CUHK 香港中文大學 | Electronic Engineering 電子工程學系

ELEG 5765 Fundamentals of Automotive Integrated Circuits

Lecture 2

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Outline

- Linux
- VCS

Tools

- Linux
- Gvim
  - Text editor for coding RTL
- VCS
  - for RTL simulation
- DVE or Verdi
  - for viewing waveform
- Design Compiler
  - for RTL compile

Basics of Linux

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- Basic commands

  https://www.runoob.com/w3cnote/linux-common-command-2.html

  https://cloud.tencent.com/developer/article/2375910

  https://blog.csdn.net/ttrr27/article/details/135424226

  https://blog.csdn.net/as604049322/article/details/120446586

- Shell scripts

  https://www.runoob.com/linux/linux-shell.html

- makefile

  https://zhaishuangdong.blog.csdn.net/article/details/106889661

  https://blog.csdn.net/ZBraveHeart/article/details/123187908

VCS

- https://www.synopsys.com/zh-cn/verification/simulation/vcs.html
- https://blog.csdn.net/Hide_in_Code/article/details/141792415
- https://cloud.tencent.com/developer/article/2111018
- https://blog.csdn.net/qq_39507748/article/details/115087549
- https://blog.csdn.net/burningCky/article/details/109891288
- https://blog.csdn.net/m0_57102661/article/details/135654223

Verdi

- https://www.synopsys.com/zh-cn/verification/debug/verdi.html
- https://blog.csdn.net/immeatea_aun/article/details/80961258

Linux

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- Linux OS for EDA tools
  - Stable, efficient, low hardware requirement and low cost
  - Case sensitive
  - Centos

- Operation in this course
  - Run command in Shell

```
command  [-options]  [parameter1]  …
```

Path

- Absolute path
  - /home/user/me/IC/course5765/project_1/RTL/top.v
  - /home/user/me/IC/course5765/project_1/script/run_vcs

- Relative path
  - Relative to the current path
  - Example: ../RTL/top.v (The path of top.v relative to run_vcs)
  - Can still work without modification when copying to other directories
  - Use relative path instead of absolute path when in file

help & man

- [command] --help
- man (manual)
  - man [command]

Command: ls

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- ls (list: list the files/directories in the target path)
  - ls ../RTL

- ls --help

```
[root@share ~]# ls --help
Usage: ls [OPTION]... [FILE]...
List information about the FILEs (the current directory by default).
Sort entries alphabetically if none of -cftuvSUX nor --sort is specified.

Mandatory arguments to long options are mandatory for short options too.
  -a, --all                  do not ignore entries starting with .
  -A, --almost-all           do not list implied . and ..
      --author               with -l, print the author of each file
  -b, --escape               print C-style escapes for nongraphic characters
      --block-size=SIZE      scale sizes by SIZE before printing them; e.g.,
                               '--block-size=M' prints sizes in units of
                               1,048,576 bytes; see SIZE format below
  -B, --ignore-backups       do not list implied entries ending with ~
  -c                         with -lt: sort by, and show, ctime (time of last
                               modification of file status information);
                               with -l: show ctime and sort by name;
                               otherwise: sort by ctime, newest first
  -C                         list entries by columns
```

Command: ls

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- ls -a # List all the files 显示所有文件（包括隐藏文件）
- ls -al # List the information of all files 显示所有文件详细信息
- ls -t # sort by modification time
- ls -h # print file size in human readable format (e.g., K, M, G)
- ls *.v # List .v files

1) d, -, l : directory, file, link
2) rwx : read, write, execute (Value 4,2,1)
3) 3 groups of rwx: owner, group user, other user
4) chmod 744 [file.name]

```
-rw-r--r-- 1 root root   90 Nov 23 10:26 passwd
drwxr-xr-t 2 root root 4.0K Nov 22 21:15 test
-rw-r--r-- 1 root root  276 Nov 24 10:01 user
lrwxrwxrwx 1 root root   14 Nov  6 19:18 web -> /var/www/html/
```

command

- pwd
  - Print Working Directory
- cd
  - Change Directory
  - Example: cd ../RTL cd ~ cd -
- mkdir
  - Make Directory
  - Example: mkdir mynewdir
- rmdir
  - Remove Directory

command

- clear
  - Clear the shell display

- history
  - history of command

command

- cp
  - Copy
  - Example: cp -ir sourcefile ./bak/targetfile
  - -i : interactive
  - -r : recursive
- touch
  - Create new file
- mv
  - Move
- rm
  - Remove

command

- grep
  - get regular expression
  - Search for pattern
  - Example: grep -r keyword ./
- find
  - find file
  - Example: find ./ -name top.v
- which
  - search command path
  - Example: which vcs
- diff
  - Compare files line by line
  - diff [OPTION] FILES

command

- ps
  - Process Select
  - Example: ps -ef
- kill
  - Kill process
  - Example: kill -SIGKILL 434

command

- df
  - Disk Free
  - Example: df -h
- du
  - Disk Usage
  - Example: du -sh [directory]
- free
  - Memory Free
  - Example: free -m

pipe

- [command 1] | [command 2]
- The pipe takes the output of the preceding command as the input for the later command
- Example: ls | grep keyword

re-direction

- grep keyword > searchresult.txt

  Output the result of command to a new file

- grep keyword >> searchresult.txt

  Output the result of command appending an existing file

tab

- Use “tab” when typing names of commands, files, directories
  - After typing the first letter, type “tab”
    - If there is only one name beginning with the given letter, “tab” will complete the full name
    - If there is more than one name beginning with the given letter, “tab” will display all the names begin with the given letter; Type the second (and third, etc., if needed) letter and then type “tab” to complete the full name
  - “tab” twice for command

  - Automatic completing
  - Checking

Basics of VCS

- Let's start from a simple example
  https://blog.csdn.net/burningCky/article/details/109891288

- Try the open-source examples

Design File: add.v

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```
 2 module add (
 3
 4     input          [20:0]    A ,
 5     input signed   [17:0]    B   ,
 6
 7     output signed [22:0]    C);
 8
 9     wire signed [21:0]  A_signed;
10
11 assign A_signed = {1'b0,A};
12 assign C = A_signed + B;
13
14 endmodule
```

Testbench File: test.v

```
1  `timescale 1ns/1ns
2
3  module test;
4
5  reg clk;
6  reg rst_n;
7
8  reg [20:0] A;
9  reg signed [17:0] B;
10
11 wire signed [22:0] C;
12
13 initial begin
14     clk = 0;
15     rst_n = 0;
16     #10;
17     rst_n = 1;
18     A = 21'b0_0000_0000_0000_1111_1111;
19     B = 18'b11_1111_1111_0000_0000;
20     #200;
21     $stop;
22
23 end
24
25 always #5 clk = ~clk;
26
27 add add_inst(
28     .A(A),
29     .B(B),
30     .C(C));
31 endmodule
```

Location of Files

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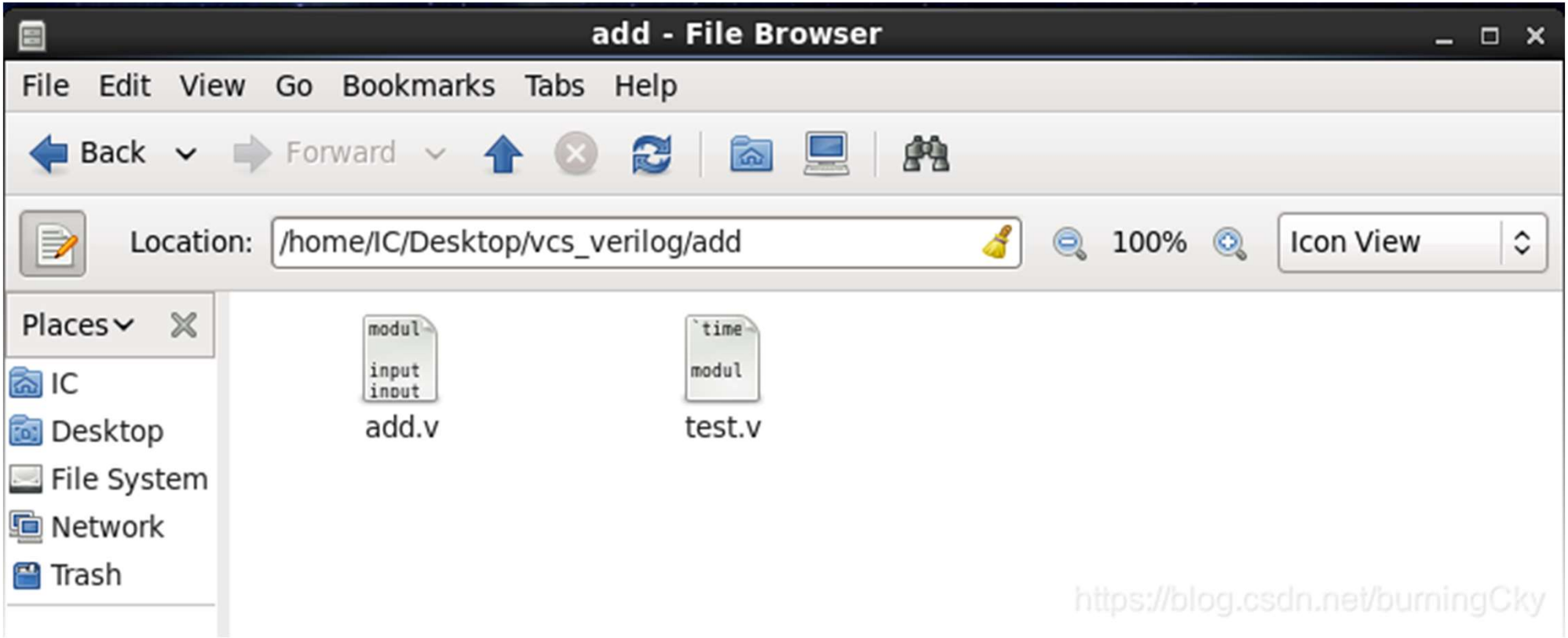
- Design and testbench files are all in the same directory.



Run VCS

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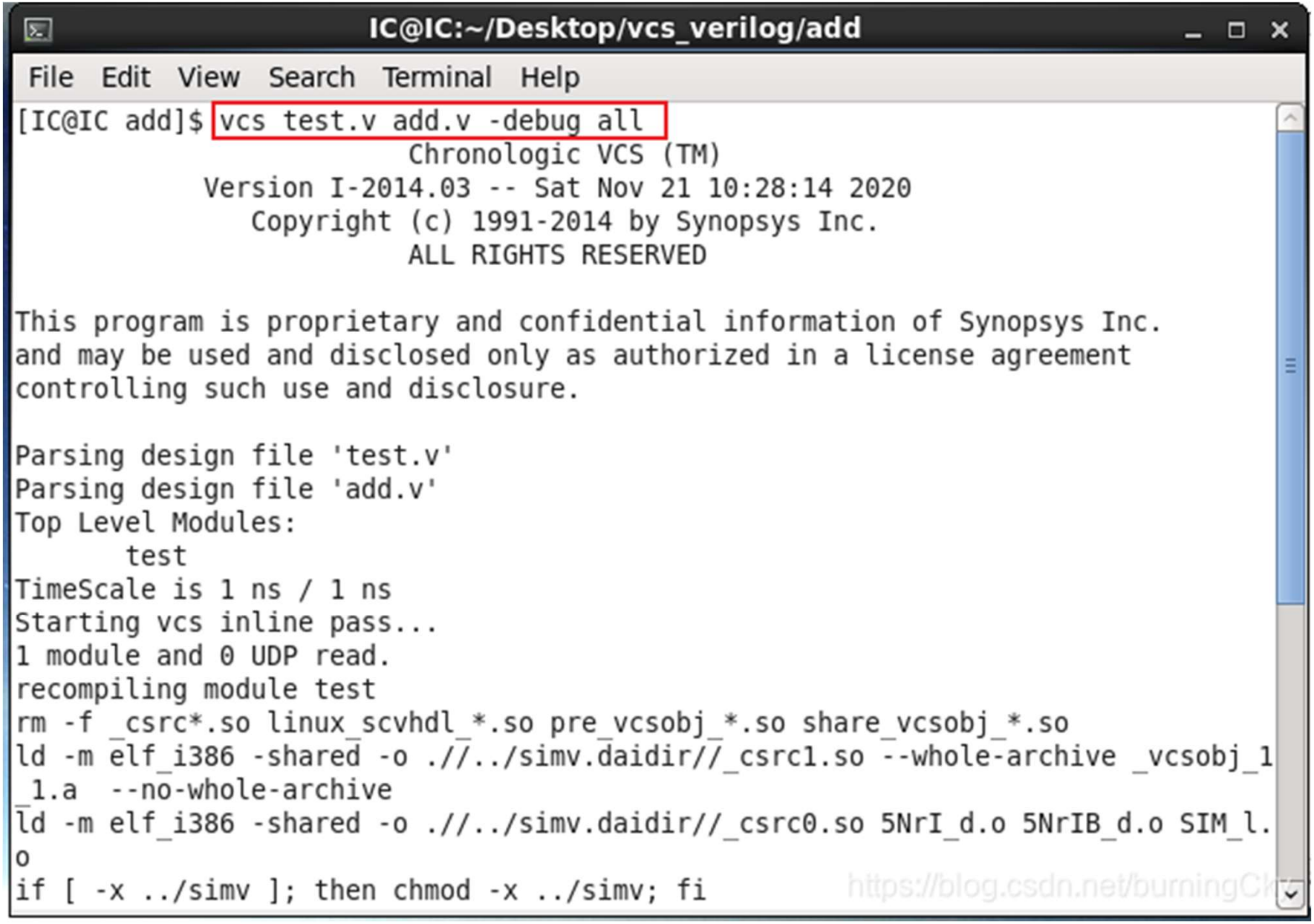
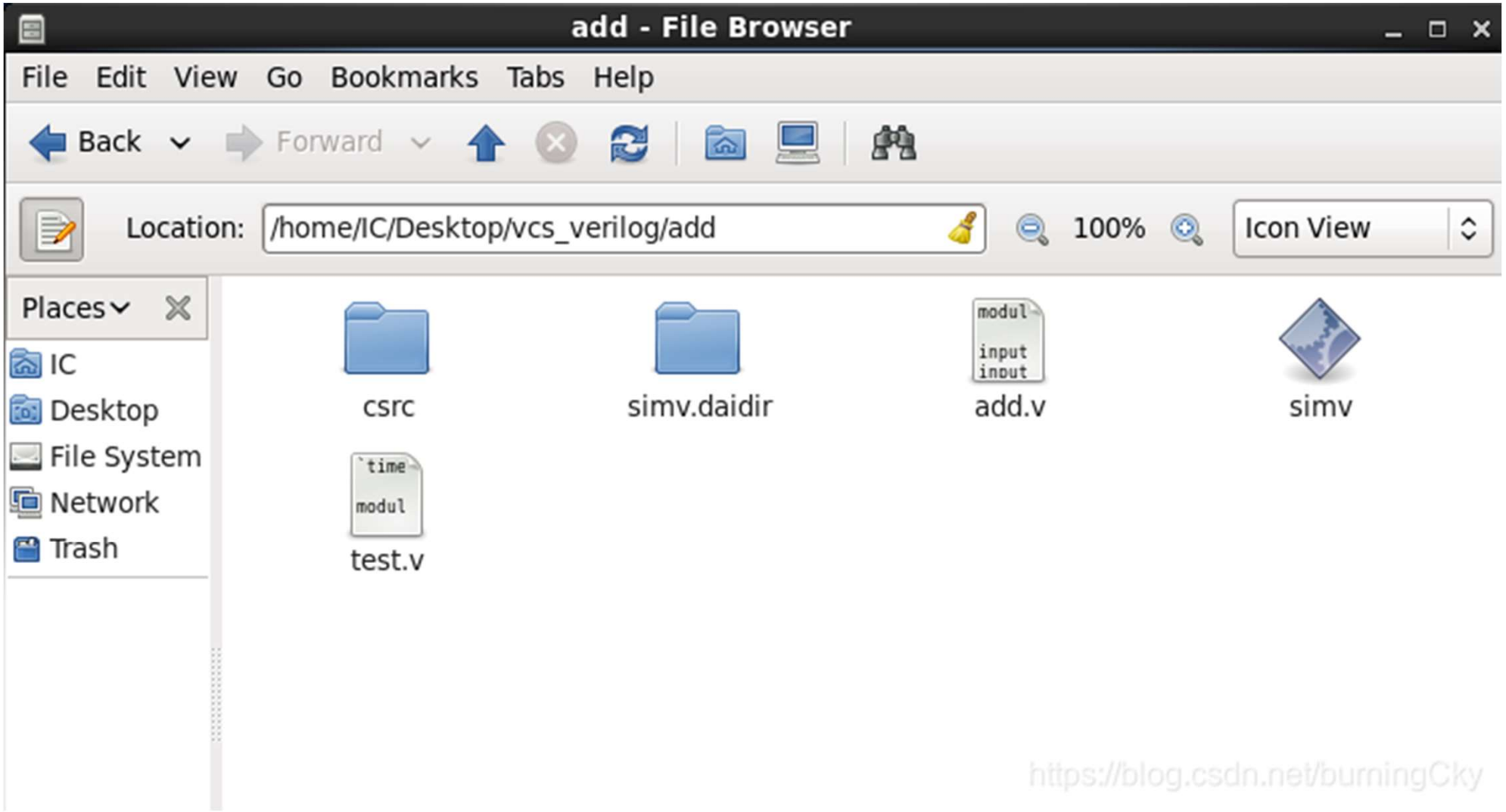
- Run VCS in the same directory as design and testbench files.
- Top file first



Files Generated by VCS

- Compilation
- simv



Run simv

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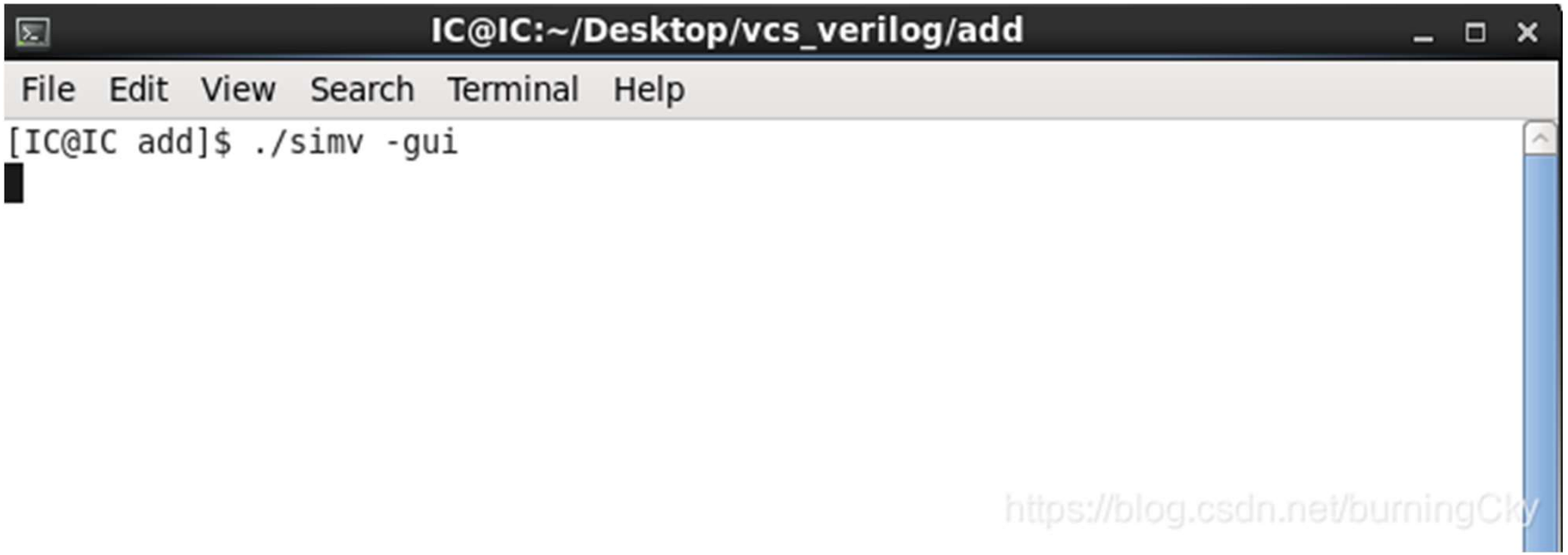
- Run simulation
- -gui : open graph window for waveform
- DVE : waveform viewer embedded in VCS



DVE

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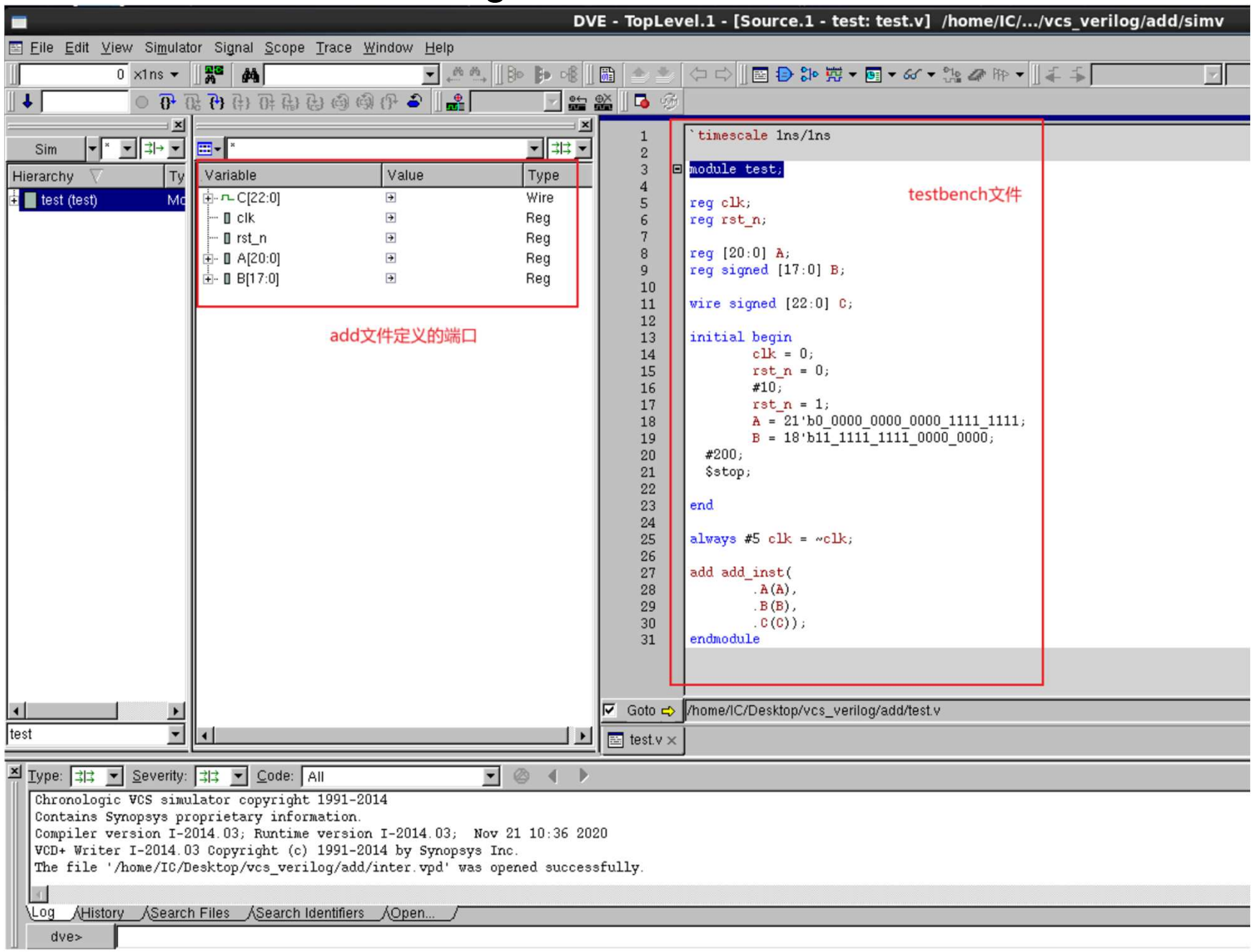
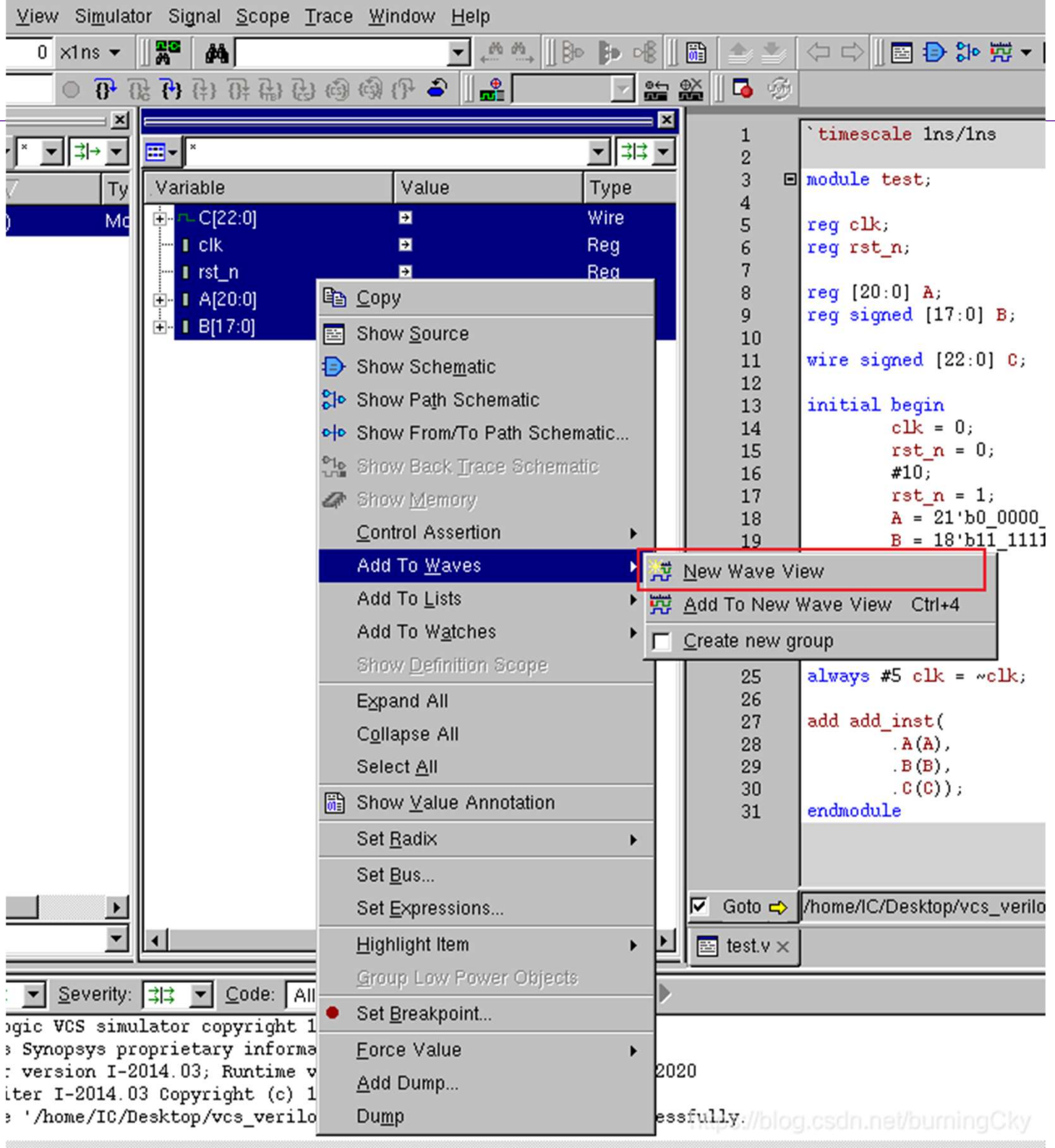
- Select file, module, signal in DVE



Add to wave

- Select signals
- Add to Waves



Waveform Window in DVE

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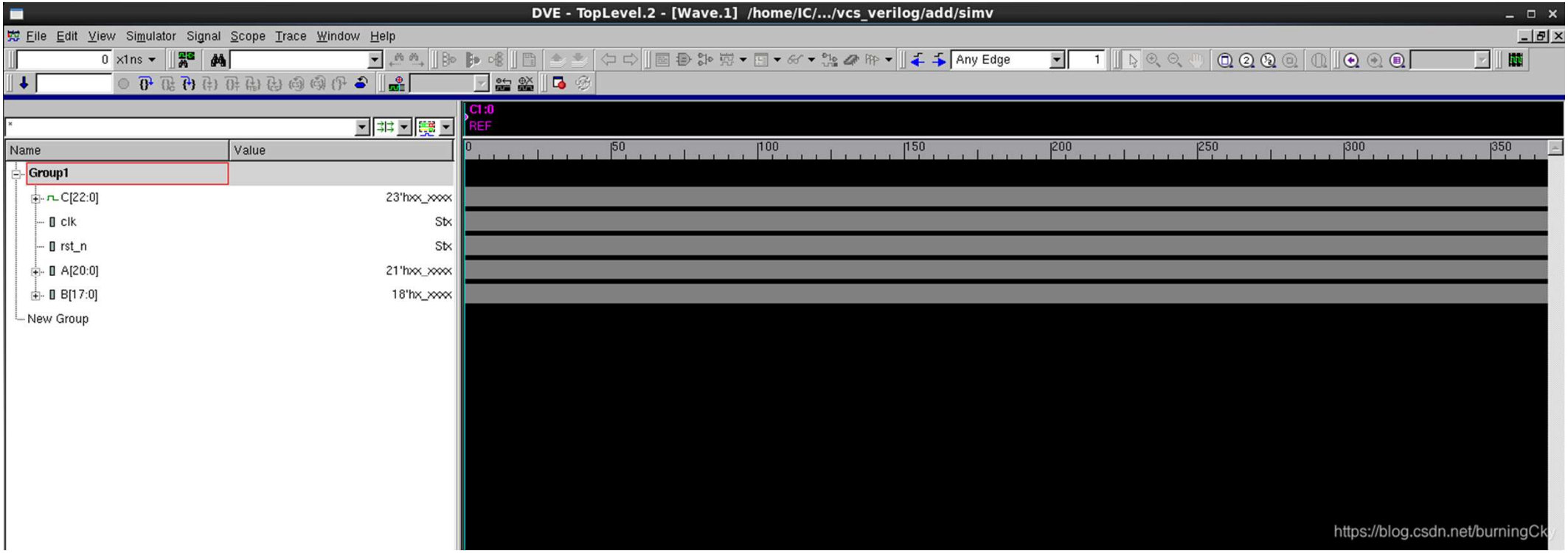

Waveform

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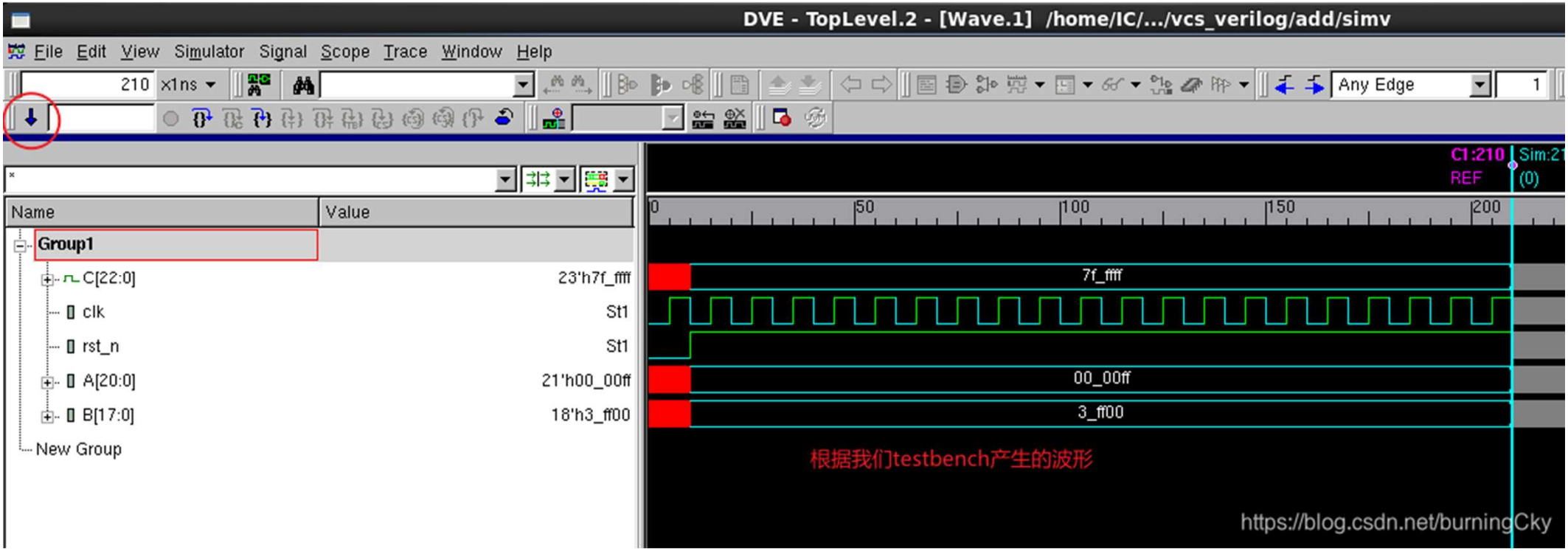

Overview

- Step 1: Compile
  - by run VCS
  - compile source files
  - generate executable file for simulation
- Step 2: Simulate
  - by run simv generated by compilation
  - generate simulation result
- Step 3: View waveform
  - open waveform in graph window by DVE

makefile

- make compile
- make sim
- make all
- make clean

```
1  all: compile sim
2
3  compile:
4      vcs test.v add.v -debug_all
5
6  sim:
7      ./simv -gui
8
9  clean:
10     rm -r csrc DVEfiles simv.daidir *.vpd simv *.key
```

Open Sources of IC

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- Search engine
- https://github.com/
- https://opencores.org/
- https://ieeexplore.ieee.org
- https://www.csdn.net/
- https://www.zhihu.com/
- https://bbs.eetop.cn/

Study Materials (Optional)

- Tiny GPU
  - https://github.com/adam-maj/tiny-gpu
- AccelTran
  - https://github.com/jha-lab/acceltran
- C906
  - https://github.com/XUANTIE-RV/openc906