Debugger Application (DEBUGGER)

version 3.1
## Contents

1 Debugger User’s Guide
   1.1 Debugger ................................................................. 1
      1.1.1 Introduction ................................................... 1
      1.1.2 Getting Started with Debugger ............................... 1
      1.1.3 Breakpoints and Break Dialogue Windows .................. 2
      1.1.4 Stack Trace ..................................................... 5
      1.1.5 The Monitor Window ............................................ 6
      1.1.6 The Interpret Dialog Window .................................. 10
      1.1.7 The Attach Process Window .................................... 12
      1.1.8 The View Module Window ..................................... 15
      1.1.9 Performance ................................................... 17
      1.1.10 Code Loading Mechanism .................................... 17
      1.1.11 Debugging Remote Nodes .................................... 17

2 Debugger Reference Manual
   2.1 debugger ................................................................ 23
   2.2 i .............................................................................. 24
   2.3 int ........................................................................... 29

List of Figures .................................................................... 37
Chapter 1

Debugger User’s Guide

Debugger is a graphical tool which can be used for debugging and testing of Erlang programs. For example, breakpoints can be set, code can be single stepped and variable values can be displayed and changed.

1.1 Debugger

1.1.1 Introduction

Debugger is a graphical user interface for the Erlang interpreter, which can be used for debugging and testing of Erlang programs. For example, breakpoints can be set, code can be single stepped and variable values can be displayed and changed.

The Erlang interpreter can also be accessed via the interface module int, see int(3) [page 29].

Warning: Note that the Debugger at some point might start tracing on the processes which execute the interpreted code. This means that a conflict will occur if tracing by other means is started on any of these processes.

1.1.2 Getting Started with Debugger

Start Debugger by calling debugger:start(). It will start the Monitor window [page 6] showing information about all debugged processes, interpreted modules and selected options.

Initially there are normally no debugged processes. First, it must be specified which modules should be debugged, or interpreted as it is also called. This is done by choosing Module->Interpret... in the Monitor window and then selecting the appropriate modules from the Interpret Dialog window [page 10].

Note:

Only modules compiled with the option debug_info set can be interpreted. Non-interpretable modules are shown within parenthesis in the Interpret Dialog window.

When a module is interpreted, it can be viewed in a View Module window [page 15]. This is done by selecting the module from the Module->module->View menu. The contents of the source file is shown and it is possible to set breakpoints [page 2].
Chapter 1: Debugger User's Guide

Now the program that should be debugged can be started. This is done the normal way from the Erlang shell. All processes executing code in interpreted modules will be displayed in the Monitor window. It is possible to attach to one of these processes, by double-clicking it, or by selecting the process and then choosing Process->Attach.

Attaching to a process will result in a Attach Process window [page 12] being opened for this process. From the Attach Process window, it is possible to control the process execution, inspect variable values, set breakpoints etc.

1.1.3 Breakpoints and Break Dialogue Windows

Once the appropriate modules are interpreted, breakpoints can be set at relevant locations in the source code. Breakpoints are specified on a line basis. When a process reaches a breakpoint, it stops and waits for commands (step, skip, continue,...) from the user.

Note: When a process reaches a breakpoint, only that process is stopped. Other processes are not affected.

Breakpoints are created and deleted using the Break menu of the Monitor window, View Module window and Attach Process window.

Executable Lines

To have effect, a breakpoint must be set at an executable line, which is a line of code containing an executable expression such as a matching or a function call. A blank line or a line containing a comment, function head or pattern in a case- or receive statement is not executable.

In the example below, lines number 2, 4, 6, 8 and 11 are executable lines:

```erlang
1: is_loaded(Module,Compiled) ->
2:   case get_file(Module,Compiled) of
3:     {ok,File} ->
4:       case code:which(Module) of
5:         ?TAG ->
6:           {loaded,File};
7:         _ ->
8:           unloaded
9:       end;
10:      false ->
11:    false
12:  end.
```
1.1: Debugger

Status and Trigger Action

A breakpoint can be either active or inactive. Inactive breakpoints are ignored. Each breakpoint has a trigger action which specifies what should happen when a process has reached it (and stopped):

- enable: Breakpoint should remain active (default).
- disable: Breakpoint should be made inactive.
- delete: Breakpoint should be deleted.

Line Breakpoints

A line breakpoint is created at a certain line in a module.

Right-clicking the Module entry will open a popup menu from which the appropriate module can be selected.

A line breakpoint can also be created (and deleted) by double-clicking the line when the module is displayed in the View Module or Attach Process window.

Conditional Breakpoints

A conditional breakpoint is created at a certain line in the module, but a process reaching the breakpoint will stop only if a given condition is true.

The condition is specified by the user as a module name CModule and a function name CFunction. When a process reaches the breakpoint, CModule::CFunction(Bindings) will be evaluated. If and only if this function call returns true, the process will stop. If the function call returns false, the breakpoint will be silently ignored.

Figure 1.1: The Line Break Dialog Window.
Chapter 1: Debugger User’s Guide

Bindings is a list of variable bindings. Use the function `int:get_binding(Variable,Bindings)` to retrieve the value of `Variable` (given as an atom). The function returns `unbound` or `{value,Value}`.

Right-clicking the Module entry will open a popup menu from which the appropriate module can be selected.

Example: A conditional breakpoint calling `c_test:c_break/1` is added at line 8 in the module `fac`. Each time the breakpoint is reached, the function is called, and when `N` is equal to 3 it returns `true`, and the process stops.

Extract from `fac.erl`:

4. `fac(0) ->`
5. `1;`
6. `fac(N) ->`  
7. `N * fac(N - 1).`

Definition of `c_test:c_break/1`:

```erlang
-module(c_test).
-export([c_break/1]).
c_break(Bindings) ->
    case int:get_binding('N', Bindings) of
```

![Conditional Break Dialog Window](image)
1.1: Debugger

Function Breakpoints

A function breakpoint is a set of line breakpoints, one at the first line of each clause in the given function.

Right-clicking the Module entry will open a popup menu from which the appropriate module can be selected.

Clicking the Ok button (or ‘Return’ or ‘Tab’) when a module name has been given, will bring up all functions of the module in the listbox.

1.1.4 Stack Trace

The Erlang emulator keeps track of a stack trace, information about recent function calls. This information is used, for example, if an error occurs:

1> catch a+1,
{EXIT},{badarith,[{erlang,'+',[a,1]},
{erl_eval,do_apply,5},
{erl_eval,expr,5},
{shell,exprs,6},
{shell,eval_exprs,6},
{shell,eval_loop,3}]}.
In the case above, the stack trace shows that the function called last was `erl_eval:eval_op/3`. See the Erlang Reference Manual, Errors and Error handling, for more information about stack trace.

Debugger emulates the stack trace by keeping track of recently called interpreted functions. (The real stack trace cannot be used, as it shows which functions of the Debugger have been called, rather than which interpreted functions).

This information can be used to traverse the chain of function calls, using the 'Up' and 'Down' buttons of the Attach Process window [page 12].

By default, the Debugger saves information about all current function calls, that is, function calls that have not yet returned a value (option 'Stack On, Tail').

This means, however, that information is saved also for tail recursive calls. For example, repeated calls to the `loop` function of an Erlang process. This may consume unnecessary amounts of memory for debugged processes with long lifetimes and many tail recursive calls. It is therefore possible to set the option 'Stack On, no tail', in which case information about previous calls are discarded when a tail recursive call is made.

It is also possible to turn off the Debugger stack trace facility ('Stack Off'). Note: If an error occurs, in this case the stack trace will be empty.

See the section about the Monitor Window [page 6] for information about how to change the stack trace option.

1.1.5 The Monitor Window

The Monitor window is the main window of Debugger and shows a listbox containing the names of all interpreted modules (double-clicking a module brings up the View Module window), which options are selected, and information about all debugged processes, that is all processes which have been/are executing code in interpreted modules.
1.1: Debugger

Figure 1.4: The Monitor Window.

The Auto Attach buttons, Stack Trace label and Back Trace Size label show some options set, see Options Menu [page 9] for further information about these options.

Process Grid

- **Pid**: The process identifier.
- **Initial Call**: The first call to an interpreted function by this process. (Module:Function/Arity)
- **Name**: The registered name, if any. If a registered name does not show up, it may be that the Debugger received information about the process before the name had been registered. Try selecting Edit->Refresh.
- **Status**: The current status, one of the following:

<table>
<thead>
<tr>
<th>Pid</th>
<th>Initial Call</th>
<th>Name</th>
</tr>
</thead>
<tbody>
<tr>
<td>&lt;0.30.0&gt;</td>
<td>ta:s/0</td>
<td></td>
</tr>
<tr>
<td>&lt;0.43.0&gt;</td>
<td>ta:’-s/0-fun-0-’/0</td>
<td></td>
</tr>
<tr>
<td>&lt;0.48.0&gt;</td>
<td>ta:’-s/0-fun-0-’/0</td>
<td></td>
</tr>
</tbody>
</table>
Chapter 1: Debugger User's Guide

**idle**  The interpreted function call has returned a value, and the process is no longer executing interpreted code.

**running**  The process is running.

**waiting**  The process is waiting in a receive statement.

**break**  The process is stopped at a breakpoint.

**exit**  The process has terminated.

**no_conn**  There is no connection to the node where the process is located.

**Information**  Additional information, if any. If the process is stopped at a breakpoint, the field contains information about the location \{Module,Line\}. If the process has terminated, the field contains the exit reason.

The File Menu

**Load Settings...**  Try to load and restore Debugger settings from a file previously saved using Save Settings..., see below. Any errors are silently ignored.

**Save Settings...**  Save Debugger settings to a file. The settings include the set of interpreted files, breakpoints, and the selected options. The settings can be restored in a later Debugger session using Load Settings..., see above. Any errors are silently ignored.

**Exit**  Stop Debugger.

The Edit Menu

**Refresh**  Update information about debugged processes. Removes information about all terminated processes from the window, and also closes all Attach Process windows for terminated processes.

**Kill All**  Terminate all processes listed in the window using exit(Pid,kill).

The Module Menu

**Interpret...**  Open the Interpret Dialog window [page 10] where new modules to be interpreted can be specified.

**Delete All**  Stop interpreting all modules. Processes executing in interpreted modules will terminate.

For each interpreted module, a corresponding entry is added to the Module menu, with the following submenu:

**Delete**  Stop interpreting the selected module. Processes executing in this module will terminate.

**View**  Open a View Module window [page 15] showing the contents of the selected module.

The Process Menu

The following menu items apply to the currently selected process, provided it is stopped at a breakpoint. See the chapter about the Attach Process window [page 12] for more information.

**Step**

**Next**

**Continue**

**Finish**
The following menu items apply to the currently selected process.

**Attach**  Attach to the process and open a Attach Process window [page 12].
**Kill** Terminate the process using `exit(Pid,kill)`.

The Break Menu

The items in this menu are used to create and delete breakpoints. See the Breakpoints [page 2] chapter for more information.

**Line Break...** Set a line breakpoint.
**Conditional Break...** Set a conditional breakpoint.
**Function Break...** Set a function breakpoint.
**Enable All** Enable all breakpoints.
**Disable All** Disable all breakpoints.
**Delete All** Remove all breakpoints.

For each breakpoint, a corresponding entry is added to the Break menu, from which it is possible to disable/enable or delete the breakpoint, and to change its trigger action.

The Options Menu

**Trace Window** Set which areas should be visible in an Attach Process window [page 12]. Does not affect already existing Attach Process windows.
**Auto Attach** Set at which events a debugged process should be automatically attached to. Affects existing debugged processes.
  - **First Call** - the first time a process calls a function in an interpreted module.
  - **On Exit** - at process termination.
  - **On Break** - when a process reaches a breakpoint.

**Stack Trace** Set stack trace option, see section Stack Trace [page 5]. Does not affect already existing debugged processes.
  - **Stack On, Tail** - save information about all current calls.
  - **Stack On, No Tail** - save information about current calls, discarding previous information when a tail recursive call is made.
  - **Stack Off** - do not save any information about current calls.

**Back Trace Size...** Set how many call frames should be fetched when inspecting the call stack from the Attach Process window. Does not affect already existing Attach Process windows.

The Windows Menu

Contains a menu item for each open Debugger window. Selecting one of the items will raise the corresponding window.

The Help Menu

**Help** View the Debugger documentation. Currently this function requires Netscape to be up and running.
1.1.6 The Interpret Dialog Window

The interpret dialog module is used for selecting which modules to interpret. Initially, the window shows the modules (erl files) and subdirectories of the current working directory.

Interpretable modules are modules for which a BEAM file, compiled with the option `debug_info set`, can be found in the same directory as the source code, or in an `ebin` directory next to it.

Modules, for which the above requirements are not fulfilled, are not interpretable and are therefore displayed within parentheses.

The `debug_info` option causes debug information or abstract code to be added to the BEAM file. This will increase the size of the file, and also makes it possible to reconstruct the source code. It is therefore recommended not to include debug information in code aimed for target systems.

An example of how to compile code with debug information using `erlc`:

```
% erlc +debug_info module.erl
```

An example of how to compile code with debug information from the Erlang shell:

```
4> c(module, debug_info).
```
Browse the file hierarchy and interpret the appropriate modules by selecting a module name and pressing Choose (or carriage return), or by double clicking the module name. Interpreted modules are displayed with a * in front of the name.

Pressing All will interpret all displayed modules in the chosen directory.
Pressing Done will close the window.

**Note:**
When the Debugger is started in global mode (which is the default, see `debugger:start/0`), modules added (or deleted) for interpretation will be added (or deleted) on all known Erlang nodes.
1.1.7 The Attach Process Window

From an Attach Process window the user can interact with a debugged process. One window is opened for each process that has been attached to. Note that when attaching to a process, its execution is automatically stopped.
1.1: Debugger

Figure 1.6: The Attach Process Window.

```haskell
slave_init(N) -> slave_loop(N).
slave_loop(N) ->
  receive
  die ->
  ok;
  Msg ->
  io:format("Slave ~p got message ~p\n", [N, Msg]),
  slave_loop(N)
end.
slave_pid(N, [#slave{pid=Pid, number=N}|Rest]) ->
  Pid;
slave_pid(N, [_Slave|Rest]) ->
  slave_pid(N, Rest).
slave_replace(Pid, [#slave{pid=Pid, number=N}|Rest]) ->
  io:format("master restarting dead slave ~p\n", [N]),
  [#slave{pid=spawn_link(ms, slave_init, [N]), number=N}|Rest]
slave_replace(Pid, [Slave | Rest]) ->
  [Slave | slave_replace(Pid, Rest)].
```

Evaluator:

<table>
<thead>
<tr>
<th>Name</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Msg</td>
<td>hello</td>
</tr>
<tr>
<td>N</td>
<td>2</td>
</tr>
</tbody>
</table>
Chapter 1: Debugger User's Guide

The window is divided into five parts:

- The Code area, showing the code being executed. The code is indented and each line is prefixed with its line number. If the process execution is stopped, the current line is marked with -. An existing break point at a line is marked with -. In the example above, the execution has been stopped at line 56, before the execution of io:format/2.
  
- The Button area, with buttons for quick access to frequently used functions in the Process menu.

- The Evaluator area, where the user can evaluate functions within the context of the debugged process, provided that process execution has been stopped.

- The Bindings area, showing all variables bindings. Clicking on a variable name will result in the value being displayed in the Evaluator area. Double-clicking on a variable name will open a window where the variable value may be edited. Note however that pid, reference, binary or port values can not be edited.

- The Trace area, showing a trace output for the process.

++ (N) Function call, where N is the call level and L the line number.

-- (N) Function return value.

== Pid : Msg The message Msg is sent to process Pid.

<== Mag The message Mag is received.

++ (N) receive Waiting in a receive.

++ (N) receive with timeout Waiting in a receive...after.

Also the back trace, a summary of the current function calls on the stack, is displayed in the Trace area.

It is configurable using the Options menu which areas should be shown or hidden. By default, all areas except the Trace area is shown.

The File Menu

Close Close this window and detach from the process.

The Edit Menu

Go to line... Go to a specified line number.

Search... Search for a specified string.

The Process Menu

Step Execute the current line of code, stepping into any (interpreted) function calls.

Next Execute the current line of code and stop at the next line.

Continue Continue the execution.

Finish Continue the execution until the current function returns.

Skip Skip the current line of code and stop at the next line. If used on the last line in a function body, the function will return skipped.

Time Out Simulate a timeout when executing a receive...after statement.

Stop Stop the execution of a running process, that is, make the process stop as at a breakpoint. The command will take effect (visibly) the next time the process receives a message.
Where Make sure the current location of the execution is visible in the code area.

Kill Terminate the process using exit(Pid,kill).

Messages Inspect the message queue of the process. The queue is printed in the evaluator area.

Back Trace Display the back trace of the process, a summary of the current function calls on the stack, in the trace area. Requires that the Trace area is visible and that the stack trace option is 'Stack On, Tail' or 'Stack On, No Tail'.

Up Inspect the previous function call on the stack, showing the location and variable bindings.

Down Inspect the next function call on the stack, showing the location and variable bindings.

The Options Menu

Trace Window Set which areas should be visible. Does not affect other Attach Process windows.

Stack Trace Same as in the Monitor window [page 6], but does only affect the debugged process the window is attached to.

Back Trace Size... Set how many call frames should be fetched when inspecting the call stack. Does not affect other Attach Process windows.

Break, Windows and Help Menus

The Break, Windows and Help menus look the same as in the Monitor window, see the chapter The Monitor Window [page 6], except that the Breaks menu apply to the local breakpoints only.

1.1.8 The View Module Window

The View Module window shows the contents of an interpreted module and makes it possible to set breakpoints.
The source code is indented and each line is prefixed with its line number.
Clicking a line will highlight it and select it to be the target of the breakpoint functions available from the Break menu. Doubleclicking a line will set a line breakpoint on that line. Doubleclicking a line with an existing breakpoint will remove the breakpoint.
Breakpoints are marked with `@-`. 

```
11: -export([start/1, stop/0, to_slave/2]).
12: -export([master_init/1, slave_init/1]).
14: start(N) ->
15: spawn(ms, master_init, [N]).
18: stop() ->
20: master ! stop.
21: to_slave(Msg, N) ->
22: master ! {to_slave, self(), Msg, N}.
24: master_init(N) ->
25: register(master, self()),
26: process_flag(trap_exit, true),
27: master_loop(start_slaves(N, [])).
29: master_loop(Slaves) ->
30: receive
31: stop ->
32: exit(stopped);
33: {to_slave, _Pid, Msg, N} ->
34: slave_pid(N, Slaves) ! Msg,
```
1.1: Debugger

File and Edit Menus

The File and Edit menus look the same as in the Attach Process window, see the chapter The Attach Process Window [page 12].

Break, Windows and Help Menus

The Break, Windows and Help menus look the same as in the Monitor window, see the chapter The Monitor Window [page 6], except that the Breaks menu apply to the local breakpoints only.

1.1.9 Performance

Execution of interpreted code is naturally slower than for regularly compiled modules. Using the Debugger also increases the number of processes in the system, as for each debugged process another process (the meta process) is created.

It is also worth to keep in mind that programs with timers may behave differently when debugged. This is especially true when stopping the execution of a process, for example at a breakpoint. Timeouts can then occur in other processes that continue execution as normal.

1.1.10 Code Loading Mechanism

Code loading works almost as usual, except that interpreted modules are also stored in a database and debugged processes uses only this stored code. Re-interpreting an interpreted module will result in the new version being stored as well, but does not affect existing processes executing an older version of the code. This means that the code replacement mechanism of Erlang does not work for debugged processes.

1.1.11 Debugging Remote Nodes

By using debugger:start/1, it can be specified if Debugger should be started in local or global mode.

dequer:start(local | global)

If no argument is provided, Debugger is started in global mode.

In local mode, code is interpreted only at the current node. In global mode, code is interpreted at all known nodes. Processes at other nodes executing interpreted code will automatically be shown in the Monitor window and can be attached to like any other debugged process.

It is possible, but definitely not recommended to start Debugger in global mode on more than one node in a network, as they will interfer with each other leading to inconsistent behaviour.
Debugger Reference Manual

Short Summaries

- Erlang Module `debugger` [page 23] - Erlang Debugger
- Erlang Module `int` [page 24] - Debugger/Interpreter Interface
- Erlang Module `int` [page 29] - Interpreter Interface

`debugger`

The following functions are exported:

- `start()` [page 23] Start Debugger.
- `start(File)` [page 23] Start Debugger.
- `start(Mode)` [page 23] Start Debugger.
- `start(Mode, File)` [page 23] Start Debugger.
- `quick(Module, Name, Args)` [page 23] Debug a process.

`i`

The following functions are exported:

- `im() -> pid()` [page 24] Start a graphical monitor
- `ii(AbsModules) -> ok` [page 24] Interpret a module
- `ii(AbsModule) -> {module, Module} | error` [page 24] Interpret a module
- `ini(AbsModules) -> ok` [page 24] Interpret a module
- `ini(AbsModule) -> {module, Module} | error` [page 24] Interpret a module
- `iq(AbsModule) -> ok` [page 24] Stop interpreting a module
• `inq(AbsModule) -> ok`
  [page 24] Stop interpreting a module
• `il() -> ok`
  [page 25] Make a printout of all interpreted modules
• `ip() -> ok`
  [page 25] Make a printout of the current status of all interpreted processes
• `ic() -> ok`
  [page 25] Clear information about processes executing interpreted code
• `iaa(Flags) -> true`
  [page 25] Set when and how to attach to a process
• `iaa(Flags, Function) -> true`
  [page 25] Set when and how to attach to a process
• `ist(Flag) -> true`
  [page 25] Set how to save call frames
• `ia(Pid) -> ok | no_proc`
  [page 25] Attach to a process
• `ia(X,Y,Z) -> ok | no_proc`
  [page 25] Attach to a process
• `ia(Pid, Function) -> ok | no_proc`
  [page 25] Attach to a process
• `ia(X,Y,Z, Function) -> ok | no_proc`
  [page 26] Attach to a process
• `ib(Module, Line) -> ok | {error, break_exists}`
  [page 26] Create a breakpoint
• `ib(Module, Name, Arity) -> ok | {error, function_not_found}`
  [page 26] Create breakpoints in the specified function
• `ir() -> ok`
  [page 26] Delete all breakpoints
• `ir(Module) -> ok`
  [page 26] Delete all breakpoints in a module
• `ir(Module, Line) -> ok`
  [page 26] Delete a breakpoint
• `ir(Module, Name, Arity) -> ok | {error, function_not_found}`
  [page 27] Delete breakpoints from the specified function
• `ibd(Module, Line) -> ok`
  [page 27] Make a breakpoint inactive
• `ibe(Module, Line) -> ok`
  [page 27] Make a breakpoint active
• `iba(Module, Line, Action) -> ok`
  [page 27] Set the trigger action of a breakpoint
• `ibc(Module, Line, Function) -> ok`
  [page 27] Set the conditional test of a breakpoint
• `ipb() -> ok`
  [page 27] Make a printout of all existing breakpoints
• `ipb(Module) -> ok`
  [page 27] Make a printout of all breakpoints in a module
int

The following functions are exported:

- `iv()` -> `atom()`
  [page 28] Current version number of the interpreter
- `help()` -> `ok`
  [page 28] Print help text

- `i(AbsModule)` -> `{module, Module} | error`
  [page 30] Interpret a module
- `i(AbsModules)` -> `ok`
  [page 30] Interpret a module
- `ni(AbsModule)` -> `{module, Module} | error`
  [page 30] Interpret a module
- `ni(AbsModules)` -> `ok`
  [page 30] Interpret a module
- `n(AbsModule)` -> `ok`
  [page 30] Stop interpreting a module
- `nn(AbsModule)` -> `ok`
  [page 30] Stop interpreting a module
- `interpreted()` -> `[Module]`
  [page 30] Get all interpreted modules
- `file(Module)` -> `File | {error, not_loaded}`
  [page 31] Get the file name for an interpreted module
- `interpretable(AbsModule)` -> `true | {error, Reason}`
  [page 31] Check if a module is possible to interpret
- `auto_attach()` -> `false | {Flags, Function}`
  [page 31] Get/set when and how to attach to a process
- `auto_attach(false)`
  [page 31] Get/set when and how to attach to a process
- `auto_attach(Flags, Function)`
  [page 31] Get/set when and how to attach to a process
- `stack_trace()` -> `Flag`
  [page 32] Get/set if and how to save call frames
- `stack_trace(Flag)`
  [page 32] Get/set if and how to save call frames
- `break(Module, Line)` -> `ok | {error, break_exists}`
  [page 32] Create a breakpoint
- `delete_break(Module, Line)` -> `ok`
  [page 32] Delete a breakpoint
- `break_in(Module, Name, Arity)` -> `ok | {error, function_not_found}`
  [page 32] Create breakpoints in the specified function
- `del_break_in(Module, Name, Arity)` -> `ok | {error, function_not_found}`
  [page 33] Delete breakpoints from the specified function
- `no_break()` -> `ok`
  [page 33] Delete all breakpoints
• no_break(Module) -> ok
  [page 33] Delete all breakpoints
• disable_break(Module, Line) -> ok
  [page 33] Make a breakpoint inactive
• enable_break(Module, Line) -> ok
  [page 33] Make a breakpoint active
• action_at_break(Module, Line, Action) -> ok
  [page 33] Set the trigger action of a breakpoint
• test_at_break(Module, Line, Function) -> ok
  [page 33] Set the conditional test of a breakpoint
• get_binding(Var, Bindings) -> {value,Value} | unbound
  [page 34] Retrieve a variable binding
• all_breaks() -> [Break]
  [page 34] Get all breakpoints
• all_breaks(Module) -> [Break]
  [page 34] Get all breakpoints
• snapshot() -> [Snapshot]
  [page 34] Get information about all processes executing interpreted code
• clear() -> ok
  [page 35] Clear information about processes executing interpreted code
• continue(Pid) -> ok | {error,not_interpreted}
  [page 35] Resume process execution
• continue(X,Y,Z) -> ok | {error,not_interpreted}
  [page 35] Resume process execution
Erlang Module

Erlang Debugger for debugging and testing of Erlang programs

Exports

start()
start(File)
start(Mode)
start(Mode, File)

Types:
- Mode = local | global
- File = string()

Starts Debugger.
If given a file name as argument, Debugger will try to load its settings from this file. Refer to Debugger User's Guide for more information about settings.
If given local as argument, Debugger will interpret code only at the current node. If given global as argument, Debugger will interpret code at all known nodes, this is the default.

quick(Module, Name, Args)

Types:
- Module = Name = atom()
- Args = [term()]

This function can be used to debug a single process. The module Module is interpreted and apply(Module, Name, Args) is called. This will open an Attach Process window, refer to Debugger User's Guide for more information.
The module `i` provides short forms for some of the functions used by the graphical Debugger and some of the functions in the `int` module, the Erlang interpreter. This module also provides facilities for displaying status information about interpreted processes and break points.

It is possible to attach to interpreted processes by giving the corresponding process identity only. By default, an attachment window pops up. Processes at other Erlang nodes can be attached manually or automatically.

By preference, these functions can be included in the module `shell.default`. By default, they are.

**Exports**

\[\text{im() - } \text{pid()}
\]

Starts a new graphical monitor. This is the Monitor window, the main window of the Debugger. All of the Debugger and interpreter functionality is accessed from the Monitor window. The Monitor window displays the status of all processes that have been/are executing interpreted modules.

\[\text{ii(AbsModules) - } \text{ok}
\]

\[\text{ii(AbsModule) - } \{\text{module, Module}} | \text{error}
\]

\[\text{ini(AbsModules) - } \text{ok}
\]

\[\text{ini(AbsModule) - } \{\text{module, Module}} | \text{error}
\]

Types:
- `AbsModules` = [AbsModule]
- `AbsModule = Module | File`
- `Module = atom()`
- `File = string()`

Interprets the specified module(s). `ii/1` interprets the module(s) only at the current node, see `int:ii/1` [page 30]. `ini/1` interprets the module(s) at all known nodes, see `int:ni/1` [page 30].

\[\text{iq(AbsModule) - } \text{ok}
\]

\[\text{inq(AbsModule) - } \text{ok}
\]

Types:
- `AbsModule = Module | File`
Debugger Reference Manual

- Module = atom()
- File = string()

Stops interpreting the specified module. \texttt{iq/1} stops interpreting the module only at the current node. \texttt{inq/1} stops interpreting the module at all known nodes.

\texttt{il() \rightarrow ok}

Makes a printout of all interpreted modules. Modules are printed together with the full path name of the corresponding source code file.

\texttt{ip() \rightarrow ok}

Makes a printout of the current status of all interpreted processes.

\texttt{ic() \rightarrow ok}

Clears information about processes executing interpreted code by removing all information about terminated processes.

\texttt{iaa(Flags) \rightarrow true}
\texttt{iaa(Flags, Function) \rightarrow true}

Types:
- Flags = [init | break | exit]
- Function = \{Module, Name, Args\}
  - Module = Name = atom()
  - Args = \{term()\}

Sets when and how to automatically attach to a debugged process; see \texttt{int:automaticAttach/2} [page 31]. Function defaults to the standard function used by the Debugger.

\texttt{ist(Flag) \rightarrow true}

Types:
- Flag = all | no_tail | false

Sets how to save call frames in the stack, see \texttt{int:stackTrace/1} [page 32].

\texttt{ia(Pid) \rightarrow ok | no_proc}

Types:
- Pid = pid()

Attaches to the debugged process \texttt{Pid}. A Debugger Attach Process window is opened for the process.

\texttt{ia(X,Y,Z) \rightarrow ok | no_proc}

Types:
- X = Y = Z = int()
  
Same as \texttt{ia(Pid)}, where \texttt{Pid} is the result of calling the shell function \texttt{pid(X,Y,Z)}.

\texttt{ia(Pid, Function) \rightarrow ok | no_proc}
Attaches to the debugged process Pid. The interpreter will call `spawn(Module, Name, [Pid])` (and ignore the result).

```
ia(X,Y,Z, Function) -> ok | no_proc
```

Types:
- Pid = pid()
- Function = {Module, Name}
- Module = Name = atom()

Same as `ia(Pid, Function)`, where Pid is the result of calling the shell function `pid(X,Y,Z)`. An attached process is expected to call the unofficial `int:attached(Pid)` function and to be able to handle messages from the interpreter, see `dbg_ui_trace.erl` for an example.

```
ib(Module, Line) -> ok | {error, break_exists}
```

Types:
- Module = atom()
- Line = int()

Creates a breakpoint at Line in Module.

```
ib(Module, Name, Arity) -> ok | {error, function_not_found}
```

Types:
- Module = Name = atom()
- Arity = int()

Creates breakpoints at the first line of every clause of the `Module:Name/Arity` function.

```
ir() -> ok
```

Deletes all breakpoints.

```
ir(Module) -> ok
```

Types:
- Module = atom()

Deletes all breakpoints in Module.

```
ir(Module, Line) -> ok
```

Types:
- Module = atom()
- Line = int()

Deletes the breakpoint located at Line in Module.
ir(Module, Name, Arity) -> ok | {error, function_not_found}

Types:
- Module = Name = atom()
- Arity = int()

Deletes the breakpoints at the first line of every clause of the Module:Name/Arity function.

ibd(Module, Line) -> ok

Types:
- Module = atom()
- Line = int()

Makes the breakpoint at Line in Module inactive.

ibe(Module, Line) -> ok

Types:
- Module = atom()
- Line = int()

Makes the breakpoint at Line in Module active.

iba(Module, Line, Action) -> ok

Types:
- Module = atom()
- Line = int()
- Action = enable | disable | delete

Sets the trigger action of the breakpoint at Line in Module to Action.

ibc(Module, Line, Function) -> ok

Types:
- Module = atom()
- Line = int()
- Function = {Module, Name}
- Name = atom()

Sets the conditional test of the breakpoint at Line in Module to Function. The conditional test is performed by calling Module:Name(Bindings), where Bindings is the current variable bindings. The function must return true (break) or false (do not break). Use int:get_binding(Var, Bindings) to retrieve the value of a variable Var.

ipb() -> ok

Makes a printout of all existing breakpoints.

ipb(Module) -> ok

Types:
- Module = atom()
Makes a printout of all existing breakpoints in Module.

**iv()** -> atom()

Returns the current version number of the interpreter. The same as the version number of the Debugger application.

**help()** -> ok

Prints help text.

### Usage


### See Also

int(3)
The Erlang interpreter provides mechanisms for breakpoints and stepwise execution of code. It is mainly intended to be used by the Debugger, see Debugger User’s Guide and debugger(3).

From the shell, it is possible to:

- Specify which modules should be interpreted.
- Specify breakpoints.
- Monitor the current status of all processes executing code in interpreted modules, also processes at other Erlang nodes.

By attaching to a process executing interpreted code, it is possible to examine variable bindings and order stepwise execution. This is done by sending and receiving information to/from the process via a third process, called the meta process. It is possible to implement your own attached process. See int.erl for available functions and dbg_ui_trace.erl for possible messages.

The interpreter depends on the Kernel, STDLIB and GS applications, which means modules belonging to any of these applications are not allowed to be interpreted as it could lead to a deadlock or emulator crash. This also applies to modules belonging to the Debugger application itself.

### Breakpoints

Breakpoints are specified on a line basis. When a process executing code in an interpreted module reaches a breakpoint, it will stop. This means that a breakpoint must be set at an executable line, that is, a line of code containing an executable expression.

A breakpoint have a status, a trigger action and may have a condition associated with it. The status is either active or inactive. An inactive breakpoint is ignored. When a breakpoint is reached, the trigger action specifies if the breakpoint should continue to be active (enable), if it should become inactive (disable), or if it should be removed (delete). A condition is a tuple (Module,Name). When the breakpoint is reached, Module:Name(Bindings) is called. If this evaluates to true, execution will stop. If this evaluates to false, the breakpoint is ignored. Bindings contains the current variable bindings, use get_binding to retrieve the value for a given variable.

By default, a breakpoint is active, has trigger action enable and has no condition associated with it. For more detailed information about breakpoints, refer to Debugger User’s Guide.
Exports

\[ i(\text{AbsModule}) \rightarrow \{\text{module}, \text{Module}\} \mid \text{error} \]
\[ i(\text{AbsModules}) \rightarrow \text{ok} \]
\[ ni(\text{AbsModule}) \rightarrow \{\text{module}, \text{Module}\} \mid \text{error} \]
\[ ni(\text{AbsModules}) \rightarrow \text{ok} \]

Types:
- \( \text{AbsModules} = \{\text{AbsModule}\} \)
- \( \text{AbsModule} = \text{Module} \mid \text{File} \mid [\text{Module} \mid \text{File}] \)
- \( \text{Module} = \text{atom}() \)
- \( \text{File} = \text{string}() \)

Interprets the specified module(s). \( i/1 \) interprets the module only at the current node. \( ni/1 \) interprets the module at all known nodes.

A module may be given by its module name (atom) or by its file name. If given by its module name, the object code \( \text{Module.beam} \) is searched for in the current path. The source code \( \text{Module.erl} \) is searched for first in the same directory as the object code, then in a \( \text{src} \) directory next to it.

If given by its file name, the file name may include a path and the \( .\text{erl} \) extension may be omitted. The object code \( \text{Module.beam} \) is searched for first in the same directory as the source code, then in an \( \text{ebin} \) directory next to it, and then in the current path.

**Note:**
The interpreter needs both the source code and the object code, and the object code must include debug information. That is, only modules compiled with the option \( \text{debug_info} \) set can be interpreted.

The functions returns \( \{\text{module}, \text{Module}\} \) if the module was interpreted, or \( \text{error} \) if it was not.

The argument may also be a list of modules/file names, in which case the function tries to interpret each module as specified above. The function then always returns \( \text{ok} \), but prints some information to stdout if a module could not be interpreted.

\[ n(\text{AbsModule}) \rightarrow \text{ok} \]
\[ nn(\text{AbsModule}) \rightarrow \text{ok} \]

Types:
- \( \text{AbsModule} = \text{Module} \mid \text{File} \mid [\text{Module} \mid \text{File}] \)
- \( \text{Module} = \text{atom}() \)
- \( \text{File} = \text{string}() \)

Stops interpreting the specified module. \( n/1 \) stops interpreting the module only at the current node. \( nn/1 \) stops interpreting the module at all known nodes.

As for \( i/1 \) and \( ni/1 \), a module may be given by either its module name or its file name.

\[ \text{interpreted}() \rightarrow [\text{Module}] \]
Types:
- Module = atom()
Returns a list with all interpreted modules.

file(Module) -> File | {error,not_loaded}
Types:
- Module = atom()
- File = string()
Returns the source code file name File for an interpreted module Module.

interpretable(AbsModule) -> true | {error,Reason}
Types:
- AbsModule = Module | File
- Module = atom()
- File = string()
- Reason = no_src | no_beam | no_debug_info | badarg | [app,App]
- App = atom()
Checks if a module is possible to interpret. The module can be given by its module name Module or its source file name File. If given by a module name, the module is searched for in the code path.

The function returns true if both source code and object code for the module is found, the module has been compiled with the option debug_info set and does not belong to any of the applications Kernel, STDLIB, GS or Debugger itself.

The function returns {error,Reason} if the module for some reason is not possible to interpret.

Reason is no_src if no source code is found or no_beam if no object code is found. It is assumed that the source- and object code are located either in the same directory, or in src and ebin directories next to each other.

Reason is no_debug_info if the module has not been compiled with the option debug_info set.

Reason is badarg if AbsModule is not found. This could be because the specified file does not exist, or because code:which/1 does not return a beam file name, which is the case not only for non-existing modules but also for modules which are preloaded or cover compiled.

Reason is [app,App] where App is kernel, stdlib, gs or debugger if AbsModule belongs to one of these applications.

Note that the function can return true for a module which in fact is not interpretable in the case where the module is marked as sticky or resides in a directory marked as sticky, as this is not discovered until the interpreter actually tries to load the module.

auto_attach() -> false | {Flags,Function}
autoAttach(false)
auto_attach(Flags, Function)
Types:
- Flags = [init | break | exit]
• Function = {Module, Name, Args}
• Module = Name = atom()
• Args = [term()]

Gets and sets when and how to automatically attach to a process executing code in interpreted modules. false means never automatically attach, this is the default. Otherwise automatic attach is defined by a list of flags and a function. The following flags may be specified:

• init - attach when a process for the very first time calls an interpreted function.
• break - attach whenever a process reaches a breakpoint.
• exit - attach when a process terminates.

When the specified event occurs, the function Function will be called as:

spawn(Module, Name, [Pid | Args])

Pid is the pid of the process executing interpreted code.

stack_trace() -> Flag
stack_trace(Flag)

Types:
• Flag = all | no_tail | false

Gets and sets how to save call frames in the stack. Saving call frames makes it possible to inspect the call chain of a process, and is also used to emulate the stack trace if an error (an exception of class error) occurs.

• all - save information about all current calls, that is, function calls that have not yet returned a value. This is the default.
• no_tail - save information about current calls, but discard previous information when a tail recursive call is made. This option consumes less memory and may be necessary to use for processes with long lifetimes and many tail recursive calls.
• false - do not save any information about current calls.

break(Module, Line) -> ok | {error,break_exists}

Types:
• Module = atom()
• Line = int()

Creates a breakpoint at Line in Module.

delete_break(Module, Line) -> ok

Types:
• Module = atom()
• Line = int()

Deletes the breakpoint located at Line in Module.

break_in(Module, Name, Arity) -> ok | {error,function_not_found}
Types:
- Module = Name = atom()
- Arity = int()

Creates a breakpoint at the first line of every clause of the \texttt{Module:Name/Arity} function.

del_break_in(Module, Name, Arity) -> ok | \{error,function_not_found\}

Types:
- Module = Name = atom()
- Arity = int()

Deletes the breakpoints at the first line of every clause of the \texttt{Module:Name/Arity} function.

no_break() -> ok
no_break(Module) -> ok

Deletes all breakpoints, or all breakpoints in Module.

disable_break(Module, Line) -> ok

Types:
- Module = atom()
- Line = int()

Makes the breakpoint at \texttt{Line} in Module inactive.

enable_break(Module, Line) -> ok

Types:
- Module = atom()
- Line = int()

Makes the breakpoint at \texttt{Line} in Module active.

action_at_break(Module, Line, Action) -> ok

Types:
- Module = atom()
- Line = int()
- Action = enable | disable | delete

Sets the trigger action of the breakpoint at \texttt{Line} in Module to \texttt{Action}.

test_at_break(Module, Line, Function) -> ok

Types:
- Module = atom()
- Line = int()
- Function = \{Module,Name\}
- Name = atom()
Sets the conditional test of the breakpoint at Line in Module to Function. The function must fulfill the requirements specified in the section Breakpoints above.

\[
\text{get\_binding}(\text{Var}, \text{Bindings}) \rightarrow \{\text{value}, \text{Value}\} \mid \text{unbound}
\]

Types:
- \text{Var} = \text{atom()}
- \text{Bindings} = \text{term()}
- \text{Value} = \text{term()}

Retrieves the binding of \text{Var}. This function is intended to be used by the conditional function of a breakpoint.

\[
\text{all\_breaks()} \rightarrow [\text{Break}]
\]
\[
\text{all\_breaks(Module)} \rightarrow [\text{Break}]
\]

Types:
- \text{Break} = \{\text{Point, Options}\}
- \text{Point} = \{\text{Module, Line}\}
- \text{Module} = \text{atom()}
- \text{Line} = \text{int()}
- \text{Options} = [\text{Status, Trigger, null, Cond }]
- \text{Status} = \text{active } \mid \text{ inactive}
- \text{Trigger} = \text{enable } \mid \text{ disable } \mid \text{ delete}
- \text{Cond} = \text{null } \mid \text{ Function}
- \text{Function} = \{\text{Module, Name}\}
- \text{Name} = \text{atom()}

Gets all breakpoints, or all breakpoints in Module.

\[
\text{snapshot()} \rightarrow [\text{Snapshot}]
\]

Types:
- \text{Snapshot} = \{\text{Pid, Function, Status, Info}\}
- \text{Pid} = \text{pid()}
- \text{Function} = \{\text{Module, Name, Args}\}
- \text{Module} = \text{Name} = \text{atom()}
- \text{Args} = [\text{term()}]
- \text{Status} = \text{idle } \mid \text{ running } \mid \text{ waiting } \mid \text{ break } \mid \text{ exit } \mid \text{ no\_conn}
- \text{Info} = [\} \mid \{\text{Module, Line} \mid \text{ ExitReason}\}
- \text{Line} = \text{int()}
- \text{ExitReason} = \text{term()}

Gets information about all processes executing interpreted code.

- \text{Pid} - process identifier.
- \text{Function} - first interpreted function called by the process.
- \text{Status} - current status of the process.
- \text{Info} - additional information.

\text{Status} is one of:
• idle - the process is no longer executing interpreted code. Info={}.  
• running - the process is running. Info={}.  
• waiting - the process is waiting at a receive. Info={}.  
• break - process execution has been stopped, normally at a breakpoint.  
  Info={Module,Line}.  
• exit - the process has terminated. Info=ExitReason.  
• no_conn - the connection is down to the node where the process is running.  
  Info={}.  

clear() -> ok  
Clears information about processes executing interpreted code by removing all  
information about terminated processes.  
continue(Pid) -> ok | {error,not_interpreted}  
continue(X,Y,Z) -> ok | {error,not_interpreted}  
Types:  
• Pid = pid()  
• X = Y = Z = int()  
Resume process execution for Pid, or for c:pid(X,Y,Z).
List of Figures

1.1 The Line Break Dialog Window. .................................................... 3
1.2 The Conditional Break Dialog Window. ...................................... 4
1.3 The Function Break Dialog Window. ......................................... 5
1.4 The Monitor Window. ................................................................. 7
1.5 The Interpret Dialog Window. .................................................... 11
1.6 The Attach Process Window. ....................................................... 13
1.7 The View Module Window. .......................................................... 16
# Index of Modules and Functions

Modules are typed in this way.
Functions are typed in this way.

<table>
<thead>
<tr>
<th>Function</th>
<th>Arguments</th>
<th>Return Type</th>
</tr>
</thead>
<tbody>
<tr>
<td>action_at_break/3</td>
<td></td>
<td>int, 33</td>
</tr>
<tr>
<td>all_breaks/0</td>
<td></td>
<td>int, 34</td>
</tr>
<tr>
<td>all_breaks/1</td>
<td></td>
<td>int, 34</td>
</tr>
<tr>
<td>auto_attach/0</td>
<td></td>
<td>int, 31</td>
</tr>
<tr>
<td>auto_attach/1</td>
<td></td>
<td>int, 31</td>
</tr>
<tr>
<td>auto_attach/2</td>
<td></td>
<td>int, 31</td>
</tr>
<tr>
<td>break/2</td>
<td></td>
<td>int, 32</td>
</tr>
<tr>
<td>break_in/3</td>
<td></td>
<td>int, 32</td>
</tr>
<tr>
<td>clear/0</td>
<td></td>
<td>int, 35</td>
</tr>
<tr>
<td>continue/1</td>
<td></td>
<td>int, 35</td>
</tr>
<tr>
<td>continue/3</td>
<td></td>
<td>int, 35</td>
</tr>
<tr>
<td>debugger</td>
<td></td>
<td></td>
</tr>
<tr>
<td>quick/3, 23</td>
<td></td>
<td></td>
</tr>
<tr>
<td>start/0, 23</td>
<td></td>
<td></td>
</tr>
<tr>
<td>start/1, 23</td>
<td></td>
<td></td>
</tr>
<tr>
<td>start/2, 23</td>
<td></td>
<td></td>
</tr>
<tr>
<td>del_break_in/3</td>
<td></td>
<td>int, 33</td>
</tr>
<tr>
<td>delete_break/2</td>
<td></td>
<td>int, 32</td>
</tr>
<tr>
<td>disable_break/2</td>
<td></td>
<td>int, 32</td>
</tr>
<tr>
<td>enable_break/2</td>
<td></td>
<td>int, 33</td>
</tr>
<tr>
<td>file/1</td>
<td></td>
<td>int, 31</td>
</tr>
<tr>
<td>get_binding/2</td>
<td></td>
<td>int, 34</td>
</tr>
<tr>
<td>help/0</td>
<td></td>
<td></td>
</tr>
<tr>
<td>help/0, 28</td>
<td></td>
<td></td>
</tr>
<tr>
<td>ia/1, 25</td>
<td></td>
<td></td>
</tr>
<tr>
<td>ia/2, 25</td>
<td></td>
<td></td>
</tr>
<tr>
<td>ia/3, 25</td>
<td></td>
<td></td>
</tr>
<tr>
<td>ia/4, 26</td>
<td></td>
<td></td>
</tr>
<tr>
<td>iaa/1, 25</td>
<td></td>
<td></td>
</tr>
<tr>
<td>iaa/2, 25</td>
<td></td>
<td></td>
</tr>
<tr>
<td>ib/2, 26</td>
<td></td>
<td></td>
</tr>
<tr>
<td>ib/3, 26</td>
<td></td>
<td></td>
</tr>
<tr>
<td>iba/3, 27</td>
<td></td>
<td></td>
</tr>
<tr>
<td>ibc/3, 27</td>
<td></td>
<td></td>
</tr>
<tr>
<td>ibd/2, 27</td>
<td></td>
<td></td>
</tr>
<tr>
<td>ibe/2, 27</td>
<td></td>
<td></td>
</tr>
<tr>
<td>ic/0, 25</td>
<td></td>
<td></td>
</tr>
<tr>
<td>ii/1, 24</td>
<td></td>
<td></td>
</tr>
<tr>
<td>il/0, 25</td>
<td></td>
<td></td>
</tr>
<tr>
<td>im/0, 24</td>
<td></td>
<td></td>
</tr>
<tr>
<td>ini/1, 24</td>
<td></td>
<td></td>
</tr>
<tr>
<td>inq/1, 24</td>
<td></td>
<td></td>
</tr>
<tr>
<td>ip/0, 25</td>
<td></td>
<td></td>
</tr>
<tr>
<td>ipb/0, 27</td>
<td></td>
<td></td>
</tr>
<tr>
<td>ipb/1, 27</td>
<td></td>
<td></td>
</tr>
<tr>
<td>iq/1, 24</td>
<td></td>
<td></td>
</tr>
<tr>
<td>ir/0, 26</td>
<td></td>
<td></td>
</tr>
<tr>
<td>ir/1, 26</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Index of Modules and Functions

ir/2, 26
ir/3, 27
ist/1, 25
iv/0, 28
i/1
  int, 30
ia/1
  i, 25
ia/2
  i, 25
ia/3
  i, 25
ia/4
  i, 26
iaa/1
  i, 25
iaa/2
  i, 25
ib/2
  i, 26
ib/3
  i, 26
iba/3
  i, 27
ibc/3
  i, 27
ibd/2
  i, 27
ibe/2
  i, 27
ic/0
  i, 25
ii/1
  i, 24
il/0
  i, 25
im/0
  i, 24
ini/1
  i, 24
inq/1
  i, 24
int
  action_at_break/3, 33
  all_breaks/0, 34
  all_breaks/1, 34
  auto_attach/0, 31
  auto_attach/1, 31
  auto_attach/2, 31
  break/2, 32
  break_in/3, 32
  clear/0, 35
  continue/1, 35
  continue/3, 35
  del_break_in/3, 33
  delete_break/2, 32
  disable_break/2, 33
  enable_break/2, 33
  file/1, 31
  get_binding/2, 34
  i/1, 30
  interpretable/1, 31
  interpretable/0, 30
  n/1, 30
  ni/1, 30
  nn/1, 30
  no_break/0, 33
  no_break/1, 33
  snapshot/0, 34
  stack_trace/0, 32
  stack_trace/1, 32
  test_at_break/3, 33
  interpretable/1
    int, 31
  interpreted/0
    int, 30
    ip/0
      i, 25
    ipb/0
      i, 27
    ipb/1
      i, 27
    iq/1
      i, 24
    ir/0
      i, 26
    ir/1
      i, 26
    ir/2
      i, 26
    ir/3
Index of Modules and Functions

\[ \text{i , 27} \]
\[ \text{ist/1} \]
\[ i , 25 \]
\[ \text{iv/0} \]
\[ i , 28 \]
\[ \text{n/1} \]
\[ \text{int , 30} \]
\[ \text{ni/1} \]
\[ \text{int , 30} \]
\[ \text{nn/1} \]
\[ \text{int , 30} \]
\[ \text{no_break/0} \]
\[ \text{int , 33} \]
\[ \text{no_break/1} \]
\[ \text{int , 33} \]
\[ \text{quick/3} \]
\[ \text{debugger , 23} \]
\[ \text{snapshot/0} \]
\[ \text{int , 34} \]
\[ \text{stack_trace/0} \]
\[ \text{int , 32} \]
\[ \text{stack_trace/1} \]
\[ \text{int , 32} \]
\[ \text{start/0} \]
\[ \text{debugger , 23} \]
\[ \text{start/1} \]
\[ \text{debugger , 23} \]
\[ \text{start/2} \]
\[ \text{debugger , 23} \]
\[ \text{test_at_break/3} \]
\[ \text{int , 33} \]