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 -al] 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
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 contains 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"]
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)
Exercise : Lab #1
Contents

- Basic commands
- Basic C coding
- Setting up Ubuntu in VM
Basic commands (1)

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

```bash
$ 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
  ```
  $ echo "Hello?"
  ```

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

- **cat**
  - Displaying files
  ```
  $ 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
  
  ```bash
  $ grep [expression] [files]
  $ grep root /etc/passwd
  ```
Basic commands (7)

- **chmod**
  - Change the permissions on a file or directory

  | u user | + to add a permission | r(4) read |
  | g group | - to remove a permission | w(2) write |
  | o other | = to assign a permission explicitly | x(1) execute (for files), access (for directories) |

$ chmod u=rw file1
$ chmod u+x,g+w,o-r file2

$ ls -l swex2/
$ chmod 750 swex2/
$ ls -l swex2/
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/SSE2033S16/Resources](http://csl.skku.edu/SSE2033S16/Resources)
  
  $ vi hello.c

• gcc
  
  - GNU compiler collection
  
  $ gcc -o hello hello.c
  
  $ ./hello
```c
#include <stdio.h>

int main(void) {
    printf("hello, world\n");
    return 0;
}
```
Exercise

- **Lab exercise #1:**
  - Make "swex2" directory on your home directory
  - Create hello.c on the directory
  - Compile it
  - Run the program
  - Remove "swex2" directory

- **Lab exercise #2:**
  - With hello.c file, make shell script that run exercise #1 automatically.
Lab exercise #3:

- Warming up coding for next assignment.
- Make “my_string.c” file for string manipulation.
- Skeleton code is uploaded ‘Assignments’

http://csl.skku.edu/SSE2033S16/Projects
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. Fun
Installing VirtualBox (1)

- Go to VirtualBox website
  - https://www.virtualbox.org/wiki/Downloads

- Download installation binary

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VirtualBox

Download VirtualBox

Here, you will find links to VirtualBox binaries and its source code.

VirtualBox binaries

By downloading, you agree to the terms and conditions of the respective license.

- VirtualBox platform packages. The binaries are released under the terms of the GPL version 2.
  - VirtualBox 4.3.16 for Windows hosts x86/amd64
  - VirtualBox 4.3.16 for OS X hosts x86/amd64
  - VirtualBox 4.3.16 for Linux hosts
  - VirtualBox 4.3.16 for Solaris hosts amd64

- VirtualBox 4.3.16 Oracle VM VirtualBox Extension Pack All supported platforms
  Support for USB 2.0 devices; VirtualBox RDP and PXE boot for Intel cards. See this chapter from the User Manual for an
  Personal Use and Evaluation License (PUEL).
  Please install the extension pack with the same version as your installed version of VirtualBox!
  If you are using VirtualBox 4.2.26, please download the extension pack here.
  If you are using VirtualBox 4.1.34, please download the extension pack here.
  If you are using VirtualBox 4.0.26, please download the extension pack here.
Installing VirtualBox (2)
Installing VirtualBox (3)

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 만들려면 창 위쪽 도구 모음의 새로 만들기 단추를 누르십시오.

F1 키를 누르면 상단에 있는 도움말을 볼 수 있으며, 최근 정보와 뉴스를 보려면 www.virtualbox.org를 방문하십시오.
Creating a VM (1)

Creating a new virtual machine in Oracle VM VirtualBox.

VirtualBox Manager

VirtualBox Manager is the main interface for managing virtual machines. It allows you to create, manage, and delete virtual machines, as well as configure their settings.

Creating a new virtual machine:

1. Open VirtualBox Manager.
2. Click on the "New" button to create a new virtual machine.
3. Enter a name for your virtual machine in the "Name" field.
4. Select the operating system type and version in the "OS Type" and "Version" dropdown menus.
5. Set any additional parameters as needed.
6. Click "Next" to proceed with the configuration.
7. Follow the wizard to complete the creation of your virtual machine.

VirtualBox configuration options:

- CPU: Number of virtual CPUs.
- RAM: Amount of RAM assigned to the virtual machine.
- Hard Disk: Size and type of the virtual hard disk.
- Video: Video adapter settings.
- Network: Network adapter settings.

VirtualBox Manager also allows you to save snapshots of your virtual machine, which can be used to revert to a previous state of the machine.

For more information on VirtualBox and its features, refer to the VirtualBox documentation.
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)
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$