BI296: Linux and Shell Programming

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Dept. of Bioinformatics & Biostatistics
Shanghai Jiao Tong University

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Outline

CS-Fundamentals

Linux Overview

Operating System (OS)

Why Linux?

Linux vs. Windows vs. MacOS

Basic Knowledge

Linux Commands

Course Overview

- **Course Description**: Linux command line, system administration and bash/python programming
- **Prerequisite**: None
- **Textbook**: None
- **Grading**: Grades will be determined roughly by
  - Assignments: 20%
  - 5 Quizzes: 25% total
  - 2 Take-home Practicals: 30%
  - Projects: 25%
- **Exams**: There will be 5 quizzes, 2 bring-home practicals. All exams will be open-book, and will cover materials from lectures, discussions, labs and extracurricular readings.
- **Webpage**: `http://cbb.sjtu.edu.cn/course/bi296`
- **Github**: `https://github.com/ricket-sjtu/bi028`

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Course Schedule

Schedule is to be changed according to the practical reasons.

- Lecture 01: Fundamental Knowledge about Linux
- Lecture 02: Dummy Linux Commands
- Lecture 03: Linux File System， Process Management
- Lecture 04: Regular Expression - GREP, SED and AWK
- Lecture 05: Shell Programming (BASH)
- Lecture 06: System Administration
- Lecture 07: Fundamental Python Programming
- Lecture 08: Data Structures and Algorithms in Python
- Lecture 09: Scientific computing with Python
- Lecture 10: Python Data Science

Assignment Policy

- To: `ricket.woo@gmail.com`
- Title: lab1_516080910001
- Attachment: lab1_5160809010001.tar.gz
- **Late Policy**
  - Solutions to assignments should be submitted before the due.
  - Being late within 3 days will get the 50% grades.
  - Later more than 3 days will get no grades.

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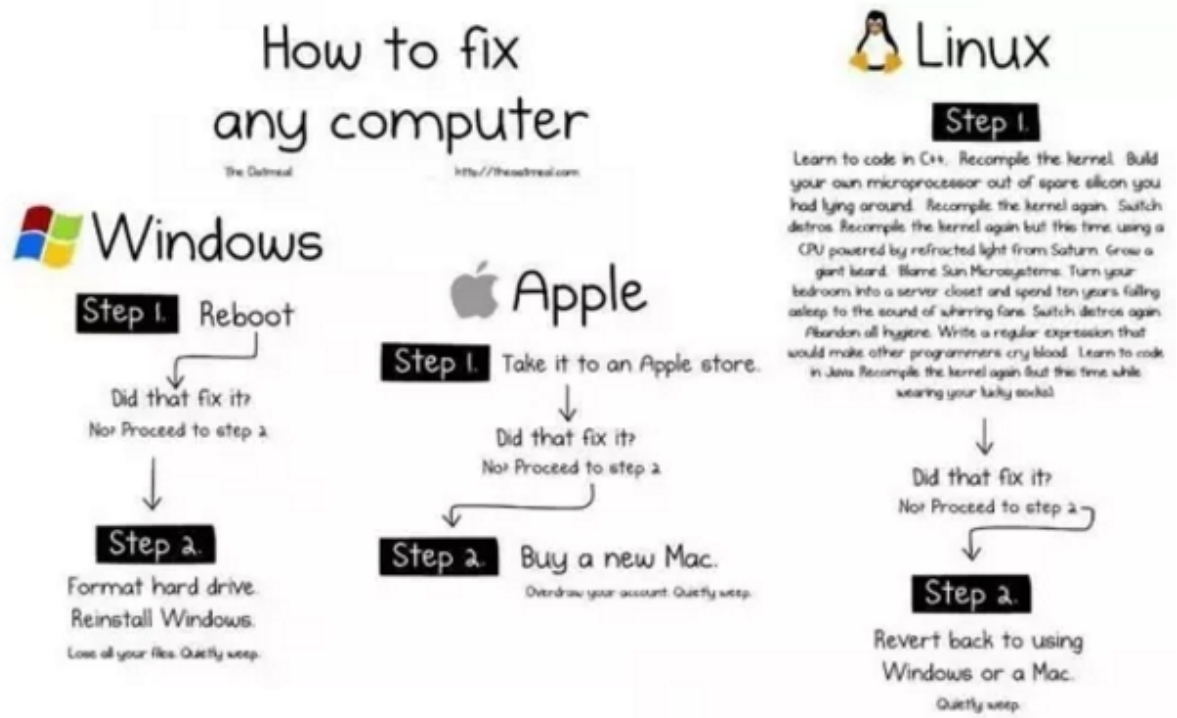

Stop here and Ask

Any Questions?

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fundamental concepts

- Central Processing Unit（CPU，中央处理器）
- Graphical Processing Unit (GPU, 图形处理器)
- Cache（高速缓存）
- Storage（存储）：bit, Byte, KB, MB, GB, TB, PB, EB, ZB
- Input/Output（输入输出）
- Controller（控制器）

Number system

- Decimal（十进制）
- Binary（二进制）
- Octal（八进制）
- Hexadecimal（十六进制）

Exercise

decimal	binary	octal	hexadecimal
12.68			
	1001110		
		7553	
			9FA5

Machine digit（机器数的二进制表示）

- Original（原码）
- One's complement（反码）
- Two's complement（补码）

Exercise

1. Convert these positive decimal to binary:
   - 133d
   - 25d
   - 73d
2. Convert these negative decimal values to negative binary using one's complement and two's complement(补码，假设计算机字长为8bit):
   - -192d
   - -16d
   - -1d
   - -0d

Network

- Host（主机）, Domain（域）
- IP Adress, IPv4, IPv6
- Physical Address (MAC Address)
- Gateway(网关), netmask（子网掩码）
- Domain Name Server（DNS，域名服务器）
- Network Communication Protocol (网络通信协议)

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The Definition of Operating System (OS)

Wikipedia

An **OS** is a collection of software that manages computer resources (CPUs, memory, storage, etc.) and provides universal services for a set of computer programs.

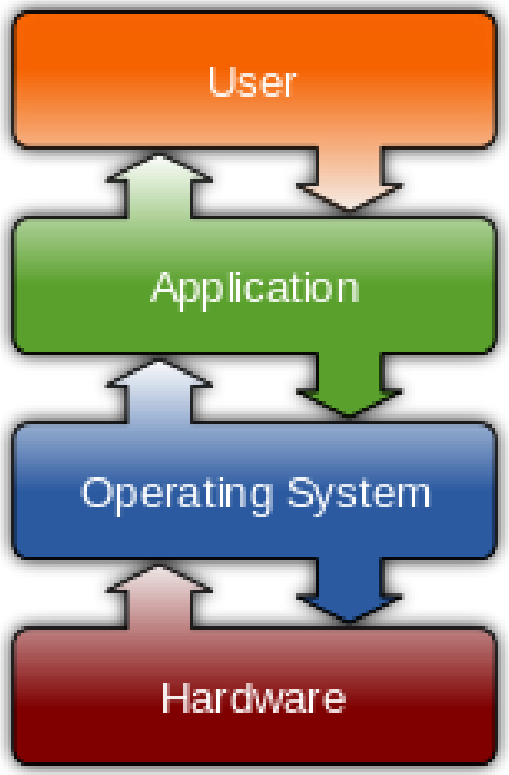

Figure : Operating System

The principal tasks of OS

- Processor (CPU) Management（处理器管理）
- Memory (Storage) Management（内存/存储管理）
- Devices Management（其他设备管理）
- Application Management（应用程序管理）
- User Interface (UI)（提供用户接口）

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What is Linux?

A free and open-source UNIX-like operating system developed under the GNU General Public License (GPL).

- Free and open source（自由、开源）.
- More and more popular（时髦）, especially in the field of scientific computing.
- Portable（可移植）: Supports most of the available computers

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A Short History of UNIX

- Prototype: *Multics* by AT&T Bell Lab, GE and MIT
- 1969, UNIX by Ken Thompson and Dennis Ritchie
- 1973 UNIX rewritten with C (providing portability)
- Berkeley UNIX (BSD UNIX)
- 1983, System V
- Commercial Products: SunOS, Solaris, HP-UX, AIX, SCO-UNIX

Advantages of UNIX

- Unix is very simple
  - Implements only hundreds of system calls（系统调用）and
  - have a straightforward, even basic design.
- In UNIX, everything is a file, which unifies the manipulation of data and devices into a set of core system calls.
- Kernels（内核）and all related system utilities are written in C and ASM
- Fast process creation and unique *fork()* system call.
- Providing simple yet robust IPC（进程通信）primitives.
- Exhibiting clean layering, with a strong separation between policy (what to do) and mechanism (how to do).

A Short History of Linux (1)

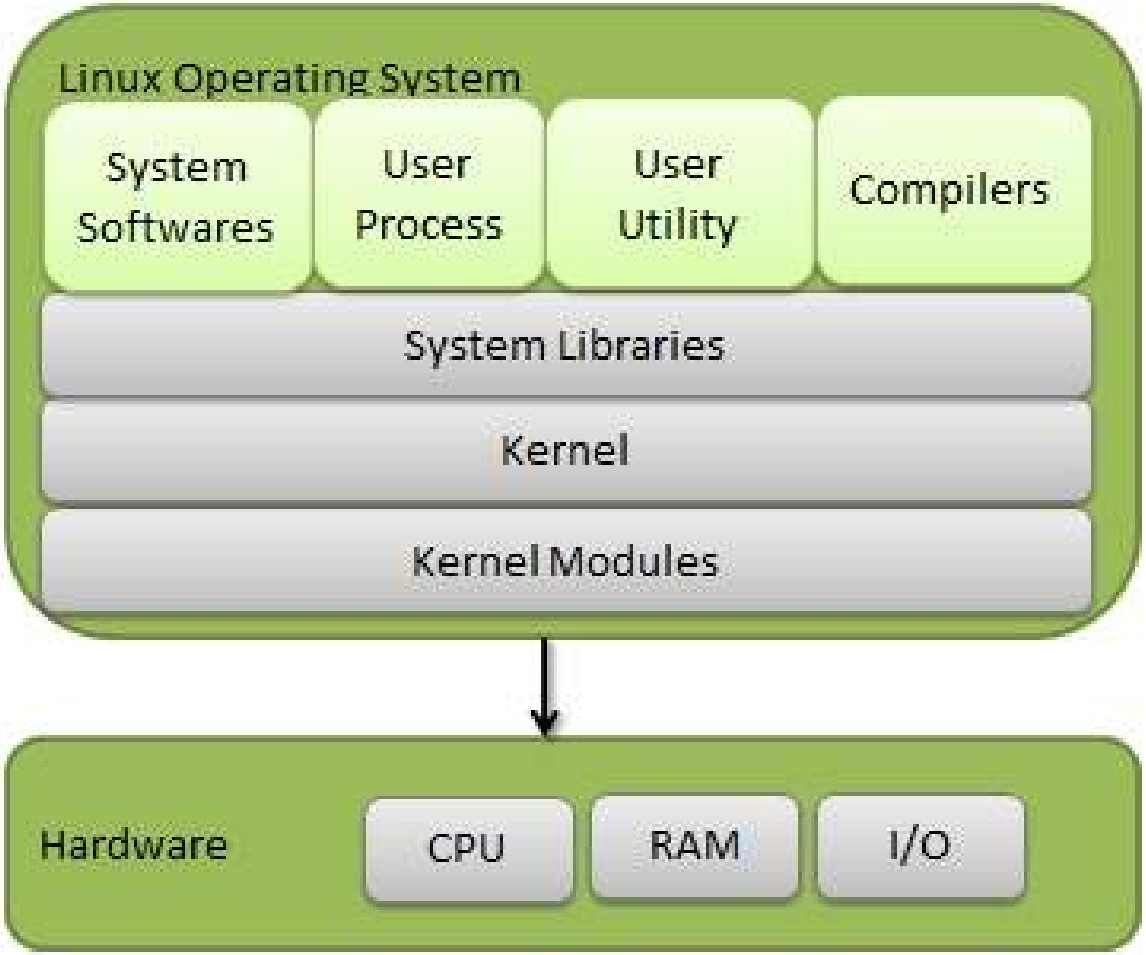
- 1984, *Richard Stallman, GNU Project*
  - GNU's Not Unix:`http://www.gnu.org`
  - Copyleft
- Purpose: *Free UNIX*
  - *Free as free speech, not free lunch.*
- 1st step: re-implementation of UNIX utilities, especially
  - C Compiler, C library
  - emacs/bash
- Free Software Foundation (FSF)
  - `http://www.fsf.org`

A Short History of Linux (2)

redhat

- 1991, *Linus Torvalds*, 1st version of *Linux Kernel*
  - Initially on the 386 protected mode
  - Linus's UNIX-Like OS = Linux
- 1992: 1st distributions emerged
  - Linux Kernel
  - GNU and other tools
  - Installation procedure
- The rest is well-known story ...
  - RedHat, Ubuntu, Debian, OpenSuSe, etc.

A Typical Computer System Architecture



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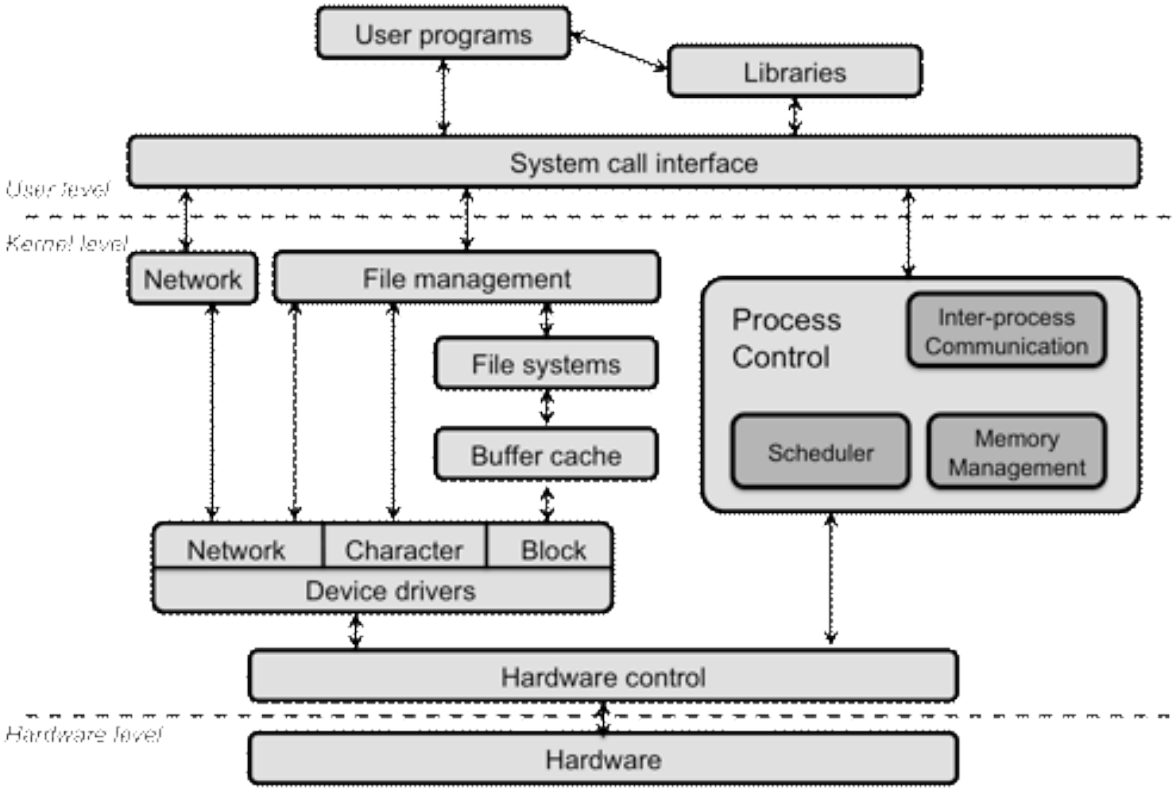
Programmer's Viewpoint



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Linux, Windows, MacOS

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M2: Multi-User and Multi-tasking

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- Linux is a multi-user, multi-tasking OS
  - Multiple users can run multiple tasks simultaneously, independent of each other.
- Always need to “log in” before using the system
  - Identify yourself with username + password
- Ways to log in to the system
  - Console: Directly attached keyboard, mouse, monitor
  - Serial terminal
  - Network connection (ssh, telnet, etc.)