UNIT I

INTRODUCTION

Introduction

- **Introduction**
  - What Operating Systems Do
  - Computer-System Architecture
  - Operating-System Structure
  - Operating-System Operations
  - Operating-System Services
  - User Operating System Interface
  - System Calls
  - Types of System Calls
  - System Programs
  - Operating System Structure
  - System Boot
- **Process Concept**
  - Process Scheduling
  - Operations on Processes
  - Interprocess Communication

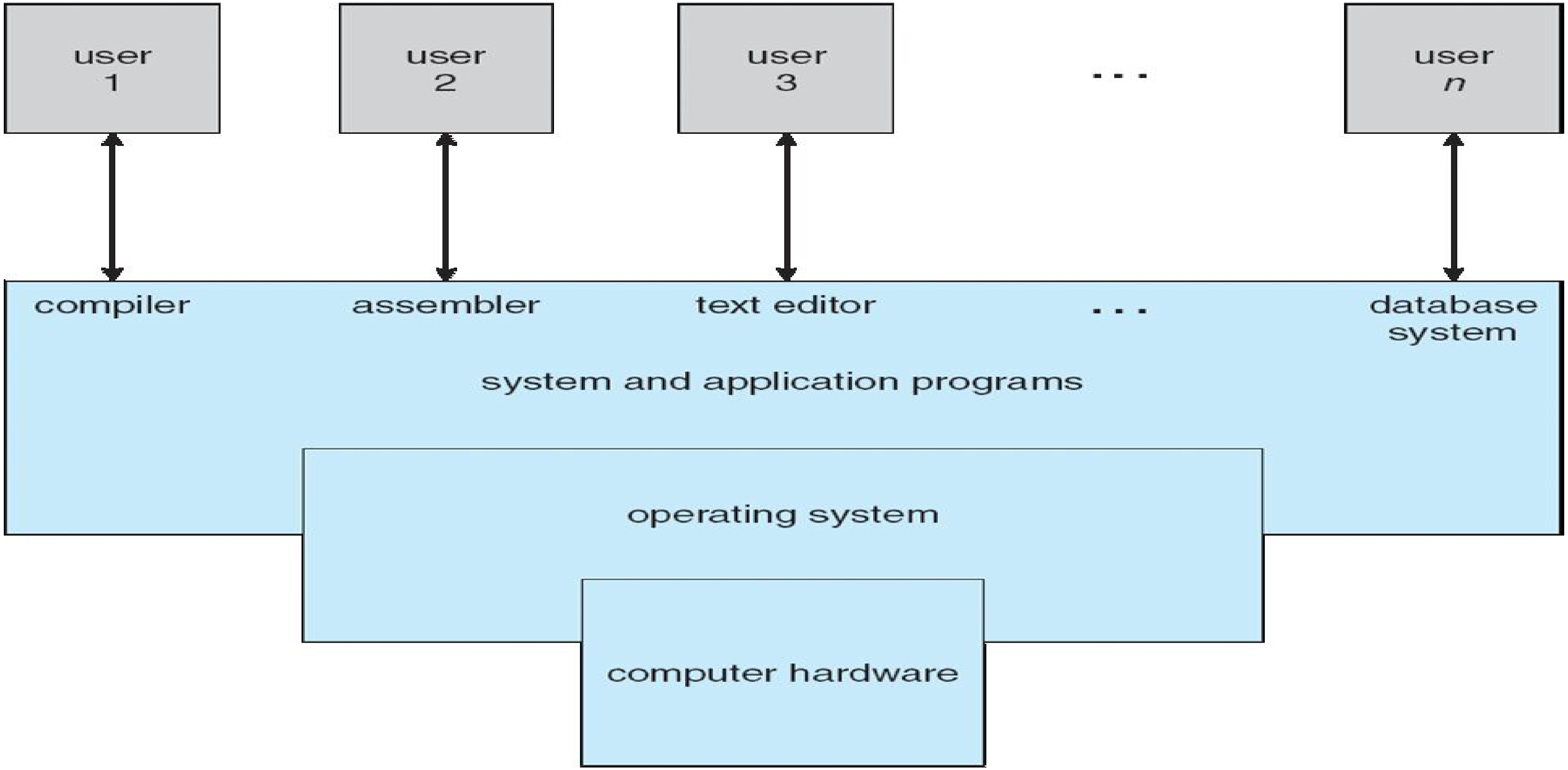
What is an Operating System?

- A program that acts as an intermediary between a user of a computer and the computer hardware
- **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 Structure

- Computer system can be divided into **four components**:
  - **Hardware** – provides basic computing resources
    - CPU, memory, I/O devices
  - **Operating system**
    - Controls and coordinates use of hardware among various applications and users
  - **Application programs** – define the ways in which the system resources are used to solve the computing problems of the users
    - Word processors, compilers, web browsers, database systems, video games
  - **Users**
    - People, machines, other computers

Four Components of a Computer System



WHAT OPERATING SYSTEMS DO

Users want convenience, **ease of use** and **good performance**

- Don't care about **resource utilization**

But shared computer such as **mainframe** or **minicomputer** must keep all users happy

Users of dedicate systems such as **workstations** have dedicated resources but frequently use shared resources from **servers**

Handheld computers are resource poor, optimized for usability and battery life

Some computers have little or no user interface, such as embedded computers in devices and automobiles

OPERATING SYSTEM DEFINITION

- OS is a **resource allocator**
  - Manages all resources
  - 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

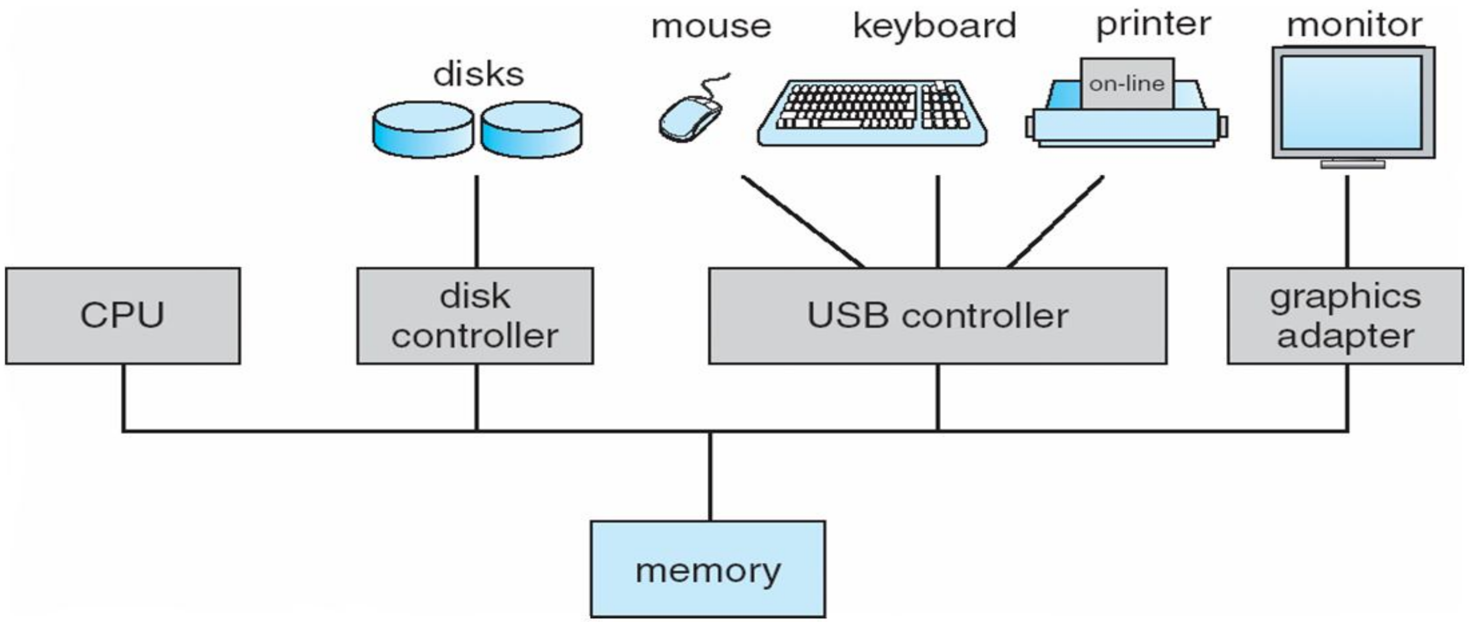
"The one program running at all times on the computer" is the **kernel**.

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
  - 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
  - Concurrent execution of CPUs and devices competing for memory cycles



COMPUTER-SYSTEM OPERATION

- I/O devices and the CPU can execute concurrently
- Each device controller is in charge of a particular device type
- Each device controller has a local buffer
- CPU moves data from/to main memory to/from local buffers
- I/O is from the device to local buffer of controller
- Device controller informs CPU that it has finished its operation by causing an interrupt

COMMON FUNCTIONS OF INTERRUPTS

- Interrupt transfers control to the interrupt service routine generally, through the **interrupt vector**, which contains the addresses of all the service routines
- Interrupt architecture must save the address of the interrupted instruction
- A **trap** or **exception** is a software-generated interrupt caused either by an error or a user request
- An operating system is **interrupt driven**

INTERRUPT HANDLING

- The operating system preserves the state of the CPU by storing registers and the program counter
- Determines which type of interrupt has occurred:
  - **polling**
  - **vectored** interrupt system
- Separate segments of code determine what action should be taken for each type of interrupt

I/O STRUCTURE

- After I/O starts, control returns to user program only upon I/O completion
  - Wait instruction idles the CPU until the next interrupt
  - Wait loop (contention for memory access)
  - At most one I/O request is outstanding at a time, no simultaneous I/O processing

I/O STRUCTURE

- After I/O starts, control returns to user program without waiting for I/O completion
  - **System call** – request to the OS to allow user to wait for I/O completion
  - **Device-status table** contains entry for each I/O device indicating its type, address, and state
  - OS indexes into I/O device table to determine device status and to modify table entry to include interrupt

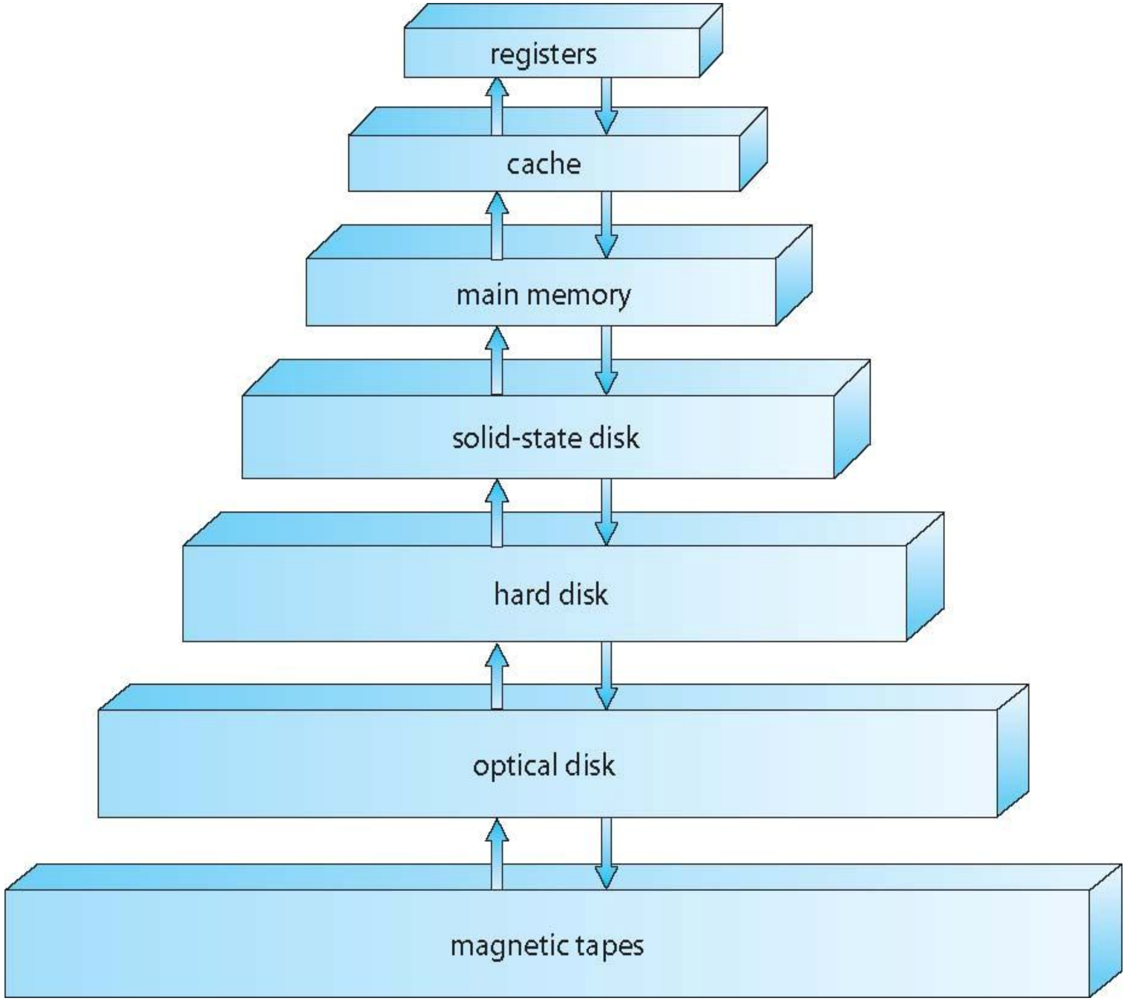
STORAGE STRUCTURE

- Main memory – only large storage media that the CPU can access directly
  - **Random access**
  - Typically **volatile**
- Secondary storage – extension of main memory that provides large **nonvolatile** storage capacity
- Hard 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
- **Solid-state disks** – faster than hard disks, nonvolatile
  - Various technologies
  - Becoming more popular

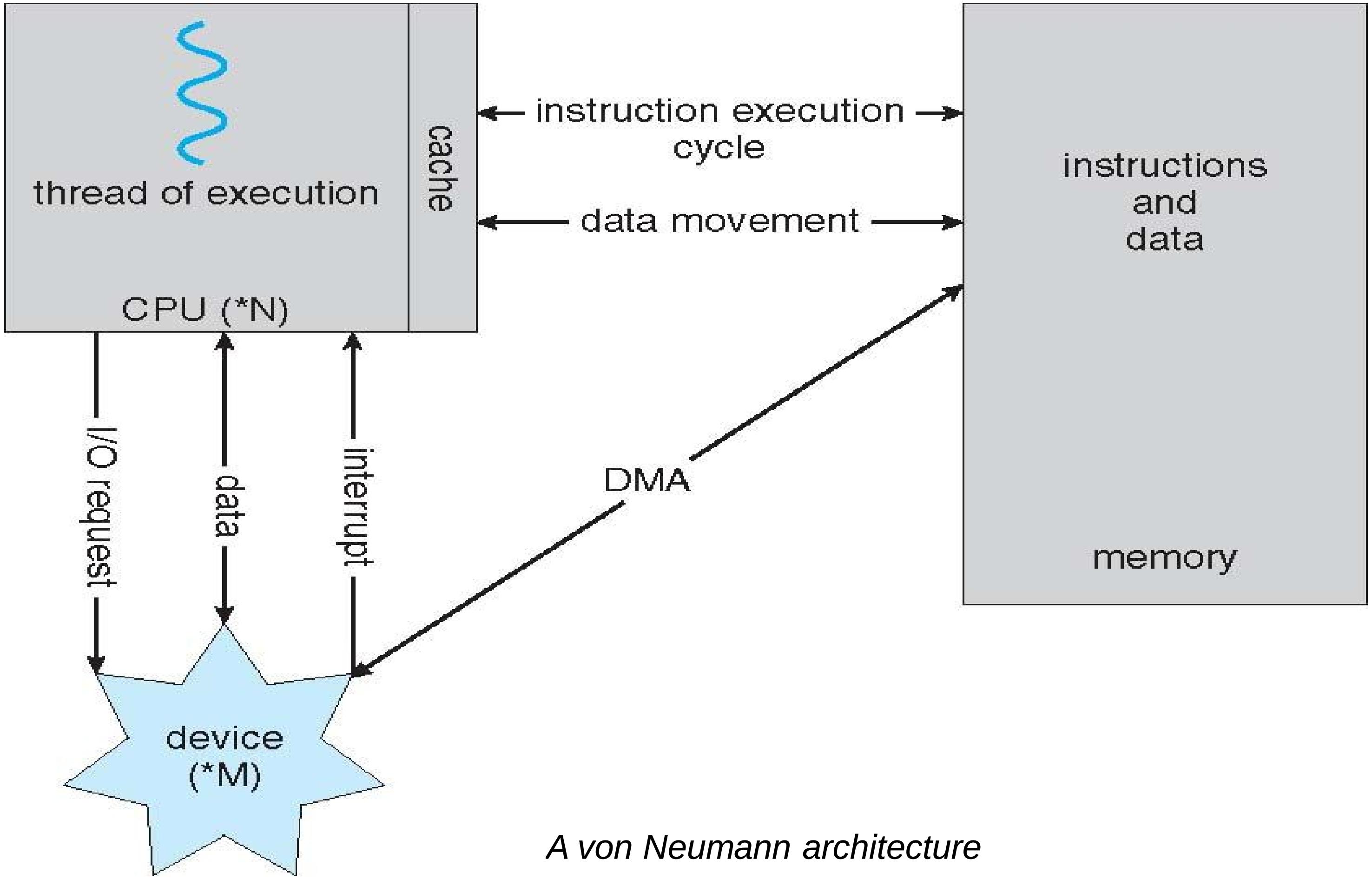
STORAGE HIERARCHY

- Storage systems organized in hierarchy
  - Speed
  - Cost
  - Volatility
- **Caching** – copying information into faster storage system; main memory can be viewed as a cache for secondary storage
- **Device Driver** for each device controller to manage I/O
  - Provides uniform interface between controller and kernel

STORAGE-DEVICE HIERARCHY



HOW A MODERN COMPUTER WORKS



A von Neumann architecture