ViTE

October 19, 2020

Technical Manual

Contents

Chapter 1

Introduction

With the ever increasing dissemination of multi-core architectures, parallel and/or distributed applications are becoming the norm, so as to use computer resources as efficiently as possible. Trace collection and visualization is useful for developers willing to debug and monitor the performance of their parallel applications. Yet, most existing trace visualization tools are proprietary or cannot handle large trace files.

ViTE is a powerful, portable and open-source profiling tool which visualizes the traces produced of parallel applications. Thanks to its scalable design, ViTE efficiently helps programmers to analyze the performance of potentially large applications running on many cores and communicating processes.

ViTE allows one to visualize traces written in various formats (such as the Pajé open format, see `http://www-id.imag.fr/Logiciels/paje/`, or the OTF format). Its features comprise the ability to export views in the SVG format, so as to integrate them easily into reports, and the production of statistics.

The aim of ViTE is to have a free and open software able to display different traces format with a user-friendly interface. That is why it is under Cecill-A licence.

More information is available on the official website of ViTE :
`http://vite.gforge.inria.fr/` , or on the forge itself :
`http://gforge.inria.fr/projects/vite/`.

Chapter 2

Convention for making code

2.1 Convention to code

Gereralities

- The software is totally written using C++ language.
- Source files must be named **.cpp* and headers **.hpp*
- Code must have commentaries in order to create automatically documentation using the *Doxygen* tool.
- The indentation is 4 spaces.
- Directories are organized using modules.

Variables

- Variables' names only contain letters and numbers. Letters belong to [a-z] and [0-9], excluding [A-Z].*eg : temp, size2*
- If a variable is composed of more than one word, then words must be separated with the **underscore symbol**, and all the letters are in [a-z][0-9] as said above. *eg : number_of_item, size_of_window, ...*
- Boolean variables must have a name that remain their functionality, so their names must start with the prefix *is_* or *has_*. *eg : is_enabled*
- Attributes of classes or structures must begin with the symbol **underscore**.*eg : _name, _is_enabled, _width*

Constants

- Constants are written using only [A-Z] and [0-9].
- If a constant is composed by more than one word, then they must be, as for variables, separated using the **underscore** symbol.

Functions and methods

- Functions' names only contain letters and numbers. Letters belong to [a-z] and [0-9], excluding [A-Z].*eg : set_width(), get_size()*
- The names of the functions must always contain an action verb.

- Accessors must start with the *get_* verb followed by the nature of the object returned. *eg : get_length(), get_value()*
- Mutators must start with the *set_* verb followed by the field modificated.*eg : set_size(), set_value()*
- Functions which return a boolean must start with *is_*.
- Each opening of bloc must be on the same line as the prototype of the function, the condition, whereas the end must be on a new line.

  Eg :

  ```
  if(bool) {
  }
  else {
  }
  ```

Classes

- The names of the classes must begin with an upper-case letter followed with only lower-case.

.cpp files

- Namespaces are declared in the *.cpp* and not in the *.hpp* file.
- For classes, each *.cpp* file corresponds to a *.hpp* file, with exactly the same name. Headers are included in the *.cpp* files.
- The file contains the implementation of all the functions declared in the *.hpp* file (unless virtual functions).

.hpp files

- Classes are defined within a *.hpp* file of same name, no function is implemented within (unless templates).
- The file begins with a *#ifndef* instruction followed by *CLASS_NAME_HPP*
- Then a *#define* instruction followed by *CLASS_NAME_HPP* as above.
- It is preferable to put includes in the *.cpp* tather than in the *.hpp*
- Classes begin with the declarations of the variables, followed by the constructors and the destructor, and finally the declarations of the methods.
- The *private* keyword must clearly be written such as *public*.
- The file must end by the *#endif* instruction.

Chapter 3

Parser module

3.1 Parser Paje

3.1.1 Representation of the file trace line by line

Introduction

A line is a syntaxical unit in a file following the Pajé trace format. Tokens are supplied by a File (a class which encapsulates a std::ifstream). In Pajé file trace format, a line is the beginning of a definition, the end of a definition, a definition or an event.

For example :

- '%EventDef PajeDefineContainerType 1'
- '% Name string'
- '111 1.03305 MT 31:11392 315706-13 112'

Implementation

Line object stands for a line. The method fill_line() fill the object. It enables the item() method to access line's tokens : the item() method is an indexed access to line's token.

Construction of a line A line is built by fill_line() that consists in append character while they do a token and as long as the current token read is different from `'\n'`.

Storage A private std::vector<std::string> stores line's tokens. Actually there is no use of an indexed access. The item() method could simply supply the next token of a line.

3.1.2 Representation of the definitions described in the trace file

Introduction

A Definition is the definition of events found while parsing the file. It is always composed by a field "name", with other caracteristics of the event such as type or values. The set of definition is stored in a table. The definition and its identifiers are paired. For example, with this file trace :

```
%EventDef PajeDestroyContainer 8
% Time date
% Name string
% Type string
%EndEventDef
%EventDef PajeDefineStateType 3
% Alias string
% ContainerType string
% Name string
%EndEventDef
```

The table of definitions will be {(8, d1),(3,d2)}, the d1 definition {"PajeDestroyContainer",{f1,f2,f3}} and the f1 field {"Alias", "string"}.

Implementation

Extensible definition fields are stored in a std::vector. Couples of definition and id are available in a std::map<int,Definition> hash table.

3.1.3 Acknowledge of definitions' lines

Introduction

ParserDefinitionDecoder performs a received Line which starts with percent.

Definition

A field Line is a Line with the two first tokens that are the name of a variable and a name. A EventDef Line is a Line with the first token that is EventDef. A EndEventDef Line is a Line with the first token that is EndEventDef.

A definition is a set of lines that begins by an EndEventDef Line, have an indefinite number of fields Line and ends with an EndEventDef Line.

Automaton of definition

Implementation faithfully uses the automaton described.

Automaton reaches "in a definition" when an EventDef Line is read and instanciated a new definition which enables :

- reading a field Line : which is translated and read fields are added to the current definition.
- reading an EndEventDef Line : which consists in storing the current definition in the table and fall in "out of a definition".

Specification

A ParserDefinitionDecoder can be instanciated by an empty constructor.

The store_definition() method requires a filled Line Object which starts with percent tokens and returns when this line is read.

get_definition() enables access to the table of definition.

3.1.4 Event parser

Introduction

The parser provides a Line which represents an event and the definition of this event. The purpose of the event parser is to give the values of this event to the data structure in order to store it.

Implementation

The event parser contains only one method which fills the data structure step by step with the lines (Line) provided. To do that, there are as many local variables as known field names in Pajé's events. The variables which fit the event defined by the definition (Definition) are filled ordered by the fields of the definition by converting the strings read in the line to the defined type. The values which do not fit some known field names are stored in a vector. Then, the event parser uses the data structure methods to fill it. The variables given as arguments for these methods depend on the Pajé event name.

3.1.5 Handling of a trace

Introduction

ParserPaje reads a file trace and sends messages to Trace accordingly.

Implementation

ParserPaje opens a file (instanciate a Line), instanciates a ParserEventDecoder and a ParserDefinitionDecoder. It reads lines until the end of the file. Each line is parsed by ParserEventDecoder or ParserDefinitionDecoder whether or not the line starts with % token.

Specification

A ParserPaje can be instanciated by an empty constructor. The parse() method requires a filename to be opened and an instance of a trace object to proceed.

Tests

A test reads a trace file, uses the ParserDefinitionDecoder and ParserEventDecoder and prints the calls to the trace object. Each event produces a call as expected.

3.2 Parser OTF

3.2.1 Introduction

The OTF format is an open format. Moreover, the OTF library provides tools to convert Vampir'`http://www.vampir-ng.de/` or Tau(`http://www.cs.uoregon.edu/research/tau/home.php`) traces which are some of the most common used trace format. An API is also provided in order to read the files.

More details can be found at
`http://tu-dresden.de/die_tu_dresden/zentrale_einrichtungen/zih/forschung/software_werkzeuge_zur_`
(in english or deutsch).

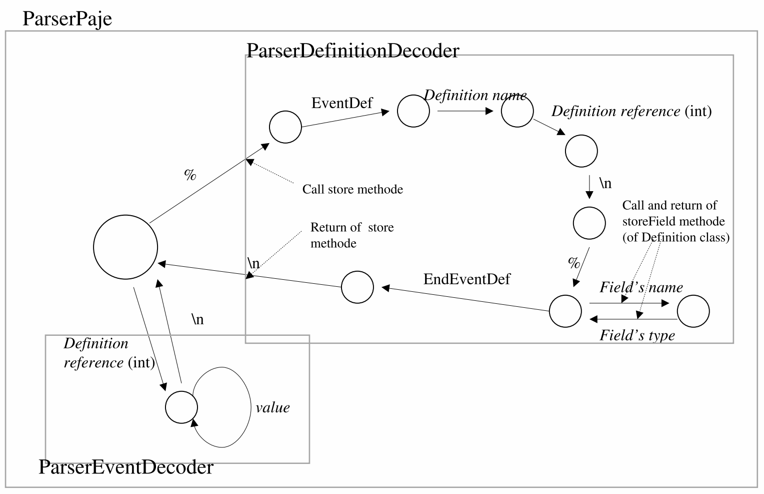


Figure 3.1: The Pajé parser automaton

3.2.2 Implementation

The OTF parser uses two parsers like the Pajé one. We decided to separate the definitions from events for a better scalabity. Moreover, we use the provided API to parse the files because it is a portable interface.

3.2.3 Supported functions

Because they are optional and do not have a direct correspondance with the Pajé format, we do not handle the following functions :

- *Definition, event, snapshot and summary Comments.*
- *DefCreator.*
- *Collective operation.*
- *Snapshots.*
- *Summaries.*

Also we do not take in account the streams in optional fields.

In the future we could consider that snapshots are events.

Correspondances and differences between this format and the Pajé one

The genericity of the Pajé format is very useful because we do not need to create other classes for the trace.

So, a process will be designed as a container in Pajé format. A process group will be considered as the container type in order to keep the Pajé format. If a process does not belong to a process group, we assign it to the empty process group (the 0). However, a process can belong to more than one process group. We do not handle this case and only consider that the first one found is the process group.

A function will be an event and its function group will be the EventType.

A counter will be a variable and a counter group the VariableType.

A message will be a link. Its value will be : "sender_name to receiver_name" because there are no message value in the OTF format.

3.2.4 Definition Parser

This parser stores all the OTF objects (process, functions...). In order to do it, we use the provided API which uses handlers.

Variables in the ParserDefinition are static because this is the only way to handle handlers.

While parsing, we only store each component. At the end of it, we create all the ContainerType. We can not create the EventType or VariableType because we do not know in which kind of process the event or the variable is used.

3.2.5 Event Parser

Due to the optionnality of the process creation, we have to check before each event or counter catched that the container exist.

Now that we know which kind of process uses the event or counter, we can create the eventType or variableType if they do not exist. Because of the fact that if an event does not exist, it is automatically created by the trace, we can not add the optional fields like source file or color. In order to pass through it, we added a boolean attribute to the function structure which says if the function has already been defined.

For the counter, we are not sure that the sender has an ancestor. If it is not the case, we consider that the ancestor is also the sender.

The handling of the remaining time is in the EventParser too. Because we consider (good consideration?) that reading the definitions is done faster than reading the events, we only take the time for events to compute the remaining time.

3.3 Parser ViTE

3.3.1 Utility of this parser

The aim of this parser is to split the Pajé traces in various files (one file per process). The main point is to enhance trace generationusing the Pajé format and avoid having various processes writting at the same time in the same file. The constraint is to have a synchron clock.

We have a definition file containing all the definitions and the creation of all the containers. An optional field containing the file name where all the events of this container is provided in order to parse it. The other files only contain actions (events, links or state changes).

3.3.2 How it works

The first file given is parsed with a **ParserPaje** and all the definitions are stored in the parserViTE. Then we get from the trace all the filenames where there are events. A parserEventPaje reads all the files and store in parallel all the end of links because it is possible to read an end before a start (in this case the link will not be printed). At the end of all the parsing, a new parserEventPaje stores all the end links.

Chapter 4

The data structure

The data structure is composed by 2 main parts :

- The first one where while parsing double chained list are built,
- The second are trees that are built above the lists.

4.1 The Main classes

To represent the diversity of the Pajé trace format, we have created a wide variety of class that represent the various abstractions on objects :

- Trace
- Container
- State
- Event
- Variable
- Entity

Moreover, we had to create some other classes that help creating these objects such as their type. The definition of these types is necessary to use polymorphism in the optionnal fields that can be added (they all inherit from the Value class).

The basic types used in the data structure are defined in the *values* directory. These types are :

- Color
- Date
- Double
- Hex
- Integer
- Name
- String
- Value

The definitions for the tree and the interval are in the *tree* directory.

4.1.1 The class Trace

The class *Trace* represents the trace object generated by the user. It contains the elements :

- List of type of container
- List of container
- List of states
- List of events
- List of links
- List of variables

Moreover an attribute that contains the date when the latest action happens in the trace has been created. The methods only enable the construction of the trace, the possibility to get the values of the attributes, and to research some elements in the trace.

4.1.2 The class container

It represents an object of type container. In this class, there are :

- A name
- The date of the beginning and end of the container
- Type of container
- A father
- A list of children
- Set of states, events, links, and their cardinal

The methods are accessors.

4.1.3 The class State

It represents a state of a processor, a container. This class contains the only object of Pajé that is not directly presented. Because the use of trees of punctual events, we do not consider the states but the change of states as a relevant facts. This class has :

- Dates of beginning and end
- Type of state
- A descriptor of the value of the state, contains the optionnal fields.

The methods are accessors and a constructor attribute by attribute.

4.1.4 The class event

It represents an event that occurs in the trace. An event is made by :

- A date when it occurs
- A type of event
- A descriptor of the value of the event, contains the optionnal fields.

Here, the only methods are accessors.

4.1.5 The class Link

It represents a communication between 2 containers in the trace. The attributes are :

- Dates of beginning and end
- A type of link
- The containers source and destination of the communication
- A descriptor with the value of the link(contains the optionnal fields). Methods are accessors.

4.2 The lists

The lists are based on the std::list template. They are built in the logical order, each time an element is sent by the parser, it is added in last position in the right list (after making sure the data are rights).

The states are not seen as having a duration but punctual, as brief moments that represent either the beginning or the end of the action. So, to remain logical, a binary tree is not made with states, but with elements from the *StateChange* class, because a state is not punctual whereas a change is, and represents the same information.

The lists may be :

- List of links, that are contained in the container that is related to the container where the communication starts and where it ends.
- List of containers
- List of States/Events, but they are transformed in binary trees after their construction

4.3 The trees

The trees do not concern the list of communications. The tree is binary and balanced.

Assuming there is a list, a class is used to build the tree reading only one time each element of the list.

The algorithm of construction is based on binary incrementation. To sum up the main idea, 1 element in the list on 2 is a leaf, as the lowest bit in binary, 1 element on 4 is a father of leaves, as the second lowest bit in binary, etc ...

Assuming we know the lenght of the list, we can calculate the height of the tree (because it is balanced) and then the number of leaves in the lowest level. While we have not reached this number of leaves, we build a binary tree linking the nodes depending on their position in the list (in binary). After this limit, a shift is necessary but the algorithm remain the same.

And so we have a binary tree, linked with an infix order kept : each node happen after all the nodes down in its left side, before all the nodes down in its right side, and these latter happen before the father date.

Then, there is a class that links the data structure and the interface, to be able to get all the events within an interval without being forced to visit each previous node.

4.4 Algorithms on the trees :

4.4.1 Browse tree

The main idea is a recursif browse of the tree. Going down we select the node that are in the interval, and going up we make sure the node is displayable, and prepare some data for the father to know if it can be displayed.

Algorithm :

```
function browse_recursif ( root, interval, zoom)

if the node is in the interval
   If the interval is wide enought to display the node

      browse_recursif ( left child )
      browse_recursif ( right child )

      If there is a problem on the left side of the left child
          Copy the problematic data in the node
      end if

      If there is a problem on the right side of the left side and
      the left side of the right child
          Making sure we can display the node, or be added to an
          interval of conflict that is then displayed
      end if

     If there is a problem on the right of the right child
        Copy the problematic data in the node
     end if

     If the node has not been displayed yet
        Display the node
     end if

   else // Not wide enought to display
      Current interval set as problematic in both problematic area
   end if

Else if node is after the interval
   browse_recursif ( left child )
   Copy the data of conflict on the left in the left child

Else // Node before the interval
   browse_recursif ( right child )
   Copy the data of conflict on the right in the right child

end if

end function
```

4.4.2 Getting informations on a clicked element

Principe : First we browse for the links (because if we start by something else : state, counter or event, we would not be able to find the links because they are over the others elements and thin enought not to hide them). Because the use of a distance, sometimes to get the right information, it is important to zoom enought.

Algorithm :

```
function get_information( positionX, positionY)

calculate the lowest container in the tree of container where
 the clic corresponds

for each container father of the container clicked
   look for a communication close enought
   if one is found
      return this communication
   end if
end for each

Search in the list of events of the lowest container
   if one corresponds
      return it
   end if
end search

Search in the list of states of the lowest container
   if one corresponds
      return it
   end if
end search

return no information found

end function
```

Chapter 5

Human-Computer Interface

The interface is divided into two main classes : the *console_interface* and the *graphical_interface* inherited from the *Interface* class.

5.1 The Interface class

The class Interface declares three pure virtual functions that are used by inherited classes to display messages for users :

- `virtual void error(const string) const = 0;`
- `virtual void warning(const string) const = 0;`
- `virtual void information(const string) const = 0;`

These functions are defined inside the Console User Interface (*Interface_console* class) and the Graphical User Interface (*Interface_graphic* class) which both inherit of the *Interface* interface.

In the first case, the messages are displayed in the Operating System terminal. In the second class, Qt text feature is used to display the messages inside a window: *Info_window*.
Nevertheless, *ViTE* modules (like the Parser, the Data Structure, the Render area, etc.) need to:

- Have an easy way to display message.
- Be independant of the place the message is displayed

Thus, to respect these two requirements, the *Message* class was created.

5.2 The *ViTE* notify message system : the *Message* class

The *Message* class was developped with the following leitmotiv : to provide an easy-to-use way to display messages for users anywhere inside the *ViTE* source code.
For all the *ViTE* parts, just a single *Message* class instance is needed. Thus, this class is a singleton. To pass many different argument types (such as *int*, *string*, *bool*), the *stringstream* class is used.
To display messages just recover the instance (the only instance) and use it like *cout* or *cerr* of the *STD* library. Nevertheless, you need to finish your message to

pass a special object instance : it will be *Message::endi* (for informative message), *Message::endw* (for warning message) or *Message::ende* (for error message).

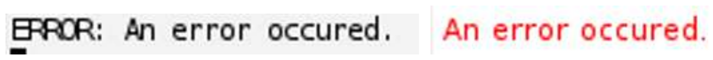
A message processing is different, depending on the special object used to end the message. For example, it influences the message color (orange for warning, red for error) in the graphical interface or add `Warning` or `ERROR` at the beginning of the message in the console interface.

Moreover, there is an other special object : *Message::endsi* (for selection informative message). It is used to display information about the mouse selected entity in the graphical interface only.

NOTE : In the graphical interface, messages are displayed in the *Info window*.

Example 1: *You need to notify the user that an error occured.*

```
*Message::get_instance() << "An error occured." << Message::ende;
```



```
ERROR: An error occured.
```

An error occured.

Figure 5.1: Message render: **Left**: in the System terminal - **Right**: int the *Info window*.

Example 2: *You need to notify the user that the trace is misformed. Use a warning message.*

```
*Message::get_instance() << "Incorrect value l." << line << " of   \
file: " << file << "." << Message::endw;
```

Take advice that you can define macro to use as debug :

```
#define message *Message::get_instance() << "(" << __FILE__ <<" l."\
<< __LINE__ << "): "
```

Thus, just use `message` instead of `*Message::get_instance()` in the source code.

5.3 Console User Interface : class Interface_console

5.3.1 Description

The *Interface_console* class is the most critical class of the software. It is the *ViTE* core since it manages and connects all the application modules. For example, it analyses the command line, launches window interface, creates a parser and triggers the data structure filling. Moreover, it is used to broadcast the messages between the render area (in OpenGL) and the graphical interface (in Qt). Besides, it triggers the SVG export of an opened file.

ViTE modules connections can be seen as a star where the *Interface_console* class is set on the middle. This organisation was designed to provide an easy and safe way to manage threads.

5.3.2 How it works

First, the *main* function of *ViTE* creates a console interface and gives it to the command line parameters.

Then the console interface analyses the parameters from its *constructor*. It gives them the `get_state()` function, which returns a code number of the right action to be executed. This latter is given the `launch_action()` function which executs the action corresponding to the code number.

For example: if the user calls *ViTE* with the command line:

`vite -h`

`get_state()` returns the `STATE_DISPLAY_HELP` code number. Then from this latter, `launch_action()` will be called and will apply the `diplay_help()` function that displays in the terminal the *ViTE* synopsis.

5.3.3 Managing of the arguments

We saw, in the last section, an example of using *ViTE* by command line to launch the help.

The arguments are managed by a loop in the `get_state()` function and the action to do is set in the integer `state`. The loop can be considered like an automaton which recognizes the arguments passed in parameter.

There are two kinds of arguments : the ones beginning with a "-" and the others. The ones beginning with a "-" are the options of *ViTE* and are predefined in the `get_state()` function. The others are the arguments of these options or, by default, the file to open.

When the option is known, the `state` value will be changed depending on the option and the option consumes the next argument if needed. If the option is unknown, the help is printed.

For example, to export a file in svg you can call : `./bin/vite -f in -e out` . The loop starts by reading the `-f` option. This option consumes the next token which corresponds to the file to open (the `in` token here). Then, because of the consumption of the argument `in`, the loop will read the `-e` option and set the next argument as the name of the destination file.

The loop makes a comparison between the argument and all the pre-defined options.

So, it is easy to add options :
First of all, depending on the option aim, you will need to add a new state in the header (for example `_STATE_OPEN_FILE` is used to set the state for opening a file). Then, in the `get_state()` function, add the case you want and what you want to do with it. If you want to change a parameter of another class, the best way is to do a static method in this class and call it in the case (it is what has be done to add the epsilon option for the export in svg and this method do not need a new state). Do not forget to consume the next parameter if necessary (check before if one exists). Maybe, you will need to do another thing and to set a new state, and moreover you will need to return it without preoccuping of the other ones. The action to set then has to be put in the `launch_action()` function. Do not forget to add the option in the help.

Some states are compatible, like for example the opening or exporting a file in an interval which are two different arguments. The choice made is to use binary operands for them and to do binary OR when we have the "-t" argument. To help to the comprehension, two states were added to specify that we are in an interval.

5.3.4 Graphical User Interface : class Interface_graphic

Graphical window interface is created by *Qt designer* in a .ui file (*main_window.ui*). The graphical interface loads it and displays the window generated from the file.

In a same way, the informative window is loaded from the *info_window.ui* file.

In the `_render_area_layout`, a `Render_area` object is created. It displays an OpenGL scene.

Chapter 6

The render system

The render system is the most important *ViTE* module since it provides graphical output of the trace files. Currently, they are two ways to render a trace file: the *direct render* or the *in-file save render*.

The *Render* class defines several *passives* displaying methods. What is a *passive* displaying method? It is a method which just perform a displaying action (calling *OpenGL* functions or in-file writing function for *SVG* output) according to its parameters.

Thus, theses methods do not call any others functions to browse, for example, the entity tree.

6.1 The render opengl

6.1.1 The drawing methods

Render_opengl uses the `QGLWidget` to display graphics using the OpenGL API. With three Qt functions, the scene is initialized (`initializeGL()`), resized when the main window is resized (`resizeGL()`) and displays the trace (`paintGL()`). Two functions are used to display a trace :

- `build()` $->$ creates the display of a trace loaded in the data structure.
- `unbuild()` $->$ releases the scene.

The build() function `build()` is called when a new trace needs to be drawn. It releases the waiting screen (currently a rabbit turning) and the timer associated with the waiting screen (for animation).

The unbuild() function This function is the complementary of the `build()` function : it releases the trace design and displays the waiting screen (and also restart the timer for the rabbit animation).

The drawing function To enhance the *ViTE* performance the drawing functions - called by the Data Structure while it browse the trace tree - are inlined functions and are defined in *render_opengl.hpp*. There must be an ordered to respect the OpenGL Display List mecanism. So, each display list should be opened, filled then closed.

Currently, there are three OpenGL Display List used for the render area: the container, state and counter Display Lists.

Nevertheless, arrows and events do not belong to a Display List since they must be drawn according to the current scale. (Else, the triangle of the arrow will be scaled and mask the states under it!)

Following, the list of calls is given and must be respected for each kind of objects else OpenGL errors should be lifted. Thus, for *container* (and also *container text*), *state*, *arrow* and *counter*, the drawing function (i.e. *draw_*()*) must be called between *start_draw_*()* and *end_draw_*()*:

1. start_draw()
2. (a) start_draw_containers()
   (b) draw_container()
   (c) draw_container_text()
   (d) end_draw_containers()
3. (a) start_draw_states()
   (b) draw_state()
   (c) end_draw_states()
4. (a) start_draw_arrows()
   (b) draw_arrow()
   (c) end_draw_arrows()
5. draw_event()
6. (a) start_draw_counter()
   (b) draw_counter()
   (c) end_draw_counter()
7. end_draw()

6.1.2 The scrolling and scaling methods

One of the most important feature of *ViTE* is to allow user to freely move in the trace render. They are two primitives available to move in the trace: the scrolling and the scaling.

NOTE: the origin of render area is at the top-left of the *QGLWidget*.

NOTE: please refer to the *ViTE* API documentation to know each following attribute meanings.

- *Scrolling* allows the user to move the image to the left, the right, the top or the bottom in the render area.
- *Scaling* allows user to resize the image, for example to perform a zoom in particular point.

Thus the user can visualize any part of an image trace just with his keyboard and his mouse. Nervertheless, *ViTE* needs to know what kind of action (push on a touch, move the mouse, etc.) the user does. The information is given by *Qt*. Since the *render opengl* is a *Qt* object (a *QGLWidget*), it receives some of these events (like mouse movement over the render area or mouse click). The others (some keyboard event) are caught by the graphical interface since they are bound as a shortcut then send to the render area with the *Qt* signal and slot mecanism.

Now, we just present the different attributes and methods used to perform scrolling and scaling.

All of them have the same type: `Element_pos`.

- - `_screen_width`: the *Qt QGLWidget* width (in pixel).
  - `_screen_height`: the *Qt QGLWidget* height (in pixel).
- - `_render_width`: the render area width (in OpenGL unit).
  - `_render_height`: the render area height (in OpenGL unit).

Both of the `_screen_*` and `_render_*` represent for the user the same area in his monitor but with a different point of view.

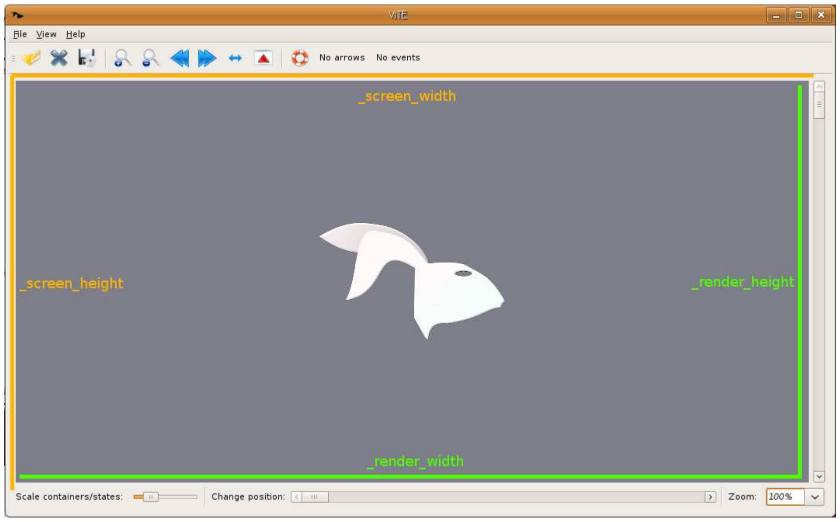


Figure 6.1: The render area dimensions. The both measures (green and orange) are the same but in different units.

To convert screen units to render units, you have to use `screen_to_render_x()` and `screen_to_render_y()` (please refer to the *ViTE* API documentation for a whole synopsis). To pass from render to screen, user `render_to_screen_x()` and `render_to_screen_y()`.
Moreover, we need to get the trace coordinates to know, for example, from which entity the user has just clicked. So, there are two methods to convert from render units to trace units: `render_to_trace_x()` and `render_to_trace_y()` and also `trace_to_render_x()` and `trace_to_render_y()`.

Another important coordinates are the trace coordinates. There are several attributes to defines a render :

NOTE: all of the following coordinates are in the trace unit. (and not in OpenGL unit)

- - **Container coordinates**
  - `_container_x_min`
  - `_container_x_max`
  - `_container_y_min`
  - `_container_y_max`
- - **State coordinates**
  - `_state_x_min`
  - `_state_x_max`

- `_state_y_min`
- `_state_y_max`

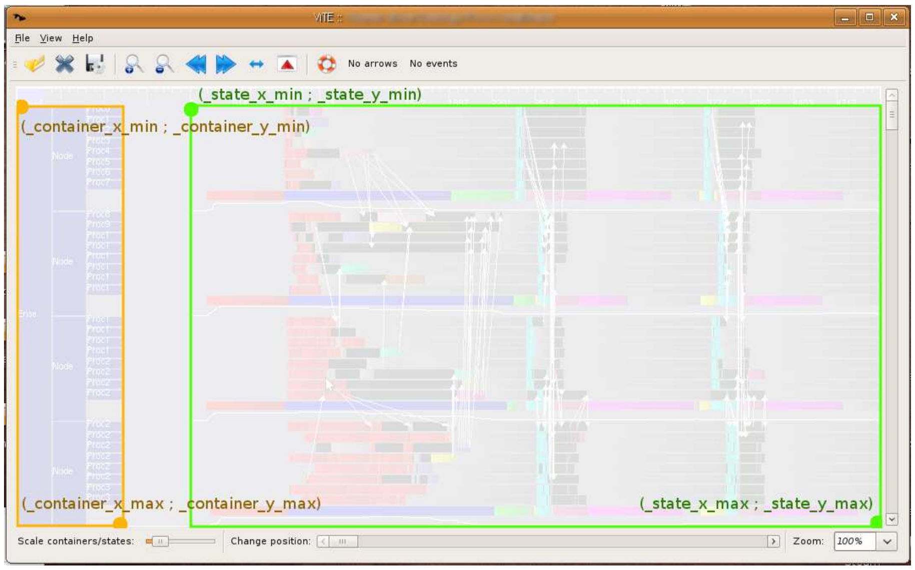

File View Help
No arrows No events
(_state_x_min ; _state_y_min)
(_container_x_min ; _container_y_min)
(_container_x_max ; _container_y_max)
(_state_x_max ; _state_y_max)
Scale containers/states:
Change position:
Zoom:
100%

Figure 6.2: Container and state dimensions in a trace. (in **trace** unit)

Finally, the trace entity positions : **NOTE: all of the following coordinates are in the OpenGL unit.**

- `_default_entity_x_translate`
- `_ruler_y`
- `_ruler_height`
- `_x_scale_container_state`

6.2 Render out Svg file

Introduction

As render_opengl, render_svg must implements the drawing functions. It consists in outputting data in a svg file. Data to be printed in the file, are buffered in differents `std::ostringstream` buffer. Main elements are stored in `_buffer`, flushed regularly by print(). In a svg viewer, the last element in the file are displayed in the front : the thinnest element must be printed as latest as possible : these are stored in `_thin_element_buffer`. Counter are stored in `_chronogramme`, and the scale is stored in `_time_scale`.

Required settings

Render in svg may produce a high weight file due to numbered elements and default scale setting may hide some relevant events. That is why render_svg allows user to set the width, heigth and accurracy of the render. These are set by default with the following static functions :

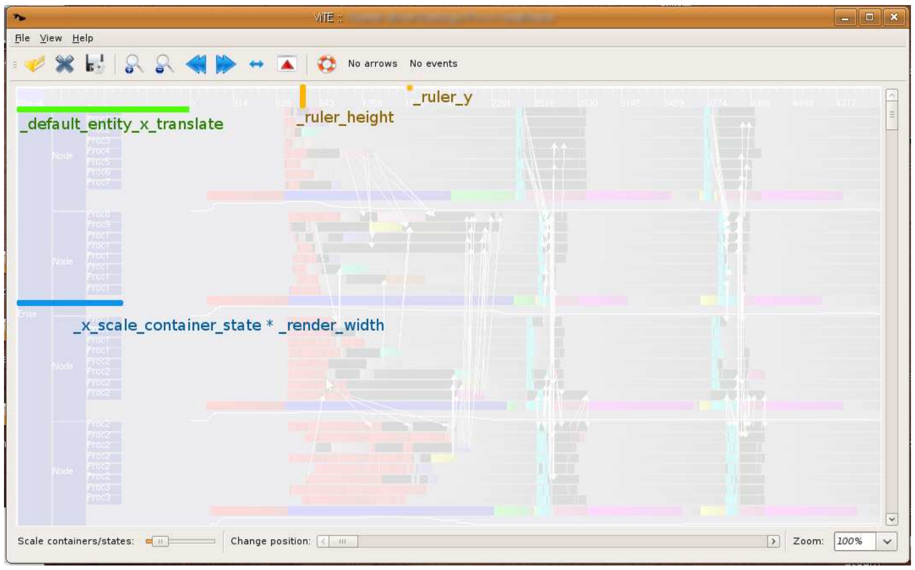


Figure 6.3: Container and state positions in a trace. (in **OpenGL** unit)

- Svg::set_height_factor(double)
- Svg::set_wide_factor(double)
- Svg::set_interval(double, double)
- Svg::set_accuracy(double)
- Svg::set_scale_frequency(double).

Initialisation

render_svg opens the file specified by `Svg::init(const char *path)` and output the header. Css embedded stylesheet reduces style attributes in each elements.

drawing

The procedure to implement functions such as `draw_arrow`, `draw_container` or `draw_state` is the same.

render_svg controls that the elements to be displayed are in the appropriate range, set by `Svg::set_interval(double,double)`. In this release, the render reshapes itself too tall elements, but in the next version of Vite, the reshapement can be replaced by warnings (a correct draw_trace function doesn't need this control).

Then, render_svg computes positions and colors according to parameters. Any elements are widen by _wide_factor to convert time in ms to pixel, heights are grown by _height_factor for the same reason.

Positions are translated to _container_width_max : the left region occuppied by containers and MARGINTOP the upper region reserved for scale. Color are converted from floats to RGB.

Whenever a time selection is set, are translated to (-) _start_interval_time (in ms, ie -_start_interval_time*_wide_factor pixel).

The computed position allows the call to basic shape painting functions such as

```
Svg::rectangle(const char* name, Element_pos w, Element_pos h,
               Element_pos x1, Element_pos y1, unsigned int r,
               unsigned int g, unsigned int b)
```

which corresponds to write in the svg output :

```
<rect class='name' title='name' width='w' height='h'
 x='x1' y='y1' fill='rgb(r,g,b)'/>
```

drawing counter

Drawing counter is an automaton. See the schema for details. Svg paths are used to display counter.

drawing scale

Each element position corresponds to a time. The latest element indicates the total time. The total time multiplies by width factor equals the total width. The scale consists in drawing a time value regulary.

ending function

`Svg::end()` flushes left buffered informations, writes the scale, the cursor and ends the svg file. The cursor is only available on javascript enabled svg viewers (e.g. firefox).

Chapter 7

The plugin module

7.1 Overview

The plugin module has been designed in order to provide more functionalities to the users. Its main utility is to show statistics of traces but it could be used for other things like communicate with other programs, use filters on the trace...

7.2 How to build a plugin

The main classes for creating plugins are the Plugin and PluginWindow ones.

The PluginWindow class looks for plugins in your $HOME/.vite directory (and the ones you have set in the preference window) and loads them. Also, it loads the static plugins created by ViTE developers. The plugins are loaded using the QLibrary class from Qt in order to be portable. The plugins window is shown on figure 7.1.

The Plugin class is the base class for plugins. It inherits the QWidget class which is the base class for showing windows in Qt. It contains the basic methods used to load and initialize a plugin :

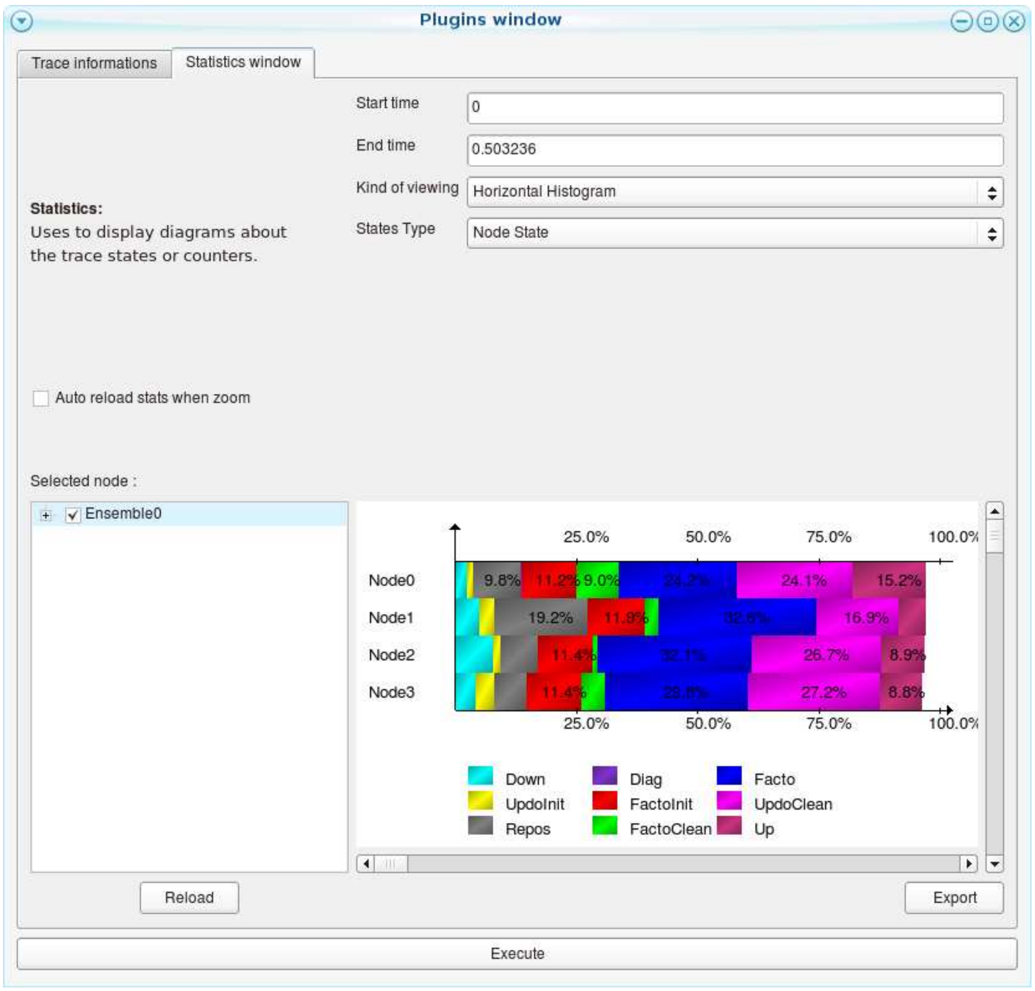
```
class Plugin : public QWidget {
protected:
    std::string _name;
    Trace* _trace;

public:
    Plugin(QWidget *parent = 0) : QWidget(parent){}
    virtual void init() = 0;
    virtual void clear() = 0;
    virtual void execute() = 0;
    virtual std::string get_name() = 0;
    virtual void set_arguments(std::map<std::string /*argname*/,
                               QVariant */*argValue*/>) = 0;

    virtual void set_trace(Trace *t) { _trace = t; }
};
```

The *init* method is called once after the plugin is created and the trace set. It should initialize the plugin.

The *clear* method clears the window corresponding to this plugin. It is called when you change the tab.



Statistics:
Uses to display diagrams about the trace states or counters.

Start time: 0
End time: 0.503236
Kind of viewing: Horizontal Histogram
States Type: Node State
☐ Auto reload stats when zoom

Figure 7.1: The plugins window.

The *execute* method is called when you click on the execute button in the plugin window. It should execute the plugin.

The *get_name* method returns the name of the plugin. The name is used as the title of the tab.

The *set_arguments* method is used to set arguments... Not yet sure of the prototype :).

Moreover, your plugin must contains a **create** function as the following one (if your class is a NewPlugin one):

```
extern "C" {
    Plugin *create() { return new NewPlugin(); }
}
```

In order to create the window, you can use the Qt Designer or create it from zero in the code.

To compile a plugin, the easiest way is to use a Qt .pro file and use qmake. You create a **lib** template and put all the files you need in order to compile the plugin.

Then to use it, you put the shared library created in the $HOME/.vite directory. You can launch *ViTE* again and it should appears in the plugin window.

You have an example of a simple plugin in the plugin_directory directory (created from zero) and a more difficult with the statistics one.

The class should looks like this :

```
#include "Plugin.hpp"

class NewPlug : public Plugin {

  private:
    attributes, methods...

  public:
    NewPlug(QWidget *parent = 0) : Plugin(parent){}
    void init() { printf("init\n"); }
    void clear() { printf("clear\n"); }
    void execute() { printf("execute\n");}
    std::string get_name() {return "New plug";}
    void set_arguments(std::map<std::string,
                          QVariant *>) { ... };
    ...
};

extern "C" {
  Plugin *create() { return new NewPlug();}
}
```

7.3 Existing plugins

7.3.1 The statistic window

This plugin allows the user to watch some statistics on the code. The statistics are provided in order to ease the access to important data. For example, without them it could be hard to compute the time for each states in a container.

It is useful when you need to know how many time a processor works.

This paragraph will describe how the statistic window works as well as the different stats already implemented.

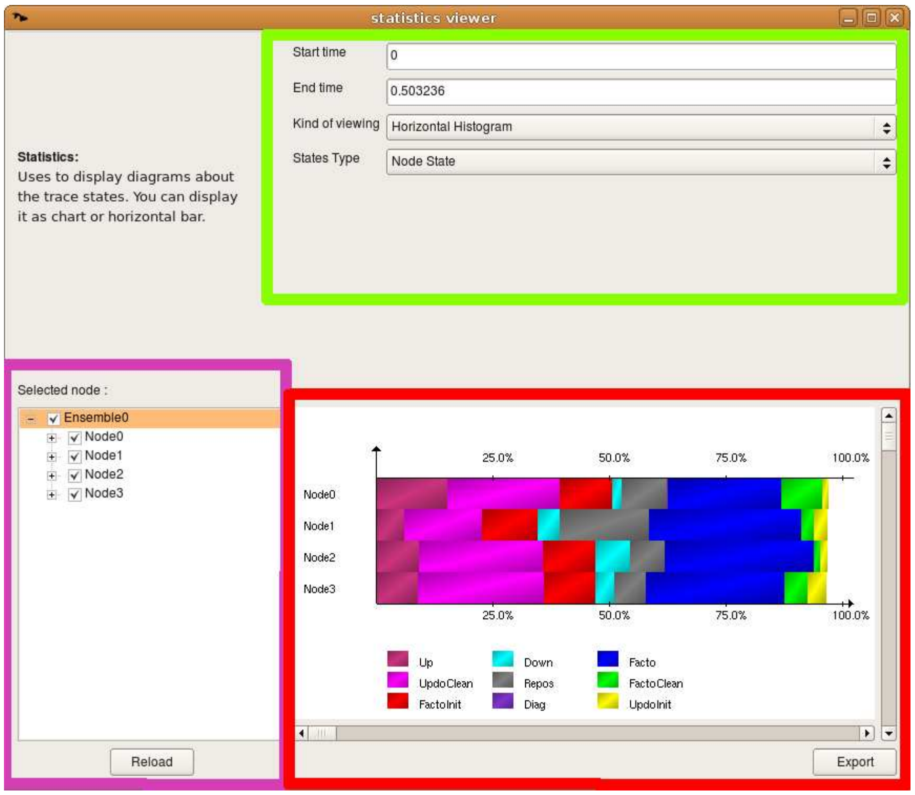
The stats window

The window is designed with *Qt Designer*. The designed file is in the *interface* folder and the source code in the *statistic* folder. It is divided in three important part as you can see in the figure 7.2. The first one is to set the values for which kind of statistic you want. There are two QLabel for the times and two box for the kind of diagram and the kind of states you want to print.

The second is the tree of each node you can have statistics. It is a QTreeWidget filled recursively in the constructor.

The third one is the most important, it is the stats render. It is a *render_stats_opengl* object. This class inherits from a *QGLWidget* and is used to show the diagrams.

The same idea that for the trace render has been used. That means that we did an interface for the render which enable us to convert stats in which format we want (... which is implemented of course). This is why we can watch the stats in two formats : the openGL one which is used for the render and the svg one which is used to be exported.


statistics viewer

Statistics:
Uses to display diagrams about the trace states. You can display it as chart or horizontal bar.

Start time: 0
End time: 0.503236
Kind of viewing: Horizontal Histogram
States Type: Node State

Selected node :
Ensemble0
Node0
Node1
Node2
Node3

Figure 7.2: The statistic window

The DrawStats template

This is the interface which takes as parameter the draw class you want. It contains a lot of attributes for the geometrical informations like the start time for drawing, the size of a container...

It is designed in order to be inherited by classes which will print the stats wanted. For example, the DrawHDiagram (H for horizontal) or the DrawCounter inherit from it.

Chapter 8

Some possible ameliorations

This section is for the maintenance of *ViTE* and describes some features that could be added to it. They are not all described here and there is a better list in http://gforge.inria.fr/pm/task.php?group_id=1596&group_project_id=3732.

Of course, there could be some features not written here that could be implemented. Moreover, some of these features are already in *Pajé*.

8.1 Using filters

Unlike *Pajé*, there is no filters in *ViTE*.

We could add some like :

- filtering on the printed data : in order to improve the legibility of the trace, we could hide some events, nodes, links ... printed in the trace.
- filtering on the trace during parsing to do not keep some events too little or some entities (links for example) to improve the time spent to parse and show only what is useful.
- filtering by container to only show the ones we want...

8.2 Export in another file format

ViTE can export a trace in a svg format.
The advantage of this kind of format (vectorial) is that the quality of the trace is perfect because we can zoom in or out with the precision we want.
The problem is that the output file can be more than three times bigger than the original file (for an export of the whole trace).
So, it can be difficult to open it after. The export in a non-vectorial format can reduce the output size and make easier to open with only a slighty difference of quality.

8.3 Allocation by lot

For the moment all the different events are stored in memory one by one.

It could be very slow for very big traces. The idea, in order to do a new object for each event, is to do a tabular which could store a group of event.

The aim is to reduce the number of allocations which cost a lot.

8.4 Reading at the flight

For a better interactivity with *ViTE*, you would like to be able to see the progress of a loading file or watch the about menu. For now, this is not possible because *ViTE* is not multi-threaded and it parses the file and then shows it.

8.5 Saves of configurations

Maybe, for a trace that you will use a lot of time, you would like to always have the same filters or anything else preloaded without setting them when you load the trace. In order to do it, a configuration file by trace could be the solution and be loaded while the trace is loaded automatically.

8.6 Interface enhancement

The interface will have to have a menu built such as a tree, listing all the containers, and enabling by selecting one of them, to display only its children.