Data can be defined as a representation of facts, concepts, or instructions in a formalized manner, which should be suitable for communication, interpretation, or processing by human or electronic machine.

Data is represented with the help of characters such as alphabets (A-Z, a-z), digits (0-9) or special characters (+,-,/,*,<,>,= etc.)

What is Information?

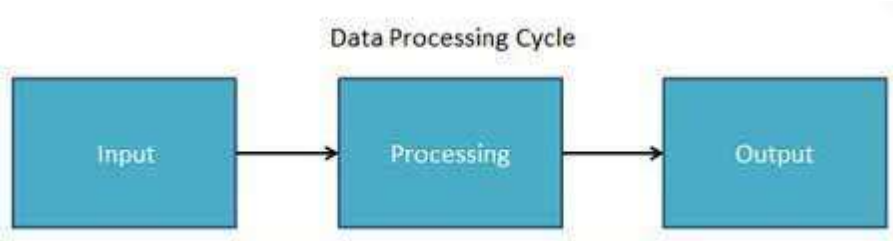
Information is organized or classified data, which has some meaningful values for the receiver. Information is the processed data on which decisions and actions are based.

For the decision to be meaningful, the processed data must qualify for the following characteristics −

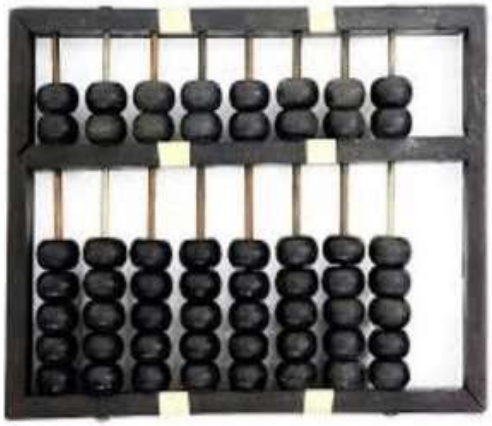
- **Timely** − Information should be available when required.
- **Accuracy** − Information should be accurate.
- **Completeness** − Information should be complete.

Data Processing Cycle

Data processing is the re-structuring or re-ordering of data by people or machine to increase their usefulness and add values for a particular purpose. Data processing consists of the following basic steps - input, processing, and output. These three steps constitute the data processing cycle.

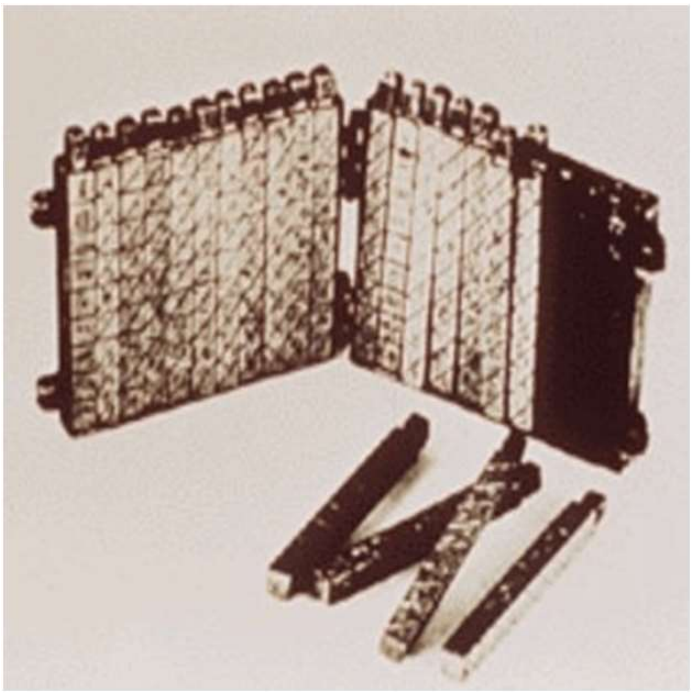


- **Input** − In this step, the input data is prepared in some convenient form for processing. The form will depend on the processing machine. For example, when electronic computers are used, the input data can be recorded on any one of the several types of input medium, such as magnetic disks, tapes, and so on.
- **Processing** − In this step, the input data is changed to produce data in a more useful form. For example, pay-checks can be calculated from the time cards, or a summary of sales for the month can be calculated from the sales orders.
- **Output** − At this stage, the result of the proceeding processing step is collected. The particular form of the output data depends on the use of the data. For example, output data may be pay-checks for employees.
- History of Computers
- The first counting device was used by the primitive people. They used sticks, stones and bones as counting tools. As human mind and technology improved with time more computing devices were developed. Some of the popular computing devices starting with the first to recent ones are described below;
- Abacus
- The history of computer begins with the birth of abacus which is believed to be the first computer. It is said that Chinese invented Abacus around 4,000 years ago.
- It was a wooden rack which has metal rods with beads mounted on them. The beads were moved by the abacus operator according to some rules to perform arithmetic calculations. Abacus is still used in some countries like China, Russia and Japan. An image of this tool is shown below;



Napier's Bones

It was a manually-operated calculating device which was invented by John Napier (1550-1617) of Merchiston. In this calculating tool, he used 9 different ivory strips or bones marked with numbers to multiply and divide. So, the tool became known as "Napier's Bones. It was also the first machine to use the decimal point.



Pascaline

Pascaline is also known as Arithmetic Machine or Adding Machine. It was invented between 1642 and 1644 by a French mathematician-philosopher Biaise Pascal. It is believed that it was the first mechanical and automatic calculator.

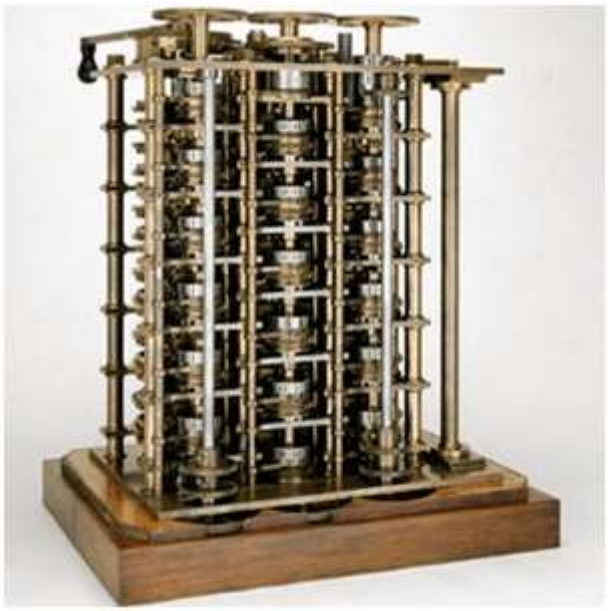
Pascal invented this machine to help his father, a tax accountant. It could only perform addition and subtraction. It was a wooden box with a series of gears and wheels. When a wheel is rotated one revolution, it rotates the neighboring wheel. A series of windows is given on the top of the wheels to read the totals. An image of this tool is shown below;

Stepped Reckoner or Leibnitz wheel

It was developed by a German mathematician-philosopher Gottfried Wilhelm Leibnitz in 1673. He improved Pascal's invention to develop this machine. It was a digital mechanical calculator which was called the stepped reckoner as instead of gears it was made of fluted drums. See the following image;

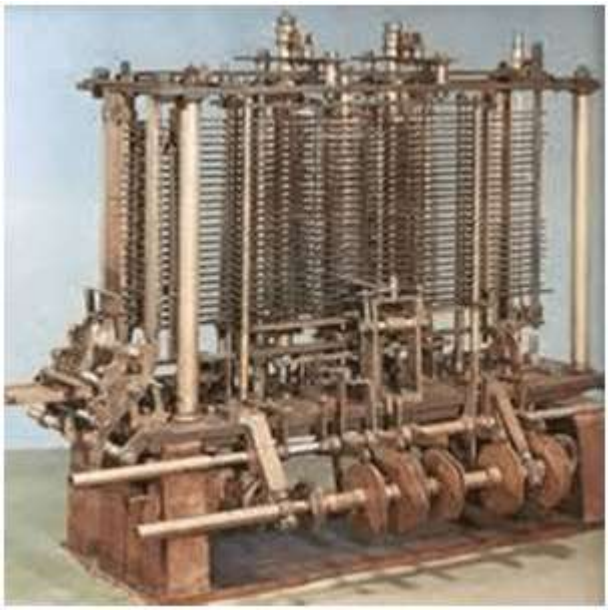
Difference Engine

In the early 1820s, it was designed by Charles Babbage who is known as "Father of Modern Computer". It was a mechanical computer which could perform simple calculations. It was a steam driven calculating machine designed to solve tables of numbers like logarithm tables.



Analytical Engine

This calculating machine was also developed by Charles Babbage in 1830. It was a mechanical computer that used punch-cards as input. It was capable of solving any mathematical problem and storing information as a permanent memory.

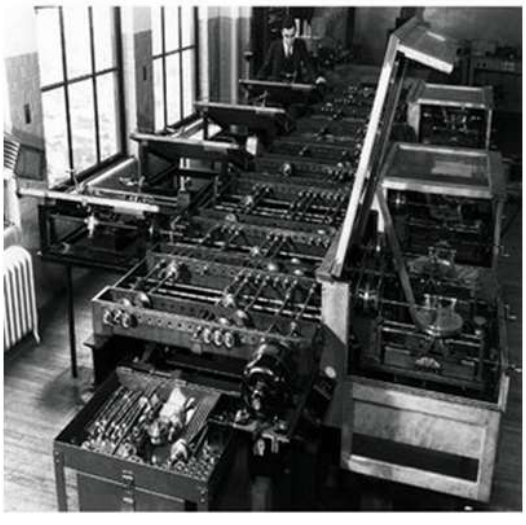


Tabulating Machine

It was invented in 1890, by Herman Hollerith, an American statistician. It was a mechanical tabulator based on punch cards. It could tabulate statistics and record or sort data or information. This machine was used in the 1890 U.S. Census. Hollerith also started the Hollerith?s Tabulating Machine Company which later became International Business Machine (IBM) in 1924.

Differential Analyzer

It was the first electronic computer introduced in the United States in 1930. It was an analog device invented by Vannevar Bush. This machine has vacuum tubes to switch electrical signals to perform calculations. It could do 25 calculations in few minutes.



Mark I

The next major changes in the history of computer began in 1937 when Howard Aiken planned to develop a machine that could perform calculations involving large numbers. In 1944, Mark I computer was built as a partnership between IBM and Harvard. It was the first programmable digital computer.

Generations of Computers

A generation of computers refers to the specific improvements in computer technology with time. In 1946, electronic pathways called circuits were developed to perform the counting. It replaced the gears and other mechanical parts used for counting in previous computing machines.

In each new generation, the circuits became smaller and more advanced than the previous generation circuits. The miniaturization helped increase the speed, memory and power of computers. There are five generations of computers which are described below;

First Generation Computers

The first generation (1946-1959) computers were slow, huge and expensive. In these computers, vacuum tubes were used as the basic components of CPU and memory. These computers were mainly depended on batch operating system and punch cards.

Magnetic tape and paper tape were used as output and input devices in this generation;

Some of the popular first generation computers are;

- **ENIAC** (Electronic Numerical Integrator and Computer)
- **EDVAC** (Electronic Discrete Variable Automatic Computer)
- **UNIVACI**(Universal Automatic Computer)
- **IBM-701**
- **IBM-650**

Second Generation Computers

The second generation (1959-1965) was the era of the transistor computers. These computers used transistors which were cheap, compact and consuming less power; it made transistor computers faster than the first generation computers.

In this generation, magnetic cores were used as the primary memory and magnetic disc and tapes were used as the secondary storage. Assembly language and programming languages like COBOL and FORTRAN, and Batch processing and multiprogramming operating systems were used in these computers.

Some of the popular second generation computers are;

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

Third Generation Computers

The third generation computers used integrated circuits (ICs) instead of transistors. A single IC can pack huge number of transistors which increased the power of a computer and reduced

the cost. The computers also became more reliable, efficient and smaller in size. These generation computers used remote processing, time-sharing, multi programming as operating system. Also, the high-level programming languages like FORTRON-II TO IV, COBOL, PASCAL PL/1, ALGOL-68 were used in this generation.

Some of the popular third generation computers are;

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

Fourth Generation Computers

The fourth generation (1971-1980) computers used very large scale integrated (VLSI) circuits; a chip containing millions of transistors and other circuit elements. These chips made this generation computers more compact, powerful, fast and affordable. These generation computers used real time, time sharing and distributed operating system. The programming languages like C, C++, DBASE were also used in this generation.

Some of the popular fourth generation computers are;

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

Fifth Generation Computers

In fifth generation (1980-till date) computers, the VLSI technology was replaced with ULSI (Ultra Large Scale Integration). It made possible the production of microprocessor

chips with ten million electronic components. This generation computers used parallel processing hardware and AI (Artificial Intelligence) software. The programming languages used in this generation were C, C++, Java, .Net, etc.

Some of the popular fifth generation computers are;

- **Desktop**
- **Laptop**
- **NoteBook**

S.No.	Type	Specifications
1	PC (Personal Computer)	It is a single user computer system having moderately powerful microprocessor
2	Workstation	It is also a single user computer system, similar to personal computer however has a more powerful microprocessor.
3	Mini Computer	It is a multi-user computer system, capable of supporting hundreds of users simultaneously.
4	Main Frame	It is a multi-user computer system, capable of supporting hundreds of users simultaneously. Software technology is different from minicomputer.

5	Supercomputer	It is an extremely fast computer, which can execute hundreds of millions of instructions per second.

- **UltraBook**
- **ChromeBook**
- Computers can be broadly classified by their speed and computing power.
- PC (Personal Computer)

- A PC can be defined as a small, relatively inexpensive computer designed for an individual user. PCs are based on the microprocessor technology that enables manufacturers to put an entire CPU on one chip. Businesses use personal computers for word processing, accounting, desktop publishing, and for running spreadsheet and database management applications. At home, the most popular use for personal computers is playing games and surfing the Internet.
- Although personal computers are designed as single-user systems, these systems are normally linked together to form a network. In terms of power, now-a-days high-end models of the Macintosh and PC offer the same computing power and graphics capability as low-end workstations by Sun Microsystems, Hewlett-Packard, and Dell.
- Workstation

- Workstation is a computer used for engineering applications (CAD/CAM), desktop publishing, software development, and other such types of applications which require a moderate amount of computing power and relatively high quality graphics capabilities.
- Workstations generally come with a large, high-resolution graphics screen, large amount of RAM, inbuilt network support, and a graphical user interface. Most workstations also have mass storage device such as a disk drive, but a special type of workstation, called diskless workstation, comes without a disk drive.
- Common operating systems for workstations are UNIX and Windows NT. Like PC, workstations are also single-user computers like PC but are typically linked together to form a local-area network, although they can also be used as stand-alone systems.
- Minicomputer
- It is a midsize multi-processing system capable of supporting up to 250 users simultaneously.
- 
- Mainframe
- Mainframe is very large in size and is an expensive computer capable of supporting hundreds or even thousands of users simultaneously. Mainframe executes many programs concurrently and supports many simultaneous execution of programs.
- 
- Supercomputer
- Supercomputers are one of the fastest computers currently available. Supercomputers are very expensive and are employed for specialized

applications that require immense amount of mathematical calculations (number crunching).

- For example, weather forecasting, scientific simulations, (animated) graphics, fluid dynamic calculations, nuclear energy research, electronic design, and analysis of geological data (e.g. in petrochemical prospecting).

Input Devices

Input device enables the user to send data, information, or control signals to a computer. The Central Processing Unit (CPU) of a computer receives the input and processes it to produce the output.

- **Some of the popular input devices are:**

1) Keyboard

The keyboard is a basic input device that is used to enter data into a computer or any other electronic device by pressing keys. It has different sets of keys for letters, numbers, characters, and functions. Keyboards are connected to a computer through USB or a Bluetooth device for wireless communication.

2) Mouse

The mouse is a hand-held input device which is used to move cursor or pointer across the screen. It is designed to be used on a flat surface and generally has left and right button and a scroll wheel between them. Laptop computers come with a touchpad that works as a mouse. It lets you control the movement of cursor or pointer by moving your finger over the touchpad. Some

mouse comes with integrated features such as extra buttons to perform different buttons.

The mouse was invented by Douglas C. Engelbart in 1963. Early mouse had a roller ball integrated as a movement sensor underneath the device. Modern mouse devices come with optical technology that controls cursor movements by a visible or invisible light beam. A mouse is connected to a computer through different ports depending on the type of computer and type of a mouse.

next →← prev

Input Devices

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Some of the popular input devices are:

1. Keyboard
2. Mouse
3. Scanner
4. Joystick
5. Light Pen
6. Digitizer
7. Microphone
8. Magnetic Ink Character Recognition (MICR)
9. Optical Character Reader (OCR)
10. Digital Camera
11. Paddle
12. Steering Wheel
13. Gesture recognition devices
14. Light Gun

15. Touch Pad
16. Remote
17. Touch screen
18. VR
19. Webcam
20. Biometric Devices

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Types of keyboards: There can be different types of keyboards based on the region and language used. Some of the common types of keyboards are as follows:

i) QWERTY Keyboard:

It is the most commonly used keyboard with computers in modern times. It is named after the first six letters of the top row of buttons and is even popular in countries that do not use Latin-based alphabet. It is so popular that some people think that it is the only type of keyboard to use with computers as an input device.

ii) AZERTY Keyboard:

It is considered the standard French keyboard. It is developed in France as an alternative layout to the QWERTY layout and is mainly used in France and other European countries. Some countries have manufactured their own versions of AZERTY.

Its name is derived from the first six letters that appear on the top left row of the keyboard. The Q and W keys in AZERTY keyboard are interchanged with A and Z keys in QWERTY keyboard. Furthermore, in AZERTY keyboard M key is located to the left of the L key.

AZERTY keyboard differs from QWERTY keyboard not only in the placement of letters but also in many other ways, e.g., it gives emphasis on accents, which is required for writing European languages like French.

iii) DVORAK Keyboard:

This type of keyboard layout was developed to increase the typing speed by reducing the finger movement while typing. The most frequently used letters are kept in a home row to improve typing.

---

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3) Scanner

- The scanner uses the pictures and pages of text as input. It scans the picture or a document. The scanned picture or document then converted into a digital format or file and is displayed on the screen as an output. It uses optical character recognition techniques to convert images into digital ones.

4) Joystick

A joystick is also a pointing input device like a mouse. It is made up of a stick with a spherical base. The base is fitted in a socket

that allows free movement of the stick. The movement of stick controls the cursor or pointer on the screen.

The frist joystick was invented by C. B. Mirick at the U.S. Naval Research Laboratory. A joystick can be of different types such as displacement joysticks, finger-operated joysticks, hand operated, isometric joystick, and more. In joystick, the cursor keeps moving in the direction of the joystick unless it is upright, whereas, in mouse, the cursor moves only when the mouse moves.

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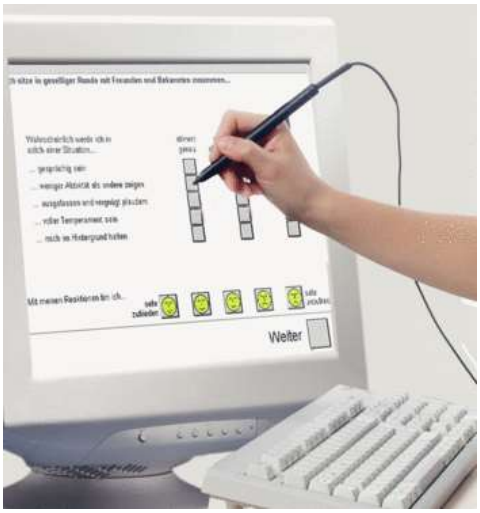
5) Light Pen



A light pen is a computer input device that looks like a pen. The tip of the light pen contains a light-sensitive detector that enables the user to point to or select objects on the display screen. Its light sensitive tip detects the object location and sends the corresponding signals to the CPU. It is not compatible with LCD screens, so it is not in use today. It also helps you draw on the screen if needed. The first light pen was invented around 1955 as a part of the Whirlwind project at the Massachusetts Institute of Technology (MIT).

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6) Digitizer

Digitizer is a computer input device that has a flat surface and usually comes with a stylus. It enables the user to draw images and graphics using the stylus as we draw on paper with a pencil. The images or graphics drawn on the digitizer appear on the computer monitor or display screen. The software converts the touch inputs into lines and can also convert handwritten text to typewritten words.

It can be used to capture handwritten signatures and data or images from taped papers. Furthermore, it is also used to receive information in the form of drawings and send output to a CAD (Computer-aided design) application and software like AutoCAD. Thus, it allows you to convert hand-drawn images into a format suitable for computer processing.

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7) Microphone

The microphone is a computer input device that is used to input the sound. It receives the sound vibrations and converts them into audio signals or sends to a recording medium. The audio signals are converted into digital data and stored in the computer. The microphone also enables the user to telecommunicate with others. It is also used to add sound to presentations and with webcams for video conferencing. A microphone can capture audio waves in different ways.

8) Magnetic Ink Character Recognition (MICR)

MICR computer input device is designed to read the text printed with magnetic ink. MICR is a character recognition technology that makes use of special magnetized ink which is sensitive to magnetic fields. It is widely used in banks to process the cheques and other organizations where security is a major concern. It can process three hundred cheques in a minute with hundred-percent accuracy. The details on the bottom of the cheque (MICR No.) are written with magnetic ink. A laser printer with MICR toner can be used to print the magnetic ink.

The device reads the details and sends to a computer for processing. A document printed in magnetic ink is required to pass through a machine which magnetizes the ink, and the magnetic information is then translated into characters.

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9) Optical Character Reader (OCR)

OCR computer input device is designed to convert the scanned images of handwritten, typed or printed text into digital text. It is widely used in offices and libraries to convert documents and books into electronic files.

It processes and copies the physical form of a document using a scanner. After copying the documents, the OCR software converts the documents into a two-color (black and white), version called bitmap. Then it is analyzed for light and dark areas, where the dark areas are selected as characters, and the light area is identified as background. It is widely used to convert hard copy legal or historic documents into PDFs. The converted documents can be edited if required like we edit documents created in ms word.

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10) Digital camera:

It is a digital device as it captures images and records videos digitally and then stores them on a memory card. It is provided with an image sensor chip to capture images, as opposed to film used by traditional cameras. Besides this, a camera that is connected to your computer can also be called a digital camera.

It has photosensors to record light that enters the camera through the lens. When the light strikes the photosensors, each of

the sensors returns the electrical current, which is used to create the images.

Output Devices

The output device displays the result of the processing of raw data that is entered in the computer through an input device. There are a number of output devices that display output in different ways such as text, images, hard copies, and audio or video.

- Some of the popular output devices are:

1) Monitor

The monitor is the display unit or screen of the computer. It is the main output device that displays the processed data or information as text, images, audio or video.

The types of monitors are given below.

i) CRT Monitor

CRT monitors are based on the cathode ray tubes. They are like vacuum tubes which produce images in the form of video signals. Cathode rays tube produces a beam of electrons through electron guns that strike on the inner phosphorescent surface of the screen to produce images on the screen. The monitor contains millions of phosphorus dots of red, green and blue color. These

dots start to glow when struck by electron beams and this phenomenon is called cathodoluminescence.

The main components of a CRT monitor include the electron gun assembly, deflection plate assembly, fluorescent screen, glass envelope, and base.The front (outer surface) of the screen onto which images are produced is called the face plate. It is made up of fiber optics.

There are three electron beams that strike the screen: red, green, and blue. So, the colors which you see on the screen are the blends of red, blue and green lights.The magnetic field guides the beams of electrons. Although LCDs have replaced the CRT monitors, the CRT monitors are still used by graphics professionals because of their color quality.

ii) LCD Monitor

The LCD monitor is a flat panel screen that is compact and light-weight as compared to CRT monitors. It is based on liquid crystal display technology which is used in the screens of laptops, tablets, smart phones, etc. An LCD screen comprises two layers of polarized glass with a liquid crystal solution between them. When the light passes through the first layer, an electric current aligns the liquids crystals. The aligned liquid crystals allow a varying level of light to pass through the second layer to create images on the screen.

The LCD screen has a matrix of pixels that display the image on the screen.Old LCDs had passive-matrix screens in which individual pixels are controlled by sending a charge. A few

electrical charges could be sent each second that made screens appear blurry when the images moved quickly on the screen.

Modern LCDs use active-matrix technology and contain thin film transistors (TFTs) with capacitors. This technology allows pixels to retain their charge. So, they don?t make screen blurry when images move fast on the screen as well as are more efficient than passive-matrix displays.

iii) LED monitor

The LED monitor is an improved version of an LCD monitor. It also has a flat panel display and uses liquid crystal display technology like the LCD monitors. The difference between them lies in the source of light to backlight the display. The LED monitor has many LED panels, and each panel has several LEDsto backlight the display, whereas the LCD monitors use cold cathode fluorescent light to backlight the display.Modern electronic devices such as mobile phones, LED TVs, laptop and computer screens, etc., use a LED display as it not only produces more brilliance and greater light intensity but also consumes less power.

iv) Plasma Monitor

The plasma monitor is also a flat panel display that is based on plasma display technology. It has small tiny cells between two glass panels. These cells contain mixtures of noble gases and a small amount of mercury. When voltage is applied, the gas in the cells turns into a plasma and emits ultraviolet light that creates images on the screen, i.e., the screen is illuminated by a tiny bit of plasma, a charged gas. Plasma displays are brighter than liquid crystal displays (LCD) and also offer a wide viewing angle than an LCD.

Plasma monitors provide high resolutions of up to 1920 X 1080, excellent contrast ratios, wide viewing angle, a high refresh rate and more. Thus, they offer a unique viewing experience while watching action movies, sports games, and more.

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2) Printer

A printer produces hard copies of the processed data. It enables the user, to print images, text or any other information onto the paper.

Based on the printing mechanism, the printers are of two types: Impact Printers and Non-impact Printers.

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1. Monitor
    - CRT Monitor
    - LCD Monitor
    - LED Monitor
    - Plasma Monitor
2. Printer
    - Impact Printers
        A. Character Printers
            i. Dot Matrix printers
            ii. Daisy Wheel printers
        B. Line printers
            i. Drum printers
            ii. Chain printers
    - Non-impact printers
        A. Laser printers
        B. Inkjet printers
3. Projector

---

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- **Impact Printers: They are of two types:**
  A. Character Printers
     i. Dot Matrix printers
     ii. Daisy Wheel printers
  B. Line printers
     i. Drum printers
     ii. Chain printers
- **Non-impact printers: They are of two types:**
  A. Laser printers
  B. Inkjet printers

Impact Printer

The impact printer uses a hammer or print head to print the character or images onto the paper. The hammer or print head strikes or presses an ink ribbon against the paper to print characters and images.

Impact printers are further divided into two types.

A. Character Printers
B. Line printers

A) Character Printers

Character printer prints a single character at a time or with a single stroke of the print head or hammer. It does not print one line at a time. Dot Matrix printer and Daisy Wheel printer are character printers. Today, these printers are not in much use due to their low speed and because only the text can be printed. The character printers are of two types, which are as follows:

i) Dot Matrix Printer

Dot Matrix Printer is an impact printer. The characters and images printed by it are the patterns of dots. These patterns are produced by striking the ink soaked ribbon against the paper with a print head. The print head contains pins that produce a pattern of dots on the paper to form the individual characters. The print head of a 24 pin dot matrix contains more pins than a 9 pin dot matrix printer, so it produces more dots which results in better printing of characters. To produce

color output, the black ribbon can be changed with color stripes. The speed of Dot Matrix printers is around 200-500 characters per second.

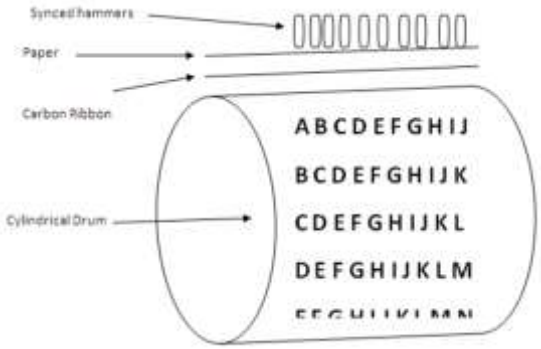
ii) Daisy Wheel Printer

Daisy Wheel Printer was invented by David S. Lee at Diablo Data Systems.It consists of a wheel or disk that has spokes or extensions and looks like a daisy, so it is named Daisy Wheel printer. At the end of extensions, molded metal characters are mounted. To print a character the printer rotates the wheel, and when the desired character is on the print location the hammer hits disk and the extension hits the ink ribbon against the paper to create the impression. It cannot be used to print graphics and is often noisy and slow, i.e., the speed is very low around 25-50 characters per second. Due to these drawbacks,these printers have become obsolete.

B) Line Printers:

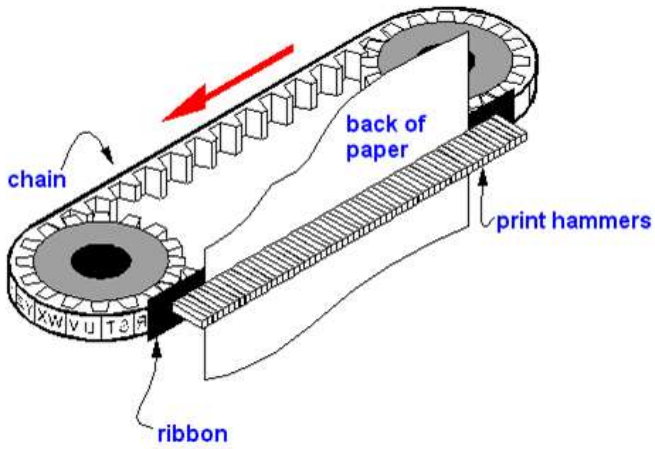
Line printer, which is also as a bar printer, prints one line at a time. It is a high-speed impact printer as it can print 500 to 3000 lines per minute. Drum printer and chain printer are examples of line printers.

i) Drum Printer:



Drum printer is a line printer that is made of a rotating drum to print characters. The drum has circular bands of characters on its surface. It has a separate hammer for each band of characters. When you print, the drum rotates, and when the desired character comes under the hammer, the hammer strikes the ink ribbon against the paper to print characters. The drum rotates at a very high speed and characters are printed by activating the appropriate hammers. Although all the characters are not printed at a time, they are printed at a very high speed. Furthermore, it can print only a predefined style as it has a specific set of characters. These printers are known to be very noisy due to the use of hammering techniques.

ii) Chain Printer:



Chain printer is a line printer that uses a rotating chain to print characters. The characters are embossed on the surface of the chain. The chain rotates horizontally around a set of hammers, for each print location one hammer is provided,

i.e., the total number of hammers is equal to the total number of print positions.

The chain rotates at a very high speed and when the desired character comes at the print location, the corresponding hammer strikes the page against the ribbon and character on the chain.They can type 500 to 3000 lines per minute. They are also noisy due to the hammering action.

Non-Impact Printer:

Non-impact printers don't print characters or images by striking a print head or hammer on the ink ribbon placed against the paper. They print characters and images without direct physical contact between the paper and the printing machinery. These printers can print a complete page at a time, so they are also known as page printers. The common types of non-impact printers are Laser printer and Inkjet printer:

i) Laser Printer:

A laser printer is a non-impact printer that uses a laser beam to print the characters. The laser beam hits the drum, which is a photoreceptor and draws the image on the drum by altering electrical charges on the drum. The drum then rolls in toner, and the charged image on the drum picks the toner. The toner is then printed on the paper using heat and pressure. Once the document is printed, the drum loses the

electric charge,and the remaining toner is collected. The laser printers use powdered toner for printing instead of liquid ink and produce quality print objects with a resolution of 600 dots per inch (dpi) or more.

ii) Inkjet Printer:

The inkjet printer is a non-impact printer that prints images and characters by spraying fine,ionized drops of ink. The print head has tiny nozzles to spray the ink. The printer head moves back and forth and sprays ionized drops of ink on the paper, which is fed through the printer. These drops pass through an electric field that guides the ink onto the paper to print correct images and characters.

An inkjet printer has cartridges that contain ink. Modern inkjet printers are color printers that have four cartridges containing different colors: Cyan, Magenta, Yellow, and Black. It is capable of printing high-quality images with different colors. It can produce print objects with a resolution of at least 300 dots per inch (dpi).

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3) Projector

A projector is an output device that enables the user to project the output onto a large surface such as a big screen or wall. It can be connected to a computer and similar devices to project their output onto a screen. It uses light and lenses to produce magnified texts, images, and videos. So, it is an ideal output device to give presentations or to teach a large number of people.

Modern projects (digital projectors) come with multiple input sources such as HDMI ports for newer equipment and VGA ports that support older devices. Some projectors are designed to support Wi-Fi and Bluetooth as well. They can be fixed onto the ceiling, placed on a stand, and more and are frequently used for classroom teaching, giving presentations, home cinemas, etc.

A digital projector can be of two types:

Liquid Crystal Display (LCD) digital projector: This type of digital projectors are very popular as they are lightweight and provide crisp output. An LCD projector uses transmissive technology to produce output. It allows the light source, which is a standard lamp, to pass through the three colored liquid crystal light panels. Some colors pass through the panels and some are blocked by the panels and thus images are on the screen.

- **Digital Light Processing (DLP) digital projector:** It has a set of tiny mirrors, a separate mirror for each pixel of the image and thus provide high-quality images. These projectors are mostly used in theatres as they fulfill the requirement of high-quality video output.

Storage device

Alternatively referred to as **digital storage**, **storage**, **storage media**, or **storage medium**, a **storage device** is any hardware capable of holding information either temporarily or permanently. The picture shows an example of a Drobo, an external secondary storage device.

There are two types of storage devices used with computers: a primary storage device, such as RAM, and a secondary storage device, such as a hard drive. Secondary storage can be removable, internal, or external.

Magnetic storage devices

Today, magnetic storage is one of the most common types of storage used with computers. This technology is found mostly on extremely large HDDs or hybrid hard drives.

Optical storage devices

Another common type of storage is optical storage, which uses lasers and lights as its method of reading and writing data.

Flash memory devices

Flash memory has replaced most magnetic and optical media as it becomes cheaper because it is the more efficient and reliable solution.

Why is storage needed in a computer?

Without a storage device, a computer cannot save or remember any settings or information and would be considered a dumb terminal.

Although a computer can run with no storage device, it would only be able to view information, unless it was connected to another computer that had storage capabilities. Even a task, such as browsing the Internet, requires information to be stored on your computer.

Why so many different storage devices?

As computers advance, the technologies used to store data do too, right along with higher requirements for storage space. Because people need more and more space, want it faster,

cheaper, and want to take it with them, new technologies have to be invented. When new storage devices are designed, as people upgrade to those new devices, the older devices are no longer needed and stop being used.

For example, when punch cards were first used in early computers, the magnetic media used for floppy disks was not available. After floppy diskettes were released, they were replaced by CD-ROM drives, which were replaced by DVD drives, which have been replaced by flash drives. The first hard disk drive from IBM cost $50,000, was only 5 MB, big, and cumbersome. Today, we have smartphones that have hundreds of times the capacity at a much smaller price that we can carry in our pocket.

Each advancement of storage devices gives a computer the ability to store more data, as well as save and access data faster.

What is a storage location?

When saving anything on a computer, it may ask you for a **storage location**, which is the area where you would like to save the information. By default, most information is saved to your computer hard drive. If you want to move the information to another computer, save it to a removable storage device, such as a USB flash drive.

Which storage devices are used today?

Most of the storage devices mentioned above are no longer used with today's computers. Most computers today primarily use an SSD to store information, as well as the ability to use USB flash drives and access to cloud storage. Most desktop computers and some laptops include a disc drive that is capable of reading and writing CDs and DVDs.

What storage device has the largest capacity?

For most computers, the largest storage device is the hard drive or SSD. However, networked computers may also have access to larger storage with large tape drives, cloud computing, or NAS devices. Below is a list of storage devices from the smallest capacity to the largest capacity.

Are storage devices input and output devices?

No. Although these devices do send and receive information, they are not considered an input device or output device. It is more proper to refer to any device capable of storing and reading information as a storage device, disk, disc, drive, or media.

File Organization

- The **File** is a collection of records. Using the primary key, we can access the records. The type and frequency of access can be determined by the type of file organization which was used for a given set of records.
- File organization is a logical relationship among various records. This method defines how file records are mapped onto disk blocks.
- File organization is used to describe the way in which the records are stored in terms of blocks, and the blocks are placed on the storage medium.
- The first approach to map the database to the file is to use the several files and store only one fixed length record in any given file. An alternative approach is to structure our files so that we can contain multiple lengths for records.
- Files of fixed length records are easier to implement than the files of variable length records.

Objective of file organization

- It contains an optimal selection of records, i.e., records can be selected as fast as possible.
- To perform insert, delete or update transaction on the records should be quick and easy.
- The duplicate records cannot be induced as a result of insert, update or delete.
- For the minimal cost of storage, records should be stored efficiently.

Types of file organization:

File organization contains various methods. These particular methods have pros and cons on the basis of access or selection. In the file organization, the programmer decides the best-suited file organization method according to his requirement.

Types of file organization are as follows:

- Sequential file organization
- Heap file organization
- Hash file organization
- B+ file organization
- Indexed sequential access method (ISAM)
- Cluster file organization

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