

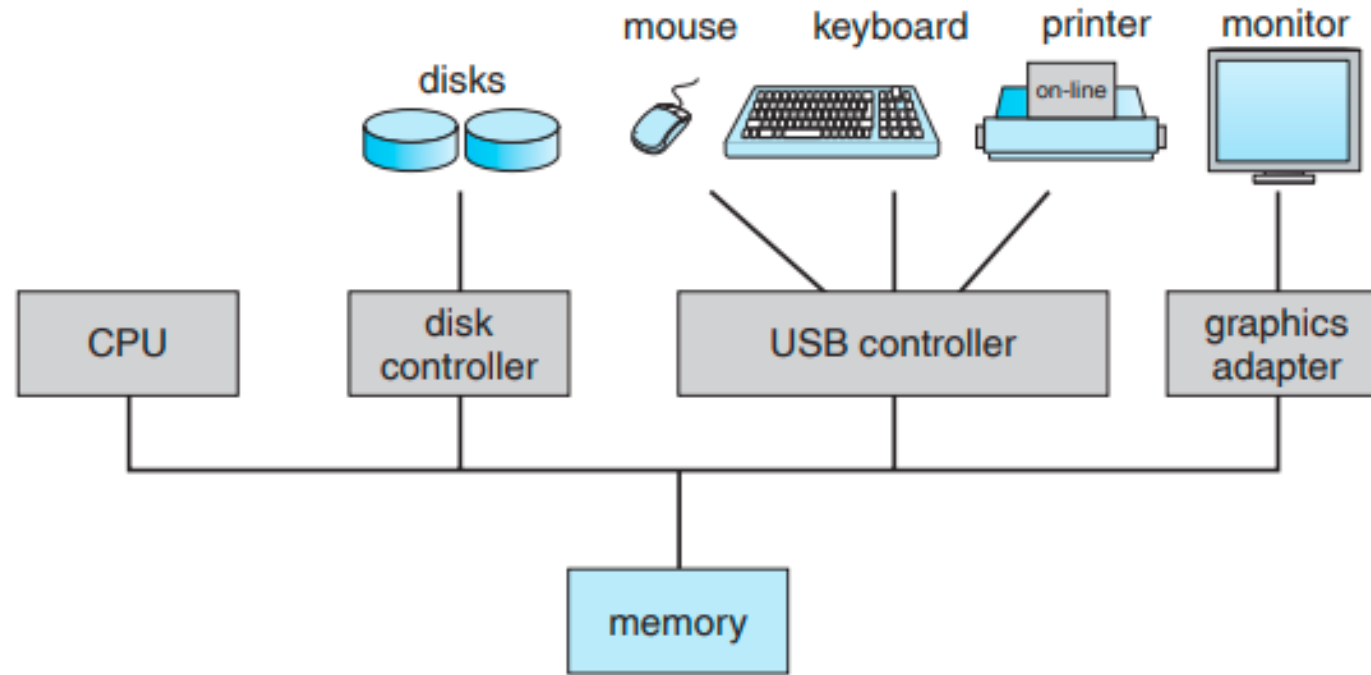
Operating System Definition

- System View
 - 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.

Operating System Definition (Cont.)

- No universally accepted definition
- “The one program running at all times on the computer” is the **kernel**.
- Everything else is either,
 - a system program, or an application program.

Computer-System Organization



A modern computer system.

- One or more CPUs
- Number of device controllers
- Shared memory
- Memory controller

Computer Startup

- **bootstrap program** is loaded at power-up or reboot
 - Stored in ROM or EPROM (erasable programmable read-only memory)
 - Known as **firmware** (permanent software programmed into a read-only memory)
 - Initializes all aspects of system
 - Loads operating system kernel and starts execution

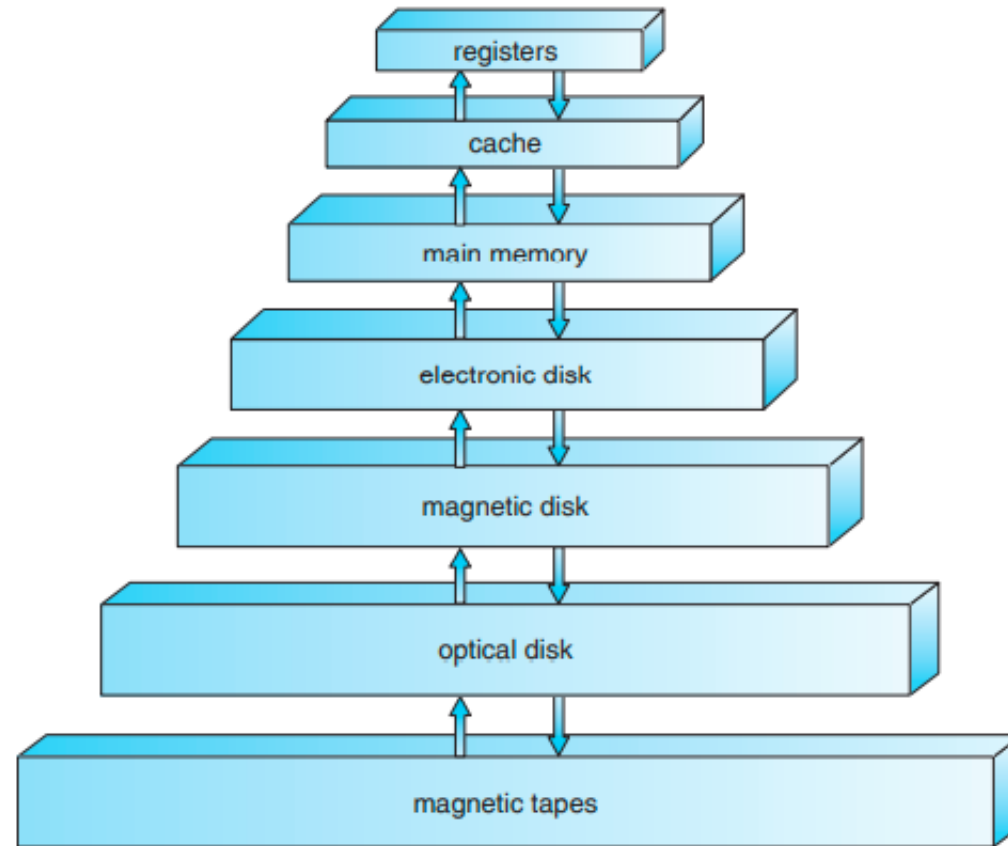
Common Functions of Interrupts

- 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**

Storage Structure

- Main Memory
 - RAM
 - Main memory is usually too small to store all needed programs and data permanently.
 - Main memory is a volatile storage device that loses its contents when power is turned off or otherwise lost
- Read-only memory (ROM)
 - A typical instruction–execution cycle
- Secondary storage
 - hold large quantities of data permanently
 - magnetic disk

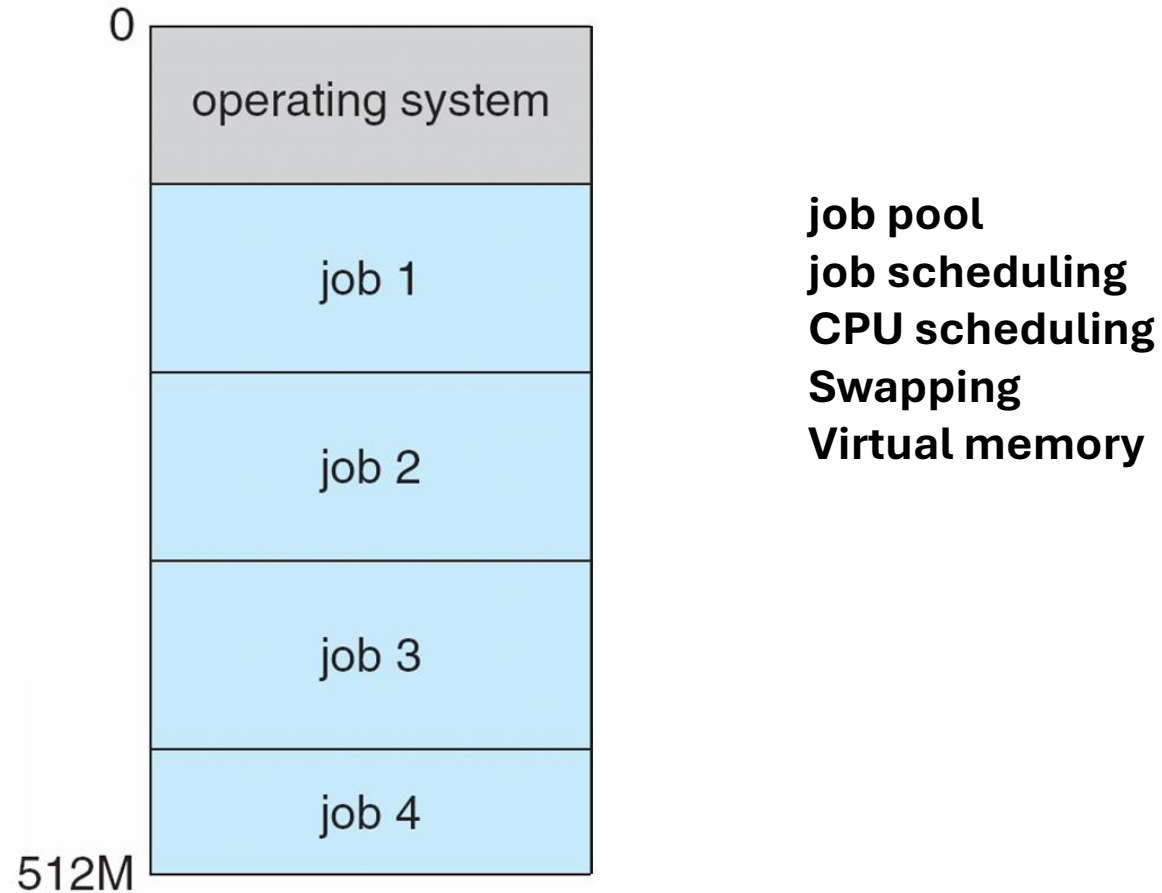
Storage-device hierarchy



Operating System Structure

- **Multiprogramming (Batch system)** needed for efficiency
 - Single user cannot keep CPU and I/O devices busy at all times
 - Multiprogramming organizes jobs (code and data) so CPU always has one to execute
 - A subset of total jobs in system is kept in memory
 - One job selected and run via **job scheduling(from job pool)**
 - When it has to wait (for I/O for example), OS switches to another job
- **Timesharing (multitasking)** is logical extension in which CPU switches jobs so frequently that users can interact with each job while it is running, creating **interactive** computing
 - **Response time** should be < 1 second
 - Each user has at least one program executing in memory ⇒ **process**
 - If several jobs ready to run at the same time ⇒ **CPU scheduling(picking jobs from memory)**
 - If processes don't fit in memory, **swapping** moves them in and out to run
 - **Virtual memory** allows execution of processes not completely in memory

Memory Layout for Multiprogrammed System



Operating-System Operations

- **Modern OS are Interrupt driven** (hardware and software)
 - Hardware interrupt by one of the devices: A signal created and sent to the CPU that is caused by some action taken by a **hardware** device. keystroke depressions and mouse movements cause hardware interrupts.
 - Software interrupt (**exception** or **trap**):
 - Software error (e.g., division by zero)
 - invalid memory access
 - Request from user program to access a specific operating system service
 - For each type of interrupt, separate segments of code in the operating system determine what action should be taken.
 - An interrupt service routine is provided that is responsible for dealing with the interrupt.
 - Other process problems include infinite loop, processes modifying each other or the operating system