COMP4651

Lab0: Linux fundamentals

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Outline

- SSH connection (p3 - p13)
- Basic Linux commands (p14 - p46)
- Using text editor (p47 - p53)
- (Appendix for Windows Users) (p54 - p55)

Why Linux?

- Almost all open-source big data systems, such as Hadoop and Spark, run in Linux/Unix OS
- We'll do labs on Amazon EC2, using Linux virtual machines

Connecting to a Linux machine

- CSE Lab 2 (csl2) has 53 workstations running CentOS
  - reachable at csl2wkXY.cse.ust.hk, where XY is the workstation ID (01..53)
- Log onto workstation 01 from your laptop (Lab3 Windows machines also have an open-ssh client)
  - in the command line, type:

    ssh your_CSD_Account_ID@csl2wk01.cse.ust.hk

  - type your CSD password, and type "**yes**" if it asks you "The authenticity of the host can't be established…"

Secure SHell: SSH

- OpenSSH/Sun_SSH
  - OpenSSH is included in a number of Linux distributions
  - also available in the Lab3 Windows machines
  - we will use it to connect to our VMs in the AWS cloud!
  - type **ssh -V** at the command line to check its version

Secure SHell: SSH

- Basic usage
  - ssh user@hostname
- TCP connection at default port 22

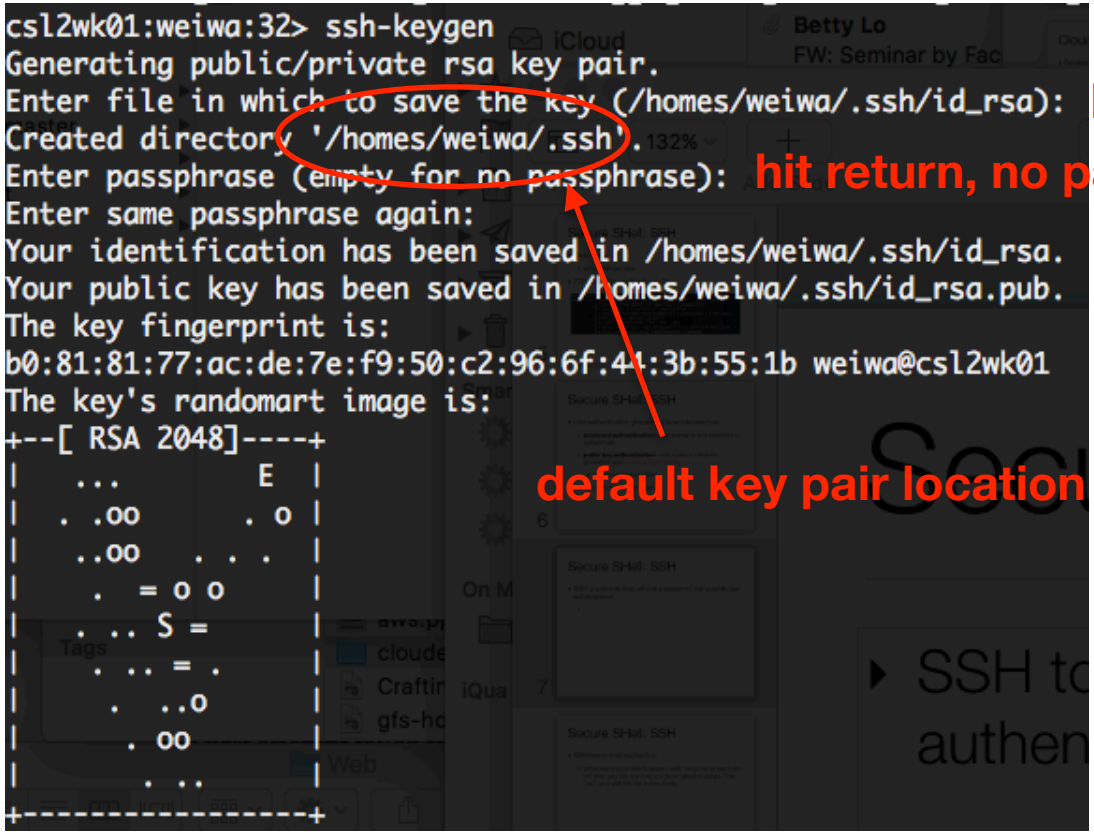
```
csl2wk01:weiwa:31> ssh
usage: ssh [-1246AaCfgKkMNnqsTtVvXxYy] [-b bind_address] [-c cipher_spec]
           [-D [bind_address:]port] [-E log_file] [-e escape_char]
           [-F configfile] [-I pkcs11] [-i identity_file]
           [-L [bind_address:]port:host:hostport] [-l login_name] [-m mac_spec]
           [-O ctl_cmd] [-o option] [-p port]
           [-Q cipher | cipher-auth | mac | kex | key]
           [-R [bind_address:]port:host:hostport] [-S ctl_path] [-W host:port]
           [-w local_tun[:remote_tun]] [user@]hostname [command]
```

Secure SHell: SSH

- User authentication: give access to an intended host
  - **password authentication:** uses username and password to authenticate
  - **public key authentication:** uses a pair of computer generated keys: public and private key
    - private key kept on client
    - public key stored on server

SSH without a password

- Log onto a remote host through a public key authentication
- Generate a public-private key pair: **ssh-keygen**



SSH without a password

- Let's take a look into "~/.ssh":
  - ls ~/.ssh
  - private key: id_rsa; public key: id_rsa.pub
- Now add the public key to the authorized keys
  - touch ~/.ssh/authorized_keys
  - cat ~/.ssh/id_rsa.pub >> ~/.ssh/authorized_keys
  - Prevent the file from being accessed by others:
    - chmod 600 authorized_keys

SSH without a password

- Log out of the workstation and go back to the laptop: **logout**
- On your laptop (**Windows users refer to the Appendix**)
  - Get the private key by Secure Copy (**scp**) and rename it as "csl2wk01.rsa" (or whatever file name you prefer):
    - **scp you@csl2wk01.cse.ust.hk:~/.ssh/id_rsa ~/.ssh/csl2wk01.rsa**
  - Prevent others to accessing the private key:
    - **chmod 600 ~/.ssh/csl2wk01.rsa**
  - Log onto the workstation through public key authentication:
    - **ssh -i ~/.ssh/csl2wk01.rsa you@csl2wk01.cse.ust.hk**

SSH without a password

- Anyone with the private key **csl2wk01.rsa** can SSH to the workstation under your identity! Remove the private key **on the workstation (csl2wkxx)**
  - rm ~/.ssh/id_rsa
- One more thing to do **on your laptop**
  - echo -e "Host csl2wk01 \nHostname csl2wk01.cse.ust.hk \nUser your_login_name \nIdentityFile ~/.ssh/csl2wk01.rsa" >> ~/.ssh/config
  - ssh csl2wk01
    - (If error, check the "config" file by "**cat ~/.ssh/config**", you can also revise it by "**vim ~/.ssh/config**", seeing "Using text editor" part for reference)

SSH known-host mechanism

- ssh is warning you that it doesn't really know the remote host yet when you ssh to a host you never talked to before. Type "yes", and add it to the known hosts
  - take a look into ~/.ssh/known_hosts

```
peng@peng-QTC6:~/Download$ ssh -i temp3.pem ubuntu@54.199.159.63
The authenticity of host '54.199.159.63 (54.199.159.63)' can't be established.
ECDSA key fingerprint is b1:20:b2:a4:9c:24:80:ef:32:68:ba:03:bc:92:ac:8a.
Are you sure you want to continue connecting (yes/no)? yes
Warning: Permanently added '54.199.159.63' (ECDSA) to the list of known hosts.

The programs included with the Ubuntu system are free software;
the exact distribution terms for each program are described in the
individual files in /usr/share/doc/*/copyright.

Ubuntu comes with ABSOLUTELY NO WARRANTY, to the extent permitted by
applicable law.
```

A detailed explanation: http://security.stackexchange.com/questions/20706/what-is-the-difference-between-authorized-keys-and-known-hosts-file-for-ssh

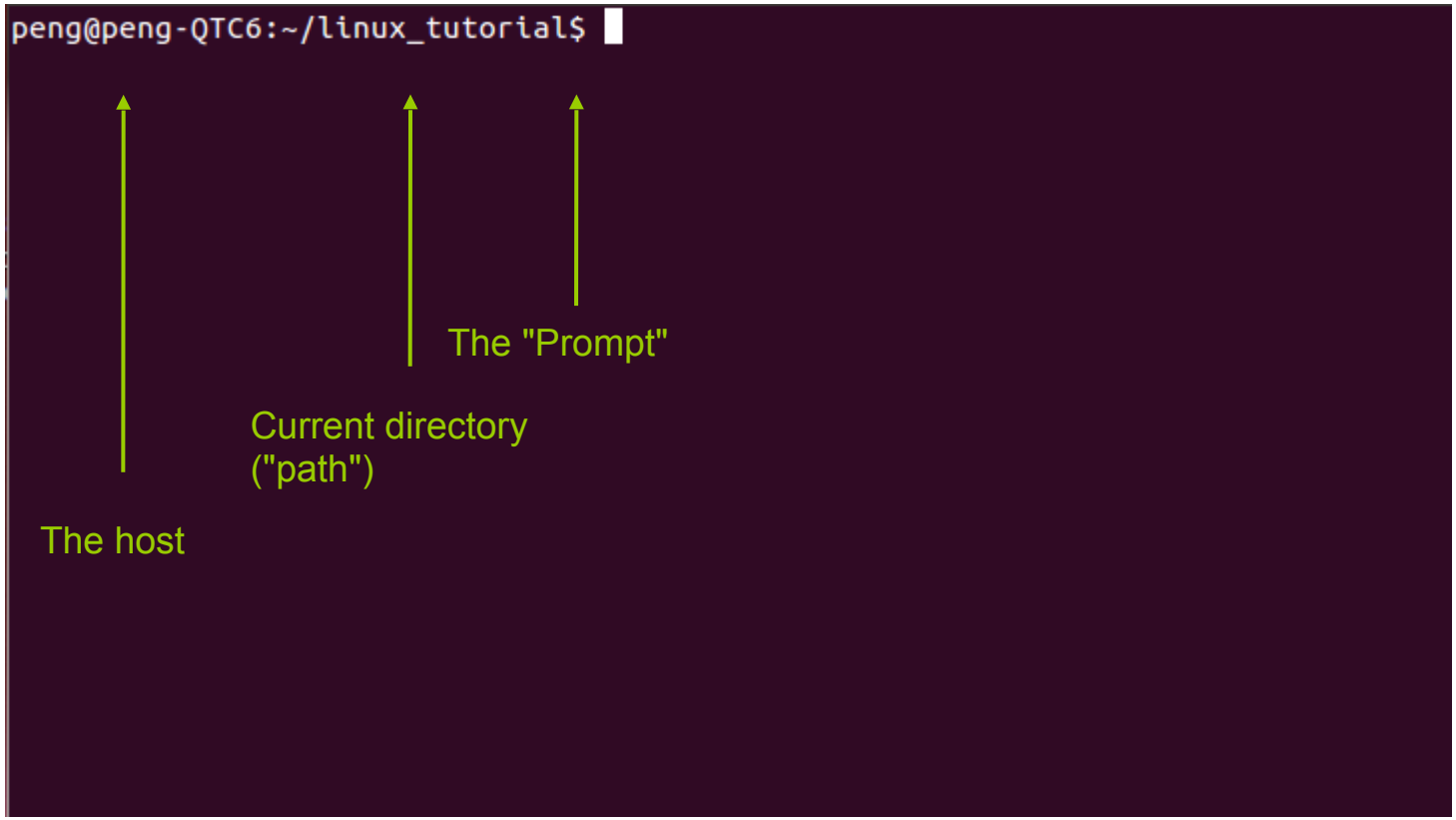
Terminating an SSH session

- Several ways depending on your Linux system
  - type **exit**
  - Or type **logout**
  - Or hit "**Ctrl + d**" on the keyboard

The end of SSH Connection Session.
Any questions?

Basic Linux commands

- Login to the Linux system again and play with it.
  - ssh csl2wk01



Basic Commands: man

- Help

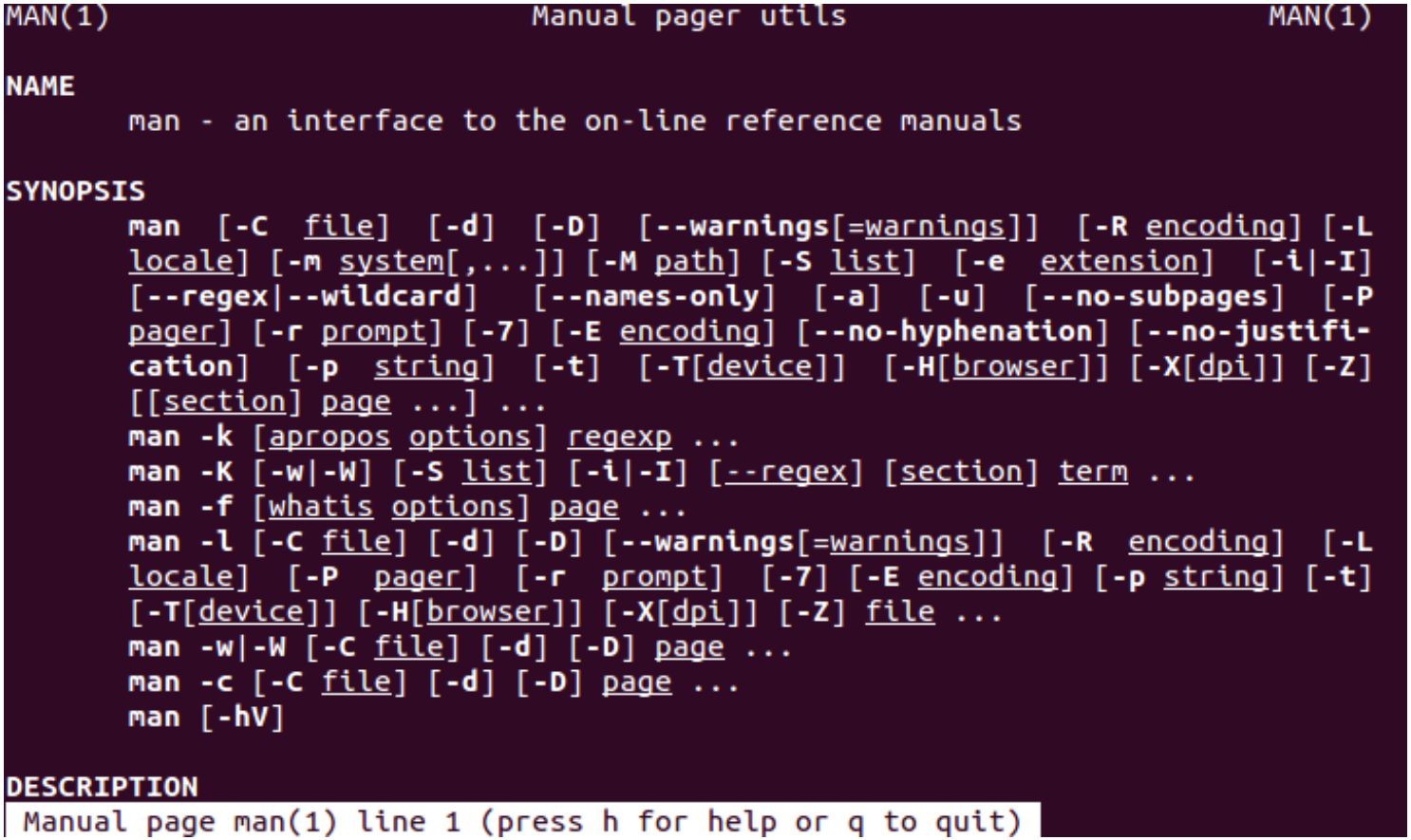
  Whenever you need help with a command, type "man" and the command name.

- Basic Syntax

  man [option(s)] keyword(s)
  hit “j” (“k”) to scroll down (up) by one line;
  hit “f” (“b”) to scroll down (up) by one screen;
  hit “q” to exit

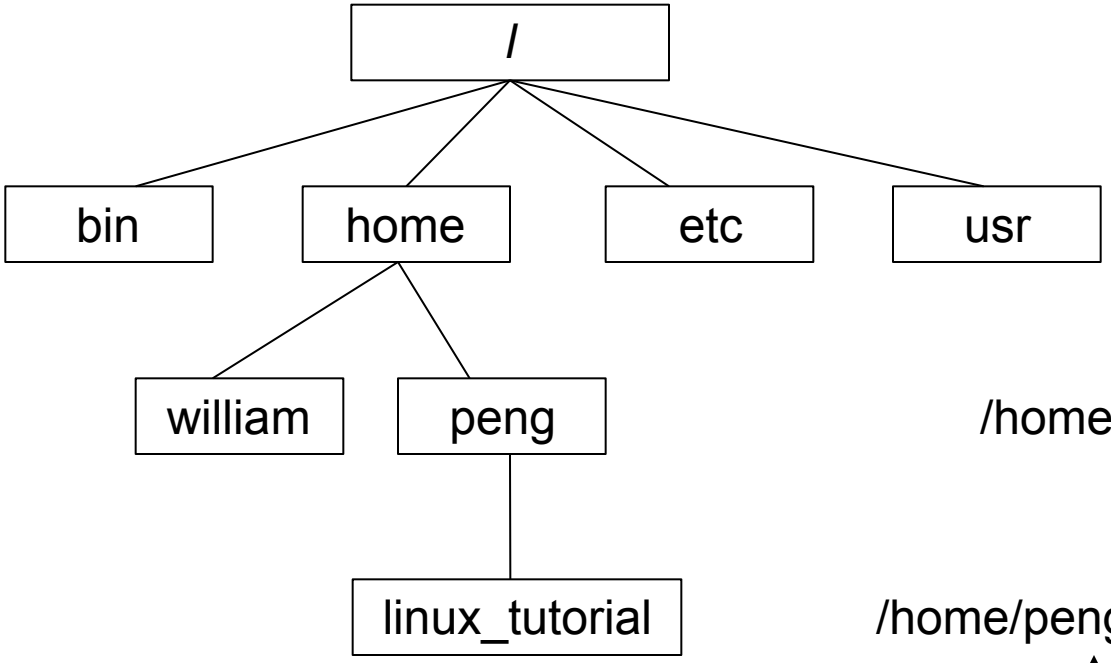
Of course, you can always use Google…

Introduction to Command: man



Linux File System

a hierarchy of directories and files



/home/peng

/home/peng/linux_tutorial

The "path"

Linux File System

- Directory Commands
  - ➢ pwd: print name of the current/working directory
  - ➢ cd: change to a specific directory
  - ➢ ls: list directory contents
  - ➢ mkdir: create a directory
  - ➢ rmdir: delete a directory
- File Commands
- File Permissions (reference only)

Linux File System

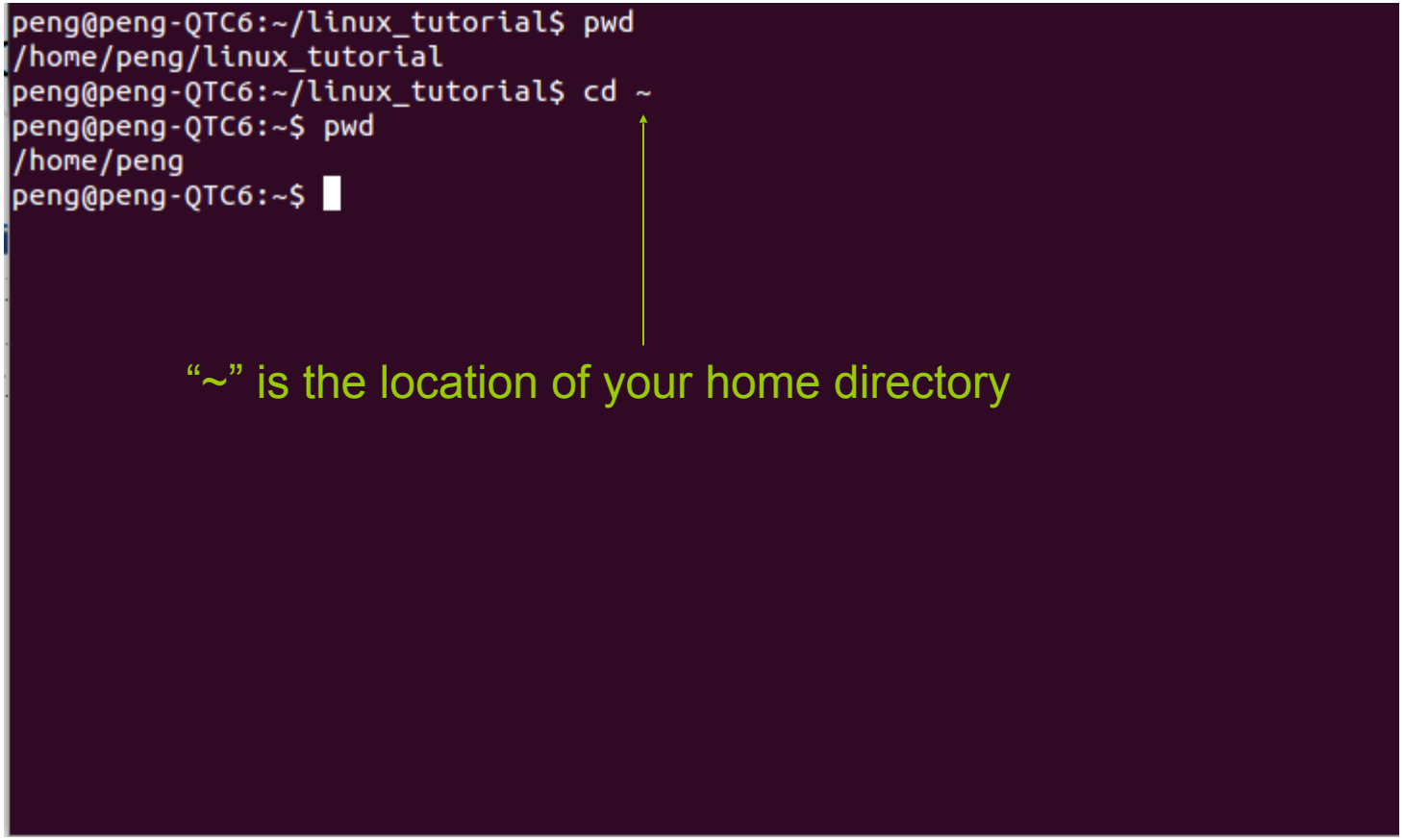
- Command: pwd

Linux File System

- Directory Commands
  - ➢ pwd: print the complete path of current/working directory
  - ➢ cd: change to a specific directory

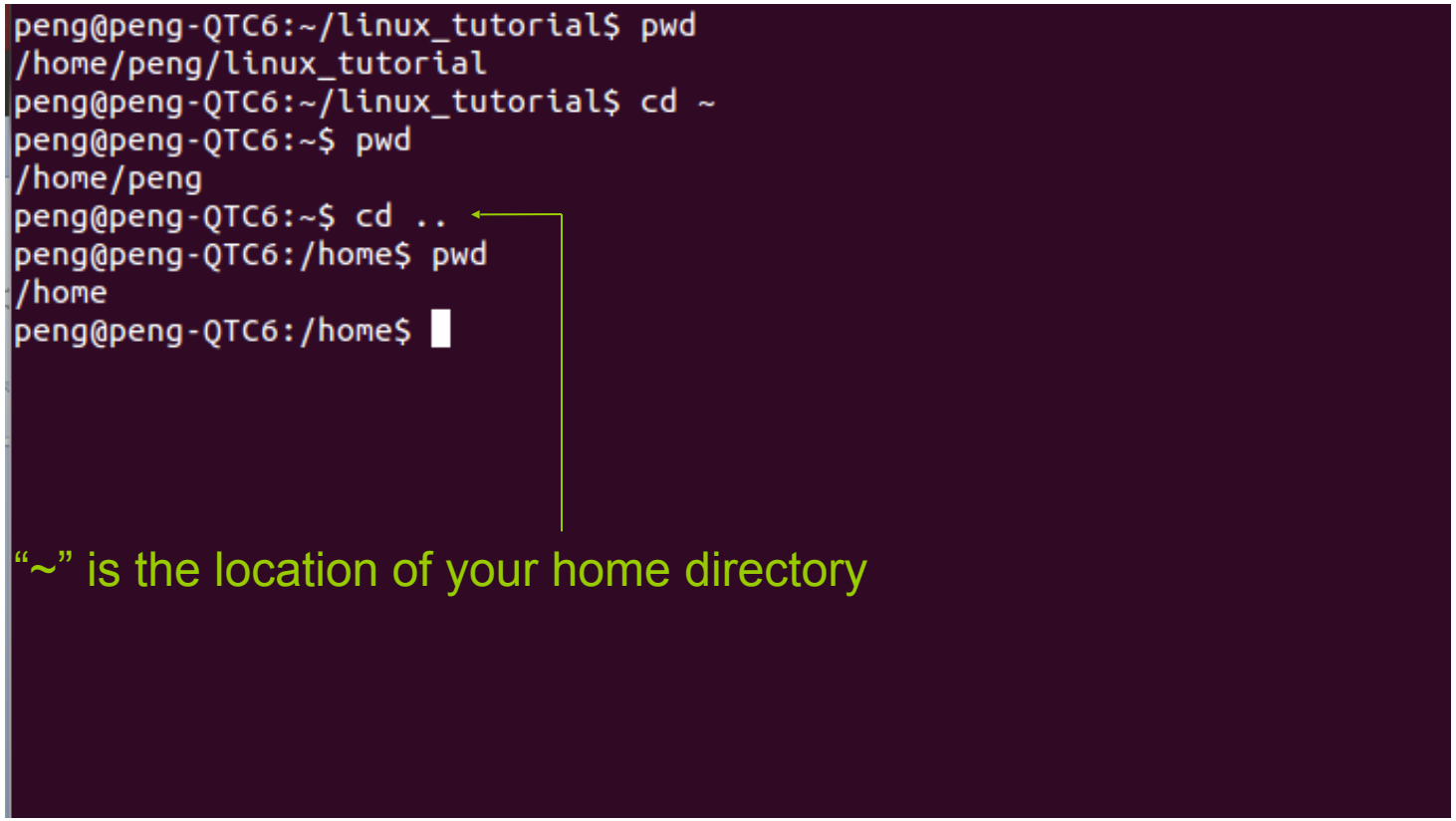
Linux File System

- Command: cd ~, or simply cd



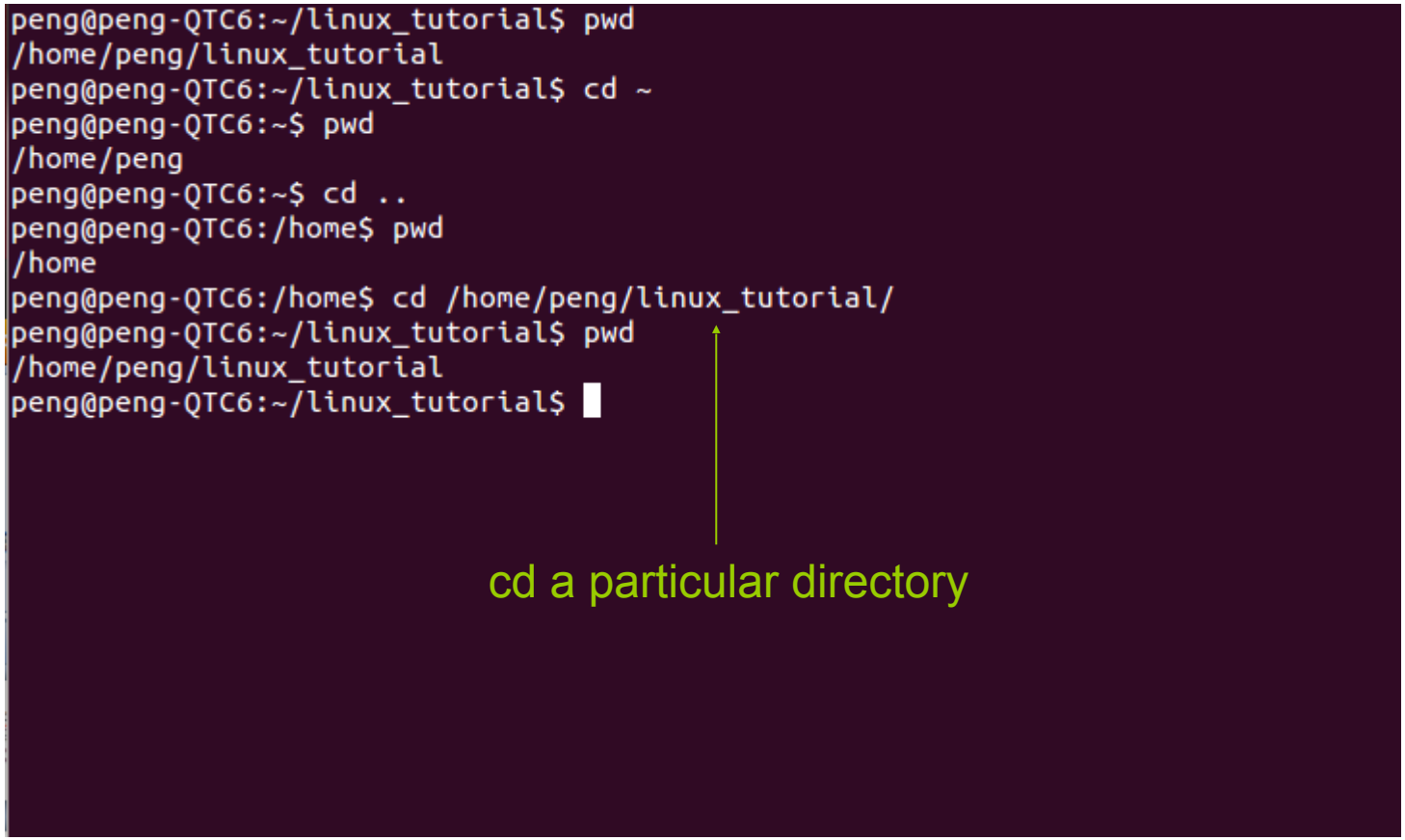
Linux File System

- Command: cd .. , goes back to the parent directory



Linux File System

- Command: cd



Linux File System

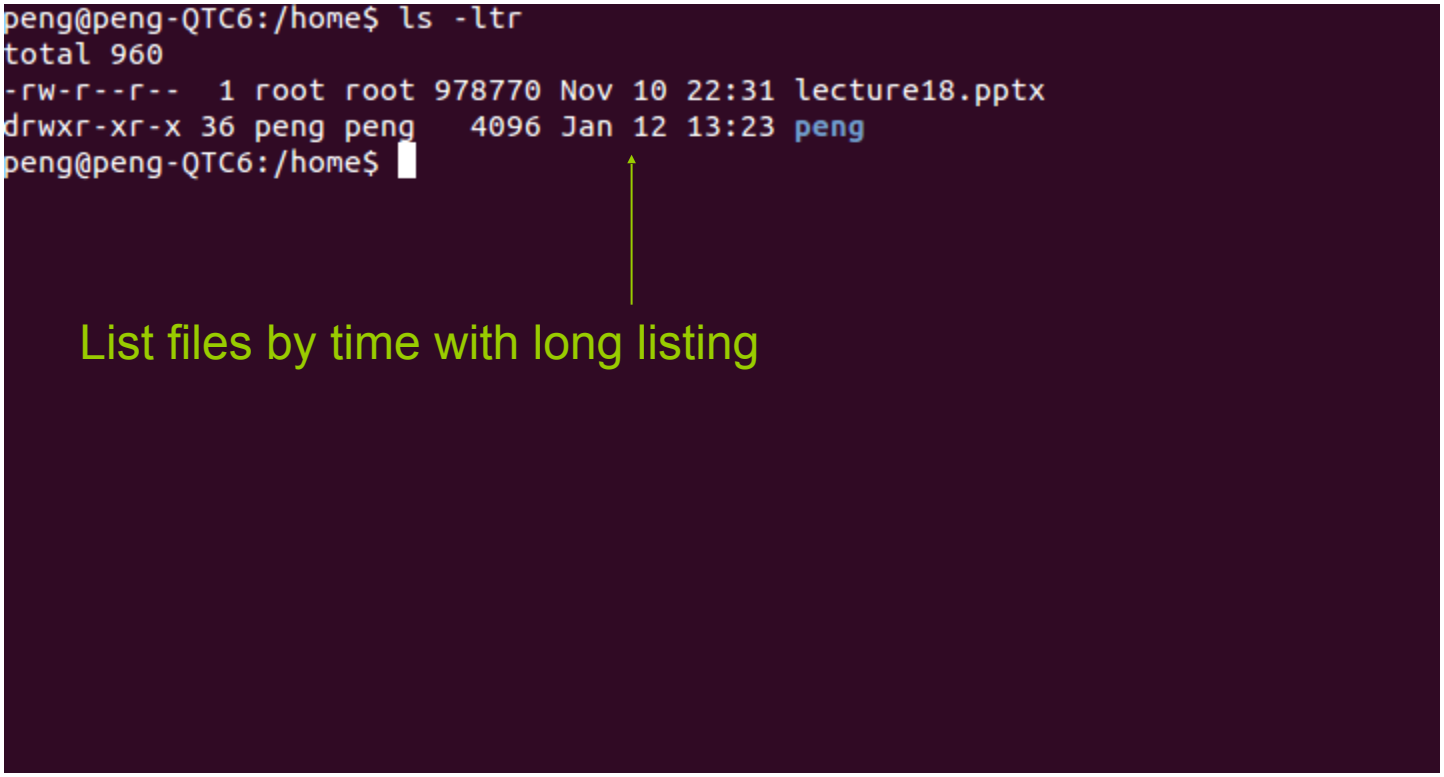
- Directory Commands
  - pwd: print name of current/working directory
  - cd: change to a specific directory
  - ls: list directory contents

Linux File System

- Command: ls
- Options:
  - -l long list (displays lots of info)
  - -a show hidden files (system files, etc.)
  - -t sort by modification time
  - -S sort by size
  - -h list file sizes in human readable format

Linux File System

- Command: ls -lt

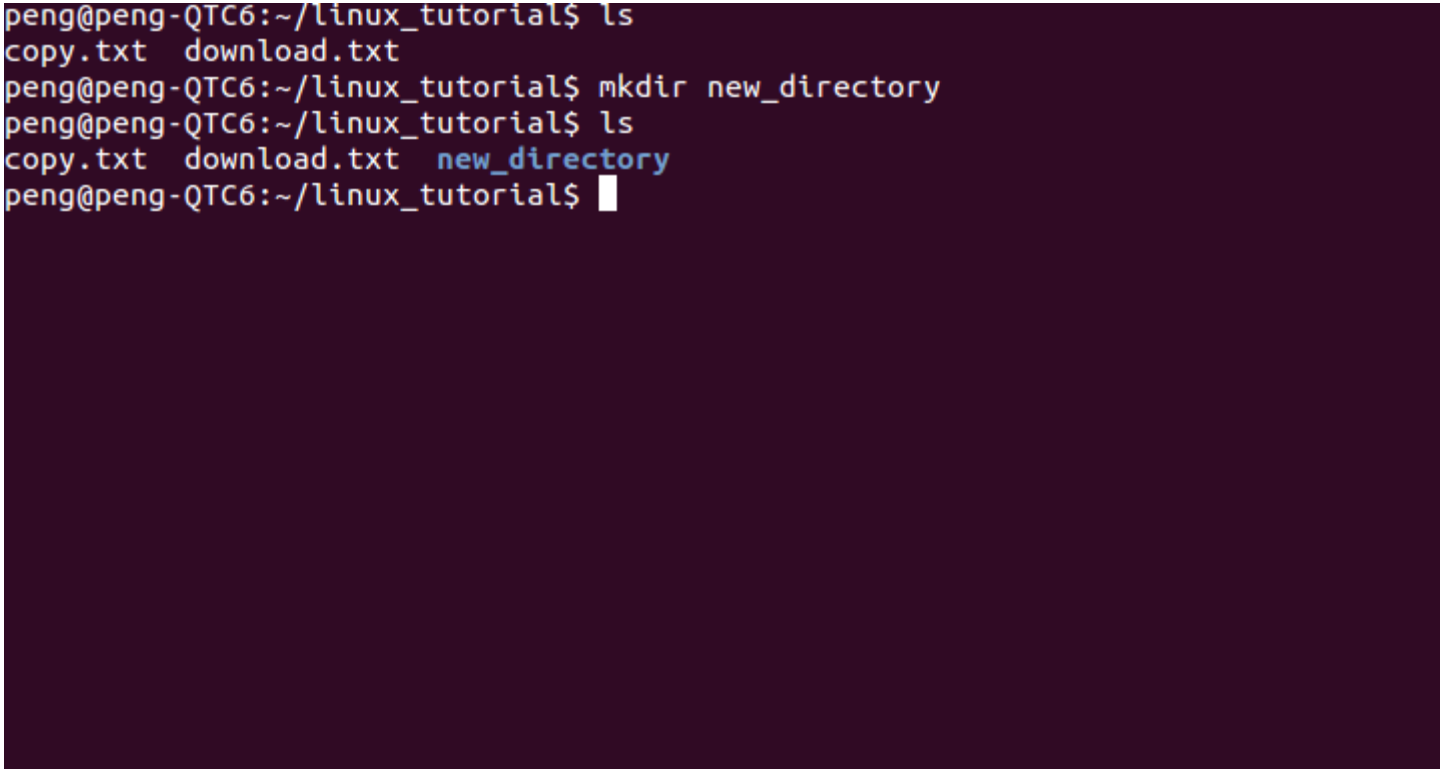


Linux File System

- Directory Commands
  - pwd: print name of current/working directory
  - cd: change to a specific directory
  - ls: list directory contents
  - mkdir: create a directory

Linux File System

- Command: mkdir. Creates a new folder in the current directory

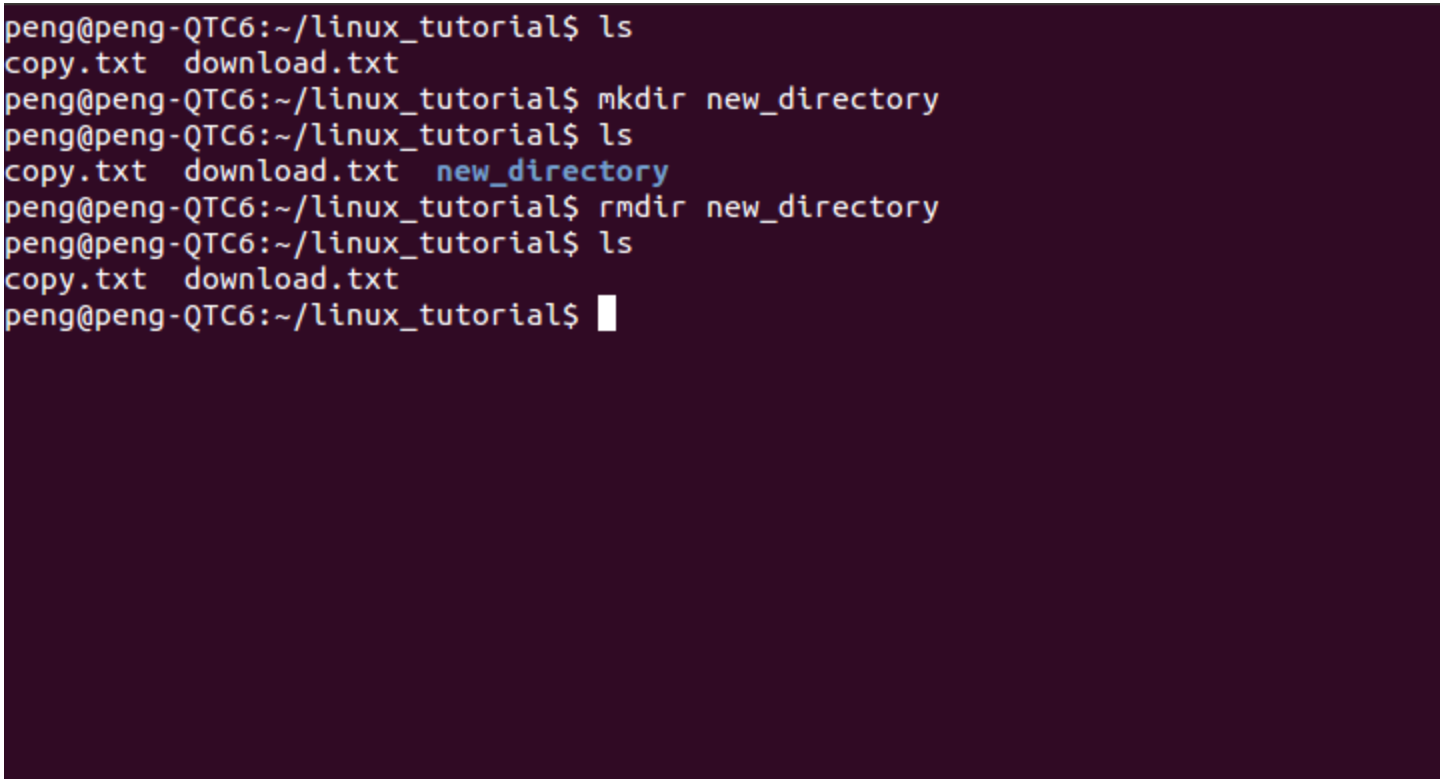


Linux File System

- Directory Commands
  - ➢ pwd: print name of current/working directory
  - ➢ cd: change to a specific directory
  - ➢ ls: list directory contents
  - ➢ mkdir: create a directory
  - ➢ rmdir : delete an empty directory
  - ➢ rm -r: delete a directory even though it's not empty (use with caution)
- File Commands
- File Permissions

Linux File System

- Command: rmdir

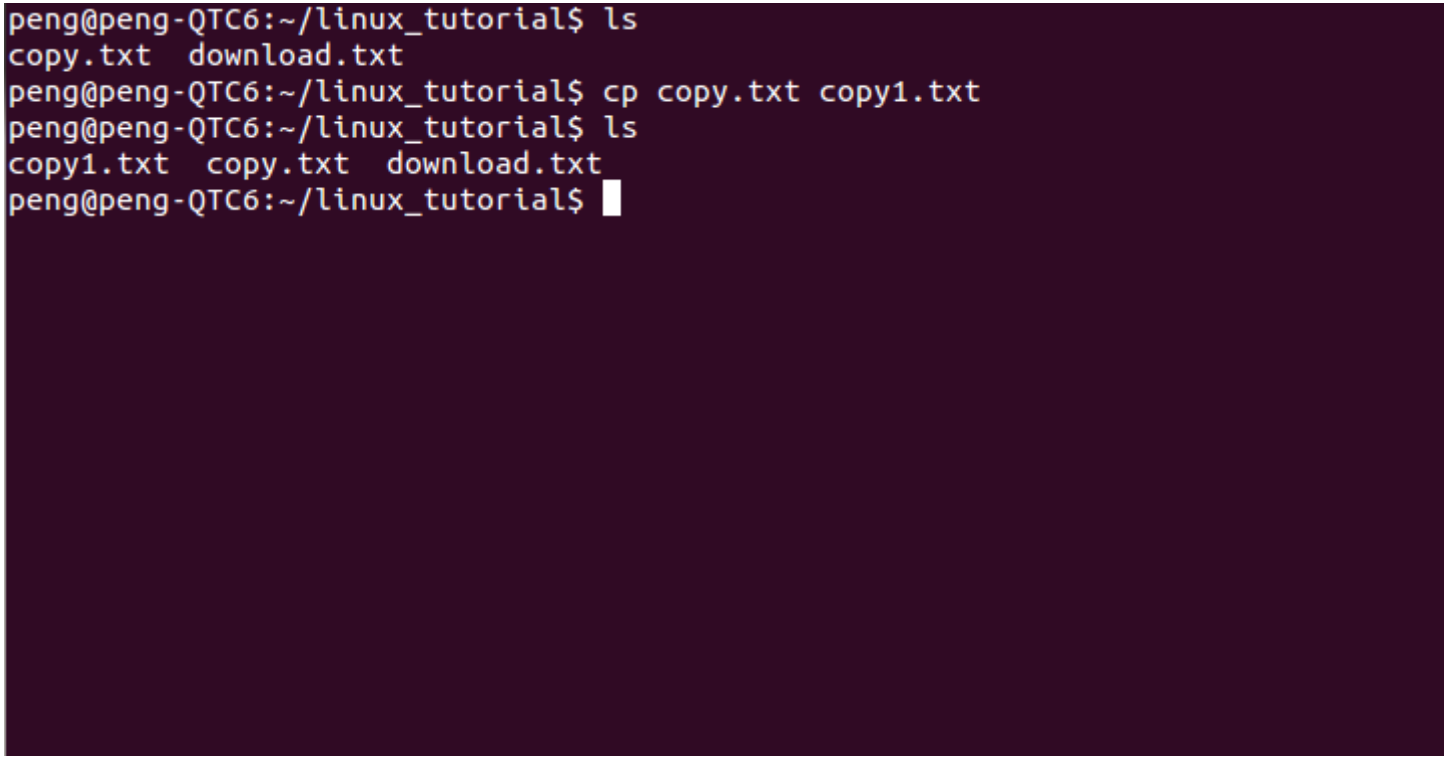


Linux File System

- Directory Commands
- File Commands
  - cp: copy files and directories
  - mv: move (rename) files
  - rm: remove a file

Linux File System

- Command: cp

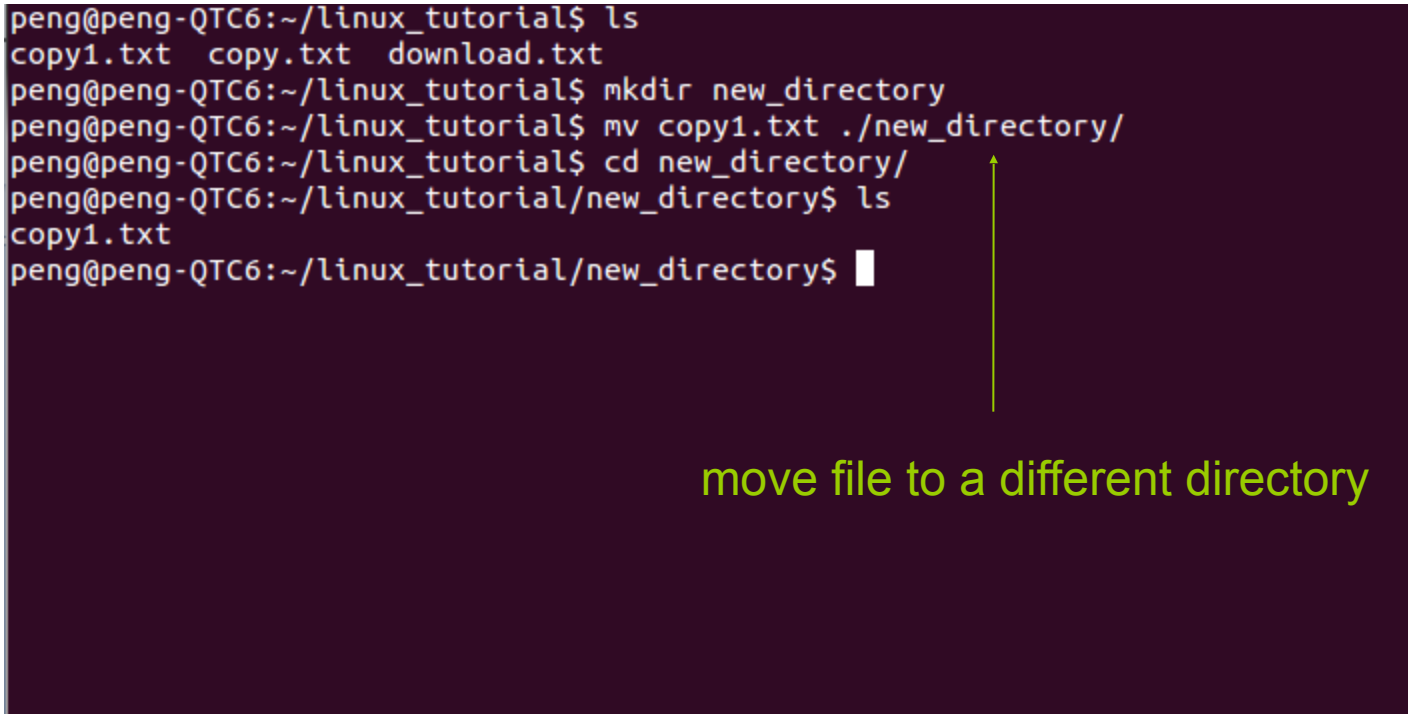


Linux File System

- Directory Commands
- File Commands
  - cp: copy files and directories
  - mv: move (rename) files

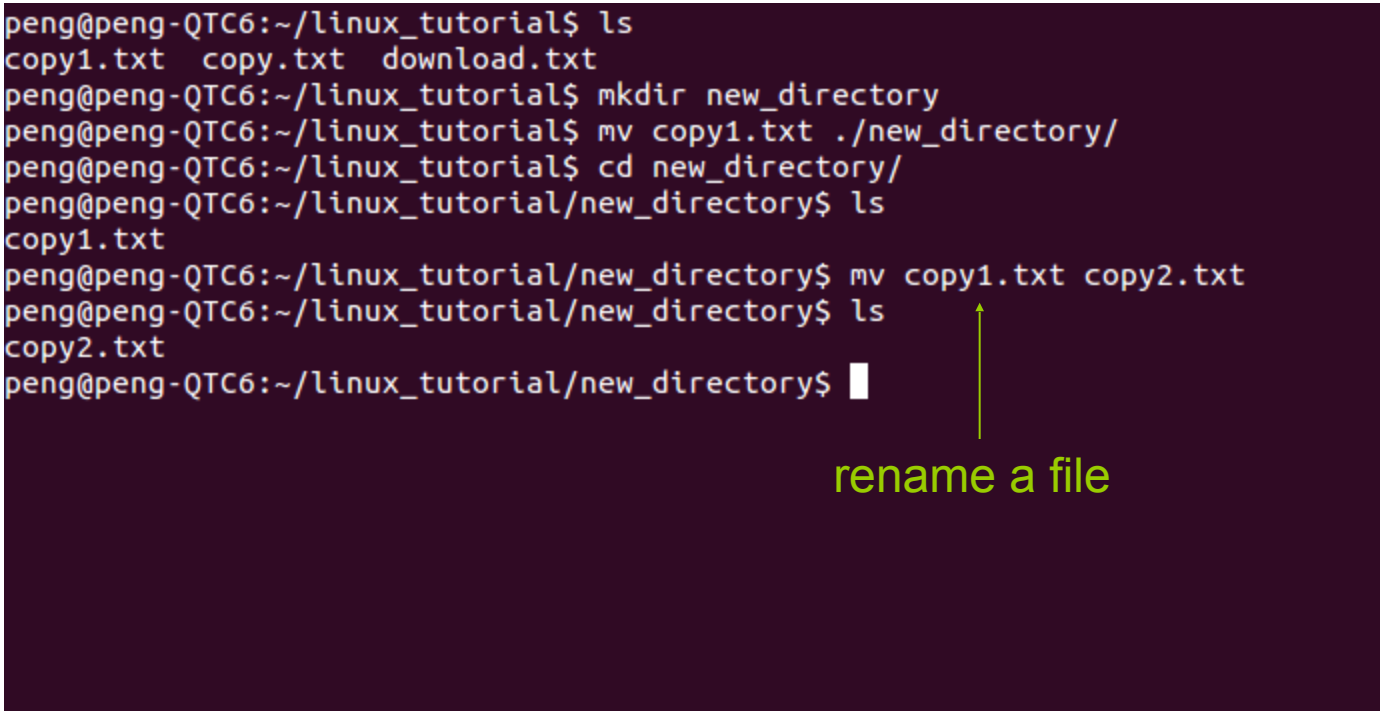
Linux File System

- Command: mv



Linux File System

- Command: mv

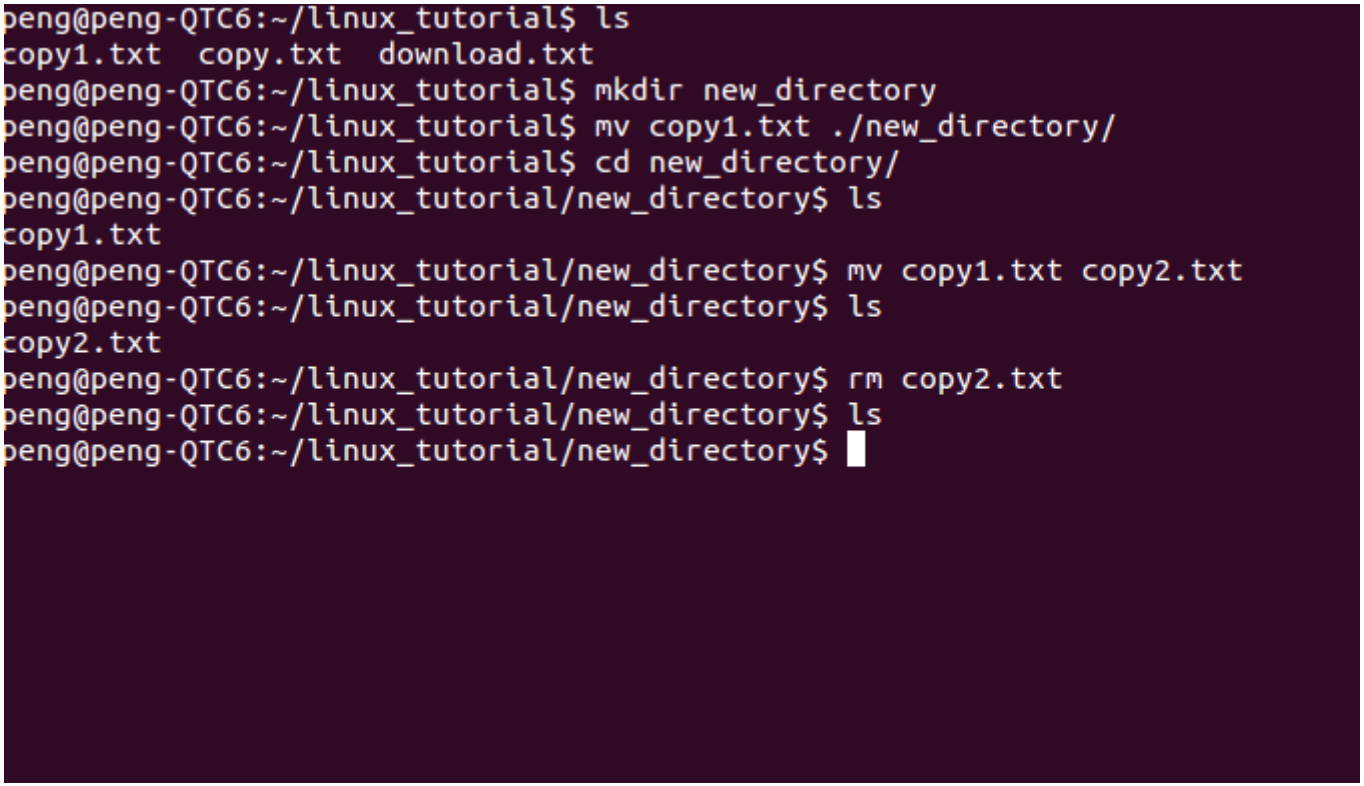


Linux File System

- Directory Commands
- File Commands
  - cp: copy files and directories
  - mv: move (rename) files
  - rm: remove a file

Linux File System

- Command: rm



Linux File System

- Directory Commands
- File Commands
- File Permissions (for reference)
  - ➢ permission level
  - ➢ chmod

Linux File System

- File Permissions
  - ➢ Each file in Unix/Linux has an associated permission level
  - ➢ This allows the user to prevent others from reading/ writing/executing their files or directories
  - ➢ Use “ls -l *filename*” to find the permission level of that file

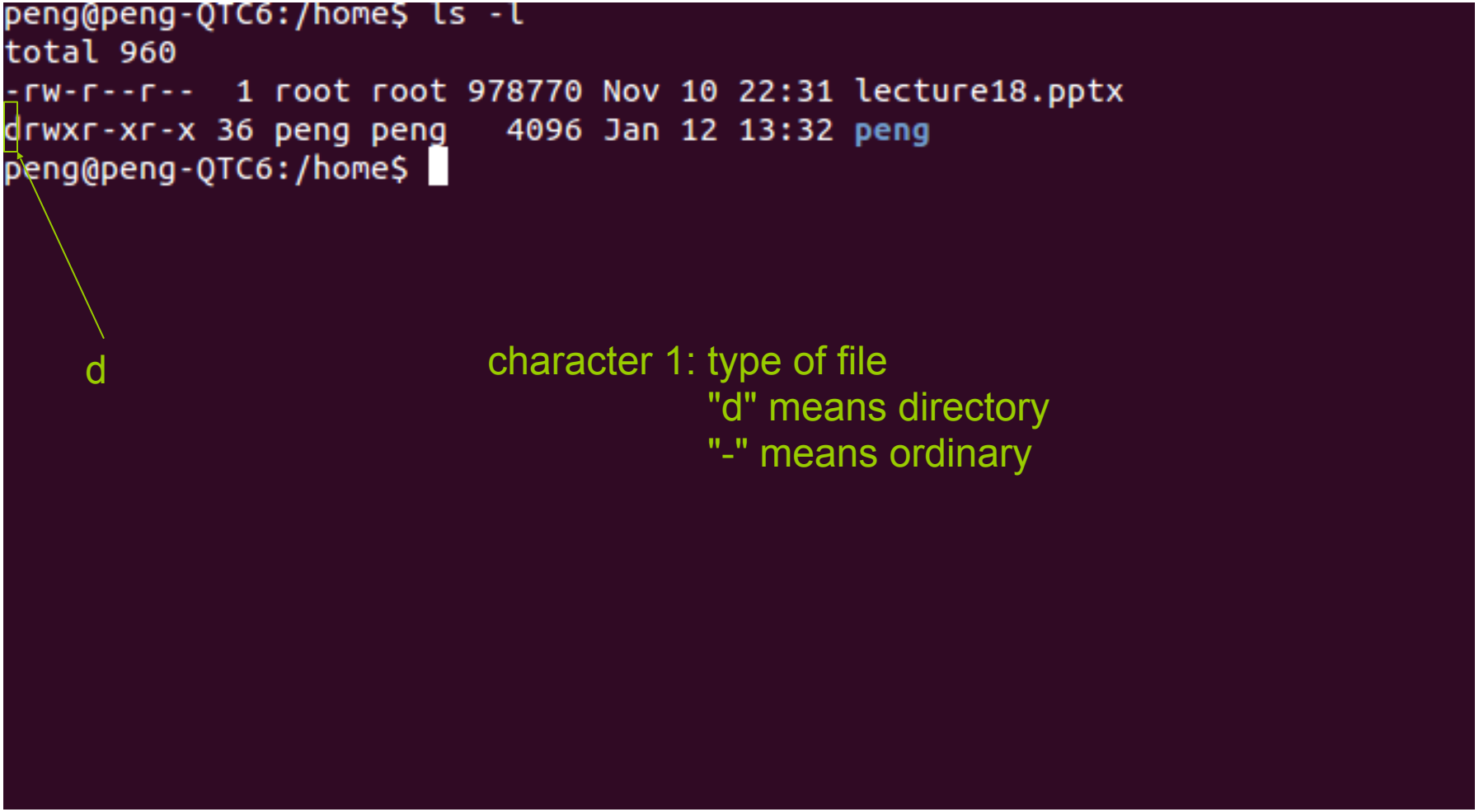
Linux File System

- Directory Commands
- File Commands
- File Permissions
  - ➢ permission level
  - ➢ Command; chmod

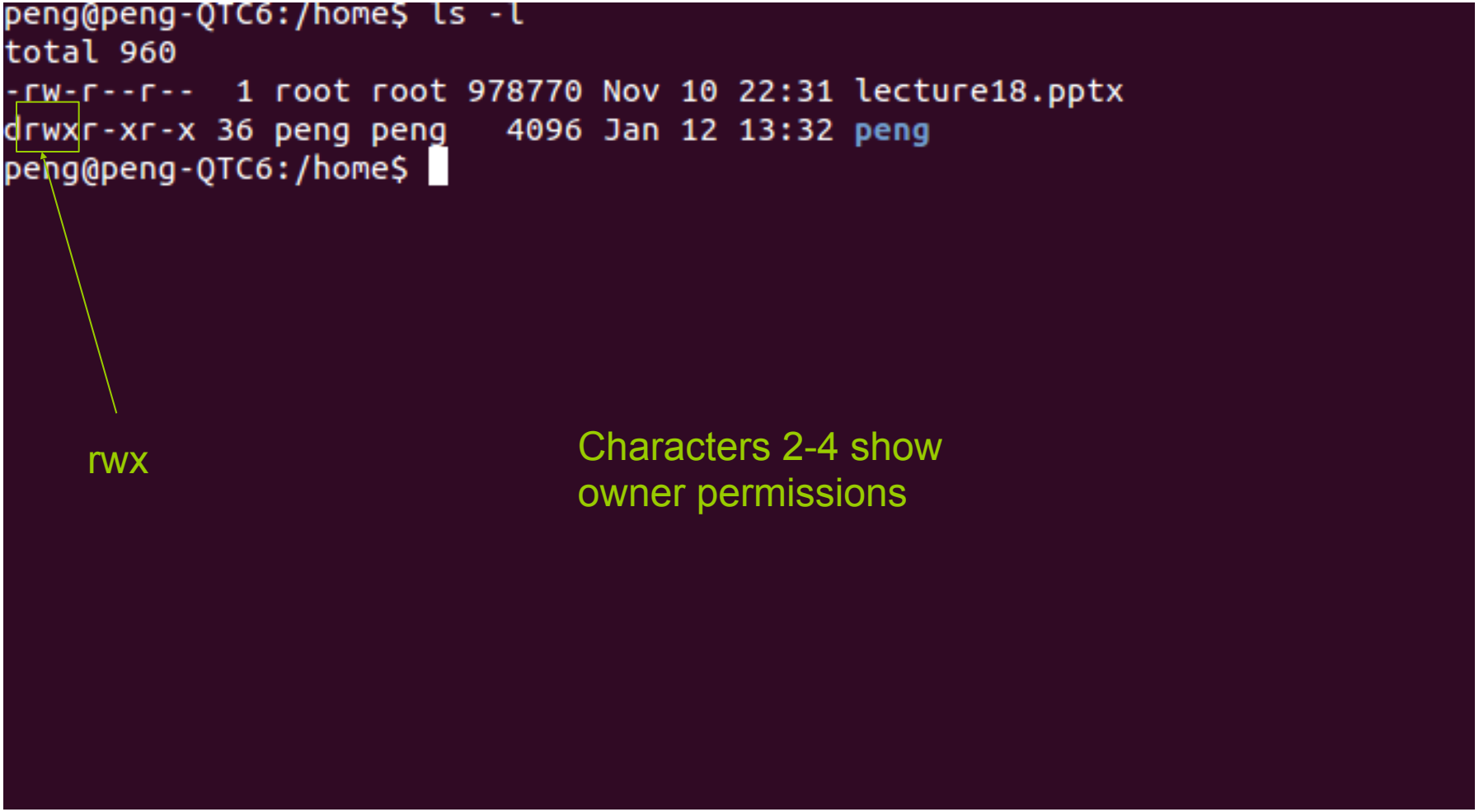
Linux File System

- Permission Level
  - ➢ “r” means “read” permission
  - ➢ “w” means “write” permission
  - ➢ “x” means “execute” permission

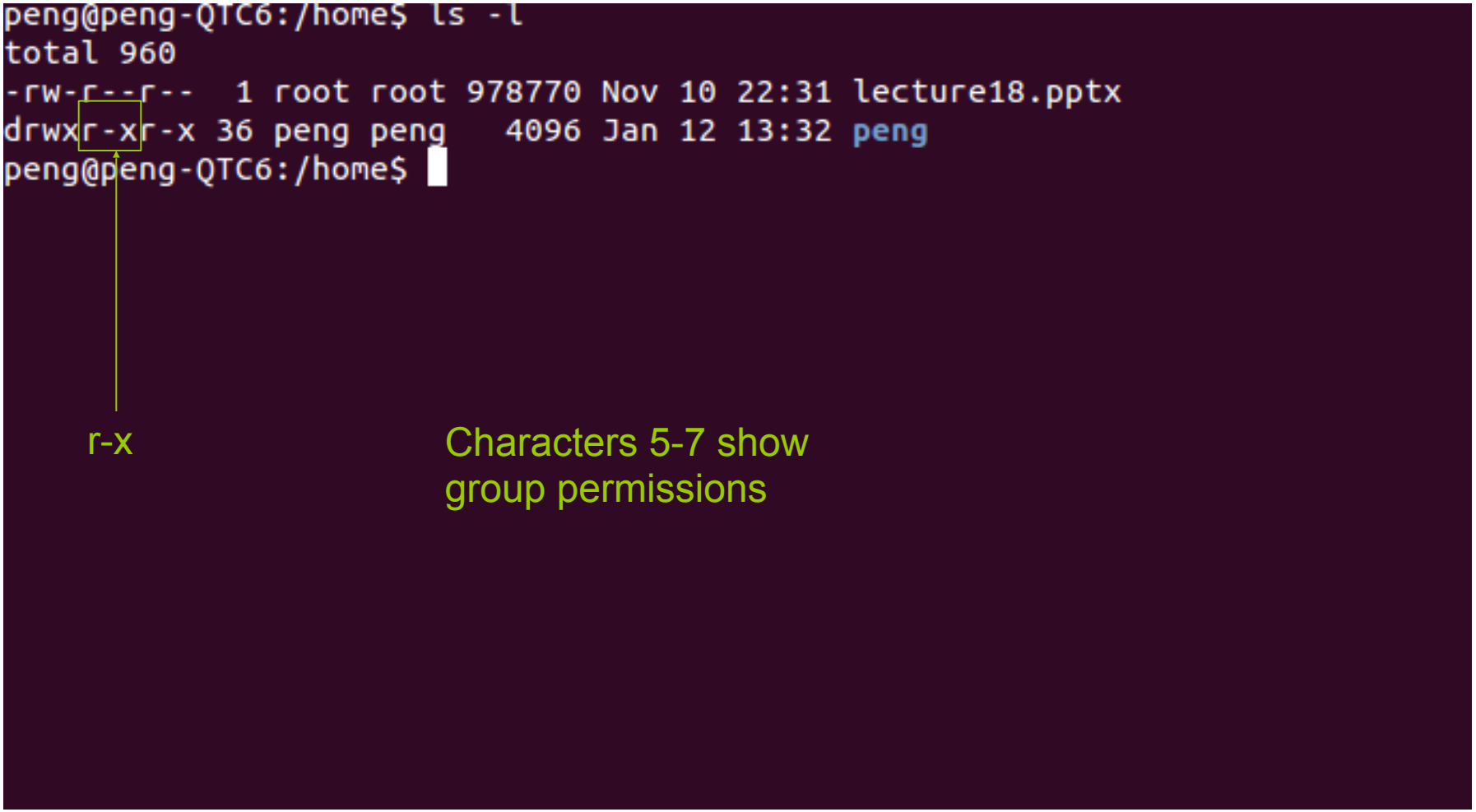
Linux File System



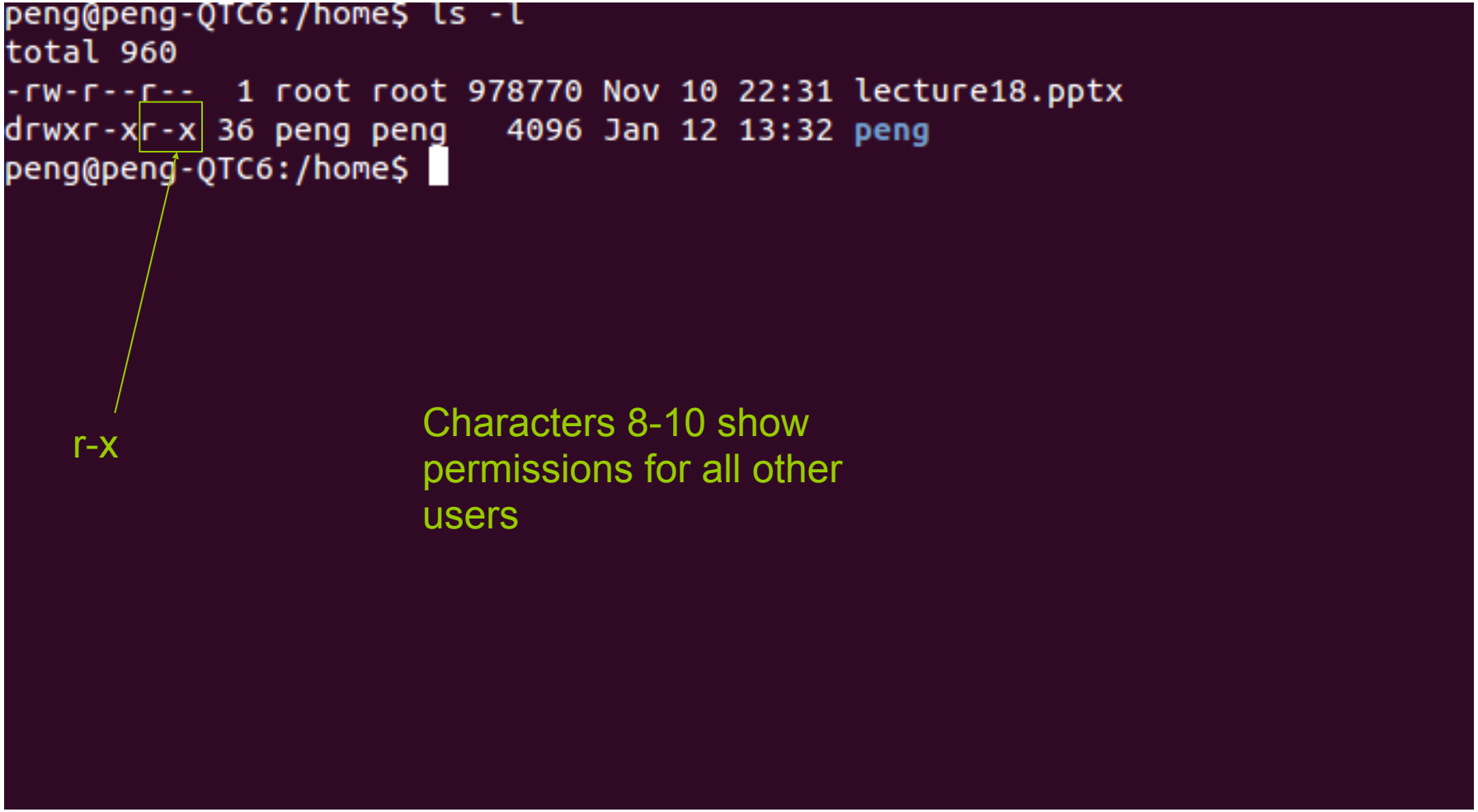
Linux File System



Linux File System



Linux File System



Linux File System

- Command: chmod

  - change file permissions with “chmod”
  - Syntax: chmod [**u**ser/**g**roup/**o**thers/**a**ll]+[permission] [file(s)]
  - Numerical Permission:
    4 read (r), 2 write (w), 1 execute (x), and 0 non (-)

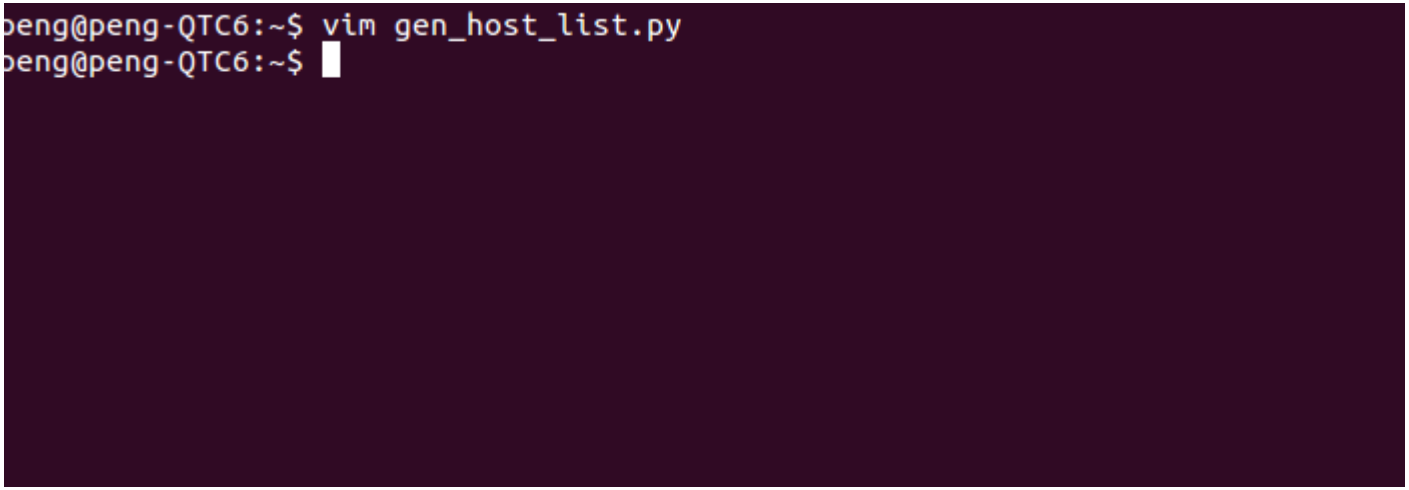
Text Editor: VIM

- Basic usage
  - ➢ *vim* <filename>
    it will create a new file if no such file exits
- Basic operations in command mode
- Enter the Insert mode
- Return to command mode

Text Editor: VIM

- Basic usage

  vim <filename>



Text Editor: VIM

```
#!/usr/bin/env python
import sys
import math


def switch_count(depth, fanout):
    num_switches = 0
    for i in range(0, depth):
        num_switches += int(math.pow(fanout, i))
    return num_switches

# This method only works for binary trees (i.e., fanount = 2)
def find_switch(host):
    switch = depth + num_hosts
    for d in range(depth-1, 0, -1):
        n = int(math.pow(fanout, d))
        if (host > n):
            switch += switch_count(d, fanout)
            host += -n
    return switch

def find_port(host):
    port = (host % fanout)
-- INSERT --                                                    1,1           Top
```

Text Editor: VIM

- Basic usage
- Basic operations in command mode
  - ➢ dw: delete to end of current word
  - ➢ dd: delete (and copy) current line
  - ➢ r: replace current character
  - ➢ p: puts the previously deleted text
  - ➢ .: repeat the last command
- Enter the insert mode
- Return to command mode

Text Editor: VIM

- Basic usage
- Basic operations in command mode
- Enter the editing mode
  - ➢ A: append any typed characters to the end of a line
  - ➢ i: enter inset mode and inset characters as you type
  - ➢ R: enter replace mode and replace characters with the ones being typed
- Return to command mode

Text Editor: VIM

- Basic usage
- Basic operations in command mode
- Enter the editing mode
- Return to command mode
  - <press ESC if you are in the editing mode>
  - :q – leave vim
  - :q! – leave without saving
  - :wq – save and leave
  - :w – save without leave
  - :w <filename> – save in a new name.

Other text editors

- Besides Vim, you can also use Emacs, Nano, etc., there is no constraint on which to use.

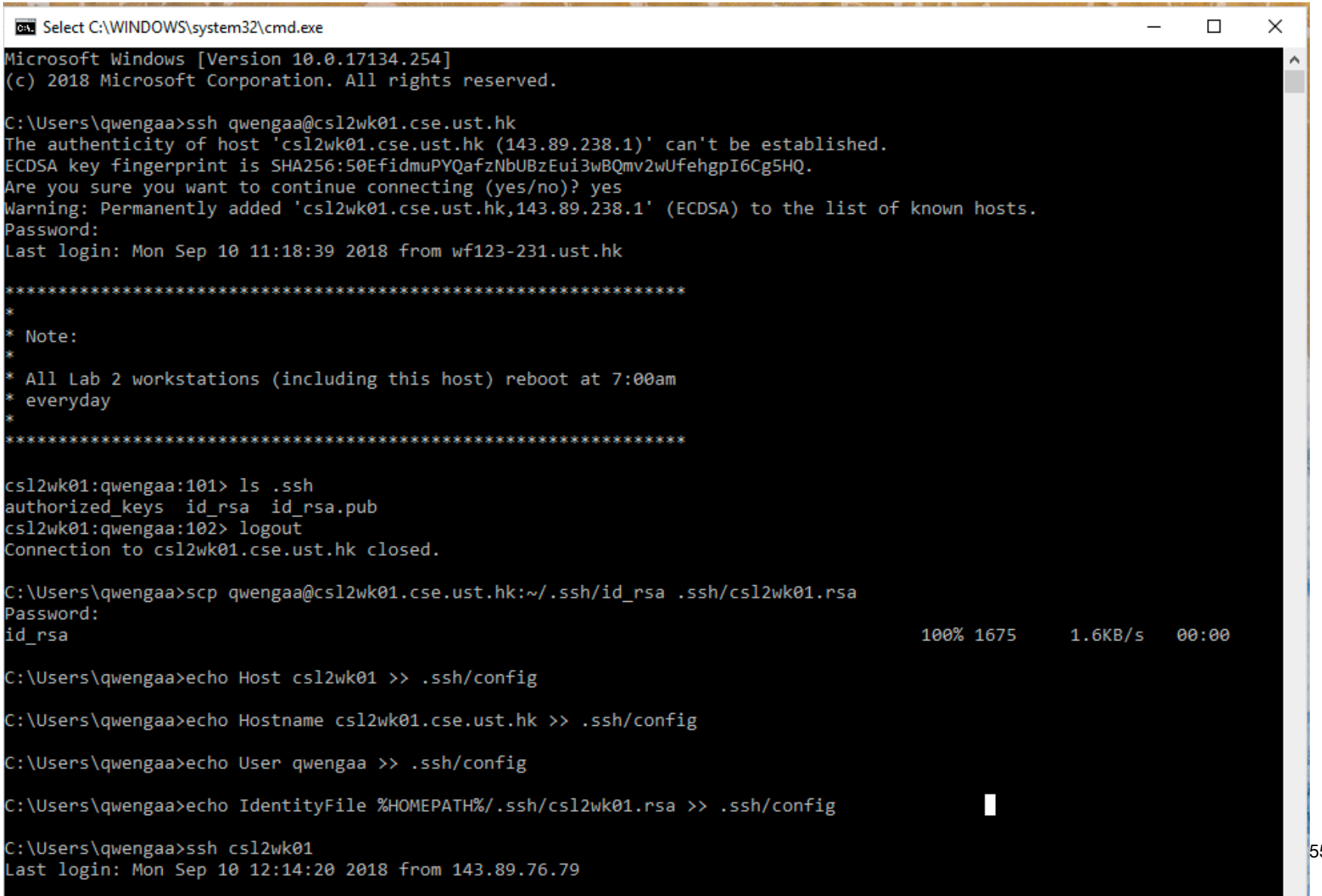
Windows users with cmd.exe

- **On your own PC laptop**.
  - Get the private key:
    scp you@csl2wk01.cse.ust.hk:.ssh/id_rsa .ssh/csl2wk01.rsa
  - Check whether you can successfully login (please **logout** afterwards)
    ssh -i .ssh/csl2wk01.rsa you@csl2wk01.cse.ust.hk
  - Configure (type four commands in the following order)

    ```
    echo Host csl2wk01 >> .ssh/config
    echo Hostname csl2wk01.cse.ust.hk >> .ssh/config
    echo User your_login_name >> .ssh/config
    echo IdentityFile %HOMEPATH%/.ssh/csl2wk01.rsa >> .ssh/config
    ```

  - Now you can log in with short command: **ssh csl2wk01**

Windows users with cmd.exe



END

Credit

- Some Slides adapted from Dr. Hong Xu's slides for CS 4296/5296 in CityU