The vw+ Debugging system

Introduction

This describes a lightweight tool for debugging a tcl/tk program. It has several features and benefits.

- Simple to install and use – designed for the new programmer to aid understanding tcl/tk
- Inserted into a program at any time with only a single *source* statement
- Can dynamically instrument code for single stepping a procedure and remove it later
- Can view global, namespace, and local variables in a procedure
- Can tailor debugging to a specific set of procedure(s).
- Animation effects to run slowly and watch variables and code progress

This pdf describes a smallish self contained variable browser and debugger with breakpoints and stepping.

It is implemented with a single file that is *sourced* into a program, usually at startup, but can also be attached to a running program as well.

The single file defines 6 procedures:

- vw+ The viewer for global/namespace variables and arrays
- bp+ A low level breakpoint command that is called by the user's program
- lbp+ The same but for procedures with local variables
- go+ The command to resume from a breakpoint
- util+ Utility commands
- instrument+ The command to insert breakpoints into a procedure. (OO not supported yet)

To minimize impact, there is only one global (array) variable used, and the file includes a section at the top where this array is initialized, as discussed later.

There are also 3 optional aliases that can be used (which can be changed or commented out to not use) that provide 3 single letter abbreviations (v, g, and u, for vw+, go+, and util+) for the 3 commands often typed in by the user.

When the file is sourced, it only sets values in its global array variable and defines the 6 procedures. It takes no further actions until some of the above commands are used. It is thus safe to source anytime.

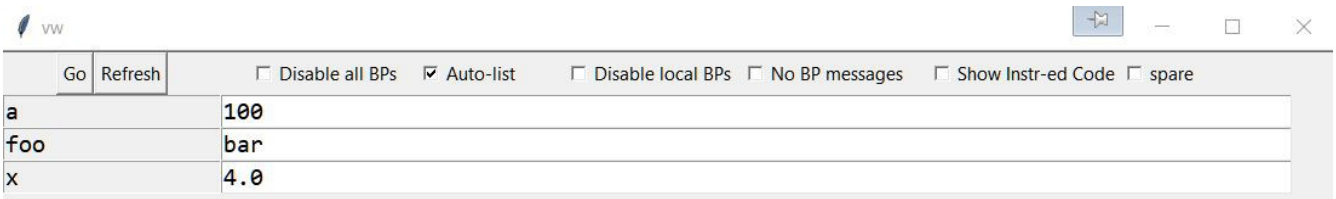
In TclOO class variables are stored in namespaces. If you know the namespace for an object, you can use the vw+ procedure to monitor those variables. When you create a new object, the TclOO system returns to you the namespace that the new object will use and And the bp+ lower level break-point can be used in OO methods as well (but not single step). That's the extent of support for TclOO at present.

There are a few ways to use this tool. The first is for small programs with code that is simply down the page outside of all procedures that makes use of global variables, perhaps including some in a namespace. This is also appropriate for TclOO, which can use globals and its object variables are stored in namespaces as well. The variables can be viewed in toplevel windows that are created by the vw+ command (aliased as v). This command creates a 2 column, spreadsheet like grid, with the variables in the left column and their values in the right (wider) column. The tool is designed to work with the console (including the console for linux) where commands may be entered and data is output to it by the debugger (and the user program). Values can be modified by entering data in the values column.

To get started, suppose we have a few lines of code at the beginning of our own tcl file. To use the vw+ system, we would add the debugging code shown in red:

```
source {pathto/vw+source.tcl}  ;# loads the vw+ debugger
console show
set   a 100 ;# sets up some variables
set foo bar
set   x 4.0
vw+ ;# show the global variables window
```

When we run this with wish (or a tclkit with the tk gui) we will get the following window plus a console (I suggest using one even on linux, where there's a wiki page on this and a TIP to include one on linux in the future) and one empty tk main window (the one called . or dot)



Above we see our 3 global variables. There are, of course, several others used by the system which did not show in the window. This is by design and is accomplished by one of the statements near the top of the source'd file which gets a list of all the initial global variables and so only shows the ones added since then. If you want a window to include all of them, you would enter a (string match like) pattern:

vw+ *

This parameter always has another * added at the end, so if you want only the global variables that begin with “err” you could enter,

vw+ err

Note that in these forms of the command, each vw+ command would reuse the window with the default name of .vw and you can see that in the title (less the dot). If you want multiple windows with different names one adds a second parameter. For example, if you want 3 windows,

vw+
vw+ * allglobals
vw+ err errorvars
Note, that you can either put these commands in your program file or type them into the console. This

is where the alias comes in handy, and the command reduces to “v”.

v
v * allglobals
v err errorvars

We will use the full name in this document unless we are typing into the console, where we will use the alias for brevity.

This vw+ command takes several forms. Interactively, from a console, one can get help:

vw+ ? (or v ? with the alias)

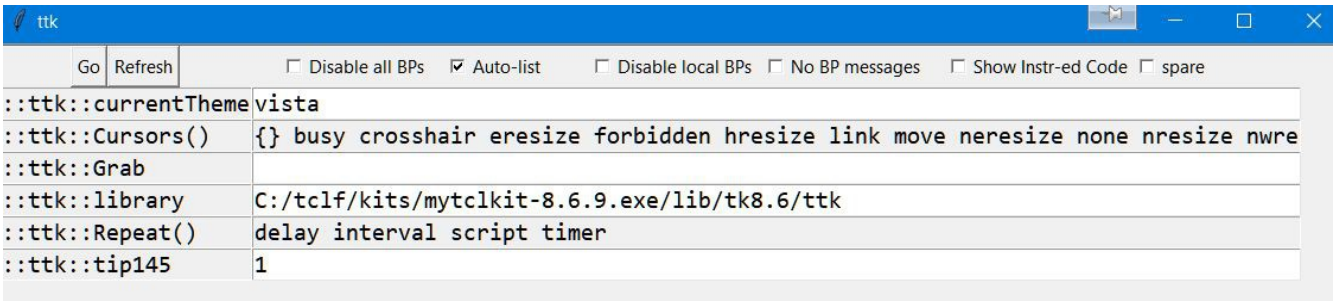
vw+ can take a list of variables or a pattern in the first argument. If a list, it must be 2 or more and be placed in {}'s.

v {foo bar baz a_global_array(x)} fooey

If you want to work with variables defined in a namespace, you enter the namespace name followed by two colons. For example, if you want to see the variables in the ::ttk namespace you would enter,

v ttk:: ttk

and you would get this: (you can also supply a pattern after the :: to see fewer variables, default is *):



With the variable names on the left and their values on the right we can see the variable *currentTheme* has the value *vista*. If the variable is an array, then the value (s) shown above are not the data, but rather

```
---------
The array ::ttk::Cursors()
---------
::::ttk::Cursors()          =
::::ttk::Cursors(busy)      = wait
::::ttk::Cursors(crosshair) = crosshair
::::ttk::Cursors(eresize)   = size_we
::::ttk::Cursors(forbidden) = no
::::ttk::Cursors(hresize)   = size_we
::::ttk::Cursors(link)      = hand2
::::ttk::Cursors(move)      = fleur
::::ttk::Cursors(neresize)  = size_ne_sw
::::ttk::Cursors(none)      =
::::ttk::Cursors(nresize)   = size_ns
::::ttk::Cursors(nwresize)  = size_nw_se
::::ttk::Cursors(seresize)  = size_nw_se
::::ttk::Cursors(sresize)   = size_ns
::::ttk::Cursors(standard)  = arrow
::::ttk::Cursors(swresize)  = size_ne_sw
::::ttk::Cursors(text)      = ibeam
::::ttk::Cursors(vresize)   = size_ns
::::ttk::Cursors(wresize)   = size_we
```

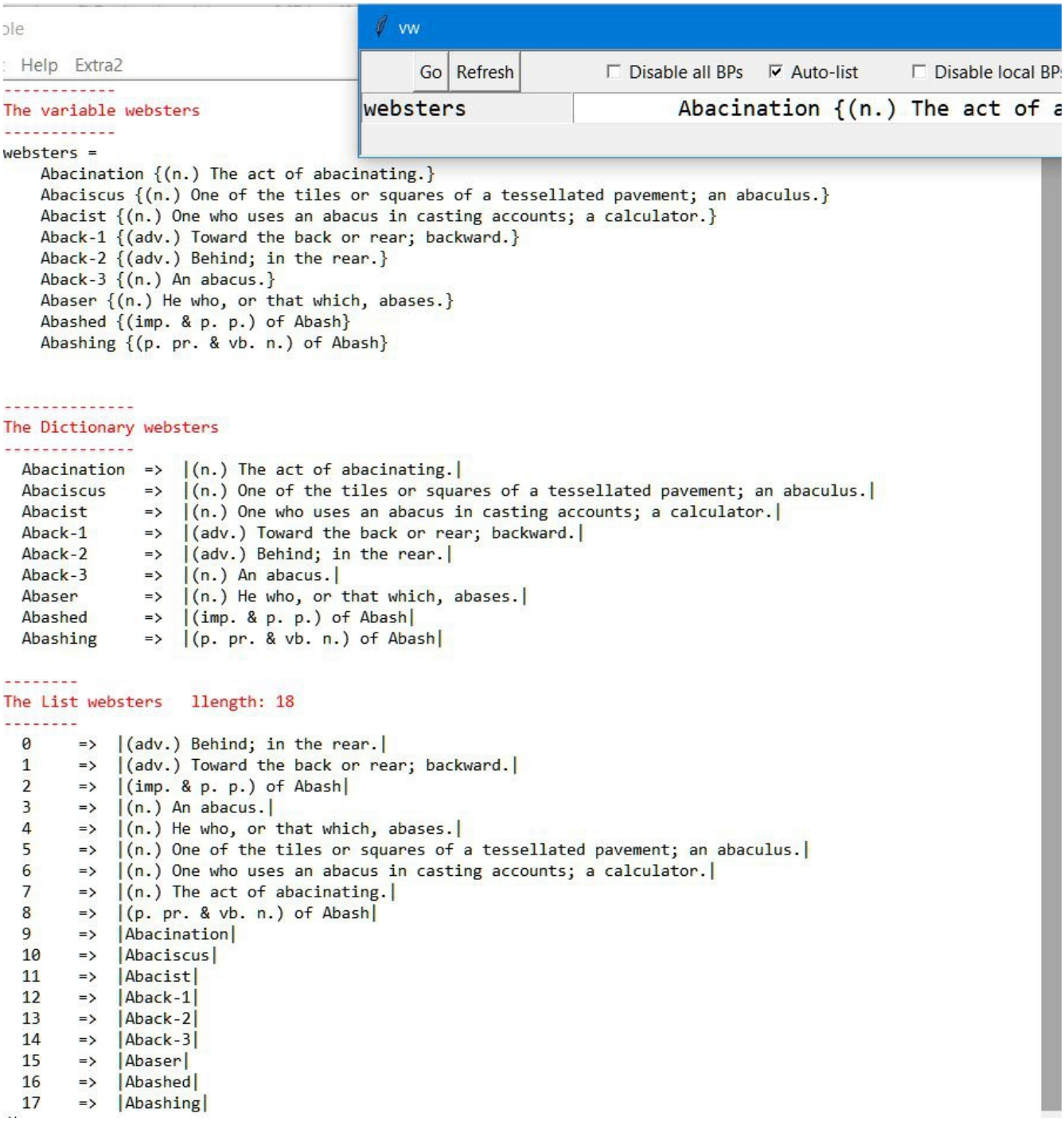
the indices. If you want to see the values of an array, you would ***left click on the array name***. For example, the *Cursors* array produced the above on my windows 10 system (onto the console). A single

array element is viewed just like a simple variable.

If you are not using a console on linux, this output would go to the terminal window (stdout). It uses the tcl supplied [parray] command to do the output. Note, some output goes to ***stderr***, since with a console, this produces output in ***red text***.

List and dictionary display

A ***shifted left click*** on a variable will attempt to format the output as a dictionary variable. For example



Also ***a control left click*** will format as a simple list, but in a single column and unsorted, so in the order in the list, while ***an alt left click*** will output the list sorted using -dictionary as the lsort option. | bars | are added so if there are any trailing or leading spaces, they are easier to see.

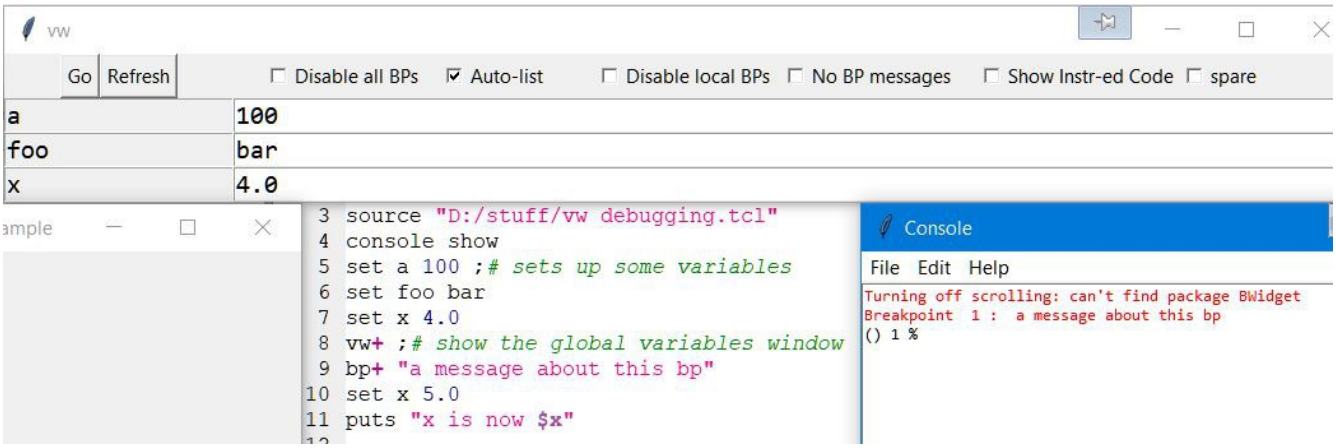
The window also has a few buttons and check-boxes. They are for use with break-points. Two of the procedures used for break-points are bp+ and lbp+. The bp+ command uses the vwait tcl command to wait until a variable is set which is part of the event system that most gui programs use. It is while the program is waiting at the point where the bp+ or lbp+ commands are made that one can view the several wndows that might be open, or enter commands into the console (or the 2 console like entry widgets described below). The global or namespace variables will all be up to date as of the point of the breakpoint call. The console will be available to type further commands including adding more variable windows using the vw+ command. lbp+ is for local procedures and will display source code. It is a higher level break-point that eventually calls the bp+ break-point.

Globals and Namespace variables can be changed by typing into the section on the right, except for arrays. They are grey'd out and are readonly. You can copy the indices, but you can't change their values. Of course, you can change the array's values in the console with a set statement or any thing else that you might run, such as calling some command or a procedure you have written. Individual array elements can be changed however, if they were included using the {...} variable list.

The button called "***Go***" is used to continue from a breakpoint. Next, let's add a break-point to the program (shown in red), which is followed by a change to the variable x.

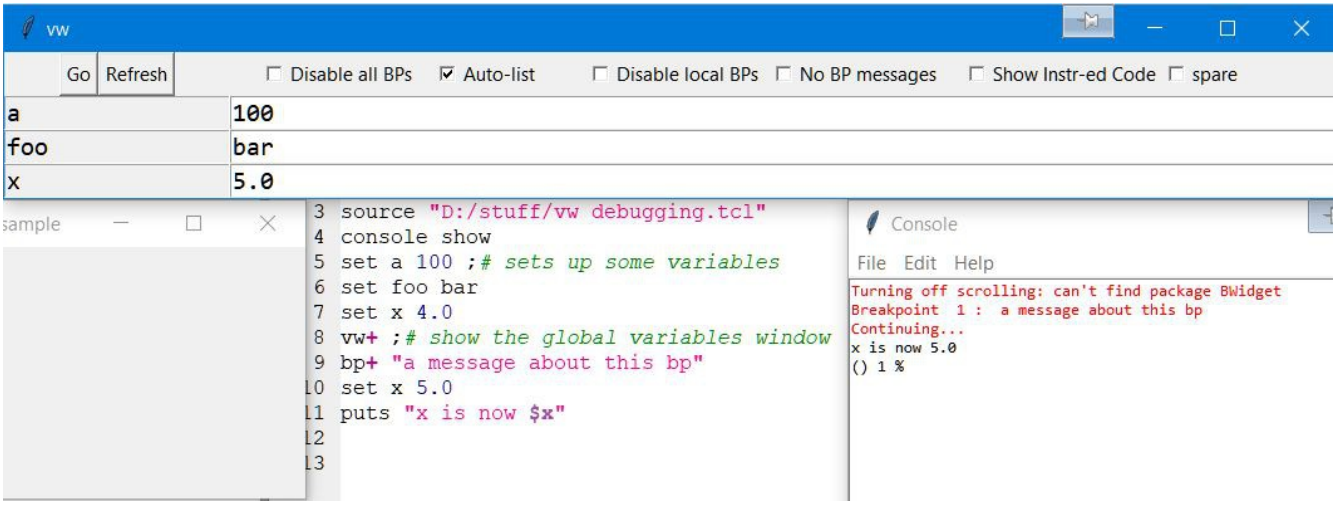
```
source {pathto/vw+source.tcl}  ;# loads the vw+ debugger
set     a 100     ;# sets up some variables
set   foo bar
set     x 4.0
vw+               ;# show the global variables window
bp+ "a message about this bp"
set     x 5.0
puts "x is now $x"
```

Running this program will result in a pause and the message in the first parameter (optional) would be shown on stdout (or the console). It might look like so (shown on top of a text editor window):



At this point you can continue by clicking the go button. This would set the value of x to 5.0 which you

will see in the variable window called vw since the vw+ command did not enter a window name. The puts statement will also have run, outputing its data to the console:



At this point, the program will have reached the end of the file, but will not exit, since it's a tk event program and it will pause in the event loop. You can check the variable windows to see the final values of the variables. The only other actions at this time would be to exit by closing the tk main window or you could type in commands to the console. You could also type exit to quit. ***Update note***: the spare checkbox is now a keep window on-top control.

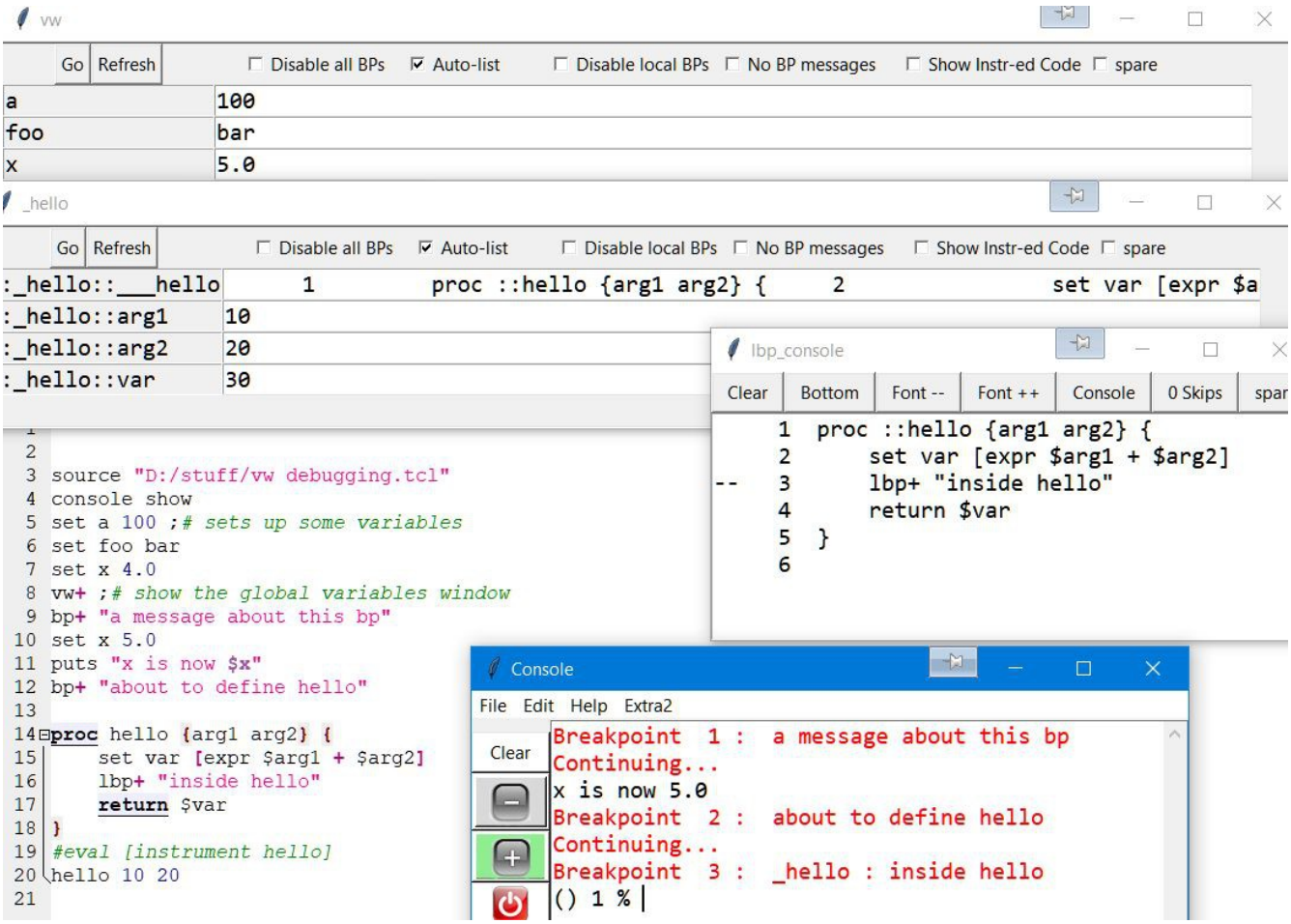
That is the simple method where there are no procedures. For procedures, with dynamic data it gets a bit more interesting.

Working with Procedures

Procedures are handled a bit differently. In that case, you would use the lbp+ command for a breakpoint instead. Suppose we now have defined a procedure “hello” like so,

```
source "D:/stuff/vw debugging.tcl"
console show
set   a   100     ;# sets up some variables
set   foo bar
set   x   4.0
vw+               ;# show the global variables window
bp+ "a message about this bp"
set   x   5.0
puts "x is now $x"
bp+  "about to define hello"

proc hello {arg1 arg2} {
    set var [expr $arg1 + $arg2]
    lbp+ "inside hello"
    return $var
}
hello 10 20
```

and when we run this, we click go 2 times. We would then see these windows:



* Note this is just a modified console, but otherwise its just the same. Ignore for now the commented eval command, it will be discussed below (since this screenshot it's been renamed instrument+).

What we see now, is that on reaching the lbp+ command with the label “inside hello” 2 more windows have appeared. One is called _hello (the _ is added by the debugger, explained later) and the other is called lbp_console. This method doesn't actually display the local variables, but rather it copies them into a namespace and then uses the namespace viewer command from vw+. The _ is added in case the user might want to have a namespace which is the same as the procedure.

Care should be taken modifying the namespace copies as there new values are now copied back to the local variables in the procedure hello. But not arrays and not the variable args.

The second window that shows up is used to list the current source code for the hello procedure. The “__” points to where the program has stopped on the breakpoint.

Note that the lbp+ procedure will need a unique comment, since that is how the debugger finds the current line to display the “--”. There can be a 3rd parameter to the lbp+ which would be used instead and should be a unique text string as well. This is also used when we get to the next section on instrumentation. **NOTE:** break-points are NOT recursive, do not call a procedure from the console

that invokes a break-point when the program is waiting at a break-point. bp+ break-points keep a level count and will ignore recursive calls. lbp+ recursive break-points could cause unpredictable results.

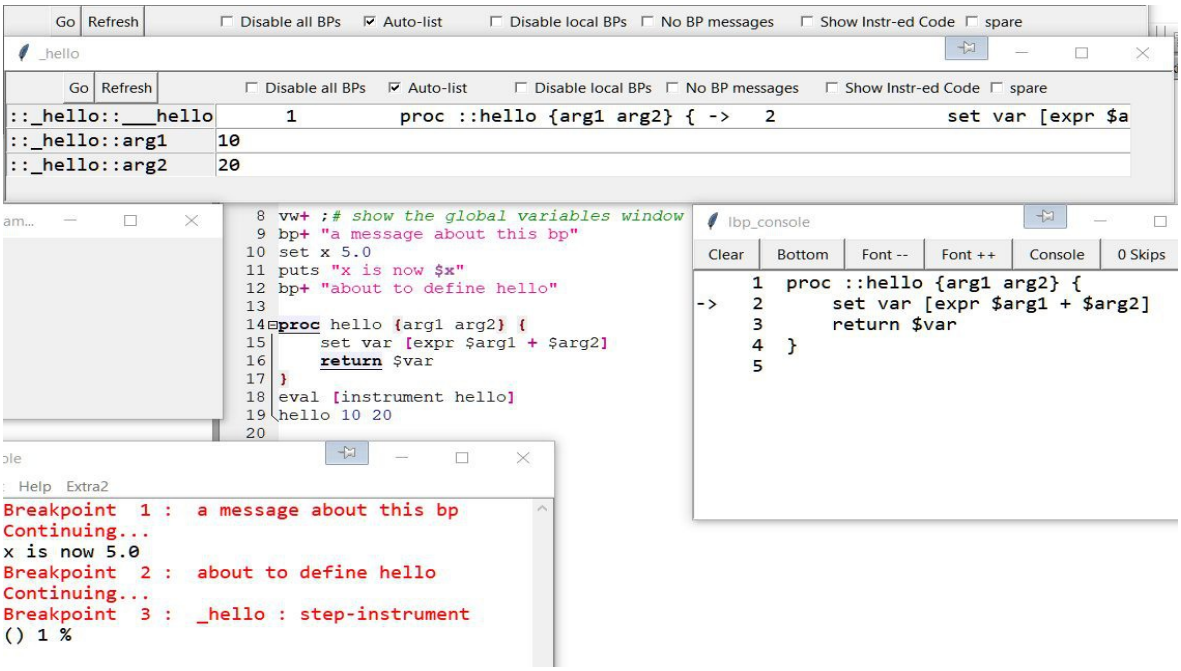
Instrumentation

Since it is sometimes useful to also single step a program, there is an experimental work in progress that can redefine a procedure by adding calls to lbp+ with a fixed comment but a unique id. The command [instrument+ <proc> ?options?] takes one argument, the name of a procedure, and using tcl introspection will add the breakpoints and produce a new procedure text that can be [eval]'d to replace the current definition. One uses this after the proc is defined, of course. The commented line in the above is how one would go about that.

Note there is one additional variable in the window, the first line __hello which holds the text of the procedure, with line numbers and the current position indicator. This can be clicked on and it will be written to stdout (console). If more than one proc are instrumented, and one calls the other, the last position in the procedure will be saved in that text. So, if you are stepping through a lower level proc, you can go back to the caller data window and click on the proc name and it will show you where you came from. There is only one window with the source code.

When the program is being debugged, the normal case is to hide the instrumentation, but there's a checkbutton that can enable it's display, in case the instrumentation was faulty. When you click on that checkbutton (show instr-ed code) you will have to step at least once for the extra code to display.

With instrumentation, one does not need to manually add breakpoints to the code. And when stepping, one will see a different indicator for the instrumented lines "->". The lbp+ command will call the debugger's vw+ command on each step. It will update variables but otherwise reuse the window. If the window is closed, the next step will create another one.



Here we see the lbp_console with a → instead of – and it stopped on the first statement. We also removed the manual break-point from previously, since we no longer needed it. In the text editor

window, we see that the [eval] statement has been enabled, and hello is called with 2 parameters. The window reflects those values, of 10 and 20. The reason the variables show up as ::_hello::arg1 and similarly for arg2, is that they have been copied to those namespace variables. It is those variables that are actually being displayed. Currently, if one types into those entry boxes, the values will appear to change, and they are reflected back to the locals they came from in the hello proc. As mentioned previously, that's only for scalars at present, and args seems special so it's not sent back.

Since single stepping can be tedious, the go+ command (abreviated g) takes an argument, a number of steps to go. So,

g 100

will run the program until 100 breakpoints have been reached. This is the total count and not just specific to the proc which was paused when you entered the command. There's no gui way to do this at present, you need a console to type into.

While it is automatically stepping, it delays updating the windows for performance reasons. The globals windows should remain updated, however.

If the value for g is negative, then a command such as,

g -30

will automatically single step until line 30 is reached. While stepping this way, the data will be updated and so giving an animated look at the program's progress. The code window will also be updated, and with smaller proc's there will not be scrolling either, so the pointer will just move rapidly. If you don't want a large loop to dominate, you can use the on/off (#enable #disable special comments) ability of the instrumenter.

There's now a new button (not shown in the screenshots above) called break. During the goto line or go a number of steps, this button will cause a break by zero-ing the number of steps remaining, or cancelling the go to line number. This should stop the program quickly.

When skipping with the go number of steps, it will report modulo 100 now. There is a command to change the modulo. See the util+ ensemble commands.

The checkbuttons are,

disable all bps – this will cause all breakpoints to be ignored. The one checkbutton is linked to all the others in any other data window.

Auto-list is on by default and causes the proc code window to be updated. If this is off, it will not, which might make the program run a bit faster. It's specific to that procedure only.

Disable all local bp's is a window and procedure specific option. It's a way to step out of a procedure. Windows that are not proc windows have no effect if that checkbutton is clicked.

No bp messages will suppress the message at a breakpoint as well as the continuing messages. Also

window specific.

Show instr-d code will (after at least one step) show the code in the text window along with the instrumentation. Window specific.

The Instrumentation process

The instrument+ procedure uses several [info] calls to reconstruct the procedures. For the most part, the same text is returned; however, there are some differences. The most important one is that line continuation is removed. This affects the look, but more importantly the line numbers. This is good and bad. The good is that the instrument+ proc doesn't need to worry about them, and the line numbers that are shown by the debugger will agree with line numbers in an error traceback report.

The bad thing is, well, it's not the true source code. But maybe that's not so important.

There is one other issue which is on-the-line comments. The instrument proc will generally append statements using a ;lbp+ step-instrument id###### with a long number so it doesn't accidentally appear in the code somewhere else. When there's a ;# at the end of a statement, appending to that will have no affect when the program is run. To counter that, the instrument proc has a regular expression in a regsub command that looks for ;# (or ;## or any number of #'s) with space or tab around it. But it also specified negative look-ahead for a following double quote, which would indicate that the ;# is likely inside a pair of quotes. So, if there's a double quote on the line following the ;# then the instrumentation will not be done for that line. Also, if there's no white-space before and after or between the ; and the # it won't work. All that really means is that there will be some statements that don't stop on the stepping. The show instrument code option can be used to see if that's the case or not. The user might add a manual lbp+ break-point if one really needs to stop there.

Also, this instrument-er assumes a certain coding style. Control structures all expect to look like a style that is popular with tcl developers. For example, a foreach loop and a multi-way if would look like so,

```
proc {} {              ← instrument here
  foreach item list {   ← instrument here
    …                    ← instrument here for mostly all simple statements completely on 1 line
  }                      ← instrument here

  if {condition} {       ← instrument here
   …
  } elseif {condition} {← instrument here
   …
  } else {               ← instrument here
   …
  }                      ← instrument here
                        ← do not instrument here on a blank line
# comment              ← do not instrument here on a comment (trims on left)

  puts “this is a test ;# of a string”  ← do not instrument ;# followed by a “
  puts “this has a comment on line” ;# comment  ← instrument  before this → ;#
}
```

So, the open braces are at the end of the line, rather than on, say, the next line. However, to do that

would cause a tcl error, so maybe it doesn't really matter, as the opening brace, if on the next line, would require that a backslash were placed on the line with the foreach or if statements. Then the introspection would return the proc body as though the newline (and the \) were not really there. But it's worth mentioning, since it's not that easy to parse a tcl program. It does use [info complete] however.

There is a problem with switch statements and if used, one cannot instrument them between the cases in the switch, since they get interpreted as another case in the switch, and worse, one that has no body. So, the code can't attach a breakpoint at the end of a } which is normally the case. For that, there is one option, so one can call the instrument as follows:

instrument+ procedure ?-norb"

which is short for no right brace. If this must be used, then one can manually add breakpoints at the places they won't occur. For example,

In the below proc , the only possibility is to manually add breakpoints and set the -norb option. It's ok if a manual breakpoint is appended with another breakpoint, it will just take 2 go's to continue and you will be able to tell since the current line indicator will change from → to – . If a switch statement is found while processing, the -norb switch will be automatically turned on from that point on.

```
    proc range {cmd {arg {}}} {
        global RANGE
        switch -- $cmd {
            "max" {
                set RANGE(max)     $arg
                set RANGE(current) -1
            } ← cannot have a statement here, it will be considered the next case
            "next" {
                upvar $arg var
                incr RANGE(current)
                set var $RANGE(current)
                if { $var < $RANGE(max) } {
                    return 1
                } else {
                    return 0
                }
            } ← nor have one one here
        } ← this is the end of the switch, you can have one here, but we can't tell
    }
```

There are some bugs in the instrumentation. If it finds code like this,

```
if {…..
        || ….
        && …
    } { …
}
```

Where there are no \ continuation escapes, the debugger will crash. So, if this happens, the only workaround at present is to add the \ to the lines. In the debugger, and in tracebacks, the escapes are

removed and the the code appears different, but it is still functionally the same.

One other problem can occur. If one writes a new control command, say, a python like for loop with an else clause, then the instrumentation will become part of code block that would be run inside the new control command, not the proc it was intended for. One must use the #disable+ option here (see next section). Break-points can still be inserted, but not in code that will be interepted (usually with an uplevel) in a different procedure.

If all else fails with instrumentation, there are now 2 special comments that can be used around some code to turn of instrumentation:

#disable+
#enable+

These are not nest-able, they do not keep a level count, simply disable at a point and enable at another. If you use the enable, you will not see it in the code, but only a blank line unless you turn on show instrumentation. Due to the way they are implemented, if you use #enable, you should add a blank line following it, since it will not stop on that line. Show the instrumentation to see why. (fixed now)

In order to make the breakpoint counting as accurate as possible, along with the go to line command, blank lines and full line comments are now also instrumented unless turned off as above.

Conclusion

This has described a tool that is intended to be a small and simple debugger. It 's roots began with a short snippit of about 12 lines of tcl code written by RS (Mr. Wiki). It's obviously grown some, but the core idea of using labels and entry widgets with an associated variable is still the core of the vw+ system.

Well, that's it for this tutorial introduction to the vw+ debugger. Hopefully you will find it useful.

Appendix

Command parameters

vw+ pattern/list window width

The vp+ command has built in help using the "?" option, as shown below:

```
% v ?
vw+ pattern   window   width   - patterns are [string match] type
vw+ {a list}  window   width   - alternate form, with list of >1 variable names
   pattern   * => all globals   ** => only user globals (the default)
             text  => text* can also use glob with [abc] etc. * always added to end
             foo:: => foo::* vars, not globals but namespace variables only
   width     width of entry widget with variable data, defaults to 80
   window    default to .vw, can use several windows at same time
   {a list}  a list of specific variables, can be undefined

   Any parameter can be a . = shorthand for default, none are required
   Note: the patten parameter cannot look like a list of > 1 element
         it must be in {}'s to use the [ab] string pattern

   On first call to vw+, BWidget's is loaded if possible to support scrolling
   if it's not available, will fall back to a single window which could be too large
```

bp+ message nobreak nomessage

This is not designed to be typed into a console. It is only to be placed in the user program where one wishes the program to pause. It is the lowest level break-point command. It does the waiting, but also checks to see if there are any windows to be refereshed when it is reached. The refresh is to update array variable indices that are displayed in a global or namespace display window.

It has 3 parameters. Only the first one is expected to be used when this statement is placed in the user program. The 2nd and 3rd parameters are for use when called by the lbp+ procedure.

message	This is a text message that will appear when this break-point is reached If there's no message, * will be displayed
nobreak	A flag used to indicate don't pause, but it will do some other work. 0 by default
nomessage	A flag to suppress messages, used when the checkbox to suppress BP messages is checked and is 0 by default

lbp+ message ID

This is not designed to be typed into a console. It is only to be placed in the user program where one wishes the program to pause.

It has 2 parameters. Both are optional; however, the code window will very likely get confused as to what line this break-point was on, and could display many such indicators. Best to have something.

message	This is a text message that will appear when this break-point is reached If there's no message, * will be displayed
ID	An identifier to be used that must be a fixed string (not a varible) that is used by the single stepping to display an indicator of the current line. If not present, will use the message in the first argument. These are generated uniquely by the instrument+ procedure

go+ skip window

This is used to continue from a breakpoint.

Skip	This is the number of breakpoints to skip over, it defaults to 0. If this is a **negative** value, it means run until this line number. It can be triggered with a double click of the line number in the code window as well.
window	for future use, internal only

instrument+ procedure -norb -revert...

This is used to create an instrumented version of a proc.

procedure	This is the name of the proc to instrument or to revert to if previously instrumented

options:

-norb	Do not instrument at right braces (has no effect if -revert is used)
-revert	Revert to a non-instrumented procedure

This command returns the source code of the specified procedure such that it can be eval'd to replace the procedure. Obviously, care must be taken when to do this. The statement would look like,

eval [instrument+ hello]

To revert is the similar, and you supply the same proc name:

eval [instrument+ hello -revert]

It does not keep more than one copy of the original code, so you can't run it twice (and will check for that now), since that would add many extra break-points to the code. While you can type this into the console, you would more likely include it in the program.

The most recent version now checks for manual lbp+ statements and does not instrument them. But this is only for those at the beginning of a line.

util+ sub-command args...

This is a utility procedure that has several ensemble sub-commands. The args depend on the particular sub-command used.

subcommands:

lp <proc> This can be used to view the current source code, it takes on argument which is the name of a proc to show the source code for. It can be used to see the results of a call to instrument+ This now no longer outputs to stdout, but returns in a functional way to the caller. If entered in the console it will display the code, but can also be used to modify code. For example,

eval [regsub courier... [util+ lp someproc] {consolas 12 }]

This will retreive the proc *someproc*, run a regsub on the code to change the font name and size (the 3 dots are regex dots, may need to place in braces), and then replace the original proc. Naturally, you need to be certain you know what you are doing here. Run in the console without the eval first to check the results.

smod N Set the modulo on how often to output skip remaining counts, also in config

clean closes all the data windows

? show little help message

Configuration

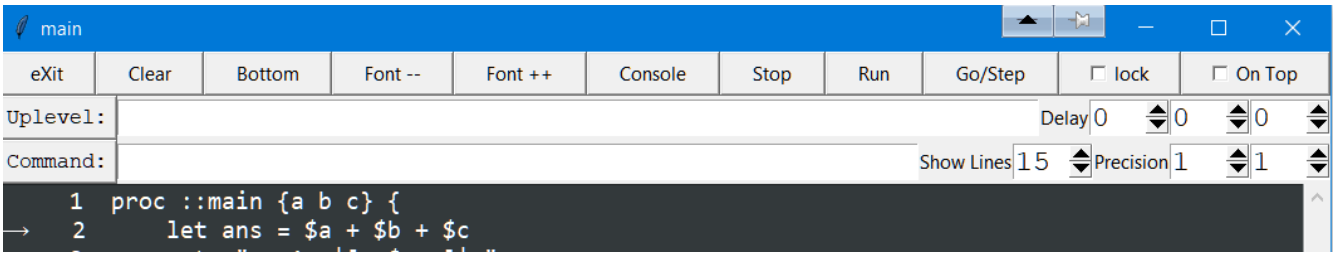
Since this is all just one single .tcl file, and this is for programmers, editing text is no biggy, so all options are simply changed in this section at the top of the file.

```
# --------------------------------
# C O N N F I G U R A T I O N begin
# --------------------------------

set ::___zz___(proc_wid) 15           ;# the number of lines to show on either side of a breakpoint line
set ::___zz___(auto_list_default) 1   ;# this sets the auto list checkbox to this value at first creation of checkbox
set ::___zz___(bp_messages_default) 1 ;# this sets the no bp messages checkbox to this value at first creation of checkbox
set ::___zz___(tooltips) 1000         ;# if > 0 tooltip enabled and set delay, if the package require fails, it will report
                                      ;# and work w/o it, 0=don't use, value is in ms.
set ::___zz___(console_hack) 1        ;# if 1, modifies console: empty <cr> line on console, repeats last command
set ::___zz___(use_ttk) 0             ;# if 1, some of the windows use the themed ttk
set ::___zz___(max_size) 3000         ;# the maximum size of a variable to monitor
set ::___zz___(skip_modulo) 100       ;# when using a large skip count on go+ how often to update skip messages
#set ::___zz___(bwidget) 0            ;# uncomment this if BWidgets are not wanted, leave undefined and it will
                                      ;# try to use it (do not set to 1 here)


interp alias {} v {} vw+ ;# shorthands since we might be typing these, optional
interp alias {} g {} go+
interp alias {} u {} util+

# ------------------------------
# C O N N F I G U R A T I O N end
# ------------------------------
```

The vw+ command can modify the console (on it's first call) to make a null command be a repeat of the previous command. This lets one use the go+ command by holding down the enter key to repeat for rapid single stepping. This is one of the options that can be user configured by editing the file in the top section. It is off by default now since the one line command entry supports repeat of last command in a similar fashion.

These initialization statements provide a way to configure certain options. Just edit the one file at the top to customize a handful of parameters. It will try to use the BWidgets package to add scrolling to frames, but can work without it, But of course it also needs Tk. It now also attempts to include the tooltip package, but can work w/o that as well.

Recently Updated Screenshot and Tips



Since the tutorial section was created, there've been some changes to the program source code window. Notice the dark mode for the code itself, which can be adjusted or changed in the configuration section in the source code.

There is now a Stop button, to stop when a go+ command is running (positive values mean N breakpoints to skip, negative values indicate a line number to stop at). The 3 delay spinboxes, can be set to a number of milliseconds to delay at each break-point that is being skipped when using the go+ command, in 100's 10's and 1's. It understands the mouse wheel and one can enter a specific (valid) integer. Precision is how many instructions per break-point, in 10's and 1's. Show lines is the configuration parameter for the number of lines to show around the current line.

The 2 buttons (Uplevel and Command) are both a label and an action: which clears the entry widget on their right. The uplevel allows executing commands in the context of the proc where the break-point was issued, and it's return value is sent to the console (stderr). The command entry is for executing commands globally, similar to the console, except it does not automatically output any values. The command must do that. Or one must use a puts [some-command].

Both entry boxes support a 50 command history available using the up/down arrows. An empty line (i.e. just the enter key or the keypad equivalent) will repeat the last command. This replaces the need for the console hack.

If the go+ value is positive, i.e. skipping break-points, it is engineered to run as fast as it can, while reporting every so often that N break-points remain. If the value is negative, and it's a line number to skip to (which can be set by double-clicking a line number), it will run much slower, on purpose.

To start automatic single stepping, one can enter a large line number (that will never be found) to just start the animated stepping. This should work with non-instrumented procedures as well, if they use the lbp+ break-point in the code also.

The uplevel entry now works, however, do NOT try to set a variable that way (except a new variable) since on the next go from the break-point it will restore the values from the data window. So, to change a variables value, do it there.

The refresh button only refreshes array indices, shift-refresh will re-run the command that created the window, and so update to any new variables specified in the pattern match.

Still need some tooltips however, for the data windows. That's a todo item.

Even this screenshot is not quite up to date, as it, and the variables windows now both have a stay on top check-box.

The Refresh button in data windows now completely redraws and populates the window using the same command originally used. So, if it had a pattern, then more (or less) variable might appear as well as all values will be updated.

The vw+ command will accept array(element) when using the {list1 list2...} form of the command, and will preserve the order in the list, instead of sorting alphabetically, as it does in other cases with a pattern being entered.

The lock checkbox will keep the current set of lines in display rather than scroll to the line.

Performance Considerations

As with any debugger, especially one where extra statements are added to the source code, there is the potential for a performance hit. Here are some tips.

Don't display too many variable windows

The biggest performance cost is likely to be from the variable display windows. They monitor changes to variables by using the Tk -variable option to cause the entry widgets to be updated when the variable in the left column (either a global or a *variable* from a namespace) is modified. Careful use of the pattern matching argument to vw+ can be used to reduce the variables being watched. However, in a procedure, this is not an option as all *local* variables will be displayed (hence the name lbp+). To many variable windows will very much slow down the g -N command when it's used to antimate the code.

Only instrument procedures you want to single step

The instrument+ procedure is completely dynamic. It can be used at any time, so if you don't want or need to single step a procedure, don't use it until it's needed. And it can be removed also.

Use the disable all break-points toggle

There is much less overhead when this is set. It will check for this at the beginning of a call to both bp+ and lbp+ and do an immediate return. While it's not documented explicitly, the variable that is being checked for is,

set ::___zz___(cb1) 1 ;# 1 to turn off all break-point code, 0 to re-enable

So, one can turn this on and off from the user program if desired. It's the same variable that is used to monitor the first checkbutton in each of the data windows. It's a 0/1 where 1 means don't break.

Use only bp+ and not lbp+

lbp+ is for breakpoints in a proc where you want to see the code in a window, and have it update when you reach another lbp+ breakpoint. The instrument+ procedure places lbp+ break-points into the program and is intended for when one is interactively single stepping, where performance should not be an issue. bp+ break-points are more efficient, but only pause the program and don't show any source text in a window.

Close variable display windows when not needed

When you close a variable window, since it's a toplevel, all widgets and -variable associations are removed by the Tk system. You can always add them again if you are using a console.

Add a console show button to your program

Make use of the console. On Linux, you can get the console.tcl file from the Wiki and use it to give you the console command. I've TIPed this for linux so it would become part of the core, but that has not yet been approved. If you have a gui program, add a button or a menu item to do a “console show” so you can make adjustments. The debugger is designed to take advantage of the console. After all, it really just another text widget. And it allows for interactive execution of commands and procedures.

Use go+ with a large skip count

When this command is used, it will only update every N steps. The “u smod” command can be used to set the modulo on when to show a message which will also affect how often the data displays are updated. There's a button break, that can clear the remaing steps to stop the program at the next step. That button also causes a go to line to be zero'd so the program should stop after the next step.

(the end – ignore these extra paragraphs – just there to aid adding more)

vrequirements h

- Needs only core tcl/tk 8.6+ functions and optionally Bwidgets and tooltip, works with 8.7a4
- Small footprint: pure tcl/tk, 6 procedures and 1 global variable in 1 file

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vw+ pattern/list window width

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