PAVENDAR BHARATHIDASAN COLLEGE OF ARTS AND SCIENCE

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FUNDAMENTALS OF INFORMATION TECHNOLOGY

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Unit 1

Introduction of computers – Generation of computers - Classification of Digital computer - Anatomy of Digital computer

Introduction of computers

Computers is an electronic device to store and retrieve the data, today's computers rule the world and it used in many places.

Genearation of Computer

Sr. No.	Generation & Description
1	**First Generation** The period of first generation: 1946-1959. Vacuum tube based.
2	**Second Generation** The period of second generation: 1959-1965. Transistor based.
3	**Third Generation** The period of third generation: 1965-1971. Integrated Circuit based.
4	**Fourth Generation** The period of fourth generation: 1971-1980. VLSI microprocessor based.
5	**Fifth Generation** The period of fifth generation: 1980-onwards. ULSI microprocessor based.

First Generation

- The main features of the first generation are:
  - Vacuum tube technology
  - Unreliable
  - Supported machine language only
  - Very costly
  - Generated a lot of heat
  - Slow input and output devices

Huge size

     Need of AC

     Non-portable

     Consumed a lot of electricity

- *Some computers of this generation were:*

     ENIAC (Electronic Numerical Integrated and Calculator)

     EDVAC (Electronic Discrete variable Automatic computer)

     UNIVAC (Universal automatic computer)

     IBM-701 (International Business Machine Corporation)

     IBM-650

Second Generations

- The main features of second generation are:

     Use of transistors

     Reliable in comparison to first generation computers

     Smaller size as compared to first generation computers

     Generated less heat as compared to first generation computers

      Consumed less electricity as compared to first generation computers

     Faster than first generation computers

     Still very costly

     AC required

     Supported machine and assembly languages

- Some computers of this generation were:

     IBM 1620

     IBM 7094

     CDC 1604

     CDC 3600

     UNIVAC 1108

Third Generation

- The main features of third generation are:

     IC used

     More reliable in comparison to previous two generations

3

- Smaller size

- Generated less heat

- Faster

- Lesser maintenance

- Costly

- AC required

- Consumed lesser electricity

- Supported high-level language

- Some computers of this generation were:

  - IBM-360 series

  - Honeywell-6000 series

  - PDP (Personal Data Processor)

  - IBM-370/168

  - TDC-316

Fourth Generation

- The main features of fourth generation are:

  - VLSI technology used

  - Very cheap

  - Portable and reliable

  - Use of PCs

  - Very small size

  - Pipeline processing

  - No AC required

  - Concept of internet was introduced

  - Great developments in the fields of networks

  - Computers became easily available

- Some computers of this generation were:

  - DEC 10

  - STAR 1000

  - PDP 11

  - CRAY-1(Super Computer)

  - CRAY-X-MP(Super Computer)

Fifth Genearation

➢ The period of fifth generation is 1980-till date. In the fifth generation, VLSI technology became ULSI (Ultra Large Scale Integration) technology, resulting in the production of microprocessor chips having ten million electronic components.

➢ This generation is based on parallel processing hardware and AI (Artificial Intelligence) software.

➢ AI is an emerging branch in computer science, which interprets the means and method of making computers think like human beings.

➢ All the high-level languages like C and C++, Java, .Net etc., are used in this generation.

AI includes:

 Robotics

 Neural Networks

 Game Playing

 Development of expert systems to make decisions in real-life situations

 Natural language understanding and generation

Classification of Computers

Sr. No.	Type	Specifications
1	PC (Personal Computer)	It is a single user computer system having moderately powerful microprocessor
2	Workstation	It is also a single user computer system, similar to personal computer however has a more powerful microprocessor
3	Mini Computer	It is a multi-user computer system, capable of supporting hundreds of users simultaneously.
4	Main Frame	It is a multi-user computer system, capable of supporting hundreds of users simultaneously. Software technology is different from minicomputer.
5	Supercomputer	It is an extremely fast computer, which can execute hundreds of millions of instructions per second.

PC (Personal Computer)

A PC can be defined as a small, relatively inexpensive computer designed for an individual user.

PCs are based on the microprocessor technology that enables manufacturers to put an entire CPU on one chip.

Businesses use personal computers for word processing, accounting, desktop publishing, and for running spreadsheet and database management applications.

At home, the most popular use for personal computers is playing games and surfing the Internet.

Although personal computers are designed as single-user systems, these systems are normally linked together to form a network.

In terms of power, now-a-days high-end models of the Macintosh and PC offer the same computing power and graphics capability as low-end workstations by Sun Microsystems, Hewlett-Packard, and Dell.

Workstation

Workstation is a computer used for engineering applications (CAD/CAM), desktop publishing, software development, and other such types of applications which require a moderate amount of computing power and relatively high quality graphics capabilities.

Workstations generally come with a large, high-resolution graphics screen, large amount of RAM, inbuilt network support, and a graphical user interface.

Most workstations also have mass storage device such as a disk drive, but a special type of workstation, called diskless workstation, comes without a disk drive.

Common operating systems for workstations are UNIX and Windows NT. Like PC, workstations are also single-user computers like PC but are typically linked together to form a local-area network, although they can also be used as stand-alone systems.

Minicomputer

Minicomputer It is a midsize multi-processing system capable of supporting up to 250 users simultaneously.

Mainframe Mainframe

Mainframe Mainframe is very large in size and is an expensive computer capable of supporting hundreds or even thousands of users simultaneously. Mainframe executes many programs concurrently and supports many simultaneous execution of programs.

Supercomputer

Supercomputers are one of the fastest computers currently available. Supercomputers are very expensive and are employed for specialized applications that require immense amount of mathematical calculations (number crunching).

For example weather forecasting, scientific simulations, (animated) graphics, fluid dynamic calculations, nuclear energy research, electronic design, and analysis of geological data (**e.g**. in petrochemical prospecting).

Anatomy of Digital Computer or Block Diagram of computer
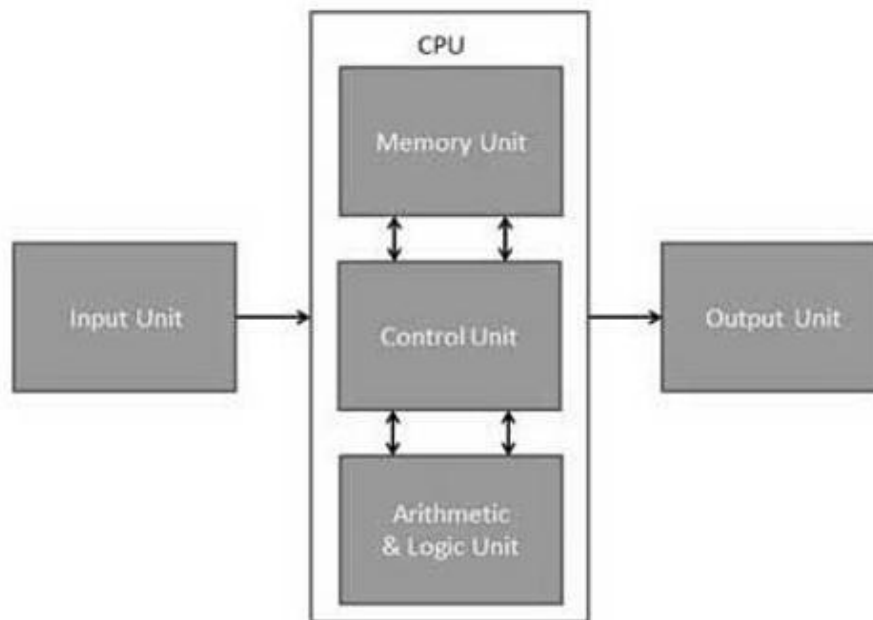
Input device accepts the coded information as source program i.e. high level language.

This is either stored in the memory or immediately used by the processor to perform the desired operations.

The program stored in the memory determines the processing steps. Basically the computer converts one source program to an object program. i.e. into machine language.

Finally the results are sent to the outside world through output device. All of these actions are coordinated by the control unit.

Input unit: -

The source program/high level language program/coded information/simply data is fed to a computer through input devices keyboard is a most common type.

Whenever a key is pressed, one corresponding word or number is translated into its equivalent binary code over a cable & fed either to memory or processor.

Joysticks, trackballs, mouse, scanners etc are other input devices.

Memory unit: -

Its function into store programs and data. It is basically to two types

1. Primary memory
2. Secondary memory

1.Primary memory: -

Is the one exclusively associated with the processor and operates at the electronics speeds programs must be stored in this memory while they are being executed.

The memory contains a large number of semiconductors storage cells. Each

ALU

Processor

Control Unit

Capable of storing one bit of information. These are processed in a group of fixed site called word.

To provide easy access to a word in memory, a distinct address is associated with each word location. Addresses are numbers that identify memory location.

Number of bits in each word is called word length of the computer.

Programs must reside in the memory during execution.

Instructions and data can be written into the memory or read out under the control of processor.

Memory in which any location can be reached in a short and fixed amount of time after specifying its address is called random-access memory (RAM).

The time required to access one word in called memory access time. Memory which is only readable by the user and contents of which can't be altered is called read only memory (ROM) it contains operating system.

Caches are the small fast RAM units, which are coupled with the processor and are aften contained on the same IC chip to achieve high performance.

Although primary storage is essential it tends to be expensive.

2 Secondary memory: -

Is used where large amounts of data & programs have to be stored, particularly information that is accessed infrequently.

Examples: - Magnetic disks & tapes, optical disks (ie CD-ROM's), floppies etc.,

Arithmetic logic unit (ALU):-

Most of the computer operators are executed in ALU of the processor like addition, subtraction, division, multiplication, etc.

the operands are brought into the ALU from memory and stored in high speed storage elements called register.

Then according to the instructions the operation is performed in the required sequence.

The control and the ALU are may times faster than other devices connected to a computer system. This enables a single processor to control a number of external devices such as key boards, displays, magnetic and optical disks, sensors and other mechanical controllers.

Output unit:-

These actually are the counterparts of input unit. Its basic function is to send the processed results to the outside world.

Examples:- Printer, speakers, monitor etc.

Control unit:-

It effectively is the nerve center that sends signals to other units and senses their states. The actual timing signals that govern the transfer of data between input unit, processor, memory and output unit are generated by the control unit.

Unit 2

CPU and MEMORY – Secondary storage devices – Input Devices – Output Devices.

CPU

- Stands for "Central Processing Unit."
- The CPU is the primary component of a computer that processes instructions.
- It runs the operating system and applications, constantly receiving input from the user or active software programs.
- It processes the data and produces output, which may stored by an application or displayed on the screen.
- The CPU contains at least one processor, which is the actual chip inside the CPU that performs calculations.
- For many years, most CPUs only had one processor, but now it is common for a single CPU to have at least two processors or "processing cores."
- A CPU with two processing cores is called a dual-core CPU and models with four cores are called quad-core CPUs.
- High-end CPUs may have six (hexa-core) or even eight (octo-core) processors. A computer may also have more than one CPU, which each have multiple cores. For example, a server with two hexa-core CPUs has a total of 12 processors.

Input devices

Following are some of the important input devices which are used in a computer −

- Keyboard
- Mouse
- Joy Stick
- Light pen
- Track Ball
- Scanner
- Graphic Tablet
- Microphone
- Magnetic Ink Card Reader(MICR)
- Optical Character Reader(OCR)
- Bar Code Reader
- Optical Mark Reader(OMR)

Keyboard

Keyboard is the most common and very popular input device which helps to input data to the computer. The layout of the keyboard is like that of traditional typewriter, although there are some additional keys provided for performing additional functions.

Keyboards are of two sizes 84 keys or 101/102 keys, but now keyboards with 104 keys or 108 keys are also available for Windows and Internet.

The keys on the keyboard are as follows −

S.No	Keys & Description
1	**Typing Keys** These keys include the letter keys (A-Z) and digit keys (09) which generally give the same layout as that of typewriters.
2	**Numeric Keypad** It is used to enter the numeric data or cursor movement. Generally, it consists of a set of 17 keys that are laid out in the same configuration used by most adding machines and calculators.
3	**Function Keys** The twelve function keys are present on the keyboard which are arranged in a row at the top of the keyboard. Each function key has a unique meaning and is used for some specific purpose.
4	**Control keys** These keys provide cursor and screen control. It includes four directional arrow keys. Control keys also include Home, End, Insert, Delete, Page Up, Page Down, Control(Ctrl), Alternate(Alt), Escape(Esc).
5	**Special Purpose Keys** Keyboard also contains some special purpose keys such as Enter, Shift, Caps Lock, Num Lock, Space bar, Tab, and Print Screen.

Mouse

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

Generally, it has two buttons called the left and the right button and a wheel is present between the buttons. A mouse can be used to control the position of the cursor on the screen, but it cannot be used to enter text into the computer.

Advantages

- Easy to use
- Not very expensive
- Moves the cursor faster than the arrow keys of the keyboard.

Joystick

Joystick is also a pointing device, which is used to move the cursor position on a monitor screen. It is a stick having a spherical ball at its both lower and upper ends. The lower spherical ball moves in a socket. The joystick can be moved in all four directions.

The function of the joystick is similar to that of a mouse. It is mainly used in Computer Aided Designing (CAD) and playing computer games.

Light Pen

Light pen is a pointing device similar to a pen. It is used to select a displayed menu item or draw pictures on the monitor screen. It consists of a photocell and an optical system placed in a small tube.

When the tip of a light pen is moved over the monitor screen and the pen button is pressed, its photocell sensing element detects the screen location and sends the corresponding signal to the CPU.

Track Ball

Track ball is an input device that is mostly used in notebook or laptop computer, instead of a mouse. This is a ball which is half inserted and by moving fingers on the ball, the pointer can be moved.

Since the whole device is not moved, a track ball requires less space than a mouse. A track ball comes in various shapes like a ball, a button, or a square.

Scanner

Scanner is an input device, which works more like a photocopy machine. It is used when some information is available on paper and it is to be transferred to the hard disk of the computer for further manipulation.

Scanner captures images from the source which are then converted into a digital form that can be stored on the disk. These images can be edited before they are printed.

Digitizer

Digitizer is an input device which converts analog information into digital form. Digitizer can convert a signal from the television or camera into a series of numbers that could be stored in a computer. They can be used by the computer to create a picture of whatever the camera had been pointed at.

Digitizer is also known as Tablet or Graphics Tablet as it converts graphics and pictorial data into binary inputs. A graphic tablet as digitizer is used for fine works of drawing and image manipulation applications.

Microphone

Microphone is an input device to input sound that is then stored in a digital form.

The microphone is used for various applications such as adding sound to a multimedia presentation or for mixing music.

Magnetic Ink Card Reader (MICR)

MICR input device is generally used in banks as there are large number of cheques to be processed every day. The bank's code number and cheque number are printed on the cheques with a special type of ink that contains particles of magnetic material that are machine readable.

This reading process is called Magnetic Ink Character Recognition (MICR). The main advantages of MICR is that it is fast and less error prone.

Optical Character Reader (OCR)

OCR is an input device used to read a printed text.

OCR scans the text optically, character by character, converts them into a machine readable code, and stores the text on the system memory.

Bar Code Readers

Bar Code Reader is a device used for reading bar coded data (data in the form of light and dark lines). Bar coded data is generally used in labelling goods, numbering the books, etc. It may be a handheld scanner or may be embedded in a stationary scanner.

Bar Code Reader scans a bar code image, converts it into an alphanumeric value, which is then fed to the computer that the bar code reader is connected to.

Optical Mark Reader (OMR)

OMR is a special type of optical scanner used to recognize the type of mark made by pen or pencil. It is used where one out of a few alternatives is to be selected and marked.

It is specially used for checking the answer sheets of examinations having multiple choice questions.

Following are some of the important output devices used in a computer.

- Monitors
- Graphic Plotter
- Printer

Monitors

Monitors, commonly called as **Visual Display Unit** (VDU), are the main output device of a computer. It forms images from tiny dots, called pixels that are arranged in a rectangular form. The sharpness of the image depends upon the number of pixels.

There are two kinds of viewing screen used for monitors.

- Cathode-Ray Tube (CRT)
- Flat-Panel Display

Cathode-Ray Tube (CRT) Monitor

The CRT display is made up of small picture elements called pixels. The smaller the pixels, the better the image clarity or resolution. It takes more than one illuminated pixel to form a whole character, such as the letter 'e' in the word help.

A finite number of characters can be displayed on a screen at once. The screen can be divided into a series of character boxes - fixed location on the screen where a standard character can be placed. Most screens are capable of displaying 80 characters of data horizontally and 25 lines vertically.

There are some disadvantages of CRT −

- Large in Size
- High power consumption

Flat-Panel Display Monitor

The flat-panel display refers to a class of video devices that have reduced volume, weight and power requirement in comparison to the CRT. You can hang them on walls or wear them on your wrists. Current uses of flat-panel displays include calculators, video games, monitors, laptop computer, and graphics display.

The flat-panel display is divided into two categories −

- **Emissive Displays** – Emissive displays are devices that convert electrical energy into light. For example, plasma panel and LED (Light-Emitting Diodes).

- **Non-Emissive Displays** – Non-emissive displays use optical effects to convert sunlight or light from some other source into graphics patterns. For example, LCD (Liquid-Crystal Device).

Printers

Printer is an output device, which is used to print information on paper.

There are two types of printers –

- Impact Printers
- Non-Impact Printers

Impact Printers

Impact printers print the characters by striking them on the ribbon, which is then pressed on the paper.

Characteristics of Impact Printers are the following –

- Very low consumable costs
- Very noisy
- Useful for bulk printing due to low cost
- There is physical contact with the paper to produce an image

These printers are of two types –

- Character printers
- Line printers

Character Printers

Character printers are the printers which print one character at a time.

These are further divided into two types:

- Dot Matrix Printer(DMP)
- Daisy Wheel

Dot Matrix Printer

In the market, one of the most popular printers is Dot Matrix Printer. These printers are popular because of their ease of printing and economical price. Each character printed is in the form of pattern of dots and head consists of a Matrix of Pins of size (5*7, 7*9, 9*7 or 9*9) which come out to form a character which is why it is called Dot Matrix Printer.

Advantages

- Inexpensive
- Widely Used
- Other language characters can be printed

Disadvantages

- Slow Speed
- Poor Quality

Daisy Wheel

Head is lying on a wheel and pins corresponding to characters are like petals of Daisy (flower) which is why it is called Daisy Wheel Printer. These printers are generally used for word-processing in offices that require a few letters to be sent here and there with very nice quality.

Advantages

- More reliable than DMP
- Better quality
- Fonts of character can be easily changed

Disadvantages

- Slower than DMP
- Noisy
- More expensive than DMP

Line Printers

Line printers are the printers which print one line at a time.

These are of two types −

- Drum Printer
- Chain Printer

Drum Printer

This printer is like a drum in shape hence it is called drum printer. The surface of the drum is divided into a number of tracks. Total tracks are equal to the size of the paper, i.e. for a paper width of 132 characters, drum will have 132 tracks.

A character set is embossed on the track. Different character sets available in the market are 48 character set, 64 and 96 characters set. One rotation of drum prints one line. Drum printers are fast in speed and can print 300 to 2000 lines per minute.

Advantages

- Very high speed

Disadvantages

- Very expensive
- Characters fonts cannot be changed

Chain Printer

In this printer, a chain of character sets is used, hence it is called Chain Printer. A standard character set may have 48, 64, or 96 characters.

Advantages

- Character fonts can easily be changed.
- Different languages can be used with the same printer.

Disadvantages

- Noisy

Non-impact Printers

Non-impact printers print the characters without using the ribbon. These printers print a complete page at a time, thus they are also called as Page Printers.

These printers are of two types −

- Laser Printers
- Inkjet Printers

Characteristics of Non-impact Printers

- Faster than impact printers
- They are not noisy
- High quality
- Supports many fonts and different character size

Laser Printers

These are non-impact page printers. They use laser lights to produce the dots needed to form the characters to be printed on a page.

Advantages

- Very high speed
- Very high quality output
- Good graphics quality
- Supports many fonts and different character size

Disadvantages

- Expensive
- Cannot be used to produce multiple copies of a document in a single printing

Inkjet Printers

Inkjet printers are non-impact character printers based on a relatively new technology. They print characters by spraying small drops of ink onto paper. Inkjet printers produce high quality output with presentable features.

They make less noise because no hammering is done and these have many styles of printing modes available. Color printing is also possible. Some models of Inkjet printers can produce multiple copies of printing also.

Advantages

- High quality printing
- More reliable

Disadvantages

- Expensive as the cost per page is high
- Slow as compared to laser printer

MEMORY

A memory is just like a human brain. It is used to store data and instructions.

Computer memory is the storage space in the computer, where data is to be processed and instructions required for processing are stored.

The memory is divided into large number of small parts called cells. Each location or cell has a unique address, which varies from zero to memory size minus one. For example, if the computer has 64k words, then this memory unit has 64 * 1024 = 65536 memory locations.

The address of these locations varies from 0 to 65535.

Memory is primarily of three types −

- Cache Memory
- Primary Memory/Main Memory
- Secondary Memory

Cache Memory

Cache memory is a very high speed semiconductor memory which can speed up the CPU.

It acts as a buffer between the CPU and the main memory. It is used to hold those parts of data and program which are most frequently used by the CPU.

The parts of data and programs are transferred from the disk to cache memory by the operating system, from where the CPU can access them.

Advantages

The advantages of cache memory are as follows −

- Cache memory is faster than main memory.

- It consumes less access time as compared to main memory.

- It stores the program that can be executed within a short period of time.

- It stores data for temporary use.

Disadvantages

The disadvantages of cache memory are as follows −

- Cache memory has limited capacity.

- It is very expensive.

Primary Memory (Main Memory)

Primary memory holds only those data and instructions on which the computer is currently working.

It has a limited capacity and data is lost when power is switched off. It is generally made up of semiconductor device.

These memories are not as fast as registers.

The data and instruction required to be processed resides in the main memory. It is divided into two subcategories RAM and ROM.

Characteristics of Main Memory

- These are semiconductor memories.

- It is known as the main memory.

- Usually volatile memory.

- Data is lost in case power is switched off.

- It is the working memory of the computer.

- Faster than secondary memories.

- A computer cannot run without the primary memory.

Secondary Memory

This type of memory is also known as external memory or non-volatile. It is slower than the main memory.

These are used for storing data/information permanently. CPU directly does not access these memories, instead they are accessed via input-output routines.

The contents of secondary memories are first transferred to the main memory, and then the CPU can access it. For example, disk, CD-ROM, DVD, etc.

Characteristics of Secondary Memory

- These are magnetic and optical memories.

- It is known as the backup memory.

- It is a non-volatile memory.

- Data is permanently stored even if power is switched off.

- It is used for storage of data in a computer.

- Computer may run without the secondary memory.

- Slower than primary memories.

AM (Random Access Memory) is the internal memory of the CPU for storing data, program, and program result.

It is a read/write memory which stores data until the machine is working. As soon as the machine is switched off, data is erased.

Access time in RAM is independent of the address, that is, each storage location inside the memory is as easy to reach as other locations and takes the same amount of time.

Data in the RAM can be accessed randomly but it is very expensive.

RAM is volatile, i.e. data stored in it is lost when we switch off the computer or if there is a power failure.

Hence, a backup Uninterruptible Power System (UPS) is often used with computers.

RAM is small, both in terms of its physical size and in the amount of data it can hold.

RAM is of two types −

- Static RAM (SRAM)
- Dynamic RAM (DRAM)

Static RAM (SRAM)

The word **static** indicates that the memory retains its contents as long as power is being supplied. However, data is lost when the power gets down due to volatile nature.

SRAM chips use a matrix of 6-transistors and no capacitors. Transistors do not require power to prevent leakage, so SRAM need not be refreshed on a regular basis.

There is extra space in the matrix, hence SRAM uses more chips than DRAM for the same amount of storage space, making the manufacturing costs higher.

SRAM is thus used as cache memory and has very fast access.

Characteristic of Static RAM

- Long life

- No need to refresh

- Faster

- Used as cache memory

- Large size

- Expensive

- High power consumption

Dynamic RAM (DRAM)

DRAM, unlike SRAM, must be continually **refreshed** in order to maintain the data.

This is done by placing the memory on a refresh circuit that rewrites the data several hundred times per second.

DRAM is used for most system memory as it is cheap and small. All DRAMs are made up of memory cells, which are composed of one capacitor and one transistor.

Characteristics of Dynamic RAM

- Short data lifetime

- Needs to be refreshed continuously

- Slower as compared to SRAM

- Used as RAM

- Smaller in size

- Less expensive

- Less power consumption

ROM stands for **Read Only Memory**. The memory from which we can only read but cannot write on it.

This type of memory is non-volatile. The information is stored permanently in such memories during manufacture.

A ROM stores such instructions that are required to start a computer. This operation is referred to as **bootstrap**.

ROM chips are not only used in the computer but also in other electronic items like washing machine and microwave oven.
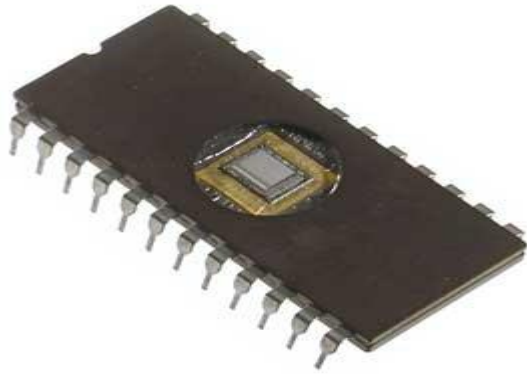
Let us now discuss the various types of ROMs and their characteristics.

MROM (Masked ROM)

The very first ROMs were hard-wired devices that contained a pre-programmed set of data or instructions.

These kind of ROMs are known as masked ROMs, which are inexpensive.

PROM (Programmable Read Only Memory)

PROM is read-only memory that can be modified only once by a user.

The user buys a blank PROM and enters the desired contents using a PROM program.

Inside the PROM chip, there are small fuses which are burnt open during programming.

It can be programmed only once and is not erasable.

EPROM (Erasable and Programmable Read Only Memory)

EPROM can be erased by exposing it to ultra-violet light for a duration of up to 40 minutes.

Usually, an EPROM eraser achieves this function. During programming, an electrical charge is trapped in an insulated gate region.

The charge is retained for more than 10 years because the charge has no leakage path.

For erasing this charge, ultra-violet light is passed through a quartz crystal window (lid).

This exposure to ultra-violet light dissipates the charge. During normal use, the quartz lid is sealed with a sticker.

EEPROM (Electrically Erasable and Programmable Read Only Memory)

EEPROM is programmed and erased electrically. It can be erased and reprogrammed about ten thousand times.

Both erasing and programming take about 4 to 10 ms (millisecond).

In EEPROM, any location can be selectively erased and programmed.

EEPROMs can be erased one byte at a time, rather than erasing the entire chip. Hence, the process of reprogramming is flexible but slow.

Advantages of ROM

The advantages of ROM are as follows −

- Non-volatile in nature
- Cannot be accidentally changed
- Cheaper than RAMs
- Easy to test
- More reliable than RAMs

Introduction to computer software – Programming Language – Operating systems – Introduction to database management system.

INTRODUCTION TO COMPUTER SOFTWARE

Software

It is a set of programs that enables the hardware to perform a specific task.

All the programs that run the computer are software. Software is of two types; system software and application software.

1) System Software

System software is the main software that runs the computer. When you turn on the computer it activates the hardware and controls and coordinates their functioning.

The application programs are also controlled by system software. Operating system is an example of system software.

Operating System

Operating system is the system software that works as an interface to enable the user communicate with the computer.

It manages and coordinates the functioning of hardware and software of the computer.

The commonly used operating systems are Microsoft Windows, Linux and Apple Mac OS X

2) Application Software

Applications software is a set of programs designed to perform a specific task.

It does not control or coordinate the working of computer. A computer can run without application software.

Application software can be easily installed or uninstalled as required. Microsoft Office Suite, Adobe Photoshop and any other software like payroll software or income tax software are application software.

PROGRAMMING LANGUAGES

The computer system is simply a machine and hence it cannot perform any work; therefore, in order to make it functional different languages are developed, which are known as programming languages or simply computer languages.

Over the last two decades, dozens of computer languages have been developed.

Each of these languages comes with its own set of vocabulary and rules, better known as syntax.

Furthermore, while writing the computer language, syntax has to be followed literally, as even a small mistake will result in an error and not generate the required output.

Following are the major categories of Programming Languages –

- Machine Language
- Assembly Language
- High Level Language
- System Language
- Scripting Language

Let us discuss the programming languages in brief

Machine Language or Code

This is the language that is written for the computer hardware. Such language is effected directly by the central processing unit (CPU) of a computer system.

Assembly Language

It is a language of an encoding of machine code that makes simpler and readable.

High Level Language

The high level language is simple and easy to understand and it is similar to English language. For example, COBOL, FORTRAN, BASIC, C, C+, Python, etc.

SQL
Java
Javascript
C#
Python
C++
PHP
IOS
Ruby/Rails
.Net

Javascript , python, swift, java, C++, Ruby, Rust, Elixir, Scala,R

VISUAL PROGRAMMING

Visual Basic .NET (VB.NET) is an object-oriented computer programming language implemented on the .NET Framework.

Although it is an evolution of classic Visual Basic language, it is not backwards-compatible with VB6, and any code written in the old version does not compile under VB.NET.

Like all other .NET languages, VB.NET has complete support for object-oriented concepts.

Everything in VB.NET is an object, including all of the primitive types (Short, Integer, Long, String, Boolean, etc.) and user-defined types, events, and even assemblies. All objects inherits from the base class Object.

VB.NET is implemented by Microsoft's .NET framework.

Therefore, it has full access to all the libraries in the .Net Framework.

It's also possible to run VB.NET programs on Mono, the open-source alternative to .NET, not only under Windows, but even Linux or Mac OSX.

The following reasons make VB.Net a widely used professional language –

- Modern, general purpose.

- Object oriented.

- Component oriented.

- Easy to learn.

- Structured language.

- It produces efficient programs.

- It can be compiled on a variety of computer platforms.

- Part of .Net Framework.

Operating System

An operating system is a program that acts as an interface between the user and the computer hardware and controls the execution of all kinds of programs.

An operating system is a software which performs all the basic tasks like file management, memory management, process management, handling input and output, and controlling peripheral devices such as disk drives and printers.

Some popular Operating Systems include

- Linux,
- Windows,
- OS X,
- VMS,
- OS/400,
- AIX,
- z/OS, etc.
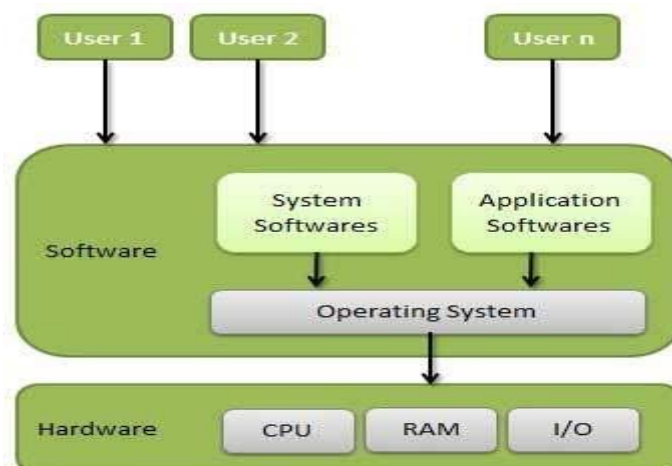
Following are some of important functions of an operating System.

- Memory Management

- Processor Management

- Device Management

- File Management

- Security

- Control over system performance

- Job accounting

- Error detecting aids

- Coordination between other software and users

Memory Management

Memory management refers to management of Primary Memory or Main Memory. Main memory is a large array of words or bytes where each word or byte has its own address.

Main memory provides a fast storage that can be accessed directly by the CPU. For a program to be executed, it must in the main memory. An Operating System does the following activities for memory management –

- Keeps tracks of primary memory, i.e., what part of it are in use by whom, what part are not in use.

- In multiprogramming, the OS decides which process will get memory when and how much.

- Allocates the memory when a process requests it to do so.

- De-allocates the memory when a process no longer needs it or has been terminated.

Processor Management

In multiprogramming environment, the OS decides which process gets the processor when and for how much time. This function is called **process scheduling**. An Operating System does the following activities for processor management –

- Keeps tracks of processor and status of process. The program responsible for this task is known as **traffic controller**.

- Allocates the processor (CPU) to a process.

- De-allocates processor when a process is no longer required.

Device Management

An Operating System manages device communication via their respective drivers. It does the following activities for device management –

- Keeps tracks of all devices. Program responsible for this task is known as the **I/O controller**.

- Decides which process gets the device when and for how much time.

- Allocates the device in the efficient way.

- De-allocates devices.

File Management

A file system is normally organized into directories for easy navigation and usage. These directories may contain files and other directions.

An Operating System does the following activities for file management –

- Keeps track of information, location, uses, status etc. The collective facilities are often known as **file system**.

- Decides who gets the resources.

- Allocates the resources.

- De-allocates the resources.

Introduction to DBMS

A database management system (DBMS) refers to the technology for creating and managing databases.

DBMS is a software tool to organize (create, retrieve, update and manage) data in a database

The main aim of a DBMS is to supply a way to store up and retrieve database information that is both convenient and efficient.

By data, we mean known facts that can be recorded and that have embedded meaning.

Normally people use software such as DBASE IV or V, Microsoft ACCESS, or EXCEL to store data in the form of database.

A datum is a unit of data. Meaningful data combined to form information. Hence, information is interpreted data - data provided with semantics.

MS. ACCESS is one of the most common examples of database management software.

Dbms uses

- Airlines: reservations, schedules, etc

- Telecom: calls made, customer details, network usage, etc

- Universities: registration, results, grades, etc

- Sales: products, purchases, customers, etc

- Banking: all transactions etc

Advantages

A DBMS manage data and has many advantages. These are:

- **Data independence:** Application programs should be as free or independent as possible from details of data representation and storage. DBMS can supply an abstract view of the data for insulating application code from such facts.

- **Efficient data access:** DBMS utilizes a mixture of sophisticated concepts and techniques for storing and retrieving data competently, and this feature becomes important in cases where the data is stored on external storage devices.

- **Data integrity and security:** If data is accessed through the DBMS, the DBMS can enforce integrity constraints on the data.

- **Data administration:** When several users share the data, integrating the administration of data can offer major improvements.

Experienced professionals understand the nature of the data being managed and can be responsible for organizing the data representation to reduce redundancy and make the data to retrieve efficiently

Unit 4

Computer Networks - World Wide Web and Internet – Email – Web Design

Computer Networks

A **computer network** is a system in which multiple computers are connected to each other to share information and resources.

Characteristics of a Computer Network

- Share resources from one computer to another.

- Create files and store them in one computer, access those files from the other computer(s) connected over the network.

- Connect a printer, scanner, or a fax machine to one computer within the network and let other computers of the network use the machines available over the network.

Following is the list of hardware's required to set up a computer network.

- Network Cables

- Distributors

- Routers

- Internal Network Cards

- External Network Cards

Network Cables

Network cables are used to connect computers. The most commonly used cable is Category 5 cable RJ-45.

Distributors

A computer can be connected to another one via a serial port but if we need to connect many computers to produce a network, this serial connection will not work.

The solution is to use a central body to which other computers, printers, scanners, etc. can be connected and then this body will manage or distribute network traffic.

Router

A router is a type of device which acts as the central point among computers and other devices that are a part of the network. It is equipped with holes called ports. Computers and other devices are connected to a router using network cables. Now-a-days router comes in wireless modes using which computers can be connected without any physical cable.

Network Card

Network card is a necessary component of a computer without which a computer cannot be connected over a network. It is also known as the network adapter or Network Interface Card (NIC). Most branded computers have network card pre-installed. Network cards are of two types: Internal and External Network Cards.

Internal Network Cards

Motherboard has a slot for internal network card where it is to be inserted. Internal network cards are of two types in which the first type uses Peripheral Component Interconnect (PCI) connection, while the second type uses Industry Standard Architecture (ISA). Network cables are required to provide network access.

External Network Cards

External network cards are of two types: Wireless and USB based. Wireless network card needs to be inserted into the motherboard, however no network cable is required to connect to the network.

Universal Serial Bus (USB)

USB card is easy to use and connects via USB port. Computers automatically detect USB card and can install the drivers required to support the USB network card automatically.

Computer Network

A network set up by connecting two or more computers through communication channels is called computer network.

It enables computers communicate with each other and to share commands, data and hardware and software resources.

The popular computer networks are:

- o Local Area Network (LAN)
- o Metropolitan Area Network (MAN)
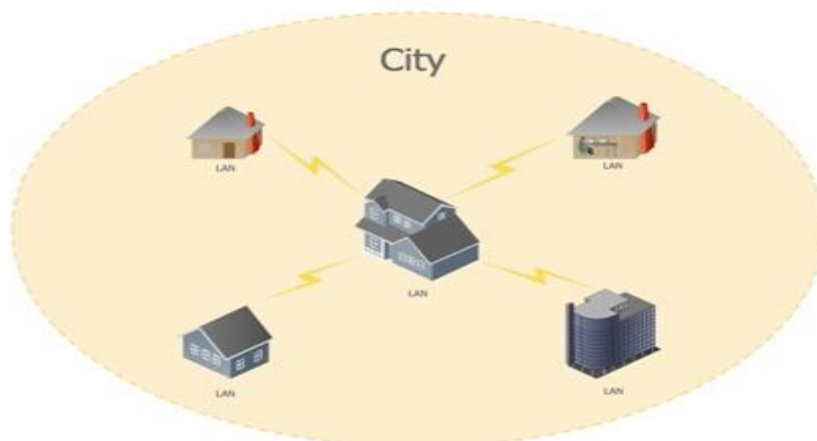- o Wide Area Network (WAN)

Local Area Network (LAN)

As the name suggests, the local area network is confined to small geographical area like within an office, company, school or any other organization. Ethernet cables are used to set up LAN.
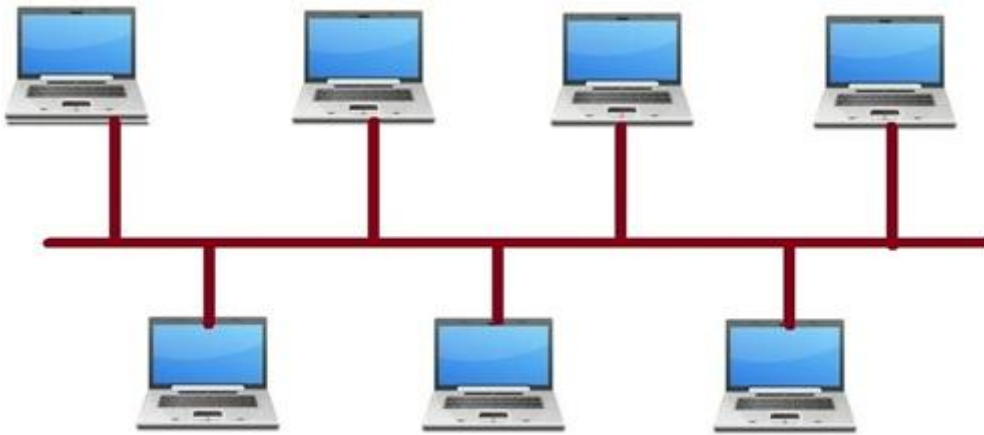
Metropolitan Area Network (MAN)

Metropolitan area network extends over a metropolitan area like a city or town. It is set up by connecting the local area networks of the city or town.

It is ideal for the people of a particular region to share data or information.

Wide Area Network (WAN)

Wide area network covers large geographical area. It is not confined within office, school or a town.

It is mainly set up by telecommunication lines.

Big organizations like banks and multinational companies communicate with their branches and customers through WAN.

Internet that we use is also a WAN.

Internet

Internet is defined as an Information super Highway, to access information over the web. However, It can be defined in many ways as follows:

- Internet is a world-wide global system of interconnected computer networks.

- Internet uses the standard Internet Protocol (TCP/IP).

- Every computer in internet is identified by a unique IP address.

- IP Address is a unique set of numbers (such as 110.22.33.114) which identifies a computer location.

- A special computer DNS (Domain Name Server) is used to give name to the IP Address so that user can locate a computer by a name.

- For example, a DNS server will resolve a name **http://www.tutorialspoint.com** to a particular IP address to uniquely identify the computer on which this website is hosted.

- Internet is accessible to every user all over the world.

Evolution

The concept of Internet was originated in 1969 and has undergone several technological & Infrastructural changes as discussed below:

- The origin of Internet devised from the concept of **Advanced Research Project Agency Network (ARPANET).**

- **ARPANET** was developed by United States Department of Defense.

- Basic purpose of ARPANET was to provide communication among the various bodies of government.

- Initially, there were only four nodes, formally called **Hosts.**

- In 1972, the **ARPANET** spread over the globe with 23 nodes located at different countries and thus became known as **Internet.**

- By the time, with invention of new technologies such as TCP/IP protocols, DNS, WWW, browsers, scripting languages etc.,Internet provided a medium to publish and access information over the web.

Advantages

Internet covers almost every aspect of life, one can think of. Here, we will discuss some of the advantages of Internet:

- Internet allows us to communicate with the people sitting at remote locations. There are various apps available on the wed that uses Internet as a medium for communication. One can find various social networking sites such as:
    - Facebook
    - Twitter
    - Yahoo
    - Google+

- o Flickr

- o Orkut

- One can surf for any kind of information over the internet. Information regarding various topics such as Technology, Health & Science, Social Studies, Geographical Information, Information Technology, Products etc can be surfed with help of a search engine.

- Apart from communication and source of information, internet also serves a medium for entertainment. Following are the various modes for entertainment over internet.

  - o Online Television

  - o Online Games

  - o Songs

  - o Videos

  - o Social Networking Apps

- Internet allows us to use many services like:

  - o Internet Banking

  - o Matrimonial Services

  - o Online Shopping

  - o Online Ticket Booking

  - o Online Bill Payment

  - o Data Sharing

  - o E-mail

- Internet provides concept of **electronic commerce**, that allows the business deals to be conducted on electronic systems

URL

Also known as a **web address**, a **URL** (**Uniform Resource Locator**) is a form of URI and a standardized naming convention for addressing documents accessible over the Internet and Intranet.

An example of a URL is Amazon.com/, which is the URL for the Amazon website.

World wide web

"www" stands for World Wide Web and is used to distinguish the content.

This portion of the URL is not required and many times can be left out. For example, typing "http://amazon.com" would still get you to the amazon web page.

This portion of the address can also be substituted for an important sub page known as a subdomain.

http:// or https://

The "http" stands for Hypertext Transfer Protocol and is what enables the browser to know what protocol it is going to use to access the information specified in the domain.

An "https" protocol is short for "Hypertext Transfer Protocol Secure" and indicates that information transmitted over HTTP is encrypted and secure. After the http or https is the colon (:) and two forward slashes (//) that separate the protocol from the remainder of the URL.

E_Mail

Electronic mail is used to send and receive message through internet.

Protocols in Email

E-mail Protocols are set of rules that help the client to properly transmit the information to or from the mail server. Here in this tutorial, we will discuss various protocols such as **SMTP, POP,** and **IMAP.**

Computer at home , Education , Entertainment , Science , Medicine and Engineering – Introduction to Computer security – Computer Viruses – Bombs and worms

How are computers used?

Today, many types of computers are used in our everyday life.

In most parts of the world, it's impossible to use a product or service that doesn't utilize a computer.

Below are examples of the industries, areas, and different fields using computers.

Banks and financial

Computers play a significant role in handling all of the world's money.

Below are examples of how computers are used in the financial market and places dealing with money.

- **ATM** - When you make a withdraw from an ATM, you are using a computer.
- **Digital currency** - When depositing money in a bank, it is stored as a digital record. A computer keeps track of how much money is in your account.
- **Trading** - Stocks and commodities are traded using computers. In fact, today there are even thousands of computers using advanced algorithms that handle trading without needing humans.

Business

Business is another big sector for computers and most money earned and spent is done using a computer. Below are some of the examples of how computers are used in business.

- **Register** - If the business deals with selling goods to a consumer (e.g., a grocery store), a cash register, which is a computer, is used to complete transactions.
- **Workers computer** - Many businesses assign each employee a computer that allows them to produce work and solve problems for the company.
- **Server** - If the business uses computers, connects to the Internet, or handles e-mail and files, a server is used to help manage everything.

Communication

Today's communication around the world is almost all digital and handled by computers.

Below are examples of how computers are used in the communication industry.

- **Smartphone** - If you have a smartphone, you have a computer in your pocket.
- **E-mail** - More electronic mail (e-mail) is sent today than postal mail (snail mail), and computers handle all creation and distribution of that e-mail.
- **VoIP** - All voice over IP communication (VoIP) is handled and done by computers.
- **Computer-assisted speech** - Those who are disabled or cannot speak can use a computer to help them communicate. For example, Stephen Hawking uses a computer to communicated.
- **Voice recognition** - Any phone or another system that uses voice recognition is using a computer to translate what is heard into text or other data that can be understood by the computer.

Defense and military

Many technologies (e.g., GPS and the Internet) were initially created or started with a defense-related purpose. Today, computers are still an important aspect of the defense industry.

- **Encryption** - Secure communication is vital in the defense industry and computers are used to encrypt communications that should remain secret.
- **GPS** - Using computers with GPS allows the military to track people and equipment and is still used today.
- **Computer-aided flight** - Many of today's jets and other aircraft require computers to fly and operate.
- **Drones** - A drone is either autonomous or remotely driven and uses computers to operate.

Education

As computers evolve, so does how computers are used in the education field.

Below is a list of how a computer can be used in education.

- **Internet** - Connecting a student to the Internet gives him or her access to an endless supply of knowledge. As mentioned later, the Internet would not be possible without computers.
- **Learning** - Computers can also be used to help design and create a more visual learning experience for students. Using electronic whiteboards with computers can also benefit a student by giving them a more hands-on experience.
- **Writing** - Although reports can still be done using pen, pencil, or even a typewriter, a computer makes it much easier to write, format, save, share, and print reports.
- **Keep records** - Computers are used to track students scores, identify struggling students, and are used to create a final report.

- **Testing** - Computers can assist students and teachers with the testing process by stepping the student through a series of questions and keep track of the results.

Internet

Without computers, the Internet would not exist. Below are a few examples of computers are used to help run the Internet.

- **DNS** - When you type in a URL like https://www.computerhope.com/, a DNS must translate it into an IP address, which helps your computer to communicate with the server.
- **Web server** - Every web page requires a web server or computer capable of receiving and sending requests when someone wants to view a web page.
- **Programs** - A computer is also needed to run scripts and programs. For example, a search engine, shopping cart, or forum are all examples of programs that need a computer.
- **Services** - Other services like e-mail, FTP, and SSH also require a computer or are daemons on the web server.

Medical

The medical field is another place where computers are vital and used every day.

Below are some examples of how computers help those in the medical field.

- **Medical records** - More and more medical records are being digitally stored. Storing these files digitally allow for quick access and transfer of medical information so doctors can know your history.
- **Monitoring** - Computers help with monitoring a patient and can alert staff in the case of an emergency.

- **Research** - A lot of the medical research that is done today is computer assisted. Without the assistance of a computer, it would either not be possible or take so much longer that it wouldn't be viable.

- **Diagnosis** - Computers can assist in the diagnosis of a patient, from gathering a patient's history and conditions to comparing that information against a database of existing information.

- **Surgery** - Although most surgery is still done with humans, it is becoming more practical and accessible for computer robot-assisted surgery. After being programmed, these robots can make surgery more accurate, faster, and less prone to human errors.

Transportation

Computers also play an important part in transportation. Below are a few examples of how computers help the transportation field.

- **Cars** - Most may not realize it, but all modern cars today have multiple computers that help control and manage the vehicle.

- **Traffic lights** - The traffic lights that help control traffic are all run by computers.

- **GPS** - Cars that include a GPS mapping system have computers for display and calculating routes.

- **Airplanes** - The airplanes that help transport millions of people and goods every year are filled with computers that help control the plane.

- **Public transportation** - Train, bus, subway, and all forms of public transportation are highly dependent on computers to manage traffic flow, monitor operation, and handle payments.

- **Self-driving cars** - Although relatively new, self-driving cars are becoming increasingly popular and rely on a computer to make all decisions on how to drive.

Multimedia

Computers also play a significant role in video and audio. Below are examples of how computers are used in the film and audio industry.

- **Editing** - Once a movie, video, song, or audio track is created a computer can edit that media instead of having to manually make cuts to the film or audio track.

- **CGI** - Computer <u>animation</u> and <u>CGI</u> has become a norm in big budget films. To create these effects computers and sometimes <u>server farms</u> are used.

- **Manipulation** - Computers can be used to manipulate pictures, video, and audio. For example, someone could use <u>Adobe Photoshop</u> to add or remove elements from an image.

- **Recording and playback** - Computers can also be used to assist in the recording of audio tracks and then selectively playback each audio track.

- **Creation** - Computers can also be used to help in creating new multimedia content. For example, creating 3D animation, 3D model, or a techno audio track can be done on a computer. After creating a 3D model, a <u>3D printer</u> could also be used to build a product.

- **TV, DVD, media players** - Today's <u>Smart TVs</u>, <u>DVD</u> players, <u>DVRs</u>, etc., contain simple computing circuitry to connect the device to the Internet, run apps, and more.

Robotics

The industry of <u>robotics</u> is exploding and computers once again play an important role in controlling robots.

Below are some examples of how computers help control robotic machinery.

- **Control** - Computers are what help control robotics. For example, without a computer, an assembly robotic arm would not know where to place a part, what speed to operate, or if a problem has occurred.

- **Learning** - Computers can take the input given by a robot and take that information to help learn and adapt to new conditions.

Simulations

Some problems are so complex that it would be impossible for humans to calculate or would take too long to calculate.

Computers are used to help solve these complex problems in a timely fashion.

- **Weather prediction** - Earth has an extremely complex weather system, and computers are used to gather all of the variables and create weather reports.
- **Product simulations** - Before some products go into development, computers simulate how they would work in the real world. By creating a simulation, a company or government agency can make adjustments before the product goes into development.
- **Big data simulation** - With cheap data storage companies can now store a massive amount of data. With this big data, a computer can be used to find unknown patterns.

Types of Viruses

A virus is a fragment of code embedded in a legitimate program. Virus are self-replicating and are designed to infect other programs.

They can wreak havoc in a system by modifying or destroying files causing system crashes and program malfunctions.

Various types of virus :

1. **File Virus :** This type of virus infects the system by appending itself to the end of a file.

It changes the start of a program so that the control jumps to its code.

After the execution of its code, the control returns back to the main program. Its execution is not even noticed.

It is also called **Parasitic virus** because it leaves no file intact but also leaves the host functional.

2. **Boot sector Virus :** It infects the boot sector of the system, executing every time system is booted and before operating system is loaded.

It infects other bootable media like floppy disks. These are also known as **memory virus** as they do not infect file system.

3. **Macro Virus :** Unlike most virus which are written in low-level language(like C or assembly language), these are written in high-level language like Visual Basic.

These viruses are triggered when a program capable of executing a macro is run.

For example, macro virus can be contained in spreadsheet files.

4. **Source code Virus :** It looks for source code and modifies it to include virus and to help spread it.

5. **Polymorphic Virus :** A **virus signature** is a pattern that can identify a virus(a series of bytes that make up virus code).

So in order to avoid detection by antivirus a polymorphic virus changes each time it is installed.

The functionality of virus remains same but its signature is changed.

6. **Encrypted Virus :** In order to avoid detection by antivirus, this type of virus exists in encrypted form. It carries a decryption algorithm along with it. So the virus first decrypts and then executes.

7. **Stealth Virus :** It is a very tricky virus as it changes the code that can be used to detect it. Hence, the detection of virus becomes very difficult.

For example, it can change the read system call such that whenever user asks to read a code modified by virus, the original form of code is shown rather than infected code.

8. **Tunneling Virus :** This virus attempts to bypass detection by antivirus scanner by installing itself in the interrupt handler chain. Interception programs, which remain in the background of an operating system and catch viruses, become disabled during the course of a tunneling virus. Similar viruses install themselves in device drivers.

9. **Multipartite Virus :** This type of virus is able to infect multiple parts of a system including boot sector,memory and files.

This makes it difficult to detect and contain.

10. **Armored Virus :** An armored virus is coded to make it difficult for antivirus to unravel and understand.

It uses a variety of techniques to do so like fooling antivirus to believe that it lies somewhere else than its real location or using compression to complicate its code.

Viruses, Worms, Trojan Horses and Zombies

Definition

Malicious software:

Any software written to cause damage to or use up the resources of a target computer.

Malicious software is frequently concealed within or masquerades as legitimate software.

In some cases, it spreads itself to other computers via e-mail or infected floppy disks.

Types of malicious software include viruses, Trojan horses, worms and hidden software for launching denial-of-service attacks.

Other Malefactors

In addition to viruses, there is a growing threat from other types of malicious software, including Trojan horses, worms and denial-of-service attacks, Viveros says. And hostile Java applets are an emerging threat.

A Trojan horse, like its mythological namesake, is a program that appears legitimate but contains a second, hidden function that may cause damage.

A common type of Trojan horse is often distributed by e-mail with the aim of stealing passwords from a victim's computer and then e-mailing the stolen data to an anonymous recipient.

Worms use up computer resources such as memory and network bandwidth, slowing down both PCs and servers.

In addition, worms sometimes delete data and spread rapidly via e-mail.

In denial-of-service attacks, specific Web sites are overwhelmed by an intentional onslaught of Internet traffic.

Such attacks rely on launching programs, sometimes called zombies, that have previously been hidden on hundreds of Internet-connected computers that belong to unsuspecting third parties such as universities, Weafer says.