Course Contents

Unit 2:Computer Hardware (8 Hrs.)

- Introduction
- Central Processing Unit(CPU)
- Components of CPU
- Instruction Format
- Instruction set
- Instruction cycle
- Microprocessor
- Computer Bus
- Components of Computer Cabinet

Course Contents

- Computer Memory: Memory Representation, Memory Hierarchy, CPU Registers, Cache Memory, Primary Memory, Secondary Memory , Access types of storage devices
- Input and Output Devices: Input-Output Unit, Input Devices, Human Data Entry Devices, Source Data Entry Devices , I/O Port , I/O System

Course Contents

Unit-2 Computer Hardware

Questions:

What is RISC and CISC? Explain RISC and CISC with their merits and demerits.

Computer Hardware

All the electronic devices which we can touch & feel is called hardware. Hardware is tangible components. As for example, Mother board, hard disk, RAM, ROM,CPU & printer etc.

Different hardware components

- Motherboard
- CPU
- RAM
- Hard drive
- Solid-state drive (SSD)
- Optical drive
- Heat sink

Different hardware components

- There are five main hardware components in a computer system: **Input, Processing, Storage, Output and Communication devices**. Are devices used for entering data or instructions to the central processing unit.

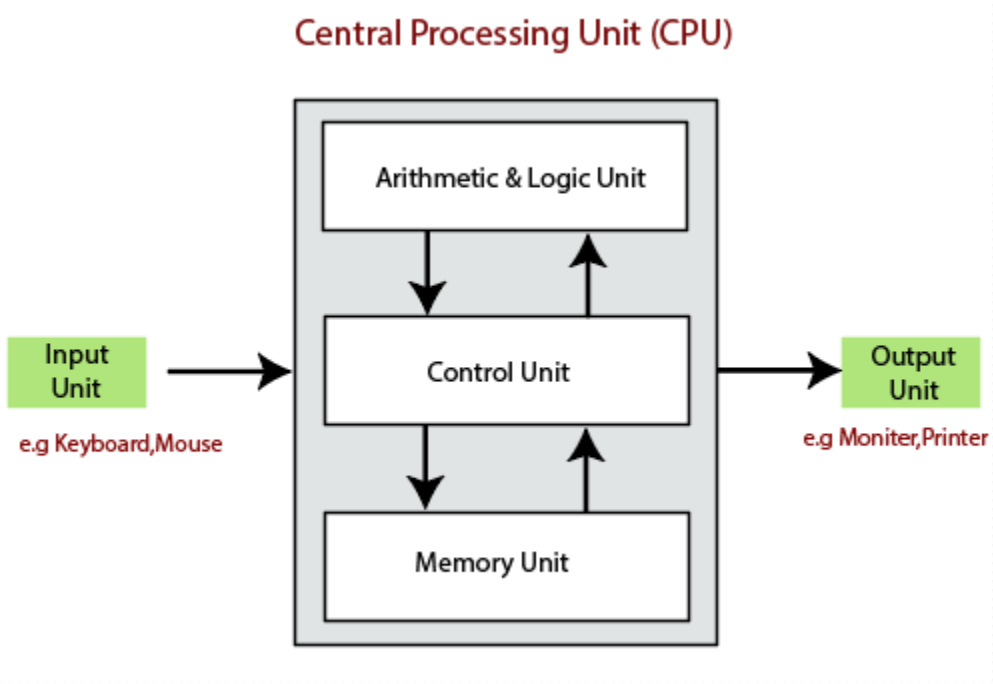
Components of CPU

- Control unit (CU)
- Arithmetic logic unit (ALU)
- Registers.

Central Processing Unit(CPU)

CPU or central processing unit is an electronic circuitry that carries out the instruction given by a computer program. CPU execute instruction by performing basic arithmetic, logical, control and I/O operations as required per instruction. CPU is considered to be the brain of the computer. The speed and efficiency of a computer mostly depends that of it's CPU. It is both the combination of control unit(CU) and ALU. It is also known as heart of computer.

Block diagram of Processor



Functions of CPU

- Transferring data between memory and I/O devices
- Controlling all other parts of the machine and sending timing signals.
- Fetching data and instructions from memory
- Decoding instruction
- Performing arithmetical and logical operations
- Executing programs stored in memory
- Performing communication among the I/O devices etc.

Computer Memory

Memory

Memory is basically a device that has the capacity to store information. A memory unit is the amount of data that the memory can hold. Besides, we measure this storage capacity in terms of bytes. Moreover, there are different units of memory as per the requirement.

Parts of Memory

- Primary Memory

This is the internal memory that stores the data and instructions of the CPU. It is volatile in nature (data is lost when the power is disconnected).

The primary memory has two types:

- **RAM (Random Access Memory)**

Data can be accessed randomly and quickly.

- **ROM (Read Only Memory)**

We can only read data and cannot write (store) to it.

Parts of Memory

- Secondary Memory

As we know that the primary memory is volatile therefore, we need some devices to store the data permanently so we use some external storage devices for this purpose which we name as the secondary memory. Some examples: CD, DVD, etc.

Units of Memory

The storage capacity of the memory is expressed in various units of memory. These are as follows:

- **Bit**

A microprocessor uses binary digits 0 and 1 to decide the OFF and ON state respectively, of various circuits. Furthermore, a bit is the smallest unit of representation in the binary language.

- **Nibble**

A nibble is a collection of 4 bits.

Units of Memory

- **Byte**

A byte is the representation of a group of 8 bits. Moreover, a byte is a unit that expresses any word, symbol, or character in the computer language. Besides, computer memory is always in terms of multiples of bytes.

Units of Memory

- **Word**

A computer word is similar to a byte, as it is also a group of bits. Moreover, a computer word is fixed for each computer. At the same time it varies from computer to computer. Besides, the length of a computer word is the **word-size or word length**. Therefore, a computer stores information in the form of computer word.

The following table shows conversion of Bits and Bytes –

Byte Value	Bit Value
1 Byte	8 Bits
1024 Bytes	1 Kilobyte
1024 Kilobytes	1 Megabyte
1024 Megabytes	1 Gigabyte
1024 Gigabytes	1 Terabyte
1024 Terabytes	1 Petabyte
1024 Petabytes	1 Exabyte
1024 Exabytes	1 Zettabyte
1024 Zettabytes	1 Yottabyte
1024 Yottabytes	1 Brontobyte

Instruction format

What is instruction format?

- An instruction is normally made up of a combination of an operation code and some way of specifying an operand, most commonly by its location or address in memory

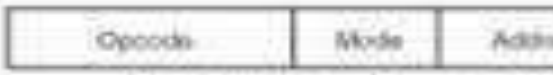
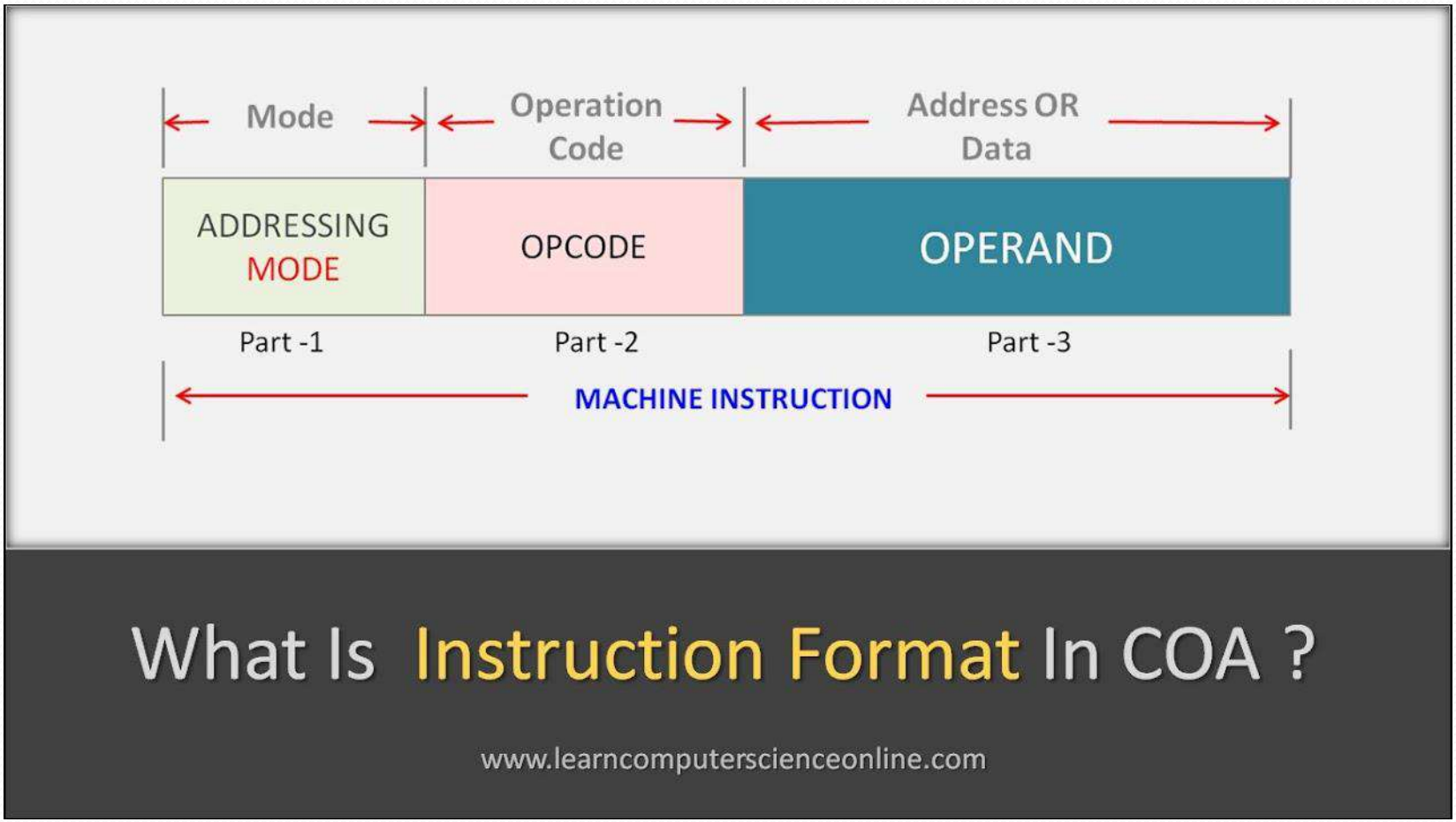


Fig. 9-3. Instruction Format with Mode Field

Concept of operation code and operand



Concept of operation code and operand

- **Addressing Modes**– The term addressing modes refers to the way in which the operand of an instruction is specified. The addressing mode specifies a rule for interpreting or modifying the address field of the instruction before the operand is actually executed.

Concept of operation code and operand

- In computing, an op code (abbreviated from operation code, also known as instruction machine code, instruction code, instruction syllable, instruction parcel or op string) is **the portion of a machine language instruction that specifies the operation to be performed**.

Concept of operation code and operand

- An operand is **the part of an instruction representing the data manipulated by the operator**. For example, when you add two numbers, the numbers are the operand and "+" is the operator.

Instruction Set

An instruction set is a group of commands for a central processing unit (CPU) in machine language. The term can refer to all possible instructions for a CPU or a subset of instructions to enhance its performance in certain situations.

Examples of instruction set

- **ADD** - Add two numbers together.
- **COMPARE** - Compare numbers.
- **IN** - Input information from a device, e.g., keyboard.
- **JUMP** - Jump to designated RAM address.
- **JUMP IF** - Conditional statement that jumps to a designated RAM address.
- **LOAD** - Load information from RAM to the CPU.
- **OUT** - Output information to device, e.g., monitor.
- **STORE** - Store information to RAM.

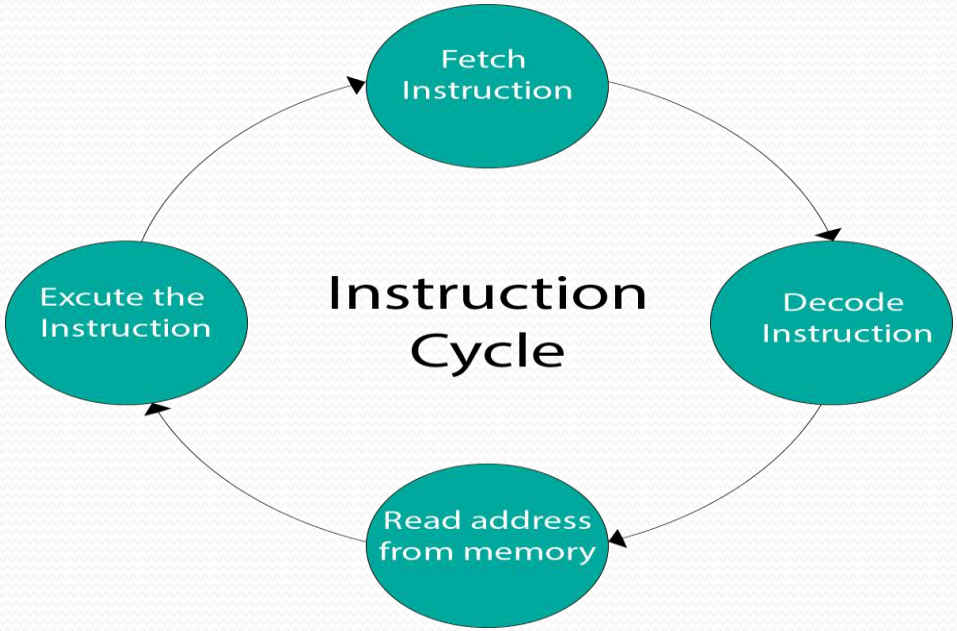
Instruction Cycle

A program residing in the memory unit of a computer consists of a sequence of instructions. These instructions are executed by the processor by going through a cycle for each instruction.

In a basic computer, each instruction cycle consists of the following phases.

1. Fetch instruction from memory.
2. Decode the instruction.
3. Read the effective address from memory.
4. Execute the instruction.

Example of Instruction Cycle



Microprocessor

- A microprocessor is an integrated circuit(IC) which incorporates core functions of a computer's central processing unit (CPU). It is a programmable multipurpose silicon chip, clock driven, register based, accepts binary data as input and provides output after processing it as per the instructions stored in the memory.

Microprocessor

How does a Microprocessor work ?

- A processor is the brain of a computer which basically consists of Arithmetical and Logical Unit (ALU), Control Unit and Register Array. As the name indicates ALU performs all arithmetic and logical operations on the data received from input devices or memory. Register array consists of a series of registers like accumulator (A), B, C, D etc. which acts as temporary fast access memory locations for processing data. As the name indicates, control unit controls the flow of instructions and data throughout the system.
- So, basically a microprocessor takes input from input devices, process it as per instructions given in the memory and produces output.

Microprocessor

Advantages of a Microprocessor

- **Low cost**

Microprocessors are available at low cost due to integrated circuit technology. Which will reduce the cost of a computer system.

- **High speed**

Microprocessor chips can work at very high speed due to the technology involved in it. It is capable of executing millions of instructions per second.

Microprocessor

Advantages of a Microprocessor

- **Small size**

Due to very large scale and ultra large scale integration technology, a microprocessor is fabricated in a very less footprint. This will reduce the size of the entire computer system.

- **Versatile**

Microprocessors are very versatile, the same chip can be used for a number of applications by simply changing the program (instructions stored in the memory).

Microprocessor

Advantages of a Microprocessor

- **Low power consumption**

Microprocessors are usually manufactured using metal oxide semiconductor technology, in which MOSFETs (Metal Oxide Semiconductor Field Effect Transistors) are working in saturation and cut off modes. So the power consumption is very low compared to others.

Microprocessor

Advantages of a Microprocessor

- **Less heat generation**

Compared to vacuum tube devices, semiconductor devices won't emit that much heat.

- **Reliable**
  Microprocessors are very reliable, failure rate is very less as semiconductor technology is used.
- **Portable**
  Devices or computer system made with microprocessors can be made portable due to the small size and low power consumption.

Microprocessor

RISC and CISC Architecture

RISC & CISC is the technologies on which design & architecture of microprocessor is based.

RISC

RISC means reduced instruction set computer in which each instruction has dedicated electronic circuits made from gates, to generate control signal . As for example Power PC,ULTRASPARC etc.

Microprocessor

RISC

Characteristics of RISC

- Simple instruction set.
- Same length instructions.
- 1-machine –cycle instructions.

Advantages of RISC

- Speed : 2 to 4 times the performance.
- Simpler hardware.
- Shorter design cycle : They can be design more quickly.

Microprocessor

CISC

CISC means complex instruction set computer which based on microprogramming techniques. The hardware is controlled by instructions coded in control memory. Such instruction is called microinstruction & coding process is called micro programming. CISC is more complex but efficient processor designing technique. As for example,80386,80486,80586,80686,I3,I5,I7 etc.

Microprocessor

Advantages of CISC

- Microprogramming is easy as assembly language to implement & much expensive than hardwiring a control unit.
- Micro coding instructions allowed to the designers to make CISC machine upwardly compatible.
- As each instruction become more capable ,fewer instructions could be used to implement a given task.

Microprocessor

Disadvantages of CISC

- Earlier generations of a processor family were generally contained as a subset in every new versions so instruction set & each generations of computers are varying.

Microprocessor

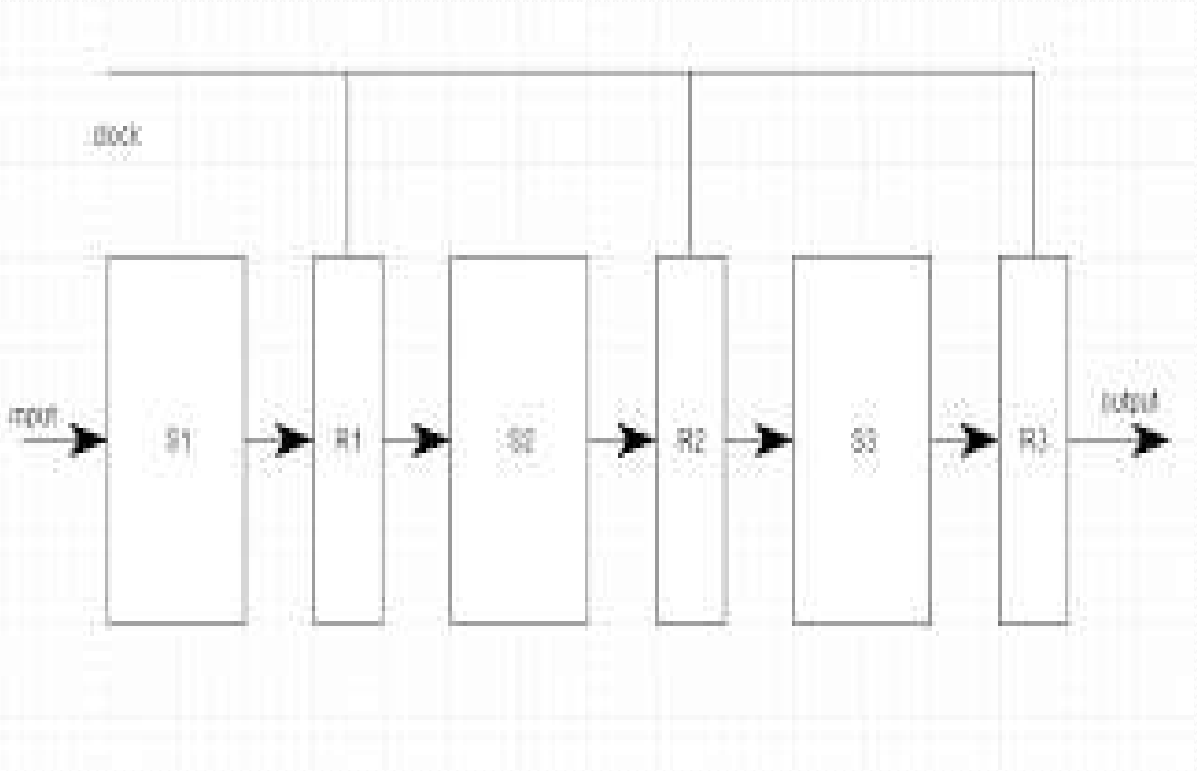
RISC VS CISC

RISC	CISC
Emphasis on software	Emphasis on hardware
Small number of fixed length instructions	Large number of instructions
Simple, standardized instructions	Complex, variable-length instructions
Single clock cycle instructions	Instructions can take several clock cycles
Heavy use of RAM	More efficient use of RAM

Concept of Pipelining

- Pipelining is **a technique where multiple instructions are overlapped during execution**. Pipeline is divided into stages and these stages are connected with one another to form a pipe like structure. Instructions enter from one end and exit from another end. Pipelining increases the overall instruction throughput.

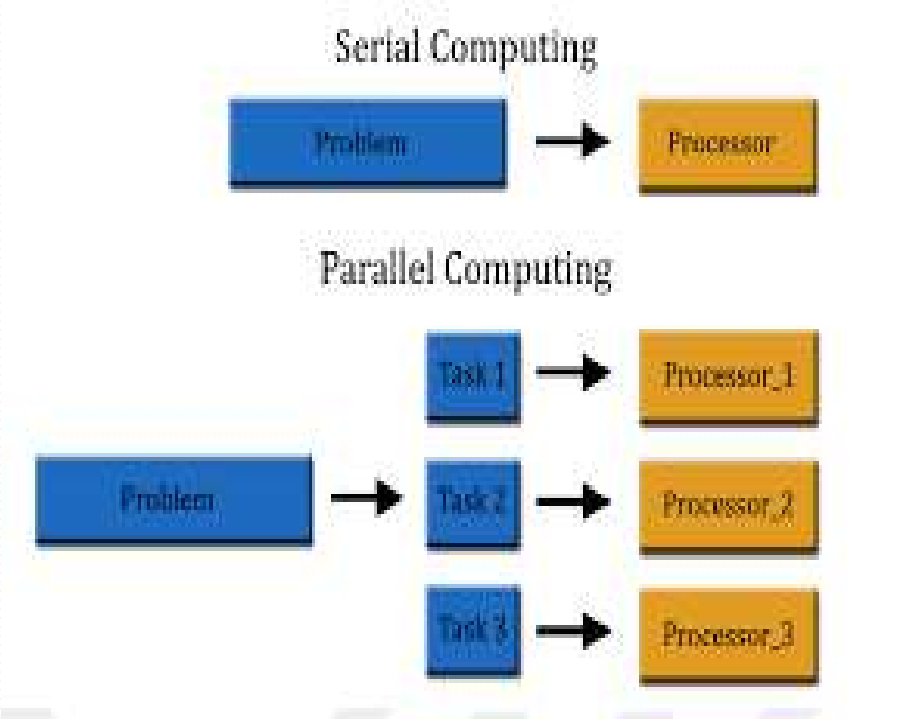
Example



Parallel Processing

Parallel processing is **a method in computing of running two or more processors (CPUs) to handle separate parts of an overall task**. Breaking up different parts of a task among multiple processors will help to reduce the amount of time to run a program.

Example


Serial Computing
Problem
Processor
Parallel Computing
Problem
Task 1
Task 2
Task 3
Processor_1
Processor_2
Processor_3

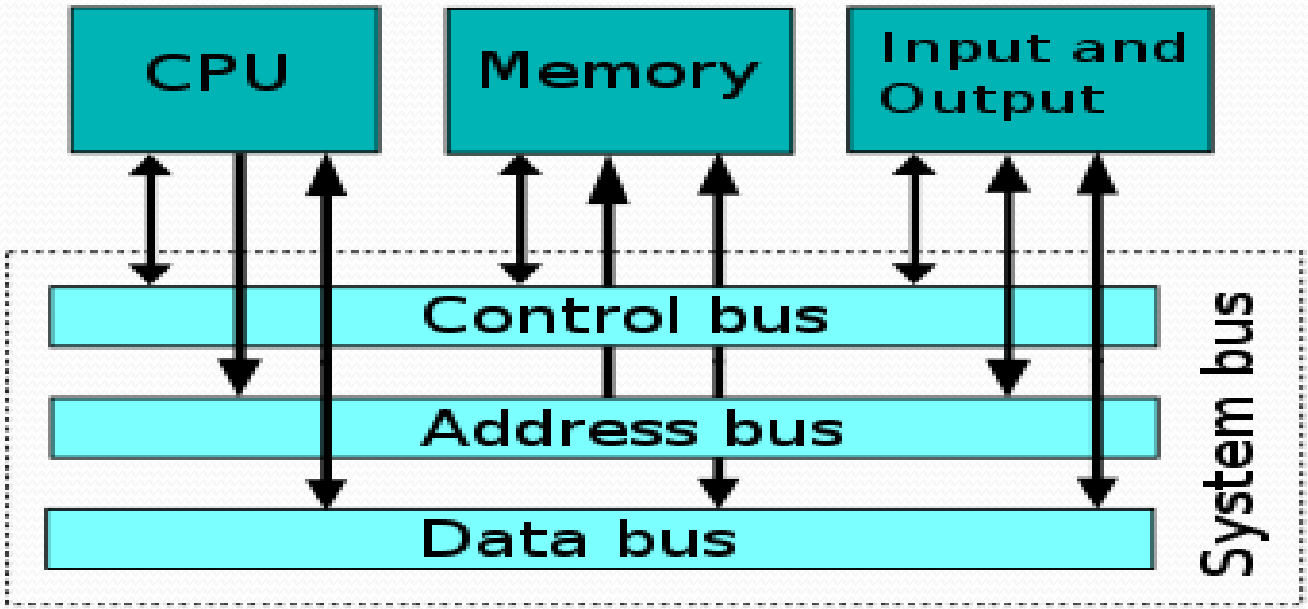
Interconnecting the Units of Computers

- Inside computers, there are many internal components. In order for these components to communicate with each other, they make use of wires that are known as a '**bus**'.
- A **bus** is a **common pathway** through which information flows from one computer component to another. This pathway is used for communication purpose and it is established between two or more computer components.

A computer bus can be divided into two types: **Internal Bus** and **External Bus**.

- **Internal Bus:** Internal bus is used to connect the internal components of computer system such as processor, RAM, chipset, hard disk. It is also called the **System Bus.**
- **External Bus:** External bus is used to connect the external components of computer system such as monitor, keyboard, printer. The external bus allows various devices to be attached to the computer. It allows for the expansion of computer's capabilities. It is generally slower than the system bus. It is also referred to as the **Expansion Bus**.

- A system bus or expansion bus comprise of three kinds of buses: data bus, address bus and control bus.



System Bus

The functions of data bus, address bus and control bus, in the system bus, are as follows:

- **Data Bus:** It transfers data between the CPU and memory. The bus width of a data bus affects the speed of computer. The size of data bus defines the size of the processor. A processor can be 8, 16, 32 or 64-bit processor. An 8–bit processor has 8 wire data bus to carry 1 byte of data. In a 16–bit processor, 16–wire bus can carry 16 bits of data, i.e., transfer 2 bytes, etc.

System Bus

- **Address Bus:** It connects CPU and RAM with set of wires similar to data bus. Address bus carries memory addresses for read and write operations. The width of address bus determines the maximum number of memory locations the computer can address. Currently, Pentium Pro, II, III, IV have 36–bit address bus that can address 236 bytes or 64 GB of memory.
- **Control Bus:** It specifies whether data is to be read or written to the memory etc.

Expansion Bus

The functions of data bus, address bus and control bus, in the expansion bus, are as follows:

- **Data Bus:** It is used to transfer data between I/O devices and CPU. The exchange of data between CPU and I/O devices is according to the industry standard data buses. The most commonly used standard is Extended Industry Standard Architecture (EISA) which is a 32-bit bus architecture. Some of the common bus technologies are:

  -Peripheral Component Interconnect (PCI) bus for hard disks, sound cards, network cards and graphics cards,

Expansion Bus

-Accelerated Graphics Port (AGP) bus for 3–D and full motion video.

-Universal Serial Bus (USB) to connect and disconnect different devices.

- **Address Bus:** It carries the addresses of different I/O devices to be accessed like the hard disk, CD ROM etc.
- **Control Bus:** It is used to carry read/write commands, status of I/O devices etc.

External Ports

The peripheral devices interact with the CPU of the computer via the bus. The connections to the bus from the peripheral devices are made via the ports and sockets provided at the sides of the computer. The different ports and sockets facilitate the connection of different devices to the computer. Some of the standard port connections available on the outer sides of the computer are— port for mouse, keyboard, monitor, network, modem, and, audio port, serial port, parallel port and USB port.

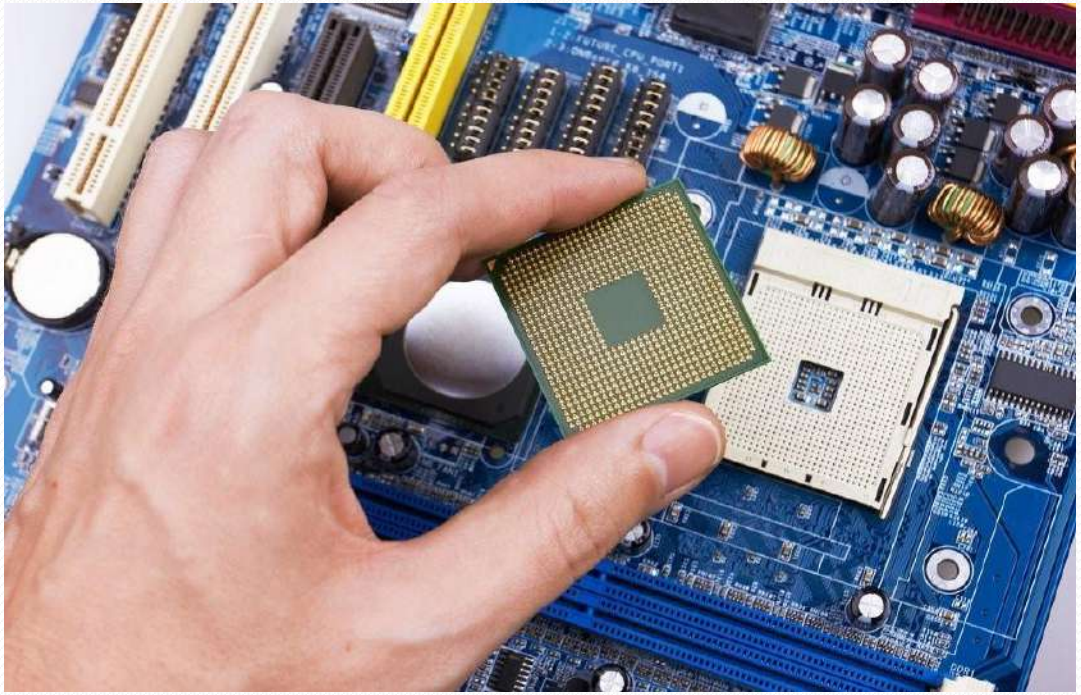
Computer Cabinet

These are the main parts/components of a computer cabinet/tower:

- Processor
- Motherboard
- Hard drive
- Power supply
- These are the biggest, most obvious parts you see when you open the computer cabinet.

Computer Cabinet

Processor



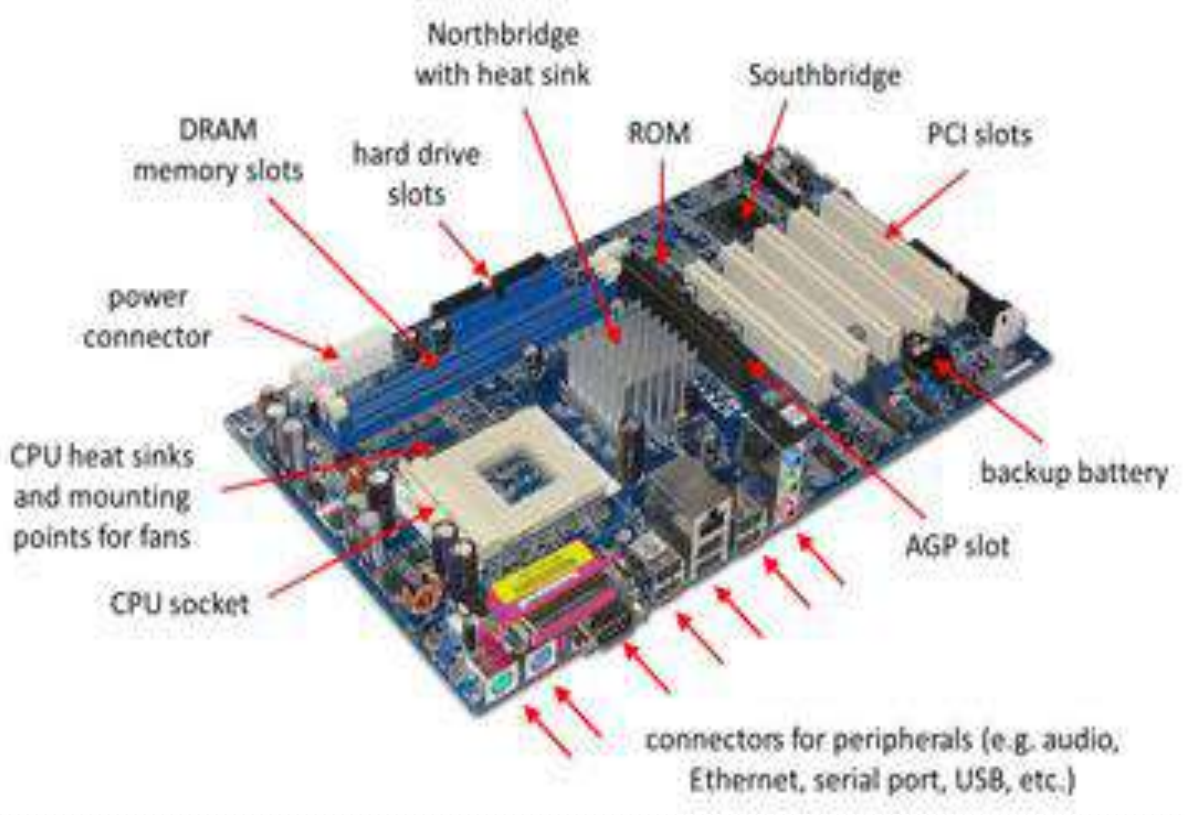
Computer Cabinet

Motherboard

The motherboard supplies power to the processor, RAM, hard disk, and other hardware components. It houses every wire and connector you can see inside the case. It also houses the famous RAM (Random Access Memory), also known as primary memory. The motherboard also houses other important components such as a graphics card, LAN card etc.

Computer Cabinet

Motherboard



Computer Cabinet

Hard drive

Computer Cabinet

Power Supply

- Also known as the SMPS – Switched Mode Power Supply, or PSU – Power Supply Unit, is the part of the enclosure that supplies power to every single component within the enclosure. It converts an alternating current of 220-230 V into a direct current that the computer can use. It is normally located in the upper corner of the enclosure and is equipped with a small fan to prevent overheating.
- There are also other parts in the cabinet, such as a floppy drive into which you insert your CDs and DVDs, an expansion card, and many wires.

Computer Cabinet

Power Supply

Computer Cabinet

Memory Chip

- A memory chip is an integrated circuit made out of millions of capacitors and transistors that can store data or can be used to process code. Memory chips can hold memory either temporarily through random access memory (RAM) or permanently through read only memory (ROM). Read only memory contains permanently stored data that a processor can read but cannot modify. Memory chips comes in different sizes and shapes. Memory chips are essential components in computer and electronic devices in which memory storage plays a key role.

Computer Cabinet

Memory Chips

Computer Memory

Memory: Memory is the storage media or device which stores data permanently or temporarily.

Memory Representation

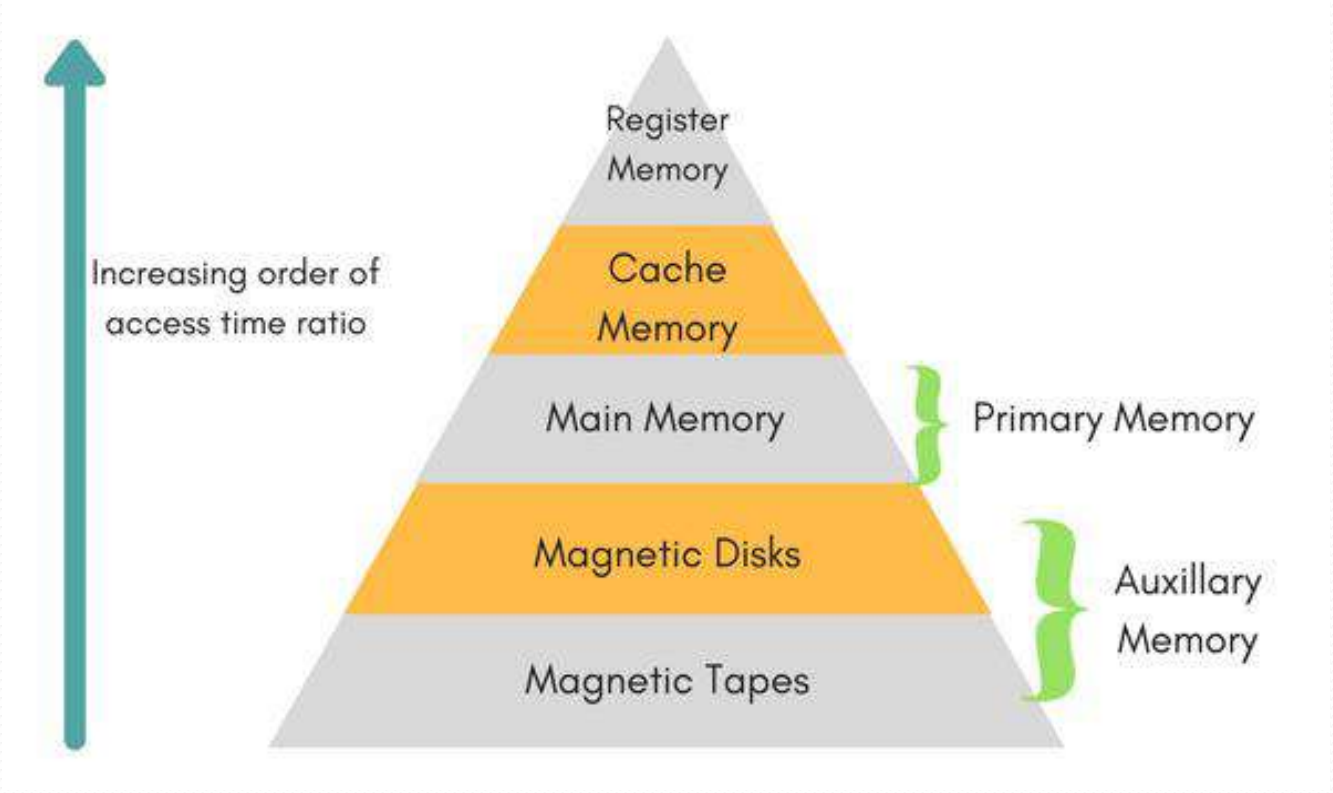
- Computer uses *a fixed number of bits* to represent a piece of data, which could be a number, a character, or others. A n-bit storage location can represent up to 2^n distinct entities. For example, a 3-bit memory location can hold one of these eight binary patterns:000B, 001B, 010B, 011B, 100B, 101B, 110B, or 111B. Hence, it can represent at most 8 distinct entities. You could use them to represent numbers 0 to 7, 11 to 18, characters 'A' to 'H', or up to 8 kinds of fruits like apple, orange, banana, etc.

Computer Memory

- Integers, for example, can be represented in 8-bit, 16-bit, 32-bit or 64-bit. You, as the programmer, choose an appropriate bit-length for your integers. Your choice will impose constraint on the range of integers that can be represented. Besides the bit-length, an integer can be represented in various *representation* schemes, e.g., unsigned vs. signed integers. An 8-bit signed integer has a range of -128 to 127; while an 8-bit unsigned integer has a range of 0 to 255.

Computer Memory

Memory Hierarchy



Computer Memory

Main Memory

The memory unit that communicates directly within the CPU, Cache memory, is called main memory. It is the central storage unit of the computer system. It is a large and fast memory used to store data during computer operations. Main memory is made up of **RAM** and **ROM.**

Computer Memory

Main memory

RAM

- Random access memory
- RAM is volatile.
- RAM can both read & write.
- When the computer switch is off, then its contents will be lost or erased.
- So, It is also known as temporary memory.

Computer Memory

Main Memory

RAM is two types

- SRAM
- DRAM

SRAM(Static RAM)

- SRAM holds information in a flip-flop circuit consisting of six transistors is needed in each memory cell.
- It is costly RAM.
- Its speed is high.

Computer Memory

SRAM(Static RAM)

- SRAM holds information in a flip-flop circuit consisting of six transistors is needed in each memory cell.
- It is costly RAM.
- Its speed is high.
- It occupies large space.
- Refresh circuit is not needed.
- Consumes less power than DRAM.

Computer Memory

DRAM(Dynamic RAM)

- It requires less number of transistors per memory cell because information is stored in capacitors. Only one transistors is needed to form a memory cell of the RAM.
- It is less costly than SRAM.
- Its speed is slower than SRAM.
- Refresh circuit is needed.
- Consumed more power.

Computer Memory

Main memory

ROM

- ROM means read only memory.
- It can only read.
- It is non-volatile memory.
- When the computer switch is off, then its contents will not be lost or deleted.
- So, it is permanent memory.

ROM can be divided into three parts.

- PROM(Programmable read only memory)
- EPROM(Erasable PROM)
- EEPROM(Electrically Erasable PROM)

Computer Memory

Main Memory

ROM can be divided into three parts.

- PROM(Programmable read only memory)
- EPROM(Erasable PROM)
- EEPROM(Electrically Erasable PROM)

Computer Memory

Main Memory

Types of ROM

PROM

- Programmable ROM.
- It is also called one –time programmable ROM and can be written to or programmed using a special device called a PROM programmer.
- Its contents cannot be erased or lost.
- The working of a PROM is similar to that of a CD-ROM.
- E.g. Firmware, CD-R

Computer Memory

Main Memory

Types of ROM

EPROM

- Erasable PROM.
- Information stored can be lost in ultraviolet light and reprogrammed whenever necessary.
- E.g. CD-RW

EEPROM

- Electrically Erasable PROM.
- Its contents can be lost by electricity & again it can be programmed like EPROM.
- E.g. Flash memory(Pen drive), SD memory card etc.

Cache Memory

- Cache memory is a small memory chip which attached between CPU & main memory whose access time is very close to the processing speed of CPU.The speed of CPU is extremely high. So, cache memory makes faster.

Cache memory can be two types

- L1 Cache
- L2 Cache
- L3 Cache

Cache Memory

L1 Cache

- L1 cache is also primary cache or internal cache which build directly into the processor chip.
- Its capacity is very small(8 KB to 64 KB).
- E.g. Pentium I, Pentium II
- Its speed is faster than L2 cache.

Cache Memory

L2 Cache

- L2 cache is also called external cache. It is not part of the processor chip.
- Its speed is slower.
- Its capacity is large(64 KB to 2 MB).
- E.g. SRAM

Cache Memory

L3 Cache(Level 3 cache)

- A memory bank built onto the motherboard or within the CPU module. The L3 cache feeds the L2 cache, and its memory is typically slower than the L2 memory, but faster than main memory.

Secondary Memory

Secondary memory is also known as auxiliary or supplement memory. Auxiliary storage are stores data permanently. It stores large amount of data.E.g. Magnetic(tape, disk & drum),floppy disk, pen drive, CD-ROM,DVD,DVD-RW etc.

Secondary Memory

Secondary Memory

Sequential & Direct access devices

Sequential or serial access:

A sequential access storage device is one in which data can be access one by one or sequence. E.g. magnetic tape.

Random Access storage or direct access:

A random access storage device in one in which any location in the device may be selected at random, access to the direct. E.g. Magnetic disk

Secondary Memory

Magnetic Tape

- Magnetic tape is the most popular storage medium for large data that are accessed & processed sequentially.

Magnetic tape has following features.

- Economical
- Long term storage & reusability
- Compact
- Backup data

Secondary Memory

Advantages of Magnetic Tape

- Their storage capacity is unlimited because many tapes can be used for storing large amount of data.
- Low cost of data reels & cartridges & high data recording densities, cost per bit of storage is very low. Tapes can be erased & reuse many times.

Secondary Memory

Disadvantages of Magnetic Tape

- It is sequential access nature. They are not suitable for random access.
- They must be stored in a dust free environment because dust can cause tape reading errors.

Secondary Memory

Magnetic Tape

Secondary Memory

Magnetic Disk

- Magnetic disks are most popular direct access storage medium. A magnetic disk is a thin circular plate made of metal & coated with magnetic material. Magnetic disk can also be erased & reused indefinitely. Each disk consists of a number of circles called tracks. Most popular magnetic disks are floppy disk & hard disk. Information is recorded on tracks. These track is divided into sectors. A good example of magnetic disk is hard disk.

Secondary Memory

Advantages of Magnetic Disk

- It support direct access medium but magnetic tape supports sequential access.
- Magnetic disks are suitable for both online & offline storage of data.
- Data transfer rate for a magnetic disk system is normally higher than a tape system.

Secondary Memory

Disadvantages of Magnetic Disk

- It is costly.
- Poor people cannot afford this.
- Bad cluster error occurs.

Secondary Memory

Hard disk or Magnetic Disk

- Hard disk is direct access storage medium. Data is stored in circles called tracks. Each track is divided into sectors. It is a circular path which stores information on these paths.

Types of hard disks

1. Zip disk

- 100 MB
- Disk drive
- Single hard disk

Secondary Memory

Hard disk

2. Disk pack

- Multiple platter hard disk.
- Separate read & write head

3. Winchester disk

- Two or more hard disk platter.
- Fixed type .

Secondary Memory

Hard disk

Secondary Memory

Floppy disk

- Floppy disk are small removable storage device. It is also known as floppy diskette.

There are two types of floppy disk

1. Mini floppy disk
2. Micro floppy disk

Secondary Memory

Mini floppy disk

- Its size is 5.25”*5.25”
- Its capacity is 1.2 MB.
- Its speed is 720 rpm(round per minute).

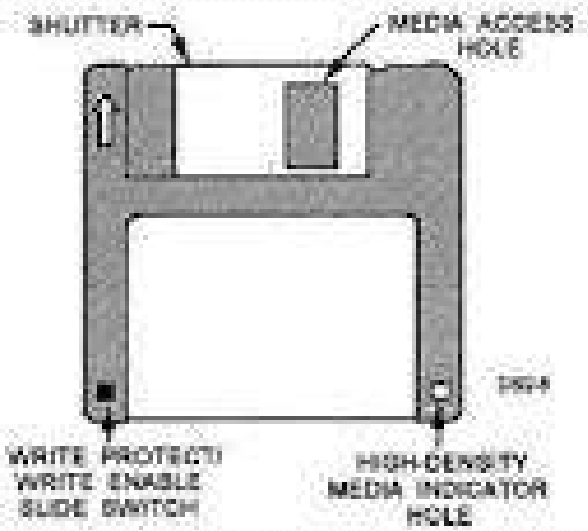
Secondary Memory

Micro floppy disk

- Its size is 3.5”*3.5”
- Its capacity is 1.44 MB
- Its speed is 360 rpm.

Secondary Memory

Floppy disk



Secondary Memory

Pen drive(Flash memory)

- Flash memory is a memory chip that holds data. It is less expensive. Its capacity are 8 MB,16 MB,32 MB,64 MB,128 MB,256 MB,512 MB,1024 MB(1 GB),2 GB,4 GB,8 GB,16 GB,32 GB,64 GB etc.
- It is a plug & play device that simply plugs into a USB(Universal Serial Bus) port of a computer.The computer detects it automatically as removable drive.

Secondary Memory

Pen drive

Secondary Memory

Optical disk

- Optical disk is latest new secondary storage medium. It is a random access medium for high capacity secondary storage because it can store extremely large amount of data in a limited space. An optical disk consists of a thin circular path coated with a thin metal or some other material that is highly reflective. Optical disks are also known as laser disks because they use laser beam technology for data read/write.

Secondary Memory

Optical disks

Storage capacity of an optical disk= No. of sectors*No. of bytes per sector

5.25” optical disks have 3,30,000 sectors each of 2352 bytes.

Total capacity=3,30,000*2352

= 776*1000000 bytes.

= 776 megabytes.

Storage capacity of optical disks are 776 MB(Total).

Formatted capacity is 650 MB.

Secondary Memory

Types of optical disks

Commonly used optical disks are CD-ROM,WORM(CD-R),CD-RW,DVD,DVD-RW.

Secondary Memory

Optical disk

Secondary Memory

The Institute of Chartered Accountants of India
(Setup by an Act of Parliament)
Board of Studies

Magneto Optical Disc

- A magneto-optical drive is a kind of optical disc drive capable of writing and rewriting data upon a magneto-optical disc.
- Both 130 mm (5.25 in) and 90 mm (3.5 in) form factors exist.
- The technology was introduced at the end of the 1980s.

Close up of Magneto-optical Disk surface

100 Hours ITT Course

Input and Output Devices

Introduction

- An input/output device, often known as an IO device, is any hardware that allows a human operator or other systems to interface with a computer. Input/output devices, as the name implies, are capable of delivering data (output) to and receiving data from a computer (input). An input/output (I/O) device is a piece of hardware that can take, output or process data. It receives data as input and provides it to a computer, as well as sends computer data to storage media as a storage output.

Uses of Input and Output Devices

Input Devices.

- Input devices are used to allow us to enter information into a computer system.

Output Devices.

- Output devices are used to send data from a digital device to a user or another device.

Input-Output Unit

The Input Unit: Computer Input unit means the device of the input and a part of the computer hardware which is used for the transport of the data processing system involves the information devices of the computer with the control and data signals of the computer. **Example –** Mouse, Camera and Keyboard

The Output Unit: Computer Output is the device which deals with transmitting the data of the computer among the device and the clients. The computer is designed for humans in the form of audio and video format.

Input Devices

Input Devices

All computer peripheral devices which use to input data and instructions to the computer are called Input Devices. A Input devices accept data and instructions from the user and convert information or data into a form which can be understood by the computer.

A good input device should provide accurate, timely and useful data to the main memory of the computer for processing.

Some Input devices or Human Data Entry Devices

1. Keyboard
2. Mouse
3. Light Pen
4. Trackball
5. Joystick
6. Scanner
7. Optical Mark Reader
8. Optical Character Reader
9. Barcode Reader
10. Magnetic Ink Character Recognition
11. Digitizer or Graphics Tablet
12. Digital Camera

Human Data Entry Devices

Keyboard

- A **computer keyboard** is an input device that allows a person to enter letters, numbers and other symbols (these are called characters) into a computer. It is one of the most used input devices for computers. Using a keyboard to enter lots of data is called typing.
- A keyboard contains many mechanical switches or push buttons called "keys". When one of these are pushed, an electrical circuit is closed, and the keyboard sends a signals to the computer that tells it what letter, number or symbol it would like to be shown on the screen.

Human Data Entry Devices

Keyboard

- The computer's CPU then shows the character on the screen, usually at the place where the curser is. Besides entering characters, computer keyboards also have keys that change the symbol (such as shift or caps lock) or give the computer special commands (such as the arrows keys , CTRL and ALT)

Human Data Entry Devices

Keyboard

Human Data Entry Devices

Mouse

A **computer mouse** is a hand-held pointing device that detects two - dimensional motion relative to a surface. This motion is typically translated into the motion of a pointer on a display which allows a smooth control of the graphical user interface . The first public demonstration of a mouse controlling a computer system was in 1968. Originally wired to a computer, modern mice are often cordless, relying on short-range radio communication with the connected system. Mice originally used a ball rolling on a surface to detect motion but modern mice often have optical sensors that have no moving parts.

Human Data Entry Devices

Wireless or Cordless Mouse

Human Data Entry Devices

Optical Mouse

Human Data Entry Devices

Light Pen

- It allows the user to point to displayed objects or draw on the screen in a similar way to a touch screen but with greater positional accuracy. A light pen can work with any CRT-based display but its ability to be used with LCDs was unclear (though Toshiba and Hitachi displayed a similar idea at the "Display 2006" show in Japan.
- A light pen detects a change of brightness of nearby screen pixels when scanned by cathode ray tube electron beam and communicates the timing of this event to the computer.

Human Data Entry Devices

Light Pen

Human Data Entry Devices

Trackball

- A **trackball** is a pointing device consisting of a ball held by a socket containing sensors to detect a rotation of the ball about two axes—like an upside-down mouse with an exposed protruding ball. The user rolls the ball to position the on-screen pointer using their thumb, fingers or commonly the palm of the hand while using the fingertips to press the mouse buttons. Compared with a mouse, a trackball has no limits on effective travel at times. A mouse can reach an edge of its working area while the operator still wishes to move the screen pointer farther.

Human Data Entry Devices

Track ball

Human Data Entry Devices

Joystick

- A **joystick** is an input device consisting of a stick that pivots on a base and reports its angle or direction to the device it is controlling. It often has supplementary switches to control various aspects of the aircraft's flight.
- Joysticks are often used to control video games and usually have one or more push-buttons whose state can also be read by the computer.

Human Data Entry Devices

Joystick

Human Data Entry Devices

Touch Screen

A **touchscreen** or **touch screen** is the assembly of both an input (touch panel) and output (display) device. The touch panel is normally layered on the top of an electronic visual display of an electronic device.

Human Data Entry Devices

Touch Screen

Human Data Entry Devices

Digitizer or Digitizing Tablet

A digitizer also known as a graphics tablet or drawing tablet, is a device that allows you to input drawings, sketches and handwritten notes into a computer.

Human Data Entry Devices

Digitizer

Source Data Entry Devices

Speech Recognition

Speech recognition is an interdisciplinary subfield of computer science and computational linguistics that develops methodologies and technologies that enable the recognition and translation of spoken language into text by computers.

Source Data Entry Devices

Speech Recognition

Source Data Entry Devices

Digital Camera

A **digital camera** is a camera that captures photographs in digital memory. Most cameras produced today are digital, largely replacing those that capture images on photographic film . Digital cameras are now widely incorporated into mobile devices like smartphones with the same or more capabilities and features of dedicated cameras (which are still available). High-end, high-definition dedicated cameras are still commonly used by professionals and those who desire to take higher-quality photographs.

Source Data Entry Devices

Digital Camera

Source Data Entry Devices

Scanner

- A scanner is a device that captures images from photographic prints, posters, magazine pages and similar sources for computer editing and display.
- Scanners work by converting the image on the document into digital information that can be stored on a computer through optical character recognition (OCR).
- This process is done by a scanning head which uses one or more sensors to capture the image as light or electrical charges.

Source Data Entry Devices

Scanner

Source Data Entry Devices

OMR

- **OMR** (**optical mark recognition**) is a form of automated data input. **Marks** are made on a specially printed paper forms which are then read by an **OMR** reader. The data is then sent to a computer for processing. One of the most common uses of **OMR** is in multiple choice examinations.

Source Data Entry Devices

OMR

Source Data Entry Devices

OCR

- **OCR** (**optical character recognition**) is the **recognition** of printed or written **text character**s by a computer. This involves photo scanning of the **text character**-by-**character**, analysis of the scanned-in image, and then translation of the **character** image into **character** codes such as ASCII, commonly used in data processing.

Source Data Entry Devices

OCR

Source Data Entry Devices

Bar code reader

- A **barcode reader** (or **barcode scanner**) is an electronic device that can read and output printed barcodes to a computer. Like a flatbed scanner , it consists of a light source, a lens and a light sensor translating optical impulses into electrical ones. Additionally, nearly all barcode readers contain *decoder* circuitry analyzing the barcode's image data provided by the sensor and sending the barcode's content to the scanner's output port.

Source Data Entry Devices

Bar code reader

Source Data Entry Devices

MICR

- **MICR code** is a character-recognition technology used mainly by the banking industry to process and clearance of cheques and other documents. The MICR encoding, called the *MICR line*, is at the bottom of cheques and other vouchers and typically includes the document-type indicator, bank code, bank account number , cheque number, cheque amount. The technology allows MICR readers to scan and read the information directly into a data-collection device. Unlike barcodes and similar technologies, MICR characters can be read easily by humans.

Source Data Entry Devices

MICR

Output devices

Output device displays result of the computer processing. A output devices return processed data that is information, back to the user.

Some of the commonly used output devices are :

- Monitor (Visual Display Unit)
- Printers
- Plotter
- Speaker
- Projector

Output Devices

Output is two types.

- Soft copy output

The **devices** that generate **soft copy output** are called **soft copy devices**. Visual **output devices** like computer monitor, visual display terminal, video system and audio response system are common **soft copy output devices**.

- Hard copy output

Hard copy output devices are devices that provide **output** on **printed paper** or other permanent media that is human readable (tangible). Examples of devices that produce **hard copy** are printers, plotters etc.

Output Devices

Monitor

- A **computer monitor** is an output device that displays information in pictorial or textual form. A discrete monitor comprises a visual display , support electronics, power supply, housing, electrical connectors and external user controls.

Output Devices

Monitors are CRT,LCD,LED,Plasma etc.

- Cathode Ray Tube(CRT)
- A cathode ray tube (**CRT**) is a specialized vacuum tube in which images are produced when an electron beam strikes a phosphorescent surface. Most desktop computer displays make use of **CRTs**. The **CRT** in a computer display is similar to the“ picture tube" in a television receiver.

Output Devices

CRT Monitors

Output Devices

Liquid Crystal Display(LCD)

is a type of flat panel display which uses liquid crystals in its primary form of operation. LEDs have a large and varying set of use cases for consumers and businesses, as they can be commonly found in smartphones, televisions, computer monitors and instrument panels.

Output Devices

LCD Monitor

Output Devices

Light-emitting diode(LED)

A light-emitting diode is a semiconductor light source that emits light when current flows through it. Electrons in the semiconductor recombine with electron holes, releasing energy in the form of photons.

Output Devices

LED Monitor

Output Devices

Printer

- Printers are one of the most used peripherals on computers and are commonly used to print text, images, and photos. Some printers can print documents stored on memory cards or from digital cameras and scanners. The world's first computer printer was a 19th-century mechanically driven apparatus invented by Charles Babbage for his difference engine.

Output Devices

Printer is two types.

- Impact Printer
- Non-impact Printer
- **Impact printers**

are **printers** which works by creating a direct contact between ink ribbon and paper. These **printers** are noisy yet popular. **Impact printers** have mechanical moving parts to conduct printing. Examples: **Dot-matrix printers**, Daisy-wheel **printers**, and line **printers**.

Output Devices

- **Non-Impact printers**

Don't uses any direct contact between ink ribbon and paper. They use laser, electrostatic, chemical or inkjet technology. These **printers** are less noisy and don't have mechanical moving parts to conduct **printing**. Examples: Inkjet **printers** and Laser **printers**.

Output Devices

Example of printers

Output Devices

Plotter

- Plotters draw lines on paper using a pen. In the latter case, they are sometimes known as a **cutting plotter**.
- In the past, plotters were used in applications such as computer-aided design , as they were able to produce line drawings much faster and of a higher quality than contemporary conventional printers. Smaller desktop plotters were often used for business graphics. Printers with graphics capabilities took away some of the market by the early 1980s.

Output Devices

Plotters

Output Devices

- **Computer speakers** or **multimedia speakers,** are speakers sold for use with computers, although usually capable of other audio uses, e.g. for an MP3 player . Most such speakers have an internal amplifier and consequently require a power source which may be by a mains power supply often via an AC adapter , batteries or a USB port.

Output Devices

Projector

- A **projector** or **image projector** is an optical device that projects an image (or moving images) onto a surface, commonly a projection screen . Most projectors create an image by shining a light through a small transparent lens but some newer types of projectors can project the image directly by using lasers.

Output Devices

Projector

I/O Port

Concept of I/O port

An I/O port is a socket on a computer that a cable is plugged into. The port connects the CPU to a peripheral device via a hardware interface or to the network via a network interface. See port, standards - hardware interfaces, Display Port, HDMI and USB.

I/O Port

Serial Ports

A serial port is a serial communication interface through which information transfers in or out sequentially one bit at a time. This is in contrast to a parallel port which communicates multiple bits simultaneously in parallel.

I/O Port

Serial Ports

I/O Port

Parallel Ports

A **parallel port** is a type of interface found on early computers (personal and otherwise) for connecting peripherals . The name refers to the way the data is sent; parallel ports send multiple bits of data at once (parallel communication), as opposed to serial communication in which bits are sent one at a time.

I/O Port

Parallel ports

I/O Port

USB Ports

Universal Serial Bus (**USB**) is an industry standard that allows data exchange and delivery of power between many various types of electronics. It specifies its architecture, in particular its physical interface and communication protocols for data transfer and power delivery to and from *hosts* such as personal computers to and from peripheral *devices*. As for example, displays, keyboards and mass storage devices.

I/O Port

USB Ports

I/O Port

Fire wire ports

- IEEE 1394, commonly known as FireWire, is a standard connection type for many electronic devices such as digital video cameras, printers and scanners, external hard drives and other peripherals.
- The terms IEEE 1394 and FireWire usually refer to the types of cables, ports and connectors used to connect these types of external devices to computers.

I/O Port

Fire wire Ports

Working of I/O System

Detail working of I/O system

The working of I/O system combines I/O hardware and I/O software. The I/O hardware includes ports, buses and device controllers for different devices, and I/O devices. The I/O software is the device driver software that may be embedded with operating system or comes with each device. The working of I/O system is described as follows:

Working of I/O System

- **I/O Devices** are attached to computer via the ports of computer. There are many standard ports available on the backside of the computer case like serial port and parallel port. If one or more devices use a common set of wires, it is called a bus. For example, PCI bus, PCI Express bus etc.

Working of I/O System

- **Device Controller** operates on a bus, a port or a device. It controls the signals on the wires of port or bus. The controllers have one or more registers for data and control signals. Controller may be simple like a serial port controller for a serial port, or, complex like a SCSI controller. Some devices have their own built-in controllers.
- **Device Driver** is software via which the operating system communicates with the device controllers. Each device has its own device driver, and a device controller which is specific to the device. The device drivers hide the differences among the different device controller and present a uniform interface to the operating system.

Working of I/O System

- **Application programs** use an I/O device by issuing commands and exchanging data with the device driver. The device driver provides correct commands to the controller, interprets the controller register and transfers data to and from device controller registers as required for the correct device operation.

Working of I/O System

- I/O Hardware is a set of specialized hardware devices that help the operating system access disk drives, printers, and other peripherals. These devices are located inside the motherboard and connected to the processor using a bus. They often have specialized controllers that allow them to quickly respond to requests from software running on top of them or even respond directly to commands from an application program.

Working of I/O System

I/O Software

- I/O Software is used for interaction with I/O devices like mouse, keyboards, USB devices, printers etc. Several commands are made via external available devices which makes the OS function upon each of them one by one.

Working of I/O System

I/O software is often organized in the following layers –

- **User Level Libraries** – This provides simple interface to the user program to perform input and output. For example, **stdio** is a library provided by C and C++ programming languages.
- **Kernel Level Modules** – This provides device driver to interact with the device controller and device independent I/O modules used by the device drivers.
- **Hardware** – This layer includes actual hardware and hardware controller which interact with the device drivers and makes hardware alive.

Working of I/O System

- **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.