# Unit 2
# Computer System Components

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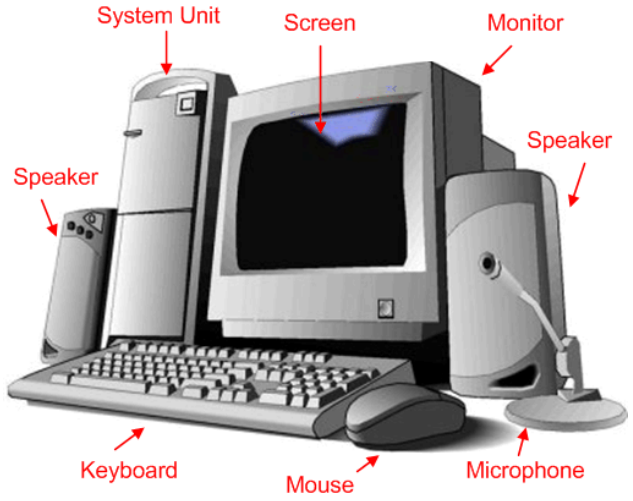
# Unit Outline

- CPU Structure and Function
- Memory Technology
  - Internal Memory
  - External Memory
- Input and Output: Computer Buses

# Computer System Overview

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| Input | | Computer | | Output |
|---|---|---|---|---|
| Keyboard<br>Mouse<br>Microphone | | System unit | | Monitor<br>Speaker |

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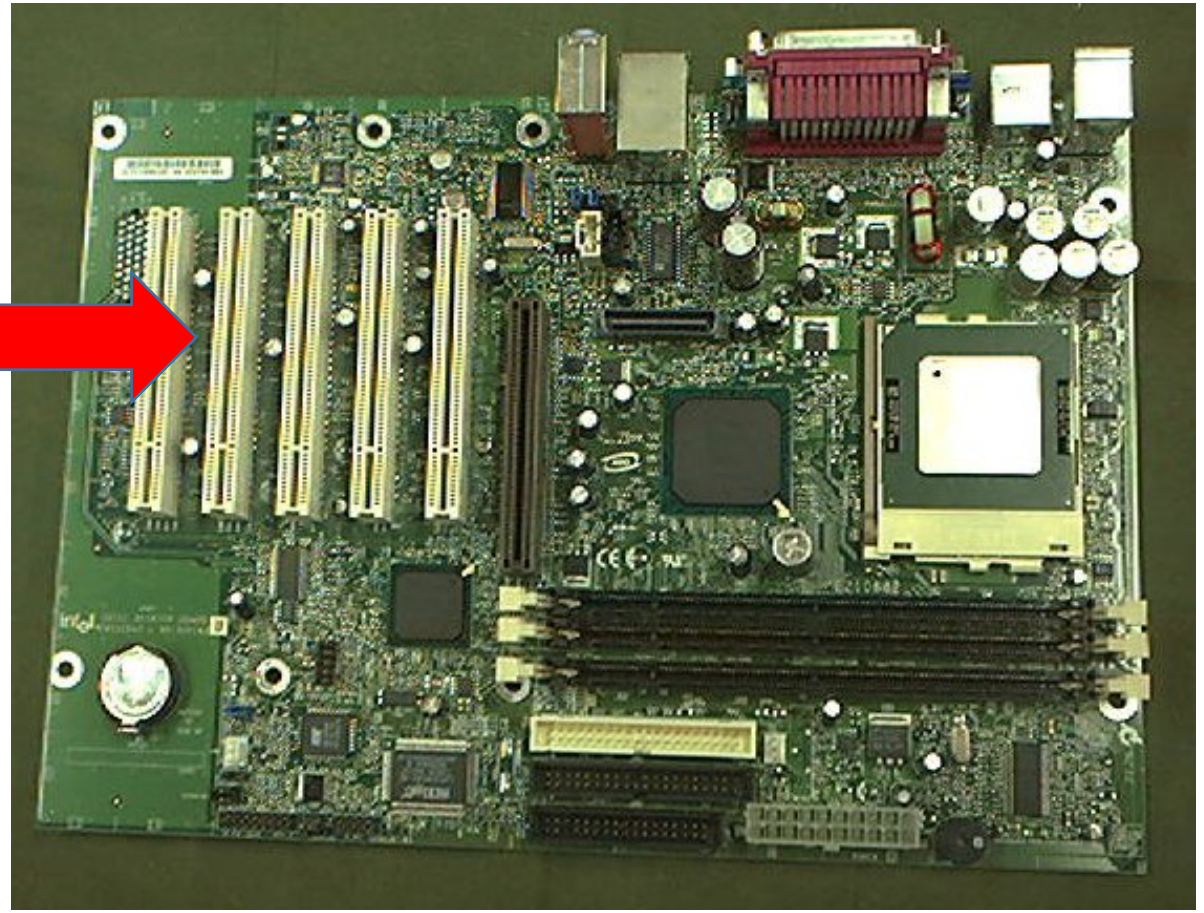
# Mainboard of the System Unit

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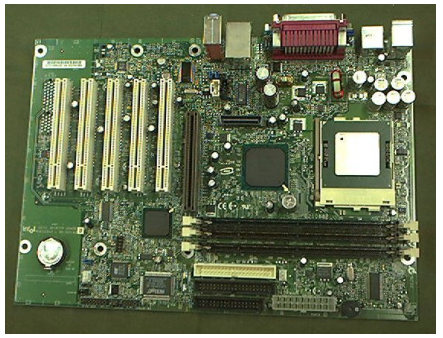
# Computer Component Interconnection



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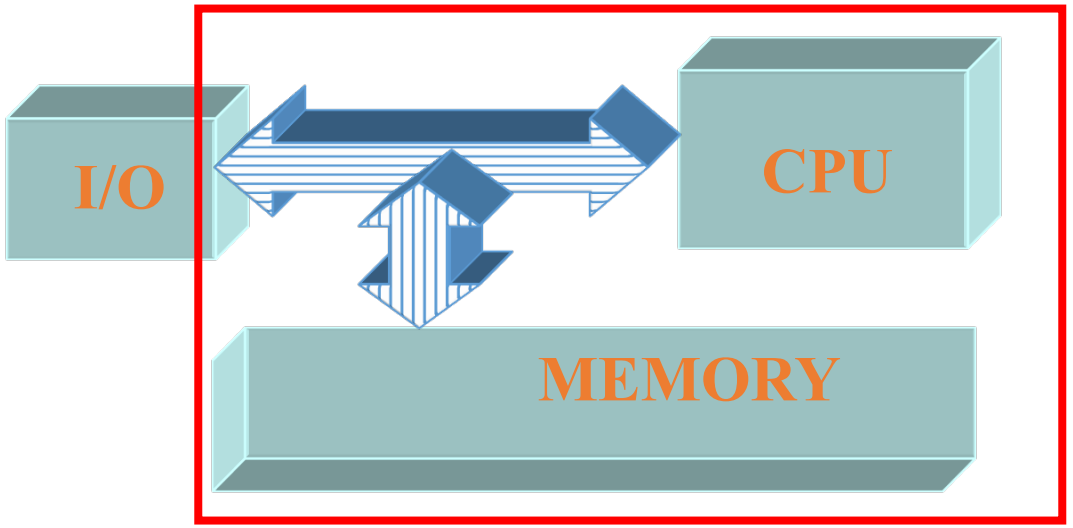
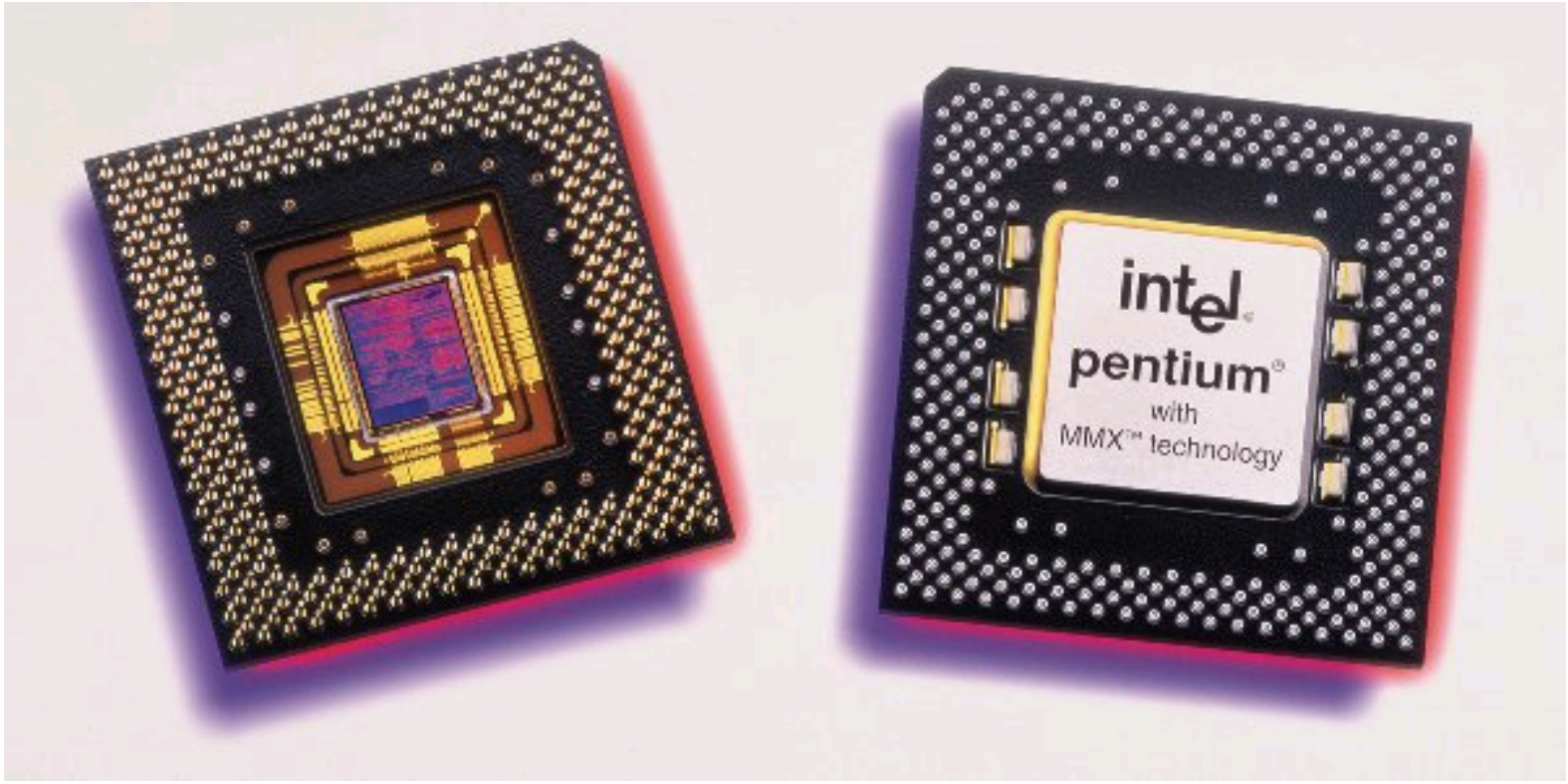


# CPU (Central Processing Unit)

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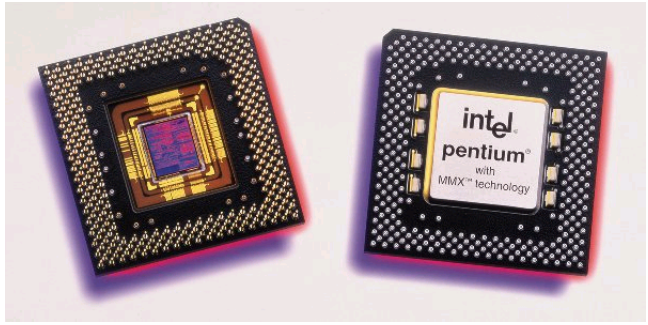
# CPU Organization





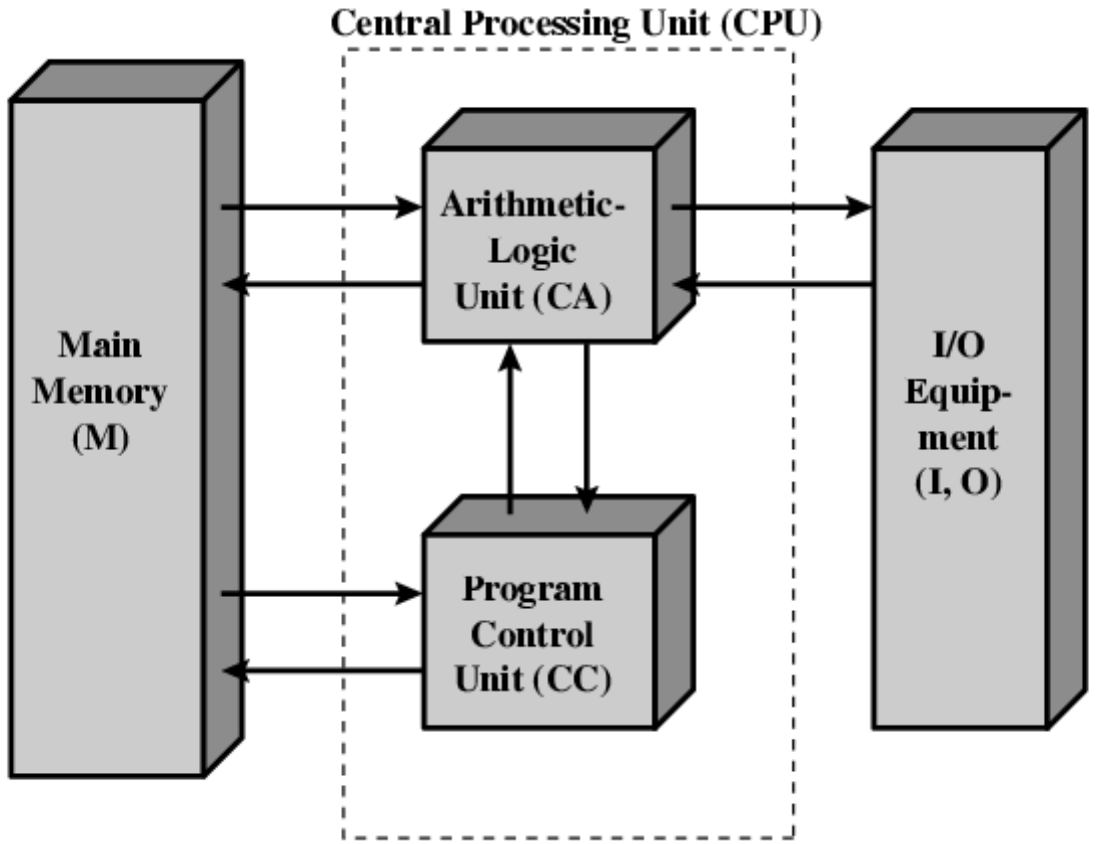
**Registers: Internal memory in the CPU**

**ALU: Arithmetic and Logic Unit,**
**the processing unit**

**CU: Control Unit**

# General-purpose (von Neumann) Architectures

- In the von-Neumann architecture, a small set of circuits can be driven to perform very different tasks, depending on the software program which is executed.



# Computer Memory

- Memory System
  - Characteristics
  - Hierarchy

# Types of Computer Memory and Its Usage

- When you think about it, it's amazing how many different types of electronic memory you encounter in daily life. Many of them have become an integral part of our vocabulary:
  - RAM
  - ROM
  - Cache
  - Dynamic RAM
  - Static RAM
  - Flash memory
  - Memory Sticks
  - Virtual memory
  - Video memory
  - BIOS

**Usage:**

- Cell phones
- PDAs
- Game consoles
- Car radios
- GPS
- TVs
- iPad

# Memory Physical Types

- Semiconductor
  - RAM
- Magnetic
  - Disk & Tape
- Optical
  - CD & DVD

# Physical Characteristics

- Decay: information lost when electrical power is switched off
- Volatility
- Erasable
- Power consumption

Characteristic:

1. volatile/non-volatile
2. erasable/non-erasable

- volatile: does the memory decay when the power is turned off?
- erasable: can you erase the memory?

# Example of non-volatile memory:

- ROM - read-only memory
  - manufacture the information into the chip
  - better not make a mistake
- PROM - programmable ROM
  - can be written once
- EPROM - erasable ROM
  - shine a UV light on it and it disperses the charge
  - can program it electronically using a high voltage
- EEPROM - electrically erasable ROM
  - Can erase a byte or a block using a high voltage
  - Can program electronically
- Flash memory
  - Program electronically, and erase a block of memory in 1-2 seconds using a high voltage

ROM

EPROM



DDR


SDRAM

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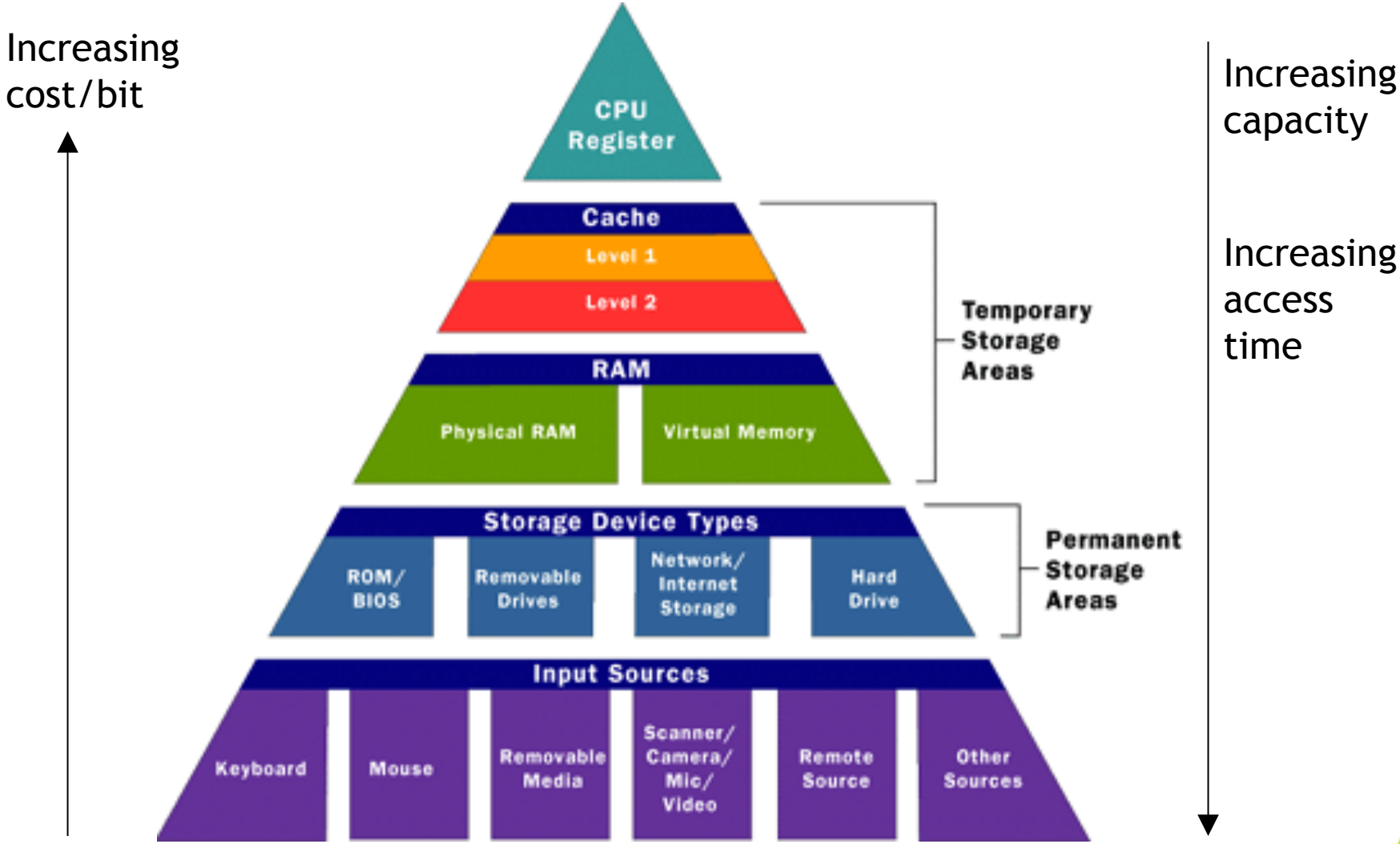
# Memory Hierarchy - Diagram



# External Memory

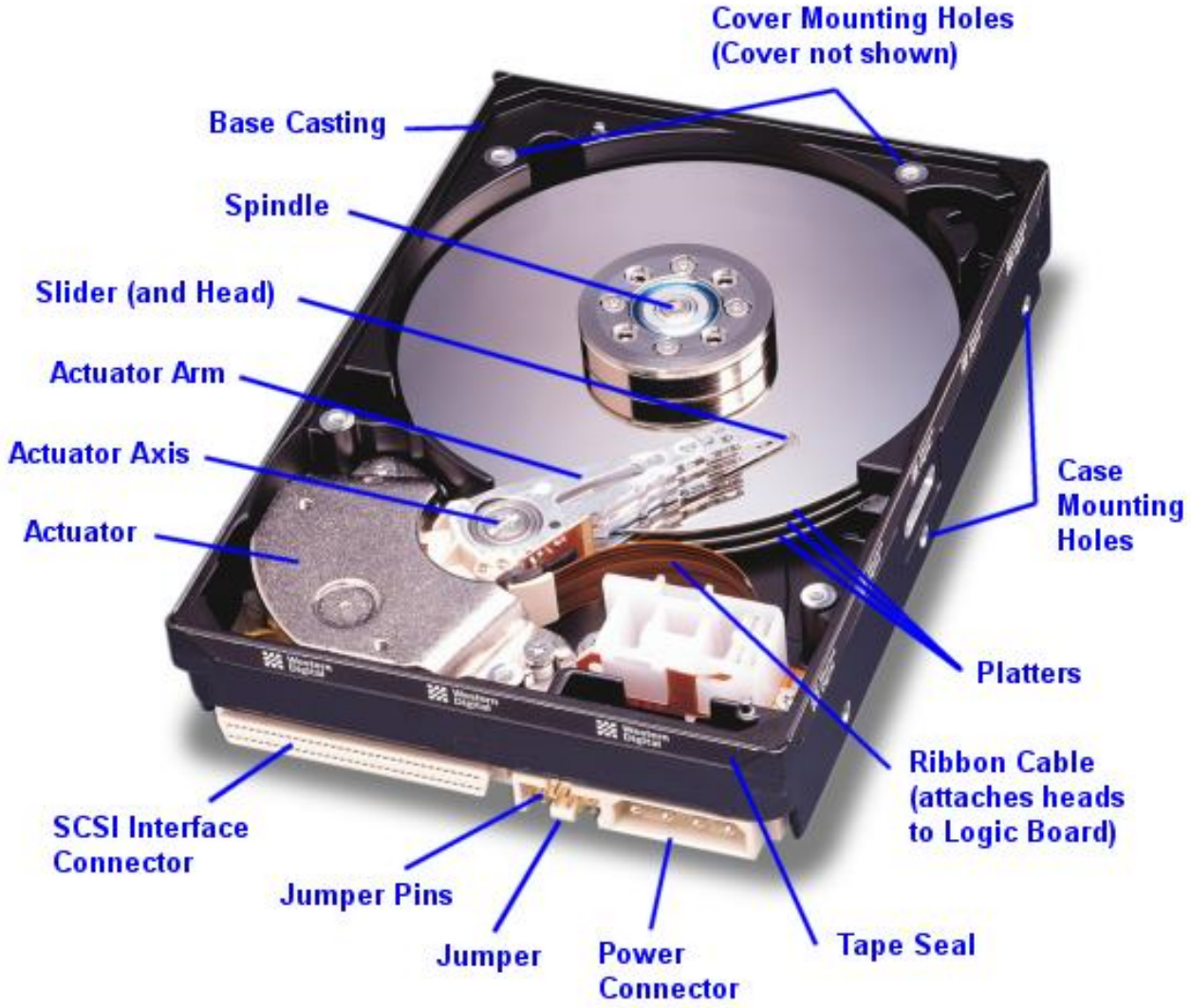
1. Magnetic Disk
   - Hard Disk
   - Floppy Disk
2. Optical
   - CD-ROM, CD-Recordable (CD-R), CD-R/W
   - DVD, DVD-R, DVD+R, DVD-RW
   - Blu-ray
3. Magnetic Tape (*Almost Obsolete*)
4. Flash Memory Drive / Solid State Drive

# Capacity and Performance

- There are two ways to measure the performance of a hard disk:
  - **Data rate** - The data rate is the number of bytes per second that the drive can deliver to the CPU. Rates between 5 and 40 megabytes per second are common.
  - **Seek time** - The seek time is the amount of time between when the CPU requests a file and when the first byte of the file is sent to the CPU. Times between 10 and 20 milliseconds are common.
- The other important parameter is the **capacity** of the drive, which is the number of bytes it can hold.
- A typical computer system will have a hard disk with a capacity between few hundreds to few thousands of gigabytes.

# Inside Hard Disk: Another example (SCSI)

**SCSI : Small Computer System Interface**

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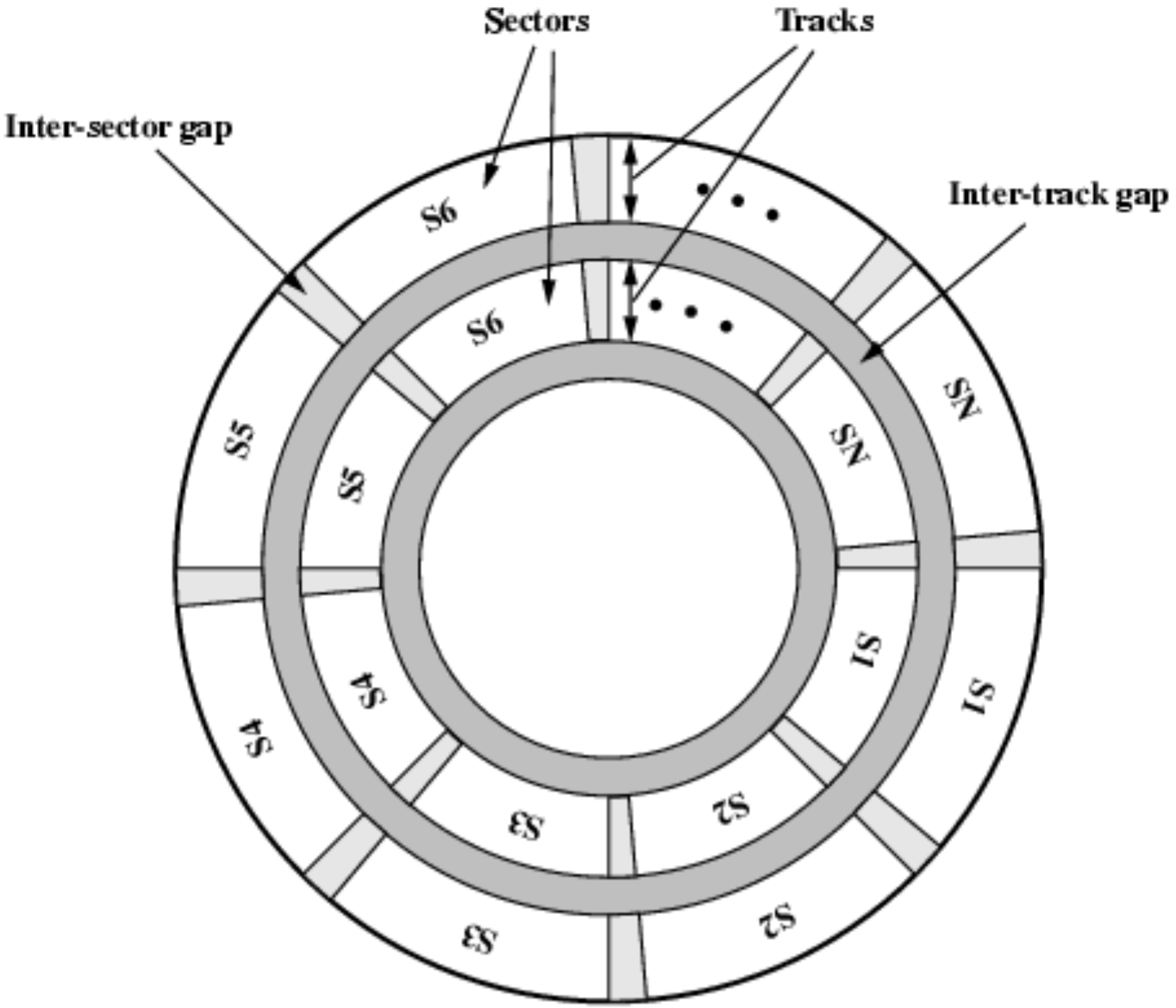
# Disk Data Layout, Data organization and format



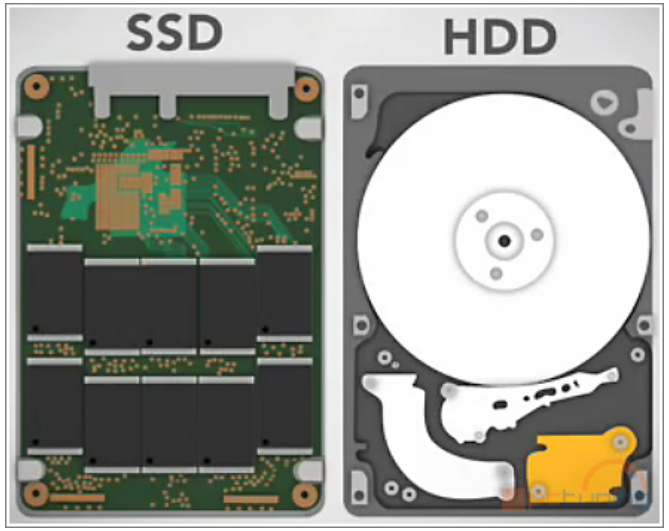
# USB Flash Drive

- Capacity:
  - 8-256GB (common)
  - 512GB and 1TB (new)


- USB 2.0 (60MB/s)
- USB 3.0 (625MB/s)
- USB 3.1 (type-C, 530MB/s)

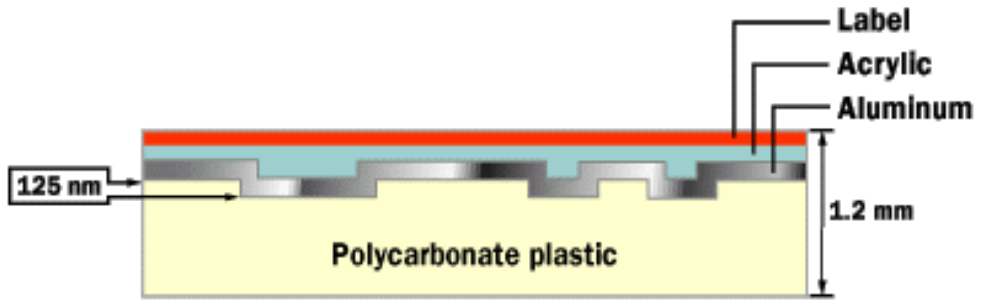
# Solid State Drive

- It uses IC assembly as memory to store data
  - Usually NAND-based flash memory is used
- No moving mechanical components, more resistant to physical shock
- Higher performance with lower access time and latency
- More expensive but improve the slow read/write performance of traditional hard disk drive



# Understanding the Optical Disk

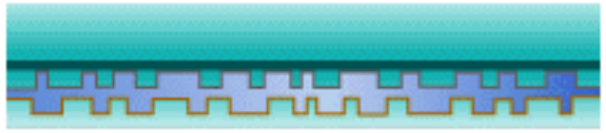
- An optical disk is a fairly simple piece of plastic, about 1.2 mm thick. Most of the optical disks consist of an **injection-molded piece of clear polycarbonate plastic**.
- During manufacturing, this plastic is impressed with microscopic bumps arranged as a single, continuous, extremely long spiral track of data.
- Once the clear piece of polycarbonate is formed, a thin, reflective aluminum layer is sputtered onto the disc, covering the bumps.
- Then a thin acrylic layer is sprayed over the aluminum to protect it. The label is then printed onto the acrylic. A cross section of a complete CD looks like this:



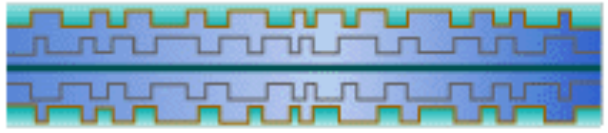
# Various Optical Storage and Multi-layer

**Single-sided, single layer (4.7GB)**

**Single-sided, double layer (8.5GB)**

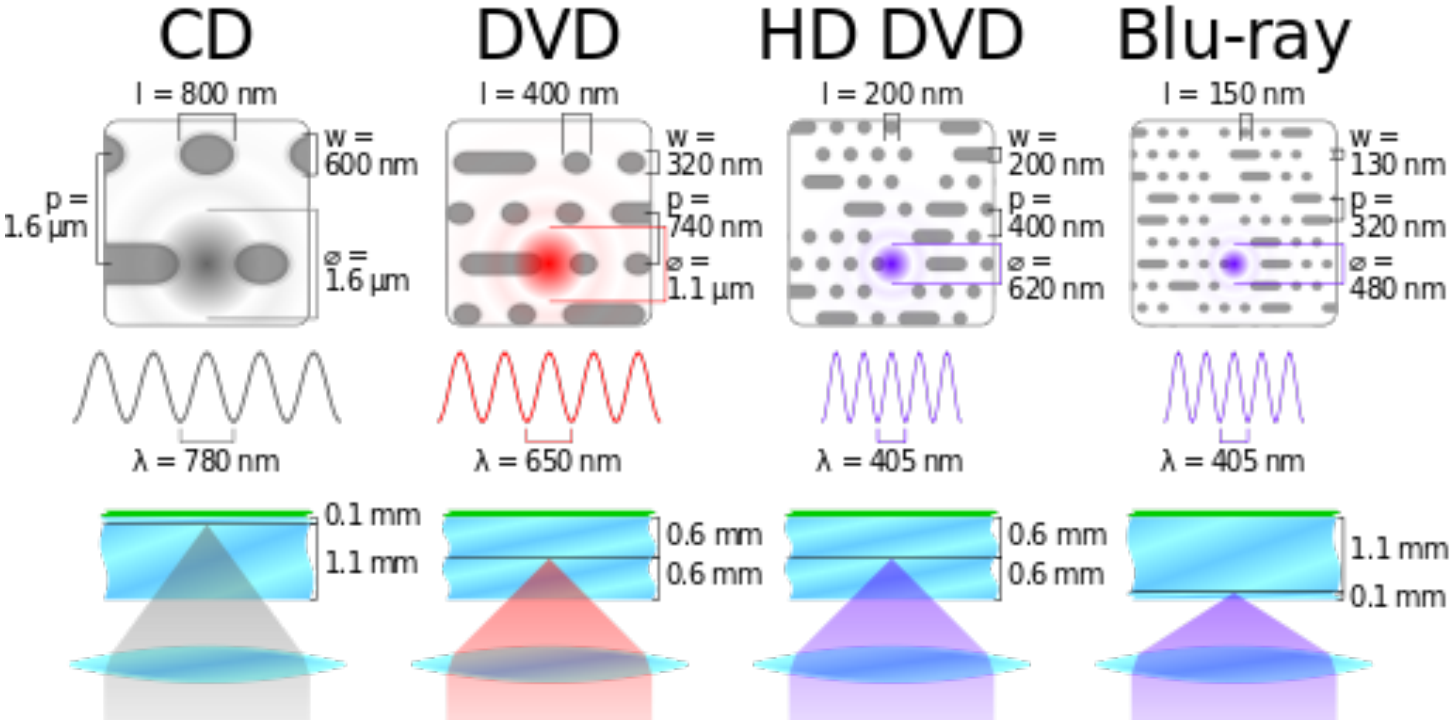


**Double-sided, double layer (17GB)**





DVD formats

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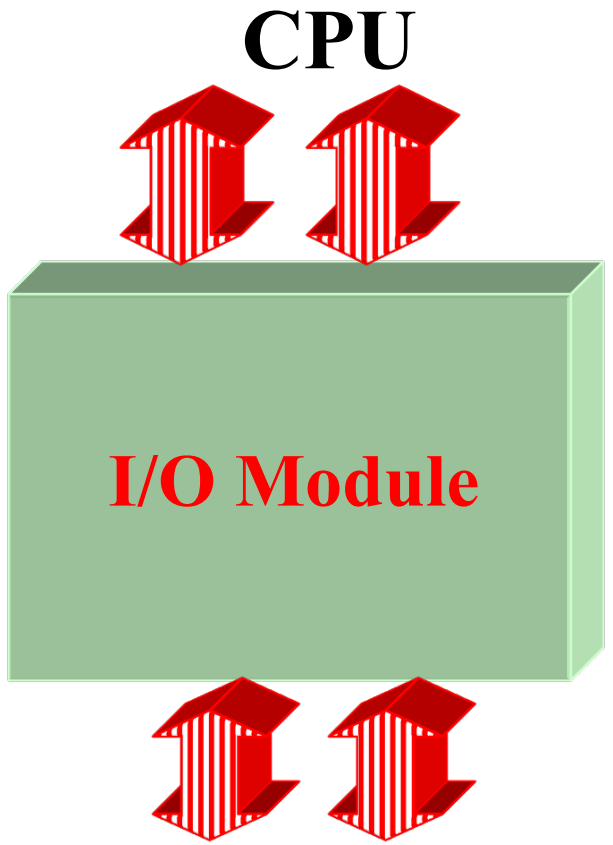
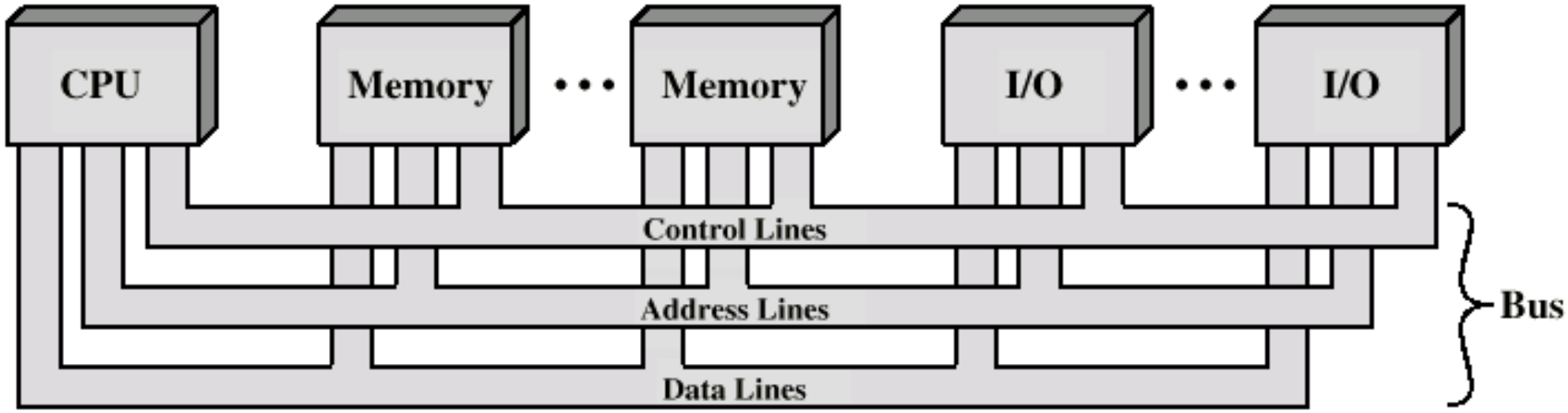
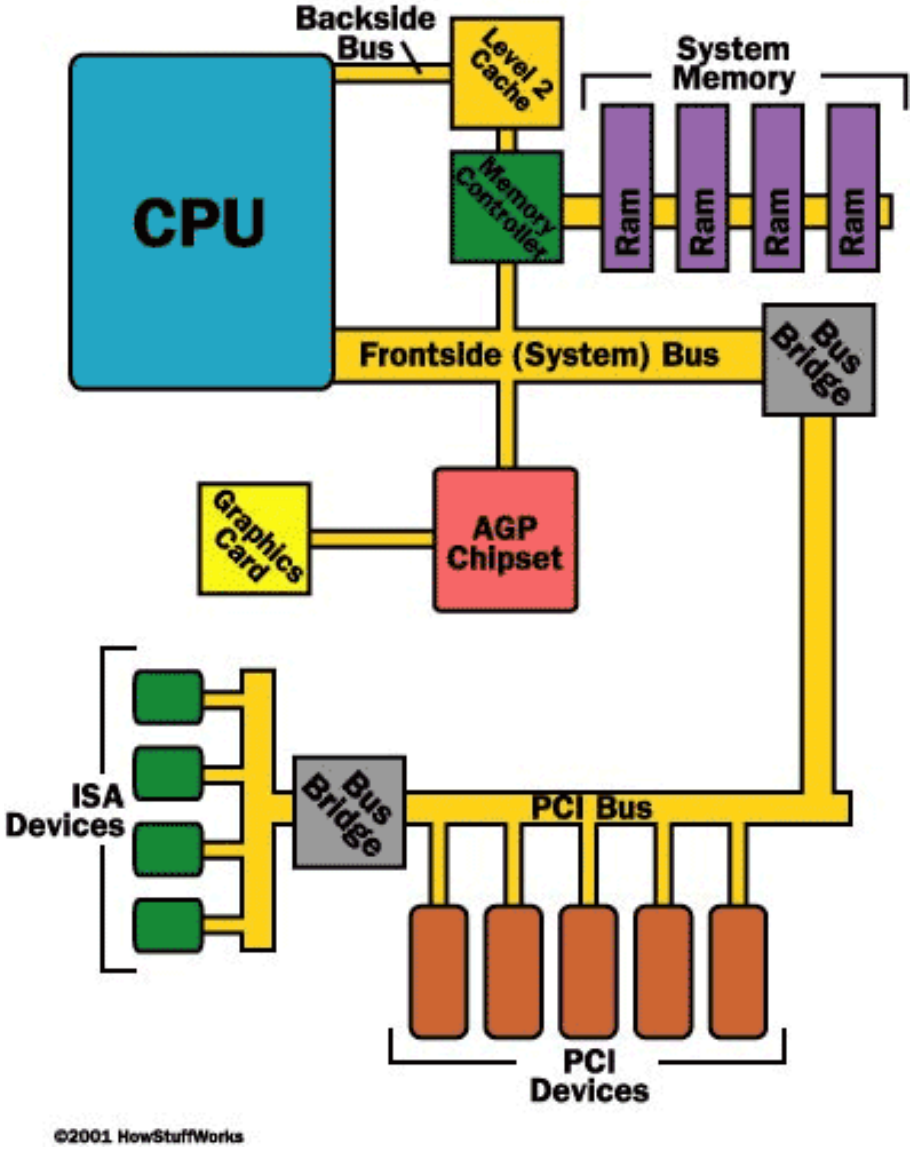
# Input / Output



# Bus Interconnection Scheme



# Computer Buses



# Summary

- CPU structure and organization
- Internal memory characteristics and its types
- External memory types and how data being organized and stored
- Bus interconnection for computer Input and Output