Introduction to Computer Science
Lecture 3: OPERATING SYSTEMS

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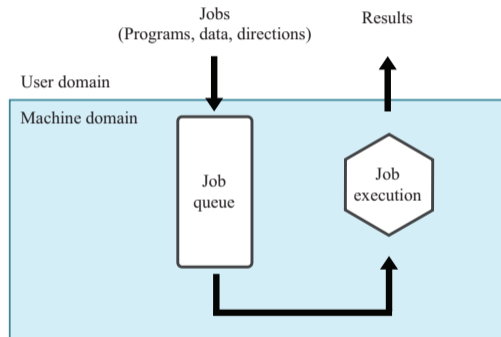National Taiwan University

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Slides made by Tian-Li Yu, Jie-Wei Wu, and Chu-Yu Hsu

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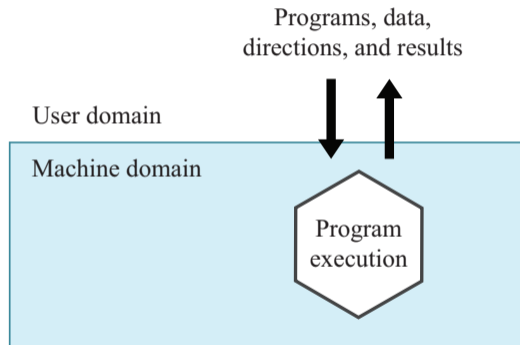## Batch Processing

- Computer operators
- First-in, first-out (FIFO)

Interactive Processing

- OS with remote terminals

Programs, data,
directions, and results

User domain

Machine domain

Program
execution
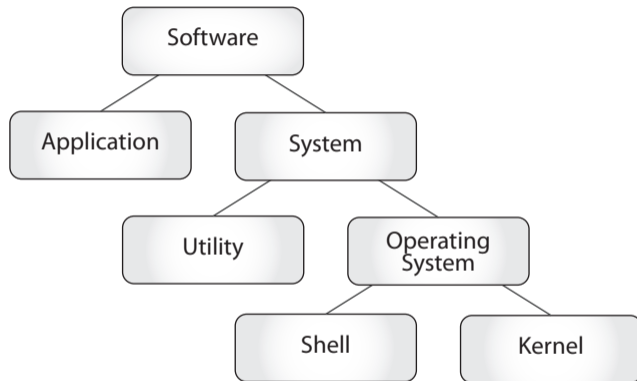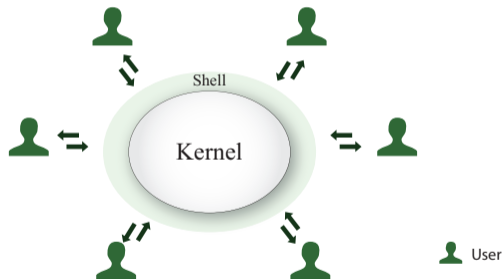
Different Types of OS

- Batch
- Interactive
- Real-time
    - Response time is critical
- Time-sharing and multitasking
    - Dividing time into intervals
    - Only one task is being performed at any given time
- Multiprocessor
    - Load balancing
    - Scaling

Software Classification

Shells

- Communication with users
  - Text based.
 - GUI (graphics user interface), such as window manager.

Kernel

- File manager
  - Directory/folder, path
- Device drivers
- Memory manager
  - Allocating main memory
  - Paging, virtual memory
- Scheduler
- Dispatcher

- Can you recognize these shell and kernel components on your PC?

Linux World

- Originally made by Linus Torvalds in 1995.
- http://www.linux.org
- Freeware & open-source
- Many distro (Linux distributions, http://distrowatch.com/)
    - For beginner: Linux Mint (http://www.linuxmint.com/)
    - Personal favorite: Gentoo (http://www.gentoo.org/)
- In fact, Linux means only the kernel.
- Better call it GNU/Linux?
- Servers, PCs, embedded systems (Android's kernel is based on Linux).

- Boot strapping (booting)
- You may change the booting sequence in BIOS (basic input/output system).
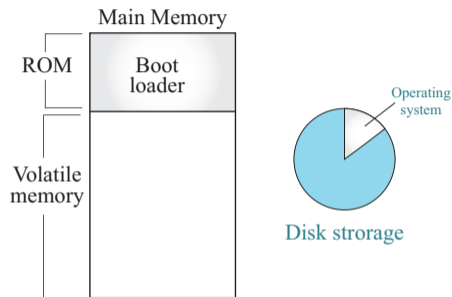
Step 1
Execute the boot loader program which is already in ROM. Operating system is stored in mass storage.
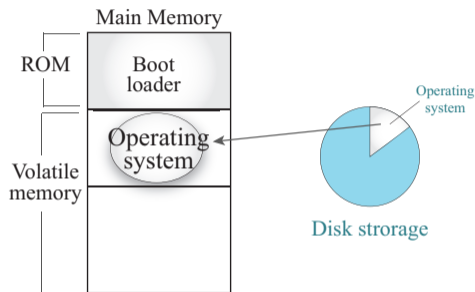
Step 2
Boot loader program directs the transfer of the operating system into main memory and then transfers control to it.

Process

- Process
  - The activity of executing a program.
- Process state
  - Program counter
  - General purpose registers
  - Associated memory cells
- Process table
  - Memory area assigned to the process
  - Priority
  - Ready/waiting

Process Administration

- Scheduler
  - maintains the process table
    - Introduces new processes.
    - Removes completed processes.
    - Decides whether a process is ready or waiting.

- Dispatcher
  - really execute the program
    - Controls the allocation of time slices to the processes in the process table.
    - Process switch (context switch) by calling interrupt.

Multiprogramming (Time-sharing) Between 2 Processes
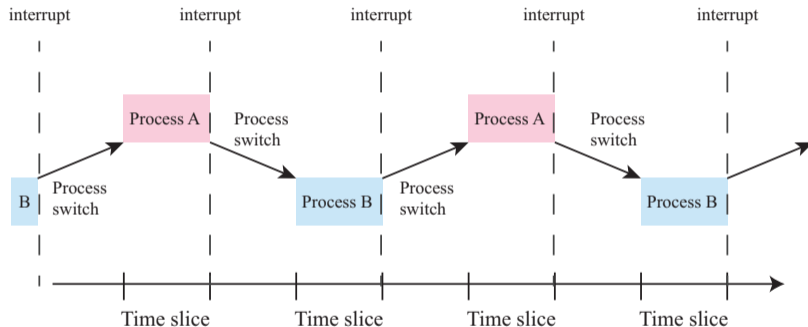
Semaphores

- A visual signaling apparatus with flags, lights, or mechanically moving arms, as one used on a railroad. (www.dictionary.com)

- Atomic TEST-AND-SET
- Critical region
- Mutual exclusion

  Operating system concepts

  Silberschatz Galvin, 1995

  Addison-Wedley

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repeat

   **while** TEST-AND-SET (*lock*) **do** *no-op*;

     critical section

    lock := false;

     remainder section

until *false*;

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## Prerequisites for Deadlock

- Deadlock may occur only if all three of the following (necessary but insufficient) conditions are satisfied:
  1. Competition for non-shareable resources.
  2. Resources are requested on a partial basis; that is, having received some resources, a process will return later to request more.
  3. Once a resource has been allocated; it cannot be forcibly retrieved.
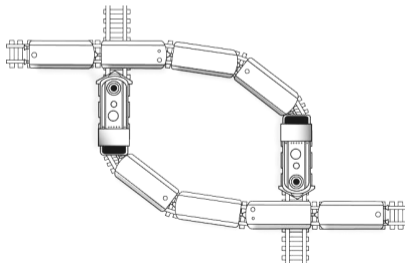
Deadlock vs. Starvation
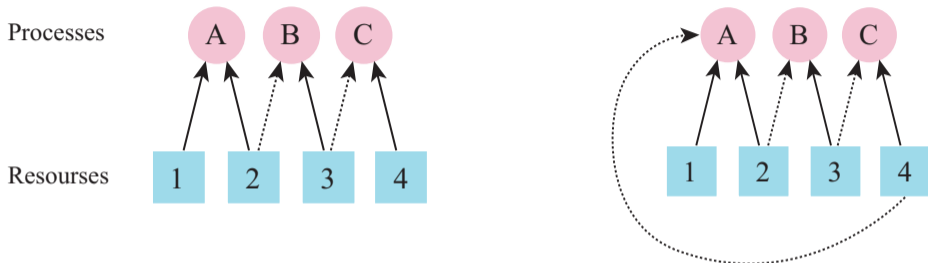
How to grant this request?

- Starvation: process cannot get the resources needed for a long time because the resources are being allocated to other processes.
- Aging: adding an aging factor to the priority of each request.

Security

- Insecure passwords & bad habits
- Auditing software (record and analyze activities)
- Sniffing software
- Virus/worms/Trojan horses
- Privilege levels & privileged instructions