Observer

Observer 1.3.1.2
January 27, 2014

January 27, 2014

1 Observer User's Guide

The *Observer* application contains tools for tracing and investigation of distributed systems.

1.1 Observer

1.1.1 Introduction

Observer, is a graphical tool for observing the characteristics of erlang systems. Observer displays system information, application supervisor trees, process information, ets or mnesia tables and contains a frontend for erlang tracing.

1.1.2 General

Normally observer should be run from a standalone node to minimize the impact of the system being observed. Example:

```
> erl -sname observer -hidden -setcookie MyCookie -run observer
```

Choose which node to observe via `Nodes` menu. The `View/Refresh Interval` controls how frequent the view should be updated. The refresh interval is set per viewer so you can have different settings for each viewer. To minimize the system impact only the active viewer is updated and the other views will be updated when activated.

Note:

Only R15B nodes can be observed.

In general the mouse buttons behaves as expected, use left click to select objects, right click to pop up a menu with most used choices and double click to bring up information about the selected object. In most viewers with several columns you can change sort order by left clicking on column header.

1.1.3 Applications

The `Applications` view lists application information. Select an application in the left list to display its supervisor tree.

`Trace process` will add the selected process identifier to `Trace Overview` view and the node the process resides on will be added as well.

`Trace named process` will add the registered name of the process. This can be useful when tracing on several nodes, then processes with that name will be traced on all traced nodes.

`Trace process tree` and `Trace named process tree` will add the selected process and all processes below, right of, it to the `Trace Overview` view.

1.1.4 Processes

The `Processes` view lists process information. For each process the following information is presented:

Pid
: The process identifier.

Reds
: This is the number of reductions that has been executed on the process

Memory
: This is the size of the process in bytes, obtained by a call to `process_info(Pid,memory)`.

MsgQ
: This is the length of the message queue for the process.

> **Note:**
>
> *Reds* can be presented as accumulated values or as values since last update.

`Trace Processes` will add the selected process identifiers to the `Trace Overview` view and the node the processes reside on will be added as well. `Trace Named Processes` will add the registered name of processes. This can be useful when tracing is done on several nodes, then processes with that name will be traced on all traced nodes.

1.1.5 Table Viewer

The `Table Viewer` view lists tables. By default ets tables are visible and unreadable, private ets, tables and tables created by the OTP applications are not visible. Use `View` menu to view "system" ets tables, unreadable ets tables or mnesia tables.

Double click to view the content of the table. Select table and activate `View/Table Information` menu to view table information.

In the table viewer you can regexp search for objects, edit and delete objects.

1.1.6 Trace Overview

The `Trace Overview` view handles tracing. Tracing is done by selecting which processes to be traced and how to trace them. You can trace messages, function calls and events, where events are process related events such as `spawn`, `exit` and several others.

When you want to trace function calls, you also need to setup `trace patterns`. Trace patterns selects the function calls that will be traced. The number of traced function calls can be further reduced with `match specifications`. Match specifications can also be used to trigger additional information in the trace messages.

> **Note:**
>
> Trace patterns only applies to the traced processes.

Processes are added from the `Applications` or `Processes` views. A special `new` identifier, meaning all processes spawned after trace start, can be added with the `Add 'new' Process` button.

When adding processes, a window with trace options will pop up. The chosen options will be set for the selected processes. Process options can be changed by right clicking on a process.

Processes added by process identifiers will add the nodes these processes resides on in the node list. Additional nodes can be added by the `Add Nodes` button.

If function calls are traced, trace patterns must be added by `Add Trace Pattern` button. Select a module, function(s) and a match specification. If no functions are selected, all functions in the module will be traced. A few basic match specifications are provided in the tool, and you can provide your own match specifications. The syntax of match specifications are described in the *ERTS User's Guide*. To simplify the writing of a match specification they can also be written as `fun/1` see *ms_transform manual page* for further information.

Use the `Start trace` button to start the trace. By default trace output is written to a new window, tracing is stopped when the window is closed, or with `Stop Trace` button. Trace output can be changed via `Options/Output` menu. The trace settings, including match specifications, can be saved to, or loaded from, a file.

More information about tracing can be found in *dbg* and in the chapter "Match specifications in Erlang" in *ERTS User's Guide* and the *ms_transform manual page*.

1.2 Trace Tool Builder

1.2.1 Introduction

The Trace Tool Builder is a base for building trace tools for single node or distributed erlang systems. It requires the `runtime_tools` application to be available on the traced node.

The main features of the Trace Tool Builder are:

- Start tracing to file ports on several nodes with one function call.
- Write additional information to a trace information file, which is read during formatting.
- Restoring of previous configuration by maintaining a history buffer and handling configuration files.
- Some simple support for sequential tracing.
- Formatting of binary trace logs and merging of logs from multiple nodes.

The intention of the Trace Tool Builder is to serve as a base for tailor made trace tools, but you may use it directly from the erlang shell (it may mimic `dbg` behaviour while still providing useful additions like match specification shortcuts). The application only allows the use of file port tracer, so if you would like to use other types of trace clients you will be better off using `dbg` directly instead.

1.2.2 Getting Started

The `ttb` module is the interface to all functions in the Trace Tool Builder. To get started the least you need to do is to start a tracer with `ttb:tracer/0/1/2`, and set the required trace flags on the processes you want to trace with `ttb:p/2`. Then, when the tracing is completed, you must stop the tracer with `ttb:stop/0/1` and format the trace log with `ttb:format/1/2` (as long as there is anything to format, of course).

`ttb:tracer/0/1/2` opens a trace port on each node that shall be traced. By default, trace messages are written to binary files on remote nodes(the binary trace log).

`ttb:p/2` specifies which processes shall be traced. Trace flags given in this call specify what to trace on each process. You can call this function several times if you like different trace flags to be set on different processes.

If you want to trace function calls (i.e. if you have the `call` trace flag set on any of your processes), you must also set trace patterns on the required function(s) with `ttb:tp` or `ttb:tpl`. A function is only traced if it has a trace pattern. The trace pattern specifies how to trace the function by using match specifications. Match specifications are described in the User's Guide for the erlang runtime system `erts`.

`ttb:stop/0/1` stops tracing on all nodes, deletes all trace patterns and flushes the trace port buffer.

`ttb:format/1/2` translates the binary trace logs into something readable. By default `ttb` presents each trace message as a line of text, but you can also write your own handler to make more complex interpretations of the trace information. A trace log can even be presented graphically via the Event Tracer application. Note that if you give the `format` option to `ttb:stop/1` the formatting is automatically done when stopping `ttb`.

Example: Tracing the local node from the erlang shell

This small module is used in the example:

```
-module(m).
-export([f/0]).
f() ->
   receive
      From when is_pid(From) ->
         Now = erlang:now(),
         From ! {self(),Now}
   end.
```

The following example shows the basic use of `ttb` from the erlang shell. Default options are used both for starting the tracer and for formatting (the custom fetch dir is however provided). This gives a trace log named `Node-ttb` in the newly-created directory, where `Node` is the name of the node. The default handler prints the formatted trace messages in the shell.

```
(tiger@durin)47> %% First I spawn a process running my test function
(tiger@durin)47> Pid = spawn(m,f,[]).
<0.125.0>
(tiger@durin)48>
(tiger@durin)48> %% Then I start a tracer...
(tiger@durin)48> ttb:tracer().
{ok,[tiger@durin]}
(tiger@durin)49>
(tiger@durin)49> %% and activate the new process for tracing
(tiger@durin)49> %% function calls and sent messages.
(tiger@durin)49> ttb:p(Pid,[call,send]).
{ok,[{<0.125.0>,[{matched,tiger@durin,1}]}]}
(tiger@durin)50>
(tiger@durin)50> %% Here I set a trace pattern on erlang:now/0
(tiger@durin)50> %% The trace pattern is a simple match spec
(tiger@durin)50> %% indicating that the return value should be
(tiger@durin)50> %% traced. Refer to the reference_manual for
(tiger@durin)50> %% the full list of match spec shortcuts
(tiger@durin)50> %% available.
(tiger@durin)51> ttb:tp(erlang,now,return).
{ok,[{matched,tiger@durin,1},{saved,1}]}
(tiger@durin)52>
(tiger@durin)52> %% I run my test (i.e. send a message to
(tiger@durin)52> %% my new process)
(tiger@durin)52> Pid ! self().
<0.72.0>
(tiger@durin)53>
(tiger@durin)53> %% And then I have to stop ttb in order to flush
(tiger@durin)53> %% the trace port buffer
(tiger@durin)53> ttb:stop([return, {fetch_dir, "fetch"}]).
{stopped, "fetch"}
(tiger@durin)54>
(tiger@durin)54> %% Finally I format my trace log
(tiger@durin)54> ttb:format("fetch").
({<0.125.0>,{m,f,0},tiger@durin}) call erlang:now()
({<0.125.0>,{m,f,0},tiger@durin}) returned from erlang:now/0 ->
{1031,133451,667611}
({<0.125.0>,{m,f,0},tiger@durin}) <0.72.0> !
{<0.125.0>,{1031,133451,667611}}
```

```
ok
```

Example: Build your own tool

This small example shows a simple tool for "debug tracing", i.e. tracing of function calls with return values.

```
-module(mydebug).
-export([start/0,trc/1,stop/0,format/1]).
-export([print/4]).
%% Include ms_transform.hrl so that I can use dbg:fun2ms/2 to
%% generate match specifications.
-include_lib("stdlib/include/ms_transform.hrl").
%%% -------------Tool API-------------
%%% ---------------------------------
%%% Star the "mydebug" tool
start() ->
    %% The options specify that the binary log shall be named
    %% <Node>-debug_log and that the print/4 function in this
    %% module shall be used as format handler
    ttb:tracer(all,[{file,"debug_log"},{handler,{{?MODULE,print},0}}]),
    %% All processes (existing and new) shall trace function calls
    %% We want trace messages to be sorted upon format, which requires
    %% timestamp flag. The flag is however enabled by default in ttb.
    ttb:p(all,call).

%%% Set trace pattern on function(s)
trc(M) when is_atom(M) ->
    trc({M,'_','_'});
trc({M,F}) when is_atom(M), is_atom(F) ->
    trc({M,F,'_'});
trc({M,F,_A}=MFA) when is_atom(M), is_atom(F) ->
    %% This match spec shortcut specifies that return values shall
    %% be traced.
    MatchSpec = dbg:fun2ms(fun(_) -> return_trace() end),
    ttb:tpl(MFA,MatchSpec).

%%% Format a binary trace log
format(Dir) ->
    ttb:format(Dir).

%%% Stop the "mydebug" tool
stop() ->
    ttb:stop(return).

%%% --------Internal functions--------
%%% ---------------------------------
%%% Format handler
print(_Out,end_of_trace,_TI,N) ->
    N;
print(Out,Trace,_TI,N) ->
    do_print(Out,Trace,N),
    N+1.

do_print(Out,{trace_ts,P,call,{M,F,A},Ts},N) ->
    io:format(Out,
              "~w: ~w, ~w:~n"
              "Call      : ~w:~w/~w~n"
              "Arguments :~p~n~n",
              [N,Ts,P,M,F,length(A),A]);
do_print(Out,{trace_ts,P,return_from,{M,F,A},R,Ts},N) ->
    io:format(Out,
              "~w: ~w, ~w:~n"
```

```
              "Return from  : ~w:~w/~w~n"
              "Return value :~p~n~n",
              [N,Ts,P,M,F,A,R]).
```

To distinguish trace logs produced with this tool from other logs, the `file` option is used in `tracer/2`. The logs will therefore be fetched to a directory named `ttb_upload_debug_log-YYYYMMDD-HHMMSS`

By using the `handler` option when starting the tracer, the information about how to format the file is stored in the trace information file (`.ti`). This is not necessary, as it might be given at the time of formatting instead. It can however be useful if you e.g. want to automatically format your trace logs by using the `format` option in `ttb:stop/1`. It also means that you don't need any knowledge of the content of a binary log to be able to format it the way it was intended. If the `handler` option is given both when starting the tracer and when formatting, the one given when formatting is used.

The `call` trace flag is set on all processes. This means that any function activated with the `trc/1` command will be traced on all existing and new processes.

1.2.3 Running the Trace Tool Builder against a remote node

The Observer application might not always be available on the node that shall be traced (in the following called the "traced node"). It is still possible to run the Trace Tool Builder from another node (in the following called the "trace control node") as long as

- The Observer application is available on the trace control node.
- The Runtime Tools application is available on both the trace control node and the traced node.

If the Trace Tool Builder shall be used against a remote node, it is highly recommended to start the trace control node as *hidden*. This way it can connect to the traced node without the traced node "seeing" it, i.e. if the `nodes()` BIF is called on the traced node, the trace control node will not show. To start a hidden node, add the `-hidden` option to the `erl` command, e.g.

```
% erl -sname trace_control -hidden
```

Diskless node

If the traced node is diskless, `ttb` must be started from a trace control node with disk access, and the `file` option must be given to the `tracer/2` function with the value `{local, File}`, e.g.

```
(trace_control@durin)1> ttb:tracer(mynode@diskless,{file,{local,
{wrap,"mytrace"}}}).
{ok,[mynode@diskless]}
```

1.2.4 Additional tracing options

When setting up a trace, several features may be turned on:

- time-constrained tracing,
- overload protection,
- autoresuming.

Time-constrained tracing

Sometimes, it may be helpful to enable trace for a given period of time (i.e. to monitor a system for 24 hours or half of a second). This may be done by issuing additional `{timer, TimerSpec}` option. If `TimerSpec` has the form of MSec, the trace is stopped after MSec milliseconds using ttb:stop/0. If any additional options are provided (TimerSpec = {MSec, Opts}), ttb:stop/1 is called instead with Opts as the arguments. The timer is started with ttb:p/2, so any trace patterns should be set up before. ttb:start_trace/4 always sets up all pattern before invoking ttb:p/2. Note that due to network and processing delays the the period of tracing is approximate. The example below shows how to set up a trace which will be automatically stopped and formatted after 5 seconds

```
(tiger@durin)1>ttb:start_trace([node()],
                               [{erlang, now,[]}],
                               {all, call},
                               [{timer, {5000, format}}]).
```

When tracing live systems, special care needs to be always taken not to overload a node with too heavy tracing. ttb provides the overload option to help to address the problem.

{overload, MSec, Module, Function} instructs the ttb backend (called observer_backend, part of the runtime_tools application) to perform overload check every MSec milliseconds. If the check (namely Module:Function(check)) returns true, tracing is disabled on the selected node.

Overload protection activated on one node does not affect other nodes, where the tracing continues as normal. ttb:stop/0/1 fetches data from all clients, including everything that has been collected before overload protection was activated. Note that changing trace details (with ttb:p and ttb:tp/tpl...) once overload protection gets activated in one of the traced nodes is not permitted in order not to allow trace setup to be inconsistent between nodes.

Module:Function provided with the overload option must handle three calls: init, check and stop. init and stop allows to perform some setup and teardown required by the check. An overload check module could look like this (note that check is always called by the same process, so put and get are possible).

```
-module(overload).
-export([check/1]).

check(init) ->
    Pid = sophisticated_module:start(),
    put(pid, Pid);
check(check) ->
    get(pid) ! is_overloaded,
    receive
        Reply ->
            Reply
    after 5000 ->
            true
    end;
check(stop) ->
    get(pid) ! stop.
```

Autoresume

It is possible that a node (probably a buggy one, hence traced) crashes. In order to automatically resume tracing on the node as soon as it gets back, resume has to be used. When it is, the failing node tries to reconnect to trace control node as soon as runtime_tools is started. This implies that runtime_tools must be included in other node's startup chain (if it is not, one could still resume tracing by starting runtime_tools manually, i.e. by an RPC call).

In order not to loose the data that the failing node stored up to the point of crash, the control node will try to fetch it before restarting trace. This must happen within the allowed time frame or is aborted (default is 10 seconds, can be customized with {resume, MSec}). The data fetched this way is then merged with all other traces.

Autostart feature requires additional data to be stored on traced nodes. By default, the data is stored automatically to the file called "ttb_autostart.bin" in the traced node's cwd. Users may decide to change this behaviour (i.e. on diskless nodes) by specifying their own module to handle autostart data storage and retrieval (`ttb_autostart_module` environment variable of `runtime_tools`). Please see the ttb's reference manual to see the module's API. This example shows the default handler

```
-module(ttb_autostart).
-export([read_config/0,
         write_config/1,
         delete_config/0]).

-define(AUTOSTART_FILENAME, "ttb_autostart.bin").

delete_config() ->
    file:delete(?AUTOSTART_FILENAME).

read_config() ->
    case file:read_file(?AUTOSTART_FILENAME) of
        {ok, Data} -> {ok, binary_to_term(Data)};
        Error      -> Error
    end.

write_config(Data) ->
    file:write_file(?AUTOSTART_FILENAME, term_to_binary(Data)).
```

Remember that file trace ports buffer the data by default. If the node crashes, trace messages are not flushed to the binary log. If the chance of failure is high, it might be a good idea to automatically flush the buffers every now and then. Passing `{flush, MSec}` as one of `ttb:tracer/2` option flushes all buffers every `MSec` milliseconds.

dbg mode

The `{shell, ShellType}` option allows to make `ttb` operation similar to `dbg`. Using `{shell, true}` displays all trace messages in the shell before storing them. `{shell, only}` additionally disables message storage (so that the tool behaves exactly like dbg). This is allowed only with ip trace ports (`{trace, {local, File}}`).

The command `ttb:tracer(dbg)` is a shortcut for the pure-dbg mode (`{shell, only}`).

1.2.5 Trace Information and the .ti File

In addition to the trace log file(s), a file with the extension `.ti` is created when the Trace Tool Builder is started. This is the trace information file. It is a binary file, and it contains the process information, trace flags used, the name of the node to which it belongs and all information written with the `write_trace_info/2` function. .ti files are always fetched with other logs when the trace is stopped.

Except for the process information, everything in the trace information file is passed on to the handler function when formatting. The `TI` parameter is a list of `{Key,ValueList}` tuples. The keys `flags`, `handler`, `file` and `node` are used for information written directly by `ttb`.

You can add information to the trace information file by calling `write_trace_info/2`. Note that `ValueList` always will be a list, and if you call `write_trace_info/2` several times with the same `Key`, the `ValueList` will be extended with a new value each time. Example:

`ttb:write_trace_info(mykey,1)` gives the entry `{mykey,[1]}` in `TI`. Another call, `ttb:write_trace_info(mykey,2)`, changes this entry to `{mykey,[1,2]}`.

1.2.6 Wrap Logs

If you want to limit the size of the trace logs, you can use wrap logs. This works almost like a circular buffer. You can specify the maximum number of binary logs and the maximum size of each log. `ttb` will create a new binary log each time a log reaches the maximum size. When the the maximum number of logs are reached, the oldest log is deleted before a new one is created.

Note that the overall size of data generated by ttb may be greater than the wrap specification would suggest - if a traced node restarts and autoresume is enabled, old wrap log is always stored and a new one is created.

Wrap logs can be formatted one by one or all at once. See *Formatting*.

1.2.7 Formatting

Formatting can be done automatically when stopping `ttb` (see *Automatically collect and format logs from all nodes*), or explicitly by calling the `ttb:format/1/2` function.

Formatting means to read a binary log and present it in a readable format. You can use the default format handler in `ttb` to present each trace message as a line of text, or write your own handler to make more complex interpretations of the trace information. You can even use the Event Tracer `et` to present the trace log graphically (see *Presenting trace logs with Event Tracer*).

The first argument to `ttb:format/1/2` specifies which binary log(s) to format. This is usually the name of a directory that ttb created during log fetch. Unless there is the `disable_sort` option provided, the logs from different files are always sorted according to timestamp in traces.

The second argument to `ttb:format/2` is a list of options. The `out` option specifies the destination where the formatted text shall be written. Default destination is `standard_io`, but a filename can also be given. The `handler` option specifies the format handler to use. If this option is not given, the `handler` option given when starting the tracer is used. If the `handler` option was not given when starting the tracer either, a default handler is used, which prints each trace message as a line of text. The `disable_sort` option indicates that there logs should not be merged according to timestamp, but processed one file after another (this might be a bit faster).

A format handler is a fun taking four arguments. This fun will be called for each trace message in the binary log(s). A simple example which only prints each trace message could be like this:

```
fun(Fd, Trace, _TraceInfo, State) ->
   io:format(Fd, "Trace: ~p~n", [Trace]),
   State
end.
```

`Fd` is the file descriptor for the destination file, or the atom `standard_io`. `_TraceInfo` contains information from the trace information file (see *Trace Information and the .ti File*). `State` is a state variable for the format handler fun. The initial value of the `State` variable is given with the handler option, e.g.

```
ttb:format("tiger@durin-ttb", [{handler, {{Mod,Fun}, initial_state}}])
                                                     ^^^^^^^^^^^^^
```

Another format handler could be used to calculate time spent by the garbage collector:

```
fun(_Fd,{trace_ts,P,gc_start,_Info,StartTs},_TraceInfo,State) ->
      [{P,StartTs}|State];
   (Fd,{trace_ts,P,gc_end,_Info,EndTs},_TraceInfo,State) ->
      {value,{P,StartTs}} = lists:keysearch(P,1,State),
```

```
      Time = diff(StartTs,EndTs),
      io:format("GC in process ~w: ~w milliseconds~n", [P,Time]),
      State -- [{P,StartTs}]
end
```

A more refined version of this format handler is the function `handle_gc/4` in the module `multitrace.erl` which can be found in the `src` directory of the Observer application.

The actual trace message is passed as the second argument (`Trace`). The possible values of `Trace` are:

- all trace messages described in `erlang:trace/3` documentation,
- `{drop, N}` if ip tracer is used (see `dbg:trace_port/2`),
- `end_of_trace` received once when all trace messages have been processed.

By giving the format handler `ttb:get_et_handler()`, you can have the trace log presented graphically with `et_viewer` in the Event Tracer application (see *Presenting trace logs with Event Tracer*).

You may always decide not to format the whole trace data contained in the fetch directory, but analyze single files instead. In order to do so, a single file (or list of files) have to be passed as the first argument to `format/1/2`.

Wrap logs can be formatted one by one or all in one go. To format one of the wrap logs in a set, give the exact name of the file. To format the whole set of wrap logs, give the name with '*' instead of the wrap count. An example:

Start tracing:

```
(tiger@durin)1> ttb:tracer(node(),{file,{wrap,"trace"}}).
{ok,[tiger@durin]}
(tiger@durin)2> ttb:p(...)
...
```

This will give a set of binary logs, like:

```
tiger@durin-trace.0.wrp
tiger@durin-trace.1.wrp
tiger@durin-trace.2.wrp
...
```

Format the whole set of logs:

```
1> ttb:format("tiger@durin-trace.*.wrp").
....
ok
2>
```

Format only the first log:

```
1> ttb:format("tiger@durin-trace.0.wrp").
....
ok
2>
```

To merge all wrap logs from two nodes:

```
1> ttb:format(["tiger@durin-trace.*.wrp","lion@durin-trace.*.wrp"]).
....
ok
2>
```

Presenting trace logs with Event Tracer

For detailed information about the Event Tracer, please turn to the User's Guide and Reference Manuals for the `et` application.

By giving the format handler `ttb:get_et_handler()`, you can have the trace log presented graphically with `et_viewer` in the Event Tracer application. `ttb` provides a few different filters which can be selected from the Filter menu in the `et_viewer` window. The filters are names according to the type of actors they present (i.e. what each vertical line in the sequence diagram represent). Interaction between actors is shown as red arrows between two vertical lines, and activities within an actor are shown as blue text to the right of the actors line.

The `processes` filter is the only filter which will show all trace messages from a trace log. Each vertical line in the sequence diagram represents a process. Erlang messages, spawn and link/unlink are typical interactions between processes. Function calls, scheduling and garbage collection are typical activities within a process. `processes` is the default filter.

The rest of the filters will only show function calls and function returns. All other trace message are discarded. To get the most out of these filters, `et_viewer` needs to known the caller of each function and the time of return. This can be obtained by using both the `call` and `return_to` flags when tracing. Note that the `return_to` flag only works with local call trace, i.e. when trace patterns are set with `ttb:tpl`.

The same result can be obtained by using the `call` flag only and setting a match specification like this on local or global function calls:

```
1> dbg:fun2ms(fun(_) -> return_trace(),message(caller()) end).
[{'_',[],[{return_trace},{message,{caller}}]}]
```

This should however be done with care, since the `{return_trace}` function in the match specification will destroy tail recursiveness.

The `modules` filter shows each module as a vertical line in the sequence diagram. External function calls/returns are shown as interactions between modules and internal function calls/returns are shown as activities within a module.

The `functions` filter shows each function as a vertical line in the sequence diagram. A function calling itself is shown as an activity within a function, and all other function calls are shown as interactions between functions.

The `mods_and_procs` and `funcs_and_procs` filters are equivalent to the `modules` and `functions` filters respectively, except that each module or function can have several vertical lines, one for each process it resides on.

In the next example, modules `foo` and `bar` are used:

```
-module(foo).
-export([start/0,go/0]).

start() ->
    spawn(?MODULE, go, []).

go() ->
    receive
        stop ->
            ok;
        go ->
```

```
            bar:f1(),
            go()
    end.
```

```
-module(bar).
-export([f1/0,f3/0]).
f1() ->
    f2(),
    ok.
f2() ->
    spawn(?MODULE,f3,[]).
f3() ->
    ok.
```

Now let's set up the trace.

```
(tiger@durin)1>%%First we retrieve the Pid to limit traced processes set
(tiger@durin)1>Pid = foo:start().
(tiger@durin)2>%%Now we set up tracing
(tiger@durin)2>ttb:tracer().
(tiger@durin)3>ttb:p(Pid, [call, return_to, procs, set_on_spawn]).
(tiger@durin)4>ttb:tpl(bar, []).
(tiger@durin)5>%%Invoke our test function and see output with et viewer
(tiger@durin)5>Pid ! go.
(tiger@durin)6>ttb:stop({format, {handler, ttb:get_et_handler()}}).
```

This should render a result similar to the following:

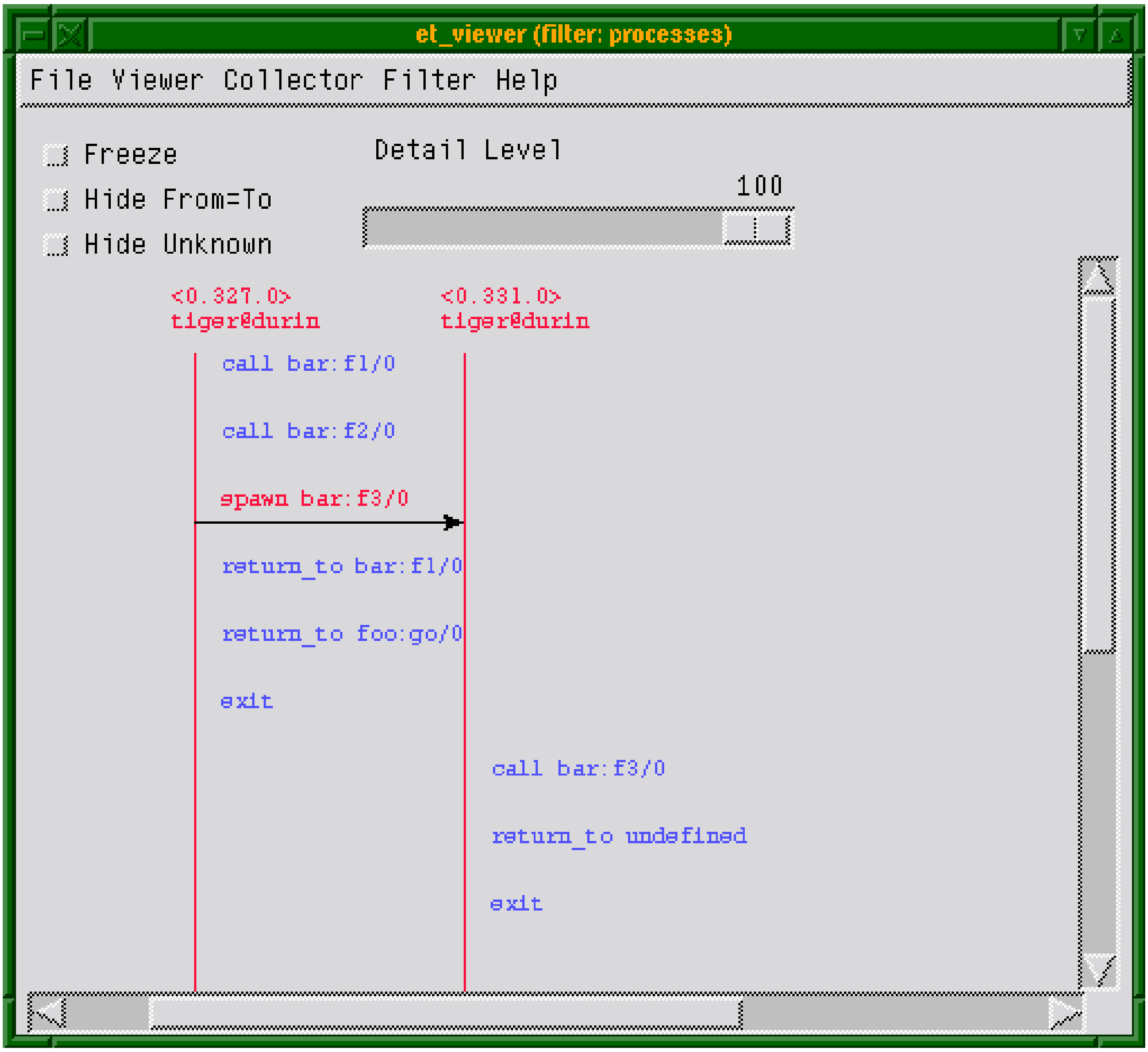


Figure 2.1: Filter: "processes"

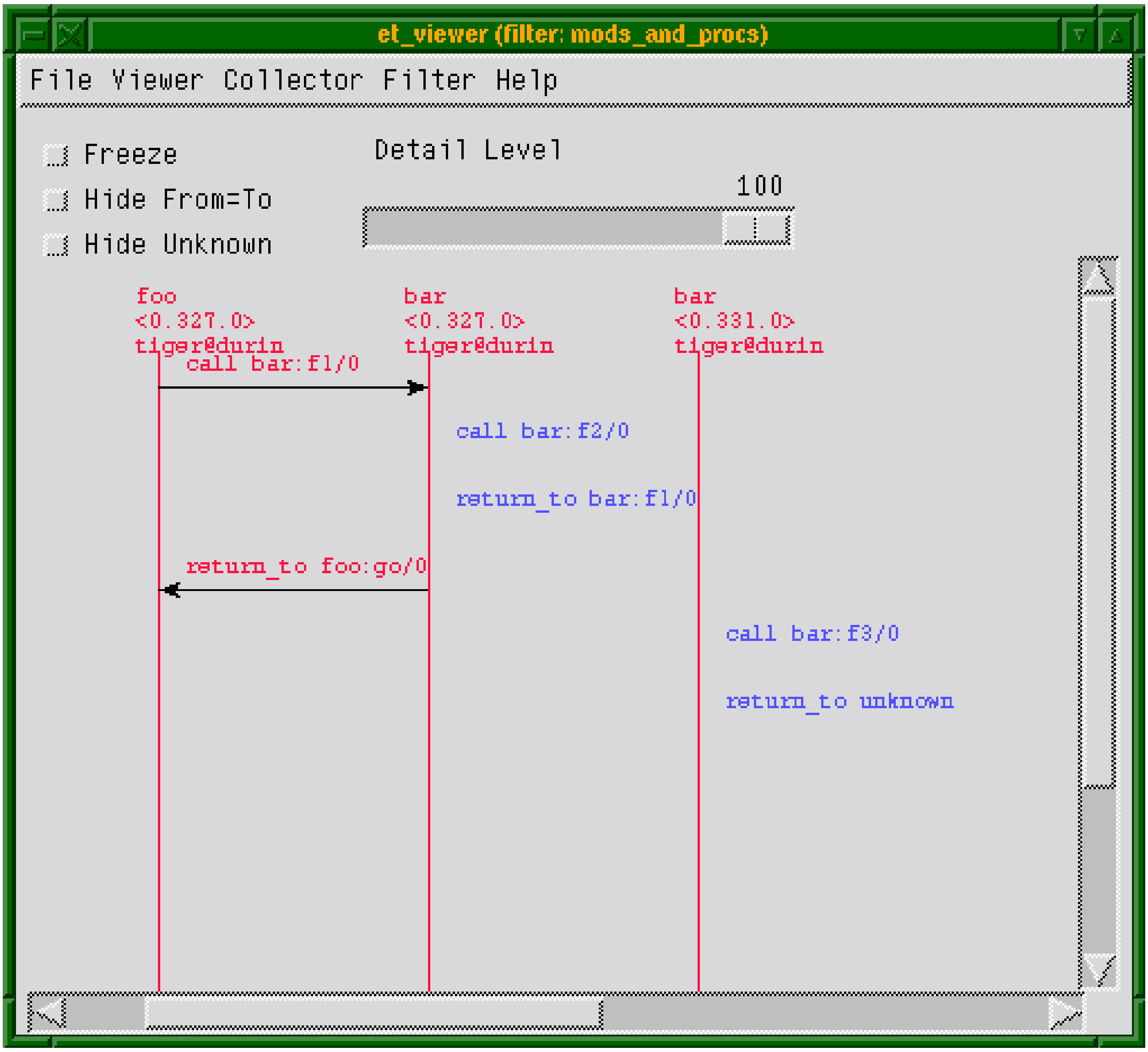


Figure 2.2: Filter: "mods_and_procs"

Note, that we can use `ttb:start_trace/4` function to help us here:

```
(tiger@durin)1>Pid = foo:start().
(tiger@durin)2>ttb:start_trace([node()],
                               [{bar,[]}],
                               {Pid, [call, return_to, procs, set_on_spawn]}
                               {handler, ttb:get_et_handler()}).
(tiger@durin)3>Pid ! go.
(tiger@durin)4>ttb:stop(format).
```

1.2.8 Automatically collect and format logs from all nodes

By default `ttb:stop/1` fetches trace logs and trace information files from all nodes. The logs are stored in a new directory named `ttb_upload-Filename-Timestamp` under the working directory of the trace control node. Fetching may be disabled by providing the `nofetch` option to `ttb:stop/1`. User can specify a fetch directory of his choice passing the `{fetch_dir, Dir}` option.

If the option `format` is given to `ttb:stop/1`, the trace logs are automatically formatted after tracing is stopped.

1.2.9 History and Configuration Files

For the tracing functionality, `dbg` could be used instead of the `ttb` for setting trace flags on processes and trace patterns for call trace, i.e. the functions `p`, `tp`, `tpl`, `ctp`, `ctpl` and `ctpg`. There are only two things added by `ttb` for these functions:

- all calls are stored in the history buffer and can be recalled and stored in a configuration file. This makes it easy to setup the same trace environment e.g. if you want to compare two test runs. It also reduces the amount of typing when using `ttb` from the erlang shell;
- shortcuts are provided for the most common match specifications (in order not to force the user to use `dbg:fun2ms` continually

Use `list_history/0` to see the content of the history buffer, and `run_history/1` to re-execute one of the entries.

The main purpose of the history buffer is the possibility to create configuration files. Any function stored in the history buffer can be written to a configuration file and used for creating a specific configuration at any time with one single function call.

A configuration file is created or extended with `write_config/2/3`. Configuration files are binary files and can therefore only be read and written with functions provided by `ttb`.

You can write the complete content of the history buffer to a config file by calling `ttb:write_config(ConfigFile,all)`. And you can write selected entries from the history by calling `ttb:write_config(ConfigFile,NumList)`, where `NumList` is a list of integers pointing out the history entries to write. Moreover, the history buffer is always dumped to `ttb_last_config` when `ttb:stop/0/1` is called.

User defined entries can also be written to a config file by calling the function `ttb:write_config(ConfigFile,ConfigList)` where `ConfigList` is a list of `{Module,Function,Args}`.

Any existing file `ConfigFile` is deleted and a new file is created when `write_config/2` is called. The option `append` can be used if you wish to add something at the end of an existing config file, e.g. `ttb:write_config(ConfigFile,What,[append])`.

Example: History and configuration files

See the content of the history buffer

```
(tiger@durin)191> ttb:tracer().
{ok,[tiger@durin]}
(tiger@durin)192> ttb:p(self(),[garbage_collection,call]).
{ok,{[<0.1244.0>],[garbage_collection,call]}}
(tiger@durin)193> ttb:tp(ets,new,2,[]).
{ok,[{matched,1}]}
(tiger@durin)194> ttb:list_history().
[{1,{ttb,tracer,[tiger@durin,[]]}},
 {2,{ttb,p,[<0.1244.0>,[garbage_collection,call]]}},
```

```
 {3,{ttb,tp,[ets,new,2,[]]}}]
```

Execute an entry from the history buffer:

```
(tiger@durin)195> ttb:ctp(ets,new,2).
{ok,[{matched,1}]}
(tiger@durin)196> ttb:list_history().
[{1,{ttb,tracer,[tiger@durin,[]]}},
 {2,{ttb,p,[<0.1244.0>,[garbage_collection,call]]}},
 {3,{ttb,tp,[ets,new,2,[]]}},
 {4,{ttb,ctp,[ets,new,2]}}]
(tiger@durin)197> ttb:run_history(3).
ttb:tp(ets,new,2,[]) ->
{ok,[{matched,1}]}
```

Write the content of the history buffer to a configuration file:

```
(tiger@durin)198> ttb:write_config("myconfig",all).
ok
(tiger@durin)199> ttb:list_config("myconfig").
[{1,{ttb,tracer,[tiger@durin,[]]}},
 {2,{ttb,p,[<0.1244.0>,[garbage_collection,call]]}},
 {3,{ttb,tp,[ets,new,2,[]]}},
 {4,{ttb,ctp,[ets,new,2]}},
 {5,{ttb,tp,[ets,new,2,[]]}}]
```

Extend an existing configuration:

```
(tiger@durin)200> ttb:write_config("myconfig",[{ttb,tp,[ets,delete,1,[]]}],
[append]).
ok
(tiger@durin)201> ttb:list_config("myconfig").
[{1,{ttb,tracer,[tiger@durin,[]]}},
 {2,{ttb,p,[<0.1244.0>,[garbage_collection,call]]}},
 {3,{ttb,tp,[ets,new,2,[]]}},
 {4,{ttb,ctp,[ets,new,2]}},
 {5,{ttb,tp,[ets,new,2,[]]}},
 {6,{ttb,tp,[ets,delete,1,[]]}}]
```

Go back to a previous configuration after stopping Trace Tool Builder:

```
(tiger@durin)202> ttb:stop().
ok
(tiger@durin)203> ttb:run_config("myconfig").
ttb:tracer(tiger@durin,[]) ->
{ok,[tiger@durin]}

ttb:p(<0.1244.0>,[garbage_collection,call]) ->
{ok,{[<0.1244.0>],[garbage_collection,call]}}

ttb:tp(ets,new,2,[]) ->
{ok,[{matched,1}]}

ttb:ctp(ets,new,2) ->
{ok,[{matched,1}]}
```

```
ttb:tp(ets,new,2,[]) ->
{ok,[{matched,1}]}

ttb:tp(ets,delete,1,[]) ->
{ok,[{matched,1}]}

ok
```

Write selected entries from the history buffer to a configuration file:

```
(tiger@durin)204> ttb:list_history().
[{1,{ttb,tracer,[tiger@durin,[]]}},
 {2,{ttb,p,[<0.1244.0>,[garbage_collection,call]]}},
 {3,{ttb,tp,[ets,new,2,[]]}},
 {4,{ttb,ctp,[ets,new,2]}},
 {5,{ttb,tp,[ets,new,2,[]]}},
 {6,{ttb,tp,[ets,delete,1,[]]}}]
(tiger@durin)205> ttb:write_config("myconfig",[1,2,3,6]).
ok
(tiger@durin)206> ttb:list_config("myconfig").
[{1,{ttb,tracer,[tiger@durin,[]]}},
 {2,{ttb,p,[<0.1244.0>,[garbage_collection,call]]}},
 {3,{ttb,tp,[ets,new,2,[]]}},
 {4,{ttb,tp,[ets,delete,1,[]]}}]
(tiger@durin)207>
```

1.2.10 Sequential Tracing

To learn what sequential tracing is and how it can be used, please turn to the reference manual for the *seq_trace* module in the *kernel* application.

The support for sequential tracing provided by the Trace Tool Builder includes

- Initiation of the system tracer. This is automatically done when a trace port is started with `ttb:tracer/0/1/2`
- Creation of match specifications which activates sequential tracing

Starting sequential tracing requires that a tracer has been started with the `ttb:tracer/0/1/2` function. Sequential tracing can then either be started via a trigger function with a match specification created with `ttb:seq_trigger_ms/0/1`, or directly by using the `seq_trace` module in the `kernel` application.

Example: Sequential tracing

In the following example, the function `dbg:get_tracer/0` is used as trigger for sequential tracing:

```
(tiger@durin)110> ttb:tracer().
{ok,[tiger@durin]}
(tiger@durin)111> ttb:p(self(),call).
{ok,{[<0.158.0>],[call]}}
(tiger@durin)112> ttb:tp(dbg,get_tracer,0,ttb:seq_trigger_ms(send)).
{ok,[{matched,1},{saved,1}]}
(tiger@durin)113> dbg:get_tracer(), seq_trace:reset_trace().
true
(tiger@durin)114> ttb:stop(format).
({<0.158.0>,{shell,evaluator,3},tiger@durin}) call dbg:get_tracer()
SeqTrace [0]: ({<0.158.0>,{shell,evaluator,3},tiger@durin})
{<0.237.0>,dbg,tiger@durin} ! {<0.158.0>,{get_tracer,tiger@durin}}
[Serial: {0,1}]
```

```
SeqTrace [0]: ({<0.237.0>,dbg,tiger@durin})
{<0.158.0>,{shell,evaluator,3},tiger@durin} ! {dbg,{ok,#Port<0.222>}}
[Serial: {1,2}]
ok
(tiger@durin)116>
```

Starting sequential tracing with a trigger is actually more useful if the trigger function is not called directly from the shell, but rather implicitly within a larger system. When calling a function from the shell, it is simpler to start sequential tracing directly, e.g.

```
(tiger@durin)116> ttb:tracer().
{ok,[tiger@durin]}
(tiger@durin)117> seq_trace:set_token(send,true), dbg:get_tracer(),
seq_trace:reset_trace().
true
(tiger@durin)118> ttb:stop(format).
SeqTrace [0]: ({<0.158.0>,{shell,evaluator,3},tiger@durin})
{<0.246.0>,dbg,tiger@durin} ! {<0.158.0>,{get_tracer,tiger@durin}}
[Serial: {0,1}]
SeqTrace [0]: ({<0.246.0>,dbg,tiger@durin})
{<0.158.0>,{shell,evaluator,3},tiger@durin} ! {dbg,{ok,#Port<0.229>}}
[Serial: {1,2}]
ok
(tiger@durin)120>
```

In both examples above, the `seq_trace:reset_trace/0` resets the trace token immediately after the traced function in order to avoid lots of trace messages due to the printouts in the erlang shell.

All functions in the `seq_trace` module, except `set_system_tracer/1`, can be used after the trace port has been started with `ttb:tracer/0/1/2`.

1.2.11 Example: Multipurpose trace tool

The module `multitrace.erl` which can be found in the `src` directory of the Observer application implements a small tool with three possible trace settings. The trace messages are written to binary files which can be formatted with the function *`multitrace:format/1/2`*.

`multitrace:debug(What)`
: Start calltrace on all processes and trace the given function(s). The format handler used is `multitrace:handle_debug/4` which prints each call and return. `What` must be an item or a list of items to trace, given on the format `{Module,Function,Arity}`, `{Module,Function}` or just `Module`.

`multitrace:gc(Procs)`
: Trace garbage collection on the given process(es). The format handler used is `multitrace:handle_gc/4` which prints start and stop and the time spent for each GC.

`multitrace:schedule(Procs)`
: Trace in- and out-scheduling on the given process(es). The format handler used is `multitrace:handle_schedule/4` which prints each in and out scheduling with process, timestamp and current function. It also prints the total time each traced process was scheduled in.

1.3 Erlang Top

1.3.1 Introduction

Erlang Top, `etop` is a tool for presenting information about erlang processes similar to the information presented by `top` in UNIX.

1.3.2 Output

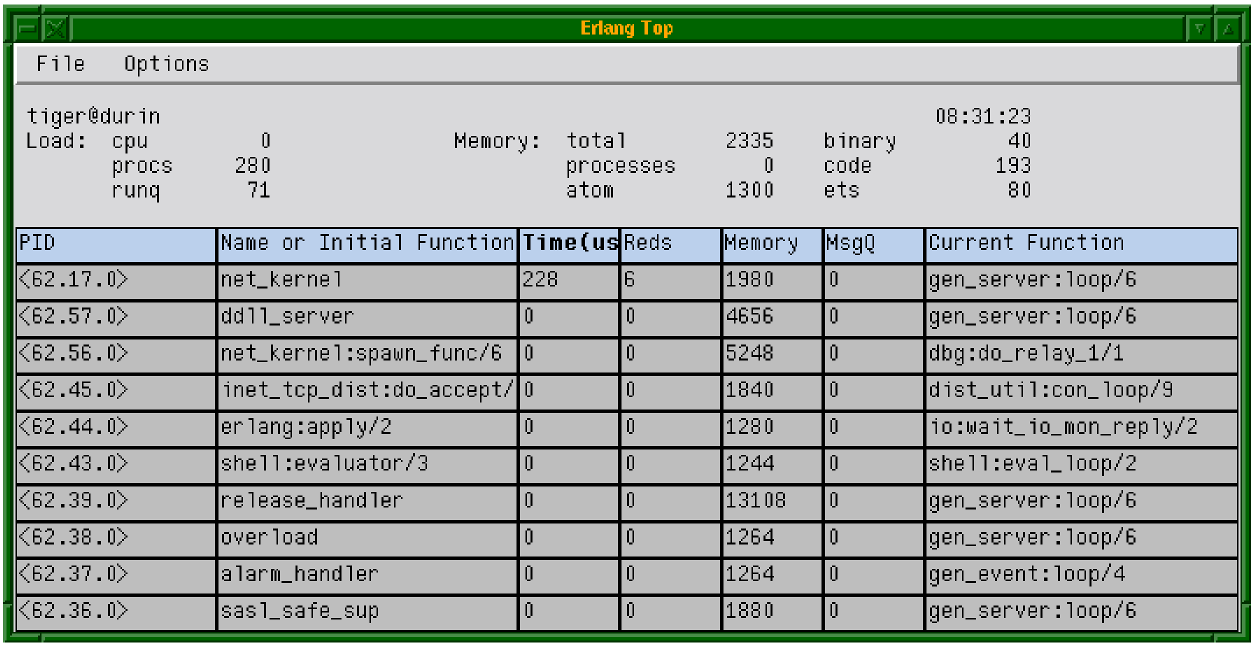
The output from `etop` can be graphical or text based.

Text based it looks like this:

```
========================================================================================
 tiger@durin                                                              13:40:32
 Load:  cpu         0               Memory:  total        1997    binary          33
        procs     197                        processes       0    code           173
        runq      135                        atom         1002    ets             95

Pid            Name or Initial Func    Time    Reds  Memory    MsgQ Current Function
----------------------------------------------------------------------------------------
<127.23.0>     code_server                0   59585   78064       0 gen_server:loop/6
<127.21.0>     file_server_2              0   36380   44276       0 gen_server:loop/6
<127.2.0>      erl_prim_loader            0   27962    3740       0 erl_prim_loader:loop
<127.9.0>      kernel_sup                 0    6998    4676       0 gen_server:loop/6
<127.17.0>     net_kernel                62    6018    3136       0 gen_server:loop/6
<127.0.0>      init                       0    4156    4352       0 init:loop/1
<127.16.0>     auth                       0    1765    1264       0 gen_server:loop/6
<127.18.0>     inet_tcp_dist:accept       0     660    1416       0 prim_inet:accept0/2
<127.5.0>      application_controll       0     569    6756       0 gen_server:loop/6
<127.137.0>    net_kernel:do_spawn_       0     553    5840       0 dbg:do_relay_1/1
========================================================================================
```

And graphically it looks like this:



Erlang Top

File Options

```
tiger@durin                                                           08:31:23
Load:  cpu        0              Memory:  total        2335    binary        40
       procs    280                       processes       0    code         193
       runq      71                       atom         1300    ets           80
```

PID	Name or Initial Function	Time(us	Reds	Memory	MsgQ	Current Function
<62.17.0>	net_kernel	228	6	1980	0	gen_server:loop/6
<62.57.0>	ddll_server	0	0	4656	0	gen_server:loop/6
<62.56.0>	net_kernel:spawn_func/6	0	0	5248	0	dbg:do_relay_1/1
<62.45.0>	inet_tcp_dist:do_accept/	0	0	1840	0	dist_util:con_loop/9
<62.44.0>	erlang:apply/2	0	0	1280	0	io:wait_io_mon_reply/2
<62.43.0>	shell:evaluator/3	0	0	1244	0	shell:eval_loop/2
<62.39.0>	release_handler	0	0	13108	0	gen_server:loop/6
<62.38.0>	overload	0	0	1264	0	gen_server:loop/6
<62.37.0>	alarm_handler	0	0	1264	0	gen_event:loop/4
<62.36.0>	sasl_safe_sup	0	0	1880	0	gen_server:loop/6

Figure 3.1: Graphical presentation of etop

The header includes some system information:

Load
: `cpu` is `Runtime/Wallclock`, i.e. the percentage of time where the node has been active, `procs` is the number of processes on the node, and `runq` is the number of processes that are ready to run.

Memory
: This is the memory allocated by the node in kilo bytes.

For each process the following information is presented:

Time
: This is the runtime for the process, i.e. the actual time the process has been scheduled in.

Reds
: This is the number of reductions that has been executed on the process

Memory
: This is the size of the process in bytes, obtained by a call to `process_info(Pid,memory)`.

MsgQ
: This is the length of the message queue for the process.

> **Note:**
>
> *Time* and *Reds* can be presented as accumulated values or as values since last update.

1.3.3 Start

To start etop with the graphical presentation, use the script `getop` or the batch file `getop.bat`, e.g. `getop -node tiger@durin`

To start etop with the text based presentation use the script `etop` or the batch file `etop.bat`, e.g. `etop -node tiger@durin`,

1.3.4 Configuration

All configuration parameters can be set at start by adding `-OptName Value` to the command line, e.g. `etop -node tiger@durin -setcookie mycookie -lines 15`.

The parameters `lines`, `interval`, `accumulate` and `sort` can be changed during runtime. Use the *Options* menu with the graphical presentation or the function `etop:config/2` with the text based presentation.

A list of all valid configuration parameters can be found in the reference manual for `etop`.

Note that it is even possible to change which information to sort by by clicking the header line of the table in the graphical presentation.

Example: Change configuration with graphical presentation

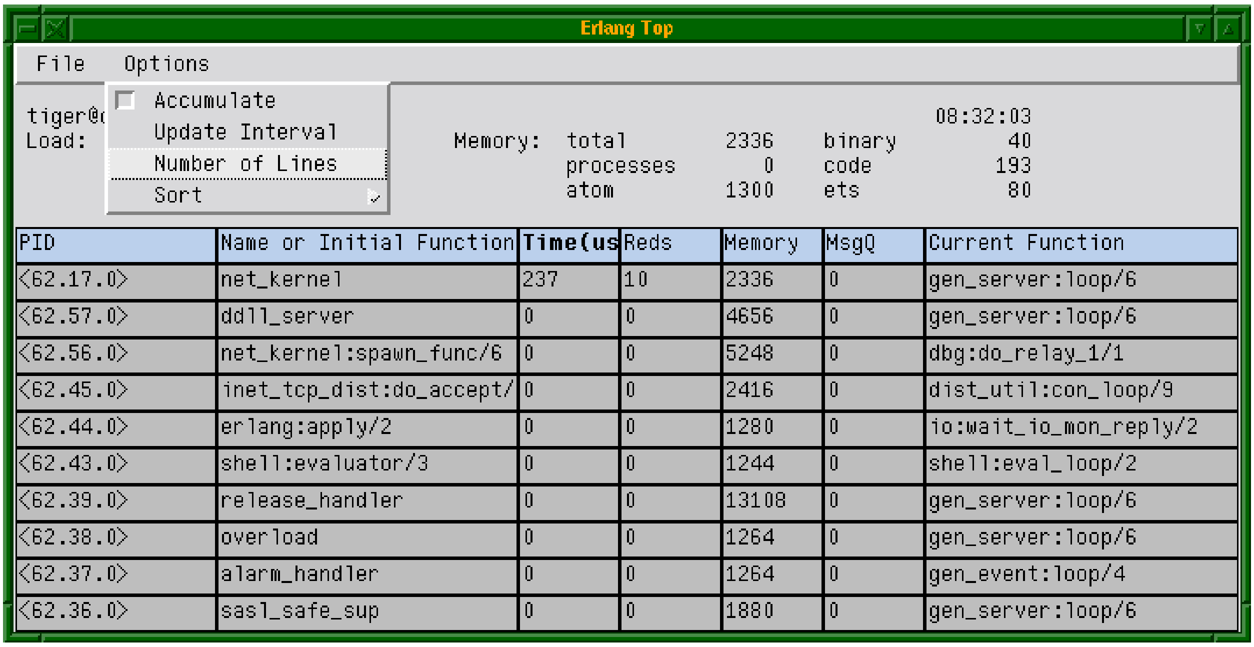


Figure 3.2: Select the option to change from the Options menu.

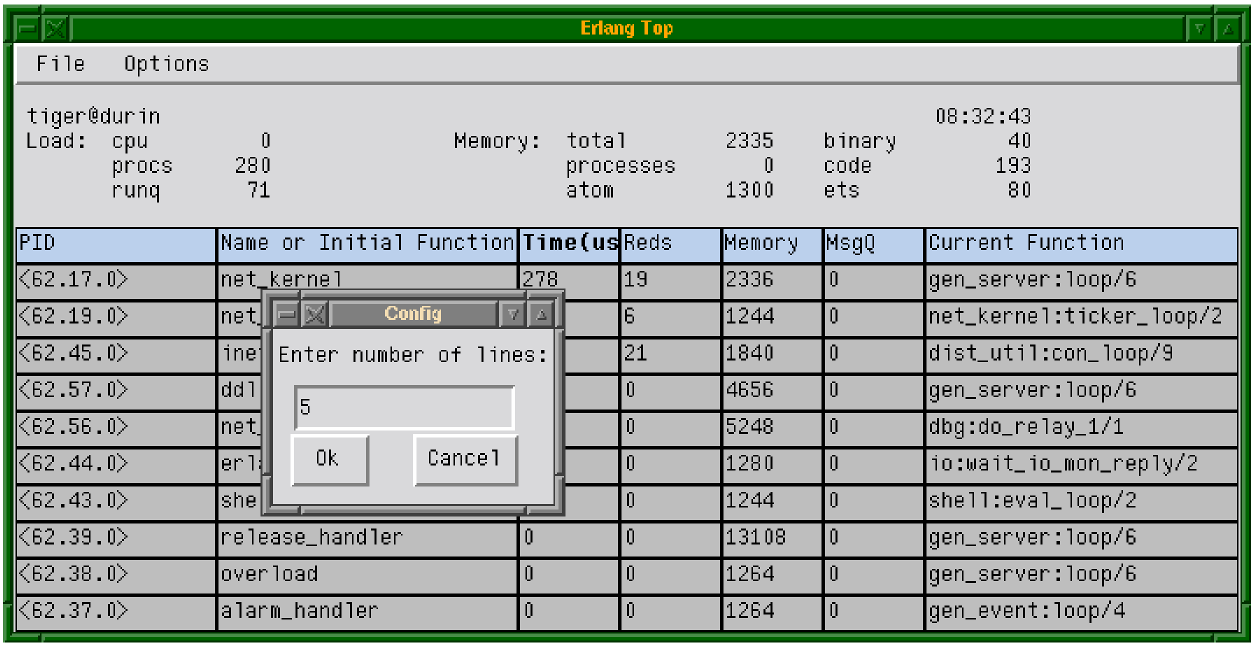


Figure 3.3: Enter the new value in the popup window and click "Ok"

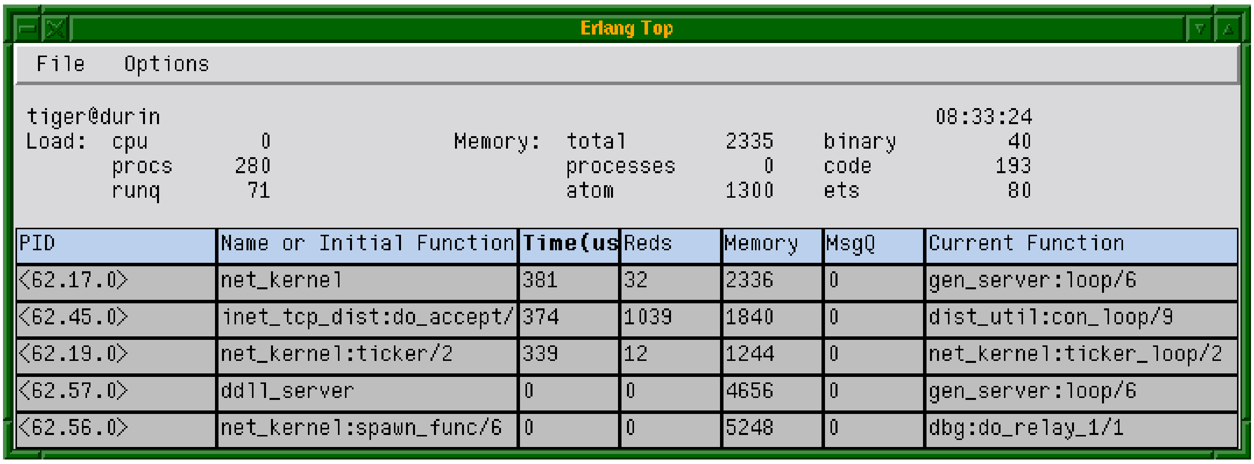


Figure 3.4: The interface is updated with the new configuration

Example: Change configuration with text based presentation

```
========================================================================================
 tiger@durin                                                            10:12:39
 Load:  cpu         0               Memory:  total        1858    binary          33
        procs     191                        processes       0    code           173
        runq        2                        atom         1002    ets             95

Pid            Name or Initial Func    Time    Reds  Memory    MsgQ Current Function
----------------------------------------------------------------------------------------
<127.23.0>     code_server                0   60350   71176       0 gen_server:loop/6
<127.21.0>     file_server_2              0   36380   44276       0 gen_server:loop/6
<127.2.0>      erl_prim_loader            0   27962    3740       0 erl_prim_loader:loop
<127.17.0>     net_kernel                 0   13808    3916       0 gen_server:loop/6
<127.9.0>      kernel_sup                 0    6998    4676       0 gen_server:loop/6
<127.0.0>      init                       0    4156    4352       0 init:loop/1
<127.18.0>     inet_tcp_dist:accept       0    2196    1416       0 prim_inet:accept0/2
<127.16.0>     auth                       0    1893    1264       0 gen_server:loop/6
<127.43.0>     ddll_server                0     582    3744       0 gen_server:loop/6
<127.5.0>      application_controll       0     569    6756       0 gen_server:loop/6
========================================================================================
```

```
etop:config(lines,5).
ok
```

```
(etop@durin)2>
========================================================================================
 tiger@durin                                                            10:12:44
 Load:  cpu         0               Memory:  total        1859    binary          33
        procs     192                        processes       0    code           173
        runq        2                        atom         1002    ets             95

Pid            Name or Initial Func    Time    Reds  Memory    MsgQ Current Function
----------------------------------------------------------------------------------------
<127.17.0>     net_kernel               183      70    4092       0 gen_server:loop/6
<127.335.0>    inet_tcp_dist:do_acc     141      22    1856       0 dist_util:con_loop/9
<127.19.0>     net_kernel:ticker/2      155       6    1244       0 net_kernel:ticker1/2
<127.341.0>    net_kernel:do_spawn_       0       0    5840       0 dbg:do_relay_1/1
<127.43.0>     ddll_server                0       0    3744       0 gen_server:loop/6
```

```
=========================================================================================
```

1.3.5 Print to file

At any time, the current `etop` display can be dumped to a text file. Use *Dump to file* on the *File* menu with the graphical presentation or the function `etop:dump/1` with the text based presentation.

1.3.6 Stop

To stop `etop`, use *Exit* on the *File* menu for the graphical presentation, or the function `etop:stop/0` with the text based presentation.

1.4 Crashdump Viewer

1.4.1 Introduction

The Crashdump Viewer is an HTML based tool for browsing Erlang crashdumps. Crashdump Viewer runs under the WebTool application.

1.4.2 Getting Started

The easiest way to start Crashdump Viewer is to use the provided shell script named `cdv` with the full path to the erlang crashdump as an argument. The script can be found in the priv directory of the `observer` application. This starts WebTool, Crashdump Viewer and a web browser, and loads the given file. The browser should then display a page named General Information which shows a short summary of the information in the crashdump.

The default browser is Internet Explorer on Windows, open on Mac OS X, or else Firefox. To use another browser, give the browser's start command as the second argument to `cdv`. If the given browser name is not known to Crashdump Viewer, the browser argument is executed as a command with the start URL as the only argument.

Under Windows the batch file `cdv.bat` can be used.

It is also possible to start the Crashdump Viewer from within an erlang node by calling *crashdump_viewer:start/0*. This will automatically start WebTool and display the web address where WebTool can be found. See the documentation for the WebTool application for further information about how to use WebTool.

Point your web browser to the address displayed, and you should now see the start page of WebTool. At the top of the page, you will see a link to "CrashDumpViewer". Click this link to get to the start page for Crashdump Viewer. (Note that if webtool is on localhost, you must configure your web browser to have direct connection to the internet, or you must set no proxy for localhost.)

From the start page of Crashdump Viewer, push the "Load Crashdump" button to load a crashdump into the tool. Then enter the filename of the crashdump in the entry field and push the "Ok" button. This will bring you to the General Information page, i.e. the same page as the `cdv` script will open in the browser.

Crashdumps generated by OTP R9C and later are loaded directly into the Crashdump Viewer, while dumps from earlier releases first are translated by the Crashdump Translater. The Crashdump Translater creates a new file with the same name as the original crashdump, but with the extension `.translated`. If there is no write access to the directory of the original file, you will be asked to enter a new path and filename for the translated file.

1.4.3 Navigating

The lefthand frame contains a menu. Menu folders can be expanded and collapsed by clicking the folder picture. When a menu item is clicked, the item information is shown in the big information frame.

The filename frame above the information frame shows the full name of the currently viewed Erlang crashdump.

To load a new crashdump, click the "Load New Crashdump" button in the menu frame.

The various information shown in the information frame will contain links to process identifiers (PIDs) and port identifiers. Clicking one of these links will take you to the detailed information page for the process or port in question. Use the "Back" button in your browser to get back to the startingpoint. If the process or port resided on a remote node, there will be no information available. Clicking the link will then take you to the information about the remote node.

1.4.4 Help

Further help on how to use the Crashdump Viewer tool can be found in the tool's menu under 'Documentation':

'Crashdump Viewer help' is a short document describing each information page and any additional information that might occur, compared to the raw dump described in 'How to interpret Erlang crashdumps'.

'How to interpret Erlang crashdumps' is a document from the Erlang runtime system describing details in the raw crashdumps. Here you will also find information about each single field in the different information pages. This document can also be found directly in the OTP online documentation, via the Erlang runtime system user's guide.

2 Reference Manual

The *Observer* application contains tools for tracing and investigation of distributed systems.

observer

Application

This chapter describes the *OBSERVER* application in OTP, which provides tools for tracing and investigation of distributed systems.

Configuration

There are currently no configuration parameters available for this application.

SEE ALSO

observer

Erlang module

The observer is gui frontend containing various tools to inspect a system. It displays system information, application structures, process information, ets or mnesia tables and a frontend for tracing with *ttb*.

See the *user's guide* for more information about how to get started.

Exports

```
start() -> ok
```

This function starts the `observer` gui. Close the window to stop the application.

ttb

Erlang module

The Trace Tool Builder `ttb` is a base for building trace tools for distributed systems.

When using `ttb`, `dbg` shall not be used in parallel.

Exports

start_trace(Nodes, Patterns, FlagSpec, Opts) -> Result

Types:

Result = see p/2
Nodes = see tracer/2
Patterns = [tuple()]
FlagSpec = {Procs, Flags}
Proc = see p/2
Flags = see p/2
Opts = see tracer/2

This function is a shortcut allowing to start a trace with one command. Each tuple in `Patterns` is converted to list which is in turn passed to `ttb:tpl`. The call:

```
ttb:start_trace([Node, OtherNode],
[{mod, foo, []}, {mod, bar, 2}],
{all, call},
[{file, File}, {handler,{fun myhandler/4, S}}])
```

is equivalent to

```
ttb:start_trace([Node, OtherNode], [{file, File}, {handler,{fun myhandler/4, S}}]),
ttb:tpl(mod, foo, []),
ttb:tpl(mod, bar, 2, []),
ttb:p(all, call)
```

tracer() -> Result

This is equivalent to `tracer(node())`.

tracer(Shortcut) -> Result

Types:

Shortcut = shell | dbg

`shell` is equivalent to `tracer(node(),[{file, {local, "ttb"}}, shell])`.

`dbg` is equivalent to `tracer(node(),[{shell, only}])`.

`tracer(Nodes) -> Result`

This is equivalent to `tracer(Nodes,[])`.

`tracer(Nodes,Opts) -> Result`

Types:

```
Result = {ok, ActivatedNodes} | {error,Reason}
Nodes = atom() | [atom()] | all | existing | new
Opts = Opt | [Opt]
Opt = {file,Client} | {handler, FormatHandler} | {process_info,PI} |
shell | {shell, ShellSpec} | {timer, TimerSpec} | {overload_check, {MSec,
Module, Function}} | {flush, MSec} | resume | {resume, FetchTimeout}
TimerSpec = MSec | {MSec, StopOpts}
MSec = FetchTimeout = integer()
Module = Function = atom()
StopOpts = see stop/2
Client = File | {local, File}
File = Filename | Wrap
Filename = string()
Wrap = {wrap,Filename} | {wrap,Filename,Size,Count}
FormatHandler = See format/2
PI = true | false
ShellSpec = true | false | only
```

This function starts a file trace port on all given nodes and also points the system tracer for sequential tracing to the same port.

The given `Filename` will be prefixed with the node name. Default `Filename` is "ttb".

`File={wrap,Filename,Size,Count}` can be used if the size of the trace logs must be limited. Default values are `Size=128*1024` and `Count=8`.

When tracing diskless nodes, `ttb` must be started from an external "trace control node" with disk access, and `Client` must be `{local, File}`. All trace information is then sent to the trace control node where it is written to file.

The `process_info` option indicates if process information should be collected. If `PI = true` (which is default), each process identifier `Pid` is replaced by a tuple `{Pid,ProcessInfo,Node}`, where `ProcessInfo` is the process' registered name its globally registered name, or its initial function. It is possible to turn off this functionality by setting `PI = false`.

The `{shell, ShellSpec}` option indicates that the trace messages should be printed on the console as they are received by the tracing process. This implies `{local, File}` trace client. If the ShellSpec is `only` (instead of `true`), no trace logs are stored.

The `shell` option is a shortcut for `{shell, true}`.

The `timer` option indicates that the trace should be automatically stopped after `MSec` milliseconds. `StopOpts` are passed to `ttb:stop/2` command if specified (default is `[]`). Note that the timing is approximate, as delays related to network communication are always present. The timer starts after `ttb:p/2` is issued, so you can set up your trace patterns before.

The `overload_check` option allows to enable overload checking on the nodes under trace. `Module:Function(check)` is performed each `MSec` milliseconds. If the check returns `true`, the tracing is disabled on a given node.

`Module:Function` should be able to handle at least three atoms: `init`, `check` and `stop`. `init` and `stop` give the user a possibility to initialize and clean up the check environment.
When a node gets overloaded, it is not possible to issue `ttb:p` nor any command from the `ttb:tp` family, as it would lead to inconsistent tracing state (different trace specifications on different node).

The `flush` option periodically flushes all file trace port clients (see `dbg:flush_trace_port/1`). When enabled, the buffers are freed each `MSec` milliseconds. This option is not allowed with `{file, {local, File}}` tracing.

`{resume, FetchTimeout}` enables the autoresume feature. Whenever enabled, remote nodes try to reconnect to the controlling node in case they were restarted. The feature requires `runtime_tools` application to be started (so it has to be present in the `.boot` scripts if the traced nodes run with embedded erlang). If this is not possible, resume may be performed manually by starting `runtime_tools` remotely using `rpc:call/4`.
`ttb` tries to fetch all logs from a reconnecting node before reinitializing the trace. This has to finish within FetchTimeout milliseconds or is aborted
By default, autostart information is stored in a file called `ttb_autostart.bin` on each node. If this is not desired (i.e. on diskless nodes), a custom module to handle autostart information storage and retrieval can be provided by specifying `ttb_autostart_module` environment variable for the `runtime_tools` application. The module has to respond to the following API:

`write_config(Data) -> ok`
: Store the provided data for further retrieval. It is important to realize that the data storage used must not be affected by the node crash.

`read_config() -> {ok, Data} | {error, Error}`
: Retrieve configuration stored with `write_config(Data)`.

`delete_config() -> ok`
: Delete configuration stored with `write_config(Data)`. Note that after this call any subsequent calls to `read_config` must return `{error, Error}`.

The `resume` option implies the default `FetchTimeout`, which is 10 seconds

`p(Procs,Flags) -> Return`

Types:

`Return = {ok,[{Procs,MatchDesc}]}`
`Procs = Process | [Process] | all | new | existing`
`Process = pid() | atom() | {global,atom()}`
`Flags = Flag | [Flag]`

This function sets the given trace flags on the given processes. The `timestamp` flag is always turned on.

Please turn to the Reference manual for module `dbg` for details about the possible trace flags. The parameter `MatchDesc` is the same as returned from `dbg:p/2`

Processes can be given as registered names, globally registered names or process identifiers. If a registered name is given, the flags are set on processes with this name on all active nodes.

Issuing this command starts the timer for this trace if `timer` option was specified with `tracer/2`.

`tp, tpl, ctp, ctpl, ctpg`

These functions should be used in combination with the `call` trace flag for setting and clearing trace patterns. When the `call` trace flag is set on a process, function calls will be traced on that process if a trace pattern has been set for the called function. Trace patterns specifies how to trace a function by using match specifications. Match specifications are described in the User's Guide for the erlang runtime system `erts`.

These functions are equivalent to the corresponding functions in `dbg`, but all calls are stored in the history. The history buffer makes it easy to create config files so that the same trace environment can be setup several times, e.g. if you want to compare two test runs. It also reduces the amount of typing when using `ttb` from the erlang shell.

`tp`
: Set trace pattern on global function calls

`tpl`
: Set trace pattern on local and global function calls

`ctp`
: Clear trace pattern on local and global function calls

`ctpl`
: Clear trace pattern on local function calls

`ctpg`
: Clear trace pattern on global function calls

With `tp` and `tpl` one of match specification shortcuts may be used (example: `ttb:tp(foo_module, caller)`). The shortcuts are:

- `return` - for `[{'_',[],[{return_trace}]}]` (report the return value)
- `caller` - for `[{'_',[],[{message,{caller}}]}]` (report the calling function)
- `{codestr, Str}` - for `dbg:fun2ms/1` arguments passed as strings (example: `"fun(_) -> return_trace() end"`)

`list_history() -> History`

Types:

`History = [{N,Func,Args}]`

All calls to `ttb` is stored in the history. This function returns the current content of the history. Any entry can be re-executed with `run_history/1` or stored in a config file with `write_config/2/3`.

`run_history(N) -> ok | {error, Reason}`

Types:

`N = integer() | [integer()]`

Executes the given entry or entries from the history list. History can be listed with `list_history/0`.

`write_config(ConfigFile,Config)`

Equivalent to `write_config(ConfigFile,Config,[])`.

`write_config(ConfigFile,Config,Opts) -> ok | {error,Reason}`

Types:

`ConfigFile = string()`
`Config = all | [integer()] | [{Mod,Func,Args}]`
`Mod = atom()`
`Func = atom()`
`Args = [term()]`
`Opts = Opt | [Opt]`
`Opt = append`

This function creates or extends a config file which can be used for restoring a specific configuration later.

The content of the config file can either be fetched from the history or given directly as a list of `{Mod,Func,Args}`.

If the complete history is to be stored in the config file `Config` should be `all`. If only a selected number of entries from the history should be stored, `Config` should be a list of integers pointing out the entries to be stored.

If `Opts` is not given or if it is `[]`, `ConfigFile` is deleted and a new file is created. If `Opts = [append]`, `ConfigFile` will not be deleted. The new information will be appended at the end of the file.

```
run_config(ConfigFile) -> ok | {error,Reason}
```

Types:

ConfigFile = string()

Executes all entries in the given config file. Note that the history of the last trace is always available in the file named `ttb_last_config`.

```
run_config(ConfigFile,NumList) -> ok | {error,Reason}
```

Types:

ConfigFile = string()
NumList = [integer()]

Executes selected entries from the given config file. `NumList` is a list of integers pointing out the entries to be executed.

The content of a config file can be listed with `list_config/1`.

Note that the history of the last trace is always available in the file named `ttb_last_config`.

```
list_config(ConfigFile) -> Config | {error,Reason}
```

Types:

ConfigFile = string()
Config = [{N,Func,Args}]

Lists all entries in the given config file.

```
write_trace_info(Key,Info) -> ok
```

Types:

Key = term()
Info = Data | fun() -> Data
Data = term()

The `.ti` file contains `{Key,ValueList}` tuples. This function adds `Data` to the ValueList associated with `Key`. All information written with this function will be included in the call to the format handler.

```
seq_trigger_ms() -> MatchSpec
```

Equivalent to `seq_trigger_ms(all)`

```
seq_trigger_ms(Flags) -> MatchSpec
```

Types:

MatchSpec = match_spec()
Flags = all | SeqTraceFlag | [SeqTraceFlag]
SeqTraceFlag = atom()

A match specification can turn on or off sequential tracing. This function returns a match specification which turns on sequential tracing with the given `Flags`.

This match specification can be given as the last argument to `tp` or `tpl`. The activated `Item` will then become a *trigger* for sequential tracing. This means that if the item is called on a process with the `call` trace flag set, the process will be "contaminated" with the seq_trace token.

If `Flags = all`, all possible flags are set.

Please turn to the reference manual for the *`seq_trace`* module in the *`kernel`* application to see the possible values for `SeqTraceFlag`. For a description of the match_spec() syntax, please turn to the *User's guide* for the runtime system (*erts*). The chapter *Match Specification in Erlang* explains the general match specification "language".

> **Note:**
>
> The *system tracer* for sequential tracing is automatically initiated by `ttb` when a trace port is started with `ttb:tracer/0/1/2`.

Example of how to use the `seq_trigger_ms/0/1` function:

```
(tiger@durin)5> ttb:tracer().
{ok,[tiger@durin]}
(tiger@durin)6> ttb:p(all,call).
{ok,{[all],[call]}}
(tiger@durin)7> ttb:tp(mod,func,ttb:seq_trigger_ms()).
{ok,[{matched,1},{saved,1}]}
(tiger@durin)8>
```

Whenever `mod:func(...)` is called after this, the seq_trace token will be set on the executing process.

`stop()`

Equivalent to `stop([])`.

`stop(Opts) -> stopped | {stopped, Dir}`

Types:

`Opts = Opt | [Opt]`

`Opt = nofetch | {fetch_dir, Dir} | format | {format, FormatOpts} | return_fetch_dir`

`Dir = string()`

`FormatOpts = see format/2`

Stops tracing on all nodes. Logs and trace information files are sent to the trace control node and stored in a directory named `ttb_upload_FileName-Timestamp`, where `Filename` is the one provided with `{file, File}` during trace setup and `Timestamp` is of the form `yyyymmdd-hhmmss`. Even logs from nodes on the same machine as the trace control node are moved to this directory. The history list is saved to a file named `ttb_last_config` for further reference (as it will be not longer accessible through history and configuration management functions (like `ttb:list_history/0`).

The `nofetch` option indicates that trace logs shall not be collected after tracing is stopped.

The `{fetch, Dir}` option allows to specify the directory to fetch the data to. If the directory already exists, an error is thrown.

The `format` option indicates that the trace logs shall be formatted after tracing is stopped. All logs in the fetch directory will be merged. You may use `{format, FormatOpts}` to pass additional arguments to `format/2`.

The `return_fetch_dir` option indicates that the return value should be `{stopped, Dir}` and not just `stopped`. This implies `fetch`.

get_et_handler()

The `et` handler returned by the function may be used with `format/2` or `tracer/2`. Example: `ttb:format(Dir, [{handler, ttb:get_et_handler()}])`.

format(File)

Same as `format(File,[])`.

format(File,Options) -> ok | {error, Reason}

Types:

File = string() | [string()]

This can be the name of a binary log, a list of such logs or the name of a directory containing one or more binary logs.

Options = Opt | [Opt]

Opt = {out,Out} | {handler,FormatHandler} | disable_sort

Out = standard_io | string()

FormatHandler = {Function, InitialState}

Function = fun(Fd,Trace,TraceInfo,State) -> State

Fd = standard_io | FileDescriptor

This is the file descriptor of the destination file `Out`

Trace = tuple()

This is the trace message. Please turn to the Reference manual for the `erlang`module for details.

TraceInfo = [{Key,ValueList}]

This includes the keys `flags`, `client` and `node`, and if `handler` is given as option to the tracer function, this is also included. In addition all information written with the `write_trace_info/2`function is included.

Reads the given binary trace log(s). The logs are processed in the order of their timestamp as long as `disable_sort` option is not given.

If `FormatHandler = {Function,InitialState}`, `Function` will be called for each trace message. If `FormatHandler = get_et_handler()`, `et_viewer` in the *Event Tracer* application (`et`) is used for presenting the trace log graphically. `ttb` provides a few different filters which can be selected from the Filter menu in the `et_viewer`. If `FormatHandler` is not given, a default handler is used which presents each trace message as a line of text.

The state returned from each call of `Function` is passed to the next call, even if next call is to format a message from another log file.

If `Out` is given, `FormatHandler` gets the file descriptor to `Out` as the first parameter.

`Out` is ignored if `et` format handler is used.

Wrap logs can be formatted one by one or all in one go. To format one of the wrap logs in a set, give the exact name of the file. To format the whole set of wrap logs, give the name with '*' instead of the wrap count. See examples in the `ttb` User's Guide.

etop

Erlang module

etop should be started with the provided scripts etop and getop for text based and graphical presentation respectively. This will start a hidden erlang node which connects to the node to be measured. The measured node is given with the -node option. If the measured node has a different cookie than the default cookie for the user who invokes the script, the cookie must be explicitly given witht the -setcookie option.

Under Windows the batch files etop.bat and getop.bat can be used.

The following configuration parameters exist for the etop tool. When executing the etop or getop scripts, these parameters can be given as command line options, e.g. getop -node testnode@myhost -setcookie MyCookie.

node
: The measured node.
  Value: atom()
  Mandatory

setcookie
: Cookie to use for the etop node - must be the same as the cookie on the measured node.
  Value: atom()

lines
: Number of lines (processes) to display.
  Value: integer()
  Default: 10

interval
: The time interval (in seconds) between each update of the display.
  Value: integer()
  Default: 5

accumulate
: If true the execution time and reductions are accumulated.
  Value: boolean()
  Default: false

sort
: Identifies what information to sort by.
  Value: runtime | reductions | memory | msg_q
  Default: runtime (reductions if tracing=off)

tracing
: etop uses the erlang trace facility, and thus no other tracing is possible on the measured node while etop is running, unless this option is set to off. Also helpful if the etop tracing causes too high load on the measured node. With tracing off, runtime is not measured.
  Value: on | off
  Default: on

All interaction with etop when running the graphical presentation should happen via the menus. For the text based presentation the functions described below can be used.

See the *user's guide* for more information about the etop tool.

Exports

`start() -> ok`

This function starts `etop`. Note that etop is preferably started with the etop and getop scripts

`start(Options) -> ok`

Types:

`Options = [Option]`
`Option = {Key, Value}`
`Key = atom()`
`Value = term()`

This function starts `etop`. Use *help/0* to see a description of the possible options.

`help() -> ok`

This function prints the help of `etop` and its options.

`config(Key,Value) -> Result`

Types:

`Result = ok | {error,Reason}`
`Key = lines | interval | accumulate | sort`
`Value = term()`

This function is used to change the tool's configuration parameters during runtime. The table above indicates the allowed values for each parameter.

`dump(File) -> Result`

Types:

`Result = ok | {error,Reason}`
`File = string()`

This function dumps the current display to a text file.

`stop() -> stop`

This function terminates `etop`.

crashdump_viewer

Erlang module

The Crashdump Viewer is an HTML based tool for browsing Erlang crashdumps. Crashdump Viewer runs under the WebTool application.

See the *user's guide* for more information about how to get started with the Crashdump Viewer.

Exports

`start() -> ok`

This function starts the `crashdump_viewer`.

`stop() -> ok`

This function stops the `crashdump_viewer`.