

Definition of Computer

A **computer** is an **electronic device** that manipulates information, or data. It has the ability to **store, retrieve, and process** data. You probably already know that you can use a computer to **type documents, send email, play games, and browse the Web**. You can also use it to edit or create **spreadsheets, presentations, and even videos**.

History of Computers

ABACUS: it is the first computer in the world. It is a manual mechanical device developed in china. It was before **1387 AD**. Even today, it is still used in many countries like Japan, India & Russia. This is considered as the **first Computer**.

Napier's bones: John Napier a Scottish mathematician invented this device in the year **1617**. Napier's bones were multiplication table written on the stripes of bones, ivory, silver or wood. The invention was used for simplifying **multiplication, division** and taking **square roots and cube roots**.

Pascal's Adding Machine: The great French mathematician **Blaise Pascal** invented this machine in the year **1642**. It has gears, wheels & dials. This machine displayed numbers by the rotation of wheel. This machine was used only for performing addition & subtraction of numbers.

Leibniz's Calculator or Pascal Calculator: **Gotfried Wilhelm Leibniz** a famous German mathematician improved Pascal machine in 1694.

His machine was able to perform all the four basic mathematical operations such as addition, subtraction, multiplication & division. He introduced shift mechanism. Moving a digit to right or left is a shift.

Real beginning of Computers

Charles Babbage a British mathematics professor is known as "**Father of Computer**". Because he introduced the concept of **General Purpose Computer**.

In the year **1822** he introduced a mechanical computer called "**Difference Engine**". Encouraged by the success of the difference engine, he developed another device called "**Analytical Engine**" in the year **1837**.

Analytical Engine used the concepts of **Automated loom & difference engine**. This machine had five units they are **input, output, store, mill & control** which are similar to the units of the modern computer.

Generation of Computers

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

Each generation of computers is characterized by major technological development that fundamentally changed the way computers operate, resulting in increasingly smaller, cheaper, more powerful and more efficient and reliable devices. Read about each generation and the developments that led to the current devices that we use today.

There are totally five computer generations known till date. Each generation has been discussed in detail along with their time period, characteristics. We've used approximate dates against each generation which are normally accepted.

Following are the generations of Computers

S.N.	Generation & Description
1	First Generation The period of first generation: 1940-1956. Vacuum tube based.
2	Second Generation The period of second generation: 1956-1963. Transistor based.
3	Third Generation The period of third generation: 1964-1971. Integrated Circuit based.
4	Fourth Generation The period of fourth generation: 1971-1990. Micros Processor.
5	Fifth Generation The period of fifth generation: 1990-onwards. Artificial Intelligence

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.

Some computers of this generation were:

□ **ENIAC: Electronic Numerical Integrator And Computer**, the world's first operational electronic digital computer, developed by John Mauchly & J. Presper Eckert of the University of Pennsylvania to compute World War II ballistic firing tables. It was announced in 1946. The **ENIAC**, weighing **30 tons**, using **200 kilowatts** of electric power and consisting of **18,000 vacuum tubes**, **1,500 relays**, and hundreds of thousands of resistors, capacitors, and inductors, was completed in **1945**. In addition to ballistics, the ENIAC's field of application included weather prediction, atomic-energy calculations, cosmic-ray studies, thermal ignition, random-number studies,

wind-tunnel design, and other scientific uses. The ENIAC soon became obsolete as the need arose for faster computing speeds.

□ **EDVAC (Electronic Discrete Variable Automatic Computer)** was one of the earliest electronic **computers**. It was designed by **John von Neumann** in the year **1945**. Unlike its predecessor the ENIAC, it was binary rather than decimal, and was a stored program **computer**. It can hold both **stored program & conditional control transfer**.

Stored-program concept: Storage of instructions in computer memory to enable it to perform a variety of tasks in sequence or intermittently. The idea was introduced in the late 1940s by John von Neumann, who proposed that a program be electronically stored in binary-number format in a memory device so that instructions could be modified by the computer as determined by intermediate computational results.

Conditional control transfer: This idea gave rise to the notion of subroutines, or small blocks of code that could be jumped to in any order, instead of a single set of chronologically ordered steps for the computer to take. The second part of the idea stated that computer code should be able to branch based on logical statements such as IF (expression) THEN, and looped such as with a FOR statement. “Conditional control transfer” gave rise to the idea of “libraries,” which are blocks of code that can be reused over and over.

□ **UNIVAC:(UNIVersal Automatic Computer I)** was the first commercial computer produced in the United States. It was designed principally by **Remington Rand** in the year **1951**.

□ IBM-701

□ IBM-650

The main features/advantages of First Generation are:

- ✓ Vacuum tube technology were used for internal operations.
- ✓ Magnetic drums were used for memory.
- ✓ Punched cards for input and printouts for output
- ✓ Supported Machine language only

Disadvantages of First Generation

- ✗ The computers were very large in size.
- ✗ They consumed a large amount of energy.
- ✗ They heated very soon due to thousands of vacuum tubes.
- ✗ They were not very reliable.
- ✗ Air conditioning was required.
- ✗ Constant maintenance was required.
- ✗ Non-portable.
- ✗ Costly commercial production.
- ✗ Limited commercial use.

- ✗ Very slow speed.
- ✗ Limited programming capabilities.
- ✗ Used machine language only.
- ✗ Used magnetic drums which provide very less data storage.
- ✗ Used punch cards for input.
- ✗ Not versatile and very faulty.

Second Generation - 1956-1963: Transistors

This generation using the **transistor** was cheaper, consumed less power, more compact in size, more reliable and faster than the first generation machines made of vacuum tubes. **Transistor is a device composed of semiconductor material that amplifies a signal or opens or closes a circuit. Invented in 1947 at Bell Labs. In this generation,** magnetic cores were used as primary memory and magnetic tape and magnetic disks as secondary storage devices.

In this generation assembly language and high level programming language like **FORTTRAN (Formula Translation), COBOL (Common Business Oriented Language)** was used. There was Batch processing and Multiprogramming Operating system used.

Some computers of this generation were: ☐ IBM 1620

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

The main features/ advantages of Second Generation are:

- ✓ Use of transistors
- ✓ Punched cards for input and printouts for output
- ✓ Reliable as compared to First generation computers
- ✓ Smaller size as compared to First generation computers
- ✓ Generate less heat as compared to First generation computers
- ✓ Consumed less electricity as compared to First generation computers
- ✓ Faster than first generation computers
- ✓ Still very costly
- ✓ A.C. needed
- ✓ Support machine and assembly languages

Disadvantages of Second Generation

- ✗ Cooling system was required
- ✗ Constant maintenance was required
- ✗ Commercial production was difficult
- ✗ Only used for specific purposes
- ✗ Costly and not versatile
- ✗ Punch cards were used for input.

Third Generation - 1964-1971: Integrated Circuits

The third generation of computer is marked by the use of Integrated Circuits (IC's) in place of transistors. A single I.C has many transistors, resistors and capacitors along with the associated circuitry. The I.C 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.

Instead of punched cards and printouts, users interacted with third generation computers through keyboards and monitors and interfaced with an operating system, which allowed the device to run many different applications at one time with a central program that monitored the memory. Computers for the first time became accessible to a mass audience because they were smaller and cheaper than their predecessors.

The main features/advantages of Third Generation are:

- ✓ Smaller in size as compared to previous generations.
- ✓ More reliable.
- ✓ Used less energy
- ✓ Produced less heat as compared to the previous two generations of computers.
- ✓ Better speed and could calculate data in nanoseconds.
- ✓ Used fan for heat discharge to prevent damage.
- ✓ Maintenance cost was low because hardware failure is rare.
- ✓ Totally general purpose
- ✓ Could be used for high-level languages.
- ✓ Good storage
- ✓ Versatile to an extent
- ✓ Less expensive
- ✓ Better accuracy
- ✓ Commercial production increased.
- ✓ Used mouse and keyboard for input.

Disadvantages of Third Generation

- ✗ Air conditioning was required.
- ✗ Highly sophisticated technology required for the manufacturing of IC chips.

Fourth Generation - 1971-90: Micro Processor

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. The Microprocessor contains thousands of ICs. **Ted Hoff** produced the first microprocessor in **1971** for **Intel**. It was known as **Intel 4004**

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.

The main features of Fourth Generation are:

- ✓ More powerful and reliable than previous generations.
- ✓ Small in size
- ✓ Fast processing power with less power consumption
- ✓ Fan for heat discharging and thus to keep cold.
- ✓ No air conditioning required.
- ✓ Totally general purpose
- ✓ Commercial production
- ✓ Less need of repair.
- ✓ Cheapest among all generations
- ✓ All types of High level languages can be used in this type of computers

Disadvantages of Third Generation

- ✗ The latest technology is required for manufacturing of Microprocessors.

Fifth Generation - 1990, Present and Beyond: Artificial Intelligence

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. Computers can understand spoken words & imitate human reasoning. Can respond to its surroundings using different types of sensors.

All the Higher level languages like C and C++, Java, .Net etc. are used in this generation. AI includes:

- ✓ Robotics
- ✓ Neural networks
- ✓ Game Playing
- ✓ Development of expert systems to make decisions in real life situations.
- ✓ Natural language understanding and generation.

The main features of Fifth Generation are:

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

Some computer types of this generation are:

- ☐ Desktop
- ☐ Laptop
- ☐ Notebook
- ☐ Ultrabook

To develop fifth Generation computers five major programs are being undertaken they are:

1. MCC Project in USA.
 2. DARPA Project in USA.
 3. Alvey Program in Britain
 4. The ICOT Program in Japan.
 5. The Esprit Program.
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1. **MCC Project in USA:** Microelectronic and computer Technology corporation (MCC) has been set by the IT corporations in USA. MCC is sponsored by Motorola and National semiconductor (companies manufacturing chips), Digital equipment's, National Cash Register (NCR). The MCC experts have to develop the advanced product development technology and give the results to the sponsoring corporations for implementation
 2. **DARPA Project in USA:** Defense Advance Research project Agency (DARPA) allocates funds of the US Government to Information technology projects with potential Military applications.
 3. **The Alvey Program in Britain:** The Alvey Program is working on four major technologies, they are intelligent knowledge based systems, software engineering intelligent user interfaces and VLSI chip architecture.
 4. **The ICOT Program in Japan:** The Japanese Computer Corporations and Universities have contracted together and have set up a central institute (ICOT) where program research is undergone. The research is mainly conducted on VLSI chip technology, advanced computer architecture and system software are carried out by consortia and universities

5. **The Esprit initiative:** The Esprit program aiming towards the co-ordination of research and development in a number of high technology fields. Thus Leading IT experts throughout the world are working on the development of fifth generation computers and spending large amount of energy, time money.

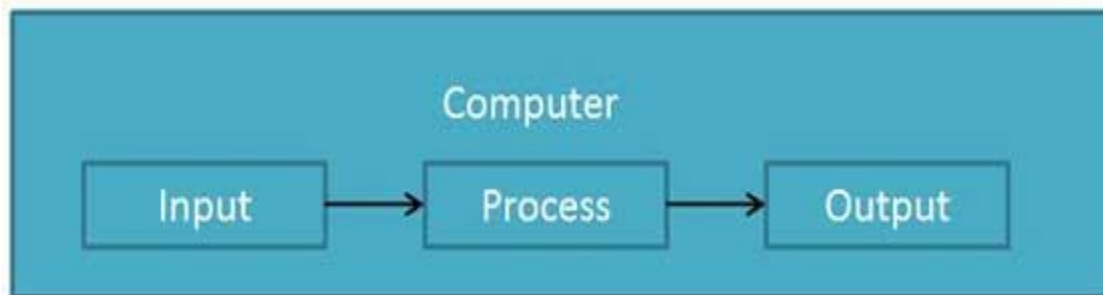
Basic characteristics about computer are:

Today's world is an information-rich world and it has become a necessity for everyone to know about computers. Purpose of this tutorial is to introduce you about computer and its fundamentals.

Functionalities of a computer

Any digital computer carries out five functions in gross terms:

- Takes data as input.
- Stores the data/instructions in its memory and use them when required.
- Processes the data and converts it into useful information.
- Generates the output
- Controls all the above four steps.



Definition

Computer is an electronic data processing device which

- accepts and stores data input,
- processes the data input, and
- Generates the output in a required format.

Advantages

Following list demonstrates the advantages of computers in today's arena.

High Speed

- Computer is a very fast device.
- It is capable of performing calculation of very large amount of data.
- The computer has units of speed in microsecond, nanosecond, and even the picoseconds.
- It can perform millions of calculations in a few seconds as compared to man who will spend many months for doing the same task.

Accuracy

- In addition to being very fast, computers are very accurate.
- The calculations are 100% error free.
- Computers perform all jobs with 100% accuracy provided that correct input has been given.

Storage Capability

- Memory is a very important characteristic of computers.
- A computer has much more storage capacity than human beings.
- It can store large amount of data.
- It can store any type of data such as images, videos, text, audio and many others.

Diligence

- Unlike human beings, a computer is free from monotony, tiredness and lack of concentration.
- It can work continuously without any error and boredom.
- It can do repeated work with same speed and accuracy.

Versatility

- A computer is a very versatile machine.
- A computer is very flexible in performing the jobs to be done.
- This machine can be used to solve the problems related to various fields.
- At one instance, it may be solving a complex scientific problem and the very next moment it may be playing a card game.

Reliability

- A computer is a reliable machine.
- Modern electronic components have long lives.
- Computers are designed to make maintenance easy.

Automation

- Computer is an automatic machine.
- Automation means ability to perform the given task automatically.
- Once a program is given to computer i.e., stored in computer memory, the program and instruction can control the program execution without human interaction.

Reduction in Paper Work

- The use of computers for data processing in an organization leads to reduction in paper work and results in speeding up a process.
- As data in electronic files can be retrieved as and when required, the problem of maintenance of large number of paper files gets reduced.

Reduction in Cost

- Though the initial investment for installing a computer is high but it substantially reduces the cost of each of its transaction.

Disadvantages

Following list demonstrates the disadvantages of computers in today's arena

No I.Q

- A computer is a machine that has no intelligence to perform any task.
- Each instruction has to be given to computer.
- A computer cannot take any decision on its own.

Dependency

- It functions as per a user's instruction, so it is fully dependent on human being

Environment

- The operating environment of computer should be dust free and suitable.

No Feeling

- Computers have no feelings or emotions.
- It cannot make judgment based on feeling, taste, experience, and knowledge unlike a human being.

Applications of Computer

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.

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.

Insurance

Insurance companies are keeping all records up-to-date with the help of computers. The insurance companies, finance houses and stock broking firms are widely using computers for their concerns.

Insurance companies are maintaining a database of all clients with information showing

- Procedure to continue with policies
- Starting date of the policies
- Next due installment of a policy
- Maturity date
- Interests due
- Survival benefits
- Bonus

Education

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.

Marketing

In marketing, uses of computer are following:

- **Advertising** - With computers, advertising professionals create art and graphics, write and revise copy, and print and disseminate ads with the goal of selling more products.
- **At Home Shopping** - Home shopping has been made possible through use of computerized catalogues that provide access to product information and permit direct entry of orders to be filled by the customers.

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.

Engineering Design

Computers are widely used in engineering purpose.

One of major areas is CAD (Computer aided design). That provides creation and modification of images. Some fields are:

- **Structural Engineering** - Requires stress and strain analysis for design of Ships, Buildings, Budgets, and Airplanes etc.
- **Industrial Engineering** - Computers deal with design, implementation and improvement of integrated systems of people, materials and equipment's.
- **Architectural Engineering** - Computers help in planning towns, designing buildings, determining a range of buildings on a site using both 2D and 3D drawings.

Military

Computers are largely used in defense. Modern tanks, missiles, weapons etc. Military also employs computerized control systems. Some military areas where a computer has been used are:

- Missile Control
- Military Communication
- Military Operation and Planning
- Smart Weapons

Communication

Communication means to convey 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. Some main areas in this category are:

- E-mail
- Chatting
- Usenet
- FTP
- Telnet
- Video-conferencing

Government

Computers play an important role in government. Some major fields in this category are:

- Budgets
- Sales tax department
- Income tax department
- Male/Female ratio
- Computerization of voters lists
- Computerization of driving licensing system
- Computerization of PAN card
- Weather forecasting

Classification of computers: -

Computers may be classified based on the following: -

1. Operating principles (based on their construction and working)
2. Applications
3. Size and capability (or classification into micro, mini, mainframe and supercomputers)

1. Classification based on Operating Principles

Based on the operating principles, computers can be classified into one of the following types: -

- a) Digital Computers
- b) Analog Computers
- c) Hybrid Computers

Digital Computers: - Operate essentially by counting. All quantities are expressed as discrete or numbers. Digital computers are useful for evaluating arithmetic expressions and manipulations of data (such as preparation of bills, ledgers, solution of simultaneous equations etc)

Analog Computers:- An **analog computer** is a form of computer that uses the continuously changeable aspects of physical phenomena such as electrical, mechanical, or hydraulic quantities to model the problem being solved. In contrast, digital computers represent varying quantities symbolically, as their numerical values change.

Hybrid Computers:- are computers that exhibit features of analog computers and digital computers. The digital component normally serves as the controller and provides logical operations, while the analog component normally serves as a solver of differential equations.

2. Classification based on area of applications

Modern computers depending upon their applications are classified as: -

- ✓ Special Purpose Computers
- ✓ General Purpose Computers

Special Purpose Computers: - A special purpose computer is designed only to meet the requirements of a particular task or application. The instructions needed to perform a particular task are permanently stored into the internal memory, so that it can perform the given task on a single command. It therefore doesn't possess unnecessary options and is less expensive.

General Purpose Computers: - A General Purpose computers are designed to meet the needs of many different applications. In these computers, the instructions needed to perform a particular task are wired permanently into the internal memory. When one job is over, instructions for another job can be loaded into the internal memory

for processing. This, a general purpose machine can be used to prepare pay-bills, manage inventories, print sales report and so on.

3. Classification digital Computer based on size and Capability

Based on size and capability, computers are broadly classified into

- A) Microcomputers.
- B) Workstations.
- C) Mini Computers.
- D) Mainframe Computers.
- E) Super Computers.

A) Microcomputers (Personal Computer)

A microcomputer is the smallest general purpose processing system. The older pc started 8-bit processor with speed of 3.7MB and current pc 64-bit processor with speed of 4.66 GB.

Examples: - IBM PCs, APPLE computers

Microcomputer can be classified into 2 types:

- 1. Desktops
- 2. Portables

The difference is portables can be used while travelling whereas desktops computers cannot be carried around.

The different portable computers are: -

- 1) Laptop
- 2) Notebooks
- 3) Palmtop (hand held)
- 4) Wearable computers

Laptop: - this computer is similar to a desktop computer but the size is smaller. They are expensive than desktop. The weight of laptop is around 3 to 5 kg.

Notebook: - These computers are as powerful as desktop but size of these computers are comparatively smaller than laptop and desktop. They weigh 2 to 3 kg. They are costlier than laptop.

Palmtop (Hand held): - They are also called as personal Digital Assistant (PDA). These computers are small in size. They can be held in hands. It is capable of doing word processing, spreadsheets and hand writing recognition, game playing, faxing and paging. These computers are not as powerful as desktop computers. Ex: - 3com palmV.

Wearable computer: - The size of this computer is very small so that it can be worn on the body. It has smaller processing power. It is used in the field of medicine. For example, pace maker to correct the heart beats. Insulin meter to find the levels of insulin in the blood.

B) Workstations: - Workstation is a computer used for engineering applications (CAD/CAM), desktop publishing, software development, and other such types of applications which require a moderate amount of computing power and relatively high quality graphics capabilities.

Workstations generally come with a large, high-resolution graphics screen, large amount of RAM, inbuilt network support, and a graphical user interface. Most workstations also have a mass storage device such as a disk drive, but a special type of workstation, called a diskless workstation, comes without a disk drive.

Common operating systems for workstations are UNIX and Windows NT. Like PC, Workstations are also single-user computers like PC but are typically linked together to form a local-area network, although they can also be used as stand-alone systems.

C) Minicomputer: - A minicomputer is a medium-sized computer. That is more powerful than a microcomputer. These computers are usually designed to serve multiple users simultaneously (Parallel Processing). They are more expensive than microcomputers.

Examples: Digital Alpha, Sun Ultra.

D) Mainframe computers: - Computers with large storage capacities and very high speed of processing (compared to mini- or microcomputers) are known as mainframe computers. They support a large number of terminals for simultaneous use by a number of users like ATM transactions. They are also used as central host computers in distributed data processing system.

Examples: - IBM 370, S/390.

E) Supercomputer: - Supercomputers have extremely large storage capacity and computing speeds which are many times faster than other computers. A supercomputer is measured in terms of tens of millions Instructions per second (mips), an operation is made up of numerous instructions. The supercomputer is mainly used for large scale numerical problems in scientific and engineering disciplines such as Weather analysis.

Examples: - IBM Deep Blue 

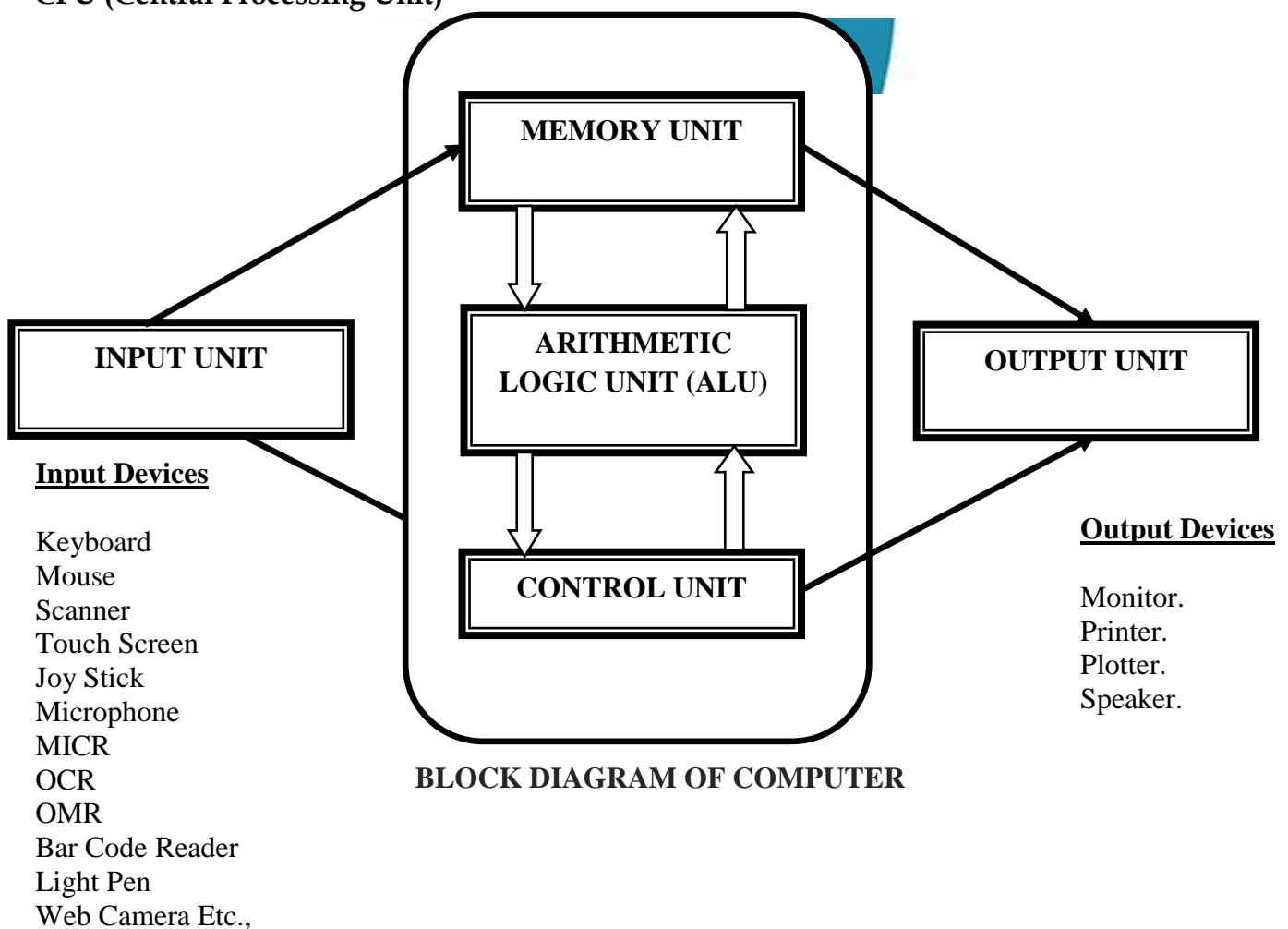
Block Diagram of Computer or Components of Computer

A computer can process data, pictures, sound and graphics. They can solve highly complicated problems quickly and accurately. A computer as shown in Fig. performs basically five major computer operations or functions irrespective of their size and make.

These are

Sl. No.	Operation	Description
1	Take Input	The process of entering data and instructions into the computer system
2	Store Data	Saving data and instructions so that they are available for processing as and when required.
3	Processing Data	Performing arithmetic, and logical operations on data in order to convert them into useful information.
4	Output Information	The process of producing useful information or results for the user, such as a printed report or visual display.
5	Control the workflow	Directs the manner and sequence in which all of the above operations are performed.

CPU (Central Processing Unit)



Input Unit:

Computers need to receive data and instruction in order to solve any problem. Therefore, we need to input the data and instructions into the computers. The input unit consists of one or more input devices. **Keyboard** is the one of the most commonly used input device. Other commonly used input devices are the Mouse, Mice etc. All the input devices perform the following functions.

Central Processing Unit:

The control unit and ALU of the computer are together known as the Central Processing Unit (CPU).

The CPU is like brain performs the following functions:

- It performs all calculations.
- It takes all decisions.
- It controls all units of the computer.

A PC may have CPU-IC such as Intel 8088, 80286, 80386, 80486, Celeron, Pentium, Pentium Pro, Pentium II, Pentium III, Pentium IV, Dual Core, and AMD etc.

1. Control Unit: It is responsible for directing and coordinating most of the computer system activities. It does not execute instructions by itself. It tells other parts of the computer system what to do. It determines the movement of electronic signals between the main memory and arithmetic logic unit as well as the control signals between the CPU and input/output devices.

2. Arithmetic logic Unit: All calculations are performed in the Arithmetic Logic Unit (ALU) of the computer. It also does comparison and takes decision. The ALU can perform basic operations such as addition, subtraction, multiplication, division, etc and does logic operations viz, >, <, =, 'etc. Whenever calculations are required, the control unit transfers the data from storage unit to ALU once the computations are done, the results are transferred to the storage unit by the control unit and then it is send to the output unit for displaying results.

3. Registers: It is a special temporary storage location within the CPU. Registers quickly, accept, store and transfer data and instructions that are being used immediately (main memory hold data that will be used shortly, secondary storage holds data that will be used later). To execute an instruction, the control unit of the CPU retrieves it from main memory and places it onto a register. The typical operations that take place in the processing of instruction are part of the instruction cycle or execution cycle. The instruction cycle refers to the retrieval of the instruction from main memory and its subsequence at decoding. The process of alerting the circuits in CPU to perform the specified operation. The time it takes to go through the instruction cycle is referred to as I-time.

4. Bus: The term Bus refers to an electrical pathway through which bits are transmitted between the various computer components. Depending on the design of the system, several types of buses may be present. The most important one is the data bus, which carries the data throughout the central processing unit. The wider the data bus, the more data it can carry at one time and thus the greater the processing speed of the computer. Ex: Intel 8088 processor uses a data bus of 8 bits wide. Some super computers contain buses that are 128 bits wide.

The main memory is used for the following purposes:

1. Storage of the copy of the main software program that controls the general operation of the computer. This copy is loaded on to the main memory when the computer is turned on, and it stays there as long as the computer is on.
2. Temporary storage of a copy of application program instruction, to be received by CPU for interpretation and processing or execution.
3. Temporary storage of data that has been input from the key board, until instructions call for the data to be transferred in to CPU for processing.
4. Temporary storage of data, which is required for further processing or transferred as output to output devices such as screen, a printer, a disk storage device.

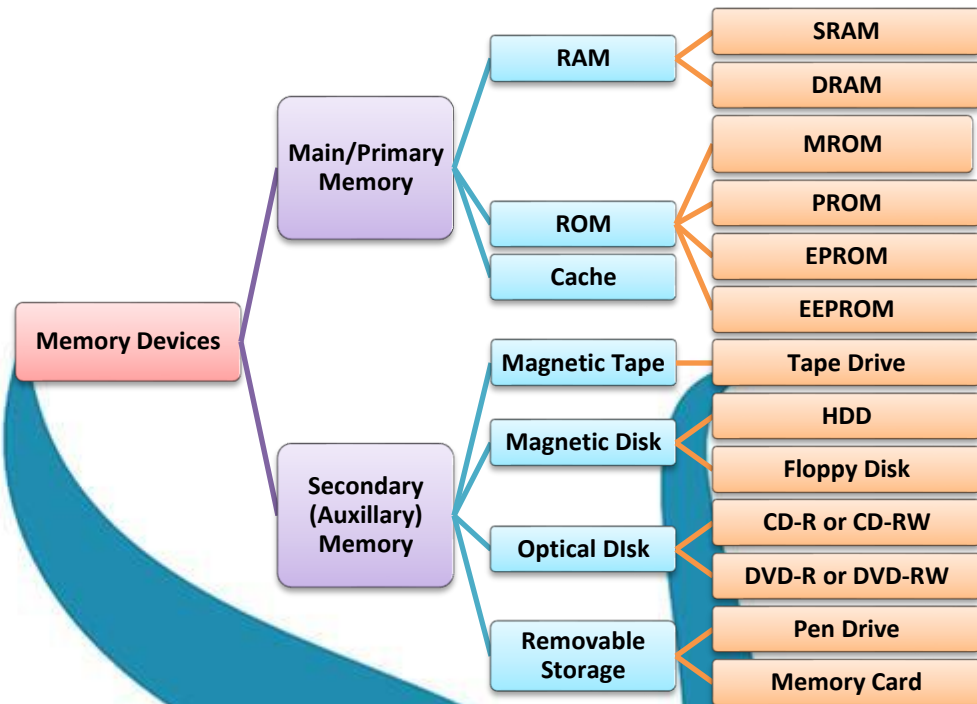
Output Unit:

The output unit of a computer provides the information and results of a computation to outside world. Printers, Visual Display Unit (VDU) are the commonly used output devices. Other commonly used output devices are printer, plotter & speaker.

Computer Memory

Computer memory is any physical device capable of storing information temporarily or permanently. Memory is an essential element of a computer. Without its memory, a computer is of hardly any use. Memory plays an important role in saving and retrieving data. For example, Random Access Memory (RAM) is a volatile memory that stores information on an integrated circuit used by the system, software, and hardware. Computer memory is divided into main (or primary) memory and auxiliary (or secondary) memory. Main memory holds instructions and data when a program is executing, while auxiliary memory holds data and programs not currently in use and provides long-term storage.

Types of Memory Devices



Main Memory or Primary Memory

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. It is divided into two subcategories RAM and ROM.

Characteristics of Main Memory

- These are semiconductor memories
- It is known as main memory.
- Usually volatile or temporary 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.
- Costlier compared to Secondary Memory.

Types of Main or Primary Memory

- RAM (Random Access Memory)
- ROM (Read Only Memory)
- Cache Memory

RAM (Random Access Memory)

RAM (Random Access Memory) is the internal memory of the CPU for storing data, program and program result. It is read/write memory which stores data until the machine is working. As soon as the machine is switched off, data is erased.

Access time in RAM is independent of the address that is, each storage location inside the memory is as easy to reach as other locations and takes the same amount of time. Data in the RAM can be accessed randomly but it is very expensive.

RAM is volatile, i.e. data stored in it is lost when we switch off the computer or if there is a power failure. Hence a backup uninterruptible power system(UPS) is often used with computers. RAM is small, both in terms of its physical size and in the amount of data it can hold.

RAM is of two types

- Static RAM (SRAM)
- Dynamic RAM (DRAM)

Static RAM (SRAM)

The word static indicates that the memory retains its contents as long as power is being supplied. However, data is lost when the power gets down due to volatile nature. SRAM chips use a matrix of 6-transistors and no capacitors. Transistors do not require power to prevent leakage, so SRAM need not have to be refreshed on a regular basis. Because of the extra space in the matrix, SRAM uses more chips than DRAM for the same amount of storage space, thus making the manufacturing costs higher. So SRAM is used as cache memory and has very fast access.



Characteristic of the Static RAM

- It has long life
- There is no need to refresh
- Faster
- Used as cache memory
- Large size
- Expensive
- High power consumption

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Dynamic RAM (DRAM)

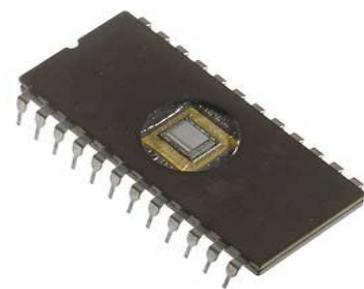
DRAM, unlike SRAM, must be continually refreshed in order to maintain the data. This is done by placing the memory on a refresh circuit that rewrites the data several hundred times per second. DRAM is used for most system memory because it is cheap and small. All DRAMs are made up of memory cells which are composed of one capacitor and one transistor.

Characteristics of the Dynamic RAM

- It has short data lifetime
- Need to be refreshed continuously
- Slower as compared to SRAM
- Used as RAM
- Lesser in size
- Less expensive
- Less power consumption

ROM (Read Only Memory)

ROM stands for Read Only Memory. The memory from which we can only read but cannot write on it. This type of memory is non-volatile. The information is stored permanently in such memories during manufacture. A ROM, stores such instructions that are required to start a computer. This operation is referred to as bootstrap. ROM chips are not only used in the computer but also in other electronic items like washing machine and microwave oven.



Types of ROM

MROM (Masked ROM)

The very first ROMs were hard-wired devices that contained a pre-programmed set of data or instructions. These kind of ROMs are known as masked ROMs which are inexpensive.

PROM (Programmable Read Only Memory)

PROM is read-only memory that can be modified only once by a user. The user buys a blank PROM and enters the desired contents using a PROM program. Inside the PROM chip there are small fuses which are burnt open during programming. It can be programmed only once and is not erasable.

EPROM (Erasable and Programmable Read Only Memory)

The EPROM can be erased by exposing it to ultra-violet light for a duration of up to 40 minutes. Usually, an EPROM eraser achieves this function. During programming, an electrical charge is trapped in an insulated gate region. The

charge is retained for more than ten years because the charge has no leakage path. For erasing this charge, ultra-violet light is passed through a quartz crystal window (lid). This exposure to ultra-violet light dissipates the charge. During normal use the quartz lid is sealed with a sticker.

EEPROM (Electrically Erasable and Programmable Read Only Memory)

The EEPROM is programmed and erased electrically. It can be erased and reprogrammed about ten thousand times. Both erasing and programming take about 4 to 10 ms (milli second). In EEPROM, any location can be selectively erased and programmed. EEPROMs can be erased one byte at a time, rather than erasing the entire chip. Hence, the process of re-programming is flexible but slow.

Advantages of ROM

- Non-volatile in nature
- These cannot be accidentally changed
- Cheaper than RAMs
- Easy to test
- More reliable than RAMs
- These are static and do not require refreshing
- Its contents are always known and can be verified

Cache Memory

Cache memory is a very high speed semiconductor memory which can speed up CPU. It acts as a buffer between the CPU and main memory. It is used to hold those parts of data and program which are most frequently used by CPU. The parts of data and programs are transferred from disk to cache memory by operating system from where CPU can access them.

Advantages

The advantages of cache memory are as follows:

- 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.

Differences between RAM and ROM

S. No	RAM	ROM
1	It is read/write memory.	It is read only memory.
2	It is volatile or temporary; its contents are lost on power failure.	It is nonvolatile or permanent memory; it retains its contents even after the power failure.
3	It contains a copy of operating system & currently executing programs.	It contains information data that are used repeatedly in system applications for conversion. Preprogrammed instructions for system initialization & operations.
4	User can directly write the contents into the RAM.	User cannot directly write the contents into the ROM
5	It is categorized as Static & Dynamic.	It is categorized as MROM, PROM, EPROM, and EEPROM.
6	As compared to ROM storage capacity of RAM is more.	In comparison to RAM. ROM has less storage capacity.

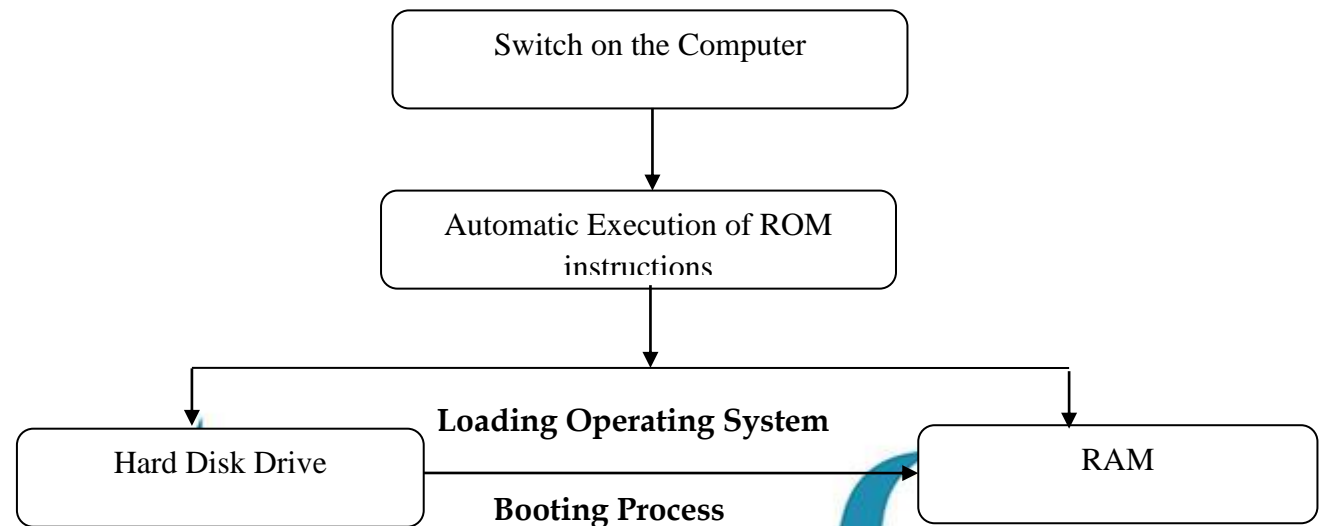
Bootng

When we start our Computer then there is an operation which is performed automatically by the Computer which is also called as Bootng. In the Bootng, System will check all the hardware's and Software's those are installed or Attached with the System and this will also load all the Files those are needed for running a system.

There are two Types of Bootng

1) Warm Bootng: when the System Starts from the Starting or from initial State Means when we Starts our System this is called as warm Bootng. In the Warm Bootng the System will be started from its beginning State means first of all, the user will press the Power Button, then this will read all the instructions from the ROM and the Operating System will be automatically gets loaded into the System.

2) Cold Bootng: The Cold Bootng is that in which System Automatically Starts when we are Running the System, For Example due to Light Fluctuation the system will Automatically Restarts So that in this Chances Damaging of system are More. and the System will not be start from its initial State So May Some Files will b Damaged because they are not Properly Stored into the System.



Power Up

The first step of any boot process is applying power to the machine. When the user turns a computer on, a series of events begins that ends when the operating system gets control from the boot process and the user is free to work. When the computer is turned on, the central processor executes some startup code in ROM that is located on the motherboard.

Power-On Self-Test

The next step in the boot process is called the POST, or power on self-test. This test checks all connected hardware, including RAM and secondary storage devices to be sure it is all functioning properly. After POST has completed its job, the boot process searches the boot device list for a device with BIOS on it.

Find a Boot Device

The I/O system is essential to the operation of the computer because it defines the rules for communications between the CPU and the other devices attached to the computer via the motherboard. The I/O system, sometimes found in the "io.sys" file on the boot device, provides extensions to the BIOS located in ROM on the motherboard.

Load the Operating System

Once the hardware functionality is confirmed and the input/output system is loaded, the boot process begins loading the operating system from the boot device. The OS is loaded into RAM, and any instructions specific to the particular operating system are executed. The actual operating system is somewhat irrelevant, as the computer will follow the same boot pattern in any case.

Transfer Control

Once the previous steps are complete and the operating system is safely loaded into RAM, the boot process relinquishes control to the OS. The OS then proceeds to execute any pre-configured startup routines to define user configuration or application execution. At the end of the handoff, the computer is ready for use.