Introduction to Linux

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Announcement (1)

- Course homepage is opened
  - http://csl.skku.edu/SWE2007F16/Overview

- You can get materials in ‘Schedule’ tab

- Prof’s office hour
  - Mon, 1:00 – 4:00
  - Wed, 3:00 – 5:00
  - You should e-mail him before visiting
Mail address

• For personal questions..
  – dylee@csl.skku.edu

• All the things except for above..
  – Questions about the course, project, HW, and so on..
  – For submitting HW
  – swe2007.2016@gmail.com
Announcement (3)

- All the scoring jobs will be done by script
  - Even if your code has some minor flaws like print format, that would not be allowed
  - Instead, you can fix your code and hand in late.
  - -20% per each day
What is OS? (1)

- **At application view**
  - Provides an execution environment for running
  - Provides an abstract view of the underlying system
    - Processors -> Processes, Threads
    - Memory -> Address space (Virtual memory)
    - Storage -> Volume, Files, Directories
    - I/O devices -> Files
    - IPC(Inter-Process Communication), Network -> Files
What is OS? (2)

- **At system view**
  - OS is a resource manager
    - Sharing
    - Protection
    - Fairness
    - Performance

- **What is resource?**
  - Hardware resource
    - CPU, Memory, I/O devices
  - Software resource
    - Queues
  - Miscellaneous
    - Energy, Power, ...
What is OS? (3)

- Implementation view
  - Highly-concurrent, event-driven software

![Diagram of OS implementation](image)
Unix (1)

- Unix is
  - Interactive
  - Time-sharing
  - Multi-tasking
  - Multi-user

- Flavors of Unix
  - System V (AT&T->USL->Novell->SCO->Caldera->SCO)
  - BSD (UC Berkeley)
  - SunOS, Solaris (Sun)
  - IRIX (SGI), AIX (IBM), HP-UX (HP), Mac OS X (Apple)
  - Linux, FreeBSD, NetBSD, and etc..
Unix (2)

Unix history and motivation

- Originally developed at AT&T Bell Labs for internal use in the early 1970s
- Borrowed best ideas from other OS’s
- Unix is designed so that users can extend the functionality – to build new tools easily and efficiently
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
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, …
OS Internals

User Application

C Library (libc)

System Call Interface

Kernel

Arch-dependent kernel code

Hardware Platform

User space

Kernel space
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
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 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"]
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
  
  ```
  $ 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
  
  ```bash
  $ mkdir swex1
  ```

- **mv**
  - Move or rename files
  
  ```bash
  $ 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>
</tbody>
</table>

- r(4) read
- w(2) write
- 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/SWE2007F16/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. Fun
Installing VirtualBox (1)

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

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](https://www.virtualbox.org/wiki/Downloads).
  If you are using VirtualBox 4.1.34, please download the extension pack [here](https://www.virtualbox.org/wiki/Downloads).
  If you are using VirtualBox 4.0.26, please download the extension pack [here](https://www.virtualbox.org/wiki/Downloads).
Installing VirtualBox (2)
VirtualBox에 오신 것을 환영합니다!

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

새 가상 마신을 만드시려면, 창 왼쪽 도구 모음의 새로 만들기 단추를 누르시면 됩니다.

F1 키를 누르면 상단에 맞는 도움말을 볼 수 있으며, 최근 정보와 뉴스를 보려면 www.virtualbox.org를 방문하여보십시오.
Creating a VM (1)
Creating a VM (2)
Creating a VM (3)

Oracle VM VirtualBox 관리자

Ubuntu VM

 일반

이름: Ubuntu VM
운영 체제: Ubuntu (64 bit)

시스템

기본 메모리: 1024 MB
부팅 순서: 플로피 디스크, CD/DVD, 하드 디스크
가속: VT-X/AMD-V, 네스티드 페이징

디스플레이

비디오 메모리: 12 MB
원격 데스크톱 세버: 사용 안함
비디오 캡처: 사용 안함

저장소

컨트롤러: IDE
IDE 세션디디 마스터: [CD/DVD] 비어 있음
컨트롤러: SATA
SATA 포트 0: Ubuntu VM, vdi (일반, 8.00 GB)

오디오

호스트 드라이버: Windows DirectSound
컨트롤러: ICH AC97
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)

This 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.

Quit  Back  Install Now
Installing Ubuntu on the VM (5)
Installing Ubuntu on the VM (6)
Installing Ubuntu on the VM (7)

- Press \textit{Ctrl} + \textit{Alt} + \textit{T} to launch a terminal (shell)

- Type the following commands:
  
  $ \text{sudo} \\ \text{apt-get} \ \text{update}$
  
  $ \text{sudo} \ \text{apt-get} \ \text{install} \ \text{build-essential}$