Components of computer

Hardware

Software

user

Data

Hardware

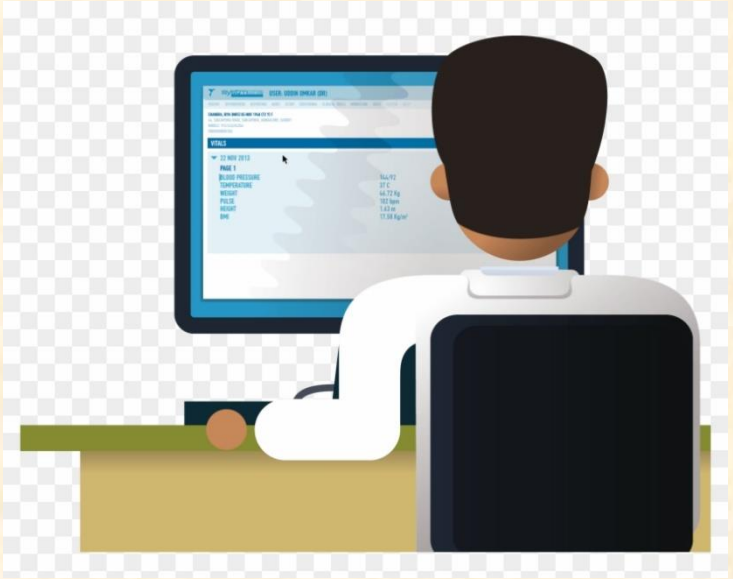
Hardware are the physical part of the computer i.e. which can be touched. Generally hardware are the electronic/digital devices which make up the computer. Example of hardware are monitor, CPU, Keyboard, mouse etc.

Software

Software is set of electronic instruction which makes the computer do the task. They are not physical part of the computer i.e. we cannot touch or feel them. Example of the software are ms-office, google chrome, zoom etc.

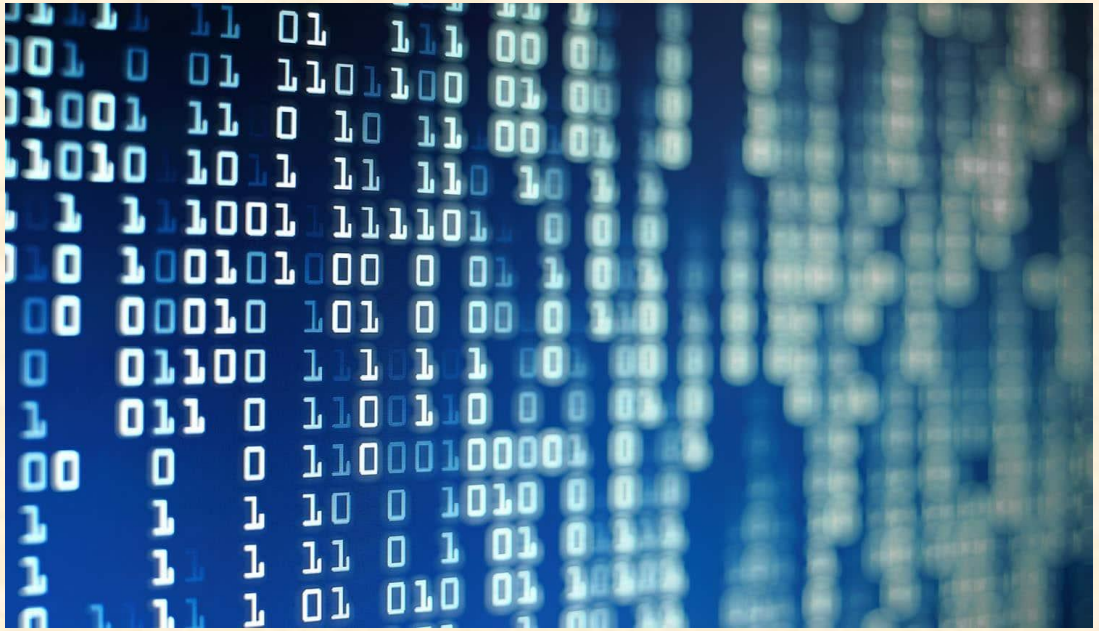
user

User are the people who operate the computer for performing some task. User give input i.e. date and instruction to the computer.



Data

Data consist of raw facts. Computer stores and reads the data in the form of number. Data can consist of letter number, sound, image or video within the computer. Data is organized into files in computer memory.



IMPORTANCE OF COMPUTER

The computer is important in a variety of ways. For example, a difficult and time-consuming task can be done in no time and in an easy way. The computer provides better and effective way to manage a large amount of information to every individual, organization, business, government and institution. The value of computer lies in the ability to perform quickly and accurately. The computer can help in producing better quality products. help in teaching and assist in elimination human error.

Characteristics of computer

Every computer has certain common characteristics irrespective of their type and size The computer is not just adding machines; they are capable of doing complex activities and operations They can be programmed to do complex, tedious and monotonous tasks. Computers are what they are because of the following characteristics:

I.) Word length

A digital computer operates on binary digits i.e. 0 and 1 It can understand information only in terms of 0s and Is A binary digit is called a bit a group of 8 bits is called a byte The number of bits that a computer can process at a time in parallel is called its word Length. Commonly used word length are or 64 bits. Word length is the major of the computing power of a computer. When we talk of a 32-bit computer, it means that it's word Length is 32 bits.

ii.)Speed

The calculation in the computer is at very high speeds For example, a micro computer can perform millions of instructions per second as many times without any mistake. The speed increases, as the power of computer
increase For example, a super computer can operate at speed measures on nanoseconds and even picosecond

1 Milli second(1ms)=1/1000 of a second

1 Micro second(1μs)=1/1000000 of a second

1 Nano Second (1ns)=1/1000000000 of a second

1Pico Second(1ps)=1/1000000000000 of a second

iii.) Accuracy

The accuracy of a computer is very high unless the input is given correctly. In most cases, the error is because of human factor rather that technology mistake. For example, if the person input wrong code or the data is corrupted, the processing result is also wrong or corrupted. So if wrong input is given, the output also will be wrong- GIGO (Garbage In Garbage Out)

iv.) Storage

The computer has main memory and auxiliary memory The computer can store a Large amount of data With more and more auxiliary storage devices, which are capable of storing huge amounts of the data, the storage capacity of a computer is virtually unlimited The reason that makes computer storage unique is not that it can store huge amount of data, but the fact that it can retrieve the information that the user wants in a few seconds. For example, computer dictionaries are available and the contents of this software version are the same as that of the printed dictionary.

Computer Memory Measurment Units

SYMBOL	FULL FORM	QUANTITY
1 BIT	BINARY DEGIT	1 CELL , BINARY 0 OR 1
4 BITS	NIBBLE	1/2 BYTE
8 BITS	BYTE	1 BYTE
1024 BYTE	KILOBYTE	1 KILOBYTE
1024 KILOBYTE	MEGABYTE	1 MEGABYTE
1024 MEGABYTE	GIGABYTE	1 GIGABYTE
1024 GIGABYTE	TERABYTE	1 TERABYTE
1024 TERABYTE	PETABYTE	1 PETABYTE
1024 PETABYTE	HEXABYTE	1 HEXABYTE
1024 HEXABYTE	ZEETABYTE	1 ZEETABYTE

v.) Versatility

Computers can perform activities ranging from simple calculation Like arithmetic calculation, to a complex calculation like launching a missile, which it makes a computer a versatile machine. some application area of
computers like a business, bank medical diagnosis, science and technology, communication and astronomy, so it is a versatile machine

vi.) Diligence

Diligence means being constant and determined in effort and application The computer can perform the repetitive task without being a bore and it never gets tired It can work continuously for several hour or day without getting bored and tired. Unlike human beings, a computer is free from tiredness, weakness, lack of concentration and monotony. Computers can perform activities ranging from simple calculation Like arithmetic calculation, to a complex calculation like launching a missile, which it makes a computer a versatile machine.

vii.) Automation

A computer is an automatic machine, capable of functioning automatically once they are an appropriate set of instruction and data provided to the computer Once the task is initiated on a computer it can proceed continuously The computer can be programmed to perform a series of a task involving multiple programs
Computers are capable of these Levels of automation f the instruction is provided correctly.

- **viii.) Reliability**
  Computers are used widely as they are reliable. The computer never gives the wrong result as Long as the input is given correctly. The probability of error in the computer is negligible. A Huge amount of verities of data like monetary transaction, banking account, personal information is stored in a computer with the strong reliability to the computer. The computer has become an integral part of our Lives and is helping us in improving the standard Living, enhancing the quality products, providing better healthcare, assisting in teaching and earning and other however computer have many limitations like lack of intelligence, Lack of reasoning capabilities and other.
- **ix) Automatic**

computer can function automatically once the process has been initiated. Is does not require a promotion from the user at each stage of the process. For this program instructions and data has to be stored with in the memory of the computer. The program instructions are executed in sequence automatically.

Application of Computer System

I. Home

Computers are used at homes for several purposes like online bill payment, watching movies or shows at home, home tutoring, social media access, playing games, internet access, etc. They provide communication through electronic mail. They help to avail work from home facility for corporate employees. Computers help the student community to avail online educational support.

II. Medical Field

Computers are used in hospitals to maintain a database of patients' history, diagnosis, X-rays, live monitoring of patients, etc. Surgeons nowadays use robotic surgical devices to perform delicate operations, and conduct surgeries remotely. Virtual reality technologies are also used for training purposes. It also helps to monitor the fetus inside the mother's womb.

III. Entertainment

Computers help to watch movies online, play games online; act as a virtual entertainer in playing games, listening to music, etc. MIDI instruments greatly help people in the entertainment industry in recording music with artificial instruments. Videos can be fed from computers to full screen televisions. Photo editors are available with fabulous features.

IV. Industry

Computers are used to perform several tasks in industries like managing inventory, designing purpose, creating virtual sample products, interior designing, video conferencing, etc. Online marketing has seen a great revolution in its ability to sell various products to inaccessible corners like interior or rural areas. Stock markets have seen phenomenal participation from different levels of people through the use of computers.

V. Education

Computers are used in education sector through online classes, online examinations, referring e-books, online tutoring, etc. They help in increased use of audio-visual aids in the education field.

vi. Government

In government sectors, computers are used in data processing, maintaining a database of citizens and supporting a paperless environment. The country's defense organizations have greatly benefitted from computers in their use for missile development, satellites, rocket launches, etc.

vii. Banking

In the banking sector, computers are used to store details of customers and conduct transactions, such as withdrawal and deposit of money through ATMs. Banks have reduced manual errors and expenses to a great extent through extensive use of computers.

viii. Business

Nowadays, computers are totally integrated into business. The main objective of business is transaction processing, which involves transactions with suppliers, employees or customers. Computers can make these transactions easy and accurate. People can analyze investments, sales, expenses, markets and other aspects of business using computers.

ix. Training

Many organizations use computer-based training to train their employees, to save money and improve performance. Video conferencing through computers allows saving of time and travelling costs by being able to connect people in various locations.

x. Science and Engineering

Computers with high performance are used to stimulate dynamic process in Science and Engineering. Supercomputers have numerous applications in area of Research and Development (R&D). Topographic images can be created through computers. Scientists use computers to plot and analyze data to have a better understanding of earthquakes.

Evolution of the computer

The electronic computer of these days were not developed in short period of time. The ideas and devices leading to the advent of the computer dates thousands of years in the history. Many scientist and engineers have worked hard to make the computers evolve in the manner it is now. We can divide evolution of computer roughly into 3 ages.

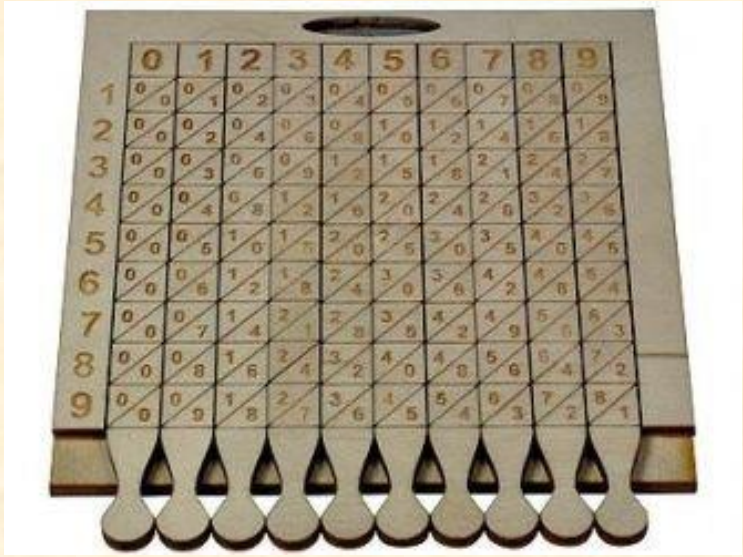
I. Age of mechanical calculators
II. Age of elector-mechanical computers
III. Age of electronic computers

Age of mechanical calculators

a. Abacus

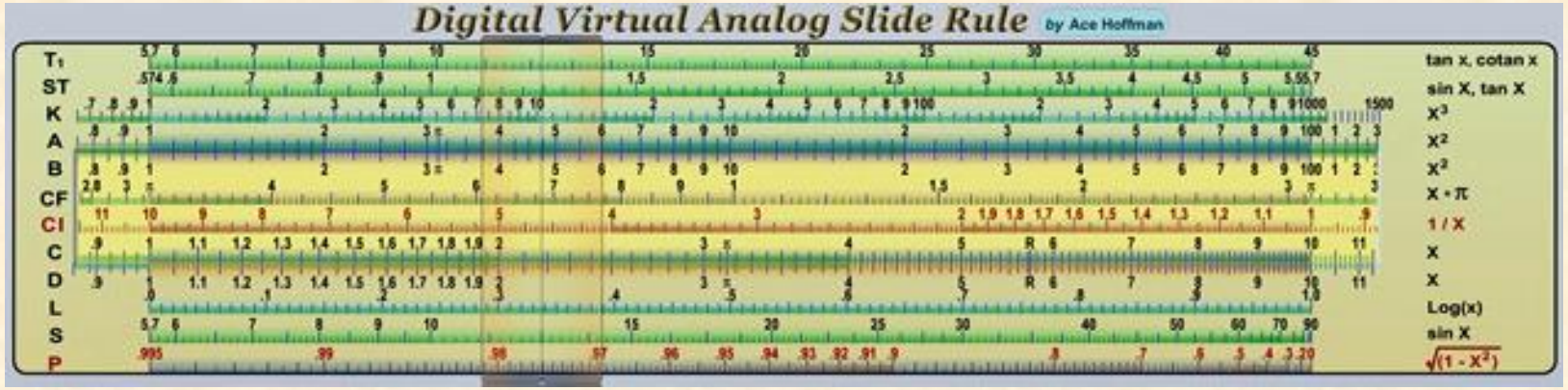
Abacus is believed to be the earliest calculating machine at 5000 B.C. This machine used bead and wires to count. The Chinese improved future to the abacus so that they could calculate and count faster. It consist of a rectangular wooden frame with vertical rods which carry round beads. The wooden frame was divided into two parts by a mid bar. The part above the mid bar is called heaven and below is called earth. In vertical rods there are 7 beads with 2 in heaven and 5 in earth. Counting is done by shifting beads from one side to another side. It could only perform addition and subtraction.

b. Napier Bones



The inventor of logarithms, Scottish mathematician, John Napier, invented a device called Napier’s Bone. It was a rectangular rod of wood or bone on which multiplication tables were inscribed. It was used for the calculation of products and quotients of numbers. The method was based on lattice multiplication, and also called 'rabdology', a word invented by **Napier**

c. Slide Rule

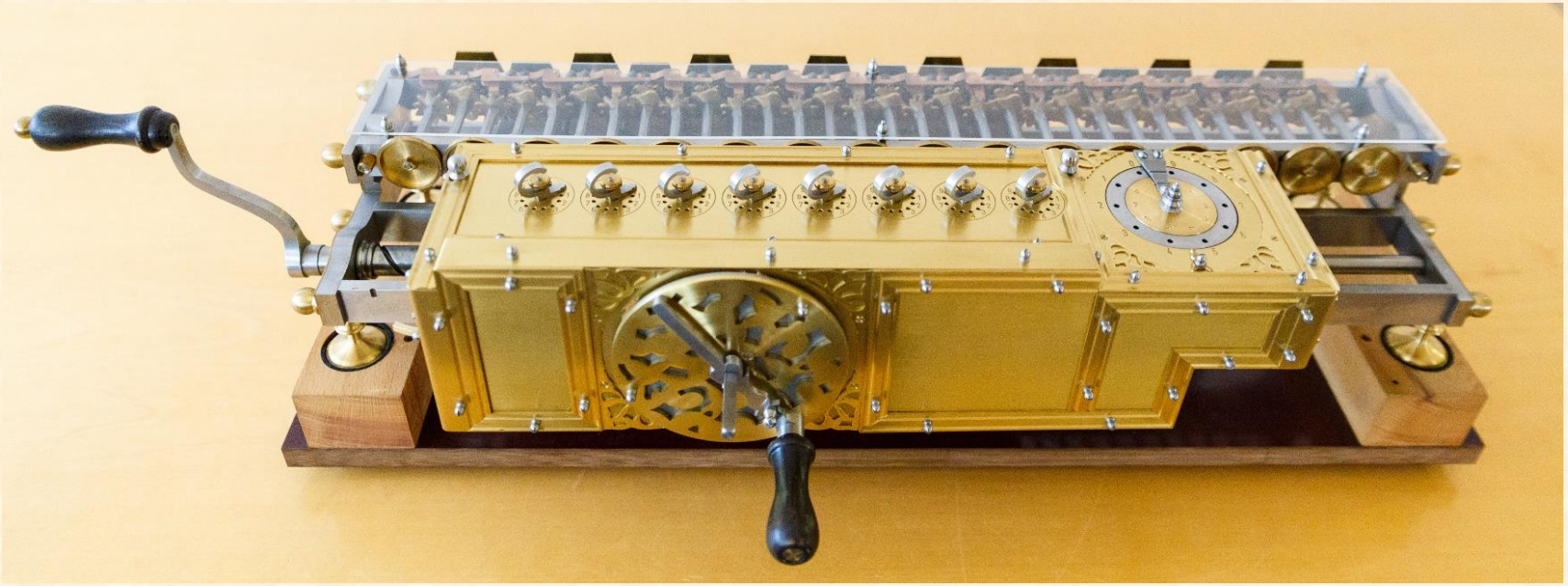


It was invented by English mathematician William Oughtred in 1620. It performs multiplication and division by adding and subtracting. It uses the same principle of logarithm except it is represented on a scale instead of a table. It was a device consisting of graduated scales capable of relative movement, by means of which simple calculations may be carried out mechanically. Typical slide rules contain scales for multiplying, dividing, and extracting square roots, and some also contain scales for calculating trigonometric functions and logarithms.

d. Pascaline first mechanical calculator

Pascal's calculator is a mechanical calculator invented by Blaise Pascal in between 1642 and 1644. Pascal was led to develop a calculator by the laborious arithmetical calculations required by his father's work as the supervisor of taxes in Rouen. It could only do addition and subtraction, with numbers being entered by manipulating its dials. **Pascaline**, also called Arithmetic Machine, the first calculator or adding machine to be produced in any quantity and actually used.

e. Liebniz Step Reckoner



Reckoner is an improved form of Pascalene. It is given by German philosopher and mathematician, Gottfried Wilhem Von Liebniz in 1694. It can perform addition, subtraction, multiplication and division. It can also extract square root by a series of repeated addition. The shift mechanism is applied for multiplication and division .In decimal system, multiplying a digit by 10, shifts it one place to the left and dividing a digit by 10, shifts it one place to the right. Shift mechanism duplicates this process.

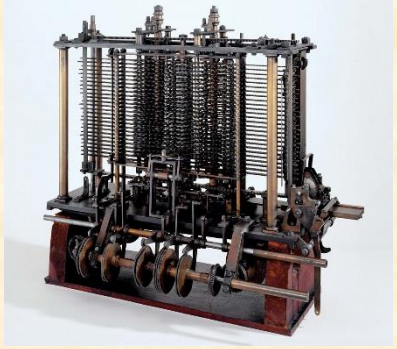
f. Jacquard's loom and punched card

In Lyon, France Joseph Marie Jacquard (1752-1834) demonstrated in 1801 a loom that enabled unskilled workers to weave complex patterns in silk. The Jacquard Loom is controlled by a chain of multiple cards punched with holes that determine which cords of the fabric warp should be raised for each pass of the shuttle. The ability to store and automatically reproduce complex operations found wide application in textile manufacturing.

g. Charles Babbage

Charles Babbage, Lucasian Professor of Mathematics at Cambridge, is known as father of computer science. He had designed difference engine 1822 and Analytical engine in 1833.

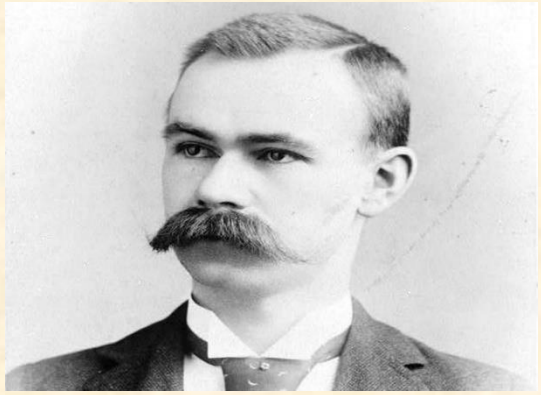
- **Difference Engine**: the inspiration of building automatic calculating machine was arisen in Babbage's mind by first commercial calculator designed by Thomas Colmar. It uses methods of finite differences to perform mathematical calculations. The difference engine was mind baby of Babbage, which never built. It was stream-driven, fully automatic, and controlled by set of instructions.
- **Analytical Engine**: was pure mechanical computing machine made from thousands of cogs, geared wheels to perform computing. It has four main sections:
  - **i. Store**: Its capacity was 1000 words of 50 decimal digits to hold variables and results.
  - ii. **Mill**: If is a processing section where mathematical works are performed.
  - **iii. Input section**: Punch cards are used lo input instructions.
  - **iv. Output section**: The result or output was obtained in the form of hard copy.



h. Lady Augusta Ada Lovelance

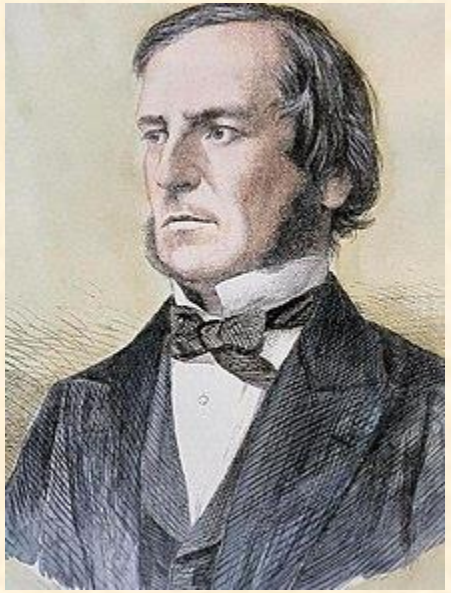
She was born on 10 December, 1815, as a daughter of illustrious English poet Lord Byron. The first programmer of the world and assistant of Charles Babbage, Lady Augusta Ada Lovelance was mathematician. She had written first instruction code in binary for analytical engine. She has coded first program to calculate Bernoulli numbers. A software language developed by the U.S. Department of Defense was named “Ada” in her honor in 1979.

i. Dr. Herman Hollerith



he was born in Buffalo N.Y. in 1860 and educated at Columbia university school of mines. Dr. Herman Hollerith was designed machine which is called tabulating machines (TH) in 1886 to compute the U.S. census with very high speed. His method used punch cards to store data information which is fed into a machine that compiled the result mechanically.

j. George Boole



George Boole, born November 2, 1815, Lincoln, Lincolnshire, England—died December 8, 1864, Ballintemple, County Cork, Ireland, English mathematician who helped establish modern symbolic logic and whose algebra of logic, now called Boolean algebra, is basic to the design of digital computer circuits.

Age of electro-mechanical computers

a. Mark I It was the first electro-mechanical computer developed by Howard Aiken in 1937. the machine was 5ft long and, 3ft wide and 8ft high used in 18000 vacuum tubes. The machine took 1 second to perform 3 mathematical calculations**.** it was also called The IBM Automatic Sequence Controlled Calculator (IBM ASCC).

b. Mark II

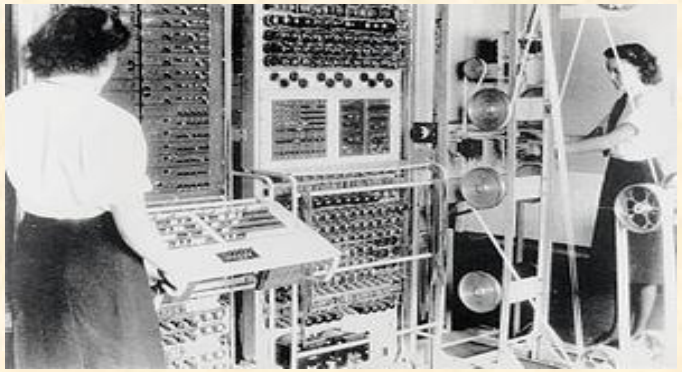
Mark II, also known as Aiken Relay Calculator, was an electromechanical computer built under the direction of Howard Aiken and was finished in 1947. It was financed by the United States Navy. Howard Aiken and Grace Hopper worked together to program and build the Mark II. The **Mark II** was constructed with high-**speed** electromagnetic relays instead of electro-mechanical counters used in the **Mark** I, making it much faster than its predecessor. It weighted 25 short tons (23 t). Its addition time was 0.125 seconds (8 Hz) and the multiplication time was 0.750 seconds.

c. Atanasoft Berry computer (ABC)

it was developed by john Vincent Atansoft and Clifford Berry in around 1938-1942. ABC used 18000 vacuum tubes. It used capacitors for storing electrical charges. Punched cards were also used as secondary storage device. It was a special purpose computer which was used for solving systems of simultaneous equations, ABC is considered as first electronic digital computer.

d. Colossus

it was a set of computers developed by British codebreakers in the years 1943–1945 to help in the cryptanalysis of the Lorenz cipher. Colossus used thermionic valves (vacuum tubes) to perform Boolean and counting operations. Colossus is thus regarded as the world's first programmable, electronic, digital computer, although it was programmed by switches and plugs and not by a stored program.



Age of electronic computers

a. ENIAC (Electronic Numerical Integrator and Computer)

it was the first programmable, electronic, general-purpose digital computer. ENIAC was completed in 1945 and first put to work for practical purposes. It was Turing-complete, and able to solve "a large class of numerical problems" through reprogramming. Although ENIAC was designed and primarily used to calculate artillery firing tables for the United States Army's Ballistic Research Laboratory (which later became a part of the Army Research Laboratory, its first program was a study of the feasibility of the thermonuclear weapon. Its weight was 30 tons and used 17468 vacuum tubes, 70000 resistors, consumed 160 kilowatts of electricity. It took 200 microseconds for addition and 3 milliseconds to perform 10-digit multiplication.

b. EDVAC (Electronic Discrete Variable Automatic Computer)

it was one of the earliest electronic computers. Unlike its predecessor the ENIAC, it was binary rather than decimal, and was designed to be a stored-program computer. ENIAC inventors John Mauchly and J. Presper Eckert proposed the EDVAC's construction in August 1944. Functionally, EDVAC was a binary serial computer with automatic addition, subtraction, multiplication, programmed division and automatic checking with an ultrasonic serial memory capacity of 1,000 34-bit words. EDVAC's average addition time was 864 microseconds and its average multiplication time was 2,900 microseconds.

c. EDSAC (Electronic delay storage automatic calculator)

was an early British computer. Inspired by John von Neumann's seminal First Draft of a Report on the EDVAC, the machine was constructed by Maurice Wilkes and his team at the University of Cambridge Mathematical Laboratory in England in 1949. It also used vacuum tubes. In this machine addition as accomplished in 1500 microsecond and multiplication in 4000 microseconds. It was first stored program computer.

d. UNIVAC (Universal Automatic Computer)

it was developed by J.P. Eckert and J. Mauchly in 1951. It was the first computer manufactured for commercial use and general purpose digital computer. It was designed to handle both numeric and textual information. Before this, all the computers were either used for defense or census. The first business use of UNICAV was by General Electric Corporation in 1954. UNIVAC I used about 5,000 vacuum tubes, weighed 7.6 ton, consumed 125 kW, and could perform about 1,905 operations per second running on a 2.25 MHz clock

Generation of computers

1. First Generation of Computer (1945-1955)

a. During the period of 1945 to 1956 first generation of computers were developed.

b. The first generation computers used vacuum tubes for circuitry and magnetic drums for memory, and were often enormous, taking up entire rooms.

c. The vacuum tube was developed by Lee De Forest. A vacuum tube is a device generally used to amplify a signal by controlling the movement of electrons in an evacuated space.

d. First generation computers 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.

e. 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.

Characteristics

a. First generation computers were based on vacuum tubes.
b. The operating systems of the first generation computers were very slow.
c. They were very large in size.
d. Production of the heat was in large amount in first generation computers.
e. Machine language was used for programming.
f. First generation computers were unreliable.
g. They were difficult to program and use.

Second Generation of Computer (1955-65)

a. During the period of 1955 to 1965 second generation of computers were developed.

b. The second generation computers emerged with development of Transistors. The transistor was invented in 1947 by three scientists J. Bardeen, H.W. Brattain and W. Shockley.

c. Second generation computers used the low level language i.e. machine level language and assembly language which made the programmers easier to specify the instructions.

d. Later on High level language programming were introduced such as COBOL and FORTRAN.

e. Magnetic core was used as primary storage. Second generation computer has faster input /output devices which thus brought improvement in the computer.

f. IBM 7000, NCR 304, IBM 650, IBM 1401, ATLAS and Mark III are the examples of second generation computers

g.

h. Characteristics

i. Transistors were used in place of vacuum tubes.

j. Second generation computers were smaller in comparison with the first generation computers.

Characteristics

a. Transistors were used in place of vacuum tubes.
b. Second generation computers were smaller in comparison with the first generation computers.
c. They were faster in comparison with the first generation computers.
d. They generated less heat and were less prone to failure.
e. They took comparatively less computational time.
f. Assembly language was used for programming.

Third Generation of Computer (1965-1975)

- During the period 1965-75, 3rd Generation computer was developed.
- The 3rd generation computer was emerged with the development of IC (Integrated Circuits)
- IC was invented by Robert Noyce and Jack Kilby in 1958-59
- Transistors were miniaturized and placed on silicon chips, called semiconductors, which drastically increased the speed and efficiency of computers.
- Keyboards and monitors developed during the period of third generation of computers. The third generation computers 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.
- PDP-8, PDP-11, ICL 2900, IBM 360 and IBM 370 are the examples of third generation computers.

Characteristics

- IC (integrated circuit) was used instead of transistors in the third generation computers.
- Third generation computers were smaller in size and cheaper as compare to the second generation computers.
- They were fast and more reliable.
- High level language was developed.
- Magnetic core and solid states as main storage.
- They were able to reduce computational time and had low maintenance cost.
- Input/output devices became more sophisticated

Fourth Generation of Computer (1975-1989)

- After 1975, the fourth generation computers were built.
- The computers were designed by using Microprocessor, as thousands of integrated circuits were built onto a single silicon chip.
- The fourth generation computer doesn’t fill the room like 1st generation computers. They are fitted on table or on single palm hand.
- The fourth generation computers became more powerful, compact, reliable and affordable. As a result, they give rise to personal computer (PC) revolution.
- For the first time in 1981 IBM introduced its computer for the home user.

Characteristics

- The fourth generation computers have microprocessor-based systems.
- They are the cheapest among all the computer generation.
- The speed, accuracy and reliability of the computers were improved in fourth generation computers.
- Many high-level languages were developed in the fourth generation such as COBOL, FORTRAN, BASIC, PASCAL
- and C language.
- A Further refinement of input/output devices was developed.
- Networking between the systems was developed.

Fifth Generation of Computer (1989 to present)

- Fifth generation computers are in developmental stage which is based on the artificial intelligence. The goal of the fifth generation is to develop the device which could respond to natural language input and are capable of learning and self-organization. Quantum computation and molecular and nanotechnology will be used in this technology. So we can say that the fifth generation computers will have the power of human intelligence.

Characteristics

- The 5th generation computer uses super large scale integrated chips.
- They have artificial intelligence.
- Fifth generation computer aims to be able to solve highly complex problem including decision making, logical reasoning.
- 5th generation computers are intended to be able to work with natural languages.
- They are able to use more than one CPU in a faster way.

Processing speed of computer

A computer’s processor clock speed determines how quickly the central processing unit (CPU) can retrieve and interpret instructions. This helps your computer complete more tasks by getting them done faster. Clock speeds are measured in gigahertz (GHz), with a higher number equating to higher clock speed. Multi-core processors were developed to help CPUs run faster as it became more difficult to increase clock speed Faster clock speeds mean that you’ll see tasks ordered from your CPU completed quicker, making your experience seamless and reducing the time you wait to interface with your favorite applications and programs.

Classification of computers

According to size, traditionally computers are divided in four categories

- **1. Super Computer**
- Super computers are the fastest, most-powerful and most expensive computers.
- It has the ability to recover automatically from failures.
- It has the ability to support several Giga Bytes of RAM.
- Unlike conventional computers, which have a single processor to process one instruction at a time, supercomputers have multiple
- processors (or CPUs) that process multiple instructions at a time.
- Supercomputers are widely used in scientific applications such as aerodynamic design and simulation, processing of geological data.
- One of the most powerful supercomputers today is "The Cray-2" and Some others are CRAY 1, CRAY - MP, SX-2, HITAC S-300, etc.

2. Mainframe Computer

- A mainframe computer is usually slower, less powerful and less expensive than supercomputers.
- Very large in size with approximately 1000 square ft. area.
- Mainframes process several million instructions per second (MIPS). More than 1,000 remote workstations can be accommodated by a typical mainframe computer.
- Mainframes are used by banks and many businesses to update inventory, etc.
- Many modern mainframes have multiprocessing capabilities.
- It supports a large number of input/output terminals, more than 100 terminals.
- User can access the mainframes resources through a device called a terminal

3.Mini Computer

- These are also a general purpose computer, smaller than mainframe computer. Medium sized computer, occupying approximately 10 sq. ft. of area.
- It is cheap and easy to operate than a mainframe computer.
- They have slower operating speed, smaller backup storage, limited hardware and less memory than mainframes.
- Minicomputers are well adapted for functions such as accounting, word processing, data base management, statistical packages for social sciences.
- More than 50 terminals and large storage capacity device than microcomputers but smaller than mainframe computers. E.g. Prime 9755

4. Micro Computer

These are also a general purpose computer, smaller than mainframe computer. Medium sized computer, occupying approximately 10 sq. ft. of area.

- They have slower operating speed, smaller backup storage, limited hardware and less memory than mainframes.
- Minicomputers are well adapted for functions such as accounting, word processing, data base management, statistical packages for social sciences
- More than 50 terminals and large storage capacity device than microcomputers but smaller than mainframe computers. E.g. Prime 9755
- It is mainly used in office, school, house, shop etc.

Mobile communication

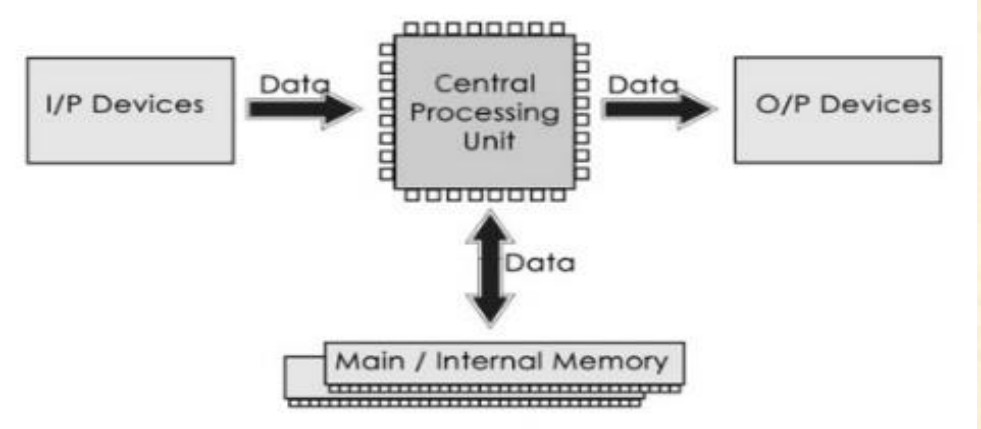
Mobile Computing is a technology that allows transmission of data, voice and video via a computer or any other wireless enabled device without having to be connected to a fixed physical link. The main concept involves

- **Mobile communication:** the mobile communication in this case, refers to the infrastructure put in place to ensure that seamless and reliable communication goes on. These would include devices such as protocols, services, bandwidth, and portals necessary to facilitate and support the stated services. The data format is also defined at this stage. This ensures that there is no collision with other existing systems which offer the same service.
- **Mobile hardware:** Mobile hardware includes mobile devices or device components that receive or access the service of mobility. They would range from portable laptops, smartphones, tablet Pc's, Personal Digital Assistants.
- **Mobile software:** Mobile software is the actual program that runs on the mobile hardware. It deals with the characteristics and requirements of mobile applications. This is the engine of the mobile device. In other terms, it is the operating system of the appliance. It's the essential component that operates the mobile device.

Application of mobile computing

- Wireless phone calls
- E-mail, web browsing, social media,
- Streamlining of business processes
- Messaging
- Entertainment
- Contact management

computer architecture and organization



Computer architecture deals with the design of computers cpu, data storage devices, and networking components that store and run programs, transmit data, and drive interactions between computers, across networks, and with users. Computer Architecture helps us to understand the functionalities of a system. A programmer can view architecture in terms of instructions, addressing modes and registers.

An organization is done on the basis of architecture.

Computer Organization is concerned with the structure and behavior of a computer system as seen by the user. Computer Organization tells us how exactly all the units in the system are arranged and interconnected. An organization is done on the basis of architecture. An organization is done on the basis of architecture.

components of computer system

a. Input Unit

An input unit or device is essentially a piece of hardware that sends data to a computer. Most input devices either interact with or control the computer in some way. The most common input devices are the mouse and the keyboard, but there are many others. The key distinction between an **input device** and an **output device** is that the former ***sends*** data to the computer, whereas the latter ***receives*** data from the computer. Input and output devices that provide computers with additional functionality are also called peripheral or auxiliary devices. Keyboard Mouse Touchpad Scanner Digital Camera Microphone Joystick Graphic Tablet Touch Screen Webcam

b. Output Unit

Computer output devices receive information from the computer, and carry data that has been processed by the computer to the user. Output devices provide data in myriad different forms, some of which include audio, visual, and hard copy media. The devices are usually used for display, projection, or for physical reproduction. Monitors and printers are two of the most commonly-known output devices used with a computer.

C. Central Processing Unit (CPU)

1. ALU (Arithmetic Logic Unit)

This unit consists of two subsections namely,

Arithmetic Section

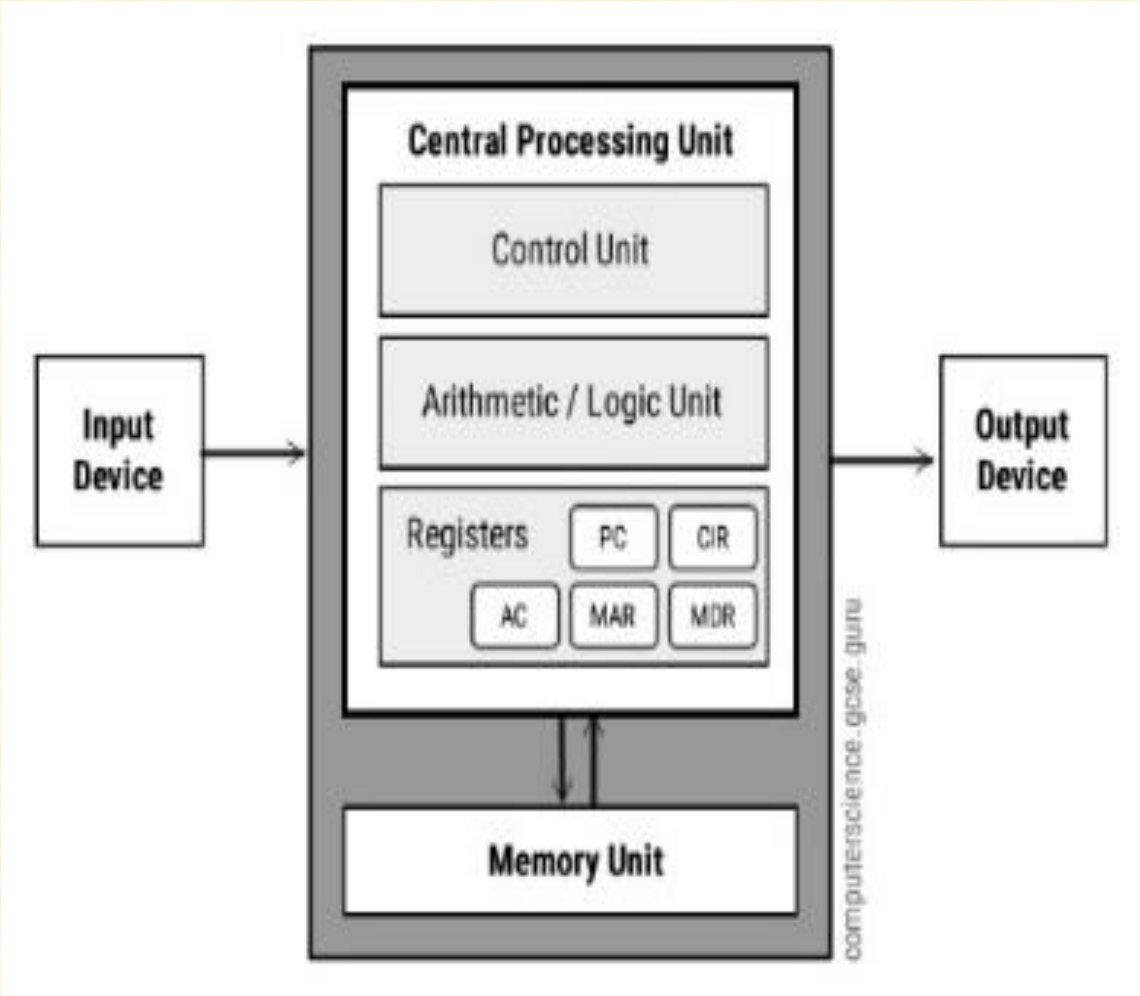
Logic Section

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 the above operations.

Logic Section

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



2. Control Unit

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

Functions of this 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.

3. Registers

Register are used to quickly accept, store, and transfer data and instructions that are being used immediately by the CPU. These registers are the top of the memory hierarchy, and are the fastest way for the system to manipulate data. In a very simple microprocessor, it consists of a single memory location, usually called an accumulator. Registers are built from fast multi-ported memory cell. There are various types of Registers those are used for various purpose. Some Mostly used Registers are

I. Memory Data Register (MDR): holds data that is being transferred to or from memory.
II. Memory Buffer Register(MBR): stores the data being transferred to and from the immediate access storage
III. Program Counter(PC): indicates where a computer is in its program sequence
IV. Accumulator(AC): stores intermediate arithmetic and logic results.
V. Input /output Register (I/O): communicates with input and output devices

4. Memory Unit

It is used to store data and instructions. Computer memory is the storage space in the computer, where data is to be processed and instructions required for processing are stored.

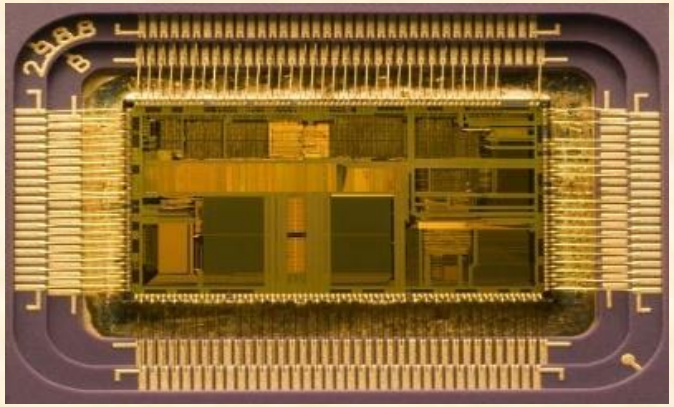
Memory is primarily of three types –

- **Cache Memory:** Cache memory is a very high speed semiconductor memory which can speed up the CPU. It acts as a buffer between the CPU and the main memory. It is used to hold those parts of data and program which are most frequently used by the CPU.
- **Primary Memory/Main Memory:** Primary memory holds only those data and instructions on which the computer is currently working. It has a 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 resides in the main memory. It is divided into two subcategories RAM and ROM.

Secondary Memory

- This type of memory is also known as external memory or non-volatile. It is slower than the 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. The contents of secondary memories are first transferred to the main memory, and then the CPU can access it. For example, disk, CD-ROM, DVD, etc.

Microprocessor

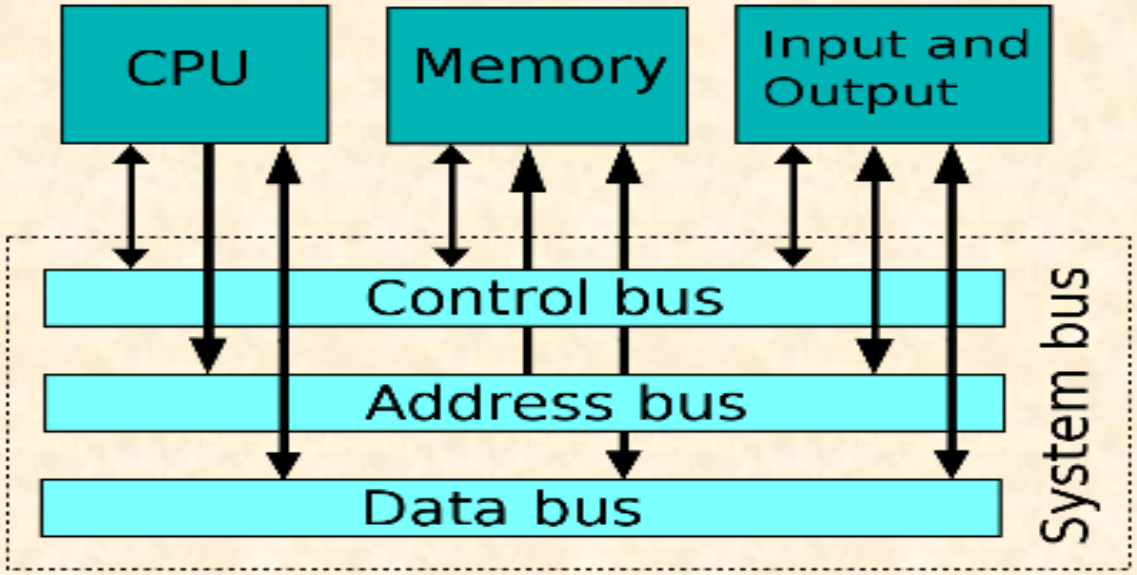


It is a type of miniature electronic device that contains the arithmetic, logic, and control circuitry necessary to perform the functions of a digital computer's central processing unit. In effect, this kind of integrated circuit can interpret and execute program instructions as well as handle arithmetic operations. It is a central processing unit on a single integrated circuit chip containing millions of very small components including transistors, resistors, and diodes that work together. Everything a computer does is described by instructions of computer programs, and microprocessors carry out these instructions many millions of times a second.

Among various functions of microprocessor some are as follows

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

Bus System



The system bus is a pathway composed of cables and connectors used to carry data between a computer microprocessor and the main memory. The bus provides a communication path for the data and control signals moving between the major components of the computer system. The system bus works by combining the functions of the three main buses: namely, the data, address and control buses. Each of the three buses has its separate characteristics and responsibilities. There are three types of buses in a microprocessor −

I. Data Bus − Lines that carry data to and from memory are called data bus. It is a bidirectional bus with width equal to word length of the microprocessor.

II. Address Bus − It is a unidirectional responsible for carrying address of a memory location or I/O port from CPU to memory or I/O port.

III. Control Bus − Lines that carry control signals like clock signals, interrupt signal or ready signal are called control bus. They are bidirectional. Signal that denotes that a device is ready for processing is called ready signal. Signal that indicates to a device to interrupt its process is called an interrupt signal.

Input devices

In computing, an input device is a piece of equipment used to provide data and control signals to an information processing system such as a computer or information appliance. Some of input devices are listed below

- Keyboard – one of the primary input devices used to input data and commands. It has function keys, control keys, arrow keys, keypad and the keyboard itself with the letters, numbers and commands. Keyboards are connected to the computer through USB or Bluetooth. A laptop keyboard is more compact than a desktop keyboard to make the laptop smaller and lighter. Smartphones and tablets use on-screen keyboard to input messages and select commands.
- Mouse – an input device used to control the cursor and coordinates. It can be wired or wireless. It allows the user to do the following:
  - Move the mouse cursor
  - Select
  - Scroll
  - Open or execute a program
  - Drag-and-drop
  - Hover
  - Perform other functions with the use of additional buttons
  - A laptop uses a touchpad as the mouse. A smartphone and tablet use a touchscreen as primary input device and the user's finger is used as the mouse.

- Microphone – an input device that allows users to input audio into their computers. Here are some uses of the microphone:
  - Audio for video
  - Computer gaming
  - Online chatting
  - Recording musical instruments
  - Recording voice for dictation, singing and podcasts
  - Voice recorder
  - Voice recognition
  - VoIP – Voice over Internet Protocol
- Digital Camera – is an input device that takes pictures digitally. Images are stored as data on memory cards. It has an LCD screen that allows users to preview and review images. Digital cameras have become popular over film cameras because of the following features:
  - LCD screen – allows users to view the photos and videos immediately
  - Storage – can store thousands of pictures
  - Picture development – allows users to choose and pick which pictures to develop
  - Size – takes up less space and can be easily carried
- Scanner – is an input device that reads an image and converts it into a digital file. A scanner is connected to a computer through USB. There are different types of scanners:
  - Flatbed scanner – uses a flat surface to scan documents
  - Sheet fed scanner – like a laser printer where paper is fed into the scanner
  - Handheld scanner – the scanner is dragged over the page to be scanned
  - Card scanner – for scanning business card

- Touchscreen – is an input device that allows users to interact with a computer using their fingers. It is used widely in laptop monitors, smartphones, tablets, cash registers and information kiosks. Most common functions of touchscreens are as follows:
  - Tap
  - Double-tap
  - Touch and hold
  - Drag
  - Swipe
  - Pinch
- Barcode Reader – also known as barcode scanner or point of sale (POS) scanner, is an input device capable of reading barcodes.
- Webcam – is an input device connected to the computer and the internet that captures still picture or motion video.
- Biometric devices – is an input device used to input biometric data into a computer. Here are the types of biometric devices:
  - Face scanner
  - Hand scanner
  - Finger scanner
  - Voice scanner
- Stylus – is a pen-shaped input device used to write or draw on the screen of a graphic tablet or device. Initially it was just used for graphic tablets and PDAs, but now, it has become popular on mobile devices as a replacement for the user's fingers. It's used for more accurate navigation and to keep oils from user's fingers off the device screen.

Output devices

- An output device is any piece of computer hardware equipment which converts information into human-readable form. It can be text, graphics, tactile, audio, and video. Some of input devices are listed below
- **Monitor** – This is the most common computer output device. It creates a visual display by the use of which users can view processed data. Monitors come in various sizes and resolutions.
- Common Types of Monitors are
- Cathode Ray Tube – this uses phosphorescent dots to generate the pixels that constitute displayed images.
- Flat Panel Screen – this makes use of liquid crystals or plasma to produce output. Light is passed through the liquid crystals in order to generate pixels. Example LCD, LED
- All monitors depend on a video card, which is positioned either on the computer motherboard or in a special expansion slot. The video card sorts out the computer data into image details that the monitors can then show.
- **Printer** – this device generates a hard copy version of processed data, like documents and photographs. The computer transmits the image data to the printer, which then physically recreates the image, typically on paper.

Types of Printers

- Ink Jet – this kind of printer sprays tiny dots of ink onto a surface to form an image.
- Laser – this type utilizes toner drums that roll through magnetized pigment, and then transfers the pigment onto a surface.
- Dot Matrix – dot matrix printers utilize a print head to set images on a surface, using an ink ribbon. These printers were commonly used between 1980 and

IMPACT PRINTERS	NON-IMPACT PRINTERS
Impact printers form images and characters by striking a mechanism such as a print hammer or wheel against an inked ribbon, leaving an image on paper.	Non-impact printers form characters and images without direct physical contact between the printing mechanism and the paper.
Printing in impact printers is done by hammering a metal pin or character dye.	Printing in non-impact printers is done by depositing ink on paper in any form.
They are low speed printers. They consume a lot of time to print a document.	They are very fast, they can print many pages per minute.
They have high level of noise because they have many moving parts and also the print head strikes on ribbon and paper.	They do not have high level of noise. The process of laying ink or toner onto paper is virtually silent.
They use pins, hammers or wheel to strike against an inked ribbon to print on a paper.	They use laser, spray of special ink or heat and pressure to print on paper.
Print quality of impact printers is lower than those of non-impact printers.	Print quality of non-impact printers is higher than those of impact printers.
They use special inked ribbons to produce print on paper when print head strikes.	They use toner or cartridge for printing on paper.
They use old printing technologies.	They use latest printing technologies.
They are often less expensive.	They are often very expensive when compared to impact printers.
They use continuous paper sheet.	They often use individual paper sheets.
With exception of dot matrix printer, impact printers cannot print graphics images.	Printing of graphical images in non-impact printers is very much possible.
With exception of dot matrix, the character style cannot be changed in the impact printers.	It can print different types of characters' form busing the individual printer.

- **Speakers** – speakers are attached to computers to facilitate the output of sound; sound cards are required in the computer for speakers to function. The different kinds of speakers range from simple, two-speaker output devices right the way up to surround-sound multi-channel units.
- **Headset** – this is a combination of speakers and microphone. It is mostly used by gamers, and is also a great tool for communicating with family and friends over the internet using some VOIP program or other.
- **Projector** – this is a display device that projects a computer-created image onto another surface: usually some sort of whiteboard or wall. The computer transmits the image data to its video card, which then sends the video image to the projector. It is most often used for presentations, or for viewing videos.
- **Plotter** – this generates a hard copy of a digitally depicted design. The design is sent to the plotter through a graphics card, and the design is formed by using a pen. It is generally used with engineering applications, and essentially draws a given image using a series of straight lines.

Hardware Interfaces

The connection and interaction between hardware, software and the user. Users "talk to" the software. The software "talks to" the hardware and other software. Hardware "talks to" other hardware. All this is interfacing. It has to be designed, developed, tested and redesigned; and with each incarnation, a new specification is born that may become yet one more de facto or regulated standard.

Hardware interfaces are the plugs, sockets, cables and electrical signals traveling through them. Examples are USB, FireWire, Ethernet, ATA/IDE, SCSI and PCI.

parallel port:

A parallel port is an external interface commonly found on PCs from the early 1980s to early 2000s. It was used to connect peripheral devices such as printers and external storage devices. It was eventually superseded by USB, which provides a smaller connection and significantly faster data transfer rates

Serial port:

The serial port is a type of connection on PCs that is used for peripherals such as mice, gaming controllers, modems, and older printers. It is sometimes called a COM port or an RS-232 port, which is its technical name.

USB port:

USB (Universal Serial Bus) is the most popular connection used to connect a computer to devices such as digital cameras, printers, scanners, and external hard drives. USB is a cross-platform technology that is supported by most of the major operating systems. On Windows, it can be used with Windows 98 and higher. USB is a hot-swappable technology, meaning that USB devices can be added and removed without having to restart the computer. USB is also “plug and play”. When you connect a USB device to your PC, Windows should detect the device and even install the drivers needed to use it.

HDMI port:

Short for High-Definition Multimedia Interface, HDMI allows your laptop to transmit compressed or uncompressed audio and visual data over a single cord. It's that weird polygonal-shaped port that you'll also find on the back of your television, game consoles and cable boxes.

Slots:

Alternatively known as a bus slot or expansion port, an expansion slot is a connection or port inside a computer on the motherboard or riser card. It provides an installation point for a hardware expansion card to be connected. For example, if you wanted to install a new video card in the computer, you'd purchase a video expansion card and install that card into the compatible expansion slot.

PCI slot:

Peripheral Component Interconnect, or PCI, is the most common way to attach add-on controller cards and other devices like graphics card to a computer motherboard. This type of connector originated in the early 1990s, and is still in use today. Presently, there are three main PCI motherboard connectors

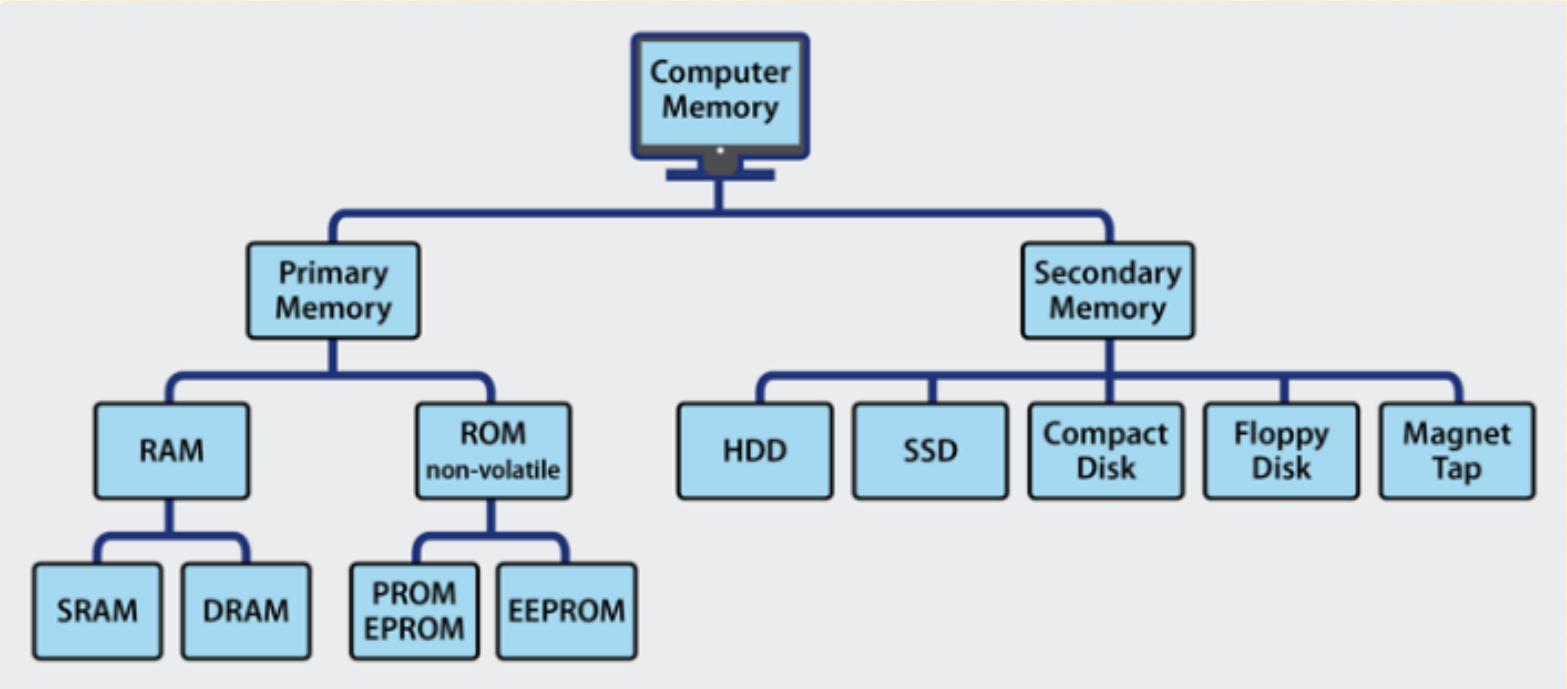
RAM slot:

A memory slot, memory socket, or RAM slot allows RAM (computer memory) to be inserted into the computer. Most motherboards have two to four memory slots, which determine the type of RAM used with the compute

CPU slots:

A CPU socket uses a series of pins to connect a CPU's processor to the PC's motherboard. If a CPU is connected via a CPU socket, it is not soldered and can therefore be replaced.

Memory



Computer memory is any physical device capable of storing information temporarily, like RAM (random access memory), or permanently, like ROM (read-only memory).

There are three types of primary memory:

RAM, or random access memory

It is a volatile type of memory wherein the memory loses its contents when the power is switched off. The processor reads instructions/data from it and also writes into it. Data and instructions are loaded into RAM from the external hard disk and processed data are stored back into the hard disk.

RAM has two subcategories:

a. Static Random Access Memory (SRAM): Transistors are used in this memory and constant power flow is needed to keep it alive. Data remains static in this memory and hence no refresh is needed at any point in time. It has a short read/write cycle, smaller in size, more expensive than dynamic RAM, and faster in data retrieval and write, and hence it is deployed in special applications like cache memory.

b. Dynamic Random Access Memory (DRAM): Capacitors are used in this type and it tends to lose energy gradually over a period of time and hence the data is likely to be lost. A periodic refresh is required to retain the data. It is a high-density type, cheaper than SRAM but slower than it, larger in size, used in main memory mostly. Different between SRAM and DRAM

Static RAM	Dynamic RAM
➢ SRAM uses transistor to store a single bit of data	➢ DRAM uses a separate capacitor to store each bit of data
➢ SRAM does not need periodic refreshment to maintain data	➢ DRAM needs periodic refreshment to maintain the charge in the capacitors for data
➢ SRAM's structure is complex than DRAM	➢ DRAM's structure is simplex than SRAM
➢ SRAM are expensive as compared to DRAM	➢ DRAM's are less expensive as compared to SRAM
➢ SRAM are faster than DRAM	➢ DRAM's are slower than SRAM
➢ SRAM are used in Cache memory	➢ DRAM are used in Main memory

ROM, or read-only memory

ROM (read only memory) is a flash memory chip that contains a small amount of non-volatile memory. Non-volatile means that its contents cannot be changed and it retains its memory after the computer is turned off. ROM contains the BIOS which is the firmware for the motherboard. The BIOS contains the bootstrap – the program which takes the computer through steps that lead up to the loading of the operating system (OS). It happens between turning on the power and the computer beeping to say it is starting to load the OS. This process is known as POST (power on self-test) on a PC.

Types of ROM include:

1. PROM (programmable read-only memory) - manufactured as blank ROM. PROM chips can be bought cheaply and programmed directly by a programmer. They are not rewritable so they can only be programmed once.
2. EEPROM (electrically erasable programmable read-only memory) - popular in PCs and smartphones as the firmware can be easily updated by the manufacturer. This is similar to a rewritable CD in that the chip can be reprogrammed.

Cache memory

Cache memory is a type of high-speed random access memory (RAM) which is built into the processor. Data can be transferred to and from cache memory more quickly than from RAM. As a result, cache memory is used to temporarily hold data and instructions that the processor is likely to reuse. This allows for faster processing as the processor does not have to wait for the data and instructions to be fetched from RAM.

different types of cache exist:

1. L1 cache has extremely fast transfer rates, but is very small in size. The processor uses L1 cache to hold the most frequently used instructions and data.
2. L2 cache is bigger in capacity than L1 cache, but slower in speed. It is used to hold data and instructions that are needed less frequently.

difference between RAM and ROM	
RAM stands for Random Access Memory.	ROM stands for Read Only Memory.
RAM data is volatile. Data is present till power supply is present.	ROM data is permanent. Data remains even after power supply is not present.
RAM data can be read, erased or modified.	ROM data is read-only.
RAM is used to store data that CPU needs for current instruction processing.	ROM is used to store data that in needed to bootstrap the computer.
RAM speed is quite high.	ROM speed is slower than RAM.
CPU can access data stored on RAM.	Data to be copied from ROM to RAM so that CPU can access its data.
RAM memory is large and high capacity.	ROM is generally small and of low capacity.
RAM is used as CPU Cache, Primary Memory.	ROM is used as firmware by microcontrollers.
RAM is costly.	ROM is cheap.

Secondary Memory

You know that processor memory, also known as primary memory, is expensive as well as limited. The faster primary memory is also volatile. If we need to store large amount of data or programs permanently, we need a cheaper and permanent memory. Such memory is called secondary memory. Here we will discuss secondary memory devices that can be used to store large amount of data, audio, video and multimedia files.

Characteristics of Secondary Memory

These are some characteristics of secondary memory, which distinguish it from primary memory −

It is non-volatile, i.e. it retains data when power is switched off

It is large capacities to the tune of terabytes

It is cheaper as compared to primary memory

Hard Disk Drive

Hard disk drive is made up of a series of circular disks called platters arranged one over the other almost ½ inches apart around a spindle. Disks are made of non-magnetic material like aluminum alloy and coated with 10-20 nm of magnetic material. Standard diameter of these disks is 14 inches and they rotate with speeds varying from 4200 rpm (rotations per minute) for personal computers to 15000 rpm for servers. Data is stored by magnetizing or demagnetizing the magnetic coating. A magnetic reader arm is used to read data from and write data to the disks. A typical modern HDD has capacity in terabytes (TB).

CD Drive

CD stands for Compact Disk. CDs are circular disks that use optical rays, usually lasers, to read and write data. They are very cheap as you can get 700 MB of storage space for less than a dollar. CDs are inserted in CD drives built into CPU cabinet. They are portable as you can eject the drive, remove the CD and carry it with you. There are three types of CDs −

CD-ROM (Compact Disk – Read Only Memory) − The data on these CDs are recorded by the manufacturer. Proprietary Software, audio or video are released on CD-ROMs.

CD-R (Compact Disk – Recordable) − Data can be written by the user once on the CD-R. It cannot be deleted or modified later.

CD-RW (Compact Disk – Rewritable) − Data can be written and deleted on these optical disks again and again.

DVD Drive

DVD stands for Digital Video Display. DVD are optical devices that can store 15 times the data held by CDs. They are usually used to store rich multimedia files that need high storage capacity. DVDs also come in three varieties – read only, recordable and rewritable.

Pen Drive

Pen drive is a portable memory device that uses solid state memory rather than magnetic fields or lasers to record data. It uses a technology similar to RAM, except that it is nonvolatile. It is also called USB drive, key drive or flash memory.

Assignment

Answer the following questions

1. What are characteristics of computer?
2. Explain any five application of computer?
3. Explain evolution of computer
4. Describe generation of computer
5. Classify and explain types of computer
6. What is mobile computing?
7. Explain components of computer system
8. What is microprocessor?
9. What is Bus system? Explain
10. Explain computer memory in details
11. Write differences between DRAM and SRAM
12. Write differences between RAM and ROM
13. Write differences between impact and non-impact printer
14. Explain hardware interface in computer