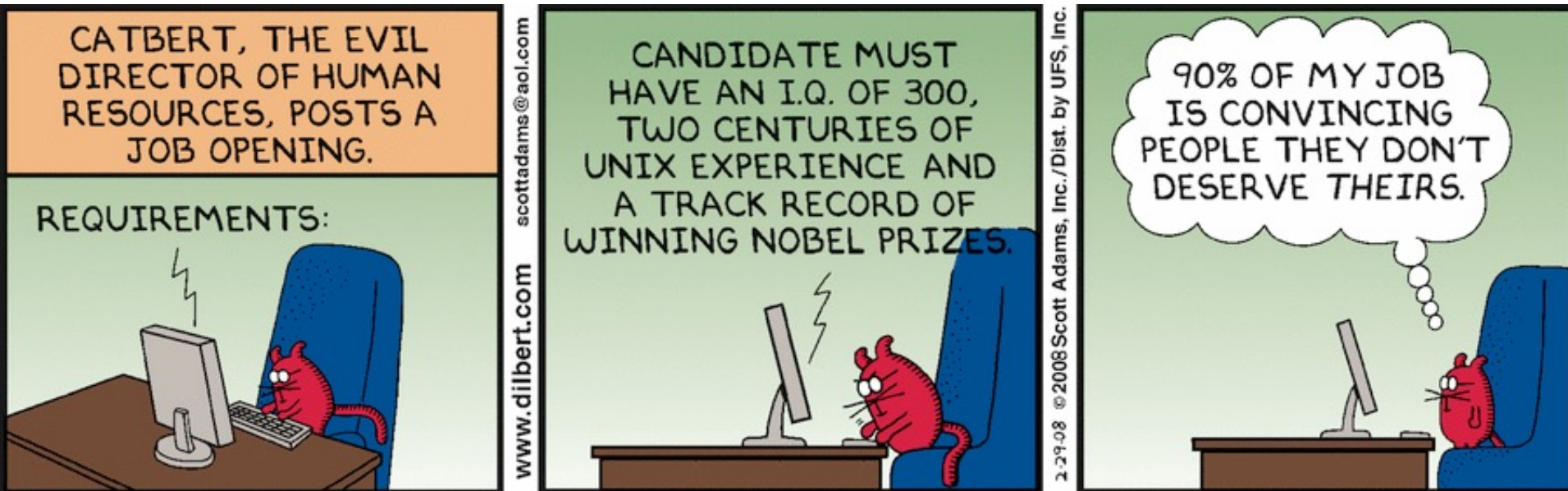


VE280 Programming and Elementary Data Structures

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UM-SJTU Joint Institute

Linux



Learning Objectives

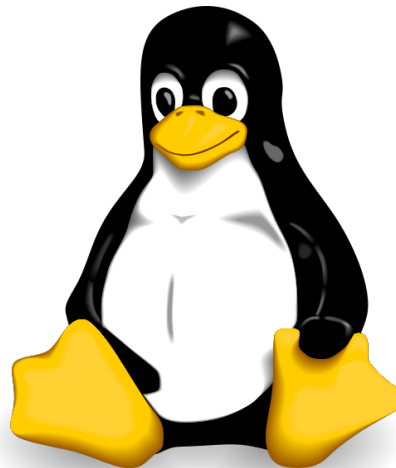
- Learn how to navigate the directory tree
- Learn how to manipulate files/directory
- Understand access rights
- Understand I/O redirection
- And a few other useful commands (diff, apt-get...)

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

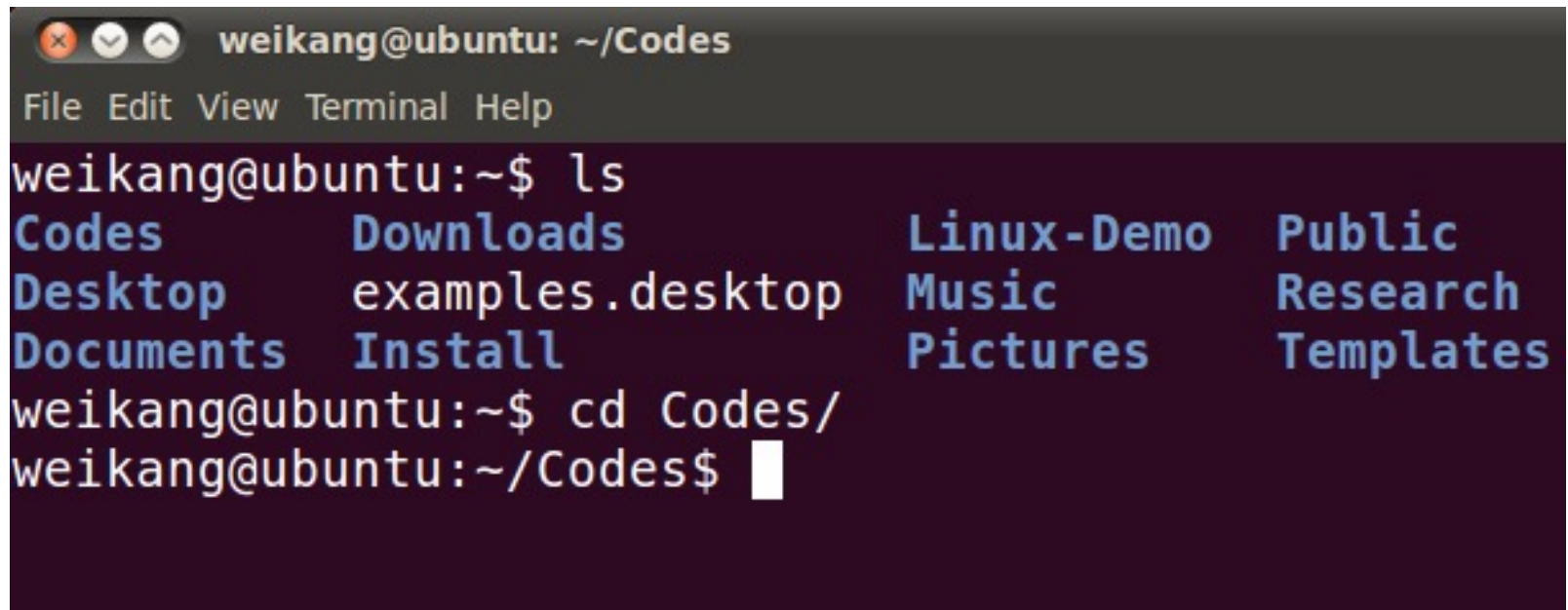
- Recommended version: **Ubuntu**
 - You can get the .iso file from:
<http://www.ubuntu.com/download/desktop>
 - Suggest to use the latest version.
- Install it directly on your machine
- OR install it on a virtual machine on your Windows/Mac operating system.
 - Install a virtual machine such as VirtualBox (<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

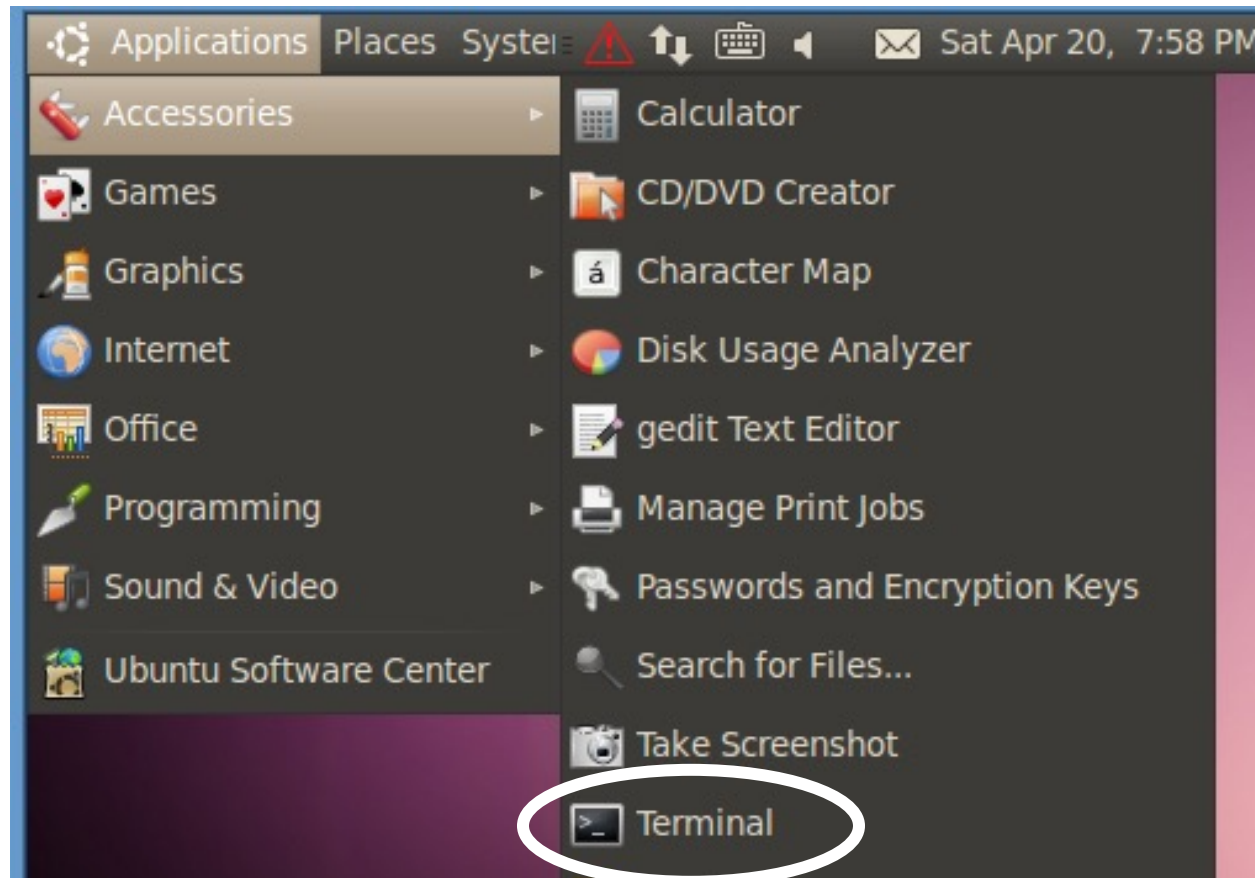
- We type commands in the terminal in Linux



The screenshot shows a terminal window titled "weikang@ubuntu: ~/Codes". The window has a menu bar with "File", "Edit", "View", "Terminal", and "Help". The terminal content shows the user typing "ls" to list the contents of the home directory. The output is a list of directories and files: Codes, Downloads, Linux-Demo, Public, Desktop, examples.desktop, Music, Research, Documents, Install, Pictures, and Templates. The user then types "cd Codes/" to navigate into the Codes directory, and the prompt changes to "weikang@ubuntu: ~/Codes\$".

```
weikang@ubuntu: ~/Codes
File Edit View Terminal Help
weikang@ubuntu:~$ ls
Codes          Downloads      Linux-Demo     Public
Desktop        examples.desktop  Music          Research
Documents      Install        Pictures       Templates
weikang@ubuntu:~$ cd Codes/
weikang@ubuntu:~/Codes$
```

Start a Terminal

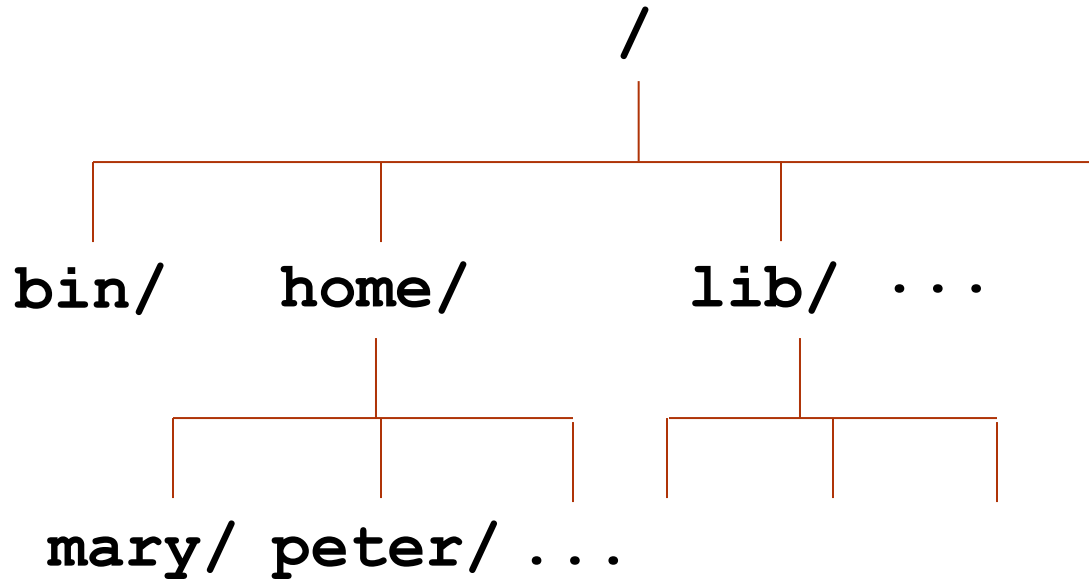


Change Directory

- 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



Options

- `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`

group modification time

-rw-----	1	john	john	576	Apr 17 1998	weather.txt
drwxr-xr-x	6	john	john	1024	Oct 9 1999	web_page
-rw-rw-r--	1	john	john	276480	Feb 11 20:41	web_site.tar
-rwx-----	1	john	john	5743	Dec 16 1998	my_app

permission

owner

file size
(in bytes)

file name

- 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/>