VE280 Programming and Elementary Data Structures

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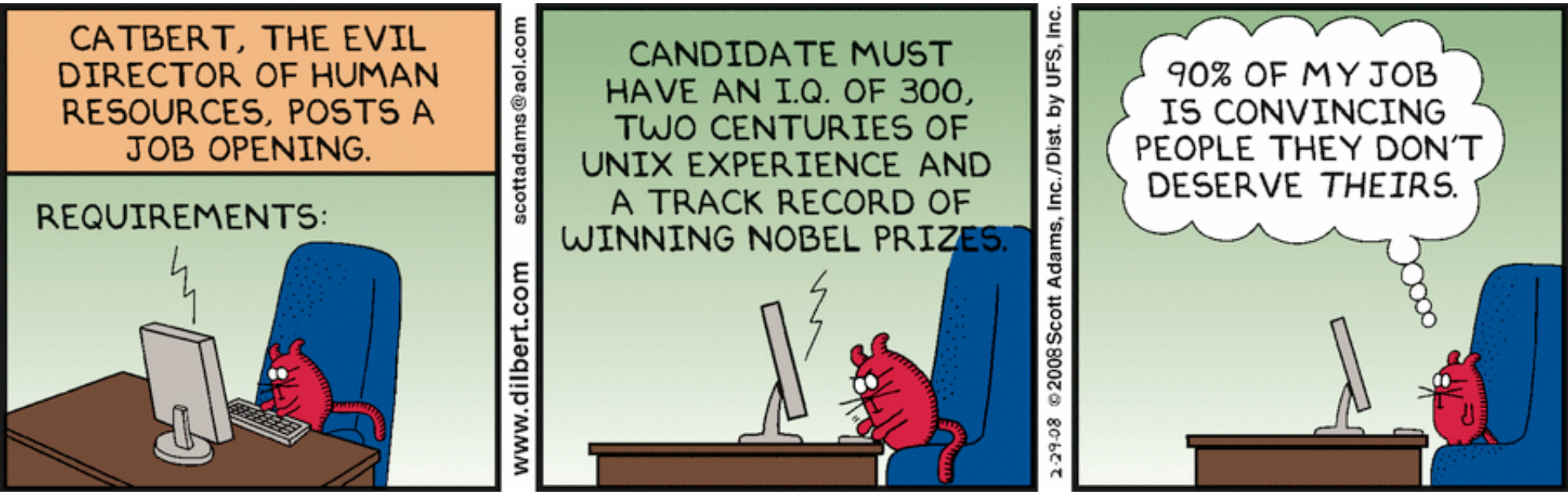
Linux



Learning Objectives

- Learn how to navigate the directory tree
- Learn how to manipulate files/directory
- Understand access rights
- Understand I/O redirection
- And a few other useful commands (diff, apt-get…)

I forgot how to use the command `ls`. Which commands can I use?

Choose all correct answers:

- **A.** `echo`
- **B.** `ls --help`
- **C.** `man`
- **D.** `bash`

I want to rename `file1.txt` into `file2.txt`. Which command can I use?

Choose one answer:

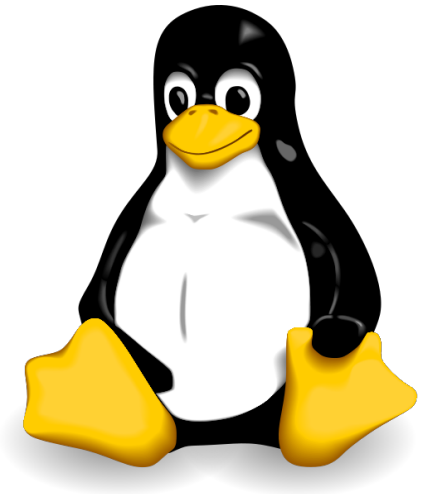
- **A.** `rename file1.txt file2.txt`
- **B.** `cp file1.txt file2.txt`
- **C.** `mv file1.txt file2.txt`
- **D.** `rm file2.txt file1.txt`

Unix

- An operating system supporting multitasking and multi-user
- Developed in 1969 by Ken Thompson, Dennis Ritchie, etc. from AT&T Bell Labs
- Many variants (Unix-like OS)
  - Linux
  - BSD (from UC Berkeley)
  - Solaris (from Sun Microsystems)
  - Android (from Google)
  - iOS (from Apple)
  - …

Linux

- A free and open source Unix-like operating system
- First released in 1991 by Linus Torvalds
- Many distributions
  - Gentoo
  - Red Hat
  - Ubuntu
  - …



Installing Linux

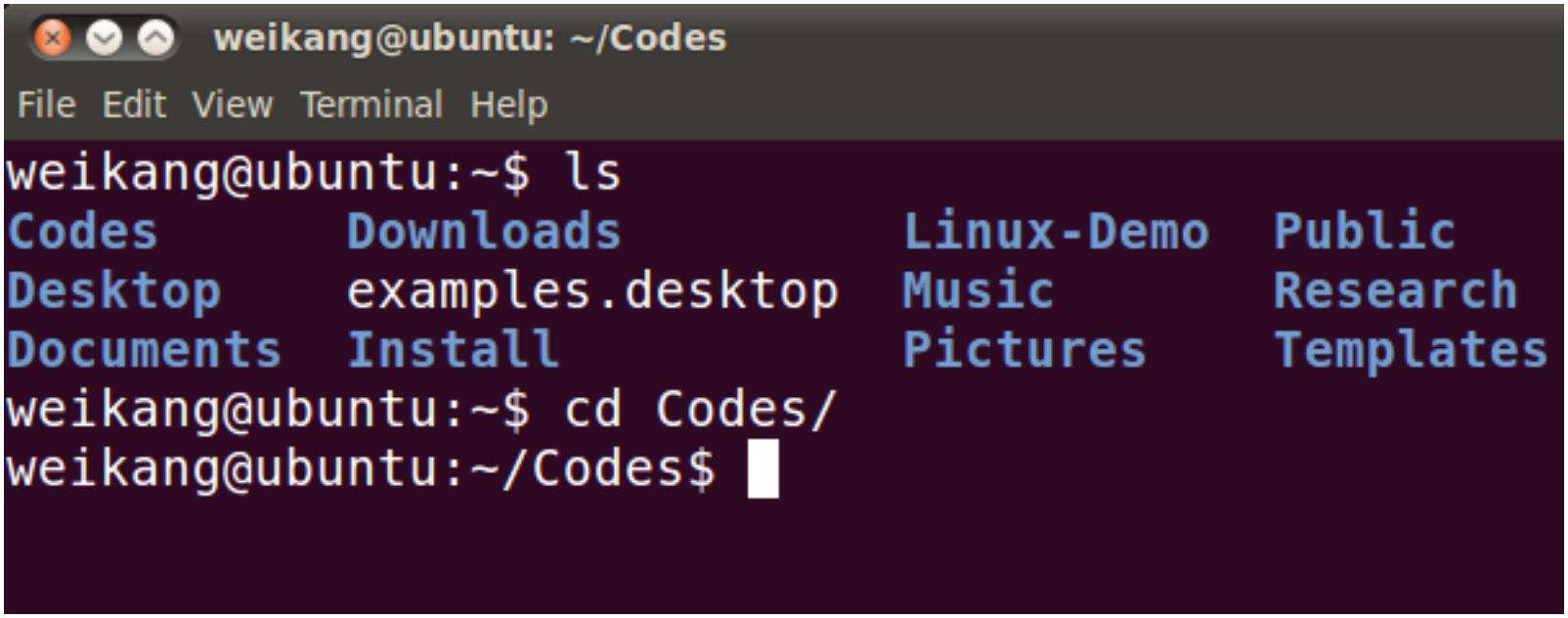
- Recommended version: **Ubuntu**
  - You can get the .iso file from: http://www.ubuntu.com/download/desktop
  - Suggest to use the latest version.
- Install it directly on your machine
- OR install it on a virtual machine on your Windows/Mac operating system.
  - Install a virtual machine such as VirtualBox (https://www.virtualbox.org/) or VMware (http://www.vmware.com/) first.
  - SJTU provides a free download of Vmware Workstation at http://vmap.sjtu.edu.cn/

Linux on Docker

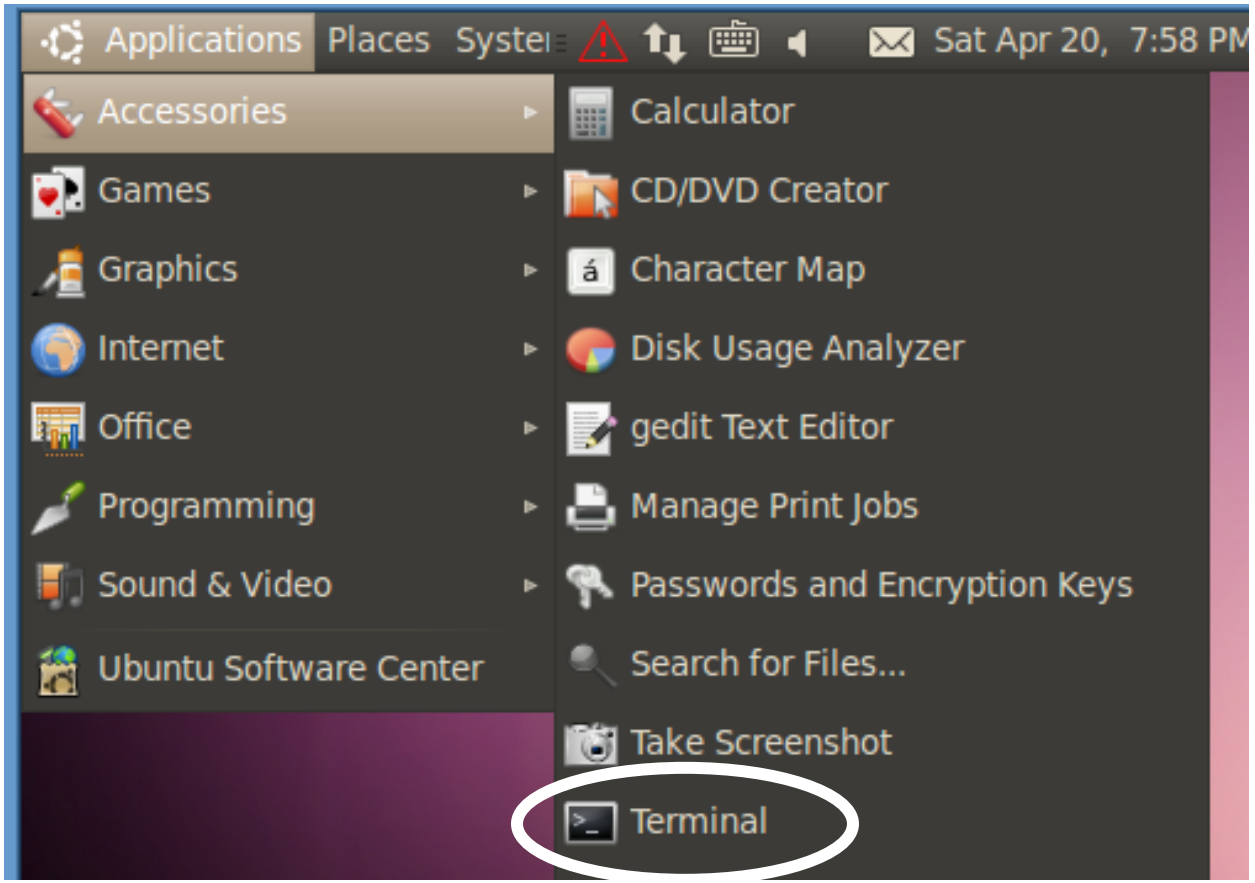
- Like a lightweight virtual machine
- Installation instructions can be found here
- Main steps:
  - Install Docker
  - Create a Linux image with Docker
  - Use a Docker container

Using Terminal in Linux

- We type commands in the terminal in Linux



Start a Terminal

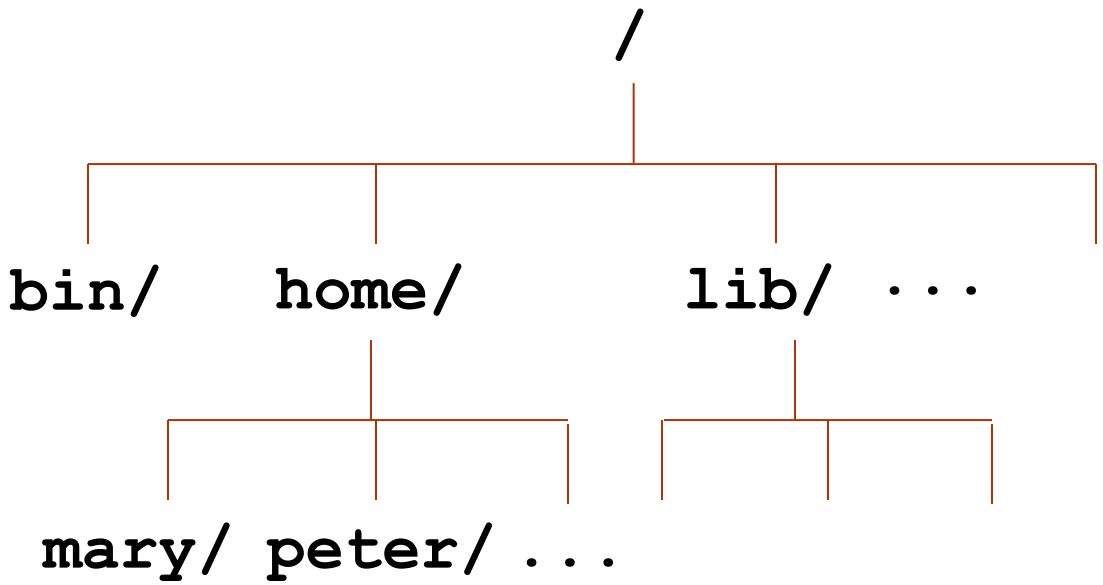


Change Directory

- Basic command: cd pathname
  - E.g., cd /usr/bin
    typical path name format
- Special characters for directories
  - root directory: /
  - home directory: ~
    - Linux is a multi-user operating system. It is your "home directory".
  - current directory: .
  - parent directory: ..

Aside: Root Directory

- Directory in Linux is organized as a tree
- The topmost directory is root directory "/"



List Contents of a Directory

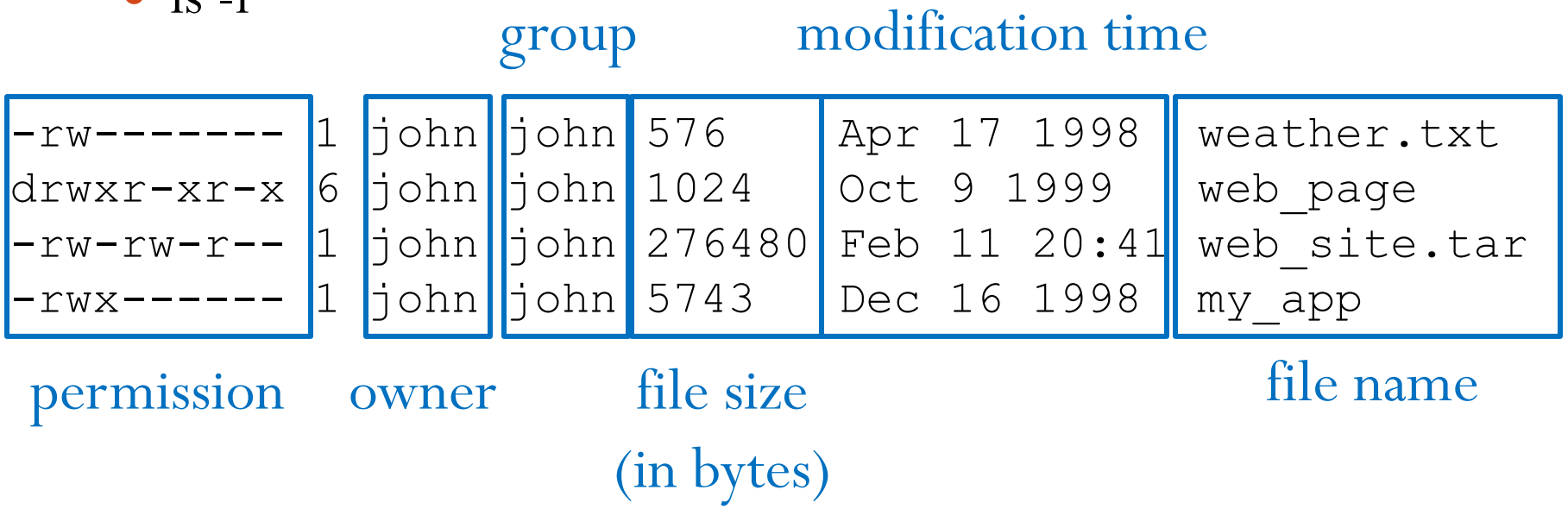
- Basic command: ls directory
  - e.g., ls /home

- ls (i.e., "ls" alone): list the current working directory

- ls -l [directory]: list in long format
- ls -a [directory]: list all files including the hidden files
  - Hidden files: file name begin with a dot, e.g., ".bash_history"
- In Linux, options can be combined together.
  - "ls -la" or "ls -l -a"

Aside: Long Format of File Information

- ls -l



- File permission
  - First character: '-' regular file; 'd' directory
  - Next three: read, write, execution permission of the owner
  - Next three: read, write, execution permission of the group
  - Final three: read, write, execution permission of everyone else

Manipulating Files/Directories

- Create directories: mkdir dir
- Delete directories: rmdir dir
  - Can only remove **empty** directory
- Create an empty file: touch file

Copy Files/Directories

- Basic command: cp source dest

- Variations
  - cp file1 file2: copy the content of file1 into file2
  - cp file1 dir: copy file into a directory
    - cp file1 file2 dir
    - cp file* dir
      - *: wildcard, matches any character
  - cp -r dir1 dir2: If dir2 does not exist, copy dir1 as dir2. If dir2 exists, copy dir1 **inside** dir2

Which command lists ALL the files with the xyz extension in the current folder?

Select all the correct answers.

- **A.** ls ./*xyz
- **B.** ls *.xyz
- **C.** ls *xyz
- **D.** None of the above.

Rename/Move a File

- Basic command: mv source dest

- Variations
  - mv file1 file2: rename file1 as file2
  - mv file1 dir: move file into a directory
  - mv dir1 dir2: If dir2 does not exist, then rename dir1 as dir2. If dir2 exists, then move dir1 **inside** dir2

Delete Files/Directories

- Basic command: rm file

- Variations
  - rm file: delete file
  - rm file1 file2: delete file1 and file2
  - rm -r dir: delete dir along with its contents

- Useful options -i: prompt before every removal
  - To use: alias rm='rm -i';
  - Put it into ~/.bashrc

Edit/Show a File

- Edit file: nano file gedit file
  - advanced editor: vim, emacs
- Show file content
  - cat file
  - less file
    - quit 'less': press 'q'
    - go to the end: press 'G' (shift + g)
    - go to the beginning: press 'g'
    - search: press '/', then enter the thing to be searched
    - press 'n' for the next match; press 'N' for the previous match.

I/O Redirection

- Most command line programs display their results on the **standard output**.
  - By default, standard output is our display.

- We can redirect from standard output to a file by using '>'.
  - E.g., ls -l > ls_rst.txt: the "ls" result is now in ls_rst.txt

I/O Redirection

- Many commands can accept input from a facility called **standard input**.
  - By default, standard input is our keyboard.

- We can redirect standard input from a file instead of keyboard by using '<'.
  - One application: testing
  - E.g., my_add < input.txt
    # my_add is a program taking two inputs from keyboard and output their sum on screen

What does the following command do?

```
sort < fruit.txt > my_favorite.txt
```

Select all the correct answers.

- **A.** The command reads fruit.txt and my_favorite.txt
- **B.** The command reads fruit.txt and writes in my_favorite.txt
- **C.** The elements of fruit.txt are in alphabetic order.
- **D.** The elements of my_favorite are in alphabetic order.

Other Commands

- Auto completion: type a few characters; then press 'Tab'
  - If there is a single match, Linux completes the remaining.
  - If there are multiple matches, press a second time, Linux shows all the possible candidates.
- Compare two files: diff file1 file2
  - If files are the same, no output
  - If there are differences, there will be some output
  - Useful option "-w": ignore white spaces (space, tab)
  - In a summary line: 'c': change; 'a': add; 'd': delete
  - Useful option "-w": ignore white spaces (space, tab)

Other Commands

- Install a program: sudo apt-get install program
  - E.g., sudo apt-get install emacs
  - sudo command: execute command as a superuser
    - Requires you to type your password
- Remove a program: sudo apt-get autoremove program
- Looking for help? man command e.g., man ls
  - Browse the manual using the same command as for 'less'

Reference

- http://linuxcommand.org/