Unit 1

Introduction to computer system

The word computer is derived from the word compute. Compute means to calculate. The computer was originally defined as a super-fast calculator. It had the capacity to solve complex arithmetic and scientific problems at very high speed. But nowadays in addition to handling complex arithmetic computations, computers perform many other tasks like accepting, sorting, selecting, moving, comparing various types of information. They also perform arithmetic and logical operations on alphabetic, numeric and other types of information. This information provided by the user to the computer is data. The information in one form which is presented to the computer is the input information or input data.

Data

We generally talk about data and information. Are they the same terms? And if not, what is the difference between them? Well, data is the raw material and information is what we get after processing the data. To be more precise, data is raw facts and figures and information is processed data, that is useful and meaningful. Data is the input to processing, and information is the output.

Information

Information is a set of data which is processed in a meaningful way according to the given requirement. Information is processed, structured, or presented in a given context to make it meaningful and useful.

It is processed data which includes data that possess context, relevance, and purpose. It also involves manipulation of raw data.

Information Processing Cycle

To understand how a computer functions you must understand the information processing cycle.

What is the information processing cycle? The sequence of events in processing information, which includes (1) input, (2) processing, (3) storage and (4) output. These processes work together and repeat over and over.

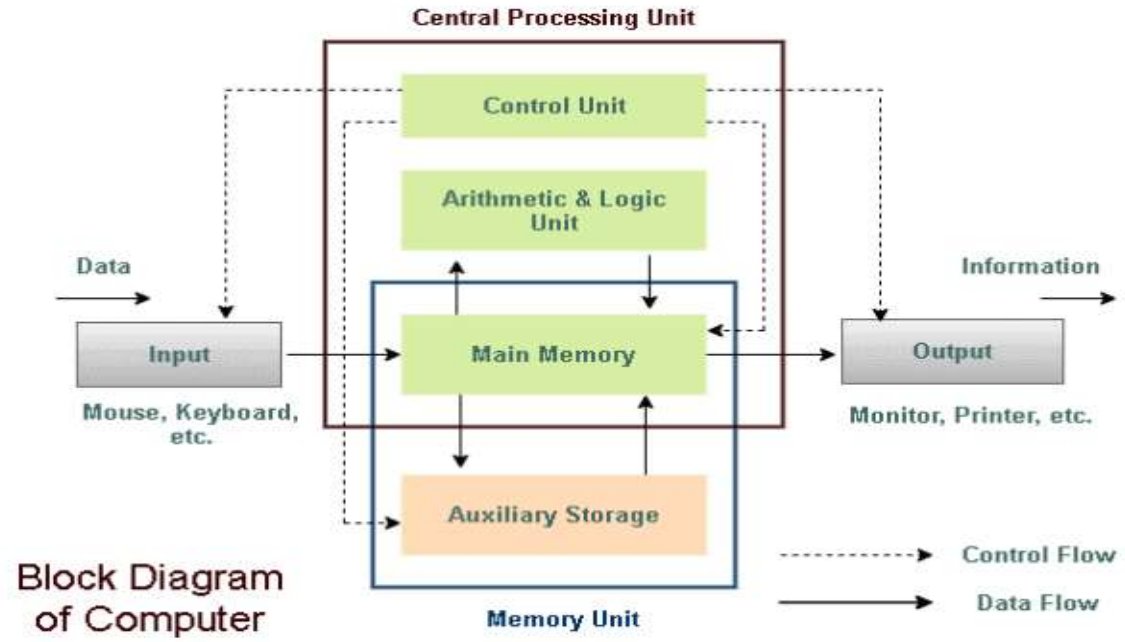
- ✓ Input—entering data into the computer.
- ✓ Processing—performing operations on the data.
- ✓ Storage—saving data, programs, or output for future use.
- ✓ Output—presenting the results.

DIGITAL AND ANALOG COMPUTERS

A digital computer uses distinct values to represent the data internally. All information are represented using the digits O's and 1's. The computers that we use at our homes and offices are digital computers.

Analog computer is another kind of a computer that represents data as variable across a continuous range of values. The earliest computers were analog computers. Analog computers are used for measuring of parameters that vary continuously in real time, such as temperature, pressure and voltage. Analog computers may be more flexible but generally less precise than digital computers. Slide rule is an example of an analog computer.

Architecture/Organization/Anatomy of computer



Let's describe about all the parts as included in the above diagram one by one.

1. The Processor Unit (CPU)

It is the brain of a computer system.

All major calculation and comparisons are made inside the CPU and it is also responsible for activation and controlling the operation of other unit.

This unit consists of two major components, that are arithmetic logic unit (ALU) and control unit (CU).

2. Arithmetic Logic Unit (ALU)

Here arithmetic logic unit performs all arithmetic operations such as addition, subtraction, multiplication and division. It also uses logic operation for comparison.

3. Control Unit (CU)

And the control unit of a CPU controls the entire operation of a computer. It also controls all devices such as memory, input/output devices connected to the CPU.

CU fetches instructions from memory, decodes the instruction, interprets the instruction to know what the task are to be performed and sends suitable control signals to the other components to perform for the necessary steps to executes the instruction.

4. Memory Unit

Memory unit is an essential component of a digital computer. It is where all data intermediate and final results are stored.

The data read from the main storage or an input unit are transferred to the computer's memory where they are available for processing.

This memory unit is used to hold the instructions to be executed and data to be processed.

CHARACTERISTICS OF COMPUTER

Speed, accuracy, diligence, storage capability and versatility are some of the key characteristics of a computer. A brief overview of these characteristics are:

1. **Speed** The computer can process data very fast, at the rate of millions of instructions per second. Some calculations that would have taken hours and days to complete otherwise, can be completed in a few seconds using the computer. For example, calculation and generation of salary slips of thousands of employees of an organization, weather forecasting that

requires analysis of a large amount of data related to temperature, pressure and humidity of various places, etc.

2. **Accuracy** Computer provides a high degree of accuracy. For example, the computer can accurately give the result of division of any two numbers up to 10 decimal places.
3. **Diligence** When used for a longer period of time, the computer does not get tired or fatigued. It can perform long and complex calculations with the same speed and accuracy from the start till the end.
4. **Storage** Capability Large volumes of data and information can be stored in the computer and also retrieved whenever required. A limited amount of data can be stored, temporarily, in the primary memory. Secondary storage devices like floppy disk and compact disk can store a large amount of data permanently.
5. **Versatility** Computer is versatile in nature. It can perform different types of tasks with the same ease. At one moment you can use the computer to prepare a letter document and in the next moment you may play music or print a document.

Computers have several limitations too. Computer can only perform tasks that it has been programmed to do. Computer cannot do any work without instructions from the user. It executes instructions as specified by the user and does not take its own decisions.

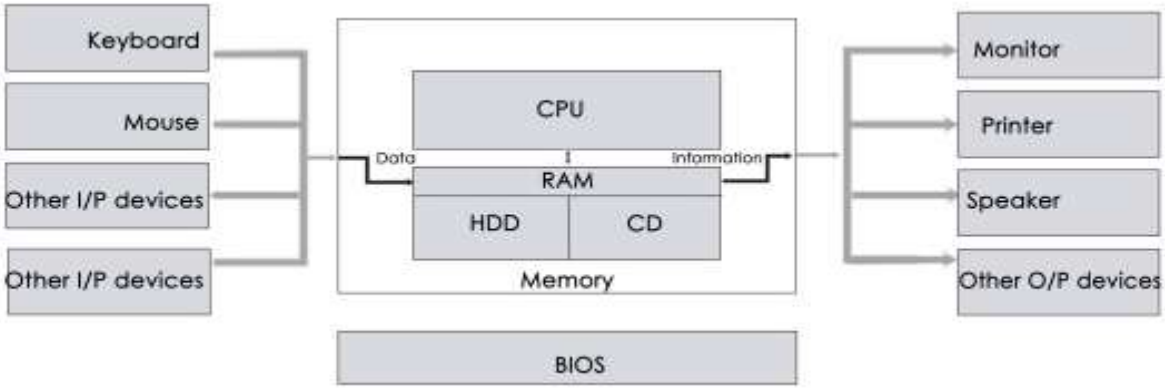
Concept of Hardware and Software

1. Hardware

The term hardware refers to mechanical device that makes up computer. Computer hardware consists of interconnected electronic devices that we can use to control computer's operation, input and output. Examples of hardware are CPU, keyboard, mouse, hard disk, etc.

Hardware Components

Computer hardware is a collection of several components working together. Some parts are essential and others are added advantages. Computer hardware is made up of CPU and peripherals as shown in image below.



Software

A set of instructions that drives computer to do stipulated tasks is called a program. Software instructions are programmed in a computer language, translated into machine language, and executed by computer. Software can be categorized into three types:

- ✓ System software
- ✓ Application software
- ✓ Utility software

1. System software

System software operates directly on hardware devices of computer. It provides a platform to run an application. It provides and supports user functionality. Examples of system software include operating systems such as Windows, Linux, Unix, etc.

2. Application software

An application software is designed for benefit of users to perform one or more tasks. Examples of application software include Microsoft Word, Excel, PowerPoint, Oracle, etc.

3. Utility software

Utility software is part of the system software and performs specific tasks to keep the computer running. Utility software is always running in the background. Examples of utility software are security and optimization programs.

Security programs include anti-virus software that scans and removes viruses. Most computers will include some sort of anti-virus software, but you can add your own.

Optimization programs can include tools for system clean-up, disk defragmentation, and file compression.

Difference Between Hardware and Software:

The following table highlights the points that differentiate a hardware from a software.

Hardware	Software
It is the physical component of a computer system.	It is the programming language that makes hardware functional.
It has the permanent shape and structure, which cannot be modified.	It can be modified and reused, as it has no permanent shape and structure.
The external agents such as dust, mouse, insects, humidity, heat, etc. can affect the hardware (as it is tangible).	The external agents such as dust, mouse, insects, humidity, heat, etc. cannot affect (as it is not tangible).
It works with binary code (i.e., 1's to 0's) .	It functions with the help of high level language like COBOL, BASIC, JAVA, etc.
It takes in only machine language, i.e., lower level language.	It takes in higher level language, easily readable by a human being.
It is not affected by the computer bug or virus.	It is affected by the computer bug or virus.
It cannot be transferred from one place to other electronically.	It can transfer from one place to other electronically.
Duplicate copy of hardware cannot be created.	A user can create copies of a software as many as he wishes.

Data Processing Cycle:

The data processing cycle is a series of steps that raw data goes through to be transformed into useful information. It's a key part of the broader data management process and is crucial in both manual and automated data processing systems.

The steps of the data processing cycle typically include:

Data Collection: The first step involves gathering the raw data. This could come from a variety of sources such as sensors, user inputs, data files, or online data sources.

Data Preparation: This step involves cleaning and transforming the raw data to prepare it for processing. This might include removing errors or inconsistencies, dealing with missing values, and converting data into a suitable format for processing.

Data Input: In this step, the prepared data is inputted into the data processing system. In an automated system, this could involve loading the data into a database or a data processing application.

Data Processing: This is where the data is manipulated to produce meaningful information. Processing could involve calculations, aggregations, sorting, filtering, or more complex data analysis techniques.

Data Output/Interpretation: The processed data is then outputted in a form that can be understood by the user. This might involve visualizing the data in graphs or tables, summarizing the data in a report, or presenting the data through a dashboard.

Data Storage: Finally, the raw and processed data is stored for future use. This could involve writing the data to a disk, storing it in a database, or archiving it in a data warehouse.

The specific steps and techniques used in the data processing cycle can vary widely depending on the nature of the data, the needs of the user, and the capabilities of the data processing system. Regardless of the specific implementation, the goal of the data processing cycle is to transform raw data into meaningful information that can support decision-making and other tasks.

Example of the Data Processing Cycle

Let's take the example of a retail company that wants to analyze its sales data to understand its top-selling products.

Data Collection: The company collects raw sales data from its point-of-sale (POS) system. This data includes details about every transaction, such as the date and time, the products sold, the quantities, and the prices.

Data Preparation: The company cleans and transforms the raw data. This might involve removing any transactions that were later cancelled or returned, converting the date and time to a standard format, and categorizing the products into broader product categories.

Data Input: The cleaned and transformed data is inputted into the company's data analysis software. This could involve loading the data into a database, a spreadsheet, or a specialized data analysis tool.

Data Processing: The company processes the data to calculate the total sales for each product. This might involve summing the quantities sold for each product, multiplying by the price to get the total sales, and then sorting the products by total sales.

Data Output/Interpretation: The processed data is outputted in a form that the company's managers can understand. This might involve creating a bar chart that shows the total sales for the top 10 products, along with a written summary of the findings.

Data Storage: Finally, the raw and processed sales data is stored for future use. This could involve saving the data in the company's database or data warehouse, allowing for future analysis and reporting.

Basic Applications of Computers:

Computers are used in every field of life, such as homes, businesses, educational institutions, research organizations, the medical field, government offices, entertainment, etc. Today we can't imagine growing our technology without computers. The various field where the computer is very essential are: Sscience, Defence system, Medical, Education, Banking, Government Sector, Entertainment etc.

Computer Network:

We are living in a connected world. Information is being produced, exchanged, and traced across the globe in real time. It's possible as almost everyone and everything in the digital world is interconnected through one way or the other.

A group of two or more similar things or people interconnected with each other is called network. Some of the examples of network in our everyday life includes:

- Social network
- Mobile network
- Network of computers
- Airlines, railway, banks, hospitals networks

A computer network is an interconnection among two or more computers or computing devices. Such interconnection allows computers to share data and resources among each other. A basic network may connect a few computers placed in a room. The network size may vary from small to large depending on the number of computers it connects. A computer network can include different types of hosts (also called nodes) like server, desktop, laptop, cellular phones.

Apart from computers, networks include networking devices like switch, router, modem, etc. Networking devices are used to connect multiple computers in different settings. For communication, data in a network is divided into smaller chunks called packets. These packets are then carried over a network. Devices in a network can be connected either through wired media like cables or wireless media like air.

Interconnectivity of computing devices in a network allows us to exchange information simultaneously with many parties through email, websites, audio/video calls, etc. Network allows sharing of resources. For example, a printer can be made available to multiple computers through a network; a networked storage can be accessed by multiple computers. People often connect their devices through hotspot, thus forming a small personal network.

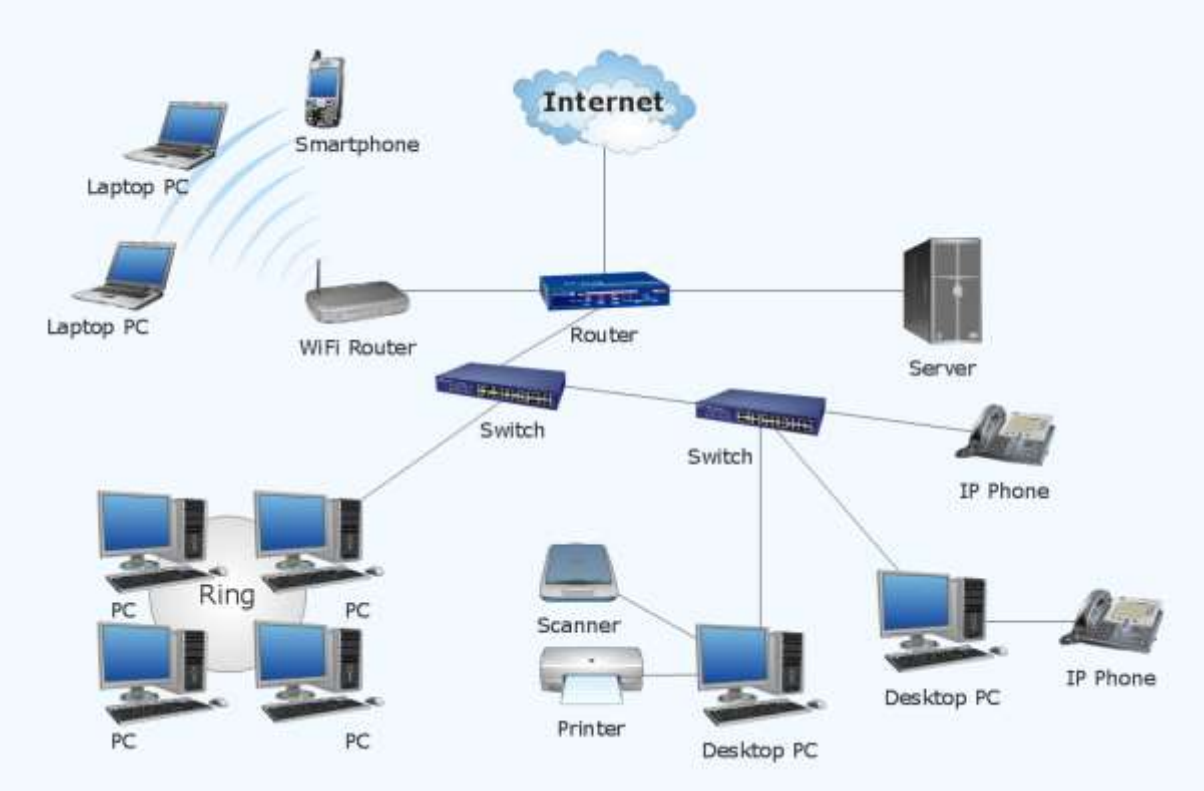


Fig: Network Diagram

Computer Program:

A computer program is a sequence or set of instructions in a programming language for a computer to execute. It is one component of software, which also includes documentation and other intangible components.

A computer program is a list of instructions that tell a computer what to do. Everything a computer does is done by the instructions of a program. A computer program is usually stored as a file on the computer's hard drive. The file contains a list of instructions. When the user runs the program, the computer reads the file does what the instructions tell it to do. These instructions can be very simple, like "add these numbers together" or "save these letters". A computer program is written by a programmer, who combines many of these simple instructions to do complicated things, like talking to the computer's screen and telling it to show a video.

Computer as a programmable device :

Technically, a computer is a programmable machine. This means it can execute a programmed list of instructions and respond to new instructions that it is given.

A computer is a programmable machine that receives input, stores and manipulates data, and provides output in a useful format

A computer is a programmable, electronic device that accepts data, performs operations on it, presents the results, and stores them in order to perform specific tasks. In this definition, we refer to four operations as input, processing, output, and storage instead of input and processing.

programming language:

A programming language is a means of communication for the user to communicate with the computer system. The programming language is a set of instructions which tells the computer what to do. This is a language which is understood by both man and machine. There are a number of programming languages. However all these languages are designed to perform at least certain basic instructions and operations; These instructions and operations are:

- Input/output operations,

- Arithmetic operations - mathematical operations like addition, subtraction,

- Logical operations - Comparison for equality, inequality etc.

- Movement of instructions and data to and from the CPU.

To use the programming language, the programmer has to strictly follow the rules of the language including all commas, punctuation marks etc. otherwise the program will not be understood by the computer. Thus, although the programming languages are much smaller and simpler than the natural languages, they have to be used with the greatest accuracy.

Types of programming languages

a) Machine Language

b) Assembly Language

c) High Level Language

a) Machine Language:

This is the only language which is understood by the computer. This is the language nearest to the machine. In this language the programs are written in binary code i.e. the instructions are made only by a combination of binary digits 0 and 1. Machine language may vary from machine to machine depending upon the computer architecture. Machine languages execute the fastest since they are immediately understood by the computer. No translation of the programs is required. Also they make efficient use of primary memory. But it is very difficult to program in this binary or machine language. It is also very tedious and time consuming,

since all the instructions have to represent as a series of Os and 1 s. Therefore there is always a possibility of errors.

b) Assembly Language:

The Os and 1 s of the machine language were substituted by letters and symbols in assembly languages. The assembly languages use mnemonics (memory aid) in place of operation codes. The language uses symbols instead of numbers to write programs. A program written using such symbols in the assembly language is called the source program. The program written in assembly language has to be converted into machine language for use by the computer. This is achieved with the help of the assembler. The **assembler** is a system program which is supplied by the manufacturer. It converts the assembly program into a machine readable program and the resulting program is called the object program. Thus the input to the assembler is the source program and the output of the assembler is the object program. The assembler translates each assembly language instruction into a corresponding machine code.

It is relatively easy to write programs in assembly language as compared to machine language. Since the machine language and assembly language both are dependent on the hardware, they are referred to as low level programming languages. Both these languages require a deep understanding of the internal structure of the computer.

c) High Level Languages :

Higher level languages make use of English like words and statements and mathematical symbols for instructions. Higher level languages make programming easier, since they are relatively easy to learn. Less time is required to write programs in high level languages. The programmer is not required to know the detailed working of the computer system in order to program in a high level language. They are machine independent. Higher level languages are also known as problem oriented languages.

However a high level language is not directly understood by the computer. It is required to be translated into machine language. Therefore they generally execute more slowly and require more memory than the same program written in assembly language.

The programs which are used to translate programs written in high level language into machine language are known as translators. The types of translators are:

I) Compiler

II) Interpreter

I) Compiler:

The compiler translates the entire source program into machine language program at once. The source code remains intact. Once a program is compiled it can be run as many times as required, without being required to be recompiled. A compiler can translate only those programs which have been written in the language for which it is designed. Also each

machine has to have its own compiler. A compiler is a program which normally resides on the secondary storage device. It gets loaded into the CPU when the source program is to be translated. A compiler checks for errors like illegal symbols, statements etc. during compilation and gives out a list of error messages at the end of execution. This is a very valuable aid to the programmer to correct the programs. However, the compiler is incapable of detecting any logical errors in the program.

II) Interpreter

The interpreter is the program which translates a high level language program into machine language as follows :

- it takes one statement from the high level language program

- translates it into a machine instruction and the instruction is immediately executed.

Since the program is translated statement by statement, the machine level program of the source program is not stored anywhere in memory.

Therefore, the program has to be interpreted every time when it has to be run. Thus no object code is generated. The interpreted programs are generally slower than compiled programs. However, if any changes are made in the source program it can interpret only those statements and it is not required to compile the entire program again. Interpreters are relatively easy to write and smaller in size as compared to compilers.

Thus assemblers, compilers and interpreters are systems software which translate the source program into object program i.e. program which can be understood by the computer. These translators are also known as language processors.

Fourth Generation Languages (4 GL):

Programming languages are sometimes classified with generations - from the lowest to the highest.

The First Generation - Machine Language

The Second Generation - Assembly Language

The Third Generation – High level Language (BASIC, COBOL, RPG, PASCAL, C, LISP etc…)