Smallworld 5 Magik debugger

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Version 0.8
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Contents

Installing and starting the debugger

Components of the debugger

There are 3 components.

Item	Description	Prerequisites
Debug agent	This is shipped as a DLL (Windows: *mda.dll*) or shared library (Linux & Solaris: *libmda.so*)	Smallworld 515 or later
Debug client running in node.js	Available from https://github.com/OpenSmallworld/magik-debugger (https://github.com/OpenSmallworld/magik-debugger). Clone or download the zip file and put in folder such as *c:\magik-debugger*	Minimum of node.js v8 required.
Web-based GUI	Browser based	Chrome or FireFox browsers. Internet Explorer not recommended

Note that the components can be co-located on the same host, or run from different hosts.

Note that source code is not a prerequisite for all functions of the debugger. It is possible to set breakpoints and inspect running threads without this.

Information in this document is based on the following component versions

Component	Version	Comments
Smallword	519	
Magik debug agent	14	
Magik debug client	"version": "0.1.1"	2018-05-25
Node.js	10.15.1	LTS stream

Starting a Smallworld session with the debug agent running

The additional Java argument **-agentpath** is passed to the Magik session with the full path to the agent library as a parameter.

Examples

Windows

```
runalias.exe -j -agentpath:%SMALLWORLD_GIS%\bin\x86\mda.dll -a
%SMALLWORLD_GIS%..\cambridge_db\config\gis_aliases cambridge_db_open_no_auth
```

Linux

```
/opt/smallworld/core/bin/share/runalias -j -agentpath:/opt/smallworld/core/bin/Linux.x86/libmda.so -a
/opt/smallworld/cambridge_db/config/gis_aliases cambridge_db_open_no_auth
```

Alternatively, this can be added to an alias using environment variable **SW_LAUNCH_JAVA_ARGS** :

```
eo_suite_open_dbg:
title = Start Smallworld Electric Office Product Suite
session = sw_electric_office:eo_suite_open
SW_ACE_DB_DIR = %SMALLWORLD_GIS%/../electric_office/example_db/ds/ds_admin
SW_CONSTRUCTION_PACK_DIR= C:/Temp
SW_LAYOUT_DOCUMENT_DIR = C:/Temp
splash_screen = %SMALLWORLD_GIS%/../electric_office/resources/base/bitmaps/smallworld_electric_splash.png
product = sw_electric_office
args = -cli
SW_LAUNCH_JAVA_MEMORY = -Xmx1500m
SW_LAUNCH_JAVA_ARGS = %SW_LAUNCH_JAVA_ARGS% -agentpath:%SMALLWORLD_GIS%\bin\x86\mda.dll
```

Starting the session for debugging then becomes:

```
%SMALLWORLD_GIS%\core\bin\x86\runalias.exe -a %SMALLWORLD_GIS%\electric_office\config\gis_aliases
eo_suite_open_dbg
```

A magik session can be started with the debug agent enabled. The debugger is then connected when required. In-house testing shows that there appears to be little overhead in the Magik process when this is run.

IMPORTANT A debugger session should NOT be left unattended in a production environment, as this poses a serious security risk.

Note that **-agentpath** also accepts an additional argument to specify the port for the client. This is useful if multiple instances of the debugger need to be run:

Example:

```
%SMALLWORLD_GIS%\core\bin\x86\runalias.exe -j -
agentpath:%SMALLWORLD_GIS%\bin\x86\mda.dll=socket:20001 -a
%SMALLWORLD_GIS%\electric_office\config\gis_aliases eo_suite_open
```

Starting the debug client in node.js

In order for the source code to be located, environment variables have to be defined for the session running the node.js Magik debugger client, to point to the locations of source.

Product	Variable name
Core product	SMALLWORLD_GIS
Other products	These are in the format <UPPERCASE PRODUCT NAME>_DIR

Examples:
PNI_DIR
PNI_FTTH_DIR
SW_DM_DIR
SCHEMATICS_DIR
SW_COMMON_OFFICE_DIR
SW_ELECTRIC_OFFICE_DIR
SW_ELECTRIC_OFFICE_LP_DIR
SW_GAS_DIST_OFFICE_DIR

Assuming that the Debug client source is in c:\magik-debugger, as in the install example above

```
cd c:\magik-debugger
c:\magik-debugger >npm start localhost:32000
> magik.debugger@0.1.1 start c:\magik-debugger
> node server.js "localhost:32000"
Listening on port 4123
Connected to agent version 14
```

The Debug Agent communicates with the Debug Client using a TCP/IP connection which by default has a port number of **32000**. This can be specified when starting up the debug client, as described in the previous section.

The port for the Web GUI defaults to **4123** but is configurable using environment variable **PORT.** This is useful if multiple debugger sessions need to be run on the same host.

Starting the web GUI

Assuming the port shown was as in the example above (4123) :

Start your web browser, and enter `localhost:4123`

You should see a display similar to this:

Debugger overview

Using the Magik debugger

Functions available in the debugger web GUI

1.Threads

- Suspend and resume threads
- Look at the stack frame for a thread.

2.Breakpoints

- Set breakpoints on method entry using the breakpoint tab
- Set breakpoints in methods at a specific source file location. Once the GUI knows about a source file one can single click on a source line to set a breakpoint. Note that this currently only works for methods.

3.Variables

- Examine local variables and object slots in a suspended thread.
- Evaluate arbitrary Magik expressions in a given stack frame on a thread (click on the ">_" button on the stack frame)

4.Step execution.

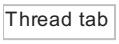
- **GUI Line step**: steps to the next line of Magik source whether it is the current method or not.
- **GUI Over**: steps to the next Magik line in the current method or its caller.
- **GUI Out**: steps until control is returned to the next Magik line executed in a method calling this one.
  - To stop execution stepping, suspend the thread.

Screenshots

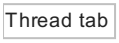
Scenario:

- List threads
- Set breakpoint in *sw_task_runner.get_next_task()*
- On break, jump to source

Thread tab (List of threads)

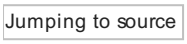


Thread tab (Selected thread stack trace)



Breakpoint tab

Thread tab (Jumping to source)



This also shows the variable list for the stack execution stage when expanded.

Limitations

Item	Limitation	Notes
Line Numbers	Sending magik code from emacs to the Magik session will lead to a mismatch in line numbers between the original code and what is compiled. Hence the debugger will not have accurate line number information.	The emacs lisp magik customization sends three extra source lines at the start of the file.
Breakpoints	Cannot set breakpoints when entering a Magik **_proc**	
	Cannot set breakpoints on Java methods	
Stepping	Stepping of execution can be very slow.	Line steps are generally not too slow.
	If the **Over** functionality has to step over a method invocation which does a lot of processing, then the time to run the step can be extremely large.	
	Similarly, the time take to execute **GUI Out** functionality can be large.	
Variables	The structure of the Magik code matches what is generated by the compiler not the source code.	This is a side-effect of cross-compilation.
	For example, the body of a loop appears as a separate method on the stack frame. As this has its own variable scope, the **_local** variables viewed in the loop body only be those used in the loop body. **_local** variables defined in the enclosing method and loop bodies but which are not used in the loop body will not be visible. In the example, when debugging the loop, variable **a** will not be visible, but variables **i**, **var_b** will be visible	See Example 1
	Similar, but slightly different: **_local** variables defined in a method but only set inside loops nested in the method might not be picked up by the debugger.	For example, the debugger will not see the **_local** *a* in Example 2
	The debugger cannot access **_dynamic** variables.	
Evaluate function	Evaluating an expression can set **_global** variables. It cannot set **_local** variables.	
	When evaluating an expression **_self** is transformed into a different form of variable lookup.Accessing private methods and slots has to be done with **sys!perform()** and **sys!slot()** respectively.	
	Evaluation of the expression **quit()** will not have the expected effect.	quit() is effectively disabled in the evaluation mechanism
Various	Viewing the source code for a **_loopbody** does not work. The GUI cannot translate the stack frame for a **_loopbody** into a meaningful method name to look up in the source	This is a consequence of the cross-compilation from Magik to Java.Changing this would be a major piece of work

Example 1

```
_method thing.test(a, b)
    a << 0
_for j _over a.elements()
_loop
   var_b << 99
     _for i _over b.elements()
     _loop
          var_b +<< i.operate(j)
     _endloop
_endloop
  >> a
_endmethod
$
```

Example 2

```
_method thing.test(a, b)
    a << 0
_for j _over a.elements()
_loop
     _for i _over b.elements()
     _loop
          a+<< i.operate(j)
     _endloop
_endloop
  >> a
_endmethod
$
```