Introduction to Linux

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What is Linux?

- A Unix-like operating system of a computer

What is an OS?

- A resource manager of a computer
- A layer of software interposed between application programs and the hardware

What is Unix?

- A time-sharing, multi-task, multi-user OS
- (Perhaps) the most important OS in computer history
What is an OS?

- **OS is a resource manager**
  - Sharing
  - Protection
  - Fairness
  - Performance

- **OS provides the program execution environment**
  - Hides the messy details which must be performed.
  - Presents users with a virtual machine, easier to use.
Linux

- Open-source development began in 1991
- First released by Linus Torvalds

Linux kernel
- The core of Linux system
- Thousands of contributors
- Supervised by Linus and other maintainers

Distribution
- A collection of software based around Linux kernel
- Red Hat, Fedora, Debian, Ubuntu, Android, ...
Layered View of a Computer System

Application Programs

Text editor

Web browser

Game

User Interfaces

Kernel

Operating system (Kernel)

Hardware

CPU

MEM

Disk

NIC
User Interfaces

- The space where we interact with machines

- Command-line interface (CLI)
  - Command interpreter
  - Difficult to learn
  - Called as “shell”

- Graphical user interface (GUI)
  - KDE, Gnome, Unity, Xfce, ...

- Touch user interface
  - Smartphones, tablets
Shell (1)

A shell allows three types of commands

- An executable file that contains object code produced by a compilation of source code
- An internal shell command (built-in command)
- An executable file that contains a sequence of shell command lines (a shell script)

There are two families of shells

- One based on “Bourne shell” (sh)
  - We will use “Bourne again shell” (bash) for the course
- The other based on “C shell” (csh)
Shell (2)

- Executing programs on a shell
  
  
  $ command [options] [arguments]

  - [$ ls] and [$ ls –a1] show different results
  - All commands, options, arguments are case-sensitive

- Shells execute commands by means of *processes*

  - A process is an instance of a program in execution
A Unix file is a sequence of bytes

- Collection of related information defined by its creator
- Unstructured sequence of bytes

File system

- Consist of two distinct parts:
  - A collection of files
  - A directory structure
- It provides the mechanism for on-line storage and access to file contents
File & File System (2)

- **Features of Unix file system**
  - A *hierarchical structure*
  - It allows dynamic growth of files
  - The ability to create and delete files
  - The protection of the file data
  - *Unix treats the peripheral devices as files*

- **“Everything is a file” in Unix**
  - Documents, directories, hard-drives, network sockets, keyboards, printers are stream of bytes exposed through the file system namespace
File & File System (3)

- All I/O devices are represented as files:
  - /dev/sdb1 (hard disk partition)
  - /dev/tty2 (terminal)

- Even the kernel is represented as a file:
  - /dev/kmem (kernel memory image)
  - /proc (kernel data structures)
File System Structure (1)

- Hierarchical, tree-like structure
  - Root
  - Non-leaf nodes
    - Directories
  - Leaf nodes
    - Directories
    - Regular files or special device files
File System Structure (2)

*http://www.linuxplanet.com/linuxplanet/tutorials/6666/1*
File System Structure (3)

- **Root directory ["/"]**
  - The top-most directory in a hierarchy

- **Home directory ["~"]**
  - A special directory for a user
  - It contain the user’s files; including texts, musics, videos, or configuration files

- **(Current) Working directory**
  - Each process has associated with it a directory
  - The directory where a user currently located
File System Structure (4)

- /bin
  - Contains certain fundamental utilities

- /dev
  - Essential devices

- /etc
  - Host-specific system-wide configuration files

- /tmp
  - A place for temporary files

- /var
  - A place for files that may change often
Path

- The general form of the name of a file or a directory
- Delimiting characters ["/"]
  - Represent each directory in path expressed in string
- Absolute path (full path)
  - A path points a location regardless of present working directory
    $ cat /home/wooyeong/textfile
    $ cat ~/textfile
- Relative path
  - A path relative to the working directory of the user
    $ cat textfile [if cwd is "/home/wooyeong"]
File Permission

- Every files have a set of permissions

Ownership
- User/owner
  - The person who owns/created the file.
- Group
  - Unix allows for the creation of groups
- Others
  - Everyone else in the world that has access to that computer

Permission for Access
- Read (4)
- Write (2)
- eXecute (1)
Basic commands (1)

- **man**
  - Display the manual page
  - Display a manual of a program or a function

$ man qsort

$ man man (manual for manual page)
Basic commands (2)

- **ls**
  - List files
  $ ls
  $ ls -al /etc
  $ ll

- **ps**
  - List process
  $ ps
  $ ps -ef
  $ man ps
Basic commands (3)

- **pwd**
  - Print working directory

- **cd**
  - Change working directory
  
  $ cd ..
  $ cd /proc
  $ cd ~
Basic commands (4)

- **echo**
  - Display a line of text
  
  $\quad$ echo "Hello?"

- **printf**
  - Print a formatted line of text
  
  $\quad$ printf "%s\n" Hello?

- **cat**
  - Displaying files
  
  $\quad$ cat /etc/issue

- **more / less**
Basic commands (5)

- **mkdir / rmdir**
  - Make / remove a directory
  
  ```
  $ mkdir swex1
  ```

- **mv**
  - Move or rename files
  
  ```
  $ mv swex1/ swex2/
  ```

- **cp**
  - Copy files

- **rm**
  - Remove files
Basic commands (6)

- **date**
  - Print or set the system date and time

- **grep**
  - Searching files for a specified expression
    
    ```
    $ grep [expression] [files]
    $ grep root /etc/passwd
    ```
Basic commands (7)

- chmod
  - Change the permissions on a file or directory

<table>
<thead>
<tr>
<th>u</th>
<th>user</th>
<th>+ to add a permission</th>
</tr>
</thead>
<tbody>
<tr>
<td>g</td>
<td>group</td>
<td>- to remove a permission</td>
</tr>
<tr>
<td>o</td>
<td>other</td>
<td>= to assign a permission explicitly</td>
</tr>
<tr>
<td>a</td>
<td>all</td>
<td>= to assign a permission explicitly</td>
</tr>
</tbody>
</table>

- $ chmod u=rw file1
- $ chmod u+x,g+w,o-r file2
- $ touch a
- $ ls -l a
- $ chmod 750 a
- $ ls -l a
**Basic commands (8)**

- **diff [file1] [file2]**
  - Reports line-by-line differences between file1 and file2
Development tools

- **vi[m]**
  - A text editor for programmers
  - $ vi [file_name]
  - Create (if not exist) or open a file 'file_name'
  - [http://csl.skku.edu/SSE2030F16/Resources](http://csl.skku.edu/SSE2030F16/Resources)
  - $ vi hello.c

- **gcc**
  - GNU compiler collection
  - $ gcc -o hello hello.c
  - $ ./hello
Setting Up a Ubuntu VM
Steps

1. Install VirtualBox on your computer

2. Create a virtual machine (VM)

3. Install Ubuntu on the VM

4. Have fun!
Installing VirtualBox (1)

- Go to VirtualBox website
  - https://www.virtualbox.org/wiki/Downloads
- Download installation binary
Installing VirtualBox (2)

The Setup Wizard will install Oracle VM VirtualBox 4.3.14 on your computer. Click Next to continue or Cancel to exit the Setup Wizard.
VirtualBox에 오신 것을 환영합니다!

이 창의 왼쪽 부분은 컴퓨터에 있는 모든 가상 머신 목록을 표시합니다. 아직 가상 머신을 만들지 않았기 때문에 이 목록은 현재 비어 있습니다.

새 가상 머신을 만드시려면 창 위쪽 도구 모음의 새로 만들기 단추를 누르시오.

F1 키를 누르면 상태에 맞는 도움말을 볼 수 있으며, 최근 정보와 뉴스를 보려면 www.virtualbox.org를 방문하십시오.
Creating a VM (1)
Creating a VM (2)
Creating a VM (3)
Installing Ubuntu on the VM (1)

- Go to http://www.ubuntu.com/download/desktop or http://ftp.daum.net/ubuntu-releases/

- Download a desktop image
Installing Ubuntu on the VM (2)
Installing Ubuntu on the VM (3)
Installing Ubuntu on the VM (4)

The computer currently has no detected operating systems. What would you like to do?

- **Erase disk and install Ubuntu**
  
  *Warning: This will delete any files on the disk.*

- **Encrypt the new Ubuntu installation for security**
  
  You will choose a security key in the next step.

- **Use LVM with the new Ubuntu installation**
  
  This will set up Logical Volume Management. It allows taking snapshots and easier partition resizing.

- **Something else**
  
  You can create or resize partitions yourself, or choose multiple partitions for Ubuntu.
Installing Ubuntu on the VM (5)
Installing Ubuntu on the VM (6)
Installing Ubuntu on the VM (7)

- Press `Ctrl + Alt + T` to launch a terminal (shell)

- Type the following commands:
  
  $ sudo apt-get update
  
  $ sudo apt-get install build-essential