COMPUTER: INTRODUCTION

- The word **"computer"** comes from **"compute"** which means **to calculate**.
- A computer is a machine that can do math and solve problems very quickly.
- A computer works with **data**. Data can be numbers, letters, or symbols.
- Computers come in different shapes and sizes, depending on what they are used for.
- A computer can **store**, **process**, and **show** information whenever we want.
- Because a computer works with data, it is sometimes called a **data processor**.

A computer follows three steps:
1. It takes in data (input),
2. It works on it (processing),
3. It gives us results (output).

Definition:

A computer is an electronic device that can **accept data (input)**, process it according to specific instructions, store the results, and **produce output (information)**.

The main task that a computer does are:
- **Input:** Taking in data and instructions.
- **Process:** Working on the data according to the instructions.
- **Output:** Giving out the final results or information.

Computer

Input → Process → Output
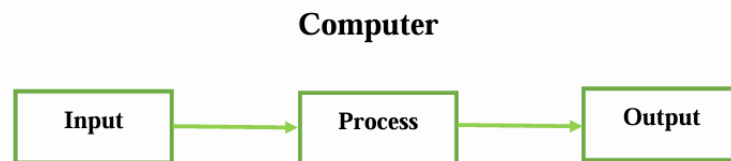
CHARACTERISTICS OF COMPUTER

Some important characteristics of a computer are as follow:

- **Automatic:**
  - Computers work automatically without human intervention once started on a task.
  - They carry on processing until the task is completed.
  - However, computers cannot start themselves; they need to be switched on by a user.
  - They follow instructions stored inside them as programs, which tell them how to perform specific jobs.

- **Accuracy:**
  - Computers provide very high accuracy in their results.
  - The level of accuracy depends on the design of the computer.

- o   Any errors produced are usually due to incorrect input or human mistakes, not because of the computer itself.
- **Speed:**
  - o   Computers are extremely fast and can perform in seconds what might take a human year.
  - o   Their speed is measured in microseconds (millionths of a second).
  - o   Powerful computers can perform billions of simple arithmetic operations every second.
- **Diligence:**
  - o   Unlike humans, computers do not get tired, bored, or lose concentration.
  - o   They can work continuously for hours without making mistakes.
  - o   Even if asked to perform millions of calculations, a computer will maintain the same speed and accuracy throughout.
- **Versatility:**
  - o   Computers are highly versatile and can perform a wide range of tasks.
  - o   For example, one moment they might process exam results, next they can prepare electricity bills, and then help in managing office correspondence—all quickly and efficiently.
- **Memory Power (Storage Capacity):**
  - o   Computers can store and remember huge amounts of data because of their large storage capacity.
  - o   Information can be saved for a long time and recalled whenever needed.
  - o   Even after many years, the recalled data is as accurate as it was when stored.
- **No Intelligence (No IQ):**
  - o   Computers do not have intelligence or decision-making ability.
  - o   Their IQ is zero; they cannot think or act on their own.
  - o   They perform only the instructions given by users in the correct sequence.
  - o   Computers cannot make decisions by themselves.
- **No Feelings:**
  - o   Computers are machines and have no feelings or emotions.
  - o   Humans use feelings, knowledge, and experience to make judgments.
  - o   Computers, however, do exactly what they are programmed to do without any emotions or personal judgment.

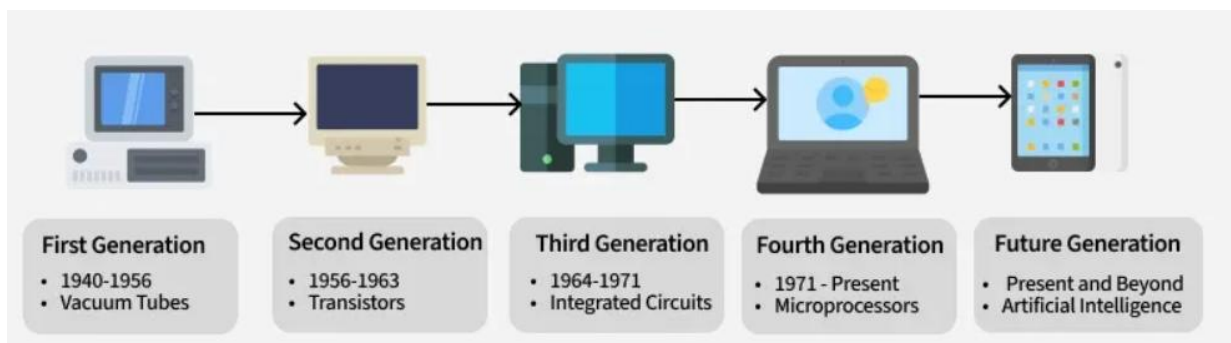## LIMITATIONS OF COMPUTERS

- **No Intelligence (No IQ):**
  Computers do not have their own intelligence. They cannot think or make decisions on their own. They only follow the instructions given by humans.
- **No Feelings or Emotions:**
  Computers cannot feel emotions or understand human feelings. They work purely based on logic and programming.

- **Lack of Decision-Making Ability:**
  Computers cannot decide or judge situations independently. They can only perform tasks for which they have been programmed.
- **Depend on Human Input:**
  Computers require human beings to provide data, instructions, and programs. They cannot start or operate on their own without human help.
- **Cannot Learn or Adapt:**
  Traditional computers do not learn from experience or adapt without specific AI programming.
- **Cannot Handle Ambiguity or Common Sense:**
  Computers need clear and precise instructions. They cannot understand vague or unclear tasks or common sense.
- **Dependent on Power Supply:**
  Computers need continuous electrical power to operate. Without power, they cannot work.
- **Susceptible to Viruses and Hacks:**
  Computers can be attacked by viruses or hacking attempts that can damage data or disrupt operation.
- **High Cost:**
  Initially, computers and their maintenance can be expensive for many users.
- **Social Impact:**
  Excessive use of computers can lead to social isolation and health issues like eye strain and back pain.

GENERATIONS OF COMPUTERS

Generation in computer terminology is a change in technology a computer is/was being used. Initially, the generation term was used to distinguish between varying hardware technologies. Nowadays, generation includes both hardware and software, which together make up an entire computer system.

First Generation	Second Generation	Third Generation	Fourth Generation	Future Generation
• 1940-1956	• 1956-1963	• 1964-1971	• 1971 - Present	• Present and Beyond
• Vacuum Tubes	• Transistors	• Integrated Circuits	• Microprocessors	• Artificial Intelligence

a) **First Generation (1940–1956): Vacuum Tube Computers**

- **Technology:** Used **vacuum tubes** as electronic switches and amplifiers.
- **Size & Power:** These computers were extremely large, often filling whole rooms, and consumed a huge amount of electricity (e.g., ENIAC used about 150 kilowatts).
- **Speed:** Very slow compared to modern computers; could execute a few hundred instructions per second.
- **Programming:** Used **machine language** (binary code) which was difficult and error-prone to write.
- **Memory:** Relied on magnetic drums and tapes with very limited storage capacity (a few kilobytes).
- **Heat:** Vacuum tubes generated a lot of heat, causing frequent hardware failures and requiring large cooling systems.
- **Examples:** ENIAC, UNIVAC.
- **Limitations:** Fragile vacuum tubes, high power consumption, excessive heat, limited memory, and low processing speed.
- **Innovations:** Introduction of stored-program concept and early programming languages like Fortran and COBOL originated in this era.

The main features of the first generation are:

- Vacuum tube technology
- Unreliable
- Supported machine language only
- Very costly
- Generates lot of heat
- Slow input and output devices
- Huge size
- Need of AC
- Non-portable
- Consumes lot of electricity

Some computers of this generation were:

- ENIAC
- EDVAC
- UNIVAC
- IBM-701
- IBM-750

b) Second Generation (1956–1963): Transistor Computers

- **Technology:** Used **transistors** instead of vacuum tubes.
- **Advantages:** Smaller size, faster processing speed, less heat generation, and more reliable.
- **Memory:** Used magnetic core memory, which was faster and more reliable than earlier storage devices.
- **Programming:** Supported assembly language and early high-level programming languages.
- **Examples:** IBM 7090, CDC 1604.
- **Impact:** Made computers more accessible for business, scientific research, and government applications.

The main features of second generation are:

- Use of transistors
- Reliable in comparison to first generation computers
- Smaller size as compared to first generation computers
- Generates less heat as compared to first generation computers
- Consumed less electricity as compared to first generation computers
- Faster than first generation computers
- Still very costly
- AC required
- Supported machine and assembly languages

Some computers of this generation were:

- IBM 1620
- IBM 7094
- CDC 1604
- CDC 3600
- UNIVAC 1108

c) Third Generation (1964–1971): Integrated Circuit (IC) Computers

- **Technology:** Used **integrated circuits** that combined many transistors on a single chip.
- **Benefits:** Smaller machines, much faster, more reliable, and energy-efficient.
- **Memory:** Larger and faster memory systems.
- **Programming:** Supported more advanced high-level languages and operating systems.
- **Examples:** IBM System/360 series.
- **Significance:** Introduction of multitasking, and time-sharing systems.

The main features of third generation are:

- Integrated Circuits (IC) used
- More reliable in comparison to previous two generations
- Smaller size
- Generated less heat
- Faster
- Lesser maintenance
- Costly
- AC required
- Consumed lesser electricity
- Supported high-level language

Some computers of this generation were:

- IBM-360 series
- Honeywell-6000 series
- PDP (Personal Data Processor)
- IBM-370/168
- TDC-316

d) Fourth Generation (1971–Present): Microprocessor Computers

- **Technology:** Use of **microprocessors** that integrate thousands of ICs into a single chip.
- **Characteristics:** Very small, portable, inexpensive, and powerful.
- **Applications:** Personal computers (PCs), laptops, smartphones, and embedded systems.
- **Programming:** Wide array of operating systems, graphical user interfaces (GUIs), and network connectivity.
- **Examples:** IBM PC, Apple II.
- **Development:** Era of networking, internet, and multimedia computing.

The main features of fourth generation are:

- VLSI technology used
- Very cheap
- Portable and reliable
- Use of PCs
- Very small size
- Pipeline processing
- No AC required
- Concept of internet was introduced
- Great developments in the fields of networks
- Computers became easily available

Some computers of this generation were:

- DEC 10
- STAR 1000
- PDP 11
- CRAY-1(Super Computer)
- CRAY-X-MP (Super Computer)

e) **Fifth Generation (Present and Beyond): AI and Advanced Computing**

- **Technology:** Focus on **Artificial Intelligence (AI)**, quantum computing, and parallel processing.
- **Capabilities:** Computers are designed to learn, reason, understand natural languages, and solve complex problems.
- **Examples:** AI assistants, robotics, and supercomputers.
- **Goal:** Creating intelligent machines that can perform tasks typically requiring human intelligence.
- **Current Status:** Ongoing research and development in AI, robotics, and quantum computing.

The main features of fifth generation are:

- ULSI technology
- Development of true artificial intelligence
- Development of Natural language processing
- Advancement in Parallel Processing
- Advancement in Superconductor technology
- More user-friendly interfaces with multimedia features
- Availability of very powerful and compact computers at cheaper rates

Some computer types of this generation are:

- Desktop
- Laptop
- Notebook
- Ultrabook
- Chromebook

TABLE: COMPUTER GENERATIONS – A SUMMARY

Generation	Period	Key Hardware Technology	Key Software Technology	Key Characteristics	Representative Systems
First	1940 – 1956	Vacuum tubes, magnetic drums, punched cards/paper tape	Machine language (binary)	Massive size, unreliable, huge power/AC needs, produced excessive heat, high cost, manual programming, slow, batch processing	ENIAC, EDVAC, UNIVAC I, IBM 701, IBM 650
Second	1956 – 1963	Transistors, magnetic core memory, punched cards	Assembly, early high-level (FORTRAN, COBOL), batch and multiprogramming OS	More reliable, smaller, faster, less heat, less power, more affordable, still large, batch/multi-programmed processing, improved storage	IBM 1620, IBM 7094, UNIVAC 1108, CDC 1604
Third	1964 – 1971	Integrated Circuits (ICs), magnetic tapes/disks	Operating systems, high-level languages (BASIC, ALGOL, PASCAL, COBOL)	Compact, cost reduction, improved speed, less maintenance, lower power, multitasking, time-sharing, support for remote and terminal access	IBM 360 series, Honeywell 6000, PDP-8, PDP-11
Fourth	1971 – 1980	VLSI chips, microprocessors, semiconductor memory; keyboard, monitor, printer	Advanced OS, high-level languages (C, C++, dBASE, various GUIs), networking	Very small, affordable, personal computers, increased speed/power, pipeline processing, no AC requirement, internet concept, networking, reliability boost	IBM PC, Apple II, CRAY-1, STAR 1000, PDP 11
Fifth	1980 – Present	ULSI (Ultra Large-Scale Integration), parallel/AI hardware, mobile & cloud devices	AI, ML, natural language, multimedia	Knowledge-based systems, AI, natural language understanding, parallel & quantum processing, cloud, portable & consumer-friendly, multimedia, robotics	Desktops, laptops, tablets, smartphones, modern AI/devices

CLASSIFICATION OF COMPUTERS

Computers can be classified according to three major criteria:

- Type
- Size
- Purpose

Each classification reflects the nature, architecture, or intended use of the computer system.

Classification	Sub-Types	Characteristics	Examples
By Type	Analog	Continuous data, scientific use	Speedometer, analog thermometer
	Digital	Binary data, general purpose	PC, laptop, smartphone, server
	Hybrid	Analog + digital combined function	ICU monitor, scientific analyzer
By Size	Supercomputer	Highest speed, very large, complex tasks	Fugaku, IBM Summit
	Mainframe	Large, multi-user data processing	IBM Z Series, banks
	Minicomputer	Mid-sized, multitasking, business use	PDP-11, VAX
	Microcomputer	Small, affordable, personal use	Desktop, laptop, tablet, smartphone
By Purpose	General Purpose	Flexible, multiple software applications	PC, laptop, workstation
	Special Purpose	Single dedicated function	ATM, microwave oven, calculator

ANALOG COMPUTER: Analog computers are made to work with analogue data.

Analogue data is continuous, meaning it changes smoothly without separate steps or exact numbers. We use analogue computers when we don't need exact values, like measuring speed, temperature, pressure, or electric current. These computers get data directly from measuring tools without changing it into numbers or codes first. They measure physical changes smoothly and usually show the result on a dial or scale. Examples of analogue computers are a speedometer in a car and a mercury thermometer.

Advantages of Using Analog Computers:

- It allows real-time operations and computation at the same time and continuous representation of all data within the rage of the analogue machine.

- In some applications, it allows performing calculations without taking the help of transducers for converting the inputs or outputs to digital electronic form and vice versa.
- The programmer can scale the problem for the dynamic range of the analogue computer. It. provides insight into the problem and helps understand the errors and their effects.

DIGITAL COMPUTER

A digital computer is designed to perform calculations and logical operations at high speed. It takes raw data as input in the form of digits or binary numbers (0s and 1s) and processes this data using programs stored in its memory to generate the desired output. Modern devices such as laptops, desktops, and smartphones commonly used at home or in the office are all examples of digital computers.

Advantages of Digital Computers:

- It allows you to store a large amount of information and to retrieve it easily whenever you need it. You can easily add new features to digital systems more easily.
- Different applications can be used in digital systems just by changing the program without
- making any changes in hardware
- The cost of hardware is less due to the advancement in the IC technology.
- It offers high speed as the data is processed digitally.
- It is highly reliable as it uses error correction codes.
- Reproducibility of results is higher as the output is not affected by noise, temperature, humidity, and other properties of its components.

HYBRID COMPUTER

A hybrid computer combines the features of both analog and digital computers. It is as fast as an analog computer while offering the memory and accuracy of a digital computer. It can process both continuous data (like analog signals) and discrete data (digital signals). Hybrid computers accept analog input signals and convert them into digital form before processing. Because of this, they are widely used in specialized fields where both types of data need to be handled. For example, fuel processors at petrol pumps convert the flow of fuel into digital information to calculate quantity and price. Hybrid computers are also used in airplanes, hospitals, and scientific research.

Advantages of Hybrid Computers:

- They offer very high computing speed due to the parallel working of the analog part.
- They provide fast and precise results that are both accurate and reliable.
- They can solve and manage large equations in real-time efficiently.
- They support online data processing, making them useful for real-time applications.

SUPERCOMPUTER

Supercomputers are the largest and fastest computers available. They are designed to handle extremely large amounts of data and can process trillions of instructions each second. This incredible speed is possible because supercomputers have thousands of processors working together. They are mainly used in scientific and engineering fields, such as weather forecasting, scientific simulations, and nuclear energy research. The first supercomputer was created by Roger Cray in 1976.

Key Features and Applications of Supercomputers:

- They can help decrypt passwords to improve security systems.
- Supercomputers produce high-quality results in animations and graphics.
- They are used for virtual testing of nuclear weapons and important medical examinations.
- These computers study climate patterns and predict weather, running systems like those at NOAA (National Oceanic and Atmospheric Administration).
- They assist in designing flight simulators that train beginner pilots.
- Supercomputers help extract valuable information from large data centers and cloud storage, such as in insurance companies.
- They play a crucial role in managing online currencies like stock markets and bitcoins.
- They assist in diagnosing serious diseases and provide accurate results for brain injuries and strokes.
- Supercomputers are used in scientific research to analyze data from space exploration, satellites, and Earth's movements.

- They are also applied in pollution control systems to predict fog and pollutant levels in the atmosphere.

MAINFRAME COMPUTER

Mainframe computers are powerful machines designed to support hundreds or even thousands of users at the same time. They can run multiple programs simultaneously, which means they can handle different tasks or processes all at once. Because of this ability, mainframes are perfect for large organizations like banks and telecom companies that need to process huge amounts of data quickly and accurately.

Characteristics of Mainframe Computers:

- They can process an enormous volume of data, such as millions of banking transactions per second.

- Mainframes have a very long lifespan and can operate smoothly for up to 50 years with proper maintenance.
- They deliver excellent performance thanks to advanced memory management systems.
- These computers can share and distribute workloads across multiple processors and input/output devices.
- Mainframes have a low error rate during processing, and if errors do occur, they can quickly fix them without slowing down performance.
- They provide strong protection for stored data and ongoing data exchanges, ensuring security.

Applications of Mainframe Computers:

- In healthcare, mainframes help hospitals maintain records of millions of patients, enabling them to manage appointments, treatment updates, and medicine information efficiently.
- In defense, mainframes allow secure sharing of sensitive information among various defense departments.
- In education, large universities use mainframes to store and manage data related to courses, admissions, students, staff, and affiliated institutions.
- In retail, companies with many branches and customers rely on mainframes to manage inventory, customer data, and handle large transaction volumes quickly and accurately.

MINICOMPUTER

A minicomputer is a medium-sized computer that can handle multiple tasks at once. It has two or more processors and can support between 4 to 200 users simultaneously. Minicomputers are commonly used in institutions and departments for tasks like billing, accounting, and managing inventory. They are smaller than mainframe computers but larger than microcomputers, placing them in between these two types.

Characteristics of Minicomputers:

- They are lightweight, making them easy to move and fit into different spaces.
- They cost less than mainframe computers.
- They operate very fast considering their size.
- They have long-lasting power or charge.
- They do not need special environmental conditions to work properly.

Applications of Minicomputers: Minicomputers serve mainly three important purposes:

- **Process Control:** In manufacturing, minicomputers help control processes by collecting data and providing feedback. If something goes wrong in the process, the minicomputer detects it and makes the necessary corrections.
- **Data Management:** Small organizations like local hospitals and hotels use minicomputers to collect, store, and share data, such as patient or customer records.
- **Communications Portal:** In larger systems, minicomputers act as a communication gateway between human operators and central computers, helping to manage information flow and commands.

GENERAL-PURPOSE COMPUTER

- General-Purpose Computers, designed for a wide range of tasks like word processing and browsing.
- **Function**: Can perform a wide variety of tasks and run different software.
- **Flexibility**: Highly versatile and can handle many different types of applications.
- **Examples**: Personal computers (desktops), laptops, smartphones, and tablets are common examples used for everyday tasks.

SPECIAL-PURPOSE COMPUTERS

- Special-Purpose Computers, built to perform specific functions with high efficiency.
- **Function**: Designed and optimized for a single or limited set of specific tasks.
- **Efficiency**: deliver high speed, accuracy, and consistency for their designated function.
- **Examples:** Supercomputers, ATMs (Automated Teller Machines), Robots in Manufacturing, Embedded Systems

BLOCK DIAGRAM OF COMPUTER OR SIMPLE MODEL COMPUTER
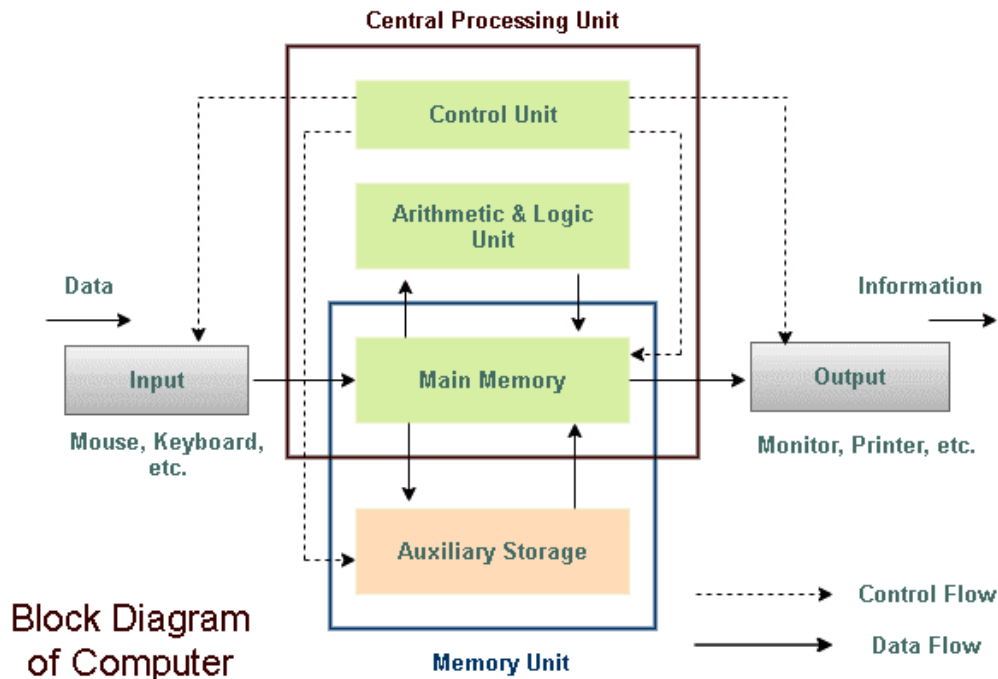
Computer Hardware: *The physical components of any electronic device or system that can be seen and touched.*

Type of hardware

   a) Internal hardware
   b) External hardware

a) Internal hardware: Internal hardware refers to the physical components inside the computer case that are essential for the system's operation. These components work together to process data, execute programs, and store information.
Example: CPU, RAM, Motherboard, Hard Disk Drive.

Central Processing Unit (CPU)

Also called the **processor**, it is often considered the **"brain" of the computer**.

Key Functions:

- Executes instructions from programs and applications
- Performs arithmetic and logical operations
- Controls the operation of other hardware components

Motherboard

The **main circuit board** of the computer that connects all internal components.

Key Features:

- Houses CPU, RAM, ROM, chipset, and expansion slots.
- Provides connectivity through ports, buses, and sockets.
- Controls communication between various components.

Random Access Memory (RAM)

This is the **primary memory** or **volatile memory**.

Functions:

- Temporarily stores data and instructions for active processes.
- Data in RAM is lost when the computer is powered off.

b) **External hardware (Peripheral's devices**): External hardware refers to the physical devices connected to a computer system from the outside**,** which help in input, output**,** External hardware refers to the physical devices connected to a computer system from the outside**,** which help in input, output, interactions with the system.

  Types of External hardware:

- Input Devices
- Output Devices

Input Devices:

- An input device allows a user to enter information or commands into a computer.
- converts physical actions—such as key presses or motions—into electronic signals that are processed into digital data by the computer's CPU.
- Input devices are essential for communication between users and computers**.**

Standard input device:

Keyboard:

- The most common input device.
- It is similar like a type writer which is used to enter data in the computer.
- Consists of keys for letters, numbers, symbols, and special functions.

Types of Keyboards:

- QWERTY keyboard
- Virtual/On-screen keyboard
- Wireless/Bluetooth keyboard

Explain Pointing Devices: Used to control the cursor or pointer on the screen.

a) Mouse

- Mouse is point-and-Draw device.
- It is small hand hold input device which is generally used for drawing purpose.
- It contains two or three buttons.
- Left button is used to point out or select any item by clicking.
- Right to generate context menu.
- When user moves mouse across flat surface, the graphic cursor moves on screen.
- Graphic cursor contains verity of symbols such as arrow, wrist, pointing finger etc.
- Depending on application text & graphic cursors are changed.
- Many types of mouse are available such as:

  1. Optical
  2. Wireless
  3. Mechanical.

b) Track Ball

- Trackball is a pointing device which is similar to a mouse.
- A ball is placed on the track ball device which is used to move the graphic cursor on the screen.
- It also contains buttons which are used to select a particular item on the screen.
- To move the graphic cursor on screen, the ball is rolled with the fingers or thumb.
- It needs not to move the whole device to move the cursor so it is often attached with some keyboards.
- It is used in CAD/CAM (Computer aided design / Computer aided manufacturing).

c) Joystick

- Joystick is a pointing device which is works on the same principle of track ball.
- It contains a stick which is placed on the spherical ball.
- The stick is used to move the cursor at desired position left or right or backward or forward.
- It also contains button that is clicked to make selection of currently pointed item.
- A joystick is similar to a mouse, except that with a mouse the cursor stops moving as soon as you stop moving the mouse.
- With a joystick, the pointer continues moving in the direction the joystick is pointing.
- To stop the pointer, you must return the joystick to its upright position.

- Some of the systems using joysticks are

  a) Motorized Wheelchairs as input device
  b) Microscopes
  c) Video Games

d) Light Pen

- Light pen is a pointing device which is used to draw directly draw on the screen. It is called light pen because it is similar to a pen & senses light.
- It's an input device in the form of light-sensitive stick used in conjunction with a CRT display.
- The light pen allows the user to point out or draw any object on the screen.
- The user brings the pen to the desired point on screen and presses the pen button to make contact.
- It has a switch on its top which allows the user to make contact with screen.
- It is useful for drawing or graphics in the program such as CAD (computer aided design).
- An engineer, architect or fashion designer can draw directly on screen.
- Used in application such as gaming, graphic arts, healthcare applications etc.
- Light pen cannot scratch or damage a screen.
- **Advantages of light pen are:**
  - ✓ Less expensive than touch screen.
  - ✓ give the user the full range of mouse capabilities, without the use of a pad or any horizontal surface o Cannot scratch or damage screen.

- ✓ Works on any size screen.

e) Touch Screen

- Touch screen is a pointing device.
- It allows the user to choose from available options by simply touching with their figure to the desired icon or menu item displayed on the computer screen.
- A touch screen is an electronic visual display that can detect the presence and location of a touch within the display area.
- The term generally refers to touching the display of the device with a finger or hand.
- Touch screens are common in devices such as computers, tablet computers& Smartphone.
- It's a very easy to operate device which users can use the system without any formal training.
- Uses optical sensors that detect the touch of the finger on screen.
- Sensors communicate the position of touch to the computer which interprets the input made by the users.
- It contains pressure sensitive monitors which are placed inside the base of computer screen.
- Pressure sensitive monitors contain sensors to measure the monitor's weight at many points.
- When user touches the screen, the changes on weights & forces transferred down to sensor which allows the device to detect the location of the touch.
- This type of monitors required little pressure to transmit the desired input.
- **Touch screen are commonly used in following places**
  - ✓ An airport or railway station.
  - ✓ Large departmental stores.
  - ✓ In large museums or zoos to guide visitors to the locations of various attractions.
  - ✓ Self-service check out
  - ✓ In ATM machines o in I-phones or PDA's

MICROPHONE
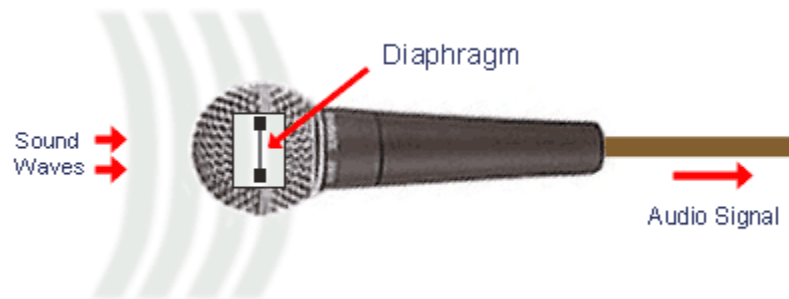
- It's an input device.
- Used to stores the voice data into the computer system. Microphones are a type of transducer- a device which converts energy from one form to another.
- Microphones convert sound waves into electrical energy.
- Different types of microphones have different ways of converting energy.
- All the microphones share one common thing: The diaphragm.
    o Thin piece of material (such as paper, plastic or aluminum) which vibrates when it is struck by sound waves.
    o When the diaphragm vibrates, it causes other components in the microphone to vibrate.
    o These vibrations are converted into an electrical current which becomes the audio signal.

SCANNER

- A scanner is a hardware input device that converts physical documents, images, or text into digital files for a computer.
- The document is placed on the glass surface (flatbed) or fed into the scanner
- A light source, such as a lamp or LEDs, illuminates the document or image placed on the scanning bed.
- The light reflects off the surface of the item. Darker areas reflect less light, while lighter areas reflect more.
- A sensor array captures these reflected light patterns.
- The sensor converts the light into an electrical charge, which is then transformed into digital data.
- The captured data is broken down into rows and columns of dots, or pixels, creating a digital image.
- Scanning software processes this digital data, separating it into components to represent colors and enhancing the image
- The final digital file is then sent to the computer, where it can be saved, viewed, edited, or shared.

Types of scanners:

a) **Flatbed scanner**
- It's like a xerox machine which consist of box having a glass plate on its top and a lid to covers the glass plate.
- The document placed inside the glass plate & light source is situated below glass plate which moves horizontally from left to right & scanning document line by line.

b) **Handheld scanner**
- It contains a set of light emitting diodes encased in small case which can be conveniently held in hand.
- To scan a document the scanner is slowly dragged on the document.
- The scanner has to be dragged carefully & steadily otherwise the document cannot scan properly.
- Used when higher accuracy is not required

c) **3D Scanner**
- Captures the shape and dimensions of objects in three dimensions.
- Used in design, medical imaging, archaeology, and 3D printing.

d) **Film/Slide Scanner**
- Designed to scan negatives, slides, or film strips.
- Provides high-quality digital images for photographers.

OMR (OPTICAL MARK READER)

- OMR is a device that is capable of recognized pre-specified type of mark made by pencil or pen.
- The Optical Mark Reader is a device which can detect the presence or absence of a mark on a paper
- The OMR recognize the marks by focusing a light on the paper being scanned & detect the reflected light pattern from mark.
- The present mark is detected due to intensity of light being reflected from the mark.
- Pencil marks made with soft lead pencil reflect the light which allowing the OMR to determine which response are mark
- OMR is used in reading answers sheets, questionnaires.

Advantages of OMR
- Speedy and accurate to generate result.
- Cheap in cost.

Disadvantage of OMR
- Cannot able to read characters.
- Erasing or cancellation is not possible.
- Good quality expensive paper is required.

OCR (OPTICAL CHARACTER RECOGNITION or OPTICAL CHARACTER READER)

- OCR capable of recognizing alphabets & numbers printed on paper.
- Technology that electronically converts images of text, whether typed, printed, or handwritten, into machine-encoded, editable text for computer processing.
- It is always used with character recognized software.
- It converts bitmap images of character to equivalent ASCII code.
- First it creates bitmap image of document & OCR software translate into ASCII code which computer interprets letter, symbol or number.

Advantages

- Improved Accuracy
- Speedy entered data.
- Accept wide range of font using ordinary mark.

Disadvantage
- Expensive
- Scanned properly only if the characters are standard size.
- Dusty paper can't scan properly.

MICR (MAGNETIC INK CHARACTER RECOGNITION

- A technology that uses special magnetic ink and unique character fonts to enable machines to read and process information from financial documents, primarily checks, with high speed and accuracy.
- Special fonts, such as E-13B, are used to print characters (numbers and symbols) on documents using a magnetic ink containing iron oxide particles.
- A MICR reader, equipped with magnetic sensors, passes over the printed characters.
- The reader detects the magnetic signals generated by the iron oxide particles in the ink, which are unique to each character.
- The reader translates these signals into digital data, extracting essential information like the routing number, account number, and check number.

Advantages
- Speedy data entry.
- Accurate output.
- Security
- Folded or roughly handled cheques are also scanned with same accuracy.

Disadvantage
- MICR software is required.
- Limited fonts are used so used in banking industries only.

BCR (BAR CODE READER) DEVICE

- An input device that scans and decodes information from printed barcodes, translating it into alphanumeric characters that a computer can understand and use for purposes like inventory management or product checkout.
- The device emits light from a built-in source, such as a red laser or an LED, through a small window onto the barcode.
- The light reflects off the barcode's bars and spaces. Black bars absorb light, while white spaces reflect it.
- A photoelectric sensor inside the scanner detects these variations in the reflected light.
- The sensor converts the detected light pattern into a series of analog electrical signals. An internal decoder processes these signals, identifying the unique pattern of bars and spaces.
- The decoder then translates this pattern into digital information—numbers, letters, or symbols—and sends it to a computer or other connected device.
- The computer uses this information to look up details about the product in a database.

OUTPUT DEVICES

An output device is a computer hardware that receives data from a computer and converts it into a human-perceptible form, such as visuals, sound, or a physical copy on paper.

Example: Monitor, printer, plotter, speaker

Functions of Output devices:
- Accept the result from the CPU.
- Convert that result into human readable form.
- Supply this result to output device.

Monitor / Visual display unit
- The monitor is the common output device mostly used It is a softcopy output device.
- The monitor acts as the interface between the user and the computer by visually presenting the processed data.
- Translates computer data into visual information, displaying text, images, and videos for users to see.
- Monitors work by receiving video signals from a computer's video card and translating them into visible output through technologies like LCD, LED
- **Two types of monitors are used**
  - ✓ CRT monitors.
  - ✓ Non-CRT monitors

CATHODE RAY TUBE (CRT) MONITORS
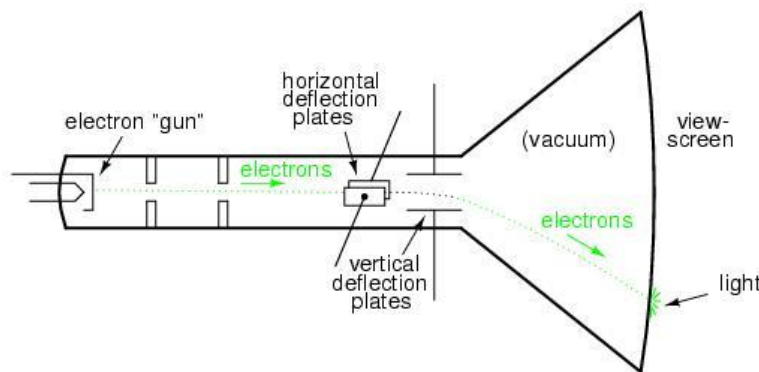
- **CRT** stands for Cathode Ray Tube.
- Most computer monitors are based on Cathode Ray Tube (CRT) technology.
- The basic operation of these tubes is similar to that in television sets.
- CRT monitor contains cathode, electron gun, focusing system, deflection plates & phosphor coated screen.
- **Electron gun**: Electron gun generates negatively charged electrons. Electron gun consists of cathode and heating filament. When heat is supplied to cathode by a heating filament its electron become loose and gets emitted from cathode surface.
- **Focusing system:** The purpose of focusing system in CRT is to force the electron beam to converge into spots and travel in straight line.
- **Deflection System:** The purpose of deflection system is to change the direction of electron beam so that electron beam can be made to strike at different locations.

- **Phosphor coated screen:** The screen is coated with phosphorus crystals called phosphors. These phosphor crystals emit small spots of light when the electron beam strikes on them.

Advantages of CRT display

- Produce more colors.
- Price is lower than LCD & Plasma.
- High contrast ratio.
- Can easily increase brightness of monitor by reflecting the light.

Disadvantages of CRT display

- High power consumed.
- Heavy to pick up and carry.
- Large space required.

NON-CRT DISPLAY

a) **Liquid Crystal Display (LCD)**
   - LCD stands for Liquid Crystal Display.
   - It's a flat-panel display technology commonly used in TVs, monitors, smart phones, calculators, digital watches, and many other electronic devices.
   - LCDs are energy-efficient and thinner than older technologies like CRT (Cathode Ray Tube), making them ideal for portable and modern electronic devices.
   - An LCD screen uses a backlight fluorescent lamp (CCFL) used in older LCD monitors, to provide the light that will form the image.
   - This light first passes through a vertical polarizing filter, which only allows light waves oscillating in a specific direction.
   - The light then travels to a layer of liquid crystals. These are special molecules that are arranged in a pattern.
   - This layer also contains electrodes, which are connected to a power source.
   - When an electric current is applied to the electrodes, the liquid crystals untwist or align themselves in a new direction.
   - The twisted or aligned liquid crystals rotate the polarization of the light passing through them.
   - The light then passes through Horizontal polarized filter.
   - If the liquid crystals are twisted, they rotate the light's polarization to match the second filter, allowing the light to pass through and the pixel to appear light.
   - If the liquid crystals are untwisted by an electric current, they do not rotate the light's polarization, and the light is blocked by the second filter, making the pixel appear dark.

- Each pixel is made up of tiny red, green, and blue (RGB) sub-pixels, each with its own color filter. By controlling how much light passes through these sub-pixels, the LCD can produce a full spectrum of colors.
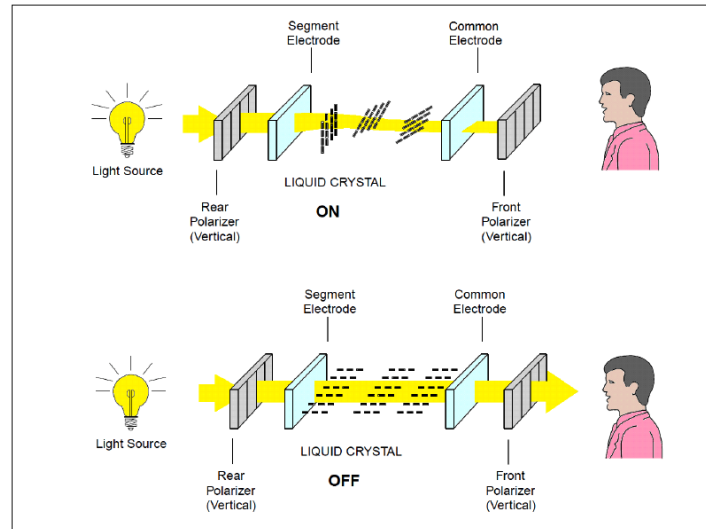
b) Light-Emitting Diodes (LED)
- LEDs use diodes made of semiconductor material that glow when electrons recombine with holes, releasing energy as light.
- LED monitor uses a panel of LEDs as its light source. These LEDs can be placed behind the screen (full-array) or along the edges (edge-lit).
- The light from the LEDs shines through the LCD panel, which contains millions of tiny liquid crystal cells arranged in a grid to form pixels.
- The liquid crystals act like tiny light switches. When an electrical current is applied, they twist or align in a specific way, controlling the amount of light that passes through them.
- Each pixel is typically composed of sub-pixels of red, green, and blue LEDs. By controlling the brightness and combination of these colors, the monitor can create the entire spectrum of colors you see.
- The specific patterns of light and dark pixels, created by the liquid crystal layer blocking or allowing the LED light, combine to form the final image on the screen.

Advantages of LED Monitors
- ✓ Energy Efficiency
- ✓ Thinner Design
- ✓ Better Contrast
- ✓ Longer Lifespan
- ✓ Better Picture Quality

DIFFERENTIATION LCD AND LED DISPLAYS

Feature	LCD (Liquid Crystal Display)	LED (Light Emitting Diode)
Full Form	Liquid Crystal Display	Light Emitting Diode
Backlighting	Uses fluorescent lamps for backlighting	Uses light-emitting diodes for backlighting
Thickness	Usually thicker	Thinner and slimmer design
Energy Efficiency	Consumes more power	More energy-efficient
Picture Quality	Good but with lower contrast and brightness	Better contrast, brightness, and colors
Viewing Angle	Limited viewing angle, colors may shift at angles	Wider viewing angles with consistent colors
Lifespan	Shorter lifespan of backlight	Longer lifespan
Price	More affordable	Generally, more expensive
Environmental Impact	Uses mercury in fluorescent lamps	Mercury-free, more eco-friendly
Typical Use	Older TVs, monitors	Modern TVs, smartphones, laptops

PRINTER

- A printer is a peripheral (hardware) device that creates a physical copy, or "hard copy," of digital content like text and images from a computer onto paper.
- Mainly printer can be classified in two types:
  - **a)** Impact printer
  - **b)** Non-impact printer

a) Impact printer:

  - ✓ An impact printer creates an image by physically striking an ink ribbon against paper.
  - ✓ Printers use a mechanical hammer, pin, or wheel to transfer ink from the ribbon onto the page, forming characters or graphics.
  - ✓ It can capable to print single character or line at the same time.
  - ✓ Commonly types of impact printers are dot matrix, daisy wheel, chain, drum printer.

  Characteristics of impact printer:
  - ✓ Physical contact with paper to produce output.
  - ✓ Low cost
  - ✓ Very noisy
  - ✓ Very slow in printing
  - ✓ Low quality print out

Different Types of Impact Printer:

1) **Dot matrix printer:**
   - ✓ It is a character printer.
   - ✓ Capable to print single character at the same time.
   - ✓ The core of the printer is a print head that moves horizontally across the page.
   - ✓ Inside the print head are a series of wire pins.
   - ✓ Print by hammering the pins on inked ribbon to leave ink impressions on the paper.
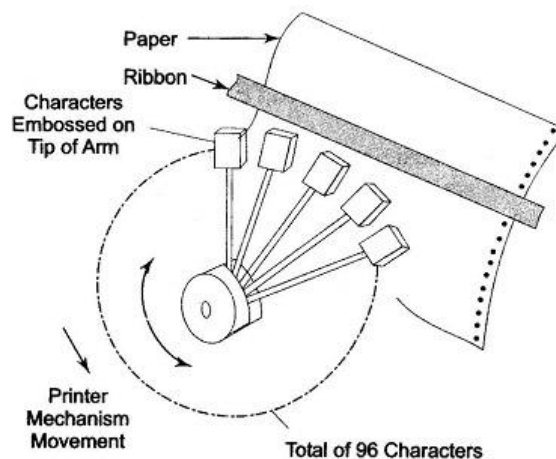
   . **Advantages:**
   - ✓ Low cost & easily available.
   - ✓ Cheap in cost.
   - ✓ Can make carbon copy of print out.
   - ✓ Low maintenance cost.
   - ✓ Work with any type of environment.

   Disadvantages:
   - ✓ Slow in speed.
   - ✓ Very noisy.
   - ✓ Cannot work perfectly in graphics

2) **Daisy wheel printer:**
   - ✓ It is a character printer.
   - ✓ Able to print a single character at the same time.
   - ✓ Contain a metal wheel on which the characters & numbers are raised on each Petal.
   - ✓ The wheel is rotated very fast when the desired characters arrive at correct Position a print hammer strike to produce output.

Paper
Ribbon
Characters Embossed on Tip of Arm
Printer Mechanism Movement
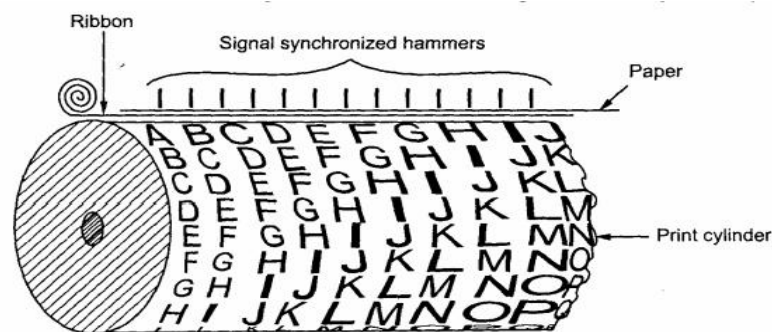Total of 96 Characters

Advantages:
- ✓ Low cost.
- ✓ Can make carbon copy of print out.
- ✓ Low maintenance cost.
- ✓ Printing quality is similar to a type writer.
- ✓ Able to print bold characters.
- ✓ Allows using different font-face in same document.

Disadvantages:
- ✓ Very slow in speed.
- ✓ Very noisy.
- ✓ Cannot print graphics.
- ✓ Only print in a single color.

3) **Drum printer:**
- ✓ It's a line printer.
- ✓ Able to print a line at the same time.
- ✓ Uses a rotating metal drum with pre-formed characters to print text at high speeds.
- ✓ A cylindrical drum has a complete set of characters and fonts on its surface.
- ✓ As the drum spins, the desired character for a specific position on the line aligns with a printing hammer.
- ✓ The hammer then strikes the ink ribbon, pushing it against the paper to imprint the character.

Advantages:
- ✓ Low cost than non-impact printer.
- ✓ Can make carbon copy of print out.
- ✓ Low maintenance cost.
- ✓ Faster than other impact printer.
- ✓ Printing quality is similar to a type writer.

Disadvantages:
- ✓ Very slow in speed.
- ✓ Very noisy.

- ✓ Large & heavy.
- ✓ Cannot print graphics.
- ✓ Only prints predefined set of characters

4) Chain /band printer:

- ✓ A chain printer is a type of impact line printer.
- ✓ Able to print a line at the same time.
- ✓ Consist of a metallic chain on which all characters of character set are embossed.
- ✓ This chain rotates at a high speed.
- ✓ A set of hammers, one for each character position on the line, sits behind the paper.
- ✓ An inked ribbon is placed between the chain and the paper.
- ✓ As the chain spins, when the desired character for a specific column reaches the correct position, its corresponding hammer strikes the paper and ribbon, creating an impression of the character.
- ✓ After a complete line is printed, the paper moves up, and the process repeats for the next line.
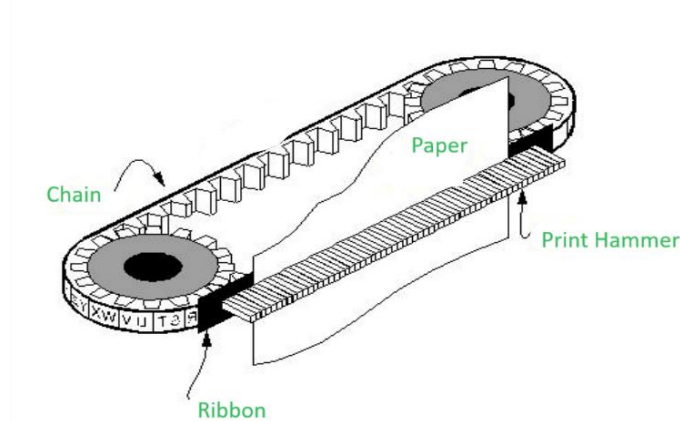
Advantages

- Prints very fast, so it's good for large jobs.
- Can change languages and fonts easily.
- Produces shiny, clear letters.
- Strong and reliable with low maintenance.

Disadvantages

- Noisy when operating.
- Usually more expensive than some other printers.

- Can only print text, no pictures or graphics.
- Uses continuous paper which can be inconvenient.
- Big size needs a lot of space.

b) Non-impact Printer:

- ✓ Non-impact printer forms characters & images on paper without actually (physically) striking the paper.
- ✓ Printer's spray tiny droplets of liquid ink onto the paper.
- ✓ Ink jet & laser printer are example of non-impact printer.

Characteristics of non-impact printer

- ✓ Faster than impact printer.
- ✓ High quality output
- ✓ More expensive than impact printer.
- ✓ Less maintenance than impact printer

1) Ink-jet Printer

- The ink-jet printer is a non-impact printer, meaning it prints without striking the paper.
- It generates text and images by precisely spraying millions of microscopic ink droplets directly onto paper or other material.
- The printer uses cartridges filled with liquid ink, which supply the ink to the print head.
- The print head is equipped with thousands of tiny nozzles. It moves back and forth across the paper, distributing ink to form the desired text or graphics.
- These nozzles fire ink droplets with great accuracy, building the image or text dot by dot.
- There are two primary technologies for forcing ink out of the nozzles:
    - ✓ *Thermal Bubble:* Tiny heaters create bubbles inside the ink. The expanding bubbles push droplets of ink out of the nozzle.
    - ✓ *Piezoelectric:* Small crystals in the print head change shape when an electric current is applied, pushing ink droplets out.
- As the print head travels line by line, the paper is gradually fed through the printer to ensure full coverage of the page.
- By combining different colored ink droplets in specific patterns, ink-jet printers can produce vivid images and clear text on paper.

Advantages

- Ink-jet printers are cheap to buy and easy to use.
- They can print high-quality color pictures and photos.
- These printers work quietly and do not make much noise.
- Ink-jet printers can print on different types of paper, including photo paper.
- They are small and lightweight, so they fit easily on a desk.

Disadvantages

- Ink cartridges cost a lot and need to be changed often.
- Printing with an ink-jet printer is slower than with other types, especially for lots of pages.
- Ink can smudge if paper gets wet or is touched too soon.
- Print heads may clog and need cleaning.
- Not good for printing a very large number of pages at once.

2) LASER Printer

- A laser printer is a non-impact printer, meaning it prints without physically striking the paper.
- It uses a laser beam to create sharp, high-quality text and images on paper.
- The printer works by using static electricity, light, and toner powder (a fine plastic powder) to form the printed image.
- First, a photosensitive drum inside the printer is given a uniform electrostatic charge.
- A laser beam scans the surface of this drum, removing the charge in specific areas to form an invisible image pattern.
- As the drum rotates, it passes by a developer roller which applies toner powder. The toner sticks to the parts of the drum left with charge, making the image visible.
- Then, paper passes under the drum, and the toner is attracted from the drum onto the paper by a stronger electrostatic charge on the paper.
- The paper moves through a fuser unit where heat and pressure melt and bond the toner permanently to the paper.
- Any leftover toner on the drum is cleaned off, and the drum is recharged for the next print cycle.

Advantages of Laser Printers

- Laser printers print very fast, so they are good when you need to print many pages quickly.
- The print quality is sharp and clear, especially for text and graphics.
- Toner cartridges last longer than ink cartridges, so printing each page costs less in the long run.
- Laser printers are reliable and often require less maintenance.

- They can print on different types of paper, including thicker paper like cards and envelopes.

Disadvantages of Laser Printers
- Laser printers usually cost more to buy than inkjet printers.
- They are bigger and heavier, so they need more space.
- They use more electricity than inkjet printers, which might increase energy costs.
- Some laser printers can be noisy when printing.
- They are not the best for high-quality photo printing compared to inkjet printers.

DIFFERENTIATE BETWEEN IMPACT PRINTERS AND NON-IMPACT PRINTERS

Feature	Impact Printer	Non-Impact Printer
Printing Mechanism	Prints by physically striking an inked ribbon	Prints without touching the paper
Print Process	Uses hammers, pins, or wheels to hit the ribbon	Uses ink spray, laser, or heat to print
Speed	Slower printing speed	Faster printing speed
Noise Level	Noisy due to mechanical striking	Quiet, no mechanical impact
Print Quality	Lower, suitable for text and simple graphics	Higher, produces sharp text and images
Ink Usage	Uses inked ribbons	Uses ink cartridges or toner
Technology	Traditional, old technology	Modern, advanced technology
Cost	Generally cheaper	More expensive
Maintenance	More frequent due to mechanical wear	Less frequent maintenance
Paper Handling	Uses continuous paper sheets	Uses individual sheets of paper
Suitable For	Printing multipart forms and carbon copies	High-quality documents, photos, and fast printing
Examples	Dot matrix, Daisy wheel, Line printers	Inkjet and Laser printers

PLOTTER

- A plotter is an output device used to produce hard copies of graphics, such as drawings, maps, and charts.
- Unlike regular printers, plotters create images by drawing continuous lines using pens or other drawing tools, making them ideal for detailed and precise line drawings.
- The computer sends commands and coordinates to the plotter, which interprets these instructions to control the movement of the pen.
- The pen or drawing tool moves precisely across the paper to create lines, curves, and shapes, generating vector-based output.
- The paper can either move on a rotating drum or remain fixed on a flat surface, while the pen moves along the X and Y axes to draw the design.

Types of Plotters

1) **Drum Plotter**

- The paper is wrapped around a cylindrical drum that rotates to move the paper back and forth (Y-axis).
- An arm holding one or more pens moves horizontally (X-axis) to draw lines and shapes.
- The combined movement of the drum and pen allows the plotter to create accurate drawings.
- Drum plotters are generally more affordable and used for standard-sized graphics.

2) **Flatbed Plotter**

- The paper is fixed on a stationary flat surface.
- The pen is mounted on a movable arm that moves along both the X and Y axes to draw the picture.
- Some flatbed plotters use interchangeable pens, allowing color drawings.
- They can produce very detailed and large drawings, sometimes as big as 20 feet by 50 feet.
- These plotters are commonly used in designing cars, aircraft, buildings, highways, and other large-scale engineering projects.

SPEAKER

A speaker is an important output device connected to a computer's sound system that allows us to hear audio signals.

- **Function:** The speaker receives electrical signals from the computer's sound card or other audio sources and converts these signals into sound waves that can be heard by humans.
- **Signal Conversion:** The audio signals received by the speaker are initially digital and must be converted into analog form. This conversion is done by a component called the **Digital-to-Analog Converter (DAC)**. The DAC turns the digital data from the computer into electrical signals that can drive the speaker.
- **Sound Production:** Inside the speaker, an electromagnetic driver uses these analog electrical signals to create sound. This driver works by passing current through a coil of wire (called the voice coil) placed within a magnetic field. When the electrical signal flows through the coil, it produces a magnetic field that interacts with the permanent magnet, causing the coil to move back and forth.
- **Diaphragm Movement:** The voice coil is attached to a diaphragm or cone, typically made of lightweight materials. As the coil moves, it causes the diaphragm to vibrate. These vibrations create pressure waves in the air, which we perceive as sound.
- **Components:** The main parts of a typical computer speaker include:
  - **Cone/Diaphragm:** Vibrates to produce sound waves.
  - **Voice Coil:** Converts electrical current into motion.
  - **Magnet:** Creates a steady magnetic field.
  - **Amplifier:** Many computer speakers have built-in amplifiers to boost the audio signal and make the sound louder and clearer.
  - **Enclosure:** The outer casing that supports the components and affects sound quality.
- **Types of Speakers:** There are various types of speakers used with computers, such as:
  - **Stereo speakers (2.0 systems):** Two speakers that provide left and right audio channels.
  - **2.1 speaker systems:** Two speakers plus a subwoofer to enhance low bass sounds.
  - **Surround sound systems (5.1 or more speakers):** Provide immersive multi-directional sound, useful for gaming and movies.
  - **Portable or Bluetooth speakers:** Allow wireless connection and easy mobility.
- **Uses:** Speakers are used for playing music, videos, games, video conferencing, notifications, and any audio content, enhancing the overall user experience.

SOFTWARE

- **Software** is a collection of programs, data, and instructions that tell a computer or electronic device how to operate and perform specific tasks.
- It enables users to interact with the device to create content, browse the internet, manage data, and much more, without needing to understand the underlying hardware.
- Software is **intangible**, meaning it is not a physical object and cannot be touched.
- It is the **logical part** of a computer that controls what the computer does and how it does it.

Types of Software

System Software

- System software acts as a platform to run other software and controls the computer's internal functions and hardware operations.
- It is usually written in low-level languages for high speed and efficiency.

Types of system software:

1) **Operating System (OS):**

   o The first program loaded when a computer starts.
   o Manages hardware resources like CPU, memory, printers, and storage.
   o Provides a user interface to interact with the computer (e.g., Windows, Linux, mac OS).

2) **Language Processors:**

   o Convert programming languages like Java, C++, or Python into machine-readable code.
   o This includes compilers, interpreters, and assemblers.

3) **Device Drivers:**

   o Help the operating system communicate with hardware devices like printers, scanners, or keyboards.
   o Each device requires its own driver to function properly.

Application Software

- Application software performs specific tasks for users, such as writing documents, creating presentations, or managing data.

- Also called end-user or productivity software.
- **Examples include:**
    - o **Productivity Software:** MS Word, Excel, Google Docs (for writing, calculations, presentations).
    - o **Web Browsers:** Chrome, Firefox, Edge (for accessing the internet).
    - o **Database Software:** MySQL, Oracle (for managing data).
    - o **Multimedia Software:** VLC Media Player, Photoshop (for videos, images, and audio).

Utility Software

- Utility software helps maintain and optimize computer performance, security, and management.
- These include antivirus programs, disk cleanup tools, backup software, and file compression utilities.

DIFFERENTIATE HARDWARE AND SOFTWARE

Feature	Hardware	Software
Definition	Physical parts of a computer that you can touch	Programs and instructions that tell hardware what to do
Tangibility	Tangible (can be seen and touched)	Intangible (cannot be touched or seen physically)
Function	Performs data processing and supports software	Controls hardware and performs specific tasks
Examples	Keyboard, mouse, monitor, CPU, printer	Operating system, MS Word, web browsers
Dependency	Cannot work without software	Cannot work without hardware
Durability	Can wear out or get damaged over time	Does not wear out but can become outdated
Development	Manufactured physically	Developed by programming and coding
Repair/Replacement	Physically repaired or replaced	Reinstalled or updated
Effect of Viruses	Not affected by viruses	Can be infected by viruses
Operation Level	Works at the machine level	Works at the logical/instruction level