MODULE 1

1. What is a computer? Write the characteristics of computer.

A computer is defined as an electronic device that is designed to accept data, perform the required mathematical and logical operations at high speed, and output the result.

The important characteristics of a computer are:

Speed: Computers can perform millions of operations per second. The speed of computers is usually given in nanoseconds and picoseconds.

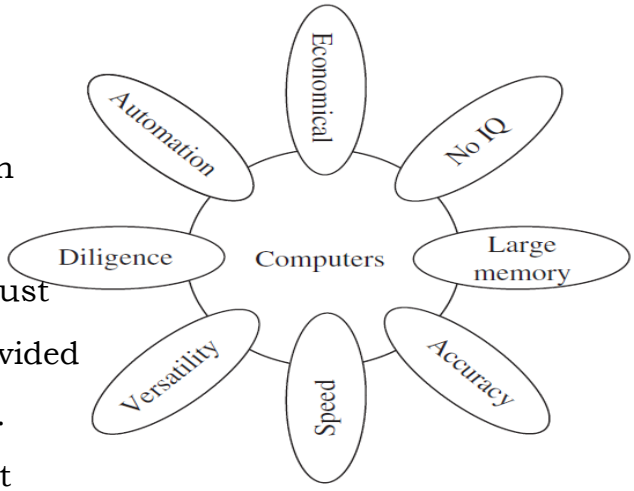


Figure 1.1 Characteristics of computers

Accuracy: A computer is a very fast, reliable, and robust electronic device. It always gives accurate results, provided the correct data and set of instructions are input to it.

Automation: Computers are automatable devices that can perform a task without any user intervention.

The user just needs to assign the task to the computer, after which it automatically controls different devices and executes the program instructions.

Diligence: Unlike humans, computers never get tired of a repetitive task. It can continually work for hours without creating errors.

Versatile: Computers are versatile devices as they can perform multiple tasks of different nature at the same time. Computers are used in our daily life in different fields.

Memory: Computers have memory. They have internal or primary memory (storage space) as well as external or secondary memory. The internal memory of computers is very expensive and limited in size (Example: RAM, ROM), and the secondary storage is cheaper and of bigger capacity (Example: Hard disk).

No IQ: Computers do not have any decision-making abilities of their own. They need guidance to perform various tasks.

Economical: Computers are considered as short-term investments for achieving long-term gains. Computers save time, energy, and money.

2. Briefly explain evolution of computer through different generations.

First Generation (1942–1955)

Hardware Technology: First generation computers were manufactured using thousands of vacuum tubes; a vacuum tube is a device made of fragile glass.

Memory: Electromagnetic relay was used as primary memory and punched cards were used to store data and instructions.

Software Technology: Programming was done in machine or assembly language.

Used for: Scientific applications.

Examples: ENIAC, EDVAC, EDSAC, UNIVAC I, IBM 701.

Second Generation (1955–1964)

Hardware Technology: This generation computers were manufactured using transistors. Transistors were reliable, powerful, cheaper, smaller, & cooler than vacuum tubes.

Memory: Magnetic core memory was used as primary memory; magnetic tapes and magnetic disks were used to store data and instructions.

Software Technology: Programming was done in high level programming languages. Batch operating system was used.

Used for: Scientific and commercial applications.

Examples: Honeywell 400, IBM 7030, CDC 1604, UNIVAC LARC.

Third Generation (1964–1975)

Hardware Technology: Third generation computers were manufactured using integrated chips (ICs) with SSI (Small Scale Integration) & MSI (Medium Scale Integration) technology. ICs consist of several components like transistors, capacitors, & resistors on a single chip to avoid wired interconnections between components. Minicomputers came into existence.

Memory: Larger magnetic core memory was used as primary memory; larger capacity magnetic tapes and magnetic disks were used to store data and instructions.

Software Technology: Programming was done in high level programming languages such as FORTRAN, COBOL, Pascal, and BASIC. Software was separated from the hardware.

Used for: Scientific, commercial, and interactive online applications.

Examples: IBM 360/370, PDP-8, PADP-11, CDC6600.

Fourth Generation (1975–1989)

Hardware Technology: Fourth generation computers were manufactured using ICs with LSI (Large Scale Integration) and later with VLSI (Very Large Scale Integration) technology. Microcomputers came into existence. Use of personal computers became widespread. High speed computer networks in the form of LANs, WANs, and MANs started growing.

Memory: Semiconductor memory was used as primary memory, large capacity magnetic disks were used as built-in secondary memory. Magnetic tapes and floppy disks were used as portable storage devices.

Software Technology: Programming was done in high level programming language such as C and C++. Graphical User Interface (GUI) based operating system (e.g. Windows) was introduced. UNIX, Apple Mac OS and MS DOS were introduced. All these operating systems had multi-processing and multiprogramming capabilities.

Used for: Scientific, commercial, interactive online, and network applications.

Examples: IBM PC, Apple II, TRS-80, VAX 9000, CRAY-1, CRAY-2, CRAY-X/MP.

Fifth Generation (1989–Present)

Hardware Technology: Fifth generation computers are manufactured using ICs with ULSI (Ultra Large Scale Integrated) technology. The use of Internet became widespread and very powerful mainframes, desktops, portable laptops, and smartphones are being used commonly. Supercomputers use parallel processing techniques.

Memory: Semiconductor memory is used as primary memory; large capacity magnetic disks are used as built-in secondary memory. Magnetic tapes and floppy disks were used as portable storage devices, which have now been replaced by optical disks and USB drives.

Software Technology: Programming is done in high-level programming languages such as Java, Python, and C#. Graphical User Interface (GUI)-based operating systems such as Windows, UNIX, Linux, Ubuntu, and Apple Mac are being used. These operating systems are more powerful and user friendly than the ones available in the previous generations.

Used for: Scientific, commercial, interactive online, multimedia (graphics, audio, and video), and network applications

Examples: IBM notebooks, Pentium PCs, IBM SP/2, Param supercomputer

3. How computers are classified? Briefly explain.

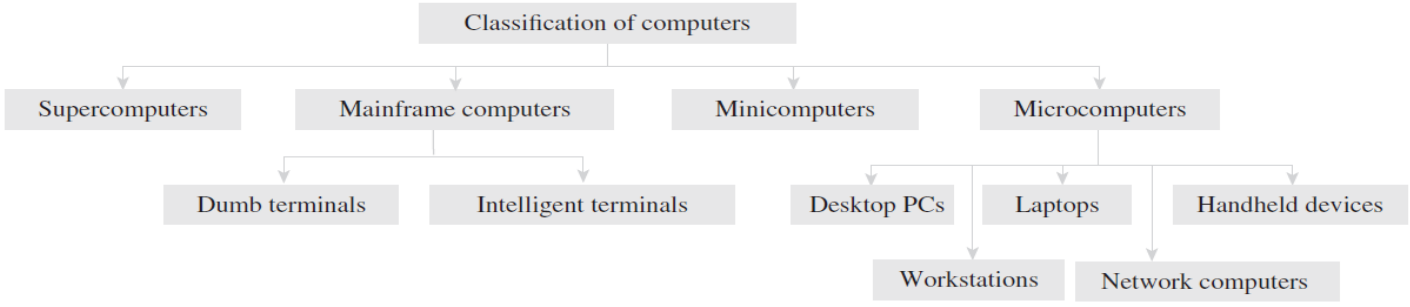


Figure 1.3 Classification of computers

Supercomputers

- Supercomputer is the fastest, most powerful, and most expensive computer.
- First developed in the 1980s to process large amounts of data and to solve complex scientific problems.
- Can perform more than one trillion calculations in a second.
- A single supercomputer can support thousands of users at the same time.
- Mainly used for weather forecasting, nuclear energy research, aircraft design, automotive design, online banking, controlling industrial units, etc.
- Examples are CRAY-1, CRAY-2, Control Data CYBER 205, and ETA A-10.

Mainframe Computers

- Mainframe computers are large-scale computers (but smaller than supercomputers).
- Very expensive and need a very large clean room with air conditioning.
- Support multiple processors. For example, the IBM S/390 mainframe can support 50,000 users at the same time.
- The two types of terminals that can be used with mainframe systems are as follows:

Dumb Terminals

Dumb terminals consist of only a monitor and a keyboard (or mouse). They do not have their own CPU and memory and use the mainframe system's CPU and storage devices.

Intelligent Terminals

Intelligent terminals have their own processor and thus can perform some processing operations. But, they do not have their own storage space.

- They are typically used as servers on the World Wide Web.
- IBM is the major manufacturer of mainframe computers.

Minicomputers

- Minicomputers are smaller, cheaper, and slower than mainframes.
- The smallest computer of their times and are also known as *midrange computers*.
- Widely used in business, education, hospitals, government organizations, etc.
- Single-user minicomputers are used for performing complex design tasks.
- Some minicomputers are specifically designed to handle multiple users simultaneously.
- They can also be used as servers in a networked environment.

- The manufacturers of minicomputers include Equipment Corporation (DEC), IBM Corporation (AS/400 computers), Data General Corporation, and Prime Computer.

Microcomputers

- Microcomputers, commonly known as PCs, are very small and cheap.
- The first microcomputer was designed by IBM and was named IBM-PC. Another type of popular PC is designed by Apple.
- PCs and PC-compatible computers commonly use the Windows operating system, while Apple computers use the Macintosh operating system (MacOS).
- PCs can be classified into the following categories:

Desktop PCs: A desktop PC is the most popular model of PCs. The system unit of the desktop PC can be placed flat on a desk or table. It is widely used in homes and offices.

Laptops: Laptops are small microcomputers that can easily fit inside a briefcase and can easily be carried from one place to another and are useful especially when going on long journeys.

Workstations: Workstations are single-user computers that have the same features as PCs, but their processing speed matches that of a minicomputer or mainframe computer.

Network Computers: They have less processing power, memory, and storage than a desktop computer and are designed to be used as terminals in a networked environment.

Handheld Computers: They can fit in one hand, while users can use the other hand to operate them. Very small in size, and hence they have small-sized screens and keyboards

Examples: Smartphones, Tablet PCs.

4. Discuss few applications of computer.

Some applications of computers are:

Word processing: Word processing software enables users to read and write documents. Users can also add images, tables, and graphs for illustrating a concept.

Internet: The Internet is a network of networks that connects computers all over the world. It gives the user access to an enormous amount of information. Browsing, e-mail, chatting, video conferencing etc. are few applications using internet.

Digital video or audio composition: Computers make audio or video composition and editing very simple. Graphics engineers use computers for developing short or full-length films and creating 3-D models and special effects in science fiction and action movies.

Desktop publishing: Desktop publishing software enables us to create page layouts for entire books.

e-Business: e-Business or electronic business is the process of conducting business via the Internet. This may include buying and selling of goods and services using computers and the Internet. The following are techniques in which e-commerce helps users to conduct business transactions: *Business-to-consumer or B2C, Business-to-business or B2B, Consumer-to-consumer or C2C.*

Electronic banking: Electronic banking, also known as cyber banking or online banking, supports various banking activities on the go.

Health care: Computers have become a necessary device in the health care industry. The following are areas in which computers are extensively used in the health care industry: *Storing records, Surgical procedures, Better diagnosis and treatment.*

Meteorology: Meteorology is the study of the atmosphere. Some of the applications include the following: *Weather forecasting, Aviation meteorology, Agricultural meteorology, Nuclear meteorology, Maritime meteorology.*

Multi-media and Animation: Multimedia and animation that combines still images, moving images, text, and sound in meaningful ways is one of most powerful aspects of computer technology. Multimedia and animation is used to add special effects in movies. In education, multimedia is used to prepare training courses.

Legal System: Computers are used by lawyers to shorten the time required to conduct legal precedent and case research.

Retail Business: Computers are used in retail shops to enter orders, calculate costs, and print receipts.

Travel and Tourism: Computers are used to prepare tickets, monitor the train's or airplane's route, and guide the plane to a safe landing. They are also used to research about hotels in an area, reserve rooms, or to rent a car.

Robotics: Robots are computer-controlled machines mainly used in the manufacturing process in extreme conditions where humans cannot work.

Education: A computer is a powerful teaching aid and can act as another teacher in the classroom. Teachers use computers to develop instructional material.

Industry and Engineering: Computers are found in all kinds of industries, such as thermal power plants, oil refineries, and chemical industries, for process control, CAD.

5. Explain the organization of a computer with the help of a neat block diagram.

A computer is an electronic device that performs five major operations:

- Accepting data or instructions (input)
- Storing data
- Processing data
- Displaying results (output)
- Controlling and coordinating all operations inside a Computer.

Figure below shows the interaction between the different units of a computer system.

Input: This is the process of entering data and instructions (also known as *programs*) into the computer system. The data and instructions can be entered by using different input devices such as keyboard, mouse, scanner, and trackball.

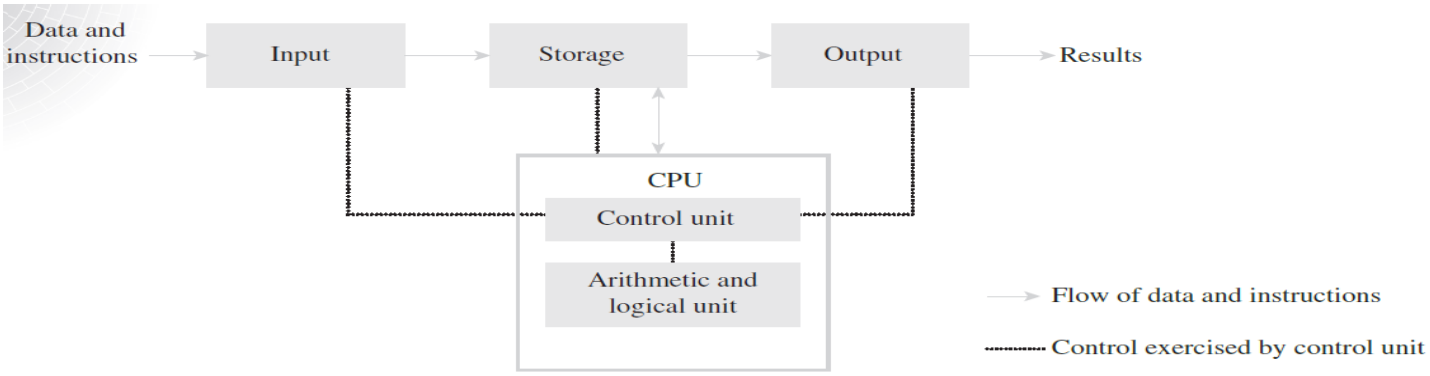


Figure 1.4 Block diagram of a computer

Storage: The computer storage space not only stores the data and programs that operate on that data but also stores the intermediate results and the final results of processing. A computer has two types of storage areas:

- **Primary storage**: Also known as the *main memory*, is the storage area that is directly accessible by the CPU at very high speeds. It is used to store the data and parts of programs, the intermediate results of processing, and the recently generated results. Example: Random Access Memory (RAM).
- **Secondary storage** Also known as auxiliary memory, is cheaper, non-volatile, and used to permanently store data and programs that are not being currently executed by CPU.

  Example: Magnetic disk used to store data, such as C and D drives, for future use.

Output: Output is the process of giving the result of data processing to the outside world (external to the computer system). The results are given through output devices such as monitor, and printer.

Control: The control unit (CU) manages and controls all the components of the computer system. The CPU is a combination of the arithmetic logic unit (ALU) and the CU. The CPU is known as the brain of the computer system.

Processing: The process of performing operations on the data as per the instructions specified by the user (program) is called *processing.* Data and instructions are taken from the primary memory and transferred to the ALU, which performs all sorts of calculations. The intermediate results of processing may be stored in the main memory. When the processing completes, the final result is then transferred to the main memory.

6. List and explain the functions of major parts of computer.

Figure: Computer case and its parts

The following are some of the major parts of the computer:

CPU: The CPU is the brain of the computer. It performs all calculations and controls the devices connected to the computer system.

RAM: RAM is the computer's memory which stores information used by applications that are currently being executed by the CPU.

Hard disk drive (HDD): The HDD is the secondary memory of the computer system where information is stored permanently. All types of data, documents, and programs are stored on the hard disk.

Modem: A modem (modulator–demodulator) is a device that enables the computer to use a telephone line to communicate and connect to the Internet.

Network card: A network card is used to connect the computer either to other computers or to the Internet.

Video card: The video card is a board that plugs into the motherboard of the computer and generates images for display. Many computers come with an in-built video chip.

Sound card: The sound cards are expansion boards that are used to enable a computer to manipulate sound.

Fans: There are one or more fans inside the computer to keep the air moving and the computer cool.

7. Explain the different types of input devices.

An input device is used to feed data and instructions into a computer. The different types of input devices are shown below:

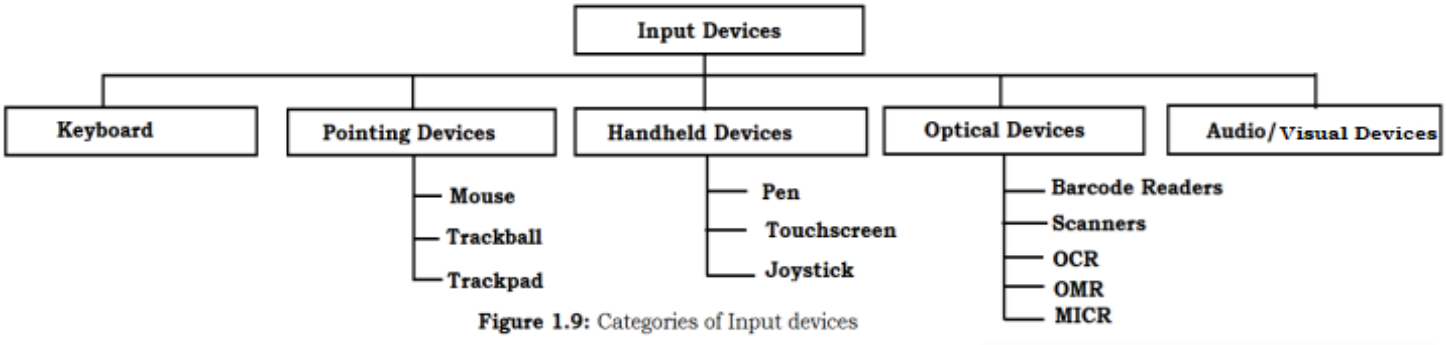


Figure 1.9: Categories of Input devices

Keyboard: The keyboard is the main input device for computers. Using a keyboard, the user can type a document, use keystroke shortcuts, access menus, play games, and perform numerous other tasks.

Pointing Devices: A pointing input device enables the users to easily control the movement of pointer to select items on a display, to draw graphics, etc. Examples: Mouse, trackball, light pen, joystick, and touchpad.

Mouse: It is the key input device used in a graphical user interface (GUT). It can be used to handle the pointer easily on the screen to perform various functions such as opening a program or file.

Handheld Devices: A handheld device is a pocket-sized computing device with a display screen and touch input and/or a miniature keyboard. Examples: Smartphones, PDAs, handheld game consoles, and portable media players.

Optical Devices: Optical devices, use light as a source of input for detecting or recognizing different objects such as characters, marks, codes, and images. These devices convert these objects into digital data and send it to the computer for further processing. Examples are barcode readers, image scanners, optical character recognition (OCR), optical mark readers (OMR), and magnetic ink character recognition (MICR) devices.

Audio-visual Input Devices:

Audio Devices: Audio devices are used to either capture or create sound. They enable computers to accept music, speech, or sound effects for recording and/or editing. Microphones and CD players are examples of two widely used audio input devices.

Video Input Devices: Video input devices are used to capture video from the outside world into the computer. The video card converts analog video signals to digital data to store it in the computer (and vice versa). Digital camera and web camera are popular examples of video input devices.

8. Explain the different types of output devices.

Any device that outputs/gives information from a computer can be called an output device. Output devices are electromechanical devices that accept digital data from the computer and convert them into human-understandable language.

Monitors and speakers are two widely used output devices. Figure below categorizes output devices into different groups.

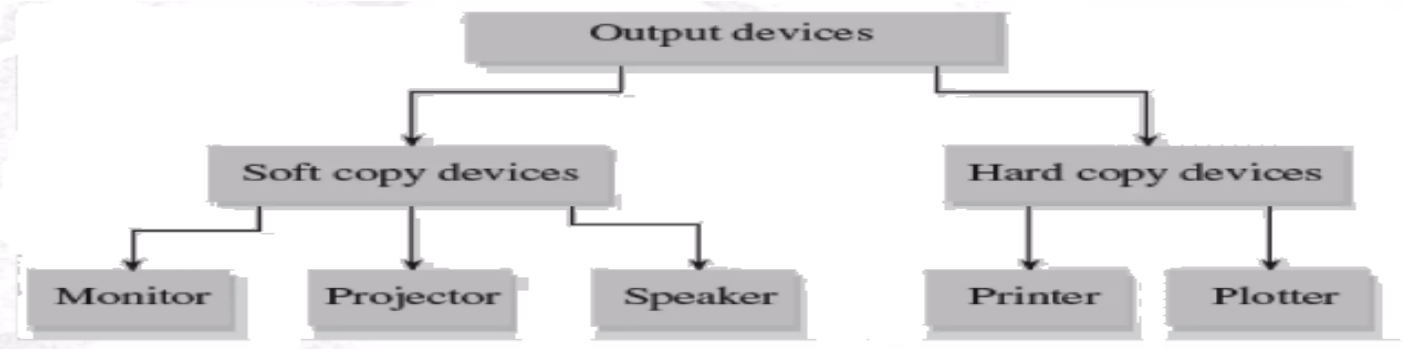


Figure: Classification of output devices

Soft Copy Devices

Soft copy output devices are those that produce an electronic version of an output and is displayed on the computer screen (monitor).

Monitors: The monitor is a soft copy output device used to display video and graphics information generated by the computer through the video card. Computer monitors are similar to television screens. The monitor is connected to the VGA port on the video card.

Three variants of monitor: cathode ray tube (CRT), liquid crystal display (LCD), & plasma.

Projectors: A projector is a device that takes an image from a video source and projects it onto a screen or another surface. The projector works by receiving a video signal from some external device and projects that signal onto a screen.

Speakers: To meet the user's demand of audio capabilities from the computers, speakers were developed in different sizes and shapes, and with different powers and sound quality. With all these types of speakers, the user can enjoy music, movie, or a game, and the voice will be spread through the entire room.

Hard Copy Devices

Hard copy output devices are those that produce a physical form of output.

Printers: A printer is a device that takes the text and graphics information obtained from a computer and prints it on a paper.

Printers can be broadly classified into two groups:

Impact Printer: These printers print characters by striking an inked ribbon against the paper. Examples-dot matrix printers, daisy wheel printer.

Non-impact printer: Non-impact printers are much quieter than impact printers. Non-impact printers use cartridge-based ink, which is either sprayed onto the page. The main types of non-impact printers are inkjet, laser, and thermal printers.

Plotters: A plotter is a printing device that is usually used to print vector graphics with high print quality. They are widely used to draw maps, in scientific applications, and computer-aided engineering (CAE).

Drum plotters: A drum plotter is used to draw graphics on paper that is wrapped around a drum. They are usually used with mainframe and minicomputer systems.

Flatbed plotter: In a flatbed plotter, the paper is spread on the flat rectangular surface of the plotter, and the pen is moved over it.

9. With the neat diagram, explain the working of CRT monitor and LCD monitor.

Working of a CRT monitor: CRT monitors work by firing charged electrons at a phosphorus film. When electrons hit the phosphor-coated screen, they glow, thereby enabling the user to see the output.

In a CRT, the stream of electrons comes out of the heated filament cathode into the vacuum. The anode attracts the electrons and focuses the stream of electrons to form a

tight beam that is then accelerated by an accelerating anode. This tight, high-speed beam of electrons flies through the vacuum in the tube and hits the flat screen at the other end of the tube. This screen is coated with phosphor, which glows when struck by the beam, thereby displaying a picture, which the user sees on the monitor.

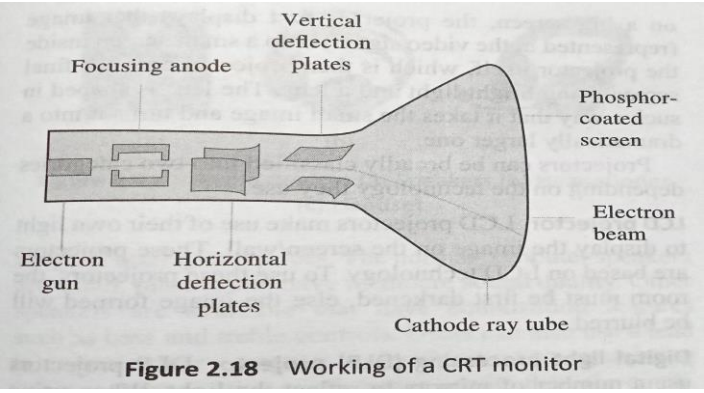


Figure 2.18 Working of a CRT monitor

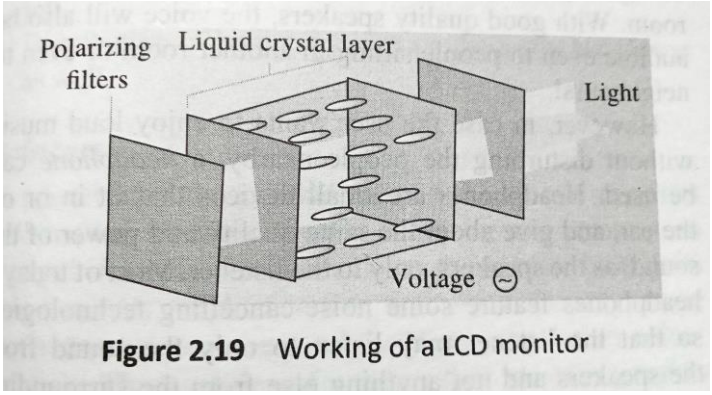


Figure 2.19 Working of a LCD monitor

Working of a LCD Monitor: An LCD monitor is a thin, flat, electronic visual display that uses the light modulating properties of liquid crystals, which do not emit light directly.

LCD technology is based on the principle of blocking light. The LCD consists of two pieces of polarizing filters that contain a liquid crystal material between them. A backlight creates light, which is made to pass through the first substrate. Simultaneously, the electrical currents cause the liquid crystal molecules to align, thus allowing varying levels of light to pass through to the second substrate and create the colors, and hence images are seen on the screen.

10. How printers are classified? Briefly explain.

Printers: A printer is a device that takes the text and graphics information obtained from a computer and prints it on a paper. Printers can be broadly classified into two groups-impact and non-impact printers as show.

Impact Printer: These printers print characters by striking an inked ribbon against the paper. Examples-dot matrix printers, daisy wheel printers, and most types of line printers.

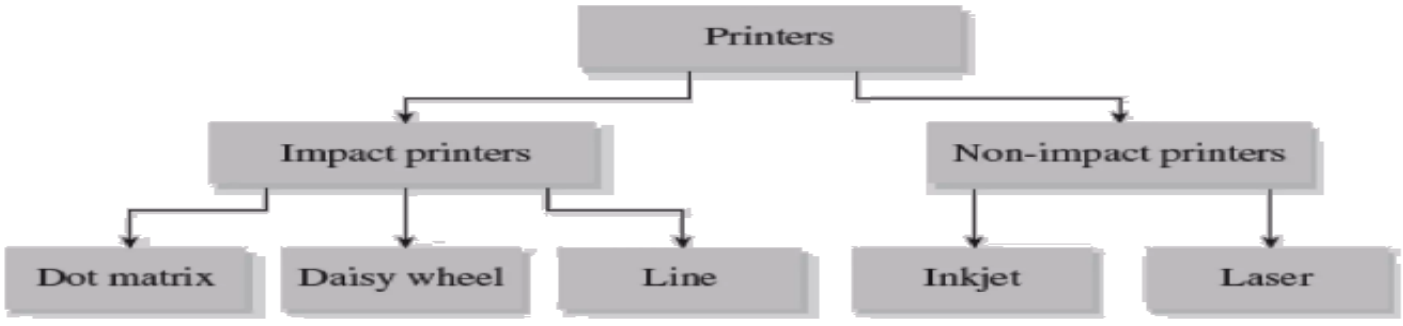


Figure 1.13: Classification of printers

Dot matrix printer: A dot matrix printer prints characters and images of all types as a pattern of dots. This printer has a print-head (or hammer) that consists of pins representing the character or image. The print-head runs back and forth on the page and prints by striking an ink-soaked cloth ribbon against the paper.

Daisy wheel printer: Daisy wheel printers use an impact printing to generate high quality output comparable to typewriters, and are three times faster. The print-head of a daisy wheel printer is a circular wheel, with arms or spokes.

Line printer: A line printer is a high-speed impact printer in which one typed line is printed at a time. The speed of a line printer usually varies from 600 to 1200 lines per minute. Band printer is a commonly used variant of line printers.

Non-impact printer: Non-impact printers are much quieter than impact printers. Non-impact printers use cartridge-based ink, which is either sprayed onto the page. The main types of non-impact printers are inkjet, laser, and thermal printers.

Inkjet printer: The print-head of inkjet printers has several tiny nozzles, called jets. As the paper moves past the print-head, the nozzles spray ink onto it, forming characters and images. An inkjet printer can produce from 100 to several hundred pages.

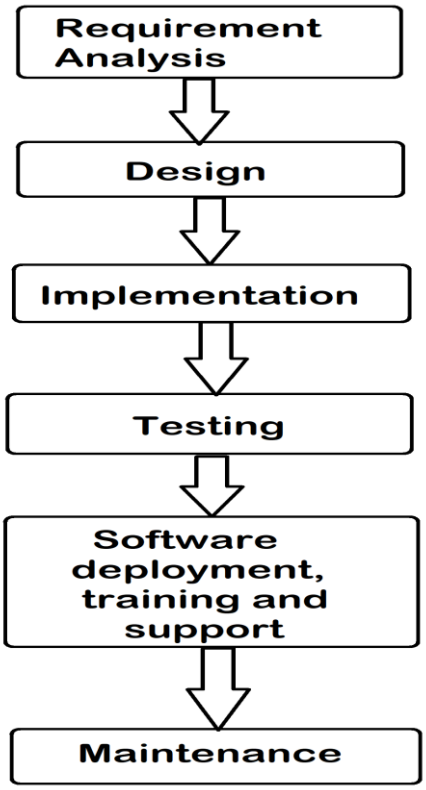
Laser printer: A laser printer is a non-impact printer that works at very high speeds and produces high-quality text and graphics. It uses the technology used in photocopier machines.

11. Explain different phases in software development life cycle (SDL).

To design and development of programs, the entire program or software development process is divided into a number of phases, where each phase performs a well- defined task. The phases in the software development life cycle (SDLC) process is shown in figure.

Requirements analysis: In this phase, the user's expectations are gathered to know why the program/software has to be built. Then, all the gathered requirements are analysed to arrive at the objective of the overall software product. The every identified requirement of the users is documented.

Design: In the design phase, a plan of actions are made and this plans will be followed throughout the development process. The core structure of the software/program is broken down into modules. The solution of the program is then specified for each module in the form of algorithms or flowcharts. The design phase, therefore, specifies how program/software will be built.



Implementation: In this phase, the designed algorithm are converted into program code using any of the high level languages. The program codes are tested by the programmer to ensure their correctness.

This phase is also called construction or code generation phase.

Testing: In this phase, all the modules are tested together to ensure that the overall system works well as a whole product. The software is tested using a large number of varied inputs, to ensure that the software is working as expected by the user's requirement.

Software deployment, training, and support: After the code is tested and has been approved by the users, it is installed or deployed in the production environment. The users must be trained to how to use it or fix up certain problems. A continuous support for the users shall be provided as and when they encounter various problems during the usage of software.

Maintenance: Maintenance and enhancements are ongoing activities that are done to cope with newly discovered problems or new requirements.

12. Explain the following terms with example: i. Algorithm ii. Pseudo code

Algorithm: An algorithm is an effective step-by-step procedure for solving a problem in a finite number of steps. The algorithm gives the logic of the program. Algorithms are mainly used to achieve software reuse. An algorithm provides a blueprint to writing a program to solve a particular problem.

Control Structures Used In Algorithms: An algorithm may employ three control structures: sequence, decision, and repetition.

Example: Algorithm to add two numbers is given below:

Step 1: Input first number as A

Step 2: Input second number as B

Step 3: Set Sum = A + B

Step 4: Print Sum

Step 5: End

Pseudocode: Pseudocode is a compact and informal high-level description of an algorithm that uses the structural conventions of a programming language. Pseudocode does not obey the syntax rules of any particular programming language i.e. it is not a real programming code. It allows the designer to focus on main logic without being distracted by programming languages syntax.

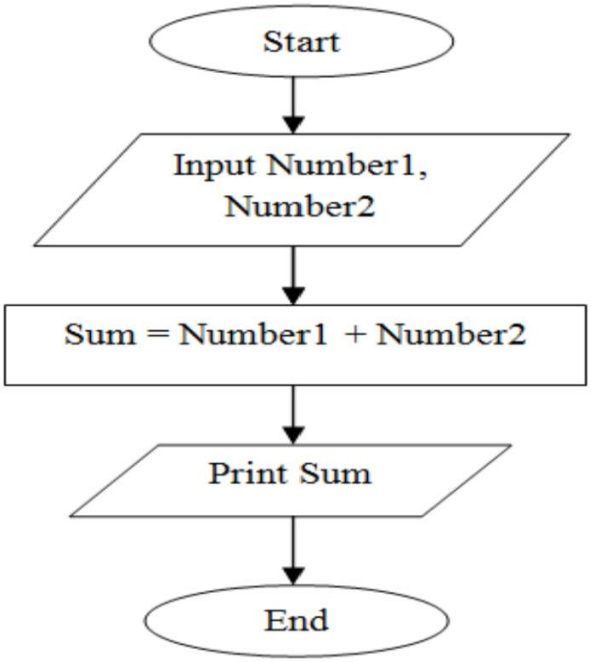
Pseudocodes are an outline of a program that can easily be converted into programming statements. The sole purpose of Pseudocodes is to enhance human understand ability of the solution.

Example: Pseudocode for calculating the price of a product after adding the sales tax:

1. Read the price of the product
2. Read the sales tax rate
3. Calculate sales tax = price of the item * sales tax rate
4. Calculate total price = price of the product + sales tax
5. Print total price
6. End

13. Define flowchart. What are the symbols used in flowchart. Give example.

Flowchart is basically a pictorial or diagrammatic representation of an algorithm using standard symbols. In other words, **flowchart** is a graphical representation that explains the sequence of operations to be performed in order to solve a problem under consideration.



Significance of Flowcharts

- Flowcharts help the programmers to understand the logic of complicated and lengthy problems.
- A flowchart follows the top-down approach in solving problems.
- They are also used for program documentation.

Limitations

- Drawing flowcharts is a laborious and a time-consuming activity.

The symbols used in a flowchart are given below:

in below table.

Flowchart Symbol	Symbol Name	Description
	Terminal (Start or Stop)	Terminals (Oval shapes) are used to represent start and stop of the flowchart.
	Flow Lines or Arrow	Flow lines are used to connect symbols used in flowchart and indicate direction of flow.
	Input / Output	Parallelograms are used to read input data and output or display information
	Process	Rectangles are generally used to represent process. For example, Arithmetic operations, Data movement etc.
	Decision	Diamond shapes are generally used to check any condition or take decision for which there are two answers, they are, yes (true) or no (false).
	Connector	It is used connect or join flow lines.

14. What are the different types of errors encountered in programming? Explain.

The errors are broadly classified under four groups as shown in Figure.

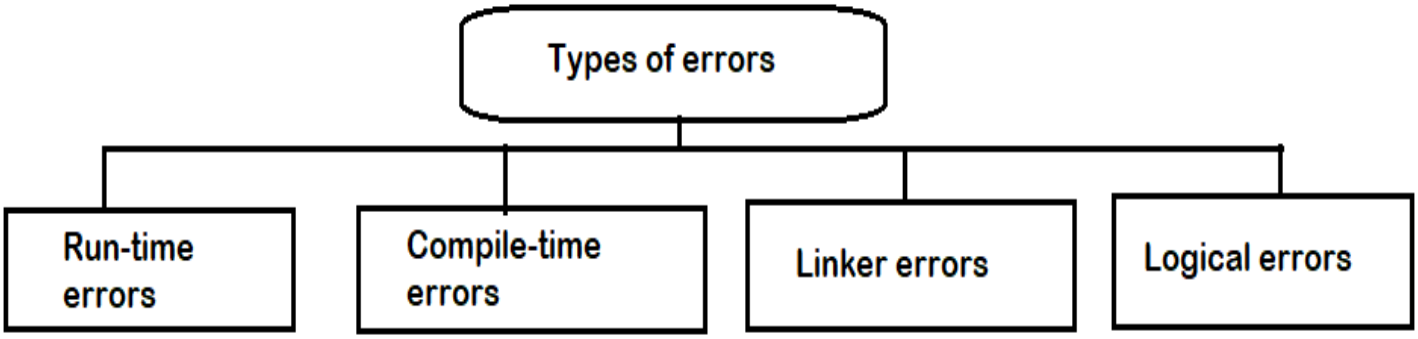


Fig. 2.6: Types of Errors

Run-time Errors: The run-time errors occur when the program is being run executed. Such errors occur when the program performs some illegal operations like:

- dividing a number by zero
- opening a file that already exists
- lack of free memory space
- finding square or logarithm of negative numbers

Run-time errors may terminate program execution.

Compile-time Errors: The compile-time errors occur at the time of compilation of the program. Such errors can be further classified as follows:

- Syntax Errors: Errors generated when rules of a programming language are violated.
- Semantic Errors: Errors which may comply with rules of the programming language but are not meaningful to the compiler.

Logical Errors: Logical errors are errors in the program code that result in unexpected and undesirable output. Such errors are not detected by the compiler, and programmers must check their code line by line or use a debugger to locate and rectify the errors. Logical errors occur due to incorrect statements.

Linker Errors: These errors occur when the linker is not able to find the function definition for a given prototype.

15. Explain characteristics of C. Mention uses of C.

Basic characteristics of C language are:

- C is a high-level programming language: The programmer needs to concentrate on the problem and not worry about the machine code on which the program would run.
- Small size: C has only 32 keywords. This makes it relatively easy to learn.
- C makes extensive use of function calls.
- C is well suited for structured programming. This feature facilitates ease in program debugging, testing, and maintenance.
- C supports loose typing: A character can be treated as an integer and vice versa).
- Structured language: The code can be organized as a collection of one or more functions.
- Stable language.
- Quick language as a well written C program is likely to be as quick as or quicker than a program written in any other language.
- Core language. Many programming languages (like C++, Java, Perl, etc.) are based on C.
- C is a portable language, i.e., a C program written for one computer can be run on another computer with little or no modification.

- C is often treated as the second best language for any given programming task. While the best language depends on the particular task to be performed, the second best language, on the other hand, will always be C.
- Supports pointers to refer computer memory, arrays, structures, and functions.
- C is an extensible language: Enables the user to add his own functions to the C library.

The uses of C language can be summarized as follows:

- C language is primarily used for system programming.
- C has been so widely accepted by professionals that compilers, libraries, and interpreters of other programming languages are often written in C.
- For portability and convenience reasons, C is sometimes used as an intermediate language for implementation of other languages.
- For C to be used as a compiler target language, C based intermediate languages was developed such as C--
- C is widely used to implement end-user applications.

16. Write a structure of a C program with an example.

A C program is composed of pre-processor commands, a global declaration section, and one or more functions.

The pre-processor directives contain special instructions that indicate how to prepare the compilation. The most important and commonly used pre-processor command is **"include"** which tells the compiler that to execute the program, some information is needed from the specified header file.

The variables that are declared outside the scope of all the functions is known as global declarations. These variables can be accessed and modified by any function or structure or in any scope.

A C program contains one or more functions, where a function is defined as a group of C statements that are executed together. The statements in a C function are written in a logical sequence to perform a specific task. The main( ) function is the most important function and is part of every C program. The execution of a C program begins at this function.

All functions are divided into two parts: the declaration section and the statement section. The declaration section is used to describe the data that will be used in the

function. The data declared within a function are known as local declaration as that data will be visible only within that function.

The statement in a function contains the code that manipulates the data to perform a specified task.

C program can have any number of functions depending on the tasks that have to be performed and each function can have any number of statements arranged according to a specific sequence.

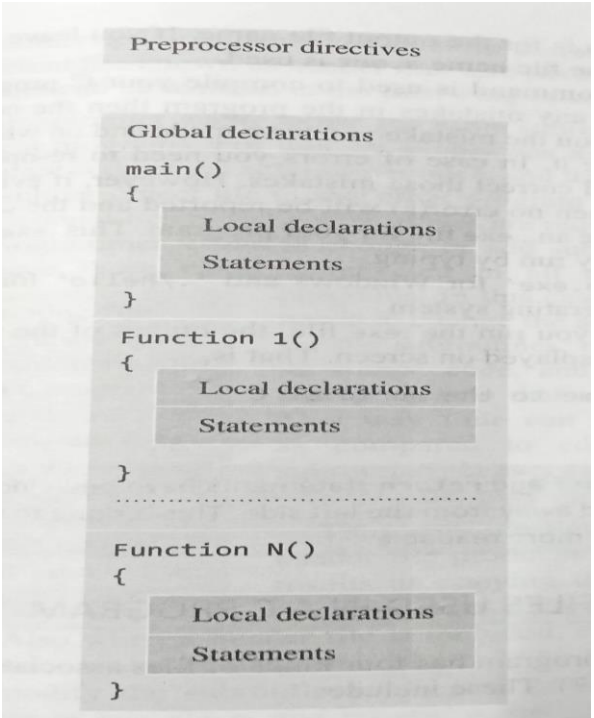


Figure 9.2 Structure of a C program

Example: C program to print a message.

```
#include<stdio.h>
int main( )
{
printf(“ Welcome to C”);
return 0;
}
```

17. Explain different input output statements in C with appropriate syntax & examples.

C language supports two formatting input / output functions: printf and scanf.

printf( ): The printf function (print formatting) is used to display information required by the user and also prints the values of the variables. For this, the printf function takes data values, converts them to a text stream using formatting specifications in the control string and passes the resulting text stream the standard output.

The syntax of printf function can be given as:

printf ("control string", variable list);

The function accepts two parameters: control string and variable list.

The control string may contain zero or more conversion specifications, textual data, and control characters to be displayed. The control string may also contain the text to be printed like instructions to the user, captions, identifiers, or any other text to make the output readable. The control characters can also be included in the printf statement. These control characters include \n, \t, \r, \a, etc.

After the control string, the function can have as many additional arguments as specified in the control string.

The prototype of the control string can be given as follows:

% [flags] [width] [.precision] [length modifier] type specifier

Each control string must begin with a % sign. The % character specifies how the next variable in the list of variables has to be printed.

scanf( ): The scanf() function (scan formatting) is used to read formatted data from the keyboard. The scanf function takes a text stream from the keyboard, extracts and formats data from the stream according to a format control string and then stores the data in specified program variables.

The syntax of the scanf() function can be given as:

scanf("control string", arg1, arg2, arg3,.....argn);

The control string specifies the type and format of the data that has to be obtained from the keyboard and stored in the memory locations pointed by arguments arg1, arg2,-, argn, i.e., the arguments are actually the variable addresses where each piece of data is to be stored.

The prototype of the control string can be given as:

% [*] [width] [modifier] type

Here * is an optional argument that suppresses assignment of the input field, i.e., it indicates that data should be read from the stream but ignored.

Example:

```
int num;
float salary;
scanf("%d %f", &num, &salary);
printf(" %d %f", num, salary);
```

In above statements, the scanf function will read integer numbers and floating point numbers while the printf function prints integer value and floating point value pointed by num and salary on the screen.

18. Define the data-types in C along with the size of identifiers.

Basic data types in C: The table below lists the basic data types, their size, range and usage for a C programmer on a 16-bit computer.

The char data type is of one byte and is used to store single characters. C does not provide any data type for storing text. This is because text is made up of individual characters.

The integer type is of two byte and is used to store the whole numbers without decimal values.

The floating point is of 4 bytes and is used to store decimal and exponential values. It is used to store decimal numbers (numbers with floating point) with single precision.

Data type	Keyword used	Size in bytes	Range	Use
Character	char	1	–128 to 127	To store characters
Integer	int	2	–32768 to 32767	To store integer numbers
Floating point	float	4	3.4E–38 to 3.4E+38	To store floating point numbers
Double	double	8	1.7E–308 to 1.7E+308	To store big floating point numbers
Valueless	void	0	Valueless	—

The double is of 8 bytes and is used to store decimal numbers (numbers with floating point) with double precision.

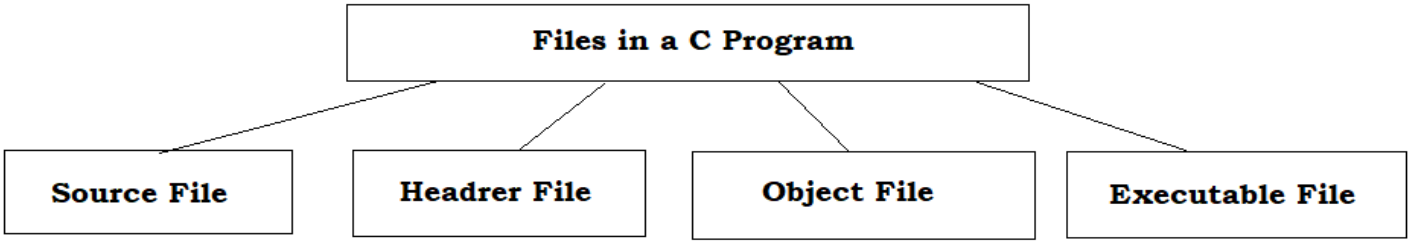
The void type holds no value. It is primarily used in three cases:

- To specify the return type of a function
- To specify the parameters of the function
- To create generic pointers.

In addition, C also supports four modifiers-two sign specifiers (signed and unsigned) and two size specifiers (short and long).

19. What are the different files used in C program? Explain.

Every C program has four files associated with it as shown below.



Source Code Files: The source code file contains the source code of the program. The file extension of any C source code file is '.c'. This file contains C source code that defines the main function and maybe other functions. A C program in general may include even other source code files (with the file extension.c).

Header Files: A header file is a file with extension '.h' that contains function declarations and macro definitions to be shared between several source files. A header file can be used in the program by including with C pre-processor directive '#include'. Some examples of using standard header files are:

#include<stdio.h> : for standardised input and output functions

#include<string.h> : for string handling functions

#include<math.h> : for mathematical functions

#include<conio.h> : for clearing the screen

#include<stdlib.h> : for some miscellaneous functions

Object Files: Object files are generated by the compiler as a result of processing the source code file. Object files contain compact binary code of the function definitions. Linker uses these object files to produce an executable file (.exe file) by combining the object files together. Object files have a '.o' extension.

Binary Executable Files: The binary executable file is generated by the linker. The linker links the various object files to produce a binary file that can be directly executed. On Windows operating system, the executable files have a '.exe' extension.

20. Define keyword. List few keywords used in C.

C has a set of reserved words often known as keywords that cannot be used as an identifier. All keywords are basically a sequence of characters that have a fixed meaning. All keywords must be written in lowercase (small) letters. Table below shows the list of keywords in C.

auto	double	int	struct
break	else	long	switch
case	enum	register	typedef
char	extern	return	union
const	float	short	unsigned
continue	for	signed	void
default	goto	sizeof	volatile
do	if	static	while

21. Define identifiers. What are the rules for forming identifier names?

Identifiers, help us to identify data and other objects in the program. Identifiers are basically the names given to program elements such as variables, arrays, and functions. Identifiers may consist of sequence of letters, numerals, or underscores.

Rules for Forming Identifier Names:

- Identifiers cannot include any special characters or punctuation marks (like #, $, ^, ?, ., etc.) except the underscore.
- There cannot be two successive underscores.
- Keywords cannot be used as identifiers.
- Identifiers must begin with a letter or an underscore.
- Identifiers can be of any reasonable length. They should not contain more than 31 characters.

Examples of valid identifiers include:

roll_number, marks, name, emp_number, basic_pay, HRA, DA, dept_code, EMP_NO

Examples of invalid identifiers include:

23_student, $_name, %marks, (DA), auto