

# OPERATING SYSTEMS

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PROVIDED BY THE TEXTBOOK, **COMPUTER SCIENCE: AN  
OVERVIEW** BY J. GLENN BROOKSHEAR AND DENNIS BRYLOW

PUBLISHER PEARSON

# Contents

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

# Evolution of Shared Computing

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- Batch processing
- Interactive processing
  - Requires real-time processing
- Time-sharing/Multitasking
  - Implemented by Multiprogramming
- Multiprocessor machines
  - Load balancing
  - Scaling
- Embedded OS

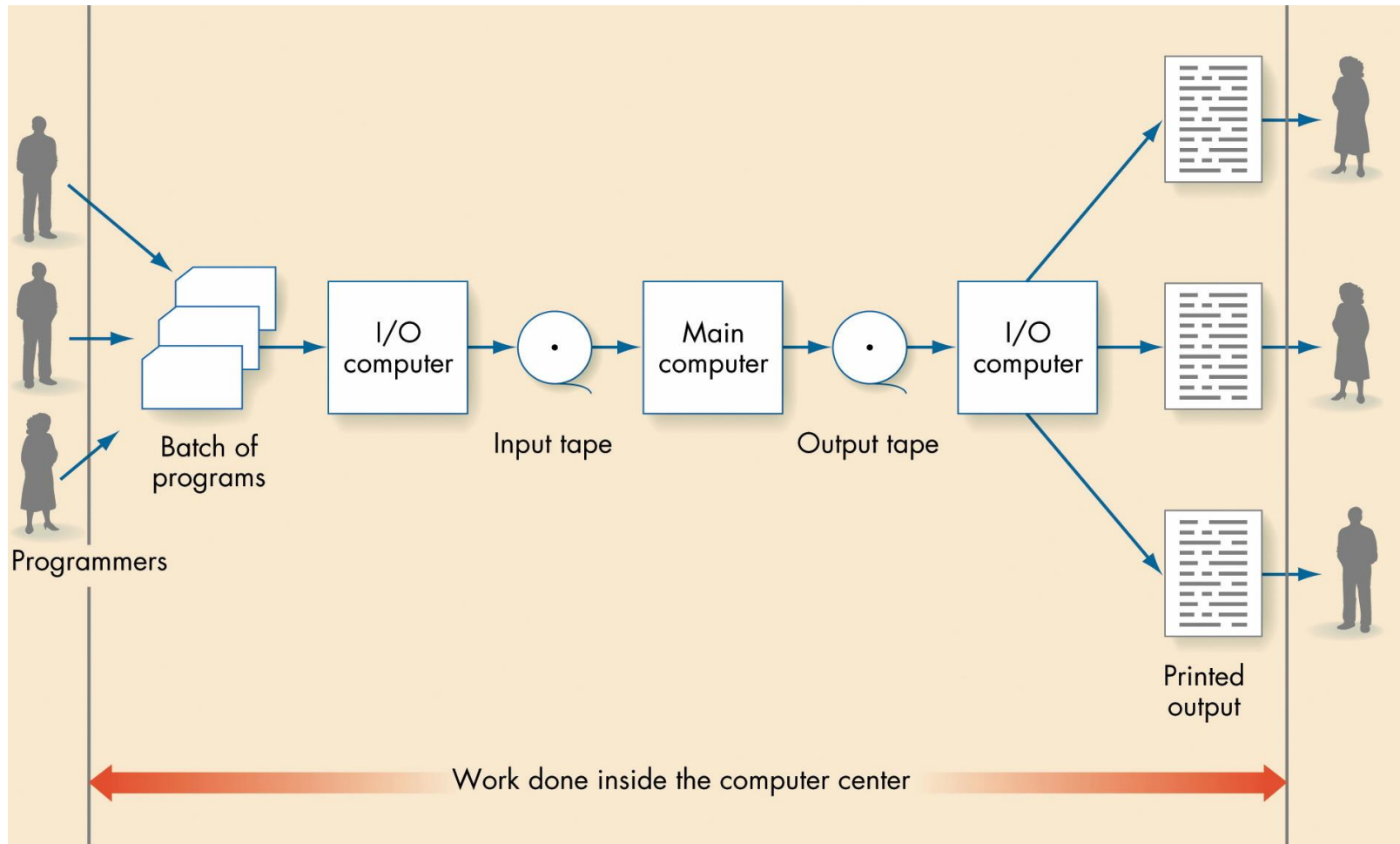
| GENERATION | APPROXIMATE DATES | MAJOR ADVANCES  |
|------------|-------------------|---|
| First      | 1945–1955         | No operating system available<br>Programmers operated the machine themselves  |
| Second     | 1955–1965         | Batch operating systems<br>Improved system utilization<br>Development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

# Batch processing

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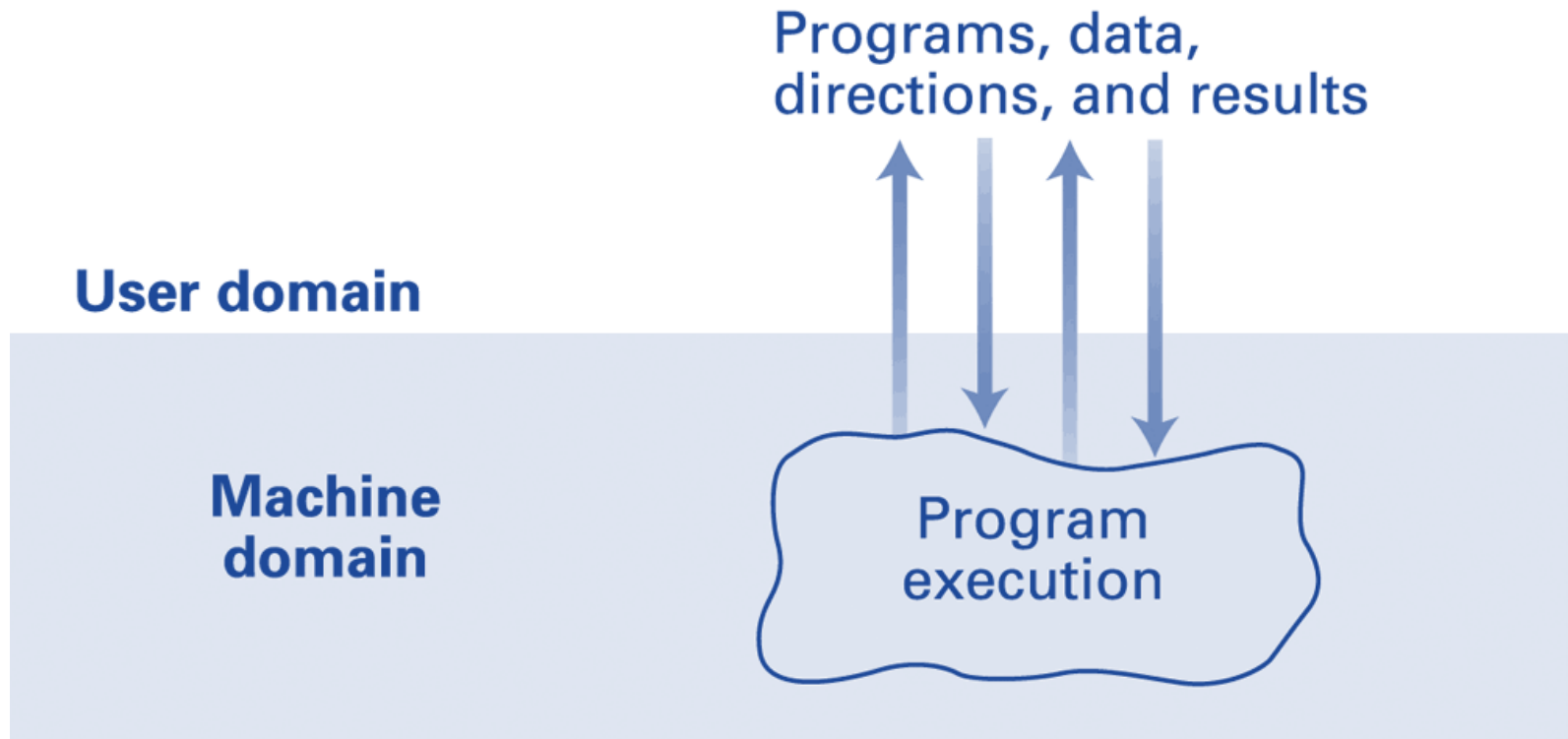


# Batch processing

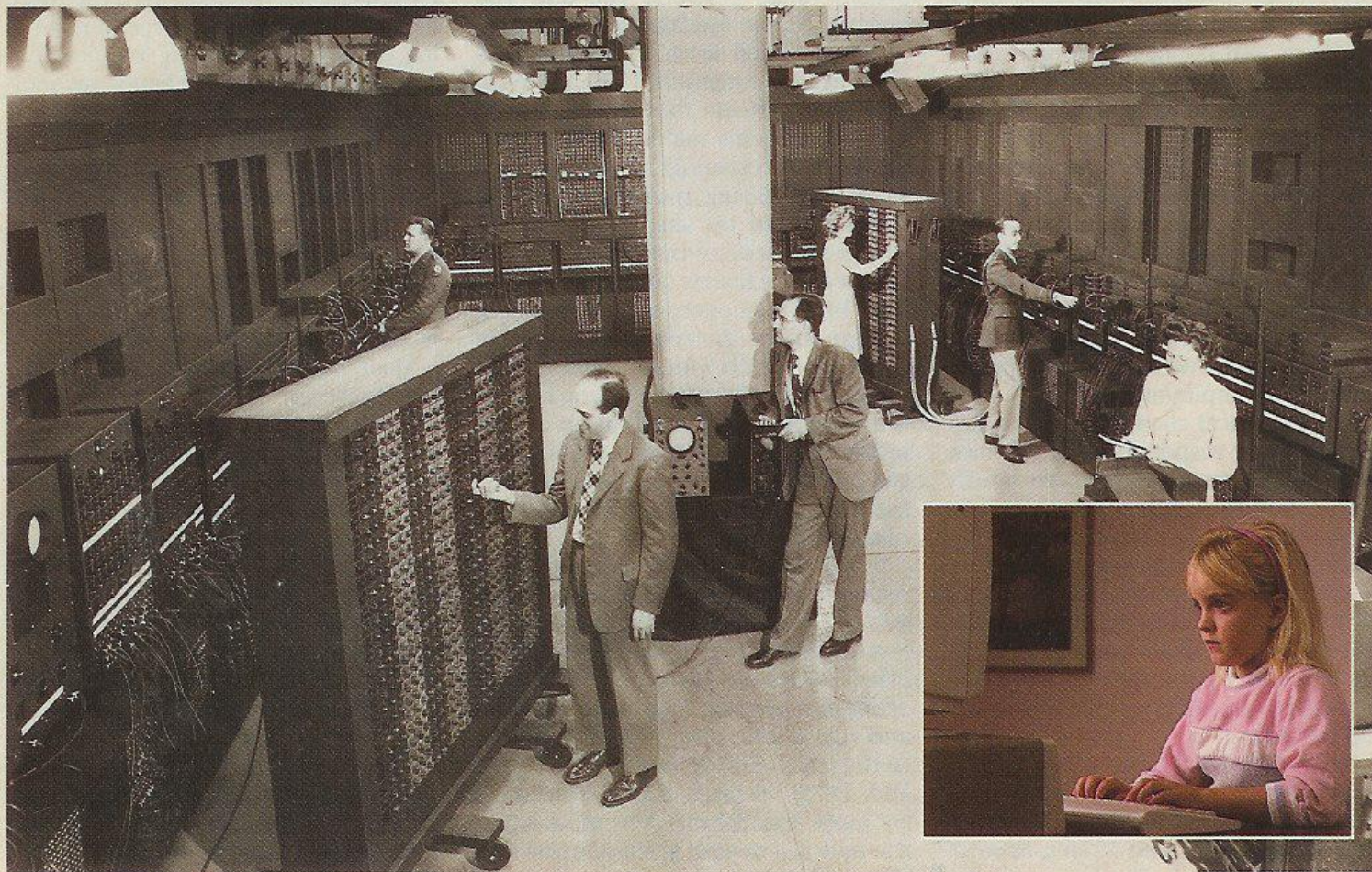


# Interactive processing

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TRAINING necessary to operate a computer has been drastically reduced as a result of advances in both hardware and software. Only highly trained operators could run the first

computers, which were developed some 40 years ago. Today's personal computers (which surpass those first machines in both memory and computing power) can be operated by a child.



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## CS Education Week

Recognizing the  
Transformative Role  
of Computing

Certified Software

A Conversation with  
Pixar's Ed Catmull

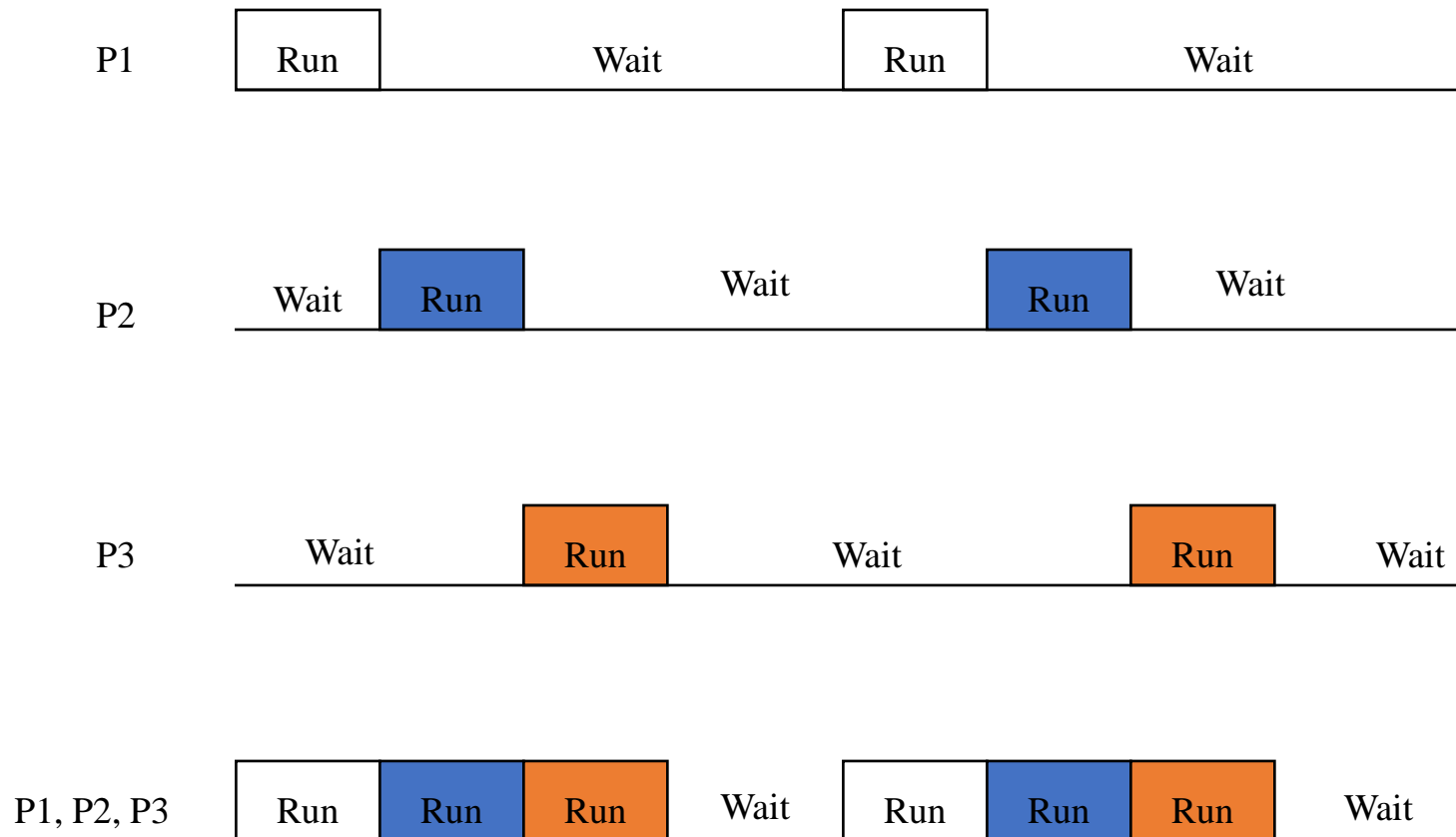
Bayesian Networks

The Theft of  
Business Innovation

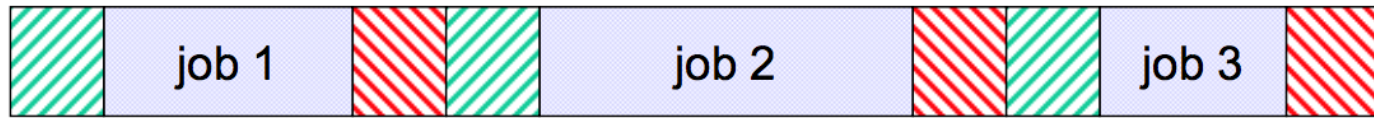


# Multi tasking processing

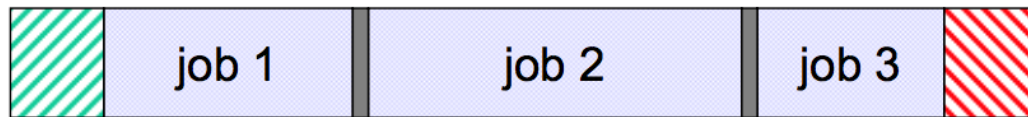
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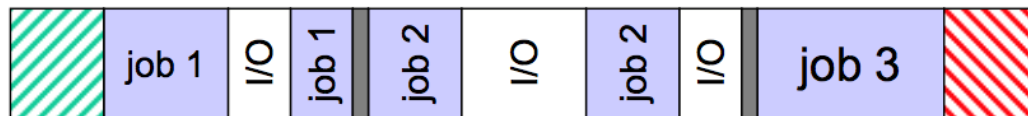
# Evolution of CPU Utilization



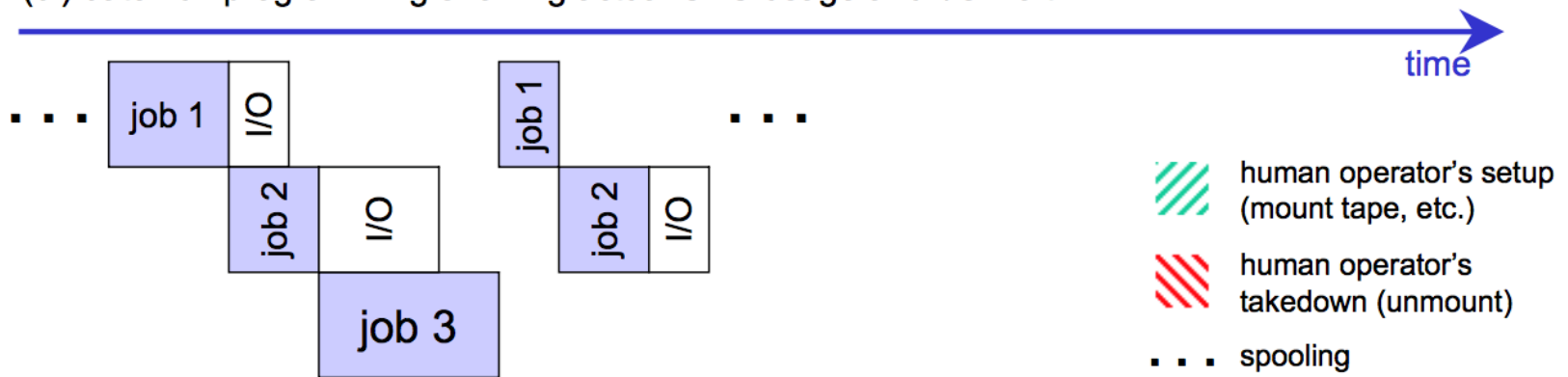
(a) serial uniprogramming



(b) batch uniprogramming



(b') batch uniprogramming showing actual CPU usage and I/O wait

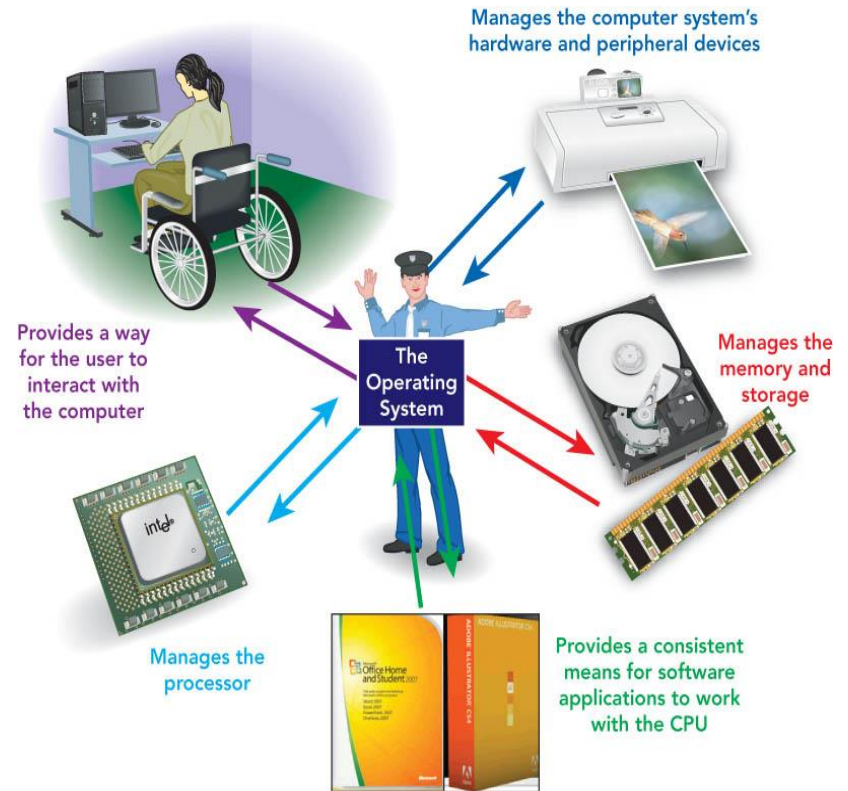


(c) multiprogramming

**Evolution of CPU utilization**

# 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



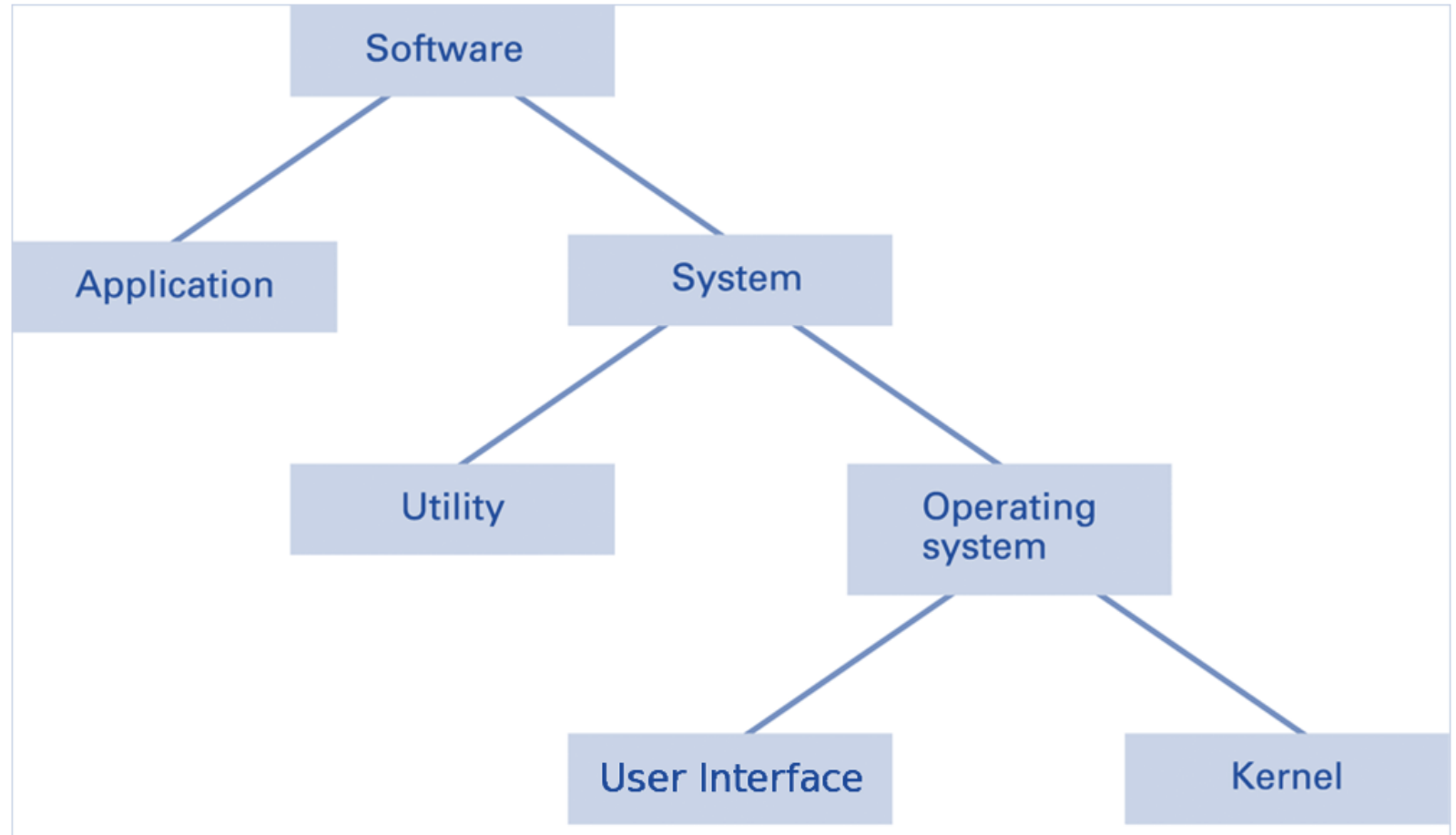
# Types of Software

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

# Software classification

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# System Software

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- 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)

# Operating System Components

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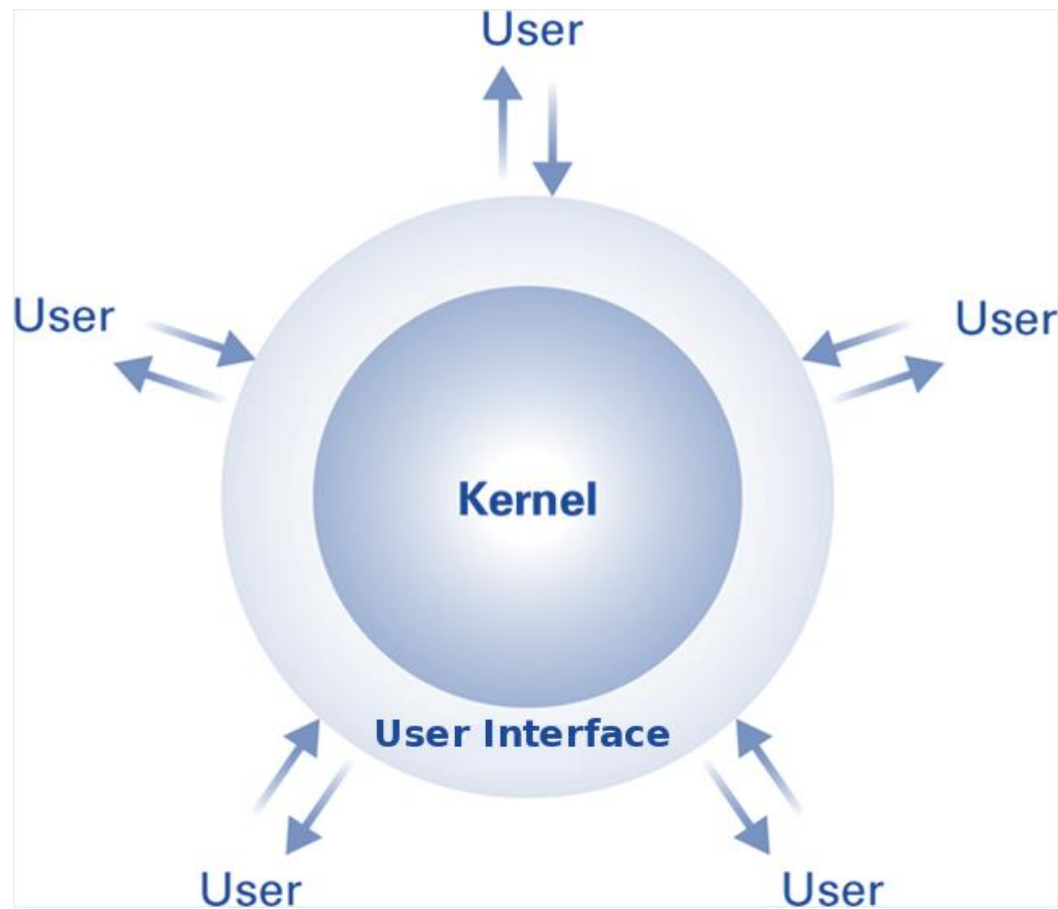
# Operating System Components

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- **User Interface:** Communicates with users
  - Text based (Shell)
  - Graphical user interface (GUI)
- **Kernel:** Performs basic required functions
  - File manager
  - Device drivers
  - Memory manager
  - Scheduler and dispatcher

# User - User interface - Kernel

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# Kernel - File Manager

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- **Directory (or Folder):** A user-created bundle of files and other directories (subdirectories)
- **Directory Path:** A sequence of directories within directories



# Kernel - File Manager

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- Searching for and managing files
  - File manager—utility software that organizes and manages data
    - Copy files
    - Determine how and where files are stored
    - Delete files
  - Search utility—enables you to locate files

# Kernel - Memory Manager

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- Allocates space in main memory
- May create the illusion that the machine has more memory than it actually does (**virtual memory**) by playing a “shell game” in which blocks of data (**pages**) are shifted back and forth between main memory and mass storage

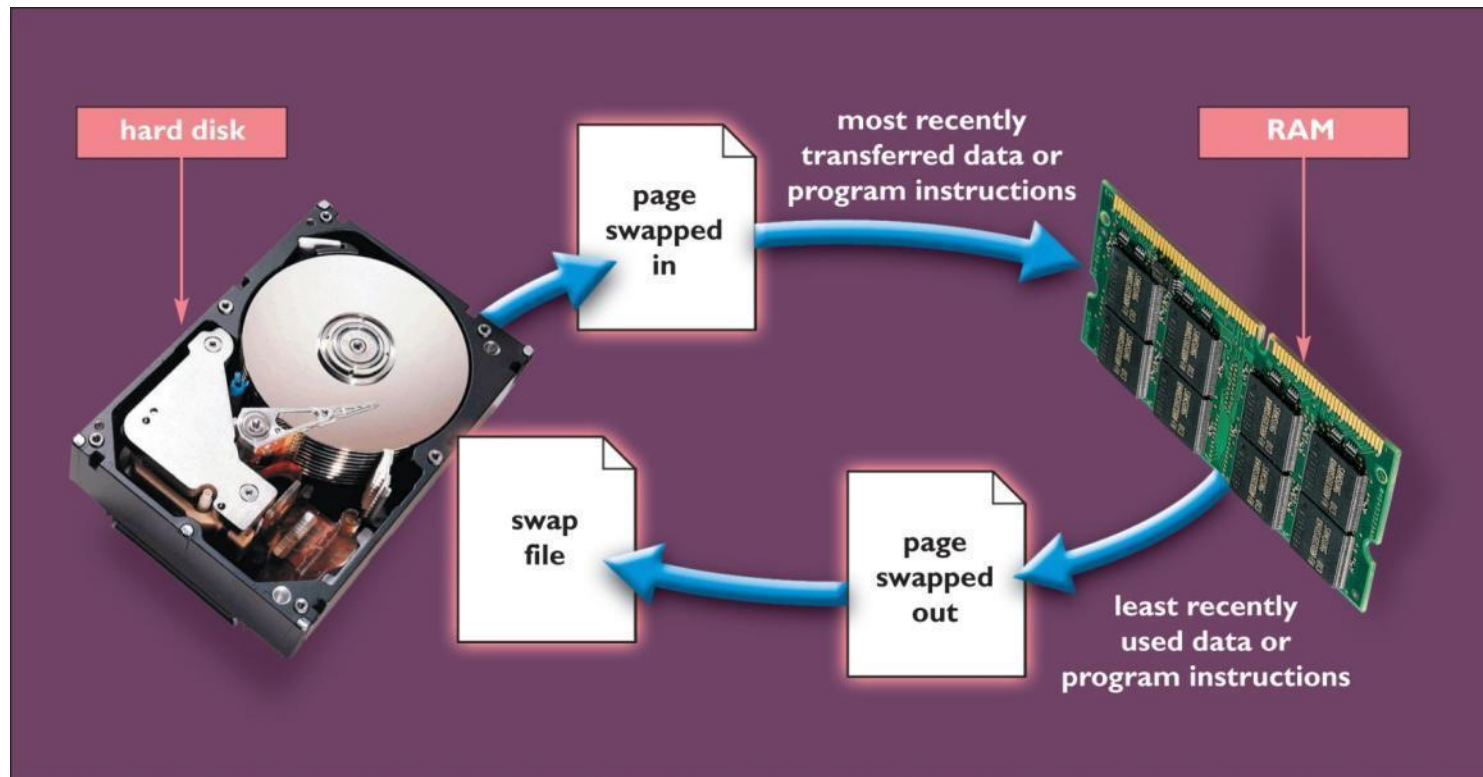
# Kernel - Memory Manager

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- Virtual memory—uses portion of hard disk to extend RAM
  - Pages—units of fixed size, contain program instructions and data
  - When RAM is full, copies of pages are temporarily stored in a swap file, a special hard disk file.
  - Transferring files between RAM and the hard disk—paging
  - Excessive paging—thrashing
  
- Adding more RAM—best way to improve computer performance:
  - Paging slows computer.
  - Accessing data from hard disk is slower than accessing from RAM.

# Kernel - Memory Manager

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# Getting It Started

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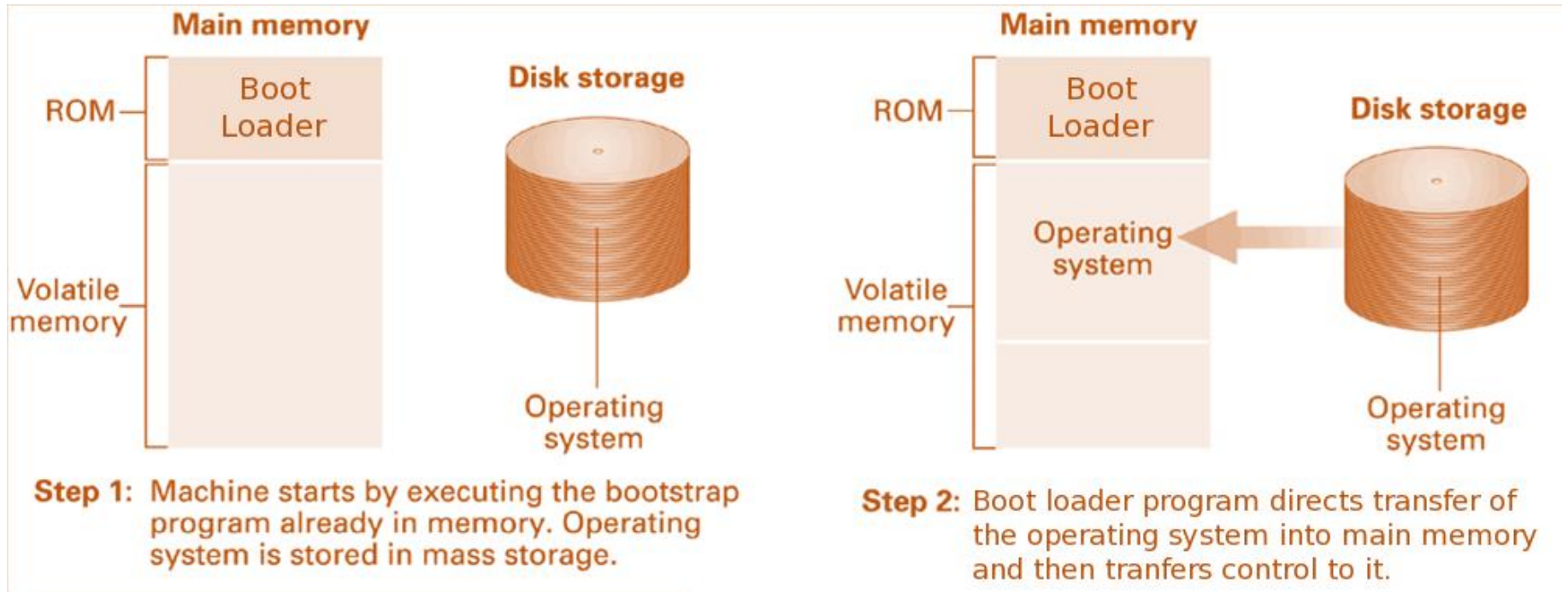
# Bootstrapping

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- **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



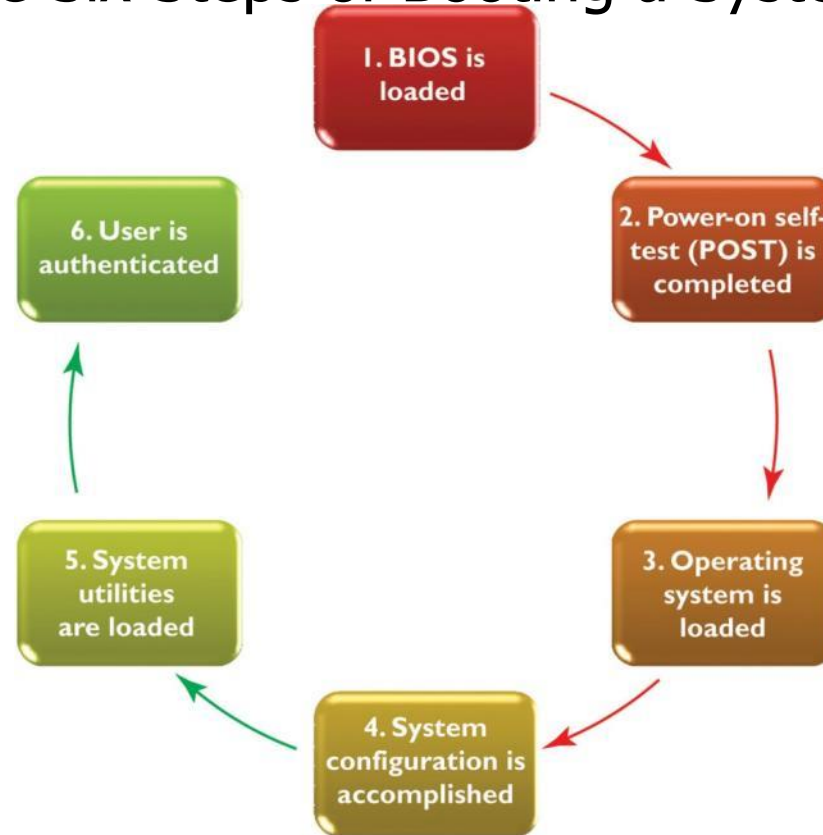
# The booting process



# The booting process

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## The Six Steps of Booting a System



# The booting process

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- **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

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## ■ 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

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- **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

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## ■ 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

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## ■ 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

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

# The booting process

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## ■ 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

# Coordinating machine's activities

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# Processes

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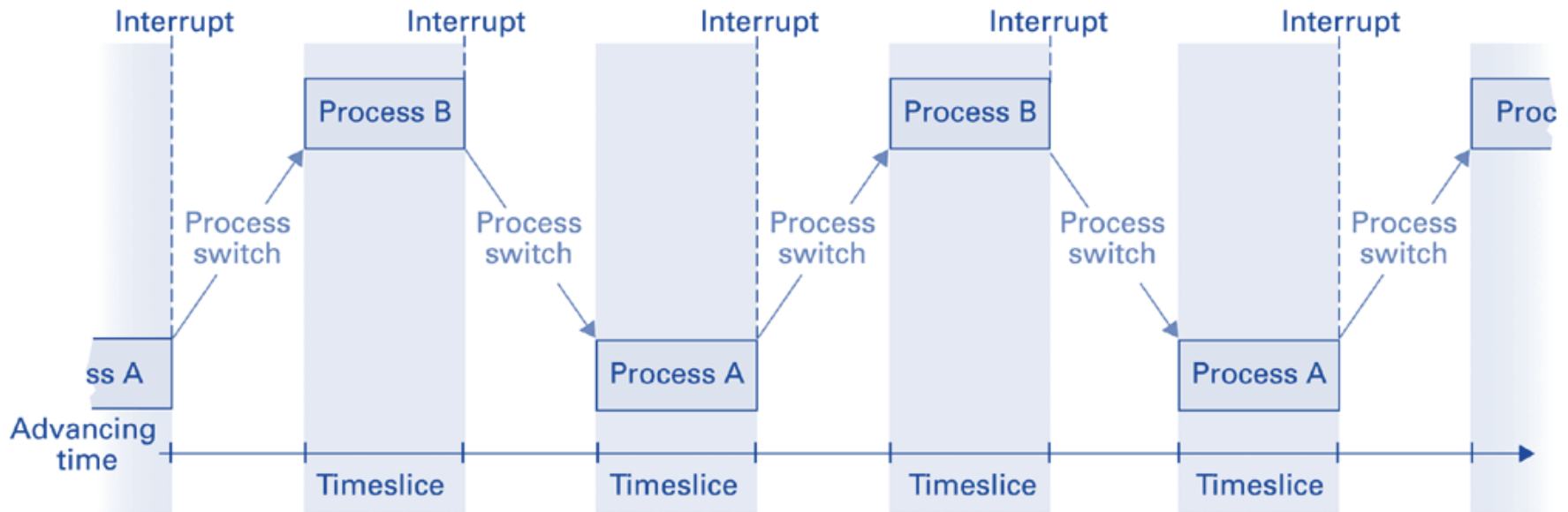
- **Process:** The activity of executing a program
- **Process State:** Current status of the activity
  - Program counter
  - General purpose registers
  - Related portion of main memory

# Process Administration

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- **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

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# Handling Competition for Resources

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- **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

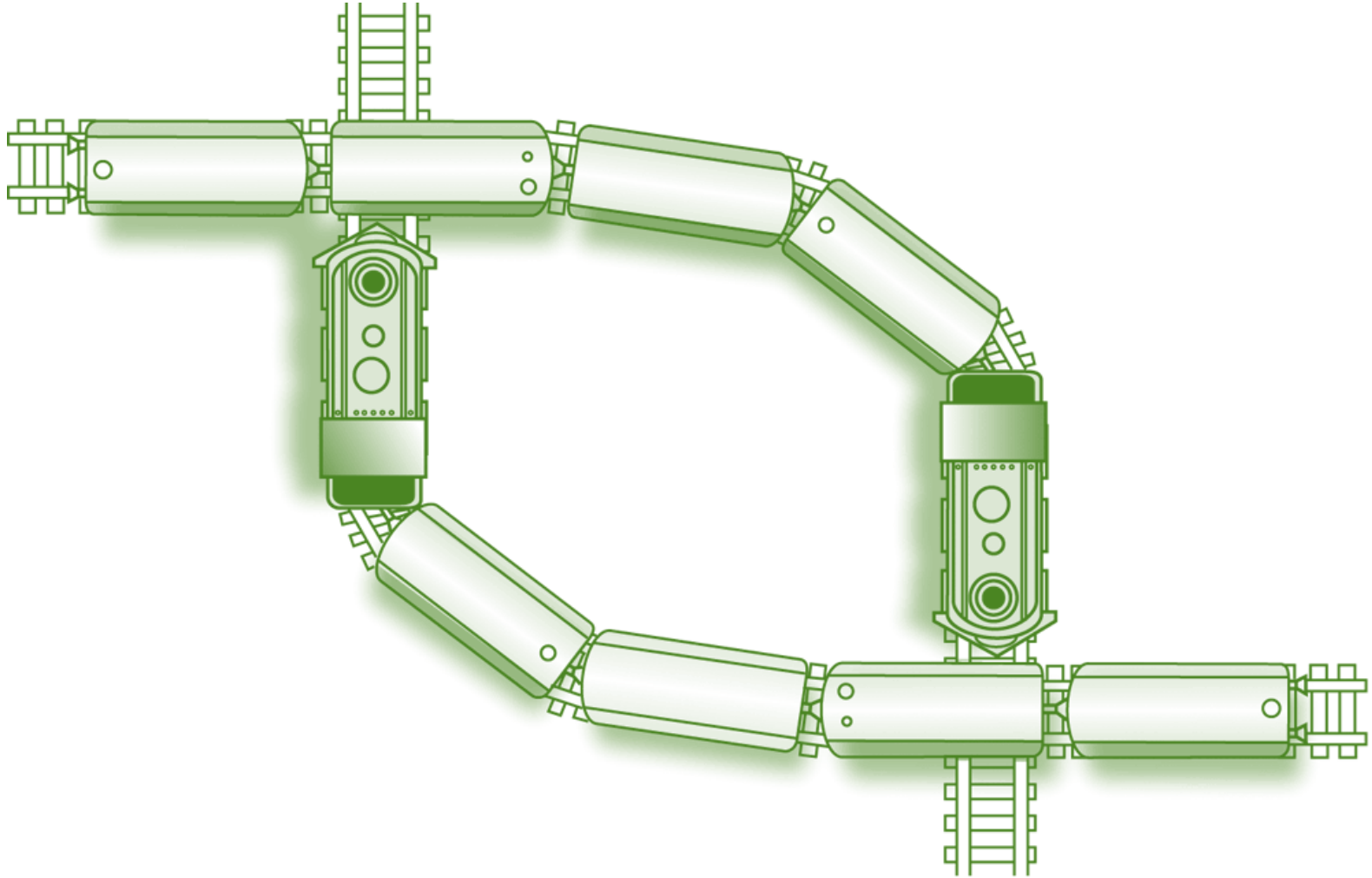
# Deadlock

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- 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

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# Security

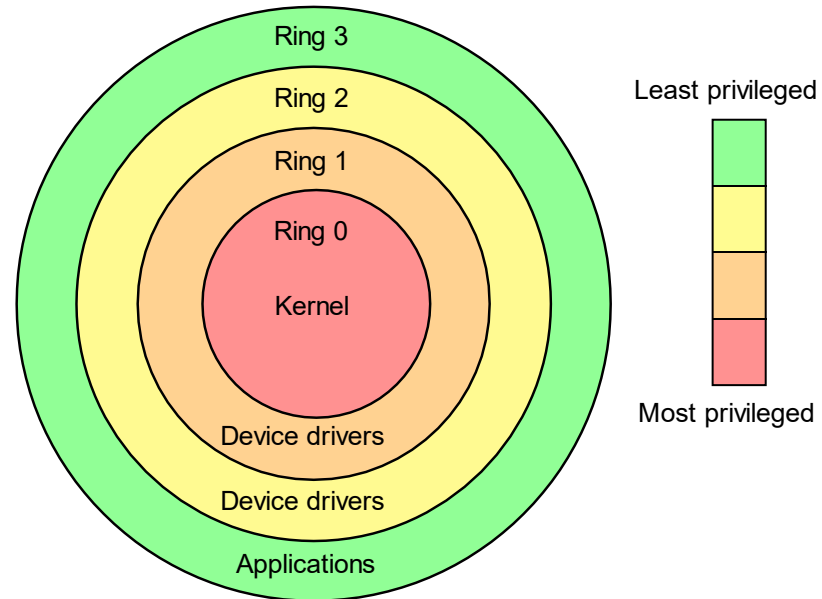
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- Attacks from outside
  - Problems
    - Insecure passwords
      - password cracker, network sniffer, Trojan horse login
    - Sniffing software
      - spyware, sniffing software
  - Counter measures
    - Auditing software

# Security

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



# Questions and Answers

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# Quiz

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Which OS is not designed for smartphones and PDAs?

- A. Android
- B. Mac OS
- C. Symbian
- D. Windows Mobile

# Quiz

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What utility program reduces a file size by as much as 80 percent by substituting short codes for lengthy data patterns?

- A. Defragmentation
- B. Compression
- C. Interrupt
- D. Cleanup



# Quiz

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Which of the following is an OS function?

- A. Creating letters
- B. Defragmenting a disk
- C. Managing memory
- D. Writing an e-mail

# Quiz

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Virtual memory is used when:

- A. booting fails.
- B. an IRQ conflict occurs.
- C. RAM is full.
- D. a power-on-self-test fails.

# Quiz

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Which test makes sure the computer and its peripherals are working correctly during the start-up process?

- A. BIOS
- B. Upgrade
- C. ReadyBoost
- D. POST

# Quiz

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Which of following are functions of the operating system?

- A. File management
- B. CPU management
- C. Task management
- D. Booting
- E. All of these

# Quiz

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Which of the following refers are specialized software programs that allow input and output devices to communicate with the rest of the computer system?

- A. Multitasking
- B. Boot-disks
- C. Utility programs
- D. Device drivers
- E. Service packs

# Quiz

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Which is the common consumer computer interface used today?

- A. command-line interface
- B. graphical user interface
- C. menu-driven interface
- D. electronic user interface
- E. biometric user interface

# Quiz

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Which type of software can you download and duplicate without any restrictions whatsoever and without fear of legal prosecution?

- A. commercial software
- B. shareware
- C. public-domain software
- D. pirated software
- E. rentalware

# Discussion

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# Discussion

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Choose one of these topics for discussion

1. Types of desktop OS?
2. Types of mobile OS?
3. Types of attacks on OS?