

# Chapter 1

## Introduction to computer system

### Introduction of computer

Today computer have become part of our life. Usage of computers in different fields has become a necessity in the present competitive world. Lot of work and evolutions has transpired from the initial computer systems to the present day computer systems. Computers are made up of electrical, electronic and mechanical components. Computers are just the machines and you must specify the work that is to be carried out by the computer. Thus to carry out a specific task series of instruction must be given to the computer in a particular order.

Most people know that a computer is a fast calculator, but it is much more than that. It is a machine, which performs fast calculations plus performs burdensome chores such as choosing, copying, moving comparing and performing other operations on alphabetic, numeric and other symbols which represent data (raw material of information).

A computer may be defined as a machine that can solve problems by accepting data, performing certain operation and presenting the results of those operations under the direction of detailed step-by-step instructions. Such a set of sequenced instructions, which cause a computer to perform particular operations, is called a program.

### Computer – Definitions

The term "computer" was originally given to humans (human computers) who performed numerical calculations using mechanical calculators, such as the abacus and slide rule. The term was later given to a mechanical device as they began replacing the human computers. Today's computers are electronic devices that accept data (input), process that data, produce output, and then store (storage) the results.

A computer is an electronic device that takes input such as numbers, text, sound, image, animations, video, etc., processes it, and converts it into meaningful information that could be understood, presenting the changed input (processed input) as output. All numbers, text, sound, images, animations, and video used as input are called data, and all numbers, text, sound, images, animations, and video returned as output are called information.

## Computer has ability of

- Accept data
- Input, store and execute instructions
- Perform mathematical and logical operations
- Output results according to user requirements.

## Data

In general, data are information that have been gathered and translated for some purpose, usually analysis. It can be any **character**, including text and numbers, pictures, sound, or video. If data are not put into context, they don't mean anything to a human or computer.

Within a computer's storage, data is a collection of numbers represented as **bytes** that are in turn composed of **bits (binary digits)** that can have the value one or zero. Data are processed by the **CPU**, which uses **logical** operations to produce new data (**output**) from source data (**input**).

## Information

Information is the processed data which we get in the required form. When information is entered into and stored in a computer, it is generally referred to as **data**. After processing (such as formatting and printing), output data can again be perceived as information.

## Hardware

Computer hardware is the collection of physical parts of a computer system. This includes the computer case, monitor, keyboard, and mouse. It also includes all the parts inside the computer case, such as the hard disk drive, motherboard, video card, and many others. Computer hardware is what you can physically touch.

## Software

Software is a collection of **instructions** that enable the user to interact with a computer, its hardware, or perform tasks. Without software, computers would be useless. For example, without your Internet **browser**, you could not surf the Internet or read this page and without an **operating system**, the browser could not run on your computer.

## Characteristics of a computer

A computer is an intelligent amplifier that performs operations in a much faster, accurate and efficient way. Thus, it gives us ample time to use it in matters involving creativity & judgment. The characteristics possessed by computers can be listed as follows:

### Speed

A computer can add and subtract numbers, compare letters to determine alphabetic sequence, move and copy numbers and letters. As such, there is nothing profound in these operations. What is significant is the speed with which computers carry out these operations. This speed varies from a few microseconds (millionth of second) to Nano (billionth of second). For instance, People would need to do a lot of waiting in queues for grocery payments, for making telephone calls, for making travel reservations, etc. but with the help of computers the processing can be done in a fraction of a second. The speed of a computer at performing a single operation can be measured in terms of:

a) Milliseconds	- One thousandth of a second (1/1000)
b) Microsecond	- One millionth of a second (1/1000000)
c) Nanosecond	- One billionth of a second (1/1000000000). The speed at which a computer performs logical operations is measured in nanoseconds.
d) Picoseconds	- One trillionth of a second (1/1000000000000).

### Accuracy

You may work for years before experiencing a system error, such as an updating of the wrong record or an incorrect addition. Errors do occur in computer-based information but precious few can be directly attributed to the computer systems. The vast majority of these errors can be traced to a program logic error, a procedural error, or erroneous data. These are human errors. Hardware errors are usually detected and corrected by the computer system itself.

Computers are very accurate. They can perform their hundreds of thousands of operations with great accuracy. They can run error less for days at a time.

### Reliability

Computer output is generally very reliable, subject to the condition that the input data entering the computer should be correct and the program of instructions should be reliable and correct. Incorrect input data and unreliable programs give us computer errors and wrong results. Hence, the phrase GARBAGE IN-GARBAGE OUT (**GIGO**).

### Storage Capability

Computer systems have total and instant recall of data and an almost unlimited capacity to store these data. A typical mainframe computer system will have many billions of characters, and perhaps thousands of graphic images, stored and available for-instant recall. When properly used, a computer can improve the efficiency of an organization. It provides a fast, accurate, and reliable device with which to process data. Similarly, computers enable companies to provide customers with instantaneous services, such as airline flight availability and charge account status. The result is that these companies can offer far more customer services than would be possible without computer. Because various computer media can store millions of characters of data in a condensed form. There is tremendous savings in the storage area required to maintain the vital records necessary in a business environment. The storing capacity of a computer is measured in terms of bytes, kilobytes and gigabytes.

Bit	Byte	Kilobyte	Megabyte	Gigabyte
8	1	-	-	-
8,192	1,024	1	-	-
8,388,608	1,048,576	1,024	1	-
8,589,934,592	1,073,741,824	1,048,576	1,024	1

### Automation

Computers are quite capable of functioning automatically, once the process is given to

the computer. They do not require any instruction from the operator at any stage of the process. Computers can be programmed to perform a series of complex tasks involving multiple programs. Computers will execute the programs in the correct sequence, provided they are programmed correctly.

### **Diligence**

Human beings suffer from physical and mental fatigue. They cannot perform the same task over and over again with the same speed, accuracy and enthusiasm as in the first time. This will affect the performance. Being a machine, a computer does not suffer from such weaknesses. The computer is capable of performing task repeatedly at the same level of speed and accuracy even if it has to carry complex operation for a long period of time.

### **Versatile**

Computers are versatile (can do many types of jobs). It can carry out processes ranging from simple mathematical calculations to highly complex and logical evaluations for any extended period of time. Computers can communicate with other computers and can receive and send data in various forms such as text, video, etc. This ability of computer to communicate to one another has led to the development of computer networks. Internet, and so on. All this is possible because of computers and other related technologies.

## **Advantages of Computers**

### **Speed Up Work Efficiency**

This is by far the biggest advantage of using computers. They have replaced the use of manpower in carrying out tedious and repetitive work. Work that can take days to complete manually can be done in a few minutes using a computer. This is made possible by the fact that data, instructions and information move very fast in the electric circuits of computers. They process trillions of instructions within a second.

### **Large and Reliable Storage Capacity**

Computers can store huge volumes of data. To put this into perspective, physical files that can fill a whole room can be stored in one computer once they are digitized. Better yet, access to the stored information is super-fast. It takes micro-seconds for data to be transferred from storage to memory in a computer. The same cannot be said for the retrieval of physical files. With a computer, you can store videos, games, applications, documents etc. that you can access whenever required. Better yet, storage can be backed up fast and efficiently.

### **Connection with Internet**

The Internet is probably the most outstanding invention in history. Computers allow you to connect to the Internet and access this global repository of knowledge. With the Internet, you can communicate faster with people across the globe. You can send email, hold voice and video calls or use IM services. The Internet also allows for instant sharing of files. You can also connect with friends and family on social networks and even learn a new language online. The Internet is a great educational resource where you can find information on virtually anything.

### **Consistency**

You always get the same result for the same process when using a computer. For example if you created a document on one computer, you can open it on another without making any special

Adjustments. This consistency makes it possible to save and edit a document from different computers in different parts of the world. Collaboration is therefore easier.

## **Disadvantage of Computer**

### **Health Risk**

Improper and prolonged use of a computer might lead to disorders or injuries of the elbows, wrist, neck, back, and eyes. As a computer user you can avoid these injuries by working in a workplace that is well designed, using a good sitting position and taking proper work breaks. Technology load and computer addiction are the major behavioral health risks. Addiction comes when you are obsessed with a computer. Technology overload comes when you are over loaded with computer and mobile phones. Both technology overload and computer addiction are avoidable if the habits are noted and a follow up is done.

### **Violation of Privacy**

When using the Internet on your computer, you run the risk of leaking your private information. This is especially so if you happen to download malicious software into your computer. Trojans and Malware can infiltrate your system and give identity thieves access to your personal information. Of particular interest to identity thieves are your bank and credit card details. Make sure to install reliable antivirus software to keep malware and Trojans at bay. You should also avoid clicking on suspicious looking links when using the Internet.

### **Impact on Environment**

Manufacturing process of computers and computer waste are harmful to the environment. When computer junk is discarded in open grounds, they release harmful chemicals like lead and mercury to the environment. Mercury can result in cancer and lead can cause radiation diseases when exposed to the environment. Disposed computers could also cause fire.

### **Data Security**

This is one of the most controversial aspects of computers today. The safety and integrity of data is key for any business. However, data stored in a computer can be lost or compromised in a number of ways. There are instances where the computer could crash wiping out all data that had been stored therein. Hackers could also gain access into your computer and compromise the integrity of your data. This is why you should always have a backup. Moreover, you should put measures in place to keep your data safe from hackers.

## **Applications of Computer**

Computers are use almost in every sector now a day. Modern world is difficult to imagine without computer. It has great impact on every aspect of mankind and plays an important role in our society. Computer technology is one of the fastest developing technologies. Some major application are of computer are Banking sectors, Industries, Education, Medical sectors, offices, Home, Communication, Designing, Military, Aviation, Robotics, Research and so on.

Some application areas of computers are briefly discussed below:

### **(a) Business**

A computer has high speed of calculation, diligence, accuracy, reliability, or versatility which made it an integrated part in all business organizations.

Computer is used in business organizations for:

- Payroll calculations
- Budgeting
- Sales analysis
- Financial forecasting
- Managing employee's database
- Maintenance of stocks etc.

### **(b) Banking**

Today banking is almost totally dependent on computer.

Banks provide following facilities:

- Banks provide online accounting facility, which includes current balances, deposits, overdrafts, interest charges, shares, and trustee records.
- ATM machines are making it even easier for customers to deal with banks.

### **(c) Education**

Computers are used as teaching aid, information resource, computing and research tool. The computer has provided a lot of facilities in the education system.

- The computer provides a tool in the education system known as CBE (Computer Based Education).
- CBE involves control, delivery, and evaluation of learning.
- The computer education is rapidly increasing the graph of number of computer students.
- There are number of methods in which educational institutions can use computer to educate the students.
- It is used to prepare a database about performance of a student and analysis is carried out on this basis.

### **(d) Health Care**

Computers have become important part in hospitals, labs, and dispensaries. The computers are being used in hospitals to keep the record of patients and medicines. It is also used in scanning and diagnosing different diseases. ECG, EEG, Ultrasounds and CT Scans etc., are also done by computerized machines.

**Some major fields of health care in which computers are used are:**

- **Diagnostic System**  
Computers are used to collect data and identify cause of illness.
- **Lab-diagnostic System**  
All tests can be done and reports are prepared by computer.
- **Patient Monitoring System**  
These are used to check patient's signs for abnormality such as in Cardiac Arrest, ECG etc.
- **Pharma Information System**  
Computer checks Drug-Labels, Expiry dates, harmful drug's side effects etc.
- **Surgery**  
Nowadays, computers are also used in performing surgery.

### **(e) Communication**

Communication means to express a message, an idea, a picture or speech that is received and

understood clearly and correctly by the person for whom it is meant for. Computer helps to cover large distances through telecommunication and satellite links. The increasing incorporation of computers technology in these areas has helped to handle the increase in the number of telephone calls, international subscriber dialing facilities, television and radio broadcasts, and so on. Some main areas in this category are:

- E-mail
- Chatting
- Use Internet
- Video-conferencing

#### **(f) Computer Games**

An important use of computers at home is playing games. Different types of games are available. These games are a source of entertainment and recreation. Many games are available that are specially developed to improve your mental capability and thinking power.

#### **(g) Working from Home**

People can manage the office work at home. The owner of a company can check the work of the employees from home. He can control his office while sitting at home.

#### **(h) Entertainment**

People can find entertainment on the internet. They can watch movies, listen to songs, and watch videos download different stuff. They can also watch live matches on the internet.

#### **(i) Information**

People can find any type of information on the internet. Educational and informative websites are available to download books, tutorials etc. to improve their knowledge and learn new things.

#### **(j) Chatting & Social Media**

People can chat with friends and family on the internet using different software like Skype etc. One can interact with friends over social media websites like Facebook, Twitter & Google Plus. They can also share photos and videos with friends.

## **Generations of Computer**

Computer were invented as a result of man's search for fast, accurate and ease calculating device. The need for calculations with the growth in science, commerce and other human activities explain the evolution of computers. Evolution of computer is actually a study of past development of computer.

The gradual development of computer system (hardware and software) leads the evolution of computer into different generation.

The development of computer system are divided into five different generations according to its processing speed, processing capability, storage capacity, size, energy consumption, cost, complexity and technology used.

## First Generation (1940-1956) Vacuum Tubes

The first computers used vacuum tubes for circuitry and magnetic drums for memory, and were often enormous, taking up entire rooms. They were very expensive to operate and in addition to using a great deal of electricity, generated a lot of heat, which was often the cause of malfunctions.

First generation computers relied on machine language, the lowest-level programming language understood by computers, to perform operations, and they could only solve one problem at a time. Input was based on punched cards and paper tape, and output was displayed on printouts.



Figure 17 Vacuum Tube

The UNIVAC and ENIAC computers are examples of first-generation computing devices. The UNIVAC was the first commercial computer delivered to a business client, the U.S. Census Bureau in 1951.

*Vacuum Tubes is a set of metal electrodes and intervening metal grids, contained in a glass or metal tube form which electrical currents between the electrodes. Formerly used for amplification and switching in electronic circuits, vacuum tubes are now used in applications such as cathode-ray tubes and those requiring very high power levels. A vacuum tube is known as a valve also. Vacuum tube was invented by Lee De Forest in 1908.*

### The main Characteristic of first generation computer

- Vacuum Tube was used as a Technology.
- Operation speed was in terms of milliseconds range.
- Machine language was used to instruct the computer programming mainly at hardware level.
- Magnetic core was used as primary memory.
- Punched Card, Magnetic tape were used as secondary memory.
- Punched card were used for input/output operation.
- It occupied vary large space, slow processing.
- The Power consumption was very high.
- Examples: ENIAC, EDVAC, UNIVAC.

## Second Generation Computer (1955-1964) Transistors

Transistors replaced vacuum tubes and ushered in the second generation of computers. The transistor was invented in 1947 but did not see widespread use in computers until the late 1950s. The transistor was far superior to the vacuum tube, allowing computers to become smaller, faster, cheaper, more energy-efficient and more reliable than their first-generation predecessors. Though the transistor still generated a great deal of heat that subjected the computer to damage, it was a vast improvement over the vacuum tube. Second-generation computers still relied on punched cards for input and printouts for output.



Figure 18 Transistor



*Transistor short for transfer resistor. A device composed of semiconductor material that amplifies a signal or opens or closes a circuit. Transistor was invented in 1947 at Bell Labs by William Shockley, John Bardeen and Walter Brattain and won the Nobel Prize in 1956. The transistor have become the key ingredient of all digital circuits, including computers. Today's microprocessor contains tens of millions of microscopic transistors.*

### **The main Characteristic of second generation computer**

- Transistor was used as a Technology.
- Operation speed was in terms of microseconds range.
- Assembly language was used to instruct the computer.
- Magnetic core was used as primary memory.
- Magnetic drum and Magnetic tape were used as secondary memory.
- Punched card were used for input/output operation.
- Transistor reduces size of computer hence It occupied less space compared to 1st generation computer.
- The Power consumption was high.
- Examples: IBM 1401, ICL 2950/10.

### **Third Generation Computer (1965-1979) Integrated Circuit**

The third generation of computer is marked by the use of Integrated Circuits (IC's) in place of transistors. A single IC has many transistors, resistors and capacitors along with the associated circuitry. The IC was invented by Jack Kilby. This development made computers smaller in size, reliable and efficient. In this generation Remote processing, Time-sharing, Real-time, Multi-programming Operating System were used. High level language (FORTRAN-II TO IV, COBOL, PASCAL PL/1, BASIC, ALGOL-68 etc.) were used during this generation.



*Figure 19 Integrated Circuit*

*Integrated Circuit (IC) is another name for a chip, an integrated circuit (IC) is a small electronic device made out of a semiconductor material. The first integrated circuit was developed in the 1950s by Jack Kilby of Texas Instruments and Robert Noyce of Fairchild Semiconductor.*

### **The main Characteristic of third generation computer**

- Integrated Circuit was used as a Technology.
- Operation speed was in terms of nanosecond range.
- High Level language was used to instruct the computer (eg. FORTRAN, BASIC).
- Semiconductor memory like RAM and ROM was used as primary memory.
- Magnetic disk and Magnetic tape were used as secondary memory.
- Keyboard and Monitors were used for input/output operation.
- Size, Cost, Power, Heat generation were decreased.
- Multiprogramming facility was developed.
- Examples: IBM-360 series, ICL-900 series.

## Fourth Generation Computer (1980-Present) Microprocessor

The fourth generation of computers is marked by the use of Very Large Scale Integrated (VLSI) circuits. VLSI circuits having about 5000 transistors and other circuit elements and their associated circuits on a single chip made it possible to have microcomputers of fourth generation. Fourth Generation computers became more powerful, compact, reliable, and affordable. As a result, it gave rise to personal computer (PC) revolution. In this generation Time sharing, Real time, Networks, Distributed Operating System were used. All the Higher level languages like C and C++, DBASE etc. were used in this generation.

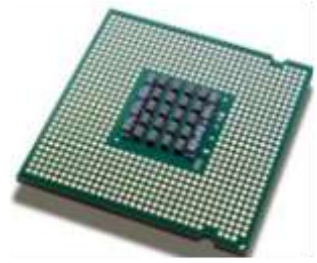


Figure 20 Microprocessor

*Microprocessor is a chip or set of chips which contains set of instructions which it understands. In other words, it is a central processing unit (CPU) on a single unit. The first commercial microprocessor was the Intel 4004 which appeared in 1971. The size of data it handled was 4 bits and invented by the duo Ted Hoff and Federico Faggin.*

### The main Characteristic of fourth generation computer

- Microprocessor is used as a Technology
- Operation speed is in terms of picoseconds range
- Problem oriented fourth generation language (4GL) is used to instruct the computer (eg. C, C++, Java).
- Semiconductor memory like RAM, ROM and cache memory is used as primary memory
- Magnetic disk, Optical memory and Magnetic tape are used as secondary memory
- Keyboard and Monitors were used for input/output operation
- Size, Cost, Power, Heat generation are very low.
- Multiprogramming, Multiprocessing facility is developed.
- More advance operating system such as Windows XP/7/8, Android, IOS etc are developed.
- Computer could be linked together and share information.
- Advanced, User-friendly, web based software are developed.
- Examples: IBM-PC, HP Laptops, Mac Notebook etc.

### Fifth Generation (Future) Bio Chips

This generation is based on parallel processing hardware and AI (Artificial Intelligence) software. AI is an emerging branch in computer science, which interprets means and method of making computers think like human beings. Scientists are going on the development of this computer.



Figure 21 BIO Chips

### Some major features of fifth generation computer will be:

- Bio-Chips will be used as a Technology
- Operation speed is in terms of LIPS and more than femto second range
- Natural language will be used to instruct the computer
- 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

	<b>First gen</b>	<b>Second gen</b>	<b>Third gen</b>	<b>Forth gen</b>	<b>Fifth gen</b>
<b>Time period</b>	1940-1956	1956-1963	1964-1970	1970-Till Date	Present and Beyond
<b>Technology</b>	Vacuum Tube	Transistor	Integrated Circuit	Microprocessor	Biochips
<b>Processing speed</b>	Millisecond	Microsecond	Nanosecond	Picosecond	Femtosecond
<b>Memory</b>	Vacuum Tube	Magnetic Cores	Semiconductors	Semiconductors	Superconductors
<b>I/o device</b>	Punch cards	Punch Cards	Keyboards/ Monitors	Keyboard/ Monitors /Other	Advancement
<b>Size, cost, power consumption, heat generation</b>	Very high	High	High	Very Low	Very Low
<b>Programming language</b>	Machine	Assembly and High level	High Level (Third Generation )	High Level (Fourth Generation)	Natural Language
<b>Examples</b>	ENIAC EDVAC IBM 700	IBM 1620 IBM 7090	IBM 370 series CC 7600, PDP11	IBM PC, Pentium PC, Apple etc.	

## Computer speed and Measurement Unit

We come across different measuring units like kilogram, meter, and liter and so on to measure weight, length and capacity or volumes of different commodities. Similarly, when we have to measure the capacity of computer's memory, storage devices and length of programs, units like kilogram, meter, and liter cannot be used. Hence, we use the units like BIT, NIBBLE, BYTE and WORD.

### BIT

BIT is an abbreviation of the words Binary digit and is the smallest unit of information. It is either '0' or '1'. The raw data fed into the computer are first converted into an electrical pulses or BITS, as the computers do not recognize the general form of data like numbers (0-9), alphabets (a-z or A-Z) and special characters like punctuation marks and arithmetical signs. The 0 and 1 of the binary system corresponds to the ON and OFF of the flow of electricity in the computer's circuits.

### NIBBLE

A NIBBLE is a string of four BITS. The earliest form of code, called 'Binary coded decimal (BCD) used a NIBBLE for every character.

### BYTE

It is the unit of measuring computer's memory and size of a program. One BYTE is the string of eight binary digits (BITS). It may represent a single letter, numeral or other characters. Computer memory is expressed in terms of BITS, BYTES, KILOBYTES (KB), MEGABYTES (MB),

GIGABYTES (GB) and TERABYTES (TB), PETABYTE (PB), EXABYTE (EB), ZETTABYTE (ZB) and YOTTABYPE (YB).

0 or 1	=	BIT
4 BITS	=	NIBBLE
8 BITS	=	1 BYTE
1024 BYTES	=	1 KILO BYTE (KB)
1024 KB	=	1 MEGA BYTE (MB)
1024 MB	=	1 GIGA BYTE (GB)
1024 GB	=	1 TERA BYTE (TB)
1024 TB	=	1 PETA BYTE (PB)
1024 PB	=	1 EXA BYTE (EB)
1024 EB	=	1 ZETTA BYTE (ZB)
1024 ZB	=	1 YOTTA BYTE (YB)

## WORD

A computer word is defined in terms of bytes. A word may be formed by combining two or more bytes. The most common combination is of four bytes. Word-Length is a length of bits that occupy one location in memory. A computer having a smaller word-length is slower than another having a larger word-length is, though the speed of both is same. Word-length is generally fixed for a computer. But some computers have a changeable word-length i.e. they can be used in doing small or big tasks. Now-a-days computers have word-length of 16,32,48,64,128 or even more bits.

## Measurement of speed-MIPS and MHZ

An electronic device like computer that provides a series of pulses at extremely regular intervals of time. The interval between successive pulses, i.e. their rate of repetition, is known as the clock speed. In computers the clock rate is measured in Mega Hertz (MHz), i.e. there are at least one million pulses per second. Now-a-day computers come with still stunning clock speed of Giga Hertz (GHz).

MIPS-short form of millions of instructions per second. The execution speed of computer is measured in terms of MIPS. For example, 0.5 MIPS is 500000 instruction per second. High speed computer and workstation perform at 200 MIPS and even higher.

## Classification of computer

There are numerous plants and animals on the earth. They are classified into different groups or phyla to study their characteristics. Similarly, there are various types of computers in use. These computers are classified into different categories on the basis of their capacities and uses. We will describe them from smallest to the largest.

A computer is a machine that can be programmed to manipulate symbols. Its principal characteristics are:

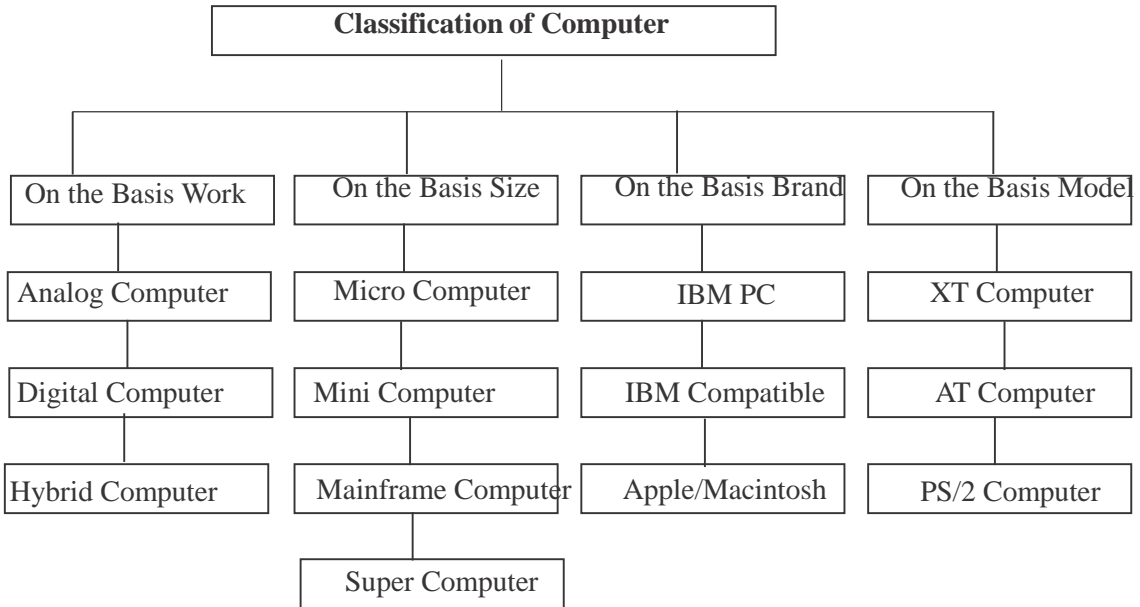
- It responds to a specific set of instructions in a well-defined manner.
- It can execute a prerecorded list of instructions (a program).
- It can quickly store and retrieve large amounts of data.
- It is easy to carry from source to destination.

Therefore computers can perform complex and repetitive procedures quickly, precisely and

reliably. Modern computers are electronic and digital. The actual machinery (wires, transistors, and circuits) is called hardware; the instructions and data are called software.

**The major classification of computer is:**

- 1. On the basis of Work
- 2. On the basis of Brand
- 3. On the basis of Size
- 4. On the basis of Model



*Fig: Classification of Computer*

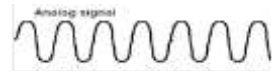
## Classification of Computers According to application/work/ Function

On the basis of work performance, Computer can be classified into 3 categories. They are:

1. Analog Computer
2. Digital Computer
3. Hybrid Computer

### 1. Analog Computer

Analog computers are used to process continuous data. Analog computers represent variables by physical quantities. Thus any computer which solve problem by translating physical conditions such as flow, Temperature, pressure, angular position or voltage into related mechanical or electrical related circuits as an analog for the physical phenomenon being investigated. In general it is a computer which uses an analog quantity and produces analog values as output. Thus an analog computer measures continuously. Analog computers are very much speedy.



An analog computer is the one that measures physical values such as temperature or pressure that fall along a continuous scale or variance in temperature or pressure. For example, a service station gasoline pump contains an analog processor (an analog device) that converts fuel flow measurements into quantity and price values.

They produce their results very fast. But their results are approximately correct. All the analog computers are special purpose computers. Analog computers are even less than 1% in use in Nepal. Example: **Mercury thermometer, barometers etc.** Speedometer in cars and motorcycles is another example of analog device.

#### Features:

1. Analog computers are faster in speed but its accuracy is poor.
2. They are generally specific purpose computers dedicated to do a single job only. A Thermometer cannot be reprogrammed to do the job of Seismograph.
3. There is less or no storage capacity.

### 2. Digital Computer

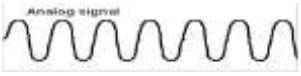

A Digital Computer is the one that directly counts numbers or digits that represent numbers, letters, or other special symbols. Digital Computer is a machine specializes in counting. It operates by counting values that are discrete. Digital Computers are used for both business data processing and accuracy. The digital computer is capable of storing data as long as needed, performing logical operations, editing input data, and printing out the results of its processing at high speed. Digital computer performs operation on binary digits (0s and 1s). it is a programmable device that process information according to logical rules. It is used in word processing, calculations, entertainment, bank, insurance, health care system, factories. Examples: **computers, calculators, etc.**



#### Features:

1. Digital computers are very accurate.
2. It has large storage capacity
3. The output generated by digital computer is easily readable by ordinary people.
4. They are general purpose computers.

## Difference between Analog and Digital Computer

SN	Analog Computer	Digital computer
1	Analog Computers Work on continuous values.	Digital computers Work on discrete values.
2	Analog Computers have low memory less storage capacity.	Digital computers have a very large memory and storage capacity.
3	The accuracy of analog computer is low.	The accuracy of digital computer is high.
4	Analog computers are less reliable.	Digital computers are more reliable.
5	Analog computers used in engineering and science and medical fields.	Digital computers are used in all fields of life.
6	Analog computers are used to calculate/measure analog quantities like speed and temperature.	Digital computers are used to calculate mathematical and logical operations. It can solve addition, subtraction, division, multiplication and other mathematical and statistical operations.
7	Analog computers provide less accurate results.	Digital computers provide 100% accurate results.
8	Normally Analog Computers are specific purpose.	Digital Computers are general purpose.
9	Analog computers are difficult to reuse the code.	Digital computers are easy to use the code.
10		
11	Examples of Analog computers are: thermometer, analog clock, speedometer, presley etc.	Examples of digital computers are: Personal Computer, laptops, smart phones etc.

### 3. Hybrid Computer

Although both analog and digital computers are extremely used in widely accepted in various industries, manufacturers have to attempt to design a computer that combines the best features of both types. This special-purpose machine called a hybrid, computer, combines the measuring capabilities of the analog computer and the logical and control capabilities of the digital computer. It offers an efficient and economical method of working out special types of problems in science and various areas of engineering. Some Hybrid machines contain special equipment to convert analog voltages into digital voltages, and vice-versa.

Hybrid computers are used in big industries, scientific research institution, airplanes etc. In an intensive-care unit of hospital, for example, analog devices measure a patient's heart function, temperature, or other vital signs. These measurements are then converted into numbers and supplied to a digital component that monitors the patient's vital signs and signals a nurse's station if abnormal readings are detected.

#### Features:

1. It has both features of analog and digital computer.
2. They are special purpose machine as analog device.



3. It usually has high cost compared to analog and digital for example hybrid watch.
4. Hybrid computers are used in big industries, scientific research institution, airplanes etc.

## On the basis of size

### 1. Super Computer

Super computers are the most powerful and expensive computers. These computers are fastest calculating devices ever invented in the history of computer which perform their work in nano second ( $10^{-9}$ ) and even in pico second ( $10^{-12}$ ) i.e. these computer are 1000's to millions times as fast as micro computers. Supercomputers are types of computers which are known to be the fastest and biggest machines today. They are capable of carrying our billion or even trillion of calculations. These computers were introduced in the 1960s. They can be seen as a system of many computers which are working together. These computers have multiple CPUs that can process multiple instructions at a time, known as parallel processing. Normally, size of a supercomputer is nearly equivalent to the size of a room.



Due to their extraordinary capabilities, super computers are very expensive. Supercomputers are faster than conventional computers due to a specifically designed memory hierarchy thousands of gigabyte of RAM. It's measured in hundreds of floating point operations (gigaflops). It's hard drive about in petabyte range. These computers are not used for carrying out transaction processes. Architecture of supercomputers is far more advanced than other types of computers. They can support upto 1000 terminals at a time.

These computers are use for weather forecasting, petroleum engineering and medicine for creating computer graphics, large scale simulation, weapon research, etc. Some examples of super computers are **CRAY, NEC, Super SXII, CYBER205, CDC-STAR 100** etc.

#### Features:

- The aerospace, automotive, chemical, electronics and petroleum industries use super-computers extensively.
- Supercomputers are used in weather forecasting and seismic analysis. They are found in many public and private research centers, such as universities and government laboratories.
- A supercomputer was used to alert scientists to the impending collision of a comet with Jupiter in 1994, giving them time to prepare to observe and record the event.
- The ultra supercomputer will simulate nuclear explosions (eliminating the need to detonate any bombs), model global weather trends, and design power plants.
- Supercomputers can perform at up to 128 gigaflops, and use bus widths of 32 or 64 bits. This capability makes supercomputers suitable for processor-intensive applications, such as graphics.

### 2. Mainframe Computer

The most expensive, largest and the most quickest or speedy computer than micro and mini computers and are called mainframe computers. These computers are used in large companies, factories, organizations etc. the mainframe computers are the most expensive computers than micro computers; they cost more than 20 million rupees. In these computers 150





users are able to work on one C.P.U. The mainframes are able to process 1 to 8 bits at a time. They have several hundreds of megabytes of primary storage and operate at a speed measured in nano second. Examples: **ES/9000, S/390, Z800** etc.

### 3. Mini Computer

Mini computers are larger than micro computers, both in size and other facilities such as speed, storage capacity and other services. They have more input and output devices. They are used when large groups need access to data simultaneously. Their speeds are rated between one and fifty million instructions per second (MIPS). They have primary storage in hundred to three hundred megabytes range with direct access storage device. These computers work well in distributed data process system (DDP Sys) i.e. computer processing power is decentralize or distributed across different computers. These computers are used in factories to control automatic assembly lines, manufacturing process control, etc. Where numerous equipment have to be co-ordinate and operated in time critical sequence such as car manufacturing plant. Examples: **IBMAS/400, HP9000** etc.



#### Features:

- Less processing speed than mainframe computers.
- Departments of large company's uses this type of computers.
- They can handle large database and accounting efficiently.
- Example: Department of computer monitoring the network traffic of whole company.

### 4. Micro Computers

These are the smallest range of computers. They were introduced in the early 70's having less storing space and processing speed. Micro computers of today are equivalent to the mini computers of yesterday in terms of performing and processing. They are also called "computer of a chip" because its entire circuitry is contained in one tiny chip also called microprocessor or CPU. The micro computers have a wide range of applications including uses as portable computer that can be plugged into any wall. These computers are also known as "Personal Computer". The name Personal Computer or PC is largely related to IBM, which introduced and marketed the first widely available, commercialized microcomputer named the IBM PC.

A micro computer is a computer with a microprocessor as its CPU. They are cheap, compact and can be easily accommodated on a study table. Now-a-days mostly used computers are microcomputers. It is called Home PC or Personal Computer (PC) because it is a single user computer. It supports many higher level languages, multimedia, graphics, 3D graphics and games. The Internet is popular due to PC and it is available

for all income groups. It contains memory in the form of ROM (Read Only Memory) and RAM (Random Access Memory), I/O (input/output) ports, and a bus or system of interconnecting wires, housed in a unit that is usually called a motherboard. IBM, Hewlett Packard, Apple, Compaq are some well known companies which manufacture microcomputers.

### Features:

- Least powerful type of computers but are the most widely used and growing in the fastest rate.
- Hardware peripherals can be attached easily.
- Includes Desktop computers, Laptops, tablet pc, Personal Digital Assistants (PDA) etc.

These computers are cheaper than other computers so they are mostly available in market.

## On the basis of brand

Brands are specific names that companies use to identify their product against others in the market. There are many companies involved in computer manufacturing. However there are two classes of computers very different in principle itself – the IBM and the Macintosh. There are many other companies that follow the principle of IBM and are called IBM Compatible computers. According to the brand computer is divided into 3 groups.

### They are:

1. IBM PC
2. IBM Compatible
3. Apple/ Macintosh

### 1. IBM PC

These are the computers developed by IBM Company. After Thomas John Watson became president of Computing Tabulating Recording in 1914, he renamed it in 1924 as International Business Machines Corporation (IBM). In 1975 IBM introduced their first personal computer (PC) which was called the Model 5100. Later on IBM teamed up with Microsoft to create an operating system because their software division was not able to meet a deadline. They also teamed up with Intel to supply its chips for the first IBM personal computer.

When the personal computer hit the market it was a major hit and IBM gained a strong power in electronic computers.

What identifies IBM computers is because of the UPU design. IBM computers use CISC (Complex Instruction Set Computing) CPUs. It uses the Intel chips for its PCs and relied to Microsoft for operating system. Example: **IBM PC 5150**

### 2. IBM Compatible

Phoenix Technologies went through published documentation of IBM PC to figure out the internal operating system (BIOS) in the IBM. In turn, they designed BIOS of their own which could be used with IBM computers. Many manufacturers jumped in and started making their own IBM Compatible computers. So, there is a class of computers that work in the same principle as that IBM PCs but are developed by other companies. These computers are generally known as Compatible Computers. Example: **IBM Compatible PC**



### Difference between IBM PC & IBM Compatible:

SN	IBM PC	IBM Compatible
1.	It is developed by IBM company itself.	It is developed by Others than IBM company.
2.	It is branded/original computer.	It is duplicate computer.
3.	It is durable and reliable.	It is less durable and reliable.
4.	It has its own OS.	It works on IBM PC.
5.	It is expensive.	It is cheaper.
6.	Parts are not easily available in the market	Parts are easily available in the market
7.	Example: <b>IBM PC Model 5150, IBM 3084</b>	Example: <b>NCR Decision Mate, Olivetti M20, Wang PC, Zenith Z-100.</b>

### 3. Apple/ Macintosh Computer

Apple Company was founded by Steve Jobs and Steve Wozniak in 1976. For about \$700 someone could buy a computer that they put together, which was called the Apple I. In 1977 the Apple II was introduced. Apple was trying to appeal more to the business world so they designed the Lisa computer that was a prototype for the Macintosh and it cost around \$10,000. It featured a 'never before seen' graphical interface and the mouse.

In 1984, they launched the Macintosh. IBM used Motorola chips and created a RISC (Reduced Instruction Set Computing) CPU that could run faster than the CISC model of the same MHz rating, so a RISC chip with a MHz rating of 100 could run just as fast as a CISC chip with MHz rating of 133.

### On the basis of Model

We can still classify computers based on another aspect – model. There are three different models of computers already available –

1. **Extended Technology or XT computer**
2. **Advanced Technology or AT computer and**
3. **Personal System or PS/2 computer.**

#### 1. Extended Technology or XT computer

The extended technology computers used 8006, 8008, 8086, 8088 processors (These are the names of Microprocessors). The period of these computers was from 1975 to 1982. These processors had 4.77 MHz clock speed (these days there are Gigahertz computers). The processors were all of 8-bit. These computers are outdated now by two reasons: first, they do not support the latest software and the second that they had low processing power as well as low storage capacity. Example: IBM PC XT (IBM 5160), Typewriter

#### 2. Advanced Technology or AT computer

With the advent of 80286 microprocessors in 1982, Advanced Technology computers were introduced. The processors were of 8-bit and 16-bit. The computers using processors like 80286, 80386, and 80486 are the examples. Advanced Technology computers' period is from 1982 to 1995. With the features of higher speed and larger memory than the XT computers, they support latest versions of available software.

AT computers may have 80286 SX or 80387 DX, 80486 SX, 80486 DX or even Pentium (80586) processors. The

AT computers support Co-processor that enhances the processing speed and capability of the main processor to perform large and computations within a short period. Example: **IBM PC AT3**.

### 3. Personal System or PS/2

With the advancement of Processors having high clock speed as well as high storage capacity, IBM developed the second generation of personal computers in early 1990s, which used new refined architecture making the computers faster and more powerful than AT computers. The PS/2 processors used VLSI (Very Large Scale Integration) for chip fabrication and their clock speed range from 85 MHz to 1GHz. Generally, PS/2 Computers use 3.5 inch floppy disks and OS/2 operating System. PS/2 computers are widely used in general purpose computation such as word processing, Database Arrangement, Controlling accounts etc.

## Different types of micro computer

Micro computer is also further categorized into following types:-

1. Portable computer
2. Non-portable computer

### 1. Portable computer

1. Laptop
2. PDA
3. Palmtop
4. Smartphone

#### 1 Laptop

Similar in operation to desktops, laptop computers are miniaturized and optimized for mobile use. Laptops run on a single battery or an external adapter that charges the computer batteries. They are enabled with an inbuilt keyboard, touch pad acting as a mouse and a liquid crystal display (LCD) and Light Emitting Diode (LED) as screen. Its portability and capacity to operate on battery power have served as a boon for mobile users.



Examples: **Acer, HP, Dell, MSI, Apple** etc.

### 2. Personal Digital Assistant (PDA)

It is a handheld computer and popularly known as a palmtop. It has a touch screen and a memory card for storage of data. PDA can also be used as portable audio players, web browsers and smart phones. Most of them can access the Internet by means of Bluetooth or Wi-Fi communication. They are small computers which can be held in hands. They are used to browse Internet and receive/send short messages. They are also used to store information which can then be transferred to PCs in leisure.

Now a days they are used to work with smart cards which have user information like Name, their loan or crop details. When the error comes from particular department, he will have PDA with him. The farmers can just swipe the card and do necessary transaction. They are good basically for information transfer rather than information processing. Examples: **RIM's Blackberry**.



## **Features:**

- Keep phone directories
- Calendars and provide calculator capabilities
- Schedule appointments
- Retrieve frequently used phone numbers
- Jot down notes.
- Most PDAs are designed to accept written input by a pen; the PDA decodes what you write.

### **3. Palmtop**

A small computer that literally fits in your palm. Compared to full-size computers, palmtops are severely limited, but they are practical for certain functions such as phone books and calendars. Palmtops that use a pen rather than a keyboard for input are often called hand-held computers or PDAs. Because of their small size, most palmtop computers do not include disk drives. However, many contain PCMCIA slots in which you can insert disk drives, modems, memory, and other devices. Palmtops are also called PDAs, hand-held computers and pocket computers.

### **4. Smartphone**

This kind of phone combines the features of a PDA with that of a mobile phone or camera phone. It has a superior edge over other kinds of mobile phones.

Smartphone's have the capability to run multiple programs concurrently. These phones include high-resolution touch screens, web browsers that can access and properly display standard web pages rather than just mobile-optimized sites, and high-speed data access via Wi-Fi and high speed cellular broadband.

The most common mobile Operating Systems (OS) used by modern smartphones include Google's Android, Apple's iOS, Nokia's Symbian, RIM's BlackBerry OS, Samsung's Bada, Microsoft's Windows Phone, and embedded Linux distributions such as Maemo and MeeGo. Such operating systems can be installed on different phone models, and typically each device can receive multiple OS software updates over its lifetime.

## **Non-portable computer**

### **1. Workstation**

Workstations are expensive, powerful machines used by engineers, scientist and other professionals who process lots of data. Person who needs to run complex programs and display both work in progress and result graphically also used workstations.

They have sophisticated display screen featuring high resolution, graphics and operating system such as UNIX.

Some examples: **Sun Apollo, Hewlett-Packard, IBM** etc.

## **Features:**

- Workstations are small, powerful systems designed to drive networks of less powerful microcomputers and to create high-quality graphics.
- Workstations typically cost \$5,000 to \$20,000.
- Major competitors in this market include DEC, Hewlett-Packard, Sun, and Silicon Graphics, Inc.

### **2. Desktop (Personal Computer)**

They are found almost everywhere nowadays. They cost less and are suitable for house and individual use. They comprise of a monitor, a keyboard, CPU with floppy, CD and Hard disks

and a mouse at the simplest. We can enhance the components in terms of numbers as well as configurations based upon needs.

They run software like word processors, excel, compilers, image viewers, games, Internet besides the operating system.

They are used basically for simple task such as documentation, writing simple programs, to watch movies, listen to the music, to browse Internet to check emails, to download material from web sites etc. Examples: **Dell Vostro, Compaq Presario** etc.

### **Mobile Computing**

Mobile computing' is a form of human-computer interaction by which a computer is expected to be transported during normal usage. Mobile computing has three aspects: mobile communication, mobile hardware, and mobile software. The first aspect addresses communication issues in ad-hoc and infrastructure networks as well as communication properties, protocols, data formats and concrete technologies. The second aspect is on the hardware, e.g., mobile devices or device components. The third aspect deals with the characteristics and requirements of mobile applications.

Mobile computing is "taking a computer and all necessary files and software out into the field."

"Mobile computing: being able to use a computing device even when being mobile and therefore changing location. Portability is one aspect of mobile computing." "Mobile computing is the ability to use computing capability without a pre-defined location and/or connection to a network to publish and/or subscribe to information."

Mobile Computing is a variety of wireless devices that has the mobility to allow people to connect to the inter net, providing wireless transmission to access data and information from where ever location they may be.

#### **Features:**

- Voice Communication
- Downloadable Applications
- Portability
- Connectivity
- Entertainment
- Ease of Research
- Enhanced Productivity

# Computer system

## Introduction

Computers are often compared to human beings since both have the ability to accept data, store, work with it, retrieve and provide information. The main difference is that human beings have the ability to perform all of these actions independently. Human beings also think and control their own activities. The computer, however, requires a program (a predefined set of instructions) to perform an assigned task. Human beings receive information in different forms, such as eyes, ears, nose, mouth, and even sensory nerves. The brain receives or accepts this information, works with it in some manner, and then stores in the brain for future use. If information at the time requires immediate attention, brain directs to respond with actions. Likewise the Central Processing Unit (CPU) is called the brain of the computer. It reads and executes program instructions, performs calculations and makes decisions.

## Concept of Computer Architecture

Computer architecture is the design which deals with the operational activities of the computer. The computer architecture is also known as the digital computer organizational design which deals with the computer system and for that the fundamental operations needs to be identified.

It represents the attributes associated with computer systems for Example: Set the instruction, the arithmetic is used, addressing technique, the mechanism of input/output (I/O). Computer architecture is related to Computer organization. Computer organization is the part that is closely related to operational units. Example: Technology hardware, interface devices, memory technology, system memory, and control signals.

## Concept of Computer Organization

Computer organization is a study of a Computer Architecture. E.g. Memory, Registers, RAM, ROM, CPU, ALU, 16 bit/ 32 bit/ 64 bit architecture, what different parts makes a computer, etc.

## Basic Computer Operations

A computer performs basically five major operations or functions irrespective of their size and make. These are:

- 1) It accepts data or instruction by way of input,
- 2) It stores data,
- 3) It can process data as required by the user,
- 4) It gives results in the form of output, and
- 5) It controls all operations inside a computer.

## Hardware

Hardware is the physical devices of the computer. It is tangible. Without hardware software can't work. It includes input devices, output devices, processing device and storage device. Examples of hardware are keyboard, monitor, CPU, hard disk and RAM.

## Software

Software is a collection of instructions that enable the user to interact with a computer or it perform specific tasks for them. Software is the term used to describe the instruction that tell the

hardware, what and how to perform a task. Without software, the hardware is useless. Examples of software are Windows 7, MS Windows-XP, MS office, Norton Antivirus, VLC media player, Internet explorer etc.

### Firmware

Firmware is the combination of software and hardware. Software (programs or data) that has been written onto read-only memory (ROM). Firmware refers to a series of program instructions placed permanently into ROM and PROM by the manufactures. Example of firmware are BIOS of computer, microcontroller chip and ROM, PROM or EEPROM.

## Anatomy of Digital Computer System – Input, Output, Processor and Storage

All types of computers follow a same basic logical structure and perform the following five basic operations for converting raw input data into information useful to their users.

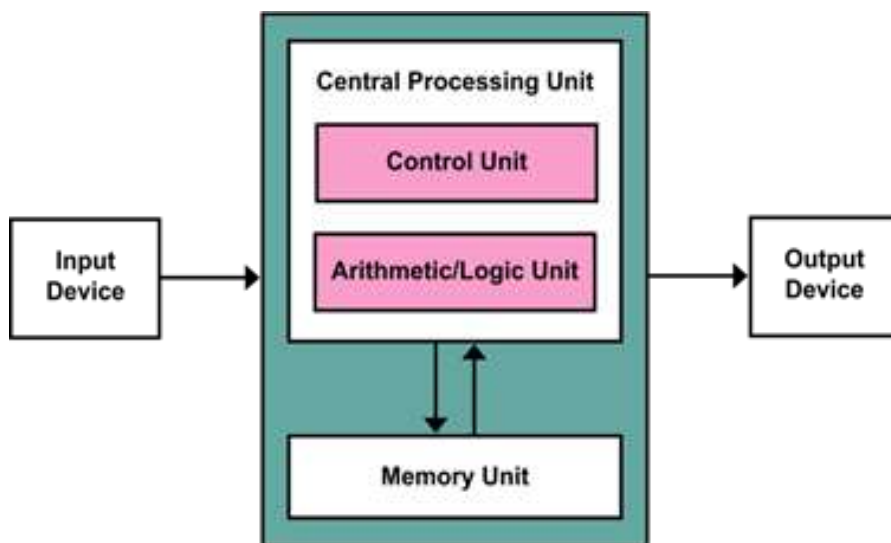


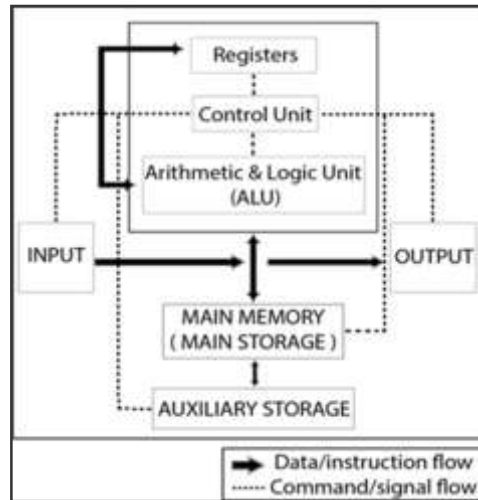
Figure: Computer Block Diagram

When referring to computers, architecture or computer architecture is the overall design and setup of the computer. This includes where connections and parts of the computer are to be placed, how each of components operate with each other, dimensions, etc.

It is a framework, functional description, design and implementation for various parts of computer. The major hardware components of computer system are:



- Input Unit
- Processor
- Storage
- Output unit



*Figure: Logical structure of computer system*

## **Input Unit**

This unit contains devices with the help of which we enter data into computer. This unit makes link between user and computer. The input devices translate the information into the form understandable by computer.

This is the process of entering data and programs in to the computer system. You should know that computer is an electronic machine like any other machine, which takes as input raw data and performs some processing giving out processed data. Therefore, the input unit takes data from us to the computer in an organized manner for processing.

## **CPU (Central Processing Unit)**

CPU is considered as the brain of the computer. CPU performs all types of data processing operations. It stores data, intermediate results and instructions (program). It controls the operation of all parts of computer.

### **CPU itself has following three components**

1. ALU (Arithmetic Logic Unit)
2. Registers
3. Control Unit

## **Arithmetic Logic Unit (ALU)**

This is the area of CPU where various computing Functions are performed. The main functions of ALU are as follows:

- It accepts operands from registers.
- It performs arithmetic and logical operations
- It returns results to register or a memory

## Control Unit

The control unit provides the necessary timing and control signals to all the operations in the computer. It controls the flow of data between the CPU and memory and peripherals.

### Functions of control Unit

- It performs data processing operation
- It sends control signal to various parts of computer system for controlling
- It gives commands to input data from input unit to memory unit to ALU.
- It transforms result from ALU to memory unit to output unit.
- It gives command to store the data, instruction and program in memory.

## Registers

Registers are the primary memory of computer system. They are mainly used to store data during the time of processing inside ALU.

### Function of Register Array

- It holds the address of the active memory locations
- It holds the contents of the accessed (read/write) memory word.
- It holds the address of the next instruction to be executed.
- It holds the data to be operated upon, the intermediate results, and the results of processing.
- It holds the current instruction being executed.

## Storage

The process of saving data and instructions permanently is known as storage. Data has to be fed into the system before the actual processing starts. It is because the processing speed of Central Processing Unit (CPU) is so fast that the data has to be provided to CPU with the same speed. Therefore the data is first stored in the storage unit for faster access and processing. This storage unit or the primary storage of the computer system is designed to do the above functionality. It provides space for storing data and instructions.

### Function of Storage Unit

- All data and instructions are stored here before and after processing.
- Intermediate results of processing are also stored here.

## Output Unit

Output unit consists of devices with the help of which we get the information from computer. This unit is a link between computer and users. Output devices translate the computer's output into the form understandable by users. Example: printer, monitor etc.

## Microprocessor (CPU) – Concepts, Components of Processor, Functions

CPU is considered as the brain of the computer. CPU performs all types of data processing operations. It stores data, intermediate results and instructions (program). It controls the operation of all parts of computer.



### **CPU consists of the following features/functions:**

- It is considered as the brain of the computer.
- It performs all types of data processing operations.
- It controls the sequence of operation.
- It give commands to all parts of the computer system
- It stores data, intermediate results and instructions (program).
- It controls the operation of all parts of computer system.

### **CPU itself has following three components.**

1. Memory or Storage Unit
2. Control Unit
3. ALU(Arithmetic Logic Unit)

### **Memory or Storage Unit**

This unit can store instructions, data and intermediate results. This unit supplies information to the other units of the computer when needed. It is also known as internal storage unit or main memory or primary storage or Random access memory (RAM).

Its size affects speed, power and capability. Primary memory and secondary memory are two types of memories in the computer. Functions of memory unit are:

- It stores all the data and the instructions required for processing.
- It stores intermediate results of processing.
- It stores final results of processing before these results are released to an output device.
- All inputs and outputs are transmitted through main memory.

### **Control Unit**

This unit controls the operations of all parts of computer but does not carry out any actual data processing operations.

### **Functions of Control unit are:**

- It is responsible for controlling the transfer of data and instructions among other units of a computer.
- It manages and coordinates all the units of the computer.
- It obtains the instructions from the memory, interprets them, and directs the operation of the computer.
- It communicates with Input/output devices for transfer of data or results from storage.
- It does not process or store data.

### **ALU (Arithmetic and Logic Unit)**

An **arithmetic logic unit (ALU)** is a digital circuit used to perform arithmetic and logic operations. It represents the fundamental building block of the **central processing unit (CPU)** of a computer. Modern CPUs contain very powerful and complex ALUs. An ALU is a digital circuit used to perform arithmetic and logic operations

### **This unit consists of two subsections namely**

1. Arithmetic section
2. Logic Section

## Arithmetic Section

Function of arithmetic section is to perform arithmetic operations like addition, subtraction, multiplication and division. All complex operations are done by making repetitive use of above operations.

## Logic Section

Function of logic section is to perform logic operations such as comparing, selecting, matching and merging of data.

	<b>CISC (Complex Instruction Set Computer)</b>	<b>RISC (Reduced Instruction Set Computer )</b>
1	Emphasis on hardware	Emphasis on software
2	Includes multi-clock complex instructions	Single-clock, reduced instruction only
3	Small code sizes	Typically larger code sizes
4	Many addressing modes	Few addressing modes,
5	An easy compiler design	A complex compiler design.
6	Pipelining does not function correctly here because of complexity in instructions.	Pipelining is not a major problem and this option speeds up the processors.

## RISC vs. CISC

Parameter	RISC	CISC
✓ Instruction types	Simple	Complex
✗ Number of instructions	Reduced (30-40)	Extended (100-200)
✓ Duration of an instruction	One cycle	More cycles (4-120)
Instruction format	Fixed	Variable
Instruction execution	In parallel (pipeline)	Sequential
Addressing modes	Simple	Complex
Instructions accessing the memory	Two: Load and Store	Almost all from the set
Register set	multiple	unique
Complexity	In compiler	In CPU (micro-program)

## Concept of System Buses: Data Bus, Address Bus, Control Bus

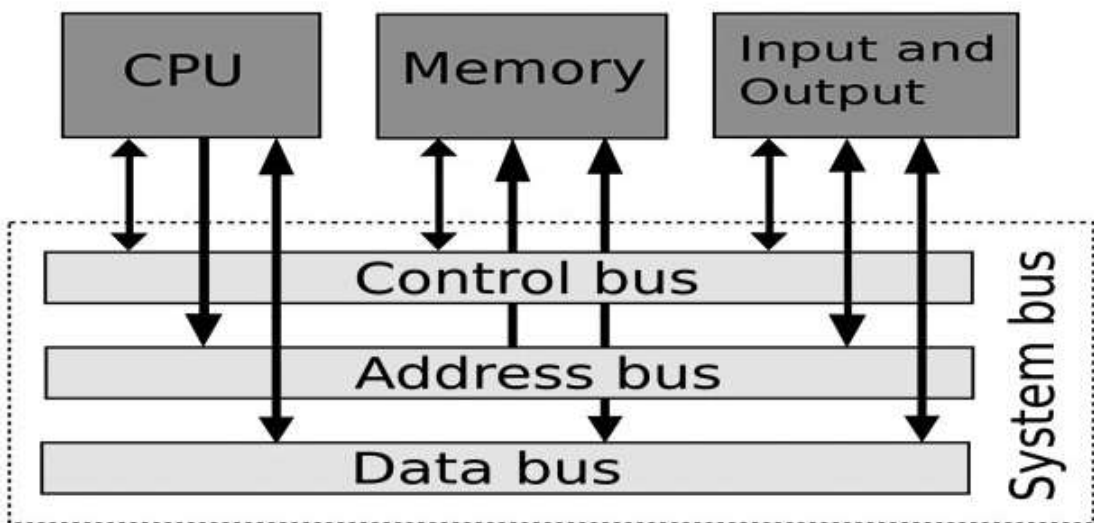
A **Bus** is a set of physical connections (cables, printed circuits, etc.) which can be shared by multiple hardware components in order to communicate with one another. The purpose of buses is to reduce the number of "pathways" needed for communication between the components, by carrying out all communications over a single data channel.

A bus is characterized by the amount of information that can be transmitted at once. This amount, expressed in bits, corresponds to the number of physical lines over which data is sent simultaneously. A 32-wire ribbon cable can transmit 32 bits in parallel. The term "**width**" is used to refer to the number of bits that a bus can transmit at once.

Additionally, the bus speed is also defined by its **frequency** (expressed in Hertz), the number of data packets sent or received per second. Each time that data is sent or received is called a **cycle**.

**The system bus consists of three types of buses:**

1. Data Bus: Carries the data that needs processing
2. Address Bus: Determines where data should be sent
3. Control Bus: Determines data processing



### Data Bus

In computer, a data bus is a group of electrical wires used to send information (data) back and forth between two or more components. A data bus has many different defining characteristics,

but one of the most important is its width. The width of a data bus refers to the number of bits (electrical wires) that make up the bus. Common data bus widths include 1, 4, 8, 16, 32, and 64-bit. When manufacturers refer to the number of bits a processor uses, such as “This computer uses a 64-bit processor,” they are referring to the width of the front side data bus, the bus that connects the processor to its main memory. Other types of data buses used in computers include the back side bus, which connects the processor to dedicated cache memory.

### Address bus

An address bus is a computer bus (a series of lines connecting two or more devices) that is used to specify a physical address. When processor or DMA-enabled device needs to read or write to a memory location, it specifies that memory location on the address bus (the value to be read or written is sent on the data bus). The width of the address bus determines the amount of memory a system can address. For example, a system with a 32-bit address bus can address 232 (4,294,967,296) memory locations. If each memory address holds one byte, the addressable memory space is 4 GB.

### Control Bus

The control bus is used by the CPU to direct and monitor the actions of the other functional areas of the computer. It is used to transmit a variety of individual signals (read, write, interrupt, acknowledge, and so forth) necessary to control and coordinate the operations of the computer. The individual signals transmitted over the control bus and their functions are covered in the appropriate functional area description.

## Memory – Cache (L1, L2), Buffer, RAM, ROM

**Computer memory** is any physical device capable of storing information temporarily or permanently. In computing, memory refers to the physical devices used to store programs (sequences of instructions) or data (e.g. program state information) on a temporary or permanent basis for use in a computer or other digital electronic device.

The term primary memory is used for the information in physical systems which are fast (i.e. RAM), as a distinction from secondary memory, which are physical devices for program and data storage which are slow to access but offer higher memory capacity. Primary memory stored on secondary memory is called "virtual memory".

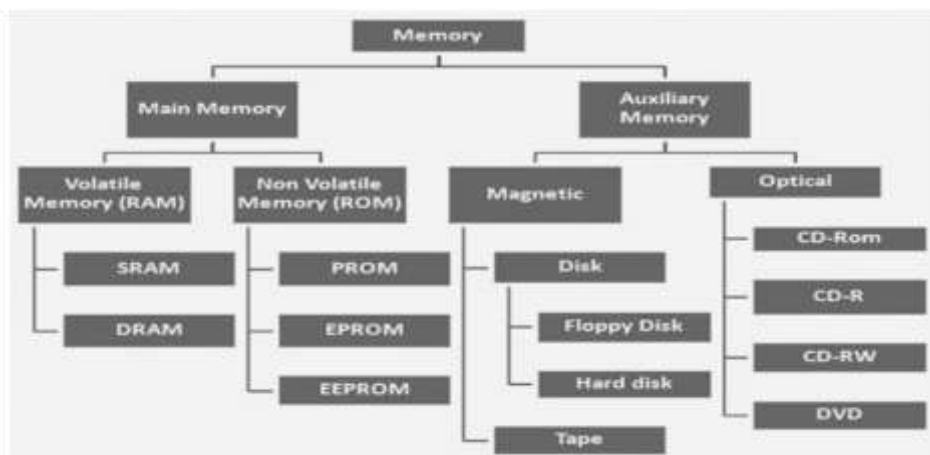


Fig: Memory Classification

## Cache-Memory

Cache memory is a very high speed semiconductor memory which can speed up CPU. A cache memory is a semiconductor primary memory placed between RAM and CPU. It is temporarily stores frequently used instructions and data for quicker processing by the processor of computer. It stores data and instructions that the CPU is likely to need next. It is very expensive memory which allows to store frequently used instructions so that the CPU process faster as it doesn't require to take time to swap instructions in and out of RAM.

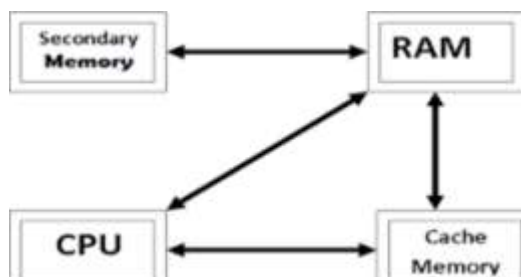


Figure: Cache Memory

### Advantages

- Cache memory is faster than main memory.
- It consumes less access time as compared to main memory.
- It stores the program that can be executed within a short period of time.
- It stores data for temporary use.

### Disadvantages

- Cache memory has limited capacity.
- It is very expensive.

### Types of cache memory

1. Internal cache: Cache presents in the CPU
2. External cache: Cache Present outside the CPU

### Different Levels of cache memory

L1 (Level 1), L2, L3 cache are some specialized memory which work hand in hand to improve computer performance.

When a request is made to the system, CPU has some set of instructions to execute, which it fetches from the RAM. Thus to cut down delay, CPU maintains a cache with some data which it anticipates it will be needed.

(L1) Level 1 Cache (2KB - 64KB) - Instructions are first searched in this cache. L1 cache very small in comparison to others, thus making it faster than the rest.

(L2) Level 2 Cache (256KB - 512KB) - If the instructions are not present in the L1 cache then it looks in the L2 cache, which is a slightly larger pool of cache, thus accompanied by some latency.

(L3) Level 3 Cache (1MB -8MB) - With each cache miss, it proceeds to the next level cache. This is the largest among the all the cache, even though it is slower, it's still faster than the RAM.

### Buffer

A **Buffer**, also called **buffer memory**, is a portion of a computer's **memory** that is set aside as a temporary holding place for data that is being sent to or received from an external device, such as a hard disk drive (HDD), keyboard or printer. It lies between the CPU and input/output devices.

## Primary memory (Main Memory)

Primary memory (or main memory or internal memory), often referred to simply as memory, is the only one directly accessible to the CPU. The CPU continuously reads instructions stored there and executes them as required. Any data actively operated on is also stored there in uniform manner.



Primary memory holds only those data and instructions on which computer is currently working. It has limited capacity and data is lost when power is switched off. It is generally made up of semiconductor device. These memories are not as fast as registers. The data and instruction required to be processed reside in main memory.

### Characteristics of Main Memory

- These are semiconductor memories
- It is known as main memory.
- Usually volatile memory.
- Data is lost in case power is switched off.
- It is working memory of the computer.
- Faster than secondary memories.
- A computer cannot run without primary memory.

It can be divided into two essential types: RAM and ROM.

### RAM (Random Access Memory)

RAM is a volatile/temporary Memory i.e. contents are lost when power supply is cut off. It is the place in a computer where the operating system, application programs, and data in current use are kept so that they can be quickly reached by the computer's processor. RAM is much faster to read from and write to than the other kinds of storage in a computer, the hard disk, floppy disk, and CD-ROM. However, the data in RAM stays there only as long as your computer is running. When you turn the computer off, RAM loses its data. When you turn your computer on again, your operating system and other files are once again loaded into RAM, usually from your hard disk.

There are two different types of RAM:

1. SRAM (Static Random Access Memory)
2. DRAM (Dynamic Random Access Memory)

### SRAM (Static Random Access Memory)

Static RAM is a type of RAM that holds its data without external refresh, for as long as power is supplied to the circuit. This is contrasted to dynamic RAM (DRAM), which must be refreshed many times per second in order to hold its data contents. SRAMs are used for specific applications within the PC, where their strengths outweigh their weaknesses compared to DRAM:

- **Simplicity:** SRAMs don't require external refresh circuitry or other work in order for them to keep their data intact.
- **Speed:** SRAM is faster than DRAM.



## **In contrast, SRAMs have the following weaknesses, compared to DRAMs:**

- **Cost:** SRAM is, byte for byte, several times more expensive than DRAM.
- **Size:** SRAMs take up much more space than DRAMs (which is part of why the cost is higher).

## **DRAM (Dynamic Random Access Memory)**

Dynamic RAM is a type of RAM that only holds its data if it is continuously accessed by special logic called a refresh circuit. Many hundreds of times each second, this circuitry reads the contents of each memory cell, whether the memory cell is being used at that time by the computer or not. Due to the way in which the cells are constructed, the reading action itself refreshes the contents of the memory. If this is not done regularly, then the DRAM will lose its contents, even if it continues to have power supplied to it. This refreshing action is why the memory is called dynamic.

## **Read-Only Memory (ROM)**

ROM stands for Read Only Memory. It is type of internal memory. The data and instructions in ROM are stored by the manufacturer at the time of its manufacturing. This data and programs cannot be changed or deleted after write. The data or instructions stored in ROM can only be read but new data or instructions cannot be written into it. This is the reason why it is called Read Only Memory. ROM stores data and instructions permanently. When the power is turned off, the instructions stored in ROM are not lost. That is the reason ROM is called *non-volatile* memory. ROM is used to store frequently used instructions and data to control the basic input & output operations of the computer. Mostly, frequently used small programs like operating system routines and data, are stored into the ROM. When the computer is switched on, instructions in the ROM are automatically activated. These instructions help the booting process of computer.

## **Types of Read-Only Memory (ROM)**

1. **Programmable ROM (PROM):** PROM stands for Programmable Read Only Memory. This form of ROM is initially blank. The user or manufacturer can write data/program on it by using special devices. However, once the program or data is written in PROM chip, it cannot be changed. If there is an error in writing instructions or data in PROM, the error cannot be erased. PROM chip becomes unusable.
2. **Erasable Programmable ROM (EPROM):** EPROM stands for Erasable Programmable Read Only Memory. This form of ROM is also initially blank. The user or manufacturer can write program or data on it by using special devices. Unlike PROM, the data written in EPROM chip can be erased by using special devices and ultraviolet rays. So program or data written in EPROM chip can be changed and new data can also be added. When EPROM is in use, its contents can only be read.
3. **Electrically Erasable Programmable ROM (EEPROM):** EEPROM stands for Electrically Erasable Programmable Read Only Memory. This kind of ROM can be written or changed with the help of electrical devices. So data stored in this type of ROM chip can be easily modified. This is the most flexible type of ROM, and is now commonly used for holding BIOS programs.

## **In EEPROMs:**

- The chip does not have to be removed to be rewritten.
- The entire chip does not have to be completely erased to change a specific portion of it.
- Changing the contents does not require additional dedicated equipment.

### Difference between RAM and ROM

SN	Random Access Memory (RAM)	Read Only Memory (ROM)
1	RAM is a type of volatile memory.	ROM is a type of non- volatile memory.
2	RAM is the memory available for the operating system, programs and processes to use when the computer is running.	ROM is the memory that comes with your computer that is pre-written to hold the instructions for booting-up the computer.
3	RAM requires a flow of electricity to retain data (e.g. the computer powered on).	ROM will retain data without the flow of electricity (e.g. when computer is powered off).
4	It allows both read and write operation.	It allows only read operation.
5	It has high storage capacity.	It has low storage capacity.
6	Types of RAM are SRAM and DRAM.	Types of ROM are PROM, EPROM and EEPROM.

### Difference between SRAM and DRAM

SN	SRAM	DRAM
1	It is made up of flip-flops.	It is made up of capacitors.
2	Large in size.	Small in size.
3	Data store in the form of voltage.	Data store in the form of charge.
4	Cost per bit is high, so expensive.	Cost per bit is low, so cheaper.
5	Low storage capacity of few MB.	High storage capacity of few GB.
6	Consume more power.	Consume less power.
7	Data access rate is higher speed.	Data access rate is Slow speed.
8	Data sustain with time, so does not need refreshing circuit.	Data loses with time, so need refreshing circuit.

### Storage Device – Definition, Use, Types: Hard Disk , Floppy Disk, Magnetic Tape, Flash Memory, Optical Disk (CD,VCD,DVD), External Storage Device

#### Secondary Memory

This type of memory is also known as external memory or non-volatile memory. It is slower than main memory. These are used for storing data/Information permanently. CPU directly does not access these memories instead they are accessed via input-output routines. Contents of secondary memories are first transferred to main memory, and then CPU can access it. For example: Hard Disk, Floppy Disk, magnetic tape etc.

## Characteristics of Secondary Memory

- These are magnetic and optical memories
- It is known as backup memory.
- It is non-volatile memory.
- Data is permanently stored even if power is switched off.
- It is used for storage of data in a computer.
- Computer may run without secondary memory.
- Slower than primary memories.

## Difference between Primary and Secondary Memory

SN	Primary Memory	Secondary Memory
1	Usually it is volatile memory.	It is non-volatile memory.
2	Data is temporarily stored, so data lost when power is switched off.	Data is permanently stored, even if power is switched off.
3	It is working memory of the computer	It is used for storage of data in a computer
4	These are semiconductor memories	These are magnetic and optical memories
5	It is known as main memory.	It is known as backup memory.
6	A computer cannot run without primary memory.	Computer may run without secondary memory
7	Faster read/write operation than secondary memories.	Slower read/write operation than primary memories.
8	It is expensive.	It is cheaper.
9	Less storage capacity.	Large storage capacity.
10	Directly accessible to CPU.	Not directly accessible to CPU.
11	Example: RAM, ROM, etc.	Example: HDD, CD, floppy disk, etc.

## Storage Device

Computer data storage, often called storage or memory, refers to computer components and recording media that retain digital data. Data storage is a core function and fundamental component of computers.

### HDD

A **Hard Disk Drive (HDD)**, **Hard Disk**, **Hard Drive** or **Fixed disk** is a data storage device used for storing and retrieving huge amount of digital information permanently, using one or more rigid ("hard") rapidly rotating **disks** (platters) coated with magnetic material.

Magnetic disks used in computer are made on the circular disk and coated with magnetic material. It rotates with very high speed inside the computer drive. Data is stored on both the surfaces of the disk. Magnetic disks



are most popular as direct access storage device. Each disk consists of a number of invisible concentric circles called tracks. Information is recorded on tracks of a disk surface in the form of tiny magnetic spots. The presence of a magnetic spot represents one bit and its absence represents zero bit. The information stored in a disk can be read many times without affecting the stored data. So the reading operation is non-destructive. But if you want to write a new data, then the existing data is erased from the disk and new data is recorded.

### Floppy Disk

A **Floppy Disk** is a magnetic storage medium for computer systems. The **floppy disk** is composed of a thin, flexible magnetic **disk** sealed in a square plastic carrier. In order to read and write data from a **floppy disk**, a computer system must have a **floppy disk drive** (FDD).

It is similar to magnetic disk. It is 3.5 inch in diameter. These come in single or double density and recorded on one or both surface of the diskette. The capacity of a high-density 3.5 inch floppy has 1.44 MB (Mega Bytes) and 5<sup>1/4</sup> has 1.2 MB storage capacity. It is cheaper than any other storage devices and is portable. The floppy is a low cost device particularly suitable for personal computer system. Now a day it is rarely used or outdated storage media.



### Magnetic Tape

Magnetic tapes are used for large computers like mainframe computers where large volume of data is stored for a longer time. In PC also can use tapes in the form of cassettes. The storage of data in tapes is inexpensive. Tapes consist of magnetic materials that store data permanently. It can be 12.5 mm to 25 mm wide plastic film-type and 500 meter to 1200 meter long, which is coated with magnetic material. The tape unit is connected to the central processor and information is fed into or read from the tape through the processor. It is similar to a cassette tape recorder.



### Flash Memory

Flash memory is a non-volatile computer storage chip that can be electrically erased and reprogrammed. It was developed from EEPROM (electrically erasable programmable read-only memory) and must be erased in fairly large blocks before these can be rewritten with new data. Example applications



of both types of flash memory include personal computers, PDAs, digital audio players, digital cameras, mobile phones, synthesizers, video games, scientific instrumentation, industrial robotics, medical electronics, and so on. In addition to being non-volatile, flash memory offers fast read access times, as fast as dynamic RAM, although not as fast as static RAM or ROM. Its mechanical shock resistance helps explain its popularity over hard disks in portable devices; as does its high durability, being able to withstand high pressure, temperature, immersion in water etc.

## **Optical Disk (CD, VCD, DVD)**

With every new application and software there is greater demand for memory capacity. It is the necessity to store large volume of data that has led to the development of optical disk storage medium. Optical disks read and write the data using light. Optical disks can be divided into the following categories:

### **CD (Compact Disk)**

#### **CD-ROM (Compact Disk - Read Only Memory)**

CD-ROM disks are made of reflective metals. CD-ROM is written during the process of manufacturing by high power laser beam. Here the storage density is very high, storage cost is very low and access time is relatively fast. Each disk is approximately 4 ½ inches in diameter and can have over 600 MB of data. As the CD-ROM can be read only we cannot write or make changes into the data contained in it.

#### **CD-R (Compact Disk - Recordable)**

It is also known as Write Once, Read Many (WORM). A WORM allows the user to write data permanently on to the disk. Once the data is written it can never be erased without physically damaging the disk. Here data can be recorded from keyboard, video scanner, OCR equipment and other devices. The advantage of WORM is that it can store vast amount of data amounting to gigabytes. Any document in a WORM can be accessed very fast, say less than 30 seconds.

#### **CD-RW (Compact Disk - Rewritable)**

These are optical disks where data can be written, erased and re-written. This makes use of a laser beam to write and re-write the data. These disks may be used as alternatives to traditional disks. Erasable optical disks are based on a technology known as magneto-optico (MO). To write a data bit on to the erasable optical disk the MO drive's laser beam heats a tiny, precisely defined point on the disk's surface and magnetizes it.

### **DVD (Digital Versatile/Video Disc)**

A DVD is an optical disc storage media format, invented and developed by Philips, Sony, Toshiba, and Panasonic in 1995. DVDs offer higher storage capacity than Compact Discs while having the same dimensions. A DVD is a type of optical media used for storing digital data. It is the same size as a CD, but has a larger storage capacity. Some DVDs are formatted specifically for video playback, while others may contain different types of data, such as software programs and computer files.

A standard DVD can hold 4.7 GB of data, which is enough to hold over 2 hours of video in 720p resolution, using MPEG-2 compression. For example, a dual-layer DVD (which has two layers of data on a single side of the disc) can store 8.5 GB of data. A dual-sided DVD can store 9.4 GB of data (4.7 x 2). A dual-layer, dual-sided DVD can store 17.1 GB of data. The larger capacity formats are not supported by most standalone DVD players, but they can be used with many computer-based DVD drives.

#### **DVD-ROM (Digital Versatile/Video Disc-ROM)**

DVD- ROM is a read-only digital versatile disc (DVD) commonly used for storing large



software applications. It is similar to a compact disk-read only memory (CD-ROM) but has a larger capacity. A DVD-ROM stores around 4.7 GB of data. A CD-ROM usually stores 620 MB of data. A DVD-ROM permanently stores data files which cannot be changed, written over or erased. A personal computer (PC) with a DVD-ROM or a DVD-RAM drive is designed to read a DVD-ROM disc. Generally a DVD-ROM disc is not equipped to be used with a DVD drive connected to a home theater system or television. Compared to a CD-ROM, a DVD-ROM has the same 5 inch diameter and 1.2 millimeter (mm) thickness. But because a DVD-ROM uses a shorter wavelength laser with tighter compacted pits, the disc capacity is increased. In fact, the smallest DVD-ROM can store approximately 7 times more data than a CD-ROM.

### **DVD-R (Digital Versatile Disc-Recordable)**

A DVD-R looks the same as a regular DVD, but like a CD-R, it can be used to record data. Once a DVD-R has been "burned," or written to, it cannot be written to again. A basic single-sided, single-layer DVD-R disc can store 4.7GB of data. Double-layer discs can store 8.5GB, while double-sided DVD-Rs can store 9.4GB.

DVD-R is the most common format of writable DVDs (compared to the DVD+R and DVD-RAM formats). Most DVD players and DVD-ROM drives can read DVD-R discs. That means you can use a DVD-R disc to back up several gigabytes of data on your computer or make your own video DVD. The Apple SuperDrive used in many Macintosh computers supports the DVD-R format.

### **DVD-RW (Digital Versatile Disc-Rewritable)**

A DVD-RW is like a DVD-R but can be erased and written to again. Like CD-RWs, DVD-RWs must be erased in order for new data to be added. DVD-RWs can hold 4.7GB of data and do not come in double-layered or double-sided versions like DVD-Rs do. Because of their large capacity and ability to be used multiple times, DVD-RW discs are a great solution for frequent backups. To record data onto a DVD-RW disc, you'll need a DVD burner that supports the DVD-RW format.

### **Blu-Ray Disk (BD)**

**Blu-ray** (not Blue-ray) also known as Blu-ray Disc (BD), is the name of a new optical disc format jointly developed by the Blu-ray Disc Association (BDA), a group of the world's leading consumer electronics, personal computer and media manufacturers (including Apple, Dell, Hitachi, HP, JVC, LG, Mitsubishi, Panasonic, Pioneer, Philips, Samsung, Sharp, Sony, TDK and Thomson). The format was developed to enable recording, rewriting and playback of high-definition video (HD), as well as storing large amounts of data. The format offers more than five times the storage capacity of traditional DVDs and can hold up to 25GB on a single-layer disc and 50GB on a dual-layer disc. This extra capacity combined with the use of advanced video and audio codec's will offer consumers an unprecedented HD experience.



While current optical disc technologies such as DVD, DVD±R, DVD±RW, and DVD-RAM rely on a red laser to read and write data, the new format uses a blue-violet laser instead, hence the name Blu-ray. The benefit of using a blue-violet laser (405nm) is that it has a shorter wavelength than a red laser (650nm), which makes it possible to focus the laser spot with even greater precision. This allows data to be packed more tightly and stored in less space, so it's possible to fit more data on the disc even though it's the same size as a CD/DVD. This together with the

change of numerical aperture to 0.85 is what enables Blu-ray Discs to hold 25GB/50GB. Recent development by Pioneer has pushed the storage capacity to 500GB on a single disc by using 20 layers.

## External Storage Device

In computing, external storage comprises devices that temporarily store information for transporting from computer to computer. Such devices are not permanently fixed inside a computer. Semiconductor memories are not sufficient to provide the whole storage capacity required in computers. The major limitation in using semiconductor memories is the cost per bit of the stored information. So to fulfill the large storage requirements of computers, magnetic disks, optical disks are generally used.

### Advantages of external storage:

- External storage provides additional storage other than that available in a computer.
- Data can be transported easily from one place to another.
- It is useful to store software and data that is not needed frequently.
- External storage also works as data backup.
- This back up may prove useful at times such as fire or theft because important data is not lost.

## Winchester Disk drive

Introduced by IBM in 1973 as the model 3340, the **Winchester disk drive** is a hard drive with 30MB of fixed and 30MB of removable storage; thus earning its nickname after the Winchester 30-30 rifle.

The disks featured a 30 millisecond access time and a coating of lubrication that allowed the heads to remain in contact with the surface when rotation speed was increased or decreased; this became the standard for mechanical hard drive development.



## Zip Disk

The **Zip drive** is a medium-to-high-capacity (at the time of its release) removable floppy disk storage system that was introduced by Iomega in late 1994. Originally, Zip disks launched with capacities of 100 MB, but later versions increased this to first 250 MB and then 750 MB.



## Super Disks

It is introduced by 3M, which later became Imation. The drive was most popular with OEM computers, such as Compaq and Packard Bell computers. Super Disks and Super Disk drives look nearly identical to a standard floppy disk and drive. Super Disk drives are backwards compatible; not only can they read and write the super high-density 120MB Super Disks, but they can also read and write the old 1.44MB floppy disks as well. One benefit from this is that you can completely replace your old floppy drive with a Super Disk drive; you'll have the benefit of high-capacity storage.



## Jaz Disk

A Jaz drive is a small, portable hard disk drive used primarily for backing up and archiving personal computer files. The Jaz drive is Developed by Iomega Corporation in late 1995. It come in two sizes, 1 GB and 2 GB. The two sizes look similar, but a 2 GB disk is not compatible with a 1 GB Jaz drive. The 2 GB Jaz drive can use both disk sizes. Internal and external Jaz drives are available. The Jaz drive uses the Small Computer System Interface (Small Computer System Interface) and requires a SCSI controller.



## Pen Drive

Pen Drive also referred as USB flash drive is a portable device which allows user to transfer data (text, images, videos etc) to and from computer quickly. Users can easily read and write the data on the Pen Drive by plugging it into the USB port on the computer. Pen Drives are quite compact and can fit easily into the pocket; they run without battery and draw power from the USB connection itself. Both Floppy disks and CDs are now being gradually replaced by Pen Drive as a preferred means of data storage. It's because latter offers mass data transfer and storage capability and at a much faster rate.



Storage capacity of the Pen Drive can vary from few megabytes to over 100 GB. Nowadays even external hard drives are available in the market with huge storage capacity, which like Pen Drive can be connected to a USB port on the computer.

## Difference between Sequential Storage Media and Random Access Media

SN	Sequential Storage Media	Random Access Media
1	Sequential storage media is not found as primary or main memory now a days.	All primary or main memory used are random storage media.
2	It is made up of Mylar plastic coated with iron oxide.	It is made up of semiconductor materials or optical disk.
3	It stores data sequentially.	It stores data randomly.
4	It is specially used to store the large volume of data sequentially	It is used to store small or large volume of data randomly.
5	It must be stored in an environment with controlled temperature and humidity levels.	It is not needed in case of random storage media
6	Now a days it is generally used for data backup.	It is used as main memory, auxiliary memory and backup memory.
7	Example : Magnetic Tape	Example: RAM, Hard disk, Optical Disk etc.

## Input Devices – Keyboard, Mouse, Scanner, Light Pen, OMR, OCR, BCR, Scanner, Touch Pad Kiosk, Microphone and Digital Camera.

### Input Devices



## Keyboard

Keyboard is the most common and very popular input device which helps in inputting data to the computer by pressing buttons, or keys. It is the primary device used to enter text. The layout of the keyboard is like that of traditional typewriter, although there are some additional keys provided for performing additional functions. A keyboard typically contains keys for individual letters, numbers and special characters, as well as keys for specific functions.



The keys typically found on computer keyboards are often classified as follows:

- **Alphanumeric keys:** The letters and numbers on the keyboard.
- **Punctuation keys:** The comma, period, semicolon, and similar keys.
- **Special keys:** This includes the function keys, control keys, arrow keys, caps Lock key, and so on.

## Mouse

Mouse is most popular handheld, pointing and clicking device. It is a very famous cursor-control device having a small palm size box with a round ball at its base which senses the movement of mouse and sends corresponding signals to CPU when the mouse buttons are pressed.

Generally it has two buttons called left and right button and a wheel is present between the buttons. Mouse can be used to control the position of cursor on screen, but it cannot be used to enter text into the computer.



## Types of Mouse

1. **Mechanical:** Has a rubber or metal ball on its underside that can roll in all directions. Mechanical sensors within the mouse detect the direction the ball is rolling and move the screen pointer accordingly.
2. **Opto-mechanical:** Same as a mechanical mouse, but uses optical sensors to detect motion of the ball.
3. **Optical:** Uses a laser to detect the mouse's movement. You must move the mouse along a special mat with a grid so that the optical mechanism has a frame of reference. Optical mice have no mechanical moving parts. They respond more quickly and precisely than mechanical and opto-mechanical mice, but they are also more expensive.

## Joystick

Joystick is also a pointing device which is used to move cursor position on a monitor screen. It is a stick having spherical ball at its both lower and upper ends. The low spherical ball moves in a socket. The joystick can be move in all four directions.

The function of joystick is similar to that of a mouse. It is mainly used in Computer Aided Designing (CAD), and a playing computer video games.

## Light Pen

Light pen is a pointing device which is similar to a pen. It is used to select a displayed menu item or draw pictures on the monitor screen. It consists of a photocell and an optical system placed in a small tube. When the tip of a light pen is moved over the monitor screen and pen button is pressed, its photocell sensing element detects the screen location and sends the corresponding signal to the CPU.



## Track Ball

Track ball is an input device that is mostly used in notebook or laptop computer, instead of a mouse. This is a ball which is half inserted and by moving fingers on ball, pointer can be moved. Since the whole device is not moved, a track ball requires less space than a mouse. A track ball comes in various shapes like a ball, a button and a square.



## Scanner

Scanner is an input device which works more like a photocopy machine. It is used when some information is available on a paper and it is to be transferred to the hard disc of the computer for further manipulation. Scanner captures images from the source which are then converted into the digital form that can be stored on the disc. These images can be edited before they are printed.



## Digitizer

Digitizer is an input device which converts analog information into digital form. Digitizer can convert a signal from the television or camera into a series of numbers that could be stored in a computer. They can be used by the computer to create a picture of whatever the camera had been pointed at. Digitizer is also known as Tablet or Graphics Tablet because it converts graphics and pictorial data into binary inputs. A graphic tablet as digitizer is used for doing fine works of drawing and image manipulation applications.

## Microphone

Microphone is an input device to input sound that is then stored in digital form. The microphone is used for various applications like adding sound to a multimedia presentation or for mixing music.



## Magnetic Ink Card Reader (MICR)

MICR input device is generally used in banks because of a large number of cheques to be processed every day. The bank's code number and cheque number are printed on the cheques with a special type of ink that contains particles of magnetic material that are machine readable. This reading process is called Magnetic Ink Character Recognition (MICR). The main advantages of MICR are that it is fast and less error prone.



## Optical Character Reader (OCR)

OCR is an input device used to read a printed text. OCR scans text optically character by character, converts them into a machine readable code and stores the text on the system memory. It is widely used as a form of data entry from printed paper data records, whether passport documents, invoices, bank statements, computerized receipts, business cards, mail, printouts of static-data, or any suitable documentation.



## Bar Code Reader (BCR)

Bar Code Reader is a device used for reading bar coded data (data in form of light and dark lines). It consists of a light source, a lens and a light sensor translating optical impulses into electrical ones. Bar coded data is generally used in labeling goods, numbering the books etc. It may be a hand held scanner or may be embedded in a stationary scanner. Bar Code Reader scans a bar code image, converts it into an alphanumeric value which is then fed to the computer to which bar code reader is connected.



## Optical Mark Reader (OMR)

OMR is a special type of optical scanner used to recognize the type of mark made by pen or pencil. It is used where one out of a few alternatives is to be selected and marked. It is specially used for checking the answer sheets of examinations having multiple choice questions.



## Touch Pad Kiosk

A simplified touch pad which detects a “touch” in a specific absolute positioning programmable zone or “enter/select” zone rather than requiring a “tap”. The touch pad also has an audible feedback device built into the touch pad for immediate feedback and a touch sensitive surface comprising a relative cursor positioning zone. By simplifying a touch pad to include only basic functions, the touch pad is easier to operate, simpler to manufacture, and more amenable to use with graphical interface display systems typically using touch screens. The invention is preferably incorporated into a kiosk where simplified use is of great benefit. An embodiment of the invention includes an enclosure which completely seals the touch pad from external contamination making the touch pad waterproof and dust proof. A cover plate also provides durability and added protection for the touch-sensitive surface of the touch pad.



## Touch Screen

A touch screen is a computer display screen that is also an input device. It allows the user to operate/make selections by simply touching the display screen. The screens are sensitive to pressure; a user interacts with the computer by touching pictures or words on the screen. Common examples of touch screen include information kiosks, and bank ATMs.



## Digital camera

A digital camera can store many more pictures than an ordinary camera. Pictures taken using a digital camera are stored inside its memory and can be transferred to a computer by connecting the camera to it. A digital camera takes pictures by converting the light passing through the lens at the front into a digital image.

## Output Devices – Monitor, Printer, Plotter, Speaker

An output device is any piece of computer hardware equipment used to communicate the results of data processing carried out by an information processing system (such as a computer) to the outside world. In computing, input/output, or I/O, refers to the communication between

an information processing system (such as a computer), and the outside world. Inputs are the signals or data sent to the system, and outputs are the signals or data sent by the system to the outside.

## Types of Output

1. Hard Copy
2. Soft Copy

### Hard Copy:

The term hard copy itself describes something touchable, physical and tangible. And copy means the result of a production or information. So the collective meaning of hard copy is production of any record or information in a physical object or form. Printed books, newspapers, magazines, documents etc.

### Soft Copy:

Soft copy means a data or information which can be stored in any kind of digital memory. It is an intangible form of preserving the material. You can see the record but cannot touch it. Monitors or projector display screens are used to see the soft copy results.

### Difference between Soft Copy Output and Hard Copy Output

SN	Soft Copy Output	Hard Copy Output
1	It's output is in electronic form.	It's output which is not in electronic form.
2	The user can see output on a computer screen or can listen from the speaker	The user can see the output on printing paper in printed form.
3	Soft copy outputs are intangible.	Hard copy outputs are tangible.
4	It is a kind of temporary output.	It is a kind of permanent output.
5	Power supply and display screen are continuously needed for uninterrupted output.	Power supply and display screen are not continuously needed.
6	It is useful for text, graphics, audio, video or animation etc.	It is useful especially for text and graphics and can't be used for audio, video or animation.
7	Example: Monitors, Speaker	Examples: Printers, Plotter, Fax etc.

## Monitor

Monitors, commonly called as Visual Display Unit (VDU), are the main output device of a computer. It forms images from tiny dots, called pixels that are arranged in a rectangular form. The sharpness of the image depends upon the number of pixels.

There are two kinds of viewing screen used for monitors.

1. Cathode-Ray Tube (CRT)
2. Flat- Panel Display

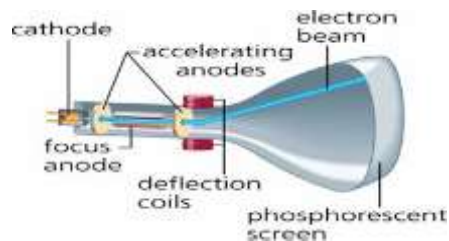
### Cathode Ray Tube

The traditional output device of a personal computer has been the CRT (Cathode Ray Tube) monitor. Just like a television set (an older



one, anyway) the CRT monitor contains a large cathode ray tube that uses an electron beam of varying strength to “paint” a picture onto the color phosphorescent dots on the inside of the screen. CRT monitors are heavy and use more electrical power than flat panel displays, but they are preferred by some graphic artists for their accurate color rendition, and preferred by some gamers for faster response to rapidly changing graphics.

Monitor screen size is measured diagonally across the screen, in inches. Not all of the screen area may be usable for image display, so the viewable area is also specified. The resolution of the monitor is the maximum number of pixels it can display horizontally and vertically (such as 800 x 600, or 1024 x 768, or 1600 x 1200). Most monitors can display several resolutions below its maximum setting. Pixels (short for picture elements) are the small dots that make of the image displayed on the screen. The spacing of the screen’s tiny phosphor dots is called the dot pitch (dp), typically .28 or .26 (measured in millimeters). A screen with a smaller dot pitch produces sharper images.



*Fig: Internal Working structure of CRT Monitor*

The CRT display is made up of small picture elements called pixels. The smaller the pixels, the better the image clarity, or resolution. It takes more than one illuminated pixel to form whole character, such as the letter ‘e’ in the word help.

#### **Advantages of CRT:**

- It is highly reliable, efficient and durable.
- It provides a clear picture quality.
- They are affordable and cost effective.
- Large viewing angle almost 180 degree.

#### **Disadvantages of CRT:**

- Large in Size, so not portable.
- High power consumption.
- Heavier and not better for human eye due to higher brightness.

#### **Flat-Panel Display Monitor**

The flat-panel display refers to a class of video devices that have reduced volume, weight and power requirement in comparison to the CRT. You can hang them on walls or wear them on your wrists. Current uses of flat-panel displays include calculators, video games, monitors, laptop computer, graphics display.

#### **The flat-panel display is divided into two categories:**

- **Emissive Displays** - The emissive displays are devices that convert electrical energy into light. Examples are plasma panel and LED (Light-Emitting Diodes).
- **Non-Emissive Displays** - The Non-emissive displays use optical effects to convert sunlight or light from some other source into graphics patterns. Example is LCD (Liquid-Crystal Device).

## LCD Monitor

**Liquid Crystal Display (LCD)** is television sets that use liquid-crystal displays to produce images. LCD televisions are thinner and lighter than cathode ray tube (CRTs) of similar display size, and are available in much larger sizes. When manufacturing costs fell, this combination of features made LCDs practical for television receivers.

LCDs are used in a wide range of applications including computer monitors, televisions, instrument panels, aircraft cockpit displays, and sign age. They are common in consumer devices such as DVD players, gaming devices, clocks, watches, calculators, and telephones, and have replaced cathode ray tube (CRT) displays in nearly all applications. They are available in a wider range of screen sizes than CRT and plasma displays, and since they do not use phosphors, they do not suffer image burn-in. LCDs are, however, susceptible to image persistence.



### Advantages:

- Colors of images look more realistic.
- LCD's are better under brighter conditions because of anti-glare technology.
- Better performance than Plasmas for smaller screen sizes.
- Power requirement is less.
- Less heat is generated.
- No radiation emission from the screen.
- Longer life span.
- Brightness range is wider.
- Lighter in weight with respect to screen size.
- Can be used as a computer monitor.
- Images appear with greater resolution.
- LCD TVs are not affected by the increase or decrease in air pressure.

### Disadvantages:

- Less picture clarity (quality) when viewed on the side or at an angle
- Prices are more expensive compared to Plasma TV of the same size
- Motion delay (lag) for fast moving images
- Contrast adjustment is narrower in range
- Pixel (dot) burns on the screen
- Response time is longer

## LED Monitor

An LED display is a flat panel display, which uses an array of light-emitting diodes as pixels for a video display. LEDs offer much more gradation in intensity and a larger light wavelength spectrum, providing a truer color quality. These types of monitors offer a better dynamic contrast ratio as well. They provide vivid and more lifelike colors, with better gradation.



### **Advantages:**

- Slim, Thinner Housings and Lighter in Weight
- Wider Color Range and Better Dynamic Contrast
- Sharper Images and Higher Brightness
- Longer Life
- Lesser Time To Power on and off
- Lower power consumption ,Lesser Heat Generated so saves electricity bills
- More energy efficient and More environmentally friendly

### **Disadvantages:**

- More expensive
- Sound quality sacrificed over slimness

### **Gas Plasma Display**

A **gas-plasma display** is a technology that is a collection of neon gas between two plates. Each plate contains a conductive print; one is horizontal, and the other is vertical. These displays ranged from 42 to 60-inches and originally cost anywhere from \$8,000 to \$30,000 or higher.

Although gas-plasma technology was found in older portable computers and large displays, like televisions, it is now obsolete. Today, because of advances in LCD technologies and the power requirements of gas-plasma displays, nearly all flat panel screens are LED backlit LCDs.



### **Advantages:**

- More clarity (quality) of picture even when viewed on the side or at an angle
- Cheaper in price compared to LCD TV of the same screen size
- Large Screen sizes can be manufactured commercially
- Contrast can be adjusted in a wider range
- Less Motion lag for rapid moving images
- Better performance for fast-moving video playback
- Response time is shorter
- Motion blur is minimal
- Better performance than LCD TV for larger screen sizes
- Plasma TVs are better for displaying deep blacks.

### **Disadvantages:**

- Does not offer better resolution compared to LCD TV
- Pictures are not so clear under bright conditions
- Excessive Heat generation
- Shorter life span.
- Image brightness range is narrower
- Heavier in weight with respect to screen size
- Less Recommended for playing video games
- Power Consumption is higher than LCD TV.

## Difference between CRT Monitor and LCD Monitor

SN	CRT Monitor	LCD Monitor
1	It is monitor based on cathode ray tube technology.	It is the monitor based on liquid crystal display technology.
2	Vacuum tube and electron gun used as functional component.	Liquid crystal used as functional component.
3	Light glow when electron beam strikes on phosphor coated screen of CRT.	Light glow while supplying electricity and liquid crystal becomes transparent.
4	CRTs are big and bulky.	LCDs are thin and light.
5	It emits radiation, so harmful for human eyes	It does not emit radiation, so less harmful for human eyes.
6	It has large viewing angle.	It has small viewing angle.
7	High power consumption and more heat production.	Low power consumption and less heat production
8	CRT have lower response time.	LCD have greater response time.
9	CRT does not suffer from dead pixels.	LCD can suffer from dead pixels.
10	It is less expensive.	It is more expensive than CRT.

## Printer

***"A printer is an external output device that takes data from a computer and generates output in the form of graphics / text on a paper"*** or Printer is a hard copy output device, which is used to print information on paper permanently.

### Printer Characteristics

Printers are also classified by the following characteristics:

- Quality of print type.
- Speed of printer: Measured in characters per second (cps) or pages per minute (ppm), the speed of printers varies widely.
- Impact or non-impact: Impact printers include all printers that work by striking an ink ribbon. Daisy-wheel, dot-matrix, and line printers are impact printers. Non-impact printers include laser printers and ink-jet printers. The important difference between impact and non-impact printers is that impact printers are much noisier.
- Graphics: Some printers (daisy-wheel and line printers) can print only text. Other printers can print both text and graphics.
- Memory of the printer.
- Fonts: Some printers, notably dot-matrix printers, are limited to one or a few fonts. In contrast, laser and ink-jet printers are capable of printing an almost unlimited variety of fonts. Daisy-wheel printers can also print different fonts, but you need to change the daisy wheel, making it difficult to mix fonts in the same document.
- Cost of the printer and its used ink.



**There are two types of printers:**

1. **Impact Printers**
2. **Non-Impact Printers**

### **Impact Printers**

The impact printers print the characters by striking them on the ribbon which is then pressed on the paper.

**Characteristics of Impact Printers are the following:**

- Very low consumable costs
- Very noisy
- Useful for bulk printing due to low cost
- There is physical contact with the paper to produce an image

**These printers are of two types**

1. Character printers
2. Line printers

### **Character Printers**

Character printers are the printers which print one character at a time.

**These are further divided into two types:**

1. Dot Matrix Printer(DMP)
2. Daisy Wheel

### **Dot Matrix Printer**

In the market one of the most popular printers is Dot Matrix Printer. These printers are popular because of their ease of printing and economical price. Each character printed is in form of pattern of dots and head consists of a Matrix of Pins of size (5\*7, 7\*9, 9\*7 or 9\*9) which comes out to form a character that is why it is called Dot Matrix Printer.

#### **Advantages**

- Inexpensive
- Widely Used
- Other language characters can be printed

#### **Disadvantages**

- Slow Speed
- Poor Quality



### **Daisy Wheel**

Head is lying on a wheel and pins corresponding to characters are like petals of Daisy (flower name) that is why it is called Daisy Wheel Printer. These printers are generally used for word-processing in offices which require a few letters to be sent here and there with very nice quality.

#### **Advantages**

- More reliable than DMP
- Better quality
- The fonts of character can be easily changed



## Disadvantages

- Slower than DMP
- Noisy
- More expensive than DMP

## Line Printers

Line printers are the printers which print one line at a time.

### These are of further two types:

1. Drum Printer
2. Chain Printer

## Drum Printer

This printer is like a drum in shape so it is called drum printer. In a drum printer characters are raised in a cylindrical drum. Values of all characters are stored in the printer buffer. When a character has to be printed, the printer sends the information to printer buffer. Then, printer drum is rotated and when the code match is done the character is printed by striking the hammer. There is a carbon ribbon in between the drum hammer and paper. So, when the hammer strikes an impression is produced in the paper.

The surface of drum is divided into number of tracks. Total tracks are equal to size of paper i.e. for a paper width of 132 characters, drum will have 132 tracks. A character set is embossed on track. The different character sets available in the market are 48 character set, 64 and 96 characters set. One rotation of drum prints one line. Drum printers are fast in speed and can print 300 to 2000 lines per minute.

## Advantages

- Very high speed

## Disadvantages

- Very expensive
- Characters fonts cannot be changed

## Chain Printer

In this printer, chain of character sets is used so it is called Chain Printer. A standard character set may have 48, 64, or 96 characters.

## Advantages

- Character fonts can easily be changed.
- Different languages can be used with the same printer.

## Disadvantages

- Noisy and heavy in weight.
- Large in size.
- Requires considerable care with lubrication and maintenance, and needs fairly competent electrical power.

## Types of Non-impact Printers

Non-impact printers print the characters without using ribbon. These printers print a complete



page at a time so they are also called as Page Printers.

### **These printers are of two types**

1. Laser Printer
2. Inkjet Printer
3. Thermal Printer

### **Characteristics of Non-impact Printers**

- Faster than impact printer.
- They are not noisy.
- High quality.
- Support many fonts and different character size.

### **Laser Printers**

These are non-impact page printers. They use laser lights to produce the dots needed to form the characters to be printed on a page.

#### **Advantages**

- Very high speed.
- Very high quality output.
- Give good graphics quality.
- Support many fonts and different character size..



#### **Disadvantages**

- Expensive.
- Cannot be used to produce multiple copies of a document in a single printing.

### **Inkjet Printers**

Inkjet printers are non-impact character printers based on a relatively new technology. They print characters by spraying small drops of ink onto paper. Inkjet printers produce high quality output with presentable features.

They make less noise because no hammering is done and these have many styles of printing modes available. Colour printing is also possible. Some models of Inkjet printers can produce multiple copies of printing also.



#### **Advantages**

- High quality printing and faster printing speed as compared to impact printer.
- More reliable and can print images and text of any size or font.
- Low operating cost.
- Appropriate for large volume printing.
- Can be single or multi colored output.

#### **Disadvantages**

- Expensive as cost per page is high.
- Slow as compared to laser printer.
- Cannot print multiple copies at a same time.

## Thermal Printers

A thermal printer is a printer that uses heat to produce an image on paper. Nowadays many businesses are using thermal printing for their transactions including airline tickets, banking, entertainment, grocery, retail shops and healthcare. It has increased popularity because of its graphic capabilities, quality of print, speed and technological advances.

There are many advantages in using a thermal printer such as costs, printing speed, efficiency, quality of print and mobility. For cost, the thermal printer is very economical since it is inkless. It does not use any ribbons or cartridges, so it means that companies can save a lot of money and avoid unnecessary expenses on ribbon supplies. The only consumables for printing would be the paper itself. Organizations have benefited from this technology because it is cost-effective and at the same time a reliable choice. Employees can now work continuously and avoid interruptions during their working hours since there is no need for them to change the ribbons or cartridges whenever the ink level becomes low. There is zero downtime in the operations which would maximize the working hours. The printing speed is one attribute that is always being considered and for thermal printers it is not a problem. Thermal printers print faster and more quietly. Labels are printed quickly with the use of thermal printers and it leaves a lasting impression on the customers being served.



## Difference between Impact Printer and Non Impact Printer

SN	Impact Printer	Non-Impact Printer
1	It is based on electromechanical mechanism.	It is based on thermal, chemical, electrostatic and laser beam technology
2	It is slow while printing.	It is fast while printing.
3	It cannot print graphics perfectly.	It can print graphic perfectly.
4	It Prints the document character by character, line by line.	It prints the document one page at a time.
5	Low print quality and printing cost is also low.	Print quality is high and printing cost is high.
6	It produces noise while printing.	It is silent in nature while printing.
7	It can produce multiple copies of document at a time using carbon paper	It cannot produce multiple copies of document at a time.
8	It is usually single colored.	It can be single or multi colored.
9	It uses ink ribbon for printing	It uses liquid or powder ink for printing
10	Example: Dot matrix, Daisy Wheel, Line Printer, chain printer etc.	Example: Thermal, laser and Ink-jet printer

## Plotter

A **plotter** is a computer hardware device much like a printer that is used for printing vector graphics. Instead of toner, plotters use a pen, pencil, marker, or another writing tool to draw multiple, continuous lines onto paper rather than a series of dots like a traditional printer. Though once widely used for computer-aided design, these devices have more or less been phased out by wide-format printers. Plotters are used to produce a hard copy of schematics and other similar applications.



### Advantages

- Plotters can work on very large sheets of paper while maintaining high resolution.
- They can print on a wide variety of flat materials including plywood, aluminum, sheet steel, cardboard, and plastic.
- Plotters allow the same pattern to be drawn thousands of times without any image degradation.

### Disadvantages

- Plotters are quite large when compared to a traditional printer.
- Plotters are also much more expensive than a traditional printer.

## Speaker

Computer speakers range widely in quality and in price. Computer speakers sometimes packaged with computer systems are small, plastic, and have mediocre sound quality. Some computer speakers have equalization features such as bass and treble controls.



## Computer Peripherals

A **computer peripheral** is a device that is connected to a computer but is not part of the core computer architecture. The core elements of a computer are the central processing unit, power supply, motherboard and the computer case that contains those three components. Technically speaking, everything else is considered a peripheral device. However, this is a somewhat narrow view, since various other elements are required for a computer to actually function, such as a hard drive and random-access memory (or RAM).

Most people use the term peripheral more loosely to refer to a device external to the computer case. You connect the device to the computer to expand the functionality of the system. For example, consider a printer. Once the printer is connected to a computer, you can print out documents. Another way to look at peripheral devices is that they are dependent on the computer system. For example, most printers can't do much on their own, and they only become functional when connected to a computer system.

### Types of Peripheral Devices

There are many different peripheral devices, but they fall into three general categories:

1. **Input devices**, such as a mouse and a keyboard
2. **Output devices**, such as a monitor and a printer
3. **Storage devices**, such as a hard drive or flash drive

Some devices fall into more than one category. Consider a CD-ROM drive; you can use it to read data or music (input), and you can use it to write data to a CD (output).

Peripheral devices can be **external** or **internal**. For example, a printer is an external device that you connect using a cable, while an optical disc drive is typically located inside the computer case. Internal peripheral devices are also referred to as integrated peripherals. When most people refer to peripherals, they typically mean external ones.

The concept of what exactly is 'peripheral' is therefore somewhat fluid. For a desktop computer, a keyboard and a monitor are considered peripherals - you can easily connect and disconnect them and replace them if needed. For a laptop computer, these components are built into the computer system and can't be easily removed.

The term 'peripheral' also does not mean it is not essential for the function of the computer. Some devices, such as a printer, can be disconnected and the computer will keep on working just fine. However, remove the monitor of a desktop computer and it becomes pretty much useless.

## Interfaces – Parallel Port, Serial Port, USB Ports, IEEE 1394 and Slots

In computing, an **interface** is a shared boundary across which two separate components of computer system exchange information. The exchange can be between software, **computer** hardware, peripheral devices, humans and combinations of these.

A port is a physical docking point using which an external device can be connected to the computer. It can also be programmatic docking point through which information flows from a program to computer or over the internet.

### Characteristics

**A port has the following characteristics:**

- External devices are connected to a computer using cables and ports.
- Ports are slots on the motherboard into which a cable of external device is plugged in.
- Examples of external devices attached via ports are mouse, Keyboard microphone, speakers etc.

### Serial Port

- Used for external modems and older computer mouse
- Two versions: 9 pin, 25 pin model
- Data travels at 115 kilobits per second



### Parallel Port

- Used for scanners and printers
- Also called printer port
- 25 pin model
- Also known as IEEE 1284-compliant Centronics port



### Universal Serial Bus (or USB) Port

- It can connect all kinds of external USB devices such as external hard disk, printer, scanner, mouse, keyboard etc.
- It was introduced in 1997.
- Most of the computers provide two USB ports as minimum.
- Data travels at 12 megabits per seconds

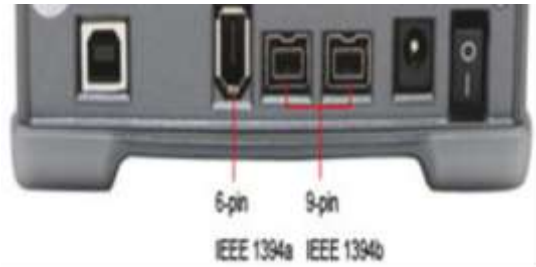


- USB compliant devices can get power from a USB port
- Connects camcorders and video equipments to the computer
- Data travels at 400 to 800 megabits per seconds
- Invented by Apple
- Three variants : 4-Pin FireWire 400 connector, 6-Pin FireWire 400 connector and 9-Pin FireWire 800 connector
- This port resides on an Ethernet Card.
- Data travels at 10 megabits to 1000 megabits per seconds depending upon the network bandwidth.

## IEEE 1394

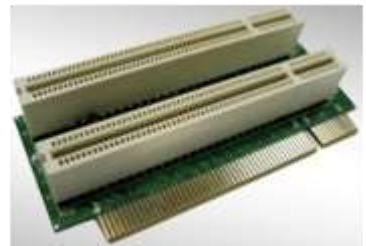
IEEE 1394 is an interface standard for a serial bus for high-speed communications and isochronous real-time data transfer. It was developed in the late 1980s and early 1990s by Apple, which called it **FireWire**. IEEE 1394 provides a single plug-and-socket connection on which up to 63 devices can be attached with data transfer speeds up to 400 Mbps. The standard describes a serial bus or pathway between one

or more peripheral devices and your computer's microprocessor. Many peripheral devices now come equipped to meet IEEE 1394. Two popular implementations of IEEE 1394 are Apple's FireWire and Sony's i.LINK.



## PCI Slot

PCI Stands for "Peripheral Component Interconnect". It is a hardware bus designed by Intel and used in both PCs and Macs. Most add-on cards such as SCSI, Firewire, and USB controllers use a PCI connection. Some graphics cards use PCI, but most new graphics cards connect to the AGP slot. PCI slots are found in the back of your computer and are about 3.5" long and about 0.5" high. So before you go buy that Firewire expansion card, make sure you have at least one PCI slot available.



## SCSI Port

SCSI stands for "Small Computer System Interface". It is also pronounced as "Scuzzy", and is one of the most commonly used interfaces for disk drives. SCSI is a standard for parallel interfaces that transfers information at a rate of eight bits per second and faster, which is faster than the average parallel interface. SCSI is capable of supporting eight devices, or sixteen devices with Wide SCSI, such as a hard drive, CD-ROM, and scanner. However, with the SCSI host adapter located on ID number 07 and boots from the ID 00. Once installed in the computer this adapter would allow multiple SCSI devices to be installed in the computer. More advanced motherboard may also have available SCSI connections on the motherboard. S Apple Macintosh and Unix computers, but also can be used with PCs. Although SCSI has



been popular in the past, today many users are switching over to SATA drives.

### PS/2 port

The **PS/2 port** is a 6-pin mini-DIN connector used for connecting keyboards and mice to a PC compatible computer system. Its name comes from the IBM Personal System/2 series of personal computers, with which it was introduced in 1987.



### Difference between serial and parallel port

SN	Serial Port	Parallel Port
1	Serial port is a serial communication physical interface through which information transfers in or out one at a time.	A parallel port is a parallel communication physical interface through which information Transfers in or out 8 or more bits at a time.
2	Serial port normally has 9 pins.	Parallel port normally has 25 pins
3	Serial ports are used principally for communications lines, modems, and mice.	A parallel interface is used to transfer data at faster rate for high speed peripherals such as disk and tape.
4	Data transfer through serial ports are slower than parallel port	Data transfer through parallel port is faster than serial port.
	Serials ports are difficult to program and slower compared to the Parallel ports.	Parallel ports are easy to program and faster compared to the serial ports.
5	Serial interface transmits a series of bits	Parallel interface transmits all bits in parallel
6		