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HEW Tcl/Tk

Application Note

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HEW Tcl/Tk
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**Tcl/Tk Overview in HEW**

A script language, Tcl/Tk is supported in HEW (High-performance Embedded Workshop). The targeted version is Tcl/Tk version 8.4.1.

Tcl/Tk is comprised of class member “Tcl” (Tool Command Language) of script language and “Tk” (Tool Kit), which is used to program graphical user interface. The script language Tcl/Tk do not need compiling, and the results of execution of the program are reflected immediately.

Tcl has a grammar, which makes simple programming possible. Tcl is used for an application of Stand Alone, and can be built in application programs. Tk makes it possible constructing GUI suits the needs of users promptly.

HEW supports Tcl/Tk. The functions and GUI prepared by default in HEW are usable, and also GUI environment can be customized to meet the users’ individual needs by programming in Tcl/Tk.
1, Use of Tcl/Tk

1-1, Start up of Tcl/Tk

This chapter describes how to use Tcl/Tk commands in HEW.

Select “View” – “TCL Tool Kit” from HEW command menu. Console window and GUI window, which supports programming in Tcl/Tk are started. You can program in Tcl/Tk using these windows.

Console window

You can program in Tcl/Tk and execute it using interpreter on Console window. You can also load script files made in advance and execute them.

GUI window

The result of execution of the program on Console window is reflected on GUI window. Toplevel window is prepared in HEW by default. Additionally, you can create GUI window newly aside from Toplevel window.
1-2, Execution method of Tcl/Tk
You can execute Tcl/Tk on HEW according to the following 3 methods.

- Interpreter method
  You can assign commands of Tcl/Tk on Console window, when you program in
  interpreter method. The assigned commands of Tk are reflected on GUI window at the
  time of Tcl/Tk Tool Kit is started up.

For example: In case of that a program execution command of HEW
  "go" is assigned on a button.

Figure: Programming in interpreter method
 Execution of loaded script file
You can program in Tcl/Tk using script file in advance, and load the file on console window. “Select a file to source” window is opened by selecting “File” – “Source” from command menu of Console window. Specify the Tcl/Tk script file created in advance after the window is opened.

Figure: Tcl/Tk source file selection

~ description in sample.tcl file ~
pack [ button .go –command {go} –text {go} ]

Figure: After source file selection
Programming in the script file is reflected on Console window after source file selection.
Execution using both of interpreter method and script load method

After loading a script file created in advance, you can add programs to the script file in interpreter method.

For example: Add reset command of HEW "reset"

Figure: Program addition
2, Basic Programming method in Tcl/Tk

2-1, Programming method in Tcl

2-1-1, Basic Grammar

Tcl has very simple grammar. Built-in commands of Tcl and procedures created by user are used as commands in Tcl programming. You can separate a command and arguments required for the command with a space, and construct one execution format. You can also separate them by starting a new line, or with a semicolon in order to describe complicated execution format.

Basic Grammar 1: List arguments by separating with spaces.

Command arg1 arg2 arg3 …

Basic Grammar 2: Separate with semicolon(;) in case of listing several commands on one line.

Command arg1 arg2 arg3 …; Command arg1 arg2 arg3 …

Basic Grammar 3: Use ¥ sign in case of listing one command in a few lines.

Command arg1 ¥
arg2 arg3…

Basic Grammar 4: Use # sign in case of describing comments.

Command arg1 #comments

Build-in command of Tcl and procedure created by user are used as commands. Arg is argument, which is required for built-in command of Tcl and procedures made by user.
2-2, Built-in command of Tcl

This chapter describes built-in commands prepared in Tcl. Built-in commands introduced in this chapter are minimum necessary for programming.

2-2-1, Variable

Variables in Tcl do not need declaration of the types before using. You can name them as you want. You can also set a value to the variable, and refer to a value of the variable in Tcl programming.

```
set count 100
```

Set 100 for variable “count”

A value of variable “count” is referred by inputting `set count` on Console window.

Figure: Setting and referring of variable

You can also set string for variable as you want in Tcl

```
String can be assigned to variable.
"$var" is used for variable substitution.
```

Figure: Assignment of string to variable
2-2-2, Array

Array can be used in Tcl. You can assign variable to each element of an array, and also to the entire of an array at one time.

![Array](image)

An assignment statement “set ary(0)” can be used, in case of assigning a variable to each element of an array.

An assignment statement “array set a{}” can be used, in case of assigning variables to the entire of an array at one time.

2-2-3, Arithmetic operation

Integer operation, floating-point operation and comparison of inequality can be executed in Tcl by using `expr` command. Operators and mathematical functions are prepared in Tcl as built-in commands.

![Arithmetic operation](image)

- `expr 100+20` Return the result of 100+20
- `expr 100/20` Return the result of 100/20
- `expr 100>20` If the inequality expression evaluates to true, “1” is returned, and if it evaluates to false, “0” is returned.

Random number function and trigonometric can be also used as arithmetic functions.

![Arithmetic operation](image)
The following lists show you operators and functions supported in Tcl, and what they stand for in Tcl.

### List: operators

<table>
<thead>
<tr>
<th>Signs</th>
<th>Meanings</th>
</tr>
</thead>
<tbody>
<tr>
<td>-, +, ^, !</td>
<td>Minus sign, Plus sign, complement, negation</td>
</tr>
<tr>
<td>*, /, %</td>
<td>Multiplication, division, remainder</td>
</tr>
<tr>
<td>+, -</td>
<td>Addition, subtraction</td>
</tr>
<tr>
<td>&lt;&lt;, &gt;&gt;</td>
<td>Left-shift, right-shift</td>
</tr>
<tr>
<td>&lt;, &gt;</td>
<td>comparison in Boolean expression</td>
</tr>
<tr>
<td>&lt;=, &gt;=</td>
<td>(greater than or equal to, less than or equal to)</td>
</tr>
<tr>
<td>==, !=</td>
<td>Equal sign, inequality sign in Boolean expression</td>
</tr>
<tr>
<td>Eq, ne</td>
<td>Equality, inequality in Boolean expression (used in strings)</td>
</tr>
<tr>
<td>&amp;, ^</td>
<td>Bitwise AND (AND), bitwise exclusive OR (XOR)</td>
</tr>
<tr>
<td>&amp;&amp;,</td>
<td></td>
</tr>
<tr>
<td>x?y:z</td>
<td>conditional</td>
</tr>
</tbody>
</table>

### List: functions

<table>
<thead>
<tr>
<th>Functions</th>
<th>Meanings</th>
</tr>
</thead>
<tbody>
<tr>
<td>Acos, cos, hypot, sinh, asin(), cosh(), log(), sqrt(), atan(), exp(), log10(), tan(), atan2(), floor(), pow(), tanh(), ceil(), fmod(), sin()</td>
<td>Mathematical functions</td>
</tr>
<tr>
<td>abs(arg)</td>
<td>Absolute value</td>
</tr>
<tr>
<td>double(arg)</td>
<td>Double-precision value</td>
</tr>
<tr>
<td>int(arg)</td>
<td>Integer value</td>
</tr>
<tr>
<td>Rand()</td>
<td>Random number value</td>
</tr>
<tr>
<td>round(arg)</td>
<td>Round value to integer</td>
</tr>
<tr>
<td>srand(arg)</td>
<td>Initial value of random number</td>
</tr>
</tbody>
</table>
2-2-4, Double-quotation marks and Curly brackets

An enclosed string within double-quotation marks " or curly brackets {} is treated as one string in Tcl.

Figure:  Double-quotation marks and curly brackets

2-2-5, Assignment of Commands

An enclosed string within square brackets [] is treated as one command in Tcl.

Figure: Assignment to command

An enclosed string within square brackets, [expr 100/20] is treated as one string in Tcl, and set command outputs “5” as the result. Additionally, expr 100/20 should be assigned to a command since set command is being used. Therefore, the same result is output by executing set command. In addition, it becomes an error, in case of not enclosing expr 100/20 within square brackets "[]".
2-2-6, Input-Output Format
Scan command and format command are prepared as I/O command in Tcl. These commands are equivalent to scanf and printf in ANSI. Additionally, you can define a style of the format using “%”.

![Figure: Input-output format]

Scan 3.1415926 “%d.%d” int float is equivalent to scanf in ANSI. Scan command scans whole part “3” and fractional part “1415926” of 3.1415926 into int and float variable each. Additionally, it returns 2 (number of times of input values) as the result of the execution.

Format “%d.%d” $int $float is equivalent to printf in ANSI. The command returns 3.1415926 as the result of an execution.

2-2-7, Description of Comments
In case of describing comments in script files of Tcl, add “#” at the head of a line. Additionally, you will add “;#” at the head of the comments, in case of inserting comments into mid-line.

![Figure: Description of comments]

Descriptions after “#”(at the head of a line) and “;#”(at the middle of a line) are treated as comments.
2-2-8, Procedure

In Tcl, a row of commands can be treated as a function of C language. A function called “procedure” can be used as a built-in command in Tcl.

Procedure can be created as a function, which gets 0 or more arguments by using the proc command. Defined variables in procedure are treated as local variables, and can be referred only in the procedure. Moreover, definition of global variable is required in procedure, in case of referring to global variable in the procedure.

Example of how to create “procedure”

```
~Sample Program~
set count3 100 ;#Assign 100 to variable count3 as an external variable
proc add {count1 count2} {  ;#Accept the argument count1 and count2
    global count3 ;#A global definition is required to refer to count3
    return [ expr $count1+$count2+$count3]
    #Define a value returned by procedure add
    #using return command
}
add 200 300 ;#Use procedure add
```

When the sample program is written, procedure add is called, and “600” is returned as the result of “add 200 300”.

If a description extends to a few lines, a prompt is replaced with “>” till the last line of the description (in the sample program, it extends from “{“ to “}”of procedure add), and data input is possible.

It becomes an error, in case of referring to variable count1, count2 in the procedure.

Figure: Creation of procedure
2-2-9, Control structure command

Tcl supports the essential control structures exist in the other high-level languages. The control structure commands are while, for, if, if...else, switch, foreach, etc.

- Example of how to use “while”

```tcl
set i 0
while { $i < 10 } {
    puts [ expr $i+$i ]
    incr i
}
```

Enclose conditions for while sentence in curly braces "{}".

- Example of how to use “for”

```tcl
for { set i 0 } { $i < 10 } { incr i } {
    puts [ expr $i+$i ]
}
```

Three conditions for “for” sentence are required to be enclosed each in curly braces "{}" in Tcl. (These conditions are described as (A;B;C) in C language.)
Example of how to use “if…else”

```plaintext
set val 1
if { $val == "0" } {
    puts 0
} else {
    puts 1
}
```

Enclose conditions for “if” sentence in curly braces “{}”.

Example of how to use “switch”

```plaintext
set val 1
switch $val {
    0 { puts 0 }
    1 { puts 1 }
    default { put 9 }
}
```

Enclose commands to be executed when the conditions are met in curly braces “{}”.
Example of how to use “foreach”

```bash
foreach i { 1 2 3 4 5 } {
    puts $i
}
```

Continue and break can be used in while, for and foreach sentences.

```bash
for { set i 0 } { $i < 10 } { incr i } {
    if { $i == "5" }{
        break ;#Break is usable
    }
    puts $i
}
```

When “i” is equal to 5, break command is enable, then bypass for loop
2-3, Programming methods in Tk
2-3-1, Basic Grammar

Widget (a supported component of GUI in Tk) is defined and allocated on GUI window, which is newly created by user in Tk programming.

Definition of widget must be described by separating "widget", "path" and "option" with blank spaces in grammatical rule of Tk programming.

    widget .path –option1 –option2 –option3 …

A path name must be started with period ".". "path" command is generated after an execution of widget command. You can allocate the "path" command on the newly created GUI window.

    pack .path

".path" command can be allocated on GUI window by using pack command, which is used to allocate "path" command.

It is possible creating various environments suit the specific needs of users in Tk programming.
2-4, Widget in Tk
2-4-1 Creation of Button

Button can be created by using button command of Tk.

```
button .test -text test -command {puts "Well come!"}
pack .test
```

In the above sample program, a button named “test” is created. Name of button can be specified in -text option. A command to be executed when the button is clicked can be specified in -command option. Therefore, the command enclosed in curly braces “{}” is executed, and output “Well come!” on Console window, when “test” button is clicked.
2-4-2, Creation of Check button

Check button can be created by using checkbutton command of Tk.

```
set test 1 ;#Set “1” to variable “test” as an initial value.
checkbutton .test –text test
pack .test
```

Create a check button with path name ".test", and set an initial value “1”. By setting the initial value “1”, the checkbutton is checked by default setting.

When the checkbutton for “test” is cleared, and refer to a value of “test” by set command, it turns to “0”.

Figure: Creation of checkbutton

In the above sample program, a button named “test” is created. A name of the button can be specified in -text option.

Additionally, the initial value “1” is set to the variable “test” by using set command.
2-4-3, Creation of Radiobutton
Radiobutton can be created by using radiobutton command of Tk.

```python
set select test1  ;#Checkbutton for test 1 is checked by default setting
radiobutton .test1 -text test1 -variable select -value test1
radiobutton .test2 -text test2 -variable select -value test2
pack .test1
pack .test2
```

When the radiobutton for test2 is clicked, test2 is replaced as a selected value in –variable option.

Figure: Creation of radiobutton

A -value of checked button is passed to a variable select, which is selected in –variable option. In the above example program, because “test1” is selected as variable select when the radiobutton is created, the radiobutton “test 1” is checked by default setting. In addition, by naming the variables of multiple radiobuttons specified in –variable option the same, checkboxes are checked exclusively.
2-4-4, Creation of Label
A single line message can be displayed on GUI window by using label command of Tk.

```
label .text –text “Well come!”
pack .text

set text “Good bye!”
label .text_var –textvariable text
pack .text_var
```

![Figure: Creation of label](image)

A selected string in -text option of label command is displayed on GUI window.
In addition, it is possible displaying a string, which is set to variable test in advance using –textvariable option.
2-4-5, Creation of Message
A few lines message can be displayed on GUI window by using message command of Tk.

```python
message .message –justify left –text “The message of two or more lines can be displayed by using the message command of Tk.”
pack .message
```

Figure: Creation of message

A few lines message can be displayed by using message command, although only a single line message can be displayed by using label command.
In addition, in case of that a command message is too long to input on a line, you can start a new line using “\n”. 
2-4-6, Creation of Entry

Output dialog can be created by using entry command of Tk.

```
set val "Well come!"
entry .text -textvariable val
pack .text
```

“Well come!” is set as an initial value of variable val by using set command. Therefore, “Well come!” is displayed by default, when the input dialog is created.

When “Good bye!” is input in the input dialog, the input string “Good bye!” is reflected in variable val.

Figure: Creation of entry

Input dialog created using entry command can accept a single line string and no more. The input string is reflected in variable val, which is specified in -textvariable option.

In case of creating an input dialog, which can accept more than a single line string, you can use text command prepared in Tk. In addition, text command offers you a diversity of options. By using those options, you can create simple editor also.
2-4-7, Creation of Spinbox
Spinbox with scroll bar can be created by using spinbox command of Tk

```
spinbox .cnt –from 1 –to 10 –textvariable var –increment 1 –wrap yes
pack .cnt
```

Figure: Creation of spinbox

You can specify the range of the settable values in the spinbox using –from and –to options of spinbox command. You can also specify the interval between the values, which is displayed in the spinbox using –increment option. The specified value is reflected in variable val specified in –textvariable.

Additionally, in case of selecting “yes” in –wrap option, the value circulates among the range of the values you specified in –from and –to options. (For example; 0 ~..~ 10 ~ 0 ~..~ 5 )
2-4-8, Creation of Frame

Frame can be created by using frame command of Tk.

```plaintext
frame .frame1 –bd 2 –width 100 –height 20 –relief raised
pack .frame1
frame .frame2 –bd 2 –width 100 –height 20 –relief sunken
pack .frame2
frame .frame3 –bd 2 –width 100 –height 20 –relief flat
pack .frame3
frame .frame4 –bd 2 –width 100 –height 20 –relief ridge
pack .frame4
frame .frame5 –bd2 –width 100 –height 20 –relief solid
pack .frame5
frame .frame6 –bd2 –width 100 –height 20 –relief groove
pack .frame6
```

A newly created GUI window by user can be arranged using frame command. The allocation method of widget to frames is described in a later chapter.

You can specify the size of a frame in --width and --height options of frame command. You can also change the shape of a frame in relief option.
2-4-9, Creation of Labelframe

Labelframe can be created using labelframe command of Tk.

```
labelframe .frame1 –text label1 –bd 2 –relief groove –width 100 –height 50
labelframe .frame2 –text label2 –bd 2 –relief solid –width 100 –height 50
pack .frame1
pack .frame2
```

Figure: Creation of labelframe

A newly created GUI window by user can be arranged using labelframe command as well as frame command. The difference of frame command is that you can name the frames using –text option.

In addition, you can specify the size of a frame in –width and –height options of labelframe command as well as frame command. You can also specify the shape of a frame in relief option of labelframe command as well as frame command.
2-4-10, Allocation of widget to frame/labelframe

You can allocate widget of Tk to frame/labelframe created in Chapter 2-4-9,2-4-10.

```
frame .frame1 -bd 2 -width 100 -height 20 -relief groove
labelframe .frame2 -text label -bd 2 -width 100 -height 50 -relief solid
pack .frame1
pack .frame2

button .frame1.test1 -text test1 -command { puts "Well come!" }
pack .frame1.test1
button .frame2.test2 -text test2 -command { puts "Good bye!" }
pack .frame2.test2
```

In case of allocating widget of Tk to frame or labelframe, the path name is different from ordinary.

In the above sample program, buttons are allocated to the frame and the labelframe. The path name of the frame is ".frame1", and the path name of the labelframe is ".frame2". Therefore, the path names of allocated buttons to the frame and the labelframe are specified as ".frame1.test1" and ".frame2.test2" each. These path names mean that the button ".test1" is allocated to the frame ".frame1", and the button ".test2" is allocated to the labelframe ".frame2".

Additionally, in case of not using the path names of frame or labelframe but the path name of
widget of Tk, widget is allocated outside of the frame or the labelframe.

```
labelframe .frame –text label –bd 2 –width 100 –height 50 –relief solid
pack .frame

button .test –text test1 –command { puts "Well come!" }
pack .test
```

![Figure: Example of widget allocation](image)

~Supplementary information~

`. (period)` used in path name of Tcl/Tk shows the route. By allocating frames and
labelframes to the route, the path names in GUI environment shows the layered system

For example:

<table>
<thead>
<tr>
<th>Path name</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>.top</td>
<td>top of GUI environment</td>
</tr>
<tr>
<td>.top.frame1</td>
<td>a path name of frame1 allocated on top</td>
</tr>
<tr>
<td>.top.frame2</td>
<td>a path name of frame2 allocated on top</td>
</tr>
<tr>
<td>.top.frame2.subframe</td>
<td>a path name of subframe allocated on frame3</td>
</tr>
</tbody>
</table>
2-4-11, Creation of New Top Level Window

Top level window can be created newly using `toplevel` command of Tk.

```
toplevel .main
wm title .main "TOP LEVEL"
wm geometry .main 200x200+100+100; update
wm maxsize .main 1028 512
wm minsize .main 128 1
```

In the above sample program, a window is created newly besides the window prepared in HEW by default by using `toplevel` command. The title and size of the new window can be specified using `wm` command.

In case of allocating widget of Tk on the new window, the path name must be started with ".".

Additionally, the new window can be deleted by `destroy` command (destroy .path name).
2-4-12, Creation of Menu

Tool menu can be specified by using menu command of Tk.

```python
menu .menu ; #Specify a path name for menu
.menu add cascade –label file –menu .menu.file
.menu add cascade –label edit –menu .menu.edit
.menu add cascade –label view –menu .menu.view
    #Specify cascades (file, edit, view) add to .menu
.menu .menu.file –tearoff no
    #When you select “yes” for –tearoff option, the created menu can be
deleted from the window
.menu.file add command –label exit –command exit
    #Allocate “exit” to menu.file as a submenu
    #Define “exit” as a submenu for when “file” is selected
.configure –menu .menu
```

Pull-down menu can be created on toplevel window using menu command.
2-4-13, Creation of Menu button

Menu button can be created using menubutton command of Tk.

```python
frame .menutop ;#Use frame command to allocate a frame on the tool bar
pack .menutop –side top –fill x
    #The created window in -slide top is allocated to top
menubutton .menutop.file –text file –menu .menutop.file.menu
    #Allocate .menutop.file.menu as a submenu in –menu option
menubutton .menutop.edit –text edit
menubutton .menutop.view –text view
pack .menutop.file .menutop.edit .menutop.view –side left
    #Allocate the created menubuttons
menu .menutop.file.menu –tearoff 0
    # When selecting "true" in -tearoff option, the created menu can
    #be deleted from the window
.menu .menutop.file.menu add command –label exit –command exit
    #Define an a submenu for when "menutop.file.menu" is selected
```

Created menu by menubutton command is the functionally same as one created by menu command. In case of allocating the menu on tool bar, a frame for the menu bar must be allocated in advance using frame command.
2-4-14, Creation of Scroll bar

Scroll bar can be created on windows, etc. using scrollbar command of Tk.

scrollbar .scroll_h –orient horizontal ;# Define a horizontal scroll bar
scrollbar .scroll_v –orient vertical ;# Define a vertical scroll bar
pack .scroll_h ;# Allocate the defined scroll bars
pack .scroll_v –side right

Figure: Creation of scroll bars

In the above sample program, the scroll bars are allocated on the top window. Scroll bar also can be allocated on frame, etc., by creating a frame in advance and specifying the path name for the scroll bar at the time of definition and allocation.

labelframe .frame –text label –bd 2 –width 100 –height 50 –relief solid
pack .frame

scrollbar .frame.scroll_v –orient vertical ;# Specify the path name of the frame
pack .frame.scroll_v
2-4-15, Creation of Scale bar to change the variable value

Scale bar to change a value of variable can be created using scale command of Tk.

```python
scale .scale -label COUNT -from 0 -to 100 -length 100
-variable var -orient horizontal -tickinterval 50 -showvalue true
pack .scale
```

When the value pointed on the scale bar is changed, it is reflected in a value of variable val, which is specified in -variable option.

Figure: Creation of scale bar

You can specify the range of the value on the scale bar using -from and -to options of scale command. The indicated value on the scale bar is reflected in variable val, which is specified in -variable option. Additionally, you can specify the interval of indicator scale to be displayed on the scale bar in –tickinterval option, and also a display value, which is indicated on the scale bar in –showvalue option.
2-4-16, Creation of Canvas
Canvas with lines, texts and polygons can be created using canvas command of Tk.

```
canvas .canvas ;#Define a canvas you create
.canvas create oval 10 10 40 40 –fill red –width 3
.canvas create rectangle 50 50 70 70 –fill blue –width 5
pack .canvas ;#Allocate the canvas
```

Figure: Creation of canvas
2-4-17, Creation of Option menu
Option menu can be created using `tk_optionMenu` command of Tk.

```
tk_optionMenu .option var start stop end
pack .option
```

When the menu is changed, it is reflected in variable `val`.

Figure: Creation of option menu

In the above sample program, variable `val` and the option menus ("start", "stop", "end") are specified using `tk_option` command. Variable `val` reflects a specified menu among the three menus.
2-4-18, Creation of Pop-up menu

Pop-up menu can be created using tk_popup command of Tk.

```
menu .popupmenu –tearoff no
    # The pop-up menu can be deleted from the window by selecting "yes" for
    # –tearoff option
    .popupmenu add command –label "open" –accelerator "Ctrl+O"
    .popupmenu add command –label "save" –accelerator "Ctrl+S"
    .popupmenu add command –label "end" –accelerator "Ctrl+E" –command exit
    # A submenu for when "end" is selected can be specified in –command option
    bind . <3> { tk_popup .popupmenu %X %Y }
```

In the above sample program, the created ".popupmenu" is defined as a pop-up menu using tk_popup command. You can specify the location of the pop-up window to be opened on the window by setting the value for %X and %Y in the following description.

```
    bind . <3> { tk_popup .popupmenu %X %Y }
```

Therefore the pop-up menu can be opened anywhere on the window.
2-4-19, Creation of Simple dialog

Simple dialog can be created using `tk_dialog` command of Tk.

```
tk_dialog .dialog Dialog "This is Dialog!" {} 0 start stop end
```

A return value depends on the clicked button on the dialog.

- start = 0
- stop = 1
- end = 2

When "stop" is clicked, it returns 1.

You can specify a window title and a message on a dialog box using `tk_dialog` command. In the above sample dialog, the window is titled "Dialog", and the message is specified as “This is Dialog!”.

You can also specify names of buttons on the dialog box and their initial values. In the above sample dialog, the buttons are named “start”, “stop” and “end”, and their initial values are specified as “0”, “1” and “2” each.

One of the return values “0”, “1” or “2” is returned as the result by clicking one of the buttons.
2-4-20, Creation of Message dialog

Message dialog can be created using `tk_messageBox` command of Tk.

```
tk_messageBox -type OK -title message -icon info -message message
```

The message dialog promotes users confirmation toward the message.

You can create interactive message dialog box by using `tk_messageBox` command. You can specify a type of the button in `-type` option, a title of the button in `-title` option, and also a message to be displayed on the dialog in `-message` option.
2-4-21, Creation of Exist File Open dialog

Dialog to open existing files can be created using `tk_getOpenFile` command of Tk.

```
set types {
    {“text” {.txt}}
}
set file [ tk_getOpenFile -filetypes $types -title open ]
```

When an existing file is selected and opened, the storage location of the file is reflected in `file` variable.

![Image of file open dialog]

**Figure: Creation of file open dialog**

You can specify a file type in `-filetypes` option, and a window title in `-title` option, when creating a file open dialog using `Tk_getOpenFile` command. In the above program, type variable is selected as the file type in `-filetypes` option. `text [ *.txt]` is specified as the file type for `type` variable by `set type{ …} command in advance.

In addition, a storage location of the selected file is returned as the result of `Tk_getOpenFile` command.

In the above program, the result is stored in `file` variable using `set` command.
2-4-22, Creation of New File Open dialog

Dialog to open and save new file can be created using `tk_getSaveFile` command of Tk.

```
set types {
    { "text" { .txt } }
}
set file [ tk_getSaveFile –filetypes $types –title save ]
```

When a new file is selected and saved, a storage location of the saved file is reflected in `file` variable.

Figure: Creation of file save dialog

You can specify a file type in `–filetypes` option, and a window title in `–title` option, when creating a file open dialog using `Tk_getSaveFile` command.

Additionally, a storage location of the selected file is returned as the result of `Tk_getSaveFile` command.
### 2-4-23, Allocation of widget

In the previous chapters, the allocation method of widget is described only by using `pack` command. However, you can also use `place` command and `grid` command to allocate widget in addition to `pack` command. The allocation method varies by command, so you can choose the most appropriate command depending on the GUI window you want to create.

#### Example of widget allocation

<table>
<thead>
<tr>
<th>Command</th>
<th>Example of use of command</th>
<th>Allocation example</th>
</tr>
</thead>
</table>
| **pack** | Lay out widget by direction.  
The direction can be set in `-side [left, right, top, bottom]` option, etc.. | ![Allocation Example](image) |
| pack [ button .test –text test –command { go } ] | | ![Allocation Example](image) |
| pack [ button .test –text test –command { go } ] –side left | | ![Allocation Example](image) |
| **place** | Lay out widget by coordinates.  
The coordinates can be specified in `-x` and `-y` options, and the size can be specified in `-width` option. | ![Allocation Example](image) |
| button .test –text test –command { go } | | ![Allocation Example](image) |
| place .test –x 10 –y 10 | | ![Allocation Example](image) |
| button .test –text test –command { go } | | ![Allocation Example](image) |
| place .test –x 50 –y 50 –width 100 | | ![Allocation Example](image) |
| **grid** | Lay out widget as grid.  
The grid location can be specified in `-column` and `-row` options, and the margin can be specified in `-padx` and `-pady` options. | ![Allocation Example](image) |
| button .test –text test –command { go } | | ![Allocation Example](image) |
| grid .test | | ![Allocation Example](image) |
| button .test –text test –command { go } | | ![Allocation Example](image) |
| grid .test –column 3 –row 4 -padx 3 –pady 5 | | ![Allocation Example](image) |

Options used in the above list are only some of examples among many. You can use more options. Please refer to Tcl/Tk reference manual, etc., for further information.
3, Tcl/Tk programming in HEW

Tcl/Tk programming in HEW is possible. Tcl/Tk create development environments, which suit the needs of users by allocating HEW commands to GUI window (buttons, etc.) created in Tcl/Tk. Therefore, the allocated commands on GUI window are issued to HEW, and HEW simulation can be controlled. The following environments can be created by Tcl/Tk.

- Issue of commands from Tcl/Tk to HEW.
  Tcl/Tk issue commands to HEW, and control simulation of HEW.
- Issue of commands from Tcl/Tk to HEW, and accepting data as the results.
  Tcl/Tk issue commands to HEW, and accepts the results and display them.

Figure: Linkage between HEW and Tcl/Tk
3-1, HEW commands available in Tcl/Tk

HEW offers a lot of commands, which is available in command line of HEW. You can use some of the commands to create a development environment matched to your needs.

A list of HEW commands, which are available in Tcl/Tk can be referred by inputting list command on Console window of Tcl/Tk. Please check the meanings of the commands before using.

Figure: A list of HEW commands on Console window
3-2, Creation of Control Commands to HEW Simulator

GUI window to control HEW simulator can be created in Tcl/Tk.

```tcl
# sample program
pack [label .text -text Simulation]
pack [button .start -text start -command { go }]
pack [button .reset -text reset -command { reset }]
pack [button .stop -text stop -command { halt }]
```

In the above sample program, the simplest commands for execution of HEW simulation are allocated on the buttons on GUI window of Tcl/Tk, an environment for controlling HEW simulator is created.

In the above sample program, the simplest commands for execution of HEW simulation are allocated on the buttons on GUI window of Tcl/Tk, an environment for controlling HEW simulator is created.

Figure: Example of execution

In the above sample program, GUI window of Tcl/Tk is created by using lavel command and button commands of Tcl/Tk. You can specify the message on the window “Simulation” using label command. You can also specify buttons to be allocated on the window, and commands to be assigned to the buttons by specifying HEW commands in the curly brackets of –command option. Therefore, one of the commands “start”, “reset” or “halt” is issued depending on clicked button on GUI window. In the above sample program, pack command is used to allocate the buttons.
3-3, Creation of Command to Input Quasi Interrupt to HEW Simulator

GUI window to input interrupt signals to HEW can be created in Tcl/Tk.

```tcl
~ sample program ~
pack [ label .text –text Interrupt ]
pack [ button .irq0 –text “IRQ0 Trigger” $
   –command { break_cycle 1 all interrupt H'04 11 }$
pack [ button .irq1 –text “IRQ1 Trigger” $
   –command { break_cycle 1 all interrupt H'05 11 }$
pack [ button .irq2 –text “IRQ2 Trigger” $
   –command { break_cycle 1 all interrupt H'06 11 }$
pack [ button .irq3 –text “IRQ3 Trigger” $
   –command { break_cycle 1 all interrupt H'07 11 }$
```

An interrupt generates and jumps to interrupt vector by clicking one of the buttons.

Figure: Example of execution
In the sample program on the previous page, quasi interrupt function, which is prepared in HEW is used. By assigning break_cycle command, which generates a quasi interrupt to the buttons on the GUI window, it is possible generating interrupts anywhere at an execution of simulation.

**BREAK commands are prepared in HEW to generate quasi interrupt.**

<table>
<thead>
<tr>
<th>Commands</th>
<th>Example of how commands are used</th>
</tr>
</thead>
<tbody>
<tr>
<td>break_access</td>
<td>break_access &lt;start_addr&gt; [&lt;end_addr&gt;] [&lt;mode&gt;] \ interrupt &lt;interrupt_type1&gt; &lt;interrupt_type2&gt; [&lt;priority&gt;]</td>
</tr>
<tr>
<td>break_cycle</td>
<td>break_cycle &lt;cycle&gt; [&lt;count&gt;] \ interrupt &lt;interrupt_type1&gt; &lt;interrupt_type2&gt; [&lt;priority&gt;]</td>
</tr>
<tr>
<td>break_data</td>
<td>break_data &lt;addr&gt; &lt;data&gt; [&lt;size&gt;] [&lt;option&gt;] \ interrupt &lt;interrupt_type1&gt; &lt;interrupt_type2&gt; [&lt;priority&gt;]</td>
</tr>
<tr>
<td>break_register</td>
<td>break_register &lt;register&gt; [&lt;data&gt; &lt;size&gt;] [&lt;option&gt;] \ interrupt &lt;interrupt_type1&gt; &lt;interrupt_type2&gt; [&lt;priority&gt;]</td>
</tr>
<tr>
<td>break_point</td>
<td>break_point &lt;addr&gt; [&lt;count&gt;] \ interrupt &lt;interrupt_type1&gt; &lt;interrupt_type2&gt; [&lt;priority&gt;]</td>
</tr>
</tbody>
</table>

These commands must be assigned to buttons before a simulation.

In the sample program on the previous page, break_cycle 1 all ...command is assigned on the buttons. (SH1 is selected as CPU ) Therefore, if a button is clicked in the middle of a simulation, a quasi interrupt generates 1 cycle later from the time when the button is clicked.
3-4, Creation of Environment to Control HEW simulation

One integrated environment is created by creating a script file, which is constructed by the control commands to HEW simulation.

```bash
#!/bin/sh
# the next line restarts using wish
exec tclsh "$0" "$@"
catch {destroy .top}

toplevel .top
wm title .top "HEW Simulation"
wgeometry .top 230x450+216+109; update
wm maxsize .top 1028 753
wm minsize .top 104 1

button .top.go -command {break_clear;go} -height 0 -pady 0
   -text {Simulation Go} -width 15
button .top.rego -command {break_clear;reset;go} -height 0 -pady 0
   -text {Reset Simulation} -width 15
button .top.reset -command {reset} -height 0 -pady 0
   -text {Reset} -width 15
```

~ sample program ~
If the quasi interrupts from IRQ0 to IRQ5 are generated using the quasi interrupt function in HEW simulator, setups of the break commands remain in the simulator of HEW. In order to execute the simulation again, the break commands must be turned off. In the above sample program, the following commands are assigned on the buttons on GUI window in addition to the break commands.

```plaintext
button .top.go  -command {break_clear;go} -height 0 -pady 0
    -text {Simulation Go} -width 15
button .top.rego -command {break_clear;reset;go} -height 0 -pady 0
    -text {Reset Simulation} -width 15
button .top.irq2 -command {break_cycle 1 all Interrupt H'06 11} -pady 0
    -text {Trigger IRQ2} -width 15
button .top.irq3 -command {break_cycle 1 all Interrupt H'07 11} -pady 0
    -text {Trigger IRQ3} -width 15
button .top.irq4 -command {break_cycle 1 all Interrupt H'08 11} -pady 0
    -text {Trigger IRQ4} -width 15
button .top.irq5 -command {break_cycle 1 all Interrupt H'09 11} -pady 0
    -text {Trigger IRQ5} -width 15
button .top.exit  -command exit
    -text {Quit} -width 15
```

If the quasi interrupts from IRQ0 to IRQ5 are generated using the quasi interrupt function in HEW simulator, setups of the break commands remain in the simulator of HEW. In order to execute the simulation again, the break commands must be turned off. In the above sample program, the following commands are assigned on the buttons on GUI window in addition to the break commands.
These commands can be assigned by listing them in curly brackets “{}” of -command option separating each command by a semicolon “;”. When a button is clicked, the listed commands are issued to HEW starting from the left.

In the sample program on the previous page, break_clear command is issued to HEW to turn off break_cycle command before an execution of “go” and “reset go” commands. Therefore, the simulation can be executed again.

If Trigger IRQ0 is clicked, break_cycle 1 command is issued in the event point of HEW, and a quasi interrupt is generated, then jumps to a interrupt vector.

Figure: Example of execution
3-5, Creation of Environment for Input Control to HEW Simulation 1

An environment for input control to HEW simulator at execution of HEW simulation. The control environment accepts external input.

~ Sample program ~

#!/bin/sh

# Initial setting of an address
set addr ff800030
# Initial setting of data
set data 0

# The command for an address setup
# An address value is stored in Variable addr.
label .l_addr –text ADDRESS
place .l_addr –x 10 –y 10
entry .addr –textvariable addr
place .addr –x 70 –y 10

# The command for an data setup.
# A data value is stored in Variable data
label .l_data –text DATA
place .l_data –x 10 –y 50
entry .data –textvariable data
place .data –x 70 –y 50

# The HEW command is set as a button.
# A push on a button sets data to arbitrary addresses.
button .set -command {memory_fill $addr $addr $data} -text {set data}
place .set –x 60 –y 100

Set initial values for variable addr and data
Create an entry box for address input
Specify the coordinates of Label and entry using place command and allocate them
Create an entry box for data input

Set a specified address and a data value using memory_fill command of HEW. Specify values for variable addr and data by entry command.
In the sample program on the previous page, one input control environment is created. Any address and data can be stored in HEW by using an entry box. When an address and data are entered on GUI window in hexadecimal and “set data” button is clicked, the data is stored in the specified address of the memory space of HEW.

Data can be stored using memory_fill command. Memory_fill command, which is issued to HEW can be selected in -command option of button command. Memory_fill command passes the address and the data values to HEW by referring the variable addr and data specified in entry command ("$" is used when the data is referred).

![Figure: Example of execution](image1)

By entering an address and data and clicking “set data” button, the entered data is stored in the memory space of HEW.
3-6, Creation of Environment for Input Control to HEW Simulation 2

An environment to set a value in memory space or registers of HEW can be created in Tcl/Tk.

```
~ sample program ~
wm geometry . 350x280

# DATA
scale .scale -label DATA -from 0 -to 10000 -length 300 -variable var -orient horizontal -tickinterval 2500 -showvalue true
place .scale -x 0 -y 0

# ADDRESS
label .l_addr -text ADDRESS
place .l_addr -x 10 -y 100

entry .addr -textvariable addr
place .addr -x 70 -y 100

# DATA size
label .l_size -text SIZE
place .l_size -x 10 -y 140

set select size8
set select_size "BYTE"
radiobutton .size8 -text 8 -variable select -value size8
radiobutton .size16 -text 16 -variable select -value size16
radiobutton .size32 -text 32 -variable select -value size32

place .size8 -x 60 -y 140
place .size16 -x 100 -y 140
place .size32 -x 140 -y 140
```
set addr 0
set addr_s 3
set addr_e 3
set var16 0
set var16_tmp 0

# Data modify proc
proc set_data { } {
    global var
    global var16
    global var16_tmp
    global select
    set var16_tmp [ format %08x $var ]

    if { $select == "size8" } {
        set var16 [ string range $var16_tmp 6 7 ]
    } elseif { $select == "size16" } {
        set var16 [ string range $var16_tmp 4 7 ]
    } else {
        set var16 $var16_tmp
    }
}

# Data size proc
proc set_size { } {
    global select_size
    global select
    if { $select == "size8" } {
        set select_size "BYTE"
    } elseif { $select == "size16" } {
        set select_size "WORD"
    } else {
        set select_size "LONG"
    }
}

Specification of initial values for each variable

Definition of a procedure for processing data, which is stored in HEW by specifying the data size.

Definition of procedure for generating an argument (a data size) of a command issued to HEW by specifying the data size.
# Start address proc
proc set_addr_s {} {
    global select
    global addr
    global addr_s
    if { $select == "size8" } {
        set addr_s [ expr $addr + 3 ]
    } elseif { $select == "size16" } {
        set addr_s [ expr $addr + 2 ]
    } else {
        set addr_s [ expr $addr + 0 ]
    }
}

# End address proc
proc set_addr_e {} {
    global select
    global addr
    global addr_e
    if { $select == "size8" } {
        set addr_e [ expr $addr + 3 ]
    } elseif { $select == "size16" } {
        set addr_e [ expr $addr + 3 ]
    } else {
        set addr_e [ expr $addr + 3 ]
    }
}

# button
label .l_data -text "DATA SET"
place .l_data -x 10 -y 180

button .set -text set -command { set_size;set_addr_s;set_addr_e;set_data;memory_fill
$addr_s $addr_e $var16 $select_size }
place .set -x 90 -y 180

Definition of a procedure for generating an argument (a start address) of a command issued to HEW by specifying the data size.

Definition of procedure for generating an argument (an ending address) of a command issued to HEW by specifying the data size.

Definition of “set” button
Procedure call command and memory_fill command are assigned to the button
H'36 is stored in the lower 8 bit, if you choose SIZE8 and write 4662 in address 0 by BYTE.
The value must be specified in decimal (analog value) in the sample program. When a "set" button is clicked after entering an address value and specifying data size, the data is stored in the specified address.

H'36 is stored in the lower 8 bit, if you choose SIZE8 and write 4662 in address 0 by BYTE. H'1236 is stored in the lower 16 bit, if you choose SIZE16 and write 4662 in address 0 by WORD. H'00001236 is stored in the 32bit, if you choose SIZE32 and write 4662 in address 0 by LONG.

The sample program is configured with setting of data, address and data size, and "set" button to set these values to HEW.

In addition, the procedures to process arguments of the data, the start address and the ending address are defined using proc command. By using these procedures in –command option of button command, arguments required for setting the data to HEW are generated at the time of clicking "set" button.

All procedures are configured simply, and they do not treat parameter passing. The procedures can be referred by defining globally the variables used in Tcl/Tk programming.
3-7, Creation of Environment for Output Control from HEW simulation 1

An environment for input control to HEW simulation can be created by creating a simple script file with commands to HEW. It is because of a one-way command issue from Tcl/Tk to HEW only. However, under an environment for output control from HEW simulation, Tcl/Tk cannot accept data directly as the result of an issued command to HEW. The result must be passed to Tcl/Tk through variable.

A file "tmp.file" to temporarily store the data (the result of the issued command) must be created in advance. Tcl/Tk accepts the data by referring to information stored in the file.
This chapter describes the procedures for creating an environment for output control from HEW, which accepts the result of an issued command directly from HEW simulator at an execution of a simulation. Under this environment, Tcl/Tk can accept value of memory and register and output them.

```
~ Sample program ~
set content "Display Address "

destroy .b
button .b -text "Update" -command {

    # For "log.txt" checking in TEMP directory
    global env
    set dir $env(TEMP)
    set dataFile [open $dir/log.txt {RDWR TRUNC CREAT}]
    close $dataFile

    # Commandline command to read address 0x00000000
    # using HEW CommandLine command
    md 0 1
    # md command to an address to refer to here is described.

    # Read value as Console text is log into "log.txt"
    # in directory pointed by env. variable TMP
    set dataFile [open $::env(TEMP)/log.txt RDWR]
    set b ""
    seek $dataFile 0 start
    set formatted [format "%08X" 0]
    while {$b!= $formatted}  {
        set e [gets $dataFile]
        set d [split $e ""]
        set b ""
        for {set j 0} {$j< 8} {incr j} {append b [lindex $d $j]}
    }

    set ar [split $e]
    set content [lindex $ar 2]
    close $dataFile
```

File open check
Retrieve the data from tmp file
Append command adds a string (lindex command gets the jth element of d) to a string b.
puts -nonewline "Content in Address 0x00000000: 0x"
puts $content

destroy .labelcontent
label .labelcontent -text $content
place .labelcontent -x 90 -y 10
}

destroy .labelcontent
label .labelcontent -text $content
place .labelcontent -x 90 -y 10

Allocate a button

Destroy command destroys the previous result, and output the updated data.

Figure: Start-up display
When “Update data” button is clicked without changing the value, “00” is output.

When “Update data” button is clicked, the data is updated in according to the memory.

~ log.txt file ~
00000000 FF
Content in Address 0x00000000: 0x FF

Figure: Example of execution