HSPICE

Source : Jh-He Lin

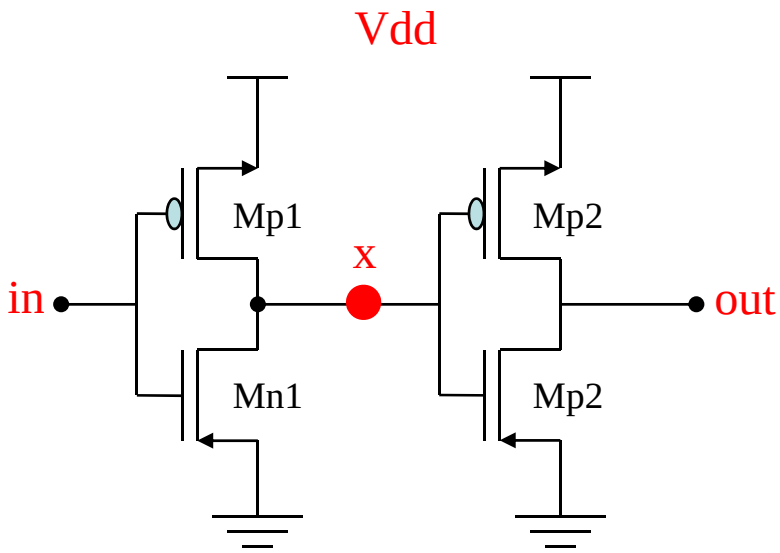
Speaker Jh-He Lin

Design Flow

- Declaration
- Voltage Source
- Circuit Statements
  - Sub-circuit
- Measures
- Operation
- Others

Declaration (1/2)

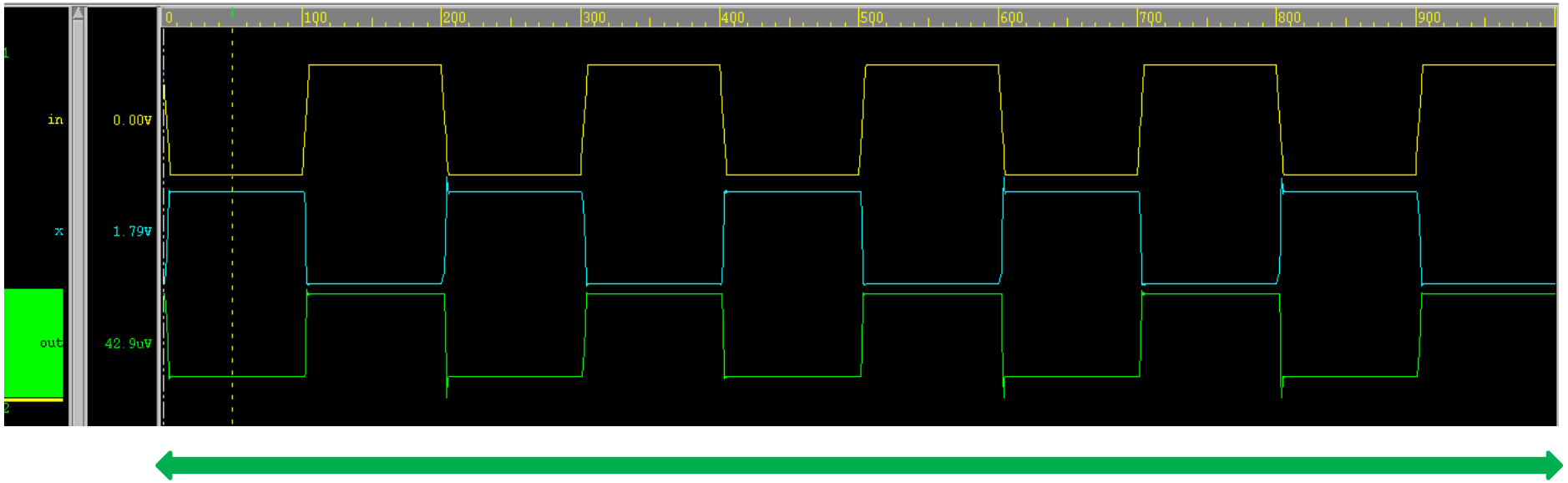
- **********example of inverter 1**********
- .LIB 'mm018.l' tt
- .GLOBAL Vdd
- .TRAN 1ns 1000ns
- .OPTION post
- **********voltage source**********
- Vsourece Vdd 0 1.8v
- Vsignal in 0 pulse(1.8v 0 0ns 5ns 5ns 95ns 200ns)
- ********** circuit statement**********
- Mp1 x in Vdd Vdd pch L=0.18u W=0.44u M=1
- Mn1 x in 0 0 nch L=0.18u W=0.22u M=1



- Mp2 out x Vdd Vdd pch L=0.18u W=0.44u M=1
- Mn2 out x 0 0 nch L=0.18u W=0.22u M=1
- **********measure**********
- .MEAS TRAN out_rise_delay TRIG v(in) VAL=0.9v TD=0 FALL=3 TARG v(x) VAL=0.9v RISE=3
- .MEAS TRAN pwr AVG POWER
- .END

Declaration (2/2)

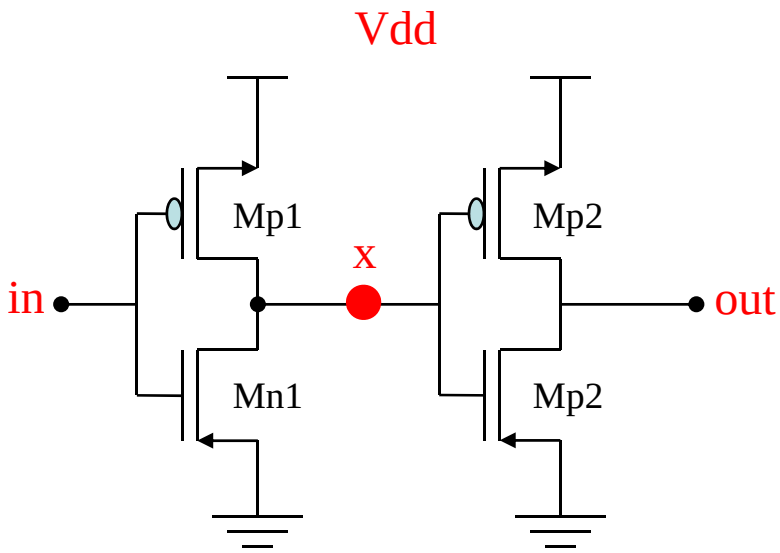
- .LIB 'mm018.l' tt
  - Using 0.18 technology to design
  - tt : typical model for 1.8V devices
- .GLOBAL Vdd
- .TRAN 1ns 1000ns
- .OPTION post



1000ns

Voltage Source (1/4)

- **********example of inverter 1**********
- .LIB 'mm018.l' tt
- .GLOBAL Vdd
- .TRAN 1ns 1000ns
- .OPTION post
- **********voltage source**********
- Vsourece Vdd 0 1.8v
- Vsignal in 0 pulse(1.8v 0 0ns 5ns 5ns 95ns 200ns)
- ********** circuit statement**********
- Mp1 x in Vdd Vdd pch L=0.18u W=0.44u M=1
- Mn1 x in 0 0 nch L=0.18u W=0.22u M=1



- Mp2 out x Vdd Vdd pch L=0.18u W=0.44u M=1
- Mn2 out x 0 0 nch L=0.18u W=0.22u M=1
- **********measure**********
- .MEAS TRAN out_rise_delay TRIG v(in) VAL=0.9v TD=0 FALL=3 TARG v(x) VAL=0.9v RISE=3
- .MEAS TRAN pwr AVG POWER
- .END

Voltage Source (2/4)

- Syntax

  Vxxx n+ n- <<DC=>dcval>

  Iyyy n+ n- <<DC=>dcval>

- Example

  V1 node1 0 DC=5v

  V2 node2 0 5v

  I3 node3 0 3mA

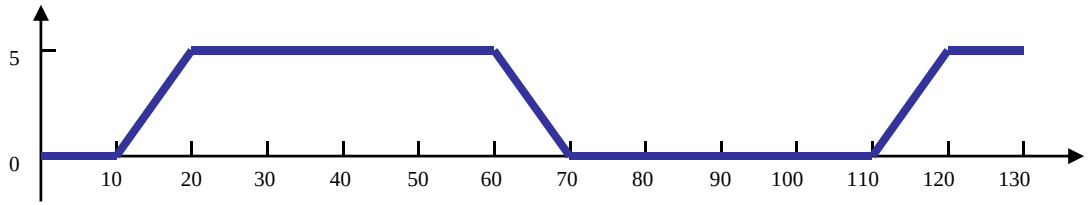
Voltage Source (3/4)

- Pulse source function: PULSE
  - Syntax

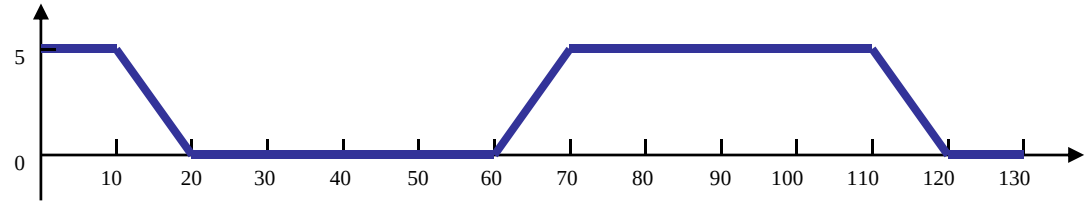
    PULSE (V1 V2 Tdelay Trise Tfall duty_cycle_width Period)

  - Example

    V1 node1 node2 **PULSE** (0V 5V 0ns 10ns 10ns 40ns 100ns)



    V2 node3 node4 **PULSE** (5V 0V 0ns 10ns 10ns 40ns 100ns)



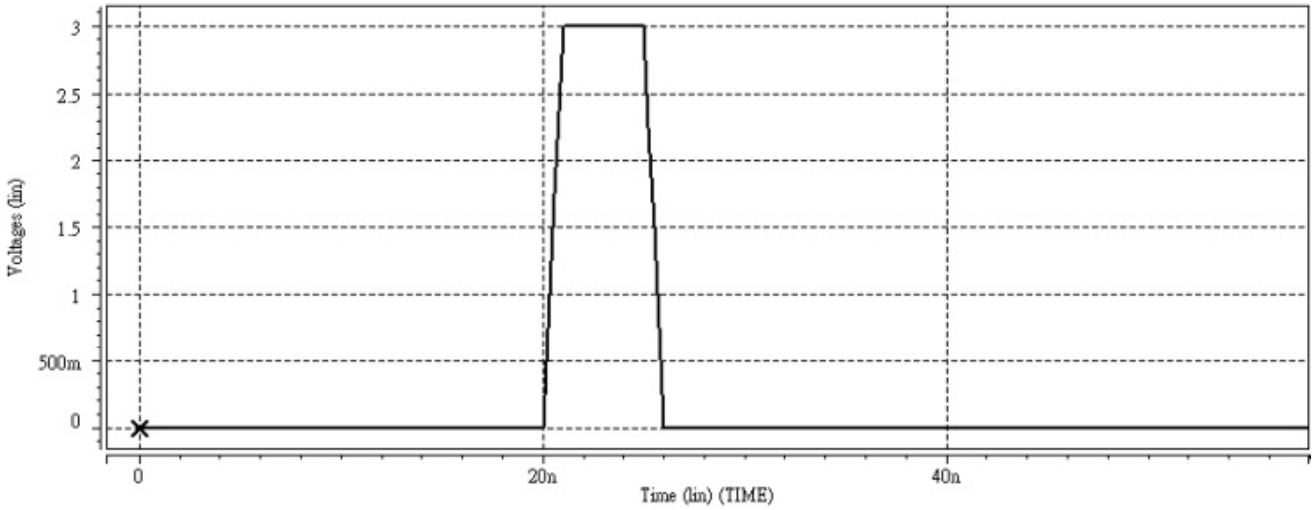
Voltage Source (4/4)

- Piecewise linear source function: PWL
  - Syntax

    PWL (t1 v1, t2 v2,)

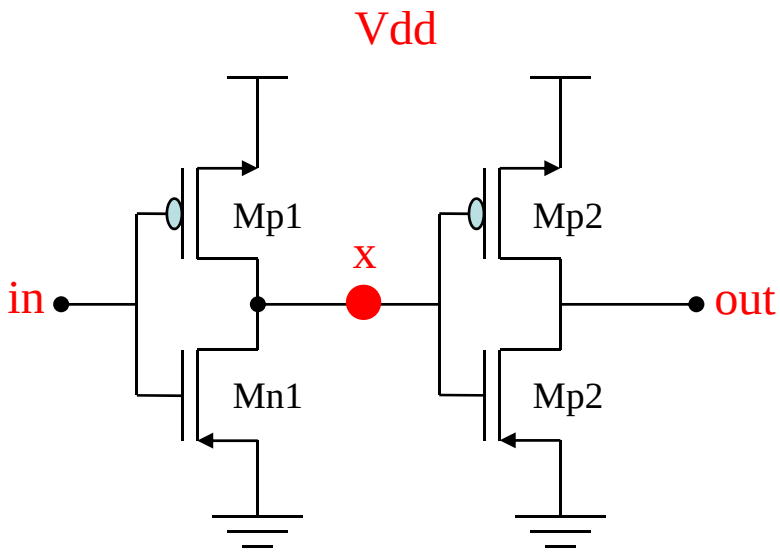
  - Example

    V1 node1 0 **PWL** (0n 0v, 20n 0v, 21n 3v, 25n 3v, 26n 0v,30n 0v)



Circuit Statements (1/5)

- **********example of inverter 1**********
- .LIB 'mm018.l' tt
- .GLOBAL Vdd
- .TRAN 1ns 1000ns
- .OPTION post
- **********voltage source**********
- Vsourece Vdd 0 1.8v
- Vsignal in 0 pulse(1.8v 0 0ns 5ns 5ns 95ns 200ns)
- ********** circuit statement**********
- Mp1 x in Vdd Vdd pch L=0.18u W=0.44u M=1
- Mn1 x in 0 0 nch L=0.18u W=0.22u M=1



- Mp2 out x Vdd Vdd pch L=0.18u W=0.44u M=1
- Mn2 out x 0 0 nch L=0.18u W=0.22u M=1
- **********measure**********
- .MEAS TRAN out_rise_delay TRIG v(in) VAL=0.9v TD=0 FALL=3 TARG v(x) VAL=0.9v RISE=3
- .MEAS TRAN pwr AVG POWER
- .END

Circuit Statements (2/5)

- Instance and element names
  - **C** Capacitor
  - **D** Diode
  - **E,F,G,H** Dependent current and voltage controlled source
  - **I** Current
  - **J** JFET or MESFET
  - **K** Mutual inductor
  - **L** Inductor
  - **M** MOSFET
  - **Q** BJT
  - **R** Resistor
  - **O,T,U** Transmission line
  - **V** Voltage source
  - **X** Subcircuit call

Cxxx Node1 Node2 Value

Ixxx Node1 Node2 Value

Lxxx Node1 Node2 Value

Mxxx D G S B Type L=val W=val M=val

Rxxx Node1 Node2 Value

Vxxx Node1 Node2 Value

Circuit Statements (3/5)

- Units
  - Ohm *Resistance
  - Farad *Capacitor
  - Henry *Inductor
- Scales
  - T 10^{12}
  - G 10^{9}
  - Meg 10^{6}
  - K 10^{3}
  - M 10^{-3}
  - U 10^{-6}
  - N 10^{-9}
  - P 10^{-12}
  - F 10^{-15}

Circuit Statements (4/5)

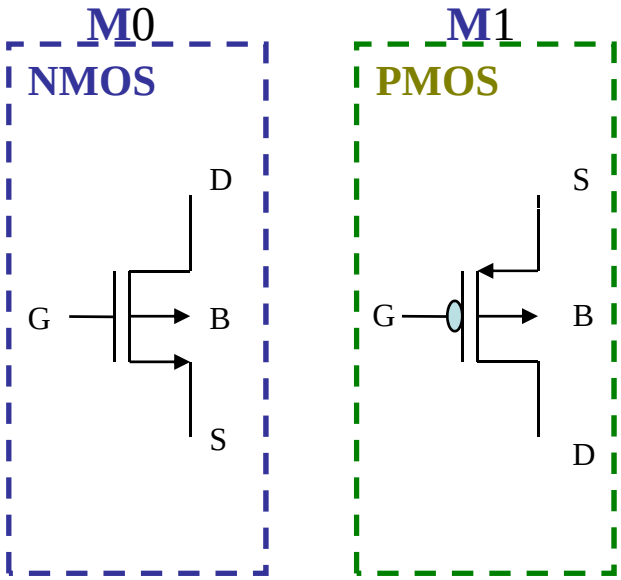
- MOSFET element
  - Syntax

    Mxxx nd ng ns nb ***mname*** **<L=val> <W=val> <M=val>**

  - Example

    M0 d0 g0 s0 b0 **nch L**=0.18u **W**=0.22u **M**=1

    M1 d1 g1 s1 b1 **pch L**=0.18u **W**=0.22u **M**=4



Circuit Statements (5/5)

****resistance “R”*****

R1 node1 node2 10k

****voltage source “V”*****

V4 node3 node4 1v

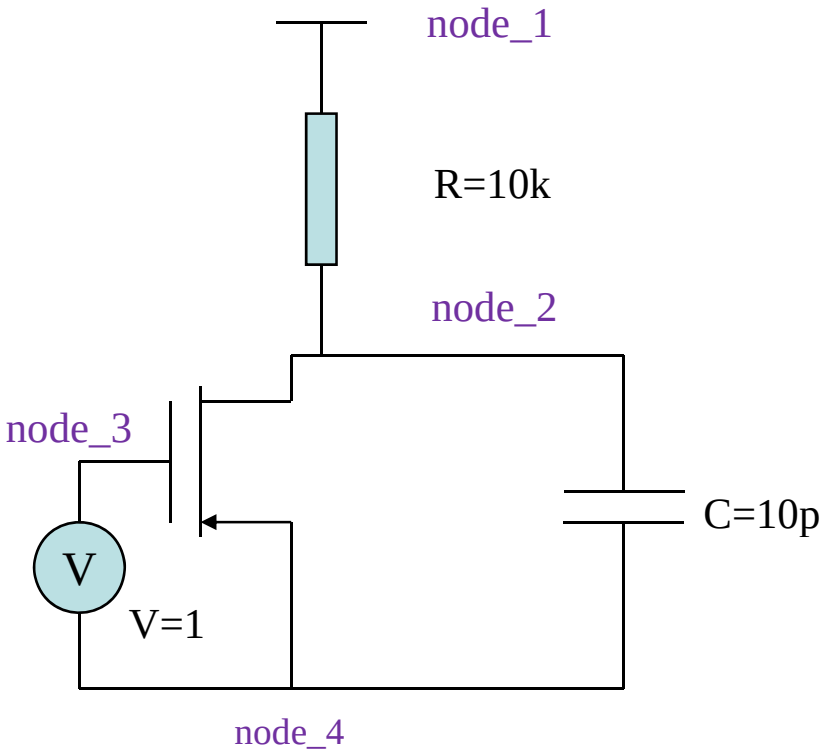
****capacitor “C”*****

C2 node2 node4 10p

****MOS “M”*****

M3 node2 node3 node4 node4

+ nch W=0.22u L=0.18u M=1



SUBCKT of Circuit Statement(1/3)

- .SUBCKT statement
  - **.SUBCKT** subname Node1 <Node2 ... >
    - The following are not included in node
      - Ground node (**0**)
      - Nodes are assigned by .GLOBAL statement
      - **.ENDS**Nodes are assigned by using BULK=node in MOSFET or BJT models
    - Param is used only in sbucircuit and it can be overridden by subckt call or values in .PARAM statement

  - Subcircuit calls example

    .**X**InstantName n1 <n2 n3 ....> SubcktName <param=val ....> <**M**=val>

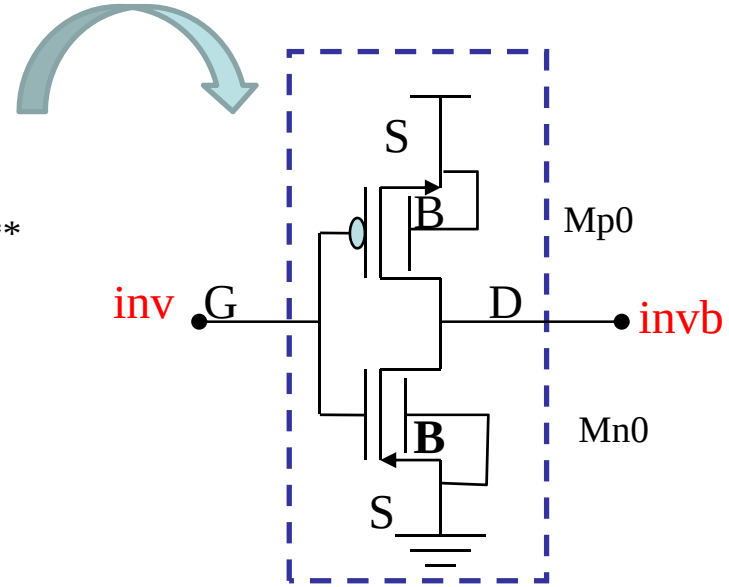
    .**X**add1 n1 n2 n3 n4 n5 FA WN=3u LN=1u **M**=3

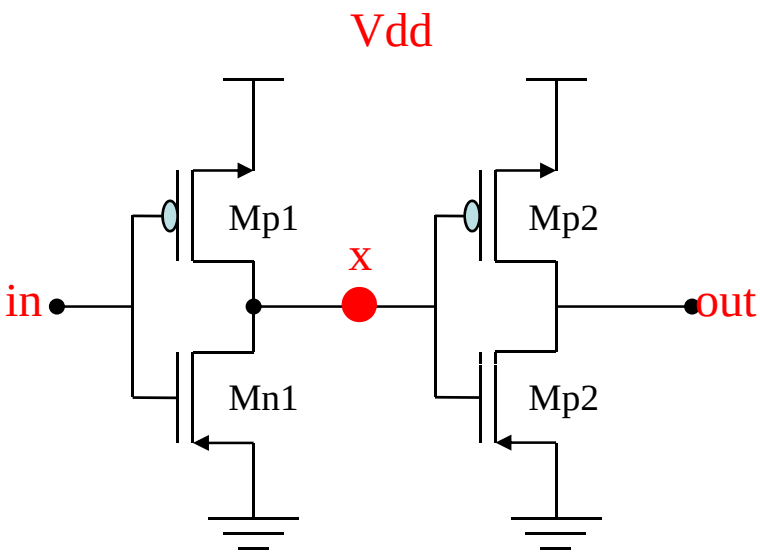
    .**x**nmos1 1 2 3 4 nos Wsize=0.2u Lsize=0.18u **M**=2

    W=WN

SUBCKT of Circuit Statement(2/3)

- **********SUBCKT statement**********
- **.SUBCKT** inverter inv invb
- Mp0 invb inv Vdd Vdd pch L=0.18u W=0.66u M=1
- Mn0 invb inv 0 0 nch L=0.18u W=0.22u M=1
- .ENDS inverter
- **********circuit statement**********
- Xinv1 in x inverter
- Xinv2 x out inverter





SUBCKT of Circuit Statement(3/3)

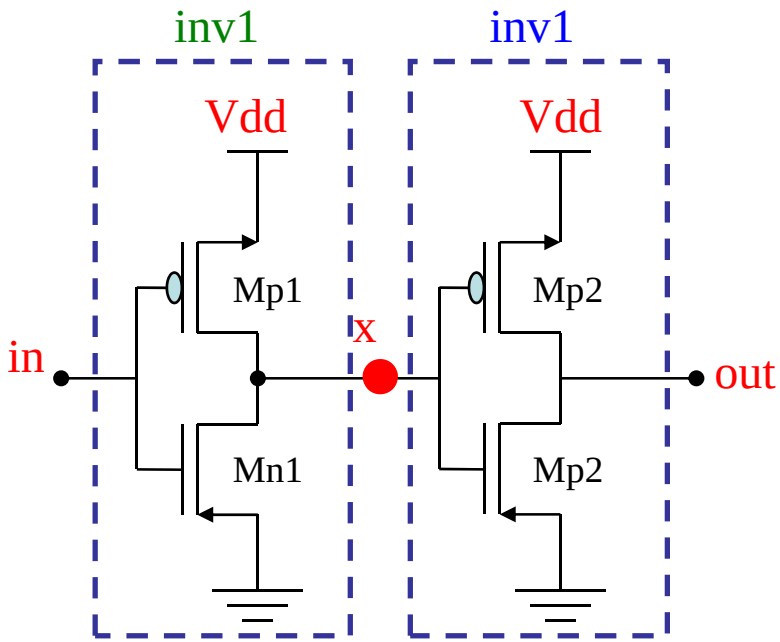
- ********** circuit statement**********
- .SUBCKT inverter inv invb
- Mp1 x in Vdd Vdd pch L=0.18u W=0.44u M=1
- Mn1 x in 0 0 nch L=0.18u W=0.22u M=1

- Mp2 out x Vdd Vdd pch L=0.18u W=0.44u M=1
- Mn2 out x 0 0 nch L=0.18u W=0.22u M=1

- **********SUBCKT statement**********
- .SUBCKT inverter inv invb
- Mp0 invb inv Vdd Vdd pch L=0.18u W=0.66u M=1
- Mn0 invb inv 0 0 nch L=0.18u W=0.22u M=1
- .ENDS inverter
- **********circuit statement**********
- Xinv1 in x inverter
- Xinv2 x out inverter

Measures (1/4)

- **********example of inverter 2**********
- .LIB 'mm018.l' tt
- .OPTION post
- .GLOBAL Vdd
- .TRAN 1ns 1000ns
- **********voltage source**********
- Vsourece Vdd 0 1.8v
- Vsignal in 0 pulse(1.8v 0 0ns 5ns 5ns 95ns 200ns)
- **********SUBCKT statement**********
- .SUBCKT inverter inv invb
- Mp0 invb inv Vdd Vdd pch L=0.18u W=0.66u M=1
- Mn0 invb inv 0 0 nch L=0.18u W=0.22u M=1
- .ENDS inverter
- **********circuit statement**********
- Xinv1 in x inverter
- Xinv2 x out inverter
- **********measure**********
- .MEAS TRAN out_rise_delay TRIG v(in) VAL=0.9v TD=0 FALL=3 TARG v(x) VAL=0.9v RISE=3
- .MEAS TRAN pwr AVG POWER
- .END

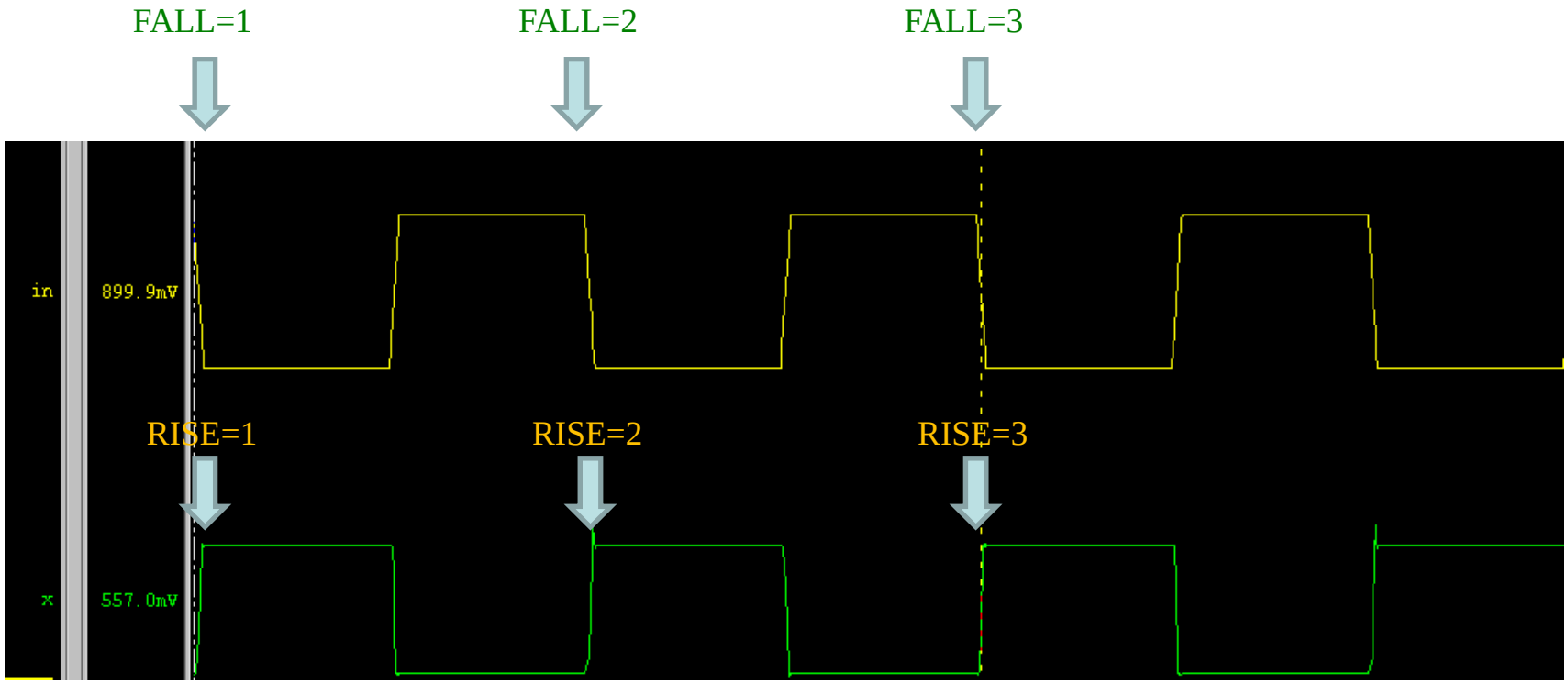


Measures (2/4)

- Syntax
  - **.MEASURE** ***TRAN*** result **TRIG... TARG...**
    - **result:** name is given the measured value in HSPICE output
    - **TRIG... : TRIG** trig_var **VAL**=trig_value <**TD**=time_delay> <**RISE**=n> +<**FALL**=n>
  - **.TRAN** power **AVG POWER**
- Example
  - **.MEAS *TRAN*** result1 **TRIG** v(in) **VAL**=2v **RISE**=2 **TARG** v(out) **VAL**=1.5v **FALL**=1
  - **.MEAS TRAN** pwr **AVG POWER**

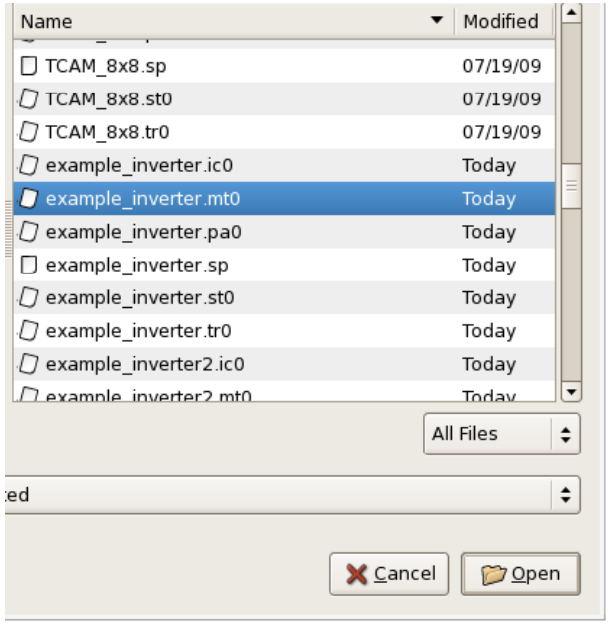
Measures (3/4)

- **********measure**********
- .MEAS TRAN out_rise_delay TRIG v(in) VAL=0.9v TD=0 FALL=3 TARG v(x) VAL=0.9v RISE=3



Measure (4/4)

- .MEAS TRAN pwr AVG POWER
- .END

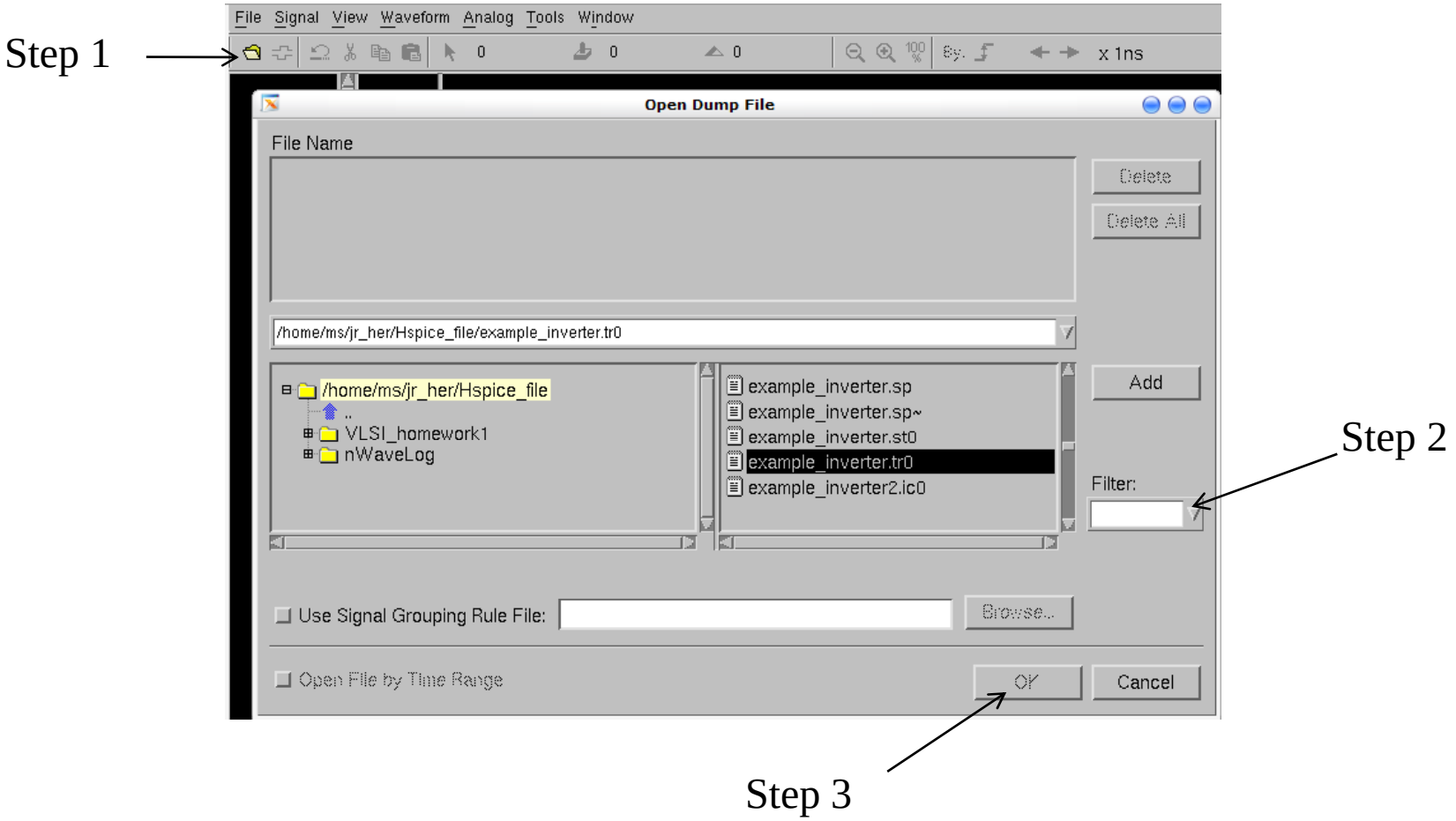


mm018.l | example_inverter.sp | example_inverter.mt0

```
$DATA1 SOURCE='HSPICE' VERSION='Z-2007.03-SP1   '
.TITLE '*******************example of inverter 2*********************'
 out_rise_delay    pwr              temper           alter#
  2.448e-10         6.048e-07         25.0000           1.0000
```

Operation (1/3)

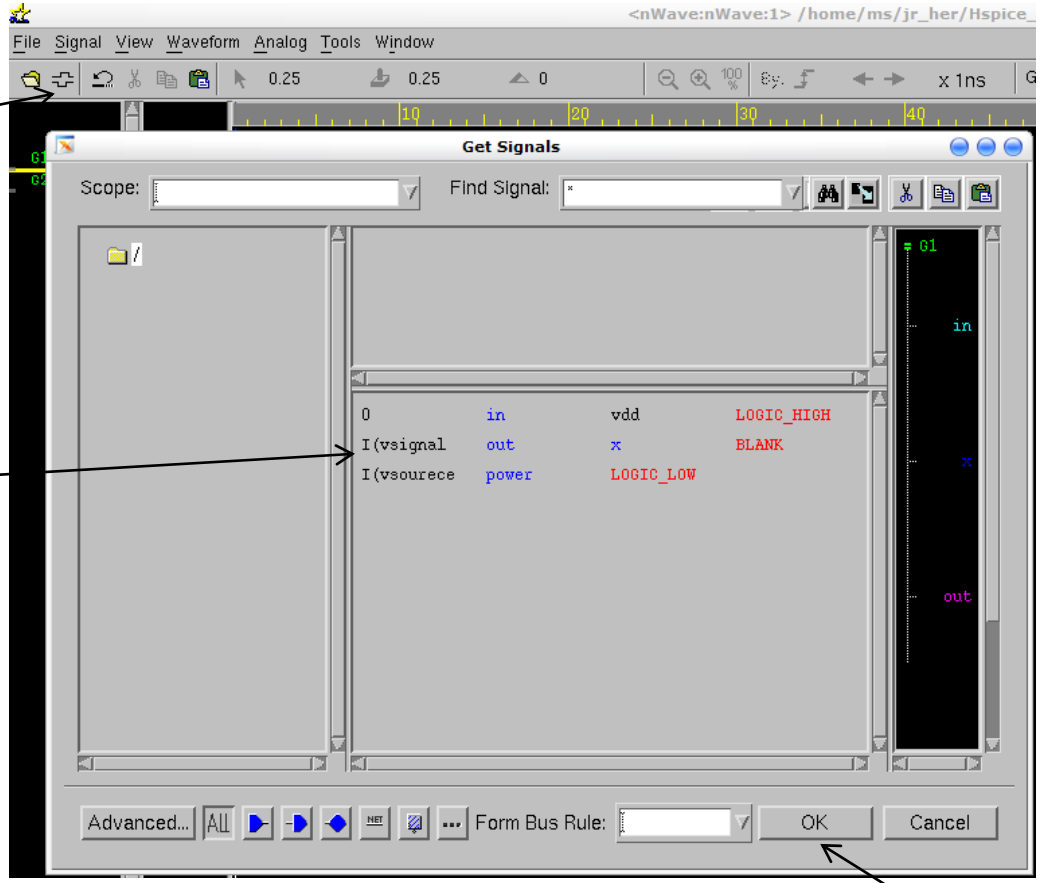
- .OPTION post
  - Creating a ".tr0" file to view waveform



Operation (2/3)

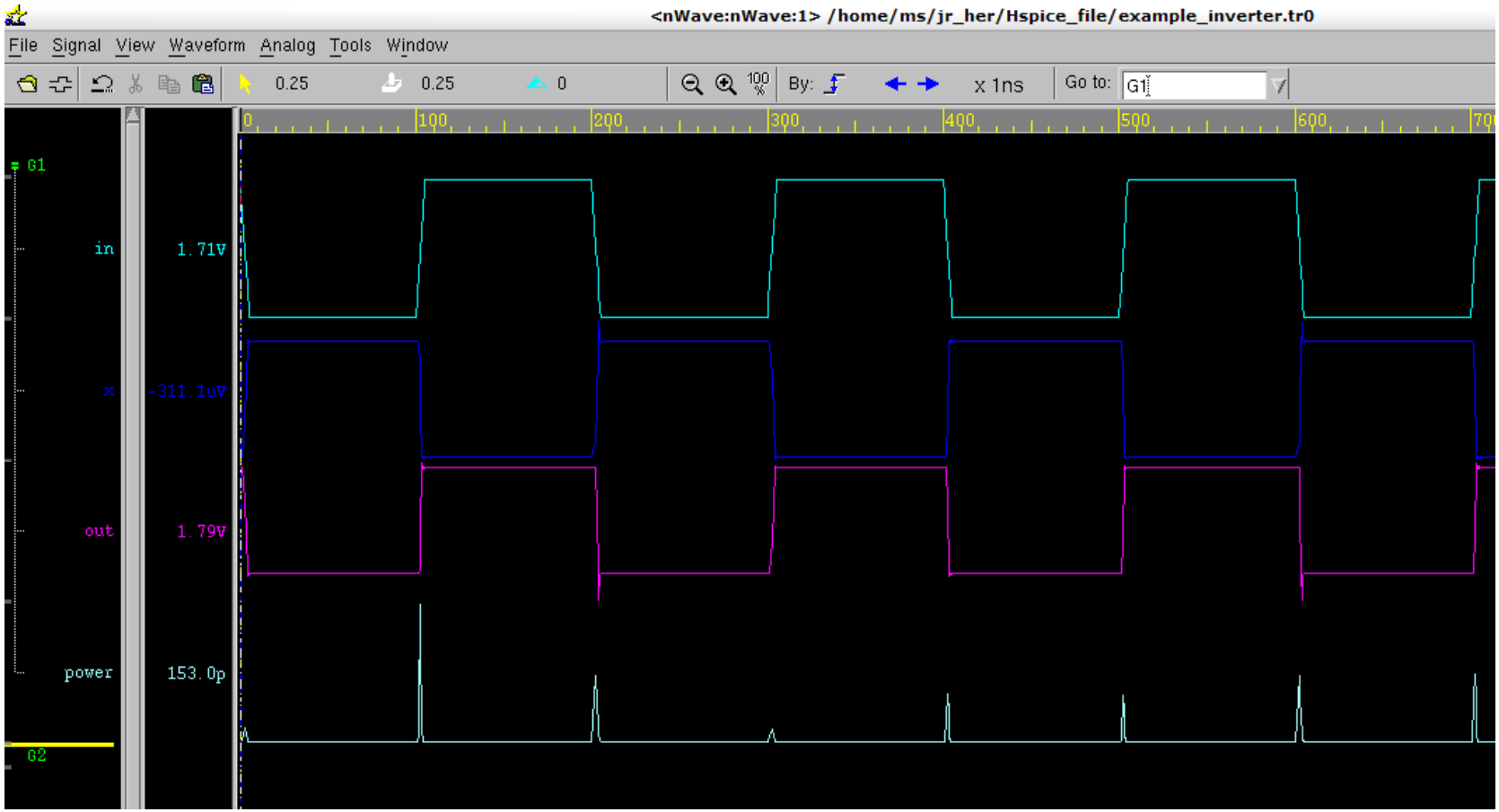
Step 4

Step 5



Step 6

Operation (3/3)

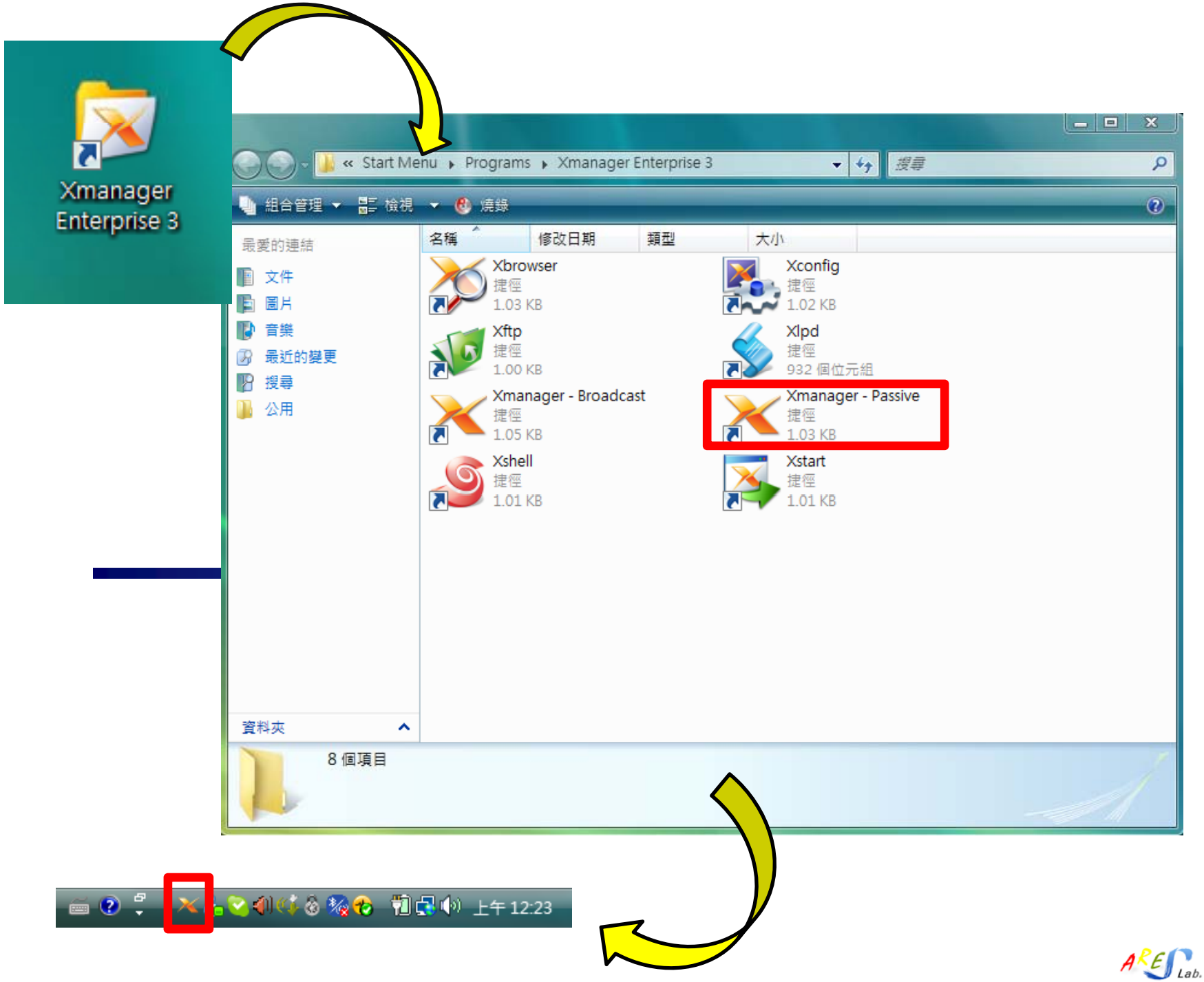


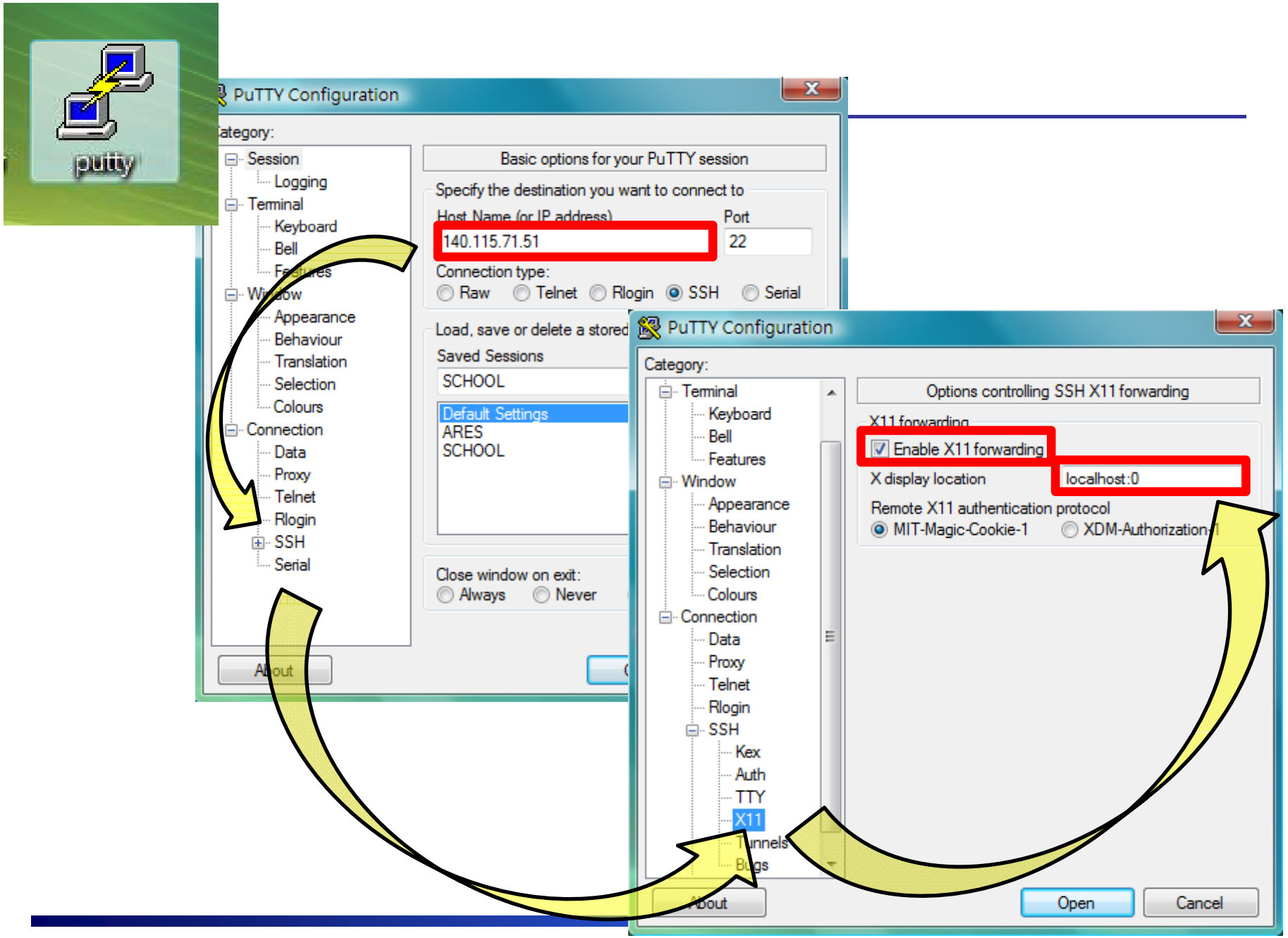
Others

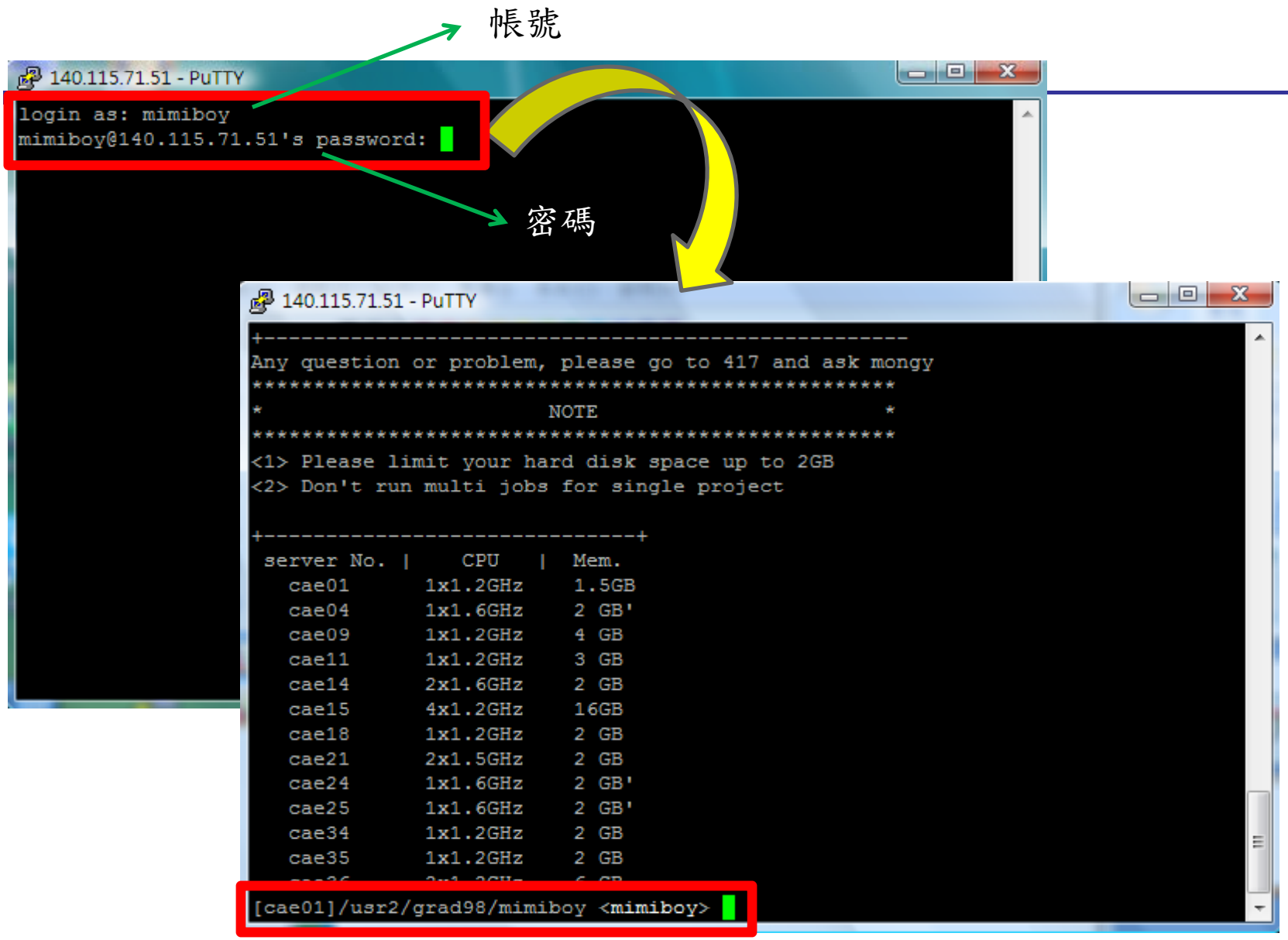
- Minimum width size is 0.22u (in meter)
- Minimum length size is 0.18u (in meter)
- Capital and lowercase are equivalence in HSPICE
- 0 and GND are equivalence
  - Vsourece Vdd 0 1.8v
  - Vsourece Vdd GND 1.8v

工作站指令教學

Source ： 侯致聖
Speaker ： 吳冠德


Xmanager
Enterprise 3
« Start Menu ▸ Programs ▸ Xmanager Enterprise 3
搜尋
組合管理
檢視
燒錄
最愛的連結
文件
圖片
音樂
最近的變更
搜尋
公用
資料夾
名稱
修改日期
類型
大小
Xbrowser
捷徑
1.03 KB
Xconfig
捷徑
1.02 KB
Xftp
捷徑
1.00 KB
Xlpd
捷徑
932 個位元組
Xmanager - Broadcast
捷徑
1.05 KB
Xmanager - Passive
捷徑
1.03 KB
Xshell
捷徑
1.01 KB
Xstart
捷徑
1.01 KB
8 個項目
上午 12:23


putty
PuTTY Configuration
Category:
Session
Logging
Terminal
Keyboard
Bell
Features
Window
Appearance
Behaviour
Translation
Selection
Colours
Connection
Data
Proxy
Telnet
Rlogin
SSH
Serial
Basic options for your PuTTY session
Specify the destination you want to connect to
Host Name (or IP address)
Port
140.115.71.51
22
Connection type:
Raw
Telnet
Rlogin
SSH
Serial
Load, save or delete a stored
Saved Sessions
SCHOOL
Default Settings
ARES
SCHOOL
Close window on exit:
Always
Never
About
PuTTY Configuration
Category:
Terminal
Keyboard
Bell
Features
Window
Appearance
Behaviour
Translation
Selection
Colours
Connection
Data
Proxy
Telnet
Rlogin
SSH
Kex
Auth
TTY
X11
Tunnels
Bugs
Options controlling SSH X11 forwarding
X11 forwarding
Enable X11 forwarding
X display location
localhost:0
Remote X11 authentication protocol
MIT-Magic-Cookie-1
XDM-Authorization-1
About
Open
Cancel


帳號
140.115.71.51 - PuTTY
login as: mimiboy
mimiboy@140.115.71.51's password:
密碼
140.115.71.51 - PuTTY
+---
Any question or problem, please go to 417 and ask mongy
****
* NOTE *
****
<1> Please limit your hard disk space up to 2GB
<2> Don't run multi jobs for single project
+------------------------------+
server No. | CPU | Mem.
cae01 1x1.2GHz 1.5GB
cae04 1x1.6GHz 2 GB'
cae09 1x1.2GHz 4 GB
cae11 1x1.2GHz 3 GB
cae14 2x1.6GHz 2 GB
cae15 4x1.2GHz 16GB
cae18 1x1.2GHz 2 GB
cae21 2x1.5GHz 2 GB
cae24 1x1.6GHz 2 GB'
cae25 1x1.6GHz 2 GB'
cae34 1x1.2GHz 2 GB
cae35 1x1.2GHz 2 GB
[cae01]/usr2/grad98/mimiboy <mimiboy>

工作站環境介紹

- 工作站與IP對照表

Hostname	IP
cae01	140.115.71.51
cae04	140.115.71.54
cae09	140.115.71.59
cae14	140.115.71.64
cae18	140.115.71.68
cae24	140.115.71.74
cae25	140.115.71.75
Cae27 (NIS)	**140.115.71.77**
Cae28 (NFS)	**140.115.71.78**
cae33	140.115.71.83
cae34	140.115.71.84
cae35	140.115.71.85
cae36	140.115.71.86

vi 文書編輯軟體

- 在終端機執行
  - vi
  - vi filename
- vi 模式
  - 一般模式 與 編輯模式

➢ 一般模式

- 用方向鍵移動游標
- x(X) 刪除後面(前面)的字
- dd 刪除一整行
- v 標記範圍
- y 複製(yy 複製該行)
- p 貼上
- u 復原
- Ctrl+r 重作

➢ 編輯模式

- i 插入(在游標字元前)
- a 插入(在游標字元後)
- o 覆蓋
- [Esc] 離開編輯模式

基本指令

- cd
  - 目錄資料夾切換
- ls
  - 列出有關檔案（file）及目錄（directory）的資訊
- pwd
  - 列出目前所在位置
- cp
  - 複製檔案
- mv
  - 搬移檔案或是重新命名
- rm
  - 刪除檔案或是資料夾
- mkdir
  - 建立資料夾
- rmdir
  - 移除空的資料夾
- ps
  - 列出所有執行程式
- kill
  - 刪除執行的程式
- tar
  - 壓縮解壓縮程式
- passwd
  - 變更使用者密碼

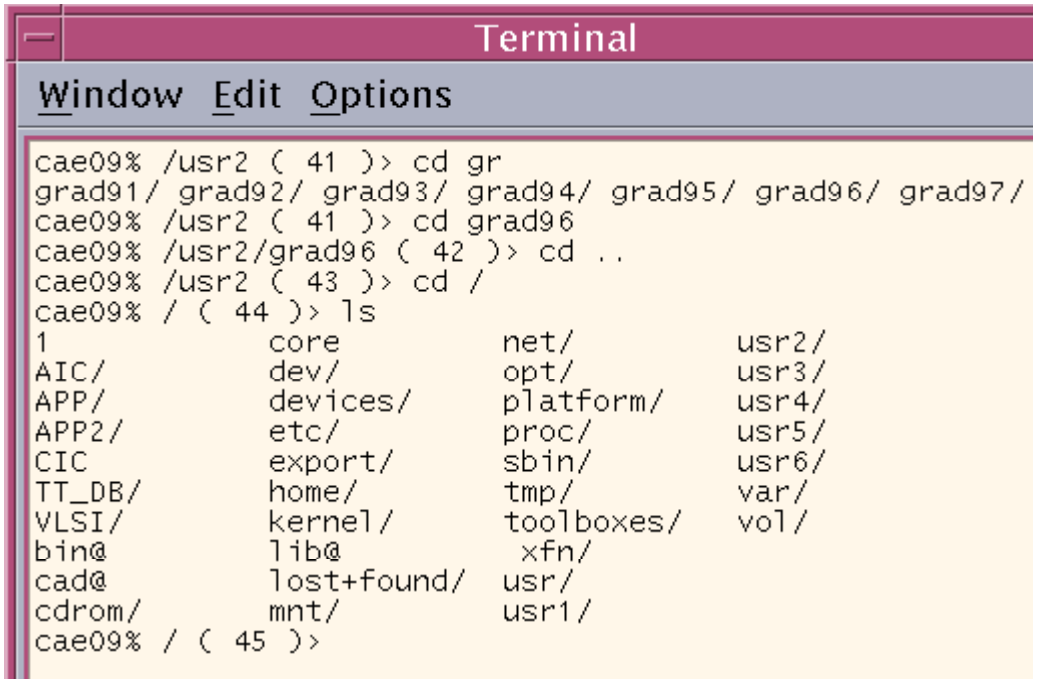
基本指令（1/12）

- cd
  - cd xxx

    切換到xxx的資料夾
  - cd ..

    回到上一層的資料夾
  - cd /

    回到根目錄



基本指令（2/12）

■ ls

ls -l 所顯示的檔案或目錄格式如下：

-rw-r-----	1	ucat	dynix	18417	Jan 23 24:00	catalog.doc
檔案性質與權限	連結檔案數量	擁有此檔案的人	擁有此檔案的群體	檔案大小	最後修改日期與時間	檔案名稱

有關檔案性質與權限共有十個字元，可分爲四組如下：

d	r w x	r w x	r w x
檔案(-)/目錄(d)	擁有人的權限	擁有團體的權限	他人的使用權限

其中：

r	read	可查看此檔案或目錄的內容
w	write	可更改此檔案或目錄的內容
x	execute	可執行此檔案
-		不具此權限

例如："-rwxrwx---" 表示其是爲一個檔案，此檔案的擁有人及擁有團體可以讀、寫、與執行此檔案，而其他非同一團體的人則完全沒有權限讀、寫、或執行此檔案。

基本指令（3/12）

- pwd

```
cae09% / ( 45 )> cd usr2/grad96/
afree/    ct/       helofox/  omega3/   tmp002/
alpha/    cwchang/  hsiny/    ponin/    tmp003/
ansgoing/ d3501017/ jun901/   ritama/   tseng/
applelee/ d3501092/ jyhong/   rogmark/  tzuo1012/
b9201027/ dragon/   ken/      sam1201/  usefun/
bbpow/    dsefkn/   kimi4231/ sapidog/  vd96/
binghung/ eda0612/  lawalaua/ shanglu/  weiciang/
brain/    garbo/    lkz/      shen/     winson/
caspar/   ggbetty/  maple/    sip04/    yuchia/
changwc/  gyamwoo/  mark1101/ temp01/   zack7465/
cloudyu/  handyc/   maxwellf/ thunder/
csk618/   headrun/  mikeee/   tmp001/
cae09% / ( 45 )> cd usr2/grad96/ct/
CDS.log           LVS.tar           d3501101/
CDS.log.1         LVS/              hspice/
CDS.log.2         Mail/             ic_contest/
CDS.log.3         PDK13.tar         libManager.log
CDS.log.4         PDK13D/           libManager.log.1
CSHRC             PEX.tar           nsmail/
DRC.tar           PEX/              panic.log
DRC/              command.log       temp/
DRE_CDS.log       core
DRE_CDS.log.1     d3501064/
cae09% / ( 45 )> cd usr2/grad96/ct/hspice/
cae09% /usr2/grad96/ct/hspice ( 46 )> pwd
/usr2/grad96/ct/hspice
cae09% /usr2/grad96/ct/hspice ( 47 )>
```

目前所在位置

基本指令（4/12）

- cp
  - cp　來源檔案　　目的檔案
    cp　abc.txt　　xyz.txt
  - cp　來源檔案　　目的路徑
    cp　/usr3/abc.txt　~/document/
    cp　/usr3/abc.txt　.
  - cp　來源檔案　　路徑/目的檔案
    cp　/usr3/abc.txt　~/document/xyz.txt
  - cp　-r　來源資料夾　　路徑/
    cp　-r　/usr3/tf/　　~/document/
    cp　-r　/usr3/tf/　　~/document/035tf/

基本指令（5/12）

- mv
  - mv　來源檔案　目標檔案
    mv　abc.txt　abc.txt.old
  - mv　來源檔案　路徑/目標檔案
    mv　abc.txt　~/document/abc.txt
  - mv　來源資料夾　目標資料夾
    mv　folder/　work/
  - mv　來源資料夾　路徑/目標資料夾
    mv　folder/　~/document/work/

基本指令（6/12）

- rm
  - rm　移除檔案

    rm　abc.txt

    rm　~/document/abc.txt

  - rm　-r　移除資料夾

    rm　-r　~/document/

基本指令（7/12）

- Mkdir
  - mkdir　　欲建立的名稱
    mkdir　　temp
    mkdir　　temp_34
    mkdir　　temp-34　(不好)

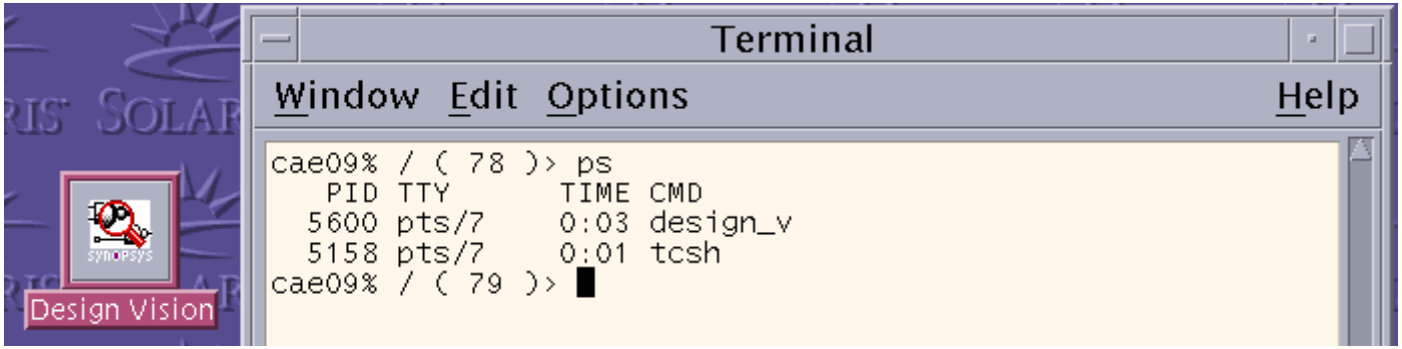
  - mkdir　　路徑/欲建立的名稱
    mkdir　　~/temp/

基本指令（8/12）

- rmdir
  - rmdir　　欲刪除的資料夾
    rmdir　　temp
    rmdir　　temp_34
  - rmdir　　路徑/欲刪除的資料夾
    rmdir　　~/temp/

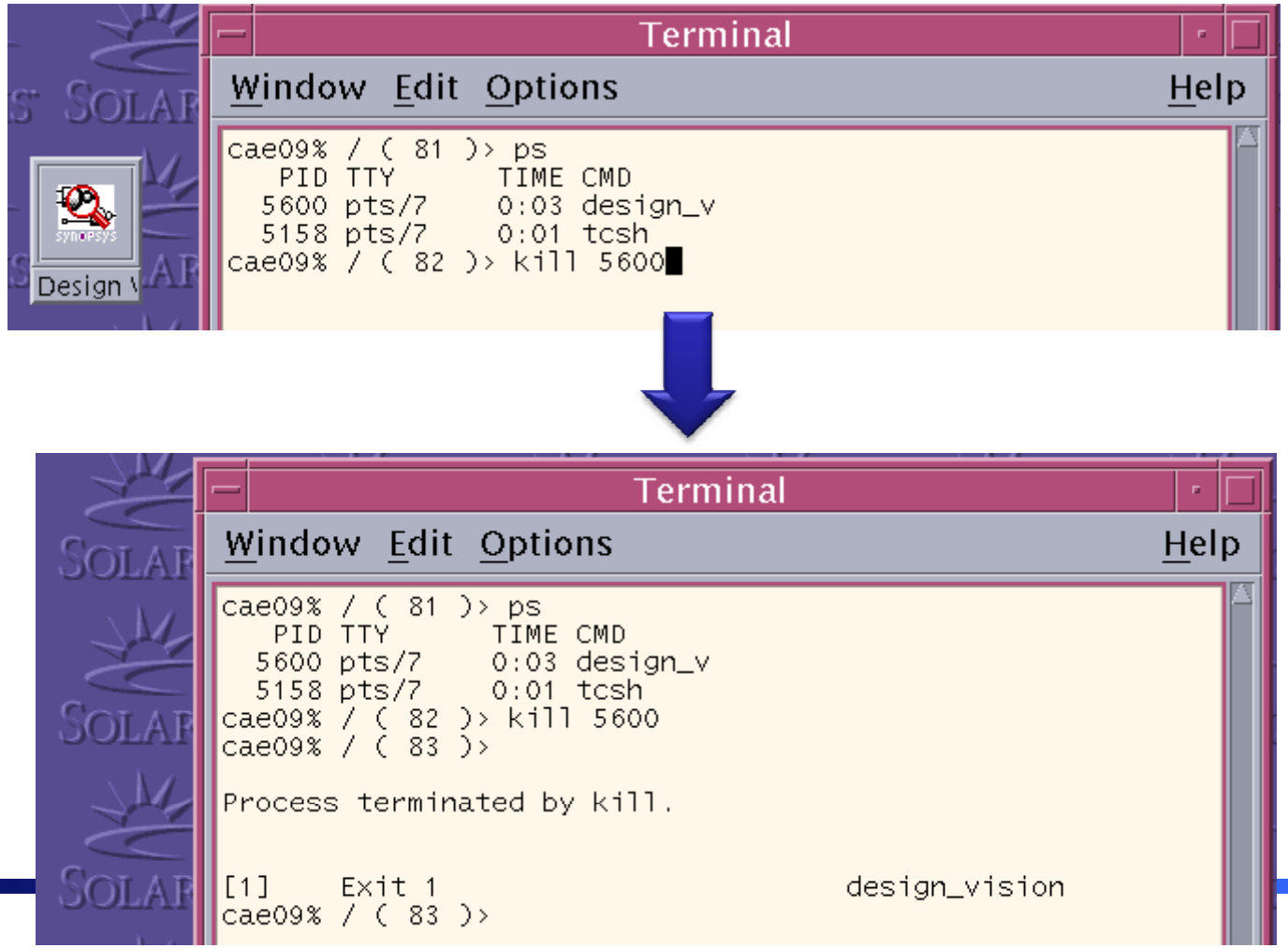
基本指令（9/12）

- ps


Terminal
Window Edit Options Help
cae09% / (78)› ps
PID TTY TIME CMD
5600 pts/7 0:03 design_v
5158 pts/7 0:01 tcsh
cae09% / (79)›
Design Vision

基本指令（10/12）

- kill
  - kill PID(執行緒)



基本指令（11/12）

- tar
  - tar -cvf 完成壓縮後的名稱 欲壓縮的資料夾
    tar -cvf document.tar ~/document/
  - tar -cvf 路徑/完成壓縮後的名稱 欲壓縮的資料夾
    tar -cvf ~/temp/document.tar ~/document/
  - tar -xvf 欲解壓縮的壓縮檔
    tar -xvf document.tar

基本指令（12/12）

- passwd

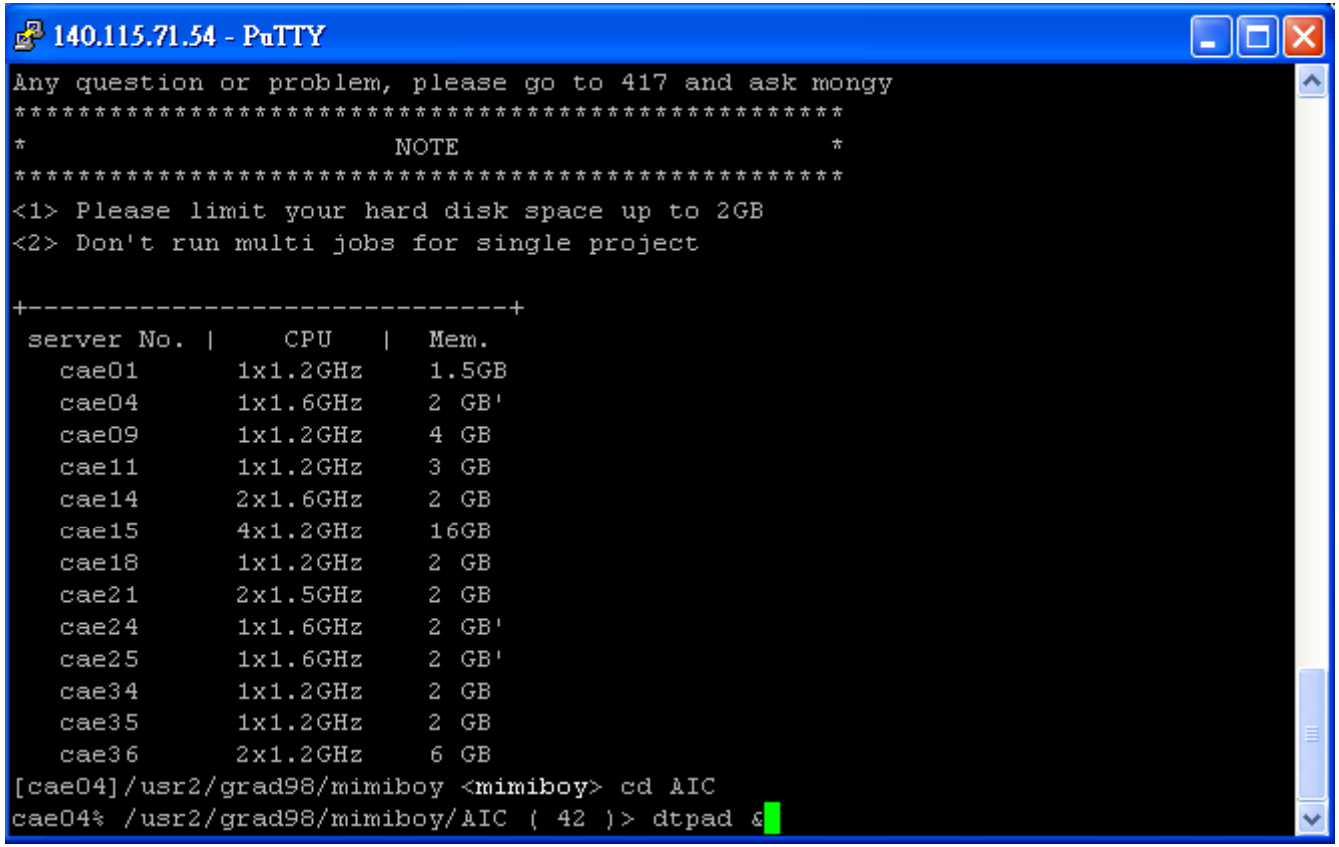
```
cae09% /usr2/grad94/mongy ( 101 )> passwd
passwd: Changing password for mongy
Enter existing login password:
New Password:
Re-enter new Password:
passwd: password successfully changed for mongy
cae09% /usr2/grad94/mongy ( 102 )>
```

舊的密碼

新的密碼

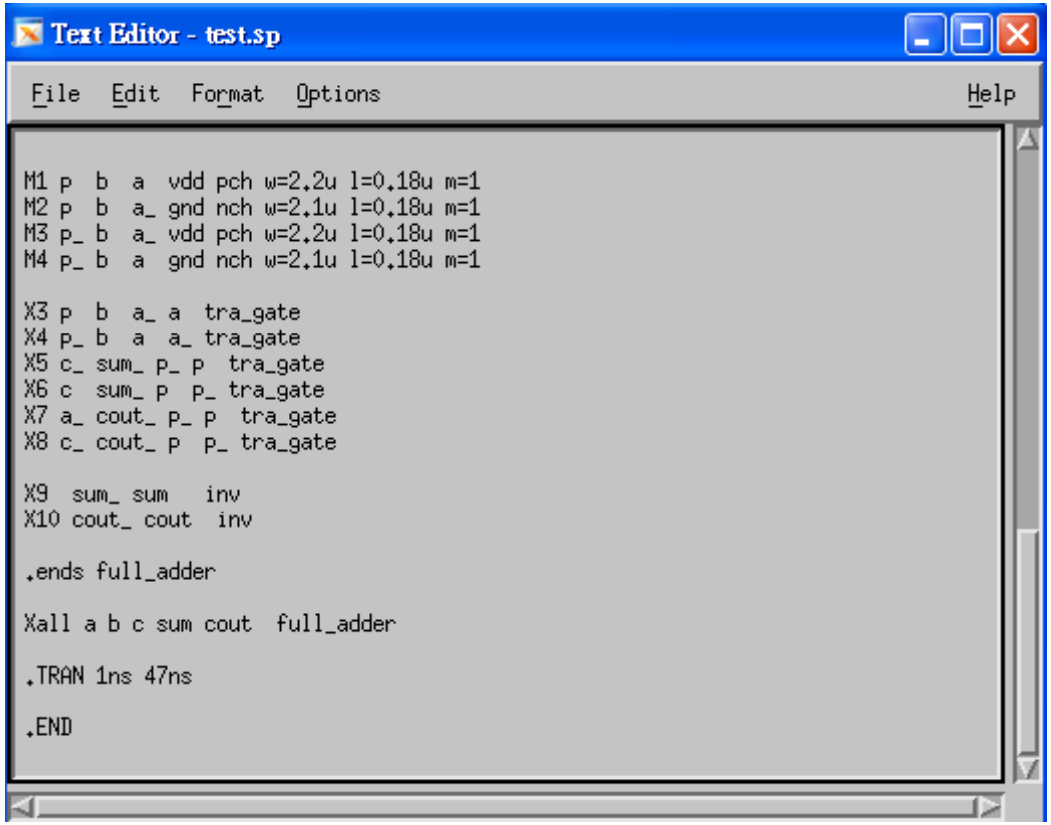
新的密碼再次確認

Operation (1/8)

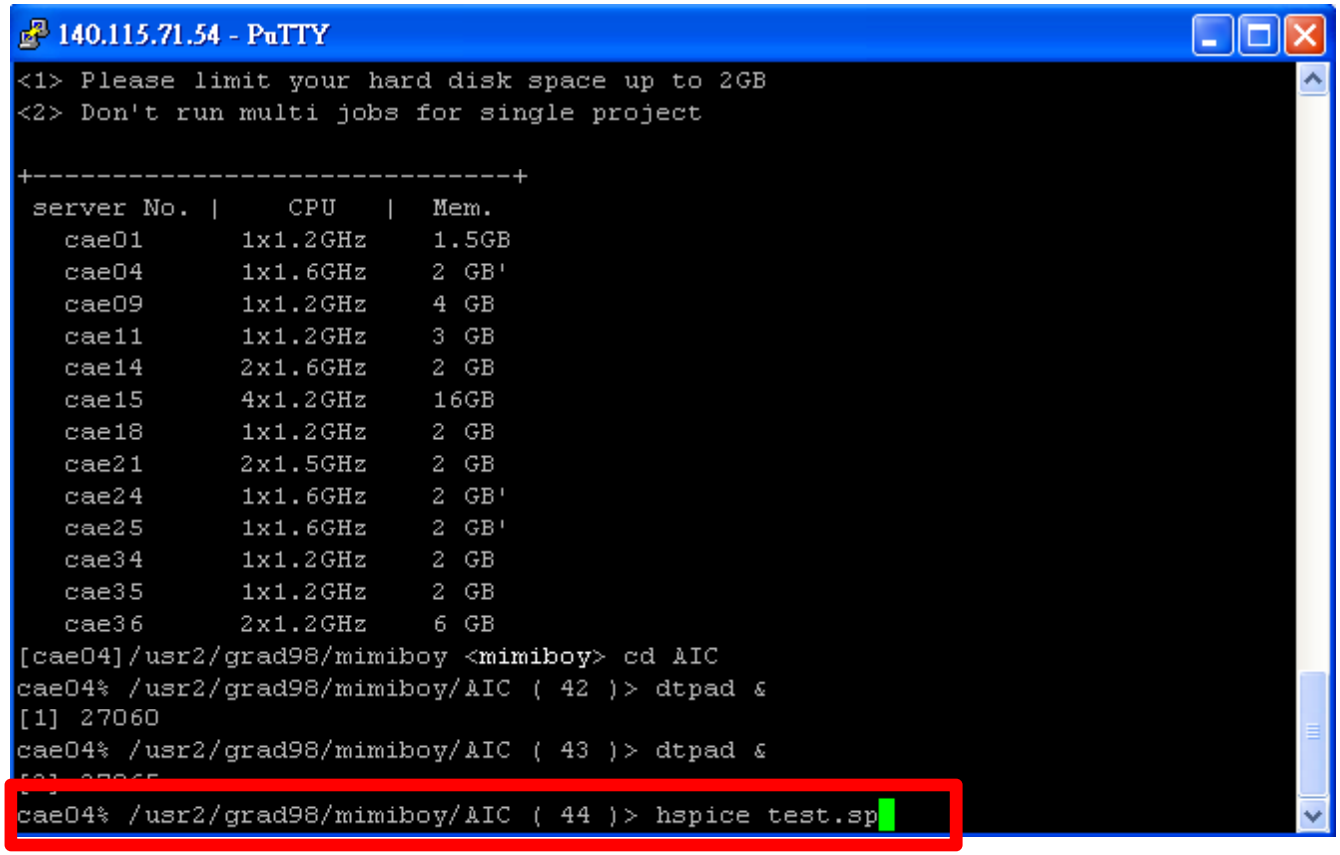


Operation (2/8)

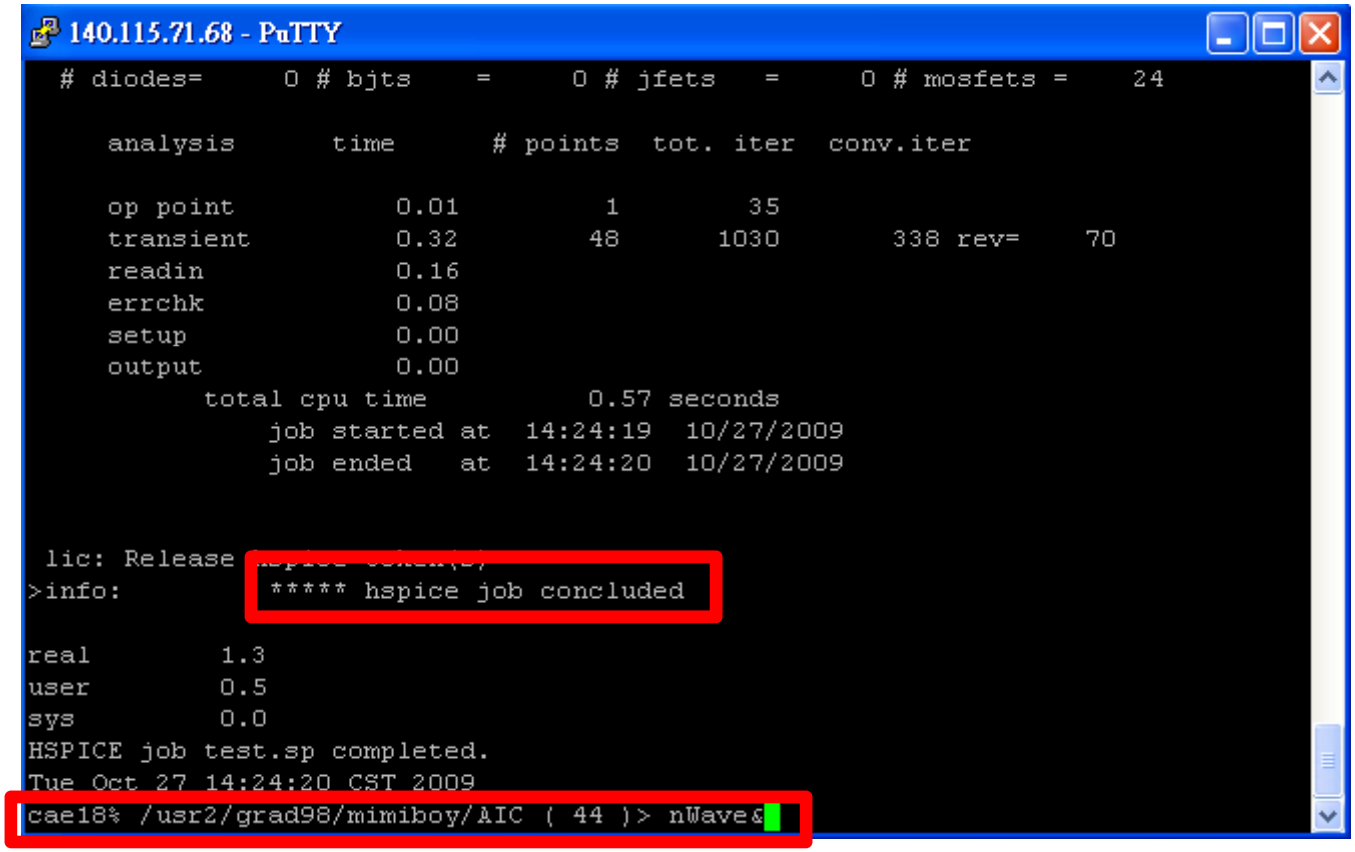
Operation (3/8)



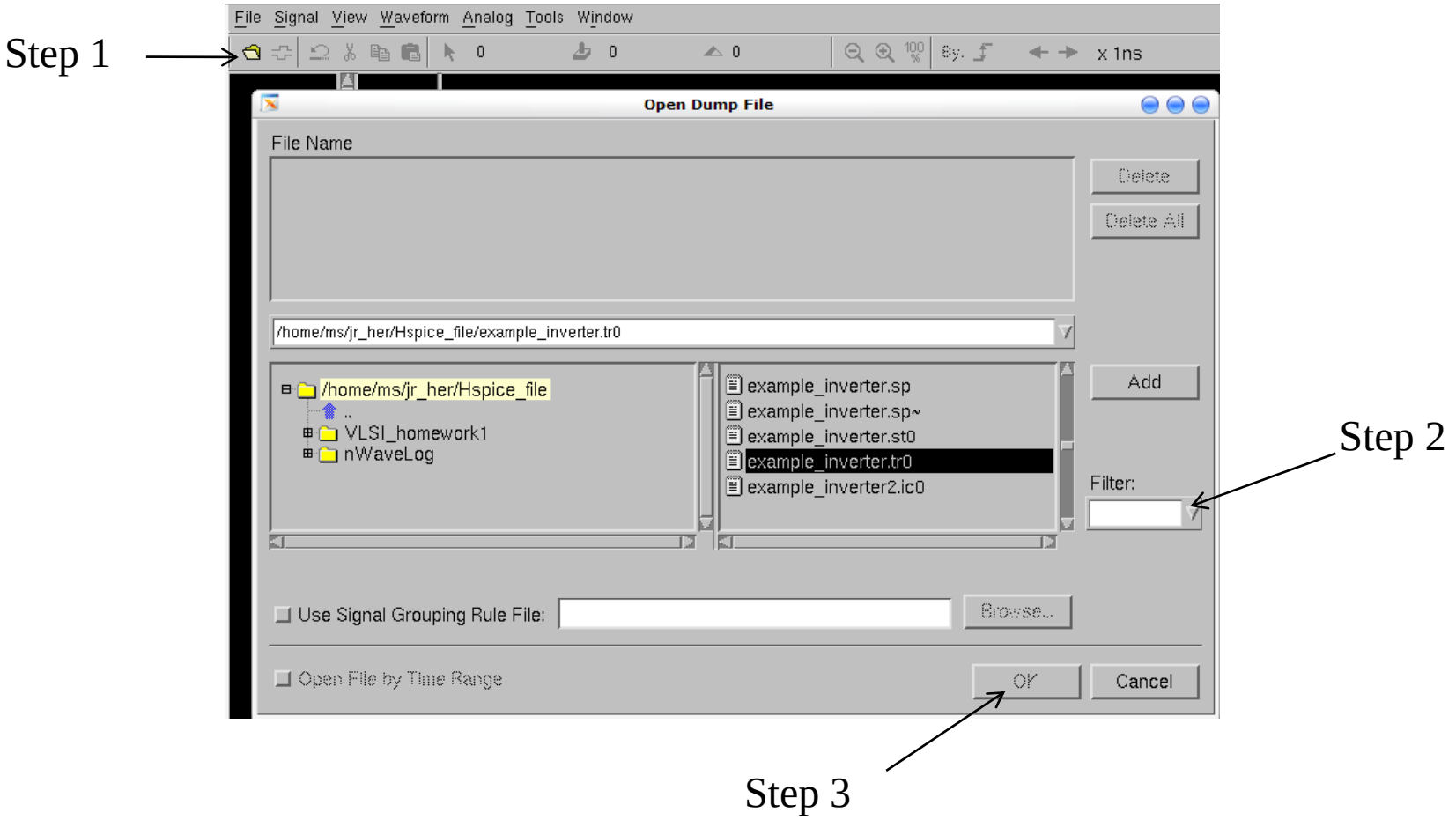
Operation (4/8)



Operation (5/8)



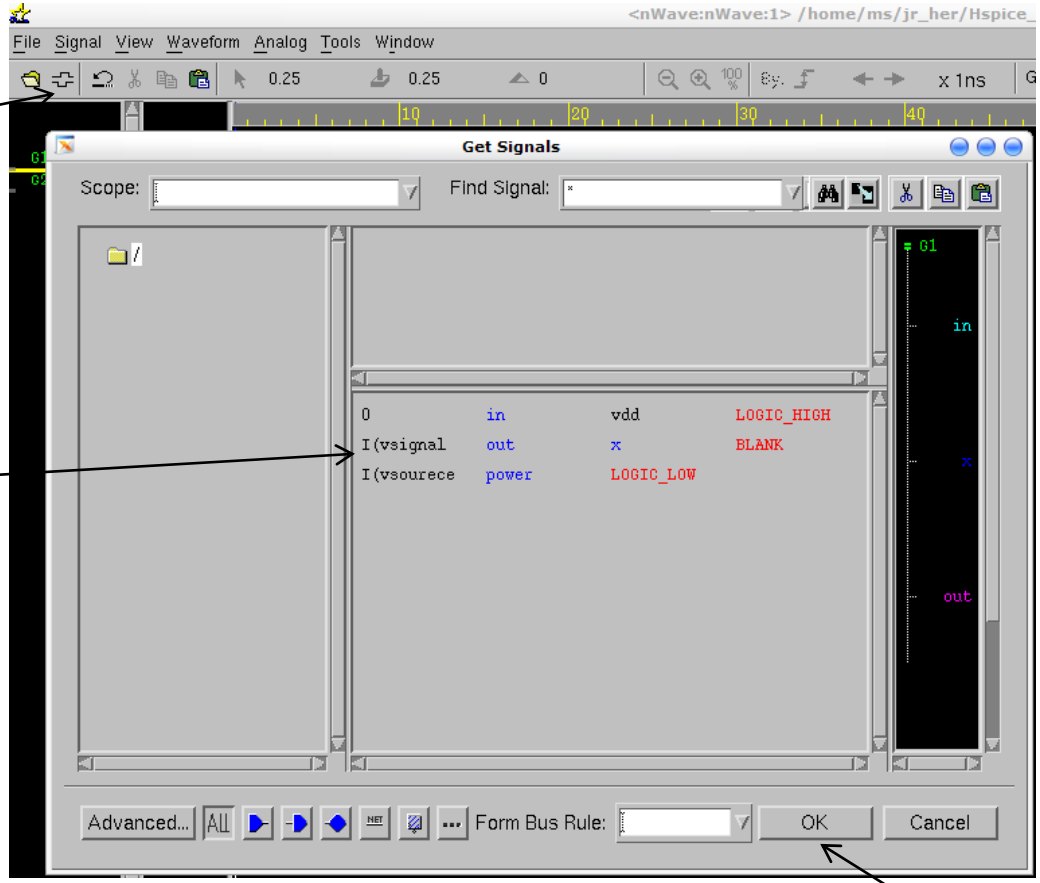
Operation (6/8)



Operation (7/8)

Step 4

Step 5



Step 6

Operation (8/8)