The New Rexx Debugger

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The New Rexx Debugger

Presentation overview

- What is “the New Rexx Debugger”
- Why create this at all
- What interpreter features does it leverage / why ooRexx ?
- Cross platform considerations
- Features / demonstration
- Links and Questions

The New Rexx Debugger

What is it

- A dialog based graphical debugger for Rexx programs
  - Source code, stack and variable views
  - Single step and run to breakpoint features
  - Console for interacting with the program and debugger
  - Standalone and embedded program can be debugged
  - Two modes – direct / embedded launch or debugger launch

- Written in Rexx – no compiled code
  - Runs in-interpreter on ooRexx 4.2 or later

- Cross platform - Windows, Linux and MacOS

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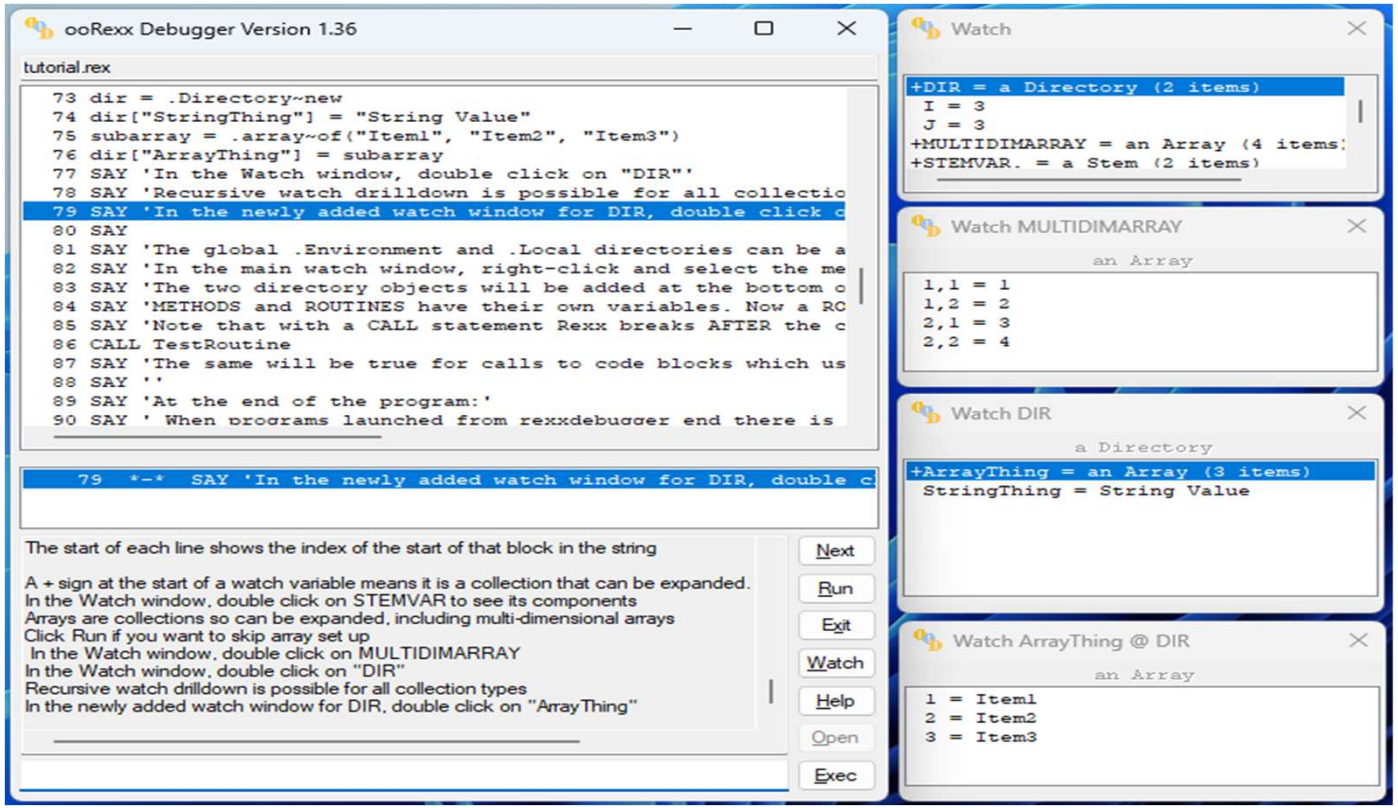
What is it – Windows

Source code

Call stack

Display console

Input console



Watch windows to display top level variables and expanded collection objects

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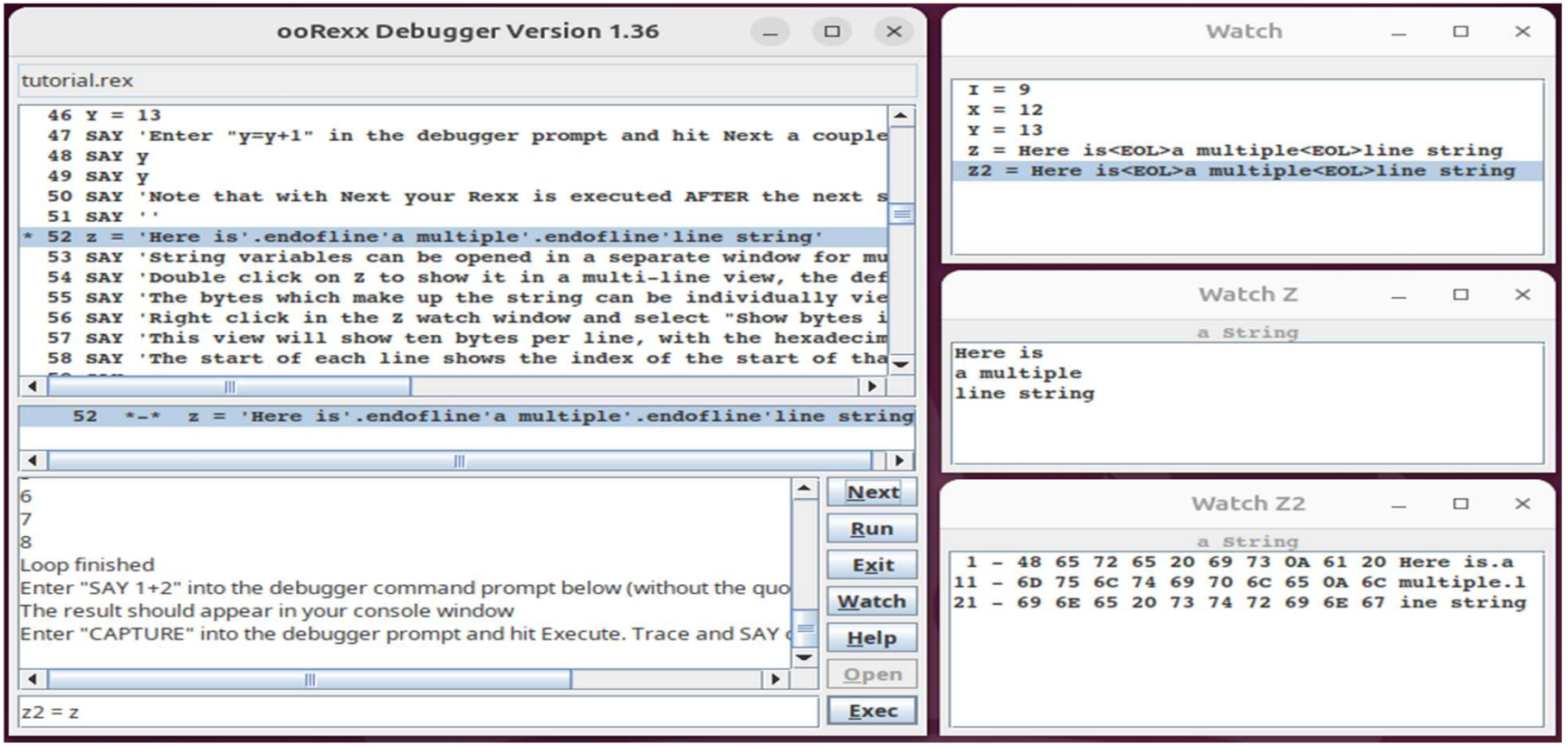
What is it – Linux



Different ways of viewing string variables

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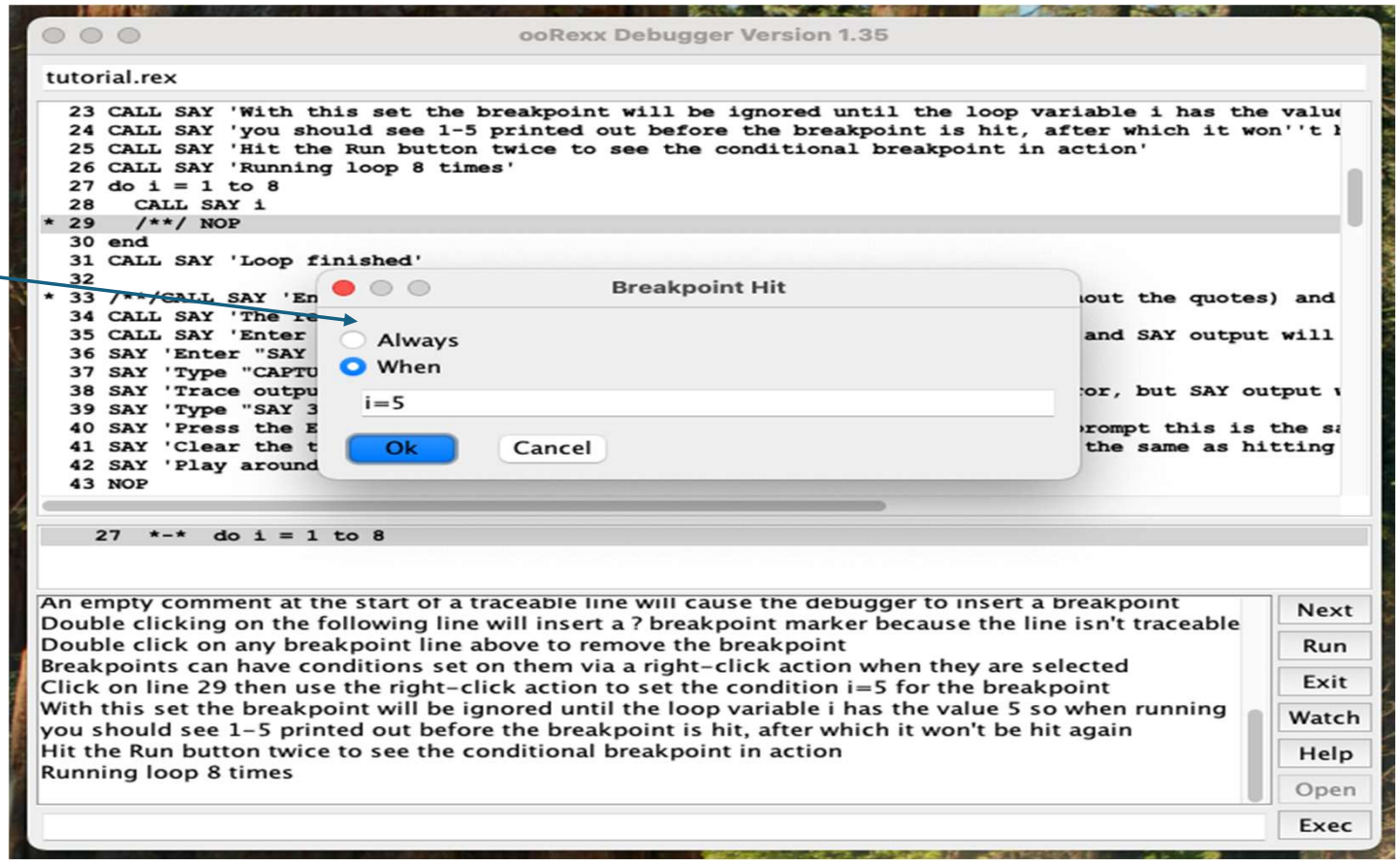
What is it – MacOS

Breakpoint settings dialog



The New Rexx Debugger

Why was it created

- Rexx has powerful debugging features already
  - TRACE
    - Report running program status
    - Interactive (after each instruction)
      View & update variables, skip instructions

- I wanted a GUI debugger for Rexx and couldn't find one
  - Mostly a Windows developer with C/C++ and I like GUI debuggers
  - I work with (oo)Rexx as an embedded application interfacing engine
    - History, going back to OS/2 is mainly with a focus on ANSI-like Rexx features
  - The initial target was embedded use on Windows (my use case)

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Why was it created - continued

- Advent of code 2023
  - Set of coding puzzles over December
  - Attempted this in ooRexx
  - Didn’t get especially far
  - Further increased my desire for a GUI debugger
  - Discovered and started to use ooRexx features
    - Became aware of language and platform features that might make an ooRexx debugger possible

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What interpreter features – why ooRexx

- Functionality a GUI debugger needs from the interpreter
  - Ability to take control of a running program
  - Ability to view and manage program state
  - Non-intrusive – isolation of debugger program state
  - A UI library
  - Some form of multi-threading support (generally, for UI)

The New Rexx Debugger

Required features - Taking control of the program

- Option: Use of Rexx system exit interfaces
  - Part of the standard Rexx programming API
  - Registered by the program running the interpreter
  - Can halt after every instruction
  - Can intercept interactive trace input responses along with program and trace output
  - An interpreter wrapper program needs to be built
  - Requires modification of embedded engines which may not be possible

The New Rexx Debugger

Required features - Taking control of the program

- Option: Leverage language hooks to intercept tracing
- Interpreter effectively calls PULL on an input stream
  - In ooRexx, this can be intercepted to call ooRexx code
  - This uses the .DEBUGINPUT global object

- How ? Intercept standard ooRexx I/O
  - Standard stream objects .STDIO, .STDIN. STDERR etc exist
    Have methods like LINEOUT, CHAROUT, LINEIN etc

    Instead of SAY: .STDOUT~LINEOUT string
    Instead of PULL: str = .STDIN~LINEIN

The New Rexx Debugger

Required features - Taking control of the program

- An extra level, the IO stream can be accessed “Monitors”
  - Monitors are literally placeholders for other objects
  - A target object is assigned to the monitor
  - The target object can be queried and modified
  - All method calls are forwarded to the current target object
  - The set of IO monitors
    - .INPUT redirects to the .STDIN object
    - .OUTPUT redirects to .STDOUT object
    - .ERROR redirects to .STDERR
    - .TRACEOUTPUT (trace output) redirects to .ERROR
    - **.DEBUGINPUT (interactive trace input)**

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Required features - Taking control of the program

For normal(*) IO processing ooRexx will use the monitor objects and not the underlying IO objects so:

Instead of SAY: . OUTPUT~LINEOUT string
Instead of PULL: str = . INPUT~LINEIN

(*) The interpreter wrapper may have set up API system exits which tell ooRexx NOT to call these – can be an issue when embedding

This is true for stdout and trace output for my organisation's application

The New Rexx Debugger

Required features - Taking control of the program

During interactive tracing, .DEBUGINPUT~LINEIN will be called to get user response (unless blocked by a registered API system exit). The following is a customized interactive debugger utilising this:

```
.DEBUGINPUT~destination(.debuginputinterceptor~new)
trace ?A /* Trace after every instruction */
do i = 1 to 10
  say i
end

::class debuginputinterceptor
::method linein
say 'Press enter to continue or type code to run'
parse pull data
return data
```

The New Rexx Debugger

Required features –Managing program state

- Program state requirements
  - Current location
    - Source file (to load the correct file)
    - Current line for tracking and breakpoints
  - Stack trace
  - Program variables e.g. for debugger Watch windows
  - Error state

- All accessible from the dynamically created .context object
  executable, line, variables , stackframes, condition

The New Rexx Debugger

Required features – Managing program state

- Communication via `.local~debug.channels object`
  - Per-thread debug state (one channel per thread)
  - Accessible to both program and debugger
  - Elements for the program to store state information
  - A “next action” field for the debugger
    - Multiple round trips to the debugger following the initial execution of a new clause
    - The interactive trace response from the debugger tells the program what information to provide next
    - If the debugger decides to stop the program, there is no response until one is provided by the debugger window

The New Rexx Debugger

Required features – A UI library

- Doesn’t need to be especially complex
- Multiple dialogs are used e.g. main dialog and watch window dialogs
- Basic dialog elements are sufficient, lists, buttons, entry fields
- Windows has ooDialog which has the above requirements
- There is no direct equivalent on other platforms so the initial releases were only on this platform

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Required features – Cross platform consideration

- After I posted details of my work a Linux version was requested
- The is no native ooRexx UI library for non-Windows platforms
- Lots of helpful discussions on the mailing list

- BSF4ooRexx provides full access to a Java JRE /JDK from ooRexx
- Java Swing /AWT libraries offer well tested basic UI elements in Java 8 and these are core components so always available
- Using Java extended support to Linux, Mac and maybe others

The New Rexx Debugger

Required features – Cross platform considerations

- The debugger comprises a core low-level debugger module RexxDebugger.rex (this also contains some cross-UI shared code) and separate UI modules
- The two UI modules are implemented as plugins in:
  - RexxDebuggerWinUI.rex for ooDialog
  - RexxDebuggerBSFUI.rex for Java /BSF4ooRexx
- Both modules implement the same UI functionality
- A thin (common) API is exposed for the core debugger to use
- One of the UI modules is loaded by the debugger at launch
- The Java UI can be used on Windows if desired

The New Rexx Debugger

Required features – Cross platform considerations

- On Windows, the debugger files can be anywhere in the path, running RexxDebugger.rex will launch the debugger
- On Unix platforms a shell script (“rexxdebugger” is provided to run the debugger with required environment options
- No “install.sh” but debugger files can be copied to e.g. /usr/local/bin and rexxdebugger made executable
- Deployment instructions are available in the README.md

The New Rexx Debugger

Direct launch - Tutorial Walkthrough

- Direct launch is running the program directly from the command line or in an application which hosts an embedded ooRexx interpreter to run the program

- The main dialog has source, stack and console views with console input and push buttons for control
- Program and trace output is not captured to the debugger console by default but debugger commands can be used to modify this behaviour
- The debugger pauses **after** executing an instruction as this is when Rexx requests trace input
- Breakpoints can be added and removed via double clicking and conditions set by right-clicking on them. Empty /**/ comments in the code can be used to indicate that the debugger should insert a breakpoint when loading the program
- Rexx statements can be typed in the console prompt to view /modify program state

The New Rexx Debugger

Direct launch - Tutorial Walkthrough (continued)

- The Watch button opens a variable listing aka “watch window”
- Watch windows update after running part of the program or executing a console statement
- Strings show on a single line by default, but double-clicking opens another watch window where the string can be viewed in multi-line and hexadecimal (byte) formats
- All collection objects (stems, arrays etc) in a watch window can be double clicked on to show their items in a new watch window. A (+) sign indicates an expandable collection
- In the top level watch window, .LOCAL and .ENVIRONMENT directories can be selected for viewing with a right-click menu action
- When in a ROUTINE, METHOD or procedure, watch windows will update to show the variables for that scope, greying out if the watch window is not valid for that scope
- For direct launch the program needs to include instructions / directives for activating interactive trace and loading the debugger, at the end of the tutorial.rex file in this instance.

The New Rexx Debugger

Launching from the debugger

- The debugger is run and loads the Rexx program itself
- The same UI is presented as for direct launch but with the addition of as Open button
- In this mode the default is for program output to be captured to the debugger console with trace output (apart from errors) silently dropped
- The program to run can be specified as a command line option e.g. rexxdebugger myprog.rex, or loaded via the Open button
- Command line options are available to customize the debug session
- No modification of the program is required

Sample TaggedClass.rex – extending a class to display object detail

- Object attributes for custom classes do not display in watch windows
- Implement an unguarded method “makedebuggerstring” to return display information
- The return value is displayed alongside the object type in watch windows
- Illustrated on the next slide

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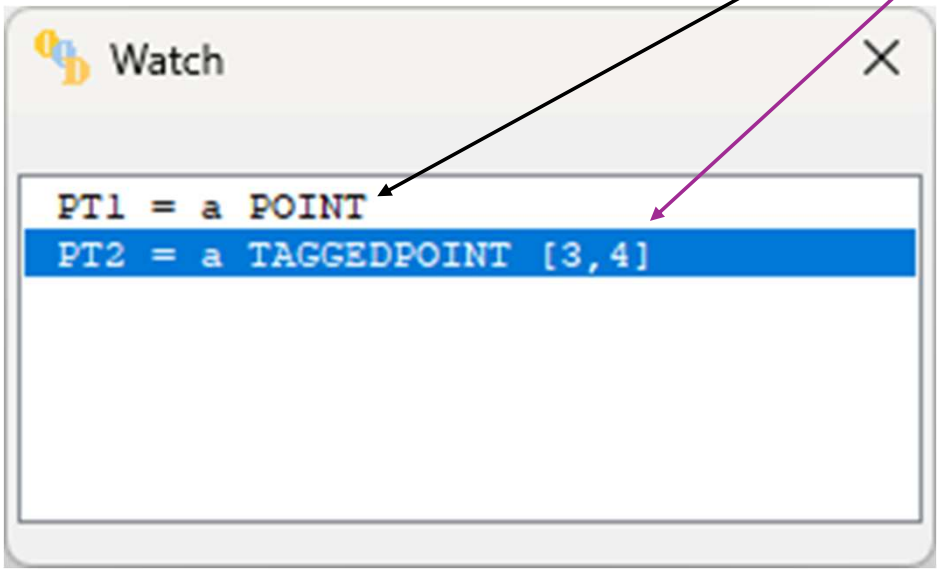
TaggedClass.rex sample




```
NOP
pt1 = .point~new(1,2)
pt2 = .taggedpoint~new(3,4)
NOP

::class point
::attribute x
::attribute y

::method init
expose x y
use arg x,y

::class taggedpoint
::method init
expose x y
use arg x,y

::attribute x
::attribute y

::method makedebuggerstring unguarded
expose x y
return x','y
```

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Questions ?

The New Rexx Debugger

Links

ooRexxDebugger
https://sourceforge.net/projects/oorexxdebugger/

ooRexx (4.2 or later required)
https://sourceforge.net/projects/oorexx/

Java UI - BSF4ooRexx (641 or later required)
https://sourceforge.net/projects/bsf4oorexx/

Java UI - Java 8 JRE (Minimum Java version tested)
https://www.oracle.com/java/technologies/javase/javase8-archive-downloads.html