CS3120

Introduction of Integrated Circuit Design

HW1 Tutorial

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Outline

- Workstation
- Vim
- Tmux
- Hspice
  - Hspice and waveview
  - Hspice tutorial
  - Hspice simulation

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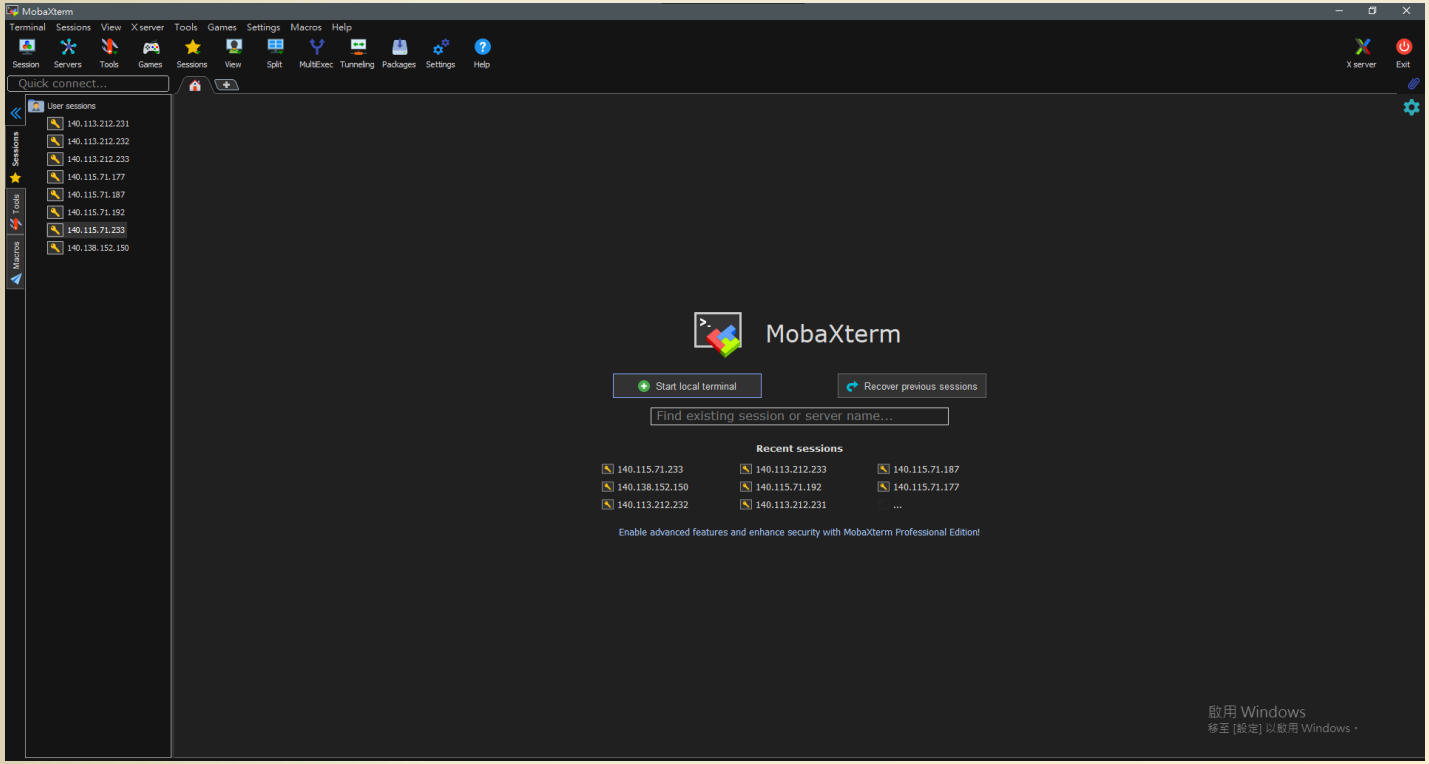
Workstation

- Basic information
  - System: Linux 3.10.0
  - Host: 140.115.71.44
  - Port: 22
  - Account/password: (A confidentiality agreement)
    - User: ts+your SturdentID
    - Password: 1234567890

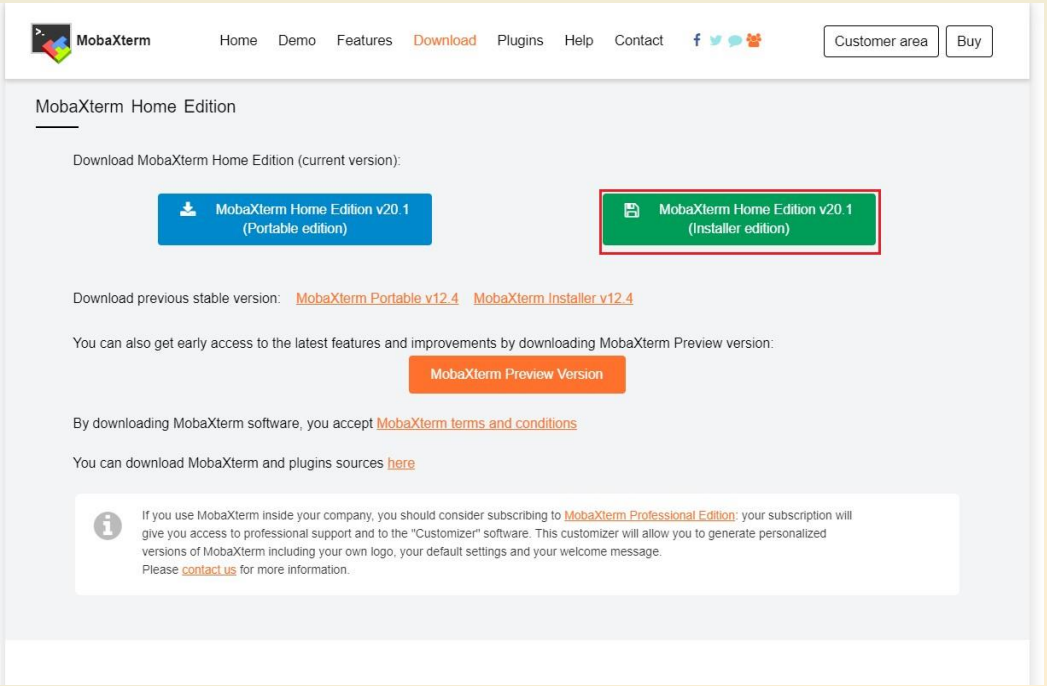
Workstation

- How to connect linux server
  - MobaXterm



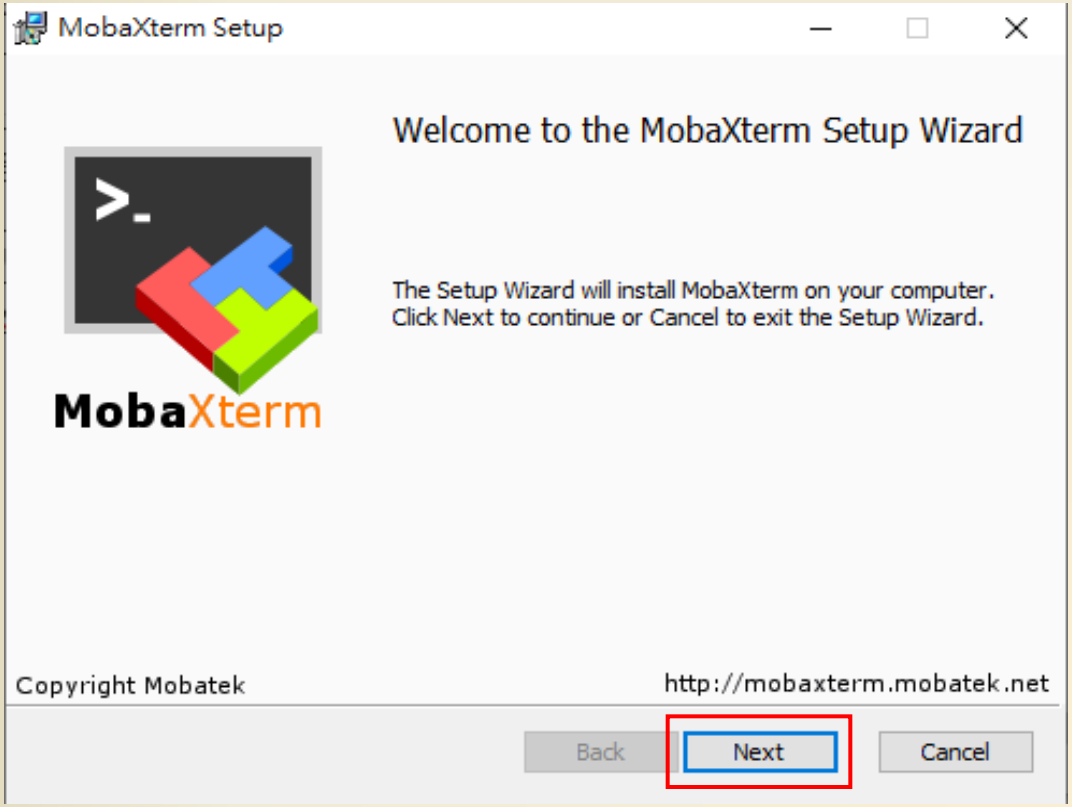
Workstation

- How to connect linux server
  - Step 1: download MobaXterm
    https://mobaxterm.mobatek.net/download-home-edition.html



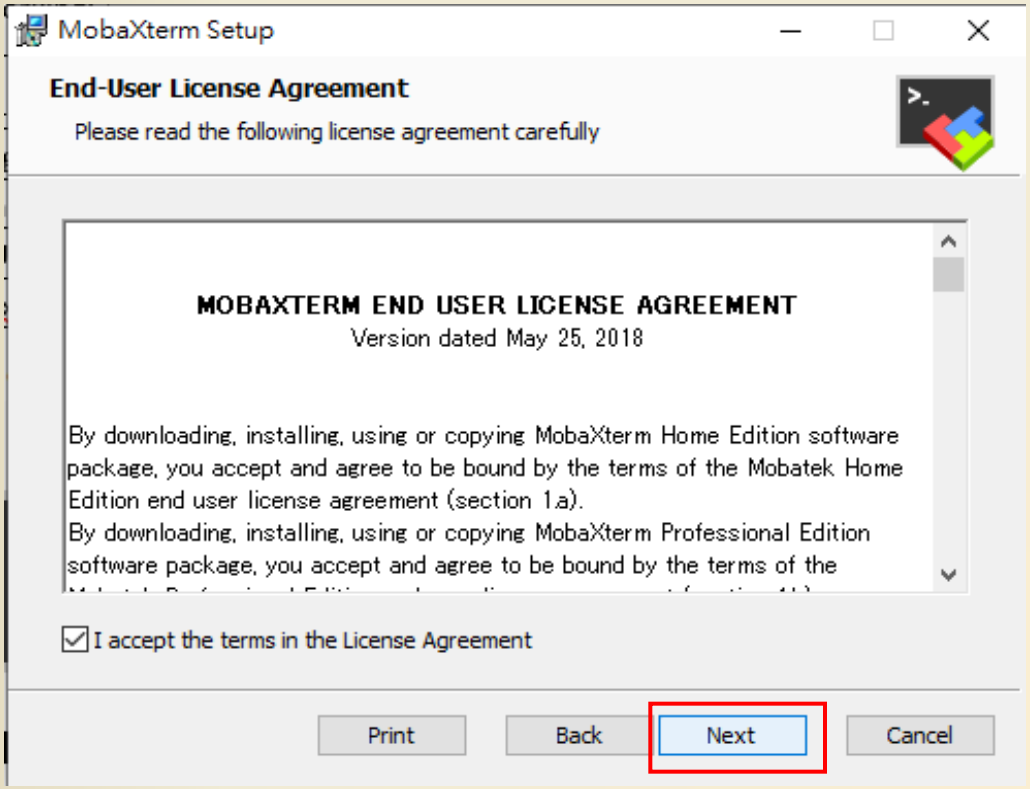
Workstation

- How to connect linux server
  - Step 2-1: install MobaXterm



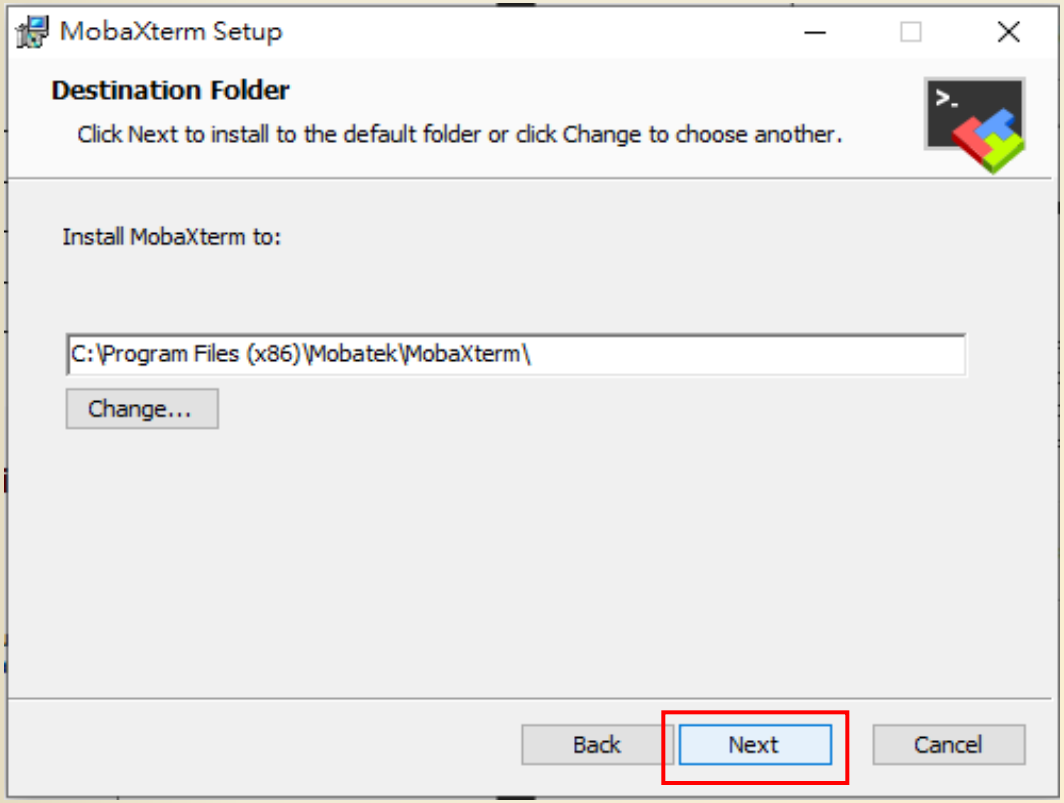
Workstation

- How to connect linux server
  - Step 2-2: install MobaXterm



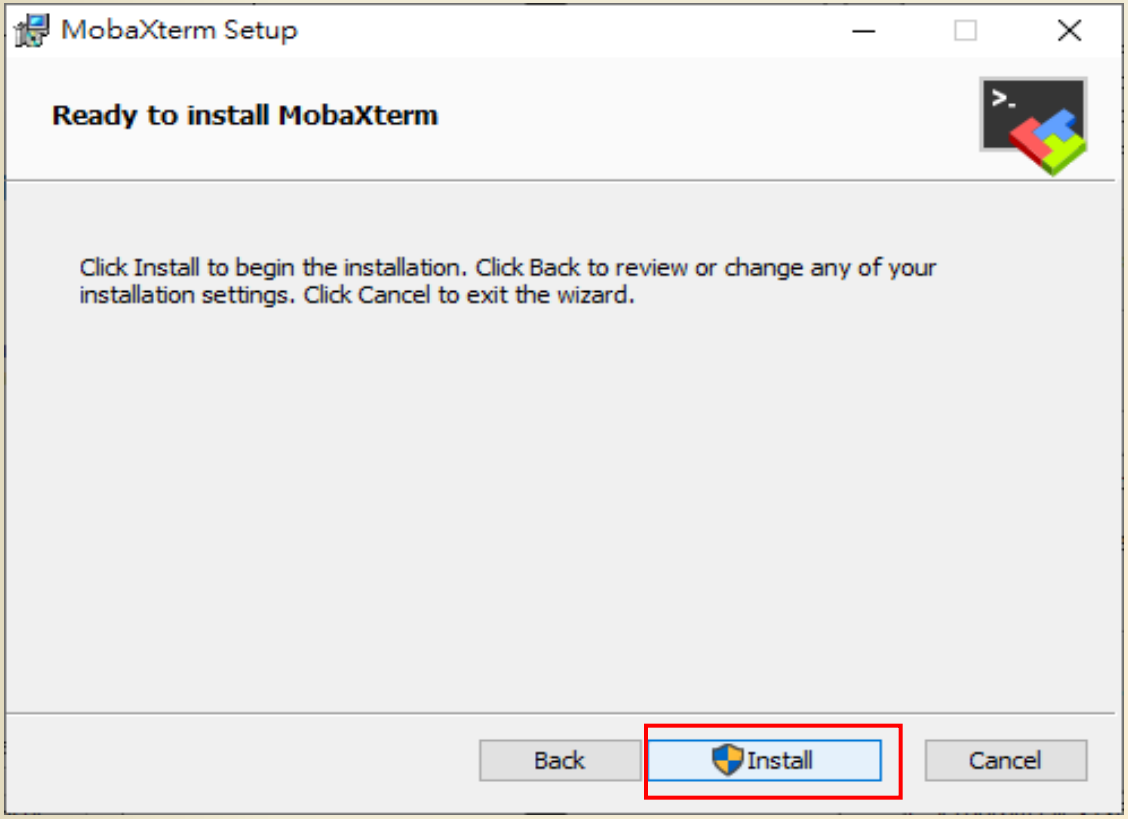
Workstation

- How to connect linux server
  - Step 2-3: install MobaXterm



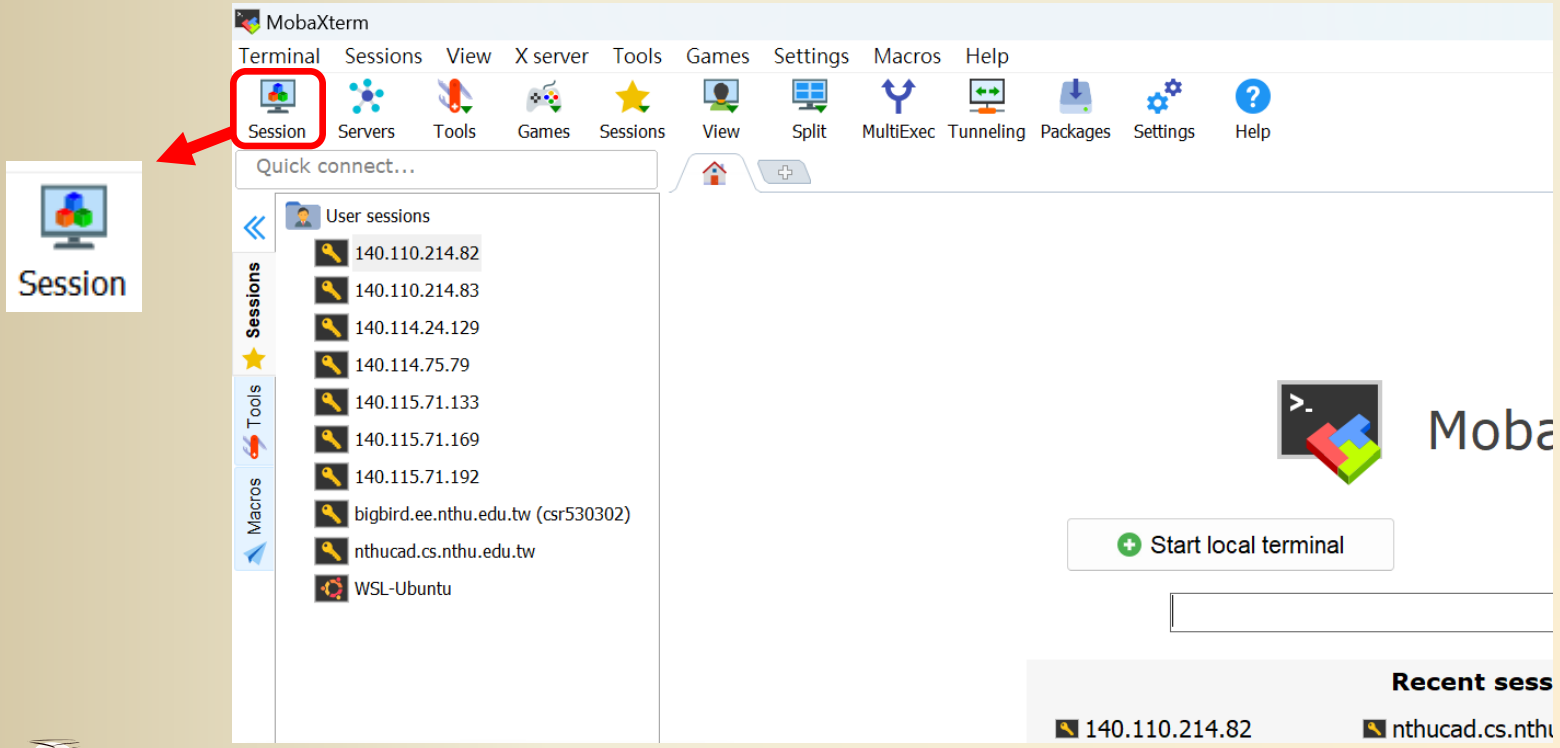
Workstation

- How to connect linux server
  - Step 2-4: install MobaXterm



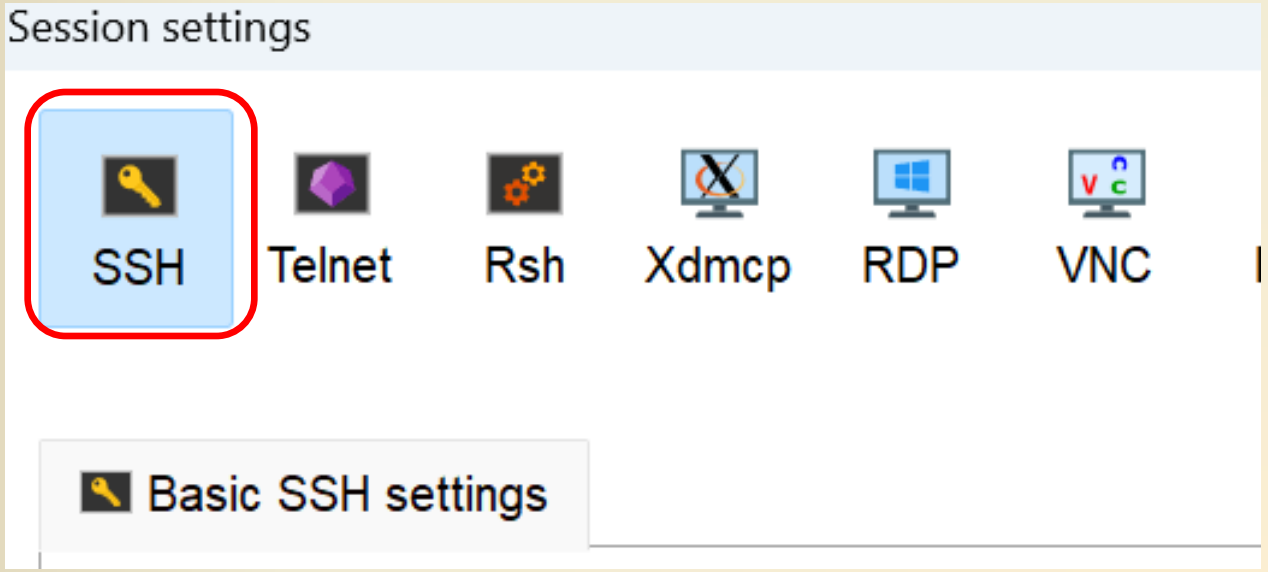
Workstation

- How to connect linux server
  - Step 3-1: Click session to create a new session



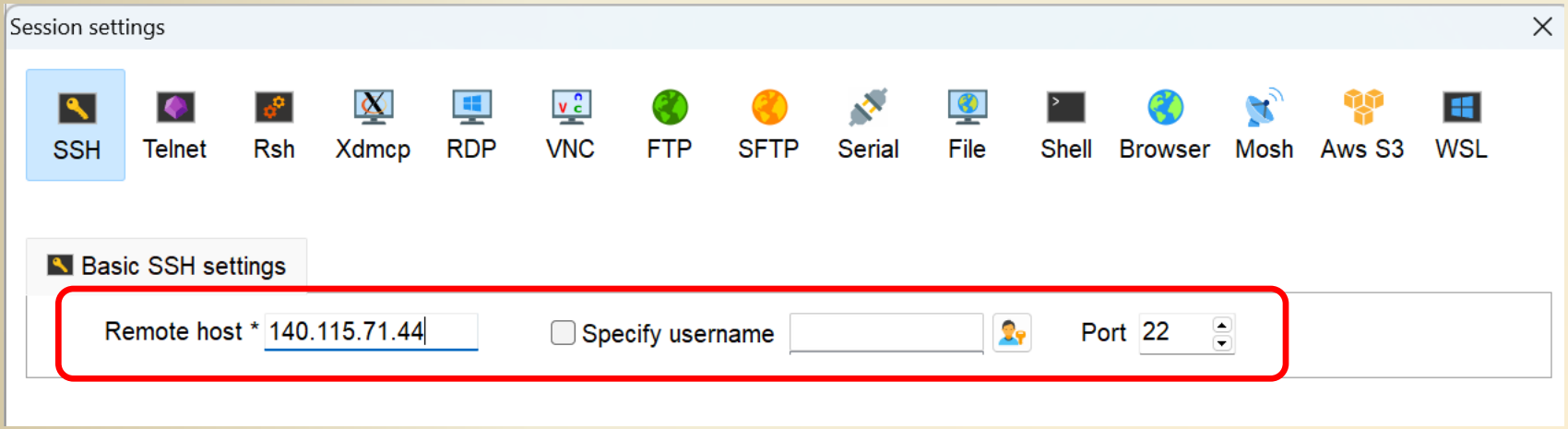
Workstation

- How to connect linux server
  - Step 3-2: Click ssh to create a new SSH session



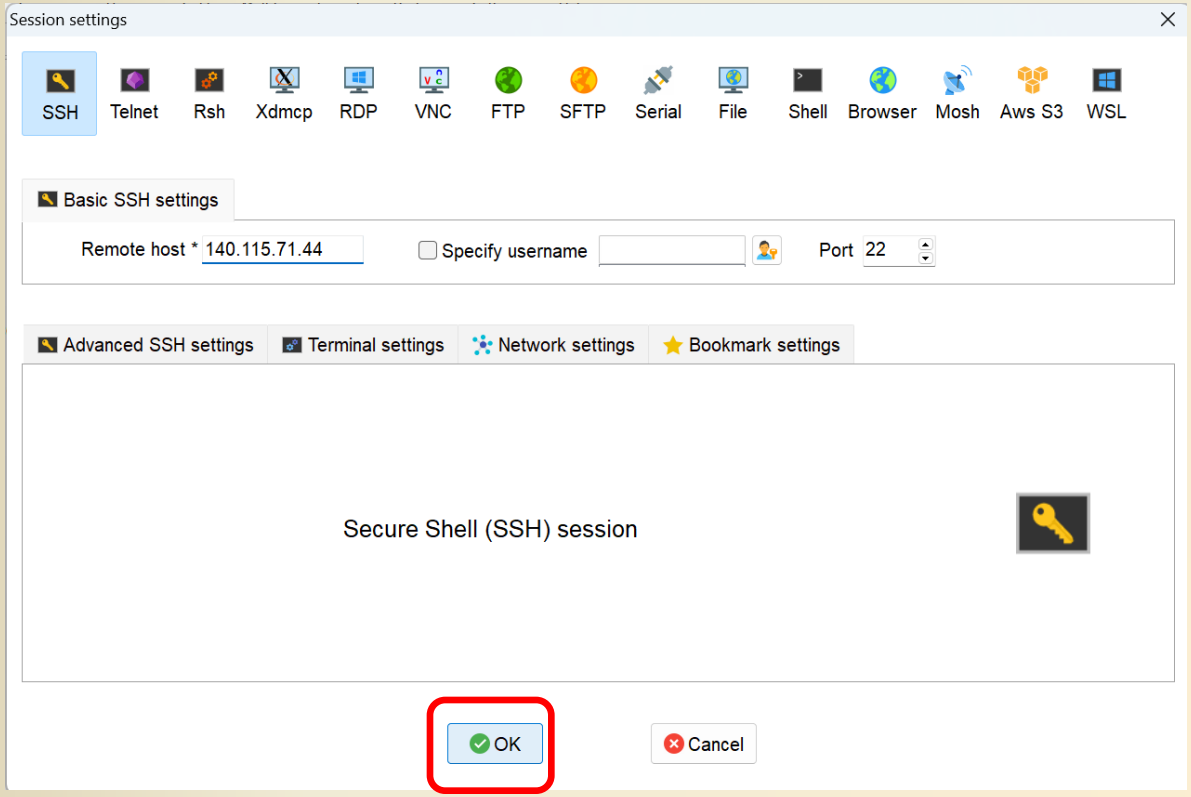
Workstation

- How to connect linux server
  - Step 3-3: Fill in the given Host to the Host field and set the port number to 22



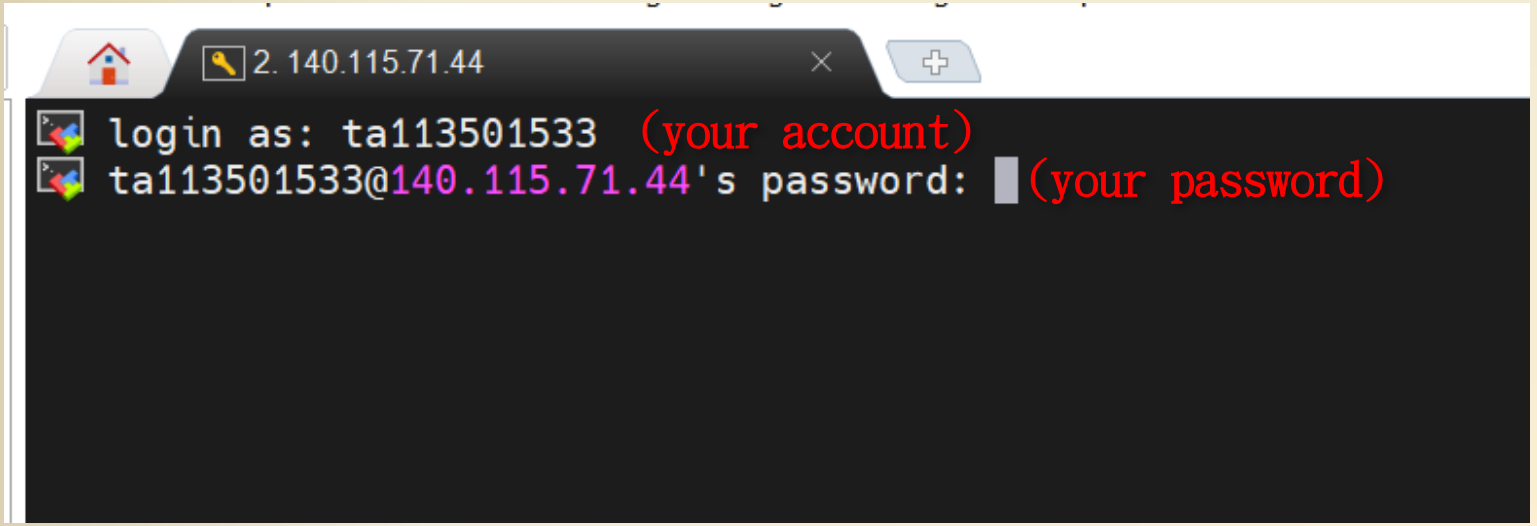
Workstation

- How to connect linux server
  - Step 3-4: Click ok



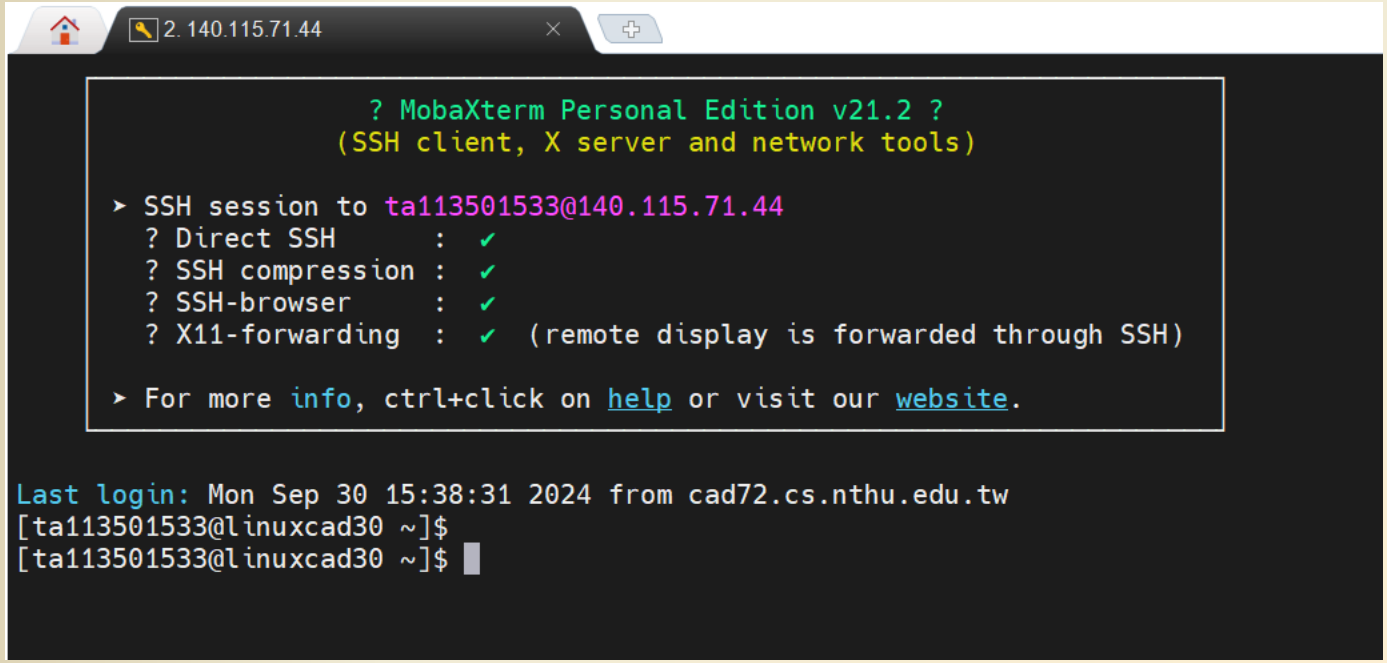
Workstation

- How to connect linux server
  - Step 3-5: Login



Workstation

- How to connect linux server
  - Step 3-6: Login



Workstation

- Change your workstation password
  - Step 4-1: Key in “ passwd ”
  - Step 4-2: Key in your current password
  - Step 4-3: Key in your new password
  - Step 4-4: Retype your new password again

```
[ta113501533@linuxcad30 ~]$ passwd   Step 4.1
Changing password for user ta113501533.
Changing password for ta113501533.
(current) UNIX password:  Step 4.2
New password:  Step 4.3
Retype new password:  Step 4.4
passwd: all authentication tokens updated successfully.
[ta113501533@linuxcad30 ~]$
[ta113501533@linuxcad30 ~]$
```

Basic command of workstation

- ls (list)
- ll (long list format)
- cd (change directory)
- pwd (print working directory)
- cp (copy)
- mv (move)
- rm (remove)
- mkdir (make directory)
- rmdir (remove directory)
- tar (compression tool)
- passwd (password)
- Ctrl + c (force quit)
- ps (process status)
- kill (kill process)

Basic Command

- mkdir

```
[109521021@eda359_forclass ~]$ mkdir PA1
[109521021@eda359_forclass ~]$
```

- ls

```
[109521021@eda359_forclass ~]$ ls
chiang  glen  isc2v-master  memory_hw  PA1
```

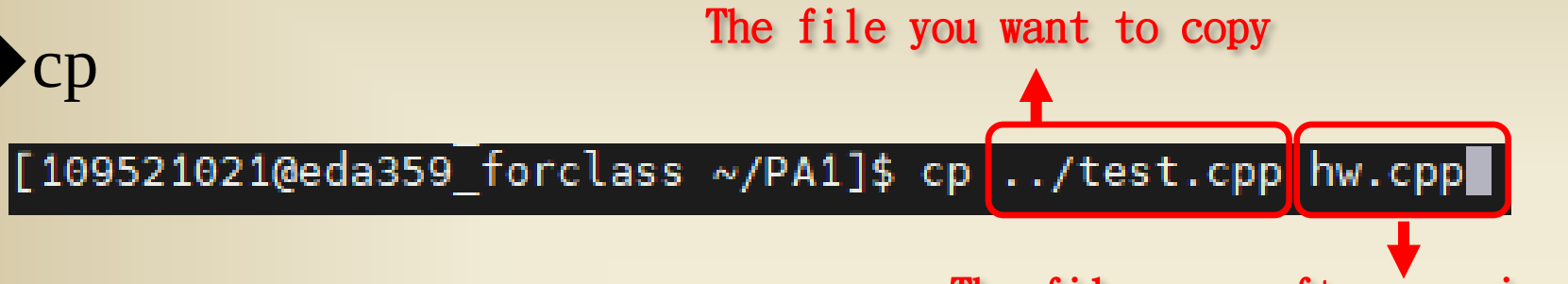
- cd

Enter PA1 directory

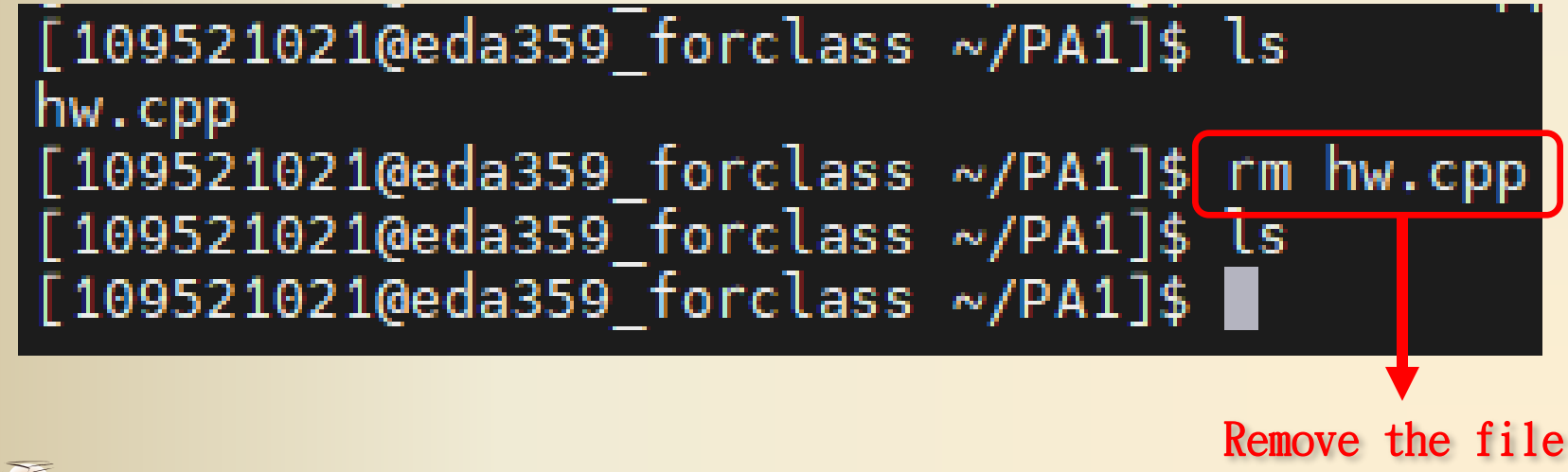
```
[109521021@eda359_forclass ~]$ cd PA1
[109521021@eda359_forclass ~/PA1]$
```

Basic Command

◆cp



◆rm



Basic Command

- rmdir

```
[109521021@eda359_forclass ~/PA1]$ cd ../
[109521021@eda359_forclass ~]$ ls
chiang  glen  isc2v-master  memory_hw  PA1
[109521021@eda359_forclass ~]$ rmdir PA1
[109521021@eda359_forclass ~]$ ls
chiang  glen  isc2v-master  memory_hw
[109521021@eda359_forclass ~]$
```

Remove the directory

Basic Command

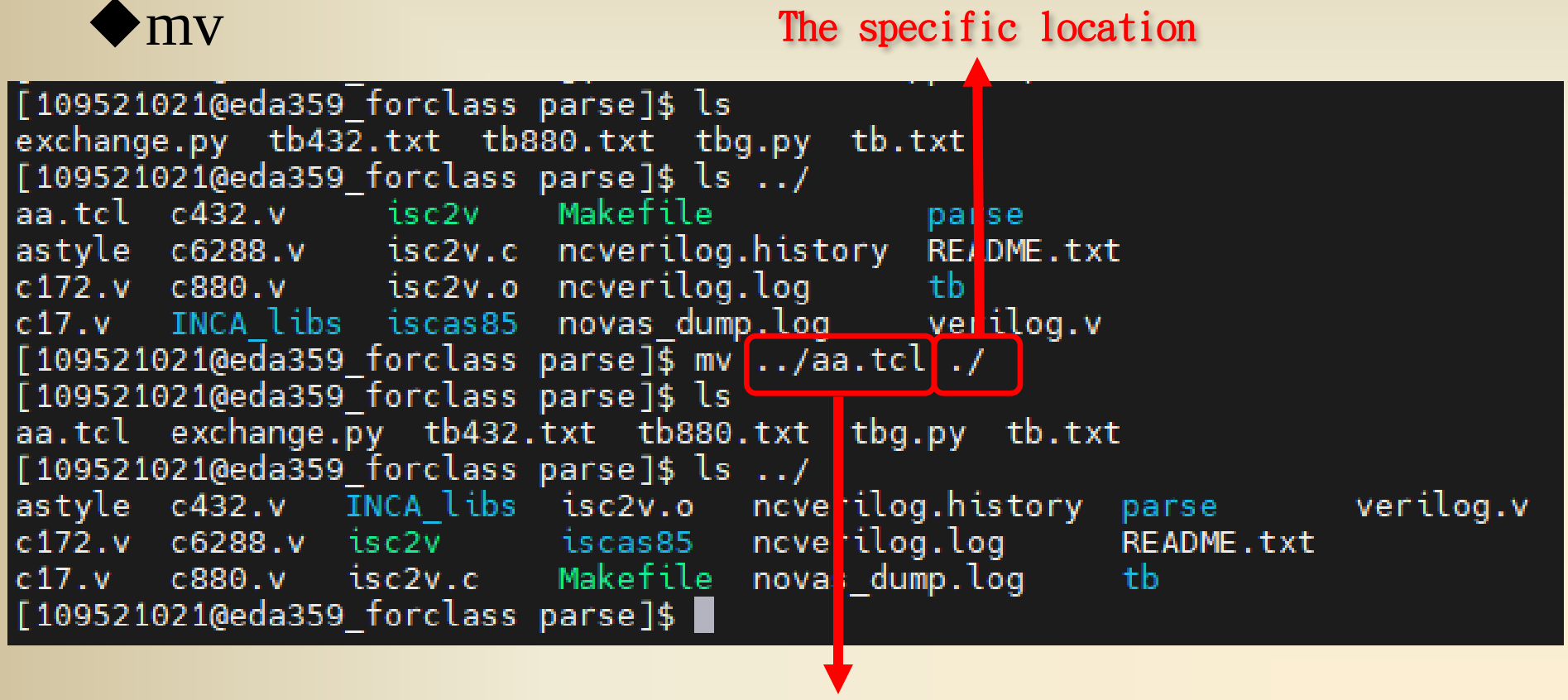
◆mv

```
[109521021@eda359_forclass parse]$ ls
exchange.py  tb432.txt  tb880.txt  tbg.py  tb.txt
[109521021@eda359_forclass parse]$ ls ../
aa.tcl  c432.v     isc2v    Makefile           parse
astyle  c6288.v    isc2v.c  ncverilog.history  README.txt
c172.v  c880.v     isc2v.o  ncverilog.log      tb
c17.v   INCA_libs  iscas85  novas_dump.log     verilog.v
[109521021@eda359_forclass parse]$ mv ../aa.tcl ./
[109521021@eda359_forclass parse]$ ls
aa.tcl  exchange.py  tb432.txt  tb880.txt  tbg.py  tb.txt
[109521021@eda359_forclass parse]$ ls ../
astyle  c432.v   INCA_libs  isc2v.o   ncverilog.history  parse       verilog.v
c172.v  c6288.v  isc2v      iscas85   ncverilog.log      README.txt
c17.v   c880.v   isc2v.c    Makefile  novas_dump.log     tb
[109521021@eda359_forclass parse]$
```

Move the file to the specific location

Basic Command

◆mv



Basic Command

- mv

```
[109521021@eda359_forclass parse]$ ls
exchange.py  tb432.txt  tb880.txt  tbg.py  tb.txt
[109521021@eda359_forclass parse]$ ls ../
aa.tcl  c432.v     isc2v    Makefile           parse
astyle  c6288.v    isc2v.c  ncverilog.history  README.txt
c172.v  c880.v     isc2v.o  ncverilog.log      tb
c17.v   INCA_libs  iscas85  novas_dump.log     verilog.v
[109521021@eda359_forclass parse]$ mv ../aa.tcl ./
[109521021@eda359_forclass parse]$ ls
aa.tcl  exchange.py  tb432.txt  tb880.txt  tbg.py  tb.txt
[109521021@eda359_forclass parse]$ ls ../
astyle  c432.v   INCA_libs  isc2v.o   ncverilog.history  parse       verilog.v
c172.v  c6288.v  isc2v      iscas85   ncverilog.log      README.txt
c17.v   c880.v   isc2v.c    Makefile  novas_dump.log     tb
[109521021@eda359_forclass parse]$
```

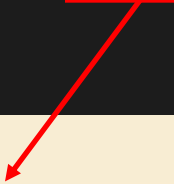
Outline

- Workstation
- Vim
- Tmux
- Hspice
  - Hspice and waveview
  - Hspice tutorial
  - Hspice simulation

Vim

- It is an efficient text editor especially developed for Linux users. This editor is mainly used to edit or create different types of files.

```
[109521021@eda359_forclass ~/isc2v-master]$ vim parser.cpp
```



Open parser.cpp or create a new file which named parser.cpp.

Vim

- Normal mode
  - You will see the below screen after executing the command. This is your normal mode in Vim.

```
~
~
~
"parser.cpp" [New File]
```

Vim

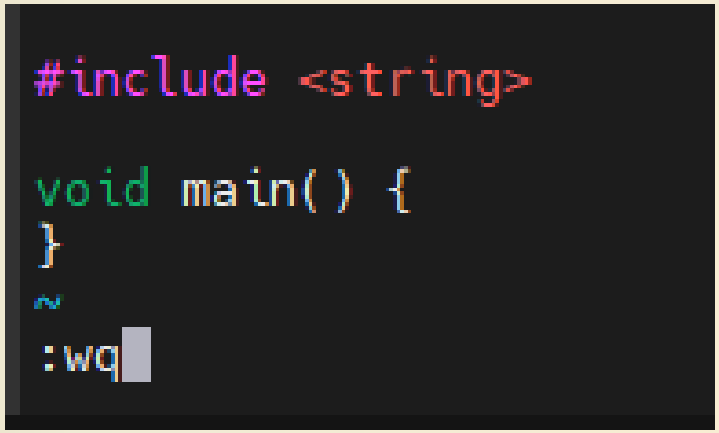
- Insert mode
  - You should be in the Insert mode if you want to **edit** your file.
  - Press “i”, “a” or “o” from your keyboard, and you will be in insert mode.
  - Press Esc to back to normal mode.

```
#include <string>

void main() {
}
~
-- INSERT --
```

Vim

- Saving your work
  - When you are in normal mode, press ":w" to save your work and press ":q" to exit vim.
  - You also can use ":wq" to save and exit vim.



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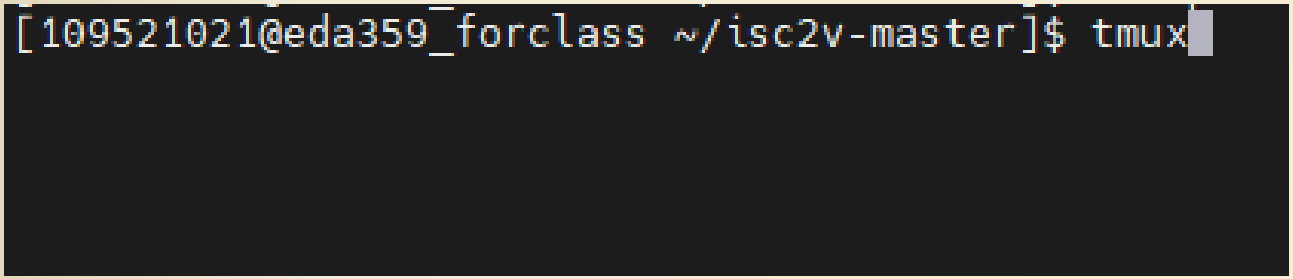
Tmux

- What is tmux?
  - Tmux is a terminal multiplexer that you can start a Tmux session and then open multiple windows inside that session.



Tmux

```
import sys

argv = sys.argv

def data_processing( argv ):
    with open( argv[1], 'r' ) as r:
        with open( argv[2], 'w') as w:
            for line in r.readlines():
                if '//' in line:
                    continue
                line = rm( line )
                line = line.split(' ')
                line = del_null( line )
                flag = False
                end = False
                if ('input' in line)|('output' in line)|('wire' in line)
:
                    flag = False
                else:
                    flag = True

                for i in range( len(line) ):
                    if (line[i]=='') & i==len(line)-1 :
                        continue
                    data = exchange( line[i] )
                    print(data)
                    if flag:
                        if i == 2:
                            w.write( '('+data+', ')
                        elif i == len(line)-1:
                            w.write( data+');\n' )
                        elif i >= 2:
                            w.write( data+', ')
                                                    1,10          Top
[0] 0:tcsh*                                                "109521021@eda359 forcl" 20:33 23-Feb-22
```

```
[109521021@eda359_forclass parse]$ g++ -std=c++11 PA1.cpp -o PA1.0
```

Tmux

- Working with tmux sessions
  - `tmux ls`: all the tmux running sessions.
  - Ctrl+b d: detach from a tmux session.
  - `tmux a -t <session_ID>`: attach to a session.
  - `tmux kill-session -t <session_ID>`: kill a session.

Tmux

- Working with tmux windows and panes
  - Ctrl+b c: Create a new window.
  - Ctrl+b w: Choose window from a list.
  - Ctrl+b 0: Switch to window 0.
  - Ctrl+b n: Switch to next window.
  - Ctrl+b p: Switch to previous window.
  - Ctrl+b %: Split current pane horizontally into two panes.
  - Ctrl+b “: Split current pane vertically into two panes.
  - Ctrl+b arrow keys: Switch pane.

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Hspice and Waveview

- Hspice
  - Commercial electronic circuit simulation software by Synopsys
  - Software:
    - Hspice: 2020.12
- Waveview
  - Visualizing the electronic waveforms generated during circuit simulations
  - Software:
    - Customexplorer: 2020.12

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Hspice Tutorial

- Netlist
  - PMOS

```
mname [drain] [gate] [source] [body] [P_18] [w=width] [l=length]

mp1    D       G       S       B      P_18   w=2.5u     l=0.18u
```

  - NMOS

```
mname [drain] [gate] [source] [body] [P_18] [w=width] [l=length]

mn1    D       G       S       B      N_18   w=1u       l=0.18u
```

<trans_name> <drain> <gate> <source> <body> <P_18/N_18> <w> <l>

Hspice Tutorial

- Netlist `.subckt <ckt_name> <input1> …… <inputk> <output> Vdd gnd`
  - Establish a sub-circuit

```
.subckt subckt_name node1 node2… noden
**   describe the sub circuit   **
.ends
```

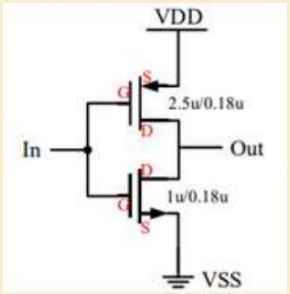
  - Call a sub-circuit `X<name> <input1> …… <inputk> Vdd gnd <ckt_name>`

```
Xname node1 node2… noden subckt_name
```

  - Example Optional, as long as it remains consistent throughout.

```
.subckt inv in out Vdd gnd
Mp1 out in vdd vdd p_18 w=2.5u l=0.18u
Mn1 out in vss vss n_18 w=1u   l=0.18u
.ends

Xinv In Out inv
```



Hspice Tutorial

- Source (Input Voltage)
  - Fixed

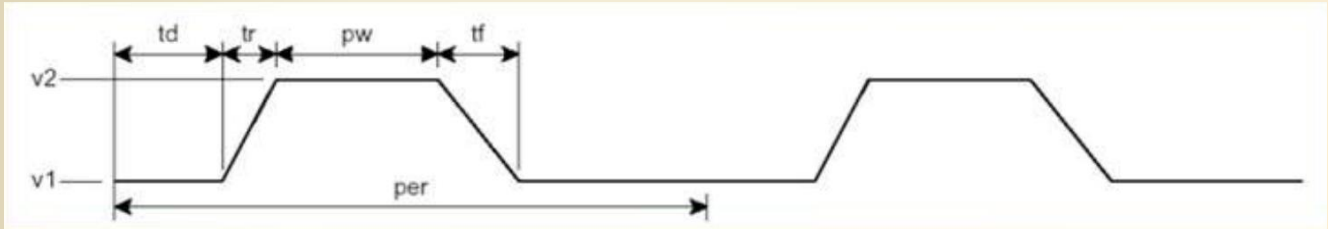
```
Vname node1 node2 dc value
```

```
Vin   in    vss   dc 1v
```

  - Square-wave

```
Vname node1 node2 pulse (V1 V2   Td  tr  tf  pw  per)
```

```
Vin   in    vss   pulse (0v 1.8v 5ns 1ns 1ns 4ns 10ns)
```



Hspice Tutorial

◆.sp File Format

```
*** PA1 test ***

.protect
.lib "/usr/cad/cic018.l" tt
.unprotect

.global vdd gnd
Vdd vdd 0 DC=+3.3v
Vgnd gnd 0 DC=0v

*m1   [drain]   [gate]    [source]   [body]   [P_18/N]   [l=length]   [w=width]

*** INV ***
.subckt INV in out vdd gnd
mp1  vdd  in  out   vdd P_18 w=0.5u   l=0.18u
mn1  out  in  gnd   gnd N_18 w=0.25u  l=0.18u
.ends
***********
```

File path of the library(process file)

Set the global voltage

Sub-circuit code

.end: end of the file

Hspice Tutorial

- .sp File Format

```
********************************** call subckt ***********************************
*** X[Name] [pin1] [pin2] [...pinx] [param=value] [circuit_name] [m=multiply] ***

*** OR ***
.subckt OR2 in1 in2 OR vdd gnd
Xor  in1 in2 out_nor vdd gnd NOR2
Xinv out_nor OR      vdd gnd INV
.ends
**********
```

Combine individual sub-circuits into a larger circuit.

```
*** logic function ***
.subckt logic A B C F vdd gnd
Xor  B     C out1  vdd gnd OR2
Xand out1  A out2  vdd gnd AND2
Xinv out2  F       vdd gnd INV
.ends
**********************

Xlogic A  B  C  F vdd gnd logic
```

Sub-circuit

The main circuit

Hspice Tutorial

◆.sp File Format

```
.tran 0.01n 130n
.unprotect
.tem 30  Simulation temperature
.option post
.op
.end
```

Transient analysis: time step is 0.01ns and stop time is 130ns

Save the results into a figure file <design>.tr

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Hspice Simulation

- Simulation
  - Command: source /usr/cad/synopsys/CIC/hspice.cshrc

```
[ta113501533@linuxcad30 ~/HW1]$ source /usr/cad/synopsys/CIC/hspice.cshrc
set hspice version: 2020.12 (default)
[ta113501533@linuxcad30 ~/HW1]$
```

  - Simulation: hspice –i <inputFile.sp> -o <outputFile.lis>

```
[ta113501533@linuxcad30 ~/HW1]$ hspice -i PA1.sp -o PA1.lis
Using: /home/tools/synopsys/hspice/2020.12/hspice/linux64/hspice  -i 'PA1.sp' -o PA1.lis

>info:          ***** hspice job concluded
```

Hspice Simulation

- Simulation
  - If aborted, you can check the error message in ".lis" file.

```
[yjtsai@ic51 ~/PA1_demo]$ hspice -i studID.sp -o outputfile.lis
Using: /tools/linux/synopsys/hspice/2014.09/hspice/amd64/hspice  -i 'studID.sp' -o outputfile.lis

>info:          ***** hspice job aborted
[yjtsai@ic51 ~/PA1_demo]$
```

studID.sp | * outputfile.lis

```
4  lic: Using FLEXlm license file:
5  lic: 26585@lshc
6  lic: Checkout 1 hspice
7  lic: License/Maintenance for hspice will expire on 31-mar-2024/2023.03
8  lic: 474(in_use)/900(total) FLOATING license(s) on SERVER 26585@lshc
9  lic:
0  Init: read install configuration file: /tools/linux/synopsys/hspice/2014
1  **error** (studID.sp:21)duplicate element Vname is defined in studID.sp
   :20
3                ***** job aborted
4  lic: Release hspice token(s)
5  lic: total license checkout elapse time:        0.72(s)
```

Hspice Simulation

- Open the waveview
  - Command:

source /usr/cad/synopsys/CIC/customexplorer.cshrc

```
[ta113501533@linuxcad30 ~/HW1]$ source /usr/cad/synopsys/CIC/customexplorer.cshrc
set customexplorer version: 2020.12 (default)
[ta113501533@linuxcad30 ~/HW1]$
```

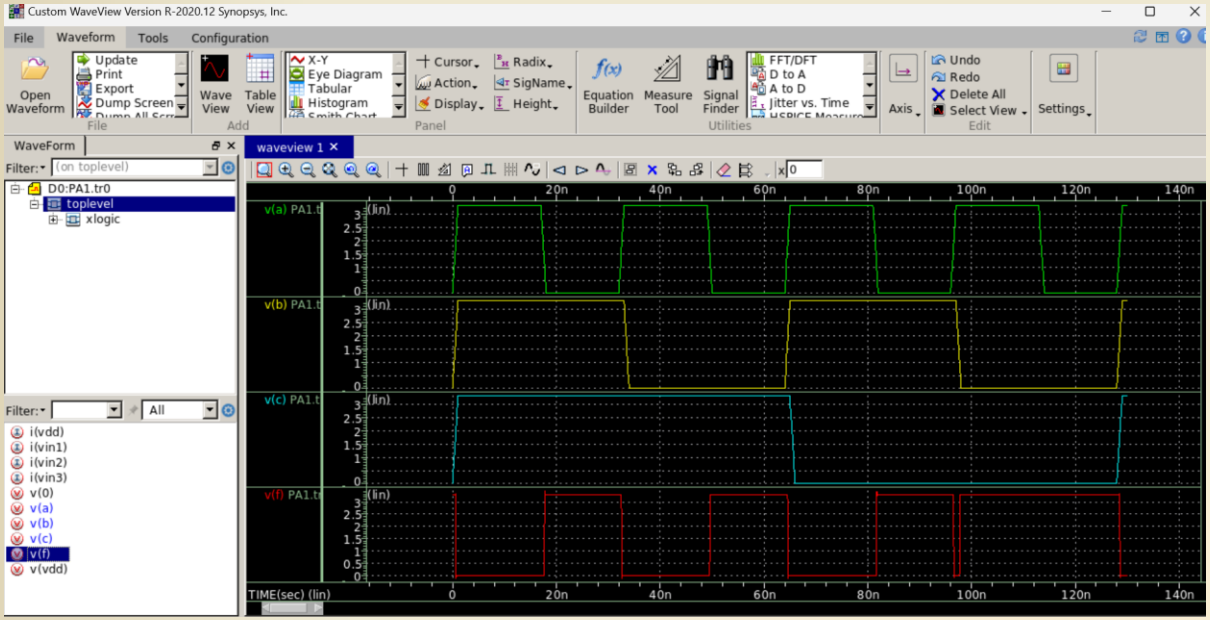
  - wv <outputFile.tr0> &

```
[ta113501533@linuxcad30 ~/HW1]$ wv PA1.tr0 &
[1] 33473
[ta113501533@linuxcad30 ~/HW1]$
```

Indicates that the window has been correctly opened

Hspice Simulation

- Waveview Result



Show the waveform to demonstrate that the output is correct for all input combinations.

Hspice Simulation

- Output file
  - .lis: output listing
  - .tr: transient analysis results
  - .ic: operating point node voltages (initial conditions)
  - .st: output status

```
-rw-rw-r--. 1 ta113501533 ta113501533   728 Oct  4 17:09 PA1.ic0
-rw-rw-r--. 1 ta113501533 ta113501533  9923 Oct  4 17:09 PA1.lis
-rw-rw-r--. 1 ta113501533 ta113501533   188 Oct  4 17:09 PA1.pa0
-rw-rw-r--. 1 ta113501533 ta113501533  1903 Oct  4 17:08 PA1.sp
-rw-rw-r--. 1 ta113501533 ta113501533  3302 Oct  4 17:09 PA1.st0
-rw-rw-r--. 1 ta113501533 ta113501533 22932 Oct  4 17:09 PA1.tr0
```

Reference

- Linux
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