HARDWARE CONCEPTS

BASIC COMPUTER OPERATIONS

The central processing unit (CPU, occasionally Central Processing Unit) is the hardware within a computer system which carries out the instructions of a computer program by performing the basic arithmetic, logical, and input/output(I/O) operations specified by the instructions. The term CPU has been in use in the computer industry at least since the early 1960s. The form, design, and implementation of CPUs have changed over the course of their history, but their fundamental operation remains almost unchanged.
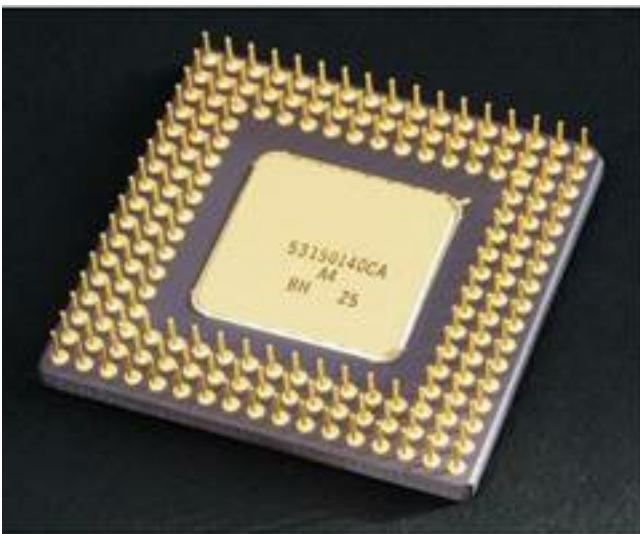
A computer as shown below performs basically five major operations or functions irrespective of their size and make. These are

1) it accepts data or instructions by way of input,

2) it stores data,

3) it can process data as required by the user,

4) it gives results in the form of output, and

5) it controls all operations inside a computer. Each of these operation is mentioned in the figure given below:
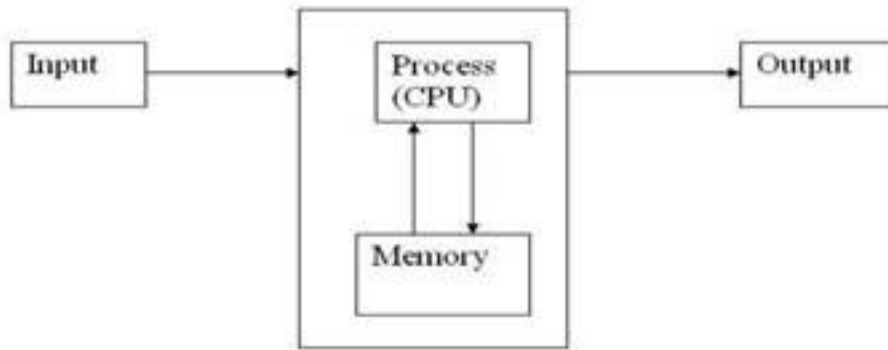
1. **Input:-** In computing, an input device is any peripheral (piece of computer hardware equipment) used to provide data and control signals to an information processing system such as a computer or other information appliance.

2. **Storage:-** Storage Devices are the data storage devices that are used in the computers to store the data. The computer has many types of data storage devices. Some of them can be classified as the removable data Storage Devices and the others as the non removable data Storage Devices.
The memory is of two types: one is the primary memory and the other one is the secondary memory.
The primary memory is the volatile memory and the secondary memory is the non volatile memory. The volatile memory is the kind of the memory that is erasable and the non volatile memory is the one where in the contents cannot be erased. Basically when we talk about the data storage devices it is generally assumed to be the secondary memory.

HARDWARE

SOFTWARE

The secondary memory is used to store the data permanently in the computer. The secondary storage devices are usually as follows: hard disk drives - this is the most common type of storage device that is used in almost all the computer systems. The other ones include the floppy disk drives, the CD ROM, and the DVD ROM. The flash memory, the USB data card etc.

The storage unit performs the following major functions: All data and instructions are stored here before and after processing. Intermediate results of processing are also stored here.

3. **Processing:-** The task of performing operations like arithmetic and logical operations is called processing. The Central Processing Unit (CPU) takes data and instructions from the storage unit and makes all sorts of calculations based on the instructions given and the type of data provided. It is then sent back to the storage unit.

4. **Output:-** This is the process of producing results from the data for getting useful information. Similarly the output produced by the computer after processing must also be kept somewhere inside the computer before being given to you in human readable form. Again the output is also stored inside the computer for further processing.

5. **Control:-** The manner how instructions are executed and the above operations are performed. Controlling of all operations like input, processing and output are performed by control unit. It takes care of step by step processing of all operations inside the computer.

Arithmetic Logical Unit (ALU)

In computing, an arithmetic and logic unit (ALU) is a digital circuit that performs arithmetic and logical operations. The ALU is a fundamental building block of the central processing unit of a computer, and even the simplest microprocessors contain one for purposes such as maintaining timers.

Control Unit (CU)

The control unit coordinates the components of a computer system. It fetches the code of all of the instructions in the program. It directs the operation of the other units by providing timing and control signals.

All computer resources are managed by the CU. It directs the flow of data between the Central Processing Unit (CPU) and the other devices.

Central Processing Unit (CPU)

The ALU and the CU of a computer system are jointly known as the central processing unit. You may call CPU as the brain of any computer system. It is just like brain that takes all major decisions, makes all sorts of calculations and directs different parts of the computer functions by activating and controlling the operations.

Personal Computer Configuration

Now let us identify the physical components that make the computer work. These are

1. Central Processing Unit (CPU)

2. Computer Memory (RAM and ROM)

3. Data bus

4. Ports

5. Motherboard

6. Hard disk

7. Output Devices

8. Input Devices

All these components are inter-connected for the personal computer to work.

Memory

There are two kinds of computer memory: primary and secondary. Primary memory is accessible directly by the processing unit. RAM is an example of primary memory. As soon as the computer is switched off the contents of the primary memory is lost. You can store and retrieve data much faster with primary memory compared to secondary memory. Secondary memory such as floppy disks, magnetic disk, etc., is located outside the computer. Primary memory is more expensive than secondary memory. Because of this the size of primary memory is less than that of secondary memory.

Random Access Memory (RAM):- It is a form of computer data storage. A random-access

device allows stored data to be accessed in very nearly the same amount of time for any storage location, so data can be accessed quickly in any random order. In contrast, other data storage media such as hard disks, CDs, DVDs and magnetic tape read and write data only in a predetermined order, consecutively, because of mechanical design limitations. Therefore the time to access a given data location varies significantly depending on its physical location. This memory is a volatile memory. The two main forms of modern RAM are static RAM (SRAM) and dynamic RAM (DRAM).

Read Only Memory (ROM):- Read-only memory (ROM) is a class of storage medium used in computers and other electronic devices. Data stored in ROM cannot be modified, or can only be modified slowly or with difficulty, so it is mainly used to distribute firmware (software that is very closely tied to specific hardware, and unlikely to need frequent updates). The memories, which do not loose their content on failure of power supply.

INPUT DEVICES

Input devices are necessary to convert our information or data in to a form which can be understood by the computer. A good input device should provide timely, accurate and useful

data to the main memory of the computer for processing. The following are the most useful input devices.

Keyboard:- A 'keyboard' is a human interface device which is represented as a layout of buttons. Each button, or key, can be used to either input a linguistic character to a computer, or to call upon a particular function of the computer. Traditional keyboards use spring-based buttons, though newer variations employ virtual keys, or even projected keyboards. On the basis of KEYS-LAYOUT they are of two types:

a) QWERTY Keyboard

b) Dvorak Keyboard

Mouse:- The mouse, sometimes called a *pointer*, is a hand-operated input device used to manipulate objects on a computer screen.Whether the mouse uses a laser or ball, or is wired or wireless, a movement detected from the mouse sends instructions to the computer to move the cursor on the screen in order to interact with files, windows, and other software elements. Even though the mouse is a peipheral device that sits outside the main computer housing, it's an essential piece of computer hardware in most systems. Analog devices, such as 3D mice, joysticks, or pointing sticks, function by reporting their angle of deflection. Movements of the pointing device are echoed on the screen by movements of the pointer, creating a simple, intuitive way to navigate a computer's GUI. There are Four types of mouse

a) Mechanical Mouse

b) Opto-Mechanical Mouse

c) Optical Mouse

d) Wireless Mouse

Light Pen:- A light pen, also called a selector pen, is a computer input device in the form of a light- sensitive wand used in conjunction with a computer's CRT(Cathode Ray Tube) display.

It allows the user to point to displayed objects or draw on the screen in a similar way to a touchscreen but with greater positional accuracy.

Scanner:- In computing, an image scanner—often abbreviated to just scanner—is a device that optically scans images, printed text, handwriting, or an object, and converts it to a digital image. Common examples found in offices are variations of the desktop (or flatbed) scanner where the document is placed on a glass window for scanning. Hand-held scanners, where the device is moved by hand, have evolved from text scanning "wands" to 3D scanners used for industrial design, reverse engineering, test and measurement, orthotics, gaming and other applications. Mechanically driven scanners that move the document are typically used for large-format documents, where a flatbed design would be impractical.

a) Hand held scanner

b) Flat Bed Scanner

Optical Character Recognition (OCR):- Optical Character Recognition, usually abbreviated to OCR, is the mechanical or electronic conversion of scanned images of handwritten,

typewritten or printed text into machine-encoded text. It is widely used as a form of data entry from some sort of original paper data source, whether documents, sales receipts, mail, or any number of printed records.

Smart Card Reader:- A smart card, chip card, or integrated circuit card (ICC) is any pocket-sized card with embedded integrated circuits. It is a common method of digitizing printed texts so that they can be electronically searched, stored more compactly, displayed on-line, and used in machine processes such as machine translation

Barcode Reader:- A barcode reader (or barcode scanner) is an electronic device for reading printed barcodes. Like a flatbed scanner, it consists of a light source, a lens and a light sensor translating optical impulses into electrical ones. Additionally, nearly all barcode readers contain decoder circuitry, analyzing the barcode's image data provided by the sensor and sending the barcode's content to the scanner's output port. There are five basic kinds of barcode readers -- pen wands, slot scanners, Charge-Couple Device (CCD) scanners, image scanners, and laser scanners.

Biometric Sensor:- Biometrics (or biometric authentication) refers to the identification of humans by their characteristics or traits. Biometrics is used in computer science as a form of identification and access control. It is also used to identify individuals in groups that are under surveillance. Many physical characteristics may be scanned by a biometric sensor including eyes, fingerprints, or DNA. Sensors contain an analog to digital converter enabling it to digitize the image and store the digital information in memory so that it can verify the user next time he or she needs to authenticate their identity.

Web Camera:- A webcam is a video camera that feeds its images in real time to a computer or computer network, often via USB, ethernet, or Wi-Fi.

Their most popular use is the establishment of video links, permitting computers to act as videophones or videoconference stations. The common use as a video camera for the World Wide Web gave the webcam its name.

OUTPUT DEVICES

Visual Display Unit:- A monitor or display (also called screen or visual display unit) is an electronic visual display for computers. The monitor comprises the display device, circuitry,

and an enclosure. The display device in modern monitors is typically a thin film transistor liquid crystal display (TFT-LCD) thin panel, while older monitors use a cathode ray tube (CRT) about as deep as the screen size.

Terminals: It is a very popular interactive input-output unit. It can be divided into two types: hard copy terminals and soft copy terminals. A hard copy terminal provides a printout on paper whereas soft copy terminals provide visual copy on monitor. A terminal when connected to a CPU sends instructions directly to the computer. Terminals are also classified as dumb terminals or intelligent terminals depending upon the work situation.

Printer:- In computing, a printer is a peripheral which produces a representation of an electronic document on physical media such as paper or transparency film. Many printers are local peripherals connected directly to a nearby personal computer. Network printers have built-in network interfaces can serve any user on the network. Individual printers are often designed to support both local and network connected users at the same time. Some printers can print documents stored on memory cards or from digital cameras and scanners. Multifunction printers (MFPs) include a scanner and can copy paper documents or send a fax; these are also called multi-function devices (MFD), or all-in-one (AIO) printers. Most MFPs include printing, scanning, and copying among their many features.
Depending on their speed and approach of printing, printers are classified as impact and non-impact printers.

Impact printers:- Uses the familiar typewriter approach of hammering a typeface against the paper and inked ribbon. Dot-matrix printers are of this type.

Non-impact printers:- Do not hit or impact a ribbon to print. They use electro-static chemicals and ink-jet technologies. Laser printers and Ink-jet printers are of this type. This

type of printers can produce color printing and elaborate graphics.

Ink-jet (bubble-jets) printers:- Ink-jets(bubble-jets) printers spray ionized tiny drops of ink onto a page to create an image. This is achieved by using magnetized plates which direct the ink's path onto the paper in the desired pattern. Almost all ink-jets offer a color option as standard, in varying degrees of resolution.

Laser Printers:- Laser printers operate by shining a laser beam to produce an image on a drum. The drum is then rolled through a pool, or reservoir, or toner, and the electrically charged portions of the drum pick up ink. Finally, using a combination of heat and pressure, the ink on the drum is transferred onto the page. Laser printers print very fast, and the supply cartridges work a long time. Color laser printers use the same toner-based printing process as black and white (B/W) laser printers, except that they combine four different toner colors.

Plotters:- Plotters are large-scale printers that are very accurate at reproducing line drawings. They are commonly used for technical drawings such as engineering drawings or architectural blueprints. The two basic types of plotters are called flatbed plotters and drum plotters. Flatbed plotters are horizontally aligned with a flat surface to which a piece of

paper is attached. The paper remains stationary and the printer moves pens across the paper to draw the image. Drum plotters, also called upright plotters, are vertically positioned. They have a drum that the paper rolls on. Drum plotters usually make more noise and are more compact than flatbed plotters.


Secondary Storage Device:- Alternatively referred to as external memory and auxiliary storage, secondary storage is a storage medium that holds information until it is deleted or overwritten regardless if the computer has power. For example, a floppy disk drive and hard disk drive are both good examples of secondary storage devices.

Magnetic Tapes:- The Magnetic Tapes is the Type of Secondary Storage Device and this Device is used for taking backup of data and this tape contains some magnetic fields and the Magnetic Tapes are used accessing the data into the Sequential Form and the tape also contains a ribbon which is coated on the single side of the tape and also contains a head which reads the data which is recorded on to the tape. And when we are reading the information from the disk then we can also read backward information means we can also back the tape for reading the previous information. And for inserting the tape into the system we also require some tape drives which contains tape and which is responsible for reading the contents from the tapes. They can store huge amount of data into the tape drive, but the main limitation of the tape drive is that we can not access the data from the disks directly, means if we want to 100th record from the tape then we must have to move all the previous i.e. 99th records first. And the tapes can also be easily damaged due to the Human Errors.

Magnetic Disks:- Magenitc Disks is also called as the hard 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.

The plate of disk is divided into the tracks and sectors and the collection of tracks makes a cylinder means all the tracks of the disk which a consecutive areas makes a cylinder.
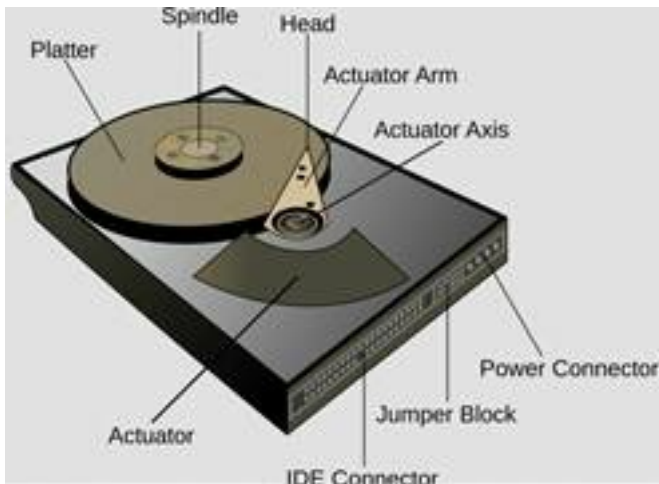
Floppy Diskette:- A floppy disk, or diskette, is a disk storage medium composed of a disk of thin and flexible magnetic storage medium, sealed in a rectangular plastic carrier lined with fabric that removes dust particles. They are read and written by a floppy disk drive (FDD). A floppy disks, initially as 8-inch media and later in 5.25-inch and 3.5-inch sizes.

The floppy disk is also called as Reusable Disk means the floppy disk provides us the facility to Read and Write the data into disk as and when necessary and also many times. We can Read and Write the data from the disk.

DVD:- DVD stands for Digital Versatile/Video Disc, DVD is an optical disc storage format, invented and developed by Philips, Sony, Toshiba, and Panasonic in 1995. DVDs offer higher storage capacity than Compact Discs while having the same dimensions.

Pre-recorded DVDs are mass-produced using molding machines that physically stamp data onto the DVD. Such discs are known as DVD-ROM, because data can only be read and not written nor erased. Blank recordable DVD discs (DVD-R and DVD+R) can be recorded once using a DVD recorder and then function as a DVD-ROM. Rewritable DVDs (DVD-RW, DVD+RW, and DVD-RAM) can be recorded and erased multiple times.

USB Drives:- A USB flash drive is a data storage device that includes flash memory with an integrated Universal Serial Bus (USB) interface. USB flash drives are typically removable and rewritable, and physically much smaller than a floppy disk. USB drives are currently available in USB 2.0 with USB 3.0 hitting the market now. These small plug-and-play drives are removable, re-writable, and great for storing personal and professional data, as many are hardware-encrypted devices for ultimate security.

Memory Card:- A memory card or flash card is an electronic flash memory data storage device used for storing digital information. They are commonly used in many electronic devices, including digital cameras, mobile phones, laptop computers, MP3 players and video game consoles. They are small, re-recordable, and able to retain data without power. There are a number of memory cards on the market, including the SD card (secure digital card), the CF card (Compact Flash card), the Smart Media card, the Memory Stick, and the Multimedia Card.

Quantities of bytes							
Common prefix				Binary prefix			
Name	Symbol	Decimal SI	Binary JEDEC	Name	Symbol		Binary IEC
kilobyte	KB/kB	10^3	2^{10}	kibibyte	KiB		2^{10}
megabyte	MB	10^6	2^{20}	mebibyte	MiB		2^{20}
gigabyte	GB	10^9	2^{30}	gibibyte	GiB		2^{30}
terabyte	TB	10^{12}	2^{40}	tebibyte	TiB		2^{40}
petabyte	PB	10^{15}	2^{50}	pebibyte	PiB		2^{50}
exabyte	EB	10^{18}	2^{60}	exbibyte	EiB		2^{60}
zettabyte	ZB	10^{21}	2^{70}	zebibyte	ZiB		2^{70}
yottabyte	YB	10^{24}	2^{80}	yobibyte	YiB		2^{80}

Flash Drives:-

Also known as thumb drives because of their size or as USB drives because that's the port they connect to, flash drives are an extremely popular way to store data in a compact and portable fashion. Flash drives range in data capacity up to a whopping one terabyte (1,000GB) as of February 2012.

External Hard Drives:-

External hard drives are exactly like the hard drive on any computer except they are outside of your computer. They usually connect through a USB port (similar to flash drives), are designed either for desktops or laptops and have a storage capacity of up to 2TB or more.

Large companies or other individuals who need secure storage often use technologies that involve combined external hard drives set up in RAID or other hot-swappable, fault-tolerant configurations.

Smart Cards:-

Smart cards are also known as memory cards. The usage and types of smart cards have evolved over the years from primary usage in laptops to cell phones and Personal Digital Assistants (PDAs). Many printers, laptops and other computers come with slots for various types of memory cards; SD cards in particular are quite popular and for the most part top out at about 2GB.

Online Storage:-

Also called "remote backup," or "cloud storage," online storage sites allow you to store information on a company's servers. SugarSync, Dropbox, IDrive and numerous other sites provide these services for free; more storage space is typically available for a fee.

Re-writable CDs and DVDs:-

Rewritable CDs and DVDs look exactly like CDs and DVDs you can buy in a store with music and movies on them, except in the case of rewritables you can store information on them. They are often used to store music, text files, photos, and other data. CD rewritables can hold up to about 700MB, DVD rewritables can hold up to about 4.7GB and Blu-ray rewritables, which are starting to become popular at the time of this writing, can hold about 25GB.

SOFTWARE CONCEPTS

Types of Software
Operating System:-

An operating system (OS) is a collection of software that manages computer hardware resources and provides common services for computer programs. The operating system is a vital component of the system software in a computer system. Application programs require an operating system to function. For hardware functions such as input and output and memory allocation, the operating system acts as an intermediary between programs and the computer hardware . The most popular and latest ones include the Windows XP, Mac, UNIX, Linux, Windows Vista, etc.

Functions of an Operating System

The major functions of an OS are:

- resource management,

- data management,

- job (task) management, and

- standard means of communication between user and computer.

The resource management function of an OS allocates computer resources such as CPU time, main memory, secondary storage, and input and output devices for use.

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

Need of an Operating System:-

At the simplest level, an operating system does two things:

1. It manages the hardware and software resources of the system. In a desktop computer,

these resources include such things as the processor, memory, disk space, etc. (On a cell phone, they include the keypad, the screen, the address book, the phone dialer, the battery and the network connection.)

2. It provides a stable, consistent way for applications to deal with the hardware without having to know all the details of the hardware.

The first task, managing the hardware and software resources, is very important, as various programs and input methods compete for the attention of the central processing unit (CPU) and demand memory, storage and input/output (I/O) bandwidth for their own purposes. In this capacity, the operating system plays the role of the good parent, making sure that each application gets the necessary resources while playing nicely with all the other applications, as well as husbanding the limited capacity of the system to the greatest good of all the users and applications.

The second task, providing a consistent application interface, is especially important if there is to be more than one of a particular type of computer using the operating system, or if the hardware making up the computer is ever open to change. A consistent application program interface (API) allows a software developer to write an application on one computer and have a high level of confidence that it will run on another computer of the same type, even if the amount of memory or the quantity of storage is different on the two machines.

In earlier day's user had to design the application according to the internal structure of the hardware. Operating System was needed to enable the user to design the application without concerning the details of the computer's internal structure. In general the boundary between the hardware & software is transparent to the user.

1. Easy interaction between the human & computer.

2. Starting computer operation automatically when power in turned on.

3. Loading & scheduling users program.

4. Controlling input & output.

5. Controlling program execution.

6. Managing use of main memory.

7. Providing security to users program.

For hardware functions such as input and output and memory allocation, the Operating System acts as an intermediary between application programs and the computer hardware, although the application code is usually executed directly by the hardware and will frequently call the OS or be interrupted by it.

Process management:-
It deals with running multiple processes. Most operating system allows a process to be assigned a priority which affects its allocation of CPU time. Interactive operating systems also employ some level of feedback in which the task with which the user is working receives higher priority. In many systems there is a background process which runs when no other process is waiting for the CPU.

Memory management:-
It is the act of managing computer memory. The essential requirement of memory management is to provide ways to dynamically allocate portions of memory to programs at their request, and freeing it for reuse when no longer needed. This is critical to the computer system.
Several methods have been devised that increase the effectiveness of memory management. Virtual memory systems separate the memory addresses used by a process from actual physical addresses, allowing separation of processes and increasing the effectively available amount of RAM using paging or swapping to secondary storage. The quality of the virtual memory manager can have an extensive effect on overall system performance.

Disk and file systems:-
Operating systems have a variety of native file systems that controls the creation, deletion, and access of files of data and programs.

Networking:-
A computer network, or simply a network, is a collection of computers and other hardware components interconnected by communication channels that allow sharing of resources and information. Where at least one process in one device is able to send/receive data to/from at least one process residing in a remote device, then the two devices are said to be in a network. Simply, more than one computer interconnected through a communication medium for information interchange is called a computer network.
Networks may be classified according to a wide variety of characteristics, such as the medium used to transport the data, communications protocol used, scale, topology, and organizational scope.

Security:-
Most operating systems include some level of security.

Language Processor

Assembler:-

It is a computer program to translate between lower-level representations of computer programs; it converts basic computer instructions into a pattern of bits which can be easily understood by a computer and the processor can use it to perform its basic operations.

Compiler:-

A compiler is a computer program (or set of programs) that transforms source code written in a programming language (the source language) into another computer language (the target language, often having a binary form known as object code). The most common reason for wanting to transform source code is to create an executable program.

A compiler can translate the programs of only that language for which it is written. For example C++ compiler can translate only those programs, which are written in C++. Each machine requires a separate compiler for each high level language.

Interpreter:-

An interpreter is a program that converts one statement of a program at a time. It executes this statement before translating the next statement of the source program. If there is an error in the statement, the interpreter will stop working and displays an error message. The advantage of interpreters over compilers is that an error is found immediately. So the programmer can make corrections during program development.

Utility Software:-

Utility software is system software designed to help analyze, configure, optimize or maintain a computer. A single piece of utility software is usually called a utility or tool.

Utility software usually focuses on how the computer infrastructure (including the computer hardware, operating system, application software and data storage) operates. Due to this focus, utilities are often rather technical and targeted at people with an advanced level of computer knowledge - in contrast to application software, which allows users to do things like creating text documents, playing games, listening to music or viewing websites.

Compression Tools: Data compression can be used for many purposes on computers and achieved many ways. There are two types of data compression, lossy and lossless. Lossy compression makes data smaller by removing excess data so that the end result is still acceptable for its purpose. This is a one-way process and the compressed data is the result. Lossless compression makes data smaller by looking for patterns that can be written more

concisely. This is a reversible process and a compressed file is the result. This file will have to be decompressed to access the original data. Advantages of data compression are that compressed data will take up less space on a computer and be quicker to transmit. Ex: 7-Zip, IZArc, WinRAR, PeaZip, The Unarchiver,
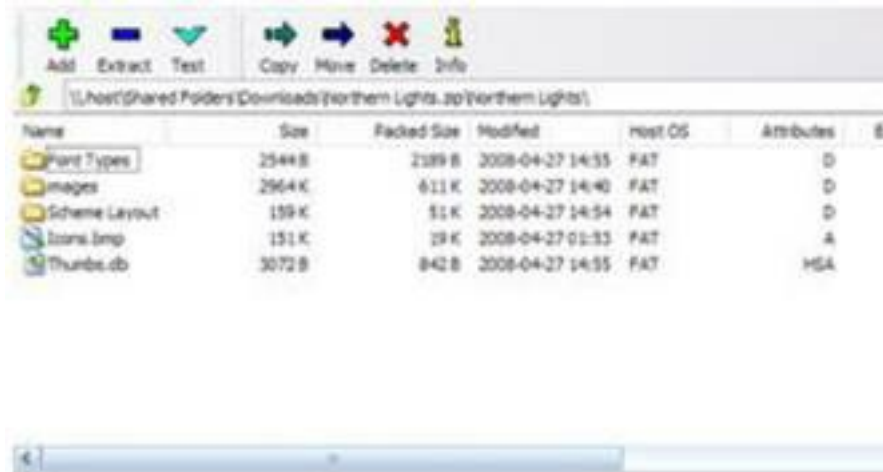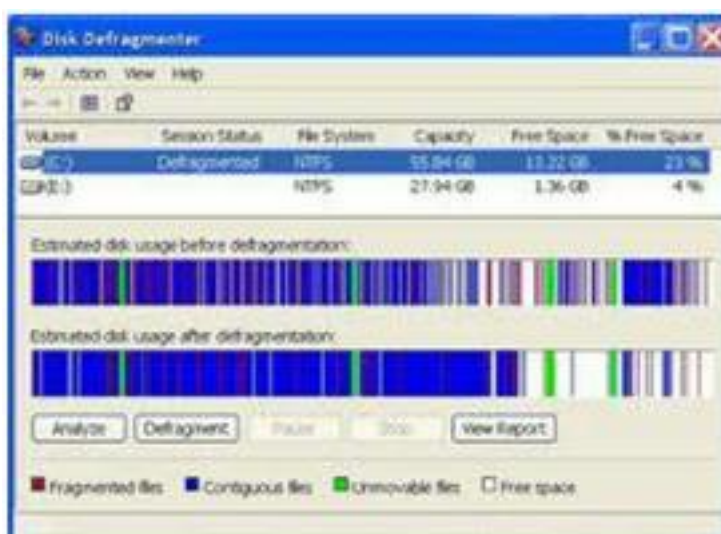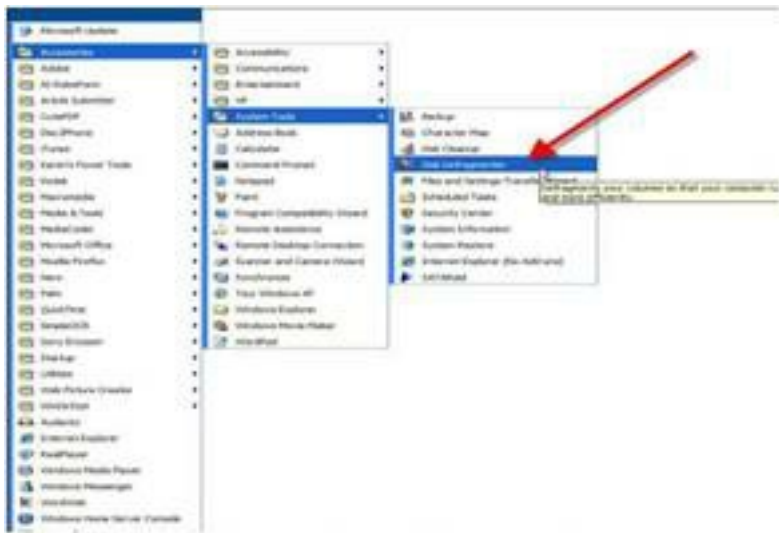

Data compression for computer files is a lossless compression. Data compression for audio can be lossy or lossless.

Data compression of images can be either lossy or lossless depending on the compression format used.

Data compression of video is primarily lossy.

Disk Defragmenter:-

Disk Defragmenter is a utility in Microsoft Windows designed to increase access speed by rearranging files stored on a disk to occupy contiguous storage locations, a technique called defragmentation. Defragmenting a disk minimizes head travel, which reduces the time it takes to read files from and write files to the disk. Beginning with Windows XP, Disk Defragmenter also reduces system startup times.

Antivirus:- Antivirus or anti-virus software is software used to prevent, detect and remove malware (of all descriptions), such as: computer viruses, adware, backdoors, malicious BHOs, dialers, fraudtools, hijackers, keyloggers, malicious LSPs, rootkits, spyware, trojan horses and worms. Computer security, including protection from social engineering techniques, is commonly offered in products and services of antivirus software companies.Commonly used Antivirus are Norton, Kaspersky, Quick heal etc.

Application Software:- Application software, also known as an application or an app, is computer software designed to help the user to perform specific tasks. Examples include enterprise software, accounting software, office suites, graphics software and media players. Many application programs deal principally with documents. Apps may be bundled with the computer and its system software, or may be published separately. Some users are satisfied with the bundled apps and need never install one.
There are two types of Application Software:
General Purpose Application Software e.g. Word, Excel, DBMS etc.
Specific Purpose Application Software e.g. Inventory Management System, Payroll System, Railway Reservation System, Hotel Management System etc.

Computer Security Threats:- Computer systems are vulnerable to many threats that can inflict various types of damage resulting in significant losses. This damage can range from errors harming database integrity to fires destroying entire computer centers. Losses can stem, for example, from the actions of supposedly trusted employees defrauding a system, from outside hackers, or from careless data entry clerks. Precision in estimating computer security-related losses is not possible because many losses are never discovered, and others are "swept under the carpet" to avoid unfavorable publicity. The effects of various threats varies considerably. Some affect the confidentiality or integrity of data while others affect the availability of a system.

Malware:- Short for "malicious software," Malware refers to software programs designed to damage or do other unwanted actions on a computer system. In Spanish, "mal" is a prefix that means "bad," making the term "badware," which is a good way to remember it (even if you're not Spanish).
Common examples of Malware include viruses, worms, Trojan horses, and spyware. Viruses, for example, can cause havoc on a computer's hard drive by deleting files or directory information. Spyware can gather data from a user's system without the user knowing it. This can include anything from the Web pages a user visits to personal information, such as credit card numbers.

Virus:- Like a biological virus, a computer virus is something you don't want to get. Computer viruses are small programs or scripts that can negatively affect the health of your computer. These malicious little programs can create files, move files, erase files, consume your computer's memory, and cause your computer not to function correctly. Some viruses can duplicate themselves, attach themselves to programs, and travel across networks. In fact opening an infected e-mail attachment is the most common way to get a virus.
We all know it's hard enough to get a computer to work well when it is healthy, let alone when it has been attacked by a virus. Therefore, it is better to prevent an attack than to try and cure it. There are many antivirus programs available that scan incoming files for viruses before they can cause damage to your computer. Some of these programs include Norton Antivirus, McAfee Virus Scan, and Virex.

Trojan Horse:- A Trojan horse, or Trojan, is a type of malware that masquerades as a legitimate file or helpful program possibly with the purpose of granting a hacker unauthorized access to a computer. Trojans do not attempt to inject themselves into other

files like a computer virus. Trojan horses may steal information, or harm their host computer systems.Trojans may use drive-by downloads or install via online games or internet-driven applications in order to reach target computers. The term is derived from the Trojan Horse story in Greek mythology because Trojan horses employ a form of "social engineering," presenting themselves as harmless, useful gifts, in order to persuade victims to install them on their computers. For example, a Trojan horse might appear to be a computer game, but once you double-click it, the program starts writing over certain parts of your hard drive, corrupting your data. While this is certainly something you want to avoid, it is good to know that these malicious programs are only dangerous if they are given a chance to run. Also, most antivirus programs can catch Trojan horses when scanning for viruses. Unlike viruses, however, Trojan horses don't replicate themselves. Though it is possible for a Trojan horse to be attached to a virus file that spreads to multiple computers.

Spyware:- Spyware is a type of malware (malicious software) installed on computers that collects information about users without their knowledge. The presence of spyware is typically hidden from the user and can be difficult to detect. Some spyware, such as keyloggers, may be installed by the owner of a shared, corporate, or public computer intentionally in order to monitor users.
As the name implies, this is software that "spies" on your computer. Nobody likes to be spied on, and your computer doesn't like it either. Spyware can capture information like Web browsing habits, e-mail messages, usernames and passwords, and credit card information. If left unchecked, the software can transmit this data to another person's computer over the Internet.

Worm:- A computer worm is a standalone malware computer program that replicates itself in order to spread to other computers. Often, it uses a computer network to spread itself. This is due to security shortcomings on the target computer. Unlike a computer virus, it does not need to attach itself to an existing program. Worms almost always cause at least some harm to the network, even if only by consuming bandwidth, whereas viruses almost always corrupt or modify files on a targeted computer.
Worms are hard to detect because they are typically invisible files. They often go unnoticed until your computer begins to slow down or starts having other problems. Unlike viruses and Trojan horses, worms can replicate themselves and travel between systems without any action from the user. For these reasons, it is good to have an antivirus program installed on

your system that can detect and remove worms before they have a chance to replicate or spread to other computers. Security updates such as Windows Update also patch security holes that allow worms to infect your computer. So keep your security updates and virus definitions up-to-date and you should be able to keep your computer worm-free.

Virus detection and its removal:- Virus detection and its removal are made through an antivirus program which finds out viruses in a computer and then possibly removes or repairs the virus problem. Some of commonly used Virus detection and its removable tools are Norton Antivirus, McAfee, Virus Scan, Kaspersky and Quick Heal etc.

Digital Certificate:- A digital certificate is a pair of files on your computer that you can use to create the digital equivalent of handwritten signatures and sealed envelopes. Each pair of files is divided into two parts: the public key and the private key. The public key is the portion that is shared; the private key is the portion that you, and only you, should have access to. Your computer and programs understand how to share only the public portion of your keys so that others can see them, while still keeping your private keys secure.
For example, when sending an e-mail message, you can digitally sign the message by attaching your digital certificate. Once they receive the message, recipients can verify that it came from you by viewing the small attachment on the e-mail, which contains your public key information. This protects you from people who might try to "spoof" an e-mail that looks like it came from you but is really sent from a different e-mail account.

Digital Signature:- A digital signature authenticates electronic documents in a similar manner a handwritten signature authenticates printed documents. This signature cannot be forged and it asserts that a named person wrote or otherwise agreed to the document to which the signature is attached. The recipient of a digitally signed message can verify that the message originated from the person whose signature is attached to the document and that the message has not been altered either intentionally or accidentally since it was signed. Also, the signer of a document cannot later disown it by claiming that the signature was forged. In other words, digital signatures enable the "authentication" and "non-repudiation" of digital messages, assuring the recipient of a digital message of both the identity of the sender and the integrity of the message.
A digital signature is issued by a Certification Authority (CA) and is signed with the CA's private key. A digital signature typically contains the: Owner's public key, the Owner's name, Expiration date of the public key, the Name of the issuer (the CA that issued the Digital ID),

Serial number of the digital signature, and the digital signature of the issuer. Digital signatures deploy the Public Key Infrastructure (PKI) technology.

Cookies:- A cookie, also known as an HTTP cookie, web cookie, or browser cookie, is usually a small piece of data sent from a website and stored in a user's web browser while a user is browsing a website. When the user browses the same website in the future, the data stored in the cookie can be retrieved by the website to notify the website of the user's previous activity. Cookies were designed to be a reliable mechanism for websites to remember the state of the website or activity the user had taken in the past. This can include clicking particular buttons, logging in, or a record of which pages were visited by the user even months or years ago.

How Do They Work
A command line in the HTML of a document tell the browser to set a cookie of a certain name or value? Here is an example of some script used to set a cookie. Set-Cookie: NAME=VALUE; expires=DATE; path=PATH; domain=DOMAIN_NAME; secure Cookies are usually run from CGI scripts, but they can also be set or read by JavaScript.

Firewall:- A firewall can either be software-based or hardware-based and is used to help keep a network secure. Its primary objective is to control the incoming and outgoing network traffic by analyzing the data packets and determining whether it should be allowed through or not, based on a predetermined rule set. A network's firewall builds a bridge between an internal network that is assumed to be secure and trusted, and another network, usually an external (inter)network, such as the Internet, that is not assumed to be secure and trusted

Hardware Firewall:- Hardware firewall providing protection to a Local Network.

Software Firewall:- Computer running firewall software to provide protection

A firewall examines all traffic routed between the two networks to see if it meets certain criteria. If it does, it is routed between the networks, otherwise it is stopped. A firewall filters both inbound and outbound traffic. It can also manage public access to private networked resources such as host applications. It can be used to log all attempts to enter the private network and trigger alarms when hostile or unauthorized entry is attempted. Firewalls can filter packets based on their source and destination addresses and port numbers. This is known as address filtering. Firewalls can also filter specific types of network traffic. This is also known as protocol filtering because the decision to forward or reject traffic is dependent upon the protocol used, for example HTTP, ftp or telnet. Firewalls can also filter traffic by packet attribute or state.

Password:- A password is a secret word or string of characters that is used for authentication, to prove identity or gain access to a resource (example: an access code is a type of password). The password should be kept secret from those not allowed access. The use of passwords is known to be ancient. Sentries would challenge those wishing to enter an area or approaching it to supply a password or watchword. Sentries would only allow a person or group to pass if they knew the password. In modern times, user names and passwords are commonly used by people during a log in process that controls access to protected computer operating systems, mobile phones, cable TV decoders, automated teller machines (ATMs), etc. A typical computer user may require passwords for many purposes: logging in to computer accounts, retrieving e-mail from servers, accessing programs, databases, networks, web sites, and even reading the morning newspaper online.

INTRODUCTION TO PROGRAMMING

Getting started with IDE

• **RAD:** Rapid Application Development is software programming technique that allows quick development of software application.

• **Integrated Development Environment (IDE):** It is a software tool to help programmer to edit, compile, interpret and debug the program in the same environment. i.e Eclipse,NetBeans, MicroSoft Visual Studio etc.

• **Byte code:** A byte code is machine instruction that the Java compiler generates and Java interpreter executes. When the compiler compiles a .java file, it produces a series of byte codes and stores them in a .class file. The Java interpreter (JVM) can execute the byte codes stored in the .class file.

• **JVM:** Java Virtual Machine (JVM) is a program which behaves as interpreter and translates the byte code into machine language as they go called just in time compilation.

• **Source Code:** The core program or text which is written in a language like C, C++ or Java is called source code.

• **Object Code:** The program which only is understood by the computer in the form of machine instructions or binary instructions called object code. In Java JVM is used to generate object code in the form of byte code.

• **GUI:** A graphical user interface (GUI) presents a pictorial interface to a program. GUI allows the user to spend less time trying to remember which keystroke sequences do what and spend more time using the program in a productive manner.

Programming Fundamentals

Token

The smallest individual unit in a program is known as Token. Java has the following types of tokens: keyword, Identifier, literal, punctuators and operators.

Keywords

Keywords are words that have a specific predefined meaning in Java. They cannot be used as

variable names. They are also known as reserve words. Eg. void, private, if, while etc.

Literals:

Items having fixed data values are referred to as Literals. They are also known as Constants. Various types of literals available in Java are:

■ Integer literals

■ Floating literals

■ Boolean literals

■ Character literals

■ String literals

■ Null literals

Variable: Variable is a named storage location in computer memory whose contents can change during a program run.

The characteristics of a variable are:

(i) It has a name.

(ii) It is capable of storing values.

(iii) It provides temporary storage.

(iv) It is capable of changing its value during program execution.

Punctuators:

The following nine ASCII charaters are the separators:

( ) { } [ ] ; , .

Operators: Operators are special symbols that perform specific operations on one, two, or three operands, and then return a result.

Operators	Precedence
Postfix	expr++ expr
Unary	++exprexpr+exprexpr~ !
Multiplicative	* / %
Additive	+ -

Shift	<<>>>>>
Relational	<><= >= instanceof
Equality	== !=
Bitwise AND	&
Bitwise	exclusive OR A
Bitwise Inclusive	OR	
Logical	AND &&
Logical	OR ||
Ternary	? :
Assignment	= += =*= /= %= &= A= |= <<= >>= >>>=

Data type states the way the values of that type are stored, and the range for that type.
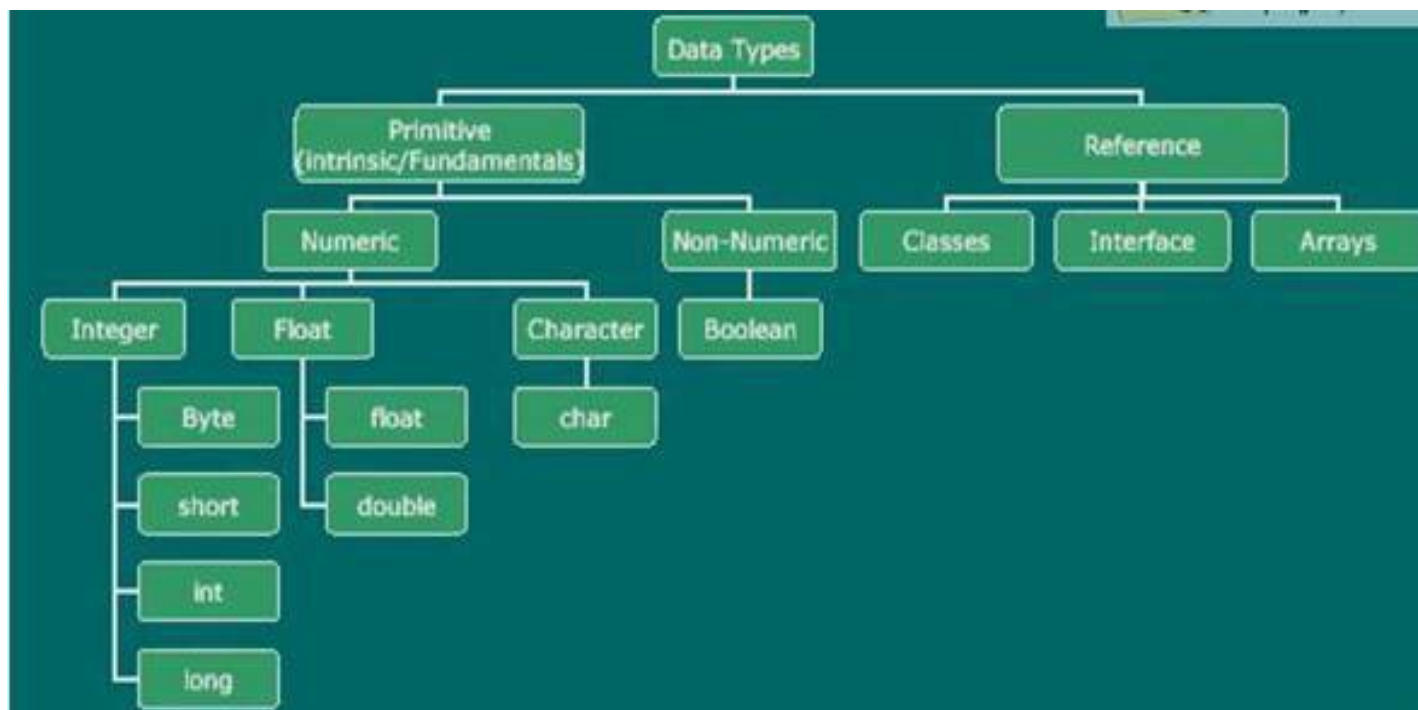
Primitive Data Types:

The Java programming language is statically typed, which means that all variables must first be declared before they can be used.

A primitive type is predefined by the language and is named by a reserved keyword. The eight primitive data types supported by the Java programming language are:

■ **byte:** The byte data type is an 8 bit signed two's complement integer. It has a minimum value of 128 and a maximum value of 127 (inclusive).

■ **short:** The short data type is a 16 bit signed two's complement integer. It has a minimum value of 32,768 and a maximum value of 32,767 (inclusive).

■ **int:** The int data type is a 32 bit signed two's complement integer. It has a minimum value of 2,147,483,648 and a maximum value of 2,147,483,647 (inclusive).

■ **long:** The long data type is a 64 bit signed two's complement integer. It has a minimum value of 9,223,372,036,854,775,808 and a maximum value of 9,223,372,036,854,775,807(inclusive).

■ **float:** The float data type is a single precision 32 bit IEEE 754 floating point.

■ **double:** The double data type is a double precision 64 bit IEEE 754 floating point.

■ **boolean:** The boolean data type has only two possible values: true and false. Use this data type for simple flags that track true/false conditions.

■ **char:** The char data type is a single 16 bit Unicode character. It has a minimum value of '\u0000' (or 0) and a maximum value of '\uffff ' (or 65,535 inclusive).

Reference Data Types: These are constructed by using primitive data types, as per user need.

Reference data types, as per user need. Reference data types store the memory address of an object. Class, store the memory address of an object.

Class, Interface and Array are the example of Interface Reference Data types.

Parse Methods: parse() methods helps to parse string into different numeric types. These are:

Method	Syntax	Usage
parseByte()	Byte.parseByte(string)	To convert a string value to byte type
parseShort()	Short.parseShort(string)	To convert a string value to type short

parseInt()	Integer.parseInt(string)	To convert a string value to Integer type
parseLong()	Long.parseLong()	To convert a string value to Long type
parseFloat()	Float.parseFloat()	To convert a string value to Float type
pareseDouble()	Double.parseDouble()	To convert a string value to Double type

Type Conversion:

The process of converting one predefined type into another is called Type Conversion.

These are of two types:

a) Implicit type conversion.

b) Explicit type conversion.

Implicit Type Conversion: In this conversion java compiler converts all operands up to the type of largest datatype.

Explicit Type Conversion: An explicit type conversion is user defined that forces an expression to be of specific type.

Flow Of Control

• **Control Flow Statements:** The statements inside your source files are generally executed from top to bottom, in the order that they appear. Control flow statements, however, breakup the flow of execution by employing decision making, looping, and branching, enabling your program to conditionally execute particular blocks of code.
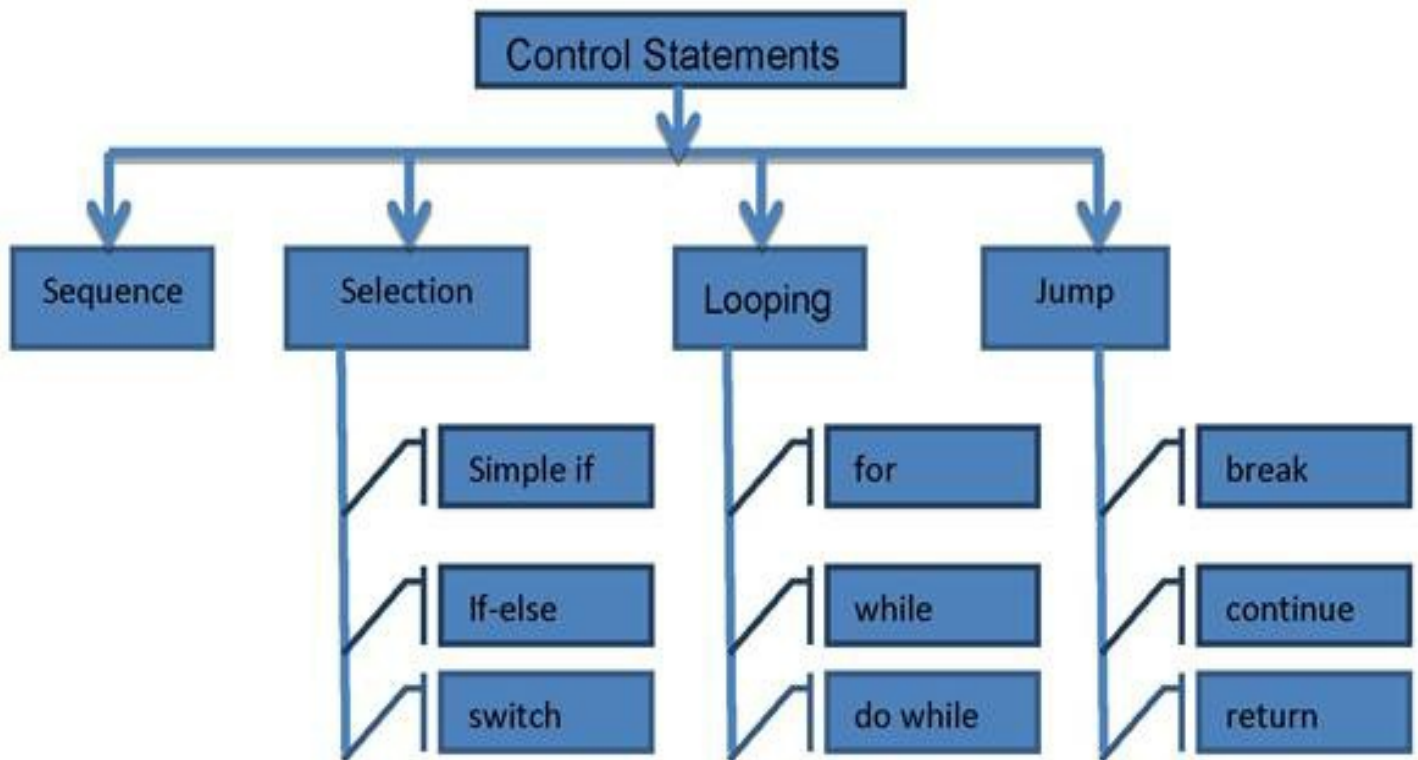
1. Selection: A selection statement selects among a set of statements depending on the value of a controlling expression.

(a) if statements: The if statement allows selection (decision making) depending upon the outcome of a condition. If the condition evaluates to true then the statement immediately following if will be executed and otherwise if the condition evaluates to false then the statements following the else clause will be executed.

(i) Simple if: The syntax of if statement is as shown below:

Syntax:

if (conditional expression)

{

Statement Block;

}

(ii) if-else: The syntax of if-else statement is as shown below:

Syntax:

if (conditional expression)

{

Statement Block;

}

else

```
{
Statement Block;
}
```

(iii) Nested if else: These control structures are used to test for multiple conditions as against the simple if statement which can be used to test a single condition. The syntax of nested if else is as follows:

Syntax:

```
if(conditional expression 1)
{
// Executes when the expression 1 is true
      if(Conditional expression 2)
        {
          // Executes when the expression 2 is true
        }
      else
        {
            Statement Block;
         }

}
```

(b) switch: This selection statement allows us to test the value of an expression with a series of character or integer values. On finding a matching value the control jumps to the statement pertaining to that value and the statement is executed, till the break statement is encountered or the end of switch is reached.

The syntax of the switch statement is as follows: switch (Variable/Expression)

```
{
case Constant1: statements1; break;
case Constant2: statements2; break;
default: statements3;
}
```

2. Looping: These statements are used to perform a set of instructions repeatedly while the

condition is true.

(i) The syntax of the for loop is:

Syntax

for (initialization; test expression; increment/decrement expression)

{

statements;

}

(ii) While loop: The while loop is an entry-controlled loop. It means that the loop condition is tested before executing the loop body. If the loop condition is initially false, for the first iteration, then loop may not execute even once.

The syntax of the while loop is as follows:

Syntax

while(test expression)

{

loop body

increment/decrement expression

}

(iii) do while: Do..While loop is an exit-controlled loop. In the do..while loop, the test occurs at the end of the loop. This ensures that the do..while loop executes the statements included in the loop body at least once.

The syntax of the loop is as follows:

Syntax:

do

{

loop body

increment/decrement expression

}

while (test expression);

3. Jump:

(i) break: The break is used to break from an enclosing do, while, for or switch statement.

Syntax:

break;

(ii) continue: The continue statement stops the execution of the current iteration and causes control to begin with next iteration.

Syntax:

continue;

(iii) return: Return is used to return value from the method

Syntax:

Return <value>;

Java IDE Programming - I, II & III

• Commonly available Swing Controls in Java

jFrame: A Frame is a container control, in which all the controls can be lace.

jLabel: JLabel allows placing un-editable text on the Frame/Panel

jTextField: JTextField allows placing editable text on the Frame/Panel. User can enter text in a textField during runtime.

jButton: JButton is used to initiate an action when it is clicked.

jList: JList is a group of values or items from which one or more selections can be made.

jComboBox: JComboBox is similar to JList but also allow to enter editable text during run time. It is a combination of jTextFiled and jList. It allows only single selection of items from group of values or items.

jRadioButton: Allow us to choose a single item from a group of jRadioButton options.

jCheckBox: Allow us to choose one or more items from a group of jCheckBox options.

jPasswordField: Allow us to enter a text during the run time but shows an encrypted text instead of the original text.

jTextArea: JTextArea is a multi-line text component to enter or edit text.

Focus: The control under execution is said to have the focus. The control having the focus obtains input form the user.

getText(): getText() method is used to obtain the text from a jTextField during the run time.

setText(): setText() method is used to set or change the text of a jTextFeild during run time.

Swing Controls Methods and Properties: These are the Swing Controls available with Netbean

IDE and their concern methods and properties are given below.

Swing Controls	Methods	Properties
jButton	• getText() • setText()	Background • Enabled • Font • Foreground • Text • Label
jLabel	• getText()	Background Enabled Font Foreground Text
jTextField	• getText() • isEditable() • isEnabled() • setText()	• Background • Editable • Enabled • Font •Foreground • Text
jRadioButton	• getText() • setText() • isSelected() • setSelected()	• Background • Button Group • Enabled • Foreground • Label • Selected
jCheckBox	• getText() • setText() • isSelected()	• Button Group • Font • Foreground • Label

		• Selected
	• setSelected()	• Text
jButtonGroup		• Add
jComboBox	• getSelectedItem() • getSelectedIndex() • setModel()	• Background • ButtonGroup • Editable • Enabled •Font • Foreground • Model • SelectedIndex • SelectedItem • Text
jList	• getSelectedValue() • getSelectedValues() • getSelectedIndex() • getSelectedIndices() • setModel()	• Background • Enabled • Font • Foreground • Model • SelectedIndex • SelectedItem • SelectedMode • Text
jTable	• addRow() • addModel()	• model
JoptionPane	• showMessageDialog()	• getRowCount() • RemoveRow() • addRow()

PROGRAMMING GUIDELINES

Stylistic Guidelines

> Use meaningful names for identifiers.

> Ensure clarity of expressions.

> Use comment and indentation.

> Insert blank lines and blank spaces.

Characteristic for a Good Program

> Effective and efficient.

> User friendly.

> Self documenting code.

> Reliable.

> Portable.

Stages of Program Development Process

A program development process is a step by step process where each stage contributes to building of an effective and efficient program.

Stages are as follows

> Crack the problem.

> Code the algorithm.

> Compile the program.

> Execute the program.

Types of Errors

> **Compile Time Error:** Occurs during compile time. When a program compiles it sources code is checked for rules of programming language.

Its types are:-

1. Syntax error: it occurs when a grammatical rule of Java is violated

2. Semantic error: it occurs when statement are not meaningful.

> **Run Time Error:** Occurs during the execution of the program.

> **Logical Error:** Occurs due to wrong logic of a program.

PROBLEM SOLVING METHODOLOGY AND TECHNIQUES

Steps to creating a working program are:-

1. Understand the problem well

2. Analyze the problem to

a) Identify minimum number of inputs required for output

b) Identify processing components.

3. Design the program by

a) Deciding step by step solution.

b) Breaking down solution into simple steps.

4. Code the program by

a) Identifying arithmetic and logical operation required for solution.

b) Using appropriate control structure such as conditional or looping control structure.

5. Test and Debug your program by

a) Finding error in it.

b) Rectifying the error.

6. Complete your documentation.

7. Maintain your program.

UNIT-5

RELATIONAL DATABASE MANAGEMENT SYSTEM

Data: Basic/raw facts about something which is not organized, for example details of some students which is not organized.

Data Item: Each piece of information about an entity, such as name of a person or address, age or name of a product or the price is a Data Item.

Database: A well organised collection of data that ensures safety, security and integrity of data.

DataBase Management System(DBMS): Comprehensive software that provides the essential services to create, manage and maintain the databases. In short, a DBMS provides the means to store the data in the database, to edit or delete the data stored, to search and analyze the data in the database. They also provide various safety and security mechanisms that ensures that in any case stored data will be safe and accessible.

Relational DataBase Management System(RDBMS): A Database Management System that conforms at-least half of the 12 rules defined by Dr. E.F. Codd (1970) in his research document. In a relational data model, the data is organized into tables (i.e. Rows and Columns). These tables are called Relations. A row in a table represents a relationship among a set of values. Since table is a collection of relationships it is generally referred to using the mathematical term Relation.

Database Systems: Systems comprising of Databases and Database Management Systems are simply referred as database systems.

Advantages of Data Base System:
1) Reduce data redundancy (duplication of data).
2) Control data inconsistency to a large extent.
3) Database facilitate sharing of data.
4) Enforce standards.

5) Centralized databases can ensure data security.

Examples of Common Database Management Systems: MySQL ,INGRES, POSTGRES, ORACLE, DB2.

Levels of Database Implementation:
1. Internal Level (Physical Level): It describes how the data are actually stored on the storage media.
2. Conceptual Level: It describes what data are actually stored in the database. It also describes the relationships existing among data.
3. External Level (View Level): It is closest to the users and is concerned with the way in which the data are viewed by individual users.
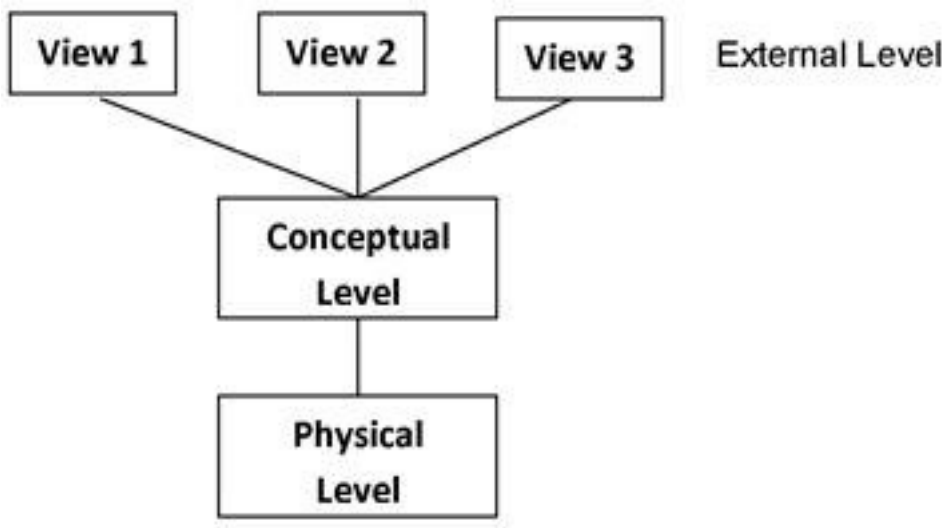
Data Independence: The ability to modify a scheme definition in one level without affecting a scheme definition in the next higher level.

Two Level of Data Independence:
1. Physical Data Independence: It refers to the ability to modify the scheme followed at the physical level without affecting the scheme followed at the conceptual level.
2. Logical data Independence: It refers to the ability to modify the scheme followed at the conceptual level without affecting the scheme followed at the external level.

Data Model: A way by which data structures and their relationships are analyzed.

Different Data Models:
1. Relational data model

2. Network data model

3. Hierarchical data model

Relational data model: In this model data is organized into tabular structures called relations. A database may contain many relations providing a better classification of data based on its nature and use. Multiple relations are then linked/ associated together on some common key data values (foreign key).

Network Data Model: In this model data is represented by collections of records and relationships among data are represented by links. A record is collection of fields i.e. attributes, each of which contents only one data value.

Hierarchical data model: In this model records are organized as trees, data is represented by collection of records connected to one another through links.

Basics of Relational Model Relation: A tabular structure containing data. To be a relation it must satisfy following four conditions:
■ Atomicity: At every row-column intersection (Cell) there must be an atomic value i.e. a value that can not be further subdivided.
■ No duplicity: No two rows of relation will be identical i.e. in any two rows value in at least one column must be different.
■ Ordering of rows is immaterial.
■ Ordering of columns is immaterial.

Tuple: A row in a relation is called a tuple.

Attribute: A column in a relation is called an attribute.

Domain: Domain of an attribute refers to the set of all the possible values for that attribute.

Degree: Number of attributes in a relation is the degree of that relation.

Cardinality: Number of tuples in a relation is the cardinality of that relation.

Candidate Key: A set of one or more minimal attributes used to uniquely identify a tuple in the relation and which can act as Primary Key. A relation can have multiple candidate keys.

Primary Key: A candidate key that is primarily chosen for unique identification of tuples in

a Relation.

Any subset of Primary key should not be Primary key.

Alternate Key: Candidate keys that not chosen as primary key are the alternate keys.

Example: In a LIBRARY Table

Candidate keys can be Accession no, Book no.

Primary key: If we select Book no as primary key for our purpose then

Alternate Key will be Accession No.

Views: A view is a virtual table whose contents are taking from other tables depending upon a condition.

Table: Student

Roll. No.	Name	Marks
101	Anu	85
102	Riya	70
103	Ankit	78

Definition of the VIEW:
CREATE VIEW toppers AS
SELECT * FROM Student
WHERE Marks > 75;
Here name of the view is toppers
Base table is students
toppers(A virtual table based on Student table)

Roll. No.	Name	Marks
101	Anu	85
102	Ankit	78

INTRODUCTION TO MYSQL

MySQL: It is an Open Source RDBMS Software that uses Structured Query Language. It is available free of cost. Key Features of MySQL:

1. High Speed.
2. Ease of Use.
3. Available Free of Cost.
4. Supports standards based SQL.
5. Provides portability.
6. High Security.
7. Provides many data types.
8. Handles large database.

MySQL Data Types: Every column (or data item) should belong to a unique domain (known as data type). These data types help to describe the kind of information a particular column holds. MySQL supports the ANSI SQL data types. Some of the commonly used data types along with their characteristics are as follows:

Class	Data Type	Description	Example
Text	CHAR(size)	A fixed-length string between 1 and 255 characters in length right-padded with spaces to the specified length when stored. Values must be enclosed in single quotes or double quotes.	'Maths' 'TexT'
	VARCHAR(size)	A variable-length string between 1 and 255 characters in length; for example VARCHAR(25). Values must be enclosed in single quotes or double quotes	'Computer' 'Me and u'
		It can represent number with or 17.3 without the fractional part. The size argument has two parts: precision	20.1

NUMERIC	DECIMAL(p,s)	and scale. Precision (p) indicates the number of significant digits and scale (s) maximum number of digits to the right of the decimal point	50000.00
	INT	It is used for storing integer values	345
Date	DATE	It represents the date including day, month and year between 1000-01-01 and 9999-12-31	2009-07-02

The Structured Query Language(SQL)

SQL (pronounced SEQUEL for Simple English Query Language) is Non-procedural universal data access language used to access and manipulate data stored in nearly all the data bases available currently. SQL standards are defined by ANSI (American National Standards Institute). SQL statements are used to retrieve and update data in a database. SQL works with database programs like MySQL, MS Access, DB2, Informix, MS SQL Server, Oracle, Sybase, etc. Most of the SQL database programs also have their own proprietary extensions in addition to the SQL standard.

SQL Commands

SQL commands can be classified into the following:

Data Definition Language (DDL): A database scheme is defined by set of definitions, which are expressed, by a special set of commands called Data Definition Language (DDL). They are used to create tables, databases, identify data items, provide unique names to the data items and to define the length and provide the range of values that each data item can assume. They are CREATE TABLE, ALTER TABLE and DROP TABLE commands.

Data Manipulation Language (DML): The data manipulation language (DML) handles operations such as entering rows into a table, changing data, deleting rows, and extracting data from rows and tables. With DML, one does not change the table's structure, but rather its contents. It contains commands like INSERT, UPDATE and DELETE.

Transaction Control Language (TCL): A transaction is a one complete unit of work. A transaction is successfully completed if and only if all its constituent steps are successfully

completed. To manage and control the transactions, the transaction control commands are used. e.g. COMMIT, ROLLBACK, SAVEPOINT.

WORKING WITH SQL

To work on MySQL, you need to open or create the database first:

To Create/Open Database:

mysql> CREATE DATABASE <name of database>;

Now the database with the given name will be created. One must be connected to the database before using it, as below:

mysql> use <name of database>;

Creating Tables

Tables are defined with the CREATE TABLE command. When tables are created its columns are named, data types and sizes supplied for each column. At least one column must be specified.

Syntax:

CREATE TABLE <TableName>(<ColumnName1> <Data Type1>,

<ColumnName2> <Data Type2>,.......,<ColumnNameN> <Data Type N>);

Example:

mysql> CREATE TABLE Students

(

RollNo DECIMAL(3),

Name VARCHAR(25)

);

Once the table is created we can insert the record in it, edit or delete existing records, and also we can search for desired record in a very comprehensive way using the SQL Select statement.

Creating tables with SQL Constraints:

^ A Constraint is a condition or check applicable on a field or set of fields.

^ Data constraints are the rules that are defined when a table is created.

^ They can also be defined or modified after creating the tables.

^ When constraints are defined any data entering in the table is first checked to satisfy the condition specified in particular constraint if it is, only then table data can be updated. If data updation/ insertion is violating the defined constraints, database rejects the data (entire

record is rejected).

^ When a constraint is applied to a single column, it is called a column level constraint but if a constraint is applied on a combination of columns it is called a table constraint.

Following Constraints can be defined on a table in SQL:

Constraints name	Description
PRIMARY KEY	Used to create a primary key.
UNIQUE	to create a unique key.
NOT NULL	to define that column will not accept null values.
FOREIGN KEY/ REFERENCES	to define referential integrity with another table.
DEFAULT	to define the columns default value.
CHECK	to define the custom rule.

Not Null and Default constraints can be applied only at column level rest all constraints can be applied on both column level and table levels.

Use of constraints:

CREATE TABLE student (Srollno integer NOT NULL, ...);

CREATE TABLE student (Srollno integer UNIQUE, ...);

CREATE TABLE student (Srollno integer NOT NULL, Sclass integer DEFAULT 12, Sname varchar(30));

CREATE TABLE student (Srollno integer CHECK (Srollno>0), Sclass integer, Sname varchar(30));

CREATE TABLE student (Srollno integer NOT NULL PRIMARY KEY, Sclass integer, Sname varchar(30));

CREATE TABLE teacher (Tid integer NOT NULL, FOREIGN KEY (Studentid) REFERENCES student (Sid));

Inserting the record in existing table:

The INSERT INTO command append a new record to an existing table and initializes it to desired values.

Syntax:

INSERT INTO table_name (column_name [,column_name])

VALUES (value [,value]);

INSERT INTO Student (RollNo, Name)

VALUES (12333,'Anu');

Inserting NULL Values:

INSERT INTO Student (RollNo, Name, Class, Grade)

VALUES (12333,'Anu',11, NULL);

Inserting Dates:

INSERT INTO Student (RollNo, Name, Class, DOB)

VALUES (12333,'Anu',11, '1998-02-24')

Inserting Data from another Table:

INSERT INTO

Marks SELECT * FROM Student

WHERE Class>10;

Note: Column names can be omitted if the values are entered in the same order in which they appear in the table. Insert into will give you an error if you omit to enter a mandatory value (non-null).

Deleting Existing records from the table:

The DELETE command deletes one, many, or even all records in a table, depending on the conditions that you specify.

Syntax:

DELETE FROM tablename

WHERE search_conditions;

for example

DELETE FROM Students

WHERE RollNo>11255;

Note: The delete command is VERY dangerous. If run without conditions, it will delete ALL records in a table. In addition, SQL has no undo function. For instance, DELETE FROM Students;

Will delete all records from Students table. This is not likely to be what you want.

Modifying the contents of records: The UPDATE command changes one, many, or even all records in a table, depending on the conditions that you specify

Syntax:

UPDATE tablename

SET column_name = expression [,column_name = expression..]

[WHERE search_conditions];

for example(assuming a customer table)

UPDATE customer SET f_name = 'Thomas'

WHERE l_name = 'Smith' and

date_of_birth = '3/2/1985';

An expression can be either a constant value (e.g., 'Thomas') or an operation done on another column or columns (see the example below, assuming a loan table with column rate.).

UPDATE TABLE loan SET rate = rate + 1.5;

Because there is no condition (i.e., no WHERE) all records will be updated. All rates will be increased by 1.5.

Selecting data from existing table:

SQL SELECT statement is a comprehensive statement used to search/select records from one or more tables. All the analysis done on a database usually involves some form of select statement.

> Choosing all fields (columns): Use an asterisk (*) to indicate all fields with the select statement:

SELECT *

FROM table_name;

SELECT *

FROM customer;

> Choosing a selected list of fields (columns)

SELECT column_name [,column_name]

FROM table_name;

SELECT f_name, l_name, date_of_birth FROM customer;

NOTE: The order in which you list the columns affects their order in the resulting output. Items within [ ] are optional.

> Temporarily renaming columns in query results

SELECT column_heading AS column_name [,column_heading AS column_name]

FROM table_name;

Example:

SELECT f_name as "Name"

FROM customer;

> Including calculated columns in the results

SELECT date_due, rate, principal, rate * principal FROM loan;

NOTE: If necessary, use parentheses to clarify order of precedence.

> Eliminating duplicate query results with distinct

If you use the keyword distinct after the keyword SELECT, you will only get unique rows.

Example:

SELECT rate,

FROM loan;

(above will display all rate values might be repeated)

SELECT distinct rate FROM loan;

(above will display only unique rate values, no repetition)

> Selecting from all the rows:

SELECT ALL rate,

FROM loan;

(above query will display all rate values)

> Selecting rows: WHERE clause is used to specify the condition for searching. Only those records will be retrieved that satisfy condition given with where clause.

SELECT SELECT_list

FROM table_list

WHERE search_conditions;

Example:

SELECT * FROM customer

WHERE f_name = 'Carl';

> Possible Search Conditions

- Comparison operators (=,<,>,!=.<>,<=,>=)

SELECT * FROM loan

WHERE principal > 100000000;

- Ranges (between and not between; inclusive)
SELECT * FROM loan
WHERE rate BETWEEN 7.5 AND 8.5;

OR

SELECT * FROM loan
WHERE rate NOT
BETWEEN 7.5 AND 8.5;

- Lists (in and not in)
SELECT *
from Customer
where city IN ('Ahmedabad', 'Baroda', 'Delhi', 'Mumbai', 'Chennai');

OR

SELECT *
from Customer
where city NOT IN ('Ahmedabad', 'Baroda', 'Delhi','Mumbai','Chennai');

- Null values
SELECT *
from Customer
where city is Null;

OR

SELECT *
from Customer
where city is Not Null;

- Character matches (like and not like)
SELECT f_name, l_name
FROM customer
WHERE l_name LIKE 'Fos%';
SELECT f_name, l_name

FROM customer

WHERE l_name LIKE '_oster';

Note: "%" (matches any string of zero or more characters) and "_" (matches any one character). In addition to those, brackets can be used to include either ranges or sets of characters.

Combinations of previous options using logical operators and, or, and not etc.: SELECT f_name, l_name FROM customer

WHERE l_name LIKE 'San%' AND City NOT IN ('Baroda','Delhi')

> Some more examples:

- 'Am%' matches any string starting with Am.

- '%Singh%' matches any string containing 'Singh'

- '%a' matches any string ending with 'a'

- ' ' matches any string that is exactly 3 characters long.

- ' %' matches any string that has at least 2 characters long.

- ' g' matches any string that is 4 characters along with 3 characters in the beginning but 'g' as the 4th character.

> Viewing a tables structures

Describe/ Desc statement is used to see the structure of a table:

Desc <tablename> ;

Describe <tablename>;

> Sorting records

The output of a SELECT query can be sorted in ascending or descending order on one or more columns, the default is ascending. This is important to note that the data in table is not sorted, only the results that appear on the screen are sorted.

Syntax:

SELECT <column name> [,<column name>, ...]

FROM <table name>

[WHERE <condition>]

[ORDER BY <column name> [, <column name>.]];

Example: (Sorting on single column)

SELECT * FROM EMPL ORDER BY ENAME;

Example: (Sorting on Multiple columns)
SELECT * FROM EMPL ORDER BY ENAME, JOB;

> Adding a column:
The ALTER TABLE command is used to change definitions of existing tables. It can add columns, delete columns or change their size,rename the name of an existing table.
Syntax:
ALTER TABLE <table name>
ADD (<column name> <data type with size> <constraints>);
Example:
ALTER TABLE Students
ADD (age NUMBER (2) CHECK (age > 5));

> Modify a column:
Syntax:
ALTER TABLE <table name>
MODIFY (column name newdatatype (newsize));
Example:
ALTER TABLE Students MODIFY (age NUMBER (1));

> Changing a column name:
ALTER TABLE <table name>
CHANGE <old_column_name> <new_column_name> <column definition> ;
Example:
ALTER TABLE Students CHANGE age s_age NUMBER (2)

> Removing table components
- To remove primary key constraints ALTER TABLE Students DROP primary key;
- To remove column from the table ALTER TABLE Students DROP COLUMN age;
> Drop a table from database:
DROP TABLE <table name>;
Example:
DROP TABLE Students;

> Renaming a table:

ALTER TABLE <old table name>

RENAME TO <new table name>;

Example:

ALTER TABLE Students RENAME TO Students_Details;

Operator Precedence:

All the operators have precedence. Precedence is the order in which different operators are evaluated. Various operators in descending order of precedence (top to bottom) are listed below:

1	!
2	(Unary minus)
3	^
4	*,/,DIV,%, MOD
5	-,+
6	=, <=, >, >=, =, !=, IS, LIKE, IN
7	BETWEEN
8	NOT
9	&&, AND
10	|| OR

MySQL Functions

Functions

A function is a predefined command set that performs some operation and returns the single value.

Numeric Functions

> POWER(): Returns the argument raised to the specified power. POW () works the same way. Example:(i)POW(2,4):Result:16 (ii)POW(2,-2):Result:0.25 (iii)POW(-2,3):Result: -8

> ROUND(): ROUND(X) Rounds the argument to the zero decimal place, where as ROUND(X,d) rounds the argument to d decimal places.

Example :

(i) ROUND(-1.23); Result: -1

(ii) ROUND(-1.58); Result: -2

(iii) ROUND(1.58); Result: 2

(iv) ROUND(3.798, 1); Result: 3.8

(v) ROUND(1.298, 0); Result: 1

(vi) ROUND(23.298, -1); Result: 20

(vii) ROUND(25.298,-1); result: 30

> TRUNCATE(): Truncates the argument to specified number of decimal places. Example: (i) TRUNCATE (7.29,1) Result: 7.2 (ii) TRUNCATE(27.29,-1) Result: 20

> SIGN(): Returns sign of a given number. Example: (i) SIGN (15) Result: 1 : (ii) SIGN (-15) Result : -1 : (iii) SIGN (0) Result : 0.

> SQRT: Returns the square root of given number. Example: (i) SQRT (25) Result: 5

Character/String Functions

> LENGTH(): Returns the length of a string in bytes/no.of characters in string. Example: LENGTH('INFORMATICS'); Result:11

> CHAR(): Returns the corresponding ASCII character for each integer passed. Example: CHAR(65) ; Result : A

> CONCAT(): Returns concatenated string i.e. it adds strings. Example: CONCAT('Informatics',' ','Practices'); Result : Informatics Practices'

> INSTR(): Returns the index of the first occurrence of substring. Example: INSTR('Informatics',' mat'); Result : 6(since 'm' of 'mat' is at 6th place)

> LOWER()/ LCASE(): Returns the argument after converting it in lowercase. Example: LOWER('INFORMATICS'); Result: informatics

> UPPER()/ UCASE(): Returns the argument after converting it in uppercase.
Example: UCASE('informatics'); Result: INFORMATICS

> LEFT () : Returns the given number of characters by extracting them from the left side of the given string
Example : LEFT('INFORMATICS PRACTICES', 3); Result : INF

> RIGHT(): Returns the given number of characters by extracting them from the right side of the given string
Example : RIGHT('INFORMATICS PRACTICES',3); Result: CES

> MID(): Returns a substring starting from the specified position in a given string.
Example: MID('INFORMATICS PRACTICES',3,4); Result : FORM

> SUBSTR(): Returns a substring from a given string.
Example: SUBSTR('INFORMATICS' , 3 , 4) ; Result : FORM
SUBSTR('INFORMATICS' , -3 , 2) ; Result : IC

> LTRIM(): Removes leading spaces.
Example : LTRIM(' INFORMATICS'); Result: 'INFORMATICS'

> RTRIM(): Removes trailing spaces.
Example : RTRIM('INFORMATICS '); Result: 'INFORMATICS'

> TRIM(): Removes leading and trailing spaces.
Example: TRIM(' INFORMATICS '); Result: 'INFORMATICS'

Date/Time Functions
> CURDATE(): Returns the current date
Example: CURDATE(); Result: '2012-09-18'

> NOW(): Returns the current date and time
Example: NOW(); Result : '2010-07-21 13:58:11'

> SYSDATE(): Return the time at which the function executes
Example: SYSDATE(); Result: '2010-07-21 13:59:23'

> DATE(): Extracts the date part of a date or datetime expression

Example: DATE('2003-12-31 01:02:03'); Result:: '2003-12-31'

> MONTH() Returns the month from the date passed
Example: MONTH('2010-07-21'); Result : 7

>MONTHNAME() Returns the name of month from the date passed
Example: MONTHNAME('2010-07-21'); Result : JULY

> YEAR(): Returns the year.
Example: YEAR('2010-07-21'); Result : 2010

> DAYNAME(): Returns the name of the weekday
Example: DAYNAME('2010-07-21'); Result : WEDNESDAY

> DAYOFMONTH(): Returns the day of the month (0-31)
Example: DAYOFMONTH('2010-07-21'); Result: 21

> DAYOFWEEK(): Returns the weekday index of the argument
Example: DAYOFWEEK('2010-07-21'); Result: 4 (Sunday is counted as 1)

> DAYOFYEAR(): Return the day of the year(1-366)
Example: DAYOFYEAR('2010-07-21'); Result: 202

E-GOVERNANCE: It refers to application of electronic means in governance with an aim of fulfilling the requirements of common man at affordable costs and in fastest possible time.

Social impacts of E-Governance:

- Improved efficiency of administration and service delivery.
- Reduced waiting time.
- Reduced cost.
- Increased public participation.
- Increased transparency.

Some E-Governance websites are:

Name of Website	Purpose
www.incometaxindia.gov.in	It Provides all the services of Income Tax department.
www.indiancourts.nic.in	It provides information related to Supreme Court and High Courts of India.
www.rti.gov.in	Right to information Act 2005 mandates timely response to citizen requests for government information.
india.gov.in	This portal not only gives the information about Government of India, but also allows the users to apply online for various services provided by the government,
www.drdo.nic.in	Defense Research and Development organization.

E-BUSINESS: It refers to any form of transaction (exchange) that uses an electronic medium to facilitate the transaction.

Social impacts of E- Business:

- Reductions in transactions and other costs.
- Increase in the internet users.
- Un-shortened supply chain.
- Improved customer service.
- Increased productivity/efficiency.
- Access to international markets.

Some E-Business websites are:

Name of Website	Purpose
www.irctc.co.in	It provides online railway ticket reservation in India.
www.licindia.com	Insurance company of India.
www.ebay.in	India's most popular online shopping mall providing free online auctions.
www.amazon.com	Online store for Books, CD's, DVD's, MP3's etc.
www.yatra.com	Online flight ticket booking service.

E-LEARNING: It is a flexible term used to describe a means of teaching through technology such as a network, browser, CDROM or DVD multimedia platform.

Social impacts of E- Learning:

- Availability of same course to millions.
- Boon for working class.
- Apprehensive Employers.
- Cultural differences obstruct the true aim of e- learning.
- High Dropout rate.

Some E-learning websites are:

Name of Website	Purpose
www.moodle.org	It is Open source Course Management System (CMS), also called as Learning Management System(LMS).
www.w3schools.com	Online web tutorial.
www.exelearning.org	Freely available open source application useful in publishing of web content.
www.ncert.nic.in	Interactive module for students to learn various topics.
www.gcflearnfree.org	It is an educational part of the GCF mission. GCF creates and provides quality, innovative online learning opportunities to anyone who wants to improve the technology, literacy, and math skills.