ANNAI WOMEN'S COLLEGE

(Arts & Science)

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DEPARTMENT OF COMPUTER SCIENCE, BCA & IT

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ALLIED PAPER III

PRINCIPLES OF INFORMATION TECHNOLOGY

Unit I:

Introduction to Computer - Classification of Digital Computer System – Computer Architecture – Memory Units – Auxiliary Storage Devices – Input and Output Devices.

Unit II:

Introduction to Computer Software – Operating System – Programming Languages – General Software Features and Trends.

Unit III:

Database Management Systems – Data Processing – Introduction to Database Management Systems – Database Design.

Unit IV:

Introduction to Telecommunication – Networking – Communication System – Distributed System – Internet – Intranet.

Unit V:

Multimedia Tools – Virtual Reality – E-Commerce – Data Warehousing – Data Mining – Applications : Geographical Information Systems – Computer in Business – Industry, Home, Education and Training.

Text Book:

1. Fundamentals of Information Technology , Alexis Leon And Mathews Leon, Vikas Publishing house Pvt. Ltd, 2009.

UNIT I

INTRODUCTION TO COMPUTERS:

- Computer is a machine that performs calculations and processes information with high speed and precision. A computer can handle vast amounts of information and solve complicated problems.
- It can take thousands of individual pieces of data and turn them into more usable information with blinding speed and almost unfailing accuracy.
- The most powerful computers can perform billions of calculations in per second. A computer is a programmable machine.
- The two principal characteristics of a computer are:
    1. It responds to a specific set of instructions in a well-defined manner.
    2. It can execute a prerecorded list of instructions (a program).

IMPORTANCE OF COMPUTER:

- Computers are important in a variety of ways.
- For example they simplify difficult or time-consuming tasks to an extraordinary degree.
- They provide businesses, governments, individuals, and institutions with an efficient way to manage large amounts of information.
- Computers also help people to understand things better by allowing them to make models and test theories. The value of computers lies in their ability to perform certain basic tasks quickly and accurately.

These tasks include:

Solving numerical problems:

- ✓ One of the most important and most difficult jobs performed by computers is the solution of complicated problems involving numbers.
- ✓ Computers can solve such problems amazingly quickly.

Storing and retrieving information:

- ✓ People use computers to solve unbelievably large quantities of information.
- ✓ Information stored in a computer is sometimes called a database.
- ✓ Database can be enormous-for example, a country entire census might be contained in a single database. A computer can search a huge database quickly to find a specific piece of information.
- ✓ In addition the information can be changed easily and quickly- often in less than a second.
- ✓ The efficiency with which computers store and retrieve information makes them valuable in a wide range of professions.

Creating and displaying documents and pictures:

- ✓ Computers can store a huge number of words in a way that makes it easy to manipulate them.
- ✓ For this reason, word processing is one of the most important and widespread uses of computers.
- ✓ A word processing program allows people to type to type words into a computer to write articles, books.

CHARACTERISTICS OF COMPUTERS:

- A computer is an intelligent amplifier that performs the above-mentioned operations in a much taster, accurate and efficient way. Thus, it gives us ample time to use it in matters involving creativity & judgment. The characteristics possessed by computers can be listed as follows:

Speed:

- ✓ Computers can calculate at very high speeds. It takes only few seconds for calculations that we take hours to complete.
- ✓ To know that computer can perform millions (1,000,000) of instructions and even more per second.
- ✓ Therefore, we determine the speed of computer in terms of microsecond (10-6 part of a second) or nanosecond (10 to the power -9 part of a second). From this you can imagine how fast your computer performs work.

Accuracy:

- ✓ The accuracy of a computer system is very high. Errors do occur in computer-based information but precious few can be directly attributed to the computer systems.
- ✓ The vast majority of these errors can be traced to a program logic error, a procedural error, or erroneous data. These are human errors.
- ✓ Hardware errors are usually detected and corrected by the computer system itself.
- ✓ Computers are very accurate. They can perform their hundreds of thousands of operations with great accuracy. They can run error less for days at a time.

Reliability:

- ✓ Computer output is generally very reliable, subject to the condition that the input data entering the computer should be correct and the program of instructions should be reliable and correct.
- ✓ Incorrect input data and unreliable programs give us computer errors and wrong results.
- ✓ Hence, the phrase GARBAGE IN-GARBAGE OUT (GIGO).

Storage Capability:

- ✓ Computer systems have total and instant recall of data and an almost unlimited capacity to store these data.
- ✓ A typical mainframe computer system will have many billions of characters, and perhaps thousands of graphic images, stored and available for-instant recall.
- ✓ When properly used, a computer can improve the efficiency of an organization. It provides a fast, accurate, and reliable device with which to process data.

Automation:

- ✓ Computers are quite capable of functioning automatically, once the process is given to the computer.
- ✓ They do not require any instruction from the operator at any stage of the process. Computers can be programmed to perform a series of complex tasks involving multiple programs.
- ✓ Computers will execute the programs in the correct sequence, provided they are programmed correctly.

Diligence:

- ✓ Human beings suffer from physical and mental fatigue.
- ✓ They cannot perform the same task over again with the same speed, accuracy and enthusiasm as in the first time. This will affect the performance.
- ✓ Being a machine, a computer does not suffer from such weaknesses.
- ✓ The computer is capable of performing task repeatedly at the same level of speed and accuracy even if it has to carry complex operation for a long period of time.

Versatile:

- ✓ Computers are versatile (can do many types of jobs). It can carry out processes ranging from simple mathematical calculations to highly complex and logical evaluations for any extended period of time.
- ✓ Computers can communicate with other computers and can receive and send data in various forms such as text, video, etc.
- ✓ This ability of computer to communicate to one another has led to the development of computer networks. Internet and so on. All this is possible because of computers and other related technologies.

Reduced Cost:

- ✓ With the ever increasing advances being made in the state of the art. Cost of computer equipments has dropped drastically over the years.
- ✓ Hardware costs have been decreasing at an estimated annual rate of 25%. Thus, Companies that at one time could not justify the cost of acquiring their own computer system may now find it not only feasible to acquire a system. But cost effective as well.

CLASSIFICATION OF COMPUTER:

There are three different types of computers according to the principles of operation. Those three types of computers are:

Super Computer:

- ✓ The fastest and most powerful type of computer Supercomputers are very expensive and are employed for specialized applications that require immense amounts of mathematical calculations.
- ✓ For example, weather forecasting requires a supercomputer.
- ✓ Other uses of supercomputers include animated graphics, fluid dynamic calculations, nuclear energy research, and petroleum exploration.

Mainframe Computer:

- ✓ A very large and expensive computer capable of supporting hundreds, or even thousands, of users simultaneously.
- ✓ In the hierarchy that starts with a simple microprocessor (in watches, for example) at the bottom and moves to supercomputers at the top, mainframes are just below supercomputers.
- ✓ In some ways, mainframes are more powerful than supercomputers because they support more simultaneous programs. But supercomputers can execute a single program faster than a mainframe.

Mini Computer:

- ✓ A midsized computer. In size and power, minicomputers lie between workstations and mainframes.
- ✓ In the past decade, the distinction between large minicomputers and small mainframes has blurred, however, as has the distinction between small minicomputers and workstations. But in general, a minicomputer is a multiprocessing system capable of supporting from 4 to about 200 users simultaneously.

Micro Computer or Personal Computer:

- ✓ Micro Computer is a small computer. Your personal computers is equivalent to the microcomputer.
- ✓ Mainframe and Mini Computer is ancestor of microcomputer.
- ✓ Integrated Circuit fabrication technology reduces the size of Mainframe and Minicomputer.
- ✓ Technically, a microcomputer is a computer in which the CPU (central processing unit, the brains of the computer) is contained on one single chip, a microprocessor, input/output devices and storage (memory) unit.
- ✓ All these components are important for a proper working of microcomputer.
  - **Desktop Computer:** a personal or micro-mini computer sufficient to fit on a desk.
  - **Laptop Computer:** a portable computer complete with an integrated screen and keyboard. It is generally smaller in size than a desktop computer and larger than a notebook computer.

WHAT COMPUTER CAN DO?

- ❖ The computer is a truly amazing machine. Whether want to do stock market analysis, publish a newsletter, design a building or play games, can do it with a computer. Now computers in everywhere like home, in school, in supermarket and so on.
- ❖ In medicine today, computers are used for everything from diagnosing illnesses to monitoring patients during surgery and controlling permanent prostheses. Doctors performing diagnosis using a CAT scan machine.
- ❖ In business, computers have become very crucial that cannot even think how able to survive without them. Business use computers for variety of purposes ranging from decision-making to electronic commerce.
- ❖ Musicians and singers have teamed up with computers to create an amazing range of instruments and sounds simply by playing a keyboard. The musical instrument digital interface (MIDI) is a system that synchronizes hardware and software that produces electronic tones.
- ❖ Computers have found their way into the household. Most of the household appliances and gadgets have computers in them.

WHAT COMPUTER CAN'T DO?

- There is no doubt that computers are fulfilling their promise to perform certain tasks better, faster and cheaper.
- In terms of the analogy with the automobile industry, if the automobile industry had grown like the computer

Productivity:

- ✓ Computers have not yet met all our expectations as a productivity improvement tool. Sometimes it takes longer to do things with a computer than it would to do them manually.
- ✓ Sometimes it takes too much time to learn how to use an application program that is supposed to increase productivity.
- ✓ But these problems are stored out with improved user interface design, easy-to-use and easy-to-learn applications, use of wizards, templates, on-line and context-sensitive help facilities etc.

Reasoning:

- ✓ In 1949 A Book Entitled stated that the computer shared similarities with the brain and the human nervous systems.
- ✓ Thus, it seems fair to say that in the same way have built machines to replace human labor also sought to build machines that do certain kind of thinking for us. But computers still lack many of the mental capabilities possessed by a five year old child. In other word the computer cannot think.

USES OF COMPUTER:

- Computers are used in so many fields in our daily life. From Engineers to Doctors, Students, Teachers, and Government Organization they all use computers to perform specific tasks, for entertainment or just to finish office work.
- Computers have made our life easier. With greater precision and accuracy and less time taking computers can do allot in short time while that task can take allot of time while doing manually.
- Computers have taken industries and businesses to a whole new level.
- They are used at Home for work and entertainment purposes, at Office, In hospitals, in government organizations.

CLASSIFICATION OF DIGITAL COMPUTER SYSTEM:

Computer systems are classified into microcomputers, minicomputers, mainframes and supercomputers.

Microcomputer:

- A microcomputer is a computer designed for individual use. The term was introduced in the 1970s to differentiate desktop computer systems from larger minicomputers. It is often used synonymously with the term "desktop computer," but it may refer to a server or laptop as well.
- In the 1960s and 1970s, computers were much larger than today, often taking up several cubic feet of space. Some mainframe computers could even fill a large room. Therefore, the first computers that could fit on a desktop were appropriately labeled "microcomputers" in comparison to these larger machines.
- The most common type of computers are Micro computers, which is portable Personal Computer that fits on top of a desk. It is a small computer, mainly consists of single chip. Average data transfer rate of a Microcomputer is 5 Lac bytes per second. It can hold from 8 to 32 bit word length.
- Microcomputers can be subdivided into 2 types
  - i. Home computer
  - ii. Personal computer

Home computer:

- ✓ They are basically meant for hobbies and games rather than professional tasks. They consist of a keyboard integrated with CPU in one box and interfaced with ordinary television and multimedia system used for entertainment and training in various computer centers and home.
- ✓ Examples of these computers are APPLE II, IBM PC JUNIOR etc. Computers are APPLE II, IBM PC JUNIOR etc.

Personal computer:

- ✓ They are found almost everywhere nowadays. They cost less and are suitable for house and individual use. They comprise of a monitor, a keyboard, CPU with floppy, CD and Hard disks and a mouse at the simplest.
- ✓ We can enhance the components in terms of numbers as well as configurations based upon needs. They run software like word processors, excel, compilers, image viewers, games, Internet besides the operating system. They are used basically for simple task such as documentation, writing simple programs, to watch movies, listen to the music, to browse Internet to check emails, to download material from web sites etc.
- ✓ These computer are designed for, small business units and office automation. PC's are use various application areas like
  - Business & professional application.
  - Computer learning
  - Electronic spread sheet
  - Word processing
  - Accounting
  - Telecommunication

Portable Computers:

- ✓ A portable computer is a personal computer that is designed to be easily transported and relocated, but is larger and less convenient to transport than a notebook computer.
- ✓ The earliest PCs designed for easy transport were called portables. As the size and weight of most portables decreased, they became known as laptop computer and later as notebook computer. Today, larger transportable computers continue to be called *portable computers*.
- ✓ Most of these are special-purpose computers - for example, those for use in industrial environments where they need to be moved about frequently.
- ✓ There are three categories of portable computers: **laptops, subnotebooks, Personal Digital Assistants(PDA).**

Mainframe computer:

- ✓ A mainframe is an ultra high-performance computer made for high-volume, processor-intensive computing. They are typically used by large businesses and for scientific purposes. You probably won't find a mainframe in any household. In the hierarchy of computers, mainframes are right below supercomputers, the most powerful computers in the world.
- ✓ Mainframes are computers used mainly by large organizations for critical applications, typically bulk data processing such as census, industry and consumer statistics, ERP, and financial transaction processing.
- ✓ The term probably originated from the early mainframes, as they were housed in enormous, room-sized metal boxes or frames. Later the term was used to distinguish high-end commercial machines from less powerful units which were often contained in smaller packages.
- ✓ Today in practice, the term usually refers to computers compatible with the IBM System/360 line, first introduced in 1965. Otherwise, systems with similar functionality but not based on the IBM System/360 are referred to as "servers." However, "server" and "mainframe" are not synonymous.

Workstation:

- ✓ A workstation is a computer intended for individual use that is faster and more capable than a personal computer.
- ✓ It's intended for business or professional use (rather than home or recreational use).
- ✓ Workstations and applications designed for them are used by small engineering companies, architects, graphic designers, and any organization, department, or individual that requires a faster microprocessor, a large amount of random access memory (RAM), and special features such as high-speed graphics adapters.
- ✓ Historically, the workstation developed technologically about the same time and for the same audience as the UNIX operating system, which is often used as the workstation operating system.
- ✓ Among the most successful makers of this kind of workstation are Sun Microsystems, Hewlett-Packard, DEC, and IBM.

- ✓ They are high end PCs. They contain more memory and high speed processor compared to PCs. They host software requiring more resource.
- ✓ They are used in business but by a single user. Typical work done on workstations includes video editing, animation, drafting of an architectural design, animation etc.

Portable Computer:

- ✓ A Portable computer is a computer that comes with a keyboard and display and one which can be easily relocated or transported, although less convenient compared to a notebook.
- ✓ They have lower specifications and are not well suited for full-time usage as they are less ergonomic.
- ✓ However, they take less space than desktop computers and come with most features found on a desktop.

Super Computer:

- ✓ Supercomputer, any of a class of extremely powerful computers. The term is commonly applied to the fastest high-performance systems available at any given time.
- ✓ Such computers have been used primarily for scientific and engineering work requiring exceedingly high-speed computations.
- ✓ Common applications for supercomputers include testing mathematical models for complex physical phenomena or designs, such as climate and weather, evolution of the cosmos, nuclear weapons and reactors, new chemical compounds (especially for pharmaceutical purposes), and cryptology.
- ✓ As the cost of supercomputing declined in the 1990s, more businesses began to use supercomputers for market research and other business-related models.
- ✓ A supercomputer is the fastest computer in the world that can process a significant amount of data very quickly.
- ✓ The computing Performance of a "supercomputer" is measured very high as compared to a general purpose computer. The computing Performance of a supercomputer is measured in FLOPS (that is floating-point operations per second) instead of MIPS.
- ✓ The supercomputer consists of tens of thousands of processors which can perform billions and trillions of calculations per second, or you can say that supercomputers can deliver up to nearly a hundred quadrillions of FLOPS.
- ✓ They have evolved from grid to cluster system of massively parallel computing.
- ✓ Cluster system computing means that machine uses multiple processors in one system instead of arrays of separate computers in a network.

Network computer:

- ✓ A computer with minimal memory, disk storage and processor power designed to connect to a network, especially the Internet. The idea behind network computers is that many users who are connected to a network don't need all the computer power they get from a typical personal computer. Instead, they can rely on the power of the network servers.
- ✓ This is really a variation on an old idea -- diskless workstations -- which are computers that contain memory and a processor but no disk storage. Instead, they rely on a server to store data. Network computers take this idea one step further by also minimizing the amount of memory and processor power required by the workstation. Network computers designed to connect to the Internet are sometimes called Internet boxes, Net PCs, and Internet appliances.
- ✓ One of the strongest arguments behind network computers is that they reduce the total cost of ownership (TCO)-- not only because the machines themselves are less expensive than PCs, but also because network computers can be administered and updated from a central network server.

Minicomputer:

- ✓ A minicomputer is also known as mini. It is a class of small computers that was introduced into the world in the mid-1960s.
- ✓ A minicomputer is a computer which has all the features of a large size computer, but its size is smaller than those.
- ✓ It lies between the mainframe and the microcomputer because its size is smaller than the former one and larger than the latter one.
- ✓ They also called as a mid-range computer. Minicomputers are mainly multi-users systems where more than one user can work simultaneously.
- ✓ Minicomputer examples: IBM's AS/400e, Honeywell200, TI-990
- ✓ Minicomputer can support multi-users at a time or you can say that minicomputer is a multiprocessing system. Also, the power of processing of minicomputers is not larger than the power of mainframe and supercomputers.
- ✓ These minicomputers can do time-sharing, batch processing, and online processing.

Size of Minicomputer:

- The size of minicomputers can range from 12 inches in width to less than 7.
- This small size is especially attractive to students because they can use it anywhere they want.

History of Minicomputer:

- The term minicomputer was come to know in the 1960s and through that time only the small computers are made by making the use of transistors and core memory technologies.
- The first minicomputer which was developed was known as **Digital Equipment Corporation,** which was made by using transistors and it costs from the US $16000.

Types of Minicomputer:

- Tablet PC, Desktop minicomputers, cell phones, notebooks, high-end mP3 players, etc.

COMPUTER ARCHITECTURE

- ❖ Computer architecture in computer engineering is the conceptual design of a computer system and the basic structure of the business.
- ❖ It is on the way for the various parts of a computer, wherein the central processing unit (CPU) to perform internal and access in the memory address, blueprints and functional description focused primarily on the requirements and the design implementation.
- ❖ Computer architecture is the design of computer systems. Set all connected to the equipment and all software running on it above standard.
- ❖ It is based on the type of program to be run (commerce, science) and the number of programs running at the same time.

FIRST ELECTRONIC COMPUTERS:

The Mark I:

- ✓ During the 1940's, the "Mark" series of computers were developed at Harvard University.
- ✓ The first of these computers---the Mark I---was put into operation in 1944 and was used until 1959. It stored and counted numbers mechanically---using 3000 decimal storage wheels, 1400 rotary dial switches, and 500 miles of wire---but transmitted and read the data electrically.
- ✓ It was programmed by punch cards, weighed 5 tons, and could do a multiplication operation in about 6 seconds.
- ✓ Like the earliest mechanical computers, the data to be used in a Mark computer was stored in a separate part of the machine from the instructions (or program) that would operate on the data.
- ✓ Also, the instructions were stored in a different format than the data.
- ✓ The technique of storing data and instructions separately has become known as the Harvard Architecture.

- ✓ As we shall see, even though this architecture has fallen out of favor in modern computer systems, it is being revived inside of many modern processors.

ENIAC:

- ✓ In the early 1940's, a separate computer was developed at the University of Pennsylvania, using 18,000 vacuum tubes and 1500 relays to move information through the machine---called the Electronic Numerical Integrator and Calculator, or ENIAC, it was the first all-electronic computer.
- ✓ ENIAC took many of its computing techniques from mechanical calculators: for example, it used an electronic version of meshed gears---called a ring-counter---for doing addition. Doing this electronically added speed to the computer: it could do 5000 additions per second or 357 multiplications per second.
- ✓ ENIAC was also programmed by punch cards and switch settings, and could read 2 numbers per second. It took a day or two to set up each new problem for the computer. But, something better would soon emerge... In the mid-1940, john Von Neumann showed that a computer's instructions could be represented in the same language used for the data.
- ✓ Instruction and data could then be stored together within the computer. The first computer to have this Von Neumann architecture was the Electronic Discrete Variable Automatic Computer (EDSAC), which became operational in 1952.
- ✓ The Von Neumann Architecture has become the standard for modern computer systems; most computers since then have some version of this architecture.
- ✓ In a typical Von Neumann system, instruction and data are mixed together in the same memory, often with data following immediately after an instruction. Instructions are just numbers, and are not distinguishable from data.
- ✓ These instructions are known as the machine language of the system.
- ✓ **Combining instructions data in the same memory has several advantages, including:**
  - **Efficient use of memory –** have one large block that can be any way want instead of two smaller blocks.
  - **Computers can handle instructions as easily as data –** since instruction and data are stored together; moving blocks of instructions (i.e programs) around becomes simple.
  - **Ease of loading programs into memory** – just reads the instructions and data from disk or other long-term storage and then executes and data then executes the newly-read information.
- ✓ **Combining instructions and data in the same memory also has disadvantages:**
  - **Data can overwrite instruction:** without special hardware precautions, an incorrect write to memory could overwrite some instructions since Von Neumann systems do not distinguish between instructions and data, the computer would attempt to execute the data as instructions and data, the computer would attempt to execute the data as instructions, usually with an undesired result.
  - **Limited bandwidth:** Storing instructions data together means they both follow the same path to get to the processor. This Von Neumann Bottleneck means that the processor has to trade off between executing a large number of instructions per second and reading in a large amount of data at the same time.

LOW LEVEL LANGUAGES:

- ✓ While Von Neumann systems deal easily with their machine language instructions, machine language is not an easy language for programmers to write and read.
- ✓ In the 1950 s, assembly language was developed. Assembly language uses mnemonic codes that are easier to learn and remember than machine language's numeric codes.

- ✓ Machine language and assembly languages are called as low level language. Assembly languages helped programmers by allowing them to think using the name of each instruction instead of its binary representation.

HIGH LEVEL LANGUAGES:

- ➢ Solving the problems assembly language would require a new kind of computer language – a high level language where the programmer could state the problem to be solved in a more "natural" and machine independent form.
- ➢ The high level languages require compilers programs that translate the high level source code into the machine language of a particular computer.
- ➢ **Compilers give high-level language programmers several advantages over assembly languages programmers;**
  - o High level languages are not tied to any particular computer, which means that programs written on one computer could be run on another by re-compiling the source for the other machine.
  - o Programmers who learn a particular high level language on one system typically can use that language on another system.
  - o Optimizing compilers can generate code, which is as efficient as the best assembly language programmers. In fact, since a compiler does not tire, it may generate better code overall than a talented assembly languages programmer.

FIRST COMMERCIAL COMPUTERS:

- ✓ The **UNIVAC I** (**Universal Automatic Computer I**) was the first commercial computer developed by the Eckert-Mauchly Computer Company, and later, by Sperry/Rand, in the 1950s. The UNIVAC was preceded by the Electronic Numerical Integrator And Computer (ENIAC) and Binary Automatic Computer (BINAC), made in the 1940s. a trademark of the Unisys corporation, was released in 1951 and 1952 when first developed by J. Presper Eckert and John Mauchly.
- ✓ The **UNIVAC** is an electrical computer containing thousands of vacuum tubes that utilizes punch cards and switches for inputting data and punch cards for outputting and storing data. The UNIVAC was later released the UNIVAC II, and III with various models, such as the 418, 490, 491, 1100, 1101, 1102, 1103, 1104, 1105, 1106, 1107, and 1108. Many of these models were only owned by a few companies or government agencies.
- ✓ UNIVAC machines were huge mainframe computers the size of vehicles or large pieces of equipment. The first model, UNIVAC 1, cost $1 million in 1950s-era money.
- ✓ The original UNIVAC was developed for the U.S. Census Bureau, but ended up being used to accurately predict the election of Dwight Eisenhower in the year 1952. Successive UNIVAC designs built on the original design, which operated at around 10,000 operations per second.
- ✓ In many ways, UNIVAC represents the birth of the modern computers that went from room-sized mainframes to small laptop and desktop computers just several decades later. Due to phenomena like Moore's law, which predicted doubling transistor density, computers quickly became smaller, faster and more capable. Within a generation of their production, UNIVAC models became profoundly obsolete, and are now museum pieces that show some of the impressive IT advancements that have been made over the last century.

INSIDE A COMPUTER SYSTEM:

- ✓ Think of the components inside the computer case as one big puzzle.
- ✓ It may seem challenging at first glance, but soon you realize that each part fits together logically like the pieces of a puzzle would.

INSIDE MEMORY:

- ✓ Computer memory comes in two basic types Random Access Memory (RAM), which the processor can read from and write to Read Only Memory (ROM) which the processor can never change. The computer RAM is used for changing information or for loading in programs from disk before running them.
- ✓ This type memory does not preserve its contents when the power is turned off. The contents of RAM and ROM are organized in the same way.
- ✓ Each type of memory has a number of cells and cell has a unique address.
- ✓ The lowest address is typically 0, and the highest legal address is determined by the processor this range of address is known as the machine's address space.

INSIDE THE PROCESSOR:

Which combines the most common parts of modern microprocessor:

Arithmetic Logic Unit:

- o Arithmetic logic units (ALUs) in microprocessors allow computers to add, subtract, multiply, divide and perform other logical operations at high speeds. The control unit accepts one instruction from the data bus and directs the rest of the units to perform the instructions**.**

The Register Bank:

- o It contains a set of memory cells internal to the processor. Each cell is typically as wide as the processor data bus (1 word). The processor can read and write data values into these locations much more quickly than it can access external memory.

The Condition Code Register:

- o It contains a set of bits which indicates whether the result of the last command was: greater than zero", "equal to zero", or "less than zero".

The Program counter:

- o It contains the address of the instructions being instructed.

PERIPHERAL DEVICES:

- ✓ A peripheral device provides input/output (I/O) functions for a computer and serves as an auxiliary computer device without computing-intensive functionality.
- ✓ Peripheral devices connect with a computer through several I/O interfaces, such as communications (COM), Universal Serial Bus (USB) and serial ports.
- ✓ Peripheral devices include the following:

Mouse, Keyboard, Printer, Webcam, Printer, Scanner, External drives, Graphics cards, CD-ROM

- ✓ A peripheral device may be classified as an internal or external peripheral device.

MEMORY MAPPED I/O

- ✓ Memory mapped I/O makes the peripheral look like a block of RAM to the main processor.
- ✓ If the processor writes a value into one of these addresses, the information is sent out to the peripheral.
- ✓ In a similar fashion, if the processor reads from one of these addresses, some information is read peripheral and delivered to the processor.

I/O INSTRUCTIONS:

The method that is used to transfer information between internal storage and external I/O devices is known as I/O interface. The CPU is interfaced using special communication links by the peripherals connected to any computer system. These communication links are used to resolve the differences between CPU and peripheral. There exists special hardware components between CPU and peripherals to supervise and synchronize all the input and output transfers that are called interface units.

I/O PROCESSORS:

- ✓ The input/output processor or I/O processor is a processor that is separate from the CPU and is designed to handle only input/output processes for a device or the computer.
- ✓ The I/O processor is capable of performing actions without interruption or intervention from the CPU. The CPU only needs to initiate the I/O processor by telling it what activity to perform.
- ✓ Once the necessary actions are performed, the I/O processor then provides the results to the CPU. Doing these actions allow the I/O processor to act as a bus to the CPU, like a CPU bus, carrying out activities by directly interacting with memory and other devices in the computer.
- ✓ A more advanced I/O processor may also have memory built into it, allowing it to perform actions and activities more quickly.

SPEEDING UP THE SYSTEM:

- ✓ One of the few constant in the computer industry is the desire for ever-faster computer systems.
- ✓ There are several places where speed up a system, including the memory, processor, connection to the peripheral devices, or the actual peripherals.

MEMORY CACHE:

- ✓ Memory cache is a type of cache memory that is installed and/or is part of a computer's main random access memory (RAM). It is a native cache memory of the RAM that provides faster data accessing and processing capabilities than the RAM itself.
- ✓ Memory cache is also known as cache store and random access memory cache (RAM cache).
- ✓ Memory cache is designed to store data and programs that are frequently accessed by the central processing unit (CPU), enabling data and programs to be delivered to the computer more quickly than via standard RAM. Despite being faster than RAM, memory cache is slower than a CPU cache, primarily because it is not in close proximity to the processor.

CISC (COMPLEX INSTRUCTION SET COMPUTING)

- ✓ This is a type of microprocessor design. The CISC architecture contains a large set of computer instructions that range from very simple to very complex and specialized.
- ✓ Though the design was intended to compute complex instructions in the most efficient way, it was later found that many small, short instructions could compute complex instructions more efficiently. This led to a design called Reduced Instruction Set Computing (RISC), which is now the other major kind of microprocessor architecture.
- ✓ Intel Pentium processors are mainly CISC-based, with some RISC facilities built into them, whereas the PowerPC processors are completely RISC-based.

Use of Microcode:

- A processor's micro programs operate on a more primitive, totally different, and much more hardware-oriented architecture than the assembly instructions visible to normal programmers.
- In coordination with the hardware, the microcode implements the programmer-visible architecture. The underlying hardware need not have a fixed relationship to the visible architecture. This makes it easier to implement a given instruction set architecture on a wide variety of underlying hardware micro-architectures.

There are **some real advantages** to a micro coded implementation:

- Since the micro coded memory can be much faster than the main memory, an instruction set can be implemented in micro coded without losing much speed over a purely hard-wired implementation.
- New chips are easier o implement and require fewer transistors than implementing the same instruction set with dedicated logic.
- A micro programmed design can be modified to handle entirely new instruction sets quickly.

Build "Rich" instruction sets:

- ✓ The **instruction set**, also called **ISA** (**instruction set architecture**), is part of a computer that pertains to programming, which is basically machine language. The instruction set provides commands to the processor, to tell it what it needs to do.
- ✓ The instruction set consists of addressing modes, instructions, native data types, registers, memory architecture, interrupt, and exception handling, and external I/O.

Examples of instruction set

- **ADD** - Add two numbers together.
- **COMPARE** - Compare numbers.
- **IN** - Input information from a device, e.g., keyboard.
- **JUMP** - Jump to designated RAM address.
- **JUMP IF** - Conditional statement that jumps to a designated RAM address.
- **LOAD** - Load information from RAM to the CPU.
- **OUT** - Output information to device, e.g., monitor.
- **STORE** - Store information to RAM.

Rise of CISC:

- ✓ A **Complex Instruction Set Computer** (**CISC**) supplies a large number of complex instructions at the assembly language level. During the early years, memory was slow and expensive and the programming was done in assembly language.
- ✓ Since memory was slow and instructions could by retrieved up to 10 times faster from a local ROM than from main memory, programmers tried to put as many instructions as possible in a microcode.

Characteristics of a CISC design:

The main characteristics of CISC (Complex Instruction Set Computer) are;

- Many instructions that access memory directly
- Large number of addressing modes
- Variable length instruction encoding
- Support misaligned accesses

RISC(REDUCED INSTRUCTION SET COMPUTER)

- ✓ It is known as Reduced Instruction Set Computer. It is a type of microprocessor that has a limited number of instructions. They can execute their instructions very fast because instructions are very small and simple.
- ✓ RISC chips require fewer transistors which make them cheaper to design and produce. In RISC, the instruction set contains simple and basic instructions from which more complex instruction can be produced. Most instructions complete in one cycle, which allows the processor to handle many instructions at same time.
- ✓ In this instructions are register based and data transfer takes place from register to register.

Salient characteristics of RISC are as follows:

1. Reduced and restricted number of instructions
2. Fewer number of addressing modes
3. Simplified instruction format and instruction are uniform
4. Only load and store instructions have access to memory
5. Hard-wired control rather than being micro-programmed
6. Pipeline architecture

Advantages of RISC Architecture:

1. Performance is better due to simplified instruction set

2. Less chip space is used due to reduced instruction set
3. Can be easily designed as compared to CISC
4. Reduced per-chip cost, as it uses smaller chips

Disadvantages of RISC Architecture:

1. Performance of the processor will vary according to the code being executed. Subsequent instructions might be relying on previous instructions for their execution.
2. RISC processors require very fast memory systems to feed various instructions. A large memory cache generally is needed.

Difference Between CISC and RISC

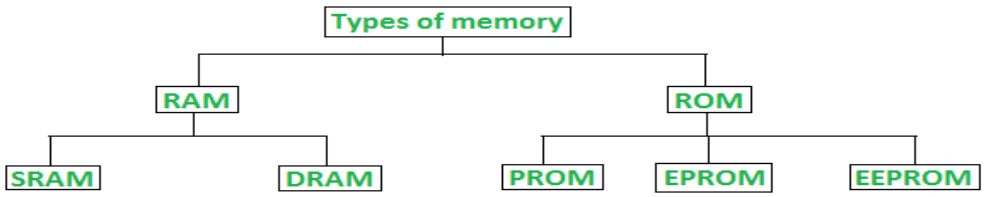
Architectural Characteristics	Complex Instruction Set Computer(CISC)	Reduced Instruction Set Computer(RISC)
Instruction size and format	Large set of instructions with variable formats (16-64 bits per instruction).	Small set of instructions with fixed format (32 bit).
Data transfer	Memory to memory.	Register to register.
CPU control	Most micro coded using control memory (ROM) but modern CISC use hardwired control.	Mostly hardwired without control memory.
Instruction type	Not register based instructions.	Register based instructions.
Memory access	More memory access.	Less memory access.
Clocks	Includes multi-clocks.	Includes single clock.
Instruction nature	Instructions are complex.	Instructions are reduced and simple

MEMORY

- 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.
- Every computer comes with a certain amount of physical memory, usually referred to as *main memory* or *RAM*. You can think of main memory as an array of boxes, each of which can hold a single byte of information.
- A computer that has 1 megabyte of memory, therefore, can hold about 1 million bytes (or characters) of information.

Memory Organization:

- ✓ Memory organization is two-fold. First we discuss the hardware (physical) organization, then the internal architecture.
- ✓ The type of computer and its size do not reflect the type of memories that the computer uses.
- ✓ Some computers have a mixture of memory types.
- ✓ For example, they may use some type of magnetic memory(core or film) and also a semiconductor memory (static or dynamic).
- ✓ They also have a read-only memory which is usually a part of the CPU. Memory in a computer can vary from one or more **modules** to one or more **pc's,** depending on the computer type.
- ✓ The larger mainframe computers use the modular arrangement, multiple modules (four or more), to make up their memories.
- ✓ Whereas, minicomputers and microcomputers use chassis or assemblies, cages or racks, and motherboard or backplane arrangements.
- ✓ Minis and micros use multiple components on one pc or groups of pc's to form the memory



Classification of computer memory

RAM (Random Access Memory):

- ✓ RAM(Random Access Memory) is a part of computer's Main Memory which is directly accessible by CPU.
- ✓ RAM is used to Read and Write data into it which is accessed by CPU randomly.
- ✓ RAM is volatile in nature, it means if the power goes off, the stored information is lost.
- ✓ RAM is used to store the data that is currently processed by the CPU.
- ✓ Most of the programs and data that are modifiable are stored in RAM.

There are two main types of RAM:

1. **Dynamic random access memory (DRAM), or Dynamic RAM, and**
2. **Static random access memory (SRAM).**

The RAM in most personal computers (PC's) is Dynamic RAM. All dynamic RAM chips on DIMMs, SIMMs or RIMMs have to refresh every few milliseconds by rewriting the data to the module.

Static RAM (SRAM) is volatile memory and is often used in cache memory and registers because it is a lot faster and does not require refreshing like Dynamic RAM. SRAM retains information and is able to operate at higher speeds than DRAM. Because DRAM is a lot cheaper than SRAM, it's common to see PC manufacturers use DRAM.

Dynamic RAM is memory that needs refreshing. The refreshing is done by the memory controller which is part of the chipset on the motherboard. Static RAM (SRAM) does not need refreshing and is used in memory cache on the central processing unit (CPU); it is called L1, L2 and L3 cache. Original SRAM was stored on the motherboard; later SRAM was inside of the CPU housing or stored on both the motherboard and inside of the CPU.

Dynamic RAM(DRAM)

- ✓ DRAM stores the binary information in the form of electric charges that applied to capacitors. The stored information on the capacitors tend to lose over a period of time and thus the capacitors must be periodically recharged to retain their usage. The main memory is generally made up of DRAM chips.

Types of DRAM

There are mainly 5 types of DRAM:

1. **Asynchronous DRAM (ADRAM):** The DRAM described above is the asynchronous type DRAM. The timing of the memory device is controlled asynchronously. A specialized memory controller circuit generates the necessary control signals to control the timing. The CPU must take into account the delay in the response of the memory.
2. **Synchronous DRAM (SDRAM):** These RAM chips' access speed is directly synchronized with the CPU's clock. For this, the memory chips remain ready for operation when the CPU expects them to be ready. These memories operate at the CPU-memory bus without imposing wait states. SDRAM is commercially available as modules incorporating multiple SDRAM chips and forming the required capacity for the modules.

3. **Double-Data-Rate SDRAM (DDR SDRAM):** This faster version of SDRAM performs its operations on both edges of the clock signal; whereas a standard SDRAM performs its operations on the rising edge of the clock signal. Since they transfer data on both edges of the clock, the data transfer rate is doubled. To access the data at high rate, the memory cells are organized into two groups. Each group is accessed separately.

4. **Rambus DRAM (RDRAM):** The RDRAM provides a very high data transfer rate over a narrow CPU-memory bus. It uses various speedup mechanisms, like synchronous memory interface, caching inside the DRAM chips and very fast signal timing. The Rambus data bus width is 8 or 9 bits.

5. **Cache DRAM (CDRAM):** This memory is a special type DRAM memory with an on-chip cache memory (SRAM) that acts as a high-speed buffer for the main DRAM.

Static RAM (SRAM)

- ✓ Static RAM is a type of RAM that holds its data without external refresh, for as long as power is supplied to the circuit.
- ✓ This is contrasted to dynamic RAM (DRAM), which must be refreshed many times per second in order to hold its data contents. SRAMs are used for specific applications within the PC, where their strengths outweigh their weaknesses compared to DRAM:
- **Simplicity:** SRAMs don't require external refresh circuitry or other work in order for them to keep their data intact.
- **Speed:** SRAM is faster than DRAM.

In contrast, SRAMs have the following weaknesses, compared to DRAMs:

- **Cost:** SRAM is, byte for byte, several times more expensive than DRAM.
- **Size:** SRAMs take up much more space than DRAMs (which is part of why the cost is higher).

These advantages and disadvantages taken together obviously show that performance-wise, SRAM is superior to DRAM, and we would use it exclusively if only we could do so economically. Unfortunately, 32 MB of SRAM would be prohibitively large and costly, which is why DRAM is used for system memory. SRAMs are used instead for level 1 cache and level 2 cache memory, for which it is perfectly suited; cache memory needs to be very fast, and not very large.

READ ONLY MEMORY (ROM):

- ✓ Read-only memory (ROM) is a type of storage medium that permanently stores data on personal computers (PCs) and other electronic devices. It contains the programming needed to start a PC, which is essential for boot-up; it performs major input/output tasks and holds programs or software instructions.
- ✓ Because ROM is read-only, it cannot be changed; it is permanent and non-volatile, meaning it also holds its memory even when power is removed. By contrast, random access memory (RAM) is volatile; it is lost when power is removed.
- ✓ There are numerous ROM chips located on the motherboard and a few on expansion boards. The chips are essential for the basic input/output system (BIOS), boot up, reading and writing to peripheral devices, basic data management and the software for basic processes for certain utilities.
- ✓ One major type of memory that is used in PCs is called *read-only memory*, or *ROM* for short. ROM is a type of memory that normally can only be read, as opposed to RAM which can be both read and written. There are two main reasons that read-only memory is used for certain functions within the PC:
- ❖ **Permanence:** The values stored in ROM are always there, whether the power is on or not. A ROM can be removed from the PC, stored for an indefinite period of time, and then replaced, and the data it contains will still be there. For this reason, it is called *non-volatile storage*. A hard disk is also non-volatile, for the same reason, but regular RAM is not.

- **Security:** The fact that ROM cannot easily be modified provides a measure of security against accidental (or malicious) changes to its contents. You are not going to find viruses infecting true ROMs, for example; it's just not possible.

Other types of non-volatile memory include:

- Programmable Read-Only Memory (PROM)
- Electrically Programmable Read-Only Memory (EPROM)
- Electrically Erasable Programmable Read-Only Memory (EEPROM; also called Flash ROM)

Types of ROM :

PROM :

- Short for programmable read-only memory, a memory chip on which data can be written only once. Once a program has been written onto a PROM, it remains there forever.
- Unlike RAM, PROMs retain their contents when the computer is turned off. The difference between a PROM and a ROM (read-only memory) is that a PROM is manufactured as blank memory, whereas a ROM is programmed during the manufacturing process. To write data onto a PROM chip, you need a special device called a PROM programmer or PROM burner. The process of programming a PROM is sometimes called burning the PROM.

EPROM :

- Acronym for erasable programmable read-only memory, and pronounced ee-prom, EPROM is a special type of memory that retains its contents until it is exposed to ultraviolet light.
- The ultraviolet light clears its contents, making it possible to reprogram the memory. To write to and erase an EPROM, you need a special device called a PROM programmer or PROM burner.

EEPROM :

- Short form of electrically erasable programmable read-only memory. EEPROM is a special type of PROM that can be erased by exposing it to an electrical charge.
- Like other types of PROM, EEPROM retains its contents even when the power is turned off.
- Also like other types of ROM, EEPROM is not as fast as RAM.

Flash Memory:

- Flash memory is an example of quite a recent type of storage technology known as **solid state devices**.
- This type of portable storage has become very popular because of its low price and high storage capacity compared to its rivals, e.g. floppy disk

REGISTERS:

- ✓ **Register** are used to quickly accept, store, and transfer data and instructions that are being used immediately by the CPU, there are various types of Registers those are used for various purpose.
- ✓ Among of the some Mostly used Registers named as AC or **Accumulator**, Data Register or DR, the AR or **Address Register**, **program counter** (PC), **Memory Data Register**(MDR) ,**Index** register, **Memory Buffer Register**.
- ✓ These Registers are used for performing the various Operations. While we are working on the System then these Registers are used by the **CPU for Performing the Operations**.
- ✓ When We Gives Some Input to the System then the I**nput will be Stored into the Registers** and When the System will gives us the Results after Processing then the Result will also be from the Registers.

FACTORS AFFECTING PROCESSING SPEED

- ✓ In the modern days competitive world, quick result is the most. We are moving so fast in our day to day life that we want to get results quickly.
- ✓ We use computer to perform various certain task quickly & accurately so that we can get our work done. But there are many factors that could affect the computer system & give us very poor result beyond our expectation. Some of the Factors That Affect Processing Speed

Following are some important factors that affect the processing speed of a computer:

- **Registers**
- RAM
- **System Clock**
- **Buses**
- **Cache Memory**

Registers: The first factor that affects the processing speed of a computer is a register. A register is a small, high-speed memory inside a CPU. CPU contains a number of registers. The data and instructions are stored by registers while the CPU processes them. The amount of data with which the computer can work at one time is determined by the size of registers. This is also named as word size.

The registers capacity is in bytes. A register can be of one, two, four or eight bytes. Computers with 32-bit registers mean the **CPU** can process four bytes of data at one time. The bigger size of the register increases the performance of the computer.

RAM: The size of RAM is also included in the factors that affect the processing speed of the computer. The bigger amount of RAM means that more program instructions and data can be stored in memory. If a computer does not have enough memory to run a program, it must move data between RAM and the hard disk frequently. This process is called swapping that can greatly slow a computer's performance.

System Clock: A system clock is an electronic component that is an important factor that affects that processing speed of the computer. It generates electric signals at a fast speed. The time required to execute a single instruction is called clock speed. Clock speed tells us how much time a CPU takes to execute each instruction. CPU takes from 1 to 6 clock ticks to execute one instruction.

Clock speed is measured as cycles per second. Its unit is Hertz (Hz). If a pc contains a clock speed of three hundred MHz, its clock ticks three hundred million times each second. A quicker clock will execute a lot of directions every second Buses. The physical path between the components of a computer is a bus. Data and instructions travel along these pats. The width of the bus decides the number of bits that can be transmitted between the **CPU** and other devices. Bus width is also considered in the factors that affect the processing speed of a computer. A higher bus width means that the user can carry more data. It increases the performance of the computer.

Cache Memory

A cache (pronounced "cash") is a high-speed memory that holds the most recent data and instructions that have been loaded by the **CPU**. It is designed to speed up the transfer of data and instructions. Cache is located directly on the **CPU** and **RAM**. It is faster than **RAM**.

The **CPU** retrieves knowledge and directions from **RAM** once while using them for the first time. Cache is employed to store a duplicate of that knowledge or directions. When the **CPU** needs that data or instructions again, it first checks in the cache. If the needed data is present there, it retrieves that data rom cache memory instead of **RAM**. This thing speeds up the **CPU** working. The computer's speed is greatly affected by the amount of cache memory.

SECONDARY STORAGE DEVICES:

- A secondary storage device refers to any non-volatile storage device that is internal or external to the computer. It can be any storage device beyond the primary storage that enables permanent data storage.
- A secondary storage device is also known as an auxiliary storage device or external storage.
- Secondary storage devices are primarily referred to a storage devices that serve as an addition to the computer's primary storage, RAM and cache memory.
- Typically, secondary storage allows for the storage of data ranging from a few megabytes to petabytes.
- These devices store virtually all programs and applications stored on a computer, including the operating system, device drivers, applications and general user data.

- Most of the secondary storage devices are internal to the computer such as the hard disk drive, the tape disk drive and even the compact disk drive and floppy disk drive.
- There are two different types of storage devices:

- **Primary storage devices:** Generally smaller in size, these are designed to hold data temporarily and are internal to the computer. They have the fastest data access speed, and include RAM and cache memory.
- **Secondary storage devices:** These usually have large storage capacity, and they store data permanently. They can be either internal or external to the computer, and they include the hard disk, optical disk drive and USB storage device.

Advantages

- Possesses the capacity to store enormous amounts of information ×
- Safe
- Reliable
- Permanent

MAGNETIC TAPE:

- A magnetic tape drive is a storage device that makes use of magnetic tape as a medium for storage.
- It uses a long strip of narrow plastic film with tapes of thin magnetizable coating. It is essentially a device which records or perhaps plays back video and audio using magnetic tape, examples of which are tape recorders and video tape recorders.
- Magnetic tape drives store data on magnetic tape using digital recording.
- The tapes are usually stored on cartridges or cassettes, but for drives that are used as data storage tape backups, the tape is often wound on reels. Magnetic tape is not the most dense data storage medium, but as of 2010 the record for the largest data capacity in magnetic tape was 29.5GB per square inch and the Linear Tape-Open (LTO) supported continuous data transfer rates up to 140 MB/s which was comparable to most hard disks drives.
- A tape drive is only able to move tape in a single direction and hence can only provide sequential access storage, unlike a disk drive which may provide random access as well as sequential access. The reason magnetic tape drives are still in use today, especially as an offline data backup, is because of long archival stability and very favorable unit costs.

DAT CARTRIDGE:

- DAT (Digital Audio Tape) is a standard medium and technology for the digital recording of audio on tape at a professional level of quality. A DAT drive is a digital tape recorder with rotating heads similar to those found in a video deck. Most DAT drives can record at sample rates of 44.1 kHz, the CD audio standard, and 48 kHz.
- DAT has become the standard archiving technology in professional and semi-professional recording environments for master recordings.
- Digital inputs and outputs on professional DAT decks allow the user to transfer recordings from the DAT tape to an audio workstation for precise editing. The compact size and low cost of the DAT medium makes it an excellent way to compile the recordings that are going to be used to create a CD master.

MAGNETIC DISK:

- A magnetic disk is a storage device that uses a magnetization process to write, rewrite and access data. It is covered with a magnetic coating and stores data in the form of tracks, spots and sectors. Hard disks, zip disks and floppy disks are common examples of magnetic disks.
- A magnetic disk primarily consists of a rotating magnetic surface and a mechanical arm that moves over it. The mechanical arm is used to read from and write to the disk. The data on a magnetic disk is read and written using a magnetization process.

- Data is organized on the disk in the form of tracks and sectors, where tracks are the circular divisions of the disk. Tracks are further divided into sectors that contain blocks of data. All read and write operations on the magnetic disk are performed on the sectors

HARD DISKS:

- A hard disk drive (HDD) is a non-volatile computer storage device containing magnetic disks or platters rotating at high speeds. It is a secondary storage device used to store data permanently, random access memory (RAM) being the primary memory device.
- Non-volatile means data is retained when the computer is turned off.
- Hard drives need a read only memory (ROM) controller board to instruct the read/write heads how, when and where to move across the platters.
- Hard drives have disks stacked together and spin in unison. The read/write heads are controlled by an actuator, which magnetically reads from and writes to the platters.
- The read/write heads float on a film of air above the platters. Both sides of the platters are used to store data.
- Each side or surface of one disk is called a head, with each one divided into sectors and tracks.
- All tracks are the same distance from the center of the disk. Collectively they comprise one cylinder. Data is written to a disk starting at the furthest track.
- The read/write heads move inward to the next cylinder once the first cylinder is filled.

FLOPPY DISKS:

- A floppy disk drive (FDD), or floppy drive, is a hardware device that reads data storage information. It was invented in 1967 by a team at IBM and was one of the first types of hardware storage that could read/write a portable device.
- FDDs are used for reading and writing on removable floppy discs. Floppy disks are now outdated, and have been replaced by other storage devices such as USB and network file transfer.
- A floppy disk commonly came in three sizes, 8 inches, 5.5 inches and 3.5 inches, becoming smaller as the technology advanced.
- The newer, 3.5-inch version used more cutting-edge technology and held more data than previous models, while the original 8-inch floppy drive was developed to load hardware-level instructions and/or data structures called microcode into the IBM System/370 mainframe.
- The 8-inch flexible diskette was read-only, held 80 kilobytes of memory and was referred to as a memory disk. Eight-inch floppy drives did not connect to the motherboard, but rotated on a turntable that was run by an idler wheel.

OPTICAL DISK:

- An optical disk is any computer disk that uses optical storage techniques and technology to read and write data.
- It is a computer storage disk that stores data digitally and uses laser beams (transmitted from a laser head mounted on an optical disk drive) to read and write data.
- An optical disk is primarily used as a portable and secondary storage device.
- It can store more data than the previous generation of magnetic storage media, and has a relatively longer lifespan. Compact disks (CD), digital versatile/video disks (DVD) and Blu-ray disks are currently the most commonly used forms of optical disks.
- These disks are generally used to:
    - Distribute software to customers
    - Store large amounts of data such as music, images and videos
    - Transfer data to different computers or devices
    - Back up data from a local machine

- Three basic types of optical disks:
  CD-ROM: Like audio CDs, CD-ROMs come with data already encoded onto them. The data is permanent and can be read any number of times, but CD-ROMs cannot be modified.
  WORM : Stands for *write-once, read -many.* With a WORM disk drive, you can writedata onto a WORM disk, but only once. After that, the WORM disk behaves just like a CD-ROM.
  Erasable: Optical disks that can be erased and loaded with new data, just like magnetic disks. These are often referred to as *EO* (**e**rasable **o**ptical) disks.

CD-ROM:

- ✓ Stands for "Compact Disc Read-Only Memory." A CD-ROM is a CD that can be read by a computer with an optical drive. The "ROM" part of the term means the data on the disc is "read-only," or cannot be altered or erased.
- ✓ Because of this feature and their large capacity, CD-ROMs are a great media format for retail software.
- ✓ The first CD-ROMs could hold about 600 MB of data, but now they can hold up to 700 MB. CD-ROMs share the same technology as audio CDs, but they are formatted differently, allowing them to store many types of data.

CD-R

- ✓ A compact disc recordable (CD-R) is a writable disc upon which a user can write once and read many times. Once finalized, a CD-R disc cannot be formatted and data cannot be deleted from it.
- ✓ A compact disc recordable is also known as a compact disc - write once (CD-WO) or write once read many (WORM). Data once written on the CD-R disc cannot be deleted, and thus if data is not written properly, it cannot be corrected.

CD-RW:

- ✓ CD–Read Writable (CD-RW) refers to an optical CD that may be written and rewritten multiple times. CD-RW allows for data erasing during each rewritable session. However, data cannot be changed during CD-RW sessions.
- ✓ Some CD-RW discs have a multisession feature, in which additional data may be written at a later time if extra space is available.
- ✓ A CD-RW can hold data for several years if the disc is protected from direct sunlight.
- ✓ Most CD-RW discs hold approximately 74 minutes and 640 MB of data, but some hold 80 minutes and 700 MB of data. Experts claim that a CD-RW's rewriting cycle may occur up to 1000 times.

DVD:

- ✓ Stands for "Digital Versatile Disc." A DVD is a type of optical media used for storing digital data. It is the same size as a CD, but has a larger storage capacity.
- ✓ Some DVDs are formatted specifically for video playback, while others may contain different types of data, such as software programs and computer files.
- ✓ It provided a number of improvements over analog VHS tapes, including higher quality video, widescreen aspect ratios, custom menus, and chapter markers, which allow you to jump to different sections within a video.
- ✓ DVDs can also be watched repeatedly without reducing the quality of the video and of course they don't need to be rewound. A standard video DVD can store 4.7 GB of data, which is enough to hold over 2 hours of video in 720p resolution, using MPEG-2 compression.

DVD-R and DVD-RW:

- ✓ These two types of blank discs have similar capacities, so you can store the same amount of data per disc whichever you chose.
- ✓ The main difference between DVD-R and DVD-RW is the ability to erase the contents in the latter. In DVD-R, you can only write to it once. When the disc is full, you can no longer alter its contents.

- ✓ In DVD-RW, you have the ability to erase the content of the entire disc and then write new files to it. You can do this up to 1000 times on a single DVD-RW disc before it fails and can no longer hold data.

Combo drives:

A combo drive refers to optical drives that are capable of recording and/or reading two or more types of optical media. As DVD drives were introduced, combo drives referred to those optical disk drivesthat combined CD media read and write capabilities with the capability to read DVD media. As the popularity of DVD media grew, the definition of what makes a drive a combo drive also changed. In CD and DVD media, the term now usually describes a DVD drive that also includes CD media read and write capabilities. Before combo drives, consumers needed to choose between a CD burner or a DVD-ROM drive.

ZIP disks:

A Zip disk was an advanced version of the floppy disk developed by Iomega. The disk needed a special drive called the Zip drive in order to be used. Zip disks were available in 100- and 250-MB capacities and were used to store, share and back up large amounts of data, which was not possible with ordinary floppy disks.

Zip disks looked similar to floppy disks, but were slightly larger and thicker, and had stronger plastic casing, making them easier to store and handle. Like floppy disks, Zip disks were lightweight, portable and relied on magnetic storage techniques. The magnetic coating used in Zip disks was of higher quality than that used in floppy disks, and they could store more data than floppy disks.

JAZ Disk

A removable disk drive developed by Iomega Corporation. The Jaz drive has a 12-ms average seek time and a transfer rate of 5.5 Mbps. The removable cartridges hold up to 2 GB of data. The fast data rates and large storage capacity make it a viable alternative for backup storage as well as everyday use.

Super disk

The **Super Disk LS-120** is a high-speed, high-capacity alternative to the 90 mm (3.5 in), 1.44 MB floppy disk.

Magneto optical disk:

A magneto-optical disk is a rewritable disk that makes use of both magnetic disk and optical technologies. It is similar to a magnetic diskette except for its larger size. Magneto-optical disks are seldom manufactured and used due to the advent of flash drives and DVD/CD drives, which are less expensive and have better writing time and reliability.

Magneto-optical disks are also known as magneto-optical drives and MO drives.

INPUT DEVICES

- ❖ An input device is a hardware or peripheral device used to send data to a computer.
- ❖ An input device allows users to communicate and feed instructions and data to computers for processing, display, storage and/or transmission.
- ❖ Because input devices are geared toward user-computer interaction, they are used to transform user actions or commands into electronic signals that are understood by computers.

Keyboard:

- ✓ A computer **keyboard** is one of the primary input devices used with a computer.
- ✓ Similar to an electric typewriter, a keyboard is composed of buttons that create letters, numbers, and symbols, as well as perform other functions.
- ✓ The following sections provide more in-depth information and answers to some of the more frequently asked questions about the keyboard.

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:

- ✓ A mouse is a small handheld input device that controls a computer screen's cursor or pointer in conjunction with the way it is moved on a flat surface. The mouse term name originates from its likeness to a small, corded and elliptical shaped device that looks like a mouse tail. Some mouse devices have integrated features, such as extra buttons that may be programmed and assigned with different commands.
- ✓ Because the mouse reduces the use of a keyboard, its invention and continuous innovation is considered one of the most important breakthroughs in computer ergonomics.

Advantages

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

The three main mouse device types are:

- **Mechanical**: Built with a trackball underneath the mouse and mechanical sensors, allowing easy movement in all directions
- **Optomechanical**: Similar to the mechanical type but uses optical, rather than mechanical, sensors to detect trackball movement
- **Optical**: The most expensive. Uses a laser to detect mouse movement, has no mechanical parts and reacts more precisely than other types.

Track ball:

- ✓ A trackball is an input device which comprises of a exposed protruding ball held by a socket having sensors for detecting the ball's rotation.

- ✓ There are usually one or two buttons provided with a trackball that have the same capability as click buttons on a mouse. Unlike other input devices which needs movement like the mouse, a trackball is stationary and does not require much space. It can also work on most surfaces which is a great advantage compared to other input devices.
- ✓ While working with a trackball, the arm and wrist motion are less compared to working with a mouse. The physical strain is less as well. Controlling of the trackball is done using thumbs, fingers or the palm of the hand. As precision control is more pronounced in case of a trackball, it's more popular for certain applications like gaming.

Joy Stick

- ✓ A **joystick** is an input device that allows the user to control a character or machine in a computer program, such as a plane in a flight simulator.
- ✓ They look similar to the control device you would find on an arcade game, but nearly always include extra buttons for additional functionality.
- ✓ The joystick is mostly used when there is a need to perform a direct pointing or when a precise function is needed.
- ✓ There are different types of joysticks such as displacement joysticks, hand-operated joysticks, finger-operated joysticks, thumb/fingertip-operated joysticks, hand-operated isometric joysticks, etc.

Scanner:

- ✓ A scanner is an electronic device which can capture images from physical items and convert them into digital formats, which in turn can be stored in a computer, and viewed or modified using software applications.
- ✓ Different types of scanners are available with different resolutions. In the world of electronic data transmission, scanning is considered to be the most cost-effective and reliable way of transmitting images.

Prominent features of a scanner include:

- **Reliability** - Unlike certain forms of data transmission, scanning involves only transfer of hard images to digital forms. The role of the end-user is limited in case of scanning. And as they are not dependent on two-way communication, they can also help in storing important information or transmitting important information.
- **Efficiency** - Modern scanners are built for efficiency and speed. And it comes with ease of use as well as convenience.
- **Quality** - Scanning ensures the best resolution possible for digital images. Compared to fax machines, which may find it difficult to reproduce the accurate details, scanners can reproduce images with high resolution and precisions. They are quite useful for photography and engineering arenas.
- **Cost saving** - One of the biggest advantage of scanning is the replacement of physical files/forms with digital ones. Along with saving physical space, which has to be used for storage, there are also environmental benefits by using scanner.

Types of scanner:

1. **Flatbed Scanners**
   - Flatbed scanners are some of the most commonly used scanners as it has both home and office functions. The way they scan documents is that a mechanism rolls under the document to obtain the image. For businesses that have a need for high processing abilities, the flatbed scanner can scan any number of documents with a click of a button.

2. **Sheet-Fed Scanners**
   - Sheet-fed scanners cost between $300 and $800. This type of scanner works like a flatbed scanner except that the image is fed through the scanner and moves along the beam to be read rather than the beam moving. This type is not useful for books, but only single sheets.

Barcode reader

- ✓ A barcode reader, also called a price scanner or point-of-sale (POS) scanner, is a hand-held or stationary input device used to capture and read information contained in a bar code . A barcode reader consists of a scanner , a decoder (either built-in or external), and a cable used to connect the reader with a computer.
- ✓ Because a barcode reader merely captures and translates the barcode into numbers and/or letters, the data must be sent to a computer so that a software application can make sense of the data. Barcode scanners can be connected to a computer through a serial port , keyboard port , or an interface device called a wedge .
- ✓ A barcode reader works by directing a beam of light across the bar code and measuring the amount of light that is reflected back. (The dark bars on a barcode reflect less light than the white spaces between them.) The scanner converts the light energy into electrical energy, which is then converted into data by the decoder and forwarded to a computer.

Card reader

- ✓ A card reader is a hardware device that can read and write to a memory card or memory stick. It is often used to deliver data to computers or other devices for display and/or storage purposes. In the most basic sense, a card reader is used to access the contents of a memory card in a given format and passes them on to another device.
- ✓ Often, the memory card or stick shows up as a "mounted drive" on a computer or device. One of the biggest aspects of designing card readers is the range of drivers and software solutions needed to achieve the conversion from one format to another.
- ✓ The methods and strategies used in such conversion vary from one product to another, but, overall, manufacturers have made improvements in making USB card readers and other devices consistently universal, so that most recipient devices can recognize and read the data from a portable card or stick.

Digitizer:

- ✓ A digitizer tablet is a peripheral device that allows users to draw on a computer screen. Tablets are typically used by artists working with graphics software such as Adobe Photoshop or Illustrator. Tablets allow for much more precise control than a mouse or trackball does by using a stylus like a pen. A digitizer tablet is also known as a graphics tablet.
- ✓ A digitizer tablet allows people working with graphics a way to easily draw and manipulate graphics on the screen. There are many these tablets on the market.
- ✓ Wacom is one of the best-known manufacturers of these graphics tablets. Tablets are used with paint, photo manipulation and animation programs.
- ✓ Tracing over a paper document, such as a drawing or blueprint, is known as “digitizing.”

Voice recognition

- ✓ Voice recognition is a technique in computing technology by which specialized software and systems are created to identify, distinguish and authenticate the voice of an individual speaker.
- ✓ Voice recognition evaluates the voice biometrics of an individual, such as the frequency and flow of their voice and their natural accent.
- ✓ Voice recognition is also known as speaker recognition. Voice recognition powered systems are primarily designed to recognize the voice of the person speaking. Before being able to recognize the voice of the speaker, voice recognition techniques require some training in which the underlying system will learn the voice, accent and tone of the speaker.

- ✓ This is generally accomplished through a series of textual words and statements that the person has to speak through the built-in or external microphone.

Web camera:

- ✓ A webcam is a small digital video camera directly or indirectly connected to a computer or a computer network. Webcams come with software that needs to be installed on the computer to help users record video on or stream it from the Web.
- ✓ Webcams are capable of taking pictures as well as high-definition videos, although the video quality can be lower compared to other camera models. Webcams are also known as Web cameras.

Digital cameras:

- ✓ A digital camera uses an electronic image sensor to create still photographs and record video. The optical system of a digital camera works like a film camera, in which a typical lens and diaphragm are used to adjust electronic image sensor lighting.
- ✓ Digital cameras equip amateur and professional photographers with multiple automated control functions. Advanced digital cameras facilitate manual control of most functions.
- ✓ A digital camera is also known as a digicam.
- ✓ Digital cameras are integrated with a wide range of digital devices, ranging from personal digital assistants (PDA) and mobile phones to the Hubble and Webb Space Telescopes. Digital photography is adaptable and compatible with email, CD/DVD, TV and computer monitors, the Web and may be stored on a PC. Some digital cameras have a built-in GPS receiver, which is used to produce geotagged photographs.

Optical character recognition (OCR):

- ✓ Optical character recognition (OCR) refers to both the technology and process of reading and converting typed, printed or handwritten characters into machine-encoded text or something that the computer can manipulate.
- ✓ It is a subset of image recognition and is widely used as a form of data entry with the input being some sort of printed document or data record such as bank statements, sales invoices, passports, resumes and business cards.
- ✓ The document is either scanned or a picture is taken and it is up to the program to recognize the characters and give an output in the form of a text document.
- ✓ Optical character recognition is the recognition of language-specific characters by a computer by analyzing an image, which is already computer-readable. This is often done by taking an image of the document first by scanning it or taking a digital picture.
- ✓ This creates a raster image made up of data that the computer understands, and through specifically programmed algorithms, most of which are used in the field of artificial intelligence, the computer recognizes the patterns in the image, and in this case the patterns are characters.
- ✓ The program then creates or outputs character codes, usually ASCII, that are equivalent to the recognized characters from the input image.
- ✓ Most OCR programs must be trained in order for them to become better at recognizing characters.

Optical mark recognition (OMR):

- ✓ Optical mark recognition (OMR) is an electronic method of gathering human-handled data by identifying certain markings on a document.

- ✓ Usually the optical mark recognition process is achieved with the aid of a scanner that checks the transmission or reflection of light through the paper; places having markings will reflect less light than the blank paper, resulting in less contrasting reflectivity.
- ✓ Optical mark recognition is also known as optical mark reading or, more commonly, by the brand name Scantron.
- ✓ Optical mark recognition technology extracts useful data from marked fields such as fill-in fields and checkboxes very quickly and with great accuracy. The most common use of OMR is in offices, academics and research departments where large numbers of hand-filled documents must be processed such as surveys, questionnaires, exams, reply cards and ballots.
- ✓ OMR can handle hundreds of thousands of physical documents per hour, and its accuracy is up to 99%. A common example is the use of standardized forms in schools where students have to fill in a predefined mark on the sheet, serving as a mark for the optical mark recognition algorithm.

Intelligent character recognition (ICR):

- ✓ Intelligent character recognition (ICR) is a computer-based interpretation of handwritten or printed characters so that they can be transcribed into a standardized format that can be recognized and understood by a computer.
- ✓ ICR and optical character recognition (OCR) have essentially the same meaning. Before these technologies were developed, written text was transformed into digital form by a data entry specialist, who continually typed written text with a keyboard.OCR/ICR technologies have since been substituted for older manual methods.
- ✓ The most common input device for characters in written, nondigital form is a scanner. These characters are processed by a digital signal processing-based (DSP-based) program, which compares characters within a stored database. This process is typically followed by a confirmation process based on a built-in dictionary that suggests matches closest to the entered characters.

Magnetic ink character (MICR):

- ✓ Magnetic ink character recognition (MICR) is a character-distinguishing technology that makes use of special magnetized ink. It is largely used in banks and other organizations where security is a high priority. Important documents such as checks and vouchers are printed using magnetic ink. A laser printer with MICR toner can print magnetic ink.
- ✓ The information found at the bottom of the checks containing the check number, sort number and account number is usually printed in magnetic ink. When a document (such as bank checks and drafts) containing this magnetic ink is to be processed, it is passed through a machine which magnetizes the ink, and then special character information is extracted and translated in the form of characters.
- ✓ MICR provides a protected and fast technique of scanning and processing information. The use of MICR can increase security and protection as well as reduce the risk of loss due to identity theft crimes.

OUTPUT DEVICES

- ❖ An output device is any device used to send data from a computer to another device or user. Most computer data output that is meant for humans is in the form of audio or video.
- ❖ Thus, most output devices used by humans are in these categories.
- ❖ Examples include monitors, projectors, speakers, headphones and printers.

Monitors:

- ✓ A monitor is an electronic visual computer display that includes a screen, circuitry and the case in which that circuitry is enclosed. Older computer monitors made use of cathode ray tubes (CRT), which made them large, heavy and inefficient.

- ✓ Nowadays, flat-screen LCD monitors are used in devices like laptops, PDAs and desktop computers because they are lighter and more energy efficient.

Classification of Monitors – Based on color:

Monochrome Monitor: Monochrome is a legacy computer display system that only displays one or two colors with several shades. Monochrome relies on two main colors - often black and white - as well as all the shades in between. The colors in a monochromatic monitor depend on the type of phosphorus used in the monitor's display tube.

Gray –scale: Grayscale is the collection or the range of monochromic (gray) shades, ranging from pure white on the lightest end to pure black on the opposite end. **Gray Scale**, a progressive series of shades ranging from black through white. Gray scales are used in computer graphics to add detail to graphical images. The number of shades of gray depends on the number of bits used to describe the "color" of each pixel (dot) in the image.

Color: A display monitor capable of displaying many colors. In contrast, a monochrome monitor can display only two colors -- one for the background and one for the foreground. Color monitors implement the RGB color model by using three different phosphors that appear **r**ed, **g**reen, and **b**lue when activated. By placing the phosphors directly next to each other, and activating them with different intensities, color monitors can create an unlimited number of colors. In practice, however, the real number of colors that any monitor can display is controlled by the video adapter.

Classification of monitors – Based on signals:

Digital Monitor: A monitor that accepts digital rather than analog signals. All monitors (except flat-panel displays) use CRT technology, which is essentially analog. The term *digital*, therefore, refers only to the type of input received from the video adapter. A digital monitor then translates the digital signals into analog signals that control the actual display.

Although digital monitors are fast and produce clear images, they cannot display continuously variable colors. Consequently, only low-quality video standards, such as *MDA* , *CGA* , and *EGA* , specify digital signals. *VGA* and *SVGA*, on the other hand, require an analog monitor. Some monitors are capable of accepting either analog or digital signals.

Analog Monitor: The traditional type of color display screen that has been used for years in televisions. In reality, all monitors based on CRT technology (that is, all monitors except *flat-panel displays*) are analog. Some monitors, however, are called *digital monitors* because they accept digital signals from the video adapter. EGA monitors, for example, must be digital because the EGA standard specifies digital signals. Digital monitors must nevertheless translate the signals into an analog form before displaying images. Some monitors can accept both digital and analog signals. Some analog monitors are also called digital because they support digital controls for adjusting the display.

Most analog monitors are multi frequency monitors, which means that they are designed to accept signals at two or more preset frequency levels.

Characteristics of a monitor:

Following are the characteristics of a monitor:

a) **Size:** The most important aspect of a monitor is its size. Screen sizes are measured in diagonal inches, the distance from one corner to another opposite corner diagonally.

b) **Resolution:** The resolution of a monitor indicates how density the pixels are packed. Pixel is short for picture element. A pixel is a single point in a graphic image. Graphic monitors display pictures by dividing the display screen into millions of pixels arranged in rows and columns. On color monitor each pixel is actually composed of three dots namely a red, a green, and a blue. The quality of a display monitor largely depends on its resolution.

c) **Band Width:** The amount of data that can be transmitted in a fixed amount of time. For digital devices, the band width is usually expressed in bits or bytes per second (bps). For analog devices it is expressed in cycle per second or Hertz (Hz).

d) **Refresh Rate:** Display monitors must be refresh many times per second. The refresh rate determines how many times per seconds the screen is to be red drawn. The refresh rate of a monitor is measured in Hertz. The faster the refresher is, the less the monitor flickers.

e) **Interlacing:** It is a technique in which instead of scanning the image one line at a time, it scans alternately i.e. alternate lines are scanned at each pass. It is used to keep band width down. Since inter leaked displaced have been reported to be more flickery, with better technology available, most monitors are non interlaced now.

f) **Dot per Inch:** It is measured for the actual sharpness of the on screen image. This depends on both the resolution & the size of the image. Practical experience shows that a smaller screen has a sharper image at the same resolution than does a large screen. This is because it will require more dots per inch to display the same number of pixels.

g) **Dot Pitch:** A measurement that indicates the vertical distance between each pixel on a display screen. It is measured in millimeter. The dot pitch is one of the principle characteristics that determine the quality of display monitors.

h) **Convergence:** It refers to how sharply an individual colour pixel on a monitor appears. Each pixel is composed of three dots namely a red, a green and a blue. If the dots are badly mis converged, the pixel will appear blurry.

Video standard:

- ✓ There are a variety of video standards that define the resolution and colors for displays. Support for a graphics standard is determined both by the monitor and by the video adapter.
- ✓ The monitor must be able to show the resolution and colors defined by the standard, and the video adapter must be capable of transmitting the appropriate signals to the monitor.

VGA

- ❖ The oldest standard is VGA. It stands for Video Graphics Array and was introduced by IBM in 1987.It has been improved since then to allow for more pixels and better performance.
- ❖ This is an Analog display standard, so cabling, and distance can degrade the quality of the output. Generally speaking, newer monitors will look better using a digital standard.

SVGA:

- ❖ A Super Video Graphics Array (SVGA) monitor is an output device which uses the SVGA standard. SVGA is a video-display-standard type developed by the Video Electronics Standards Association (VESA) for IBM PC compatible personal computers (PCs).
- ❖ SVGA includes an array of computer display standards utilized for the manufacturing of computer monitors and screens. It features a screen resolution of 800x600 pixels.
- ❖ Monitors that use the SVGA graphic standard are intended to perform better than normal VGA monitors.

PRINTER:

- ✓ A **printer** is an external hardware output device that takes the electronic data stored on a computer or other device and generates a hard copy of it.
- ✓ For example, if you created a report on your computer you could print several copies to hand out at a staff meeting.
- ✓ Printers are one of the most popular computer peripherals and are commonly used to print text and photos.

Dot Matrix Printer :

- o It prints characters as combination of dots. Dot matrix printers are the most popular among serial printers. These have a matrix of pins on the print head of the printer which form the character.

- The computer memory sends one character at a time to be printed by the printer. There is a carbon between the pins & the paper.
- The words get printed on the paper when the pin strikes the carbon. There are generally 24 pins.

Daisy wheel printer:

- A daisy wheel printer is a specific type of mechanical impact printer popular in the 1970s that used individual letter, number and symbol keys to imprint text on paper.
- This innovation on the electric typewriter became popular for its speed and quality, but later fell out of fashion in the 1990s.
- Part of the appeal of a daisy wheel printer was that it would produce what was called "letter-quality" print.
- Another popular type of printer of that time, the dot matrix printer, usually did not produce letter-quality text, but produced a rather rough output of text characters generated by sequences of small dots.
- Because the daisy wheel printer used a letter-quality imprint, the print results were letter quality.
- However, in the 1980s, manufacturers started coming up with laser printers and inkjet printers that would provide letter-quality printing, and daisy wheel printers largely became obsolete.

Ink-jet printer:

- Inkjet printers are a category of printer in which printing is done with the help of inkjet technology.
- The technology works by spraying ionized ink directed by magnetic plates onto the paper, which is fed through the printer.
- As inkjet printers are more affordable than other types of printers, they are commonly used as home and business printers.
- An inkjet printer consists of a print head, ink cartridges, paper feed assembly, belt and stabilizer bar. Inkjet printers are capable of creating high-quality images and high-resolution photos with vivid colors.
- They can work with most types of papers, although they work best with high-quality papers.
- Inkjet printers have many advantages. Compared to most printers, they are affordable and easy to use. Similar to laser printers, inkjet printers are inherently quiet.
- They are great image printers and are quick starters. They are ready to print and do not require any warm-up time. They are also compact, generally requiring less space.
- With these features, they are more popular as home printers.

Laser printer:

- A laser printer is a type of printer that uses a laser and electrical charge model instead of the traditional printing of ink onto paper.
- Laser printers have increased the neatness and sophistication of print projects, with typical resolutions of 600 dots per inch or higher.
- In a laser print operation, a laser beam fires on a mechanical cylinder known as a photoreceptor.
- This results in a pattern on the photoreceptor that gets coated with toner. Because of electrical charges, the toner sticks to the paper in patterns that are dictated by the software used to print.
- Finally, the paper is heated in order to fuse the toner to the paper.

Plotter:

- A plotter is a computer vector graphic printer that gives a hard copy of the output based on instructions from the system. Plotters are widely used to print designs of things such as cars, ships and buildings on a piece of paper using a pen. Plotters are different than a printer in that they are more precise and they are most commonly used in engineering, where precision is mandatory. They are also more expensive than ordinary printers.

Sound card and speakers

- ✓ A sound card is an expansion component used in computers to receive and send audio. Sound cards are configured and utilized with the help of a software application and a device driver. The input device attached to receive audio data is usually a microphone, while the device used to output audio data is generally speakers or headphones.
- ✓ The sound card converts incoming digital audio data into analog audio so that the speakers can play it. In the reverse case, the sound card can convert analog audio data from the microphone into digital data that can be stored on the computer and altered using audio software.

A **speaker** is a term used to describe the user who is giving vocal commands to a software program.
A **computer speaker** is a hardware device that connects to a computer to generate sound. The signal used to produce the sound that comes from a computer speaker is created by the computer's sound card.

UNIT II
INTRODUCTION TO COMPUTER SOFTWARE

- ❖ A computer needs both hardware and software for its proper functioning. By the system consists of hardware, the electronic devices that are capable of computing and manipulating information, and software (set of instructions) that carries out predefined tasks to complete a given job.

Introduction to Computers Software:

- ❖ Computer software is anything that can be stored electronically. The term is used to contrast with computer hardware (the physical objects); unlike hardware, software cannot be touched. Hardware and software require each other and neither has any value without the other.
- ❖ Software refers to the computer programs and data held in the storage of the computer. In other words, software is a set of programs, procedures, algorithms and its documentation concerned with the operation of a data processing system.
- ❖ On most computer platforms, software can be grouped into two broad categories:

System software is the basic software needed for a computer to operate (most notably the Operating System) including: DOS, Windows, UNIX, Linux, Mac OS, etc. Is all the software that uses the computer system to perform useful work beyond the operation of the computer itself.

Application software

Examples of common applications are: word processor, spreadsheet, database, Internet browser, email, games, etc. Data is all the documents and files that are created or manipulated by application software, including documents, spreadsheets, pictures, movies, etc.

HARDWARE/SOFTWARE INTERACTION

Software:

- o The entire computer software can be broadly categorized into three types: Device Drivers, Operating System, and Application Software.
- o Simply all these types encompass the totality of the programs present in your computer. Generally each and every program has its specific task to perform.
- o For that matter, the entire program is a set of instructions that are written to alter the state of hardware. Before actually getting into how these instructions affect the hardware here's something you need to understand about computer hardware.

Hardware:

- o The Monitor, Printer, Hard Drive, RAM, Graphic Card and all the other physical components which are connected to the computer (or) which can be physically touched is the computer hardware. Without hardware, software has no idea where to work on. Hence hardware and software run hand in hand for implementing whatever the user wants.
- o An interrupt is a programmer set of steps that the CPU follows, such as adding two numbers.
- o The results are returned to the computer's memory and program tells the CPU what do next.

- The following steps happen in sequence:

- Once a programmer has decided how to solve a problem, they need to write the solution out in a valid programming language. Source code is the program created in a human-readable format.
- This "human-readable" format cannot be directly run by the computer, so when go to run the program a compiler must first be used to translate the source code into executable code.
- The compiler translates the source code into another format, one which the computer can run or execute. Source code is generally portable whereas executables rely on machine-specific information. Executable programs are stored on secondary storage.
- To execute a program it must be copied into main memory, and space set aside for variables, subroutine calls, etc. Every individual instruction, and every piece of data, exists at some unique location in memory. To execute a program, the computer keeps track of the memory address of the next instruction it must execute.

Fetch-Decode-Execute Cycle:

Fetch:

-Instructions pulled from memory and stored in main memory.
-Program Counter (a register) stores the address location of the instruction
-Program Counter and instructions are placed in the Instruction Register (IR)
-Program Counter is incremented by 1

Decode:

-Decoder interprets the opcode/function of the instruction within the IR
-Here the data from main memory are placed into registers (MDR and MAR)

Execute:

- CPU will execute the instructions that are placed inside the registers

Summary of the fetch-decode-execute cycle

1. The processor checks the program counter to see which instruction to run next.
2. The program counter gives an address value in the memory of where the next instruction is.
3. The processor fetches the instruction value from this memory location.
4. Once the instruction has been fetched, it needs to be decoded and executed. For example, this could involve taking one value, putting it into the ALU, then taking a different value from a register and adding the two together.
5. Once this is complete, the processor goes back to the program counter to find the next instruction.
6. This cycle is repeated until the program ends.

CLASSIFICATION OF SOFTWARE:

Software can be applied in countless fields such as business, education, social sector, and other fields. It is designed to suit some specific goals such as data processing, information sharing, communication, and so on. It is classified according to the range of potential of applications. These classifications are listed below.

System software: This class of software manages and controls the internal operations of a computer system. It is a group of programs, which is responsible for using computer resources efficiently and effectively.

For example, an operating system is a system software, which controls the hardware, manages memory and multitasking functions, and acts as an interface between application programs and the computer.

Applications Software or **simply applications:** They are often called productivity programs or end-user programs because they enable the user to complete tasks, such as creating documents, spreadsheets, databases and publications, doing online research, sending email, designing graphics, running businesses, and even playing games! Application software is specific to the task it is designed for and can be as simple as a calculator application or as complex as a word processing application.

OPERATING SYSTEM:

- The **o***perating* **s***ystem (***OS***)* is the most important program that runs on a computer.
- Every general-purpose computer must have an operating system to run other programs and applications.
- Computer operating systems perform basic tasks, such as recognizing input from the keyboard, sending output to the display screen, keeping track of files and directories on the storage drives, and controlling peripheral devices, such as printers.

UTILITIES:

- A program that performs a very specific task, usually related to managing system resources. Operating systems contain a number of utilities for managing disk drives, printers, and other devices.
- Utilities differ from applications mostly in terms of size, complexity and function.
- For example, word processors, spreadsheet programs, and database applications are considered applications because they are large programs that perform a variety of functions not directly related to managing computer resources.

COMPILERS AND INTERPRETER:

- Compiler and Interpreter are two different ways to execute a program written in a programming or scripting language.
- A compiler takes entire program and converts it into object code which is typically stored in a file. The object code is also refereed as binary code and can be directly executed by the machine after linking. Examples of compiled programming languages are C and C++.
- An Interpreter directly executes instructions written in a programming or scripting language without previously converting them to an object code or machine code.
- Examples of interpreted languages are Perl, Python and Matlab.

WORD PROCESSOR

- A word processor is software or a device that allows users to create, edit, and print documents.
- It enables you to write text, store it electronically, display it on a screen, modify it by entering commands and characters from the keyboard, and print it.
- Of all computer applications, word processing is the most common.
- Today, most word processors are delivered either as a cloud service or as software that users can install on a PC or other device.

Basic capabilities of word processor:

- Word processors vary considerably, but all word processors, whether cloud-based or installed on a system, support the following basic features:

1. **insert text:** Allows you to insert text anywhere in the document.
2. **delete text:** Allows you to erase characters, words, lines, or pages.
3. **cut and paste:** Allows you to remove (cut) a section of text from one place in a document and insert (paste) it somewhere else.
4. **copy:** Allows you to duplicate a section of text.
5. **page size and margins:** Allows you to define various page sizes and margins, and the word processor will automatically readjust the text so that it fits.
6. **search and replace:** Allows you to direct the word processor to search for a particular word or phrase. You can also direct the word processor to replace one group of characters with another everywhere that the first group appears.
7. **word wrap:** Automatically moves to the next line when you have filled one line with text, and it will readjust text if you change the margins.

8. **print:** Allows you to send a document to a printer to get hard copy.
9. **file management:** Provides file management capabilities that allow you to create, delete, move, and search for files.
10. **font specifications:** Allows you to change fonts within a document. For example, you can specify bold, italics, and underlining. Most word processors also let you change the font size and even the typeface.
11. **windows*:*** Allows you to edit two or more documents at the same time. Each document appears in a separate window. This is particularly valuable when working on a large project that consists of several different files.
12. **spell checking*:*** Identifies words that don't appear in a standard dictionary.

Advanced features of word processor:

- Most installable modern word processor software supports additional features that enable you to manipulate and format documents in more sophisticated ways. Full-featured word processors usually support the following advanced features, and cloud-based word processors may have some of these features as well:

1. **grammar checking***:* Identifies sentences, paragraphs, and punctuation that doesn't appear to meet commonly recognized rules of grammar.
2. **footnotes and cross-references:** Automates the numbering and placement of footnotes and enables you to easily cross-reference other sections of the document.
3. **automated lists:** Automatically creates bulleted or numbered lists, including multi-level outlines.
4. **graphics*:*** Allows you to embed illustrations, graphs, and possibly even videos into a document. Some word processors let you create the illustrations within the word processor; others let you insert an illustration produced by a different program.
5. **headers, footers, *and page numbering:*** Allows you to specify customized headers and footers that the word processor will put at the top and bottom of every page. The word processor automatically keeps track of page numbers so that the correct number appears on each page.
6. **layout*:*** Allows you to specify different margins within a single document and to specify various methods for indenting paragraphs.
7. **macros*:*** Enables users to define and run macros, a character or word that represents a series of keystrokes. The keystrokes can represent text or commands. The ability to define macros allows you to save yourself a lot of time by replacing common combinations of keystrokes.
8. **merge:** Allows you to merge text from one file into another file. This is particularly useful for generating many files that have the same format but different data. Generating mailing labels is the classic example of using merges.
9. **tables of contents and indexes:** Allows you to automatically create a table of contents and index based on special codes that you insert in the document.
10. **thesaurus:** Allows you to search for synonyms without leaving the word processor.
11. **collaboration*:*** Allows users to track changes to the document when more than one person is editing. Some cloud-based word processors also allow multiple users to edit the same document at the same time.
12. **Internet features:** Allows users to embed Web links into their documents and format their documents for the Web. Some also link to Web services that can help users create their documents.
13. **translation and speech:** As artificial intelligence capabilities become more commonplace, some word processors have gained the ability to read text aloud, to accept voice commands, and to translate text from one language to another.

SPREADSHEETS

- A spreadsheet is a software application that enables a user to save, sort and manage data in an arranged form of rows and columns.
- A spreadsheet stores data in a tabular format as an electronic document.
- An electronic spreadsheet is based on and is similar to the paper-based accounting worksheet.
- A spreadsheet may also be called a worksheet.
- A spreadsheet is primarily designed to provide a digital form of the paper-based worksheet.
- Spreadsheets work through spreadsheet application software.
- The rows and columns within the spreadsheet contain cells that are filled with data to create unique operations.
- A typical spreadsheet program can have multiple functions such as:
    1. Numerous rows and columns for data and values storage
    2. Support for mathematical formulas and calculations
    3. Data sorting and analysis
    4. Multiple worksheets and their interlinking
    5. Integration and visualization of data in the form of graphs and charts

Advantage and drawback of spreadsheet:

Advantages

- 'What-if' questions can be asked without rebuilding a model from scratch each time a test is run.
- Automatic re-calculation: if a change is made then all related formulae and values change.
- Graphs can be produced: values are changed on the graph as any other values change.
- Variables and constants can be used: the entire model can be changed by changing one value.
- The model can be saved and backed up: if the original becomes lost or corrupted, there will be a spare copy.
- The model can be shared between different people in different locations.
- No additional software is required: standard business software. No specialist training is needed.
- It might be quicker and cheaper to build a computer model than a physical model.
- Only one model needs to be build which can then be changed. If a physical model was made, a new one would need to be built every time a change is made.
- It's a lot safer to run a simulation under extreme conditions than to build the actual model and test it.
- Computer-based models can be speeded up or slowed down to see effects that are difficult to see n real life.

Disadvantages

- The model may not be an accurate representation of the real world. The real world is complex.
- If the model relates to people then an accurate result may not be given. For example, if a model is constructed to show the time taken to evacuate a building it might not take into account the fact that people panic.
- Many variables may need to be considered and it is easy to miss things out! This may lead to misleading results.
- Producing an effective model may be time consuming and running the model may need expensive hardware and software.

IMAGE PROCESSORS

- **Image processing** is a method to convert an image into digital form and perform some operations on it, in order to get an enhanced image or to extract some useful information from it.
- It is a type of signal dispensation in which input is image, like video frame or photograph and output may be image or characteristics associated with that image.

Paint programs:

- ✓ A graphics program that enables you to draw pictures on the display screen which are represented as bit maps (bit-mapped graphics). In contrast, *draw programs* use vector graphics (object-oriented images), which scale better.
- ✓ Most paint programs provide the *tools* shown below in the form of icons. By selecting an icon, you can perform functions associated with the tool.
- ✓ In addition to these tools, paint programs also provide easy ways to draw common shapes such as straight lines, rectangles, circles, and ovals. Sophisticated paint applications are often called *image editing programs*.
- ✓ These applications support many of the features of draw programs, such as the ability to work with objects. Each object, however, is represented as a bit map rather than as a vector image.

Draw programs:

- ✓ A graphics program used for creating illustrations. It maintains an image in vector graphics format, which allows all elements of the picture to be isolated, moved and scaled independent of the others.
- ✓ Drawing programs and CAD programs are similar; however, drawing programs usually provide a large number of special effects for fancy illustrations, while CAD programs provide precise dimensioning and positioning of each graphic element in order that the objects can be transferred to other systems for engineering analysis and manufacturing. Adobe Illustrator and Corel DRAW are popular drawing programs. Contrast with paint program. See graphics and diagramming program.

Image Editors:

- ✓ Image editing refers to modifying or improving digital or traditional photographic images using different techniques, tools or software.
- ✓ Images produced by scanners, digital cameras or other image-capturing devices may be good, but not perfect.
- ✓ Image editing is done to create the best possible look for the images and also to improve the overall quality of the image according to different parameters.

PROGRAMMING LANGUAGES

- ❖ A programming language is a computer language engineered to create a standard form of commands. These commands can be interpreted into a code understood by a machine.
- ❖ Programs are created through programming languages to control the behavior and output of a machine through accurate algorithms, similar to the human communication process.
- ❖ A programming language is also known as a programming system, computer language or computer system.

Types of Programming Languages:

- ❖ There are two **types of programming languages**, which can be categorized into the following ways:

1. **Low level language**
   - *a) Machine language (1GL)*
   - *b) Assembly language (2GL)*
2. **High level language**
   - *a) Procedural-Oriented language (3GL)*
   - *b) Problem-Oriented language (4GL)*
   - *c) Natural language (5GL)*

Low level language

- This language is the most understandable language used by computer to perform its operations.

It can be further categorized into:

a) Machine Language (1GL)

❖ Machine language consists of strings of binary numbers (i.e. 0s and 1s) and it is the only one language, the processor directly understands.
❖ Machine language has an Merits of very fast execution speed and efficient use of primary memory.

Merits:

✓ It is directly understood by the processor so has faster execution time since the programs written in this language need not to be translated.
✓ It doesn't need larger memory.

Demerits:

✓ It is very difficult to program using 1GL since all the instructions are to be represented by 0s and 1s.
✓ Use of this language makes programming time consuming.
✓ It is difficult to find error and to debug.
✓ It can be used by experts only.

b) Assembly Language

❖ Assembly language is also known as low-level language because to design a program programmer requires detailed knowledge of hardware specification.
❖ This language uses mnemonics code (symbolic operation code like 'ADD' for addition) in place of 0s and 1s.
❖ The program is converted into machine code by assembler.
❖ The resulting program is referred to as an object code.

Merits:

✓ It is makes programming easier than 1GL since it uses mnemonics code for programming. Eg: ADD for addition, SUB for subtraction, DIV for division, etc.
✓ It makes programming process faster.
✓ Error can be identified much easily compared to 1GL.
✓ It is easier to debug than machine language.

Demerits:

✓ Programs written in this language is not directly understandable by computer so translaters should be used.
✓ It is hardware dependent language so programmers are forced to think in terms of computer's architecture rather than to the problem being solved.
✓ Being machine dependent language, programs written in this language are very less or not portable.
✓ Programmers must know its mnemonics codes to perform any task.

High level language

- Instructions of this language closely resembles to human language or English like words.
- It uses mathematical notations to perform the task.
- The high level language is easier to learn. It requires less time to write and is easier to maintain the errors.
- The high level language is converted into machine language by one of the two different languages translator programs; **interpreter or compiler.**

The examples of high-level languages are:

- Fortran
- COBOL
- Basic
- Pascal
- C
- C++
- Java

High level language can be further categorized as:

a) Procedural-Oriented language (3GL)

- Procedural Programming is a methodology for modeling the problem being solved, by determining the steps and the order of those steps that must be followed in order to reach a desired outcome or specific program state.
- These languages are designed to express the logic and the procedure of a problem to be solved.
- It includes languages such as Pascal, COBOL, C, FORTAN, etc.

Merits:

- ✓ Because of their flexibility, procedural languages are able to solve a variety of problems.
- ✓ Programmer does not need to think in term of computer architecture which makes them focused on the problem.
- ✓ Programs written in this language are portable.

Demerits:

- ✓ It is easier but needs higher processor and larger memory.
- ✓ It needs to be translated therefore its execution time is more.

b) Problem-Oriented language (4GL)

- It allows the users to specify what the output should be, without describing all the details of how the data should be manipulated to produce the result.
- This is one step ahead from 3GL. These are result oriented and include database query language.

Eg: Visual Basic, C#, PHP, etc.

The objectives of 4GL are to:

- Increase the speed of developing programs.
- Minimize user's effort to botain information from computer.
- Reduce errors while writing programs.

Merits:

✓ Programmer need not to think about the procedure of the program. So, programming is much easier.

Demerits:

✓ It is easier but needs higher processor and larger memory.
✓ It needs to be translated therefore its execution time is more.

c) Natural language (5GL)

❖ Natural language are still in developing stage where we could write statements that would look like normal sentences.

Merits:

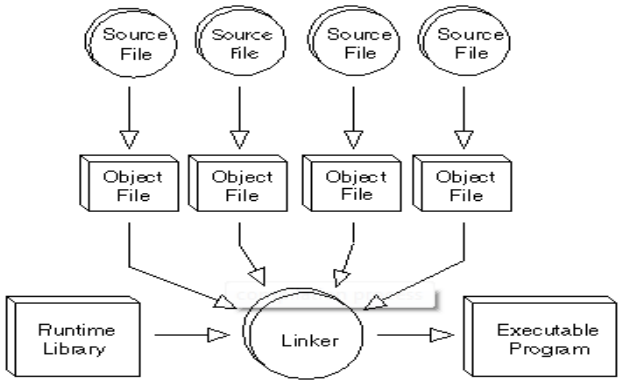
✓ Easy to program.
✓ Since, the program uses normal sentences, they are easy to understand.
✓ The programs designed using 5GL will have artificial intelligence (AI).
✓ The programs would be much more interactive and interesting.

Demerits:

✓ It is slower than previous generation language as it should be completely translated into binary code which is a tedious task.
✓ Highly advanced and expensive electronic devices are required to run programs developed in 5GL. Therefore, it is an expensive approach.

COMPILATION PROCESS:

❖ To transform a program written in a high-level programming language from *source code* into *object code*. Programmers write programs in a form called source code.
❖ Source code must go through several steps before it becomes an executable program.
❖ The first step is to pass the source code through a *compiler*, which translates the high-level language instructions into object code. The final step in producing an executable program -- after the compiler has produced object code is to pass the object code through a *linker*.
❖ The linker combines modules and gives real values to all symbolic addresses, thereby producing machine code.



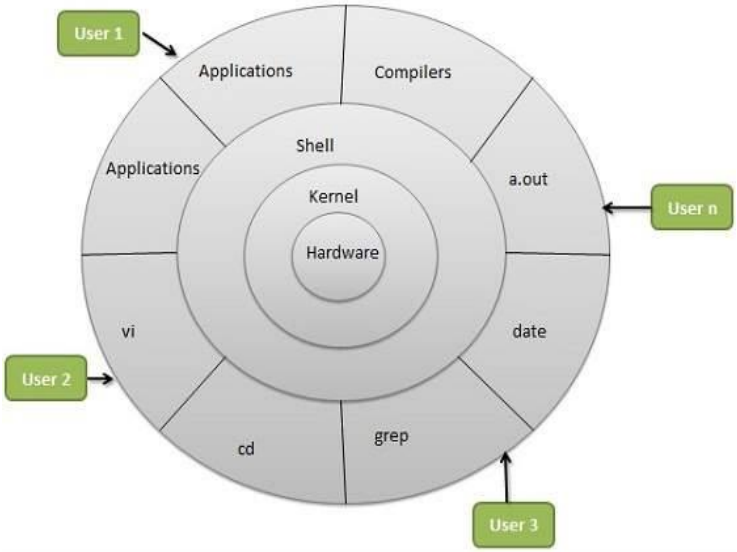
OPERATING SYSTEMS

- An operating system, or "OS," is software that communicates with the hardware and allows other programs to run. It is comprised of system software, or the fundamental files your computer needs to boot up and function. Every desktop computer, tablet, and smartphone includes an operating system that provides basic functionality for the device.
- Common desktop operating systems include Windows, OS X, and Linux. While each OS is different, most provide a graphical user interface, or GUI, that includes a desktop and the ability to manage files and folders.
- They also allow you to install and run programs written for the operating system. Windows and Linux can be installed on standard PC hardware, while OS X is designed to run on Apple systems.
- Therefore, the hardware you choose affects what operating system(s) you can run.

The Operating System is a program with the following features −

- An operating system is a program that acts as an interface between the software and the computer hardware.
- It is an integrated set of specialized programs used to manage overall resources and operations of the computer.
- It is a specialized software that controls and monitors the execution of all other programs that reside in the computer, including application programs and other system software.

Functions of Operating System:



Function of an Operating System:

Job management:

- The job management function of an OS prepares, schedules, controls, and monitors jobs submitted for execution to ensure the most efficient processing.
- A job is a collection of one or more related programs and their data.

Batch processing:

- System software is available to support the different methods of processing a job, with batch processing, the most basic method, and data are accumulated and processed in groups.
- Payroll applications, for example are often processed this way. Once in every week, hourly records are grouped and the payroll software is run.

Online processing:

- In online processing data are processed instantaneously. For example, a sales person may need to find out whether a particular item requested by a customer is in stock for immediate shipment.
- It is an individual processing system in which the task is processed on individual basis as soon as they are provided by the user.
- It has features like:
  1. Individual task is processed at a time
  2. User can provide input in between processing
  3. It is appropriate when all inputs ate not known in advance
  4. It doesn't require large memory
  5. CPU ideal time is more
  6. Monitor is appropriate output device
  7. It is modern processing technique and mostly used in present

Data Management:

- The data management functions of an OS govern the input and output of the data and their location, storage, and retrieval

Virtual Storage:

- If there are programs larger than main memory (RAM) of the computer, OS uses the reserved space in the secondary memory which is termed as virtual memory.
- It makes the execution of larger program (than RAM) possible but at the same times the operation becomes slower.

I/O Management:

- OS manages I/O devices and makes the I/O process effective.
- OS accepts the input from the input device, stores it in the main memory, ask the CPU to process it and finally provides the result to the output devices for output.

Classification of operating system:

i) Multiuser OS:

- In a multiuser OS, more than one user can use the same system at a same time through the multi I/O terminal or through the network. For example: windows, Linux, Mac, etc.
- A multiuser OS uses timesharing to support multiple users.

ii) Multiprocessing OS:

- A multiprocessing OS can support the execution of multiple processes at the same time. It uses multiple number of CPU.
- It is expensive in cost however, the processing speed will be faster. It is complex in its execution. Operating system like Unix, 64 bit edition of windows, server edition of windows, etc. are multiprocessing.

iii) Multiprogramming OS:

- In a multiprogramming OS more than one programs can be used at the same time.
- It may or may not be multiprocessing. In a single CPU system , multiple program are executed one after another by dividing the CPU into small time slice. Example: Windows, Mac, Linux,etc.

iv) Multitasking OS:

- In a multitasking system more than one task can be performed at the same time but they are executed one after another through a single CPU by time sharing.
- For example: Windows, Linux, Mac, Unix, etc.
- Multitasking OS are of two types:

  a)Pre-emptive multitasking

  b) Co-operative multitasking.

  In the pre-emptive multitasking, the OS allows CPU times slice to each program. After each time slice, CPU executes another task.

  Example: Windows XP

v) Multithreading:

- A program in execution is known as process. A process can be further divided into multiple sub-processers. These sub-processers are known as threads.
- A multi-threading OS can divide process into threads and execute those threads. This increases operating speed but also increases the complexity.
- For example: Unix, Server edition of Linux and windows.

Mainframe Systems

Reduce setup time by batching similar jobs Automatic job sequencing – automatically transfers control from one job to another. First rudimentary operating system. Resident monitor

- initial control in monitor
- control transfers to job
- when job completes control transfers to monitor

Sever operating system:

- A server operating system (OS) is a type of operating system that is designed to be installed and used on a server computer. It is an advanced version of an operating system, having features and capabilities required within a client-server architecture or similar enterprise computing environment.

Desktop operating system

- The control program in a user's machine (desktop or laptop). Also called a "client operating system," Windows is the overwhelming majority while the Macintosh comes second.
- There are also several versions of Linux for the desktop.

Real-time operating system (RTOS)

- Real-time operating systems are used to control machinery, scientific instruments and industrial systems.
- An RTOS typically has very little user-interface capability, and no end-user utilities, since the system will be a "sealed box" when delivered for use.
- A very important part of an RTOS is managing the resources of the computer so that a particular operation executes in precisely the same amount of time, every time it occurs.
- In a complex machine, having a part move more quickly just because system resources are available may be just as catastrophic as having it not move at all because the system is busy.

GENERAL SOFTWARE FEATURES AND TRENDS

Graphical user interface (GUI):

- A graphical user interface (GUI) is an interface through which a user interacts with electronic devices such as computers, hand-held devices and other appliances. This interface uses icons, menus and other visual indicator (graphics) representations to display information and related user controls, unlike text-based interfaces, where data and commands are in text.
- GUI representations are manipulated by a pointing device such as a mouse, trackball, stylus, or a finger on a touch screen.
- The need for GUI became apparent because the first human/computer text interface was through keyboard text creation by what is called a prompt (or DOS prompt).
- Commands were typed on a keyboard at the DOS prompt to initiate responses from a computer. The use of these commands and the need for exact spelling created a cumbersome and inefficient interface.
- In the late 1970s, the Xerox Palo Alto research laboratory created GUIs, which are now common in Windows, Mac OS, and many software applications.
- By using specially designed and labeled images, pictures, shapes and color combinations, objects were depicted on the computer screen that either resembled the operation to be performed or were intuitively recognized by the user.
- Today, each OS has its own GUI. Software applications use these and add additional GUIs of their own.

How we interface with a computer is constantly being revised and reinvented. Human ingenuity has brought users from the keyboard to the mouse and trackball, touch screens and voice commands.

SOFTWARE QUALITY AND RELIABILITY:

- **Software reliability** A measure of the extent to which a software system can be expected to deliver usable services when those services are demanded. Software reliability differs considerably from program "correctness" (see program correctness proof). Correctness is the static property that a program is consistent with its specification, while reliability is related to the dynamic demands that are made upon the system and the ability to produce a satisfactory response to those demands.
- Software quality measurement quantifies to what extent a software program or system rates along each of these five dimensions. An aggregated measure of software quality can be computed through a qualitative or a quantitative scoring scheme or a mix of both and then a weighting system reflecting the priorities. This view of software quality being positioned on a linear continuum is supplemented by the analysis of "critical programming errors" that under specific circumstances can lead to catastrophic outages or performance degradations that make a given system unsuitable for use regardless of rating based on aggregated measurements.

SOFTWARE SECURITY:

- Software security is an idea implemented to protect software against malicious attack and other hacker risks so that the software continues to function correctly under such potential risks. Security is necessary to provide integrity, authentication and availability.

OBJECT LINKING AND EMBEDDING:

- Object linking and embedding (OLE) is a Microsoft technology that facilitates the sharing of application data and objects written in different formats from multiple sources.
- Linking establishes a connection between two objects, and embedding facilitates application data insertion.

- ❖ OLE is used for compound document management, as well as application data transfer via drag-and-drop and clipboard operations.
- ❖ An OLE object may display as an icon. Double clicking the icon opens the associated object application or asks the user to select an application for object editing.

OPEN SOURCE SOFTWARE:

- ❖ Open-source software (OSS) is software that is distributed with source code that may be read or modified by users. The OSS community generally agrees that open-source software should meet the following criteria:
  - The program must be freely distributed
  - Source code must be included with the program
  - Anyone must be able to modify the source code
  - Modified versions of the source code may be redistributed

Unlike traditional software distributed in an unchangeable compiled format, open-source software is delivered with both compiled and non-compiled formats, allowing open code modification. In traditional software licenses, this privilege would be reserved for copyright holders.

DISTRIBUTED COMPUTING:

- ❖ A type of computing in which different components and objects comprising an application can be located on different computers connected to a network.
- ❖ So, for example, a word processing application might consist of an editor component on one computer, a spell-checker object on a second computer, and a thesaurus on a third computer. In some distributed computing systems, each of the three computers could even be running a different operating system.
- ❖ One of the requirements of distributed computing is a set of standards that specify how objects communicate with one another.
- ❖ There are currently two chief distributed computing standards: CORBA and DCOM.

SERVICE ORIENTED ARCHITECTURE:

- ❖ Service-oriented architecture (SOA) references a set of principles and methodologies applied by software engineers to design and develop software in the form of interoperable services.
- ❖ Services are usually built in the form of components that can be reused for different purposes than originally intended.
- ❖ For this reason, the interfaces are often defined in a practical manner, allowing use across varying applications and multiple platforms.
- ❖ SOA's primary goal is to provide agility to businesses, allowing them to adapt quickly and cost-efficiently to changes in the marketplace.

EMBEDDED SYSTEM:

- ❖ An embedded system is a combination of computer hardware and software, either fixed in capability or programmable, designed for a specific function or functions within a larger system.
- ❖ Industrial machines, agricultural and process industry devices, automobiles, medical equipment, cameras, household appliances, airplanes, vending machines and toys, as well as mobile devices, are possible locations for an embedded system.

WEB ENABLING:

- ❖ Web enabled refers to a product or service that can be used through, or in conjunction with, the World Wide Web.
- ❖ A Web-enabled product may be accessed through a Web browser or be able to connect to other Web-based applications in order to synchronize data.

- This term used to be an attractive buzzword to include in a product description, but now it would be rarer to have technology that is not Web enabled.
- For a short time during the Internet bubble, Web-enabled and Web-based were being used interchangeably to describe applications that were accessed using a Web browser.
- The term soon split off, and Web-based was used to refer to applications that don't do their processing on the user's computer.
- Web-enabled, if it is used at all, usually refers to a program that does some (or all) of its processing on the user's computer before uploading the output to the Web.
- A content management system, for example, may still use the term Web-enabled to highlight the fact that it can publish content to the Web in HTML format.

CLOUD COMPUTING:

- Cloud computing is a type of computing that relies on shared computing resources rather than having local servers or personal devices to handle applications.
- Cloud computing is the the use of various services, such as software development platforms, servers, storage and software, over the internet, often referred to as the "cloud."
- In general, there are three cloud computing characteristics that are common among all cloud-computing vendors:

1. The back-end of the application (especially hardware) is completely managed by a cloud vendor.
2. A user only pays for services used (memory, processing time and bandwidth, etc.).
3. Services are scalable

Many cloud computing advancements are closely related to virtualization. The ability to pay on demand and scale quickly is largely a result of cloud computing vendors being able to pool resources that may be divided among multiple clients.

NETWORK COMPUTING:

- Network computing refers to the use of computers and other devices in a linked network, rather than as unconnected, stand-alone devices.
- As computing technology has progressed during the last few decades, network computing has become more frequent, especially with the creation of cheap and relatively simple consumer products such as wireless routers, which turn the typical home computer setup into a local area network.

MOBILE COMPUTING:

- A mobile computing device is any device that is created using mobile components, such as mobile hardware and software. Mobile computing devices are portable devices capable of operating, executing and providing services and applications like a typical computing device.
- Mobile computing devices also may be known as portable computing devices or handheld computing devices. Mobile computing devices have similar hardware and software components as those used in personal computers, such as processors, random memory and storage, Wi-Fi, and a base operating system.
- However, they differ from PCS in that they are built specifically for mobile architecture and to enable portability. Among the common examples of mobile computing devices is a tablet PC, which has a built-in processor, memory and operating system (OS), and executes most applications built for a comparable PC.

SOFTWARE AS A SERVICE:

- Software as a service (SaaS) is a model for the distribution of software where customers access software over the Internet. In SaaS, a service provider hosts the application at its data center and a customer accesses it via a standard web browser.

There are a few major characteristics that apply to most SaaS vendors:

- Updates are applied automatically without customer intervention
- The service is purchased on a subscription basis
- No hardware is required to be installed by the customer

UNIT III

DATABASE MANAGEMENT SYSTEMS

Database:

- Database is a collection of inter-related data which helps in efficient retrieval, insertion and deletion of data from database and organizes the data in the form of tables, views, schemas, reports etc.
- For Example, university database organizes the data about students, faculty, and admin staff etc. which helps in efficient retrieval, insertion and deletion of data from it.

Database Management System: (DBMS)

- The software which is used to manage database is called Database Management System.
- For Example, MySQL, Oracle etc. are popular commercial DBMS used in different applications. DBMS allows users the following tasks:

INFORMATION:

- Information is data that has been processed in such a way as to be meaningful to the person who receives it. it is anything that is communicated.

DATA AND DATA MANAGEMENT:

- Computer data is information processed or stored by a computer. This information may be in the form of text documents, images, audio clips, software programs, or other types of data.
- Computer data may be processed by the computer's CPU and is stored in files and folders on the computer's hard disk.Data management refers to an organization's management of information and data for secure and structured access and storage.
- some important points regarding data:
  - Data constitutes the building blocks of information.
  - Information is produced by processing data.
  - Information is used to reveal the meaning of the data.
  - Accurate, relevant, and timely information is the key to good decision making.
  - Good decision making is the key to organizing survival in a good environment.

FILE BASED DATA MANAGEMENT:

- One way to keep information on a computer is to store it in permanent files. A company system has a number of application programs; each of them is designed to manipulate data files.
- These application programs have been written at the request of the users in the organization.

- New applications are added to the system as the need arises. The system just described is called the file-based system.

Many organizations created separate data processing departments to manage the data and the data requirements. The database administrators and programmers were the members of this department and their primary activity was to meet the information requirements of the organization.

The file based data management systems suffered from disadvantages of the file based data management systems.

- The file based system has structural dependency making any change to the files structure such as addition or deletion of a filed, requires the modification of all programs using that file.
- The file system is dependent on the data and hence all data access programs are subject to change when any of the file data characteristics change.
- In a file system the same information is stored in more than one place.
- Since the same data is stored in many places, modification, deletion, and addition of data can create data inconsistencies.
- Need for programming and skilled personnel.
- Lack of data security

DATABASE SYSTEMS:

- ❖ A collection of data designed to be used by different people is called a database.
- ❖ It is a collection interrelated data stored together with controlled redundancy to serve one or more applications in an optimal fashion.
- ❖ A common controlled approach is used in adding new data and modifying and retrieving existing data within database.

Why a database:

Deficiencies of pre database information processing include the following:

- ✓ Encoded data.
- ✓ Interdependence between programs and data files
- ✓ Data repetition or redundancy
- ✓ Data inconsistency
- ✓ Lack of data integrity
- ✓ Ad hoc representation of relationships
- ✓ Ad hoc data management techniques
- ✓ Lack of coordination across applications
- ✓ Lack of fool proof data security mechanisms

Advantages of database

- ❖ The database management system has a number of advantages as compared to traditional computer file-based processing approach. The DBA must keep in mind these benefits or capabilities during databases and monitoring the DBMS.

The Main advantages of DBMS are described below.

Controlling Data Redundancy : In non-database systems each application program has its own private files. In this case, the duplicated copies of the same data are created in many places. In DBMS, all data of an organization is integrated into a single database file. The data is recorded in only one place in the database and it is not duplicated.

Sharing of Data: In DBMS, data can be shared by authorized users of the organization. The database administrator manages the data and gives rights to users to access the data. Many users can be authorized to access the same piece of information simultaneously. The remote users can also share same data. Similarly, the data of same database can be shared between different application programs.

Data Consistency : By controlling the data redundancy, the data consistency is obtained. If a data item appears only once, any update to its value has to be performed only once and the updated value is immediately available to all users. If the DBMS has controlled redundancy, the database system enforces consistency.

Integration of Data: In Database management system, data in database is stored in tables. A single database contains multiple tables and relationships can be created between tables (or associated data entities). This makes easy to retrieve and update data.

Integration Constraints: Integrity constraints or consistency rules can be applied to database so that the correct data can be entered into database. The constraints may be applied to data item within a single record or the may be applied to relationships between records.

Data Security : Form is very important object of DBMS. You can create forms very easily and quickly in DBMS. Once a form is created, it can be used many times and it can be modified very easily. The created forms are also saved along with database and behave like a software component. A form provides very easy way (user-friendly) to enter data into database, edit data and display data from database. The non-technical users can also perform various operations on database through forms without going into technical details of a database.

ORGANIZATION OF DATABASE

Database consists of four elements:- **data, relationship, constraints, and schema.**

1. **Data** are binary computer representations of stored logical entities. Data is distinct pieces of information, usually formatted in a special way.
   All software is divided into two general categories: data and programs. Programs are collections of instructions for manipulating data. Data can exist in a variety of forms — as numbers or text on pieces of paper, as bits and bytes stored in electronic memory, or as facts stored in a person's mind. Since the mid-1900s, people have used the word data to mean computer information that is transmitted or stored. Strictly speaking, data is the plural of *datum*, a single piece of information. In practice, however, people use data as both the singular and plural form of the word, and as a mass noun (like "sand").
2. **Relationship** represents a corresponding between the various data elements.
3. **Constraints** are predicates that define correct database states.
4. **Schema** describes the organization of data relationship within the database management system and for the application’s security.

CHARACTERISTICS OF DATA IN DATABASE:

The data in a database should have the following features:

- **Shared -** Data in a database are shared among different users and applications.
- **Persistence -** Data in a database exist permanently in the sense the data can live beyond the scope of the process that created it.
- **Validity/Integrity/Correctness** - Data should be correct with respect to the real world entity that they represent.
- **Security -** Data should be protected from unauthorized access.
- **Consistency -** Whenever more than one data element in a database represents related real-world values, the values should be consistent with respect to the relationship.
- **Non-redundancy -** No two data items in a database should represent the same real-world entity.
- **Independence -** The three levels in the schema (internal, conceptual and external) should be independent of each other so that changes in the schema at one level should not affect the other levels.

DATABASE MANAGEMENT SYSTEMS (DBMS)

- A DBMS is software for creating and managing databases. The DBMS provides users with a systematic way to create, retrieve, update and manage data.
- It is a middleware between the database which store all the data and the users or applications which need to interact with that stored database.
- A DBMS can limit what data the end user sees, as well as how that end user can view the data, providing many views of a single database schema

Following are examples of database applications:

- Computerized library systems
- Automated teller machine
- Flight reservation systems
- Computerized parts inventory systems
- Enterprise Resource Management (ERO) system

Benefits of using DBMS:

1. ***Reducing Data Redundancy***

- ✓ The file based data management systems contained multiple files that were stored in many different locations in a system or even across multiple systems. Because of this, there were sometimes multiple copies of the same file which lead to data redundancy.
- ✓ This is prevented in a database as there is a single database and any change in it is reflected immediately. Because of this, there is no chance of encountering duplicate data.

2. ***Sharing of Data***

- ✓ In a database, the users of the database can share the data among themselves. There are various levels of authorization to access the data, and consequently the data can only be shared based on the correct authorization protocols being followed.
- ✓ Many remote users can also access the database simultaneously and share the data between themselves.

3. ***Data Integrity***

- ✓ Data integrity means that the data is accurate and consistent in the database. Data Integrity is very important as there are multiple databases in a DBMS. All of these databases contain data that is visible to multiple users. So it is necessary to ensure that the data is correct and consistent in all the databases and for all the users.

4. ***Data Security***

- ✓ Data Security is vital concept in a database. Only authorized users should be allowed to access the database and their identity should be authenticated using a username and password.
- ✓ Unauthorized users should not be allowed to access the database under any circumstances as it violates the integrity constraints.

5. ***Privacy***

- ✓ The privacy rule in a database means only the authorized users can access a database according to its privacy constraints.
- ✓ There are levels of database access and a user can only view the data he is allowed to.
- ✓ For example - In social networking sites, access constraints are different for different accounts a user may want to access.

6. ***Backup and Recovery***

- ✓ Database Management System automatically takes care of backup and recovery.

- ✓ The users don't need to backup data periodically because this is taken care of by the DBMS. Moreover, it also restores the database after a crash or system failure to its previous condition.

7. Data Consistency

- ✓ Data consistency is ensured in a database because there is no data redundancy. All data appears consistently across the database and the data is same for all the users viewing the database.
- ✓ Moreover, any changes made to the database are immediately reflected to all the users and there is no data inconsistency.

FUNCTION OF DBMS:

- ❖ **Transaction Management:** A transaction is a series of database operations, carried out by a single user or application program, which accesses or changes the contents of the database. Therefore, a DBMS must provide a mechanism to ensure either that all the updates corresponding to a given transaction are made or that none of them is made.
- ❖ **Concurrency Control Service:** Since DBMSs support sharing of data among multiple users, they must provide a mechanism for managing concurrent access to the database. DBMSs ensure that the database kept in consistent state and that integrity of the data is preserved.
- ❖ **Backup and Recovery Management:** The DBMS provides mechanisms for backing up data periodically and recovering from different types of failures. This prevents the loss of data,
- ❖ **Security Management:** Security Management is another important function of Database Management System(DBMS). The DBMS creates a security system that enforces user security and data privacy. Security rules determine which users can access the database, which data items each user can access, and which data operations (read, add, delete, or modify) the user can perform. This is especially important in multiuser database systems.
- ❖ **Language interface:** The DBMs provides language fir the definition and manipulation of data in the database. The data structures
- ❖ **Data Storage Management:** One of the DBMS functionality is creating and managing the complex structures required for data storage, thus relieving you from the difficult task of defining and programming the physical data characteristics.
  A modern DBMS system provides storage not only for the data, but also for related data entry forms or screen definitions, report definitions, data validation rules, procedural code, structures to handle video and picture formats, and so on.
  Data storage management is also important for database performance tuning. Performance tuning relates to the activities that make the database perform more efficiently in terms of storage and access speed. So, the data storage management is another important function of Database Management System.
- ❖ **Data Catalog Management: Data catalog or data dictionary** is a system database that contains descriptions of the data in the database(metadata).

DATABASE USERS:

End Users:

- ✓ End users are those who access the database from the terminal end. They use the developed applications and they don't have any knowledge about the design and working of database. These are the second class of users and their main motto is just to get their task done. There are basically two types of end users that are discussed below.

Casual User:

- ✓ These users have great knowledge of query language. Casual users access data by entering different queries from the terminal end. They do not write programs but they can interact with the system by writing queries.

Naïve:

- ✓ Any user who does not have any knowledge about database can be in this category. There task is to just use the developed application and get the desired results. For example: Clerical staff in any bank is a naïve user. They don't have any dbms knowledge but they still use the database and perform their given task.

Database Administrators:

- ✓ In any organization where many people use the same resources, there is a need for a chief administrator to oversee and manage these resources.
- ✓ In a database environment, the primary resource is the database itself and the secondary resource is the DBMS and related software. Administering these resources is the responsibility of the database administrator (DBA).
- ✓ The DBA is responsible for authorizing access to the database, coordinating and monitoring its use, and acquiring software and hardware resources as needed. The DBA is accountable for problems such as breach of security or poor system response time. In large organizations, the DBA is assisted by a staff that carries out these functions.

Database Designers:

- ✓ Database designers are responsible for identifying the data to be stored in the database and for choosing appropriate structures to represent and store this data. These tasks are mostly undertaken before the database is actually implemented and populated with data.
- ✓ It is the responsibility of database designers to communicate with all prospective database users in order to understand their requirements and to create a design that meets these requirements. In many cases, the designers are on the staff of the DBA and may be assigned other staff responsibilities after the database design is completed.
- ✓ Database designers typically interact with each potential group of users and develop views of the database that meet the data and processing requirements of these groups.
- ✓ Each view is then analyzed and integrated with the views of other user groups. The final database design must be capable of supporting the requirements of all user groups.

Application Programmers:

- ✓ As its name shows, application programmers are the one who writes application programs that uses the database. These application programs are written in programming languages like COBOL or PL (Programming Language 1), Java and fourth generation language.
- ✓ These programs meet the user requirement and made according to user requirements. Retrieving information, creating new information and changing existing information is done by these application programs.

DATA PROCESSING

- ❖ Data processing occurs when data is collected and translated into usable information. Usually performed by a data scientist or team of data scientists, it is important for data processing to be done correctly as not to negatively affect the end product, or data output.
- ❖ Data processing starts with data in its raw form and converts it into a more readable format (graphs, documents, etc.), giving it the form and context necessary to be interpreted by computers and utilized by employees throughout an organization.

The Six Stages of Data Processing

1. **Data Collection**: Data collection is the first step in data processing. Data is pulled from available sources, including data lakes and data warehouses. It is important that the data sources available are trustworthy and well-built so the data collected (and later used as information) is of the highest possible quality.

2. **Data Preparation** : Once the data is collected, it then enters the data preparation stage. Data preparation, often referred to as "pre-processing" is the stage at which raw data is cleaned up and organized for the following stage of data processing. During preparation, raw data is diligently checked for any errors. The purpose of this step is to eliminate bad data (redundant, incomplete, or incorrect data) and begin to create high-quality data for the best business intelligence.
3. **Data Input** : The clean data is then entered into its destination (perhaps a CRM like Sales force or a data warehouse like Red shift), and translated into a language that it can understand. Data input is the first stage in which raw data begins to take the form of usable information.
4. **Processing**: During this stage, the data inputted to the computer in the previous stage is actually processed for interpretation. Processing is done using machine learning algorithms, though the process itself may vary slightly depending on the source of data being processed (data lakes, social networks, connected devices etc.) and its intended use (examining advertising patterns, medical diagnosis from connected devices, determining customer needs, etc.).
5. **Data Output/Interpretation** : The output/interpretation stage is the stage at which data is finally usable to non-data scientists. It is translated, readable, and often in the form of graphs, videos, images, plain text, etc.). Members of the company or institution can now begin to self-serve the data for their own data analytics projects.
6. **Data Storage** : The final stage of data processing is storage. After all of the data is processed, it is then stored for future use. While some information may be put to use immediately, much of it will serve a purpose later on. Plus, properly stored data is a necessity for compliance with data protection legislation like GDPR. When data is properly stored, it can be quickly and easily accessed by members of the organization when needed.

DATABASE DESIGN

- Database design provides a means to represent the real world entities in a form that can be processed by the computer. Database models present a process of abstracting real-world entities into computer representations.
- To develop a good design, one has to understand the meaning of information and the intended use of stored representation within the computer system.
- Once develop the understanding and identify the use of information in the application, can determine how much and what kind of information require. And also determine in what format these information should be captured and represented in the computer system or database.

It is important to collect and analyze the static and dynamic information available the real world application before starting the database design. For evolving a good database design it is important that one uses a model, a database design model.

The database design models have the following benefit:

- They provide a means to represent real-world objects in computer usable form.
- They capture and represent associations and relationships among the real world objects, allowing the application designers to capture the dynamic nature of the real world enterprise activities.
- They define how the objects in the application interact in logical terms.
- They allow the database designer to capture static dynamic organization, and flow of information within a modeled enterprise.
- They help in improving the maintainability, scalability, and reliability of the system.

REQUIREMENT ANALYSIS:

- To determine how to construct the DBMS for an application, the database design team must first determine the scope of the problem requiring the database system.
- Requirements Analysis technique are used to define the scope of the requirements of an applications domain.

Requirements Analysis examines the entire scope of the problem domain and includes:

- Defining the human factor of the applications.
- Defining the application's functionality.
- Defining all the information managed and used by the application.
- Determining from where or to where all interfaces to an application are derived.
- Identifying all resource requirements including hardware, software, and other physical resources.
- Deciding on the security requirements and mechanisms.
- Defining the quality, reliability, performance, and operational aspects of the application.

For all these requirements, the analyst must examine the data collected and determine how useful they are for the application, particularly; the information must be analyzed with regard to the following criteria:

Correctness:- the information should correctly represent the real-old system that it is modeling.

Consistency:- the data should adequately capture the constraints of the real-world entity. Once the entity has been defined, must be certain that the definition covers the entire range of possible values that the entity may take.

Completeness:- the represented real-world entity should not have any missing attributes. All the relevant components of the real world entity should be present in the model.

Realistic representation:- the representation of the real world entity should make sense.

Need: - the information that is being captured should be required for the application.

Information Modeling: the objective of information modeling is to identify the major entities that are fundamental in an application and model them in a target database schema model. The information collected during the requirements analysis stage forms the input for information modeling. This information will enable the database designer to fully and correctly define the major entities to be modeled in the database. The attributes that define the entities of the application are grouped together according to the data model used and stored for further references.

Design constrains: database systems are designed to represent the real world systems. The database systems require certain controls and limits for it to truly represent the real world system's behavior. These limits or controls are called constraints in the database parlance.

Structural constraints: the structural of the information within the database gives an idea about entities in the database. For example, simple data structures are represented using simple structures, while complex data structures will need advanced structures. Structural constraints are specified to force the placement of information into structures that best matches the application.

Type Constraints: A type constraint limits the application to only one representation of information for an entity's attribute. For example, the database designers might want to limit the name attribute to a fixed length character string, the age attribute to a number, etc. Type constraints allow a limitation of the range of information representations that an attribute can have.

Range Constraints: Range constraints limit the values an attribute can take. It refers to the possible values that a particular data item. Range constraints can be used to limit the value of a particular attribute within a range.

Relationship Constraints: These constraints represent relationships on values between entities. For example there could be a relationship constraint between the entities MANAGER and EMPLOYEE that the maximum bonus of the manager should not be greater than six times that of the employee.

Temporal Constraints: These constraints indicate the time period for which some information is valid. For example the value of the attribute sales tax o exise duty is valid only for a specific period.

UNIT IV

INTRODUCTION TO TELECOMMUNICATION

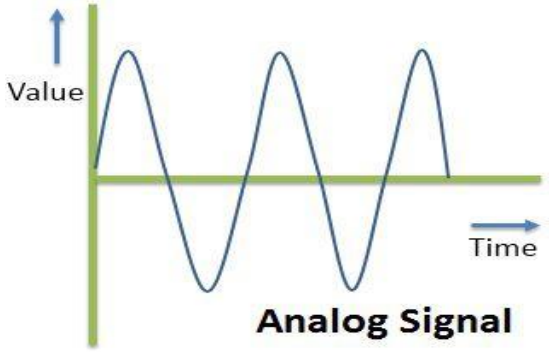
- Telecommunication refers to all types of data transmission, from voice to video. End user need to communicate electronically in today's world.
- Communication is a process in which information is transferred from source to destination. Information can be in any form e.g Voice, Data, Video, Graphics etc.
- Voice communication is the simplest mode of communication.
- Telecommunications represent the transfer of information, from an entity at one place to an entity at another place, whereas the information can be in the form of data, voice or symbol.
- The entities can be human beings, computers, facsimile machines, telegraphy machines, phones or so on.

ANALOG AND DIGITAL SIGNAL:

The principal feature of analog representations is that they are continuous. In contrast, digital representations consist of values measured at discrete intervals. Analog and Digital are the different forms of signals. Signals are used to carry information from one device to another. Analog signal is a continuous wave that keeps on changing over a time period. Digital signal is discrete in nature. The fundamental difference between analog and digital signal is that analog signal is represented by the sine waves whereas; the digital signal is represented by square waves.

Analog Signal:

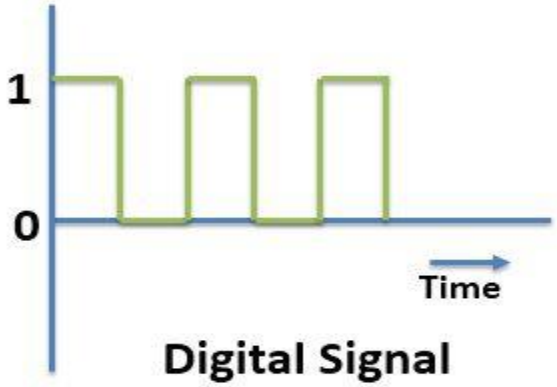
- ✓ Analog signal is a kind of continuous wave form that changes over time. An analog signal is further classified into simple and composite signals. A simple analog signal is a sine wave that cannot be decomposed further.
- ✓ On the other hand, a composite analog signal can be further decomposed into multiple sine waves. An analog signal is described using amplitude, period or frequency and phase.
- ✓ Amplitude marks the maximum height of the signal.
- ✓ Frequency marks the rate at which signal is changing. Phase marks the position of the wave with respect to time zero.
- ✓ An analog signal can be used to measure changes in some physical phenomena such as light, sound, pressure, or temperature.
- ✓ For instance, an analog microphone can convert sound waves into an analog signal.
- ✓ Even in digital devices, there is typically some analog component that is used to take in information from the external world, which will then get translated into digital form (using an analog-to-digital converter).



An analog signal is not immune to noise hence; it faces distortion and decrease the quality of transmission. The range of value in an analog signal is not fixed.

Digital Signal:

- ✓ Digital signals also carry information like analog signals but is somewhat is different from analog signals. Digital signal is non continuous, discrete time signal.
- ✓ Digital signal carries information or data in the binary form i.e. a digital signal represent information in the form of bits.
- ✓ Digital signal can be further decomposed into simple sine waves that are called harmonics. Each simple wave has different amplitude, frequency and phase.
- ✓ Digital signal is described with bit rate and bit interval. Bit interval describes the time require for sending a single bit. On the other hand, bit rate describes the frequency of bit interval.



A digital signal refers to an electrical signal that is converted into a pattern of bits. Unlike an analog signal, which is a continuous signal that contains time-varying quantities, a digital signal has a discrete value at each sampling point. The precision of the signal is determined by how many samples are recorded per unit of time.

A digital signal is more immune to the noise; hence, it hardly faces any distortion. Digital signals are easier to transmit and are more reliable when compared to analog signals. Digital signal has a finite range of values. The range of a digital signal lies between 0 to 1 or on and off.

Key Differences between Analog and Digital Signal

1. An analog signal represents a continuous wave that keeps changing over a time period. On the other hand, a digital signal represents a noncontinuous wave that carries information in a binary format and has discrete values.
2. An analog signal is always represented by the continuous sine wave whereas, a digital signal is represented by square waves.
3. While talking of analog signal we describe the behaviour of the wave in respect of amplitude, period or frequency, and phase of the wave. On the other hand, while talking of discrete signals we describe the behaviour of the wave in respect of bit rate and bit interval.
4. The range of an analog signal is not fixed whereas the range of the digital signal is finite and ranges between 0 to 1.
5. An analog signal is more prone to distortion in response to noise, but a digital signal has immunity in response to noise hence it rarely faces any distortion.
6. An analog signal transmits data in the form of wave whereas; a digital signal transmits the data in the binary form i.e. in the form of bits.
7. The best example of an analog signal is a human voice, and the best example of a digital signal is the transmission of data in a computer.

MODULATION:

- Modulation is a process through which audio, video, image or text information is added to an electrical or optical carrier signal to be transmitted over a telecommunication or electronic medium.
- Modulation enables the transfer of information on an electrical signal to a receiving device that demodulates the signal to extract the blended information.
- Modulation is primarily used in telecommunication technologies that require the transmission of data via electrical signals.
- It is considered the backbone of data communication because it enables the use of electrical and optical signals as information carriers. Modulation is achieved by altering the periodic waveform or the carrier.
- This includes carrying its amplitude, frequency and phase.

Need For Modulation:

Modulation is necessary in communication systems due to the following reasons:

- **Antenna length:**

When the transmission of a signal occurs over free space, the transmitting antenna radiates the signal out and receiving antenna receives it. In order to effectively transmit and receive the signal, the antenna height should be approximately equal to the wavelength of the signal to be transmitted.

- **Avoids mixing of signals:**

This is a point from the practical side of things. Suppose you are transmitting the baseband signal as it is to a receiver, say your friends phone. Just like you , there will be thousands of people of people in the city using their mobile phones. There is no way to tell such signals apart and they will interfere with each other leading to a lot of noise in the system and a very bad output. By using a carrier wave of high frequencies and allotting a band of frequencies to each message, there is no mixing up of signals and the received signals are absolutely perfect.

- **Wireless communication**

In radio communication, the signal is radiated directly into space. The baseband signals have very low frequency range (I.e. 20 Hz to 20 KHz). So it is not possible to radiate baseband signals directly into space because of its poor signal strength. However, by using the modulation technique, the frequency of the baseband signal is shifted from low frequency to high frequency. Therefore, after modulation, the signal can be directly radiated into space.

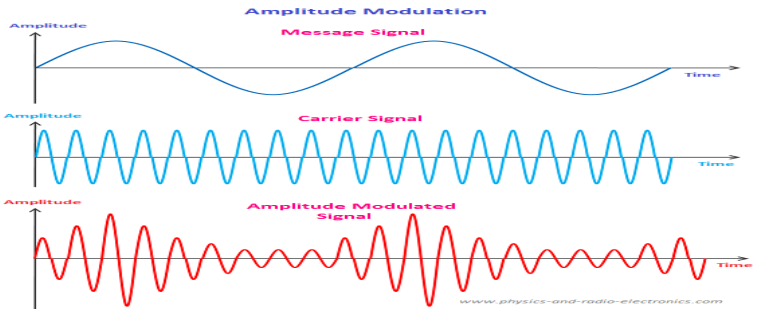
TYPES OF MODULATION:

Modulation is the process of changing the amplitude or frequency or phase of a carrier wave in accordance with the intensity of the signal. Accordingly, there are three types of modulation:

- **Amplitude Modulation**
- **Frequency Modulation**
- **Phase Modulation**

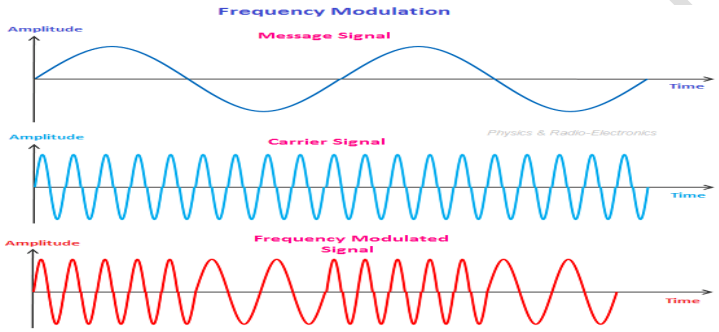
1) Amplitude Modulation:

- Amplitude modulation is a type of modulation where the amplitude of the carrier signal is varied (changed) in accordance with the amplitude of the message signal while the frequency and phase of carrier signal remain constant.
- The below figure shows the amplitude modulation. The first figure shows the modulating signal or message signal which contains information, the second figure shows the high frequency carrier signal which contains no information and the last figure shows the resultant amplitude modulated signal. From the above three figures, it can be observed that the amplitude of the carrier signal is varied in accordance with the instant amplitude of the message signal.



2) Frequency Modulation

- Frequency modulation is a type of modulation where the frequency of the carrier signal is varied (changed) in accordance with the amplitude of the message signal while the amplitude and phase of carrier signal remain constant.

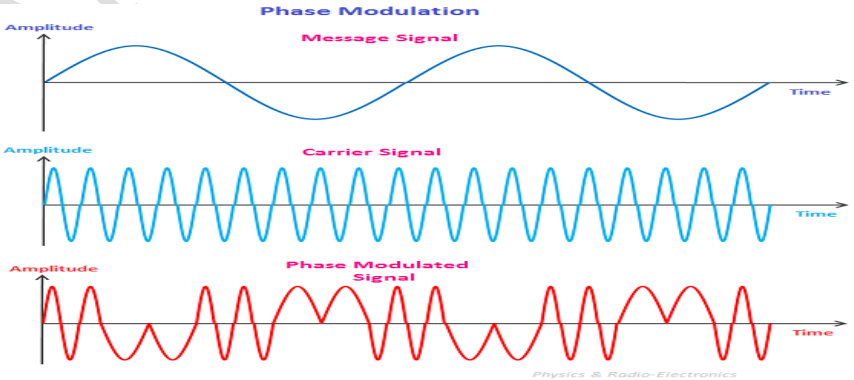


The above figure shows the frequency modulation.

- The first figure shows the modulating signal or message signal, the second figure shows the high frequency carrier signal which contains no information and the last figure shows the resultant frequency modulated signal.
- From the above three figures, it can be observed that the frequency of the carrier signal is varied in accordance with the instant amplitude of the message signal.

3) Phase modulation

- Phase modulation is a type of modulation where the phase of the carrier signal is varied (changed) in accordance with the amplitude of the message signal while the amplitude of carrier signal remains constant.



The above figure shows the phase modulation.

The first figure shows the modulating signal or message signal, the second figure shows the high frequency carrier signal which contains no information and the last figure shows the resultant phase modulated signal.

From the above three figures, it can be observed that the phase of the carrier signal is varied in accordance with the instant amplitude of the message signal.
In this type of modulation, when the phase is changed it also affects the frequency so this modulation also comes under frequency modulation.
The frequency and phase modulation comes under angle modulation. When the frequency or phase of the carrier signal is varied (changed) in accordance with the amplitude of the message signal, then it is called angle modulation.

DIGITAL MODULATION:

- **Digital Modulation** provides more information capacity, high data security, quicker system availability with great quality communication. Hence, digital modulation techniques have a greater demand, for their capacity to convey larger amounts of data than analog modulation techniques.
- There are many types of digital modulation techniques and also their combinations, depending upon the need. Of them all, we will discuss the prominent ones.

ASK – Amplitude Shift Keying

The amplitude of the resultant output depends upon the input data whether it should be a zero level or a variation of positive and negative, depending upon the carrier frequency.

FSK – Frequency Shift Keying

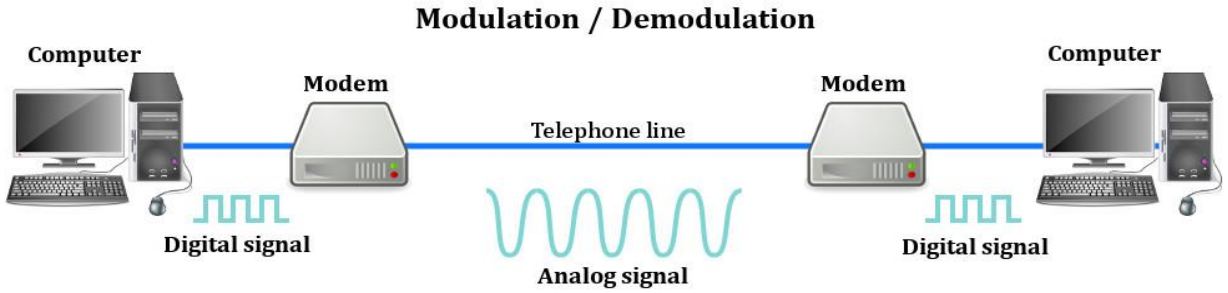
The frequency of the output signal will be either high or low, depending upon the input data applied.

PSK – Phase Shift Keying

The phase of the output signal gets shifted depending upon the input. These are mainly of two types, namely Binary Phase Shift Keying (BPSK) and Quadrature Phase Shift Keying (QPSK), according to the number of phase shifts. The other one is Differential Phase Shift Keying (DPSK) which changes the phase according to the previous value.

MODEMS

- A modem is a very important piece of network hardware that allows a computer to send and receive data through a telephone line or cable connection. In simple words it's device that connects a computer to the internet.
- Modem is short for modulator and demodulator. It's an electronic device used to access the internet that modulator carrier waves to encode information to be transmitted and also demodulates incoming carrier waves to decode the information they carry.
- The word modem is actually made by combining parts of two different words: Modulator and Demodulator. Both modulates and demodulates signals that encode and that retrieve information, respectively. For starters, modulation is a process of adding meaningful information to carrier wave so that it can be transmitted over long distances.
- Basically, what the modem does is take the digital signal from the computer and add it on top of an analog telephone signal (i.e. modulates it) so that it can be transferred through the telephone line.
- Since modem sends information through a telephone line by modulating digital signals, it is also needs to have another kind of translator that helps it demodulate the analog signals it receives via telephone line.



It is important to require standalone modem to link to the internet. Most modems today are capable of sending and receiving faxes. These modems are called Fax-Modems. Most manufactures supply the software for their modems.

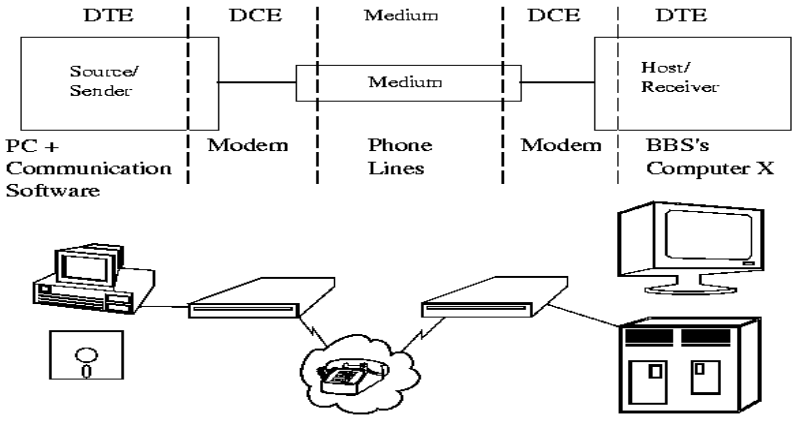
COMPUTER NETWORKING

- **Computer Network** is a group of computers connected with each other through wires, optical fibers or optical links so that various devices can interact with each other through a network.
- The aim of the computer network is the sharing of resources among various devices.
- In the case of computer network technology, there are several types of networks that vary from simple to complex level.

Overview of A Network

A telecommunications network is an arrangement of computing and telecommunications resources for communication of information between distant locations. A telecommunications network includes the following components:

1. **Terminals** for accessing the network
2. **Computers** that process information and are interconnected by the network
3. **Telecommunications links** that form a channel through which information is transmitted from a sending device to a receiving device.
4. **Telecommunications equipment** that facilitates the transmission of information.
5. **Telecommunications software** that controls message transmission over the network.



COMMUNICATION PROCESSORS

Communication processors for the connection of different target and source systems, such as systems or serially to underlying scanners, printers and other peripherals.

MODEMS

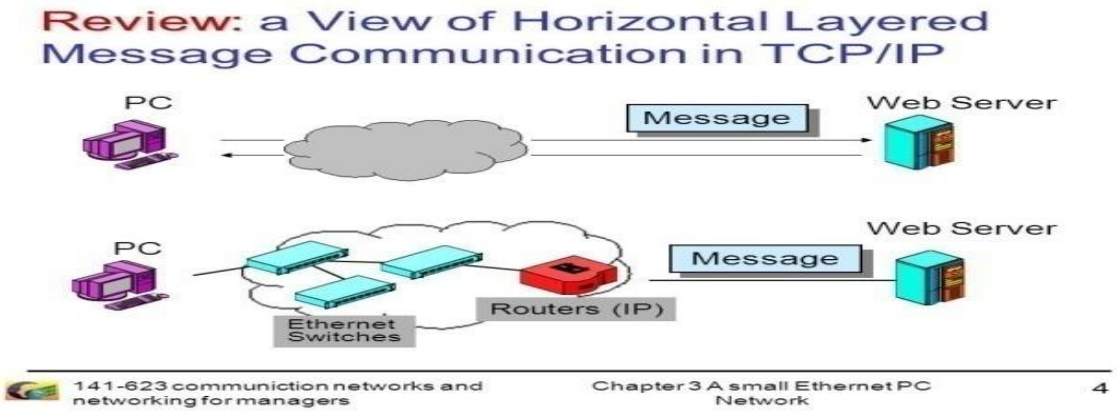
A modem modulates outgoing digital signals from a computer or other digital device to analog signals for a conventional copper twisted pair telephone line and demodulates the incoming analog signal and converts it to a digital signal for the digital device.

MESSAGE SWITCHERS

It is a processor that receives data messages from terminals, determines their destination, and routes them one at a time to the CPU. It distributes the messages from the CPU to the appropriate terminal.

MULTIPLEXER

The Multiplexer acts as a multiple-input and single-output switch.



CONCENTRATORS

A concentrator merges a certain number of incoming lines with a number of outgoing lines, or provides a central communication link for a number of devices.

CONTROLLERS

Manages several terminals, connecting them to a single telecommunications link, and performs communication tasks for them, such as screen formatting, code conversion, and error checking. A cluster controller may also allow the terminals to share a high-speed printer and may handle electronic mail among the cluster terminals.

FRONT-END PROCESSORS

Relieves the host computer of most of the tasks involved in network control. Under the control of its own software, the front-end processor accepts messages coming from the network and routes outgoing messages to their destinations. It performs the necessary code conversions, encrypts and decrypts secure messages, and performs error checking so that the host.

COMMUNICATION MEDIA

1. **Twisted Pair** a communications medium consisting of a pair of wires.
2. **Coaxial Cable** a communications medium that consists of a relatively thick central conductor shielded by several layers of insulation and the second conductor just under the cable's shell
3. **Fiber Optics** high-capacity communications medium that consists of many strands of pure glass with a data carrying core in the middle, surrounded by a reflective coating and a protective sheath.
4. **Microwave** long-distance telecommunications by means of microwave signals travelling on the surface of the earth.
5. **Satellite Transmission** form of microwave transmission in which the signal is transmitted by an earth station to a satellite which rebroadcasts the signal to the receiving station.

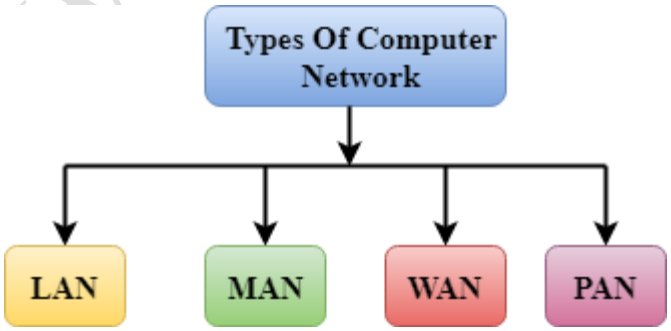
TELECOMMUNICATION SOFTWARE:

- Telecommunications software is any type of software package that aids in the process of electronic communications, especially those that involve the transmission of audio in some manner.

1. **Access Control :** The connections between terminals and computers in a network.
2. **Transmission Control** : It allows computers and terminals to send and receive information.
3. **Network Control** : This function manages communication in a network.
4. **Error Control** : It involves detection and correction of transmission errors.
5. **Security Control :** It protects a communications network from unauthorized access.

COMPUTER NETWORK TYPES

- A computer network is a group of computers linked to each other that enables the computer to communicate with another computer and share their resources, data, and applications.
- A computer network can be categorized by their size. A **computer network** is mainly of **four types**:



- LAN(Local Area Network)
- PAN(Personal Area Network)
- MAN(Metropolitan Area Network)
- WAN(Wide Area Network)

LAN(Local Area Network)

- Local Area Network is a group of computers connected to each other in a small area such as building, office.
- LAN is used for connecting two or more personal computers through a communication medium such as twisted pair, coaxial cable, etc.
- It is less costly as it is built with inexpensive hardware such as hubs, network adapters, and ethernet cables.
- The data is transferred at an extremely faster rate in Local Area Network.
- Local Area Network provides higher security.

PAN(Personal Area Network)

- Personal Area Network is a network arranged within an individual person, typically within a range of 10 meters.
- Personal Area Network is used for connecting the computer devices of personal use is known as Personal Area Network.
- **Thomas Zimmerman** was the first research scientist to bring the idea of the Personal Area Network.
- Personal Area Network covers an area of **30 feet**.
- Personal computer devices that are used to develop the personal area network are the laptop, mobile phones, media player and play stations.

There are two types of Personal Area Network:

- Wired Personal Area Network
- Wireless Personal Area Network

Wireless Personal Area Network: Wireless Personal Area Network is developed by simply using wireless technologies such as WiFi, Bluetooth. It is a low range network.

Wired Personal Area Network: Wired Personal Area Network is created by using the USB.

Examples of Personal Area Network:

- **Body Area Network:** Body Area Network is a network that moves with a person. **For example**, a mobile network moves with a person. Suppose a person establishes a network connection and then creates a connection with another device to share the information.
- **Offline Network:** An offline network can be created inside the home, so it is also known as a **home network**. A home network is designed to integrate the devices such as printers, computer, television but they are not connected to the internet.
- **Small Home Office:** It is used to connect a variety of devices to the internet and to a corporate network using a VPN

MAN(Metropolitan Area Network)

- A metropolitan area network is a network that covers a larger geographic area by interconnecting a different LAN to form a larger network.
- Government agencies use MAN to connect to the citizens and private industries.
- In MAN, various LANs are connected to each other through a telephone exchange line.
- The most widely used protocols in MAN are RS-232, Frame Relay, ATM, ISDN, OC-3, ADSL, etc.It has a higher range than Local Area Network(LAN).

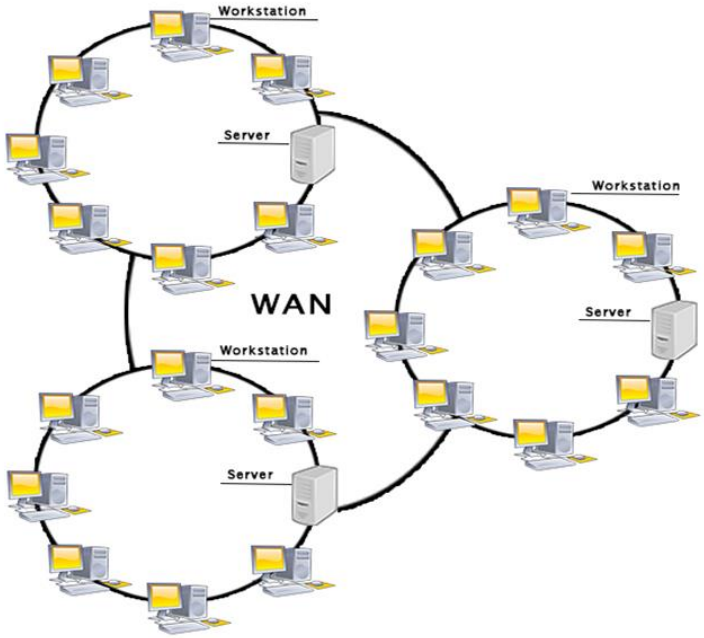
Uses Of Metropolitan Area Network:

- MAN is used in communication between the banks in a city.
- It can be used in an Airline Reservation.
- It can be used in a college within a city.

- It can also be used for communication in the military.

WAN(Wide Area Network)

- A Wide Area Network is a network that extends over a large geographical area such as states or countries.
- A Wide Area Network is quite bigger network than the LAN.
- A Wide Area Network is not limited to a single location, but it spans over a large geographical area through a telephone line, fibre optic cable or satellite links.
- The internet is one of the biggest WAN in the world.
- A Wide Area Network is widely used in the field of Business, government, and education.



Examples Of Wide Area Network:

- **Mobile Broadband:** A 4G network is widely used across a region or country.
- **Last mile:** A telecom company is used to provide the internet services to the customers in hundreds of cities by connecting their home with fiber.
- **Private network:** A bank provides a private network that connects the 44 offices. This network is made by using the telephone leased line provided by the telecom company.

Advantages Of Wide Area Network:

Following are the advantages of the Wide Area Network:

- **Geographical area:** A Wide Area Network provides a large geographical area. Suppose if the branch of our office is in a different city then we can connect with them through WAN. The internet provides a leased line through which we can connect with another branch.
- **Centralized data:** In case of WAN network, data is centralized. Therefore, we do not need to buy the emails, files or back up servers.

- **Get updated files:** Software companies work on the live server. Therefore, the programmers get the updated files within seconds.
- **Exchange messages:** In a WAN network, messages are transmitted fast. The web application like Facebook, Whatsapp, Skype allows you to communicate with friends.
- **Sharing of software and resources:** In WAN network, we can share the software and other resources like a hard drive, RAM.
- **Global business:** We can do the business over the internet globally.
- **High bandwidth:** If we use the leased lines for our company then this gives the high bandwidth. The high bandwidth increases the data transfer rate which in turn increases the productivity of our company.

Disadvantages of Wide Area Network:

The following are the disadvantages of the Wide Area Network:

- **Security issue:** A WAN network has more security issues as compared to LAN and MAN network as all the technologies are combined together that creates the security problem.
- **Needs Firewall & antivirus software:** The data is transferred on the internet which can be changed or hacked by the hackers, so the firewall needs to be used. Some people can inject the virus in our system so antivirus is needed to protect from such a virus.
- **High Setup cost:** An installation cost of the WAN network is high as it involves the purchasing of routers, switches.
- **Troubleshooting problems:** It covers a large area so fixing the problem is difficult.

NETWORK TOPOLOGY:

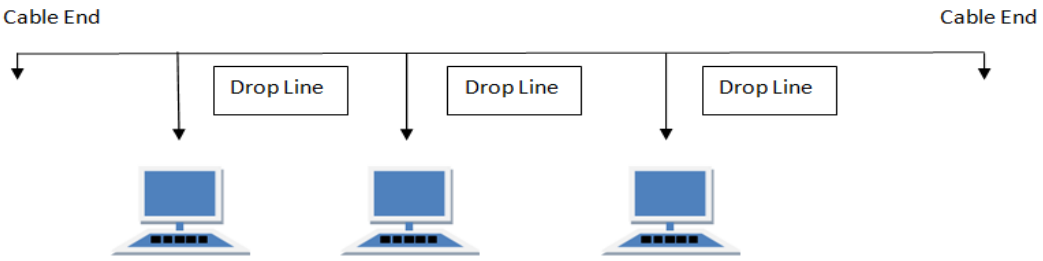
- Network topology refers to the physical or logical layout of a network.
- It defines the way different nodes are placed and interconnected with each other.
- Alternately, network topology may describe how the data is transferred between these nodes.
- There are two types of network topologies: **physical and logical.**
  - ✓ ***Physical topology*** emphasizes the physical layout of the connected devices and nodes, while the ***logical topology*** focuses on the pattern of data transfer between network nodes.

TYPES OF NETWORK TOPOLOGY

Network Topology is the schematic description of a network arrangement, connecting various nodes(sender and receiver) through lines of connection.

BUS Topology:

- Bus topology is a network type in which every computer and network device is connected to single cable. When it has exactly two endpoints, then it is called **Linear Bus topology**.



Features of Bus Topology

1. It transmits data only in one direction.
2. Every device is connected to a single cable

Advantages of Bus Topology

1. It is cost effective.
2. Cable required is least compared to other network topology.
3. Used in small networks.
4. It is easy to understand.
5. Easy to expand joining two cables together.

Disadvantages of Bus Topology

1. Cables fails then whole network fails.
2. If network traffic is heavy or nodes are more the performance of the network decreases.
3. Cable has a limited length.
4. It is slower than the ring topology.

RING Topology

- It is called ring topology because it forms a ring as each computer is connected to another computer, with the last one connected to the first.
- Exactly two neighbors for each device.

Features of Ring Topology

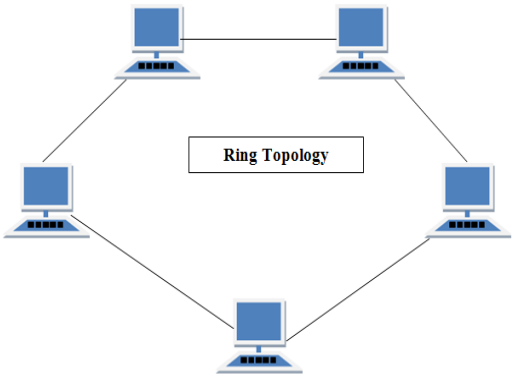
1. A number of repeaters are used for Ring topology with large number of nodes, because if someone wants to send some data to the last node in the ring topology with 100 nodes, then the data will have to pass through 99 nodes to reach the 100th node. Hence to prevent data loss repeaters are used in the network.
2. The transmission is unidirectional, but it can be made bidirectional by having 2 connections between each Network Node, it is called **Dual Ring Topology**.
3. In Dual Ring Topology, two ring networks are formed, and data flow is in opposite direction in them. Also, if one ring fails, the second ring can act as a backup, to keep the network up.
4. Data is transferred in a sequential manner that is bit by bit. Data transmitted, has to pass through each node of the network, till the destination node.

Advantages of Ring Topology

1. Transmitting network is not affected by high traffic or by adding more nodes, as only the nodes having tokens can transmit data.
2. Cheap to install and expand

Disadvantages of Ring Topology

1. Troubleshooting is difficult in ring topology.
2. Adding or deleting the computers disturbs the network activity.
3. Failure of one computer disturbs the whole network.

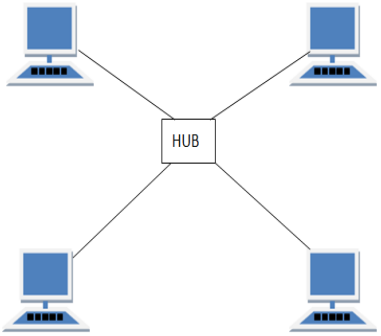


STAR Topology:

- In this type of topology all the computers are connected to a single hub through a cable.
- This hub is the central node and all others nodes are connected to the central node.

Features of Star Topology

1. Every node has its own dedicated connection to the hub.
2. Hub acts as a repeater for data flow.
3. Can be used with twisted pair, Optical Fibre or coaxial cable.



Advantages of Star Topology

1. Fast performance with few nodes and low network traffic.
2. Hub can be upgraded easily.
3. Easy to troubleshoot.
4. Easy to setup and modify.
5. Only that node is affected which has failed, rest of the nodes can work smoothly.

Disadvantages of Star Topology

1. Cost of installation is high.
2. Expensive to use.
3. If the hub fails then the whole network is stopped because all the nodes depend on the hub.
4. Performance is based on the hub that is it depends on its capacity

MESH Topology

- It is a point-to-point connection to other nodes or devices.
- All the network nodes are connected to each other.
- Mesh has `n(n-1)/2` physical channels to link `n` devices.

There are two techniques to transmit data over the Mesh topology, they are :

1. Routing
2. Flooding

MESH Topology: Routing

- In routing, the nodes have a routing logic, as per the network requirements.
- Like routing logic to direct the data to reach the destination using the shortest distance. Or, routing logic which has information about the broken links, and it avoids those node etc.
- We can even have routing logic, to re-configure the failed nodes.

MESH Topology: Flooding

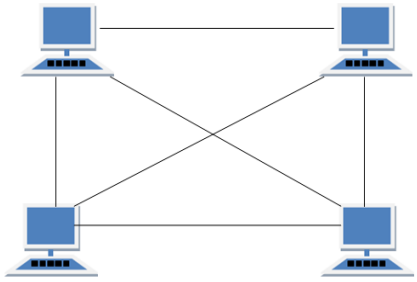
- In flooding, the same data is transmitted to all the network nodes, hence no routing logic is required.
- The network is robust, and the its very unlikely to lose the data.
- But it leads to unwanted load over the network.

Types of Mesh Topology

1. **Partial Mesh Topology :** In this topology some of the systems are connected in the same fashion as mesh topology but some devices are only connected to two or three devices.
2. **Full Mesh Topology :** Each and every nodes or devices are connected to each other.

Features of Mesh Topology

1. Fully connected.
2. Robust.
3. Not flexible.



Advantages of Mesh Topology

1. Each connection can carry its own data load.
2. It is robust.
3. Fault is diagnosed easily.
4. Provides security and privacy.

Disadvantages of Mesh Topology

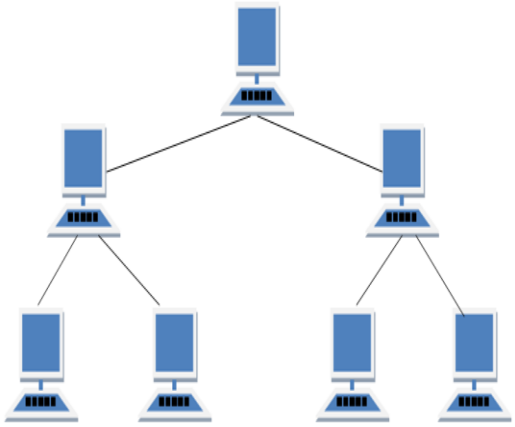
1. Installation and configuration is difficult.
2. Cabling cost is more.
3. Bulk wiring is required.

TREE Topology

- It has a root node and all other nodes are connected to it forming a hierarchy.
- It is also called hierarchical topology.
- It should at least have three levels to the hierarchy.

Features of Tree Topology

1. Ideal if workstations are located in groups.
2. Used in Wide Area Network.



Advantages of Tree Topology

1. Extension of bus and star topologies.
2. Expansion of nodes is possible and easy.
3. Easily managed and maintained.
4. Error detection is easily done.

Disadvantages of Tree Topology

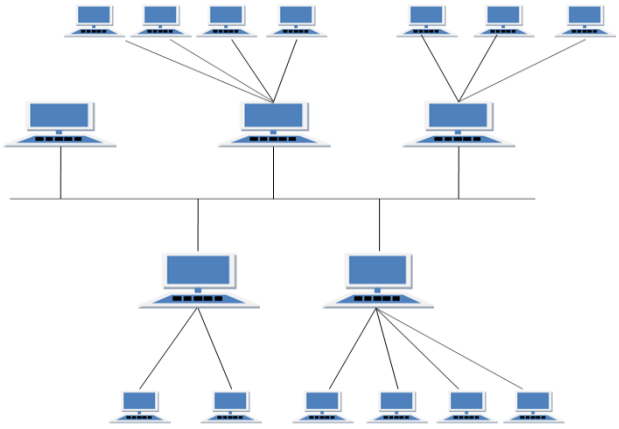
1. Heavily cabled.
2. Costly.
3. If more nodes are added maintenance is difficult.
4. Central hub fails, network fails.

HYBRID Topology

- It is two different types of topologies which is a mixture of two or more topologies. For example if in an office in one department ring topology is used and in another star topology is used, connecting these topologies will result in Hybrid Topology (ring topology and star topology).

Features of Hybrid Topology

1. It is a combination of two or topologies
2. Inherits the advantages and disadvantages of the topologies included



Advantages of Hybrid Topology

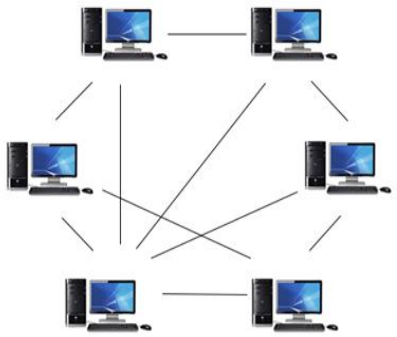
1. Reliable as Error detecting and trouble shooting is easy.
2. Effective.
3. Scalable as size can be increased easily.
4. Flexible.

Disadvantages of Hybrid Topology

1. Complex in design.
2. Costly.

NETWORK PROCOLS:

- Network protocols are formal standards and policies comprised of rules, procedures and formats that define communication between two or more devices over a network.
- Network protocols govern the end-to-end processes of timely, secure and managed data or network communication.
- Network protocols incorporate all the processes, requirements and constraints of initiating and accomplishing communication between computers, servers, routers and other network-enabled devices.
- Network protocols must be confirmed and installed by the sender and receiver to ensure network/data communication and apply to software and hardware nodes that communicate on a network.

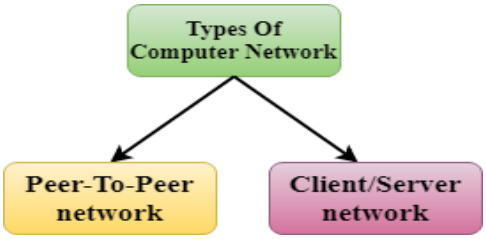


There are several broad types of networking protocols, including:

- **Network communication protocols:** Basic data communication protocols, such as TCP/IP and HTTP.
- **Network security protocols:** Implement security over network communications and include HTTPS, SSL and SFTP.
- **Network management protocols:** Provide network governance and maintenance and include SNMP and ICMP.

COMPUTER NETWORK ARCHITECTURE

- Computer Network Architecture is defined as the physical and logical design of the software, hardware, protocols, and media of the transmission of data.
- Simply we can say that how computers are organized and how tasks are allocated to the computer.



The two types of network architectures are used:

- Peer-To-Peer network
- Client/Server network

Peer-To-Peer network

- Peer-To-Peer network is a network in which all the computers are linked together with equal privilege and responsibilities for processing the data.
- Peer-To-Peer network is useful for small environments, usually up to 10 computers.
- Peer-To-Peer network has no dedicated server.
- Special permissions are assigned to each computer for sharing the resources, but this can lead to a problem if the computer with the resource is down.

Advantages of Peer-To-Peer Network:

- It is less costly as it does not contain any dedicated server.
- If one computer stops working but, other computers will not stop working.
- It is easy to set up and maintain as each computer manages itself.

Disadvantages of Peer-To-Peer Network:

- In the case of Peer-To-Peer network, it does not contain the centralized system . Therefore, it cannot back up the data as the data is different in different locations.
- It has a security issue as the device is managed itself.

Client/Server Network

- Client/Server network is a network model designed for the end users called clients, to access the resources such as songs, video, etc. from a central computer known as Server.
- The central controller is known as a **server** while all other computers in the network are called **clients**.
- A server performs all the major operations such as security and network management.
- A server is responsible for managing all the resources such as files, directories, printer, etc.
- All the clients communicate with each other through a server. For example, if client1 wants to send some data to client 2, then it first sends the request to the server for the permission. The server sends the response to the client 1 to initiate its communication with the client 2.

Advantages of Client/Server network:

- A Client/Server network contains the centralized system. Therefore we can back up the data easily.
- A Client/Server network has a dedicated server that improves the overall performance of the whole system.
- Security is better in Client/Server network as a single server administers the shared resources.
- It also increases the speed of the sharing resources.

Disadvantages of Client/Server network:

- Client/Server network is expensive as it requires the server with large memory.
- A server has a Network Operating System(NOS) to provide the resources to the clients, but the cost of NOS is very high.
- It requires a dedicated network administrator to manage all the resources.

DISTRIBUTED SYSTEM

A distributed system contains multiple nodes that are physically separate but linked together using the network. All the nodes in this system communicate with each other and handle processes in tandem. Each of these nodes contains a small part of the distributed operating system software.

Distributing the processing and storage functions

The processing function distributes the computing load to computers away from the central computer, DDP is chosen because storage too can be distributed.

Ex, how the ATM application works.

1. When a customer initiates a withdrawl transaction, the data associated with request are first sent to the central computer.

2. The branch at which the customer's records are maintained must be determined and the request forwarded to the appropriate branch computer.
3. The branch computer verify the customer account details whether the balance in the account.
4. If there is enough money in the account, the depositor's record will be updated to reflect the withdrawl.
5. The data are returned to the ATM, and the machine dispenses the cash and prints a receipt.
6. All these events take place with the span of a few seconds.

Advantages of Distributed System :

- **Sharing Data :** There is a provision in the environment where user at one site may be able to access the data residing at other sites.
- **Autonomy :** Because of sharing data by means of data distribution each site is able to retain a degree of control over data that are stored locally.
- In distributed system there is a global database administrator responsible for the entire system. A part of global data base administrator responsibilities is delegated to local data base administrator for each site. Depending upon the design of distributed database each local database administrator may have different degree of local autonomy.
- **Availability :** If one site fails in a distributed system, the remaining sites may be able to continue operating. Thus a failure of a site doesn't necessarily imply the shutdown of the System.

Disadvantages of Distributed Systems :

The added complexity required to ensure proper co-ordination among the sites, is the major disadvantage. This increased complexity takes various forms :

- **Software Development Cost :** It is more difficult to implement a distributed database system; thus it is more costly.
- **Greater Potential for Bugs :** Since the sites that constitute the distributed database system operate parallel, it is harder to ensure the correctness of algorithms, especially operation during failures of part of the system, and recovery from failures. The potential exists for extremely subtle bugs.
- **Increased Processing Overhead:** The exchange of information and additional computation required to achieve intersite co-ordination are a form of overhead that does not arise in centralized system.

COMMUNICATION SYSTEMS

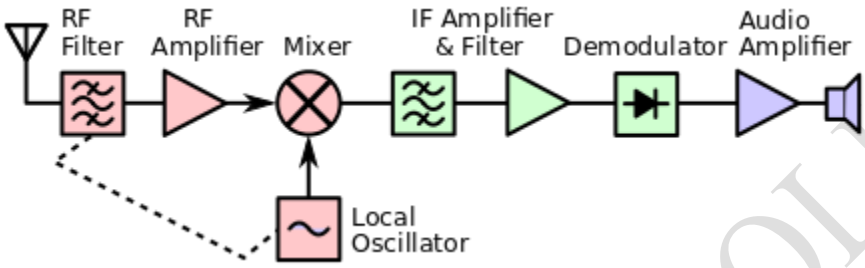
Communication is the transmission of data from one computer to another, one place to another or from one device to another. A communications device, is any machine that assists data transmission. Ex Radio, TV, Satellites are all communication devices.

Radio:

Radio waves are the basic unit of wireless communication. 3 By varying the characteristics of a radio wave—frequency, amplitude, or phase—these waves can be made to communicate information of many types, including audio, video, and data. Radio waves that carry information are called radio signals, and the process of encoding intelligence onto a radio wave so that it can be transmitted over the air is called modulation.4 In the process of modulation, the information or message to be transmitted-a human voice, recorded music, or a television signal—is impressed onto (modulates) a "carrier" radio wave that is then transmitted

over the air. When a radio signal is received, the information is converted back into its original form (demodulated) by a receiver and output as sound, images, or data.

- Commercial AM radio signals, for example, consist of very long waves (approximately 100 to 300 meters)
- Microwave signals, on the other hand, are very short (as little as 0.3 centimeters)
- Method denotes relative position in the spectrum: very low frequency (VLF), high frequency (HF), very high frequency (VHF), superhigh frequency (SHF)

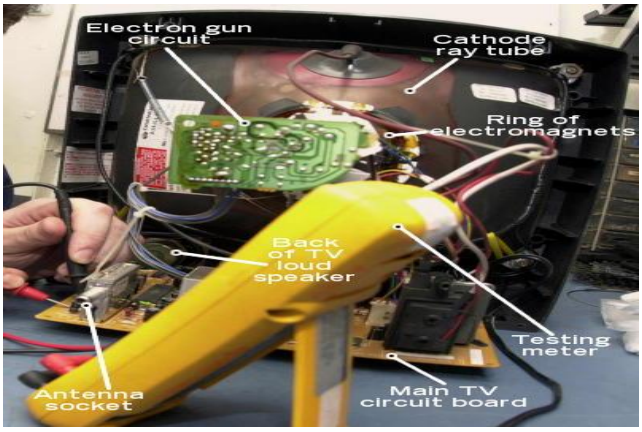


Television

Television (TV) is a telecommunication medium used for transmitting moving images in monochrome (black and white), or in colour, and in two or three dimensions and sound. The term can refer to a television set, a television program ("TV show"), or the medium of television transmission. Television is a mass medium for entertainment, education, news, politics, gossip and advertising.

How A TV Work

1. An antenna (aerial) on your roof picks up radio waves from the transmitter. With satellite TV, the signals come from a satellite dish mounted on your wall or roof. With cable TV, the signal comes to you via an underground fiber-optic cable.
2. The incoming signal feeds into the antenna socket on the back of the TV.
3. The incoming signal is carrying picture and sound for more than one station (program). An electronic circuit inside the TV selects only the station you want to watch and splits the signal for this station into separate audio (sound) and video (picture) information, passing each to a separate circuit for further processing.
4. The electron gun circuit splits the video part of the signal into separate red, blue, and green signals to drive the three electron guns.
5. The circuit fires three electron guns (one red, one blue, and one green) down a cathode-ray tube, like a fat glass bottle from which the air has been removed.
6. The electron beams pass through a ring of electromagnets. Electrons can be steered by magnets because they have a negative electrical charge. The electromagnets steer the electron beams so they sweep back and forth across the screen, line by line.



7. The electron beams pass through a grid of holes called a mask, which directs them so they hit exact places on the TV screen. Where the beams hit the phosphors (colored chemicals) on the

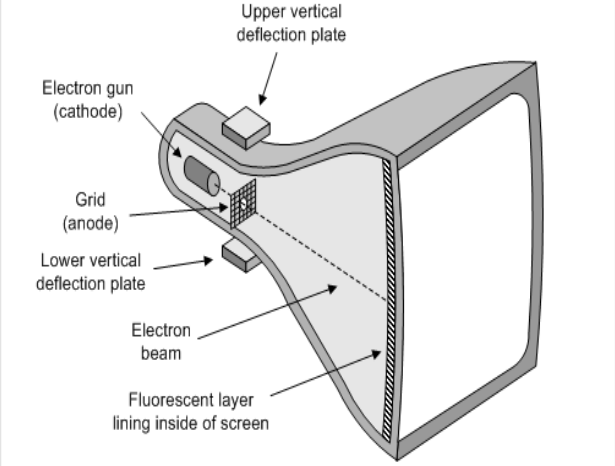
screen, they make red, blue, or green dots. Elsewhere, the screen remains dark. The pattern of red, blue, and green dots builds up a colored picture very quickly.

8. Meanwhile, audio (sound) information from the incoming signal passes to a separate audio circuit.
9. The audio circuit drives the loudspeaker (or loudspeakers, since there are at least two in a stereo TV) so they recreate the sound exactly in time with the moving picture.

How A Picture Tube Work

A CRT is an electronic tube designed to display the electrical data. The basic CRT consists of four major components.

1. Electron Gun – It is used for producing a strain of electrons.
2. Focusing & Accelerating Anodes – These are used for producing a narrow and sharply focus beam of electrons.
3. Horizontal & Vertical Deflection plates – These are used for controlling the path of the beam.



Cross-sectional representation of a cathode ray tube

Television Camera and Scanning

It is used to produce a television program. Most cameras have 3 basic elements.

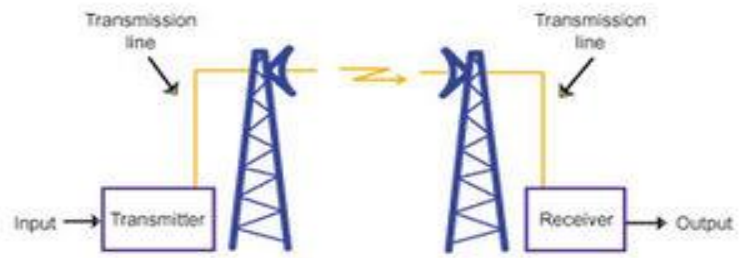
1. Optical System(lenses) – capturing an image
2. Pickup device – translating the image into electronic signals
3. Encoder – Encoding the signals so that may be transmitted.

Transmission of Television Signals

The high-frequency waves radiated by transmitting antennas can travel only in a straight line, and may be blocked by obstacles. So that reason, transmitting antennas must be placed on tall buildings or towers.

Microwave Transmission

There are several frequency ranges assigned to microwave systems, all of which are in the Giga Hertz (GHz) range and the wavelength in the millimeter range. This very short wavelength gives rise to the term microwave. Such high frequency signals are especially susceptible to attenuation and, therefore must be amplified or repeated after a particular distance.



Communication Satellites

The process of satellite communication begins at an earth station. Here an installation is designed to transmit and receive signals from a satellite in orbit around the earth. Earth stations send information to satellites in the form of high powered, high frequency (GHz range) signals.

The satellites receive and retransmit the signals back to earth where they are received by other earth stations in the coverage area of the satellite. Satellite's footprint is the area which receives a signal of useful strength from the satellite.

The transmission system from the earth station to the satellite through a channel is called the uplink.

The system from the satellite to the earth station through the channel is called the downlink.

Advantages of Satellite

The advantages of Satellite Communications are as follows −

- The Coverage area is very high than that of terrestrial systems.
- The transmission cost is independent of the coverage area.
- Higher bandwidths are possible.

Disadvantages of Satellite

The disadvantages of Satellite Communications are as follows −

- Launching satellites into orbits is a costly process.
- The bandwidths are gradually used up.
- High propagation delay for satellite systems than the conventional terrestrial systems.

ISDN

It Stands for "Integrated Services Digital Network." ISDN is a telecommunicationstechnology that enables the transmission of digital data over standard phone lines. It can be used for voice calls as well as data transfers.

Why is ISDN important

More than just a means for fast, accurate, data transmission, ISDN truly represents the next generation of the world's telephone service for all forms of telecommunications, including voice.

INTERNET

What is the Internet?

- ❖ The Internet is a global collection of computer networks that are linked together by devices called routers and use a common set of protocols for data transmission known as TCP/IP (transmission control protocol / Internet protocol).
- ❖ The primary purpose of the Internet is to facilitate the sharing of information. There are many different tools used on the Internet to make this possible.
- ❖ Some of the more common tools include email, listservs, newsgroups, telnet, gopher, FTP, and the world wide web.
- ❖ Probably the most popular of all Internet tools is the world wide web.

What is the World Wide Web (WWW)?

- ❖ The WWW is a collection of Internet sites that can be accessed by using a hypertext interface.
- ❖ Hypertext documents on the web contain links to other documents located anywhere on the web.

- ❖ By clicking on a link, you are immediately taken to another file or site to access relevant materials.
- ❖ The interesting thing about Hypertext links is that the links might take you to related material on another computer located anywhere in the world, rather than just to a file on your local hard drive.

INTERNET ACESS:

The internet in one of two basic ways, dialing into an Internet Service Provider's (ISP) computer, or with a direct connection to an internet service provider

Dial-up Connection

- 'Dial-up' connection is also known as Level Two connection. This provides connection to Internet through a dial-up terminal connection. The computer, which provides Internet access is known as 'Host' and the computer that receives the access, is 'Client' or 'Terminal'.
- The client computer uses modem to access a "host" and acts as if it is a terminal directly connected to that host. 56K modem access is now widely available and supported by most ISPs. It allows user to surf the Web at 56 Kbps with graphics. So this type of connection is also known as 'Remote Modem Access' connection. And the host to which the client gets connected is actually connected to the Internet by a full time connection (See Leased Connection).
- In dial-up connection to Internet, Host carries all the command that are typed on a client machine and forward them to Internet. It also receives the data or information from the Internet on behalf of the 'Client' and passes it to them. The client computer acts as a 'dumb' terminal connected to remote host.

Direct Connection:

- A direct connection is a situation in which one computer is directly linked to another computer by a cable instead of a network. This might be using a crossover cable instead of going through an Ethernet switch. This kind of connection is typically faster than using a network. The two computers can transfer data through this method.
- A direct connection connects two computers together. The actual method of connection can vary. It could be using a serial null modem cable, an Ethernet crossover cable or even a Wi-Fi direct connection. The thing they have in common is that two computers are connected directly without having to go through a switch or a hub.
- The main advantage is that this kind of networking is extremely simple to set up. All a user needs to connect the computers is a cable, if a wired connection is being used. Once connected, the computers can share files and even play multiplayer games over this ad hoc connection.

INTERNET PROTOCOLS:

- ➢ Transmission Control Protocol/Internet Protocol(TCP/IP)
- ➢ File Transfer Protocol(FTP)
- ➢ Hyper Text Transfer Protocol (HTTP)
- ➢ Telnet
- ➢ Gopher
- ➢ World Area Information Service(WAIS)

Transmission Control Protocol/Internet Protocol (TCP/IP)

- o TCP/IP these two protocols were developed in the early days of the Internet by the U.S. military. The purpose was to allow computers to communicate over long distance networks. The TCP part has to do with the verifying delivery of the packets.
- o The IP part refers to the moving of data packets between nodes. TCP/IP has since then become the foundation of the Internet. Therefore, TCP/IP software is built into all major operating systems, such as Unix, Windows, and the Mac OS.

- As with any form of communication, two things are needed: a message to transmit and the means to reliably transmit the message. The TCP layer handles the message part. The message is broken down into smaller units, called packets, which are then transmitted over the network.
- The packets are received by the corresponding TCP layer in the receiver and reassembled into the original message.
- The IP layer is primarily concerned with the transmission portion. This is done by means of a unique IP address assigned to each and every active recipient on the network.

File Transfer Protocol(FTP)

- File Transfer Protocol (FTP) is a client/server protocol used for transferring files to or exchanging files with a host computer. It may be authenticated with user names and passwords.
- Anonymous FTP allows users to access files, programs and other data from the Internet without the need for a user ID or password. Web sites are sometimes designed to allow users to use 'anonymous' or 'guest' as a user ID and an email address for a password. Publicly available flies are often found in a directory called pub and can be easily FTPed to a user's computer.
- FTP is also the Internet standard for moving or transferring files from one computer to another using TCP or IP networks.

Hyper Text Transfer Protocol (HTTP)

- HyperText Transfer Protocol (HTTP) is an application-layer protocol used primarily on the World Wide Web. HTTP uses a client-server model where the web browser is the client and communicates with the webserver that hosts the website.
- The browser uses HTTP, which is carried over TCP/IP to communicate to the server and retrieve Web content for the user.
- HTTP is a widely used protocol and has been rapidly adopted over the Internet because of its simplicity. It is a stateless and connectionless protocol.

A basic HTTP request involves the following steps:

1. A connection to the HTTP server is opened.
2. A request is sent to the server.
3. Some processing is done by the server.
4. A response from the server is sent back.
5. The connection is closed.

TELNET

- Telnet (TN) is a networking protocol and software program used to access remote computers and terminals over the Internet or a TCP/IP computer network. Telnet was conceived in 1969 and standardized as one of the first Internet standards by the Internet Engineering Task Force (IETF).
- Telnet is an Application layer protocol providing reliable unencrypted communication allowing users to access the command line of a computer from a remote location and provides very little security.
  - ✓ Telnet is one of the earliest protocols developed
  - ✓ Telnet provides reliable communication via TCP
  - ✓ Telnet is an Application (operates at the OSI Model's Application Layer)
  - ✓ Telnet provides access to the command prompt remotely
  - ✓ Telnet utilizes TCP/IP to support communication
  - ✓ Information is communicated as ASCII Text
  - ✓ Telnet is carried inside the payload of TCP (encapsulated in TCP)

The Telnet Protocol

The Telnet protocol is designed to provide a bi-directional, eight-bit byte oriented communications facility to allow for a standard method of interfacing terminal devices and processes.

GOPHER:

- Gopher is an application-layer protocol that provides the ability to extract and view Web documents stored on remote Web servers. The gopher system allows people to search for and retrieve information using a text interface.
- The technology is based on a client-server structure, where a gopher client program is used to search gopher servers. These servers can store documents, articles, programs, and other information.
- Instead of hyperlinks, the gopher interface uses menus of links to other documents and programs. However, this was around the same time that the World Wide Web was introduced. Because the Web used hypertext and images, it soon became the preferred way to search and browse for information.
- While there are still servers and client programs that use gopher technology, their use is not nearly as widespread as the Web.

World Area Information Service(WAIS):

- WAIS (Wide Area Information Servers) is an Internet system in which specialized subject databases are created at multiple server locations, kept track of by a *directory of servers* at one location, and made accessible for searching by users with WAIS client programs.
- The user of WAIS is provided with or obtains a list of distributed database s. The user enters a search argument for a selected database and the client then accesses all the servers on which the database is distributed.
- The results provide a description of each text that meets the search requirements. The user can then retrieve the full text.

Internet Addressing:

An Internet address uniquely identifies a node on the Internet. Internet address may also refer to the name or IP of a Web site(URL).

IP address:

An **IP address** is a number identifying of a computer or another device on the Internet. It is similar to a mailing address, which identifies where postal mail comes from and where it should be delivered. IP addresses uniquely identify the source and destination of data transmitted with the Internet Protocol.

The numerals in an IP address are divided into 2 parts:

- The network part specifies which networks this address belongs to and
- The host part further pinpoints the exact location.

Domain Names:

A domain name is your website name. A domain name is the address where Internet users can access your website. A domain name is used for finding and identifying computers on the Internet. Computers use IP addresses, which are a series of number. However, it is difficult for humans to remember strings of numbers. Because of this, domain names were developed and used to identify entities on the Internet rather than using IP addresses.

A domain name can be any combination of letters and numbers, and it can be used in combination of the various domain name extensions, such as .com, .net and more.

The domain name must be registered before you can use it. Every domain name is unique. No two websites can have the same domain name. If someone types in www.yourdomain.com, it will go to your website and no one else's.

Domains.

For example:

- **gov** - Government agencies
- **edu** - Educational institutions
- **org** - Organizations (nonprofit)
- **mil** - Military
- **com** - commercial business
- **net** - Network organizations
- **ca** - Canada
- **th** - Thailand

The following points explain how they work and how they are used:

- Domain names have two parts that are separated by a dot, such as example.com.
- A domain name can be used to identify a single IP address or group of IP addresses.
- A host or organization may use a domain name as an alternate IP address because domain names are alphanumeric (as opposed to all numbers), making them easier to memorize.
- A domain name is used as part of a URL to identify a website.
- The part that follows the dot is the top level domain (TLD), or group to which the domain name belongs. For example, .gov is the TLD for U.S. government domains.
- The IP address in the domain name's background is converted to a recognizable, alphanumeric domain name by a system known as the domain name system (DNS).

ELECTRONIC MAIL ADDRESS:

- ❖ An email address is a unique identifier for an email account. It is used to both send and receive email messages over the Internet. Similar to physical mail, an email message requires an address for both the sender and recipient in order to be sent successfully.
- ❖ Every email address has two main parts: a username and domain name. The username comes first, followed by an at (@) symbol, followed by the domain name. In the example below, "mail" is the username and "techterms.com" is the domain name.

mail@techterms.com

When a message is sent (typically through the SMTP protocol), the sending mail server checks for another mail server on the Internet that corresponds with the domain name of the recipient's address. For example, if someone sends a message to a user at techterms.com, the mail server will first make sure there is a mail server responding at techterms.com. If so, it will check with the mail server to see if the username is valid. If the user exists, the message will be delivered.

Email Address Formatting

While a basic email address consists of only a username and domain name, most email clients and webmail systems include names with email addresses. An email address that contains a name is formatted with the name first, followed by the email address enclosed in angle brackets, as shown below.

Full Name <user@domain.com>

Email can be sent to recipients with or without a name next to the email address. However, emails sent to addresses that include a name are less likely to be filtered as spam. Therefore, it is a good idea to fill in your full name when setting up an email account. Most mail clients and webmail systems will automatically include your name in your sending email address.

Uniform Resource Locator(URL)

A URL is the address of a specific webpage or file on the Internet. For example, the URL of the TechTerms website is "http://techterms.com." The address of this page is "http://techterms.com/definition/url" and includes the following elements:

1. **http://** – the URL prefix, which specifies the protocol used to access the location

2. **techterms.com** – the server name or IP address of the server
3. **/definition/url** – the path to the directory or file

While all website URLs begin with "http," several other prefixes exist. Below is a list of various URL prefixes:

- http – a webpage, website directory, or other file available over HTTP
- ftp – a file or directory of files available to download from an FTP server
- news – a discussion located within a specific newsgroup
- telnet – a Unix-based computer system that supports remote client connections
- gopher – a document or menu located on a gopher server
- wais - a document or search results from a WAIS database
- mailto - an email address (often used to redirect browsers to an email client)
- file - a file located on a local storage device (though not technically a URL because it does not refer to an Internet-based location)

World Wide Web (WWW):

- The World Wide Web, or just "the Web," as ordinary people call it, is a subset of the Internet. The Web consists of pages that can be accessed using a Web browser. The World Wide Web is what most people think of as the Internet.
- It is all the Web pages, pictures, videos and other online content that can be accessed via a Web browser. The Internet, in contrast, is the underlying network connection that allows us to send email and access the World Wide Web.
- The early Web was a collection of text-based sites hosted by organizations that were technically gifted enough to set up a Web server and learn HTML.
- It has continued to evolve since the original design, and it now includes interactive (social) media and user-generated content that requires little to no technical skills.

Web pages and HTML:

- A Web page is a document for the World Wide Web that is identified by a unique uniform resource locator (URL). HTML stands for Hyper Text Markup Language. HTML describes the structure of Web pages using markup
- A Web page can be accessed and displayed on a monitor or mobile device through a Web browser . The data found in a Web page is usually in HTML or XHTML format. The Web pages usually also contain other resources such as style sheets, scripts and images for presentation. Users may be able to navigate to other pages through hypertext links.
- A Web page is a representation of a document that is actually located at a remote site. The information on a Web page is displayed online with the help of a Web browser such as Internet Explorer, Mozilla Firefox or Google Chrome. The Web browser is connected to the Web server, where the website's contents are hosted through HTTP. Every Web page corresponds to various types of information presented to the visitor in a visual and readable manner.

WEB BROWSER:

- A web browser, or simply "browser," is an application used to access and view websites. Common web browsers include Microsoft Internet Explorer, Google Chrome, Mozilla Firefox, and Apple Safari.
- A web browser is an interface that helps a computer user gain access to all the content that is on the Internet and the hard disk of the computer. It can view images, text documents, audio and video files, games, etc. More than one web browser can also be installed on a single computer.
- The user can navigate through files, folders and websites with the help of a browser.

- When the browser is used for browsing web pages, the pages may contain certain links which can be opened in a new browser.
- Multiple tabs and windows of the same browser can also be opened.

There are four leading web browsers: Explorer, FireFox, Netscape and Safari but there are many others browsers available.

Netscape

Netscape is one of the original Web browsers. This is what Microsoft designed Internet Explorer to compete against. Netscape and IE comprise the major portion of the browser market. Netscape was introduced in 1994.

Internet Explorer

Internet Explorer (IE) is a product from software giant Microsoft. This is the most commonly used browser in the universe. This was introduced in 1995 along with Windows 95 launch and it has passed Netscape popularity in 1998.

Safari

Safari is a web browser developed by Apple Inc. and included in Mac OS X. It was first released as a public beta in January 2003. Safari has very good support for latest technologies like XHTML, CSS2 etc.

Firefox

Firefox is a new browser derived from Mozilla. It was released in 2004 and has grown to be the second most popular browser on the Internet.

Opera

Opera is smaller and faster than most other browsers, yet it is full- featured. Fast, user-friendly, with keyboard interface, multiple windows, zoom functions, and more. Java and non Java-enabled versions available. Ideal for newcomers to the Internet, school children, handicap and as a front-end for CD-Rom and kiosks.

Google Chrome

This web browser was developed by Google. Its beta and commercial versions were released in September 2008 for Microsoft Windows. It has soon become the fourth-most widely used web browser with a market share of 1.23%. The browser versions for Mac OS X are under development. The browser options are very similar to that of Safari, the settings locations are similar to Internet Explorer 7, and the window design is based on Windows Vista.

Web Browsing:

Browsing is the act of looking through a set of information quickly, without a specific sense of purpose. In the context of the internet, it usually refers to using the world wide web. The term may imply a sense of aimlessness, with the user just wasting time on the internet.

Searching the web:

An **internet search**, otherwise known as a search query, is an entry into a search engine that yields both paid and organic results. The paid results are the ads that appear at the top and the bottom of the page, and they are marked accordingly. The organic results are the unmarked results that appear in between the ads.

Web Directory:

A **web directory**, also known as a **link directory** or a **subject directory**, is a directory concerned with web sources on the World Wide Web. The purpose of the web directory is to help users find the websites they seek by providing a layer of categories and sub-categories. Each web directory creates its own categories according to primary user groups needs. For example, Yahoo Web Directory is designed for general interests. Accordingly, its main category includes links needed for daily life such as shopping, entertainment, and travel. Another type of web directory such as an academic web directory would not ordinarily carry such links.

Web directories vary in coverage, size, and purpose. Some directories such as Yahoo! or Open Directory Project are large and offer comprehensive coverage covering all types of websites on the Internet. Some directories are designed for specific search areas such as academic resources or professional information sources. Some directories such as phone books focus on narrowly specific information; namely phone numbers and addresses. We can also find small directories on personal websites, which lists information relevant and according to a webmaster's interests.

Search engines:

Search engine is a service that allows Internet users to search for content via the World Wide Web (WWW). A user enters keywords or key phrases into a search engine and receives a list of Web content results in the form of websites, images, videos or other online data. The list of content returned via a search engine to a user is known as a search engine results page (SERP).

Where to Search:

Google is the search engine of choice for most people in the world. The quality of their results tends to outshine their competitors. Search results are integrated with their other databases: Maps, News, Images, Gmail, and Videos (Google owns YouTube). Google has shifted over the years to providing results based strictly on popularity (links) to more of a focus on the user intent of queries.

Meta-search Engines:

A **metasearch engine** is an Internet tool that queries multiple search engines and then produces its own search results from the data collected. Essentially, when a user does a metasearch, they are not using just one search engine but a combination of many at once; the effect is highly optimized search results. Popular metasearch engines include MetaCrawler, Excite, and Dogpile.

While this strategy gives your search a broader scope than searching a single search engine, the results are not always better. This is because the meta search engine must use its own algorithm to choose the best results from multiple search engines. Often, the results returned by a meta search engine are not as relevant as those returned by a standard search engine.

INTERNET CHAT:

Chat is a text-based communication that is live or in real-time. For example, when talking to someone in chat any typed text is received by other participants immediately. In contrast, other text-based communications such as e-mail are modes of correspondence that are not real-time.

Internet Relay Chat (IRC):

Stands for "Internet Relay Chat." IRC is a service that allows people to chat with each other online. It operates on a client/server model where individuals use a clientprogram to connect to an IRC server. IRC is an application layer protocol that facilitates communication in the form of text. The chat process works on a client/server networking model. IRC clients are computer programs that users can install on

their system or web based applications running either locally in the browser or on 3rd party server. These clients communicate with chat servers to transfer messages to other clients.[1] IRC is mainly designed for group communication in discussion forums, called channels,[2] but also allows one-on-one communication via private messages[3] as well as chat and data transfer,[4]including file sharing.[5]

Chatting on Web:

A **web chat** is a system that allows users to communicate in real time using easily accessible web interfaces. It is a type of Internet online chat distinguished by its simplicity and accessibility to users who do not wish to take the time to install and learn to use specialized chat software.[1] This trait allows users instantaneous access and only a web browser is required to chat. Users will always get the latest version of a chat service because no software installation or updates are required.

INTRANET

- An **intranet** is a private computer network that uses Internet Protocol technologies to securely share any part of an organization's information or operational systems within that organization.
- The term is used in contrast to *internet* , a network between organizations, and instead refers to a network within an organization.

CHARACTERISTICS OF INTRANET:

- Openness – Open architecture based on internet.
- Ease of use – World Wide Web facilitates it.
- Low cost – Low network cost, license fee, client program installation expense.
- Flexibility – All of the solutions available for customizing
- Scalability – Easy to scale up and down
- Innovation – Easy to accommodate new technology.

ADVANTAGES OF THE INTRANET:

- **Cost Effectiveness**: Every business wants to save money and one of the LS intranet's main advantages is that for a low monthly or yearly fee the whole office organization can use the services of the Intranet. You don't have to worry about extra costs for faxing or posting files, just send them using the digital connection.
- **Digitized Workplace:** In today's dynamic world LS intranet provides an online workplace which connects all your workers, regardless of their location. This advantage of Intranet allows your workers to be kept up-to-date and also it creates a dynamic and unique work environment for your employees.
- **Easy Information Exchange:** With Intranet, you can send files to you colleagues in the other department with just one click of a button. Files can be uploaded, downloaded, emailed or put on a notice board in a matter of seconds.

  The intranet advantage is that you can even authorize certain people to have access to only certain files so that information remain prices are classified in cases where such organization is needed.
- **More Productivity:** Another advantage of the intranet is that information is more easily acquirable so your workers can spend more time getting their work done, rather than wasting time searching for files or data they can't seem to find. The productivity of the manager is also increased because then he or she will be able to prioritize analyzing information.

DISADVANTAGES OF THE INTRANET:

- **Information Security Risk**
  Although Intranet software does have security settings, this technology is quite susceptible to being hacked or damaged. There is a chance that data may be stolen and privacy may be violated. This puts your business and its work at quite a risk.
- **Less Personal Interaction**
  With Intranet providing a digitized workplace, there will probably be a decrease in the face-to-face interactions that the workers have since they'll be working mainly on computers. The lack of direct interaction may possibly hinder the cooperation and personal bonds between colleagues.
- **Change in Work Culture**
  With the increase in productivity that advantages of intranet bring, it will also bring in more and more customers, queries and tasks. A number of tasks compared to workers available to meet the demand may not be in proportion, which consequently leads to a pile up of work. This will send the business into chaos as they cannot meet the rapid demand.

EXTRANET

❖ An extranet is a controlled private network allowing customers, partners, vendors, suppliers and other businesses to gain information, typically about a specific company or educational institution, and do so without granting access to the organization's entire network. An extranet is often a private part of a website. It is restricted to select users through user IDs, passwords and other authentication mechanisms on a login page.

UNIT V
MULTIMEDIA

- Multimedia is content that uses a combination of different content forms such as text, audio, images, animations, video and interactive content.
- Multimedia offers a wide variety of ways of presenting content through computers and/or electronic devices.
- Multimedia finds its uses and application in various areas like business, education, entertainment, scientific research, arts, journalism, medicine, mathematics, engineering etc.
- But it has typically meant one of the following:

- Text and sound
- Text, sound, and still or animated graphic images
- Text, sound, and video images
- Video and sound
- Multiple display areas, images, or presentations presented concurrently
- In live situations, the use of a speaker or actors and "props" together with sound, images, and motion video

Multimedia widely used in the entertained and education fields. For entertainment, one can play computer games that are almost lifelike, complete with sound and motion.

WHAT IS A MULTIMEDIA FILE?

- A **multimedia file** can be any computer file that plays audio and video, audio only, or video only.
- Some examples of popular multimedia files include the .mp3 audio file, .mp4, video, and avi video, and wmv files.

WHY USE MULTIMEDIA?

- showing what things look like, how they move and how they change
- keeping an audience's interest,
- establishing personal contact
- establishing the identity and academic credibility of a speaker
- communicating the speaker's enthusiasm for the subject

MULTIMEDIA SYSTEMS

A multimedia system is a system capable of processing multimedia data and application. A multimedia system is characterized by the processing, storage, generation, manipulation and rendition of multimedia information.

Characteristics of a Multimedia system:

A Multimedia system has four basic characteristics:

- Multimedia systems must be computer controlled.
- Multimedia systems are integrated.
- The information they handle must be represented digitally.
- The interface to the final presentation of media is usually interactive

FEATURES OF A MULTIMEDIA SYSTEM:

Very High Processing Power -- needed to deal with large data processing and real time delivery of media. Special hardware common place.

Multimedia Capable File System - Needed to deliver real-time media -**e.g.** Video/Audio Streaming. Special Hardware/Software needed **e.g.** RAID technology.
Data Representations/File formats that support multimedia --- Data representations/file formats should be easy to handle yet allow for compression/decompression in real-time.
Efficient and High I/O -- input and output to the file subsystem needs to be efficient and fast. Needs to allow for real-time recording as well as playback of data. **e.g.** Direct to Disk recording systems.
Special Operating System -- to allow access to file system and process data efficiently and quickly. Needs to support direct transfers to disk, real-time scheduling, fast interrupt processing, I/O streaming **etc.**
Storage and Memory -- large storage units (of the order of 50 -100 Gb or more) and large memory (50 -100 Mb or more). Large Caches also required and frequently of Level 2 and 3 hierarchy for efficient management.
Network Support -- Client-server systems common as distributed systems common.
Software Tools -- user friendly tools needed to handle media, design and develop applications, deliver media.

COMPONENTS OF COMPUTER:

Capture devices: Video Camera, Video Recorder, Audio Microphone, Keyboards, mice, graphics tablets, 3D input devices, tactile sensors, VR devices. Digitizing /Sampling Hardware
Storage Devices: Hard disks, CD-ROMs, Jaz /Zip drives, DVD, etc
Communication Networks: Ethernet, Token Ring, FDDI, ATM, Intranets, Internets.
Computer Systems: Multimedia Desktop machines, Workstations, MPEG/VIDEO/DSP Hardware
Display Devices: CD-quality speakers, HDTV,SVGA, Hi-Res monitors, Colour printers etc.

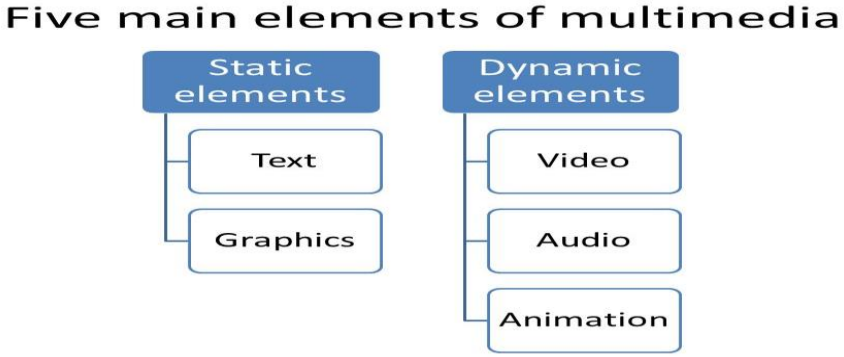
APPLICATIONS:

Examples of Multimedia Applications include:

- World Wide Web
- Hypermedia courseware
- Video conferencing
- Video-on-demand
- Interactive TV
- Groupware
- Home shopping
- Games
- Virtual reality
- Digital video editing and production systems
- Multimedia Database systems

ELEMENTS OF MULTIMEDIA:

❖ Multimedia fall into one of five main categories and use varied techniques for digital formatting. One or any combination of this content can be used to enhance your website or social media platform. Here's an overview of each of the multimedia elements:



1: Text:

As a multimedia option, text can easily be overlooked, but it is still the most fundamental element and most effective way to communicate in multimedia. Text is used as headlines, subtitles, and slogans. Its purpose is to express specific information or reinforce information in other media. It involves the use of text types, sizes, colors and background color. For example, you can choose the font and its size and color to set a tone or project an image, or you can choose the mood you want to evoke with background color.

2: Graphics:

Graphics are an important part of multimedia because humans are visually oriented. Images including photographs, illustrations, drawings, clip art, icons or any other non-text elements on a website or in social media are an example of graphics. There is no movement in these types of pictures. Still/static pictures typically accompany text to illustrate the point or ideas the text makes. Photos in a multimedia application go beyond using them just as decoration.

3: Animation:

Animated elements are common multimedia applications. Animation is a series of images put together to give the effect of movement. In multimedia, 2D and 3D digital animation is used. Movement, rather than just viewing a still image, is especially useful for illustrating concepts that involve movement. Animation is used to add visual interest or bring attention to important information or links. It can illustrate how things work or present information in entertaining ways.

4: Audio:

Sound can enhance your website design and social media platforms. It is a multimedia application that uses dialogue, recorded narration, music and sound effects. These are called the audio or sound elements. When used in moderation, adding multimedia such as sound to your presentation can be a great way to catch and focus the visitor's attention, to deliver information to visitors, and to help reinforce the visitor's comprehension of the information presented.

5: Video:

Video is a visual multimedia application that combines a sequence of images to form moving pictures and sound. Video can have an impact on websites and on social media platforms in a very unique and powerful way. You can inform the world that your company exists, spread the word about your company, grab attention to show your visitors how to do something, showcase a new product, build brand awareness, or even promote an upcoming event. You name it, you can do it with video.

6. **Images**:

When imagine graphics images you probably think of "still" images-that is ,images such as those in a photograph or drawing. There is no movement in these types of picture. Static graphics images are an important part of multimedia because humans are visually oriented. As the old Chinese proverb goes ,"A picture is worth a thousand words."Windows is also a visual environment. This makes displaying graphics images easier than it would be in a DOS-based environment.

Static graphics images have a number of formats and can be created in a number of different ways. Just as you can see an unlimited number of photographs or pictures; the types of static graphics images that you can include in a multimedia application are almost unlimited.

MULTIMEDIA AUTHORING TOOLS:

Multimedia Authoring: These are the tools which provide the capability for creating a complete multimedia presentation, including interactive user control, are called authoring tools/programs. Multimedia authoring tools provide the frame work for organizing and editing the elements of multimedia projects. Authoring software provides an integrated element for combining the content and the functions of the project. It enables the developer to combine text, graphics, audio, video and animation into an interactive presentation. Authoring system includes editing tools to create, edit and convert multimedia elements such as animation and video clips.

TYPES OF PRESENTATION:

There are two basic types of multimedia presentation- non interactive and interactive. Interactive Multimedia is any package of materials that includes some combination of texts, graphics, still images, animation, video, and audio. These materials are packaged, integrated, and linked together in some way that offers users the ability to browse, navigate and analyze these materials through various searching and indexing features, as well as the capacity to annotate or personalize these materials. non-interactive or linear presentations are like movies. In the automatic mode everything appears on the screen only for the time determined by the developer.

Presentation Graphics Programs:

Easy-to-use presentation graphics programs allow typical end-users to put together multimedia shows for presentations on their own. Originally designed to create overhead transparencies they originally allowed to add text, create outlines and bulleted lists, and illustrate key points using chart and graphs.

Professional Development Tools:

Multimedia development programs called authoring software give total control over an interactive presentation. In addition, to allowing to give the viewer interactive control over the sequence and timing of sounds, videos, graphics, and animations, they provide a scripting language in which write program to control the action.

MULTIMEDIA APPLICATION

A Multimedia Application is an application which uses a multiple media sources e.g. text, graphics, images, sound/audio, animation and/or video.

MULTIMEDIA IN EDUCATION AND TRAINING

In education, multimedia is used to produce Computer Based Training and providing reference books like Encyclopedia and Alma's. Computer based training leads the users go through the CD of the presentation text about particular and associated information in various formats. The combination of education and entertainment gives us edutainment [i.e., education with entertainment and entertainment with education.

COMPUTER BASED TRAINING:

C*omputer*-**b***ased* **t***raining* (**CBT**) is a type of education in which the student learns by executing special training programs on a computer. CBT is especially effective for training people to use computer applications because the CBT program can be integrated with the applications so that students can practice using the application as they learn.

Computer- based training allows for flexible, on the spot training, business, for example, can set up corporate training labs, so employees can update their skills without leaving the workplace. Installing software on an employee's computer or on the company network provides even more flexibility by allowing employees to update their job skill at their desks, at home, or while travelling.

MULTIMEDIA ON THE WEB

In today's world web plays a vital role in diversifying multimedia experience. It has been a broadcast medium offering various online facilities like live TV, Pre-recorded videos, photos, animations etc. During the coming years most multimedia applications experience on the internet and occur on the WWW [World Wide Web].

Plug-ins is software programs that work with web browser to display multimedia. When web browser encounters a multimedia file it hands off the data to the plug-in to play (or) display the file. Multimedia

players are also software programs that can play audio and video files both ON and OFF the web. The concept of streaming media is important to understand how media can be delivered on the web.

WEB BASED TRAINING AND DISTANCE LEARNING:

Web-based training (sometimes called e-learning) is anywhere, any-time instruction delivered over the Internet or a corporate intranet to browser-equipped learners. There are two primary models of Web-based instruction: synchronous (instructor-facilitated) and asynchronous (self-directed, self-paced). Instruction can be delivered by a combination of static methods (learning portals, hyperlinked pages, screen cam tutorials, streaming audio/video, and live Web broadcasts) and interactive methods (threaded discussions, chats, and desk-top video conferencing).

Flexibility and time

- Training may occur anytime, anyplace that there is Internet access.
- Individuals can learn at their own pace and around their own schedules within a given training time frame.
- Individuals gain access to colleagues and experts from geographic locations with whom they would ordinarily not have the opportunity to communicate.
- Individuals are able to take advantage of lifelong learning without relocating or quitting their jobs.

ELECTRONIC BOOK:

E-book (or e-book) is short for "electronic book." It is a digital publication that can be read on a computer, e-reader, or other electronic device. An electronic book (e-book) is a digital publication that can consist of text, images or a combination of both. An electronic book can be read on a proprietary digital device (an e-reader) or on a computer, which requires special software.

ELECTRONIC REFERENCE BOOKS:

An electronic reference text, sometimes called e-text, is a digital version of a reference book that uses text, graphics, sound, animation,, and video, to explain a topic or to provide additional information. The multimedia encyclopedia, Microsoft Encarta, for example includes the complete text of a multivolume encyclopedia.

NEWSPAPERS AND MAGAZINES

A multimedia newspaper and a magazine are digital versions of a m\newspaper or magazine distributed on CD, DVD, or via the World Wide Web. Today, many print-based magazines and newspapers have companion websites, which provide multimedia versions of some or all of their printed content.

MULTIMEDIA IN ENTERTAINMENT

Multimedia is heavily used in the entertainment industry, especially to develop special effects in movies and animations (VFX, 3D animation, etc.). Multimedia games are a popular pastime and are software programs available either as CD-ROMs or online. Some video games also use multimedia features. Multimedia applications that allow users to actively participate instead of just sitting by as passive recipients of information are called *interactive multimedia*.

ENTERTAINMENT AND EDUTAINMENT:

Multimedia combines the media elements of television and interactivity, thus making it ideal for entertainment. Multimedia computer games, for example, use a combination of graphics, audio, and video to create a realistic and entertaining game situation. Often the game simulates a real or fictitious. World, in which users play the role of character and have direct control of what happens in the game.

MULTIMEDIA IN MARKETING:

Marketing is one of the most crucial aspects to running a successful business. The marketing strategy that a business chooses to use can ultimately determine its success. A strong business will use social media marketing but the strongest and most successful marketing strategy will incorporate social media along with other platforms to create a multimedia marketing strategy.

VIRTUAL REALITY

- Virtual Reality (VR) is the use of computer technology to create a simulated environment. Unlike traditional user interfaces, VR places the user inside an experience. Instead of viewing a screen in front of them, users are immersed and able to interact with 3D worlds. By simulating as many senses as possible, such as vision, hearing, touch, even smell, the computer is transformed into a gatekeeper to this artificial world. The only limits to near-real VR experiences are the availability of content and cheap computing power.

BRIEF HISTORY OF VIRTUAL REALITY:

1965– Ivan Sutherland creates the first VR head-mounted display system. His device is so large and heavy that it has to be suspended from the ceiling, and its awe-inspiring (or terrifying) look gives it the nickname, 'The Sword of Damocles'.

1969 -Myron Kruegere – one of the first virtual reality computer artists – helps create 'GlowFlow', a computer controlled environment that responds to the people in it.

1984– VPL Research, one of the first companies to create VR products including its famous DataGlove, is co-founded by engineer Tom Zimmerman and dreadlocked VR pioneer and visionary Jaron Lanier.

PRESENT USES OF VIRTUAL REALITY:

Virtual reality (VR) has dominated tech headlines in recent years with its ability to immerse its users in a virtual, yet safe, world. Gaming is one of the more well-known uses for VR but its potential doesn't stop there. Here are some ways VR technology can be applied in other fields:

1. Military

The military in the UK and the US have both adopted the use of virtual reality in their training as it allows them to undertake a huge range of simulations. This is used in all branches of service.

VR can put a trainee in a number of different situations, places and environments so the military are using it for flight simulations, battlefield simulations, medic training, vehicle simulation and virtual boot camp, among other things. A key benefit for the use of VR in the military is the reduction in costs for training. In addition to this, it can safely replicate dangerous training situations.

2. Sport

VR is revolutionizing the sports industry for both players and viewers. It's used as a training aid in many sports and to help measure athletic performance and analyze technique. VR has also been used to enhance the viewer's experience of a sporting event. Broadcasters are now streaming live games in virtual reality and preparing to one day sell "virtual tickets" to live games.

3. Mental Health

VR has become a primary method for treating post-traumatic stress. Using VR exposure therapy, a person enters a re-enactment of a traumatic event.

It has also been used to treat anxiety, phobias and depression. Virtual reality technology can provide a safe environment for patients to come into contact with things they fear, whilst remaining in a controlled and safe environment.

4. Medical Training

Medical and dental students use VR to practice surgeries and procedures, allowing for a consequence free learning environment. Virtual patients are used to allow students to develop skills which can later be applied in the real world.

5. Education

Virtual reality has been adopted in education for teaching and learning situations. Students are able to interact with each other and within a three dimensional environment. Students can also be taken on virtual field trips, for example, to museums, taking tours of the solar system and going back in time to different eras. Students with special needs, such as autism, are also using VR technology. Research has found that VR can be a motivating platform to safely practice social skills for children.

E-COMMERCE

The buying and selling of products and services by businesses and consumers through an electronic medium, without using any paper documents. E-commerce is widely considered the buying and selling of products over the internet, but any transaction that is completed solely through electronic measures can be considered e-commerce. E-commerce is subdivided into three categories: business to business or B2B (Cisco), business to consumer or B2C (Amazon), and consumer to consumer or C2C (eBay). also called electronic commerce. E-commerce facilitates the growth of online business. It is categorized as follows:

- Online marketing
- Online advertising
- Online sales
- Product delivery
- Product service
- Online billing
- Online payments

DATA WAREHOUSING

A data warehousing is a technique for collecting and managing data from varied sources to provide meaningful business insights. It is a blend of technologies and components which allows the strategic use of data. It is electronic storage of a large amount of information by a business which is designed for query and analysis instead of transaction processing. It is a process of transforming data into information and making it available to users in a timely manner to make a difference.

The primary goals of a data warehouse are the following:

- Provide access to the data of an organization
- Data consistency
- Capacity to separate and combine data
- Inclusion of tools set to query, analyze, and present information
- Publish used data
- Drive business re-engineering

DATA IN THE DATA WAREHOUSE:

The collection of data used by data warehouse may be characterized as subject oriented, integrated, non-volatile, and time variant.

Subject-oriented – the data warehouse toward those major subject areas of the organization, which have been defined in the data model. Examples of typical subject areas include the following: customer, product. Transaction or activity, account, etc.,

Integrated – the data warehouse potentially can receive data from a number of sources. Each of these sources had application designers, each freely encoding, naming conventions, physical attributes, and measurement of attributes.

Nonvolatile – while it is common in the operational environment for data to be updated and therefore changed, the same is not true in the data warehouse. Data loaded and accessed but not changed.

Time-Variant - The time horizon

for data warehouse is quite extensive compared with operational systems. The data collected in a data warehouse is recognized with a particular period and offers information from the historical point of view. It contains an element of time, explicitly or implicitly.

DATAWAREHOUSE ARCHITECTURE:

The major components of a data warehouse are given below:

- Summarized data
- Operational systems of record
- Integration/ Transformation programs
- Current detail
- Data ware house architecture or metadata
- Archive

Meta data

Meta data is data about data that describes the data warehouse. It is used for building, maintaining, managing and using the data warehouse. Meta data can be classified into:

- Technical meta data, which contains information about warehouse data for use by warehouse designers and administrators when carrying out warehouse development and management tasks.
- Business Meta data, which contains information that gives users an easy-to-understand perspective of the information stored in the data warehouse.

Summary Information is a part of data warehouse that stores predefined aggregations. These aggregations are generated by the warehouse manager. Summary Information must be treated as transient. It changes on-the-go in order to respond to the changing query profiles.

The points to note about summary information are as follows −

- Summary information speeds up the performance of common queries.
- It increases the operational cost.
- It needs to be updated whenever new data is loaded into the data warehouse.
- It may not have been backed up, since it can be generated fresh from the detailed information.

Current Detail:

The heart of a data warehouse is its current detail, where the bulk of data resides. Current detail comes directly from operational systems and may be stored as raw data or as aggregation of raw data. Current detail, organized by subject area, represents the entire enterprise, rather than a given application. Current details are the lowest level of data warehousing.

System of Record:

A system record is the source of the data that feed data warehouse. Data in a data warehouse differ from operational systems data in that they can only be read, not modified. Thus, it is necessary that a data warehouse be supported with the highest quality data available.

Integration and transformation programs:

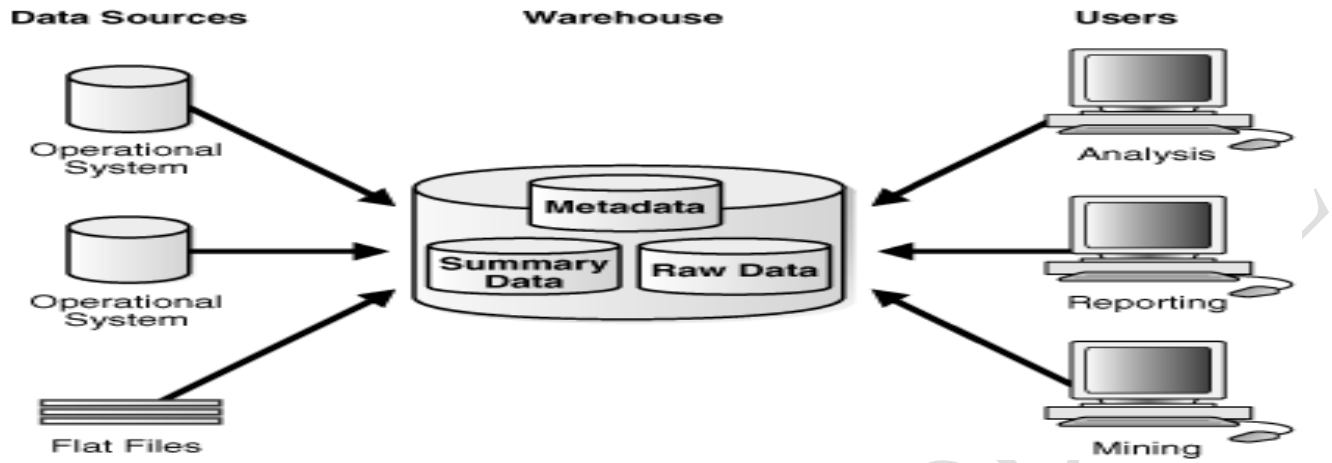
The highest quality operational data cannot usually be copied, as it is, into a data warehouse. These integration and transformation programs perform functions such as:

- Reformatting, recalculating, or modifying key structures
- Adding time elements
- Identifying default values
- Supplying logic to choose between multiple data sources
- Summarizing, tallying, and merging data from multiple sources.

Archives:

Data warehouse archives contain old data of significant, continuing interest and value to the enterprise. There is usually a massive amount of data stored in the data warehouse archives, with a low incidence of access.

DATA WAREHOUSING SYSTEMS:



The primary goal of data warehousing is that the data stored for business analysis can most effectively be accessed by separating it from the data in the operational systems. A data warehouse is a collection of computer based information that is critical to successful execution of enterprise initiatives. A data warehouse is more that an archive for corporate data and more than a new way of accessing corporate data.

One of the principal reasons for developing a data warehouse is to integrate operational data from various sources into a single and consistent architecture that supports analysis and decision making within the enterprise.

ADVANTAGES OF A DATA WAREHOUSE:

More cost effective decision-making:- A data warehousing allows reduction of staff and computer resources required to support queries and reports against operational and production databases.

Better enterprise intelligence: - Increased quality and flexibility of enterprise analysis arises from the multi-tiered data structures of a data warehouse that support data ranging from detailed transactional level to high-level summary information.

Enhanced customer services: - An enterprise can maintain better customer relationship by correlating all customer data via single data warehouse architecture.

Business re-engineering: allowing ultimate analysis information often provides an insight into enterprise processes that may yield breakthrough ideas for re engineering those processes.

Information system re-engineering:- A data warehouse that is based upon enterprise wide data requirements provides a cost-effective means of establishing both data standardization and operational system inter-operability.

DATA MINING

- Data mining is the process of **extracting the useful information**, which is stored in the large database.
- It is a powerful tool, which is useful for organizations to retrieve the useful information from available data warehouses.
- Data mining can be applied to relational databases, object-oriented databases, data warehouses, structured-unstructured databases, etc.
- Data mining is used in numerous areas like banking, insurance companies, super market etc.

WHY USE DATA MINING?

Specific data mining benefits vary depending on the goal and the industry. Sales and marketing departments can mine customer data to improve lead conversion rates or to create one-to-one marketing campaigns. Data mining information on historical sales patterns and customer behaviors can be used to build prediction models for future sales, new products and services.

WHAT CAN DATA MINING DO FOR YOU?

Most businesses and organizations collect data about their operations. They then examine this data for insights into their operations and into the transactions their business performs.

For businesses, data mining is used to discover patterns and relationships in the data in order to help make better business decisions. Data mining can help spot sales trends, develop smarter marketing campaigns, and accurately predict customer loyalty. Specific uses of data mining include:

- ***Market segmentation*** - Identify the common characteristics of customers who buy the same products from your company.
- ***Customer churn*** - Predict which customers are likely to leave your company and go to a competitor.
- ***Fraud detection*** - Identify which transactions are most likely to be fraudulent.
- ***Direct marketing*** - Identify which prospects should be included in a mailing list to obtain the highest response rate.
- ***Interactive marketing*** - Predict what each individual accessing a Web site is most likely interested in seeing.
- ***Market basket analysis*** - Understand what products or services are commonly purchased together; e.g., beer and diapers.
- ***Trend analysis*** - Reveal the difference between typical customers this month and last.

Data mining technology can generate new business opportunities by:

***Automated prediction of trends and behaviors*:** Data mining automates the process of finding predictive information in a large database. Questions that traditionally required extensive hands-on analysis can now be directly answered from the data. A typical example of a predictive problem is targeted marketing. Data mining uses data on past promotional mailings to identify the targets most likely to maximize return on investment in future mailings. Other predictive problems include forecasting bankruptcy and other forms of default, and identifying segments of a population likely to respond similarly to given events.

DATA MINING PROCESS:

Data mining is a promising and relatively new technology. Data mining is defined as a process of discovering hidden valuable knowledge by analyzing large amounts of data, which is stored in databases or data warehouse, using various data mining techniques such as machine learning, artificial intelligence(AI) and statistical.

Many organizations in various industries are taking advantages of data mining including manufacturing, marketing, chemical, aerospace… etc, to increase their business efficiency. Therefore, the needs for a standard data mining process increased dramatically. A data mining process must be reliable and it must be repeatable by business people with little or no knowledge of data mining background. As the result, in 1990, a cross-industry standard process for data mining (CRISP-DM) first published after going through a lot of workshops, and contributions from over 300 organizations.

DATA MINING METHODS:

Association:

Association is one of the best-known data mining technique. In association, a pattern is discovered based on a relationship between items in the same transaction. That's is the reason why association technique is also known as *relation technique*. The association technique is used in *market basket analysis* to identify a set of products that customers frequently purchase together.

Retailers are using association technique to research customer's buying habits. Based on historical sale data, retailers might find out that customers always buy crisps when they buy beers, and, therefore, they can put beers and crisps next to each other to save time for the customer and increase sales.

Classification:

Classification is a classic data mining technique based on machine learning. Basically, classification is used to classify each item in a set of data into one of a predefined set of classes or groups. Classification method makes use of mathematical techniques such as decision trees, linear programming, neural network, and statistics. In classification, we develop the software that can learn how to classify the data items into groups. For example, we can apply classification in the application that "given all records of employees who left the company, predict who will probably leave the company in a future period." In this case, we divide the records of employees into two groups that named "leave" and "stay". And then can ask our data mining software to classify the employees into separate groups.

Clustering:

Clustering is a data mining technique that makes a meaningful or useful cluster of objects which have similar characteristics using the automatic technique. The clustering technique defines the classes and puts objects in each class, while in the classification techniques, objects are assigned into predefined classes. To make the concept clearer, we can take book management in the library as an example. In a library, there is a wide range of books on various topics available. The challenge is how to keep those books in a way that readers can take several books on a particular topic without hassle. By using the clustering technique, we can keep books that have some kinds of similarities in one cluster or one shelf and label it with a meaningful name. If readers want to grab books in that topic, they would only have to go to that shelf instead of looking for the entire library.

Prediction:

The prediction, as its name implied, is one of a data mining techniques that discovers the relationship between independent variables and relationship between dependent and independent variables. For instance, the prediction analysis technique can be used in the sale to predict profit for the future if we consider the sale is an independent variable, profit could be a dependent variable. Then based on the historical sale and profit data, we can draw a fitted regression curve that is used for profit prediction.

Sequential Patterns:

Sequential patterns analysis is one of data mining technique that seeks to discover or identify similar patterns, regular events or trends in transaction data over a business period. In sales, with historical transaction data, businesses can identify a set of items that customers buy together different times in a year. Then businesses can use this information to recommend customers buy it with better deals based on their purchasing frequency in the past.

ADVANTAGE OF DATA MINING:

To Predict Future Trends: Most of the working nature of the systems carries on all the informational factors. And these factors belong to elements and their structure.

Also, it can be derived from these data mining systems. That they can be helpful while predicting future trends. And that is quite possible with the help of technology. And also behavioral changes adopted by the people.

Helps in Decision Making: People use these data mining techniques to help them with some kind of decision making.

Nowadays, all the information can be determined with the help of technology. Similarly, with the help of such technology one can make a precise decision about something unknown and unexpected.

Quick Fraud Detection: Basically, data mining information gathered with the help of market analysis can find fraudulent acts and products available in the market.

So, this was all about the Advantages of Data Mining. Hope you like our explanation.

TECHNOLOGIES USED IN DATA MINING:

Neural networks: Non-linear predictive models that learn through training and resemble biological neural networks in structure. In order to make meaningful predictions a neural network first has to be trained on data describing previous situation for which both, input parameters and correct reaction to them are known. Training consists of selecting weights ascribed to intra-neural connections that provided the maximal closeness of reactions produced by the network to the known correct reactions.

Rule induction: it is used in the extraction of useful if-then rules from data based on statistical significance.

Evolutionary programming: at present this is the youngest and evidently and evidently the most promising branch of data mining. The underlying idea of the method is that the system automatically formulates hypothesis about the dependence of the target variable on other variables in the form of programs expressed in an internal programming language.

Case-based reasoning (CBR): The main idea underlying this method is very simple. To forecast a future situation, or to make a correct decision, such systems find the closest past analogs of the present situation and chosen the same solution.

Decision trees: They are tree shaped structures that represent sets of decisions. These decisions generate rules for the classification of a dataset.

OLAP (ONLINE ANALYTICAL PROCESSING):

Stands for "Online Analytical Processing." OLAP allows users to analyze database information from multiple database systems at one time. While relational databases are considered to be two-dimensional, OLAP data is multidimensional, meaning the information can be compared in many different ways. For example, a company might compare their computer sales in June with sales in July, then compare those results with the sales from another location, which might be stored in a different database.

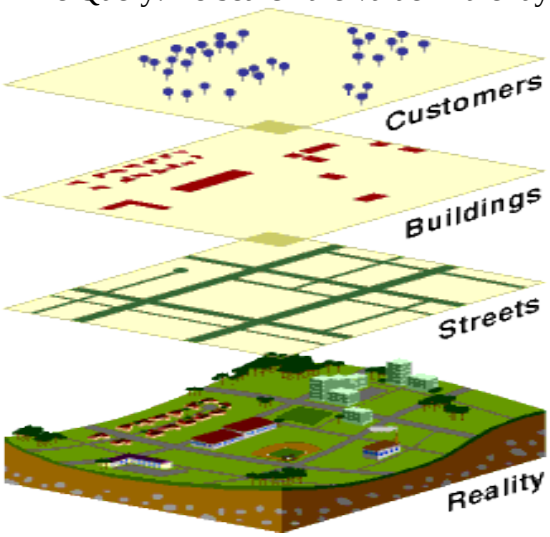
In order to process database information using OLAP, an OLAP server is required to organize and compare the information. Clients can analyze different sets of data using functions built into the OLAP server. Some popular OLAP server software programs include Oracle Express Server and Hyperion Solutions Ess base. Because of its powerful data analysis capabilities, OLAP processing is often used for data mining, which aims to discover new relationships between different sets of data.

GEOGRAPHIC INFORMATION SYSTEM:

Geographic Information System (GIS) is a computer system build to capture, store, manipulate, analyze, manage and display all kinds of spatial or geographical data. GIS applications are tools that allow end users to perform spatial query, analysis, edit spatial data and create hard copy maps. In simple way GIS can be define as an image that is referenced to the earth or has x and y coordinate and it's attribute values are stored in the table. These x and y coordinates are based on different projection system and there are various types of projection system. Most of the time GIS is used to create maps and to print. To perform the basic task in GIS, layers are combined, edited and designed.

HOW GIS WORKS:

- Visualizing Data: The geographic data that is stored in the databases are displayed in the GIS software.
- Combining Data: Layers are combined to form a maps of desire.
- The Query: To search the value in the layer or making a geographic queries.



Geographic References: geographic information contains either an explicit geographic reference, such as a latitude and longitude or national grid coordinate or implicit references such as an address, postal code, census tract name, forest stand identifier, or road name. an automated process called geocoding is used to create explicit geographic references form implicit references .

Vector and raster models:

Raster Data: Raster data store information of features in cell based manner. Satellite images, photo grammetry and scanned maps are all raster based data. Raster model are used to store data which varies continuously as in aerial photography, a satellite image or elevation values (DEM- Digital Elevation Model).

Vector Data: There are three types of vector data, points, lines and polygons. These data are created by digitizing the base data. They store information in x, y coordinates. Vectors models are used to store data which have discrete boundaries like country borders, land parcels and roads.

COMPONENT OF GIS:

Hardware: Hardware is the physical component of the computer and GIS runs on it. Hardware may be hard disk, processor, mother board and so on. All these hardware work together to function as a computer. GIS software run on these hardware. Computer can be standalone called desktop or server based. GIS can run on both of them.

Software: GIS Software provides tools and functions to input and store spatial data or geographic data. It provides tool to perform geographic query, run analysis model and display geographic data in the map form. GIS software uses Relation Database Management System (RDBMS) to store the geographic data. Software talks with the database to perform geographic query.

Data: Data are the fuel for the GIS and the most important and expensive component. Geographic data are the combination of physical features and it's information which is stored in the tables. These tables are maintained by the RDBMS. The process of capturing the geographic data are called digitization which is the most tedious job. It is the process of converting scanned hardcopy maps into the digital format. Digitization is done by tracing the lines along the geographic features for example to capture a building you will trace around the building on the image.

People: People are the user of the GIS system. People use all above three component to run a GIS system. Today's computers are fast and user friendly which makes it easy to perform geographic queries, analysis and displaying maps. Today everybody uses GIS to perform their daily job.

DATA FOR GIS:

Base Maps: base map has Watershed Boundaries, country and state boundaries, city names, and generalized rivers. Someone interested in viewing hydrographic may not be interested in major highways or National Park boundaries so these layers are excluded from the base map.

Business Maps and data: includes data related to census/demography, consumer products, financial services, health care, real estate, telecommunication, emergency preparedness, crime, advertising, business establishments, and transportation.

Environmental Maps and Data: includes data related to the environment, weather, environment risk, satellite imagery, topography, and natural resources.

General References Maps: world and country maps and data that can be foundation for your database.

GIS AND RELATED TECHNOLOGY:

GISs are closely related to several other types of information systems, but it is the ability to manipulate and analyze geographic data that sets GIS technology apart. Although there are no hard and fast rules about how to classify information systems, the following discussion should help differentiate GIS from desktop mapping, computer-aided design (CAD), remote sensing, DBMS, and global positioning systems (GPS) technologies.

Desktop Mapping: A desktop mapping system uses the map metaphor to organize data and user interaction. The focus of such systems is the creation of maps: the map is the database. Most desktop mapping systems have more limited data management, spatial analysis, and customization capabilities. Desktop mapping systems operate on desktop computers such as PCs, Macintoshes, and smaller UNIX workstations.

CAD: CAD systems evolved to create designs and plans of buildings and infrastructure. This activity required that components of fixed characteristics be assembled to create the whole structure. These systems require few rules to specify how components can be assembled and very limited analytical capabilities. CAD systems have been extended to support maps but typically have limited utility for managing and analyzing large geographic databases.

Remote Sensing and GPS: Remote sensing is the art and science of making measurements of the earth using sensors such as cameras carried on airplanes, GPS receivers, or other devices. These sensors collect data in the form of images and provide specialized capabilities for manipulating, analyzing, and visualizing those images. Lacking strong geographic data management and analytical operations, they cannot be called true GISs.

DBMS: Database management systems specialize in the storage and management of all types of data including geographic data. DBMSs are optimized to store and retrieve data and many GISs rely on them for this purpose. They do not have the analytic and visualization tools common to GIS.

What Can GIS Do for You?

Perform Geographic Queries and Analysis

The ability of GISs to search databases and perform geographic queries has saved many companies literally millions of dollars. GISs have helped reduce costs by

- Streamlining customer service.
- Reducing land acquisition costs through better analysis.
- Reducing fleet maintenance costs through better logistics.
- Analyzing data quickly, as in this example:

Improve Organizational Integration: Many organizations that have implemented a GIS have found that one of its main benefits is improved management of their own organization and resources. Because GISs have the ability to link data sets together by geography, they facilitate interdepartmental information sharing and communication. By creating a shared database, one department can benefit from the work of another - data can be collected once and used many times.

Make Better Decisions: The old adage "better information leads to better decisions" is as true for GIS as it is for other information systems. A GIS, however, is not an automated decision making system but a tool to query, analyze, and map data in support of the decision making process. GIS technology has been used to assist in tasks such as presenting information at planning inquiries, helping resolve territorial disputes, and sitting pylons in such a way as to minimize visual intrusion.

Making Maps: Maps have a special place in GIS. The process of making maps with GIS is much more flexible than are traditional manual or automated cartography approaches. It begins with database creation. Existing paper maps can be digitized and computer-compatible information can be translated into the GIS. The GIS-based cartographic database can be both continuous and scale free. Map products can then be created centered on any location, at any scale, and showing selected information symbolized effectively to highlight specific characteristics.

Making GIS Data Work for You

In today's global community, the more information you have at your fingertips, the easier it is to make an informed decision. In today's high-tech world, information comes in many different ways, from company reports and statistics from down the hall to digital photos and multimedia from across the world.

Information can be overwhelming and the need for timely decisions calls not only for innovative ways to access accurate, up-to-the minute information, but also tools to help present the information in useful ways.

A geographic information system or GIS allows you to bring all types of data together based on the geographic and location component of the data.

What is GPS: The Global Positioning System (GPS) is a U.S.-owned utility that provides users with positioning, navigation, and timing (PNT) services. This system consists of three segments: the space segment, the control segment, and the user segment. The U.S. Air Force develops, maintains, and operates the space and control segments.

- **Space Segment:** The space segment consists of a nominal constellation of 24 operating satellites that transmit one-way signals that give the current GPS satellite position and time.
- **Control Segment:** The control segment consists of worldwide monitor and control stations that maintain the satellites in their proper orbits through occasional command maneuvers, and adjust the satellite clocks. It tracks the GPS satellites, uploads updated navigational data, and maintains health and status of the satellite constellation.
- **User Segment:** The user segment consists of the GPS receiver equipment, which receives the signals from the GPS satellites and uses the transmitted information to calculate the user's three-dimensional position and time.

COMPUTERS IN BUSINESS AND INDUSTRY

The basic business operations like decision making, customer services, operations, marketing strategies, financial management, Human Resources management, etc. are done are being reformed with the use of computers. Most of our current day business operations are dependent on computers either partially or entirely.

Office Automation

It is defined as using computer and communication technology to help people better use and manage information . Office Automation technology includes all types of computers, telephones, electronic mail and office machines that use microprocessors or other high-technology

components. There are five primarily technologies used in managing information in office automation:

- Text or Written words.
- Data , as in numbers or other non- text forms.
- Graphics, including drawings , charts and photographs.
- Audio, as in telephone, voice mail or voice recognition systems
- Video, such as captures images, videotapes or teleconferencing.

Transaction processing:

Most business activity involves Transactions activities with suppliers, employees , or customers. Computer can make these transactions possible.

COMPUTERS IN INDUSTRY

Computers are used in industry in different types of systems. Computer-controlled robots are used to perform many complicated jobs in industry. Robots are computer controlled programmable machines. They can perform mechanical jobs, too, like pick and place different parts, welding or painting cars etc. Perhaps the most popular applications of robots are in industrial welding. The repeatability, uniformity quality, and speed of robotic welding is unmatched.

Computer controlled Robots can be found in the manufacturing industry, the military, space exploration, transportation, and medical applications.

Design Systems

Computer programs are used to design the model of a product on the computer. This process is called Computer Aided Design or CAD. Due to CAD, we can test the designed product with the help of computer. When the design is completed successfully, the actual product is manufactured.

Automated Production Systems

Today, computer-controlled robots are used to assemble cars. No doubt, these systems work faster than human beings. Another popular and efficient use for computer controlled robots is in the field of spray painting. The consistency and repeatability of a robot's motion have enabled near perfect quality painting while at the same time wasting no paint and leaving no place without paint.

COMPUTERS IN HOME

1. ***Home Budget*** - Computer can be used to manage the home budget. The user can easily calculate expenses and income. It can list all expenses in one column and income in another column. It can apply any calculation on these columns to plan home budget.
2. ***Computer Games*** - An important use of computer at home is playing games. Different types of games are available. These games are a source of entertainment and recreation. Many games are available that are specially developed to improve your mental capability and thinking power.
3. ***Working from Home*** - People can manage office work at home. The owner of a company can check the work of employees from home. He can control his office while sitting at home.
4. ***Entertainment*** - People can find entertainment on the internet using computer. They can watch movies, hear songs and download different stuff. They can also watch live matches on internet.

5. ***Information*** - Any person can find any type of information from internet. Educational and informative websites are available to download books, tutorials etc. to improve knowledge.
6. ***Chatting*** - You can chat with your friends on internet. You can also talk with them. Different messages, files and information can be sent to them.

COMPUTERS IN EDUCATION & INDUSTRY

Computers are being used actively in educational institutes to improve the learning process. Teachers can use audio video aids through computer to prepare lesson plans. They can use Microsoft Power Point to prepare electronic presentations about their lectures. These electronic presentations will be displayed on multimedia projectors in class rooms. This will be interesting and easy to learn for students. Multimedia presentations are easy to deliver for teachers too. Computers will be helpful for:

1. Instructing the students using PowerPoint slides, Word documents or Web pages and using hyperlinks for better concept clarity.
2. Helps in improving pronunciation of students by using microphones, earphones, speakers, specially prepared software and special dedicated websites.
3. Encouraging the students to use internet, surf web pages and gather relevant detailed information through search engines.

Online Education

Many web sites provide online education. You can read or download educational material and books.

Research

Computers are also used for research work. Internet is a huge source of information on any topic. Different researchers can share their research work using Internet.

Administration

Computers are being used to perform many tasks in educational institutions, easily and quickly:

Keeping Records of students

- o Storing Records of employees of school / college
- o Managing Accounts of the institution
- o Fees collection and maintenance of fees record.
- o Circulation of instruction/notices and getting it in printed form
- o Preparation of school/ college magazine, etc.

UNITS COMPLETED