

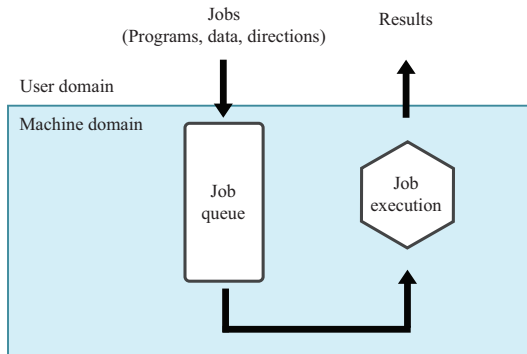
Introduction to Computer Science

Lecture 3: OPERATING SYSTEMS

Department of Electrical Engineering
National Taiwan University

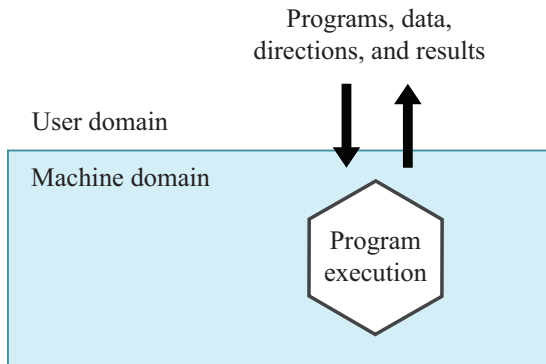
Batch Processing

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



Interactive Processing

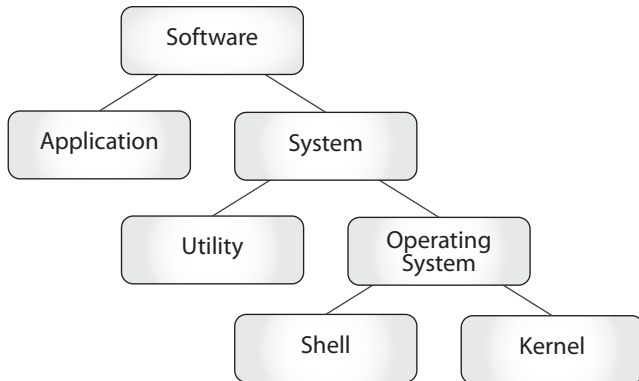
- OS with remote terminals



Different Types of OS

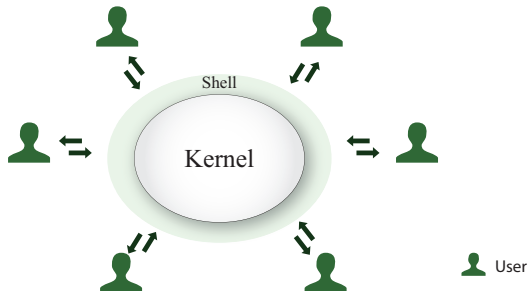
- Batch
- Interactive
- Real-time
 - Response time is critical
- Time-sharing and multitasking
 - Dividing time into intervals
 - Only one task is being performed at any given time
- Multiprocessor
 - Load balancing
 - Scaling

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

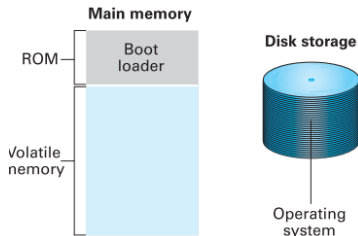
- Can you recognize these shell and kernel components on your PC?

Linux World

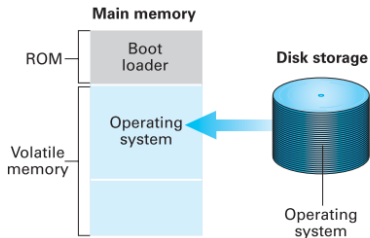
- Originally made by Linus Torvalds in 1991.
- <http://www.linux.org>
- Freeware & open-source
- Many **distro** (Linux distributions, <http://distrowatch.com/>)
 - Recommendation for beginners:
 - SolydXK (<http://solydtk.com/>)
 - Linux Mint (<http://www.linuxmint.com/>)
 - Personal favorite: Gentoo (<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: Machine starts by executing the boot loader program already in memory. 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.

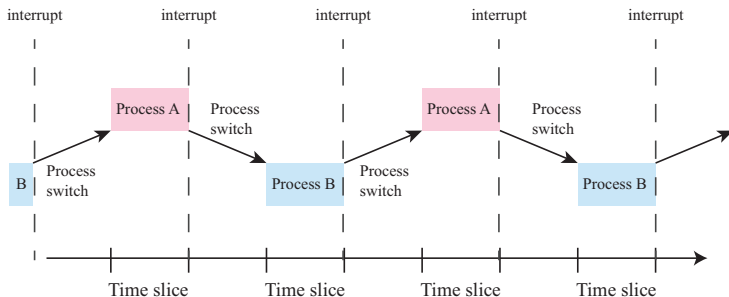
Process

- 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

repeat

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

critical section

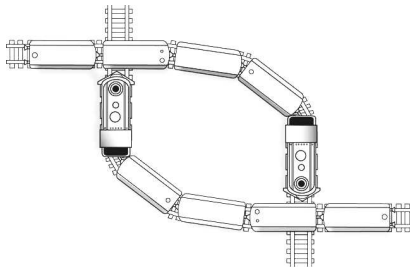
lock := *false*;

remainder section

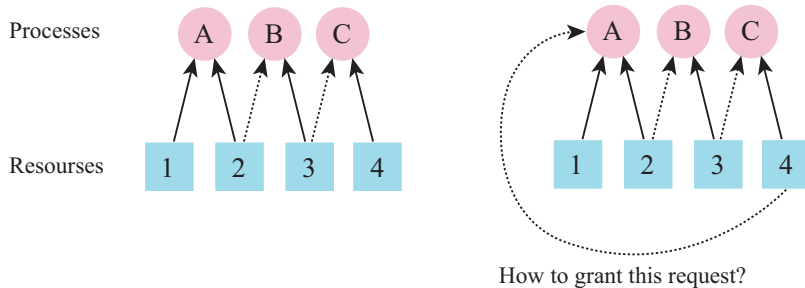
until *false*;

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



- **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