

Rule 4

degree of 3 is smaller than

$$\lim_{n \rightarrow \infty} \frac{f(n)}{n^3} = \frac{1}{3}$$

Example

evaluate the following limits

$$\lim_{x \rightarrow \infty} \frac{5x^3 - 2x^2 + 4x - 1}{x^3 + 2x^2 - 1}$$

$$\lim_{x \rightarrow \infty} (5x^3 - 2x^2 + 4x - 1) / (x^3 + 2x^2 - 1)$$

$$= \lim_{x \rightarrow \infty} \frac{5 - 2/x + 4/x^2 - 1/x^3}{1 + 2/x + 2/x^2 - 1/x^3}$$

$$= \lim_{x \rightarrow \infty} \frac{5 - 0 + 0 - 0}{1 + 0 + 0 - 0} = 5$$

$$\lim_{x \rightarrow \infty} 5 = 5$$

$$\lim_{x \rightarrow \infty} 0 = 0$$

## Introduction to Information Technology

### - What is Information Technology?

Information Technology is the use of computers and software to:

- Store information

- Process information

- Transmit/share information

- Protect information

- Retrieve information

IT helps businesses:

- Automate Work

- Make Decisions

- Communicate with customers

- Increase Productivity

Definition by Organizations

- Information Technology Association of America.

- IT includes the study, design, development, support and management of computer based information systems.

- Association for Computing Machinery (ACM)

IT graduates are trained to meet the computer needs of businesses, hospitals, schools and govt organizations

## Examples of IT Tasks

People Working In IT May;

- Set up and Manage Computer networks
- Maintain Database systems
- Develop Websites
- Manage Cyber security
- Maintain email systems
- Upgrade or replace software and hardware

## What Is A Computer?

A computer is an electronic device programmed to receive input, process it and produce output.

A computer can;

- Follow Instructions
- Store large amount of Data
- Perform tasks fast and accurately

## Computer Components

### Components

CPU (Central Processing Unit) The Brain of the computer, executes instruction

### Memory (RAM)

### Storage (SSD/HDD)

### Functions

Stores data temporarily

Stores data permanently

Input devices

Output devices

Keyboard, Mouse - allow the user to send data to the user.  
Monitor, printer - Show results.

### Types of 'Computers'

From Smallest to Largest

#### Description

##### Type

Personal Computer

Workstation

Minicomputer

Mainframe

Supercomputer

Single User Computer

More powerful than PC

Supports Multiple Users

Support hundreds or thousands

extremely powerful, used in weather forecasting, research etc.

### Portable Computers

##### Type

Notebook / Laptop Portable PC

Sub notebook

#### Description

Smaller version of laptop

Handheld / PDA

Tiny device for basic tasks like Calendars and notes.

### (CPU International) Organization

Includes

v. ALU (Arithmetic logic Unit) - handles calculations

v. Control Unit - Manage activities and communicate with other

Registers - Small, fast Memory Inside the CPU.  
Software types:  
System Software.

Includes:

- Operating system (Windows, Linux, Mac OS)
- Utility software (Antivirus, Disk clean up)

### Application Software.

Programmed designed for users, like:

- Word Processors.
- Browsers.
- Games.

### Operating Systems.

- Manage hardware
- Controls files and memory
- Helps users run programs  
e.g. Windows, Linux, Mac OS, Android.

## Chapter 3: COMPUTER HARDWARE

### Meaning of Computer Hardware.

- Computer refers to the physical, tangible parts of a computer system that you can touch and see.

## 2. Categories of Hardware.

- Input devices

- Output devices

- Processing devices

- Storage devices

## 3. Input devices

Standard devices: Keyboard, Mouse, Touchpad.

Advanced devices: Scanner, Microphone, Webcam,  
Biometric Reader, Touchscreen, Joystick.

## 4. Output devices:

Visual: Monitors, Projector.

Hardcopy: Printer (laser, Inkjet, dot Matrix), Plotter.

Audio: Speakers.

## 5. Storage Devices:

Primary storage: RAM, ROM, Cache.

Secondary Storage: HDD, SSD, flash disk, Memory card, CD/DVD,  
Cloud storage.

## 6. Processing

6. Processing hardware

CPU (ALU, CU, Registers), Motherboard Components.

## 7. Motherboard Components:

CPU socket, Ram slot, BIOS, expansion slots,

Power Connectors, SATA / NVMe Ports, USB Ports.

### 8. Computer Ports and Cables

Ports: USB, HDMI, Ethernet, Audio

Cables: USB cable, HDMI cable, power cable, ethernet cable

### 9. Power supply Unit (PSU)

Converts AC to DC and Power the Computer Components.

### 10. Expansion Cards

GPU, sound card, NIC, WiFi Card, TV Tuner.

### 11. Maintenance of Hardware

Keep dust free, avoid liquids, use UPS, Proper Ventilation, careful handling.

### 12. Differences b/w hardware & Software

Hardware is physical; software is instructions

### 13. Examples

Keyboard - Input - Typing

Monitor - Output - Displays information

HDD - Storage - Stores Data

### 14. Future Trends

Quantum Computers, small processors, foldable screen

Biometrics Wearable computers

# Introduction to Programming languages

## What are Programming languages

Programming languages

- One structured system that allows humans to give instructions to computers. They enable us to:
  - Create software
  - Applications.
  - Websites
  - Automated Solutions

### Key points

i. Machine code:

- The Only Word Computer Understand directly, Made of binary digits (0, and 1).

ii. Bridge Between Humans and Machines

Programming languages Translate human readable instructions into machine-readable form

Used for Many tasks:

1. Writing instructions the computer can execute
2. Expressing algorithms (step by step solutions).
3. Facilitating human-computer interaction

### Categories of Programming languages

i. Machine language (1<sup>st</sup> generation)

- i) lowest level language → directly interacts with hardware
- ii) Written in binary digits (0s and 1s)

- iii) Directly understood by the computer.
  - iv) Very difficult for human to read and write. Or debug.
2. Assembly language (2<sup>nd</sup> generation).
- 1. Uses Mnemonics like ADD, SUB, MOVE instead of binary
  - 2. Requires an assembler to translate into machine code.
  - 3. Easier to write and debug compared to machine language.

### 3. High level language (3<sup>rd</sup>, 4<sup>th</sup>, & 5<sup>th</sup> Generation)..

Designed to be closer to human being for easier programming.

- i. English like Syntax.
- ii. Portable across different computer systems.
- iii. Require a compiler or interpreter.
- iv. Focus on problem solving - solving rather than hardware details.

#### Sub categories

##### 3<sup>rd</sup> generation (procedural language)

Focus on step by step instructions

Examples: BASIC, C, C++, Java.

##### 4<sup>th</sup> generation (problem oriented languages).

Designed for specific tasks like date handling or reporting e.g. SQL, MATLAB

5<sup>th</sup> generation (Natural language).

Access Instructions Similar to natural human language

examples: LISP, PROLOG.

Characteristics of high level languages (expanded).

- Easy to learn.
- Highly portable.
- Easy debugging.
- library support
- faster development.

Advantages & disadvantages of programming languages

Advantages of high level languages.

- Easy to Read and Write.
- Portable across Platforms.
- faster development.
- Reduced errors.
- Efficient debugging.

Disadvantages

- Slower than Machine code.
- Require translators (Compiler/Interpreter).
- ~~- Effort development~~
- loss control over hardware

## Difference b/w Low level & High level languages

| Feature                | Low level (Machine)                        | Low level (Assembly) | High level.            |
|------------------------|--|----------------------|------------------------|
| 1. Readability         | Very hard                                  | Very fast            | Easy to read           |
| 2. Speed               | Slow                                       | Fast                 | Slower.                |
| 3. Hardware dependence | Yes  | No                   | No                     |
| 4. Translator          | None of Machine, assembler<br>for assembly | System Programming   | Compiler / Interpreter |
| 5. Use Case            |  |                      | General programming    |

### Importance of programming

Simplifies Software dev'p by reducing complexity

Enables automation of repetitive tasks.

Drives Modern technology, including:

- ↳ Artificial Intelligence.
- ↳ Robotics.
- ↳ Banking & Finance systems
- ↳ Medical and diagnostic softwares
- ↳ Web & Mobile Applications

Characteristics of good program.

Efficiency: Use Minimum time and Memory

Readability: Easy for other programmers to understand.

Maintainability: Can be updated or repaired easily.

Accuracy: Produces correct, reliable results.

Reusability: Components can be used in other programs.

examples & Application

(Common Programming languages)

i) Python: AI, data science, automation, Web apps.

ii) Java: Android apps, enterprise systems.

iii) C++: Games, system software, performance-critical apps.

iv) JavaScript: Web dev'l p, Interactive Websites

Real-world applications

i) Mobile apps: WhatsApp, TikTok.

ii) Web systems: E-commerce platforms.

iii) Robotics: Manufacturing and Automation Robots.

iv) Banking System: Secure financial transaction systems.

v) Medical System: Patient Management, diagnostic

vi) Games: Video games like Grand Theft Auto

language translators

Programming language Negine frameworks so the computer can understand them.

Types Of Translators

## 1. Compiler

1. Translate the entire program at once.
2. Produces an executable file.
3. Faster execution.
4. Examples : C, C++, Java.

## 2. Translator-Interpreter

1. Translate line by line.
2. Slower execution.
3. Stops when it meets an error.
4. Examples : Python, Basic, Javascript.

## 3. Assembler

Converts assembly language into Machine Code.

Program dev process : (990) did not fit

1. Problem definition  
Understand the task to be solved.

2. Problem analysis

Identify Inputs, Outputs, Constraints

3. Algorithm design.

Step by step (logical sequence).

4. flow chart / Pseudo code

Diagram or Structured English.

## Basics of Computer hardware & software

### Computer

⇒ Is an electric device, operating under the control of instructions stored in its own memory that

### comp Hardware

Hardware refers to physical parts of computer system.

### Many Components Of Computer

#### → CPU (Central Processing Unit)

- CPU is considered the brain of the computer. It performs all types of data processing operations, stores data, intermediate results and instruction (Program). Controls the control all parts of computer.

A CPU has 3 components listed below.

#### A. CU (control Unit).

- CU is a component of computer's Central Processing Unit (CPU) that directs operation of the processor. It tells the Computer Memory, Arithmetic logic Unit and Input and Output devices how to respond to a program instruction.

## B) ALU (Arithmetic logic Unit)

- Think of the ALU as the logical part of the Brain. When any Mathematical Calculation or decision logic needs to be carried out, instruction is passed on the ALU.

## C) Memory

Primary Memory is Memory that is part of the Computer Itself & necessary for its functioning. Consist of two types of Memories

### 1) Random Access Memory (RAM).

- Is the external Memory of the CPU for storing data, program and program results. It is read/write memory which stores data until machine is working. Volatile (loses data when power is off).

#### • Dynamic Random Access Memory (DRAM)

- Type of Physical Memory used in most personal computers the term dynamic indicates that the memory must be constantly refreshed or it loses its contents. This type of memory is economical.

#### • Static Random Access Memory (SRAM)

- A type of memory that is stored faster and less

- Volatile than DRAM, but requires More Power and is More expensive. The ~~few~~
- Synchronous Dynamic Random Access Memory (SDRAM)  
- A type of Memory that has Much higher Processing Speed.

## ii) Read Only Memory (Rom)

- The Memory from Which We can Only Read but Cannot Write On It. This type of Memory is non Volatile. The Information is Stored permanently during Manufacture, Stores such Instructions that are required to Start a computer. Different types of Rom's include
- MROM (Masked Rom): The first Rom's were Hard-Wired devices that contained a Pre-Programmed Set of data or Instructions.
- PROM (Programmable Read Only Memory)  
- PROM is read Only Memory that can be Modified Only Once by user. The user buys a blank PROM and enters the desired Content.

- **EPRON (Erasable And Programmable Read Only Memory)**: The EPROM is a type of PROM which can be programmed by the user multiple times.
- **EEPROM (Electrically Erasable and Programmable Read only Memory)**: The EEPROM is programmed and erased electrically.

## 2. Secondary Storage (External storage devices)

Floppy diskettes, hard disk, tapes & optical discs come under the category of external storage devices or auxiliary storage devices. These devices are sensitive to environmental conditions (humidity & temperature). They are not compulsory for the functioning computer but are useful for expanding the computer's memory.

### (A) Floppy disk

Floppy disks are primarily used on PCs. Information on a floppy disk is recorded on the magnetized states of particles of iron oxides placed upon concentric circles known as tracks.

### (B) Hard disk

- It is non-removable enclosed Magnetic disk included in Most PCs.

### (C) Magnetic tape

- This is a plastic tape, usually Made of Mylar that is coated with Iron Oxide, thereby enabling the introducing (Writing); retention (Memory) and reading of Magnetically recorded information.

### (D) Optical disc drive

- An optical disc drive (ODD) is a disk drive that uses laser light or electromagnetic waves for reading or Writing data to or from optical discs (normally CD-Rom).

### (E) USB

A USB flash drive, also commonly known as USB drive, USB stick and a variety of other names. Is a storage data device that included flash Memory With an integrated USB interface.

### ③ Peripherals

Peripheral devices are devices connected to the computer externally. If Peripheral is connected

a computer can still work.

### (A) Keyboard.

The most common and very popular input device which helps in inputting data to the computer. Consist of keys that are capable of inputting alphabets, numbers & special characters.

### (B) Mouse

Mouse is the most popular pointing device and cursor-control devices having a small palm size box with a round ball at its base which senses the movement of mouse & sends corresponding signals to CPU. When the mouse buttons are pressed.

### (C) Monitors

Monitors, commonly called as visual display unit (VDU), are the main output device of a computer. It forms images from tiny dots, called pixels, that are arranged in a rectangular form.

• Printer - Is an output device which used to print information on paper.

characters by striking them on the ribbon the ribbon which is passed the pressed on the paper.

. Non-Impact Printers: Non-Impact printers print the characters without using ribbon, these printers print a complete page at a time so they are also called as Page Printers.

### (E) Joy stick

It is a device used to move a cursor position on a monitor screen. Mainly used in Computer Aided Designing & Computer Playing games.

### (F) Scanner

A scanner allows you to scan printed material and convert it into file format that may be used within the PC.

### (G) Plotter

Is used to create a high-quality visual on Paper

Drum Plotter: The paper is placed over the drum that rotates back and forth. A carriage holding one or more pens moves horizontally across

the drum. The Carriage With the Pens Moves horizontally Over the Paper.

**Flat Bed Plotter.** In flat bed plotter, the paper does not move. The carriage holding the pens should provide all the motions. Inkjet plotters can also produce large drawings with different colbuts

**Difference b/w Hardware & Software**

**Hardware**

e.g. CPU, printer  
mouse

**Software**

e.g. OS, brogue d.  
MS office

- | <b>HW</b>                                   | <b>SW</b>                                   |
|---|---|
| ① HW is a physical parts of the computer    | ① SW is a program which is executed by CPU. |
| ② It can be touch                           | ② It's too non-tangible.                    |
| ③ HW can't work perform any task without SW | ③ SW can be executed without Hardware.      |
| ④ It is not affected by computer viruses    | ④ It is affected by viruses                 |
| ⑤ We can't make duplicate copies of HW      | ⑤ We can make many copies of SW             |
| ⑥ We can't transfer hardware electronically | ⑥ Can be transferred software electrically  |

Computer Software - Set of Instructions that tells the computer hardware what to do

## Types of Software

- ① System Software
- ② Application Software
- ③ Web Software

### ① System Software

⇒ Controls Computer Internal functioning, chiefly through an operating system and also controls such peripherals as Monitors, Printers, and storage devices.

### ② Application Software

⇒ directs the computer to execute commands given by user and may be used to include any program that processes data for user.

⇒ An application can be self contained or it can be a group of programs that run the application for the user.

### ③ Web Software / Application

- On the other hand, only require Internet access to work; they do not rely on the hardware.

and system software to run.

Consequently User can launch Web applications from device that have a web browser (include: Webmail, Word processor, & spreadsheets).

## Introduction to Computer Hardware

A is an electronic device, operating under the control of instructions stored in its own Memory that can accept data (input)

### X-tics of a computer

High Speed

- It's a very fast device.
- Capable of performing calculation of very large amount of data.
- Computer units of speeds in Microsecond, Nanosecond and even the picosecond.

Can perform Millions of calculation in few seconds as compared to man who will spend Many Months to perform the same task.

Accuracy

As they are very fast, computers are very accurate.

- The calculations are 100% error free.
  - Performs all jobs with 100% accuracy provided all the inputs correct
- Storage Capability
- Memory is a very important X-tics of a computer