Session 04
OPERATING SYSTEMS

Lecture slides are adapted/modified from slides provided by the textbook, Computer Science: An Overview by J. Glenn Brookshear and Dennis Brylow
publisher Pearson

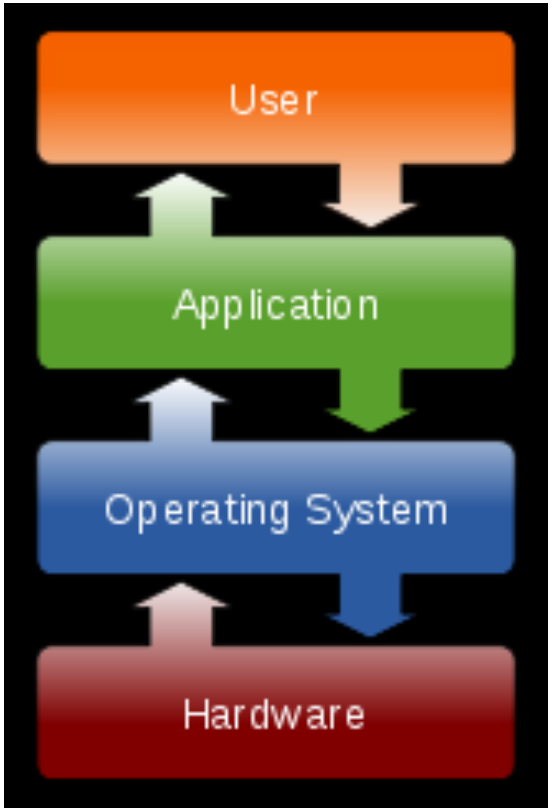
KHOA CÔNG NGHỆ THÔNG TIN
TRƯỜNG ĐẠI HỌC KHOA HỌC TỰ NHIÊN

Contents

- The History of Operating Systems
- Operating System Architecture
- Coordinating the Machine's Activities
- Handling Competition Among Processes
- Security

Definition

- A software layer between the hardware and application / user, it provides a virtual machine interface (*virtual machine)*: easy and secure.
- A *resource manager* allows programs / users to share hardware resources: fair and efficient.
- A set of utilities to simplify application development.



Utility

- For programmers:
  - Easier to developing.
    - Working only on high level of abstraction, no need to know hardware details..
    - Ex: working on files instead of blocks on hardware…
  - Compatibility.

Utility

- For end users:
  - Easier to use.
    - Can you imagine using a computer without an operating system?
  - Safe.
    - OS protects program among various programs.
    - OS protects the user among various users.

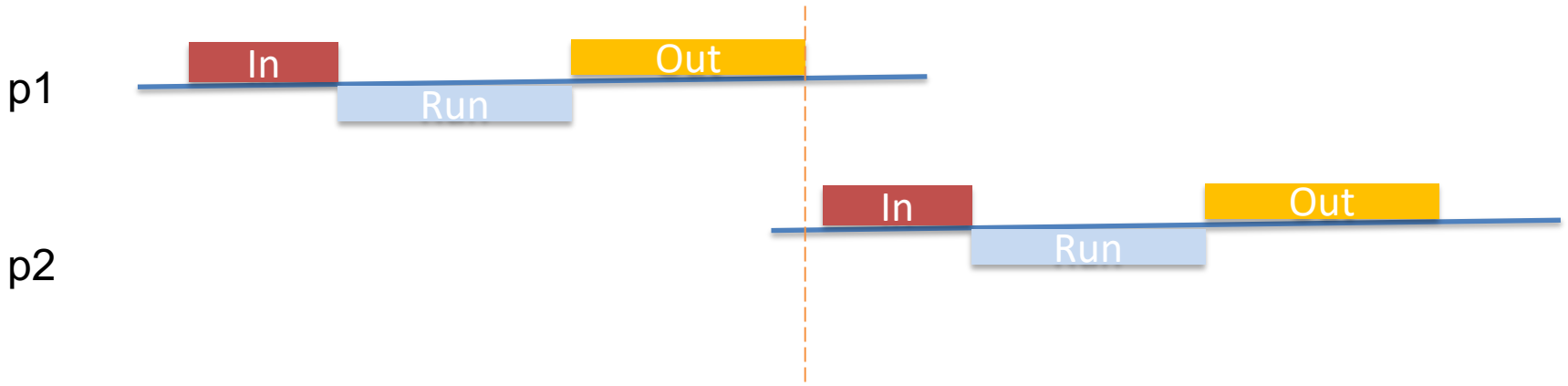
Main function

- Memory management
  - Main memory monitoring
  - Memory allocation and recall
- CPU management
  - CPU usage authorization
  - Dertermine the execution status of the program → restoring state.
- Equipment management
  - Grant and revoke access to the device.

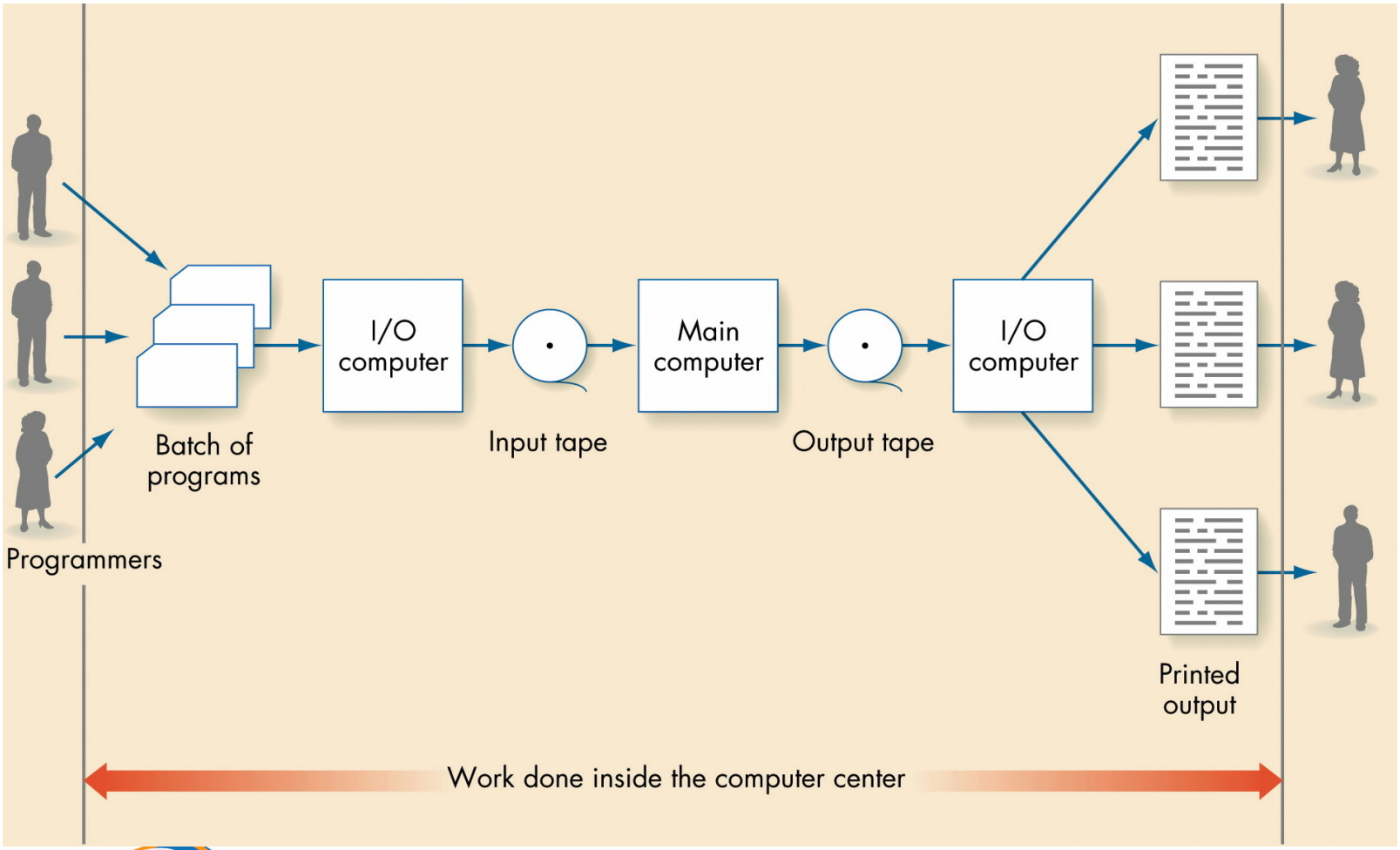
Generation	Approximate Dates	Major Advances
First	1945–1955	No operating system available Programmers operated the machine themselves
Second	1955–1965	Batch operating systems Improved system utilization Development of the first command language
Third	1965–1985	Multiprogrammed operating systems Time-sharing operating systems Increasing concern for protecting programs from damage by other programs Creation of privileged instructions and user instructions Interactive use of computers Increasing concern for security and access control First personal computer operating systems
Fourth	1985–present	Network operating systems Client-server computing Remote access to resources Graphical user interfaces Real-time operating systems Embedded systems
Fifth	??	Multimedia user interfaces Massively parallel operating systems Distributed computing environments

Categorization

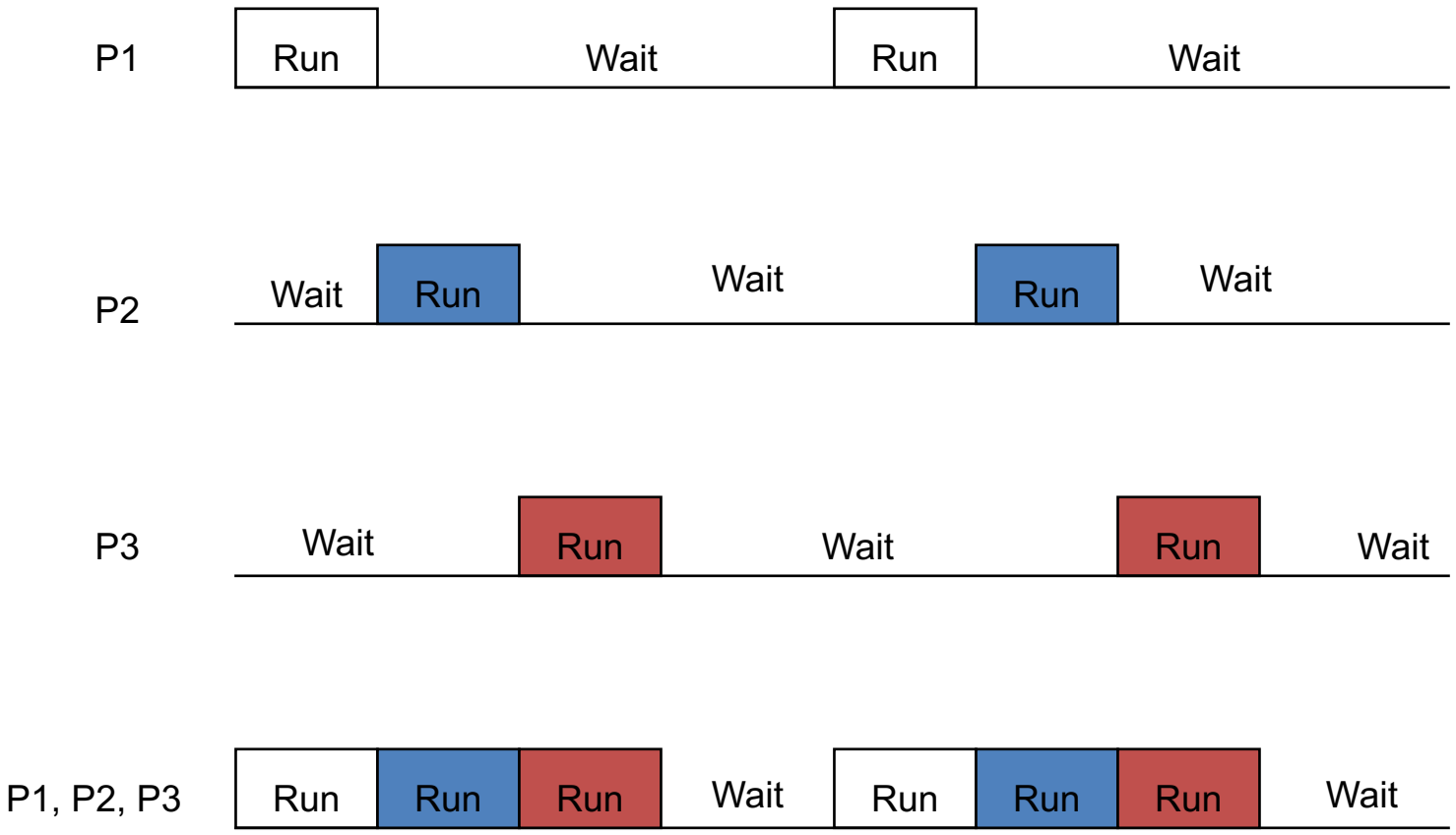
Batch processing



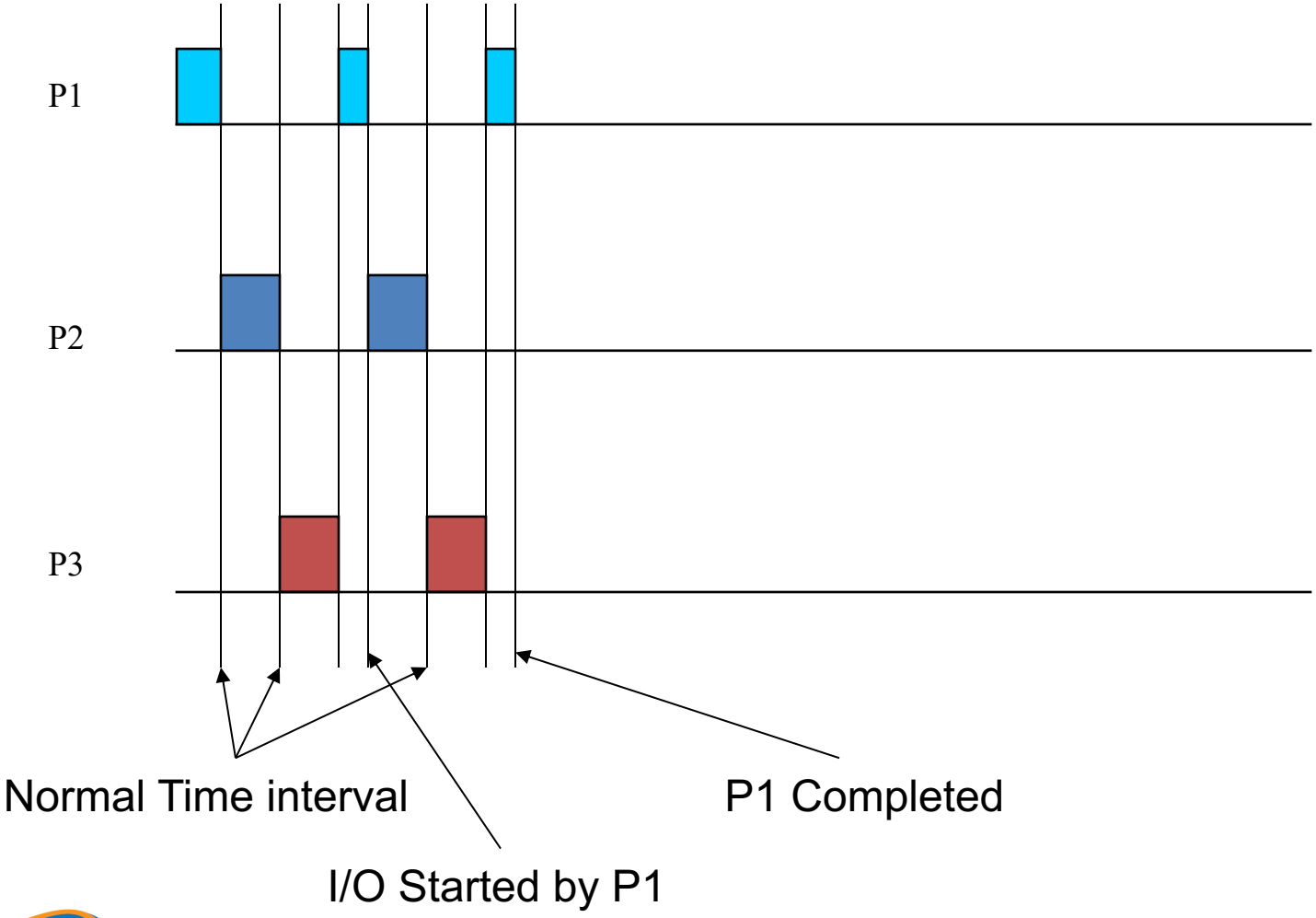
Batch processing



Multi tasking processing



Time-sharing system



Other systems

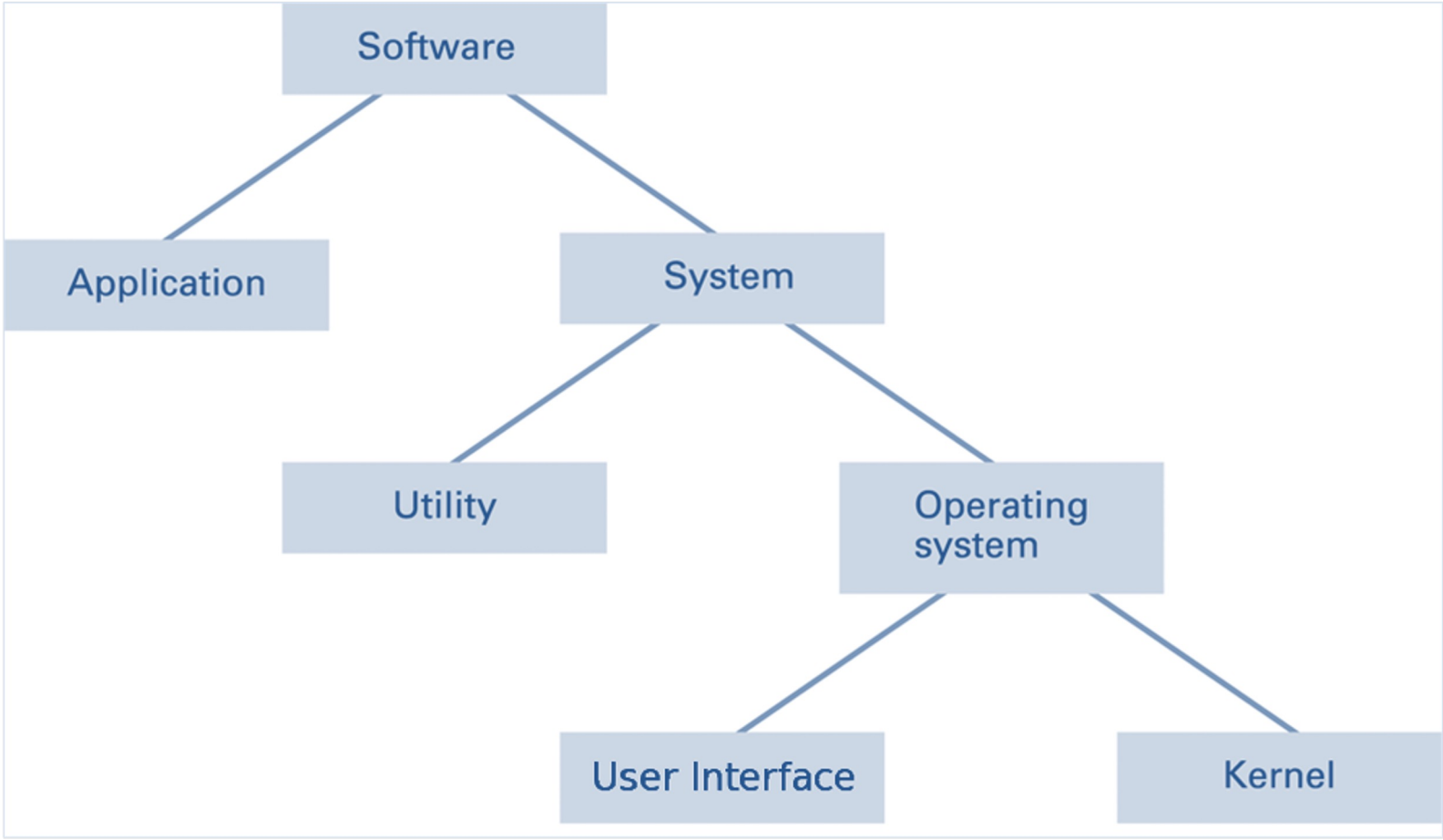
- Parallel system
- Real-time system:
  - Hard Real-time
  - Soft Real-time
- Distributed system

Operating System Architecture

Types of Software

- Application software
  - Performs specific tasks for users
- System software
  - Provides infrastructure for application software
  - Consists of operating system and utility software

Software classification



System Software

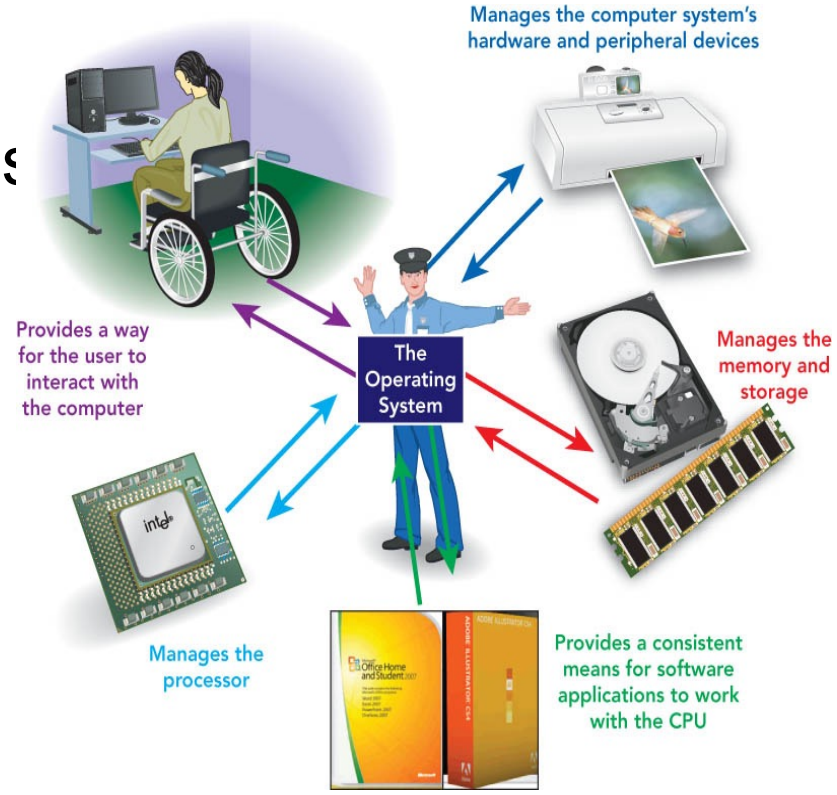
- Consists of all the programs that enable the computer and its peripheral devices to function smoothly
- Divided into two main categories:
  - The operating system
  - System utilities (utility programs)

The Operating System

- Operation system (OS)
  - Set of programs that coordinates:
    - Interactions of hardware components to each other
    - Interaction between application software and computer hardware

Basic functions of operating systems

- Five basic functions
  - Starts the computer
  - Manages applications
  - Manages memory
  - Handles input and output device messages
  - Provides a user interface for communication

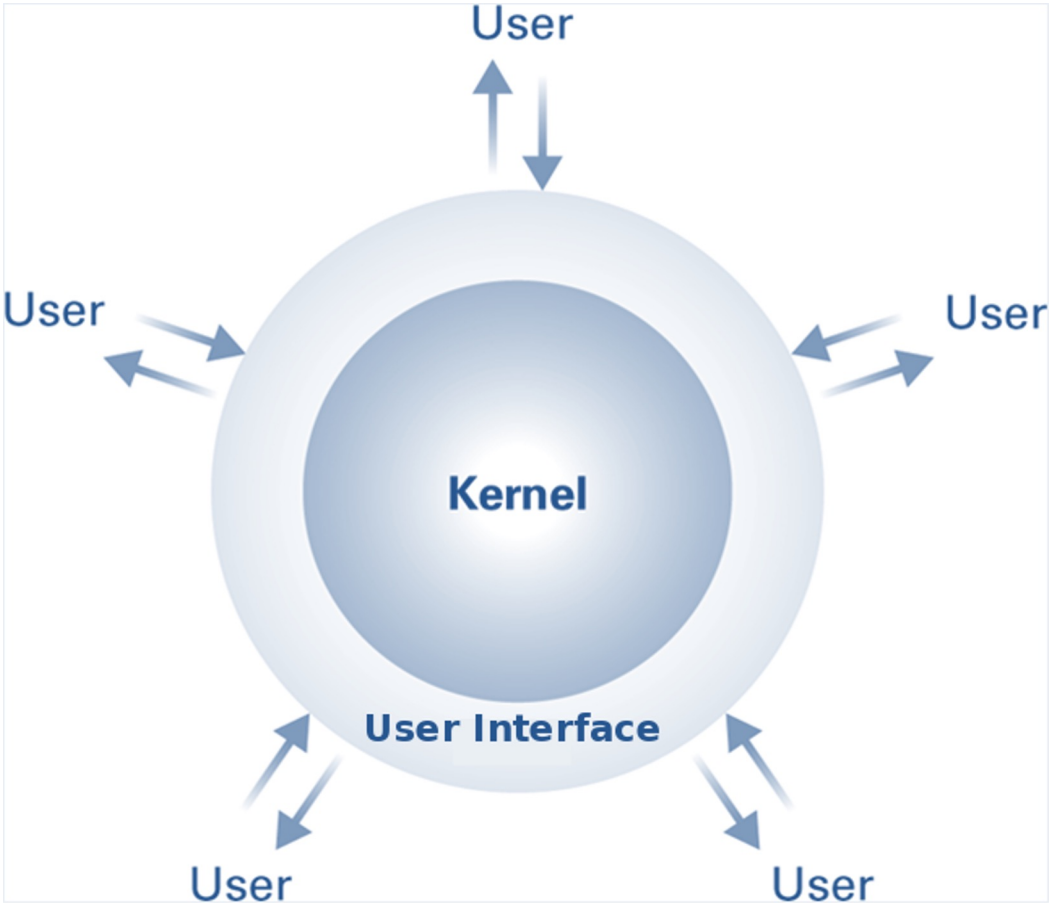


OPERATING SYSTEM COMPONENTS

Operating System Components

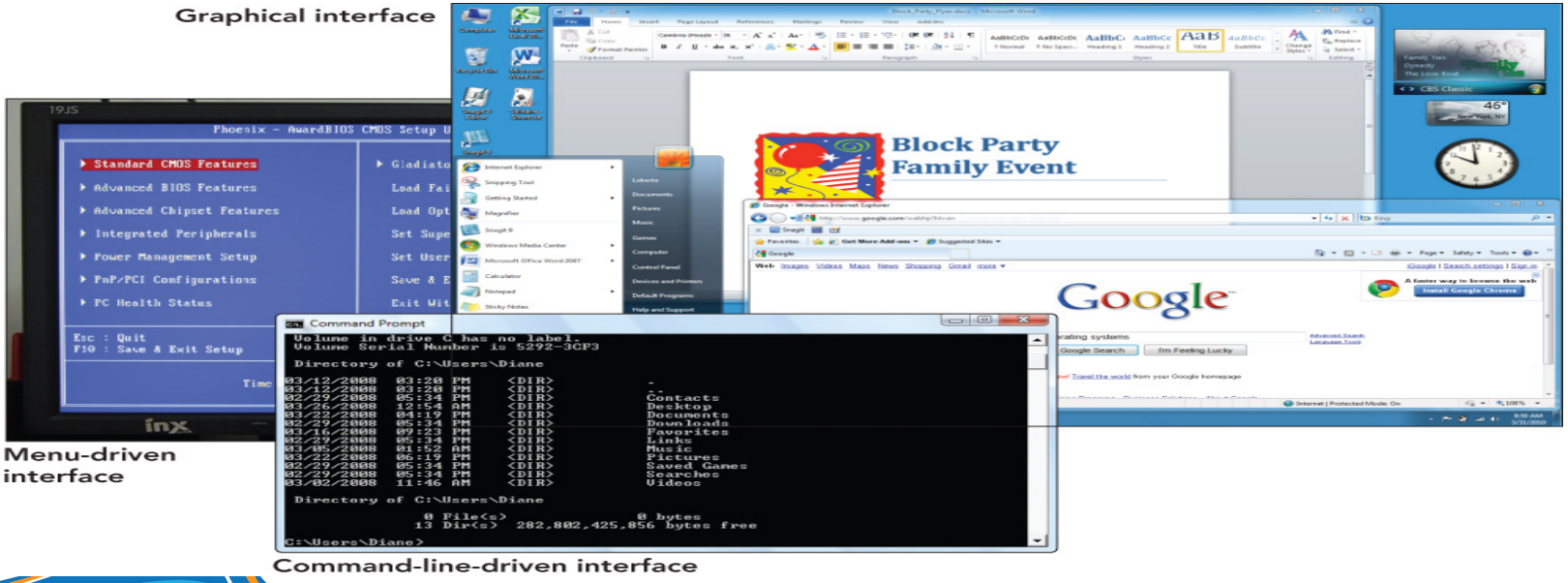
- **User Interface (shell):** Communicates with users
  - Text-based.
  - Windows-based.
- **Kernel:** Performs basic required functions
  - File manager
  - Device drivers
  - Memory manager
  - Scheduler and dispatcher

User - User interface - Kernel



User interface

- Types of user interfaces
  - Graphical user interface (GUI)
  - Menu-driven user interface
  - Command-line user interface



COORDINATING MACHINE'S ACTIVITIES

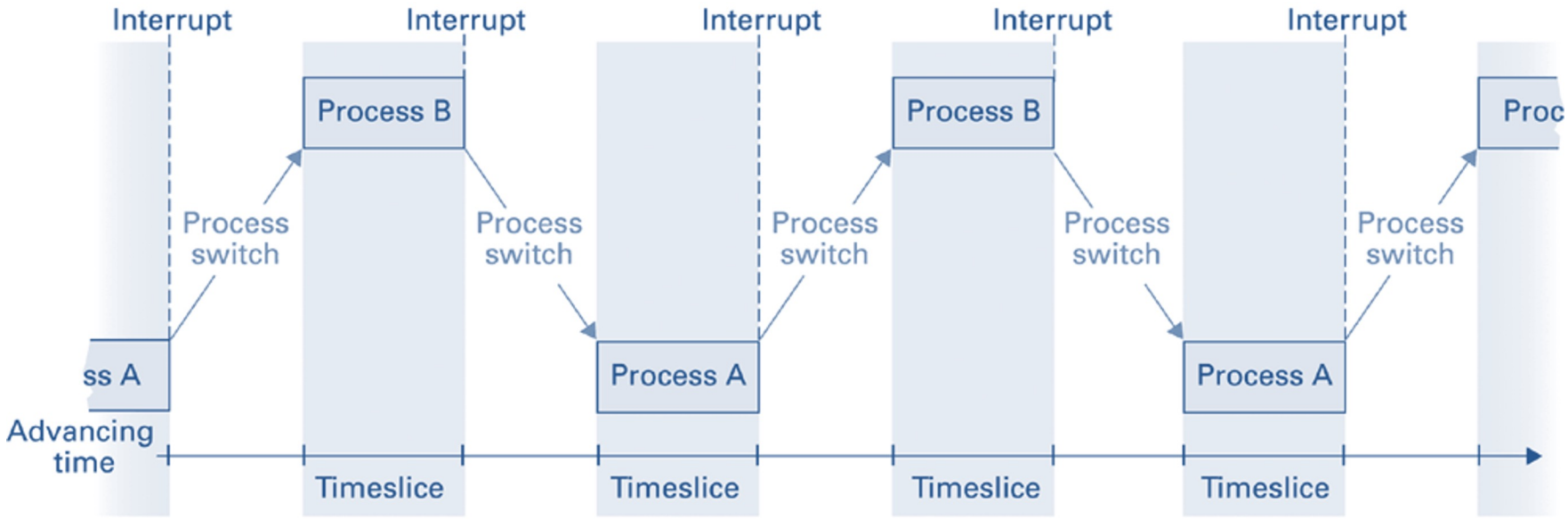
Processes

- **Process:** The activity of executing a program
- **Process State:** Current status of the activity
  - Program counter
  - General purpose registers
  - Related portion of main memory

Process Administration

- **Scheduler:** Adds new processes to the process table and removes completed processes from the process table
- **Dispatcher:** Controls the allocation of time slices to the processes in the process table
  - The end of a time slice is signaled by an interrupt.

Time-sharing



HANDLING COMPETITION FOR RESOURCES

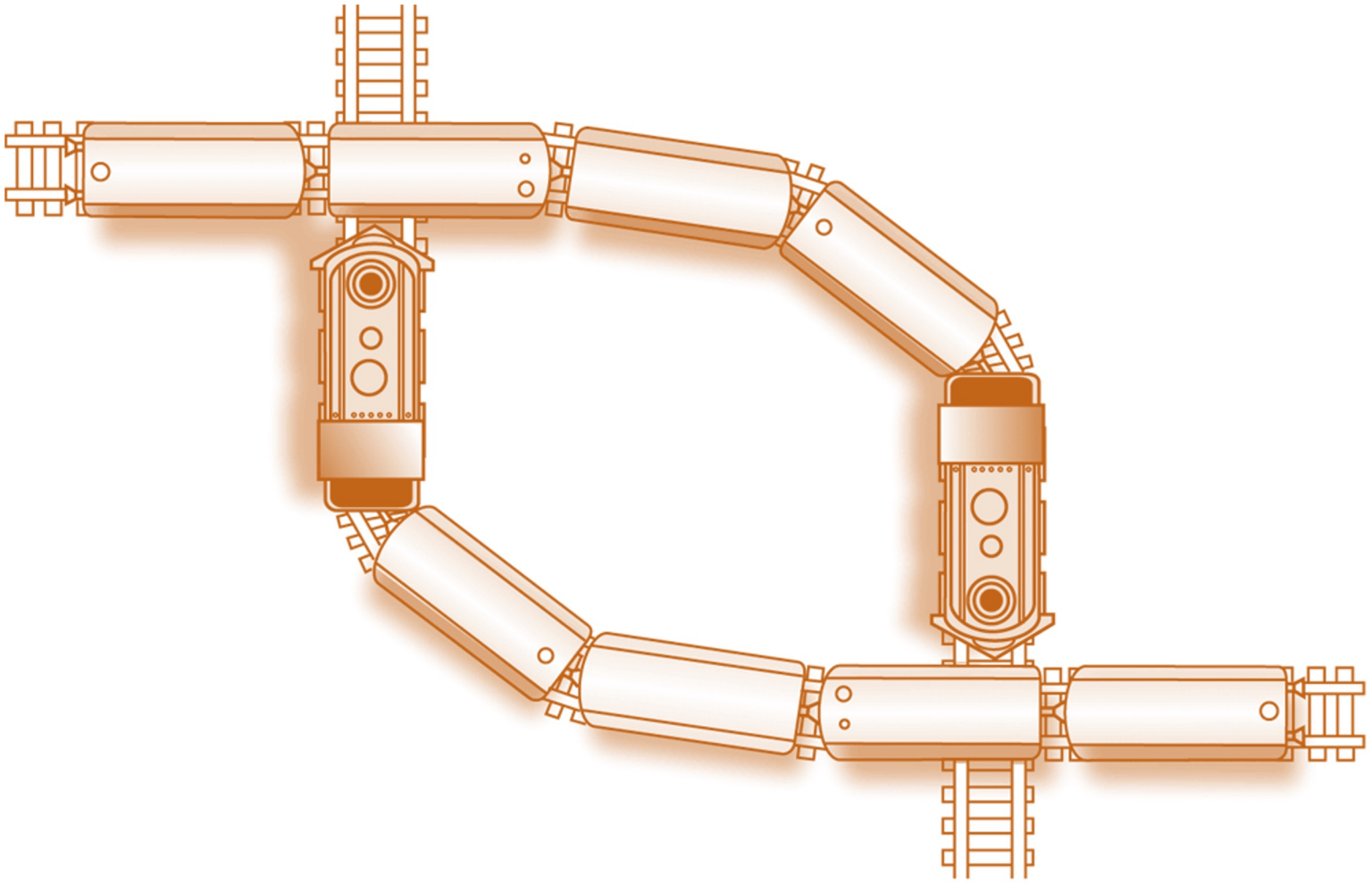
Handling Competition for Resources

- **Semaphore:** A “control flag”
- **Critical Region:** A group of instructions that should be executed by only one process at a time
- **Mutual exclusion:** Requirement for proper implementation of a critical region

Deadlock

- Processes block each other from continuing
- Conditions required for deadlock
  1. Competition for non-sharable resources
  2. Resources requested on a partial basis
  3. An allocated resource can not be forcibly retrieved

A deadlock resulting from competition for nonshareable railroad intersections

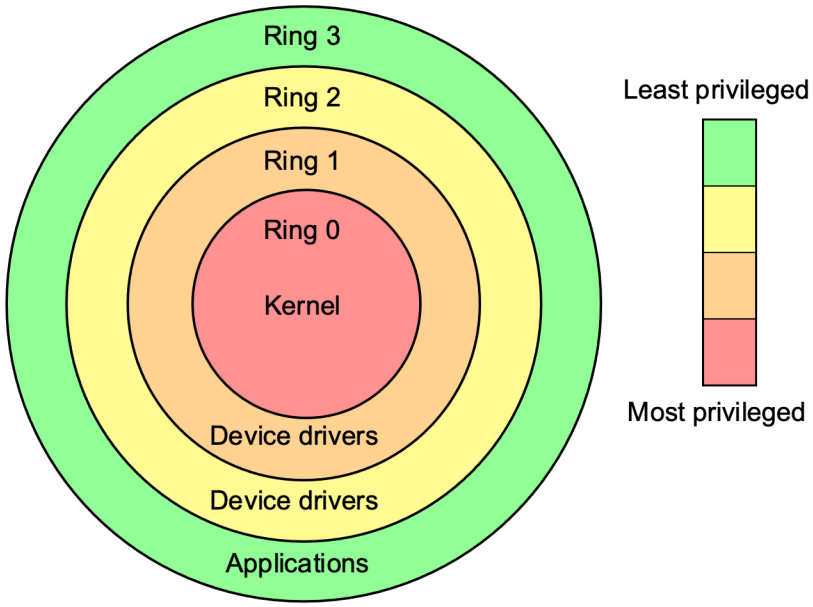


Security

- Attacks from outside
  - Problems
    - Insecure passwords
      - password cracker, network sniffer, Trojan horse login
    - Sniffing software
      - spyware, sniffing software
  - Counter measures
    - Auditing software

Security

- Attacks from within
  - Problem: Unruly processes
  - Counter measures: Control process activities via privileged modes and privileged instructions

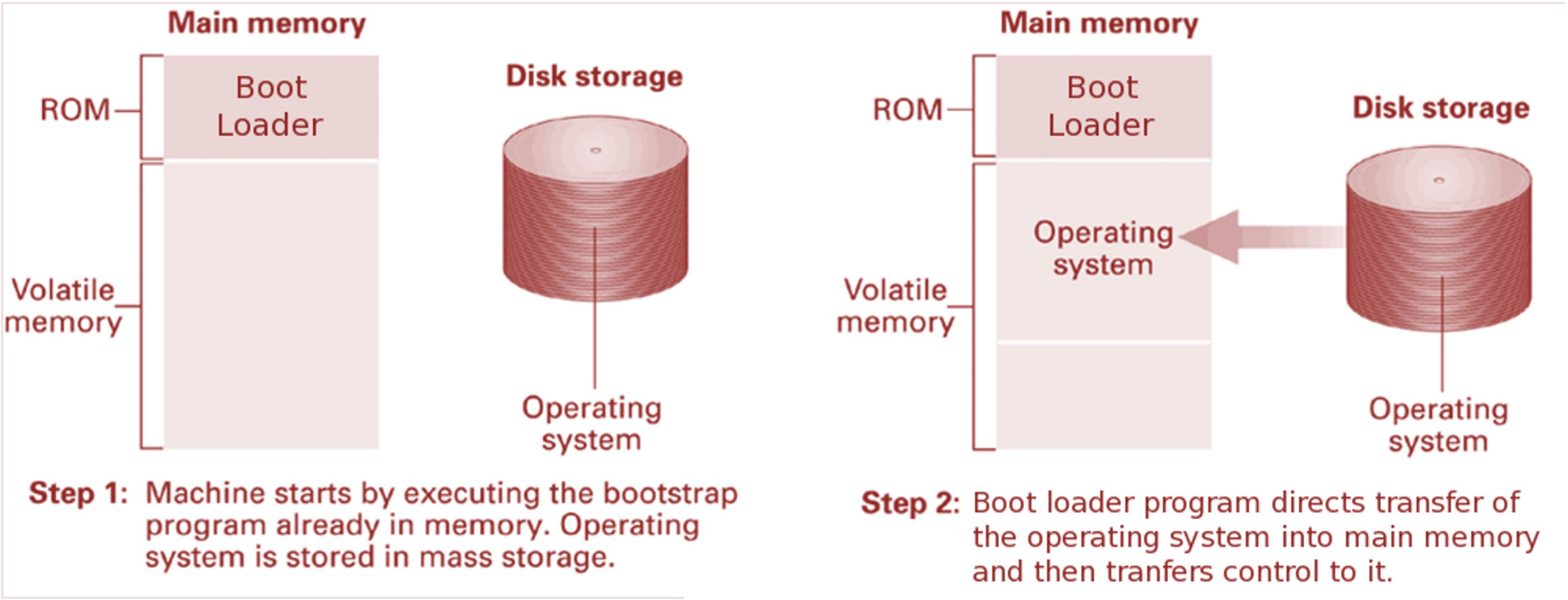


GETTING IT STARTED

Bootstrapping

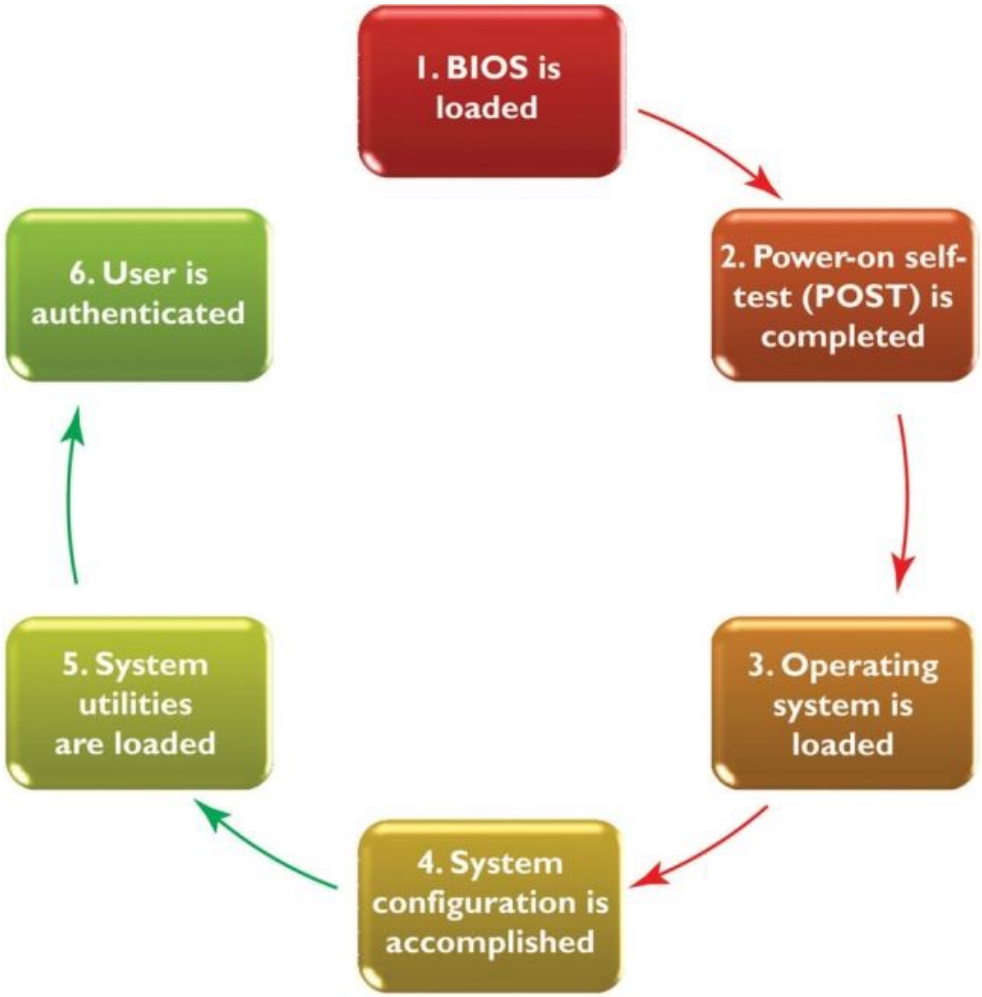
- **Boot loader:** Program in ROM (example of firmware)
  - Run by the CPU when power is turned on
  - Transfers operating system from mass storage to main memory
  - Executes jump to operating system
  - Cold boot: Starting computer when it has not yet been turned on
  - Warm boot: Restarting a computer that is already on

The booting process



The booting process

The Six Steps of Booting a System



The booting process

- **Step 1: Activate the BIOS and Setup Program**
  - BIOS (Basic Input Output System) instructions provide the computer with descriptions of the internal equipment
    - BIOS is encoded on ROM (read-only memory)
    - Does not control external devices
  - Adjustable energy settings
  - Setup program
    - Includes settings that control computer hardware
    - Do not alter—making incorrect changes to a BIOS device will cause the system not to boot

The booting process

- BIOS Settings
  - Change the Boot Order
  - Load BIOS Setup Defaults
  - Remove a BIOS Password
  - Create a BIOS Password
  - Change the Date and Time
  - Change Floppy Drive Settings
  - Change Hard Drive Settings
  - Change CD/DVD/BD Drive Settings
  - View Amount of Memory Installed
  - Change the Boot Up NumLock Status
  - Enable or Disable the Computer Logo
  - Enable or Disable the Quick Power On Self Test (POST)

The booting process

- **Step 2: Initiate the Power-On Self-Test**
  - Power-on self-test (POST)—to confirm that both the computer and its peripheral devices are working properly
  - If the POST fails:
    - A beep will sound.
    - An error message will appear on the monitor.
    - The computer will stop.

The booting process

- **Step 3: Load the Operating System**
  - BIOS
    - Looks for the operating system
    - Loads the kernel into memory—the central part of the operating system
  - The operating system loads the system configuration information.

The booting process

- **Step 4: Configure the System**
  - Operating system
    - Checks the registry
      - Database that stores information about software and peripherals choices, for configuration information
    - Checks the configuration for drivers
      - Utility programs containing instructions for the proper functioning of peripheral devices.
    - Automatically detects plug-and-play (PnP) devices
    - Checks for conflicts between devices
    - Installs and loads needed drivers

The booting process

- **Step 5: Load System Utilities**
  - Antivirus software
  - Speaker volume control
  - Power management options

The booting process

- **Step 6: Authenticate a User**
  - Verifies authorized users
    - Enter an authentication/login user name and password
  - Profile—a record of a specific user's preferences for the desktop theme, icons, and menu styles
  - Account—for multiuser computer systems each user has an account
    - Consists of user name, password, and storage space
    - Created by server/computer administrator