_strassen
  - FFLAS, 124, 142
- fsytrf
  - FFPACK, 311, 312
- fsytrf.C, 773
  - CUBE, 774
  - GFOPS, 774
  - main, 774
- fsytrf\_BC\_Crout
  - FFPACK, 350
- fsytrf\_BC\_RL
  - FFPACK, 350
- fsytrf\_LOW\_RPM\_BC\_Crout
  - FFPACK, 351
- fsytrf\_nonunit
  - FFPACK, 312, 352
- fsytrf\_RPM
  - FFPACK, 352
- fsytrf\_UP\_RPM
  - FFPACK, 351
- fsytrf\_UP\_RPM\_BC\_Crout
  - FFPACK, 351
- fsytrf\_UP\_RPM\_BC\_RL
  - FFPACK, 351
- ftranspose
  - FFLAS, 154
- ftrmm
  - FFLAS, 124, 125, 175
- ftrmm\_3\_modular\_double
  - fflas\_c.h, 959
  - fflas\_lvl3.C, 980
- ftrmmLeftLowerNoTransNonUnit< Element >, 470
- ftrmmLeftLowerNoTransUnit< Element >, 470
- ftrmmLeftLowerTransNonUnit< Element >, 470
- ftrmmLeftLowerTransUnit< Element >, 470
- ftrmmLeftUpperNoTransNonUnit< Element >, 470
- ftrmmLeftUpperNoTransUnit< Element >, 470
- ftrmmLeftUpperTransNonUnit< Element >, 470
- ftrmmLeftUpperTransUnit< Element >, 471
- ftrmmRightLowerNoTransNonUnit< Element >, 471
- ftrmmRightLowerNoTransUnit< Element >, 471
- ftrmmRightLowerTransNonUnit< Element >, 471
- ftrmmRightLowerTransUnit< Element >, 471
- ftrmmRightUpperNoTransNonUnit< Element >, 471
- ftrmmRightUpperNoTransUnit< Element >, 471
- ftrmmRightUpperTransNonUnit< Element >, 471
- ftrmmRightUpperTransUnit< Element >, 472
- ftrmv
  - FFLAS, 140
- ftrsm
  - FFLAS, 126, 127, 141, 144, 145, 175
- ftrsm\_3\_modular\_double
  - fflas\_c.h, 959
  - fflas\_lvl3.C, 980
- ftrsmLeftLowerNoTransNonUnit< Element >, 472
- ftrsmLeftLowerNoTransUnit< Element >, 472
- ftrsmLeftLowerTransNonUnit< Element >, 472
- ftrsmLeftLowerTransUnit< Element >, 472
- ftrsmLeftUpperNoTransNonUnit< Element >, 472
- ftrsmLeftUpperNoTransUnit< Element >, 473
- ftrsmLeftUpperTransNonUnit< Element >, 473
- ftrsmLeftUpperTransUnit< Element >, 473
- ftrsmRightLowerNoTransNonUnit< Element >, 473
- ftrsmRightLowerNoTransUnit< Element >, 473
- ftrsmRightLowerTransNonUnit< Element >, 473
- ftrsmRightLowerTransUnit< Element >, 473
- ftrsmRightUpperNoTransNonUnit< Element >, 473



- ftsmRightUpperNoTransUnit< Element >, [474](#)
- ftsmRightUpperTransNonUnit< Element >, [474](#)
- ftsmRightUpperTransUnit< Element >, [474](#)
- ftssyr2k
  - FFPACK, [310](#)
- ftstr
  - FFPACK, [310](#)
- ftsv
  - FFLAS, [128](#), [174](#)
- ftsv\_2\_modular\_double
  - fflas\_c.h, [959](#)
  - fflas\_lvl2.C, [979](#)
- fttri
  - FFPACK, [309](#), [364](#)
- fttri.C, [774](#)
  - CUBE, [774](#)
  - GFOPS, [774](#)
  - main, [775](#)
- fttri\_modular\_double
  - ffpack.C, [988](#)
  - ffpack\_c.h, [1010](#)
- fttrtm
  - FFPACK, [309](#), [365](#)
- fttrtm\_modular\_double
  - ffpack.C, [989](#)
  - ffpack\_c.h, [1010](#)
- fzero
  - FFLAS, [130](#), [133](#), [135](#), [159](#), [165](#)
- fzero\_1\_modular\_double
  - fflas\_c.h, [952](#)
  - fflas\_lvl1.C, [972](#)
- fzero\_2\_modular\_double
  - fflas\_c.h, [955](#)
  - fflas\_lvl2.C, [975](#)
- gather
  - Simd128\_impl< true, true, false, 2 >, [564](#), [566](#)
  - Simd128\_impl< true, true, false, 4 >, [574](#), [576](#)
  - Simd128\_impl< true, true, false, 8 >, [584](#), [586](#)
  - Simd128\_impl< true, true, true, 2 >, [594](#)
  - Simd128\_impl< true, true, true, 4 >, [603](#)
  - Simd128\_impl< true, true, true, 8 >, [612](#)
  - Simd256\_impl< true, false, true, 8 >, [623](#)
  - Simd256\_impl< true, true, false, 2 >, [631](#), [634](#)
  - Simd256\_impl< true, true, false, 4 >, [643](#), [645](#), [648](#)
  - Simd256\_impl< true, true, false, 8 >, [659](#), [662](#)
  - Simd256\_impl< true, true, true, 2 >, [669](#)
  - Simd256\_impl< true, true, true, 4 >, [680](#), [686](#)
  - Simd256\_impl< true, true, true, 8 >, [696](#)
  - Simd512\_impl< true, false, true, 8 >, [705](#)
  - Simd512\_impl< true, true, false, 8 >, [712](#), [715](#)
  - Simd512\_impl< true, true, true, 8 >, [723](#)
- GaussJordan
  - FFPACK::Protected, [391](#)
- GCC\_VERSION
  - fflas-ffpack-config.h, [822](#)
- gebp
  - FFLAS::details, [205](#)
- genData
  - benchmark-fgemv.C, [790](#)
- GenericTag, [474](#)
- genInputs
  - ScalFunctions< Element >, [551](#)
- genInputsWithZero
  - ScalFunctions< Element >, [551](#)
- get
  - Simd128\_impl< true, true, false, 8 >, [587](#)
  - Simd128\_impl< true, true, true, 8 >, [612](#)
  - Simd256\_impl< true, true, false, 8 >, [662](#)
  - Simd256\_impl< true, true, true, 8 >, [696](#)
- get\_default\_random\_generator
  - ScalFunctionsBase< Element, typename enable\_if< is\_floating\_point< Element >::value >::type >, [556](#)
  - ScalFunctionsBase< Element, typename enable\_if< is\_integral< Element >::value >::type >, [558](#)
- getArgumentValue
  - FFLAS, [185](#)
- getDataType
  - FFLAS, [151](#), [152](#)
- getEchelonForm
  - FFPACK, [336](#)
- getEchelonForm< FFLAS\_FIELD< FFLAS\_ELT > >
  - FFPACK, [373](#)
- getEchelonForm\_modular\_double
  - ffpack.C, [1000](#)
  - ffpack\_c.h, [1020](#)
- getEchelonFormin\_modular\_double
  - ffpack.C, [1000](#)
  - ffpack\_c.h, [1020](#)
- getEchelonTransform
  - FFPACK, [337](#)
- getEchelonTransform< FFLAS\_FIELD< FFLAS\_ELT > >
  - FFPACK, [373](#)
- getEchelonTransform\_modular\_double
  - ffpack.C, [1001](#)
  - ffpack\_c.h, [1020](#)
- getListArgs
  - args-parser.h, [1039](#)
- getLTBruhatGen
  - FFPACK, [341](#)
- getReducedEchelonForm
  - FFPACK, [338](#), [339](#)
- getReducedEchelonForm< FFLAS\_FIELD< FFLAS\_ELT > >
  - FFPACK, [374](#)
- getReducedEchelonForm\_modular\_double
  - ffpack.C, [1001](#)
  - ffpack\_c.h, [1021](#)
- getReducedEchelonFormin\_modular\_double
  - ffpack.C, [1001](#)
  - ffpack\_c.h, [1021](#)
- getReducedEchelonTransform
  - FFPACK, [339](#)

- getReducedEchelonTransform< FFLAS\_FIELD< FFLAS\_ELT > >  
FFPACK, [374](#)
- getReducedEchelonTransform\_modular\_double  
ffpack.C, [1001](#)  
ffpack\_c.h, [1021](#)
- getSeed  
FFLAS, [189](#)
- getStat  
FFLAS, [154](#)
- getStatus  
TestOneMethod< Simd >, [762](#)
- getTestName  
TestOneMethod< Simd >, [762](#)
- getTLBSize  
FFLAS, [189](#)
- getTriangular  
FFPACK, [335](#)
- getTriangular< FFLAS\_FIELD< FFLAS\_ELT > >  
FFPACK, [372](#), [373](#)
- getTriangular\_modular\_double  
ffpack.C, [1000](#)  
ffpack\_c.h, [1019](#)
- getTriangularin\_modular\_double  
ffpack.C, [1000](#)  
ffpack\_c.h, [1019](#)
- getTridiagonal  
FFPACK, [352](#)
- gf2ModularBalanced  
regression-check.C, [1051](#)
- GFOPS  
charpoly.C, [772](#)  
fsyrk.C, [773](#)  
fsytrf.C, [774](#)  
ftrtri.C, [774](#)  
pluq.C, [775](#)  
winograd.C, [776](#)
- Givaro, [396](#)
- GRAIN  
benchmark-fgemm-rns.C, [786](#)
- Grain, [474](#)
- greater  
ScalFunctions< Element >, [554](#)  
Simd128\_impl< true, true, false, 2 >, [564](#)  
Simd128\_impl< true, true, false, 4 >, [574](#)  
Simd128\_impl< true, true, false, 8 >, [584](#)  
Simd128\_impl< true, true, true, 2 >, [599](#)  
Simd128\_impl< true, true, true, 4 >, [608](#)  
Simd128\_impl< true, true, true, 8 >, [617](#)  
Simd256\_impl< true, false, true, 8 >, [627](#)  
Simd256\_impl< true, true, false, 2 >, [632](#)  
Simd256\_impl< true, true, false, 4 >, [644](#), [646](#)  
Simd256\_impl< true, true, false, 8 >, [660](#)  
Simd256\_impl< true, true, true, 2 >, [674](#)  
Simd256\_impl< true, true, true, 4 >, [685](#), [691](#)  
Simd256\_impl< true, true, true, 8 >, [700](#)  
Simd512\_impl< true, false, true, 8 >, [708](#)  
Simd512\_impl< true, true, false, 8 >, [713](#)
- Simd512\_impl< true, true, true, 8 >, [728](#)
- greater\_eq  
ScalFunctions< Element >, [554](#)  
Simd128\_impl< true, true, false, 2 >, [565](#)  
Simd128\_impl< true, true, false, 4 >, [575](#)  
Simd128\_impl< true, true, false, 8 >, [585](#)  
Simd128\_impl< true, true, true, 2 >, [599](#)  
Simd128\_impl< true, true, true, 4 >, [608](#)  
Simd128\_impl< true, true, true, 8 >, [617](#)  
Simd256\_impl< true, false, true, 8 >, [627](#)  
Simd256\_impl< true, true, false, 2 >, [632](#)  
Simd256\_impl< true, true, false, 4 >, [644](#), [646](#)  
Simd256\_impl< true, true, false, 8 >, [660](#)  
Simd256\_impl< true, true, true, 2 >, [674](#)  
Simd256\_impl< true, true, true, 4 >, [685](#), [691](#)  
Simd256\_impl< true, true, true, 8 >, [700](#)  
Simd512\_impl< true, false, true, 8 >, [709](#)  
Simd512\_impl< true, true, false, 8 >, [713](#)  
Simd512\_impl< true, true, true, 8 >, [728](#)
- hadd  
Simd256\_impl< true, false, true, 8 >, [627](#)  
Simd512\_impl< true, false, true, 8 >, [709](#)
- hadd\_to\_scal  
Simd128\_impl< true, true, false, 2 >, [566](#)  
Simd128\_impl< true, true, false, 4 >, [576](#)  
Simd128\_impl< true, true, false, 8 >, [586](#)  
Simd128\_impl< true, true, true, 2 >, [599](#)  
Simd128\_impl< true, true, true, 4 >, [608](#)  
Simd128\_impl< true, true, true, 8 >, [617](#)  
Simd256\_impl< true, false, true, 8 >, [628](#)  
Simd256\_impl< true, true, false, 2 >, [633](#)  
Simd256\_impl< true, true, false, 4 >, [645](#), [647](#)  
Simd256\_impl< true, true, false, 8 >, [662](#)  
Simd256\_impl< true, true, true, 2 >, [675](#)  
Simd256\_impl< true, true, true, 4 >, [685](#), [691](#)  
Simd256\_impl< true, true, true, 8 >, [701](#)  
Simd512\_impl< true, false, true, 8 >, [709](#)  
Simd512\_impl< true, true, false, 8 >, [715](#)  
Simd512\_impl< true, true, true, 8 >, [728](#)
- half\_t  
Simd256\_impl< true, true, false, 2 >, [631](#)  
Simd256\_impl< true, true, false, 4 >, [642](#)  
Simd256\_impl< true, true, false, 8 >, [659](#)  
Simd256\_impl< true, true, true, 2 >, [668](#)  
Simd256\_impl< true, true, true, 4 >, [679](#)  
Simd256\_impl< true, true, true, 8 >, [695](#)  
Simd512\_impl< true, true, false, 8 >, [712](#)  
Simd512\_impl< true, true, true, 8 >, [722](#)
- has\_equal  
FFLAS, [73](#)
- has\_minus  
FFLAS, [73](#)
- has\_minus\_eq  
FFLAS, [73](#)
- has\_minus\_eq\_impl< C >, [474](#)  
value, [475](#)
- has\_minus\_impl< C >, [475](#)  
value, [475](#)



- has\_mul
  - FFLAS, [73](#)
- has\_mul\_eq
  - FFLAS, [73](#)
- has\_mul\_eq\_impl< C >, [475](#)
  - value, [475](#)
- has\_mul\_impl< C >, [475](#)
  - value, [476](#)
- has\_operation< T >, [476](#)
  - value, [476](#)
- has\_plus
  - FFLAS, [73](#)
- has\_plus\_eq
  - FFLAS, [73](#)
- has\_plus\_eq\_impl< C >, [476](#)
  - value, [476](#)
- has\_plus\_impl< C >, [476](#)
  - value, [477](#)
- HAVE\_BLAS
  - config.h, [815](#)
- HAVE\_CBLAS
  - config.h, [815](#)
- HAVE\_CXX11
  - config.h, [815](#)
- HAVE\_DLFCN\_H
  - config.h, [816](#)
- HAVE\_FLOAT\_H
  - config.h, [816](#)
- HAVE\_INT128
  - config.h, [816](#)
- HAVE\_INTTYPES\_H
  - config.h, [816](#)
- HAVE\_LAPACK
  - config.h, [816](#)
- HAVE\_LIMITS\_H
  - config.h, [816](#)
- HAVE\_LITTLE\_ENDIAN
  - config.h, [816](#)
- HAVE\_PTHREAD\_H
  - config.h, [816](#)
- HAVE\_STDDEF\_H
  - config.h, [816](#)
- HAVE\_STDINT\_H
  - config.h, [816](#)
- HAVE\_STDIO\_H
  - config.h, [816](#)
- HAVE\_STDLIB\_H
  - config.h, [816](#)
- HAVE\_STRING\_H
  - config.h, [816](#)
- HAVE\_STRINGS\_H
  - config.h, [816](#)
- HAVE\_SYS\_STAT\_H
  - config.h, [816](#)
- HAVE\_SYS\_TIME\_H
  - config.h, [817](#)
- HAVE\_SYS\_TYPES\_H
  - config.h, [817](#)
- HAVE\_UNISTD\_H
  - config.h, [817](#)
- HelperFlag, [477](#)
  - aut, [477](#)
  - coo, [477](#)
  - csr, [477](#)
  - ell, [477](#)
  - none, [477](#)
  - pm1, [477](#)
- HelperMod
  - HelperMod< Field, ElementCategories::MachineIntTag >, [478](#)
  - HelperMod< Field, FFLAS::ElementCategories::ArbitraryPrecIntTag >, [479](#)
  - HelperMod< Field, FFLAS::ElementCategories::FixedPrecIntTag >, [479](#)
  - HelperMod< Field, FFLAS::ElementCategories::MachineFloatTag >, [480](#)
  - HelperMod< Field, ElementCategories::MachineIntTag >, [478](#)
    - HelperMod, [478](#)
    - invp, [478](#)
    - max, [478](#)
    - min, [478](#)
    - p, [478](#)
    - pow50rem, [478](#)
  - HelperMod< Field, ElementTraits >, [477](#)
  - HelperMod< Field, FFLAS::ElementCategories::ArbitraryPrecIntTag >, [479](#)
    - HelperMod, [479](#)
    - p, [479](#)
  - HelperMod< Field, FFLAS::ElementCategories::FixedPrecIntTag >, [479](#)
    - HelperMod, [479](#)
    - p, [480](#)
  - HelperMod< Field, FFLAS::ElementCategories::MachineFloatTag >, [480](#)
    - HelperMod, [480](#)
    - invp, [480](#)
    - max, [480](#)
    - min, [480](#)
    - p, [480](#)
- helpString
  - Argument, [400](#)
- HYB\_ZO
  - FFLAS, [76](#)
- hyb\_zo.h, [903](#)
- hyb\_zo\_pspmm.inl, [903](#)
  - \_\_FFLASFFPACK\_fflas\_sparse\_HYB\_ZO\_pspmm\_INL, [903](#)
- hyb\_zo\_pspmv.inl, [903](#)
  - \_\_FFLASFFPACK\_fflas\_sparse\_HYB\_ZO\_pspmv\_INL, [904](#)
- hyb\_zo\_spm.inl, [904](#)
  - \_\_FFLASFFPACK\_fflas\_sparse\_HYB\_ZO\_spm\_INL, [904](#)
- hyb\_zo\_spmv.inl, [904](#)
  - \_\_FFLASFFPACK\_fflas\_sparse\_HYB\_ZO\_spmv\_INL, [904](#)

- 905
- hyb\_zo\_utils.inl, 905
- \_\_FFLASFFPACK\_fflas\_sparse\_HYB\_ZO\_utils\_INL, 905
- Hybrid, 481
- Hybrid\_KGF\_LUK\_MinPoly
  - FFPACK::Protected, 394
- ibeg
  - ForStrategy1D< blocksize\_t, Cut, Param >, 465
- ibegin
  - ForStrategy2D< blocksize\_t, Cut, Param >, 467
- idamax\_
  - config-blas.h, 811
- iend
  - ForStrategy1D< blocksize\_t, Cut, Param >, 465
  - ForStrategy2D< blocksize\_t, Cut, Param >, 467
- igebb11
  - FFLAS::details, 204
- igebb14
  - FFLAS::details, 204
- igebb21
  - FFLAS::details, 204
- igebb24
  - FFLAS::details, 203
- igebb41
  - FFLAS::details, 204
- igebb44
  - FFLAS::details, 203
- igebp
  - FFLAS::details, 205
- igemm
  - FFLAS::Protected, 221
- igemm.doxy, 857
- igemm.h, 857
- igemm.inl, 857
- \_\_FFLASFFPACK\_fflas\_igemm\_igemm\_INL, 858
- igemm\_
  - FFLAS, 128
- igemm\_colmajor
  - FFLAS::Protected, 221
- igemm\_kernels.h, 858
- igemm\_kernels.inl, 858
- \_\_FFLASFFPACK\_fflas\_igemm\_igemm\_kernels\_INL, 859
- igemm\_tools.h, 859
- igemm\_tools.inl, 859
- \_\_FFLASFFPACK\_fflas\_igemm\_igemm\_tools\_INL, 860
- in\_range
  - flimits.h, 1046
- index\_t
  - fflas\_sparse.h, 883
  - parallel.h, 1030
- InfNorm
  - FFLAS, 76
- Info, 481, 482
  - begin, 482, 483
  - Info, 481, 482
- operator=, 481, 483
- perm, 482, 483
- size, 482, 483
- info
  - BlockTransposeSIMD< Field, Simd, >, 407
- init
  - FieldSimd< \_Field >, 448, 449
  - rns\_double, 525, 526
  - rns\_double\_extended, 536, 537
  - RNSInteger< RNS >, 541
  - RNSIntegerMod< RNS >, 545, 546
- init\_transpose
  - rns\_double, 526
- init\_y
  - FFLAS::sparse\_details, 226
- initA
  - MMHelper< Field, AlgoTrait, ModeTrait, ParSeq-Trait >, 503
- initB
  - MMHelper< Field, AlgoTrait, ModeTrait, ParSeq-Trait >, 503
- initC
  - MMHelper< Field, AlgoTrait, ModeTrait, ParSeq-Trait >, 503
- initialize
  - ForStrategy1D< blocksize\_t, Cut, Param >, 464
  - ForStrategy2D< blocksize\_t, Cut, Param >, 467
- initOut
  - MMHelper< Field, AlgoTrait, ModeTrait, ParSeq-Trait >, 503
- INLINE
  - fflas\_simd.h, 870
- inplace
  - Bench< Elt >, 406
- inputs
  - TestOneMethod< Simd >, 762
- INST\_OR\_DECL
  - fflas\_L1\_inst.C, 960
  - fflas\_L1\_inst.h, 961
  - fflas\_L2\_inst.C, 964
  - fflas\_L2\_inst.h, 965
  - fflas\_L3\_inst.C, 967
  - fflas\_L3\_inst.h, 969
  - ffpack\_inst.C, 1022
  - ffpack\_inst.h, 1023
- integer
  - rns\_double, 524
  - rns\_double\_extended, 535
  - RNSInteger< RNS >, 539
  - RNSIntegerMod< RNS >, 544
- Interfaces, 42
- interfaces.doxy, 948
- IntType
  - ScalFunctionsBase< Element, typename enable\_if< is\_floating\_point< Element >::value >::type >::FloatingPointTestDistribution, 463
- inv
  - RNSIntegerMod< RNS >, 547

- Invert
  - FFPACK, [320](#), [367](#)
- Invert2
  - FFPACK, [321](#), [367](#)
- Invert2\_modular\_double
  - ffpack.C, [996](#)
  - ffpack\_c.h, [1015](#)
- Invert\_modular\_double
  - ffpack.C, [995](#)
  - ffpack\_c.h, [1015](#)
- Invertin\_modular\_double
  - ffpack.C, [995](#)
  - ffpack\_c.h, [1015](#)
- invp
  - HelperMod< Field, ElementCategories::MachineIntTag >, [478](#)
  - HelperMod< Field, FFLAS::ElementCategories::MachineIntTag >, [480](#)
- is\_all\_same< Args >, [483](#)
- is\_all\_same< T, Args... >, [483](#)
  - value, [483](#)
- is\_all\_same<>, [483](#)
  - value, [484](#)
- is\_same\_element
  - Bench< Elt >, [404](#)
  - NoSimd< T >, [516](#)
  - Simd128\_impl< true, true, false, 2 >, [563](#)
  - Simd128\_impl< true, true, false, 4 >, [573](#)
  - Simd128\_impl< true, true, false, 8 >, [583](#)
  - Simd128\_impl< true, true, true, 2 >, [594](#)
  - Simd128\_impl< true, true, true, 4 >, [603](#)
  - Simd128\_impl< true, true, true, 8 >, [612](#)
  - Simd256\_impl< true, false, true, 8 >, [622](#)
  - Simd256\_impl< true, true, false, 2 >, [630](#)
  - Simd256\_impl< true, true, false, 4 >, [642](#)
  - Simd256\_impl< true, true, false, 8 >, [659](#)
  - Simd256\_impl< true, true, true, 2 >, [669](#)
  - Simd256\_impl< true, true, true, 4 >, [679](#), [680](#)
  - Simd256\_impl< true, true, true, 8 >, [695](#)
  - Simd512\_impl< true, false, true, 8 >, [704](#)
  - Simd512\_impl< true, true, false, 8 >, [712](#)
  - Simd512\_impl< true, true, true, 8 >, [723](#)
  - Test< Elt >, [758](#)
- is\_simd< T >, [484](#)
  - type, [484](#)
  - value, [484](#)
- isMOne
  - RNSInteger< RNS >, [540](#)
  - RNSIntegerMod< RNS >, [544](#)
- isOdd
  - FFPACK, [375](#)
- isOne
  - RNSInteger< RNS >, [540](#)
  - RNSIntegerMod< RNS >, [544](#)
- IsSingular
  - FFPACK, [325](#), [369](#)
- IsSingular\_modular\_double
  - ffpack.C, [996](#)
- ffpack\_c.h, [1016](#)
- isSparseMatrix< Field, M >, [484](#)
- isSparseMatrix< Field, Sparse< Field, SparseMatrix\_t::COO > >, [484](#)
- isSparseMatrix< Field, Sparse< Field, SparseMatrix\_t::COO\_ZO > >, [485](#)
- isSparseMatrix< Field, Sparse< Field, SparseMatrix\_t::CSR > >, [485](#)
- isSparseMatrix< Field, Sparse< Field, SparseMatrix\_t::CSR\_HYB > >, [485](#)
- isSparseMatrix< Field, Sparse< Field, SparseMatrix\_t::CSR\_ZO > >, [486](#)
- isSparseMatrix< Field, Sparse< Field, SparseMatrix\_t::ELL > >, [486](#)
- isSparseMatrix< Field, Sparse< Field, SparseMatrix\_t::ELL\_simd > >, [486](#)
- isSparseMatrix< Field, Sparse< Field, SparseMatrix\_t::ELL\_simd\_ZO > >, [486](#)
- isSparseMatrix< Field, Sparse< Field, SparseMatrix\_t::ELL\_ZO > >, [487](#)
- isSparseMatrix< Field, Sparse< Field, SparseMatrix\_t::HYB\_ZO > >, [487](#)
- isSparseMatrix< Field, Sparse< Field, SparseMatrix\_t::SELL > >, [487](#)
- isSparseMatrix< Field, Sparse< Field, SparseMatrix\_t::SELL\_ZO > >, [487](#)
- isSparseMatrixMKLFormat< F, M >, [488](#)
- isSparseMatrixSimdFormat< F, M >, [488](#)
- isTerminated
  - ForStrategy1D< blocksize\_t, Cut, Param >, [464](#)
  - ForStrategy2D< blocksize\_t, Cut, Param >, [467](#)
- isZero
  - RNSInteger< RNS >, [540](#)
  - RNSIntegerMod< RNS >, [544](#)
- isZOSparseMatrix< F, M >, [488](#)
- isZOSparseMatrix< Field, Sparse< Field, SparseMatrix\_t::COO\_ZO > >, [489](#)
- isZOSparseMatrix< Field, Sparse< Field, SparseMatrix\_t::CSR\_ZO > >, [489](#)
- isZOSparseMatrix< Field, Sparse< Field, SparseMatrix\_t::ELL\_simd\_ZO > >, [489](#)
- isZOSparseMatrix< Field, Sparse< Field, SparseMatrix\_t::ELL\_ZO > >, [489](#)
- isZOSparseMatrix< Field, Sparse< Field, SparseMatrix\_t::SELL\_ZO > >, [490](#)
- Iterative, [490](#)
- iters
  - Bench< Elt >, [406](#)
- jbegin
  - ForStrategy2D< blocksize\_t, Cut, Param >, [467](#)
- jend
  - ForStrategy2D< blocksize\_t, Cut, Param >, [467](#)
- kaapi\_routines.inl, [1029](#)
- \_\_FFLASFFPACK\_KAAPI\_ROUTINES\_INL, [1029](#)
- KellerGehrig
  - FFPACK::Protected, [391](#)
- KGFast

- FFPACK::Protected, [392](#)
- KGFast\_generalized
  - FFPACK::Protected, [392](#)
- kmax
  - Sparse< \_Field, SparseMatrix\_t::COO >, [733](#)
  - Sparse< \_Field, SparseMatrix\_t::COO\_ZO >, [735](#)
  - Sparse< \_Field, SparseMatrix\_t::CSR >, [736](#)
  - Sparse< \_Field, SparseMatrix\_t::CSR\_HYB >, [738](#)
  - Sparse< \_Field, SparseMatrix\_t::CSR\_ZO >, [740](#)
  - Sparse< \_Field, SparseMatrix\_t::ELL >, [741](#)
  - Sparse< \_Field, SparseMatrix\_t::ELL\_simd >, [743](#)
  - Sparse< \_Field, SparseMatrix\_t::ELL\_simd\_ZO >, [745](#)
  - Sparse< \_Field, SparseMatrix\_t::ELL\_ZO >, [746](#)
  - Sparse< \_Field, SparseMatrix\_t::SELL >, [748](#)
  - Sparse< \_Field, SparseMatrix\_t::SELL\_ZO >, [750](#)
- KrylovElim
  - FFPACK, [369](#)
- KrylovElim\_modular\_double
  - ffpack.C, [996](#)
  - ffpack\_c.h, [1015](#)
- lapack.C, [1050](#)
  - \_\_FFLASFFPACK\_CONFIGURATION, [1050](#)
  - \_\_FFLASFFPACK\_HAVE\_LAPACK, [1050](#)
  - main, [1050](#)
- LAPACKPerm2MathPerm
  - FFPACK, [303](#)
  - ffpack.C, [985](#)
  - ffpack\_c.h, [1007](#)
- lastBlockSize
  - ForStrategy1D< blocksize\_t, Cut, Param >, [465](#)
- lastCBS
  - ForStrategy2D< blocksize\_t, Cut, Param >, [469](#)
- lastRBS
  - ForStrategy2D< blocksize\_t, Cut, Param >, [469](#)
- launch\_fger
  - test-fger.C, [1066](#)
- launch\_fger\_dispatch
  - test-fger.C, [1066](#)
- launch\_MM
  - test-fgemm.C, [1062](#)
- launch\_MM\_dispatch
  - test-fgemm-check.C, [1060](#)
  - test-fgemm.C, [1062](#)
- launch\_MV
  - test-fgemv.C, [1064](#)
- launch\_MV\_dispatch
  - test-fgemv.C, [1064](#)
- launch\_test
  - test-charpoly.C, [1052](#)
  - test-lu.C, [1089](#)
  - test-quasisep.C, [1095](#)
- launch\_wino
  - benchmark-wino.C, [801](#)
- LazyTag, [490](#)
- LD
  - fflas\_transpose.h, [912](#)
- ld
  - Sparse< \_Field, SparseMatrix\_t::ELL >, [742](#)
  - Sparse< \_Field, SparseMatrix\_t::ELL\_simd >, [743](#)
  - Sparse< \_Field, SparseMatrix\_t::ELL\_simd\_ZO >, [745](#)
  - Sparse< \_Field, SparseMatrix\_t::ELL\_ZO >, [747](#)
- LeadingSubmatrixRankProfiles
  - FFPACK, [331](#)
  - ffpack.C, [998](#)
  - ffpack\_c.h, [1018](#)
- lesser
  - ScalFunctions< Element >, [554](#)
  - Simd128\_impl< true, true, false, 2 >, [564](#)
  - Simd128\_impl< true, true, false, 4 >, [575](#)
  - Simd128\_impl< true, true, false, 8 >, [585](#)
  - Simd128\_impl< true, true, true, 2 >, [599](#)
  - Simd128\_impl< true, true, true, 4 >, [608](#)
  - Simd128\_impl< true, true, true, 8 >, [617](#)
  - Simd256\_impl< true, false, true, 8 >, [626](#)
  - Simd256\_impl< true, true, false, 2 >, [632](#)
  - Simd256\_impl< true, true, false, 4 >, [644](#), [646](#)
  - Simd256\_impl< true, true, false, 8 >, [660](#)
  - Simd256\_impl< true, true, true, 2 >, [674](#)
  - Simd256\_impl< true, true, true, 4 >, [685](#), [691](#)
  - Simd256\_impl< true, true, true, 8 >, [700](#)
  - Simd512\_impl< true, false, true, 8 >, [708](#)
  - Simd512\_impl< true, true, false, 8 >, [713](#)
  - Simd512\_impl< true, true, true, 8 >, [728](#)
- lesser\_eq
  - ScalFunctions< Element >, [554](#)
  - Simd128\_impl< true, true, false, 2 >, [565](#)
  - Simd128\_impl< true, true, false, 4 >, [575](#)
  - Simd128\_impl< true, true, false, 8 >, [585](#)
  - Simd128\_impl< true, true, true, 2 >, [599](#)
  - Simd128\_impl< true, true, true, 4 >, [608](#)
  - Simd128\_impl< true, true, true, 8 >, [617](#)
  - Simd256\_impl< true, false, true, 8 >, [626](#)
  - Simd256\_impl< true, true, false, 2 >, [632](#)
  - Simd256\_impl< true, true, false, 4 >, [644](#), [646](#)
  - Simd256\_impl< true, true, false, 8 >, [660](#)
  - Simd256\_impl< true, true, true, 2 >, [675](#)
  - Simd256\_impl< true, true, true, 4 >, [685](#), [691](#)
  - Simd256\_impl< true, true, true, 8 >, [700](#)
  - Simd512\_impl< true, false, true, 8 >, [708](#)
  - Simd512\_impl< true, true, false, 8 >, [714](#)
  - Simd512\_impl< true, true, true, 8 >, [728](#)
- limits< char >, [491](#)
  - digits, [491](#)
  - max, [491](#)
  - min, [491](#)
  - T, [491](#)
- limits< double >, [491](#)
  - digits, [492](#)
  - max, [492](#)
  - min, [492](#)
  - T, [492](#)
- limits< float >, [492](#)
  - digits, [492](#)

- max, [492](#)
- min, [492](#)
- T, [492](#)
- limits< Givaro::Integer >, [493](#)
  - max, [493](#)
  - min, [493](#)
  - T, [493](#)
- limits< int >, [493](#)
  - digits, [494](#)
  - max, [494](#)
  - min, [494](#)
  - T, [493](#)
- limits< long >, [494](#)
  - digits, [494](#)
  - max, [494](#)
  - min, [494](#)
  - T, [494](#)
- limits< long long >, [494](#)
  - digits, [495](#)
  - max, [495](#)
  - min, [495](#)
  - T, [495](#)
- limits< ReclInt::rint< K > >, [495](#)
  - max, [495](#)
  - min, [495](#)
  - T, [495](#)
- limits< ReclInt::ruint< K > >, [496](#)
  - max, [496](#)
  - min, [496](#)
  - T, [496](#)
- limits< short int >, [496](#)
  - digits, [497](#)
  - max, [497](#)
  - min, [497](#)
  - T, [497](#)
- limits< signed char >, [497](#)
  - digits, [497](#)
  - max, [497](#)
  - min, [497](#)
  - T, [497](#)
- limits< T >, [491](#)
- limits< unsigned char >, [498](#)
  - digits, [498](#)
  - max, [498](#)
  - min, [498](#)
  - T, [498](#)
- limits< unsigned int >, [498](#)
  - digits, [499](#)
  - max, [499](#)
  - min, [499](#)
  - T, [498](#)
- limits< unsigned long >, [499](#)
  - digits, [499](#)
  - max, [499](#)
  - min, [499](#)
  - T, [499](#)
- limits< unsigned long long >, [499](#)
  - digits, [500](#)
- max, [500](#)
- min, [500](#)
- T, [500](#)
- limits< unsigned short int >, [500](#)
  - digits, [500](#)
  - max, [500](#)
  - min, [500](#)
  - T, [500](#)
- load
  - Simd128\_impl< true, true, false, 2 >, [564](#), [566](#)
  - Simd128\_impl< true, true, false, 4 >, [574](#), [576](#)
  - Simd128\_impl< true, true, false, 8 >, [584](#), [587](#)
  - Simd128\_impl< true, true, true, 2 >, [594](#)
  - Simd128\_impl< true, true, true, 4 >, [603](#)
  - Simd128\_impl< true, true, true, 8 >, [612](#)
  - Simd256\_impl< true, false, true, 8 >, [623](#)
  - Simd256\_impl< true, true, false, 2 >, [631](#), [634](#)
  - Simd256\_impl< true, true, false, 4 >, [643](#), [645](#), [649](#)
  - Simd256\_impl< true, true, false, 8 >, [660](#), [662](#)
  - Simd256\_impl< true, true, true, 2 >, [670](#)
  - Simd256\_impl< true, true, true, 4 >, [680](#), [686](#)
  - Simd256\_impl< true, true, true, 8 >, [696](#)
  - Simd512\_impl< true, false, true, 8 >, [705](#)
  - Simd512\_impl< true, true, false, 8 >, [713](#), [716](#)
  - Simd512\_impl< true, true, true, 8 >, [724](#)
- loadu
  - Simd128\_impl< true, true, false, 2 >, [564](#), [566](#)
  - Simd128\_impl< true, true, false, 4 >, [574](#), [577](#)
  - Simd128\_impl< true, true, false, 8 >, [584](#), [587](#)
  - Simd128\_impl< true, true, true, 2 >, [594](#)
  - Simd128\_impl< true, true, true, 4 >, [603](#)
  - Simd128\_impl< true, true, true, 8 >, [613](#)
  - Simd256\_impl< true, false, true, 8 >, [623](#)
  - Simd256\_impl< true, true, false, 2 >, [631](#), [634](#)
  - Simd256\_impl< true, true, false, 4 >, [643](#), [646](#), [649](#)
  - Simd256\_impl< true, true, false, 8 >, [660](#), [662](#)
  - Simd256\_impl< true, true, true, 2 >, [670](#)
  - Simd256\_impl< true, true, true, 4 >, [680](#), [687](#)
  - Simd256\_impl< true, true, true, 8 >, [696](#)
  - Simd512\_impl< true, false, true, 8 >, [705](#)
  - Simd512\_impl< true, true, false, 8 >, [713](#), [716](#)
  - Simd512\_impl< true, true, true, 8 >, [724](#)
- LQUPtoInverseOfFullRankMinor
  - FFPACK, [345](#), [375](#)
- LT\_OBJDIR
  - config.h, [817](#)
- LTBruhatGen
  - FFPACK, [340](#)
- LTQSorter
  - FFPACK, [342](#)
- LUdivine
  - FFPACK, [314](#), [353](#), [354](#), [365](#)
- LUdivine\_construct
  - FFPACK::Protected, [390](#), [396](#)
- LUdivine\_gauss
  - FFPACK, [353](#), [366](#)

- LUdivine\_gauss\_modular\_double
  - ffpack\_c.h, [1011](#)
- LUdivine\_modular\_double
  - ffpack.C, [989](#)
  - ffpack\_c.h, [1011](#)
- LUdivine\_small
  - FFPACK, [353](#), [365](#)
- LUdivine\_small\_modular\_double
  - ffpack\_c.h, [1011](#)
- LUKrylov
  - FFPACK::Protected, [392](#)
- LUKrylov\_KGFast
  - FFPACK::Protected, [393](#)
- m
  - Bench< Elt >, [406](#)
  - Sparse< \_Field, SparseMatrix\_t::COO >, [733](#)
  - Sparse< \_Field, SparseMatrix\_t::COO\_ZO >, [735](#)
  - Sparse< \_Field, SparseMatrix\_t::CSR >, [736](#)
  - Sparse< \_Field, SparseMatrix\_t::CSR\_HYB >, [738](#)
  - Sparse< \_Field, SparseMatrix\_t::CSR\_ZO >, [740](#)
  - Sparse< \_Field, SparseMatrix\_t::ELL >, [742](#)
  - Sparse< \_Field, SparseMatrix\_t::ELL\_simd >, [743](#)
  - Sparse< \_Field, SparseMatrix\_t::ELL\_simd\_ZO >, [745](#)
  - Sparse< \_Field, SparseMatrix\_t::ELL\_ZO >, [746](#)
  - Sparse< \_Field, SparseMatrix\_t::SELL >, [748](#)
  - Sparse< \_Field, SparseMatrix\_t::SELL\_ZO >, [750](#)
- MachineFloatTag, [501](#)
- MachineIntTag, [501](#)
- main
  - 101-fgemm.C, [1103](#)
  - 2x2-fgemm.C, [1103](#)
  - 2x2-ftsrv.C, [1104](#)
  - 2x2-pluq.C, [1104](#)
  - arithprog.C, [771](#)
  - benchmark-charpoly-mp.C, [777](#)
  - benchmark-charpoly.C, [778](#)
  - benchmark-checkers.C, [779](#)
  - benchmark-dgemm.C, [780](#)
  - benchmark-dgetrf.C, [781](#)
  - benchmark-dgetri.C, [781](#)
  - benchmark-dsytrf.C, [782](#)
  - benchmark-dtrsm.C, [782](#)
  - benchmark-dtrtri.C, [783](#)
  - benchmark-fadd-lvl2.C, [783](#)
  - benchmark-fdot.C, [784](#)
  - benchmark-fgemm-mp.C, [785](#)
  - benchmark-fgemm-rns.C, [787](#)
  - benchmark-fgemm.C, [787](#)
  - benchmark-fgemv-mp.C, [788](#)
  - benchmark-fgemv.C, [792](#)
  - benchmark-fgesv.C, [792](#)
  - benchmark-fsyr2k.C, [793](#)
  - benchmark-fsyrc.C, [793](#)
  - benchmark-fsytrf.C, [794](#)
  - benchmark-ftrsm-mp.C, [795](#)
  - benchmark-ftrsm.C, [795](#)
  - benchmark-ftsrv.C, [796](#)
  - benchmark-ftrtri.C, [796](#)
  - benchmark-inverse.C, [797](#)
  - benchmark-lqup-mp.C, [797](#)
  - benchmark-lqup.C, [798](#)
  - benchmark-pluq.C, [799](#)
  - benchmark-quasisep.C, [800](#)
  - benchmark-storage-transpose.C, [801](#)
  - benchmark-wino.C, [802](#)
  - cblas.C, [1048](#)
  - charpoly.C, [772](#)
  - clapack.C, [1049](#)
  - cuda.C, [1049](#)
  - det.C, [802](#)
  - fblas.C, [1050](#)
  - fflas-101\_1.C, [1104](#)
  - fflas-101\_3.C, [1105](#)
  - fflas\_101.C, [1105](#)
  - fflas\_101\_lvl1.C, [1105](#)
  - ffpack-fgesv.C, [1106](#)
  - ffpack-solve.C, [1106](#)
  - fsyrc.C, [773](#)
  - fsytrf.C, [774](#)
  - ftrtri.C, [775](#)
  - lapack.C, [1050](#)
  - matmul.C, [802](#)
  - pluq.C, [776](#)
  - rank.C, [803](#)
  - regression-check.C, [1051](#)
  - solve.C, [803](#)
  - test-charpoly-check.C, [1052](#)
  - test-charpoly.C, [1053](#)
  - test-compressQ.C, [1054](#)
  - test-det-check.C, [1054](#)
  - test-det.C, [1055](#)
  - test-echelon.C, [1057](#)
  - test-fadd.C, [1058](#)
  - test-fdot.C, [1060](#)
  - test-fgemm-check.C, [1061](#)
  - test-fgemm.C, [1063](#)
  - test-fgemv.C, [1065](#)
  - test-fger.C, [1067](#)
  - test-fgesv.C, [1068](#)
  - test-finit.C, [1069](#)
  - test-fscal.C, [1070](#)
  - test-fsyr2k.C, [1072](#)
  - test-fsyrc.C, [1074](#)
  - test-fsytrf.C, [1075](#)
  - test-ftrmm.C, [1076](#)
  - test-ftrmv.C, [1078](#)
  - test-ftrsm-check.C, [1078](#)
  - test-ftrsm.C, [1079](#)
  - test-ftrssyr2k.C, [1081](#)
  - test-ftrstr.C, [1082](#)
  - test-ftsrv.C, [1083](#)
  - test-ftrtri.C, [1084](#)
  - test-interfaces-c.c, [1084](#)
  - test-invert-check.C, [1085](#)



- test-io.C, [1086](#)
- test-lu.C, [1089](#)
- test-maxdelayeddim.C, [1090](#)
- test-minpoly.C, [1091](#)
- test-multifile2.C, [1092](#)
- test-nullspace.C, [1093](#)
- test-permutations.C, [1094](#)
- test-pluq-check.C, [1095](#)
- test-quasisep.C, [1096](#)
- test-rankprofiles.C, [1097](#)
- test-rpm.C, [1098](#)
- test-simd.C, [1101](#)
- test-solve.C, [1102](#)
- test-storage-transpose.C, [1102](#)
- winograd.C, [777](#)
- mainpage.doxy, [802](#)
- mask\_high
  - Simd128\_impl< true, true, false, 8 >, [590](#)
  - Simd128\_impl< true, true, true, 8 >, [617](#)
  - Simd256\_impl< true, true, false, 8 >, [666](#)
  - Simd256\_impl< true, true, true, 8 >, [701](#)
  - Simd512\_impl< true, true, false, 8 >, [719](#)
  - Simd512\_impl< true, true, true, 8 >, [729](#)
- mask\_t
  - read\_sparse.h, [906](#)
- maskstore
  - Simd512\_impl< true, true, false, 8 >, [713](#), [716](#)
  - Simd512\_impl< true, true, true, 8 >, [724](#)
- MatF2MatD\_Triangular
  - FFLAS::Protected, [222](#)
- MatF2MatFI\_Triangular
  - FFLAS::Protected, [222](#)
- MathPerm2LAPACKPerm
  - FFPACK, [303](#)
  - ffpack.C, [985](#)
  - ffpack\_c.h, [1007](#)
- Matio.h, [1046](#)
  - read\_field, [1046](#)
  - write\_field, [1046](#)
- matmul.C, [802](#)
  - main, [802](#)
- matmul.doxy, [837](#)
- Matrix Multiplication Algorithms, [42](#)
- MatrixApplyS
  - FFPACK, [355](#), [356](#)
- MatrixApplyS\_modular\_double
  - ffpack.C, [985](#)
  - ffpack\_c.h, [1007](#)
- MatrixApplyT
  - FFPACK, [357](#)
- MatrixApplyT\_modular\_double
  - ffpack.C, [986](#)
  - ffpack\_c.h, [1007](#)
- MatVecMinPoly
  - FFPACK, [324](#), [368](#)
  - FFPACK::Protected, [393](#)
- max
  - HelperMod< Field, ElementCategories::MachineIntTag >, [478](#)
  - HelperMod< Field, FFLAS::ElementCategories::MachineFloatTag >, [480](#)
  - limits< char >, [491](#)
  - limits< double >, [492](#)
  - limits< float >, [492](#)
  - limits< Givaro::Integer >, [493](#)
  - limits< int >, [494](#)
  - limits< long >, [494](#)
  - limits< long long >, [495](#)
  - limits< Reclnt::rint< K > >, [495](#)
  - limits< Reclnt::ruint< K > >, [496](#)
  - limits< short int >, [497](#)
  - limits< signed char >, [497](#)
  - limits< unsigned char >, [498](#)
  - limits< unsigned int >, [499](#)
  - limits< unsigned long >, [499](#)
  - limits< unsigned long long >, [500](#)
  - limits< unsigned short int >, [500](#)
- max3
  - FFLAS, [77](#)
- max4
  - FFLAS, [77](#)
- MAX\_THREADS
  - parallel.h, [1031](#)
- MAX\_WITH\_SIZE\_T
  - test-maxdelayeddim.C, [1090](#)
- maxCardinality
  - FFLAS, [154](#)
- maxCardinality< Givaro::Modular< int32\_t > >
  - FFLAS, [154](#)
- maxCardinality< Givaro::Modular< int64\_t > >
  - FFLAS, [154](#)
- maxCol
  - StatsMatrix, [753](#)
- maxColDifference
  - StatsMatrix, [754](#)
- MaxDelayedDim
  - MMHelper< Field, AlgoTrait, ModeTrait, ParSeq-Trait >, [503](#)
- maxElement
  - RNSIntegerMod< RNS >, [545](#)
- maxpy
  - FieldSimd< \_Field >, [452](#)
- maxpyin
  - FieldSimd< \_Field >, [452](#)
- maxRow
  - StatsMatrix, [753](#)
- maxrow
  - Sparse< \_Field, SparseMatrix\_t::COO >, [734](#)
  - Sparse< \_Field, SparseMatrix\_t::COO\_ZO >, [735](#)
  - Sparse< \_Field, SparseMatrix\_t::CSR >, [737](#)
  - Sparse< \_Field, SparseMatrix\_t::CSR\_HYB >, [738](#)
  - Sparse< \_Field, SparseMatrix\_t::CSR\_ZO >, [740](#)
  - Sparse< \_Field, SparseMatrix\_t::ELL >, [742](#)
  - Sparse< \_Field, SparseMatrix\_t::ELL\_simd >, [743](#)

- Sparse< \_Field, SparseMatrix\_t::ELL\_simd\_ZO >, 745
- Sparse< \_Field, SparseMatrix\_t::ELL\_ZO >, 747
- Sparse< \_Field, SparseMatrix\_t::SELL >, 748
- Sparse< \_Field, SparseMatrix\_t::SELL\_ZO >, 751
- maxRowDifference
  - StatsMatrix, 754
- MaxStorableValue
  - MMHelper< Field, AlgoTrait, ModeTrait, ParSeqTrait >, 506
- MG\_DEFAULT
  - benchmark-fgemm-mp.C, 785
  - benchmark-fgemv-mp.C, 788
- min
  - HelperMod< Field, ElementCategories::MachineIntTag >, 478
  - HelperMod< Field, FFLAS::ElementCategories::MachineIntTag >, 480
  - limits< char >, 491
  - limits< double >, 492
  - limits< float >, 492
  - limits< Givaro::Integer >, 493
  - limits< int >, 494
  - limits< long >, 494
  - limits< long long >, 495
  - limits< Reclnt::rint< K > >, 495
  - limits< Reclnt::ruint< K > >, 496
  - limits< short int >, 497
  - limits< signed char >, 497
  - limits< unsigned char >, 498
  - limits< unsigned int >, 499
  - limits< unsigned long >, 499
  - limits< unsigned long long >, 500
  - limits< unsigned short int >, 500
- min3
  - FFLAS, 76
- min4
  - FFLAS, 77
- min\_types
  - FFLAS::Protected, 219, 220
- minCardinality
  - FFLAS, 154
- minCol
  - StatsMatrix, 753
- minColDifference
  - StatsMatrix, 754
- minElement
  - RNSIntegerMod< RNS >, 545
- MinPoly
  - FFPACK, 323, 368
- minRow
  - StatsMatrix, 753
- minRowDifference
  - StatsMatrix, 754
- MKL\_CONFIG, 396
- MKLSparseMatrixFormat
  - FFLAS, 72
- MMHelper< Field, AlgoTrait, ModeTrait, ParSeqTrait >, 502, 503
- MMHelper< Field, AlgoTrait, ModeTrait, ParSeqTrait >, 501
  - Amax, 505
  - Amin, 505
  - Aunfit, 504
  - Bmax, 505
  - Bmin, 505
  - Bunfit, 504
  - checkA, 504
  - checkB, 504
  - checkOut, 504
  - Cmax, 505
  - Cmin, 505
  - DelayedField, 502
  - DelayedField, 506
  - DelayedField\_t, 502
  - DFelt, 502
  - FieldMax, 505
  - FieldMin, 505
  - initA, 503
  - initB, 503
  - initC, 503
  - initOut, 503
  - MaxDelayedDim, 503
  - MaxStorableValue, 506
  - MMHelper, 502, 503
  - operator<<, 505
  - Outmax, 506
  - Outmin, 506
  - parseq, 506
  - recLevel, 505
  - Self\_t, 502
  - setOutBounds, 504
- mod
  - FieldSimd< \_Field >, 450
  - Simd128\_impl< true, true, false, 2 >, 570
  - Simd128\_impl< true, true, false, 4 >, 580
  - Simd128\_impl< true, true, false, 8 >, 590
  - Simd128\_impl< true, true, true, 2 >, 599
  - Simd128\_impl< true, true, true, 4 >, 608
  - Simd128\_impl< true, true, true, 8 >, 617
  - Simd256\_impl< true, false, true, 8 >, 628
  - Simd256\_impl< true, true, false, 2 >, 638
  - Simd256\_impl< true, true, false, 4 >, 655, 656
  - Simd256\_impl< true, true, false, 8 >, 666
  - Simd256\_impl< true, true, true, 2 >, 675
  - Simd256\_impl< true, true, true, 4 >, 685, 692
  - Simd256\_impl< true, true, true, 8 >, 701
  - Simd512\_impl< true, true, false, 8 >, 719
  - Simd512\_impl< true, true, true, 8 >, 729
- MODE
  - parallel.h, 1033
- ModeTraits< Field >, 506
  - value, 506
- ModeTraits< Givaro::Modular< Element, Compute > >, 507



- value, [507](#)
- ModeTraits< Givaro::Modular< Givaro::Integer, Compute > >, [507](#)
  - value, [507](#)
- ModeTraits< Givaro::Modular< int16\_t, Compute > >, [507](#)
  - value, [508](#)
- ModeTraits< Givaro::Modular< int32\_t, Compute > >, [508](#)
  - value, [508](#)
- ModeTraits< Givaro::Modular< int64\_t, uint64\_t > >, [508](#)
  - value, [508](#)
- ModeTraits< Givaro::Modular< int8\_t, Compute > >, [509](#)
  - value, [509](#)
- ModeTraits< Givaro::Modular< ReclInt::ruint< K >, Compute > >, [509](#)
  - value, [509](#)
- ModeTraits< Givaro::Modular< uint16\_t, Compute > >, [509](#)
  - value, [510](#)
- ModeTraits< Givaro::Modular< uint32\_t, Compute > >, [510](#)
  - value, [510](#)
- ModeTraits< Givaro::Modular< uint8\_t, Compute > >, [510](#)
  - value, [510](#)
- ModeTraits< Givaro::ModularBalanced< Element > >, [511](#)
  - value, [511](#)
- ModeTraits< Givaro::ModularBalanced< Givaro::Integer > >, [511](#)
  - value, [511](#)
- ModeTraits< Givaro::ModularBalanced< int16\_t > >, [511](#)
  - value, [512](#)
- ModeTraits< Givaro::ModularBalanced< int32\_t > >, [512](#)
  - value, [512](#)
- ModeTraits< Givaro::ModularBalanced< int8\_t > >, [512](#)
  - value, [512](#)
- ModeTraits< Givaro::Montgomery< T > >, [513](#)
  - value, [513](#)
- ModeTraits< Givaro::ZRing< double > >, [513](#)
  - value, [513](#)
- ModeTraits< Givaro::ZRing< float > >, [513](#)
  - value, [513](#)
- ModeTraits< Givaro::ZRing< Givaro::Integer > >, [514](#)
  - value, [514](#)
- ModField
  - rns\_double, [524](#)
  - rns\_double\_extended, [535](#)
  - RNSIntegerMod< RNS >, [544](#)
- modp
  - FFLAS::vectorised, [282](#)
  - FFLAS::vectorised::unswitch, [284](#), [285](#)
- ModularBalanced< T >, [514](#)
- ModularTag, [514](#)
- mOne
  - RNSInteger< RNS >, [542](#)
  - RNSIntegerMod< RNS >, [548](#)
- mone
  - FFLAS, [76](#)
- MonotonicApplyP
  - FFPACK, [305](#)
- MonotonicCompress
  - FFPACK, [354](#)
- MonotonicCompressCycles
  - FFPACK, [354](#)
- MonotonicCompressMorePivots
  - FFPACK, [354](#)
- MonotonicExpand
  - FFPACK, [355](#)
- Montgomery< T >, [514](#)
- mul
  - FieldSimd< \_Field >, [450](#), [451](#)
  - RNSIntegerMod< RNS >, [546](#)
  - ScalFunctions< Element >, [552](#)
  - Simd128\_impl< true, true, false, 2 >, [569](#)
  - Simd128\_impl< true, true, false, 4 >, [579](#)
  - Simd128\_impl< true, true, false, 8 >, [589](#)
  - Simd128\_impl< true, true, true, 2 >, [597](#)
  - Simd128\_impl< true, true, true, 4 >, [606](#)
  - Simd128\_impl< true, true, true, 8 >, [615](#)
  - Simd256\_impl< true, false, true, 8 >, [625](#)
  - Simd256\_impl< true, true, false, 2 >, [637](#)
  - Simd256\_impl< true, true, false, 4 >, [653](#)
  - Simd256\_impl< true, true, false, 8 >, [665](#)
  - Simd256\_impl< true, true, true, 2 >, [672](#)
  - Simd256\_impl< true, true, true, 4 >, [683](#), [689](#)
  - Simd256\_impl< true, true, true, 8 >, [698](#)
  - Simd512\_impl< true, false, true, 8 >, [707](#)
  - Simd512\_impl< true, true, false, 8 >, [718](#)
  - Simd512\_impl< true, true, true, 8 >, [726](#)
- mul\_r
  - FieldSimd< \_Field >, [451](#)
- mulhi
  - ScalFunctionsBase< Element, typename enable\_if< is\_integral< Element >::value >::type >, [558](#)
  - Simd128\_impl< true, true, false, 2 >, [565](#)
  - Simd128\_impl< true, true, false, 4 >, [575](#)
  - Simd128\_impl< true, true, false, 8 >, [585](#)
  - Simd128\_impl< true, true, true, 2 >, [597](#)
  - Simd128\_impl< true, true, true, 4 >, [606](#)
  - Simd128\_impl< true, true, true, 8 >, [615](#)
  - Simd256\_impl< true, true, false, 2 >, [632](#)
  - Simd256\_impl< true, true, false, 4 >, [644](#), [646](#)
  - Simd256\_impl< true, true, false, 8 >, [661](#)
  - Simd256\_impl< true, true, true, 2 >, [673](#)
  - Simd256\_impl< true, true, true, 4 >, [683](#), [689](#)
  - Simd256\_impl< true, true, true, 8 >, [698](#)
  - Simd512\_impl< true, true, false, 8 >, [714](#)
  - Simd512\_impl< true, true, true, 8 >, [726](#)
- mulhi\_fast

- Simd128\_impl< true, true, false, 8 >, [590](#)
- Simd128\_impl< true, true, true, 8 >, [617](#)
- Simd256\_impl< true, true, false, 8 >, [666](#)
- Simd256\_impl< true, true, true, 8 >, [701](#)
- Simd512\_impl< true, true, false, 8 >, [719](#)
- Simd512\_impl< true, true, true, 8 >, [729](#)
- mulin
  - FieldSimd< \_Field >, [451](#)
  - ScalFunctions< Element >, [553](#)
  - Simd256\_impl< true, false, true, 8 >, [625](#)
  - Simd512\_impl< true, false, true, 8 >, [707](#)
- mullo
  - ScalFunctionsBase< Element, typename enable\_if<
    - is\_integral< Element >::value >::type >, [558](#)
 >
    - Simd128\_impl< true, true, false, 2 >, [569](#)
    - Simd128\_impl< true, true, false, 4 >, [579](#)
    - Simd128\_impl< true, true, false, 8 >, [585](#)
    - Simd128\_impl< true, true, true, 2 >, [597](#)
    - Simd128\_impl< true, true, true, 4 >, [606](#)
    - Simd128\_impl< true, true, true, 8 >, [615](#)
    - Simd256\_impl< true, true, false, 2 >, [637](#)
    - Simd256\_impl< true, true, false, 4 >, [653](#)
    - Simd256\_impl< true, true, false, 8 >, [661](#)
    - Simd256\_impl< true, true, true, 2 >, [672](#)
    - Simd256\_impl< true, true, true, 4 >, [683](#), [689](#)
    - Simd256\_impl< true, true, true, 8 >, [698](#)
    - Simd512\_impl< true, true, false, 8 >, [714](#)
    - Simd512\_impl< true, true, true, 8 >, [726](#)
- mulx
  - ScalFunctionsBase< Element, typename enable\_if<
    - is\_integral< Element >::value >::type >, [558](#)
 >
    - Simd128\_impl< true, true, false, 2 >, [565](#)
    - Simd128\_impl< true, true, false, 4 >, [575](#)
    - Simd128\_impl< true, true, false, 8 >, [585](#)
    - Simd128\_impl< true, true, true, 2 >, [597](#)
    - Simd128\_impl< true, true, true, 4 >, [606](#)
    - Simd128\_impl< true, true, true, 8 >, [615](#)
    - Simd256\_impl< true, true, false, 2 >, [632](#)
    - Simd256\_impl< true, true, false, 4 >, [644](#), [647](#)
    - Simd256\_impl< true, true, false, 8 >, [661](#)
    - Simd256\_impl< true, true, true, 2 >, [673](#)
    - Simd256\_impl< true, true, true, 4 >, [683](#), [689](#)
    - Simd256\_impl< true, true, true, 8 >, [699](#)
    - Simd512\_impl< true, true, false, 8 >, [714](#)
    - Simd512\_impl< true, true, true, 8 >, [726](#)
- mvcnt
  - test-lu.C, [1090](#)
- n
  - Bench< Elt >, [406](#)
  - count\_nonconst\_lvalue\_reference< const T &, O... >, [435](#)
  - count\_nonconst\_lvalue\_reference< T &, O... >, [435](#)
  - count\_nonconst\_lvalue\_reference< T, O... >, [435](#)
  - count\_nonconst\_lvalue\_reference<>, [436](#)
  - Sparse< \_Field, SparseMatrix\_t::COO >, [733](#)
  - Sparse< \_Field, SparseMatrix\_t::COO\_ZO >, [735](#)
  - Sparse< \_Field, SparseMatrix\_t::CSR >, [736](#)
  - Sparse< \_Field, SparseMatrix\_t::CSR\_HYB >, [738](#)
  - Sparse< \_Field, SparseMatrix\_t::CSR\_ZO >, [740](#)
  - Sparse< \_Field, SparseMatrix\_t::ELL >, [742](#)
  - Sparse< \_Field, SparseMatrix\_t::ELL\_simd >, [743](#)
  - Sparse< \_Field, SparseMatrix\_t::ELL\_simd\_ZO >, [745](#)
  - Sparse< \_Field, SparseMatrix\_t::ELL\_ZO >, [747](#)
  - Sparse< \_Field, SparseMatrix\_t::SELL >, [749](#)
  - Sparse< \_Field, SparseMatrix\_t::SELL\_ZO >, [751](#)
- name
  - TestOneMethod< Simd >, [762](#)
- nChunks
  - Sparse< \_Field, SparseMatrix\_t::ELL\_simd >, [744](#)
  - Sparse< \_Field, SparseMatrix\_t::ELL\_simd\_ZO >, [745](#)
  - Sparse< \_Field, SparseMatrix\_t::SELL >, [749](#)
  - Sparse< \_Field, SparseMatrix\_t::SELL\_ZO >, [751](#)
- nDenseCols
  - StatsMatrix, [754](#)
- nDenseRows
  - StatsMatrix, [754](#)
- need\_field\_characteristic< Field >, [515](#)
- need\_field\_characteristic< Givaro::Modular< Field > >, [515](#)
- need\_field\_characteristic< Givaro::ModularBalanced< Field > >, [515](#)
- NeedDoublePreAddReduction
  - FFLAS::Protected, [214](#)
- NeedPreAddReduction
  - FFLAS::Protected, [213](#)
- NeedPreAxyReduction
  - FFLAS::Protected, [219](#)
- NeedPreScalReduction
  - FFLAS::Protected, [218](#), [219](#)
- NeedPreSubReduction
  - FFLAS::Protected, [213](#)
- neg
  - RNSIntegerMod< RNS >, [546](#)
- nElements
  - Sparse< \_Field, SparseMatrix\_t::COO >, [734](#)
  - Sparse< \_Field, SparseMatrix\_t::COO\_ZO >, [735](#)
  - Sparse< \_Field, SparseMatrix\_t::CSR >, [737](#)
  - Sparse< \_Field, SparseMatrix\_t::CSR\_HYB >, [738](#)
  - Sparse< \_Field, SparseMatrix\_t::CSR\_ZO >, [740](#)
  - Sparse< \_Field, SparseMatrix\_t::ELL >, [742](#)
  - Sparse< \_Field, SparseMatrix\_t::ELL\_simd >, [743](#)
  - Sparse< \_Field, SparseMatrix\_t::ELL\_simd\_ZO >, [745](#)
  - Sparse< \_Field, SparseMatrix\_t::ELL\_ZO >, [747](#)
  - Sparse< \_Field, SparseMatrix\_t::SELL >, [749](#)
  - Sparse< \_Field, SparseMatrix\_t::SELL\_ZO >, [751](#)

- nEmptyCols
  - StatsMatrix, [754](#)
- nEmptyColsEnd
  - StatsMatrix, [754](#)
- nEmptyRows
  - StatsMatrix, [754](#)
- newD
  - FFPACK::Protected, [394](#)
- NEWWINO
  - fgemm\_winograd.inl, [836](#)
- nMOnes
  - Sparse< \_Field, SparseMatrix\_t::CSR\_HYB >, [739](#)
  - StatsMatrix, [753](#)
- nnz
  - Sparse< \_Field, SparseMatrix\_t::COO >, [733](#)
  - Sparse< \_Field, SparseMatrix\_t::COO\_ZO >, [735](#)
  - Sparse< \_Field, SparseMatrix\_t::CSR >, [736](#)
  - Sparse< \_Field, SparseMatrix\_t::CSR\_HYB >, [738](#)
  - Sparse< \_Field, SparseMatrix\_t::CSR\_ZO >, [740](#)
  - Sparse< \_Field, SparseMatrix\_t::ELL >, [742](#)
  - Sparse< \_Field, SparseMatrix\_t::ELL\_simd >, [743](#)
  - Sparse< \_Field, SparseMatrix\_t::ELL\_simd\_ZO >, [745](#)
  - Sparse< \_Field, SparseMatrix\_t::ELL\_ZO >, [747](#)
  - Sparse< \_Field, SparseMatrix\_t::SELL >, [749](#)
  - Sparse< \_Field, SparseMatrix\_t::SELL\_ZO >, [751](#)
  - StatsMatrix, [753](#)
- none
  - HelperFlag, [477](#)
- nOnes
  - Sparse< \_Field, SparseMatrix\_t::CSR\_HYB >, [739](#)
  - StatsMatrix, [753](#)
- nonsquare\_inplace\_v1
  - FFLAS::\_ftranspose\_impl, [190](#)
- nonsquare\_inplace\_v2
  - FFLAS::\_ftranspose\_impl, [190](#)
- NonZeroRandomMatrix
  - FFPACK, [375](#), [376](#)
- NORML\_MOD
  - fflas\_simd.h, [870](#)
- NoSimd< T >, [516](#)
  - aligned\_allocator, [516](#)
  - aligned\_vector, [516](#)
  - alignment, [517](#)
  - compliant, [517](#)
  - is\_same\_element, [516](#)
  - scalar\_t, [516](#)
  - type\_string, [516](#)
  - valid, [516](#)
  - vect\_size, [517](#)
  - vect\_t, [516](#)
- NoSimdSparseMatrix
  - FFLAS, [72](#)
- NOSPLIT
  - parallel.h, [1035](#)
- not\_inplace
  - FFLAS::\_ftranspose\_impl, [190](#)
- nOthers
  - Sparse< \_Field, SparseMatrix\_t::CSR\_HYB >, [739](#)
  - StatsMatrix, [753](#)
- NotMKLSparseMatrixFormat
  - FFLAS, [72](#)
- NotZOSparseMatrix
  - FFLAS, [72](#)
- NullSpaceBasis
  - FFPACK, [328](#), [371](#)
- NullSpaceBasis\_modular\_double
  - ffpack.C, [998](#)
  - ffpack\_c.h, [1017](#)
- NUM\_THREADS
  - parallel.h, [1031](#)
- NUMARGS
  - parallel.h, [1034](#)
- number\_kind
  - FFLAS, [75](#)
- numBlock
  - ForStrategy1D< blocksize\_t, Cut, Param >, [466](#)
- numblocks
  - ForStrategy1D< blocksize\_t, Cut, Param >, [465](#)
- numColBlock
  - ForStrategy2D< blocksize\_t, Cut, Param >, [469](#)
- numRowBlock
  - ForStrategy2D< blocksize\_t, Cut, Param >, [469](#)
- numthreads
  - Parallel< C, P >, [518](#)
  - Sequential, [560](#)
- one
  - FFLAS, [76](#)
  - RNSInteger< RNS >, [542](#)
  - RNSIntegerMod< RNS >, [548](#)
- OPENBLAS\_NUM\_THREADS
  - config.h, [817](#)
- operator!=
  - rns\_double\_elt\_cstptr, [531](#)
  - rns\_double\_elt\_ptr, [534](#)
- operator<
  - rns\_double\_elt\_cstptr, [531](#)
  - rns\_double\_elt\_ptr, [534](#)
- operator<<
  - Compose< H1, H2 >, [423](#)
  - FFLAS, [151](#)
  - ForStrategy2D< blocksize\_t, Cut, Param >, [468](#)
  - MMHelper< Field, AlgoTrait, ModeTrait, ParSeqTrait >, [505](#)
  - Parallel< C, P >, [518](#)
  - Sequential, [560](#)
  - test-fsytrf.C, [1075](#)
  - test-simd.C, [1101](#)
- operator()
  - callLUdivine\_small< double >, [409](#)
  - callLUdivine\_small< Element >, [408](#)
  - callLUdivine\_small< float >, [410](#)

- Failure, [445](#)
- readMyMachineType< Field, mpz\_t >, [522](#)
- readMyMachineType< Field, T >, [521](#)
- RNSInteger< RNS >::RandIter, [519](#)
- RNSIntegerMod< RNS >::RandIter, [520](#)
- rnsRandIter< RNS >, [549](#), [550](#)
- ScalFunctionsBase< Element, typename enable\_if< is\_floating\_point< Element >::value >::type >::FloatingPointTestDistribution, [463](#)
- tfn\_minus, [763](#)
- tfn\_minus\_eq, [763](#)
- tfn\_mul, [764](#)
- tfn\_mul\_eq, [764](#)
- tfn\_plus, [764](#)
- tfn\_plus\_eq, [765](#)
- operator+
  - rns\_double\_elt\_cstptr, [531](#)
  - rns\_double\_elt\_ptr, [533](#)
- operator++
  - ForStrategy1D< blocksize\_t, Cut, Param >, [465](#)
  - ForStrategy2D< blocksize\_t, Cut, Param >, [467](#)
  - rns\_double\_elt\_cstptr, [531](#)
  - rns\_double\_elt\_ptr, [533](#)
- operator+=
  - rns\_double\_elt\_cstptr, [531](#)
  - rns\_double\_elt\_ptr, [534](#)
- operator-
  - rns\_double\_elt\_cstptr, [531](#)
  - rns\_double\_elt\_ptr, [534](#)
- operator--
  - rns\_double\_elt\_cstptr, [531](#)
  - rns\_double\_elt\_ptr, [533](#)
- operator-=
  - rns\_double\_elt\_cstptr, [531](#)
  - rns\_double\_elt\_ptr, [534](#)
- operator=
  - Coo< Field >, [432](#)
  - Coo< ValT, IdxT >, [430](#), [433](#)
  - FieldSimd< \_Field >, [448](#)
  - Info, [481](#), [483](#)
  - rns\_double\_elt\_cstptr, [531](#)
  - rns\_double\_elt\_ptr, [534](#)
- operator&
  - rns\_double\_elt, [529](#)
  - rns\_double\_elt\_cstptr, [530](#), [531](#)
  - rns\_double\_elt\_ptr, [533](#), [534](#)
- operator[]
  - rns\_double\_elt\_cstptr, [530](#), [531](#)
  - rns\_double\_elt\_ptr, [533](#)
- operator\*
  - rns\_double\_elt\_cstptr, [530](#)
  - rns\_double\_elt\_ptr, [533](#)
- other
  - FFLAS, [76](#)
  - rns\_double\_elt\_cstptr, [532](#)
  - rns\_double\_elt\_ptr, [534](#)
- Outmax
  - MMHelper< Field, AlgoTrait, ModeTrait, ParSeq-Trait >, [506](#)
- Outmin
  - MMHelper< Field, AlgoTrait, ModeTrait, ParSeq-Trait >, [506](#)
- outputs\_scalar
  - TestOneMethod< Simd >, [763](#)
- outputs\_simd
  - TestOneMethod< Simd >, [762](#)
- p
  - HelperMod< Field, ElementCategories::MachineIntTag >, [478](#)
  - HelperMod< Field, FFLAS::ElementCategories::ArbitraryPrecIntTag >, [479](#)
  - HelperMod< Field, FFLAS::ElementCategories::FixedPrecIntTag >, [480](#)
  - HelperMod< Field, FFLAS::ElementCategories::MachineFloatTag >, [480](#)
- pack
  - ScalFunctions< Element >, [555](#)
  - Simd128\_impl< true, true, false, 2 >, [568](#)
  - Simd128\_impl< true, true, false, 4 >, [578](#)
  - Simd128\_impl< true, true, false, 8 >, [588](#)
  - Simd128\_impl< true, true, true, 2 >, [596](#)
  - Simd128\_impl< true, true, true, 4 >, [605](#)
  - Simd128\_impl< true, true, true, 8 >, [614](#)
  - Simd256\_impl< true, false, true, 8 >, [624](#)
  - Simd256\_impl< true, true, false, 2 >, [635](#)
  - Simd256\_impl< true, true, false, 4 >, [651](#)
  - Simd256\_impl< true, true, false, 8 >, [664](#)
  - Simd256\_impl< true, true, true, 2 >, [671](#)
  - Simd256\_impl< true, true, true, 4 >, [682](#), [688](#)
  - Simd256\_impl< true, true, true, 8 >, [697](#)
  - Simd512\_impl< true, false, true, 8 >, [706](#)
  - Simd512\_impl< true, true, false, 8 >, [717](#)
  - Simd512\_impl< true, true, true, 8 >, [725](#)
- pack\_even
  - ScalFunctions< Element >, [555](#)
  - Simd128\_impl< true, true, false, 2 >, [568](#)
  - Simd128\_impl< true, true, false, 4 >, [578](#)
  - Simd128\_impl< true, true, false, 8 >, [588](#)
  - Simd128\_impl< true, true, true, 2 >, [596](#)
  - Simd128\_impl< true, true, true, 4 >, [605](#)
  - Simd128\_impl< true, true, true, 8 >, [614](#)
  - Simd256\_impl< true, false, true, 8 >, [624](#)
  - Simd256\_impl< true, true, false, 2 >, [635](#)
  - Simd256\_impl< true, true, false, 4 >, [651](#)
  - Simd256\_impl< true, true, false, 8 >, [664](#)
  - Simd256\_impl< true, true, true, 2 >, [671](#)
  - Simd256\_impl< true, true, true, 4 >, [682](#), [688](#)
  - Simd256\_impl< true, true, true, 8 >, [697](#)
  - Simd512\_impl< true, false, true, 8 >, [706](#)
  - Simd512\_impl< true, true, false, 8 >, [717](#)
  - Simd512\_impl< true, true, true, 8 >, [725](#)
- pack\_lhs
  - FFLAS::details, [205](#)
- pack\_odd
  - ScalFunctions< Element >, [555](#)

- Simd128\_impl< true, true, false, 2 >, [568](#)
- Simd128\_impl< true, true, false, 4 >, [578](#)
- Simd128\_impl< true, true, false, 8 >, [588](#)
- Simd128\_impl< true, true, true, 2 >, [596](#)
- Simd128\_impl< true, true, true, 4 >, [605](#)
- Simd128\_impl< true, true, true, 8 >, [614](#)
- Simd256\_impl< true, false, true, 8 >, [624](#)
- Simd256\_impl< true, true, false, 2 >, [635](#)
- Simd256\_impl< true, true, false, 4 >, [651](#)
- Simd256\_impl< true, true, false, 8 >, [664](#)
- Simd256\_impl< true, true, true, 2 >, [671](#)
- Simd256\_impl< true, true, true, 4 >, [682](#), [688](#)
- Simd256\_impl< true, true, true, 8 >, [697](#)
- Simd512\_impl< true, false, true, 8 >, [706](#)
- Simd512\_impl< true, true, false, 8 >, [717](#)
- Simd512\_impl< true, true, true, 8 >, [725](#)
- pack\_rhs
  - FFLAS::details, [205](#)
- PACKAGE
  - config.h, [817](#)
- PACKAGE\_BUGREPORT
  - config.h, [817](#)
- PACKAGE\_NAME
  - config.h, [817](#)
- PACKAGE\_STRING
  - config.h, [817](#)
- PACKAGE\_TARNAME
  - config.h, [817](#)
- PACKAGE\_URL
  - config.h, [817](#)
- PACKAGE\_VERSION
  - config.h, [817](#)
- PAR\_BLOCK
  - parallel.h, [1031](#)
- Parallel
  - Parallel< C, P >, [518](#)
- Parallel< C, P >, [517](#)
  - Cut, [517](#)
  - numthreads, [518](#)
  - operator<<, [518](#)
  - Parallel, [518](#)
  - Param, [517](#)
  - set\_numthreads, [518](#)
- parallel.h, [1029](#)
  - \_\_FFLASFFPACK\_SEQUENTIAL, [1030](#)
  - BARRIER, [1030](#)
  - BEGIN\_PARALLEL\_MAIN, [1031](#)
  - CHECK\_DEPENDENCIES, [1030](#)
  - COMMA, [1033](#)
  - CONSTREFERENCE, [1031](#)
  - END\_PARALLEL\_MAIN, [1032](#)
  - FOR1D, [1032](#)
  - FOR2D, [1033](#)
  - FORBLOCK1D, [1032](#)
  - FORBLOCK2D, [1032](#)
  - index\_t, [1030](#)
  - MAX\_THREADS, [1031](#)
  - MODE, [1033](#)
  - NOSPLIT, [1035](#)
  - NUM\_THREADS, [1031](#)
  - NUMARGS, [1034](#)
  - PAR\_BLOCK, [1031](#)
  - PARFOR1D, [1032](#)
  - PARFOR2D, [1033](#)
  - PARFORBLOCK1D, [1032](#)
  - PARFORBLOCK2D, [1033](#)
  - PP\_ARG\_N, [1034](#)
  - PP\_NARG\_, [1034](#)
  - PP\_RSEQ\_N, [1035](#)
  - READ, [1031](#)
  - READWRITE, [1031](#)
  - RETURNPARAM, [1033](#)
  - SET\_THREADS, [1031](#)
  - splitt, [1036](#)
  - SPLITTER, [1036](#)
  - splitting\_0, [1035](#)
  - splitting\_1, [1035](#)
  - splitting\_2, [1036](#)
  - splitting\_3, [1036](#)
  - SYNCH\_GROUP, [1031](#)
  - TASK, [1030](#)
  - THREAD\_INDEX, [1031](#)
  - VALUE, [1031](#)
  - WAIT, [1030](#)
  - WRITE, [1031](#)
- Param
  - Parallel< C, P >, [517](#)
- PARFOR1D
  - parallel.h, [1032](#)
- PARFOR2D
  - parallel.h, [1033](#)
- PARFORBLOCK1D
  - parallel.h, [1032](#)
- PARFORBLOCK2D
  - parallel.h, [1033](#)
- parseArguments
  - FFLAS, [185](#)
- parseq
  - MMHelper< Field, AlgoTrait, ModeTrait, ParSeqTrait >, [506](#)
  - TRSMHelper< ReclterTrait, ParSeqTrait >, [767](#)
- PBASECASE\_K
  - ffpack\_ppluq.inl, [940](#)
- pColumnEchelonForm
  - FFPACK, [316](#)
- pColumnEchelonForm\_modular\_double
  - ffpack.C, [992](#)
- pColumnEchelonForm\_modular\_float
  - ffpack.C, [993](#)
- pColumnEchelonForm\_modular\_int32\_t
  - ffpack.C, [994](#)
- pColumnRankProfile
  - FFPACK, [331](#)
- pDet
  - FFPACK, [326](#)
- perm

- Info, [482](#), [483](#)
- Sparse<\_Field, SparseMatrix\_t::SELL >, [749](#)
- Sparse<\_Field, SparseMatrix\_t::SELL\_ZO >, [751](#)
- PermApplyS
  - FFPACK, [356](#)
- PermApplyS\_double
  - ffpack.C, [986](#)
  - ffpack\_c.h, [1007](#)
- PermApplyT
  - FFPACK, [358](#)
- PermApplyT\_double
  - ffpack.C, [986](#)
  - ffpack\_c.h, [1008](#)
- pfadd
  - FFLAS, [78](#)
- pfaddin
  - FFLAS, [79](#)
- pfgemm
  - FFLAS, [142](#), [182–184](#)
- pfgemm\_1D\_rec
  - FFLAS, [142](#)
- pfgemm\_2D\_rec
  - FFLAS, [143](#)
- pfgemm\_3D\_rec
  - FFLAS, [143](#)
- pfgemm\_3D\_rec2
  - FFLAS, [144](#)
- pfgemm\_variants.inl, [1036](#)
- pfgemv.inl, [1037](#)
- pftrand
  - FFLAS, [181](#)
- pfreduce
  - FFLAS, [109](#)
- pfspmm
  - FFLAS::sparse\_details, [232–234](#)
  - FFLAS::sparse\_details\_impl, [249](#), [256](#), [257](#), [259–261](#), [271](#)
- pfspmm\_dispatch
  - FFLAS::sparse\_details, [231](#), [232](#)
- pfspmm\_mone
  - FFLAS::sparse\_details\_impl, [250](#)
- pfspmm\_one
  - FFLAS::sparse\_details\_impl, [250](#)
- pfspmm\_zo
  - FFLAS::sparse\_details\_impl, [261](#)
- pfspmv
  - FFLAS::sparse\_details, [234](#), [235](#)
  - FFLAS::sparse\_details\_impl, [251](#), [258](#), [261](#), [262](#), [267](#), [271–274](#)
- pfspmv\_mone
  - FFLAS::sparse\_details\_impl, [252](#), [262](#), [263](#), [268](#), [274](#)
- pfspmv\_one
  - FFLAS::sparse\_details\_impl, [251](#), [252](#), [262](#), [268](#), [274](#)
- pfspmv\_task
  - FFLAS::sparse\_details\_impl, [251](#)
- pfsub
  - FFLAS, [79](#)
- pfsubin
  - FFLAS, [79](#)
- pfzero
  - FFLAS, [181](#)
- PLUQ
  - FFPACK, [313](#), [314](#), [361](#), [362](#), [365](#)
- pluq.C, [775](#), [776](#)
- CUBE, [775](#)
- GFOPS, [775](#)
- main, [776](#)
- PLUQ\_basecaseCROUT
  - FFPACK, [360](#)
- PLUQ\_basecaseV2
  - FFPACK, [360](#)
- PLUQ\_basecaseV3
  - FFPACK, [360](#)
- PLUQ\_modular\_double
  - ffpack.C, [989](#)
  - ffpack\_c.h, [1011](#)
- PLUQtoEchelonPermutation
  - FFPACK, [340](#)
  - ffpack.C, [1002](#)
  - ffpack\_c.h, [1021](#)
- pm1
  - HelperFlag, [477](#)
- pMMH
  - TRSMHelper< ReclterTrait, ParSeqTrait >, [766](#)
- pow50rem
  - HelperMod< Field, ElementCategories::MachineIntTag >, [478](#)
- PP\_ARG\_N
  - parallel.h, [1034](#)
- PP\_NARG\_
  - parallel.h, [1034](#)
- PP\_RSEQ\_N
  - parallel.h, [1035](#)
- pPLUQ
  - FFPACK, [313](#)
- pRank
  - FFPACK, [325](#)
- preamble
  - FFLAS, [186](#)
- precompute\_cst
  - rns\_double, [525](#)
  - rns\_double\_extended, [536](#)
- pReducedColumnEchelonForm
  - FFPACK, [318](#)
- pReducedColumnEchelonForm\_modular\_double
  - ffpack.C, [993](#)
- pReducedColumnEchelonForm\_modular\_float
  - ffpack.C, [994](#)
- pReducedColumnEchelonForm\_modular\_int32\_t
  - ffpack.C, [995](#)
- pReducedRowEchelonForm
  - FFPACK, [319](#)
- pReducedRowEchelonForm\_modular\_double
  - ffpack.C, [993](#)



- pReducedRowEchelonForm\_modular\_float
  - ffpack.C, [994](#)
- pReducedRowEchelonForm\_modular\_int32\_t
  - ffpack.C, [995](#)
- prefetch
  - FFLAS, [189](#)
- print
  - Failure, [445](#)
- printHelpMessage
  - args-parser.h, [1039](#)
- printPolynomial
  - test-charpoly-check.C, [1052](#)
- printvect
  - test-compressQ.C, [1053](#)
- productBruhatxTS
  - FFPACK, [344](#), [347](#)
- pRowEchelonForm
  - FFPACK, [317](#)
- pRowEchelonForm\_modular\_double
  - ffpack.C, [993](#)
- pRowEchelonForm\_modular\_float
  - ffpack.C, [994](#)
- pRowEchelonForm\_modular\_int32\_t
  - ffpack.C, [994](#)
- pRowRankProfile
  - FFPACK, [330](#)
- PSeq
  - benchmark-fgemm-rns.C, [787](#)
- pSolve
  - FFPACK, [328](#)
- PTRSM\_HYBRID\_THRESHOLD
  - fflas\_ptrsm.inl, [869](#)
- PURE
  - fflas\_simd.h, [870](#)
- queryCacheSizes
  - FFLAS, [189](#)
- queryL1CacheSize
  - FFLAS, [189](#)
- queryTopLevelCacheSize
  - FFLAS, [189](#)
- RandInt
  - FFPACK, [379](#)
- RandIter
  - RNSInteger< RNS >::RandIter, [519](#)
  - RNSIntegerMod< RNS >::RandIter, [520](#)
- random
  - RNSInteger< RNS >::RandIter, [519](#)
  - RNSIntegerMod< RNS >::RandIter, [520](#)
  - rnsRandIter< RNS >, [549](#), [550](#)
- RandomIndexSubset
  - FFPACK, [380](#)
- RandomKrylovPrecond
  - FFPACK::Protected, [393](#)
- RandomLTQSMatixWithRankandQSorder
  - FFPACK, [388](#)
- RandomLTQSRankProfileMatrix
  - FFPACK, [382](#)
- RandomMatrix
  - FFPACK, [376](#), [377](#)
  - test-fscal.C, [1070](#)
- RandomMatrixWithDet
  - FFPACK, [387](#)
- RandomMatrixWithRank
  - FFPACK, [379](#), [380](#)
- RandomMatrixWithRankandRandomRPM
  - FFPACK, [385](#)
- RandomMatrixWithRankandRPM
  - FFPACK, [382](#), [383](#)
- RandomNullSpaceVector
  - FFPACK, [328](#), [345](#), [371](#)
- RandomNullSpaceVector\_modular\_double
  - ffpack.C, [997](#)
  - ffpack\_c.h, [1017](#)
- RandomPermutation
  - FFPACK, [381](#)
- RandomRankProfileMatrix
  - FFPACK, [381](#)
- RandomSymmetricMatrix
  - FFPACK, [379](#)
- RandomSymmetricMatrixWithRankandRandomRPM
  - FFPACK, [386](#)
- RandomSymmetricMatrixWithRankandRPM
  - FFPACK, [383](#), [384](#)
- RandomSymmetricRankProfileMatrix
  - FFPACK, [382](#)
- RandomTriangularMatrix
  - FFPACK, [377](#), [378](#)
- Rank
  - FFPACK, [324](#), [325](#), [369](#)
- rank.C, [803](#)
  - main, [803](#)
- Rank\_modular\_double
  - ffpack.C, [996](#)
  - ffpack\_c.h, [1016](#)
- RankProfileFromLU
  - FFPACK, [331](#)
  - ffpack.C, [998](#)
  - ffpack\_c.h, [1018](#)
- READ
  - parallel.h, [1031](#)
- read\_field
  - Matio.h, [1046](#)
- read\_sparse.h, [905](#)
  - DNS\_BIN\_VER, [906](#)
  - mask\_t, [906](#)
- readDnsFormat
  - FFLAS, [152](#)
- readMachineType
  - FFLAS, [152](#)
- ReadMatrix
  - FFLAS, [186](#)
- readMyMachineType< Field, mpz\_t >, [521](#)
  - Element, [521](#), [522](#)
  - Element\_ptr, [521](#), [522](#)
  - operator(), [522](#)

- readMyMachineType< Field, T >, 520
  - Element, 521
  - Element\_ptr, 521
  - operator(), 521
- readOrRandomMatrixWithRankAndRandomRPM
  - test-nullspace.C, 1092
- readSmsFormat
  - FFLAS, 151
- readSprFormat
  - FFLAS, 151
- READWRITE
  - parallel.h, 1031
- Rec\_Initialize
  - benchmark-pluq.C, 799
- RecInt, 396
- recLevel
  - MMHelper< Field, AlgoTrait, ModeTrait, ParSeq-Trait >, 505
- Recursive, 522
- reduce
  - FFLAS::vectorised, 281, 282
  - rns\_double, 526
  - rns\_double\_extended, 537
  - RNSInteger< RNS >, 541
  - RNSIntegerMod< RNS >, 545
- reduce\_modp
  - RNSIntegerMod< RNS >, 547, 548
- reduce\_modp\_rnsmajor
  - RNSIntegerMod< RNS >, 548
- ReducedColumnEchelonForm
  - FFPACK, 317, 318, 367
- ReducedColumnEchelonForm\_modular\_double
  - ffpack.C, 990
  - ffpack\_c.h, 1013
- ReducedColumnEchelonForm\_modular\_float
  - ffpack.C, 991
  - ffpack\_c.h, 1013
- ReducedColumnEchelonForm\_modular\_int32\_t
  - ffpack.C, 992
  - ffpack\_c.h, 1014
- ReducedRowEchelonForm
  - FFPACK, 319, 366
- ReducedRowEchelonForm2\_modular\_double
  - ffpack\_c.h, 1014
- ReducedRowEchelonForm\_modular\_double
  - ffpack.C, 990
  - ffpack\_c.h, 1013
- ReducedRowEchelonForm\_modular\_float
  - ffpack.C, 991
  - ffpack\_c.h, 1014
- ReducedRowEchelonForm\_modular\_int32\_t
  - ffpack.C, 992
  - ffpack\_c.h, 1014
- REF\_modular\_double
  - ffpack\_c.h, 1015
- regression-check.C, 1050
  - check1, 1051
  - check2, 1051
  - check3, 1051
  - check4, 1051
  - checkZeroDimCharpoly, 1051
  - checkZeroDimMinPoly, 1051
  - gf2ModularBalanced, 1051
  - main, 1051
- Residu
  - Bench< Elt >, 404
  - Test< Elt >, 758
- RETURNPARAM
  - parallel.h, 1033
- Ring
  - CheckerImplem\_charpoly< Givaro::ZRing< Givaro::Integer >, Polynomial >, 412
- ring
  - RNSInteger< RNS >::RandIter, 519
  - RNSIntegerMod< RNS >::RandIter, 520
  - rnsRandIter< RNS >, 550
- rint< K >, 523
- RNS, 43
  - benchmark-fgemm-rns.C, 786
- rns
  - RNSInteger< RNS >, 540
  - RNSIntegerMod< RNS >, 544
- rns-double-elt.h, 944
- rns-double-recint.inl, 945
  - \_\_FFLASFFPACK\_field\_rns\_double\_recint\_INL, 945
- rns-double.h, 945
  - ROUND\_DOWN, 946
- rns-double.inl, 946
  - \_\_FFLASFFPACK\_field\_rns\_double\_INL, 946
- rns-integer-mod.h, 946
- rns-integer.h, 947
- rns.h, 948
- rns.inl, 948
  - \_\_FFLASFFPACK\_field\_rns\_INL, 948
- rns\_double, 523
  - \_M, 527
  - \_MMi, 527
  - \_Mi, 527
  - \_basis, 527
  - \_basisMax, 527
  - \_crt\_in, 527
  - \_crt\_out, 527
  - \_field\_rns, 527
  - \_invbasis, 527
  - \_ldm, 528
  - \_mi\_sum, 528
  - \_negbasis, 527
  - \_pbits, 528
  - \_size, 527
- BasisElement, 524
- ConstElement\_ptr, 524
- convert, 526, 527
- convert\_transpose, 526
- Element, 524
- Element\_ptr, 524



- init, [525](#), [526](#)
- init\_transpose, [526](#)
- integer, [524](#)
- ModField, [524](#)
- precompute\_cst, [525](#)
- reduce, [526](#)
- rns\_double, [525](#)
- rns\_double\_elt, [528](#)
  - \_alloc, [529](#)
  - \_ptr, [529](#)
  - \_stride, [529](#)
  - ~rns\_double\_elt, [528](#)
  - operator&, [529](#)
  - rns\_double\_elt, [528](#), [529](#)
- rns\_double\_elt\_cstptr, [529](#)
  - \_alloc, [532](#)
  - \_ptr, [532](#)
  - \_stride, [532](#)
  - operator!=, [531](#)
  - operator<, [531](#)
  - operator+, [531](#)
  - operator++, [531](#)
  - operator+=", [531](#)
  - operator-, [531](#)
  - operator--, [531](#)
  - operator=, [531](#)
  - operator=, [531](#)
  - operator&, [530](#), [531](#)
  - operator[], [530](#), [531](#)
  - operator\*, [530](#)
  - other, [532](#)
  - rns\_double\_elt\_cstptr, [530](#)
- rns\_double\_elt\_ptr, [532](#)
  - \_alloc, [534](#)
  - \_ptr, [534](#)
  - \_stride, [534](#)
  - operator!=, [534](#)
  - operator<, [534](#)
  - operator+, [533](#)
  - operator++, [533](#)
  - operator+=", [534](#)
  - operator-, [534](#)
  - operator--, [533](#)
  - operator=, [534](#)
  - operator=, [534](#)
  - operator&, [533](#), [534](#)
  - operator[], [533](#)
  - operator\*, [533](#)
  - other, [534](#)
  - rns\_double\_elt\_ptr, [533](#)
- rns\_double\_extended, [535](#)
  - \_M, [538](#)
  - \_MMi, [538](#)
  - \_Mi, [538](#)
  - \_basis, [537](#)
  - \_basisMax, [537](#)
  - \_crt\_in, [538](#)
  - \_crt\_out, [538](#)
  - \_field\_rns, [538](#)
  - \_invbasis, [537](#)
  - \_ldm, [538](#)
  - \_negbasis, [537](#)
  - \_pbits, [538](#)
  - \_size, [538](#)
  - BasisElement, [535](#)
  - ConstElement\_ptr, [536](#)
  - convert, [537](#)
  - Element, [536](#)
  - Element\_ptr, [536](#)
  - init, [536](#), [537](#)
  - integer, [535](#)
  - ModField, [535](#)
  - precompute\_cst, [536](#)
  - reduce, [537](#)
  - rns\_double\_extended, [536](#)
- RNSElementTag, [538](#)
- RNSInteger
  - RNSInteger< RNS >, [540](#)
- RNSInteger< RNS >, [538](#)
  - \_rns, [542](#)
  - assign, [541](#)
  - BasisElement, [539](#)
  - cardinality, [541](#)
  - characteristic, [540](#)
  - ConstElement\_ptr, [540](#)
  - convert, [541](#)
  - Element, [539](#)
  - Element\_ptr, [540](#)
  - init, [541](#)
  - integer, [539](#)
  - isMOne, [540](#)
  - isOne, [540](#)
  - isZero, [540](#)
  - mOne, [542](#)
  - one, [542](#)
  - reduce, [541](#)
  - rns, [540](#)
  - RNSInteger, [540](#)
  - size, [540](#)
  - write, [541](#)
  - zero, [542](#)
- RNSInteger< RNS >::RandIter, [518](#)
  - operator(), [519](#)
  - RandIter, [519](#)
  - random, [519](#)
  - ring, [519](#)
- RNSIntegerMod
  - RNSIntegerMod< RNS >, [544](#)
- RNSIntegerMod< RNS >, [542](#)
  - \_F, [548](#)
  - \_Mi\_modp\_rns, [548](#)
  - \_RNSdelayed, [548](#)
  - \_iM\_modp\_rns, [548](#)
  - \_p, [548](#)
  - \_rns, [548](#)
  - add, [546](#)

- areEqual, [547](#)
- assign, [546](#)
- axpyin, [546](#)
- BasisElement, [544](#)
- cardinality, [545](#)
- characteristic, [545](#)
- ConstElement\_ptr, [543](#)
- convert, [546](#)
- delayed, [544](#)
- Element, [543](#)
- Element\_ptr, [543](#)
- init, [545](#), [546](#)
- integer, [544](#)
- inv, [547](#)
- isMOne, [544](#)
- isOne, [544](#)
- isZero, [544](#)
- maxElement, [545](#)
- minElement, [545](#)
- ModField, [544](#)
- mOne, [548](#)
- mul, [546](#)
- neg, [546](#)
- one, [548](#)
- reduce, [545](#)
- reduce\_modp, [547](#), [548](#)
- reduce\_modp\_rnsmajor, [548](#)
- rns, [544](#)
- RNSIntegerMod, [544](#)
- size, [544](#)
- sub, [546](#)
- write, [547](#)
- write\_matrix, [547](#)
- write\_matrix\_long, [547](#)
- zero, [549](#)
- RNSIntegerMod< RNS >::RandIter, [519](#)
- operator(), [520](#)
- RandIter, [520](#)
- random, [520](#)
- ring, [520](#)
- RNSModulus
- FFLAS::CuttingStrategy, [198](#)
- rnsRandIter
- rnsRandIter< RNS >, [549](#)
- rnsRandIter< RNS >, [549](#)
- operator(), [549](#), [550](#)
- random, [549](#), [550](#)
- ring, [550](#)
- rnsRandIter, [549](#)
- round
- ScalFunctionsBase< Element, typename enable\_if<  
is\_floating\_point< Element >::value >::type  
>, [556](#)
- ScalFunctionsBase< Element, typename enable\_if<  
is\_integral< Element >::value >::type >, [558](#)
- Simd128\_impl< true, true, false, 2 >, [570](#)
- Simd128\_impl< true, true, false, 4 >, [580](#)
- Simd128\_impl< true, true, false, 8 >, [590](#)
- Simd128\_impl< true, true, true, 2 >, [599](#)
- Simd128\_impl< true, true, true, 4 >, [608](#)
- Simd128\_impl< true, true, true, 8 >, [617](#)
- Simd256\_impl< true, false, true, 8 >, [627](#)
- Simd256\_impl< true, true, false, 2 >, [638](#)
- Simd256\_impl< true, true, false, 4 >, [655](#)
- Simd256\_impl< true, true, false, 8 >, [665](#)
- Simd256\_impl< true, true, true, 2 >, [675](#)
- Simd256\_impl< true, true, true, 4 >, [685](#), [692](#)
- Simd256\_impl< true, true, true, 8 >, [701](#)
- Simd512\_impl< true, false, true, 8 >, [709](#)
- Simd512\_impl< true, true, false, 8 >, [719](#)
- Simd512\_impl< true, true, true, 8 >, [729](#)
- ROUND\_DOWN
- fflas\_sparse.h, [883](#)
- rns-double.h, [946](#)
- Row, [550](#)
- row
- Coo< Field >, [432](#)
- Coo< ValT, IdxT >, [430](#), [433](#)
- Sparse< \_Field, SparseMatrix\_t::COO >, [733](#)
- Sparse< \_Field, SparseMatrix\_t::COO\_ZO >, [735](#)
- rowblockindex
- ForStrategy2D< blocksize\_t, Cut, Param >, [468](#)
- rowBlockSize
- ForStrategy2D< blocksize\_t, Cut, Param >, [468](#)
- rowdim
- StatsMatrix, [753](#)
- RowEchelonForm
- FFPACK, [316](#), [317](#), [366](#)
- RowEchelonForm\_modular\_double
- ffpack.C, [990](#)
- ffpack\_c.h, [1012](#)
- RowEchelonForm\_modular\_float
- ffpack.C, [991](#)
- ffpack\_c.h, [1012](#)
- RowEchelonForm\_modular\_int32\_t
- ffpack.C, [992](#)
- ffpack\_c.h, [1013](#)
- rownumblocks
- ForStrategy2D< blocksize\_t, Cut, Param >, [467](#)
- RowRankProfile
- FFPACK, [329](#), [330](#), [371](#)
- RowRankProfile\_modular\_double
- ffpack.C, [998](#)
- ffpack\_c.h, [1018](#)
- RowRankProfileSubmatrix
- FFPACK, [333](#), [372](#)
- RowRankProfileSubmatrix\_modular\_double
- ffpack.C, [999](#)
- ffpack\_c.h, [1019](#)
- RowRankProfileSubmatrixIndices
- FFPACK, [332](#), [372](#)
- RowRankProfileSubmatrixIndices\_modular\_double
- ffpack.C, [999](#)
- ffpack\_c.h, [1018](#)
- ruint< K >, [550](#)
- run

- Bench< Elt >, 405
- Test< Elt >, 759
- run\_with\_field
  - benchmark-charpoly.C, 778
  - benchmark-fdot.C, 784
  - benchmark-quasisep.C, 800
  - test-charpoly.C, 1053
  - test-echelon.C, 1057
  - test-fdot.C, 1059
  - test-fgemm-check.C, 1061
  - test-fgemm.C, 1063
  - test-fgemv.C, 1065
  - test-fger.C, 1066
  - test-fgesv.C, 1068
  - test-finit.C, 1069
  - test-fsyr2k.C, 1072
  - test-fsyrk.C, 1074
  - test-fsytrf.C, 1075
  - test-ftrmm.C, 1076
  - test-ftrmv.C, 1077
  - test-ftrsm.C, 1079
  - test-ftrssyr2k.C, 1080
  - test-ftrstr.C, 1081
  - test-ftrsv.C, 1083
  - test-ftrtri.C, 1084
  - test-io.C, 1085
  - test-lu.C, 1089
  - test-minpoly.C, 1091
  - test-nullspace.C, 1093
  - test-quasisep.C, 1096
  - test-rankprofiles.C, 1097
  - test-solve.C, 1102
- run\_with\_Integer
  - test-fdot.C, 1060
- saxpy\_
  - config-blas.h, 810
- ScalAndReduce
  - FFLAS::Protected, 214, 218
- scalar\_t
  - FieldSimd< \_Field >, 448
  - NoSimd< T >, 516
  - Simd128\_impl< true, true, false, 2 >, 563
  - Simd128\_impl< true, true, false, 4 >, 573
  - Simd128\_impl< true, true, false, 8 >, 583
  - Simd128\_impl< true, true, true, 2 >, 593
  - Simd128\_impl< true, true, true, 4 >, 602
  - Simd128\_impl< true, true, true, 8 >, 611
  - Simd256\_impl< true, false, true, 8 >, 622
  - Simd256\_impl< true, true, false, 2 >, 630
  - Simd256\_impl< true, true, false, 4 >, 642
  - Simd256\_impl< true, true, false, 8 >, 659
  - Simd256\_impl< true, true, true, 2 >, 668
  - Simd256\_impl< true, true, true, 4 >, 679
  - Simd256\_impl< true, true, true, 8 >, 695
  - Simd512\_impl< true, false, true, 8 >, 704
  - Simd512\_impl< true, true, false, 8 >, 712
  - Simd512\_impl< true, true, true, 8 >, 722
- ScalFunctions< Element >, 550
  - add, 552
  - addin, 552
  - blend, 555
  - div, 553
  - eq, 554
  - fmadd, 553
  - fmaddin, 553
  - fmsub, 553
  - fmsubin, 553
  - fnmadd, 553
  - fnmaddin, 553
  - genInputs, 551
  - genInputsWithZero, 551
  - greater, 554
  - greater\_eq, 554
  - lesser, 554
  - lesser\_eq, 554
  - mul, 552
  - mulin, 553
  - pack, 555
  - pack\_even, 555
  - pack\_odd, 555
  - sub, 552
  - subin, 552
  - unpackhi, 554
  - unpacklo, 554
  - unpacklohi, 554
  - vand, 551
  - vandnot, 552
  - vectElt, 551
  - vor, 552
  - vxor, 552
  - zero, 551
- ScalFunctionsBase< Element, Enable >, 555
- ScalFunctionsBase< Element, typename enable\_if<
  - is\_floating\_point< Element >::value >::type
  - >, 556
  - \_zero, 557
  - blendv, 556
  - ceil, 556
  - cmp\_false, 557
  - cmp\_true, 557
  - floor, 556
  - fma, 556
  - get\_default\_random\_generator, 556
  - round, 556
- ScalFunctionsBase< Element, typename enable\_if<
  - is\_floating\_point< Element >::value >::type
  - >::FloatingPointTestDistribution, 463
  - FloatingPointTestDistribution, 463
  - IntType, 463
  - operator(), 463
- ScalFunctionsBase< Element, typename enable\_if<
  - is\_integral< Element >::value >::type >, 557
  - \_zero, 559
  - cmp\_false, 560
  - cmp\_true, 559
  - fma, 558

- fmaddx, [558](#)
- fmaddxin, [558](#)
- fmsubx, [558](#)
- fmsubxin, [559](#)
- fnmaddx, [559](#)
- fnmaddxin, [559](#)
- get\_default\_random\_generator, [558](#)
- mulhi, [558](#)
- mullo, [558](#)
- mulx, [558](#)
- round, [558](#)
- sll, [559](#)
- sra, [559](#)
- srl, [559](#)
- scalp
  - FFLAS::vectorised, [282](#), [283](#)
  - FFLAS::vectorised::unswitch, [285](#)
- schedule\_bini.inl, [837](#)
  - \_\_FFLASFFPACK\_fgemm\_bini\_INL, [837](#)
- schedule\_winograd.inl, [837](#)
  - \_\_FFLASFFPACK\_fgemm\_winograd\_INL, [838](#)
- schedule\_winograd\_acc.inl, [838](#)
  - \_\_FFLASFFPACK\_fgemm\_winograd\_acc\_INL, [838](#)
- schedule\_winograd\_acc\_ip.inl, [839](#)
  - \_\_FFLASFFPACK\_fgemm\_winograd\_acc\_ip\_INL, [839](#)
- schedule\_winograd\_ip.inl, [839](#)
  - \_\_FFLASFFPACK\_fgemm\_winograd\_ip\_INL, [840](#)
- scopy\_
  - config-blas.h, [812](#)
- sdot\_
  - config-blas.h, [811](#)
- second\_component
  - Compose< H1, H2 >, [422](#)
- Self
  - Coo< ValT, IdxT >, [430](#), [433](#)
- Self\_t
  - MMHelper< Field, AlgoTrait, ModeTrait, ParSeqTrait >, [502](#)
- SELL
  - FFLAS, [76](#)
- sell.h, [906](#)
- sell\_pspmv.inl, [907](#)
  - \_\_FFLASFFPACK\_fflas\_sparse\_sell\_pspmv\_INL, [907](#)
- sell\_spmv.inl, [907](#)
  - \_\_FFLASFFPACK\_fflas\_sparse\_sell\_spmv\_INL, [908](#)
- sell\_utils.inl, [908](#)
  - \_\_FFLASFFPACK\_fflas\_sparse\_sell\_utils\_INL, [909](#)
- SELL\_ZO
  - FFLAS, [76](#)
- Sequential, [560](#)
  - numthreads, [560](#)
  - operator<<, [560](#)
  - Sequential, [560](#)
- set
  - Simd128\_impl< true, true, false, 2 >, [563](#), [566](#)
  - Simd128\_impl< true, true, false, 4 >, [574](#), [576](#)
  - Simd128\_impl< true, true, false, 8 >, [584](#), [586](#)
  - Simd128\_impl< true, true, true, 2 >, [594](#)
  - Simd128\_impl< true, true, true, 4 >, [603](#)
  - Simd128\_impl< true, true, true, 8 >, [612](#)
  - Simd256\_impl< true, false, true, 8 >, [623](#)
  - Simd256\_impl< true, true, false, 2 >, [631](#), [634](#)
  - Simd256\_impl< true, true, false, 4 >, [643](#), [645](#), [648](#)
  - Simd256\_impl< true, true, false, 8 >, [659](#), [662](#)
  - Simd256\_impl< true, true, true, 2 >, [669](#)
  - Simd256\_impl< true, true, true, 4 >, [680](#), [686](#)
  - Simd256\_impl< true, true, true, 8 >, [695](#)
  - Simd512\_impl< true, false, true, 8 >, [705](#)
  - Simd512\_impl< true, true, false, 8 >, [712](#), [715](#)
  - Simd512\_impl< true, true, true, 8 >, [723](#)
- set1
  - Simd128\_impl< true, true, false, 2 >, [563](#), [566](#)
  - Simd128\_impl< true, true, false, 4 >, [574](#), [576](#)
  - Simd128\_impl< true, true, false, 8 >, [584](#), [586](#)
  - Simd128\_impl< true, true, true, 2 >, [594](#)
  - Simd128\_impl< true, true, true, 4 >, [603](#)
  - Simd128\_impl< true, true, true, 8 >, [612](#)
  - Simd256\_impl< true, false, true, 8 >, [623](#)
  - Simd256\_impl< true, true, false, 2 >, [631](#), [633](#)
  - Simd256\_impl< true, true, false, 4 >, [643](#), [645](#), [648](#)
  - Simd256\_impl< true, true, false, 8 >, [659](#), [662](#)
  - Simd256\_impl< true, true, true, 2 >, [669](#)
  - Simd256\_impl< true, true, true, 4 >, [680](#), [686](#)
  - Simd256\_impl< true, true, true, 8 >, [695](#)
  - Simd512\_impl< true, false, true, 8 >, [705](#)
  - Simd512\_impl< true, true, false, 8 >, [712](#), [715](#)
  - Simd512\_impl< true, true, true, 8 >, [723](#)
- set\_numthreads
  - Parallel< C, P >, [518](#)
- SET\_THREADS
  - parallel.h, [1031](#)
- setErrorStream
  - Failure, [445](#)
- setOutBounds
  - MMHelper< Field, AlgoTrait, ModeTrait, ParSeqTrait >, [504](#)
- sgemm\_
  - config-blas.h, [814](#)
- sgemv\_
  - config-blas.h, [811](#)
- sger\_
  - config-blas.h, [812](#)
- shuffle
  - Simd128\_impl< true, true, false, 2 >, [567](#)
  - Simd128\_impl< true, true, false, 4 >, [577](#)
  - Simd128\_impl< true, true, false, 8 >, [587](#)
  - Simd128\_impl< true, true, true, 2 >, [595](#)
  - Simd128\_impl< true, true, true, 4 >, [604](#)
  - Simd128\_impl< true, true, true, 8 >, [613](#)

- Simd256\_impl< true, true, false, 2 >, [635](#)
- Simd256\_impl< true, true, false, 4 >, [650](#)
- Simd256\_impl< true, true, false, 8 >, [663](#)
- Simd256\_impl< true, true, true, 2 >, [670](#)
- Simd256\_impl< true, true, true, 4 >, [681](#), [687](#)
- Simd256\_impl< true, true, true, 8 >, [697](#)
- Simd512\_impl< true, false, true, 8 >, [705](#)
- Simd512\_impl< true, true, false, 8 >, [716](#)
- Simd512\_impl< true, true, true, 8 >, [724](#)
- shuffle\_twice
  - Simd256\_impl< true, true, false, 4 >, [649](#), [650](#)
  - Simd256\_impl< true, true, true, 4 >, [681](#), [687](#)
- sigma
  - Sparse< \_Field, SparseMatrix\_t::SELL >, [748](#)
  - Sparse< \_Field, SparseMatrix\_t::SELL\_ZO >, [751](#)
- signbits
  - Simd128\_impl< true, true, false, 8 >, [590](#)
  - Simd128\_impl< true, true, true, 8 >, [618](#)
  - Simd256\_impl< true, true, false, 8 >, [666](#)
  - Simd256\_impl< true, true, true, 8 >, [701](#)
  - Simd512\_impl< true, true, false, 8 >, [719](#)
  - Simd512\_impl< true, true, true, 8 >, [729](#)
- Simd
  - fflas\_simd.h, [870](#)
- simd
  - FieldSimd< \_Field >, [448](#)
- SIMD wrapper, [42](#)
- simd.doxy, [871](#)
- Simd128
  - simd128.inl, [871](#)
- simd128.inl, [871](#)
  - \_\_FFLASFFPACK\_fflas\_ffpack\_utils\_simd128\_INL, [871](#)
  - Simd128, [871](#)
- simd128\_double.inl, [871](#)
  - \_\_FFLASFFPACK\_fflas\_ffpack\_utils\_simd128\_double\_INL, [872](#)
- simd128\_float.inl, [872](#)
  - \_\_FFLASFFPACK\_fflas\_ffpack\_utils\_simd128\_float\_INL, [872](#)
- Simd128\_impl< ArithType, Int, Signed, Size >, [561](#)
- Simd128\_impl< true, false, true, 4 >, [561](#)
- Simd128\_impl< true, false, true, 8 >, [561](#)
- Simd128\_impl< true, true, false, 2 >, [561](#)
  - add, [568](#)
  - addin, [568](#)
  - aligned\_allocator, [563](#)
  - aligned\_vector, [563](#)
  - alignment, [571](#)
  - blend, [568](#)
  - compliant, [566](#)
  - eq, [570](#)
  - fmadd, [569](#)
  - fmaddin, [569](#)
  - fmaddx, [565](#)
  - fmaddxin, [565](#)
  - fmsub, [569](#)
  - fmsubin, [570](#)
  - fmsubx, [565](#)
  - fmsubxin, [566](#)
  - fnmadd, [569](#)
  - fnmaddin, [569](#)
  - fnmaddx, [565](#)
  - fnmaddxin, [565](#)
  - gather, [564](#), [566](#)
  - greater, [564](#)
  - greater\_eq, [565](#)
  - hadd\_to\_scal, [566](#)
  - is\_same\_element, [563](#)
  - lesser, [564](#)
  - lesser\_eq, [565](#)
  - load, [564](#), [566](#)
  - loadu, [564](#), [566](#)
  - mod, [570](#)
  - mul, [569](#)
  - mulhi, [565](#)
  - mullo, [569](#)
  - mulx, [565](#)
  - pack, [568](#)
  - pack\_even, [568](#)
  - pack\_odd, [568](#)
  - round, [570](#)
  - scalar\_t, [563](#)
  - set, [563](#), [566](#)
  - set1, [563](#), [566](#)
  - shuffle, [567](#)
  - sll, [567](#)
  - sll128, [570](#)
  - sra, [564](#)
  - srl, [567](#)
  - srl128, [570](#)
  - store, [564](#), [567](#)
  - storeu, [564](#), [567](#)
  - stream, [564](#), [567](#)
  - sub, [569](#)
  - subin, [569](#)
  - transpose, [568](#)
  - type\_string, [563](#)
  - unpackhi, [567](#)
  - unpackhi\_intrinsic, [567](#)
  - unpacklo, [567](#)
  - unpacklo\_intrinsic, [567](#)
  - unpacklohi, [568](#)
  - valid, [566](#)
  - vand, [570](#)
  - vandnot, [571](#)
  - vect\_size, [571](#)
  - vect\_t, [563](#)
  - vor, [570](#)
  - vxor, [571](#)
  - zero, [570](#)
- Simd128\_impl< true, true, false, 2 >::Converter, [424](#)
  - t, [424](#)
  - v, [424](#)
- Simd128\_impl< true, true, false, 4 >, [571](#)
  - add, [578](#)

- addin, [578](#)
- aligned\_allocator, [573](#)
- aligned\_vector, [573](#)
- alignment, [581](#)
- blend, [578](#)
- compliant, [576](#)
- eq, [580](#)
- fmadd, [579](#)
- fmaddin, [579](#)
- fmaddx, [575](#)
- fmaddxin, [575](#)
- fmsub, [579](#)
- fmsubin, [580](#)
- fmsubx, [576](#)
- fmsubxin, [576](#)
- fnmadd, [579](#)
- fnmaddin, [579](#)
- fnmaddx, [575](#)
- fnmaddxin, [575](#)
- gather, [574](#), [576](#)
- greater, [574](#)
- greater\_eq, [575](#)
- hadd\_to\_scal, [576](#)
- is\_same\_element, [573](#)
- lesser, [575](#)
- lesser\_eq, [575](#)
- load, [574](#), [576](#)
- loadu, [574](#), [577](#)
- mod, [580](#)
- mul, [579](#)
- mulhi, [575](#)
- mullo, [579](#)
- mulx, [575](#)
- pack, [578](#)
- pack\_even, [578](#)
- pack\_odd, [578](#)
- round, [580](#)
- scalar\_t, [573](#)
- set, [574](#), [576](#)
- set1, [574](#), [576](#)
- shuffle, [577](#)
- sll, [577](#)
- sll128, [580](#)
- sra, [574](#)
- srl, [577](#)
- srl128, [580](#)
- store, [574](#), [577](#)
- storeu, [574](#), [577](#)
- stream, [574](#), [577](#)
- sub, [579](#)
- subin, [579](#)
- transpose, [578](#)
- type\_string, [574](#)
- unpackhi, [578](#)
- unpackhi\_intrinsic, [577](#)
- unpacklo, [577](#)
- unpacklo\_intrinsic, [577](#)
- unpacklohi, [578](#)
- valid, [576](#)
- vand, [580](#)
- vandnot, [581](#)
- vect\_size, [581](#)
- vect\_t, [573](#)
- vor, [580](#)
- vxor, [581](#)
- zero, [580](#)
- Simd128\_impl< true, true, false, 4 >::Converter, [424](#)
- t, [424](#)
- v, [424](#)
- Simd128\_impl< true, true, false, 8 >, [581](#)
- add, [589](#)
- addin, [589](#)
- aligned\_allocator, [583](#)
- aligned\_vector, [583](#)
- alignment, [591](#)
- blend, [588](#)
- compliant, [586](#)
- eq, [590](#)
- fmadd, [589](#)
- fmaddin, [589](#)
- fmaddx, [585](#)
- fmaddxin, [585](#)
- fmsub, [590](#)
- fmsubin, [590](#)
- fmsubx, [586](#)
- fmsubxin, [586](#)
- fnmadd, [589](#)
- fnmaddin, [589](#)
- fnmaddx, [585](#)
- fnmaddxin, [586](#)
- gather, [584](#), [586](#)
- get, [587](#)
- greater, [584](#)
- greater\_eq, [585](#)
- hadd\_to\_scal, [586](#)
- is\_same\_element, [583](#)
- lesser, [585](#)
- lesser\_eq, [585](#)
- load, [584](#), [587](#)
- loadu, [584](#), [587](#)
- mask\_high, [590](#)
- mod, [590](#)
- mul, [589](#)
- mulhi, [585](#)
- mulhi\_fast, [590](#)
- mullo, [585](#)
- mulx, [585](#)
- pack, [588](#)
- pack\_even, [588](#)
- pack\_odd, [588](#)
- round, [590](#)
- scalar\_t, [583](#)
- set, [584](#), [586](#)
- set1, [584](#), [586](#)
- shuffle, [587](#)
- signbits, [590](#)

- sll, [587](#)
- sll128, [591](#)
- sra, [584](#)
- srl, [587](#)
- srl128, [591](#)
- store, [584](#), [587](#)
- storeu, [584](#), [587](#)
- stream, [584](#), [587](#)
- sub, [589](#)
- subin, [589](#)
- transpose, [588](#)
- type\_string, [584](#)
- unpackhi, [588](#)
- unpackhi\_intrinsic, [588](#)
- unpacklo, [588](#)
- unpacklo\_intrinsic, [587](#)
- unpacklohi, [588](#)
- valid, [586](#)
- vand, [591](#)
- vandnot, [591](#)
- vect\_size, [591](#)
- vect\_t, [583](#)
- vor, [591](#)
- vxor, [591](#)
- zero, [590](#)
- Simd128\_impl< true, true, false, 8 >::Converter, [424](#)
- t, [425](#)
- v, [425](#)
- Simd128\_impl< true, true, true, 2 >, [591](#)
- add, [596](#)
- addin, [597](#)
- aligned\_allocator, [593](#)
- aligned\_vector, [594](#)
- alignment, [600](#)
- blend, [596](#)
- compliant, [594](#)
- eq, [599](#)
- fmadd, [597](#)
- fmaddin, [597](#)
- fmaddx, [597](#)
- fmaddxin, [598](#)
- fmsub, [598](#)
- fmsubin, [598](#)
- fmsubx, [598](#)
- fmsubxin, [599](#)
- fnmadd, [598](#)
- fnmaddin, [598](#)
- fnmaddx, [598](#)
- fnmaddxin, [598](#)
- gather, [594](#)
- greater, [599](#)
- greater\_eq, [599](#)
- hadd\_to\_scal, [599](#)
- is\_same\_element, [594](#)
- lesser, [599](#)
- lesser\_eq, [599](#)
- load, [594](#)
- loadu, [594](#)
- mod, [599](#)
- mul, [597](#)
- mulhi, [597](#)
- mullo, [597](#)
- mulx, [597](#)
- pack, [596](#)
- pack\_even, [596](#)
- pack\_odd, [596](#)
- round, [599](#)
- scalar\_t, [593](#)
- set, [594](#)
- set1, [594](#)
- shuffle, [595](#)
- sll, [595](#)
- sll128, [600](#)
- sra, [595](#)
- srl, [595](#)
- srl128, [600](#)
- store, [595](#)
- storeu, [595](#)
- stream, [595](#)
- sub, [597](#)
- subin, [597](#)
- transpose, [596](#)
- type\_string, [594](#)
- unpackhi, [596](#)
- unpackhi\_intrinsic, [595](#)
- unpacklo, [595](#)
- unpacklo\_intrinsic, [595](#)
- unpacklohi, [596](#)
- valid, [594](#)
- vand, [600](#)
- vandnot, [600](#)
- vect\_size, [600](#)
- vect\_t, [593](#)
- vor, [600](#)
- vxor, [600](#)
- zero, [600](#)
- Simd128\_impl< true, true, true, 2 >::Converter, [425](#)
- t, [425](#)
- v, [425](#)
- Simd128\_impl< true, true, true, 4 >, [601](#)
- add, [605](#)
- addin, [605](#)
- aligned\_allocator, [602](#)
- aligned\_vector, [603](#)
- alignment, [609](#)
- blend, [605](#)
- compliant, [603](#)
- eq, [608](#)
- fmadd, [606](#)
- fmaddin, [606](#)
- fmaddx, [606](#)
- fmaddxin, [606](#)
- fmsub, [607](#)
- fmsubin, [607](#)
- fmsubx, [607](#)
- fmsubxin, [607](#)

- fnmadd, [607](#)
- fnmaddin, [607](#)
- fnmaddx, [607](#)
- fnmaddxin, [607](#)
- gather, [603](#)
- greater, [608](#)
- greater\_eq, [608](#)
- hadd\_to\_scal, [608](#)
- is\_same\_element, [603](#)
- lesser, [608](#)
- lesser\_eq, [608](#)
- load, [603](#)
- loadu, [603](#)
- mod, [608](#)
- mul, [606](#)
- mulhi, [606](#)
- mullo, [606](#)
- mulx, [606](#)
- pack, [605](#)
- pack\_even, [605](#)
- pack\_odd, [605](#)
- round, [608](#)
- scalar\_t, [602](#)
- set, [603](#)
- set1, [603](#)
- shuffle, [604](#)
- sll, [604](#)
- sll128, [608](#)
- sra, [604](#)
- srl, [604](#)
- srl128, [609](#)
- store, [603](#)
- storeu, [604](#)
- stream, [604](#)
- sub, [605](#)
- subin, [606](#)
- transpose, [605](#)
- type\_string, [603](#)
- unpackhi, [604](#)
- unpackhi\_intrinsic, [604](#)
- unpacklo, [604](#)
- unpacklo\_intrinsic, [604](#)
- unpacklohi, [605](#)
- valid, [603](#)
- vand, [609](#)
- vandnot, [609](#)
- vect\_size, [609](#)
- vect\_t, [602](#)
- vor, [609](#)
- vxor, [609](#)
- zero, [608](#)
- Simd128\_impl< true, true, true, 4 >::Converter, [425](#)
- t, [425](#)
- v, [425](#)
- Simd128\_impl< true, true, true, 8 >, [609](#)
- add, [614](#)
- addin, [615](#)
- aligned\_allocator, [612](#)
- aligned\_vector, [612](#)
- alignment, [619](#)
- blend, [614](#)
- compliant, [612](#)
- eq, [617](#)
- fmadd, [615](#)
- fmaddin, [615](#)
- fmaddx, [615](#)
- fmaddxin, [616](#)
- fmsub, [616](#)
- fmsubin, [616](#)
- fmsubx, [616](#)
- fmsubxin, [617](#)
- fnmadd, [616](#)
- fnmaddin, [616](#)
- fnmaddx, [616](#)
- fnmaddxin, [616](#)
- gather, [612](#)
- get, [612](#)
- greater, [617](#)
- greater\_eq, [617](#)
- hadd\_to\_scal, [617](#)
- is\_same\_element, [612](#)
- lesser, [617](#)
- lesser\_eq, [617](#)
- load, [612](#)
- loadu, [613](#)
- mask\_high, [617](#)
- mod, [617](#)
- mul, [615](#)
- mulhi, [615](#)
- mulhi\_fast, [617](#)
- mullo, [615](#)
- mulx, [615](#)
- pack, [614](#)
- pack\_even, [614](#)
- pack\_odd, [614](#)
- round, [617](#)
- scalar\_t, [611](#)
- set, [612](#)
- set1, [612](#)
- shuffle, [613](#)
- signbits, [618](#)
- sll, [613](#)
- sll128, [618](#)
- sra, [613](#)
- srl, [613](#)
- srl128, [618](#)
- store, [613](#)
- storeu, [613](#)
- stream, [613](#)
- sub, [615](#)
- subin, [615](#)
- transpose, [614](#)
- type\_string, [612](#)
- unpackhi, [614](#)
- unpackhi\_intrinsic, [613](#)
- unpacklo, [614](#)



- unpacklo\_intrinsic, 613
- unpacklohi, 614
- valid, 612
- vand, 618
- vandnot, 618
- vect\_size, 619
- vect\_t, 611
- vor, 618
- vxor, 618
- zero, 618
- Simd128\_impl< true, true, true, 8 >::Converter, 425
  - t, 426
  - v, 426
- simd128\_int16.inl, 872
  - \_\_FFLASFFPACK\_fflas\_ffpack\_utils\_simd128\_int16\_INL, 872
- simd128\_int32.inl, 872
  - \_\_FFLASFFPACK\_fflas\_ffpack\_utils\_simd128\_int32\_INL, 873
- simd128\_int64.inl, 873
  - \_\_FFLASFFPACK\_fflas\_ffpack\_utils\_simd128\_int64\_INL, 873
  - vect\_t, 873
- Simd128i\_base, 619
  - sll128, 619
  - srl128, 619
  - vand, 620
  - vandnot, 620
  - vect\_t, 619
  - vor, 620
  - vxor, 620
  - zero, 619
- Simd256
  - simd256.inl, 874
- simd256.inl, 873
  - \_\_FFLASFFPACK\_fflas\_ffpack\_utils\_simd256\_INL, 874
  - Simd256, 874
- simd256\_double.inl, 874
  - \_\_FFLASFFPACK\_fflas\_ffpack\_utils\_simd256\_double\_INL, 874
- simd256\_float.inl, 874
  - \_\_FFLASFFPACK\_fflas\_ffpack\_utils\_simd256\_float\_INL, 875
- Simd256\_impl< ArithType, Int, Signed, Size >, 620
- Simd256\_impl< true, false, true, 4 >, 620
- Simd256\_impl< true, false, true, 8 >, 621
  - add, 625
  - addin, 625
  - aligned\_allocator, 622
  - aligned\_vector, 622
  - alignment, 628
  - blend, 625
  - blendv, 625
  - ceil, 627
  - compliant, 623
  - div, 625
  - eq, 626
  - floor, 627
  - fmadd, 626
  - fmaddin, 626
  - fmsub, 626
  - fmsubin, 626
  - fnmadd, 626
  - fnmaddin, 626
  - gather, 623
  - greater, 627
  - greater\_eq, 627
  - hadd, 627
  - hadd\_to\_scal, 628
  - is\_same\_element, 622
  - lesser, 626
  - lesser\_eq, 626
  - load, 623
  - loadu, 623
  - mod, 628
  - mul, 625
  - mulin, 625
  - pack, 624
  - pack\_even, 624
  - pack\_odd, 624
  - round, 627
  - scalar\_t, 622
  - set, 623
  - set1, 623
  - store, 623
  - storeu, 623
  - stream, 623
  - sub, 625
  - subin, 625
  - transpose, 624
  - type\_string, 622
  - unpackhi, 624
  - unpackhi\_intrinsic, 624
  - unpacklo, 624
  - unpacklo\_intrinsic, 624
  - unpacklohi, 624
  - valid, 622
  - vand, 627
  - vandnot, 627
  - vect\_size, 628
  - vect\_t, 622
  - vor, 627
  - vxor, 627
  - zero, 623
- Simd256\_impl< true, false, true, 8 >::Converter, 426
  - t, 426
  - v, 426
- Simd256\_impl< true, true, false, 2 >, 628
  - add, 636
  - addin, 636
  - aligned\_allocator, 630
  - aligned\_vector, 630
  - alignment, 638
  - blend, 636
  - compliant, 633

- eq, [637](#)
- fmadd, [637](#)
- fmaddin, [637](#)
- fmaddx, [632](#)
- fmaddxin, [633](#)
- fmsub, [637](#)
- fmsubin, [637](#)
- fmsubx, [633](#)
- fmsubxin, [633](#)
- fnmadd, [637](#)
- fnmaddin, [637](#)
- fnmaddx, [633](#)
- fnmaddxin, [633](#)
- gather, [631](#), [634](#)
- greater, [632](#)
- greater\_eq, [632](#)
- hadd\_to\_scal, [633](#)
- half\_t, [631](#)
- is\_same\_element, [630](#)
- lesser, [632](#)
- lesser\_eq, [632](#)
- load, [631](#), [634](#)
- loadu, [631](#), [634](#)
- mod, [638](#)
- mul, [637](#)
- mulhi, [632](#)
- mullo, [637](#)
- mulx, [632](#)
- pack, [635](#)
- pack\_even, [635](#)
- pack\_odd, [635](#)
- round, [638](#)
- scalar\_t, [630](#)
- set, [631](#), [634](#)
- set1, [631](#), [633](#)
- shuffle, [635](#)
- simdHalf, [630](#)
- sll, [634](#)
- sra, [632](#)
- srl, [635](#)
- store, [631](#), [634](#)
- storeu, [632](#), [634](#)
- stream, [632](#), [634](#)
- sub, [636](#)
- subin, [636](#)
- transpose, [636](#)
- type\_string, [631](#)
- unpackhi, [635](#)
- unpackhi\_intrinsic, [635](#)
- unpacklo, [635](#)
- unpacklo\_intrinsic, [635](#)
- unpacklohi, [635](#)
- valid, [633](#)
- vect\_size, [638](#)
- vect\_t, [631](#)
- zero, [638](#)
- Simd256\_impl< true, true, false, 2 >::Converter, [426](#)
- t, [426](#)
- v, [426](#)
- Simd256\_impl< true, true, false, 4 >, [638](#)
- add, [652](#)
- addin, [653](#)
- aligned\_allocator, [642](#)
- aligned\_vector, [642](#)
- alignment, [656](#)
- blend, [652](#)
- compliant, [648](#)
- eq, [655](#)
- fmadd, [654](#)
- fmaddin, [654](#)
- fmaddx, [644](#), [647](#)
- fmaddxin, [644](#), [647](#)
- fmsub, [655](#)
- fmsubin, [655](#)
- fmsubx, [645](#), [647](#)
- fmsubxin, [645](#), [647](#)
- fnmadd, [654](#)
- fnmaddin, [654](#)
- fnmaddx, [644](#), [647](#)
- fnmaddxin, [645](#), [647](#)
- gather, [643](#), [645](#), [648](#)
- greater, [644](#), [646](#)
- greater\_eq, [644](#), [646](#)
- hadd\_to\_scal, [645](#), [647](#)
- half\_t, [642](#)
- is\_same\_element, [642](#)
- lesser, [644](#), [646](#)
- lesser\_eq, [644](#), [646](#)
- load, [643](#), [645](#), [649](#)
- loadu, [643](#), [646](#), [649](#)
- mod, [655](#), [656](#)
- mul, [653](#)
- mulhi, [644](#), [646](#)
- mullo, [653](#)
- mulx, [644](#), [647](#)
- pack, [651](#)
- pack\_even, [651](#)
- pack\_odd, [651](#)
- round, [655](#)
- scalar\_t, [642](#)
- set, [643](#), [645](#), [648](#)
- set1, [643](#), [645](#), [648](#)
- shuffle, [650](#)
- shuffle\_twice, [649](#), [650](#)
- simdHalf, [642](#)
- sll, [649](#)
- sra, [643](#), [646](#)
- srl, [649](#)
- store, [643](#), [646](#), [649](#)
- storeu, [643](#), [646](#), [649](#)
- stream, [643](#), [646](#), [649](#)
- sub, [653](#)
- subin, [653](#)
- transpose, [652](#)
- type\_string, [643](#), [645](#)
- unpackhi, [650](#), [651](#)

- unpackhi\_intrinsic, [650](#)
- unpacklo, [650](#)
- unpacklo\_intrinsic, [650](#)
- unpacklohi, [651](#)
- valid, [647](#), [648](#)
- vand, [656](#)
- vandnot, [656](#)
- vect\_size, [656](#)
- vect\_t, [642](#)
- vor, [656](#)
- vxor, [656](#)
- zero, [656](#)
- Simd256\_impl< true, true, false, 4 >::Converter, [426](#)
- t, [427](#)
- v, [427](#)
- Simd256\_impl< true, true, false, 8 >, [657](#)
- add, [664](#)
- addin, [664](#)
- aligned\_allocator, [659](#)
- aligned\_vector, [659](#)
- alignment, [666](#)
- blend, [664](#)
- compliant, [662](#)
- eq, [665](#)
- fmadd, [665](#)
- fmaddin, [665](#)
- fmaddx, [661](#)
- fmaddxin, [661](#)
- fmsub, [665](#)
- fmsubin, [665](#)
- fmsubx, [661](#)
- fmsubxin, [661](#)
- fnmadd, [665](#)
- fnmaddin, [665](#)
- fnmaddx, [661](#)
- fnmaddxin, [661](#)
- gather, [659](#), [662](#)
- get, [662](#)
- greater, [660](#)
- greater\_eq, [660](#)
- hadd\_to\_scal, [662](#)
- half\_t, [659](#)
- is\_same\_element, [659](#)
- lesser, [660](#)
- lesser\_eq, [660](#)
- load, [660](#), [662](#)
- loadu, [660](#), [662](#)
- mask\_high, [666](#)
- mod, [666](#)
- mul, [665](#)
- mulhi, [661](#)
- mulhi\_fast, [666](#)
- mullo, [661](#)
- mulx, [661](#)
- pack, [664](#)
- pack\_even, [664](#)
- pack\_odd, [664](#)
- round, [665](#)
- scalar\_t, [659](#)
- set, [659](#), [662](#)
- set1, [659](#), [662](#)
- shuffle, [663](#)
- signbits, [666](#)
- simdHalf, [659](#)
- sll, [663](#)
- sra, [660](#)
- srl, [663](#)
- store, [660](#), [662](#)
- storeu, [660](#), [663](#)
- stream, [660](#), [663](#)
- sub, [664](#)
- subin, [664](#)
- transpose, [664](#)
- type\_string, [659](#)
- unpackhi, [663](#)
- unpackhi\_intrinsic, [663](#)
- unpacklo, [663](#)
- unpacklo\_intrinsic, [663](#)
- unpacklohi, [663](#)
- valid, [662](#)
- vect\_size, [666](#)
- vect\_t, [659](#)
- zero, [666](#)
- Simd256\_impl< true, true, false, 8 >::Converter, [427](#)
- t, [427](#)
- v, [427](#)
- Simd256\_impl< true, true, true, 2 >, [666](#)
- add, [672](#)
- addin, [672](#)
- aligned\_allocator, [669](#)
- aligned\_vector, [669](#)
- alignment, [675](#)
- blend, [672](#)
- compliant, [669](#)
- eq, [674](#)
- fmadd, [673](#)
- fmaddin, [673](#)
- fmaddx, [673](#)
- fmaddxin, [673](#)
- fmsub, [674](#)
- fmsubin, [674](#)
- fmsubx, [674](#)
- fmsubxin, [674](#)
- fnmadd, [673](#)
- fnmaddin, [673](#)
- fnmaddx, [673](#)
- fnmaddxin, [674](#)
- gather, [669](#)
- greater, [674](#)
- greater\_eq, [674](#)
- hadd\_to\_scal, [675](#)
- half\_t, [668](#)
- is\_same\_element, [669](#)
- lesser, [674](#)
- lesser\_eq, [675](#)
- load, [670](#)

- loadu, [670](#)
- mod, [675](#)
- mul, [672](#)
- mulhi, [673](#)
- mullo, [672](#)
- mulx, [673](#)
- pack, [671](#)
- pack\_even, [671](#)
- pack\_odd, [671](#)
- round, [675](#)
- scalar\_t, [668](#)
- set, [669](#)
- set1, [669](#)
- shuffle, [670](#)
- simdHalf, [668](#)
- sll, [670](#)
- sra, [670](#)
- srl, [670](#)
- store, [670](#)
- storeu, [670](#)
- stream, [670](#)
- sub, [672](#)
- subin, [672](#)
- transpose, [671](#)
- type\_string, [669](#)
- unpackhi, [671](#)
- unpackhi\_intrinsic, [671](#)
- unpacklo, [671](#)
- unpacklo\_intrinsic, [670](#)
- unpacklohi, [671](#)
- valid, [669](#)
- vect\_size, [675](#)
- vect\_t, [668](#)
- zero, [675](#)
- Simd256\_impl< true, true, true, 2 >::Converter, [427](#)
- t, [427](#)
- v, [427](#)
- Simd256\_impl< true, true, true, 4 >, [675](#)
- add, [683](#), [689](#)
- addin, [683](#), [689](#)
- aligned\_allocator, [679](#)
- aligned\_vector, [679](#), [680](#)
- alignment, [692](#)
- blend, [682](#), [689](#)
- compliant, [680](#), [686](#)
- eq, [685](#), [691](#)
- fmadd, [683](#), [690](#)
- fmaddin, [683](#), [690](#)
- fmaddx, [684](#), [690](#)
- fmaddxin, [684](#), [690](#)
- fmsub, [684](#), [691](#)
- fmsubin, [684](#), [691](#)
- fmsubx, [685](#), [691](#)
- fmsubxin, [685](#), [691](#)
- fnmadd, [684](#), [690](#)
- fnmaddin, [684](#), [690](#)
- fnmaddx, [684](#), [690](#)
- fnmaddxin, [684](#), [690](#)
- gather, [680](#), [686](#)
- greater, [685](#), [691](#)
- greater\_eq, [685](#), [691](#)
- hadd\_to\_scal, [685](#), [691](#)
- half\_t, [679](#)
- is\_same\_element, [679](#), [680](#)
- lesser, [685](#), [691](#)
- lesser\_eq, [685](#), [691](#)
- load, [680](#), [686](#)
- loadu, [680](#), [687](#)
- mod, [685](#), [692](#)
- mul, [683](#), [689](#)
- mulhi, [683](#), [689](#)
- mullo, [683](#), [689](#)
- mulx, [683](#), [689](#)
- pack, [682](#), [688](#)
- pack\_even, [682](#), [688](#)
- pack\_odd, [682](#), [688](#)
- round, [685](#), [692](#)
- scalar\_t, [679](#)
- set, [680](#), [686](#)
- set1, [680](#), [686](#)
- shuffle, [681](#), [687](#)
- shuffle\_twice, [681](#), [687](#)
- simdHalf, [679](#)
- sll, [681](#), [687](#)
- sra, [681](#), [687](#)
- srl, [681](#), [687](#)
- store, [681](#), [687](#)
- storeu, [681](#), [687](#)
- stream, [681](#), [687](#)
- sub, [683](#), [689](#)
- subin, [683](#), [689](#)
- transpose, [682](#), [688](#)
- type\_string, [680](#), [686](#)
- unpackhi, [682](#), [688](#)
- unpackhi\_intrinsic, [681](#), [688](#)
- unpacklo, [682](#), [688](#)
- unpacklo\_intrinsic, [681](#), [687](#)
- unpacklohi, [682](#), [688](#)
- valid, [680](#), [686](#)
- vand, [692](#)
- vandnot, [692](#)
- vect\_size, [692](#)
- vect\_t, [679](#)
- vor, [692](#)
- vxor, [692](#)
- zero, [692](#)
- Simd256\_impl< true, true, true, 4 >::Converter, [427](#)
- t, [428](#)
- v, [428](#)
- Simd256\_impl< true, true, true, 8 >, [693](#)
- add, [698](#)
- addin, [698](#)
- aligned\_allocator, [695](#)
- aligned\_vector, [695](#)
- alignment, [701](#)
- blend, [698](#)

compliant, 695  
 eq, 700  
 fmadd, 699  
 fmaddin, 699  
 fmaddx, 699  
 fmaddxin, 699  
 fmsub, 700  
 fmsubin, 700  
 fmsubx, 700  
 fmsubxin, 700  
 fnmadd, 699  
 fnmaddin, 699  
 fnmaddx, 699  
 fnmaddxin, 699  
 gather, 696  
 get, 696  
 greater, 700  
 greater\_eq, 700  
 hadd\_to\_scal, 701  
 half\_t, 695  
 is\_same\_element, 695  
 lesser, 700  
 lesser\_eq, 700  
 load, 696  
 loadu, 696  
 mask\_high, 701  
 mod, 701  
 mul, 698  
 mulhi, 698  
 mulhi\_fast, 701  
 mullo, 698  
 mulx, 699  
 pack, 697  
 pack\_even, 697  
 pack\_odd, 697  
 round, 701  
 scalar\_t, 695  
 set, 695  
 set1, 695  
 shuffle, 697  
 signbits, 701  
 simdHalf, 695  
 sll, 696  
 sra, 696  
 srl, 696  
 store, 696  
 storeu, 696  
 stream, 696  
 sub, 698  
 subin, 698  
 transpose, 698  
 type\_string, 695  
 unpackhi, 697  
 unpackhi\_intrinsic, 697  
 unpacklo, 697  
 unpacklo\_intrinsic, 697  
 unpacklohi, 697  
 valid, 695  
 vect\_size, 701  
 vect\_t, 695  
 zero, 701  
 Simd256\_impl< true, true, true, 8 >::Converter, 428  
 t, 428  
 v, 428  
 simd256\_int16.inl, 875  
 \_\_FFLASFFPACK\_fflas\_ffpack\_utils\_simd256\_int16\_INL, 875  
 simd256\_int32.inl, 875  
 \_\_FFLASFFPACK\_fflas\_ffpack\_utils\_simd256\_int32\_INL, 876  
 simd256\_int64.inl, 876  
 \_\_FFLASFFPACK\_fflas\_ffpack\_utils\_simd256\_int64\_INL, 876  
 vect\_t, 876  
 Simd256fp\_base, 702  
 Simd256i\_base, 702  
 vect\_t, 702  
 zero, 702  
 Simd512  
 simd512.inl, 877  
 simd512.inl, 876  
 \_\_FFLASFFPACK\_simd512\_INL, 877  
 Simd512, 877  
 simd512\_double.inl, 877  
 \_\_FFLASFFPACK\_simd512\_double\_INL, 877  
 simd512\_float.inl, 877  
 \_\_FFLASFFPACK\_simd512\_float\_INL, 877  
 Simd512\_impl< ArithType, Int, Signed, Size >, 702  
 Simd512\_impl< true, false, true, 4 >, 702  
 Simd512\_impl< true, false, true, 8 >, 703  
 add, 707  
 addin, 707  
 aligned\_allocator, 704  
 aligned\_vector, 704  
 alignment, 709  
 blend, 707  
 blendv, 707  
 ceil, 709  
 compliant, 704  
 div, 707  
 eq, 708  
 floor, 709  
 fmadd, 707  
 fmaddin, 708  
 fmsub, 708  
 fmsubin, 708  
 fnmadd, 708  
 fnmaddin, 708  
 gather, 705  
 greater, 708  
 greater\_eq, 709  
 hadd, 709  
 hadd\_to\_scal, 709  
 is\_same\_element, 704  
 lesser, 708  
 lesser\_eq, 708

- load, [705](#)
- loadu, [705](#)
- mul, [707](#)
- mulin, [707](#)
- pack, [706](#)
- pack\_even, [706](#)
- pack\_odd, [706](#)
- round, [709](#)
- scalar\_t, [704](#)
- set, [705](#)
- set1, [705](#)
- shuffle, [705](#)
- store, [705](#)
- storeu, [705](#)
- stream, [705](#)
- sub, [707](#)
- subin, [707](#)
- transpose, [706](#)
- type\_string, [704](#)
- unpackhi, [706](#)
- unpackhi\_intrinsic, [706](#)
- unpacklo, [706](#)
- unpacklo\_intrinsic, [705](#)
- unpacklohi, [706](#)
- valid, [704](#)
- vect\_size, [709](#)
- vect\_t, [704](#)
- zero, [704](#)
- Simd512\_impl< true, true, false, 8 >, [709](#)
  - add, [718](#)
  - addin, [718](#)
  - aligned\_allocator, [712](#)
  - aligned\_vector, [712](#)
  - alignment, [720](#)
  - blend, [718](#)
  - compliant, [715](#)
  - eq, [719](#)
  - fmadd, [718](#)
  - fmaddin, [718](#)
  - fmaddx, [714](#)
  - fmaddxin, [714](#)
  - fmsub, [719](#)
  - fmsubin, [719](#)
  - fmsubx, [714](#)
  - fmsubxin, [715](#)
  - fmadd, [718](#)
  - fmaddin, [719](#)
  - fmaddx, [714](#)
  - fmaddxin, [714](#)
  - gather, [712](#), [715](#)
  - greater, [713](#)
  - greater\_eq, [713](#)
  - hadd\_to\_scal, [715](#)
  - half\_t, [712](#)
  - is\_same\_element, [712](#)
  - lesser, [713](#)
  - lesser\_eq, [714](#)
  - load, [713](#), [716](#)
  - loadu, [713](#), [716](#)
  - mask\_high, [719](#)
  - maskstore, [713](#), [716](#)
  - mod, [719](#)
  - mul, [718](#)
  - mulhi, [714](#)
  - mulhi\_fast, [719](#)
  - mullo, [714](#)
  - mulx, [714](#)
  - pack, [717](#)
  - pack\_even, [717](#)
  - pack\_odd, [717](#)
  - round, [719](#)
  - scalar\_t, [712](#)
  - set, [712](#), [715](#)
  - set1, [712](#), [715](#)
  - shuffle, [716](#)
  - signbits, [719](#)
  - simdHalf, [712](#)
  - sll, [716](#)
  - sra, [713](#)
  - srl, [716](#)
  - store, [713](#), [716](#)
  - storeu, [713](#), [716](#)
  - stream, [713](#), [716](#)
  - sub, [718](#)
  - subin, [718](#)
  - transpose, [717](#)
  - type\_string, [712](#)
  - unpackhi, [717](#)
  - unpackhi\_intrinsic, [717](#)
  - unpacklo, [717](#)
  - unpacklo\_intrinsic, [716](#)
  - unpacklohi, [717](#)
  - valid, [715](#)
  - vand, [720](#)
  - vandnot, [720](#)
  - vect\_size, [720](#)
  - vect\_t, [712](#)
  - vor, [720](#)
  - vxor, [720](#)
  - zero, [720](#)
- Simd512\_impl< true, true, false, 8 >::Converter, [428](#)
  - t, [428](#)
  - v, [428](#)
- Simd512\_impl< true, true, true, 8 >, [720](#)
  - add, [726](#)
  - addin, [726](#)
  - aligned\_allocator, [723](#)
  - aligned\_vector, [723](#)
  - alignment, [730](#)
  - blend, [726](#)
  - compliant, [723](#)
  - eq, [728](#)
  - fmadd, [727](#)
  - fmaddin, [727](#)
  - fmaddx, [727](#)
  - fmaddxin, [727](#)

fmsub, [728](#)  
 fmubin, [728](#)  
 fmsubx, [728](#)  
 fmsubxin, [728](#)  
 fnmadd, [727](#)  
 fnmaddin, [727](#)  
 fnmaddx, [727](#)  
 fnmaddxin, [727](#)  
 gather, [723](#)  
 greater, [728](#)  
 greater\_eq, [728](#)  
 hadd\_to\_scal, [728](#)  
 half\_t, [722](#)  
 is\_same\_element, [723](#)  
 lesser, [728](#)  
 lesser\_eq, [728](#)  
 load, [724](#)  
 loadu, [724](#)  
 mask\_high, [729](#)  
 maskstore, [724](#)  
 mod, [729](#)  
 mul, [726](#)  
 mulhi, [726](#)  
 mulhi\_fast, [729](#)  
 mullo, [726](#)  
 mulx, [726](#)  
 pack, [725](#)  
 pack\_even, [725](#)  
 pack\_odd, [725](#)  
 round, [729](#)  
 scalar\_t, [722](#)  
 set, [723](#)  
 set1, [723](#)  
 shuffle, [724](#)  
 signbits, [729](#)  
 simdHalf, [722](#)  
 sll, [724](#)  
 sra, [724](#)  
 srl, [724](#)  
 store, [724](#)  
 storeu, [724](#)  
 stream, [724](#)  
 sub, [726](#)  
 subin, [726](#)  
 transpose, [725](#)  
 type\_string, [723](#)  
 unpackhi, [725](#)  
 unpackhi\_intrinsic, [725](#)  
 unpacklo, [725](#)  
 unpacklo\_intrinsic, [725](#)  
 unpacklohi, [725](#)  
 valid, [723](#)  
 vand, [729](#)  
 vandnot, [729](#)  
 vect\_size, [730](#)  
 vect\_t, [722](#)  
 vor, [729](#)  
 vxor, [729](#)  
 zero, [729](#)  
 Simd512\_impl< true, true, true, 8 >::Converter, [428](#)  
 t, [429](#)  
 v, [429](#)  
 simd512\_int32.inl, [878](#)  
 \_\_FFLASFFPACK\_simd512\_int32\_INL, [878](#)  
 simd512\_int64.inl, [878](#)  
 \_simd512\_int64\_INL, [878](#)  
 vect\_t, [878](#)  
 Simd512i\_base, [730](#)  
 vand, [731](#)  
 vandnot, [731](#)  
 vect\_t, [730](#)  
 vor, [730](#)  
 vxor, [730](#)  
 zero, [730](#)  
 SIMD\_INT  
 fflas\_simd.h, [870](#)  
 simd\_modular.inl, [879](#)  
 SimdChooser< T, bool, bool >, [731](#)  
 SimdChooser< T, false, b >, [731](#)  
 value, [731](#)  
 SimdChooser< T, true, false >, [731](#)  
 value, [732](#)  
 SimdChooser< T, true, true >, [732](#)  
 value, [732](#)  
 simdHalf  
 Simd256\_impl< true, true, false, 2 >, [630](#)  
 Simd256\_impl< true, true, false, 4 >, [642](#)  
 Simd256\_impl< true, true, false, 8 >, [659](#)  
 Simd256\_impl< true, true, true, 2 >, [668](#)  
 Simd256\_impl< true, true, true, 4 >, [679](#)  
 Simd256\_impl< true, true, true, 8 >, [695](#)  
 Simd512\_impl< true, true, false, 8 >, [712](#)  
 Simd512\_impl< true, true, true, 8 >, [722](#)  
 SimdSparseMatrix  
 FFLAS, [72](#)  
 simdToType< T >, [732](#)  
 Single, [732](#)  
 size  
 BlockTransposeSIMD< Field, Simd, >, [407](#)  
 Info, [482](#), [483](#)  
 RNSInteger< RNS >, [540](#)  
 RNSIntegerMod< RNS >, [544](#)  
 SIZEOF\_\_INT64\_T  
 config.h, [818](#)  
 SIZEOF\_CHAR  
 config.h, [817](#)  
 SIZEOF\_INT  
 config.h, [817](#)  
 SIZEOF\_LONG  
 config.h, [817](#)  
 SIZEOF\_LONG\_LONG  
 config.h, [818](#)  
 SIZEOF\_SHORT  
 config.h, [818](#)  
 sll

- ScalFunctionsBase< Element, typename enable\_if<  
is\_integral< Element >::value >::type >, 559
- Simd128\_impl< true, true, false, 2 >, 567
- Simd128\_impl< true, true, false, 4 >, 577
- Simd128\_impl< true, true, false, 8 >, 587
- Simd128\_impl< true, true, true, 2 >, 595
- Simd128\_impl< true, true, true, 4 >, 604
- Simd128\_impl< true, true, true, 8 >, 613
- Simd256\_impl< true, true, false, 2 >, 634
- Simd256\_impl< true, true, false, 4 >, 649
- Simd256\_impl< true, true, false, 8 >, 663
- Simd256\_impl< true, true, true, 2 >, 670
- Simd256\_impl< true, true, true, 4 >, 681, 687
- Simd256\_impl< true, true, true, 8 >, 696
- Simd512\_impl< true, true, false, 8 >, 716
- Simd512\_impl< true, true, true, 8 >, 724
- sll128
  - Simd128\_impl< true, true, false, 2 >, 570
  - Simd128\_impl< true, true, false, 4 >, 580
  - Simd128\_impl< true, true, false, 8 >, 591
  - Simd128\_impl< true, true, true, 2 >, 600
  - Simd128\_impl< true, true, true, 4 >, 608
  - Simd128\_impl< true, true, true, 8 >, 618
  - Simd128i\_base, 619
- Solve
  - FFPACK, 327, 370
- solve.C, 803
  - main, 803
- Solve\_modular\_double
  - ffpack.C, 997
  - ffpack\_c.h, 1016
- solveLB
  - FFPACK, 346, 370
- solveLB2
  - FFPACK, 346, 370
- solveLB2\_modular\_double
  - ffpack.C, 997
  - ffpack\_c.h, 1017
- solveLB\_modular\_double
  - ffpack.C, 997
  - ffpack\_c.h, 1017
- Sparse< \_Field, SparseMatrix\_t::COO >, 732
  - col, 733
  - dat, 733
  - delayed, 733
  - Field, 733
  - kmax, 733
  - m, 733
  - maxrow, 734
  - n, 733
  - nElements, 734
  - nnz, 733
  - row, 733
- Sparse< \_Field, SparseMatrix\_t::COO\_ZO >, 734
  - col, 735
  - cst, 735
  - dat, 735
  - delayed, 735
- Field, 734
- kmax, 735
- m, 735
- maxrow, 735
- n, 735
- nElements, 735
- nnz, 735
- row, 735
- Sparse< \_Field, SparseMatrix\_t::CSR >, 736
  - col, 737
  - dat, 737
  - delayed, 736
  - Field, 736
  - kmax, 736
  - m, 736
  - maxrow, 737
  - n, 736
  - nElements, 737
  - nnz, 736
  - st, 737
  - stend, 737
- Sparse< \_Field, SparseMatrix\_t::CSR\_HYB >, 737
  - col, 738
  - dat, 738
  - delayed, 738
  - Field, 738
  - kmax, 738
  - m, 738
  - maxrow, 738
  - n, 738
  - nElements, 738
  - nMOnes, 739
  - nnz, 738
  - nOnes, 739
  - nOthers, 739
  - st, 738
- Sparse< \_Field, SparseMatrix\_t::CSR\_ZO >, 739
  - col, 740
  - cst, 740
  - dat, 741
  - delayed, 740
  - Field, 740
  - kmax, 740
  - m, 740
  - maxrow, 740
  - n, 740
  - nElements, 740
  - nnz, 740
  - st, 740
  - stend, 740
- Sparse< \_Field, SparseMatrix\_t::ELL >, 741
  - col, 742
  - dat, 742
  - delayed, 741
  - Field, 741
  - kmax, 741
  - ld, 742
  - m, 742



- maxrow, [742](#)
- n, [742](#)
- nElements, [742](#)
- nnz, [742](#)
- Sparse< \_Field, SparseMatrix\_t::ELL\_simd >, [742](#)
  - chunk, [743](#)
  - col, [744](#)
  - dat, [744](#)
  - delayed, [743](#)
  - kmax, [743](#)
  - ld, [743](#)
  - m, [743](#)
  - maxrow, [743](#)
  - n, [743](#)
  - nChunks, [744](#)
  - nElements, [743](#)
  - nnz, [743](#)
- Sparse< \_Field, SparseMatrix\_t::ELL\_simd\_ZO >, [744](#)
  - chunk, [745](#)
  - col, [745](#)
  - cst, [744](#)
  - dat, [745](#)
  - delayed, [744](#)
  - kmax, [745](#)
  - ld, [745](#)
  - m, [745](#)
  - maxrow, [745](#)
  - n, [745](#)
  - nChunks, [745](#)
  - nElements, [745](#)
  - nnz, [745](#)
- Sparse< \_Field, SparseMatrix\_t::ELL\_ZO >, [746](#)
  - col, [747](#)
  - cst, [746](#)
  - dat, [747](#)
  - delayed, [746](#)
  - Field, [746](#)
  - kmax, [746](#)
  - ld, [747](#)
  - m, [746](#)
  - maxrow, [747](#)
  - n, [746](#)
  - nElements, [747](#)
  - nnz, [747](#)
- Sparse< \_Field, SparseMatrix\_t::SELL >, [747](#)
  - chunk, [748](#)
  - chunkSize, [749](#)
  - col, [749](#)
  - dat, [749](#)
  - delayed, [748](#)
  - Field, [748](#)
  - kmax, [748](#)
  - m, [748](#)
  - maxrow, [748](#)
  - n, [748](#)
  - nChunks, [749](#)
  - nElements, [749](#)
  - nnz, [749](#)
  - perm, [749](#)
  - sigma, [748](#)
  - st, [749](#)
- Sparse< \_Field, SparseMatrix\_t::SELL\_ZO >, [749](#)
  - chunk, [750](#)
  - chunkSize, [751](#)
  - col, [751](#)
  - cst, [750](#)
  - dat, [751](#)
  - delayed, [750](#)
  - Field, [750](#)
  - kmax, [750](#)
  - m, [750](#)
  - maxrow, [751](#)
  - n, [750](#)
  - nChunks, [751](#)
  - nElements, [751](#)
  - nnz, [751](#)
  - perm, [751](#)
  - sigma, [751](#)
  - st, [751](#)
- Sparse< Field, SparseMatrix\_t, IdxT, PtrT >, [732](#)
- sparse\_delete
  - FFLAS, [146–150](#), [153](#)
- sparse\_init
  - FFLAS, [145–150](#), [153](#)
- sparse\_matrix\_traits.h, [909](#)
- sparse\_print
  - FFLAS, [147](#), [150](#), [153](#)
- SparseMatrix\_t
  - FFLAS, [76](#)
- SpecRankProfile
  - FFPACK, [369](#)
- SpecRankProfile\_modular\_double
  - ffpack.C, [996](#)
  - ffpack\_c.h, [1016](#)
- splitt
  - parallel.h, [1036](#)
- SPLITTER
  - parallel.h, [1036](#)
- splitting\_0
  - parallel.h, [1035](#)
- splitting\_1
  - parallel.h, [1035](#)
- splitting\_2
  - parallel.h, [1036](#)
- splitting\_3
  - parallel.h, [1036](#)
- SpMat< Field, flag >, [751](#)
  - \_coo, [752](#)
  - \_csr, [752](#)
  - \_ell, [752](#)
- square\_inplace
  - FFLAS::ftranspose\_impl, [190](#)
- sra
  - ScalFunctionsBase< Element, typename enable\_if<
    - is\_integral< Element >::value >::type >, [559](#)
 Simd128\_impl< true, true, false, 2 >, [564](#)

- Simd128\_impl< true, true, false, 4 >, [574](#)
- Simd128\_impl< true, true, false, 8 >, [584](#)
- Simd128\_impl< true, true, true, 2 >, [595](#)
- Simd128\_impl< true, true, true, 4 >, [604](#)
- Simd128\_impl< true, true, true, 8 >, [613](#)
- Simd256\_impl< true, true, false, 2 >, [632](#)
- Simd256\_impl< true, true, false, 4 >, [643](#), [646](#)
- Simd256\_impl< true, true, false, 8 >, [660](#)
- Simd256\_impl< true, true, true, 2 >, [670](#)
- Simd256\_impl< true, true, true, 4 >, [681](#), [687](#)
- Simd256\_impl< true, true, true, 8 >, [696](#)
- Simd512\_impl< true, true, false, 8 >, [713](#)
- Simd512\_impl< true, true, true, 8 >, [724](#)
- srl
  - ScalFunctionsBase< Element, typename enable\_if< is\_integral< Element >::value >::type >, [559](#)
  - Simd128\_impl< true, true, false, 2 >, [567](#)
  - Simd128\_impl< true, true, false, 4 >, [577](#)
  - Simd128\_impl< true, true, false, 8 >, [587](#)
  - Simd128\_impl< true, true, true, 2 >, [595](#)
  - Simd128\_impl< true, true, true, 4 >, [604](#)
  - Simd128\_impl< true, true, true, 8 >, [613](#)
  - Simd256\_impl< true, true, false, 2 >, [635](#)
  - Simd256\_impl< true, true, false, 4 >, [649](#)
  - Simd256\_impl< true, true, false, 8 >, [663](#)
  - Simd256\_impl< true, true, true, 2 >, [670](#)
  - Simd256\_impl< true, true, true, 4 >, [681](#), [687](#)
  - Simd256\_impl< true, true, true, 8 >, [696](#)
  - Simd512\_impl< true, true, false, 8 >, [716](#)
  - Simd512\_impl< true, true, true, 8 >, [724](#)
- srl128
  - Simd128\_impl< true, true, false, 2 >, [570](#)
  - Simd128\_impl< true, true, false, 4 >, [580](#)
  - Simd128\_impl< true, true, false, 8 >, [591](#)
  - Simd128\_impl< true, true, true, 2 >, [600](#)
  - Simd128\_impl< true, true, true, 4 >, [609](#)
  - Simd128\_impl< true, true, true, 8 >, [618](#)
  - Simd128i\_base, [619](#)
- sscal\_
  - config-blas.h, [813](#)
- ST
  - fflas\_transpose.h, [912](#)
- st
  - Sparse< \_Field, SparseMatrix\_t::CSR >, [737](#)
  - Sparse< \_Field, SparseMatrix\_t::CSR\_HYB >, [738](#)
  - Sparse< \_Field, SparseMatrix\_t::CSR\_ZO >, [740](#)
  - Sparse< \_Field, SparseMatrix\_t::SELL >, [749](#)
  - Sparse< \_Field, SparseMatrix\_t::SELL\_ZO >, [751](#)
- StatsMatrix, [752](#)
  - averageCol, [753](#)
  - averageColDifference, [754](#)
  - averageRow, [753](#)
  - averageRowDifference, [754](#)
  - coldim, [753](#)
  - denseCols, [754](#)
  - denseRows, [754](#)
  - deviationCol, [753](#)
  - deviationColDifference, [754](#)
  - deviationRow, [753](#)
  - deviationRowDifference, [754](#)
  - maxCol, [753](#)
  - maxColDifference, [754](#)
  - maxRow, [753](#)
  - maxRowDifference, [754](#)
  - minCol, [753](#)
  - minColDifference, [754](#)
  - minRow, [753](#)
  - minRowDifference, [754](#)
  - nDenseCols, [754](#)
  - nDenseRows, [754](#)
  - nEmptyCols, [754](#)
  - nEmptyColsEnd, [754](#)
  - nEmptyRows, [754](#)
  - nMOnes, [753](#)
  - nnz, [753](#)
  - nOnes, [753](#)
  - nOthers, [753](#)
  - rowdim, [753](#)
- STD\_RECINT\_SIZE
  - benchmark-fgemm-mp.C, [785](#)
  - benchmark-fgemv-mp.C, [788](#)
- STDC\_HEADERS
  - config.h, [818](#)
- stend
  - Sparse< \_Field, SparseMatrix\_t::CSR >, [737](#)
  - Sparse< \_Field, SparseMatrix\_t::CSR\_ZO >, [740](#)
- store
  - Simd128\_impl< true, true, false, 2 >, [564](#), [567](#)
  - Simd128\_impl< true, true, false, 4 >, [574](#), [577](#)
  - Simd128\_impl< true, true, false, 8 >, [584](#), [587](#)
  - Simd128\_impl< true, true, true, 2 >, [595](#)
  - Simd128\_impl< true, true, true, 4 >, [603](#)
  - Simd128\_impl< true, true, true, 8 >, [613](#)
  - Simd256\_impl< true, false, true, 8 >, [623](#)
  - Simd256\_impl< true, true, false, 2 >, [631](#), [634](#)
  - Simd256\_impl< true, true, false, 4 >, [643](#), [646](#), [649](#)
  - Simd256\_impl< true, true, false, 8 >, [660](#), [662](#)
  - Simd256\_impl< true, true, true, 2 >, [670](#)
  - Simd256\_impl< true, true, true, 4 >, [681](#), [687](#)
  - Simd256\_impl< true, true, true, 8 >, [696](#)
  - Simd512\_impl< true, false, true, 8 >, [705](#)
  - Simd512\_impl< true, true, false, 8 >, [713](#), [716](#)
  - Simd512\_impl< true, true, true, 8 >, [724](#)
- storeu
  - Simd128\_impl< true, true, false, 2 >, [564](#), [567](#)
  - Simd128\_impl< true, true, false, 4 >, [574](#), [577](#)
  - Simd128\_impl< true, true, false, 8 >, [584](#), [587](#)
  - Simd128\_impl< true, true, true, 2 >, [595](#)
  - Simd128\_impl< true, true, true, 4 >, [604](#)
  - Simd128\_impl< true, true, true, 8 >, [613](#)
  - Simd256\_impl< true, false, true, 8 >, [623](#)
  - Simd256\_impl< true, true, false, 2 >, [632](#), [634](#)
  - Simd256\_impl< true, true, false, 4 >, [643](#), [646](#), [649](#)

- Simd256\_impl< true, true, false, 8 >, [660](#), [663](#)
- Simd256\_impl< true, true, true, 2 >, [670](#)
- Simd256\_impl< true, true, true, 4 >, [681](#), [687](#)
- Simd256\_impl< true, true, true, 8 >, [696](#)
- Simd512\_impl< true, false, true, 8 >, [705](#)
- Simd512\_impl< true, true, false, 8 >, [713](#), [716](#)
- Simd512\_impl< true, true, true, 8 >, [724](#)
- stream
  - Simd128\_impl< true, true, false, 2 >, [564](#), [567](#)
  - Simd128\_impl< true, true, false, 4 >, [574](#), [577](#)
  - Simd128\_impl< true, true, false, 8 >, [584](#), [587](#)
  - Simd128\_impl< true, true, true, 2 >, [595](#)
  - Simd128\_impl< true, true, true, 4 >, [604](#)
  - Simd128\_impl< true, true, true, 8 >, [613](#)
  - Simd256\_impl< true, false, true, 8 >, [623](#)
  - Simd256\_impl< true, true, false, 2 >, [632](#), [634](#)
  - Simd256\_impl< true, true, false, 4 >, [643](#), [646](#), [649](#)
  - Simd256\_impl< true, true, false, 8 >, [660](#), [663](#)
  - Simd256\_impl< true, true, true, 2 >, [670](#)
  - Simd256\_impl< true, true, true, 4 >, [681](#), [687](#)
  - Simd256\_impl< true, true, true, 8 >, [696](#)
  - Simd512\_impl< true, false, true, 8 >, [705](#)
  - Simd512\_impl< true, true, false, 8 >, [713](#), [716](#)
  - Simd512\_impl< true, true, true, 8 >, [724](#)
- string, [755](#)
- string::const\_iterator, [423](#)
- string::const\_reverse\_iterator, [423](#)
- string::iterator, [490](#)
- string::reverse\_iterator, [523](#)
- strmm\_
  - config-blas.h, [813](#)
- strsm\_
  - config-blas.h, [813](#)
- sub
  - FFLAS::vectorised, [280](#)
  - FieldSimd< \_Field >, [449](#), [450](#)
  - RNSIntegerMod< RNS >, [546](#)
  - ScalFunctions< Element >, [552](#)
  - Simd128\_impl< true, true, false, 2 >, [569](#)
  - Simd128\_impl< true, true, false, 4 >, [579](#)
  - Simd128\_impl< true, true, false, 8 >, [589](#)
  - Simd128\_impl< true, true, true, 2 >, [597](#)
  - Simd128\_impl< true, true, true, 4 >, [605](#)
  - Simd128\_impl< true, true, true, 8 >, [615](#)
  - Simd256\_impl< true, false, true, 8 >, [625](#)
  - Simd256\_impl< true, true, false, 2 >, [636](#)
  - Simd256\_impl< true, true, false, 4 >, [653](#)
  - Simd256\_impl< true, true, false, 8 >, [664](#)
  - Simd256\_impl< true, true, true, 2 >, [672](#)
  - Simd256\_impl< true, true, true, 4 >, [683](#), [689](#)
  - Simd256\_impl< true, true, true, 8 >, [698](#)
  - Simd512\_impl< true, false, true, 8 >, [707](#)
  - Simd512\_impl< true, true, false, 8 >, [718](#)
  - Simd512\_impl< true, true, true, 8 >, [726](#)
- sub\_r
  - FieldSimd< \_Field >, [450](#)
- subin
  - FieldSimd< \_Field >, [450](#)
- FieldSimd< \_Field >, [450](#)
- ScalFunctions< Element >, [552](#)
- Simd128\_impl< true, true, false, 2 >, [569](#)
- Simd128\_impl< true, true, false, 4 >, [579](#)
- Simd128\_impl< true, true, false, 8 >, [589](#)
- Simd128\_impl< true, true, true, 2 >, [597](#)
- Simd128\_impl< true, true, true, 4 >, [606](#)
- Simd128\_impl< true, true, true, 8 >, [615](#)
- Simd256\_impl< true, false, true, 8 >, [625](#)
- Simd256\_impl< true, true, false, 2 >, [636](#)
- Simd256\_impl< true, true, false, 4 >, [653](#)
- Simd256\_impl< true, true, false, 8 >, [664](#)
- Simd256\_impl< true, true, true, 2 >, [672](#)
- Simd256\_impl< true, true, true, 4 >, [683](#), [689](#)
- Simd256\_impl< true, true, true, 8 >, [698](#)
- Simd512\_impl< true, false, true, 8 >, [707](#)
- Simd512\_impl< true, true, false, 8 >, [718](#)
- Simd512\_impl< true, true, true, 8 >, [726](#)
- subin\_r
  - FieldSimd< \_Field >, [450](#)
- subp
  - FFLAS::vectorised, [280](#)
- support\_fast\_mod< double >, [755](#)
- support\_fast\_mod< float >, [756](#)
- support\_fast\_mod< int64\_t >, [756](#)
- support\_fast\_mod< T >, [755](#)
- support\_simd< T >, [756](#)
- support\_simd\_add< T >, [756](#)
- support\_simd\_mod< T >, [757](#)
- swapval
  - FFPACK, [381](#)
- SYNCH\_GROUP
  - parallel.h, [1031](#)
- SysTimer
  - FFLAS, [74](#)
- T
  - limits< char >, [491](#)
  - limits< double >, [492](#)
  - limits< float >, [492](#)
  - limits< Givaro::Integer >, [493](#)
  - limits< int >, [493](#)
  - limits< long >, [494](#)
  - limits< long long >, [495](#)
  - limits< RecInt::rint< K > >, [495](#)
  - limits< RecInt::ruint< K > >, [496](#)
  - limits< short int >, [497](#)
  - limits< signed char >, [497](#)
  - limits< unsigned char >, [498](#)
  - limits< unsigned int >, [498](#)
  - limits< unsigned long >, [499](#)
  - limits< unsigned long long >, [500](#)
  - limits< unsigned short int >, [500](#)
- t
  - Simd128\_impl< true, true, false, 2 >::Converter, [424](#)
  - Simd128\_impl< true, true, false, 4 >::Converter, [424](#)

- Simd128\_impl< true, true, false, 8 >::Converter, [425](#)
- Simd128\_impl< true, true, true, 2 >::Converter, [425](#)
- Simd128\_impl< true, true, true, 4 >::Converter, [425](#)
- Simd128\_impl< true, true, true, 8 >::Converter, [426](#)
- Simd256\_impl< true, false, true, 8 >::Converter, [426](#)
- Simd256\_impl< true, true, false, 2 >::Converter, [426](#)
- Simd256\_impl< true, true, false, 4 >::Converter, [427](#)
- Simd256\_impl< true, true, false, 8 >::Converter, [427](#)
- Simd256\_impl< true, true, true, 2 >::Converter, [427](#)
- Simd256\_impl< true, true, true, 4 >::Converter, [428](#)
- Simd256\_impl< true, true, true, 8 >::Converter, [428](#)
- Simd512\_impl< true, true, false, 8 >::Converter, [428](#)
- Simd512\_impl< true, true, true, 8 >::Converter, [429](#)
- TASK
  - parallel.h, [1030](#)
- tBC
  - test-lu.C, [1089](#)
  - test-permutations.C, [1094](#)
- Test
  - Test< Elt >, [759](#)
- test
  - test-maxdelayeddim.C, [1090](#)
- Test< Elt >, [757](#)
  - \_mm, [759](#)
  - \_nn, [759](#)
  - cardinality, [759](#)
  - doTests, [759](#)
  - Elt\_ptr, [758](#)
  - enable\_if\_no\_simd\_t, [758](#)
  - enable\_if\_simd128\_t, [758](#)
  - enable\_if\_simd256\_t, [758](#)
  - enable\_if\_simd512\_t, [758](#)
  - enable\_if\_t, [758](#)
  - F, [759](#)
  - Field, [758](#)
  - is\_same\_element, [758](#)
  - Residu, [758](#)
  - run, [759](#)
  - Test, [759](#)
  - test\_ftranspose, [759](#)
- test-charpoly-check.C, [1051](#)
  - ENABLE\_CHECKER\_charpoly, [1052](#)
  - main, [1052](#)
  - printPolynomial, [1052](#)
  - TIME\_CHECKER\_CHARPOLY, [1052](#)
- test-charpoly.C, [1052](#)
  - launch\_test, [1052](#)
  - main, [1053](#)
  - run\_with\_field, [1053](#)
- test-compressQ.C, [1053](#)
  - Field, [1053](#)
  - main, [1054](#)
  - printvect, [1053](#)
- test-det-check.C, [1054](#)
  - ENABLE\_CHECKER\_Det, [1054](#)
  - main, [1054](#)
  - TIME\_CHECKER\_Det, [1054](#)
- test-det.C, [1054](#)
  - main, [1055](#)
  - test\_det, [1055](#)
- test-echelon.C, [1055](#)
  - \_\_FFLASFFPACK\_GAUSSJORDAN\_BASECASE, [1056](#)
  - \_\_FFLASFFPACK\_PLUQ\_THRESHOLD, [1056](#)
  - \_\_FFLASFFPACK\_SEQUENTIAL, [1056](#)
  - main, [1057](#)
  - run\_with\_field, [1057](#)
  - test\_colechelon, [1056](#)
  - test\_redcoechelon, [1056](#)
  - test\_redrowechelon, [1057](#)
  - test\_rowechelon, [1056](#)
- test-fadd.C, [1057](#)
  - main, [1058](#)
  - test\_fadd, [1058](#)
  - test\_faddin, [1058](#)
  - test\_fsub, [1058](#)
  - test\_fsubin, [1058](#)
- test-fdot.C, [1059](#)
  - check\_fdot, [1059](#)
  - ENABLE\_ALL\_CHECKINGS, [1059](#)
  - main, [1060](#)
  - run\_with\_field, [1059](#)
  - run\_with\_Integer, [1060](#)
- test-fgemm-check.C, [1060](#)
  - ENABLE\_ALL\_CHECKINGS, [1060](#)
  - launch\_MM\_dispatch, [1060](#)
  - main, [1061](#)
  - run\_with\_field, [1061](#)
- test-fgemm.C, [1061](#)
  - check\_MM, [1062](#)
  - ENABLE\_CHECKER\_fgemm, [1062](#)
  - launch\_MM, [1062](#)
  - launch\_MM\_dispatch, [1062](#)
  - main, [1063](#)
  - run\_with\_field, [1063](#)
- test-fgemv.C, [1063](#)
  - check\_MV, [1064](#)
  - launch\_MV, [1064](#)
  - launch\_MV\_dispatch, [1064](#)
  - main, [1065](#)
  - run\_with\_field, [1065](#)
- test-fger.C, [1065](#)
  - check\_fger, [1066](#)

- launch\_fger, 1066
- launch\_fger\_dispatch, 1066
- main, 1067
- run\_with\_field, 1066
- TIME, 1066
- test-fgesv.C, 1067
  - main, 1068
  - run\_with\_field, 1068
  - test\_rect\_fgesv, 1067
  - test\_square\_fgesv, 1067
- test-finit.C, 1068
  - main, 1069
  - run\_with\_field, 1069
  - test\_freduce, 1069
- test-fscal.C, 1069
  - main, 1070
  - RandomMatrix, 1070
  - test\_fscal, 1070
  - test\_fscaln, 1070
- test-fsyr2k.C, 1071
  - check\_fsyr2k, 1072
  - ENABLE\_ALL\_CHECKINGS, 1071
  - main, 1072
  - run\_with\_field, 1072
- test-fsyrr.C, 1072
  - check\_computeS1S2, 1074
  - check\_fsyrr, 1073
  - check\_fsyrr\_bkdiag, 1073
  - check\_fsyrr\_diag, 1073
  - ENABLE\_ALL\_CHECKINGS, 1073
  - main, 1074
  - run\_with\_field, 1074
- test-fsytrf.C, 1074
  - main, 1075
  - operator<<, 1075
  - run\_with\_field, 1075
  - test\_generic\_fsytrf, 1075
  - test\_RPM\_fsytrf, 1075
- test-ftmm.C, 1075
  - \_\_FFLASFFPACK\_SEQUENTIAL, 1076
  - check\_ftmm, 1076
  - main, 1076
  - run\_with\_field, 1076
- test-ftmv.C, 1077
  - \_\_FFLASFFPACK\_SEQUENTIAL, 1077
  - check\_ftmv, 1077
  - ENABLE\_ALL\_CHECKINGS, 1077
  - main, 1078
  - run\_with\_field, 1077
- test-ftsm-check.C, 1078
  - ENABLE\_ALL\_CHECKINGS, 1078
  - main, 1078
- test-ftsm.C, 1078
  - \_\_FFLASFFPACK\_SEQUENTIAL, 1079
  - check\_ftsm, 1079
  - ENABLE\_ALL\_CHECKINGS, 1079
  - main, 1079
  - run\_with\_field, 1079
- test-ftssyr2k.C, 1080
  - check\_ftssyr2k, 1080
  - ENABLE\_ALL\_CHECKINGS, 1080
  - main, 1081
  - run\_with\_field, 1080
- test-ftstr.C, 1081
  - check\_ftstr, 1081
  - ENABLE\_ALL\_CHECKINGS, 1081
  - main, 1082
  - run\_with\_field, 1081
- test-ftsv.C, 1082
  - \_\_FFLASFFPACK\_SEQUENTIAL, 1082
  - check\_ftsv, 1082
  - ENABLE\_ALL\_CHECKINGS, 1082
  - main, 1083
  - run\_with\_field, 1083
- test-fttri.C, 1083
  - \_\_FFLASFFPACK\_SEQUENTIAL, 1083
  - check\_fttri, 1084
  - ENABLE\_ALL\_CHECKINGS, 1083
  - main, 1084
  - run\_with\_field, 1084
- test-interfaces-c.c, 1084
  - main, 1084
- test-invert-check.C, 1084
  - ENABLE\_ALL\_CHECKINGS, 1085
  - main, 1085
- test-io.C, 1085
  - main, 1086
  - run\_with\_field, 1085
- test-lu.C, 1086
  - \_\_FFLASFFPACK\_SEQUENTIAL, 1087
  - \_\_LUDIVINE\_CUTOFF, 1087
  - BASECASE\_K, 1087
  - launch\_test, 1089
  - main, 1089
  - mvcnt, 1090
  - run\_with\_field, 1089
  - tBC, 1089
  - test\_LUdivine, 1087
  - test\_pluq, 1088
  - tgemm, 1089
  - timtot, 1090
  - tperm, 1089
  - trest, 1089
  - ttrsm, 1089
  - verifPLUQ, 1087
- test-maxdelayeddim.C, 1090
  - main, 1090
  - MAX\_WITH\_SIZE\_T, 1090
  - test, 1090
- test-minpoly.C, 1090
  - check\_minpoly, 1091
  - main, 1091
  - run\_with\_field, 1091
- test-multifile1.C, 1091
- test-multifile2.C, 1091
  - main, 1092

- test-nullspace.C, 1092
  - checkingMessage, 1092
  - main, 1093
  - readOrRandomMatrixWithRankAndRandomRPM, 1092
  - run\_with\_field, 1093
  - test\_nullspace, 1093
- test-permutations.C, 1093
  - checkMonotonicApplyP, 1094
  - main, 1094
  - tBC, 1094
  - tgemm, 1094
  - timtot, 1094
  - tperm, 1094
  - trest, 1094
  - ttrsm, 1094
- test-pluq-check.C, 1094
  - ENABLE\_ALL\_CHECKINGS, 1095
  - main, 1095
- test-quasisep.C, 1095
  - launch\_test, 1095
  - main, 1096
  - run\_with\_field, 1096
  - test\_BruhatGenerator, 1095
  - testLTQSRPM, 1096
- test-rankprofiles.C, 1096
  - \_\_FFLASFFPACK\_SEQUENTIAL, 1097
  - main, 1097
  - run\_with\_field, 1097
- test-rpm.C, 1097
  - checkRPM, 1097
  - checkSymmetricRPM, 1097
  - main, 1098
- test-simd.C, 1098
  - \_TEST\_ONE, 1099
  - check\_eq, 1100
  - cmp, 1100
  - eval\_func\_on\_array, 1100
  - main, 1101
  - operator<<, 1101
  - TEST\_IMPL, 1100
  - test\_impl, 1101
  - test\_impl\_base, 1101
  - TEST\_ONE\_OP, 1099
  - TEST\_ONE\_OP\_WZ, 1099
- test-solve.C, 1101
  - check\_solve, 1101
  - main, 1102
  - run\_with\_field, 1102
- test-storage-transpose.C, 1102
  - main, 1102
- test-utils.h, 1047
- test\_BruhatGenerator
  - test-quasisep.C, 1095
- test\_colechelon
  - test-echelon.C, 1056
- test\_det
  - test-det.C, 1055
- test\_fadd
  - test-fadd.C, 1058
- test\_faddin
  - test-fadd.C, 1058
- test\_freduce
  - test-finit.C, 1069
- test\_fscal
  - test-fscal.C, 1070
- test\_fscalin
  - test-fscal.C, 1070
- test\_fsub
  - test-fadd.C, 1058
- test\_fsubin
  - test-fadd.C, 1058
- test\_ftranspose
  - Test< Elt >, 759
- test\_generic\_fsytrf
  - test-fsytrf.C, 1075
- TEST\_IMPL
  - test-simd.C, 1100
- test\_impl
  - test-simd.C, 1101
- test\_impl\_base
  - test-simd.C, 1101
- test\_LUdivine
  - test-lu.C, 1087
- test\_nullspace
  - test-nullspace.C, 1093
- TEST\_ONE\_OP
  - test-simd.C, 1099
- TEST\_ONE\_OP\_WZ
  - test-simd.C, 1099
- test\_pluq
  - test-lu.C, 1088
- test\_rect\_fgesv
  - test-fgesv.C, 1067
- test\_redcolechelon
  - test-echelon.C, 1056
- test\_redrowechelon
  - test-echelon.C, 1057
- test\_rowechelon
  - test-echelon.C, 1056
- test\_RPM\_fsytrf
  - test-fsytrf.C, 1075
- test\_square\_fgesv
  - test-fgesv.C, 1067
- testLTQSRPM
  - test-quasisep.C, 1096
- TestOneMethod
  - TestOneMethod< Simd >, 761
- TestOneMethod< Simd >, 760
  - Element, 761
  - enable\_if\_t, 761
  - evaluate\_scalar\_method, 761
  - evaluate\_simd\_method, 762
  - getStatus, 762
  - getTestName, 762
  - inputs, 762

- name, [762](#)
- nb\_lref, [762](#)
- outputs\_scalar, [763](#)
- outputs\_simd, [762](#)
- TestOneMethod, [761](#)
- vect\_size, [762](#)
- vect\_t, [761](#)
- vectElt, [761](#)
- writeDebugData, [762](#)
- writeResultLine, [762](#)
- tfn\_minus, [763](#)
  - operator(), [763](#)
- tfn\_minus\_eq, [763](#)
  - operator(), [763](#)
- tfn\_mul, [763](#)
  - operator(), [764](#)
- tfn\_mul\_eq, [764](#)
  - operator(), [764](#)
- tfn\_plus, [764](#)
  - operator(), [764](#)
- tfn\_plus\_eq, [765](#)
  - operator(), [765](#)
- tgemm
  - test-lu.C, [1089](#)
  - test-permutations.C, [1094](#)
- THREAD\_INDEX
  - parallel.h, [1031](#)
- THREADS
  - benchmark-fgemm-rns.C, [786](#)
- Threads, [765](#)
- threads\_fgemm
  - FFPACK, [361](#)
- threads\_ftsm
  - FFPACK, [361](#)
- THREED
  - benchmark-fgemm-rns.C, [786](#)
- ThreeD, [765](#)
- THREEDA
  - benchmark-fgemm-rns.C, [786](#)
- ThreeDAdaptive, [765](#)
- ThreeDInPlace, [765](#)
- THREEDIP
  - benchmark-fgemm-rns.C, [786](#)
- TIME
  - test-fger.C, [1066](#)
- TIME\_CHECKER\_CHARPOLY
  - test-charpoly-check.C, [1052](#)
- TIME\_CHECKER\_Det
  - test-det-check.C, [1054](#)
- Timer
  - FFLAS, [73](#)
- timer.h, [1047](#)
- timtot
  - test-lu.C, [1090](#)
  - test-permutations.C, [1094](#)
- TInverter
  - FFPACK, [344](#), [347](#)
- tmain
  - benchmark-fgemm-mp.C, [785](#)
  - benchmark-fgemv-mp.C, [788](#)
- Todo List, [9](#)
- tperm
  - test-lu.C, [1089](#)
  - test-permutations.C, [1094](#)
- transpose
  - BlockTransposeSIMD< Field, Simd, >, [407](#), [408](#)
  - Simd128\_impl< true, true, false, 2 >, [568](#)
  - Simd128\_impl< true, true, false, 4 >, [578](#)
  - Simd128\_impl< true, true, false, 8 >, [588](#)
  - Simd128\_impl< true, true, true, 2 >, [596](#)
  - Simd128\_impl< true, true, true, 4 >, [605](#)
  - Simd128\_impl< true, true, true, 8 >, [614](#)
  - Simd256\_impl< true, false, true, 8 >, [624](#)
  - Simd256\_impl< true, true, false, 2 >, [636](#)
  - Simd256\_impl< true, true, false, 4 >, [652](#)
  - Simd256\_impl< true, true, false, 8 >, [664](#)
  - Simd256\_impl< true, true, true, 2 >, [671](#)
  - Simd256\_impl< true, true, true, 4 >, [682](#), [688](#)
  - Simd256\_impl< true, true, true, 8 >, [698](#)
  - Simd512\_impl< true, false, true, 8 >, [706](#)
  - Simd512\_impl< true, true, false, 8 >, [717](#)
  - Simd512\_impl< true, true, true, 8 >, [725](#)
- trest
  - test-lu.C, [1089](#)
  - test-permutations.C, [1094](#)
- trinv\_left
  - FFPACK, [309](#), [365](#)
- trinv\_left\_modular\_double
  - ffpack.C, [989](#)
  - ffpack\_c.h, [1010](#)
- TRSMBound
  - FFLAS::Protected, [212](#)
- TRSMHelper
  - TRSMHelper< ReclterTrait, ParSeqTrait >, [766](#)
- TRSMHelper< ReclterTrait, ParSeqTrait >, [765](#)
  - parseq, [767](#)
  - pMMH, [766](#)
  - TRSMHelper, [766](#)
- TTimer
  - arithprog.C, [771](#)
  - benchmark-dgemm.C, [780](#)
  - charpoly.C, [772](#)
- ttrsm
  - test-lu.C, [1089](#)
  - test-permutations.C, [1094](#)
- Tutorial, [2](#)
- TWOD
  - benchmark-fgemm-rns.C, [786](#)
- TwoD, [767](#)
- TWODA
  - benchmark-fgemm-rns.C, [786](#)
- TwoDAdaptive, [767](#)
- type
  - Argument, [400](#)
  - associatedDelayedField< const FFPACK::RNSIntegerMod< RNS > >, [401](#)



- associatedDelayedField< const Givaro::Modular< T, X > >, [402](#)
- associatedDelayedField< const Givaro::ModularBalanced< T > >, [402](#)
- associatedDelayedField< const Givaro::ZRing< T > >, [403](#)
- associatedDelayedField< Field >, [401](#)
- CompactElement< double >, [419](#)
- CompactElement< Element >, [419](#)
- CompactElement< float >, [419](#)
- CompactElement< int16\_t >, [420](#)
- CompactElement< int32\_t >, [420](#)
- CompactElement< int64\_t >, [420](#)
- is\_simd< T >, [484](#)
- TYPE\_BOOL
  - args-parser.h, [1038](#)
- TYPE\_DOUBLE
  - args-parser.h, [1039](#)
- TYPE\_INT
  - args-parser.h, [1039](#)
- TYPE\_INTEGER
  - args-parser.h, [1039](#)
- type\_integer
  - args-parser.h, [1038](#)
- TYPE\_INTLIST
  - args-parser.h, [1039](#)
- TYPE\_LONGLONG
  - args-parser.h, [1039](#)
- TYPE\_NONE
  - args-parser.h, [1039](#)
- TYPE\_STR
  - args-parser.h, [1039](#)
- type\_string
  - NoSimd< T >, [516](#)
  - Simd128\_impl< true, true, false, 2 >, [563](#)
  - Simd128\_impl< true, true, false, 4 >, [574](#)
  - Simd128\_impl< true, true, false, 8 >, [584](#)
  - Simd128\_impl< true, true, true, 2 >, [594](#)
  - Simd128\_impl< true, true, true, 4 >, [603](#)
  - Simd128\_impl< true, true, true, 8 >, [612](#)
  - Simd256\_impl< true, false, true, 8 >, [622](#)
  - Simd256\_impl< true, true, false, 2 >, [631](#)
  - Simd256\_impl< true, true, false, 4 >, [643](#), [645](#)
  - Simd256\_impl< true, true, false, 8 >, [659](#)
  - Simd256\_impl< true, true, true, 2 >, [669](#)
  - Simd256\_impl< true, true, true, 4 >, [680](#), [686](#)
  - Simd256\_impl< true, true, true, 8 >, [695](#)
  - Simd512\_impl< true, false, true, 8 >, [704](#)
  - Simd512\_impl< true, true, false, 8 >, [712](#)
  - Simd512\_impl< true, true, true, 8 >, [723](#)
- TYPE\_UINT64
  - args-parser.h, [1039](#)
- unfit
  - FFLAS::Protected, [220](#), [221](#)
- unpackhi
  - ScalFunctions< Element >, [554](#)
  - Simd128\_impl< true, true, false, 2 >, [567](#)
  - Simd128\_impl< true, true, false, 4 >, [578](#)
- Simd128\_impl< true, true, false, 8 >, [588](#)
- Simd128\_impl< true, true, true, 2 >, [595](#)
- Simd128\_impl< true, true, true, 4 >, [604](#)
- Simd128\_impl< true, true, true, 8 >, [614](#)
- Simd256\_impl< true, false, true, 8 >, [624](#)
- Simd256\_impl< true, true, false, 2 >, [635](#)
- Simd256\_impl< true, true, false, 4 >, [650](#), [651](#)
- Simd256\_impl< true, true, false, 8 >, [663](#)
- Simd256\_impl< true, true, true, 2 >, [671](#)
- Simd256\_impl< true, true, true, 4 >, [682](#), [688](#)
- Simd256\_impl< true, true, true, 8 >, [697](#)
- Simd512\_impl< true, false, true, 8 >, [706](#)
- Simd512\_impl< true, true, false, 8 >, [717](#)
- Simd512\_impl< true, true, true, 8 >, [725](#)
- unpackhi\_intrinsic
  - Simd128\_impl< true, true, false, 2 >, [567](#)
  - Simd128\_impl< true, true, false, 4 >, [577](#)
  - Simd128\_impl< true, true, false, 8 >, [588](#)
  - Simd128\_impl< true, true, true, 2 >, [595](#)
  - Simd128\_impl< true, true, true, 4 >, [604](#)
  - Simd128\_impl< true, true, true, 8 >, [613](#)
  - Simd256\_impl< true, false, true, 8 >, [624](#)
  - Simd256\_impl< true, true, false, 2 >, [635](#)
  - Simd256\_impl< true, true, false, 4 >, [650](#)
  - Simd256\_impl< true, true, false, 8 >, [663](#)
  - Simd256\_impl< true, true, true, 2 >, [671](#)
  - Simd256\_impl< true, true, true, 4 >, [681](#), [688](#)
  - Simd256\_impl< true, true, true, 8 >, [697](#)
  - Simd512\_impl< true, false, true, 8 >, [706](#)
  - Simd512\_impl< true, true, false, 8 >, [717](#)
  - Simd512\_impl< true, true, true, 8 >, [725](#)
- unpacklo
  - ScalFunctions< Element >, [554](#)
  - Simd128\_impl< true, true, false, 2 >, [567](#)
  - Simd128\_impl< true, true, false, 4 >, [577](#)
  - Simd128\_impl< true, true, false, 8 >, [588](#)
  - Simd128\_impl< true, true, true, 2 >, [595](#)
  - Simd128\_impl< true, true, true, 4 >, [604](#)
  - Simd128\_impl< true, true, true, 8 >, [614](#)
  - Simd256\_impl< true, false, true, 8 >, [624](#)
  - Simd256\_impl< true, true, false, 2 >, [635](#)
  - Simd256\_impl< true, true, false, 4 >, [650](#)
  - Simd256\_impl< true, true, false, 8 >, [663](#)
  - Simd256\_impl< true, true, true, 2 >, [671](#)
  - Simd256\_impl< true, true, true, 4 >, [682](#), [688](#)
  - Simd256\_impl< true, true, true, 8 >, [697](#)
  - Simd512\_impl< true, false, true, 8 >, [706](#)
  - Simd512\_impl< true, true, false, 8 >, [717](#)
  - Simd512\_impl< true, true, true, 8 >, [725](#)
- unpacklo\_intrinsic
  - Simd128\_impl< true, true, false, 2 >, [567](#)
  - Simd128\_impl< true, true, false, 4 >, [577](#)
  - Simd128\_impl< true, true, false, 8 >, [587](#)
  - Simd128\_impl< true, true, true, 2 >, [595](#)
  - Simd128\_impl< true, true, true, 4 >, [604](#)
  - Simd128\_impl< true, true, true, 8 >, [613](#)
  - Simd256\_impl< true, false, true, 8 >, [624](#)
  - Simd256\_impl< true, true, false, 2 >, [635](#)



- Simd256\_impl< true, true, false, 4 >, [650](#)
- Simd256\_impl< true, true, false, 8 >, [663](#)
- Simd256\_impl< true, true, true, 2 >, [670](#)
- Simd256\_impl< true, true, true, 4 >, [681](#), [687](#)
- Simd256\_impl< true, true, true, 8 >, [697](#)
- Simd512\_impl< true, false, true, 8 >, [705](#)
- Simd512\_impl< true, true, false, 8 >, [716](#)
- Simd512\_impl< true, true, true, 8 >, [725](#)
- unpacklohi
  - ScalFunctions< Element >, [554](#)
  - Simd128\_impl< true, true, false, 2 >, [568](#)
  - Simd128\_impl< true, true, false, 4 >, [578](#)
  - Simd128\_impl< true, true, false, 8 >, [588](#)
  - Simd128\_impl< true, true, true, 2 >, [596](#)
  - Simd128\_impl< true, true, true, 4 >, [605](#)
  - Simd128\_impl< true, true, true, 8 >, [614](#)
  - Simd256\_impl< true, false, true, 8 >, [624](#)
  - Simd256\_impl< true, true, false, 2 >, [635](#)
  - Simd256\_impl< true, true, false, 4 >, [651](#)
  - Simd256\_impl< true, true, false, 8 >, [663](#)
  - Simd256\_impl< true, true, true, 2 >, [671](#)
  - Simd256\_impl< true, true, true, 4 >, [682](#), [688](#)
  - Simd256\_impl< true, true, true, 8 >, [697](#)
  - Simd512\_impl< true, false, true, 8 >, [706](#)
  - Simd512\_impl< true, true, false, 8 >, [717](#)
  - Simd512\_impl< true, true, true, 8 >, [725](#)
- UnparametricTag, [767](#)
- updateD
  - FFPACK::Protected, [394](#)
- USE\_OPENMP
  - config.h, [818](#)
- UserTimer
  - FFLAS, [74](#)
- utils.h, [910](#)
- v
  - Simd128\_impl< true, true, false, 2 >::Converter, [424](#)
  - Simd128\_impl< true, true, false, 4 >::Converter, [424](#)
  - Simd128\_impl< true, true, false, 8 >::Converter, [425](#)
  - Simd128\_impl< true, true, true, 2 >::Converter, [425](#)
  - Simd128\_impl< true, true, true, 4 >::Converter, [425](#)
  - Simd128\_impl< true, true, true, 8 >::Converter, [426](#)
  - Simd256\_impl< true, false, true, 8 >::Converter, [426](#)
  - Simd256\_impl< true, true, false, 2 >::Converter, [426](#)
  - Simd256\_impl< true, true, false, 4 >::Converter, [427](#)
  - Simd256\_impl< true, true, false, 8 >::Converter, [427](#)
  - Simd256\_impl< true, true, true, 2 >::Converter, [427](#)
- Simd256\_impl< true, true, true, 4 >::Converter, [428](#)
- Simd256\_impl< true, true, true, 8 >::Converter, [428](#)
- Simd512\_impl< true, true, false, 8 >::Converter, [428](#)
- Simd512\_impl< true, true, true, 8 >::Converter, [429](#)
- val
  - Coo< Field >, [432](#)
  - Coo< ValT, IdxT >, [430](#), [433](#)
- valid
  - NoSimd< T >, [516](#)
  - Simd128\_impl< true, true, false, 2 >, [566](#)
  - Simd128\_impl< true, true, false, 4 >, [576](#)
  - Simd128\_impl< true, true, false, 8 >, [586](#)
  - Simd128\_impl< true, true, true, 2 >, [594](#)
  - Simd128\_impl< true, true, true, 4 >, [603](#)
  - Simd128\_impl< true, true, true, 8 >, [612](#)
  - Simd256\_impl< true, false, true, 8 >, [622](#)
  - Simd256\_impl< true, true, false, 2 >, [633](#)
  - Simd256\_impl< true, true, false, 4 >, [647](#), [648](#)
  - Simd256\_impl< true, true, false, 8 >, [662](#)
  - Simd256\_impl< true, true, true, 2 >, [669](#)
  - Simd256\_impl< true, true, true, 4 >, [680](#), [686](#)
  - Simd256\_impl< true, true, true, 8 >, [695](#)
  - Simd512\_impl< true, false, true, 8 >, [704](#)
  - Simd512\_impl< true, true, false, 8 >, [715](#)
  - Simd512\_impl< true, true, true, 8 >, [723](#)
- VALUE
  - parallel.h, [1031](#)
- value
  - AlgoChooser< ModeCategories::ConvertTo< ElementCategories::RNSElementTag >, ParSeq >, [397](#)
  - AlgoChooser< ModeT, ParSeq >, [397](#)
  - ALL< false, v... >, [398](#)
  - ALL< true, v... >, [398](#)
  - ALL<>, [398](#)
  - AreEqual< X, X >, [399](#)
  - AreEqual< X, Y >, [399](#)
  - compatible\_data\_type< Field >, [421](#)
  - compatible\_data\_type< Givaro::ZRing< double > >, [421](#)
  - compatible\_data\_type< Givaro::ZRing< float > >, [421](#)
  - ElementTraits< double >, [438](#)
  - ElementTraits< Element >, [438](#)
  - ElementTraits< FFPACK::rns\_double\_elt >, [438](#)
  - ElementTraits< float >, [439](#)
  - ElementTraits< Givaro::Integer >, [439](#)
  - ElementTraits< int16\_t >, [439](#)
  - ElementTraits< int32\_t >, [440](#)
  - ElementTraits< int64\_t >, [440](#)
  - ElementTraits< int8\_t >, [440](#)
  - ElementTraits< Reclnt::rint< K > >, [441](#)
  - ElementTraits< Reclnt::rmint< K, MG > >, [441](#)
  - ElementTraits< Reclnt::ruint< K > >, [442](#)

- ElementTraits< uint16\_t >, [442](#)
- ElementTraits< uint32\_t >, [442](#)
- ElementTraits< uint64\_t >, [443](#)
- ElementTraits< uint8\_t >, [443](#)
- has\_minus\_eq\_impl< C >, [475](#)
- has\_minus\_impl< C >, [475](#)
- has\_mul\_eq\_impl< C >, [475](#)
- has\_mul\_impl< C >, [476](#)
- has\_operation< T >, [476](#)
- has\_plus\_eq\_impl< C >, [476](#)
- has\_plus\_impl< C >, [477](#)
- is\_all\_same< T, Args... >, [483](#)
- is\_all\_same<>, [484](#)
- is\_simd< T >, [484](#)
- ModeTraits< Field >, [506](#)
- ModeTraits< Givaro::Modular< Element, Compute >>, [507](#)
- ModeTraits< Givaro::Modular< Givaro::Integer, Compute >>, [507](#)
- ModeTraits< Givaro::Modular< int16\_t, Compute >>, [508](#)
- ModeTraits< Givaro::Modular< int32\_t, Compute >>, [508](#)
- ModeTraits< Givaro::Modular< int64\_t, uint64\_t >>, [508](#)
- ModeTraits< Givaro::Modular< int8\_t, Compute >>, [509](#)
- ModeTraits< Givaro::Modular< RecInt::ruint< K >, Compute >>, [509](#)
- ModeTraits< Givaro::Modular< uint16\_t, Compute >>, [510](#)
- ModeTraits< Givaro::Modular< uint32\_t, Compute >>, [510](#)
- ModeTraits< Givaro::Modular< uint8\_t, Compute >>, [510](#)
- ModeTraits< Givaro::ModularBalanced< Element >>, [511](#)
- ModeTraits< Givaro::ModularBalanced< Givaro::Integer >>, [511](#)
- ModeTraits< Givaro::ModularBalanced< int16\_t >>, [512](#)
- ModeTraits< Givaro::ModularBalanced< int32\_t >>, [512](#)
- ModeTraits< Givaro::ModularBalanced< int8\_t >>, [512](#)
- ModeTraits< Givaro::Montgomery< T >>, [513](#)
- ModeTraits< Givaro::ZRing< double >>, [513](#)
- ModeTraits< Givaro::ZRing< float >>, [513](#)
- ModeTraits< Givaro::ZRing< Givaro::Integer >>, [514](#)
- need\_field\_characteristic< Field >, [515](#)
- need\_field\_characteristic< Givaro::Modular< Field >>, [515](#)
- need\_field\_characteristic< Givaro::ModularBalanced< Field >>, [515](#)
- SimdChooser< T, false, b >, [731](#)
- SimdChooser< T, true, false >, [732](#)
- SimdChooser< T, true, true >, [732](#)
- width< double >, [768](#)
- width< float >, [769](#)
- width< T >, [768](#)
- vand
  - ScalFunctions< Element >, [551](#)
  - Simd128\_impl< true, true, false, 2 >, [570](#)
  - Simd128\_impl< true, true, false, 4 >, [580](#)
  - Simd128\_impl< true, true, false, 8 >, [591](#)
  - Simd128\_impl< true, true, true, 2 >, [600](#)
  - Simd128\_impl< true, true, true, 4 >, [609](#)
  - Simd128\_impl< true, true, true, 8 >, [618](#)
  - Simd128i\_base, [620](#)
  - Simd256\_impl< true, false, true, 8 >, [627](#)
  - Simd256\_impl< true, true, false, 4 >, [656](#)
  - Simd256\_impl< true, true, true, 4 >, [692](#)
  - Simd512\_impl< true, true, false, 8 >, [720](#)
  - Simd512\_impl< true, true, true, 8 >, [729](#)
  - Simd512i\_base, [731](#)
- vandnot
  - ScalFunctions< Element >, [552](#)
  - Simd128\_impl< true, true, false, 2 >, [571](#)
  - Simd128\_impl< true, true, false, 4 >, [581](#)
  - Simd128\_impl< true, true, false, 8 >, [591](#)
  - Simd128\_impl< true, true, true, 2 >, [600](#)
  - Simd128\_impl< true, true, true, 4 >, [609](#)
  - Simd128\_impl< true, true, true, 8 >, [618](#)
  - Simd128i\_base, [620](#)
  - Simd256\_impl< true, false, true, 8 >, [627](#)
  - Simd256\_impl< true, true, false, 4 >, [656](#)
  - Simd256\_impl< true, true, true, 4 >, [692](#)
  - Simd512\_impl< true, true, false, 8 >, [720](#)
  - Simd512\_impl< true, true, true, 8 >, [729](#)
  - Simd512i\_base, [731](#)
- VEC\_ADD
  - FFLAS::vectorised, [279](#)
- VEC\_SUB
  - FFLAS::vectorised, [279](#)
- vect\_size
  - FieldSimd< \_Field >, [452](#)
  - NoSimd< T >, [517](#)
  - Simd128\_impl< true, true, false, 2 >, [571](#)
  - Simd128\_impl< true, true, false, 4 >, [581](#)
  - Simd128\_impl< true, true, false, 8 >, [591](#)
  - Simd128\_impl< true, true, true, 2 >, [600](#)
  - Simd128\_impl< true, true, true, 4 >, [609](#)
  - Simd128\_impl< true, true, true, 8 >, [619](#)
  - Simd256\_impl< true, false, true, 8 >, [628](#)
  - Simd256\_impl< true, true, false, 2 >, [638](#)
  - Simd256\_impl< true, true, false, 4 >, [656](#)
  - Simd256\_impl< true, true, false, 8 >, [666](#)
  - Simd256\_impl< true, true, true, 2 >, [675](#)
  - Simd256\_impl< true, true, true, 4 >, [692](#)
  - Simd256\_impl< true, true, true, 8 >, [701](#)
  - Simd512\_impl< true, false, true, 8 >, [709](#)
  - Simd512\_impl< true, true, false, 8 >, [720](#)
  - Simd512\_impl< true, true, true, 8 >, [730](#)
  - TestOneMethod< Simd >, [762](#)
- vect\_t

- FieldSimd< \_Field >, 448
- NoSimd< T >, 516
- Simd128\_impl< true, true, false, 2 >, 563
- Simd128\_impl< true, true, false, 4 >, 573
- Simd128\_impl< true, true, false, 8 >, 583
- Simd128\_impl< true, true, true, 2 >, 593
- Simd128\_impl< true, true, true, 4 >, 602
- Simd128\_impl< true, true, true, 8 >, 611
- simd128\_int64.inl, 873
- Simd128i\_base, 619
- Simd256\_impl< true, false, true, 8 >, 622
- Simd256\_impl< true, true, false, 2 >, 631
- Simd256\_impl< true, true, false, 4 >, 642
- Simd256\_impl< true, true, false, 8 >, 659
- Simd256\_impl< true, true, true, 2 >, 668
- Simd256\_impl< true, true, true, 4 >, 679
- Simd256\_impl< true, true, true, 8 >, 695
- simd256\_int64.inl, 876
- Simd256i\_base, 702
- Simd512\_impl< true, false, true, 8 >, 704
- Simd512\_impl< true, true, false, 8 >, 712
- Simd512\_impl< true, true, true, 8 >, 722
- simd512\_int64.inl, 878
- Simd512i\_base, 730
- TestOneMethod< Simd >, 761
- vectElt
  - ScalFunctions< Element >, 551
  - TestOneMethod< Simd >, 761
- vector< T >, 767
  - elements, 768
- vector< T >::const\_iterator, 423
- vector< T >::const\_reverse\_iterator, 424
- vector< T >::iterator, 490
- vector< T >::reverse\_iterator, 523
- verification\_PLUQ
  - benchmark-pluq.C, 799
- verifPLUQ
  - test-lu.C, 1087
- VERSION
  - config.h, 818
- vor
  - ScalFunctions< Element >, 552
  - Simd128\_impl< true, true, false, 2 >, 570
  - Simd128\_impl< true, true, false, 4 >, 580
  - Simd128\_impl< true, true, false, 8 >, 591
  - Simd128\_impl< true, true, true, 2 >, 600
  - Simd128\_impl< true, true, true, 4 >, 609
  - Simd128\_impl< true, true, true, 8 >, 618
  - Simd128i\_base, 620
  - Simd256\_impl< true, false, true, 8 >, 627
  - Simd256\_impl< true, true, false, 4 >, 656
  - Simd256\_impl< true, true, true, 4 >, 692
  - Simd512\_impl< true, true, false, 8 >, 720
  - Simd512\_impl< true, true, true, 8 >, 729
  - Simd512i\_base, 730
- vxor
  - ScalFunctions< Element >, 552
  - Simd128\_impl< true, true, false, 2 >, 571
  - Simd128\_impl< true, true, false, 4 >, 581
  - Simd128\_impl< true, true, true, 2 >, 600
  - Simd128\_impl< true, true, true, 4 >, 609
  - Simd128\_impl< true, true, true, 8 >, 618
  - Simd128i\_base, 620
  - Simd256\_impl< true, false, true, 8 >, 627
  - Simd256\_impl< true, true, false, 4 >, 656
  - Simd256\_impl< true, true, true, 4 >, 692
  - Simd512\_impl< true, true, false, 8 >, 720
  - Simd512\_impl< true, true, true, 8 >, 729
  - Simd512i\_base, 730
- WAIT
  - parallel.h, 1030
- width< double >, 768
  - value, 768
- width< float >, 769
  - value, 769
- width< T >, 768
  - value, 768
- Winograd, 769
  - FFLAS::BLAS3, 193
- winograd.C, 776
  - balanced, 777
  - DOUBLE\_TO\_FLOAT\_CROSSOVER, 776
  - GFOPS, 776
  - main, 777
- Winograd\_L\_S
  - FFLAS::BLAS3, 196
- Winograd\_LR\_S
  - FFLAS::BLAS3, 196
- Winograd\_R\_S
  - FFLAS::BLAS3, 197
- WinogradAcc\_2\_24
  - FFLAS::BLAS3, 194
- WinogradAcc\_2\_27
  - FFLAS::BLAS3, 194
- WinogradAcc\_3\_21
  - FFLAS::BLAS3, 194
- WinogradAcc\_3\_23
  - FFLAS::BLAS3, 193
- WinogradAcc\_L\_S
  - FFLAS::BLAS3, 196
- WinogradAcc\_LR
  - FFLAS::BLAS3, 195
- WinogradAcc\_R\_S
  - FFLAS::BLAS3, 195
- WinogradCalc
  - FFLAS::Protected, 217
- WinogradPar, 769
- WinogradSteps
  - FFLAS::Protected, 216
- WinogradThreshold
  - FFLAS::Protected, 215
- WinoPar
  - FFLAS::BLAS3, 193
- WINOTHRESHOLD
  - fflas.h, 824

## WRITE

parallel.h, [1031](#)

## write

RNSInteger< RNS >, [541](#)RNSIntegerMod< RNS >, [547](#)

## write\_field

Matio.h, [1046](#)

## write\_matrix

benchmark-fgemv-mp.C, [788](#)RNSIntegerMod< RNS >, [547](#)

## write\_matrix\_long

RNSIntegerMod< RNS >, [547](#)

## writeCommandString

FFLAS, [185](#)

## writeDebugData

TestOneMethod< Simd >, [762](#)

## writeDnsFormat

FFLAS, [152](#)

## WriteMatrix

FFLAS, [185](#), [187](#)

## WritePermutation

FFLAS, [187](#)

## writeResultLine

TestOneMethod< Simd >, [762](#)

## zero

FFLAS, [76](#)FieldSimd< \_Field >, [450](#)RNSInteger< RNS >, [542](#)RNSIntegerMod< RNS >, [549](#)ScalFunctions< Element >, [551](#)Simd128\_impl< true, true, false, 2 >, [570](#)Simd128\_impl< true, true, false, 4 >, [580](#)Simd128\_impl< true, true, false, 8 >, [590](#)Simd128\_impl< true, true, true, 2 >, [600](#)Simd128\_impl< true, true, true, 4 >, [608](#)Simd128\_impl< true, true, true, 8 >, [618](#)Simd128i\_base, [619](#)Simd256\_impl< true, false, true, 8 >, [623](#)Simd256\_impl< true, true, false, 2 >, [638](#)Simd256\_impl< true, true, false, 4 >, [656](#)Simd256\_impl< true, true, false, 8 >, [666](#)Simd256\_impl< true, true, true, 2 >, [675](#)Simd256\_impl< true, true, true, 4 >, [692](#)Simd256\_impl< true, true, true, 8 >, [701](#)Simd256i\_base, [702](#)Simd512\_impl< true, false, true, 8 >, [704](#)Simd512\_impl< true, true, false, 8 >, [720](#)Simd512\_impl< true, true, true, 8 >, [729](#)Simd512i\_base, [730](#)

## ZOSparseMatrix

FFLAS, [72](#)