PUFacademy

A PUFsecurity Alliance

Digital Logic Design
- Lecture 0
- Workstation and Linux

2025 Spring

PUFacademy
A PUFsecurity Alliance

Agenda

1. Login Workstation
2. Linux / VIM Basic Commands
3. CAD / VIM Environment Setting
4. Verdi / nWave Basic Operations
5. Git Version Control

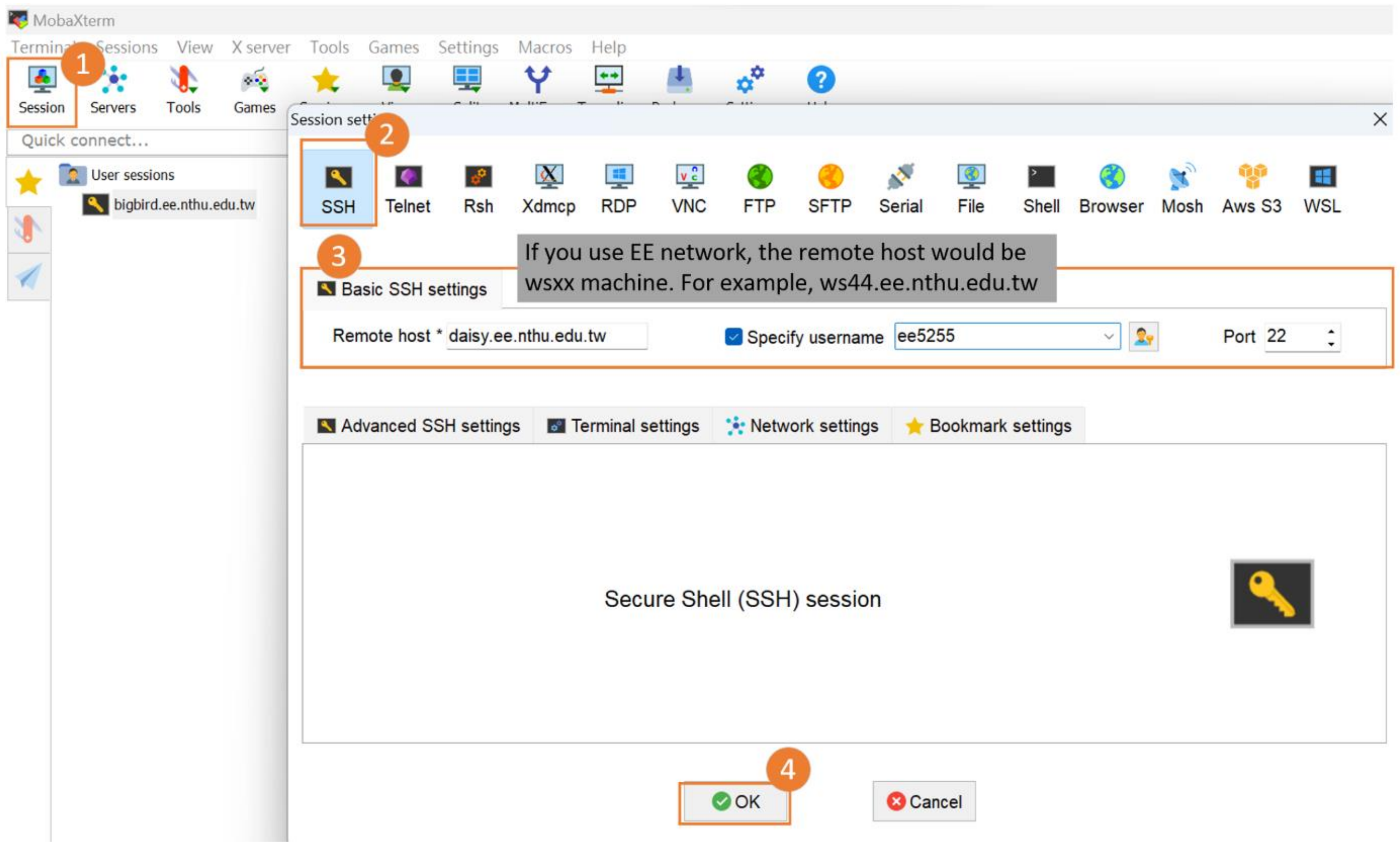
Login Workstation

- Open MobaXterm
- Host:

  if not in EE network
  - daisy.ee.nthu.edu.tw
  - bigbird.ee.nthu.edu.tw

  if in EE network
  - wsXX.ee.nthu.edu.tw
  - (wsXX from ws25~ws48)

- Username:
  - <your account>



If you use EE network, the remote host would be wsxx machine. For example, ws44.ee.nthu.edu.tw

Remote host * daisy.ee.nthu.edu.tw
[✓] Specify username ee5255
Port 22

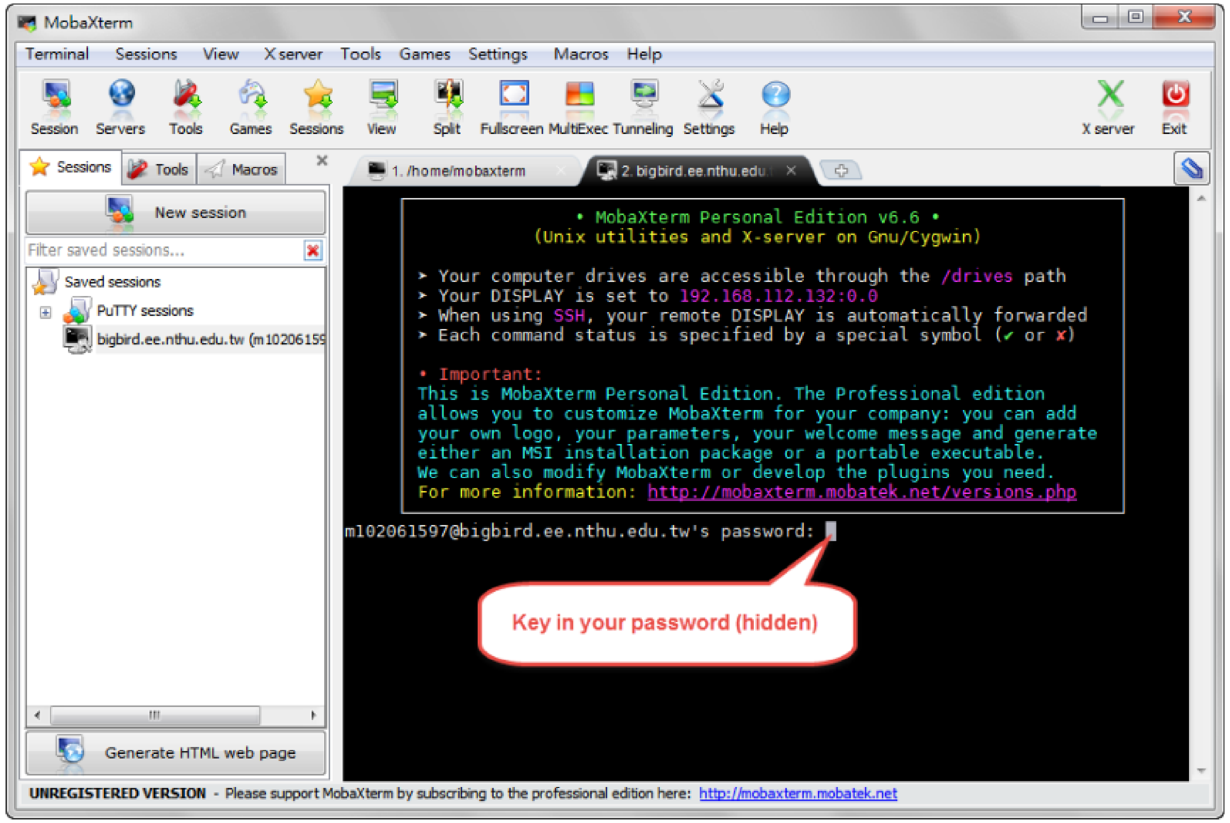
Secure Shell (SSH) session

Login Workstation

- Enter password

- If you are in daisy or bigbird
  - $ ssh –X wsXX
  - (wsXX from ws25~ws48)

- 登入後請用 yppasswd 指令來更改您的密碼。


MobaXterm
Terminal Sessions View X server Tools Games Settings Macros Help
Session Servers Tools Games Sessions View Split Fullscreen MultiExec Tunneling Settings Help X server Exit
Sessions Tools Macros
1. /home/mobaxterm
2. bigbird.ee.nthu.edu
New session
Filter saved sessions...
Saved sessions
PuTTY sessions
bigbird.ee.nthu.edu.tw (m10206159
Generate HTML web page
Key in your password (hidden)

```
        • MobaXterm Personal Edition v6.6 •
    (Unix utilities and X-server on Gnu/Cygwin)

➤ Your computer drives are accessible through the /drives path
➤ Your DISPLAY is set to 192.168.112.132:0.0
➤ When using SSH, your remote DISPLAY is automatically forwarded
➤ Each command status is specified by a special symbol (✓ or ✗)

• Important:
This is MobaXterm Personal Edition. The Professional edition
allows you to customize MobaXterm for your company: you can add
your own logo, your parameters, your welcome message and generate
either an MSI installation package or a portable executable.
We can also modify MobaXterm or develop the plugins you need.
For more information: http://mobaxterm.mobatek.net/versions.php

m102061597@bigbird.ee.nthu.edu.tw's password:
```

UNREGISTERED VERSION - Please support MobaXterm by subscribing to the professional edition here: http://mobaxterm.mobatek.net

Reference

- EE工作站 登入說明
  - https://web.ee.nthu.edu.tw/var/file/175/1175/img/1191/1030310-LoginWS.pdf
- EE工作站 常見問題
  - https://web.ee.nthu.edu.tw/var/file/175/1175/img/1191/wsqq.pdf
- CAD Tool List
  - https://web.ee.nthu.edu.tw/p/405-1175-169285,c4918.php?Lang=zh-tw

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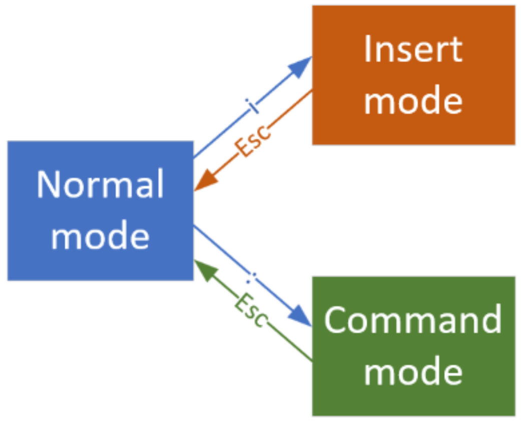
Linux Basic Commands

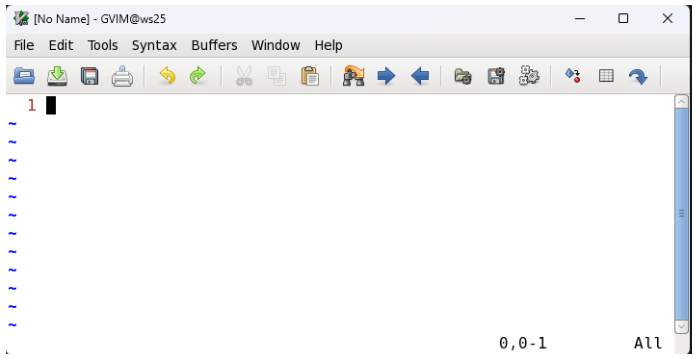
- $ pwd
  - print working directory
- $ mkdir
  - make directory
- $ ls
  - list the contents of a directory
- $ cd
  - change directory
- $ rm
  - remove (delete)
- $ cp
  - Copy
- $ mv
  - move (rename)
- $ touch
  - create an empty file
- $ chmod
  - change mode (permission)
- “Tab” key
  - for command or filename completion

Vim mode

- Vim is a powerful text editor in Linux
- $ vim
- $ gvim (with GUI)
- $ vim <filename>
  - Open a file named <filename>

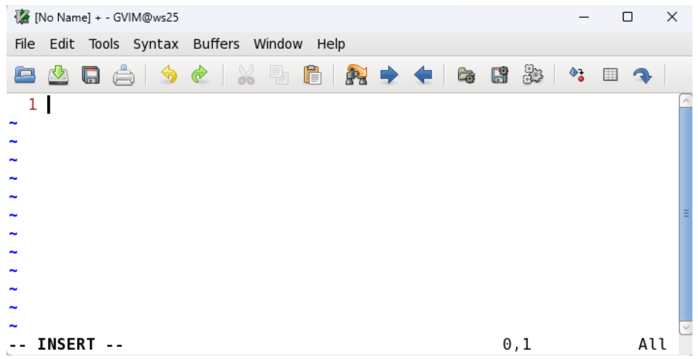


- Normal mode



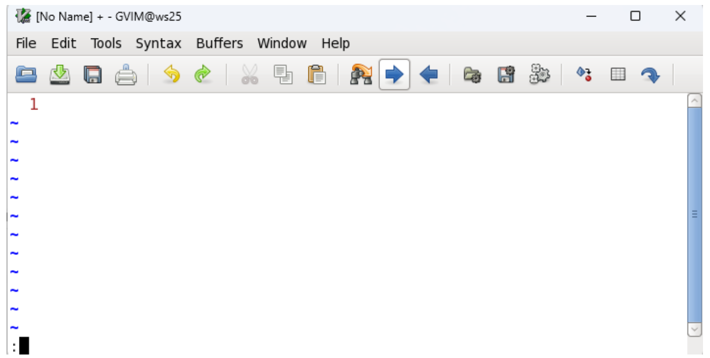
```
0,0-1         All
```

- Insert mode



```
-- INSERT --                       0,1         All
```

- Command mode



```
:
```

Vim Normal mode command

- i
  - Enter insert mode to edit the file
- :
  - Enter command mode
- v
  - Enter visual mode (still in normal mode)
  - For selecting text
- V
  - Enter visual mode (still in normal mode)
  - For selecting line
- gg
  - Move to first row
- G
  - Move to last row
- ggVG
  - Select all lines in the file
- y
  - copy
- p
  - paste
- d
  - delete

VIM Command mode Commands

- Esc
  - Exit Command mode and return to Normal mode

- :w
  - Write (save file)
- :q
  - Quit vim
- :wq
  - Write and Quit

- :w!
  - Force write (a read-only file)
- :q!
  - Quit without saving
- :wq!
  - Force write and quit

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1. Login Workstation
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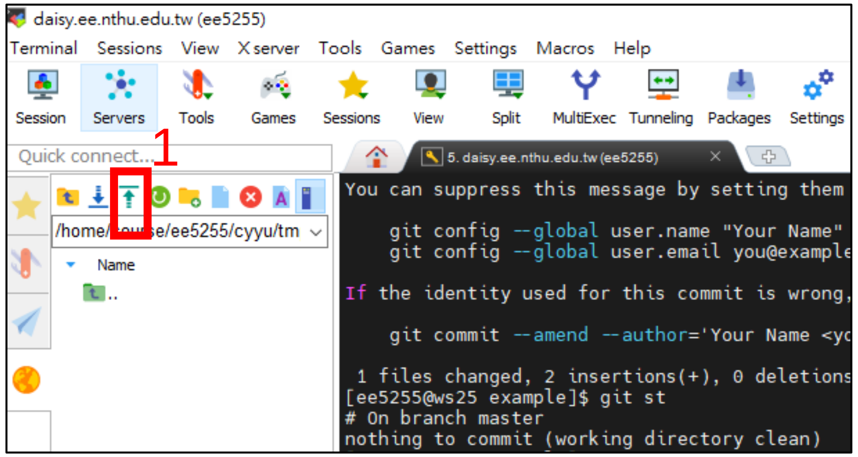
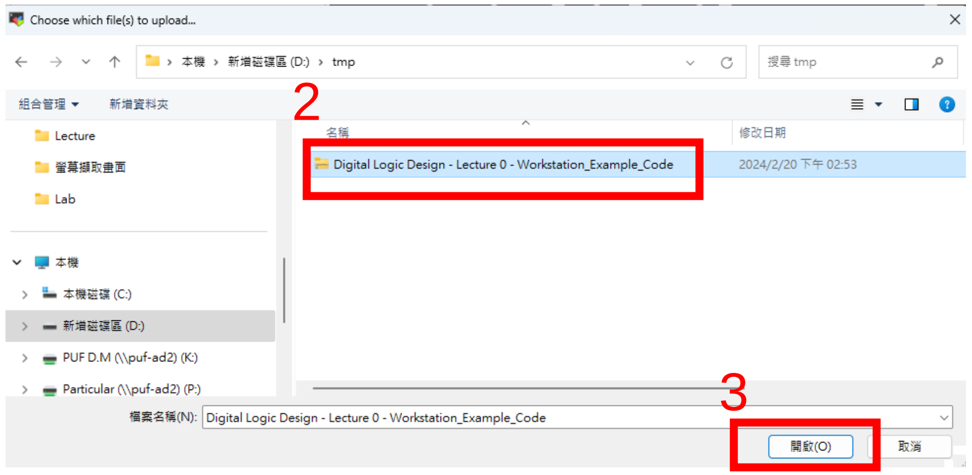
CAD Environment Setting

- Or upload Digital_logic_Design_Lecture0.zip (/home/course/<username>/)



daisy.ee.nthu.edu.tw (ee5255)
Terminal Sessions View X server Tools Games Settings Macros Help
Session Servers Tools Games Sessions View Split MultiExec Tunneling Packages Settings
Quick connect...
1
5. daisy.ee.nthu.edu.tw (ee5255)
/home/course/ee5255/cyyu/tm
Name
..

```
You can suppress this message by setting them

    git config --global user.name "Your Name"
    git config --global user.email you@example

If the identity used for this commit is wrong,

    git commit --amend --author='Your Name <yo

 1 files changed, 2 insertions(+), 0 deletions
[ee5255@ws25 example]$ git st
# On branch master
nothing to commit (working directory clean)
```



Choose which file(s) to upload...
本機 › 新增磁碟區 (D:) › tmp
搜尋 tmp
組合管理 ▾
新增資料夾
2
名稱
修改日期
Lecture
螢幕擷取畫面
Lab
Digital Logic Design - Lecture 0 - Workstation_Example_Code
2024/2/20 下午 02:53
本機
本機磁碟 (C:)
新增磁碟區 (D:)
PUF D.M (\\puf-ad2) (K:)
Particular (\\puf-ad2) (P:)
3
檔案名稱(N): Digital Logic Design - Lecture 0 - Workstation_Example_Code
開啟(O)
取消

- $ unzip Digital_Logic_Design_Lecture0.zip
- $ cd Digital_Logic_Design_Lecture0

CAD Environment Setting

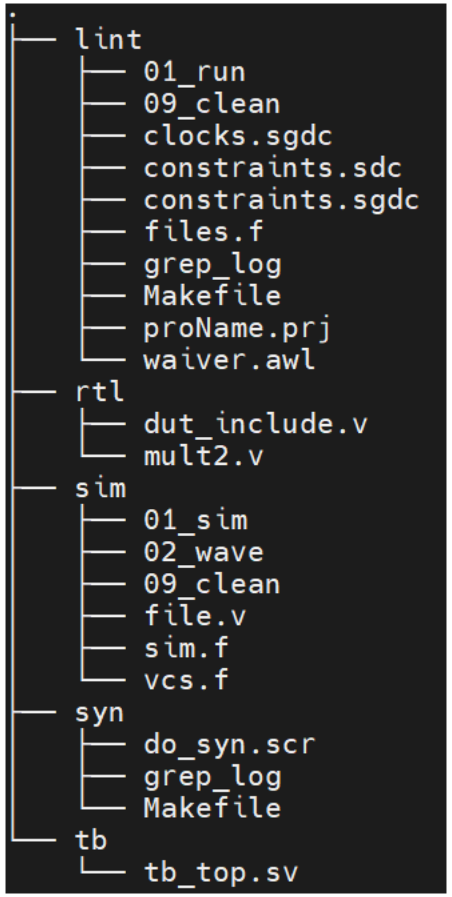
- $ cd
  - To your user directory (/home/course/<username>/)
- $ touch .tcshrc
- $ vim .tcshrc

```
#vcs
source /usr/cadtool/user_setup/08-vcs.csh

#verdi nWave
source /usr/cadtool/user_setup/08-verdi.csh

#Design Compiler
source /usr/cadtool/user_setup/08-synthesis.csh

#Spyglass
source /usr/cadtool/user_setup/08-spyglass.csh

#vcs-mx
alias src_dve 'source /usr/cadtool/user_setup/08-vcs-mx.csh'

#others
alias grep 'grep --color=auto'
```

- $ source .tcshrc
- (or re-login, will automatic source .tcshrc)
- (or copy Digital_Logic_Design_Lecture0/,tcshrc to user directory
- $ls –la
  - To find .tcshrc in Digital_Logic_Design_Lecture0 folder

Setup Example Folder

- $ unzip module_mult2.zip

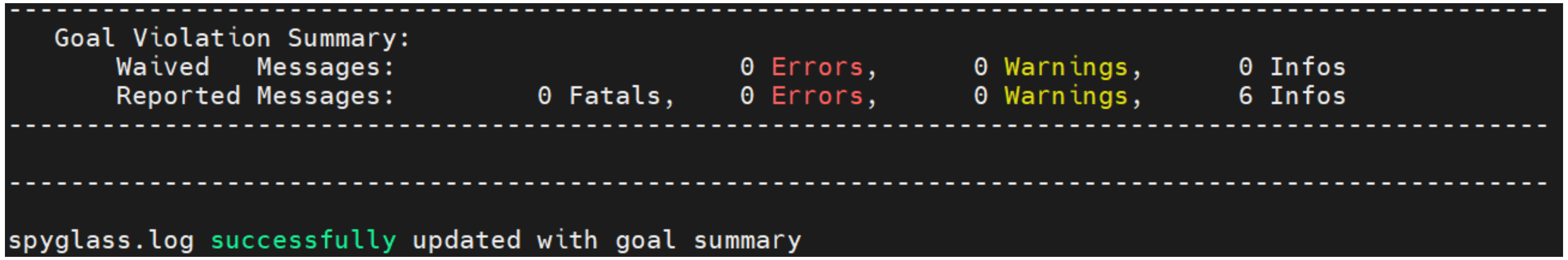


```
.
├── lint
│   ├── 01_run
│   ├── 09_clean
│   ├── clocks.sgdc
│   ├── constraints.sdc
│   ├── constraints.sgdc
│   ├── files.f
│   ├── grep_log
│   ├── Makefile
│   ├── proName.prj
│   └── waiver.awl
├── rtl
│   ├── dut_include.v
│   └── mult2.v
├── sim
│   ├── 01_sim
│   ├── 02_wave
│   ├── 09_clean
│   ├── file.v
│   ├── sim.f
│   └── vcs.f
├── syn
│   ├── do_syn.scr
│   ├── grep_log
│   └── Makefile
└── tb
    └── tb_top.sv
```

- $ cd module_mult2

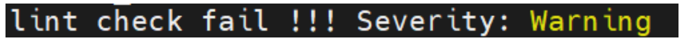
Run Lint

- $ cd lint/
- ./01_run
  - pass



```
--------------------------------------------------------------------------------------------------
   Goal Violation Summary:
       Waived   Messages:                         0 Errors,      0 Warnings,      0 Infos
       Reported Messages:            0 Fatals,    0 Errors,      0 Warnings,      6 Infos
--------------------------------------------------------------------------------------------------

--------------------------------------------------------------------------------------------------

spyglass.log successfully updated with goal summary
```

  - no pass

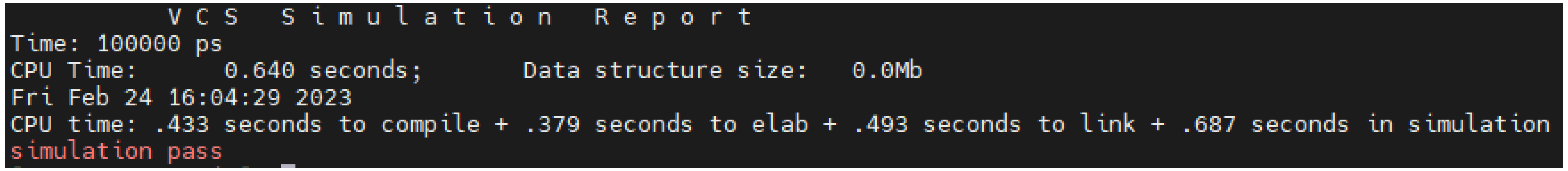


```
lint check fail !!! Severity: Warning
```

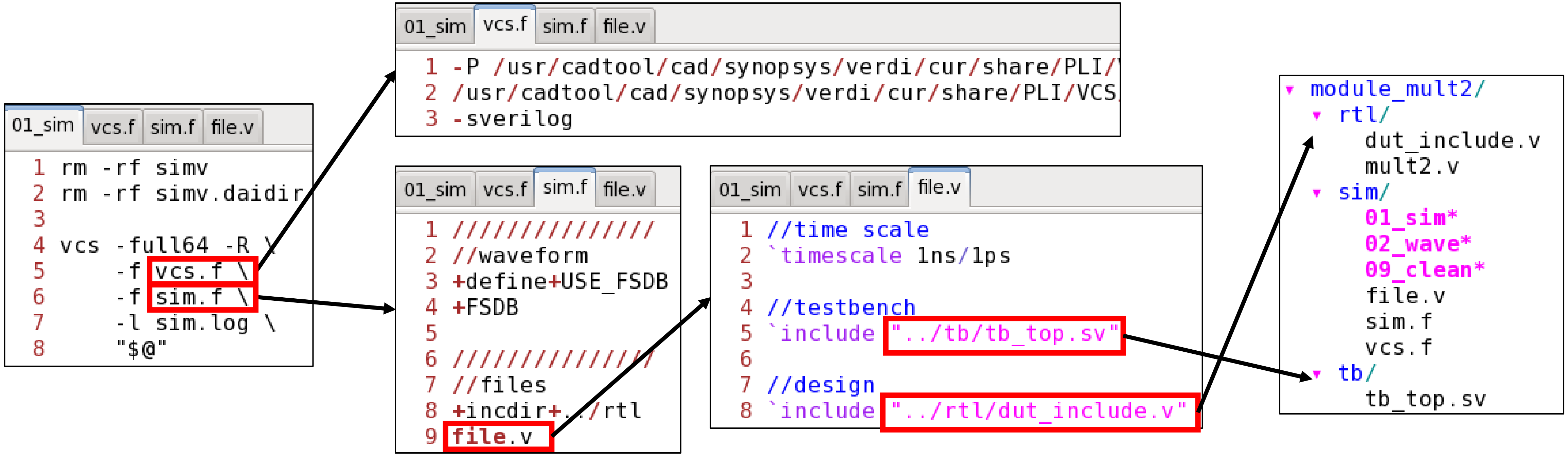
- ./09_clean

Run Simulation Using VCS

- $ cd ../sim/
- $ ./01_sim



```
          V C S   S i m u l a t i o n   R e p o r t
Time: 100000 ps
CPU Time:      0.640 seconds;       Data structure size:   0.0Mb
Fri Feb 24 16:04:29 2023
CPU time: .433 seconds to compile + .379 seconds to elab + .493 seconds to link + .687 seconds in simulation
simulation pass
```



01_sim:

```
rm -rf simv
rm -rf simv.daidir

vcs -full64 -R \
     -f vcs.f \
     -f sim.f \
     -l sim.log \
     "$@"
```

vcs.f:

```
-P /usr/cadtool/cad/synopsys/verdi/cur/share/PLI/
/usr/cadtool/cad/synopsys/verdi/cur/share/PLI/VCS
-sverilog
```

sim.f:

```
///////////////
//waveform
+define+USE_FSDB
+FSDB

//////////////
//files
+incdir+../rtl
file.v
```

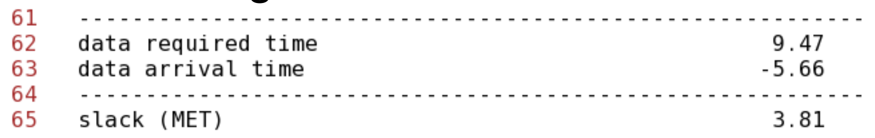
file.v:

```
//time scale
`timescale 1ns/1ps

//testbench
`include "../tb/tb_top.sv"

//design
`include "../rtl/dut_include.v"
```

```
▾ module_mult2/
  ▾ rtl/
      dut_include.v
      mult2.v
  ▾ sim/
      01_sim*
      02_wave*
      09_clean*
      file.v
      sim.f
      vcs.f
  ▾ tb/
      tb_top.sv
```

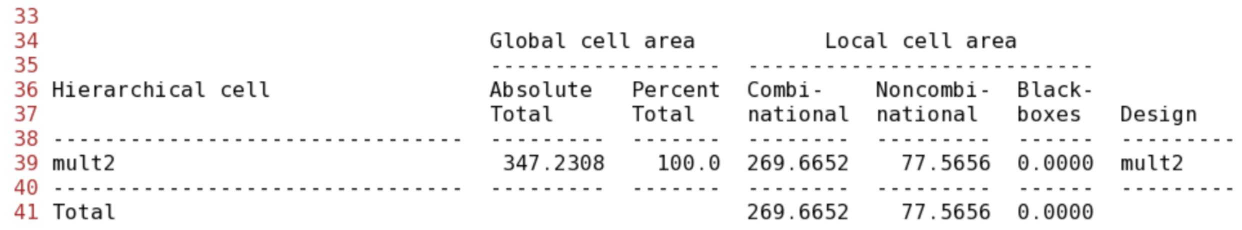
Synthesize

- cd ../syn
- $ make 01
- $ gvim syn_timing.log
  - check timing



```
---------------------------------------------------------
data required time                                   9.47
data arrival time                                   -5.66
---------------------------------------------------------
slack (MET)                                          3.81
```

- $ gvim syn_area.log
  - check area



```

                                Global cell area          Local cell area
                                ------------------  ---------------------------
Hierarchical cell               Absolute    Percent Combi-    Noncombi-  Black-
                                Total       Total   national  national   boxes    Design
------------------------------  ---------   ------- --------  ---------  ------   ---------
mult2                            347.2308     100.0 269.6652    77.5656  0.0000   mult2
------------------------------  ---------   ------- --------  ---------  ------   ---------
Total                                               269.6652    77.5656  0.0000
```

- $ make 90

Vim Environment Setting

- $ cd
  - To your user directory (/home/course/<username>)
- $ touch .vimrc
- Edit .vimrc

```
set guifont=monospace\ 12
set autoindent expandtab tabstop=3 shiftwidth=3
set number
```

  - Press “tab” to enter 3 spaces
  - Keep indent during newline.
  - Display line number

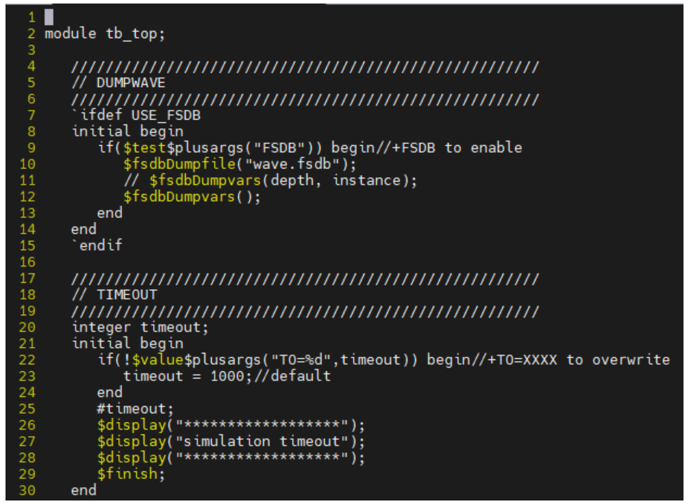
Vim Environment Setting

- $ cd
  - To your user directory (/home/course/<username>)
- $ mkdir -p .vim/syntax/

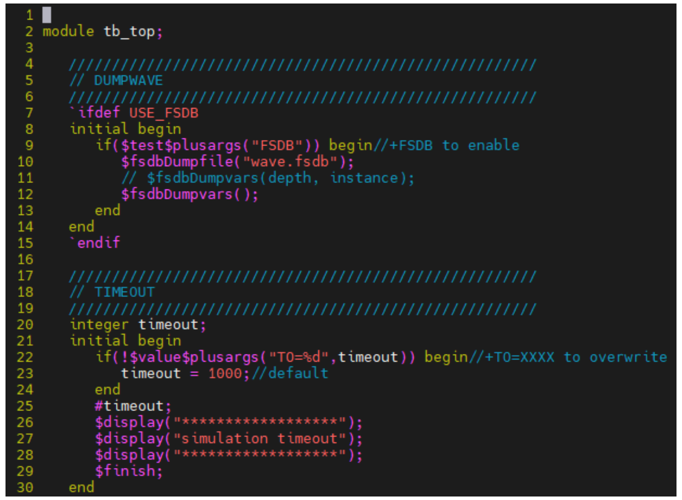
- Upload file filetype.vim to
  - .vim/

- Upload file systemverilog.vim to
  - .vim/syntax/

- $ vim module_mult2/tb/tb_top.sv
  - Will see code with highlight



```

module tb_top;

   ////////////////////////////////////////////////////////
   // DUMPWAVE
   ////////////////////////////////////////////////////////
   `ifdef USE_FSDB
   initial begin
      if($test$plusargs("FSDB")) begin//+FSDB to enable
         $fsdbDumpfile("wave.fsdb");
         // $fsdbDumpvars(depth, instance);
         $fsdbDumpvars();
      end
   end
   `endif

   ////////////////////////////////////////////////////////
   // TIMEOUT
   ////////////////////////////////////////////////////////
   integer timeout;
   initial begin
      if(!$value$plusargs("TO=%d",timeout)) begin//+TO=XXXX to overwrite
         timeout = 1000;//default
      end
      #timeout;
      $display("******************");
      $display("simulation timeout");
      $display("******************");
      $finish;
   end
```



```

module tb_top;

   ////////////////////////////////////////////////////////
   // DUMPWAVE
   ////////////////////////////////////////////////////////
   `ifdef USE_FSDB
   initial begin
      if($test$plusargs("FSDB")) begin//+FSDB to enable
         $fsdbDumpfile("wave.fsdb");
         // $fsdbDumpvars(depth, instance);
         $fsdbDumpvars();
      end
   end
   `endif

   ////////////////////////////////////////////////////////
   // TIMEOUT
   ////////////////////////////////////////////////////////
   integer timeout;
   initial begin
      if(!$value$plusargs("TO=%d",timeout)) begin//+TO=XXXX to overwrite
         timeout = 1000;//default
      end
      #timeout;
      $display("******************");
      $display("simulation timeout");
      $display("******************");
      $finish;
   end
```

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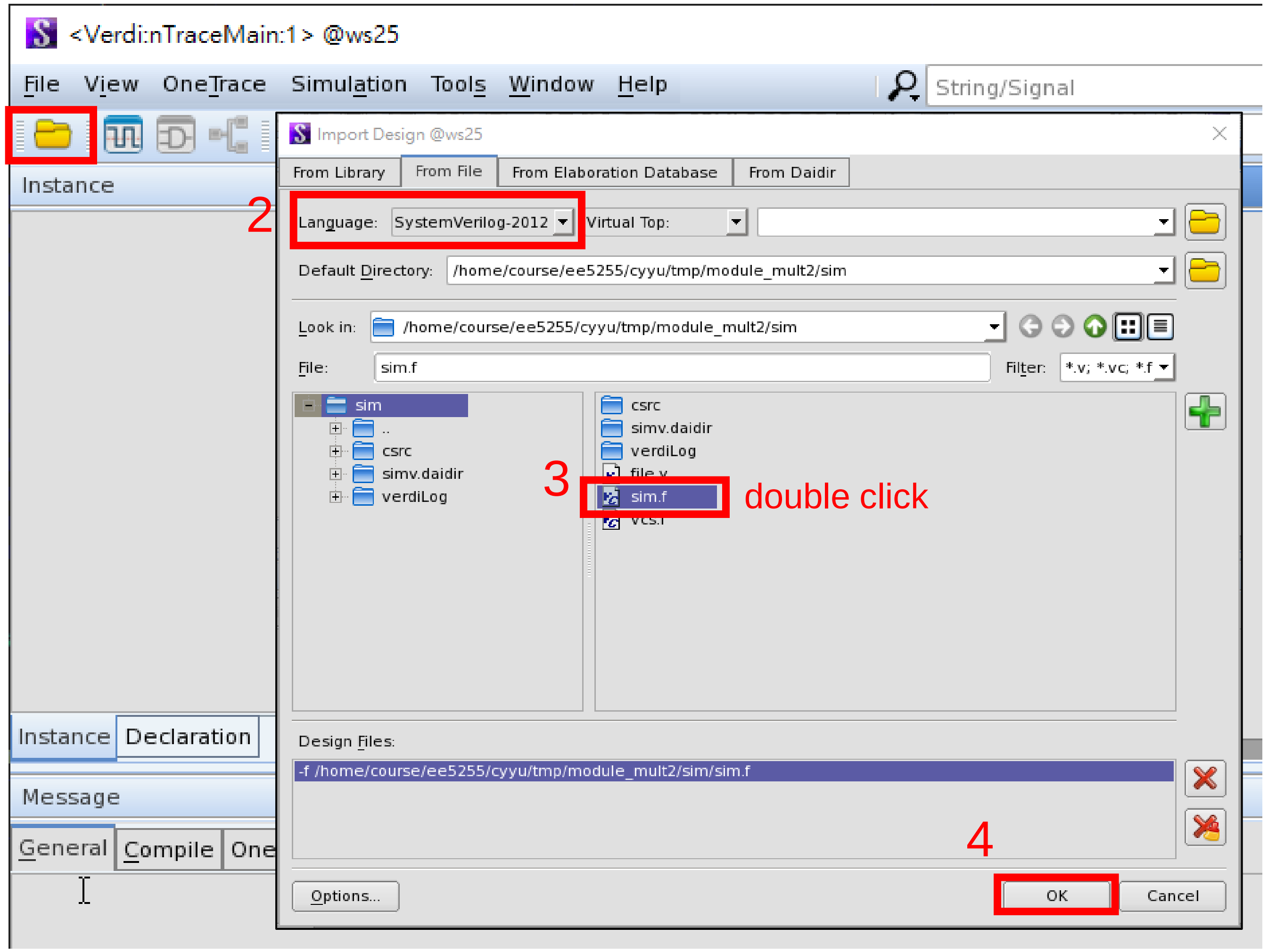
Open Verdi

- $ cd module_mult2/sim/
- $ verdi &

- adding “&” after a command runs in the background, allowing you to continue using the terminal



Language: SystemVerilog-2012

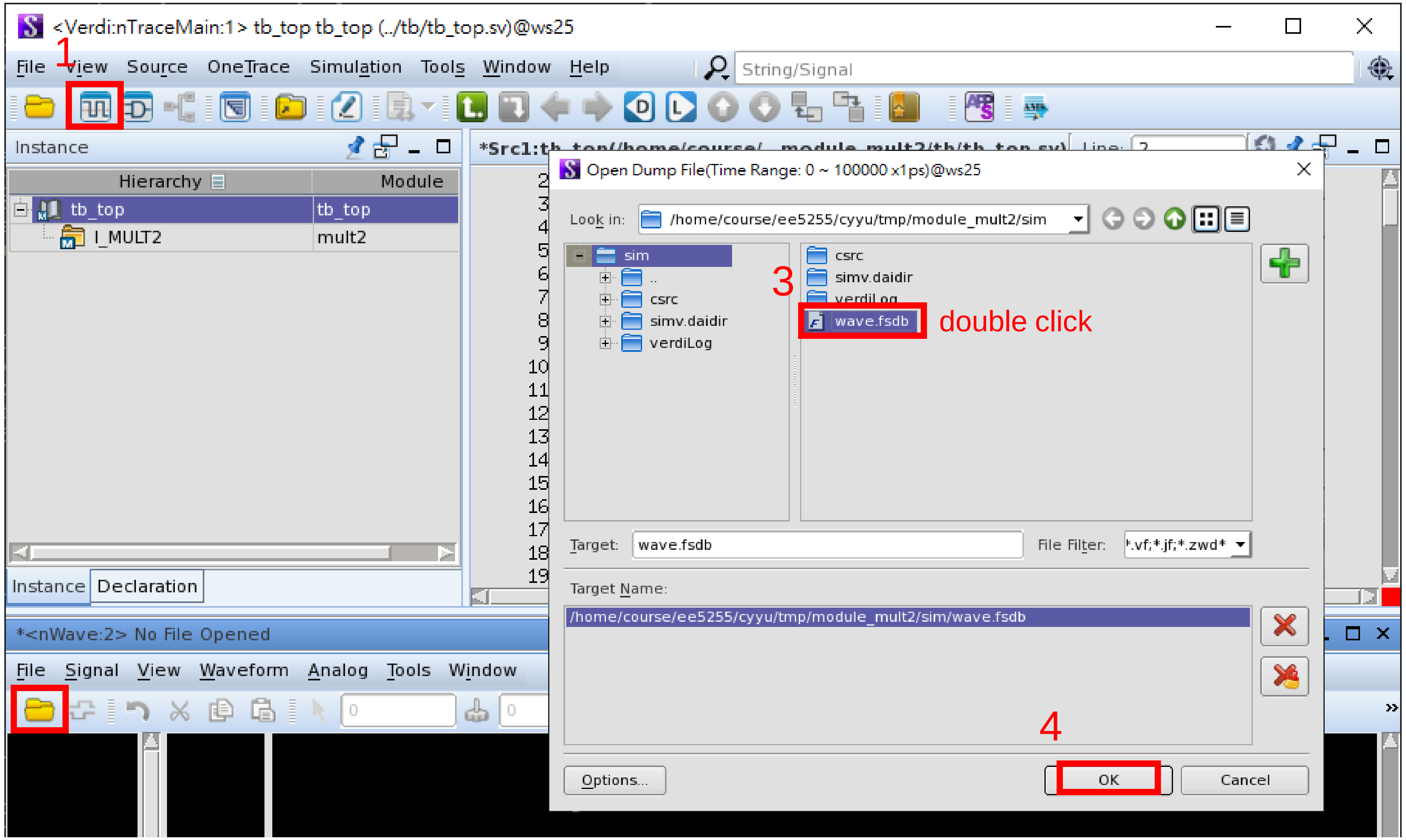
Default Directory: /home/course/ee5255/cyyu/tmp/module_mult2/sim

Look in: /home/course/ee5255/cyyu/tmp/module_mult2/sim

File: sim.f

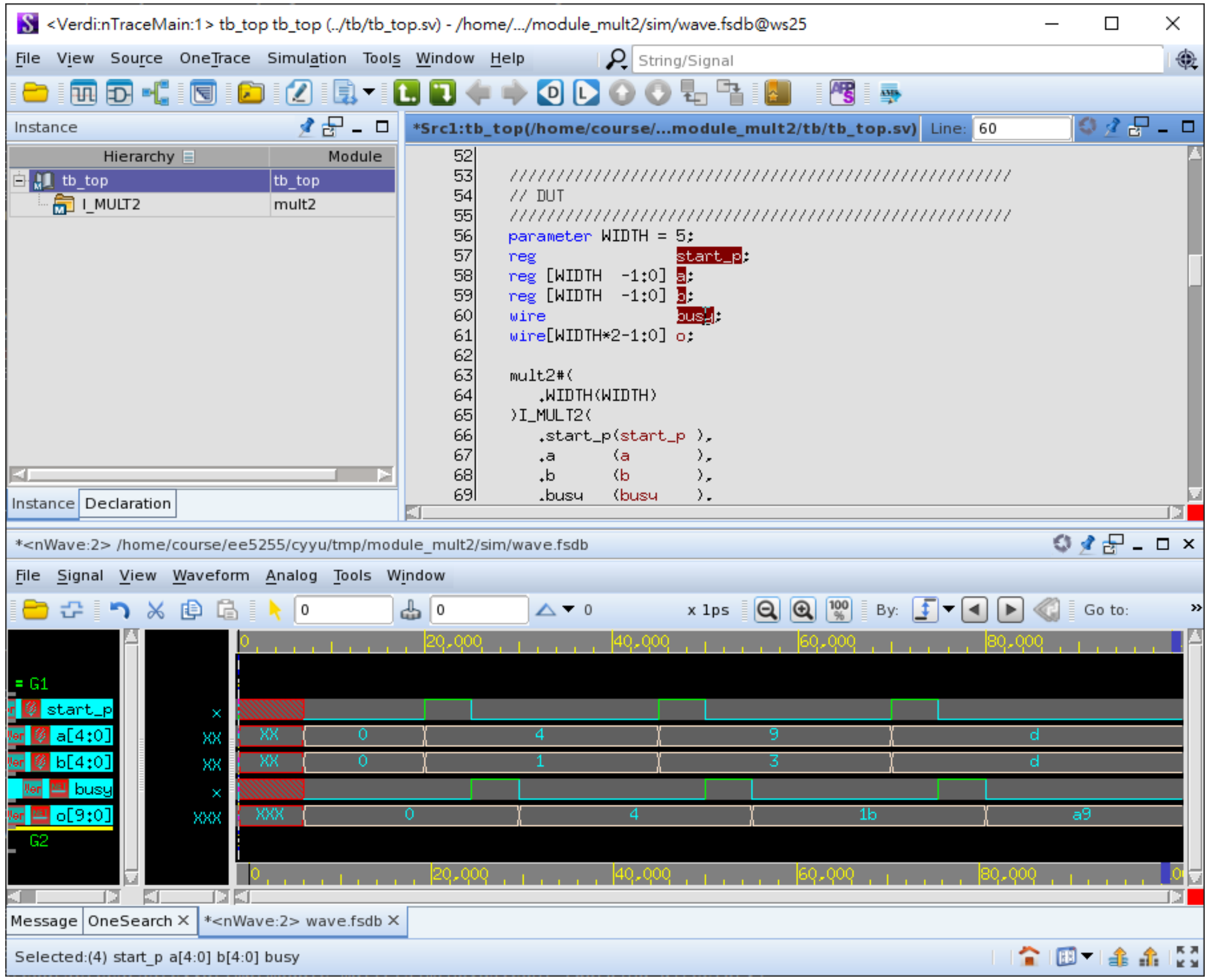
Design Files:
-f /home/course/ee5255/cyyu/tmp/module_mult2/sim/sim.f

Open nWave in Verdi


1
2
3
double click
4
<Verdi:nTraceMain:1> tb_top tb_top (../tb/tb_top.sv)@ws25
File View Source OneTrace Simulation Tools Window Help
String/Signal
Instance
Hierarchy
Module
tb_top
tb_top
I_MULT2
mult2
Instance
Declaration
*<nWave:2> No File Opened
File Signal View Waveform Analog Tools Window
Open Dump File(Time Range: 0 ~ 100000 x1ps)@ws25
Look in:
/home/course/ee5255/cyyu/tmp/module_mult2/sim
sim
..
csrc
simv.daidir
verdiLog
csrc
simv.daidir
verdiLog
wave.fsdb
Target:
wave.fsdb
File Filter:
.vf;.jf;*.zwd*
Target Name:
/home/course/ee5255/cyyu/tmp/module_mult2/sim/wave.fsdb
Options...
OK
Cancel

View Signal in Verdi and nWave

- Select the signal in Verdi, press “ctl+w”, to display the waveform on the nWave



<Verdi:nTraceMain:1> tb_top tb_top (../tb/tb_top.sv) - /home/.../module_mult2/sim/wave.fsdb@ws25
File View Source OneTrace Simulation Tools Window Help
String/Signal
Instance
Hierarchy
Module
tb_top
tb_top
I_MULT2
mult2
Instance
Declaration
*Src1:tb_top(/home/course/...module_mult2/tb/tb_top.sv)
Line: 60
*<nWave:2> /home/course/ee5255/cyyu/tmp/module_mult2/sim/wave.fsdb
File Signal View Waveform Analog Tools Window
x 1ps
By:
Go to:
G1
start_p
a[4:0]
b[4:0]
busy
o[9:0]
G2
0
20,000
40,000
60,000
80,000
Message
OneSearch
*<nWave:2> wave.fsdb

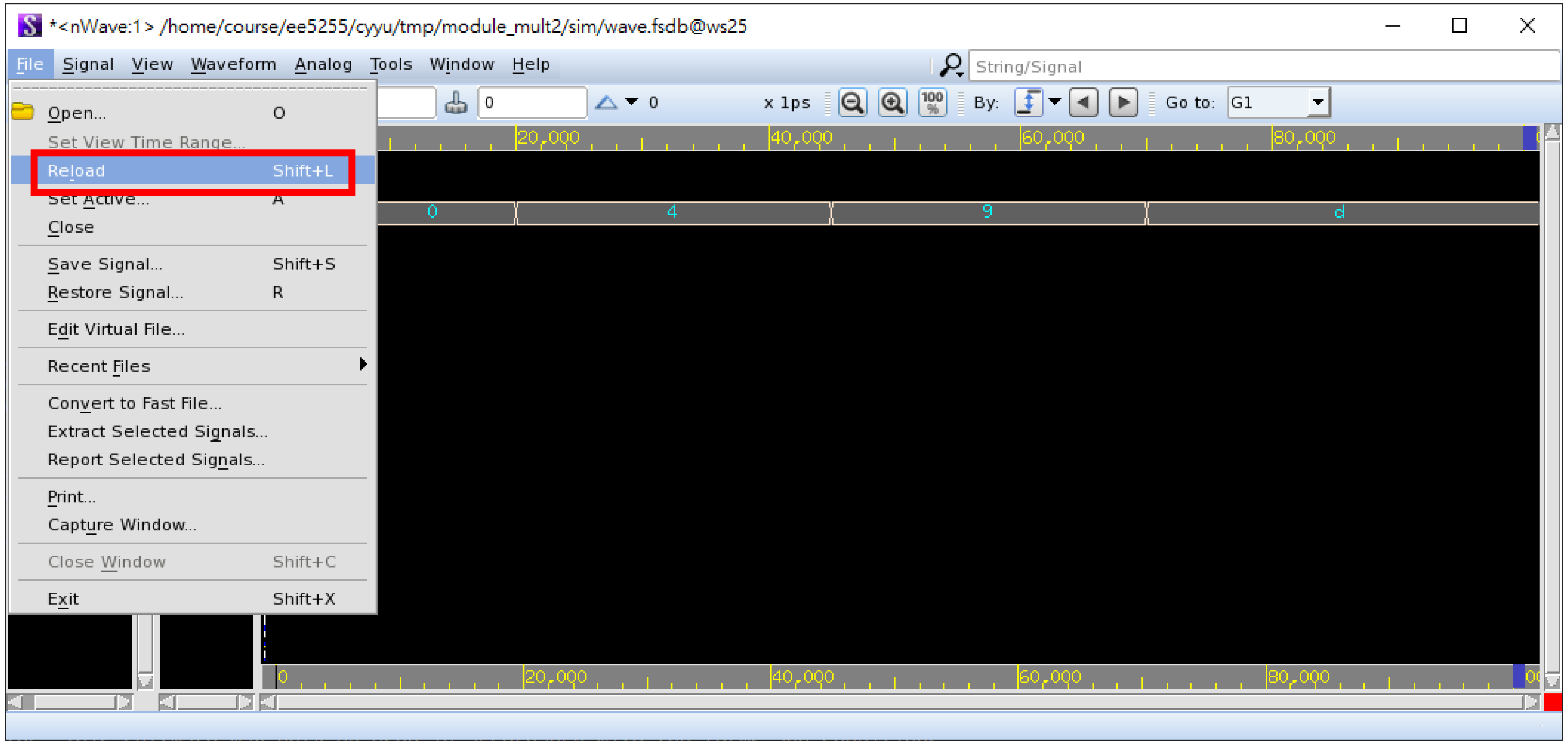
```
////////////////////////////////////////////////////////
// DUT
////////////////////////////////////////////////////////
parameter WIDTH = 5;
reg                  start_p;
reg [WIDTH  -1:0]    a;
reg [WIDTH  -1:0]    b;
wire                 busy;
wire[WIDTH*2-1:0]    o;

mult2#(
   .WIDTH(WIDTH)
)I_MULT2(
   .start_p(start_p ),
   .a      (a       ),
   .b      (b       ),
   .busy   (busy    ),
```

```
start_p   x
a[4:0]    XX    XX   0   4   9   d
b[4:0]    XX    XX   0   1   3   d
busy      x
o[9:0]    XXX   XXX  0   4   1b  a9
```

Selected:(4) start_p a[4:0] b[4:0] busy

Reload waveform

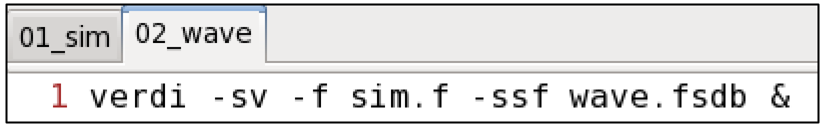
- You can use "shift+L" to reload fsdb after changing the code or simulation.



*<nWave:1> /home/course/ee5255/cyyu/tmp/module_mult2/sim/wave.fsdb@ws25

View Signal in Verdi and nWave

- Or use
  $ ./02_wave

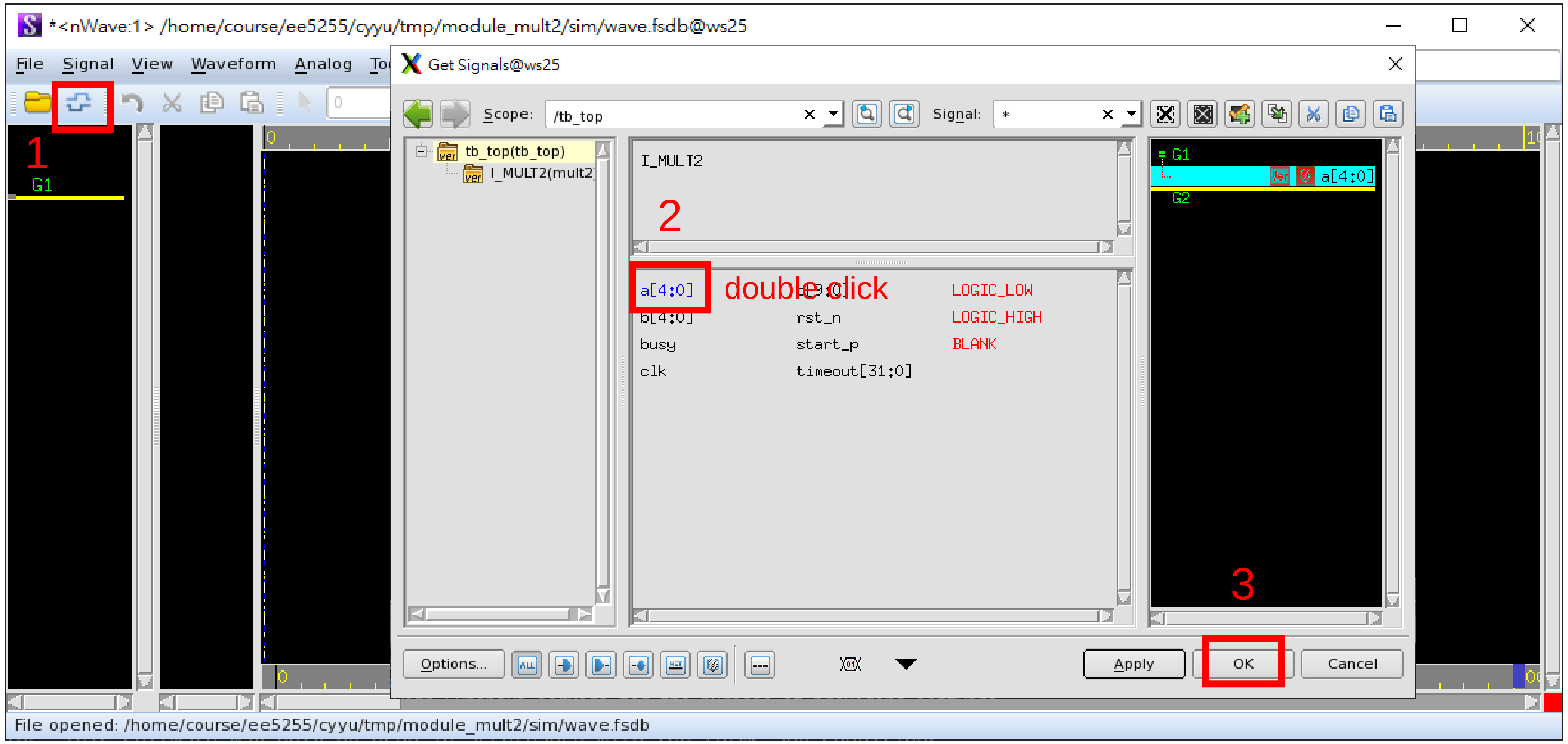
```
verdi -sv -f sim.f -ssf wave.fsdb &
```

  to open Verdi and nWave

Open nWave Only

- Because Verdi take more resources, sometimes it is very slow.
  If necessary, you can only open nWave.

- $ nWave &



File opened: /home/course/ee5255/cyyu/tmp/module_mult2/sim/wave.fsdb

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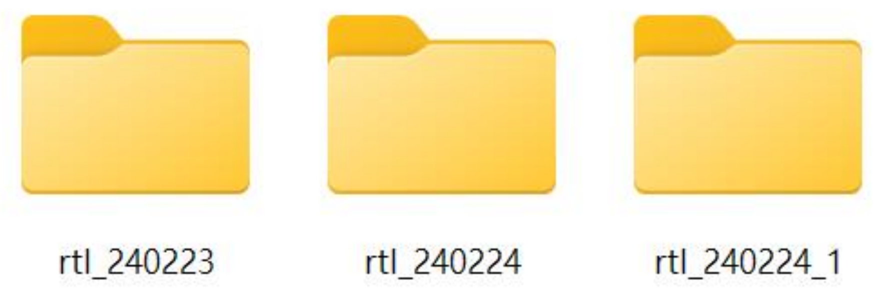
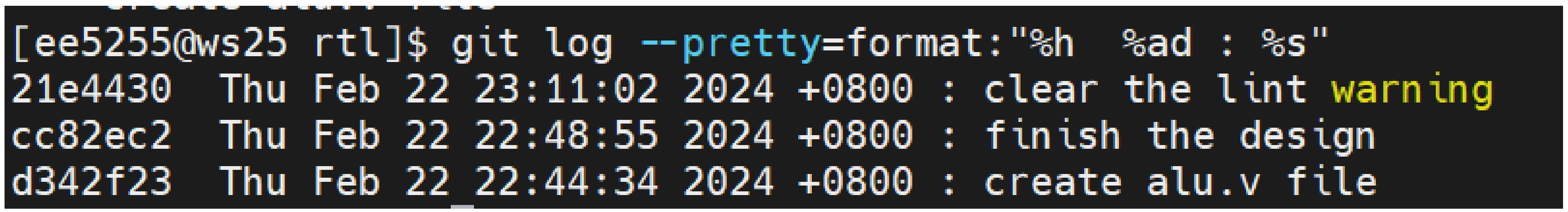
Git Introduction

- Without version control, workspaces can become complex over time.



- With version control, your workspace will be clean and your editing information will be preserved.



```
[ee5255@ws25 rtl]$ git log --pretty=format:"%h  %ad : %s"
21e4430  Thu Feb 22 23:11:02 2024 +0800 : clear the lint warning
cc82ec2  Thu Feb 22 22:48:55 2024 +0800 : finish the design
d342f23  Thu Feb 22 22:44:34 2024 +0800 : create alu.v file
```

Git Quick Guide

- Git is a version control system that helps developers to track changes to their source code.

- Create a new Git repository in the current directory

  $ git init

- Making untracked or modified files be tracked in Git

  $ git add <filename> → staged

  $ git commit → unmodified in work directory

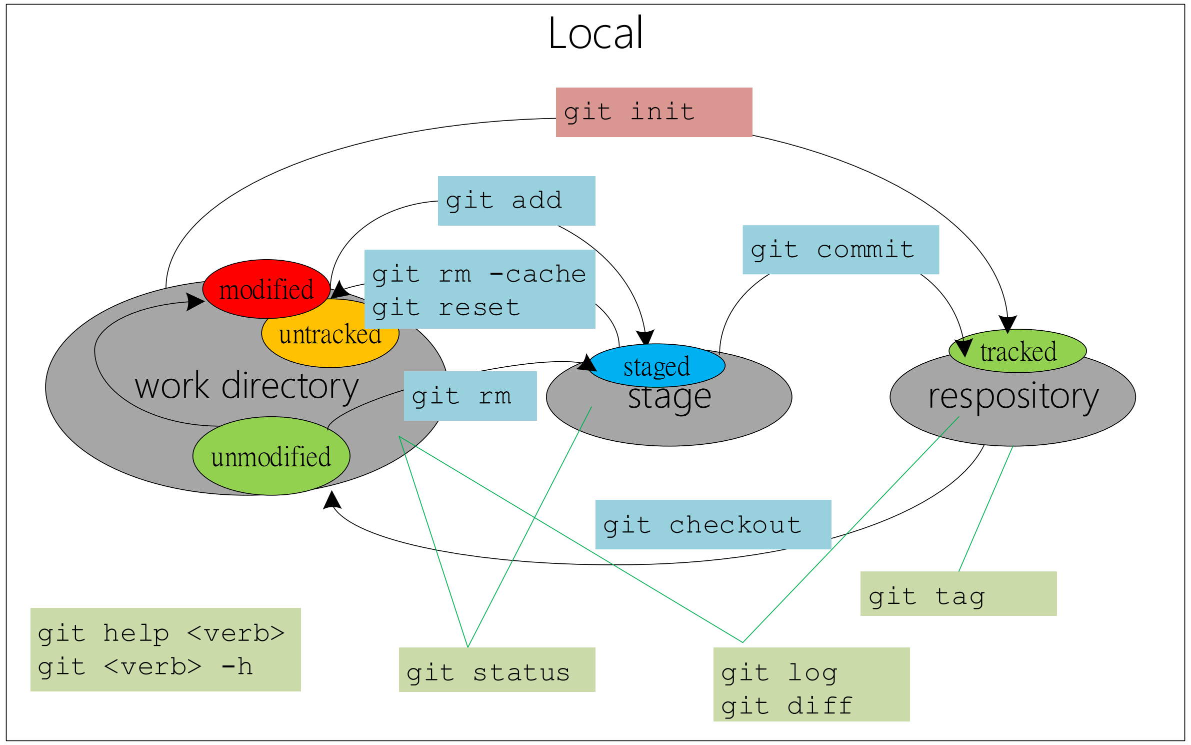
  tracked in repository

- Deleting unmodified files in Git

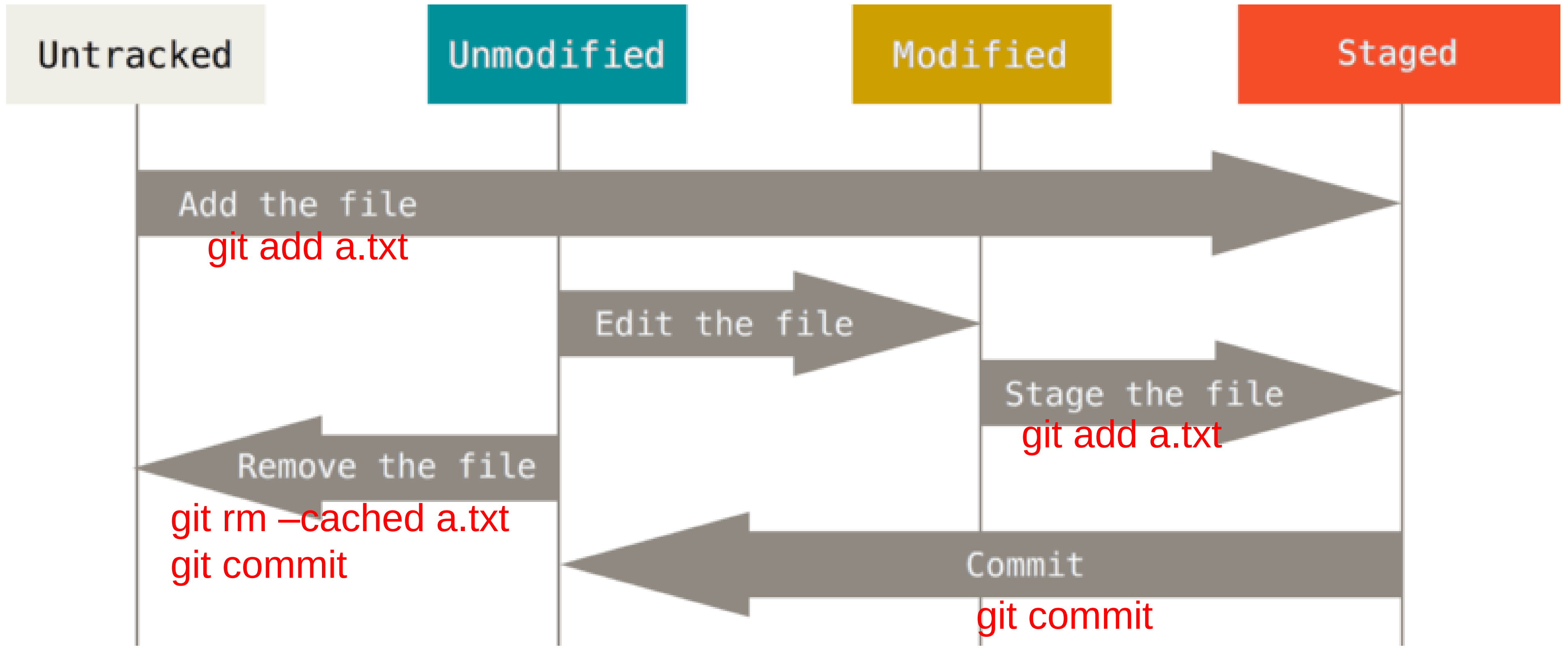
  $ git rm <filename> → staged

  remove in work directory

  $ git commit → remove be tracked in git repository



Git file status



Git Quick Guide

- $ cd <new_dir>
  - which you want to use it as the root of this git project.
- $ git init
  - create a new Git repository in the current directory
- $ git status
  - shows the current status of the repository
- $ git add <filename>
  - add the specified file to the staging area
- $ git commit -m "commit message“
  - save the changes to the repository with a message describing the changes
- $ git rm <filename>
  - remove a file from the Git repository

Git Quick Guide

- $ git log
  - shows the commit history, type “q” to exit
- $ git reset
  - Reset a files or commit (discard followed by commit)(won’t modify files)
- $ git checkout
  - checkout a file or commit (discard changes of files)(will modify the files)

Feedback to us

NTHU 晶片安全設計 回饋單

https://forms.office.com/r/DYDu8vLaWN

Thank you!

PUFacademy

A PUFsecurity Alliance

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