

CSE-141

COMPUTER FUNDAMENTALS

Chapter : 2 (Lesson 1+2)

Topic : Microcomputer System

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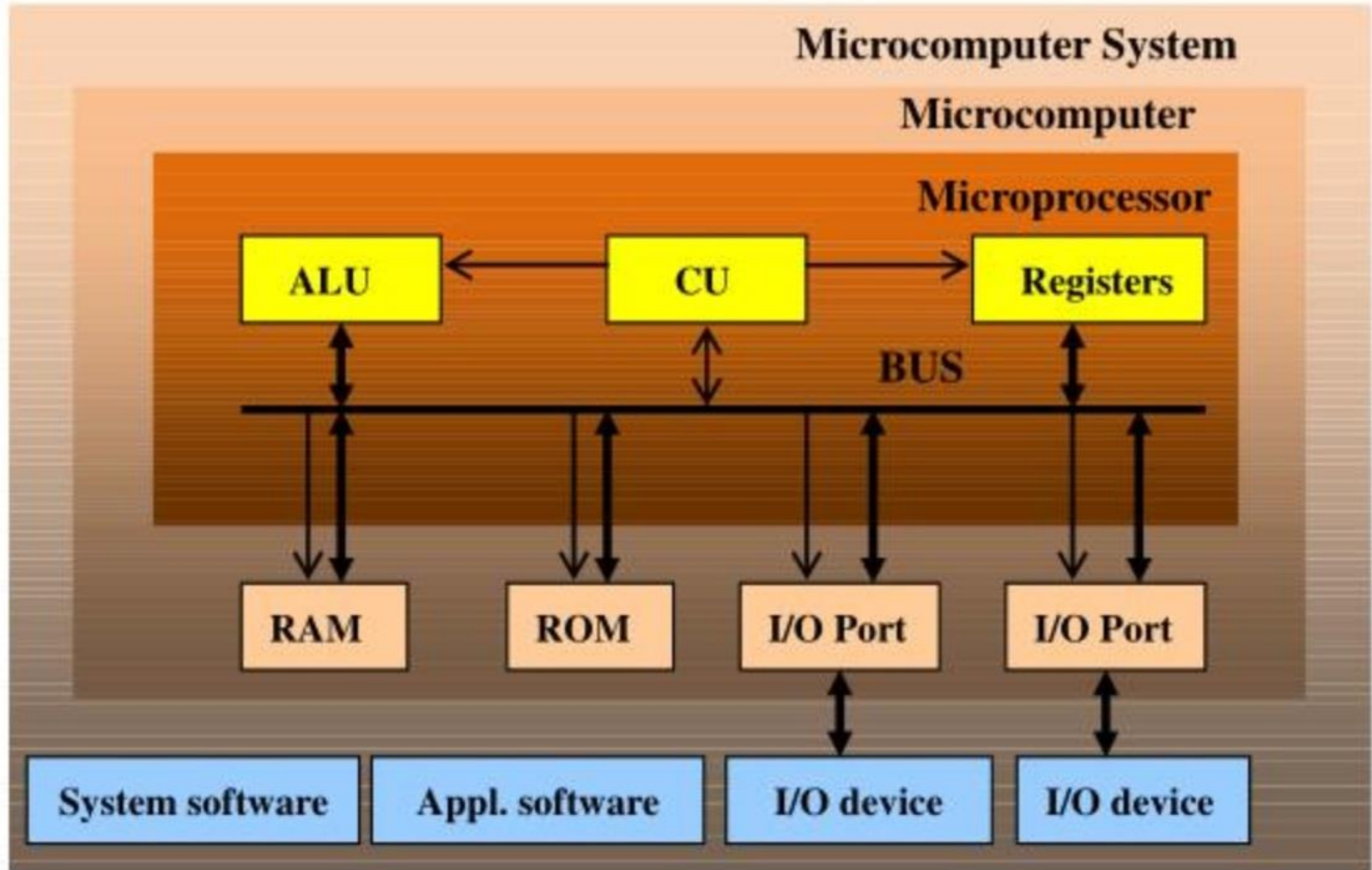
CONTENTS

- Microcomputer System
- Components of microcomputer
- Microprocessor
- Memory
- PC and PC clones

Microcomputer System

- Microcomputer system is a small and inexpensive computer that contains an
 1. Microprocessor Unit (MPU)
 2. Memory (Primary)
 3. Input and output (I/O) devices
 4. Storages (Secondary memory)
 5. Program (Software)

Microcomputer System



Microcomputer System

1. Processor:

- A **processor** is an **integrated** electronic circuit that performs the calculations that run a computer.
- A **processor** performs arithmetical, logical, input/output (I/O) and other basic instructions that are passed from an operating system (OS).
- There are two primary manufacturers of computer microprocessors.
- **Intel and Advanced Micro Devices (AMD)** lead the market in terms of speed and quality.
- Intel's desktop CPUs include **Celeron, Pentium and Core.**
- AMD's desktop **processors** include **Sempron, Athlon and Phenom.**

Microcomputer System

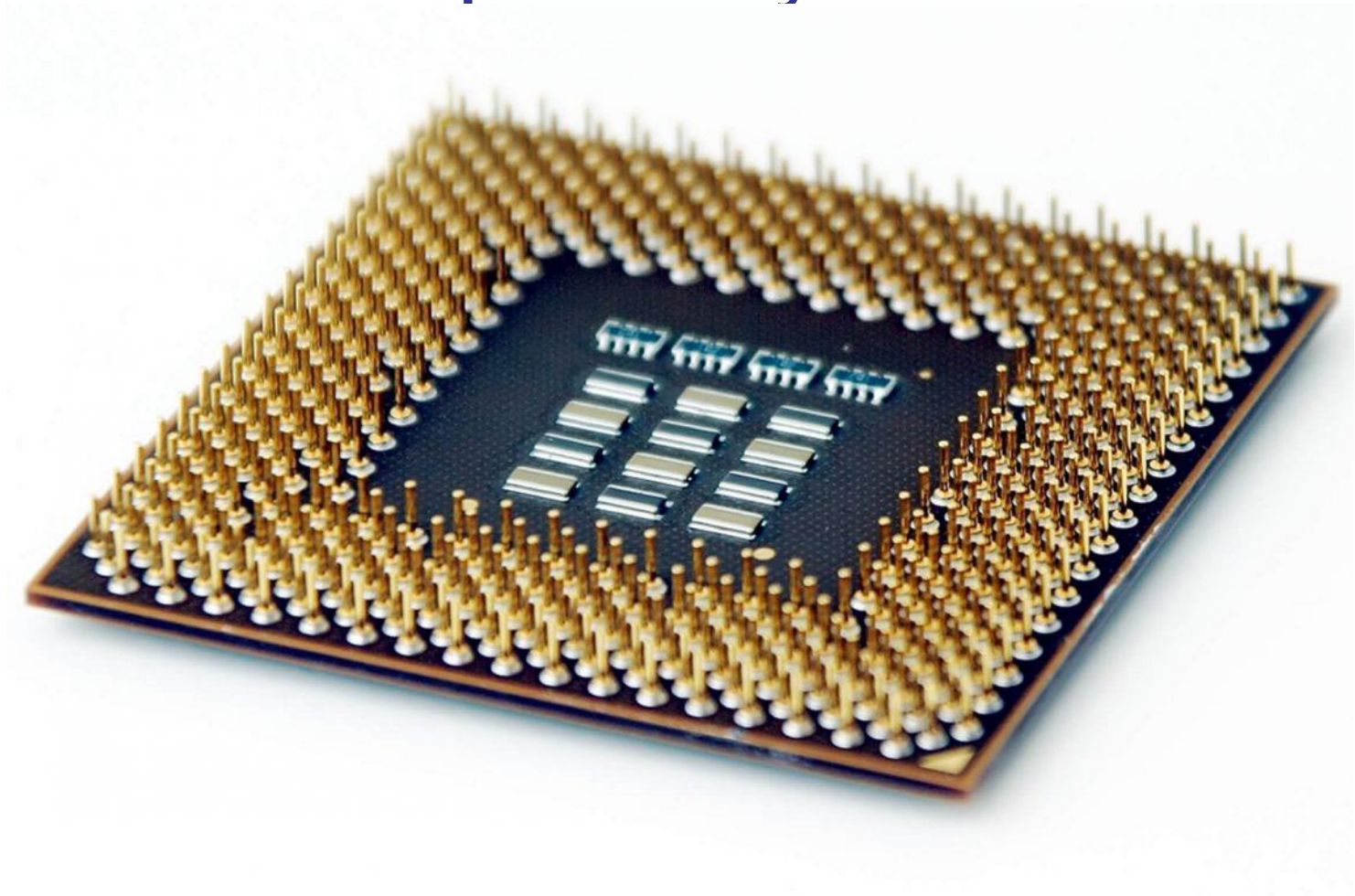


Figure: Inner view of a processor.

Microcomputer System

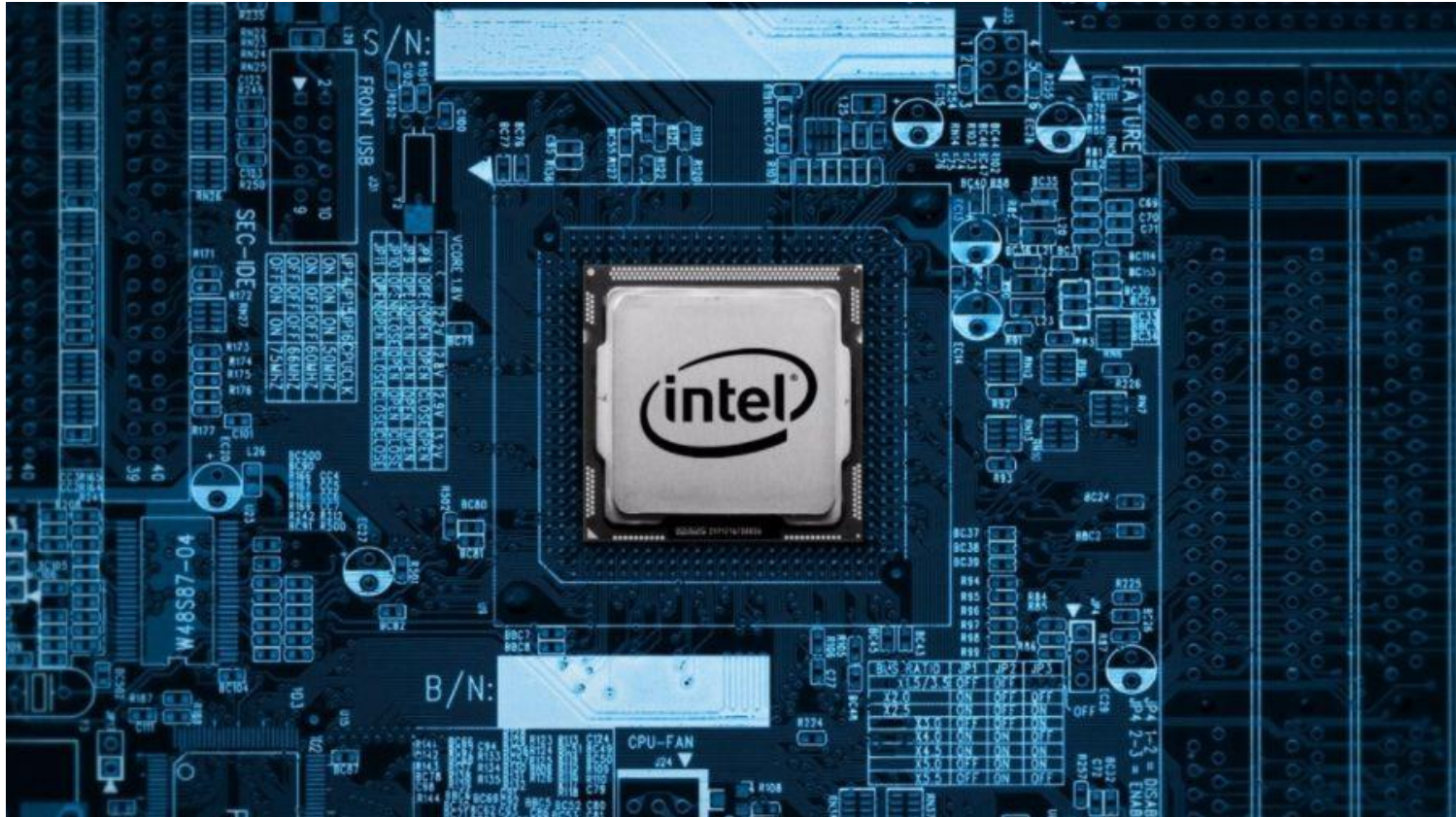


Figure: core i9 processor.

Microcomputer System

2. Memory:

- **Computer memory** is any physical device capable of storing information temporarily, like **RAM** (random access **memory**), or permanently, like **ROM** (read-only **memory**).
- **RAM** can be **read and written** to anytime the CPU commands it, but **ROM** is pre-loaded with data and software that never changes, so the **CPU can only read from it**.
- **ROM** is typically used to store the **computer's initial start-up instructions**.

Microcomputer System



Hard Disk



RAM



ROM



CD/DVD



Fig: Different types of memory

Microcomputer System

3. I/O Devices:

- Input/output (I/O), refers to the communication between an information processing system (such as a computer), and the outside world possibly a human, or another information processing system.
- Input devices such as a keyboard and mouse enable a user to bring data to the computer.
- Output devices like a monitor, printer, and speaker allow the computer to send output to the user, depending on the data it received.
- Devices that provide input or output to the computer are called peripherals.

Microcomputer System

4. Storages:

- A computer's storage is a device that contains the digital data.
- Examples of this are a solid state drive (**SSD**) or a hard disk drive (**HDD**).

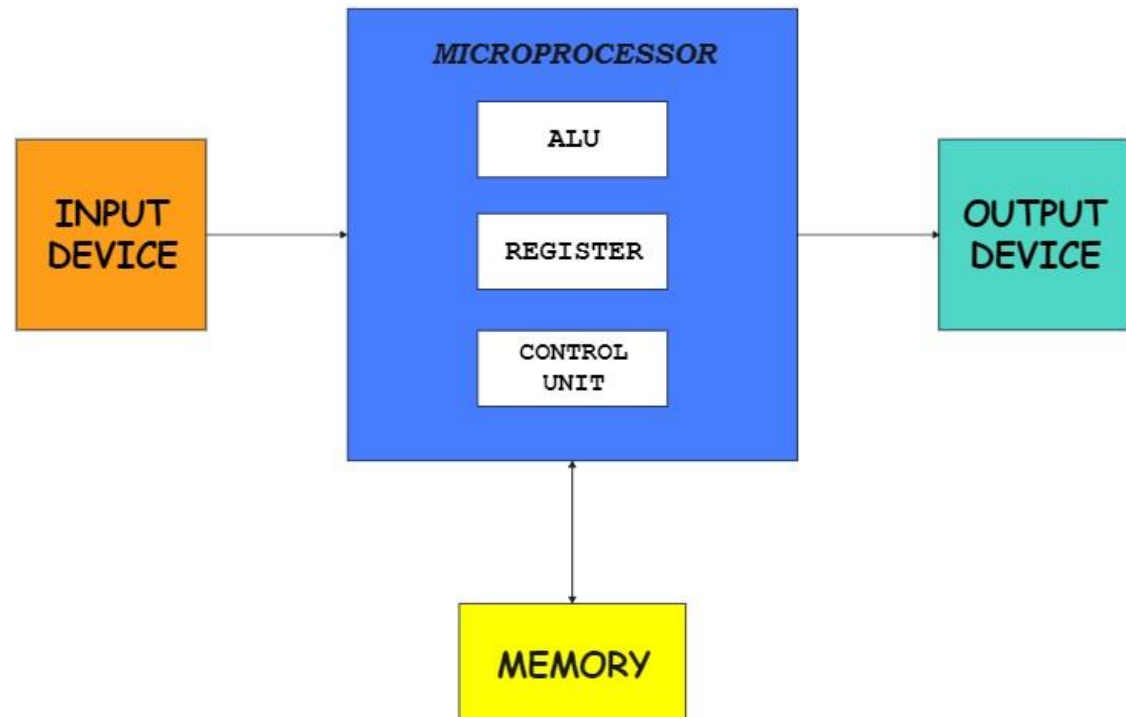
Microcomputer System

5. Program:

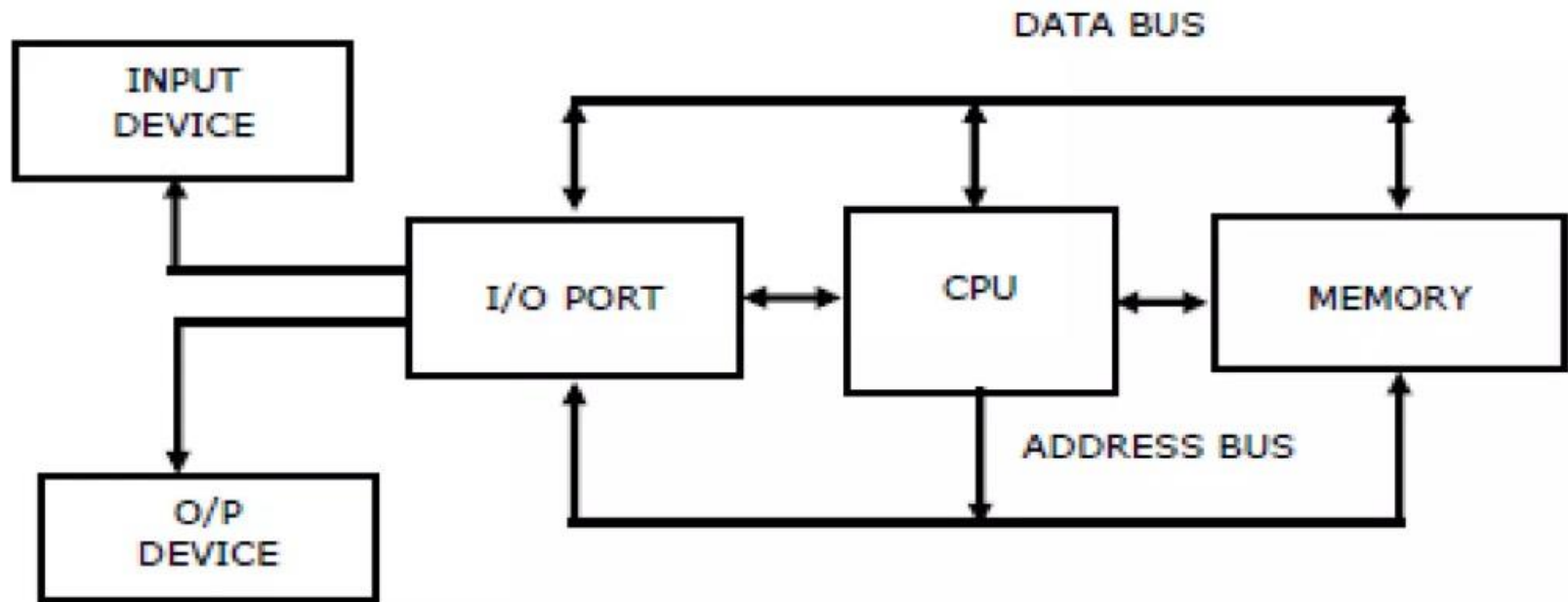
- Basically a software is a program.
- Generally two types of software:
 - i. System Software
 - ii. Application Software

Basic Components of Microcomputer

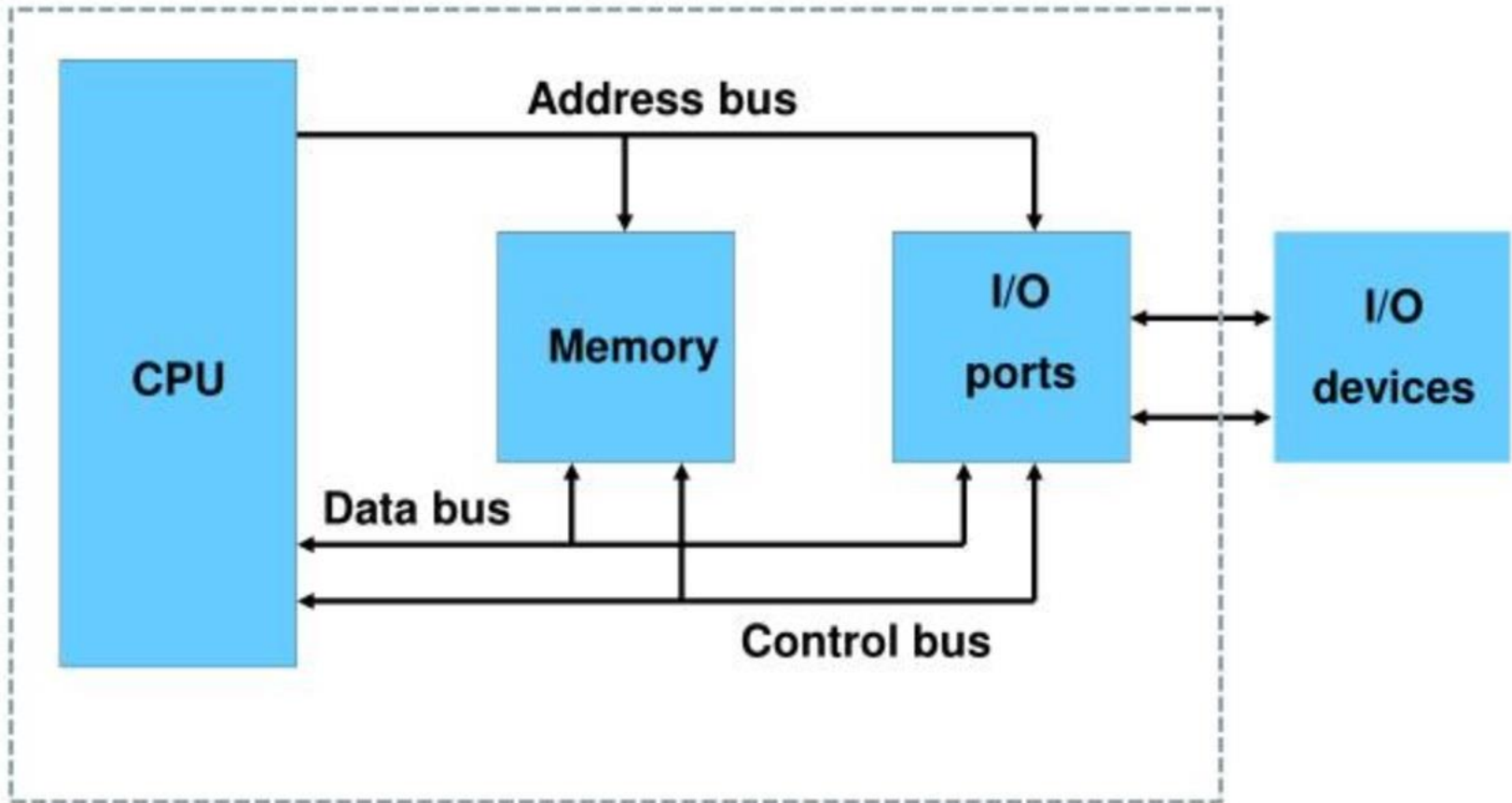
- CPU
- Memory Unit
- Input Unit
- Output Unit



Block Diagram of a Microcomputer



Block Diagram of a Microcomputer



Block Diagram of a Microcomputer

Central Processing Unit (CPU):

- CPU is the brain of microcomputer, which is also sometimes known as MPU (micro-processor unit).
- There are three parts contains here:
 - i. Arithmetic Logical Unit (ALU)
 - ii. Register
 - iii. Control Unit (CU)

Block Diagram of a Microcomputer

i. Arithmetic Logical Unit (ALU)

- The ALU performs **arithmetic operation** such as addition and subtraction, and logic operations such as AND, OR and exclusive OR.
- Results are stored either in **registers or in memory** or set to output devices.

ii. Register

- The registers are used to **store data temporarily** during the execution of program.

iii. Control Unit (CU)

- This unit provides the necessary **control signal** to all the operations in the microcomputer.

Block Diagram of a Microcomputer

System Bus

- i. Address Bus
- ii. Data Bus
- iii. Control Bus

Block Diagram of a Microcomputer

i. Address Bus

➤ A group of lines that are used to send a memory address or device address from the CPU to the memory location or the peripheral.

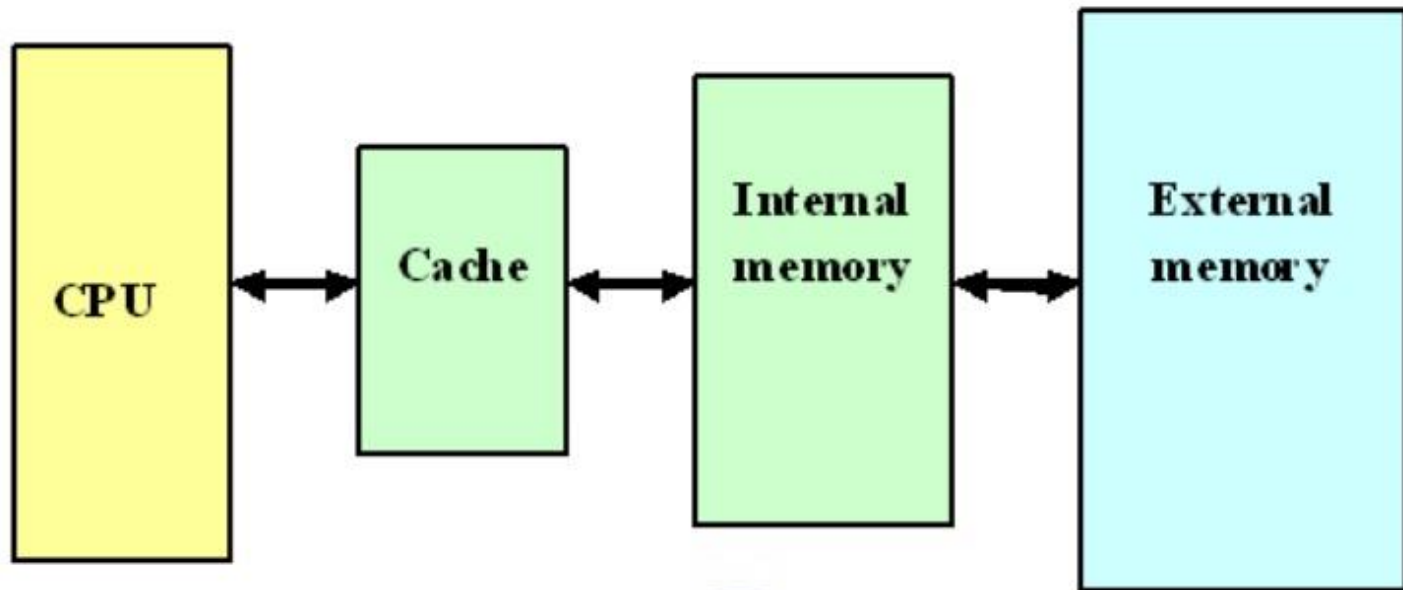
ii. Data Bus

➤ A group of bi-directional lines which are used to transfer data between the CPU and peripherals or memory

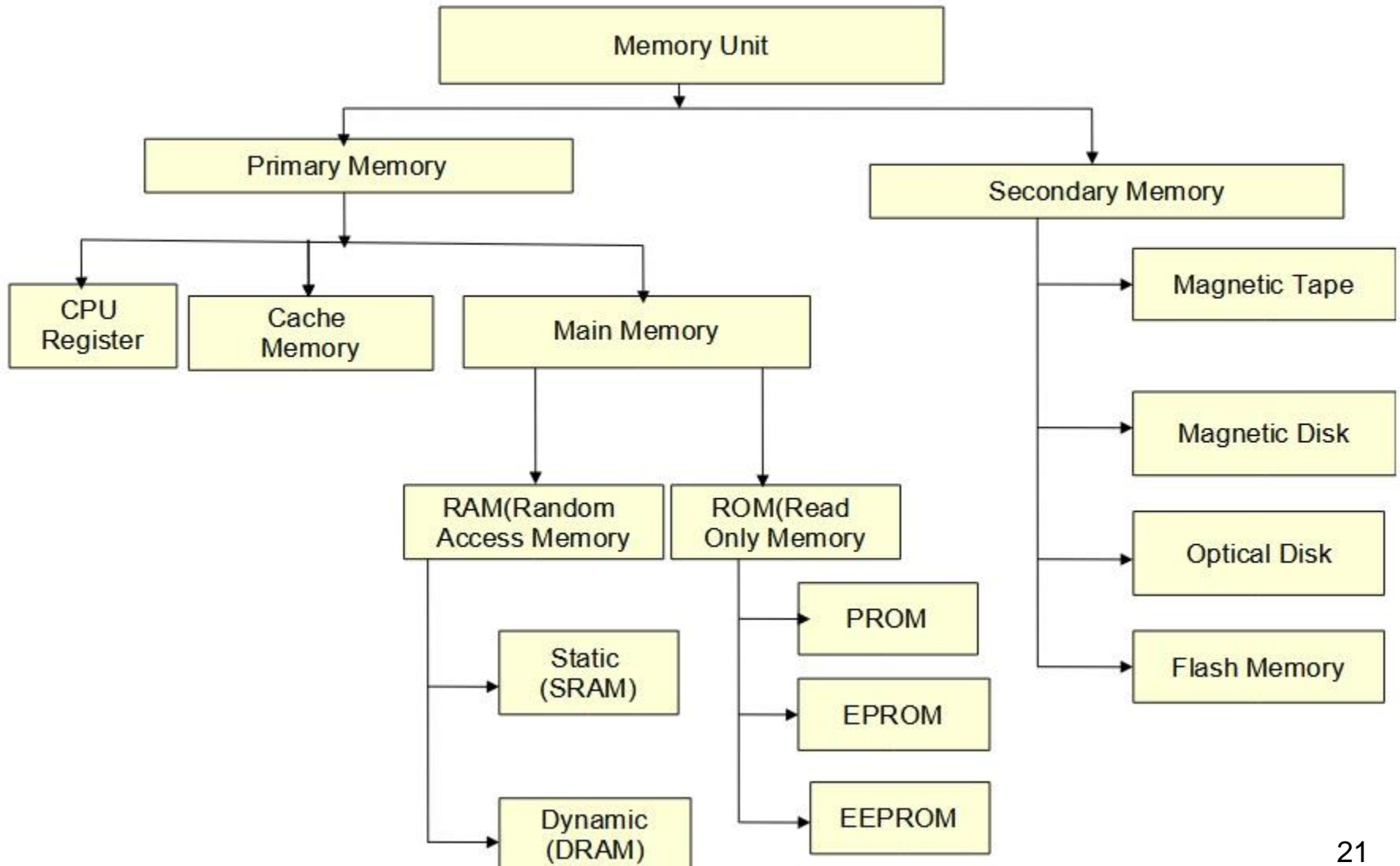
iii. Control Bus

➤ single lines that are generated by the processor to provide controlling of various operations.

Computer Memory



Computer Memory



Computer Memory

Primary Memory (Main Memory)

- There are two types of primary memory. They are:
 - 1) Read Only Memory (ROM)
 - 2) Random Access Memory

1) Read Only Memory (ROM)

- i. MROM
- ii. PROM
- iii. EPROM
- iv. EEPROM

2) Random Access Memory (RAM)

- i. Static RAM
- ii. Dynamic RAM

Computer Memory

RAM	ROM
1. Temporary Storage.	1. Permanent storage.
2. Store data in MBs.	2. Store data in GBs.
3. Volatile.	3. Non-volatile.
4.Used in normal operations.	4. Used for startup process of computer.
5. Writing data is faster.	5. Writing data is slower.

Difference between RAM and ROM

Computer Memory

1) Read Only Memory (ROM)

i. MROM (Mask Read Only Memory)

- MROM is the **earliest** kind of read-only memory (ROM). It is **no longer in use** because it has become outdated.
- This type of pre-programmed chip **cannot** be altered, **reprogrammed**, or erased later.
- Like other types of ROM, mask ROM **cannot enable the user to change the data stored in it**. If it can, the process would be difficult or slow.

Computer Memory

ii. PROM or programmable ROM (programmable read-only memory)

- PROM is a computer memory chip that can be programmed **once after it is created.**
- Once the PROM is programmed, the information written is **permanent and cannot be erased or deleted.**
- PROM was first developed by Wen Tsing Chow in 1956.
- An example of a PROM is a computer BIOS in early computers.
- Today, **PROM in computers has been replaced by EEPROM.**

Computer Memory

iii. EPROM (Erasable Programmable Read-Only Memory)

- **EPROM** is a non-volatile memory chip that was invented by Dov Frohman in 1971 while at Intel that can only be read.
- If exposed to ultraviolet light, an EPROM can be reprogrammed if needed, but otherwise does not accept or save any new data.
- Hardware manufactures use EPROM when it may be needed that the data contained on the EPROM needs to be changed.

Computer Memory

iv. EEPROM(Electrically Erasable Programmable read-only Memory)

- **EEPROM** is a PROM that can be **erased and reprogrammed** using an **electrical charge**.
- Unlike most memory inside a computer, this memory **remembers data when the power is turned off**.
- EEPROM was a replacement for PROM and EPROM chips and is used for later **computer's BIOS** that were built after 1994.
- Having a computer with an EEPROM allows a computer user to **update the BIOS** in their computer without having to open the computer or remove any chips.

Computer Memory

2) Random Access Memory (RAM)

i. Static RAM:

- SRAM stands for Static Random Access Memory.
- It is a type of **semiconductor** which is widely used in computing devices and microprocessors.

ii. Dynamic RAM:

- DRAM stands for Dynamic Random Access Memory.
- It is made of **Capacitors** and has **smaller data life** span than Static RAM.
- There are three types of DRAM:
 - a. SDRAM
 - b. RDRAM
 - c. DDR SDRAM

Computer Memory

DRAM	SRAM
1. Constructed of tiny capacitors that leak electricity.	1. Constructed of circuits similar to D flip-flops.
2. Requires a recharge every few milliseconds to maintain its data.	2. Holds its contents as long as power is available.
3. Inexpensive.	3. Expensive.
4. Slower than SRAM.	4. Faster than DRAM.
5. Can store many bits per chip.	5. Can not store many bits per chip.
6. Uses less power.	6. Uses more power.
7. Generates less heat.	7. Generates more heat.
8. Used for main memory.	8. Used for cache.

Difference between SRAM and DRAM

Computer Memory

ii. Dynamic RAM

a. SDRAM (Synchronous DRAM)

- It is a type of memory that **synchronizes itself** with the **computer's system clock**.
- Being synchronized, allows the memory to run at higher speeds than previous memory types and asynchronous DRAM and also supports up to 133 MHz system bus cycling. Since 1993, this is the prevalent type of memory used in computers around the world.

b. RDRAM (Rambus DRAM)

- This type of RAM chips works in **parallel**, which allows to achieve a data rate of 800 MHz or 1,600 Mbps.
- It generates **much more heat** as they operate at such high speeds.

Computer Memory

c. DDR RAM (Double Data Rate RAM):

- It was first introduced in 1996 and has since been replaced by DDR2.
- DDR utilizes both the rising and falling edge of the system clock, potentially doubling the speed of the memory.
- Today, DDR technology is found on high-end video cards and computer memory such as DDR-SDRAM.

c-1. DDR2:

- DDR2 is the second generation of DDR memory that was released in September 2003.
- DDR2 is capable of operating at greater speeds than DDR, offers a greater bandwidth potential, operates on less power, and generates less heat.
- Due to architectural differences, DDR2 memory modules are incompatible with DDR slots.

Computer Memory

c-2. DDR3:

- It was released in June 2007 as the successor to DDR2.
- DDR3 chips have bus clock speed of 400 MHz up to 1066 MHz, range in size from 1 to 24 GB, and consume nearly 30% less power than their predecessors.
- DDR3 RAM sticks for a desktop computer have 240 pins. For a laptop computer, DDR3 RAM sticks have 204 pins.

c-3. DDR4:

- It was released in September 2014 as the successor to DDR3.
- DDR4 has bus clock speeds that range from 800 to 1600 MHz and range in storage capacity from 4 to 128 GB per DIMM (Dual In-line Memory Module).
- DDR4 is also more efficient at 1.2 V when compared to DDR3's 1.5 to 1.65 V range.

Computer Memory

EDO RAM (Extended Data Out RAM)

- It was developed in 1995 by Micron that was first used with Pentium computers.
- EDO allows a CPU to access memory 10-15% faster.
- An upgraded variation of EDO memory is BEDO (Burst EDO), although it was never widely used.

Computer Memory

Some special memory

- i. Cashe Memory
- ii. Flash Memory
- iii. Virtual Memory

i. Cashe Memory

- Very high speed memory placed **between RAM and CPU**.
- It **increases the speed** of processing.
- It is a storage buffer that **stores data temporarily** and makes available to CPU at a fast rate.

ii. Flash Memory

- It is a semiconductor based **non-volatile rewritable memory**.
- Mostly used in digital camera, mobile phone, printer etc.

iii. Virtual Memory

- It is a storage allocation scheme in which **secondary memory can be addressed** as though it were part of the main memory.
- One major advantages of this memory is that **program can be larger than main memory**.

Computer Memory

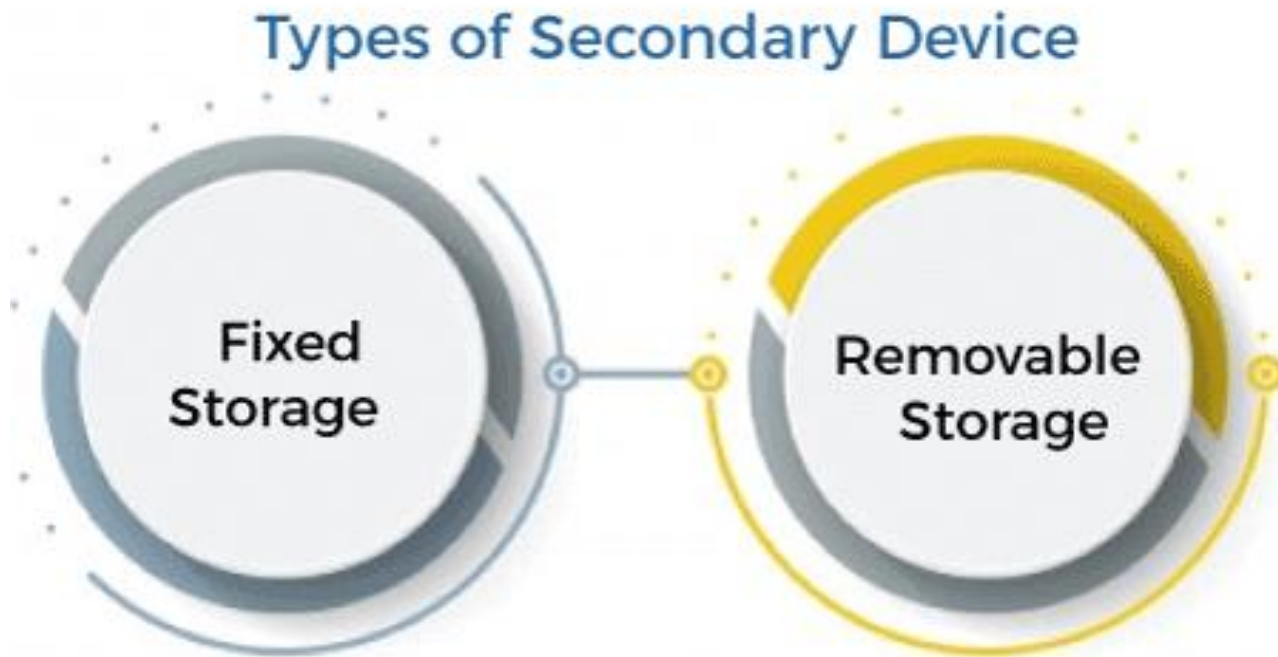
Primary storage	Secondary storage
Also known as Main memory or Internal memory.	Also known as External memory or Auxiliary memory.
Data is directly accessed by the processing unit.	Data is first transferred to main memory and then routed to processing unit.
Semi conductor chips are used to store information in primary memory.	Magnetic disk, optical disks are used to store information in secondary memory.
Information stored is temporary and it can be lost when there is a sudden power cut.	Information stored is permanent unless one deletes it intentionally.
Data operated and stored in uniform manner.	Data stored is not uniform in secondary memory.
Primary memory devices are more expensive than secondary storage devices.	Secondary memory devices are less expensive when compare to primary memory devices.
Nature of Parts of Primary memory varies. RAM- volatile in nature. ROM- Non-volatile	It is little slow in interacting with micro processor.
Primary memory has limited storage capacity.	Whereas secondary memory can store bulk amounts of data in a single unit.
Examples: RAM, ROM, Cache memory, PROM, EPROM, Registers etc	Examples: Magnetic Tapes, Optical Disc, Floppy Disks, Flash memory [USB drives], Paper Tape, Punched cards etc.

Computer Memory

Secondary Memory

There are two types of secondary memory. They are:

- 1) Fixed Storage
- 2) Removable Storage



Computer Memory

1) Fixed Storage

- Fixed storage is an **internal media device** used by a computer system to store data.
- Usually, these are referred to as the fixed disk drives or Hard Drives.
- Example:
 - ✓ Internal flash memory (rare)
 - ✓ SSD (solid-state disk) units
 - ✓ Hard disk drives (HDD)

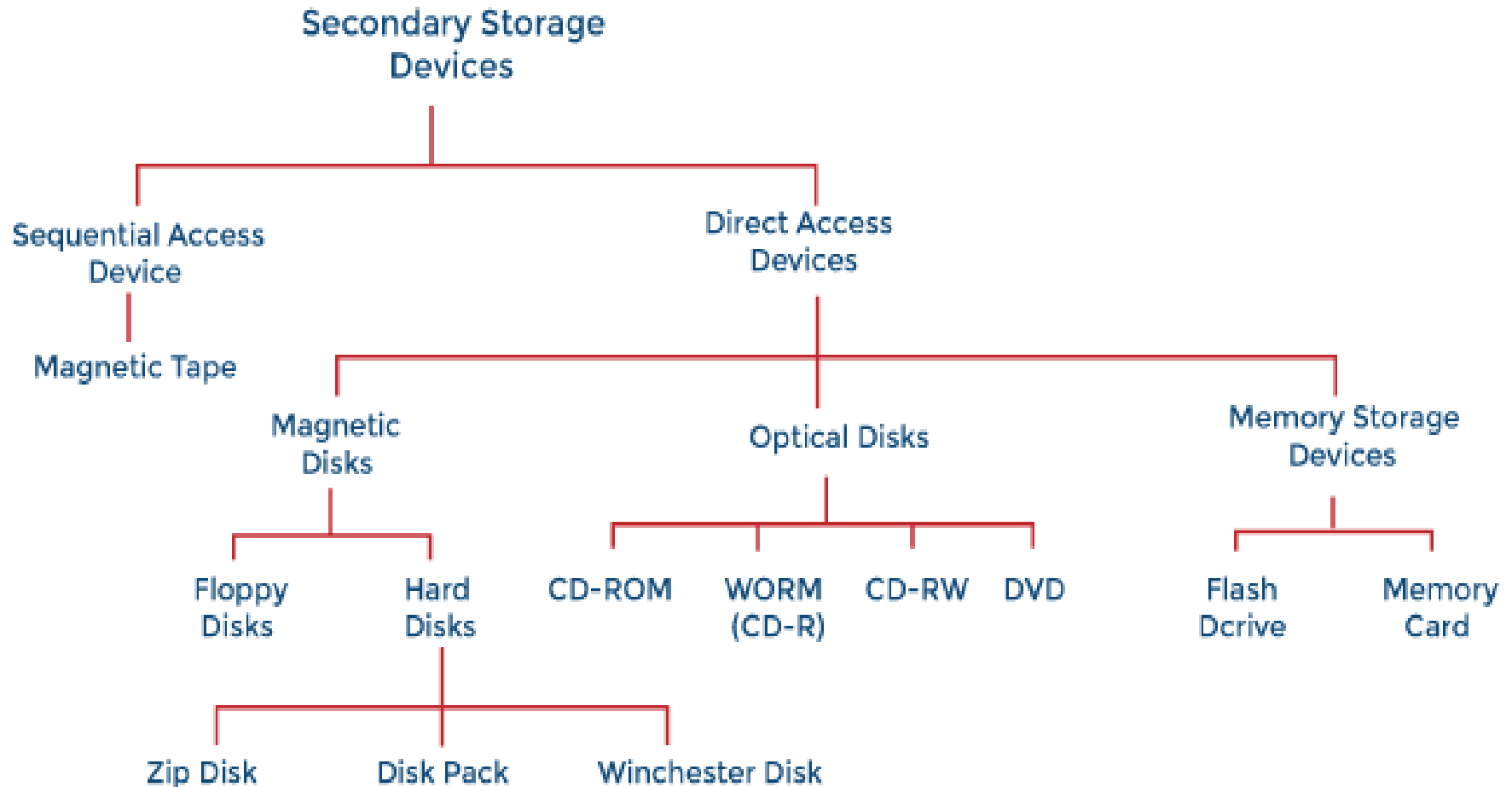
Computer Memory

2) Removable Storage

- Removable storage is an **external media device** that is used by a computer system to store data.
- Usually, these are referred to as the Removable Disks drives or the External Drives.
- Example:
 - ✓ Optical discs (CDs, DVDs, Blu-ray discs)
 - ✓ Memory cards
 - ✓ Floppy disks
 - ✓ Magnetic tapes
 - ✓ Disk packs
 - ✓ Paper storage (punched tapes, punched cards)

Computer Memory

Classification of Secondary Storage Devices



Computer Memory

1. Sequential Access Storage Device

- It is a class of data storage devices that read stored data in a sequence.

i. Magnetic tape:

- ✓ It is a medium for magnetic recording, made of a thin, magnetizable coating on a long, narrow strip of plastic film.
- ✓ Devices that record and play audio and video using magnetic tape are tape recorders and videotape recorders.
- ✓ A device that stores computer data on magnetic tape is known as a tape drive.

Magnetic tape



Computer Memory

2. Direct Access Storage Devices

- It is a class of data storage devices that read stored data in a sequence.
 - i. **Magnetic disks:**
 - ✓ A magnetic disk is a storage device that uses a magnetization process to write, rewrite and access data.
 - ✓ It is covered with a magnetic coating and stores data in the form of tracks, spots and sectors.
 - ✓ Hard disks, zip disks and floppy disks are common examples of magnetic disks.

Computer Memory

2. Direct Access Storage Devices

i. Magnetic disks

a. Floppy disks:

- ✓ A floppy disk is a flexible disk with a **magnetic coating** on it, and it is packaged inside a protective plastic envelope.
- ✓ These are among the oldest portable storage devices that could store up to 1.44 MB of data, but now they are not used due to very little memory storage.

Magnetic Disks (Floppy Disk)



Computer Memory

2. Direct Access Storage Devices

i. Magnetic disks

b. Hard Disk Drive (HDD):

- ✓ Hard disk drive comprises a series of circular disks called platters arranged one over the other almost $\frac{1}{2}$ inches apart around a spindle.
- ✓ Disks are made of non-magnetic material like aluminum alloy and coated with 10-20 nm magnetic material.
- ✓ The standard diameter of these disks is 14 inches, and they rotate with speeds varying from 4200 rpm (rotations per minute) for personal computers to 15000 rpm for servers.
- ✓ Data is stored by magnetizing or demagnetizing the magnetic coating. A magnetic reader arm is used to read data from and write data to the disks.
- ✓ A typical modern HDD has a capacity in terabytes (TB).

Magnetic Disks (Hard Disk)



Computer Memory

2. Direct Access Storage Devices

ii. Optical disks:

- ✓ An optical disk is any computer disk that uses optical storage techniques and technology to read and write data.
- ✓ It is a computer storage disk that stores data digitally and uses laser beams to read and write data.

Computer Memory

2. Direct Access Storage Devices

ii. Optical disks

a. CD Drive:

- CD stands for Compact Disk. CDs are circular disks that use optical rays, usually lasers, to read and write data.
- There are three types of CDs:
 - ❖ **CD-ROM** (Compact Disk - Read Only Memory):
 - ✓ The manufacturer recorded the data on these CDs.
 - ✓ Proprietary Software, audio or video are released on CD-ROMs.
 - ❖ **CD-R** (Compact Disk - Recordable):
 - ✓ The user can write data once on the CD-R.
 - ✓ It cannot be deleted or modified later.
 - ❖ **CD-RW** (Compact Disk - Rewritable):
 - ✓ Data can repeatedly be written and deleted on these optical disks.

Optical Disks (CD Drive)



Computer Memory

2. Direct Access Storage Devices

ii. Optical disks

b. DVD Drive:

- ✓ DVD stands for digital video display.
- ✓ DVD is an optical device that can store 15 times the data held by CDs.
- ✓ They are usually used to store rich multimedia files that need high storage capacity.
- ✓ DVDs also come in three varieties - read-only, recordable and rewritable..

Optical Disks (DVD Drive)



Computer Memory

2. Direct Access Storage Devices

ii. Optical disks

c. Blu Ray Disk:

- ✓ Blu Ray Disk (BD) is an optical storage media that stores high definition (HD) video and other multimedia files.
- ✓ BD uses a shorter wavelength laser than CD/DVD, enabling the writing arm to focus more tightly on the disk and pack in more data.
- ✓ BDs can store up to 128 GB of data.

Optical Disks (Blu Ray Disk)



Computer Memory

3. Memory Storage Devices

- A memory device contains **trillions** of interconnected memory cells that store data.
- When switched on or off, these cells hold millions of transistors representing 1s and 0s in binary code, allowing a computer to read and write information.
- It includes **USB drives, flash memory devices, SD and memory cards.**

Memory Storage Devices



Clone PC

- Today, a PC clone is a Windows computer **that is not made by one of the major PC vendors** such as HP, Dell or Lenovo.
- The term “clone PC” lost its meaning around 1990. We need to go back to the '80s to determine what it was.
- In the **1980s**, there was the IBM PC, the original. a **PC clone was a PC not made by IBM.**
- After a while, other manufacturers **starting making their own machines, built on IBM's design.** These were the “clones”. Their main selling point was “it works the same as IBM's”.
- Later, these makers started to make their own improvements, while still being able to run MS-DOS and Windows.