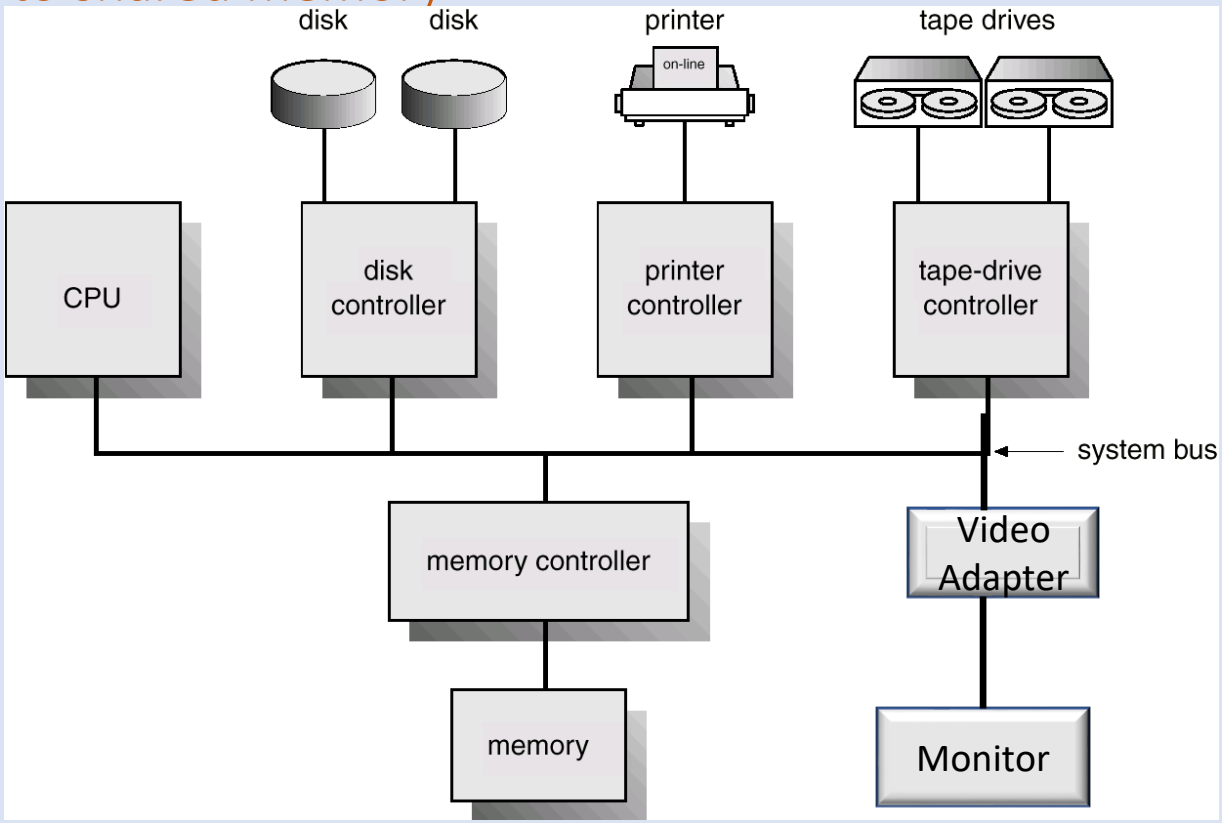
Lec-2

1. Computer-System Structures and Operations
2. Features of OS

Computer-System Structures and Operations

- Computer System Operation
- I/O Structure
- Storage Structure
- Storage Hierarchy

A modern general-purpose computer system consists of one or more CPUs and number of device controllers connected through a common bus that provides access to shared memory

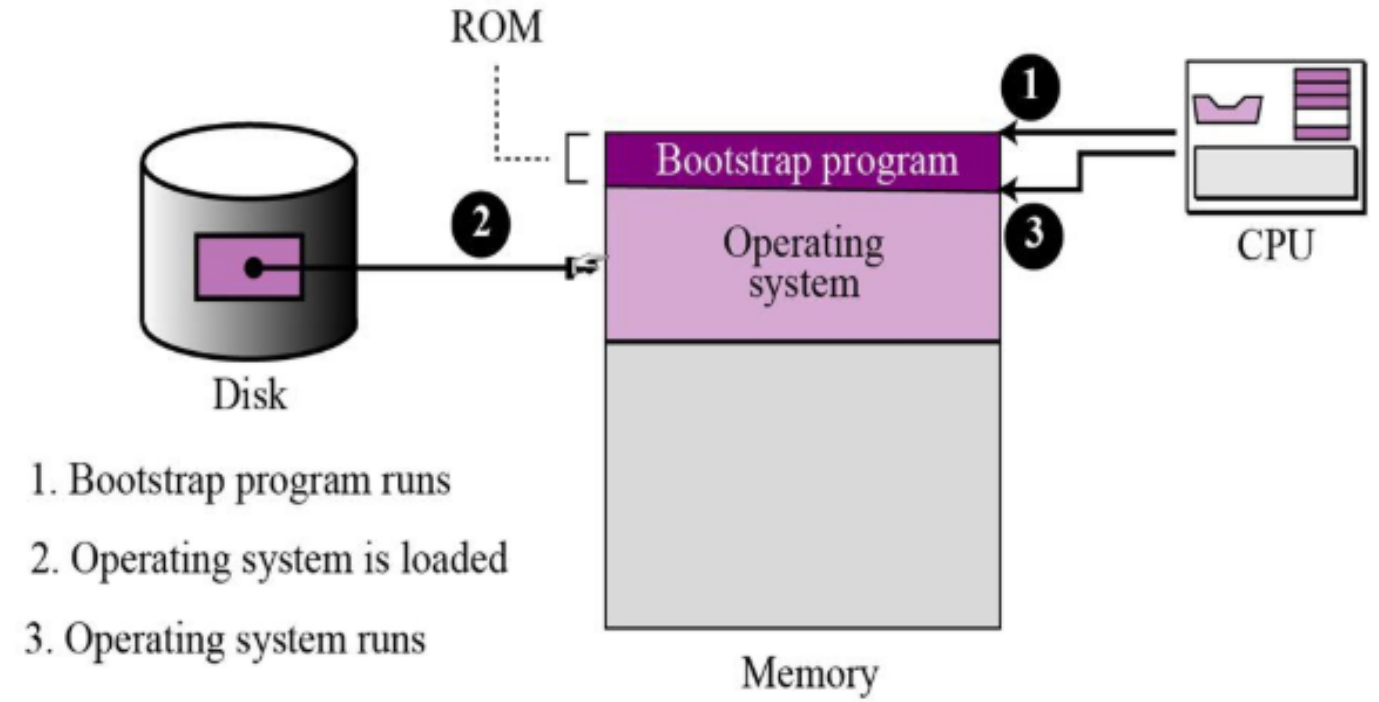


Disk controller: circuitry on the computer's motherboard or on a plug-in circuit board that controls the operation of your hard disk drive, floppy disk drives, or both.

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*.

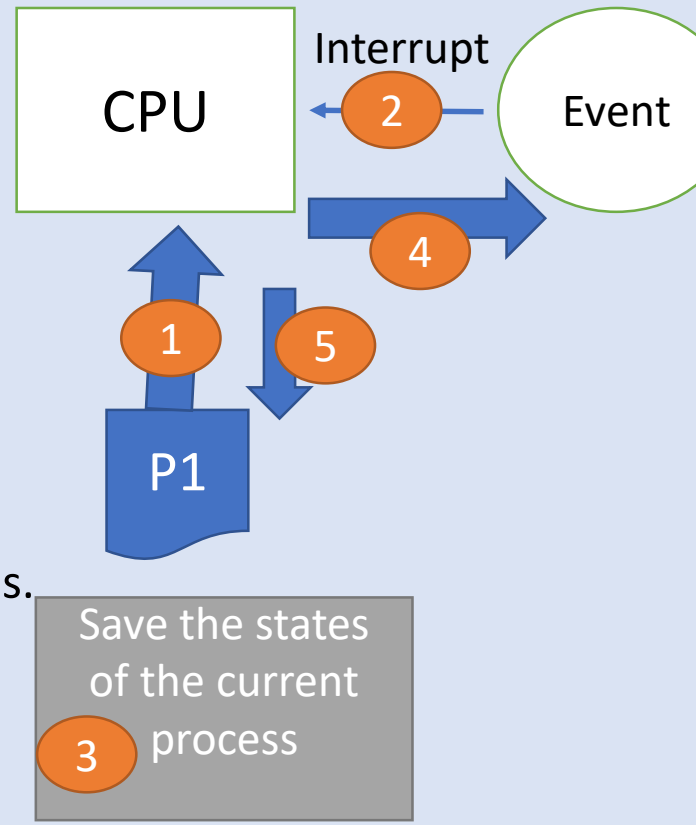
Some Important Terms:



1. A bootstrap program: is the first code that is executed when the computer system is started. The entire operating system depends on the bootstrap program to work correctly as it loads the operating system.

2. Interrupt:

- In digital computers, an interrupt is an input signal to the processor indicating an event that needs immediate attention.
- It requests the processor to stop the current execution.
- If the request is accepted, the processor responds by suspending its current activities, saving its state, and executing a function called an interrupt handler (or an interrupt service routine, ISR) to deal with the event.
- The occurrence of an event is usually signalled by an Interrupt from Hardware or Software.
- Hardware may trigger an Interrupt at any time by sending the signal to the CPU, usually by the way of the system bus.



3. System Call (Monitor Call):

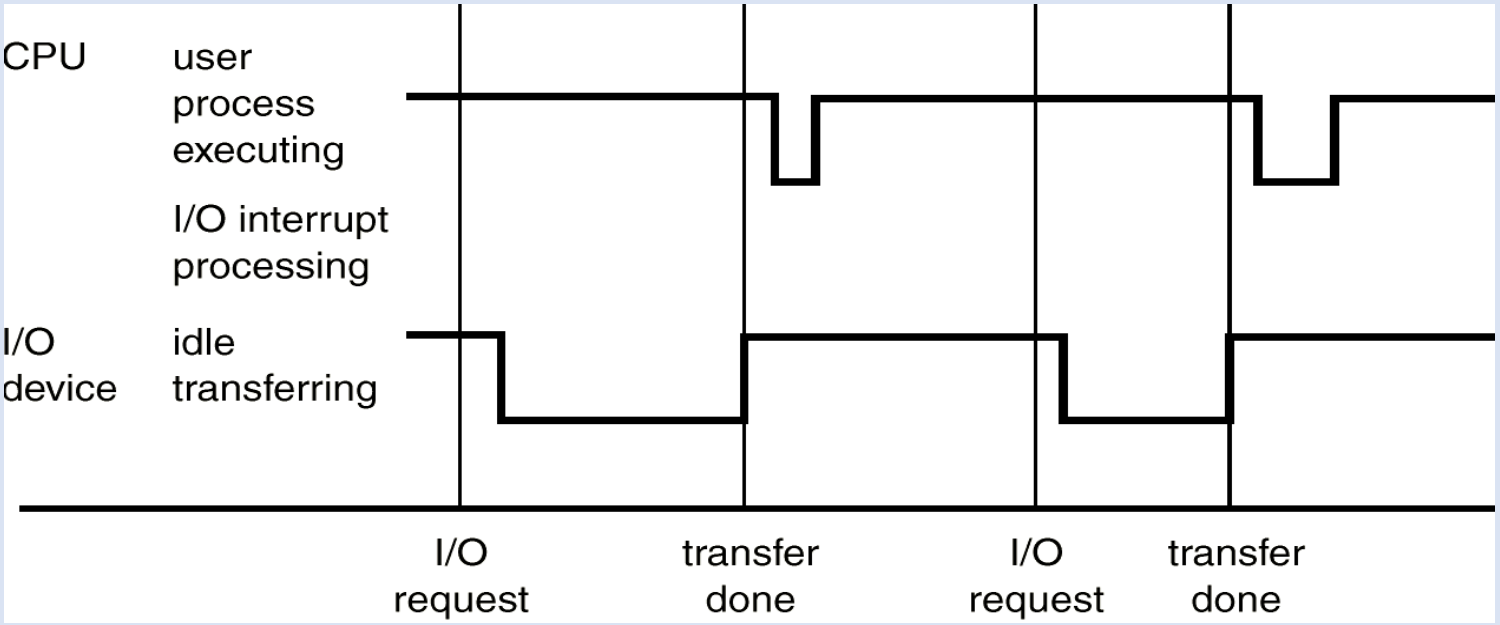
- Software may trigger an interrupt by executing a special operation called System Call.

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:

- Separate segments of code to determine what action should be taken for each type of interrupt

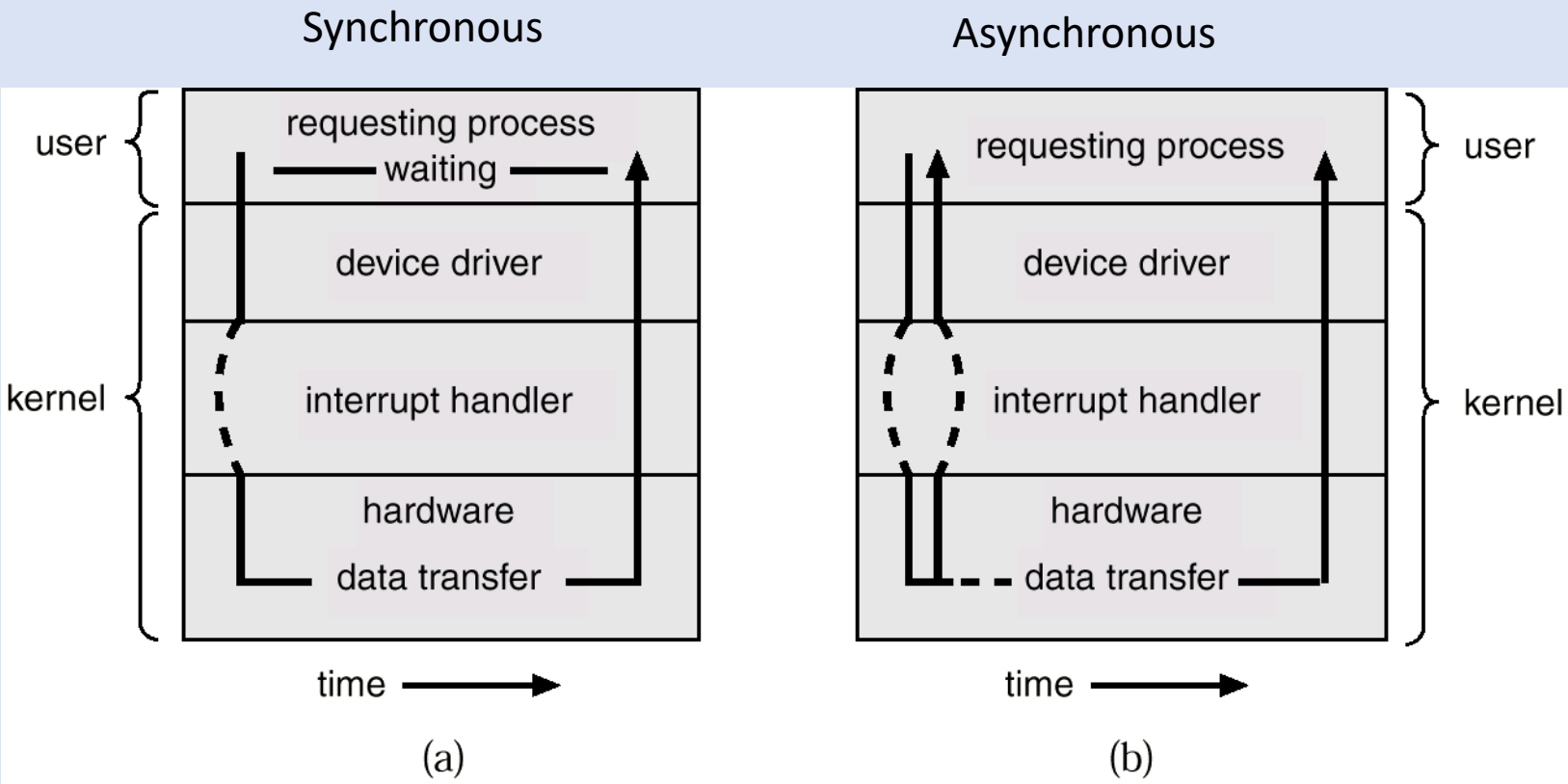
Interrupt Time Line For a Single Process Doing Output



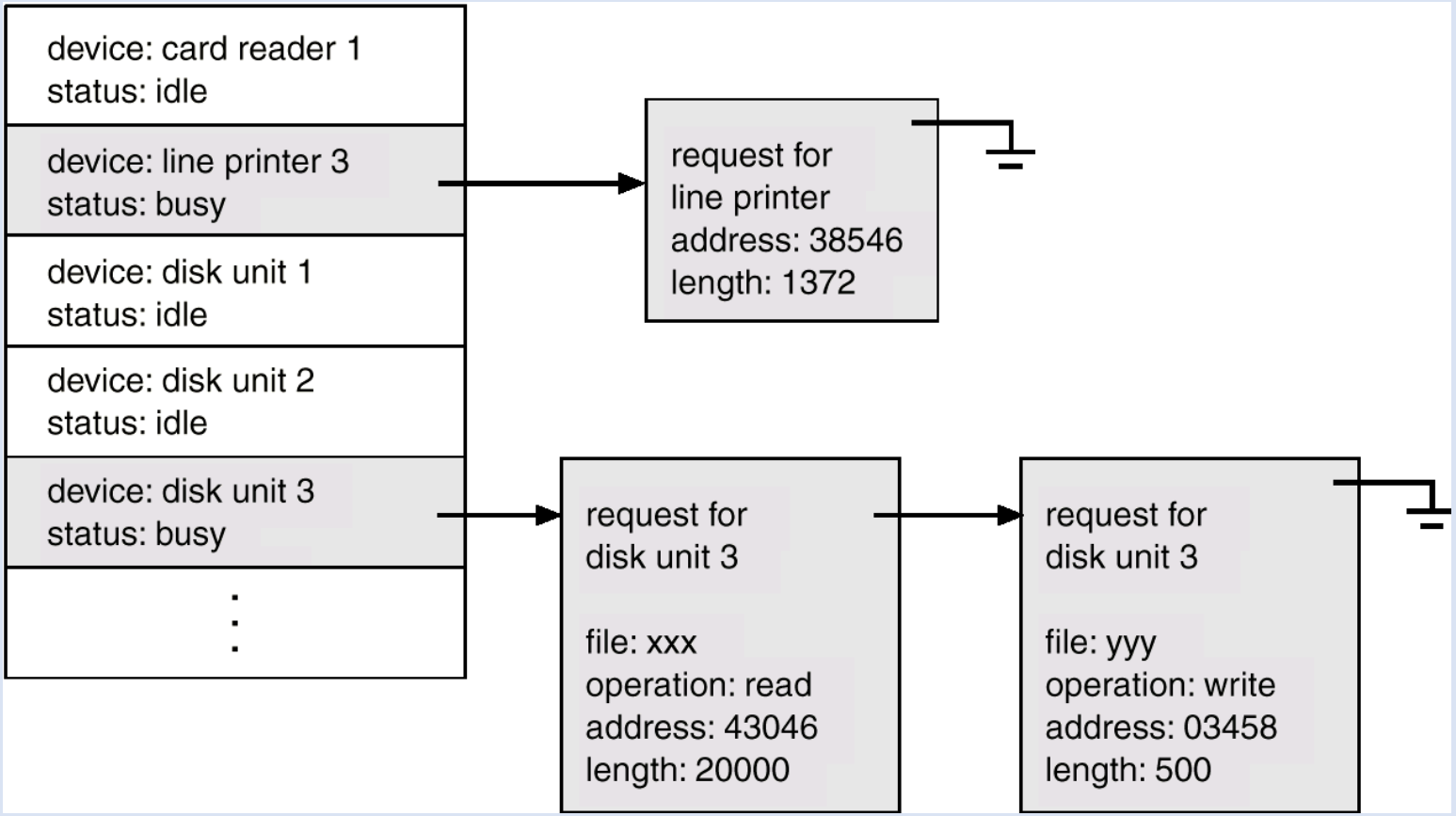
I/O Structure

- After I/O starts, control returns to user program only upon I/O completion.
- After I/O starts, control returns to user program without waiting for I/O completion.

Two I/O methods



Device-Status Table



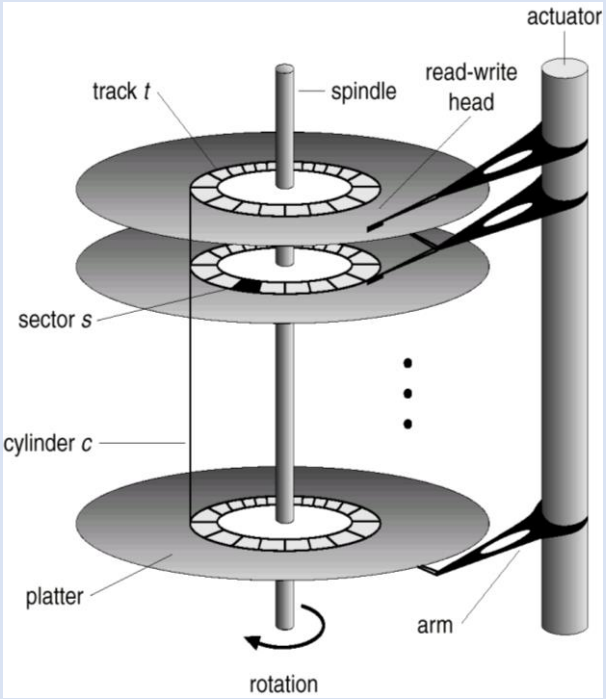
Direct Memory Access (DMA) Structure

- Device controller transfers blocks of data from buffer storage directly to main memory without CPU intervention.

Storage Structure

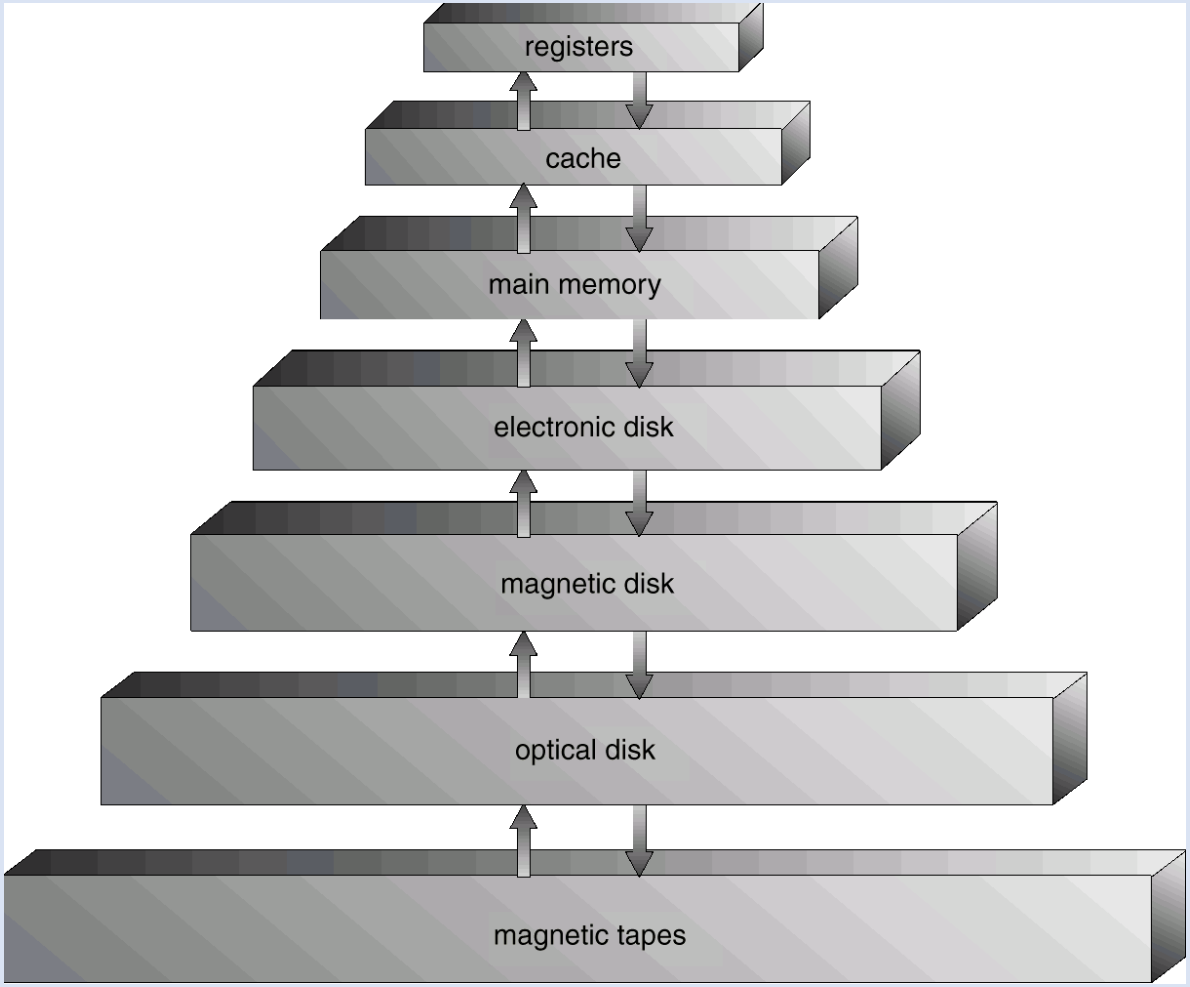
- Main memory – only large storage media that the CPU can access directly.
- Secondary storage – extension of main memory that provides large nonvolatile storage capacity.
- Magnetic disks – rigid metal or glass platters covered with magnetic recording material
  - Disk surface is logically divided into *tracks*, which are subdivided into *sectors*.
  - The *disk controller* determines the logical interaction between the device and the computer.

Moving-Head Disk Mechanism



https://www.youtube.com/watch?v=NtPc0jI21i0

Storage-Device Hierarchy



2. Component or Features of OS

OS features:

- Process Management
- Main Memory Management
- Secondary-Storage Management
- I/O System Management
- File Management
- Protection System

Process Management

- A program in execution is called process.
- When program in execution (*i.e.,* process), it needs certain resources including CPU, memory, files, and I/O devices to accomplish its task.
- Hence, the OS has to perform the following activities in connection with process management.
  - Process creation
  - Process termination
  - Process control block (PCB)
  - Process scheduling
  - Process synchronization
  - Inter process communication

Main-Memory Management

- Memory is a large array of words or bytes, each with its own address. It is a repository of quickly accessible data shared by the CPU and I/O devices.
- Main memory is a volatile storage device. It loses its contents in the case of system failure/power off.
- The operating system is responsible for the following activities in connections with memory management:
  - Keep track of which parts of memory are currently being used and by whom.
  - Decide which processes to load when memory space becomes available.
  - Allocate and deallocate memory space as needed.

Secondary-Storage Management

- Since main memory (*primary storage*) is volatile and too small to accommodate all data and programs permanently, the computer system must provide *secondary storage* to back up main memory.
- Most modern computer systems use disks as the principle on-line storage medium, for both programs and data.
- The operating system is responsible for the following activities in connection with disk management:
  - Free space management
  - Storage allocation
  - Disk scheduling

I/O System Management

- One of the important jobs of an OS is to manage various I/O devices including mouse, keyboards, touch pad, USB devices, LED, audio I/O, printers etc.
- An I/O system is required to take an application I/O request and send it to the physical device, then take whatever response comes back from the device and send it to the application.
- I/O devices can be divided into two categories
  - **Block devices** − A block device is one with which the driver communicates by sending entire blocks of data. For example, Hard disks, USB cameras, Disk-On-Key, etc.
  - **Character devices** − A character device is one with which the driver communicates by sending and receiving single characters (bytes, octets). For example, serial ports, parallel ports, sounds cards, etc.

File Management

- A file is a collection of related information defined by its creator. Commonly, files represent programs (both source and object forms) and data.
- The operating system is responsible for the following activities in connections with file management:
  - File creation and deletion.
  - Directory creation and deletion.
  - Support of primitives for manipulating files and directories.
  - Mapping files onto secondary storage.
  - File backup on stable (nonvolatile) storage media.

Protection System

- *Protection* refers to a mechanism for controlling access by programs, processes, or users to both system and user resources.
- The protection mechanism must:
  - distinguish between authorized and unauthorized usage.
  - must be protect against unauthorized access, viruses, worms etc.