# Bachelor of Commerce
# (B.Com)

# COMPUTER APPLICATION
# (DBCMSE301T24)

## Self-Learning Material
## (SEM III)

## Jaipur National University
## Centre for Distance and Online Education

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## Course Introduction

Computer Application is assigned 2 credits and contains 6 units. Its objective is to equip students with proficiency in essential software tools such as word processors, spreadsheets, and presentation software Computer Application makes the manager manage and analyze data efficiently using various applications.

Each unit is divided into sections and sub-sections. Each unit begins with statement of objectives to indicate what we expect you to achieve through the unit.

## Course Outcomes

After studying this course, a student will able to:

1. Describe the basics of computers &windows and Microsoft Office
2. Summarize categories of programs, system software and applications. Organize and work with files and folders
3. Compute the Internet Web resources and evaluate on-line e-business system
4. Analyze common business problems using appropriate Information Technology applications and systems
5. Assess technical knowledge and perform specific technical skills
6. Invent new information technology for industry centric.

We hope you will enjoy the course.

## Acknowledgement

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# Unit: 1

# Introduction of Computer

**Structure:**



**Learning Objectives:**

- Define a computer, identify its characteristics and functions;
- Understand the evolution of computers
- Learn about the Generations of Computers
- Describe the different classifications of computers

## 1. IntroductionTo Computers

The word "computer" is derived from the verb "to compute," which implies to perform calculations. Computers have a huge, obvious impact on all aspects of our daily lives.In this module, you will learn how computers operate, how they evolved, and different classifications.

### 1.1 Computer?

A computer is an electrical machine that can receive in sequence or data and carry out a number of tasks in line with an established set of tasks. Data or information is produced as a result of this. A computer is a device that can act on data and solve issues. It accepts the input, goes through various mathematical and logical processes to process it, and then produces the desired result.

Thus, a computer can be defined as a device of electronic equipment that converts data into information. The capabilities of a computer can also be used to characterise it. High speed, precision, diligence, adaptability, and storage are key attributes of a computer.

### 1.2 Computer Organisation

In general, a computer performs five main tasks, which are:
(1) Accepting data or instructions via input;
(2) Storing data;
(3) Processing data following user requirements;
(4) Providing results in the form of output; and
(5) Regulating all computer-related actions.

We go over each of these operations below.

1. INPUT: Entering data and information into the computer system.
2. CONTROL UNIT (PCU): This unit is in charge of overseeing the input, output, processing, and storage processes. It determines when data is to be received, when it is to be stopped, where data is to be stored, etc. It handles the step-by-step processing of all computer processes.
3. MEMORY UNIT: Data and instructions are stored in the computer's memory unit.

4. OUTPUT: This process generates information-rich outcomes from the data.

A computer system's central processing unit (CPU) refers to both the ALU and the CU.

### 1.3 Characteristics of a Computer

Let's examine some of a computer's qualities to understand better.

- **Accuracy** -Computers display a very high level of precision. Most errors are caused by human error, whether erroneous data, improper instructions, or a chip flaw.
- **Reliability** – Computers can consistently perform the same tasks without making mistakes brought on by fatigue or boredom, which are highly common in humans.
- **Versatility**: Computers are capable of doing a wide range of tasks, from simple mathematical calculations and buying tickets to sophisticated calculations and ongoing astronomical observations. The computer will function if you input the required data and follow the instructions.
- **Storage Capacity** – Computers can store enormous amounts of data at a fraction of the price of conventional file storage. Additionally, data is protected from paper's typical wear and tear.

### 1.4 Evolution of Computers

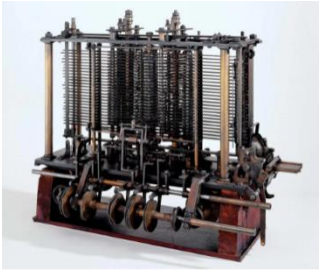
Man has always needed to count things, do calculations, or analyse data.

#### 1.4.1 Early Developments

The ABACUSis a rack of wood that contains parallel rods on which beads are strung. It is theearly computing device. Addition and subtraction was possible by this tool. Abacus

French scholar Blaise Pascal (1623-1662) developed mechanical adding machine in 1642 which represented an important step in developing computer systems.

In 1671 Gottfried Wilhelm von Leibniz improved the formula by adding the ability to multiply, divide, and discover the square root.



First mechanical calculator was sold commercially in 1829. Charles Xavier Thomas created this. Multiplication, Division, Addition and Subtraction was possible through this desktop calculator. Better mechanical calculators came after that.

Charles Babbage created “difference engine,"in 1822. It is a mechanical calculator that operates automatically. His "analytic machine" was a general-purpose, programmable, Difference Engine automatic mechanical digital computer that went into production in 1833. He earned the title of "father of the modern computer" as well.

The development of punch cards, an automatic calculating employed for the first time by Herman Hollerith and James

### 1.4.2 Present-Day Developments

Numerous research teams put forth a lot of effort to create an autonomous digital computer by the late 1930s. ENIAC (Electronic Numerical Integrator and Calculator) was designed in 1942 by physicist John W. Mauchly and electrical engineer J. Presper of Eckert. In 1946, ENIAC began operatingRelays were replaced by vacuum tubes as the logic components. It was, therefore, 1,000 times faster than its electromechanical forerunners.

However, the magnitude and complexity of ENIAC were unparalleled.

EDVAC (Electronic Discrete Variable Automatic Computer), a stored-program computer, followed ENIAC in 1950. in 1947 to produce computers for the market. The business created the UNIVAC I (Universal Automatic Computer) in 1951 for the US Census Bureau.

## 1.5 Generations of Computer

Every generation has smaller and more advanced circuitry than the one before it.

Today,. Additionally, it may be used to edit or make presentations, videos, and spreadsheets. However, this complicated system has been developing ever since the first generation of computers was introduced in the 1940s.

### 1.5.1 The First Generation: 1946- 1958 (Vacuum Tubes)

The first generation of computers was characterised by size, speed, and reliability issues. They occupied entire rooms, relied on vacuum tubes for their circuitry and magnetic drums for their memory. They were quite expensive and produced lot of heat.

Examples: NIAC, EDVAC, UNIVAC, IBM-701, IBM-650

Features:

- “Vacuum tube technology”
- Unreliable
- Supported Machine language only

- Very costly
- Huge size

### 1.5.2 "The Second Generation: 1959-1964 (Transistors)"

The second generation of computers was powered by transistors, which replaced vacuum tubes. Vacuum tubes were surpassed by transistors. This made these computers smaller and cheaper. They were more dependable than their first-generation forebears. In place of the opaque binary machine language, Symbolic, or assembly, languages were introducedin second-generation computers.Ithelped programmers to define commands in words. COBOL and FORTRAN (High-level programming languages), were also introduced.

Magnetic core technology was used instead of a magnetic drum for storing instructions.

Few Examples are: IBM 7094, Honeywell

Important Features:

- Use of transistors
- Reliable
- Small Size
- Generate less heat
- Consumption of Less Electricity
- Fast.

### 1.5.3 Third Generation: 1965-1970 (Integrated Circuits IC)

The improvement of the built-in route distinguished the third generation of computers. Smaller semiconductors were used in these computers. Keyboard and monitors were used to interact with the system. These systems were interfaced with an operating system. Because they were lighter and less expensive than their forerunners, computers, for the first time, were affordable to spectators. Few Examples are: PDP-8, PDP-11, ICL 2900, IBM 360, IBM 370

Features:

- Use if Integrated Circuits
- Reliability
- Compact Size
- Less heat was generated
- Fast

- Low maintenance required
- Less electricity was consumed
- high level languages were supported

### 1.5.4 The Fourth generation: 1971- today (Microprocessors)

All computer components such as central processing unit, memory, and input/output controllers, were housed on a single chip (Intel 4004 chip), which was created in 1971. In "1981 IBM released its first personal computer for home use.In 1984 Apple released the Macintosh. These computers were connected together which eventually gave birth to the Internet". GUIs, the mouse, and handheld devices were all developed in conjunction with the fourth generation of computers. This generation used all high-level languages, such as C and C++, DBASE, etc.

Few Examples are: IBM 4341, DEC 10, STAR 1000, PUP 11

Features:

- VLSI technology used
- Very Affordable
- Portable and reliable
- Very small size
- Introduction of "Internet".

### 1.5.5 FIFTH GENERATION

1980 and beyond are called the fifth generation phase. Some applications, such as speech recognition, are currently in use, but the fifth generation of computer devices based on artificial intelligence is still being developed. Superconductors and parallel processing are accelerating the development of artificial intelligence. The goal of fifth-generation computing was to develop systems that could learn, self-organize, and respond to natural language inputs.

This generation uses all higher-level languages like C and C++, Java,.Net, etc.

Few Examples are: Desktop, Laptop, NoteBook, UltraBook, Chromebook

Features:

- True Artificial Intelligence
- ULSI technology
- Parallel Processing
- Natural language processing
- Superconductor technology
- User-friendly interfaces and multimedia features

### 1.6 Major Type of Computers

We can divide these electronic devices as follows:

1. Digital Computers
2. Analog Computers
3. Hybrid Computers

#### 1.6.1 Digital Computers

Instead of the actual quantities utilized in analogue computers, a digital computer works with data that is represented as digits. This means that its input must be precise rather than continuous and may include different sets of integers, letters, and special symbols that are expressed in the proper programming language.

#### 1.6.2 Analog Computers

They use physical quantities like electric current, voltage, resistance, mechanical motions, etc., to represent numerical magnitudes. These are devices made to carry out mathematical operations.

These devices are used where temperatures, force, and liquid flow must be continuously monitored, like petrol pumps, where they translate fuel flow measurements into quantities and prices.

The inability to store vast amounts of data, the lack of analytical capabilities, and the fact that only arithmetic operations could be performed on them are some drawbacks of using them.

#### 1.6.3 Hybrid Computers

These computers are a cross between the two categories mentioned above. Analogue or digital data may be used or produced by a hybrid computer. It is achieved by linking a digital and analogue computer together using a hybrid interface or by having the unit of

analoguebuilt into a digital computer's core CPU, which finally facilitates for direct getting of input and output.

Scientific applications and industrial process control require the use of hybrid computers. In either of the case, a user can use the machine's capacity for processing discrete and continuous data.

### 1.7 Type of Computers Based on Size

The following classification would apply if we were to group computers according to their sizes:

1. Supercomputers
2. Mainframe Computers
3. Super Mini Computers
4. Mini Computers
5. Micro Computers/Personal Computers

#### 1.7.1 Supercomputers

A supercomputer has multiple processing units that work in parallel to increase speed. They are employed for more complex applications since they are, in fact, extremely large computers. Among major super computers in India, one of them was used by the meteorological service for weather forecasting.

#### 1.7.2 Mainframe Computer

It is different from supercomputers because it may be linked to other computers for sharing theirsources the airline reservation system is an example of an everyday application. At their headquarters, the airlines have a mainframe computer where they keep data on all flights. Small systems are connected to the main data bank so that the most recent flight information is available.

#### 1.7.3 Super Mini Computers

These are hybrids of supercomputers and minicomputers. They are frequently employed as single-purpose computers to perform one processing task at a time.

#### 1.7.4 Mini Computers

They are slower and have less storage than mainframe computers. They can also accommodate different terminals. Actually, they can accommodate as many as 100 terminals.

Minicomputers can accommodate several users thanks to their operating systems' multitasking and network features. The primary applications for these systems are in local government and education, as well as front-end processors for main-frame computers. Additionally, word processing uses it. They are used in business for things like billing, inventory management, payroll, sales analysis, etc.

### 1.7.5 Micro Computers and Personal Computers

Digital computers, known as microcomputers, have processing units with one or more microprocessors, I/O devices, and enough memory for operations. These devices often have a monitor, a keyboard, and storage for tapes and diskettes. They can be desktop or portable. They are mainly intended for individual operation, although they can be utilised as workstations in terminal emulation mode.

Type of Micro Computers

- Desktop microcomputers
- Notebook or laptop microcomputers
- Tablet and Smartphone microcomputers
- Mini Tower and Full Tower micro computers

## 1.8 Summary

- A computer is a device that can act on data and solve issues.
- CPU refers to ALU and CU.
- Fourth generation of computers used integrated circuits.
- The goal of fifth-generation computing was to develop systems that could learn, self-organize, and respond to natural language inputs.
- Analogue computers are extensively employed in manufacturing facilities where temperatures, pressure, or liquid flow must be continuously monitored
- For scientific applications or for industrial process control Hybrid computers are used.
- A supercomputer has multiple processing units that work in parallel to increase speed.
- Minicomputers can accommodate several users thanks to their operating systems' multitasking and network features.

## 1.9Keywords

- Iteration: the repetition of a process

- Forerunner: a person or thing that precedes the coming or development
- Reliability: performing consistently well
- Handheld devices: They are the portable devices.
- quantum: a required or allowed amount
- magnitude; a numerical quantity or value

## 1.10 Self-Assessment Questions

- 'Computers have a huge, obvious impact on all aspects of our daily lives'. Give reasons to justify this statement.
- Briefly explain the characteristics of a computer.
- Write a brief note on evolution of computers.
- How the computers in each generation different from one another?
- What is the purpose of third generation of computers?
- What is the history of computers, generation by generation?

## 1.11 Case Study

For a long time, computer science and programming were not taught as official disciplines in New Zealand schools; instead, the emphasis in computing classes was on teaching students how to utilise computers. The newly introduced curriculum offers to explore a variety of computer science topics such as human-computer interaction, algorithms and complexity, artificial intelligence, encryption, formal languages, computer graphics, etc. ICT (Information and Communication technology) was defined within a wide and literal domain, when in 1995 the school curriculum adopted and included “technology” as a learning subject.

**Questions**

- Discuss how the school would have implemented the new ICT curriculum.
- Do you think it would be easy for junior and senior learners to adapt to the new curriculum?

# Unit: 2

# Computer Interface

**Structure:**



**Learning Objectives:**

- To understand the concept and function of computer interface
- Learn about Data Processing and Block Diagram
- Analyse the Computer System Architecture
- Learn about the different Input and Output Devices

## 2. Introduction

The art of linking computers and devices is known as computer interfacing. Even though the PC has many plug-and-play internal hardware options, connecting various external devices requires technical expertise. The interface is the link and interaction between the user, the software, and the hardware. It needs to be created, tested and then redesigned.

**Hardware Interfaces:** They are the cables, sockets, plugs, and electrical impulses. Examples include ATA/IDE, Ethernet, FireWire,

**Software/Programming Interfaces:** They are the languages, codes, and messages that are used to communicate. Examples include the Windows, Mac, and Linux operating systems,

### 2. 1 Function of Computer Interface

Every interface implies a structure and function. Electronic signals engage hardware-level processes; data is read, written, sent, received, error-checked, etc. Instructions at the software level turn on the hardware. At higher levels, the data being transported or communicated might even make a function request (client/server, program to program, etc.).

**User Interfaces:** A "user interface" is the layout of the user's interaction with a computer. "Protocols" are the agreements, forms, and interactions between the various parts of a communications system or network. Keyboards, Mouse, commands, and menus are examples of user interfaces that you use to interact with a computer.

### 2.2 Data Processing

These systems are referred as Information systems. Data are most valuable when displayed correctly. These systems typically modify raw data into information.

Data is the figures or lettering. It represents capacity from the genuine globe. A datum refers single real-world capacity. Measured information is algorithmically derived, logically inferred, or statistically calculated from various data.

Although, data conversion would be the most natural and accurate phrase, "data processing" can refer to any operation that transforms data between different formats.

The process of transforming information into data and then back into information is known as data processing.

#### 2.2.1 Data

Data is any unprocessed information such as facts, figures, and text. It comprises:

- Information about operations or transactions. For example sales, costs, inventories, payroll, and accounting.
- Information including industry sales, forecasts, and macroeconomic information.
- Metadata is information about the data, such as definitions from a data dictionary or a logical database design.

### 2.2.2 Information

These data's patterns, interactions, and affiliations may have information. For instance, analysing transaction data from retail point-of-sale systems might reveal when products are selling.

## 2.3 Block Diagram

Every time a computer is used, there are three fundamental stages it must go through in order to finish any task. Input, processing, and output are these. These steps are completed by a computer executing a agenda. A program is a set of detailed instructions that specify the processing of computer to get the desired result.

### 2.3.1 Input

Intake of data by a computer is the focus of the input stage of computing. This is accomplished using input devices. The keyboard and mouse are the two most often utilised input methods.

### 2.3.2 Processing

The application includes instructions on how to handle the input. The computer uses the recently input data to execute these instructions during processing. The output quality that the computer generates after this phase depends on the program's instructions.

### 2.3.3 Output

It is the processed data in the form of information. This information is valuable to the user. It is done using output devices.

## 2.4 Computer System Architecture

The computer's 'brain' is located here. All of the searching, sorting, maths, and decision-making happen here. By executing software instructions, the CPU takes the input from the

devices (Keyboard, mouse etc) and transforms it into relevant information. After this the output data is transferred to printers and monitors.

The central processing unit (CPU) is a silicon chip microprocessor made up of micro electrical switches known as "transistors." Megahertz (MHz) or Gigahertz (GHz) are units used to express how quickly a processor performs its tasks. The processing speed of the computer increases with the MHz value. Today's typical CPU operates at 3 GHz or more.

### 2.5 Input Devices

Before processing the data it must be converted into device legible form and to be entered into the PC by a put in devices Several input devices will be introduced in this section.

#### 2.5.1 Keyboard

It is the most popular input device for entering data and commands into computers. It is organised into four primary regions, each with a set of alphabetic, numeric, and function keys:

Function keys are on the top, letter keys are in the middle portion. There is a numeric keypad to the right. Keys for editing and cursor movement are also there.

A QWERTY keyboard is the configuration of the keys on a keyboard. It is used in many nations. QWERTY is in the first six keys on the top row of the alphabetic characters. Other keyboards include incorporated wrist support, while others offer additional Internet keys.

Hundreds of times every second, the computer's processor checks the keyboard to determine whether any keys have been pressed.

Advantages:

- Is commonly attached to computers.
- It is the means for text and number data input.
- Data can be entered quickly by a proficient typist.
- There are specialtykeyboards available.

Disadvantages:

- Mistakes might happen while entering data
- It may be quite time-consuming process
- Entering data, such as the specifics of diagrams and images, is particularly challenging

### 2.5.2 Mouse

The most common pointing device you will encounter is a mouse. You can slide it about the desk to adjust the on-screen cursor's position and movement.

The mouse's buttons allow you to click and drag items about the screen and choose options from menus. 'Mouse click' is the sound made when a mouse button is pressed. The terms "double click," "click and drag," and "drag and drop" may be familiar to you.

Most mice move in the direction using a little ball that is situated underneath them. Two rollers inside the mouse rotate. One is for recording in an east-west direction. The computer moves the pointer based on information the mouse gives to it about how far and in which direction the ball is turning.

Advantages:

- They work well with desktop computers
- Most computer users are accustomed to using them.

Disadvantages:

- They require a flat surface area next to function
- It is difficult to operate the mouse with a laptop, notebook, or palmtop. Touch sensitive pad is required.

### 2.5.3 Trackball

The pointer on the screen is moved when you turn the ball with your hand. It operates with extremely minimum room requirements and frequently works in conjunction with computer-aided design. It features buttons like a regular mouse. Instead of a traditional mouse, you will frequently find a little trackball incorporated into laptop computers.

Advantages:

- It is helpful with laptops as they can be integrated into the keyboard.
- It is useful where flat space next to the computer is restricted.

Disadvantage:

- Not included as standard, thus they cost extra

### 2.5.4 Joystick

It is similar to tracker ball, with the exception that you move the stick rather than a rolling ball. Computer games require joysticks to be played. An ordinary joystick has eight directions in which it can be moved.

The computer uses the information provided by the joystick, which indicates the direction in which it is being moved, to, for instance, drive a racing vehicle on the screen. Several buttons on a joystick may also be used to initiate activities like firing a missile.

Advantage:

- When you shift the stick, a direction change is immediately felt.

Disadvantages:

- It can break easily.
- Some people may find it challenging to use

### 2.5.5 Touch Screen

These screens serve the same purpose as concept keyboards. The screen has a grid of thin wires or light beams running over it. When you press the screen the computer senses it since the rays are blocked.

Since they are user-friendly and convenient, touch screens are frequently used as input devices in public locations including airports, museums, ATMs, etc.

Advantages:

- Easy to use
- No further peripherals are required beyond the touch screen display itself
- Neither computer system proficiency nor expertise required to use it.

Disadvantages:

- It is quite expensive
- Entering large data is not possible
- Does not work with accuracy
- Touch displays are not reliable

### 2.5.6 Digital Camera

A digital camera resembles a traditional camera. It makes use of several light sensors. When a photograph is taken, sensors that are at the behind of lens convert the colors that make up the image into digital signals (binary).

Digital cameras allow to view the image instantly and you can erase it if you don't like it.. The image can be uploaded to a computer and can be edited by using photo editing software. The resolution of each image determines how much memory it uses. The number of dots that make the image determines the resolution. More the dots sharper the image is.

Advantages:

- Photographs can be printed, distributed via email, or uploaded to websites.
- Unwanted photographs can be immediately erased.
- Editing or enhancing images is possible

Disadvantages

- They are typically more expensive than conventional cameras
- Photographs take up too much memory space

**2.5.7 Scanner**

A scanner captures still images and text that can be used on a computer. During scanning beam of light shines onto the surface of the object. The reflected light builds up the image.
Commonly used scanners are Flatbed and Handheld
Most popular one is flatbed. It is similar to a Xerox machine. Flatbed scanners are more accurate.
Handheld scanners are rolled across the image which is to be scanned.

Advantages:

- Flat-bed scanners are more accurate as compared to a digital camera
- Image in Computer Format

Disadvantages:

- Scanned images consume memory space.
- Quality of image largely depends upon the original image..

### 2.5.8 Graphics Tablets

They are used by designers and illustrators. A graphics tablet has a flat pad (the tablet) on which a drawing can be made by using a special pen. Image is created on the screen when you draw. It produces accurate screen design.It is accurate to within hundredths of an inch. Device called puck is used to draw on the graphics tablet.

Advantage:

- It is the most efficient tool for accuracy.

Disadvantage:

- Clicking on the tools is sometimes difficult.

## 2.6 Output Devices

### 2.6.1 Monitor

Very first window that we see just after loading operating system is called as monitor.It displays the output on the screen.

Measures of a monitor are 17 inches, 19 inch, 20 inch and 21 inches. Output quality depends upon the resolution, contras, viewing angle and how fast it refreshes the screen.
The picture on a monitor is made up of pixels. The quality of the picture on a monitor depends on pixels. Denser pixels give the clarity to the screen image.
Matrix of dots of Red, Green and Blue (RGB) displays millions of colors.

The two most common types of monitor are:

1. Cathode-ray tube (CRT): Used in computer monitors and Televisions.
2. Liquid crystal display (LCD): Used in Portable electronic games, Video projection systems etc

Advantages of monitors

- Affordable
- More Reliable
- Display in a wide range of colours

Disadvantages of monitors:

- Results disappear when the computer is switched off
- Limited information can be displayed at once.
- Fragile glass screens

### 2.6.2 Printers

Printers produce outputs on papers. Output can be in the form of a text or image on paper. Colour Printers gives the colored outputs. Special paper can be used for generating photographs also.

There are three main types of printers. Classification is based on purchase costs, running costs, quality and speed.

- Laser
- Dot Matrix
- Inkjet

### 2.6.3 Plotter

A plotter is a type of output device used to produce high-quality, large-scale graphics such as architectural blueprints, engineering designs, maps, and other technical drawings.

Advantage:

- Larger paper sizes than those found on most printers can be used.

Disadvantages:

- Plotters are slower than printers.
- Cost is more as compared to printers.

## 2.7 Summary

- ❖ CPU takes the input from the devices (Keyboard, mouse etc) and transforms it into relevant information
- ❖ Data must be converted into machine-readable form and to be entered into the computer by a input devices
- ❖ Very first window that we see just after loading operating system is called as monitor

- ❖ Printers produce outputs on papers. Output can be in the form of a text or image on paper.

## 2.8 Key words

- Input
- Output
- Pixels

## 2.9 Self Assessment Questions

- Explain the difference between data and information.
- Explain the examples of input, output and processing devices.
- Write a short note about the architecture of a computer system.
- Give three examples of input devices and explain advantages and disadvantages of the same.
- Discuss how plotter is different from a printer?

# Unit: 3

# Number System

**Structure:**



**Learning Objectives:**

- To understand the Number system.
- To understand the binary addition, binary subtraction.
- To understand Floating Point representation of numbers.

### 3.1 Introduction to Number System

Decimal number takes up ten values i.e. from 0, 1, 2, 3, 4, 5, 6, 7, 8 and 9. On the other hand binary number takes only two values i.e. zeros and ones.

#### 3.1.1 Description of Number System

**(a) Binary Number System**

Its base is '2' and digits used are 0 & 1.

**(b) Octal Number System**

Its base is '8' and digits used are 0 to 7.

**(c) Hexa Decimal Number System**

Its base is '16' and digits used are 0 to 9 with letters A to F.

### 3.2 Representation of Integers

Integers and floating-point numbers are treated differently in computers.

There are two representation schemes for integers:

Zero and positive integers are represented by *Unsigned Integers*

Zero, positive and negative integers are represented by *Signed Integers.*For signed integers three representation schemes had been proposed which are given below:

Representation of Sign-Magnitude

Representation of 1's Complement

Representation of 2's Complement

### 3.3 Octal and Hexadecimal representation of numbers

#### 3.3.1 Octal Number System

- It has eight digits, 0, and 1,2,3,4,5,6,7.
- It has base 8
- Example Octal Number: 125708

#### 3.3.2 Hexadecimal Number System

- It has 16 digits – 0,1,2,3,4,5,6,7,8,9,A,B,C,D,E,F.

- It has values from 0-9. After this A = 10, B = 11, C = 12, D = 13, E = 14, F = 15.
- It has base 16
- Example 16 X where X represents the last position - 1.

### 3.4 Decimal to Binary conversion

Let's understand the conversion with the help of an example:

Convert $(101.101)_2 = (?)_{10}$

101.101

= 1 x 22

+0 x 21

+ 1 x 20

.1 x 2-1+0 x 2-2 + 1 x 2-3

=1x4+0x2+1x1.1x (1/2)+0x(1/4)+1x(1/8)

=4+0+1.(1/2)+0+(1/8)

= 5+0.5+0.125

= 5.625

Therefore $(101.101)_2 = (5.625)_{10}$

### 3.5Binary Addition

The following is the binary addition table

| A+B | SUM | CARRY |
|---|---|---|
| 0+0 | 0 | 0 |
| 0+1 | 1 | 0 |
| 1+0 | 1 | 0 |
| 1+1 | 0 | 1 |

Example :

**Add $(1010)_2$ and $(0011)_2$**

1010 (Augends)
0011 (Addend)
_____
1101 (sum)
_____

The addition is operated above as following .

Step-1: The least significant bits are added, i.e. 0+1=1 with a carry of 0

Step-2: The carry in the previous is added to the next higher significant bits, i.e. 0+1+1=0 with a carry 1.

Step-3: The carry in the previous is added to the next higher significant bits, i.e. 1+0+0=1 with a carry 0.

Step-4: The preceding carry is added to the most significant bit i.e. 0+1+0 = 1 with a carry0**.**

**Thus the sum is 1101.**

### 3.6 Subtraction of Numbers

The following is table for Binary Subtraction

| A+B | DIFFERENCE | BORROW |
|---|---|---|
| 0-0 | 0 | 0 |
| 0-1 | 1 | 1 |
| 1-0 | 1 | 0 |
| 1-1 | 0 | 0 |

**Example:**

**Subtract (0101)2 from (1011)2**

**1011 (Minuend)**

**0101 (Subtrahend)**

**_____**

**0110 (Difference)**

**_____**

**Steps:**

Step-1: The LSB in the first column are 1 and 1. Thus, the difference is 1 - 1 = 0

Step-2: The column, the subtraction is performed as 1-0=1

Step-3: In the third column, the difference is given by 0-1=1

Step- 4: In the fourth column (MSB), the difference is given by 0-0 = 0 since 1 is borrowed for the third column.

### 3.7 Binary Multiplication

The following is the Binary Multiplication table

| A*B | PRODUCT |
|---|---|
| 0*0 | 0 |
| 0*1 | 0 |
| 1*0 | 0 |
| 1*1 | 1 |

**Example:**

Multiplicand * Multiplier

10110.1x01001.1

_____

101101

101101

000000

000000

101101

000000

_____

011010101.11 (Final product)

_____

### 3.8 Binary Division

The following is the Binary Division table

| A÷B | PRODUCT |
|---|---|
| 0÷0 | Undefined |
| 0÷1 | 0 |
| 1÷0 | Undefined |
| 1÷1 | 1 |

**Example:**

Dividend ÷ Divisor

11011.1 ÷ 101

101.1 (QUOTIENT)

DIVISOR 101 √11011.1 (DIVIDEND)

101

———————

111

101

———————

101

101

———————

0

———————

### 3.9 Floating Point Representation of Numbers

Example:

$6.6310\times10^{-34}$ (Planck's constant)

The first bit describes the non-zero part of the number which is known as the ‘Mantissa’, the second part describes how many positions the decimal point needs to be shifted.This is

known as the ‘Exponent’. It can be positive when shifting the decimal point to the right and negative when shifting to the left.

| | | |
|---|---|---|
| 6.63 | x | $10^{-34}$ |
| Mantissa | | Exponent |

If it is needed to write out that number in full, onewill have to shift the decimal point in the exponent 34 places to the left, resulting in:
0.0000000000000000000000000000000000663

This would need a significant amount of time to write and make it difficult for the naked eye to count the zeros. Planck's constant, for example, is a multi-digit quantity that can be stored in a small number of digits when we are willing to accept a particular level of accuracy (6.63 = 3 significant figures). You are constantly balancing the accuracy (number of significant bits) of the number with its scope (or range).

### 3.10 Summary

Binary System is very important technique. Computer can only understand language of 0 & 1 to respond to a command

### 3.11 Keywords

- Integers
- Floating Point representation of numbers
- Mantissa

### 3.12 Self-Assessment Questions

- Discuss the characteristics of the Octal Number System
- Explain binary division with the help of an example.
- Explain binary addition and subtraction.

### 3.13 Case Study

Mr. X from school ABC organised a game of binary calculation and several students participated in the same. He provided following equation to be calculated based on the basis of binary calculation: 0*1÷1+1-0 and asked to provide the correct answer for the same by following the BODMAS rule.

1. What is the correct answer for the same?

   Answer- 1

2. What is the answer of 1’s complement?

   Answer- 0

## Unit: 4

# Computer Memory

**Structure:**



**Learning Objectives:**

- Defining memory cell
- Comprehending the Characteristics of Memory Cell
- Understanding types if storage in a computer
- Read-Only Memory and types
- Random Access Memory and its types
- Serial Access Memory

## 4.0 Introduction

The maintenance of a computer's performance requires a variety of factors. Computers need memory to store data that the central processor unit uses to process and execute instructions in order to operate effectively. This chapter will explain to us what computer memory is, why it's crucial, and the various kinds of computer memory.

You need a way to store the data if you want to keep all your work on your computer. Many storage systems can take care of this for you. Hard disks, floppy disks, CD-ROMs, and DVDs are a few of the more popular types you have encountered.

When looking into SSDs or memory, you've encountered a memory cell. You may have also come across acronyms like SLC, MLC, or TLC. These words describe various memory cell types that are utilized by flash storage. Any time you purchase a USB flash drive, SD card, or SSD, you will discover these variations in your available alternatives.

## 4.1 What is Computer Memory?

Memory can be internal or external. It stores the data and instructions. It has memory cells with different identifying number.

Memory stores the instructions to be proceed, under processed and already processed.

## 4.2 Why is computer memory so important?

Computer memory is essential because without it, devices instructions cannot be processed. It manages the task and maintains your computer. You can also employ specific sorts of data to save information for later use.

## 4.3 What is a memory cell?

The tiniest data storage unit is a memory cell. Another name for it is a binary memory cell. One piece of data can be stored in a memory cell.

Although the computing industry uses various memory cell types, NVRAM (Non-Volatile Random Access Memory) cells are the most often employed in SSDs and other storage devices. Non-volatile cells retain the value they were given whilst in use, even after you turn them off.

A single memory cell:

A dynamic cell comprises a transistor and a capacitor.

A static RAM contains around five transistors.

### 4.3.1 Where are memory cells found?

Memory cells of any kind, whether RAM or ROM, can be found in almost every part of the computer.

Many little segments make up the memory. For instance, a memory unit holds 64 × 1024 = 65536 memory locations if the machine has 64k words. These places have addresses ranging from 0 to 65535.

There are mainly two types of memory.

- Internal Memory: Primary and cache memory
- External memory: Examples include Magnetic disks, optical disks, etc.

### 4.3.2 Characteristics of Memory Cell

Characteristics of the memory hierarchy are as follows:

The amount of storage capacity grows.

Storage becomes less expensive per bit.

The CPU's ability to access memory quickly reduces.

The CPU's access time increases.

## 4.4 Storage

Bytes measure a computer's storage capacity. The smallest data unit that can be stored is a byte consisting of 8 bits (also known as binary digits).

Binary numbers, such as 1 or 0, represent bits.

A keyboard letter, number, or symbol equals one byte (a binary term).

More storage is required to keep the work safe.

Typically, Kilobytes (kB), Megabytes (MB), and Gigabytes (GB) are used to describe a computer's storage capacity (or, on really big systems, Terabytes!).

## 4.5 Quantity Information

Bit: It is the smallest unit of data which is either a 0 or 1

Byte 8 bits: It is the series of 0s and 1s, e.g. 00111010

Each keyboard character = 1 byte

Kilobyte (kB): 1000 keyboard characters = 1000 bytes or 1 kB (kilobyte).

Megabyte (MB): 1000 kilobytes = 1 MB (1 million keyboard characters)

Gigabyte (GB): 1000 Megabytes = 1 GB (gigabytes or 1 billion characters)

## 4.6 Types of Memory

### 4.6.1 Internal

Where smaller bits of information are stored is called as internal memory. It is considered as primary memory. Chips comprise internal memory. RAM and ROM are the two primary types into which internal memory is separated.

### 4.6.2 Random Access Memory

Internal memory of CPU is called as RAM. It is temporary in nature.

RAM is also referred to as "volatile memory". When the device is turned off this memory is lost. The work done is saved in RAM..

The size of RAM has grown as operating systems and computer programs have become more complicated. Nowadays, most PCs come with 256MB or 512MB of RAM.

RAM is of two types

Static RAM

Dynamic RAM

#### 4.6.2.1 DRAM, or dynamic RAM

DRAM- Dynamic random access memory is the type of RAM used in contemporary gadgets like laptops, desktop computers, portable electronics, and gaming systems. It produces high-capacity memory and is the less expensive of the two forms of RAM.

It is constructed of two parts—transistors and capacitors—that must be recharged periodically in order to maintain data retention. It has volatile memory, just as RAM, and loses data when the power goes out.

DRAM, needs to be refreshed. It rewrites the data many hundred times per second.

#### 4.6.2.2 SRAM, or Static RAM

Static Random AccessMemory (SRAM) stores the data as long as there is electricity in the system. It costs more than DRAM since it retains power for a longer period of time, which usually prevents it from being as popular. SRAM is quicker than DRAM because it is frequently used as cache memory by users

SRAM utilizes more chips because matrix has more room. It increases the cost of production.

### 4.6.3 Read-Only Memory (ROM)

Another type of primary internal memory is read-only memory (ROM), although unlike RAM, ROM is non-volatile and retains data over time. 'Non-volatile memory' is another name for this kind of memory.

A ROM chip is placed on the motherboard of a computer. The BIOS is another name for this program.

A ROM is an ideal option whenever any data needs to be permanently stored. For example many automotive computers will have ROM chips that are used to run the relevant engine.

The various ROM kinds are as follows.

#### 4.6.3.1 Masked ROM (MROM)

Devices with a pre-programmed collection of data or instructions and had Hard-wired made up the earliest ROMs. These ROMs fall under the category of "masked ROMs." It is an affordable ROM.

#### 4.6.3.2 PROM - Programmable Read-Only Memory

It is read-only memory. Blank PROM can be used to enter the desired data by using PROM application.

#### 4.6.3.3 EPROM - Erasable Programmable Read-Only Memory

During programming, an electrical charge gets trapped in an insulated gate region. The charge lasts for more than ten years since it lacks an escape or leakage path. When in use, a sticker seals the quartz cover.

#### 4.6.3.4 Electrically Erasable Programmable Read-Only Memory (EEPROM)

Electrical currents are used for programing and erasing the EEPROM. It has more than ten thousand reprogramming and wipe cycles.

### 4.6.4 Serial Access Memory

Sequential access requires the system to look through the storage device. It starts with the memory address till it locates the needed data. A Sequential Access Memory, or S, is a memory device that permits such access.

Data storage devices that read data sequentially are called serial access memory (SAM).

Sequential access memory allows for uncontrolled access by "seeking" the desired position. However, this process could be more efficient.

### 4.6.5 Cache Memory

It accelerate the CPU. It serves as a buffer when main memory is used.. Operating systems move data and program components from disk to cache memory so CPUs can access them.

Advantages

Faster than main memory

Takes less time to access

It keeps the programs that can run quickly in storage

Data is stored for short-term use

## 4.7 Summary

- The computing industry uses a variety of memory cell types.
- Non-volatile cells retain the value they were given whilst in use even after you turn them off.
- A cell in dynamic RAM memory has a transistor and a capacitor.
- A cell in static RAM memory contains roughly five transistors
- Memory cells of any kind, whether they are RAM or storage, can be found in almost every part of the computer.
- Bytes are used to measure a computer's storage capacity.
- Binary numbers, such as 1 or 0, are used to represent bits.
- Terabyte (TB) Equal to 1,099,000,000,000 bytes.
- CD ROM disks have a capacity of 650 MB.
- PROM is read-only memory that a user can only modify once.
- Electrical currents are used for programming and erasing the EEPROM.
- Random Access Memory, as opposed to ROM, is volatile memory.
- RAM is of two types: Static RAM and Dynamic RAM
- DRAM, is to be refreshed to keep the data.
- Serial Access Memory is frequently employed as supplementary storage in general-purpose computers

## 4.8Keywords

- Non-volatile memory
- Volatile memory
- Byte
- Mounting
- Supplementary Storage

## 4.9 Self-Assessment Questions

1. Explain three ways in which RAM is different from ROM.
2. Differentiate between volatile and non-volatile memory using suitable examples.
3. Define the concept of memory storage and bytes. Name the different types of bytes.
4. What are the advantages of cache memory?
5. Differentiate between RAM and ROM. Also, state its different types.
6. Discuss how a computer's storage capacity affects its performance.

## Unit: 5

# Computer Hardware

**Structure:**



**Learning Objectives:**

- To understand the concept of storage capacity
- Define Internal Computer Hardware Components
- Learn about Physical Devices used to Construct Memories
- Acquire knowledge about different types of data storage and storage devices

## 5.0 Introduction

Any sort of tangible component of a digital or analogue computer will be called as “computer hardware” altogether. The term “hardware” is tangible and term “Software” in non tangible.

Software tells hardware what task is to be completed. A machine cannot work if there is no coordination between hardware and software.

**5.1 Computer Hardware Components (Internal)**

Inputs are stored and processed by these internal components. They are composed off:

**Motherboard**: It is a circuit board which is a hub for all other hardware components. It is mostly present inside the central processing unit (CPU) and is very important hardware.

**CPU**: It is responsible for processing and executing digital instructions from multi level programs. The CPU's clock frequency impacts the computer's overall performance and results of data processing.

**RAM**: RAM is an interim memory that provides programs on-the-spot access to data. Because RAM is eruptive memory and any stored data vanishes when the machine is closed.

**Hard disk**: This storage device, which functions a bit like a filing container, stores all applications and data. If a comparison is made in between floppy disk and hard disk in context to speedy data access, hard disk will result out as quicker option.

The whirringsound a hard drive generates is caused by the millions of times per minute it spins inside its metal case. Although external drives that plug into the computer are also available, most hard disks are installed inaccessibly inside computers.

**SSD or solid-state disk**: An SSD, or Solid State Drive, is a type of storage device that uses solid-state memory to store data persistently. Unlike traditional hard disk drives (HDDs), which use spinning disks and magnetic storage to store data, SSDs have no moving parts and store data electronically on interconnected flash-memory chips.

**Heat sink**: It reduces heat from the system's parts to control their temperature which in turn helps them to function normally. The heat sink is typically mounted on the top of the internal component.

**Graphics Processor**: It handles graphic data. It is chip based.

**NIC or Network Interface Card(**network adapter): It enables the computer to connect to a network. It facilitates the Ethernet network.

Semiconductors, transistors, power sources, and USB ports are also the Internal hardware’s.

## 5.2 Physical Devices Used to Construct Memories

The amount of RAM installed in your computer is known as physical memory. The operating system, as well as particular apps and files, are loaded onto your computer using this RAM.

What are physical devices? They are any computing device that deals with input/output, storage, etc., such as a disk, printer, modem, or screen.

What is the physical memory of a computer? Physical memory is simply the computer's physical RAM, typically installed on motherboards as cards (DIMMs). It is the only storage type that the CPU can way in directly and is often referred to as primary memory. It contains the executable program instructions.

High physical memory utilization is due to a flaw in a process that would typically be much less resource-intensive or by running too many resource-intensive apps. Numerous factors might contribute to slow processing, some of which will be more challenging to address than others.

### What are physical computer devices?

It is a collection of all the computer's touchable components, including the keyboard, mouse, display, etc.

Physical memory, often referred to as random-access memory (RAM), is a quick but unstable way to store data. Physical disks are frequently timed in milliseconds (10001), but RAM modules are commonly timed in nanoseconds (10003).

### What kind of memory is used in a computer?

Memory in computing refers to the actual hardware used to temporarily or permanently store data, such as program state information or programs (order of commands) for use in a system or other digital electronic device.

## 5.3 External Memory

Secondary memory, also referred to as external memory, is memory that isn't directly connected to the CPU and which is removable as per the need. People use various types of External Memory in their gadgets.

Examples include CDs, flash drives, memory chips, and external hard drives. With the help of External Memory, data can be stored, transferred and accessed in any other suitable device.

**Floppy Disk**

Floppy disks, which have been around since about 1980, are among the earliest types of mobile storage devices still considered for usage.

You can create backup copies of your work to guard against losing it using the floppy disk drive to fetch micro files between different systems. The material used to create floppy disks is known as Mylar. They have a magnetic surface that enables data to be recorded. While the first (3 1/2 inch) floppy disks were actually "floppy," the ones we use today are covered in hard plastic. The read/write head may access the disk because the disk rotates in the drive. The maximum capacity of Floppy Disk is 1.44 Mb which equalizes to text of approximately 300 pages on an A4 size page. However, as graphic images are frequently quite huge, floppy disk are not suggested mediums to work on those files.

Prior to writing data to the disk, all disks must be formatted. The disk is divided into sectors during formatting so that data files can be put there. Pre-formatted floppy disks are frequently marketed.

Floppy Disks should be handled carefully to safeguard the data. You should avoid touching the disk's surface and keep it away from hot or cold places and strong magnetic fields like those that may be present next to speakers, as doing so could cause all of your data to be lost.

**Zip Drive**

The Zip drive resembles a floppy disk but has a storage capacity of 100 MB to 250 MB, which is approximately 70 times greater than a floppy.

The Zip disk requires a separate drive and is marginally thicker than a floppy disk. Zip disks are very helpful for recovering crucial data and for quickly transferring data between computers. Data is compressed to make big files to fit on a floppy disk smaller.

**Magnetic Tape**

Magnetic tapes are considered as the most popular media for bulk data holding, back-up, archiving, and exchange. Hard disk and tape have historically had a far higher capacity-to-price ratio than hard disk, but the two have moved closer together recently. Numerous formats exist, many exclusive to specific platforms or industries, such as mainframes or a specific type of personal computer.

Though entrance time on tape is slow, the rate of continuous exploration of data is quick as the tape is a sequential access medium.

Examples of organizations using this medium:-

- Space Borne Photography companies have a pile-up of many photographs.
- Film studios that store their digital films in archives
- Companies that specialize in architecture, automobiles, and design and hold hundreds of CAD drawings.
- Scientific institutions like CERN keep the outcomes of previous experiments.
- Weather service providers.

There are two types of magnetic tape:

- Tape reels: It can store huge data and used for backup data from mainframe systems.
- Cassettes or cartridges: It is small but stores enough data to back up the information stored on a personal computer or network.

**Compact Disc**

Compact discs hold the data that can be recovered or used at a later time. Software for your computer can be found on CDs. Storing music to play in a CD player and files to access on system.

A typical CD can store 650 MB of data or 72 minutes of music. Data on an 80-minute CD can be stored in 700 MB.

Compact Discs can be categorized on:

End-use: Video, Audio, Photo, Graphics

Operations: Read-Only, Recordable, Rewritable

**Optical Drive**

External memory known as an optical drive may store and read data using light. CDs, DVDs, and Blu-ray discs are the three most popular varieties. You insert the disc into the optical drive and the computer spins it so you can access the information on the disc.

It is scanned by an internal laser beam, which also downloads the data from the optical disk into the computer after receiving it. This sort of memory can be helpful because it often costs little, is simple to use, and holds a lot of data.

**Magnetic Data Storage**

Data is encoded as an electric current in magnetic storage devices, which have a covering of magnetic material. Small portions of a metal spinning disk are magnetized in this sort of memory using magnetic fields.

Each segment, which denotes a "1" or a "0," is quite large, frequently containing many terabytes of data. Users favor this sort of memory because it is inexpensive, robust, and capable of holding a large amount of data. Floppy disks, hard drives, and magnetic tape are examples of common magnetic storage media.

**Solid State Drives**

External memory in the form of solid-state drives makes use of silicon microchips. Solid-state drives are more contemporary than magnetic storage devices, but they share the ability to be removed from the device from which data is being stored or extracted.

The universal serial bus (USB) memory stick or USB flash drive are popular types.

**Virtual Storage**

Virtual memory transfers data to a paging file, a section of a hard drive that serves as an extension of RAM, when RAM space is running low. This is a transient process that ends once there is enough RAM space available.

## 5.4 Summary

- Storage capacity is determined in bytes.
- Kilobytes (KB), Megabytes (MB), and Gigabytes (GB) are common numbers used to describe a computer's storage capacity
- The Zip drive resembles a floppy drive but has a storage capacity of 100 MB, which is at least 70 times greater than a floppy
- Hardware for has internal and exterior parts. The whirringsound a hard drive generates is caused by the hundreds of times per minute that it spins inside its metal shell.
- You may quickly back up the work on DVDs for security.

## 5.5 Keywords

- Back-up
- Storage

- Hardware

## 5.6 Self-Assessment Questions

- Explain Storage Capacity? Discuss how it can be measured.
- Differentiate between RAM and ROM
- Differentiate between Megabyte and GigaByte
- Explain any three examples of storage devices.
- With the help of suitable examples discuss different types of files.
- Explain File Generations? Explain with the help of suitable examples.

## Unit: 6

## Programming Languages

**Structure:**



**Learning Objectives:**

- Computer languages
- Classification of programming languages –machine, assembly, and high-level languages
- Common programming language tools
- Concepts of flowcharts and Decision Table
- Features of an Ideal Programming Language.

## 6.0 Introduction

To do any task with the data supplied by the user, a computer needs instructions. A program is a combination of commands that are supplied to a device to carry out particular activities. The actions that are outlined by the software should be carried out by the computer. A program controls how a computer interprets and utilizes data.

set of instructions that carry out certain activities on a computer system is known as a program. Software instructs a machine to carry out a certain processing function or set of procedures. A combination of coding commands used to guide the device to perform sequence of calculations or operations is referred to as a program. The keyboard, a magnetic disk, or any other device can be used to enter these commands into the computer.

## 6.1 Features of Programming Languages

Programming Language is used as a tool to develop a Software program, which is a set of commands and grammar. Key characteristics of programming languages include:

- Syntax: A combination of protocols and structures used by computer language to write code.
- Data Types: Various types of values include booleans, strings, and numbers.
- Variables: Values can be stored in specific locations.
- Operators: Used for basic arithmetic operations on values.
- Control Structures: Guides the direction flow of a program, such as if-else statements, loops, and function calls
- Paradigms: It is a programming style which is used in the language, such as procedural, object-oriented, or functional

Some are JavaScript, Python, Ruby, C++, etc. Each language has its own advantages and disadvantages.

A programming language describes the sequence of commands for a computer to adhere in order to perform particular task.

## 6.2 Computer language Hierarchy

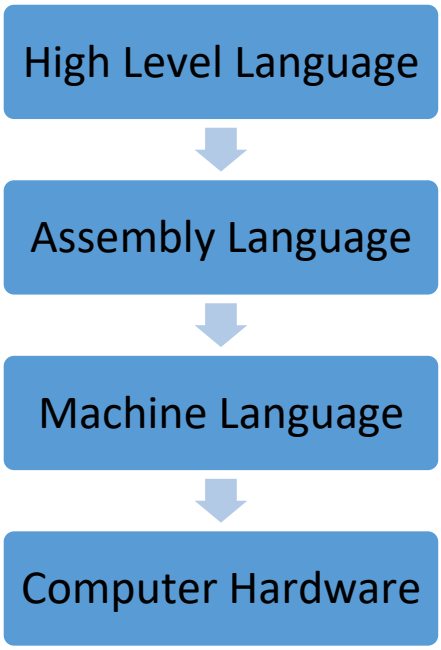



Figure 1: Hierarchy of Computer Languages

Few of the popular programming languages are mentioned below:

C and C++

Python, Java, SCALA

R,Ruby,Go, Swift,JavaScript

### 6.3 Programming Languages Characteristics

Features of an Ideal Programming Language are:

- Easy to learn
- Can be read by humans
- Can be translated into machine code
- Well organized.
- They have tools for testing.
- Should provide an integrated development environment (IDE)
- Should have the quality of ‘abstraction’ which increases usability

## 6.4 Benefits of Programming language

- Enhanced Productivity: Programming languages provides developers a combination of inputs that enable them to write code more rapidly and effectively.
- Portability/Flexibility: High-level programming languages are portable, meaning they may be used to create programs that run across a wide range of platforms and operating systems.
- Readability: Effective programming languages can help both the original author and other developers understand and read code more easily.
- Large Communities: There are sizable user and developer communities for many programming languages, which can offer assistance, libraries, and tools.

**Programming language drawbacks**

- Complexity: Particularly for beginners, learning some programming languages can be challenging and complex.
- Performance: High-level programming languages have a tendency to run programs more slowly than comparative minor-level languages.
- Limited Functionality: Few programming languages could lack native support for specific job types or might need additional libraries to carry out specific tasks.
- Programming language diversity may lead to division. It is hard to exchange code and work together with other developers.

## 6.5 The Need for Assembly Language

The computer directly decodes the 0-1 combinations that make up machine language code. However, the following issues exist with the machine language:

Writing in 0-1 Assembly Language forms is challenging for most people and heavily dependent on the machine.

DEBUGGING in programming is challenging as it's quite difficult to decipher the machine code. Thus, program logic will be challenging to comprehend.

To get around these issues, computer manufacturers created terms that sound like English and stand in for a machine's binary instructions. An instruction's symbolic code is known as a

mnemonic. The letters that make up the mnemonic for a specific command suggest the action that instruction is supposed to take.

The mnemonic ADD is used, for example, to add two numbers. These mnemonics facilitate the symbolic representation of machine language instructions, with each machine instruction being represented by a single equivalent symbolic instruction. This is referred to as an assembly language.

### 6.6 Advantages of Using Assembly Language

Due to its ability to analyze the instruction set, addressing modes, interrupts, etc., assembly language gives you more flexibility over how to handle certain software and hardware components.

Assembler programming creates executable modules that are smaller and more compact. Because of this closer proximity to the machine, assembly programming may enable you to create highly optimized applications. As a result, programs run more quickly.

Programs written in assembly language have at least 30% more data in them than equivalent programs written in upper-level language. The reason behind this is that, in contrast to assembly language, which generates a single line of code for each instruction, compilers currently produce a lengthy list of code for each instruction. This will be especially true for programs that deal with strings in C.

Assembly language, on the other hand, is machine-dependent. There are unique sets of instructions for every CPU. Assembly programs are not portable as a result.

Assembly language has extremely few limitations or regulations; almost everything is up to the programmer's discretion. This allows programmers a great deal of flexibility when building their systems.

### 6.7 High Level and Low Level Languages

| High-level Languages | Low-level Languages |
|---|---|
| It is a programmer-friendly language. | It is a machine friendly language. |
| High-level language is less memory efficient. | Low-level language is high memory efficient. |
| It is easy to understand. | It is tough to understand. |
| Debugging is easy. | Debugging is complex comparatively. |
| It is simple to maintain. | It is complex to maintain comparatively. |
| It is portable. | It is non-portable. |
| It can run on any platform. | It is machine-dependent. |
| It needs a compiler or interpreter for translation. | It needs an assembler for translation. |
| It is widely used for programming. | It is not used nowadays. |

Figure 2: Table Illustrating the Difference Between High-level and Low-level Languages

### 6.8 Language Processors: Assembler, Compiler and Interpreter

Programs are created in high-level languages and are converted o machine code that a computer can read via compilers and interpreters.

Even though the mnemonics used to represent instructions in assembly language are not directly understandable by machines, a High-Level language is independent of machine. Machine code, or instructions that are expressed as 0s and 1s, is understood by computers.

System software called as language processor is used to translate programs written in high-level languages into machine code, where the program is then known as an object program or object code.

There are three different categories of language processors that can be used:

#### 6.8.1 Compiler

A compiler is a  language processor. It can read an entire high-level program written in source code and translate it into an equivalent machine code program in one sitting. For instance, C, C++, Java, and C#.

If there are no errors in the source code, a compiler can properly translate it into object code.

### 6.8.2 Assembler

The Assembler converts the Assembly language program into machine code. The source code is a set of assembly language instructions that is fed into an assembler. Assembler is required for humans and machines to connect with one another.The assembler can turn mnemonics (instructions) such as ADD, MUL, MUX, SUB, DIV, MOV etc into binary code.

### 6.8.3 Interpreter

It is a language processor which moves on to the next line after translating a single statement. If there is a problem in the statement the translator stops translating and creates an error message.After fixing the error the interpreter moves on to the next line. An interpreter reads the instructions line by line,

For instance, Python, Perl and Matlab.

## 6.9 Algorithm

Algorithms are used to describe a program's logic. It provides a step-by-step breakdown to solve a problem. It is the set of instructions which is carried out in the right order to produce the desired results.

An instruction set has following qualities:

- Every instruction needs to be clear and concise.
- Every instruction should be carried out in a set amount of time.
- A command or a series of commands shouldn't be repeated endlessly.
- The intended outcomes are attained when the instructions have been followed.

The verbose and confusing nature of natural language statements makes them unsuitable for complex or specialized algorithms.

**Pseudocode** and **flowcharts** are structured approaches to express algorithms that, while remaining independent of a specific implementation language, avoid numerous ambiguities present in regular language assertions.

**Algorithm** definition or documentation is frequently done using programming languages, which are primarily designed for expressing algorithms in a computer-executable form.

### 6.10 Flow Chart

An algorithm is depicted visually in a flowchart. In order to graphically organize the processes required to address an issue using a computer, programmers frequently use it as a program planning tool. To indicate different types of instructions, it uses boxes with various shapes. Within these boxes, the real instructions are given in simple, direct language.

#### 6.10.1 Symbol for flowcharts

In a flowchart, only a few symbols are required to represent the required steps in a process.

**Terminal Symbol:** denotes the start, stop, and halt points in the logic flow of a program. It is a flowchart's first and last symbol.

**Input/Output Symbol**: they represent all input/output functions in a program.

**Processing Symbols:** represent instructions for computation and data transport. This symbol also designates the logical operations that transfer data from one area of the main memory to another (assignment statement).

**Decision Symbol:** denotes a decision point, or a place where a line can split off and go in one of two or more different directions.

**Arrowheads**: The exact order in which the instructions are carried out is shown by flow lines with arrowheads, which also show the flow of operation. A flowchart typically moves from left to right and from top to bottom. Only when the standard flow is not followed do arrowheads become necessary.

**Connectors**: whenever a flowchart is too complicated connectors are used in place of flow lines or when the flowchart occupies more than one page.

### 6.11 Decision Table

The decision table represents the interaction of circumstances and actions. It is like the if/then rules set. The key advantage is that more than one condition determines the action in a decision table, and more than one action can be connected to each set of criteria. The appropriate action or acts are only possible if the necessary requirements are fulfilled.

## 6.12 Summary

- A computer program is a set of instructions to carry out certain activities on a computer system.
- Few of the popular programming languages are Ruby, JavaScript, C++, Python, and Java.
- Programming languages have their own advantages and disadvantages.
- High-level programming languages have a tendency to run programs more slowly than lower-level languages.
- Some programming languages could lack native support for specific job types or might need additional libraries to carry out specific tasks.
- Programs written in assembly language have at least 30% more data as compared to high-level language
- Programming languages are either high-level languages or low-level languages.
- Programs created in high-level languages are converted into machine code that a computer can understand via compilers and interpreters
- Algorithms describe a program's logic.
- Pseudocode and flowcharts are structured approaches to express algorithms.

## 6.13 Keywords

- Complexity
- Diversity
- Computer-understandable
- Mnemonics
- Perplexing
-

## 6.14 Self-Assessment Questions

1. Briefly explain a computer program and features of programming languages.
2. Write a short note describing the characteristics of programming languages.
3. What are the benefits of programming languages?
4. Why do we need to use Assembly Language? What are the Advantages of Using Assembly Language?
5. Differentiate between Languages of the High-Level and Low Level

6. Explain Language Processors: Assembler, Compiler and Interpreter
7. Define (1) Algorithm (2) Flow Chart (3) Decision Table

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