Computer Operator and Programming Assistant Trade Theory Annual Pattern (As per July 2022 syllabus)

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Syllabus

Safe working practices, Scope of the COPA trade, Safety rules and safety signs, Types and working of fire extinguishers, Introduction to Computer components

Safe working practices

1) Do not touch power connections or loose power cables without permission.
2) Do not eat in the lab space.
3) Keep your water bottles away from computer components like CPU, monitor, keyboard, mouse, printer, etc.
4) Report any hardware issues immediately to the lab in-charge.
5) Never open surf the Internet in the absence of your faculty/ supervisor.
6) Do not play games on computer.
7) Properly shutdown the computer after completing your works.
8) Do not charge any mobile devices.
9) Keep the lab space clean.
10) Report any abnormal conditions immediately.

Safety Rules

Figure: Safe working practices[1]

Figure: Rules to be followed in computer lab[2]

Job Opportunities

1) Data entry job in any commercial organization.
2) One may setup Common Services Centre or browsing centre.
3) Recruitment in State Government and Central Government agencies for Data Entry Operator job.
4) One year apprenticeship in any Government or Private organization.
5) Programming assistant job in software firms.
6) Point of Sale (PoS) Operator job in malls and other commercial establishments.

Safety symbols

Figure: Safety symbols)[**?**]

Components of computer

1) Central Processing Unit (CPU) is the main component of comptuer.
2) CPU contains motherboard, RAM, Hard Disk, CD/DVD drive, etc.
3) Motherboard contains a special RAM called CMOS (Complimentary Metal Oxyde Semiconductor) for storing date, time and other settings.
4) CMOS is kept in power-on condition using CR20232 battery.
5) Monitor is the display device. It is otherwise called Visual Display Unit (VDU).
6) Keyboard and mouse are the most common input devices.
7) Processor cycles are governed by control unit.
8) Calculations and comparisons are carried out at Arithmetic and Login Unit (ALU).
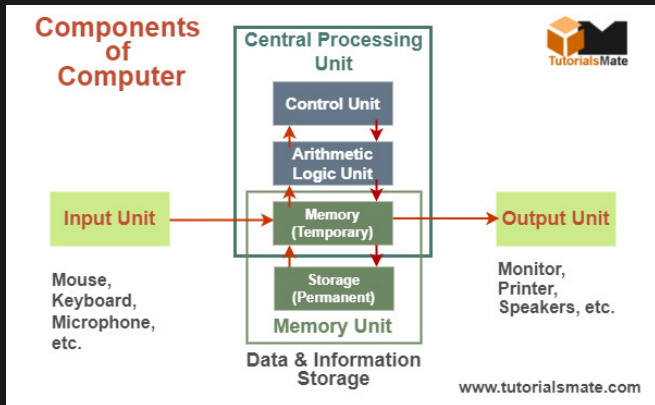
Block diagram showing components of computer

Figure: Components of computer[**?**]

Concept of hardware and software

Hardware and software are the body and mind of the computer. The physical hardware runs according to the directions of the invisible software. The main differences between hardware and software are presented in Table 1.

Table: Hardware & software

Sl. No.	Hardware	Software
1	Physically accessible	Physically inaccessible
2	Can be touched, when power is off	Cannot be touched, whether power on or power off
3	Consumes lot of power	Causes other components to consume power to make them work. It does not consume any power.
4	Occupies space	Does not occupy visible space
5	Directly verifiable	Its existence is inferred through the working of hardware

Computer hardware

- The parts of computer which can be seen and touched are called hardware. Generally, computer hardware consists of the following 3 units:

  1. **Input unit:** Input unit helps to send commands and data to the Central Processing Unit (CPU) and fuels the processor of the computer. Keyboard, mouse, scanner, light pen, etc. are some of the common input units.

  2. **Output unit**: The peripherals like Visual Display Unit (VDU)/Monitor, Printer, Plotter, etc. are some of the most common output units.

  3. **Central Processing Unit (CPU)** The Central Processing Unit (CPU) processes input data and produces results, which are out output data.

Central Processing Unit

▶ The processing centre of computer where mathematical and logical operations are carried out by the processor is called Central Processing Unit. The Central Processing Unit has the following internal components:

1. Microprocessor.
2. Main Memory or Primary Storage or Random Access Memory.
3. Mother board.
4. Secondary Storage or Auxiliary Storage (Hard disk, optical (CD/DVD) drive, floppy drive (obsolete).)
5. Switch Mode Power Supply (SMPS).
6. Connectors for storage and power controls.
7. Ports for connecting other devices.

Microprocessor

- ▶ Microprocessor is the chip that performs arithmetic and logical operations based on given input data and instructions and sends out the results of such processing operation.

- ▶ Microprocessor contains huge number of electronic devices like transistors, capacitors, resistors and inductors embedded in neatly etched circuitry.

- ▶ Microprocessor is the brain of computer since all other parts of computer simply coordinate with this one chip.

- ▶ Processor can complete one operation per clock cycle. The number of clock cycles per second is called the speed of the processor, measured in kHz (1 kHz = thousand cycles per second) or FLOPS (FLoating Point OPerations per Second).

- ▶ Registers in microprocessor hold the data required for processing.

- ▶ Control unit of the microprocessor directs the work to be carried out by other parts of a computer. It coordinates with the memory registers and Arithmetic and Logic Unit to complete processing.
- ▶ Arithmetic and Logic Unit (ALU) is the part of microprocessor circuitry which does the number crunching and comparison works.
- ▶ Parallel processing in microprocessors is made possible through multiple processor cores cast in a single chip.
- ▶ Multi-core processors gain higher speed if proper multi-processing algorithms are combined with multi-core processors.
- ▶ Small memory called cache memory is etched on board the micro-processor.
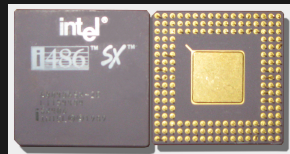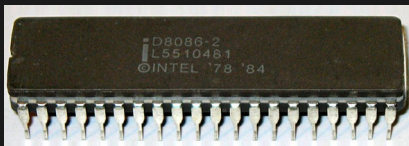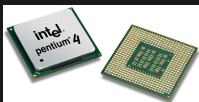
(a) Pentium 4 Processor[47]

(b) Core 2 Duo Processor[48]

(c) Core i3 Processor[49]

(d) Core i5 Processor[50]

(e) Core i7 Processor[51]

(f) Athlon Micro

Main Memory or Primary Storage or Random Access Memory

▶ Main memory is the storage reserved for the data and instructions moving to and from the processor.
▶ Main memory is very fast.
▶ Main memory does not retain any data. It looses data when a program exits or when the computer is rebooted. Hence, it is called **Volatile storage** - the storage that evaporates.
▶ Main memory is otherwise called primary storage, volatile storage or the more common name of Random Access Memory (RAM).

(a) SDRAM[53]　　　　　　　(b) DDRSDRAM[54]

Figure: Common types of RAM

- ▶ Different types of RAM are:
  1. **SRAM:** Static Random Access Memory
  2. **DRAM:** Dynamic Random Access Memory
  3. **FPM DRAM:** Fast Page Mode Dynamic Random Access Memory
  4. **EDO DRAM:** Extended Data Out Dynamic Random Access Memory
  5. **SDRAM:** Synchronous Dynamic Random Access Memory
  6. **DDR SDRAM:** Double Data Rate Synchronous Dynamic Random Access Memory
  7. **RDRAM:** Rambus Random Access Memory
  8. **VRAM:** Video Random Access Memory
  9. **MPDRAM:** Multi-Port Dynamic Random Access Memory
  10. **SGRAM:** Synchronous Graphics Random Access Memory

Mother board

- ▶ The board containing the electronic components needed for supporting the micro-processor (μP), RAM and other components is called the mother board.
- ▶ Mother board has slots for connecting secondary storage units like hard disk, CD drive, DVD drive, floppy disk, etc.
- ▶ Motherboard contains the **Complimentary Metal Oxide Semiconductor - CMOS**, which keeps configuration data needed at boot time. It is a RAM, but kept constantly powered on by a special battery called CMOS battery.
- ▶ Motherboard supports **Basic Input Output System (BIOS)**, which helps booting of the computer (power up process).
- ▶ The motherboard supports **Communication & Network Riser - (CNR), Accelerated Graphics Port (AGP), Parallel Advanced Technology Attachment (PATA) or Integrated Drive Electronics (IDE), Serial Advanced Technology Attachment (SATA), Northbridge chipset (for datatransfer to and from the processor), Southbridge chipset (data transfer to and from**
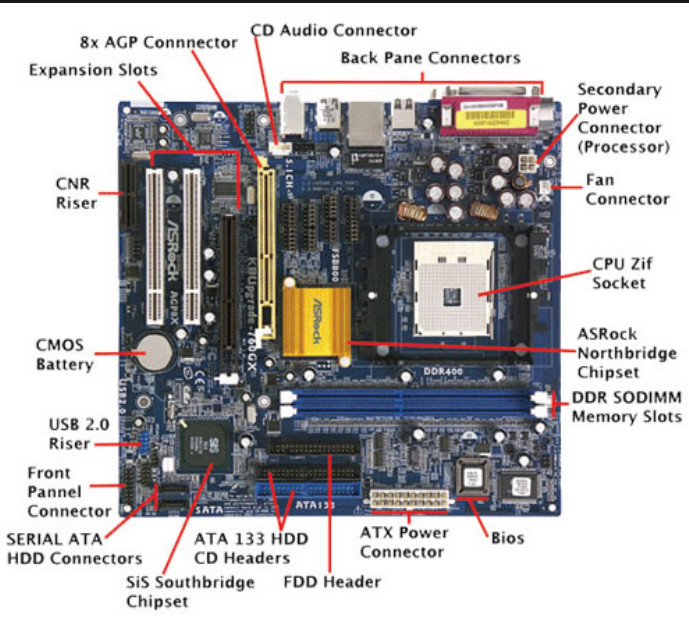
Figure: Motherboard[55]

Secondary Storage or Auxiliary Storage

▶ Secondary storage or auxiliary storage is very slow compared to the Random Access Memory, but it provides permanent storage for data.

▶ Data stored in secondary storage or auxiliary memory will be available even after the computer reboots.

▶ Hard disk, CD/ DVD drive, floppy drive, etc. are some of the secondary storage units.

▶ Hard disk uses a magnetic plate mounted on motorized spindle to store and retrieve data.

▶ Compact Disk (CD) or Digital Versatile Disk (DVD) drive uses LASER beam of low strength for reading and high strength for writing data.

▶ Floppy disk is a magnetic film coated plastic plate which can store very small amount of data. Floppy disk is easily damaged and is no longer used in computers.

▶ Chip based storages like SD (Secure Digital) Card, Micro-SDCARD, PCMCIA (Personal Computer Memory Card International Association), pen drive, external hard disk

Read Only Memory

- Chip level storage, like the information stored in BIOS, is called Read Only Memory.
- Read only memory is classified as follows:
  1. **PROM - Programmable Read Only Memory:** Programmable Read Only Memory. It may be reprogrammed using PROM programmer, but only once.
  2. **EPROM - Erasable Programmable Read Only Memory:** Contents of EPROM may be erased using Ultra Violet (UV) rays and reprogrammed using RPROM programmer.
  3. **EEPROM - Electronically Erasable Programmable Read Only Memory:** Contents of EEPROM may be erased in the circuit where it is located and the same may be reprogrammed. BIOS chip belongs to EEPROM category.

Common storage sizes are presented in Table 2.

Table: Memory sizes

Sl. No.	Storage name	Storage size	Remarks
1	Bit	1 bit	Smallest size memory. Stores 0 or 1
2	Nibble	4 bits	
3	Byte	8 bits	Smallest allocation unit through programs.
4	kilo Byte (kB)	1024 bytes	2^{10} (1024) bytes
5	Mega Byte (MB)	1024 kilo bytes	2^{20} (1048576) bytes
6	Giga Byte (GB)	1024 mega bytes	2^{30} (1073741824) bytes
7	Tera Byte (TB)	1024 Giga bytes	2^{40} (1099511627776) bytes
8	Peta Byte (PB)	1024 Tera bytes	2^{50} (1125899906842624) bytes
9	Exa Byte (EB)	1024 Peta bytes	2^{60} (1152921504606846976) bytes

Table: Storage capacities for computer media (secondary storage)

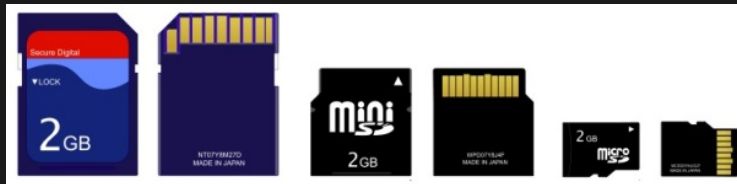| Sl. No.	Media	Storage capacity
1	CD	700MB
2	DVD	4.7GB
3	SD/ Mini-SD/ Micro-SD card	2GB to 128GB
4	Pen drive	2GB to 128GB
5	Hard disk	250GB to 1TB

(a) Hard drive[56]

(b) CD/DVD drive[57]

(c) Floppy drive[58]

(d) Pen drive[59]

(e) SD, Mini SD and Micro-SD cards[60]

Switch Mode Power Supply (SMPS)

► Switch Mode Power Supply (SMPS) takes 240V input and converts it to varying levels of output to suit the requirements of different components of the CPU.

► SMPS is very efficient in power conversion and minimizes wastage of electricity.

► SMPS produces radio frequency interference, which affects communication signals in the radio frequency (mobile phone, radio receiver, etc.)

Figure: Switch Mode Power Supply (SMPS)

CPU ports

- ▶ Ports are located at the rear panel of CPU.
- ▶ Ports help connection of various peripherals (like keyboard, mouse, printer, scanner, camera, speaker, microphone, audio-input, monitor, serial modem, broadband line, etc.) to the computer.
- ▶ Some of the most common ports are: (i) PS/2 (Personal System 2) ports for keyboard and mouse; (ii) RS-232 (Recommended Standard 232)/ Serial port for mouse, modem and other serial devices; (iii) VGA (Video Graphics Array) port for connecting monitor or projector; (iv) Ethernet / RJ-45 (Registered Jack 45) for broadband connection; (v) USB (Universal Serial Bus) port for connecting printer, fax, pen drive, external hard disk, external DVD writer, web camera, etc.; (vi) LPT (Line Printer Terminal) port for connecting old style dot matrix/ line printers; (vii) 3.5mm audio jack for speaker output/ mic input; (viii) Game port - port for connecting joystick.
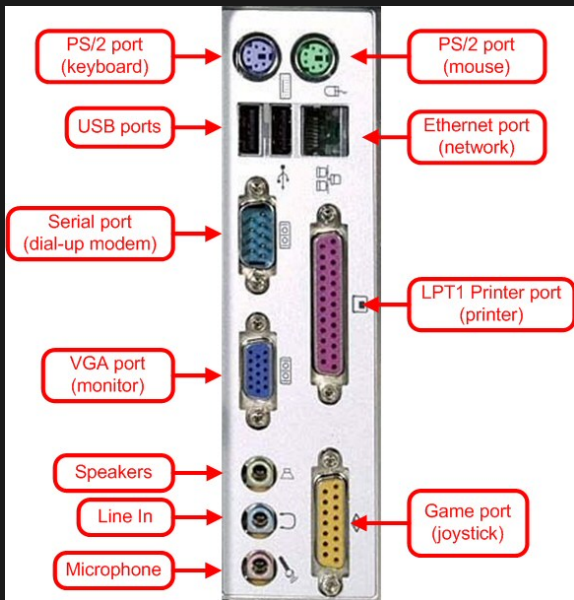
Figure: Ports in CPU

Input unit

1) **Keyboard**: Keyboard is otherwise called console input unit. Common layout of keyboard supports English(US), English(UK) and local languages like Hindi, Tamil, etc.

Figure: Keyboard [27]

Input unit

2) **Mouse** - Mouse has LASER based or roller based tracking mechanism to measure change of position. The movement of the mouse causes movement of pointer on the VDU. Mouse has 3 buttons: (a) the left button, (b) the right button and (c) the centre button which doubles as mouse roller for scrolling.

Figure: Mouse [28]

Input unit

3) **Scanner** - It helps to convert content available on paper to digital image using a moving scan system.
4) **Tablet** - It converts whatever is written with fingers or a stylus to characters and images on screen.
5) **Light pen** - The device has a light sensitive tip which converts traces the features of display on CRT monitor and converts it to a new digital image.

(a) Scanner[29]   (b) Tablet[30]   (c) Light pen[31]

Output unit

1) **Monitor (otherwise called Console Output Unit or Visual Display Unit (VDU))**

    1. Cathode Ray Tube (CRT) monitors were used in the early days of computer.
    2. Plasma (Ionized gas) monitors were also used with computers. But, they are now used for large panel televisions instead of computers. It is not economical to manufacture plasma monitors less than 32" in size.
    3. Liquid Crystal Display (LCD), Light Emitting Diode (LED) and Thin Film Transistor (TFT) monitors are commonly used. LCD may be a bit dull compared to LED and TFT monitors.
    4. Plasma, LCD, LED and TFT monitors consume lower power compared to the CRT monitors, occupy less space and present vivid range of colours.
    5. The maximum permissible resolution for LCD and LED monitors is numerically limited but have sufficient resolution (PPI - Pixels Per Inch) to produce vivid images.

(a) CRT[32]

(b) LCD[34]

(c) TFT[33]

(d) LED[35]

Figure: Types of monitor

Monitor resolution and aspect ratio

1) **Resolution of monitor** refers to the number of pixels (Picture Elements, dots) which can be placed on the display area.

2) **Aspect ratio** is ratio between the number of pixels in the horizontal direction to the number of pixels in the vertical direction.

3) The CRT monitors had aspect ratio of 4:3. Resolutions of 400x300 and 800x600 fall under the aspect ratio of 4:3.

4) Modern LCD, LED and TFT monitors have aspect ratios of 16:9, 16:10, etc. Modern monitors are called wide screen displays due to the higher width to height ratio. Resolution of 1920x1080 is the typical resolution for aspect ratio of 16:9 and 1280x800 is the typical resolution for aspect ratio of 16:10.

5) Monitor resolution may also be measured using Pixels Per Inch (PPI), which is the number of pixels in one inch distance of the monitor.

6) In monitor resolution, the term **High Definition (HD)** denotes the closely spaced pixels to produce clear display of images.

Monitor resolutions

W

Table: Monitor resolutions

No.	Display Definition	Pixel resoultion	Progressive Resolution
1	Standard Definition (SD)	640x480	480p
2	High Definition (HD)	1280x720	720p
3	Full High Definition (FHD)	1980x1080	1080p
4	2k resolution	2048x1080	2k
5	4k resolution	3840x2160	4k/ ultra HD

2) **Printer:** Printer produces paper copies called hard copies. Following printers are available:

1. **Impact type printers:** Impact type printers hit the paper using characters and shapes to produce an imprint on the paper. Dot matrix printer, line printer, chain printer, golf ball printer, daisy wheel printer, etc. are examples of impact printers.

2. **Non-impact type printers:** Non-impact type printers do not physically hit the shapes and characters on the paper. Some of the most common types of non-impact printer are:

   (i) **Inkjet printer:** Inkjet printer uses ink cartridges and print head. The head spits ink in desired pattern to produced characters and shapes.

   (ii) **LASER printer:** Laser printer uses heat generated by LASER beam to create shapes/characters and make the toner powder to stick to the paper

   (iii) **Thermal printer:** Thermal printer creates desired shapes and characters using heating filament on a special paper coated with BisPhenol A (BPA). It is used in ATM machines, ticketing machines, point of sale terminals, etc.

   (iv) **Plotter:** Plotter is a large printer (usually non-impact type) used to produce large size drawings on paper.

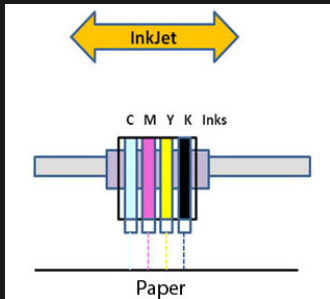(a) DOT matrix printer[36]

(b) Line printer[37]
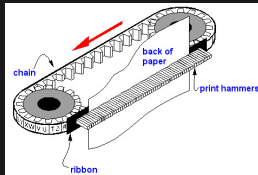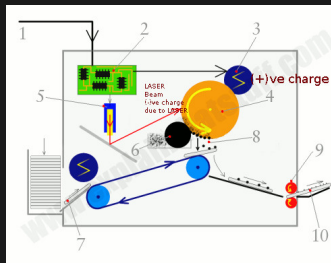

(c) Chain printer[38]

(d) Golf ball printer[39]

(e) Daisy wheel printer[39]

(a) Inkjet printer[41]

(b) LASER printer[42]
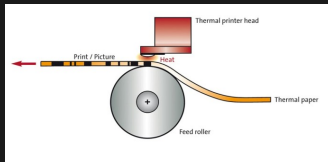
(c) Thermal printer[43]

(d) Plotter[44]

Common terms related to computer hardware

1) **CPU**: Central Processing Unit
2) **PS2**: Personal System 2
3) **USB**: Universal Serial Bus
4) **RS-232 (Serial) port**: Recommended Standard 232
5) **LPT (Parallel) port**: Line Print Terminal
6) **VGA**: Video Graphics Array
7) **RJ-45**: Registered Jack 45. Other names: Ethernet port or LAN Port. LAN stands for Local Area Network. Used for broadband connection.
8) **RJ-11**: Registered Jack 11. Used for connecting telephone line or networking through telephone line.
9) **DVI**: Digital Visual Interface.
10) **HDMI**: High Definition Media Interface.
11) **SMPS**: Switch Mode Power Supply.
12) **HDD**: Hard Disk Drive.

Common terms related to computer hardware

13) **FDD**: Floppy Disk Drive.
14) **SATA**: Serial Advanced Technology Attachment.
15) **PATA**: Parallel Advanced Technology Attachment. Otherwise called Parallel port or IDE port.
16) **IDE**: Integrated Device Electronics. This is an alternate name for PATA.
17) **RAM**: Random Access Memory. Otherwise called Primary storage or main memory or volatile memory.
18) **CMOS**: Complimentary Metal Oxide Semi-conductor.
19) **BIOS**: Basic Input Output System.
20) **CNR**: Communication and Network Riser.
21) **IEEE 1394**: Institute of Electrical and Electronics Engineers 1394. Otherwise called Firewire port.
22) **ATA**: Advanced Technology Attachment.
23) **ATX**: Advanced Technology eXtension.
24) **DDR**: Double Data Rate.

Computer software

- ▶ Computer software decides how the hardware works.
- ▶ Software is the reason why computers can produce output based on given input.
- ▶ Software can be divided into 2 essential categories:
    1. **System software:** The software needed for by the computer to support other software and hardware components is called the system software. The Basic Input Output System (BIOS), the Operating System (Windows, Unix, Linux, Mac OS, etc.) and device drivers are the major system software. System software does not directly carry out any productive work (like document editing). It helps other software packages to work and produce desired output through available hardware.
    2. **Application software:** Application software helps in productive working of computer like creating documents, spreadsheets, playing music/video, managing databases, etc.. It does not worry about booting the computer or controlling the hardware (these works are relegated to the system software).

Functions of an operating system

1) Operating system coordinates with BIOS in identifying hardware available at the time of booting.

2) Operating system initializes, operates and controls all peripheral units through appropriate *drivers*.

3) Operating system coordinates application programs and allows time sharing or parallelism. Parallel processing helps several applications to run concurrently through sharing of the processor time. Users feel as if all the applications are running continuously in the background and foreground.

4) Operating system allots, manages and frees memory needed for other processes.

Introduction to operating system

5) Operating system makes secondary storage devices to load and save data.

6) Operating system manages network connections and shares available connection between programs needing network access.

7) Operating system manages hard disk fragmentations and tries to arrange storage tracks in continuous chunks.

8) The core of the operating system, handling hardware, file system and networking is called the *kernel* of the operating system.

9) The part of the operating system which interacts with the user is called *shell* of the operating system. Shell can provide command line interface or Graphical User Interface (GUI).

Popular Operating Systems in use

▶ Following are the most popular operating systems on computers:

1. Microsoft Windows
2. Apple Mac OS
3. Linux
4. UNIX
5. Free BSD, Darwin, BeOS, Solaris, IBM AIX, etc.

Microsoft Windows

- ▶ Microsoft Disk Operating System (MSDOS) released in 1981. Development of MS DOS was stopped in the year 2000.

- ▶ MS DOS based Windows 1.0 was released by Microsoft in 1985. After Windows 3.1, subsequent releases were named Windows 95, Windows 98, Windows Me. The MSDOS based Windows were discontinued.

- ▶ Microsoft released a stable, multi-tasking, multi-processor operating system named Windows NT in 1993. It was succeeded by Windows 2000, Windows XP, Windows Vista, Windows 7, Windows 8, Windows 10 and Windows 11.

Windows 11
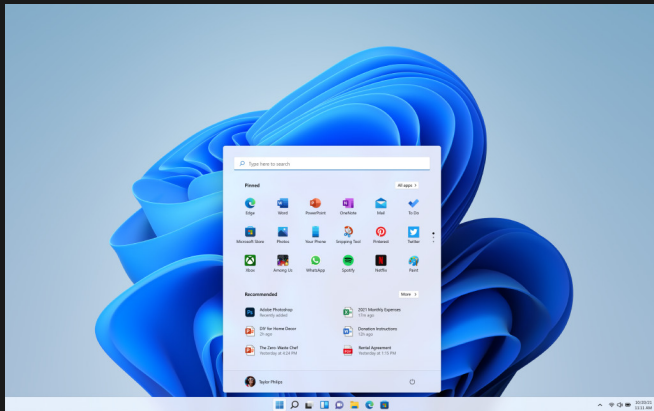
Figure: Windows 11 [4]

(a) Windows 10[?]

(b) Windows 10 Mobile[65]

Figure: Windows 10

Mac OS

▶ Apple computers released the first version of GUI based Mac OS in the year 1984.

(a) Mac OS[63]

(b) iOS
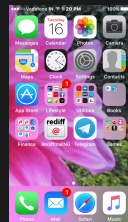
Figure: Mac OS and iOS

Linux

- Linux was developed by Linus Torvalds in the year 1991.
- Linux is distributed under the GNU General Public License (GNU GPL), which permits free access to source code, but mandates redistribution of software under the same license.
- Linux operating system was inspired by Unix operating system.
- Linux provides a stable, scalable, highly productive kernel.
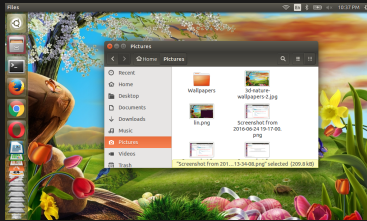
(a) GNOME on Linux[63]
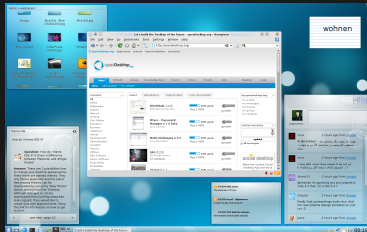
(b) KDE on Linux[?]

Mobile adaptations of Linux kernel
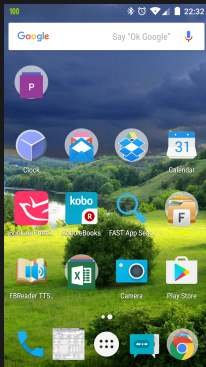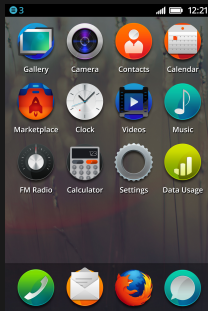
(a) Android   (b) Firefox OS[67]   (c) Tizen[68]

Figure: Mobile versions of Linux

UNIX

- ▶ UNIX was one of the first operating systems to support multi-tasking and multiple user logins.
- ▶ UNIX was developed at AT&T Bell Labs in the year 1970 by Ken Thompson, Dennis Ritchie, M. D. McIlroy and J. F. Ossanna and others.
- ▶ UNIX still remains the gold standard for any operating system.
- ▶ The UNIX operating system was standardized by POSIX (Portable Operating System Interface), which was superceded by SUS (Single Unix Standard).
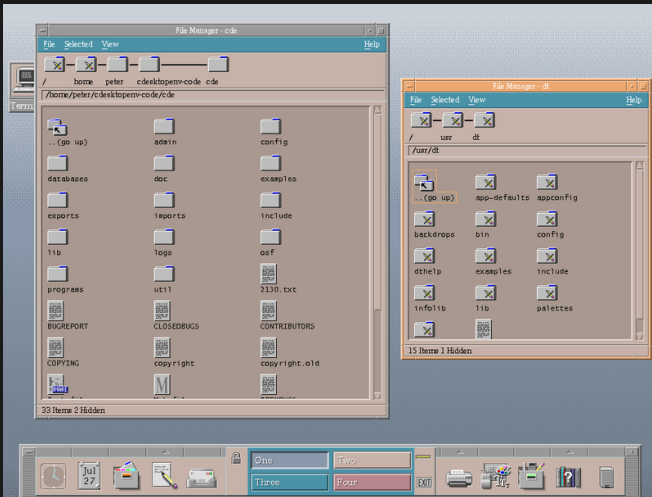
Figure: Common Desktop Environment (CDE) on UNIX

Overview of operating systems

- ▶ By market share, Microsoft Windows is the most common operating system used in personal computers.
- ▶ Windows 10 and Windows 11 are the most common versions of Windows at present.
- ▶ Windows 3.1, Windows 95, Windows 98, Windows Me, Windows NT, Windows 2000, Windows 2003, Windows XP and Windows 7 and Windows 8 are some of the obsolete versions of Windows operating system.
- ▶ Apple computers installs Mac OS X in its computers. This operating system presents a Graphical User Interface (GUI) and good security. Mac OS Big Sur is the latest version of Mac.
- ▶ Free operating system named Linux is available for variety of computers from desktops to servers. Linux kernel has been repacked with a variety of features in the names of Debian, Ubuntu, Red Hat, Fedora, SUSE, etc. are some of the popular versions of Linux.
- ▶ Many more operating systems like BeOS, Free BSD, Darwin,

Main features of Windows O.S.

1) Windows is based on a graphical user environment called Desktop.
2) The desktop contains a collection of icons, named *desktop icons or shortcut icons*.
3) Windows provides a *taskbar*. The Taskbar contains start menu, quick launch icons and the system tray.
4) The start button opens a list of applications which can be run by clicking on their names or icons. Usually, start button appears at the left most end of task bar.
5) Quick launch icons are provided near the start button. They offer shortcuts to frequently used programs.
6) System tray provides status of several background tasks, data and time, volume control (optional) and network connectivity icon. The system tray is a quintessential control panel for background programs.
7) Clicking any icon in the desktop area or quick launch bar opens the corresponding application.
8) The list of processes currently running in the foreground is

Directory structure

1) Windows provides a directory named *user* (also called *Documents and Settings*) in the root folder of C: drive.

2) The user folder contains sub-folders representing the name of each user who logs in. In addition to individual sub-folders, a sub-folder named Public is available, the contents of which are shared with all users.

3) The sub-folder named after the individual user is called the *Home* folder. E.g., a person having login name *krish* gets a home folder called $C : \backslash users \backslash krish$.

4) Within the home directory, folder named *Desktop* stores all items seen in the desktop, *Documents* saves all files created by the user, *Downloads* saves all files downloaded from the Internet, *Pictures* stores all image files, *Videos* saves all video files, folder named *Music* saves all music files.

Features of Windows Explorer

- ▶ Windows Explorer may be opened from the start menu or by pressing *Windows button+E*.
- ▶ To rename a file, right click on the file (or select the file and press F2). The name file becomes editable.
- ▶ To copy a file, right click and choose copy (or press Ctrl+C). Press Ctrl+V at the new destination where a copy of the original file is needed.
- ▶ To cut a file (make a copy file and remove the original file), right click and choose cut (or press Ctrl+X). Press Ctrl+V at the new destination where a copy of the original file is needed. After copying, the original file will be deleted.
- ▶ To open a document, spreadsheet, music file, video file or any other file having a known support application (like MS Word, Excel, Windows Media Play/VLC), simply open the file by double clicking (or single click if enabled).

- ▶ To create desktop shortcut to a file, right click on the file, choose *Send to − > Desktop (create shortcut)*.

- ▶ To burn a file to CD/DVD, right click the file, choose *Send to− >X: <CD/DVD Drive name>*. The file writing dialog will appear when a blank CD/DVD is inserted. Follow on screen instructions to complete the process.

- ▶ To compress a file, right click, choose *Send to − > Compressed/Zipped archive*. The file will be compressed. If a third party zipping program like WinZip or WinRAR is installed, separate entries will be available for zipping.

- ▶ To unzip a compresed archive, simply double click the archive. Otherwise, right click the archive and choose appropriate option for unzipping.

- ▶ Large files can be compressed into smaller size with the help of zipping. WinRAR provides support for splitting a file into chunks (which can be combined at a new location) of specified size (to fit a CD/DVD).

Shortcut keys in Windows

- ▶ **F1** - Windows help.
- ▶ **F2** - Rename.
- ▶ **F3** - Find all files.
- ▶ **F5** - Refresh current window.
- ▶ **F6** - Move among panes in Windows Explorer.
- ▶ **Windows + L** - Lock computer.
- ▶ **Windows + M** - Show desktop.
- ▶ **Windows + D** - Show desktop.
- ▶ **Windows + R** - Run a command.
- ▶ **Windows + P** - Display sharing (with projector, secondary monitor, etc.).
- ▶ **Windows + V** - start clipboard.
- ▶ **Windows + K** - Audio/ video sharing.
- ▶ **Windows + I** - Windows settings.
- ▶ **Windows + A** - Alerts/ notifications.
- ▶ **Windows + S** - Open cortana.
- ▶ **Windows + F** - Windows feedback.
- ▶ **Windows + E** - Open Windows Explorer.

...Shortcut keys in Windows

- ▶ **Alt+F4** - Close current program/shutdown Windows.
- ▶ **Alt+Tab** - Cycle through currently running processes.
- ▶ **Alt+Down arrow** - Pop down list.
- ▶ **Alt+Space** - Window's system menu.
- ▶ **Alt+-** - System menu for child window.
- ▶ **Alt+Enter** -properties of the selected object.
- ▶ **Alt+Left arrow** - Previous folder in Windows Explorer.
- ▶ **Shift+Delete** - Delete permanently.
- ▶ **Shift+F10** - Context menu; equivalent to right click.
- ▶ **SHIFT** - Disable autorun for newly inserted media.
- ▶ **Ctrl+F4** - Closes the current child window.
- ▶ **Ctrl+X** - Cut a file.
- ▶ **Ctrl+C** - Copy a file.
- ▶ **Ctrl+V** - Paste a file.
- ▶ **Ctrl+Esc** - Start menu.
- ▶ **Ctrl+Shift+Esc** - Task Manager.

Booting process of computer

- ▶ Booting is the process of harware waking up and getting ready to load the operating system (Windows, Linux, Mac OS X, etc.).
- ▶ When the computer boots, the BIOS (Basic Input Output System) activates a series of hardware checkes called Power On Self Test (POST).
- ▶ The BIOS reads essential settings like date, time and boot device order, as customized by the user, from the CMOS.
- ▶ BIOS initializes all devices (disc drives, video cards, sound cards, network cards, floppy drives, USB ports and hard drives) connected to the computer.
- ▶ BIOS later works with the processor to transfer data to and from those devices.
- ▶ The programs needed for BIOS routines are stores in a BIOS chip.

Booting process of computer

- ▶ On successful completion of the POST routines, the *boot loader* loads the operating system from specified boot device (hard disk, DVD ROM, CD ROM, etc.).

- ▶ The boot loaded initially loads from a chip and is called *Primary Boot Loader*. The primary boot loader then calls a more elaborate boot loader program called *Secondary Boot Loader*.

- ▶ The secondary boot loader is normally stored in Master Boot Record (MBR). GNU GRUB, BOOTMGR, NTLDR, UEFI (Unified Extensible Firmware Interface) or ESP (EFI system partition).)

- ▶ The secondary boot loader, loads the operating system. When the operating system finishes loading, booting is complete and the computer is ready for usage.

- ▶ The computer beeps when the POST routines are successfully completed. It beeps and error message if there is some failure of POST.

Booting process of computer

- In case the POST fails, codified beeps are issued to denote the type of error encounted during POST. The beep codes and messages are as follows:
    1. **Steady, short beeps:** Power supply may be bad
    2. **Long continuous beep tone:** Memory failure
    3. **Steady, long beeps:** Power supply bad
    4. **No beep:** No power supply or beeper damaged.
    5. **One long, two short beeps:** Video card failure

BIOS settings

- ▶ BIOS is the Basic Input Output System in computer.
- ▶ Settings needed for BIOS are stored in CMOS (a RAM chip).
- ▶ CMOS is kept continuously power on using a special battery called CMOS battery (model No.CR2032).
- ▶ When CMOS battery fails or is removed, all settings stored in CMOS are lost.
- ▶ BIOS settings may be accessed by pressing DEL, F2, ESC, or any other key (depending on the manufacturer) immediately after switching the power supply on.

BIOS settings

- The BIOS settings may be classified under the following heads:
    1. **Main:** Settings related to date, time, drive options, memory details, etc.
    2. **Advanced:** Configuration of processor, on board features of the motherboard, configuration of USB, etc. can be accessed through Advanced option.
    3. **Power:** Power options relate to the options to deal with power off and subsequent restart, suspension of disk drive after particular duration, etc.
    4. **Boot:** The options relating to UEFI, order of the boot devices and options to change boot order, etc. are displayed in boot settings.
    5. **Security:** The options related to setting of user and administrator passwords is available from Security menu.
    6. **Exit:** Options for saving the settings before exit, load optimal defaults before exit, load previous settings that worked, discard all changes and exit the CMOS settings, etc. are displayed under this menu.

Figure: Message to access BIOS settings
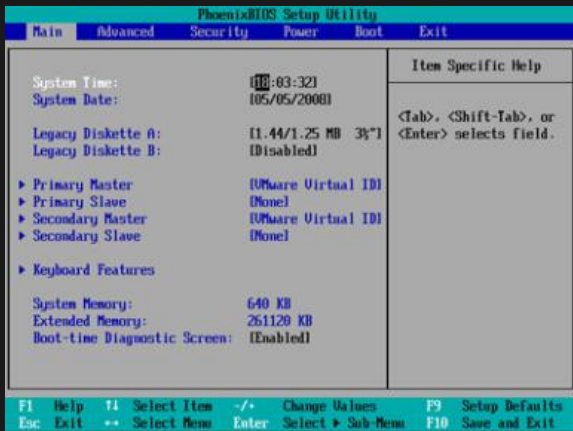
Figure: BIOS - Main settings
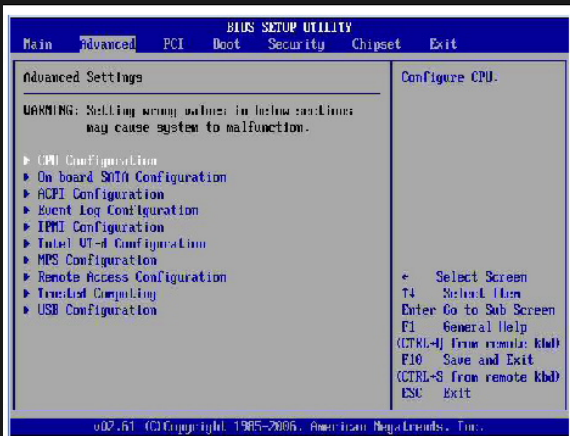
Figure: BIOS - Advanced settings
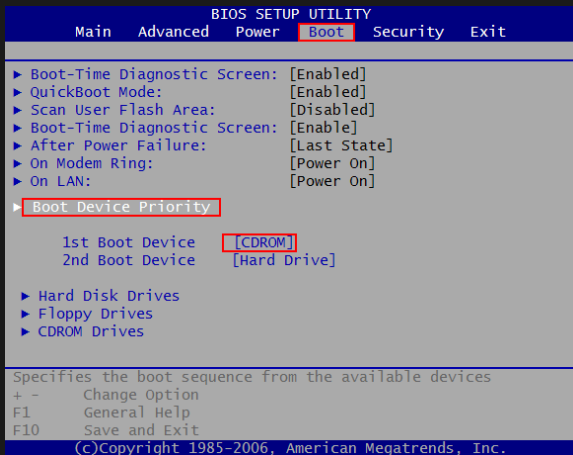
Figure: BIOS - Boot settings
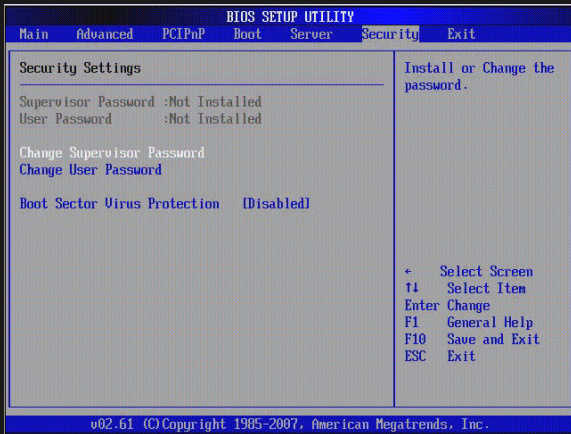
Figure: BIOS - Security settings

Figure: Message for booting from CD

Basic Hardware and software issues and their solutions

1) **Brute solution to many problems:** Reboot the computer. It solves several problems without going through the details. So, restart is the first solution to fix problems in a running computer.

2) **Computer is slow:** Remove Internet connection. Run disk cleanup from control panel. Open task manager (run taskmgr, press Ctrl+Shift+Esc, or press Ctrl+Alt+Delete and choose task manager), right click unwanted programs and choose End Process.

3) **Computer misbehaves:** Remove all peripherals. Connect just monitor, keyboard and mouse. Boot PC to know whether problems recurs. Add all other peripheral units one by one. Identify whether the problem occurs due to any particular peripheral.

4) **PC does not boot:** Reconnect/ replace power cables. Check whether SMPS is running (SMPS switch turned on and fan running in the rear panel). Check whether motherboard LED is lit up.

5) **Long beeps & boot halted:** Remove RAM chip. Clean the RAM canal and the ram chip. Reinsert the chip.

6) **Insert boot media error:** Open BIOS settings. Arrange boot devices in right order. Reboot. If problem persists, see whether the required media is listed in the BIOS. Boot from alternate media (like CD, DVD or pen drive) to check whether the PC can boot at all.

7) **Boot halted due to wrong settings:** Press Del or F2 or enlisted key to access BIOS. Set correct date and time.

8) **PC does not switch on:** Check power cables. Check SMPS.

9) **BIOS settings are lost after each poweroff:** Replace CMOS battery (CR2032).

10) **Printers do not work:** Open control panel. Go to services. Click on *Print Spooler* service. If it is not running (most probable), start the service.

11) **PC Reboots while working:** Try another RAM. If problem persists, try another SMPS. Check all IDE/ SATA cables. Reinsert all power cables.

12) **Internet connection is slow:** See whether Windows is automatically downloading updates. Pause the updates and check connection speed (Automatic updates may be disabled using control panel).

13) **Cannot install new program:** Right click on setup file and choose *Run as administrator*. If it does not solve the problem, choose compatible installer (32 bit or 64 bit) for the operating system.

14) **Paper jam error:** Switch off printer. Remove top cover. Remove jammed paper. Power on the printer and check whether it works.

Usage of application software

- ▶ Application software packages help in making productive use of computers.
- ▶ Microsoft Office is one of the most popular appication software packages.
- ▶ MS Office contains Word for document editing, Excel for spreadsheets, PowerPoint for making presentations.
- ▶ MS Paint helps in preparation of drawings and editing of images.
- ▶ Third party applications may be installed for image editing (Photoshop, GIMP, Corel Draw, etc.), video editing (Adobe Premier, Openshot, etc.) or any other task.
- ▶ For browsing the web, Microsoft Edge (Based on Chrome) is available. Third party browsers like Firefox, Google Chrome and Opera are also available.

Antivirus

- ▶ Antivirus prevents malicious software from infecting the computer.
- ▶ Antivirus packages like McAffee, Norton, Kaspersky, K7, Bitdefender, Panda, AVG, etc. are available for annual payment for renewal.
- ▶ Some free antivirus packages like Avast, Avira, AVG (free version), Malwarebytes, etc. are also available.
- ▶ Generally, installation of antivirus slows down the performance of computer.
- ▶ Antivirus prevents viruses spreading through pen drives, DVDs and the Internet/ email.

Introduction to DOS

- ▶ MS DOS was a small operating system released by Microsoft Corporation in the year 1981 to run on IBM Personal Computer.
- ▶ After releasing version 8.0 in September 2000, development work on MS DOS ceased.
- ▶ MS DOS applications had either .COM extension or .EXE extension.
- ▶ MS DOS supports two types of commands:
    - (i) **Internal DOS commands** - the commands which were part of the DOS os and loaded to memory, whether called for or not. These commands are also called **Memory Resident DOS Commands**.
    - (ii) **External DOS commands** - the commands which were kept in disk and loaded only when invoked from the command prompt.
- ▶ A collection of DOS commands may be typed inside a file (typically beginning with @echo off) having .BAT extension (called a batch file). The batch file can be invoked as a new command.

Internal DOS commands

1	CLS	Clear screen.
2	DIR	Show list of files and directories.
3	VER	Show version number of MS DOS.
4	VOL	Show volume label for a disk drive.
5	DATE	Show current date; set new date if necessary.
6	TIME	Show current time; set new time if necessary.
7	COPY	Create copy of one file to another file.
8	TYPE	Display contents of a file in the command window.
9	COPY CON	Copy the typed content to a file name provided in as argument. Copying stops when Ctrl+Z (end of file indicator) is pressed.
10	REN	Rename the file (first argument - old name; second argument - new name).
11	DEL or ERASE	Delete a file.
12	MD or MKDIR	Create new directory.
13	CD or CHDIR	Change to new working directory.
14	RD or RMDIR	Remove given directory.

15	ECHO	Takes on or off argument to decide whether commands file batch file are displayed or not.
16	EXIT	Closes command prompt.
17	PATH	Displays list of directories in which a command is looked for. Sets new path if necessary.
18	PAUSE	Hold on processing until Enter key is pressed.
19	PROMPT	Set new command prompt instead of $C : \backslash >$
20	REM	Remarks.
21	SET	Set new values for an environment variable.

External DOS commands

1	APPEND	Adds given directories to the end of PATH environment variable.
2	ASSIGN	Change given drive name to a new drive letter.
3	ATTRIB	Change attributes (a-archive, h-hidden, r-read only, s-system file).
4	BACKUP	Backup specified files to given destination.
5	CHKDSK	Check the disk for errors and rectify errors.
6	COMMAND.COM	MS DOS operating system program.
7	COMP	Compare two files. Report first mismatch.
8	DEBUG	Debug given program. One can examine values store in variables.
9	DISKCOMP	Compare 2 disks with each other.
10	DISKCOPY	Copy contents of one disk to another.
11	DOSKEY	Store command history.
12	DOSSHEL	A visual shell for exploring files and directories.

External DOS commands

13	EDIT	MS DOS Editor.
14	EDLIN	Edit single line.
15	EXPAND	Decompress files.
16	FC	Compare 2 files.
17	FDISK	Create disk partitions.
18	FORMAT	Format specified partition.
19	HELP	Display help about MS DOS commands.
20	LABEL	Display disk label.
21	VOL	Display volume details.
22	MEM	Display memory usage details.
23	MIRROR	Create backup file named MIRROR.FIL at root directory to restore lost information, if any, at a later date.
24	MORE	Show given information in small chunks for easy reading. Pressing a key moves forward. Pressing $<$ *space* $>$ shows next page, $<$ *enter* $>$ shows next line, $=$ shows line number, Q quits.

External DOS commands

25	MOVE	Create a new file having contents of the old file, but delete the old file.
26	PRINT	Send given file to the printer.
27	SCANDISK	Check and correct errors in the file system of given drive. Works similar to CHKDSK command.
28	SORT	Sort given input lines in alphabetic order. /R option sorts in reverse order (Z to A or 9 to 0).
29	SYS	Make given disk bootable. It should be issued from C: drive.
30	TREE	Display files and directories in tree structure.
31	UNDELETE	Restore recently deleted file.
32	XCOPY	Extended copy mode for copying directories, subdirectories and files.

Output redirection in MS DOS

1	>	Write the output of the left side program to the file provided on the right side. If the file does not exist, it is created. If the file already exists, its contents are deleted.
2	>>	Write the ouput of the program on the left side to the file indicated on the right. If the file does not exist, it is created. If it exists, new content is appended to the end of file.
3	|	Pipe symbol. Pass the output of the program on the left to that on the right of the pipe.

Special characters in MS DOS

1. `*` Match any number of characters.
2. `?` Match any one character.

Introduction to Open Source Software

- ▶ Open source software denotes software for which the original source code is available (not necessarily free of cost).
- ▶ Open source software helps capable users to correct bugs or add new features to the software.
- ▶ Open source model of software development enabled developers across the world to contribute to the improvement of a software.
- ▶ Open source model opposes the closed source monopoly of large corporates.
- ▶ Advent of open source software paved the way for creation of valuable software like Linux operating system, Mozilla Firefox browser, Open Office software package, GIMP image editor, QCAD drafting & design software, Blender 3D modelling and animation software, etc.

Introduction to Open Source Software

▶ Some of the software licenses which adopt open source licensing system are: Apache License, BSD license, GNU General Public License, GNU Lesser General Public License, MIT License, Eclipse Public License and Mozilla Public License.

▶ Richard Stallman created the GNU (GNU Not Unix) project.

▶ Linus Torwalds released the Linux operating system in 1991. Source code for Linux was distributed under the GNU General Public License.

Features of Linux OS

- ▶ Linux operating system provides software packages for almost all common tasks.
- ▶ LibreOffice provides swriter for document editing, scalc for spreadsheets, impress for editing presentations.
- ▶ GIMP is one of the most powerful packages for image editing.
- ▶ Blender is free 3D modelling and animation package.
- ▶ Video editors like Openshot help in multimedia related works.
- ▶ Settings app is provided for controlling the work environment and hardware features.
- ▶ Linux provides several compilers and IDEs for programming.
- ▶ The shell environment (Terminal) provided by Linux is an excellent tool for working in command line.
- ▶ File app, disks app and startup disk creator are suitable managing files.

Applications menu in Linux
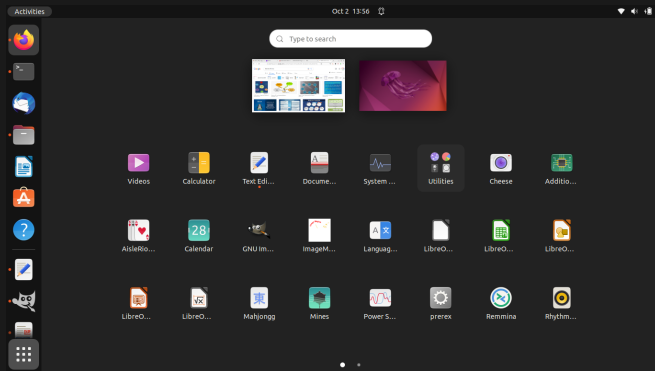
Figure: Application list in GNOME

Browser
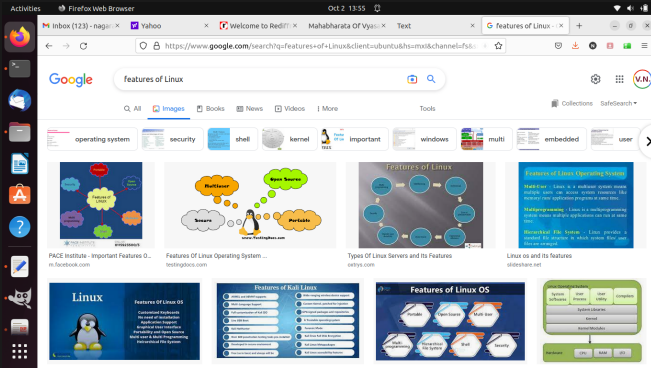
Figure: Firefox browser

Settings app in Linux
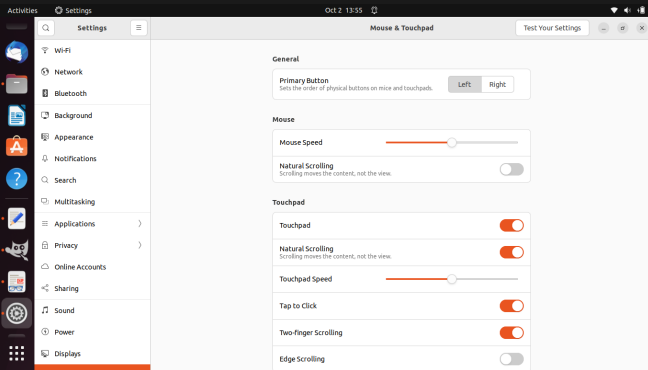
Figure: Settings app

Document editing using LibreOffice Writer
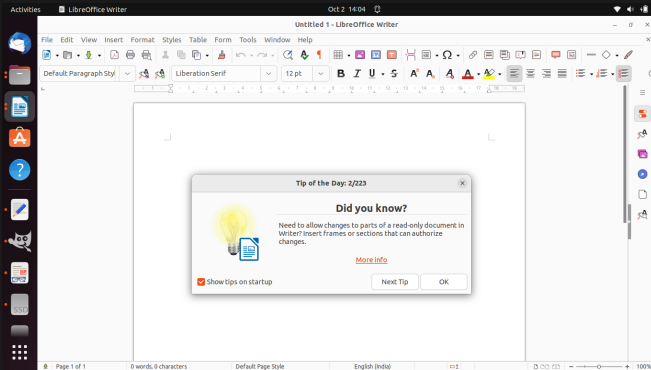
Figure: LibreOffice Writer

Spreadsheet using LibreOffice Calc
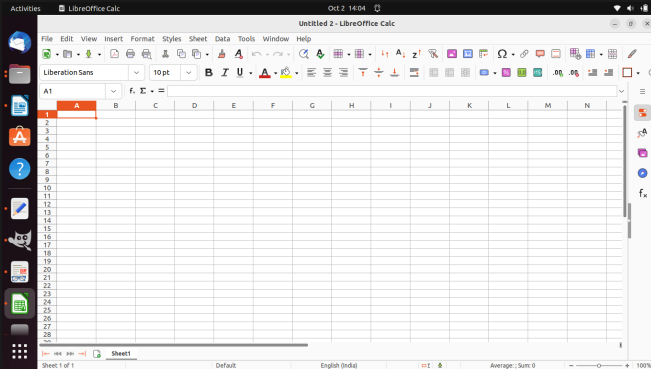
Figure: LibreOffice Calc

Image editing using GIMP
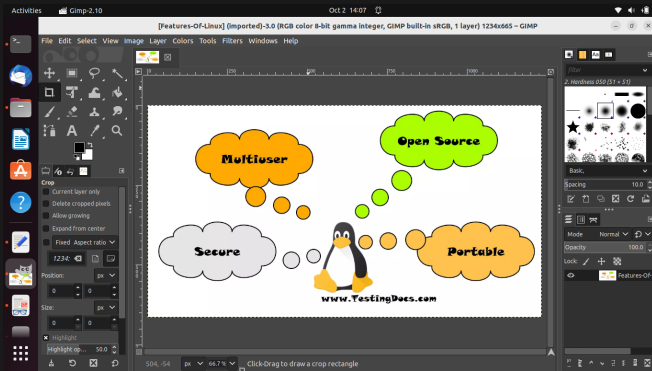
Figure: GNU Image Manipulation Program (GIMP)

Files app
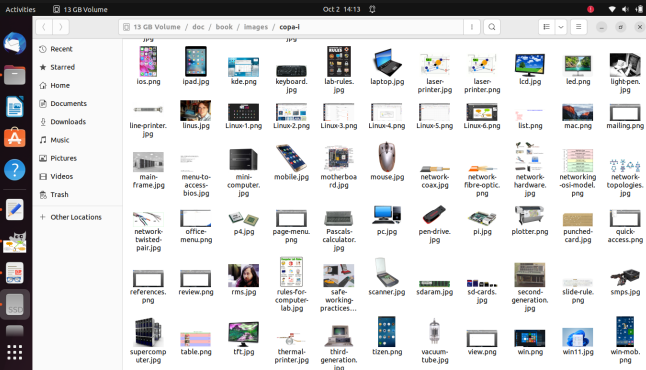
Figure: Files app

Basic Linux commands

- ▶ Linux operating system contains 2 essential components, (i)the kernel which controls the computer peripherals, (ii)the shell, which transmits commands issued by the user to the kernel for processing.

- ▶ Linux commands may also be typed inside a text file and used as a new command. Such text file is called shell script.

- ▶ Several shells are available for interaction with the Linux kernel. Some of the most common shells are: (i)sh - Bourne Again Shell or bash, #/bin/sh at the beginning of shell script denotes bash script. (ii)csh - C shell. It supports conditions and loops features similar to C programming language. (iii)ksh - Korn Shell. Korn shell was released as an improvement to the Bourne shell by AT&T Bell Labs.

Basic Linux shell commands

1	ls	List files and folders.
2	mkdir	Make directory having given name.
3	rmdir	Remove directory having given name.
4	cp	Copy given file to new name.
5	mv	Move given file to new name.
6	cd	Change directory.
7	cd ..	Change to parent directory.
8	cd ~	Change to home directory.
9	cd /	Change to root directory.
10	mount	Mount a file system/ drive.
11	umount	Unmount a file system/drive.
12	eject	Eject a drive.
13	shutdown -r $< time >$	Restart the computer after given time.
14	shutdown -h $< time >$	Halt the computer after given time.
15	sleep	Stop processing work for given duration.
16	sort	Sort given input.

Basic Linux shell commands

17	ln	Create a link to the original file.
18	tar	Tape archive. Create an archive.
19	zip (or) gzip	Zip a file.
20	unzip (or) gunzip	Decompres given file.
21	ls -l	long list of files.
22	more	Display screenfulls of output.
23	less	Display screenfulls of output.
24	find	Search for a file having given name from given directory. find . -name temp.txt -exec ls -l {} \; search for a file named temp.txt from the current directory (.). Execute the command ls -l on the resulting file ({}).
25	banner	Display given text in banner format.
26	rm	Remove a file.
27	cat	display contents of a file on screen.
28	cat - >	Store keyboard input to a new file.
29	cat - >>	Append keyboard input to given file.
30	date	Display and set current date and time.

Basic Linux shell commands

33	cc	Run C-language compiler.
34	vi	Open VI text editor.
35	emacs	Open emacs text editor.
36	gedit	Open gedit text editor.
37	useradd	Create new user. Works in super user mode.
38	userdel	Deletes given user name.
39	passwd	Changes password of the given user.
40	su	Increase previleges to super user level.
41	sudo	Run given command with super user previlege.
42	cal	Display calendar.
43	calc/ bc	Calculator.
44	cron	Run given programs as per scheduled timings.
45	awk	Interpreted language and filter for text handling.
46	sed	Stream editor and filter for text handling.
47	which	Find full path of given command.
48	file	Display file type of the argument.

Basic Linux shell commands

49	tr	Substotute given character in place of unwanted one.
50	chown	Change ownership of file.
51	chmod	Change file access mode for owner, group and world. 1-read, 2 - write, 4 - execute.
52	groupadd	Create a new group.
53	groupdel	Delete a group.
54	grep	Catch lines with given text.
55	test	Test file for read, write or execute permissions.
56	if	If condition is true, then part is executed. else and elif are supported. fi is the end of if.
57	while	Run the loop so long as given condition is true.
58	for	Run given loop with stated arguments.
59	tree	Display tree structure of files and directories.
60	c++	Run C++ language compiler.
61	export	Place the variable, value pair in the shell environment.
62	clear	Clear contents of the screen.
63	ps	Display list of running processes.
64	kill	Kill/ terminate process with given process ID.

Special characters in Linux shell

1	#	What follows '#' character is comment.
2	*	The wild card. Matches any number of letters.
3	?	Match any single character.
4	>	Send output to a new file. Delete contents if file already exists.
5	>>	Append the output of program to given file.
6	|	Send output of the left side program to the input of the right side program.
7	$?	Exit code of previous process. 0 denotes success.
8	&	Run process to the left of & in the background.
9	-	Denotes standard input (keyboard).
10	~	Home directory.
11	[[ ]]	Test condition.
12	!	Negation of condition.
13	&&	Run right side program only if the left side program succeeds.
14	||	Run right side program only if the left side program fails.

Introduction to the various applications in office. Introduction to Word features, office button, toolbars. Creating, saving and formatting and printing documents using Word. Working with inserting objects, macro, mail merge, templates and other tools in Word. Page setup and printing documents using Word.

Introduction to the various applications in office

- Microsoft office has a collection of tools for carrying out various productive jobs like preparation of document, accouting, mailing, presentation, database management, preparation of banners, visiting cards, etc.

- The packages in Microsoft office and their purposes are as follows:

Table: Tools in MS Office

Sl. No.	Name of tool	Description /purpose
1	Word	Helps preparation of documents.
2	Excel	Preparation of spreadsheets.
3	Powerpoint	Preparation of presentations.
4	Access	Creation and maintenance of databases.
5	Publisher	Tool for creating page based publications. Useful for creation of reports, banners, ID cards, etc.
6	Onenote	The program for creating and sharing notes.
7	Outlook	Email client. It fetches emails from several servers. It can also send emails.

Features of MS Word

- MS Word may be used for preparation of letters, memos, books, reports, theses, brochures and visiting cards.
- MS Word supports the paradigm of "WYSWYG" - which stands for What You See, What You Get. It means the hard copy will be similar to what is seen on screen.
- MS Word provides template documents for creating several types of publications. You may choose a template, fill required details to get a professional looking publication.
- MS Office supports a large number of images called clip arts.
- MS Word can take list from Excel or Access and create mail merged document addressed to several persons individually.
- MS Word checks spelling (red underline below spelling errors) and Grammar (green underline below grammatic mistakes).
- MS Word can handle tables, images and lists.
- MS Word supports water marks behind main text of the document, as in the case of certificates.

Office button in MS Word

- ▶ The circular button located at top left corner of MS Word window is the office button. In recent versions, office button has been renamed to File (($Alt + F$)).
- ▶ Office button contains the following menu items (Fig.103):
  1) **Save:** Saves file (Ctrl+S or Alt+F+S).
  - ▶ **Save As:** Saves another copy of the file with new name (Alt+F+A).
  2) **Open:** Open a file (Ctrl+O or Alt+F+O).
  3) **Close:** Close current file (Alt+F+C).
  4) **Info:** Show permissions, author name, version details, pages, lines, words, duration of editing, etc. pertaining to current file (Alt+F+I).
  5) **Recent:** Show recently opened files (Alt+F+R).
  6) **New:** Create a new document (Ctrl+N or Alt+F+N). Templates may be chosen to provide a skeleton for the document.
  7) **Print:** Print the current document (Ctrl+P or Alt+F+P). Printer, paper size, finishing details, etc. can be controlled.

Office button in MS Word
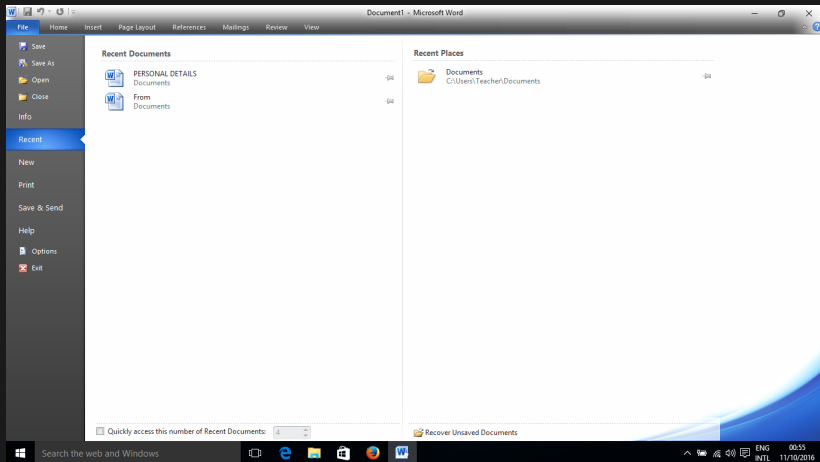
Figure: Office menu in MS Word

Office button in MS Word

8) **Save & Send:** Save current document and send it through email, save it on the web, share it to the blog, (Alt+F+D).

9) **Help:** Help regarding MS Word (Alt+F+H or F1).

10) **Options:** Options help to control several features of MS Word (Alt+F+T). Choosing *Advanced− > Print* and removing the tick mark in front of "Scale content for A4 or 8.5'x11' paper sizes is important after installing windows. Otherwise all pages will be scaled to letter size paper instead of A4 size paper. General, display, proofing, save, language, advanced, etc. are common headings displayed under Options.

11) **Exit:** Close all documents and exit MS Word (Alt+F+X).

Toolbars in MS Word

- ▶ Toolbars in MS Word are organized under the following menus:
  - (a) Home ($Alt + H$)
  - (b) Insert ($Alt + N$)
  - (c) Page Layout ($Alt + P$)
  - (d) References ($Alt + S$)
  - (e) Mailing ($Alt + M$)
  - (f) Review ($Alt + R$)
  - (g) View ($Alt + W$)
- ▶ On pressing each menu, the toolbar related to that menu appears.
- ▶ The toolbar is organized into suitable groups with a heading shown at the bottom of the toolbar.
- ▶ Pressing the square shaped button at the bottom of each item in the toolbar opens a detailed menu related to that toolbar.

Home menu in MS Word

- ▶ Fig.106 shows the items contained in Home menu of MS Word.
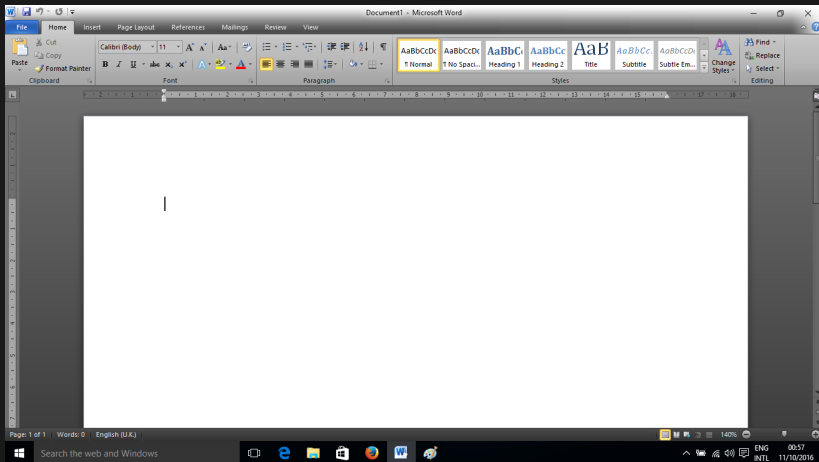
Figure: Home menu in MS Word

Home menu in MS Word

▶ Home menu contains many of the most essential items required for formatting a document (Fig.106), as detailed below:

(a) Clipboard ($Alt + H + FO$) - cut ($Ctrl + X$ or $Alt + H + X$), copy ($Ctrl + C$ or $Alt + H + C$), paste ($Ctrl + V$ or $Alt + H + V$) & format painter ($Alt + H + FP$).

(b) Font style ($Alt + H + FN$) - bold ($Ctrl + B$ or $Alt + H + 1$), italic ($Ctrl + I$ or $Alt + H + 2$), underline ($Ctrl + U$ or $Alt + H + 3$), strikethrough ($Alt + H + 4$), subscript ($Ctrl + Plus$ or $Alt + H + 5$), superscript ($Ctrl + Shift + Plus$ or $Alt + H + 6$), font name ($Alt + H + FF$), font size ($Alt + H + FS$), fill colour ($Alt + H + I$), font colour ($Alt + H + FC$).

(c) Paragraph formating ($Alt + H + PG$) - bullets ($Alt + H + U$) & numbering ($Alt + H + N$), multilevel list ($Alt + H + M$), paragraph alignment (left ($Ctrl + L$ or $Alt + H + AL$), right ($Ctrl + R$ or $Alt + H + AR$), centre ($Ctrl + E$ or $Alt + H + AC$) & justified ($Ctrl + J$ or $Alt + H + AJ$)), line spacing ($Alt + H + K$), borders ($Alt + H + B$), fill color ($Alt + H + H$), decrease indent ($Alt + H + AO$), increase

Insert menu in MS Word

- ▶ Fig.108 shows the items contained in Insert menu of MS Word.
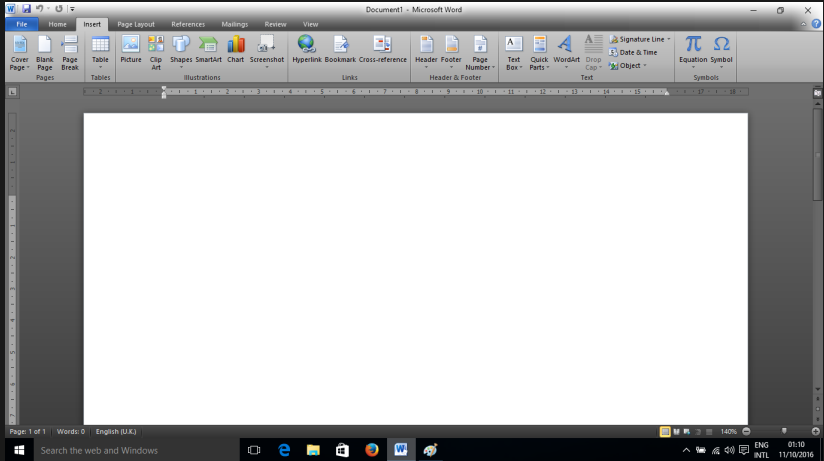
Figure: Insert menu in MS Word

Insert menu in MS Word

▶ Insert menu $(Alt + N)$ contains items insertion of items like pages, tables and images, as detailed below (Fig.108):

(a) Page insertion - cover page $(Alt + N + V)$, blank page $(Alt + N + NP)$ & page break $(Alt + N + B)$.

(b) Table insertion $(Alt + N + T)$ - simple table, table by rows and columns $(Alt + N + T + I)$, draw table $(Alt + N + D)$, convert text to table $(Alt + N + T + V)$, Excel spreadsheet $(Alt + N + T + X)$ & quick table $(Alt + N + T + T)$.

(c) Illustrations - pictures $(Alt + N + P)$, clip art $(Alt + N + F)$, shapes $(Alt + N + SH)$ [line, rectangle, circle, arrows, flow chart, etc.]), chart $(Alt + N + C)$, smart art $(Alt + N + M)$, screenshot $(Alt + N + SC)$).

(d) Links - hyperlink $(Alt + N + I)$, bookmark $(Alt + N + K)$, cross reference $(Alt + N + RF)$.

(e) Header & Footer - header $(Alt + N + H)$, footer $(Alt + N + O)$, page number $(Alt + N + NU)$.

(f) Text - text box $(Alt + N + X)$, quick parts $(Alt + N + Q)$, word art $(Alt + N + I)$, drop cap $(Alt + N + RC)$, signature $(Alt + N + G)$, date & time $(Alt + N + D)$, object $(Alt + N + J)$.

Page Layout menu in MS Word

- ▶ Fig.110 shows the items contained in Page Layout menu in MS Word.
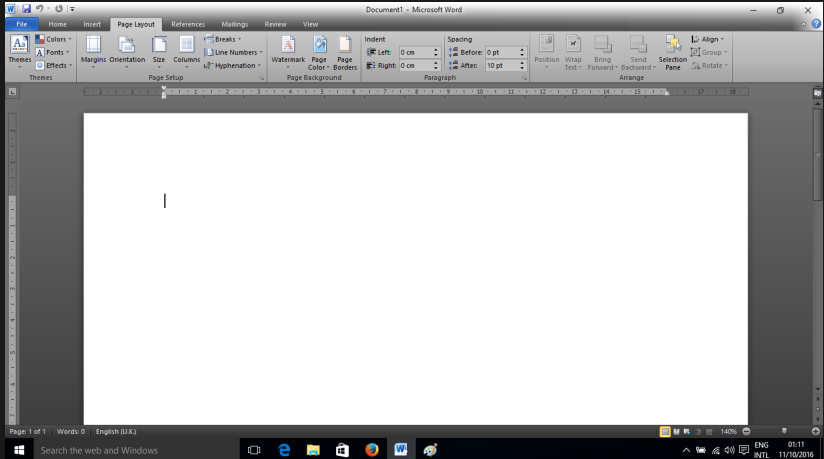
Figure: Page Layout menu in MS Word

Page Layout menu in MS Word

▶ Page Layout ($Alt + P$) menu (Fig.110) contains several options related to page size and layout, as detailed below:

(a) Theme - Theme ($Alt + P + TH$), Colors ($Alt + P + TC$), Fonts ($Alt + P + TF$), effects ($Alt + P + TE$).

(b) Page Setup ($Alt + P + SP$) - margins ($Alt + P + M$), orientation ($Alt + P + O$), size ($Alt + P + SZ$), columns ($Alt + P + J$ or ($Alt + P + J + C$)), break ($Alt + P + B$), line number ($Alt + P + LN$) & hyphenation ($Alt + P + H$).

(c) Page background - water mark ($Alt + P + PW$), page color ($Alt + P + PC$) & page border ($Alt + P + PB$).

(d) Paragraph ($Alt + P + PG$) - indent left ($Alt + P + IL$), indent right ($Alt + P + IR$) & spacing before ($Alt + P + SB$) and space after ($Alt + P + SA$).

(e) Arrange object - position ($Alt + P + PO$), text wrap ($Alt + P + TW$), bring forward ($Alt + P + AF$), selection pane ($Alt + P + AE$), select para ($Alt + P + AP$), align ($Alt + P + AA$), group ($Alt + P + G$) & rotate ($Alt + P + AY$)).

References menu in MS Word

- Fig.112 shows the items contained in References menu in MS Word.
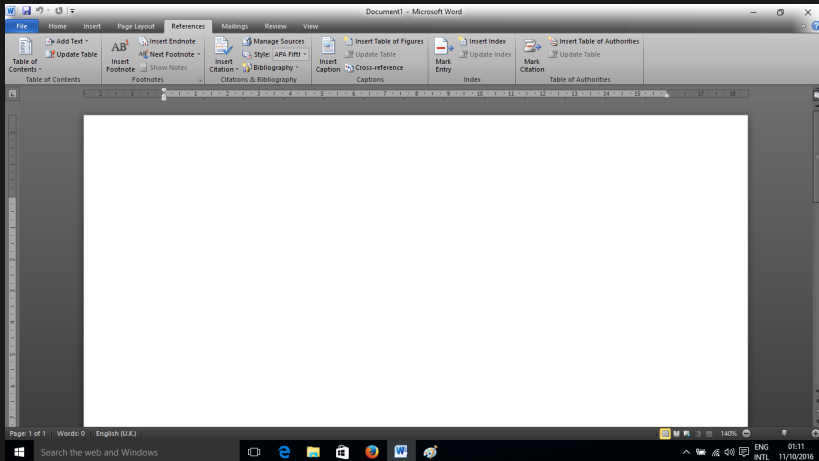
Figure: References menu in MS Word

References menu in MS Word

- References ($Alt + S$) menu (Fig.112) contains several options related to cross referencing of tables, images and citations, as detailed below:

  (a) Table of Contents - table of contents ($Alt + S + T$), add text ($Alt + S + A$), update table ($Alt + S + U$).

  (b) Foot notes (Alt+S+Q) - insert footnote ($Alt + S + F$), insert endnote ($Alt + S + E$), next footnote ($Alt + S + O$) & show notes ($Alt + S + H$)

  (c) Citaion & Bibliography - insert citation ($Alt + S + C$), manage sources ($Alt + S + M$), style ($Alt + S + L$), bibliography ($Alt + S + B$).

  (d) Captions - insert caption ($Alt + S + P$), insert table of figures ($Alt + S + G$), update table ($Alt + S + V$), cross reference ($Alt + S + RF$).

  (e) Index - mark entry ($Alt + S + N$), insert index ($Alt + S + X$), update index ($Alt + S + D$).

  (f) Table of authorities - mark citation ($Alt + S + I$), insert table of authorities ($Alt + S + RT$), update table ($Alt + S + RU$).

Mailings menu in MS Word

▶ Fig.114 shows the items contained in Mailings menu in MS Word.
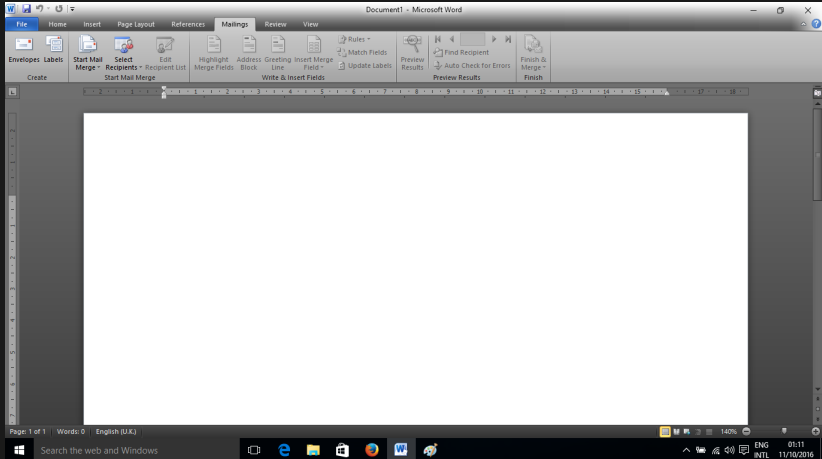
Figure: Mailings menu in MS Word

Mailings menu in MS Word

► Mailings ($Alt + M$) menu (Fig.**??**) is the source of the famous mail merge function in MS Word. Mail merge functions may be visualized as a high level fill in the blanks, which can produce individualized messages from a general template. It has the following options:

(a) Create - envolopes ($Alt + M + E$), labels ($Alt + M + L$).

(b) Start Mail Merge - start mail merge ($Alt + M + S$), select recepient ($Alt + M + R$) - type new list ($Alt + M + R + N$), use existing list ($Alt + M + R + E$), select from outlook contacts ($Alt + M + R + O$) & edit recepient list ($Alt + M + D$).

(c) Write & Insert Fields - highlight merge fields ($Alt + M + H$), address book ($Alt + M + A$), greeting line ($Alt + M + G$), insert merge field ($Alt + M + I$), rules ($Alt + M + U$), match fields ($Alt + M + T$), update labels ($Alt + M + B$).

(d) Preview Results - preview results ($Alt + M + P$), first record ($Alt + M + Q$), previous record ($Alt + M + M$), record number ($Alt + M + W$), next record($Alt + M + X$), last record ($Alt + M + V$).

(e) Finish & Merge - finish & merge ($Alt + M + F$), merge to new document, merge & print.

Review menu in MS Word

- ▶ Fig.116 shows the items contained in Review menu in MS Word.
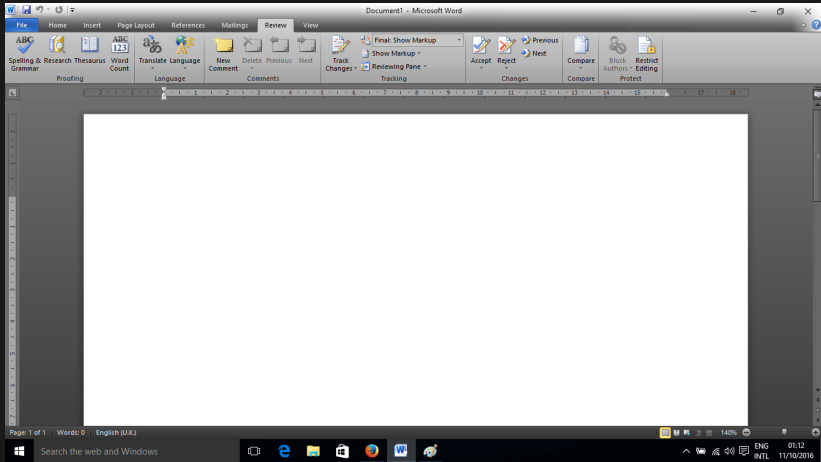
Figure: Review menu in MS Word

Review menu in MS Word

- Review ($Alt + R$) menu (Fig.116) helps to check spelling, grammer and document statistics. It contains the following options:
  - (a) Proofing - spelling & grammer ($Alt + R + S$), research ($Alt + R + R$), thesaurus ($Alt + R + E$), word count ($Alt + R + W$).
  - (b) Languages - translate ($Alt + R + L$), language ($Alt + R + U$).
  - (c) Comments - new comment ($Alt + R + C$), delete ($Alt + R + D$), previous record ($Alt + R + V$), next ($Alt + R + N$).
  - (d) Tracking - track changes ($Alt + R + G$), final: show markup ($Alt + R + TD$), show markup ($Alt + R + TM$), reviewing pane ($Alt + R + TP$).
  - (e) Changes - accept ($Alt + R + A$), reject ($Alt + R + J$), previous ($Alt + R + F$), next ($Alt + R + H$).
  - (f) Compare - compare ($Alt + R + M$).
  - (g) Protect - block authors ($Alt + R + PB$), restrict editing ($Alt + R + PE$).

View menu in MS Word

▶ Fig.118 shows the items contained in View menu in MS Word.
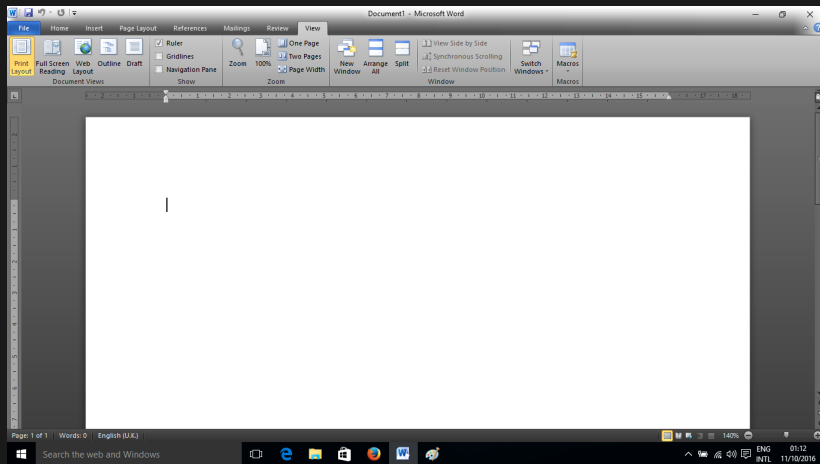
Figure: View menu in MS Word

Review menu in MS Word

▶ View ($Alt + W$) menu (Fig.118) helps to customize the appearance of document:

(a) Document Views - page layout ($Alt + W + P$), full screen reading ($Alt + W + F$), web layout ($Alt + W + L$), outline ($Alt + W + U$), draft ($Alt + W + E$).

(b) Show - ruler ($Alt + W + R$), gridlines ($Alt + W + G$), navigation pane ($Alt + W + K$).

(c) Zoom - zoom ($Alt + W + Q$), 100 ($Alt + W + J$), two pages ($Alt + W + 1$), ($Alt + W + 2$), page width ($Alt + W + I$).

(d) Window - new window ($Alt + W + n$), arrange all ($Alt + W + A$), split ($Alt + W + S$), view side by side ($Alt + W + B$), synchronous scrolling ($Alt + W + YS$), reset window position ($Alt + W + T$), switch windows ($Alt + W + W$).

(e) Macros - Macros ($Alt + W + M$)

Creating, saving and formatting documents using M.S. Word

- ▶ When MS Word is opened without any argument, it displays a blank document.

- ▶ MS Word provides the following online templates (available only over an Internet connection) for creating new document: (i)agenda, (ii)award certificate, (iii)business cards, (iv)resumes, (v)budget, (vi)flier, (vii)brocher, (viii)visiting cards, (ix)calendars, (x)reports/ books, etc.

- ▶ After opening a document, it is necessary to set paper size, paper orientation (landscape or portrait) and margins on all four sides, before entering text. These settings can be accessed from $PageLayout->Page\ Setup\ (Alt+P+SP)$ menu.

- ▶ Line spacing should be set through $PageLayout->Paragraph(Alt+P+PG)$ menu.

Creating, saving and formatting documents using M.S. Word

- ▶ Text alignment can be set to center (Ctrl+E), left (Ctrl+L), right (Ctrl+R) or justified (Ctrl+J).
- ▶ Font face/name (Alt+H+FF), font size (Alt+H+FS), font colour (Alt+H+FC) and background colour (Alt+H+I) may be set to appropriate values for given document.
- ▶ Tables, figures and equations may be assigned caption using References-¿Insert caption (Alt+S+P). This will help MS Word to create list of tables, list of figures and list of equations automatically.
- ▶ To insert book title, chapter title, heading1, heading2, normal text, sue appropriate icons available under *Home−> Styles* menu (*Alt + H + L*). Using this menu will help in the insertion of automatic table of contents.

Creating, saving and formatting documents using M.S. Word

- ► While typing references, use
  References−> Insert Citation $(Alt + S + C)$. This will help in the insertion of automatic bibliography.
- ► To mark the words to be automatically indexed, use
  References−> Mark Entry $(Alt + S + N)$. This will help in automatic insertion of index of words at the end of a document.
- ► Use Insert menu to insert table, picture, shapes, flow charts, headers, footers, page numbers, word art, drop cap, equation or symbol.
- ► To save a document, use
  File−> Save $(Ctrl + S$ or $Alt + F + S)$.
- ► To save the document in a new name, use *File−> SaveAs* menu $(Alt + F + A)$.

Inserting objects in MS Word

- ▶ The most common objects used in MS Word are: (i)table, (ii)picture, (iii)geometric shapes, (iv)clip arts, (v)equations, (vi)lists.
- ▶ Table can be inserted from *Insert− > Table* menu ($Alt + N + T$) in MS Word. Table caption is placed above the table. Use *References− > Insert Caption* ($Alt + S + N$) to insert table caption.
- ▶ Pictures can be inserted from *Insert− > Picture* ($Alt + N + P$) in MS Word. Picture caption is placed below the picture. Use *References− > Insert Caption* ($Alt + S + N$) to insert table caption.
- ▶ Geometric shapes like line, circle, rectangle, text box, clip art, word art, flow chart symbols, etc. can be inserted from Insert menu.
- ▶ Equation may be inserted using *Insert− > Equation* ($Alt + N + E$) menu. Equation numbers should be inserted using

Inserting objects in MS Word

▶ To insert predefined art works, choose
  Insert− > ClipArt (Alt + N + F) menu. This permits several
  simple artworks to be inserted in a document.

▶ Word art provides attractive size and shape for text headings.
  To insert word art, click *Insert− > Word Art (Alt + N + RC)*
  menu.

▶ To insert a drop cap (First letter having height of several
  lines), use *Insert− > Drop Cap (Alt + N + RC)* menu.

▶ Inserting a list is very simple in MS Word. Type a number or
  letter enclosed in parantheses [like (1)] or succeded by a right
  paranthesis [like 1)]. This will induce MS Word to create a
  new list. Use the options available under
  Home− > Paragraph to customize the number format, letter
  format or bullet used for the list. Although MS Word
  automatically inserts successive numbers for list, specific
  values may be set by right clicking the unwanted number and
  choosing *Numbering− > Set Numbering Value* and typing
  required number in the number field.

Inserting macros in MS Word

- ▶ Macros help to create custom commands in MS Word, which will help us complete repeated works with ease. Imagine macro as a pet dog, which can take care of repeated works, once the initial training is complete.
- ▶ Macros may be assigned keystrokes or buttons.
- ▶ Initially, word does not show macros menu. Choose *File− > Word Options* (*Alt + F + T*) menu, click *Trust Center* in the left side pane, click *Trust Center Settings* and click *Enable all macros (not recommended, potentially dangerous code can run)*.
- ▶ To record a new macro (e.g. to type Government ITI for Women, Pondicherry, whenever Alt+W is pressed), open View menu, click Macros, choose Record Macro (Alt+W+M+R).
- ▶ Choose whether you create a button (left) or a keyboard shortcut.
- ▶ Choose whether the macro should be available to all documents or the present document only.

Inserting macros in MS Word

- ▶ Type a description of what the macro does and and press OK. This starts the recording of macro. Mouse is disabled during macro recording. Hence, use keyboard to control the document.

- ▶ Simply carry out the work and allow the macro to learn what you do.

- ▶ When your work is complete, choose
  $View-> Macro-> Stop\ Recording\ (Alt + W + M + R)$.

- ▶ Now, you can press the macro button placed at the title bar or type required keystroke to invoke the macro and get your work done.

Performing mail merge in MS Word

- ▶ Mail merge helps to make general purpose document targetting several persons to look as if the document was prepared for each individual separately, giving a feeling of trust and affinity.

- ▶ Prepare a document with blank spaces where individualized items like name, address, gender, age, etc. are to appear.

- ▶ Prepare a list of using MS Excel or MS Access, with suitable column names. The list could even be prepared using notepad, sufficient that rows are separated by newline and columns are separated by TAB.

- ▶ After completing the document, open *Mailings−> SelectRecepients−> UseExistingList (Alt + M + R + E)*. Choose the MS Excel, MS Access or notepad text document containing the personal details. For MS Excel or MS Access name list, select work book name or table name (as appropriate) containing the list.

Performing mail merge in MS Word

- ▶ Now, choose *Mailings− > InsertMergeField* (*Alt + M + I*) and choose the appropriate column name to be filled in each blank space.
- ▶ Choose *Mailings− > PreviewResults* (*Alt + M + P*) to view the mail merged results.
- ▶ Mail merge results for each record may be viewed by accessing *Mailing− > PreviewResults* tool bar and changing the record number.
- ▶ A new word document containing all mail merge results can be created using *Mailings− > EditIndividualDocuments* (*Alt + F + E*). This document may be saved under a different name. Record range may be chosen for finishing the mail merge to new document.
- ▶ The mail merge results may be printed using *Mailings− > PrintDocuments* (*Alt + F + P*). Record range may be chosen for finishing the mail merge to printer.
- ▶ The mail merge results may be sent through email to email ID's specified in the document (if included) using *Mailings− > SendE − mailMessages* (*Alt + F + S*). For this option to work, each row should have the email ID of the recepient.

Creating and using templates in MS Word

- ▶ Template in MS Word may be visualized as a standard mould using which several objects may be cast.
- ▶ After creating a document which is so well formatted that it is fit to serve as the standard for other documents, choose *File− > Save As*. In the save as dialog, click the triangular button to the right of *Save as type* and choose *Word Template*.
- ▶ A word template has *.dotx* extension, instead of the usual extension of *.docx* for normal word documents.
- ▶ When a Word template is opened, edited changes can be saved in a new word document with *.docx* extension.
- ▶ Templates are published magazines and journals to help the authors typeset their content according to the style specified in the template and suitable for their magazine or journal.

Page setup and printing documents using Word

- ▶ The first work on creating a document is page setup and the last work is to print or email that document.
- ▶ Page setup can be accessed using
  Page Layout− > Page Setup (*Alt + P + SP*) menu.
- ▶ Page setup brings a dialog containing 3 panels, viz., Margins, Paper & Layout.
- ▶ Margins panel in page setup dialog helps to specify left margin, right margin, top margin and bottom margin. In addition to the margins, gutter margin (for binding) and gutter position (left or top) may also be specified.
- ▶ Margins panel in page setup dialog permits choosing paper orientation (portrait [width is less than height] or landscape[width is larger than height]), margin arrangement for multiple pages, preview of margin setup and applicability of the new page setup.
- ▶ Paper panel in page setup dialog permits selection of paper size (A4, letter, legal, etc.) and paper source.
- ▶ Layout panel of page setup dialog helps to choose whether

Page setup and printing documents using Word

▶ Printing a document is possible by choosing
  File− > Print (*Ctrl + P*) in the menu.

▶ The name of printer (which has already been installed),
  number of copies, page ranges to be printed, type of printing
  to be adopted for multiple copies (collated - divide by set,
  uncollated - take given number of copies in each page before
  proceeding to print the next page)

▶ Print dialog also permits access to printer properties, which
  may control print resolution, colour mode (in case of colour
  printer), finishing of pages, quality of print, etc.

▶ The print dialog also permits scaling of pages to suit available
  paper size.

▶ Pressing the print button sends the document to the printer
  and produces hard copy of the document.

Introduction to Excel features and Data Types. Cell referencing. Use of functions of various categories, linking Sheets. Introduction to various functions in all categories of Excel. Concepts of Sorting, Filtering and Validating Data. Analyzing data using charts, data tables, pivot tables, goal seek and scenarios. Introduction to Reporting.

Introduction to features of Excel

- ► Excel works on the basis of cells, one cell being the intersection of a column and a row.
- ► Columns (vertically aligned dividers) have the alphabet names (A,B,C, ... Z, AA, AB, ..., AZ, BA...).
- ► Rows have numeric identifier (1, 2, 3, ...).
- ► Cells are addressed by combination of column name - row number, e.g. A1 for the first cell, B6 for the cell at second column, sixth row.
- ► Excel has a large collection of functions (entered in a cell after typing $=$ sign), which are helpful in data analysis and computations.
- ► Excel can sort and arrange data in easily readable format.
- ► Excel can draw charts (like pie, bar, column, scatter, etc.) to help visualize data entered in cells.
- ► The latest version of Excel can have maximum of 10,48,576 rows and 16,384 columns. The maximum number of rows and columns may vary from version to version.

Introduction to features of Excel

- ▶ MS Excel can work with other applications like MS Word and MS Access.
- ▶ MS Excel can be used for storage and manipulation of small amount of data which may not qualify to occupy a database.
- ▶ MS Excel supports recording repeated actions and calling the same action sequences with the help of macros.
- ▶ MS Excel supports full fledged programming using Visual Basic for Applications (VBA).
- ▶ Each excel file is called a Workbook. Each workbook can have several sheets.
- ▶ By default, sheets in MS Excel are Sheet1, Sheet2, etc. The sheets can be renamed or copied by right clicking on sheet name.
- ▶ MS Excel files have default extension of *.xlsx*.
- ▶ Macro enabled excel files have the extension of *.xlsm*.
- ▶ A cell in MS Excel can reference data in teh same sheet, other sheet in the same workbook or a sheet in another workbook.

Data types in Excel

▶ Following types of data are available in MS Excel:

1) *General* - Can be number, text, date, time or any other type.

2) *Number* - number permits control of decimal places and grouping of digits.

3) *Currency* - Currency format permits control of decimal places, digit grouping and prefixing of currency symbol.

4) *Accounting* - Permits control of number of digits and prefixing of currency symbol.

5) *Date* - Permits selection of date format from several available formats. The default date format used in India is DD/MM/YYYY.

6) *Time* - Permits selection time format.

7) *Percentage* - Displays a fraction (between 0 and 1) as a percentage. Decimal places of the percentage can be controlled.

Data types in Excel

8) *Fraction* - Permits display of decimal fraction into common fraction or vulgar fraction.

9) *Scientific* - Displays numbers in exponential notation.

10) *Text* - Displays given data as text.

11) *Special* - Special type is useful for tracking list and database values.

12) *Custom* - Number format may be customized using # (space or digit. 0 - zero or digit). Any text enclosed in double quotes is displayed as without any changes.

Cell referencing

- ▶ When the name of cell (like B5) is referenced in a formula, it can be done in 3 different ways, as detailed below:
    - a) Relative referencing - dynamic row & column change mode
    - b) Semi-relative referencing - fynamic row & static column mode or static row and dynamic column mode
    - c) Absolute referencing - static row & static column mode
- ▶ *Relative referencing:* In this mode, copying the formula to a new cell (e.g., add 4 to columns & 3 to rows) causes the cell reference to change relative to the new column (by adding the same 4 to columns & 3 to rows to the reference made in the formula).
- ▶ *Semi-relative referencing:* In this mode, either the row or column references are static, denoted by a $ symbol preceding the row number or column name.
- ▶ *Absolute referencing:* In this mode, both column name and row number are static and are preceded by a $ symbol. When the formula is copied from one cell to another, the cell references do not change.

Examples of cell referencing systems

a) *Relative referencing:* The formula $= D3 + E3$ is entered in cell F3. On copying the formula to cell K4, the copied formula becomes $= I4 + J4$, which references cells in relation to the cell containing the formula.

b) *Semi-relative referencing:* The formula $= \$D3 + \$E3$ is entered in cell F3. On copying the formula to cell K4, the copied formula becomes $= \$D4 + \$E4$, which references rows in relation to the cell containing the formula, but freezes any changes to the column name.

c) *Semi-Relative referencing:* The formula $= D\$3 + E\$3$ is entered in cell F3. On copying the formula to cell K4, the copied formula becomes $= I3 + J3$, which references columns in relation to the cell containing the formula, but freezes any changes to the row number.

d) *Absolute referencing:* The formula $= \$D\$3 + \$E\$3$ is entered in cell F3. On copying the formula to cell K4, the copied formula becomes $= \$D\$3 + \$E\$3$. Absolute system freezes all cell references.

Use of functions of various categories

- **Cube functions:** These functions look up and analyze data from a multi-dimensional database stored in a spreadsheet.
- **Database functions:** These functions help to access databases from Excel.
- **Date and Time functions:** These functions display and manipulate date and time values.
- **Engineering functions:** Converts number from one base to another, supports complex numbers, helps bit shifting and provides Bessel function.
- **Financial functions:** These functions support financial accounting in Excel.
- **Information functions:** These functions support determination of the properties of data (whether blank, number, text, etc.) contained in a cell.

Use of functions of various categories

- **Logical functions:** These are comparison functions which help carry out Boolean logic on data.
- **Lookup and reference functions:** These functions help to fund cell references using search, lookup, etc.
- **Math & Trigonometry functions:** These function help to manipulate numbers and determine trigonometric values.
- **Statistical functions:** These functions help to calculate statistical quantities like average, mode, median, standard deviation, etc.
- **Text functions:** These functions help to search, concatenate and manipulate text strings.

DATE functions

1	DATE	Takes the arguments YYYY, MM, DD as input and returns a date.
2	DATEDIF	Calculates difference between given dates in years or months or days. Takes the start date, end date and the unit ("Y" for years, "M" for months and "D" for days.
3	DATEVALUE	Parses a text string and calculates date.
4	DAY	Returns day of month.
5	DAYS	Returns the number of days between two dates.
6	DAYS360	Calculates the number of days between two dates based on a 360-day year
7	EDATE	Returns the date which occurs particular number of months before or after the given date. Takes date as first argument, number of months as the second argument.

DATE functions

8	EOMONTH	Returns the date last day of month given a start date and number of months. Takes date as first argument, number of months as the second argument.
9	HOUR	Converts a serial number to an hour.
10	ISOWEEKNUM	Returns the number of the ISO week number of the year for a given date.
11	MINUTE	Converts a serial number to a minute.
12	MONTH	Converts a serial number to a month
13	NETWORKDAYS	Returns the number of whole workdays between two dates.
14	NETWORKDAYS.INTL	Returns the number of whole workdays between two dates using parameters to indicate which and how many days are weekend days.
15	NOW	Returns the serial number of the current date and time.
16	SECOND	Converts a serial number to a second.
17	TIME	Returns the serial number of a particular time.

DATE functions

18	TIMEVALUE	Converts a time in the form of text to a serial number.
19	TODAY	Returns the serial number of today's date.
20	WEEKDAY	Converts a serial number to a day of the week.
21	WEEKNUM	Converts a serial number to a number representing where the week falls numerically with a year.
22	WORKDAY	Returns the serial number of the date before or after a specified number of workdays.
23	WORKDAY. INTL	Returns the serial number of the date before or after a specified number of workdays using parameters to indicate which and how many days are weekend days.
24	YEAR	Converts a serial number to a year.
25	YEARFRAC	Returns the year fraction representing the number of whole days between start_date and end_date.

Engineering functions

1	BIN2DEC	Converts binary number to decimal number.
2	BIN2HEX	Converts binary number to hexadecimal number.
3	BIN2OCT	Converts binary number to Octal number.
4	BITAND	Returns bitwise and for given numbers.
5	BITLSHIFT	Bitwise left shift.
6	BITOR	Bitwise OR for given numbers.
7	BITRSHIFT	Bitwise right shift of number.
8	BITXOR	Bitwise XOR of given numbers.
9	CONVERT	Converts given value from one system of units to another (e.g. "m" to "ft").
10	DEC2BIN	Converts decimal number to binary number.
11	DEC2HEX	Converts decimal number to hexadecimal number.
12	DEC2OCT	Converts decimal number to Octal number.
13	DELTA	Tests whether given values are equal.
14	HEX2BIN	Converts hexadecimal number to binary number.

Engineering functions

15	HEX2DEC	Converts hexadecimal number to decimal number.
16	HEX2OCT	Converts hexadecimal number to octal number.
17	COMPLEX	Creates a complex number from real and imaginary parts.
18	IMABS	Displays the absolute value of complex function.
19	IMAGINARY	Returns imaginary part of complex number.
20	IMREAL	Returns real part of complex number.
21	IMREAL	Returns conjugate of a complex number.
22	OCT2BIN	Converts octal number to binary number.
23	OCT2DEC	Converts octal number to decimal number.
24	OCT2HEX	Converts octal number to hexadecimal number.

Cell functions

1	ERROR.TYPE	Returns a numeric identifier corresponding to an error type.
2	INFO	returns information about the current operating environment.
3	ISBLANK	Returns true if a cell is blank.
4	ISERR	Returns true if the cell contains an error (other than #NA).
5	ISEVEN	Returns true if the number is even.
6	ISODD	Returns true if the cell contains an odd number.
7	ISFORMULA	Returns true if the cell contains a formula.

Cell functions

8	ISLOGICAL	Returns true if the cell contains a logical (true of false) value.
9	ISNA	Returns true if there is #NA error.
10	ISNONTEXT	Returns true if the cell contains anything other than text.
11	ISNUMBER	Returns true if the cell contains a number.
12	ISREF	Returns true if the cell contains a reference to another cell.
13	ISTEXT	Returns true if the cell contains text.
14	N	Converts given input to a number.
15	NA	Returns a number corresponding to the #NA error type.
16	TYPE	Returns a number corresponding to the data type of the cell.

Logical functions

1	AND	Returns true only if all given conditions are true.
2	OR	Returns true if at least one of the given conditions is true.
3	FALSE	Returns FALSE logical value.
4	TRUE	Returns TRUE logical value.
5	IF	Contains 3 parts separated by comma. In case the condition given at first part is true, the second part is executed. Otherwise, the condition given at the third part is executed.

Math functions

1	ABS	Returns the absolute (positive) value of the function, whether the input number is positive or negative.
2	ASIN	Inverse of sine value. Returns angle in radian for given input value (Input should be between 0 and 1).
3	ACOS	Inverse of cosine value. Returns angle in radian for given input value (Input should be between 0 and 1).
4	ATAN	Inverse of tangent value. Returns angle in radian for given input value.
5	ACOT	Inverse of cot value. Returns angle in radian for given input value (Input should be between 0 and 1).
6	ATAN2	Inverse of tangent value from given X and Y coordinates. Returns angle in radian for given input value.
7	AGGREGATE	Returns aggregate value like sum, count, etc. from a database.

Math functions

8	ARABIC	Converts Roman numberal to Arabic numeral.
9	ASINH	Returns inverse of hyperbolic sin.
10	ATANH	Returns inverse of hyperbolic tangent.
11	CEILING	Returns an integer just above the given fractional number. e.g. =CEIL(2.1) returns 3.
12	FLOOR	Returns an integer just below the given fractional number. e.g. =FLOOR(2.99) returns 2.
13	ROUND	Rounds a number to given number of digits. e.g. =ROUND(2.99,1) returns 3.0, =ROUND(2.629,2) returns 2.63, =ROUND(2.5,0) returns 3.0, =ROUND(23154.25,-2) returns 23200.
14	ROUNDDOWN	Rounds a number to given number of digits. But it simply truncates the trailing digits, without considering whether the truncated digit is below 5 or not. e.g. =ROUNDDOWN(2.99,1) returns 2.9, =ROUNDDOWN(2.629,2) returns 2.62, =ROUNDDOWN(2.5,0) returns 2.0, =ROUNDDOWN(23154.25,-2) returns 23100

Math functions

15	ROUNDUP	Rounds a number to given number of digits. But it simply adds one to the last digit, without considering whether the truncated digit is below 5 or not. e.g. =ROUNDUP(2.99,1) returns 3.0, =ROUNDUP(2.622,2) returns 2.63, =ROUNDUP(2.1,0) returns 3.0, =ROUNDUP(23124.25,-2) returns 23200.
16	COMBIN	Returns number of possible combinations for given number of objects $^{n}C_{r}$.
17	DEGREES	Returns degree value of angle for given angular value in radian.
18	EVEN	Returns the nearest even number just above the given number.
19	ODD	Returns the nearest odd number just above the given number.
20	EXP	Returns exponential value of a given number.

Math functions

21	FACT	Returns factorial of given number.
22	FACTDOUBLE	Returns factorial of given number.
23	GCD	Returns greatest common divisor of the number.
24	INT	Returns integer value just below the given real number.
25	LCM	Returns least common multiple of given numbers.
26	LN	Returns natural logarithm of given number.
27	LOG	Returns common logarithm of given number.
28	LOG10	Returns logarithm of given number to the base 10.
29	MDETERM	Returns determinant of given matrix.
30	MINVERSE	Returns inverse of given matrix.
31	MMUL	Multiplication result of given matrices.
32	MOD	Returns modulo reminder of division.
33	MROUND	Returns nearest value rounded to the given multiple.
34	PI	Returns the value of PI (3.1415...).
35	POWER	Returns the the given power of a number.

Math functions

36	QUOTIENT	Returns quotient of division.
37	RADIANS	Returns radians for given degree angle.
38	RAND	Returns a random number.
39	RANDBETWEEN	Returns a random number between given input numbers.
40	ROMAN	Returns Roman numeral for given Arabic number.
41	SIGN	Returns sign $\pm$ + or -.
42	SQRT	Returns square root of the given number (only positive numbers are permitted in argument).
43	SUBTOTAL	Returns subtotal of given numbers.
44	SUM	Returns sum of given numbers.
45	SUMIF	Returns sum of given numbers if given condition is fulfilled.
46	SUMSQ	Returns sum of squares of given numbers.
47	TRUNC	Truncates given number to integer value.

Statistical functions

1	AVEDEV	Returns average of absolute/unsigned deviation of data from the mean.
2	AVERAGE	Returns average of given numbers.
3	AVERAGEA	Returns average of given numbers, text and logical values.
4	AVERAGEIFS	Returns average of given numbers which meet criteria specified.
5	CORREL	Returns coefficient of correlation between given data sets.
6	COUNT	Returns count of items in specified range.
7	COUNTIF	Counts the number of items in specified range, only if that item meets specified criterion.
8	COUNTIFS	Counts the number of items in specified range, only if that item meets several criteria specified after the first argument.
9	COUNTA	Counts the number of arguments provided to the function.
10	COUNTBLANK	Counts the number of blank cells in specified range.

Statistical functions

11	DEVSQ	Returns sum of squares of deviations.
12	FORECAST	Returns the most probable next value in a set of dependent and independent variables.
13	GEOMEAN	Returns geometric mean of given values.
14	GROWTH	Returns exponential forecast for a new X value based on given Y and X values.
15	LARGE	Returns rank based large value in a data set.
16	MAX	Returns highest numeric value.
17	MAXA	Returns highest value from the given numbers, text or logical values.
18	MEDIAN	Returns the median (the data that occurs at the middle) of given set of data.
19	MIN	Returns the least value of given numbers.

Statistical functions

20	MINA	Returns the least value of given numbers, text and logical values.
21	PERMUT	Returns permutation for given number of objects.
22	RANK	Returns rank for a given value in comparison to a list of values.
23	SMALL	Returns smallest number having given rank value.
24	STDEV	Returns standard deviation of given list of numbers.

Text functions

1	CHAR	Returns character having the given code number under ASCII (American Standard Code for Information Interchange) system.
2	CODE	Returns numeric code of given character.
3	CONCATENATE	Combines multiple string values.
4	DOLLAR	Returns given number in currency format based on current locale.
5	EXACT	Compares given text values.
6	FIND	Returns the index/ location count of the occurrence of first string within the second (larger) string.
7	FORMAT	Formats a number with fixed number of decimal places.
8	LEFT	Returns leftmost character from a string.
9	RIGHT	Returns rightmost character from a string.
10	LEN	Returns length of a string.

Statistical functions

11	LOWER	Converts given string to lowercase letters.
12	UPPER	Converts given string to uppercase letters.
13	PROPER	Capitalizes the first letter of each word in given string.
14	REPLACE	Takes a string for first argument. Takes start location for replacement, number of characters to be replaced as second and third arguments. The given range is replaced using the string given in the fourth argument.
15	REPT	Repeat the text given in first argument for number of times specified in second argument.
16	SEARCH	Returns the index/location of occurrence of first text within second text (case insensitive).

Text functions

17	SUBSTITUTE	Takes target string, search string and replacement string as arguments. Replaces second string with the third string in the first string.
18	T	Returns text value. Does not return anything for number and logical values.
19	TEXT	Formats the number given in the first argument according to format specified in the second argument.
20	TRIM	Removes spaces from the beginning and end of given string.
21	VALUE	Converts text to number.

Sorting in MS Excel

▶ To sort data, select all the cells containing the data to be sorted.

▶ Avoid the most common mistakes of selecting the just the single column containing the values to be sorted and omitting some columns which you might consider unnecessary of inclusion. Such an error may result in separation of data from its proper row members.

▶ Click *Data− > Sort*. In the dialog that opens, keep or remove the tick mark against the field "My data contains headers".

▶ The sort options contain 3 columns. First, select the column using which data needs to be sorted. In case the data contains headers, the header name is displayed. Otherwise, column name in alphabets (A,B,C,...) is displayed.

▶ In the second criterion, choose either values, cell color or cell icon.

▶ In the third criterion, choose smallest to largest or largest to smallest for number. Choose A to Z or Z to A for text data.

▶ Press sort button to sort the data.

Filtering of data in MS Excel

- ▶ For filtering data, the first row should contain headers.
- ▶ Select all the data including headers.
- ▶ Choose *Data− > Filter*. A triangular filter marker appears to the right of each column in the first row of data.
- ▶ Clicking the triangular marker of any column permits sorting in ascending or descending order, sorting by color, search for specific values, applying several filter conditions for numbers (like equals, does not equal, greater than, less than, less than or equal to, between, top 10, above average, below average, custom filter) and text (like equals, does not equal, begins with, ends with, contains, does not contain,custom filter).
- ▶ Filter helps to select data based on convenient criterion.

Validation of data in MS Excel

- ▶ Select the cells (or column or row) in which data validation is required.
- ▶ Choose *Data− > Data Validation* from the menu. Select Data Validation.
- ▶ The data validation dialog appears.
- ▶ Select the data type from *Allow* criterion.
- ▶ Select the data criterion (between, not between, equal to, not equal to, greater than, less than, greater than or equal to, less than or equal to).
- ▶ Enter the values for validation.
- ▶ If you wish to display an error message for wrong input, click Input Message tab and enter the title and content of error message.
- ▶ Press OK to apply the condition.
- ▶ To indicate error in data by circle, choose *Data− > Data Validation− > Circle invalid data*.

Analyzing data using charts in MS Excel

- ▶ MS Excel supports column, line, pie, area, scatter and other chart types like stock, surface, doughnut, bubble and radar.
- ▶ To display a chart like column, line, pie or bar, type X-Axis title in the one column and Y-Axis title in the next column.
- ▶ Enter X-Axis values and Y-Axis values in the selected columns.
- ▶ Select the data (including title).
- ▶ Choose Insert menu. Click the type of chart like column, line, pie, bar or scatter.
- ▶ The chart is inserted by Excel.
- ▶ Edit display parameters if necessary.

Data tables in MS Excel

- ▶ Using data table, Excel can be made to calculate the results for a row, a column or an array.
- ▶ If you wish to create a column based data table, fill the input values on the left. Calculate the result for the first row.
- ▶ Select the entire table, choose Data− >What If Analysis− >Data Table.
- ▶ Choose first column in the input box (leave the row value blank).
- ▶ Excel will fill up the remaining blank cells.
- ▶ Similarly, you can create a row based data table. You need to create a row based input, calculate the result in the first column of the next row. Choose first cell of the row in row input (leave the column value blank) during creation of data table.

Data tables in MS Excel

- ▶ If you wish to create a matrix using data table, enter input values in 2 cells, calculate the result value in a new cell.
- ▶ Create a row of inputs to the right of the result cell.
- ▶ Create a column of inputs below the result cell.
- ▶ Select the new matrix. Leave the row and column input cells unselected.
- ▶ Choose What Data− >If Analysis− >Data Table.
- ▶ In the input box, select the cells for row and column input.
- ▶ When OK button is pressed, Excel fills all the cells of the matrix based on your formula.

Pivot table in MS Excel

- ▶ Pivot table (and pivot chart) provide a means for summarizing data presented in a table.
- ▶ Choose the table based on which pivot table needs to be created.
- ▶ Choose Insert− >Pivot− >Pivot Table.
- ▶ MS Excel inserts a summary table in a new worksheet.

Goal seek in MS Excel

- ▶ Suppose you have a formula in a cell.
- ▶ If you wish to know the input for which the formula will yield a desired result, goal seek will help you.
- ▶ Click the cell containing the formula. Choose Data− >What If Analysis− >Goal Seek.
- ▶ In the first cell of the dialog, enter desired result.
- ▶ In the second cell, enter the address of the cell containing wrong input, which needs to be adjusted to produce the desired new result.
- ▶ Press seek button and see the suggested new input value.
- ▶ Press OK to accept the modified input and cancel to discard the changes.

Scenarios in MS Excel

▶ Scenario helps to save different sets of input values and compare the results of different scenario later on.

▶ To create a scenario, create a set of input values and calculate the result.

▶ Choose Data− >What If Analysis− >Scenario. Enter a title.

▶ Choose cells for which different sets of input values are to be tested. Use control to select more than one cell.

▶ Save the scenario with an optional comment.

▶ Repeat the same steps to create more such scenarios. Save different input values for each scenario.

▶ You can choose any of the scenario at a later time to see the results.

Image editing, Introduction to the properties and editing of images. Introduction to Open Office. Introduction to PowerPoint and its advantages. Creating Slide Shows. Fine tuning the presentation and good presentation techniques.

Types of image

▶ Images belong to the following 2 categories:

    (i) **Raster image:** Raster images have pixel as their basic unit. The most common types of raster image are JPEG (Joint Photographics Experts Group), PNG (Picture Natural Group), TIFF (Tagged Image File Format), GIF (Graphics Interchange Format), PNG (Portable Network Graphics), etc.

    (ii) **Vector image:** Vector images store details of geometrical shapes and the parameters needed to redraw those shapes. The most common formats used to store vector images are SVG (Scalable Vector Graphics), CGM (Computer Graphics Metafile), etc.

Basics of digital images

- ▶ Digital images comprise of pixels arranged in rectangular grids.
- ▶ Each pixel is a dot in an image.
- ▶ In monitor display, the colour of each pixel is determined based on RGB (Red-Green-Blue) system, HSL (Hue-Saturation-Lightness) system or HSV (Hue Saturation Value) system.
- ▶ For printing, CMYK (Cyan-Magenta-Yellow-blacK) colour system is adopted.
- ▶ The transparency value of a pixel is represented by Alpha value (usually 0 to 255).
- ▶ The spacing of pixels per inch on an image display is measured using PPI (Pixels Per Inch).
- ▶ The spacing of pixels per inch on an image display is measured using PPI (Pixels Per Inch).

Image editing

- ▶ Digital images are generated through digital photography, digital image editing software, scanning of painted images, etc.
- ▶ Image editing is necessitated due to:
  - (i) Photograph having low exposure.
  - (ii) Photos which require touchup.
  - (iii) Merging or splitting of digital images.
  - (iv) Resizing or scaling of digital images.
  - (v) Adjusting brightness of digital images.
  - (vi) Adjusting contrast of digital images.
  - (vii) Creating printable albums and layouts.
- ▶ Software packages like GIMP, Adobe Photoshop, CorelDraw, etc. help in editing digital images.

Basic adjustments to an image

- **Brightness and contrast** values of an image may be adjusted using Image− >Adjustments− >Brightness/Contrast menu. Brightness and contrast sliders may be used to make changes to the image.

- **Brightness, contrast and threshold** values of an image may be adjusted using Image− >Adjustments− >Levels menu. The histogram values may be adjusted to make changes to the image.

- **Brightness and contrast** values of an image may be adjusted using Image− >Adjustments− >Curves menu. The straight line on the histogram values may be adjusted up or down to make changes to the image.

Tools available in Adobe Photoshop

- **Rectangular Marquee Tool (M)** in Adobe Photoshop permits selection of rectangular/elliptical areas. It also permits single or single column marquee selection.

- **Lasso Tool (L)** in Adobe Photoshop permits selection of irregular areas (like face from an image, hand from an image, etc). Lasso tool provides Polygonal lasso and magnetic lasso options. Whereas Lasso selection is made between a click and release of mouse button, polygonal lasso permits placing several points along a selection path. Magnetic lasso tool places suitable points along the path of selection when the mouse is simply dragged through a boundary.

- **Quick selection tool (W)** in Adobe Photoshop creates a polygonal selection using the selection points. It provides Magic wand option, which is very popular to select areas having a specific colour similarity.

- **Crop tool (C)** in Adobe Photoshop retains selected area and discards unwanted portions.

Tools available in Adobe Photoshop

- **Eye dropper tool (I)** in Adobe Photoshop selects colour from specific point.
- **Spot healing brush tool (J)** in Adobe Photoshop take sample from one image (or area) and blend it with another image. Spot healing tools can be configured to work as Healing brush tool, Patch tool, Content-aware move tool or Red eye tool.
- **Brush tool (B)** in Adobe Photoshop helps to draw using selected colour. Brush tool can be configured to work like Pencil tool, Color replacement tool or Mixer brush tool.
- **Clone stamp tool (S)** in Adobe Photoshop takes a sample from one area (Alt+Mouse click) and applies the same in a new place (Mouse click). This tool has the option for Pattern stamp tool.

Tools available in Adobe Photoshop

- **History brush tool (S)** in Adobe Photoshop stores previous sample and mixes the same with the newly painted layer.
- **Eraser tool (E)** in Adobe Photoshop removes contents of the current layer and exposes the background layer. It has the options for Background eraser tool and Magic eraser tool.
- **Gradient tool (G)** in Adobe Photoshop fills selected area with a colour gradient, which gradually changes from one colour to another. It has the option for Bucket fill tool.
- **Blur tool** in Adobe Photoshop reduces the visibility/ clarity of selected portion of an image. It has the options for Sharpen tool and Smudge tool.
- **Dodge tool (O)** in Adobe Photoshop reduces the sharpness of an image. It has the option of Burn tool to increase sharpness and Sponge tool to saturate or de-saturate colours.

Tools available in Adobe Photoshop

- **Pen tool (O)** in Adobe Photoshop helps to draw a shape and convert the shape to selection, path or vector mask or define a custom shape by right clicking the closed shape.

- **Horizontal type tool (T)** in Adobe Photoshop helps to type text elements. It has options for vertical type, horizontal type mask and vertical type mask.

- **Path selection tool (A)** in Adobe Photoshop selects elements bounded by a path. It has option for direct selection tool.

- **Rectangle tool (U)** in Adobe Photoshop draws a rectangle. It has options for rounded rectangle, ellipse, polygon and line.

- **Hand tool (H)** in Adobe Photoshop drags a drawing (PAN). It has option for Rotate tool.

- **Zoom tool (Z)** in Adobe Photoshop enlarges or shrinks the visible area of image on the screen. It does not affect the size of the original image.

Simple tasks in image editing

- **Create maxi size photos:** Choose File− >New (Ctrl+N). Set the width to 12 inches and 8 inches and resolution to 200 pixels per inch. If Ruler is not visible, press Ctrl+R (View− >Rulers). Drag the left line and top line of ruler to mid width and mid height respectively. Drag and drop 4 photos on 4 parts of the image. Adjust the size and other effects of photos as you desire.

- **Create Passport size photo layout:** Choose File− >New (Ctrl+N). Set the width to 12 inches and 8 inches and resolution to 200 pixels per inch. Open the photo which should be set to passport size. Use polygonal lasso (or any other tool) to select the required portion of image. Select All (Ctrl+A) and Copy (Ctrl+C) the photo. Create new image, paste the photo. Choose Image− >Image Size and enter 3cm x 5cm size (for passport size photo). Press Ctrl+A, Ctrl+C to copy. Choose Original blank image (12in x 8in). Paste multiple times, drag the photo and arrange the photos without wastage of space.

Simple tasks in image editing

- **Create a photo album:** Choose File− >New (Ctrl+N). Set width=16inch and height=10 inch (width and height may change based on requirements). Set resolution to 300 dots per inch. Drag the required photo and place it on the page. Resize the photo and place it in a convenient position. Drag more photos and organize them. Use blur tool or smudge tool or sponge tool to blend the overlapping portions. Save the file. Export it to JPG format. Create many such pages (one page per file).

- **Create a banner:** Choose File− >New (Ctrl+N). Set width=72 inch and height=48 inch (width and height may change based on requirements). Set resolution to 300 dots per inch. Draw a rectangle and choose suitable fill color for background. Place text objects are required locations. Copy and paste (or drag and drop) images. Resize the images to required size. Save the document and export it to JPG type.

Simple tasks in image editing

- **Create a video using photos:** Choose File−>New (Ctrl+N). At the bottom of Adobe Photoshop window, video timeline appears. Click the triangular button next to video frame icon and choose Add media. Select all the photos to be used in the video. Increase or decrease the duration for each photo (default 5 seconds) by dragging the boundary of the photo. Audio track can be added using the audio icon. Choose File−>Export−>Render video. Enter file name and press Render button. The video is exported to MP4 format.

Introduction to Open Office

- *OpenOffice.org* was an open source and free software released in the year 2000, as the successor to the proprietary office suite called Star Office.

- OpenOffice contains a word processor (Writer), spreadsheet (Calc), Presentation creator (Impress), drawing editor (Draw), formula editor (Math) and a database tool (Base).

- File− >New menu in OpenOffice permits creation of all types of document supported by OpenOffice.

- OpenOffice displays File, Edit, View, Insert, Format, Tools, Window and Help menus by default. Some extra menus might appear to suit the needs of specific programs.

- OpenOffice features similar to those offered by MS Office.

- OpenOffice can open and edit most of the MS Office documents.

- The native file formats of OpenOffice.org are presented in Table 6.

File formats for OpenOffice documents

Table: File formats for OpenOffice documents

No.	File extension	Purpose
1	.odt	ODF Text.
2	.ott	ODF Template Text.
3	.odm	ODF Master Document.
4	.ods	ODF Spreadsheet.
5	.ots	ODF Spreadsheet Template.
6	.odg	ODF Drawing.
7	.otg	ODF Template Drawing.
8	.odp	ODF Presentation.
9	.otp	ODF Template Presentation.
10	.odf	ODF Formula.
11	.odb	ODF Database.

Introduction to Power Point

- ▶ Microsoft Powerpoint, (command name **powerpnt**), is a tool for creating presentations.
- ▶ Powerpoint is included as a part of Microsoft Office.
- ▶ Powerpoint files have extension of **.pptx**. Files created using Powerpoint in earlier versions of MS Office (up to 2003) had extension of **.ppt**.
- ▶ Powerpoint helps to create slide by slide presentations.
- ▶ Powerpoint is helpful for making classroom presentations, business proposals and progress reports.

Menu structure of Power Point

▶ Powerpoint has the following menu structure:

(i) **File/ office**:
- (a) Save (Alt+F+S, Ctrl+S)
- (b) Save As (Alt+F+A)
- (c) Open (Alt+F+O, Ctrl+O)
- (d) Close (Alt+F+C)
- (e) Info (Alt+F+I)
- (f) Recent (Alt+F+R)
- (g) New (Alt+F+N, Ctrl+N)
- (h) Print (Alt+F+P, Ctrl+P)
- (i) Save & Send (Alt+F+D)
- (j) Help (Alt+F+H)
- (k) Options (Alt+F+T)
- (l) Exit (Alt+F+X).

Home menu

(ii) **Home**:

    (a) **Clipboard (Alt+H+FO)**, Paste (Alt+H+V, Ctrl+V), Cut (Alt+H+X, Ctrl+X), Copy (Alt+H+C, Ctrl+C), Format Painter (Alt+H+FP).

    (b) **Slides**, Insert (Alt+H+I, Ctrl+M), Layout (Alt+H+L), Reset (Alt+H+Q), Selection (Alt+H+T).

    (c) **Font (Alt+H+FN)**, Font Face (ALt+H+FF), Font Size (Alt+H+FS), Font Grow (Alt+H+FG), Font Decrease (Alt+H+FK), Bold (Alt+H+1, Ctrl+B), Italic (Alt+H+I, Ctrl+I), Underline (Alt+H+U, Ctrl+U), Text Shadow (Alt+H+5), Strikethrough (Alt+H+4), Character spacing (Alt+H+6), Change case (Alt+H+7, Shift+F3), Font Color (Alt+H+FC).

    (d) **Paragraph (Alt+H+PG)**, Bullets (Alt+H+U), Numbering (Alt+H+N), Decrease list level (Alt+H+AO), Increase list level (Alt+H+AI), Align left (Alt+H+AL, Ctrl+L), Align Right (Alt+H+AR, Ctrl+R), Justify (Alt+H+AJ, Ctrl+J), Columns (Alt+H+J), Line Spacing (Alt+H+K), Text direction (Alt+H+AX), Align text (Alt+H+AT), Convert to Smart Art Graphic (Alt+H+M).

Home menu ...Contd.

(e) **Drawing (Alt+H+O)**, Shapes (Alt+H+SH), Arrange (Alt+H+G), Shape Quick Styles (Alt+H+SS), Shape Fill (Alt+H+SF), Shape Outline (Alt+H+SO), Shape Effects (Alt+H+SE).

(f) **Editing**, Find (Alt+F+FD, Ctrl+F), Replace (Alt+H+R, Ctrl+H), Select (Alt+H+SL), Select All (Ctrl+A).

Insert & Design menu

(iii) **Insert**:
- (a) **Table (Alt+N+T)**.
- (b) **Images**, Picture (Alt+N+P), Clip Art (Alt+N+F), Screenshot (Alt+N+SC), Photo (Alt+N+A).
- (c) **Illustrations**, Picture (Alt+N+SH), Smart Art (Alt+N+M), Chart (Alt+N+C).
- (d) **Links**, Hyperlink (Alt+N+U), Action (Alt+N+K).
- (e) **Text**, Text Box (Alt+N+X), Header & Footer (Alt+N+H), Word Art (Alt+N+W), Date & Time (Alt+N+D), Slide Number (Alt+N+SN), Object (Alt+N+J).
- (f) **Symbols**, Equation (Alt+N+E), Symbol (Alt+N+U)

(iv) **Design**:
- (a) **Page Setup**, Page Setup (Alt+G+S), Slide Orientation (Alt+G+O).
- (b) **Themes**, Colours (Alt+G+TC), Fonts (Alt+G+TF), Effects (Alt+G+TE), More (Alt+G+H).
- (c) **Background (Alt+G+G)**, Background Styles (Alt+G+B), Slide Background (Alt+G+M)

Transitions & Animations menu

(v) **Transitions**

   (a) **Preview** Preview (Alt+K+P, F5)

   (b) **Transition**, More (Alt+K+T), Effect Options (Alt+K+O).

   (c) **Timing**, Sound (Alt+K+U), Duration (Alt+K+E), Apply to all (Alt+K+L), On mouse click (Alt+K+M), After (Alt+K+F).

(vi) **Animations**

   (a) **Preview**, Preview (Alt+A+P), Animations (Alt+A+M), Shapes (Alt+A+S), Effect Options (Alt+A+O).

   (b) **Advance Animation**, Add Animation (Alt+A+AA), Animation Pane (Alt+A+C), Trigger (Alt+A+AT), Animation Painter (Alt+A+AP).

   (c) **Timing**, Start (Alt+A+T), Duration (Alt+A+DU), Delay (Alt+A+DE), Move Earlier (Alt+A+E), Move Later (Alt+A+L).

(vii) **Slide Show**
- (a) **Start Slide Show** From Beginning (Alt+S+B, F5), From Current (Alt+S+C, Shift+F5), Broadcast Slide Show (Alt+S+D), Slide show (Alt+A+M).
- (b) **Setup** Setup Slide Show (Alt+S+S), Hide Slide (Alt+S+H), Rehearse Timings (Alt+S+T), Record Slide Show (Alt+S+N), Play Narrations (Alt+S+P), Use Timings (Alt+S+U), Show Media Controls (Alt+S+W).
- (c) **Monitors** Resolution (Alt+S+R), Show On (Alt+S+O), Use Presenter View (Alt+S+V).

(viii) **Review**
- (a) **Proofing**, Spelling (Alt+R+S), Research (Alt+R+R), Thesaurus (Alt+R+E).
- (b) **Language**, Translate (Alt+R+2), Language (Alt+R+U).
- (c) **Comments**, Show Markup (Alt+R+M), View Comment (Alt+R+C), Edit Comment (Alt+R+T), Delete (Alt+R+D), Edit Comment (Alt+R+T), Previous (Alt+R+V), Next (Alt+R+N).
- (d) **Compare**, Compare (Alt+R+G), Accept (Alt+R+A), Reject (Alt+R+T), Previous (Alt+R+F), Next (Alt+R+H), Preview Pane (Alt+R+I), End Review (Alt+R+W).

Creating Slide Shows

- ▶ Slide show can be created by choosing File− >New from menu or by pressing Ctrl+N/ Alt+F+N.
- ▶ Presentation starts with a single slide.
- ▶ Choose suitable design for the presentation from Design menu. Different slide colours and designs are available.
- ▶ Choose Headers and Footers from Insert− >Text− >Header & Footer (Alt+N+H). Set appropriate values for header and footer.
- ▶ First slide requires name of presentation, author name and other details related to the presentation.
- ▶ Insert new slide by choosing Home− >Slides− >Insert or pressing Ctrl+M/ Alt+H+I.
- ▶ The new slide has a caption. Fill appropriate caption.
- ▶ Text can be typed in the contents area. If table or image is required, moving the mouse on the contents permits changing the display area to table or image.
- ▶ Content layout in a slide can be changed by from design menu.

Creating Slide Shows

- ▶ Slide transition effects may be controlled using Transitions− >Transition menu.
- ▶ Animation for slide transition may be applied from Animations− >Preview− >Animations or Animations− >Preview− >Shapes or Animations− >Preview− >Effect Options.
- ▶ Slide show can be started from current slide (Shift+F5) or from the beginning (F5). To stop presentation, press Esc key.
- ▶ Mistakes in spelling are underlined in red colour. Spelling mistakes can be corrected by choosing Review− >Proofing− >Spelling from menu or by pressing Alt+R+S.

Fine tuning a presentation

- ▶ Presentation may be made to change slides at specified interval automatically using Animations− >Timing− >Duration.

- ▶ Specified tone may be permitted to play at the time of each slide transition using Transitions− >Timing− >Sound.

- ▶ Audio may be recorded for each slide using Slide Show− >Setup− >Record Narration (Alt+S+N). This audio plays when the slide is presented. Recording may be verified using Slide Show− >Setup− >Play Narration (Alt+S+P).

- ▶ Search may be carried out using Home− >Editing− >Find (Ctrl+F/ Alt+H+FD).

- ▶ Replace may be carried out using Home− >Editing− >Replace (Ctrl+H/ Alt+H+R).

Good presentation techniques

- ▶ Choose contrasting background and foreground colours (light background and dark foreground OR dark background and light foreground).
- ▶ Choose mild animations for slide transition. Fast and repeating animations create irritation to the audience.
- ▶ Transition effects may be applied uniformly to all slides. Different transition effect for each slide might distract the attention of the audience.
- ▶ Text in each slide should be large enough for the audience to read without strain.
- ▶ In case of automated slide transition in presentation, the duration should be sufficient for even the slowest reader to read/ observe the slide.

Syllabus

Concept of DBMS, RDBMS, Data Models, Concept of DBA, Database Users, Database Schema, Designing Database using Normalization Rules, Various data types Data integrity, DDL, DML and DCL statements, Enforcing Primary key and foreign key, Adding Indices, Concepts of Transactions, ACID Property of Transaction, Constraints, Joining of tables, Sub Queries, Functions used in query like sum, average, max, min, count etc.

Data

- Information collected for storage, reference and analysis purpose is called data.
- Data may be in the form of digital text or numbers.
- Data may be stored in paper format or in electronic storage.
- Datum is the singular form for the word data.
- Data related to financial transactions is used for accounting.
- Survey is a systematic method for data collection.
- Specialized software for storage, analysis and retrieval of data is called Database Management System (DBMS).

Information

- ▶ Details collected about an particular object is called information.
- ▶ While data can be a collection of unrelated details, information has some common theme.
- ▶ Information is always used in singular form.
- ▶ Storage and transmission of information is the main use of communication technology in the modern era.
- ▶ Digital information may be stored in hard drive, optical drive, SD card, pen drive, cloud storage or data centre.

Database

- ▶ The system for storage and retrieval of data in digital format is called database.
- ▶ Database can be stored in a single computer or in multiple computers.
- ▶ Database makes the storage and retrieval of data easy for the client.
- ▶ Databases are of the following types:
    - (i) Navigational or Hierarchical database - 1960-1970
    - (ii) Relational Database - Edgar Codd - 1970 - SQL (Structured Query Language)
    - (iii) Object Oriented Database Management System (OODBMS) - 1990
    - (iv) NoSQL - 2000 - Fast, unstructured, inconsistent - Mostly used by Social Media platforms.
    - (v) NewSQL - 2000 - Combination of NoSQL engine with SQL interface.

Concept of DBMS

▶ Data Base Management System (DBMS) was invented for storing and retrieving information in tables.
▶ Each table has columns (which are given names) and rows, which represented information.
▶ All data in DBMS was usually packed in a single table.
▶ Since a single table had to store all information, in any given row, may columns remained without value.
▶ DBMS like DBase, Foxpro, etc. made data management easier.
▶ DBMS were inherently inefficient in storing data. The relational system superceded the DBMS.

ID	NAME	CLASS	MARK	GENDER
1	John Deo	Four	75	female
2	Max Ruin	Three	85	male
3	Arnold	Three	55	male
4	Krish Star	Four	60	female
5	John Mike	Four	60	female
6	Alex John	Four	55	male
7	My John Rob	Five	78	male
8	Asruid	Five	85	male
9	Tes Qry	Six	78	male
10	Big John	Four	55	female

Figure: Data Base Management System (DBMS)[5]

Concept of RDBMS
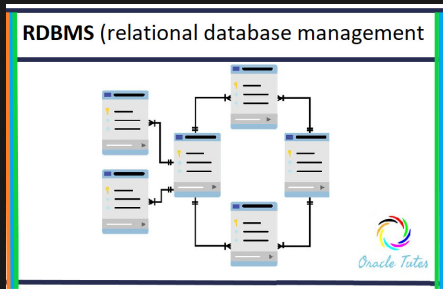
Figure: Relational Data Base Management System (RDBMS)[6]

Concept of RDBMS

- ▶ Relational Data Base Management System (RDBMS) was an evlution of DBMS.
- ▶ The RDBMS system was proposed by Edgar Codd of IBM in the year 1970.
- ▶ Edgar Codd stipulated 13 rules, numbered from Rule 0 to Rule 12, which are to be enforced by any RDBMS.
- ▶ The concept of set theory and relations were applied to database tables and the same was called RDBMS.
- ▶ RDBMS supports many tables, each table related to the other using some key column.
- ▶ RDBMS allows inner join, outer join and sub-query when selecting data.
- ▶ RDBMS madates that all data operations should be carried out through Structured Query Language (SQL).

Data Models
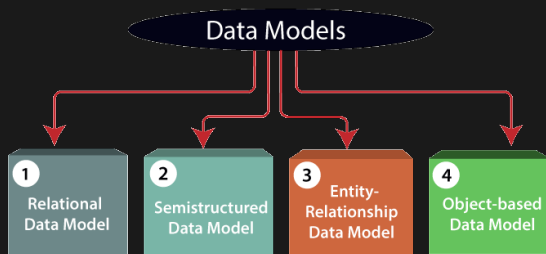
Figure: Data Models[7]

Data Models

1. **RDBMS**: Relational Data Base System (RDBMS) is used in most of the commercial software applications. RDBMS is reliable, fast and flexible. The security model of RDBMS is also makes it suitable for enterprise software applications.

2. **Entity Relationship Model**: Entities, also called objects, are created. Relations between entities are defined. This entity relationship model was proposed by Peter Chen in 1976. An entity named 'student' may have relationship sets named 'student_roll_number','student_name','student_dob'. etc.

3. **Object Relational Model**: Entity Relational model was extended with the name of Object Relational Model using Object oriented concepts of methods, encapsulation, inheritance, etc.

4. **Semi-structured model**: Semi-structured data model does not enfoce particular column structure for information. Each item has got different structure. Structure is defined as and when needed using XML (eXtensible Markup Language).

Popular Database Engines

1. **Oracle**: Oracle is one of the most popular database software. Oracle is fully compliant with all the rules applicable for Relational Database Management System (RDBMS). Oracle is the platform preferred by many professional organizations.

2. **Microsoft SQL Server**: Microsoft SQL Server is fast growing platform for database management. It provides fast performance and is available for Windows, Linux and Mac operating systems. It provides easy integration with MS Excel and other software packages.

3. **IBM DB2**: IBM DB2 is a high performance database engine providing back end services for many business organizations and insurance companies. IBM was the leader in the field of Relational Database Management, since Edgar Codd, was an employee of IBM and DB2 was one of the first relational database systems.

4. **Teradata**: Teradata supports large scale databases and provides fast data analytics to help in business decision making.

Popular databases

5. **MySQL**: MySQL was developed by MySQL AB, bought by Sun Microsystems and bought again by Oracle. MySQL is an open source database engine. MySQL is the preferred database system for web based applications.

6. **PostgreSQL**: PostgreSQL is an enterprise grade RDBMS and OODBMS available under open source licensing.

7. **MongoDB**: MongoDB is a NOSQL database engine. MongoDB has the advantage of speed and flexibility and is used by social media platforms where speed and flexibility are more important than data integrity.

8. **SAP ASE**: SAP (formerly Sybase) Adaptive Server Enterprise (ASE) is a fast relational database system.

9. **Informix**: Informix is an object oriented database system and supports NoSQL features. It is owned by IBM.

10. **Microsoft Access**: Microsoft Access is suitable for desktop based database management. It provides facilities to create forms and reports.

11. **SQLite**: SQLite is a light weight database engine used for

Codd's Rules for RDBMS

- **Rule 0 - Foundation rule**: A relational database system must be able to manage data entirely through relational rules.
- **Rule 1 - Information rule**: data in a database should be held only in table.
- **Rule 2 - Guaranteed access rule**: Each and every datum should be accessible through a combination of table, key and column.
- **Rule 3 - Null value rule**: Absence of data should be represented through null value, irrespective of data type.
- **Rule 4 - Active online catalogue rule**: Table schema should also be stored in tables and should be accessible through SQL.
- **Rule 5 - Comprehensive data sublanguage rule**: Database should be accessed only through data sublanguage (SQL). No other mode of access is permitted.
- **Rule 6 - View updating rule**: All views theoretically updatable should be updatable by the system.

Codd's Rules for RDBMS

- ▶ **Rule 7 - High level insert, update and delete rule**: The data sub-language should support insert, update and delete operations in addition to select option.
- ▶ **Rule 8 - Physical data independence**: The mode of physical storage media and structure of media should not affect the data sub-language.
- ▶ **Rule 9 - Logical data independence**: Any application accessing the data should be unaffected by the changes to schema used for data tables.
- ▶ **Rule 10 - Integrity independence**: Database must be independent of the application using the data.
- ▶ **Rule 11 - Distribution independence**: End user must not feel any difference between data stored in local media and data stored in several locations (over the network).
- ▶ **Rule 12 - Non-subversion rule**: Data must not be manipulated through any mode other than the data sub-language (SQL).

Key terms related to RDBMS

1. **RDBMS**: Relational Database Management System. It is compliant with Codd's rules and is accessed through SQL.
2. **SQL**: Structured Query Language - the sub-language used to work with RDBMS.
3. **Database**: A collection of tables used to store data.
4. **Table**: A group of columns used to store data related to an individual entity.
5. **Column**: One subhead for storing data in a table (like name, mobile_number, email_id, etc.)
6. **Row or Record**: One set of information relating to an object which fills up all the columns with data values (including null value), like ('Krish','345345345','krish@gmail.com').

Key terms related to RDBMS

7. **Row**: One set of information relating to an object which fills up all the columns with data values (including null value), like ('Pavithra','345345345','pavithra@gmail.com').

8. **Data Type**: A column may have a data type. Common data types supported by MySQL are char, varchar, int, date, time, datetime, bigint, double, clob, blob. Different database servers support slightly different names for data types.

9. **Primary key**: The main column used for indexing and searching data is called primary key. Primary key does not support duplicate values.

10. **Foreign key**: The primary key of a different table used in another table for relational, searching and indexing purposes is called foreign key. Foreign key permits duplicate values.

11. **Constraints**: NOT NULL, AUTO_INCREMENT, UNIQUE, DEFAULT, PRIMARY KEY, FOREIGN KEY, INDEX etc. are some of the constraints used to fill columns with valid data.

Data Base Administrator (DBA)

Figure: Data Base Administrator's Roles[8]

- Data Base Administrator (DBA) designs databases and tables.
- DBA decides the structure of table, called schema of table.
- DBA is responsible for creating relationships between tables.
- DBA creates user id and passwords for use by others.
- DBA is responsible for creating backup at periodic intervals.
- DBA restores data from backups whenever necessary.
- DBA is responsible for overall maintenance of the RDBMS engine.

Data Base User

- Database users have a login id and password.
- Users login and perform tasks within their assigned rights.
- Some users can create databases and tables (just like admin), some can alter tables, some can only insert data or select data, some can only view data.
- Rights for each user can be granted or revoked by the DBA.
- Normal users can be dropped (removed) by the DBA.
- To create a new user name 'krish', the DBA would run the following mysql query:
  CREATE USER 'krish'@'localhost' IDENTIFIED BY 'password';

Data Base User

- ▶ There are previleges to CREATE, SELECT, INSERT, UPDATE, DELETE and DROP for normal users. e.g., DBA may grant create, select and insert previleges to krish using the following query:
  GRANT CREATE, SELECT, INSERT ON * . * TO 'krish'@'localhost';

- ▶ Using REVOKE in place of GRANT in the above query will revoke permissions. To remove create and insert permissions, the following query will work:
  REVOKE CREATE,INSERT ON * . * TO 'krish'@'localhost';

- ▶ Finally, a user may be removed from the list of users using drop command. The following query removes our user account:
  DROP USER 'krish'@'localhost';

Schema

- ▶ Schema describes the structure of a database table.
- ▶ Normally, the column names, data types and constraints form the *logical schema* for table.
- ▶ The storage allocation and file/ disk related activities constitute the *physical schema*.
- ▶ In mysql, decribe command displays the table schema. e.g., to display the structure of a table named ITI, one may issued the following SQL command: *DESCRIBE ITI;*
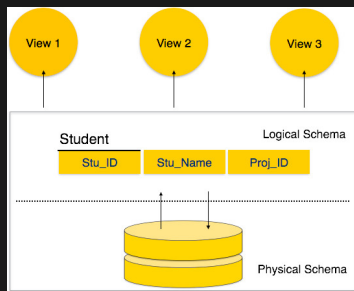
Figure: Table Schema[9]

Rules for designing good tables

1. Determine the purpose of the database.
2. Organize the information to be stored in the database.
3. Divide the information into suitable tables.
4. Define column values and primary key.
5. Define relationships between tables.
6. Normalization is the process of defining the columns required and methodically grouping them into suitable tables.
7. The purpose of normalization is to create a table in such a way that each column may be closely related to the other.
8. When certain columns repeat with duplicate values, those columns may be divided into separate tables.
9. Primary key is the unique identifier for each table. Values in primary key column are to be unique (to occur only once).
9. Foreign key holds reference to primary key of another table.

Normalization of tables

► The process of starting with all required columns and finishing with different tables and relationships is called Normalization.

► Normamization is applied in 5 different stages called Normal Forms as follows:

  (i) **1NF or First Normal Form**: Define column names and data types.
  (ii) **2NF or Second Normal Form**: Remove repetition of data.
  (iii) **3NF or Third Normal Form**: Define a primary key for each table.
  (iv) **4NF or Fourth Normal Form**: Divide unrelated columns of table into separate tables.
  (v) **5NF or Fifth Normal Form**: If columns in a table can be divided into separate tables connected by appropriate keys, the table should be further divided.

Integrity rules and constraints in a table

1. **Domain Integrity**: Specifying suitable constraints and setting values permitted and not permitted in a table is called domain integrity. For example, specifying that ID is a primary key and has auto_increment attributes is one way of specifying domain integrity.

2. **Entity integrity**: Every table should have a primary key.

3. **Referential integrity**: Value referred in a foreign key column should be present in some other table as a value in primary column.

Relationships in tables

1. **One to many relationship**: One primary key column of a table getting referred many times through foreign key value in another table (patient.ID and visit.PATIENT_ID columns in patient and visit tables).

2. **Many to many relationship**: The appearance of many keys of first table against many other keys of a second table is called many to many relationship (Many product IDs of product table appearing in several order IDs of order table is an example of many to many relationship).

3. **One to one relationship**: If one key value of first table appears only once in a second table, it is called one to one relationship (the relation between personal.AADHAR and contact.AADHAR is one to one and cannot have more than one relationship).

String datatypes in MySQL

1. **CHAR(n)**: Character data type with n characters (fixed). Maximum length: 255 characters.
2. **VARCHAR(n)**: Variable number of characters. Maximum length: 65,535.
3. **BINARY(n)**: Stores binary bytes (instead of human readable strings).
4. **VARBINARY(n)**: Stores variable number of binary bytes (instead of human readable strings).
5. **TINYBLOB**: Stores up to 255 binary bytes of data.
6. **TINYTEXT**: Stores up to 255 characters of data.
7. **TEXT(n)**: Stores up to 65,535 characters of data.
8. **BLOB(n)**: Stores up to 65,535 Binary Large OBjects (BLOB) of data.
9. **MEDIUMTEXT**: Stores up to 16,777,215 Characters of data.
10. **MEDIUMBLOB**: Stores up to 16,777,215 Binary Large OBjects (BLOB) of data.

String datatypes

11 **LONGTEXT**: Stores up to 4,294,967,295 Characters of data.

12 **LONGBLOB**: Stores up to 4,294,967,295 Binary Large OBjects (BLOB) of data.

13 **ENUM("one","two","three")**: Enum data type creates a column whose data can have one of the given values.

12 **SET("one","two","three")**: Set creates a data type where the columns can have any one or combination of values defined inside the set (for the above type, "one,two","one,three","one,two,three","two,three" are some of the permissible values for given column).

Numeric datatypes in MySQL

1. **BIT(n)**: Can hold bit values. Maximum size is 64 bits.
2. **TINYINT**: Can hold integer values in the range of -128 to $+127$ or 0 to 255.
3. **BOOL or BOOLEAN**: TRUE or FALSE value (0 - FALSE, $\neq$ 0 - TRUE).
4. **SMALLINT**: Integer values of -32768 to 32767 (signed) or 0 to 65535 (unsigned) may be stored.
5. **MEDIUMINT**: Integer values of -8388608 to 8388607 (signed) or 0 to 16777215 (unsigned) may be stored.
6. **INT or INTEGER**: Integer values of -2147483648 to 2147483647 (signed) or 0 to 4294967295 (unsigned) may be stored.
7. **BIGINT**: Integer values of -9223372036854775808 to 9223372036854775807 (signed) or 0 to 18446744073709551615 (unsigned) may be stored.
8. **FLOAT(size, d)**: Stores floating point numbers of given size with d decimal places. It will be removed in future versions.
9. **DOUBLE(size, d)**: Can store decimal numbers of given size

Date and Time datatypes in MySQL

1 **DATE**: Holds date in 'yyyy-mm-dd'.

2 **DATETIME**: Holds date and time in the format 'YYYY-MM-DD hh:mm:ss'.

3 **TIMESTAMP**: Number of seconds since 01-Jan-1970 (UNIX epoch)).

4 **TIME**: Time value in hh:mm:ss format.

5 **YEAR**: Four digit year values may be stored. e.g., '2022'.

Data Definition Language (DDL)

1. **DDL - Data Definition Language**: The commands used to create or alter databases and tables is called DDL. Typical DDL commands are:
   (i) create database ITI;
   (ii) create table TRAINEE (reg_no varchar(14) primary key, name varchar(50), dob date not null, mark int not null default 0, max_mark int not null default 1);
   (iii) alter table trainee add column percentage double default 0 after max_mark;
   (iv) drop table TRAINEE;
   (v) drop database ITI;

Data Manipulation language (DML)

2. **DML - Data Manipulation language**: Helps to insert, update and delete data values.

   (i) insert into trainee
       values('001784000132','Mala','2002-03-19',460,500,92.00);
   (ii) update trainee set name='Malarvizhi' where
        reg_no='001784000132';
   (iii) delete from trainee where reg_no='001784000132';

Data Query Language (DQL)

3 **DQL - Data Query Language**: SQL commands used to select data from tables falls under the category of DQL. Typical DQL commands are:

   (i) select reg_no, name, dob from TRAINEE where name='Malarvizhi';

   (ii) select reg_no, name, dob from TRAINEE where reg_no='001784000132 ';

   (iii) select * from TRAINEE order by dob;

   (iv) select * from TRAINEE order by dob DESC;

   (v) select * from TRAINEE where name like 'Ma%' order by dob;

   (vi) select * from TRAINEE where name like '%arvi%' order by dob;

   (vii) select average(percentage) from TRAINEE;

   (viii) select average(percentage) from TRAINEE group by dob;

   (ix) select average(percentage) from TRAINEE group by dob order by percentage;

   (x) select average(percentage) from TRAINEE having dob > '2000-01-01' group by dob order by percentage;

Data Control Language (DCL)

4. **DCL - Data Control Language**: Used for database administration functions like creating user, changing password, granting rights, revoking rights, etc.

   1. To create a new user name 'krish', the DBA would run the following mysql query:
      CREATE USER 'krish'@'localhost' IDENTIFIED BY 'password';

   2. There are previleges to CREATE, SELECT, INSERT, UPDATE, DELETE and DROP for normal users. e.g., DBA may grant create, select and insert previleges to krish using the following query:
      GRANT CREATE, SELECT, INSERT ON * . * TO 'krish'@'localhost';

   3. Using REVOKE in place of GRANT in the above query will revoke permissions. To remove create and insert permissions, the following query will work:
      REVOKE CREATE,INSERT ON * . * TO 'krish'@'localhost';

   4. Finally, a user may be removed from the list of users using drop command. The following query removes our user account:
      DROP USER 'krish'@'localhost';

Enforcing primary key

- ▶ Primary key is a unique identifier for one row of data in a table. No duplicate enties are permitted.
- ▶ As an example, one may create a table for storing name, address and phone numbers. Since a person may have one address and many mobile numbers, we may create two tables as follows:
  1. **address**: Containing id, name and address columns. It may be created using the following command:
     create table address (id bigint, name varchar(50) not null, address varchar(300) not null default '',primary key(id));
  2. **phone**: containing id, person_id, mobile columns, created using the following command:
     create table phone (id bigint auto_increment primary key, person_id bigint, phone varchar(20) not null default '', constraint fk foreign key(person_id) REFERENCES address(id));
- ▶ Primary key in address table is referred as foreign key in phone table.

Enforcing primary key and foreign key

- ▶ The following commands are permitted on address table:
  insert into address values(1,'Ram','Uttar Pradesh');
  insert into address values(2,'Krish','Gujarat');
- ▶ The following command will fail because primary key value of 2 has already been allotted to Krish:
  insert into address values(2,'Govind','Andra Pradesh');
- ▶ The following commands will work on phone table:
  insert into phone values(0,1,'23423422');
  insert into phone values(0,1,'4563453343');
  insert into phone values(0,1,'23423422');
  insert into phone values(0,2,'23423423');
  insert into phone values(0,2,'45646454');
- ▶ The zero (0) value against id column is permissible since auto_increment property has been set.
- ▶ Multiple insertions of same person_id values is permissible, since the column is only a foreign key.
- ▶ Primary key in address table is referred as foreign key in mobile table.

Adding Indices

1. Index is a special column on which frequent search operation may be performed while querying the table.

2. We might like to create index on column *name* in table address. This is possible using the following query:
   create index name on address(name);

3. Alternately, index may have been declared while creating the table itself. The SQL should be mildly modified as follows:
   create table address (id bigint, name varchar(50) not null, address varchar(300) not null default '',primary key(id), index(name));

4. Declaration of index will make queries to work faster.

Concepts of Transactions

1. Transactions are a set of tasks to be carried out on a database.
2. Each query like insert, delete, drop, alter, grant, revoke creates certain transactions.
3. Each transaction begins with opening of a particular entity (typically a table) and ends in its closing.
4. Each transaction may contain several smaller tasks.
5. We might invoke an update query as follows:
   update address set name='Sriram' where id=1;
6. Typically, the query will generate following operations to complete the transaction:
   open(address);
   search for index=1;
   set name='Sriram';
   close(address);

ACID Property of Transaction

1. ACID property stands for Atomicity, Consistency, Isolation, Durability.

2. **A**tomicity: The transaction should have either taken place or failed. It should not leave the database with unfinished transaction.

3. **C**onsitency: Each transaction should leave the database with proper values of data.

4. **I**solation: Although several transactions take place at the same time, each transaction should be carried out as though it were the only transaction.

5. **D**urability: Result of each transaction should remain permanent, no matter what happens to the computer (like a restart).

Constraints

- ▶ Constraints are restrictions placed on the values a column may or may not permit.
- ▶ Constraint specifiers follow the declaration of column name and data type.
- ▶ Following are the constraints enforced by mysql:
    1. **NOT NULL:** Ensures that the column value is always something other than NULL.
    2. **UNIQUE:** Duplicate values are not permitted in the column.
    3. **PRIMARY KEY:** It is a combination of NOT NULL and UNIQUE. It ensures unique non-null value for column.
    4. **FOREIGN KEY:** Ensures that relationships between tables tables are not removed.
    5. **DEFAULT:** This value is inserted if not value is specified for the particular column.
    6. **CREATE INDEX:** Helps to improve the search speed in data tables.

Joining of tables

- Connecting two tables to produce results for select query is called join.
- Four types of JOIN operations are permitted by mysql. They are:
  1. **INNER JOIN:** Intersection of two tables is selected.
  2. **LEFT JOIN:** Intersection of two tables and entire data in left table are selected.
  3. **RIGHT JOIN:** Intersection of two tables and entire data in right table are selected.
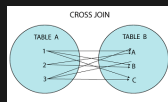 4. **CROSS JOIN:** Each row in left table is joined with all rows in right table.
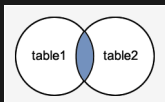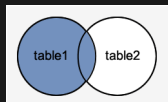
(a) INNER JOIN   (b) LEFT JOIN   (c) RIGHT JOIN   (d) CROSS JOIN
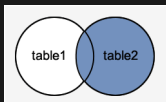
Examples of join statements

- ▶ The query *select address.id, address.name, phone.phone from address INNER JOIN phone on address.id=phone.person_id;* will prodce inner join selection.

- ▶ The query *select address.id, address.name, phone.phone from address LFET JOIN phone on address.id=phone.person_id;* will prodce left join selection.

- ▶ The query *select address.id, address.name, phone.phone from address RIGHT JOIN phone on address.id=phone.person_id;* will prodce right join selection.

- ▶ The query *select address.id, address.name, phone.phone from address CROSS JOIN phone on address.id=phone.person_id;* will prodce cross join selection.

Examples of join statements

```
mysql> select address.id, address.name, phone.phone from address INNER JOIN phone on address.id=phone.person_id;
+----+-------+------------+
| id | name  | phone      |
+----+-------+------------+
|  2 | Krish | 23423423   |
|  2 | Krish | 45646454   |
|  1 | Ram   | 23423422   |
|  1 | Ram   | 4563453343 |
|  1 | Ram   | 23423422   |
+----+-------+------------+
5 rows in set (0.00 sec)
```

(a) INNER JOIN

```
mysql> select address.id, address.name, phone.phone from address LEFT JOIN phone on address.id=phone.person_id;
+----+-------+------------+
| id | name  | phone      |
+----+-------+------------+
|  2 | Krish | 23423423   |
|  2 | Krish | 45646454   |
|  1 | Ram   | 23423422   |
|  1 | Ram   | 4563453343 |
|  1 | Ram   | 23423422   |
+----+-------+------------+
5 rows in set (0.00 sec)
```

(b) LEFT JOIN

Examples of join statements


```
mysql> select address.id, address.name, phone.phone from address RIGHT JOIN phone on address.id=phone.person_id;
+------+-------+------------+
| id   | name  | phone      |
+------+-------+------------+
|    1 | Ram   | 23423422   |
|    1 | Ram   | 4563453343 |
|    1 | Ram   | 23423422   |
|    2 | Krish | 23423423   |
|    2 | Krish | 45646454   |
+------+-------+------------+
5 rows in set (0.00 sec)
```

(c) RIGHT JOIN


```
mysql> select address.id, address.name, phone.phone from address CROSS JOIN phone on address.id=phone.person_id;
+----+-------+------------+
| id | name  | phone      |
+----+-------+------------+
|  2 | Krish | 23423423   |
|  2 | Krish | 45646454   |
|  1 | Ram   | 23423422   |
|  1 | Ram   | 4563453343 |
|  1 | Ram   | 23423422   |
+----+-------+------------+
5 rows in set (0.00 sec)
```

(d) CROSS JOIN

Figure: Resuls of JOIN Operations in MySQL

Sub Queries

▶ Sub queries are executed first and the result substituted in the main query.

▶ Imagine a condition where we know the name of person to be contacted (Ram) and wish to get contact numbers.

▶ Since ID value in address for Ram is not known, one may execute a subquery (select id from address where name='Ram';) to find the same.

▶ The query with subquery may be executed as follows:
select phone from phone where person_id=(select id from address where name='Ram');

▶ Results of the subquery for names of Ram and Krish are shown in fig.51.

Aggregate functions in MySQL

- ▶ Aggregate functions help to calculate count, sum, average, minimum, maximum, standard deviation, etc.
- ▶ Following aggregate functions are commonly available in mysql:
  1. **count:** Number of rows matching given condition (where clause).
  2. **sum:** Sum of values in particular column where rows match given condition (where clause).
  3. **avg:** Average of values in particular column where rows match given condition (where clause).
  4. **min:** Minimum value of particular column where rows match given condition (where clause).
  5. **max:** Maximum value of particular column where rows match given condition (where clause).
  6. **stddev:** Standard deviation of value contained in particular column where rows match given condition (where clause).

Aggregate functions in MySQL

- ▶ A table named result with id, name, subject and mark columns is created using the following query:
  create table result (id bigint auto_increment primary key, name varchar(20), subject ENUM('Tamil','English','Maths','Science','Social'), mark int);

- ▶ Following values may be inserted into the result table:
  emph insert into result values(0,'Ram','Tamil',94);
  insert into result values(0,'Ram','English',92);
  insert into result values(0,'Ram','Maths',100);
  insert into result values(0,'Ram','Science',98);
  insert into result values(0,'Ram','Social',91);
  insert into result values(0,'Krish','Social',76);
  insert into result values(0,'Krish','Maths',93);

Aggregate functions in MySQL

Figure: Inserting data into result table

Aggregate functions in MySQL

- ► Following queries were run to populate the result table:
  emph select subject, count(subject) from result group by
  subject order by subject;
  select name, sum(mark) from result group by name order by
  name;
  elect name, avg(mark) from result group by name order by
  name;
  select min(mark) from result;
  select max(mark) from result;

Aggregate functions in MySQL

```
mysql> select subject, count(subject) from result group by subject order by subject;
+---------+----------------+
| subject | count(subject) |
+---------+----------------+
| Tamil   |              1 |
| English |              1 |
| Maths   |              2 |
| Science |              1 |
| Social  |              2 |
+---------+----------------+
5 rows in set (0.00 sec)
```

(a) Count

```
mysql> select name, sum(mark) from result group by name order by name;
+-------+-----------+
| name  | sum(mark) |
+-------+-----------+
| Krish |       169 |
| Ram   |       475 |
+-------+-----------+
2 rows in set (0.00 sec)
```

(b) Sum

Aggregate functions in MySQL

```
mysql> select name, avg(mark) from result group by name order by name;
+-------+-----------+
| name  | avg(mark) |
+-------+-----------+
| Krish |   84.5000 |
| Ram   |   95.0000 |
+-------+-----------+
2 rows in set (0.00 sec)
```

(c) Average

```
mysql> select min(mark) from result;
+-----------+
| min(mark) |
+-----------+
|        76 |
+-----------+
1 row in set (0.00 sec)
```

```
mysql> select max(mark) from result;
+-----------+
| max(mark) |
+-----------+
|       100 |
+-----------+
1 row in set (0.00 sec)
```

(d) Min   (e) Max

Figure: Aggregate functions in MySQL

Syllabus

Local Networks, Communicating on a Local Network, Principles of Communications, How do Ethernet Networks Work?, How are Networks Built?, Routing Across Networks, How end-user devices and local networks interact with the global Internet. Concept of network communication. Local Networks Explain the roles of devices in a network. What Does a Home Network Look Like? How Does Wi-Fi Work? Introduction to LAN Devices, Internetworking Devices, Introduction to www, Concept of Internet, Web Browsers, internet servers and search engines. Concepts of Domain naming Systems and E mail communication. Introduction to video chatting tools and Social Networking concepts.

Computer Networks

- ▶ The communication infrastructure meant for sharing of data between computers is called computer network.
- ▶ Connection between computers may be through cable, WiFi (Wireless Fidelity), bluetooth or any other method.
- ▶ Modem, repeater, hub, bridge, switch, firewall, etc. are the essential infrastructure to run a network.
- ▶ Each computer connected to a computer assumes a unique identifier called IP (Internet Protocol) Address (IP4 - 216.58.201.174, IP6 - 2001:0db8:85a3:0000:0000:8a2e:0370:7334).
- ▶ Domain name is converted to equivalent IP address using Domain Name Server (DNS).
- ▶ IP4 address is 32 bits (4 bytes) in length.
- ▶ Internet is controlld by the World Wide Web Consortium (W3C).

Computer Networks

▶ There are 3 classes of IP address, as detailed below:

  (i) **Class - A network (Fig.54)**: High order byte (right most 8 bits) of the network is reserved for network ID. The remaining 24 bits are used to set IP address of the host. This permits 126 networks and 16,777,214 hosts per network.
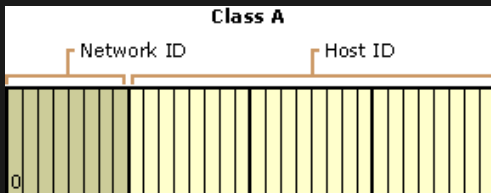

Figure: Address bit configuration: Class A network [69]

Computer Networks

(ii) **Class - B network (Fig.55)**: High order 2 bytes (right most 16 bits) of the network are reserved for network ID. The first and second bits of network ID are always 1 and 0. The remaining 14 bits are used to set network IDs (16,384 networks). The lower 2 bytes of the IP address are meant for host ID (16,534 hosts).
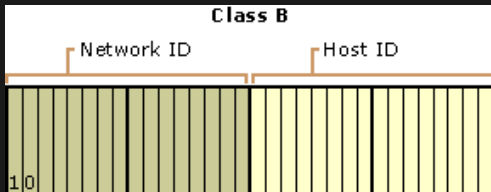

Figure: Address bit configuration: Class B network [69]

Computer Networks

(iii) **Class - C network (Fig.56)**: High order 3 bytes (right most 24 bits) of the network are reserved for network ID. The first, second and third bits of network ID are always 1, 1 and 0. The remaining 21 bits are used to set network IDs (2,097,152 networks). The lowest byte of the IP address is meant for host ID (254 hosts).
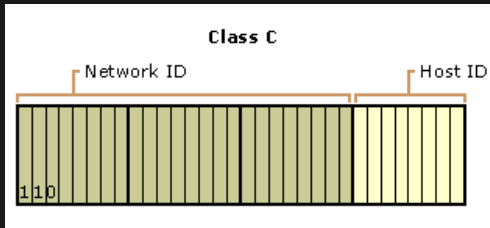

Figure: Address bit configuration: Class C network [69]

Client Server computing

- ▶ Client and server are two computers behaving like a customer and service person in a hotel desk.
- ▶ Both the client and the server have a unique IP address (to locate the computer on the network) and Port number (to identify the program which communicates over the network).
- ▶ The sets of $\{IP_{client}, Port_{client}\}$ and $\{IP_{server}, Port_{server}\}$ are called half associations.
- ▶ Taken together, the IP and port data of client and server ($\{IP_{client}, Port_{client}\}$ and $\{IP_{server}, Port_{server}\}$) form a full association.
- ▶ On getting connected, the client places a request to the server to get some job done (like the customer placing an order to the service person in a hotel desk).

Client Server computing

- ▶ The server gets any additional data required for processing, completes the job and delivers the result to the client (like the service person in a hotel desk offering the food items ordered by the customer).
- ▶ The client side half association $\{IP_{client}, Port_{client}\}$ is called client **socket**.
- ▶ The server side half association $\{IP_{server}, Port_{server}\}$ is called server **socket**.
- ▶ As a real world example, www.google.com is a server and the user computer accessing it is a client.
- ▶ The server awaits the arrival of a client request, completes the request and keeps waiting for clients (called listening).
- ▶ The client and server might use Transmission Control Protocol (TCP) for error free transmission of sensitive data (like bank transactions, email, etc.).
- ▶ The client and server might use User Datagram Protocol (UDP) for fast communication with some errors (like video sharing, audio sharing) where small errors are permissible.

Peer to peer networking

- ▶ Peer to peer communication takes place between two computers connected on an equal status (unlike client and server).
- ▶ Peer to peer communication helps to share files and folders.
- ▶ Peer to peer communication helps in the easy sharing of printers and scanners.
- ▶ Peer to peer communication has the limitation of not permitting connection to any external network.

Proxy server, Firewall and Proxy Firewall

▶ **Proxy servers**: Proxy servers run as the intermediary between actual server and the client. The proxy server helps in content filtering and load balancing of web servers.

▶ **Firewall**: Firewall separates a small network from the Internet. It scrutinizes all incoming and outgoing data and prevents communication of harmful data.

▶ **Proxy Firewall**: Proxy Firewall is an improvement to the actual firewall and provides security at deeper levels (layer 7 of the 7 layer OSI model) of communication than the firewall. Proxy firewall separates a small network from the Internet. It scrutinizes all incoming and outgoing data and prevents communication of harmful data.
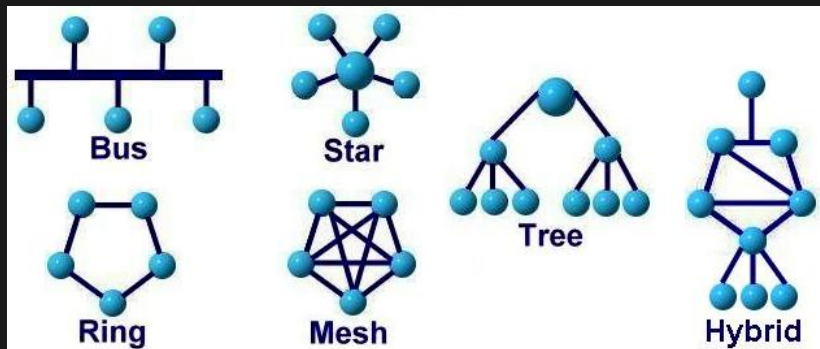
Network Topologies

Figure: Network topologies [70]

Network Topologies (Fig.57)[70]

(i) **Bus topology**: Bus topology provides a single linear network cable to which all other nodes are connected.

(ii) **Star topology**: Star topology provides single central node through which all other nodes communicate with each other.

(iii) **Ring topology**: Ring topology ends where it began, all computers/ nodes connected to the endless ring.

(iv) **Mesh topology or Fully connected topology**: Mesh topology or fully connected topology has direct connection between all computers connected to the network. It offers speed by it is costly.

(v) **Tree topology**: Tree topology allows each node of the network to divide/ diverge into 2 separate connections, each new node dividing till the end of network is reached.

(vi) **Hybrid topology**: Hybrid topology allows different portions of the network to adopt different topologies (like tree, mesh, ring, etc.), with each topology connected to the other.

Network types

(i) **PAN - Personal Area Network**: Tiny network running inside a few rooms of a building, typically created using Bluetooth technology, is called Personal Area Network (PAN).

(ii) **LAN - Local Area Network**: Small network running inside a building is called Local Area Network (LAN).

(iii) **CAN - Campus Area Network**: The network consisting of several LANs located inside the campus, typically inside a University or College, is called Campus Area Network (CAN).

(iv) **MAN - Metropolitan Area Network**: A network larger than a LAN, running across several buildings in a geographical area (or a small city) is called Metropolitan Area Network (MAN)

(v) **WAN - Wide Area Network**: The network spread over a large area, interconnecting several LANs and MANs is called Wide Area Network (WAN).

Networking hardware

(i) **Gateway**: Gateway converts speeds, protocols and speeds between heterogeneous networks.

(ii) **Router**: Router forwards data packets to other routers. Each router commands the traffic between different networks.

(iii) **Hub**: Hub transmits data between computers connected in a LAN. Hub simply receives a data packet and forwards the data to all other computers connected to the network, whether the data is addressed to a computer or not. Hub results in inefficient data transmission.

(iv) **Switch**: Switch is a device which transmits data received from one node to just those computers which are meant to receive the data. It results in efficient data transmission.

(v) **Bridge**: Bridge is a device which connects several networking segments.

(vi) **Repeater**: Repeater receives a signal which is weak and transmits the same at full energy to increase the range of the signal.

(vii) **MODEM**: MODEM stands for MODulation DEModulation

Networking hardware

Figure: Networking hardware [71]

Networking cables

(i) **Unshielded Twisted Pair (UTP) Cable**: 4 pairs of cables twisted together and usually connected through RJ45 is called twisted pair. CAT 5e and CAT 6 cables are common twisted pair cables.

(ii) **Shielded Twisted Pair (STP) Cable**: When each cable of twisted pair is individually shielded using metal foil and the entire set of cables is collectively shielded, the cable is called shielded twisted pair. This type of cable is less susceptible to electromagnetic interferences.

(iii) **Coaxial Cable**: A copper core surrounded by plastic insulation and a metal hood is called coaxial cable. Provides fast data transmission and long range.

(iv) **Fiber Optic Cable**: Glass fibre core surrounded by plastic insulation and a metal core is called fire optic cable. It provides very high speed, very long range and very low loss of energy during transmission. Fibre optic cable is not affected by electromagnetic disturbances.

Networking cables

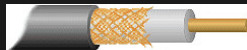Figure: Unshielded and Shielded twisted pair [72]

Figure: Coaxial cable [73]

Figure: Coaxial cable [74]

Wireless communication

(i) **NFC - Near Field Communication**: It works between two mobile devices when gently touching each other. Used for payment at PoS and pairing of bluetooth devices.

(ii) **Bluetooth**: Bluetooth is a wireless communication technology with connection range of 40m to 400m under bluetooth version 4.

(iii) **WiFi - Wireless Fidelity**: WiFi is a technology for fast data transmission within a range of 100m. Mobile devices have to pair to a WiFi hotspot to enable data transmission.

Ethernet

- ▶ Ethernet provides a unique physical address to the computer or any connected device.
- ▶ The physical address in ethernet (RJ-45 port) is called Media Access Control (MAC) address.
- ▶ When a computer joins a network, the MAC address is linked to an Internet Protocol (IP) address.
- ▶ The MAC to IP mapping lasts till the termination of connection.
- ▶ Data communication over the network is governed by the Open System Interconnection (OSI) 7 layer model.
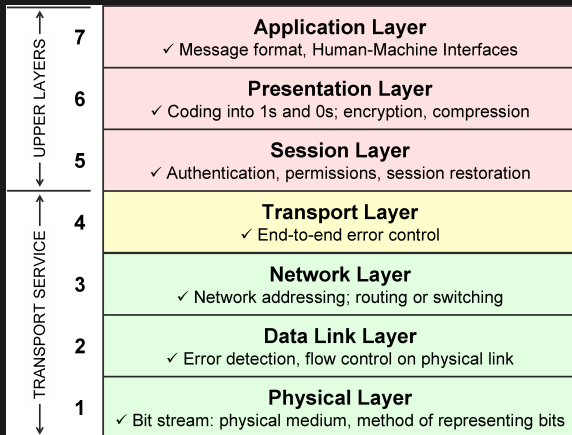
OSI 7 layer model

Figure: OSI 7 layer model [75]

Network protocols

- ▶ Protocol is a set of rules for transmission of data across the network and communication between client and server.
- ▶ **IP**: Internet Protocol (IP) is the procedure used for transmission of data by routing of data packets from one host to another. Each host connected to a network is assigned a unique ID called IP Address.
- ▶ **TCP/IP**: Transmission Control Protocol (TCP) over Internet Protocol (IP): TCP divides large data into smaller packets, assigns sequence number to the packet, transmits the data through IP layer, received the packets at the remote host, receives acknowledgement from the remote host, allows reassembling of data packets at the remote host. TCP is an error free protocol for transmission of data. It is a bit slow compared to User Datagram Protocol. TCP requires a dedicated connection.

Network protocols

- **UDP/IP**: User Datagram Protocol (UDP) over Internet Protocol (IP) divides data packets into smaller packets. UDP packets, called datagram packets, are transmitted over the IP network. UDP applies checksums to verify integrity of data packets. But, it does not care to verify whether all data packets were received by the remote host. UDP is fast but unreliable. UDP is adopted by streaming audio and streaming video channels on the Internet. UDP is not suitable for financial accounting applications like core banking (where reliability is required).

- **Telnet**: Telnet is a protocol working on of TCP/IP to login and control a remote computer over the Internet. Telnet works on port number 23. It permits logging in to a computer through the Internet.

Network protocols

- **File Transfer Protocol (FTP)**: File Transfer Protocol (FTP) helps in the transfer of large files between local and remote hosts over the Internet. Port number 21 is used for FTP control sequences and port number 20 is used for data transfer.

- **Simple Mail Transfer Protocol (FTP)**: Simple Mail Transfer Protocol (FTP) is used for transfer of email between local host and remote host. Port number 25 is used SMTP. The Interim Mail Access Protocol (IMAP) uses port number 143, Post Office Protocol version 2 (POP2) uses port 109 and POP3 uses port number 110. Email transmission over Secure Socket Layer (SSL) uses port number 993.

Logical and physical addresses

- ▶ Logical address is the IP address assigned to a host when it is connected to a network.

- ▶ Physical address is the address of the networking hardware (like ethernet adapter). It is also called the Media Access Control (MAC) address.

- ▶ The mapping of a logical address to a physical address is called address binding.

Dynamic Host Configuration Protocol (DHCP)

- ▶ When a Local Area Network (LAN) is implemented, each new host connected to a LAN requires a unique IP address.
- ▶ Instead of assigning a static IP address to each host, the DHCP assigns a new IP for each connected host.
- ▶ DHCP claims back unused IP addresses and reuses the address, thus leading to efficient use of the addressing system.
- ▶ DHCP maintains a free pool of assignable IP addresses for new hosts connected to the network.

Internet

- ▶ The global network of networks is called Internet.
- ▶ Internet supports several modes of data exchange, like Hyper Text Transfer Protocol (HTTP), Hyper Text Transfer Protocol over Secure Socket Layer (HTTPS), File Transfer Protocol (FTP), Simple Mail Transfer Protocol (SMTP), Voice Over Internet Protocol (VOIP), etc.
- ▶ Internet supports many communication protocols like TCP/IP and UDP/IP.
- ▶ Internet originated through a United States Government project called ARPANET (Advanced Research Projects Agency Network) created in 1969.
- ▶ All nodes connected to the Internet share the Internet Protocol (IP).
- ▶ Internet works on the principle of Packet Switching, which means information packets are transmitted and received through various hardware and software components of the Internet till they reach the destination.
- ▶ Each Packet has a TTL (Time To Live), which is the duration

Introduction to WWW

- The WWW (World Wide Web) is governed by W3C (World Wide Web Consortium).
- WWW works through Hyper Text Transfer Protocol (HTTP) and Hyper Text Transfer Protocol over Secure Socket Layer (HTTPS) on top of the TCP/IP protocol stack.
- Web pages are created using Hyper Text Markup Language (HTML).
- WWW was invented by Tim Berners Lee at the CERN labs, Geneva.
- Hyper text helps to create navigational links called hyper links.
- Each web address is called a URL (Uniform Resource Locator).
- Each website has a web server which shares its data with clients.
- Web clients are called browsers.
- First web browser was called WorldWideWeb and was created by Tim Berners Lee.

Web browser

- Web browser receives data from a web server and renders the same on the screen of the client machine.
- First web browser was called WorldWideWeb and was created by Tim Berners Lee.
- Most popular web browsers are Firefox, Google Chrome, Opera, Microsoft Edge, Apple Safari, etc.
- Browsers like Netscape navigator, Internet Explorer are dead for all practical purposes.
- Web browser essentially renders the text, images, video and animations from a web page.
- The address bar of the web browser can be opened using the shortcut Ctrl+L.
- Normally, pressing Ctrl+S saves the web page, Ctrl+P prints the web page, Ctrl+T opens new tab, Ctrl+Page Up/ Ctrl+Page Down navigate through tabs.

Internet server and search engine

- ▶ Internet server is a software that sends pages requested through URL.
- ▶ The data sent by the web server is rendered by the web browser.
- ▶ Web server usually runs on port number 80 (HTTP) and port number 443 (HTTPS).
- ▶ Apache web server is the most popular open source web server.
- ▶ Microsoft IIS (Internet Information Server), nginx, GWS (Google Web Server), etc. are some of the most common, commercially supported web servers.
- ▶ At hardware level, a computer hardware that helps the running of web server software is also called a web server.
- ▶ Rack mounted servers with option for inserting or removing server machines is most common in the server industry.

Domain Name System (DNS)

- ▶ Domain Name System (DNS) is the convention used for naming URL.
- ▶ Different components of URL are separated by dot (.).
- ▶ The URL labels identify the owner of the domain (e.g., google, yahoo, rediff, microsoft, etc.), the type of organization (e.g., .com for commercial ventures, .edu for educational Institutions, .org for organizations, .in for Indian domains, etc.)
- ▶ Domain names are mapped to an IPV4 or IPV6 address.
- ▶ Address Resolution Protocol (ARP) is used by servers which take human readable address and send back IP address.
- ▶ Reverse Address Resolution Protocol (RARP) is used by servers which take IP address and send the human readable address in return.
- ▶ DNS helps the conversion between names and IP addresses.

Email

- ▶ The system for electronic transmission of text and documents over a network from the sender to recipient is called email.
- ▶ Email servers use port numbers 25 - SMTP (Simple Mail Transfer Protocol), 109 - POP2 (Post Office Protocol 2), 110 - POP3 (Post Office Protocol 3), 993 - IMAP (Internet Message Access Protocol).
- ▶ Email clients have made it possible to access mailing system from the browser or dedicated client programs.
- ▶ Email messages are fast in message delivery.
- ▶ the most popular email servers are gmail.com, yahoo.com, rediff.com, rediffmail.com, ymail.com, icloud.com, hotmail.com, etc.
- ▶ Corporate companies have their own email servers with their own domains.
- ▶ To use email service, a person needs to register and obtain an email address from any of the email servers.
- ▶ To login, the URL of the email server should be accessed. Login credentials are the email address and password of the

Video chat tool

- ▶ Video chat tools help in sharing of live video between the caller and the receiver.
- ▶ Video chat tools like Viber, Skype, Facebook Messenger, Google Hangouts, Instagram, etc. are widely used.
- ▶ Video calling facility works through data streaming over the Internet.

Voice Over IP (VOIP)

- ▶ Voice Over Internet Protocol (VOIP) is a system for making audio calls over the Internet.
- ▶ VOIP clients bind to the mobile number of the user.
- ▶ When VOIP call is made, the recipient cannot distinguish the call from a GSM (Global System for Mobile communication) call.
- ▶ VOIP streams audio over the Internet and uses the mobile number of the caller as the identifier.

Social media networking

- ▶ Social media permits sharing of casual, usually non-commercial information with one or several other persons.
- ▶ Social media permits sharing of photos, videos, text messages, etc. over the Internet.
- ▶ Social media websites like Facebook, Twitter, LinkedIn Instagram, Skype, Hangouts, WhatsApp, Telegram, etc. are some of the most popular social media platforms.
- ▶ Social media encourages sharing of personal information and getting appreciation from the recipients.
- ▶ Social media has become one of the necessary evils of the modern society.
- ▶ Many modern day crimes relate to extracting information from innocent youngsters and women and using the same information for blackmailing the individual.
- ▶ Bullies in social media use fake identities and fake personal details to attract innocent persons.
- ▶ Each person using the social media should exercise self restraint and should not share any information which can be

Syllabus

Concepts of Static and Dynamic Web pages. Introduction to HTML and various tags in HTML. Creating Forms with controls using HTML. Concepts of CSS and applying CSS to HTML Introduction to open source CMS viz,. Joomla, Wordpress, etc. and web authoring tools viz. Kompozer,FrontPage etc.

Static web pages

- Web pages which provide fixed content in the form of text, images and video without any user interaction are called static web pages.
- Web pages which interact with the user and provide based on the actions of the user are called dynamic web pages.
- Static web pages use HTML (Hyper Text Markup Language).

Dynamic web pages

- ▶ Dynamic web page is created by scripts which result in dynamic content based on the interaction of the user.
- ▶ Dynamic web pages can be created by:
  - (i) **Server side script**: Script stored in the server and written in languages like PHP, Perl, Python, ASP.NET, etc. is called server side script. Server side scripts are useful for data storage, data retrieval, storing photos received from forms, authentication of login, managing session, etc.
  - (ii) **Client side script**: Script written in languages like JavaScript, VBScript, etc. and running inside a browser (or the client) is called client side script. Client side scripts are suitable for error checking in forms and dynamic interaction using mouse or keyboard.
- ▶ A combination of client side and server side scripting will render a web page highly attractive and useful.

HTML tags

All HTML tags have a corresponding closing tag. Some tags might not have a closing tag with end with $/>$ symbol.

- **HTML**: All HTML files begin with $<HTML>$ and end with $</HTML>$.
- **HEAD**: The title and meta information of a HTML file are entered inside a pair of $<HEAD>$ and $</HTML>$ tags.
- **TITLE**: Title of the document is enclosed inside a pair of $<TITLE>$ and $</TITLE>$ tags.
- **BODY**: All contents of the HTML file are enclosed inside a $<BODY>$ and $</BODY>$.
- **H1 to H6**: Defines various levels of headings from level 1 to level 6.
- **TABLE**: Table tag encloses a table. It has border option wherein border thickness can be specified. TH tag defines table header, TD defines table column and TR defines table row.
- **P**: defines a paragraph.

HTML tags

- **INPUT**: Input tag can have several type options (like text, date, email, number, etc.), a name, an ID and other attributes like readonly if necessary.
- **SELECT** Select tag displays a combo box with various options enclosed inside OPTION tags. Each option would have a value property.
- **OL**: Ordered list. Each list item is defined by LI tag.
- **UL**: Un-ordered list. Each list item is defined by LI tag.
- textbfFORM: The contents enclosed inside a FORM tag can be submitted to a server side script for data storage and be accessed by a client side script for validation of input. It has options for ACTION, METHOD (POST or GET), etc.
- **SUBMIT**: Submit button completes form data entry and sends the data to specified URL.
- **RESET**: Reset button clears all entries from a form and provides a blank form.

HTML tags

- ▶ **BUTTON**: Displays a button with specified name, text and ID.
- ▶ **A**: Anchor tag for hyper text linking. HREF option takes the URL to be loaded when the link is clicked.
- ▶ **B**: BOLD tag.
- ▶ **FONT**: specifies name, color and size for font.
- ▶ **IMG**: IMS tag loads an image specified by the SRC option.
- ▶ **CENTER**: Centre aligns text and objects.
- ▶ **SPAN**: A place holder with an ID and name.
- ▶ **MARQUEE**: Marquee tag displays scrolling message, as seen at the bottom of television display.

Special characters in HTML

Table: Special characters in HTML

code	char	code	char	code	char	code	char
"	"	#	#	$	$	%	%
&	&	'	'	(	(	)	)
*	*	+	+	,	,	−	-
.	.	/	/	:	:	;	;
<	<	=	=	>	>	?	?
@	@	[	[	\	\	]	]
^	^	_	_	`	`	{	{
}	}	|	—	˜	~	α	α
β	β	γ	γ	δ	δ	π	π
θ	θ	φ	ϕ	ψ	ψ	ω	ω

Creating HTML pages

- ▶ HTML pages can be edited using text editor (notepad, gedit, etc.) or can be edited using specialized tools like Dreamweaver, Komposer, etc.
- ▶ The HTML files should be previewed in a browser (like Firefox, Google Chrome, Edge, Safari, Opera, etc.).
- ▶ Firefox browser provides a debugging tool to spot errors through Developer Console (shortcut: Ctrl+Shift+K).
- ▶ Some of the special characters used in HTML are tabulated in Table 7.
- ▶ Sample HTML pages and their results are presented in the following subsections.

Static information page

```html
<html>
<head>
<title>
My Intro Page
</title>
<style>
p {
text-align:justify;
font-size:240%;
font-style:bold;
font-weight:bold;
color:blue;
text-indent:10mm
}
</style>
</head>
<body>
<h1 style="color:red; text-align:center;font-size:300%">
Welcome to my introduction page: Your name
</h1>
<p>
My name is .... I am studying COPA trade in Govt. ITI for Women, Puducherry. I am preparing for first semester
examination. The examination starts on 29-Jan-2018.
</p>
<p>
The second semester starts on 01-02-2018.
</p>
</body>
</html>
```

Welcome to my introduction page: Your name

My name is .... I am studying COPA trade in Govt. ITI for Women, Puducherry. I am preparing for first semester examination. The examination starts on 29-Jan-2018.

The second semester starts on 01-02-2018.

Figure: Intro page in HTML

Creating ordered and unordered lists

```html
<html>
<head>
<title>
List of computer peripherals
</title>
<style>
h1{text-align:center; color:blue}
ol {font-size:120%; color:red}
</style>
</head>
<body>
<h1>List of computer peripherals</h1>
<ol>
<li>Monitor</li>
<li>Keyboard</li>
<li>Mouse</li>
<li>Printer
<ul>
<li>Line matrix printer</li>
<li>Daisy wheel printer</li>
<li>Golf ball printer</li>
<li>Dot matrix printer</li>
<li>Inkjet printer</li>
<li>LASER printer</li>
<li>Thermal printer</li>
<li>Dot matrix printer</li>
</ul>
</li>
<li>Scanner</li>
</ol>
</body>
</html>
```

Figure: List page in HTML

Creating table

```
<html>
<head>
<title>Ice creams</title>
<style>
h1{color:green; text-align:center}
th {vertical-align:middle; text-align:centre; font-weight:bold; background:lightgreen; color:red; font-size:120%}
#odd {vertical-align:middle; text-align:centre; font-weight:normal; background:#FFBBBB; color:blue;
font-size:120%}
#even {vertical-align:middle; text-align:centre; font-weight:normal; background:#BBBBFF; color:red;
font-size:120%}
</style>
</head>
<body>
<h1>Types of ice cream (<your name>)</h1>
<span align="center">
<table border=1>
<tr><th>Sl. No.</th><th>Name</th><th>Cream</th><th>Rate</th></tr>
<tr id="odd"><td>1</td><td>Dessert</td><td><img width=20%
src="ice-creams/01-dessert.jpg"></td><td>Rs.120/-</td></tr>
<tr id="even"><td>2</td><td>Cone</td><td><img width=20%
src="ice-creams/02-cone.jpg"></td><td>Rs.60/-</td></tr>
<tr id="odd"><td>1</td><td>Chocolate</td><td><img width=20%
src="ice-creams/03-chaco.jpg"></td><td>Rs.90/-</td></tr>
<tr id="even"><td>4</td><td>Cone</td><td><img width=20%
src="ice-creams/04-strawberry.jpg"></td><td>Rs.100/-</td></tr>
</table>
</span>
</body>
</html>
```

Figure: Table page in HTML

Cascading Style Sheet (CSS)

- ▶ A text file containing style properties is called Cascading Style Sheet (CSS).
- ▶ CSS defines how
- ▶ The cascading sheet sheet can be linked to a HTML file at the header section.
- ▶ The following tag helps to insert a CSS sheet:
  <**link rel="stylesheet" type="text/css" href="**<**style-sheet**>**.css"**>
- ▶ The following subsection shows the appearance of HTML file with different CSS linkages.
- ▶ Styles may be specified in any one of the following methods:
  - (a) **Inline style**: Specifying style just inside the tag is called inline style specification. e.g., <h1 style="color:#FF0000;text-align:center;background-color:#0000FF">Heading</h1> specifies that text should be red in color, alignment should be centred and background should be blue.

Red color theme with style sheet

```html
<html>
<head>
<title>Red style</title>
<link rel="stylesheet" type="text/css" href="red.css">
</had>
<body>
<h1>Ridge TV Channel</h1>
<marquee>
Breaking news
          &n
Nothing new under the Sun!
          &n
Keep your cool!!
</marquee>
</body>
</html>
```

Red color theme with style sheet

```
body {
background-color: #222277;
font-size: 300%;
color: #FF0000
}
h1 {
color: #FF0000;
text-align: center
}
marquee {
background-color: #0000FF
}
```

Green color theme with style sheet

```
<html>
<head>
<title>Green style</title>
<link rel="stylesheet" type="text/css" href="green.css">
</had>
<body>
<h1>Ridge TV Channel</h1>
<marquee>
Breaking news
          &n
Nothing new under the Sun!
          &n
Keep your cool!!
</marquee>
</body>
</html>
```

Green color theme with style sheet

The green.css file is shown below:

```
body {
background-color: #222266;
font-size: 300%;
color: #00FF00
}
h1 {
color: #00FF00;
text-align: center
}
marquee {
background-color: #0000FF
}
```

CSS Property elements

1. **align-content**: Align content to left, right or center.
2. **background**: Specifies background color (Color is specified in #000000 (black) #FFFFFF (white). First 2 digits represent red, second 2 digits represent green and third 2 digits represent blue. Each digit can change from 0 to F under hexadecimal system).
3. **background-color**: Specifies background color (Color is specified in #000000 (black) #FFFFFF (white). First 2 digits represent red, second 2 digits represent green and third 2 digits represent blue. Each digit can change from 0 to F under hexadecimal system).
4. **border**: size, type (solid, dotted, dashed, double dashed) and color of border.
5. **color**: Color of element.
6. **font-style**: Font style may be italic, normal, oblique.
7. **font-weight**: may be normal, bold, bolder, lighter (number 400 is normal, 700 is bold).
8. **font-size**: Font size may be specified in pixels (e.g. 24px) or

Creating HTML forms

- Forms begin with the $<$form$>$ tag and end with $</$form$>$ tag.
- Action property of form refers to the URL to be invoked when the form is submitted.
- Method property of form submission may be GET or POST.
- Input type of "submit" may be used to submit data to the specified action URL.
- Input type of "reset" may be used for clearing all changes to the form.
- Some simple forms to calculate sum, difference, product, quotient, age and power are presented in the following sections.

HTML form for greeting

HTML form to greet a person is presented in the following HTML code:

```html
<html>
<head>
<title>Enter your name</title>
<link rel="stylesheet" type="text/css" href="red.css">
</head>
<body>
<h1>Name form</h1>
<form name="nameForm" action="#" method="POST">
<center>
<table border=0>
<tr><td>Name</td><td>:</td><td><input type="text" name="n"
placeholder="Name"></td></tr>
</table>
<input type="submit" value="Greeting" onClick="alert('Welcome '+n.value)">
</center>
</form>
</body>
</html>
```

HTML form for addition

HTML form to add 2 numbers:

```html
<html>
<head>
<title>Add numbers</title>
<link rel="stylesheet" type="text/css" href="red.css" >
</head>
<body>
<h1>Add form</h1>
<form name="addForm" action="#" method="POST" >
<center>
<table border=0>
<tr><td>Enter x</td><td>:</td><td><input type="text" name="x" ></td></tr>
<tr><td>Enter y</td><td>:</td><td><input type="text" name="y" ></td></tr>
<tr><td colspan=3 style="text-align:center" ><input type="button" value="Add" onClick="z.value =
Number(x.value) + Number(y.value)" ></td></tr>
<tr><td>Result</td><td>:</td><td><input type="text" name="z" readonly></td></tr>
</table>
</center>
</form>
</body>
</html>
```

HTML form for subtraction

HTML form to subtract a number from another numbers:

```html
<html>
<head>
<title>Subtract numbers</title>
<link rel="stylesheet" type="text/css" href="red.css">
</head>
<body>
<h1>Subtract form</h1>
<form name="subForm" action="#" method="POST">
<center>
<table border=0>
<tr><td>Enter x</td><td>:</td><td><input type="text" name="x"></td></tr>
<tr><td>Enter y</td><td>:</td><td><input type="text" name="y"></td></tr>
<tr><td colspan=3 style="text-align:center"><input type="button" value="Subtract" onClick="z.value =
Number(x.value) - Number(y.value)"></td></tr>
<tr><td>Result</td><td>:</td><td><input type="text" name="z" readonly></td></tr>
</table>
</center>
</form>
</body>
</html>
```

HTML form for multiplication

HTML form to multiply 2 numbers:

```html
<html>
<head>
<title>Multiplication form</title>
<link rel="stylesheet" type="text/css" href="red.css">
</head>
<body>
<h1>Multiply form</h1>
<form name="mulForm" action="#" method="POST">
<center>
<table border=0>
<tr><td>Enter x</td><td>:</td><td><input type="text" name="x"></td></tr>
<tr><td>Enter y</td><td>:</td><td><input type="text" name="y"></td></tr>
<tr><td colspan=3 style="text-align:center"><input type="button" value="Multiply" onClick="z.value =
Number(x.value) * Number(y.value)"></td></tr>
<tr><td>Result</td><td>:</td><td><input type="text" name="z" readonly></td></tr>
</table>
</center>
</form>
</body>
</html>
```

HTML form for division

HTML form to divide a number by another numbers:

```html
<html>
<head>
<title>Division of numbers</title>
<link rel="stylesheet" type="text/css" href="red.css" >
</head>
<body>
<h1>Division form</h1>
<form name="divForm" action="#" method="POST" >
<center>
<table border=0>
<tr><td>Enter x</td><td>:</td><td><input type="text" name="x" ></td></tr>
<tr><td>Enter y</td><td>:</td><td><input type="text" name="y" ></td></tr>
<tr><td colspan=3 style="text-align:center" ><input type="button" value="Divide" onClick="z.value =
Number(x.value) / Number(y.value)" ></td></tr>
<tr><td>Result</td><td>:</td><td><input type="text" name="z" readonly></td></tr>
</table>
</center>
</form>
</body>
</html>
```

HTML form to calculate age

HTML form to calculate age:

```html
<html>
<head>
<title>Age calculation</title>
<link rel="stylesheet" type="text/css" href="green.css">
</head>
<body>
<h1>Age calculation</h1>
<form name="ageForm" action="#" method="POST">
<center>
<table border=0>
<tr><td>Enter DOB</td><td>:</td><td><input type="date" name="dob"></td></tr>
<tr><td colspan=3 style="text-align:center"><input type="button" value="Age" onClick="res.value = (new
Date(Date.now() - new Date(dob.value).getTime()).getUTCFullYear()-1970)"></td></tr>
<tr><td>Age</td><td>:</td><td><input type="text" name="res" readonly></td></tr>
</table>
</center>
</form>
</body>
</html>
```

HTML form to calculate power of a number

HTML form to calculate power of a number:

```html
<html>
<head>
<title>Power</title>
<link rel="stylesheet" type="text/css" href="green.css">
</head>
<body>
<h1>Power form</h1>
<form name="powForm" action="pow.php" method="POST">
<center>
<table border=0>
<tr><td>Enter x</td><td>:</td><td><input type="text" name="x"></td></tr>
<tr><td>Enter y</td><td>:</td><td><input type="text" name="y"></td></tr>
<tr><td colspan=3 style="text-align:center"><input type="submit" value="Power"> <input type="reset"
value="Reset"> </td></tr>
</table>
</center>
</form>
</body>
</html>
```

PHP script to calculate power of a number

PHP script to calculate power of a number:

```php
<?php
$x = $_POST['x'];
$y = $_POST['y'];
$z = pow($x, $y);
echo $x . " ^ " . $y . " = " . $z;
?>
```

Syllabus
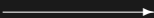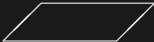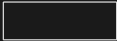
Introduction to Web Servers and their features. Introduction to Programming and Scripting Languages. Introduction to JavaScript and its application for the web. JavaScript Basics – Data types, Variables, Constants. Conversion between data types. The Arithmetic, Comparison, Logical and String Operators in JavaScript. Operator precedence. Arrays in JavaScript – concepts, types and usage. Program Control Statements and loops in JavaScript. Introduction to Functions in JavaScript. Built in JavaScript functions overview. The String data type in JavaScript. Introduction to String, Math and Date Functions. Concepts of Pop Up boxes in JavaScript. Introduction to the Document Object Model. Concepts of using Animation and multimedia files in JavaScript.

Algorithms

1) The sequence steps taken to solve a problem is called an algorithm.

2) Algorithm helps to create computer program for problem solving.

Flowcharts

1) Graphical representation of the step by step solution of a problem is called flowchart.
2) Flowchart symbols and their purposes are given below:

1		Oval	Start or End of flowchart.
2		Circle	Connector - Indicates flowchart continues where a matching name or number is found.
3		Arrow	Indicates flow direction.
4		Parallelogram	Input or output.
5		Rectangle	Processing
6		Rhombus	Decision making (conditions - if/ switch, loops - for/while).

Introduction to web servers

1. Web server sends HTML pages in response to request from client. Web server uses Hyper Text Transfer Protocol (HTTP).
2. Web server uses port number 80 for general data exchange and port number 443 for data exchange over Secure Socket Layer (SSL).
3. Scripts executed by the webserver are called server side scripts.
4. PHP, Perl, Python and ASP.NET are some of the programming languages used for server side scripting.
5. Some scripts embedded in HTML pages are executed by the browser. The scripts executed on browser are called client side scripts.
6. Javascript and VBScript are some of the most common client side scripting languages.
7. Microsoft Internet Information Server (IIS), Apache httpd, ngingx, Google Web Sever (GWS) and IBM Websphere are some of the most common web servers.

Features of web server

1. Port numbers 80 and 443 are used by web servers.
2. Web address is called Uniform Resource Locator (URL).
3. URL parts are separated by forward slash (/) symbol.
4. If a URL begins with http:// the communication takes place on port number 80 and it is unsecure.
5. If a URL begins with https:// the communication takes place on port number 443. Secure Socket Layer (SSL) protocol is used to prevent data intrusion.
6. The last part of a web URL is the name of the file.
7. A folder named 'htdocs' or 'wwwroot' serves as the root directory of the web server.

Compiler based programming languages

1. The human readable program is called source code.

2. A special program called compiler converts the source code to machine readable binary code.

3. A source code should follow certain formatting details, called syntax, if the program should be successfully compiled.

4. Compiler detects errors and converts/ translates the code only if the entire program has correct syntax.

5. Since compilation is done only once, the time spent on removing syntax and logical errors (called debugging) does not affect the time required for running on a computer.

6. After compilation, machine code runs very fast on a computer.

7. Assembly language, C, C++, Java, C#, etc. are some of the most popular compiled languages.

8. Compiler based languages are very strict about syntax and data types.

Interpreter based programming languages

1. Interpreter is a special program to translate few lines of source code, load it to the processor based on program flow.

2. Interpreted programs are slower than compiled programs.

3. Interpreted programming languages enforce liberal syntax (they forgive some deviations) and have less stringent data types.

4. Interpreted programs are easier and faster to develop for small projects.

5. The liberal nature of interpreted programming languages permits more errors and more complications for large programs.

6. A class of languages suitable for embedding inside a larger program are called scripting languages.

7. Javascript, Perl, Python, Unix/Linux shell script, etc. are some of the most popular scripting languages.

Javascript

1. Javascript loosely follows the syntax of Java programming language.
2. Javascript is embedded inside HTML code.
3. A Javascript function is embedded inside a pair of $< script >$ $< /script >$ tags.
4. The script tag begins with one or both of the following attributes: type="text/javascript" and language="javascript".
5. Javascript can be used as a procedural language (only functions are permitted) or as an Object oriented language (new data types called classes are permitted).
6. Each line of Javascript code ends with a semi-colon (;), unless it begins a new block using curly brace({).
7. Javascript runs inside a browser.
8. Script can be written within the HTML file itself or in an external file (with .js extension).
9. External script file (say welcome.js) may be embedded using src attribute of script tag.

Comments in Javascript

1. Comments in Javascript can cover single line or multiple lines.
2. Single line comments start with // symbol and run till the end of the line in which it is placed. For example,
   x*=2; //current value of x is doubled.
   //The following code calcualtes age of a person.
   are examples of single line comment.
3. Multiple line comment starts with /∗ and ends only when ∗/ is found. For example,
   /∗
   The following lines are ignored by the browser.
   x+=5;
   y=Math.pow(x,2);
   ∗/
   is an example of multi-line comment.
5. Commented portions are ignored by the browser.
6. Comments help the programmer to understand the meaning of code at a later date.

Application of Javascript for web

1. Javascript can be embedded in HTML code.
2. Support for Javascript is available in all the modern web browsers.
3. Javascript methods can be easily invoked through onClick property of a button.
4. Javascript can be used to dynamically interact with the user of a web page.
5. Since Javascript is executed inside a browser, the danger of malware spreading to the system through the script is very low.

Data types in Javascript

1 Javascript supports the following primitive (basic level) data types:

Sl. No.	Primitive type	Description
1	String	A sequence of characters is called a String. e.g., " It is enclosed in double quotes.
2	Number	Any numerical value, whether integer or floating po Number.e.g. 3, 6.23.
3	Boolean	Contains the result of a logical expression. e.g., true
4	Undefined	When a variable is undeclared, it is categorized as und
5	NULL	It signifies the absence of any specific value.

Data types in Javascript

2 Javascript supports non-primitive data types called Object
(reference type objects).

Sl. No.	Non-Primitive	Description
1	Object	Represents the basic reference type. New data ty Javascript may be defined using function itself.
2	Array	Array represents a collection of indexed values. var num=new Array("Zero","One", "Two", "Th alert(num[2]); displays Two in the alert dialog.
3	RegExp	Regular expression used for manipulation of strings.

Variables and constants in Javascript

1 A variable represents a memory location in which values can be stored and retrieved.

2 Javascript variable names must start with alphabets (A-Z or a-z) or underscore (_) or dollar symbol ($).

3 Numbers can be used in variable names anywhere except the first location.

4 Variable declaration starts with the keyword *var*. e.g., var $x=1,y=3,_z;

5 Javascript variables are case sensitive. i.e., var a=10, A=20; declares two different variables named *a* and *A*.

6 A variable declared outside the scope of any function is called a **global variable**.

7 If a declaration starts with the keyword *const* instead of *var*, the variable so declared can be assigned a value only once. e.g., const PI=3.14159625; will make PI a constant. New values assigned to it (like PI=1;) will fail.

Conversion between data types

1. Data of any type (e.g. "25.67") can be converted to number using the **Number()** function (e.g., x=Number("25.67");)

2. Data of any type can be converted to String using **String()** function (e.g. str=String(23.23);).

3. Data of any type can be converted to Boolean type (true or false) using **Boolean()** function.

4. The **typeof** operator helps to determine the data type of a variable. e.g.,
   var name="Desiga", mark=95; alert(typeof name);
   alert(typeof mark);
   displays String and Number as the data types respectively.

5. **NaN** is a special number which indicates a value too large for storage in number type (like ∞).

6. **null** is another data type stored in a variable when there is no value in a variable.

7. var x; alert(typeof x); displays that x is undefined.

Arithmetic Operators in Javascript

1 Javascript provides operators for basic operations like Division, Multiplication, Addition, Subtraction, etc.

Table: List of arithmetic operators in Javascript

Sl. No.	Airthmetic Operator	Purpose	Example	Precedence
1	**	Exponentiation	$x = 10/2;$ // x value is 2.	1
2	*	Multiplication	$x = 10 * 2;$ // x value is 20.	2
3	/	Division	$x = 10/2;$ // x value is 2.	3
4	%	Modulo Remainder	$x = 10\%4;$ // x value is 2.	4
5	+	Addition	$x = 10 + 2;$ // x value is 12.	5
6	−	Subtraction	$x = 10 - 2;$ // x value is 8.	6
7	++	Increment	$x = 10; x + +;$ // x value is 11.	7
8	−−	Decrement	$x = 10; x - -;$ // x value is 9.	8

Assignment Operators in Javascript

1 Javascript provides assignment operators to assign the results of mathematical expression to variables.

Table: List of assignment operators in Javascript

Sl. No.	Assignment Operator	Purpose	Example	Precedence
1	$=$	Assignment	$x = 10;$ // x value is 10.	1
2	$+ =$	Add and Assign	$x = 10; x+ = 4;$ // x value is 14.	2
3	$- =$	Subtract and Assign	$x = 10; x- = 4;$ // x value is 6.	3
4	$* =$	Multiply and Assign	$x = 10; x* = 4;$ // x value is 40.	4
5	$** =$	Take power and Assign	$x = 2; x** = 4;$ // x value is 16 ($\because 2^4 = 2x2x2x2 = 16$).	5
6	$/ =$	Divide and Assign	$x = 10; x/ = 4;$ // x value is 2.5	6

Comparison operators in Javascript

1. Comparison operators compare the left and right side results based on Boolean logic (true or false) results. List of comparison operators is shown in Table 10.

Table: Comparison operators in Javascript

Sl. No.	Operator	Purpose
1	==	Equal to (ignore data type. e.g., "20"==20 gives true as the result, since data types are not considered.)
2	===	Equal to (compare data type and value. "20" === 20 is false.)
3	! =	Not equal to. Ignore data type.
4	! ==	Not equal to. Gives true result only when the data type and value are identical.
5	>	Greater than.
6	>=	Greater than or equal to.
7	<	Less than.
8	<=	Less than or equal to.

Logical operators in Javascript

1. Logical operators help to combine the results of several logical operations (AND, OR, NOT, etc.) based on Boolean logic. Table 11 shows the logical operators used in Javascript.

Table: Logical operators in Javascript

Sl. No.	Operator	Purpose
1	&&	Logical AND.
2	|||	Logical OR.)
3	!	Logical NOT operator (Negation).

Special operators in Javascript

1 Following are some of the uncategorized, but important operators used in Javascript (Table 12).

Table: Special operators in Javascript

Sl. No.	Operator	Purpose
1	*typeof*	Returns the data type of a variable.
2	*new*	Creates a new object.
3	? : ternary	Evaluates the logical expression to the left of ?. Executes left side of : if it is true, right side of : otherwise. e.g., $var\ x = 2; y = (x! = 2)?5 : 8;$ sets y value to 8, since the logical expression is false.
4	*instanceof*	Checks whether a variable belongs to particular data type.
5	*in*	Takes a value from an array. Used in for loops. e.g., $var\ x = \{'One', 'Two', 'Three'\}; for(var\ y\ in\ x)\ alert(y);$

String operators in Javascript

1 String class supports assignment and string concatenation operators (Table 13).

Table: String operators in Javascript

Sl. No.	Operator	Purpose
1	=	Assigns string value on the right side to a variable on the left side. e.g., var name="Gayathri".
2	+	Adds 2 strings together. *var x="COPA", y=" is great.";* *var z=x+y;* sets "COPA is great." as the value in z.
3	+=	Appends the string on right side to the variable on left side. e.g., *var x="Sun", y=" is the nearest star.";* *x+=y;* sets "Sun is the nearest star." in variable x.

Arrays in Javascript

1. Array is a collection of values in a single variable.

2. Array elements are numbered from 0 (0,1,2,3,...).

3. Each element of an array may be accessed using []. e.g.
   $x = \{3, 5, 2, 10\}$; *alert(x[1])*; displays 5.

4. In a for loop, elements of array may be accessed using index
   values (0 to n) or using *in* operator. e.g.,
   x={3,5,2,10};
   for(var i=0;i<x.length; i++)
    alert(x[i]);
   and
   x={3,5,2,10};
   for(var y in x)
    alert(x[y]);
   display all the elements array *x*.

5. Array may be declared using a pair of { } or *new Array()*;
   function.

Associative arrays in Javascript

1. Instead of accessing array elements using a numeric index, it is possible to permit some name to each element.

2. Such an array having a name for index is called an associative array or hash map.

3. An associative array may be declared in any one of the following styles:
   var x={'Tamil':92,'English':80, 'Maths':83, 'Science':87, 'Social Science':81};
   or
   var x= new Array('Tamil':92,'English':80, 'Maths':83, 'Science':87, 'Social Science':81);

4. Left side of an associative array or hash is called key and the right side is called value. e.g., in array *x*, 'Maths' is key and 83 is value.

5. Elements of associative arrays are accessed using the key. e.g., *y = x['Tamil'];* sets value of *y* to 92.

Control statements in Javascript

1. Control statements help in conditional execution of portions of code.

2. Conditional controls may be imposed using
(i)if...else condition,
(ii)switch ... case ...break condition, or
(iii)ternary operator (?:).

If ... else condition

1. The *if* condition contains a condition part. In case the condition is true, the block (enclosed by a pair of { }) immediately following *if* condition is executed.

2. An *if* condition having a single line might omit the pair of { }.

3. In case the *if* condition fails, an optional *else* block may be coded. Else may also check for a condition using an if (*else if*).

4. Else block may also omit the pair of { } if the code for it contains a single line.

Example of if condition

```html
<html>
<head>
<title>Test of if condition</title>
<script type="text/javascript" language="javascript">
function ageMessage() {
var age = this.ageForm.age.value;
if(age < 13) {
    document.write("<h1 style='color:#FF0000'>You are a kid </h1>");
    }
else if(age < 20) {
    document.write("<h1 style='color:#FF0000'>You are a teenager! </h1>");
    }
else if(age < 36)
    document.write("<h1 style='color:#FF0000'>You are young! </h1>");
else if(age < 50)
    document.write("<h1 style='color:#FF0000'>You are middle aged! </h1>");
else
    document.write("<h1 style='color:#FF0000'>You are old! </h1>");
}
</script>
</head>
<body>
<form name="ageForm">
<center>
Enter your age: <input type="number" name="age"></br />
<input type="button" value="Get message" onClick="ageMessage()">
</center>
</form>
</body>
</html>
```

How the if condition program works?

1. The if ladder first tests whether the age is less than 13. In case it is correct, the message "You are a kid!" is displayed.

2. In case the value is the first test fails (age $\geq$ 13), the else if part tests whether the age is between 13 and 19. In such a case, the message "You are a teenager!" loads.

3. In case the age is greater than or equal to 20, the third else if condition checks whether the age is less than 36. If so, the message "You are young!" is displayed.

4. In case the age is greater than or equal to 36, the third else if condition checks whether the age is less than 50. If so, the message "You are middle aged!" is displayed.

5. When all the if conditions fail, the last else is reached. It displays the message "You are old!".

Switch condition

1. Switch condition takes one argument (e.g. switch(x)).

2. It checks the input against several case values (e.g., case 2:) and executes the lines following the matching case.

3. All cases, other than the last one end with *break* keyword.

4. The last condition may be called *default* :, which handles cases not matching any of the previous ones.

```html
<html>
<head>
<title>Test of switch condition</title>
<script type="text/javascript" language="javascript">
function nameMessage() {
var name = this.nameForm.name.value;
var length=name.length;
switch(length) {
    case 1:
    case 2:
    case 3:
    case 4:
    case 5:
        document.write("<h1 style='color:#FF0000'>Very short name! </h1>");
        break;
    case 6:
    case 7:
    case 8:
    case 9:
    case 10:
        document.write("<h1 style='color:#FF0000'>Length of your name is normal! </h1>");
        break;
    case 11:
        document.write("<h1 style='color:#FF0000'>Your name is bit long! </h1>");
        break;
    default:
        document.write("<h1 style='color:#FF0000'>Your name is too long! </h1>");
    }
}
</script>
</head>
<body>
<form name="nameForm">
<center>
Enter your name: <input type="text" name="name" ></br />
<input type="button" value="Get message" onClick="nameMessage()">
</center>
</form>
```

How the switch...case program works?

1. The switch takes length of name as argument.
2. For cases 1, 2, 3, 4 and 5, it displays the message "Very short name!".
3. For cases 6, 7, 8, 9 and 10, it displays the message "Length of your name is normal!".
4. For case 11, it displays the message "Your name is bit long!".
5. As the default case ($length > 11$), it displays the message "Your name is too long!".
6. Note that cases and case groups end with *break*.
7. The last condition (default) need not have a *break*.

The ternary operator (?:)

1 A simple if ... else condition may be re-written using one liner called ternary.

2 Ternary operator has 3 parts.

3 First part of the ternary operator (to the left of ?) is the condition. The condition may be either true or false.

4 The second part of the ternary, placed to the right of ? and the left of :, is executed if the condition is *true*.

4 The third part of the ternary, placed to the right of :, is executed if the condition is *false*.

5 Consider the following lines:
$x = 25$;
$y = (x < 21)? "Good" : "Bad"$;
can you guess the value of y?

6 y has the value of "Bad", since the condition turns out to be false.

Example of ternary operator (?:)

```html
<html>
<head>
<title>Test of if condition</title>
<script type="text/javascript" language="javascript" >
function bmiMessage() {
var wt = this.bmiForm.wt.value,
    ht=this.bmiForm.ht.value/100; //Convert height from centimeter to metre.
var bmi=wt/ht/ht;
var mess="Your BMI is ";
mess += bmi<=20.3?"very good!":"very high. You need exercise!"
document.getElementById("res").innerHTML="<h1 color=#FF0000> "+mess+"</h1>";
}
</script>
</head>
<body>
<form name="bmiForm" >
<center>
Enter weight: <input type="number" name="wt" ></br />
Enter height in centi metre: <input type="number" name="ht" ></br />
<input type="button" value="Get message" onClick="bmiMessage()" >
<span id="res" > </span>
</center>
</form>
</body>
</html>
```

Loops in Javascript

1. Javascript supports 4 types of loops:
   (a) *for* loop with index value.
   (b) *for − in* loop with list of array elements.
   (c) *while* loop.
   (d) *do − while* loop.

2. For loop having index value handle only integer index.

1. Index value of *for* loop may be declared before commencement of the loop or at the loop itself. (e.g., *var i*; *for*($i = 0; i < 10; i++$) is equivalent to *for*(*var* $i = 0; i < 10; i++$)).

2. The *for* loop has 3 parts, viz., (i)initialization part, (ii)condition part, (iii)increment part.

3. The initialization part sets the initial value of index variable.

4. The *for* loop keeps running so long as the condition part (second of the three parts) is true.

5. The increment part increases or decreases value of variable. e.g., *for*(*var* $i = 0; i < 100; i++$), *for*(*var* $i = 0; i < 100; i += 2$), *for*(*var* $i = 100; i >= 0; i--$), *for*(*var* $i = 0; i < 100; ++i$), *for*(*var* $i = 0; i < 100; i += 10$) are all valid increments to the index variable of *for* loop.

6. Each of the 3 parts of *for* loop is separated by a ; (semi-colon).

7. One of more of the parts of for loop may be omitted.e.g., *var* $i = 0$; *for*(; $i < 10; i++$), *for*(*var* $i = 0; i < 10;$),

Example of for loop

```
<html>
<head>
<title>
Example of for loop
</title>
</head>
<body>
<script type="text/javascript" language="javascript">
var x = new Array(4,2,6,8,12,15,25), sum=0;
document.write("Sum of ");
for(var i=0; i<x.length; i++) {
    document.write(x[i] + (i==x.length-1?" = ":" + "));
    sum += x[i];
    }
document.write(sum);
</script>
</body>
</html>
```

for − *in* loop in Javascript

1. *for* − *in* loop is used in conjunction with arrays and lists.

2. A typical *for* − *in* loop to move through the elements of an array creates an index variable which changes value from the first index to the last.

3. The *for* − *in* loop is a convenient replacement to for loop having separate declaration, index limit checking and increment parts.

Example of *for − in* loop

```html
<html>
<head>
<title>
Example of for-in loop
</title>
</head>
<body>
<script type="text/javascript" language="javascript">
var x = new Array(4,2,6,8,12,15,25), sum=0;
document.write("Sum of ");
for(var y in x) {
    document.write(x[y] + " ");
    sum += x[y];
    }
document.write(" is "+sum);
</script>
</body>
</html>
```

Mark statement using *for − in* loop and associative array

```html
<html>
<head>
<title>
Example of for-in loop
</title>
</head>
<body>
<script type="text/javascript" language="javascript">
var x = {'Tamil':92, 'English':98, 'Maths':100, 'Science':94, 'Social':91};
var sum=0;
document.write("<center><h1>Mark statement</h1> <table border=1>");
document.write("<tr><th>Subject</th> <th>Mark</th></tr>");
for(var y in x) {
    document.write("<tr><td>"+y+"</td><td
style='text-align:right'>"+x[y]+"</td></tr>");
    sum += x[y];
    }
document.write("<tr><td style='color:#FF0000;
text-align:center'>Total</td><td style='color:#FF0000;
text-align:right'>"+sum+"</td></tr></table>");
</script>
</body>
</html>
```

While loop in Javascript

1. While loop checks a condition. If the condition yields *true*, the loop portion is executed.

2. If the loop contains only one statement, use of a pair of curly braces ({ }) is optional.

3. If the loop contains more than one statement, the entire loop body is enclosed in a pair of curly braces({ }).

4. Index variable of the while loop should be declared and initialized before the while loop begins.

5. Index variable, if any, should be incremented or decremented in a separate line within the while loop.

Example of while loop

```html
<html>
<head>
<title>
Example of for-in loop
</title>
<script>
function table() {
var x=this.document.tabForm.n.value, y, i=1;
document.write("<center><h1 style='color:#FF0000'>"+x+" Table</h1><h2>");
while(i<=10) {
    y = i*x;
    document.write(i+" x "+x+" = "+y+"<br />");
    i++
    }
document.write("</h2></center>");
}
</script>
</head>
<body>
<center>
<form name="tabForm" method="GET" action="#">
Enter table number: <input type="number" name="n"> <br />
<input type="button" value="Create table" onClick="table()">
</form>
</center>
</body>
</html>
```

The do ... while loop in Javascript

1. Do ... while loop is a special loop which gets executed at least once, because the condition is checked only at the last statement of the loop.

2. The index variable, if any, should be declared outside the loop.

3. The do ... while loop checks the condition at the last line (which is a while).

Example of do ... while loop - Fibonacci series <html>

```html
<head>
<title>
Example of do ... while loop
</title>
</head>
<body>
<script>
var i=1, x=1,y=1;
document.write("<h1 style='color:#FF0000'>Fibonacci series</h1><br
/>");
document.write("<h1 style='color:#0000FF'>"+i+") "+x+"<br />");
var next=false;
do {
document.write((++i)+") "+y+"<br />");
var z=x;
x=y;
y+=z;
next = confirm("Do you want the next Fibonacci number");
}while(next);
document.write("</h2>");
</script>
</body>
</html>
```

Functions in Javascript

1. Generally, functions have 3 components:
   (a) The function keyword at the beginning.
   (b) The name of function following the function keyword. The name of function contains pair of brackets (), which might contain arguments.
   (c) Body of the function enclosed in a pair of curly braces ({ }). The function might use *return* keyword to return a value after processing data.

2. In general, a named block of code is called function, which may be invoked using the given name.

3. A variable declared inside the function dies within that function.

4. A function may access variables declared inside the function or with a global scope (outside any function).

5. Any changes made by a function to the global variables is permanent and is visible in other functions too.

The following code shows 3 functions, having different combination of
arguments and return values. <html>
<head>
<title>
Test of Javascript functions
</title>
<script>

```
//Function without argument and without return value
function add1() {
var x = prompt("Enter x"), y = prompt("Enter y"),
z=Number(x)+Number(y);
alert(x+" + "+y+" = "+z);
}
//Function with arguments but without return value
function add2(x, y, z) {
var z=Number(x)+Number(y);
alert(x+" + "+y+" = "+z);
}
//Function with arguments and return value
function add3(x, y) {
var z = Number(x)+Number(y);
return z;
}
</script>
```

Use of function for OOPS in Javascript

1. OOPS stands for Object Oriented Programming System.
2. Object is a programming entity having properties (to store values) and methods (to work with properties).
3. Javascript supports Object creation using function.
4. A function can be converted to a class definition.
5. Variable declared inside the function is accessed with dot operator.
6. A method is declared using the expression *this.method = function() {}*.

Example of objects using Javascript function

```html
<html>
<head>
<title>
OOPS using Javascript
</title>
<script>
function Student(name, dob, grade) {
this.name=name;
this.dob=dob;
this.grade=grade;
this.getName = function() {
    return this.name;
    }
this.getDOB = function() {
    return this.dob;
    }
this.getGrade = function() {
    return this.grade;
    }
this.setGrade = function(gr) {
    this.grade = gr;
    }
}
</script>
</head>
<body>
<script>
var s1 = new Student('Desiga', '2000-05-12','A'),
    s2 = new Student('Gayathri','2001-03-01','B');
document.write("<h1 style='color:#FF0000'>Before changing grade</h1><h2 style='color:#0000FF'>");
document.write(s1.getName()+": "+s1.getDOB()+": "+s1.getGrade()+" <br />");
document.write(s2.getName()+": "+s2.getDOB()+": "+s2.getGrade()+" <br />");
s1.setGrade('S');
s2.setGrade('A');
document.write("</h2><br /><br /><h1 style='color:#FF0000'>After changing grade</h1><h2
style='color:#0000FF'>");
document.write(s1.getName()+": "+s1.getDOB()+": "+s1.getGrade()+" <br />");
document.write(s2.getName()+": "+s2.getDOB()+": "+s2.getGrade()+" <br />");
```

Built in JavaScript functions overview

1. Functions which are readily available in the general environment of Javascript are called built-in functions.

2. Buil-in functions help to process data belonging to the built-in data types.

3. Built-in functions of Javascript may be categorized under the following heads:
   (a) Number functions
   (b) String functions
   (c) Array functions
   (d) Date functions
   (e) Math functions

4. The built-in functions belonging to the above categories are described in the following sections.

Built-in functions in Number data type

- ▶ **toExponential()**: Formats a number in exponential ($X \times 10^y$) notation.
- ▶ **toFixed(digits)**: Formats a number with given number of digits after the decimal point.
- ▶ **toLocaleString()**: Formats a number based on browser geo-location.
- ▶ **toPrecision(digits)**: Formats the number with given total number of digits (including those to the left and right of decimal point).
- ▶ **toString()**: Returns String value.
- ▶ **valueOf()**: Returns value of the number.

Built-in functions in String data type

- ▶ **charAt(index)**: Returns character at given index location. Counting starts from 0.
- ▶ **charCodeAt(index)**: Returns UNICODE value of the character at given location. Counting starts from 0.
- ▶ **concat(s1,s2, s3)**: Joins given Strings (s1, s2, s3, etc.) with original String and returns the joined String.
- ▶ **indexOf(s1)**: Returns the location where the given String s1 occurs inside the original String. Returns -1 if no occurrence of s1 is available inside the original String.
- ▶ **lastIndexOf(s1)**: Returns the last location where the given String s1 occurs inside the original String. Returns -1 if no occurrence of s1 is available inside the original String.
- ▶ **localeCompare(s1)**: Compares original String and given String. Returns -1 if the original String sorts before given String, 0 if both are equal and 1 if the original String sorts after the given String.
- ▶ **length()**: Returns the length of String.

Built-in functions in String data type

- **match(s1)**: Compares the original and given Strings based on regular expression notation.
- **replace(s1, s2)**: Search for occurrences of s1 inside the original String and replace with s2. String s1 may have regular expression.
- **search(s1)**: Searches the original String for the given String s1. The String s1 may have regular expression.
- **slice(begin, end)**: Splits the original String between given beginning and end points. Returns the split String.
- **toLocalLowerCase()/ toLocalUpperCase()**: Returns lower case version (or upper case version) according locale String based on current geo-locale.
- **toLowerCase()/ toUpperCase()**: Returns lower case version (or upper case version) according locale String.

Built-in functions in Array data type

- **concat(a1, a2, a3)**: Appends arrays a1, a2, a3, etc. to the original array and return the resultign array.
- **every(function)**: Returns values which satisfy given function. The function should return Boolean value.
- **filter(function)**: Returns values which satisfy given filter function. The function should return Boolean value.
- **forEach(function)**: Calls given function for each element of the array.
- **indexOf(val)**: Returns the firts occurrence location of the given value in the original array.
- **join()**: Creates a String using the values of the array.
- **lastIndexOf(val)**: Returns the last location at which given value occurs.
- **map(function)**: Calls given function with each element of the array and returns the results in new array.

Built-in functions in Array data type

- ▶ **pop()**: Remove the last element of the array.
- ▶ **push()**: Add new element to the end of the array.
- ▶ **reduce()**: Apply given function to the right and left elements and replace them with given result till there remains only a single element.
- ▶ **reduceRight()**: Reduces given array from right to left, applies given function and returns a single value.
- ▶ **shift()**: Removes the first element of the array. Returns the value of removed element.
- ▶ **slice(begin, end)**: Splits the array from given beginning through the given end.
- ▶ **sort()**: Sorts elements of the array.
- ▶ **splice(location, length, value)**: Adds given value at given location. It removes elements at given location if the length is greater than 0.
- ▶ **unshift()**: Adds one element to the beginning of array.

Built-in functions in Date data type

- **Date()**: Date and time of today and now.
- **getDate()**: Returns day of month (month counting starts at 0).
- **getDay()**: Returns day of week (day count starts at 0).
- **getFullYear()**: Returns year stored in the date object in 4 digit format.
- **getHours()**: Return the time stored in the date object in 24 hour format.
- **getMilliSeconds()**: Returns the millisecond value of time stored in date object.
- **getMinutes()**: Returns the minutes part of time stored in the date object.
- **getMonth()**: Returns month value stored in the date object (month count starts at 0).
- **getSeconds()**: Returns the seconds part stored in the date object.

Built-in functions in Date data type

- **getTime()**: Returns milliseconds passed since the epoch date of 01.01.1970 (midnight).
- **getUTCDate(), getUTCDay(), getUTCFullYear(), getUTCHours(), getUTCMilliseconds(), getUTCMinutes(), getUTCMonth(), getUTCSeconds()**: get day of month, day of week, year, hours, milli-seconds, minutes, month and seconds in Coordinated Universal Time.
- **setDate(dt)**: Set dt value in the day of month part of date object.
- **setFullYear(y)**: Set y value in full year part of date object.
- **toDateString()**: Returns the date and time values in human readable string format.
- **toGMTString()**: Returns human readable date and time in Greenwich Mean Time format.
- **toLocalFormat()**: Converts date to given format string.
- **toLocaleString()**: Returns string value of date to the local date and time format.

Built-in functions in Date data type

- ▶ **toLocaleTimeString()**: Returns time part of the date according local format.
- ▶ **toSource()**: Return string equivalent of date object.
- ▶ **toUTCString()**: Returns string value of date object in Coordinated Universal Time format.
- ▶ **valueOf()**: Returns the primitive value of date object.
- ▶ **Date.parse(str)**: Parse the string and obtain equivalent date object.
- ▶ **Date.UTC()**: Returns milliseconds value based on Coordinated Universal Time.

Built-in functions in String Math type

- ▶ **Math.abs(x)**: Returns absolute value of given number, ignoring $+$ or - signs.
- ▶ **Math.acos(x)**: Returns arc cosine (cos^{-1}) value of x.
- ▶ **Math.asin(x)**: Returns arc sine (sin^{-1}) value of x.
- ▶ **Math.atan(x)**: Returns arc tangent (tan^{-1}) value of x.
- ▶ **Math.atan2(x, y)**: Returns the arc tangent (tan^{-1}) of $\frac{x}{y}$ value.
- ▶ **Math.ceil(x)**: Returns the integer just greater than given fraction x.
- ▶ **Math.cos(x)**: Returns the cosine value of x.
- ▶ **Math.exp(x)**: Return e^x value of x, where e is the base for Napier's logarithm ($e = 2.718281828459$)
- ▶ **Math.floor(x)**: Returns the integer just lower than the given fraction x.
- ▶ **Math.log(x)**: Returns natural logarithm to the base e for the value of given x.

Built-in functions in Math data type

- **Math.log10(x)**: Returns logaithm to the base 10 for value of x.
- **Math.max(x,y,z,...)**: Returns maximum of the given set of values.
- **Math.min(x,y,z,...)**: Returns minimum of the given set of values.
- **Math.pow(x,y)**: Returns x power y (x^y) value.
- **Math.random()**: Returns random number between 0 and 1.
- **Math.round(x)**: Rounds given number x to the nearest integer value.
- **Math.sin(x)**: Returns sine value of x.
- **Math.sqrt(x)**: Returns square root of x.
- **Math.tan(x)**: Returns tangent value of x.

Built-in functions in RegExp data type

- **RegExp.match(exp)**: Matches given *exp* regular expression against the given string. Returns the matching part.
- **RegExp.test(exp)**: Matches given *exp* regular expression against the given string. Returns true if a matching part is found.

Popup boxes in Javascript

1. Popup box opens out of a web page to convey an information, to confirm an action or to obtain an input.

2. Following types of popup boxes are supported by Javascript:
   (i) **alert(message)**: Displays given message through a popup dialog.
   (ii) **confirm(message)**: Confirms whether given option should be *OK* or *Cancel*.
   (iii) **prompt(message, default)**: Prompts for an input by displaying a message and a default value (optional).

Example of dialogs in Javascript

```html
<html>
<head>
<title>Dialogs in Javascript</title>
</head>
<body>
<script>
var x = prompt("Enter x:","10");
var y = prompt("Enter y:","20");
if(confirm("Do you wish to add the numbers?")) {
     var z = Number(x)+Number(y);
     alert(x+" + "+y+" = "+z);
     }
else
     alert("You have chosen not to do anything with the given
numbers");
</script>
</body>
</html>
```

Document Object Model (DOM)

1. Accessing elements of a web page as though they belong to a document (using the this.document interface methods and properties) is called Document Object Model (DOM).
2. Document Object Model (DOM) may be visualized as shown in Fig.66.
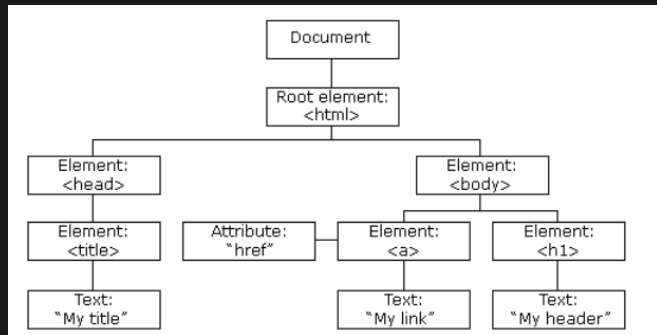
Figure: Document Object Model[78]

Properties of Document Object Model (DOM)

3 DOM supports access to HTML elements. Such element properties of DOM are shown in Fig.67.
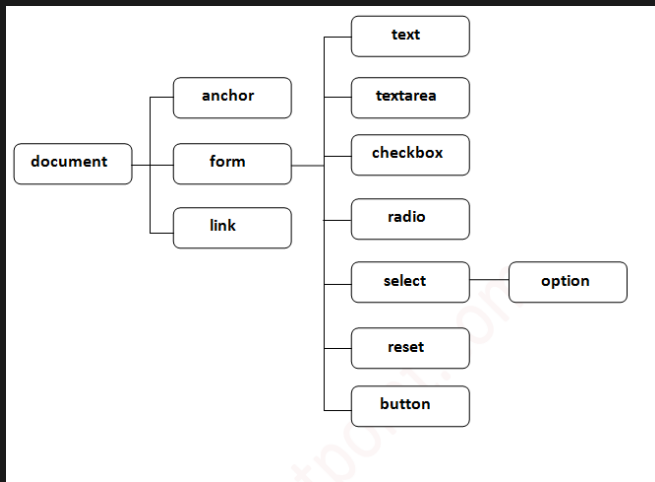
Figure: Properties of Document Object Model[79]

Methods and properties of Document Object Model (DOM)

(1) **getElementById(id)**: Returns the element having the given id from the HTML document.

(2) **getElementByName(name)**: Returns the HTML element having the given name.

(3) **getElementsByTagName(tag)**: Returns an array of elements having the given tag name.

(4) **getElementsByClassName(cls)**: Returns an array of objects belonging to given class name.

(5) **write(str)**: Writes given string value to the document.

(6) **writeln(str)**: Writes given string value to the document and appends a newline character.

(7) **innerHTML**: Sets HTML portion for a particular element of the document.

(8) **innerText**: Sets text value for a particular element of the document.

Example of DOM

```html
<html>
<head>
<title>
Test of DOM
</title>
<script type="text/javascript">
function welcome() {
var name = document.nameForm.n.value; //DOM access
document.write("Welcome "+name+"!"); //DOM method write is used
}
</script>
</head>
<body>
<form name="nameForm" method="GET" action="#">
<center>
Enter name: <input type="text" name="n"><br />
<input type="button" value="Message" onClick="welcome()">
</center>
</form>
</body>
</html>
```

Browser Object Model (BOM) in Javascript

1. Browser Object Model (BOM) is supported by the window class.
2. The window class of BOM is the parent of all other objects. The structure of BOM is shown in Fig.68.
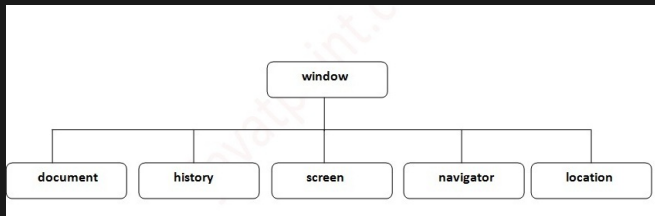
Figure: Properties of Browser Object Model[79]

Methods of window object in BOM

1. **alert(msg)**: Displays alert message.
2. **prompt(msg, default)**: Displays input dialog with given message and default value.
3. **confirm(msg)**: Displays confirmation dialog with OK and Cancel options.
4. **open()**: Opens a new window.
5. **close()**: Closes current window.
6. **setTimeout()**: Waits for given amount of time before taking action.

Methods of window.history object in BOM

1. **window.history.forward()**: Equivalent to pressing forward button in browser.
2. **window.history.back()**: Equivalent to pressing back button in browser.
3. **window.history.go(number)**: Loads given page number in history object.

Methods of window.history object in BOM

1. **window.screen.width**: Returns the width of screen.
2. **window.screen.height**: Returns the height of screen.
3. **window.screen.availWidth**: Returns available width after deducting the width of unusable portions.
4. **window.screen.availHeight**: Returns available height after deducting the height of unusable portions (like title bar, status bar, etc.).
5. **window.screen.colorDepth**: Returns color depth.
6. **window.screen.pixelDepth**: Returns pixel depth.

Syllabus

MS excel revision (row, columns, basic formatting, insert menu, Print setup, etc.) and Look up introduction and functions Types of references and cell naming Excel Linkage Custom Format and Excel Protection Tips and tricks Pivot table and Pivot chart Conditional formatting Advanced Graphs Power Queries

Introduction to features of Excel

- ▶ Excel works on the basis of cells, one cell being the intersection of a column and a row.
- ▶ Columns (vertically aligned dividers) have the alphabet names (A,B,C, ... Z, AA, AB, ..., AZ, BA...).
- ▶ Rows have numeric identifier (1, 2, 3, ...).
- ▶ Cells are addressed by combination of column name - row number, e.g. A1 for the first cell, B6 for the cell at second column, sixth row.
- ▶ Excel has a large collection of functions (entered in a cell after typing = sign), which are helpful in data analysis and computations.
- ▶ Excel can sort and arrange data in easily readable format.
- ▶ Excel can draw charts (like pie, bar, column, scatter, etc.) to help visualize data entered in cells.
- ▶ The latest version of Excel can have maximum of 10,48,576 rows and 16,384 columns. The maximum number of rows and columns may vary from version to version.

Lookup functions

- ▶ Lookup functions search in an array of data for a particular value.
- ▶ They return given column value when matching row is found.
- ▶ Lookup functions are:
    1. **LOOKUP(value, range to search, range to return):** Searches for given value in the range of cells specified. It returns the corresponding value from the matching row.
    2. **VLOOKUP(value, range to search, column index to return):** Searches for given value in the first column of the range of cells specified. It returns the corresponding column index value from the matching row.
    3. **HLOOKUP(value, range to search, row index to return):** Searches for given value in the first row of the range of cells specified. It returns the corresponding row index value from the matching row.

Cell protection

- ▶ Cells can be protected at the cell level, sheet level or workbook level.
- ▶ Selected cell can be protected by opening Home− >Alignment− >Format cells. Choose Locked checkbox. Pressing Ok button locks the cells.
- ▶ To protect a sheet or workbook, go to Review− >Changes− >Protect Sheet or Review− >Changes− >Protect Workbook.

Sorting in MS Excel

- ▶ To sort data, select all the cells containing the data to be sorted.
- ▶ Avoid the most common mistakes of selecting the just the single column containing the values to be sorted and omitting some columns which you might consider unnecessary of inclusion. Such an error may result in separation of data from its proper row members.
- ▶ Click *Data− > Sort*. In the dialog that opens, keep or remove the tick mark against the field "My data contains headers".
- ▶ The sort options contain 3 columns. First, select the column using which data needs to be sorted. In case the data contains headers, the header name is displayed. Otherwise, column name in alphabets (A,B,C,...) is displayed.
- ▶ In the second criterion, choose either values, cell color or cell icon.
- ▶ In the third criterion, choose smallest to largest or largest to smallest for number. Choose A to Z or Z to A for text data.
- ▶ Press sort button to sort the data.

Cell referencing

- ▶ When the name of cell (like B5) is referenced in a formula, it can be done in 3 different ways, as detailed below:
  - a) Relative referencing - dynamic row & column change mode
  - b) Semi-relative referencing - fynamic row & static column mode or static row and dynamic column mode
  - c) Absolute referencing - static row & static column mode
- ▶ *Relative referencing:* In this mode, copying the formula to a new cell (e.g., add 4 to columns & 3 to rows) causes the cell reference to change relative to the new column (by adding the same 4 to columns & 3 to rows to the reference made in the formula).
- ▶ *Semi-relative referencing:* In this mode, either the row or column references are static, denoted by a $ symbol preceding the row number or column name.
- ▶ *Absolute referencing:* In this mode, both column name and row number are static and are preceded by a $ symbol. When the formula is copied from one cell to another, the cell references do not change.

Filtering of data in MS Excel

- ▶ For filtering data, the first row should contain headers.
- ▶ Select all the data including headers.
- ▶ Choose *Data− > Filter*. A triangular filter marker appears to the right of each column in the first row of data.
- ▶ Clicking the triangular marker of any column permits sorting in ascending or descending order, sorting by color, search for specific values, applying several filter conditions for numbers (like equals, does not equal, greater than, less than, less than or equal to, between, top 10, above average, below average, custom filter) and text (like equals, does not equal, begins with, ends with, contains, does not contain,custom filter).
- ▶ Filter helps to select data based on convenient criterion.

Validation of data in MS Excel

- ▶ Select the cells (or column or row) in which data validation is required.
- ▶ Choose *Data− > Data Validation* from the menu. Select Data Validation.
- ▶ The data validation dialog appears.
- ▶ Select the data type from *Allow* criterion.
- ▶ Select the data criterion (between, not between, equal to, not equal to, greater than, less than, greater than or equal to, less than or equal to).
- ▶ Enter the values for validation.
- ▶ If you wish to display an error message for wrong input, click Input Message tab and enter the title and content of error message.
- ▶ Press OK to apply the condition.
- ▶ To indicate error in data by circle, choose *Data− > Data Validation− > Circle invalid data*.

Analyzing data using charts in MS Excel

- ▶ MS Excel supports column, line, pie, area, scatter and other chart types like stock, surface, doughnut, bubble and radar.
- ▶ To display a chart like column, line, pie or bar, type X-Axis title in the one column and Y-Axis title in the next column.
- ▶ Enter X-Axis values and Y-Axis values in the selected columns.
- ▶ Select the data (including title).
- ▶ Choose Insert menu. Click the type of chart like column, line, pie, bar or scatter.
- ▶ The chart is inserted by Excel.
- ▶ Edit display parameters if necessary.

Data tables in MS Excel

- ▶ Using data table, Excel can be made to calculate the results for a row, a column or an array.
- ▶ If you wish to create a column based data table, fill the input values on the left. Calculate the result for the first row.
- ▶ Select the entire table, choose Data− >What If Analysis− >Data Table.
- ▶ Choose first column in the input box (leave the row value blank).
- ▶ Excel will fill up the remaining blank cells.
- ▶ Similarly, you can create a row based data table. You need to create a row based input, calculate the result in the first column of the next row. Choose first cell of the row in row input (leave the column value blank) during creation of data table.

Data tables in MS Excel

- ▶ If you wish to create a matrix using data table, enter input values in 2 cells, calculate the result value in a new cell.
- ▶ Create a row of inputs to the right of the result cell.
- ▶ Create a column of inputs below the result cell.
- ▶ Select the new matrix. Leave the row and column input cells unselected.
- ▶ Choose What Data− >If Analysis− >Data Table.
- ▶ In the input box, select the cells for row and column input.
- ▶ When OK button is pressed, Excel fills all the cells of the matrix based on your formula.

Pivot table in MS Excel

- ▶ Pivot table (and pivot chart) provide a means for summarizing data presented in a table.
- ▶ Choose the table based on which pivot table needs to be created.
- ▶ Choose Insert− >Pivot− >Pivot Table.
- ▶ MS Excel inserts a summary table in a new worksheet.

Goal seek in MS Excel

- ▶ Suppose you have a formula in a cell.
- ▶ If you wish to know the input for which the formula will yield a desired result, goal seek will help you.
- ▶ Click the cell containing the formula. Choose Data− >What If Analysis− >Goal Seek.
- ▶ In the first cell of the dialog, enter desired result.
- ▶ In the second cell, enter the address of the cell containing wrong input, which needs to be adjusted to produce the desired new result.
- ▶ Press seek button and see the suggested new input value.
- ▶ Press OK to accept the modified input and cancel to discard the changes.

Scenarios in MS Excel

- ▶ Scenario helps to save different sets of input values and compare the results of different scenario later on.
- ▶ To create a scenario, create a set of input values and calculate the result.
- ▶ Choose Data− >What If Analysis− >Scenario. Enter a title.
- ▶ Choose cells for which different sets of input values are to be tested. Use control to select more than one cell.
- ▶ Save the scenario with an optional comment.
- ▶ Repeat the same steps to create more such scenarios. Save different input values for each scenario.
- ▶ You can choose any of the scenario at a later time to see the results.

Advanced graphs in MS Excel

▶ Insert menu in MS Excel provides several graph options, including line chart, scatter diagram, column bart, bar chart, pie chart and 3-D surface charts.

▶ The data to be visualized in the graph is to be entered with appropriate column headings.

▶ After selecting the data to be visualized, accessing the Insert− >Chart menu item provides the list of options available for charting.

▶ Chart may be inserted as a floating frame over a spreadsheet or as a separate sheet.

▶ Right clicking various regions of a chart provides the options for customizing the chart.

Advanced graphs in MS Excel [13]

- ▶ Insert menu in MS Excel provides several graph options, including line chart, scatter diagram, column bart, bar chart, pie chart and 3-D surface charts.
- ▶ The data to be visualized in the graph is to be entered with appropriate column headings.
- ▶ After selecting the data to be visualized, accessing the Insert− >Chart menu item provides the list of options available for charting.
- ▶ Chart may be inserted as a floating frame over a spreadsheet or as a separate sheet.
- ▶ Right clicking various regions of a chart provides the options for customizing the chart.
- ▶ Fig.69 shows some of the advanced chart options available in MS Excel.

Advanced graphs in MS Excel [13]

(a) Column chart
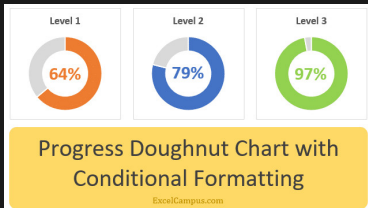
(b) Donut chart
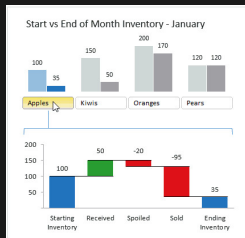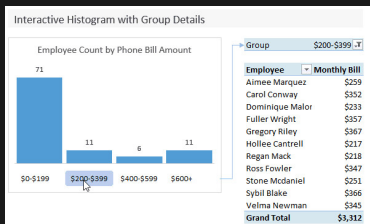
Power query in MS Excel [14]

- ▶ MS Excel provides advanced option for importing data from cloud storages and other data sources.
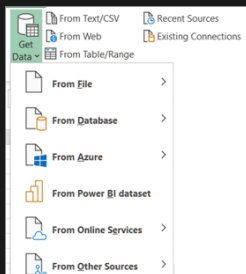
Figure: Menu for importing external data in MS Excel [14]

- ▶ Fig.70 shows the menu for connecting to external data source in MS Excel.

Power query in MS Excel [14]

- ▶ On connecting to an external data source, the raw data is to be imported to a worksheet.

- ▶ The raw data imported into the worksheet should be suitably transformed/ reorganized for easy charting.

- ▶ An appropriate chart may be created using the transformed data and chart elements modified as per requirements.

- ▶ Whenever the particular workbook is opened in MS Excel or when $Ctrl + F5$ is pressed to refresh the spreadsheet or when $Ctrl + Alt + F5$ is pressed to refresh the entire workbook, external data is synchronized and fresh data is imported.

- ▶ Charts created using power query option are automatically redrawn by MS Excel when data changes.

E-Commerce

Introduction to E Commerce and advantages. Building business on the net. Payment and Order Processing, Authorization, Chargeback and other payment methods. Security issues and payment gateways.

Definition of E-Commerce

1. e-commerce stands for electronic commerce, which means selling or buying goods through electronic means like Internet, phone line, sms, etc.

2. Selling or buying goods through electronic means (based on product description and photos) is called E-Commerce.

3. e-commerce may be carried out over phone line, SMS or the Internet.

4. The buyer relies upon the description, photos and videos of the product being sold online to make a decision.

5. e-commerce involves to entities (the buyer and the seller) connected through a common platform.

Types of e-commerce

1. **B2B or Business to Business**: When the seller is a business firm and the buyer too is business firm (not an individual consumer), the e-commerce transaction is called B2B or Business to Business transaction.

2. **B2C or Business to Consumer**: When the seller is an online business firm and the buyer is an individual, the online business transaction is called B2C or Business to Consumer.

3. **C2B or Consumer to Business**: When the seller is an individual and the buyer is a business firm, the online business model is called C2B or Consumer to Business.

4. **C2C or Consumer to Consumer**: When the seller and the buyer are both individuals, the online business model is called C2C or Consumer to Consumer.

Scope of e-commerce platform

1. e-commerce platforms like quikr, olx, etc. have local scope.
2. e-commerce platforms like Flipkart, Shopclues, Snapdeal, etc.
3. e-commerce platforms like eBay, amazon, etc. have global scope in electronic commerce.
4. Scope of the e-commerce platform ranges from local level to global level.
5. Benefits

Benefits of e-commerce

1. Electronic commerce helps the buyer to choose the most competitive price for a product from several alternate sellers.

2. e-commerce allows a seller to fetch competitive price for products.

3. e-commerce helps a consumer to order a product from far off places, even if such product is not available in the local market.

Disadvantages of e-commerce

1. Descriptions and photos provided by the seller may not match the delivered product.
2. A product may get damaged during transit, since the seller and the buyer are located at far off places.
3. The buyer may fail to pay for a product.
4. The buyer might return the product after using it for few days, which could result in the loss of transit and other expenses to the seller.
5. The buyer might get delivery of the product on the expected date.

Difference between E-Commerce and traditional commerce

Table: Difference between E-Commerce and traditional commerce

No.	e-commerce	traditional commerce
1	Buyer cannot touch or feel the product before buying.	Buyer can examine the product before buying.
2	Bargaining is restricted.	Bargaining is possible.
3	Shipping time results in delay in getting the product.	Immediate delivery of product.
4	User needs to figure out the usage procedure by himself.	Usually, a demo is given at the shop floor.
5	Testing a product before purchase is not possible.	Testing before purchase is possible.
6	In case of dispute, the buyer and seller need to be fluent in a common language (like English).	Conversations regarding a product are easy.
7	e-commerce platform allows manufacturers to speedily distribute their new products.	Product infiltration through the market chain takes time.
8	Fraudulant platforms might result in loss to the buyer.	The buyer can be assured of product delivery for the money paid.
9	e-commerce permits comparison of several products.	Visiting several shops to buy a product is cumbersome.

Capabilities required for e-commerce

1. An e-commerce platform should provide a cart, where items may be added or removed.
2. Options for payment through CoD (Cash on Delivery), credit card, debit card, netbanking and wallet transfer should be supported by the platform.
3. e-commerce platform should provide a dedicated transport mechanism to deliver the products on specified time line.
4. The buyer and seller should be permitted to share and rate their experience for each online transaction.

Technology issues for e-commerce

1. The online platform should provide secure transaction facilities to prevent fraudsters from cheating a buyer or seller.

2. The payment gateway should be secure and be available 24×7.

3. Reward points and redemption system should be provided to encourage the buyer.

4. Broken Internet connection before completing a transaction might result in loss of money to the buyer.

Types of E-Commerce web sites

1. **Transactional type sites**: In transactional type, physical stores provide an online alternative. Customers can either visit the physical store or the online store to get a product.

2. **Information delivery sites**: Large manufacturers might run websites simply to disseminate information about their products. These sites might include online fora for discussion on technical issues.

3. **e-market place**: This type of website permits registration of buyers and sellers. The e-marketplace functions as the facilitator between the buyer and the seller and takes commission amount for the service.

Building business on the net

1. Building an online business requires the seller to create visuals and descriptions for the products.
2. The seller should ensure that the description is unambiguous.
3. The seller should keep the buyer updated about each stage of the online transaction from purchase to eventual delivery of product.
4. The seller should ensure that the buyer is provided a pleasant experience through all stages of his transaction.
5. The buyer should have the service and support for the online product.
6. The online business platform should provide an easy interface to the users.

- ▶ Providing full description of a product sold online is called the online catelogue.
- ▶ The online catelogue shoud describe all physical and internal features.
- ▶ The online catelogue should provide clear instructions for operating a product.
- ▶ Online catelogue should provide clear price tag for each product.
- ▶ Online catelogue should describe defects, if any, in the product.

Shopping cart

- The place for keeping all selected items before final checkout from an online store is called a cart.
- Cart provides facility to add, remove or modify products through online.
- Cart items are deleted when a purchase transaction is made online.

Checkout pages

▶ After adding items to the cart, the customer is provided detailed list of items, quantities, rates and amounts for each transaction.

▶ When the user provides confirmation that the items in the cart are really meant to be purchased, the checout page redirects the user to payment page.

Payment for e-commerce transaction

▶ Payment for an online transaction may be made through the following methods:

 (i) **Cash On Delivery (COD)**: The buyer pays money when the product is delivered.

 (ii) **Credit card**: A card bearing 16 digit number, expiry month & year, name of card holder and a Card Verification Value (CVV) and permitting permitting spending first and collection on later date is called credit card. This card permits payment of money for goods and services. This amount should be paid up during the credit card bill cycle. Credit card permits conversion of large purchase amount to EMI (Equated Monthly Installment) payment.

 (iii) **Debit card**: A card bearing 16 digit number, expiry month & year, name of card holder and a Card Verification Value (CVV) is called and permits spending the money already debosited in an account is called debit card. This card permits payment of money for goods and services from prepaid deposits.

 (iv) **Internet banking**: Internet banking permits logging in to a bank site using an ID and password and authorizing the online payment. Some banks send an OTP (One Time Password) to

Security issues for online payment

- ▶ The user should ensure that green color lock icon appears near the address bar of the browser.
- ▶ The user should ensure that the lock icon is not crossed out.
- ▶ The user should ensure that the Internet connection is stable for completing payment transaction in one go.
- ▶ The user should ensure that the payment transaction is completed within the shortest possible time limit. Otherwise, the session might expire and the money may remain unpaid to the e-commerce site, but debited from the bank account of the user.
- ▶ The user should ensure that the payment URL begins with https, which is a secure communication protocol over hyper text transmission protocol.

Payment gateway

- ▶ A third party online payment system which receives money from the buyer and transfers the same to the seller is called a payment gateway.
- ▶ CCAvenue, PaySeal, PayPal, etc. are some of the common payment gateways.
- ▶ For each successful transaction, the payment gateway takes a commission and transfers the remaining amout to the account of the beneficiary.

Cyber security

Overview of Information Security, SSL, HTTPS, Security threats, information Security vulnerability and Risk management. Introduction to Directory Services, Access Control, Security, Privacy protection, Audit and Security. Introduction to IT Act and penalties for cybercrimes.

Cyber security

1. Protecting computer users from online attacks aimed at damaging the data, software, monetary loss or any other damages is called cyber security.

2. The term cyber means interaction of computers through Network.

3. Cyber crime is a malafide act happening inside the networking domain.

4. Victims of cyber crimes might loose data or money.

Information security

- ▶ Information security is the practice of preventing unauthorized use of information.
- ▶ Information Security is abbreviated to *InfoSec*.
- ▶ Under information security, any device having processor and memory is categorised under computing device.
- ▶ Keeping the data of a device safe from unauthorized users is called information security.
- ▶ **CIA**: CIA is the abbreviation for Confidentiality, Integrity & Availability under information security.

Threats to information security

- **Worms**: Worms are little scripts sent through email attachments. These enter the computer system when user tries to open the attachment. Worms might result in scare, loss of data from the system.
- **Phising attacks**: Creating a cheat URL resembling an authentic website and making the victim to reveal login credentials is called phishing attack. In most of the cases, phishing victims innocently reveal bank login details, which are misused by the attacker.
- **Trojans**: A normal looking program may have an embedded malware. The malware might collect sensitive data and transmit the same to the attacker.
- **Computer virus**: A malicious which becomes hooked to the opearating system and keeps continuously working to damage data stored in the device is called virus. Virus spreads through Internet, storage media like pen drive, etc.
- Breach of information security might result in theft of proprietory manufacturing processes or fomulae from large

Vulnerability

- ▶ Sources of weakness in the IT infrastructure for potential theft of information is called vulnerability.

- ▶ Vulnerabilities may be found in the operating system. These vulnerabilities are targeted by hackers and exploited.

- ▶ The network connection might be insecure due to lack of firewall, anti-virus and other online protection software packages.

- ▶ An application software might include a vulnerability. When this software runs, hackers may intrude the system and cause damages.

- ▶ Failure to conduct periodic security audit of computer systems might result in data vulnerability.

- ▶ Identifying sources of data disruption and ensuring continuous safety of business data is called risk management.

Risk management

- The likelihood of loss of data due to security vulnerability is called risk.
- Risk management is the process of ensuring smooth functioning of business without permitting any attack on the information held by an organization.
- A team of people calculate the risk faced by an organization based on existing vulnerabilities and sources of threat. The team decides upon the safe practices, software and hardware implementations to be adopted for complete information safety.
- To ensure information safety, an organization should have (i)security policy, (ii)organization of information security, (iii)human resource security, (iv)access control, (v)physical security, (vi)security incident management, (vii)safe disposal of damaged hard copies, (viii)safe disposal of damaged storage media.

Introduction to Directory Services

- ▶ Directory service is a single access point which could take a user to sevel other services located at different URLs.
- ▶ The directory service simplies the job of security administrator to the safe maintenance of directory service alone.
- ▶ Directory service may store data in several computers. But, the user should find that the directory is a single point.
- ▶ The directory service should be able to include new objects based on changes to network.
- ▶ Searching for information from various locations on the network should be easy.
- ▶ The directory system should be independent of the physical location of the user or the administrator.
- ▶ The information stored in directory service should be accessible from any operating system.
- ▶ LDAP (Light Weight Directory Access Protocol) provides an easy mechanism for querying directory service.

Access control

- Access control is the selective permission to particular individuals to access a computer and perform their works.
- Access control may be physical security to the computer. Users may be permitted to use the computer only if they are authenticated through smart card, finger print, iris scan, etc.
- Access control may be implemented through software. Users may be required to provide a valid pair of identifier (ID) and password.
- Access control may be implemented through a combination of physical and software controls.
- The layout of the access control components is called access control topology.

Software development security

- ▶ Security is implemented at the development stage of a software.
- ▶ Security of software is designed to cover the entire life cycle of software.
- ▶ Software Development Life Cycle (SDLC) is the planning of the security measures to be incorporated in a software throughout the life span of the software.
- ▶ **Protection from disclosure**: is the prevention of disclosure of source code by any individual involved in the development of a software product.
- ▶ **Protection from alteration**: The source code should not be altered without appropriate authorization.
- ▶ **Protection from destruction**: Any individual should not have the right to delete or destroy the entire software.
- ▶ **Whois making the request**: Any request for changing or deleting software components should be recorded.
- ▶ **Verify access rights**: Any request from a user should be verified against the rights granted to the user. The user

Privacy protection

- ▶ Data relating to several types of individuals may be held in the IT infrastructure of an organization.
- ▶ Protecting the data from unauthorized access is called privacy protection.
- ▶ Breach of privacy protection might result in huge damage to individuals and organizations.
- ▶ Medical records of patients, record of criminals, financial data of companies, genetic material, address and contact details of individuals, record of web surfing behaviour, record of credit card, debit card or Internet banking creditials are some of the privacy data which should not be compromized.

Information security audit

- ▶ Information security is audited by a team of experts with reference to vulnerabilities, threats and preventive measures for data protection.
- ▶ The information security audit thoroughly analyses all threat events of the past and formulates security measures for the future.
- ▶ Information security audit should be performed in a periodic manner, i.e., once every month, every quarter, etc.
- ▶ Seggregation of duties should be adopted to ensure that no single employee has all the data needed to make a fraudulant transaction.
- ▶ All segments of the organization should be protected through physical and password security measures.
- ▶ The audit team should ensure that customers of the organization can feel safe when their data is divulged for business purpose.
- ▶ IT audit should probe abnormal behaviour of any individual, which might be an indication of potential fraud / theft of data.

Introduction to I.T. Act

- ▶ Information Technology Act, 2000 was introduced to prevent and punish cyber crimes.
- ▶ I.T. Act provides support for ecommerce.
- ▶ I.T. Act protects individuals from being victimized by cyber frauds.
- ▶ A major amendment to the IT act was made in 2008.

Penalties for cybercrimes

Table: Cyber crimes and punishments

No.	Section	Cyber crime	Max. Imprisonment	Max. Fine	Both imp' a
1	65	Tampering with computer source documents	2 years	2Lakh	Yes
2	66	Hacking	3 years	5Lakh	Yes
3	66B	Receiving stolen computer/ mobile	3 years	1Lakh	Yes
4	66C	Misuse of password	3 years	1Lakh	Yes
5	66D	Cheating with computer	3 years	1Lakh	Yes
6	66E	Publishing private images of others	3 years	2Lakh	Yes
7	66F	Cyber terrorism	Life	—	No
8	67	Publishing obscene content	5 years	1Lakh	Yes
9	67A	Publishing sexual content	7 years	1Lakh	Yes
10	67B	Publishing child porn	5; 7 years (subsequent)	1Lakh; 1Lakh (subsequent)	Yes
11	67C	Failure to maintain records by operator	3 years	undefined	Yes
12	68	Failure to comply with orders	3 years	2Lakh	Yes
13	69	Refusal to decrypt data			

Syllabus

Benefits of cloud services, different categories. Resources available in cloud. Identify Phases of the Application Development Life Cycle. Describe Roles in each of phases of the Application Development Life Cycle.

Cloud computing

- ▶ Cloud computing means storage and processing of data on remote computers connected through the Intenet.
- ▶ Thin clients like Chromebooks can store data and run programs in the remote cloud.
- ▶ Cloud services are offered by several companies, including Microsoft, IBM, Apple Computer, Google, DropBox, etc.

Categories of cloud services

- **Private clouds:** Private clouds are services maintained by large firms for their internal usage.
- **Public clouds:** Public cloud services are accessed over the common Internet. The services may be paid or free. OneDrive, iCloud, Google Drive, DropBox, etc. are examples of public cloud.
- **Hybrid clouds:** Hybrid clouds provide some public services accessible to everyone and some restricted services accessible for internal use of employees.
- **Community clouds:** Some individuals or organizations having common interests may share data and storage on a cloud. For persons or organizations outside the particular community, the cloud looks like a private cloud.

Resources available on cloud

- **Data storage:** Photos and documents may be uploaded to cloud server and accessed from any device.
- **SaaS:** Software as a Service (SaaS) provides for access to software from any connected device. This has created annual subscription and renewal model for software packages.
- **IaaS:** Infrastructure as a Service (IaaS) provides access to state of the art IT infrastructure through cloud computers. Amazon Web Services (AWS), Google Cloud, IBM Cloud and Microsoft Azure are some of the IaaS services for enterprises.
- **PaaS:** Certain program development projects might require specific platforms, which may be costly to acquire. PaaS (Platform as a Service) provides complete development platform for specific duration on rental over the Internet.

Application Development Lifecycle

- ▶ Application development begins with the assessment of customer demand, passes through planning, development and testing.
- ▶ After testing, the software may be deployed.
- ▶ Deplyoment brings new bugs to light.
- ▶ Bug fixing and maintenance are the next phases in software development lifecycle.
- ▶ Some software packages might require minor improvements or complete revamping. New releases of the software should be brought out to address such needs.

Application Development Lifecycle
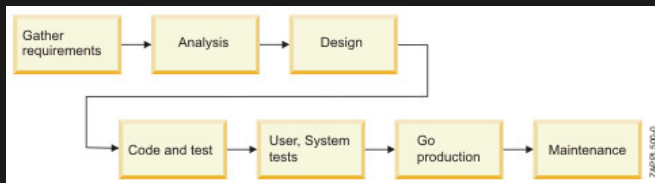
Figure: Application Development Life Cycle[77]

- ▶ ADLC involves the following phases:
    1. Gathering information
    2. Analysis
    3. Design
    4. Coding and testing
    5. User and system tests
    6. Deploymet (Production)
    7. Maintenance

Syllabus

Introduction to Python, History of Python, Features, Setting up path, Basic Syntax, Comments, Variables, Different Data Types, Casting, string, Boolean
Python Operators Conditional Statements, Looping Control Statements, String Manipulation, Lists, Tuple, sets, Dictionaries, Arrays, Iterators, date, math modules, Input and Output.

Introduction to Python

- ▶ Python is a general purpose programming language created by Guido van Rossum[12] in the year 1991.
- ▶ It supports dynamic data types, which means the language decides the data type to be used for a variable.
- ▶ Python supports automatic garbage collection, which means unused memory will be automatically released.
- ▶ Python uses indentation (aligning code to the right) for defining blocks and inner blocks of code (no need to use { and }.)

Figure: Giodo Van Rossum, Creator of Python[12]

History of Python

- Python was developed as a successor to ABC programming language.
- Python was developed by Guido van Rossum in 1991 at Centrum Wiskunde & Informatica (WCI) in Netherlands.
- Python2 was released on 2000 and Python3 in 2008.
- Guido van Rossum relinquished all responsibilities relating to Python in the year 2018.
- Python version 3.10, released in 2022, is the current release of Python.
- Python language interpreter is available for several platforms and the same may be downloaded from the URL https://www.python.org/downloads/.

Features of Python

- ▶ Python supports both procedural programming (function oriented) and Object Oriented Programming System (OOPS).
- ▶ Python support Aspect Oriented Programming (AOP) and metaprogramming, which help to create special objects called magic objects.
- ▶ Python is a dynamically typed language. Data types need not be declared by the programmer.
- ▶ Python has an automatic garbage collector to reclaim unused memory.
- ▶ Python supports late binding (otherwise called dynamic linkage), which means that function names are looked up only during execution.
- ▶ Late binding offers flexibility during development, where programs may compile even when some functions are not yet implemented.
- ▶ Python has support for filter, map, list, set, dictionary, generator, itertools, functools, etc.
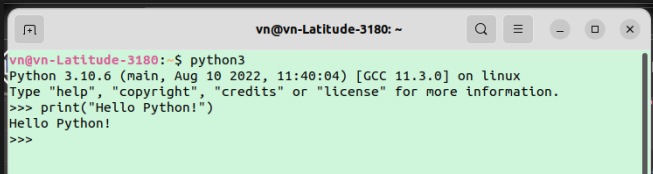
Setting up path for Python

- ▶ On installation of the latest version of Python, a folder named **c:**
  python3x, where x is the release number, is available.

- ▶ To include Python from the command line, one may issue the command **PATH=%PATH%;c:**
  python3.

- ▶ To permenantly add the Python folder to PATH variable:
  1. Open control panel or settings app.
  2. Search for environment variables.
  3. Choose either system variables or user variables.
  4. Click upon variable named PATH. Press Edit button.
  5. Add the line c:
     python3 to the PATH variable.
  6. Save the changes. Now, Python would run from command line.

Basic Syntax
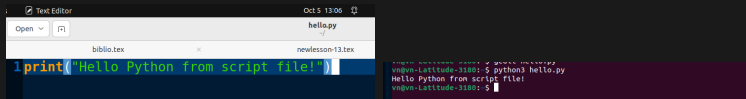
- ▶ Python statements need not end with ;
- ▶ Each block of code is indented to the right.
- ▶ Fig. 73 shows a simple hello statement displayed through print function in Python.
- ▶ Instead of running the code on the command line, program code may be typed in a file (say hello.py) and executed by invoking python interpreter with the file name as argument, e.g., (**python3 hello.py**)

Basic Syntax

(a) Command Line Execution

(b) Editing Python script

(c) Executing Python script

Figure: Executing Python Code

Comments in Python

- ▶ Single line comments may start with # symbol. Any text to the right of single line comment is ignored.
- ▶ Multiline comments may start with three double quote symbols ("""). Any content till the occurrence of same triplet of double quotes (""") is ignored.
- ▶ Comments are ignored by Python.

Variables in Python

► A variable may start with any alphabet or underscore (_).

► A variable name may contain alphabets, numbers and underscore (_). No special characters are allowed.

► Variables are case sensitive. x=5 and X=10 will assign values to x and X as different variables. **(print(x,X)** will produce 5 10 as result.

► Variables come into existence on first assignment of value.

► Obsolete variables will be automatically removed from memory (garbage collection).

Data Types in Python

1. **byte**: One byte of size of data. Stores values from -128 to +127.
2. **int**: Integer data type. Occupies 2 or 8 bytes of storage.
3. **float**: Floating point number storage. Memory occupied may be in the range of 2 bytes to 8 bytes.
4. **complex**: Contains a real part and imaginary part, representing a complex number.
5. **bool**: Stores TRUE or FALSE as the value.
6. **str**: String data type.
7. **None** Variable does not belong to any data type.
8. **list**: A list is enclosed inside square brackets [].
9. **tuples**: Tuples are enclosed inside paranthises().

Data Types in Python

1. **dict**: Name value pairs are stored in dict. Dict is enclosed inside curly braces{ }. Names and values are separated by colon : symbol.

2. **set**: A list of items enclosed in curly braces{ } is called a set.

3. **frozenset**: A list of items enclosed in curly braces{ }, which are themselves arguments for frozenset() function is called a frozenset.

4. **memoryview**: Holds memory address of given variable.

5. **bytearray**: A series of byte values of given size.

Casting data to other types

▶ Data belonging to one type (e.g. str) may be cast to other types using casting functions which have the name of target data type itself (e.g. int()).

▶ Following are the common data casting functions:

1. **int()**: Casts given data to integer type.
   x=int("12")
   will store integer 12 in variable x.

2. **float()**: Casts given data to float type.
   x=float("12.74")
   will store floating point number 12.74 in variable x.

3. **str()**: Casts given data to string type.
   x=25
   y=12
   z=str(x)+str(y)
   print(z)
   will display 2512, since both x and y were converted to strings and then added (concatenated).

4. **boolean()**: Casts given data TRUE or FALSE. The value is FALSE for 0 and TRUE for 1.

▶ Fig. 74 shows the conversion of data to int type and str type.

Casting data to other types

(a) Casting to int using int()

(b) Casting to string using

Arithmetic operators in Python

Arithmetic operators are shown in Table 16.

Table: Arithmetic operators in Python

Sl. No.	Operator	Purpose	Typical Usage
1	$+$	Addition	$z = x + y$
2	$-$	Subtraction	$z = x - y$
3	$*$	Multiplication	$z = x * y$
4	$/$	Division	$z = x/y$
5	%	Integer / modulo remainder after division	$z = x\%y$
6	$**$	Power	$z = x * *y$
7	$//$	Quotient of division operation	$z = x//y$

Assignment operators in Python

Assignment operators are shown in Table 17.

Table: Assignment operators in Python

Sl. No.	Operator	Purpose	Typical Usage
1	$=$	Assigns right side result to left side identifier	$z = x + y$
2	$+ =$	Add and assign.	$z = 5$ $z+ = 12$ # makes z value 17.
3	$- =$	Substract and assign	$z = 5$ $z- = 12$ # makes z value -7.
4	$* =$	Multiply and assign	$z = 12$ $z* = 5$ # makes z value 60.
5	$/ =$	Divide and assign	$z = 60$ $z/ = 5$ # makes z value 12.
6	$** =$	Calculate Power and assign	$z = 3$ $z * * = 2$ # makes z value to become 9
7	$\% =$	Find modulo remainder and assign the same	$z = 13$ $z\% = 5$ # makes z value 3
8	$// =$	Find quotient and assign the same	$z = 13$ $z// = 5$ # makes z value 2
9	$// =$	Find quotient and assign the same	$z = 13$ $z// = 5$ # makes z value 2
10	$\& =$	Find bitwise AND and assign the same	$z = 5$ $z\& = 4$ # makes z value 4
11	$| =$	Find bitwise OR and assign the same	$z = 5$ $z| = 8$ # makes z value 13
12	$=$	Find bitwise XOR and assign the same	$z = 5$ $z^=7$ # makes z value 2
13	$>>=$	Find bitwise Right shift and assign the same	$z = 5$ $z >>= 2$ # makes z value 1
14	$<<=$	Find bitwise left shift and assign the same	$z = 5$ $z <<= 2$ # makes z value 20

Comparison operators in Python

Comparison operators are shown in Table 18.

Table: Comparison operators in Python

Sl. No.	Operator	Purpose	Typical Usage
1	==	Equal to. Compares left and right sides. Returns TRUE only if both sides are equal.	$if(x == y)$
2	!=	Not equal to. Compares left and right sides. Returns TRUE only if both sides are NOT equal.	$if(x! = y)$
3	>	Greater than. Returns TRUE only if left side is greater than right side.	$if(z > 6)$
4	<	Less than. Returns TRUE only if left side is less than right side.	$if(z < 6)$
5	>=	Greater than or equal to. Returns TRUE only if left side is greater than or equal to the right side.	$if(z > 6)$
6	<=	Less than or equal to. Returns TRUE only if left side is less than or equal to the right side.	$if(z < 6)$

Logical operators in Python

Logical operators are shown in Table 19.

Table: Logical operators in Python

Sl. No.	Operator	Purpose	Typical Usage
1	and	Returns TRUE only if both left side and right side expressions are TRUE.	$if(x == yandy == z)$
2	or	Returns TRUE if either left side or right side expression is TRUE.	$if(x! = yory == z)$
3	not	Returns TRUE if the right side expression is FALSE.	$if(notz > 6)$

Identity operators in Python

Identity operators are shown in Table 20.

Table: Identity operators in Python

Sl. No.	Operator	Purpose	Typical Usage
1	in	Returns TRUE of both variables refer to the same object.	$if(x is y)$
2	is not	Returns TRUE of both variables DO NOT refer to the same object.	$if(x is not y)$

List Membership operators in Python

List membership operators are shown in Table 21.

Table: List Membership operators in Python

Sl. No.	Operator	Purpose	Typical Usage
1	in	Returns TRUE if a value is found in a list of items.	$if(x\,is\,y)$
2	not in	Returns TRUE if a value is NOT FOUND in a list of items.	$if(x\,is\,not\,y)$

Bitwise operators in Python

Bitwise operators are shown in Table 22.

Table: Bitwise operators in Python

Sl. No.	Operator	Purpose	Typical Usage
1	&	Bitwise AND.	$z = 5$ $z\&4$ returns 4
2	|	Bitwise OR	$z = 5$ $z\|8$ returns 13
3	^	Bitwise XOR	z=5 z^7 returns 2
4	>>	Bitwise Right shift	$z = 5$ $z >>= 2$ returns 1
5	<<	Bitwise left shift	$z = 5$ $k = z << 2$ makes k to assume a value of 20

Conditional Statements

- ▶ Python supports if ... elif ... else ... condition. The elif and else parts are optional.
- ▶ Each block (if, elif or else) is denoted by a : and appropriate indentation.
- ▶ Sample code for the three forms of if condition is presented below:

1) **if condition:** *x = int(input("Enter your age: "))*
   if(x<18):
   print("You are a kid!")

Conditional Statements

2) **if else condition:**

```
x = int(input("Enter your age: "))
if(x<18):
        print("You are a kid!")
else:
        print("You are not a kid!")
```

3) **if elif else condition:**

```
x = int(input("Enter your age: "))
if(x<18):
        print("You are a kid!")
elif(x<25):
        print("You are young!")
elif(x<50):
        print("You are middle aged!")
else:
        print("You are a respectable senior!")
```

Looping in Python

- Python supports 2 types of loops:

  1. **for loop:** For loop can take a string, an array or a range object as argument. Following is a for loop to print numbers from 2 to 10:

     for x in range(2,11,1):

         print(x)

     else:

         print("Finished for loop")

     Else part in the above loop is optional. The following for loop prints one, two, three:

     for x in ["one","two","three"]:

         print(x)

     The following for loop prints Hello (string is split into letters):

     for x in "Hello":

         print(x)

  2. **while loop:** The while loop gets executed till given condition is true. Following while loop prints numbers from 2 to 10:

     i=2 while i <= 10:

         print(x)

         i+=1

Functions in Python

- Functions begin **def** keyword.
- Functions have a name and arguments (which may be blank).
- Return values can be specified using return statement.
- The folllowing function calculates factorial of given number. *def fact(n):*

  f=1

  for x in range(1,n+1,1):

  f ∗ = x

  return f

  print(fact(6))
- Arbitrary number of arguments can be taken as argument to a function if declared with ∗ before the argument name. Following function calcualtes average of given numbers:

  def avg(∗n):

  s=1

  for x in n:

  s += x

  return s/len(n)

  print(avg(6,2,8,1,4))

  print(avg(2,4))

  The result would be 4.4 and 3 (average of given numbers).

File handling in Python

▶ Files can be opened using open function.

▶ Permitted modes are: r - read, w - write, a - append, x - write (error if file already exists.

▶ Calling close function on file object closes the file.

▶ Following function writes the string **All the best with Python programming!** to a file named copa.txt:
f = open("copa.txt","w")
f.write("All the best with Python programming!");
f.close()

▶ Following code reads the file copa.txt and displays the content:
f = open("copa.txt","r")
print(f.read())
f.close()
It prints **All the best with Python programming!** on the screen.

▶ readline() function may be used instead of read function to read the file line by line.

Strings in Python

▶ Python supports single line strings and multiline strings.

▶ Single line strings begin and end with " or ' (double quote or single quote).
e.g.,
x="Good "
y="morning"

▶ Multiline strings begin and end with """ or ''' (3 consecutive double quotes or single quotes). e.g.,
x="""Hello,
How are you?"""

▶ Parts of string may be printed using array symbol. e.g.,
print(x[0:2]) would print He.

▶ lower, upper, strip (trim spaces), lstrip, rstrip, find, swapcase, title, split, isupper, islower, istitle, isspace, isnumeric, isdigit, isdecimal, isalnum, capitalize, endswith, startswith, splitlines, swapcase, join, ljust, rjust, repalce, capitalize, casefold and center are some of the methods which can be called upon given string.

Lists in Python

- ▶ Lists in Python are enclosed in [ ] (square brackets).e.g., $x =$ ["COPA","is","an","excellent","course"] is a valid list.

- ▶ Lists behave similar to arrays. List elements can be accessed using their index (beginning in 0)
  e.g.,
  $x =$ ["COPA","is","an","excellent","course"]
  print(x[3])
  prints the word excellent.

- ▶ append, clear, copy, count, extend, index, insert, pop, remove, reverse and sort are some of the methods which can be called upon given list.

- ▶ Lists allow duplicate values.

Tuples in Python

- Tuples in Python are enclosed in ( ) (parantheses).e.g., $x =$ ("COPA","is","an","excellent","course") is a valid tuple.

- Tuples behave similar to arrays. List elements can be accessed using their index (beginning in 0)
  e.g.,
  $x =$ ("COPA","is","an","excellent","course")
  print(x[3])
  prints the word excellent.

- Although tuples look similar lists, tuples elements cannot be modified after declaration.

- Tuples allow duplicate values.

- count and index are the two methods which can be called upon given tuples.

Dictionaries in Python

- ▶ Dictionaries are key value pairs separated by : symbol and enclosed in { } (curly brackets).e.g., $x = \{"trade":"COPA","name":"Krish","year":2022,"mark","100\%"\}$ is a valid Dictionary.

- ▶ Dictionary does not permit duplicate entries of key values. Newer values overwrite older values for the same key. e.g. $x["name"]="Ram"$ will change name from Krish to Ram.

- ▶ Dictionary elements can be modified after declaration.

- ▶ New elements may be added to dictionary after declaration.

- ▶ Dictionary **does not** allow duplicate values.

- ▶ clear, copy, fromkeys, get, items, keys, pop, popitem, setdefault, update, values are the two methods which can be called upon given sets.

Arrays in Python

- ▶ Arrays in Python are enclosed in [ ] (square brackets).e.g., $x =$ ["COPA","is","an","excellent","course"] is a valid array.
- ▶ Arrays and lists share many similarities.
- ▶ Array elements can be accessed using their index (beginning in 0)
  e.g.,
  $x =$ ["COPA","is","an","excellent","course"]
  print(x[3])
  prints the word excellent.
- ▶ append, clear, copy, count, extend, index, insert, pop, remove, reverse and sort are some of the methods which can be called upon given arrays.
- ▶ Lists allow duplicate values.

Iterators in Python

▶ Iterators help to access all elements of lists, sets, tuples and arrays sequentially.

▶ Calling next() method gives the next element of iterator.

▶ Iterator can be created using iter() method.
  e.g.,
  x = ["COPA","is","an","excellent","course"]
  y=iter(x)
  print(next(y))
  print(next(y))
  prints the word COPA followed by is.

Datetime module in Python

- ▶ Datetime module provides date and time classes.
- ▶ Date class has three components, viz., year, month and day.
- ▶ Date class provides a constructor which takes year, month and day values.
- ▶ Date class provides following functions: ctime, fromisocalendar, fromisoformat, fromordinal, fromtimestamp, isocalendar, isoformat, isoweekday, replace, strftime, timetuples, today, toorinal and weekday.
- ▶ strftime may be formatted using %Y, %m, %d, %H, %M %S, etc. for formatting date and time.

Math module in Python

- ▶ Math module provides several statistical, scientific and trigonometric functions.

- ▶ Salient functions in math module are: math.acos. math.acosh, math.asin, math.asinh, math.atan, math.atanh, math.atan2, math.ceil, math.comb, math.copysign, math.cos, math.cosh, math.degrees, math.dist, math.erf, math.erfc, math.exp, math.expm1, math.fabs, math.factorial, math.floor, math.fmod, math.frexp, math.fsum, math.gamma, math.gcd, math.hypot, math.isclose, math.isinfinite, math.isinf, math.isnan, math.isqrt, math.idexp, math.igamma, math.log, math.log10, math.log1p, math.log2, math.perm, math.pow, math.prod, math.radians, math.remainder, math.sin, math.sinh, math.sqrt, math.tan, math.tanh, math.trunc.

- ▶ Math class provides the following constants: math.e, math.inf, math.nan, math.pi, math.tau.

Input and output in Python

- ▶ Python provides a function called **input** for collecting input from the keyboard.
- ▶ Output in Python can be provided through **print** function.
- ▶ The following code shows a simple program which collects name of a person and offers a greeting:
  name = input("Enter your name: ")
  print("Hello "+name+", Have a pleasant day!")

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