CHAPTER 1 Basics of Information Technology

Overview

We are living in the Information Age of a Global Village today. That means Information is the key factor in this era and it is rightly said that "Information is the most precious commodity of today's day-to-day business". Everything evolves around it whether it is education, medicine, history, geographical phenomena, sports, research or business. You name the system and Information is there to play a key role in its functionality and existence.

Information can be defined as the facts and figures about anything i.e. The know-how about any object that exists and plays its role in any system. The system is any identified and known work that accepts data / information into itself, manipulates in the shape of certain output(s) and delivers so that it becomes useful and meaningful. And precisely, that is what is known as "Data processing" or "Computing", for which we need a computer to accomplish the task.

Few years back, this accomplished task was available to the computer users/clients in a prescribed locality only. That locality could be his own office or organization. But with the advent of Communication technology, our globe has become virtually a one-community area i.e. Global Village. The organizations expanded to remote cities and countries and it was felt to make the data/**information** and the ultimate accomplished task available to them where-ever they are. There came communication **technology** to our rescue and a new term emerged i.e. "Information Technology" that can be precisely defined as:

"Information Technology is the technology that merges computing with high-speed communication links carrying data in the form of text, sound, images, video etc", from place to place over this global village. For this purpose, the computer systems are networked in such a way that the data/information stored/processed on them is always available from anywhere, at any place, at any moment. Thus, the computer users are almost always sharing and exchanging their information in such a manner as if they are sitting in a drawing room face to face. So in short, Information Technology enables the heterogeneous types of industries and institutions to a phenomenon known as digital convergence. The digital convergence is the technological merger of various industries/enterprises through some electronic gadgets that exchange information between them. The industries are computers, electronics, telecommunications, and mass media etc. It has tremendous significance in modern scenario. It means that from a common electronic base, information can be communicated to any shape that the users are accustomed to see i.e. photographs, movies, audio, graphical shapes, text form, analog diagrams etc.

Modern Scenario

The modern impact of Information Technology has broadened the base of computing and communication through satellite, fiber-optic, mobile phone, fax machine, multi-media/hyper-media, e-commerce, m-commerce etc. Thus enhancing the implications of this shift from single isolated technologies to a unified digital convergence and enabling the computer users to experience a beautiful and fantastic scenario of computer utilization in the fields like:

(i) Artificial Intelligence
(ii) Web-based Applications
(iii) E-commerce, M-commerce (Mobile Commerce)
(iv) Computer Animation
(v) Multi-media, Hyper-media
(vi) Distributed Computing

There are numerous fields of computer applications, but we need not to go into the details of all those as it is beyond the scope of this book. What we need to know here is that the Information Technology has brought about a revolution in our life style. We may call it the Computer Revolution, Information Revolution, Communications Revolution, Internet Revolution, Multi-media Revolution or whatsoever. So it is beyond any doubt that today, we are living in a society that is making use of "Information Highway" which is heading towards a real future "Global Village" of the human history.

1.1 Hardware and Software

"A computer is a machine that can be programmed to accept data (input), process it into useful information (output), and store it away (in a secondary storage device) for safekeeping or later reuse". We have four words in this definition which are of prime importance in the whole computing process i.e. **machine**, **program**, **input** and **output**. By conventions, machine is called **hardware**, whereas a program is known as **software** in the discussion of computer science. Here, input and output devices are part of the machine that can now be called as a complete Computer system. So, to function, a computer system requires four main aspects of data handling i.e. input, processing, output and storage (figure 1.1). The hardware, responsible for these four areas, operates as described below:

- Input devices accept data in a form that the computer can use, and then sends it to the processing unit.
- The processor (CPU), has the electronic circuitry that manipulates input data into the form of useful information. The processor actually executes the instructions (Programs) in a logical sequence.
- Output devices show us the processed data i.e. information, in the shape we want it.

- Storage usually means secondary storage, which consists of secondary storage devices, such as hard disk, floppy diskettes, CDs etc. which can store data and programs outside the computer itself. These devices actually *supplement* main memory, which can hold data and programs only temporarily.

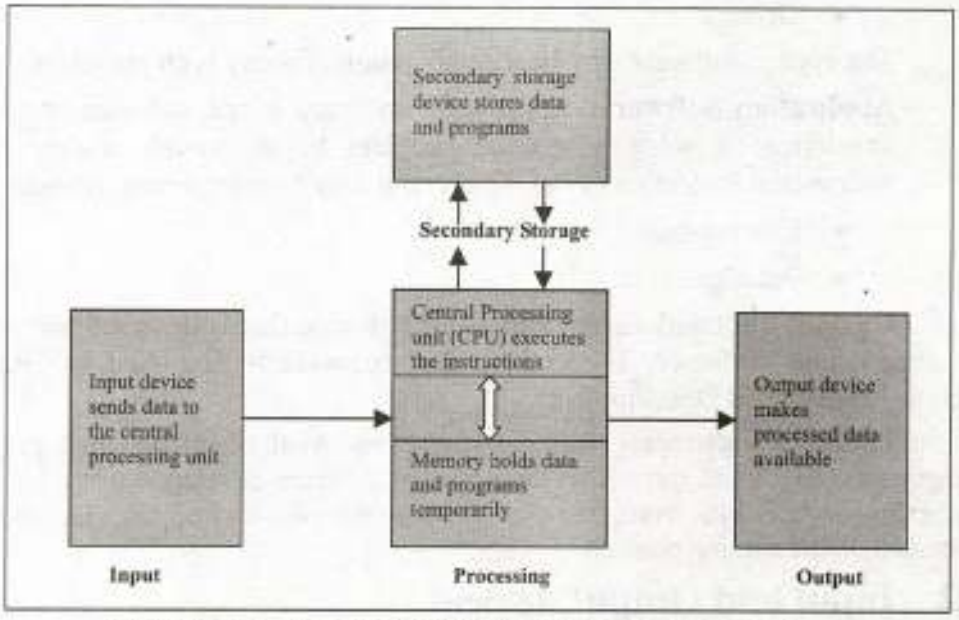


Figure 1.1: A generalized Computing Environment

1.1.1 Hardware Devices

Following are the main hardware devices in any computer system:

- Input Devices i.e. Keyboards, Mouse, Microphones etc.
- Output Devices i.e. Printers, Speakers, Monitors etc.
- Main Memory comprising of RAM and ROM
- I/O Device i.e. Terminals, Touch Screen etc.
- Secondary Memory i.e. Hard disk, Floppy disk, Compact disk, Tape etc.
- Inter-connectors i.e. Cables, Ports, Buses etc.
- Networking Devices i.e. Modem, Bridge, Router etc.

1.1.2 Software Classification

Software can be classified into following main two categories:

- System Software
- Application Software

System Software: System software is used to control the usage and allocation of different hardware components and enables the other application programs to execute. For example,

- Operating Systems
- Utility Programs (Backup/Restore)
- Drivers

The system software may be a combination of many such programs

Application Software: Application software is the software that has been developed to solve a specific problem or to provide audio, video, or multimedia entertainment to the users. It may be categorized as under

- Custom-built
- Packaged

Custom-built software: This is the software that is designed and developed for a particular customer. The custom-built software is discussed in detail in the section 1.6 (Systems Development).

Packaged software: This software is the kind of **off-the-shelf** programs or components, developed for sale to the potential software developers/users for their use. The examples are: MS-Word, MS-Power point, Personal Oracle etc. few of these are discussed in the coming chapters.

1.2 Input and Output devices

We need some, device(s) to enter the data into the computer (Input devices) and some device(s) to see the outcome (or processed information) of the computer (Output devices). Both discussed as below:

1.2.1 Input devices

Sometimes, the data is entered directly to the computer and sometimes indirectly. In the first case, the data goes directly to the computer from the source and in the second case; we have to carry out some intermediate handling. In either case the task is to gather data to be processed by the computer. There are three general types of input hardware, namely:

- Keyboards
- Pointing devices
- Source data-entry devices

Keyboard: The keyboard may look like a typewriter keypad to which some special keys have been added. The keys normally available on the keyboards are Numeric, Alphabetic, Function and additional Special-purpose keys. Figure 1.2 shows the complete layout of an extended keyboard on a personal computer. It has some additional keys between the main keypad and the

numeric keys, and status lights in the upper-right corner. This standard keyboard is also called "QWERTY", which describes the beginning keys in the top row of alphabetic letters.

Function Keys: The function keys are an easy way to give certain commands to the computer. The particular software we use defines what each function key does.

Main Keyboard: The main keyboard includes the familiar keys found on a typewriter keypad, as well as some special command keys. The command keys have different uses/effects that depend on the software being used. Some of the most common uses are listed here:

101-Key "Enhanced" Keyboard Layout extra buttons and keys are based on this layout.

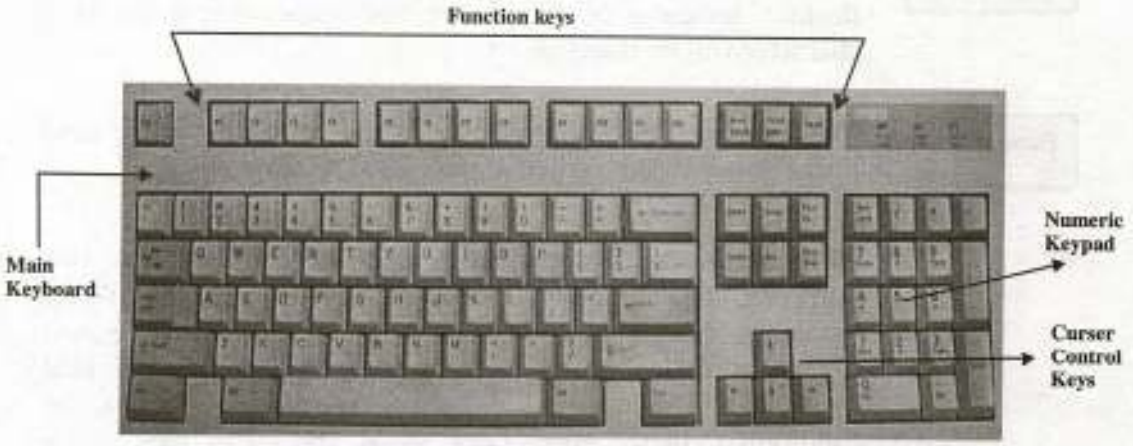


Figure 1.2: A 101-key "Enhanced" keyboard, showing the layout of the various key groups.

The **Escape key**, is used in different ways by different programs; often it allows to "escape" to the previous screen of the program.

The **Tab key**, is used to tab across the screen and set tab stops as on a typewriter.

When the **CapsLock** key is pressed, upper case letters are produced. Numbers and Symbols are not affected. The number or symbol shown on the bottom of a key is still produced. When the CapsLock is pressed, the status light under "CapsLock" lights up.

The **Shift key** is pressed in combination with other keys to produce upper case letters and the upper symbols shown on the keys.

The **Control key** is pressed in combination with other keys to initiate commands as specified by the software.

The **Alternate key** is also used in combination with other keys to initiate commands.

The **Backspace** is used to delete a character to the left of the cursor, moving the cursor back one position. The cursor is the flashing indicator on the screen that shows where the next character will be inserted.

The Enter key moves the cursor to the beginning of the next line. For instance it is used at the end of a paragraph.

Numeric Keys: The **numeric keys** serve one of the two purposes, depending on the status of the Num Lock key. When the computer is in the Num Lock mode, these keys can be used to enter numeric data and mathematical symbols (/ for "divided by", * for "multiplied by", - for "subtraction" and + for "addition"). In the Num Lock mode, the status light under "Num Lock" key lights up. When the computer is not in the Num Lock mode, the numeric keys can be used to move the cursor and perform other functions, as given below.

In some programs, the End key moves the cursor to the bottom-right corner of the screen.

This key moves the cursor down one line.

The Page Down key advances one full screen while the cursor stays at the same place.

This key moves the cursor one character to the left.

This key moves the cursor one character to the right.

In some programs, the Home key moves the cursor to the top-left corner of the screen.

This key moves the cursor one line up.

The Page Up key backs up to the previous screen while the cursor stays at the same place.

The Insert key, when toggled off, causes keyed characters to override/affix with the existing characters.

The Delete key deletes a character, space, or selected text.

Extended keyboards include additional keys that duplicate the cursor movement functions of the numeric keys. Users who enter a lot of numeric data can leave their computers in the Num Lock mode and use these additional keys to control the cursor.

The **Arrow keys**, to the left of the numeric keys, move the cursor position, just as the numeric keys 2,4,6, and 8 do when they are not in the Num Lock mode.

Just above the Arrow keys are six keys --- **Insert, Delete, Home, End, Page Up, and Page Down** --- which duplicate functions of the numeric keys 0, decimal point (Del), 7,1,9, and 3.

At the top of the keyboard, to the right of the function keys, are keys that perform additional tasks, as mentioned below:

The **Print Screen** key causes the current screen display to be taken a copy of information or image on the screen.

The **Scroll Lock** key causes lines of text images - not the cursor – to move. When the computer is in the Scroll Lock mode, the status light under "Scroll Lock" lights up.

The **Pause key** causes the screen to pause when information is appearing on the screen too fast to read.

Function Keys: These keys are at the top of a computer keyboard labelled F1, F2, F3, F4, F5, F6, F7, F8, F9, F10, F11 and F12. The functional keys are an easy way to give certain commands to the computer, which are usually operated by keyboard commands. They have different functions in different program. These functions are particularly important in an application program.

Pointing devices: Pointing devices control the position of the cursor or pointer on the screen. They include the following:

- Mouse
- Pointing Stick
- Touch Screen
- Digitizing/Graphic tablet
- Trackball
- Touch pad
- Light pen
- Pen-based system

A brief description is given as under:

Mouse: A **mouse** is an input device that looks a little bit like a mouse. It has a ball on its underside that is rolled on a flat surface or mouse-pad. The rolling movement causes a corresponding cursor movement on the screen. It enables us to reposition the cursor (or pointer) on the screen where ever we want. It also has buttons on its top which communicate certain commands to the computer while pressed. In particular, button is often used to click on an **icon** (icon represents a computer activity or command) to invoke the command.

Trackball: The **trackball** is a movable ball, on top of a stationary device, that is rotated with fingers or palm of the hand. Its popularity surged with the advent of laptop computers where traveling users found themselves without a flat surface to roll the traditional mouse. It looks like the mouse turned upside down and likewise, has additional buttons whose functions vary depending on the software.

Pointing Stick: A **pointing stick** is a pointing device that looks like a pencil eraser protruding from the keyboard between the **G, H,** and **B** keys. We move the pointing stick with our forefinger while using the thumb to press buttons located in front of the space bar. Another device like a Pointing stick is the **Joystick,** It is a pointing device that consists of a vertical handle like a

gearshift lever mounted on a base with one or two buttons. It is basically used in video games and in some computer-aided design systems.

Touch pad: The **touch pad** is a small, flat surface over which we slide our finger, using the same movements as we would with a mouse. As we move the finger, the cursor follows the movement. We "click" by tapping the finger on the pad's surface or by pressing button positioned close by the pad. Touch pads are now common on the portable computers (laptops).

Touch Screen: A **touch screen** is a video display screen that is sensitized to receive input from simply touching our fingers onto it. It is covered with a plastic layer, behind which are invisible beams of infrared light. We simply touch the provided buttons or menus and get the information on the display screen accordingly.

Light Pen: The **light pen** is a light-sensitive stylus, or pen-like device, connected by a wire to the computer terminal. The user brings the pen to a desired point on the display screen and presses the pen button, which identifies that screen location to the computer. Engineers, graphic designers, and illustrators use light pens.

Digitizing/Graphic Tablet: A digitizing tablet consists of a tablet connected by a wire to a stylus or puck. A **stylus** is a pen-like device with which the user "sketches" an image. A **puck** is a copying device with which the user copies an image, such as an architectural drawing or a civil engineering map. A puck looks a bit like a mouse but has different types of buttons and a clear plastic section extending from one end with crosshairs printed on it. The intersection of the crosshairs points to a location on the graphics tablet, which in turn is mapped to a specific location on the screen.

Digitizing tablets are used primarily in design and engineering. When used with drawing and painting software, a digitizing tablet and stylus allow us to do shading and many other effects similar to those artists achieve with pencil, pen, or charcoal. Alternatively, when we use a puck, we can trace a drawing laid on the tablet, and a digitized copy is stored in the computer.

Pen-Based Systems: In the next few years, students may be able to take notes in class without ink and paper, if pen-based computer systems are introduced. These computers use a pen-like stylus to allow people to enter handwriting and marks onto a computer screen rather than typing on a keyboard. This system connects an instructor's electronic "whiteboard" on the classroom wall with student's pen computers, so that the students could receive notes directly, without having to copy information word for word. "The idea is that the students should concentrate on the lecture listening only".

Source Data-Entry Devices: These devices are used for direct data entry to the computer systems. Few of them are as under:

Scanning Devices:

- Bar-Code Reader
- Mark- and character-recognition device
  - MICR (Magnetic-Ink Character Recognition)
  - OMR (Optical Mark-Recognition)
  - OCR (Optical Character-Recognition)
  - Magnetic-stripe cards
  - Smart cards
- Fax machine
- Imaging system
- Audio/Video Devices
  - Audio-input device
  - Video-input device
  - Digital camera

NOTE : Scanners use laser beams and reflected light to translate images of text, drawings, photos, and the like into digital form.

Scanning Devices

Bar-Code Reader: Bar codes are the vertical zebra-stripped marks we find on most of the manufactured products in the market. This bar-code system is also called the "Universal Product Code". These are read by bar-code readers, photoelectric scanners that translate the bar-code symbols into digital code, which is then fed to the computers for further processing.

MICR: It is a method of machine-reading characters made of magnetized particles. MICR characters, which are printed with magnetized ink, are read by MICR equipment, producing a digitized signal, which goes to the computer as data for further processing.

OMR: Optical recognition systems use a light beam to scan input data to convert it into electrical/digital signals, which are then sent to the computer for processing. The most well known example is the OMR technology used to read the SAT and GRE test marks.

OCR: It uses a device that reads preprinted characters in a particular font and converts them to digital code.The common examples are some utility bills and price tags in the department stores.

Magnetic-strip cards: A magnetic-strip card has a strip of magnetically encoded data on its back. They are used for personal identification during driving, in the stores, at public places etc.

Smart cards: It looks like a credit card but a microprocessor and memory chip have been added additionally. When inserted into a reader, it exchanges data with the corresponding information on a central computer. It can store

some basic information also. A Mobile-SIM card and an ATM card are good examples of this type.

Fax Machine: The fax or facsimile transmission machine scans an image and sends it as electrical signals over telephone lines to a receiving fax machine, which re-creates the image on paper. We have two types of fax machines i.e. dedicated fax machines and fax modems. Dedicated fax machines are the normal fax machines whereas, the fax modem is a circuit board inside the system unit. It has a capability to send signals directly to someone else's fax machine or computer fax modem, from computer to computer.

Imaging System: Image scanner (graphic scanner) converts text, drawings, and photographs into digital form and stores it to the computer system for further processing. The system scans each image (color or black and white) with light and breaks the image into light and dark dots or color dots, which are then converted to digital form. This is also called **raster graphics,** which refers to the technique of representing a graphic image as a matrix of dots.

Audio/ Video Input Devices

Audio-Input device: An audio-input device records analog sound and translate it for digital storage and processing. The principal use of audio-input devices is to provide digital input for multimedia computers, which incorporate text, graphics, sound, video and animation in a single digital presentation. Sound (analog form) goes through a special circuit board called an audio board, which converts analog sound to digital form and stores it for further processing and/or plays it back. Microphone is mostly used as an audio-input device.

Video-Input device: Films and video images from VCR or camcorder are converted to digital form with the help of a special digitizing card (called video-capture card). It has two types:

Frame-grabber video card: It can capture and digitize only a single frame at a time.

Full-motion video card: Also known as **adapters**, can convert analog to digital signals at the rate of up to 30 frames per second, giving the effect of a continuously flowing motion picture.

Digital Camera: A digital camera uses a light-sensitive processor chip to capture photographic images in digital form on a small diskette inserted in the camera or on flash-memory chips. The digital form is then uploaded to the computer for manipulation and printing out.

1.2.2 Output Devices

The information processed by the computer is translated into a form that we understand, and displayed by these machines. Normally, the output is classified as **Softcopy output** or **Sound output** and **Hardcopy output.**

Softcopy refer to data that is shown on a display screen or is in audio or voice form. This kind of output is not tangible; it cannot be touched. Virtual reality and robots might also be considered softcopy devices. **Hardcopy** refer to printed output. The principal examples are printouts, whether text or graphics, from printers, plotters etc.

Display Screens: Also known as CRTs, Monitors, or simply screens, differ in **size, color, resolution, and video display adapter card**. These are used for inputting the data or displaying the information after processing.

Size: Monitor come in different sizes, from small screen built into palmtops and laptop to extra large monitors used for special purposes.

Color: Many monitors display color. These RGB displays can create 256 colors and several thousand variations on them by blending shades of **R**ed, **G**reen, and **B**lue (RGB). Monochrome displays show information using a single foreground color on a contrasting background color.

Resolution: All the characters and images on a monitor are made up of dot patterns; the number of dot, or **pixels**, per inch determines resolution, or the sharpness of the image. A higher number of pixels means a shaper image.

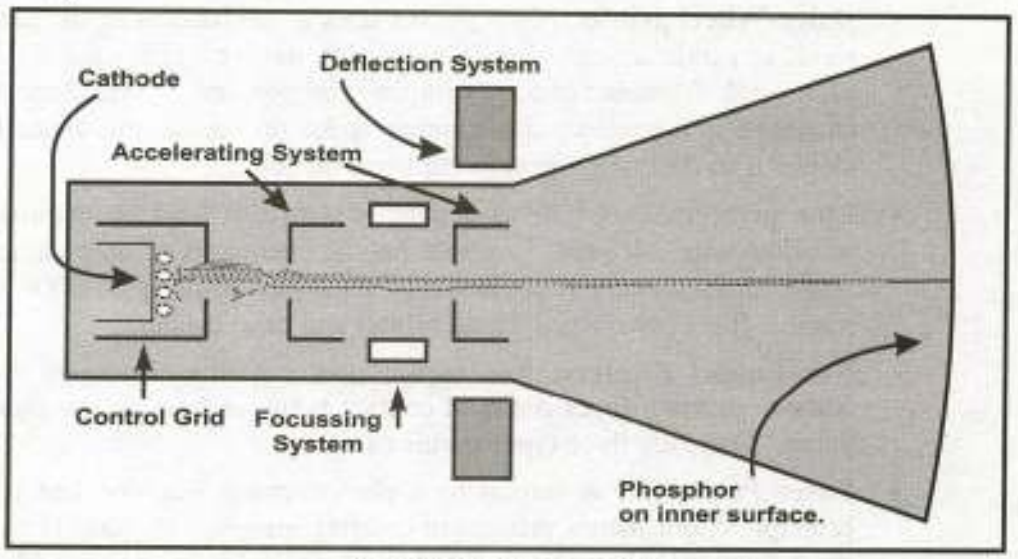
Video Display Adapters: To display graphics, a display screen must have a video display adapter attached with the computer. It is known as a video graphics card, and is a circuit board that determines the resolution, number of colors, and speed with which images appear on the display screen. So far, there are three types of graphics cards introduced in the market.

- **VGA:** Video Graphics Array, support 16-256 colors, depending on screen resolution. At 320 x 200 pixels, it will support 16 colors and at 640 x 480 pixels, 256 colors. It is called 4-bit color.

- **SVGA:** Super Video Graphics Array, support 256 colors at higher resolution than VGA. It has two graphics modes: 800 x 600 pixels and 1024 x 768 pixels. It is called 8-bit color.
- **XGA:** Extended Graphics Array, supports up to 16.7 million colors at a resolution of 1024 x 768 pixels. Depending on the video display adapter memory chip, XGA will support 256, 65536, or 16,777,216 colors. It is called 24-bit color or True color

Types of Screen: Display screens are of two types i.e. Cathode-Ray Tubes and Flat-Panel Displays.

CRT (Cathode-Ray Tubes): The most common form of display screen is the CRT. A Cathode-Ray tube is a vacuum tube used as a display screen in a computer or video display terminal. This same kind of technology is found not only in the screens of desktop computers but also in television set and in fight-information monitors in airport. A stream of bits defining the image is sent from the computer (from the CPU) to the CRT's electron gun, where the bits are converted to electrons. The inside of the front of the CRT screen is coated with phosphor. When a beam of electrons from the electron gun (deflected through a yoke) hits the phosphor, it lights up selected pixels to generate an image on the screen.



how CRT screen work

Flat-Panel Displays: The flat-panel displays are much thinner, weightless, and consume less power to CRT. Thus, they are better for portable computers. Flat-panel displays are made up of two plates of glass with a substance in between them, which is activated in different ways. There are three types of technology used in flat-panel display screens: **LCD (Liquid-Crystal Display)** consists of a substance called liquid crystal, the molecules of which line up in a way that lighting behind the screen is blocked or allowed through to create an image. **EL (Electro- Luminescent Display)** contain a substance that glows when it is charged by an electric current. **Gas-plasma display** is like a neon bulb, in which the display uses a gas that emits light in the presence of an electric current.

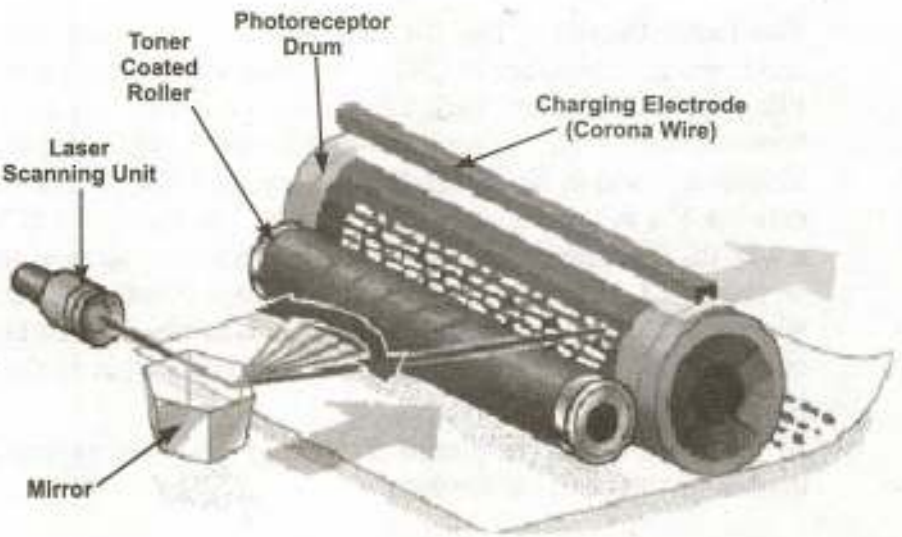
At present, EL and gas-plasma technology are more expensive thus are not used as often as LCD technology.

Printers: Printers are used to print characters, symbols, and graphics on paper. They are divided into two categories:

- Impact printers
- Non-impact printers

Impact Printers: An impact printer forms characters or images by striking a mechanism such as a print hammer or wheel against an inked ribbon, leaving an image on the paper. Following are a few types of impact printers:

- **Dot-Matrix printer:** It contains a print head of small pins, which strike an inked ribbon against paper, forming characters or images. Print heads are available with 9, 18, or 24 pins, with the 24-pin head offer the best quality prints.
- **Daisy-Wheel printer:** This printer uses a mechanism in the shape of a series of petals arranged on a petal wheel, having a character at the end of each petal. A character comes into a print position by wheel rotation and an image is formed by the hammer strike on the desired character; It is slower than dot-matrix printer but better in quality.
- **Line printer:** This type of printer is normally used by mainframe and minicomputers. It prints a whole line of characters at once rather than a single character at a time. Some of these can print up to 3000 lines per minute. It is of two types: chain printer and band printer.
- **Non-Impact Printers:** Non-impact printer forms characters or images without making direct physical contact between printing mechanism and paper. There are three types in this category.
- **Laser Printer:** It is similar to a photocopying machine and it use the principle of dot-matrix printers of creating images with dots. These images are created on a drum, treated with a magnetically charged ink-like toner



(powder), and then transferred from drum to paper. The laser printer can produce high quality images of both text and graphics (ranging from 300 dpi to 1200 dpi). Its speed varies from 4-32 text-only pages per minute for microcomputers and up to 200 pages per minute for mainframes.

- **Ink-jet Printer:** Ink-jet printer sprays small, electrically charged droplets of ink from four nozzles through holes in a matrix at high speed on to paper. It is cheaper compared to laser printer but lower in resolution (300-720 dpi) and is slower also (1-6) text-only pages per minute. It has another type of printer i.e. bubble-jet printer, which uses miniature heating elements to force specially formulated inks through print heads with 128 tiny nozzles.
- **Thermal Printer:** Thermal printer uses colored waxes and heat to produce images by burning dots on to special paper. The colored wax sheets are not required for black-and-white output. It produces a high quality printout but is quite expensive compared to other non-impact printers.

Plotters: A plotter is used to produce high-quality graphics in many colors and used for specialized applications i.e. architectural drawings, maps, graphs, and charts. Plotters are of two basic kinds:

- Flatbed plotter
- Drum plotter

Flatbed Plotter: A flatbed plotter is the one, which has a paper lying flat on a table-like surface. The bed-size varies according to the need. One to four color pens move across the paper and the images are printed by the computer accordingly.

Drum Plotter: It works like a flatbed plotter with a difference that the paper is mounted over a drum, enabling a continuous output. A typical usage is to track an earthquake readings.

Sound Output: Speakers are most commonly used to have this type of output.

Speaker: As we use microphone to input audio data to the computer, conversely we use speaker to get audio output from the computer. It works on the same principles to convert sound data into machine usable form. A variety of speakers are available in the market to satisfy the requirements of the users.

1.3 System Software vs Application Software

Generally speaking, a computer is a "deaf and dumb" machine, which cannot do anything at its own unless it is told to do so. We instruct it to do some number calculation, to create/modify a document, to work on some engineering application

and so on. So this instruction(s) is the driving force that allows a computer to perform a certain task and known as "a **Program** or a **Software**". It is this "**Software**" that tells the machine's physical components what to do and how to do.

The software falls into two major categories i.e. System Software and Application Software. They are discussed as below:

1.3.1 System Software

The system software basically manages and monitors the different resources of the whole computer system i.e. Operating system, Backup and Restore utility program, drivers etc.

Operating system is the main and foremost part of the system software. It is discussed in chapter 7.

1.3.2 Application Software

Computer Programs or Application software is basically a set of programs that are used to accomplish a given task. It is basically designed and implemented by the computer users or different software houses. The application software is available in many forms/categories i.e. Commercial software, scientific software, Financial packages, Games etc. A comprehensive discussion, about how to design and implement the software, is given under the topic "Systems Development" in section 1.5.

1.4 Basic Units of Data Storage

The memory (main or secondary) is composed of an electronic circuitry, which is a combination of "On" and "Off" switches. This On/Off state has been conceived by the computer's manufacturers as the numbers "1" and "0", as the circuit can show 1 (on state) or 0 (off state) at a given time. Based on these two numbers i.e. 1 and 0 (the binary numbers), the computer can construct sophisticated ways of representing data in the memory. Thus, converting the numbers, alphabets, and characters (and their combinations) into binary digits enable us to represent them in the computer memory.

1.4.1 Bit

The binary number 1 or 0 is called a **bit** (for **b**inary dig**it**), which is the basic unit for storing data in the computer memory. The circuit being on or off at a time, a bit in the memory is always storing some kind of data.

1.4.2 Byte

A byte is a combination of 8-bits, that can store a single character of data (a letter, numeral or special character). The capacity of the memory or the storage is expressed in terms of number of bytes it can hold or store. The following table shows the commonly used storage capacity terms:

Unit	Abbreviation	No. of bytes (approx)	No. of bytes
Kilobyte	K or KB	$(2)^{10}$	1024
Megabyte	M or MB	$(2)^{20}$	About one million
Gigabyte	G or GB	$(2)^{30}$	About one billion
Terabyte	T or TB	$(2)^{40}$	About one trillion

Table 1: Storage Capacity Terms

Example: Convert 240 MB of memory in bytes and kilo-bytes?

Solution:

Number of bytes in one MB = 2^{20}

Total number of bytes in 240 MB = 240 * 2^{20} bytes

Number of Kilo-bytes in one MB = 2^{10} KB = 1024 KB

Total number of Kilo-bytes in 240 MB = 240 * 1024 KB

1.4.3 Word

A computer word, typically the size of a register, is defined as the number of bits that constitute a common unit of data, as defined by the computer system. The length of a word varies from computer to computer. Generally, the larger the word, the more powerful is the computer. The following table illustrates this factor:

No. of bytes/words	Number of bits	Era of computer
One byte	8	Very early personal computers
Two byte	16	Traditional micro-computers
Single word	32	Mainframes, some mini-computers, and some micro-computers
Double word (DW)	64	Super computers and some micro-computers

Table 2: Capacity vs Computer Era

Example: Convert 60 GB of memory into words?

Solution:

Number of bytes in one GB = 2^{30}

Number of bytes in 60 GB = $60 * 2^{30}$

Number of words in 4 bytes = 1 W

Number of words in 60 GB= $60/4 * 2^{30}$

$= 15 * 2^{30}$ words

Remember that: An 8-bit machine could handle only one-byte (a character) at time, whereas a 64-bit machine handles two words or 8 bytes at a time, making its processing speed eight times faster.

1.5 System Development

1.5.1 System Components

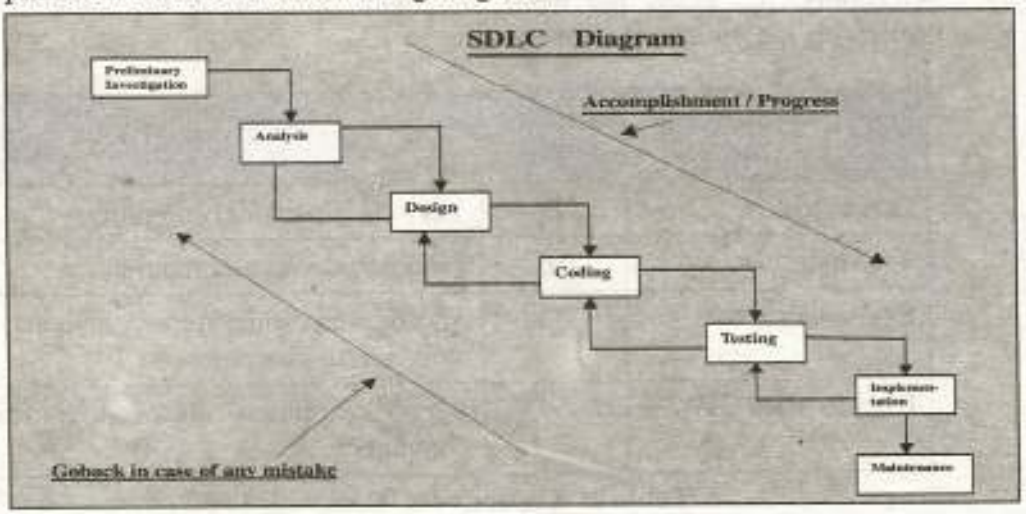
The system comprises of the following necessary components

(i) Hardware
(ii) Software
(iii) People / Users
(iv) Data / Information
(v) Communication setup

What is a System?
A system can be defined as a combination of some related components that interact with each other to perform some specific tasks.

Our main discussion here is focused on the Application Software development process, leaving aside the software packages (which are always available in the market).

To develop a system, several distinct phases are to be worked out. For this purpose, **SDLC** (**S**oftware **D**evelopment **L**ife **C**ycle) was developed, which is an organized way to develop a successful system. It involves five phases as shown in the following diagram.



1.5.2 System Development Life Cycle

Preliminary Investigation: The objective of preliminary investigation is to conduct an initial analysis and findings of the system as discussed below:

- **System Identification:** The system is to be identified at this stage. This is very important step as everything done in future will depend on the basis of this definition.
- **System Scope:** The scope of the system is established at this stage. Sometimes, it becomes necessary to curtail the projects to certain limits due to financial, political, or time constraints.
- **Alternate solutions:** There may be alternate solutions to develop the system. Identify all those and choose the best one. The best strategy in this regard would be to interview the concerned people inside the organization, clients or customers of the system, suppliers and consultants. We can also watch what the competitors are doing for the same type of systems.
- **Feasibility study:** We have to see the financial, political, and time-frame viabilities to go ahead for the system. There may be some social and technical constraint to be considered also.
- **Preliminary plan:** Here, we need to wind up all the findings and submit as a written document for approval. The readers of this document (also known as **feasibility report**) are top managers who will then decide about the future actions to be taken, based on this report. They might would like to make few amendments in the project or shelve it, depending on the whole preliminary investigation.

Systems Analysis: Here, the analyst will conduct the following activities:

Needs Analysis: This activity is also called Requirements Analysis. Here, the analyst would sum up the requirements of the system from the users and the managers. The developed system should satisfy these requirements during testing phase.

Data Gathering: For this activity, the systems analyst uses different tools and methods, depending on the situation. They are discussed as under:

- **Written documents:** In case we want to computerize the existing manual system or upgrade the existing computer-based system, much of the handful information can be made available using these documents. They are the reports, forms, memos, business plans, policy statements, organizational charts and many others.
- **Interviews:** Interviewing the managers, users/clients, suppliers, and competitors will help the analysts/designers to gain more knowledge about the system. The emphasis is on the fact that the questions to be asked from them should be precise and relevant.

- **Questionnaires:** It may be difficult to interview many people, so it is better to design some questionnaires to collect the information from as many people as we like. This is very convenient and inexpensive method to collect handful of data but sometimes the response may be ambiguous and insufficient.
- **Observations:** The analyst or his team may go and watch the working, behavior, and similar things to know more about the similar systems around. He may be a participant or non-participant observer depending on the permission he got from the other party.
- **Sampling:** If there were a large number of people or events involved in the system, it would be better to work on a portion of all of them to save time.

Data Analysis: As we are living in the **"Information age"** so it is generally believed in today's computing scenario that data or information is the most precious commodity. Therefore, data must be accurate, complete, and readily available in the systems we design. So to keep it in proper shape, we have many tools available. For example: DFDs (Data Flow Diagrams), System Flowcharts, Connectivity Diagrams, Grid Charts, and Decision Tables etc. It is beyond the scope of this course to discuss them in details here.

Analysis Report: Once the analysis work is over, we need to document it in a presentable form to the higher management for their review and approval of the project. This report should have three parts : First, it should explain how the current system (manual or automated if exists) works. Second, it should explain the problems in the existing system, and finally it should describe the requirements for the new system and make recommendations for future.

Design: In this phase of SDLC, the analyst works on the preliminary (Logical) design, detail (Physical) design, and then writes a detailed report.

- **Logical design:** It describes the general functional capabilities of a proposed system. It reviews the system requirements and considers the major system components. Case tools and project management software (MS-Project, Gantt chart, PERT chart etc) may be used to accomplish this task. You will learn about these tools and software in some advanced course.
- **Physical design:** It describes how a proposed system will deliver the general capabilities described in the Logical design. It will address the following points: Output requirements, input requirements, storage requirements, processing requirements, and system control and backup/recovery.
- **Report:** A detailed report on logical, physical design is to be submitted to the higher management along with some sort of presentation, explaining them the details of the proposed system.

Coding: This is the core area of the system development process. It consists of writing the segments and programs, which will be coupled together in the shape of a complete system. It needs a lot of time, effort and budget to acquire a workable system. The program specifications, algorithms, flowcharts are given to the programmers/ software engineers to code the required programs. Off-the-Shelf-Components (already written programs) can also be used and embedded in the system to save time and effort.

Testing: Having proper hardware acquired, the programs can be tested in two stages:

- **Unit-testing:** It is also called modular testing where individual modules, programs can be tested using test (sample) data.
- **System-testing:** In this, parts or modules are linked together to test their workability as a one system. Actual data may be used to do the system testing and at the same time, erroneous data can also be used to check whether the system fails or not.

  If the system passes all the tests, we can implement the system on the servers, so that the organization and other clients can use it.

Implementation: This activity consists of transferring the hardware, software and data (files, database etc) to the new working environment (server). Users of the system are also trained in this phase. Implementation may be achieved in five approaches.

- **Direct Implementation:** In this way, the users start using the new system right away and stop working on the old one.
- **Parallel Implementation:** Using this approach, the new and old systems are used side by side until it is felt that the new system is quite reliable.
- **Phased Implementation:** In this approach, parts of the system are implemented from time to time, until the whole system is implemented.
- **Pilot Implementation:** This type of implementation allows us to implement the complete system but to a selected group of users or selected departments.
- **Users Training:** Involving the users in the SDLC process from the beginning and ensuring their proper training is very much essential throughout the system design activity. A variety of methods/tools are used to do so i.e. Instruction Manual, Videotapes/CDs, and Lectures etc. The training may be conducted "In-house" or it may be "Contracted out".

Comment: In general, the pilot and phased implementation are the most favored and popular approaches to implement the systems. **Phased** approach is preferable for organizations where different types of functions are carried out whereas **Pilot** approach is preferred where almost same type of work is going on in the organization.

Maintenance: The last phase adjusts and improves the system by considering the users evaluation, feedback, and enhancements based on their due recommendations. In this phase, due maintenance and help is also provided to the users against their queries, problems, and ambiguities.

Exercise 1C

1. Fill in the blanks:

(i) A bridge is used where the _____ type of networks are to be joined together.

(ii) WAN stand for_____.

(iii) A set of instruction given to the computer to solve a problem is called _____.

(iv) _____ and _____ printer are non impact printer.

(v) Trackball is popular among user of _____ computer.

(vi) SVGA stands for _____.

(vii) 1024 GB are equal to _____.

(viii) OMR reads _____ marks and converts them into computer-usable form.

(ix) LCD stands for _____.

(x) Fax stand for _____.

(xi) Dot matrix printer is a (n) _____ type printer.

2. Choose the correct option:

(i) The name for the screen clarity:

(a) Resolution (b) Discrete

(c) Pixel (d) LCD

(ii) Another word for pointer:

(a) Monochrome (b) Pixel

(c) Cursor (d) None of the above

(iii) A device used for optical-character recognition is a:

(a) Wand reader (b) Cursor

(c) Pen. (d) MICR reader

(iv) Imaging uses what device to input data:

(a) scanner (b) icon

(c) bar code reader (d) tablet

(v) An ink-jet printer is an example of a(n)

(a) Laser printer (b) Impact printer

(c) COM printer (d) Non-impact printer

(vi) Soft copy refer to:

(a) Screen output (b) Peripheral devices

(c) OCR (d) None of the above.

(vii) Smallest unit of memory is:

(a) Byte (b) Bit

(c) Character (d) Word

(viii) The printer which can print one complete line at a time is:

(a) Dot matrix printer (b) Daisy wheel printer

(c) Laser printer (d) Line printer

(ix) The microphone converts the sound into:

(a) Mechanical signals (b) Electrical signal

(c) Computer file (d) Software

(x) An input device, which is used for playing computer games:

(a) Light Pen (b) Mouse

(c) Joy Stick (d) Scanner

3. Write T for true and F for false statement:

(i) The keyboard arrangement provided as standard on most keyboard is the QWERTY arrangement.

(ii) A picture element on the screen is called a pixel.

(iii) CRTs are used on portable computers.

(iv) Audio-output device can output only music.

(v) Non-impact printers are quitter than impact printers.

(vi) A trackball is a pointing input device almost like a mouse turned upside down.

(vii) The disk drives are known as I/O devices.

(viii) Function keys are used the same way with every software application.

(ix) EGA stand for Extended Graphic Adapter.

(x) The two basic types of plotter are the Drum plotter and the Flatbed plotter.

4. What is the difference between hardware and software?

5. What is information Technology? Describe it in detail?

6. What implementation? Describe it Approaches.

7. What is the usage of an input device? List few of them.

8. Describe the enhanced Keyboard and it segment?

9. Write the name of the Input device that can control the cursor movement?

10. What is the function of an output device? List few of them.

11. Describe the functioning of a Laser printer. Name few of them.

12. What is the usage of a plotter? Name its different kinds.

13. Define the term "Operating System" in your own words.

14. Describe the function of the following input device?

(i) Mouse (ii) Joystick (iii) Trackball

(iv) Scanner (v) Light Pen (vi) Digital Camera

15. What do you understand by "SDLC"? Define its steps properly.

Answers

1.

(i) Similar	(ii) Wide Area Network	(iii) Program	(iv) Inkjet, Laser
(v) Laptop	(vi) Super Video Graphic Array		(vii) On Tara Byte
(viii) SAT or GRE	(ix) Liquid Crystal Display	(x) Facsimile	(xi) Impact

2.

(i) a	(ii) c	(iii) d	(iv) a	(v) d
(vi) a	(vii) b	(viii) d	(ix) b	(x) c

3.

(i) T	(ii) T	(iii) F	(iv) F	(v) T
(vi) T	(vii) T	(viii) F	(ix) F	(x) T