# Introduction to Computer Science
# Lecture 3: Operating Systems

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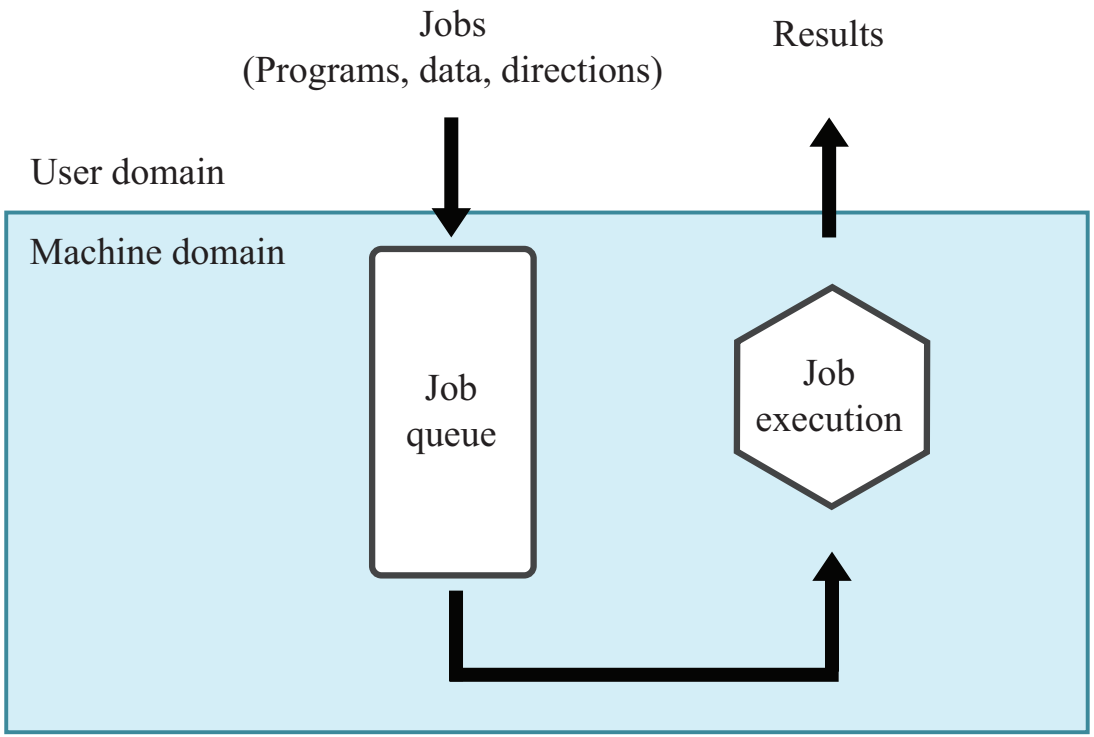
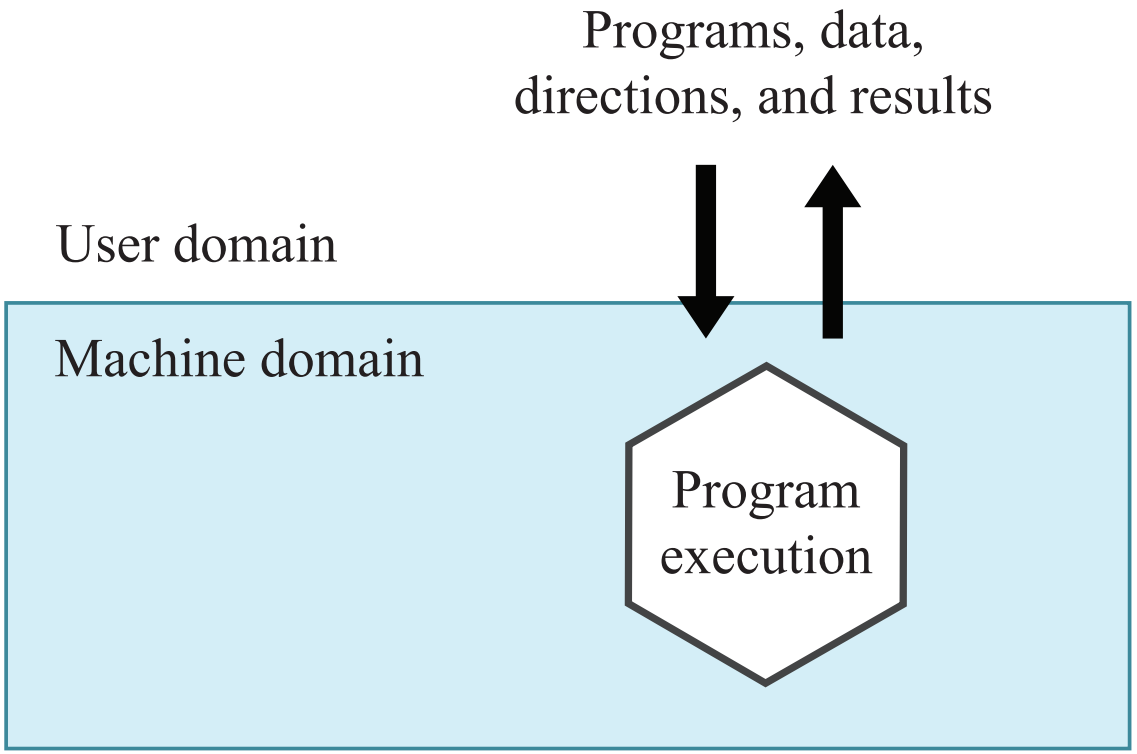
# Batch Processing

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



# Interactive Processing

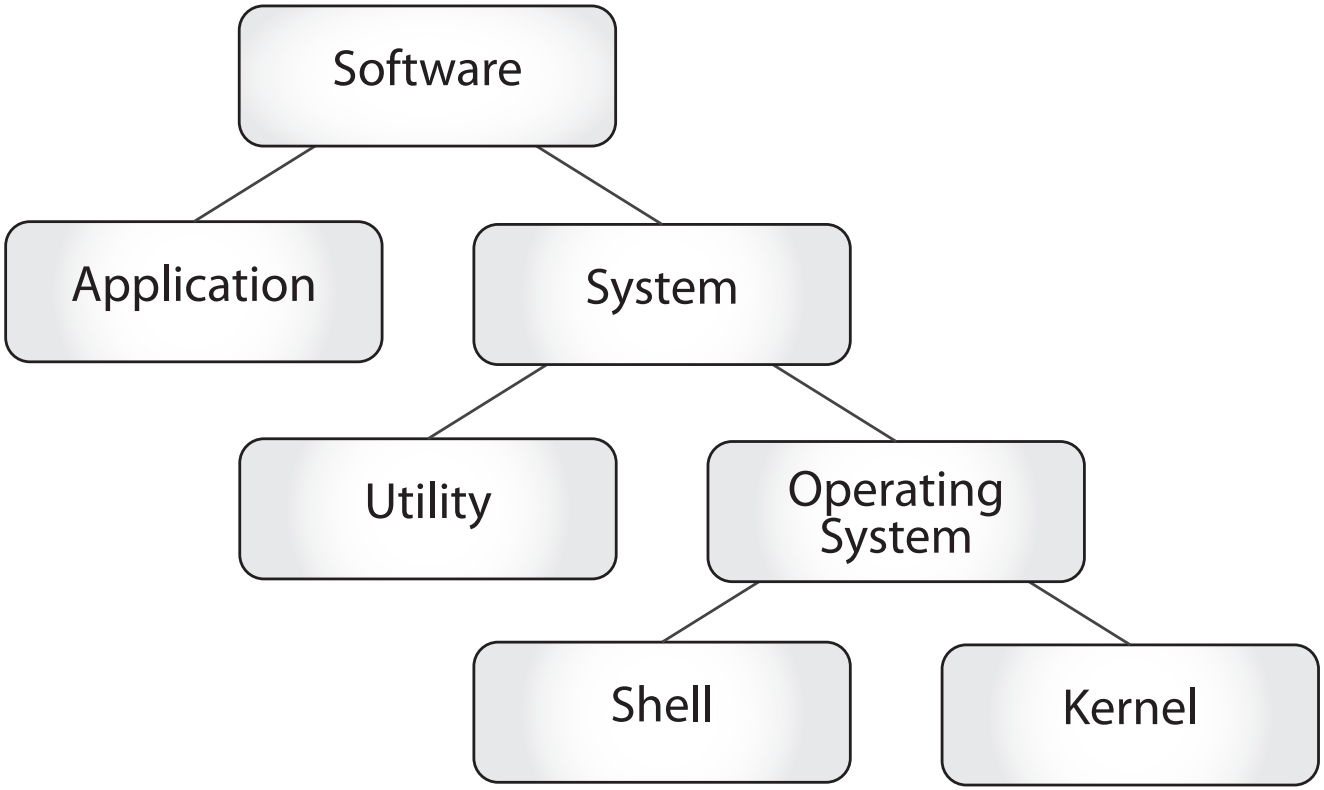
- OS with remote terminals



# Different Types of OS

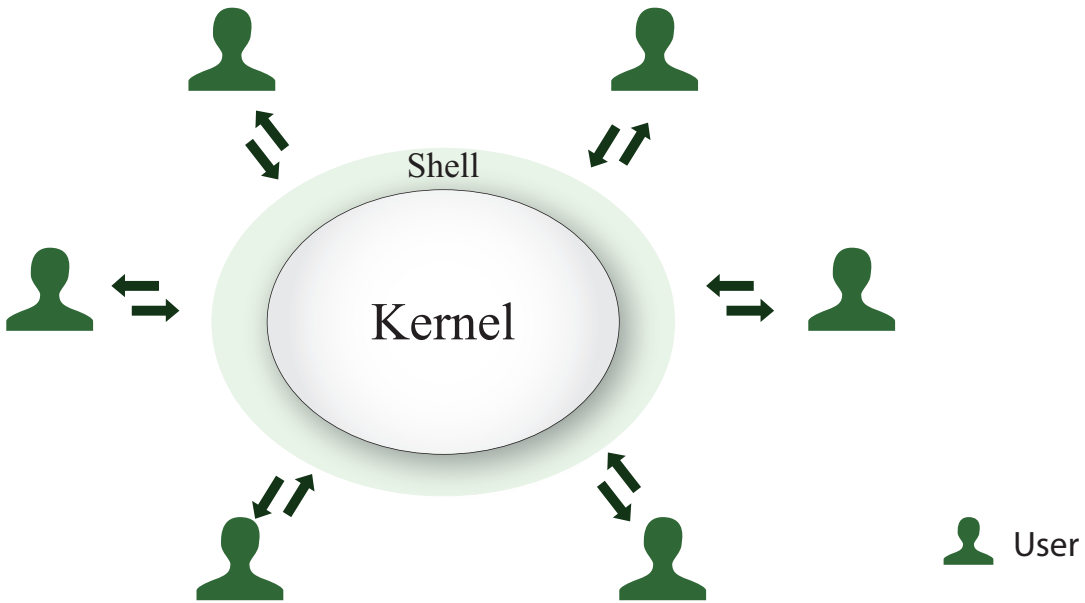
- Batch
- Interactive
- Real-time
  - Response time is critical
- Time-sharing and multitasking
  - Dividing time into intervals
  - Only one task is being performed at any given time
- Multiprocessor
  - Load balancing
  - Scaling

# 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

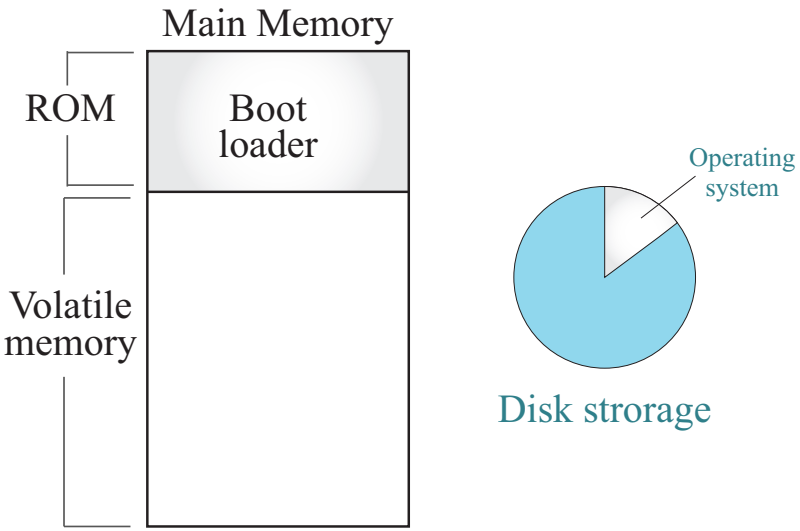
- Can you recognize these shell and kernel components on your PC?

# Linux World

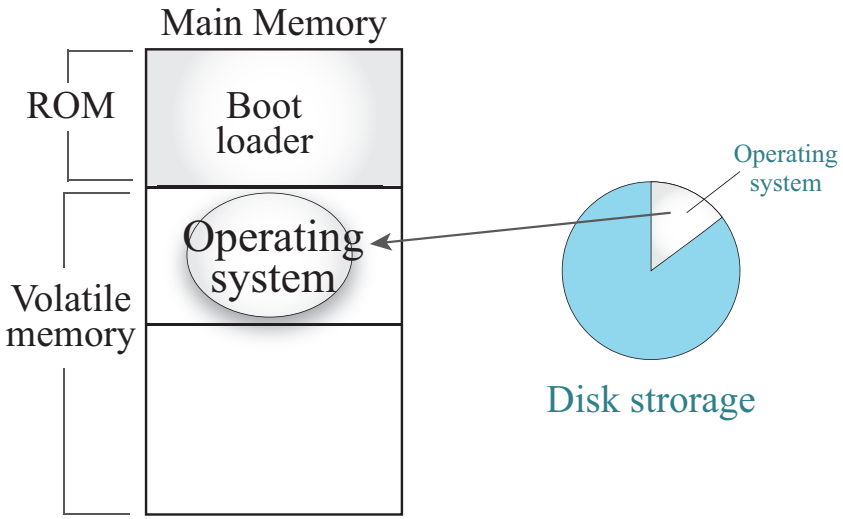
- Originally made by Linus Torvalds in 1991.
- http://www.linux.org
- Freeware & open-source
- Many distro (Linux distributions, http://distrowatch.com/)
  - Recommendation for beginners:
    - SolydXK (http://solydxk.com/)
    - Linux Mint (http://www.linuxmint.com/)
  - Personal favorite: Gentoo (http://www.gentoo.org/)
- 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**
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

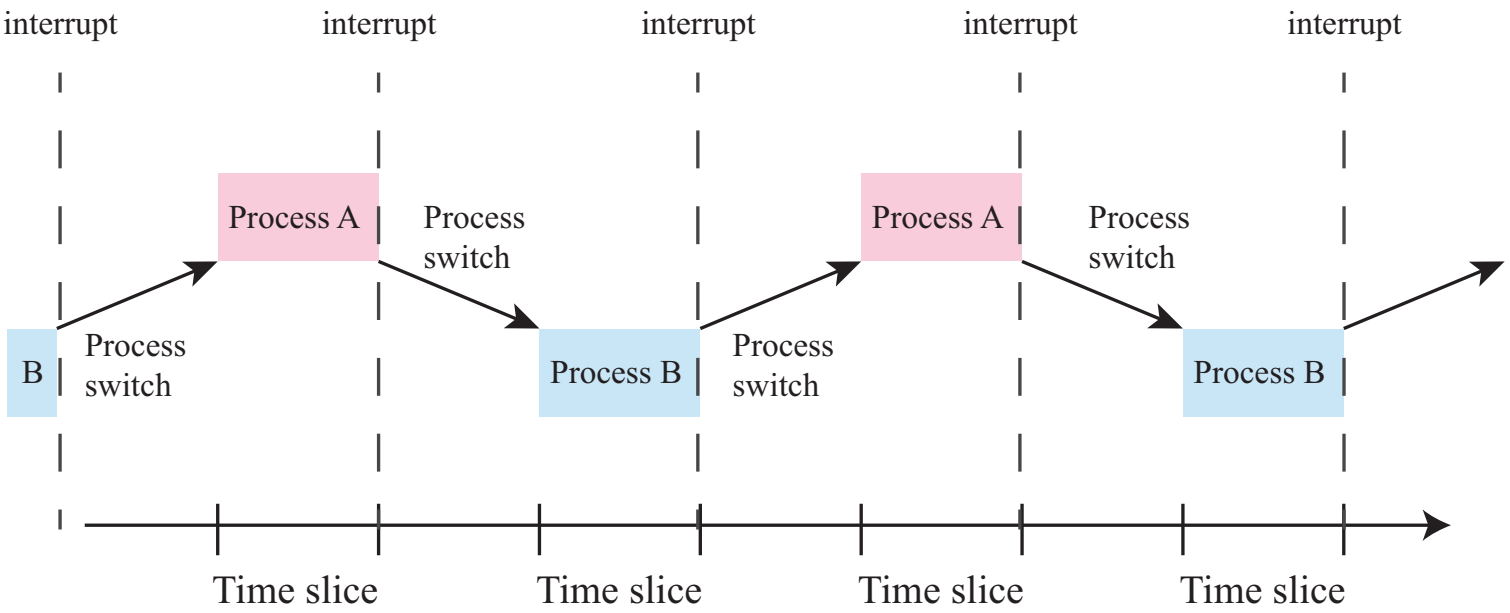
- Process
  - The activity of executing a program.
- Process state
  - Program counter
  - General purpose registers
  - Associated memory cells
- Process table
  - Memory area assigned to the process
  - Priority
  - Ready/waiting

# 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

**repeat**

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

critical section

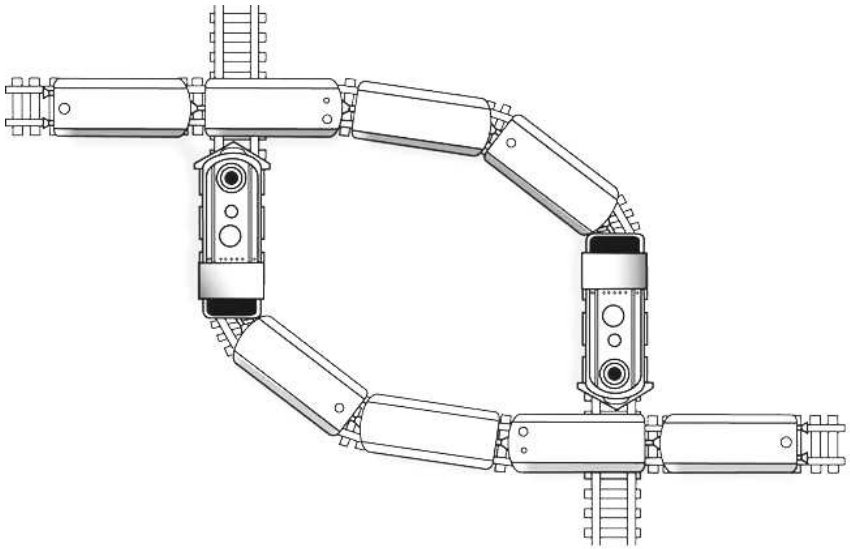
*lock* := *false*;

remainder section

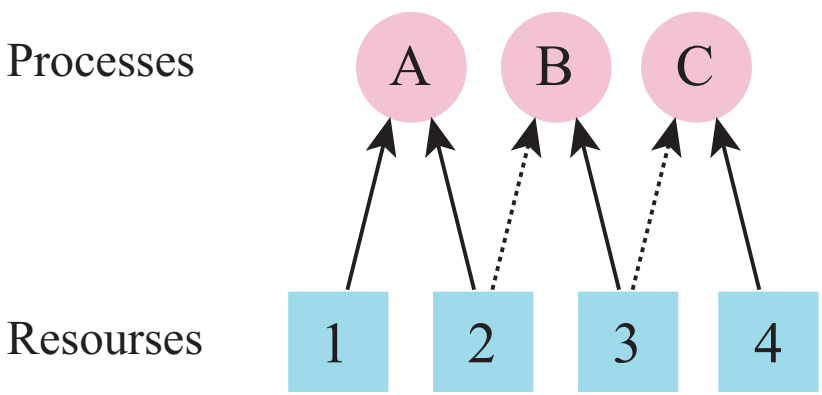
**until** *false*;

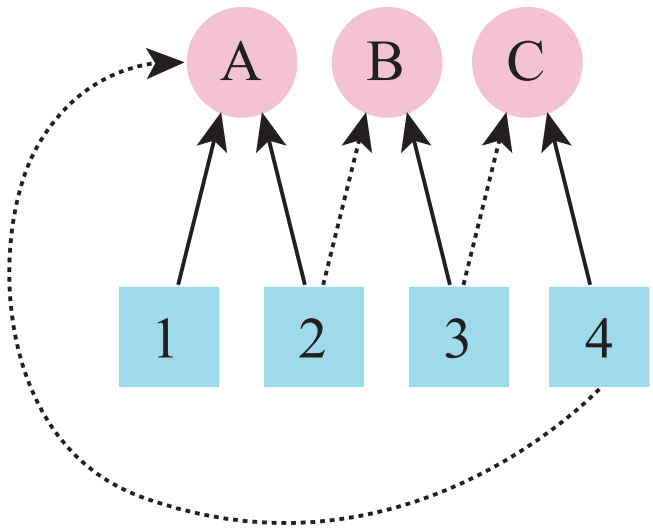
# Prerequisites for Deadlock

- 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




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