GUIS - a GUI widget server

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Please be nice to send me (basile@starynkevitch.net) an email if you use this information and this Guis software.

Guis is available (as a gnuzipped source tarball) from http://www.starynkevitch.net/Basile/guis- and this document is on http://www.starynkevitch.net/Basile/guisdoc.html . See also my home page on http://www.starynkevitch.net/Basile/ or Guis page http://freshmeat.net/projects/guis/ on Freshmeat for announcement of newer versions. Please feel free to send suggestions, patches, criticisms, etc...

1 Overview and usage

This section gives a short overview with the classical adder example. Then the usage details are given.

1.1 Motivations and related stuff

Guis is a small widget server. It is a gtk2 (see http://www.gtk.org/) based program listening on a pipe for widget requests (requests are Python [or Ruby] scripts - see http://www.python.org/ using the PyGTK 2.0 binding of GTK2 to Python - see http://www.daa.com.au/~james/software/pygtk/) and outputting events or replies *Guis* is useful for programs (in particular, setuid programs or (ruby,ocaml,perl...) scripts) which do not want to link in a full widget toolkit but prefer to delegate the user interface to another process.

The choice of the scripting language is not critical provided it does have a full Gtk2 binding. Porting Guis to another scripting language should be easy.

(Many years ago, I was a satisfied user of Sun OpenWindows system with its programmable NeWS [widget] server. I still miss that widget server (see a message I posted in october 1993 on http://www.zendb.com/vsta/mail/1/0146.html which is copied on http://starynkevitch.net/Basile/NeWS_descr_oct_1993.html) I don't understead why the NeWS team, which also probably designed Java, did not consider to embed the JVM inside the X11 server, as a standard X11 extension, and embedding a toolkit inside Java, like Swing does, is not an answer.)

A similar project is *entity* - see http://www.entity.cx/ . The major difference between *entity* and *guis* is that *guis* is a server (listening for orders on a pipe...) while *entity* is a script engine.

The IRAF widget server - see http://iraf.noao.edu/iraf/web/projects/x11iraf/ had similar goals. And PicoGui http://picogui.org/ is also server based.

The XUL system of mozilla (see http://www.xulplanet.com/) also describes an interface with XML.

The (previously Berlin, now) Fresco server should be a corba server for widgets - which seems nearly dormant. see http://www.fresco.org/

1.2 Introduction

Guis is a graphical user interface program communication with a client application (using separate protocols). The application send widget building requests to *Guis* (so these requests are input for *Guis*) and handles widget events sent from *Guis*. Usually Guis is started with a small Python initial script which defines common functions and build some widgets. The requests are Python source code chunks. The replies (i.e. events sent back from *Guis* to the application) are just some textual lines sent (by some Python code calling `guis_send`).

Actually, *Guis* is strongly dependent on GTK2, and depends less of Python. The code is designed to make *Guis* easily portable[1] to any other scripting interpreter able to evaluate requests in textual strings, provided this interpreter has a binding to GTK2. The only reason I use Python here is the availability of a nearly complete binding of Python to GTK2. (I would prefer some other scripting languages). To remind that *Guis* is using Python its binary is called `pyguis` .

Since version 1.3, *Guis* is also interfaced to Ruby. See section 4 below.

1.2.1 callbacks

The initial script (or the application) is responsible for installing appropriate callbacks with the **connect** primitive (or equivalent) of the scripting language (Python or Ruby).

IMPORTANT Callbacks in Guis should be robust: **callbacks cannot raise uncaught exceptions** (because they are run by the `gtk_main_loop` in *Guis*, outside of the (Python or Ruby...) interpreter. Applications should encapsulate callbacks with the appropriate mechanism (catch ...) in the scripts.

1.2.2 initial script

Usually, *Guis* runs an initial script (in Python or Ruby) which is interpreted by the scripting language before entering the `gtk_main_loop` . This initial script usually builds the widget and defines some application specific functions (to implement the protocol specific to your application).

The initial script is run once. It is specified with the `-s` option or with the `-scripter` trick. See below 2.2 and the man page.

You might (if possible) end your initial script with a call to `gtk_main_loop` as provided by the (Python or Ruby) GTK2 binding. Calling it will make the request evaluation better under control and might permit exceptions in callbacks

[1] To port Guis to another language you just have to link `gguis.c` with a file similar to `py_guis.c` for your scripting language which provides the following functions : `initialize_interpreter(void)` (called once to initialise the interpreter), `load_initial_script(char * scriptname)` (called once with either the initial script name -a file path- or NULL), `interpret_request(char * request)` (called for every request), and `end_of_input_hook(int timeout)` (called at end of input with a timeout in milliseconds). These last 3 functions should return 0 if successful, or a static C string describing the error.

(see your documentation of the GTK binding you are using). Then you have to exit explicitly *Guis* (by calling the `exit` primitive of Python or Ruby) or tell *Guis* (using `guis_main_loop_in_script`) that you call the main loop.

I still strongly advise against uncaught exceptions in callbacks.

1.2.3 protocols

Every request sent from the application to *Guis* should end with two consecutive newline[2] characters coded in C as `\n\n` or with a formfeed (coded in C as `\f`, decimal 12).

Obviously requests cannot contain (inside) a double newline which is a convention suitable for most scripting languages (including Python, Ruby, Ocaml, Lua, Rep-Lisp, Slang, ...).

A convenient way to debug *Guis* initial scripts is to run `pyguis` with an explicit FIFO input: make it with `mkfifo /tmp/fifo` and then run `pyguis -s yourscript -i /tmp/fifo -o -`; in another xterm, run `cat >> /tmp/fifo` and don't forget to end every request with a double newline (ie return) character.

Events or replies sent from *Guis* to the application are single lines (maybe very long) ended with a newline. They should not contain any control character (eg newline or formfeed) inside. Requests and replies are asynchronous (a request can be sent without any replies and vice versa).

The driving idea of *Guis* is that the input and output protocols are tailored to your application. On the input side (requests from your application to *Guis*) the protocol is usually made of calls to specific functions defined in the initial script. On the output side (replies or events from *Guis* to your application) the protocol is defined by sending (thru an appropriate primitive, usually `guis_send`, of the scripting language) arbitrary lines to your application from callbacks.

1.2.4 other toolkits (Qt3)?

It would be interesting to have a similar approach with QT3. I tried, and leave some (bad, incomplete, not even compilable) C++ code under the `bad_qt_stuff/` directory of this *Guis*. Feel free to reuse this code (under a GNU license). My main problem was lack of good binding to QT3 and threading problems (notably threads are nearly incompatible with an embedded Python).

1.3 Small example

For illustration purpose, suppose we have an application which computes the sum of 2 integers, and we want to give it a nice graphical interface containing two (editable) textual entry widgets, a quit button, and a label widget displaying the sum.

[2]The newline is coded decimal 10 in ASCII or IsoLatin1

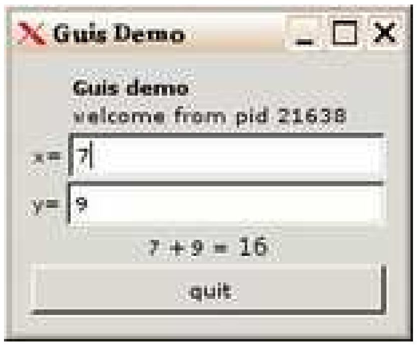


Figure 1: Simple example demo window

1.3.1 protocols

We have to think first about the messages sent from the application to *Guis*. We need first to `start` the interface (giving some nice title). We will need to display a sum using `displaysum` and to display an error message using `displayerror`. And we need to stop the demo, thru a `stopdemo` function. All these functions are Python functions defined in the initial script file.

We also need to define the messages sent from *Guis* back to the application. We will send a plain `END` for end, and a more complex message starting with `ADD` to ask the application to make an addition (displaying the result with a `displaysum` request. The `ADD` message should contain the textual content of the two entry widgets. Since the textual content can be anything (it could even contain control characters like newlines) it should be encoded. We use a C like encoding convention, so will usually send `ADD "1" "3"` -or even `ADD "\t1" "3"` if the first entry starts with a tab[3]. The application is in charge of checking that the entries contain valid numbers.

The *Guis* server program buffers all input (python requests) and output (event replies), reading and writing as soon as possible.

A typical exchange between the application and Guis might be as follow; first the application starts and sends

```
start("pid 1234")
```

Then *Guis* shows the window and let the user interact with it. Some user interaction makes *Guis* send back messages like

```
ADD "2" "5"
```

To which the application responds with

```
displaysum(2,5,7)
```

[3]How to enter a tab character inside a Gtk entry widget is left as an exercise to the reader.

When the user closes the window, *Guis* send back

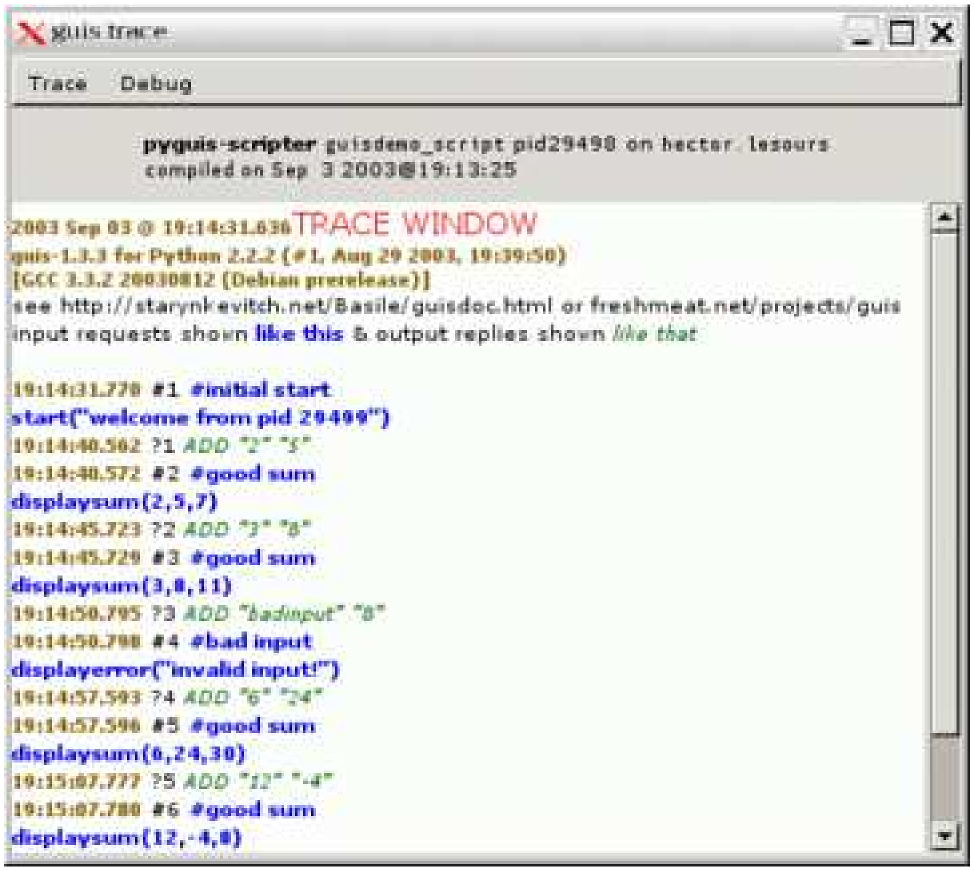
```
END
```

To which the application responds with

```
stopdemo()
```

and then exits.

When run with the `-T` flag, *Guis* opens a window to show the trace of all requests and replies (this is useful for script and application debugging):



```
pyguis-scripter guisdemo_script pid29498 on hector. lesours
compiled on Sep  3 2003@19:13:25

2003 Sep 03 @ 19:14:31.636 TRACE WINDOW
guis-1.3.3 for Python 2.2.2 (#1, Aug 29 2003, 19:39:50)
[GCC 3.3.2 20030812 (Debian prerelease)]
see http://starynkevitch.net/Basile/guisdoc.html or freshmeat.net/projects/guis
input requests shown like this & output replies shown like that

19:14:31.770 #1 #initial start
start("welcome from pid 29499")
19:14:40.562 ?1 ADD "2" "5"
19:14:40.572 #2 #good sum
displaysum(2,5,7)
19:14:45.723 ?2 ADD "3" "8"
19:14:45.729 #3 #good sum
displaysum(3,8,11)
19:14:50.795 ?3 ADD "badinput" "8"
19:14:50.798 #4 #bad input
displayerror("invalid input!")
19:14:57.593 ?4 ADD "6" "24"
19:14:57.596 #5 #good sum
displaysum(6,24,30)
19:15:07.777 ?5 ADD "12" "-4"
19:15:07.780 #6 #good sum
displaysum(12,-4,8)
```

Figure 2: Protocol trace window

1.3.2 initial Python script

We write a small Python initial script. A special trick in *Guis* is that if `Guis` is invoked with a name (i.e. `argv[0]` in C parlance) ending with `-scripter` then the next (second) argument is the initial script name. Hence we can start our script with

```
#! /usr/bin/env    pyguis-scripter
# file  guisdemo_script     in -*- python  -*-
```

With such a trick, our initial script can be invoked by any pyguis-scripter found in our $PATH . We make it a symbolic link to the pyguis executable.

We need to tell python to use the gtk module (provided by pygtk) and the guis module (builtin inside pyguis).

```
import  gtk
import  guis
```

Next, we need to define a callback used by the *quit* button; it just sends back the END string to the application

```
def  end_cb( *args):
     guis.guis_send("END")
```

We also define a callback used when text entries are updated. It uses the guis.to _guis primitive to convert a C string to its textual representation but we could have used Python repr function.

We need to define the start function, invoked by the application in its first request, to build the graphical widgets and connect them to callbacks. It first builds a window and its contained vertical box (using GTK2 calls in Python):

```
def  start(welcomsg):
     global  window,  xent,  yent,  sumlab
     window  = gtk.Window(gtk.WINDOW_TOPLEVEL)
     window.set_title("Guis      Demo")
     vbox  = gtk.VBox(gtk.FALSE,2)
     window.add(vbox)
```

Then it builds the other widgets (details deleted here, see the source of guisdemo _script file). At last, it makes the *quit* button, connect it to the end _cb callback, add it into vbox and show all of the window :

```
     # ...
     quitbut  = gtk.Button("quit")
     quitbut.connect("clicked",       end_cb)
     vbox.add(quitbut)
     window.show_all()
```

We need to define the displaysum function

```
def  displaysum(x,y,sum):
     sumlab.set_markup(('<i>%d</i>        + <i>%d</i>'  % (x,y))
                       + (' = <big>%d</big>'    % sum))
```

We need to define the `displayerror` function. To avoid messing the Gtk2 (pango provided) XML-like markup, we convert the message to its XML representation (i.e. using `&lt;` for < etc...) using the `guis.xml_coded` primitive.

```
def displayerror(message):
    sumlab.set_markup('<b>ERROR:</b> '
                      + (guis.xml_coded(message)))
```

A `stopdemo` function is also needed (see the source file).

1.3.3 client application

We suppose the client application is written in C. You can code it in any language able to communicate on channels in a textual way. We comment here parts of the file `guisdemo_client.c`. You don't need to link any *Guis* specific library to it!

We declare a big line buffer, and the requests and replies files. We could also use the `glibc` specific `getline` function which dynamically allocates the line buffer.

```
char linbuf[1024];
FILE *toguis = stdout;
FILE *fromguis = stdin;
```

At first, we want to send a request like `start("<b>guis</b> demo")`. Requests may start with a comment used to help identify them in error messages[4].

```
fprintf (toguis, "#initial start\n"
         "start(\"pid %d\")\n\n",
         (int) getpid ());
fflush (toguis);
```

Never forget to flush your request channel very often, and to end every request with two newlines.

Of course we need a loop to read events (or replies) messages from *Guis* - each of them is a single (sometimes very long) line ended with a single newline.

```
while (!feof (fromguis)) {
  fgets (linbuf, sizeof (linbuf) - 1, fromguis);
```

if the reply line starts with `ADD` we scan it appropriately and ask to display a fancy line like "*2* + *3* = 5" otherwise (bad scan because of non-numeric entries) we display "**invalid input**"

[4]Actually requests are identified by their first line in error messages.

```
    if (!strncmp (linbuf, "ADD", 3)) {
      int x=0, y=0, pos=0;
      if (sscanf (linbuf, "ADD \"%d\" \"%d\" %n",
                  &x, &y, &pos) > 0 && pos > 0) {
        fprintf (toguis, "#good sum\n"
                 "displaysum(%d,%d,%d)\n\n",
                 x, y, x + y);
      } else {
        fprintf (toguis, "#bad input\n"
                 "displayerror(\"bad input\")\n\n");
      }
```

If the reply is `END` we stop gently (by sending a `stopdemo()` request and exiting):

```
    } else if (!strncmp (linbuf, "END", 3)) {
      fprintf (toguis, "#stop\n" "stopdemo()\n\n");
      fflush (toguis);
      sleep (1);
      exit (0);
    }
```

After warning against unexpected input lines, we flush the request channel and end the loop.

```
    fflush (toguis);
  }; // end of while feof
```

Normally the while loop should never be ended, since our guis python script should signal termination with `END` (handled above).

2 Reference

2.1 installing Guis

You need Python (2.2.x or 2.3.y from `http://www.python.org/`), GTK (2.2 or better from `http://www.gtk.org/`) and PyGTK (1.99.18 or 2.0 or better from `http://www.daa.com.au/~james/software/pygtk/`) to build `pyguis` (the Python version of *Guis*). You need Ruby (1.8.x) from `http://www.ruby-lang.org/` and ruby-gnome 0.9.1 or later from `http://ruby-gnome2.sourceforge.jp/` to build `ruguis` (the Ruby version of *Guis*). I built a thread-less Python-2.2[5] which works with Guis. I am using GNU gcc (3.3) and GNU make (3.80). You may add a local `_local.mk` file containing definitions for your installation, such as `PREFIX=/usr`, `CC=gcc-3.3`, `PYTHONCFLAGS=-I/usr/include/python2.2`

[5] I passed the -disable-threads option to Python's configure script

or `PYTHONLDFLAGS=-lpython2.2` `RUBY=ruby` etc... you may even edit the Makefile.

First configure, either with `make config` or with the `./Configure` script. Run it with `-help` to get usage information.

Then run `make` then `make install` (which usually requires to be root).

You may build only the Ruby version with `make ruguis` or only the Python version with `make pyguis` .

To run the demo, you probably need to add `.` or the *Guis* source directory to your `$PATH` before running `guis_demo.sh` or you can run the `guisdemo_script -p guisdemo_client -T` command. use `guisdemo_rubyscript` to run the Ruby version.

2.2 invoking Guis

See the man page in the source distribution for complete reference of invocation, or invoke the binay with the `--help` option.

Guis is usually invoked as `pyguis` command, or indirectly as `pyguis-scripter` if started by its initial script.

Guis can be started in a slave fashion (after the application has started) by specifing its input and output channels (thru the `-i` and `-o` options). You may specify file descriptors or paths as channels.

Guis can also be started as a master, by giving the application command as argument with `-p`. You usually need to quote this argument (because of your shell) unless the command has no spaces!

The `-T` option is interesting to show the exchange between *guis* and its application in a separate window. This is very useful to debug your initial script or your application.

The `-D` option (disabled with `-DNDEBUG` compile flag) show lots of debugging information (to debug `pyguis` itself).

The `-L` option writes all requests into a log file.

the `-I` or `--input-encoding` option set the input encoding (as supported by GLib2 on input channels). Likewise for `-O` or `--output-encoding`

3 Guis for Python

3.1 invocation

as usual, see section 2.2 above.

3.1.1 added Python primitives

In alphabetical order, here are the names wired in the `guis` builtin Python module. You need of course to learn and use the modules provided by `pygtk` to actually build any GTK2 widget! You should not explicitly call `gtk_main_loop` from Python, since it is is already called by `pyguis`

3.1.2 end_of_input_hook

With a callable argument, sets the hook called at end of input. Always return the previous hook (even without any arguments). You probably also need to set the end timeout using `end_timeout` below.

3.1.3 end_timeout

Get (without arguments) or set (with an integer argument) the timeout in milliseconds after which `pyguis` exits at end of input. Useful with `end_of_input_hook` above.

3.1.4 guis_send

Send the string argument on the output channel to the application. The string should not contain control characters (this is not checked) otherwise the application might have trouble scanning it. A newline is added if needed. (You may use many Python packages to build the sent string; eg you could send XML stuff).

3.1.5 main_loop_in_script

Get (without argument) or set (with a truth-value argument) the flag telling *Guis* that the main loop `gtk_main` was called from the initial script.

3.1.6 nb_replies

Get (without arguments) the number of sent replies (event lines sent to application). You might set this number with an integer argument (but I see no reason to do this).

3.1.7 nb_requests

Get the number of processed Python requests. You might set this number with an integer argument (but I see no reason to do this).

3.1.8 pipe_check_period

Get (without arguments) or set (with an integer argument) the period in milliseconds (should be 0 or 50 to 10000) to check for application termination (in master mode). Useful with `end_of_input_hook` above.

3.1.9 to_guis

Convert an object (or many of them, considered as a tuple) to a string sendable to the application using the following algorithm:

- if the object is string, represent it in C syntax (except that double quotes are escaped as `\Q` so they are only string delimiters in the converted string) , so the string made of 4 characters (a, tabulation, double-quote, z) is converted to the 7 character string `"a\t\Qz"`
- if the object is an integer, represent it in decimal notation
- if the object is a double, represent it like in C with a # prefix[6], eg `#3.14`
- if the object is a tuple, convert each component using the same `to_guis` builtin function and catenate each substring with spaces for separation - if any component fails to be converted, the entire tuple conversion fails.
- if the object has a `to_guis` attribute, fetch it: if it is a string, return it, if it is callable, apply it to the object.
- if the object has a `to_guis` method, call it (without any arguments except the recieving object).
- otherwise, fail

3.1.10 xml_coded

Quickly convert a Python string or unicode to its XML representation (so the 3 characters string `a<b` is converted to the 6 characters string `a&lt;b`), escaping characters per XML requirements:

- `&` as `&amp;`
- `'` as `&apos;`
- `"` as `&quot;`
- `<` as `&lt;`
- `>` as `&gt;`
- other strict ASCII printable characters are kept identical
- all other characters including control and IsoLatin1 accentuated characters like `é à` are represented by a numerical entity (character number in decimal) like `&#231;` for the lowercase c with cedilla `ç`

The result of `guis.xml _coded` is a string with only ASCII printable characters (coded 32-126).

[6]Distinguishing floating numbers from integers with a prefix should make parsing easier for the application.

4 Guis with Ruby

Guis has been ported to Ruby 1.8. See `http://www.ruby-lang.org/` for more on Ruby. The binary name is `ruguis` (including the `ruguis-scripter` trick) and has the same invocation as the `pyguis` (Python) version. The Ruby port is in the file `ru_gguis.c`

This port uses the *ruby-gnome2* binding of GTK2. See `http://ruby-gnome2.sourceforge.jp/` .

The demo works in a Ruby way - it is in the `guisdemo_rubyscript` file and can be run as `ruguis -T -D -s guisdemo_rubyscript -p guisdemo_client` (provided that `.` is inside your `$PATH`)

4.1 open questions

I don't know if a builtin module can have virtual variables (as defined by the `rb_define_virtual_variable` C function of the Ruby runtime).

I would like to print more (e.g. the current environment in `debug_extra`) but I don't know how to code it.

4.2 Ruby API

There is a builtin `Guis` Ruby module. It contains the `guis_send` primitive to send a string back to the application.

`$guis_nbreq` , `$guis_nbsend` and `$guis_pipecheckperiod` are (global) virtual variables (implemented thru `rb_define_virtual_variable` C function).

`$guis_main_loop_in_script` is a global variable which when set to a true value avoid calling `gtk_main` after interpreting the initial script (which should hence call `Gtk.main` explicitly).

Conversion to XML notation is done by the `to_xml` method added to the existing `String` class.

Conversion to a C-like notation (like `to_guis` in Python above 3.1.9) is done by the `to_guis` method with built-in implementations for arrays, strings, integers, floats, symbols. The user could add other methods to existing classes by Ruby code like

```
ExistingClass.class_eval {
  def to_guis
    return "result"
  end
}
```

Then end of input hook is settable with

```
Guis::on_end_of_input do |timeout|
  # user end input hook
done
```

To remove the end of input hook, just do

```
#removing end of input hook
Guis::on_end_of_input
```

5 experimental and incomplete Slang version of GUIS using slgtk

See `http://s-lang.org/` for the Slang interpreter. See `http://space.mit.edu/home/mnoble/slgtk/` for the Slgtk binding.

The GUIS port to Slang is incomplete and barely tested. See the source code for details. Feedback is welcome.

6 Feedback

6.1 Feedback welcome

Please send comments, criticisms, suggestions and patches to `basile@starynkevitch.net` mentioning `guis` in the subject line. Feel free to suggestion new features. Tell me about any success stories (ie Guis use) in your applications!

6.2 Change log

version 1.5 (may 10, 2004) - ported to Gtk2.2, added Slang preliminary port (and non-working port to Perl).

version 1.4 (september 5, 2003) bugfix (read buffer uses `GString`) and added `guis_main_loop_in_script`), with both Python2.2 and Python2.3 support.

version 1.3 (september 2, 2003) contains the experimental Ruby port (and warns against exception in callbacks).

- 1.3.1 added word wrap in trace window,
- 1.3.2 added logfiles with `-L` with the Gtk.init requirement in user scripts for Ruby
- 1.3.3 (september 3, 2002) shows the versions info in trace window
- 1.3.4 (september 4, 2002) removed the Gtk.init requirement in the user initial script

version 1.2 (august 31, 2003) minor fixes: just added the `guis.xml_coded` primitive and updated the demo and the documentation.

version 1.1 (august 30, 2003) made a major switch to Python using PyGTK previous versions used Lua).

versions $<= 0.3$ (march 22, 2003) and older was Lua based (with a Gtk binding to Lua generated by a CommonLisp script)