# Syllabus

# Unit 1:

Introduction: Introduction to Computers, Hardware and Software, Classification and History of Computers, Functions of the different Units, Applications of Computers, Representation of data and information, Machine language, Assembly Language, High level Language, Number System and Conversion.

# What is Computer?

A computer is a programmable electronic device that accepts raw data as input and processes it with a set of instructions (a program) to produce the result as output. It renders output just after performing mathematical and logical operations and can save the output for future use. It can process numerical as well as non-numerical calculations. The term "computer" is derived from the Latin word "computare" which means to calculate.

A computer is designed to execute applications and provides a variety of solutions through integrated hardware and software components. It works with the help of programs and represents the decimal numbers through a string of binary digits. It also has a memory that stores the data, programs, and result of processing. The components of a computer such as machinery that includes wires, transistors, circuits, hard disk are called hardware. Whereas, the programs and data are called software.

It is believed that the Analytical Engine was the first computer which was invented by Charles Babbage in 1837. It used punch cards as read-only memory. Charles Babbage is also known as the father of the computer.

**The basic parts without which a computer cannot work are as follows:**

- **Processor:** It executes instructions from software and hardware.
- **Memory:** It is the primary memory for data transfer between the CPU and storage.
- **Motherboard:** It is the part that connects all other parts or components of a computer.
- **Storage Device:** It permanently stores the data, e.g., hard drive.
- **Input Device:** It allows you to communicate with the computer or to input data, e.g., a keyboard.
- **Output Device:** It enables you to see the output, e.g., monitor.

**Computers are divided into different types based on different criteria. Based on the size, a computer can be divided into five types:**

1. Micro Computer
2. Mini Computer
3. Mainframe Computer
4. Super Computer
5. Workstations

---

## 1. Micro Computer:

It is a single-user computer which has less speed and storage capacity than the other types. It uses a microprocessor as a CPU. The first microcomputer was built with 8-bit microprocessor chips. The common examples of microcomputers include laptops, desktop computers, personal digital assistant (PDA), tablets, and smartphones. Microcomputers are generally designed and developed for general usage like browsing, searching for information, internet, MS Office, social media, etc.

## 2. Mini Computer:

Mini-computers are also known as "Midrange Computers." They are not designed for a single. They are multi-user computers designed to support multiple users simultaneously. So, they are generally used by small businesses and firms. Individual departments of a company use these computers for specific purposes. For example, the admission department of a University can use a Mini-computer for monitoring the admission process.

## 3. Mainframe Computer:

It is also a multi-user computer capable of supporting thousands of users simultaneously. They are used by large firms and government organizations to run their business operations as they can store and process large amounts of data. For example, Banks, universities, and insurance companies use mainframe computers to store the data of their customers, students, and policyholders, respectively.

## 4. Super Computer:

Super-computers are the fastest and most expensive computers among all types of computers. They have huge storage capacities and computing speeds and thus can perform millions of instructions per second. The super-computers are task-specific and thus used for specialized applications such as large-scale numerical problems in scientific and engineering disciplines including applications in electronics, petroleum engineering, weather forecasting, medicine, space research and more. For example, NASA uses supercomputers for launching space satellites and monitoring and controlling them for space exploration.

### 5. Work stations:

It is a single-user computer. Although it is like a personal computer, it has a more powerful microprocessor and a higher-quality monitor than a microcomputer. In terms of storage capacity and speed, it comes between a personal computer and minicomputer. Work stations are generally used for specialized applications such as desktop publishing, software development, and engineering designs.

---

## Benefits of Using a Computer:

- **Increases your productivity:** A computer increases your productivity. For example, after having a basic understanding of a word processor, you can create, edit, store, and print the documents easily and quickly.
- **Connects to the Internet:** It connects you to the internet that allows you to send emails, browse content, gain information, use social media platforms, and more. By connecting to the internet, you can also connect to your long-distance friends and family members.
- **Storage:** A computer allows you to store a large amount of information, e.g., you can store your projects, ebooks, documents, movies, pictures, songs, and more.
- **Organized Data and Information:** It not only allows you to store data but also enables you to organize your data. For example, you can create different folders to store different data and information and thus can search for information easily and quickly.
- **Improves your abilities:** It helps write good English if you are not good at spelling and grammar. Similarly, if you are not good at math, and don't have a great memory, you can use a computer to perform calculations and store the results.
- **Assist the physically challenged:** It can be used to help the physically challenged, e.g., Stephen Hawking, who was not able to speak used computer to speak. It also can be used to help blind people by installing special software to read what is on the screen.
- **Keeps you entertained:** You can use the computer to listen to songs, watch movies, play games and more.

The computer has become a part of our life. There are plenty of things that we do in a day are dependent on a computer. Some of the common examples are as follows:

1. **ATM:** While withdrawing cash from an ATM, you are using a computer that enables the ATM to take instructions and dispense cash accordingly.
2. **Digital currency:** A computer keeps a record of your transactions and balance in your account and the money deposited in your account in a bank is stored as a digital record or digital currency.
3. **Trading:** Stock markets use computers for day to day trading. There are many advanced algorithms based on computers that handle trading without involving humans.
4. **Smartphone:** The smartphone that we use throughout the day for calling, texting, browsing is itself a computer.
5. **VoIP:** All voice over IP communication (VoIP) is handled and done by computers.

# Introduction of Computer

Organization of Computer System

The creation of a computer is made up of many units and devices called components or components of the computer. All these units and devices work together, so the computer is also called a computer system. Its structure consists of the following units

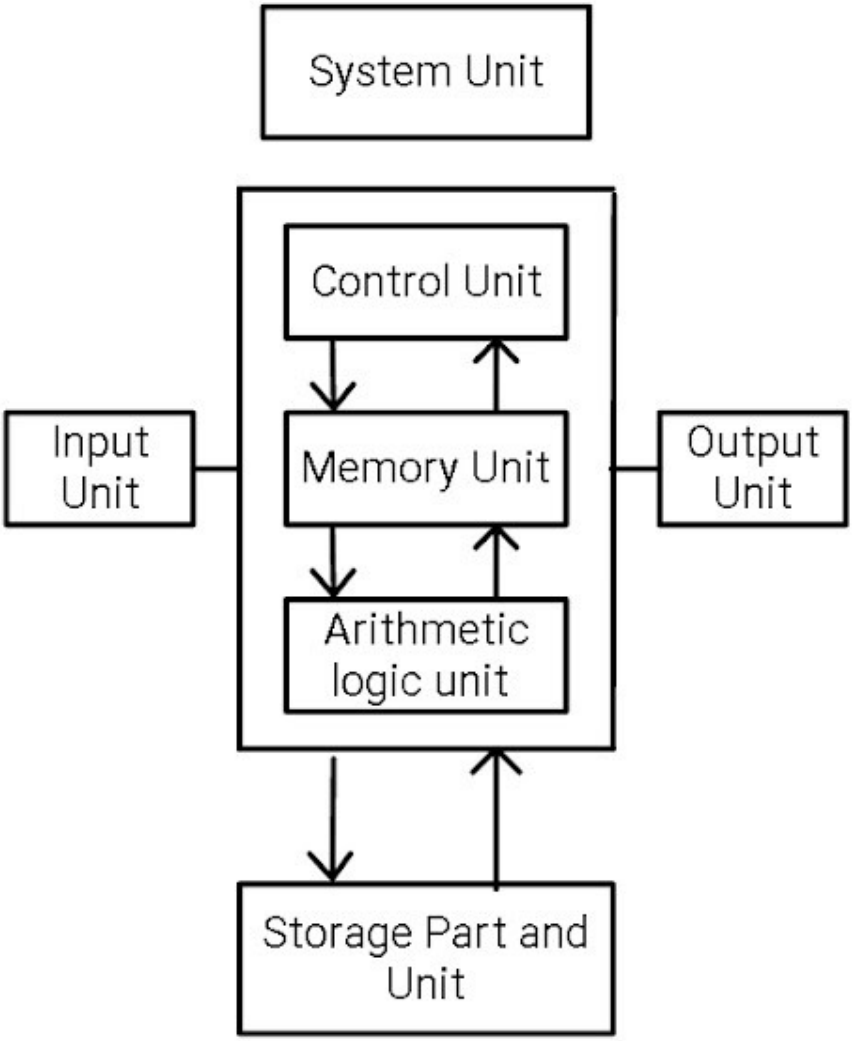



Fig. Block diagram of computer

(1) Input Untit

is the device that we input your data or instructions in Computer. There are lots of input diet that computers is directed to the CRU of the computer that he should do? What is the key to the most important input device of keyboard and mouse computer. Apart from this, there is some other important Input Device is follow-up: Joystick, Trackball, Touch Screen etc. The input Device main

do the following

***Users accept data inputed.***

(B) Converts the data from our language (English) to the computer's understandable language (Machine / Binary).

(C) Binary data is sent to the System Unit for processing.

(2) The System Unit System Unit is also called the CPU is Central Processing Unit. Its Hindi name is the Central Processing Unit. This is the most important part of the computer. Without this the computer system can not be completed. This connects all the computer's Devices like Keyboard, Mouse, Monitor, Printer etc. It is also called Brain of Computer. Its main function is to execute the program (Execute) and to process the data. In addition, the CPU also controls the functions of all sections like Memory, Input, Output Devices. CPU has three parts

(A) ALU

The full name of Alu Alu is Arithmetic Logic Unit. This unit does not have a variety of actions (add-added, addresses, partners, and logical activities (comparison and decisions). Alu Controls instructions from UNIT. This receives data from memory and returns to the information in memory. After the work of Alu, the speed of the work (Speed) is very fast. This makes it an electronic circuit which is capable of calculating binary arithmetic.

***(B) Memory Unit***

Keeps the data and instructions in the computer and receives the information you received by Input Device. It is also called the memory of the computer. In other words, the location of the computer is called the memory where all information, the basis and instructions are kept by the store. This main work is to be stored in the values and stores the data being procedures. This memory is an integral part of CPU. It also says the main memory of the computer and the main memory of the computer, internal memory.

***(C) Control Units***

The full name of the CU is the Control Unit. CU controls and operates the operation of all the hardware of the computer. This controls control the Output actions, as well as directs the exchange of data between Memory and ALU. These programs receive the instructions from the memory to execute the program. Its main function is to obtain order sequentially from memory, interpreting it, and converting to electrical signals and reaching the appropriate Devices.

***3) Output Unit***

Output Unit is the device that provides data input by the user as a result. There are lots of Output Device in Computer which present the results of inputted data and processing for us. Monitor and Printer are two most essential output devices. Apart from this, there is something more important Output Device - Speaker, Projector, Touch Screen etc. The Output Devices mainly perform the following functions-

(A) The system accepts results after processing from the unit.

(B) Convert the results from the computer to the understandable language (Machine / Binary) to our language.

(C) Displays the results for us on screen or printed on paper.

# History of Computers

The first counting device was used by the primitive people. They used sticks, stones and bones as counting tools. As human mind and technology improved with time more computing devices were developed. Some of the popular computing devices starting with the first to recent ones are described below;

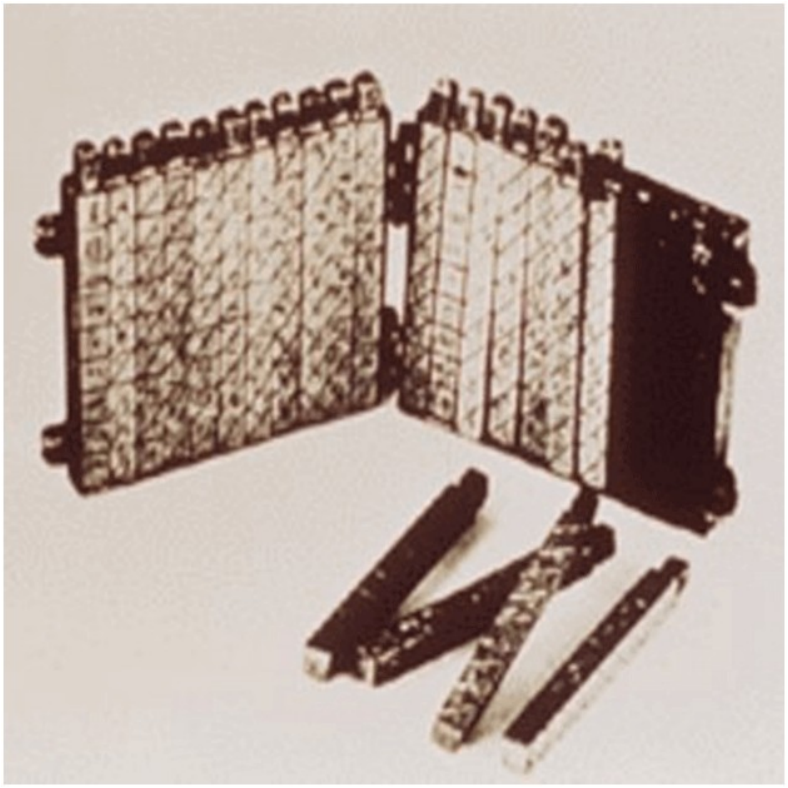
## Abacus

The history of computer begins with the birth of abacus which is believed to be the first computer. It is said that Chinese invented Abacus around 4,000 years ago.

It was a wooden rack which has metal rods with beads mounted on them. The beads were moved by the abacus operator according to some rules to perform arithmetic calculations. Abacus is still used in some countries like China, Russia and Japan. An image of this tool is shown below;

## Napier's Bones

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



## Pascaline

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

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

## Stepped Reckoner or Leibnitz wheel

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

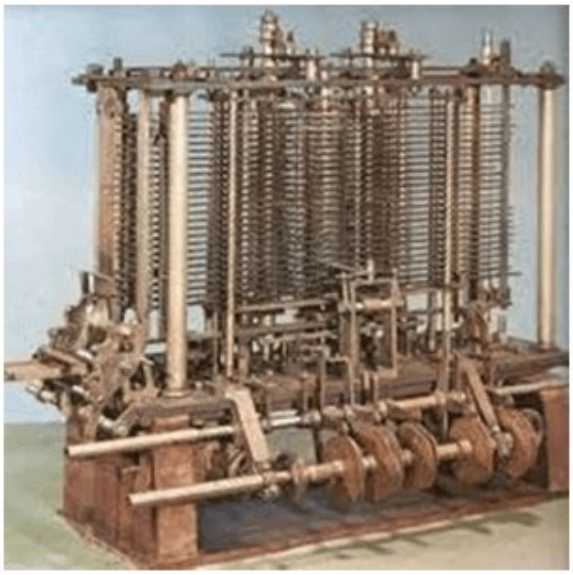
## Difference Engine

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

## Analytical Engine

This calculating machine was also developed by Charles Babbage in 1830. It was a mechanical computer that used punch-cards as input. It was capable of solving any

+-mathematical problem and storing information as a permanent memory.

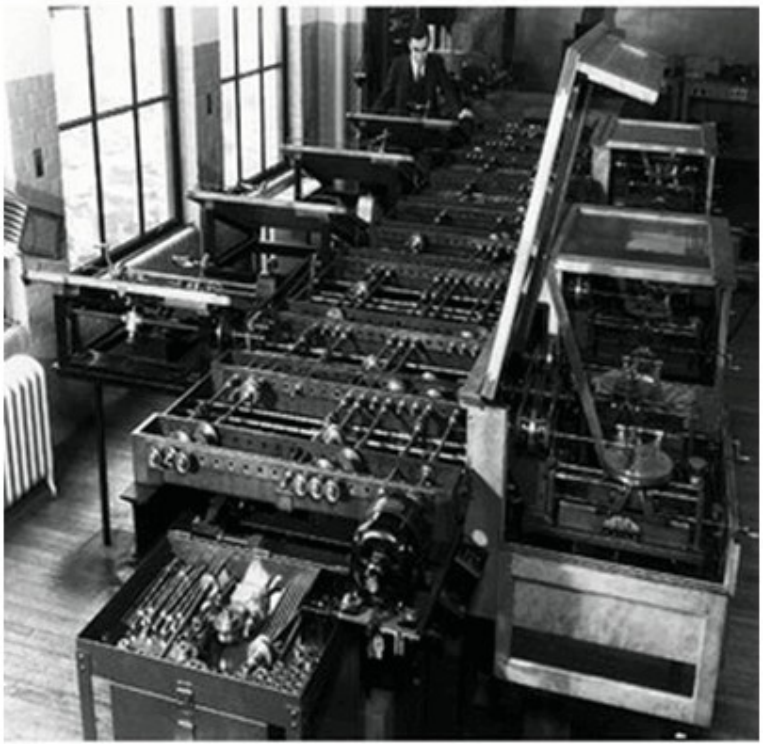


## Tabulating Machine

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

## Differential Analyzer

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



## Mark I

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

# Generations of Computers

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

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

## First Generation Computers

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

Some of the popular first generation computers are;

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

## Second Generation Computers

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

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

Some of the popular second generation computers are;

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

## Third Generation Computers

The third generation computers used integrated circuits (ICs) instead of transistors. A single IC can pack huge number of transistors which increased the power of a computer and reduced the cost. The computers also became more reliable, efficient and smaller in size. These generation computers used remote processing, time-sharing, multi programming as operating system. Also, the high-level programming languages like FORTRON-II TO IV, COBOL, PASCAL PL/1, ALGOL-68 were used in this generation.

Some of the popular third generation computers are;

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

## Fourth Generation Computers

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

Some of the popular fourth generation computers are;

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

# Fifth Generation Computers

In fifth generation (1980-till date) computers, the VLSI technology was replaced with ULSI (Ultra Large Scale Integration). It made possible the production of microprocessor chips with ten million electronic components. This generation computers used parallel processing hardware and AI (Artificial Intelligence) software. The programming languages used in this generation were C, C++, Java, .Net, etc.

Some of the popular fifth generation computers are;

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

## Representation of data and information

### 1.3.3 Data

Computers transform data into information. Data is the raw material; information is processed data. Data is the input to the processing; information is the output. A useful model to describe the relationship between data and information is called the systems model. It shows that data goes into a process and information is then output. Fig. 1.3.1 describes this model.

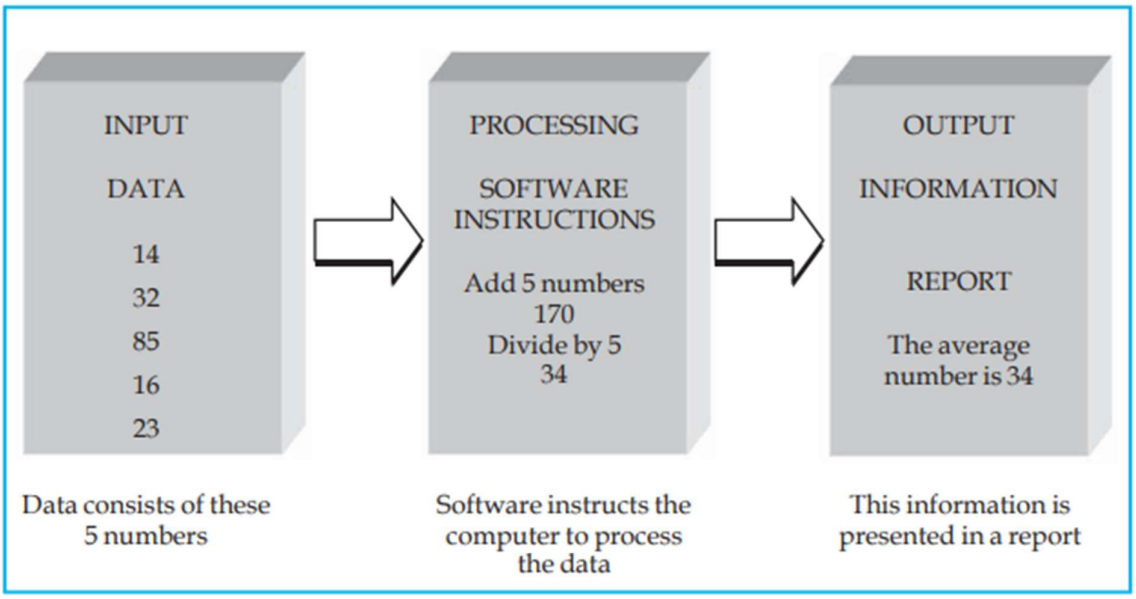



*Fig. 1.3.1: A System Model*

Several characteristics distinguish useful information from data. The purpose of information is to help people for making well-informed decisions, but what makes information useful? Information must be relevant, timely, accurate, concise and complete in order to be useful. Data must be accurate but doesn't need to be relevant, timely or concise. Table 1.3.1 describes these characteristics.

\

| Characteristics | Description |
|---|---|
| Relevant | Information applies to the current situation. |
| Timely | Information is up-to-date and available when it is needed. |
| Accurate | Data given to the computer and the output are correct in every detail. |
| Concise | Information is condensed into a usable length. |
| Complete | All important items are included. |

*Table 1.3.1: Characteristics of useful information*

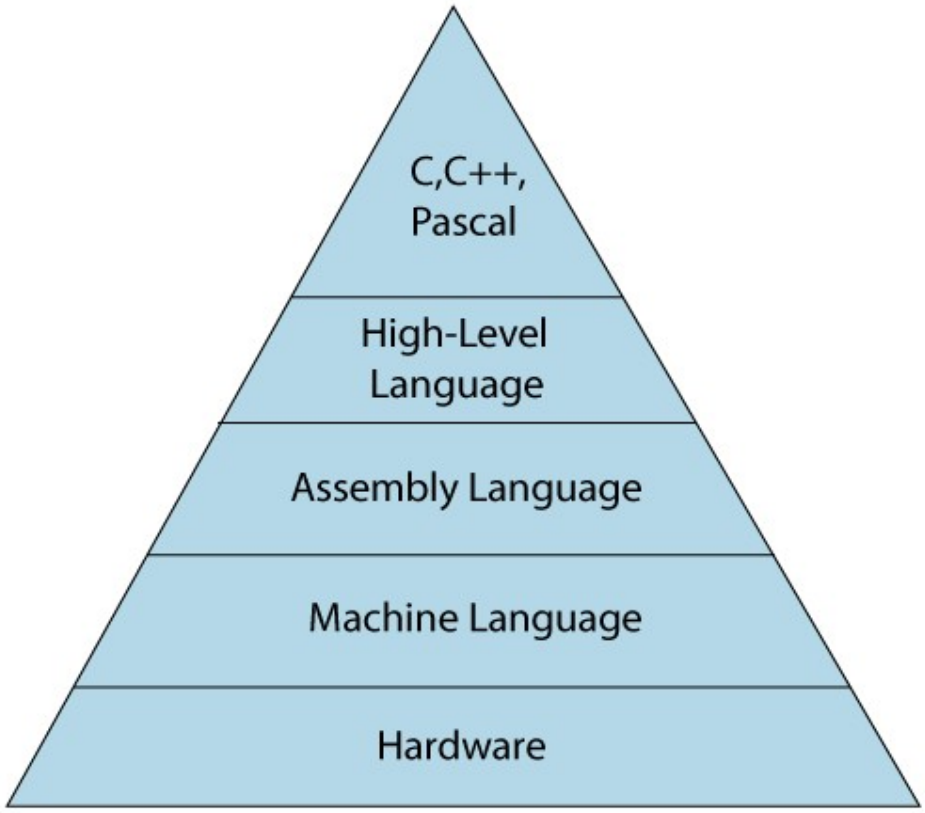
# What is a programming language?

A programming language defines a set of instructions that are compiled together to perform a specific task by the CPU (Central Processing Unit). The programming language mainly refers to high-level languages such as C, C++, Pascal, Ada, COBOL, etc.

Each programming language contains a unique set of keywords and syntax, which are used to create a set of instructions. Thousands of programming languages have been developed till now, but each language has its specific purpose. These languages vary in the level of abstraction they provide from the hardware. Some programming languages provide less or no abstraction while some provide higher abstraction. Based on the levels of abstraction, they can be classified into two categories:

- Low-level language
- High-level language

The image which is given below describes the abstraction level from hardware. As we can observe from the below image that the machine language provides no abstraction, assembly language provides less abstraction whereas high-level language provides a higher level of abstraction.




## Low-level language

The low-level language is a programming language that provides no abstraction from the hardware, and it is represented in 0 or 1 forms, which are the machine instructions. The languages that come under this category are the Machine level language and Assembly language.

## Machine-level language

The machine-level language is a language that consists of a set of instructions that are in the binary form 0 or 1. As we know that computers can understand only machine instructions, which are in binary digits, i.e., 0 and 1, so the instructions given to the computer can be only in binary codes. Creating a program in a machine-level language is a very difficult task as it is not easy for the programmers to write the program in machine instructions. It is error-prone as it is not easy to understand, and its maintenance is also very high. A machine-level language is not portable as each computer has its machine instructions, so if we write a program in one computer will no longer be valid in another computer.

## Assembly Language

The assembly language contains some human-readable commands such as mov, add, sub, etc. The problems which we were facing in machine-level language are reduced to some extent by using an extended form of machine-level language known as assembly language. Since assembly language instructions are written in English words like mov, add, sub, so it is easier to write and understand.

As we know that computers can only understand the machine-level instructions, so we require a translator that converts the assembly code into machine code. The translator used for translating the code is known as an assembler.

The assembly language code is not portable because the data is stored in computer registers, and the computer has to know the different sets of registers.

The assembly code is not faster than machine code because the assembly language comes above the machine language in the hierarchy, so it means that assembly language has some abstraction from the hardware while machine language has zero abstraction.

## Differences between Machine-Level language and Assembly language

The following are the differences between machine-level language and assembly language:

| Machine-level language | Assembly language |
|---|---|
| The machine-level language comes at the lowest level in the hierarchy, so it has zero abstraction level from the hardware. | The assembly language comes above the machine language means that it has less abstraction level from the hardware. |
| It cannot be easily understood by humans. | It is easy to read, write, and maintain. |

| | |
|---|---|
| The machine-level language is written in binary digits, i.e., 0 and 1. | The assembly language is written in simple English language, so it is easily understandable by the users. |
| It does not require any translator as the machine code is directly executed by the computer. | In assembly language, the assembler is used to convert the assembly code into machine code. |
| It is a first-generation programming language. | It is a second-generation programming language. |

## High-Level Language

The high-level language is a programming language that allows a programmer to write the programs which are independent of a particular type of computer. The high-level languages are considered as high-level because they are closer to human languages than machine-level languages.

When writing a program in a high-level language, then the whole attention needs to be paid to the logic of the problem.

A compiler is required to translate a high-level language into a low-level language.

High-level programming language (HLL) is designed for **developing user-friendly software programs and websites**. This programming language requires a compiler or interpreter to translate the program into machine language (execute the program).

The main advantage of a high-level language is that it is **easy to read, write, and maintain**.

High-level programming language includes **Python, Java, JavaScript, PHP, C#, C++, Objective C, Cobol, Perl, Pascal, LISP, FORTRAN, and Swift programming language**.

A high-level language is further divided into two parts -

**i. Procedural Oriented programming language**

Procedural Oriented Programming (POP) language is derived from structured programming and based upon the procedure call concept. It divides a program into small procedures called **routines or functions**.

Procedural Oriented programming language is used by a software programmer to create a program that can be accomplished by using a programming editor like IDE, Adobe Dreamweaver, or Microsoft Visual Studio.

The advantage of POP language is that it helps programmers to easily track the program flow and code can be reused in different parts of the program.

> ***The advantage of POP language is that it helps programmers to easily track the program flow and code can be reused in different parts of the program.***

**Example:** C, FORTRAN, Basic, Pascal, etc.

**ii. Object-Oriented Programming language**

Object-Oriented Programming (OOP) language is **based upon the objects**. In this **programming language, programs are divided into small parts called objects**. It is used to implement real-world entities like inheritance, polymorphism, abstraction, etc in the program to makes the program resusable, efficient, and easy-to-use.

The main advantage of object-oriented programming is that OOP is faster and easier to execute, maintain, modify, as well as debug.

**Advantages of a high-level language**

- The high-level language is easy to read, write, and maintain as it is written in English like words.
- The high-level languages are designed to overcome the limitation of low-level language, i.e., portability. The high-level language is portable; i.e., these languages are machine-independent.

## Differences between Low-Level language and High-Level language

**The following are the differences between low-level language and high-level language:**

| Low-level language | High-level language |
|---|---|
| It is a machine-friendly language, i.e., the computer understands the machine language, which is represented in 0 or 1. | It is a user-friendly language as this language is written in simple English words, which can be easily understood by humans. |
| The low-level language takes more time to execute. | It executes at a faster pace. |
| It requires the assembler to convert the assembly code into machine code. | It requires the compiler to convert the high-level language instructions into machine code. |

| | |
|---|---|
| The machine code cannot run on all machines, so it is not a portable language. | The high-level code can run all the platforms, so it is a portable language. |
| It is memory efficient. | It is less memory efficient. |
| Debugging and maintenance are not easier in a low-level language. | Debugging and maintenance are easier in a high-level language. |

# Number Systems

The language we use to communicate with each other is comprised of words and characters. We understand numbers, characters and words. But this type of data is not suitable for computers. Computers only understand the numbers.

So, when we enter data, the data is converted into electronic pulse. Each pulse is identified as code and the code is converted into numeric format by ASCII. It gives each number, character and symbol a numeric value (number) that a computer understands. So to understand the language of computers, one must be familiar with the number systems.

The Number Systems used in computers are:

- Binary number system
- Octal number system
- Decimal number system
- Hexadecimal number system

## Binary number system

It has only two digits '0' and '1' so its base is 2. Accordingly, In this number system, there are only two types of electronic pulses; absence of electronic pulse which represents '0'and presence of electronic pulse which represents '1'. Each digit is called a bit. A group of four bits (1101) is called a nibble and group of eight bits (11001010) is called a byte. The position of each digit in a binary number represents a specific power of the base (2) of the number system.



## Octal number system

It has eight digits (0, 1, 2, 3, 4, 5, 6, 7) so its base is 8. Each digit in an octal number represents a specific power of its base (8). As there are only eight digits, three bits (23=8) of

binary number system can convert any octal number into binary number. This number system is also used to shorten long binary numbers. The three binary digits can be represented with a single octal digit.

### Decimal number system

This number system has ten digits (0, 1, 2, 3, 4, 5, 6, 7, 8, 9) so its base is 10. In this number system, the maximum value of a digit is 9 and the minimum value of a digit is 0. The position of each digit in decimal number represents a specific power of the base (10) of the number system. This number system is widely used in our day to day life. It can represent any numeric value.

### Hexadecimal number system

This number system has 16 digits that ranges from 0 to 9 and A to F. So, its base is 16. The A to F alphabets represent 10 to 15 decimal numbers. The position of each digit in a hexadecimal number represents a specific power of base (16) of the number system. As there are only sixteen digits, four bits (24=16) of binary number system can convert any hexadecimal number into binary number. It is also known as alphanumeric number system as it uses both numeric digits and alphabets.

## Differences between Hardware and Software

## Computer Hardware

Hardware refers to the physical components of a computer or a machine that we can see and touch. It contains circuit board, ICs, or other electronics in a computer system. It is a physical component that is used in different ways to build a computer or any other machine. The Memory Devices, Processor, Central Processing Unit, Mouse, and the keyboard all are the examples of the hardware in the computer system. On the other hand, the screen on which you are viewing this page is the best example of the hardware, whether you are viewing this page on the tablet, monitor, or smartphone. A computer system would not be existing without any hardware and not able to run any software. An example of an external

hardware peripheral, a keyboard, is shown in the picture. It allows users to give input to the computer.

## Different types of Computer Hardware

1. **Input Devices:** Data and instructions are entered into computers via input devices. They let users communicate with the system and enter data. Keyboards, mice, scanners, microphones, webcams, and joysticks are examples of input devices.

2. **Output Devices:** They show or provide the user with the processed information. Users may view or experience the outcomes of their interactions with the computer by using them. Examples of common output devices are printers, speakers, headphones, and monitors or display screens.

3. **Storage Devices:** Storage devices are important for storing and accessing data on a computer. They store both user-generated data and the operating system. SSD and HDD are the two most commonly used types of storage devices. While SSDs use flash memory technology, HDDs store, and access data using rotating magnetic discs.

4. **Internal Components:** Internal components are the electronic circuits and pieces that comprise the basic infrastructure of a computer system. Those components are in charge of how the computer processes information and functions. The central processing unit (CPU), which serves as the computer's "mind" through carrying out computations and executing instructions, is certainly one of its essential internal components. The CPU can swiftly retrieve data and instructions temporarily stored in random access memory (RAM). The primary circuit board, or motherboard, links and controls all the computer's internal parts and creates paths for data transmission.

# Computer Software

Software is a collection of procedures, instructions, documentation that tells a computer exactly what to do or allows users to interact with a computer. Sometimes it is abbreviated as S/W and SW, which is most important for a computer or other similar devices. Most of the computers may be useless without software. For example, if a software program, MS-Word is not installed into your computer, you cannot make any document that can be completed through MS-Word. Also, you cannot surf the Internet or visit any website if your system has no Internet browser software. Additionally, the browser could not run on the computer without an operating system. The Google Chrome, Photoshop, MS Word, Excel, MySQL and more are examples of software. The picture is shown below, is an example of software, which is a picture of Google Chrome, which is an Internet software program.

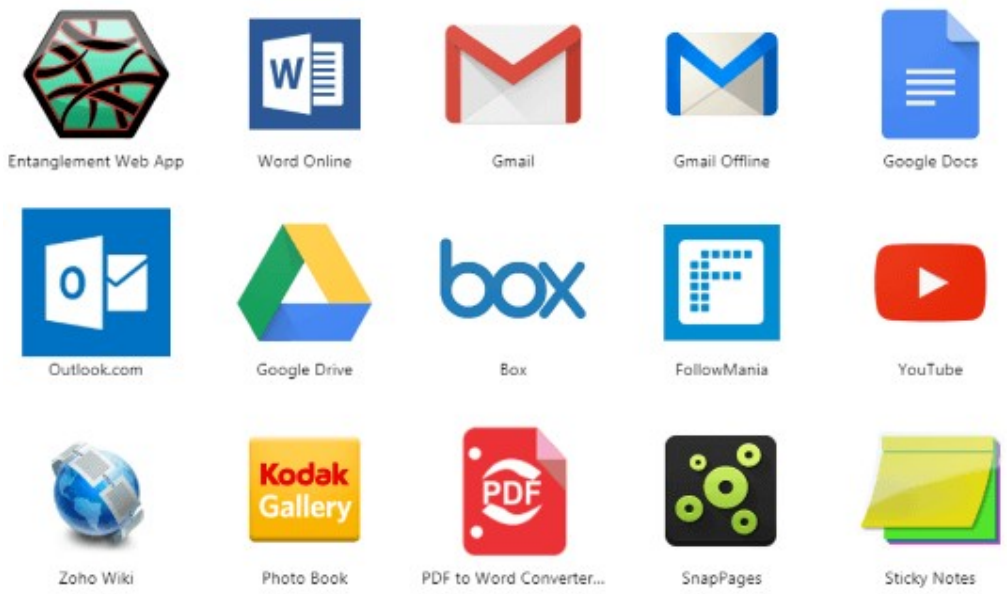
## Different types of Computer Software

**1. System Software**


System software is the software that maintains and controls the basic functions of a computer system. It serves as a bridge between the user and the hardware, ensuring the computer runs smoothly. Operating systems, device drivers, and utility programs are a few examples of system software.

- **Operating systems:** An OS, or operating system, is the essential software that controls the resources of computer hardware and applications.
- **Device Drivers:** Device drivers are software elements that help the operating system, and other linked hardware devices communicate with one another.
- **Utility programs:** They are software applications created to perform particular tasks to enhance system performance or offer extra features.

### 2. Application Software




Application software refers to programs and software applications executing certain tasks or giving end users features. These programs are made to satisfy users' requirements in various areas, including communication, creativity, entertainment, and productivity.

- **Productivity Software:** project management tools, word processors, spreadsheets, and presentation software programs are all examples of productivity software. Users might also create, edit, and control files, spreadsheets, presentations, and work-related activities with those tools.
- **Creative Software:** 3-D modeling programs, photograph- and video-editing programs, image design tools, and music-production software are all examples of creative software. Users can express their creativity and produce digital material because of these programs.
- **Entertainment Software:** Video games, multimedia players, and streaming programs are examples of entertainment software. These programs allow users to participate in engaging, entertaining, and recreational activities.
- **Communication Software:** Email clients, instant messaging programs, video conferencing tools, and web browsers are all examples of communication software. These programs allow users to connect, work together, and access internet resources.

Software is a collection of instructions run on the computer, whereas hardware is a physical device used with or on the computer. On the other hand, the software cannot be touch and held in your hand, whereas hardware can be touch and held in your hand.

**Below is given a table that holds the differences between hardware and software.**

| Hardware | Software |
| --- | --- |
| Hardware is a physical component of computers that executes the instruction. | Software is a program that enables users to interact with the computer, its hardware. |
| It is manufactured in factories. | It is developed by software programmers or software development companies. |
| Storage Devices, Input Devices, Output Devices, and Internal components are the primary categories of hardware. | Operating Systems, Application Software, and Programming Software are the main categories of software. |
| Hardware can be seen and touch as it is a physical, electronic device. | The software can be seen but cannot be touched as it is virtual, not physical. |
| Computer viruses cannot affect hardware. | Computer viruses can affect software. |
| Hardware can be replaced with a new one if it is damaged. | The software is reinstalled if it gets damaged. |
| Through the network, hardware cannot be transferred electrically. Only, it can be physically transferred. | The software can be transferred easily. |
| Examples of hardware are RAM, ROM, Printer, Monitor, Mouse, Hard disk and more. | Examples of software are Google Chrome, MySQL, MS Word, Excel, PowerPoint, Notepad, Photoshop and more. |