SNS COLLEGE OF TECHNOLOGY

Coimbatore-35
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DEPARTMENT OF INFORMATION TECHNOLOGY

23CST202 – Operating Systems

II YEAR - IV SEM

UNIT 1 – Overview and Process Management

TOPIC 1 – Basic Discussion

Syllabus

UNIT I OVERVIEW AND PROCESS MANAGEMENT 9

Introduction - Computer System Organization, Architecture, Operation, Process Management – Memory Management – Storage Management – Operating System – Process concept – Process scheduling – Operations on processes – Cooperating processes – Inter process communication. Threads - Multi-threading Models – Threading issues.

UNIT II PROCESS SCHEDULING AND SYNCHRONIZATION 10

CPU Scheduling - Scheduling criteria – Scheduling algorithms – Multiple-processor scheduling – Real time scheduling – Algorithm Evaluation. Process Synchronization - The critical-section problem – Synchronization hardware – Semaphores – Classical problems of synchronization. Deadlock - System model – Deadlock characterization – Methods for handling deadlocks – Deadlock prevention – Deadlock avoidance – Deadlock detection – Recovery from deadlock.

UNIT III MEMORY MANAGEMENT 9

Memory Management - Background – Swapping – Contiguous memory allocation – Paging – Segmentation – Segmentation with paging. Virtual Memory - Background – Demand paging – Process creation – Page replacement – Allocation of frames – Thrashing.

UNIT IV FILE SYSTEMS 8

File concept - Access methods – Directory structure – Files System Mounting – File Sharing – Protection. File System Implementation - Directory implementation – Allocation methods – Free-space management.

UNIT V I/O SYSTEMS 9

I/O Systems - I/O Hardware – Application I/O interface – Kernel I/O subsystem – Streams – Performance. Mass-Storage Structure: Disk scheduling – Disk management – Swap-space management – RAID – Disk attachment – Stable storage – Tertiary storage. Case study: Implementation of Distributed File system in Cloud OS / Mobile OS.

L :45 P:0 T: 45 PERIODS

Syllabus

TEXT BOOKS

1 Silberschatz, Galvin, and Gagne, “Operating System Concepts”, Tenth Edition, Wiley India Pvt Ltd, 2018.

2. Andrew S. Tanenbaum, “Modern Operating Systems”, Fourth Edition, Pearson Education, 2010.

REFERENCES

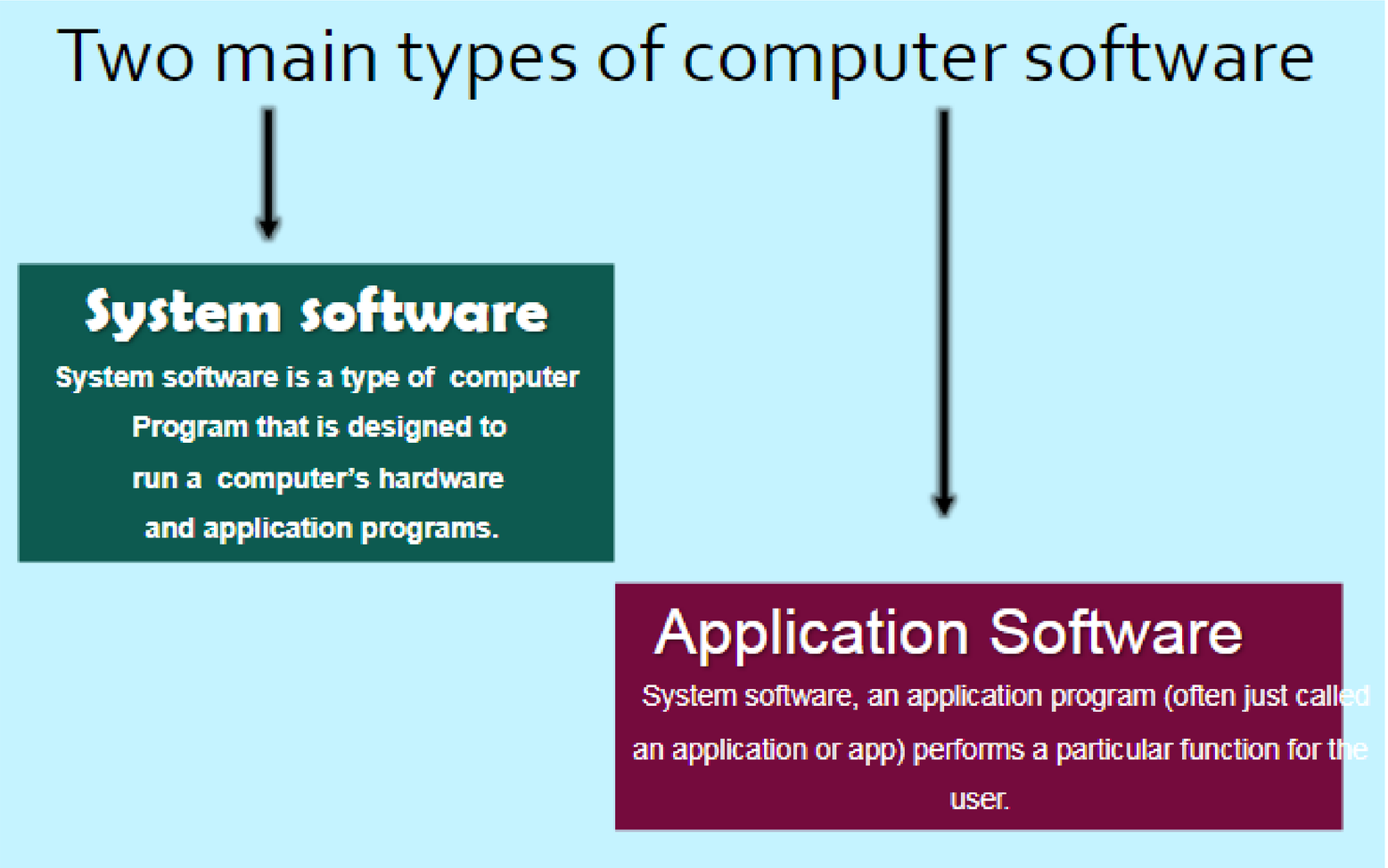
1 Gary Nutt, “Operating Systems”, Third Edition, Pearson Education, 2004.

2 Harvey M. Deitel, “Operating Systems”, Third Edition, Pearson Education, 2004.

3 Abraham Silberschatz, Peter Baer Galvin and Greg Gagne, “Operating System Concepts”, 9th Edition, John Wiley and Sons Inc., 2012.

4 William Stallings, “Operating Systems – Internals and Design Principles”, 7th Edition, Prentice Hall, 2011.

BASIC INTRODUCTION TO OPERATING SYSTEMS



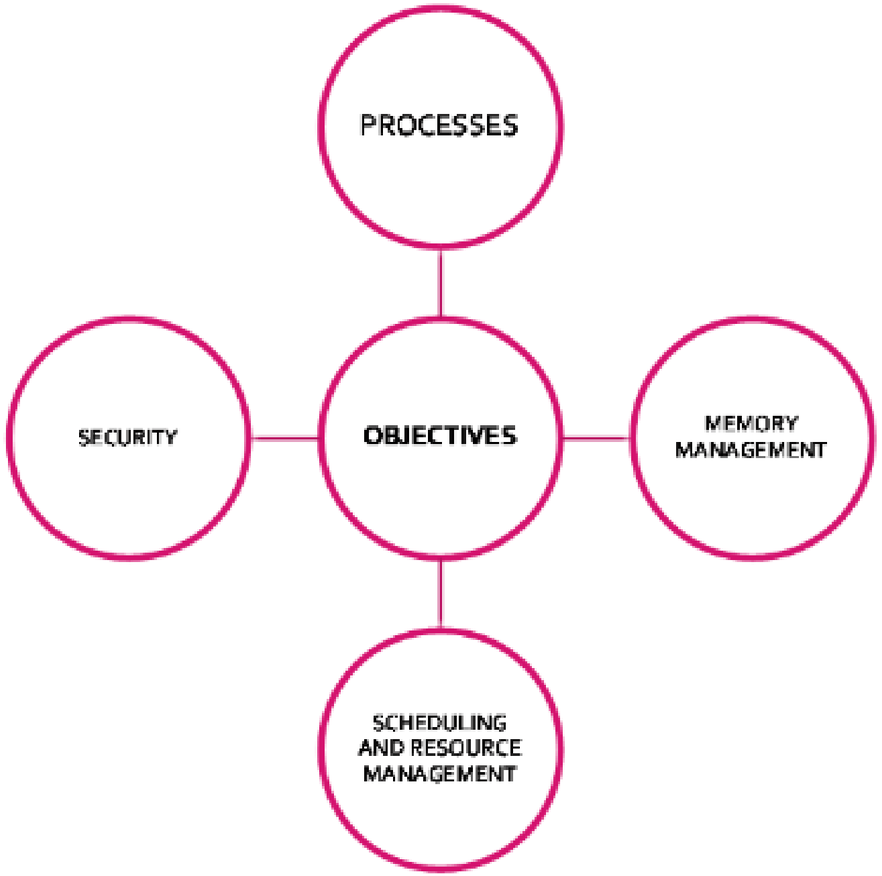
BASIC INTRODUCTION TO OPERATING SYSTEMS

Introduction : OS (Operating System)

An operating system (OS) is system software that manages computer hardware and software resources and provides services for computer programs.

BASIC INTRODUCTION TO OPERATING SYSTEMS

OBJECTIVES AND FUNCTIONS OF AN OPERATING SYSTEM



BASIC INTRODUCTION TO OPERATING SYSTEMS

SINGLE TASKING AND MULTI TASKING

Single Tasking : A single-tasking system can only run one program at a time,

Multi-Tasking : Multi-tasking operating system allows more than one program to be running in concurrency.

How multi-tasking works ??

This is achieved by time-sharing, dividing the available processor time between multiple processes which are each interrupted repeatedly in time-slices by a task scheduling subsystem of the operating system.

BASIC INTRODUCTION TO OPERATING SYSTEMS

SINGLE USER AND MULTI USER

Single User : Single-user operating systems have no facilities to distinguish users, but may allow multiple programs to run at the same time.

Multi User : A multi-user operating system extends the basic concept of multi-tasking with facilities that identify processes and resources, such as disk space, belonging to multiple users, and the system permits multiple users to interact with the system at the same time.

BASIC INTRODUCTION TO OPERATING SYSTEMS

Distributed OS

A distributed operating system manages a group of distinct computers and makes them appear to be a single computer. The development of networked computers that could be linked and communicate with each other gave rise to distributed computing. Distributed computations are carried out on more than one machine. When computers in a group work in cooperation, they form a distributed system

BASIC INTRODUCTION TO OPERATING SYSTEMS

Embedded

Embedded operating systems are designed to be used in embedded computer systems. They are designed to operate on small machines like PDAs with less autonomy. They are able to operate with a limited number of resources. They are very compact and extremely efficient by design.

Computer System Organization

Operating System

- A program that acts as an intermediary between a user of a computer and the computer hardware
- OS is a **resource allocator**
  - Manages all resources (OS as a government allegory)
  - Decides between conflicting requests for efficient and fair resource use
- OS is a **control program**
  - Controls execution of programs to prevent errors and improper use of the computer
- **Operating system goals:**
  - Execute user programs and make solving user problems **easier**
  - Make the computer system **convenient** to use
  - Use the computer hardware in an **efficient** manner

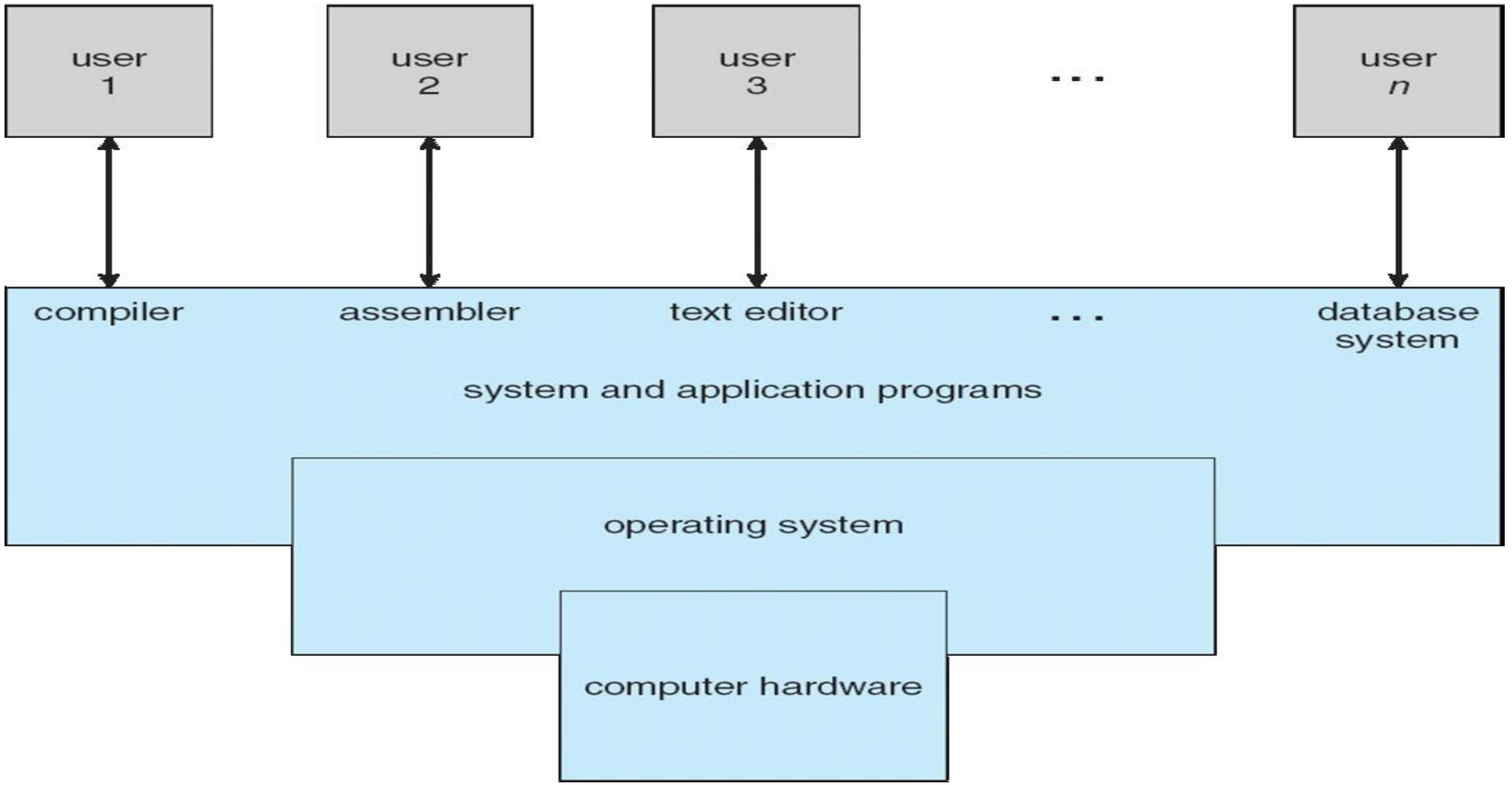
Computer System Organization

Computer System Components

- 1. **Hardware** – provides basic computing resources (CPU, memory, I/O devices).
- 2. **Operating system** – controls and coordinates the use of the hardware among the various application programs for the various users.
- 3. **Applications programs** – define the ways in which the system resources are used to solve the computing problems of the users (compilers, database systems, video games, business programs).
- 4. **Users** (people, machines, other computers).

Computer System Organization

Abstract View of System Components



Operating System Definitions

- Resource allocator – manages and allocates resources.
- Control program – controls the execution of user programs and operations of I/O devices .
- Kernel – the one program running at all times (all else being application programs).

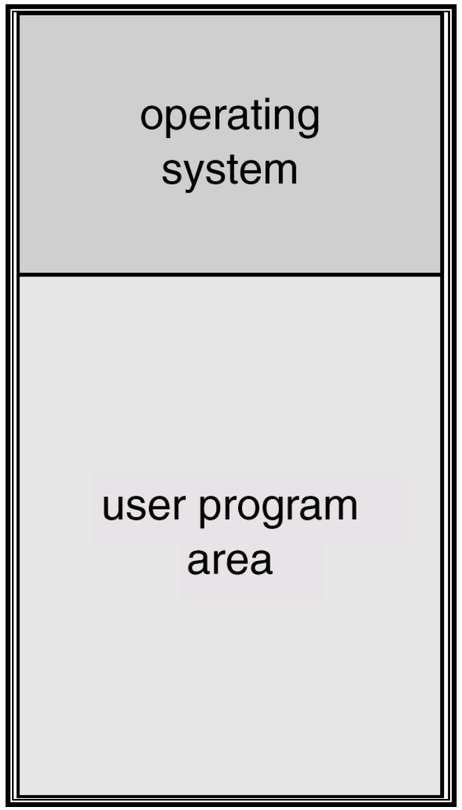
BASIC INTRODUCTION TO OPERATING SYSTEMS

Mainframe Systems

- Reduce setup time by batching similar jobs
- Automatic job sequencing – automatically transfers control from one job to another. First rudimentary operating system.
- Resident monitor
  - initial control in monitor
  - control transfers to job
  - when job completes control transfers pack to monitor

BASIC INTRODUCTION TO OPERATING SYSTEMS

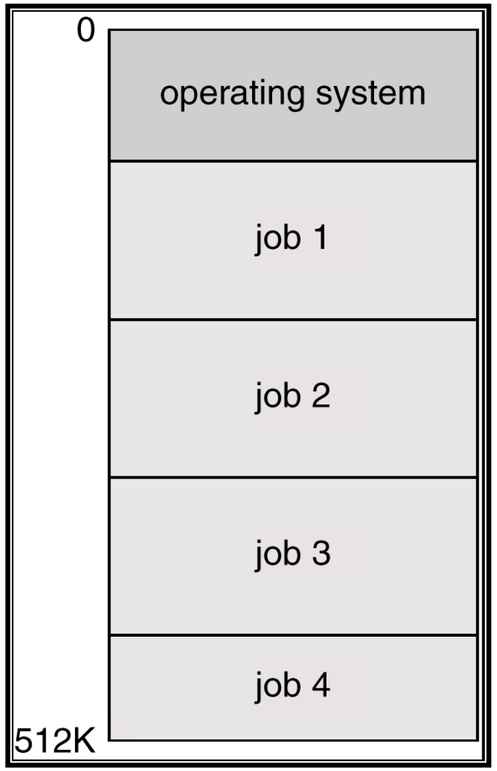
Memory Layout for a Simple Batch System



BASIC INTRODUCTION TO OPERATING SYSTEMS

Multiprogrammed Batch Systems

Several jobs are kept in main memory at the same time, and the CPU is multiplexed among them.



BASIC INTRODUCTION TO OPERATING SYSTEMS

OS Features Needed for Multiprogramming

- I/O routine supplied by the system.
- Memory management – the system must allocate the memory to several jobs.
- CPU scheduling – the system must choose among several jobs ready to run.
- Allocation of devices.

BASIC INTRODUCTION TO OPERATING SYSTEMS

Desktop Systems

- *Personal computers* – computer system dedicated to a single user.
- I/O devices – keyboards, mice, display screens, small printers.
- User convenience and responsiveness.
- Can adopt technology developed for larger operating system' often individuals have sole use of computer and do not need advanced CPU utilization of protection features.
- May run several different types of operating systems (Windows, MacOS, UNIX, Linux)

BASIC INTRODUCTION TO OPERATING SYSTEMS

Parallel Systems

- Multiprocessor systems with more than on CPU in close communication.
- Tightly coupled system – processors share memory and a clock; communication usually takes place through the shared memory.
- Advantages of parallel system:
- Increased throughput
- Economical
- Increased reliability
  - –graceful degradation
  - –fail-soft systems

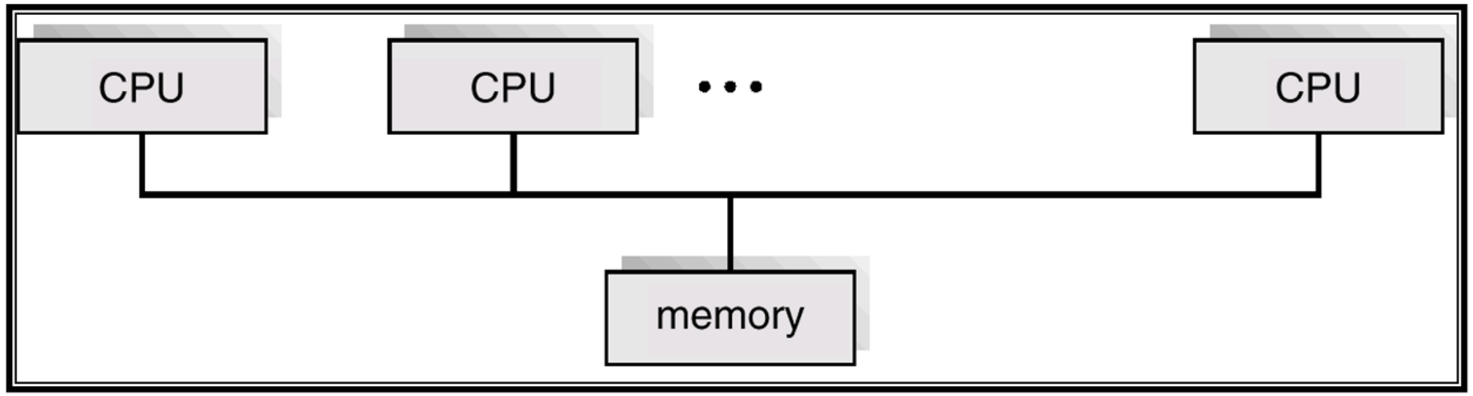
BASIC INTRODUCTION TO OPERATING SYSTEMS

Parallel Systems

- Symmetric multiprocessing (SMP)
  - –Each processor runs and identical copy of the operating system.
  - –Many processes can run at once without performance deterioration.
  - –Most modern operating systems support SMP
- Asymmetric multiprocessing
  - –Each processor is assigned a specific task; master processor schedules and allocated work to slave processors.
  - –More common in extremely large systems

BASIC INTRODUCTION TO OPERATING SYSTEMS

Symmetric Multiprocessing Architecture



BASIC INTRODUCTION TO OPERATING SYSTEMS

Distributed Systems

- Distribute the computation among several physical processors.
- Loosely coupled system – each processor has its own local memory; processors communicate with one another through various communications lines, such as high-speed buses or telephone lines.
- Advantages of distributed systems.
  - –Resources Sharing
  - –Computation speed up – load sharing
  - –Reliability
  - –Communications

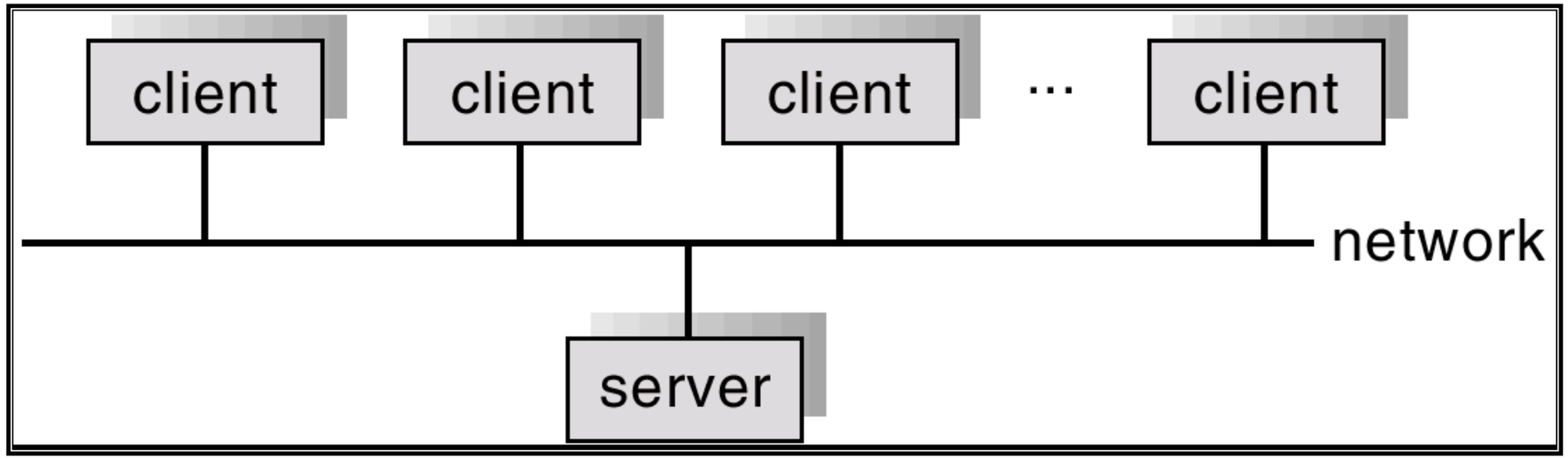
BASIC INTRODUCTION TO OPERATING SYSTEMS

Distributed Systems

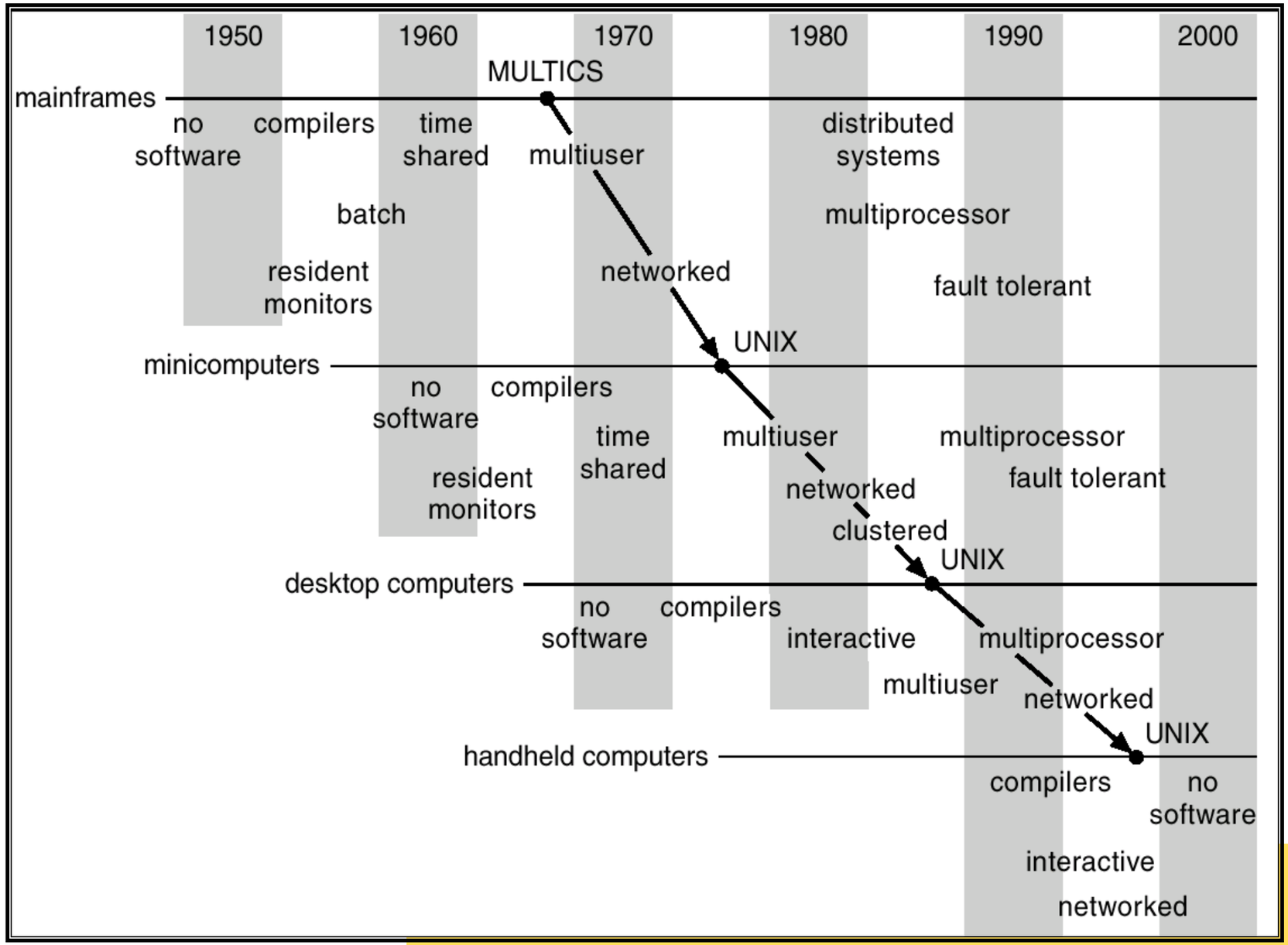
- Requires networking infrastructure.
- Local area networks (LAN) or Wide area networks (WAN)
- May be either client-server or peer-to-peer systems.

BASIC INTRODUCTION TO OPERATING SYSTEMS

General Structure of Client-Server



Migration of Operating-System Concepts and Features



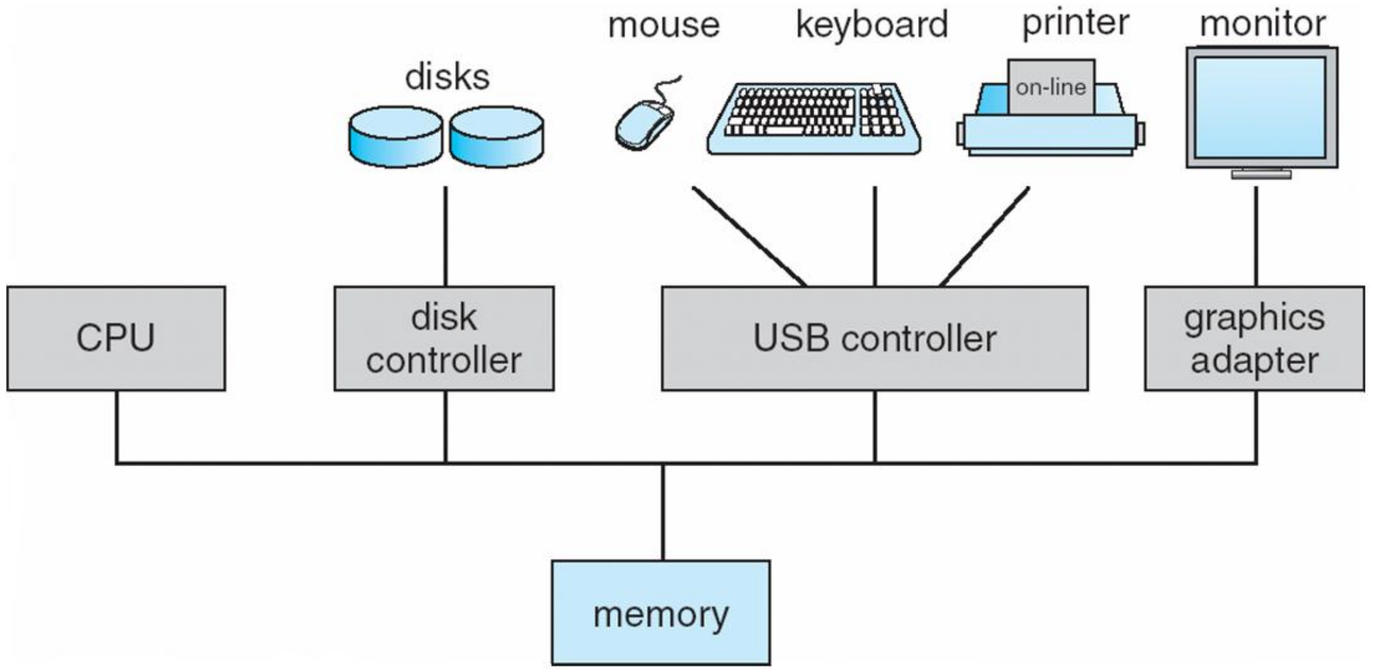
Computer Startup

bootstrap program is loaded at power-up or reboot

- Typically stored in ROM or EPROM, generally known as **firmware**
- Initializes all aspects of system (CPU registers, device controllers, memory contents, etc.)
- Loads operating system kernel and starts execution

Computer System Organization

- Computer-system operation
  - One or more CPUs, device controllers connect through common bus providing access to shared memory



Computer System Architecture

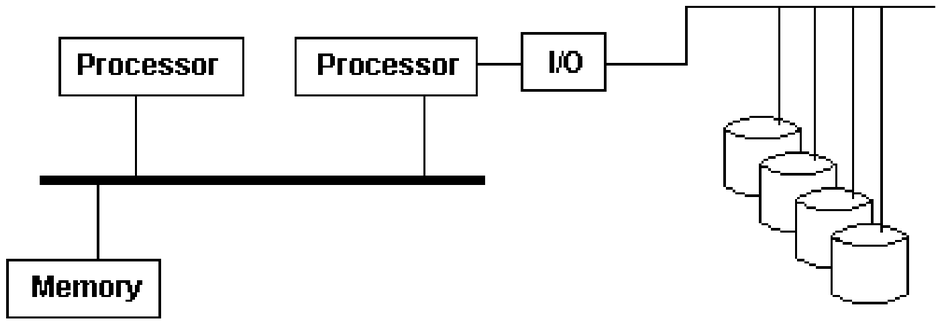
- Most systems use a single general-purpose processor

  – Most systems have special-purpose processors as well

- Multiprocessors systems (two or more processors in close communication, sharing bus and sometimes clock and memory) growing in use and importance
  – Also known as parallel systems, tightly-coupled systems
  – Advantages include
    1. Increased throughput
    2. Economy of scale
    3. Increased reliability – graceful degradation or fault tolerance

Computer System Architecture

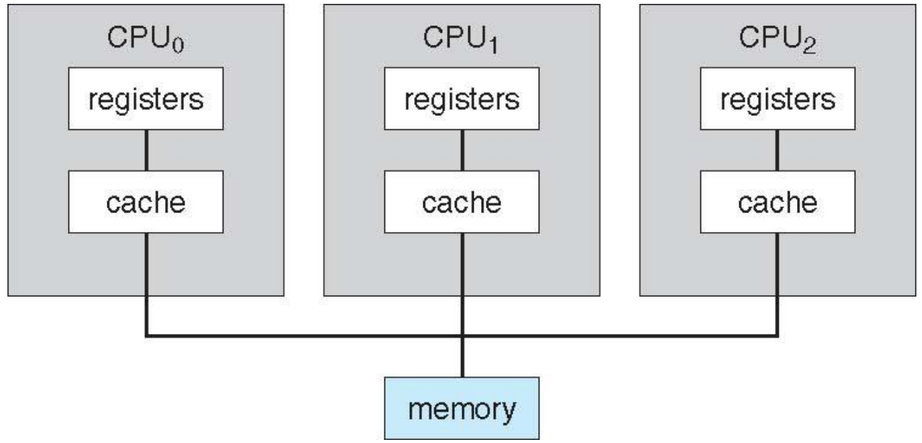
Key role – the scheduler



Multiprocessors systems

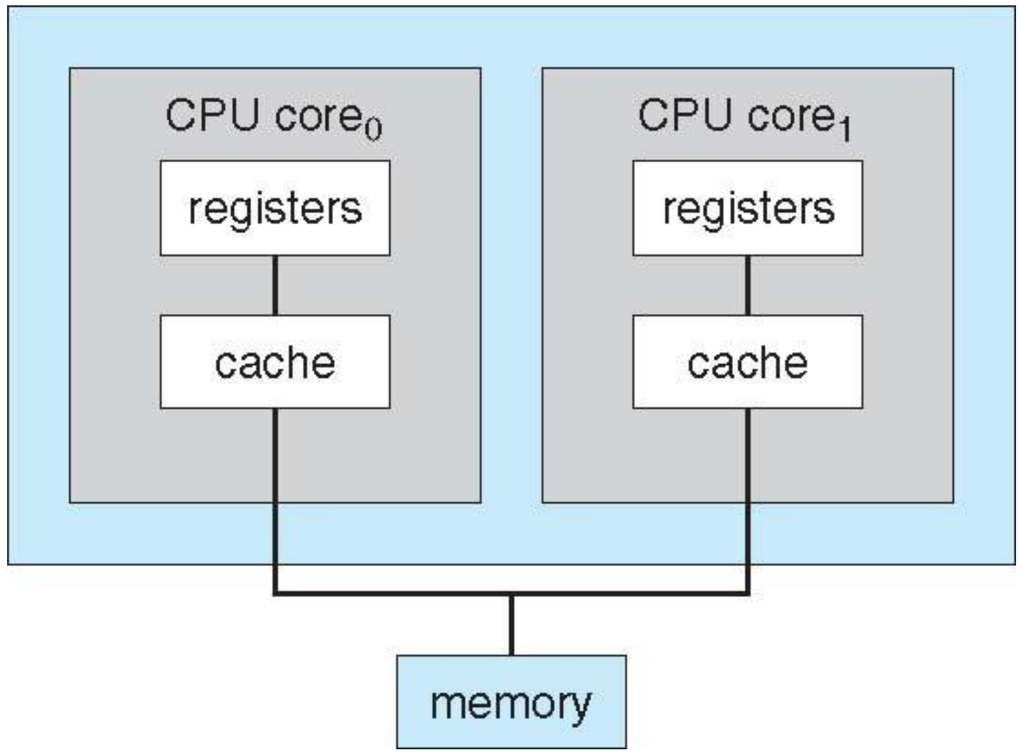
– Two types of Multiprocessing:

1. Asymmetric Multiprocessing - assigns certain tasks only to certain processors. In particular, only one processor may be responsible for handling all of the interrupts in the system or perhaps even performing all of the I/O in the system
2. Symmetric Multiprocessing - treats all of the processing elements in the system identically



Computer System Architecture

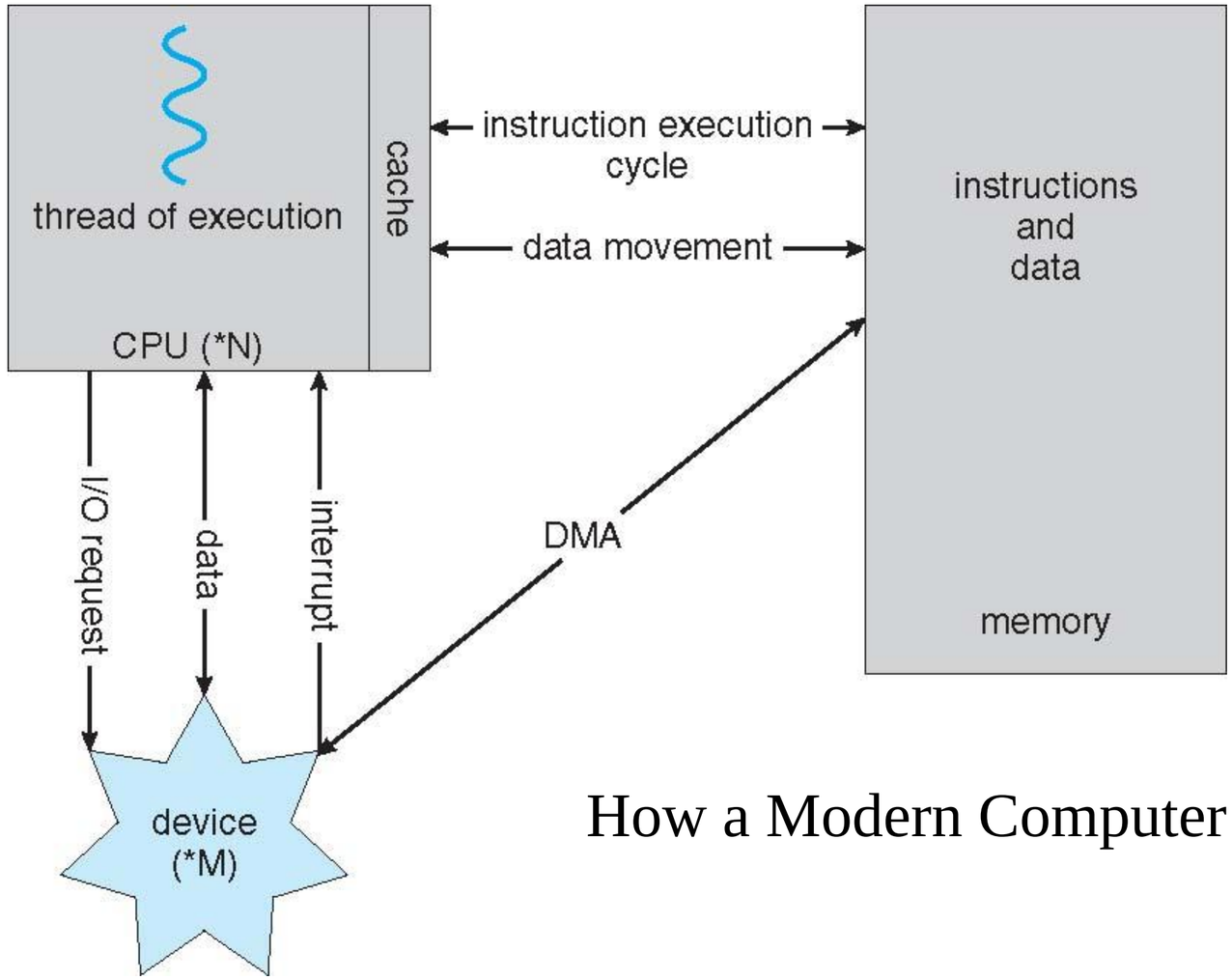
A Dual-Core Design



Clustered Systems

- Like multiprocessor systems, but **multiple systems working together**
  - Usually sharing storage via a storage-area network (SAN)
  - Provides a high-availability service which survives failures
    - Asymmetric clustering has one machine in hot-standby mode
    - Symmetric clustering has multiple nodes running applications, monitoring each other
  - Some clusters are for high-performance computing (HPC)
    - Applications must be written to use parallelization

Computer System Architecture



How a Modern Computer Works

Memory Management

- All data in memory before and after processing
- All instructions in memory in order to execute
- Memory management determines what is in memory when
  - Optimizing CPU utilization and computer response to users
- Memory management activities
  - Keeping track of which parts of memory are currently being used and by whom
  - Deciding which processes (or parts thereof) and data to move into and out of memory
  - Allocating and deallocating memory space as needed

Process Management

- Process and Program:
- A process is a program in execution (unit of work within the system).
- Program is a passive entity, process is an active entity.
- Process needs resources to accomplish its task
- CPU, memory, I/O, files (received upon creation and along execution)
- Initialization data (e.g., a process for presenting the status of a file)
- Process termination requires reclaim of any reusable resources
- Single-threaded process has one program counter specifying location of next instruction to execute
- Process executes instructions sequentially, one at a time, until completion
- Multi-threaded process has one program counter per thread
- Typically system has many processes, some user, some operating system running concurrently on one or more CPUs
- Concurrency by multiplexing the CPUs among the processes / threads

Process Management

- A process is a program in execution.
- A process needs certain resources, including CPU time, memory, files, and I/O devices, to accomplish its task.
- The operating system is responsible for the following activities in connection with process management.
  - Process creation and deletion.
  - process suspension and resumption.
  - Provision of mechanisms for:
  - process synchronization
  - process communication

Storage Management

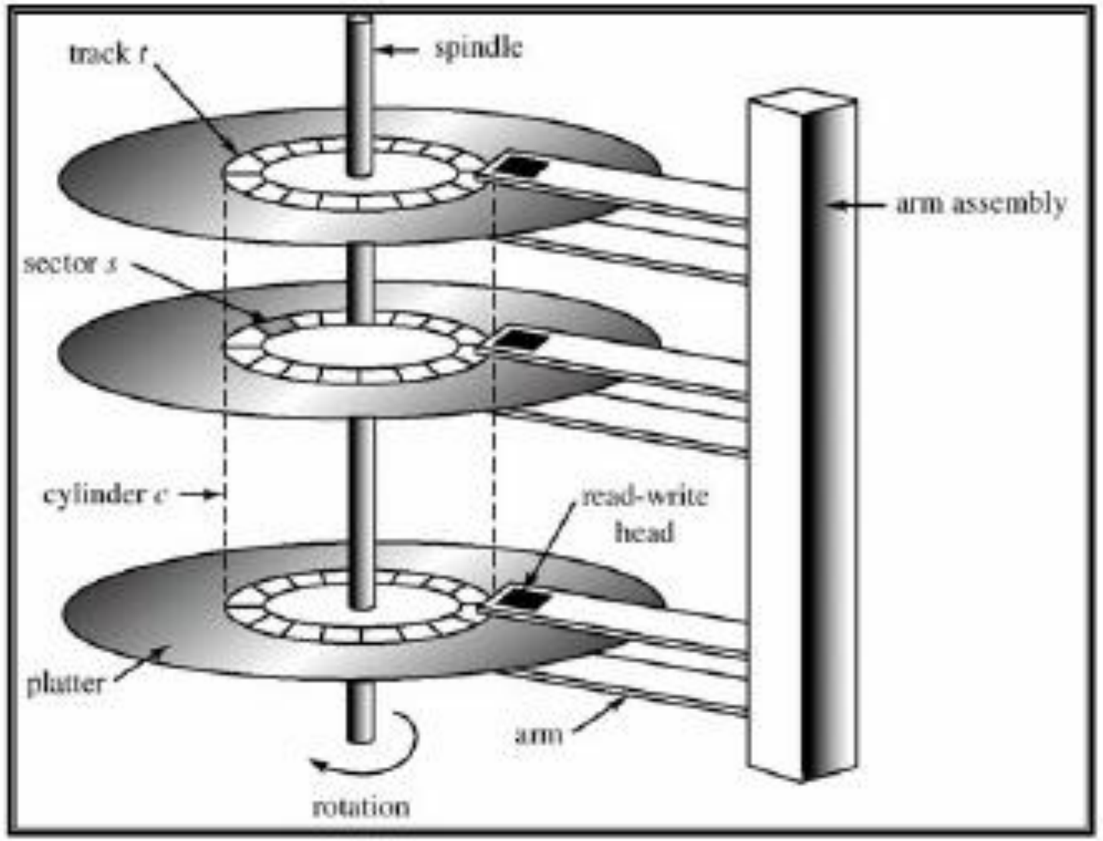
- OS provides uniform, logical view of information storage
- Abstracts physical properties to logical storage unit - file
- Each medium is controlled by device (i.e., disk drive, tape drive)
- Varying properties include access speed, capacity, data-transfer rate, access method (sequential or random)
- File-System management
- Files usually organized into directories
- Access control on most systems to determine who can access what
- OS activities include
- Creating and deleting files and directories
- Primitives to manipulate files and dirs
- Mapping files onto secondary storage
- Backup files onto stable (non-volatile) storage media

Mass-Storage Management

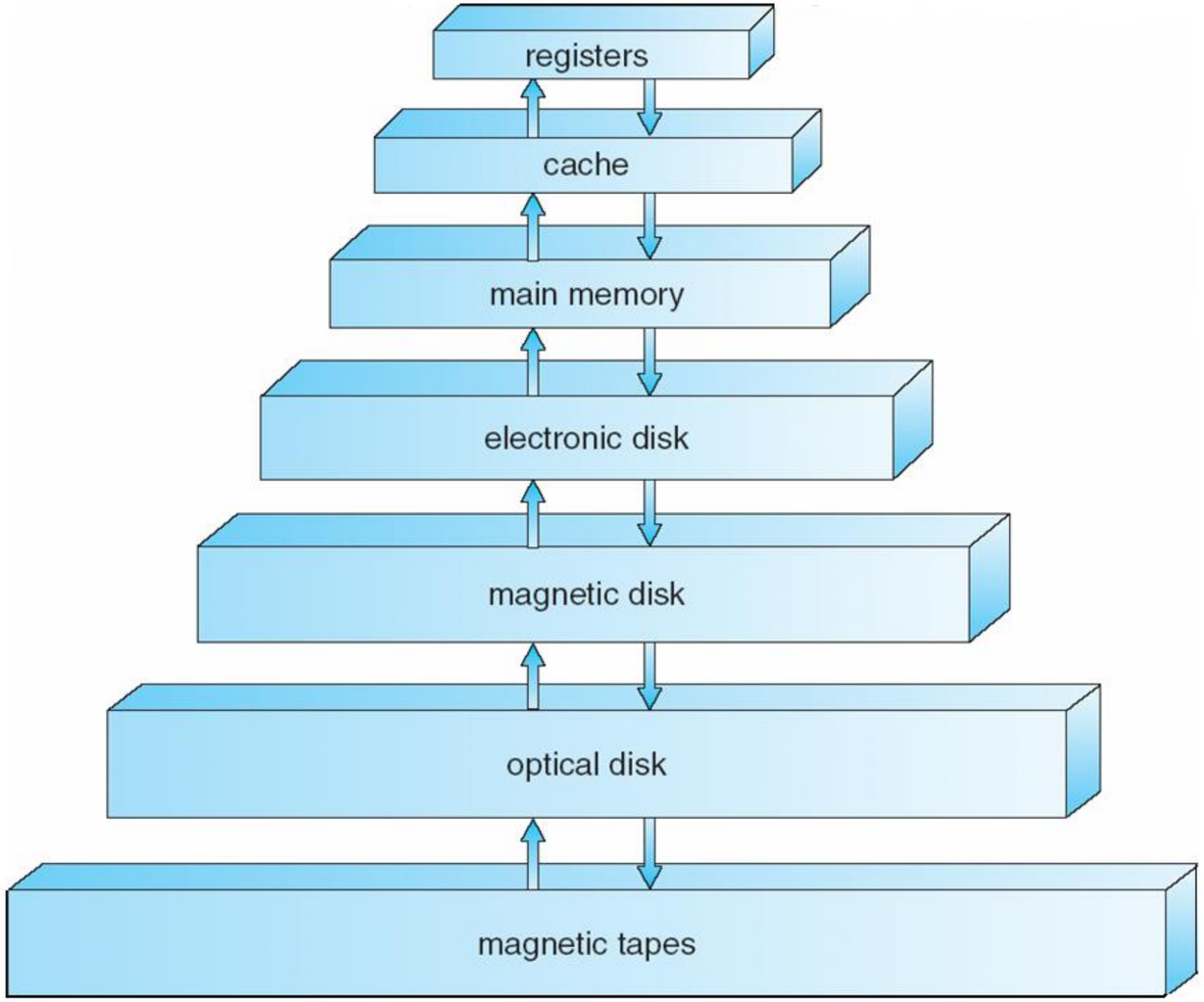
- Main memory – only large storage media that the CPU can access directly
- Why using disks?
- Store data that does not fit in main memory
- Store data that must be kept for a “long” period of time
- Proper management is of central importance
- Entire speed of computer operation hinges on disk subsystem and its algorithms
- OS activities
- Free-space management
- Storage allocation
- Disk scheduling

Storage Structure

- Secondary storage:
  - Extension of main memory
  - Provides large nonvolatile storage capacity
- Magnetic disks – rigid metal or glass platters covered with magnetic recording material
  - Disk surface is logically divided into **tracks**, which are subdivided into **sectors**
  - The **disk controller** determines the logical interaction between the device and the computer



Storage Structure



Storage Structure