

GEO - INFORMATICS ASSISTANT

NSQF LEVEL - 4

TRADE THEORY

SECTOR: IT & ITES

(As per revised syllabus July 2022 - 1200 Hrs)



Directorate General of Training

DIRECTORATE GENERAL OF TRAINING
MINISTRY OF SKILL DEVELOPMENT & ENTREPRENEURSHIP
GOVERNMENT OF INDIA



**NATIONAL INSTRUCTIONAL
MEDIA INSTITUTE, CHENNAI**

Post Box No. 3142, CTI Campus, Guindy, Chennai - 600 032

Sector : IT & ITES

Duration : 1 - Year

Trade : GEO - Informatics Assistant - Trade Theory - NSQF LEVEL - 4 (Revised 2022)

Developed & Published by



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FOREWORD

The Government of India has set an ambitious target of imparting skills to 30 crores people, one out of every four Indians, to help them secure jobs as part of the National Skills Development Policy. Industrial Training Institutes (ITIs) play a vital role in this process especially in terms of providing skilled manpower. Keeping this in mind, and for providing the current industry relevant skill training to Trainees, ITI syllabus has been recently updated with the help of Mentor Councils comprising various stakeholder's viz. Industries, Entrepreneurs, Academicians and representatives from ITIs.

The National Instructional Media Institute (NIMI), Chennai has now come up with instructional material to suit the revised curriculum for **GEO - Informatics Assistant - Trade Theory - NSQF Level - 4 (Revised 2022) in IT & ITES Sector under Annual Pattern**. The NSQF Level - 4 (Revised 2022). Trade Theory will help the trainees to get an international equivalency standard where their skill proficiency and competency will be duly recognized across the globe and this will also increase the scope of recognition of prior learning. NSQF Level - 4 (Revised 2022) trainees will also get the opportunities to promote life long learning and skill development. I have no doubt that with NSQF Level - 4 (Revised 2022) the trainers and trainees of ITIs, and all stakeholders will derive maximum benefits from these IMPs and that NIMI's effort will go a long way in improving the quality of Vocational training in the country.

The Executive Director & Staff of NIMI and members of Media Development Committee deserve appreciation for their contribution in bringing out this publication.

Jai Hind

Additional Secretary / Director General of Training
Ministry of Skill Development & Entrepreneurship
Government of India.

New Delhi - 110 001

PREFACE

The National Instructional Media Institute (NIMI) was established in 1986 at Chennai by then Directorate General of Employment and Training (D.G.E & T), Ministry of Labour and Employment, (now under Directorate General of Training, Ministry of Skill Development and Entrepreneurship) Government of India, with technical assistance from the Govt. of the Federal Republic of Germany. The prime objective of this institute is to develop and provide instructional materials for various trades as per the prescribed syllabi (NSQF) under the Craftsman and Apprenticeship Training Schemes.

The instructional materials are created keeping in mind, the main objective of Vocational Training under NCVT/NAC in India, which is to help an individual to master skills to do a job. The instructional materials are generated in the form of Instructional Media Packages (IMPs). An IMP consists of Theory book, Practical book, Test and Assignment book, Instructor Guide, Audio Visual Aid (Wall charts and Transparencies) and other support materials.

The trade practical book consists of series of exercises to be completed by the trainees in the workshop. These exercises are designed to ensure that all the skills in the prescribed syllabus are covered. The trade theory book provides related theoretical knowledge required to enable the trainee to do a job. The test and assignments will enable the instructor to give assignments for the evaluation of the performance of a trainee. The wall charts and transparencies are unique, as they not only help the instructor to effectively present a topic but also help him to assess the trainee's understanding. The instructor guide enables the instructor to plan his schedule of instruction, plan the raw material requirements, day to day lessons and demonstrations.

In order to perform the skills in a productive manner instructional videos are embedded in QR code of the exercise in this instructional material so as to integrate the skill learning with the procedural practical steps given in the exercise. The instructional videos will improve the quality of standard on practical training and will motivate the trainees to focus and perform the skill seamlessly.

IMPs also deals with the complex skills required to be developed for effective team work. Necessary care has also been taken to include important skill areas of allied trades as prescribed in the syllabus.

The availability of a complete Instructional Media Package in an institute helps both the trainer and management to impart effective training.

The IMPs are the outcome of collective efforts of the staff members of NIMI and the members of the Media Development Committees specially drawn from Public and Private sector industries, various training institutes under the Directorate General of Training (DGT), Government and Private ITIs.

NIMI would like to take this opportunity to convey sincere thanks to the Directors of Employment & Training of various State Governments, Training Departments of Industries both in the Public and Private sectors, Officers of DGT and DGT field institutes, proof readers, individual media developers and coordinators, but for whose active support NIMI would not have been able to bring out this materials.

Chennai - 600 032

EXECUTIVE DIRECTOR

ACKNOWLEDGEMENT

National Instructional Media Institute (NIMI) sincerely acknowledges with thanks for the co-operation and contribution extended by the following Media Developers and their sponsoring organisations to bring out this Instructional Material (**Trade Theory**) for the trade of **GEO - Informatic Assistant NSQF Level - 4 (Revised 2022)** under **IT & ITES** Sector for ITIs.

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NIMI records its appreciation for the Data Entry, CAD, DTP operators for their excellent and devoted services in the process of development of this Instructional Material.

NIMI also acknowledges with thanks the invaluable efforts rendered by all other NIMI staff who have contributed towards the development of this Instructional Material.

NIMI is also grateful to everyone who has directly or indirectly helped in developing this Instructional Material.

INTRODUCTION

TRADE PRACTICAL

The trade practical manual is intended to be used in practical workshop. It consists of a series of practical exercises to be completed by the trainees during the Course of the **GEO- Informatics Assistant** Trade supplemented and supported by instructions/ informations to assist in performing the exercises. These exercises are designed to ensure that all the skills in compliance with NSQF LEVEL - 4 (Revised 2022) syllabus are covered.

| | |
|-----------|--|
| Module 1 | Trade and Orientation |
| Module 2 | Computer Components and Windows Operating System |
| Module 3 | Computer Hardware Basic and Software Installation |
| Module 4 | Word Processing Software |
| Module 5 | Spread Sheet Application & PowerPoint Presentation |
| Module 6 | Image Editing Using Photoshop |
| Module 7 | Database Management Systems and Using MS Access |
| Module 8 | Configuring and Using Networks |
| Module 9 | Internet Concepts |
| Module 10 | Introduction to GIS Software |
| Module 11 | GIS Database / Digitization |
| Module 12 | Principles of Remote Sensing |
| Module 13 | Platforms, Sensors and Data Products |
| Module 14 | Digital Image Processing |
| Module 15 | Image Interpretation and Feature Extraction |
| Module 16 | Digital Cartography |
| Module 17 | Global Positioning System |
| Module 18 | Differential Global Positioning System |

The skill training in the shop floor is planned through a series of practical exercises centred around some practical project. However, there are few instances where the individual exercise does not form a part of project.

While developing the practical manual a sincere effort was made to prepare each exercise which will be easy to understand and carry out even by below average trainee. However the development team accept that there is a scope for further improvement. NIMI looks forward to the suggestions from the experienced training faculty for improving the manual.

TRADE THEORY

The manual of trade theory consists of theoretical information for the Course of the **GEO - Informatics Assistant** Trade. The contents are sequenced according to the practical exercise contained in NSQF LEVEL - 4 (Revised 2022) syllabus on Trade practical. Attempt has been made to relate the theoretical aspects with the skill covered in each exercise to the extent possible. This correlation is maintained to help the trainees to develop the perceptual capabilities for performing the skills.

The Trade Theory has to be taught and learnt along with the corresponding exercise contained in the manual on trade practical. The indications about the corresponding practical exercises are given in every sheet of this manual.

It will be preferable to teach/learn the trade theory connected to each exercise atleast one class before performing the related skills in the shop floor. The trade theory is to be treated as an integrated part of each exercise.

The material is not for the purpose of self learning and should be considered as supplementary to class room instruction.

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LEARNING / ASSESSABLE OUTCOME

On completion of this book you shall be able to

| S.No | Learning Outcome | Ref. Ex.No |
|------|---|------------|
| 1 | Identify various components of a desktop computer and familiarise with computer operating system following safety precaution. (NOS: SSC/N3022) | 1 - 14 |
| 2 | Install and set up operating system and related software in a computer. (NOS: SSC/N3022) | 15 - 22 |
| 3 | Create, format and edit document using word processing application software. (NOS: SSC/N3022) | 23 - 29 |
| 4 | Create, format, edit and develop a workbook by using spreadsheet application software & prepare and customize slides for power point presentation. (NOS: SSC/N3022) | 30 - 41 |
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| 8 | Analyze and manage data using GIS software. (NOS: SSC/N9470) | 66 - 70 |
| 9 | Plan, capture, store, manipulate and present spatial or geographic data by using GIS. (NOS: SSC/N9471) | 71 - 90 |
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| 13 | Plan and implement Digital Cartography process for collection of data and produce maps. (NOS: SSC/N9475) | 123 - 127 |
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SYLLABUS FOR - GEO - INFORMATICS ASSISTANT

| Duration | Reference Learning Outcome | Professional Skills (Trade Practical) With Indicative Hours | Professional Knowledge (Trade Theory) |
|---|---|--|--|
| Professional Skill 42 Hrs; Professional Knowledge 12 Hrs | Identify various components of a desktop computer and familiarize with computer operating system following safety precaution. (NOS: SSC/N3022) | <ol style="list-style-type: none"> 1. Visit to various sections of the institute and identify location of various installations. (5 hrs.) 2. Identify safety signs for danger, warning, caution & personal safety message. (4 hrs.) 3. Use of personal protective equipment (PPE). (3 hrs.) 4. Practice elementary first aid. (4 hrs.) 5. Preventive measures for electrical accidents & steps to be taken in such accidents. (4 hrs.) 6. Use of Fire extinguishers. (3 hrs.) | <p>Familiarization with the working of Industrial Training Institute system.</p> <p>Importance of safety and precautions to be taken in the industry/shop floor.</p> <p>Introduction to PPEs. Introduction to First Aid. Response to emergencies e.g. power failure, fire, and system failure.</p> <p>Importance of housekeeping & good shop floor practices.</p> <p>Occupational Safety & Health: Health, Safety and Environment guidelines, legislations & regulations as applicable. (06 hrs)</p> |
| | | <ol style="list-style-type: none"> 7. Identify computer peripherals and internal components of a disassembled desktop computer. (3 hrs.) 8. Assemble components of desktop computer. (3 hrs.) 9. Practice on Windows interface and navigating windows. (3 hrs.) 10. Practice on managing files and folders using removable drives. (4 hrs.) 11. Customize the desktop settings and manage user accounts. (2 hrs.) 12. View system properties and control panel details. (2 hrs.) 13. Work with keyboard shortcut commands. (2 hrs.) 14. Print and scan document using different commands. (2 Hrs.) | <p>Introduction to computer system. Concepts of Hardware and Software.</p> <ul style="list-style-type: none"> • Function of motherboard components and various processors. • Various Input/ Output devices in use and their features. • Introduction to operating System • Main features of Windows OS • Concept of various shortcut commands. (06 hrs) |
| Professional Skill 21 Hrs; Professional Knowledge 06 Hrs | Install and set up operating system and related software in a computer. (NOS: SSC/N3022) | <ol style="list-style-type: none"> 15. View the BIOS settings and their modifications. (3 hrs.) 16. Identify and rectify common hardware and software issues. (3 hrs.) 17. Install Windows operating system. (3 hrs.) 18. Format hard disk and create partition. (3 hrs.) 19. Install necessary application software for Windows i.e. Office Package, PDF Reader, Media Player etc. (3 hrs.) 20. Configure Bluetooth and Wi- Fi settings. (2 hrs.) | <ul style="list-style-type: none"> • Introduction to the booting process. • BIOS settings and their modification, introduction to various types of memories and their features. • Basic hardware and software issues and their solution. • Formatting and loading OS and Application software and antivirus. (06 hrs) |

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| | | <p>21. Install Drivers for printer, scanner, webcam and DVD etc. (2 hrs.)</p> <p>22. Burn data, video and audio files on CD/ DVD using application software. (2 hrs.)</p> | |
| <p>Professional Skill 21 Hrs; Professional Knowledge 06 Hrs</p> | <p>Create, format and edit document using word processing application software. (NOS: SSC/N3022)</p> | <p>23. Familiarization with the Word Window Components. (2 hrs.)</p> <p>24. Creating, saving and editing documents using Word. (3 hrs.)</p> <p>25. Inserting and formatting tables and other objects. (3 hrs.)</p> <p>26. Using templates, autocorrect tools, and mail merge tool. (3 hrs.)</p> <p>27. Working with Page layout settings and printing documents. (3 hrs.)</p> <p>28. Typing practice using open source typing tutor tools. (4 hrs.)</p> <p>29. Practice of using shortcut keys. (3 hrs.)</p> | <ul style="list-style-type: none"> • Introduction to various applications in MS office. Introduction to Word features, Office button, Toolbars. • Concept of Creating, saving and formatting documents. Concept of inserting objects Macro, mail-merge, templates and other tools in Word. • Page setup and printing documents using Word. (06 hrs) |
| <p>Professional Skill 21 Hrs; Professional Knowledge 06 Hrs</p> | <p>Create, format, edit and develop a workbook by using spreadsheet application software & prepare and customize slides for power point presentation. (NOS: SSC/N3022,)</p> | <p>30. Opening MS Excel and familiarize with basic application components. (2 hr.)</p> <p>31. Creating, Saving and Formatting Excel Spreadsheets. (2 hrs.)</p> <p>32. Using Absolute and Relative referencing, linking sheets, Conditional formatting etc. (2 hrs.)</p> <p>33. Using Excel functions of all major categories. (3 hrs.)</p> <p>34. Using various data types in Excel, Sorting, filtering and validating data. (2 hrs.)</p> <p>35. Creating and formatting charts. (2 hrs.)</p> <p>36. Importing & Exporting Excel Data. (2 hrs.)</p> <p>37. Modifying Excel Page setup and printing. (2 hr.)</p> <p>38. Open power point presentation and familiarize with basic application components. (2 hrs.)</p> <p>39. Creating Slide shows, Inserting objects. (1 hrs.)</p> <p>40. Animating Slide transitions and Objects. (1 hrs.)</p> <p>41. Creating a simple presentation. (1 hrs.)</p> | <ul style="list-style-type: none"> • Introduction to Excel features and Data Types. • Cell referencing. Use of functions of various categories, linking Sheets. Introduction to various functions in a categories of Excel • Concepts of Sorting, Filtering and Validating Data Analyzing data using charts, data tables, pivot tables. • Introduction to Power Point and its advantages • Creating slide shows. • Fine tuning the presentation and good presentation technique. (06 hrs) |
| <p>Professional Skill 42 Hrs; Professional Knowledge 12Hrs</p> | <p>Design, Create, format and edit images using P h o t o s h o p software. (NOS: SSC/ N9491)</p> | <p>42. Practice on various tools- Brush Tool. Pencil & Eraser Tools, the Red Eye Tool. (5 hrs.)</p> | <ul style="list-style-type: none"> • Introduction to Photoshop • Introduction to the properties and editing of images. • Navigating Photoshop |

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| | | <p>43. Zooming & Panning an Image, Working with Multiple Images, Rulers, Guides & Grids, Undoing Steps with History, Adjusting Colour with the New Adjustments Panel, the Image Size Command. (10 hrs.)</p> <p>44. Cropping & Straightening an Image, Adjusting Canvas Size & Canvas Rotation, Selecting with the Elliptical Marquee Tool, Using the Magic Wand & Free Transform Tool, Selecting with the Regular & Polygonal Lasso Tools. (8 hrs.)</p> <p>45. Using the Magnetic Lasso Tool, Using the Quick Selection Tool's Refine Edge, Modifying Selections. (7 hrs.)</p> <p>46. Understanding the Background Layer, Creating, Selecting, Linking & Deleting Layers, Locking & Merging Layers, Copying Layers, Using Perspective & Layer Styles, Filling & Grouping Layers. (8 hrs.)</p> <p>47. Blending Modes, Opacity & Fill. Creating & Modifying Text. (7 hrs.)</p> <p>48. Working with Colours and Swatches, Creating & Using Gradients, Creating & Working with Brushes. (6 hrs.)</p> | <ul style="list-style-type: none"> • Menus and panels • Opening new files • Opening Existing files. (12hrs) |
| <p>Professional Skill 63 Hrs; Professional Knowledge 18Hrs</p> | <p>Plan, create and manage database file by using MS Access. (NOS: SSC/N9469)</p> | <p>49. Creating database and designing a simple tables in Access. (10 hrs.)</p> <p>50. Practice enforcing Integrity constraints and modifying the properties of tables and fields. (10 hrs.)</p> <p>51. Creation of Relationships and join Tables. (8 hrs.)</p> <p>52. Queries with various criteria and calculations. (8 hrs.)</p> <p>53. Modifying form design with controls, macros and events. (9 hrs.)</p> <p>54. Importing and exporting data to and from Access. (9 hrs.)</p> <p>55. Compressing and Encrypting database. (9 hrs.)</p> <p>56. Viewing Network connections. (4 hrs.)</p> | <ul style="list-style-type: none"> • Concepts of Data, Information and Databases. • What is database system, purpose of database system, view of data, relational database, database architecture. • Rules for designing good tables. • Integrity rules and constraints in a table. • Introduction to view, data independence, security, updates on views, comparison between tables and views. • Relationships in table. • Introduction to various types of queries and their uses. (18 hrs) |
| <p>Professional Skill 84 Hrs; Professional Knowledge 24Hrs</p> | <p>Plan, install setup/ configure, and secure computer network including Internet. (NOS: SSC/N3022)</p> | <p>57. Connecting a computer to a network and sharing of Devices files and Folders. (8 hrs.)</p> <p>58. Familiarization with various Network devices, Connectors and Cables. (8 hrs.)</p> <p>59. IP Addressing and Subnet for IPv4 / IPV6, Masking, pinging to test networks. (8 hrs.)</p> | <ul style="list-style-type: none"> • Introduction to Computer Networks Necessity and Advantages. • Client Server and peer to peer networking concepts. • Network topologies. Introduction to LAN, WAN and MAN |

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| | | <p>60. Network basic and configuration (14 hrs.)</p> <ul style="list-style-type: none"> • Setting IP addresses. • Sharing files and folders. • Network Troubleshooting. • PING Test, IP configuration Etc. | <ul style="list-style-type: none"> • Network components, viz. Modem Hub, Switch, Router, Bridge, Gateway etc. • Network Cables, Wireless networks and Blue Tooth technology. • Logical and physical Addresses, Classes of Networks. • Network security & firewall concepts. (12hrs) |
| | | <p>61. Browsing the Internet for information. (8 hrs.)</p> <p>62. Creating and using e-mail for communication. (6 hrs.)</p> <p>63. Communication using text, video chatting and social networking sites. (10 hrs.)</p> <p>64. Identifying various threats to the system connected to the net. (8 hrs.)</p> <p>65. Protecting the computer against various internet threats. (8 hrs.)</p> <p>66. Familiarization with GIS Software Installation, Sample Data, starting and Stopping QGIS. (10 hrs.)</p> | <ul style="list-style-type: none"> • 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, Social Networking concepts. • Concept of Cloud storage and Open Web Server • Introduction to Internet Security Threats and attacks, Malicious Software types, Internet security products and their advantages. (12hrs) |
| <p>Professional Skill 42 Hrs; Professional Knowledge 12 Hrs</p> | <p>Analyze and manage data using GIS software. (NOS: SSC/ N9470)</p> | <p>67. Explore various toolbars for data and compose maps, Create, Edit, Manage and View data. (8 hrs.)</p> <p>68. Identify various toolbars to Analyze data, Digitizing, Map Composer, Symbology. (8 hrs.)</p> <p>69. Familiarization with User Interface, Menu Bar, toolbar, Map Legend, Map View, Status Bar, Keyboard shortcuts. (8 hrs.)</p> <p>70. How to use Context help Rendering, Measuring, Identify features Annotation Tools. (8 hrs.)</p> | <ul style="list-style-type: none"> • Definition and scope of GIS. • Functional requirements of GIS, GIS components. • Cartography-GIS interface. • Recent trends and applications of GIS. • Open source GIS. (12 hrs) |
| <p>Professional Skill 84 Hrs; Professional Knowledge 24Hrs</p> | <p>Plan, capture, store, manipulate and present spatial or geographic data by using GIS.</p> | <p>71. Introduction to Creation of a shape file, adding attributes. (5 hrs.)</p> <p>72. Introduction to Database Creation (Data Entry, Editing) & Topology Creation. (5 hrs.)</p> <p>73. Introduction to Linking of Spatial data with non- Spatial data sets. (4 hrs.)</p> <p>74. Introduction to Spatial Analysis (Raster & Vector). (4 hrs.)</p> <p>75. Introduction to Spatial Analysis GIS analysis: proximity thematic mapping and Over lay. (5 hrs.)</p> | <ul style="list-style-type: none"> • Geographic data: Spatial and non-spatial. • Data models: Raster and vector. • Database Management System (DBMS). • Data structures: Relational, hierarchical and network. • Data Input: Digitization of maps and imageries. • Coordinate transformation. • Attribute data generation. (24hrs) |

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| | | <p>76. Introduction to Spatial data input and Geo referencing Digitization of maps and imageries. (5 hrs.)</p> <p>77. Introduction to coordinate transformation. (4 hrs.)</p> <p>78. Attribute data generation. (5 hrs.)</p> <p>79. Introduction to Spatial data base creation. (4 hrs.)</p> <p>80. Creation of non-spatial data sets into DBF format. (4 hrs.)</p> <p>81. Overview of projection Support. (3 hrs.)</p> <p>82. Practice of Re projection of data. (3 hrs.)</p> <p>83. Practice of Default datum transformations. (5 hrs.)</p> <p>84. Explore Supported Data Formats. (3 hrs.)</p> <p>85. Explore The Vector properties Dialog. (4 hrs.)</p> <p>86. Explore Editing of shape files. (4 hrs.)</p> <p>87. Explore Query Builder, Field Calculator. (4 hrs.)</p> <p>88. Practice of various quires in query builder. (5 hrs.)</p> <p>89. Explore Raster properties Dialog. (4 hrs.)</p> <p>90. Practice use of Raster Calculator. (4 hrs.)</p> | |
| <p>Professional Skill 63 Hrs; Professional Knowledge 18 Hrs</p> | <p>Select, install and operate various remote sensing software and record the data. (NOS: SSC/N9472)</p> | <p>91. Familiarization with RS Software (Any open source-ILWIS) - installation, Starting and Stopping ILWIS. (4 hrs.)</p> <p>92. Introduction to opening and saving and reopening projects in ILWIS. (4 hrs.)</p> <p>93. Observing Title bar, Menu bar, Standard toolbar, Object. (3 hrs.)</p> <p>94. Identify various toolbars Selection toolbar, Command line catalog, Status bar and operations/Navigator pane. (5 hrs.)</p> <p>95. Use of Operation tree, Operation List, Navigator, Output, View data. (7 hrs.)</p> <p>96. Explore data and compose maps, Create, edit manage and export data. (5 hrs.)</p> <p>97. Analyzing data Digitizing, Map Composer, Symbology User Interface, Map Legend, Map View. (8 hrs.)</p> <p>98. Explore Measuring, identify features Annotation Tools. (3 hrs.)</p> | <ul style="list-style-type: none"> • Definition, History • Types and scope • Advantages of remote sensing, Disadvantage of remote sensing • Stages in remote sensing data acquisition, Components of a Remote Sensing System Electromagnetic Radiation (ER) and electromagnetic spectrum, Ultraviolet, Visible Range, Infra-red Region, Thermal Region, Microwave Region • Interaction of EMR with atmosphere-Reflection, Refraction, Absorption Scattering • Interaction of EMR with Earth's surface features: Absorption, Transmission, Reflection. • Atmospheric windows. (18 hrs) |

| | | | |
|---|---|---|---|
| | | <p>99. Identify user interface with DIP software (ILWIS). (3 hrs.)</p> <p>100. Familiarization with loading of digital data into DIP software. (5 hrs.)</p> <p>101. Exploring how to convert digital data into image processing software format. (5 hrs.)</p> <p>102. Practice on how to apply Projection and datum for newly loaded data. (5 hrs.)</p> <p>103. Practice on changing Projection and datum for newly loaded data. (6 hrs.)</p> | |
| <p>Professional Skill 63 Hrs; Professional Knowledge 18 Hrs</p> | <p>Select different platforms & various data products, sensors used in different platforms and their use. (NOS: SSC/N9473)</p> | <p>104. Identify different type of data products available. (12 hrs.)</p> <p>105. Identify Images from different Satellites and sensors used. (12 hrs.)</p> <p>106. Identify features of Digital images in Hard Copy. (15 hrs.)</p> <p>107. Identify the Natural Color Composite satellite image. (12 hrs.)</p> <p>108. Identify the False Color Composite satellite image. (12 hrs.)</p> | <ul style="list-style-type: none"> • Definition platforms, Sensors • Remote sensing platforms: Ground based, Airborne, Space borne • Types of satellite orbit: Geostationary Orbit, Near polar Orbit, Sun- synchronous orbit • Sensors: Imaging Sensors, Non imaging sensors, Active, passive MSS(Multi Spectral Scanner) TM (Thematic Mapper), ETM+ (Enhanced Thematic Mapper+), LISS (Linear Imaging Self Scanning), PAN (Panchromatic), HRV (High Resolution Visible), SAR (Synthetic Aperture Radar), WiFS(Wide Field Sensor) AWiFS (Advanced Wide Field Sensor) AVHRR (Advanced Very High Resolution Radiometer), OLI (Operational Land Imager) • Remote sensing data products: Hard Copy Maps, Natural Colour Composite (NCC), False Colour Composite (FCC) • Earth Observation Satellites- IRS LANDSAT, SPOT, IKONOS, Quick Bird Types & characteristics of sensors on satellites, resolution, swath etc. (18 hrs) |
| <p>Professional Skill 126 Hrs; Professional Knowledge 36Hrs</p> | <p>Plan and implement Digital image processing techniques by selecting appropriate procedure, interpret images and feature extraction. (NOS: SSC/N9474)</p> | <p>109. Practice of how to Import Data in image processing software. (6 hrs.)</p> <p>110. Practice of Image Geo- referencing, Registration /Rectification. (8 hrs.)</p> <p>111. Practice of Mosaic creation, Sub Setting, Visualization of single band images. (8 hrs.)</p> <p>112. Practice of displaying of Individual pixel Values. (6 hrs.)</p> | <ul style="list-style-type: none"> • Digital Image, Digital Data Format, LUT. Radiometric Correction of Data Geometric Correction of Data • Image Enhancements Techniques. Band Ratios, Vegetation Indices, Resolution Merge Techniques o'r Image Fusion |

| | | | |
|---|--|--|---|
| | | <p>113. Displaying pixel values of more than one band. (4 hrs.)</p> <p>114. Displaying Color Composites. (4 hrs.)</p> <p>115. Introduction to supervised classification. (4 hrs.)</p> <p>116. Practicing the different controls used in supervised classification. Defining clusters, Accuracy assessment. (6 hrs.)</p> <p>117. Introduction to unsupervised classification. (5 hrs.)</p> <p>118. Practicing unsupervised classification Defining, Classes, Recording, Accuracy assessment, Area calculation. (8 hrs.)</p> <p>119. Understand the difference of Supervised and Unsupervised classification. (6 hrs.)</p> | <ul style="list-style-type: none"> • Thematic Information Extraction Procedures: Multi-spectral patterns, Spectral Discrimination and Signature Bank, Supervised and Unsupervised Classification Methods, Multi-date Data Analysis and change detection processes. Accuracy assessment.(18 hrs) |
| | | <p>120. Study of Satellite Imagery in Different bands and Visual interpretation. (31 hrs.)</p> <p>121. Preparation of land use map from satellite imagery. (20 hrs.)</p> <p>122. Interpretation of Cultural details from high resolution imagery. (10 hrs.)</p> | <ul style="list-style-type: none"> • Factors affecting image interpretation • Digital image, Resolution-Spectral Spatial, Radiometric, Temporal True colour image, False colour image • Spectral Signature, spectral reflectance curve, Significance of spectral signature in remote sensing Spectral Signature for Vegetation Soil, Water, Snow • Image characteristics and preparation of image interpretation keys Elements of Image interpretation Basic Principle of Image Interpretation, Visual image Interpretation: tone, shape, size pattern, texture, shadow and association. • Methods and techniques of image interpretation, Methods Visual and DIP, Types of interpretation Qualitative and Quantitative, Visual image interpretation, Digital Image interpretation. (18 hrs) |
| Professional Skill 42 Hrs; Professional Knowledge 12 Hrs | Plan and implement Digital Cartography process for collection of data and produce maps. (NOS: SSC/N9475) | <p>123. Identification of Composer items, Manage items. (8 hrs.)</p> <p>124. Familiarization with Revert and Restore tools, Atlas ' generation. (10 hrs.)</p> <p>125. Generation of Output Map, Inserting Let Long. (8 hrs.)</p> | <ul style="list-style-type: none"> • Essentials of map making: Scale, type of scales coordinate system, map projection, map generalization and symbolization, map designing • Types and series of maps, topo sheets numbering system (12 hrs) |

| | | | |
|---|---|---|--|
| | | <p>126. Map composition using Map projection, Map generalization and symbolization. (8 hrs.)</p> <p>127. Understanding different features of topo sheets, Numbering system of topo sheets. (8 hrs.)</p> | |
| <p>Professional Skill 42 Hrs; Professional Knowledge 12 Hrs</p> | <p>Select datum units and scale, identify GPS, Signal, code, Biases and measure the location. (NOS: SSC/N9476)</p> | <p>128. Identification of different types of GPS. (6 hrs.)</p> <p>129. Identification of various buttons of GPS. (4 hrs.)</p> <p>130. Demonstration on operating GPS. (4 hrs.)</p> <p>131. Selection of datum units and scale. (4 hrs.)</p> <p>132. Practice on GPS measurement. (10 hrs.)</p> <p>133. Collection of GCPs. (4 hrs.)</p> <p>134. Introduction to Mobile mapping. (4 hrs.)</p> <p>135. Familiarization to various data collecting apps freely available on internet. (3 hrs.)</p> <p>136. Transferring of GPS data in to GIS software. (3 hrs.)</p> | <ul style="list-style-type: none"> • Introduction to Global positioning System GNSS • Coordinate and Time system • Satellite and conversional geodetic system • GPS, Signal, code and Biases • GPS segment organization • GPS Survey Methods. Basic geodetic co-ordinate • Ground Support equipment • GPS receiver Types • Modes of measurements and Post processing of data • Accuracy of GPS measurements and application of GPS. (12 hrs) |
| <p>Professional Skill 42 Hrs; Professional Knowledge 12 Hrs</p> | <p>Select and set up DGPS for Calculating position, measuring distance, data downloading and processing in software. (NOS: SSC/N9477)</p> | <p>137. Introduction to Various components of DGPS. (8 hrs.)</p> <p>138. Familiarization to operating base and rover. (6 hrs.)</p> <p>139. Setting up Base and Rover RTK. (6 hrs.)</p> <p>140. Options and Menu settings. (4 hrs.)</p> <p>141. Calculating position. (6 hrs.)</p> <p>142. Measuring Distance. (4 hrs.)</p> <p>143. Triangulation (Geodetic). (4 hrs.)</p> <p>144. Data downloading and processing in software. (4 hrs.)</p> | <ul style="list-style-type: none"> • Introduction to DGPS • Components of DGPS • Types of DGPS • Errors in DGPS • Survey Methods in DGPS: Rapid static method, Traverse method, and Triangulation Method (12 hrs) |
| <p>Professional Skill 42 Hrs; Professional Knowledge 12Hrs</p> | <p>Publish Files on Geo server using Web GIS.</p> | <p>145. Creation of shape files in QGIS. (4 hrs.)</p> <p>146. Importing data to post gres. (4 hrs.)</p> <p>147. Connecting post gres to Geo server. (4 hrs.)</p> <p>148. Publishing File on Geo server. (4 hrs.)</p> <p>149. Creating Map services, Feature Services Coverage services. (4 hrs.)</p> <p>150. Google earth: introduction, digitization-point, line, poly, converting kml to shape file and vice versa, calculating distance. (4 hrs.)</p> | <ul style="list-style-type: none"> • Open source Software- QGIS, post gres, Geo server • Services- WMS, WFS, WCS • Introduction to Bhuvan • Introduction to Google Earth (12 hrs) |

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| | | <p>151. Downloading images from google earth and mosaicing them. (4 hrs.)</p> <p>152. Demonstration and use of Bhuvan portal. (5 hrs.)</p> <p>153. Downloading satellite data from Bhuvan. (4 hrs.)</p> <p>154. Use of Bhuvan portal (ISRO) for activity planning at Panchayat Level. (5 hrs.)</p> | |
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Familiarization with the Working of Industrial Training Institute System

Objectives: At the end of this lesson you shall be able to

- to familiarise with working of ITI
- identify the staff structure of the institute
- identify the available trades in the institute and their function
- brief about the stores procedure.

Introduction**Directorate General of Training (DGT)**

Directorate General of Training (DGT) in Ministry of Skill Development & Entrepreneurship is an apex organization for development and coordination of the vocational training including Women's Vocational Training of the employable youth in the country and to provide skilled manpower to the economy.

Two verticals of Directorate General of Employment & Training (DGE&T) working under Deputy Director General (Training) & Deputy Director General (Apprenticeship Training) along with their support systems were transferred to Ministry of Skill Development & Entrepreneurship (MSDE).

DGT affiliated institutions offers a wide range of training courses catering to the needs of different segments in the Labour market. Courses are available for school leavers, ITI pass outs, ITI instructors, industrial workers, technicians, junior and middle level executives, supervisors/foremen, women, physically disabled persons and SC/STs.

It also conducts training oriented research and develops instructional media packages for the use of trainees and instructors etc.

DGT acts a secretariat and implementing arm of National Council for Vocational Training (NCVT).

Training Institutes under DGT

- 13350 Industrial Training institutes (ITIs)
- 31 Central Institutes
- 10 Advanced Training Institutes (ATIs)
- 2 ATI-EPs (Advanced Training Institutes - Electronic

Process Instrumentation)

- 2 Foremen Training Institutes (FTIs)
- 1 Central Training Institutes (CTI)
- 1 National Vocational Training Institute (NVTI) for Women
- 15 Regional Vocational Training Institutes (RVITs) for Women
- 12 Private Institute for Training of Trainers (IToTs)
- 2 State Government IToTs
- Central Staff Training and Research Institute (CSTARI)
- National Instructional Media Institute (NIMI)

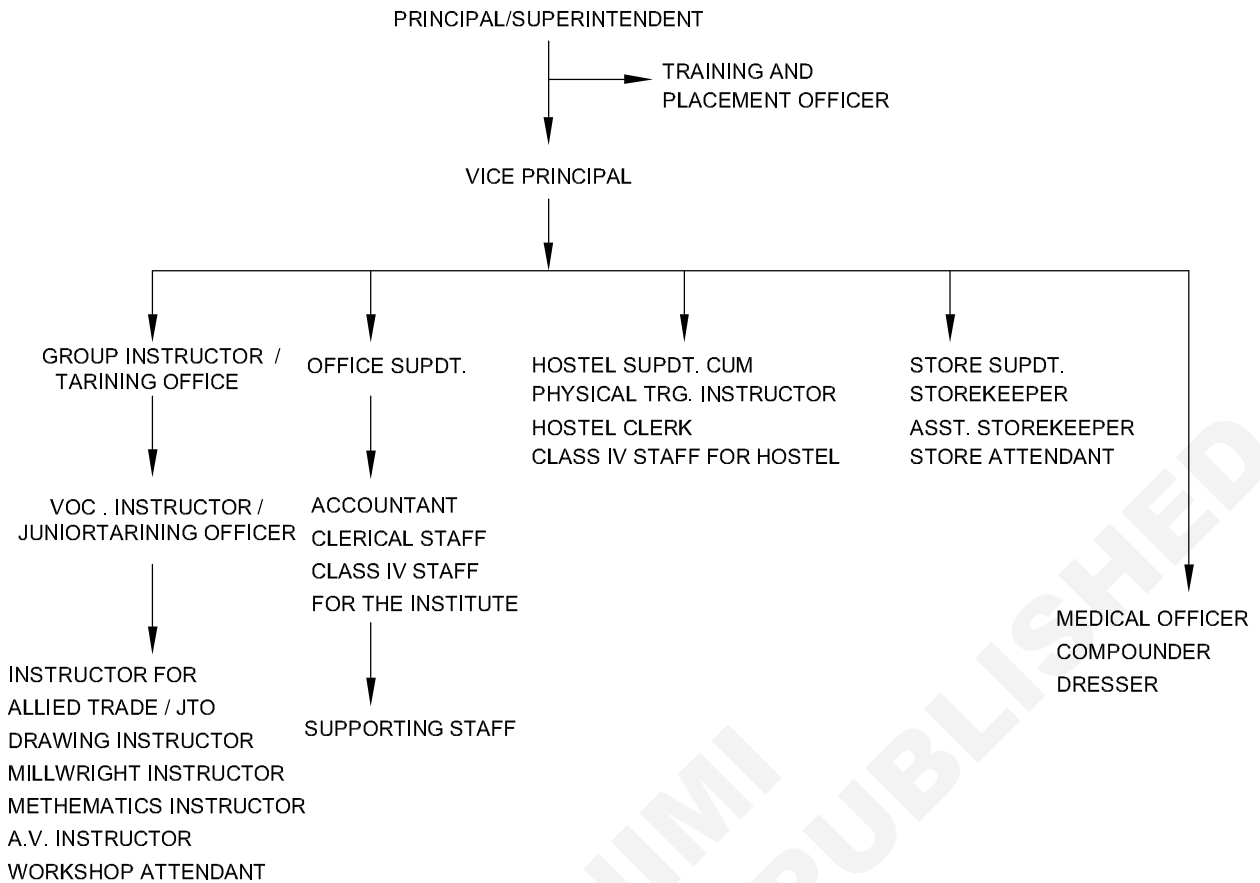
The industrial training institute throughout India follow the same syllabus pattern given by the National council for Vocational Training (NCVT). In India there are about 13,350 Government ITIs and Private ITI 's Based on the Govt. of India, Ministry of Skill Development and Entrepreneurship (MSDE) Annual report of 2016-2017. The Government Industrial Training Institute in each state work under the Directorate of Employment and Training which is a department under the Labour Ministry in most of the states.

The head of the industrial training institute is the Principal, under whom there is one vice-principal, Group Instructor(s) Training officers and a number of Vocational Instructor(s) Assitant Training Officer(s) and Junior Training Officer and so on as shown in the Organisation Chart of ITI. (Fig 1)

In every industrial training institute there is a store and the in charge of the store is storekeeper for inward and outward movement of tools, equipment and consumable. The instructor will indent the training requirement on receiving from stores, the instructor will issue the training requirement to the trainees according to the graded exercises as per syllabus.

Fig 1

ORGANISATIONAL CHART OF ITI



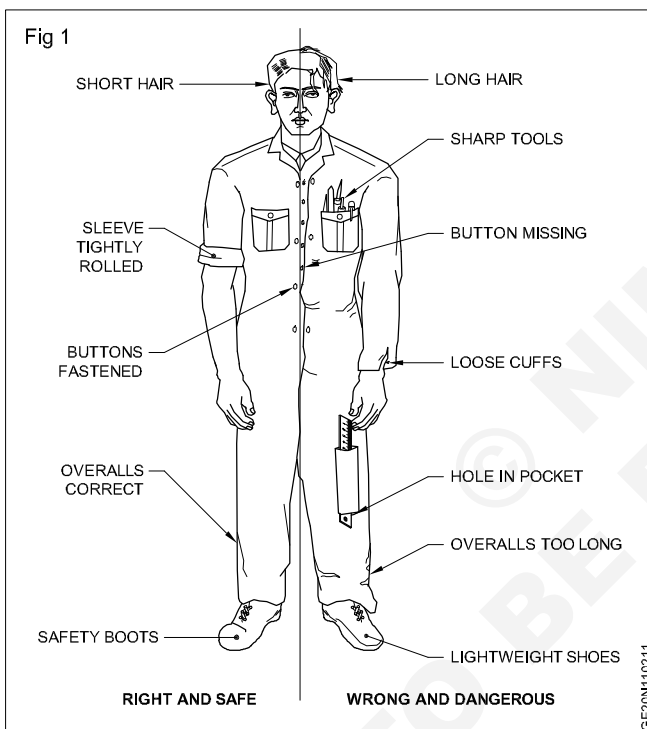
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Importance of Safety and Precautions to be Taken in the Industry/Shop Floor

Objectives: At the end of this lesson you shall be able to

- state the importance of safety
- list out the safety precautions to be observed in a industry/shop floor
- list out the personal safety precautions to be observed in machine shop
- list out the safety precautions to be observed while working on the machines.

Generally accidents do not happen; they are caused. Most accidents are avoidable. A good craftsman, having a knowledge of various safety precautions, can avoid accidents to himself and to his fellow workers and protect the equipment from any damage. To achieve this, it is essential that every person should follow safety procedure. (Fig 1)



Safety in a workshop can be broadly classified into 3 categories.

- General safety
- Personal safety
- Machine safety

General safety

- Keep the floor and gangways clean and clear.
- Move with care in the workshop, do not run.
- Don't leave the machine which is in motion.
- Don't touch or handle any equipment/ machine unless authorised to do so.
- Don't walk under suspended loads.

- Don't cut practical jokes while on work.
- Use the correct tools for the job.
- Keep the tools at their proper place.
- Wipe out split oil immediately.
- Replace worn out or damaged tools immediately.
- Never direct compressed air at yourself or at your co-worker.
- Ensure adequate light in the workshop.
- Clean the machine only when it is not in motion.
- Sweep away the metal cuttings.
- Know everything about the machine before you start it.

Personal safety

- Wear a one piece overall or boiler suit.
- Keep the overall buttons fastened.
- Don't use ties and scarves.
- Roll up the sleeves tightly above the elbow.
- Wear safety shoes or boots
- Cut the hair short.
- Don't wear a ring, watch or chain.
- Never lean on the machine.
- Don't clean hands in the coolant fluid.
- Don't remove guards when the machine is in motion.
- Don't use cracked or chipped tools.
- Don't start the machine until
 - the workpiece is securely mounted
 - the feed machinery is in the neutral
 - the work area is clear.
- Don't adjust clamps or holding devices while the machine is in motion.
- Never touch the electrical equipment with wet hands.
- Don't use any faulty electrical equipment.
- Ensure that electrical connections are made by an authorised electrician only.

- Concentrate on your work. Have a calm attitude.
- Do things in a methodical way.
- Don't engage yourself in conversation with others while concentrating on your job.
- Don't distract the attention of others.
- Don't try to stop a running machine with hands.

Machine safety

- Switch off the machine immediately if something goes wrong.
- Keep the machine clean.
- Replace any worn out or damaged accessories, holding devices, nuts, bolts etc as soon as possible.
- Do not attempt operating the machine until you know how to operate it properly.

- Do not adjust tool or the workpiece unless the power is off.
- Stop the machine before changing the speed.
- Disengage the automatic feeds before switching off.
- Check the oil level before starting the machine.
- Never start a machine unless all the safety guards are in position.
- Take measurements only after stopping the machine.
- Use wooden planks over the bed while loading and unloading heavy jobs.

Safety is a concept, understand it. Safety is a habit, cultivate it.

Personal Protective Equipment (PPE)

Objectives: At the end of this lesson you shall be able to

- state what is personal protective equipment and its purpose
- name the two categories of personal protective equipment
- list the most common type of personal protective equipment
- list the conditions for selection of personal protective equipment.

Personal Protective Equipment (PPE)

Devices, equipments, or clothing used or worn by the employees, as a last resort, to protect against hazards in the workplace. The primary approach in any safety effort is that the hazard to the workmen should be eliminated or the workmen through the use of personal protective controlled by engineering methods rather than protecting the workmen through the use of personal protective equipment (PPE). Engineering methods could include design change, substitution ventilation, mechanical handling, automation, etc. in situations where it is not possible to introduce any effective engineering methods for controlling hazards, the workman shall use appropriate types of PPE.

As changing times have modernized the workplace, government and advocacy groups have brought more safety standards to all sorts of work environments. The Factories Act, 1948 and several other labour legislations 1996 have provisions for effective use of appropriate types of PPE. Use of PPE is very important.

Ways to ensure workplace safety and use personal protective equipment (PPE) effectively.

- Workers to get up-to date safety information from the regulatory agencies that oversees workplace safety in their specific area.
- To use all available text resources that may be in work area and for applicable safety information on how to use PPE best.
- When it comes to the most common types of personal protective equipment, like goggles, gloves or bodysuits, these items are much less effective if they are not worn at all times, or whenever a specific danger exists in a work process. Using PPE consistently will help to avoid some common kinds of industrial accidents.

- Personal protective gear is not always enough to protect workers against workplace dangers, Knowing more about the overall context of your activity can help to fully protect from anything that might threaten health and safety on the job.
- Inspection of gear throughly to make sure that it has the standard of quality and adequately protect the user should be continuously carried out.

Categories of PPE-Small's'

Depending upon the nature of hazard, the PPE is broadly divided into the following two categories.

Non-respiratory : Those used for protection against injury from outside the body, i.e. for protecting the head,eye, face, hand, arm, foot, leg and other body parts

Respiratory: Those used for protection from harm due to inhalation of contaminated air.

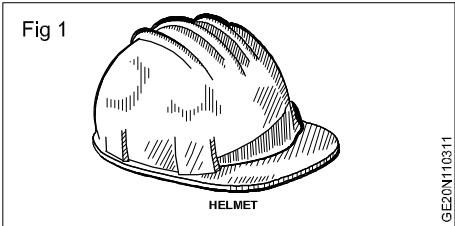
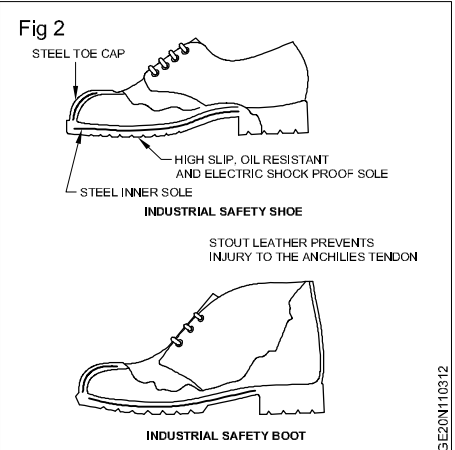
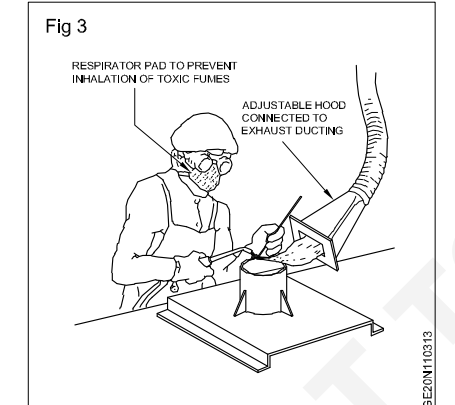
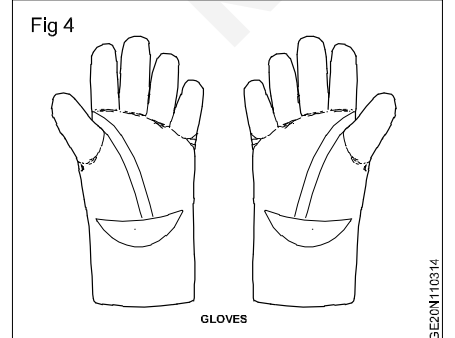
They are to meet the applicable BIS (Bureau of Indian Standards) standards for different types of PPE.

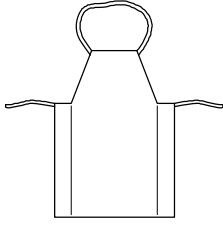
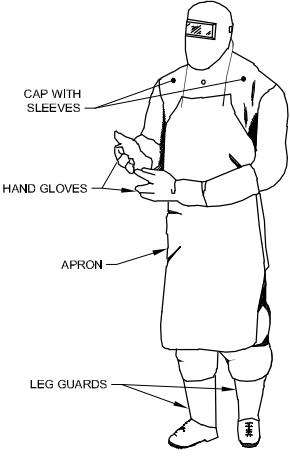
The guidelines on 'Personal Protective Equipment' is issued to facilitate the plant management in maintaining an effective programme with respect to protection of persons against hazards, which cannot be eliminated or controlled by engineering methods listed in table 1.

Table 1

| No | Title |
|------|----------------------------------|
| PPE1 | Helmet |
| PPE2 | Safety footwear |
| PPE3 | Respiratory protective equipment |
| PPE4 | Arms and hands protection |
| PPE5 | Eyes and face protection |
| PPE6 | Protective clothing and coverall |
| PPE7 | Ears protection |
| PPE8 | Safety belt harness |

Personal protective equipments and their uses and hazards are listed in Table 2

| Types of protection | Hazards | PPE to be used |
|--|---|--|
| <p>Head protection (Fig 1)</p>  <p>Fig 1</p> <p>HELMET</p> <p>GE20N110311</p> | <ol style="list-style-type: none"> 1. Falling objects 2. Striking against objects 3. Spatter | <p>Helmets</p> |
| <p>Foot protection (Fig 2)</p>  <p>Fig 2</p> <p>STEEL TOE CAP</p> <p>HIGH SLIP, OIL RESISTANT AND ELECTRIC SHOCK PROOF SOLE</p> <p>STEEL INNER SOLE</p> <p>INDUSTRIAL SAFETY SHOE</p> <p>STOUT LEATHER PREVENTS INJURY TO THE ANCHILIES TENDON</p> <p>INDUSTRIAL SAFETY BOOT</p> <p>GE20N110312</p> | <ol style="list-style-type: none"> 1. Hot spatter 2. Falling objects 3. Working wet area | <p>Leather leg guards</p> <p>Safety shoes</p> <p>Gum boots</p> |
| <p>Nose (Fig 3)</p>  <p>Fig 3</p> <p>RESPIRATOR PAD TO PREVENT INHALATION OF TOXIC FUMES</p> <p>ADJUSTABLE HOOD CONNECTED TO EXHAUST DUCTING</p> <p>GE20N110313</p> | <ol style="list-style-type: none"> 1. Dust particles 2. Fumes/gases/ vapours | <p>Nose mask</p> |
| <p>Hand Protecion (Fig 4)</p>  <p>Fig 4</p> <p>GLOVES</p> <p>GE20N110314</p> | <ol style="list-style-type: none"> 1. Heat burn due to direct contact 2. Blows spark moderate heat 3. Electric shock | <p>Hand gloves</p> |

| Types of protection | Hazards | PPE to be used |
|---|---|---|
| <p>Body protection (Fig 8, & Fig 9)</p> <div> <p>Fig 10</p>  <p>APRON</p> <p style="writing-mode: vertical-rl; transform: rotate(180deg);">GE20N11031A</p> </div> <div> <p>Fig 11</p>  <p>CAP WITH SLEEVES</p> <p>HAND GLOVES</p> <p>APRON</p> <p>LEG GUARDS</p> <p>LEG GUARDS</p> <p style="writing-mode: vertical-rl; transform: rotate(180deg);">GE20N11031B</p> </div> | <p>1. Hot particles</p> | <p>Leather aprons</p> |

Quality of PPE's

PPE must meet the following criteria with regard to its quality-provide absolute full protection against possible hazard and PPE's be so designed and manufactured out of materials that it can withstand the hazards against which it is intended to be used.

Selection of PPE's requires certain conditions

- Nature and severity of the hazard
- Type of contaminant, its concentration and location of contaminated area with respect to the source of respirable air
- Expected activity of workman and duration of work, comfort of workman when using PPE
- Operating characteristics and limitation of PPE
- Easy of maintenance and cleaning
- Conformity to Indian / International standards and availability of test certificate.

Proper use of PPEs

Having selected the proper type of PPE, it is essential that the workman wears it. Often the workman avoids using PPE. The following factors influence the solution to this problem.

- The extent to which the workman understands the necessity of using PPE
- The ease and comfort with which PPE can be worn with least interference in normal work procedures
- The available economic, social and disciplinary sanctions which can be used to influence the attitude of the workman
- The best solution to this problem is to make wearing of PPE' mandatory for every employee.
- In other places, education and supervision need to be intensified. When a group of workmen are issued PPE for the first time.

Introduction to First Aid

Objectives: At the end of this lesson you shall be able to

- **state what is first aid**
- **list the key aims of first aid**
- **explain the ABC of the first aid**
- **brief how to give first-aid for a victim who need first aid.**

First aid is defined as the immediate care and support given to an acutely injured or ill person, primarily to save life, prevent further deterioration or injury, plan to shift the victims to safer places, provide best possible comfort and finally help them to reach the medical centre/ hospital through all available means. It is an immediate life-saving procedure using all resources available within reach.

Imparting knowledge and skill through institutional teaching at younger age group in schools, colleges, entry point at industry level is now given much importance. Inculcating such habits at early age, helps to build good healthcare habits among people.

First aid procedure often consists of simple and basic life saving techniques that an individual performs with proper training and knowledge.

The key aims of first aid can be summarized in three key points:

- **Preserve life:** If the patient was breathing, a first aider would normally place them in the recovery position, with the patient leant over on their side, which also has the effect of clearing the tongue from the pharynx. It also avoids a common cause of death in unconscious patients, which is choking on regurgitated stomach contents. The airway can also become blocked through a foreign object becoming lodged in the pharynx or larynx, commonly called choking. The first aider will be taught to deal with this through a combination of 'back slaps' and 'abdominal thrusts'. Once the airway has been opened, the first aider would assess to see if the patient is breathing.
- **Prevent further harm:** Also sometimes called prevent the condition from worsening, or danger of further injury, this covers both external factors, such as moving a patient away from any cause of harm, and applying first aid techniques to prevent worsening of the condition, such as applying pressure to stop a bleed becoming dangerous.
- **Promote recovery:** First aid also involves trying to start the recovery process from the illness or injury, and in some cases might involve completing a treatment, such as in the case of applying a plaster to a small wound.

Training

Basic principles, such as knowing to use an adhesive bandage or applying direct pressure on a bleed, are often acquired passively through life experiences. However, to provide effective, life-saving first aid interventions requires instruction and practical training. This is especially true where it relates to potentially fatal illnesses and injuries, such as those that require cardiopulmonary resuscitation (CPR); these procedures may be invasive, and carry a risk of further injury to the patient and the provider. As with any training, it is more useful if it occurs before an actual emergency, and in many countries, emergency ambulance dispatchers may give basic first aid instructions over the phone while the ambulance is on the way. Training is generally provided by attending a course, typically leading to certification. Due to regular changes in procedures and protocols, based on updated clinical knowledge, and to maintain skill, attendance at regular refresher courses or re-certification is often necessary. First aid training is often available through community organization such as the Red cross and St. John ambulance.

ABC of first aid

ABC stands for airway, breathing and circulation.

- **Airway:** Attention must first be brought to the airway to ensure it is clear. Obstruction (choking) is a life-threatening emergency.
- **Breathing:** Breathing if stops, the victim may die soon. Hence means of providing support for breathing is an important next steps. There are several methods practiced in first aid.
- **Circulation:** Blood circulation is vital to keep person alive. The first aiders now trained to go straight to chest compressions through CPR methods.

When providing first aid one needs to follow some rule. There are certain basic norms in teaching and training students in the approach and administration of first aid to sick and injured.

Not to get panic

Panic is one emotion that can make the situation more worse. People often make mistake because they get panic. Panic clouds thinking and causes mistakes. First aider need calm and collective approach. If the first aider himself is in a state of fear and panic gross mistakes may result. It's far easier to help the suffering, when they know what they are doing, even if unprepared to encounter a situation. Emotional approach and response always lead

to wrong doing and may cloud one to do wrong procedures. Hence be calm and focus on the given institution. Quick and confident approach can lessen the effect of injury.

Call medical emergencies

If the situation demands, quickly call for medical assistance. Prompt approach may save the life.

Surroundings play vital role

Different surroundings require different approach. Hence first aider should study the surrounding carefully. In other words, one need to make sure that they are safe and are not in any danger as it would be of no help that the first aider himself get injured.

Do no harm

Most often over enthusiastically practiced first aid viz. administering water when the victim is unconscious, wiping clotted blood (which acts as plug to reduce bleeding), correcting fractures, mishandling injured parts etc., would leads to more complication. Patients often die due to wrong FIRST AID methods, who may otherwise easily survive. Do not move the injured person unless the situation demands. It is best to make him lie wherever he is because if the patient has back, head or neck injury, moving him would causes more harm.

This does not mean do nothing. It means to make sure that to do something the care givers feel confident through training would make matters safe. If the first aider is not confident of correct handling it is better not to intervene of do it. Hence moving a trauma victim, especially an unconscious one, need very careful assessment. Removals of an embedded objects (Like a knife, nail) from the wound may precipitate more harm (e.g. increased bleeding). Always it is better to call for help.

Reassurance

Reassure the victim by speaking encouragingly with him.

Stop the bleeding

If the victim is bleeding, try to stop the bleeding by applying pressure over the injured part.

Golden hours

India have best of technology made available in hospitals to treat devastating medical problem viz. head injury, multiple trauma, heart attack, strokes etc, but patients often do poorly because they don't gain access to that technology in time. The risk of dying from these conditions, is greatest in the first 30 minutes, often instantly. This period is referred to as Golden period. By the time the patient reach hospitals, they would have passed that critical period. First aid care come handy to save lives. It helps to get to the nearest emergency room as quickly as possible through safe handling and transportation. The shorter that time, the more likely the best treatment applied.

Maintain the hygiene

Most importantly, first aider need to wash hands and dry before giving and first aid treatment to the patient or wear

gloves in order to prevent infection.

Cleaning and dressing

Always clean the wound thoroughly before applying the bandage lightly wash the wound with clean water.

Not to use local medications on cuts or open wounds

They are more irritating to tissue than it is helpful. Simple dry cleaning or with water and some kind of bandage are best.

CPR (Cardio-Pulmonary Resuscitation) can be life-sustaining

CPR can be life sustaining. If one is trained in CPR and the person is suffering from choking or finds difficulty in breathing, immediately begin CPR. However, if one is not trained in CPR, do not attempt as you can cause further injury. Bur some people do it wrong. This is a difficult procedure to do in a crowded area. Also there are many studies to suggest that no survival advantage when bystanders deliver breaths to victims compared to when they only do chest compressions. Second, it is very difficult to carry right maneuver in wrong places. But CPR, if carefully done by highly skilled first aiders is a bridge that keeps vital organs oxygenated until medical team arrives.

Declaring death

It is not correct to declare the victim's death at the accident site. It has to be done by qualified medical doctors.

How to report an emergency?

Reporting an emergency is one of those things that seems simple enough, until actually when put to use in emergency situations. A sense of shock prevail at the accident sites. Large crowd gather around only with inquisitive nature, but not to extend helping hands to the victims. This is common in road side injuries. No passerby would like to get involved to assist the victims. Hence first aid management is often very difficult to attend to the injured persons. The first aiders need to adapt multitask strategy to control the crowd around, communicate to the rescue team, call ambulance etc., all to be done simultaneously. The mobile phones helps to a greater deal for such emergencies. Few guidelines are given below to approach the problems.

Assess the urgency of the situation. Before you report an emergency, make sure the situation is genuinely urgent. Call for emergency services if you believe that a situation is life-threatening or otherwise extremely disruptive.

- A crime, especially one that is currently in progress. If you're reporting a crime, give a physical description of the person committing the crime.
- A fire - If you're reporting a fire, describe how the fire stated and where exactly it is located. If someone has already been injured or is missing, report that as well.
- A life-threatening medical emergency, explain how the incident occurred and what symptoms the person currently displays.

- A car crash - Location, serious nature of injuries, vehicle's details and registration, number of people involved etc.

Call emergency service

The emergency number varies - 100 for Police & Fire. 108 for Ambulance.

Report your location

The first thing the emergency dispatcher will ask is where you are located, so the emergency services can get there as quickly as possible. Give the exact street address, if you're not sure of the exact address, give approximate information.

Give the dispatcher your phone number

This information is also imperative for the dispatcher to have, so that he or she is able to call back if necessary.

Describe the nature of the emergency

Speak in a calm, clear voice and tell the dispatcher why you are calling. Give the most important details first, then answer the dispatcher's follow-up question as best as you can.

Do not hang up the phone until you are instructed to do so. Then follow the instructions you were given.

Basic first aid

Basic first aid refers to the initial process of assessing and addressing the needs of someone who has been injured or is in physiological distress due to choking, a heart attack, allergic reactions, drugs or other medical emergencies. Basic first aid allows one to quickly determine a person's physical condition and the correct course of treatment.

Important guideline for first aiders

Evaluate the situation

Are there things that might put the first aider at risk. When faced with accidents like fire, toxic smoke, gasses, an unstable building, live electrical wires or other dangerous scenario, the first aider should be very careful not to rush into a situation, which may prove to be fatal.

Remember A-B-Cs

The ABCs of first aid refer to the three critical things the first aiders need to look for.

- Airway - Does the person have an unobstructed airway?
- Breathing - Is the person breathing?
- Circulation - Does the person show a pulse at major pulse points (wrist, carotid artery, groin)

Avoid moving the victim

Avoid moving the victim unless they are in immediate danger. Moving a victim will often make injuries worse, especially in the case of spinal cord injuries.

Call emergency services

Call for help or tell someone else to call for help as soon

as possible. If alone in at the accident scene, try to establish breathing before calling for help, and do not leave the victim alone unattended.

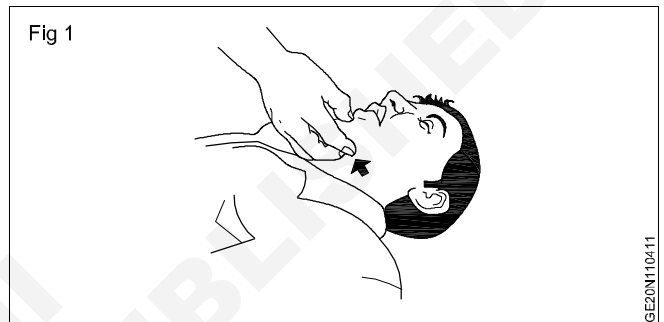
Determine responsiveness

If a person is unconscious, try to rouse them by gently shaking and speaking to them.

If the person remains unresponsive, carefully roll them on the side (recovery position) and open his airway.

- Keep head and neck aligned.
- Carefully roll them onto their back while holding his head.
- Open the airway by lifting the chin. (Fig 1)

Fig 1



Look, listen and feel for signs of breathing

Look for the victim's chest to raise and fall, listen for sounds of breathing.

If the victim is not breathing, see the section below

- If the victim is breathing, but unconscious, roll them onto their side, keeping the head and neck aligned with the body. This will help drain the mouth and prevent the tongue or vomit from blocking the airway.

Check the victim's circulation

Look at the victim's colour and check their pulse (the carotid artery is a good option; it is located on either side of the neck, below the jaw bone). If the victim does not have a pulse, start CPR.

Treat bleeding, shock and other problems as needed

After establishing that the victim is breathing and has a pulse, next priority should be to control any bleeding. Particularly in the case of trauma, preventing shock is the priority.

- **Stop bleeding:** Control of bleeding is one of the most important things to save a trauma victim. Use direct pressure on a wound before trying any other method of managing bleeding.
- **Treat shock:** Shock, a loss of blood flow from the body, frequently follows physical and occasionally psychological trauma. A person in shock will frequently have ice cold skin, be agitated or have an altered mental status, and have pale colour to the skin around the face and lips. Untreated, shock can be fatal.

Anyone who has suffered a severe injury or life-threatening situation is at risk for shock.

- **Choking victim:** Choking can cause death or permanent brain damage within minutes.
- **Treat a burn:** Treat first and second degree burns by immersing or flushing with cool water. Don't use creams, butter or other ointments, and do not pop blisters. Third degree burns should be covered with a damp cloth. Remove clothing and jewellery from the burn, but do not try to remove charred clothing that is stuck to burns.
- **Treat a concussion:** If the victim has suffered a blow to the head, look for signs of concussion. Common symptoms are: loss of consciousness following the injury, disorientation or memory impairment, vertigo, nausea, and lethargy.
- **Treat a spinal injury victim:** If a spinal injury is suspected, it is especially critical, not move the victim's head, neck or back unless they are in immediate danger.

Stay with the victim until help arrives

Try to be a calming presence for the victim until assistance can arrive.

Unconsciousness (COMA)

Unconscious also referred as Coma, is a serious life threatening condition, when a person lie totally senseless and do not respond to calls, external stimulus. But the basic heart, breathing, blood circulation may be still intact, or they may also be failing. If unattended it may lead to death.

The condition arises due to interruption of normal brain activity. The causes are too many.

- Shock (Cardiogenic, Neurogenic)
- Head injury (Concussion, Compression)
- Asphyxia (obstruction to air passage)
- Extreme of body temperature (Heat, Cold)
- Cardiac arrest (Heart attack)
- Stroke (Cerebro-vascular accident)
- Blood loss (Haemorrhage)
- Dehydration (Diarrohea & vomiting)
- Diabetes (Low or high sugar)
- Blood pressure (Very low or very high)
- Over dose of alcohol, drugs
- Poisoning (Gas, Pesticides, Bites)
- Epileptic fits (Fits)
- Hysteria (Emotional, Psychological)

The following symptoms may occur after a person has been unconscious:

- Confusion
- Drowsiness
- Headache
- Inability to speak or move parts of his or her body (see stroke symptoms)
- Light headedness
- Loss of bowel or bladder control (incontinence)
- Rapid heartbeat (palpitation)
- Stupor

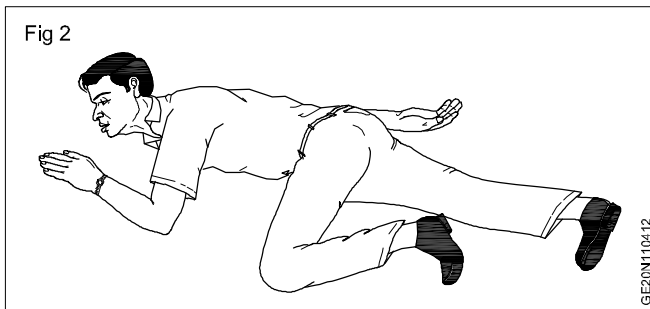
First aid

- Call EMERGENCY number.
- Check the person's airway, breathing, and pulse frequently. If necessary, begin rescue breathing and CPR.
- If the person is breathing and lying on the back and after ruling out spinal injury, carefully roll the person onto the side, preferably left side. Bend the top leg so both hip and knee are at right angles. Gently tilt the head back to keep the airway open. If breathing or pulse stops at any time, roll the person on to his back and begin CPR.
- If there is a spinal injury, the victims position may have to be carefully assessed. If the person vomits, roll the entire body at one time to the side. Support the neck and back to keep the head and body in the same position while you roll.
- Keep the person warm until medical help arrives.
- If you see a person fainting, try to prevent a fall. Lay the person flat on the floor and raise the level of feet above and support.
- If fainting is likely due to low blood sugar, give the person something sweet to eat or drink when they become conscious.

DO NOT

- Do not give an unconscious person any food or drink.
- Do not leave the person alone.
- Do not place a pillow under the head of an unconscious person.
- Do not slap an unconscious person's face or splash water on the face to try to revive him.

Loss of consciousness may threaten life if the person is on his back and the tongue has dropped to the back of the throat, blocking the airway. Make certain that the person is breathing before looking for the cause of unconsciousness. If the injuries permit, place the casualty in the recovery position with the neck extended. Never give anything by mouth to an unconscious casualty.



How to diagnose an unconscious injured person

- **Consider alcohol:** look for signs of drinking, like empty bottles or the smell of alcohol.
- **Consider epilepsy:** are there signs of a violent seizure, such as saliva around the mouth or a generally dishevelled scene?
- **Think insulin:** might the person be suffering from insulin shock (see 'How to diagnose and treat insulin shock')?
- **Think about drugs:** was there an overdose? Or might the person have under dosed - that is not taken enough of a prescribed medication?
- **Consider trauma:** is the person physically injured?
- **Look for signs of infection:** redness and/ or red streaks around a wound.
- **Look around for signs of Poison:** an empty bottle of pills or a snakebite wound.
- **Consider the possibility of psychological trauma:** might the person have a psychological disorder of some sort?

- Consider stroke, particularly for elderly people.
- Treat according to what you diagnose.

Shock (Fig 3)

A severe loss of body fluid will lead to a drop in blood pressure. Eventually the blood's circulation will deteriorate and the remaining blood flow will be directed to the vital organs such as the brain. Blood will therefore be directed away from the outer area of the body, so the victim will appear pale and the skin will feel ice cold.



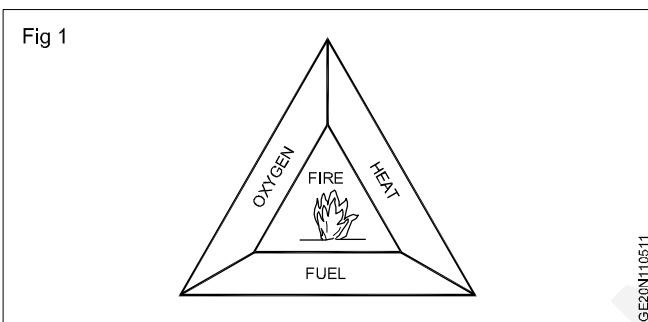
Response to Emergencies - Power Failure, Fire and System Failure

Objectives : At the end of this lesson you shall be able to

- state the effects of a fire breakout
- state the causes for fire in the workshop
- state the reason of emergency power failure
- state the causes of system failure.

Fire is the burning of combustible material. A fire in an unwanted place and on an unwanted occasion and in uncontrollable quantity can cause damage or destroy property and materials. Fires injure people, and sometimes, cause loss of life. Hence, every effort must be made to prevent fire. When a fire outbreak is discovered, it must be controlled and extinguished by immediate correct action.

Is it possible to prevent fire? Yes, by eliminating anyone of the three factors that cause fire. (Fig 1)



The factors that must be present in combination for a fire to continue to burn are as follows.

- Fuel** Any substance, liquid, solid, or gas will burn if given oxygen and high enough temperature.
- Heat** Every fuel will begin to burn at a certain temperature. Solids and liquids give off vapour when heated and it is this vapour which ignites. Some liquids give off vapour even at normal room temperature say 15°C, eg. petrol.
- Oxygen** Usually it exists in sufficient quantity in air to keep a fire burning.

Extinguishing of fires

Isolating or removing any of these factors from the combination will extinguish the fire. There are three basic ways of achieving this.

- Starving the fire of fuel by removing the fuel in the vicinity of fire.
- Smothering - i.e by isolating the fire from the supply of oxygen by blanketing it with foam, sand etc.
- Cooling - i.e. by using water to lower the temperature.

Preventing fires

The majority of fires begin with small outbreaks which burn unnoticed until they become big fires of uncontrollable magnitude. Most of the fires could be prevented with more care and by following some rules of simple commonsense.

Accumulation of combustible refuse (cotton waste soaked with oil, scrap wood, paper, etc.) in odd corners are of fire risk. Refuse should be removed to collection points.

The cause of fire in electrical equipment is misuse or neglect. Loose connections, wrongly rated fuses or cables, overloaded circuits cause over heating which may in turn lead to fire. Damage to insulation between conductors in cables also causes fire.

Clothing and anything else which might catch fire should be kept well away from heaters. Make sure the heater is shut off at the end of a working day.

Highly flammable liquids and petroleum mixtures (Tinner, Adhesive solutions, Solvents, Kerosene, Spirit, LPG Gas etc.) should be stored in a separated place called the flammable material storage area.

Blowlamps and torches must not be left burning when they are not in use.

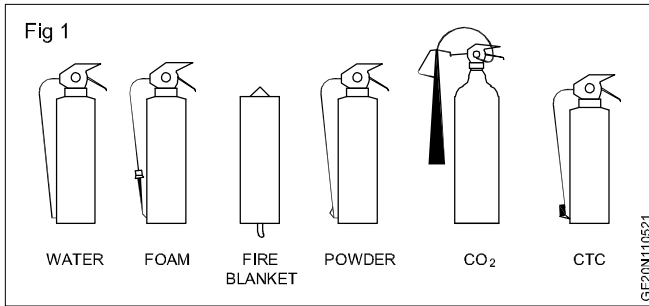
Types of Fire Extinguishers

Objectives : At the end of this lesson you shall be able to

- distinguish different types of fire extinguishers
- determine the correct type of fire extinguisher to be used based on the class of fire
- describe the general procedure to be adopted in the event of a fire.

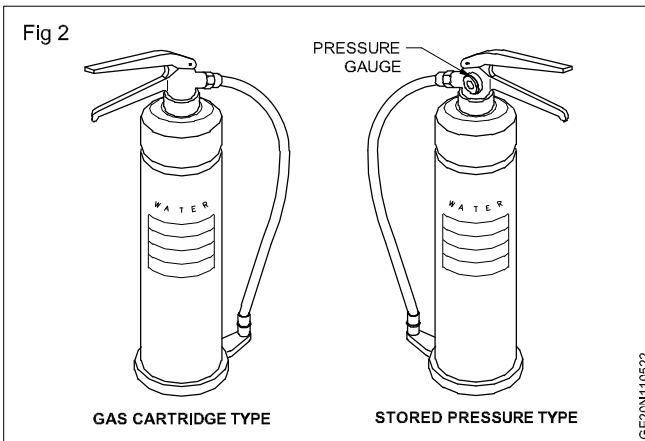
A fire extinguisher, flame extinguisher or simply extinguisher is an active fire protection device used to extinguish or control small fires, often in emergency situation. It is not intended for use on and out of control fire.

Many types of fire extinguishers are available with different extinguishing 'agents' to deal with different classes of fires. (Fig 1)



Water-filled extinguishers

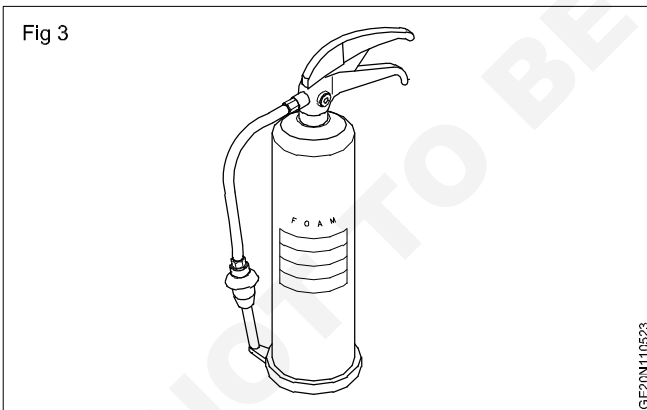
There are two methods of operation. (Fig 2)



- Gas cartridge type
- Stored pressure type

With both methods of operation the discharge can be interrupted as required, conserving the contact and preventing unnecessary water damage.

Foam extinguishers (Fig 3)



These may be of stored pressure or gas cartridge types.

Always check the operating instructions on the extinguisher before use.

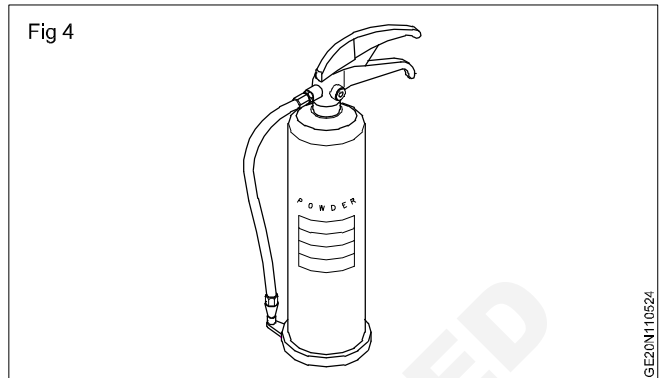
Foam extinguishers are most suitable for:

- flammable liquid fires
- running liquid fires

Must not be used where electrical equipment is involved.

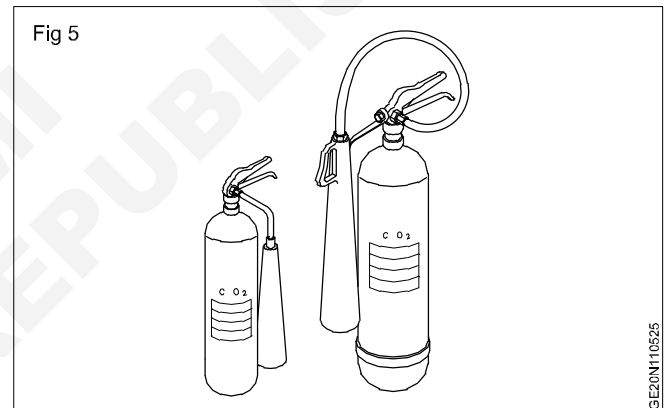
Dry powder extinguishers (Fig 4)

Extinguishers fitted with dry powder may be of the gas cartridge or stored pressure type. Appearance and method of operation is the same as that of the water-filled one. The main distinguishing feature is the fork-shaped nozzle. Powders have been developed to deal with class D fires.



Carbon dioxide (CO₂)

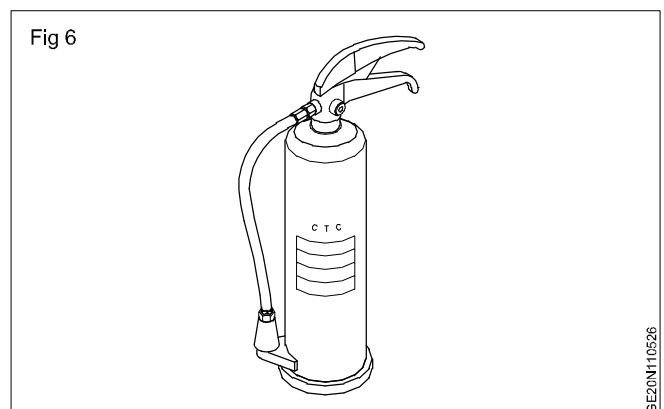
This type is easily distinguished by the distinctively shaped discharge horn. (Fig 5)



Suitable for class B fires. Best suited where contamination by deposits must be avoided. Not generally effective in open air.

Always check the operating instructions on the container before use, available with different gadgets of operation such as -plunger, lever trigger etc.

Halon extinguishers (Fig 6)



These extinguishers may be filled with carbon tetrachloride and bromochlorodifluoro methane (BCF).

They may be of either gas cartridge or stored pressure type.

They are more effective in extinguishing small fires involving pouring liquids. These extinguishers are particularly suitable and safe to use on electrical equipment as the chemicals are electrically non-conductive.

The fumes given off by these extinguishers are dangerous, especially in confined space.

General procedure to be adopted in the event of a fire to be adopted.

- Raise an alarm.

- Turn off all machinery and power (gas and electricity).
- Close the doors and windows, but do not lock or bolt them. This will limit the oxygen fed to the fire and prevent its spreading.
- Try to deal with the fire if you can do so safely. Do not take risk, getting in trapped.
- Anybody not involved in fighting the fire should leave calmly using the emergency exits and go to the designated assembly point. Failure to do this may mean that some person is unaccounted for and others may have to put themselves to the trouble of searching for him or her at risk to themselves.

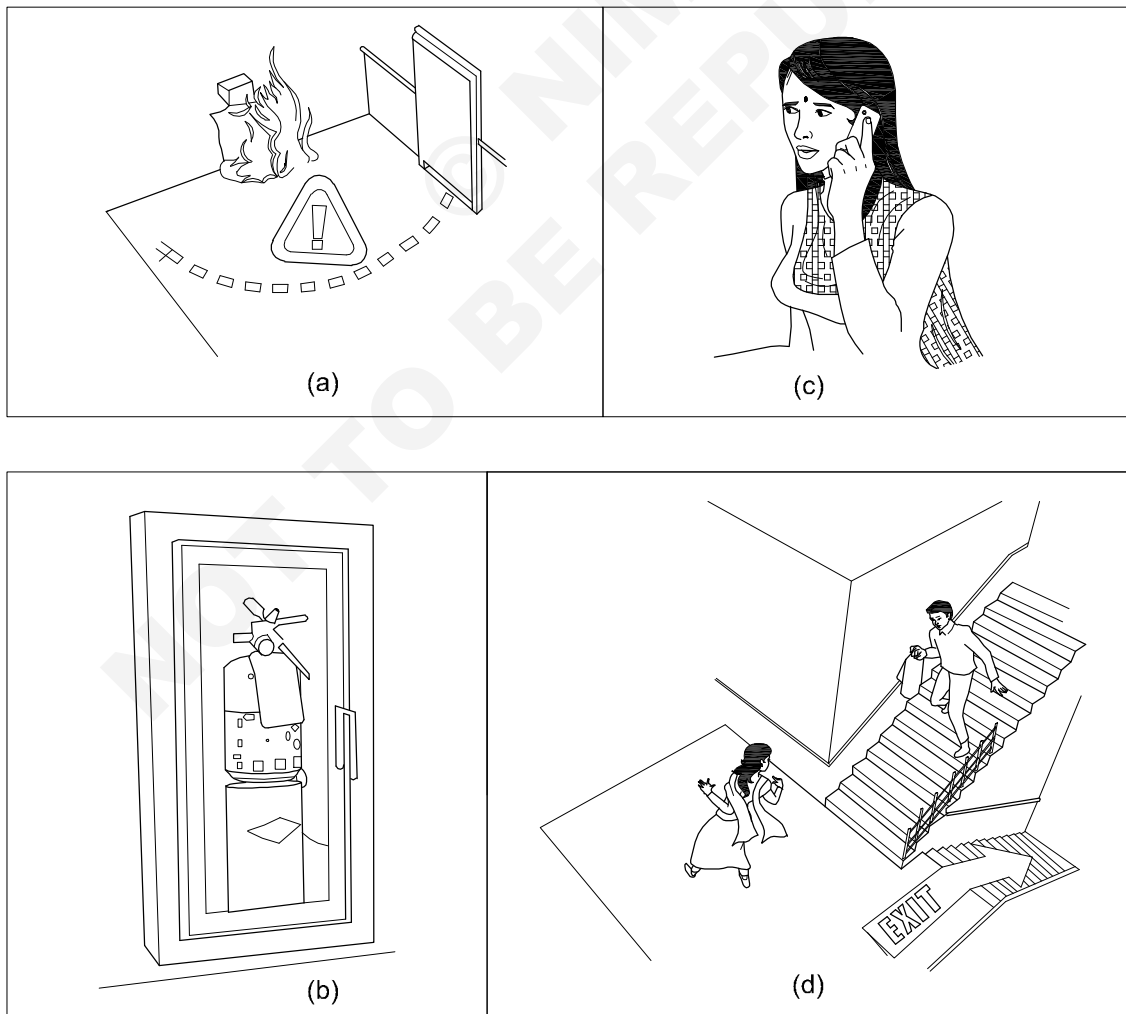
Working on Fire Extinguishers

Objectives : At the end of this lesson you shall be able to

- state about the selection of the fire extinguishers according to the type of fire
- state the method of operation of the fire extinguishers
- explain how to extinguish the fire.

- Alert people surrounding by shouting fire, fire, fire when observe the fire (Fig 1a& b)
- Inform fire service or arrange to inform immediately. (Fig 1c)
- Open emergency exit and ask them to go away. (Fig 1d)
- Put "off" electrical power supply.

Fig 1



Don't allow people to go nearer to the fire

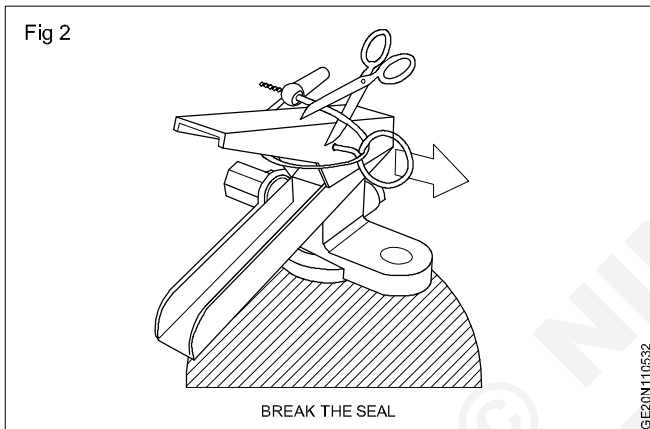
- Analyze and identify the type of fire. Refer Table 1.

Table 1

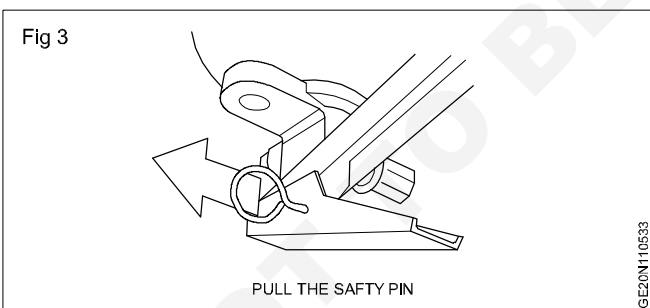
| | |
|-----------|---|
| Class 'A' | Wood, paper, cloth, solid material |
| Class 'B' | Oil based fire (grease gasoline, oil) liquefiable gases |
| Class 'C' | Gas and liquefiable gases |
| Class 'D' | Metals and electrical equipment |

Assume the fire is 'B' Type (flammable liquid solids)

- Select CO₂ (Carbon dioxide) fire extinguisher.
- Locate and pick up CO₂ fire extinguisher. Check for its expiry date.
- Break the seal (Fig 2)



- Pull the safety pin from the handle (Pin located at the top of the fire extinguisher) (Fig 3)



- Aim the extinguisher nozzle or hose at the base of the fire (this will remove the source of fuel fire) (Fig 4)

Keep yourself low

- Squeeze the handle lever slowly to discharge the agent (Fig 5)
- Sweep side to side approximately 15 cm over the fuel fire until the fire is put off (Fig 5)

Fire extinguishers are manufactured for use from the distance.

Caution

- While putting off fire, the fire may flare up
- Do not be panicked before it is put off promptly.
- If the fire doesn't respond well after you have used up the fire extinguisher move away yourself away from the fire point.
- Do not attempt to put out a fire where it is emitting toxic smoke leave it for the professionals.
- Remember that your life is more important than property. So don't place yourself or others at risk.

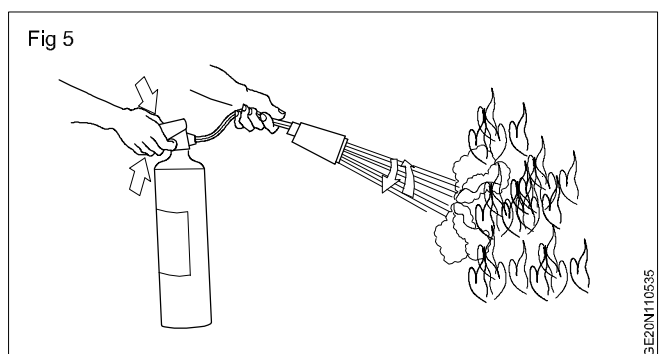
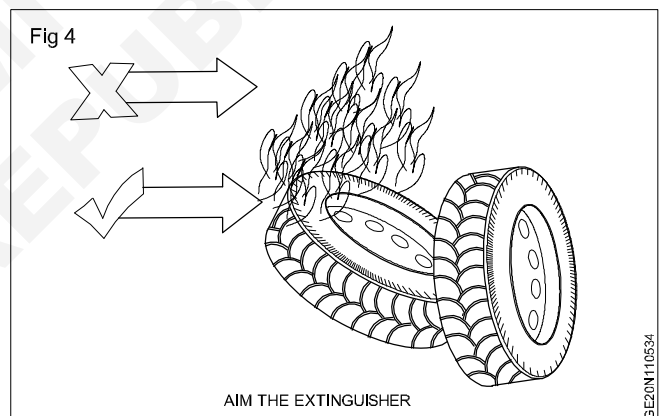
In order to remember the simple operation of the extinguisher, remember P.A.S.S. This will help you to use the fire extinguisher.

P for Pull

A for Aim

S for Squeeze

S for Sweep



Question about your safety

Do you know the general safety rules that cover your place of work?

Are you familiar with the safety laws that govern your particular job?

Do you know how to do your work without causing danger to yourself, your workmates and the general public?

Are the plant, machinery and tools that you use really safe? Do you know how to use them safely and keep them in a safe condition?

Do you wear all the right protective clothing, and have you been provided with all the necessary safety equipment?

Have you been given all the necessary safety information about the materials used?

Have you been given training and instruction to enable you to do your job safely?

Do you know who is responsible for safety at your place of work?

Do you know who are the appointed 'Safety Representatives'?

Power Failure

1 If there is a power failure, start the emergency generator. This provides power to close the shutter, which is the first priority. The generator will also keep the UPSs and the cryogenic compressors running,

- Get a flash light.
- Look out for power transfer switch and switch over to normal power to emergency power by pressing the latch.
- Check the fuel valves open or not - Open the valves.
- Check to see that the main breaker switch ON the generator is in OFF position.

Reporting Emergency

Objectives : At the end of this lesson you shall be able to

- explain the report an emergency
- report through emergency services.

Report an emergency

Reporting an emergency is one of those things that seems simple enough, until actually when put to use in emergency situations. A sense of shock prevail at the accident sites. Large crowd gather around only with inquisitive nature, but not to extend helping hands to the victims. This is common in road side injuries. No passer by would like to get involved to assist the victims. Hence first aid managements is often very difficult to attend to the injured persons. The first aiders need to adapt multitask strategy to control the crowd around, communicate to the rescue team, call ambulance etc, all to be done simultaneously. The mobile phones helps to a greater deal for such emergencies. Few guidelines are given below to approach the problems.

Assess the urgency of the situation. Before you report an emergency, make sure that the situation is genuinely urgent. Call for emergency services if you believe that a situation is life-threatening or otherwise extremely disruptive.

- Move the starter switch of the generator to run position. The engine will start at once.
- Allow few minutes to warm up the engine.
- Check all the gauges, pressure, temperature, voltage and frequency.

- Check the "AC line" and "Ready" green light on the front panel.

2 System failure

- If the bug or virus, invades the system. The system failure happens.
- Several varieties of bugs are there

1 Assassin bug

2 Lightning bug

3 Brain bug

For more details refer instruction manual for "System failure".

3 Fire failure

When fire alarm sounds in your buildings

- 1 Evacuate to outside immediately.
- 2 Never go back
- 3 Make way for fire fighters and their trucks to come
- 4 Never use an elevator
- 5 Do not panic

- A fire - If you're reporting a fire, describe how the fire started and where exactly it is located. If someone has already been injured, missing, report that as well.

- A life - threatening medical emergency, explain how the incident occurred and what symptoms the person currently displays.

Call emergency service

The emergency number varies - 100 for Police & Fire, 108 for Ambulance.

Report your location

The first thing the emergency dispatcher will ask where you are located, so the emergency services can get there as quickly as possible. Give the exact street address, if you're not sure of the exact address, give approximate information.

Operation of Electrical Mains/ Circuit Breakers and Electrical Safety

Objectives : At the end of this lesson you shall be able to

- understand the operation of electrical mains/circuit breaker
- state the importance of electrical safety.

Electrical safety

Electric shock

If a person happens to come in contact with an electrical live wire and if he has not insulated himself, then electric current flows through his body. Since the human body cannot withstand current flow more than a few tens of milliamps, the human body suffers a phenomenon generally known as electric shock. Electric shock may turn out to be hazardous to some of the parts of the human body and some times even to the life of the person.

The severity of an electric shock depends on:

- the level of current passing through the body
- how long does the current keep passing through the body.

Therefore, the higher the current or longer the time, the shock may result in a causality.

In addition to the above factors, other factors which influences the severity of shock are:

- age of the person receiving a shock
- surrounding weather condition
- condition of the floor (wet or dry)
- voltage level of electricity
- insulating property of the footwear or wet footwear, and so on.

Effects of electric shock

The effect of electric shock at very low voltage levels (less than 40 V) may only be an unpleasant tingling sensation. But this shock itself may be sufficient to cause someone to lose his balance and fall, resulting in casualty.

At higher voltage levels the muscles may contract and the person will be unable to break off from the contact by himself. He may lose consciousness. The muscles of the heart may contract spasmodically (fibrillation). This may even turn out to be fatal.

At an excessive level of voltage, the person receiving a shock may be thrown off his feet and will experience severe pain and possibly burns at the point of contact. This in most cases is fatal.

Electric shock can also cause burning of the skin at the point of contact.

Action to be taken in case of an electric shock

If the victim of an electric shock is in contact with the supply, break the contact the victim is making with the electricity by any one or more of the following.

- Switch off the electric power,insulate yourself and pull away the person from the electrical contact

or

Remove the mains electric plug. Avoid direct contact with the victim. Wrap your hands using dry cloth or paper, if rubber gloves are not available.

or

Remove the electric contact made by wrenching the cable/equipment/point free from contact using whatever is at hand to insulate yourself such as a wooden bar, rope, a scarf, the victim's coat-tails, any dry article of clothing, a belt, rolled up newspaper, non-metallic hose, PVC tubing, baked paper, tube etc. and break the contact by pushing or pulling the person or the cable/equipment/point free

or

Stand on some insulating material such as dry wood, rubber or plastic, or whatever is at hand to insulate yourself and break the contact by pushing or pulling the person or the cable/equipment/point free.

If you are uninsulated, do not touch the victim with your bare hands. Otherwise you also will get a shock and become a victim.

If the victim is aloft(working on a pole or at raised place), take suitable measures to prevent him from falling or atleast ensure that his fall is safe.

Treatment to be given for the victim of electric shock

Electric burns on the victim may not look big/large. But it may be deep rooted. Cover the burnt area with a clean, sterile dressing. Get a doctor's help to treat him as quickly as possible.

If the victim is unconscious after an electric shock, but is breathing, carry out the following first aid:

- loosen the clothing at the neck, chest and waist
- place the victim in the recovery position.
- Keep a constant check on the breathing and pulse rate. If you find them feeble, immediately give artificial respiration and press the lower rib to improve the heartbeat.
- Keep the casualty warm and comfortable.
- Send for a doctor immediately.

Do not give an unconscious person anything through the mouth.

Do not leave a unconscious person unattended.

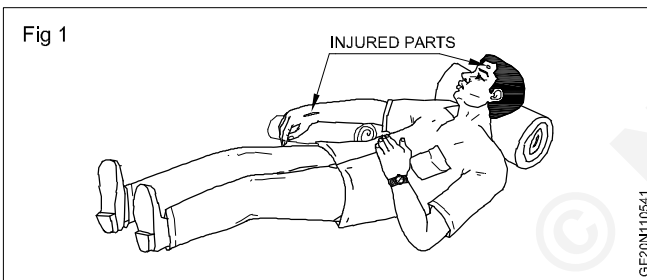
A person having received electric shock may also have burn injuries. DO NOT waste time by applying first aid to the burns until breathing has been restored and the patient can breathe normally unaided.

Treatment to be given in case of burns, severe bleeding

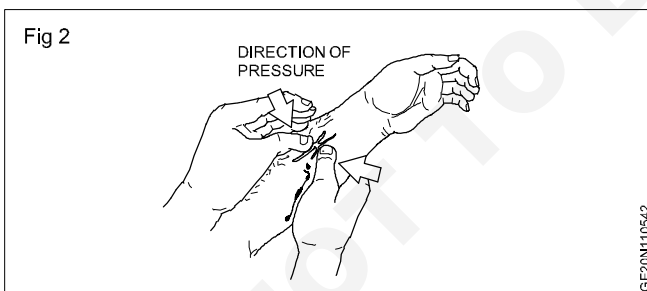
Burns caused due to electrical shock are very painful. If a large area of the body is burnt, clean the wound using clear water, or with clean paper, or a clean shirt. This treatment relieves the victim of pain. Do not give any other treatment on your own. Send for a doctor for further treatment.

A wound which is bleeding profusely, especially in the wrist, hand or fingers must be considered serious and must receive a doctor's attention. As an immediate first aid measure, carry out the following;

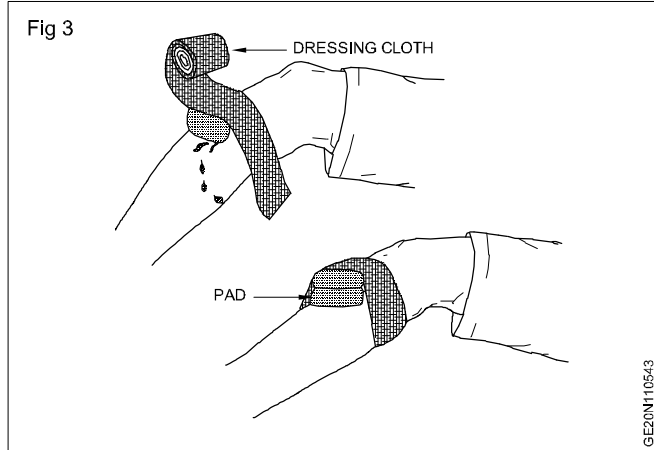
- make the patient lie down and rest
- if possible, raise the injured part above the level of the body as shown in Fig 1.



Squeeze together the sides of the wound as shown in Fig 2. Apply pressure as long as it is necessary to stop the bleeding.



When the bleeding stops temporarily, put a dressing over the wound using sterilized cotton, and cover it with a pad of soft material as shown in Fig 3.



If the wound is in the abdominal area (stab wound), caused by falling on a sharp tool, keep the patient bending over the wound to stop internal bleeding.

General procedural steps to be adopted for treating a person suffering from an electrical shock

- 1 Observe the situation. Choose the appropriate method (listed in earlier paragraphs) to release the person from electrical contact.

Do not run to switch off the supply that is far away or start searching for the mains switch.

- 2 Move the victim gently to the nearest ventilated place.
- 3 Check the victim's breathing and consciousness. Check if there are injuries in the chest or abdomen. Give artificial respiration/applying pressure on the heart if found necessary (refer in this lesson/exercise).

Use the most suitable method of giving artificial respiration depending upon the injuries if any on the chest/abdomen.

- 4 Send for a doctor.

Till the doctor arrives, you stay with the victim and render help as best as you can.

- 5 Place the victim in the recovery position.
- 6 Cover the victim with a coat, socks or any such thing to keep the victim warm.

Actions listed above must be taken systematically and briskly. Delay in treating the patient may endanger his life.

Area of Control of Switches - Operation on Emergency

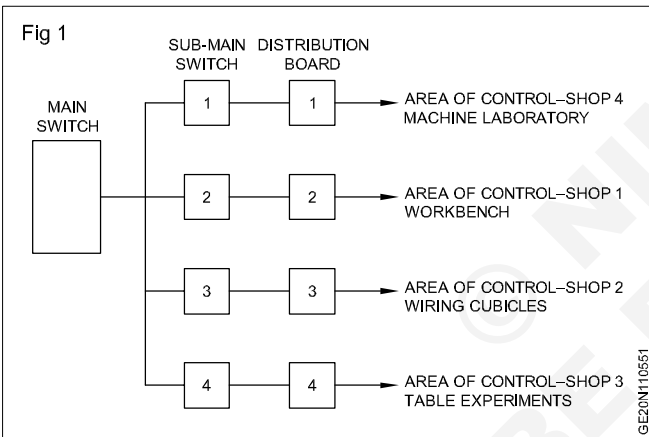
Objectives : At the end of this lesson you shall be able to

- explain the term 'emergency'
- explain the need to switch off the circuit during emergency
- explain the method of locating the area sub-main and switches in the shop floor
- explain the position of handle with respect to ON & OFF in case of iron clad switches, MCB and ordinary house hold sitches.

An emergency is an unexpected occurrence and requires immediate action. In a place like a workshop such a situation can arise when a person gets a shock due to electrical current or a person gets injured by the rotating part of a machine.

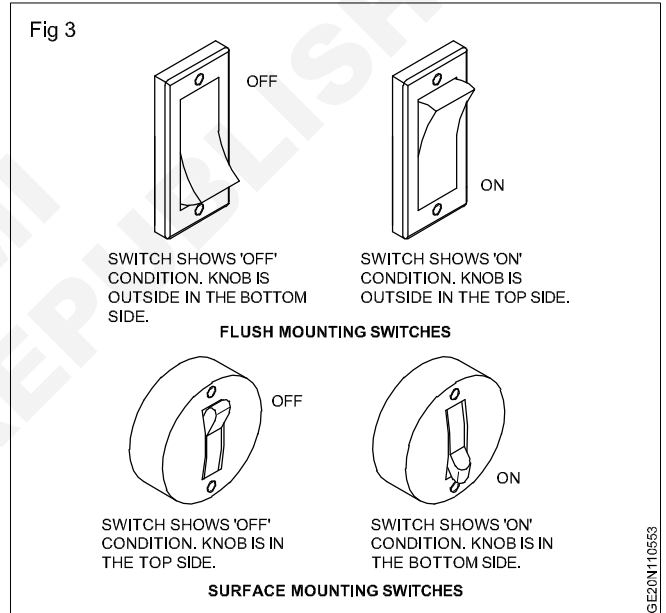
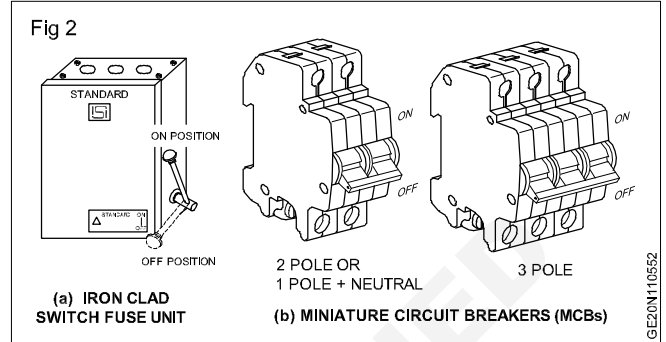
In such situations, switching off the supply will be the first and best solution to avoid further damage to the victim. For this, every person involved in the workshop should know which switch controls the area where the victim of shock remains.

Normally the total wiring in a workshop is controlled by a main switch and the different areas within the workshop may have two or more sub-main switches as shown in Fig.1.



To ascertain the area of the sub-main control, switch off one of the sub-main switches and try to switch 'on' the lights, fans and power points in that suspected area. If they do not work, then the area covered by the fan, light and power points are controlled by the sub-main switch. One after another, switch off the sub-main switches and locate their area of control. Mark the area of control of the switch in the plan of the wireman's section.

In a well organised workshop, the main switch, the submain switches and distribution ways will have clear marking to show their area of control. (Fig 1) If this is not found, do this now. However, If you are not sure about the area of control the sub-main of the switches it is always better to switch 'off' the main switch itself.



The handle of iron clad switches and the knob of MCB should be pushed down to switch 'off' the circuits as shown in Fig 2. whereas in the ordinary switches, the switch off the circuit should be done by pushing the switch to upward position. (Fig 3)

The emergency situations could happen even at home Hence, identify the area of control of the switch and mark them in the main/sub-main/ distribution bound of your house switch board as a safety measure. Educate the intimates of the house how to switch off the circuit in case of any emergency.

Safety Rules on Electrical Equipments

Objectives : At the end of this lesson you shall be able to

- explain the necessary of adopting the safety rules
 - list the safety rules and follow them.
-

Safety rules

Necessity of safety rules: Safety consciousness is one of the essential attitudes required for any job. A skilled electrician always should strive to form safe working habits. Safe working habits always save men, money and material. Unsafe working habits always end up in loss of production and profits, personal injury and even death. The safety hints given below should be followed by Electrician to avoid accidents and electrical shocks as his job involves a lot of occupational hazards.

The listed safety rules should be learnt, remembered and practised by every electrician. Here a electrician should remember the famous proverb, "Electricity is a good servant but a bad master".

Safety rules

- Only qualified persons should do electrical work
- Keep the workshop floor clean, and tools in good condition.
- Do not work on live circuits, if unavoidable, use rubber gloves rubber mats, etc.
- Use wooden or PVC insulated handle screwdrivers when working on electrical circuits.
- Do not touch bare conductors.
- When soldering, place the hot soldering irons in their stand. Never lay switched 'ON' or heated soldering iron on a bench or table as it may cause a fire to break out.
- Use only correct capacity fuses in the circuit. If the capacity is less it will blow out when the load is connected. If the capacity is large, it gives no protection and allows excess current to flow and endangers men and machines, resulting in loss of money.
- Replace or remove fuses only after switching off the circuit switches.
- Use extension cords with lamp guards to protect lamps against breakage and to avoid combustible material coming in contact with hot bulbs.
- Use accessories like sockets, plugs and switches and appliances only when they are in good condition and

be sure they have the mark of BIS (ISI). (Necessity using BIS (ISI) marked accessories is explained under standardisation.

- Never extend electrical circuits by using temporary wiring.
- Stand on a wooden stool, or an insulated ladder while repairing live electrical circuits/appliances or replacing fused bulbs. In all the cases, it is always goog to open the main switch and make the circuit dead.
- Stand on rubber mats while working/ operating switch panels, control gears etc.
- Position the ladder, on firm ground.
- While using a ladder, ask the helper to hold the ladder against any possible slipping.
- Always use safety belts while working on poles or high rise points.
- Never place your hands on any moving part of rotating machine and never work around moving shafts or pulleys of motor or generator with loose shirt sleeves or dangling neck ties.
- Only after identifying the procedure of operation, operate any machine or apparatus.
- Run cables or cords through wooden partitions or floor after inserting insulating procelain tubes.
- Connections in the electrical apparatus should be tight. Loosely connected cables will heat up and end in fire hazards.
- Use always earth connection for all electrical appliances along with 3-pin sockets and plugs.
- While working on dead circuits remove the fuse grips; keep them under safe custody and also display 'Men on line' board on the switchboard.
- Do not meddle with inter locks of machines/switch gears
- Do not connect earthing to the water pipe lines.
- Do not use water on electrical equipment.
- Discharge static voltage in HV lines/equipment and capacitors before working on them.

Importance of Housekeeping & Good Shop Floor Practices

Objectives: At the end of this lesson you shall be able to

- list the benefits of a shop floor maintenance
- state what is 5s
- list the benefits of 5s.

Benefits of a shop floor maintenance

Some of the benefits which may be derived from the utilization of a good Shop Floor Maintenance are as follows:

- Improved productivity
- Improved operator efficiencies.
- Improved support operations such as replenishment moves and transportation of work in process and finished goods.
- Reduction of scrap
- Better control of your manufacturing process
- More timely information to assist shop floor supervisors in managing their assigned production responsibilities.
- Reduction of down time due to better machine and tool monitoring.
- Better control of work in progress inventory, what is and where it is improved on time schedule performance.

5S concept

5S is a Japanese methodology for workplace organisation. In Japanese it stands for seiri (SORT), seiton (SET), seiso (SHINE), seiketsu (STANDARDIZE) and shitsuke (SUSTAIN).

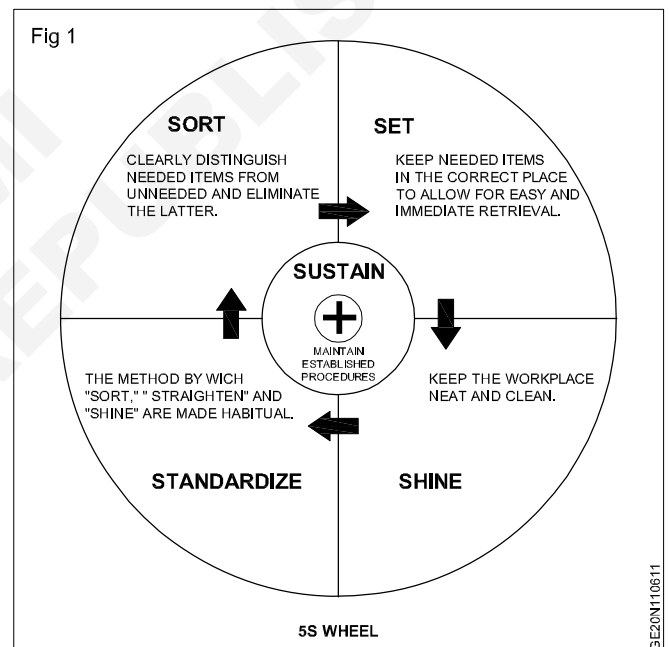
The list describes how to organize a work space for efficiency and effectiveness by identifying and storing the items used, maintaining the area and items, and

sustaining the new order. The list describes how to organize a work space for efficiency and effectiveness by identifying and storing the items used, maintaining the area and items, and sustaining the new order.

5S Wheel (Fig 1)

The Benefits of the 5s system

- Increases in productivity
- Increases in quality
- Reduction in cost



Importance of Housekeeping

Objectives: At the end of this lesson you shall be able to

- list the steps involves in house keeping
- state good shop floor practices followed in industry
- good shop practices.

Housekeeping

The following activities to be performed for better up keep of working environment:

- 1 **Cleaning of shop floor:** Keep clean and free from accumulation of dirt and scrap daily
- 2 **Cleaning of Machines :** Reduce accidents to keep machines cleaned well

- 3 **Prevention of Leakage and spillage:** Use splash guards in machines and collecting tray
- 4 **Disposal of Scrap-** Empty scrap, wastage, swarf from respective containers regularly
- 5 **Tools Storage-** Use special racks, holders for respective tools
- 6 **Storage Spaces:** Identify storage areas for respective items. Do not leave any material in gangway

- 7 **Piling Methods-** Do not overload platform, floor and keep material at safe height.
- 8 **Material handling:** Use forklifts, conveyors and hoist according to the volume and weight of the package.

Good shop floor practices followed in industry

Good Shop floor practices are motivating action plans for improvement of the manufacturing process.

- All workers are communicated with daily target on manufacturing, activities.
- Informative charts are used to post production, quality and safety results compared to achievements.
- Workers are trained on written product quality standards.
- Manufactured parts are inspected to ensure adherence to quality standards.

- Production processes are planned by engineering to minimize product variation.
- 5s methods are used to organize the shop floor and production lines.
- Workers are trained on plant safety practices in accordance with Occupational Safety Health (OSH) standards.
- Workers are trained on "root cause" analysis for determining the causes of not following.
- A written preventive maintenance plan for upkeep of plant, machinery & equipment
- Management meets with plant employees regularly to get input on process improvements.
- Process Improvement Teams are employed to implement "best practices"

Disposal of Waste Material

Objectives: At the end of this lesson you shall be able to

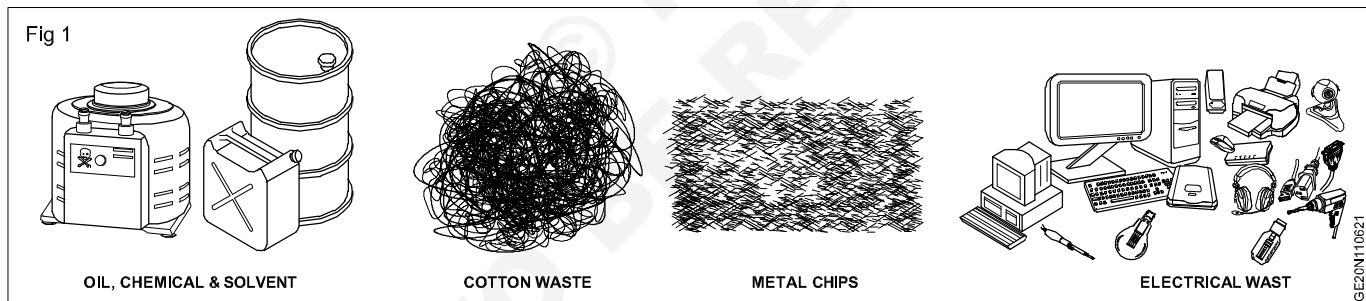
- state what is waste material
- list the waste materials in a work shop
- explain the methods of disposal of waste material.
- state advantage of disposal of waste material.
- state colour code for bins for waste segregation.

Waste material

industrial waste is the waste produced by industrial activity such as that of factories, mills and mines.

List of waste material (Fig 1)

- Cotton waste
- Metal chips of different material.



- Oily waste such as lubricating oil, coolant etc.
- Other waste such electrical, glass etc.

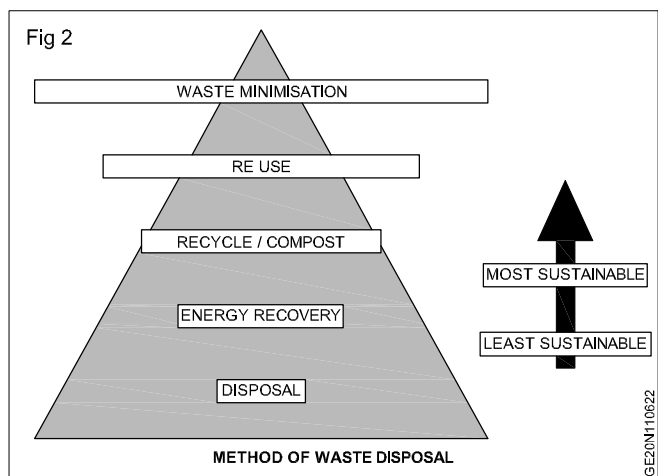
Methods of waste disposal

Recycling

Recycling is one of the most well known method of managing waste. It is not expensive and can be easily done by you. If you carry out recycling, you will save a lot of energy, resources and thereby reduce pollution.

Composting

This is a natural process that is completely free of any hazardous by-products. This process involves breaking down the materials into organic compounds that can be used as manure.



Landfills

Waste management through the use of landfills involves the use of a large area. This place is dug open and filled with the waste.

Burning the waste material

If you cannot recycle or if there are no proper places for setting up landfills, you can burn the waste matter generated in your household. Controlled burning of waste at high temperatures to produce steam and ash is a preferred waste disposal technique.

Advantage of waste disposal:

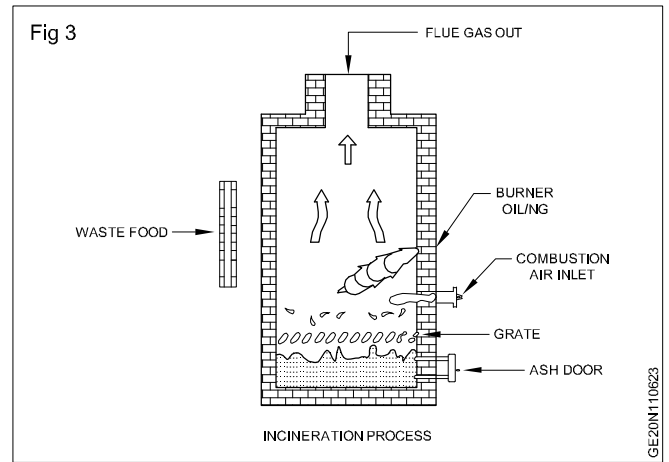
- Ensures workshop neat & tidy
- Reduces adverse impact on health
- Improves economic efficiency
- Reduce adverse impact on environment

Incineration (Fig.3)

It is the process of controlled combustion of garbage to reduce it to incombustible matter, ash, waste gas and heat. It is treated and released into the environment (Fig.3). This reduced 90% volume of waste, some time the heat generated used to produce electric power.

Waste compaction

The waste materials such as cans and plastic bottles compact into blocks and send for recycling. This process space need, thus making transportation and positioning easy.



Colour code for bins for waste segregation given in Table-1

Table-1

| Sl.No. | Waste Material | Color code |
|--------|----------------|------------|
| 1 | Paper | Blue |
| 2 | Plastic | Yellow |
| 3 | Metal | Red |
| 4 | Glass | Green |
| 5 | Food | Black |
| 6 | Others | Sky blue |

Occupational Safety and Health

Objectives: At the end of this lesson you shall be able to

- define safety
- state the goal of occupational health and safety
- explain need of occupational health and safety
- state the occupational hygiene
- explain occupational hazards.

Safety

Safety means freedom or protection from harm, danger, hazard, risk, accident, injury or damage.

Occupational health and safety

- Occupational health and safety is concerned with protecting the safety, health and welfare of people engaged in work or employment.
- The goal is to provide a safe work environment and to prevent hazards.
- It may also protect co-workers, family members, employers, customers, suppliers, nearby communities, and other members of the public who are affected by the workplace environment.

- it involves interactions among many related areas, including occupational medicine, occupational (or industrial) hygiene, public health, and safety engineering, chemistry, and health physics.

Need of occupational health and safety

- Health and safety of the employees is an important aspect of a company's smooth and successful functioning.
- It is a decisive factor in organizational effectiveness. It ensures an accident-free industrial environment.
- Proper attention to the safety and welfare of the employees can yield valuable returns.
- Improving employee morale
- Reducing absenteeism
- Enhancing productivity

- Minimizing potential of work-related injuries and illnesses
- Increasing the quality of manufactured products and / rendered services.

Occupational (Industrial) hygiene

- Occupational hygiene is anticipation, recognition, evaluation and control of work place hazards (or) environmental factors (or) stresses
- This is arising in (or) from the workplace.
- Which may cause sickness, impaired health and well being (or) significant discomfort and inefficiency among workers.

Anticipation (Identification): Methods of identification of possible hazards and their effects on health.

Recognition (Acceptance): Acceptance of ill-effects of the identified hazards

Evaluation (Measurement & Assessment): Measuring or calculating the hazard by Instruments, Air sampling and Analysis, comparison with standards and taking judgement whether measured or calculated hazard is more or less than the permissible standard.

Control of workplace hazards: Measures like Engineering and Administrative controls, medical examination use of Personal Protective Equipment (PPE) education, training and supervision.

Occupational hazards

"Source or situation with a potential for harm in terms of injury or ill health, damage to property, damage to the workplace environment, or a combination of these"

Types of occupational health hazards

- Physical Hazards
- Chemical Hazards
- Biological Hazards
- Physiological Hazards
- Psychological Hazards
- Mechanical Hazards
- Electrical Hazards
- Ergonomic Hazards

1 Physical hazards

- Noise
- Heat and cold stress
- Vibration
- Radiation (ionising & Non-ionising)
- Illumination etc.,

2 Chemical hazards

- Inflammable

- Explosive
- Toxic
- Corrosive
- Radioactive

3 Biological hazards

- Bacteria
- Virus
- Fungi
- Plant pest
- Infection

4 Physiological

- Old age
- Sex
- Ill health
- Sickness
- Fatigue.

5 Psychological

- Wrong attitude
- Smoking
- Alcoholism
- Unskilled
- Poor discipline
- absentism
- disobedience
- aggressive behaviour
- Accident proneness etc,
- Emotional disturbances
- violence
- bullying
- sexual harassment

6 Mechanical

- Unguarded machinery
- No fencing
- No safety device
- No control device etc.,

7 Electrical

- No earthing
- Short circuit
- Current leakage
- Open wire
- No fuse or cut off device etc,

8 Ergonomic

- Poor manual handling technique
- Wrong layout of machinery
- Wrong design

- Poor housekeeping
- Awkward position
- Wrong tools etc,

Safety Slogan

A safety rule breaker, is an accident maker

Safety, Health and Environment Guidelines

Objectives : At the end of this lesson you shall be able to

- state safety, health and environment guidelines.
- state various section provided in factories act, 1948 on occupational safety and health.

Safety, Health and Environment guidelines as per

Rules & regulations followed in india are listed as follows:

- 1 The Environment (Protection) Act, 1986
- 2 The Environment (Protection) Rules, 1986
- 3 Environmental Impact Assessment of Development Projects 1994
- 4 The Prevention and control of pollution (uniform consent procedure) Rules, 1999
- 5 Manufacture, Storage and Import of Hazardous chemicals Rules, 1989
- 6 Manufacture, Storage and Import of Hazardous chemical (Amendment) Rules, 2000
- 7 Hazardous Wastes (Management and Handling) Rules, 1989
- 8 Bio-Medical Waste (Management and Handling) Rules, 1998
- 9 Batteries (Management & Handling) Rules, 2000
- 10 Ozone Depleting Substances (Regulation) Rules, 2000
- 11 The Air (Prevention and Control of Pollution) Act, 1981 as amended by Amendment Act, 1987
- 12 The Air (Prevention and Control of Pollution) Act, 1982
- 13 The Air (Prevention and Control of Pollution) Rules, 1982
- 14 The Tamil Nadu Air (Prevention and Control of Pollution) Rules, 1983
- 15 Noise Pollution (Regulation and Control) Rules, 2000
- 16 The Water (Prevention and Control of Pollution) Act, 1974 as amended in 1978 & 1988
- 17 The Tamil Nadu Water (Prevention and Control of Pollution) Rules, 1983
- 18 The Water (Prevention and Control of Pollution) Cess Act, 1977 as amended by Amendment Act, 1991.
- 19 The Water (Prevention and Control of Pollution) Cess Rules, 1978
- 20 Factories Act, 1948

21 Tamilnadu Factories Rules, 1950

22 The Gas Cylinders Rules, 1981

23 The Indian Electricity Act, 1910

24 The Indian Electricity Rules, 1956

25 The Petroleum Act, 1934

26 The Petroleum Rules, 1976

27 The Public Liability Insurance Act, 1991

28 The Public Liability Insurance Rules, 1991

29 Hazardous Wastes (Management and Handling) Rules, 2000

Poor working conditions affect a worker's health and safety. Unsafe or unhealthy working conditions are not eliminated to industries and can be anywhere. Whether inside or outside, the workshop workers may face many health and safety hazards. It also affects the environment of the workers. Occupational hazards have harmful effects on workers, their families, and other people in the community, as well as on the physical environment around the workplace.

The provisions made in as applicable to the Factories Act, 1948 (Act No.63 of 1948), as amended by the Factories (Amendment) Act, 1987 (Act 20 of 1987) are as follows:

Occupational safety and health

various sections provided in factories act, 1948 are under the following headings:

- Fencing of machinery
- Work on or near machinery in motion
- Employment of young persons on dangerous machines
- Striking gear and devices for cutting off power
- Self-acting machines
- Casing of new machinery
- Prohibition of employment of women and children near cotton-openers
- Hoist and lifts
- Lifting machines, chains, ropes and lifting tackles
- Revolving machinery

- Pressure plant
- Floors, stairs and means of access
- Excessive weights
- Protection of eyes
- Precautions against dangerous fumes, gases, etc
- Precautions regarding the use of portable electric light
- Explosive or inflammable dust, gas, etc
- Precautions in case of fire
- Power to require specifications of defective parts or test of stability
- Safety of buildings and machinery
- Maintenance of buildings
- Power to make rules to supplement this Chapter
- Cleanliness
- Disposal of wastes and effluents
- Ventilation and temperature
- Dust and fume
- Artificial humidification
- Overcrowding
- Lighting
- Drinking water
- Latrines and urinals
- Spittoon

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Introduction to Computer System, Hardware & Software

Objectives : At the end of this lesson you shall be able to

- **define and classify computers**
- **list the advantages and limitations of computers**
- **list the applications of computer**
- **describe the voltages and currents in the computer.**

Computer - Definitions

A computer is an electronic machine, operating under the control of instructions stored in its own memory that can accept data (input), manipulate the data according to specified rules (process), produce results (output), and store the results for future use.

Technically, a computer is a programmable machine. This means it can execute a list of programmed instructions and respond to new instructions that it is given.

History of Computer

Charles babbage's machine

The working principles of today's computers were provided by an English mathematician Charles Babbage around 1833's invented a machine called the "Analytical Engine". A machine which could calculate and print tables of functions using limited techniques.

The Analytical Engine had four parts. A mill, which was the section which did the calculations, essentially the CPU; the store, where the information was kept recorded, essentially the memory; the reader, which would allow data to be entered using punched cards, essentially the keyboard, and the printer.

Hence, Charles Babbage is considered as the "Father of the Computer" as in Fig 1.

Fig 1



The generations of computers are characterized by a major technological development that fundamentally changed the way computers operate, resulting in increasingly smaller, cheaper, more powerful and more efficient and reliable devices. The various generations of computers are listed below:

First Generation (1946-1954): In 1946 the digital computer using **electronic valves** (Vacuum tubes) are known as first generation computers. The first '**computer**' to use electronic valves i.e. vacuum tubes. The high cost of vacuum tubes prevented their use for main memory. They stored information in the form of propagating sound waves.

The vacuum tube consumes a lot of power. These computers were large in size and writing programs on them was difficult. Some of the computers of this generation were:

Mark I :The **IBM Automatic Sequence Controlled Calculator (ASCC)**, called the Mark I by **Harvard University**, was an **electro-mechanical computer**. Mark I is the first machine to successfully perform a long services of **arithmetic and logical operation**. Mark I is the **First Generation Computer**.

ENIAC: It was the first electronic computer built in 1946 at University of Pennsylvania, USA by John Eckert and John Mauchly. It was named Electronic Numerical Integrator and Calculator (ENIAC). The ENIAC was 30-50 feet long, weighted 30 tons, contained 18,000 vacuum tubes, 70,000 resistors, 10,000 capacitors and required 150,000 watts of electricity. Today computer is many times as powerful as ENIAC, still size is very small.

EDVAC: It stands for **Electronic Discrete Variable Automatic Computer** and was developed in 1950. The concept of storing data and instructions inside the computer was introduced here. This allowed much faster operation since the computer had rapid access to both data and instructions. The other advantage of storing instruction was that computer could do logical decision internally. The EDVAC was a **binary serial computer** with automatic addition, subtraction, multiplication, programmed division and automatic checking with an ultrasonic serial memory.

EDSAC: It stands for **Electronic Delay Storage Automatic Computer** and was developed by **M.V. Wilkes at Cambridge University in 1949**. The **EDSAC** is the first **stored-program computer**. The EDSAC performed computations in the three millisecond range. It performed arithmetic and logical operations without human intervention. The key to the success was in the stored instructions which it depended upon solely for its operation.

This machine marked the beginning of the computer age.

UNIVAC-1: It stands for Universal Automatic computer and it was the First commercial computer developed by United States In 1951. The machine was 25 feet by 50 feet in length, contained 5,600 tubes, 18,000 crystal diodes, and 300 relays. It utilized serial circuitry, 2.25 MHz bit rate, and had an internal storage capacity 1,000 words or 12,000 characters.

The UNIVAC was used for **general purpose computing** with large amounts of input and output. The UNIVAC was also the first computer to come equipped with a magnetic tape unit and was the **first computer to use buffer memory**.

Limitations of First Generation Computer

Followings are the major drawbacks of First generation computers.

- They used valves or vacuum tubes as their main electronic component.
- They were large in size, slow in processing and had less storage capacity.
- They consumed lots of electricity and produced lots of heat.
- Their computing capabilities were limited.
- They were not so accurate and reliable.
- They used machine level language for programming.
- They were very expensive.

Second Generation (1955-1964): The second-generation computer used **transistors** for CPU components and **ferrite cores for main memory & magnetic disks** for secondary memory. They used high-level languages such as **FORTRAN (1956), ALGOL (1960) & COBOL (1960 - 1961)**. Input Output (I/O) processor was included to control I/O operations.

Manufacturing cost was also very low. Thus the size of the computer got reduced considerably.

It is in the second generation that the concept of Central Processing Unit (CPU), memory, programming language and input and output units were developed. Some of the second generation computers are IBM 1620, IBM 1401, CDC 3600.

Features

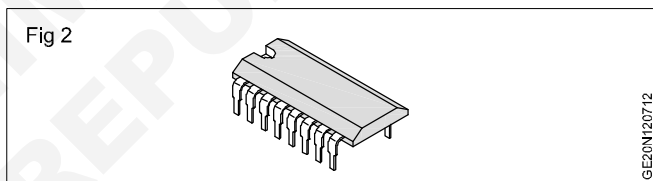
- Transistors were used instead of Vacuum Tube.
- Processing speed is faster than First Generation Computers (Micro Second)
- Smaller in Size (51 square feet)
- The input and output devices were faster.

Third Generation (1964-1977): By the development of a small chip consisting of the capacity of the **300 transistors**. These Integrated Circuits (IC)s are popularly known as **Chips**.

A single IC has many transistors, registers and capacitors built on a single thin slice of silicon. So it is quite obvious that the size of the computer got further reduced. Some of the computers developed during this period were **IBM-360, ICL-1900, IBM-370, and VAX-750**. Higher level language such as **BASIC (Beginners All purpose Symbolic Instruction Code)** was developed during this period.

Computers of this generation were small in size, low cost, large memory and processing speed is very high. Very soon ICs were replaced by **LSI (Large Scale Integration)**, which consisted about 100 components.

An IC containing about 100 components is called LSI as in (Fig 2).



Features

- They used Integrated Circuit (IC) chips in place of the transistors.
- Semi conductor memory devices were used.
- The size was greatly reduced, the speed of processing was high, and they were more accurate and reliable.
- Large Scale Integration (LSI) and Very Large Scale Integration (VLSI) were also developed.
- The mini computers were introduced in this generation.
- They used high level language for programming.

Fourth Generation (1978 - present): An IC containing about 100 components is called LSI (Large Scale Integration) and the one, which has more than 1000 such components, is called as VLSI (Very Large Scale Integration).

It uses large scale Integrated Circuits (LSIC) built on a single silicon chip called microprocessors. Due to the development of microprocessor it is possible to place computer's central processing unit (CPU) on single chip. These computers are called microcomputers.

Later very large scale Integrated Circuits(VLSIC) replaced LSICs. Thus the computer which was occupying a very large room in earlier days can now be placed on a table. The personal computer (PC) that you see in your school is a Fourth Generation Computer Main memory used fast semiconductors chips up to 4 M bits size. Some of the Fourth generation computers are IBM PC, Apple-Macintosh, etc.

Hard disks were used as secondary memory. Keyboards, dot matrix printers etc. were developed. Operating System (OS)-such as MS-DOS, UNIX, Apple's Macintosh were available. Object oriented language, C++ etc were developed.

Features

- They used Microprocessor (VLSI) as their main switching element.
- They are also called as micro computers or personal computers.
- Their size varies from desktop to laptop or palmtop.
- They have very high speed of processing; they are 100% accurate, reliable, diligent and versatile.
- They have very large storage capacity.

Fifth Generation (PRESENT AND FUTURE): 5th generation computers use ULSI (Ultra-Large Scale Integration) chips. Millions of transistors are placed in a single IC in ULSI chips.

64 bit microprocessors have been developed during this period.. Memory chips and flash memory up to 1 GB, hard disks up to 600 GB & optical disks up to 50 GB have been developed (Fig 3).

Fifth generation computing devices, based on Artificial Intelligence, are still in development, though there are some applications, such as voice recognition, that are

being used today. All generation computers advantages and Disadvantages shown in Table 1

Fig 3



Artificial Intelligence is the branch of computer science concerned with making computers behave like humans. The term was coined in 1956 by John McCarthy at the Massachusetts Institute of Technology. Artificial intelligence includes:

- **Games Playing:** Programming computers to play games such as chess and checkers
- **Expert Systems:** Programming computers to make decisions in real-life situations (for example, some expert systems help doctors diagnose diseases based on symptoms)
- **Natural Language:** Programming computers to understand natural human languages
- **Neural Networks:** Systems that simulate intelligence by attempting to reproduce the types of physical connections that occur in animal brains
- **Robotics:** programming computers to see and hear and react to other sensory stimuli.

Table --1

| Generation | Electronic Component | Advantages | Disadvantages |
|------------|----------------------|--|---|
| First | Vaccum tube | Helped in calculation and computational work | <ol style="list-style-type: none"> 1.Big size 2.Very costly 3.Slow speed 4.Low accuracy 5.Low storage 6.High power requirements 7.High heat generation 8.High failure rate 9.Used machine language 10.No operating system |
| Second | Transistor | <ol style="list-style-type: none"> 1.Smaller size+ 2.Less cost 3.Better speed | <ol style="list-style-type: none"> 1.Need air conditioning 2.Constant maintenance 3.No operating systems |

| Generation | Electronic Component | Advantages | Disadvantages |
|---|---|---|--|
| Third | Integrated Circuits(IC) small & medium scale | 4.Low power consumption and less heat generation 5.Better storage capacity 6.Better accuracy and more reliability 1.Better in all aspects compared to I & II 2.Used operating systems and high level language | 4.Later stage computers used assembly languages 1.Initial problem with manufacturers 2.No insight obtained into internal working |
| Fourth | VLSI or Microprocessor | 1.Low cost 2.Excellent speed and reliability 3.Computers close to man | 1.Less powerful than main frame computers |
| Fifth (Knowledge Information Processing Systems) | ULSI or Bio-Chips | 1.Very cheap 2.super speeds 3.Very high storage capacity 4.Highly sophisticated OS 5.posses intelligence and decision making ability | 1.New low level language needed |

Classification of computers

Computers are classified according to the following criteria:

- Principle of Operation
- Computing Power, Memory Capacity and cost
- Technological Development
- Principle of operation
- Analog computer
- Digital Computer
- Hybrid Computer

Analog Computer

It is a computer that measures continuously changing physical quantities such as current, temperature, pressure etc. and converts them into quantities which can be used as data for computation. As these computers deal with continuously varying quantities they will give only approximate results. Its output is usually displayed on a meter or scale. Analog computer has low memory and fewer functions. These are used for engineering and scientific applications.

- Thermometer
- Speedometer
- Analog clock

Uses of Mini Computer

Mini computers are often used by small and medium-

sized companies to provide centralized store of information.

Mainframe Computer

Mainframe computers were introduced in 1975. A mainframe computer is a very large computer in size. It is processors. It is designed to perform multiple tasks for multiple users at the same time. Mainframe computers can serve up to 50,000 users at the same time.

The users access a mainframe computer through terminal or personal computer. A typical mainframe computer can execute 16 million instructions per second. Some of the main computers models are

- NEC 610
- DEC 10

Uses of Mainframe Computer

Mainframe computers are used primarily by corporate and governmental organizations for critical applications, bulk data processing such as senses, industry and consumer statistics, and transaction processing.

Super computer

Super computers were introduced in 1980s. Super computer is the fastest computer. Super computer is the biggest in size and the most expensive in price than any other computers.

It is the most sophisticated, complex and advanced computer. It has a very large storage capacity. It can process trillions of instructions in one second. Super

Computer is the fastest and most powerful computer of a time. Supercomputers are very expensive. Supercomputers are used for highly calculation-intensive tasks. Super computers are also used for specialized applications that require immense amounts of mathematical calculations.

Applications of Super Computer

- Weather forecasting,
- Animated graphics like in Hollywood movies,
- Fluid dynamic calculations
- Nuclear energy research
- Space science
- Weapon and missile design
- Petroleum exploration, and etc.

Today, supercomputers are produced by traditional companies such as Cray, IBM and Hewlett- Packard. Since October 2010, the Tianhe-1A supercomputer has been the fastest in the world; it is located in China.

The main difference between a supercomputer and a mainframe is that a supercomputer channels all its power into executing a single program as fast as possible, whereas a mainframe uses its power to execute many programs concurrently. The modern super computer consists of thousands of microprocessors. Super computer uses high-speed facilities such as satellite for online processing.

Sum of the super computers models are CRAY-XP, ETA-10, Param and Deep Blue .

Advantages of computers

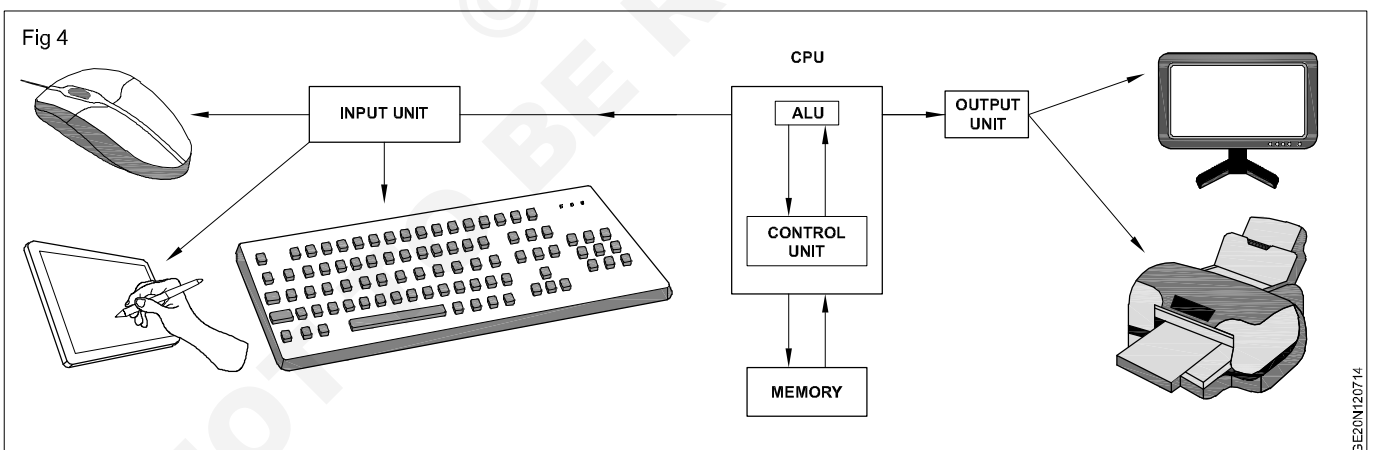
- A computer has a very high processing speed with high reliability.
- Large volume of information can be stored in the memory any particular data/program can be retrieved immediately.
- Solution to a complicated problem is possible at a very high speed.
- Processing of large volume of data saves a lot of clerical work which reduces the processing cost.
- Computers perform operations efficiently at environments where presence of human being is not possible such as furnace, poisonous atmosphere, vacuum, unmanned satellite, etc.

Limitation of computers

- High initial cost.
- Input information has to be prepared in the form of statements called program which requires a considerable amount of knowledge.
- usage of computers will be economical only when there is clerical data processing for large volume of data and are repetitive in nature
- It is a merely a machine it cannot correct errors on its own.

Functions of Computers

All computers are made up of following basic units as shown in Fig 4. They are as follows:-



- 1 Input Unit
- 2 Central processing Unit (CPU)
 - a) Arithmetic Logic Unit (ALU)
 - b) Control Unit (CU)
- 3 Memory
- 4 Output Unit

Input Unit

Computers need to receive data and instruction in order

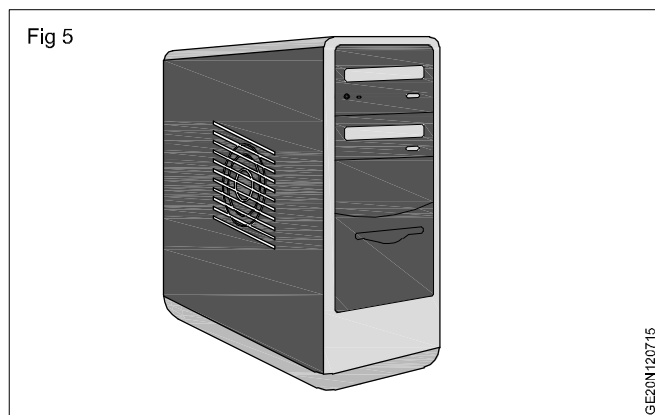
to solve any problem. Therefore we need to input the data and instructions into the computers. The input unit consists of one or more input devices. Keyboard is the one of the most commonly used input device. Some of the input devices are listed in Fig 6.

Input devices perform the following functions.

- Accept the data and instructions from the outside world.
- Convert it to a form that the computer can understand.

- Supply the converted data to the computer system for further processing.

Central Processing Unit (CPU) (Fig 5)



The central processing unit (CPU) is the electronic brain of the computer as in Fig 5. The CPU in a personal computer is usually a single chip. It organizes and carries out instructions that come from either the user or from the software. The processor is made up of many components. CPU performs the following functions:

- It performs all calculations.
- It takes all decisions.
- It controls all units of the computer.

Two typical components of a **CPU** are the following:

The arithmetic logic unit (ALU), which performs arithmetic and logical operations.

The control unit (CU), which extracts instructions from memory and decodes and executes them, calling on the ALU when necessary.

Memory

Memory refers to the physical device used to store the program or data on the temporary or permanent basis for use in a computer or other digital electronic device.

There are two types of memory in computer.

- Primary Memory
- Secondary Memory

Output Unit

Output unit receive the informations from the processing unit and provide the results in human readable form.

Output Devices

The some of the output devices are

- Monitor
- Printer
- Plotter
- Speaker

Applications of computers

Science: Scientists have been using computers to develop theories and to analyse and test the data. The high speed and accuracy of the computer allow different scientific analyses to be carried out. They can be used to generate detailed studies of how earthquakes affect buildings or pollution affects weather pattern. Satellite-based applications have not been possible without the use of computers. Moreover, it would not be possible to get the information of the solar system and the cosmos without computers.

Education: Computers have also revolutionized the whole process of education. Currently, the classrooms, libraries and museums are efficiently utilizing computers to make the education much more interesting. Unlike recorded television shows, computer-aided education (CAE) and computer-based training (CBT) packages are making learning much more interactive.

Medicine and Health Care: There has been an increasing use of computers in the field of medicine. Now, doctors are using computers right from diagnosing the illness to monitoring a patient's status during complex surgery. By using automated imaging techniques, doctors are able to look inside a person's body and can study each organ in detail (e.g. CT scans or MRI scans), which was not possible few years ago. There are several examples of special-purpose computers that can operate within the human body such as cochlear implant, a special kind of hearing aid that makes it possible for deaf people to hear.

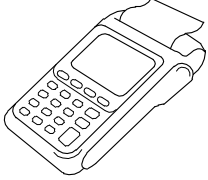
Engineering/Architecture/Manufacturing: The architects and engineers are extensively using computers in designing and drawings. Computers can create objects that can be viewed from all the three dimensions. By using techniques like virtual reality, architects can explore houses that have been designed but not built. The manufacturing factories are using computerized robotic arms to perform hazardous jobs. Besides, computer-aided manufacturing (CAM) can be used in designing the product, ordering the parts and planning production. Thus, computers help in coordinating the entire manufacturing process.

Entertainment: Computers are finding greater use in entertainment industry. They are used to control the images and sounds. The special effects, which mesmerize the audience, would not have been possible without the computers. In addition, computerized animation and colourful graphics have modernized the film industry.

Communication: E-mail or electronic mail is one of the communication media in which computer is used. Through e-mail, messages and reports are passed from one person to one or more persons with the aid of computer and telephone line. The advantage of this service is that while transferring the messages it saves time, avoids wastage of paper and so on. Moreover, the person who is receiving the messages can read the messages whenever he is free and can save it, reply it, forward it or delete it from the computer.

Business Application: This is one of the important uses of the computer. Initially, computers were used for batch-processing jobs, where one does not require the immediate response from the computer. Currently, computers are mainly used for real-time applications (like at the sales counter) that require immediate response from the computer. There are various concerns where

computers are used such as in business forecasting, to prepare pay bills and personal records, in banking operations and data storage, in various types of life insurance business and as an aid to management. Businesses are also using the networking of computers, where a number of computers are connected together to share the data and the information. Use of e-mail and the Internet has changed the ways of doing business.

| | |
|--|---|
| <p>Fig 6</p>  <p>MOUSE</p> |  <p>KEYBOARD</p> |
|  <p>SCANNER</p> |  <p>CAMERA</p> |
|  <p>WEB CAMERA</p> |  <p>JOY STICK</p> |
|  <p>TRACK BALL</p> |  <p>TOUCH PAD</p> |
|  <p>LIGHT PEN</p> |  <p>BAR CODE READER</p> |
|  <p>MICROPHONE</p> |  <p>GRAPHIC TABLET</p> |
|  <p>MAGNETIC INK CHARACTER READER</p> |  <p>OPTICAL MARK READER</p> |
|  <p>MAGNETIC CARD READER</p> |  <p>BLUETOOTH</p> |

Publishing: Computers have created a field known as desktop publishing (DTP). In DTP, with the help of computer and a laser printer one can perform the publishing job all by oneself. Many of the tasks requiring long manual hours such as making table of contents and index can be automatically performed using the computers and DTP software.

Banking: Computers are extensively used in the field of banking and finance. People can use the ATM (automated teller machine) services 24 hours a day to deposit and withdraw cash. When different branches of the bank are connected through computer networks, the inter branch transactions such as cheque and draft can be performed without any delay.

Railway Reservation System

Using this system, the user can perform following operations through online. (web site: www.irctc.co.in)

- search the train and its timings
- check seats and birth availability
- booking and cancelling tickets
- status of PNR (Passenger Name Record)

Telephone / Electricity Board Billing:

The users can do the following operations through online by using this system. (Web site: portal.bsnl.in - BSNL)

- Register the telephone / electricity board number
- Check and pay the bill amount
- Register the complaints

E-Governance

E-Governance implies technology driven governance. E-Governance is the application of Information and Communication Technology (ICT) for delivering government services, exchange of information communication transactions, integration of various stand-alone systems and services between Government-to-Citizens (G2C), Government-to-Business(G2B), Government-to-Government(G2G) as well as back office processes and interactions within the entire government frame work.

E-Governance covers all the sectors with a view to providing hassle free, transparent and efficient service to the common man (both in urban and rural areas).

Concept of hardware and software

Computer hardware is the collection of physical elements that constitutes a computer system. Computer hardware is the physical parts or components of a computer, such as the monitor, mouse, keyboard, computer data storage, hard disk drive (HDD), graphic cards, sound cards, memory, motherboard and so on all of which are physical objects that are tangible. In contrast, software is instructions that can be stored and run by hardware.

- CPU (central processing unit)
- Motherboard

- RAM (Random Access memory)
- HDD/SSD (Hard disk drive / solid state drive)
- PSU (Power supply unit)
- GPU (Graphics processing unit)
- Computer Tower/Case
- Computer Monitor
- Optical drive CD/Blu-ray

Computer software is programming code executed on a computer processor. The code can be machine-level code, or code written for an operating system. Software is any set of machine-readable instructions that directs a computer's processor to perform specific operations, An operating system is software intended to provide a predictable and dependable layer for other programmers to build other software on which are known as applications. It also provides a dependable layer for hardware on, which are known as applications. It also provides a dependable layer for hardware manufacturers. This standardization creates an efficient environment for programmers to create smaller programs, which can be run by millions of computers, software can also be thought of as an expression that contrasts with hardware, the physical components of a computer are the hardware: the digital programs running on the hardware are the software. Software can also be updated or replaced much easier than hardware.

Software is a set of programs, which is designed to perform a well-defined function. A program is sequence of instructions written to solve a particular problem.

There are two types of software

- System software
- Application software

System software

The system software is a collection of programs designed to operate, control, and extend the processing capabilities of the computer itself. System software is generally prepared by the computer manufacturers. These software products comprise of programs written in low-level languages, which interact with the hardware at a very basic level. System software serves as the interface between the hardware at a very basic level. System software serves as the interface between the hardware and the end users

Some examples of system software are operating system, compilers, interpreter assemblers, etc.

Here is a list of some of the most prominent features of a system software.

- Close to the system
- Fast in speed
- Difficult to design
- Difficult to understand
- Less interactive

- Smaller in size
- Difficult to manipulate
- Generally written in low-level language

Application Software

Application software products are designed to satisfy a particular need of a particular environment. All software applications prepared in the computer lab can come under the category of application software

Application software may consist of a single program, such as Microsoft's notepad for writing and editing a simple text. It may also consist of a collection of programs, often called a software package, which work together to accomplish a task, such as a spread sheet package.

Examples of application software are the following

- Payroll software
- Student record software
- Inventory management software
- Income tax software
- Railways reservation software
- Microsoft office suite software
- Microsoft word
- Microsoft excel
- Microsoft PowerPoint

Hardware Identification

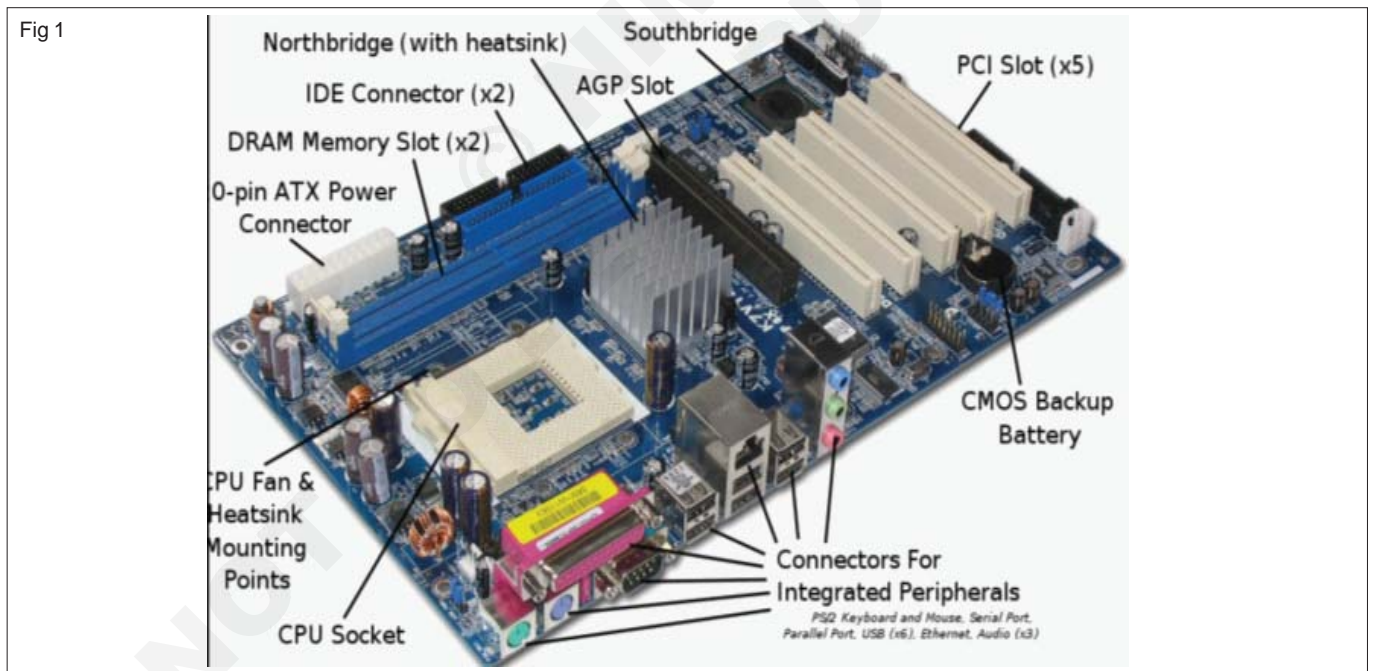
Objectives : At the end of this lesson you shall be able to

- define and classify computers
- list the advantages and limitations of computers
- list the applications of computer
- describe the voltages and currents in the computer.

Motherboard Components and Connectors (Fig 1)

Every motherboard has connectors and slots to connect all the remaining parts of CPU. here the list of all the slot and connector of motherboard.

- CPU Socket
- North Bridge
- South Bridge



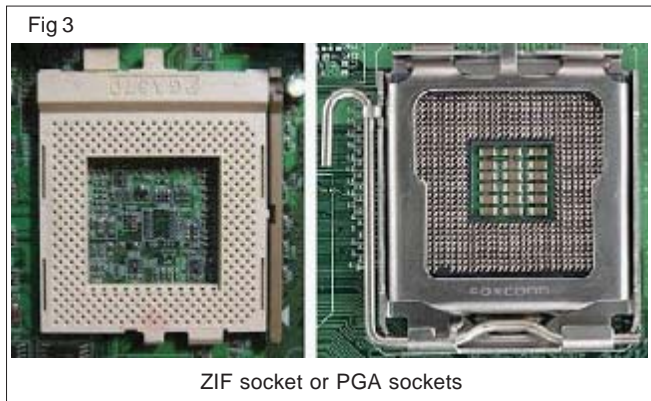
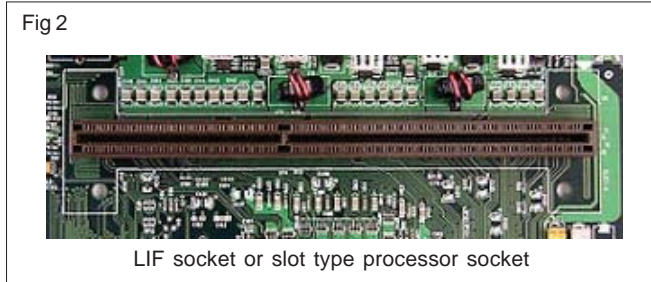
- RAM Slots
- AGP Slot
- PCI Slots
- CNR Slot
- Floppy Connector
- Primary and Secondary IDE Connectors
- SATA connectors

- Power Connector
- BIOS
- CMOS battery
- Ports

CPU Socket

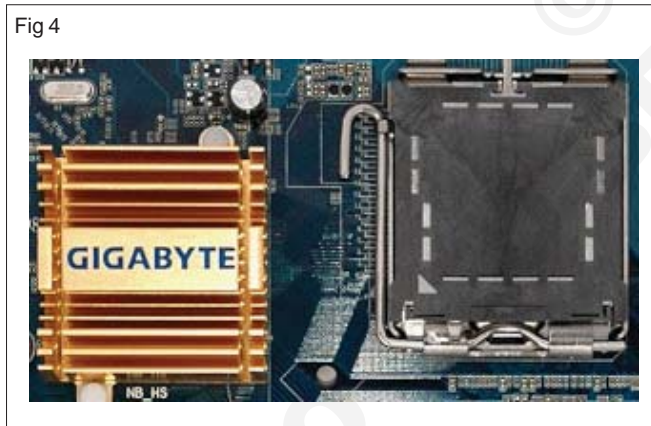
CPU Socket or Processor Socket. Which is used to install or insert the processor. we have two types of sockets. LIF sockets and ZIF socket. LIF stands for Low Insertion

Force, this is the old model sockets and ZIF stands for Zero Insertion Force, this is the present model sockets. (Fig 2 & Fig 3)



North Bridge

North Bridge is always near the processor socket, which is one of the important component of a motherboard. It is a focal Point of Motherboard and It is also called as Memory Controller Hub. North Bridge interconnects Processor socket, RAM slots and AGP slot. here Gigabyte chip is north bridge it is near Processor socket. (Fig 4)

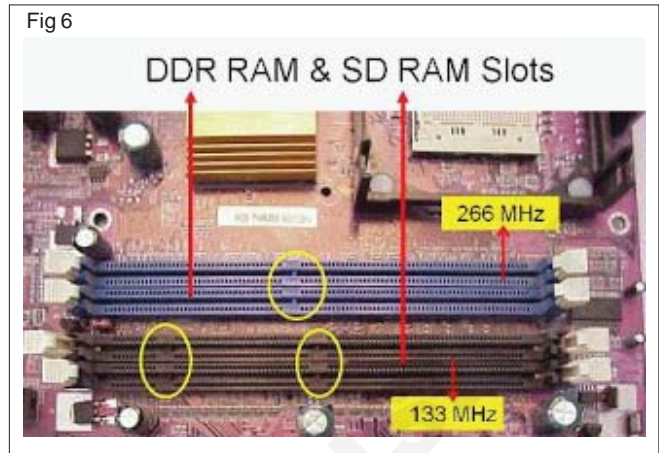
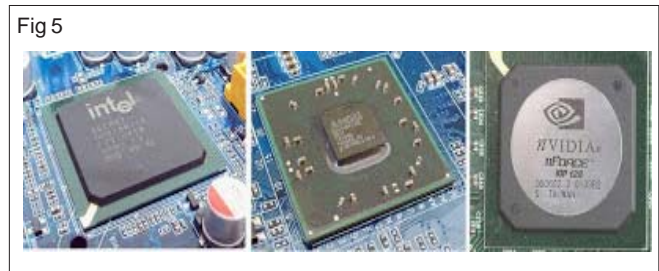


South Bridge

North bridge and south bridge are the two main poles of a motherboard. South Bridge interconnects Primary and Secondary IDE interfaces, SATA connectors, Floppy Drive Connector, PCI slots and BIOS. (Fig 5)

RAM Slots

RAM slots are used to insert RAMs. there are so many types of ram slots. they are SD ram slots, DDR ram slots, DDR2 and DDR3 ram slots. SD stands for synchronize Dynamic and DDR Stands for Double Data Rate. (Fig 6)



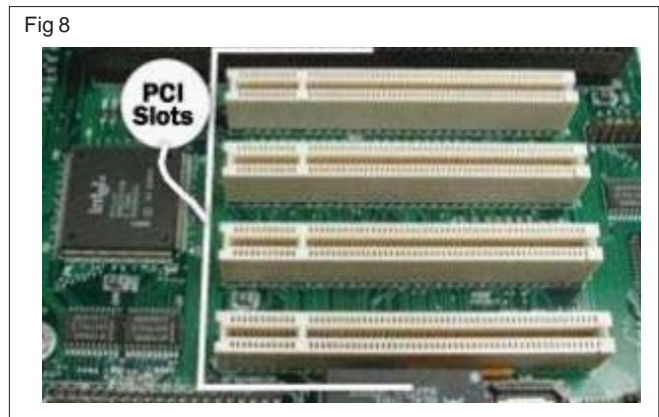
AGP slot

AGP slots are used to insert or install AGP Cards. AGP full form is Accelerated Graphics Port. This slot is for graphics and 3d gaming purpose. it is always beside the PCI slots. (Fig 7)



PCI slots

PCI slots are used to Insert or install Add-on cards, such as LAN cards, Sound cards, Capture cards and TV tuner cards. PCI full form is Peripheral Component Interconnect. (Fig 8)



Floppy Drive Connector

Floppy Drive Connector is used to connect floppy drives. It supports two floppy drives. so that A and B drives are reserved for two floppy drives in My computer. it has 32 pins.

Primary and Secondary IDE Interfaces

Primary and Secondary IDE interfaces are also called as IDE connectors or PATA connectors. IDE full form is Integrated Device Electronics. it supports IDE devices, such as Hard disks and CD and DVD drives. (Fig 9)

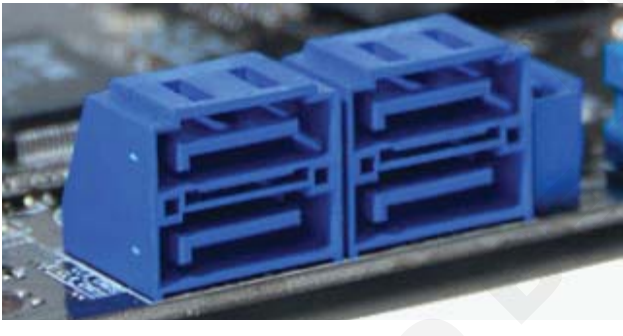
Fig 9



SATA Connectors

SATA connectors are also called as Serial ATA connectors. SATA full form is Serial Advanced Technology Attachment. These are connect with serial ATA devices, such as Hard disk drives and CD or DVD drives. (Fig 10)

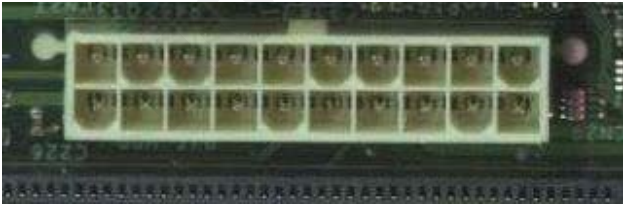
Fig 10



Power Connector

This power connector is ATX power connector. it has 20 or 24 pin connector. mother takes the power from this connector to work. (Fig 11)

Fig 11



BIOS

BIOS stands for Basic input and Output system. This is also one of the important chips. it conducts the POST (Power On Self Test). (Fig 12)

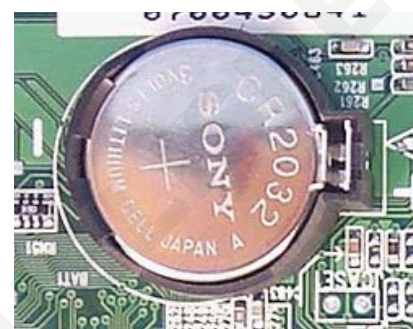
Fig 12



CMOS battery

There is a battery in the motherboard, which is used to power the south bridge and the BIOS to save the setting, data and time. (Fig 13)

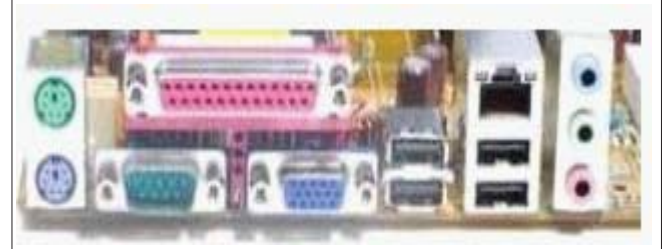
Fig 13



Ports

Ports are used to connect input and output devices. they are attached and come with motherboard and they are in backside of CPU. (Fig 14)

Fig 14



CPU(Processor)

Processor Sockets

CPU is connected to the mother board through a socket . The pins of the processor are connected to main system, memory, bios and motherboard chipset.

Various types of sockets are provided for Processor and memory modules. Processor Sockets generally seen on many types of mother boards have numbers such as socket 1, socket 2, socket 3, socket 4, socket 5, socket 6, socket 7, socket 370. They are also called ZIF sockets (zero insertion force). Inserting ICs into sockets without this facility needs careful handling of pins. With ZIF socket, insertion is made easy by widening the pin holes and tightening it after insertion. CPU sockets have pin orientation. Processor Pin 1 and socket pin 1 markings should match while insertion or always ensure processor

IC pin arrangements match with that of socket. Different types of sockets.

Sound Card

Sound card with 16 bit ISA or 32 bit PCI interface. Sound card is an essential component of multimedia. The sound card comes with features for using microphone, speakers, audio input and joy stick input for playing video games. Musical instrument digital interface (MIDI) port for playing keyboard instrument.

The sound card also has a provision to connect CD ROM drives audio output, to play audio CD's directly. With this facility songs from CD's can be played through CD drive in background while working on a program. Fig gives the sound card layout. Now a days sound card comes as built in resource of the motherboard. (Fig 15)

Fig 15



The sound card converts digitized audio signal, stored in CDROM or hard disk as wav files, to an analog signal, which is fed to the amplifier/speaker. Similarly external audio through a microphone can be digitized and stored as wav files in hard disk.

RCA jacks and DB 15 game port connector are fixed on the bracket. All sound cards comes with drivers for different operating systems. Without proper installation of drivers the sound card may not function properly.

Microsoft Windows users can determine the sound card currently installed in their computer by following the steps below.

- 1 Click the Start Button and then click the "Programs" folder.
- 2 Next, click the "Accessories" and then the "System Information" folder.
- 3 Within the System Information window, click the + symbol next to Components.
- 4 Click "Sound Device" (or "Multimedia" and then "Sound Device") and in the right-side of the window you should be able to locate complete information about the sound card.

Another method of determining the sound card manufacturer or model is by opening the computer and physically looking at the sound card. Commonly the sound card manufacturer and model will be listed on the card.

Ports on a PC (Fig 16)

- Is a physical docking point using which an external device can be connected to the computer.
- can also be programmatic docking point through which information flows from a program to computer or over the internet.

Characteristics

A port has the following characteristics:

- External devices are connected to a computer using cables and ports.
- Ports are slots on the motherboard into which a cable of external device is plugged in.
- Examples of external devices attached via ports are mouse, keyboard, monitor, microphone, speakers etc.

Following are few important types of ports:

Serial Port

- Used for external modems and older computer mouse
- Two versions : 9 pin, 25 pin model
- Data travels at 115 kilobits per second

Parallel Port

- Used for scanners and printers
- Also called printer port
- 25 pin model
- Also known as IEEE 1284-compliant Centronics port

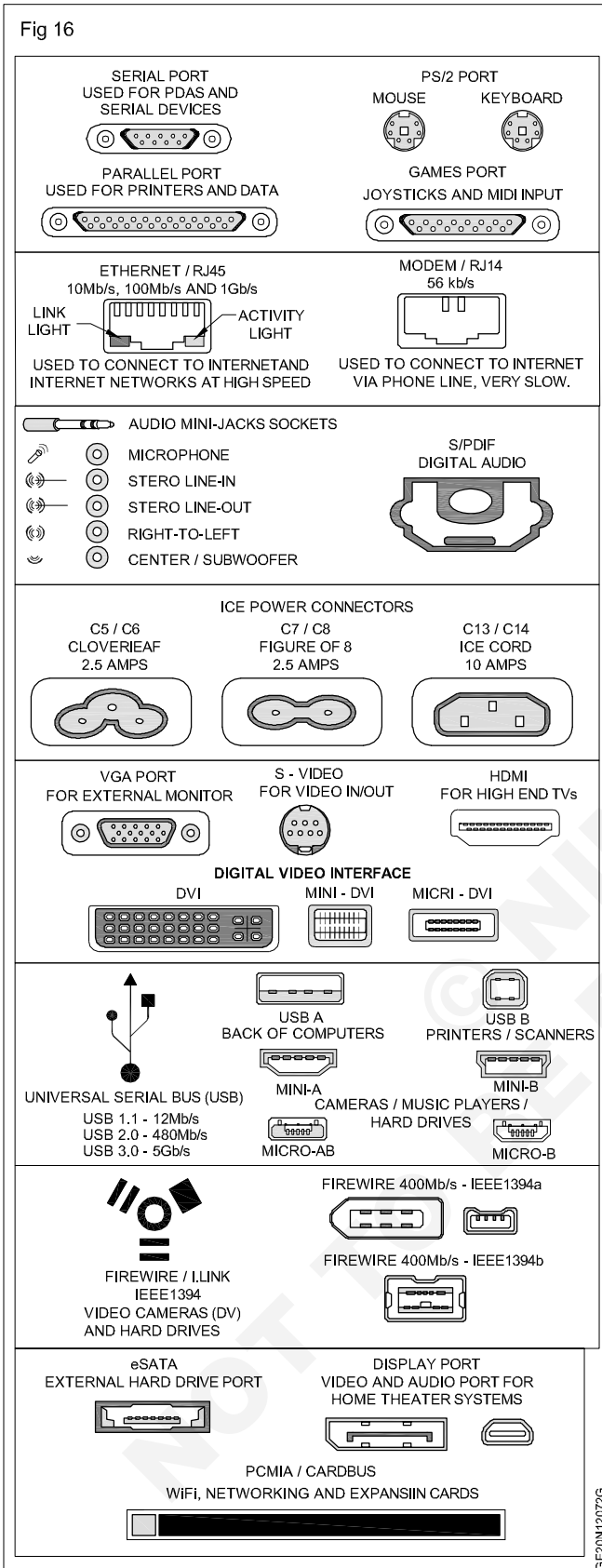
PS/2 Port

- Used for old computer keyboard and mouse
- Also called mouse port
- Most of the old computers provide two PS/2 port, each for mouse and keyboard
- Also known as IEEE 1284-compliant Centronics port

Universal Serial Bus (or USB) Port

- It can connect all kinds of external USB devices such as external hard disk, printer, scanner, mouse, keyboard etc.
- It was introduced in 1997.
- Most of the computers provide two USB ports as minimum.
- Data travels at 12 megabits per seconds
- USB compliant devices can get power from a USB port

Fig 16



VGA Port

- Connects monitor to a computer's video card.
- Has 15 holes.
- Similar to serial port connector but serial port connector has pins, it has holes.

Power Connector

- Three-pronged plug
- Connects to the computer's power cable that plugs into a power bar or wall socket

Firewire Port

- Transfers large amount of data at very fast speed.
- Connects camcorders and video equipments to the computer
- Data travels at 400 to 800 megabits per seconds
- Invented by Apple
- Three variants : 4-Pin FireWire 400 connector, 6-Pin FireWire 400 connector and 9-Pin FireWire 800 connector

Modem Port

- Connects a PC's modem to the telephone network

Ethernet Port

- Connects to a network and high speed Internet.
- Connect network cable to a computer.
- This port resides on an Ethernet Card.
- Data travels at 10 megabits to 1000 megabits per seconds depending upon the network bandwidth.

Game Port

- Connect a joystick to a PC
- Now replaced by USB.

Digital Video Interface, DVI port

- Connects Flat panel LCD monitor to the computer's high end video graphic cards.
- Very popular among video card manufacturers.

Sockets

- Connect microphone, speakers to sound card of the computer.

Connecting or removing connectors from PC port.

Setting up a desktop computer (Fig 17)



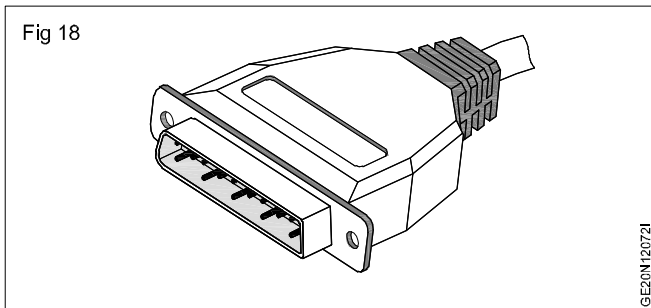
Step 1

Unpack the monitor and computer case from the box. Remove any plastic covering or protective tape. Place the monitor and computer case where you wish on the desk or work area.

Think about where you want your desk or work area to be located, as well as where you want your monitor, computer case, and other hardware. Be sure to place your computer case in an area that is well-ventilated and that has good air flow. This will help to prevent overheating.

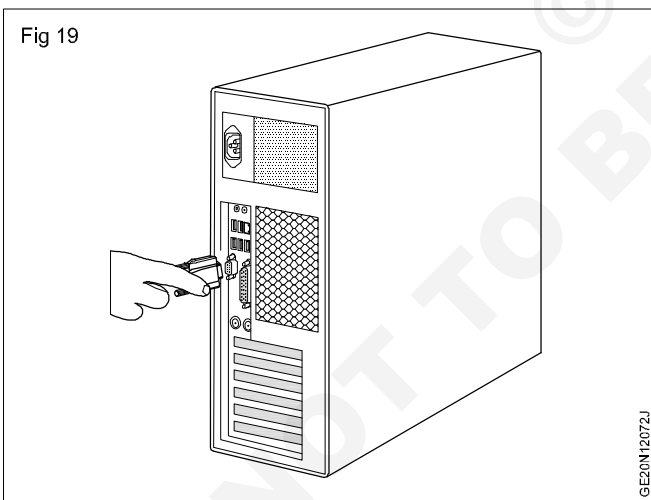
Step 2

Locate the monitor cable. It will usually be either a VGA or DVI cable. VGA cables will often have blue connectors to make them easier to identify. (If you have an all-in-one computer that's built into the monitor. (Fig 18)



Step 3

Connect one end of the cable to the monitor port on the back of the computer case and the other end to the monitor. Hand-tighten the plastic-covered screws on the monitor cable to secure it. (Fig 19)

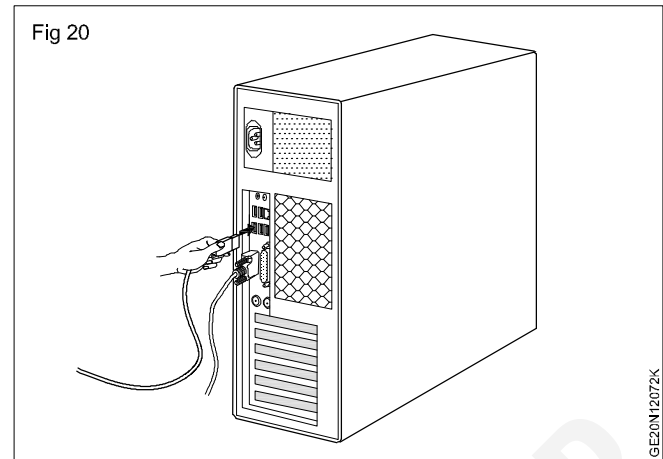


Many computer cables will only fit a specific way. If the cable doesn't fit, don't force it or you might damage the connectors. Make sure the plug aligns with the port, then connect it.

Step 4

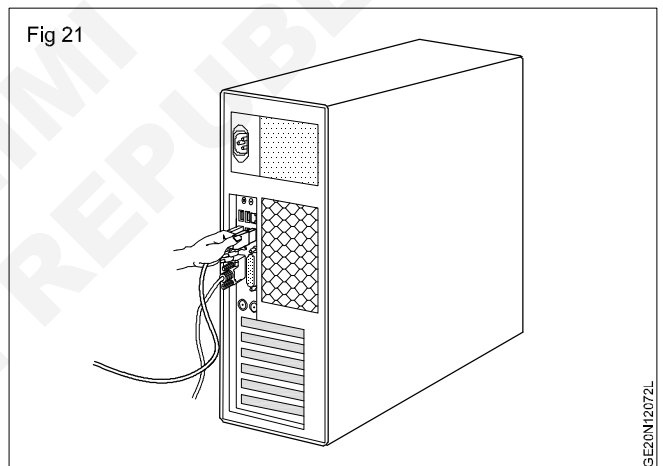
Unpack the keyboard and determine whether it uses a USB (rectangular) connector or a PS/2 (round) connector. If it uses a USB connector, plug it into any of the USB ports on the back of the computer. If it uses a PS/2

connector, plug it into the purple keyboard port on the back of the computer. (Fig 20)



Step 5

Unpack the mouse and determine whether it uses a USB (rectangular) connector or a PS/2 (round) connector. If it uses a USB connector, plug it into any of the USB ports on the back of the computer. If it uses a PS/2 connector, plug it into the green mouse port on the back of the computer. (Fig 21)



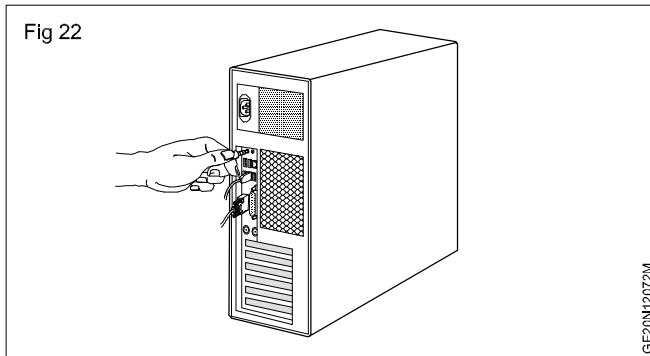
If your keyboard has a USB port, you can connect your mouse to the keyboard instead of connecting it directly to your computer.

If you have a wireless mouse or keyboard, you may need to connect a Bluetooth dongle (USB adapter) to your computer. However, many computers have built-in Bluetooth, so a dongle may not be necessary.

Step 6

If you have external speakers or headphones, you can connect them to your computer's audio port (either on the front or the back of the computer case). Many computers have color-coded ports. Speakers or headphones connect to the green port, and a microphone can connect to the pink port. The blue port is the line in, which can be used with other types of devices.

Some speakers, headphones, and microphones have USB connectors instead of the usual audio plug. These can be connected to any USB port. In addition, many computers have speakers or microphones built into the monitor. (Fig 22)



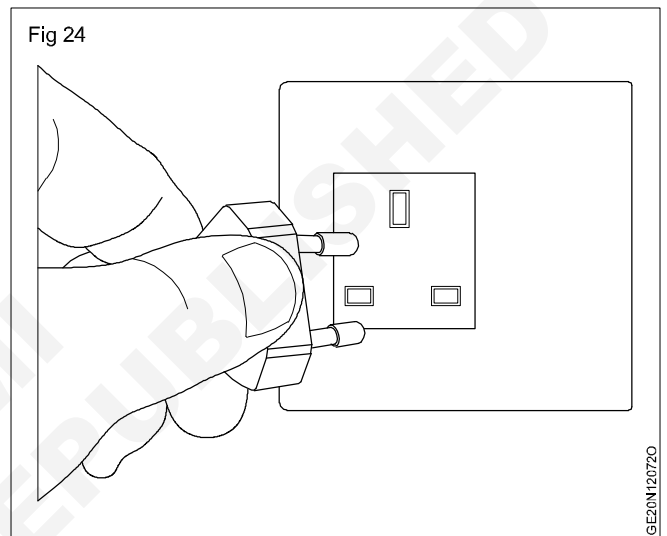
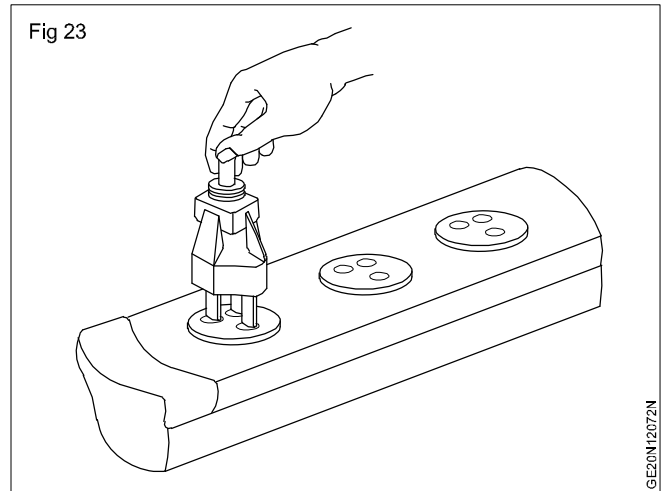
Step 7

Locate the two power supply cables that came with your computer. Plug the first power supply cable into the back of the computer case, and then into a surge protector. Then, using the other cable, connect the monitor to the surge protector. (Fig 23)

Step 8

Finally, plug the surge protector into a wall outlet. You may also need to turn the surge protector on if it has a power switch.

If you don't have a surge protector, you can plug the computer directly into the wall. However, this is not recommended, as electrical surges can damage your computer. (Fig 24)



Hardware Installation / Uninstallation

Objectives: At the end of this lesson you shall be able to

- explain memory devices
- explain random access memory (RAM)
- explain read only memory (ROM)
- explain construction and operation of hard disk drives.

Memory Devices

A memory is just like a human brain. It is used to store data and instruction. Computer memory is the storage space in computer where data is to be processed and instructions required for processing are stored.

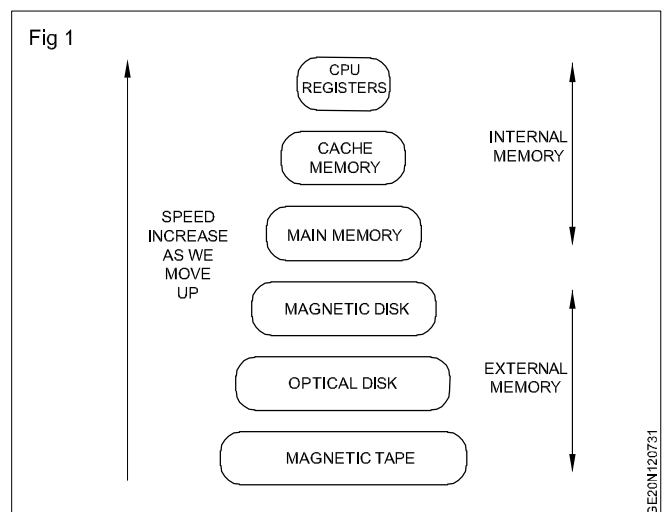
The memory is divided into large number of small parts. Each part is called cell. Each location or cell has a unique address which varies from zero to memory size minus one.

For example if computer has 64k words, then this memory unit has $64 * 1024 = 65536$ memory location. The address of these locations varies from 0 to 65535.

Memory is primarily of two types

- Internal Memory : Cache memory and primary/main memory

- External Memory : Magnetic disk / optical disk etc. (Fig 1)



Characteristics of Memory Hierarchy are following when we go from top to bottom.

- Capacity in terms of storage increases.
- Cost per bit of storage decreases.
- Frequency of access of the memory by the CPU decreases.
- Access time by the CPU increases

RAM (Random Access Memory)

RAM is considered "random access" because you can access any memory cell directly if you know the row and column that intersect at that cell. RAM is made in electronic chips made of so called semiconductor material, just like processors and many other types of chips. In RAM, transistors make up the individual storage cells which can each "remember" an amount of data, for example, 1 or 4 bits - as long as the PC is switched on. Physically, RAM consists of small electronic chips which are mounted in modules (small printed circuit boards). The modules are installed in the PC's motherboard using sockets - there are typically 2, 3 or 4 of these.

There are two basic types of RAM :

- i Dynamic Ram
- ii Static RAM

Dynamic RAM : loses its stored information in a very short time (for milli sec.) even when power supply is on. D-RAM's are cheaper & lower.

Similar to a microprocessor chip is an Integrated Circuit (IC) made of millions of transistors and capacitors.

In the most common form of computer memory, Dynamic Memory Cell, represents a single bit of data. The capacitor holds the bit of information - a 0 or a 1. The transistor acts as a switch that lets the control circuitry on the memory chip read the capacitor or change its state. A capacitor is like a small bucket that is able to store electrons. To store a 1 in the memory cell, the bucket is filled with electrons.

To store a 0, it is emptied. The problem with the capacitor's bucket is that it has a leak. In a matter of a few milliseconds a full bucket becomes empty. Therefore, for dynamic memory to work, either the CPU or the Memory Controller has to come along and recharge all of the capacitors holding it before they discharge. To do this, the memory controller reads the memory and then writes it right back. This refresh operation happens automatically thousands of times per second.

This refresh operation is where dynamic RAM gets its name. Dynamic RAM has to be dynamically refreshed all of the time or it forgets what it is holding. The downside of all of this refreshing is that it takes time and slows down the memory.

Static RAM uses a completely different technology. S-RAM retains stored information only as long as the power supply is on. Static RAM's are costlier and consume more

power. They have higher speed than D-RAMs. They store information in Hip-Hope.

In static RAM, a form of flipflop holds each bit of memory. A flip-flop for a memory cell takes four or six transistors along with some wiring, but never has to be refreshed. This makes static RAM significantly faster than dynamic RAM. However, because it has more parts, a static memory cell takes up a lot more space on a chip than a dynamic memory cell. Therefore, you get less memory per chip, and that makes static RAM a lot more expensive. Static RAM is fast and expensive, and dynamic RAM is less expensive and slower. Static RAM is used to create the CPU's speed-sensitive cache, while dynamic RAM forms the larger system RAM space.

Some other RAMS are :

- **EDO (Extended Data Output) RAM** : In an EDO RAMs, any memory location can be accessed. Stores 256 bytes of data information into latches. The latches hold next 256 bytes of information so that in most programs, which are sequentially executed, the data are available without wait states.
- **SDRAM (Synchronous DRAMS)** : SGRAMs (Synchronous Graphic RAMs) These RAM chips use the same clock rate as CPU uses. They transfer data when the CPU expects them to be ready.
- **DDR-SDRAM (Double Data Rate - SDRAM)** : This RAM transfers data on both edges of the clock. Therefore the transfer rate of the data becomes doubles.

A RAM constitutes the internal memory of the CPU for storing data, program and program result. It is read/write memory. It is called random access memory (RAM).

Since access time in RAM is independent of the address to the word that is, each storage location inside the memory is as easy to reach as other location & takes the same amount of time. We can reach into the memory at random & extremely fast but can also be quite expensive.

RAM is volatile, i.e. data stored in it is lost when we switch off the computer or if there is a power failure. Hence a backup uninterruptible power system(UPS) is often used with computers. RAM is small , both in terms of its physical size and in the amount of data it can hold.

RAM is of two types

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

Static RAM (SRAM)

The word static indicates that the memory retains its contents as long as power remains applied. However, data is lost when the power gets down due to volatile nature. SRAM chips use a matrix of 6-transistors and no capacitors. Transistors do not require power to prevent leakage, so SRAM need not have to be refreshed on a regular basis.

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

Static RAM is used as cache memory needs to be very fast and small.

Dynamic RAM (DRAM)

DRAM, unlike SRAM, must be continually refreshed in order for it to maintain the data. This is done by placing the memory on a refresh circuit that rewrites the data several hundred times per second. DRAM is used for most system memory because it is cheap and small. All DRAMs are made up of memory cells. These cells are composed of one capacitor and one transistor.

RAM Description

- 1 RAM comes in a variety of models and speeds. The type of RAM can get is dependent on computer's motherboard. Check motherboard or computer's documentation, or check the manufacturer's website for the RAM specifications that are compatible with hardware.
- 2 RAM is available as DDR (double data rate), DDR2, and DDR3. Most new computers use DDR2 or 3. So get the type that matches the motherboard and supports.
- 3 RAM is identified by two different speed numbers: the PC/PC2/PC3 number and the MHz speed. Make sure that both match your motherboard's specifications.
- 4 The speed of the RAM is signified by the number after the DDR specification (ex. DDR3 1600=1600 MHz)
- 5 Mother board has a limit to the number RAM sticks you can install. Some mother boards. Support only two, while other supports four, six or even more.

Steps to Install/Remove a RAM

- 1 Unplug the computer and peripherals connected to the computer, such monitors, keyboards, and mice.
- 2 Lay the computer tower on its side, so that you can access the motherboard when the side panel is removed. You may need a Phillips-head screwdriver to remove the panel, or you may be able to unscrew it by hand.
- 3 Most motherboards have 2 or 4 RAM slots. RAM sockets are typically located near the CPU, though their location may vary depending on the manufacturer or model. Refer to your motherboard's layout diagram in your documentation if you are having difficulty locating he sockets
- 4 If you are replacing old RAM, remove it by releasing the clamps on each side of the socket. The RAM will be released from the socket, and you'll be able to lift it straight out of the motherboard with little to no effort.
- 5 Carefully remove the Ram from the shielded packaging. Grip it from the sides to avoid touching the contacts on the bottom or the circuitry on the board.

- 6 Line up the notch in the stick of RAM to the break in the slot. Set the stick into the slot and then apply equal pressure onto the stick until the clamps on the side click and lock the RAM in. You may have to apply a fair amount of pressure, but never force it in.
- 7 Make sure matching pairs are inserted into their matching sockets. Most are labelled on the board or by colour, though you may need to refer to your motherboard layout diagram. Make sure that they are facing the same way.
- 8 Once you've finished inserting your RAM sticks, you can put the panel back on and screw it back in. Avoid running your computer while the panel is off, as this will actually reduce the cooling power of your fans. Plug your peripherals and monitor back in.
- 9 Press the Windows key + Pause/Break to open the System Properties. Can also click the Start menu, right click on Computer/My Computer and click Properties. RAM will be listed in the System section or at the bottom of the window

ROM (Read Only Memory)

- 1 ROM stands for Read Only Memory. The memory from which we can only read but cannot write on it. This type of memory is non-volatile. The information is stored permanently in such memories during manufacture.
- 2 A ROM, stores such instruction as are required to start computer when electricity is first turned on, this operation is referred to as bootstrap. ROM chip are not only used in the computer but also in other electronic items like washing machine and microwave oven. (Fig 2)

Fig 2



Following are the various types of ROM

1 MROM (Masked ROM)

The very first ROMs were hard-wired devices that contained a pre-programmed set of data or instructions. These kinds of ROMs are known as masked ROMs. It is inexpensive ROM.

2 PROM (Programmable Read only Memory)

PROM is read-only memory that can be modified only once by a user. The user buys a blank PROM and enters the desired contents using a PROM programmer. Inside the PROM chip there are small fuses which are burnt open during programming. It can be programmed only once and is not erasable.

3 EPROM (Erasable and Programmable Read Only Memory)

The EPROM can be erased by exposing it to ultra-violet light for duration of up to 40 minutes. Usually, an EPROM eraser achieves this function. During programming an electrical charge is trapped in an insulated gate region. The charge is retained for more than ten years because the charge has no leakage path. For erasing this charge, ultra-violet light is passed through a quartz crystal window (lid). This exposure to ultra-violet light dissipates the charge. During normal use the quartz lid is sealed with a sticker.

4 EEPROM (Electrically Erasable and Programmable Read Only Memory)

The EEPROM is programmed and erased electrically. It can be erased and reprogrammed about ten thousand times. Both erasing and programming take about 4 to 10 ms (milli second). In EEPROM, any location can be selectively erased and programmed. EEPROMs can be erased one byte at a time, rather than erasing the entire chip. Hence, the process of re-programming is flexible but slow.

Memory packaging

Earlier main memory was in DIP package and used in earlier boards upto 286-386 where DIP sockets were provided. Later memory was available as single in line package(SIP) female Berg strip. Then single in line Memory modules are developed and used with SIMM sockets provided on the mother board. SIMM sockets available as 30 pin and 72 pin packages. Latest Mother boards comes with DIMM sockets. DIMM sockets has 168 pins. Cache memory sockets are dip type in earlier boards. Modern board comes with DIMM socket. These sockets have locking arrangement to firmly seat the modules. These sockets have locking arrangement to firmly seat the modules. These sockets have keys to prevent user from wrongly inserting the modules Fig 3 shows the DIMM and its socket arrangement Fig 4 & 5 shows SIMM and it socket arrangement.

Hard disk drive

Construction and Operation of the Hard Disk

It is hard to really understand the factors that affect performance, reliability and interfacing without knowing how the drive works internally. Fortunately, most hard disks are basically the same on the inside. While the technology evolves, many of the basics are unchanged from the first PC hard disks in the early 1980s. (Fig 6)

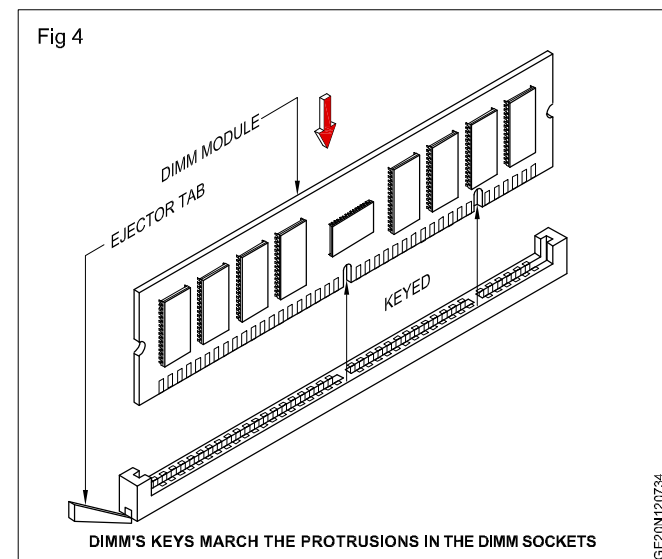
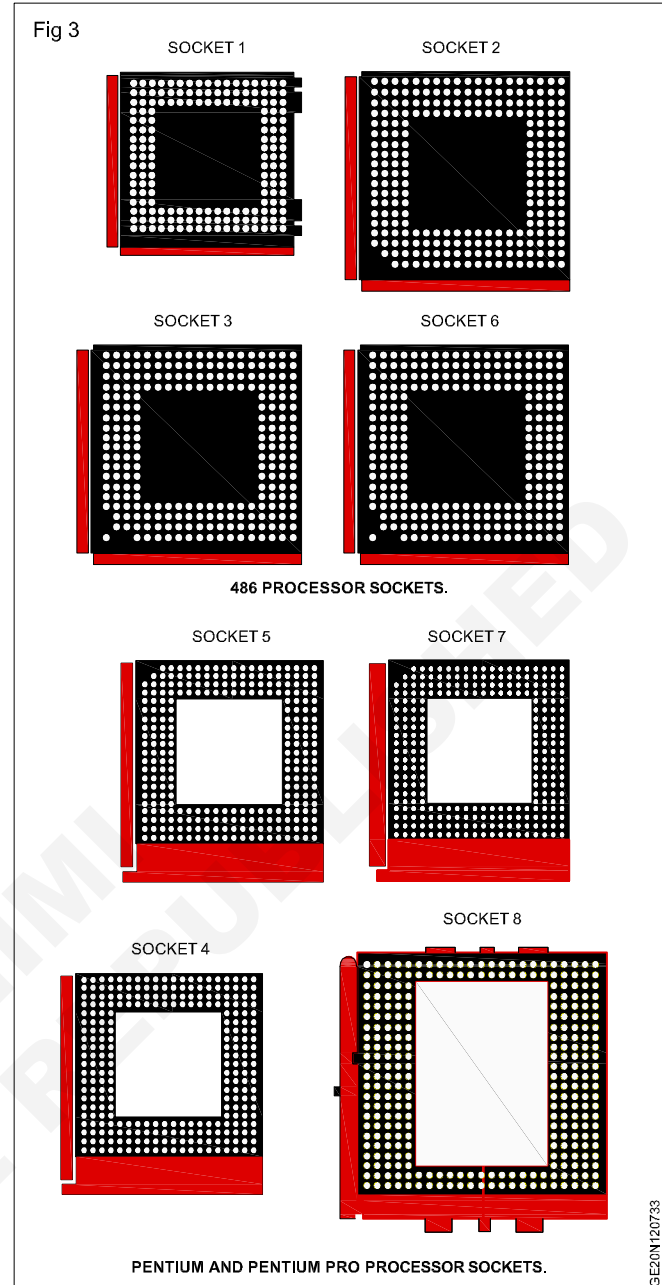
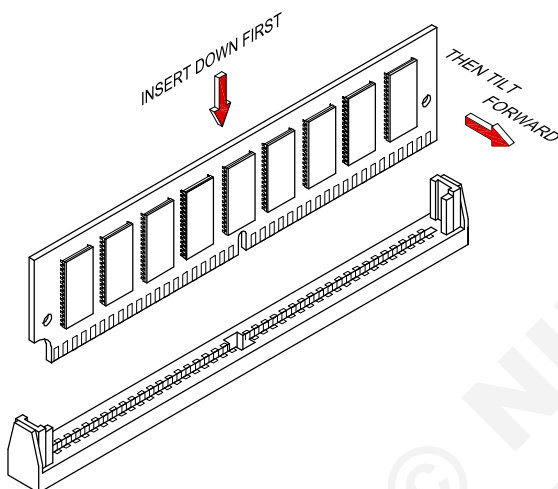
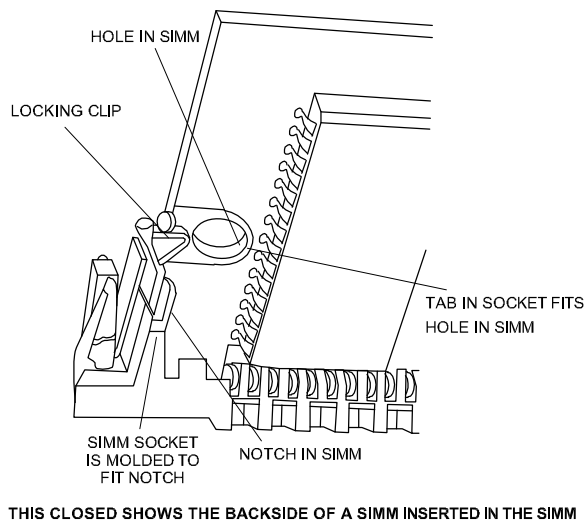


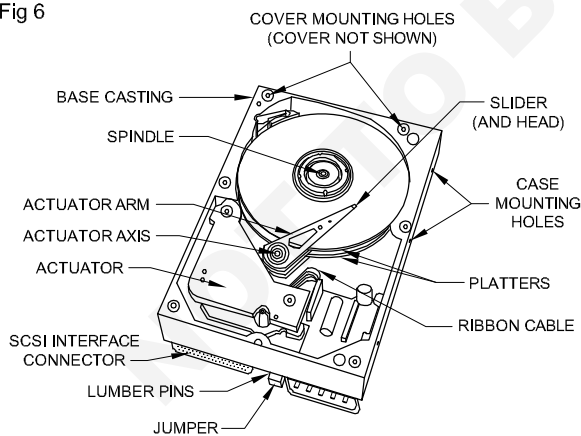
Fig 5



THE NOTCH ON THIS SIMM IS SHOWN ON THE LEFT END. INSERT THE SIMM AT AN ANGLE AND THEN TILT IT FORWARD UNTIL THE LOCKING CLIPS SNAP INTO PLACE.

GE20N120735

Fig 6



GE20N120736

Hard disk operational overview

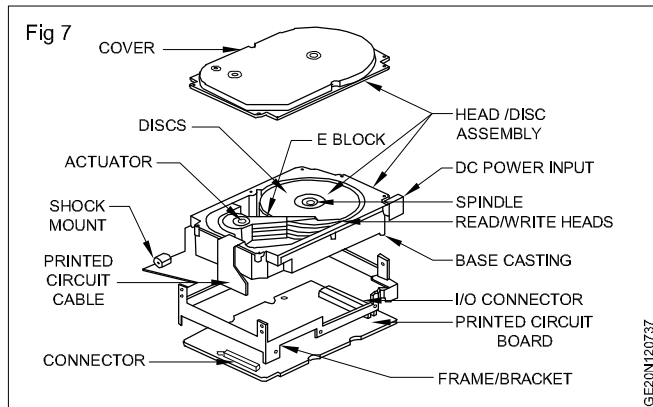
A hard disk uses round, flat disks called platters, coated on both sides with a special media material designed to store information in the form of magnetic patterns. The platters are mounted by cutting a hole in the center and stacking them onto a spindle.

The platters rotate at high speed, driven by a special spindle motor connected to the spindle. Special electromagnetic read/write devices called heads are mounted on to sliders and used to either record information onto the disk or read information from it. The sliders are mounted onto arms, all of which are mechanically connected into a single assembly and positioned over the surface of the disk by a device called an actuator. A logic board controls the activity of the other components and communicates with the rest of the PC.

Each surface of each platter on the disk can hold tens of billions of individual bits of data. These are organized into larger "chunks" for convenience, and to allow for easier and faster access to information. Each platter has two heads, one on the top of the platter and one on the bottom, so a hard disk with three platters (normally) has six surfaces and six total heads. Each platter has its information recorded in concentric circles called tracks. Each track is further broken down into smaller pieces called sectors, each of which holds 512 bytes of information.

- 1 The first step in accessing the disk is to figure out where on the disk to look for the needed information. Between them, the application, operating system, system BIOS and possibly any special driver software for the disk, do the job of determining what part of the disk to read.
- 2 The location on the disk undergoes one or more translation steps until a final request can be made to the drive with an address expressed in terms of its geometry. The geometry of the drive is normally expressed in terms of the cylinder, head and sector that the system wants the drive to read. (A cylinder is equivalent to a track for addressing purposes). A request is sent to the drive over the disk drive interface giving it this address and asking for the sector to be read.
- 3 The hard disk's control program first checks to see if the information requested is already in the hard disk's own internal buffer (or cache). If it is then the controller supplies the information immediately, without needing to look on the surface of the disk itself.
- 4 In most cases the disk drive is already spinning. If it isn't (because power management has instructed the disk to "spin down" to save energy) then the drive's controller board will activate the spindle motor to "spin up" the drive to operating speed.
- 5 The controller board interprets the address it received for the read, and performs any necessary additional translation steps that take into account the particular characteristics of the drive. The hard disk's logic program then looks at the final number of the cylinder requested. The cylinder number tells the disk which track to look at on the surface of the disk. The board instructs the actuator to move the read/write heads to the appropriate track.

- 6 When the heads are in the correct position, the controller activates the head specified in the correct read location. The head begins reading the track looking for the sector that was asked for. It waits for the disk to rotate the correct sector number under itself, and then reads the contents of the sector.
- 7 The controller board coordinates the flow of information from the hard disk into a temporary storage area (buffer). It then sends the information over the hard disk interface, usually to the system memory, satisfying the system's request for data. (Fig 7)



Hard disk platters and media

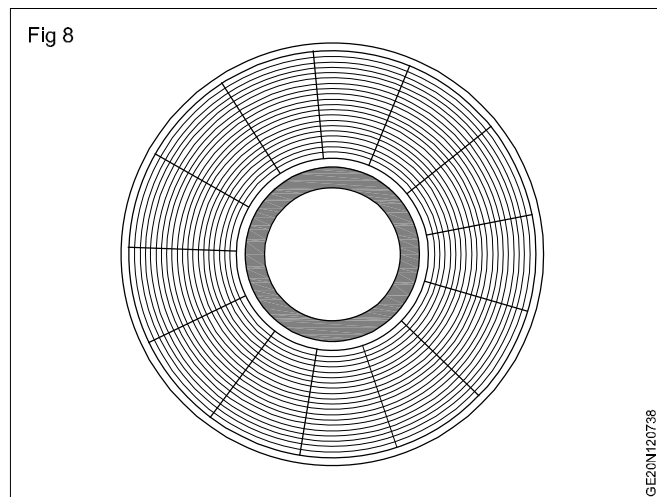
Every hard disk contains one or more flat disks that are used to actually hold the data in the drive. These disks are called platters (sometimes also "disks" or "discs"). They are composed of two main substances: a substrate material that forms the bulk of the platter and gives it structure and rigidity, and a magnetic media coating which actually holds the magnetic impulses that represent the data. Hard disks get their name from the rigidity of the platters used, as compared to floppy disks and other media which use flexible "platters" (actually, they aren't usually even called platters when the material is flexible.)

Tracks and Sectors

Platters are organized into specific structures to enable the organized storage and retrieval of data. Each platter is broken into tracks--tens of thousands of them--which are tightly-packed concentric circles. These are similar in structure to the annual rings of a tree (but not similar to the grooves in a vinyl record album, which form a connected spiral and not concentric rings).

A track holds too much information to be suitable as the smallest unit of storage on a disk, so each one is further broken down into sectors. A sector is normally the smallest individually-addressable unit of information stored on a hard disk, and normally holds 512 bytes of information.

The first PC hard disks typically held 17 sectors per track. Today's hard disks can have thousands of sectors in a single track, and make use of zoned recording to allow more sectors on the larger outer tracks of the disk. (Fig 8)



Head Actuator

The actuator is the device used to position the head arms to different tracks on the surface of the platter (actually, to different cylinders, since all head arms are moved as a synchronous unit, so each arm moves to the same track number of its respective surface).

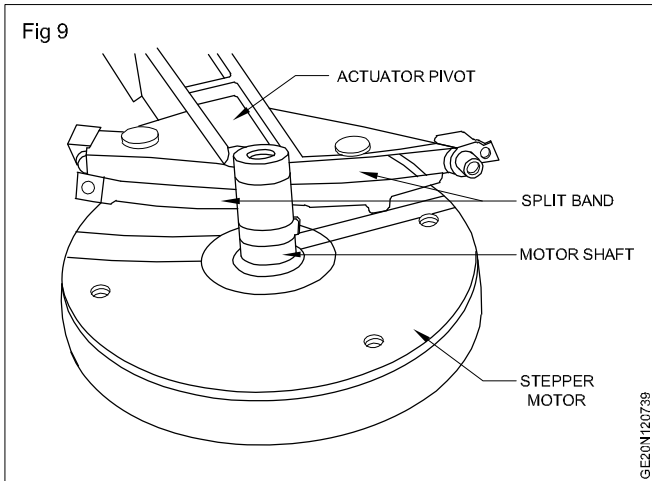
The actuator is a very important part of the hard disk, because changing from track to track is the only operation on the hard disk that requires active movement: changing heads is an electronic function, and changing sectors involves waiting for the right sector number to spin around and come under the head (passive movement).

Head actuators come in two general varieties

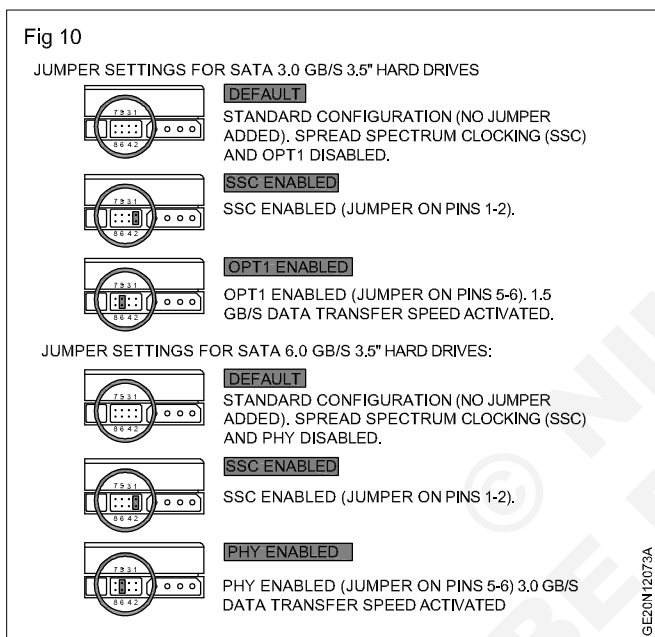
- Stepper Motors: Originally, hard disk drives used a stepper motor to control the movement of the heads over the surface of the platters. A regular motor turns in a rotary fashion continuously; it can stop at any point in its rotation as it spins around, kind of like the second hand on a wind-up wristwatch.
- A stepper motor can only stop at predefined "steps" as it turns around, much the way the second hand turns on an electronic, quartz wristwatch. A hard drive using a stepper motor for an actuator attaches the arms to the motor, and each time the motor steps one position clockwise or counterclockwise, the arms move in or out one position.
- Each position defines a track on the surface of the disk. Stepper motors are also commonly used for both turning the spindle and positioning the head on floppy disk drives. If you have a floppy drive, find one of its motors and turn it slowly with your hand; you will feel the discrete step-wise nature of its motion. (Fig 9)

Setting the jumpers in Hard disk drive

Depending on your drive, your jumper settings will vary. There is generally no need to change the default jumper setting in order to use the drive. Your drive's label will show the exact jumper settings your drive supports. See the images below for examples of our most common jumper settings.



Serial ATA (SATA) I, II, and 6 Gb/s Hard Drive Jumper Settings for 3.5" drives: (Fig 10)



Trends in PC/Laptop, Server Hard Disk Drives

Performance

A crucial factor for hard drive performance is how fast the disk spins. A typical hard drive for a PC or laptop will spin at 5,400 or 7,200 revolutions per minute (rpm). A server hard drive will spin at 10,000rpm to 15,000 rpm. The faster it spins the faster it can find, read and write data. You can see this in the latency rate in the table.

It's important to recognise that servers are serving not just one person but often hundreds of people simultaneously. Performance is crucial to productivity when many people access the same machine.

Reliability

This is the biggie. Drives are rated in terms of Mean Time Between Failures (MTBF) and also Annualised Failure Rate (AFR). The MTBF is the average (mean) life of a hard drive. The failure rate follows a bell curve so most failures will occur around the mean but 50% of drives will be expected to fail before the mean. Some may fail on day 1 and others can last 10 years.

The Annualised Failure Rate (AFR) is based upon the % of drives expected to fail in the first year of service.

A desktop hard drive may have a MTBF of 50,000 hours. A server hard drive may have a MTBF of 100,000 hours. This is a significant difference. You see a similar result in the AFR with server enterprise drives having a lower failure rate than desktop/laptop drives. An outage for a single PC means one person can't do their work. A failure on a server can impact hundreds of users.

Most servers use RAID. RAID is an array of multiple disks used to give redundancy in the event that a drive fails. In the most common RAID arrangements a disk drive can fail without causing a loss of data. RAID controllers typically use advanced hardware built into the server to achieve fast throughput. This is another reason why server storage costs more than desktops.

Space (Density)

Space may seem insignificant but when you're trying to cram as much storage into a rack/datacentre as possible having smaller physical drives is an advantage. This is one reason server drives are often the 2.5" size (same size as a laptop) and not the larger 3.5" size of a desktop.

One of the reasons that server drives (2.5") perform so well is that a smaller rotating disk can spin faster.

Laptops also use 2.5" drives but this is more to save on space and reduce power consumption (important to battery life).

Another reason for servers using the 2.5" size is that it uses less electricity. The by-product is that less heat is generated which means less air conditioning and savings on energy.

Warranty

A desktop hard drive may have a 1 year warranty while a server hard drive will have a 3 to 5 year warranty.

Interface

Desktop/Laptop hard drives have SATA interfaces which work great for single users. SATA is quite fast and reliable. Enterprise hard drives use SAS or Fibre Channel. These interfaces are designed for faster and more reliable access. SATA is typically half the speed of SAS. The SATA interface is catching up in some of the latest desktop drives.

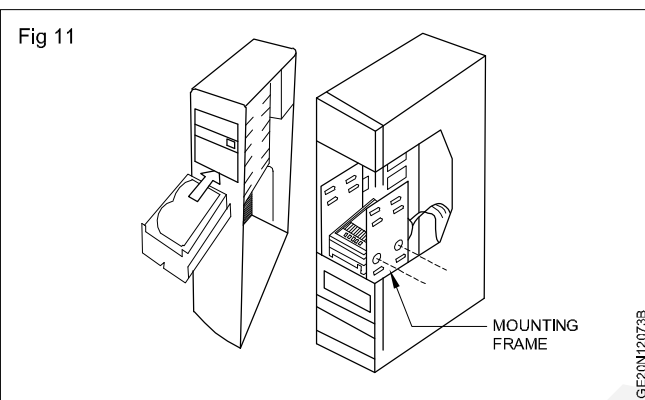
SATA drives are still used in servers but usually as a second or third tier of storage. Tier 1 is typically high speed SAS or Fibre Channel drives for fastest access. Tier 2 or 3 storage is for files that aren't accessed regularly and so speed is sacrificed for the benefits of cheaper storage.

Storage

It may seem surprising but laptop and PC drives usually have more storage capacity per drive. This is not necessarily a bad thing for servers. Servers tend to have lots of smaller drives in order to provide higher performance rather than a few big drives.

Precautions to be taken while installing and uninstalling Hard Disk Drive

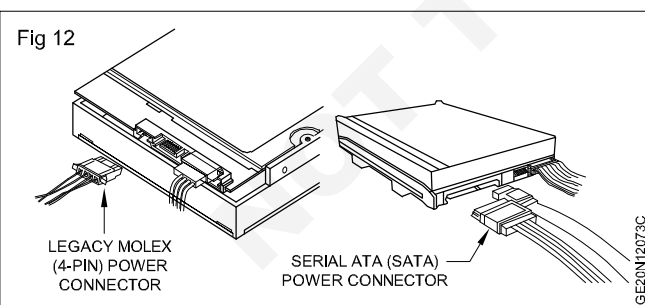
- 1 Turn the system's power off
- 2 Mount the drive in the system
 - Desktop Drives : The drive can be mounted in a standard 3.5" device bay. The drive can be mounted sideways, on end, or even upside down as long as the mounting screws are used properly. Use either the four bottom screws or four of the side mounting screws to support the drive. This will prevent vibration and provide additional electrical grounding.
 - Mobile Drives : Mobile drive installation will vary based on the manufacturing of the system it is being placed in. Please contact your system manufacturer for instructions on mounting your drive in your system. (Fig 11)



Attach the power supply cable

To supply power to the drive you may use either the SATA power connector or the legacy ATA-4-pin (Molex) power connector on the back of the drive (see image below).

If your drive has both power connectors, do not connect both the SATA and the legacy ATA power cable to the drive at the same time. This may result in damage to the drive. (Fig 12)



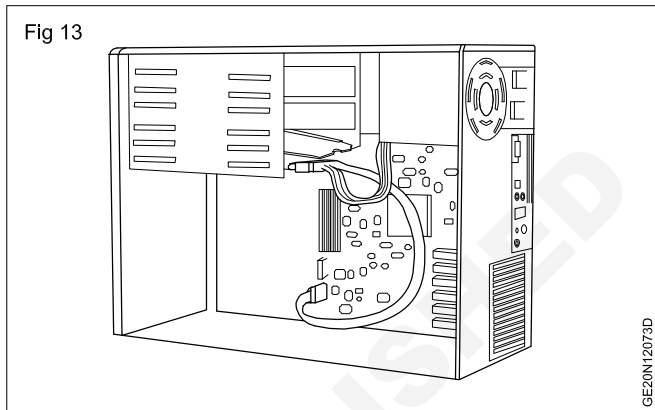
SATA Drives

The drive can be configured in one of two ways:

- Connected to a SATA host adapter card installed to the system.
- Connected directly to a Serial ATA connector on the motherboard

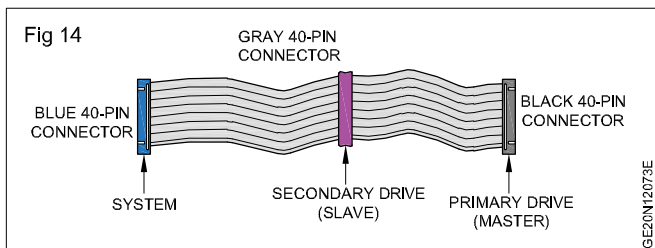
Unlike EIDE cables, either end of a standard SATA cable can be connected to the drive. Once you have connected the cable to the drive, connect the other end into the SATA host adapter card, or the motherboard. SATA interface cables have keyed connectors to prevent incorrect installation. Make sure the cable is no longer than 39 inches to minimize line noise and to remain within the SATA specification.

(This illustration shows the drive being connected the motherboard.) (Fig 13)



EIDE (PATA) Drives

- Connect the EIDE (PATA) Interface Cable to the hard drive(s):
- If installing the hard drive as the only drive on the cable:
- Connect the black connector of the EIDE (PATA) interface cable to the drive.
- If installing two drives on the same EIDE (PATA) interface cable: Jumper the bootable drive as Master, and the other drive as Slave; then connect the Master drive to the black connector of the EIDE (PATA) interface cable, and the Slave drive to the gray connector. (Fig 14)



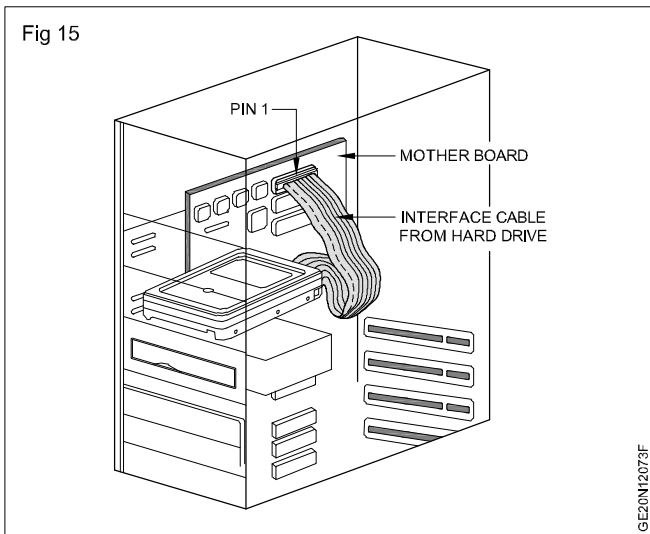
- Connect the IDE Interface Cable to the Motherboard:

Attach the blue end of the IDE interface cable to the 40-pin connector on the motherboard. Match pin 1 on the IDE interface cable to the connector on the motherboard. (Fig 15)

Power on Your Computer

- 1 Replace the system cover, reconnect the power cord, and power on the system. At startup, the computer will display all the devices detected on the system.
- 2 If the drive you installed is not detected, restart the computer.

- 3 At startup, run the CMOS Setup program and configure your BIOS so your drive is detected. Your system or motherboard manual should provide these instructions. If it does not you will need to contact your system or motherboard manufacturer for assistance.
- 4 Restart the system to make sure the drive is detected.



Scan Disk and Defrag

One of the best ways to ensure optimum performance of your computer is to perform regular maintenance on the hard drive. Scan Disk and Disk Defragmenter (Defrag) are two programs that when run in conjunction with each other have the ability to detect and resolve many of the problems which can cause poor performance and in more serious cases the loss of files.

Both Scan Disk and Defrag can be found under System Tools located within the Accessories group, which can be found by clicking "Start" on your task bar and highlighting "Programs". Before running either of these utilities, be sure to disable any screensavers and or virus protection programs that you may have set on your PC. To run a thorough ScanDisk followed by Defrag, it can take up to 30 minutes. Should a screen saver be enabled, it will continuously interrupt these programs causing them to have to restart after each interruption.

ScanDisk

Windows XP

- 1 Double-click My Computer.
- 2 Right-click the hard disk drive you wish to scan.
- 3 Click Properties.
- 4 Click the Tools tab.
- 5 Under Error-checking, click Check Now.
- 6 Select the Scan for and attempt recovery of bad sectors check box and the Automatically fix file system errors box.

- 7 Click Yes to schedule after the restart.
- 8 Restart your computer for the scan to run.

Windows Vista/Windows 7/Windows 8

- 1 Click the Start button (Windows Key + Q in Windows 8).
- 2 Click Computer.
- 3 Right-click the hard disk drive that you wish to check (this will commonly be C:\).
- 4 Click Properties.
- 5 Click the Tools tab.
- 6 Under Error-checking, click Check Now.
- 7 Under Check disk options, select Scan for and attempt recovery of bad sectors box and Automatically fix file system errors box.
- 8 Select Yes to schedule after restart.
- 9 Restart your computer.

Defrag

Do not perform disk defragmentation (defrag) on Solid State Drives (SSD) as it may cause permanent damage to the drive. If you are unsure what type of disk drive you have, consult your PC manufacturer.

Windows XP

- 1 Double-click My Computer and select the local disk you want to check.
- 2 Click File.
- 3 Click Properties
- 4 Click the Tools tab.
- 5 Click Defragment Now.
- 6 Select the volume to defragment.
- 7 Click Defragment.

Windows Vista/Windows 7/Windows 8

- 1 Click Start (Windows Key + Q in Windows 8).
- 2 Select Computer.
- 3 Right click on the Hard disk that you wish to check.
- 4 Select Properties from the pop-up menu.
- 5 Click the Tools tab.
- 6 Under Defragmentation, click Defragment Now.
- 7 Select volume to defragment.
- 8 Click Defragment.

Hardware Maintenance

Objectives: At the end of this lesson you shall be able to

- explain types of I/O devices on a standard PC
- explain the types of ports on a standard PC
- explain the different types of computer cases
- explain front and rear panel controls and ports on a PC
- explain a CPU cooling fan
- explain about cables and connectors
- explain power supply connections
- explain video cards.

Types of I/O Devices and Ports on a Standard PC for connecting I/O devices

Input Device

An input device is any hardware device that sends data to a computer, allowing users to interact with and control it.

Following are few of the important input devices which are used in a computer:

- Keyboard
- Mouse
- Joy Stick
- Light pen
- Track Ball
- Scanner
- Graphical Tablet
- Microphone
- Magnetic Ink Card Reader(MICR)

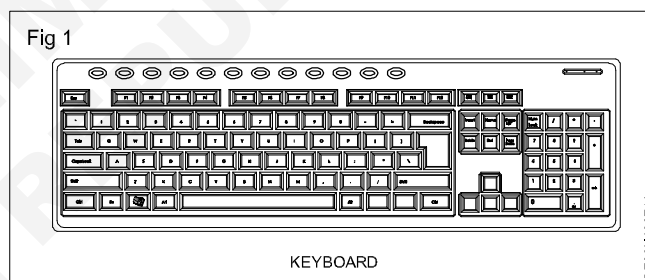
- Optical Character Reader(OCR)
- Bar Code Reader
- Optical Mark Reader(OMR)

Keyboard

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

Keyboards are of two sizes 84 keys or 101/102 keys, but now keyboards with 104 keys or 108 keys are also available for Windows and Internet. (Fig 1)

The keys on the keyboard are as follows:

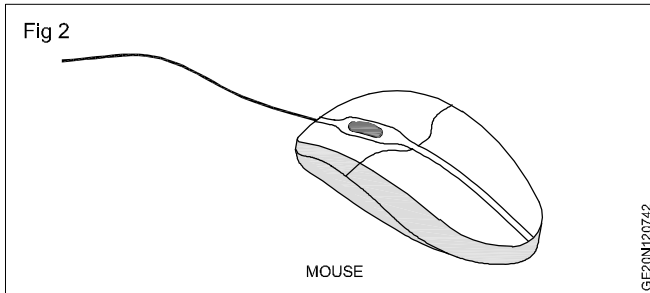


| Sl.No. | Keys | Description |
|--------|----------------------|---|
| 1 | Typing Keys | These keys include the letter keys (A-Z) and digit keys (0-9) which generally give same layout as that of typewriters. |
| 2 | Numeric Keypad | It is used to enter numeric data or cursor movement. Generally, it consists of a set of 17 keys that are laid out in the same configuration used by most adding machines and calculators. |
| 3 | Function Keys | The twelve function keys are present on the keyboard which are arranged in a row at the top of the keyboard. Each function key has unique meaning and is used for some specific purpose. |
| 4 | Control keys | These keys provide cursor and screen control. It includes four directional arrow keys. Control keys also include Home, End, Insert, Delete, Page Up, Page Down, Control(Ctrl), Alternate(Alt), Escape(Esc). |
| 5 | Special Purpose Keys | Keyboard also contains some special purpose keys such as Enter, Shift, Caps Lock, Num Lock, Space bar, Tab, and Print Screen. |

Mouse

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

Generally it has two buttons called left and right button and a wheel is present between the buttons. Mouse can be used to control the position of cursor on screen, but it cannot be used to enter text into the computer. (Fig 2)



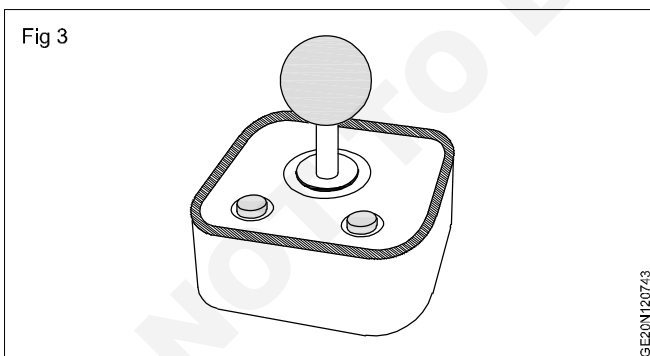
Advantages

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

Joystick

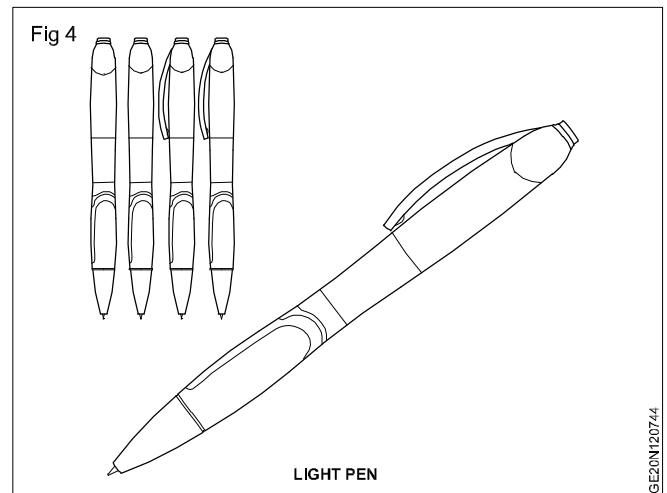
Joystick is also a pointing device which is used to move cursor position on a monitor screen. It is a stick having a spherical ball at its both lower and upper ends. The lower spherical ball moves in a socket. The joystick can be moved in all four directions.

The function of joystick is similar to that of a mouse. It is mainly used in Computer Aided Designing (CAD) and playing computer games. (Fig 3)



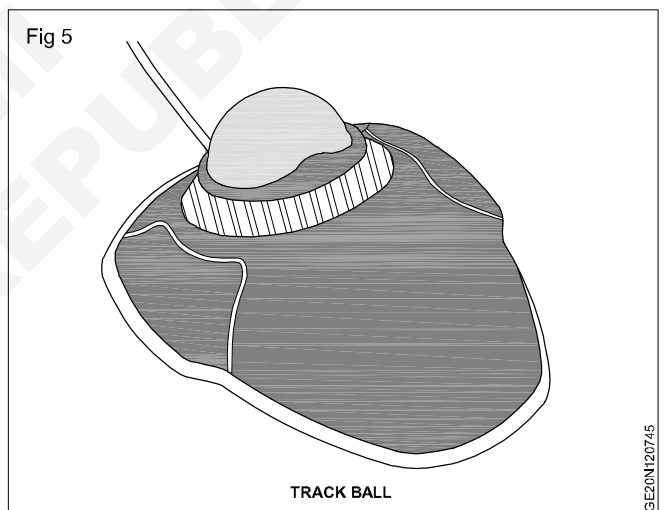
Light Pen

Light pen is a pointing device which is similar to a pen. It is used to select a displayed menu item or draw pictures on the monitor screen. It consists of a photocell and an optical system placed in a small tube. When the tip of a light pen is moved over the monitor screen and pen button is pressed, its photocell sensing element detects the screen location and sends the corresponding signal to the CPU. (Fig 4)



Track Ball

Track ball is an input device that is mostly used in notebook or laptop computer, instead of a mouse. This is a ball which is half inserted and by moving fingers on ball, pointer can be moved. Since the whole device is not moved, a track ball requires less space than a mouse. A track ball comes in various shapes like a ball, a button and a square. (Fig 5)



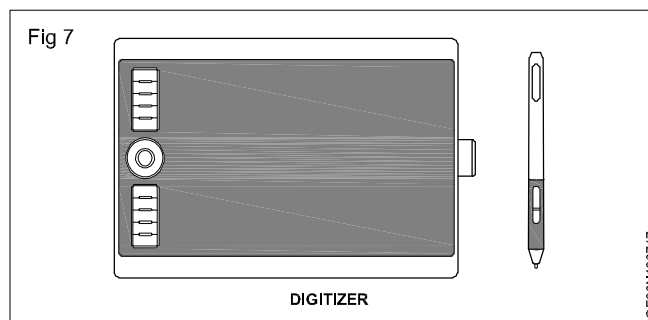
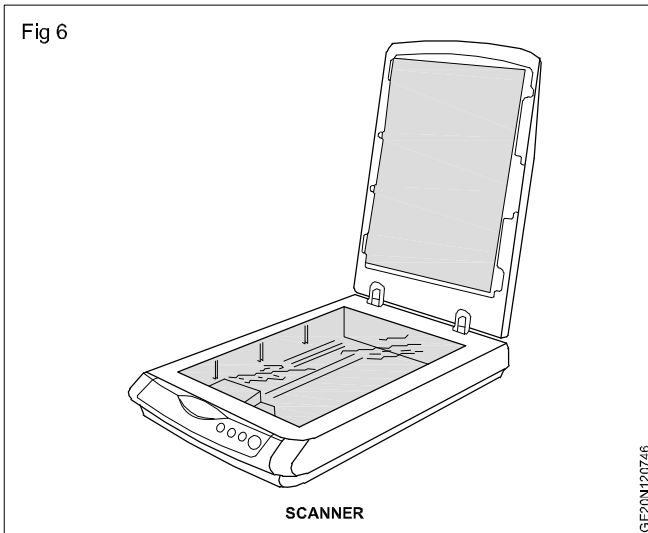
Scanner

Scanner is an input device which works more like a photocopy machine. It is used when some information is available on a paper and it is to be transferred to the hard disc of the computer for further manipulation. Scanner captures images from the source which are then converted into the digital form that can be stored on the disc. These images can be edited before they are printed. (Fig 6)

Digitizer

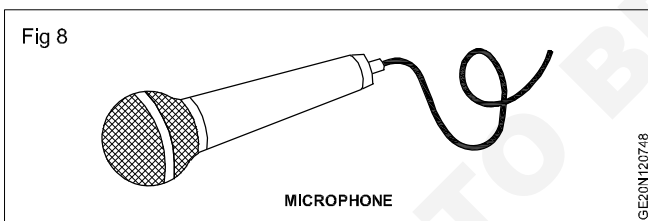
Digitizer is an input device which converts analog information into digital form. Digitizer can convert a signal from the television or camera into a series of numbers that could be stored in a computer. They can be used by the computer to create a picture of whatever the camera had been pointed at. Digitizer is also known as Tablet or Graphics Tablet because it converts graphics and pictorial data into binary inputs. A graphic tablet as digitizer is

used for doing fine works of drawing and image manipulation applications. (Fig 7)



Microphone

Microphone is an input device to input sound that is then stored in digital form. The microphone is used for various applications like adding sound to a multimedia presentation or for mixing music. (Fig 8)

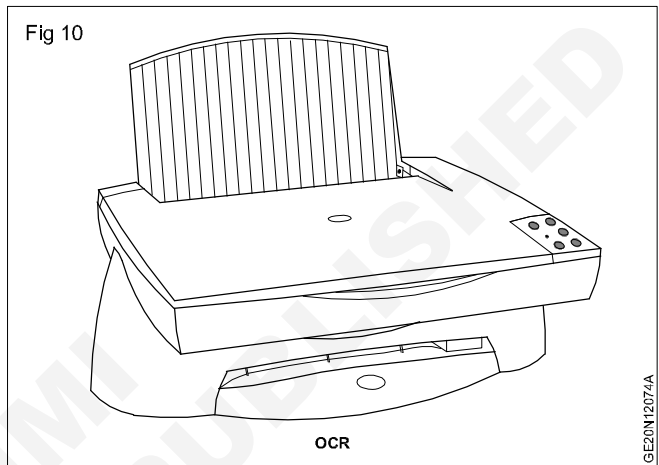
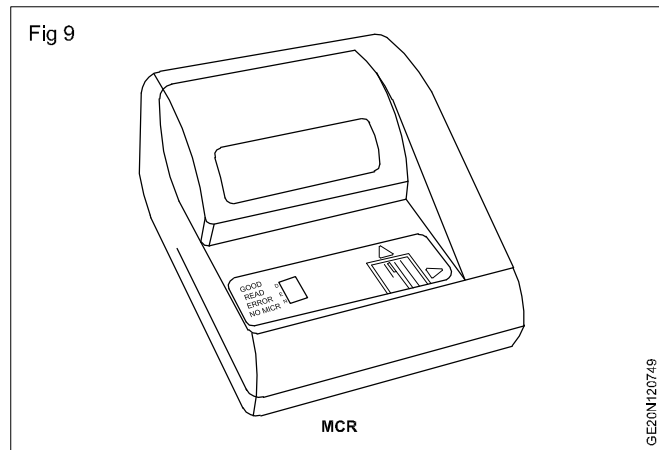


Magnetic Ink Card Reader (MICR)

MICR input device is generally used in banks because of a large number of cheques to be processed every day. The bank's code number and cheque number are printed on the cheques with a special type of ink that contains particles of magnetic material that are machine readable. This reading process is called Magnetic Ink Character Recognition (MICR). The main advantages of MICR is that it is fast and less error prone. (Fig 9)

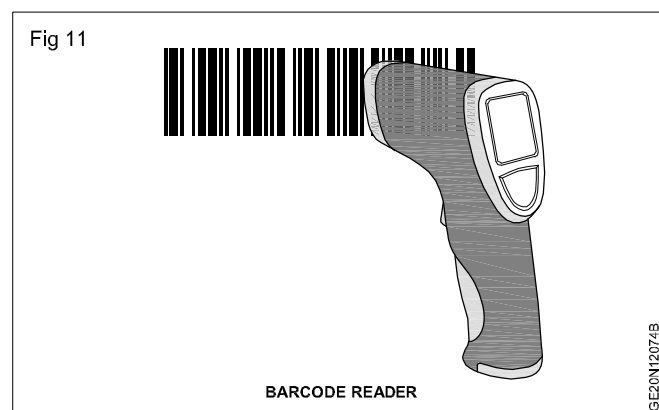
Optical Character Reader(OCR)

OCR is an input device used to read a printed text. OCR scans text optically character by character, converts them into a machine readable code and stores the text on the system memory. (Fig 10)



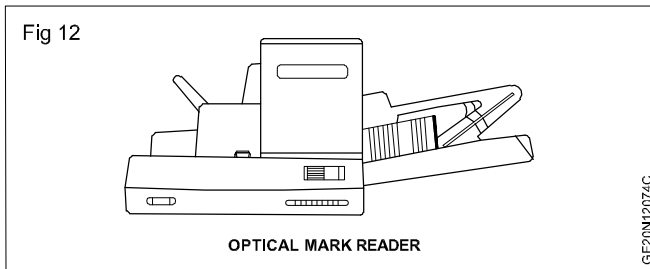
Bar Code Readers

Bar Code Reader is a device used for reading bar coded data (data in form of light and dark lines). Bar coded data is generally used in labelling goods, numbering the books etc. It may be a hand held scanner or may be embedded in a stationary scanner. Bar Code Reader scans a bar code image, converts it into an alphanumeric value which is then fed to the computer to which bar code reader is connected. (Fig 11)



Optical Mark Reader (OMR)

OMR is a special type of optical scanner used to recognize the type of mark made by pen or pencil. It is used where one out of a few alternatives is to be selected and marked. It is specially used for checking the answer sheets of examinations having multiple choice questions. (Fig 12)



Output Devices

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

- Monitors
- Graphic Plotter
- Printer

Monitors

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

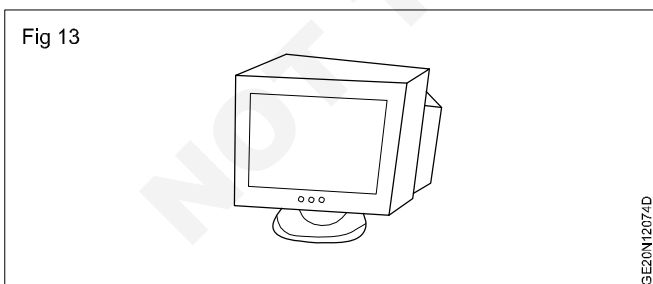
There are two kinds of viewing screen used for monitors.

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

Cathode-Ray Tube (CRT) Monitor

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

A finite number of characters can be displayed on a screen at once. The screen can be divided into a series of character boxes - fixed location on the screen where a standard character can be placed. Most screens are capable of displaying 80 characters of data horizontally and 25 lines vertically. There are some disadvantages of CRT: (Fig 13)



- Large in Size
- High power consumption

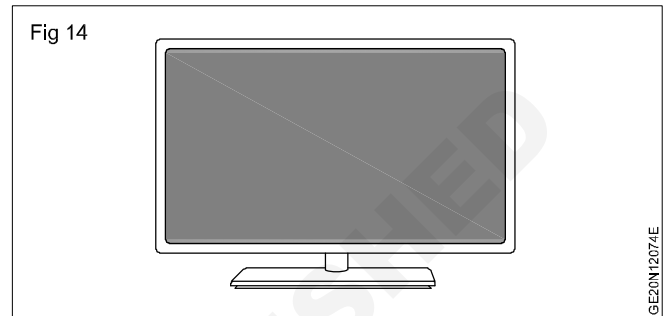
Flat-Panel Display Monitor

The flat-panel display refers to a class of video devices that have reduced volume, weight and power requirement in comparison to the CRT. You can hang them on walls or

wear them on your wrists. Current uses of flat-panel displays include calculators, video games, monitors, laptop computer, graphics display.

The flat-panel display is divided into two categories:

- **Emissive Displays** : The emissive displays are devices that convert electrical energy into light. Example are plasma panel and LED(Light-Emitting Diodes).
- **Non-Emissive Displays**: The Non-emissive displays use optical effects to convert sunlight or light from some other source into graphics patterns. Example is LCD(Liquid-Crystal Device) (Fig 14)



Printers

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

There are two types of printers:

- Impact Printers
- Non-Impact Printers

Impact Printers

The impact printers print the characters by striking them on the ribbon which is then pressed on the paper.

Characteristics of Impact Printers are the following:

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

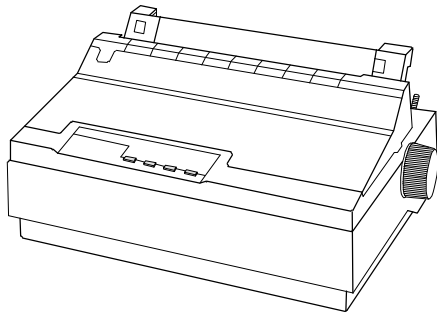
These are further divided into two types:

- Dot Matrix Printer(DMP)
- Daisy Wheel

Dot matrix printer

In the market one of the most popular printers is Dot Matrix Printer. These printers are popular because of their ease of printing and economical price. Each character printed is in form of pattern of dots and head consists of a Matrix of Pins of size (5*7, 7*9, 9*7 or 9*9) which come out to form a character that is why it is called Dot Matrix Printer. (Fig 15)

Fig 15



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Advantages

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

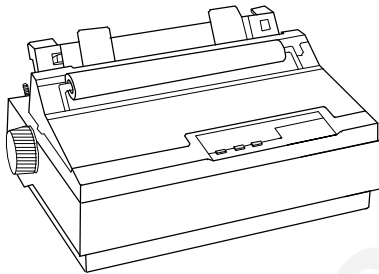
Disadvantages

- Slow Speed
- Poor Quality

Daisy wheel printer

Head is lying on a wheel and pins corresponding to characters are like petals of Daisy (flower name) that is why it is called Daisy Wheel Printer. These printers are generally used for word-processing in offices which require a few letters to be sent here and there with very nice quality. (Fig 16)

Fig 16



GE20N12074G

Advantages

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

Disadvantages

- Slower than DMP
- Noisy
- More expensive than DMP

Line Printers

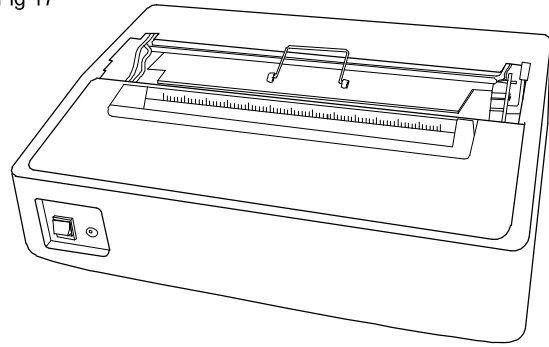
Line printers are the printers which print one line at a time. (Fig 17)

These are of further two types

- Drum Printer

- Chain Printer

Fig 17



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Drum printer

This printer is like a drum in shape so it is called drum printer. The surface of drum is divided into number of tracks. Total tracks are equal to size of paper i.e. for a paper width of 132 characters, drum will have 132 tracks. A character set is embossed on track. The different character sets available in the market are 48 character set, 64 and 96 characters set. One rotation of drum prints one line. Drum printers are fast in speed and can print 300 to 2000 lines per minute.

Advantages

- Very high speed

Disadvantages

- Very expensive
- Characters fonts cannot be changed

Chain printer

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

Advantages

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

Disadvantages

- Noisy

Non-impact Printers

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

These printers are of two types

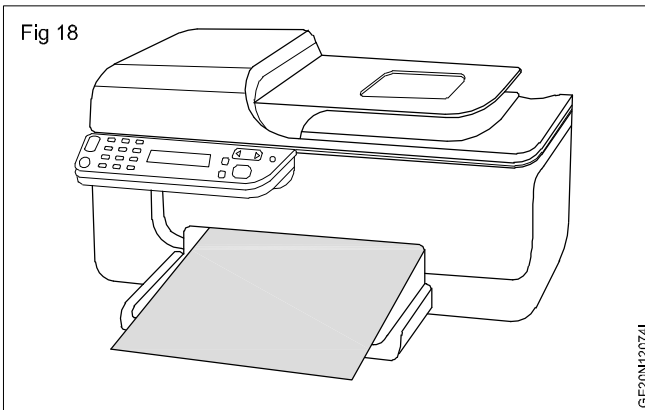
- Laser Printers
- Inkjet Printers

Characteristics of Non-impact Printers

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

Laser Printers

These are non-impact page printers. They use laser lights to produce the dots needed to form the characters to be printed on a page. (Fig 18)



Advantages

- Very high speed
- Very high quality output
- Give good graphics quality
- Support many fonts and different character size

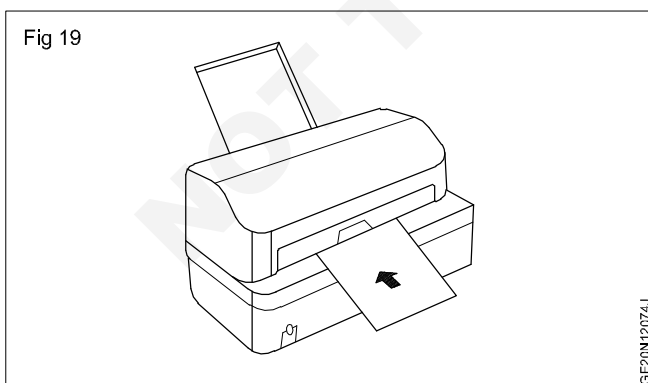
Disadvantages

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

Inkjet Printers

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

They make less noise because no hammering is done and these have many styles of printing modes available. Colour printing is also possible. Some models of Inkjet printers can produce multiple copies of printing also. (Fig 19)



Advantages

- High quality printing
- More reliable

Disadvantages

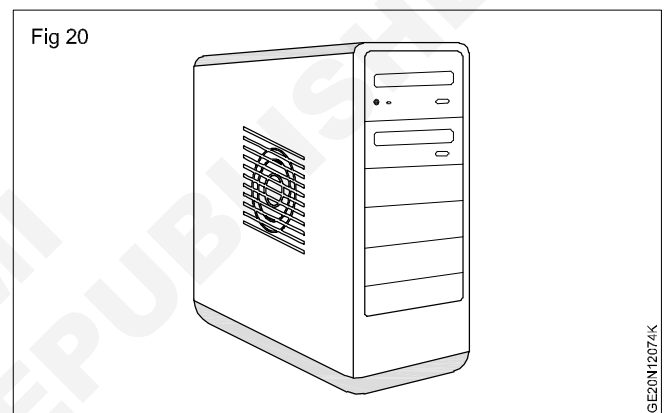
- Expensive as cost per page is high
- Slow as compared to laser printer

Computer Cases

The most common system case type is the tower. Depending on the specific number of internal drive bays and the height of the tower, these cases can be further classified into mini-size, mid-size and full-size tower cases. One of the biggest considerations when choosing between case sizes is the number of slots and the number of devices we would like to add to those cases.

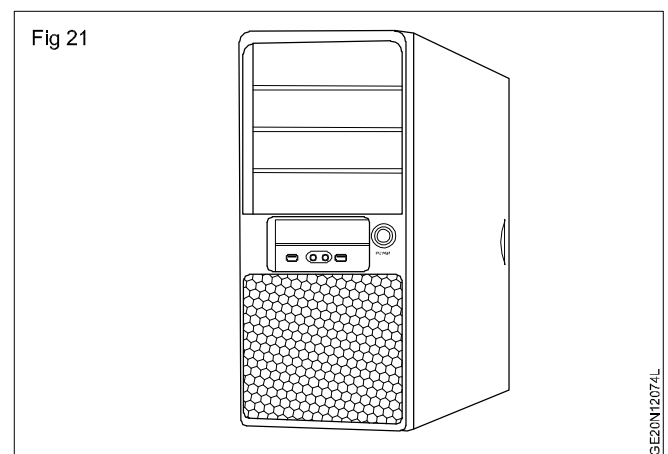
Full Tower

Full-tower cases are generally big with a height that is about or more than 30 inches (more than 76 cm). The number of internal drive bays inside these cases can be between 6 and 10. (Fig 20)



Mid Tower

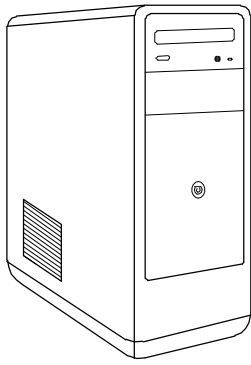
Another case that might be a step down, would be classified as a mid tower case. Mid-tower cases are the most widely used computer cases. Mid Tower cases are about 18 to 24 (45 to 60 cm) inches high and they usually contain 2 to 4 internal drive bays and a similar number of external bays (for CD/DVD readers and similar) (Fig 21)



Mini Tower

Mini-tower usually have up to 2 or sometimes 3 internal drive bays. Mini-cases normally stand at a height of 12 to 18 inches (30 to 45 cm). Expandability is a problem with these cases. (Fig 22)

Fig 22



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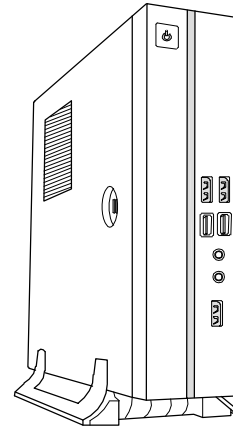
Slim Line Case

Slim line cases are simply tower cases turned on their sideways. They can hold a monitor on top of the case. (Fig 23)

Small Form Factor (SFF) Case

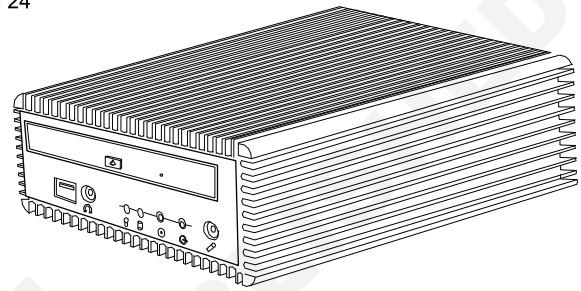
Small form factor or SFF cases are custom cases that are designed to minimize the spatial volume of a desktop computer. SFFs are available in a variety of sizes and shapes, including shoe boxes, cubes, and book-sized PCs. (Fig 24)

Fig 23



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Fig 24



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Operating System and its Commands

Objective: At the end of this exercise you shall be able to

- **list out the windows versions and features.**

Windows versions and its features

Microsoft Windows has seen nine major versions since its first release in 1985. Over 29 years later, Windows looks very different but somehow familiar with elements that have survived the test of time, increases in computing power and - most recently - a shift from the keyboard and mouse to the touchscreen.

Here's a brief look at the history of Windows, from its birth at the hands of Bill Gates with Windows 1 to the latest arrival under new Microsoft chief executive SatyaNadella.

Windows 7

Windows 7 was everything Windows Vista should have been.

Considered by many as what Windows Vista should have been, Windows 7 was first released in October 2009. It was intended to fix all the problems and criticism faced by Vista, with slight tweaks to its appearance and a concentration on user-friendly features and less "dialogue box overload".

It was faster, more stable and easier to use, becoming the operating system most users and business would upgrade to from Windows XP, forgoing Vista entirely.

Handwriting recognition debuted in 7, as did the ability to "snap" windows to the tops or sides of the screen, allowing faster more automatic window resizing.

Windows 7 saw Microsoft hit in Europe with antitrust investigations over the pre-installing of IE, which led to a browser ballot screen being shown to new users allowing them to choose, which browser to install on first boot.

Windows 8

Windows 8 focused more on touch than a keyboard and mouse.

Released in October 2012, Windows 8 was Microsoft's most radical overhaul of the Windows interface, ditching the Start button and Start menu in favour of a more touch-friendly Start screen.

Advertisement

The new tiled interface saw programme icons and live tiles, which displayed at-a-glance information normally associated with "widgets", replace the lists of programmes and icons. A desktop was still included, which resembled Windows 7.

Windows 8 was faster than previous versions of Windows and included support for the new, much faster USB 3.0 devices.

The Windows Store, which offers universal Windows apps that run in a full-screen mode only, was introduced. Programs could still be installed from third-parties like other iterations of Windows, but they could only access the traditional desktop interface of Windows.

The radical overhaul was not welcomed by many. Microsoft attempted to tread a fine line between touchscreen support and desktop users, but ultimately desktop users wanting to control Windows with a traditional mouse and keyboard and not a touchscreen felt Windows 8 was a step back.

There were also too few touchscreens in use, or on offer, to make its touch-oriented interface useful or even necessary - despite the parallel rise of tablets such as the iPad, and smartphones, which had begun outselling PCs by the end of 2010.

Windows RT, which runs on ARM-based processors traditionally found in smartphones and non-PC tablets, was introduced at the same time as Windows 8 with the Microsoft Surface tablet.

It looked and felt like Windows 8, but could not run traditional Windows applications, instead solely relying on the Windows Store for third-party apps.

Windows 8.1

Windows 8.1 and the great reappearance of the Start button.

A free point release to Windows 8 introduced in October 2013, Windows 8.1 marked a shift towards yearly software updates from Microsoft and included the first step in Microsoft's U-turn around its new visual interface.

Windows 8.1 re-introduced the Start button, which brought up the Start screen from the desktop view of Windows 8.1. Users could also choose to boot directly into the desktop of Windows 8.1, which was more suitable for those using a desktop computer with a mouse and keyboard than the touch-focused Start screen.

Windows 10

With Windows 10, Microsoft is trying to keep some of the touch and tablet features it created for Windows 8, combine them with the familiar Start menu and desktop, and run it all on top of an improved operating system with more security, a new browser, the Cortana assistant, its own version of Office for on-the-go editing and plenty of new features intended to make life simpler.

Of course, that also means it's very different to use, whether you come from Windows 7, Windows 8 or Windows XP. You have to look in a new place even to turn your PC off.

On top of that, Windows 10 is more than just a PC operating system; it's also what will run on Windows phones - and on small tablets as well, because a 6-inch phone and a 7-inch tablet aren't such very different devices.

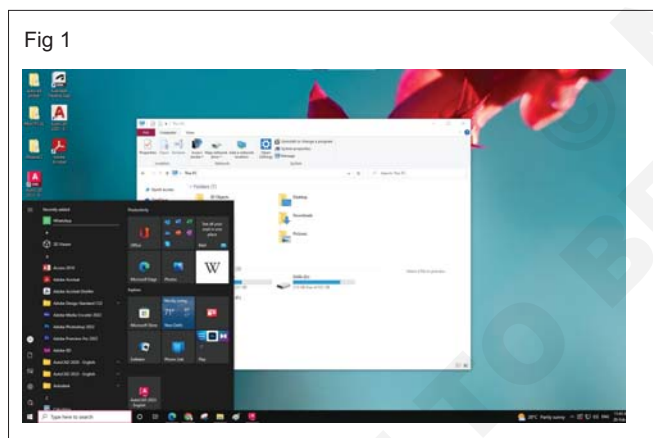
Microsoft is expecting people to put Windows 10 on a billion devices (which ought to encourage more app developers to at least take a look at building their apps for Windows phones and tablets, as well as for Xbox One and HoloLens).

The Start menu evolves

The full-screen Start screen of Windows 8 is back to being a Start menu in Windows 10 that tries to combine the best of both options. A scrolling Start menu that's restricted to a single column, with jump lists and flyout menus for extra options, divided into frequently used and recently installed programs, with the option to switch to a scrolling view of all the applications, sorted alphabetically.

But also get an extra pane, where can pin Windows 8-style tiles, complete with 'rotating 3D cube' animations of live tiles. drag the Start menu to be a larger size or even set it to be full screen.

Desktop Background (Fig 1)



Another component of the Desktop is the Background. This is simply an image that appears at the back of the screen. Most computers come with a pre-selected background, but change it to any image.

To change the background, follow these steps:

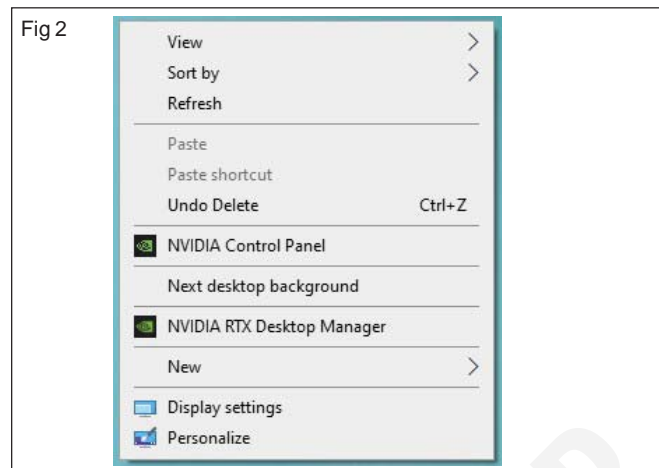
- 1 Right-click on the background and choose "Personalize"
- 2 From the Personalization window, choose from a series of pre-selected pictures or browse for your own.

After choosing a picture, the Background will change automatically.

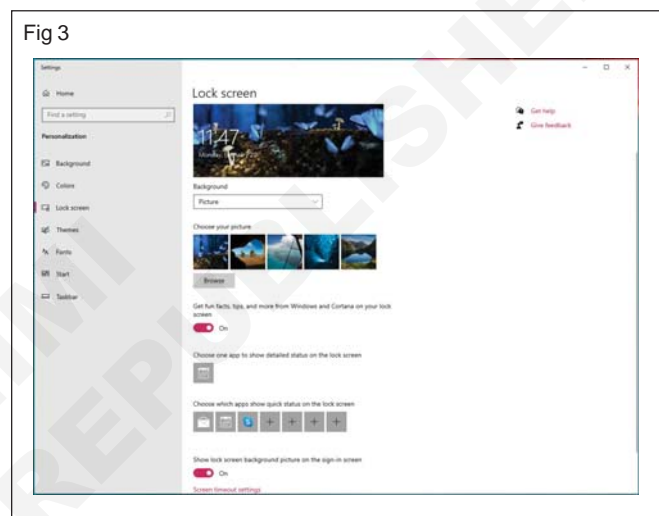
Start Menu (Fig 2)

If looking for a specific application, open the Start Menu

and click "All Applications". This will open an alphabetical list of all the applications installed on computer.



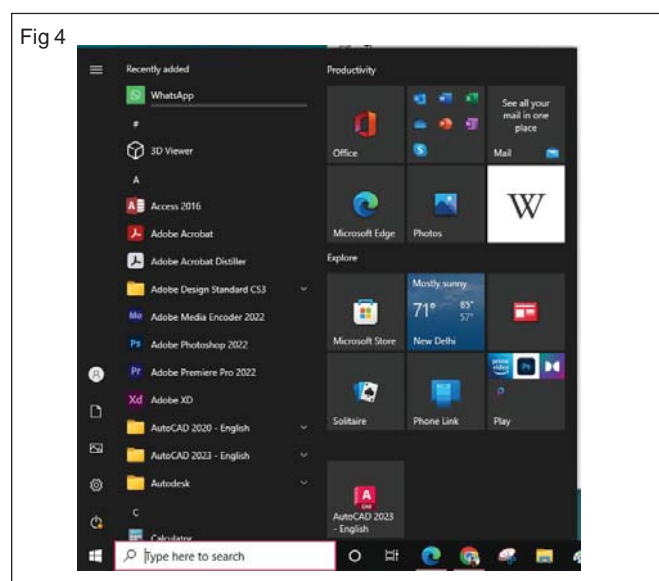
File Explorer (Fig 3)



If you are looking for a specific document, another alternative is to use the File Explorer by clicking on the Folder icon on the Taskbar.

In the File Explorer window, browse all the folders and documents.

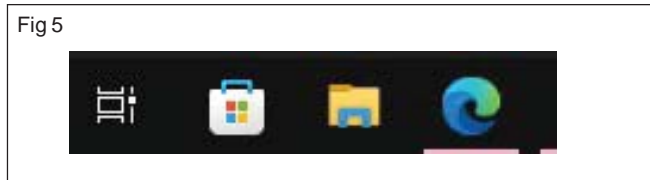
Virtual Desktops (Fig 4)



One of the new features of Windows 10 is the addition of Virtual Desktops. This allows you to have multiple desktop screens where to keep open windows organized.

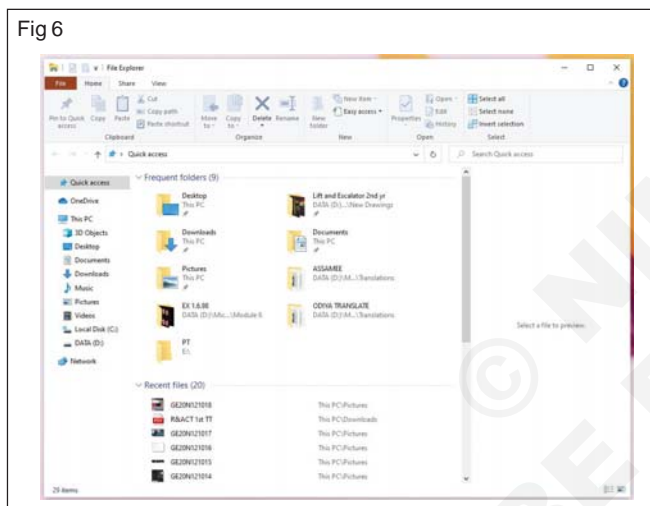
To add a virtual desktop, follow these steps:

- 1 Click Task View on the Taskbar
- 2 Click the "New desktop" option on the lower-right corner. You can access or delete the new Desktop by clicking Task View again. (Fig 5)



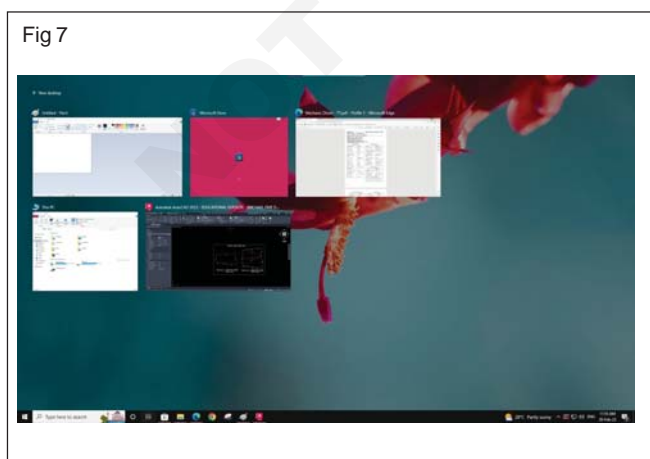
Cortana helps as with search and control

Cortana, the Windows Phone assistant, shows up in Windows 10 as a search pane on the taskbar, which can also trigger by saying 'Hey Cortana' - and when start searching the Start menu. (Fig 6)



That gets theapps have installed, documents access to, apps could install from the Store, search results from the web and a range of other information - including from apps and services that integrate with Cortana.

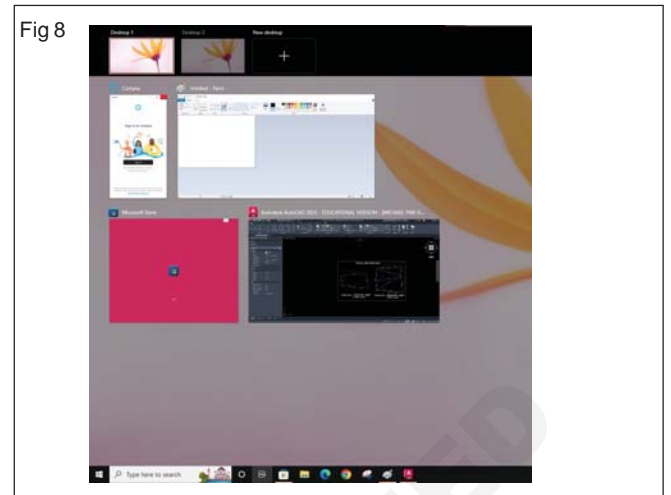
Activating Cortana (Fig 7)



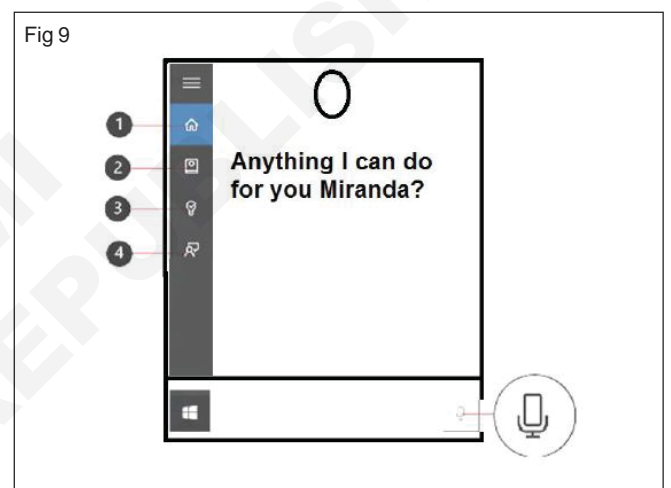
If Cortana isn't active, can turn it on by typing "Cortana" in the Taskbar search to access the Cortana settings, or

just clicking the "Gear" icon on the left-side of the menu.

After activating Cortana, it will start gathering information about to personalize the experience. (Fig 8)

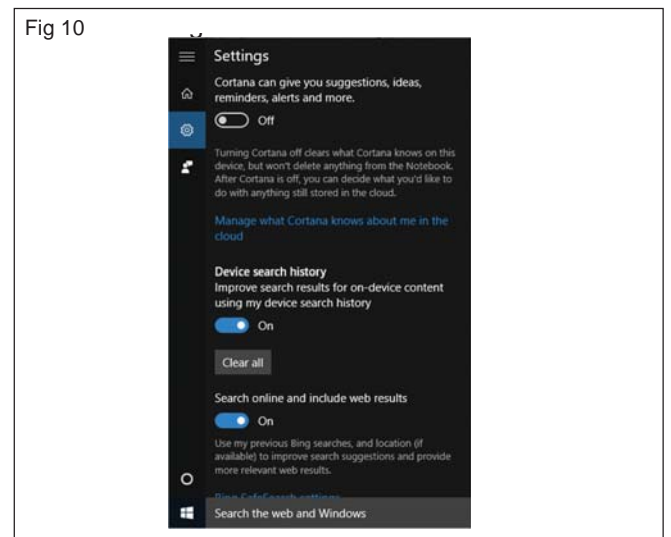


Task switcher (Fig 9)



Most Windows users don't know the Alt-Tab keyboard combination to see and switch between all running apps, so as well as having a redesigned task switcher with bigger thumbnails, Windows 10 also puts a task view icon in the taskbar to help them find it.

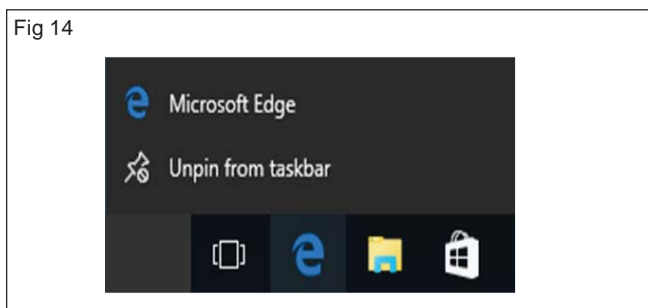
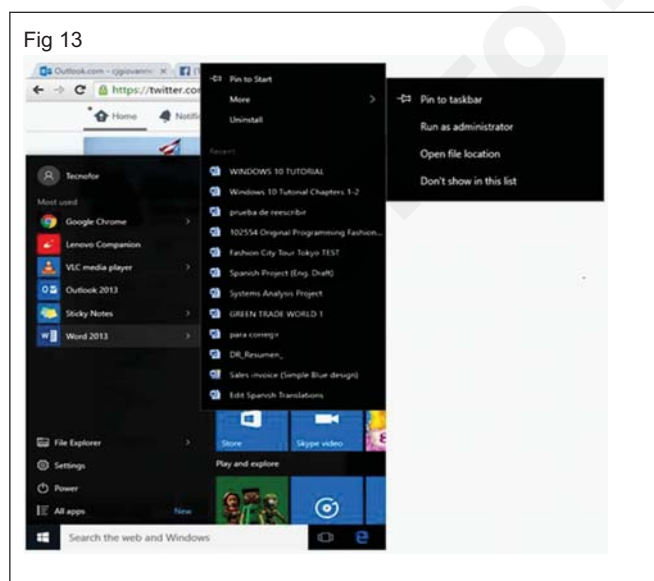
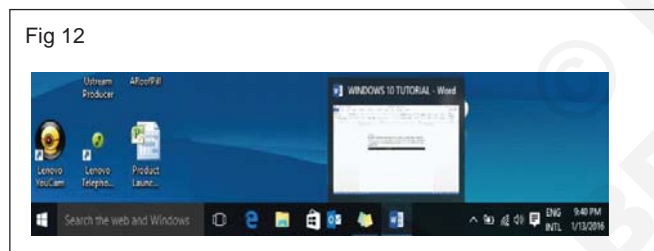
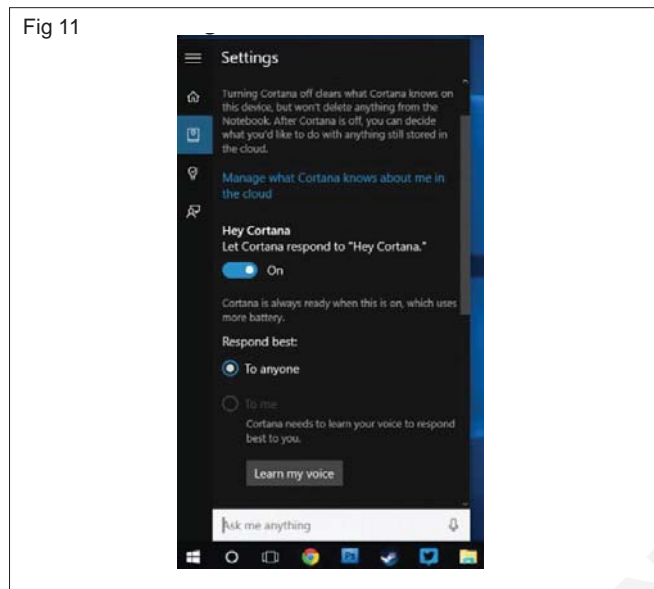
TASKBAR (Fig 10)



The Windows 10 taskbar sits at the bottom of the screen giving the user access to the Start Menu, as well as the icons of frequently used applications. On the right-side, the Taskbar features the Notification Area which informs the user of different things like the state of the Internet connection or the charge of the laptop battery.

The icons in the middle of the Taskbar are "pinned" applications, which is a way to have a quick access to applications you use frequently. "Pinned" applications will stay in the Taskbar until you "unpin" them.

Pin an Application to the Taskbar (Fig 11 to Fig 14)



Step 1: Search for the application you want to pin in the Start Menu.

Step 2: Right-click on the application.

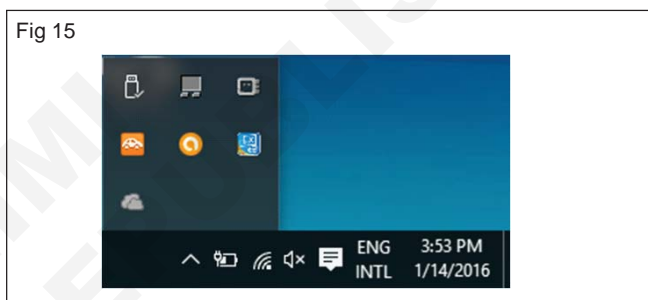
Step 3: Select "More" option at the top of the menu.

Step 4: Select the "Pin to taskbar" option.

Unpin an Application from the Taskbar

To "unpin" it, just right-click the icon in the Taskbar and select "Unpin from taskbar". You can "pin" it back again any time you want.

Notification Area (Fig 15)



The Notification Area is located at the right side of the Taskbar. It shows different types of notifications from your computer like your Internet connection, or the volume level.

At first, the Notification Area shows a limited amount of icons. But you can click the upward arrow on its left-side to see other icons as well.

Snap Assist

Because all the apps and programs run in windows on the desktop, instead of modern apps from the Store being in their own space, and can no longer drag across the left edge of the screen to bring another app on screen and get a split view. Instead, drag windows into the corners of the screen to get the familiar Snap view.

Now use all four corners of the screen if want each window to take up a quarter of the screen instead of half, and the space that isn't filled by the window you just dragged shows thumbnails of your other windows to make it easier to snap the next one into place.

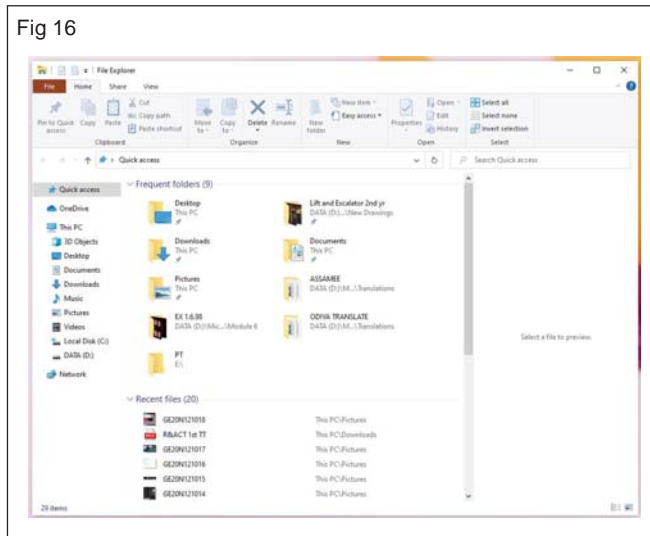
Action Center

If we used Windows Phone 8.1 (or Android and/or iOS), we used to a notification centre can drag down from the top of the screen.

Windows 10 puts that on the right of the screen, where the charms bar was in Windows 8, with notifications from

various apps at the top and the choice of various settings buttons at the bottom for quick access.

The command prompt (Fig 16)



Those of us that use the command prompt have been stuck with pretty much the same experience since the 1990s, but in Windows 10 can finally resize the command prompt window and use familiar keyboard shortcuts to copy and paste at the command prompt.

It's far from ground-breaking but it's a very welcome improvement after years of frustration.

FILE EXPLORER

File Explorer is the file management application used by Windows operating systems to browse folders and files. It provides a graphical interface for the user to navigate and access the files stored in the computer.

The main way to access the File Explorer is by clicking the folder icon in the Taskbar. After clicking the icon, the File Explorer window will open.

The initial File Explorer window is comprised of the following sections:

- 1 The File Explorer ribbon, which resembles the ribbon featured in Microsoft Office. The ribbon contains buttons for common tasks to perform with your files and folders.
- 2 The Navigation Pane gives you access to your libraries of documents and pictures, as well as your storage devices. It also features frequently used folders and network devices.
- 3 The Frequent folders section on the right features the folders you've worked with recently to allow for quick access to them.
- 4 The Recent files section in the lower part of the window features files and documents that you've opened recently.

The new Edge browser

To catch up with fast-moving browsers like Chrome and Firefox, Microsoft took its browser back to basics, ripping

out years of code that didn't fit with web standards and making a lean, fast browser.

It's a work in progress - it won't get support for things like ad-blocking extensions until a while after Windows 10 launches - but can do plenty of neat things here. For example, and can scribble notes on a web page to send to a friend and Edge has Cortana built in to pull useful information out of web pages, like the phone number of a restaurant, or the opening hours.

Sites like Medium that didn't work properly with IE should look better and have more features in Edge.

Multiple desktops

User need to arrange a lot of windows and don't have multiple monitors, user can put them on multiple virtual desktops. And can use Alt-Tab to move between apps as usual and then Windows-Ctrl and the left and right arrow keys to move between desktops.

Schedule restarts

No more having Windows announce that you have fifteen minutes to get everything done before it restarts to apply an update. Instead of leaving Windows 10 to decide when to do that, if there's an update that will need a restart and can have Windows ask when you want to schedule that for.

User can only do that once the update has been downloaded. If user want to have certain times off-limits for restarts, they will need the features in Windows Update for Business (for Windows 10 Pro and Enterprise) which lets block restarts so they don't happen in working hours, or on certain dates.

Universal apps - including Office

Windows 10 gets a new Windows Store, where download desktop programs as well as modern Windows apps. Many of those apps will be universal apps that are the same code on a PC, a Windows phone, an Xbox One and even on HoloLens, with the interface changing to suit the different screen sizes. The Office for Windows apps like Word and Excel are universal apps, as are the Outlook Mail and Calendar apps.

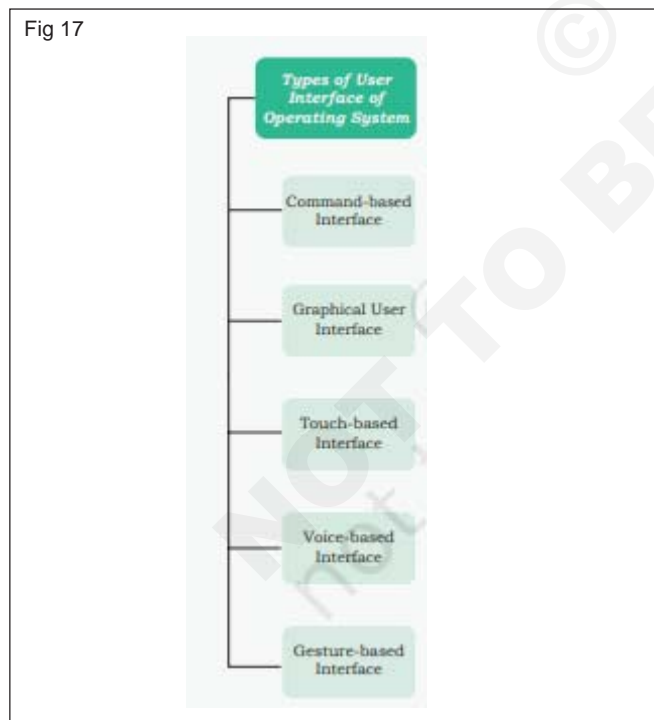
Main features of windows OS

OPERATING SYSTEM: An operating system (OS) can be considered to be a resource manager which manages all the resources of a computer, i.e., its hardware including CPU, RAM, Disk, Network and other input-output devices. It also controls various application software and device drivers, manages system security and handles access by different users. It is the most important system software. Examples of popular OS are Windows, Linux, Android, Macintosh and so on. The primary objectives of an operating system are two-fold. The first is to provide services for building and running application programs. When an application program needs to be run, it is the operating system which loads that program into memory and allocates it to the CPU for execution. When multiple application programs need to be run, the operating system

decides the order of the execution. The second objective of an operating system is to provide an interface to the user through which the user can interact with the computer. A user interface is a software component which is a part of the operating system and whose job is to take commands or inputs from a user for the operating system to process.

OS User Interface: There are different types of user interfaces each of which provides a different functionality. Some commonly used interfaces are shown in Figure (A) Command-based Interface Command-based interface requires a user to enter the commands to perform different tasks like creating opening, editing or deleting a file, etc. The user has to remember the names of all such programs or specific commands which the operating system supports. The primary input device used by the user for command based interface is the keyboard. Command based interface is often less interactive and usually allows a user to run a single program at a time. Examples of operating systems with command-based interface include MS-DOS and Unix.

Graphical User Interface (Fig 17): Graphical User Interface (GUI) lets users run programs or give instructions to the computer in the form of icons, menus and other visual options. Icons usually represent files and programs stored on the computer and windows represent running programs that the user has launched through the operating system. The input devices used to interact with the GUI commonly include the mouse and the keyboard. Examples of operating systems with GUI interfaces include Microsoft Windows, Ubuntu, Fedora and Macintosh, among others.



Touch-based Interface: Today smartphones, tablets and PCs allow users to interact with the system simply using the touch input. Using the touchscreen, a user provides inputs to the operating system, which are interpreted by the OS as commands like opening an app, closing an

app, dialing a number, scrolling across apps, etc. Examples of popular operating systems with touchbased interfaces are Android and iOS. Windows 8.1 and 10 also support touch-based interfaces on touchscreen devices.

Voice-based Interface: Modern computers have been designed to address the needs of all types of users including people with special needs and people who want to interact with computers or smartphones while doing some other task. For users who cannot use the input devices like the mouse, keyboard, and touchscreens, modern operating systems provide other means of human-computer interaction. Users today can use voice-based commands to make a computer work in the desired way. Some operating systems which provide voice-based control to users include iOS (Siri), Android (Google Now or “OK Google”), Microsoft Windows 10 (Cortana) and so on.

Gesture-based Interface Some smartphones based on Android and iOS as well as laptops let users interact with the devices using gestures like waving, tilting, eye motion and shaking. This technology is evolving faster and it has promising potential for application in gaming, medicine and other areas.

Functions of Operating System: Now let us explore the important services and tasks that an operating system provides for managing the computer system.

Process Management: While a computer system is operational, different tasks are running simultaneously. A program is intended to carry out various tasks. A task in execution is known as process. We can activate a system monitor program that provides information about the processes being executed on a computer. In some systems it can be activated using Ctrl+Alt+Delete. It is the responsibility of operating system to manage these processes and get multiple tasks completed in minimum time. As CPU is the main resource of computer system, its allocation among processes is the most important service of the operating system. Hence process management concerns the management of multiple processes, allocation of required resources, and exchange of information among processes.

Memory Management: Primary or main memory of a computer system is usually limited. The main task of memory management is to give (allocate) and take (free) memory from running processes. Since there are multiple processes running at a time, there arises a need to dynamically (on-the-go) allocate and free memory to the processes. Operating system should do it without affecting other processes that are already residing in the memory and once the process is finished, it is again the responsibility of the operating system to take the memory space back for reutilisation. Hence, memory management concerns with management of main memory so that maximum memory is occupied or utilised by large number of processes while keeping track of each and every location within the memory as free or occupied.

File Management:Data and programs are stored as files in the secondary storage of a computer system. File management involves the creation, updation, deletion and protection of these files in the secondary memory. Protection is a crucial function of an operating system, as multiple users can access and use a computer system. There must be a mechanism in place that will stop users from accessing files that belong to some other user and have not been shared with them. File management system manages secondary memory, while memory management system handles the main memory of a computer system.

Device Management:A computer system has many I/O devices and hardware connected to it. Operating system manages these heterogeneous devices that are interdependent. The operating system interacts with the device driver and the related software for a particular device. The operating system must also provide the options for configuring a particular device, so that it may be used by an end user or some other device. Just like files, devices

also need security measures and their access to different devices must be restricted by the operating system to the authorised users, software and other hardware only.

Settings and control panel

The Windows 8 Settings app has taken over many more of the settings that used to be in Control Panel, and it has a Control Panel-style interface with icons to navigate with. But the old Control Panel interface is still there, for settings that aren't in the new Settings app (or if you're just used to finding things there).

Windows 10 - Keyboard Shortcuts

Like most Windows applications, there are several keyboard shortcuts you can use to make it easier or faster for some to perform certain tasks.

Most of the new Windows shortcuts use the Windows key () combined with other keys to perform several actions. The following are some of the most common or useful shortcuts used in Windows 10.

Keyboard Shortcuts for Navigating Windows 10

| Press This | To Do This |
|----------------|--|
| Windows Logo | Toggle the Start menu |
| Windows Logo+A | Open the Notifications pane |
| Windows Logo+B | Activate the notification area's Show Hidden Icons arrow (press Enter to display the hidden icons) |
| Windows Logo+C | Open Cortana for voice commands |
| Windows Logo+D | Minimize all open windows to display the desktop |
| Windows Logo+E | Run File Explorer |
| Windows Logo+F | Display the Start menu and activate the Search box |
| Windows Logo+H | Display the Share pane |
| Windows Logo+I | Run the Settings app |
| Windows Logo+K | Display the Devices pane |
| Windows Logo+L | Lock your computer |
| Windows Logo+M | Minimize all windows |
| Windows Logo+O | Turn the tablet orientation lock on and off |
| Windows Logo+P | Display the Project pane to configure a second display |
| Windows Logo+Q | Open Cortana for voice commands |
| Windows Logo+R | Open the Run dialog box |
| Windows Logo+S | Open Cortana for keyboard commands |
| Windows Logo+T | Activate the taskbar icons (use the arrow keys to navigate the icons) |
| Windows Logo+U | Open the Ease of Access Center |
| Windows Logo+W | Activate the Search box |
| Windows Logo+X | Display a menu of Windows tools and utilities |
| Windows Logo+Z | Display an app's commands (although this works in only some Modern apps) |
| Windows Logo+= | Open Magnifier and zoom in |
| Windows Logo+- | Zoom out (if already zoomed in using Magnifier) |

| Press This | To Do This |
|-------------------------|--|
| Windows Logo+, | Temporarily display the desktop |
| Windows Logo+Enter | Open Narrator |
| Windows Logo+Left | Snap the current app to the left side of the screen |
| Windows Logo+Right | Snap the current app to the right side of the screen |
| Windows Logo+Up | Restore a minimized app; maximize a restored app |
| Windows Logo+Down | Restore a maximized app; minimize a restored app |
| Windows Logo+PgUp | Move the current app to the left monitor |
| Windows Logo+PgDn | Move the current app to the right monitor |
| Windows Logo+PrtSc | Capture the current screen and save it to the Pictures folder |
| Windows Logo+Ctrl+D | Create a virtual desktop |
| Windows Logo+Ctrl+Right | Switch to the next virtual desktop |
| Windows Logo+Ctrl+Left | Switch to the previous virtual desktop |
| Windows Logo+Ctrl+F4 | Close the current virtual desktop |
| Windows Logo+Tab | Open Task View, which displays thumbnails for each running app as well as the available virtual desktops |

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Introduction to the Booting Process & BIOS Setting

Objectives : At the end of this lesson you shall be able to

- define and classify computers
- list the advantages and limitations of computers
- list the BIOS setting.

In order to boot into a Partition, it must be designated as **bootable partition** or Active Partition. Active Partition is that partition which is flagged as bootable or which contains OS, this is generally a Primary Partition.

Types of Partitions:

- Master
- Partition
- Extended and
- Logical Extended

Master Boot Record (MBR): MBR is a small 512 bytes partition which is at the first physical sector of the hard disk. The location is denoted as CHS 0,0,1 meaning 0th Cylinder, 0th Head and 1st Sector.

MBR contains a small program known as bootstrap program which is responsible for booting into any OS. MBR also contains a table known as Partition Table.

This Partition Table is a table which lists the available Primary Partitions in the hard disk. Partition table considers whole Extended Partition as one Primary partition and lists it in the table.

So a Partition table can have two possible entries:-

- Up to 4 Primary Partitions.
- Up to 3 Primary Partitions and 1 Extended Partition. (Total not exceeding 4) .

Partition Boot Sector (PBR): This is the logical first sector, that is sector at the start of a Primary Partition. This is also 512 byte area, which contains some programs to initialize or run OS files. All Primary Partitions have its own PBRs.

Extended Boot Sector (EBR): This is the logical first sector, that is the sector at the start of the Extended Partition. This EBR contains a Partition Table, which lists the available Logical Partitions inside Extended Partition. That is it contains the Starting addresses of each Logical Partitions.

Logical Extended Boot Sector (LEBR): This is the logical first sector residing at the start of each Logical Partition. This is similar to PBR for Primary Partitions.

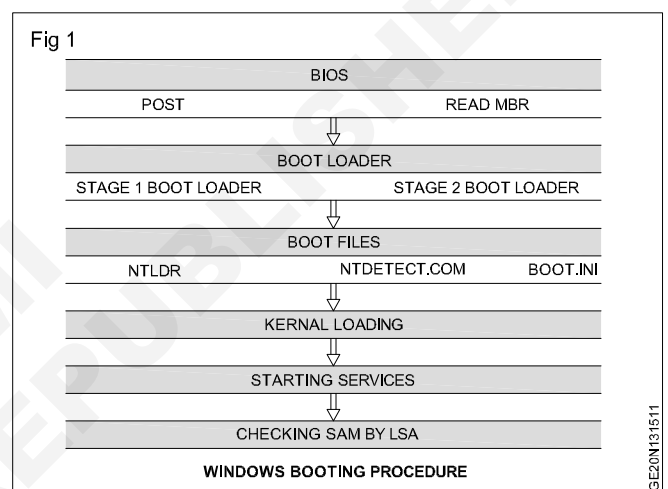
Booting

Booting is a process of loading the operating system (OS) and checking all the system software and hardware those are installed in the computer.

Booting procedure of Windows operating system

Functions of BIOS

The first process starts, when the computer switched on Basic Input Output System (BIOS) perform two functions, to conduct POST and read MBR (Fig 1).



POST - POST stands for Power OnSelf Test. POST checks all the hardware devices connected to a computer like RAM, hard disk etc and make sure that the system can run smoothly with those hardware devices. If the POST is a failure the system halts with a beep sound.

Now BIOS checks the **boot priority**. We can set the boot priority as CD drive, hard disk or floppy drive.

MBR - The next duty of BIOS is to read the MBR. MBR stands for Master Boot Record and it's the first sector on a hard disk. MBR contains the partition table and boot loader.

Functions of Boot loader

Now BIOS has passed the control to boot loader and boot loader is a small program which loads kernel to computers memory. Actually there are two stages of boot loaders, stage 1 boot loader and stage 2 boot loader.

The stage 1 boot loader is a link to the stage 2 boot loader. The stage 2 boot loader resides in the boot partition and it loads the kernel to memory.

Boot files and functions

There are three boot files in a Windows operating system and they are NTLDR, NTDETECT.COM and Boot.ini. The boot files are found in the active partition of hard disk and its normally C drive in a Windows machine.

NTLDR - NTLDR stands for NT Loader and it's the second stage boot loader. The path of NTLDR is C:\Windows\i386\NTLDR.

Boot.ini - Boot.ini contains the configuration files of NTLDR. When the operating system is loaded we cannot pass any arguments to kernel, so those arguments are passed through boot.ini. You can edit boot.ini by opening through notepad. The path of Boot.ini is C:\boot.ini.

NTDETECT.COM

This file detects hardware's and passes information to NTLDR. Using the collected information the NTLDR creates a hardware key and this key is used to detect hardware's.

A new hardware key is generated after each reboot of the operating system and that's why system asks to reboot after installation of a new hardware. The hardware keys created by NTLDR can be found in Windows registry at HKEY_LOCAL_MACHINE \ HARDWARES.

Kernel and its functions

After executing the functions of boot files the control is passed to Kernel. ntoskrnl.exe is the kernel file in a Windows machine and its path is C:\Windows\system32\ntoskrnl.exe.

Kernel acts as a layer between software and hardware. The library file hal.dll (C:\Windows\system32\hal.dll) helps Kernel to interact with hardware's. HAL stands for Hardware Abstraction Layer and this hal.dll file is machine specific.

Now the drivers for hardware's are loaded from the file C:\Windows\system32\config\system and the Kernel is loaded to primary memory.

Services and log in procedure

When kernel is loaded in the primary memory, services for each process is started and the registry entry for those services can be found at HKEY_LOCAL_MACHINE - System - Current control set - Services.

Winlogon.exe (C:\Windows\system32\winlogon.exe) is the last service started during this process. Winlogon.exe starts the log in procedures of windows machine. It first calls the library file msgina.dll (C:\Windows\system32\msgina.dll).

MSGINA stands for Microsoft Graphics Identification and Authentication and it provides the log in window. Now msginal.dll passes the control to LSA (Local Security Authority), it verifies the username and password from the SAM file. SAM (Security Accounts Manager) contains the information about all users created in a Windows operating system.

Now the booting procedure is over and it has reached the desktop of Windows operating system.

Bios setting

The BIOS (Basic Input/Output System) boots up your computer and manages the data flow between the operating system (OS) and attached devices. Since the

BIOS is tied to a computer's motherboard, the appearance of each computer's BIOS will vary slightly depending on the manufacturer. You should only configure the BIOS settings if you're absolutely certain about the changes. This will show you how to access and modify the BIOS page for your Windows 8, 10, or 11 computer.

Things You Should Know

- Never make changes to your BIOS unless you're confident on what it will do.
- To access the BIOS, turn on your computer and press the startup key. In most cases, this is "F2" or "Del".
- Change BIOS settings by using the arrow keys on your keyboard and "Enter".

Part 1

Entering the BIOS on Startup

1 Turn on your computer : You'll only be able to access the BIOS upon startup.

- If your computer is already on, you'll need to restart your computer.

2 Press Del or F2 to enter setup : You can press and hold or repeatedly press this button. The setup button is usually **Del** or **F2**, but this could vary depending on your device.

- Here's a list of some of the most common setup keys by manufacturer:

- Acer: F2 or DEL
- ASUS: F2 or Del
- Dell: F2 or F12
- HP: ESC or F10
- Lenovo: F2 or Fn + F2
- Lenovo Desktops: F1
- Lenovo ThinkPads: Enter + F1.
- MSI: DEL for motherboards and PCs
- Microsoft Surface Tablets: Press and hold the volume-up button.
- Origin PC: F2
- Samsung: F2
- Sony: F1, F2, or F3
- Toshiba: F2

- It's best to start pressing the setup key as soon as the computer begins to restart.

- If you see "Press [key] to enter setup" or something similar flash across the bottom of the screen and then disappear, you'll need to restart your computer and try again.

- Look at your computer model's manual or online support page to confirm your computer's BIOS key.

3 Wait for your BIOS to load : After successfully hitting the setup key, the BIOS will load. This should only take a few moments. When the loading is complete, you will be taken to the BIOS settings menu.

- You can now update your computer's BIOS.
- This is the quickest way to enter the BIOS, but you can also access the BIOS through the Windows Settings.

Entering the BIOS with Settings

1 Open Settings on your computer : Click the Start menu, then click the cog icon to open **Settings**.

- Use this method to enter the BIOS from your Windows Settings rather than a setup key.

2 Click Update & Security : This will be towards the bottom of the screen.

3 Click Recovery : This is in the left panel, underneath **Troubleshoot**.

4 Click Restart now : This will be underneath the **Advanced startup header**.

- Your computer will restart, then load a special menu.

5 Click Troubleshoot : Within the **Troubleshoot** window, select **Advanced Options**, then **UEFI Firmware Settings**.

6 Click Restart : Your computer will restart and enter the BIOS.

Adjusting BIOS Settings

1 Familiarize yourself with the BIOS controls : Since BIOS menus don't support mouse input, you'll need to use the arrow keys and other computer-specific keys to navigate the BIOS. You can usually find a list of controls in the bottom-right corner of the BIOS homepage.

2 Change your settings carefully : When adjusting settings in your BIOS, be sure that you certain what the settings will affect. Changing settings incorrectly can lead to system or hardware failure.

- If you don't know what you want to change coming into the BIOS, you probably shouldn't change anything.

3 Change the boot order : If you want to change what device to boot from, enter the **Boot** menu. From here, you can designate which device the computer will attempt to boot from first. This is useful for booting from a disc or flash drive to install or repair an operating system.

- You'll typically use the arrow keys to go over to the **Boot** tab to start this process.

4 Create a BIOS password : You can create a password that will lock the computer from booting unless the correct password is entered.

- You can always reset your BIOS password later.

5 Change your date and time: Your BIOS's clock will dictate your Windows clock. If you replace your computer's battery, your BIOS clock will most likely be reset.

6 Change fan speeds and system voltages : These options are for advanced users only. In this menu, you can overclock your CPU, potentially allowing for higher performance. This should be performed only if you are comfortable with your computer's hardware.

7 Save and exit : When you are finished adjusting your settings, you will need to save and exit by using your BIOS' "Save and Exit" key in order for your changes to take effect. When you save and restart, your computer will reboot with the new settings.

- Check the BIOS key legend to see which key is the "Save and Exit" key.

Introduction to memory

A memory is just like a human brain. It is used to store data and instructions. Computer memory is the storage space in the computer, where data is to be processed and instructions required for processing are stored. The memory is divided into large number of small parts called cells. Each location or cell has a unique address, which varies from zero to memory size minus one. For example, if the computer has 64k words, then this memory unit has $64 * 1024 = 65536$ memory locations. The address of these locations varies from 0 to 65535.

Memory is primarily of three types -

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

Cache Memory (Fig 2)

Fig 2



Cache memory is a very high speed semiconductor memory which can speed up the CPU. It acts as a buffer between the CPU and the main memory. It is used to hold those parts of data and program which are most frequently used by the CPU. The parts of data and

programs are transferred from the disk to cache memory by the operating system, from where the CPU can access them.

Advantages

The advantages of cache memory are as follows -

- Cache memory is faster than main memory.
- It consumes less access time as compared to main memory.
- It stores the program that can be executed within a short period of time.
- It stores data for temporary use.

Disadvantages

The disadvantages of cache memory are as follows -

- Cache memory has limited capacity.
- It is very expensive.

Primary Memory (Main Memory) (Fig 3)

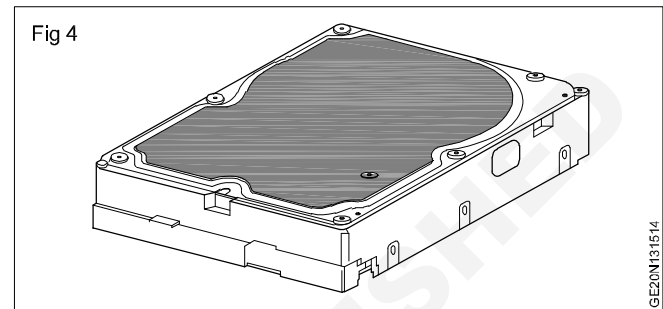


Primary memory holds only those data and instructions on which the computer is currently working. It has a limited capacity and data is lost when power is switched off. It is generally made up of semiconductor device. These memories are not as fast as registers. The data and instruction required to be processed resides in the main memory. It is divided into two subcategories RAM and ROM.

Characteristics of Main Memory

- These are semiconductor memories.
- It is known as the main memory.
- Usually volatile memory.
- Data is lost in case power is switched off.
- It is the working memory of the computer.
- Faster than secondary memories.
- A computer cannot run without the primary memory.

Secondary Memory (Fig 4)



This type of memory is also known as external memory or non-volatile. It is slower than the main memory. These are used for storing data/information permanently. CPU directly does not access these memories, instead they are accessed via input-output routines. The contents of secondary memories are first transferred to the main memory, and then the CPU can access it. For example, disk, CD-ROM, DVD, etc.

Characteristics of Secondary Memory

- These are magnetic and optical memories.
- It is known as the backup memory.
- It is a non-volatile memory.
- Data is permanently stored even if power is switched off.
- It is used for storage of data in a computer.
- Computer may run without the secondary memory.
- Slower than primary memories.

Hardware, Software Issues and Antivirus

Objectives: At the end of this lesson you shall be able to

- **identify hardware, software issues**
 - **finding the section of issues**
 - **describe the application of antivirus.**
-

Common Software Issues

Technology is an important part of the world today. Not only does technology determine the way businesses operate today, but it also sets the pace of development in many industries across the globe. Human progress and business growth are left at the whim of technology, as the pace of technological advancement determines the pace of development and growth in the business world.

Knowing our dependency on core IT functions and processes, minor issues in software and hardware operations can lead to long stoppages and downtimes. Be it a remote employee working from home, or an organization with a database of their own, IT issues and problems can lead to long downtimes and can hinder efficiency and productivity.

While there are new IT and software problems popping up around us, the more you know about these problems, the easier it is for you to solve them. Corrupted computer software can significantly hinder the speed of work inside an organization. Poor software can also lead to associated problems in other related applications and hardware.

Inappropriate software can also slow down office systems, leading to delays in work, general inefficiencies and a lack of productivity. In this article, we look at some of the common software problems and what you can do to fix them. Knowing more about these problems will help enhance your response to them.

Corrupt Drivers

A corrupt driver is one of the most common reasons behind a software problem in your system. Corrupt drivers usually show up in the form of the blue screen of death, also known as the BSOD. A corrupt driver would mean that your system screen freezes, and you are unable to work on anything else on it.

You can rectify a corrupt driver by working on the following steps:

- Open the device manager in your system and write down the command `devmgmt.msc` in your Run tab.
- Expand the menu categories you now see the different drivers that are running on your system. Once you have a list of drivers in front of you, you should look for a yellow icon next to the drivers to see the corrupt status.

- Once you find any corrupt drivers, the yellow sign is usually an indication of them. You can right-click on the driver and update it to bring things back to normalcy.

Inability to Access Email

Emails play an important role in your daily operations today. Inability to run emails can lead to a few problems. The right way to fix email issues is to log out from your app and then restart it. Once you restart it, log back in with your credentials.

Try logging in through the web. If you are able to login through the web and not through your app, the problem is with the app.

Windows Displaying Blue Screen

Your Windows or Operating System could be displaying a blue screen for many reasons:

- If the screen shows up when you start your system, you can go for the 'start windows normally' option and check if you see an improvement.
- You can force restart the system by clicking Ctrl, Alt and Delete together. Now go back to the windows option and see if it still shows the blue screen.
- You can press the F8 menu and choose safe mode from the Windows Startup Menu. Running the computer in a safe mode usually helps clear away errors.
- Go for the 'last known good configuring option', which will restart your system based on the last setting that worked.
- If none of the techniques above work, go for a system restore.

Slow Downloading and Uploading

Slow downloading and uploading is another common software problem faced by many today. Your internet speeds can seriously suffer if there are more people at home. You can run a speed test online to see where your speeds are currently and if there need for improvements. Also, check your browser background for any files that could be downloading or uploading.

You can try resetting the modem, check your network card for expiry and eventually call your service provider if nothing else works.

New Applications Don't Install

Most users get a software issue when they aren't able to install new files into their system. Based on the nature of your work, you would want to download and install new systems and files on your PC. While the inability to install new files is mostly attributed to space issues, it can also be due to malware. You should first try freeing up the space in your computer to see if the file now installs. If this step doesn't work, you should look for malware.

Your computer's software can cause trouble because of a variety of reasons. However, you shouldn't be concerned by them, as software problems can be rectified through expert help.

Outdated systems

Software issues also occur when you miss the right audit of your system and software. A constant check on the updates is very important to maintain the credibility of your system and software. If you don't remember if you have updated your system or not your system may face frequent shut down or other issues. A routine update or audit is required to maintain the health of your software.

Lack of a plan

You and your team should always be ready with options or a long-term plan for your software or system. Any issues can arise anytime and therefore you should know how to avoid any problem from happening. The long view plan must have new technologies to enhance your software processes and more proactive solutions.

Some of the most common PC hardware problems that need troubleshooting are:

- 1 Your computer won't turn on.
- 2 Your computer turns on, but still doesn't work.
- 3 Your computer screen freezes.
- 4 Your computer has insufficient memory.
- 5 You get a CMOS error.
- 6 Your operating system is missing or your hard drive isn't detected.
- 7 You get the blue screen of death.

When it comes to hardware, some techs may have trouble assessing what steps to take to figure out what's wrong and how to repair it. Which component is having the issue? Should you just replace the component? Should you try to troubleshoot the software first?

In this article we'll go over how to troubleshoot common PC hardware issues (seven of them, to be exact) and the best way to go about fixing them. Remember this, though. The most basic tip is to always try the most obvious solutions first. It could save you a lot of time and frustration.

Your Computer Won't Turn On

This is a common problem that often offers a simple solution.

- 1 Is everything plugged in? I can't tell you how many times I have come across a "broken" computer that simply had an unplugged component.
- 2 Try plugging into different power outlets. It isn't uncommon to blow a fuse, especially with more power-hungry systems.
- 3 Is either the monitor, mouse, or keyboard the only thing not working? If so, try plugging in a different one to see if that does the job. Most of the time, replacing one of these is cheaper than attempting a repair.

Once you've completed the above steps, it's time to look at the tower.

- 1 Are the lights on in the front or back of the tower? If not, the power supply unit (PSU) may be turned off.
- 2 Next, you can open up your tower and look at the motherboard. Most have a small LED light built in to show if power is running to the motherboard. If it's turned off, you can either try using a PSU tester, or replace the PSU. Never try to open a PSU and try to repair it yourself as this is extremely dangerous.

Your Computer Turns on, But Still Doesn't Work

If power is obviously flowing to the computer system and its peripherals, there may be a component issue. When you first turn on the computer, do you hear or see anything out of the ordinary? Many times the computer's Power-On Self-Test (POST) will let you know what's going on with the machine.

Beep Codes

If you hear any beeps when your computer turns on, they can help you troubleshoot common PC hardware problems. Here's a list of beep codes (hint: remember these if you're taking the COMPTIA A+ exam).

- No beep but the system turns on and runs fine - Under normal circumstances, most computer systems will beep one short beep when turned on. If yours doesn't, your "beeper" may have died out.
- No beep - The power supply is not plugged in or turned on. Or, the power supply is completely dead.
- Steady, short beeps - The power supply may be bad or the voltages might be wrong. A replacement would usually be necessary.
- Steady, long beeps - The power supply has gone bad.
- Long, continuous beep - Your Random Access Memory (RAM) sticks may have gone bad. If there is more than one stick installed, try taking one out to see if the computer boots. If it does not, try the same thing with the other stick. This will tell you which stick has gone bad and you can replace or upgrade accordingly. If there is only one stick installed, you will need to replace or upgrade it to fix the problem.
- One long, two short beeps - There has been a video card failure. Your first action is to try reseating the video card. This often solves the problem when the

computer system is connected to projectors because the VGA/DVI/Video cable gets moved so often that the card can be slowly unplugged. If reseating doesn't work, replace the video card.

Your Computer Screen Freezes

When your computer freezes and isn't responsive to your mouse or keyboard, the first thing to do is just wait. Sometimes it will just take a few minutes for your computer to process. Then, end-task the non-responding program. If that doesn't work, turn off the computer by holding down the power button and then rebooting into Safe Mode (don't forget about saving your work first, if you can).

If you've tried all of this and your computer still won't unlock, you may be dealing with either defective hardware or a defective device driver. If this is your case, replace the defective piece immediately so it doesn't cause further damage.

Another thing you could be dealing with is a virus that is overwhelming your system. Run a virus scan, remove the virus, recover or reinstall damaged files or software, and implement the latest security software.

Your Computer has Insufficient Memory

Receiving an "insufficient memory or disk space" error message can usually be solved (at least temporarily) by closing extra windows to free up some RAM. If you've done that and the error still comes up, you can try rebooting your computer and installing the latest operating system update.

If you really don't have enough available memory and space (which can be checked in Windows 10 by pressing the Windows-R button and typing perfmon in the Open field to run the Performance Monitor), you can uninstall or delete any unused or unnecessary files, especially those of the video/music type. Your final solution is to add more RAM.

You get a CMOS Error

The CMOS (complementary metal-oxide semiconductor) is an onboard chip that stores information ranging from the time and date to system hardware settings. If you get a CMOS alert message showing up on your screen, it's likely you need to replace the CMOS battery located on the motherboard. Remove it carefully, insert a new battery that is exactly the same as the old one, and enter the CMOS values to the defaults.

Your Operating System Is Missing

If the message "Missing Operating System" shows up on your screen, there are four possibilities the problem could be (and four ways to solve it):

- 1 The basic input/output system (BIOS) doesn't detect Windows' hard disk, or the disk failed. If you know how, take out the hard drive and reconnect it. If that doesn't work, the hard drive's interface is forbidden or the hard drive is seriously damaged.

Restart the computer and watch for the message telling you which key to strike to go into the BIOS. The key can vary from system to system so you may need to use a search engine to find the instructions for your system. Be sure to strike the specified key as soon as you see the message.

In the BIOS highlight the hard drive and set it to "Auto". If it's still invisible, you need a hard drive repair or replacement.

- 2 The BIOS settings are incorrect. Set the BIOS back to Default State.
- 3 The Master Boot Record (MBR) is damaged or corrupted. Rebuild the MBR using either the Windows installation disk, the Windows repair disk, or a bootable partitioning tool.
- 4 The Windows boot file partition isn't active. Start the computer using a bootable partitioning tool. If that doesn't work, set the wrong partition to 'inactive' and activate the correct partition.

The Blue Screen of Death

The blue screen of death (BSOD) appears when Microsoft Windows has an unrecoverable, critical error that causes a crash and subsequent data loss. This can be caused by the low-level software in Windows crashing.

When the BSOD occurs, the computer automatically creates a minidump file and restarts the computer. If the blue screen appears again, follow the prompts, identify and search for the error code online, and learn how to fix the problem.

Some of the common solutions are to:

- Make sure your computer isn't overheating. If it is, close unused applications, check the fan is working properly, and conduct a good dusting after the computer is turned off before trying other solutions for an overheating PC.
- Boot into Safe Mode before trying to fix a problem.
- Test your hardware components and check the computer's memory for errors.
- Check for incorrectly installed or buggy drivers. Install updated drivers.
- Scan for Malware that is causing the crash.
- Reset or reinstall Windows.

Use System Restore to get your computer back to its previous state. If it works, you probably have a software problem on your hands.

Antivirus

Definition

Software that is created specifically to help detect, prevent and remove malware (malicious software).

Antivirus is a kind of software used to prevent, scan, detect and delete viruses from a computer. Once installed, most

antivirus software runs automatically in the background to provide real-time protection against virus attacks.

Comprehensive virus protection programs help protect your files and hardware from malware such as worms, Trojan horses and spyware, and may also offer additional protection such as customizable firewalls and website blocking.

Introduction to Malware

Malware is an abbreviated term meaning "malicious software." This is software that is specifically designed to gain access or damage a computer without the knowledge of the owner. There are various types of malware including spyware, key loggers, true viruses, worms, or any type of malicious code that infiltrates a computer. Generally, software is considered malware based on the intent of the creator rather than its actual features. Malware was originally created as experiments and pranks, but eventually led to vandalism and destruction of targeted machines. Today, much of malware is created for profit through forced advertising (adware), stealing sensitive information (spyware), spreading email spam or child pornography (zombie computers), or to extort money (ransom ware). Various factors can make computers more vulnerable to malware attacks, including defects in the operating system design, having all of the computers on a network run the same OS, giving users too much permissions or just using the Windows OS (due to its popularity, it gets the most malware written for it). The best protection from malware continues to be the usual advice: be careful about what email attachments open, be cautious when surfing and stay away from suspicious websites, and install and maintain an updated, quality antivirus program.

Symptoms of Malware Infection

Some of the symptoms of a Malware infected system are:

- Change in browsers home page or default search
- Web browser hangs or becomes sluggish
- Computer starts behaving sluggishly or hangs often
- Unable to open security-related sites or Microsoft.com domains.
- Web pages get re-directed to unintended pages.
- Unexpected toolbars displayed in the browser
- Security software or Firewall gets disabled
- Security software shows up warnings or its icon turns red.
- Unknown or excessive Pop-ups while browsing.

Malware Cleaning steps

- Disconnect from network
- Identify malicious processes and drivers
- Terminate identified processes

- Identify and delete malicious autostarts
- Delete malware files
- Reboot and repeat the steps.

Virus

A virus is just a computer program. Like any other program, it contains instructions that tell your computer what to do. But unlike an application, a virus usually tells your computer to do something you don't want it to do, and it can usually spread itself to other files on your computer-and other people's computers.

The most common entry-points used by viruses are the following:

- Removable disk drives
- Computer networks
- Internet
- E-mail
- Web pages
- File Transfers (FTP)
- Downloads
- Newsgroups

Types of Viruses

Worms

Worms are different to other viruses since they do not infect other files. Their sole objective is to propagate or spread to other systems as quickly as possible. They do however make use of replication (propagation) techniques. In fact their objective is to copy themselves and then infect other systems. Their infections or replications usually take place through e-mails, computer networks and Internet IRC Channels. They could also replicate inside the memory of a PC.

Trojan Horses (or Trojans)

Trojans cannot be considered viruses as such. They seem to be harmless programs which get into a computer through any channel. When that program is executed (they have names or characteristics which trick the user into doing so), they install other programs on the computer which could be harmful.

Logic Bombs

These activate and damage an infected system only when one or more condition/s are met. They are not considered viruses as such, since they do not replicate, but rather depend on the actions taken by the user (the user usually copies and/ or executes them unintentionally).

Encrypted

Rather than a virus category, this is a technique that viruses could use. A virus could belong to another category and be also encrypted (if it uses this technique). The virus encodes or encrypts itself so that antivirus programs cannot easily detect it. In order to perform these activities,

the virus de-encrypts itself and, when it is finished, encrypts itself again.

Polymorphic

These are virus that use a new technique to avoid detection by antivirus programs (they are usually the hardest viruses to find). They change with every infection they carry out. In this way, they create a large number of copies of themselves.

Symptoms of Virus

It may appear that you have a virus in your computer, but you cannot be sure that this is the case until it is detected using an antivirus tool (programs that detect and eliminate viruses). Some actions that can be carried out by a virus are obvious enough to be recognized and could include: messages displayed onscreen, operations slowing down, the properties of some files change, files and folders disappear, the computer will not start, the content of the infected disk is lost, etc.

What do virus infect.

The main targets of viruses are files located in storage devices such as hard and floppy disks. They target program files, although other types of files and documents can also be infected. A program is simply a file with an EXE or COM extension, which can be run to perform specific operations.

As we have already mentioned, there are viruses designed to infect files that are not programs. However, these documents contain elements known as macros.

Macros are small programs that the user can include in certain types of files.

Other elements prone to virus attack are the storage devices themselves, especially boot sector. By attacking the places in which files are stored, the damage produced by the virus will affect all of the information they contain.

Virus Detection and Prevention Tips

- 1 Do not open any files attached to an email from an unknown, suspicious or untrustworthy source.
- 2 Do not open any files attached to an email unless you know what it is, even if it appears to come from a dear friend or someone you know. Some viruses can replicate themselves and spread through email.
- 3 Do not open any files attached to an email if the subject line is questionable or unexpected. If the need to do so is there always save the file to your hard drive before doing so.
- 4 Delete chain emails and junk email. Do not forward or reply to any to them. These types of email are considered spam, which is unsolicited, intrusive mail that clogs up the network.
- 5 Do not download any files from unknown sources .
- 6 Exercise caution when downloading files from the Internet. Ensure that the source is a legitimate and reputable one. Verify that an anti-virus program checks

the files on the download site. If you're uncertain, don't download the file at all or download the file and test it with anti-virus software.

- 7 Update your anti-virus software regularly. These updates should be at least the product's, virus signature files. Also update the product's scanning engine.
- 8 Back up files on a regular basis. Store the backup copy in a separate location from the work files, one that is preferably not on computer.
- 9 When in doubt, do not open, download, or execute any files or email attachments. Check with the product vendors for updates which include those for the operating system web browser, and e-mail

What is a Rootkit?

The term rootkit is used to describe the mechanisms and techniques whereby malware, including viruses, spyware, and trojans, attempt to hide their presence from spyware blockers, antivirus, and system management utilities. There are several rootkit classifications depending on whether the malware survives reboot and whether it executes in user mode or kernel mode.

Persistent Rootkits

A persistent rootkit is one associated with malware that activates each time the system boots. Because such malware contain code that must be executed automatically each system start or when a user logs in, they must store code in a persistent store, such as the Registry or file system, and configure a method by which the code executes without user intervention.

Memory-Based Rootkits

Memory-based rootkits are malware that has no persistent code and therefore does not survive a reboot.

User-mode Rootkits

There are many methods by which rootkits attempt to evade detection. For example, a user-mode rootkit might intercept all calls to the Windows FindFirstFile/FindNextFile APIs, which are used by file system exploration utilities, including Explorer and the command prompt, to enumerate the contents of file system directories. When an application performs a directory listing that would otherwise return results that contain entries identifying the files associated with the rootkit, the rootkit intercepts and modifies the output to remove the entries.

The Windows native API serves as the interface between user-mode clients and kernel-mode services and more sophisticated user-mode rootkits intercept file system, Registry, and process enumeration functions of the Native API. This prevents their detection by scanners that compare the results of a Windows API enumeration with that returned by a native API enumeration.

Kernel-mode Rootkits

Kernel-mode rootkits can be even more powerful since, not only can they intercept the native API in kernel-mode, but they can also directly manipulate kernel-mode data structures. A common technique for hiding the presence of a malware process is to remove the process from the kernel's list of active processes. Since process management APIs rely on the contents of the list, the malware process will not display in process management tools like Task Manager or Process Explorer..

• Manual Identification

The process of manually identifying viruses/spyware can be difficult and sometimes impossible. Sometimes viruses/spyware will leave other artifacts (such as files) or present symptoms (such as high CPU usage) that will provide the clues needed to identify their presence.

From these clues perform research to correlate the clues to the causes.

Create a list of reasons or symptoms that led to the system infect by a virus/spyware.

Check for Internet browser popping up even when there is no browsing?

Check whether the system is performing very slowly?
Check whether the system is locking up or rebooting without warning?

Check for unusually high usage of your system's CPU (processor). In order to monitor CPU usage, look in the Windows Task Manager (right click the mouse on the Windows toolbar and select "Task Manager"). Select the "Processes" tab. Locate a column titled "CPU" that generally indicates which programs (or "processes") are using the most computing resources. This sometimes indicates a problem program. Monitor the column titled "CPU" and look for any processes that have a high number in the "CPU" column (the numbers in this column continue to change, so you may have to observe the data for a few minutes). If any processes appear to be using a significant amount of CPU time, you may want to do take note of them.

When you start your Firefox browser window, it should load to your homepage. If not, there may be a problem. This could mean that your browser has been hijacked. Browser hijacks occur in many ways. Most common attacks happen when you visit a web page and trigger code to download to your hard drive. Do not panic if you have been the victim of browser hijacking. Most hijackers do not want to do anything malicious to your computer but use this as a way to direct traffic to certain websites. Take some steps to fix a hijacked Firefox browser and return your computer to a healthy state.

Browser redirection and browser hijackers

Search engine redirection problem (often referred to as a Google redirection problem) is, no doubt, a very serious and quite annoying issue for many active Internet users these days. It is called Google redirection because most

often they use Google as their search engine. Yet, such problems might occur with any search engine, including Yahoo, AOL, Bing, etc. Why do some people create applications that modify your browser settings, set up certain web sites as the default search pages and cause search redirections via these sites? The answer to these questions is quite predictable and understandable. Through installing these redirecting toolbars their owners have an opportunity to advertise various products or services together with the search results that are summarized in the redirected page. Obviously, this can bring a tremendous amount of money for developers and owners of browser hijackers. They can either promote their own commodities or services or act as promoters for other companies, their goods and services offered by them. This all brings lots of money for the owners and developers of such browser hijackers.

Methods of browser hijackers' intrusion into computers

Installation authorized by user

There are two specific methods of how browser hijackers may integrate themselves with your browser. They can do it either legally or illegally. The first method implies user's participation in the installation process of browser hijackers. Users are directly notified about installation of a special program of browser add-on. It is clearly stated by the program that in case of installing such application the search engine will be modified, the default start page will be amended and replaced with a new one (depending on the name of browser hijacker). As a result of such installation authorized by user, a new add-on is installed, resulting search redirections through a new window that has certain web address, instead of the default blank page of your browser.

Installation without user's permission

In many cases browser hijackers enter into computers without user's permission. If so, the installer is generally brought into your system by malware through application of certain browser vulnerabilities available. The installation procedure is hidden from user's attention. User doesn't even realize some unauthorized installation is taking place. If this is the case, then surely it's fair to categorize such installer as malicious and potentially unwanted applications that surely doesn't use legal ways of entering your system. There are many examples of such malicious browser hijackers that don't even ask for user's consent when getting inside the computer.

Software through which browser hijackers and add-ons are installed.

The majority of browser hijackers is bundled with other programs which users can easily download online, and then install onto their computers. These can be either freeware or shareware applications. The installers of such applications most often clearly indicate that they will install browser add-ons by default. Yet, the option is given to users to uncheck the respective box and simply install

the program of their initial preference. Sometimes users fail to read the install wizard instructions carefully - this is how they install many extras, including browser add-ons that actually hijack the start page of your default browser. There are, in fact, many programs with their installers bundled with those of browser hijackers. As examples we can recall mp3 players, video players and codecs, pdf converters, etc. Yet, in many cases hijackers may be spread through direct participation of trojan horses and other forms of malware, which is obviously the result of poor anti-spyware protection level of your computer.

Lists of recommended steps to fix browser redirection problem:

- 1 Remove all adware, browser hijackers and other unwanted programs through the Control Panel of your computer.

- 2 Scan your system with powerful antivirus program.
- 3 Check the Local Area Network (LAN) settings of your system.
- 4 Check if DNS settings have been amended by browser hijacker.
- 5 Check browser add-ons. Remove all unknown or suspicious add-ons detected (enabled).
- 6 Checking Windows HOSTS file contents
- 7 Use CCleaner to remove all undesirable system/temp files and browser cache.
- 8 Run adware-cleaning applications.
- 9 Restoring desktop shortcuts of hijacked browsers.
- 10 Reset the Router to the factory default settings.

Introduction to the MS Office

Objectives : At the end of this lesson you shall be able to

- state what is MS Office
- brief what is MS Word and starting steps
- explain various screen blocks of MS Word
- explain procedures to create, save, print a document.

Microsoft office is a application software package introduced by Microsoft Corporation. MS Office consists of the following popular packages :

- Microsoft Word
- Microsoft Excel
- Microsoft Powerpoint
- Microsoft Access
- Microsoft Outlook

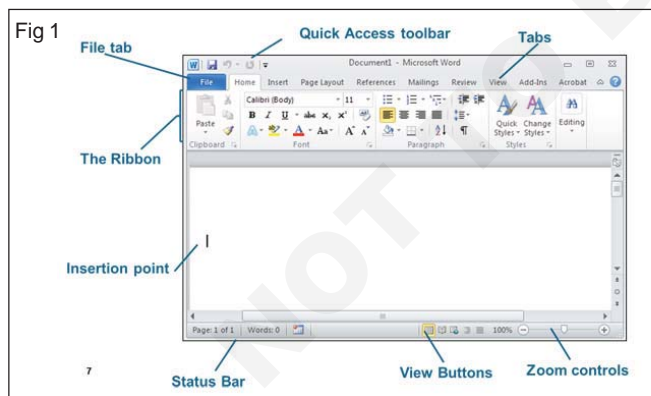
Word 2010

It is a word processor package that helps to create and edit a document. It is the most known word processor of nowadays. It makes professional looking documents by providing a comprehensive set of tools for creating and formatting a document, memos, letters, reports, brochures, business documents and even internet web pages.

Starting Word

Click on the Start > (windows Logo) All programmes > Microsoft office > Microsoft Word. MS Word opens along with a default blank document with default settings page layout.

Default page layout (Fig 1)

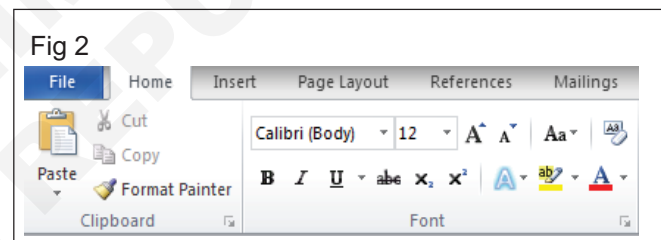


Unlike previous version, MS Office 2010 has a common set of features for all the components. It makes it easy to understand and common utilities to remain available on all the packages of MS Office including Word, Excel, PowerPoint, Access, etc. Many features are redesigned so as enabling the diverted users of other packaged can afford with. These enhancements and utilities in Word 2010 are described as below.

The Ribbon tab of Word has eight major parts viz. File, Home, Insert, Page Layout, References, Mailings, Review and View.

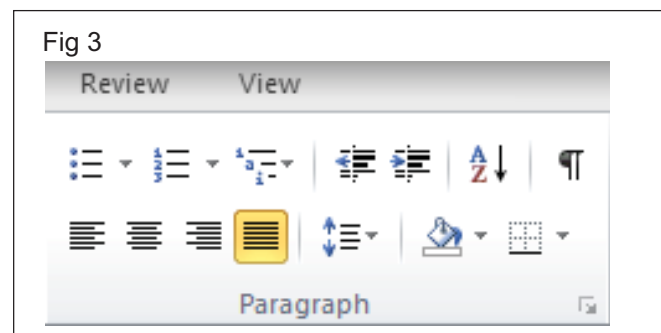
File tab of the ribbon is useful to create a new file, a blank or a template page as required. Ctrl + N always create a new blank document in Office Package. The documents so created can be saved as default word document or given compatible format. Furthermore, permission for accessing a documents can be fixed, share a document on a network, even manage a document to be compatible with previous and external versions. Print option makes the document to get a hard copy or a pdf format according to the installed printer features. Recently opened files can also be viewed to find it easy to work again. Help on word is there in the same tab.

Home Tab (Fig 2)



Home tab has clipboard options including cut, copy, paste and paste special. The Font block has all the options of setting fonts, size, superscript, subscript, bold, italic, underline, strikethrough, font colors, etc.

Paragraph Group (Fig 3)



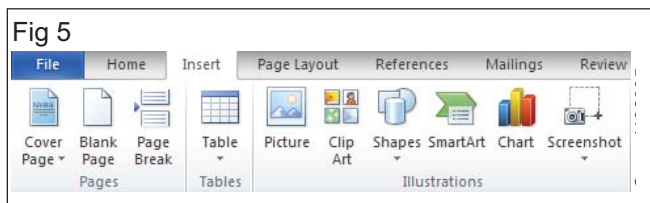
Paragraph group creates the formatting paragraphs with alignments left, right, center, justify and indentations, para and line spacing. Line and page breaks allows to create pagination options and exceptions of formatting.

Styles and Editing Group (Fig 4)



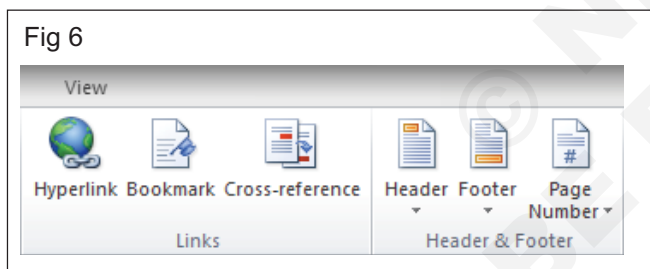
The Styles group allows preformatted text styles like Heading styles, Paragraph styles, Subtitles, etc. Custom styles can also be stored with altered specifications. The Editing group used to select specific area, find and / or replace option in a specified area in text.

The Insert tab has 7 groups. Fig 5 - Pages, Tables and Illustrations blocks (Fig 5)



Page group makes cover pages, blank pages insertion and page breaks. Tables group helps to insert a table in a text document with ready specified row-column set or a customized table format. Illustration group inserts pictures from external sources, cliparts, shapes, smart art, charts of data, even screenshot into the text document.

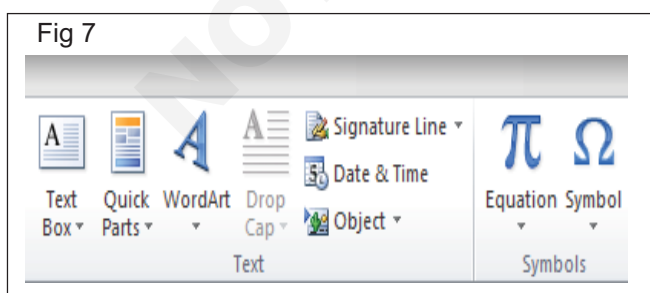
Links and Header/Footer Groups (Fig 6)



Links group creates hyperlink on texts, bookmarks and cross references in a document.

The header and footer group inserts header, footer to be appearing on every page and page numbers to display as to placement area.

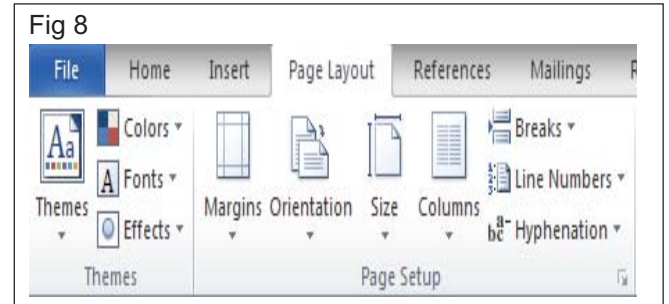
Text and Symbols block (Fig 7)



Text group allows creating text box, quick parts likely to create brochures, designed text as WordArt, paragraph styles, a signature line, date and time and an object insert option.

Symbols group inserts symbols of equations like math equations or symbols like currency, math symbols, etc.

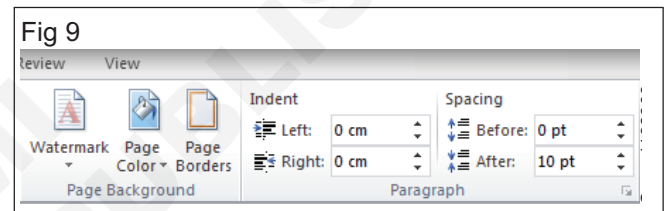
Themes and Page Setup Group (Fig 8)



Page Layout tab has five major groups. Themes block creates predefined template setup using themes on documents. Even new themes customized can be created and saved for future use.

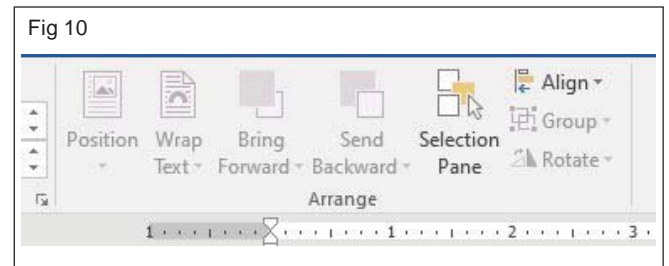
Page setup group has features on margin around, page orientation i.e. vertical or horizontal, paper size, columns to display, breaks, line numbers and hyphenation.

Page Background and Paragraph Group (Fig 9)



Page Background group creates a watermark, page Background color and page borders. Paragraph block has specified options already discussed in Home -> Paragraph group.

Arrange Group (Fig 10)



The arrange group creates position of objects, text elements, text wrapping, arranging objects, aligning of objects, grouping and transformations.

References tab has six blocks.

TOC and Footnotes Group (Fig 11)

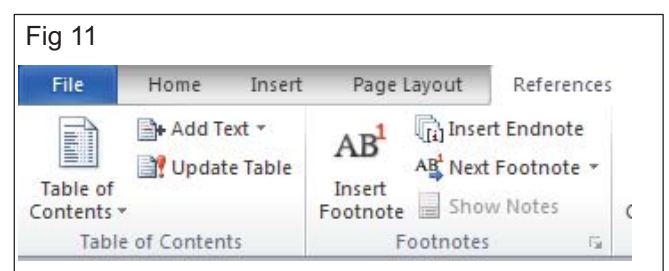
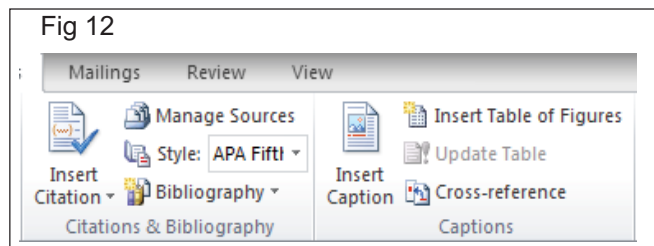


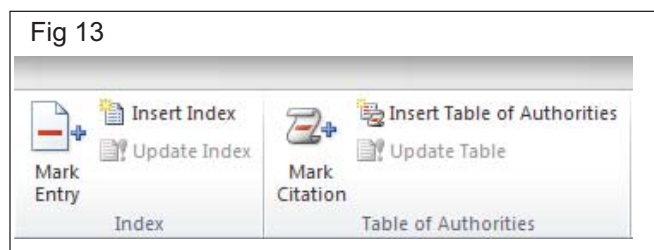
Table of contents creates the TOC of a particular publication document automatically and upon modifications updatable. Footnotes tab creates footnotes of a page, block area which includes explanatory phrases or references. Endnote makes the note at the end of the document.

Citations, Bibliography and Captions Group (Fig 12)



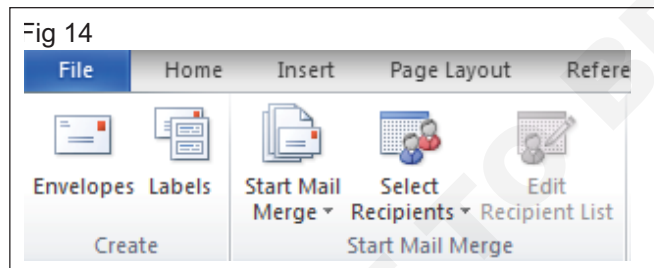
Citation and Bibliography makes an external source as citation, reference tables and credits of authors related to the publication. Captions tab inserts a caption, table of figures, cross references inside a text.

Index and Table of Authorities Group (Fig 13)



Index enters a value on a main topic or sub topic and create the index accordingly. Table of authorities has the citation mark includes the list of the cases, statutes and other authorities cited in the document.

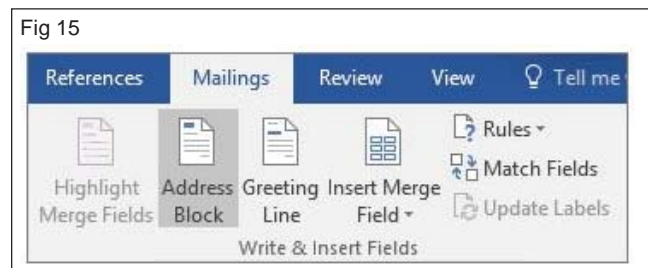
Create and Mailmerge Groups (Fig 14)



Mailings tab used to create mailing of a letter or order using common mailing features. Create block makes envelopes print using predefined formats as well as custom formats. Labels can also be printed to which the delivery address is mentioned.

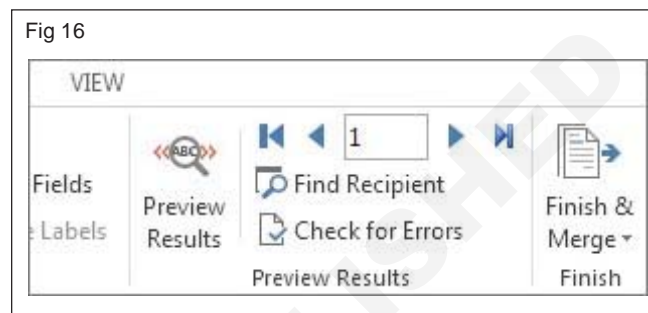
Mail merge block is used to create mail merge of a letter, email. If a common letter is created and to be sent to many recipients, this option allows to create an Address block where the recipient's info should appear. Even selective recipients can be listed as well as a new recipient list can be created.

Write and Insert fields Group (Fig 15)



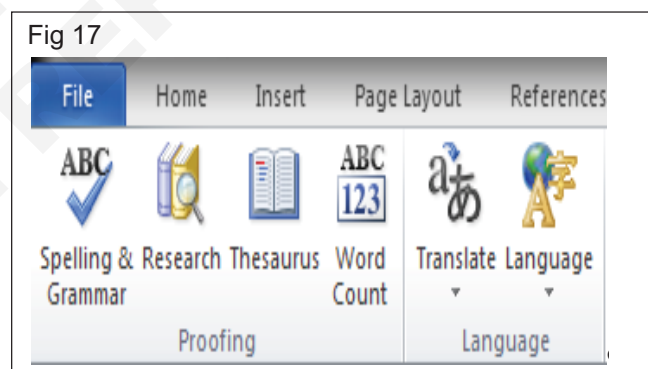
While writing a letter, it has many parts, which this mail merge creates fields of Address Block, Greetings Line, Merged field of content, labels, etc.

Preview Results and Finish Groups (Fig 16)



On successful completion of mail merge, it can be previewed and checked for errors for each recipients and edit accordingly. Upon validation the mail merge gets finished.

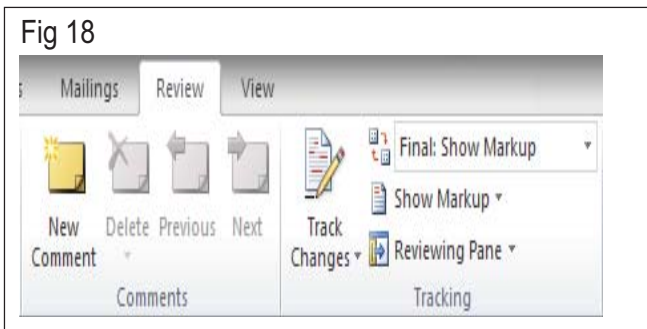
Proofing and Language Groups (Fig 17)



Review tab here is used for the various document areas to be reviewed. Proofing makes easier to check Spelling and Grammar of a document. Accidental errors can be corrected here. Research refines the search not only inside the document, but also the referenced documents. Thesaurus identifies the completeness of the document using the standard language compatibility of the region like English UK or English USA etc. Word count shows the analysis of the document as total words, total characters, with and without spaces, no. of paragraphs, lines, etc. Here Text blocks can also be included for such analysis.

Language Block helps to translate a page into the installed other languages and to change the proofing language. It requires the direct translator service from Microsoft Online.

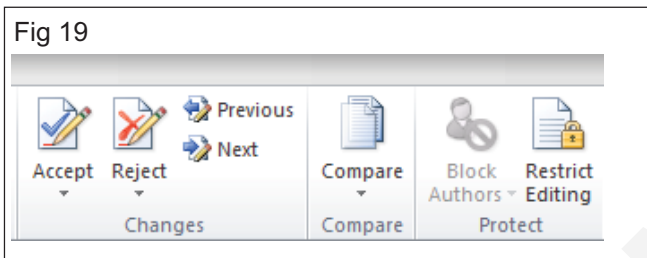
Comments & Tracking Group (Fig 18)



Comments group inserts a comment for a specific paragraph or text block.

Tracking group finds the changes made on a document by other authors in a protected mode. For example, if a document is created by user X and edited by user Y, is tracked separately with Track marks.

Changes, Compare and Protect Groups (Fig 19)



Changes hence made on the documents can either then accepted or rejected. More than a document can be compared for similarity using Compare. Also the document can be protected from editing by other authors.

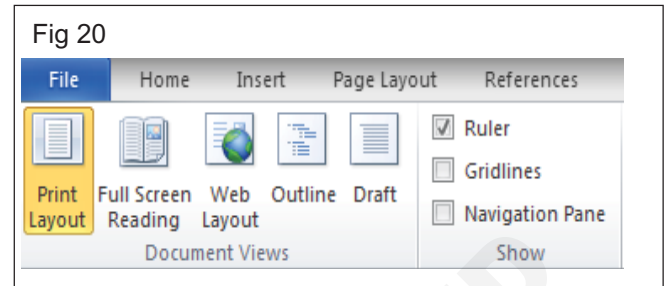
Document views and show Groups (Fig 20)

View tab shows the way of displaying the word document. Document views have a Print Layout, a common view of Word, Full Screen Reading, minimises the tabs and

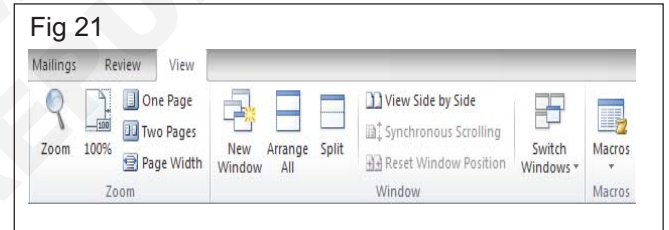
ribbons to disappear and easy to read, Web Layout, which previews a html compatible view, Outline, views the basic version of document in mere text mode and Draft mode for a text editing mode.

The Rulers, Gridlines and Navigation Pane can be shown or hidden according to user preferences.

Zoom / Window / Macro Groups (Fig 21)



Also the view of the page can be Zoomed to full page, two pages view, 100% of the document and custom view. To make easy editing a document the window can be split into two, a new window for a document to cut paste, etc. can be created and all open word documents can be arranged for view. While formatting the documents, for repetition of commands the Macro option can be used. It uses the Record option to store the set of commands and repeat it again on other part of document or on another document on a single click.

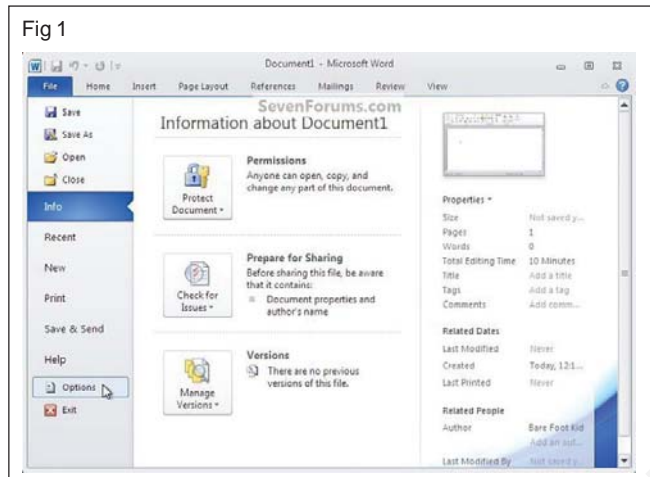


Creating a File, Save and other Options

Objectives: At the end of this lesson you shall be able to

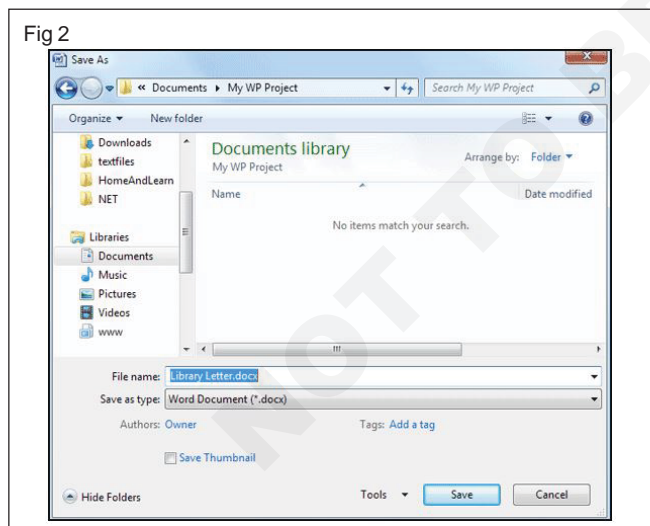
- explain how to create a new document, save and print
- state how to edit, format text and document styles
- brief using tables inside word document with data
- explain how to create styles in a document and save for future use
- explain Few unique features of word 2010
- brief the mail merge processing.

File Info view (Fig 1)



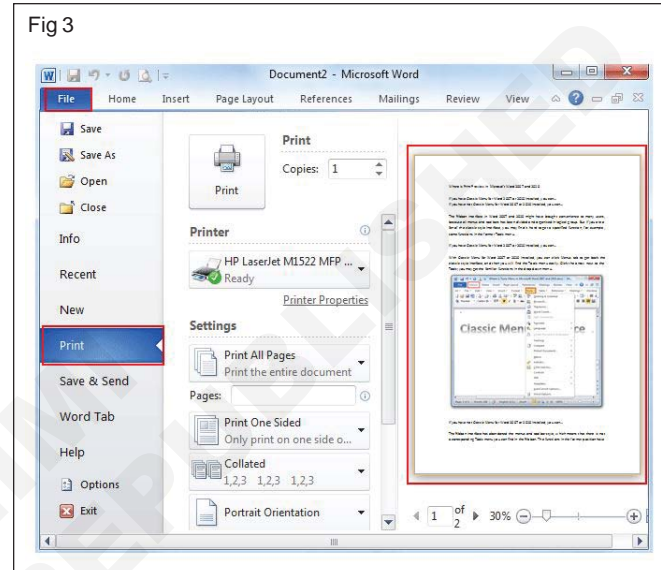
Word 2010 new document can be created as usual with Ctrl + N or through File menu New option. Basically the file created is saved as a word document extended format as docx in word file.

Save options in Word (Fig 2)



It can be saved using save as option in any compatible format or old versions of office, like 2003 or earlier versions. Main utility of the word software is the creation of word processing documents. It may be any of a format like publication, letter, brochure, etc. Word supports all type of formatting to design a text based presentation. Also it supports output files in major accepted formats according to industry standards.

Print options in word (Fig 3)

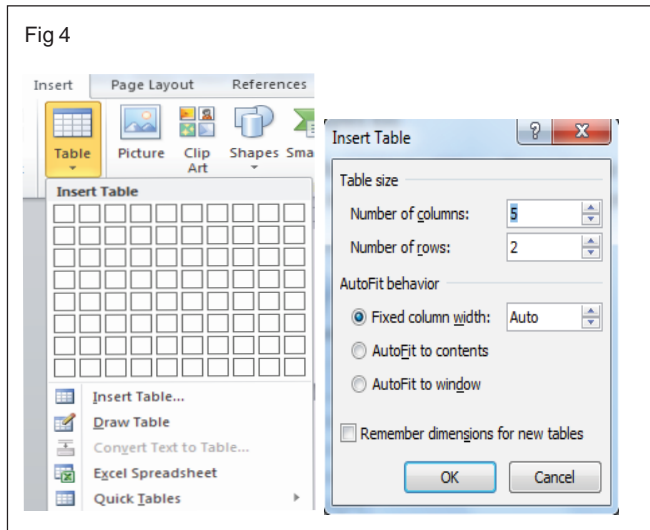


The saved documents can be printed using the File Menu -> Print option and the installed printer support makes it easy to get the document printed. If Adobe Acrobat Professional is installed, the same document can be stored as a PDF file for sharing purposes. Apart from printing and storage, the file created can be published in web as a web page or template that can be used for future publications in same format.

Basic concepts to be noted while using Word are Text properties. It includes Font type, Font size, Text Color, and usual decorations of text. Also creating of paragraphs styles are to be kept in mind. Paragraph alignment has left, right, center and justified settings. Text elements may contain items like ordered list, unordered list, subsection lists. They are found there paragraph formatting block of Home Tab. Indenting of text for creating Quotes is also there inside the same tab. According to the page size, line spacing and paragraph spacing can be adjusted, like before and after paragraph spaces, line heights, etc. The Styles can be predefined to use as ready to put on places where it required. Standard templates are available but it allows to create custom styles too.

Tables can be inserted for various utilities. Normal table has adjustable width and columns so it can simply inserted with Insert > Table option directly.

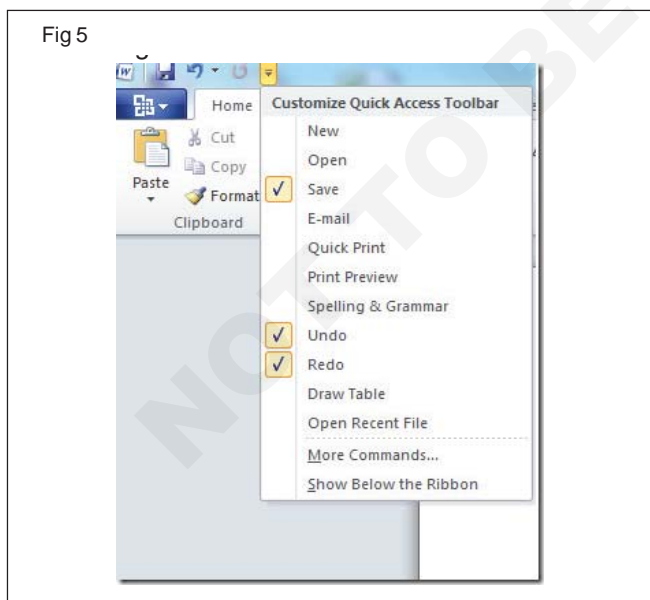
Table insert wizard options (Fig 4)



In case of custom sized table is required, it can be created using insert table / draw table options. Insert table allows custom values for columns, width and other properties. Draw table creates custom table using a pen drawing tool through which new table can be drawn according to the available text contents.

Customizable Quick Access Tool Bar

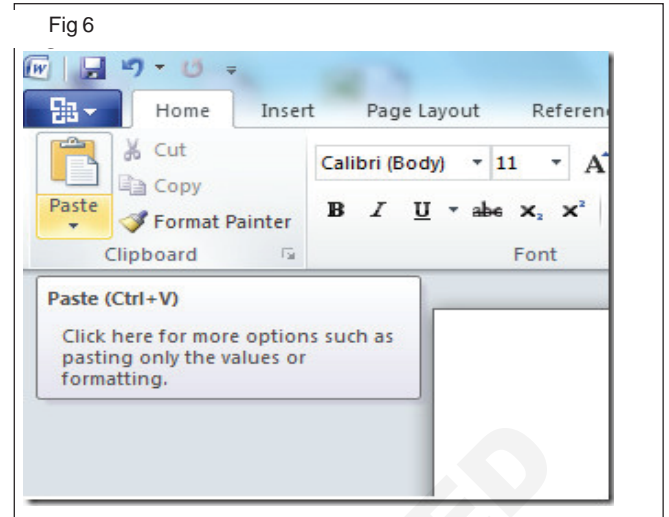
Word 2010's Quick Access Toolbar displays all the commonly used options. It is located in the top left side corner of the application window, near the office button. By default it displays the following three options, Save, Undo and Redo, but is customizable and you may easily add more options to it. (Fig 5)



Paste Preview

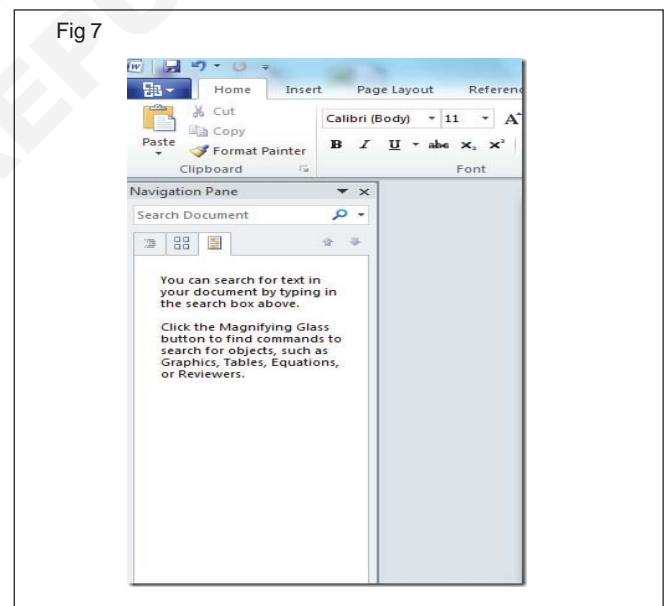
It happens with most users that after copying and pasting something into their document, they need to undo the some changes. Word 2010 has made it easy for users, now you may eliminate this unnecessary step by using

the paste preview option. It allows users to paste only the values or the formatting. (Fig 6)



Navigation Pane

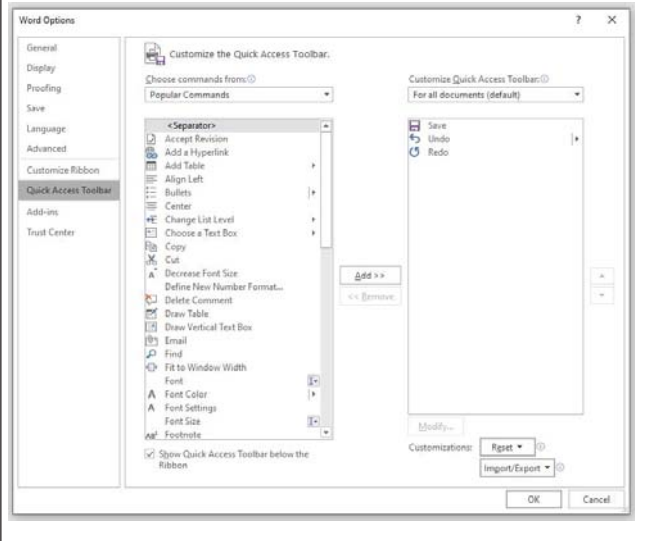
In the previous versions of Microsoft Office, one has to use the Ctrl+F hotkey to find any word or phrase from within a document. Word 2010 has added a new magic to this option, Ctrl+F now summons a Navigation Pane that appears on the left side of the document. You will see the three views available by clicking on their respective tabs, the Heading View, Thumbnail Page View, and the Search Result View. (Fig 7)



Customizable Ribbon Button

Apparently the Ribbon button in Word 2010 looks like the one in Word 2007. But there is one big addition, you may customize the word 2010's Ribbon button. In order to customize the Ribbon button navigate to the following option Office Button > Word Option > Customize Ribbon. (Fig 8)

Fig 8



Improved Collaborations

Microsoft Word 2010 has a new feature called co-authoring. It allows more than one authors to edit a document at the same time. Word 2010 tells you how many authors are editing the document and their changes can be viewed too. (Fig 9)

Screen Capture Tool

Word 2010 includes a feature called Screen Capturing, now there is no need to use a third party or additional tool to capture a screenshot in order to use it in Word, just simply use Word 2010's built in tool to capture any area of the screen. A Screenshot may be taken by navigating to the following option Insert > Screenshot. (Fig 10)

Fig 9

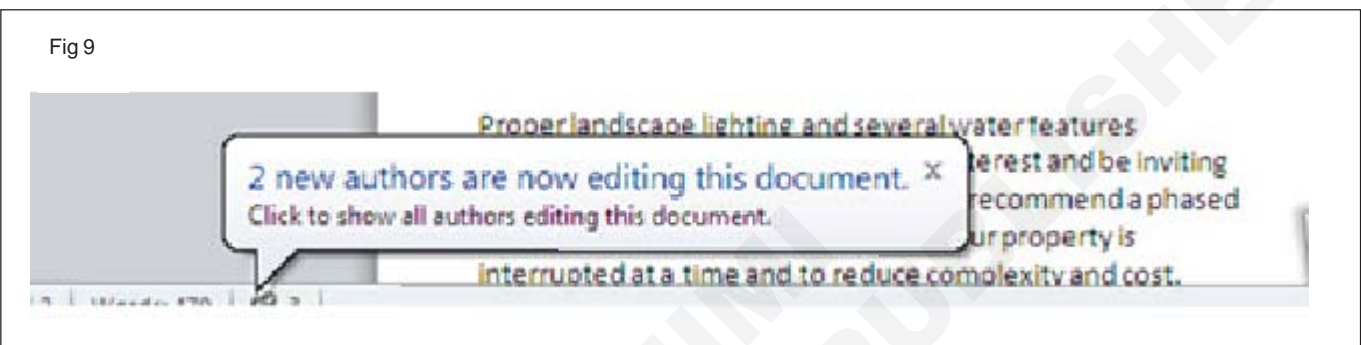
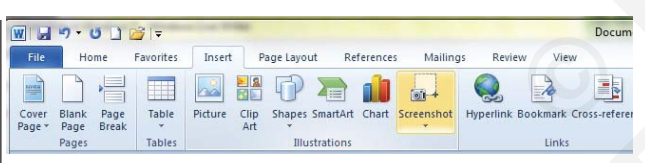


Fig 10



The Background Removal Option

Office 2010 has an awesome option by the name of Background Removal, which simply removes the background of any image. Yes, you don't need Photoshop anymore to remove the background. First insert the picture in your Word document from the Insert > Picture option. Then locate the Background Removal tool and get rid of the background. (Fig 12)

Artistic Effects

In Word 2010 users can now apply a number of snazzy artistic effects to the pictures. In order to add the artistic effects to your document, Navigate to the following option Insert > Illustrations > Picture. Then browse and select the picture you want, Once the picture is added to your document, then the Picture Tools contextual tab is displayed and you will be able to see the new Artistic Effects drop down button over here. (Fig 11)

Fig 11

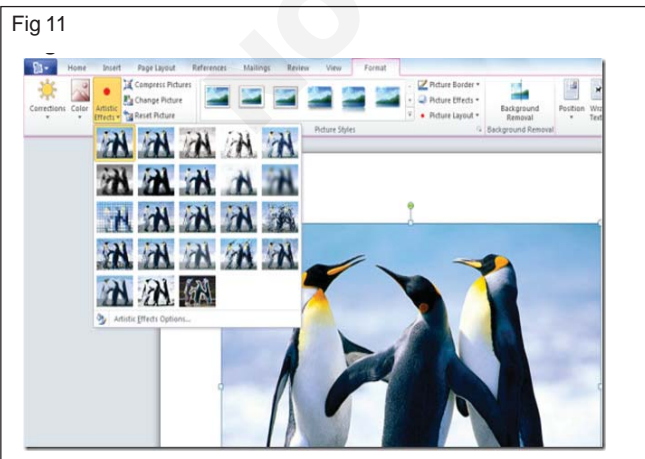
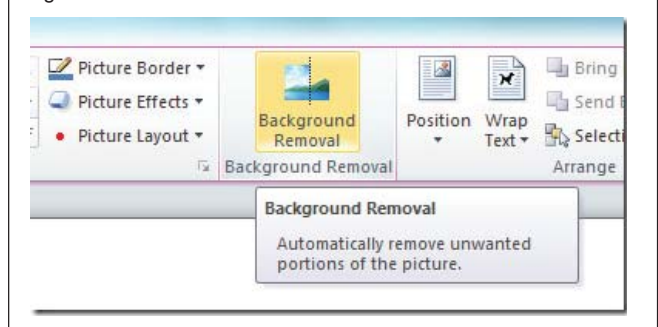


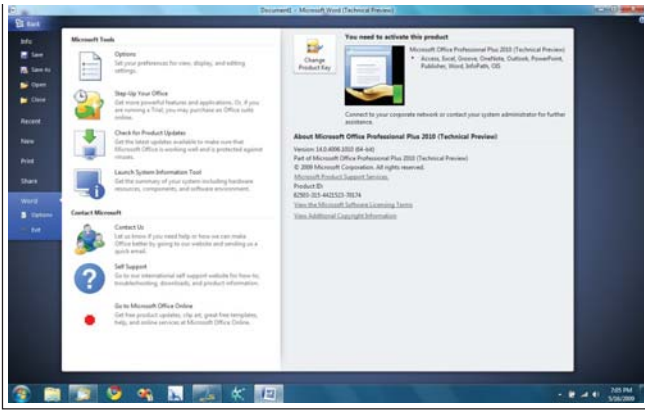
Fig 12



Office Backstage

The Office Backstage is a new concept, it is the enhanced form of the plain old office button and provides a much user-friendly menu. It helps users to manage documents, presentations, or spreadsheets at a greater level. (Fig 13)

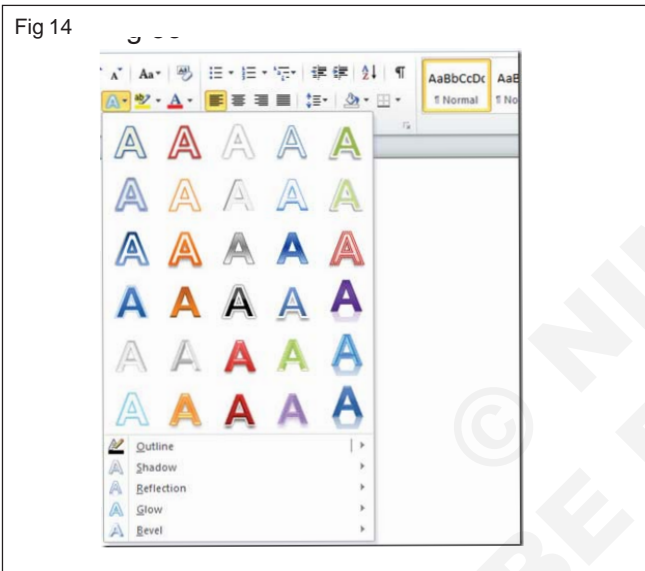
Fig 13



New Art Effects in WordArt

Just like other features, WordArt has been updated with new colorful art effects. Select the text, then click Word Art and a list of all the available options will be displayed. (Fig 14)

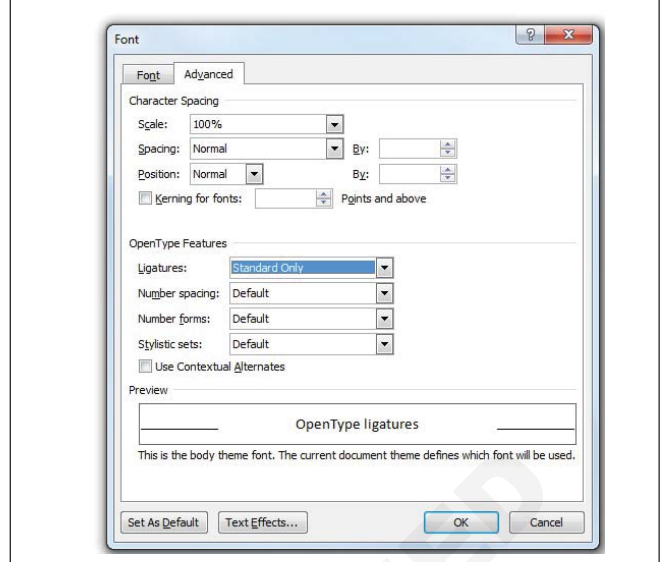
Fig 14



Ligatures

You might have heard about Ligatures. They make the fonts look fancy and they are also used to keep letters separate allowing you to search the text as if the font were regular. Its true that not all fonts support ligatures, but a large variety of the fonts supports them. You may enable them from Font Preferences > advanced, then select the standard only option in the ligatures drop down box. (Fig 15)

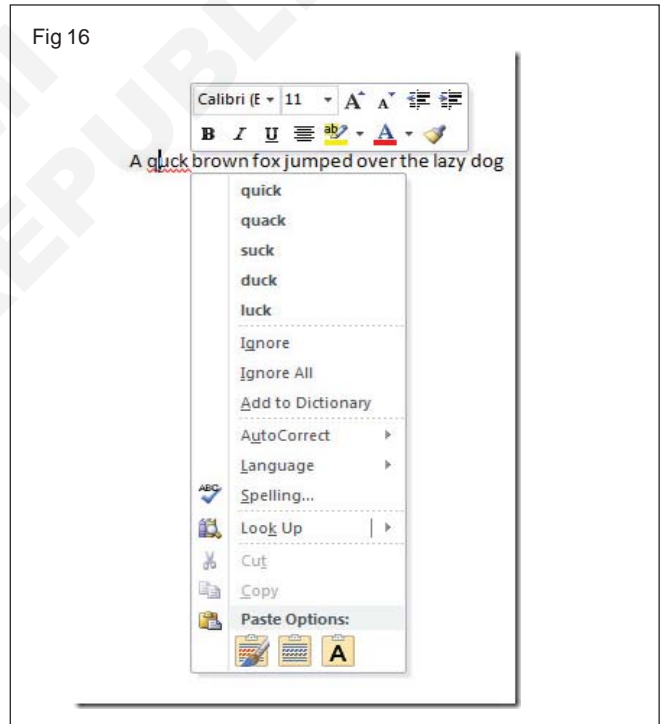
Fig 15



Improved Spell Checks

Word 2010 has added some new features to its spell checker, now it will detect the mistake and suggest changing the sentence.

Fig 16



Shortcut Keys in Word 2010

Objective : At the end of the lesson you shall be able to

- learn the shortcut keys in MS Word.

| | |
|--------------|---|
| CTRL+SHIFT+A | converts the selected text to capital letters or vice versa |
| CTRL+SHIFT+F | Displays the Font dialog box. |
| CTRL+SHIFT+G | Displays the Word Count dialog box. |

| | |
|------------------------|--|
| CTRL+SHIFT+S | Displays the Apply Styles task pane. |
| ALT+R | Displays the Review tab |
| ALT+CTRL+1 | Apply Heading 1, Similarly ALT + CTRL + 2 will apply heading 2 |
| CTRL+SHIFT+L | Applies Bullets |
| CTRL+SHIFT+F5 | Bookmark |
| CTRL + B | Bold Text |
| CTRL + I | Italic Text |
| CTRL + U | Underline Text |
| CTRL+PAGE DOWN | Browse Next |
| CTRL+E | Navigate to the center Paragraph |
| CTRL+SHIFT+ENTER | Column Break |
| CTRL+SHIFT+C | Copy Format |
| ALT+SHIFT+F7 | Dictionary |
| ALT+CTRL+S | Splits the Document |
| CTRL+SHIFT+D | Double Underline |
| CTRL+END | End of Document |
| END | End of line |
| CTRL+SHIFT+P | Font size select |
| SHIFT+F5 or ALT+CTRL+Z | Go Back to previous state |
| CTRL+SHIFT+. | Grow Font |
| CTRL+]] | Grow Font one point |
| ALT+SHIFT+R | Header Footer Link |
| CTRL+K | Hyperlink |
| CTRL+M | Indentation |
| CTRL+J | Justifies Paragraph |
| ALT+F8 | Inserts Macros |
| ALT+SHIFT+K | Mail Merge Check |
| F10 | Menu Mode |
| ALT+F7 | Moves to the Next Misspelling |
| CTRL+H | Replace |
| CTRL+P | Print |
| CTRL+SHIFT+F12 | Also launches Print |
| ALT+SHIFT+BACKSPACE | Redo |
| F12 | Save As |
| CTRL+SHIFT+K | Small Caps |
| CTRL+SHIFT+S | Style |
| SHIFT+F7 | Thesaurus |
| ALT+SHIFT+T | Time Field |
| CTRL+SHIFT+M | Unindent |


Formatting :Format text

- 1 Select the text you want to format.

To select a single word, double-click it. To select a line of text, click to the left of it.

- 2 Select an option to change the font, font size, font color, or make the text bold, italic, or underline.

Copy formatting

- 1 Select the text with the formatting you want to copy.
- 2 Click **Format Painter**  , and then select the text you want to copy the formatting to. (Fig 17)



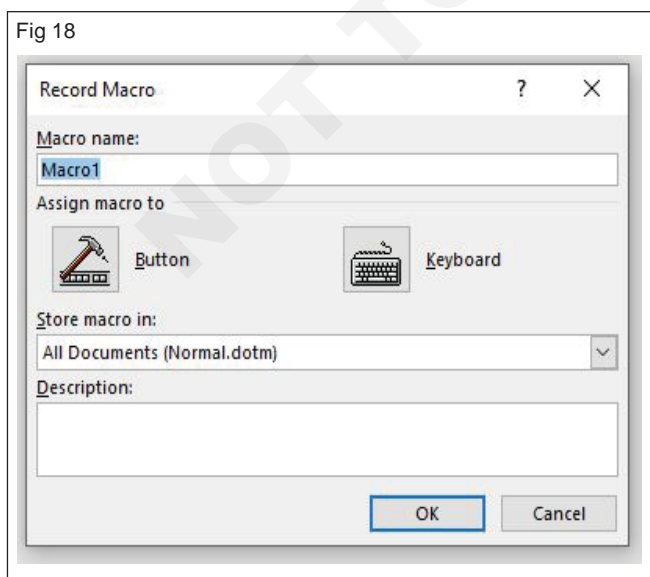
Macros

A macro is a symbol, series of commands, or keystrokes that you create to perform a single action. MS Word 2003 has dozens of examples of macros. The boldfaced icon is essentially a macro. You click that to perform an action: boldfacing text.

MS Word 2003 allows you to create – or record -- your own macros. You can use macros to record a series of actions, so that it makes it as easy as clicking the macro to repeat those actions again later. An example is that you could create a macro to boldface the word "cat" every time that you type it.

To Record a New Macro (Fig 18)

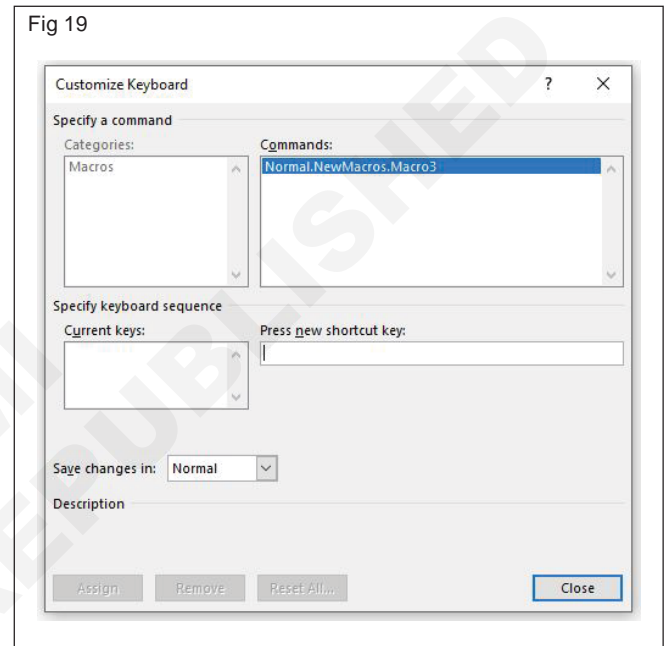
- Go to the 'Tools' menu on the menu bar and click 'Macro.'
- Select 'Record New Macro'



- Type a name for the macro.
- In the 'Store macro in box' select a template or document that you want to record the macro in.
- Type a description for the macro in the 'Description' box.
- If you don't want to assign the macro a toolbar, menu, or shortcut key, click 'OK' to record the macro.
- A toolbar will appear. You will have to click the circle to stop recording the macro.

To Assign a Shortcut to a Macro (Fig 19)

To assign a shortcut to the macro, click the 'Keyboard' icon. The window below will appear.



Go to the 'Commands' box and click the macro you are recording.

In the 'Press New Shortcut Key' box, type the key sequence for the macro, then click 'Assign.'

When you click 'Close,' you begin recording the macro.

Perform the actions that you want included in your macro.

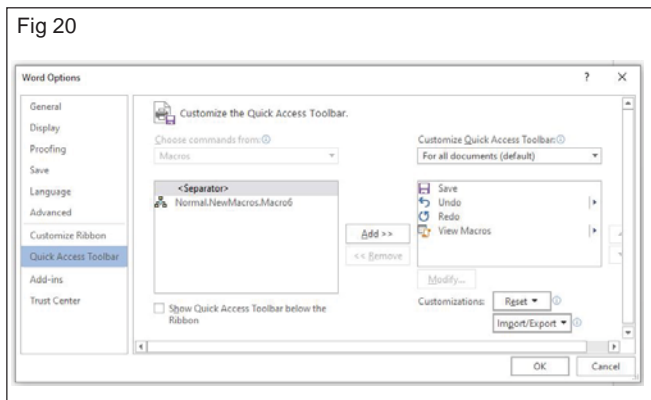
To Assign a Menu or Toolbar to a Macro

- Click on 'Toolbars' in the 'Record Macro' window.
- Click the 'Commands' tab.
- Select the macro that you are recording, then drag it to the toolbar or menu that you want it assigned to.
- Click close to begin recording.

To Run a Macro

- If you've selected a toolbar or menu, simply click on the icon to run the macro. (Fig 20)

Fig 20



- If you've selected a keyboard shortcut, enter the sequence of keys to run the macro.

Protect Document (Fig 21)

Protecting a document means that you add security. It doesn't matter how much security you have on your computer, your individual documents don't have any unless you add it. MS Word 2003 allows you to protect your documents to keep them from being edited by unauthorized parties. Even if you send the document out in an email at a later date, it will still be protected. No software on your computer will do that for you.

If you want to protect any document that you create, go to the 'Tools' menu on the menu bar and select 'Protect Document.' You'll see the following window open to the right of the text area:

There are three different sections to this window.

- 1 Formatting restrictions:** Here you can limit the type of formatting that can be changed within the document.
- 2 Editing restrictions:** In this area, you can limit the types of edits to be made to the document, such as read only, track changes, comments, and filling in forms. Below the editing restrictions, you'll see exceptions. MS Word 2003 allows you to specify which users can edit which parts of the document. When you enter in a user name, a drop down window will appear to allow you to add permitted regions of the document that the individual user can edit.
- 3 Start Enforcement (Fig 22):** Once you've applied your security measures, click 'Yes, Start Enforcing Protection.'

When you click 'Yes, Start Enforcing Protection,' a dialogue box like the one below will appear.

Enter a password, and then reenter it to confirm. Only users with the password can remove the protection from the document.

Remove Protection

- On the 'Tools' menu, click 'Unprotect Document'
- Enter the password.

Fig 21

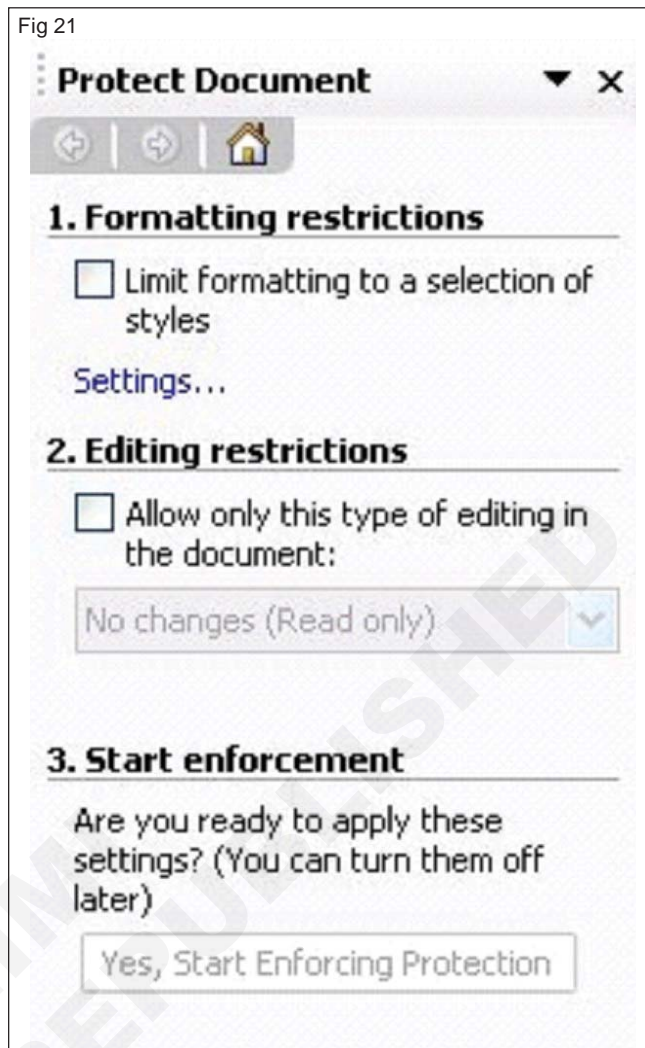


Fig 22



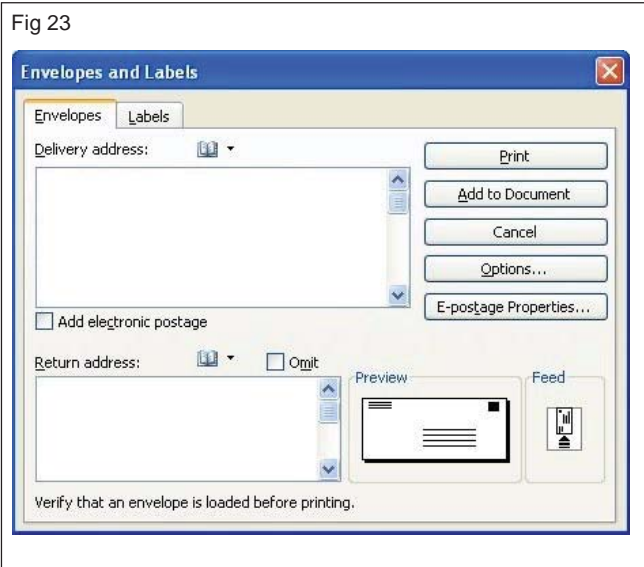
Mailing Lists

To create mailing lists, envelopes, labels, and merge mail lists, you will go to the 'Tools' menu, then 'Letters and Mailings'

To Create Envelopes (Fig 23)

- Select Envelopes and Labels from 'Letters and Mailings'.
- Enter the information for the envelope.

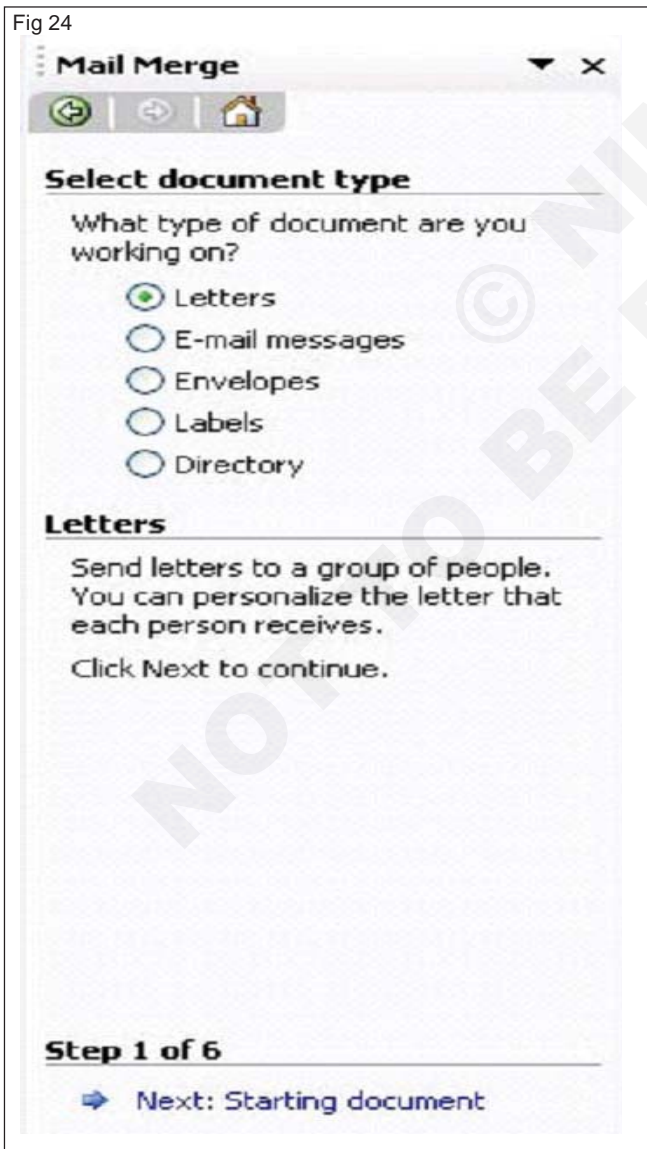
Fig 23



You will see the same dialogue box when you create labels, except the Labels tab will be on top. Enter the information for your labels and either add it to the document or print it.

Creating a List for Mail Merge (Fig 24)

Fig 24



If you need to send out a letter to a bunch of different recipients, as in a form letter, you can use Mail Merge to do this without typing the same letter over and over. Mail merge will use fields in places where you want different information filled in for each recipient.

For example, the field:

- City , State

City and State would be filled in with your recipient's City and State when mail merge is executed.

The first thing you need to do is create a list of recipients for mail merge. To do this, go to 'Mail Merge.' A window will appear to the right of the text area.

Select the document type (we've selected letters), then click 'Next: Starting Document.'

The next window will ask you how you want to set up your letters: using the current document, starting from a template, or from an existing template. We're going to use the current document.

The third window will have you select recipients. You can use an existing list, select from Outlook contacts, or create a new list.

We've chosen to create a new list. (Fig 25)

Fig 25



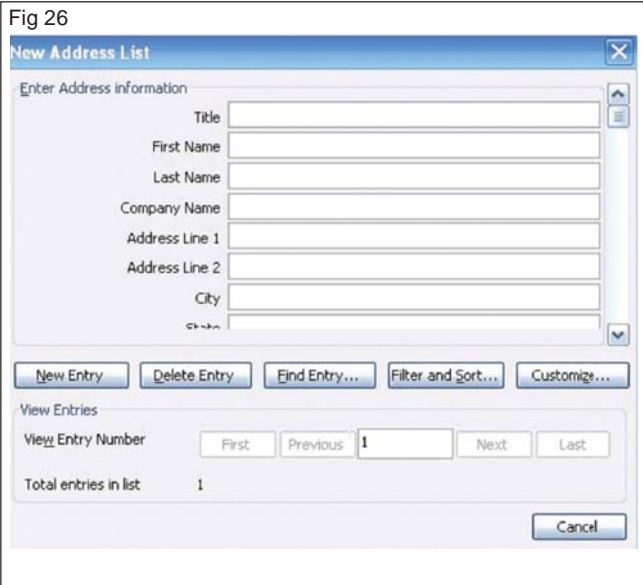
Click 'Create.' A window like the one below will appear:

Enter in all names and addresses for your new mailing list or click customize to gather the information that you need. (Fig 26)

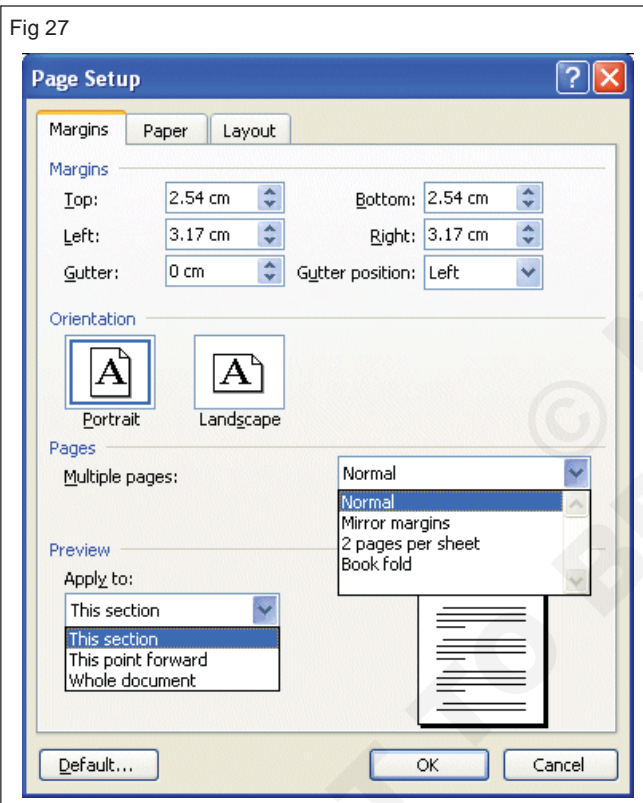
You can use this window to rename fields and add more fields.

Follow the rest of the instructions to create your letters and merge your mailing lists.

Word - Page setup and printing



Page setup (Fig 27)



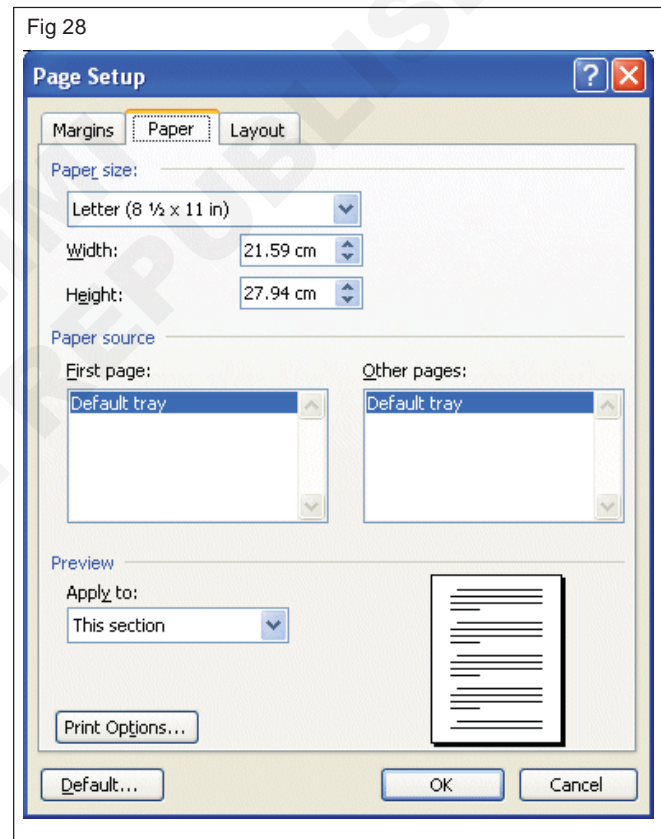
- Word offers you several options to change the presentation of the text such as to put the text in bold, in italic or in underlined. It's also possible to change the font as well as cuts it letters and its colors from the others. The pagination allows you to control the options of presentation of your document on paper. You can change the margins, the size(format) of the paper, the orientation of the paper and the other options that will be explained below on this page.
- From the **File** menu, select the option **Page setup** option.
- Click on the **Margins** tab.

Under this tab, you can control the margins of the document as well as the place of the heading and the foot of page inside the superior margins and subordinates. The option of binding is to add a supplementary space of the left-hand side to be able to connect the document.

In the left lower corner, the option " Pages in towards " can be very important. This option controls the margins for impressions(printings) " first side reverse " or for the impressions(printings) on both sides of a sheet. The right and left margins are transformed into internal margins and outsides.

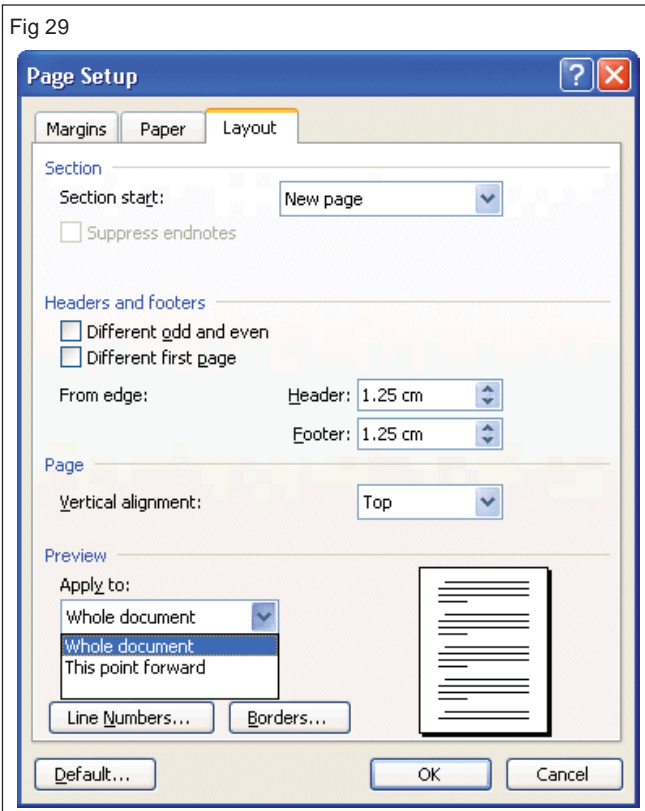
The option To apply is important too. It's from this option that you apply the changes that you brought to the margins or to the other options for all the document or only from the place where is the cursor at this moment. If you use the option " From this point ", it forces the addition of a jump of section. This option is very important for the structure of your document. It's explained in detail on the page of the other Word options.

- Click on the **Paper** tab. (Fig 28)



From this window, you can change the size(format) of the paper as well as its orientation. It's especially necessary to pay attention to the size(format) of the paper. Some notice too late that they have the bad size(format) of paper. Generally, the size(format) of the paper is in " A4 " when it should be for the size(format) " US Letter ". The size(format) A4 is the one that is used in Europe and not in North America. make sure to have the right size(format) before continuing or even beginning a new document. Otherwise, you'll not only have to change the size(format) of the paper but also the presentation of your document.

- Click on the **Layout** tab. (Fig 29)



You can control the food of the paper in the printer. You can decide to let the computer take charge automatically of the food or to change it if your printer has several tubs of papers or for an printing on some special paper. Unless a special need, leave the options with " Tub by default ".


Under this tab, there are several options to control the arrangement of the text on the page. From these, there is a place of the debuts of section. I don't see the advantage of this option because you may insert a jump of section any time and the necessary type from the **Insert** menu.

The options in the category of Headers and the feet of page are more interesting. They are used when you print first side reverse. For example, the place of the numbering of pages can be different on an even page that on an odd page. With the option " different Front page ", the heading of the front page of your document can have supplementary elements such as the corporate logo and the address of the company. This heading will not be on the other pages of the document. You can put the another heading for the rest of the document.

The option of vertical adaptation brings the advantage of power to centre vertically the contents of the page. It's now useless to try to centre manually. This is very advantageous for the page an picture, but not titles of the document or for a page with a table or for a common page. The option "Height" is generally used for the rest of the document.

To end, there is an option for the numbering of rows. It's rarely used, unless being paid among rows of text.

Printing

You can print all your document by pressing on the  button. However, Word offers you also several options for the printing.

- From the **File** menu, select the **Print** option. (Fig 30)

You can first select the printer of your choice. This is practical if you have access to several printers from your job(workstation). It's however necessary to pay attention. The presentation of your document changes according to the printer that you chose. It's necessary to select the good printer and to make a preview before printing to make sure to have the good result in the printing.

You can also control the vast of your printing. You can print all the document, the page where is the cursor at this moment, the block of text that you selected or certain pages in your choice.

Sometime, you don't want to print a document completely but only a couple of pages. The last option of the section on the area offers you this possibility. It's necessary just to know that you must put a semicolon (;) between every page or block of page. It's necessary to put a hyphen (-) between the first and the back page of a series of pages to be printed. There is a small example at the foot of the window. In this example, you could print pages 1 , 3 , 5 - 12 up to and including as well as page 14 of your document (1; 3; 5-12; 14).

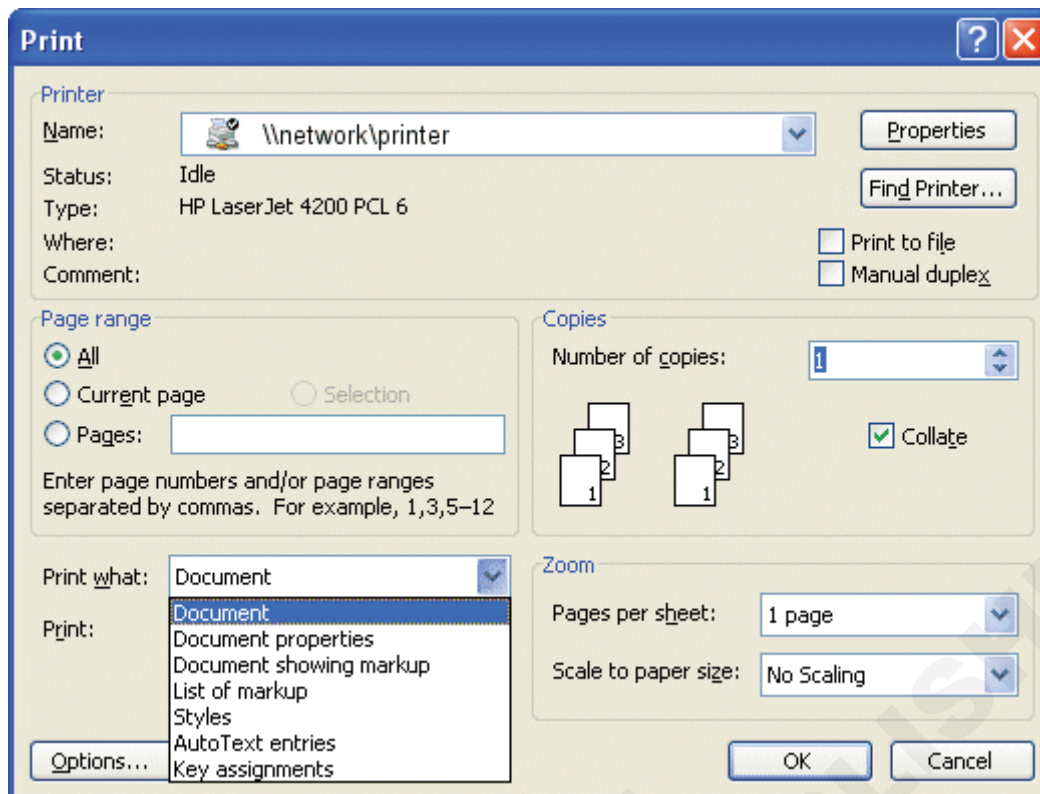
You have also the control on the number of copies that will be printed. This is practical if you have to print a document for several persons for a report, a committee or a meeting. leave the option with " assembled Copies ". Otherwise, you should replace in order all the pages of your copies.

Most of the time, you'll want to print the document. But he can have moments or you'll want to take advantage of the other possibilities such as the printing of the properties of the document or the comments.

The last option allows you to print all the pages or the pages odd peers or pages. One of the advantages of this option is to be able to print manually a document in first side reverse. Here are the stages.

- Select the option of printing of pages indiscretions and print all the document.
- Invert the paper and put back it in the tub of the printer.
- Select the option of printing of pages peers.
- Press the **Options** button in the left lower corner of the Print window.

Fig 30



Introduction to MS-Excel 2010

Objectives : At the end of this lesson you shall be able to

- features & Functions of Microsoft Excel
- formulas and Functions
- move Around in Excel 2010
- conditional Formatting
- link Excel Spreadsheet Data.

Features & Functions of Microsoft Excel

Whether for work or home use, an Excel spreadsheet is the best tool in Microsoft Office for organizing data and making lists. Although Word documents can include tables and columns, Excel makes laying out information for easier. Excel also has a range of functions for designing formulas that automate calculations. Although Excel looks intimidating at first, the program's layout is similar to other Office applications.

Cells and Worksheets

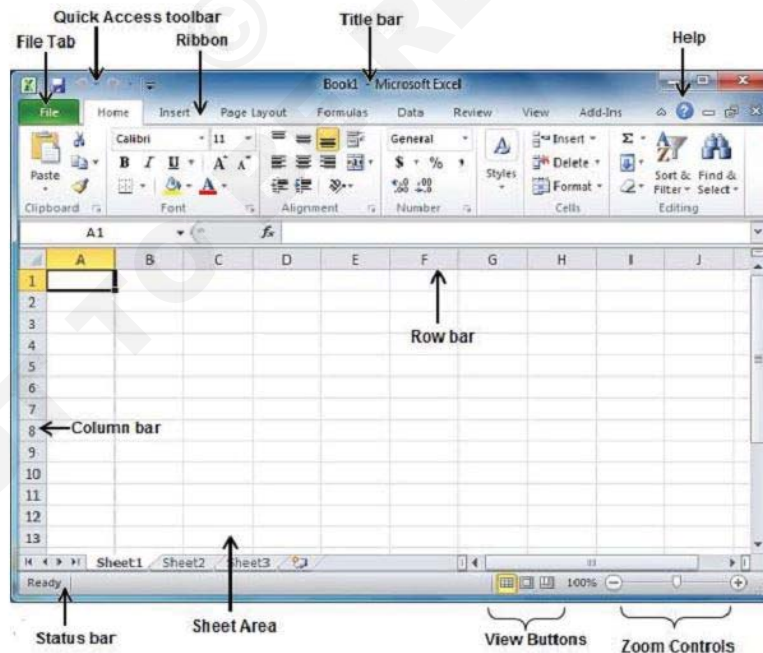
The main portion of Excel's window consists of a spreadsheet -- or worksheet of cells. Just as with a paper spreadsheet, each cell can contain any numbers or any text -- unlike working with an Access database, Excel allows to simply click on any cell and fill it however best fits the project.

In some cases, such as to track spending, if want to use an organized series of rows and columns. Other times, such as building a list of team members, cell order and positioning won't play a major role. One advantage to Excel is how simple it makes reorganizing data: select a cell and drag its border to move it to a new spot on the sheet.

Excel Workbooks

Every Excel file, called a workbook, contains one or more worksheets. To switch between sheets in a workbook, use the tabs in the lower left corner of the window. Since Excel 2010, most workbooks use the file extension XLSX, whereas older versions used XLS files. New copies of Excel can read these old files, but to open a new workbook in an old edition, the old PC needs the Office compatibility pack.

Fig 1



Formulas and Functions

In addition to containing plain text and numbers, cells can contain formulas, which always start with an equals sign. With a formula, Excel displays the result of an equation in a cell, but automatically keeps that result up-

to-date as you change its components. A basic formula can take the place of a calculator: write `"=2+4"` and Excel displays `"6."` Formulas also work with data in other cells: `"=A1+B1"` adds the values of cells A1 and B1.

For procedures other than direct arithmetic, use functions to perform various operations on data. Functions' abilities range from simple math, such as "AVERAGE" to average a range of cells, to modifying text, such as "LOWER" to convert a line to lower case.

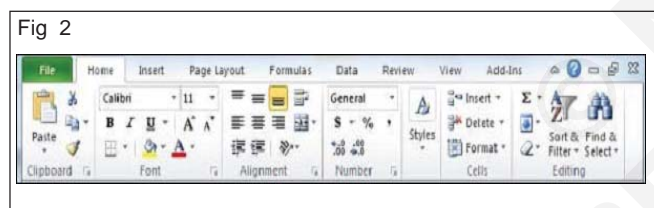
The two terms are often confused, but remember that each cell can contain only one formula, but each formula can use multiple functions, such as "=AVERAGE(A1, B1)+SUM(A2, B2)" to add the sum of two cells to the average of two other cells.

The following basic window appears when you start the excel application. Let us

now understand the various important parts of this window as shown in Fig 1.

Ribbon Tabs

As with the rest of Office since 2007, Microsoft has replaced Excel's menus with ribbon tabs as shown in Fig 2. The tab as visual menus that remain open each tab contains a set of related features with explanatory icons. For example, the Home tab contains the most common options, such as font and text color, while the Insert tab offers ways to insert tables, text boxes and charts. One tab, File, behaves differently. File still contains basic tasks including "New," "Open" and "Save," but displays these tasks in a full-screen area with extra options, called the backstage view. For example, the "New" button in the backstage view offers a searchable selection of templates for new workbooks.



Ribbon contains commands organized in three components:

Tabs: They appear across the top of the Ribbon and contain groups of related commands. Home, Insert, Page Layout is the examples of ribbon tabs.

Groups: They organize related commands; each group name appears below the group on the Ribbon. For example, group of commands related to fonts or group of commands related to alignment etc.

Home: Use this tab when creating, formatting, and editing a spreadsheet.

This tab is arranged into the Clipboard, Font, Alignment, Number, Styles, Cells, and Editing groups.

Insert: Use this when adding particular elements (including graphics, PivotTables, charts, hyperlinks, and headers and footers) to a spreadsheet. This tab is arranged into the Tables, Illustrations, Sparkline, Filter, Charts, Links, and Text groups.

Page Layout: Use this tab when preparing a spreadsheet for printing or reordering graphics on the sheet. This tab is arranged into the Themes, Page Setup, Scale to Fit, Sheet Options, and Arrange groups.

Formulas: Use this tab when adding formulas and functions to a spreadsheet or checking a worksheet for formula errors. This tab is arranged into the Function Library, Defined Names, Formula Auditing, and Calculation groups. Note that this tab also contains a Solutions group when activate certain add-in programs,

Data: Use this tab when importing, querying, outlining, and subtotaling the data placed into a worksheet's data list. This tab is arranged into the Get External Data, Connections, Sort & Filter, Data Tools, and Outline groups.

Review: Use this tab when proofing, protecting, and marking up a spreadsheet for review by others. This tab is arranged into the Proofing, Language, Comments, and Changes groups. Note that this tab also contains an Ink group with a sole Start Inking button if you're running Office 2010 on a Tablet PC or on a computer equipped with some sort of electronic input tablet.

View: Use this tab when changing the display of the Worksheet area and the data it contains. This tab is arranged into the Workbook Views, Show, Zoom, Window, and Macros groups.

Title Bar

This lies in the middle and at the top of the window. Title bar shows the program and the sheet titles.

Help

The Help Icon can be used to get excel related help anytime you like. This provides nice tutorial on various subjects related to excel.

Zoom Control

Zoom control lets to zoom in for a closer look at your text. The zoom control consists of a slider that user can slide left or right to zoom in or out. The + buttons can be clicked to increase or decrease the zoom factor.

View Buttons

The group of three buttons located to the left of the Zoom control, near the

bottom of the screen, lets to switch among excel's various sheet views.

Normal Layout view: This displays the page in normal view.

Page Layout view: This displays pages exactly as they will appear when printed. This gives a full screen look of the document.

Page Break view: This shows a preview of where pages will break when printed.

Sheet Area

The area where to enter data. The flashing vertical bar is called the insertion point and it represents the location where text will appear when type.

Row Bar

Rows are numbered from 1 onwards and keeps on increasing as to keep entering data. Maximum limit is 1,048,576 rows.

Column Bar

Columns are numbered from A onwards and keeps on increasing as to keep

entering data. After Z, it will start the series of AA, AB and so on. Maximum limit is 16,384 columns.

Status Bar

This displays the sheet information as well as the insertion point location. From left to right, this bar can contain the total number of pages and words in the document, language etc.

user can configure the status bar by right-clicking anywhere on it and by selecting or deselecting options from the provided list

File Tab

The File tab replaces the Office button from Excel 2010. user can click it to check the Backstage view, where user come to open or save files, create new sheets, print a sheet, and do other file-related operations.

Quick Access Toolbar

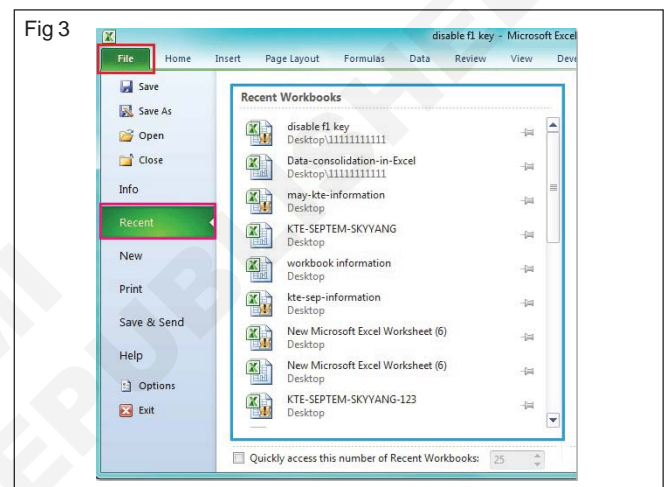
The File tab and its purpose is to provide a convenient resting place for the Excel's most frequently used commands. And customize this toolbar based on the comfort.

Dialog Box Launcher

This appears as a very small arrow in the lower-right corner of many groups on the Ribbon. Clicking this button opens a dialog box or task pane that provides more options about the group.

If already have an opened sheet then it will display a window showing the

details about the opened sheet as shown Fig 4. Backstage view shows three columns when select most of the available options in the first column.



First column of the backstage view will have the following options as shown in Table 1.

Table 1

| Option | Description |
|-------------|--|
| Save | If an existing sheet is opened, it would be saved as is, otherwise it will display a dialogue box asking for the sheet name. |
| Save As | A dialogue box will be displayed asking for sheet name and sheet type. By default, it will save in sheet 2010 format with extension .xlsx. |
| Open | This option is used to open an existing excel sheet. |
| Close | This option is used to close an opened sheet. |
| Info | This option displays the information about the opened sheet. |
| Recent | This option lists down all the recently opened sheets. |
| New | This option is used to open a new sheet. |
| Print | This option is used to print an opened sheet. |
| Save & Send | This option saves an opened sheet and displays options to send the sheet using email etc. |
| Help | You can use this option to get the required help about excel 2010. |
| Options | Use this option to set various option related to excel 2010. |
| Exit | Use this option to close the sheet and exit. |

Sheet Information

When click Info option available in the first column, it displays the following information in the second column of the backstage view:

Compatibility Mode: If the sheet is not a native excel 2007/2010 sheet, a Convert button appears here, enabling to easily update its format. Otherwise, this category does not appear.

Permissions: This option used to protect the excel sheet. And can set a password so that nobody can open the sheet, or lock the sheet so that nobody can edit the sheet.

Prepare for Sharing: This section highlights important information should know about the sheet before send it to others, such as a record of the edits the made as developed the sheet.

Versions: If the sheet has been saved several times, and may be able to access previous versions of it from this section.

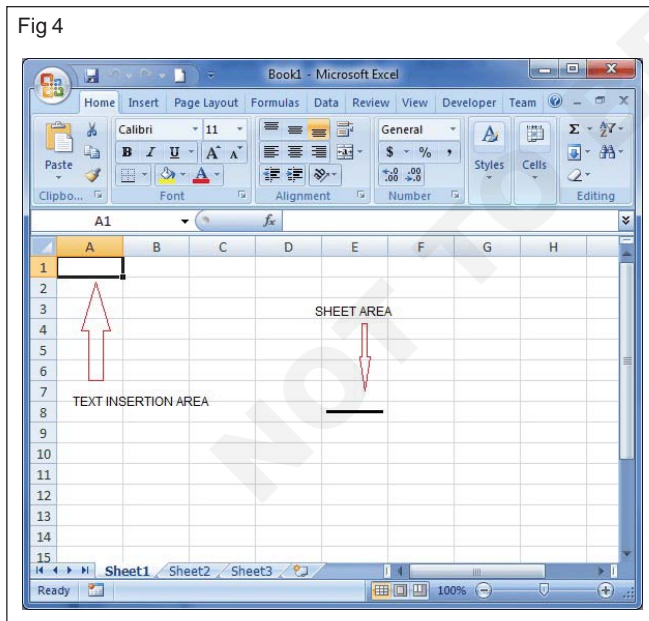
Sheet Properties

When click Info option available in the first column, it displays various properties in the third column of the backstage view. These properties include sheet size, title, tags, categories etc.

user can also edit various properties. Just try to click on the property value and if property is editable, then it will display a text box where can add the text like title, tags, comments, Author.

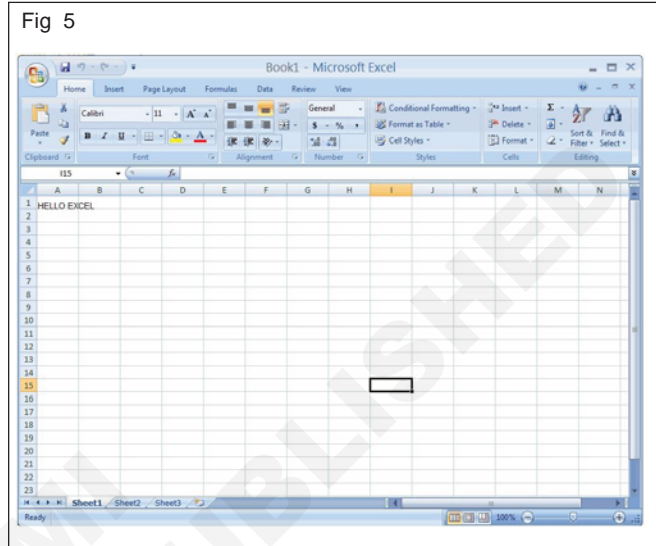
Entering values

A new sheet is displayed by default when open an excel sheet as shown in the Fig 4 screen shot.



Sheet area is the place of type the text. The flashing vertical bar is called the insertion point and it represents the location where text will appear when type. When click on a box then the box is highlighted. When double click the box, the flashing vertical bar appears and can start entering the data.

So, just keep the mouse cursor at the text insertion point and start typing whatever text would like to type. We have typed only two words "HelloExcel" as shown Fig 5. The text appears to the left of the insertion point.



There are following three important points, which would help while typing:

- Press Tab to go to next column.
- Press Enter to go to next row.
- Press Alt + Enter to enter a new line in the same column.

Move Around in Excel 2010

Excel provides a number of ways to move around a sheet using the mouse and the keyboard.

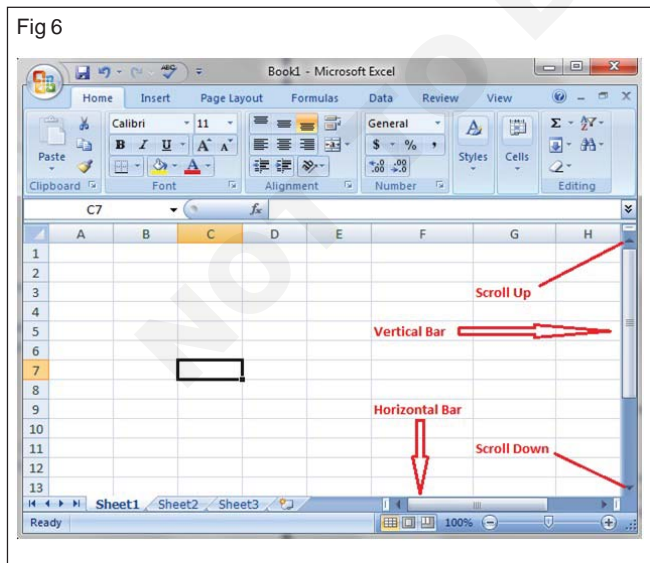
First of all, let us create some sample text before we proceed. Open a new excel sheet and type any data. A sample data table as shown table-2.

Table - 2

| OrderDate | Region | Rep | Item | Units | Unit Cost | Total |
|-----------|---------|----------|--------|-------|-----------|----------|
| 1/6/2010 | East | Jones | Pencil | 95 | 1.99 | 189.05 |
| 1/23/2010 | Central | Kivell | Binder | 50 | 19.99 | 999.5 |
| 2/9/2010 | Central | Jardine | Pencil | 36 | 4.99 | 179.64 |
| 2/26/2010 | Central | Gill | Pen | 27 | 19.99 | 539.73 |
| 3/15/2010 | West | Sorvino | Pencil | 56 | 2.99 | 167.44 |
| 4/1/2010 | East | Jones | Binder | 60 | 4.99 | 299.4 |
| 4/18/2010 | Central | Andrews | Pencil | 75 | 1.99 | 149.25 |
| 5/5/2010 | Central | Jardine | Pencil | 90 | 4.99 | 449.1 |
| 5/22/2010 | West | Thompson | Pencil | 32 | 1.99 | 63.68 |
| 6/8/2010 | East | Jones | Binder | 60 | 8.99 | 539.4 |
| 6/25/2010 | Central | Morgan | Pencil | 90 | 4.99 | 449.1 |
| 7/12/2010 | East | Howard | Binder | 29 | 1.99 | 57.71 |
| 7/29/2010 | East | Parent | Binder | 81 | 19.99 | 1,619.19 |
| 8/15/2010 | East | Jones | Pencil | 35 | 4.99 | 174.65 |

Moving with Mouse

Mouse can easily move the insertion point by clicking in the text anywhere on the screen. Sometime if the sheet is big then user cannot see a place need to move. In such situations, to use the scroll bars, as shown Fig 6 screen shot.



user can scroll the sheet by rolling mouse wheel, which is equivalent to clicking the up-arrow or down-arrow buttons in the scroll bar.

Moving with Scroll Bars

As shown in the above screen capture, there are two scroll bars: one for moving vertically within the sheet, and one for moving horizontally. Using the vertical scroll bar, user may?

- Move upward by one line by clicking the upward-pointing scroll arrow.
- Move downward by one line by clicking the downward-pointing scroll arrow.
- Move one next page, using next page button (footnote).
- Move one previous page, using previous page button (footnote).
- Use Browse Object button to move through the sheet, going from one chosen object to the next.

Moving with Keyboard

The following keyboard commands, used for moving around your sheet, also move the insertion point . (Table 3 & 4)

Table - 3

| Keystroke | Where the Insertion Point Moves |
|-----------|--|
| → | Forward one box |
| ← | Back one box |
| ↑ | Up one box |
| ↓ | Down one box |
| PageUp | To the previous screen |
| PageDown | To the next screen |
| Home | To the beginning of the current screen |
| End | To the end of the current screen |

User can move box by box or sheet by sheet. Now click in any box containing data in the sheet. It would have to hold down the Ctrl key while pressing an arrow key, which moves the insertion point as described here -

Table - 4

| Key Combination | Where the Insertion Point Moves |
|------------------|---|
| Ctrl + → | To the last box containing data of the current row. |
| Ctrl + ← | To the first box containing data of the current row. |
| Ctrl + ↑ | To the first box containing data of the current column. |
| Ctrl + ↓ | To the last box containing data of the current column. |
| Ctrl + Page Up | To the sheet in the left of the current sheet. |
| Ctrl + Page Down | To the sheet in the right of the current sheet. |
| Ctrl + Home | To the beginning of the sheet. |
| Ctrl + End | To the end of the sheet. |

Moving with Go To Command

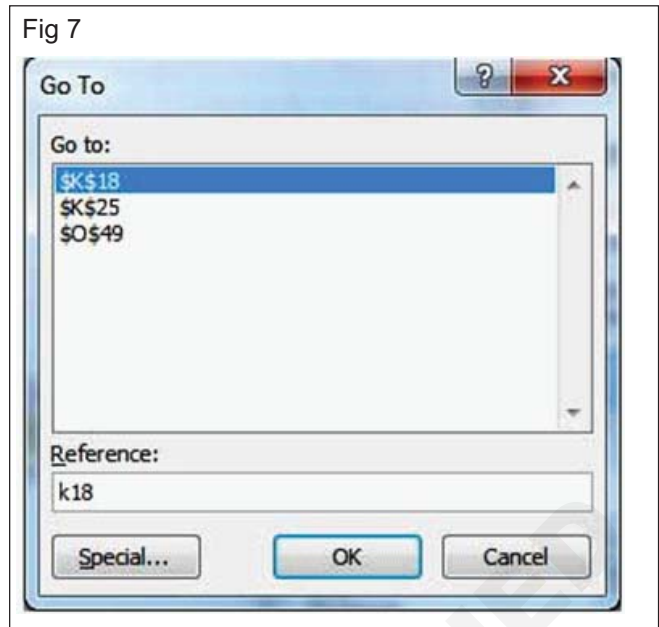
Press F5 key to use Go To command as shown in Fig 7, which will display a dialogue box contains various options to reach to a particular box.

Normally, we use row and column number, for example K5 and finally press Go To button.

Conditional Formatting

MS Excel 2010 Conditional Formatting feature enables to format a range of values so that the values outside certain limits, are automatically formatted.

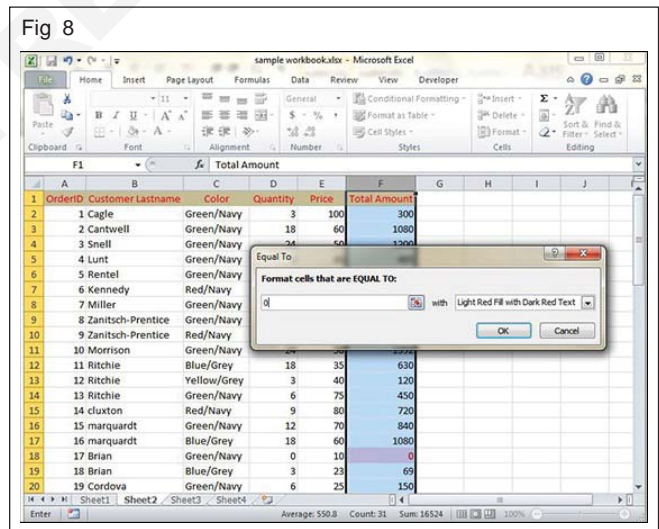
Choose Home Tab " Style group " Conditional Formatting dropdown.



Various Conditional Formatting Options

- Highlight Cells Rules ? It opens a continuation menu with various options for defining the formatting rules that highlight the cells in the cell selection that contain certain values, text, or dates, or that have values greater or less than a particular value, or that fall within a certain ranges of values.

Suppose to find cell with Amount 0 and Mark them as red. Choose Range of cell " Home Tab " Conditional Formatting DropDown " Highlight Cell Rules " Equal To as on Fig 8.

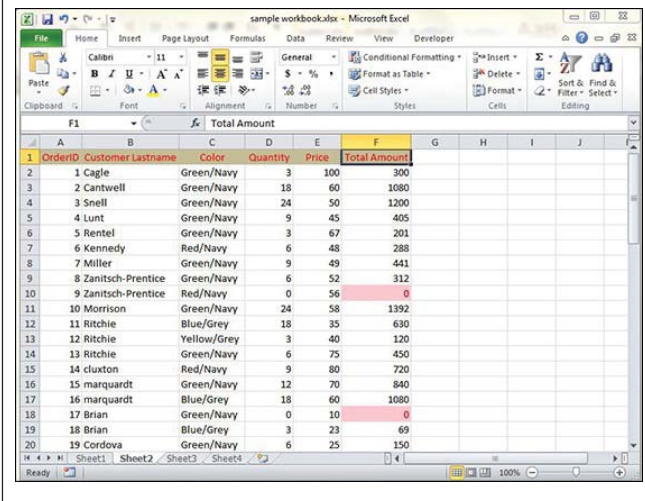


After Clicking ok, the cells with value zero are marked as red as shown in Fig 9.

- **Top/Bottom Rules:** It opens a continuation menu with various options for defining the formatting rules that highlight the top and bottom values, percentages, and above and below average values in the cell selection.

Suppose want to highlight the top 10% rows user can do this with these Top/Bottom rules as shown in Fig 10.

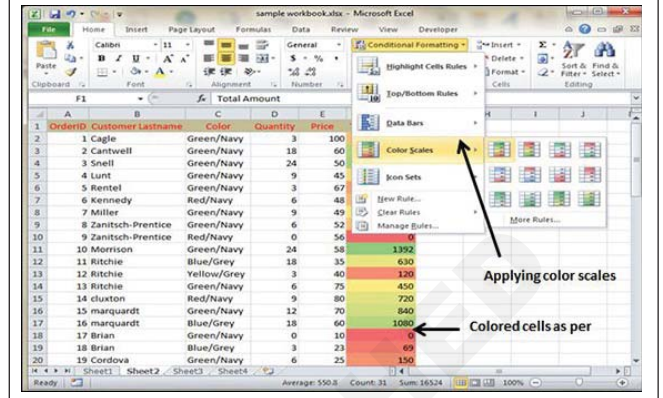
Fig 9



With this conditional Formatting data Bars will appear in each cell.

- **Color Scales (Fig 12):** It opens a palette with different three- and two-colored scales that can apply to the cell selection to indicate their values relative to each other by clicking the color scale thumbnail.

Fig 12



See the below screenshot with Color Scales, conditional formatting applied.

- **Icon Sets (Fig 13)?** It opens a palette with different sets of icons that can apply to the cell selection to indicate their values relative to each other by clicking the icon set.

Fig 10

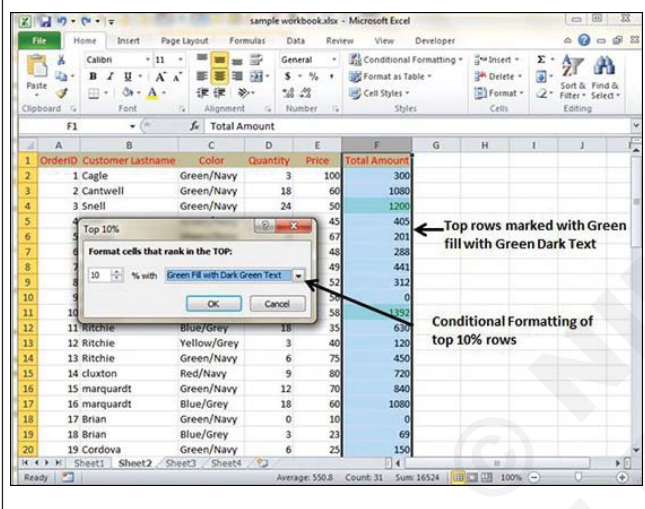
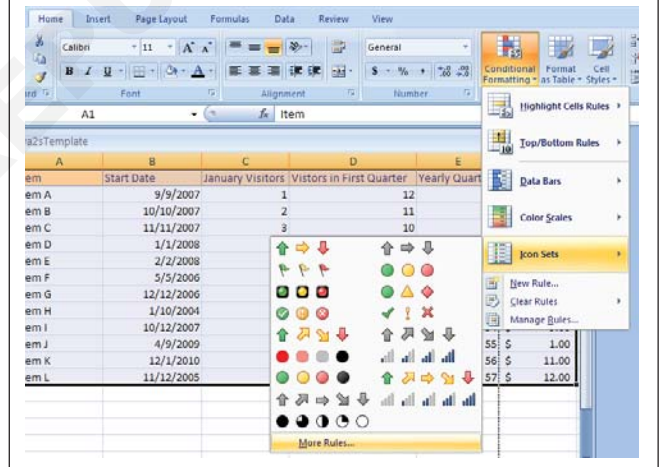
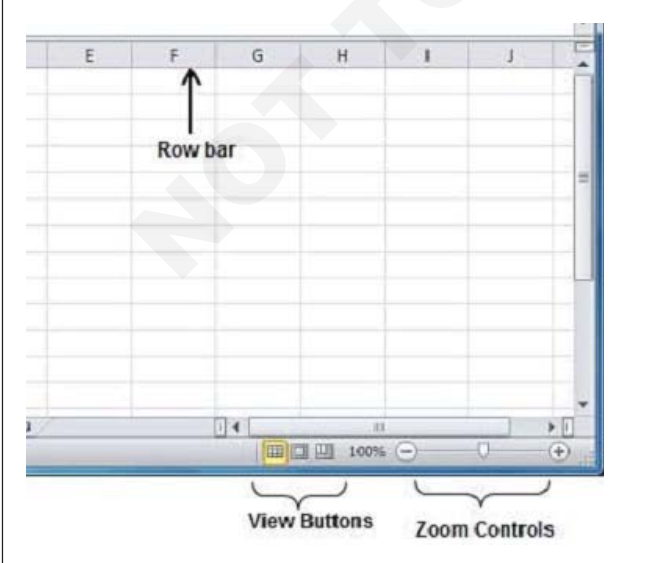


Fig 13



- **Data Bars (Fig 11):** It opens a palette with different color data bars that can apply to the cell selection to indicate their values relative to each other by clicking the data bar thumbnail.

Fig 11



See the below screenshot with Icon Sets conditional formatting applied.

- **New Rule:** It opens the New Formatting Rule dialog box, where define a custom conditional formatting rule to apply to the cell selection.

- **Clear Rules:** It opens a continuation menu, where can remove the conditional formatting rules for the cell selection by clicking the Selected Cells option, for the entire worksheet by clicking the Entire Sheet option, or for just the current data table by clicking the This Table option.

- **Manage Rules:** It opens the Conditional Formatting Rules Manager dialog box, edit and delete particular rules as well as adjust their rule precedence by moving them up or down in the Rules list box.

Link Excel Spreadsheet Data: Microsoft Excel provides the ability for cells in one worksheet to be linked to cells in one or more other worksheets. This is a great productivity tool and can reduce the need for additional worksheets!

Linking Excel Worksheet Data Overview: In Excel, a link is a formula that dynamically pulls in data from a cell in another worksheet. The worksheet can be in the same workbook or a different workbook.

The destination worksheet is the worksheet that contains the link formula. The worksheet containing the data that will be brought in is called the source worksheet.

Any time the cell value in the source worksheet changes, the cell containing the link formula will be updated as well the next time the spreadsheet containing the link formula is opened. This is just one of many reasons the Excel software program is so powerful.

Need for Linking Spreadsheet Data

The ability to create links often eliminates the need to have identical data entered and updated in multiple sheets. This saves time, reduces errors, and improves data integrity. For example, a company's prices can be stored in a 'Master Price List' worksheet, and others needing pricing data can link to that worksheet.

Consider a Sales Manager who has a detailed spreadsheet for each salesperson, but would like a summary sheet to compare salespersons' performance and create grand totals. The summary sheet (destination) would bring in data from all the salespersons' sheets (source).

Create the Worksheet Link

Before creating the link, format the cell containing the link formula in the destination worksheet to equal the format of the source data.

For example, if the data from the source spreadsheet is currency with 2 decimal points, then first format the target cell for currency with 2 decimal places.

METHOD ONE

- 1 In the source worksheet, select the cell need to link to and click the Copy button on the Home tab. Or press Ctrl+C, or right-click and select Copy.
- 2 Switch to the destination spreadsheet and click the cell want to link. Then, depending on the version of Excel:
 - Excel 2007, 2010, and 2013: On the Home tab, click the down arrow below Paste and click Paste Link. In newer versions also right-click and select the Paste Link from the Paste menu.
 - Excel 2003 and older versions: On the Edit menu, click Paste Special, and then click Paste Link.
3. Return to the source worksheet and press ESC to remove the animated border around the cell.

METHOD TWO

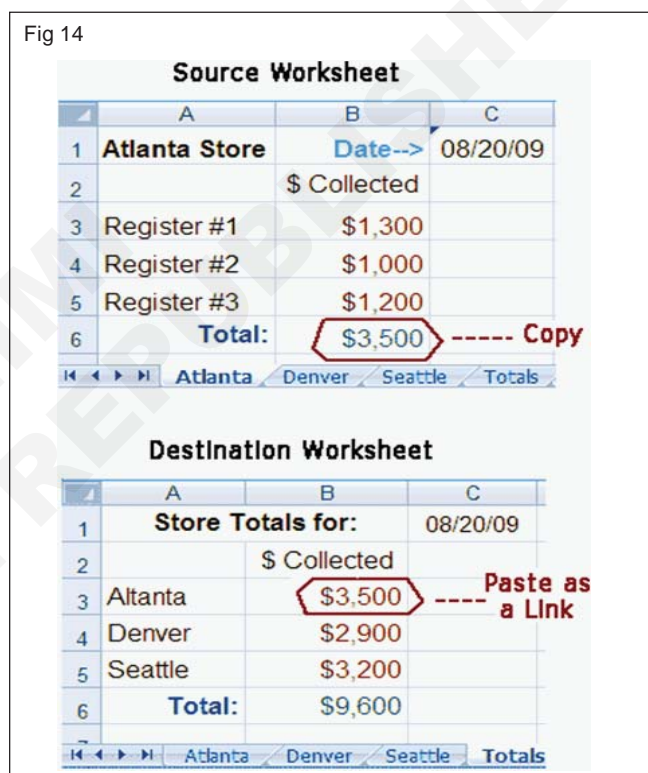
This is a fast method that works in a different order than Method One.

- 1 In the destination worksheet cell that will contain the link formula, enter an equal sign (=).
- 2 In the source worksheet, click in the cell that contains the data and press the Enter key.

Link Formula Example (Fig 14)

In the example below, using Method One, we click in cell B6 in the source worksheet and click Copy. Then, on the destination worksheet, we click in cell B3, and paste the link. The value (\$3,500) automatically displays.

Follow the same steps to link the data from the Denver and Seattle worksheets to the Store Totals worksheet. And first formatted the cells to display the data as Currency. (Fig 14)



Formulas in MS Excel

Formula, worksheet will be just simple tabular representation of data. A formula consists of special code, which is entered into a cell. It performs some calculations and returns a result, which is displayed in the cell.

Formulas use a variety of operators and worksheet functions to work with values and text. The values and text used in formulas can be located in other cells, which makes changing data easy and gives worksheets their dynamic nature. For example, it can quickly change the data in a worksheet and formulas works.

Elements of Formulas

A formula can consist of any of these elements ?

- **Mathematical operators, such as +(for addition) and *(for multiplication)**

Example -

=A1+A2 Adds the values in cells A1 and A2.

- **Values or text**

Example -

=200*0.5 Multiplies 200 times 0.5. This formula uses only values, and it always returns the same result as 100.

- **Cell references (including named cells and ranges)**

Example -

=A1=C12 Compares cell A1 with cell C12. If the cells are identical, the formula returns TRUE; otherwise, it returns FALSE.

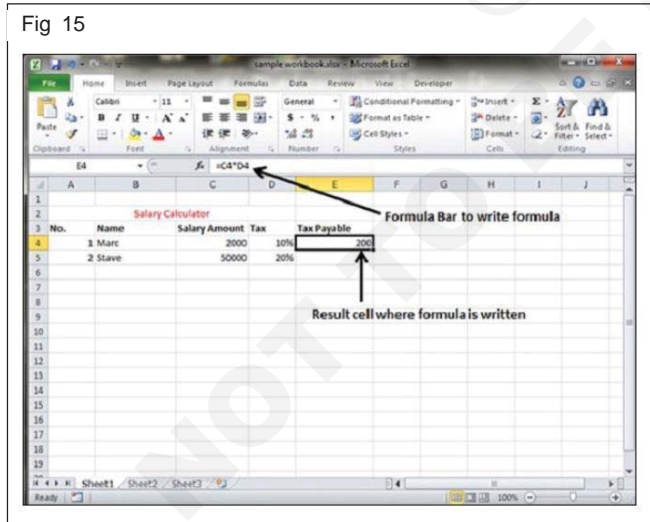
- **Worksheet functions (such as SUM or AVERAGE)**

Example -

=SUM(A1:A12) Adds the values in the range A1:A12.

Creating Formula

For creating a formula need to type in the Formula Bar. Formula begins with '=' sign. When building formulas manually, and can either type in the cell addresses or can point to them in the worksheet. Using the Pointing method to supply the cell addresses for formulas is often easier and more powerful method of formula building. When using built-in functions, to click the cell or drag through the cell range that want to use when defining the function's arguments in the Function Arguments dialog box as shown in Fig 15.



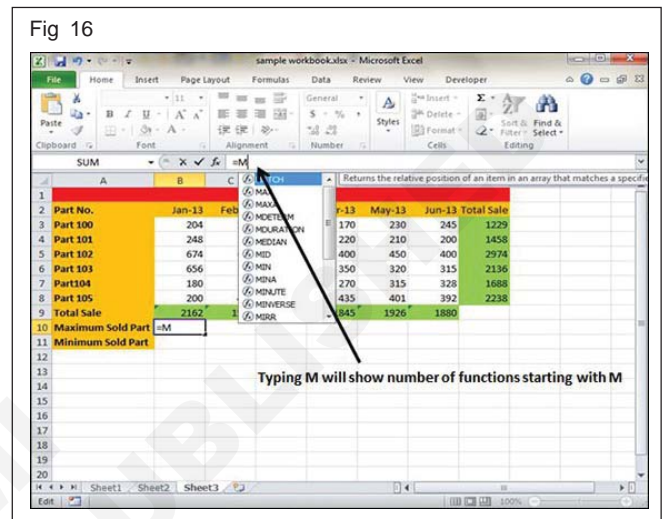
As soon as complete a formula entry, Excel calculates the result, which is then displayed inside the cell within the worksheet (the contents of the formula, however, continue to be visible on the Formula bar anytime the cell is active). If you make an error in the formula that prevents Excel from being able to calculate the formula at all, Excel displays an Alert dialog box suggesting how to fix the problem.

Functions in Formula

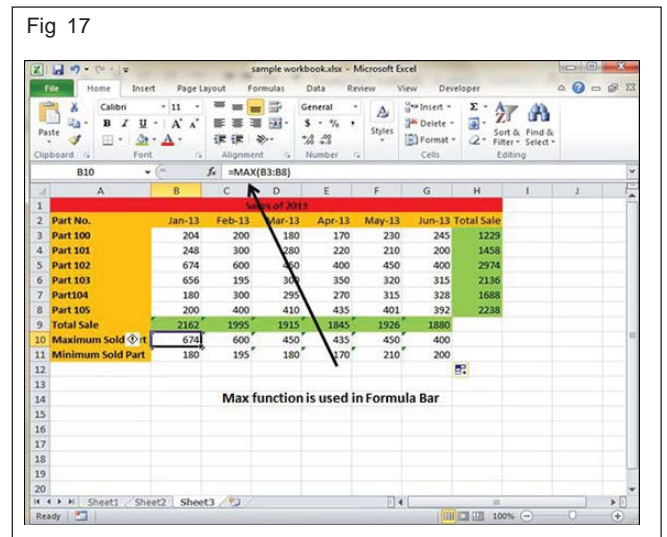
Many formulas are create use available worksheet functions. These functions enable to greatly enhance the power of the formulas and perform calculations that are difficult if use only the operators. For example, and can use the LOG or SIN function to calculate the Logarithm or Sin ratio. And cannot do this complicated calculation by using the mathematical operators alone.

Using Functions

When type = sign and then type any alphabet the searched functions will show Fig 16.

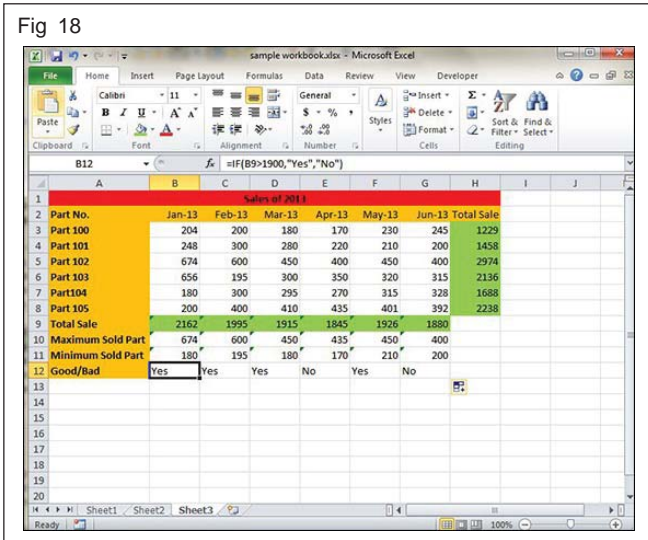


Suppose need to determine the largest value in a range. A formula can't tell the answer without using a function. We will use formula that uses the MAX function to return the largest value in the range B3:B8 as = MAX (A1:D100) as shown in Fig 17.



Another example of functions. Suppose to find if the cell of month is greater than 1900 then we can give Bonus to Sales representative. The we can achieve it with writing formula with IF functions as =IF(B9>1900,"Yes","No") as shown in Fig 18.

Fig 18



Function Arguments

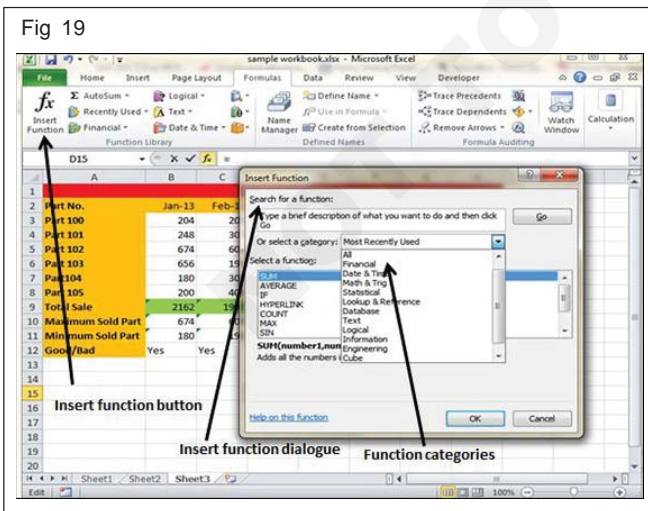
In the above examples, notice that all the functions used parentheses. The information inside the parentheses is the list of arguments.

Functions vary in how they use arguments. Depending on what it has to do, a function may use.

- **No arguments** - Examples ? Now(), Date(), etc.
- **One argument** - UPPER(), LOWER(), etc.
- **A fixed number of arguments** - IF(), MAX(), MIN(), AVERAGE(), etc.
- **Infinite number of arguments**
- **Optional arguments**

Built In Functions

MS Excel has many built in functions, which we can use in our formula. To see all the functions by category, choose Formulas Tab " Insert Function as shown in Fig 19. Then Insert function Dialog appears from which we can choose the function.



Functions by Categories

Let us see some of the built in functions in MS Excel.

Text Functions

LOWER: Converts all characters in a supplied text string to lower case

UPPER : Converts all characters in a supplied text string to upper case

TRIM : Removes duplicate spaces, and spaces at the start and end of a text string

CONCATENATE : Joins together two or more text strings.

LEFT : Returns a specified number of characters from the start of a supplied text string.

MID : Returns a specified number of characters from the middle of a supplied text string

RIGHT : Returns a specified number of characters from the end of a supplied text string.

LEN: Returns the length of a supplied text string

FIND: Returns the position of a supplied character or text string from within a supplied text string (case-sensitive).

Date & Time

DATE: Returns a date, from a user-supplied year, month and day.

TIME: Returns a time, from a user-supplied hour, minute and second.

DATEVALUE: Converts a text string showing a date, to an integer that represents the date in Excel's date-time code.

TIMEVALUE: Converts a text string showing a time, to a decimal that represents the time in Excel.

NOW: Returns the current date & time.

TODAY: Returns today's date.

Statistical

MAX: Returns the largest value from a list of supplied numbers.

MIN: Returns the smallest value from a list of supplied numbers.

AVERAGE: Returns the Average of a list of supplied numbers.

COUNT: Returns the number of numerical values in a supplied set of cells or values.

COUNTIF: Returns the number of cells (of a supplied range), that satisfies a given criteria.

SUM: Returns the sum of a supplied list of numbers

Logical

AND: Tests a number of user-defined conditions and returns TRUE if ALL of the conditions evaluate to TRUE, or FALSE otherwise

OR: Tests a number of user-defined conditions and returns TRUE if ANY of the conditions evaluate to TRUE, or FALSE otherwise.

NOT: Returns a logical value that is the opposite of a user supplied logical value or expression i.e. returns FALSE if the supplied argument is TRUE and returns TRUE if the supplied argument is FALSE

Math & Trig

ABS: Returns the absolute value (i.e. the modulus) of a supplied number.

SIGN: Returns the sign (+1, -1 or 0) of a supplied number.

SQRT: Returns the positive square root of a given number.

MOD: Returns the remainder from a division between two supplied numbers.

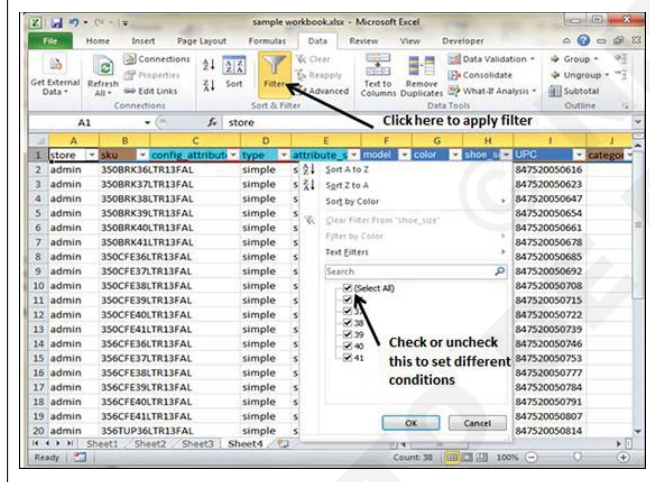
Filters in MS Excel

Filtering data in MS Excel refers to displaying only the rows that meet certain conditions. (The other rows gets hidden.)

Using the store data, if user interested in seeing data where Shoe Size is 36, then set filter to do this. Follow the below mentioned steps to do this.

- Place a cursor on the Header Row.
- Choose **Data Tab > Filter** to set filter as shown in Fig 20.

Fig 20



- Click the drop-down arrow in the Area Row Header and remove the check mark from Select All, which unselects everything.
- Then select the check mark for Size 36 which will filter the data and displays data of Shoe Size 36 as shown in Fig 21.
- Some of the row numbers are missing; these rows contain the filtered (hidden) data.
- There is drop-down arrow in the Area column now shows a different graphic - an icon that indicates the column is filtered. (Fig 21)

Using Multiple Filters (Fig 22)

Filtering of records by multiple conditions i.e. by multiple column values. Suppose after size 36 is filtered, need to

have the filter where color is equal to Coffee. After setting filter for Shoe Size, choose Color column and then set filter for color. (Fig 22)

Fig 21

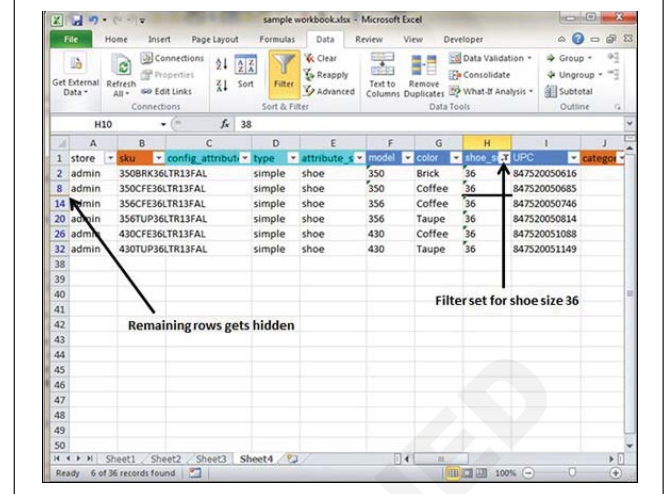
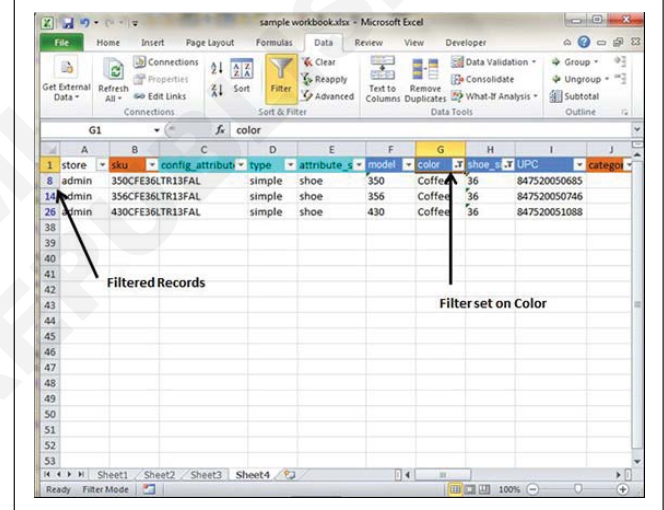


Fig 22



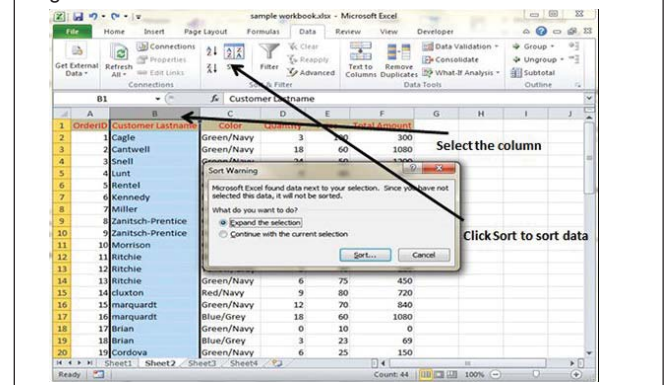
Sorting in MS Excel

Sorting data in MS Excel rearranges the rows based on the contents of a particular column. sort a table to put names in alphabetical order Or sort data by Amount from smallest to largest or largest to smallest.

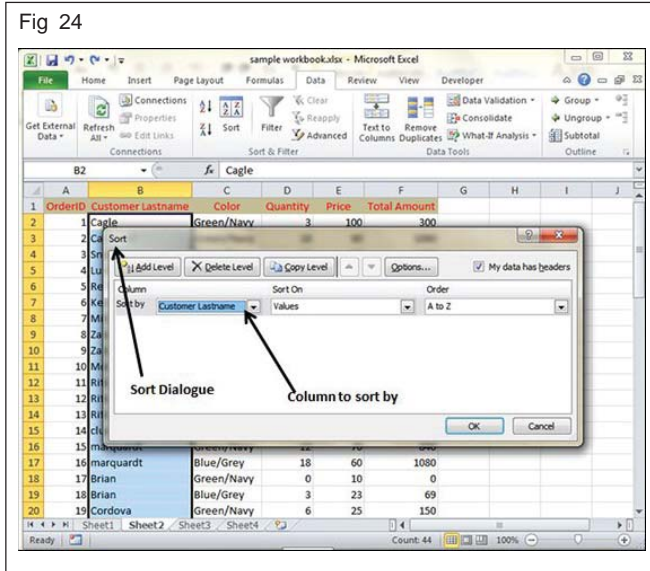
To Sort the data follow the steps mentioned below.

- Select the Column to sort data as on Fig 23.

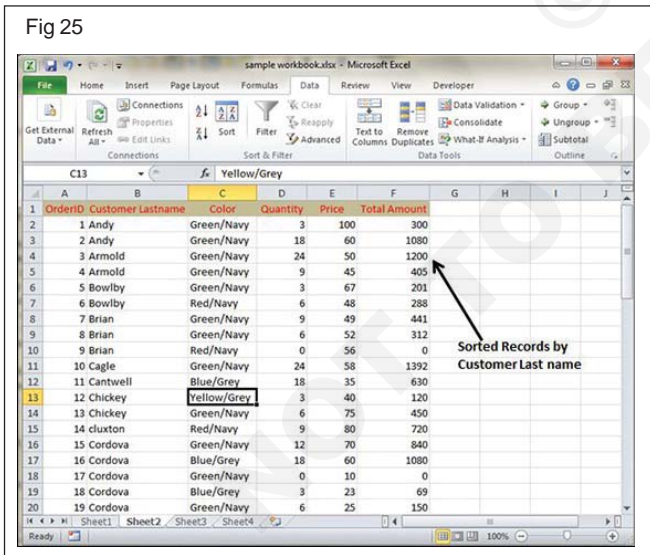
Fig 23



- Choose Data Tab " Sort Below dialog appears.
- If the user sort data based on a selected column, Choose Continue with the selection or if the data sorting based on other columns, choose Expand Selection.
- Sort the data based on the below Conditions as on Fig 24.



- **Values** - alphabetically or numerically.
- **Cell Color** - Based on Color of Cell.
- **Font Color** - Based on Font color.
- **Cell Icon** - Based on Cell Icon.
- Clicking Ok will sort the data as on Fig 25.

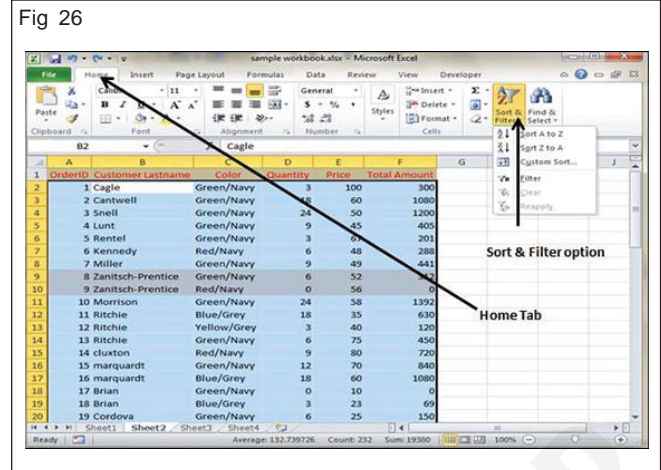


Sorting option is also available from the Home Tab. Choose Home Tab " Sort & Filter. You can see the same dialog to sort records as on Fig 26.

Ranges in MS Excel

A cell is a single element in a worksheet that can hold a value, some text, or a formula. A cell is identified by its address, which consists of its column letter and row

number. For example, cell B1 is the cell in the second column and the first row.

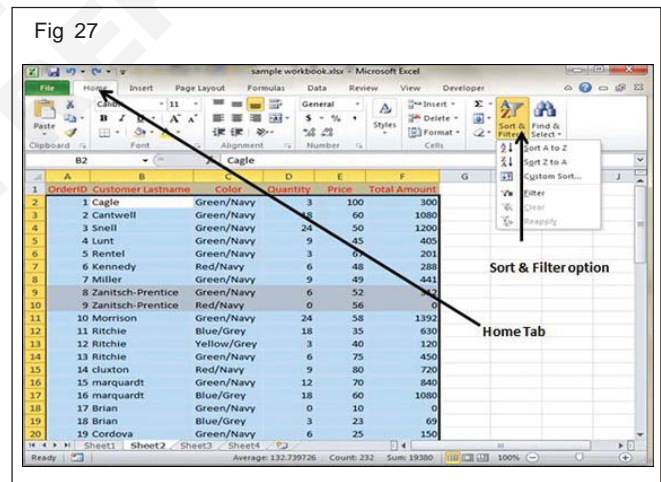


A group of cells is called a range. You designate a range address by specifying its upper-left cell address and its lower-right cell address, separated by a colon.

Example of Ranges:

- **C24** - A range that consists of a single cell.
- **A1:B1** - Two cells that occupy one row and two columns.
- **A1:A100** - 100 cells in column A.
- **A1:D4** - 16 cells (four rows by four columns).

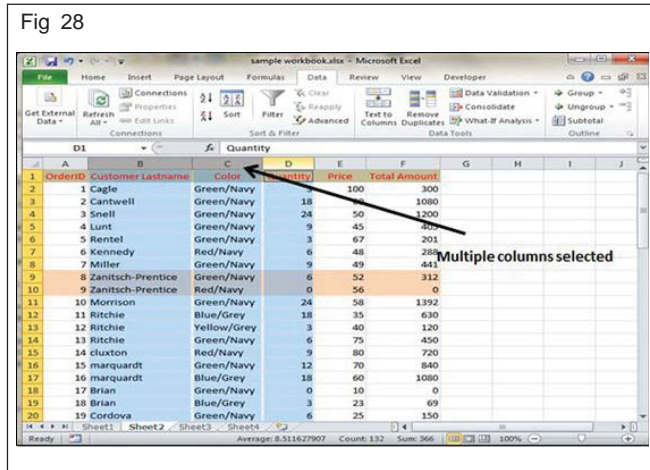
Selecting Ranges (Fig 27)



Selecting a range in several ways ?

- Press the left mouse button and drag, highlighting the range. Then release the mouse button. If drag to the end of the screen, the worksheet will scroll.
- Press the Shift key while uses the navigation keys to select a range.
- Press F8 and then move the cell pointer with the navigation keys to highlight the range. Press F8 again to return the navigation keys to normal movement.
- Type the cell or range address into the Name box and press Enter. Excel selects the cell or range that specified. (Fig 27)

Selecting Complete Rows and Columns (Fig 28)



When user need to select an entire row or column and can select entire rows and columns in much the same manner as select ranges:

- Click the row or column border to select a single row or column.

- To select multiple adjacent rows or columns, click a row or column border and drag to highlight additional rows or columns.
- To select multiple (nonadjacent) rows or columns, press Ctrl while click the row or column borders. (Fig 28)

Create or change a cell reference

A cell reference refers to a cell or a range of cells on a worksheet and can be used in a formula so that Microsoft Office Excel can find the values or data that you want that formula to calculate.

In one or several formulas, you can use a cell reference to refer to:

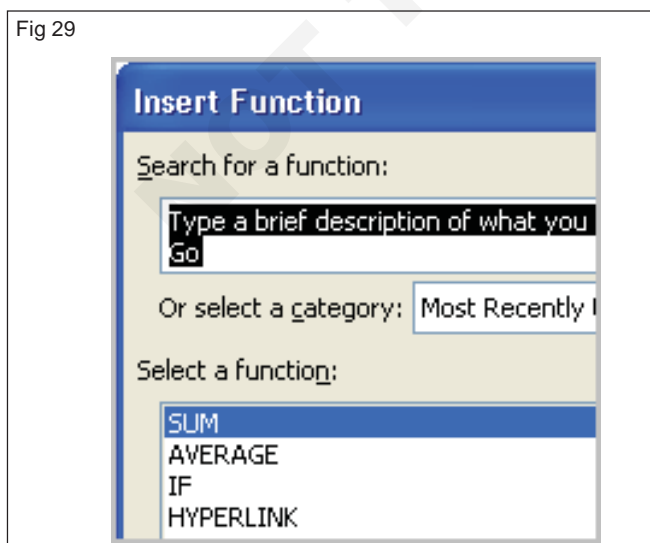
- Data from one or more contiguous cells on the worksheet.
- Data contained in different areas of a worksheet.
- Data on other worksheets in the same workbook. (Table 5)

Table - 5

| This formula: | Refers to: | And Returns: |
|------------------|--|---|
| =C2 | Cell C2 | The value in cell C2. |
| =A1:F4 | Cells A1 through F4 | The values in all cells, but you must press Ctrl+Shift+Enter after you type in your formula. Note: This functionality doesn't work in Excel for the web. |
| =Asset-Liability | The cells named Asset and Liability | The value in the cell named Liability subtracted from the value in the cell named Asset. |
| {=Week1+Week2} | The cell ranges named Week1 and Week 2 | The sum of the values of the cell ranges named Week1 and Week 2 as an array formula. |
| =Sheet2!B2 | Cell B2 on Sheet 2 | The value in cell B2 on Sheet2. |

Use of function

Introduction



A **function is a predefined formula** that performs calculations using specific values in a particular order. While you may think of formulas as being short mathematical equations, like 2+2 or F2*C2, they can actually be very lengthy and involve complex mathematical calculations.

One of the key benefits of functions is that they can save you time because you do not have to write the formula yourself. For example, you could use an Excel function called **Average** to quickly find the average of a range of numbers or the **Sum** function to find the sum of a cell range. (Fig 29)

In this lesson, you will learn how to use basic functions such as SUM and AVERAGE, use functions with more than one argument, and access other Excel 2007 functions.

Basic functions

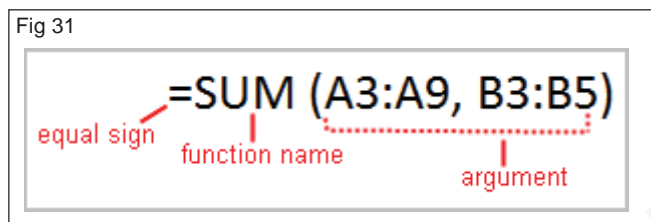
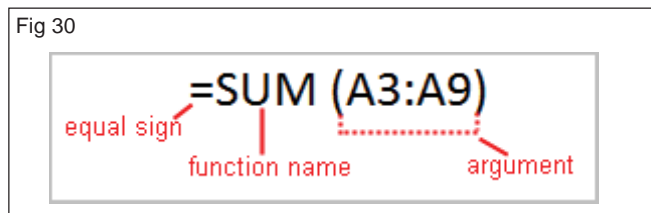
Download the **example** to work along with the video.

The parts of a function:

Each function has a specific order, called **syntax**, which must be strictly followed for the function to work correctly.

Syntax order:

- 1 All functions begin with the = sign.
- 2 After the = sign, define the **function name** (e.g., Sum).
- 3 Then there will be an **argument**. An argument is the cell range or cell references that are enclosed by parentheses. If there is more than one argument, separate each by a comma. (Fig 30 & 31)



An example of a function with one argument that adds a range of cells, A3 through A9:

An example of a function with **more than one argument** that calculates the sum of two cell ranges:

Excel literally has hundreds of different **functions** to assist with your calculations. Building formulas can be difficult and time consuming. Excel's functions can save you a lot of time and headaches.

Excel's different functions

There are many different functions in Excel 2007. Some of the more common functions include:

Statistical functions:

- **SUM**: Adds a range of cells together
- **AVERAGE**: Calculates the average of a range of cells
- **COUNT**: Counts the number of chosen data in a range of cells
- **MAX**: Identifies the largest number in a range of cells
- **MIN**: Identifies the smallest number in a range of cells

Financial functions:

- Interest rates
- Loan payments
- Depreciation amounts

Date and time functions:

- **DATE**: Converts a serial number to a day of the month
- **Day of Week**
- **DAYS 360**: Calculates the number of days between two dates based on a 360-day year
- **TIME**: Returns the serial number of a particular time
- **HOURL**: Converts a serial number to an hour
- **MINUTE**: Converts a serial number to a minute
- **TODAY**: Returns the serial number of today's date
- **MONTH**: Converts a serial number to a month
- **YEAR**: Converts a serial number to a year

You don't have to memorize the functions, but you should have an idea of what each can do for you.

To calculate the sum of a range of data using AutoSum:

- Select the **Formulas** tab.
- Locate the **Function Library** group. From here, you can access all available functions.
- Select the cell where you want the function to appear. In this example, select G42.
- Select the drop-down arrow next to the **AutoSum** command.
- Select **Sum**. A formula will appear in the selected cell, G42.
 - This formula, `=SUM(G2:G41)`, is called a **function**. The AutoSum command automatically selects the range of cells from G2 to G41, based on where you inserted the function. You can alter the cell range if necessary.
- Press the **Enter key** or **Enter button** on the formula bar. The total will appear.

Excel **will not always tell you** if your formula contains an error, so it's up to you to check all of your formulas. To learn how to do this, read the **Double-Check Your Formulas** lesson from our **Excel Formulas** tutorial.

To edit a function:

- Select the cell where the **function is defined**.
- Insert the cursor in the formula bar.
- **Edit the range** by deleting and changing necessary cell numbers.
- Click the **Enter** icon.

To calculate the sum of two arguments (Fig 32)

- Select the **cell** where you want the **function to appear**—in this example, G44.
- Click the **Insert Function** command on the Formulas tab. A dialog box appears. (Fig 33)
- SUM is selected by default.

Fig 32

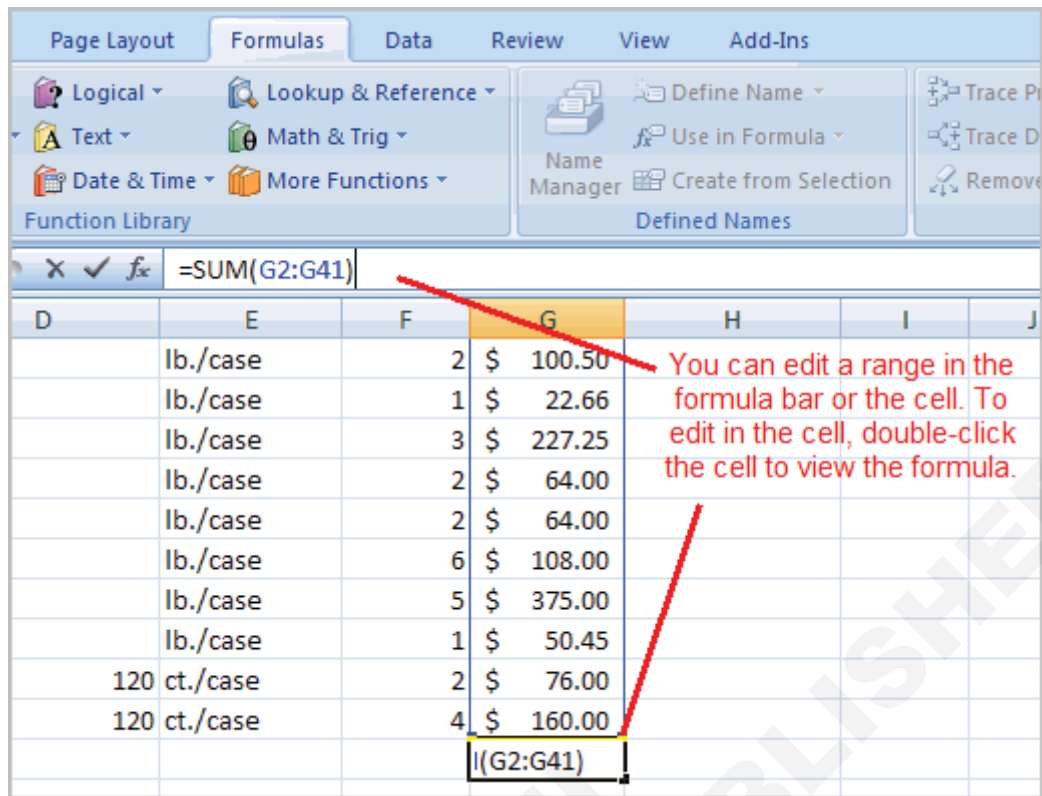
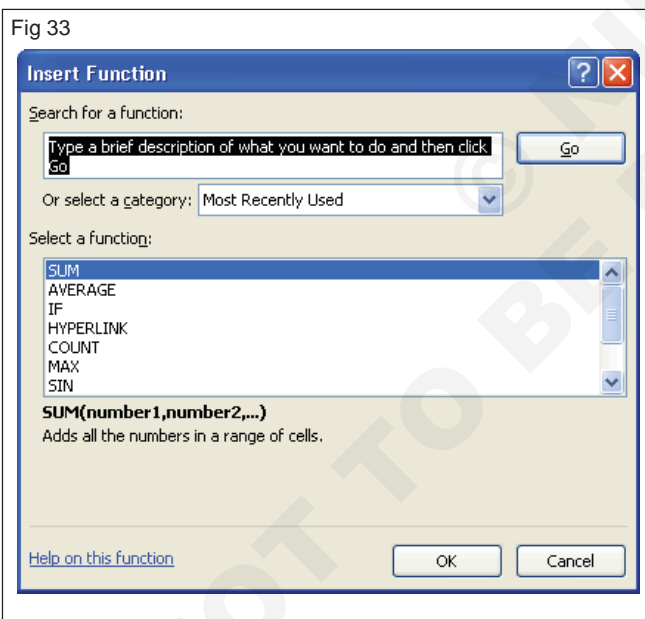


Fig 33



- Click **OK**, and the **Function Arguments** dialog box appears so you can enter the range of cells for the function. (Fig 34)
- Insert the cursor in the **Number 1** field.
- In the spreadsheet, select the **first range of cells**—in this example, G21 through G26. The argument appears in the Number 1 field.
 - To select the cells, **left-click cell G21** and **drag the cursor** to G26, then release the mouse button.
- Insert the cursor in the **Number 2** field.

- In the spreadsheet, select the **second range of cells**—in this example, G40 through G41. The argument appears in the Number 2 field.
- Notice that both arguments appear in the function in cell G44 and the formula bar when G44 is selected.
- Click **OK** in the dialog box, and the **sum of the two ranges** is calculated. (Fig 35)

To calculate the average of a range of data:

- Select the cell where you want the function to appear.
- Click the drop-down arrow next to the AutoSum command.
- Select Average.
- Click on the **first cell** (in this example, C8) to be included in the formula.
- Left-click and **drag** the mouse to define a cell range (C8 through cell C20, in this example).
- Click the **Enter** icon to calculate the average.

Accessing Excel 2007 functions

To access other functions in Excel

- Using the point-click-drag method, select a cell range to be included in the formula.
- On the Formulas tab, click the drop-down part of the **AutoSum** button.
- If you don't see the function you want to use (Sum, Average, Count, Max, Min), display additional functions by selecting **More Functions**.

Fig 34

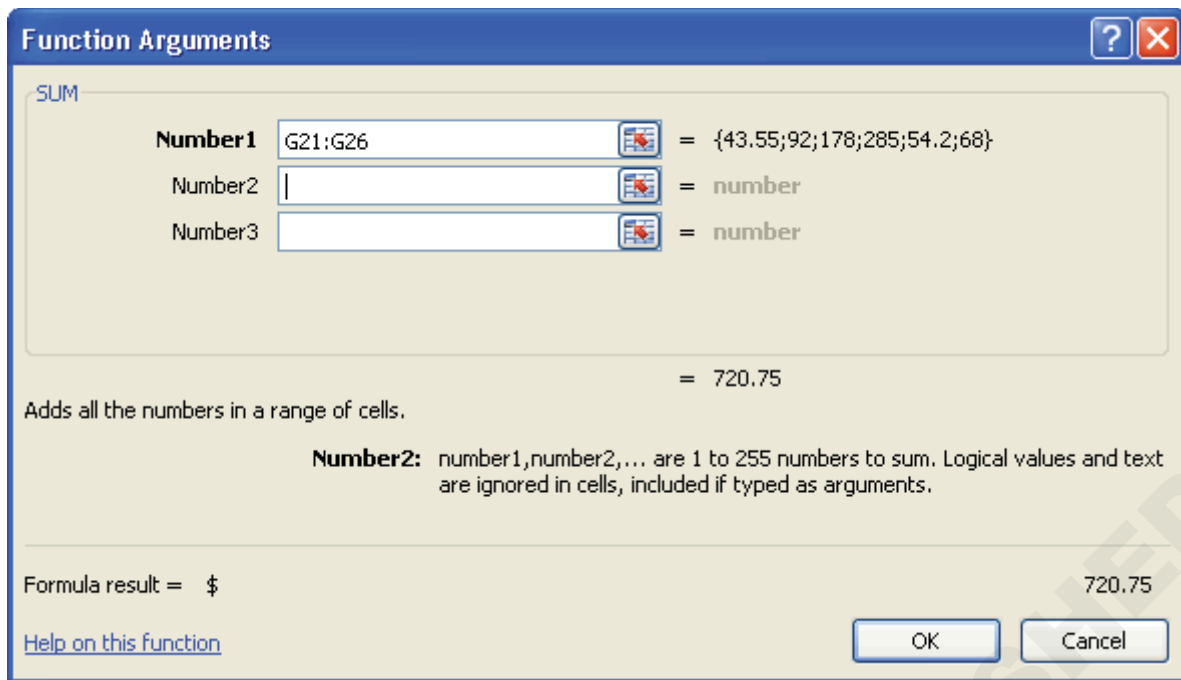
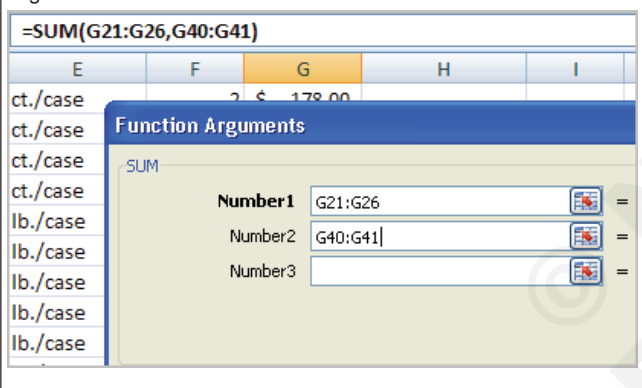


Fig 35

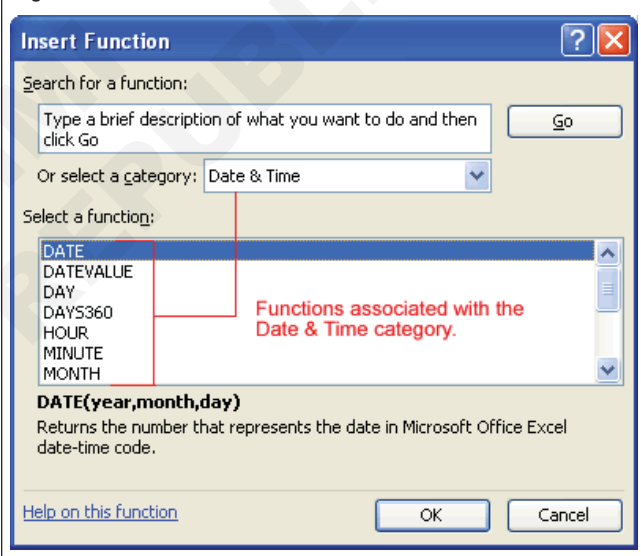


- The **Insert Function** dialog box opens. (Fig 36)
- There are three ways to locate a function in the **Insert Function** dialog box:
 - You can type a question in the **Search for a function box** and click **GO**.
 - You can scroll through the alphabetical list of functions in the **Select a function** field.
 - You can select a function category in the **Select a category** drop-down list and review the corresponding function names in the **Select a function** field.
- Select the function you want to use, then click the **OK** button.

Concepts of sorting ,Filtering and Validation

Managing MS Excel data is the everyday task to many accountants. I share to you how to use different Excel data tools, such as sorting, filtering and validation to help you working efficiently in front of thousands of rows in a spreadsheet.

Fig 36



Sorting Data (Fig 37)

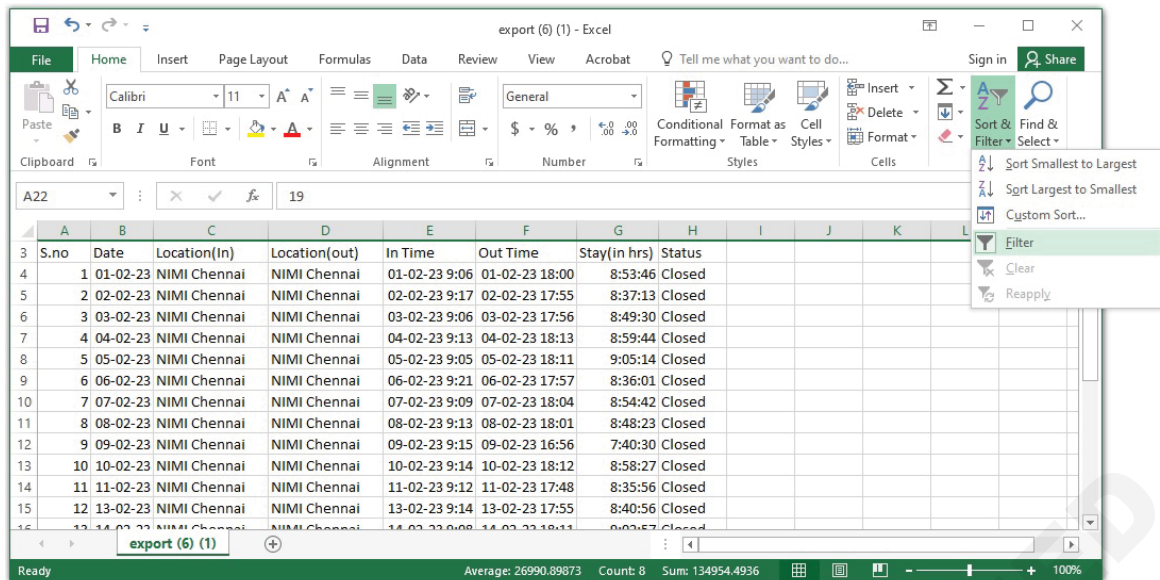
You can sort your data into different orders, using a single column or multiple columns. You access the Sort functions in the 'Sort & Filter' group of the ribbon.

First you need to select the range that you want to sort, which in this case is A1:E7

Excel will automatically detect that there are column headers and check the box for 'My data has headers' so that the headers do not form part of the sort. However, make sure that your header row is not included in the sort and that the headers box has been ticked.

You do not need to have a header row – in that case make sure that the headers box is unticked.

Fig 37



Sorting Function in Sort & Filter group of the ribbon

In the 'Sort By' dropdown, you choose the first column that you want to sort by e.g. Product. You would normally use the default of 'Cell Values' to sort on in the 'Sort On' dropdown, but you can also sort by cell colour or font colour using this dropdown.

The 'Order' dropdown gives you ascending or descending options

Once you have selected the options in the three dropdowns then click OK and the data will be sorted (Image 2).

You can add further sorting levels by clicking on 'Add Level'. If you wanted to sort by Product first and then Price you would add a new level for the Price sort.

You can also delete or copy a selected level when fine tuning your sort.

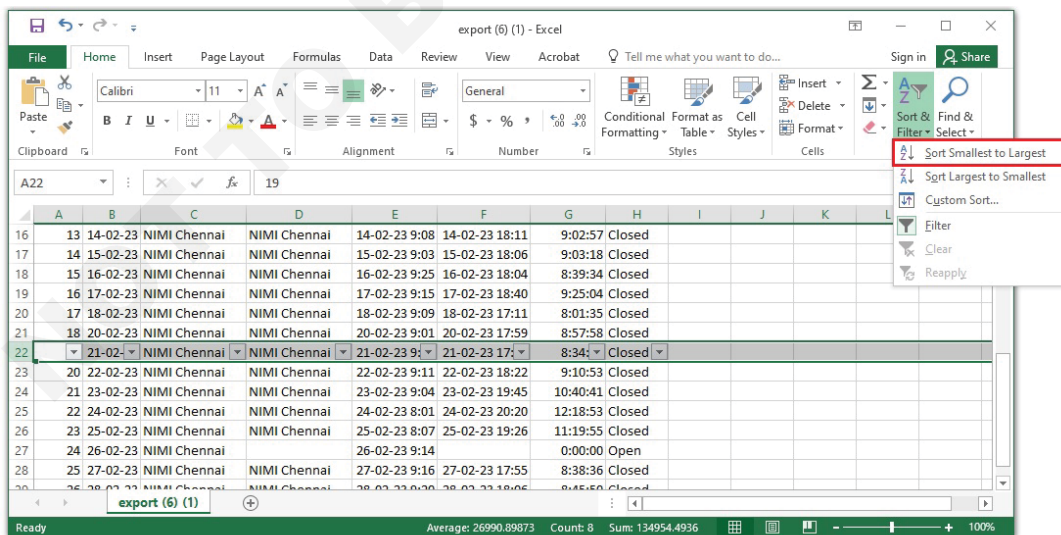
The 'Options' button allows you to sort top to bottom or left to right .

Filtering (Fig 38)

Filtering allows you to display a sub set of your data. To invoke this function, you click on 'Filter' in the 'Sort & Filter' group of the ribbon. This will put a dropdown for each of your column headers.

To remove the filter, simply click again on 'Filter'

Fig 38



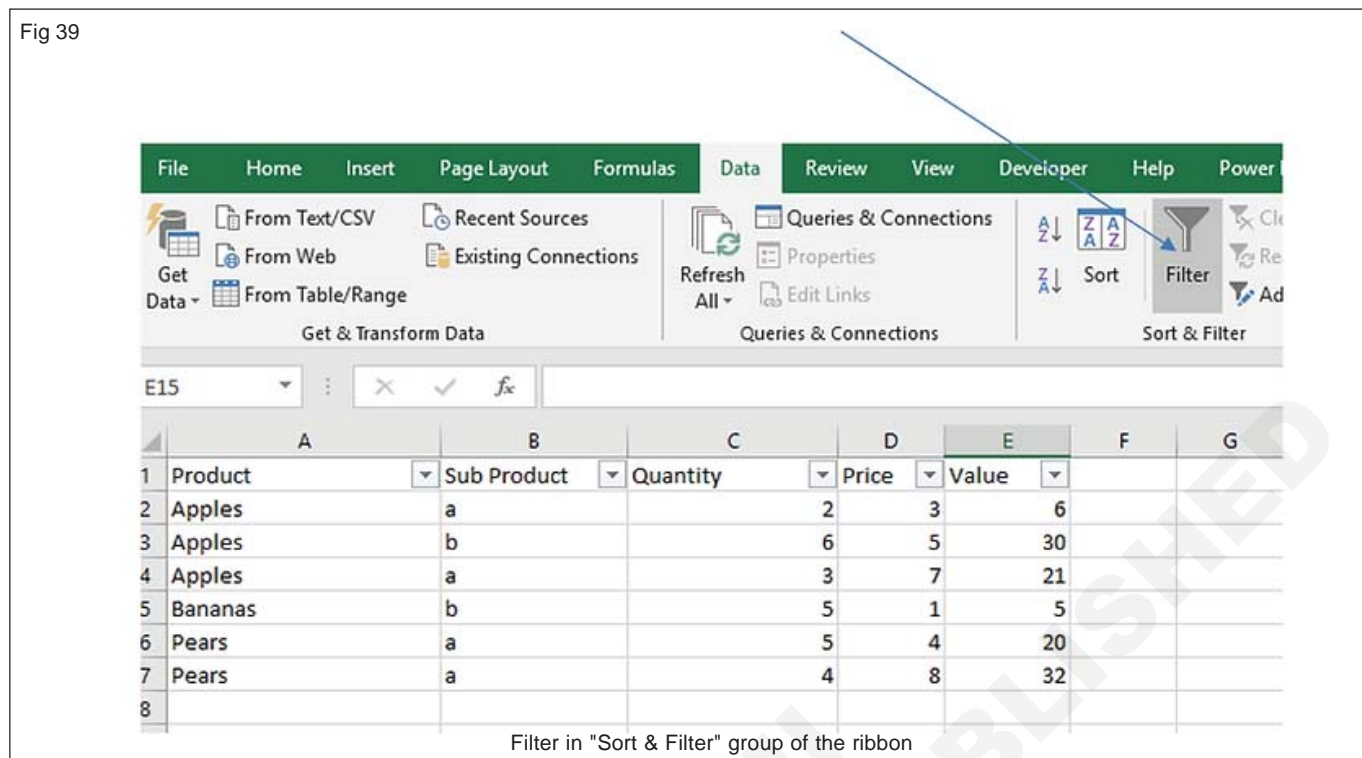
Add one level in sorting

By clicking on the dropdown on a column header in the data range, there are a large number of options to filter your data.

If, for example, you only wanted to show 'Apples' the you untick the 'Select All' box and tick the 'Apples' box. This will then only show 'Apples' data

If the column is a text column, you can use the 'Text Filters' for more complicated filtering, and if it is a numeric column, you can use 'Number Filters' in the same way.

You can also use the sorting options on the pop-up menu to sort your sub set of data. (Fig 39).



Data Tools

Text to Columns

This function is found in the 'Data Tools' group of the Data tab on the ribbon. This useful function allows you to split a single column of data into multiple columns by using a standard delimiter to split each part of the text.

In this example you have a column of data giving first name and last name, separated by a space.

Select your data and then click on 'Text to Columns'. This will display a three step Wizard that will allow you to define how your data is to be split and to show you a preview of what your data will look like

Accept the default value of 'Delimited' and click on 'Next'. You will then see 'Step 2' of the Wizard (Image 9). Tick the 'Space' box as the delimiter, and make sure that all other Delimiter tick boxes are unchecked.

The Preview box will show you how the data will appear in your spreadsheet.

At this stage, you can click 'Finish'. The third step of the Wizard gives options for date formats and converting text to numbers and dates.

Your single column of names will now show in two columns. (Fig 40)

Flash Fill

This function allows you to put in an example of how you want data displayed, and then Flash Fill will continue this

example for the rest of the data. The Flash Fill icon is in the Data Tools group on the Data tab of the ribbon.

For example, we have data in two columns of first name and last name. We want to see it as last name first name separated by a comma and a space. The example goes in cell C1

Click on the Flash Fill icon (shown by the arrow above) and the data will be filled in below the example

Remove Duplicates

Data that has been imported into a spreadsheet will sometimes contain duplicate values which you often do not need. The 'Remove Duplicates' function will allow you to quickly remove these values

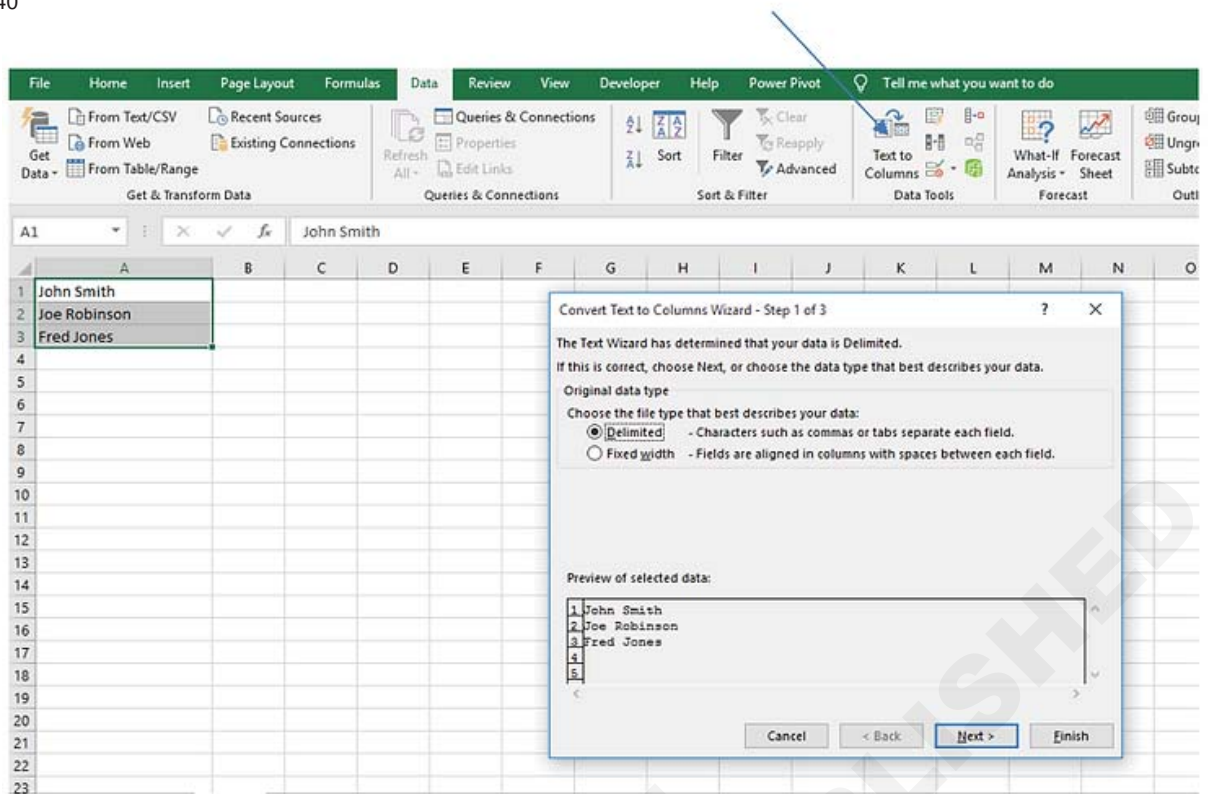
The 'Remove Duplicates' icon is in the 'Data Tools' group on the Data tab of the ribbon (see arrow below)

In this example, there are several duplicate names. Select the range of data and click on the 'Remove Duplicates' icon.

This will display a pop-up menu showing the columns within the data range. You can also indicate whether the range contains headers or not. (Fig 41)

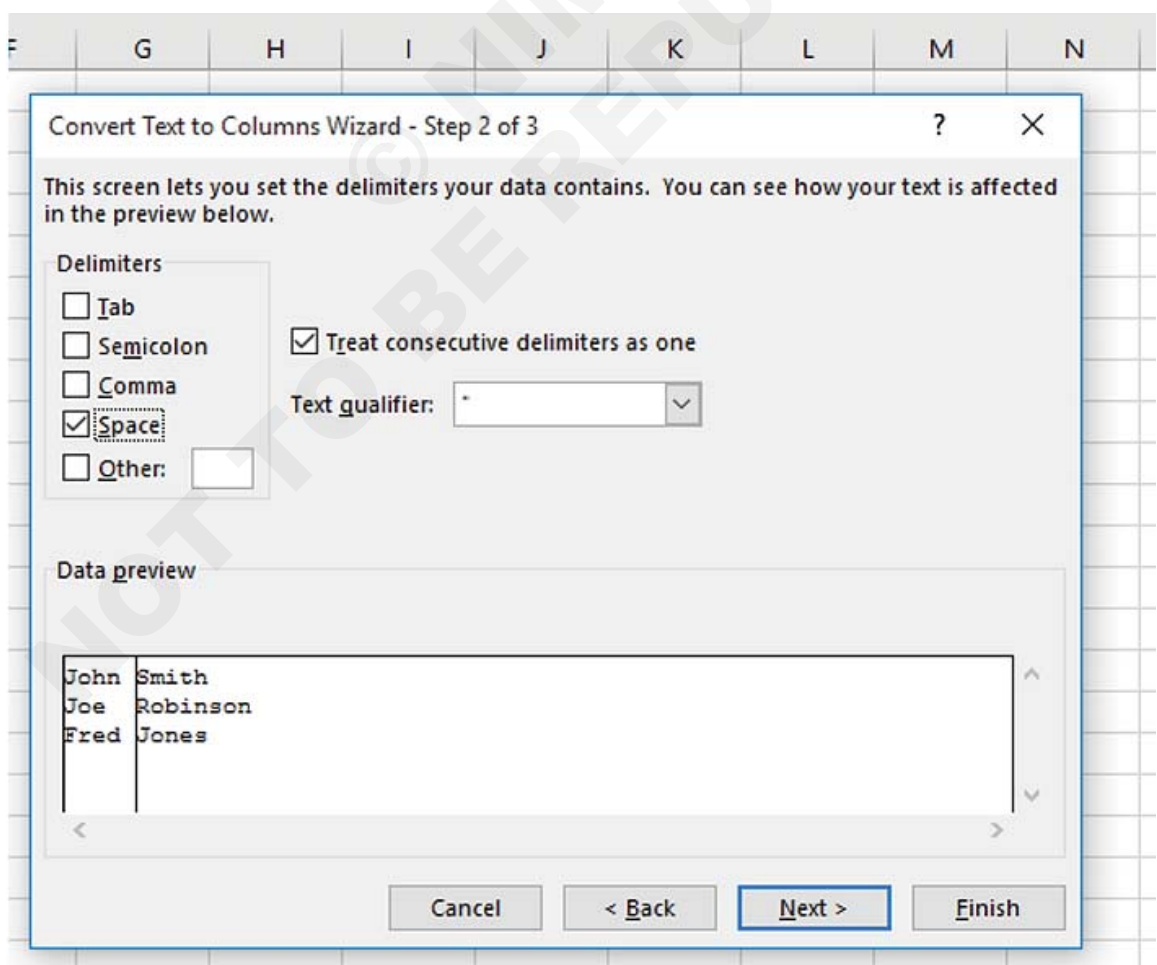
In this case we can use all three columns. Click OK and the duplicates will be removed, showing a status message of how many duplicates have been removed and how many unique values remain.

Fig 40



Text to column in Data Tools group of the ribbon

Fig 41



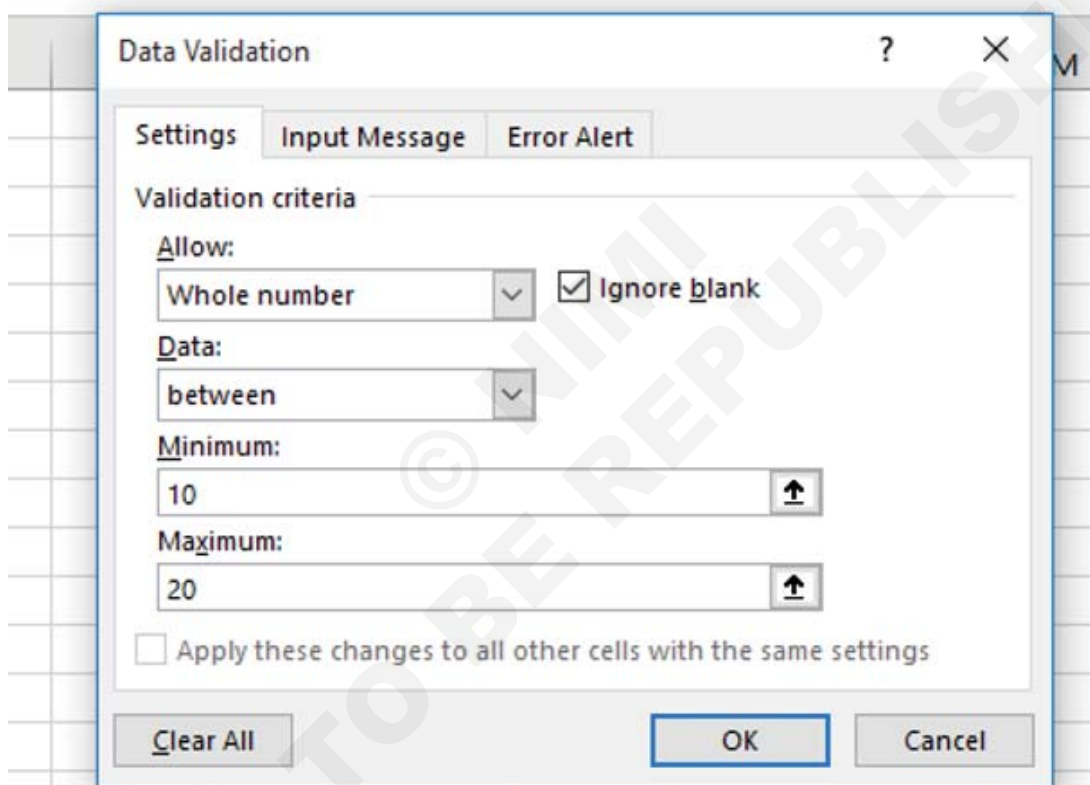
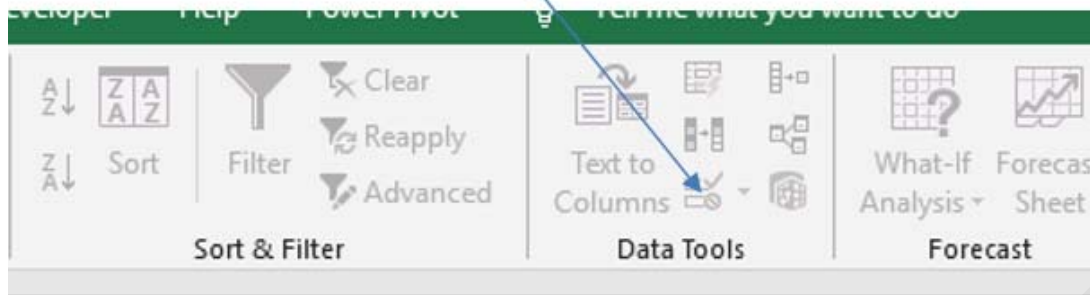
Step 2 in "text to column"

Data Validations

You can use this to specify a rule for what data can be entered into a cell. See where the arrow is pointing in

'Data Tools' in the 'Data' tab on the ribbon. The 'Allow' drop down gives several options, but for this example we will use 'Whole Number' and 'Between' with minimum set to 10 and maximum set to 20. (Fig 42)

Fig 42



Data Validations in "Data Tools" in the Data tab on the ribbon

You can enter an input message to prompt a user who goes to enter a value into the cell, and you can also create an error message if the rule is breached. These two tabs are optional – if the user breaks the rule, a default message will appear.

Click on OK and that validation rule will now apply to the selected cell.

Data Validation

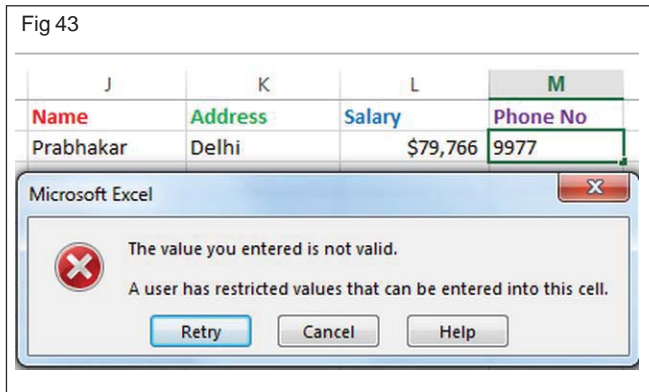
MS Excel data validation feature allows to set up certain rules that dictate what can be entered into a cell. For example, user want to limit data entry in a particular cell

to whole numbers between 0 and 10. If the user makes an invalid entry, and display a custom message as shown Fig 43.

Validation Criteria

To specify the type of data allowable in a cell or range, follow the steps below, which shows all the three tabs of the Data Validation dialog box.

- **Select the cell or range.**
- Choose Data " Data Tools " Data Validation. Excel displays its Data Validation dialog box having 3 tabs settings, Input Message and Error alert.



Settings Tab

Here user can set the type of validation. Choose an option from the Allow drop-down list. The contents of the Data Validation dialog box will change, displaying controls based on your choice.

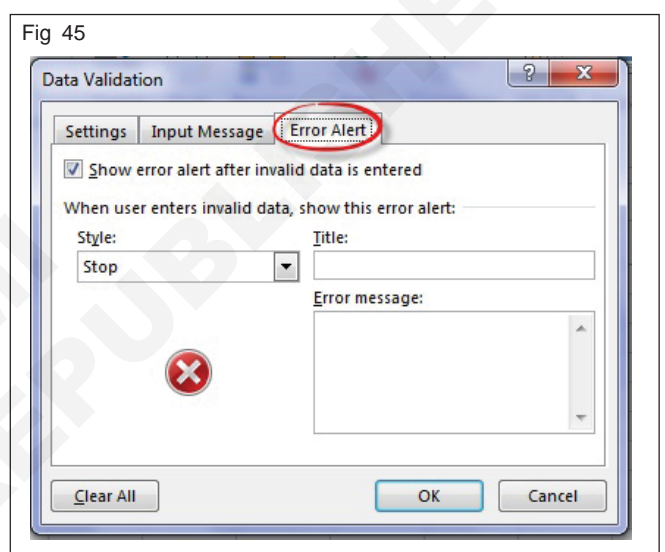
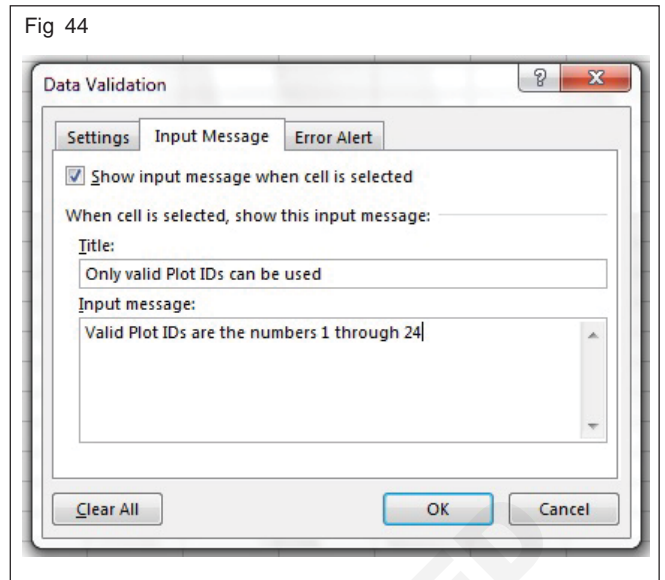
- **Any Value** - Selecting this option removes any existing data validation.
- **Whole Number** - The user must enter a whole number. For example, you can specify that the entry must be a whole number greater than or equal to 50.
- **Decimal** - The user must enter a number. For example, you can specify that the entry must be greater than or equal to 10 and less than or equal to 20.
- **List** - The user must choose from a list of entries you provide. You will create drop-down list with this validation. You have to give input ranges then those values will appear in the drop-down.
- **Date** - The user must enter a date. You specify a valid date range from choices in the Data drop-down list. For example, you can specify that the entered data must be greater than or equal to January 1, 2013, and less than or equal to December 31, 2013.
- **Time** - The user must enter a time. Specify a valid time range from choices in the Data drop-down list. For example, user can specify that the entered data must be later than 12:00 p.m.
- **Text Length** - The length of the data (number of characters) is limited. specify a valid length by using the Data drop-down list. For example, that the length of the entered data be 1 (a single alphanumeric character).
- **Custom** - To use this option, must supply a logical formula that determines the validity of the user's entry (a logical formula returns either TRUE or FALSE).

Input Message Tab (Fig 44)

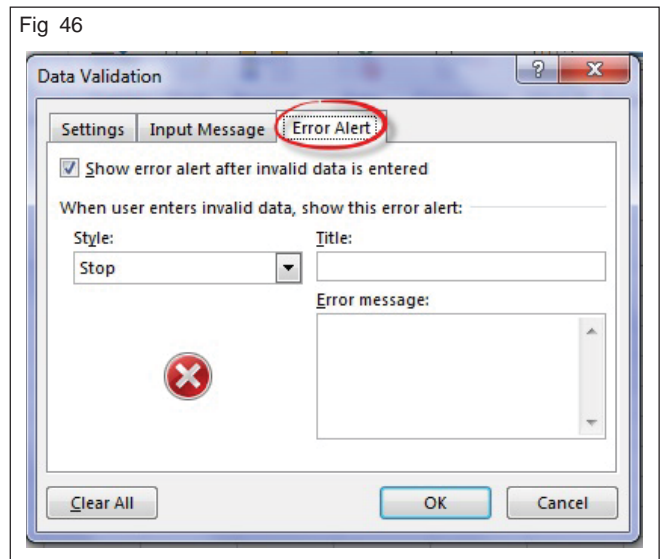
User can set the input help message with this tab. Fill the title and Input message of the Input message tab and the input message will appear when the cell is selected.

Error Alert Tab (Fig 45)

User specify an error message with this tab. Fill the title and error message. Select the style of the error as stop, warning or Information as per user need.

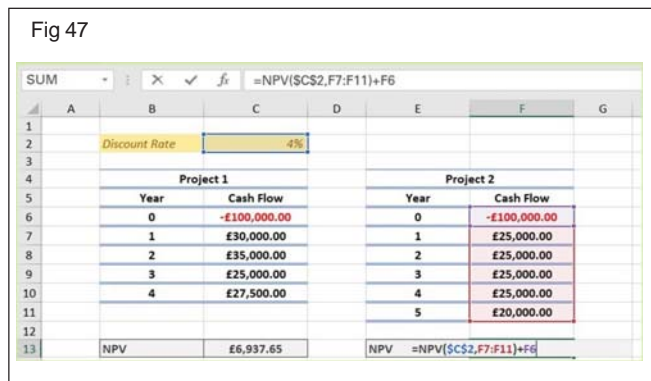


Data Table with Example (Fig 46)

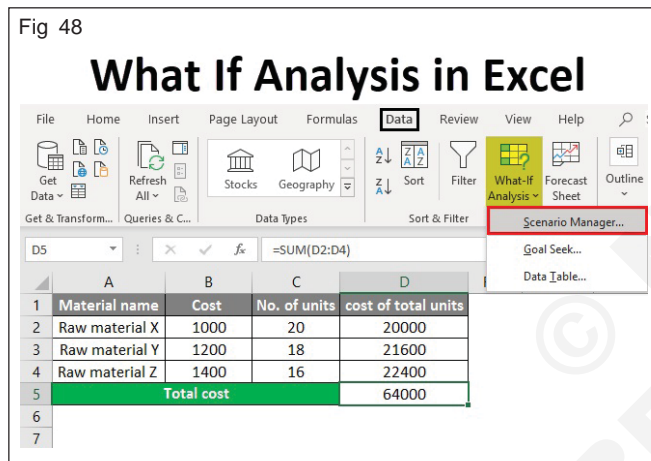


Here user have the Price and quantity of many values. Also, have the discount for that as third variable for calculating the Net Price. And can keep the Net Price value in the organized table format with the help of the data table. The Price runs horizontally to the right while

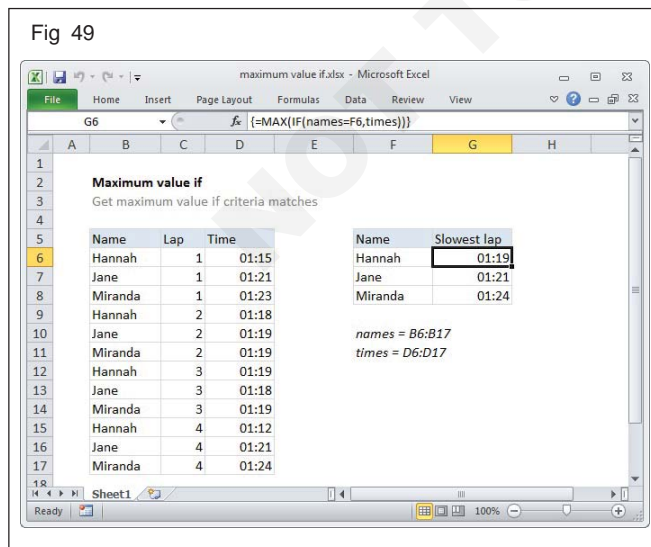
quantity runs vertically down. We are using a formula to calculate the Net Price as Price multiplied by Quantity minus total discount (Quantity * Discount for each quantity) as shown in Fig 47.



Now, for creation of data table select the range of data table. Choose Data Tab " What-if analysis dropdown " Data table. It will display dialogue asking for Input row and Input Column. Give the Input row as Price cell (In this case cell B3) and Input column as quantity cell (In this case cell B4) as shown in Fig 48.



Clicking OK will generate data table as shown in Fig 49. It will generate the table formula. And change the price horizontally or quantity vertically to see the change in the Net Price.

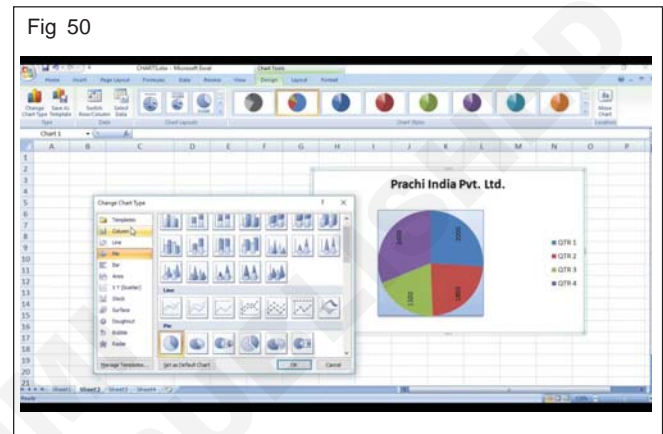


Charts

A chart is a visual representation of numeric values. Charts (also known as graphs) have been an integral part of spreadsheets. Charts generated by early spreadsheet products were quite crude, but they have improved significantly over the years. Excel provides you with the tools to create a wide variety of highly customizable charts. Displaying data in a well-conceived chart can make your numbers more understandable. Because a chart presents a picture, charts are particularly useful for summarizing a series of numbers and their interrelationships.

Types of Charts

There are various chart types available in MS Excel as shown in Fig 50.



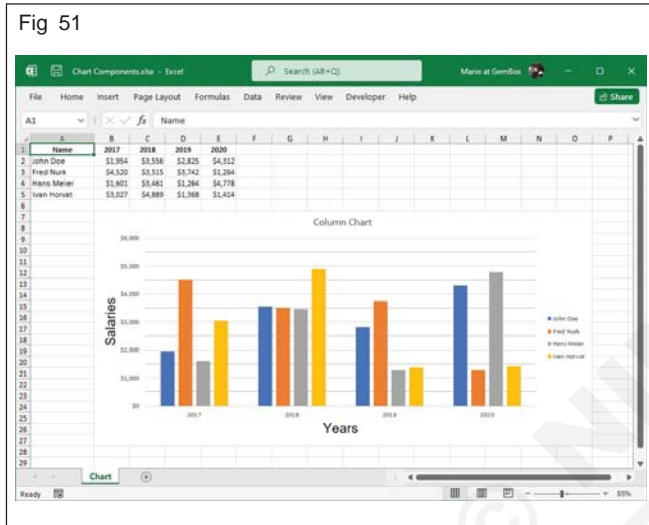
- **Column:** Column chart shows data changes over a period of time or illustrates comparisons among items.
- **Bar:** A bar chart illustrates comparisons among individual items.
- **Pie:** A pie chart shows the size of items that make up a data series, proportional to the sum of the items. It always shows only one data series and is useful to emphasize a significant element in the data.
- **Line:** A line chart shows trends in data at equal intervals.
- **Area:** An area chart emphasizes the magnitude of change over time.
- **X Y Scatter:** An xy (scatter) chart shows the relationships among the numeric values in several data series, or plots two groups of numbers as one series of xy coordinates.
- **Stock:** This chart type is most often used for stock price data, but can also be used for scientific data (for example, to indicate temperature changes).
- **Surface:** A surface chart is useful to find the optimum combinations between two sets of data. As in a topographic map, colors and patterns indicate areas that are in the same range of values.
- **Doughnut:** Like a pie chart, a doughnut chart shows the relationship of parts to a whole; however, it can contain more than one data series.

- **Bubble:** Data that is arranged in columns on a worksheet, so that x values are listed in the first column and corresponding y values and bubble size values are listed in adjacent columns, can be plotted in a bubble chart.
- **Radar:** A radar chart compares the aggregate values of a number of data series.

Creating Chart

To create charts for the data by below mentioned steps.

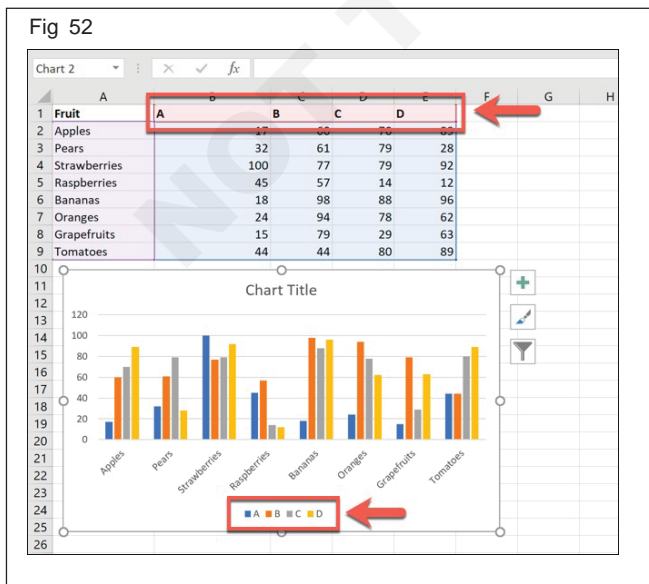
- Select the data for which you want to create the chart.
- Choose Insert Tab " Select the chart or click on the Chart group to see various chart types.
- Select the chart of the choice and click OK to generate the chart as shown in Fig 51.



Editing Chart

You can edit the chart at any time after you have created it.

- select the different data for chart input with Right click on chart " Select data. Selecting new data will generate the chart as per the new data, as shown in Fig 52.



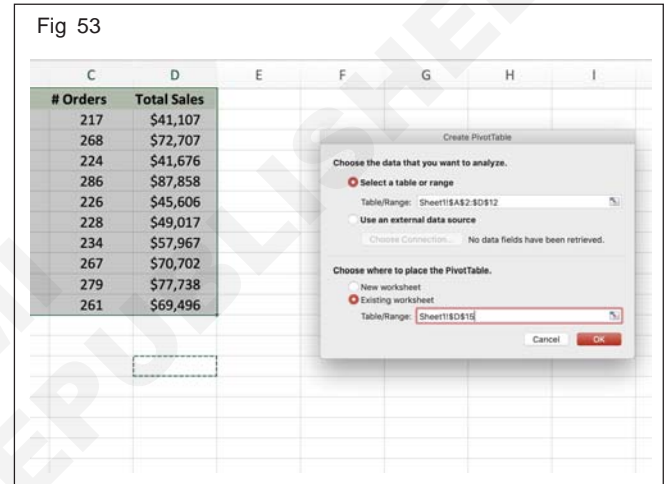
- change the X axis of the chart by giving different inputs to X-axis of chart.
- change the Y axis of chart by giving different inputs to Y-axis of chart.

Pivot Tables

A pivot table is essentially a dynamic summary report generated from a database. The database can reside in a worksheet (in the form of a table) or in an external data file. A pivot table can help transform endless rows and columns of numbers into a meaningful presentation of the data. Pivot tables are very powerful tool for summarized analysis of the data.

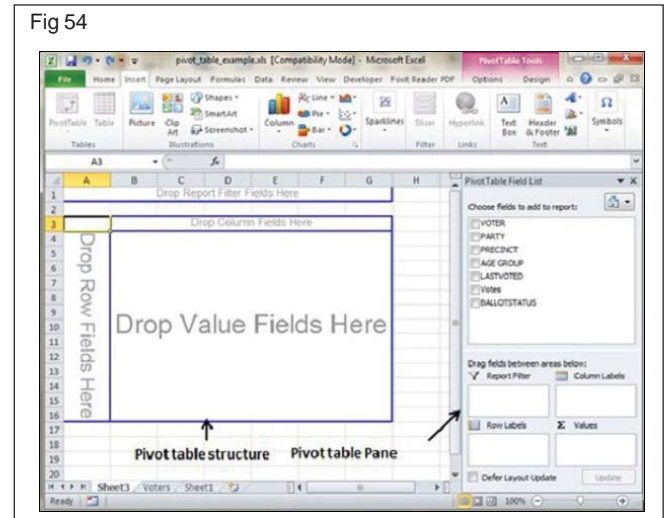
Pivot tables are available under Insert tab " PivotTable dropdown " PivotTable.

Pivot Table Example (Fig 53)



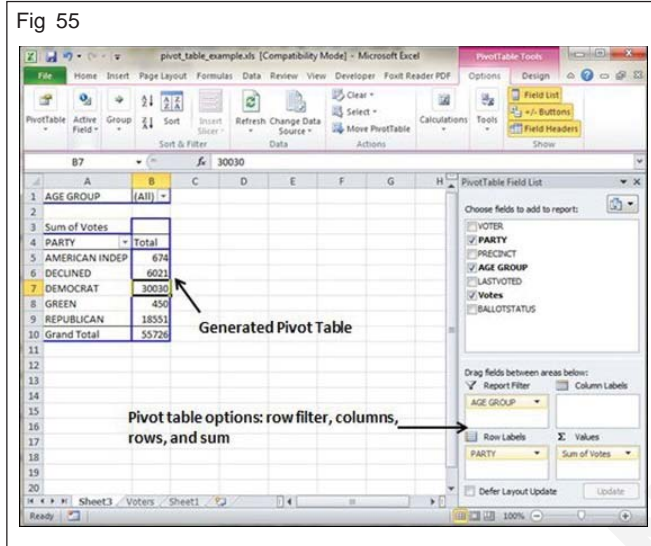
Now, let us see Pivot table with the help of example. Suppose huge data of voters and need to see the summarized data of voter Information per party, use the Pivot table for it. Choose Insert tab " Pivot Table to insert pivot table. MS Excel selects the data of the table. and select the pivot table location as existing sheet or new sheet. (Fig 53)

This will generate the Pivot table pane as shown in Fig 41. various options available in the Pivot table pane. And can select fields for the generated pivot table. (Fig 54)



- **Column labels:** A field that has a column orientation in the pivot table. Each item in the field occupies a column.
- **Report Filter:** User can set the filter for the report as year, and then data gets filtered as per the year.
- **Row labels:** A field that has a row orientation in the pivot table. Each item in the field occupies a row.
- **Values area:** The cells in a pivot table that contain the summary data. Excel offers several ways to summarize the data (sum, average, count, and so on).

After giving input fields to the pivot table, it generates the pivot table with the data as shown in Fig 55.



Pivot Charts

A pivot chart is a graphical representation of a data summary, displayed in a pivot table. A pivot chart is always based on a pivot table. Although Excel lets to create a pivot table and a pivot chart at the same time, user can't create a pivot chart without a pivot table. All Excel charting features are available in a pivot chart.

Pivot charts are available under **Insert tab > PivotTable dropdown > PivotChart**.

Pivot Chart Example

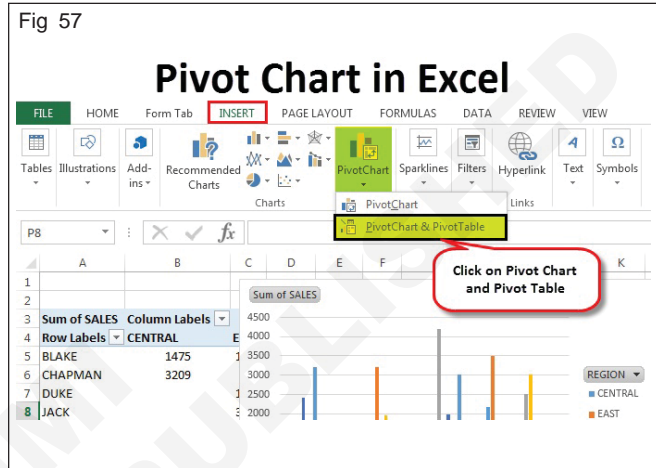
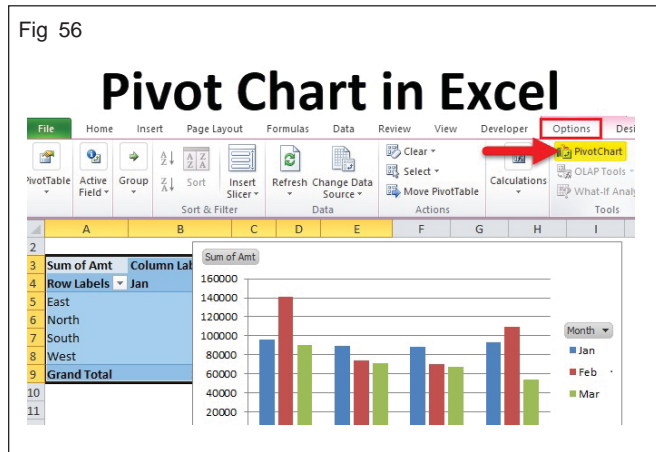
Suppose huge data of voters and need to see the summarized view of the data of voter

Information per party in the form of charts, then use the Pivot chart for it. Choose **Insert tab > Pivot Chart** to insert the pivot table. (Fig 56)

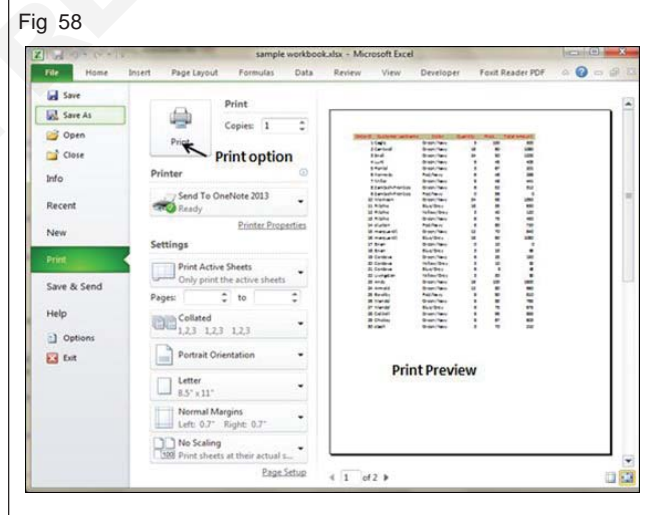
MS Excel selects the data of the table. And select the pivot chart location as an existing sheet or a new sheet. Pivot chart depends on automatically created pivot table by the MS Excel. generate the pivot chart in the below Fig 57.

Quick Print

If user want to print a copy of a worksheet with no layout adjustment, use the Quick Print option. There are two ways in which we can use this option.



- Choose File " Print (which displays the Print pane), and then click the Print button as shown in Fig 58.



- Press Ctrl+P and then click the Print button (or press Enter).

Adjusting Common Page Setup Settings

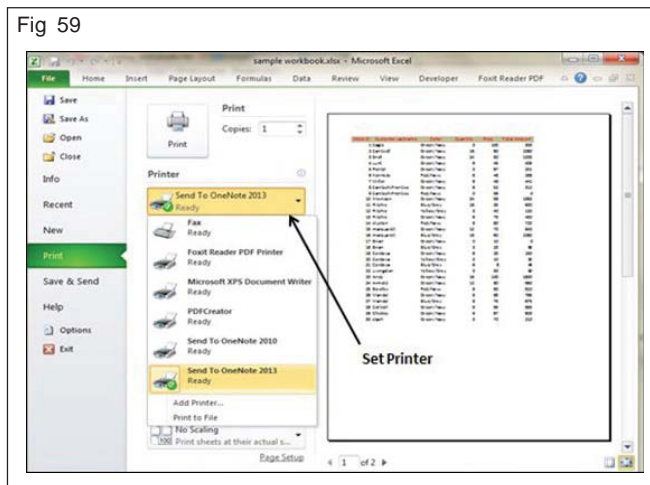
User can adjust the print settings available in the Page setup dialogue in different ways as discussed below. Page setup options include Page orientation, Page Size, Page Margins, etc.

- The Print screen in Backstage View, displayed when choose File " Print.

- The Page Layout tab of the Ribbon.

Choosing Your Printer

To switch to a different printer, choose **File > Print** and use the drop-down control in the Printer section to select any other installed printer. (Fig 59)



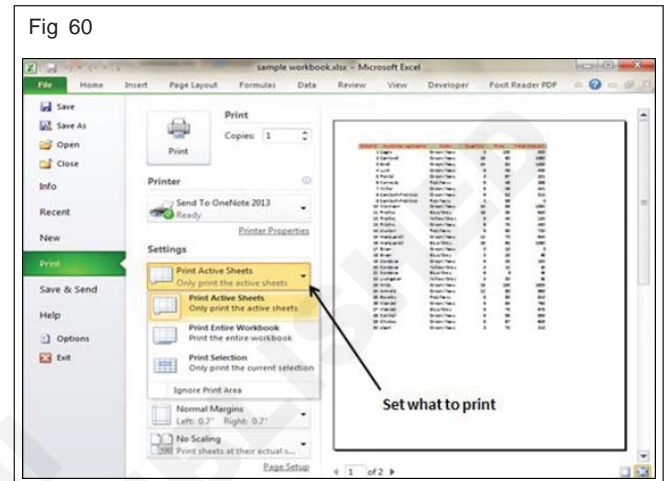
Specifying What You Want to Print

Sometimes print only a part of the worksheet rather than the entire active area. Choose **File > Print** and use the controls in the Settings section to specify what to print.

- **Active Sheets:** Prints the active sheet or sheets that you selected.
- **Entire Workbook:** Prints the entire workbook, including chart sheets.
- **Selection:** Prints only the range that selected before choosing **File > Print**.

MS Excel Keyboard Short-cuts

MS Excel offers many keyboard short-cuts. Below is the list of all the major shortcut keys in Microsoft Excel. (Fig 60)



- | | | |
|----------------------------|---|---|
| • Ctrl + A | - | Selects all contents of the worksheet. |
| • Ctrl + B | - | Bold highlighted selection. |
| • Ctrl + I | - | Italicizes the highlighted selection. |
| • Ctrl + K | - | Inserts link. |
| • Ctrl + U | - | Underlines the highlighted selection. |
| • Ctrl + 1 | - | Changes the format of selected cells. |
| • Ctrl + 5 | - | Strikethrough the highlighted selection. |
| • Ctrl + P | - | Brings up the print dialog box to begin printing. |
| • Ctrl + Z | - | Undo last action. |
| • Ctrl + F3 | - | Opens Excel Name Manager. |
| • Ctrl + F9 | - | Minimizes the current window. |
| • Ctrl + F10 | - | Maximize currently selected window. |
| • Ctrl + F6 | - | Switches between open workbooks or windows. |
| • Ctrl + Page up | - | Moves between Excel work sheets in the same Excel document. |
| • Ctrl + Page down | - | Moves between Excel work sheets in the same Excel document. |
| • Ctrl + Tab | - | Moves between Two or more open Excel files. |
| • Alt + = | - | Creates a formula to sum all of the above cells |
| • Ctrl + ' | - | Inserts the value of the above cell into cell currently selected. |
| • Ctrl + Shift + ! | - | Formats the number in comma format. |
| • Ctrl + Shift + \$ | - | Formats the number in currency format. |
| • Ctrl + Shift + # | - | Formats the number in date format. |
| • Ctrl + Shift + % | - | Formats the number in percentage format. |

- **Ctrl + Shift + ^** - Formats the number in scientific format.
- **Ctrl + Shift + @** - Formats the number in time format.
- **Ctrl + Arrow key** - Moves to the next section of text.
- **Ctrl + Space** - Selects the entire column.
- **Shift + Space** - Selects the entire row.
- **Ctrl + -** - Deletes the selected column or row.
- **Ctrl + Shift + =** - Inserts a new column or row.
- **Ctrl + Home** - Moves to cell A1.
- **Ctrl + ~** - Switches between showing Excel formulas or their values in cells.
- **F2** - Edits the selected cell.
- **F3** - After a name has been created F3 will paste names.
- **F4** - Repeat last action. For example, if you changed the color of text in another cell pressing F4 will change the text in cell to the same color.
- **F5** - Goes to a specific cell. For example, C6.
- **F7** - Spell checks the selected text or document.
- **F11** - Creates chart from the selected data.
- **Ctrl + Shift + ;** - Enters the current time.
- **Ctrl + ;** - Enters the current date.
- **Alt + Shift + F1** - Inserts New Worksheet.
- **Alt + Enter** - While typing text in a cell pressing Alt + Enter will move to the next line allowing for multiple lines of text in one cell.
- **Shift + F3** - Opens the Excel formula window.
- **Shift + F5** - Brings up the search box.

Powerpoint Presentation

Objectives : At the end of this lesson you shall be able to

- Introduction to Power Point and its advantages
- Creation of slide shows
- Fine tuning of presentations.

Introduction

PowerPoint is a presentation graphics software program that is part of the Microsoft Office package. It uses a graphical approach for the presentations in the form of slide shows that accompany the oral delivery of the topic. This program is widely used in business and classrooms and is an effective tool when used for training purposes.

PowerPoint is one of the simplest computer programs to learn. It is the easiest program used worldwide for presentations that creates professional looking presentations. It is easy to customize presentations with company logo and has design templates that come with the programs. In addition to an on screen slide show, PowerPoint has printing options that allow the presenter to provide handouts and outlines for the audience as well as notes pages for the speaker to refer to during the presentation.

PowerPoint 2010 allowsto create presentations for printing or online viewing using a variety of tools. These include wizards to help with the content and look and feel of the presentations to animation tools to create moving images.

Presentation

A presentation is a collection of data and information that is to be delivered to a specific audience. A PowerPoint presentation is a collection of electronic slides that can have text, pictures, graphics, tables, sound and video. This collection can run automatically or can be controlled by a presenter.

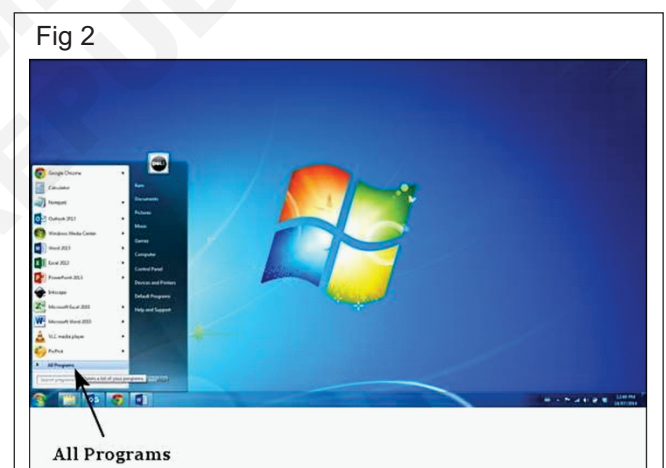
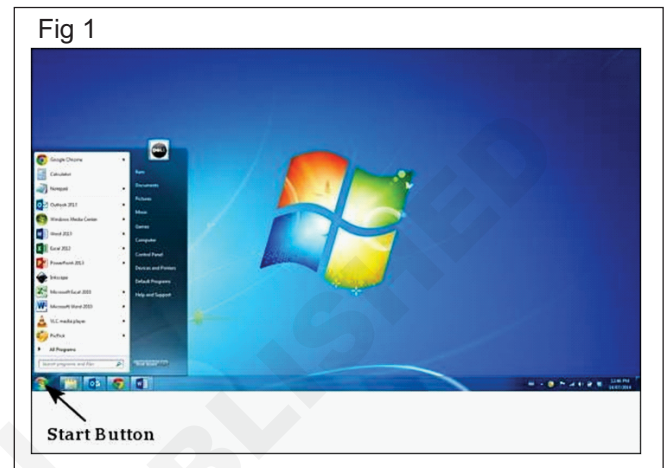
Advantage and application of PowerPoint 2010

- Professional looking presentations
- Animated presentations shown on a monitor or overhead screen
- Notes for the speaker
- Handouts for the audience
- Paper printouts of your slide
- Overhead projector transparencies
- Movies

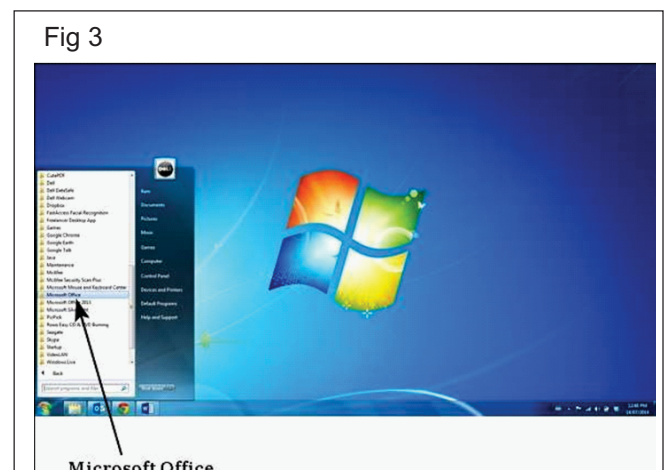
Working with PowerPoint 2010

Step 1: Click the Start button. (Fig 1)

Step 2: Click All Programs option from the menu. (Fig 2)



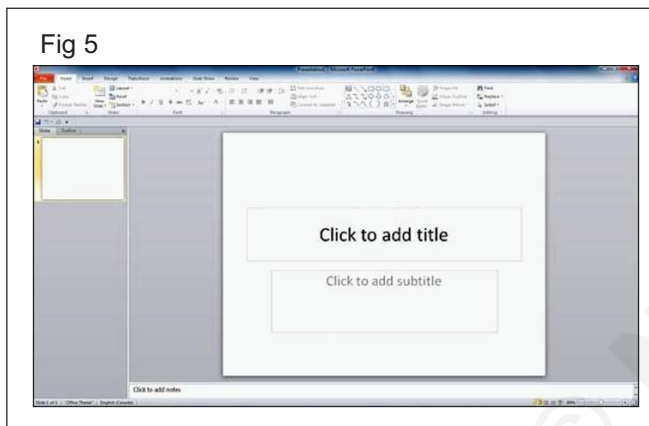
Step 3: Search for Microsoft Office from the sub menu and click it. (Fig 3)



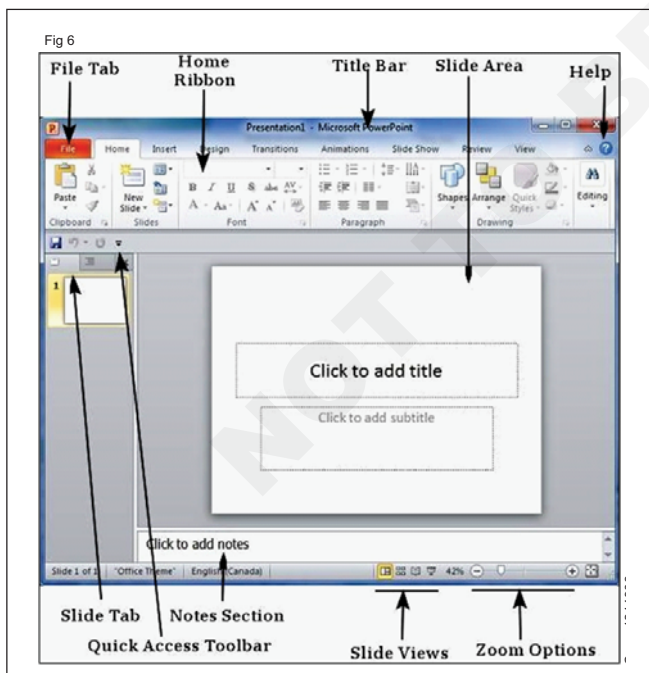
Step 4: Search for Microsoft PowerPoint 2010 from the submenu and click it. (Fig 4)



This will launch the Microsoft PowerPoint 2010 application and the following is the presentation window. (Fig 5)



PowerPoint Screen (Fig 6)

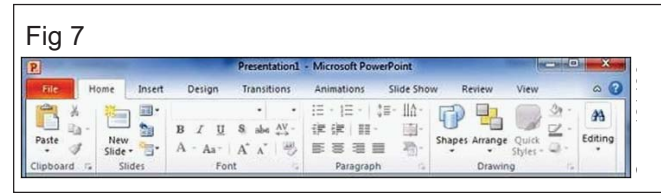


File Tab

This tab opens the Backstage view which basically allows to manage the file and settings in PowerPoint. This can

save presentations, open existing ones and create new presentations based on blank or predefined templates. The other file related operations can also be executed from this view.

Ribbon (Fig 7)



The ribbon contains three components:

- **Tabs:** They appear across the top of the Ribbon and contain groups of related commands. Home, Insert, Page Layout are examples of ribbon tabs.
- **Groups:** They organize related commands; each group name appears below the group on the Ribbon. For example, a group of commands related to fonts or a group of commands related to alignment, etc.
- **Commands:** Commands appear within each group as mentioned above.

Title Bar

This is the top section of the window. It shows the name of the file followed by the name of the program which in this case is Microsoft PowerPoint.

Slide Area

This is the area where the actual slide is created and edited. Add, edit and delete text, images, shapes and multimedia is supported in this section.

Help

The Help Icon can be used to get PowerPoint related help anytime. Clicking on the "?" opens the PowerPoint Help window where there is a list of common topics to browse from. Specific topics from the search bar at the top can also be used for searching.

Zoom Options

The zoom control zooms in for a closer look at the text. The zoom control consists of a slider that can slide left or right to zoom in or out, - and + buttons to can be used to increase or decrease the zoom factor. The maximum zoom supported by PowerPoint is 400% and the 100% is indicated by the mark in the middle.

Slide Views

The group of four buttons located to the left of the Zoom control, near the bottom of the screen, lets to switch between PowerPoint views.

- Normal Layout view: 1 This displays page in normal view with the slide on the right and a list of thumbnails to the left. This view allows user to edit individual slides and also rearrange them.

- Slide Sorter view: This displays all the slides as a matrix. This view only allows the user to rearrange the slides but not edit the contents of each slide.
- Reading View: This view is like a slideshow with access to the Windows task bar in case the user need to switch windows. However, like the slideshow user cannot edit anything in this view.

Notes Section

This sections allows user to add notes for the presentation. These notes will not be displayed on the screen during the presentation; these are just quick reference for the presenter.

Quick Access Toolbar

The Quick Access Toolbar is located just under the ribbon. This toolbar offers a convenient place to group the most commonly used commands in PowerPoint. User can customize this toolbar to suit their needs.

Slide Tab

This section is available only in the Normal view. It displays all the slides in sequence. User can add, delete and reorder slides from this section.

Backstage View in Powerpoint 2010

In Office 2010, Microsoft replaced the traditional file menu with the new Backstage view. This view not only offers all the menu items under the file menu, but additional details which makes management of files a lot easier.

Accessing Backstage View

User can access the Backstage view simply by clicking on the File tab. They can exit this view by clicking on any tab (including the File tab again). 'Esc' button on the keyboard can also be pressed for the same.

Organization of Backstage View

The backstage view has three sections or panes. (Fig 8)

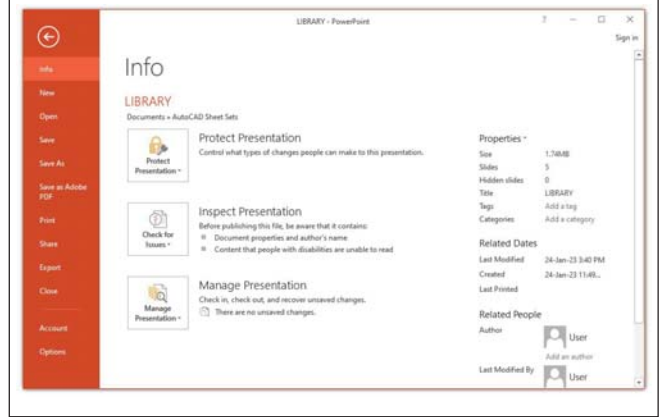
- First Pane ? This is the commands pane which consists of all the commands that would typically found in the file menu of older versions. it also has the Options menu which edits the options on the program like customizing the ribbon.

Various commands under the first pane are described in the table below ?

S.No Command & Description

| S.No | Command | Description |
|------|----------------|---|
| 1 | Save | This allows user to save a new file or an existing file in standard format. If user is working on a previously saved file this will save the new changes in the same file format. If user is working on a new file, this command would be similar to the Save As command. |
| 2 | Save As | Allows user to specify the file name and the file type before saving the file. |

Fig 8



- Open**
Allows user to open new PowerPoint files.
- Close**
Allows user to close an existing file.
- Info**
Displays the information about the current file.
- Recent**
Lists series of recently viewed or edited PowerPoint files.
- New**
Allows user to create a new file using blank or pre-defined templates.
- Print**
Allows user to select the printer settings and print the presentation.
- Save & Send**
Allows user to share your presentation with larger audience via emails, web, cloud services, etc.
- Help**
Provides access to PowerPoint Help.
- Options**
Allows user to set various options related to PowerPoint program.
- Exit**
Closes the presentation and exits the program.

- Second Pane ? This is the subcommands pane. This will list all the commands related to the main command chosen in the first pane. For example, if user selects Print in the first pane, user get to choose the printer and adjust the print settings in the second pane.
- Third Pane ? This is the preview or file information page. Depending on the command and the subcommand user select, this pane will either display the properties of the file or give a preview of the file.

Creating Presentation using Powerpoint 2010

PowerPoint offers a host of tools that will aid the user in creating a presentation. These tools are organized logically

into various ribbons in PowerPoint. The table below describes the various commands that can be accessed from the different menus.

Table - 1

| Menu Category | Ribbon Commands |
|---------------|---|
| Home | Clipboard functions, manipulating slides, fonts, paragraph settings, drawing objects and editing functions. |
| Insert | Insert tables, pictures, images, shapes, charts, special texts, multimedia and symbols. |
| Design | Slide setup, slide orientation, presentation themes and background. |
| Transitions | Commands related to slide transitions. |
| Animations | Commands related to animation within the individual slides. |
| Slide Show | Commands related to slideshow set up and previews. |
| Review | Proofing content, language selection, comments and comparing presentations. |
| View | Commands related to presentation views, Master slides, color settings and window arrangements. |

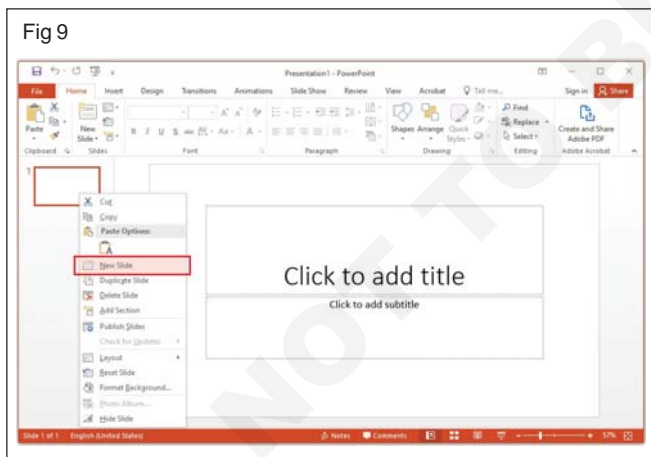
Besides these depending on the objects selected in the slide, there are other menu tabs that get enabled.

Add New Slides in Powerpoint 2010

The following are the steps that allows the user to insert a new slide .

Step 1: Right-click in the Navigation Pane under any existing slide and click on the New Slide option.

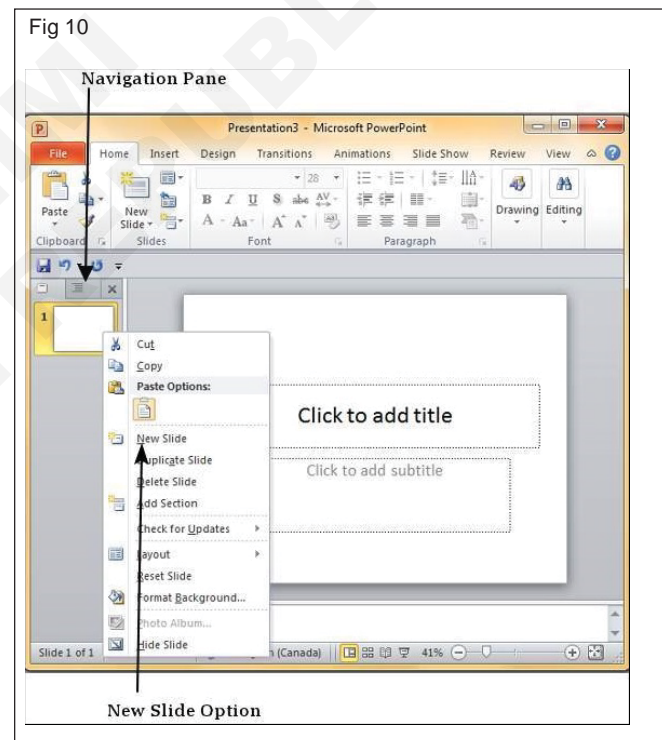
Step 2: The new slide is inserted. The layout of this slide can be changed to suit the design requirements. (Fig 9)



Step 3: To change the slide layout, right-click on the newly inserted slide and go to the Layout option where user can choose from the existing layout styles available.

Same steps can be followed to insert a new slide in between existing slides or at the end on the slide list.

When we insert a new slide, it inherits the layout of its previous slide with one exception. If inserting a new slide after the first slide (Title slide), the subsequent slide will have the Title and Content layout. (Fig 10 to 12)



Adding Text in Boxes in Powerpoint 2010

PowerPoint allows users to add text to the slide in a well-defined manner to ensure the content is well distributed and easy to read. The procedure to add the text in a PowerPoint slide is always the same - just click in the text box and start typing. The text will follow the default formatting set for the text box, although this formatting can be changed later as required.

The most common content blocks in PowerPoint are:

Fig 11

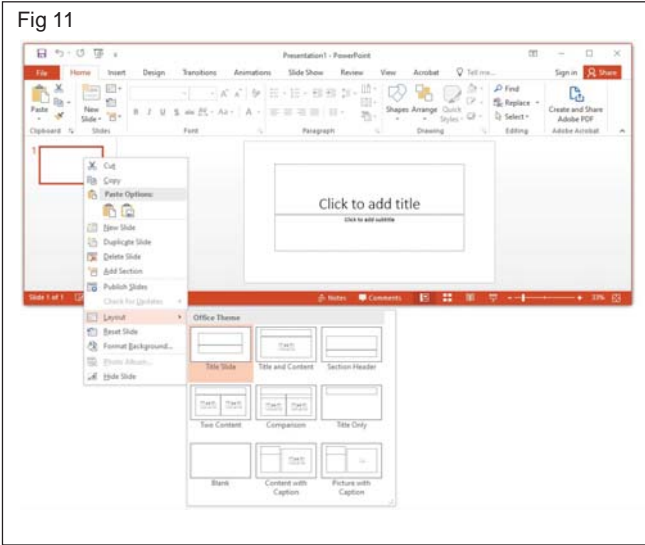
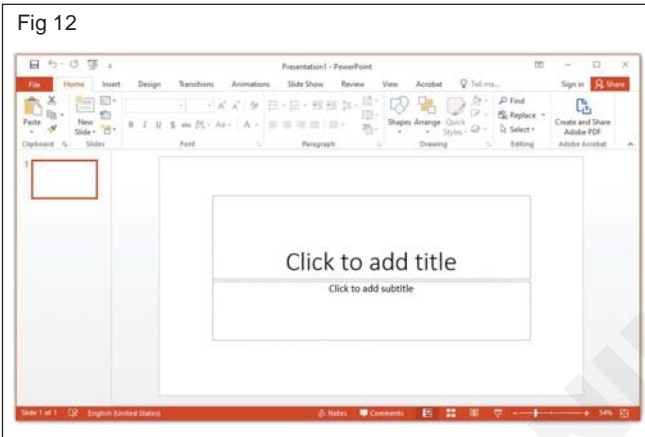
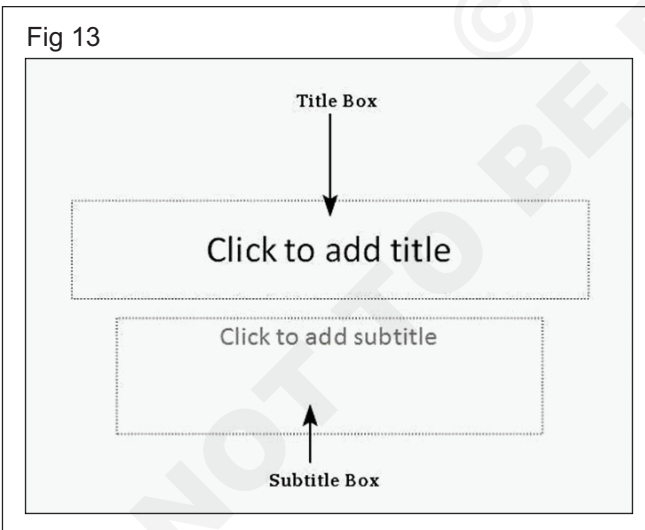


Fig 12



Title Box (Fig 13)

Fig 13



This is typically found on slides with the title layout and in all the slides that have a title box in them. This box is indicated by "Click to add title".

Subtitle Box (Fig 14)

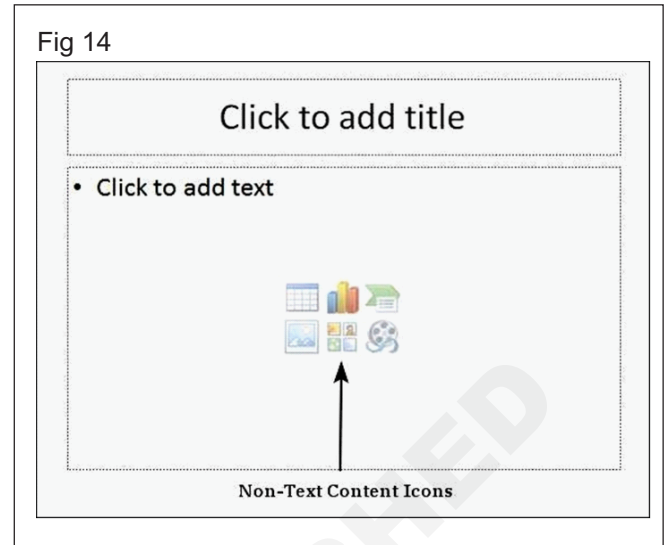
This is found only in slides with the Title layout. This is indicated by "Click to add subtitle"

Content Box

This is found in most of the slides that have a placeholder for adding content. This is indicated by "Click to add text".

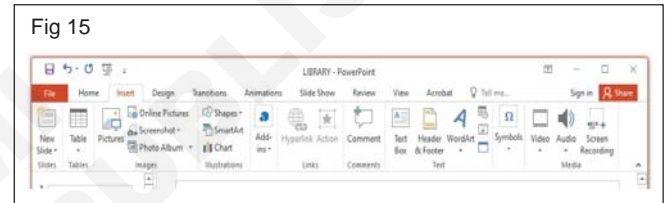
This box allows user to add text as well as non-text content. To add text to such a box, click anywhere on the box, except on one of the content icons in the center and start typing.

Fig 14



Text Only Box (Fig 15)

Fig 15



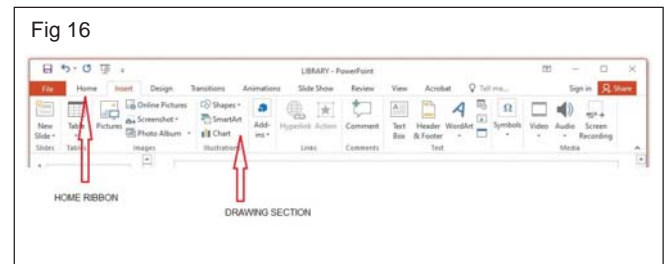
This is not a default content box available in PowerPoint, but user can create it using Slide Master, if required. This between the Text Only Box and the Content Box is that the former only supports text in the content area.

Adding New Text Boxes in Powerpoint 2010

Most of the standard layouts come with the text box option. As mentioned, text boxes will have "Click to add text" as the default text. Here are the steps to add new text boxes in slide.

Step 1: Click on the Text Box icon in the Home ribbon under the Drawing section. (Fig 16)

Fig 16

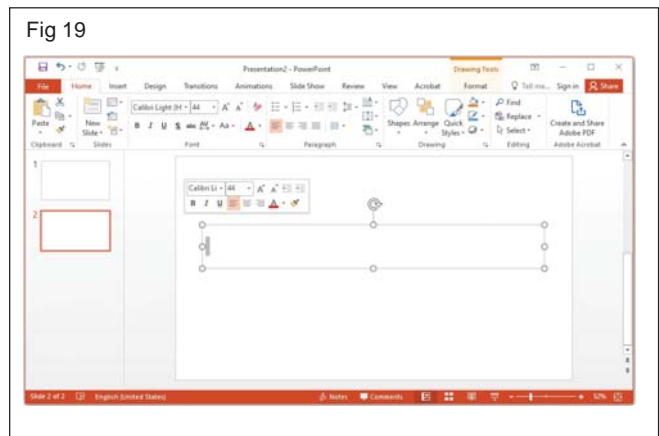
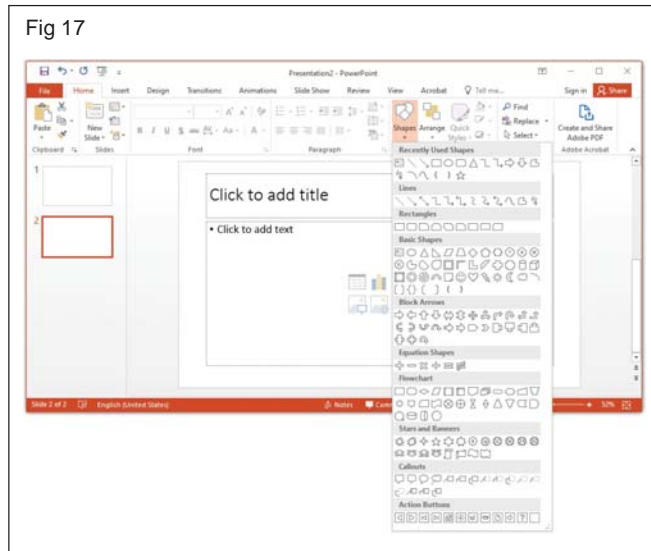


Step 2 : User will get the insert text box cursor that looks like an inverted cross.

Step 3: Click to insert a text box. User can now start typing directly into the text box.

Step 4: Alternately, user can click and drag the cursor without releasing the click to create a text box.

The size of the text box can be adjusted by selecting one of the edges marked by squares or corners marked by circles. (Fig 17 to 20)



Slide Show in Powerpoint 2010 (Fig 20)

Most PowerPoint presentations are created to be run as a slideshow. Most of these features of PowerPoint 2010 are really to help user create a good slideshow without having to go through the entire presentation over and over again after every minor change. Features related to running the slideshow are grouped under the Slideshow ribbon. Table 2)

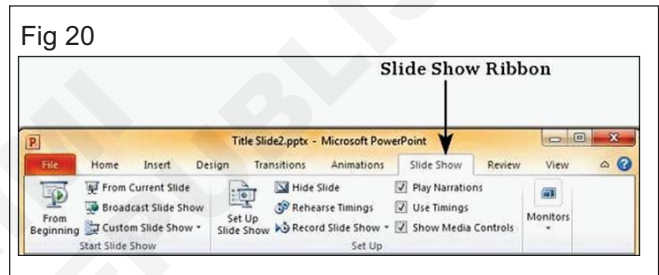
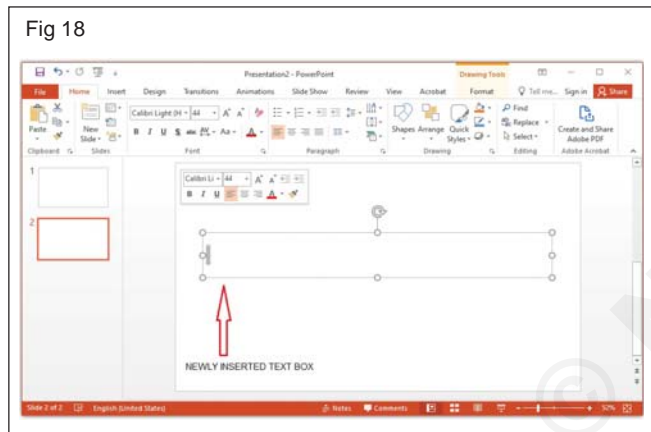


Table - 2

| Section | Menu Item | Description |
|-----------------|---------------------|---|
| Start Slideshow | From Beginning | Starts slideshow from beginning |
| | From Current Slide | Starts slideshow from the current slide |
| | Broadcast Slideshow | Allows users to broadcast the slideshows using Microsoft's PowerPoint Broadcast Service |
| | Custom Slideshow | Builds a custom slideshow by picking the slides you want to run |
| Set Up | Set Up Slideshow | Helps set up the slideshow including browser/ full screen display, show options with or without narration/ animation, pen and laser color during the slideshow and the slides to be presented during the show |
| | Hide Slide | Helps mark/ unmark the slide as hidden, so it is skipped or shown during the slideshow respectively |
| | Rehearse Timing | Allows users to rehearse the timing on each slide and the entire slideshow |
| | Record Slideshow | Records the slideshow including narration and animation |

| Section | Menu Item | Description |
|----------|----------------------|---|
| Monitors | Slideshow Checkboxes | Helps set or avoid the use of narrative audio and rehearsed timings during the show. Display media controls in the slideshow view |
| | Resolution | Defines resolution in slideshow view |
| | Show Presentation on | Picks the monitor to display the presentation one - in case of multiple monitors |
| | Use Presenter View | Run presentation in Presenter view rather than just slideshow view |

Fine Tuning Your Presentation

Introductions

Often the hardest part of making a presentation is getting started. Once you begin, adrenaline kicks in, you become excited talking about your topic, and you find that the experience is actually enjoyable. Following are five easy ways to begin a presentation.

- Tell a story
- Establish a common bond with the audience
- Directly address your subject
- Illustrate a point
- Use humor

Beyond serving to jump-start your presentation, introductions have a specific purpose. Good introductions should actually accomplish the following:

- Capture the audience's attention by using one of the following techniques:
 - Ask a question
 - Tell a joke
 - Give a quotation
 - State a startling fact
 - Give an example
 - Illustrate a point
 - Tell a story
 - Refer to an occasion
 - Refer to a historic event
 - Establish a common bond
- Establish your credentials to speak to the audience
- Establish your empathy with the issue, problem, or subject
- Establish your desire to present your information
- Provide your audience a reason to stay for the rest of your presentation
- Provide an easy transition to the body of your speech

Prepare Conclusions

A poor closing statement can ruin the lasting impression of a well-prepared and superbly delivered presentation. Conclusions are also an important, and often, overlooked element of presentations. Conclusions should be used to review your main points. This can be accomplished by using one of the following techniques:

- Repeat your points in order of delivery
- Summarize your main points
- Combine a summary and a repetition

Ideally, presentations should end with a memorable statement. Use the following techniques to create a memorable statement:

- Synopsise your main theme
- Ask the audience to do take an action
- Paint a verbal picture of the future
- Return the audience to the past
- Transition the audience to what will follow

Never do the following in the conclusion of a presentation:

- Draw out your conclusion
- Apologize for not doing a good job
- Tell a dumb joke or story
- Say that you've forgotten something
- Steal an upcoming speaker's thunder

Practice

Once your presentation is fully developed and fine-tuned to your satisfaction, it is time to practice your delivery. Use the following form to successfully and effectively practice presentations.

- Pretend you are in front of your audience; practice everything (e.g., eye contact, voice inflections, gestures, using your notes)
- Practice acting naturally
- After you are familiar with your speech, practice in front of a mirror or videotape yourself
- Practice in different locations to prepare yourself for the unknown

- Practice in front of people who will give you constructive feedback
- Become familiar with your speech before you begin practicing the use of visual supports
- Practice using eye contact and gestures along with visual supports
- Practice using visual supports in different rooms under different lighting

Use the following checklist to assist you in practicing your presentation:

- Practice your speech at least six times
- Become familiar with your broad themes
- Practice silently at first, making notes to yourself on eye contact, gestures, tone, and timing
- Practice your entire speech each practice session
- Practice in front of a mirror or videotape yourself
- Practice using your audio-visual supports
- Once you are prepared, stop practicing

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Introduction to Photography

Objective : At the end of this lesson you shall be able to

- practice on various tool-brush tool, pencil & eraser tools, the red eye.

Introduction to photoshop CSS

Explain the capabilities and features for photoshop

Introduction (Fig 1)

Photoshop can be described as a digital editing application for digital-copy of raster images. Besides the standard colour and lighting correction tools along with filtering, painting, masking, and layering options, it provides additional functionality to work with 3D objects, digital animations, and video editing.

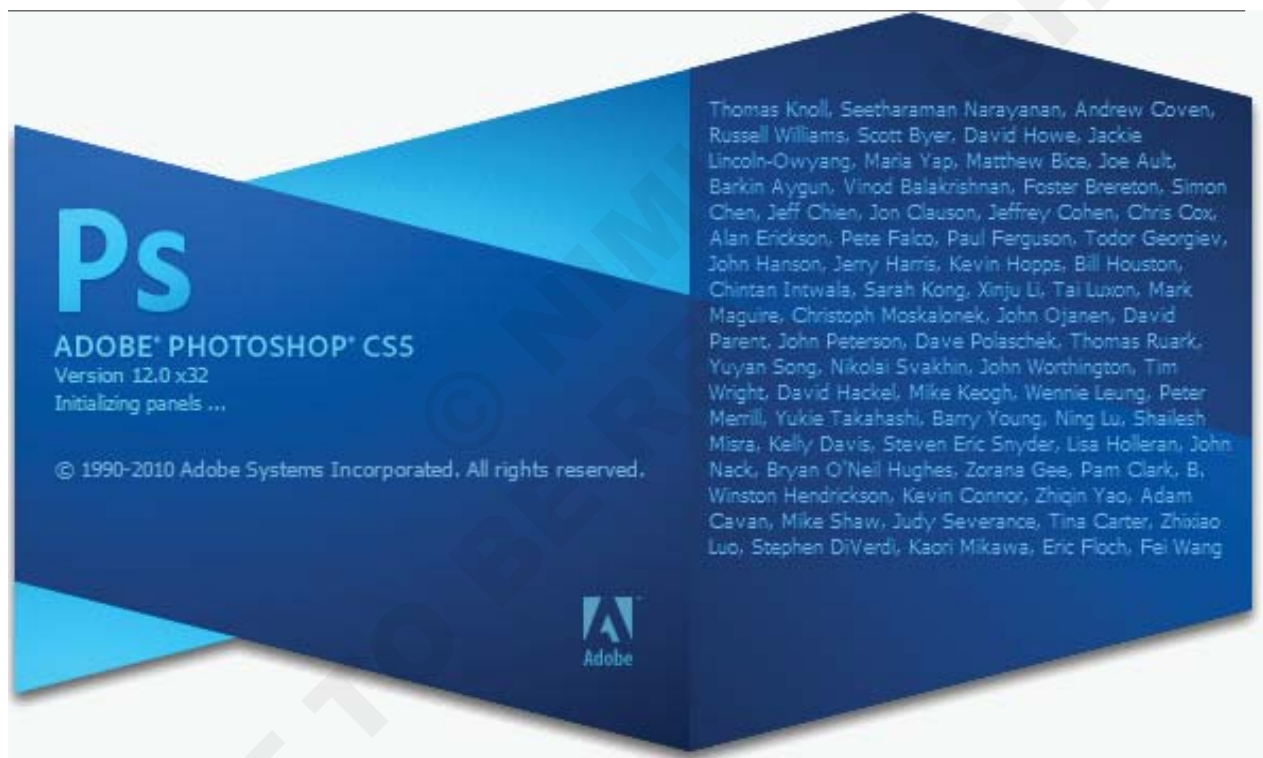
Photo Corrections

Photoshop's strength lies in the ability to correct digital images to restore original color and lighting as well as to correct problems introduced in images by camera lenses.

Photo composition

Image editing may be used to combine multiple images into one single image or composition. Multiple images taken from different horizontal angles from the same spot can be merged into a single panoramic image.

Fig 1



Artistic effects

Photoshop provides the ability to use different filters and warping tools to apply artistic effect to images. The combination of numerous tools and filters in Photoshop can create unexpected results.

Painting

Photoshop is one of the best applications available for creating digital paintings. The addition of wet brush capability in Photoshop CS5 makes it the first choice for digital painting. Many of the powerful features, such as the layering and masking, are available for use with the painting tools. The paint-brushes are integrated into many of the other tools in Photoshop.

Creating vector artwork

Photoshop also is an excellent application to use for creating vector artworks. The path tool quickly creates/manipulates vector artwork created on a separate masked layer upon any raster image. You also can add vector artwork (including vector text) to raster images.

Adding text to images

Photoshop provides various type tools used to add text upon images. The text can be resized, warped, and adjusted to add special visual effects to the image(s).

Creating Web images

Another area where Photoshop excels is preparing images for the web. Photoshop provides utilities to quickly format

images with the appropriate size, file format, and colors for use in web pages. Photoshop also provides tools for slicing of an image into clickable sections and provides the required HTML code for use of the slices in Web pages.

Print preparation

Photoshop is often used to convert the images from one colour format to another making it ready for being printed. Usually RGB colour mode is changed to CMYK for four-colour printing. Spot colors are added separately and color separations are also created.

Creating 3D objects

Photoshop has the capability to create and manipulate 3D objects. Although it is not the best utility for creating 3D objects, it is very good at manipulating them and then applying them to 2D images.

Adding textures to 3D objects

Photoshop has a big advantage over other 3D applications at applying textures to 3D objects. With Photoshop's filter and painting capabilities, edit the textures of your 3D objects in ways that you may not have thought possible.

Video corrections

Just as with 3D modeling, Photoshop should not be your choice for creating video projects; however, using Photoshop's color, lighting, and filter effects, quickly apply corrections to video and even add some artistic effects.

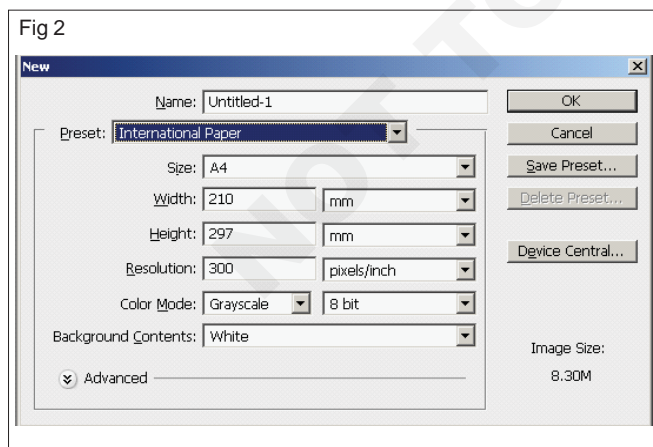
Animating images

Another fun feature of Photoshop is the ability to add animation to your images. Animated images can give life to web pages and allow you to create short animated movies.

New Photoshop document

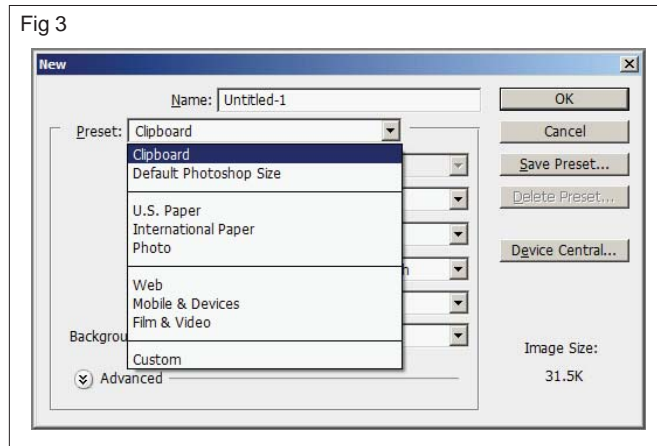
New

Go to File Menu → Choose the Option New from file menu. The New Dialogue box opens as shown in Fig 2.



Name (Fig 3)

These settings specify the name of the document which is used to locate the document in the file system later.



Preset

This option includes a drop down list as shown below.

Size

This settings to select drop down list based on the preset setting selected standard photo sizes and paper sizes or custom sizes available on the clip board.

Width

This setting specify the sizes document width area available on the size, The available units they are inches, mm, cm, picas, point, pixels and columns the available in the preset.

Height

This setting specify the sizes document height area available on the size, The available units they are inches, mm, cm, picas, point, pixels and columns the available in the preset.

Resolution

This settings specify the resolution and the units to set the resolution of the new document, The available units are pixels/inch and pixels/cm

Color mode

This settings specify the Colour mode and number of channels to use the creating document, Colour mode (Bitmap, RGB colour, CMYK colour, Gray scale, Lab Colour and bit level (1 bit, 8 bit, 16 bit, 32 bit) available on the new document

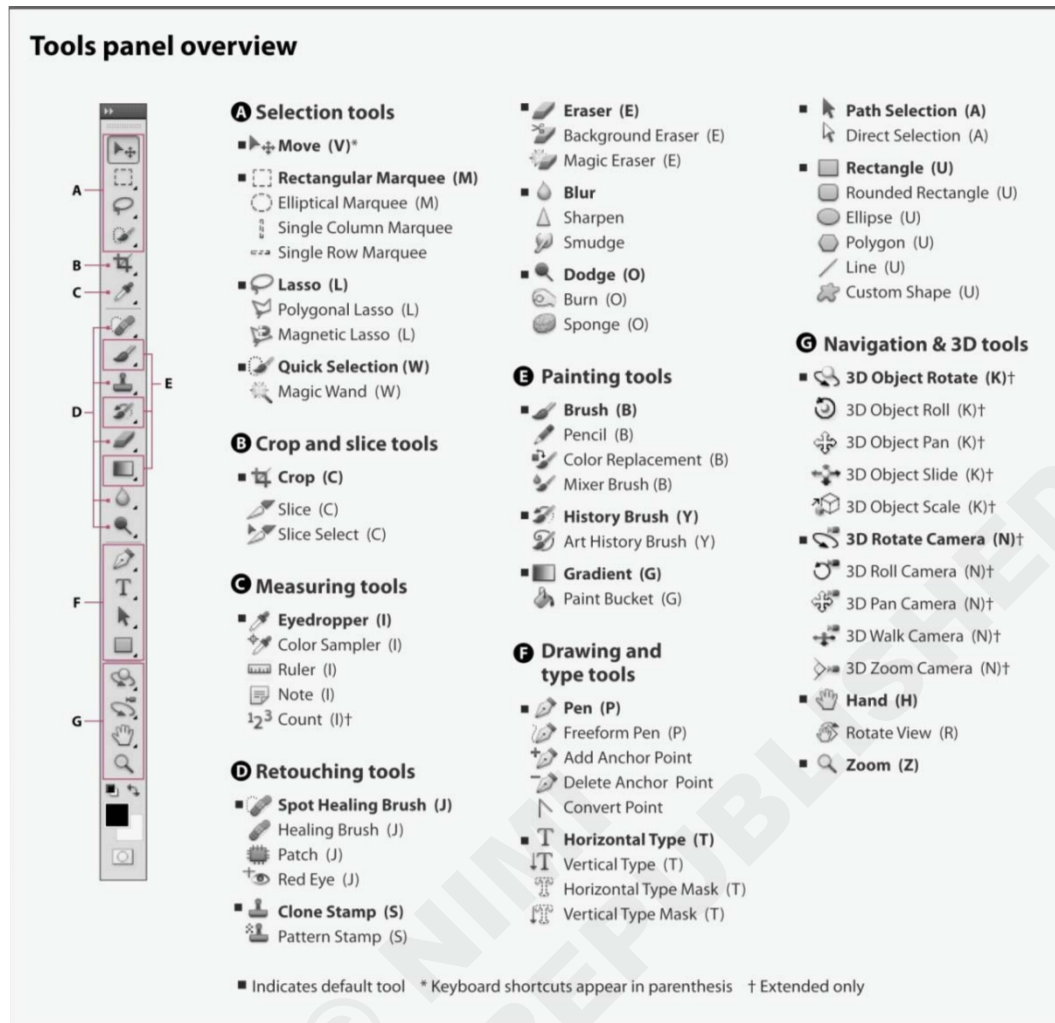
Background Contents

This setting specifies the contents of the background of the new document, This options are white, background color and transparent . background Colour is selected the Colour is selected the Colour of the back ground Photoshop toolbox is used as the background for the document.

Photoshop CS5 tools

When you start Photoshop, the Tools panel appears at the left of the screen. Some tools in the Tools panel have options that appear in the context-sensitive options bar. You can expand some tools to show hidden tools beneath them. A small triangle at the lower right of the tool icon indicates the presence of hidden tools. (Fig 4)

Fig 4



You can view information about any tool by positioning the pointer over it. The name of the tool appears in a tool tip below the pointer.

When you start Photoshop, the Tools panel appears at the left of the screen. Some tools in the Tools panel have options that appear in the context-sensitive options bar.

You can expand some tools to show hidden tools beneath them. A small triangle at the lower right of the tool icon signals the presence of hidden tools.

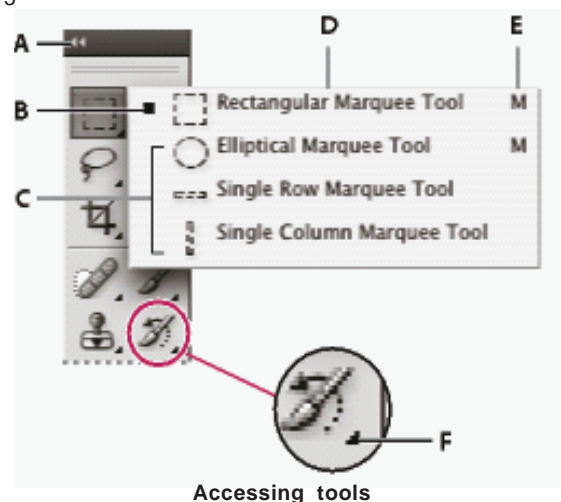
You can view information about any tool by positioning the pointer over it. The name of the tool appears in a tool tip below the pointer.

Selecting and displaying tools

Select a tool (Fig 5)

- Click a tool in the Tools panel. If there is a small triangle at a tool's lower right corner, hold down the mouse button to view the hidden tools. Then click the tool you want to select.
- Press the tool's keyboard shortcut. The keyboard shortcut is displayed in its tool tip. For example, you can select the Move tool by pressing the V key.

Fig 5



A. Tools panel B. Active tool C. Hidden tools D. Tool name E. Tool shortcut F. Hidden tool triangle

Pressing and holding a keyboard shortcut key lets you temporarily switch to a tool. When you let go of the shortcut key, Photoshop returns to the tool you were using before the temporary switch.

Change tool pointers

Each default pointer has a different hotspot, where an effect or action in the image begins. With most tools, you can switch to precise cursors, which appear as cross hairs centered around the hotspot.

In most cases, the pointer for a tool is the same as the icon for that tool; you see that pointer when you select the tool. The default pointer for the marquee tools is the cross-hair pointer; for the text tool, the default pointer is the I beam; and for the painting tools the default pointer is the Brush Size icon.

- 1 Choose Edit > Preferences > Cursors (Windows)
- 2 Choose tool pointer settings under Painting Cursors or Other Cursors:

Standard

Displays pointers as tool icons.

Precise

Displays pointers as cross hairs.

Normal Brush Tip

The pointer outline corresponds to approximately 50% of the area that the tool will affect. This option shows the pixels that would be most visibly affected.

Full Size Brush Tip

The pointer outline corresponds to nearly 100% of the area that the tool will affect, or nearly all the pixels that would be affected.

Show Crosshair In Brush Tip

Displays cross hairs in the center of the brush shape.

Show Only Crosshair While Painting

Improves performance with large brushes.

- 3 Click OK.

The Painting Cursors options control the pointers for the following tools:

Eraser, Pencil, Paintbrush, Healing Brush, Clone Stamp, Pattern Stamp, Quick Selection, Smudge, Blur, Sharpen, Dodge, Burn, and Sponge tools

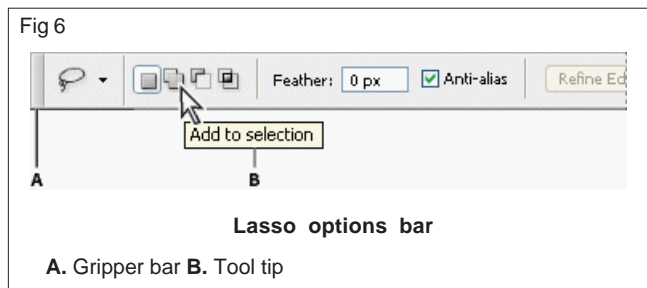
The Other Cursors options control the pointers for the following tools:

Marquee, Lasso, Polygonal Lasso, Magic Wand, Crop, Slice, Patch, Eyedropper, Pen, Gradient, Line, Paint Bucket, Magnetic Lasso, Magnetic Pen, Freeform Pen, Measure, and Color Sampler tools

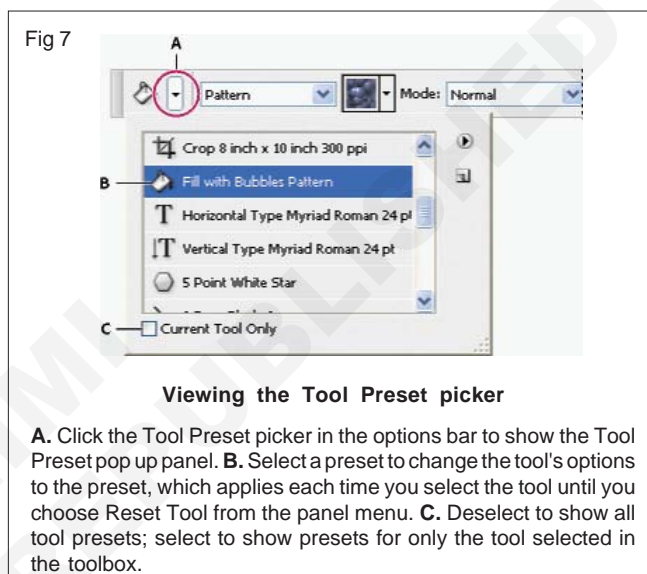
Using the options bar

The options bar appears below the menu bar at the top of the workspace. The options bar is context sensitive-it changes as you select different tools. Some settings in the options bar (such as painting modes and opacity) are common to several tools, and some are specific to one tool.

You can move the options bar in the workspace by using the gripper bar, and you can dock it at the top or bottom of the screen. Tool tips appear when you position the pointer over a tool. To show or hide the options bar, choose Window > Options. (Fig 6)



Tool presets (Fig 7)



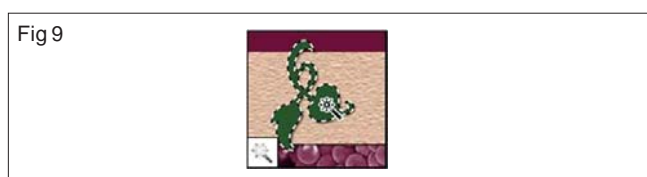
Tool presets let you save and reuse tool settings. You can load, edit, and create libraries of tool presets using the Tool Preset picker in the options bar, the Tool Presets panel, and the Preset Manager.

To choose a tool preset, click the Tool Preset picker in the options bar, and select a preset from the pop up panel. You can also choose Window > Tool Presets and select a preset in the Tools Presets panel.

The **marquee tools** make rectangular, elliptical, single row, and single column selections. (Fig 8)



The **Magic Wand tool** selects similarly colored areas. (Fig 9)



The **Move tool** moves selections, layers, and guides. (Fig 10)



The **lasso tools** make free hand, polygonal (straight-edged), and magnetic (snap-to) selections. (Fig 11)

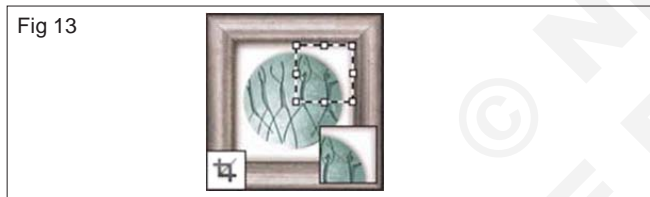


The **Quick Selection tool** lets you quickly "paint" a selection using an adjustable round brush tip. (Fig 12)



- **Crop and slice tools gallery**

Crop tool trims images. (Fig 13)



The **tool** creates slices. (Fig 14)



The **Slice Select tool** selects slices. (Fig 15)

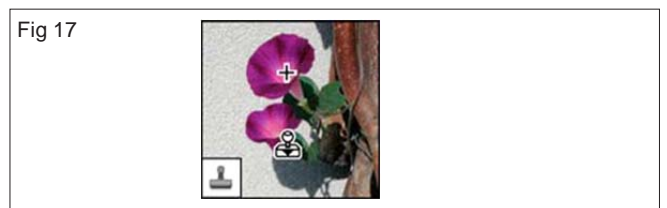
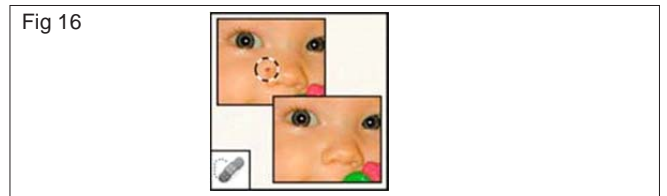


- **Retouching tools gallery**

The **Spot Healing Brush tool** removes blemishes and objects. (Fig 16)

The **Clone Stamp tool** paints with a sample of an image. (Fig 17)

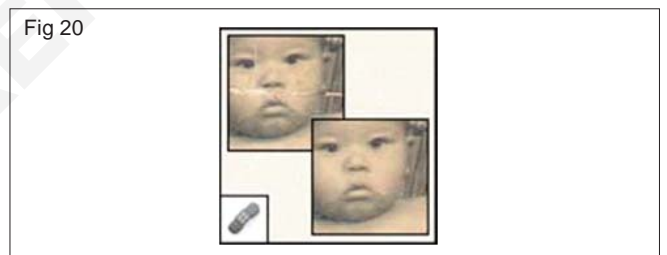
The **Magic Eraser tool** erases solid-colored areas to transparency with a single click. (Fig 18)



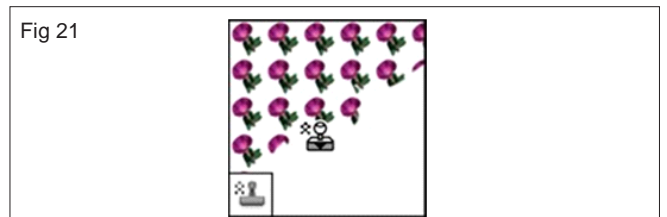
The **Dodge tool** lightens areas in an image. (Fig 19)



The **Healing Brush tool** paints with a sample or pattern to repair imperfections in a image. (Fig 20)



The **Pattern Stamp tool** paints with part of an image as a pattern. (Fig 21)



The **Blur tool** blurs hard edges in an image. (Fig 22)



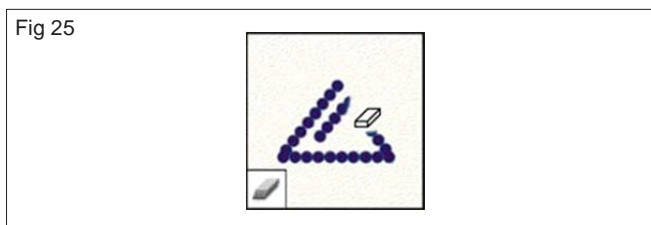
The **Burn tool** darkens are as in an image. (Fig 23)



The **Patch tool** repairs imperfections in a selected area of an image using a sample pattern. (Fig 24)



The **Eraser tool** erases pixels and restores parts of an image to a previously saved state. (Fig 25)



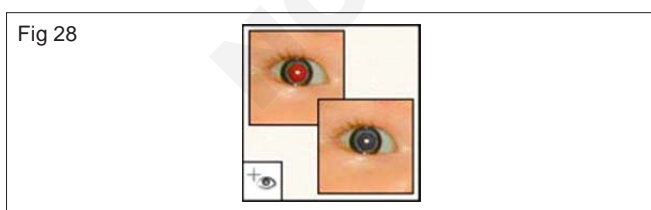
The **Sharpen tool** sharpens soft edges in an image. (Fig 26)



The **Sponge tool** changes the color saturation of an area. (Fig 27)



The **Red Eye tool** removes the red reflection caused by a flash. (Fig 28)



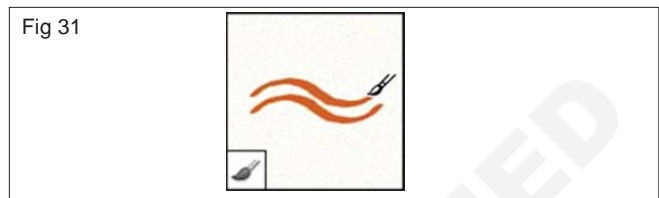
The **Background Eraser tool** erases are as to transparency by dragging. (Fig 29)



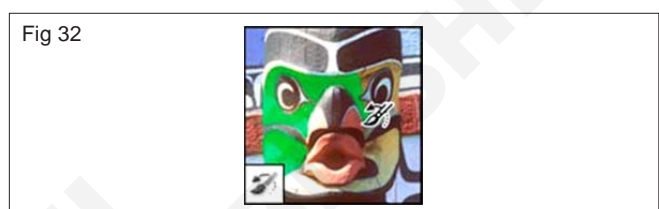
The **Smudge tools** smudges data in an image. (Fig 30)



• **Painting tools** gallery. (Fig 31)

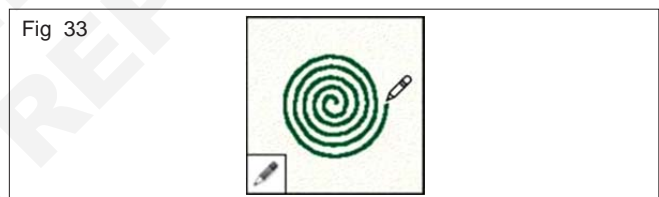


The **Brush tool** paints brush strokes. (Fig 32)



The **History Brush tool** paints a copy of the selected state or snaps hot into the current image window.

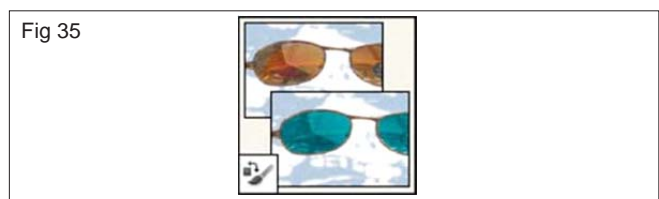
The **Pencil tool** paints hard-edged strokes. (Fig 33)



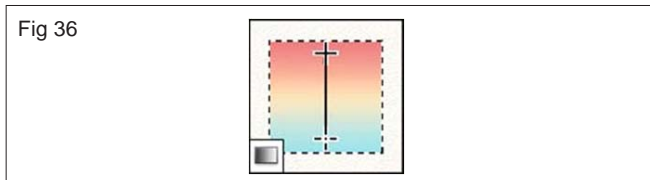
The **Art History brush tool** paints with stylized strokes that simulate the look of different paint styles, using a selected state or snapshot. (Fig 34)



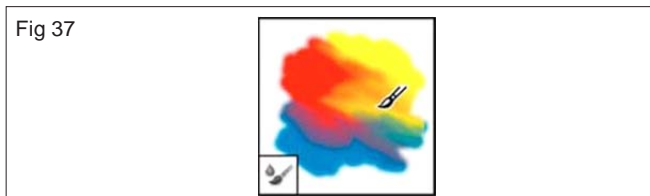
The **Color Replacement tool** replaces a selected color with a new color. (Fig 35)



The **gradient tools** create straight-line, radial, angle, reflected, and diamond blends between colors. (Fig 36)



The **Mixer Brush tool** Simulates realistic painting techniques such as blending canvas colors and varying paint wetness. (Fig 37)

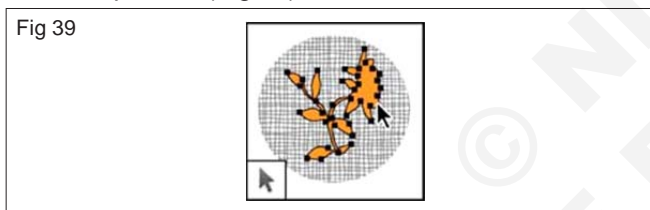


The **Paint Bucket tool** fills similarly colored areas with the foreground color. (Fig 38)

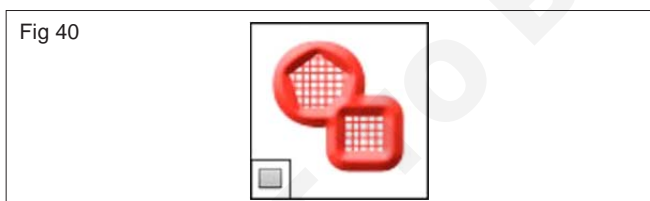


- **Drawing and type tools gallery.**

The **path selection tools** make shape or segment selections showing anchor points, direction lines, and direction points. (Fig 39)



The **shape tools and Line tool** draw shapes and lines in a normal layer or a shape layer. (Fig 40)



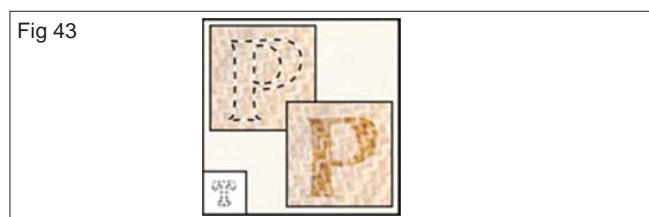
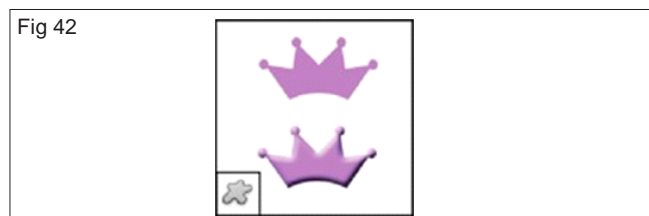
The **type tools** create type on an image. (Fig 41)



The **Custom Shape tool** makes customized shapes selected from a custom shape list. (Fig 42)

The **type mask tools** create a selection in the shape of type. (Fig 43)

The **pen tools** let you draw smooth-edged paths. (Fig 44)



- **Navigation, notes and measuring tools gallery.** (Fig 45)

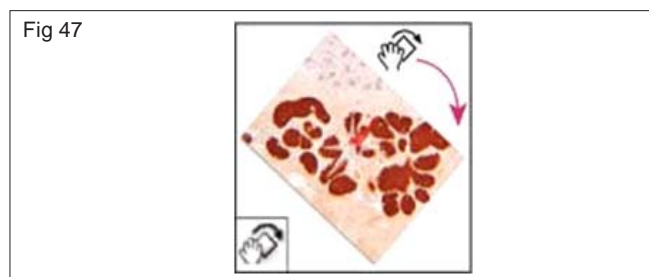
The **Hand tool** moves an image within its window.



The **Eye dropper tool** samples colors in an image. (Fig 46)



The **Rotate View tool** non-destructively rotates the canvas. (Fig 47)



The **Color Sampler tool** displays color values for upto four areas. (Fig 48)

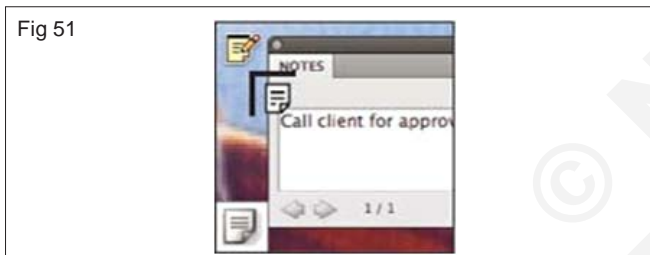
The **Zoom tool** magnifies and reduces the view of an image. (Fig 49)



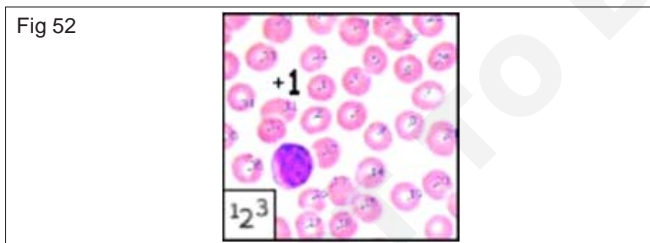
The **Ruler tool** measures distances, locations, and angles. (Fig 50)



The **Note tool** makes notes that can be attached to an image. (Fig 51)

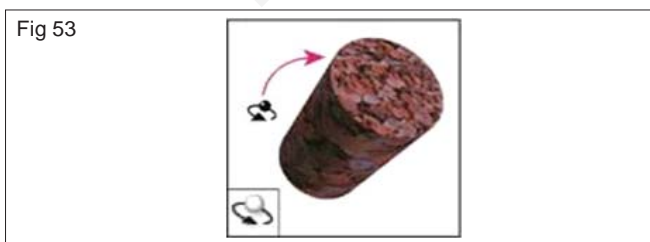


The **Count tool** counts objects in an image. (Photoshop Extended only) (Fig 52)

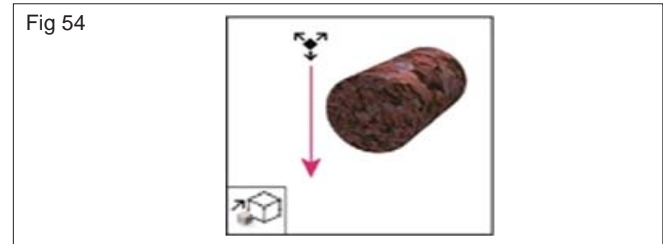


• **3D tools gallery**

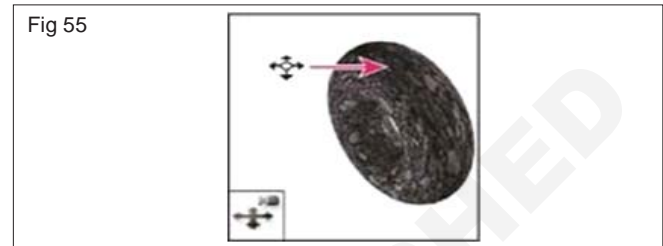
The **3D Object Rotate tool** rotates the object around its x- axis. (Fig 53)



The **3D Object Scale tool** scales the object larger or smaller. (Fig 54)



The **3D Walk Camera tool** moves laterally when you drag horizontally, or forward and back when you drag vertically. (Fig 55)



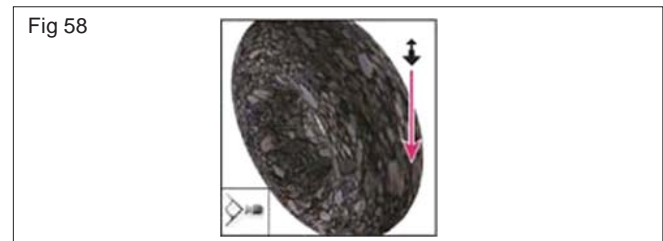
The **3D Object Roll tool** rotates the object around its z-axis. (Fig 56)



The **3D Rotate Camera tool** orbits the camera in the x or y direction. (Fig 57)



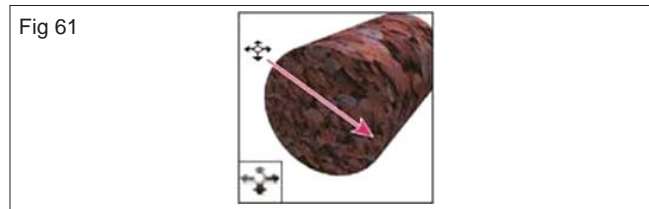
The **3D Zoom Camera tool** changes the field of view closer or farther away. (Fig 58)



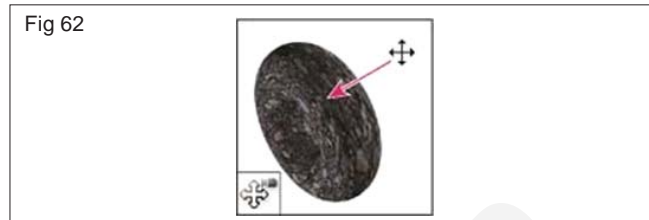
The **3D Object Pan tool** pans the object in the x or y direction. (Fig 59)

The **3D Roll Camera tool** rotates the camera around the z-axis. (Fig 60)

The **3D Object Slide tool** moves the object laterally when you drag horizontally, or forward and back when you drag vertically. (Fig 61)



The **3D Pan Camera** tool pans the camera in the x or y direction. (Fig 62)



Selecting, Editing and Cropping the Images

Objectives : At the end of this lesson you shall be able to

- use of Marquee tools in Adobe Photoshop
- use of Lasso, Polygonal Lasso, and Magnetic Lasso Tools
- learning about Transformation, Crop, Rotation and Canvas.

Marquee tool

The marquee tools let you select rectangles, ellipses, and 1 pixel rows and columns.


Select with the Lasso tool

The Lasso tool is useful for drawing freeform segments of a selection border.

Select with the Polygonal Lasso tool

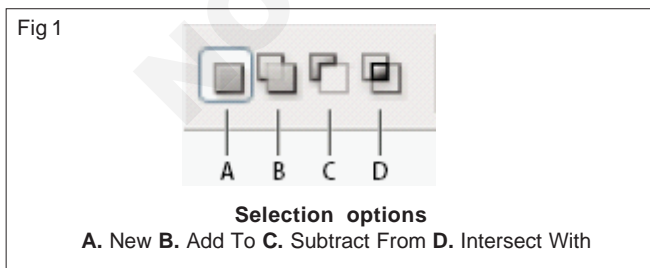
The Polygonal Lasso tool is useful for drawing straight-edged segments of a selection border.

Select with the Magnetic Lasso tool

When you use the Magnetic Lasso tool , the border snaps to the edges of defined areas in the image. The Magnetic Lasso tool is not available for 32 bits-per-channel images.

The Magnetic Lasso tool is especially useful for quickly selecting objects with complex edges set against high-contrast backgrounds.

- 1 Select the Magnetic Lasso tool. (Fig 1)



- 2 Specify one of the selection options in the options bar.
- 3 (Optional) Set feathering and anti-aliasing in the options bar
- 4 Set any of these options:

Width

To specify a detection width, enter a pixel value for Width. The Magnetic Lasso tool detects edges only within the specified distance from the pointer.

To change the lasso pointer so that it indicates the lasso width, press the Caps Lock key. You can change the pointer while the tool is selected but not in use. Press the right bracket (]) to increase the Magnetic Lasso edge width by 1 pixel; press the left bracket ([) to decrease the width by 1 pixel.

Contrast

To specify the lasso's sensitivity to edges in the image, enter a value between 1% and 100% for Contrast. A higher value detects only edges that contrast sharply with their surroundings; a lower value detects lower-contrast edges.

Frequency

To specify the rate at which the lasso sets fastening points, enter a value between 0 and 100 for Frequency. A higher value anchors the selection border in place more quickly.

On an image with well-defined edges, try a higher width and higher edge contrast, and trace the border roughly. On an image with softer edges, try a lower width and lower edge contrast, and trace the border more precisely.

Stylus Pressure

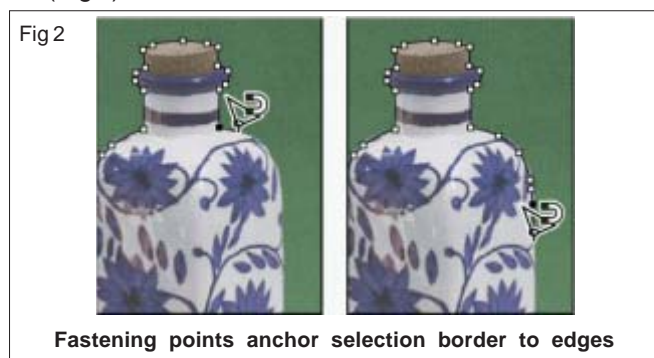
If you are working with a stylus tablet, select or deselect the Stylus Pressure option. When the option is selected, an increase in stylus pressure decreases the edge width.

- 5 Click in the image to set the first fastening point. Fastening points anchor the selection border in place.

- 6 Release the mouse button or keep it depressed, and then move the pointer along the edge you want to trace.

The most recent segment of the selection border remains active. As you move the pointer, the active segment snaps to the strongest edge in the image, based on the detection width set in the options bar. Periodically, the Magnetic Lasso tool adds fastening points to the selection border to anchor previous segments.

- 7 If the border doesn't snap to the desired edge, click once to add a fastening point manually. Continue to trace the edge, and add fastening points as needed. (Fig 2)



- 8 To switch temporarily to the other lasso tools, do one of the following:
 - To activate the Lasso tool, hold down Alt (Windows) or Option (Mac OS), and drag with the mouse button depressed.
 - To activate the Polygonal Lasso tool, hold down Alt (Windows) or Option (Mac OS), and click.
9. To erase recently drawn segments and fastening points, press the Delete key until you've erased the fastening points for the desired segment.
10. Close the selection border:
 - To close the border with a magnetic segment, double-click, or press Enter or Return. (To manually close the border, drag over the starting point and click.)
 - To close the border with a straight segment, hold down Alt (Windows), and double-click.
11. (Optional) Click Refine Edge to further adjust the selection boundary.

Transforming objects

Transformations

Transforming scales, rotates, skews, stretches, or warps an image. You can apply transformations to a selection, an entire layer, multiple layers, or a layer mask. You can also apply transformations to a path, a vector shape, a vector mask, a selection border, or an alpha channel. Transforming affects image quality when you manipulate the pixels. To apply non-destructive transformations to raster images, use Smart Objects. Transforming a vector shape or path is always non-destructive because you're

only changing the mathematical calculations producing the object.

To make a transformation, first select an item to transform and then choose a transformation command. If necessary, adjust the reference point before manipulating the transformation. You can perform several manipulations in succession before applying the cumulative transformation. For example, you can choose Scale and drag a handle to scale, and then choose Distort and drag a handle to distort. Then press Enter or Return to apply both transformations.

Photoshop uses the interpolation method selected in the General area of the Preferences dialog box to calculate the color values of pixels that are added or deleted during transformations. This interpolation setting directly affects the speed and quality of the transformation. Bicubic interpolation, the default, is slowest but yields the best results.

You can also warp and distort raster images using the Liquify filter

Transform submenu commands

Scale

Enlarges or reduces an item relative to its reference point, the fixed point around which transformations are performed. You can scale horizontally, vertically, or both horizontally and vertically.

Rotate

Turns an item around a reference point. By default, this point is at the center of the object; however, you can move it to another location.

Skew

Slants an item vertically and horizontally.

Distort

Stretches an item in all directions.

Perspective

Applies one-point perspective to an item.

Warp

Manipulates the shape of an item.

Rotate 180, Rotate 90 CW, Rotate 90 CCW

Rotates the item by the specified number of degrees, either clockwise or counterclockwise.

Flip

Flips the item vertically or horizontally.

Set or move the reference point for a transformation

All transformations are performed around a fixed point called the reference point. By default, this point is at the center of the item you are transforming. However, you can change the reference point or move the center point to a different location using the reference point locator in the options bar.

- 1 Choose a transformation command. A bounding box appears in the image.
- 2 Do one of the following:
 - In the options bar, click a square on the reference point locator. Each square represents a point on the bounding box. For example, to move the reference point to the upper-left corner of the bounding box, click the top left square on the reference point locator.
 - In the transform bounding box that appears in the image, drag the reference point. The reference point can be outside the item you want to transform.

Transform freely

The Free Transform command lets you apply transformations (rotate, scale, skew, distort, and perspective) in one continuous operation. You can also apply a warp transformation. Instead of choosing different commands, you simply hold down a key on your keyboard to switch between transformation types.

If you are transforming a shape or entire path, the Transform command becomes the Transform Path command. If you are transforming multiple path segments (but not the entire path), the Transform command becomes the Transform Points command.

Warp an item

The Warp command lets you drag control points to manipulate the shape of images, shapes, or paths, and so on. You can also warp using a shape in the Warp Style pop-up menu in the options bar. Shapes in the Warp Style pop-up menu are also malleable; drag their control points.

When using the control points to distort an item, choosing View > Extras shows or hides the warp mesh and control points.

Puppet Warp

Puppet Warp provides a visual mesh that lets you drastically distort specific image areas, while leaving other areas intact. Applications range from subtle image retouching (such as shaping hair) to total transformations (such as repositioning arms or legs). (Fig 4)

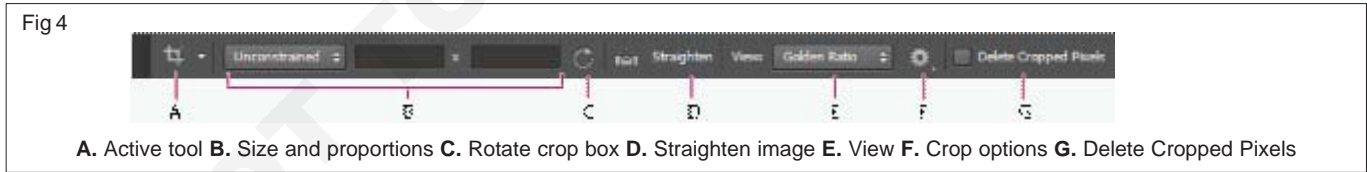
In addition to image layers, you can apply Puppet Warp to layer and vector masks. To nondestructively distort images, use Smart Objects.

Crop images (Fig 3)

Cropping is the process of removing portions of an image to create focus or strengthen the composition. You can crop an image using the Crop tool and the Crop command. You can also trim pixels using the Crop And Straighten and the Trim commands.

Cropping is the process of removing portions of an image to create focus or strengthen the composition. Use the Crop tool to crop and straighten images in Photoshop. The Crop tools in Photoshop CC and CS6 are non-destructive and you can choose to retain the cropped pixels to optimize the crop boundaries later. The Crop tool also provides intuitive methods to straighten the image while cropping.

For all operations, visual guides provide an interactive preview. When you crop or straighten photos, real-time feedback helps you visualize the final result.



Using Crop tools

Watch how to preview the angle of your image to confirm that your crop is plumb. You can revisit a crop any time you like, so you never waste effort.

Size and proportions

Choose a ratio or size for the crop box. You can also choose a preset, enter your own, or even define your own preset values for later use.

View

Choose a view to display overlay guides while cropping. Guides such as Rule of Thirds, Grid, and Golden Ratio are

available. To cycle through all the options, press O.

Crop Options

Click the Settings menu to specify additional crop options.

Use Classic mode

Enable this option if you want to use the Crop tool like it was in previous versions of Photoshop.

Auto-center preview

Enable this option to place the preview in the center of the canvas.

Show Cropped Area

Enable this option to display the area that is cropped. If this option is disabled, only the final area is previewed.

Enable crop shield

Use the crop shield to overlay the cropped areas with a tint. You can specify a color and opacity. If you Enable Auto Adjust Opacity, the opacity is reduced when you edit the crop boundaries.

Delete cropped pixels

Disable this option to apply a non-destructive crop and retain pixels outside the crop boundaries. Non-destructive cropping does not remove any pixels. You can later click the image to see areas outside current crop borders.

Enable this option to delete any pixels that are outside the crop area. These pixels are lost and are not available for future adjustments.

Right-click the Crop box and access common crop options from the context menu.

Crop an image using the Trim command

The Trim command crops an image by removing unwanted image data in different ways than the Crop command. You can crop an image by trimming surrounding transparent pixels, or background pixels of the color you specify.

Transform perspective while cropping | CS5 (Fig 5)



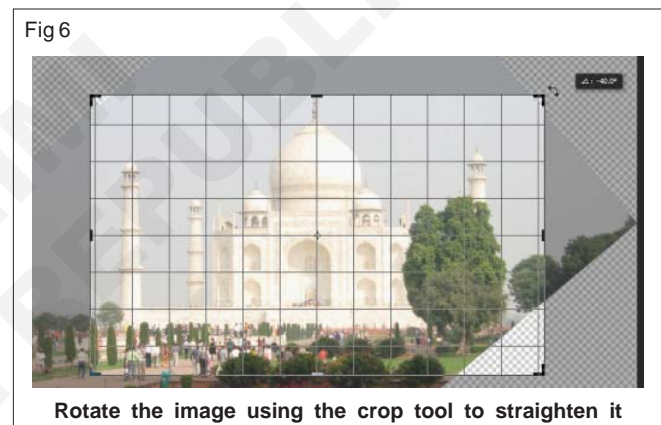
The Crop tool has an option that lets you transform the perspective in an image. Transforming the perspective is useful when working with images that contain keystone distortion. Keystone distortion occurs when an object is photographed from an angle rather than from a straight on view. For example, if you take a picture of a tall building from ground level, the edges of the building appear closer to each other at the top than they do at the bottom.

Crop and straighten scanned photos

You can place several photos on your scanner and scan them in one pass, which creates a single image file. The Crop and Straighten Photos command is an automated feature that can create separate image files from the multiple-image scan.

For best results, keep 1/8 inch between the images in your scan, and the background (typically the scanner bed) should be a uniform color with little noise. The Crop and Straighten Photos command works best on images with clearly delineated outlines. If the Crop and Straighten Photos command cannot properly process the image file, use the Crop tool.

Straighten an image (Fig 6)




You can straighten an image while cropping. The image is rotated and aligned to straighten it. The image canvas is automatically resized to accommodate the rotated pixels.

- To straighten an image do one of the following:
- Place the pointer a little outside the corner handles and drag to rotate the image. A grid displays inside the crop box and the image rotates behind it.
- Click Straighten in the control bar and then using the Straighten tool, draw a reference line to straighten the photo. For example, draw a line along the horizon or an edge to straighten the image along it.

Straighten an image

The Ruler tool provides a Straighten option that quickly aligns images with horizon lines, building walls, and other key elements.

- 1 Select the Ruler tool . (If necessary, click and hold the Eyedropper tool to reveal the Ruler.)

- 2 In the image, drag across a key horizontal or vertical element.
- 3 In the options bar, click Straighten.

Photoshop straightens the image and automatically crops it. To reveal image areas that extend beyond the new document boundaries, choose Edit > Undo.

Rotate or flip an entire image

The Image Rotation commands let you rotate or flip an entire image. The commands do not work on individual layers or parts of layers, paths, or selection borders. If you want to rotate a selection or layer, use the Transform or Free Transform commands.

Choose Image > Image Rotation, and choose one of the following commands from the submenu:

180°

Rotates the image by a half-turn.

90° CW

Rotates the image clockwise by a quarter-turn.

90° CCW

Rotates the image counterclockwise by a quarter-turn.

Arbitrary

Rotates the image by the angle you specify. If you choose this option, enter an angle between -359.99 and 359.99 in the angle text box. (In Photoshop, you can select °CW or °CCW to rotate clockwise or counterclockwise.) Then click OK.

Image Essentials

Objectives : At the end of this lesson you shall be able to

- explain Raster and Vector graphics
- learn about various file format used in Adobe Photoshop
- explain Tonal value and Tonal Gradation.

Bitmap images (Fig 1)

Bitmap images-technically called raster images-use a rectangular grid of picture elements (pixels) to represent images. Each pixel is assigned a specific location and color value. When working with bitmap images, you edit

Flip Canvas Horizontal or Vertical

Flips the image along the corresponding axis.

Image Rotation is destructive editing and actually modifies the file information. If you want to non-destructively rotate the image for viewing, use the Rotation tool.

Change the canvas size

The canvas size is the full editable area of an image. The Canvas Size command lets you increase or decrease an image's canvas size. Increasing the canvas size adds space around an existing image. Decreasing an image's canvas size crops into the image. If you increase the canvas size of an image with a transparent background, the added canvas is transparent. If the image doesn't have a transparent background, there are several options for determining the color of the added canvas.

Crop and straighten photos

Cropping is the process of removing portions of an image to create focus or strengthen the composition. Use the Crop tool to crop and straighten images in Photoshop. The Crop tools in Photoshop CC and CS6 are non-destructive and you can choose to retain the cropped pixels to optimize the crop boundaries later. The Crop tool also provides intuitive methods to straighten the image while cropping.

For all operations, visual guides provide an interactive preview. When you crop or straighten photos, real-time feedback helps you visualize the final result.

Fig 1



pixels rather than objects or shapes. Bitmap images are the most common electronic medium for continuous-tone images, such as photographs or digital paintings, because they can more efficiently represent subtle gradations of shades and color.

Bitmap images are resolution-dependent—that is, they contain a fixed number of pixels. As a result, they can lose detail and appear jagged if they are scaled to high magnifications on-screen or if they are printed at a lower resolution than they were created for.

Bitmap images sometimes require large amounts of storage space, and often need to be compressed to keep file sizes down when used in certain Creative Suite components. For instance, you compress an image file in its original application before you import it into a layout.

In Adobe Illustrator, you can create bitmap effects in your artwork using effects and graphic styles.

Vector graphics

Vector graphics (sometimes called vector shapes or vector objects) are made up of lines and curves defined by mathematical objects called vectors, which describe an image according to its geometric characteristics.

You can freely move or modify vector graphics without losing detail or clarity, because they are resolution-independent—they maintain crisp edges when resized, printed to a PostScript printer, saved in a PDF file, or imported into a vector-based graphics application. As a result, vector graphics are the best choice for artwork, such as logos, that will be used at various sizes and in various output media.

The vector objects you create using the drawing and shape tools in Adobe Creative Suite are examples of vector graphics. You can use the Copy and Paste commands to duplicate vector graphics between Creative Suite components.

Combining vector graphics and bitmap images

When combining vector graphics and bitmap images in a document, it's important to remember that how your artwork looks on-screen isn't always how it will look in its final medium (whether commercially printed, printed on a desktop printer, or viewed on the web). The following factors influence the quality of your final artwork:

Transparency

Many effects add partially transparent pixels to your artwork. When your artwork contains transparency, Photoshop performs a process called flattening before printing or exporting. In most cases, the default flattening process produces excellent results. However, if your artwork contains complex, overlapping areas and you require high-resolution output, you will probably want to preview the effects of flattening.

Image Resolution

The number of pixels per inch (ppi) in a bitmap image. Using too low a resolution for a printed image results in pixelation—output with large, coarse-looking pixels. Using too high a resolution (pixels smaller than what the output device can produce) increases the file size without

increasing the quality of the printed output, and slows the printing of the artwork.

Printer resolution and screen frequency

The number of ink dots produced per inch (dpi) and the number of lines per inch (lpi) in a halftone screen. The relationship between image resolution, printer resolution, and screen frequency determines the quality of detail in the printed image.

Color channels

Every Photoshop image has one or more channels, each storing information about color elements in the image. The number of default color channels in an image depends on its color mode. By default, images in Bitmap, Grayscale, Duotone, and Indexed Color mode have one channel; RGB and Lab images have three; and CMYK images have four. You can add channels to all image types except Bitmap mode images.

Channels in color images are actually grayscale images that represent each of the color components of an image. For example, an RGB image has separate channels for red, green, and blue color values.

In addition to color channels, alpha channels can be added to an image for storing and editing selections as masks, and spot color channels can be added to add spot color plates for printing.

Bit depth

Bit depth specifies how much color information is available for each pixel in an image. The more bits of information per pixel, the more available colors and more accurate color representation. For example, an image with a bit depth of 1 has pixels with two possible values: black and white. An image with a bit depth of 8 has 256 possible values. Grayscale mode images with a bit depth of 8 have 256 possible gray values.

RGB images are made of three color channels. An 8-bit per pixel RGB image has 256 possible values for each channel which means it has over 16 million possible color values. RGB images with 8-bits per channel (bpc) are sometimes called 24-bit images (8 bits x 3 channels = 24 bits of data for each pixel).

In addition to 8-bpc images, Photoshop can also work with images that contain 16-bpc or 32-bpc. Images with 32-bpc are also known as high dynamic range (HDR) images.

Photoshop support for 16-bit images

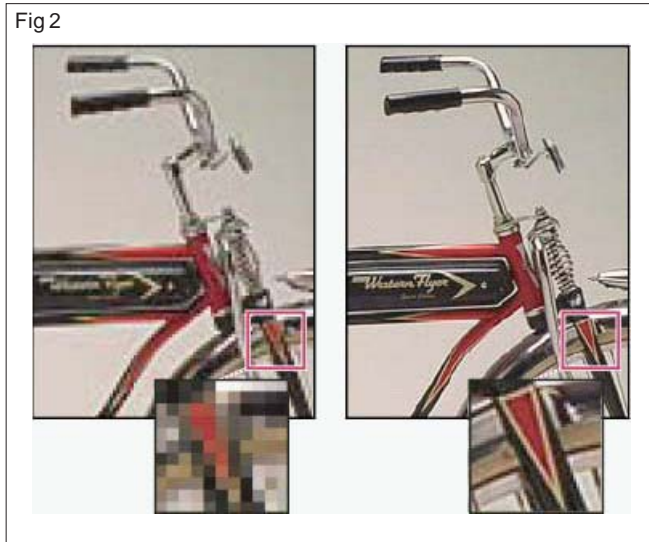
Photoshop provides the following support for working with 16-bpc images:

- Working in Grayscale, RGB Color, CMYK Color, Lab Color, and Multichannel, modes.
- All tools in the toolbox, except the Art History Brush tool, can be used with 16-bpc images.
- Color and tonal adjustment commands are available
- You can work with layers, including adjustment layers, in 16-bpc images.

- Many Photoshop filters can be used with 16-bpc images.

To take advantage of certain Photoshop features, such as some filters, you can convert a 16-bpc image to an 8-bpc image. It's best if you do a Save As and convert a copy of the image file so the original file retains the full 16-bpc image data.

Convert between bit depths (Fig 2)



- Do any of the following:
- To convert between 8 bpc and 16 bpc, Choose Image > Mode > 16 Bits/Channel or 8 Bits/Channel.
- To convert from 8 bpc or 16 bits to 32 bpc, choose Image > Mode > 32 Bits/Channel.

Pixel dimensions and printed image resolution

Pixel dimensions measure the total number of pixels along an image's width and height. Resolution is the fineness of detail in a bitmap image and is measured in pixels per inch (ppi). The more pixels per inch, the greater the resolution. Generally, an image with a higher resolution produces a better printed image quality.

Unless an image is resampled the amount of image data remains constant as you change either the print dimensions or resolution. For example, if you change the resolution of a file, its width and height change accordingly to maintain the same amount of image data.

In Photoshop, you can see the relationship between image size and resolution in the Image Size dialog box (choose Image > Image Size). Deselect Resample Image, because you don't want to change the amount of image data in your photo. Then change width, height, or resolution. As you change one value, the other two values change accordingly. With the Resample Image option selected, you can change the resolution, width, and height of the image to suit your printing or on-screen needs.

Quickly display the current image size

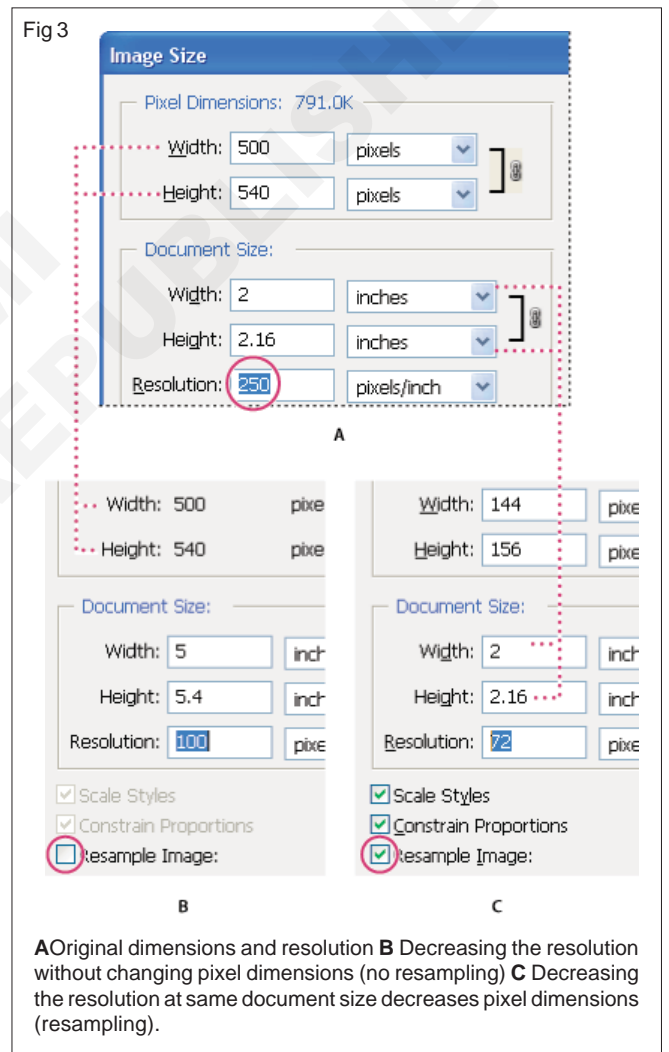
If you want to quickly display a document's current image size, use the information box at the bottom of the document window.

- Position the pointer over the file information box, and hold down the mouse button.

File size

The file size of an image is the digital size of the image file, measured in kilobytes (K), megabytes (MB), or gigabytes (GB). File size is proportional to the pixel dimensions of the image. Images with more pixels may produce more detail at a given printed size, but they require more disk space to store and may be slower to edit and print. Image resolution thus becomes a compromise between image quality (capturing all the data you need) and file size.

Another factor that affects file size is file format. Because of the varying compression methods used by GIF, JPEG, PNG, and TIFF file formats, file sizes can vary considerably for the same pixel dimensions. Similarly, color bit-depth and the number of layers and channels in an image affect file size. (Fig 3)

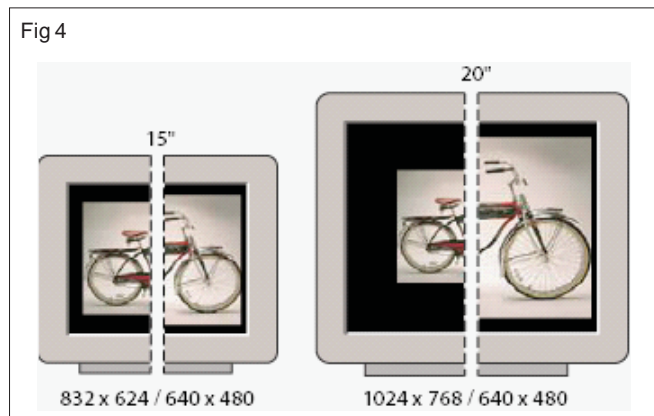


Photoshop supports a maximum pixel dimension of 300,000 by 300,000 pixels per image. This restriction places limits on the print size and resolution available to an image.

Monitor resolution (Fig 4)

Your monitor's resolution is described in pixel dimensions. For example, if your monitor resolution and your photo's pixel dimensions are the same size, the photo will fill the

screen when viewed at 100%. How large an image appears on-screen depends on a combination of factors—the pixel dimensions of the image, the monitor size, and the monitor resolution setting. In Photoshop, you can change the image magnification on-screen, so you can easily work with images of any pixel dimensions.



When preparing images for viewing on-screen, you should consider the lowest monitor resolution that your photo is likely to be viewed on.

Printer resolution

Printer resolution is measured in ink dots per inch, also known as dpi. Generally, the more dots per inch, the finer the printed output you'll get. Most inkjet printers have a resolution of approximately 720 to 2880 dpi. (Technically, inkjet printers produce a microscopic spray of ink, not actual dots like imagesetters or laser printers.)

Printer resolution is different from, but related to image resolution. To print a high quality photo on an inkjet printer, an image resolution of at least 220 ppi should provide good results.

Screen frequency is the number of printer dots or halftone cells per inch used to print grayscale images or color separations. Also known as screen ruling or line screen, screen frequency is measured in lines per inch (lpi)—or lines of cells per inch in a halftone screen. The higher the resolution of the output device, the finer (higher) a screen ruling you can use.

The relationship between image resolution and screen frequency determines the quality of detail in the printed image. To produce a halftone image of the highest quality, you generally use an image resolution that is from 1.5 to at most 2 times the screen frequency. But with some images and output devices, a lower resolution can produce good results. To determine your printer's screen frequency, check your printer documentation or consult your service provider.

Some imagesetters and 600-dpi laser printers use screening technologies other than halftoning. If you are printing an image on a nonhalftone printer, consult your service provider or your printer documentation for the recommended image resolutions.

Resampling

Resampling is changing the amount of image data as you change either the pixel dimensions or the resolution of an image. When you downsample (decrease the number of pixels), information is deleted from the image. When you resample up (increase the number of pixels, or upsample), new pixels are added. You specify an interpolation method to determine how pixels are added or deleted.

About file formats

Graphic file formats differ in the way they represent image data (as pixels or as vectors), in compression technique, and in which Photoshop and ImageReady features they support.

If a supported file format does not appear in the appropriate dialog box or submenu, you may need to install the format's plug-in module.

BMP

BMP is a standard Windows image format on DOS and Windows-compatible computers. BMP format supports RGB, Indexed Color, Grayscale, and Bitmap color modes. You can specify either Windows or OS/2® format and a bit depth for the image. For 4-bit and 8-bit images using Windows format, you can also specify RLE compression.

Photoshop EPS

Encapsulated PostScript (EPS) language file format can contain both vector and bitmap graphics and is supported by virtually all graphic, illustration, and page-layout programs. EPS format is used to transfer PostScript-language artwork between applications. When you open an EPS file containing vector graphics, Photoshop rasterizes the image, converting the vector graphics to pixels.

EPS format supports Lab, CMYK, RGB, Indexed Color, Duotone, Grayscale, and Bitmap color modes, and does not support alpha channels. EPS does support clipping paths. Desktop Color Separations (DCS) format, a version of the standard EPS format, lets you save color separations of CMYK images. You use DCS 2.0 format to export images containing spot channels. To print EPS files, you must use a PostScript printer.

EPS TIFF or EPS PICT Preview (Photoshop)

These formats let you open images saved in file formats that create previews but are not supported by Adobe Photoshop (such as QuarkXPress®). An opened preview image can be edited and used like any other low-resolution file. EPS PICT Preview is available only in Mac OS.

GIF

Graphics Interchange Format (GIF) is the file format commonly used to display indexed-color graphics and images in hypertext markup language (HTML) documents over the World Wide Web and other online services. GIF is an LZW-compressed format designed to minimize file size and electronic transfer time. GIF format preserves

transparency in indexed-color images; however, it does not support alpha channels.

JPEG

Joint Photographic Experts Group (JPEG) format is commonly used to display photographs and other continuous-tone images in hypertext markup language (HTML) documents over the World Wide Web and other online services. JPEG format supports CMYK, RGB, and Grayscale color modes, and does not support alpha channels. Unlike GIF format, JPEG retains all color information in an RGB image but compresses file size by selectively discarding data.

A JPEG image is automatically decompressed when opened. A higher level of compression results in lower image quality, and a lower level of compression results in better image quality. In most cases, the Maximum quality option produces a result indistinguishable from the original.

PDF

Portable Document Format (PDF) is a flexible, cross-platform, cross-application file format. Based on the PostScript imaging model, PDF files accurately display and preserve fonts, page layouts, and both vector and bitmap graphics. In addition, PDF files can contain electronic document search and navigation features such as electronic links.

Photoshop and ImageReady recognize two types of PDF files: Photoshop PDF files and Generic PDF files. You can open both types of PDF files; however, you can only save images to Photoshop PDF format.

PNG

Developed as a patent-free alternative to GIF, Portable Network Graphics (PNG) format is used for lossless compression and for display of images on the World Wide Web. Unlike GIF, PNG supports 24-bit images and produces background transparency without jagged edges; however, some Web browsers do not support PNG images. PNG format supports RGB, indexed-color, grayscale, and Bitmap-mode images without alpha channels. PNG preserves transparency in grayscale and RGB images.

TIFF

Tagged-Image File Format (TIFF) is used to exchange files between applications and computer platforms. TIFF is a flexible bitmap image format supported by virtually all paint, image-editing, and page-layout applications. Also, virtually all desktop scanners can produce TIFF images.

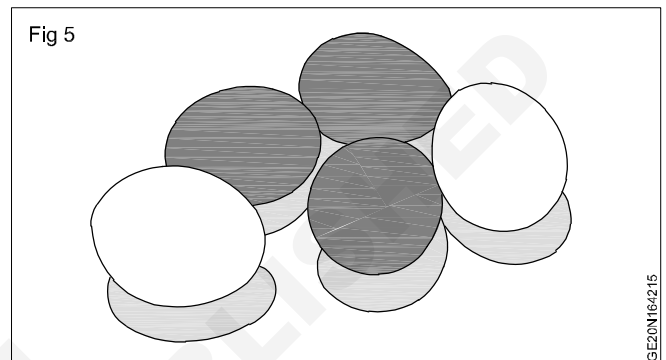
TIFF format supports CMYK, RGB, Lab, indexed-color, and grayscale images with alpha channels and Bitmap-mode images without alpha channels. Photoshop can save layers in a TIFF file; however, if you open the file in another application, only the flattened image is visible. Photoshop can also save annotations, transparency, and multiresolution pyramid data in TIFF format.

Tonal Value is defined as the comparative flimsiness or darkness of tones linking black and white. These are the

darkened lines of a drawing. Tonal values are what make a painting 'talk' not the color - no matter how much color you put in a picture.

Tone refers to the degree of lightness or darkness of an area. Tone varies from the bright white of a light source through shades of gray to the deepest black shadows. How we perceive the tone of an object depends on its actual surface lightness or darkness, color and texture, the background and lighting. Tone is may be used broadly ('global tone') to denote the major planes of an object; realist artists use 'local tone' to accurately denote subtle changes within the plane

Tonal gradation (Fig 5)



In pictures often concentrate on the density and detail of highlights and shadows when they should actually be considering the most important or middle tones of the negative. Middle tones are the various tones of gray between the highlights and the shadows; that is, the densities that are not highlights or shadows are termed middle tones or intermediate tones.

The middle tones vary with the type of film and the subject contrast. A negative should have a range of middle tone densities that correspond proportionally to the middle reflective brightness of the subject. A panchromatic negative that does not have proportionate mid tones is contrasty or flat.

Continuous tone

A continuous tone image is one where each color at any point in the image is reproduced as a single tone, and not as discrete halftones, such as one single color for monochromatic prints, or a combination of halftones for color prints.

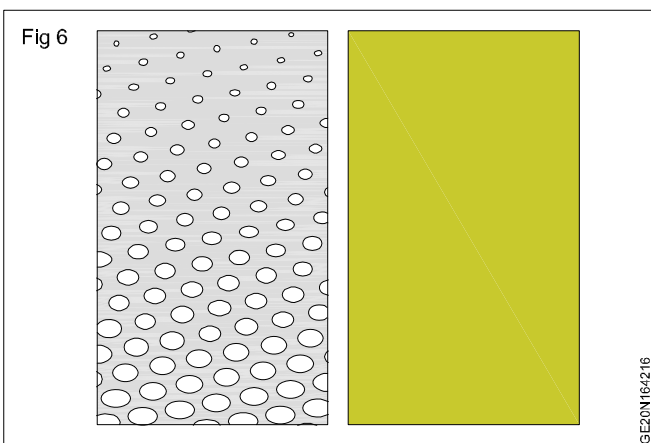
The most common continuous tone images are digital photographs every single pixel of which can take a continuous range of colors depending on the quantity of captured radiance. On the other hand, at a microscopic level, developed black-and-white photographic film consists of only two colors, and not an infinite range of continuous tones. For details, see film grain. Therefore, film is a halftone medium.

An example of a continuous-tone device is a CRT computer screen. Here, any pixel can represent any color, because the color components of the pixel are analog and can vary in infinite steps, and hence do not need halftones to make

the colors. Of course, because the computer is a digital device, it cannot provide the CRT with infinite tone variations. In 24-bit color mode, it provides the monitor with 256 discrete steps for each channel (red, green, and blue), for a total of 16,777,216 (256³) discrete colors. A purely analog video signal (one that has not been manipulated by a computer of any kind) can provide infinite tone variations inside its own gamut.

A halftone device, in contrast, uses discrete dots of color, which at a certain distance printers. Magazines and most printed material also use th look closely like the intended color. Examples of this are inkjetis technique to create the colors.

Halftone (Fig 6)



Halftone is the reprographic technique that simulates continuous tone imagery through the use of dots, varying either in size, in shape or in spacing, thus generating a gradient like effect as shown in Fig 6. "Halftone" can also be used to refer specifically to the image that is produced by this process.

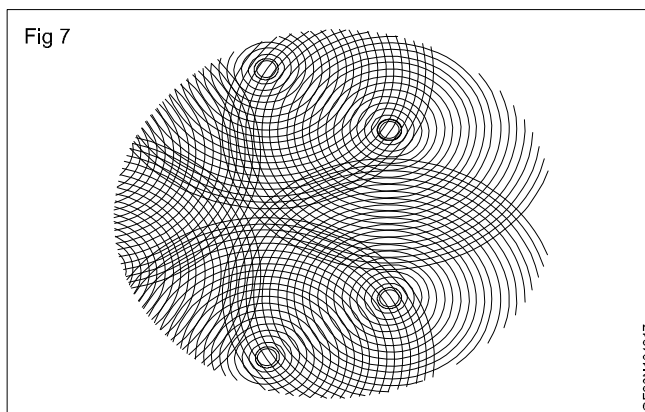
Where continuous tone imagery contains an infinite range of colors or greys, the halftone process reduces visual reproductions to an image that is printed with only one color of ink, in dots of differing size. This reproduction relies on a basic optical illusion-that these tiny halftone dots are blended into smooth tones by the human eye. At a microscopic level, developed black-and-white photographic film also consists of only two colors, and not an infinite range of continuous tones. For details, see film grain.

Just as color photography evolved with the addition of filters and film layers, color printing is made possible by repeating the halftone process for each subtractive color-most commonly using what is called the "CMYK color model". The semi-opaque property of ink allows halftone dots of different colors to create another optical effect-full-color imagery.

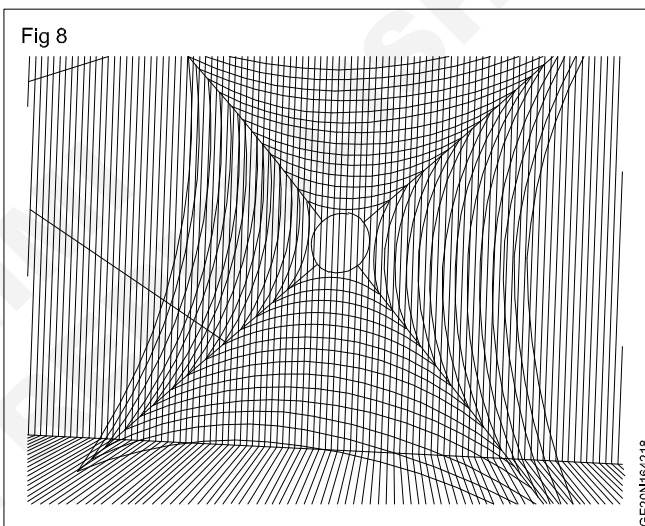
Moire pattern (Fig 7)

A moire pattern is a secondary and visually evident superimposed pattern created, for example, when two identical (usually transparent) patterns on a flat or curved surface (such as closely spaced straight lines drawn radiating from a point or taking the form of a grid) are

overlaid while displaced or rotated a small amount from one another.



This interference is called a **moire pattern**. In a scanned image, Moiré patterns are caused by interference between two sets of fine pattern grids, the scanner samples and the halftone screen in the original image as in Fig 8. Every scanner does this.



Any image printed on a printing press (like a book, magazine, newspaper, postcard, calendar, etc.) is printed with halftone screen patterns. The printed image is composed of a pattern of dots. A strong magnifying glass will show them. The halftone dots are printed entirely in black if a B&W image, or there are four screens in each of the three primary colors plus black (CMYK) if a Color image. These fine dots cause optical problems in a scanned image because the scanned image is also composed of fine dots.

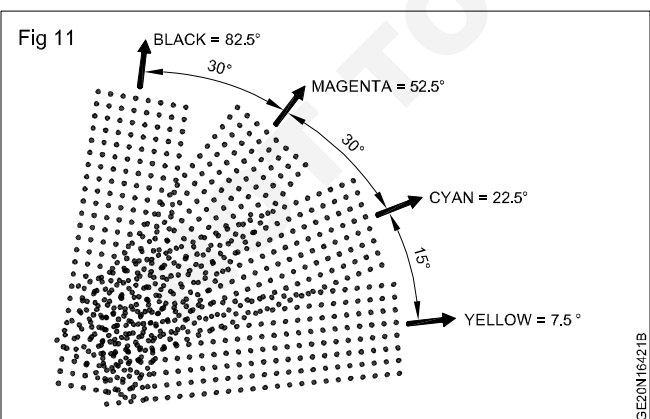
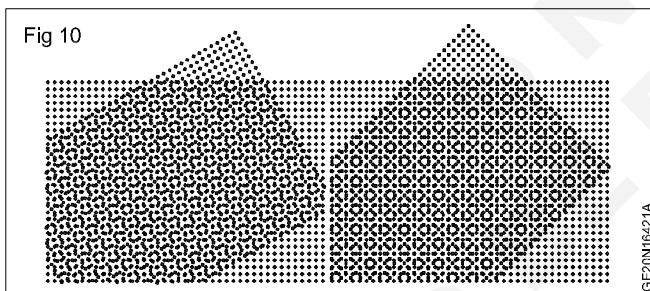
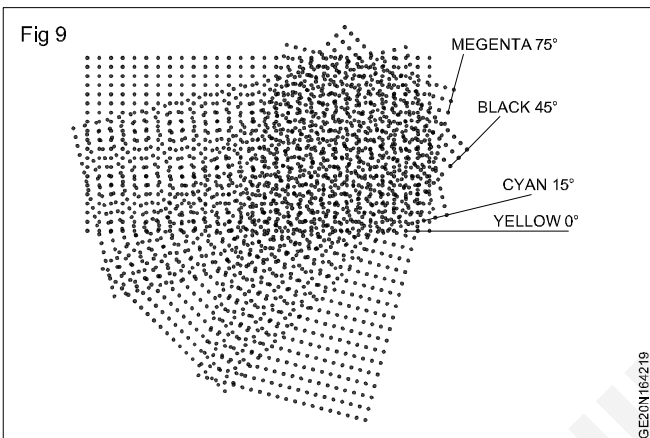
The two patterns of dots, the printed magazine's 133 or 150 lpi screened pattern, and the 300 or 600 dpi scanner CCD cells, combine into maximums or minimums every several pixels in the image, depending on the spacing of the dots as shown in Fig.4. It affects the overall light intensity in periodic patterns that become very visible. The pattern is named Moire.

In the graphic arts, the term moiré means an excessively visible moiré pattern. Part of the prepress art consists of selecting screen angles and halftone frequencies which minimize moiré. The visibility of moiré is not entirely predictable. The same set of screens may produce good

results with some images, but visible moiré with others.

In graphic arts and prepress, the usual technology for printing full-color images involves the superimposition of halftone screens. These are regular rectangular dot patterns-often four of them, printed in cyan, yellow, magenta, and black. Some kind of moiré pattern is inevitable, but the spatial frequency of the moiré is so high that it is not noticeable.

With the help of a strong magnifying glass you might discover these crosshatched or dotted pattern in your scanned images from printed material. Some image scanner driver programs provide an optional filter, called a "descreen" filter, to remove Moiré-pattern artifacts which would otherwise be produced when scanning printed halftone images to produce digital images. (Fig 9 to 11)



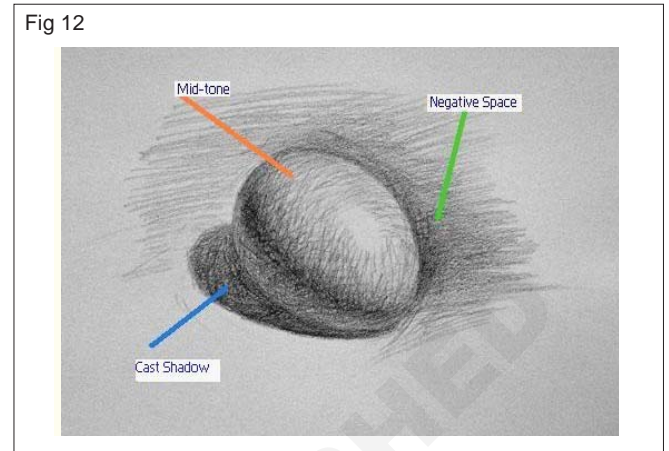
Highlight, middletone and shadow area

It's important to know what shadows, midtones and highlights in photographic in terms of photograph. These three elements are present are in every photograph color or black and white so it is important to understand how to improve an adjust these settings.

Highlight

Highlight are the lightest area of an image, therefore the parts that have the most light hitting it. if something has too many highlights we may say that it is overexposed and the area is lacking in detail.

Middle tone (Fig 12)



Midtones show the middle tones of an image - the colors that are in between. For example - If we had black and white image, the midtone would be grey somewhere between the two. You want a good amount of midtone in a balanced image but at the same time, you don't want everything to be 'grey' or flat.

Shadow area

Shadows are the darkest areas of a photograph. A shadow is also devoid of color, it could be black in the photograph or just the areas that carry little light. An image with too many shadows may be underexposed and, will not show so much detail although this can be normally adjusted.

Contrast

Contrast is the difference in luminance and/or color that makes an object (or its representation in an image or display) distinguishable. In visual perception of the real world, contrast is determined by the difference in the color and brightness of the object and other objects within the same field of view. Because the human visual system is more sensitive to contrast than absolute luminance, we can perceive the world similarly regardless of the huge changes in illumination over the day or from place to place. The maximum contrast of an image is the contrast ratio or dynamic range.

Contrast is also the difference between the color or shading of the printed material on a document and the background on which it is printed, for example in optical character recognition.

Saturation

In graphics and imaging, color saturation is used to describe the intensity of color in the image. A saturated image has overly bright colors. Using a graphics editing program you can increase saturation on under-exposed images, or vice versa.

Image Editing Softwares

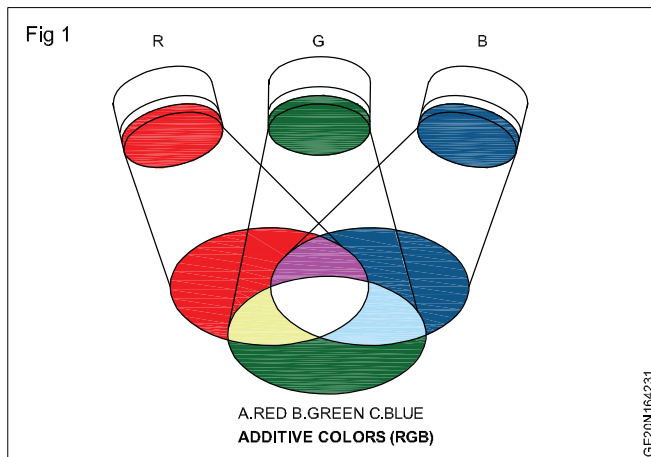
Objectives : At the end of this lesson you shall be able to

- understanding about color
- convert an image to another color mode
- learning about Hue, Saturation and vibrance.

Understanding color

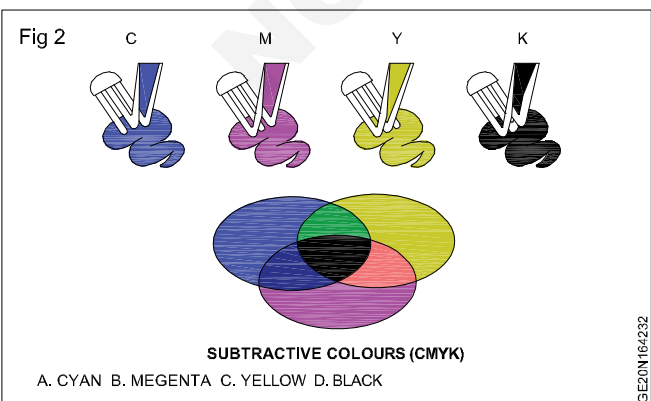
Knowing how colors are created and how they relate to each other lets you work more effectively in Photoshop. Instead of achieving an effect by accident, you'll produce consistent results thanks to an understanding of basic color theory.

Primary colors (Fig 1)



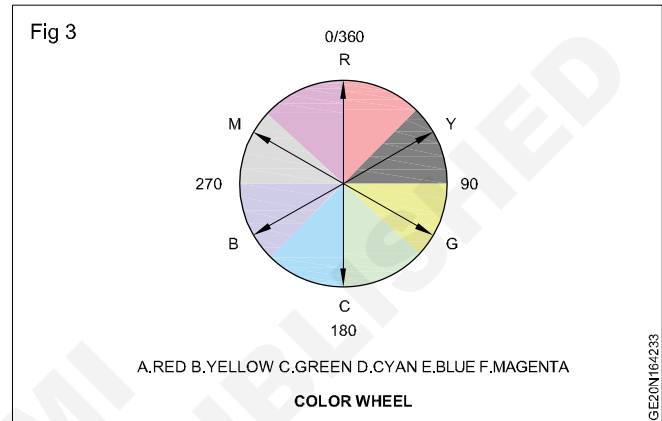
Additive primaries are the three colors of light (red, green, and blue) that produce all the colors in the visible spectrum when added together in different combinations. Adding equal parts of red, blue, and green light produces white. The complete absence of red, blue, and green light results in black. Computer monitors are devices that use the additive primaries to create color.

Subtractive primaries are pigments, which create a spectrum of colors in different combinations. Unlike monitors, printers use subtractive primaries (cyan, magenta, yellow, and black pigments) to produce colors through subtractive mixing. The term "subtractive" is used because the primary colors are pure until you begin mixing them together, resulting in colors that are less pure versions of the primaries. For example, orange is created through the subtractive mixing of magenta and yellow together. (Fig 2)



The color wheel

If you're new to adjusting color components, it helps to keep a standard color wheel diagram on hand when you work on color balance. You can use the color wheel to predict how a change in one color component affects other colors and also how changes translate between RGB and CMYK color models. (Fig 3)



For example, you can decrease the amount of any color in an image by increasing the amount of its opposite on the color wheel-and vice versa. Colors that lie opposite each other on the standard color wheel are known as complementary colors. Similarly, you can increase and decrease a color by adjusting the two adjacent colors on the wheel, or even by adjusting the two colors adjacent to its opposite.

In a CMYK image, you can decrease magenta either by decreasing the amount of magenta or by increasing its complement, which is green (the color on the opposite side of the color wheel from magenta). In an RGB image, you can decrease magenta by removing red and blue or by adding green. All of these adjustments result in an overall color balance containing less magenta.

Color models, spaces, and modes

A color model describes the colors we see and work with in digital images. Each color model, such as RGB, CMYK, or HSB, represents a different method (usually numeric) for describing color.

A color space is a variant of a color model and has a specific gamut (range) of colors. For example, within the RGB color model are a number of color spaces: Adobe RGB, sRGB, ProPhoto RGB, and so on.

Each device, like your monitor or printer, has its own color space and can only reproduce colors in its gamut. When an image moves from one device to another, image colors may change because each device interprets the RGB or CMYK values according to its own color space. You can

use color management when moving images to ensure that most colors are the same or similar enough so they appear consistent.

In Photoshop, a document's color mode determines which color model is used to display and print the image you're working on. Photoshop bases its color modes on the color models that are useful for images used in publishing. You can choose from RGB (Red, Green, Blue), CMYK (Cyan, Magenta, Yellow, Black), Lab Color (based on CIE L* a* b*), and Grayscale. Photoshop also includes modes for specialized color output such as Indexed Color and Duotone. Color modes determine the number of colors, the number of channels, and the file size of an image. Choosing a color mode also determines which tools and file formats are available.

When you work with the colors in an image, you are adjusting numerical values in the file. It's easy to think of a number as a color, but these numerical values are not absolute colors in themselves—they only have a color meaning within the color space of the device that is producing the color.

Adjusting color hue, saturation, and brightness

Based on the human perception of color, the HSB model describes three fundamental characteristics of color:

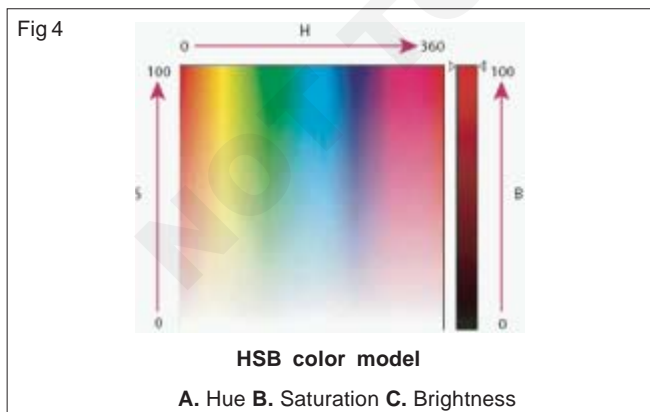
Hue

Color reflected from or transmitted through an object. It is measured as a location on the standard color wheel, expressed as a degree between 0° and 360°. In common use, hue is identified by the name of the color, such as red, orange, or green.

Saturation

Strength or purity of the color (sometimes called chroma). Saturation represents the amount of gray in proportion to the hue, measured as a percentage from 0% (grey) to 100% (fully saturated). On the standard color wheel, saturation increases from the center to the edge.

Brightness (Fig 4)



Relative lightness or darkness of the color, usually measured as a percentage from 0% (black) to 100% (white).

Convert an image to another color mode

You can change an image from its original mode (source mode) to a different mode (target mode). When you choose a different color mode for an image, you permanently change the color values in the image. For example, when you convert an RGB image to CMYK mode, RGB color values outside the CMYK gamut (defined by the CMYK working space setting in the Color Settings dialog box) are adjusted to fall within gamut. As a result, some image data may be lost and can't be recovered if you convert the image from CMYK back to RGB.

Before converting images, it's best to do the following:

- Do as much editing as possible in the original image mode (usually RGB for images from most scanners or digital cameras, or CMYK for images from traditional drum scanners or imported from a Scitex system).
- Save a backup copy before converting. Be sure to save a copy of your image that includes all layers so that you can edit the original version of the image after the conversion.
- Flatten the file before converting it. The interaction of colors between layer blending modes changes when the mode changes.

Convert an image to Bitmap mode

- Converting an image to Bitmap mode reduces the image to two colors, greatly simplifying the color information in the image and reducing its file size.
- When converting a color image to Bitmap mode, first convert it to Grayscale mode. This removes the hue and saturation information from the pixels and leaves just the brightness values. However, because only a few editing options are available for Bitmap mode images, it's usually best to edit the image in Grayscale mode and then convert it to Bitmap mode.
- Images in Bitmap mode are 1 bit per channel. You must convert a 16 or 32 bits-per-channel image to 8 bit Grayscale mode before converting it to Bitmap mode.

50% Threshold

Converts pixels with gray values above the middle gray level (128) to white and pixels with gray values below that level to black. The result is a very high-contrast, black-and-white representation of the image.

Pattern Dither

Converts an image by organizing the gray levels into geometric configurations of black and white dots.

Diffusion Dither

Converts an image by using an error-diffusion process, starting at the pixel in the upper-left corner of the image. If the pixel's value is above middle gray (128), the pixel is changed to white—if below it, to black. Because the original pixel is rarely pure white or pure black, error is inevitably introduced. This error is transferred to surrounding pixels and diffused throughout the image, resulting in a grainy, film-like texture.

Halftone Screen

Simulates the appearance of halftone dots in the converted image. Enter values in the Halftone Screen dialog box:

- For Frequency, enter a value for the screen frequency, and choose a unit of measurement. Values can range from 1.000 to 999.999 for lines per inch and from 0.400 to 400.00 for lines per centimeter. You can enter decimal values. The screen frequency specifies the ruling of the halftone screen in lines per inch (lpi). The frequency depends on the paper stock and type of press used for printing. Newspapers commonly use an 85 line screen. Magazines use higher resolution screens, such as 133 lpi and 150 lpi. Check with your print shop for correct screen frequencies.
- Enter a value for the screen angle in degrees from 180 to +180. The screen angle refers to the orientation of the screen. Continuous-tone and black-and-white halftone screens commonly use a 45° angle.
- For Shape, choose the dot shape you want.

The halftone screen becomes part of the image. If you print the image on a halftone printer, the printer will use its own halftone screen as well as the halftone screen that is part of the image. On some printers, the result is a moiré pattern.

Custom Pattern

Simulates the appearance of a custom halftone screen in the converted image. Choose a pattern that lends itself to thickness variations, typically one with a variety of gray shades.

To use this option, you first define a pattern and then screen the grayscale image to apply the texture. To cover the entire image, the pattern must be as large as the image. Otherwise, the pattern is tiled. Photoshop comes with several self-tiling patterns that can be used as halftone screen patterns.

Convert a Bitmap mode image to Grayscale mode

You can convert a Bitmap mode image to Grayscale mode in order to edit it. Keep in mind that a Bitmap mode image edited in Grayscale mode may not look the same when you convert it back to Bitmap mode. For example, suppose a pixel that is black in Bitmap mode is edited to a shade of gray in Grayscale mode. When the image is converted back to Bitmap mode, that pixel is rendered as white if its gray value is above the middle gray value of 128.

- 1 Choose Image > Mode > Grayscale.
- 2 Enter a value between 1 and 16 for the size ratio.

The size ratio is the factor for scaling down the image. For example, to reduce a grayscale image by 50%, enter 2 for the size ratio. If you enter a number greater than 1, the program averages multiple pixels in the Bitmap mode image to produce a single pixel in the grayscale image. This process lets you generate multiple shades of gray from an image scanned on a 1 bit scanner.

Convert a grayscale or RGB image to indexed color

Converting to indexed color reduces the number of colors in the image to at most 256—the standard number of colors supported by the GIF and PNG 8 formats and many multimedia applications. This conversion reduces file size by deleting color information from the image.

To convert to indexed color, you must start with an image that is 8 bits per channel and in either Grayscale or RGB mode.

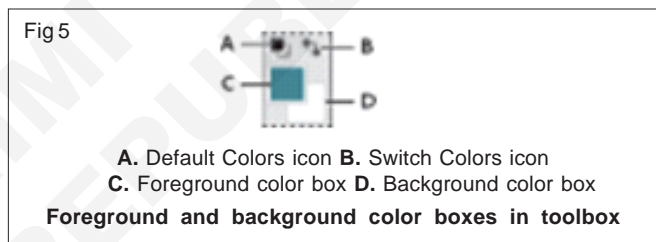
About foreground and background colors

Photoshop uses the foreground color to paint, fill, and stroke selections and the background color to make gradient fills and fill in the erased areas of an image. The foreground and background colors are also used by some special effects filters.

You can designate a new foreground or background color using the Eyedropper tool, the Color panel, the Swatches panel, or the Adobe Color Picker.

The default foreground color is black, and the default background color is white. (In an alpha channel, the default foreground is white, and the background is black.)

Choose colors in the toolbox (Fig 5)



The current foreground color appears in the upper color selection box in the toolbox; the current background color appears in the lower box.

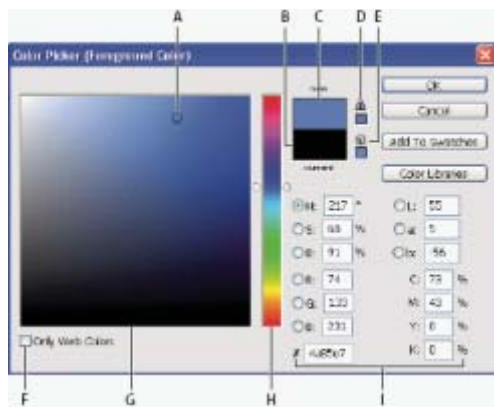
- To change the foreground color, click the upper color selection box in the toolbox, and then choose a color in the Adobe Color Picker.
- To change the background color, click the lower color selection box in the toolbox, and then choose a color in the Adobe Color Picker.
- To reverse the foreground and background colors, click the Switch Colors icon in the toolbox.
- To restore the default foreground and background colors, click the Default Colors icon in the toolbox.

Adobe Color Picker overview

In the Adobe Color Picker, you choose colors using four color models: HSB, RGB, Lab, and CMYK. Use the Adobe Color Picker to set the foreground color, background color, and text color. You can also set target colors for different tools, commands, and options.

You can configure the Adobe Color Picker to let you choose only colors that are part of the web-safe palette or choose from specific color systems. Photoshop Extended users can access an HDR (high dynamic range) picker to choose colors for use in HDR images. (Fig 6)

Fig 6



A. Picked color B. Original color C. Adjusted color D. Out-of-gamut alert icon E. Not a web-safe color alert icon F. Displays only web-safe colors G. Color field H. Color slider I. Color values

Why colors sometimes don't match

No device in a publishing system is capable of reproducing the full range of colors viewable to the human eye. Each device operates within a specific color space that can produce a certain range, or gamut, of colors.

A color model determines the relationship between values, and the color space defines the absolute meaning of those values as colors. Some color models (such as CIE L*a*b) have a fixed color space because they relate directly to the way humans perceive color. These models are described as being device-independent. Other color models (RGB, HSL, HSB, CMYK, and so forth) can have many different color spaces. Because these models vary with each associated color space or device, they are described as being device-dependent.

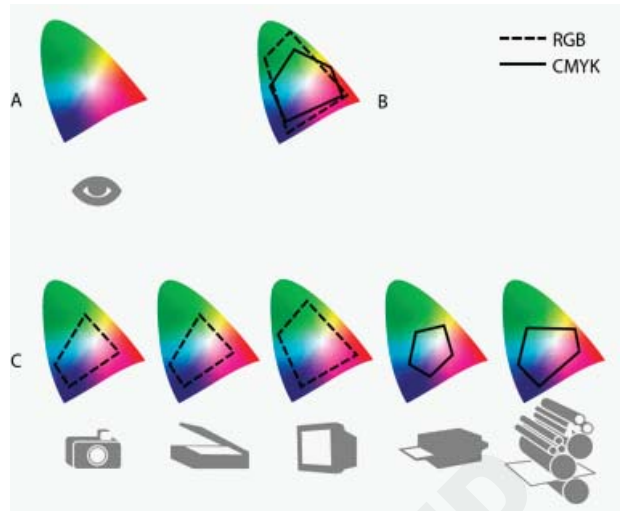
Because of these varying color spaces, colors can shift in appearance as you transfer documents between different devices. Color variations can result from differences in image sources; the way software applications define color; print media (newsprint paper reproduces a smaller gamut than magazine-quality paper); and other natural variations, such as manufacturing differences in monitors or monitor age.

What is a color management system?

Color-matching problems result from various devices and software using different color spaces. One solution is to have a system that interprets and translates color accurately between devices. A color management system (CMS) compares the color space in which a color was created to the color space in which the same color will be output, and makes the necessary adjustments to represent the color as consistently as possible among different devices. (Fig 7)

A color management system translates colors with the help of color profiles. A profile is a mathematical description of a device's color space. For example, a scanner profile tells a color management system how your scanner "sees" colors. Adobe color management uses ICC profiles, a format defined by the International Color Consortium (ICC) as a cross-platform standard.

Fig 7



A. Lab color space B. Documents (working space) C. Devices
Colorgamuts of various devices and documents

Because no single color-translation method is ideal for all types of graphics, a color management system provides a choice of rendering intents, or translation methods, so that you can apply a method appropriate to a particular graphics element. For example, a color translation method that preserves correct relationships among colors in a wildlife photograph may alter the colors in a logo containing flat tints of color.

Do you need color management?

Without a color management system, your color specifications are device-dependent. You might not need color management if your production process is tightly controlled for one medium only. For example, you or your print service provider can tailor CMYK images and specify color values for a known, specific set of printing conditions.

The value of color management increases when you have more variables in your production process. Color management is recommended if you anticipate reusing color graphics for print and online media, using various kinds of devices within a single medium (such as different printing presses), or if you manage multiple workstations.

About color profiles

Precise, consistent color management requires accurate ICC-compliant profiles of all of your color devices. For example, without an accurate scanner profile, a perfectly scanned image may appear incorrect in another program, simply due to any difference between the scanner and the program displaying the image. This misleading representation may cause you to make unnecessary, time-wasting, and potentially damaging "corrections" to an already satisfactory image. With an accurate profile, a program importing the image can correct for any device differences and display a scan's actual colors.

A color management system uses the following kinds of profiles:

Monitor profiles

Describe how the monitor is currently reproducing color. This is the first profile you should create because viewing color accurately on your monitor allows for critical color decisions in the design process. If what you see on your monitor is not representative of the actual colors in your document, you will not be able to maintain color consistency.

Input device profiles

Describe what colors an input device is capable of capturing or scanning. If your digital camera offers a choice of profiles, Adobe recommends that you select Adobe RGB. Otherwise, use sRGB (which is the default for most cameras). Advanced users may also consider using different profiles for different light sources. For scanner profiles, some photographers create separate profiles for each type or brand of film scanned on a scanner.

Output device profiles

Describe the color space of output devices like desktop printers or a printing press. The color management system uses output device profiles to properly map the colors in a document to the colors within the gamut of an output device's color space. The output profile should also take into consideration specific printing conditions, such as the type of paper and ink. For example, glossy paper is capable of displaying a different range of colors than matte paper.

Most printer drivers come with built in color profiles. It's a good idea to try these profiles before you invest in custom profiles.

Document profiles

Define the specific RGB or CMYK color space of a document. By assigning, or tagging, a document with a profile, the application provides a definition of actual color appearances in the document. For example, R=127, G=12, B=107 is just a set of numbers that different devices will display differently. But when tagged with the Adobe RGB color space, these numbers specify an actual color or wavelength of light-in this case, a specific color of purple.

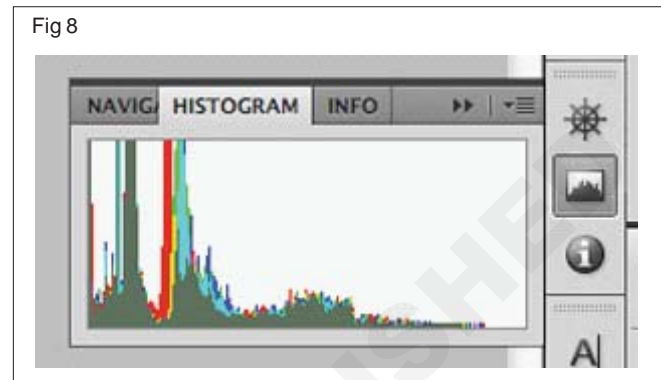
When color management is on, Adobe applications automatically assign new documents a profile based on Working Space options in the Color Settings dialog box. Documents without assigned profiles are known as untagged and contain only raw color numbers. When working with untagged documents, Adobe applications use the current working space profile to display and edit colors.

Managing color with profiles

A Profiles describe the color spaces of the input device and the document.

- B Using the profiles' descriptions, the color management system identifies the document's actual colors.
- C The monitor's profile tells the color management system how to translate the document's numeric values to the monitor's color space.
- D Using the output device's profile, the color management system translates the document's numeric values to the color values of the output device so the correct appearance of colors is printed.

Color Correction (Fig 8)



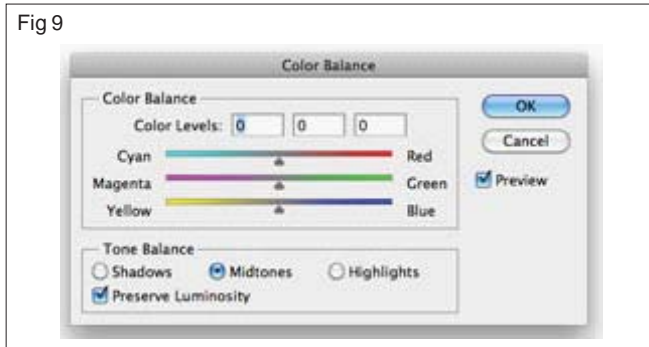
Color correction is a lot easier than you think. You just need to know which colors are complimentary (meaning on the opposite end of the color wheel) and you can use those to cancel out too much of another color. (If you need a refresher on color, check out our color guide.) You also need to be able to spot where colors are the most prominent. This means being able to tell, for example, when red is dominating the light areas of the photo and blue is dominating the dark areas. If you simply applied a blue filter to the entire photo, you'd end up with more neutral highlights-which you want-but a photo that looks too cool because the shadows are overly saturated with blue color. To recap, you need to pay attention to two major things when color correcting: which colors are dominating the photograph and which colors aren't, and also where, tonally, those dominating colors exist.

This is something you can generally do just by eying the photo, but the proper method is to consult the histogram. You can bring this up by going into the Window menu and choosing Histogram. The left side represents the shadows, the right side the highlights, leaving the middle for the midtones. If a particular color is dominating the photo in any area, you'll see it dominating that space on the histogram. This can be a handy guide for spotting necessary corrections.

Now that you've got a basic idea of what we're going to be targeting, let's take a look at some of the best color balancing tools Photoshop has to offer. You can find all the adjustments we'll be discussing in the following places:

- You can find standard adjustments that apply to a single layer by going to the Image menu, choosing Adjustments, then choosing the adjustment you want.
- If you want to create an adjustment layer that can apply to multiple layers and be adjusted after the first

application you can create an adjustment layer. You can either do this by going into the Layers menu, choosing Adjustment Layer, and then selecting the adjustment you want, or just selecting the adjustment you want from the Adjustments palette. (Fig 9)



Color Balance

Color Balance is not a very flexible tool, but sometimes you just need minor adjustments to color and you can use Color Balance to apply them quickly. If the brightest parts of your photo are just a little bit too red-something that's common with photos taken in low light-you can just select the Highlights radio button and then move the sliders towards cyan and blue a bit until you start to see the colors look a bit more balanced and neutral. You can also use Color Balance to create some interesting color effects by emphasizing different colors in the shadows, midtones, and highlights.

Levels

Levels is like Curves (which we'll discuss next) with training wheels. You have three main sliders. On the left, you have the shadows slider. Moving it to the right will increase the intensity of the shadows. On the right, you have the highlights slider. Moving it to the left will increase the intensity of the highlights of your photo. In the middle, you have the midtones slider. Moving it to the left will brighten up your photo and moving it to the right will make it darker.

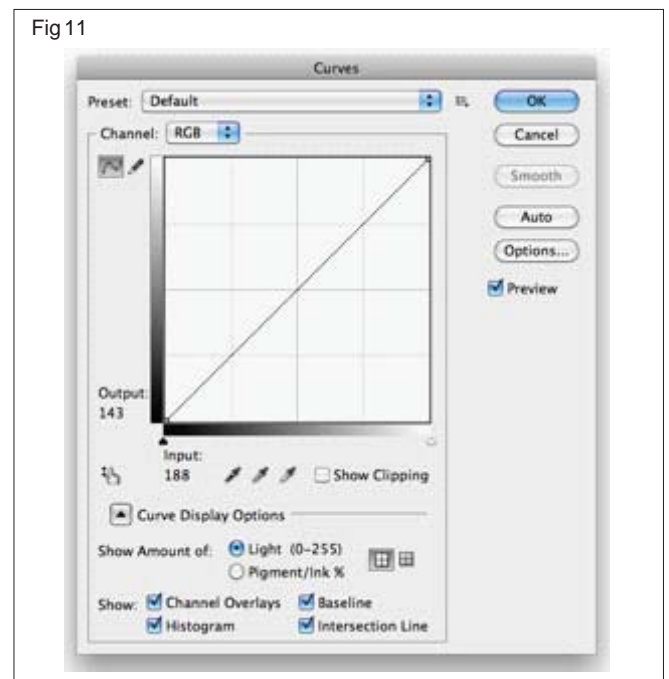
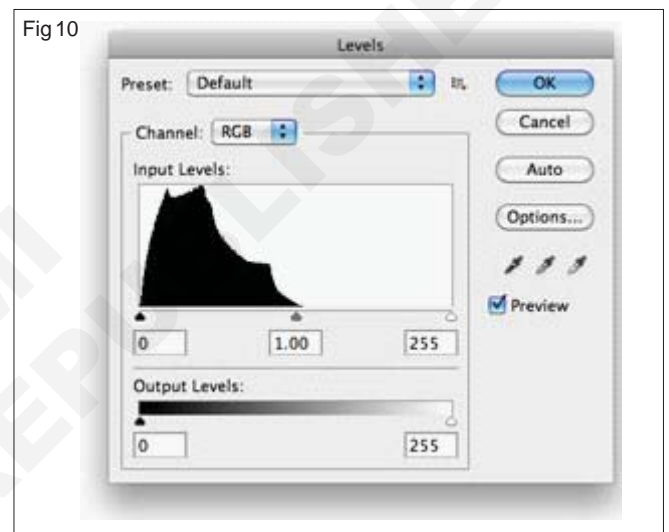
These sliders mainly affect contrast. The sliders under Output Levels affect brightness. Moving the black slider towards the white one will brighten things up. Moving the white slider toward the black one will darken them. By default, Levels applies any of these changes to the entire photo, but you can select a specific color channel and alter it all by itself. There's a little drop-down menu at the top of the Levels panel that lets you select from all channels-I'm going to assume you're in the RGB colorspace and it says RGB-or each individual channel (red, green, and blue). If you want to brighten or darken just the reds, select the red channel and make your adjustments.

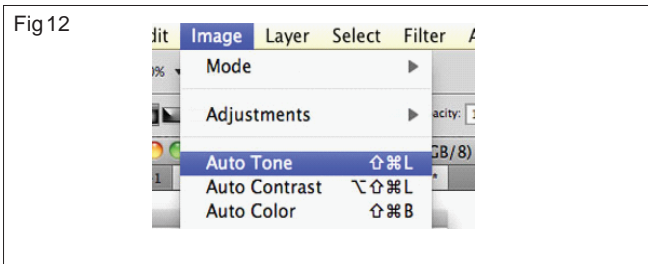
Curves

Curves is definitely the best color correction tool you've got in Photoshop, but you might find it a little intimidating and shy away from it since Levels seems to work well enough. Trust me-curves is much better, so take the time to get to know it and learn how it works so you're using it to do most of your adjustments. It's powerful, versatile, and very easy

to control once you get the hang of it. That said, it works a lot like levels only you set your own points. You can adjust the entire image or just specific channels, just like you can in levels. To make a point on the curve, you just click anywhere on the line and drag in a particular direction. If you pull towards the top left corner, you'll brighten things up. If you pull down towards the bottom right corner, you'll darken things. The middle of the line in curves represents the midtones. The bottom of the line, touching the bottom left corner, represents the shadows. That would leave the top, which represents the highlights.

Here's an example of creating a simple curve: make a point at the midpoint of the line and then two more points that are each about one grid space away from the midpoint. Pull the bottom-most point down into the shadows a bit and the top-most point up into the highlights. This will create basic contrast and is the simplest adjustment you can make in curves. (Fig 10 to 12)





Auto Tone

Sometimes you can just let Photoshop do a lot of the work for you. While you don't want to rely on Photoshop's Auto Tone option, you can just choose it from the Image menu to let Photoshop make an educated guess about what your photo needs in terms of tone and color adjustments. Sometimes you can save yourself a little time by just using Auto Tone, but definitely don't rely on it. Sometimes it just gets it right and it takes about two seconds to try it out and see if it works. If it doesn't work, undo it, and do the corrections yourself. If it does work, you just saved yourself some time.

Photo Retouching and Enhancing

Basic photo retouching and enhancing is very easy and very effective if done with the right level of subtlety. We're going to take a look at some options for correcting problems in your photos-like cuts on a face, dry skin, dust from the lens, etc.-and also how to enhance a portrait to make it look especially nice.

Touch Ups

Most of the touch ups you're going to want to perform can be accomplished with the healing brush or the cloning stamp. If you're trying to just make a person look their best-which is all you really ought to be doing with a portrait-you can do most of what you want to do with the healing brush and clone stamp. We'll also take a brief look at some of your other options as well.

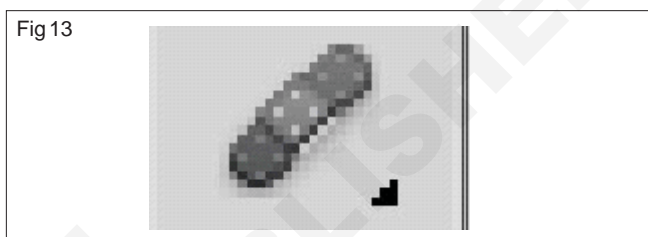
The Healing Brush Revisited

Basically it works by selecting a source point (which you do by option-clicking an area of the photo) and painting over the area you want to "heal" with image data from the source point. The healing brush then uses its magic to blend in the painted source material with the stuff surrounding it. Generally this results in a more realistic result than you'd get with the Clone Stamp, but not always. The Clone Stamp works in the exact same fashion as the Healing Brush, but the Clone Stamp doesn't do any healing. All it does is replace the target area with whatever you selected as a source point. While you're technically cloning another part of the photo and this may seem like it's going to look redundant, when you're correcting small areas it can sometimes look better than what the Healing Brush will give you-especially when you're near hard edges and areas of contrast.

Other Tools

In addition to the Healing Brush and Clone Stamp, there are a few other ways to make corrections. If you're looking to reduce redness in certain parts of the skin, often times

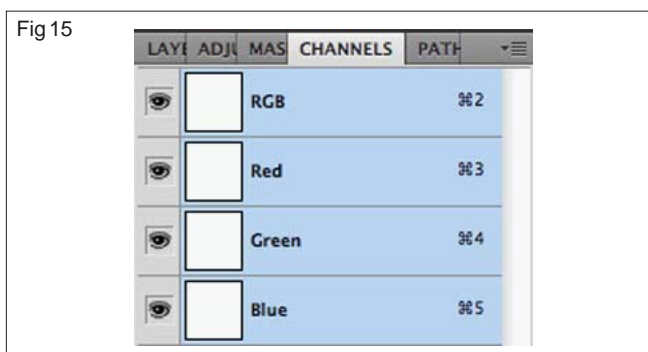
you can accomplish this by simply desaturating the red area a little bit. The Sponge Tool can help you easily desaturate a particular area. If you're removing blemishes and want some alternatives, the Spot Healing Brush can sometimes be a little easier to use than the regular Healing Brush (you can find it by clicking and holding down the Healing Brush in the tool bar). It doesn't require you to set a source point. One last option is using Content-Aware Fill, which is a new feature in Photoshop CS5. To use it, what you want to remove needs to be in the background layer. Select the part you want to remove with a Marquee or Lasso tool and press delete. You should be presented with a dialogue box asking you what you want to do. If "Use:" isn't set to Content-Aware, change that and then press OK. Once you do, Photoshop will try to figure out what your photo should look like without that element. The more precise your selection is, the more successful Photoshop will be in replacing it. (Fig 13 & 14)



Enhancing a Portrait

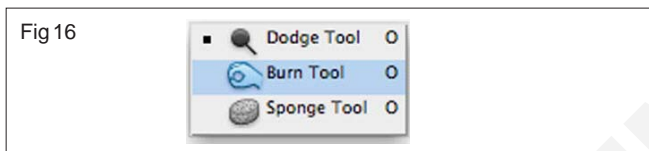
Using a couple of minor enhancements, you can make a portrait look significantly better than the original photograph. Everything we're going to discuss here is designed to bring out the best in the image of the person you're working on and not necessarily look better than they actually do. Photos tend to pick up more detail than we'd normally notice and people generally don't have pimples, cuts, or other blemishes on their faces all the time. The idea is to bring out the best in the subject and not perform anything that's untrue to their appearance or is just downright unrealistic.

Color Channeling (Fig 15)



One of the best and easiest tricks to enhancing a portrait is making use of your color channels. You can find your

color channels in the Channels palette on the right side of your screen. Assuming you're in the RGB color space, you'll see four options: RGB, red, green, and blue. RGB is the color image as you know it. The others are the respective channels. Click each of these and note their differences. You'll find that red has the most light, blue has the most detail, and green is kind of a combination of them both. When you're dealing with people, detail in skin is generally something you want to avoid and that's exactly what the red channel can help you do. Sometimes it's a near-perfect black and white photo all by itself, but if we're working with color it's still very useful. To make a nice adjustment, select the red channel, then select all and copy the image. Now switch back to the RGB combine channel, go back to your Layers palette, and paste the red channel. This will create a new layer on top of your background and you'll see only the red channel on your canvas. From the Layers palette, select a blending mode of Overlay for your red channel layer and reduce its opacity to somewhere between 20 and 30 percent. This is one of the easiest adjustments to make and it's incredibly useful. It removes unwanted detail in the skin, adds contrast right where you want it, and often improves your photo's color as well. (Fig 16)



Burning and Dodging


Burning and dodging can also be extremely useful when applying "virtual makeup" to your subject. This is something you'll want to do for men as well as women, because we're going to be very subtle and make it look as natural as possible. The idea is to place added contrast in the features of the face we want to emphasize: the eyes, nose, and mouth. You can use the burn tool to burn the midtones and shadows of the eyelashes and eyebrows, the curve of the nose, and the inner edges of the lips. You can use the dodge tool to brighten up the midtones of the colored and white parts of the eye and the inside of the lips.

While these enhancements are pretty minor, they make a significant difference in the overall look of the photo.

Hue/Saturation lets you adjust the hue, saturation, and lightness of a specific range of colors in an image or simultaneously adjust all the colors in an image. This adjustment is especially good for fine-tuning colors in a CMYK image so that they are in the gamut of an output device.


Apply a Hue/Saturation adjustment

Do one of the following:


- Click the Hue/Saturation icon  in the Adjustments panel.
- (CS5) Click a Hue/Saturation preset in the Adjustments panel.
- Choose Layer > New Adjustment Layer > Hue/Saturation. Click OK in the New Layer dialog box.

The two color bars in the dialog box represent the colors in their order on the color wheel. The upper color bar shows the color before the adjustment; the lower bar shows how the adjustment affects all of the hues at full saturation.

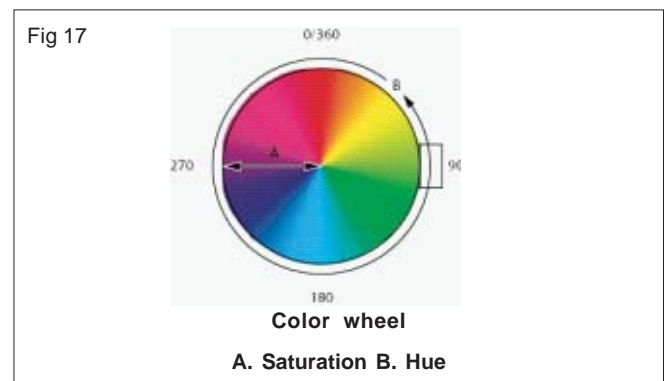
You can also choose Image > Adjustments > Hue/Saturation. But keep in mind that this method makes direct adjustments to the image layer and discards image information.

- In the Adjustments panel (CS5) or the Properties panel (CS6), choose from the menu to the right of the On-image adjustment tool .
- Choose Master to adjust all colors at once.
- Choose one of the other preset color ranges listed for the color you want to adjust. To modify the color range, Choose a Hue/Saturation preset from the Preset menu.
- For Hue, enter a value or drag the slider until you are satisfied with the colors.


The values displayed in the box reflect the number of degrees of rotation around the wheel from the original color of the pixel. A positive value indicates clockwise rotation; a negative value, counterclockwise rotation. Values can range from 180 to +180.

You can also select the On-image adjustment tool  in the Adjustments panel (CS5) or the Properties panel (CS6), and then Ctrl-click a color in the image. Drag left or right in the image to modify the hue value.

- For Saturation, enter a value or drag the slider to the right to increase the saturation or to the left to decrease it. (Fig 17)



The color shifts away from or toward the center of the color wheel. Values can range from 100 (percentage of desaturation, duller colors) to +100 (percentage of saturation increase).

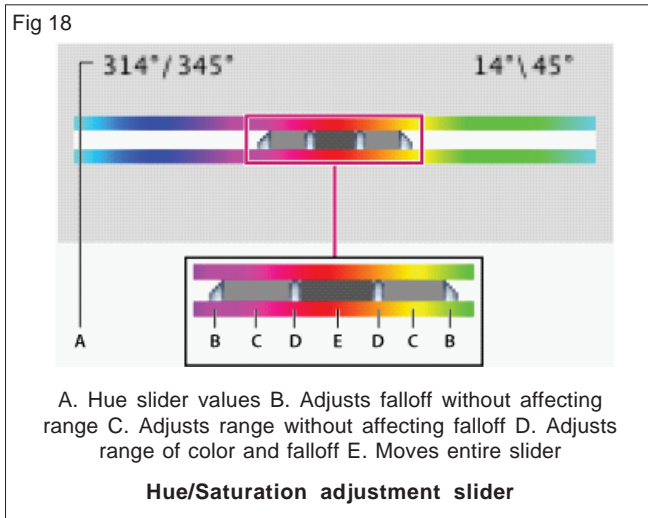
You can also, select the On-image adjustment tool  in the Adjustments panel (CS5) or the Properties panel (CS6), and click a color in the image. Drag left or right in the image to decrease or increase saturation of the color range that includes the pixel you clicked.


- For Lightness, enter a value or drag the slider to the right to increase the lightness (add white to a color) or to the left to decrease it (add black to a color). Values can range from 100 (percentage of black) to +100 (percentage of white).

Click the Reset button to undo a Hue/Saturation setting in the Adjustments panel (CS5) or the Properties panel (CS6).




Specify the range of colors adjusted using Hue/Saturation

- Apply a Hue/Saturation adjustment. (Fig 18)



- In the Adjustments panel (CS5) or the Properties panel (CS6), choose a color from the menu to the right of the On-image adjustment button .

Four color wheel values (in degrees) appear in the Adjustments panel (CS5) or the Properties panel (CS6). They correspond to the adjustment sliders that appear between the color bars. The two inner vertical sliders define the color range. The two outer triangle sliders show where the adjustments on a color range "fall off" (falloff is a feathering or tapering of the adjustments instead of a sharply defined on/off application of the adjustments).

- Use either the eyedropper tools or the adjustment sliders to modify the range of colors.
 - Click or drag in the image with the Eyedropper tool  to select a color range. To expand the range, click or drag in the image with the Add To Sample Eyedropper tool . To reduce the range of color, click or drag in the image with the Subtract From Sample Eyedropper tool . While an eyedropper tool is selected, you can also press Shift to add to the range, or Alt (Windows) or Option (Mac OS) to subtract from it.
 - Drag one of the white triangle sliders to adjust the amount of color falloff (feathering of adjustment) without affecting the range.

- Drag the area between the triangle and the vertical bar to adjust the range without affecting the amount of falloff.
- Drag the center area to move the entire adjustment slider (which includes the triangles and vertical bars) to select a different color area.
- Drag one of the vertical white bars to adjust the range of the color component. Moving a vertical bar from the center of the adjustment slider and closer to a triangle increases the color range and decreases the falloff. Moving a vertical bar closer to the center of the adjustment slider and away from a triangle decreases the color range and increases the falloff.
- Ctrl-drag (Windows) or Command-drag (Mac OS) the color bar so that a different color is in the center of the bar.

If you modify the adjustment slider so that it falls into a different color range, the name in the Edit menu changes to reflect this change. For example, if you choose Yellow and alter its range so that it falls in the red part of the color bar, the name changes to Red 2. You can convert up to six of the individual color ranges to varieties of the same color range (for example, Red through Red 6).


By default, the range of color selected when you choose a color component is 30° wide, with 30° of falloff on either side. Setting the falloff too low can produce banding in the image.

Colorize a grayscale image or create a monotone effect

- (Optional) If you are colorizing a grayscale image, choose Image > Mode > RGB Color to convert the image to RGB.
- Apply a Hue/Saturation adjustment.
- In the Adjustments panel (CS5) or the Properties panel (CS6), select the Colorize option. If the foreground color is black or white, the image is converted to a red hue (0°). If the foreground color is not black or white, the image is converted to the hue of the current foreground color. The lightness value of each pixel does not change.
- (Optional) Use the Hue slider to select a new color. Use the Saturation and Lightness sliders to adjust the saturation and lightness of the pixels.

Adjust color saturation using Vibrance

- Vibrance adjusts the saturation so that clipping is minimized as colors approach full saturation. This adjustment increases the saturation of less-saturated colors more than the colors that are already saturated. Vibrance also prevents skintones from becoming over saturated.
- Do one of the following:
 - In the Adjustments panel, click the Vibrance icon .

- Choose Layer > New Adjustment Layer > Vibrance
. In the New Layer dialog box, type a name for the Vibrance adjustment layer and click OK.

You can also choose Image > Adjustments > Vibrance. But keep in mind that this method makes direct adjustments to the image layer and discards image information.

- In the Adjustments panel (CS5) or the Properties panel (CS6), drag the Vibrance slider to increase or decrease color saturation without clipping when colors become more saturated. Then, do one of the following:
 - To apply more adjustment to less saturated colors and prevent colors clipping as they reach total saturation, move the Vibrance slider to the right.
 - To apply the same amount of saturation adjustment to all colors regardless of their current saturation, move the Saturation slider. In some situations, this may produce less banding than the Saturation slider in the Hue/Saturation Adjustments panel or Hue/Saturation dialog box.
 - To decrease saturation, move either the Vibrance or the Saturation slider

Adjust color saturation in image areas

The Sponge tool subtly changes the color saturation of an area. When an image is in Grayscale mode, the tool increases or decreases contrast by moving gray levels away from or toward the middle gray. (Fig 19)

- Select the Sponge tool .

- Choose a brush tip and set brush options in the options bar.
- In the options bar, choose the way you want to change the color from the Mode menu:

Saturate

Intensifies the color's saturation

Desaturate

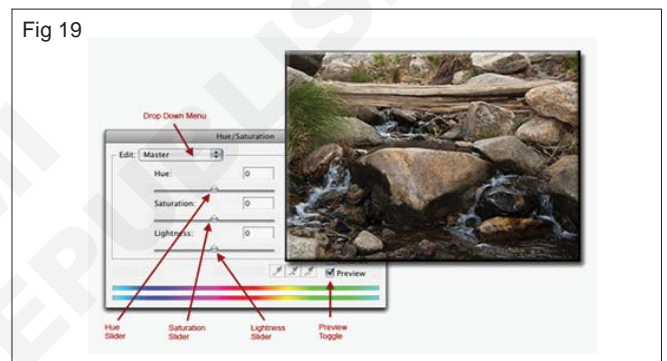
Dilutes the color's saturation

- Specify the flow for the Sponge tool.
- Select the Vibrance option to minimize clipping for fully saturated or desaturated colors.
- Drag over the part of the image you want to modify.

The "Hue/Saturation" Adjustment Layer in Photoshop

In a well-exposed image, it is quite possible that Levels and Hue / Saturation are the only 2 tools that you'll need for working with the first 4 elements: Contrast, Color Balance, Luminance, and Color Saturation.

Fig 19



Cropping and Straightening an Image, Adjusting Canvas Size and Canvas Rotation, Selecting with the Elliptical Mar Queue Tool, Using the Magic Wand and Free Transformation Tool, Selecting with the Regular and Polygonal Lasso Tools

Objective : At the end of this lesson you shall be able to

- to cropping and straightening an image, adjusting canvas size and canvas Rotation, selecting with the elliptical Mar queue tool, using the magic wand and free transformation tool, selecting with the regular and polygonal lasso tools.

Open a photo

Open a photo in Photoshop that needs straightening or cropping. (Fig 1 & 2)

You'll use the Crop tool with its Content-Aware option to rotate and straighten this sample photo and automatically fill the area around the straightened image with matching content.

You'll also change the photo's composition to a square and expand it beyond its original boundaries, relying on Content-Aware technology in the Crop tool to automatically fill in the outside edges of the recomposed photo.

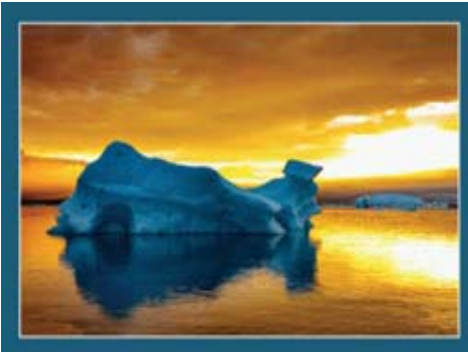
The Crop tool's Content-Aware option improves your photo-editing experience and brings the Crop tool into the family

of Photoshop features that use special Content-Aware technology.

Fig 1



Fig 2



Enable the Crop tool's Content-Aware option

Select the Crop tool in the Toolbar. A crop boundary appears around the photo.

In the Options bar at the top of the screen, check the Content-Aware checkbox to turn on the Crop tool's Content-Aware option.

Rotate and straighten with Content-Aware Crop (Fig 3 & 4)

Fig 3

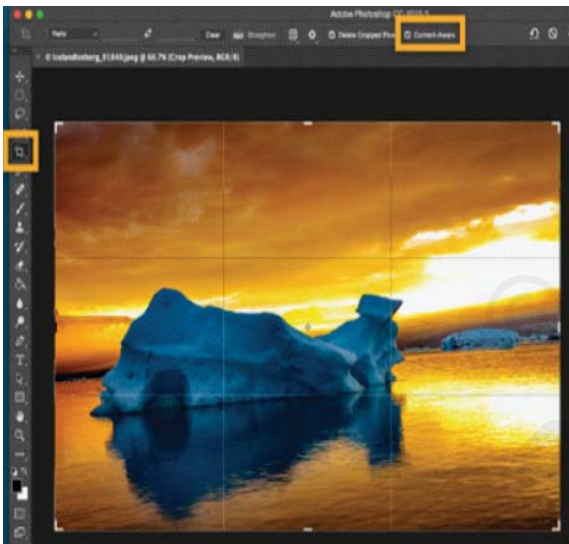


Fig 4



Move your cursor outside of a corner of the crop boundary. When the cursor changes to a double-pointed, curved arrow, drag to rotate and straighten the photo. Use the crop grid that appears as a guide to straightening an object in the photo, like the bottom of this iceberg. Then release your mouse.

To commit the crop, click the checkmark in the Options bar or press Enter or Return on your keyboard.

The Content-Aware option automatically fills the edges with content that matches the rest of the photo!

Compare: Without the Content-Aware option enabled, rotating the sample photo with the Crop tool would leave parts of the photo outside the crop boundary. (Fig 5)

Fig 5



Trying to fix that by manually expanding the crop boundary would create empty areas at the edges that would require further retouching. (Fig 6)

Fig 6



Content-Aware Crop solves that problem. It expands the rotated crop boundary and automatically fills in any leftover empty areas with content that matches the photo.

Change the aspect ratio with Content-Aware Crop

Another common use for the Crop tool is to crop a photo to a different aspect ratio-for example, from horizontal to square. The Crop tool's Content-Aware option is a great way to automatically fill in any resulting empty areas at the edges.

With the Crop tool still selected, go to the Aspect Ratio menu in the Options bar and choose 1 : 1 (Square). A

square crop boundary appears on the photo. Click inside the crop boundary and drag to reposition the iceberg inside the crop boundary.

Now expand the square crop boundary to include more of the iceberg. Move your cursor over a corner anchor point of the crop boundary and drag outward past the top edge of the photo. There is now an empty area inside the expanded crop boundary.

With the Content-Aware option still enabled in the Options bar, just click the checkmark in the Options bar or press Enter or Return on your keyboard, and the empty area is automatically filled with content that matches the photos (Fig 7 & 8)

Fig 7



Fig 8



Learn more about other Photoshop features that use Content-Aware technology.

Note: If the Crop and Straighten Photos command incorrectly splits one of your images, make a selection border around the image and some background, and then hold down Alt (Windows) or Option (Mac OS) as you choose the command. The modifier key indicates that only one image should be separated from the background.

Rotate or flip an entire image

Note: Image Rotation is destructive editing and actually modifies the file information. If you want to non-destructively rotate the image for viewing, use the Rotation tool.

The Image Rotation commands let you rotate or flip an entire image. The commands do not work on individual layers or parts of layers, paths, or selection borders. If you want to rotate a selection or layer, use the Transform or Free Transform commands.

Change the canvas size

The canvas size is the full editable area of an image. The Canvas Size command lets you increase or decrease an image's canvas size. Increasing the canvas size adds space around an existing image. Decreasing an image's canvas size crops into the image. If you increase the canvas size of an image with a transparent background, the added canvas is transparent. If the image doesn't have a transparent background, there are several options for determining the colour of the added canvas.

Make a frame by increasing the canvas size

You can make a photo frame by increasing the canvas size and filling it with a colour.

You can also use one of the pre-recorded actions to make a styled photo frame. It's best to work on a copy of your photo.

- 1 Open the Actions panel. Choose Window > Actions.
- 2 Choose Frames from the Actions panel menu.
- 3 Choose one of the frame actions from the list.
- 4 Click the Play Selection button.

The action plays, creating the frame around your photo.

Note: To reposition a rectangular or elliptical marquee, first drag to create the selection border, keeping the mouse button depressed. Then hold down the spacebar and continue to drag. Release the spacebar, but keep the mouse button depressed, if you need to continue adjusting the selection border.

Using the Magnetic Lasso Tool, Using the Quick Selection Tools Refine Edge, Modifying Selections

Objective : At the end of this lesson you shall be able to

- to use the magnetic lasso tool, using the quick selection tools refine edge, modifying selections.

Select with the magnetic lasso tool

The magnetic lasso tool is especially useful for quickly selecting objects with complex edges set against high-contrast backgrounds.

Width

To specify a detection width, enter a pixel value for width. The magnetic lasso tool detects edges only within the specified distance from the pointer.

Note: To change the lasso pointer so that it indicates the lasso width, press the caps lock key. You can change the pointer while the tool is selected but not in use. Press the right bracket (]) to increase the magnetic lasso edge width by 1 pixel; press the left bracket ([) to decrease the width by 1 pixel.

Contrast

To specify the lasso's sensitivity to edges in the image, enter a value between 1% and 100% for contrast. A higher value detects only edges that contrast sharply with their surroundings; a lower value detects lower-contrast edges.

Frequency

To specify the rate at which the lasso sets fastening points, enter a value between 0 and 100 for frequency. A higher value anchors the selection border in place more quickly.

Note: On an image with well-defined edges, try a higher width and higher edge contrast, and trace the border roughly. On an image with softer edges, try a lower width and lower edge contrast, and trace the border more precisely.

How do you use the quick selection tool in photoshop?

Now, let's go through all the steps for selecting objects using the quick selection tool.

Keep in mind that, in some cases, the quick selection tool doesn't always create a clean cut. So we'll also teach you how to clean your selection for better results.

Craig adderley- pexels

Duplicating a layer

Understanding the Background Layer, Creating, Selecting, Linking and Deleting Layers, Locking and Merging Layers, Copying Layers, Using Perspective and Layers Styles, Filling and Grouping Layers

Objectives : At the end of this lesson you shall be able to

- to Understanding the background layer, creating, selecting, linking and deleting layers, locking and merging layers, copying layers, using perspective and layers styles, Filling and grouping layers.

About Photoshop layers

Photoshop layers are like sheets of stacked acetate. You can see through transparent areas of a layer to the layers below. You move a layer to position the content on the layer, like sliding a sheet of acetate in a stack. You can also change the opacity of a layer to make content partially transparent. (Fig 1)

Transparent areas on a layer let you see layers below.

You use layers to perform tasks such as compositing multiple images, adding text to an image, or adding vector graphic shapes. You can apply a layer style to add a special effect such as a drop shadow or a glow.

Unlock the layer in the layer menu at the lower right of your screen. Right-click on it and click duplicate layer. You'll see another layer appear.

Click on the eye icon on the bottom layer to hide it (this hidden lower layer is a back-up in case of photoshop disasters).

Revealing your selection

At the top of your screen, click layer>layer mask>reveal selection.

This is the 'aha!' moment when your background will disappear, showing the rough cut-out shape you've selected.

Opening the background

To ensure photoshop displays both the background and your selection, check if the layers on the lower right of your screen are in the right order. Your background should be underneath your selection and layer mask.

To move the layers around, click on one of the layers and drag it up or down.

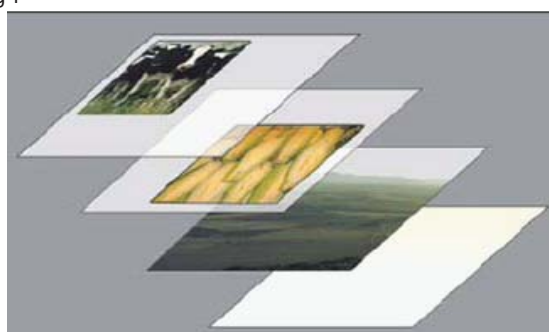
Adjusting the background

If the subject and background images look mismatched or inconsistent, use lightroom or adobe camera raw to make adjustments. Start with the temperature and brightness of one of the photos.

Sometimes adjusting saturation and luminance of individual colours also helps. If the images still don't quite match, try converting both photos to black and white. But make sure the contrast, clarity, and shadows are the same.

Converting your image to black and white allows you to work with shades of grey and black. The elimination of colour would help you better match your selection to the background.

Fig 1



Organizing Photoshop layers

A new image has a single layer. The number of additional layers, layer effects, and layer sets you can add to an image is limited only by your computer's memory.

You work with layers in the Layers panel. Layer groups help you organize and manage layers. You can use groups to arrange your layers in a logical order and to reduce clutter in the Layers panel. You can nest groups within other groups. You can also use groups to apply attributes and masks to multiple layers simultaneously.

For some great tips for working with layers, see the tutorial video Organize with layers and layer groups.

Photoshop layers for non-destructive editing

Sometimes layers don't contain any apparent content. For example, an adjustment layer holds color or tonal adjustments that affect the layers below it. Rather than edit image pixels directly, you can edit an adjustment layer and leave the underlying pixels unchanged.

A special type of layer, called a Smart Object, contains one or more layers of content. You can transform (scale, skew, or reshape) a Smart Object without directly editing image pixels. Or, you can edit the Smart Object as a separate image even after placing it in a Photoshop image. Smart Objects can also contain smart filter effects, which allow you to apply filters non-destructively to images so that you can later tweak or remove the filter effect. See Non-destructive editing and Work with Smart Objects.

Video layers

You can use video layers to add video to an image. After importing a video clip into an image as a video layer, you can mask the layer, transform it, apply layer effects, paint on individual frames, or rasterize an individual frame and convert it to a standard layer. Use the Timeline panel to play the video within the image or to access individual frames. See Supported video and image sequence formats.

Convert background and Photoshop layers (Fig 2)



When you create a new image with a white background or a colored background, the bottommost image in the Layers panel is called Background. An image can have only one background layer. You cannot change the

stacking order of a background layer, its blending mode, or its opacity. However, you can convert a background into a regular layer, and then change any of these attributes.

When you create a new image with transparent content, the image does not have a background layer. The bottommost layer is not constrained like the background layer; you can move it anywhere in the Layers panel and change its opacity and blending mode.

Photoshop provides a variety of effects—such as shadows, glows, and bevels—that change the appearance of a layer's contents in a non-destructive way. Layer effects are linked to the layer contents. When you move or edit the contents of the layer, the same effects are applied to the modified contents. For example, if you apply a drop shadow to a text layer and then add new text, the shadow is added automatically to the new text.

A layer style is one or more effects applied to a layer or layer group. You can apply one of the preset styles provided with Photoshop or create a custom style using the Layer Style dialog box. The layer effects icon appears to the right of the layer's name in the Layers panel. You can expand the style in the Layers panel to view or edit the effects that compose the style.

You can apply multiple effects in a single layer style. Also, more than one instance of some effects can comprise a layer style.

Layers panel showing layer with multiple effects applied

A. Layer effects icon B. Click to expand and show layer effects C. Layer effects

When you save a custom style, it becomes a preset style. Preset styles appear in the Styles panel and can be applied to a layer or group with a single click.

How to use new Presets in Photoshop

Learn all about applying Photoshop's new and improved Presets panels. Julieanne Kost explores everything from swatches to patterns, from gradients to styles and shapes. Julieanne Kost

Apply preset styles

You can apply preset styles from the Styles panel. The layer styles that come with Photoshop are grouped into libraries by function. For example, one library contains styles for creating web buttons; another library contains styles for adding effects to text. To access these styles, you need to load the appropriate library. For information on loading and saving styles, see Create and manage preset styles.

Note: You cannot apply layer styles to a background, locked layer, or group.

Layer style options

Beginning with Photoshop 21.2, you can also set an angle to rotate the pattern overlay and easily change its orientation.

Altitude

For the Bevel and Emboss effect, sets the height of the light source. A setting of 0 is equivalent to ground level, 90 is directly above the layer.

Angle

Determines the lighting angle at which the effect is applied to the layer. You can drag in the document window to adjust the angle of a Pattern Overlay, Drop Shadow, Inner Shadow, or Satin effect.

Anti-alias

Blends the edge pixels of a contour or gloss contour. This option is most useful on small shadows with complicated contours.

Blend Mode

Determines how the layer style blends with the underlying layers, which may or may not include the active layer. For example, an inner shadow blends with the active layer because the effect is drawn on top of that layer, but a drop shadow blends only with the layers beneath the active layer. In most cases, the default mode for each effect produces the best results. See Blending modes.

Choke

Shrinks the boundaries of the matte of an Inner Shadow or Inner Glow prior to blurring.

Color

Specifies the color of a shadow, glow, or highlight. You can click the color box and choose a color.

Contour

With solid color glows, Contour allows you to create rings of transparency. With gradient-filled glows, Contour allows you to create variations in the repetition of the gradient color and opacity. In beveling and embossing, Contour allows you to sculpt the ridges, valleys, and bumps that are shaded in the embossing process. With shadows, Contour allows you to specify the fade. For more information, see Modify layer effects with contours.

Distance

Specifies the offset distance for a shadow or satin effect. You can drag in the document window to adjust the offset distance.

Depth

Specifies the depth of a bevel. It also specifies the depth of a pattern.

Use Global Light

This setting allows you to set one "master" lighting angle that is then available in all the layer effects that use shading: Drop Shadow, Inner Shadow, and Bevel and Emboss. In any of these effects, if Use Global Light is selected and you set a lighting angle, that angle becomes the global lighting angle. Any other effect that has Use Global Light selected automatically inherits the same

angle setting. If Use Global Light is deselected, the lighting angle you set is "local" and applies only to that effect. You can also set the global lighting angle by choosing Layer Style > Global Light.

Gloss Contour

Creates a glossy, metallic appearance. Gloss Contour is applied after shading a bevel or emboss.

Gradient

Specifies the gradient of a layer effect. Click the gradient to display the Gradient Editor, or click the inverted arrow and choose a gradient from the pop up panel. You can edit a gradient or create a new gradient using the Gradient Editor. You can edit the color or opacity in the Gradient Overlay panel the same way you edit them in the Gradient Editor. For some effects, you can specify additional gradient options. Reverse flips the orientation of the gradient, Align with Layer uses the bounding box of the layer to calculate the gradient fill, and Scale scales the application of the gradient. You can also move the center of the gradient by clicking and dragging in the image window. Style specifies the shape of the gradient.

Highlight or Shadow Mode

Specifies the blending mode of a bevel or emboss highlight or shadow.

Jitter

Varies the application of a gradient's color and opacity.

Layer Knocks Out Drop Shadow

Controls the drop shadow's visibility in a semi transparent layer.

Noise

Specifies the number of random elements in the opacity of a glow or shadow. Enter a value or drag the slider.

Opacity

Sets the opacity of the layer effect. Enter a value or drag the slider.

Pattern

Specifies the pattern of a layer effect. Click the pop up panel and choose a pattern. Set the Angle selector at a certain degree or manually type in an angle value to rotate your pattern at the desired angle. Click the New Preset button to create a new preset pattern based on the current settings. Click Snap To Origin to make the origin of the pattern the same as the origin of the document (when Link With Layer is selected), or to place the origin at the upper-left corner of the layer (if Link With Layer is deselected). Select Link With Layer if you want the pattern to move along with the layer as the layer moves. Drag the Scale slider or enter a value to specify the size of the pattern. Drag a pattern to position it in the layer; reset the position by using the Snap To Origin button. The Pattern option is not available if no patterns are loaded.

Position

Specifies the position of a stroke effect as Outside, Inside, or Center.

Range

Controls which portion or range of the glow is targeted for the contour.

Size

Specifies the radius and size of blur or the size of the shadow.

Soften

Blurs the results of shading to reduce unwanted artifacts.

Source

Specifies the source for an inner glow. Choose Center to apply a glow that emanates from the center of the layer's content, or Edge to apply a glow that emanates from the inside edges of the layer's content.

Spread

Expands the boundaries of the matte prior to blurring.

Style

Specifies the style of a bevel: Inner Bevel creates a bevel on the inside edges of the layer contents; Outer Bevel creates a bevel on the outside edges of the layer contents; Emboss simulates the effect of embossing the layer contents against the underlying layers; Pillow Emboss simulates the effect of stamping the edges of the layer contents into the underlying layers; and Stroke Emboss confines embossing to the boundaries of a stroke effect applied to the layer. (The Stroke Emboss effect is not visible if no stroke is applied to the layer.)

Technique

Smooth, Chisel Hard, and Chisel Soft are available for bevel and emboss effects; Softer and Precise apply to Inner Glow and Outer Glow effects.

Smooth blurs the edges of a matte slightly and is useful for all types of mattes, whether their edges are soft or hard. It does not preserve detailed features at larger sizes. Chisel Hard uses a distance measurement technique and is primarily useful on hard-edged mattes from anti-aliased shapes such as type. It preserves detailed features better than the Smooth technique. Chisel Soft uses a modified distance measurement technique and, although not as accurate as Chisel Hard, is more useful on a larger range of mattes. It preserves features better than the Smooth technique. Softer applies a blur and is useful on all types of mattes, whether their edges are soft or hard. At larger sizes, Softer does not preserve detailed features. Precise uses a distance measurement technique to create a glow and is primarily useful on hard-edged mattes from anti-aliased shapes such as type. It preserves features better than the softer technique.

Texture

Applies a texture. Use Scale to scale the size of the texture. Select Link with Layer if you want the texture to move along with the layer as the layer moves. Invert inverts the texture. Depth varies the degree and direction (up/down) to which the texturing is applied. Snap To Origin makes the origin of the pattern the same as the origin of the document (if Link with Layer is deselected) or places the origin in the upper-left corner of the layer (if Link with Layer is selected). Drag the texture to position it in the layer.

Blending Modes, Opacity and Fill, Creating and Modifying Text

Objectives : At the end of this lesson you shall be able to

- to Blend modes, opacity and fill
 - to create and modify text.
-

Blending mode descriptions

Choose from the Mode pop up menu in the options bar.

Note: In the Blend Mode pop-up menu, scroll over different options to see how they look on your image. Photoshop displays a live preview of blend modes on the canvas.

Only the Normal, Dissolve, Darken, Multiply, Lighten, Linear Dodge (Add), Difference, Hue, Saturation, Color, Luminosity, Lighter Color, and Darker Color blending modes are available for 32 bit images.

Normal

Edits or paints each pixel to make it the result color. This is the default mode. (Normal mode is called Threshold when you're working with a bitmapped or indexed-color image.)

Dissolve

Edits or paints each pixel to make it the result color. However, the result color is a random replacement of the pixels with the base color or the blend color, depending on the opacity at any pixel location.

Behind

Edits or paints only on the transparent part of a layer. This mode works only in layers with Lock Transparency deselected and is analogous to painting on the back of transparent areas on a sheet of acetate.

Clear

Edits or paints each pixel and makes it transparent. This mode is available for the Shape tools (when fill region is selected), Paint Bucket tool, Brush tool, Pencil tool, Fill command, and Stroke command. You must be in a layer with Lock Transparency deselected to use this mode.

Darken

Looks at the color information in each channel and selects the base or blend color-whichever is darker-as the result color. Pixels lighter than the blend color are replaced, and pixels darker than the blend color do not change.

Multiply

Looks at the color information in each channel and multiplies the base color by the blend color. The result color is always a darker color. Multiplying any color with black produces black. Multiplying any color with white leaves the color unchanged. When you're painting with a color other than black or white, successive strokes with a painting tool produce progressively darker colors. The effect is similar to drawing on the image with multiple marking pens.

Color Burn

Looks at the color information in each channel and darkens the base color to reflect the blend color by increasing the contrast between the two. Blending with white produces no change.

Linear Burn

Looks at the color information in each channel and darkens the base color to reflect the blend color by decreasing the brightness. Blending with white produces no change.

Lighten

Looks at the color information in each channel and selects the base or blend color-whichever is lighter-as the result color. Pixels darker than the blend color are replaced, and pixels lighter than the blend color do not change.

Screen

Looks at each channel's color information and multiplies the inverse of the blend and base colors. The result color is always a lighter color. Screening with black leaves the color unchanged. Screening with white produces white. The effect is similar to projecting multiple photographic slides on top of each other.

Color Dodge

Looks at the color information in each channel and brightens the base color to reflect the blend color by decreasing contrast between the two. Blending with black produces no change.

Linear Dodge (Add)

Looks at the color information in each channel and brightens the base color to reflect the blend color by increasing the brightness. Blending with black produces no change.

Overlay

Multiplies or screens the colors, depending on the base color. Patterns or colors overlay the existing pixels while preserving the highlights and shadows of the base color. The base color is not replaced, but mixed with the blend

color to reflect the lightness or darkness of the original color.

Soft Light

Darkens or lightens the colors, depending on the blend color. The effect is similar to shining a diffused spotlight on the image. If the blend color (light source) is lighter than 50% gray, the image is lightened as if it were dodged. If the blend color is darker than 50% gray, the image is darkened as if it were burned in. Painting with pure black or white produces a distinctly darker or lighter area, but does not result in pure black or white.

Hard Light

Multiplies or screens the colors, depending on the blend color. The effect is similar to shining a harsh spotlight on the image. If the blend color (light source) is lighter than 50% gray, the image is lightened, as if it were screened. This is useful for adding highlights to an image. If the blend color is darker than 50% gray, the image is darkened, as if it were multiplied. This is useful for adding shadows to an image. Painting with pure black or white results in pure black or white.

Vivid Light

Burns or dodges the colors by increasing or decreasing the contrast, depending on the blend color. If the blend color (light source) is lighter than 50% gray, the image is lightened by decreasing the contrast. If the blend color is darker than 50% gray, the image is darkened by increasing the contrast.

Linear Light

Burns or dodges the colors by decreasing or increasing the brightness, depending on the blend color. If the blend color (light source) is lighter than 50% gray, the image is lightened by increasing the brightness. If the blend color is darker than 50% gray, the image is darkened by decreasing the brightness.

Pin Light

Replaces the colors, depending on the blend color. If the blend color (light source) is lighter than 50% gray, pixels darker than the blend color are replaced, and pixels lighter than the blend color do not change. If the blend color is darker than 50% gray, pixels lighter than the blend color are replaced, and pixels darker than the blend color do not change. This is useful for adding special effects to an image.

Hard Mix

Adds the red, green and blue channel values of the blend color to the RGB values of the base color. If the resulting sum for a channel is 255 or greater, it receives a value of 255; if less than 255, a value of 0. Therefore, all blended pixels have red, green, and blue channel values of either 0 or 255. This changes all pixels to primary additive colors (red, green, or blue), white, or black.

Note:

For CMYK images, Hard Mix changes all pixels to the primary subtractive colors (cyan, yellow, or magenta), white, or black. The maximum color value is 100.

Difference

Looks at the color information in each channel and subtracts either the blend color from the base color or the base color from the blend color, depending on which has the greater brightness value. Blending with white inverts the base color values; blending with black produces no change.

Exclusion

Creates an effect similar to but lower in contrast than the Difference mode. Blending with white inverts the base color values. Blending with black produces no change.

Subtract

Looks at the color information in each channel and subtracts the blend color from the base color. In 8- and 16-bit images, any resulting negative values are clipped to zero.

Divide

Looks at the color information in each channel and divides the blend color from the base color.

Hue

Creates a result color with the luminance and saturation of the base color and the hue of the blend color.

Saturation

Creates a result color with the luminance and hue of the base color and the saturation of the blend color. Painting with this mode in an area with no (0) saturation (gray) causes no change.

Color

Creates a result color with the luminance of the base color and the hue and saturation of the blend color. This preserves the gray levels in the image and is useful for coloring monochrome images and for tinting color images.

Luminosity

Creates a result color with the hue and saturation of the base color and the luminance of the blend color. This mode creates the inverse effect of Color mode.

Lighter Color

Compares the total of all channel values for the blend and base color and displays the higher value color. Lighter Color does not produce a third color, which can result from the Lighten blend, because it chooses the highest channel values from both the base and blend color to create the result color.

Darker Color

Compares the total of all channel values for the blend and base color and displays the lower value color. Darker Color does not produce a third color, which can result from the Darken blend, because it chooses the lowest channel

values from both the base and the blend color to create the result color.

A layer's blending mode determines how its pixels blend with underlying pixels in the image. You can create a variety of special effects using blending modes.

Specify a blending mode for a layer or group

By default, the blending mode of a layer group is Pass Through, which means that the group has no blending properties of its own. When you choose a different blending mode for a group, you effectively change the order in which the image components are put together. All of the layers in the group are put together first. The composite group is then treated as a single image and blended with the rest of the image using the selected blending mode. Thus, if you choose a blending mode other than Pass Through for the group, none of the adjustment layers or layer blending modes inside the group will apply to layers outside the group.

Note: There is no Clear blending mode for layers. For Lab images, the Color Dodge, Color Burn, Darken, Lighten, Difference, Exclusion, Subtract, and Divide modes are unavailable. For HDR images, see Features that support 32 bpc HDR images.

Group blend effects

To view blending options for a text layer, choose Layer > Layer Style > Blending Options, or choose Blending Options from the Add A Layer Style button at the bottom of the Layers panel menu.

- 1 Specify the scope of blending options:
 - Select Blend Interior Effects As Group to apply the blending mode of the layer to layer effects that modify opaque pixels, such as Inner Glow, Satin, Color Overlay, and Gradient Overlay.
 - Select Blend Clipped Layers As Group to apply the blending mode of the base layer to all layers in the clipping mask. Deselecting this option, which is always selected by default, maintains the original blending mode and appearance of each layer in the group.

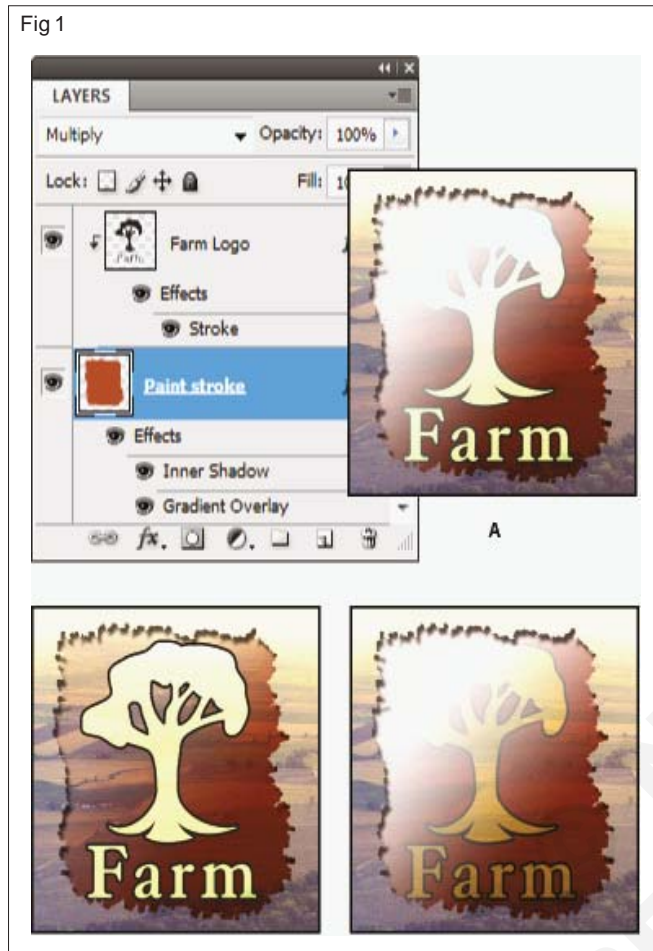
Advanced blending options

- Select Transparency Shapes Layers to restrict layer effects and knockouts to opaque areas of the layer. Deselecting this option, which is always selected by default, applies these effects throughout the layer.
- Select Layer Mask Hides Effects to restrict layer effects to the area defined by the layer mask.
- Select Vector Mask Hides Effects to restrict layer effects to the area defined by the vector mask.

Fill new layers with a neutral color (Fig 1 & 2)

You can't apply certain filters (such as the Lighting Effects filter) to layers with no pixels. Selecting Fill With (Mode)-Neutral Color in the New Layer dialog box resolves this

problem by first filling the layer with a preset, neutral color. This invisible, neutral color is assigned according to the layer's blending mode. If no effect is applied, filling with a neutral color has no effect on the remaining layers. The Fill With Neutral Color option is not available for layers that use the Normal, Dissolve, Hard Mix, Hue, Saturation, Color, or Luminosity modes.



New to Photoshop? Want to learn how to use the Type tool? You've come to the right place.

Find quick and easy answers, tips, and video tutorials for the most frequently asked questions about the Type tool.

Download sample file and fonts to try

To help you practice and create something nice, here's a sample file. Download and open this PSD (ZIP, 1.35 MB) and try out all the tasks in your own file. Play with font size, font colour, and placement of text to get the results you want.

If you don't have the fonts used in the sample file, you can substitute them with default fonts you have. You can also get the fonts used in the file - Nunito and Roboto. See Activate fonts for details.



Working with Colours and Swatches, Creating and Using Gradients, Creating and Working with Brushes

Objective : At the end of this lesson you shall be able to

- to work with colours and swatches, to create and use gradients, to create and work with brushes.

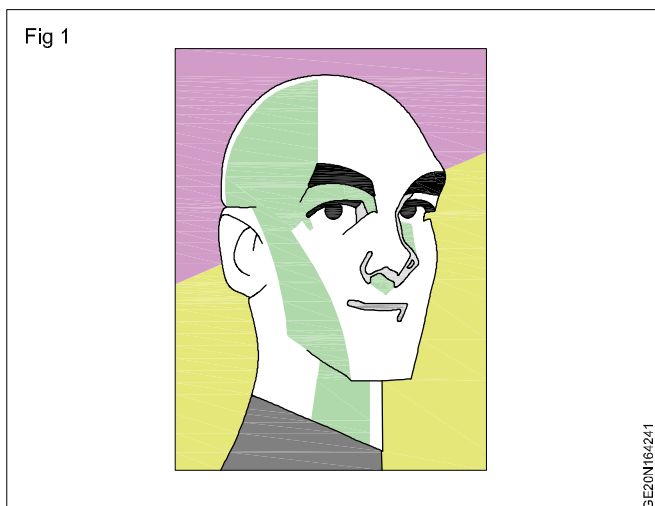
Getting started with advanced custom brushes (Fig 1)

Create a brush tip from an image

- 1 Using any selection tool, select the image area you want to use as a custom brush. The brush shape can be up to 2500 pixels by 2500 pixels in size.

When painting, you can't adjust the hardness of sampled brushes. To create a brush with sharp edges, set Feather to zero pixels. To create a brush with soft edges, increase the Feather setting.

Note: If you select a color image, the brush tip image is converted to grayscale. Any layer mask applied to the image doesn't affect the definition of the brush tip.



2 Choose Edit > Define Brush Preset.

3 Name the brush, and click OK.

Create a brush and set painting options

1 Select a painting, erasing, toning, or focus tool. Then choose Window > Brush Settings.

2 In the Brush Settings panel, select a brush tip shape, or click Brush Presets to choose an existing preset.

3 Select Brush Tip Shape on the left side and set options.

4 To set other options for the brush, see the following topics:

- Add dynamic elements to brushes
- Determine the scattering in a stroke
- Create textured brushes
- Determine how a brush changes dynamically
- Draw or paint with a graphics tablet

5 To lock brush tip shape attributes (retaining them if you select another brush preset), click the unlock icon . To unlock the tip, click the lock icon .

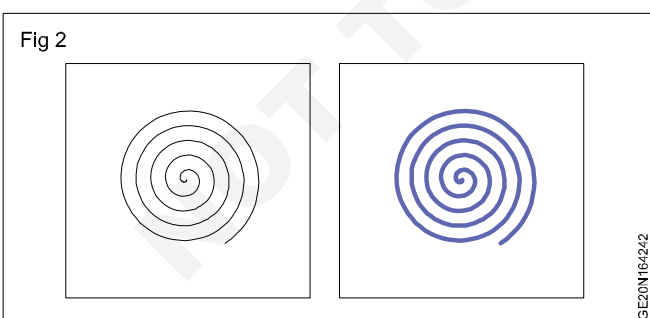
6 To save the brush for use later, choose New Brush Preset from the Brush panel menu.

Note: To save your new brush permanently or distribute it to other users, you must save the brush as part of a set of brushes. Choose Save Brushes from the Brush Presets panel menu, and then save to a new set or overwrite an existing set. If you reset or replace the brushes in the Brush Presets panel without saving it in a set, you could lose your new brush.

Standard brush tip shape options

For standard brush tips, you can set the following options in the Brush Settings panel:

Size (Fig 2)



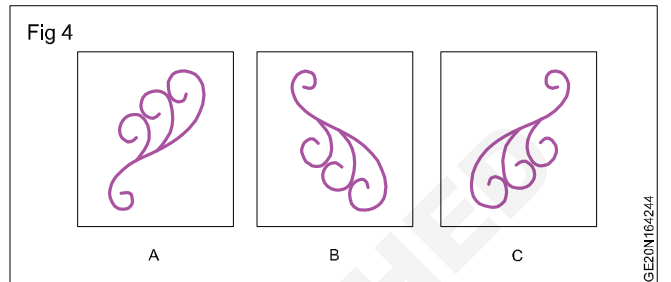
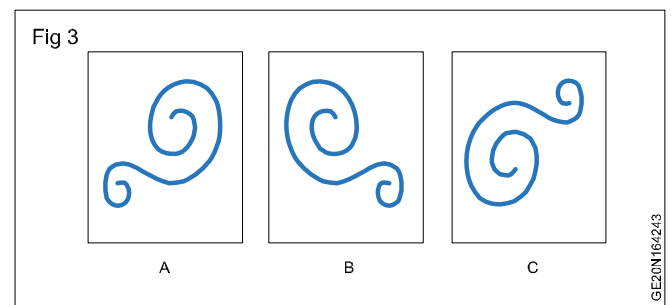
Controls the size of the brush. Enter a value in pixels or drag the slider.

Brush strokes with different diameter values

Use Sample Size

Resets the brush to its original diameter. This option is available only if the brush tip shape was created by sampling pixels in an image.

Flip X (Fig 3 & 4)



Changes the direction of a brush tip on its x axis.

Flipping a brush tip on its x axis

A Brush tip in its default position

B Flip X selected

C Flip X and Flip Y selected

Flip Y

Changes the direction of a brush tip on its y axis.

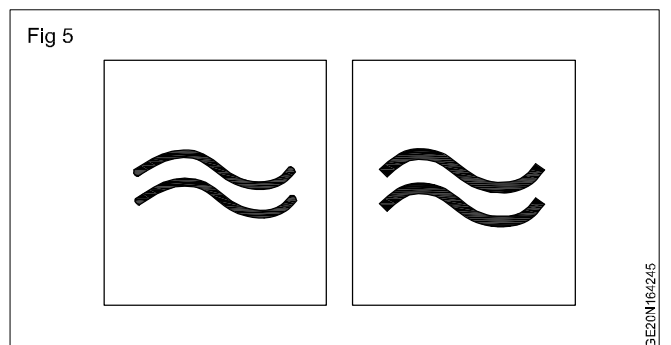
Flipping a brush tip on its y axis

A Brush tip in its default position

B Flip Y selected

C Flip Y and Flip X selected

Angle (Fig 5)

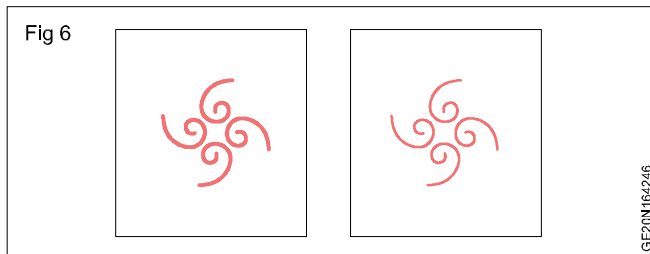


Specifies the angle by which an elliptical or sampled brush's long axis is rotated from horizontal. Type a value in degrees, or drag the horizontal axis in the preview box.

Angled brushes create a chiseled stroke

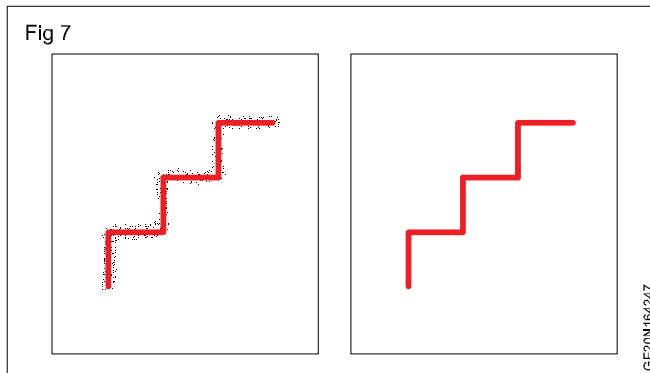
Roundness (Fig 6)

Specifies the ratio between the brush's short and long axes. Enter a percentage value, or drag the points in the preview box. A value of 100% indicates a circular brush, a value of 0% indicates a linear brush, and intermediate values indicate elliptical brushes.



Adjusting roundness to compress a brush tip shape

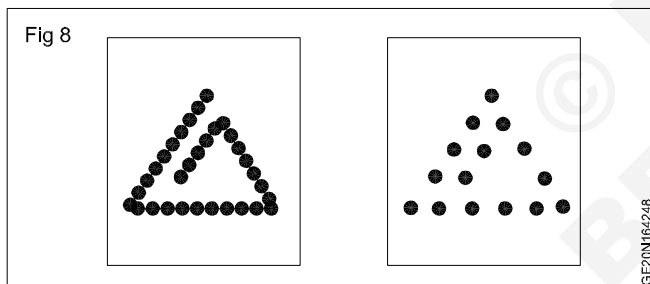
Hardness (Fig 7)



Controls the size of the brush's hard center. Type a number, or use the slider to enter a value that is a percentage of the brush diameter. You can't change the hardness of sampled brushes.

Brush strokes with different hardness values

Spacing (Fig 8)



Controls the distance between the brush marks in a stroke. To change the spacing, type a number, or use the slider to enter a value that is a percentage of the brush diameter. When this option is deselected, the speed of the cursor determines the spacing.

Bristle tip shape options

Bristle tips let you specify precise bristle characteristics, creating highly realistic, natural-looking strokes. Set the following brush tip shape options in the Brush panel:

Shape

Determines the overall arrangement of bristles.

Bristles

Controls overall bristle density.

Length

Changes bristle length.

Thickness

Controls the width of individual bristles.

Stiffness

Controls bristle flexibility. At low settings, brush shape deforms easily.

Note: To vary stroke creation when using a mouse, adjust the stiffness setting.

Spacing

Controls the distance between the brush marks in a stroke. To change the spacing, type a number or use the slider to specify a percentage of the brush diameter. When this option is deselected, the speed of the cursor determines the spacing.

Angle

When painting with a mouse, determines the brush tip angle.

Brush preview

Shows brush tip that reflects changes to settings above, as well as current pressure and stroke angle. Click the preview window to see the brush from different sides. The brush preview window has been discontinued in Photoshop 21.0.3 (January 2020 release) and is no longer available.

Erodible tip options

Erodible tip brushes behave similar to pencils and crayons, and wear down naturally as you draw. You can see the amount of wear with the Live Brush Tip Preview to the upper left of the image.

Size

Controls the size of the brush. Enter a value in pixels or drag the slider.

Softness

Controls the rate of wear. Enter a value in percentage or drag the slider.

Shape

Controls the shape of the tip. Choose from a variety of tip options.

Sharpen Tip

Returns the tip to the original sharpness.

Spacing

Controls the distance between the brush marks in a stroke. To change the spacing, type a number or use the slider to specify a percentage of the brush diameter. When this option is deselected, the speed of the cursor determines the spacing.

Brush preview

Shows brush tip that reflects changes to settings above, as well as current pressure and stroke angle. Click the preview window to see the brush from different sides. The

brush preview window has been discontinued in Photoshop 21.0.3 (January 2020 release) and is no longer available.

Airbrush tip options

Airbrush tips replicate spray cans with a 3D conical spray. With a stylus, you can alter the spread of sprayed strokes by changing pen pressure.

Size

Controls the size of the brush. Enter a value in pixels or drag the slider.

Hardness

Controls the size of the brush's hard center.

Distortion

Controls the distortion to apply to the spray of paint.

Granularity

Controls how grainy the paint drops look.

Spatter Size

Controls the size of the paint droplets.

Spatter Amount

Controls the number of paint droplets.

Spacing

Controls the distance between the droplets. If this option is deselected, the speed of the cursor determines the spacing.

Brush preview

Shows brush tip that reflects changes to settings above, as well as current pressure and stroke angle. Click the preview window to see the brush from different sides. The brush preview window has been discontinued in Photoshop 21.0.3 (January 2020 release) and is no longer available.

Brush pose options

Brush pose options let you achieve stylus-like effects and let you control the angle and position of the brush.

Tilt X

Determines the tilt angle of the brush from left to right.

Tilt Y

Determines the tilt angle of the brush from front to back.

Rotation

Determines the rotation angle of the bristles.

Pressure

Determines the pressure the brush applies on the canvas.

Enable Override options to maintain a static brush pose.

Other brush options

Noise

Adds additional randomness to individual brush tips. This option is most effective when applied to soft brush tips (brush tips that contain gray values).

Wet Edges

Causes paint to build up along the edges of the brush stroke, creating a watercolor effect.

Airbrush/Build-up

Applies gradual tones to an image, simulating traditional airbrush techniques. The Airbrush option in the Brush panel corresponds to the Airbrush option in the options bar.

Smoothing


Produces smoother curves in brush strokes. This option is most effective when you are painting quickly with a stylus; however, it may produce a slight lag time in stroke rendering.

Protect Texture

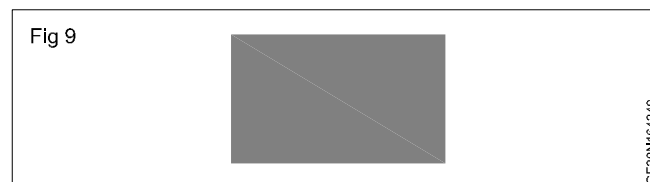
Applies the same pattern and scale to all brush presets that have a texture. Select this option to simulate a consistent canvas texture when painting with multiple, textured brush tips.

Stroke smoothing

Photoshop performs intelligent smoothing on your brush strokes. Simply enter a value (0-100) for Smoothing in the Options bar when you're working with one of the following tools: Brush, Pencil, Mixer Brush, or Eraser. A value of 0 is the same as legacy smoothing in earlier versions of Photoshop. Higher values apply increasing amounts of intelligent smoothing to your strokes.

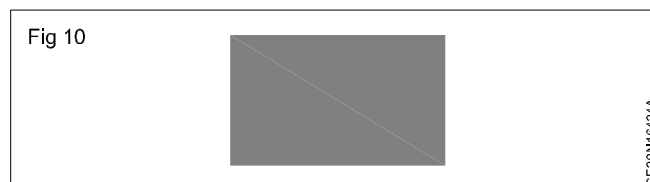
Stroke smoothing works in several modes. Clicking the gear icon  to enable one or more of the following modes:

Pulled String Mode (Fig 9)



Paints only when the string is taut. Cursor movements within the smoothing radius leave no mark.

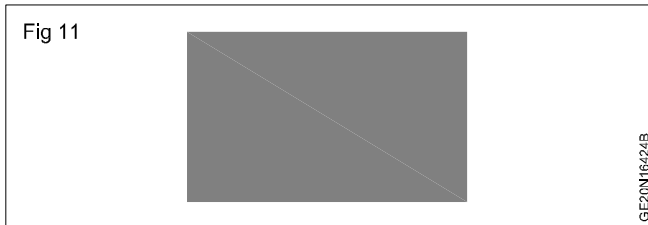
Stroke Catch Up (Fig 10)



Allows the paint to continue catching up with your cursor while you've paused the stroke. Disabling this mode stops paint application as soon as the cursor movement stops.

Catch-Up On Stroke End (Fig 11)

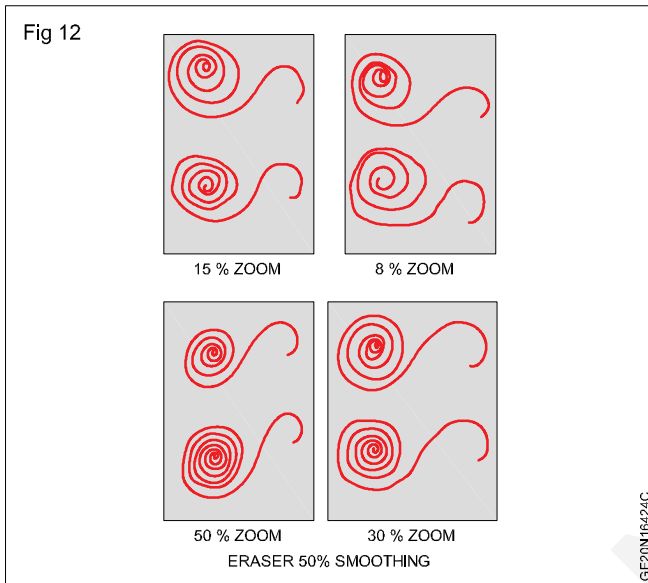
Completes the stroke from the last paint position to the point where you released the mouse/stylus control.



Adjust For Zoom

Prevents jittery strokes by adjusting smoothing. Decreases smoothing when you zoom in the document; increases smoothing when you zoom out.

Brush scattering (Fig 12)



Brush scattering determines the number and placement of marks in a stroke.

Brush strokes without scattering (left) and with scattering (right)

Scatter and Control

Specifies how brush marks are distributed in a stroke. When Both Axes is selected, brush marks are distributed in a radial direction. When Both Axes is deselected, brush marks are distributed perpendicular to the stroke path.

To specify the maximum percentage of scattering, enter a value. To specify how you want to control the scattering variance of brush marks, choose an option from the Control pop up menu:

Off (Fig 13)

Specifies no control over the scattering variance of brush marks.

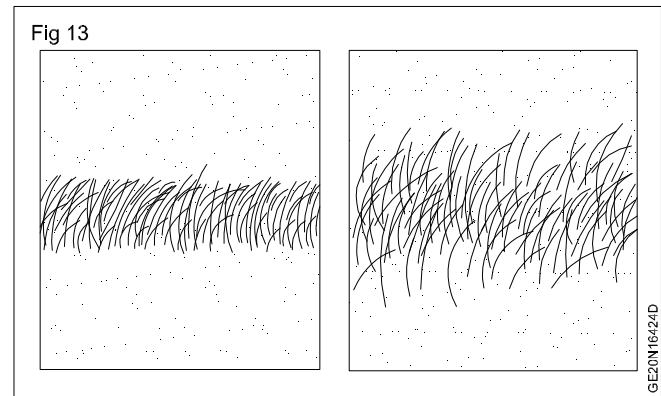
Fade

Fades the scattering of brush marks from maximum scattering to no scattering in the specified number of steps.

Pen Pressure, Pen Tilt, Stylus Wheel, Rotation

Varies the scattering of brush marks based on the pen

pressure, pen tilt, position of the pen thumbwheel, or rotation of the pen.



Count

Specifies the number of brush marks applied at each spacing interval.

Navigating

Basic image navigation shortcuts

Zoom in and Zoom out

The **Zoom In** and **Zoom Out** commands are the most basic ways of zooming in or out of an image in Photoshop. You'll find them both under the View menu in the Menu Bar. To use the Zoom In command from your keyboard, on a Windows PC, press and hold your **Ctrl** key and press the "+" (plus) sign. On a Mac, press and hold your **Command** key and press the "+" (plus) sign.

To use the Zoom Out command from your keyboard, on a Windows PC, press and hold your **Ctrl** key and press the "-" (minus) sign. On a Mac, press and hold your **Command** key and press the "-" (minus) sign.

Fit on Screen

Photoshop's **Fit on Screen** command displays your image at the largest possible zoom level while still being able to view it entirely on the screen. Like the Zoom In and Zoom Out commands, you'll find it under the View menu in the Menu Bar. To select Fit on Screen from your keyboard, on a Windows PC, press **Ctrl+0**. On a Mac, press **Command+0**. You can also select Fit on Screen by double-clicking on the **Hand Tool** in the Toolbar (sunglasses photo from Adobe Stock) (Fig 14)

100%

The **100%** command (known as "Actual Pixels" in earlier versions of Photoshop) instantly jumps your image to a zoom level of 100%. At this zoom level, each pixel in your image takes up exactly one pixel on your screen, letting you **view** the image in full detail. This is the ideal zoom level for image sharpening. The 100% command can be found under the View menu in the Menu Bar. To select 100% from the keyboard, press **Ctrl+1** (Win) / **Command+1** (Mac). You can also select it by double-clicking on the **Zoom Tool** in the Toolbar.

Fig 14



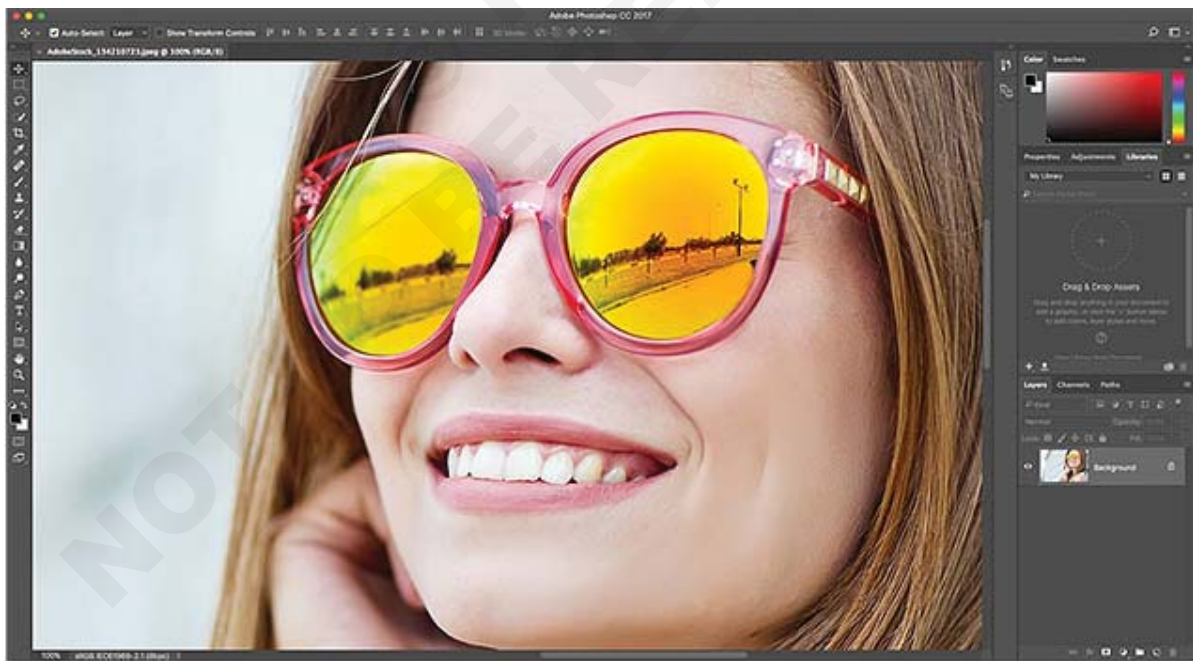
Press Ctrl+0 (Win) / Command+0 (Mac) to fit the image on your screen. Photo credit: Adobe Stock.

Screen navigation shortcuts

Here's some handy shortcuts you can use to quickly navigate around your image while you're zoomed in. Press the **Home** key on your keyboard to instantly jump to the upper left of the image, or the **End** key to jump to the

lower right. Press the **Page Up** key to move up one full screen, or **Page Down** to move down one full screen. Pressing **Ctrl+Page Up** (Win) / **Command+Page Up** (Mac) will move you one full screen to the left, while **Ctrl+PageDown** (Win) / **Command+Page Down** (Mac) will move one full screen to the right. (Fig 15)

Fig 15



Press Ctrl+1 (Win) / Command+1 (Mac) to zoom the image to 100%.

Zoom Tool shortcuts

Selecting the Zoom Tool

To quickly select Photoshop's Zoom Tool, press the **Z** key on your keyboard. With the Zoom Tool selected, click on your image to zoom in. To switch the Zoom Tool from

"zoom in" to "zoom out" mode, press and hold the **Alt** (Win) / **Option** (Mac) key on your keyboard.

To temporarily switch to the Zoom Tool when any other tool is active, press and hold **Ctrl+spacebar** (Win) / **Command+spacebar** (Mac) on your keyboard. Click on

the image to zoom in, and then release the keys to switch back to the previous tool.

To temporarily switch to the Zoom Tool and zoom out from the image, press **Ctrl+Alt+spacebar** (Win) / **Option+spacebar** (Mac). Click on the image to zoom out, and then release the keys.

Zoom all open images

If you have two or more images open in Photoshop, you can zoom all images at the same time. Just press and hold the **Shift** key on your keyboard as you're zooming in or out. To switch back to zooming a single image at a time, release the Shift key. (Fig 16)



Continuous zoom

To zoom in continuously on the same spot, click and hold on the image with the Zoom Tool. Photoshop will gradually zoom in closer until you release your mouse button. To zoom out continuously, add your **Alt** (Win) / **Option** (Mac) key.

The "Spring-Loaded" Zoom Tool

Most of Photoshop's tools can be accessed as spring-loaded tools. Pressing and holding the keyboard shortcut for a tool will temporarily switch you to that tool for as long as the key is held down. When you release the key, you'll switch back to the previously-active tool.

To use the Zoom Tool as a spring-loaded tool, press and hold the **Z** key on your keyboard. Click on the image to zoom in, or add the **Alt** (Win) / **Option** (Mac) key to zoom out, and then release the Z key to revert back to your previous tool.

Scrubby zoom

Photoshop's **Scrubby Zoom** feature is the fastest way to zoom images. Press and hold **Ctrl+spacebar** (Win) / **Command+spacebar** (Mac) on your keyboard to temporarily access the Zoom Tool, and then click on the image and drag left or right. Dragging to the right will zoom you in, while dragging to the left will zoom you out. Drag slower or faster to change the speed of the zoom.

Hand Tool shortcuts

Selecting the Hand Tool

To scroll, or pan, images in Photoshop, we use the Hand Tool. To select the Hand Tool from the keyboard, press

the **H** key. Or, to temporarily switch to the Hand Tool when any other tool is active, press and hold your **spacebar**. Click and drag the image to reposition it within the document window, and then release the spacebar to switch back to the previous tool.

Scroll all open images

To scroll all open images at once, with the Hand Tool selected, press and hold your **Shift** key as you click and drag one of the images.

Birds Eye View

When zoomed in on an image, Photoshop's Birds Eye View feature lets you quickly jump from one part of an image to another. To use Birds Eye View, press and hold the **H** key (the shortcut for the Hand Tool) on your keyboard. Photoshop instantly zooms the image out so that it fits entirely on the screen, giving you a "birds eye view" of where you are. Drag the **rectangle** over the area where you want to zoom in, and then release your H key. Photoshop will instantly zoom in to the selected area, and you'll return to your previously-active tool.

Navigator Panel shortcuts

Selecting the area to zoom in

When using Photoshop's Navigator panel, the fastest way to zoom in on your image is by dragging a selection around the area you need. Press and hold your **Ctrl** (Win) / **Command** (Mac) key and drag out a selection (a View Box) around the area where you want to zoom in. Release your mouse button, and Photoshop will instantly zoom in to that area. (Fig 17)

Fig 17



In the Navigator panel, hold Ctrl (Win) / Command (Mac) and draw a selection to zoom in.

Rotate View Tool shortcuts

Selecting the Rotate View Tool

The Rotate View Tool in Photoshop lets you easily rotate the viewing angle of an image as you work. You can select the Rotate View Tool from the keyboard by pressing the letter **R**.

Rotating your view in steps

By default, the Rotate View Tool will rotate the angle freely as you drag. To snap the angle to incremental steps of 15 degrees, press and hold your Shift key as you drag.

The "spring-loaded" Rotate View Tool

The best way to use the Rotate View Tool is as a spring-loaded tool. When any other tool is active, press and hold the **R** key to temporarily switch to the Rotate View Tool. Click and drag inside the document window to rotate your view, and then release the R key to switch back to the previous tool and continue working.

Resetting the view

To reset your view and restore the image to its upright position, press the Esc key on your keyboard. Or, double-click on the **Rotate View Tool** in the Toolbar.

Working in the Edit workspace of Photoshop Elements gives you choices about working with your files. You can set options for opening, saving, and exporting files by type, by file size, and resolution. You can also process and save camera raw files. These tools make it easy to combine files of different types and optimize them in Adobe Photoshop Elements.

In the Edit workspace, you can create a blank file, open a recently used file, specify which files types to open in Photoshop Elements, and more.

An additional option for working in the Edit workspace is to use the Guided Edit feature. Guided Edits helps you when you're unsure of a workflow or how to accomplish a task. They empower users to complete complex editing workflows in a small number of easy steps.

Create a new blank file

You may want to create a web graphic, banner, or company logo and letterhead, in which case you need to start from a new blank file.

- 1 Choose File > New > Blank File.
- 2 Enter options for the new image and click OK.

Preset

Provides options for setting the width, height, and resolution of images that you intend to print or to view on screen. Select Clipboard to use the size and resolution of data that you copied to the clipboard. You can also base a new image on the size and resolution of any open image by choosing its name from the bottom of the Preset menu.

Size

Choose from a list of standard sizes available for the selected preset.

Width, Height, and Resolution

Sets these options individually. The default values are based on the last image you created, unless you've copied data to the clipboard.

Color Mode

Sets an image to RGB color, grayscale, or bitmap (1 bit mode).

Background Contents

Sets the color of the image Background layer. White is the default. Select Background Color to use the current background color (shown in the toolbox). Select Transparent to make the default layer transparent, with no color values—the new image will have a Layer 1 instead of a Background layer.

Open a file

You can open and import images in various file formats. The available formats appear in the Open dialog box, the Open As dialog box, and the Import submenu.

1. Do one of the following
 - Choose File > Open. Locate and select the file you want to open. If the file does not appear, choose All Formats from the Files Of Type menu. Click Open.
 - Click the Open drop-down (above the tool box). The Open drop-down is a list of recently opened files.
 - Drag an image from a folder on your computer or storage device, and drop it in the Editor.

In the dialog box that appears, set format-specific options, and continue opening the file.

There may be instances when Photoshop Elements cannot determine the correct format of a file. For example, transferring a file between Mac OS® and Windows can cause the format to be mislabeled. In such cases, you must specify the correct format in which to open the file.

Open a file in an Application Frame (Mac OS)

- 1 Drag a file from any location on your computer into the Application Frame. You can also drag photos from the Photo Browser and any storage device connected to your computer.
- 2 To drag additional images into the Application Frame to open them, enable floating document windows (see View and arrange multiple windows). Convert open images into floating document windows to view the Application Frame.

Open a recently edited file

- 1 Choose File > Open Recently Edited File, and select a file from the submenu.

Specify the file format in which to open a file

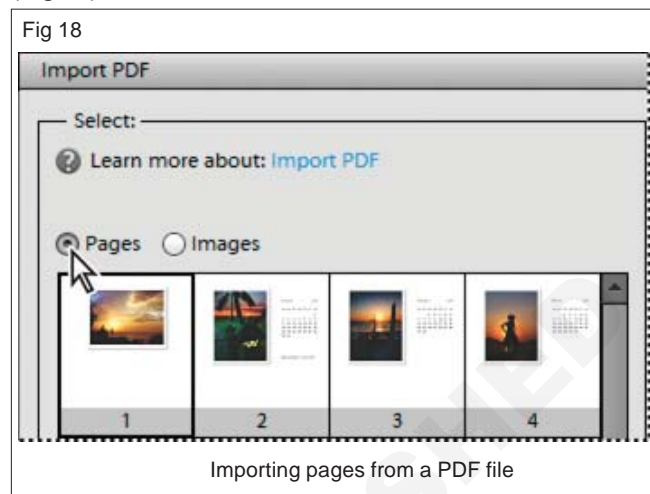
- 1 Choose File > Open As, and select the file you want to open. Then choose the desired format from the Open As menu, and click Open.

Open a PDF file

Portable Document Format (PDF) is a versatile file format that can represent both vector and bitmap data and can contain electronic document search and navigation features. PDF is the primary format for Adobe® Acrobat®.

With the Import PDF dialog box, you can preview the pages and images in a multipage PDF file, then decide if

you want to open them in the Photoshop Editor. You can choose to import full pages (including text and graphics), or you can import just the images from a PDF file. If you import only the images, the resolution, size, and color mode of the images remains unchanged. If you import pages, you can change the resolution and color mode. (Fig 18)



Each page is shown as a thumbnail. To increase the size, choose an option from the Thumbnail Size menu.

- 1 Choose File > Open.
- 2 Select a PDF file, and click Open. You can change which types of files are shown by selecting an option from the Files Of Type menu.
- 3 To import just the images from a PDF file, choose the Images option from the Select area, in the Import PDF dialog box. Select the image or images you want to open. (To select multiple images, hold Ctrl (Windows) or Command (Mac OS) and click each image). If you do not want to import pages, skip to step 5.
- 4 To import pages from a PDF file, choose the Pages option from the Select area in the Import PDF dialog box, and then do any of the following:
 - If the file contains multiple pages, select the page or pages you want to open, and click OK. (To select multiple pages, press Ctrl (Windows) or Command (Mac OS) and click each page.)
 - Under Page Options, accept the existing name, or type a new filename in the Name box.
 - Select Anti-aliased to minimize the jagged edges as the image is rasterized (bitmapped).
 - Specify the Width and Height. Enable Constrain Proportions to avoid image distortion due to change in size.
 - For Resolution, accept the default (300 ppi) or type a new value. A higher resolution increases the file size.

- Choose an option from the Mode menu (RGB to keep the photos in color, or Grayscale to automatically make them black and white). If the file has an embedded ICC (International Color Consortium) profile, you can choose the profile from the menu.
- 5 Select Suppress Warnings to hide any error messages during the import process.
- 6 Click OK to open the file.

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Concepts of Data and Databases

Objectives : At the end of this lesson you shall be able to

- explain database structure and control
- describe Ms access database utilities.

Microsoft Access is a Database Management System (DBMS) from Microsoft that combines the relational Microsoft Jet Database Engine with a graphical user interface and software-development tools. It is a member of the Microsoft Office suite of applications, included in the professional and higher editions.

- Microsoft Access is just one part of Microsoft's overall data management product strategy.
- It stores data in its own format based on the Access Jet Database Engine.
- Like relational databases, Microsoft Access also allows you to link related information easily. For example, customer and order data. However, Access 2013 also complements other database products because it has several powerful connectivity features.
- It can also import or link directly to data stored in other applications and databases.
- As its name implies, Access can work directly with data from other sources, including many popular PC database programs, with many SQL (Structured Query Language) databases on the desktop, on servers, on minicomputers, or on mainframes, and with data stored on Internet or intranet web servers.
- Access can also understand and use a wide variety of other data formats, including many other database file structures.
- You can export data to and import data from word processing files, spreadsheets, or database files directly.
- Access can work with most popular databases that support the Open Database Connectivity (ODBC) standard, including SQL Server, Oracle, and DB2.
- Software developers can use Microsoft Access to develop application software.

Microsoft Access stores information which is called a database. To use MS Access, you will need to follow these four steps:

- **Database Creation:** Create your Microsoft Access database and specify what kind of data you will be storing.
- **Data Input:** After your database is created, the data of every business day can be entered into the Access database.

- **Query:** This is a fancy term to basically describe the process of retrieving information from the database.
- **Report (optional):** Information from the database is organized in a nice presentation that can be printed in an Access Report.

Architecture

- Access calls anything that can have a name an object. Within an Access desktop database, the main objects are tables, queries, forms, reports, macros, data macros, and modules.
- If you have worked with other database systems on desktop computers, you might have seen the term database used to refer to only those files in which you store data.
- But, in Access, a desktop database (.accdb) also includes all the major objects related to the stored data, including objects you define to automate the use of your data.

RDBMS

In the computing system (web and business applications), there are enormous data that comes out every day from the web. A large section of these data is handled by Relational database management systems (RDBMS). The idea of relational model came with E.F.Codd's 1970 paper "A relational model of data for large shared data banks" which made data modeling and application programming much easier. Beyond the intended benefits, the relational model is well-suited to client-server programming and today it is predominant technology for storing structured data in web and business applications.

MS Access - RDBMS

Microsoft Access has the look and feel of other Microsoft Office products as far as its layout and navigational aspects are concerned, but MS Access is a database and, more specifically, a relational database.

- Before MS Access 2007, the file extension was *.mdb, but in MS Access 2007 the extension has been changed to *.accdb extension.
- Early versions of Access cannot read accdb extensions but MS Access 2007 and later versions can read and change earlier versions of Access.
- An Access desktop database (.accdb or .mdb) is a fully functional RDBMS.

- It provides all the data definition, data manipulation, and data control features that you need to manage large volumes of data.
- You can use an Access desktop database (.accdb or .mdb) either as a standalone RDBMS on a single workstation or in a shared client/server mode across a network.
- A desktop database can also act as the data source for data displayed on webpages on your company intranet.
- When you build an application with an Access desktop database, Access is the

RDBMS.

Data Definition

Let us now understand what Data Definition is:

- In document or a spreadsheet, you generally have complete freedom to define the contents of the document or each cell in the spreadsheet.
- In a document, you can include paragraphs of text, a table, a chart, or multiple columns of data displayed with multiple fonts.
- In spreadsheet, you can have text data at the top to define a column header for printing or display, and you might have various numeric formats within the same column, depending on the function of the row.
- An RDBMS allows you to define the kind of data you have and how the data should be stored.
- You can also usually define rules that the RDBMS can use to ensure the integrity of your data.
- For example, a validation rule might ensure that the user can't accidentally store alphabetic characters in a field that should contain a number.

Data Manipulation

Working with data in RDBMS is very different from working with data in a word processing or spreadsheet program.

- In a word processing document, you can include tabular data and perform a limited set of functions on the data in the document.
- You can also search for text strings in the original document and, with ActiveX controls, include tables, charts, or pictures from other applications.
- In a spreadsheet, some cells contain functions that determine the result you want, and in other cells, you enter the data that provides the source information for the functions.
- An RDBMS provides you many ways to work with your data. For example,
- You can search a single table for information or request a complex search across several related tables.
- You can update a single field or many records with a single command.

- You can write programs that use RDBMS commands to fetch data that you want to display and allow the user to update the data.

Access uses the powerful SQL database language to process data in your tables. Using SQL, you can define the set of information that you need to solve a particular problem, including data from perhaps many tables.

Data Control

Spreadsheets and word processing documents are great for solving single-user problems, but they are difficult to use when more than one person needs to share the data.

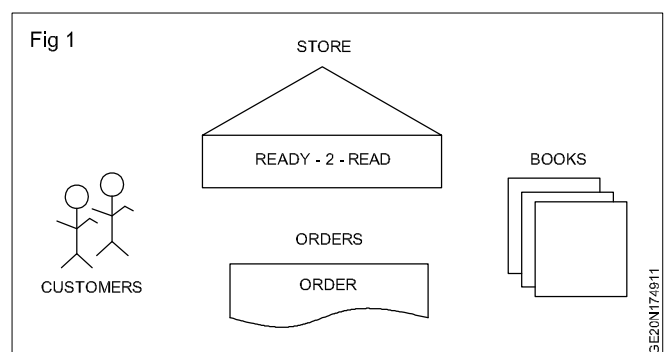
- When you need to share your information with others, RDBMS gives you the flexibility to allow multiple users to read or update your data.
- An RDBMS that is designed to allow data sharing also provides features to ensure that no two people can change the same data at the same time.
- The best systems also allow you to group changes (which is also known as transaction) so that either all the changes or none of the changes appear in your data.
- You might also want to be sure that no one else can view any part of the order until you have entered all of it.
- Because you can share your Access data with other users, you might need to set some restrictions on what various users are allowed to see or update.

Designing a Database

The first step in creating a database is to think about why you need it-what is its purpose? Once you know the answer, you can begin designing your own database. Ask yourself questions like What kinds of information will it store? How will I have to break down this information so it can be stored in my database? How will I use the data once it's in there?

The bookstore scenario (Fig 1)

The best way to learn about designing a database is to jump right in to the process. Let's pretend we work for the bookstore, and we need to build a database for the store to use. Let's think about what we might need the database to do for us.



The following diagram shows that we have **customers** and sell **books** via **orders**, both in the store and online.

The store needs a way to keep track of these things.

Determine the purpose of the database

The first step of designing a database is to determine the purpose of the database. What do we need it to do?

At Ready-2-Read, our customers will place orders for books. At the very least, we will want our database to track the books we sell, the customers we sell them to, and the date of each of the orders.

The database will also be able to tell us where our customers live when we need to send them books or coupons. Additionally, we can use it to track our sales or to make a bestseller list to post in the store.

Plan database tables

Once we've established its purpose, we can begin about how to break up the information into the tables the database will need to store data. Recall that a table is a collection of records, and each record is broken up into the smallest pieces of needed information, called fields.

Because we're planning a database to track our customers, the books we have, and the orders our customers place, we will need a table for each one of these.

- Customers
- Orders
- Books

Plan table fields

Once you know what tables you need, the next step is deciding what fields belong in each table. Remember that fields are the smallest chunk of information in any record.

Let's look at our Ready-2-Read bookstore example again. There will be several fields in our Customers table -1. We'll obviously want each customer's first name and last name. We'll also need an address if we need to send a customer his order. Email will be necessary if we need to contact the customer if there is an issue with the order.

Table - 1

| Customers | Books | Orders |
|--------------|--------------|----------|
| First Name | Title | Customer |
| Last Name | Author First | Book |
| Street | Author Last | Date |
| City | Price | |
| State | Category | |
| Pin/Zip Code | | |
| Email | | |

We will also need several fields in the Books table. Title and Author make sense for books. We'll need a Price for each book. Category will help us know what type of books

sell the best so we can order more books that fit into this category.

The Orders table will have fewer fields. We'll need this table to track the Customer who is placing the order, the Book the customer is ordering, and the Date the order is placed.

Creating a new database with Access

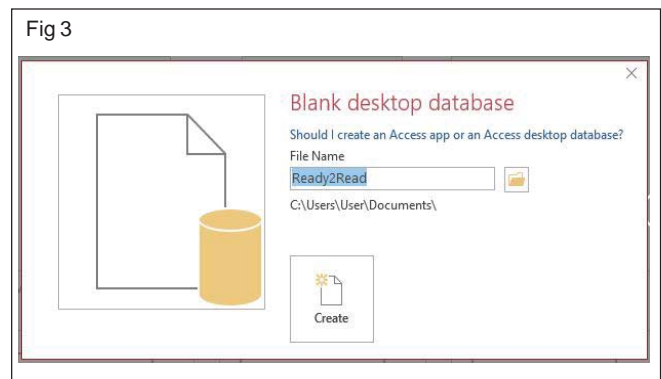
When you launch Access 2007/2010, you will see the Getting Started window.

In the left pane, the template categories-including the featured local templates-are listed, as well as the categories on Office Online. Templates are prebuilt databases focused on a specific task that you can download and use immediately.

You will also see the New Blank Database option, which allows you to build your own database from scratch. (Fig 2)



When you choose the New Blank Database option at the top of the window, you will be prompted to rename the database from the default name, which is Database1.accdb. Rename the database whatever you want. In the example below, we named the database Ready2Read because it's the name of the store in our scenario. (Fig 3)

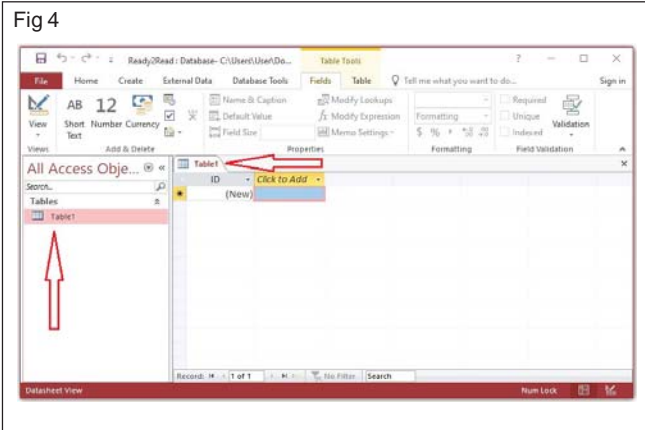


Click Create to finish naming the database.

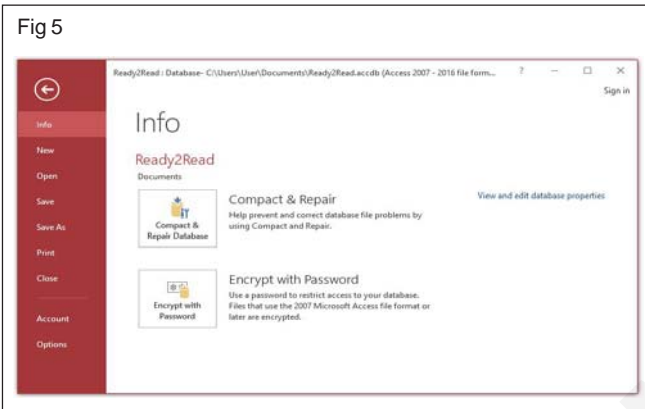
Setting up tables (Fig 4)

The new database opens with one table showing as a default. It also defaults to naming this table Table1 in both the navigation pane and the Table tab itself. You will want to name your tables based on your database design plan.

Fig 4



Naming a table (Fig 5)



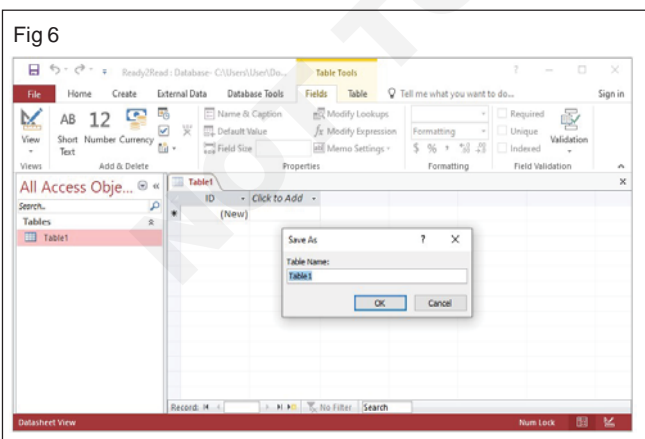
To give the table a unique name, you must first click on the Microsoft Office button in the upper-left corner of the application.

Next, select Save from the menu. The Save As dialog box will appear to let you save the table whatever name you want.

The new table names appear in both the navigation pane and the Table tab itself, as you can see in the picture below.

TIP: Give your tables logical, easy-to-understand names.

To rename a table (Fig 6)



With the table closed, right-click the Table you want to rename in the navigation pane. Select the Rename option that appears in the menu.

The table name will be highlighted and a cursor will appear, which means you can now type the new name right there. Left-click anywhere outside of the table name to make the change. (Fig 7 & 8)

Fig 7

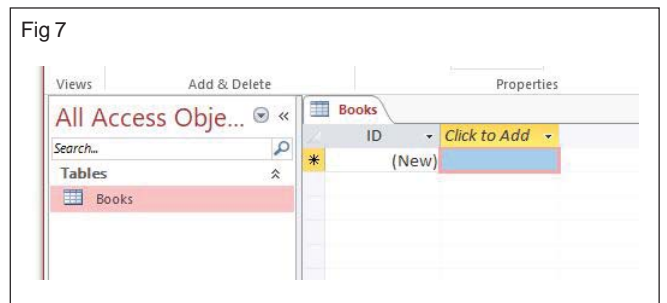
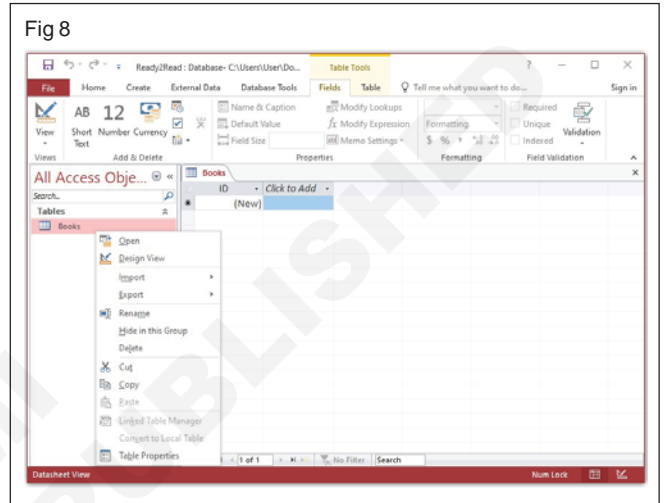
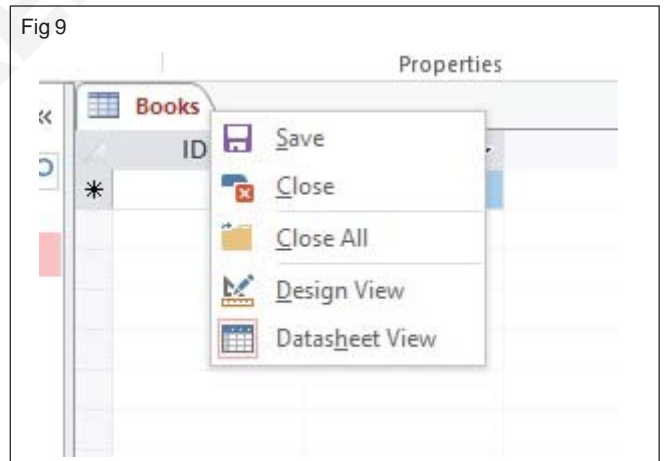


Fig 8



To close a table (Fig 9)



There are several ways to close an active table. You can right-click the Table tab and choose Close from the menu.

A more common method is to click the X that appears in the top-right corner of the active database object window.

To open a table (Fig 10)

To open a table, right-click the Table name of the table you want to open in the navigation pane, then choose Open from the menu.

A more common method is to double-click the table name in the navigation pane. The selected table will open in the active database object window.

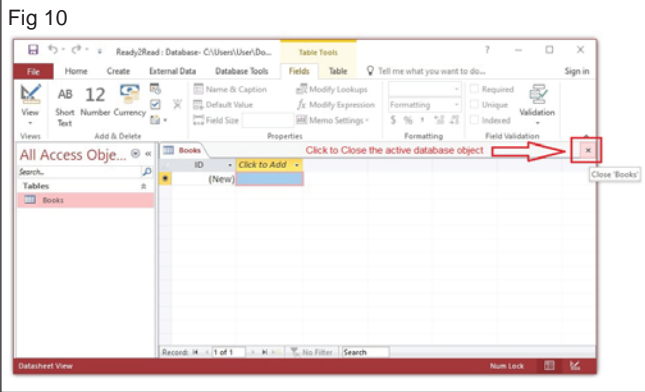
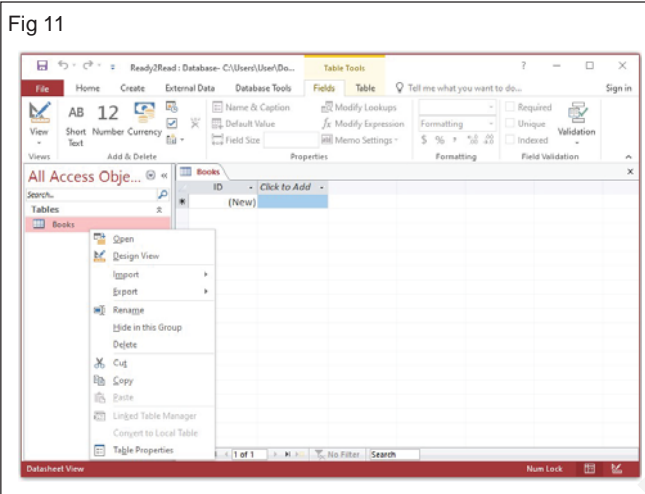


Fig 10
Adding more tables to the database (Fig 11)



By default, Access 2007 starts out with one table. To add more tables to the database, click the Create tab on the Ribbon.

Next, select Table from the Tables command group. A new table will open in the active database object window. You must name your table using the Save command from Microsoft Office menu.

Adding fields to a table

Access 2007 allows you to add fields to tables when you are:

- Working in Datasheet view, which looks like a spreadsheet
- Working in Design view, where you are able to set more controls for your fields

Either way, you need to know how to switch between the two views.

To switch views (Fig 12)

Select the Views command group from either the Home tab (seen below) or the Datasheet tab on the Ribbon. Select the view option you want from the menu.

Adding fields in Datasheet view (Fig 13)

By default, Access 2007 creates one field in each new table: the ID field. This field auto-numbers to give each record in the table a unique number identifier. Recall that records are the rows in a table. You may want to rename the ID field with a unique name because the ID field

appears automatically in every table you create. While this is not necessary, it may help avoid confusion when setting up table relationships. (Fig 14)

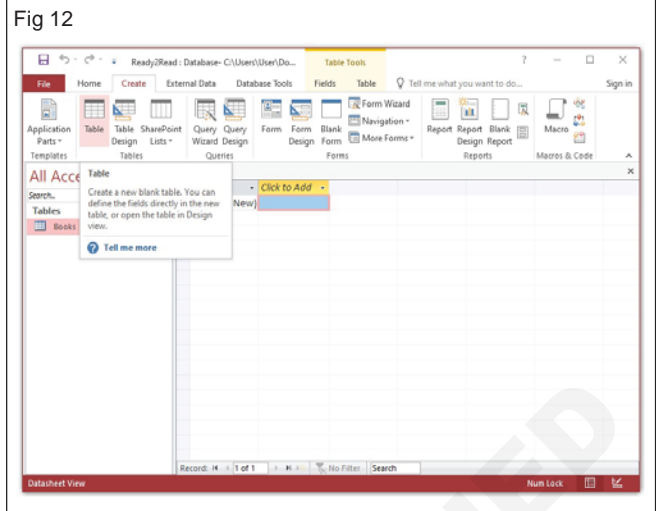


Fig 12

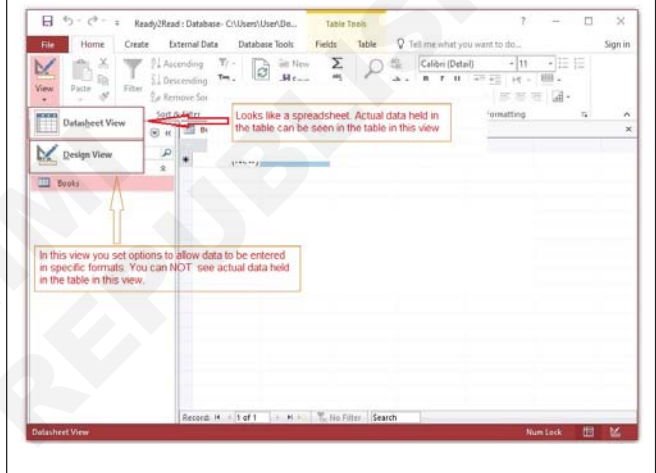


Fig 13

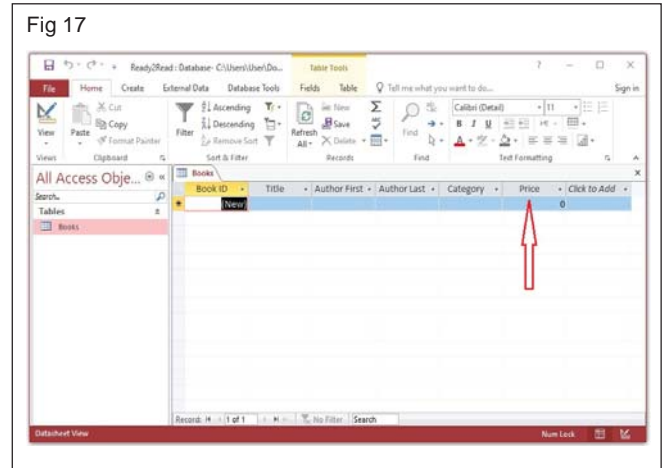
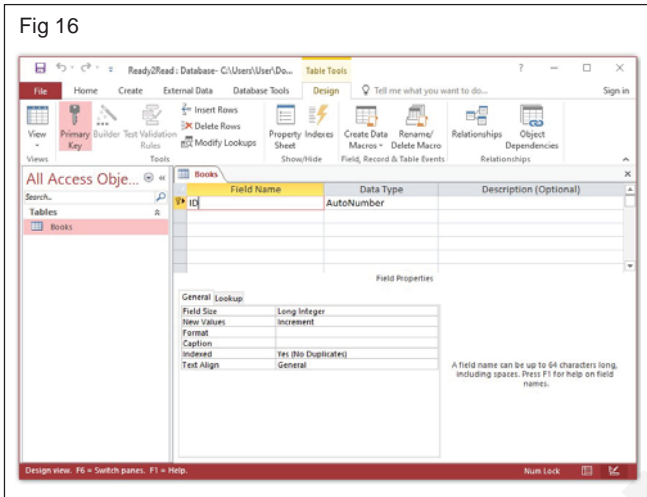


To add more fields to a table in Datasheet view, double-click the Add New Field header. (Fig 15)

The Add New Field text will disappear from the header. Name the field by typing the name directly into the header. Press the Tab key on your keyboard to move to the next field.

Adding fields in Design view (Fig 16)

In Design view, the field names are along the lefthand column instead of across the top like in Datasheet view, as seen below.



Datatypes

Every field in a table has properties and these properties define the field's characteristics and behavior. The most important property for a field is its data type. A field's data type determines what kind of data it can store. MS Access supports different types of data, each with a specific purpose.

- The data type determines the kind of the values that users can store in any given field.
- Each field can store data consisting of only a single data type.

Here are some of the most common data types you will find used in a typical Microsoft Access database table - 2.

To add a new field to a table in Design view, click in the cell where you want the new field and type the field name. When you switch back to Datasheet view, your new field appears as its own column, as seen below. (Fig 17)

Table -2

| Type of Data | Description | Size |
|--------------|---|---------------------|
| Short Text | Text or combinations of text and numbers, including numbers that do not require characters. calculating (e.g. phone numbers). | Up to 255 |
| Long Text | Lengthy text or combinations of text and numbers, characters. | Up to 63, 999 |
| Number | Numeric data used in mathematical (16 bytes if set to calculations. Replication ID). | 1, 2, 4, or 8 bytes |
| Date/Time | Date and time values for the years 100 through 9999. | 8 bytes. |
| Currency | Currency values and numeric data used in mathematical calculations involving data with one to four decimal places. | 8 bytes. |
| AutoNumber | A unique sequential (incremented by 1) 4 bytes (16 bytes if number or random number assigned by set to Replication Microsoft Access whenever a new record is ID). added to a table. | 1 bit. |
| Yes/No | Yes and No values and fields that contain only one of two values (Yes/No, True/False, or | 1 bit. |
| Attachment | Files, such as digital photos. Multiple files can be attached per record. This data type is not available in earlier versions of Access. | Up to about 2 GB. |

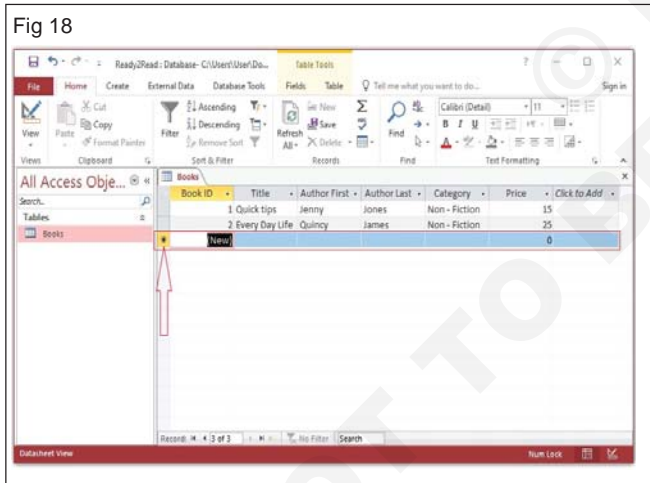
| Type of Data | Description | Size |
|-------------------|--|---|
| OLE objects | OLE objects can store pictures, audio, video, or other BLOBs (Binary Large Objects) | Up to about 2 GB. |
| Hyperlink | Text or combinations of text and numbers stored a | Up to 8,192 (each part of a Hyperlink data type can contain up to 2048 characters). |
| Lookup | The Lookup Wizard entry in the Data Type column in the Design view is not actually a data type. When you choose this entry, a wizard starts to help you define either a simple or complex lookup field. | Dependent on the data type of the lookup field. |
| Wizard | A simple lookup field uses the contents of another table or a value list to validate the contents of a single value per row. A complex lookup field allows you to store multiple values of the same data type in each row. | |
| Calculated | You can create an expression that uses data from one or more fields. You can designate different result data types from the expression. | You can create an expression that uses data from one or more fields. You can designate different result data types from the expression. |

MS Access - Adding Data

Adding records to tables

When you enter records into your table, you are populating the database. In Access 2007, you can do this a few different ways.

To add records in the new record row (Fig 18)



- Click the record row with the asterisk that appears at the bottom of the table.
- Type the data into the appropriate fields.
- Hit Enter or the Tab key to move to the next field.

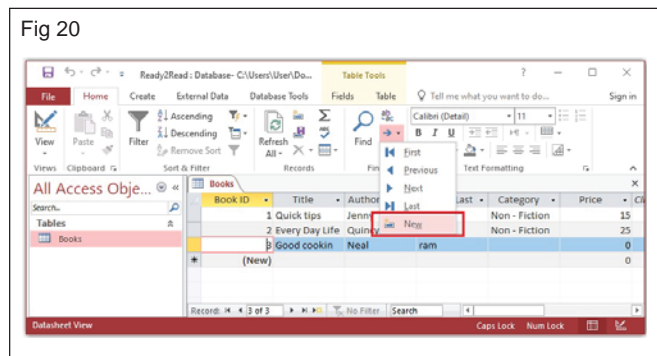
To add records with the New Record navigation button (Fig 19)

- Click the New Record button in the navigation bar. The navigation bar is located in the bottom-left corner of the open object pane.
- Type data into the appropriate fields.
- Hit Enter or the Tab key to move to the next field.

Fig 19



To add records with the New Record command (Fig 20)

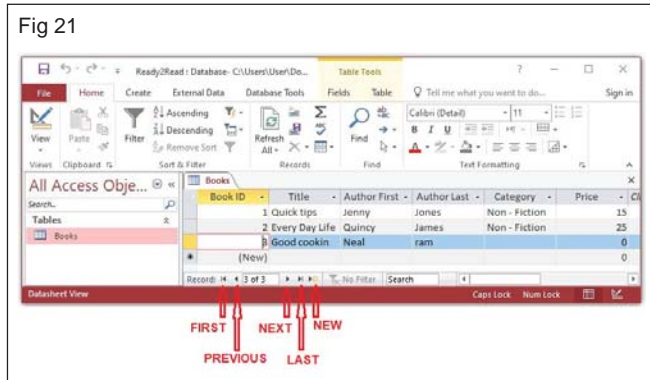


- Click the New Record command in the Records group in the Ribbon.
- Type the data into the appropriate fields.
- Hit the Enter or the Tab key to move to the next field.

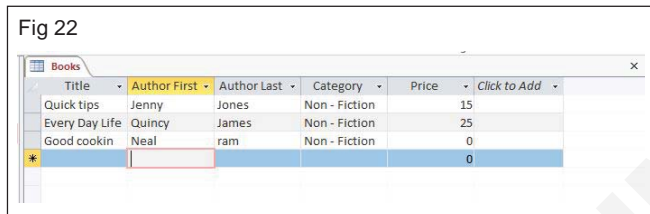
Editing records in tables

Sometimes it is necessary to edit records in the database. Like with every other task in Access 2007, this can be done several different ways.

To edit a record directly (Fig 21)

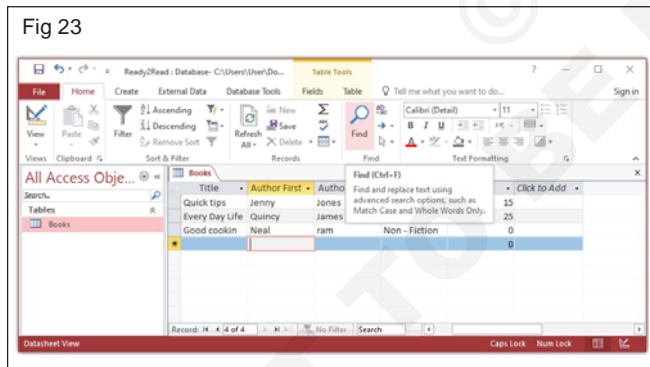


- Scroll through the records, or use the navigation buttons on the navigation bar to find the record to edit.
- Click the cell containing the information that must be edited. A pencil icon appears to indicate edit mode.
- Type the new information into the field.
- Click outside of the record row to apply the change. (Fig 22)

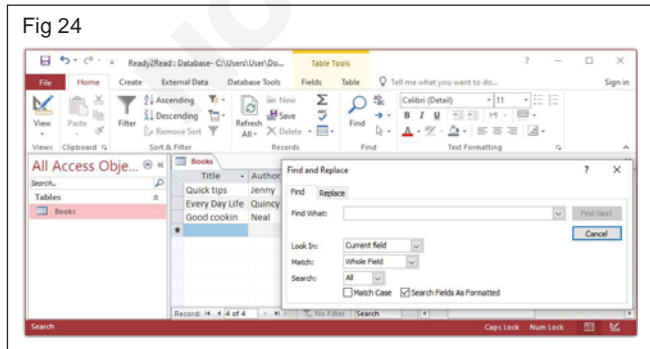


To edit a record using Find and Replace

- Click the Find command in the Find group on the Ribbon. (Fig 23)



- The Find and Replace dialog box opens. (Fig 24)



- Tell Access what to find by typing it into the Find What: area.

- Type the replace term in the Replace With: area.
- Tell Access where to look with the Look In: drop-down list. The first choice in the drop-down list is the field you were last in within the table.
- Tell Access what to Match: Any part of the field, the whole field, or just the start of the field.
- Tell Access how to Search: Up finds records above the cursor, Down finds records below the cursor, and All searches all records.
- Click one of the action options:
 - Find Next will find the next instance of the word in the table.
 - Replace will put the new word into the table, overwriting what is currently there.
 - Cancel stops the editing process.

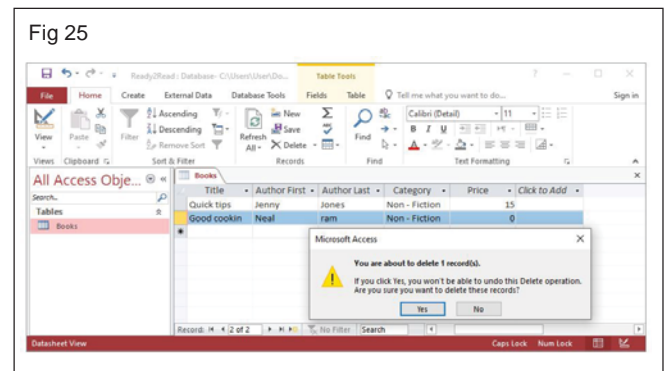
CAUTION: DO NOT use Replace All because it will overwrite every instance of the Find term in the table, which can have a serious impact on your data.

To copy and paste a Record

- Select the record you want to copy. Right-click, then select Copy.
- Select the new record row. Right-click and select Paste. The record information appears with a new record ID number.

To delete a record

- Select the record you want to delete, then right-click and select Delete Record.
- A dialog box appears, telling you the action cannot be undone and asking if you are sure you want to delete the record. (Fig 25)

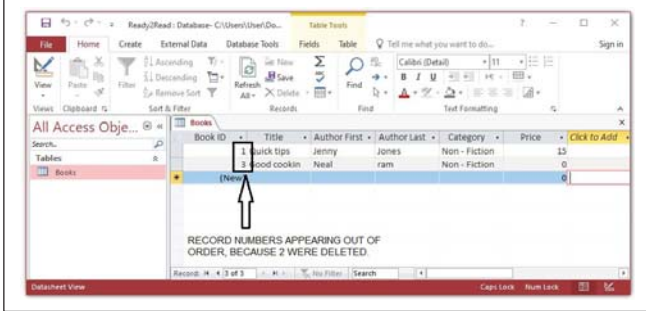


There may be other records that rely on the record you are trying to delete. DO NOT delete a record without knowing how it will impact the rest of your database.

When you delete a record, the record number is permanently deleted from the database table. If you delete the last record from a table and then add a new record, your new record numbers will appear to be out of sequence.

Data validation (Fig 26)

Fig 26



Data validation is an important database concept. It is the process by which Access tests the data that is being entered into the database to make sure it is in an acceptable-or valid-format.

Let's say one of your database users has entered an order date of January 4, 2008, in the month/date/year format as 01/04/2008. Another user has entered an order placed on that same date in the day/month/year format as 04/01/2008. If the database is tracking all sales for the month of January 2008, it may not show both orders as placed in January, even though both were placed on the same date.

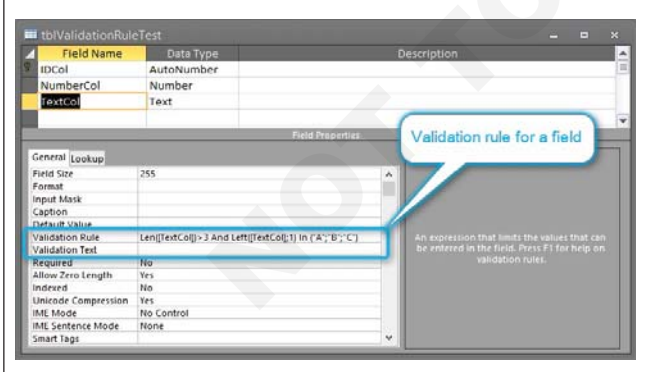
Access 2007 allows you to set **field properties** and **data validation** rules to force the person entering data to follow a specific format.

Data types and validation rules

Data validation begins when data types are set during the process of building tables and fields. For example, if a field data type had been set to Currency and a text value is entered in that table field during data entry, Access will not accept an invalid format and will display a validation error, like the one below.

Data validation is accomplished by setting data validation rules and other field properties for various fields. (Fig 27)

Fig 27



To set data validation rules

- In Design view, highlight the field that requires a validation rule.
- In the Field Properties section at the bottom half of the window, set your validation rule using the Expression Builder. The Expression Builder offers common syntax to set up a data validation rule.

Validation rules work most easily with numerical fields. Rules for text fields require you to enclose each acceptable value inside its own quotation marks, separating them with Or, as seen above. (Fig 28 & 29)

Fig 28

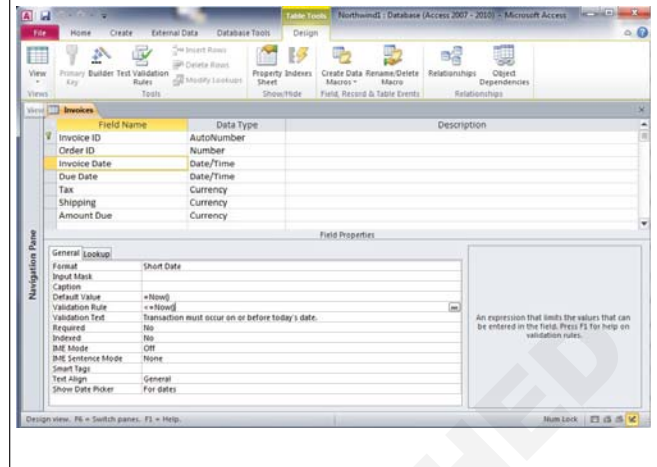
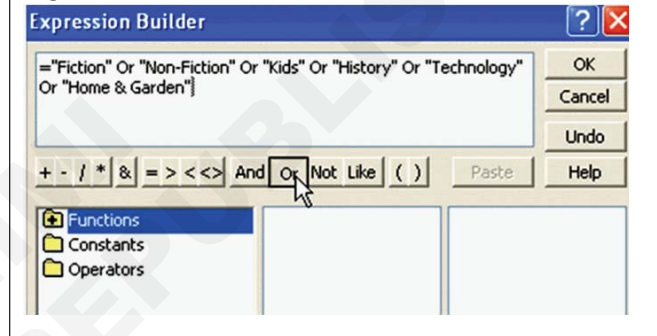


Fig 29



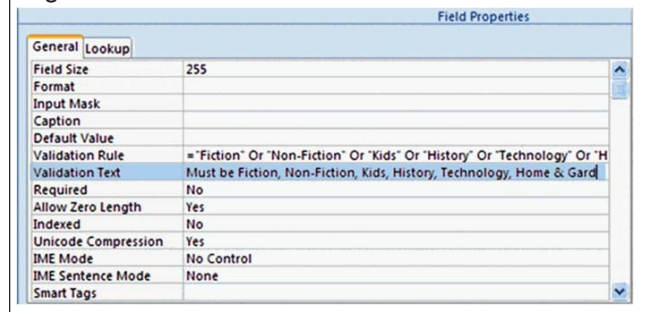
Validation text

Validation text is a specialized error message you can set to have Access tell the user entering data the specific way you want that person to enter it.

To set the validation text, enter the error message exactly as you want it to appear to users in the row directly beneath the Validation Rule row in the Field Properties section of Design view. For the validation rule we set for Category, you'd set the validation text like this:

The image below shows the resulting error message users would see when the Category validation rule has been broken. (Fig 30)

Fig 30



Using field properties to ensure data integrity (Fig 31)



Another way to ensure data integrity is by setting field properties such as Field Size, Format, and Required.

- Field Size can be set to hold a specific number of characters, up to as many as 255 for text fields. If you were using a text field to hold the two-letter state postal abbreviation, the field size could be set to 2 to ensure no one enters a full state name into this field.
- The Format field property can be set to display text or numbers in a standardized way. For example, text can be set to show as all uppercase, and numbers can be set to show scientific numbers, percentages, or decimals.
- Set the Required property to Yes if you want users entering data to be required to enter something in the field. Choose No if users are allowed to leave the field blank.

These are just some ways Access helps you ensure data being entered into your database is valid.

Integrity rules and constraints

Constraints are a very important feature in a relational model. In fact, the relational model supports well defined theory of constraints on attributes or tables. Constraints are useful because they allow a designer to specify the semantics of data in the database and constraints are the rules to enforce DBMSs to check that data satisfies the semantics.

Domain integrity

Domain restricts the values of attributes in the relation and it is a constraint of the relational model. However, there are real - world semantics on data that cannot be specified if used only with domain constraints. We need more specific ways to state what data values are/are not allowed and what format is suitable for an attribute. For example, the employee ID must be unique, the employee birthday is in the range (Jan 1, 1950, Jan 1, 2000). Such information is provided in logical statements called integrity constraints.

There are several kinds of integrity constraints

Entity integrity - Every table requires a primary key. The primary key, nor any part of the primary key, can contain NULL values. This is because NULL values for the primary key means we cannot identify some rows. For example, in the EMPLOYEE table, phone cannot be a key because some people may not have a phone.

Referential integrity - a foreign key must have a matching primary key or it must be null.

This constraint is specified between two tables (parent and child); it maintains the correspondence between rows in these tables. It means the reference from a row in one table to another table must be valid. Examples of Referential integrity constraints.

Referential integrity examples

In the customer/order database:

- Customer (custid, custname)
- Order (order ID, custid, order date)

To ensure that there are no orphan records, we need to enforce referential integrity.

An orphan record is one whose foreign key value is not found in the corresponding entity - the entity where the PK is located. Recall that a typical join is between a PK and FK.

The referential integrity constraint states that the cust ID in the order table must match a valid cust ID in the customer table. Most relational databases have declarative referential integrity. In other words, when the tables are created the referential integrity constraints are set up.

In the course/class database

- Course (CrsCode, Deptcode, description)
- Class (CrsCode, section, class time)

The referential integrity constraint states that CrsCode in the table must match a valid CrsCode in the course table. In this situation, it's not enough that the Crscode and section in the class table make up the PK, we must also enforce referential integrity.

When setting up referential integrity it is important that the PK and FK have the same data types and come from the same domain. Otherwise the RDBMS will not allow the join.

Referential integrity in MS access

In MS access referential integrity is set up by joining the PK in the customer table to the custID in the order table.

Referential integrity using transact SQL (MS SQL server)

Create table customer

(custID Integer primary Key

Cust Name Char (35))

Create table orders

(orderID Integer primary Key,

CustID integer references customer (CustID),

Order Date DATE TIME)

The referential integrity is set when creating the table (Orders) with the FK.

What is Database Systems or DBMS?

Database Systems or DBMS is software that caters to the collection of electronic and digital records to extract

useful information and store that information is known as Database Systems/ Database Management Systems or DBMS. The purpose of a standard database is to store and retrieve data. Databases, such as Standard Relational Databases, are specifically designed to store and process structured data.

Generally, Databases have a table to store data, they use Structured Query Language (SQL) to access the data from these tables. Databases and Database Systems play a vital role in processing hard, fast and diverse datasets. Without a Database Management System, businesses won't receive valuable insights and deep analytics.

In the Database environment, data is accessed, modified, controlled, and then presented into a well-organized form, allowing the business corporations to execute multiple data-processing operations. The data is usually organized in the form of rows and columns to minimize the workload pressure and achieve accurate results instantly.

Different types of data that can be stored, processed, or retrieved in Database Management System include numerical, time series, textual and binary data.

The figure below highlights what is Database Systems and how they are used to monitor and collect data from multiple sources to gather valuable business insights from them:

Key Characteristics of Database Systems

By now, you are fairly clear on the idea of what is Database Systems. Let's now have a look at the many characteristics that make them suitable for handling multiple data sources and also helping in Data Analytics to gather valuable business insights. The key characteristics of Database Systems are given below:

- Less Duplication
- Limited Redundancy
- Ease of Use
- Multiple Layouts and Presentations
- Reduces Storage Space
- Data Security
- Data Recovery and Backup Plan
- Maintaining Integrity
- Improvised Efficiency

Less Duplication

Database Systems provides a specific identity number for each entry. By having a specific ID number for all entries, users won't experience duplication errors and issues.

Limited Redundancy

Undoubtedly, there are high chances of data repetition as multiple users use the same version/ software of a Database to store their files. To avoid large chances of redundancy, a DBMS offers a single data repository and various Data Mapping functionalities.

Ease of Use

There's no need to get noble experience or technical skills to use a DBMS. The reason is all these tools contain a smooth and easy-to-use interface. Whether you're familiar with programming languages or not, you can easily use queries to insert, update, delete or search records in Database Systems.

Multiple Layouts and Presentations

Database Systems has different layouts and presentation formats through which one can easily select knowledge and language options, according to his/her expertise. Some Databases contain translating options that allow you to move from one layout to another without making any change in the integrity of data.

Reduces Storage Space

Public and private companies use Database Systems to save a massive amount of data, files, documents, media, audio and video extensions. Companies need a lot of space to store these assets, but DBMS provides proper integration, helping users to reduce space as compared to traditional systems. This functionality permits enterprises to save cost as well.

Data Security

Security of data is the foremost and essential need for companies as hacking is common in this digital world. DBMS is accessible to all users, employees, clients, thus different policies, and rules must be implemented to restrict multiple windows.

While keeping this in mind, Database Systems are built with tenacious security functions that allow companies to protect confidential information. Enterprises deploy policies to restrict access for particular users, letting them minimize security breaches and insiders attacks.

Data Recovery and Backup Plan

Nowadays, Database Systems are coming up with data recovery and backup options. Companies know that intentional and unintentional events can occur at any time. For instance, in some cases employees remove data accidentally, developers delete or discard manufacturing and production tables.

Consequently, DBMS are embedded with Data Recovery options and a Backup Plan to avoid such incidents. They work like a permanent storage plan in which it is impossible to eradicate data.

Maintaining Integrity

Database Systems contain schemas, primary and secondary key options that permit companies, especially E-Commerce and inventory stores, to maintain integrity, consistency and concurrency of data.

Improvised Efficiency

With functions and tools of DBMS, raw information gets converted into valuable statistics. Companies use these statistics to make a wise and quick decision in a Real-

Time environment. It advances the Database's performance and efficiency of the system.

Languages Supported by Database Systems

Database Systems comprise of specific languages that are used by operators, programmers and end-users to interact with Database queries and updates. There are generally 4 types of Database Languages:

- Data Definition Language (DDL)
- Data Control Language (DCL)
- Data Manipulation Language (DML)
- Transaction Control Language (TCL)

Data Definition Language (DDL)

It is also called Data Description Language and is used to describe data structures, create and modify data. SQL commands and statements like Create, Alter, Drop, Truncate, Rename, and Comment are used to form the pattern of the Database.

Data Control Language (DCL)

DCL commands include Revoke and Grant used to retrieve previously stored and saved data. The syntax of DCL commands is similar to programming languages. These statements play an essential role to describe the “Rights & Permissions” across the Database system.

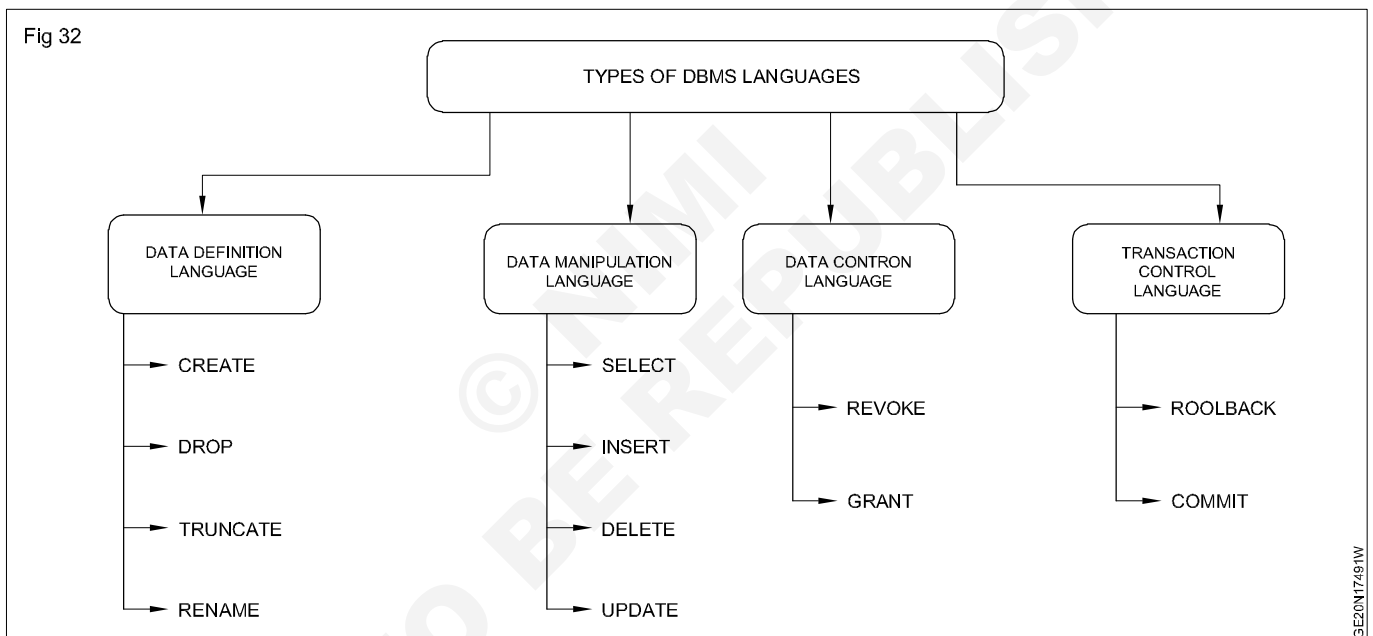
Data Manipulation Language (DML)

DML commands include Select, Insert, Update, Delete, Merge and Call. These are used to access and manipulate data in the Database. These statements are commonly meant for handling user requests.

Transactional Control Language (TCL)

TCL is used to handle all the transactions within Database Systems. TCL commands include Commit, Rollback and SavePoint.

The figure below depicts all the languages in a DBMS along with their commands. (Fig 32)



Types of Database Systems

There are 4 mainly types of Database Systems:

- Hierarchical Database System
- Network Database System
- Relational Database System
- Object-Oriented Database System

Hierarchical Database System

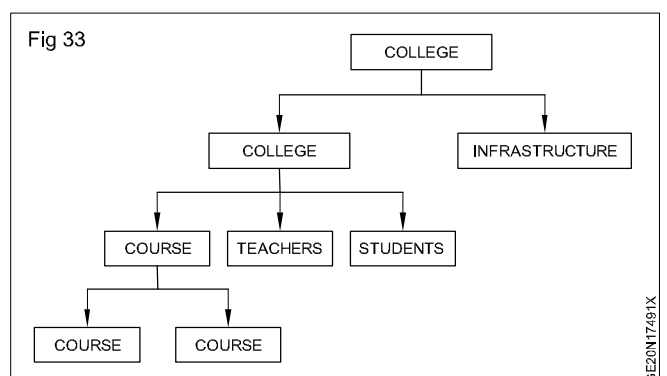
The Hierarchical Database System follows a tree-like procedure to present the data. It arranges data in either Top-Down or Down-Up flow and defines the flow through the parent-child relationship.

The Hierarchical Database System includes two types of relationships; **One-to-One** and **One-to-Many** relationship. A parent can have only one child in a One-to-One relationship, whereas a parent can have more than one

child in a One-to-Many relationship.

Some of the popular Hierarchical Database Systems include IBM Information Management Systems (IMS), Windows Registry, RDM Mobile, XML, and XAML.

The figure below depicts the Hierarchical Database System: (Fig 33)



Network Database System

The Network Database System enables users to build Many-to-Many relationships due to which it is more complicated and intricated than the other types of DBMS. It is feasible for users to access data from the Network Database System as data is arranged in a graphical format and can be acquired through different data routes.

By having a Many-to-Many relationship, a child can have more than one parent and vice versa. In this way, multiple relationships can be built in a Network Database System, permitting enterprises to achieve efficiency.

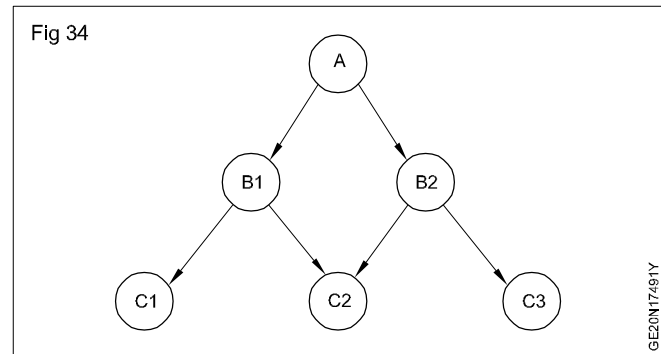
Some of the popular Network Database Systems include Integrated Database Management System (IDMS), Raima Database Manager, TurboIMAGE, Integrated Data Store (IDS) and Univac DMS-1100.

The given figure below depicts the Network Database System:

Relational Database System

In the Database field, the Relational Database System is one of the most extensive and complicated ones. It allows developers and programmers to normalize data and

organize information as rationally independent tables. (Fig 34)



Connections are made by using “Select” and “Join” options. The concept of referential integrity is used in Relational Database Systems to preserve the reliability of the connection between different tables. (Fig 35)

Some of the popular Relational Database Systems include DB2 and Informix Dynamic Server, Microsoft Access & SQL Server, RDB and Oracle.

The figure below depicts the Relational Database System:

Fig 35

| STUDENT_ID | NAME | AGE |
|------------|------|-----|
| 1 | AKON | 17 |
| 2 | BKON | 18 |
| 3 | CKON | 17 |
| 4 | DKON | 18 |

| STUDENT_ID | NAME | TEACHER |
|------------|------|------------|
| 1 | JAVA | Mr.J |
| 2 | C++ | Miss C |
| 3 | C# | Mr. C HASH |
| 4 | Php | Mr. P H P |

| STUDENT_ID | SUBJECT_ID | MARKS |
|------------|------------|-------|
| 1 | 1 | 98 |
| 1 | 2 | 72 |
| 2 | 1 | 76 |
| 3 | 2 | 88 |

Object-Oriented Database System

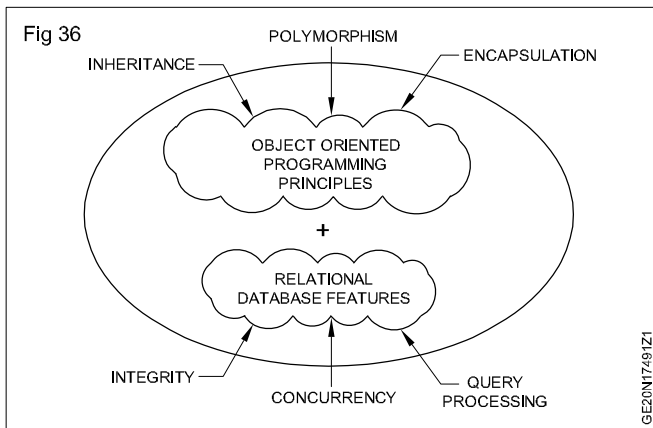
In an Object-Oriented Database System, diverse programming languages, such as Perl, Scala, .NET, Java, Python, JavaScript, Delphi, Visual Basic and C++, are used by programmers to build relationships between variables and establish schemas.

Some of the popular Object-Oriented Database Systems include Cache, ConceptBase.cc, Db4o (Database 4 objects).

The figure below depicts the Object-Oriented Database System: (Fig 36)

Advantages of Database Systems

Now that have understood about Database Systems, different languages it supports, and types of Database Systems. In this section, you will read about the advantages of Database Systems. A few benefits of Database Systems are listed below:



- **Data Safety:** As the number of users accessing the Database increases, the threats to data breaches increase. Database Systems ensure data confidentiality and safety through controlled user access.
- **Improves Efficiency:** Using better-streamlined software to access data that can convert data into valuable information for analysis helps companies make better data-driven business decisions.
- **Data Sharing:** Database Systems or DBMS allow users to easily share data, whether it's available on On-premise Database or remote users by following the correct authorization protocols. It provides well-managed data to get faster query responses.
- **Data Integration:** Data Systems support many integrations and provide users a holistic view of the data. It also helps users to know how different activities affect other activities and monitor the progress of the company's activities.
- **Better Decision Making:** Database Systems keep the data in a well-managed form, which helps businesses to have better capacity in making sound decisions.

Applications of Database Systems

Let's go through some of the most common applications of Database Systems or DBMS. A few applications are listed below:

- **Telecommunication:** Databases Systems store all the data related to monthly bills, call archives, user information, retaining balances, subscription packages, and other details.
- **Sales and Marketing:** Companies store all the user information, Sales details, prospects, leads, and information on Marketing Campaigns in Database Systems.
- **Airlines:** All the information on flight bookings, payments, customers, offers, destination, and venue is stored in Databases.
- **Human Resources:** Database Systems store and manage all the data related to salary, employees, departments, finances, deductions, and other confidential information.
- **Banks:** DBMS stores all the data related to clients and their bank accounts, deposit and withdrawal, credits, and mortgages.
- **Education:** Student's details, records, marks, achievements, courses, and other details are managed in Database Systems.
- **Economics and Finance:** Database Systems store all the data on transactions, bonds, fiscal instruments such as shares

Rules for designing good table (Table - 3)

- Right-align your numbers
- Left-align your texts
- Use decimals appropriately (one or two is often enough)
- Display units (e.g., \$, %) sparsely (e.g., only on first row)
- Highlight outliers
- Highlight column headers
- Use subtle highlights and dividers
- Use white space between rows and columns
- Use white space (or dividers) to highlight groups
- Use visualizations for large tables

Table - 3

| | 2010 | 2011 | 2012 | 2013 | 2014 | 2015 | 2016 |
|---------------|--------|------|------|-------|--------|--------|--------|
| China | 10.10 | 9.01 | 7.33 | 77.23 | 6.76 | 6.36 | 6.12 |
| India | 8.76 | 5.25 | 4.13 | 5.10 | 6.14 | 6.90 | 5.89 |
| United States | 1.68 | 0.85 | 1.46 | 0.96 | 1.80 | 2.09 | 0.74 |
| Indonesia | 4.83 | 4.79 | 4.68 | 4.24 | 3.73 | 3.65 | 3.85 |
| Brazil | 6.50 | 3.00 | 0.98 | 2.07 | - 0.38 | - 4.37 | - 4.25 |
| Pakistan | - 0.48 | 0.61 | 1.34 | 2.21 | 2.51 | 2.61 | 3.44 |
| Nigeria | 5.00 | 2.12 | 1.52 | 2.61 | 3.52 | - 0.02 | - 4.16 |
| Bangladesh | 4.40 | 5.25 | 5.28 | 4.77 | 4.84 | 5.37 | 5.96 |

| | 2010 | 2011 | 2012 | 2013 | 2014 | 2015 | 2016 |
|--------|-------------|-------------|-------------|---------------|---------------|---------------|---------------|
| Russia | 4.46 | 5.20 | 3.48 | 1.57 | - 1.04 | - 3.04 | - 0.41 |
| Mexico | 3.49 | 2.12 | 2.15 | - 0.06 | 1.45 | 1.90 | 1.58 |

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Introduction to View, Data Independence

Objectives : At the end of this lesson you shall be able to

- **explain the view and its importance?**
- **explain database relationship and forms**
- **explain queries and reports.**

Geo-Access

Introduction to view data independence security updates on view

A database view is a subset of a database that is based on a query that runs on one or more database tables. Database views are saved in the database as named queries and can be used to save complete queries that are frequently used

Static and dynamic views

There are two type of database views: dynamic and static views. Dynamic views contain data from one or two tables and automatically include all columns of the specified table or tables. Dynamic views can be updated dynamically when related or extended objects are created or modified static views contain data from several tables and the necessary columns of these tables must be specified in the select and where clauses of the static view. Dynamic views can be updated manually when related objects or extended objects are created or modified.

When creating a dynamic view with data from two tables you must ensure that both tables have the same PRIMARYKEYCOLSEQ columns or contain unique indexes with the same column name in the same order.

In a multitenant environment. The global administrator creates initial database views, which are part of the default data that is provided to tenants, the tenant ID must be added to the select and where clauses of static views to ensure that specific tenant views are created. Dynamic views should be used to create tenant-specific database views for tenants with extended attributes static views do not support extended attributes.

Database views are filled based on the object on which they are based. For example. If you add or delete an attribute of the work order object the attribute is added or removed from the dynamic view based on the object. When you modify an attribute, not all changes are applied to the associated database view. For example view. For example. If you change the data type of an attribute, the change will be applied to the database view. However, if you change or add a domain to the default value of the work order object, the change will not be automatically applied to the database view. Instead, you must apply this change to the database view.

Importance of views

To the database. The view is the same as a real table for a user with the set of column names and row data. SQL creates a custom view by giving the view the same name as a table name and store a definition of the view in the database.

A view is used for security purpose in the database and acts as an intermediate between real tables schema and programmability. It also restricts the user from viewing specific columns and rows; views always represent custom output, which is mentioned in the query and returns that data defined in the query at the time of creation.

Views also provide these specific features

Consistency

Views always represent the same presentation, even when we perform normalizations to the tables schema or if we rename the tables or restructure the table.

Data integrity

When a data is viewed or entered by a view in a database, the DBMS will automatically check the data to ensure that it meets the specified integrity constraints.

Security

Views provide security from unauthorized access to data. Each user is given permission to access the database from a view that contains a specified data that a user is authorized to see.

Structural unity

Views provide a custom view of database structure, which represents a database same as a set of a virtual or custom table that is useful for a user and presents only relevant data.

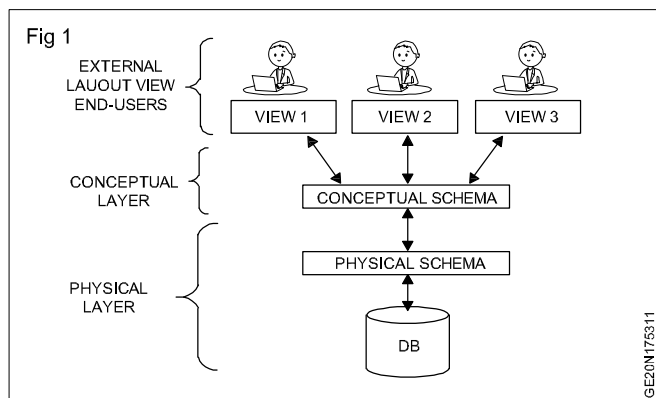
Data independence

Views provide data independence to an application as the application depends on a views but not on a real table. Therefore, any change in the table will not affect the application, and an application will always be independent of the table schema design.

Data independence of DBMS

Data independence is defined as a property of DBMS that helps user to change the database schema at one level of a database system without requiring to change

the schema at the next higher level. Data independence helps you to keep data separated from all programs that make use of it. The stored data for computing and presentation. In many systems data independence is an essential function for components of the system. (Fig 1)



Consider an example of a university database. At the different levels this is how the implementation will look like Table -1

Table -1

| Type of schema | Implementation |
|-------------------|---|
| External schema | view 1: Course info (cid:int,cname: string) View 2: studeninfo(id:int. name:string) |
| Conceptual schema | students(id: int,name: string, login: string,age: integer) Courses (id: int, cname,string, credirs:integer) |
| Physical schema | Enrolled (id: int, grade: string) Relations stored as unordered files. Index on the first column of students. |

Physical data independence

Physical data independence helps you to separate conceptual levels from the internal/physical levels. It allows you to provide a logical description of the database without the need to specify physical structures. Compared to logical independence, it is easy to achieve physical data independence.

With physical independence, you can easily change the physical storage structures or devices with an effect of the conceptual schema. Any change done would be absorbed by the mapping between the conceptual and internal levels. Physical data independence is achieved by the presence of the internal level of the database and then the transformation from the conceptual level of the database to the internal level.

Examples of changes under physical data independence.

Due to physical independence, any of the below change will not affect the conceptual layer

- Using a new storage device like hard drive or magnetic tapes
- Modifying the file organization technique in the database

Types of data independence

In DBMS there are two types of data independence

- Physical data independence
- Logical data independence

Levels of database

Before we learn data independence a refresher on database levels is important.

The database has 3 levels as shown in the diagram below

- Physical/internal
- Conceptual
- External

- Switching to different data structures.
- Changing the access method.
- Modifying indexes.
- Changes to compression techniques or hashing algorithms.
- Change of location of database from say c drive to D drive

Logical data independence

Logical data independence is the ability to change the conceptual scheme without changing

- 1 External views
- 2 External API or programs

Any change made will be absorbed by the mapping between external and conceptual levels

When compared to physical data independence. It is challenging to achieve logical data independence.

Examples of changes under logical data independence

Due to logical independence, any of the below change will not affect the external layer

1 Add/modify/delete a new attribute, entity or relationship is possible without a rewrite of existing application programs

2 Merging two records into one

3 Breaking an existing record into two or more records

Difference between physical and logical data independence - Table - 2.

Table - 2

| Logical data independence | Physical data independence |
|---|--|
| <p>Logical data independence is mainly concerned with the structure or changing the data definition</p> <p>It is difficult as the retrieving of data is mainly dependent on the logical structure of data.</p> <p>Compared to logical independence it is easy to achieve physical data independence</p> <p>You need to make changes in the application if new fields are added or deleted from the database</p> <p>Modification at the logical levels is significant whenever the logical structures of the database are changed.</p> <p>Concerned with conceptual schema</p> <p>Example: add/modify/delete a new attribute</p> | <p>Mainly concerned with the storage of the data</p> <p>It is easy to retrieve.</p> <p>Compared to logic physical independence it is difficult to achieve logical data independence</p> <p>Modifications made at the internal levels may or may not be needed to improve the performance of the structure</p> <p>Concerned with internal scheme</p> <p>Concerned with internal schema</p> <p>Example: change in compression techniques, hashing algorithms, storage devices, etc</p> |

Importance of data independence

- Helps you to improve the quality of the data
- Database system maintenance becomes affordable
- Enforcement of standards and improvement in database security
- You don't need to alter data structure in application programs
- Permit developers to focus on the general structure of the database rather than worrying about the internal implementation
- It allows you to improve state which is undamaged or undivided
- Database incongruity is vastly reduced.
- Easily make modifications in the physical level is needed to improve the performance of the system.

In a relational database (Access), the data in one table is related to the data in other tables. In general, tables can be related in one of three different ways: one-to-one, one-to-many or many-to-many. The relationship is used to cross reference information between tables.

One to One

In a one-to-one relationship each record in one table has at most one related record in another table.

In a one-to-one relationship, each record in Table A can have only one matching record in Table B, and each record in Table B can have only one matching record in Table A. This type of relationship is not common, because most information related in this way would be in one table. You might use a one-to-one relationship to divide a table with

many fields, to isolate part of a table for security reasons, or to store information that applies only to a subset of the main table.

One to Many

A one-to-many relationship, often referred to as a "master-detail" or "parent-child" relationship.

A one-to-many relationship is the most common type of relationship. In a one-to-many relationship, a record in Table A can have many matching records in Table B, but a record in Table B has only one matching record in Table A.

Many to Many

In a many-to-many relationship, a record in Table A can have many matching records in Table B, and a record in Table B can have many matching records in Table A. This type of relationship is only possible by defining a third table (called a junction table) whose primary key consists of two fields the foreign keys from both Tables A and B. A many-to-many relationship is really two one-to-many relationships with a third table.

A many-to-many relationship means that for each record in one table there can be many records in another table and for each record in the second table there can be many in the first.

Many-to-many relationships can not be directly represented in relational database programs and have to be built by using two or more one-to-many relationships.

Defining relationships

You define a relationship by adding the tables that you want to relate to the Relationships window, and then

dragging the key field from one table and dropping it on the key field in the other table.

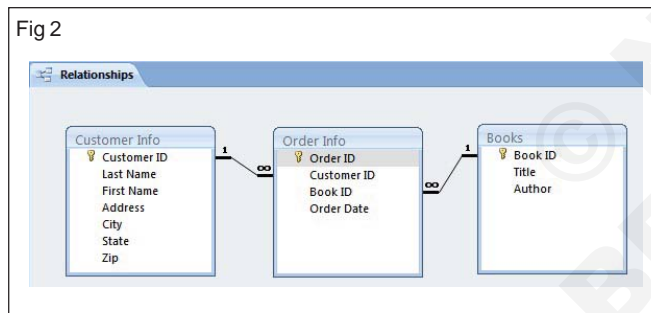
- The kind of relationship that Microsoft Access creates depends on how the related fields are defined:
- A one-to-many relationship is created if only one of the related fields is a primary key or has a
- A one-to-one relationship is created if both of the related fields are primary keys or have unique indexes.
- A many-to-many relationship is really two one-to-many relationships with a third table whose primary key consists of two fields the foreign keys from the two other tables.

Move a table that appears in the relationship map

- Place your mouse over the table you want to move.
- Hold down the left mouse button, then drag the table to a new location.
- Release the mouse button to drop the table in its new place.

Understanding the relationship map

The relationship map lists all of the tables that were selected to relate, as well as all of the fields that were previously set up for that table. Notice that the first field has a key icon next to it. This is the primary key for the table. (Fig 2)

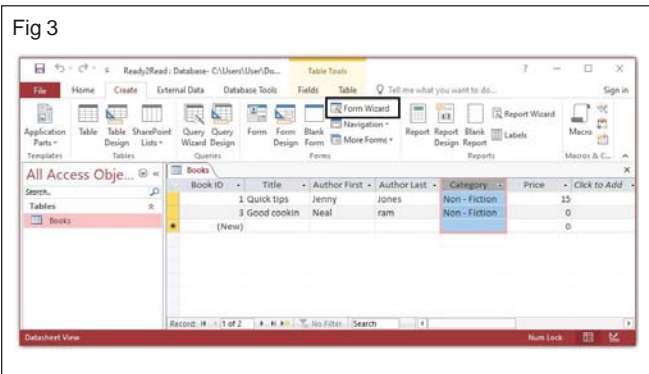


Primary and foreign keys

A primary key is the first field in each table of the database. You may recall that this field auto-numbers by default, so every record in the table has its own unique number to identify it. Access uses this number to quickly pull information together when you run queries or reports, which are covered later.

In the example above, the primary key for the Customers table is Customer ID, the primary key for the Orders table is Order ID, and the primary key for the Books table is Book ID.

A foreign key is a field that is the primary field in its own table but that shows up in another table. If you look closely at the Orders table, the fields Customer ID and Book ID appear there, as well as in their own respective tables. These fields are the primary key in their own tables, but in the Orders table, they are considered foreign keys. (Fig 3)



Forms

A form is a database object that you can use to enter, edit, or display data from a table or a query. You can use forms to control access to data, such as which fields of data are displayed. For example, certain users may not need to see all of the fields in a table. Providing those users with a form that contains just the necessary fields makes it easier for them to use the database.

Create a form with a single click,

- 1 Open the table or query upon which you want to base the form.
- 2 To create a form on which all fields from the underlying table or query are placed, displaying one record at a time, on the Create tab, click Form.

Forms in Access are like display cases in stores that make it easier to view or get the items that you want. Since forms are objects through which you or other users can add, edit, or display the data stored in your Access desktop database, the design of your form is an important aspect. There's a lot you can do design-wise with forms in Microsoft Access. You can create two basic types of forms

- Bound forms
- Unbound forms

Bound Forms

- Let us now understand what Bound Forms are ?
- Bound forms are connected to some underlying data source such as a table, query, or SQL statement.
- Bound forms are what people typically think of when they think of the purpose of a form.
- Forms are to be filled out or used to enter or edit data in a database.
- Examples of bound forms will typically be what users use to enter, view or edit data in a database.

Unbound Forms

Let us look into Unbound Forms

- These forms are not connected to an underlying record or data source.
- Unbound forms could be dialog boxes, switch boards, or navigation forms.

- In other words, unbound forms are typically used to navigate or interact with the database at large, as opposed to the data itself.

Types of Bound Forms

There are many types of bound forms you can create in Access. Let us understand the types ?

Single Item Form

This is the most popular one and this is where the records are displayed - one record at a time.

Multiple Item Form

This displays multiple records at a time from that bound data source.

Split Form

The form is divided into halves, either vertically or horizontally. One half displays a single item or record, and the other half displays a list or provides a datasheet view of multiple records from the underlying data source.

Form Controls

Every object on a form or report is a control and has its own set of properties (displayed in the Property list) that determine the characteristics of the data it contains. Some controls are linked to fields in the underlying table or query and some are merely text or graphical objects not related to any data source. Two of the most commonly used controls in a form or report are text boxes and labels.

- 1 Label: displays unchanging or informational text often times as headings or titles. Labels do not come from a source in the database such as a field or expression. This is called an unbound control because it is not bound to any data source.
- 2 Text Box: displays data as text and is a bound control. A bound control displays information that is stored in a field from the data. Text boxes are used to display, enter, and update values from fields in your database.

Form Sections

Forms consist of header, footer, and detail sections. In forms, there are two types of headers/footers. Form headers and footers are visible on every page of the form. Page headers/footers only appear on a printed copy of a form. There are never visible in Form View. Information about individual records appears in the detail sections.

Sizing Sections

Adjust the size of the area for any of the sections (headers, footers, detail), by dragging the horizontal border for that section with your mouse. To adjust line spacing in the detail section, drag the Detail border. There is no other line spacing control.

Working with Queries

Queries are questions you ask of your database. They allow you to select certain fields out of a table, or pull together data from various related tables and display it together. Queries can be used to perform calculations,

and to edit the data in your tables. Queries can also form the basis of forms and reports.

Query Results

- If a query contains fields from two or more related tables, the results will only include records that have related records in all the tables. (In other words, in the query shown above, customers without records in the Orders table will not appear in the query results.) To display such records, use an outer join (see page 6) in your query.
- WARNING! Any change you make in a query (adding, deleting or editing data) WILL BE CHANGED IN THE TABLES TOO!!!

Sort query results

In Design View, click the Sort row in the column you wish to sort by. A dropdown arrow appears; choose Ascending or Descending. If you sort by more than one column, the sorts will be done left-to-right.

Create a concatenated field in a query

Concatenated fields combine information from two or more fields into one. Ex: Combine first and last names into one field, called "FullName". In Design View, click in a blank column and type the following:

FullName:[FirstName]&" "&[LastName]

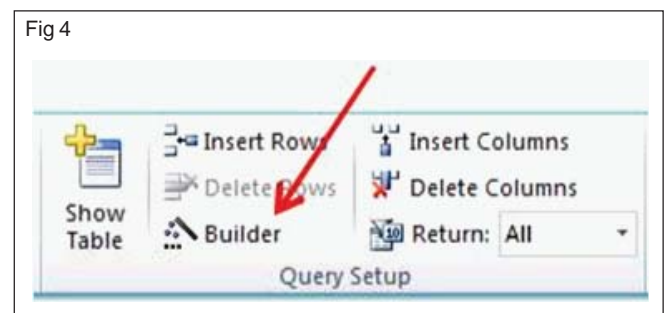
(Type a space between the two sets of quotation marks, and use square brackets around the field names.)

Create a calculated field in a query

In Design View, click in a blank column and type a mathematical expression, typing field names in square brackets. Any of the normal mathematical operators (+ - * / ^) can be used. If desired, give the expression a name as in the sample below. The following expression calculates a total cost by multiplying quantity times price:

Item Total:[Quantity]*[Price]

Use the Expression Builder to create calculated or concatenated fields (Fig 4)



You can simplify the process of creating concatenated fields and other expressions with the Expression Builder. Create a blank column in your query grid and then click the Builder button in the Query Setup group on the Query Design Ribbon. The Expression Builder opens.

Type the expression in the large box at the top. One advantage is that you have way more room to type and see your expression than you have at the top of a query grid column!

A second advantage is that you can add fields to the expression by double clicking them in the Expression Categories column rather than by typing them. This removes the possibility of typos.

Specify criteria in a query (Filtering)

In Query Design View, click in the criteria row for the field you want to filter, and type the criteria (ex: type "OH" in the criteria row of the State field). When you run the query, only records matching the criteria. (Fig 5)

Using Multiple Criteria

You can type criteria in more than one field.

- Criteria typed on the same line must all be met for a record to be displayed ("AND" logic). Ex: "OH" in the state field and "Smith" in the LastName field pulls up only Ohio-dwelling Smiths.
- If criteria are typed on different lines, records matching any of them will be retrieved ("OR" logic). Ex: "WA" and "OH" on different lines in the State field retrieves records for both states.

Criteria Ranges - Table 3

Criteria ranges broaden and customize a search. Type a criteria range instead of a single value in the Criteria row of the query grid. (Fig 6)

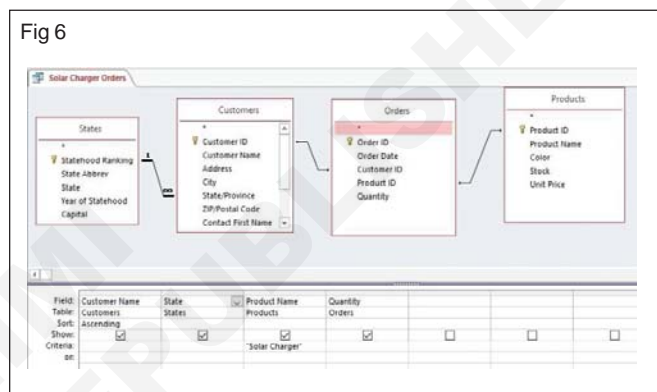
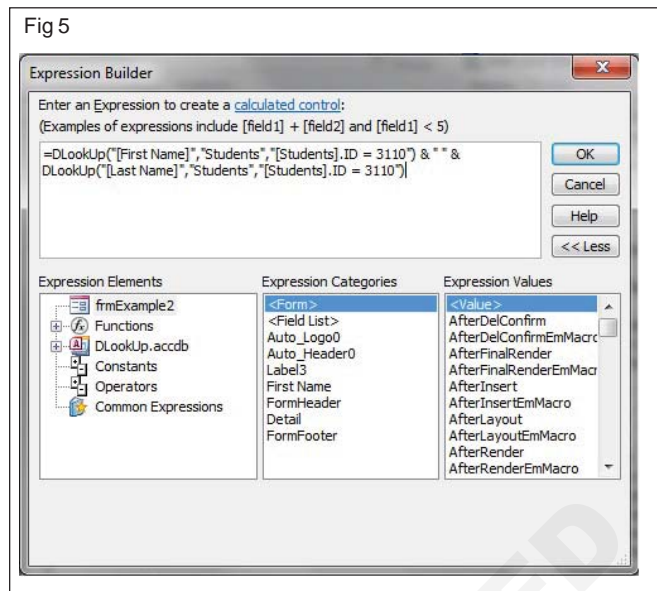


Table - 3

| Criteria | Example | Description and Result |
|----------|---------------|---|
| < | <14 | Finds records where the field is less than a certain value. Records will have values under 14. |
| <= | <= #2/2/2006# | Finds records where the field is less than or equal to a certain value. Records will have dates on or before February 2, 2006 Note: dates are enclosed between # signs. |
| > | >100 | Similar to above: Finds records where the value is |
| >= | >=100 | greater than 100. The second expression displays records where the value is greater than or equal to 100. |
| = | = "Diana" | Finds records where the value in the field is Diana. Note: text is enclosed in double quotes. |

Expressions like these may be combined - for example, a criteria of <49 Or >=100 would return records with values

below 49, or 100 or above, but not ones with values between 49 and 99.99. (Table 4)

Table - 4

| | | |
|----------------------------|---|---|
| Between ___ And ___ | Between 1 and 4 | Finds records where the field is between the endpoints. |
| Is Null | Is Null | Finds records where the field is empty. |
| Is Not Null | Is Not Null | Finds records where the field is not empty. |
| Like | Like U* | Finds records where the criteria match parts of the field. |
| Between ___ And ___ | Between 1 and 4 Like "[U-X]*" Like "*Korea*" Like "*ina" Like "Chi??" Like "*4.99" | Finds records where the field is between the endpoints. The * wildcard stands for any number of characters, and the ? wildcard stands for a single character. The sample criteria will return records where the field 1) starts with U; 2) starts with U, V, W or X, 3) contains the letters 'Korea'; 4) ends in the letters 'ina' as in ballerina; 5) has five letters and begins with the letters 'Chi' as in Chile or China; 6) is a number and ends in the digits '4.99' as in 24.99. |

Create a parameter query

Parameters make queries flexible by letting users choose their own criteria each time they run the query. In the criteria box, type a phrase in square brackets; Access will use this phrase to prompt the user for a value. Ex: In a State field, type [Enter a state]. If the user types CA, only California records will be retrieved.

Specify a range in a parameter query

In the criteria box, type the following:

Between [___] And [___]

Inside the brackets, type text telling the user what kind of information to enter.

Inner Joins vs. Outer Joins (Fig 7)



Excel normally uses inner joins in its queries. These queries return only those rows from both tables in the join that match on the joining field (e.g., customers in the

Customers table with corresponding orders in the Orders table.)

If you need to display all customers, with or without orders, as well as any available order information, you need to use an outer join.

In the query tray, double click the join line between two related tables. The Join Properties dialog box will appear:

Select button 2 or 3 depending on which field's records you want to display completely.

Action Queries

Action queries modify groups of records in one fell swoop. Types of action queries include:

- Update Queries (modify all records in a table that meet specific criteria - ex: change the tax rate for all Ohio customers from 5.75% to 6%)
- Delete Queries (remove records from a table - ex: delete all customers whose last order date is more than 2 years ago)
- Append Queries (add records to an existing table - ex: at the end of the year, add the year's orders to the end of an archive table)
- Make-table Queries (create a new table - ex: extract a subset of records into a new table, for a subordinate who needs Ohio customers only)

Other Specialized Queries

Instructions for creating and running these special query types can be found in the Access help manual by clicking the Help button in the upper right corner of the screen (Internet connection required).

Find Duplicates query: Lets you locate duplicate records in a table by displaying a field containing duplicate values alongside other fields for comparison, to help you tell if

the record is really a duplicate.

Find Unmatched query: Lets you compare two tables and identify records in one of the tables that have no corresponding records in the other table.

Crosstab query: This is a special type of Totals query that presents summary information in a compact format that is similar to a spreadsheet.

Union query: Lets you review all of the data that is returned by several similar select queries together, as a combined set.

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Concepts of Network

Objectives : At the end of this lesson you shall be able to

- **define computer network and its advantages and disadvantages**
- **name and explain the types of network and their characteristics**
- **explain the types of topologies**
- **state about the cables used for network system**
- **name and state about the various connectors used in network system**
- **explain about the hub, modem and internet**
- **describe about the internet protocols connection sharing (ICS) using windows.**

Define computer network

A computer network is an interconnection of various computer systems located at different places. In computer network two or more computers are linked together with a medium and data communication devices for the purpose of communicating data and sharing resources. The computer that provides resources to other computers on a network is known as server. In the network the individual computers, which access shared network resources, are known as workstations or nodes.

Advantages of Computer Networks

The following are some of the advantages of computer networks.

- **File Sharing:** Networks offer a quick and easy way to share files directly. Instead of using a disk or USB key to carry files from one computer or office to another, you can share files directly using a network.
- **Security:** Specific directories can be password protected to limit access to authorized users. Also, files and programs on a network can be designated as "copy inhibit" so you don't have to worry about the illegal copying of programs.
- **Resource Sharing:** All computers in the network can share resources such as printers, fax machines, modems, and scanners.
- **Communication:** Even outside of the internet, those on the network can communicate with each other via electronic mail over the network system. When connected to the internet, network users can communicate with people around the world via the network.
- **Flexible Access:** Networks allow their users to access files from computers throughout the network. This means that a user can begin work on a project on one computer and finish up on another. Multiple users can also collaborate on the same project through the network.
- **Workgroup Computing:** Workgroup software like Microsoft BackOffice enables many users to contribute to a document concurrently. This allows for interactive teamwork.

- **Error reduction and improve consistency:** One can reduce errors and improve consistency by having all staff work from a single source of information, so that standard versions of manuals and directories can be made available, and data can be backed up from a single point on a scheduled basis, ensuring consistency.

Network Application Areas

There is a long list of application areas, which can be benefited by establishing Computer Networks. Few of the potential applications of Computer Networks are:

- 1 Information retrieval systems which search for books, technical reports, papers and articles on particular topics
- 2 News access machines, which can search past news, stories or abstracts with given search criteria.
- 3 Airline reservation, hotel booking, railway-reservation, car-rental, etc.
- 4 A writer's aid: a dictionary, thesaurus, phrase generator, indexed dictionary of quotations, and encyclopaedias.
- 5 Stock market information systems which allow searches for stocks that meet certain criteria, performance comparisons, moving averages, and various forecasting techniques.
- 6 Electronic Financial Transactions (EFT) between banks and via cheque clearing house.
- 7 Games of the types that grow or change with various enthusiasts adding to the complexity or diversity.
- 8 Electronic Mail Messages Systems (EMMS).
- 9 Corporate information systems such as marketing information system, customer information system, product information system, personnel information system, etc.
- 10 Corporate systems of different systems such as Order-Entry System, Centralized Purchasing, Distributed Inventory Control, etc.
- 11 On-line systems for Investment Advice and Management, Tax Minimization, etc.

- 12 Resources of interest to a home user.
- 13 Sports results.
- 14 Theatre, movies, and community events information.
- 15 Shopping information, prices, and advertisements.
- 16 Restaurants; good food guide.
- 17 Household magazine, recipes, book reviews, film reviews.
- 18 Holidays, hotels, travel booking.
- 19 Radio and TV programmes.
- 20 Medical assistance service.
- 21 Insurance information.
- 22 Computer Assisted Instruction (CAI).
- 23 School homework, quizzes, tests.
- 24 Message sending service.
- 25 Directories.
- 26 Consumer reports.
- 27 Employment directories and Job opportunities.
- 28 Tax information and Tax assistance.
- 29 Journey planning assistance viz. Train, bus, plane etc.
- 30 Catalogue of Open University and Virtual University courses.

Computer Networks may be classified on the basis of geographical area in two broad categories.

- 1 Local Area Network (LAN)
- 2 Wide Area Network (WAN)
- 3 Metropolitan Area Network (MAN)

A classification of computer networks can be done to distance as in the table.

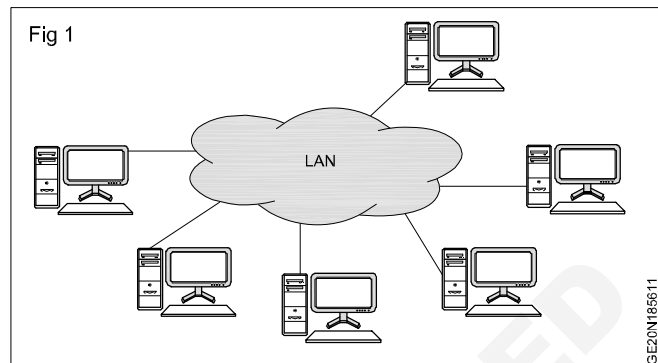
| Interprocess (or) Distance | Network Type |
|----------------------------|---------------------------------|
| 0 to 1 Km | Local Area Network (LAN) |
| 1 Km to 10 Km | Metropolitan Area Network (MAN) |
| 10 Km to 1000 Km | Wide Area Network (WAN) |
| Above 1000 Km | Internet |

Local Area Network (LAN)

Networks used to interconnect computers in a single room, rooms within a building or buildings on one site are called Local Area Network (LAN). LAN transmits data with a speed of several megabits per second (10⁶ bits per second). The transmission medium is normally coaxial cables.

LAN (Fig 1) links computers, i.e., software and hardware, in the same area for the purpose of sharing information. Usually LAN links computers within a limited geographical

area because they must be connected by a cable, which is quite expensive. People working in LAN get more capabilities in data processing, work processing and other information exchange compared to stand-alone computers. Because of this information exchange most of the business and government organisations are using LAN.



Major Characteristics of LAN

- every computer has the potential to communicate with any other computers of the network
- high degree of interconnection between computers
- easy physical connection of computers in a network
- inexpensive medium of data transmission
- high data transmission rate

Types of Connection

Peer to Peer: Peer to peer is an approach to computer networking where all computers share equivalent responsibility for processing data. Peer-to-peer networking (also known simply as peer networking) differs from client-server networking, where certain devices have responsibility for providing or "serving" data and other devices consume or otherwise act as "clients" of those servers.

Client server: The term client-server refers to a popular model for computer networking that utilizes client and server devices each designed for specific purposes. The client-server model can be used on the Internet as well as LAN.

Advantages of LAN

- The reliability of network is high because the failure of one computer in the network does not affect the functioning for other computers.
- Addition of new computer to network is easy.
- High rate of data transmission is possible.
- Peripheral devices like magnetic disk and printer can be shared by other computers.

Disadvantages of LAN

If the communication line fails, the entire network system breaks down.

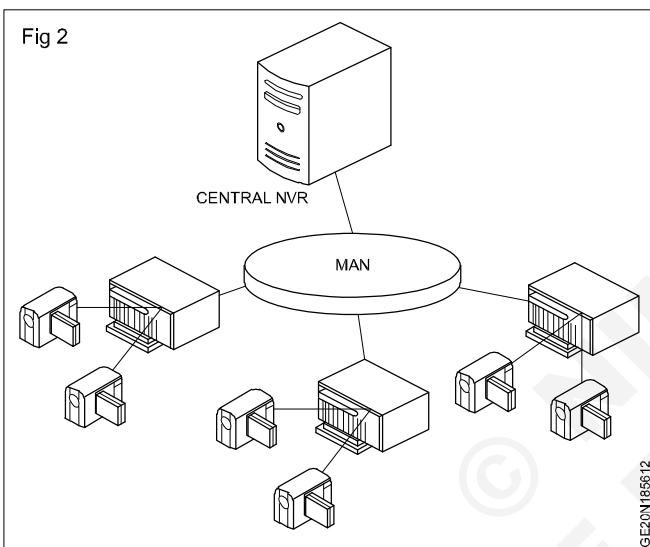
Use of LAN

Followings are the major areas where LAN is normally used

- File transfers and Access
- Word and text processing
- Electronic message handling
- Remote database access
- Personal computing
- Digital voice transmission and storage

Metropolitan Area Network (MAN)

A Data network designed for a town or city. In terms of geographic breadth, MANs are larger than, but smaller than. MANs (Fig 2) are usually characterized by very high-speed connections using or other digital media.

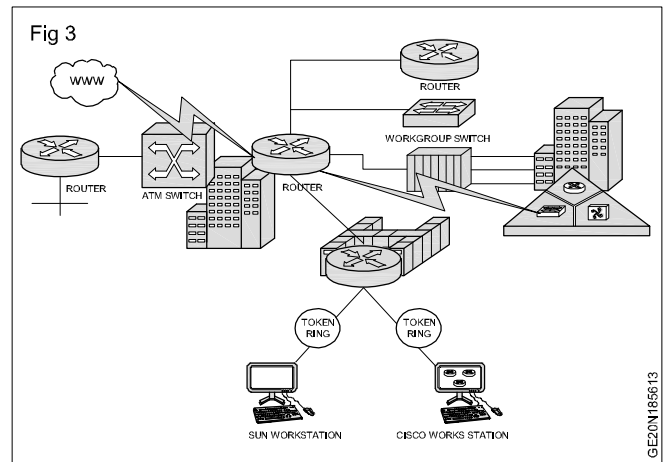


Characteristic of MAN

- 1 The network size falls intermediate between LANs and WANs. A MAN typically covers an area of between 5 and 50 km range. Many MANs cover an area the size of a city, although in some cases MANs may be as small as a group of buildings.
- 2 A MAN (like a WAN) is not generally owned by a single organisation. The MAN, its communications links and equipment are generally owned by either a consortium of users or by a network service provider who sells the service to the users.
- 3 A MAN often acts as a high speed network to allow sharing of regional resources. It is also frequently used to provide a shared connection to other networks using a link to a WAN.

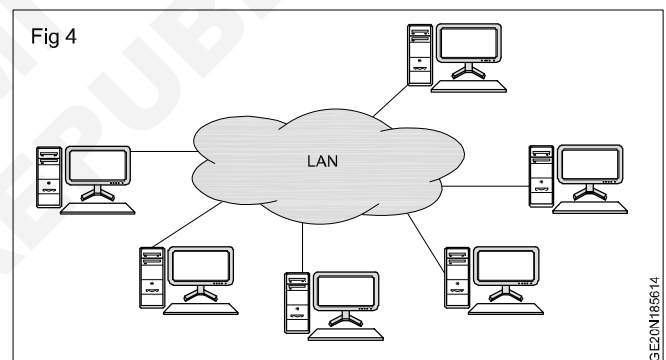
Campus Area Network (CAN)

A Campus Area Network or Corporate Area Network (CAN) is a network is made up of an interconnection of local area network within a limited geographical area. A CAN (Fig 3) is larger than a local area network but smaller than a Wide area Network



Wide Area Network (WAN)

The term Wide Area Network (Fig 4) is used to describe a computer network spanning a regional, national or global area. For example, for a large company the head quarters might be at Delhi and regional branches at Bombay, Madras, Bangalore and Calcutta. Here regional centres are connected to head quarters through WAN. The distance between computers connected to WAN is larger. Therefore the transmission mediums used are normally telephone lines, microwaves and satellite links.



Characteristics of WAN

Followings are the major characteristics of WAN.

- 1 **Communication Facility:** For a big company spanning over different parts of the country the employees can save long distance phone calls and it overcomes the time lag in overseas communications. Computer conferencing is another use of WAN where users communicate with each other through their computer system.
- 2 **Remote Data Entry:** Remote data entry is possible in WAN. It means sitting at any location you can enter data, update data and query other information of any computer attached to the WAN but located in other cities.
- 3 **Centralised Information:** In modern computerised environment you will find that big organisations go for centralised data storage. This means if the organisation is spread over many cities, they keep their important business data in a single place. As the data are generated at different sites, WAN permits collection of this data from different sites and save at a single site.

Examples of WAN

- 1 **Ethernet:** Ethernet developed by Xerox Corporation is a famous example of WAN. This network uses coaxial cables for data transmission. Special integrated circuit chips called controllers are used to connect equipment to the cable.
- 2 **Arpanet:** The Arpanet is another example of WAN. It was developed at Advanced Research Projects Agency of U. S. Department. This Network connects more than 40 universities and institutions throughout USA and Europe.

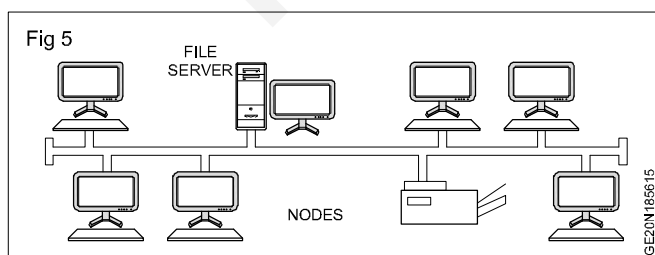
Difference between LAN and WAN

- LAN is restricted to limited geographical area of few kilometers. But WAN covers great distance and operate nationwide or even worldwide.
- In LAN, the computer terminals and peripheral devices are connected with wires and coaxial cables. In WAN there is no physical connection. Communication is done through telephone lines and satellite links.
- Cost of data transmission in LAN is less because the transmission medium is owned by a single organisation. In case of WAN the cost of data transmission is very high because the transmission medium used is hired either telephone lines or satellite links.
- The speed of data transmission is much higher in LAN than in WAN. The transmission speed in LAN varies from 0.1 to 100 megabits per second. In case of WAN the speed ranges from 1800 to 9600 bits per second (bps).
- Few data transmission errors occur in LAN compared to WAN. It is because in LAN the distance covered is negligible.

Open Systems Interconnection (OSI)

The **Open Systems Interconnection (OSI)** model is a reference tool for understanding data communications between any two networked systems. It divides the communications processes into seven layers. Each layer both performs specific functions to support the layers above it and offers services to the layers below it. The three lowest layers focus on passing traffic through the network to an end system. The top four layers come into play in the end system to complete the process.

An Overview of the OSI Model (Fig 5)



Application Layer (Layer 7): This layer interfaces directly to and performs common application services for the application processes. The common application services provide semantic conversion between associated application processes. Examples of common application services include the virtual file, virtual terminal (for example, Telnet), and "Job transfer and Manipulation protocol" (JTM, standard ISO/IEC 8832)

Presentation Layer (Layer 6): The Presentation layer relieves the Application layer of concern regarding syntactical differences in data representation within the end-user systems. MIME encoding, encryption and similar manipulation of the presentation of data are done at this layer. An example of a presentation service would be the conversion of an EBCDIC-coded text file to an ASCII-coded file.

Session Layer (Layer 5): The Session layer provides the mechanism for managing the dialogue between end-user application processes. It provides for either duplex or half-duplex operation and establishes check pointing, adjournment, termination, and restart procedures. This layer is responsible for setting up and tearing down TCP/IP sessions.

Transport Layer (Layer 4): The purpose of the Transport layer is to provide transparent transfer of data between end users, thus relieving the upper layers from any concern with providing reliable and cost-effective data transfer. The transport layer controls the reliability of a given link. Some protocols are state ful and connection oriented. This means that the transport layer can keep track of the packets and retransmit those that fail. The best known example of a layer 4 protocol is TCP.

Network Layer (Layer 3): The Network layer provides the functional and procedural means of transferring variable length data sequences from a source to a destination via one or more networks while maintaining the quality of service requested by the Transport layer. The Network layer performs network routing, flow control, segmentation/desegmentation, and error control functions. The router operates at this layer - sending data throughout the extended network and making the Internet possible, although there are layer 3 (or IP) switches. This is a logical addressing scheme - values are chosen by the network engineer. The addressing scheme is hierarchical.

Data Link Layer (Layer 2): The Data link layer provides the functional and procedural means to transfer data between network entities and to detect and possibly correct errors that may occur in the Physical layer. The addressing scheme is physical which means that the addresses (MAC) are hard-coded into the network cards at the time of manufacture. The addressing scheme is flat.

Physical Layer (Layer 1): The physical layer defines all electrical and physical specifications for devices. This includes the layout of pins, voltages, and cable specifications. Hubs and repeaters are physical-layer devices. The major functions and services performed by the physical layer are:

- Establishment and termination of a connection to a communications medium.
- Participation in the process whereby the communication resources are effectively shared among multiple users. For example, contention resolution and flow control.
- Modulation or conversion between the representation of digital data in user equipment and the corresponding signals transmitted over a communications channel. These are signals operating over the physical cabling - copper and fiber optic, for example. SCSI operates at this level.

Network Topology

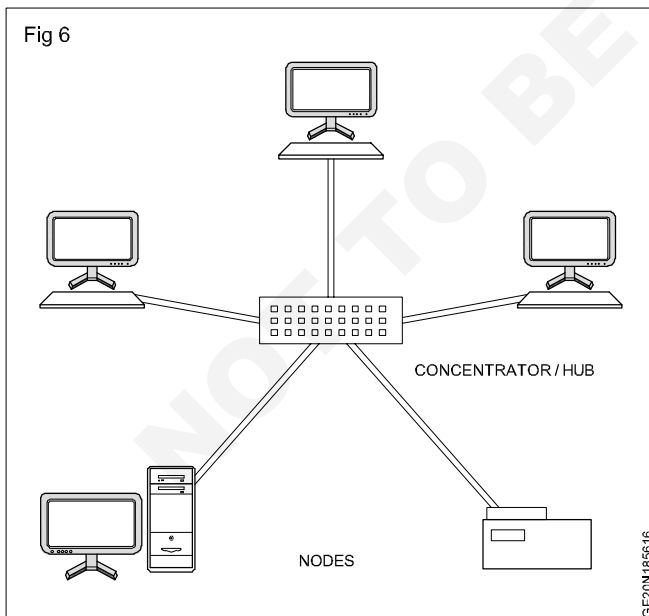
The physical topology of a network refers to the configuration of cables, computers, and other peripherals. Physical topology should not be confused with logical topology which is the method used to pass information between workstations.

Main Types of Physical Topologies

- LINEAR BUS
- STAR
- RING
- TREE
- MESH

Linear Bus Topology

A linear bus topology (Fig 6) consists of a main run of cable with a terminator at each end. All nodes (file server, workstations, and peripherals) are connected to the linear cable.



Advantages of a Linear Bus Topology

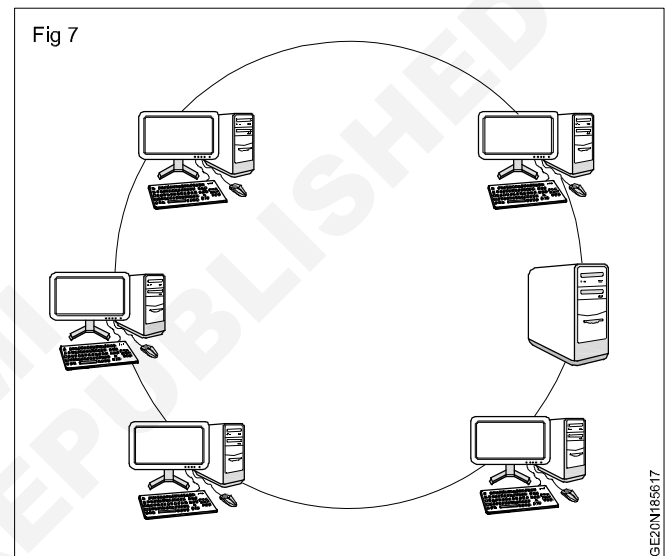
- Easy to connect a computer or peripheral to a linear bus.
- Requires less cable length than a star topology.

Disadvantages of a Linear Bus Topology

- Entire network shuts down if there is a break in the main cable.
- Terminators are required at both ends of the backbone cable.
- Difficult to identify the problem if the entire network shuts down.
- Not meant to be used as a stand-alone solution in a large building.

Star Topology

A star topology (Fig 7) is designed with each node (file server, workstations, and peripherals) connected directly to a central network hub, switch, or concentrator.



Data on a star network passes through the hub, switch, or concentrator before continuing to its destination. The hub, switch, or concentrator manages and controls all functions of the network. It also acts as a repeater for the data flow.

This configuration is common with twisted pair cable; however, it can also be used with coaxial cable or fiber optic cable.

Advantages of a Star Topology

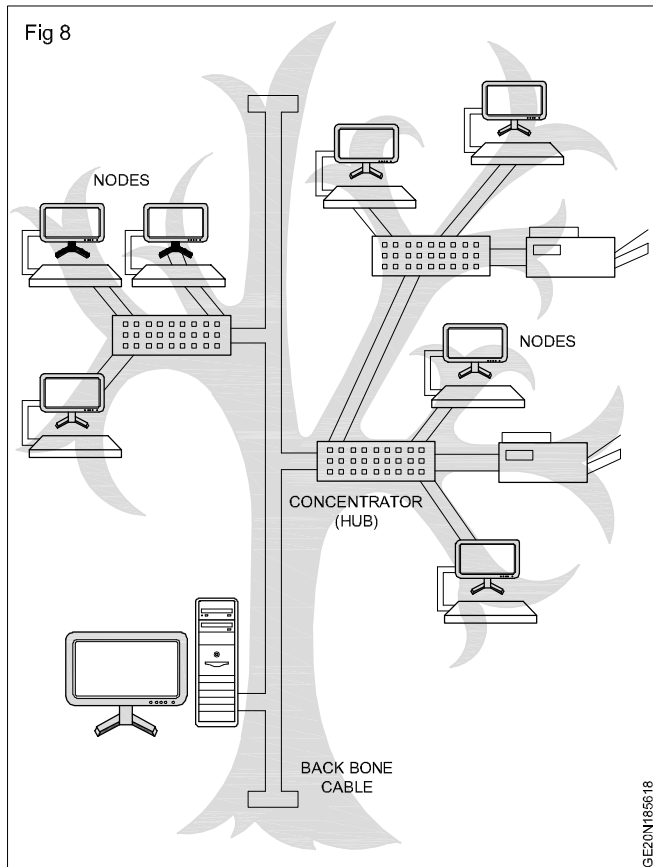
- Easy to install and wire.
- No disruptions to the network when connecting or removing devices.
- Easy to detect faults and to remove parts.

Disadvantages of a Star Topology

- Requires more cable length than a linear topology.
- If the hub, switch, or concentrator fails, nodes attached are disabled.
- More expensive than linear bus topologies because of the cost of the hubs, etc.

Ring Topology

The ring topology (Fig 8) is one which the network is a loop where data is passed from one workstation to another.



Advantages of Ring Topology

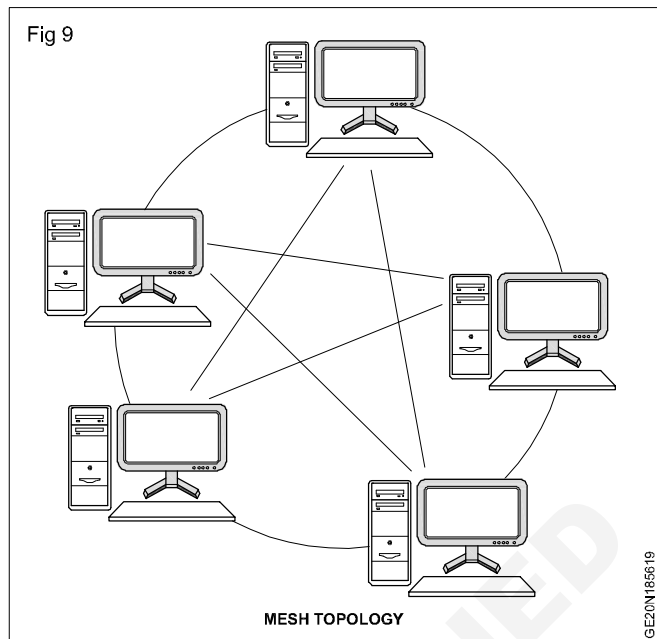
- This is very organized. Each node gets to send the data when it receives an empty token. This helps to reduce chances of collision. Also in ring topology all the traffic flows in only one direction at very high speed.
- There is no need for network server to control the connectivity between workstations.
- Additional components do not affect the performance of network.
- Each computer has equal access to resources.

Disadvantages of Ring Topology

- Each packet of data must pass through all the computers between source and destination.
- If one workstation or port goes down, the entire network gets affected.
- Network is highly dependent on the wire which connects different components.
- MAU's and network cards are expensive as compared to Ethernet cards and hubs.

Tree or Expanded Star

A tree topology (Fig 9) combines characteristics of linear bus and star topologies. It consists of groups of star-configured workstations connected to a linear bus backbone cable. Tree topologies allow for the expansion of an existing network, and enable schools to configure a network to meet their needs.



Advantages of a Tree Topology

- Point-to-point wiring for individual segments.
- Supported by several hardware and software vendors.

Disadvantages of a Tree Topology

- Overall length of each segment is limited by the type of cabling used.
- If the backbone line breaks, the entire segment goes down.
- More difficult to configure and wire than other topologies.

Mesh Topology

A network setup where each of the computers and network devices are interconnected with one another, allowing for most transmissions to be distributed, even if one of the connections go down. This topology is not commonly used for most computer networks as it is difficult and expensive to have redundant connection to every computer. However, this topology is commonly used for wireless networks (Fig 10).

Advantages of Mesh topology

- Data can be transmitted from different devices simultaneously. This topology can withstand high traffic.
- Even if one of the components fails there is always an alternative present. So data transfer doesn't get affected.
- Expansion and modification in topology can be done without disrupting other nodes.

Disadvantages of Mesh topology

- There are high chances of redundancy in many of the network connections.
- Overall cost of this network is way too high as compared to other network topologies.

- Set-up and maintenance of this topology is very difficult. Even administration of the network is tough.

PROTOCOLS

Network Protocol

A **network protocol** defines rules and conventions for communication between network devices. Protocols for computer networking all generally use packet switch techniques to send and receive messages in the form of packets. Network protocols include mechanisms for devices to identify and make connections with each other, as well as formatting rules that specify how data is packaged into messages sent and received. Some protocols also support message acknowledgement and data compression designed for reliable and/or high-performance network communication. Hundreds of different computer network protocols have been developed each designed for specific purposes and environments.

Parameters of Protocol

- 1 Physical cable or transmission media.
- 2 Number of bits transmitted on the media.
- 3 When to transmit the data on the network.
- 4 Volume of data to be transmitted.
- 5 Interact with a network with different cable type or topology.
- 6 Ensure that the message has been delivered intact and in a proper manner.

List of Network Protocols

- 1 **TCP/IP: Transmission Control Protocol / Internet Protocol** is an industry standard protocol widely used. It is used for inter operating among different types of computers. Almost all types of networks support TCP/IP. It is the protocol used by the Internet. It uses a 32-bit addressing scheme.

IP Address

IP defines an addressing scheme that is independent of the underlying physical address (e.g. 48-bit MAC address). IP specifies a unique 32-bit number for each host on a network.

This number is known as the **Internet Protocol Address**, the **IP Address** or the **Internet Address**. These terms are interchangeable. Each packet sent across the internet contains the IP address of the source of the packet and the IP address of its destination.

- 2 **UDP - User Datagram Protocol** - is a simple OSI transport layer protocol for client/server network applications based on Internet Protocol (IP). UDP is the main alternative to TCP and one of the oldest network protocols in existence, introduced in 1980. UDP is often used in videoconferencing applications or computer games specially tuned for real-time performance.
- 3 **FTP: File Transfer Protocol (FTP)** is a standard network protocol used to transfer files from one host or to another

host over a TCP-based network, such as the Internet.

FTP is built on a client-server architecture and uses separate control and data connections between the client and the server. FTP users may authenticate themselves using a clear-text sign-in protocol, normally in the form of a username and password, but can connect anonymously if the server is configured to allow it.

For secure transmission that hides (encrypts) the username and password, and encrypts the content, FTP is often secured with SSL/TLS ("FTPS"). **SSH File Transfer Protocol (SFTP)** is sometimes also used instead.

4 SMTP

Simple Mail Transfer Protocol (SMTP) is an Internet standard for electronic mail (e-mail) transmission across Internet **Protocol (IP)** networks.

While electronic mail servers and other mail transfer agents use SMTP to send and receive mail messages, user-level client mail applications typically only use SMTP for sending messages to a mail server for relaying.

For receiving messages, client applications usually use either the Post Office Protocol (**POP**) or the Internet **Message Access Protocol (IMAP)** or a proprietary system (such as Microsoft Exchange or Lotus Notes/Domino) to access their mail box accounts on a mail server.

5 Telnet

Telnet is a network protocol used on the Internet or local area networks to provide a bidirectional interactive text-oriented communication facility using a virtual terminal connection. User data is interspersed in-band with Telnet control information in an 8-bitbyte oriented data connection over the **Transmission Control Protocol (TCP)**.

Telnet provided access to a command-line interface (usually, of an operating system) on a remote host. Most network equipment and operating systems with a TCP/IP stack support a Telnet service for remote configuration (including systems based on Windows NT). Because of security issues with Telnet, its use for this purpose has waned in favour of SSH.

6 HTTP

The **Hypertext Transfer Protocol (HTTP)** is an application protocol for distributed, collaborative, hypermedia information systems. HTTP is the foundation of data communication for the World Wide Web.

Hypertext is a multi-linear set of objects, building a network by using logical links (the so-called hyperlinks) between the nodes (e.g. text or words). HTTP is the protocol to exchange or transfer hypertext.

7 SSH File Transfer Protocol

In computing, the **SSH File Transfer Protocol** (also **Secure File Transfer Protocol**, **Secure FTP**, or **SFTP**) is a network protocol that provides file access, file transfer, and file management functionalities over any reliable data stream.

It was designed by the Internet Engineering Task Force (IETF) as an extension of the Secure Shell Protocol (SSH) version 2.0 to provide secure file transfer capability, but is also intended to be usable with other protocols.

The IETF of the Internet Draft states that even though this protocol is described in the context of the SSH-2 protocol, it could be used in a number of different applications, such as secure file transfer over Transport Layer Security (TLS) and transfer of management information in VPN applications.

This protocol assumes that it is run over a secure channel, such as SSH, that the server has already authenticated the client, and that the identity of the client user is available to the protocol.

8 Post Office Protocol

In computing, the Post Office Protocol (POP) is an application-layer Internet standard protocol used by local e-mail clients to retrieve e-mail from a remote server over a TCP/IP connection. POP and IMAP (Internet Message Access Protocol) are the two most prevalent Internet standard protocols for e-mail retrieval.

Virtually all modern e-mail clients and servers support both. The POP protocol has been developed through several versions, with version 3 (POP3) being the current standard. Most webmail service providers such as Hotmail, Gmail and Yahoo! Mail also provide IMAP and POP3 service.

Networking Components

- **Gateway:** A device sitting at a network node for interfacing with another network that uses different protocols. Works on OSI layers 4 to 7.
- **Router:** A specialized network device that determines the next network point to which it can forward a data packet towards the destination of the packet. Unlike a gateway, it cannot interface different protocols. Works on OSI layer 3.
- **Switch:** A device that allocates traffic from one network segment to certain lines (intended destination(s)) which connect the segment to another network segment. So unlike a hub a switch splits the network traffic and sends it to different destinations rather than to all systems on the network. Works on OSI layer 2.
- **Bridge:** A device that connects multiple network segments along the data link layer. Works on OSI layer 2.
- **Hub:** It connects multiple Ethernet segments together making them act as a single segment. When using a hub, every attached device shares the same broadcast domain and the same collision domain. Therefore, only one computer connected to the hub is able to transmit at a time.

Depending on the network topology, the hub provides a basic level 1 OSI model connection among the network objects (workstations, servers, etc.). It provides bandwidth which is shared among all the objects, compared to

switches, which provide a connection between individual nodes.

- **Repeater:** A device to amplify or regenerate digital signals received while sending them from one part of a network into another. Works on OSI layer 1.
- **Modem (MoDem):** A device that modulates an analog "carrier" signal (such as sound), to encode digital information, and that also demodulates such a carrier signal to decode the transmitted information, as a computer communicating with another computer over the telephone network

In today's technology-oriented world, sharing has become an integral part of businesses and other activities. This sharing can be achieved by networking. A computer network is linking two or more computers in order to share files or resources.

Here, we will see why we need computer networks in more detail below -

To share computer files

Networks enable users to share files with others. For example, in a company, one file is to be shared by multiple branches. When we locate this file on the network system, all the branches can use this file.

To share computer equipment

Laser printers and large hard-disk drives can be expensive. Networks enable users to share such equipment by networking microcomputers or workstations together.

To enable unlike computer equipment to communicate

A company with computers of multiple uses using several operating systems, including MS-DOS, UNIX, WINDOWS 95, and Apple DOS, cannot share files from one computer to another unless arranged using a Networking operating system including Network 4.1 or Windows NT 4.0.

To improve communication speed and accuracy

Sending messages through networks is virtually instantaneous, and there is also less chance of a message being lost.

To reduce the cost of data transfer

The cost of transfers of files using computers associated with networks is less expensive than other traditional means like telegrams.

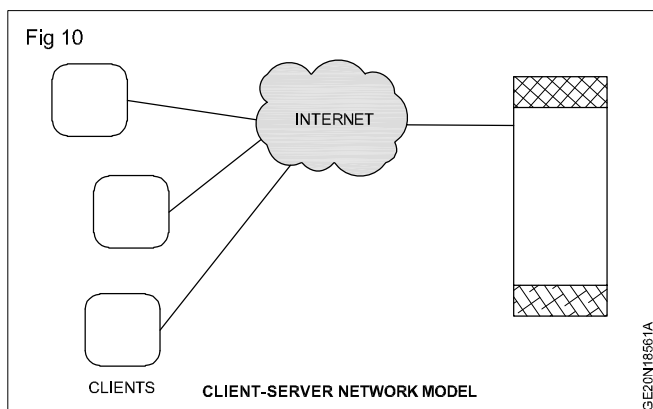
Verify Data Transfer

Fluctuations of costs in foreign exchange and shares can be broadcasted promptly using the channel of computer communications. The transmission can be increased and checked at any occurrence of time.

High Reliability

All files can be recreated on a few machines, and therefore if one of them is unavailable (because of hardware failure), the different copies can be used.

Client-Server Network: This model are broadly used network model. In Client-Server Network, Clients and server are differentiated, Specific server and clients are present. In Client-Server Network, Centralized server is used to store the data because its management is centralized. In Client-Server Network, Server respond the services which is request by Client. (Fig 10)

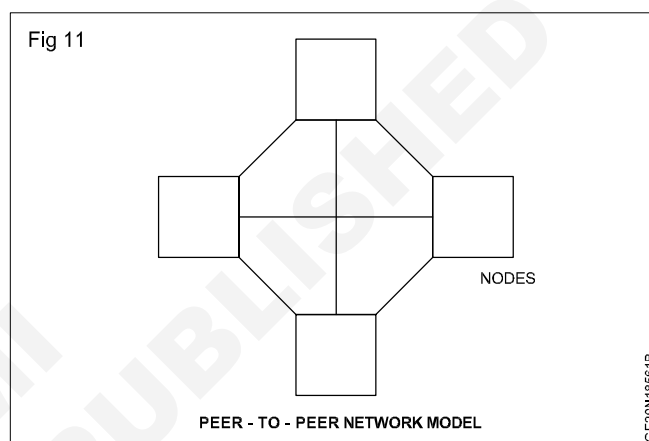


Peer-to-Peer Network: This model does not differentiate the clients and the servers, In this each and every node is itself client and server. In Peer-to-Peer Network, Each and every node can do both request and respond for the services.

- Peer-to-peer networks are often created by collections of 12 or fewer machines. All of these computers use unique security to keep their data, but they also share

data with every other node.

- In peer-to-peer networks, the nodes both consume and produce resources. Therefore, as the number of nodes grows, so does the peer-to-peer network's capability for resource sharing. This is distinct from client-server networks where an increase in nodes causes the server to become overloaded.
- It is challenging to give nodes in peer-to-peer networks proper security because they function as both clients and servers. A denial of service attack may result from this.
- The majority of contemporary operating systems, including Windows and Mac OS, come with software to implement peer. (Fig 11)



Difference between Client-Server and Peer-to-Peer Network:

| S.No | Client-Server Network | Peer-to-Peer Network |
|------|---|--|
| 1 | In Client-Server Network, Clients and server are differentiated, Specific server and clients are present. | In Peer-to-Peer Network, Clients and server are not differentiated. |
| 2 | Client-Server Network focuses on information sharing. | While Peer-to-Peer Network focuses on connectivity. |
| 3 | In Client-Server Network, Centralized server is used to store the data. | While in Peer-to-Peer Network, Each peer has its own data. |
| 4 | In Client-Server Network, Server respond the services which is request by Client. | While in Peer-to-Peer Network, Each and every node can do both request and respond for the services. |
| 5 | Client-Server Network are costlier than Peer-to-Peer Network. | While Peer-to-Peer Network are less costlier than Client-Server Network. |
| 6 | Client-Server Network are more stable than Peer-to-Peer Network. | While Peer-to-Peer Network are less stable if number of peer is increase. |
| 7 | Client-Server Network is used for both small and large networks. | While Peer-to-Peer Network is generally suited for small networks with fewer than 10 computers. |

Types of MODEM

External Modem: This is a modem separated from the system unit in the computer case. It is connected to the serial port of the computer by means of a cable. It is connected to the telephone wall jack by another cable.

Internal Modem: An internal modem is a circuit board (a modem card) that can be added to the system unit of the computer. It takes one of the expansion slots.

Wired Modem / Standard Modem

Most modem's used today are called standard modems. These modems are usually operated by commands entered from a microcomputer keyboard. Users control

the functions (dialling, etc.) of a modem through the keyboard. Modems may use different command languages to control their functions,

Wireless Modems: Wireless modems transmit the data signals through the air instead of by using a cable. They sometimes are called a radiofrequency modem. This type of modem is designed to work with cellular technology, and wireless local area networks. Wireless modems are not yet perfected, but the technology is rapidly improving.

ADSL Modem

Asymmetric Digital Subscriber Line, ADSL is a type of DSL broadband communications technology used for connecting to the Internet. ADSL allows more data to be sent over existing copper telephone lines POTS, when compared to traditional modem lines. A special filter, called a micro filter, is installed on a subscriber's telephone line to allow both ADSL and regular voice (telephone) services to be used at the same time. ADSL requires a special ADSL modem and subscribers must be in close geographical locations to the provider's central office to receive ADSL service. Typically this distance is within a radius of 2 to 2.5 miles. ADSL supports data rates of from 1.5 to 9 Mbps when receiving data (known as the downstream rate) and from 16 to 640 Kbps when sending data (known as the up-stream rate).

Network Interface Card (NIC)



NIC (Fig 12) provides the hardware interface between a computer and a network. A NIC technically is network adapter hardware in the form factor of an add-in card such as a PCI or PCMCIA card. Some NIC cards work with wired connections while others are wireless. Most NICs support either wired Ethernet or WI-FI wireless standards.

Ethernet NICs plug into the system bus of the PC and include jacks for network cables, while WI-FI NICs contain built-in transmitters / receivers (transceivers). In new computers, many NICs are now pre-installed by the manufacturer. All NICs feature a speed rating such as 11 Mbps, 54 Mbps or 100 Mbps that suggest the general performance of the unit.

Network Cables Standards

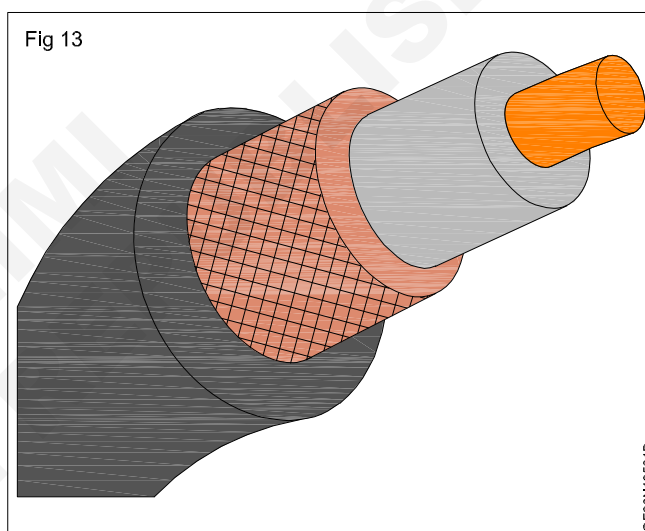
Cable is the medium through which information usually

moves from one network device to another. There are several types of cable which are commonly used with LANS. In some cases, a network will utilize only one type of cable, other networks will use a variety of cable types. The type of cable chosen for a network is related to the network's topology, protocol, and size. Understanding the characteristics of different types of cable and how they relate to other aspects of a network is necessary for the development of a successful network.

Cable standards

A wide range of cabling types are been used to run Ethernet systems. Therefore, different types of cabling standards are being used for the networks involved in connecting devices together using different types of cabling system.

Coaxial cable (Fig 13) is the kind of copper cable used by companies between the community antenna and user homes and businesses. Coaxial cable is sometimes used by telephone companies from their central office to the telephone poles near users. It is also widely installed for use in business and corporation and other types of.



Coaxial cable is called "coaxial" because it includes one physical that carries the signal surrounded (after a layer of insulation) by another concentric physical channel, both running along the same axis. The outer channel serves as a ground. Many of these cables or pairs of coaxial tubes can be placed in a single outer sheathing and, with repeaters, can carry information for a great distance.

10BASE-T Cable Standard: 10Base-T is one of the Ethernet standards for cabling in a network environment. 10BaseT uses a twisted pair cable with a maximum length of 100 meters. Standard 10BaseT operates at 10 Mbps. It is commonly used in a star topology.

10BASE-FL Cable Standard: 10BaseFL is a fibber optic cable standard designed to run at 10 Mbps. It is similar to 10Base-T, though the media type is fibber. For use up to 2000 meters.

100BASE-TX Cable Standard: 100 Mbps Fast Ethernet over category 5 twisted pair cable. Maximum cable length of 100 meters.

100BASE-FX Cable Standard: 100 Mbps Fast Ethernet standard over fiber cable. Can transmit data up to 2000 meters.

100BASE-T Cable Standard: Gigabit Ethernet over twisted pair copper wires. Transmit up to 1000 Mbps. 100 meter maximum cable length. Cat5 or better required (Cat6 cabling recommended).

100BASE-CX Cable Standard: Gigabit Ethernet over a special copper twinax cable. Up to 25 meters in length. Typically used in a wiring closet or data center as a short jumper cable.

100BASE-SX Cable Standard: Gigabit Ethernet using a short-wavelength laser device over multimode fiber optic cable. 50 μm core (max 300 meters) or 62.5 μm core (max 500 meters). 1000Mbps maximum transfer speed.

100BASE-LX Cable Standard: Gigabit Ethernet using long-wavelength laser transmitters over fiber optic cable. Up to 3,000 meters. Uses single mode fiber and requires SC connectors for terminating the cable.

10 GBASE-SR Cable Standard: 802.3ae standard. 33 meters for 62.5 μm fiber optic cable, 300 meters for 50 μm cables. 10 Gbps (Gigabit per second) transfer rate.

10 GBASE-LR Standard: 10 Gbps transfer rate. 10 kilometres maximum distance. Fiber optic cable.

10 GBASE-ER Standard: 10 Gbps transfer rate. 40 kilometres maximum cable length. Fiber optic cable.

Media types

A cable is a device which contains a number of signal conductors usually in the form of separate wires. It is the medium through which information usually moves from one system to another through the network. There are several types of cable which are commonly used with the local area network. In some cases, a network utilizes only one type of cable, whereas other networks use a variety of cable types. The type of cable chosen for a network is related to network topology, protocol and size.

Twisted Pair

Twisted pair cable is the most common type of network medium used in LAN today. A transmission media consists of color-coded pairs of two shielded insulated copper wires which are arranged in a spiral pattern. The spiral pattern is an important aspect of twisted-pair cables in order to minimize cross talk or interference between adjoining wires.

The advantages of using twisted pair cables are

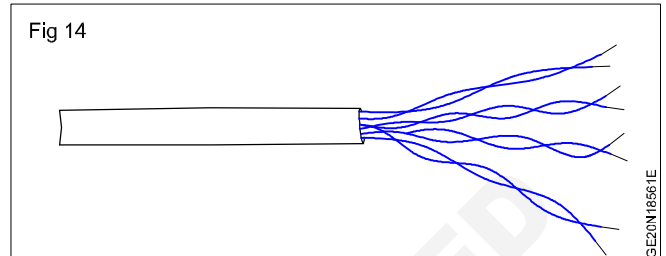
- It is lighter, thinner and more flexible
- Easy to install
- It is inexpensive

There are two varieties of twisted pair cabling, they are

- **Unshielded Twisted Pair (UTP)**
- **Shielded Twisted Pair (STP)**

Unshielded twisted pair (UTP)

Unshielded twisted pair (Fig 14) cabling consists of two unshielded wires twisted around each other that contain no shielding. It is commonly used in telephone wires and is common for computer networking because of the high flexibility of the cables. It is a plastic connector that looks like a large telephone-style connector. The standard connector for unshielded twisted pair cabling is RJ-45 connector.



UTP has five categories of cable standards defined by the Electronic Industries Association and Telecommunications Industry Association (commonly known as EIA/TIA). The five categories of unshielded twisted pair are:

Categories of Unshielded Twisted Pair

In order to manage the network cabling, you need to be familiar with the standards that may be used on modern networks. The categories of the unshielded twisted pair cable are described below.

Category 1

- It is a form of UTP that contains two pairs of wire.
- CAT 1 is suitable for voice communications but not for data.
- It can carry up to 128 kilobits per second (Kbps) of data.
- It is usually used for telephone wire. Data rate - 1 Mbps. This type of wire is not capable of supporting computer network traffic and is not twisted.

Category 2

- It contains four wire pairs and can carry up to 4 Mbps of data.
- CAT 2 is rarely found on modern networks.
- Category 2 or CAT 2 is capable of transmitting data up to 4 Mbps. This type of cable is seldom used.

Category 3

- CAT 3 is made up of four twisted-pair wires, each twist is three times per foot. It is certified to transmit data up to 10 Mbps.
- CAT 3 has typically been used for 10 Mbps Ethernet or 4 Mbps Token Ring networks.
- The CAT 3 cabling is gradually replaced with CAT5 to accommodate higher throughput.

Category 4

- CAT 4 is made up of four twisted-pair wires, specialized to transmit data up to 16 Mbps and is rarely used in new installations.
- CAT 4 may be used for 16Mbps Token Ring or 10 Mbps Ethernet networks. It is guaranteed for signals as high as 20 MHz and Provides More protection against crosstalk and attenuation than CAT1, CAT2, orCAT 3.

Category 5

- CAT 5 is the most popular twisted pair Ethernet cabling designed for high signal integrity which is in common use today.
- CAT 5 contains four wire pairs and supports up to 100 Mbps throughout.
- It is the most popular form of UTP for new network installations and upgrades to Fast Ethernet.
- In addition to 100 Mbps Ethernet, CAT 5 wiring can support other fast networking technologies.
- It is popular because it is both affordable and high speed for today's local area networks Cat 5 cables are often used in structured cabling for computer networks such as fast Ethernet.

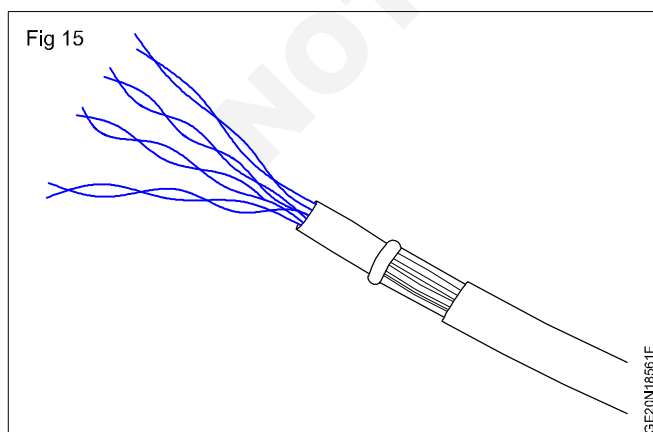
Category 6

- CAT 6 cable was originally designed to support gigabit Ethernet. It is similar to CAT 5 wire, but contains a physical separator between the four

Twisted copper wires pairs to further reduce the electromagnetic interference.

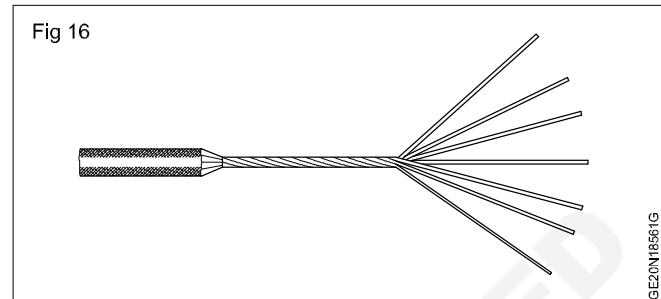
- It is a twisted-pair cable that contains four wire pairs, each wrapped in foil insulation. Additional foil insulation covers the bundle of wire pairs, and a fire-resistant plastic sheet covers the second foil layer.
- The foil insulation provides excellent resistance to crosstalk and enables CAT 6 to support at least six times the throughput supported by regular CAT 5.
- When the CAT 6 is used as a patch cable, it is usually terminated in RJ-45 Electrical connectors.

Shield Twisted Pair (Fig 15)



A type of copper telephone wiring in which each of the two copper wires that are twisted together are coated with an insulating coating that functions as a ground for the wires. The extra covering in shielded twisted pair wiring protects the transmission line from leaking into or out of the cable. STP cabling often is used in networks, especially fast data rate Ethernets.

Fiber Optic Cable (Fig 16)



A technology that uses glass (or plastic) threads (fibers) to transmit. A fiber optic cable consists of a bundle of glass threads, each of which is capable of transmitting messages on to light waves.

Fibre optics has several advantages over traditional metal lines:

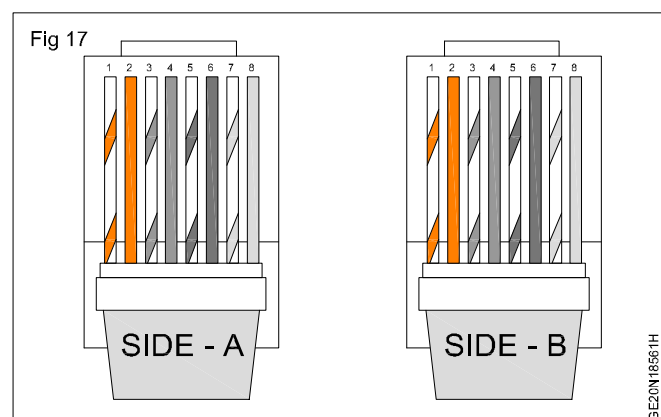
- Fibre optic cables have a much greater than metal cables. This means that they can carry more data.
- Fibre optic cables are less susceptible than metal cables to interference.
- Fibre optic cables are much thinner and lighter than metal wires.
- Data can be transmitted (the natural form for data) rather than analogically.

The main disadvantage of fibre optics is that the cables are expensive to install. In addition, they are more fragile than wire and are difficult to splice.

In addition, telephone companies are steadily replacing traditional telephone lines with fibre optic cables. In the future, almost all communications will employ fibre optics.

Straight Cable

A straight cable (Fig 17) is to connect different type of devices. This type of cable will be used most of the time and can be used to:

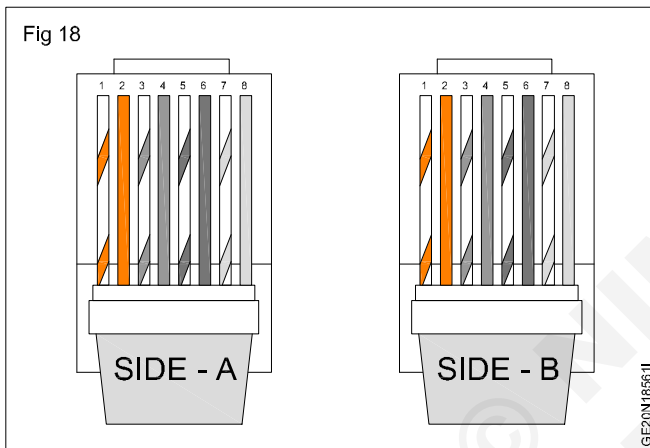


- 1 Connect a computer to a switch/hub's normal port.
- 2 Connect a computer to a cable/DSL modem's LAN port.
- 3 Connect a router's WAN port to a cable/DSL modem's LAN port.
- 4 Connect a router's LAN port to a switch/hub's uplink port. (Normally used for expanding network)
- 5 Connect 2 switches/hubs with one of the switch/hub using an uplink port and the other one using normal port.

If you need to check how straight cable looks like, it's easy. Both sides (side A and side B) of cable have wire arrangement with same colour.

Crossover Cable

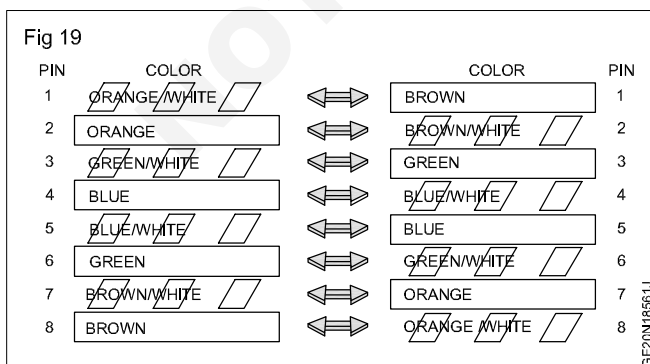
A crossover cable (Fig 18), it's usually used to connect same type of devices. A crossover cable can be used to:



- 1 Connect 2 computers directly.
- 2 Connect a router's LAN port to a switch/hub's normal port. (Normally used for expanding network).
- 3 Connect 2 switches/hubs by using normal port in both switches/hubs.

In you need to check how crossover cable looks like, both side (side A and side B) of cable have wire arrangement with following different colour.

Rollover Cable (Fig 19)



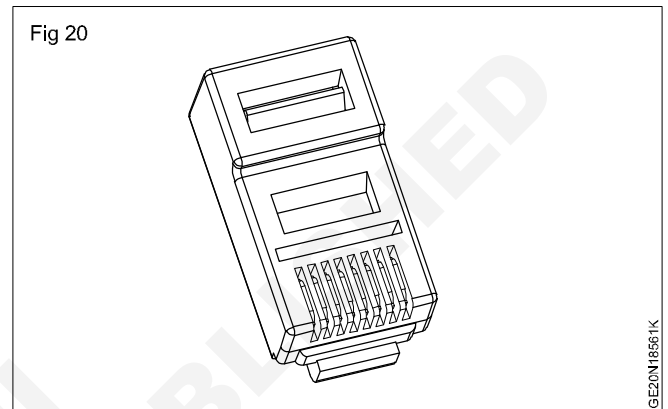
Rollover cable (also known as **Cisco Console Cable** or a **Yost Cable**) is a type of cable that is often used to connect a computer terminal to a router's port. This cable is

typically flat (and has a light blue colour) to help distinguish it from other types of network cabling. It gets the name rollover because the pin outs on one end are reversed from the other, as if the wire had been rolled over and you were viewing it from the other side.

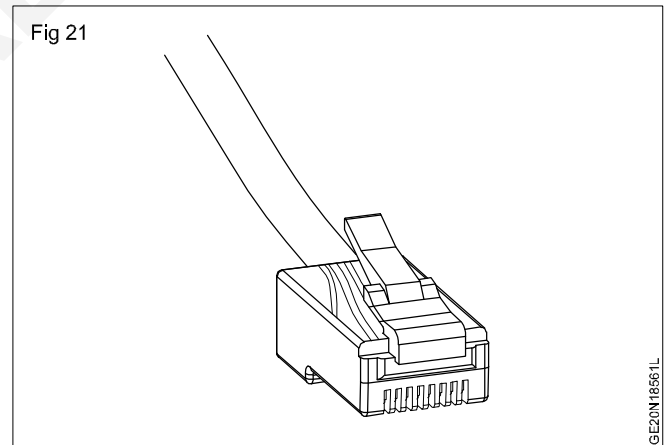
Connectors

The media connectors are the physical devices that help to transfer the data between the systems.

RJ11: Registered Jack-11 (Fig 20) a four- or six-wire used primarily to connect telephone equipment. RJ-11 connectors are also used to connect some types of some types of Local area network.



RJ45: RJ45 (Fig 21) connectors feature eight pins to which the wire strands of a cable interface electrically. Standard RJ-45 pinouts define the arrangement of the individual wires needed when attaching connectors to a cable.

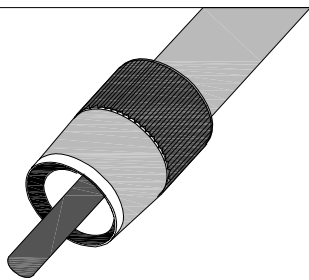


ST: ST stands for **Straight Tip** (Fig 22) - a quick release bayonet style developed by AT&T. STs were predominant in the late 80s and early 90s.

ST Connectors are among the most commonly used fiber optic connectors in networking applications. They are cylindrical with twist lock coupling, 2.5mm keyed ferrule. ST connectors are used both short distance applications and long line systems.

SC: SC stands for **Subscriber Connector** (Fig 23) - a general purpose push/pull style Connector developed by NTT. SC has an advantage in keyed duplexibility to support send/receive channels.

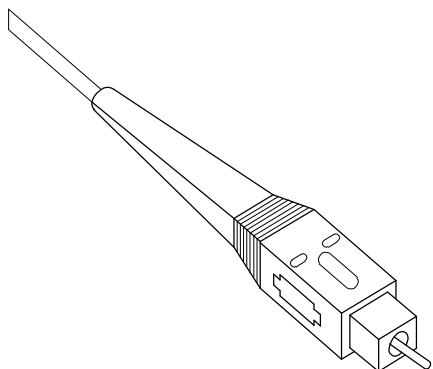
Fig 22



GE20N18561M

A Standard-B plug-which has a square shape with beveled exterior corners-typically plugs into an "upstream receptacle" on a device that uses a removable cable, e.g. a printer. A Type B plug delivers power in addition to carrying data. On some devices, the Type B receptacle has no data connections, being used solely for accepting power from the upstream device. This two-connector-type scheme (A/B) prevents a user from accidentally creating an Electrical loop.

Fig 23



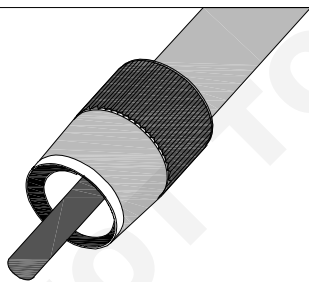
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SC Connectors are frequently used for newer Network applications. The SC is a snap-in connector that is widely used in single mode systems for its performance. The SC connector is also available in a Duplex configuration. They offer low cost, simplicity, and durability. SC connectors provide for accurate alignment via their ceramic ferrules.

The square, snap-in connector latches with a simple push-pull motion and is keyed. They feature a 2.5mm Ferrule and molded housing for protection. Typical matched SC connectors are rated for 1000 mating cycles and have an Insertion Loss of 0.25 dB.

LC: LC stands for Lucent Connector (Fig 24). The LC is a small form factor fiber optic connector.

Fig 24



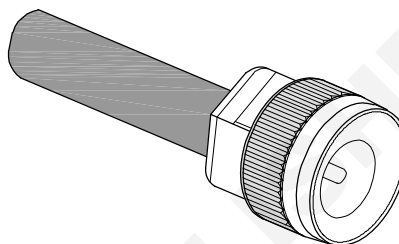
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The LC Connector uses a 1.25 mm ferrule, half the size of the ST. Otherwise, it is a standard ceramic Ferrule connector. The LC has good performance and is highly favoured for single mode.

USB: The USB 2.0 Standard-A type of USB plug is a flattened rectangle which inserts into a "downstream-port" receptacle on the USB host, or a hub, and carries both power and data. This plug is frequently seen on cables that are permanently attached to a device, such as one connecting a keyboard or mouse to the computer via USB connection.

BNC: Bayonet Neill Concelman (Fig 25) connector, (sometimes erroneously called a British Naval Connector or Bayonet Nut Connector, a type of connector used with coaxial cable such as the RG-58 A/U cable used with the 10Base2. The basic BNC connector is a male type mounted at each end of a cable.

Fig 25



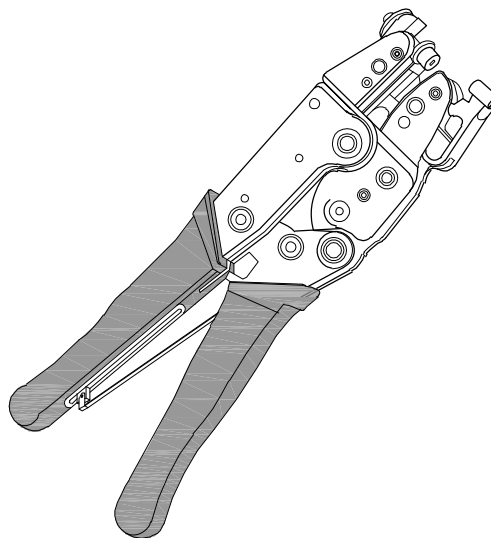
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This connector has a center pin connected to the center cable conductor and a metal tube connected to the outer cable shield. A rotating ring outside the tube locks the cable to any female connector.

BNC T-connectors (used with the 10Base-2 system) are female devices for connecting two cables to a NIC. A BNC barrel connector allows connecting two cables together.

BNC connectors can also be used to connect some monitor, which increases the accuracy of the signals sent from the adapter.

Fig 26



GE20N18561Q

Crimping Tool: A crimping tool (Fig 26) is a tool designed to crimp or connect a connector to the end of a cable. For example, network cables and phone cables are created using a crimping tool to connect the RJ45 and RJ11

connectors to the end of the cable. In the picture to the right, is an example of what a crimping tool looks like. This shows a tool capable of crimping both RJ-11 and RJ-45 connectors.

How to Crimp RJ45

- 1 Strip 1 to 2 inches (2.5 to 5.1 cm) of the outer skin at the end of the cable wire by making a shallow cut in the skin with a utility knife. Run the knife around the cable, and the jacket should slide off easily. There will be 4 pairs of twisted wires exposed, each of them a different color or colour combination.

Orange-white striped and solid orange

Green-white striped and solid green

Blue-white striped and solid blue

Brown-white striped and solid brown

- 2 Fold each pair of wires backwards to expose the core of the cable.
- 3 Cut off the core and discard.
- 4 Straighten the twisted wires using 2 pair of tweezers. Grasp a wire beneath a bend with 1 pair of tweezers, and use the other pair to gently straighten the bend. The straighter your wires, the easier your job will be
- 5 Arrange the untwisted wires in a row, placing them into the position, running from right to left, in which they will go into the RJ-45 connector:

- Orange with a white stripe
- Orange
- Green with a white stripe
- Blue
- Blue with a white strip
- Green
- Brown with a white stripe
- Brown

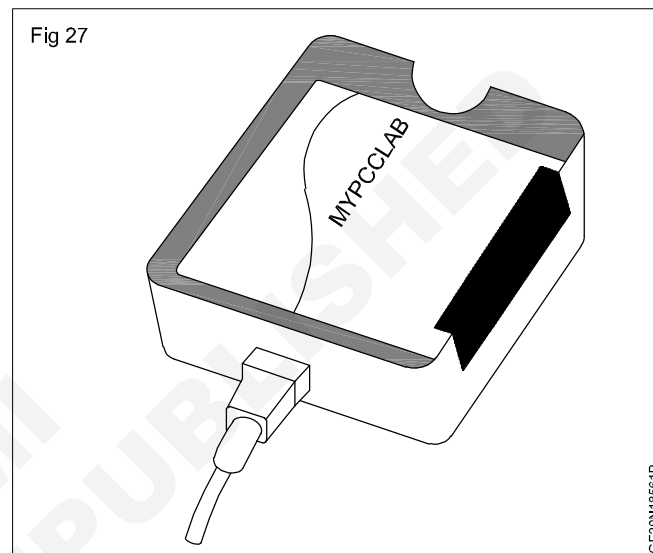
- 6 Trim the untwisted wires to a suitable length by holding the RJ-45 connector next to the wires. The insulation on the cable should be just inside the bottom of the RJ-45 connector. The wires should be trimmed so that they line up evenly with the top of the RJ-45 connector.
 - Trim the wires in small increments, checking frequently to ensure a correct fit. It's better to cut the untwisted wires a few times than have to go back and start all over again because you trimmed off too much.
- 7 Insert the wires into the RJ-45 connector, making sure that they stay aligned and each color goes into its appropriate channel. Make sure that each wire goes all the way to the top of the RJ-45 connector. If you don't make these checks, you will find that your newly crimped RJ-45 connector is useless.

- 8 Use the crimping tool to crimp the RJ-45 connector to the cable by pressing the jacket and cable into the connector so that the wedge at the bottom of the connector is pressed into the jacket.

Re crimp the cable once more to ensure proper connection.

- 9 Follow the instructions above to crimp an RJ-45 connector to the opposite end of the cable
- 10 Use a cable tester to assure that your cable is working properly when both ends are crimped.

Cable Tester (Fig 27)



When connected to an Ethernet cable, a network cable tester tells if the cable is capable of carrying an Ethernet signal. If the cable carries the signal, this indicates that all the circuits are closed, meaning that electric current can move unimpeded through the wires, and that there are no short circuits, or unwanted connections, in the wire.

Network cable testers vary in complexity and price, but a basic tester consists of a source of electrical current, a measuring device that shows if the cable is good, and a connection between the two, usually the cable itself.

Computer networks use Ethernet cables to allow computers in the network to "talk" to each other. An Ethernet cable has eight wires that are arranged in four pairs. For current to flow correctly, the wire pairs must be connected in the proper order.

A network cable tester can identify if the wires are paired correctly. It can also show if there is a break in the insulation, a situation which allows crosstalk between two wires that should not be connected. The tester can also tell whether the cable has the proper level of resistance.

A network cable tester can be a simple apparatus that merely identifies whether current flows through the cable, or it may be a professional-level, complex device that gives additional information that helps identify the problem.

Professional-level network cable testers may not only tell if an open circuit exists, but may identify where the break

is located. Some also identify the gauge of wire used and can generate their own signal to test for interference.

How to Check with the Tester

- 1 Turn on your network cable tester.
- 2 Plug one end of the Ethernet cable you are trying to test into the "IN" Ethernet input on the network cable tester.
- 3 Plug the other end of your Ethernet cable you are trying to test into the "OUT" input on the network cable tester.
- 4 Press the "Test" button. The network cable tester will send a signal across the Ethernet cable. If the signal gets from one end of the cable to the other, a green light will appear on the device, letting you know that the test was successful. If the signal does not get from one end of the cable to the other, a red light will appear on the device, letting you know that the test was not successful and that the cable is bad.

Switch

A **Network Switch** is a small hardware device that joins multiple computers together within one Local Area Network. Technically, network switches operate at layer two (Data Link Layer) of the OSI.

Network switches appear nearly identical to hub, but a switch generally contains more intelligence (and a slightly higher price tag) than a hub. Unlike hubs, network switches are capable of inspecting data packet as they are received, determining the source and destination device of each packet, and forwarding them appropriately.

By delivering messages only to the connected device intended, a network switch conserves bandwidth and offers generally better performance than a hub.

Availability of Switches

- 1 8 Port Switches
- 2 16 port switches
- 3 24 port switches
- 4 32 port switches

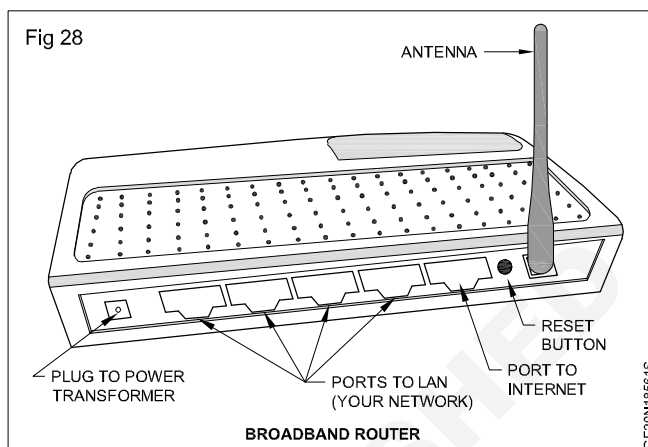
Hub: A Hub is a small, simple, inexpensive device that joins multiple computers together. Many network hubs available today support the Ethernet standard. Other types including USB hubs also exist, but Ethernet is the type traditionally used in home networking.

To network a group of computers using an Ethernet hub, first connect an Ethernet cable into the unit, and then connect the other end of the cable to each computer's NIC. All Ethernet hubs accept the RJ45 connectors of standard Ethernet cables.

Ethernet hubs vary in the speed (network data rate or bandwidth they support. Some years ago, Ethernet hubs offered only 10 Kbps rated speeds. Newer types of hubs offer 100 Mbps Ethernet. Some support both 10 Mbps and 100 Mbps (so-called dual-speed or 10/100 hubs).

Routers

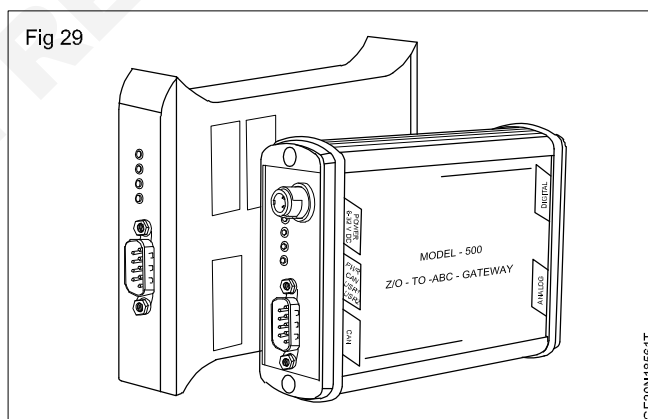
Routers (Fig 28) are physical devices that join multiple wired or wireless networks together. Technically, a wired or wireless router is a Layer 3 gateway, meaning that the wired/wireless router connects networks (as gateways do), and that the router operates at the network layer of the OSI model.



Home networkers often use an Internet Protocol (IP) wired or wireless router, IP being the most common OSI network layer protocol. An IP router such as a DSL or cable modem router joins the home's LAN to the WAN of the Internet.

Bridges

A bridge (Fig 29) device filters data traffic at a network boundary. Bridges reduce the amount of traffic on a LAN by dividing it into two segments.



Bridges operate at the data link layer (Layer 2) of the OSI model. Bridges inspect incoming traffic and decide whether to forward or discard it. An Ethernet bridge, for example, inspects each incoming Ethernet frame - including the source and destination MAC addresses, and sometimes the frame size - in making individual forwarding decisions.

ISP: Internet Service Provider, it refers to a company that provides Internet services, including personal and business access to the internet. For a monthly fee, the service provider usually provides a software package, Username, password and access phone number.

Equipped with a modem you can then log on to the Internet and browse the world wide web and USENET and send and receive email For broadband access you typically

receive the broadband modem hardware or pay a monthly fee for this equipment that is added to your ISP account billing.

In addition to serving individuals, ISPs also serve large companies, providing a direct connection from the company's networks to the Internet. ISPs themselves are connected to one another through Network Access Point (NAPs). ISPs may also be called IAPs (Internet Access Provider).

State Owned ISP's

- **BSNL** - Servicing all of India except Mumbai and Delhi. Triple-play Broadband Services provided by ADSL and VDSL. Also providing internet services over GPRS, 3G, as well as WiMax
- **MTNL** - Servicing Mumbai and Delhi. Triple-play Broadband Services provided by ADSL under the "Tri-Band" brand. Also providing GPRS and 3G internet services.

Private Owned nationwide ISP's

- Airtel - ADSL, GPRS, 3G & 4G LTE
- Skynet Broadband - Internet Service Provider
- Aircel - GPRS & 3G
- Hathway - Broadband over Cable
- Idea - GPRS & 3G
- MTS India - CDMA/EV-DO
- O-Zone Networks Private Limited - Pan - India Public Wi-Fi hotspot provider
- Reliance Communications - ADSL, GPRS & 3G, Metro-Ethernet, CDMA/EV-DO, Wimax
- Reliance Industries - LTE (to be launched)
- Sify - Broadband over cable
- Tata DoCoMo - GPRS & 3G
- Tata Indicom - ADSL, CDMA/EV-DO, Metro-Ethernet, WiMax
- Vodafone - GPRS & 3G

NSP: Network Service Providers (NSP) is a business or organization that sells bandwidth or network access by providing direct Internet backbone access to the Internet

Transmission Media and Network Components

Objective: At the end of this lesson you shall be able to

- explain cable media, wireless media and network adapter.

Network media : Media are what the message is transmitted over. Different media have different properties and are most effectively used in different environments for different purposes.

In computer networking, the medium affects nearly every aspect of communication. Most important, it determines how quickly and to whom a computer can talk and how expensive the process is.

and usually access to its **Network Access Point (NAPs)**.

Network service providers may consist of Telecommunications companies, data carriers, wireless communications providers, Internet service provider, and Cable television operators offering high-speed Internet access.

Dial up: Dial-up access is really just like a phone connection, except that the parties at the two ends are computer devices rather than people. Because dial-up access uses normal telephone lines, the quality of the connection is not always good and data rate are limited.

In the past, the maximum data rate with dial-up access was 56 Kbps (56,000 bits per second), but new technologies such as ISDN are providing faster rates.

Broadband: The term broadband refers to a telecommunications signal or device of greater Bandwidth (signal processing), in some sense, than another standard or usual signal or device (and the broader the band, the greater the capacity for traffic).

Wireless (Wi-Fi): Wireless broadband is high-speed Internet service via wireless technology. Wireless broadband is available in Internet cafés, local "hot spots" within many cities, private businesses and many homes.

The advantage of wireless broadband is that the computer receiving the Internet signal need not be tethered by an Ethernet or network cable to the broadband modem or router.

A wireless broadband modem receives the service and transmits it via radio waves to the immediate surrounding area. Any computer equipped with wireless capacity within receiving distance can pick up the signal, making the Internet 'portable.' The most common way to take advantage of wireless broadband is by using a laptop computer.

Mobile Broadband: The term mobile broadband refers to high-speed wireless Internet connections and services designed to be used from arbitrary locations.

Cellular networks normally provide broadband connections suitable for mobile access. The technologies in use today fall into two categories -3G (third generation cell networks) and 4G (fourth generation).

Cable media : Cables have a central conductor that consists of a wire or fiber surrounded by a plastic jacket. Three types of cable media are twisted-pair, coaxial and fiber-optic cable. Two types of twisted-pair cable are used in networks: unshielded (UTP) and shielded (STP).

Table-1 summarizes the characteristics of these types of cable media, which are discussed in the following sections.

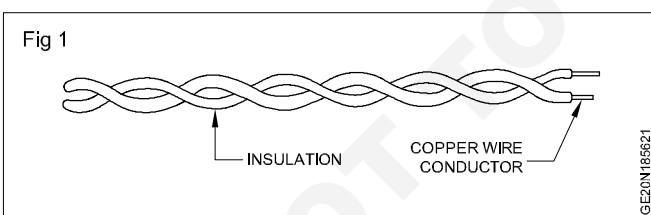
Table - 1

| Factor | UTP | STP | Coaxial | Fiber-optic |
|---------------------------|--|--|--|--------------------------------------|
| Cost | Lowest | Moderate | Moderate | Highest |
| Installation | Easy | Fairly easy | Fairly easy | Difficult |
| Bandwidth capacity | 1- to 155 Mbps (typically 10 Mbps) | 1- to 155Mbps (typically 16 Mbps) | Typically 10 Mbps | 2 Gbps (typically 100 Mbps) |
| Node capacity per segment | 2 | 2 | 30 (10base 2) 100 (10 base 5) | 2 |
| Attenuation | High (range of hundreds of meters) | High (range of hundreds of meters) | Lower (range of a few kilometers) | Lowest (range of tens of kilometers) |
| EMI | Most vulnerable to EMI and eavesdropping | Less vulnerable than UTP but still vulnerable to EMI and eavesdropping | Less vulnerable than UTP but still vulnerable to EMI and eavesdropping | Not affected by EMI or eavesdropping |

Twisted-pair cable : Twisted-pair cable uses one or more pairs of two twisted copper wires to transmit signals. It is commonly used as telecommunications cable.

When copper wires that are close together conduct electric signals, there is a tendency for each wire to produce interference in the other. One wire interfering with another in this way is called crosstalk. To decrease the amount of crosstalk and outside interference, the wires are twisted. Twisting the wires allows the emitted signals from one wire to cancel out the emitted signals from the other and protects them from outside noise.

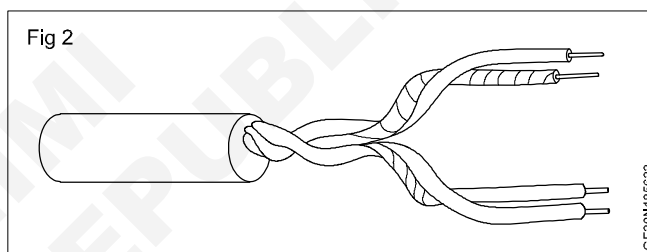
Twisted pairs are two color-coded, insulated copper wires that are twisted around each other. A twisted-pair cable consists of one or more twisted pairs in a common jacket. Fig 1 shows a twisted-pair cable.



The two types of twisted-pair cable are unshielded and shielded.

Unshielded twisted-pair cable : Unshielded twisted-pair (UTP) cable consists of a number of twisted pairs with a simple plastic casing. UTP is commonly used in telephone systems. Fig 2 shows a UTP cable.

The Electrical Industries Association (EIA) divides UTP into different categories by quality grade. The rating for each category refers to conductor size, electrical characteristics and twists per foot. The following categories are defined.

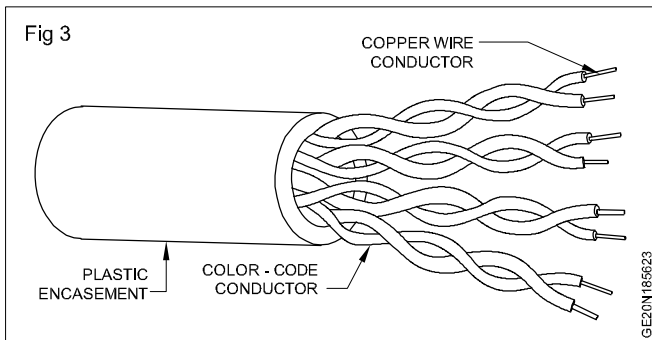


- Categories 1 and 2 were originally meant for voice communication and can support only low data rates, less than 4 megabits per second (Mbps). These cannot be used for high-speed data communications. Older telephone networks used Category 1 cable.
- Category 3 is suitable for most computer networks. Some innovations can allow data rates much higher, but generally Category 3 offers data rates up to 16 Mbps. This category of cable is the kind currently used in most telephone installations.
- Category 4 offers data rates upto 20 Mbps.
- Category 5 offers enhancements over Category 3, such as support for Fast Ethernet, more insulation and more twists per foot, but Category 5 requires compatible equipment and more stringent installation. In a Category 5 installation, all media, connectors and connecting equipment must support Category 5 or performance will be affected.

Data-grade UTP cable (Categories 3,4 and 5) consists of either four or eight wires. A UTP cable with four wires is called a two-pair. Network topologies that use UTP require atleast two-pair wire. You may want to include an extra pair for future expansion. Fig 3 shows a four-pair cable.

Because UTP cable was originally used in telephone systems, UTP installations are often similar to telephone installations. For a four-pair cable, you need a modular RJ-

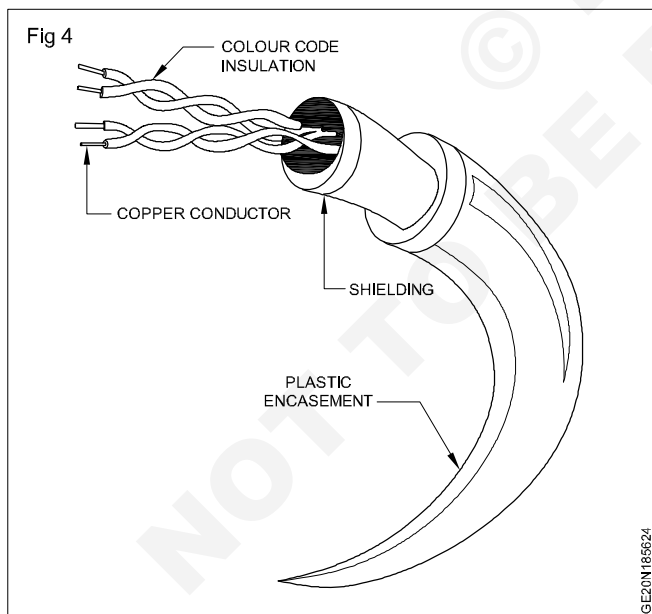
45 telephone connector. For a two-pair cable, you need a modular RJ-11 telephone connector. These connectors are attached to both ends of a patch cable. One end of the patch cable is then inserted into a computer or other device, and the other end is inserted into a wall jack. The wall jack connects the UTP drop cable (another length of cable) to a punch-down block.



The other side of the punch-down block is wired to a patch panel. The patch panel provides connectivity through patch cables to other user devices and connectivity devices.

UTP's popularity is partly due to the, first usage of the same in telephone systems. In many cases a network can be run over the already existing wires installed for the phone system, at a great savings in installation cost.

Shielded twisted-pair cable : The only difference between shielded twisted pair (STP) and UTP is that STP cable has a shielded usually aluminium/polyester between the outer jacket or casing and the wires. Fig 4 shows STP cable.



The shield makes STP less vulnerable to EMI because the shield is electrically grounded. If a shield is grounded correctly, it tends to prevent signals from getting into or out of the cable. It is a more reliable cable for LAN environments. STP was the first twisted-pair cable to be used in LANs. Although many LANs now use UTP, STP is still used.

Transmission media specifications from IBM and Apple Computer use STP cable. IBM's Token Ring network uses STP and IBM has its own specifications for different

qualities and configurations of STP. A completely different type of STP is the standard for Apple's Apple Talk networks. Networks that conform to each vendor's specifications have their own special requirements, including connector types and limits on cable length.

STP has the following characteristics

Cost : Bulk STP is fairly expensive. STP costs more than UTP and thin coaxial cable but less than thick coaxial or fiber-optic cabling.

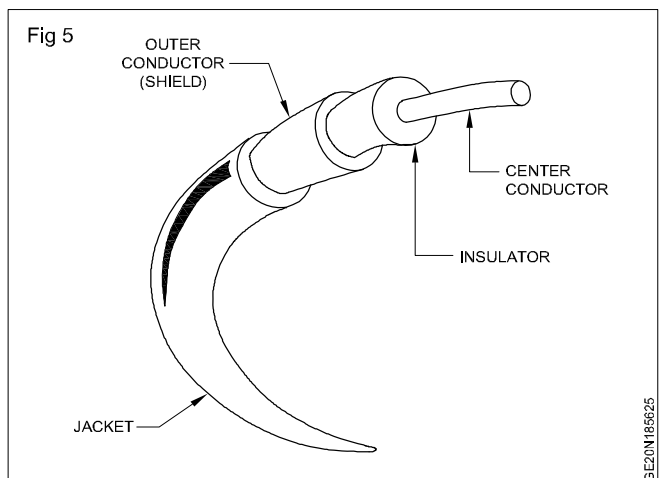
Installation : The requirement for special connectors can make STP more difficult to install than UTP. An electrical ground must be created with the connectors. To simplify installation, use standardised and prewired cables. Because STP is rigid and thick (up to 1.5 inches in diameter), it can be difficult to handle.

Bandwidth capacity : With the outside interference reduced by the shielding, STP can theoretically run at 500 Mbps for a 100 meter cable length. Few installations run at data rates higher than 155 Mbps. Currently, most STP installations have data rates of 16 Mbps.

Node capacity : Since only two computers can be connected together by an STP cable, the number of computers in an STP network is not limited by the cable. Rather, it is limited by the hub or hubs that connect the cables together. In a Token Ring network, which is the most common type of STP network, the useful upper limit is around 200 nodes in a single ring, but it depends on the type of data traffic in your network. There is a specified maximum limit of 270, but you will probably never reach this limit.

Attenuation : STP does not outperform UTP by much in terms of attenuation. The most common limit is 100 meters.

EMI : The biggest different between STP and UTP is the reduction of EMI. The shielding blocks a considerable amount of the interference. However, since it is copper wire, STP still suffers from EMI and is vulnerable to eavesdropping.



Coaxial cable : Coaxial cable commonly called coax has two conductors that share the same axis. A solid copper wire or stranded wire runs down the center of the cable and this wire is surrounded by plastic foam insulation.

The form is surrounded by a second conductor, a wire mesh tube, metallic foil or both. The wire mesh protects the wire from EMI. It is often called the shield. A tough plastic jacket forms the cover of the cable, providing protection and insulation. Fig 5 shows a coaxial cable.

Coaxial cable comes in different sizes. It is classified by size (RG) and by the cable's resistance to direct or alternating electric currents (measured in ohms also called impedance)

The following are some coaxial cables commonly used in networking:

50 ohm, RG-8 and RG-11 used for thick ethernet.

50 ohm, RG-58 used for thin ethernet.

75 ohm, RG-59 used for cable TV.

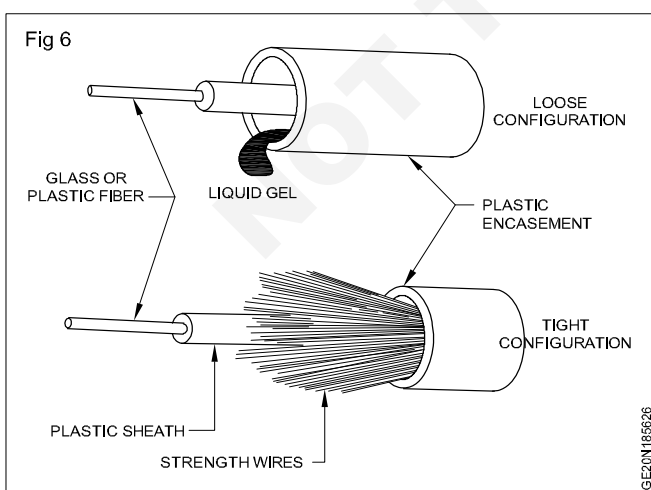
93 ohm, RG-62 used for ARCnet.

PVC and plenum cable : Polyvinyl chloride (PVC) is commonly used in coaxial cabling because it is a flexible, inexpensive plastic well suited for use as insulation and cable jacketing. PVC is often used in the exposed areas of an office.

A plenum is the space between the false ceiling of an office and the floor above. The air in the plenum circulates with the air in the rest of the building, and there are strict fire codes about what can be placed in a plenum environment.

Because PVC gives off poisonous gases when burned, you cannot use it in a plenum environment. You must use plenum grade cable instead. Plenum grade cable is certified to be fire resistant to produce a minimum amount of smoke. Plenum cable is also used in vertical runs (walls) without conduit (a tube to hold the cable). Plenum cable is more expensive and less flexible than PVC.

Fiber-optic cable : Fiber-optic cable transmits light signals rather than electrical signals. It is enormously more efficient than the other network transmission media. As soon as it comes down in price (both in terms of the cable and installation costs) fibre optic will be the choice for network cabling.



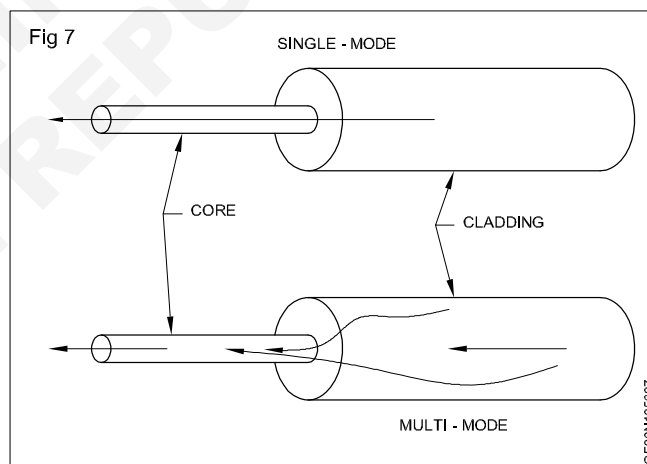
Each fiber has an inner core of glass or plastic that conducts light. The inner core is surrounded by cladding, a layer of glass that reflects the light back into the core.

Each fiber is surrounded by a plastic sheath. The sheath can be either tight or loose. Fig 6 shows examples of these two types of fiber optic cables.

Tight configurations completely surround the fibers with a plastic sheath and sometimes include wires to strengthen the cable (although these wires are not required). Loose configurations leave a space between the sheath and the outer jacket, which is filled with a gel or other material. The sheath provides the strength necessary to protect against breaking or extreme heat or cold. The gel, strength wires and outer jacket provide extra protection.

A cable may contain a single fiber, but often fibers are bundled together in the center of the cable. Optical fibers are smaller and lighter than copper wire. One optical fiber is approximately the same diameter as a human hair.

Optical fibers may be multimode or single mode. Single mode fibers allow a single light path and are typically used with laser signaling. Single mode fiber can allow greater bandwidth and cable runs than multimode but is more expensive. Multimode fibers use multiple light paths. The physical characteristics of the multimode fiber make all parts of the signal (those from the various paths) arrive at the same time, appearing to the receiver as though they were one pulse. If you want to save money, look into multimode, since it can be used with LEDs (light emitting diodes) which are a more affordable light source than lasers. Fig 7 shows single mode and multi mode fibers.



Optical fibers are differentiated by core/cladding size and mode. The size and purity of the core determine the amount of light that can be transmitted. The following are the common types of fiber-optic cable.

8.3 micron core/125 micron cladding, single mode

62.5 micron core/125 micron cladding, multimode

50 micron core/125 micron cladding, multimode

100 micron core/140 micron cladding, multimode

A typical LAN installation starts at a computer or network device that has a fiber-optic network interface and (NIC). This NIC has an incoming interface and an outgoing interface. The interfaces are directly connected to fiber-optic cables with special fibre-optic connectors. The opposite ends of the cables are attached to a connectivity device or splice center.

Wireless media : Wireless media do not use an electrical or optical conductor. In most cases, the earth's atmosphere is the physical path for the data. Wireless media is therefore useful when distance or obstructions make bounded media difficult. There are three main types of wireless media: radio wave, micro wave and infrared.

Radio wave transmission systems : Radio waves have frequencies between 10 kilohertz (KHz) and 1 gigahertz (GHz). The range of the electromagnetic spectrum between 10 KHz and 1 GHz is called radio frequency (RF).

Radio wave include the following types.

Short wave

Very high frequency (VHF) television and FM radio

Ultra-high frequency (UHF) radio and television

Radio waves can be broadcast omnidirectionally or directionally. Various kinds of antennas can be used to broadcast radio signals.

Microwave transmission systems : Microwave communication makes use of the lower gigahertz frequencies of the electromagnetic spectrum. These frequencies, which are higher than radio frequencies, produce better throughput and performance. There are two types of microwave data communication systems: terrestrial and satellite.

Terrestrial microwave : Terrestrial microwave systems typically use directional parabolic antennas to send and receive signals in the lower gigahertz range. The signals are highly focused and the physical path must be line-of-sight. Relay towers are used to extend signals. Terrestrial microwave systems are typically used when using cabling is cost prohibitive.

Because terrestrial microwave equipment often uses licensed frequencies, additional costs and time constraints may be imposed by licensing commissions or government agencies (the FCC, in the United States).

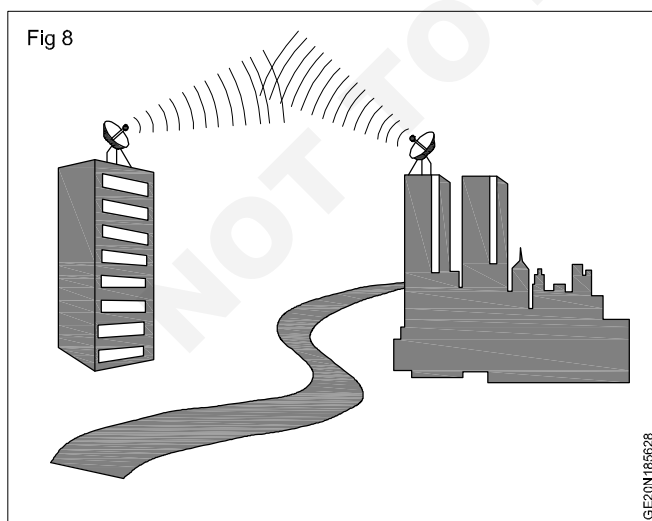


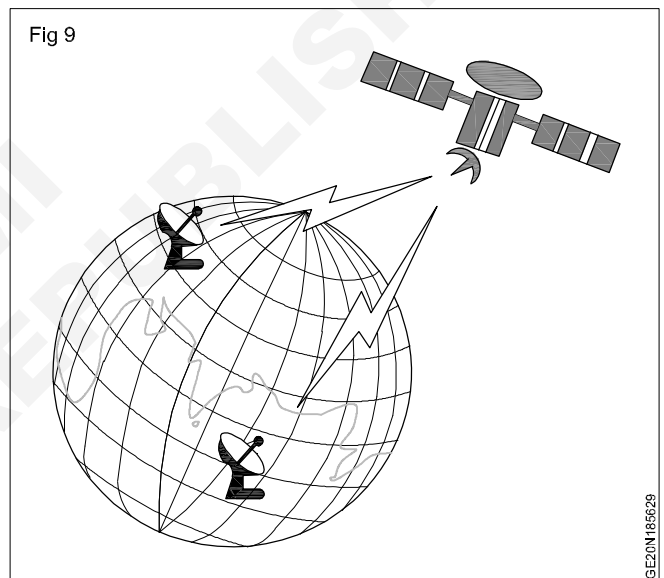
Fig 8 shows a microwave system connecting separate buildings. Smaller terrestrial microwave systems can be used within a building, as well. Microwave LANs operate at low power, using small transmitters that communicate with omnidirectional hubs. Hubs can then be connected to

form an entire network.

Satellite : Satellite microwave systems transmit signals between directional parabolic antennas. Like terrestrial microwave systems, they use low gigahertz frequencies and must be in line-of-sight. The main difference with satellite system is that one antenna is on a satellite in geosynchronous orbit about 50,000 kilometers (22,300 miles) above the earth. Because of this, satellite microwave systems can reach the most remote places on earth and communicate with mobile devices.

Here's how it usually works: a LAN sends a signal through cable media to an antenna (commonly known as a satellite dish), which beams the signal to the satellite in orbit above the earth. The orbiting antenna then transmits the signal to the another location on the earth or, if the destination is on the opposite side of the earth, to another satellite, which then transmits to a location on earth.

Fig 9 shows a transmission being learned from a satellite dish on earth to an orbiting satellite and then back to earth.



Because the signal must be transmitted 50,000 kilometers to the satellite and 50,000 kilometers back to earth, satellite microwave transmissions take about as long to cover a few kilometers as they do to span continents. Because the transmission must travel long distances, satellite microwave systems experience delays between the transmission of a signal and its reception. These delays are called propagation delays. Propagation delays range from .5 to 5 seconds.

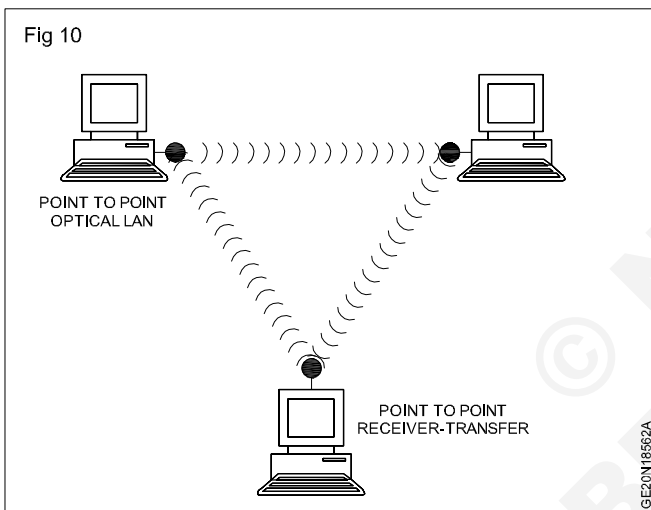
Infrared transmission systems : Infrared media use infrared light to transmit signals. LEDs or ILDs transmit the signals and photodiodes receive the signals. Infrared media use the tera-hertz range of the electromagnetic spectrum. The remote controls we use for television, VCR and CD players use infrared technology to send and receive signals.

Because infrared signals are in the terahertz (higher-frequency) range, they have good throughput. Infrared signals do have a downside: the signals cannot penetrate walls or other objects and they are diluted by strong light sources.

Infrared media use pure light, normally containing only electromagnetic waves or photons from a small range of the electromagnetic spectrum. Infrared light is transmitted either line-of-sight (point-to-point) or broadcast omnidirectionally, allowing it to reflect off walls and ceilings. Point-to-point transmission allows for better data rates, but devices must remain in their locations. Broadcast, on the other hand, allows for more flexibility but with lower data rates. (Part of the signal strength is lost with each reflection.)

Point-to-point : Infrared beams can be tightly focused and directed at a specific target. Laser transmitters can transmit line-of-sight across several thousand meters.

One advantage of infrared is that an FCC license is not required to use it. Also, using point-to-point infrared media reduces attenuation and makes eavesdropping difficult. Typical point-to-point infrared computer equipment is similar to that used for consumer product with remote controls. Careful alignment of transmitter and receiver is required. Fig 10 shows how a network might use point-to-point infrared transmission.



Broadcast : Broadcast infrared systems spread the signal to cover a wider area and allow reception of the signal by several receivers. One of the major advantage is mobility; the workstations or other devices can be moved more easily than with point-to-point infrared media. Fig 11 shows how a broadcast infrared system might be used.

Because broadcast infrared signals are not as focussed as point-to-point, this type of system cannot offer the same throughput. Broadcast infrared is typically limited to less than 1 Mbps, making it too slow for most network needs.

Network adapters, sometimes called Network Interface Cards (NICs) are peripheral cards that plug into the motherboard of your computer and into a network cable. It is through the network adapter that your computer communicates on the network. Many newer IBM-compatible computers have built-in networking adapters for Ethernet.

Network adapters perform all the functions required to communicate on a network. They convert data from the form stored in the computer to the form transmitted or

received (or transceived) on the cable and provide a physical connection to the network.

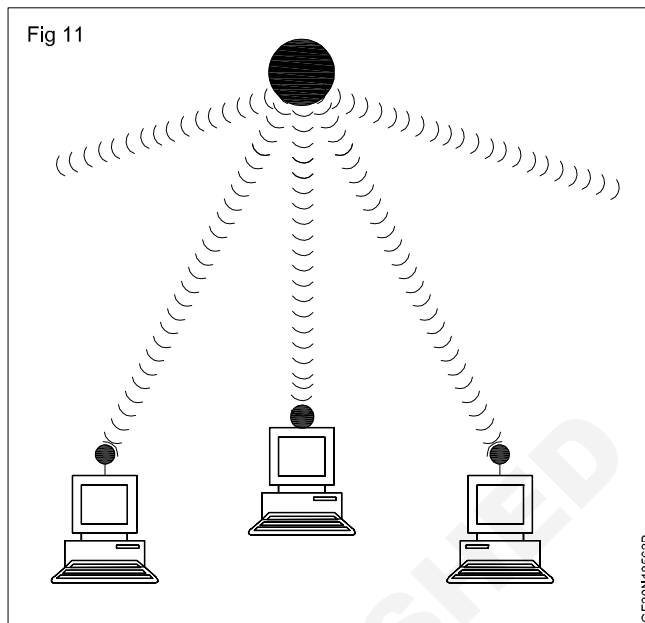
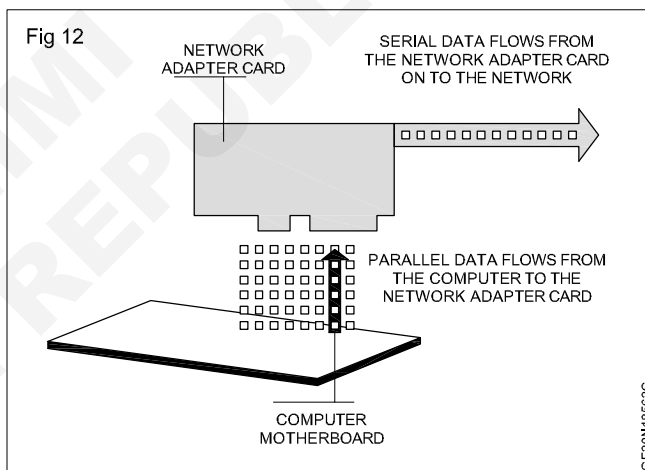


Fig 12 shows how an adapter plugs into a computer and attaches to a network cable.



Adapters in Abstract : Your computer software does not have to be aware of how the network adapter performs its function because the network driver software handles all the specifics for your computer. The applications running on your computer need only address data and hand it to the adapter card.

This is much the way the post office or a parcel delivery service works. You don't care about the details of postal delivery; you simply address your parcel and hand it to the delivery driver. The postal service manages the process of delivering it for you.

This abstraction allows your computer to use a microwave radio transmitter just as easily as a fiber-optic network adapter or an adapter that works over coaxial cable. Everything in your computer remains the same except for the actual network adapter and the driver software for that adapter.

How network adapters work : Network adapters receive the data to be transmitted from the motherboard of your computer into a small amount of RAM called a buffer. The data in the buffer is moved into a chip that calculates a checksum value for the chunk and adds address information, which includes the address of the destination card and its own address, which indicates where the data is from. Ethernet adapter addresses are permanently assigned when the adapter is made at the factory. This chunk is now referred to as a frame.

For example, in Ethernet, the adapter listens for silence on the network when no other adapters are transmitting. It then begins transmitting the frame one bit at a time, starting with the address information, then the chunk of data and then the checksum.

The network adapter must still convert the serial bits of data to the appropriate media in use on the network. For instance, if the data is being transmitted over optical fiber, the bits are used to light up an infrared LED (light emitting diode) or laser diode, which transmits light pulses down the fiber to the receiving device's APD (avalanche photo diode) or photo-transistor. If the data is being sent over twisted-pair cable, the adapter must convert the bits of data from the 5-volt logic used in computers to the differential logic used for digital twisted-pair transmission.

The circuitry used to perform this media conversion is called a transceiver. Ethernet is the same no matter what type of media you use only the transceiver changes. Transceivers can be external devices attached through the AUI port on an Ethernet adapter, or they can be internal on the card. Some cards (usually called combo cards) have more than one type of transceiver built in so you can use them with your choice of media. AUI interfaces on Ethernet adapters are not transceivers—they are where you attach a transceiver for the different media types.

Because a network signal travels through copper and optical fiber at about 66 percent as fast as the speed of light, there's a chance that one of two adapters far away from each other could still be hearing silence when the other has in fact started transmitting. In this case, they could transmit simultaneously and garble their data. This is referred to as a collision.

While adapters transmit, they listen to the wire to make sure the data on the line matches the data being transmitted. As long as it does, everything is fine. If another adapter has interrupted, the data being, "heard" by the transmitting network adapter will not match the data being transmitted. If this happens, the adapter ceases transmitting and transmits a solid on state instead, which indicates to all computers that it has detected a collision and that they should discard the current frame because it has been corrupted. The network adapter waits a random amount of time and then again attempts to transmit the frame.

Configuring network adapters : Because network adapters have not been around since computers were invented, there is no assigned place for cards to be set to. Most adapter cards require their own interrupt, port address

and upper memory range. PCI motherboards automatically assign IRQ and post settings to your PCI card, so you don't need to worry about it.

Unfortunately, network adapters in computers with ISA buses can conflict with other devices, since no two devices should share the same interrupt or port. No software that comes with your computer will tell you every interrupt and port in use unless your computer is already running Windows NT, so you must be somewhat familiar with the hardware in your computer or use a program that can probe for free resources to find one. Many adapters have test programs that can tell you whether the adapter is working correctly with the settings you've assigned.

Introduction to TCP/IP : TCP and IP were developed by Department of Defense (DOD) research project to connect a number different networks designed by different vendors into a network of networks (the "Internet"). It was initially successful because it delivered a few basic services that everyone needs (file transfer, electronic mail, remote logon) across a very large number of client and server systems. Several computers in a small department can use TCP/IP (along with other protocols) on a single LAN. The IP component provides routing from the department to the enterprise network, then to regional networks, and finally to the global internet. On the battlefield a communications network will sustain damage, so the DOD designed TCP/IP to be robust and automatically recover from any node or phone failure. This design allows the construction of very large networks with less central management. However, because of the automatic recovery, network problems can go undiagnosed and uncorrected for long periods of time.

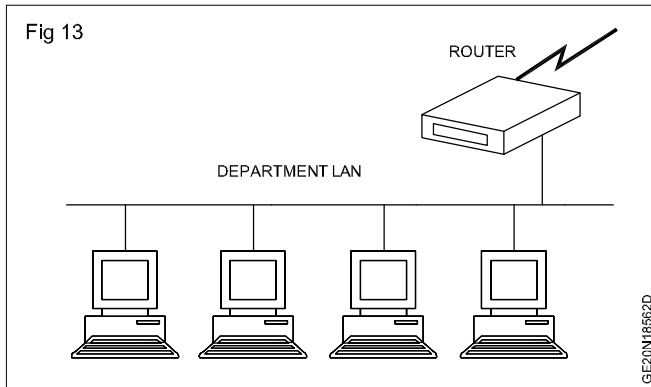
As with all other communications protocol, TCP/IP is composed of layers:

IP is responsible for moving packet of data from node to node. IP forwards each packet based on a four byte destination address (the IP number). The Internet authorities assign ranges of numbers to different organisations. The organisations assign groups of their numbers to departments. IP operates on gateway machines that move data from department to organisation to region and then around the world.

TCP is responsible for verifying the correct delivery of data from client to server. Data can be lost in the intermediate network. TCP adds support to detect errors or lost data and to trigger retransmission until the data is correctly and completely received.

Sockets is a name given to the package of subroutines that provide access to TCP/IP on most systems.

The Internet Protocol was developed to create a Network of Networks (the "Internet"). Individual machines are first connected to a LAN (Ethernet or Token Ring). TCP/IP shares the LAN with other users (a Novell file server, Windows for Workgroups peer systems). One device provides the TCP/IP connection between the LAN and the rest of the world. (Fig 13)



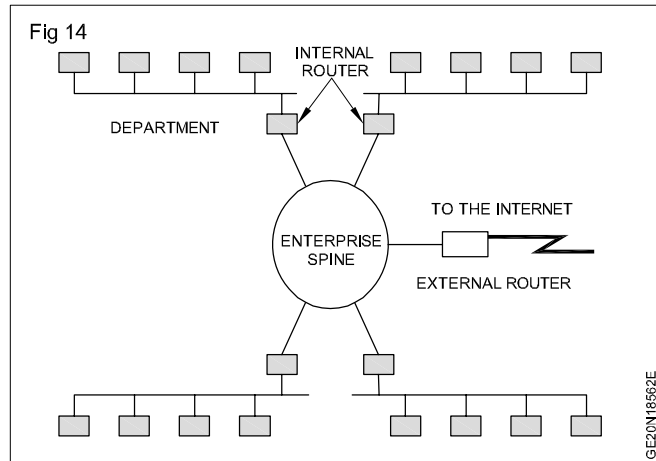
To insure that all types of systems from all vendors can communicate, TCP/IP is absolutely standardised on the LAN. However, larger networks based on long distances and phone lines are more volatile. In US, many large corporations would wish to reuse large internal networks based on IBM's SNA. In Europe, the national phone companies traditionally standardize on X.25. However, the sudden explosion of high speed microprocessors, fiber optics and digital phone systems has created a burst of new options: ISDN, frame relay, FDDI, Asynchronous Transfer Mode (ATM). New technologies arise and become obsolete within a few years. With cable TV and phone companies competing to build the National Information Superhighway, no single standard can govern citywide, nationwide, or worldwide communications.

The original design of TCP/IP as a Network of Networks fits nicely within the current technological uncertainty. TCP/IP data can be sent across a LAN or it can be carried within an internal corporate SNA network or it can piggyback on the cable TV service. Furthermore, machines connected to any of these networks can communicate to any other network through gateways supplied by the network vendor.

Addresses : Each technology has its own convention for transmission messages between two machines within the same network. On a LAN, messages are sent between machines by supplying the six byte unique identifier (the "MAC" address). In an SNA network, every machine has Logical Units with their own network address. DECNET, Appletalk and Novell IPX all have a scheme for assigning numbers to each local network and to each workstation attached to the network.

On top of these local or vendor specific network addresses, TCP/IP assigns a unique number to every workstation in the world. This "IP number" is a four byte value that, by convention, is expressed by converting each byte into a decimal number (0 to 255) and separating the bytes with a period. For example, a server IP is like 130.132.59.234

Subnets: Although the individual subscribers do not need to tabulate network numbers or provide explicit routing, it is convenient for most Class B networks to be internally manage as much smaller and simpler version of the larger network organisations. It is common to subdivide the two bytes available for internal assignment into a one byte department number and a one byte workstation ID. (Fig 14)



The enterprise network is built using commercially available TCP/IP router boxes. Each router has small tables with 255 entries to translate the one byte department number into selection of a destination Ethernet connected to one of the routers.

TCP treats the data as a stream of bytes. It logically assigns a sequence number to each byte. The TCP packet has a header that says, in effect, "This packet starts with byte 379642 and contains 200 bytes of data." The receiver can detect missing or incorrectly sequenced packets. TCP acknowledges data that has been received and retransmits data that has been lost. The TCP design means that error recovery is done end-to-end between the Client and Server machine. There is no formal standard for tracking problems in the middle of the network, though each network has adopted some adhoc tools.

There are three levels of TCP/IP knowledge. Those who administer a regional or national network must design a system of long distance phone lines, dedicated routing devices and very large configuration files. They must know the IP numbers and physical locations of thousands of subscriber networks. They must also have a formal network monitor strategy to detect problems and respond quickly.

Each large company or university that subscribes to the Internet must have an intermediate level of network organisation and expertise. A half dozen routers might be configured to connect several dozen departmental LANs in several buildings. All traffic outside the organisation would typically be routed to a single connection to a regional network provider.

However, the end user can install TCP/IP on a personal computer without any knowledge of either the corporate or regional network. Three pieces of information are required:

- 1 The IP address assigned to this personal computer.
- 2 The part of the IP address (the subnet mask) that distinguishes other machines on the same LAN (messages can be sent to them directly) from machines in other departments or elsewhere in the world (which are sent to a router machine)
- 3 The IP address of the router machine that connects this LAN to the rest of the world.

Network basics: IP Network classes

Network addressing architecture divides the address space for internet protocol version 4 (IPv4) into five address classes. Each class coded in the first four bits of the address, defines either a different network size, i.e. number of hosts for unicast addresses (classes A, B, V) or multicast network (class D). The fifth class (E) address range is reserved for future or experimental purposes. Knowing network classes becomes an issue when you deal with routing.

All actual network IDs and addresses are managed and distributed by the internet assigned number authority (IANA), which manages the entire pool of addresses. Addresses used to be permanently assigned to organizations, and any organizations (government, universities, or corporations) could purchase an address block (typically, a class network). During the 1990's, IANA and IAB realized that IP addresses were being consumed faster than expected and in light of the shortage of IP addresses, this practice has slowed a stop.

Currently, if you need public IP addresses, your internet service provider (ISP) usually lease you an appropriately sized block while you get your internet services from that ISP. The day of companies purchasing IP addresses are in the past

This section looks at the address classes in descending size order, from class A to class E.

Class A

Class A addresses are IP addresses that are assigned to network devices, such as computers, and include all addresses in which the first bit of the first octet is set to 0 (zero). This includes all values from 00000001 to 11111111, or 1 to 127. For class A networks, the first octet represents a network ID that is defined in the address by a subnet mask.

The network ID is not allowed to have all its bits set to 0 or all bits set to 1 the 127 network ID is excluded from this address class.

Thus, 126 possible class a networks are available to organizations around the world. With only 126 class A networks, owning one puts you in an exclusive club. You can no longer acquire a network block of addresses, and when possible, IANA to redistribute addresses in a more efficient and temporary manner.

Class B

Class B addresses are IP addresses that assigned to network devices, such as computers, and include all addresses in which the first two bits of the first octet are

10. This includes all value up ofs from 10000000 to 10111111 or 128 to 191,

The definition of the class B network is represented with a subnet mask, but the class B network ID is made up of the values in the first two octets. Unlike class A networks, all network IDs in this range are available for use.

Class C

Class C addresses are IP addresses that are assigned to network devices, such as computers, and include all addresses in which the first three bits of the first octet are set to 110. This includes all values from 11000000 to 11011111, or 192 to 223.

The default subnet mask for class C networks defines the first three octets as the network ID for these networks. Like with class B networks. All the network IDs are available for use on network. This is the last of the network classes that will be used for network devices on a TCP/IP network.\

Class D

Class D network addresses are not assigned to devices on a network. These addresses are used for special-purpose, multicast applications (such as video- and audio-streaming applications)

These addresses all need to be registered with IANA to be used globally. Addresses in this class have the first bits of the octet set to 1110, yielding addresses in the first octet ranging from 11100000 to 11101111, or 224 to 239. These addresses are not defined by a normal subnet mask; instead, each address is used for a specific purpose. And because each address is individually used, it uses a 255.255.255.255 mask.

Class E

If class D is special, class E addresses are even more special. There is no defined use for this address class officially it is listed as reserved for usage and testing by LANA and the internet research task force (IRTE). In fact as of RFC3330 in 2002, class E was Updated to "reserved" for future use",

Class E Comprises absolutely all valid addresses with 240 or higher in the first octet. The first bits of the first octet is 1111, which yields addresses from 11110000 to 11111110 or technically, 11111111 which in decimals are 240 to 254 or 255.

Because this address class is not being used for address allocation, you cannot know what the network ID, which defines the valid addresses in a range is so the inclusion of 255 at the end of the range is moot because this address range is not available for you to use all you need to know is that by definition class E includes all valid addresses higher that class D.

Network Security

Objectives: At the end of this lesson you shall be able to

- **define network security**
- **explain network security concepts.**

Network security consists of the provisions and policies adopted by a network administrator to prevent and monitor unauthorized access, misuse, modification, or denial of a computer network and network-accessible resources. Network security involves the authorization of access to data in a network, which is controlled by the network administrator.

Network security concepts

Network security refers to any activities designed to protect your network. Specifically, these activities protect the usability, reliability, integrity, and safety of your network and data. Effective network security targets a variety of threats and stops them from entering or spreading on your network.

Network security starts with authenticating, commonly with a username and a password. Since this requires just one detail authenticating the user name -i.e. the password- this is sometimes termed one-factor authentication. With two-factor authentication, something the user needs a 'dongle', an ATM card, or a mobile phone, and with three-factor authentication, something the user needs a fingerprint or retinal scan.

Once authenticated, a firewall decides what services are allowed to be accessed by the network users. Though effective to prevent unauthorized access, this component may fail to check potentially harmful content such as computer worms or Trojans being transmitted over the network.

Anti-virus software or an intrusion prevention system (IPS) helps detect and inhibit the action of such malware.

Encrypting the communication between two hosts using a network helps maintain privacy.

Surveillance and early-warning tools sometimes referred to as Honeypots can be employed.

Honeypot is a trap set to detect, deflect, or, in some manner, counteract attempts at unauthorized use of information systems. Generally, a honeypot consists of a computer, data, or a network site that appears to be part of a network, but is actually isolated and monitored, and which seems to contain information or a resource of value to attackers. This is similar to the police baiting a criminal and then conducting undercover surveillance.

The Foundations of Security

Security relies on the following elements:

• **Authentication**

Authentication addresses the question: who are you? It is the process of uniquely identifying the clients of your applications and services. These might be end users, other services, processes, or computers. In security

parlance, authenticated clients are referred to as principals.

• **Authorization**

Authorization addresses the question: what can you do? It is the process that governs the resources and operations that the authenticated client is permitted to access. Resources include files, databases, tables, rows, and so on, together with system-level resources such as registry keys and configuration data. Operations include performing transactions such as purchasing a product, transferring money from one account to another, or increasing a customer's credit rating.

• **Auditing**

Effective auditing and logging is the key to non-repudiation. Non-repudiation guarantees that a user cannot deny performing an operation or initiating a transaction. For example, in an e-commerce system, non-repudiation mechanisms are required to make sure that a consumer cannot deny ordering 100 copies of a particular book.

• **Confidentiality**

Confidentiality, also referred to as privacy, is the process of making sure that data remains private and confidential, and that it cannot be viewed by unauthorized users or eavesdroppers who monitor the flow of traffic across a network. Encryption is frequently used to enforce confidentiality. Access control lists (ACLs) are another means of enforcing confidentiality.

• **Integrity**

Integrity is the guarantee that data is protected from accidental or deliberate (malicious) modification. Like privacy, integrity is a key concern, particularly for data passed across networks. Integrity for data in transit is typically provided by using hashing techniques and message authentication codes.

• **Availability**

From a security perspective, availability means that systems remain available for legitimate users. The goal for many attackers with denial of service attacks is to crash an application or to make sure that it is sufficiently overwhelmed so that other users cannot access the application. Threats, Vulnerabilities, and Attacks Defined

A threat is any potential occurrence, malicious or otherwise, that could harm an asset. In other words, a threat is any bad thing that can happen to your assets.

A vulnerability is a weakness that makes a threat possible. This may be because of poor design, configuration mistakes, or inappropriate and insecure coding techniques. Weak input validation is an example of an application layer vulnerability, which can result in input attacks.

An attack is an action that exploits a vulnerability or enacts a threat. Examples of attacks include sending malicious input to an application or flooding a network in an attempt to deny service.

How Do You Build a Secure Web Application?

It is not possible to design and build a secure Web application until you know your threats. An increasingly important knowledge needed is about threat modeling. The purpose of threat modeling is to analyze your application's architecture and design and identify potentially vulnerable areas that may allow a user, perhaps mistakenly, or an attacker with malicious intent, to compromise your system's security.

After you know your threats, design with security in mind by applying proven security principles. You must follow secure coding techniques to develop secure, robust, and hack-resilient solutions. The design and development of application layer software must be supported by a secure network, host, and application configuration on the servers where the application software is to be deployed.

The set of security services provided at the IP layer includes access control, data origin integrity, protection against replays, and confidentiality. The algorithm allows these sets to work independently without affecting other parts of the implementation. The IPsec implementation is operated in a host or security gateway environment giving protection to IP traffic.

Security token

Some online sites offer customers the ability to use a six-digit code which randomly changes every 30-60 seconds on a security token. The keys on the security token have built in mathematical computations and manipulate numbers based on the current time built into the device. This means that every thirty seconds there is only a certain array of numbers possible which would be correct to validate access to the online account. The website that the user is logging into would be made aware of that devices' serial number and would know the computation and correct time built into the device to verify that the number given is indeed one of the handful of six-digit numbers that works in that given 30-60 second cycle. After 30-60 seconds the device will present a new random six-digit number which can log into the website.

Electronic mail security (E-mail)

Background

Email messages are composed, delivered, and stored in a multiple step process, which starts with the message's composition. When the user finishes composing the message and sends it, the message is transformed into a standard format: an RFC 2822 formatted message. Afterwards, the message can be transmitted. Using a network connection, the mail client, referred to as a mail user agent (MUA), connects to a mail transfer agent (MTA) operating on the mail server. The mail client then provides the sender's identity to the server. Next, using the mail server commands, the client sends the recipient list to

the mail server. The client then supplies the message. Once the mail server receives and processes the message, several events occur: recipient server identification, connection establishment, and message transmission. Using Domain Name System (DNS) services, the sender's mail server determines the mail server(s) for the recipient(s). Then, the server opens up a connection(s) to the recipient mail server(s) and sends the message employing a process similar to that used by the originating client, delivering the message to the recipient(s).

Pretty Good Privacy (PGP)

Pretty Good Privacy provides confidentiality by encrypting messages to be transmitted or data files to be stored using an encryption algorithm such Triple DES or CAST-128. Email messages can be protected by using cryptography in various ways, such as the following:

- Signing an email message to ensure its integrity and confirm the identity of its sender.
- Encrypting the body of an email message to ensure its confidentiality.
- Encrypting the communications between mail servers to protect the confidentiality of both message body and message header.

The first two methods, message signing and message body encryption, are often used together; however, encrypting the transmissions between mail servers is typically used only when two organizations want to protect emails regularly sent between each other. For example, the organizations could establish a virtual private network (VPN) to encrypt the communications between their mail servers over the Internet. Unlike methods that can only encrypt a message body, a VPN can encrypt entire messages, including email header information such as senders, recipients, and subjects. In some cases, organizations may need to protect header information. However, a VPN solution alone cannot provide a message signing mechanism, nor can it provide protection for email messages along the entire route from sender to recipient.

Multipurpose Internet Mail Extensions (MIME)

MIME transforms non-ASCII data at the sender's site to Network Virtual Terminal (NVT) ASCII data and delivers it to client's Simple Mail Transfer Protocol (SMTP) to be sent through the Internet. The server SMTP at the receiver's side receives the NVT ASCII data and delivers it to MIME to be transformed back to the original non-ASCII data.

Message Authentication Code

A Message authentication code (MAC) is a cryptography method that uses a secret key to encrypt a message. This method outputs a MAC value that can be decrypted by the receiver, using the same secret key used by the sender. The Message Authentication Code protects both a message's data integrity as well as its authenticity.

Firewalls

A firewall (computing) controls access between networks. It generally consists of gateways and filters which vary from one firewall to another. Firewalls also screen network traffic and are able to block traffic that is dangerous. Firewalls act as the intermediate server between SMTP and Hypertext Transfer Protocol (HTTP) connections.

Role of firewalls in web security

Firewalls impose restrictions on incoming and outgoing Network packets to and from private networks. Incoming or outgoing traffic must pass through the firewall; only authorized traffic is allowed to pass through it. Firewalls create checkpoints between an internal private network and the public Internet, also known as choke points (borrowed from the identical military term of a combat limiting geographical feature). Firewalls can create choke points based on IP source and TCP port number. They can also serve as the platform for IPsec. Using tunnel mode capability, firewall can be used to implement VPNs. Firewalls can also limit network exposure by hiding the internal network system and information from the public Internet. Also, WE HAVE A LOT OF BIG WAYE to deal with it.

Types of firewalls

Packet filter

A packet filter is a first generation firewall that processes network traffic on a packet-by-packet basis. Its main job is to filter traffic from a remote IP host, so a router is needed to connect the internal network to the Internet. The router is known as a screening router, which screens packets leaving and entering the network.

Stateful packet inspection

In a stateful firewall the circuit-level gateway is a proxy server that operates at the network level of an Open Systems Interconnection (OSI) model and statically defines what traffic will be allowed. Circuit proxies will forward Network packets (formatted unit of data) containing a given port number, if the port is permitted by the algorithm. The main advantage of a proxy server is its ability to provide Network Address Translation (NAT), which can hide the user's IP address from the Internet, effectively protecting all internal information from the Internet.

Application-level gateway

An application-level firewall is a third generation firewall where a proxy server operates at the very top of the OSI model, the IP suite application level. A network packet is forwarded only if a connection is established using a known protocol. Application-level gateways are notable for analyzing entire messages rather than individual packets of data when the data are being sent or received.

Malicious software

Malware

A computer user can be tricked or forced into downloading software onto a computer that is of malicious intent. Such

programs are known as malware and come in many forms, such as viruses, Trojan horses, spyware, and worms. Malicious software is sometimes used to form botnets.

Viruses

Computer Viruses are programs that can replicate their structures or effects by infecting other files or structures on a computer. The common use of a virus is to take over a computer to steal data.

Worms

Computer worms are programs that can replicate themselves throughout a computer network, performing malicious tasks throughout.

Trojan horse

A Trojan horse commonly known as a Trojan is a general term for malicious software that pretends to be harmless, so that a user willingly allows it to be downloaded onto the computer.

Ransomware and Scareware

Botnet

A botnet is a network of zombie computers that have been taken over by a robot or bot that performs large-scale malicious acts for the creator of the botnet.

Spyware

The term spyware refers to programs that surreptitiously monitor activity on a computer system and report that information to others without the user's consent.

Denial-of-service attack

A denial-of-service attack (DoS attack) or distributed denial-of-service attack (DDoS attack) is an attempt to make a computer resource unavailable to its intended users. Although the means to carry out, motives for, and targets of a DoS attack may vary, it generally consists of the concerted efforts to prevent an Internet site or service from functioning efficiently or at all, temporarily or indefinitely.

Browser choice

Web browser statistics tend to affect the amount a Web browser is exploited. For example, Internet Explorer 6, which used to own a majority of the Web browser market share, is considered extremely insecure because vulnerabilities were exploited due to its former popularity. Since browser choice is more evenly distributed (Internet Explorer at 28.5%, Firefox at 18.4%, Google Chrome at 40.8%, and so on) and vulnerabilities are exploited in many different browsers.

Application vulnerabilities

Applications used to access Internet resources may contain security vulnerabilities such as memory safety bugs or flawed authentication checks. The most severe of these bugs can give network attackers full control over the computer. Most security applications and suites are incapable of adequate defense against these kinds of attacks.

Internet security products

Antivirus

Antivirus programs and Internet security programs can protect a programmable device from malware by detecting and eliminating viruses; Before 2000 a user would pay for antivirus software, 10 years later however, computer users can choose from a host of free security applications on the Internet.

Security Suites

So called "security suites" were first offered for sale in 2003 (McAfee) and contain a suite of firewalls, anti-virus, anti-spyware and more. They may now offer theft protection, portable storage device safety check, private internet browsing, cloud anti-spam, a file shredder or make security-related decisions (answering popup windows) and several were free of charge as of at least 2012.

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Internet Concepts

Objectives : At the end of this lesson you shall be able to

- **define networking concept**
- **explain internet and their servers**
- **describe about internet threats.**

Internet is a global communication system that links together thousands of individual networks. It allows exchange of information between two or more computers on a network. Thus internet helps in transfer of messages through mail, chat, video & audio conference, etc. It has become mandatory for day-to-day activities: bills payment, online shopping and surfing, tutoring, working, communicating with peers, etc.

In this topic, we are going to discuss in detail about concepts like basics of computer networks, Local Area Network (LAN), Wide Area Network (WAN), concept of internet, basics of internet architecture, services on internet, World Wide Web and websites, communication on internet, internet services, preparing computer for internet access, ISPs and examples (Broadband/Dialup/Wi-Fi), internet access techniques, web browsing software, popular web browsing software, configuring web browser, search engines, popular search engines/search for content, accessing web browser, using favorites folder, downloading web pages and printing web pages.

Internet WWW, Web Browsers Concepts & Description

1 Basics of Computer Networks.

Computer Network is an interconnection between two or more hosts/computers. Different types of networks include LAN, WAN, MAN, etc.

2 Internet Architecture

Internet is called the network of networks. It is a global communication system that links together thousands of individual networks. Internet architecture is a meta-network, which refers to a congregation of thousands of distinct networks interacting with a common protocol

3 Services on Internet

Internet acts as a carrier for numerous diverse services, each with its own distinctive features and purposes.

4 Communication on Internet

Communication can happen through the internet by using Email, Internet Relay Chat Video Conference etc.

5 Preparing Computer for Internet Access

We shall learn how to use functions and charts in Microsoft Excel using formulas like addition, subtraction, multiplication, division

6 Internet Access Techniques

A chart is a graphical representation of worksheet data. Charts can make data interesting, attractive and easy to read and evaluate. They can also help you to analyse and compare data.

7 Web Browsing Software

“World Wide Web” or simple “Web” is the name given to all the resources of internet. The special software or application program with which you can access web is called “Web Browser”

8 Configuring Web Browser

Search Engine is an application that allows you to search for content on the web. It displays multiple web pages based on the content or a word you have typed

9 Search Engines

Search Engine is an application that allows you to search for content on the web. It displays multiple web pages based on the content or a word you have typed.

10 Search for the content

Search Engine helps to search for content on web using the different stages

11 Accessing Web Browser

There are several ways to access a web page like using URLs, hyperlinks, using navigating tools, search engine, etc.

A website may be

- Personal website
- Commercial website
- E-Government
- Non-profit organization website.

Static Website

A static website is one that has web pages stored on the server in the format that is sent to a client web browser. It is primarily coded in Hypertext Markup Language (HTML).

Simple forms or marketing examples of websites, such as classic website, a five-page website or a brochure website are often static websites, because they present pre-defined, static information to the user. This may include information about a company and its products and services through text, photos, animations, audio/video and interactive menus and navigation.

This type of website usually displays the same information to all visitors. Similar to handing out a printed brochure to customers or clients, a static website will generally provide consistent, standard information for an extended period of time. Although the website owner may make updates periodically, it is a manual process to edit the text, photos and other content and may require basic website design skills and software.

Advantages

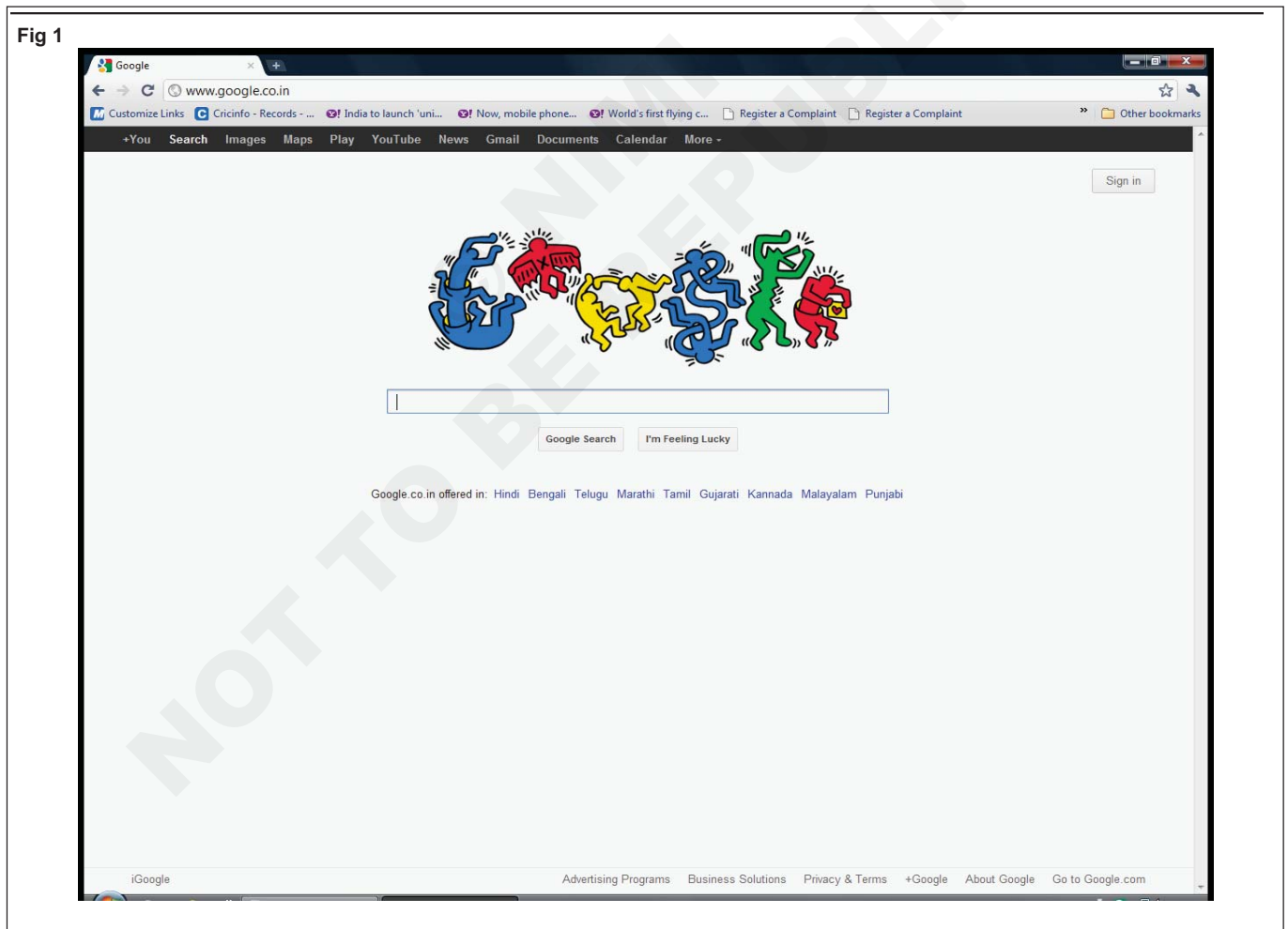
- Static Websites are easier to develop
- Can be developed quickly
- They are indexed easily by search engines as all the web pages actually exist on the server, which is not the case with dynamic websites.
- Warez: a site designed to host and let users download copyrighted materials illegally.
- Web portal: a site is vehicle that provides a gateway to other resources on the Internet or an intranet.

Web Pages

A web page or webpage is a Document or information resource that is suitable for the world wide Web and can be accessed through a web browser and displayed on a computer display or mobile device. This information is usually in HTML or XHTML format, and may provide navigation bar to other web pages via Hyper text Hyper link. Web pages frequently subsume other resources such as Cascading Style Sheet, Client-side-scripting and Images into their final presentation.

Web pages may be retrieved from a local computer or from a remote Web server. The web server may restrict access only to a private network, e.g. a corporate Intranet or it may publish pages on the World Wide Web. Web pages are requested and served from web. Web server using Hypertext Transfer Protocol (HTTP).

Web pages may consist of files of static text and other Web content stored within the Web server 's file system(Static Web page), or may be constructed by Server-side scripting when they are requested (Dynamic web page). Client-side scripting can make web pages more responsive to user input once on the client browser.



Web Browser

A Web browser can have a Graphical User Interface, like Internet Explorer, Mozilla Firefox, Google Chrome and Opera (web browser), or can be Command Line Interface, like Lynx (web browser) (Fig 1) or Links (web browser).

Web users with disabilities often use assistive technologies and adaptive strategies to Web accessibility web pages. Users may be colour blind, may or may not want to use a mouse perhaps due to repetitive stress injury or motor-neurone problems, may be deaf and require

audio to be captioned, may be blind and using a Screen reader or display, may need screen magnification, etc. Disabled and able-bodied users may disable the download and viewing of images and other media, to save time, network bandwidth or merely to simplify their browsing experience.

Users of mobile devices often have restricted displays and bandwidth. Anyone may prefer not to use the fonts, font sizes, styles and colour schemes selected by the web page designer and may apply their own CSS styling to the page. The World Wide Web Consortium (W3C) and Web Accessibility Initiative (WAI) recommend that all web pages should be designed with all of these options in mind.

Concept of Proxy Server

Objectives : At the end of this lesson you shall be able to

- explain the meaning of proxy server
 - explain common connection point
 - explain packet filtering, domain filtering and control user access by service
 - explain logging and web publishing.
-

What is a proxy server? To be a “proxy” means to act on behalf of another. This is exactly what a proxy server does; it acts on behalf of its proxy clients to interact with other servers. You could say that a proxy server is a “mediator” for computer communications.

Placing a proxy server on your network gives you several advantages, including security enhancements, coaching enhancements and greater control over your network users. The advantages of using Microsoft Proxy Server (MPS) is listed below:

- Common connection point
- Caching
- Packet filtering
- Domain filtering
- Control user access by service
- Logging
- Web publishing

Common connection point : MPS was designed to connect two networks, rather like a gateway. Typically, MPS connects an internal network and the Internet. This configuration gives the internal computers a common connection point to the Internet-through MPS.

When used to provide a common connection, MPS lets clients share a single connection to the Internet. Instead of giving each user on a Local Area Network (LAN) a separate modem, phone line and dial-up account to the Internet, MPS can function as a gateway to the Internet using a single connection. Instead of using separate standard phone line connections, users can share a single higher-speed connection through the proxy server. The net effect is usually an overall cost savings and reduction in administrative overhead. One connection is usually cheaper and easier to maintain than several separate connections.

Caching : Since you can use MPS as a common connection point to the Internet, you can also use it to cache frequently accessed resources. MPS allocates a portion of the server’s hard disk space to store frequently accessed objects.

Caching can either be passive or active. Passive caching just stores objects as they are requested so the cache is updated only when users request information. Active caching directs the server to refresh objects in the cache automatically.

You can selectively control MPS caching so that you can limit the size of cached objects, change the expiration limits (control the freshness of objects) and determine whether MPS always caches or always excludes from cache certain content.

Caching only works with the Web Proxy Service in MPS. You will learn more about the Web Proxy Service later in this chapter.

Packet Filtering : To protect internal users from the outside world (in other words to protect the network from outsiders), MPS provides packet-filtering services. A packet filter prevents unauthorized access from the outside by limiting the available connection points coming into the network. To that end, packet filters stop various types of protocols from entering the network.

MPS supports both static and dynamix packet filters. A static filter keeps all traffic of a certain description or type from passing through MPServer. A dynamic packet filter automatically determines which type of traffic is allowed in or out. With a static filter the administrator defines the port, the protocol and may be the IP address. With a dynamic filter the administrator just defines the service to be allowed or filtered.

Domain Filtering : MPS also lets you limit the access of your internal clients to the Internet. You can configure filters for a single computer, a group of computers or a domain name. Many companies prefer to have this type of control over their users because they can block access to Internet sites that they believe reduce employee productivity or contain offensive material. Some popular examples of domain filtering are blocking access to Internet game servers or Web sites that contain pornographic material.

You can configure domain filters for a specific IP address, IP address and subnet mask or domain name. IP address filters prevent users from contacting a single computer.

Using the IP address and subnet mask as a filter limits access to an entire group (a subnet) of computers. Domain name filters can apply to an entire Web site or to subsections of that site.

Control user access by Protocol or Service : You can also selectively enable and disable ports, services and protocols through MPS. MPS lets you control access to Internet services at the user level. You can also enable or restrict access to protocols on a user or group basis. Many protocols are predefined in the default MPS configuration.

If the protocol or service you would like to enable or disable is not defined in the MPS property sheets, you can create a new sheet. you can define a protocol by TCP (Transmission Control Protocol) or UDP (User Datagram Protocol) port number or range. This gives you the ability to control access by port.

Logging : Because all traffic between networks passes through MPS, MPS has the unique opportunity to log and track communication. You can track the information your internal clients get from other networks or the Internet and monitor inbound communication. You can use this information to help you secure your internal network from attack and unauthorized access. Plus, you can monitor where your users spend their time on the Internet and what information they are downloading.

Web publishing : MPS can also act as a Web server. MPS can service requests from cache on behalf of a Web server, pass requests to the Web server on the local system or pass requests to another Web server on the internal network. The terms “reverse proxying” and “reverse hosting” describe the Web Publishing services that MPS provides.

As a reverse proxy, MPS listens to incoming Web requests for a single Web server on the local network. The incoming requests are simply forwarded to another Web server. Web hosting requires more work on the part of MPS. As a reverse host, MPS can send requests to one of many Web servers. In this case, MPS responds as if the entire site were contained locally, even though the actual data may be coming from several different Web servers.

The main difference between reverse proxying and reverse hosting is that in performing reverse proxying, MPS forwards all requests to the Web server. In performing reverse hosting, MPS selectively forwards requests to multiple Web servers on the internal network. In reverse hosting, the Microsoft Proxy Server routes an external request for a resource (that specifies an Internet domain name) to one or more internal Web servers. For instance, requests for <http://www.hudlogic.com/bios> might be routed to an internal server named “business” (<http://business>), while requests for <http://www.hudlogic.com/pictures> could be sent to a different Web server named “server1” (<http://server1>).

Services : Microsoft Proxy Server 2.0 supports Hypertext Transfer Protocol (HTTP) version 1.1, Windows Sockets version 1.1, SOCKS version 4.3a and Secure Sockets Layer (SSL) 3.0. The MPS services that provide this support are the Web Proxy service, WinSock Proxy service and the SOCKS Proxy service, respectively.

Web Proxy Service : The Web Proxy service provides support for HTTP (a.k.a. Web publishing), FTP, Gopher and secure (SSL) communications. The Web Proxy service works with any CERN-compliant Web browser, such as Internet Explorer or Netscape Navigator. Because the Web Proxy supports only these widely adopted Internet standard communication methods, it isn't operating system dependent. Clients running Unix, Macintosh or Windows operating systems can communicate with the Web Proxy service as long as they're configured with a CERN-complaint Web browser.

Any operating system using a CERN-compliant Web browser can communicate through the Web Proxy server, regardless of its underlying operating system.

WinSock Proxy Service : The WinSock Proxy service supports Microsoft Windows operating systems using Windows Sockets. This support is available for both Transmission Control Protocol/Internet Protocol (TCP/IP) and Internetwork Packet Exchange/Sequenced Packet Exchange (IPX/SPX) protocols. The WinSock Proxy service applies mainly to Windows clients including Windows 3.x, Windows 95 and Windows NT.

Windows Sockets is an interprocess communication mechanism derived from the Berkeley Sockets interface (originally designed for Unix systems). The Sockets interface was extended to support Windows-based clients running Microsoft implementations of TCP/IP. The name given to this Sockets interface for Windows was WinSock (for Windows Sockets).

The WinSock Proxy Service doesn't support 16-bit IPX/SPX clients such as the Windows 3.x 16-bit Netware clients.

SOCKS Proxy Service : The SOCKS Proxy service supports SOCKS version 4.3a client applications such as FTP, Gopher and Telnet. Operating systems like Macintosh and Unix can run SOCKS 4.3a and access the SOCKS Proxy service when communicating through the Microsoft Proxy Server. One limitation of the SOCKS proxy service on MPS is that it does not support UDP-based protocols.

UDP-based protocols aren't supported through the SOCKS Proxy service, but the WinSock Proxy service does support UDP for Windows clients.

E-mail

Objectives : At the end of this lesson you shall be able to

- **state the hotmail services offered**
- **explain MSN outlook express and its tools**
- **explain popular search engines**
- **state the FAQs about hotmail.**

Hotmail: MSN Hotmail is the world's largest provider of free Web-based e-mail. Hotmail is based on the premise that e-mail access should be easy and possible from any computer connected to the World Wide Web.

By adhering to the universal HyperText Transfer Protocol (HTTP) standard, Hotmail eliminates the disparities that exist between different e-mail programs. Sending and receiving e-mail from Hotmail is as easy as going to the Hotmail web site at <http://www.hotmail.com>, or by clicking on the Hotmail link at <http://www.msn.com>, signing in, and sending an e-mail message.

Hotmail is the web-based e-mail provider, which means you can send and receive messages from any computer connected to the Internet. You can use Hotmail from home, work, school, an Internet cafe, a friend's house or any other computer in the world with an Internet connection. Your messages are stored in a central location, so your Inbox will always be up to date. This is great for people who use more than one computer, travel frequently, or don't even own a computer.

Advantages of Hotmail

Get a permanent e-mail address: When you create a Hotmail account, you choose a permanent e-mail address that will never change as long as you continue to use Hotmail. This is great for people who: Want to switch Internet Service Providers. Your Hotmail address will be the same no matter how you access the Internet, so you don't have to worry about retrieving messages from your old address or notifying friends, family and associates of a new e-mail address. You are free to select any Internet Service Provider that suits your needs.

When you leave town for travel, you may no longer have access to your ISP's e-mail account. But with Hotmail, your friends will always know where to reach you.

Your e-mail is private and secure: When you sign up for Hotmail, you choose your personal ID and password. The only way you can access your account is by using the password you selected. This means that only you will have access to your Hotmail account, even if you use a computer at a public terminal or a friend's house. Because the messages in your Hotmail account are stored securely at a central location, you don't have to worry about losing important information if something happens to your computer. Hotmail is strongly committed to keeping your personal information confidential.

Hotmail is fast and easy to use: Hotmail is recognized world wide as the best Web-based e-mail service. It is also stated that 'while others provide similar services, none can match Hotmail's general ease of use'. If everything is fine, it takes less than a minute to get started on Hotmail and its pages are so worked out to load quickly knowing that the users time is valuable.

Get an additional e-mail account for FREE: Hotmail offers everyone the opportunity to get a free e-mail account. Hotmail can offer e-mail accounts for free because it places banner advertising on some of its pages. Some Internet Service Providers charge a monthly fee for additional e-mail accounts. Hotmail lets an unlimited number of people use a single Internet Service Provider account and have a free, personal e-mail account.

Keep your personal e-mail separate from your work e-mail: People who use e-mail for work will find it convenient to keep their personal messages separate from their work messages. You can use Hotmail for your personal correspondence and your company's e-mail system only for business messages. Additionally, you don't have to store personal e-mail on your company's servers. All messages in your Hotmail account are securely stored in a central location that you access via the Internet with the password you select.

Outlook Express

Microsoft Outlook Express puts the world of online communication on your desktop. Whether you want to exchange e-mail with colleagues and friends or join newsgroups to trade ideas and information. Some of the tools offered by outlook express are;

Manage multiple mail and news accounts: If you have several mail or news accounts, you can use them all from one window. You can also create multiple users, or identities, for the same computer. Each identity gets its own mail folders and Address Book. The ability to create multiple accounts and identities makes it easy for you to keep work separate from personal mail and also between individual users.

Browse through messages quickly & easily: Using the message list and preview pane, you can view a list of messages and read individual messages at the same time. The Folders list contains mail folders, news servers, and newsgroups, and you can easily switch between them. You can also create new folders to organize and sort messages, and then set up message rules so that income.

Chatting, Video Chatting and Using Social Network Sites

Objectives : At the end of this lesson you shall be able to

- explain chatting process
- explain video chatting process
- explain social network services.

Chatting Process

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

Video Chat

In video chat video of both caller and receiver can be seen on screen of both user along with audio. So it gives an impression of face to face interaction though the caller and receiver can be thousands of mile apart.

Social Networking services

A social networking service is a platform to build social networks or social relations among people who, share interests, activities, backgrounds or real-life connections. A social network service consists of a representation of each user (often a profile), his social links, and a variety of additional services. Social networking is web-based services that allow individuals to create a public profile, to create a list of users with whom to share connection, and view and cross the connections within the system. Most social network services are web-based and provide means for users to interact over the Internet, such as e-mail and instant messaging. Social network sites are varied and they incorporate new information and communication tools such as, mobile connectivity, photo/video/sharing and blogging. Online community services are sometimes considered as a social network service, though in a broader sense, social network service usually means an individual-centered service whereas online community services are group-centered. Social networking sites allow users to share ideas, pictures, posts, activities, events, interests with people in their network.

The main types of social networking services are those that contain category places (such as former school year or classmates), means to connect with friends (usually with self-description pages), and a recommendation system linked to trust. Popular methods now combine many of these, with American-based services such as Facebook, Google+, YouTube, LinkedIn, Instagram, Pinterest, Tumblr and Twitter widely used worldwide; Nexopia in Canada; Badoo, Bebo, V Kontakte (Russia), Delphi (also called Delphi Forums), Draugiem.lv (mostly in Latvia), Hi5 (Europe), Hyves (mostly in The Netherlands), iWiW (mostly in Hungary), Nasza-Klasa, Soup (mostly in Poland), Glocals in Switzerland, Skyrock, The Sphere, StudiVZ (mostly in Germany), Tagged, Tuenti

(mostly in Spain), and XING in parts of Europe; Hi5 and Orkut in South America and Central America; Mxit in Africa; and Cyworld, Mixi, Orkut, renren, weibo and Wretch in Asia and the Pacific Islands.

There have been attempts to standardize these services to avoid the need to duplicate entries of friends and interests (see the FOAF standard and the Open Source Initiative). According to experts, the largest social networking users are Asian-Pacific regions with 615.9 million people. A 2013 survey found that 73% U.S adults use social networking sites.

A web threat is any threat that uses the World Wide Web to facilitate cybercrime. Web threats use multiple types of malware and fraud, all of which utilize HTTP or HTTPS protocols, but may also employ other protocols and components, such as links in email or IM, or malware attachments or on servers that access the Web. They benefit cybercriminals by stealing information for subsequent sale and help absorb infected PCs into botnets.

Web threats pose a broad range of risks, including financial damages, identity theft, loss of confidential information/data, theft of network resources, damaged brand/personal reputation, and erosion of consumer confidence in e-commerce and online banking.

It is a type of threat related to information technology (IT). The IT risk, i.e. risk affecting has gained and increasing impact on society due to the spread of IT processes.

Web threats can be divided into two primary categories, based on delivery method - push and pull. Push-based threats use spam, phishing, or other fraudulent means to lure a user to a malicious (often spoofed) website which then collects information and/or injects malware. Push attacks use phishing, DNS poisoning (or pharming), and other means to appear to originate from a trusted source.

Precisely-targeted push-based web threats are often referred to as spear phishing to reflect the focus of their data gathering attack. Spear phishing typically targets specific individuals and groups for financial gain. In other push-based web threats, malware authors use social engineering such as enticing subject lines that reference holidays, popular personalities, sports, pornography, world events and other hot topics to persuade recipients to open the email and follow links to malicious websites or open attachments with malware that accesses the Web.

Pull-based web threats are often referred to as "drive-by" threats by experts (and more commonly as "drive-by downloads" by journalists and the general public), since they can affect any website visitor. Cybercriminals infect legitimate websites, which unknowingly transmit malware

to visitors or alter search results to take users to malicious websites. Upon loading the page, the user's browser passively runs a malware downloader in a hidden HTML frame (IFRAME) without any user interaction.

Internet security

Internet security is a tree branch of computer security specifically related to the Internet, often involving browser security but also network security on a more general level as it applies to other applications or operating systems on a whole. Its objective is to establish rules and measures to use against attacks over the Internet. The Internet represents an insecure channel for exchanging information leading to a high risk of intrusion or fraud, such as phishing. Different methods have been used to protect the transfer of data, including encryption.

Types of security

Network layer security

TCP/IP which stands for Transmission Control Protocol (TCP) and Internet Protocol (IP) aka Internet protocol suite can be made secure with the help of cryptographic methods and protocols. These protocols include Secure Sockets Layer (SSL), succeeded by Transport Layer Security (TLS) for web traffic, Pretty Good Privacy (PGP) for email, and IPsec for the network layer security.

Internet Protocol Security (IPsec)

This protocol is designed to protect communication in a secure manner using TCP/IP aka Internet protocol suite. It is a set of security extensions developed by the Internet Task force IETF, and it provides security and authentication at the IP layer by transforming data using encryption. Two main types of transformation that form the basis of IPsec: the Authentication Header (AH) and ESP. These two protocols provide data integrity, data origin authentication, and anti-replay service. These protocols can be used alone or in combination to provide the desired set of security services for the Internet Protocol (IP) layer.

The basic components of the IPsec security architecture are described in terms of the following functionalities:

- Security protocols for AH and ESP
- Security association for policy management and traffic processing
- Manual and automatic key management for the internet key exchange (IKE)
- Algorithms for authentication and encryption

The set of security services provided at the IP layer includes access control, data origin integrity, protection against replays, and confidentiality. The algorithm allows these sets to work independently without affecting other parts of the implementation. The IPsec implementation is operated in a host or security gateway environment giving protection to IP traffic.

Security token

Some online sites offer customers the ability to use a six-digit code which randomly changes every 30-60 seconds on a security token. The keys on the security token have built in mathematical computations and manipulate numbers based on the current time built into the device. This means that every thirty seconds there is only a certain array of numbers possible which would be correct to validate access to the online account. The website that the user is logging into would be made aware of that devices' serial number and would know the computation and correct time built into the device to verify that the number given is indeed one of the handful of six-digit numbers that works in that given 30-60 second cycle. After 30-60 seconds the device will present a new random six-digit number which can log into the website.

Electronic mail security (E-mail)

Background

Email messages are composed, delivered, and stored in a multiple step process, which starts with the message's composition. When the user finishes composing the message and sends it, the message is transformed into a standard format: an RFC 2822 formatted message. Afterwards, the message can be transmitted. Using a network connection, the mail client, referred to as a mail user agent (MUA), connects to a mail transfer agent (MTA) operating on the mail server. The mail client then provides the sender's identity to the server. Next, using the mail server commands, the client sends the recipient list to the mail server. The client then supplies the message. Once the mail server receives and processes the message, several events occur: recipient server identification, connection establishment, and message transmission. Using Domain Name System (DNS) services, the sender's mail server determines the mail server(s) for the recipient(s). Then, the server opens up a connection(s) to the recipient mail server(s) and sends the message employing a process similar to that used by the originating client, delivering the message to the recipient(s).

Pretty Good Privacy (PGP)

Pretty Good Privacy provides confidentiality by encrypting messages to be transmitted or data files to be stored using an encryption algorithm such Triple DES or CAST-128. Email messages can be protected by using cryptography in various ways, such as the following:

- Signing an email message to ensure its integrity and confirm the identity of its sender.
- Encrypting the body of an email message to ensure its confidentiality.
- Encrypting the communications between mail servers to protect the confidentiality of both message body and message header.

The first two methods, message signing and message body encryption, are often used together; however, encrypting the transmissions between mail servers is typically used only when two organizations want to protect

emails regularly sent between each other. For example, the organizations could establish a virtual private network (VPN) to encrypt the communications between their mail servers over the Internet. Unlike methods that can only encrypt a message body, a VPN can encrypt entire messages, including email header information such as senders, recipients, and subjects. In some cases, organizations may need to protect header information. However, a VPN solution alone cannot provide a message signing mechanism, nor can it provide protection for email messages along the entire route from sender to recipient.

Multipurpose Internet Mail Extensions (MIME)

MIME transforms non-ASCII data at the sender's site to Network Virtual Terminal (NVT) ASCII data and delivers it to client's Simple Mail Transfer Protocol (SMTP) to be sent through the Internet. The server SMTP at the receiver's side receives the NVT ASCII data and delivers it to MIME to be transformed back to the original non-ASCII data.

Message Authentication Code

A Message authentication code (MAC) is a cryptography method that uses a secret key to encrypt a message. This method outputs a MAC value that can be decrypted by the receiver, using the same secret key used by the sender. The Message Authentication Code protects both a message's data integrity as well as its authenticity.

Firewalls

A firewall (computing) controls access between networks. It generally consists of gateways and filters which vary from one firewall to another. Firewalls also screen network traffic and are able to block traffic that is dangerous. Firewalls act as the intermediate server between SMTP and Hypertext Transfer Protocol (HTTP) connections.

Role of firewalls in web security

Firewalls impose restrictions on incoming and outgoing Network packets to and from private networks. Incoming or outgoing traffic must pass through the firewall; only authorized traffic is allowed to pass through it. Firewalls create checkpoints between an internal private network and the public Internet, also known as choke points (borrowed from the identical military term of a combat limiting geographical feature). Firewalls can create choke points based on IP source and TCP port number. They can also serve as the platform for IPsec. Using tunnel mode capability, firewall can be used to implement VPNs. Firewalls can also limit network exposure by hiding the internal network system and information from the public Internet. Also, WE HAVE A LOT OF BIG WAYE to deal with it.

Types of firewalls

Packet filter

A packet filter is a first generation firewall that processes network traffic on a packet-by-packet basis. Its main job is to filter traffic from a remote IP host, so a router is needed to connect the internal network to the Internet.

The router is known as a screening router, which screens packets leaving and entering the network.

Stateful packet inspection

In a stateful firewall the circuit-level gateway is a proxy server that operates at the network level of an Open Systems Interconnection (OSI) model and statically defines what traffic will be allowed. Circuit proxies will forward Network packets (formatted unit of data) containing a given port number, if the port is permitted by the algorithm. The main advantage of a proxy server is its ability to provide Network Address Translation (NAT), which can hide the user's IP address from the Internet, effectively protecting all internal information from the Internet.

Application-level gateway

An application-level firewall is a third generation firewall where a proxy server operates at the very top of the OSI model, the IP suite application level. A network packet is forwarded only if a connection is established using a known protocol. Application-level gateways are notable for analyzing entire messages rather than individual packets of data when the data are being sent or received.

Malicious software

Malware

A computer user can be tricked or forced into downloading software onto a computer that is of malicious intent. Such programs are known as malware and come in many forms, such as viruses, Trojan horses, spyware, and worms. Malicious software is sometimes used to form botnets.

Viruses

Computer Viruses are programs that can replicate their structures or effects by infecting other files or structures on a computer. The common use of a virus is to take over a computer to steal data.

Worms

Computer worms are programs that can replicate themselves throughout a computer network, performing malicious tasks throughout.

Trojan horse

A Trojan horse commonly known as a Trojan is a general term for malicious software that pretends to be harmless, so that a user willingly allows it to be downloaded onto the computer.

Ransomware and Scareware

Botnet

A botnet is a network of zombie computers that have been taken over by a robot or bot that performs large-scale malicious acts for the creator of the botnet.

Spyware

The term spyware refers to programs that surreptitiously monitor activity on a computer system and report that information to others without the user's consent.

Denial-of-service attack

A denial-of-service attack (DoS attack) or distributed denial-of-service attack (DDoS attack) is an attempt to make a computer resource unavailable to its intended users. Although the means to carry out, motives for, and targets of a DoS attack may vary, it generally consists of the concerted efforts to prevent an Internet site or service from functioning efficiently or at all, temporarily or indefinitely.

Browser choice

Web browser statistics tend to affect the amount a Web browser is exploited. For example, Internet Explorer 6, which used to own a majority of the Web browser market share, is considered extremely insecure because vulnerabilities were exploited due to its former popularity. Since browser choice is more evenly distributed (Internet Explorer at 28.5%, Firefox at 18.4%, Google Chrome at 40.8%, and so on) and vulnerabilities are exploited in many different browsers.

Application vulnerabilities

Applications used to access Internet resources may contain security vulnerabilities such as memory safety

bugs or flawed authentication checks. The most severe of these bugs can give network attackers full control over the computer. Most security applications and suites are incapable of adequate defense against these kinds of attacks.

Internet security products

Antivirus

Antivirus programs and Internet security programs can protect a programmable device from malware by detecting and eliminating viruses; Before 2000 a user would pay for antivirus software, 10 years later however, computer users can choose from a host of free security applications on the Internet.

Security Suites

So called "security suites" were first offered for sale in 2003 (McAfee) and contain a suite of firewalls, anti-virus, anti-spyware and more. They may now offer theft protection, portable storage device safety check, private internet browsing, cloud anti-spam, a file shredder or make security-related decisions (answering popup windows) and several were free of charge as of at least 2012.

Introduction to GIS Software

Objectives : At the end of this lesson you shall be able to

- **define GIS**
- **state the scope of GIS**
- **state the GIS components**
- **explain cartography - GIS interface**
- **state the trends and applications of GIS**
- **explain about open source GIS.**

Definition and scope of GIS

Definition of GIS

A Geographical Information System (GIS) is a system for capturing, storing, analyzing, manipulating, checking, displaying and managing data and associated attributes, which are spatially referenced to the Earth. The geographical information system is also called as a geographic information system or geospatial information system. It is an information system capable of integrating, storing, editing, analyzing, sharing, and displaying geographically referenced information.

Scope of GIS

GIS is integration of Mapping techniques, Surveying, Remote sensing & Satellite Imagery, Photogrammetry, Geography, Geology, Cartography and Global Positioning Systems (GPS). The benefits of using GIS in sectors like Agriculture, Rural development, Irrigation, Industries & Minerals, Energy, Transport, Communications, Science, Technology and Environment. GIS can be used for scientific investigations, resource management, and development planning. GIS used in Computer Science, Civil Engineering, Mathematics, Statistics and Operations Research. With GIS, we can create new approaches that help us understand the relationship between man and the environment. This calls for more integrated tools that build a holistic and comprehensive approach to resolving planning problems.

GIS is a growing market. The GIS market is projected to reach \$25.6 billion by 2030, increasing at a compound annual growth rate of 12.1 percent between 2020 and 2030, per Prescient & Strategic Intelligence.

Functional requirements of GIS, GIS components

Functional requirements of GIS

Spatial operations are the core functionality of a GIS. Objects, perform polygon operations, and perform a spatial query of the database, subsequent analysis.

GIS components

A Geographic Information System (GIS) integrates hardware, software, and data for capturing, managing, analyzing, and displaying all forms of geographically referenced information.

A working GIS integrates these five key components: hardware, software, data, people, and methods.

Hardware

Hardware is the computer on which a GIS operates. Today, GIS runs on a wide range of hardware types, from centralized computer servers to desktop computers used in standalone or networked configurations.

Software

GIS software provides the functions and tools needed to store, analyze, and display geographic information. Key software components are:

- A database management system (DBMS)
- Tools for the input and manipulation of geographic information
- Tools that support geographic query, analysis, and visualization
- A graphical user interface (GUI) for easy access to tools

People

GIS technology is of limited value without the people who manage the system and to develop plans for applying it. GIS users range from technical specialists who design and maintain the system, to those who use it to help them do their everyday work.

Methods

A successful GIS operates according to a well-designed plan and business rules, which are the models and operating practices unique to each organization.

Data

The most important component of a GIS is the data. Geographic data and related tabular data can be collected in-house or bought from a commercial data provider. Most GIS employ a DBMS to create and maintain a database to help organize and manage data.

The data that a GIS operates on consists of any data bearing a definable relationship to space, including any data about things and events that occur in nature. At one time this consisted of hard-copy data, like traditional cartographic maps, surveyor's logs, demographic

statistics, geographic reports, and descriptions from the field. Advances in spatial data collection, classification, and accuracy have allowed more and more standard digital base-maps to become available at different scales.

Cartography-GIS interface.

Cartography is the study and practice of making maps. Early maps and map-like drawings were produced on mud slab, soft clay, rock, skin, cloth etc.

GIS technology promises to transform cartography by changing what gets mapped, what form maps take, who makes and uses maps, and how maps are used. We can also expect a better tailoring of maps to user needs and characteristics.

The key issue between cartography and GIS is that cartography is concerned with representation while GIS is concerned with analysis of spatial relationships. GIS is a product of the development of computer-assisted cartography, which generated geo-referenced spatial digital databases.

Recent trends and applications of GIS

The recent trends and developments in GIS.

3D in GIS

Use of 3D in GIS began around a decade back. Now most of the GIS software has the capability to create 3D visualisation complete with landscape objects such as buildings, trees, etc.

Web GIS

The advent of web mapping can be regarded as a major new trend. With web mapping, freely available mapping technologies and geodata potentially allow every skilled person to produce web maps. Web mapping is the process of designing, implementing, generating and delivering maps on the World Wide Web and its products.

Location Based Services (LBS)

Convergence of different technologies, such as wireless networks, internet, GIS and GPS have introduced a new type of information technology, called Location Based Services (LBS). It is developing rapidly in the mobile and IT fields. Advancement of LBS is governed by increased demand and interest in utilising geospatial information through wireless networks. LBS is an information or entertainment service, accessible with mobile devices through the mobile network utilising the ability to make use of the geographical position of the mobile device. LBS can be used in a variety of contexts, such as health, indoor object search, entertainment, work, personal life, etc.

Mobile GIS

GIS is rapidly extending into the mobile environment also which is now known as Mobile GIS. Mobile GIS is the use of geographic data in the field on mobile devices. It integrates three essential components; Global Navigation Satellite Systems (GNSS), rugged handheld computers,

and GIS software.

Bringing these three technologies together make the enterprise database directly accessible to field personnel whenever and wherever it is required. Mobile GIS has an advantage over LBS. Location based systems require either you or at least your phone to be there to get location but it is difficult in some cases. Mobile GIS is useful in such cases. Mobile GIS is a mapping technology for resource managers and other field workers to visualise and improve their field-based management and research tasks. With mobile GIS, field workers may capture spatial data directly in the field and, with access to a wireless communication network; the data can then be remotely transferred in real time to the central database back at the company office.

Enterprise GIS

Enterprise GIS is a geographic information system that is integrated through an entire organisation so that a large number of users can manage, share, and use spatial data and related information to address a variety of needs, including data creation, modification, visualisation, analysis, and dissemination.

GIS Customisation and Software Automation

With the advent of web applications/client server concept, several organization are opting for software customisation to make it more user friendly for their clients/customers. Client/customer would be more happy to get the results or output at the click of the button rather than bother about the long and tedious back end process. In the current scenario, GIS customisation has got numerous benefits as mentioned below:

- It reduces the cycle time of certain project processes
- Manual intervention could be greatly minimised
- Human induced errors are significantly reduced as the process is automated
- With little modification of the custom built application, the same tool or scripts could be reused in other applications as well.

Applications of GIS

Geographic Information Systems is a vast field in Information Technology and, like any other booming technology, also has various applications in multiple domains.

Geographic Information Systems are applied in various domains. The count of its applications is only growing day by day. Below are some of the well-known applications concerning GIS.

1 Agriculture

Agriculture is one of the important tasks of human civilization. It is not only done for feeding the bellies but also to run the global business. GIS has spearheaded into this field with many of the applications.

Drought: Identifying the drought area or land to avoid further damage of plant seeds, human effort, and costly fertilizers.

Pest control: Predicting the pest attacks like locust and rodent attacks from the available spatial data sets of particular agricultural lands. This will allow the governing body and farmers to plan out on various things.

Land and Soil Analysis: Using previous data sets, satellite imagery or even the field analysis, which field workers do.

Planning of future food demand: Depending on the population's need, the governing body and the farmers can plan out on the production of sufficient level crops. Geo-Spatial data sources and GIS will allow great decision-making and avoid further hassle.

2 Urban and Town Planning

Developers, Builders, Architects, and Engineers are now using spatial data sets to plan on the futuristic township. With the help of granular information, it becomes easier for engineers and architects to hardly miss out on any of the parts. Governing bodies like CIDCO for New – Mumbai and BMC for greater Mumbai have also used GIS data and tools for planning out on various mega projects. The data is also useful to tackle water clogging during the time of flood and cloud burst in monsoons. It has also helped in redesigning the drainage models.

3 Oil Spill

Oil Spill can be intentional or accidental, depending on the conditions. The price is always paid by the Marine life and the humans who have frequent access to that particular sea route. GIS and geospatial data sets are used to curb such havoc spreading spills. According to various reports, most oil spills happen in the Malaysian coastal areas. Governing bodies have implemented GIS to tackle such spills. It is cost-effective than the hazardous oil spill, which is also harmful to marine life.

4 Disaster Management

GIS is used to monitor disaster and natural calamity prone areas. The geospatial data sets and databases allow organizations to store data of all levels. The database can contain all the information related to risk-prone areas like hospitals and isolation centres near the risk-prone zones, quick habitation centres, history of the calamities in that area, and the effect of the past disaster to plan for further contingency plans. Most Remotes Sensing and GIS is used on the areas which are prone to volcanic eruptions and earthquakes. With the help of both the technologies, organizations and municipality of any city

or admin can be prepared and ready to avoid the maximum effect. Using a GIS in a disaster is to create more awareness and be prepared and ready for the future.

5 Mapping and Navigation

The best example of today's world mapping and navigation is Google Maps. It is the most widely used service of Google by people. Humans around the world use it while travelling to a new place and also to review any place. It has also become a popular tool within Cab and carpool service providers. GPS, with the help of GIS, adds crispness and edge to the experience of navigation. It is not just about looking at the data on an application, but consumers are also allowed to post any unknown or unnamed information in the map data set. Google accepts consumer map edits and also has its map maker. However, Here Maps also collects data from local consumers and people in its proprietary tool, which is known as Map creator.

6 Reservoir and Dam Site location

Geo-Spatial data is used to find the perfect location for constructing a reservoir and dam. For selecting any dam site location, various factors should be looked after, like economic factors, environmental conditions, and engineering factors. Geo-spatial data have all the information concerning this; hence it's feasible to use GIS before implementing any of such major engineering projects.

7 Deforestation and Vegetation Management

Using GIS and geospatial data of forest lands allows organizations and governments to keep track of the rate of deforestation. The past information of different periods is used for analysis to plan for reforestation and vegetation. Due to the increasing number of deforestation, government bodies are also keeping track of forest and tree-related data. The datasets are used for the further analytical purpose of reforestation. With the help of heat maps and imagery sources, the data can be classified and visualized to take further actions.

8 GIS for Business, Marketing, and Sales

Apart from all the above applications, GIS also has unusual usage in making business and marketing sales. Geospatial databases store data of target customers, marketing campaigns and sales territories. This application enables companies and organizations to become strategically more competitive and strong in the market.

GIS Database /Digitization

Objectives : At the end of this lesson you shall be able to

- types of geographic data
- state data models
- explain database management system (DBMS)
- explain data structures and there types.

Geographic data: Spatial and non-spatial

Spatial data or Objects data or Location data

Spatial data comprise the relative geographic information about the earth and its features. A pair of latitude and longitude coordinates defines a specific location on earth. Spatial data are of two types according to the storing technique, namely, raster data and vector data.

Physical object that can be represented by numerical values in a geographic coordinate system (latitude and longitude) is known as spatial data.

Location Information: it indicates about *where is it?*

- Coordinates are used to define the spatial location and extent of geographic objects.
- Represents features, activities, or events that have a known location on the earth.

Non-spatial

Non Spatial data or Attributes or aspatial data

Attribute Information: it indicates about *what is it?*

- Attribute/non-spatial data is property of spatial data, this data are linked with coordinate data to define each spatial object in the spatial database

Attribute is a description or characteristic or properties of a spatial feature

Attribute Value The value given to an Attribute. Like text, integer, float, double and date.

Eg. Teak, 15 Sq.m, 0.75 m, 100 crores and 17-03-2022

- Non spatial data or Tables are composed of Fields or columns and Records or rows

Data models: Raster and vector

Raster Data

Raster data represents continuous phenomena that may change continuously across a region

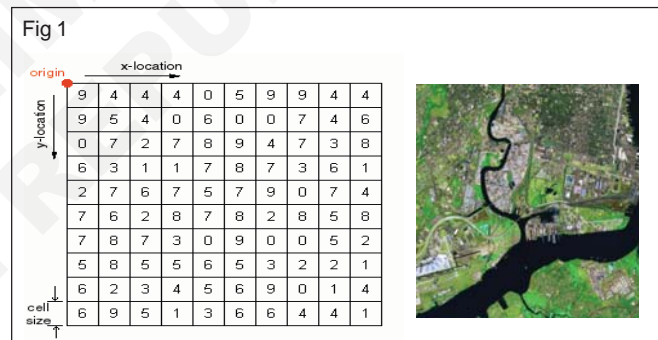
E.g. Elevation, rainfall, temperature, soil moisture, etc.

- Raster model uses grid cells for representing continuous phenomena
- Raster Data Model defines the world as a regular set of cells in a uniform grid pattern
- Cells are square and evenly spaced in the x and y directions

- Each cell represent attribute values and cell location of phenomena
- Cell dimension specifies length and width of the cell in surface units
- Raster data model may also be used to represent discrete data

E.g. Land cover: forest, wetlands, urban areas

- Raster data are digital aerial photographs, imagery from satellites, digital pictures, or even scanned maps
- Origin is set explicitly
- Cell size is always known
- Cell references (row/column locations) are known (Fig 1)



- Cell values are referenced to row/column location
- Values represent numerical phenomena or index codes for non-numerical phenomena.(Table - 1)

Table - 1

| File | File Format |
|--------|-------------|
| TIFF | image.tif |
| Bitmap | image.bmp |
| BIL | image.bil |
| JPEG | image.jpg |

- Rectangular grid of square cells
- Shape of features generalized by cells
- Simple data structure
- Good at representing continuous phenomena
- Wind speed, Elevation, slope, aspect
- EM reflectance (photographic or satellite imagery)

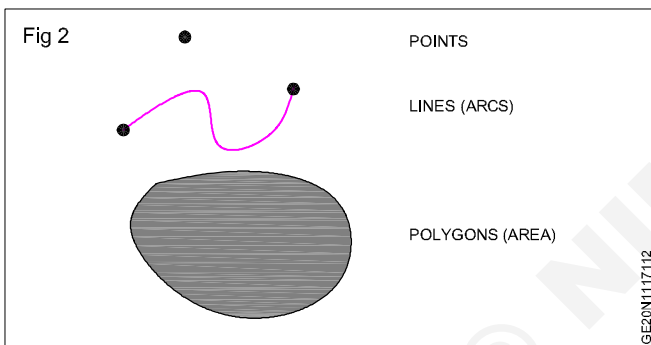
Advantages

- Simple data structure
- Easy and efficient overlaying
- Compatible with RS imagery
- High spatial variability is efficiently represented
- Simple for own programming
- Same grid cells for several attributes

Disadvantages

- Inefficient use of computer storage
- Errors in perimeter and shape
- Difficult network analysis
- Inefficient projection transformations
- Loss of information when using large cells
- Less accurate map output

VECTOR DATA (Fig 2)



Features in the real world can be represented either as:

- Points (*nodes*): intersections, homes, trees, poles, airports, cities
- Lines (*arcs*): streets, sewers, streams
- Areas (*polygons*): land parcels, cities, counties, forest, rock type

We use these three spatial elements to represent real world features and attach locational information to them.

- Vector data is more complex, but more accurate and flexible
- **Points:** Represent discrete point features.

Have a single geographic coordinate, simplest element and each point location has a record in the table

- Points are discrete Nodes and Vertices
- Eg: Tree, Well, and Lamp post
- **Lines:** Represent linear features, a series of geographic coordinates joined to form a line (arc).
- Lines start *and* end at nodes
- Vertices determine shape of line
- Nodes and vertices are stored as coordinate pairs

- Lines are discrete Nodes, Vertices and Arcs
- Eg: Road, Stream and Railway
- **Polygons:** represent bounded areas; a series of geographic coordinates joined together to form a boundary (polygon).
- Closed area (Lines + points) = polygons
- Eg: Lake, Soil types and forest

In Vector Data Model Features positioned accurately, Shape of features represented correctly, Features represented discretely (no fuzzy boundaries) and Complex data structure (especially for polygons).

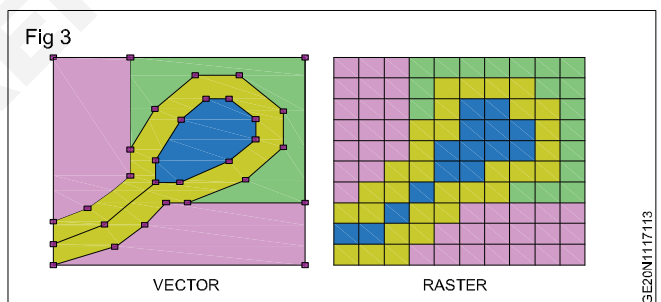
Advantages

- Compact data structure
- Accurate map output
- Efficient for network analysis
- Efficient projection transformation

Disadvantages

- Complex data structure
- Difficult overlay operations
- High spatial variability is inefficiently represented
- Not compatible with RS imagery

Vector & Raster data can be displayed simultaneously. V.data can be converted to R.data and vice-versa. (Fig 3)



Database Management System (DBMS)

Database management system is software that is used to manage the database. The database is a collection of inter-related data which is used to retrieve, insert and delete the data efficiently. It is also used to organize the data in the form of a table, schema, views, and reports, etc. For example: The college Database organizes the data about the admin, staff, students and faculty etc.

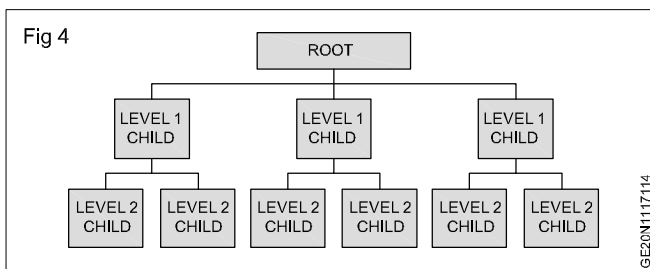
Using the database, you can easily retrieve, insert, and delete the information. For example: MySQL, Oracle, etc are a very popular commercial database which is used in different applications. DBMS provides an interface to perform various operations like database creation, storing data in it, updating data, creating a table in the database and a lot more. It provides protection and security to the database. In the case of multiple users, it also maintains data consistency.

Data structures: Relational, hierarchical and network

Hierarchical Data Model

Hierarchical data model is the oldest type of the data model. It was developed by IBM in 1968. It organizes data in the tree-like structure. Hierarchical model consists of the following:

- It contains nodes which are connected by branches.
- The topmost node is called the root node.
- If there are multiple nodes appear at the top level, then these can be called as root segments.
- Each node has exactly one parent.
- One parent may have many children.



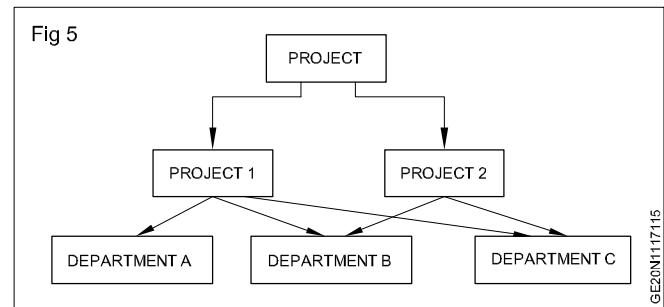
In the above figure 4 is the root node which has two children. These two has further children for which they act as parent. It follows one to many relationships.

Network Data Model

It is the advance version of the hierarchical data model. To organize data it uses directed graphs instead of the tree-structure. In this child can have more than one parent. It uses the concept of the two data structures i.e. Records and Sets.

In the figure 5, Project is the root node which has two children i.e. Project 1 and Project 2. Project 1 has 3 children and Project 2 has 2 children. Total there are 5 children i.e. Department A, Department B and Department C, they are network related children as we said that this model can have more than one parent. So, for the

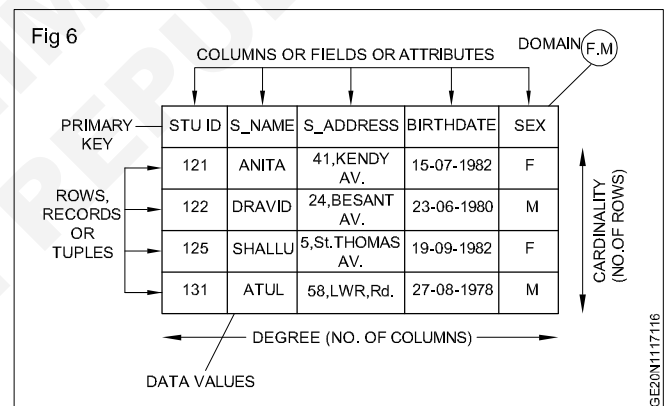
Department B and Department C have two parents i.e. Project 1 and Project 2.



Relational Data Model

The relational data model was developed by E.F. Codd in 1970. There are no physical links as they are in the hierarchical data model. Following are the properties of the relational data model: (Fig 6)

- Data is represented in the form of table only.
- It deals only with the data not with the physical structure.
- It provides information regarding metadata.
- At the intersection of row and column there will be only one value for the tuple.
- It provides a way to handle the queries with ease.



Digitization of Maps and Imageries

Objectives : At the end of this lesson you shall be able to

- explain data input in modern days
- explain coordinate transformation
- explain attribute data generation.

Data Input: Digitization of maps and imageries

Any information that is provided to a computer or a software program is known as input. Since the information provided is also considered to be data, the process of providing information to the computer is also known as data input. In GIS we can give data input through digitization process.

Digitizing is the process of making features in GIS software. Digitizing: Refers to the process of converting raster data (geo-referenced data) to digital format (vector). Valuable Geo-spatial information is contained in a wide variety of maps available in the form of images.

Unfortunately, we cannot analyse this data without digitizing it. The conventional approach is to manually extract data and store it in a digital format. Often a large amount of GIS time is spent in digitizing raster data to create vector layers that you use in your analysis.

Coordinate transformation

The introduction of a new set of mathematical coordinates that are stated distinct functions of the original coordinates. Transformations move or shift data within a coordinate system. They are often used to convert data from unknown digitizer or scanner units to real-world coordinates. We have two types of coordinate systems. They are

1 Geographic Coordinate System (GCS)

2 Projected Coordinate System (PCS)

Convert of one coordinate system to another coordinate system is called coordinate transformation or re-projection.

Attribute data generation

When we are doing digitizing of a feature in any GIS software automatically one row will generated for that feature and that feature and the row is interlinked. And whatever the data is available in tabular form that data we can join into as attribute data in any GIS software.

Data input is the procedure of encoding data into a computer-readable form and writing the data to the GIS data base. There are two types of data to be entered in a GIS - spatial (geographic location of features) and non-spatial.

There are three types of data entry:

- Manual;
- Digitizing;
- Scanning;

Digitizing is a process of entering digital codes of analyzed data into computer. Digitizing can be manual (using digitizing tablet) or automatic (using scanner). The difference between two methods is that digitizing tablet allows to do georeferencing during the digitizing process, while scanning require georeferencing later, after digital file (usually TIFF, GIF or JPEG image) has been created. Another difference between methods is speed and accuracy of the data processing. Apparent slowness of the work on digitizing tablet compensates often for the amount of editing after scanning process. At the same time good scanning allows automatic layer separation (for example, separation of red-colored roads from brown-colored contour lines), while digitizing of the map on a tablet requires manual creation of separate themes. In this case the condition of the original hardcopy is very important. Since human operator can use more cognitive tools and knowledge than the software support for scanning device, digitizer can handle better the hardcopy in a poor condition. Special kind of scanned data is remote sensing image, taken either by satellite camera, digital camera or video camera.

A geographic datum transformation is a calculation used to convert between two geographic coordinate systems to ensure that data is properly aligned.

Geographic coordinate systems describe how locations on the earth are placed on a hypothetical reference spheroid. They use angular units, such as degrees, to assign locations to coordinates on a reference spheroid. There is more than one geographic coordinate system because each is meant to best fit certain portions of the earth. This is necessary because the earth is actually a lumpy and slightly squashed sphere. The transformation is a calculation to convert the geographic coordinate system of the layers to match the geographic coordinate

system of the map as the map draws so that everything is aligned. The data is not changed by a transformation. This real-time translation is sometimes referred to as projecting on the fly.

The best geographic coordinate system to use depends on where and how much of the earth's geography you are mapping. In ArcGIS Pro, the best transformation for your map is suggested based on the data and the extent, but you can specify a different one.

Some transformations that require files are not installed with ArcGIS Pro. You can download and install the ArcGIS Pro Coordinate System Data files from My Esri. The additional files are the EGM2008 and GEOID12b geoid models; VERTCON files; GEOCON v1; and three NTV2 files for Switzerland, XRail, and OSTN15.

In ArcGIS Pro, both maps and their layers have coordinate systems, and they are not always the same. Each coordinate system may be either geographic or projected. Projected coordinate systems always include an underlying geographic coordinate system. A projection transforms the angular coordinates (such as latitude and longitude) from the reference spheroid to distance units (such as meters) on a flat surface. For example, the projection may describe how the spheroid coordinates will map to a flat rectangle hypothetically wrapped around the reference spheroid as a cylinder.

Transformations relate to the underlying geographic coordinate systems only. A transformation is applied only when the geographic coordinate systems are not identical. If layers have a different projected coordinate system than the map they are in, but both the layers and the map reference the same underlying geographic coordinate system, a transformation is not needed.

Transformations in scenes

When you work with global scenes, there are only two available coordinate systems: World Geodetic System 1984 (WGS84) or China Geodetic Coordinate System 2000 (CGCS 2000). In the case of CGCS 2000, there are no publicly available transformations. In the absence of a custom transformation, data added to a scene that uses CGCS 2000 is transformed to WGS84. In or near China, WGS84 closely matches CGCS 2000, but datum shifts may be substantial outside China.

Project data to a new coordinate system

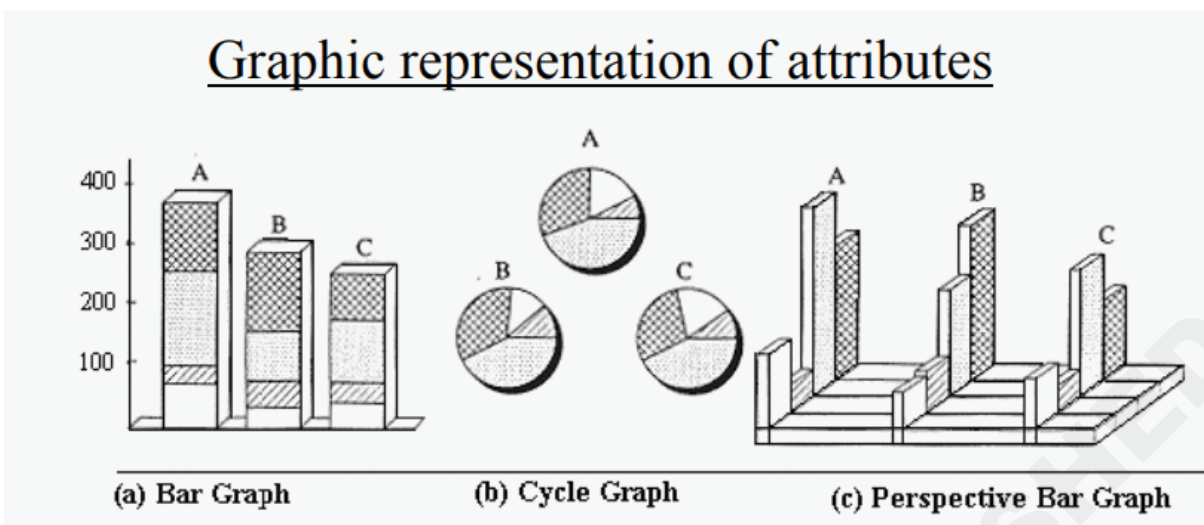
Relying on transformations to project layers in real time is helpful when you are exploring data because everything aligns. However, applying a transformation comes with costs in drawing performance and accuracy. It is a best practice to work with data in the same coordinate system when performing edits or analysis on your data. It is recommended that you use one coordinate system for the map and all the data in it. Use the Project tool to project vector spatial data from one coordinate system to another. If you are working with raster data, use the Project Raster tool.

Attributes (Fig 1)

- Labels affixed to data points, lines, or polygons.
- Used to describe the feature that you want to map.

- Can include text or numeric descriptors: i.e. nominal, ordinal, or interval/ratio data types.
- Must be careful in how the different data types are integrated and used – dangerous to mix and match.

Fig 1



Statistics of Traffic Accidents

| City | Pedestrian | Bicycle | Motorcycle | Car | Total |
|-------|------------|---------|------------|-----|-------|
| A | 65 | 26 | 165 | 115 | 371 |
| B | 32 | 36 | 100 | 126 | 294 |
| C | 48 | 24 | 110 | 74 | 256 |
| Total | 145 | 86 | 375 | 315 | 921 |

Remote Sensing Types & Advantages

Objectives : At the end of this lesson you shall be able to

- explain types and scope
- state advantage and disadvantage of remote sensing
- explain the stages in remote sensing and there components
- explain radiation
- types of radiation and there region.

Principles of Remote Sensing

Definition, History

Remote sensing refers to the science and technology of acquiring information about the earth's surface (i.e., land and ocean) and atmosphere without physical touch using sensors onboard airborne (e.g., aircraft or balloons) or spaceborne (e.g., satellites and space shuttles) platforms.

History of Remote Sensing

The term "remote sensing" is a relatively new term and was first used to describe the field in the 1960s. While the term remote sensing wasn't coined until the mid-twentieth century, remote sensing first began nearly 150 years ago. Aerial photography is the earliest form of remote sensing. This began with the invention of the camera in the 1800s. The first successful photographs were produced in the early 1800s by French inventor Nicéphore Niépce. Soon after the development of photography, people became interested in taking aerial photographs. The

earliest aerial photographs were taken from balloons.

In 1850 Gaspard-Félix Tournachon, more commonly known by his pseudonym Nadar, captured the first aerial photograph. Using a hot air balloon, Nadar produced the first successful aerial photograph of a French village in 1858. Unfortunately none of these early aerial photographs exist today. The oldest aerial photograph that has survived was taken in Boston in 1860 by James Wallace Black. Nadar's earliest surviving aerial image was taken from a balloon above Paris in 1866.

In the early 20th century remote sensing images were captured using kites and even with cameras mounted on pigeons. In Europe carrier pigeons were already being used in military communication and aerial reconnaissance was an appealing application. Small light weight cameras were attached to the birds and photos were automatically taken using a timing mechanism. The pigeon photography was successful but didn't become widely used due to the rapid development of aviation technology. (Fig 1)

Fig 1



Collage of pigeons with Julius Neubronner's cameras and three aerial photos taken by the method. The photos were taken in the early 1900s in Germany.

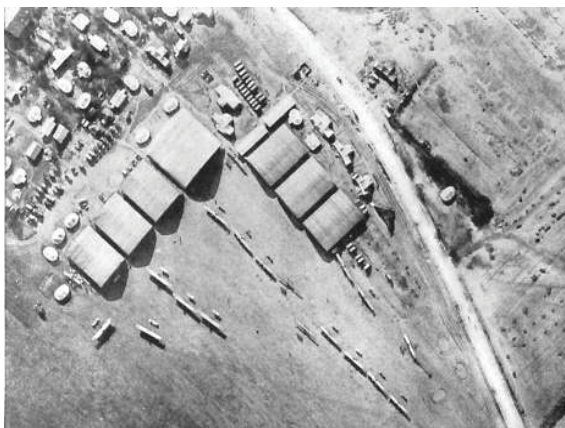
In 1906 professional photographer George Lawrence used a string of kites to raise a 49 pound camera 1000 feet in the air to capture the devastation of the earthquake in San Francisco. The steel kite line carried an electric current to remotely trigger the shutter. The famous photograph "San Francisco in Ruins" was taken 6 weeks after the earthquake and subsequent fires in San Francisco.

The first aerial photographs taken from an airplane were in 1909, by Wilbur Wright. By the 1st World War, cameras mounted on airplanes provided aerial views of large surface areas that proved invaluable in military reconnaissance.

By World War II airplanes were commonly equipped with cameras, in fact allied forces recruited a team of experts to review millions of stereoscopic aerial images to detect hidden Nazi rocket bases. During the Cold War the use of aerial reconnaissance increased with U-2 aircraft flying at ultra-high altitude (70,000 ft) to capture imagery. Aerial photography grew quickly following the war and was soon employed for a variety of purposes. These new photographs provided people a realistic vantage of the world few had seen before. Aerial photography was a much faster and cheaper way to produce maps compared to traditional ground surveys. In the United States aerial

photography was used for farm programs beginning in the Dust Bowl Era of the 1930s with the passing of the Agricultural Adjustment Act. The agency then known as the Agricultural Adjustment Administration (AAA) began its aerial photography program in 1937 and by 1941 the AAA has flown and acquired aerial photographs of more than 90% of the agricultural land in the US. The Agriculture Department's aerial photography program became a tool for conservation and land planning as well as an instrument of fair and accurate measurement. The agricultural agencies have since been consolidated and are now known as Farm Service Agency (FSA). The FSA is still responsible for aerial imagery programs in the US. Aerial photography remained the primary tool for depicting the Earth's surface until the early 1960s. (Fig 2)

Fig 2



Aerial photographer during World War I, and a French air field

The development of satellite based remote sensing began with the "space race" in the 1950s and 1960s. In 1957 the Soviet Union launched Sputnik, the world's first artificial satellite. The United States followed in 1960 with the successful launch of Explorer 1. The next decades brought about rapid developments in satellites and imaging technology. The first successful meteorological satellite (TIROS-1) was launched in 1960. In 1972 Landsat 1, the first earth resource satellite was launched by the US. The original goal of the Landsat program was to collect data from the Earth through remote sensing techniques. Landsat 1 was originally named Earth Resources Technology Satellite 1 and was later renamed Landsat 1. The Landsat program has continued for 45 years with Landsat 8 launched in 2013.

Since the launch of Sputnik in 1957 thousands of satellites have been launched. There are a myriad of commercial and government satellites in operation today, many of which are used for remote sensing applications. There are currently over 3,600 satellite orbiting the Earth, but only approximately 1400 are operational. Of these satellites, well over 100 are earth observing satellites that carry a variety of different sensors to measure and capture data about the Earth. These satellites are often launched by governments to monitor Earth's resources, but private commercial companies are becoming increasingly active in launching earth observing satellites as well.

Types and scope

The two main types of remote sensing classified according to the source of signal they use to explore the object, **active** vs. **passive**. Active remote sensing instruments operate with their own source of emission or light, while passive ones rely on the reflected one.

Passive systems: A passive sensor is a device that detects and responds to some type of input from the physical environment. Passive sensor technologies gather target data through the detection of vibrations, light, radiation, heat or other phenomena occurring in the subject's environment.

Photographic camera, television camera, returns beam vidicon (RBV), electro-optical scanner.

Active systems: An active sensor is a sensing device that requires an external source of power to operate; active sensors contrast with passive sensors, which simply detect and respond to some type of input from the physical environment.

RADAR, microwave, photographic camera with flash light

Scope of remote sensing

Most of the countries in the world have started specializing in remote sensing (RS). In India, the lack of skilled workforce has always been a concern. With the advent of new and advanced technology, the importance of geospatial science is going to amplify. Accelerated growth and development prospects in india would encourage several industries and businesses to use GIS and remote sensing.

Advantages of remote sensing, Disadvantage of remote sensing

Advantages of Remote Sensing

The basic advantages of remote sensing are listed below:

- 1 A relatively cheap and rapid method of acquiring up-to-date information over a large geographical area.
- 2 It is the only practical way to obtain data from inaccessible regions, e.g., Antarctica, Amazonia.
- 3 At small scales, regional phenomena which are invisible from the ground are clearly visible (e.g., beyond man's visibility); for example, faults and other geological structures.

- 4 Cheap and rapid method of constructing base maps in the absence of detailed land surveys.
- 5 Easy to manipulate with the computer and combine with other geographic coverage's in the GIS.

Disadvantages of Remote Sensing

The basic disadvantages of remote sensing are given below:

- 1 They are not direct samples of the phenomenon, so they must be calibrated against reality. This calibration is never exact; a classification error of 10% is excellent.
- 2 They must be corrected geometrically and geo-referenced in order to be useful as maps, not only as pictures.
- 3 Distinct phenomena can be confused if they look the same to the sensor, leading to classification error — for example, artificial and natural grass in green light.
- 4 Phenomena which were not meant to be measured can interfere with the image and must be accounted for.
- 5 Resolution of satellite imagery is too coarse for detailed mapping and for distinguishing small contrasting areas.

Stages in remote sensing data acquisition, Components of a Remote Sensing System

Electromagnetic Radiation (ER) and electromagnetic spectrum, Ultraviolet, Visible Range, Infra-red Region, Thermal Region, Microwave Region

Components of Remote Sensing (Fig 3)

In much of remote sensing, the process involves an interaction between incident radiation and the targets of interest. This is exemplified by the use of imaging systems

where the following seven elements are involved:

Energy Source or Illumination (A): The first requirement for remote sensing is to have an energy source which illuminates or provides electromagnetic energy to the target of interest.

Radiation and the Atmosphere (B): as the energy travels from its source to the Target, it will come in contact with and interact with the atmosphere it passes through. This interaction may take place a second time as the energy travels from the target to the sensor.

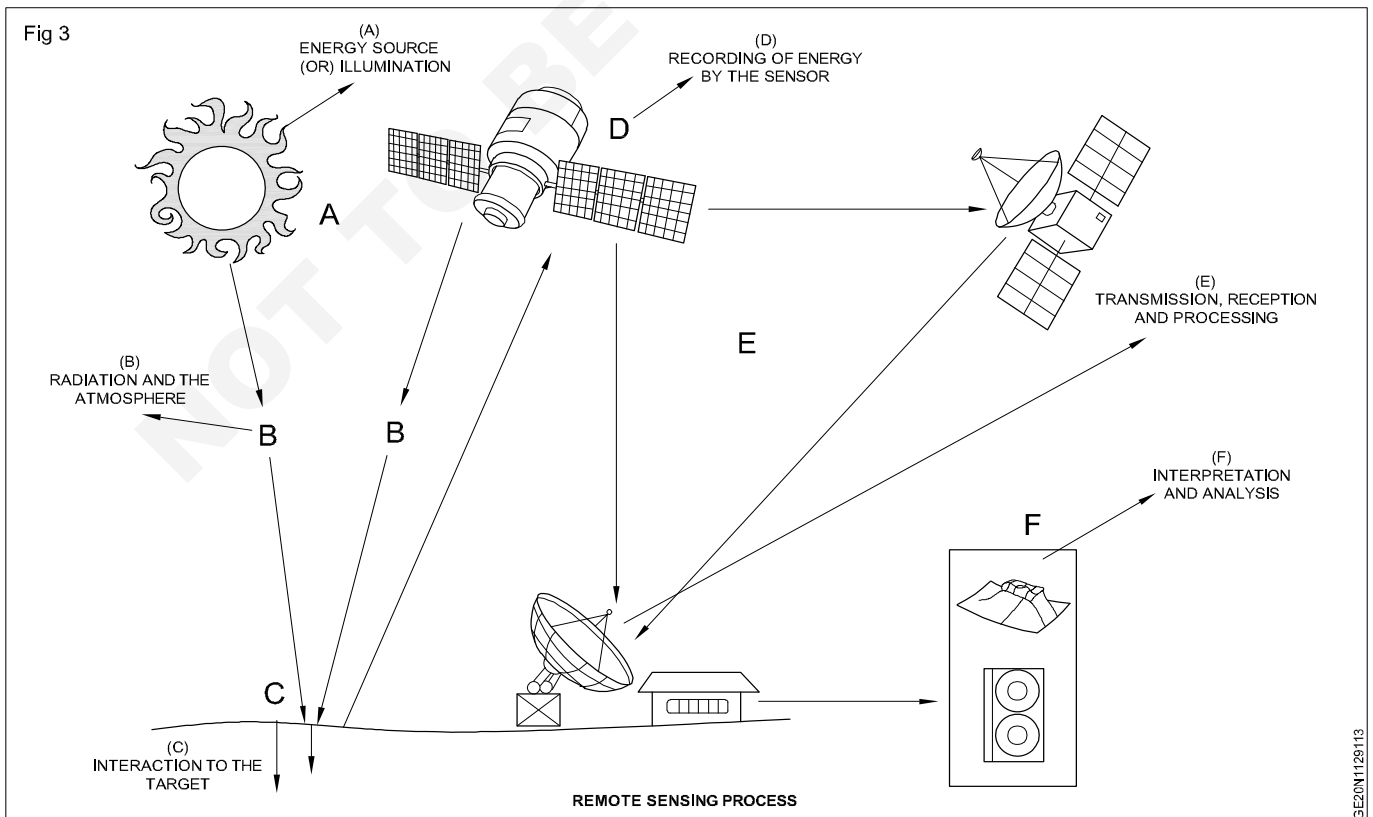
Interaction With the Target (C): once the energy makes its way to the target through the atmosphere, it interacts with the target depending on the properties of both the target and the radiation

Recording of Energy by the Sensor (D): after the energy has been scattered by, or emitted from the target; we require a sensor (remote, not in contact with the target) to collect and record the electromagnetic radiation.

Transmission, Reception, and Processing (E): the energy recorded by the sensor has to be transmitted, often in electronic form, to a receiving and processing station where the data are processed into an image (hardcopy and/or digital).

Interpretation and Analysis (F): the processed image is interpreted, visually and/or digitally or electronically, to extract information about the target which was illuminated.

Application (G): the final element of the remote sensing process is achieved when we apply the information we have been able to extract from the imagery about the target in order to better understand it, reveal some new information, or assist in solving a particular problem.



The remote sense imaging or data acquisition systems have following essential components...

- 1 Energy Source or Illumination (A)
- 2 Radiation and the Atmosphere (B)
- 3 Interaction with the Target (C)
- 4 Recording of Energy by the Sensor (D)
- 5 Transmission, Reception, and Processing (E)
- 6 Interpretation and Analysis (F)

COMPONENTS OF REMOTE SENSING Though the methods for collection, processing, and interpretation of remotely sensed data are very diverse, imaging systems have the following essential components

- 1 **Energy Source or Illumination** The first requirement for remote sensing is to have an energy source, which illuminates or provides electromagnetic energy to the target of interest. Sensors can be classified as passive or active, based on the energy source they are using. Sensors, which sense natural radiations, either emitted or reflected from the Earth, are called passive sensors. Most of the remote sensing sensors are passive in nature, which measure the solar radiation reflected from the target. On the other hand, the sensors which produce their own electromagnetic radiation, are called active sensors (e.g. LIDAR, RADAR).
- 2 **Interaction with the Target** As the energy travels from its source to the target, it will come in contact with and interact with the atmosphere it passes through. This interaction may take place a second time as the energy travels from the target to the sensor. Once the energy makes its way to the target through the atmosphere, it interacts with the target depending on the properties of both the target and the radiation. A number of interactions are possible when Electromagnetic energy encounters matter, whether solid, liquid or gas. Radiation may be transmitted, that is, passed through the substance.
 - Radiation may be absorbed by a substance and give up its energy largely to heating the substance.

Radiation may be emitted by a substance as a function of its structure and temperature. All matter at temperatures above absolute zero, 0°K, emits energy.

Radiation may be scattered, that is, deflected in all directions and lost ultimately to absorption or further scattering (as light is scattered in the atmosphere).

Radiation may be reflected

- 3 **Recording of Energy by the Sensor** After the energy has been scattered by, or emitted from the target, we require a sensor (mounted on a satellite orbiting in space) to collect and record the electromagnetic radiation. The sensors are popularly known by the EMR region they sense. Remote sensing can be broadly classified as optical and microwave. In optical remote sensing, sensors detect solar radiation in the visible,

near-, middle- and thermal-infrared wavelength regions, reflected/scattered or emitted from the earth (Table 1).

On the other hand, when the sensors work in the region of electromagnetic waves with frequencies between 10⁹ and 10¹² Hz, it is called microwave remote sensing. This is highly useful, as it provides observation of the earth's surface, regardless of day/night and the atmospheric conditions. The Radar is an active microwave remote sensing system, which illuminates the terrain with electromagnetic energy, detects the scattered energy returning from the terrain (called radar return) and then records it as an image. Intensity of radar return, for both aircraft and satellite-based systems, depends upon radar system properties and terrain properties.

Table -1

| Region | Wavelength | Property |
|----------------------------|---------------|---|
| Visible (Blue, Red, Green) | 0.4 - 0.7 μm | Reflectance |
| Reflective Infrared | 0.7 - 3.0 μm | Reflectance |
| Thermal Infrared | 3.0 - 15.0 μm | Radiative Temperature |
| Microwave | 0.1 - 30 cm | Brightness Temperature (Passive) Backscattering (Active) |

The sensor, for taking observations, needs to be mounted on a platform. This platform can be ground-based (e.g. handheld radiometers), airborne (e.g. AVIRIS sensor of NASA) or space borne, i.e. satellite based. The operational remote sensing systems are generally space borne.

Resolution is a major sensor parameter, which has bearing on optimum utilization of data. There are four types of resolution.

Spatial Resolution: Sensor's Ability to image (record) closely spaced objects so that they are distinguishable as separate objects
Spectral Resolution: The spectral bandwidth in which the data is collected.

Radiometric Resolution: The capability of the sensor to differentiate the smallest change in the spectral reflectance/emittance between various targets. This is represented as the noise equivalent change in reflectance (NE_T)

Temporal Resolution represents the capability to view the same target, under similar conditions, at regular intervals. It is time interval between imaging collections over the same geographic location

- 4 **Transmission, Reception, and Processing** The energy recorded by the sensor has to be transmitted, often in electronic form, to a receiving and processing station at earth where the data are processed and stored in digital form.

- 5 Interpretation and Analysis The processed data is interpreted, visually and/or digitally to extract information about the target which was illuminated. Specialized instruments/hardware and software are used for this purpose that are commonly known as image processing tools. The final element of the remote sensing process is achieved when we apply the extracted information in solving a particular problem. Specialists working in each application field/theme generally are able to carry out this task. Image processing, also called digital image processing as it handles digital data, involves four basic steps. Those are:
- a Image correction/ restoration - Image data recorded by sensors on a satellite or aircraft contain errors related to geometry and brightness values of the pixels. These errors are corrected using suitable mathematical models, which are either definite or statistical models.
 - b Image enhancement - Image enhancement is the modification of image, by changing the pixel brightness values, to improve its visual impact. Image enhancement techniques are performed by deriving the new brightness value for a pixel either from its existing value or from the brightness values of a set of surrounding pixels.
 - c Image transformation- The multi-spectral character of image data allows it to be spectrally transformed to a new set of image components or bands with a purpose to get some information more evident or to preserve the essential information content of the image (for a given application) with a reduced number of transformed dimensions. The pixel values of the new components are related to the original set of spectral bands via a linear operation.
 - d Image classification - The overall objective of image classification procedures is to automatically categorize all pixels in an image into land cover classes or themes. A pixel is characterized by its spectral signature, which is determined by the relative reflectance in the different wavelength bands. Multi-spectral classification is an information extraction process that analyses these spectral signatures and assigns the pixels to classes based on similar signatures.

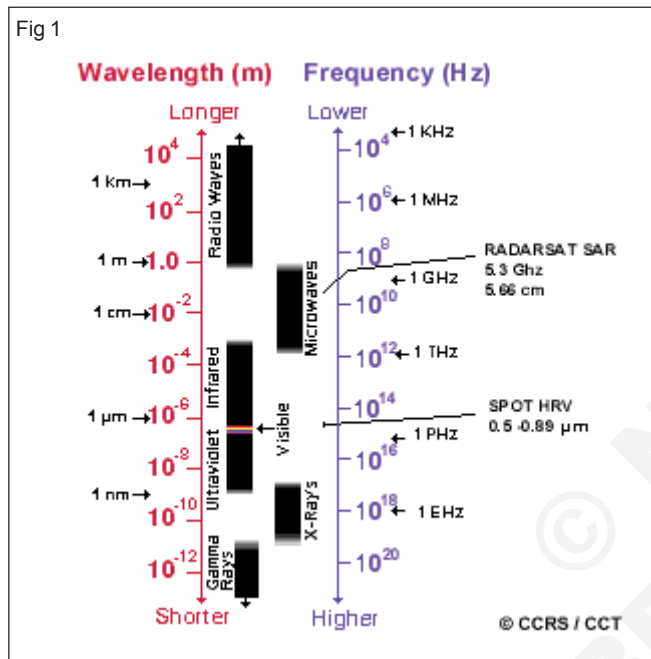
Interaction of Electromagnetic Radiation

Objectives : At the end of this lesson you shall be able to

- explain interaction of EMR spectrum
- explain interaction of EMR with earth's surface features
- state atmospheric windows.

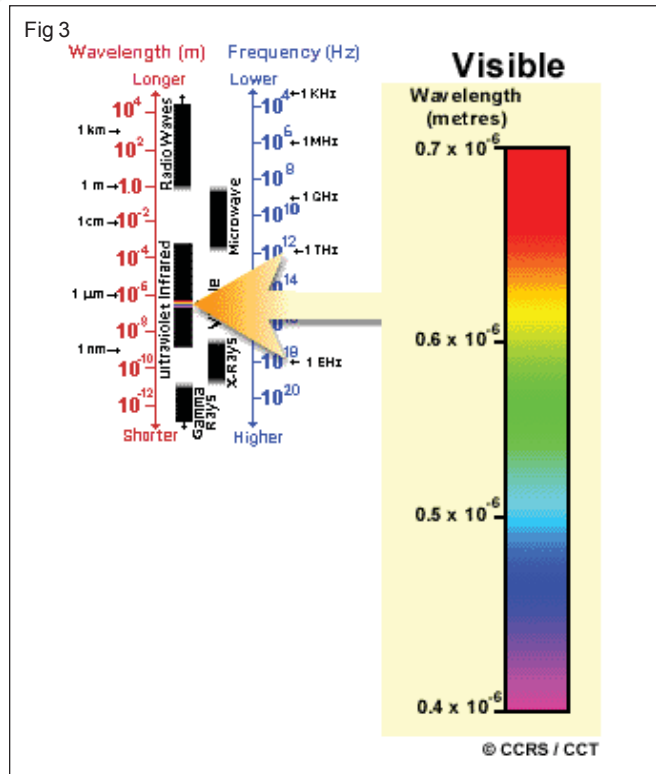
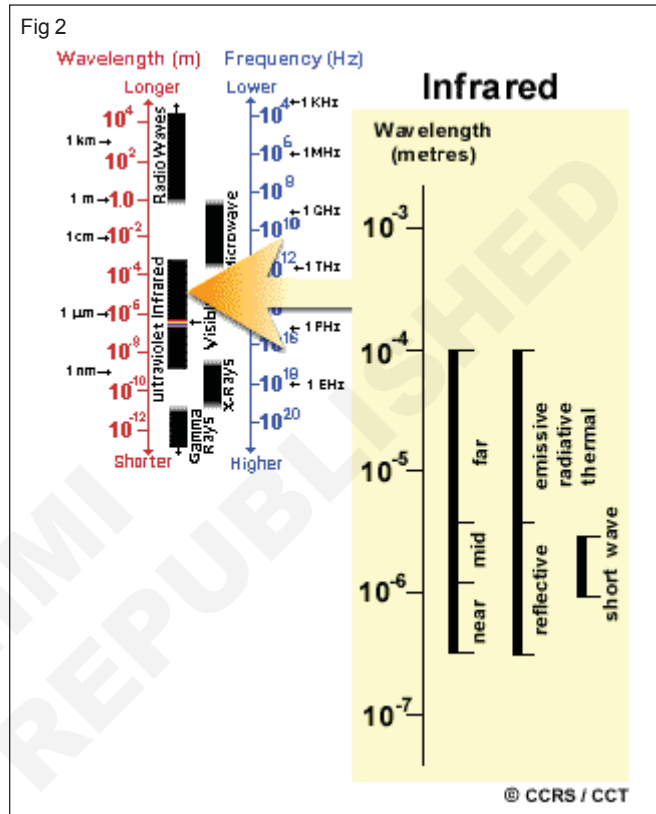
The Electromagnetic Spectrum (Fig 1)

The **electromagnetic spectrum** ranges from the shorter wavelengths (including gamma and x-rays) to the longer wavelengths (including microwaves and broadcast radio waves). There are several regions of the electromagnetic spectrum which are useful for remote sensing.



For most purposes, the **ultraviolet** or **UV** portion of the spectrum has the shortest wavelengths which are practical for remote sensing. This radiation is just beyond the violet portion of the visible wavelengths, hence its name. Some Earth surface materials, primarily rocks and minerals, fluoresce or emit visible light when illuminated by UV radiation.

The light which our eyes - our "remote sensors" - can detect is part of the **visible spectrum**. It is important to recognize how small the visible portion is relative to the rest of the spectrum. There is a lot of radiation around us which is "invisible" to our eyes, but can be detected by other remote sensing instruments and used to our advantage. The visible wavelengths cover a range from approximately 0.4 to 0.7 μ m. The longest visible wavelength is red and the shortest is violet. Common wavelengths of what we perceive as particular colours from the visible portion of the spectrum are listed below. It is important to note that this is the only portion of the spectrum we can associate with the concept of **colours**. (Fig 2 & 3)



Violet: 0.4 - 0.446 μm

Blue: 0.446 - 0.500 μm

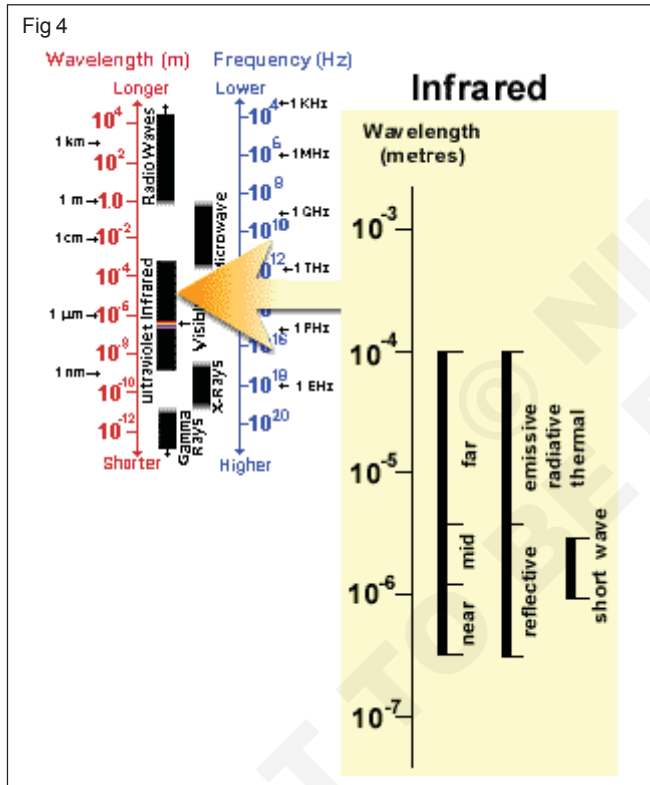
Green: 0.500 - 0.578 μm

Yellow: 0.578 - 0.592 μm

Orange: 0.592 - 0.620 μm

Red: 0.620 - 0.7 μm

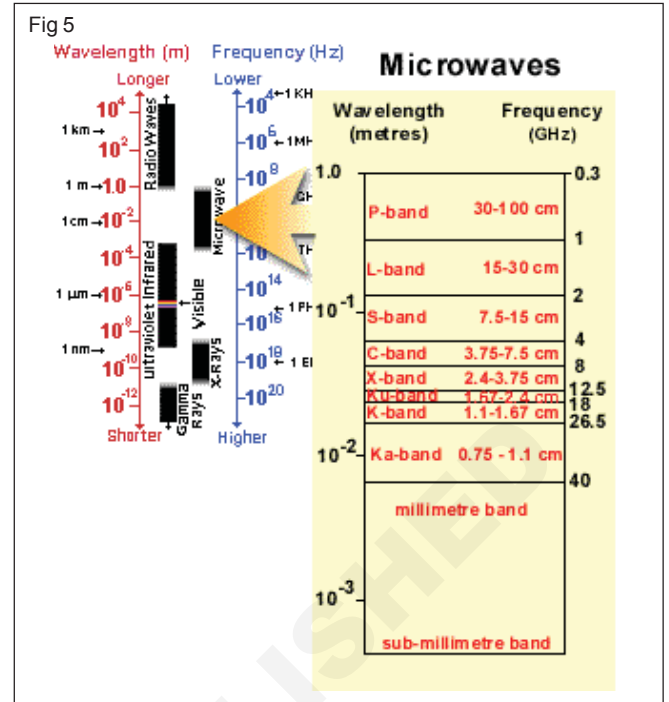
Blue, green, and red are the **primary colours** or wavelengths of the **visible spectrum**. They are defined as such because no single primary colour can be created from the other two, but all other colours can be formed by combining blue, green, and red in various proportions. Although we see sunlight as a uniform or homogeneous colour, it is actually composed of various wavelengths of radiation in primarily the ultraviolet, visible and infrared portions of the spectrum. The visible portion of this radiation can be shown in its component colours when sunlight is passed through a **prism**, which bends the light indiffering amounts according to wavelength. (Fig 4)



The next portion of the spectrum of interest is the infrared (IR) region which covers the wavelength range from approximately 0.7 μm to 100 μm - more than 100 times as wide as the visible portion! The infrared region can be divided into two categories based on their radiation properties - the **reflected IR**, and the emitted or thermal IR. Radiation in the **reflected IR** region is used for remote sensing purposes in ways very similar to radiation in the visible portion. The reflected IR covers wavelengths from approximately 0.7 μm . (Fig 5)

to 3.0 μm . The thermal IR region is quite different than the visible and reflected IR portions, as this energy is essentially the radiation that is emitted from the Earth's

surface in the form of heat. The thermal IR covers wavelengths from approximately 3.0 μm to 100 μm .

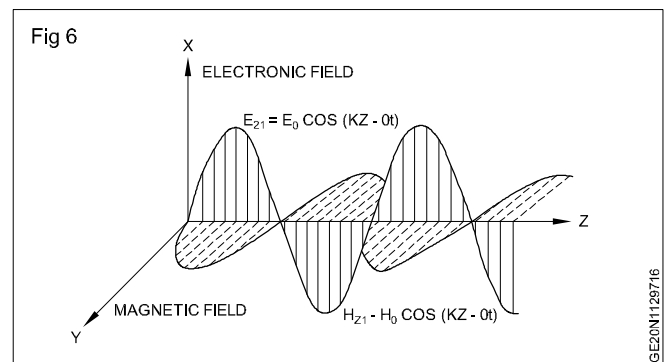


The portion of the spectrum of more recent interest to remote sensing is the **microwave region** from about 1 mm to 1 m. This covers the longest wavelengths used for remote sensing. The shorter wavelengths have properties similar to the thermal infrared region while the longer wavelengths approach the wavelengths used for radio broadcasts.

Electromagnetic Radiation (EMR) and electromagnetic spectrum (EMS)

Electromagnetic radiation is a form of energy with the properties of a wave, and its major source is the sun. Solar energy traveling in the form of waves at the speed of light (denoted as c and equals to $3 \times 10^8 \text{ ms}^{-1}$) is known as the electromagnetic.

Electromagnetic waves may be characterized by two principal measures: wavelength and frequency. The wavelength λ is the distance between successive crests of the waves. The frequency ν is the number of oscillations completed per second. Wavelength and frequency are related by the following equation: $C = \lambda \times \nu$. (Fig 6)



The electromagnetic radiation reaching the earth's surface is partitioned into three types by interacting with features on the earth's surface. Transmission refers to the movement of energy through a surface. The amount of transmitted energy depends on the wavelength and is measured as the ratio of transmitted radiation to the incident radiation, known as transmittance. Remote sensing systems can detect and record both reflected and emitted energy from the earth's surface.

Reflectance is the term used to define the ratio of the amount of electromagnetic radiation reflected from a surface to the amount originally striking the surface. When a surface is smooth, we get specular reflection, where all (or almost all) of the energy is directed away from the surface in a single direction. When the surface is rough and the energy is reflected almost uniformly in all directions, diffuse reflection occurs. Most features of the earth's surface lie somewhere between perfectly specular or perfectly diffuse reflectors. Whether a particular target reflects specularly or diffusely or somewhere in between depends on the surface roughness of the feature in comparison with the wavelength of the incoming radiation. If the wavelengths are much smaller than the surface variations or the particle sizes that make up the surface, diffuse reflection will dominate. Some electromagnetic radiation is absorbed through electron or molecular reactions within the medium. A portion of this energy then is reemitted, as emittance, usually at longer wavelengths, and some of it remains and heats the target.

The electromagnetic spectrum, despite being seen as a continuum of wavelengths and frequencies, is divided into different portions by scientific convention. Major divisions of the electromagnetic spectrum, ranging from short wavelength, high-frequency waves to long-wavelength, low-frequency waves, include gamma rays, x-rays, ultraviolet (UV) radiation, visible light, infrared (IR) radiation, microwave radiation, and radio waves. (Table -1)

The visible spectrum, commonly known as the rainbow of colors we see as visible light (sunlight), is the portion of

the electromagnetic spectrum with wavelengths between 400 and 700 billionths of a meter (0.4–0.7 μm).

Although it is a narrow spectrum, the visible spectrum has a great utility in satellite remote sensing and for the identification of different objects by their visible colors in photography.

The IR spectrum is the region of electromagnetic radiation that extends from the visible region to about 1 mm (in wavelength). Infrared waves can be further partitioned into the near-IR, mid-IR, and far-IR spectrum, which include thermal radiation. IR radiation can be measured by using electronic detectors. IR images obtained by sensors can yield important information on the health of crops and can help in visualizing forest fires even when they are enveloped in an opaque curtain of smoke.

Microwave radiation has a wavelength ranging from approximately 1 mm to 30 cm. Microwaves are emitted from the earth, from objects such as cars and planes, and from the atmosphere. These microwaves can be detected to provide information, such as the temperature of the object that emitted the microwave.

Because their wavelengths are so long, the energy available is quite small compared with visible and IR wavelengths. Therefore, the fields of view must be large enough to detect sufficient energy to record a signal. Most passive microwave sensors thus are characterized by low spatial resolution.

Active microwave sensing systems (e.g., radar) provide their own source of microwave radiation to illuminate the targets on the ground. A major advantage of radar is the ability of the radiation to penetrate through cloud cover and most weather conditions owing to its long wavelength. In addition, because radar is an active sensor, it also can be used to image the ground at any time during the day or night. These two primary advantages of radar, all-weather and day or night imaging, make radar a unique sensing system.

Table -1

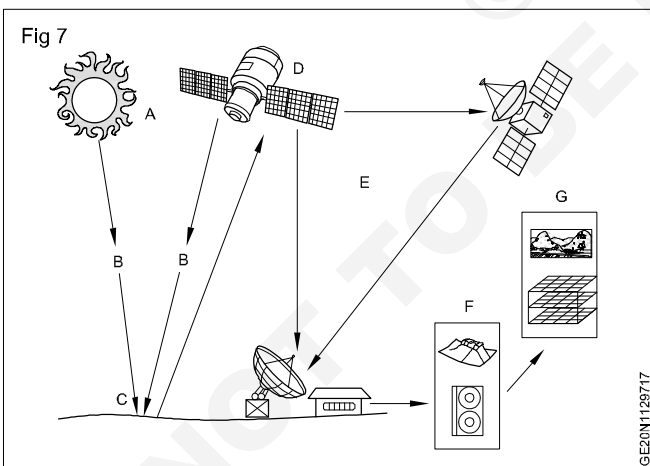
| Region | Wavelength | Remarks |
|----------------------|---------------------------|---|
| Gamma ray | <0.03 nm | Incoming radiation is completely absorbed by the upper atmosphere and is not available for remote sensing |
| X-ray | 0.03 to 3.0 nm | Completely absorbed by atmosphere. Not employed in remote sensing. |
| Ultraviolet | 0.3 to 0.4 μm | Incoming wavelengths less than 0.3 μm are completely absorbed by ozone in the upper atmosphere. |
| Photographic UV band | 0.3 to 0.4 μm | Transmitted through atmosphere. Detectable with film and photodetectors, but atmospheric scattering is severe |
| Visible | 0.4 to 0.7 μm | Imaged with film and photodetectors. Includes reflected energy peak of earth at 0.5 μm . |
| Infrared | 0.7 to 1.00 μm | Interaction with matter varies with wave length. Atmospheric transmission windows are separated. |

| Region | Wavelength | Remarks |
|-------------------|---------------------------|--|
| Reflected IR band | 0.7 to 3.0 μm | Reflected solar radiation that contains information about thermal properties of materials. The band from 0.7 to 0.9 μm is detectable with film and is called the photographic IR band |
| Thermal IR | 3 to 5 μm band | Principal atmospheric windows in the 8 to 14 μm thermal region, Images at these wavelengths are acquired by optical mechanical scanners and special vidicon systems but not by film. Microwave 0.1 to 30 cm longer wavelengths can penetrate clouds, fog, and rain Images may be acquired in the active or passive mode |
| Radar | 0.1 to 30 cm | Active form of microwave remote sensing. Radar images are acquired at various wavelength bands. |
| Radio | >30 cm | Longest wave length portion of electromagnetic spectrum. Some classified radars with very long wavelengths operate in this region. |

Interaction of EMR with atmosphere-Reflection, Refraction, Absorption Scattering

Before radiation used for remote sensing reaches the Earth's surface it has to travel through some distance of the Earth's atmosphere. Particles and gases in the atmosphere can affect the incoming light and radiation. These effects are caused by the mechanisms of **scattering** and **absorption**.

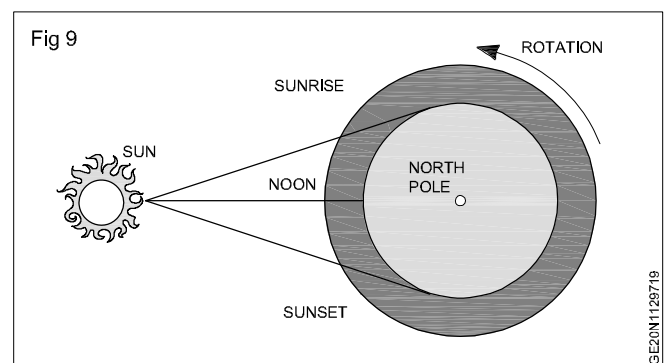
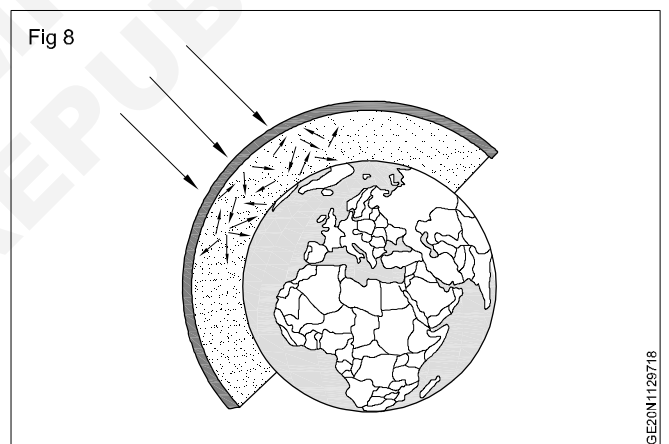
Scattering occurs when particles or large gas molecules present in the atmosphere interact with and cause the electromagnetic radiation to be redirected from its original path. How much scattering takes place depends on several factors including the wavelength of the radiation, the abundance of particles or gases, and the distance the radiation travels through the atmosphere. There are three (3) types of scattering which take place. (Fig 7)



- Rayleigh scattering
- Mie scattering
- Nonselective scattering

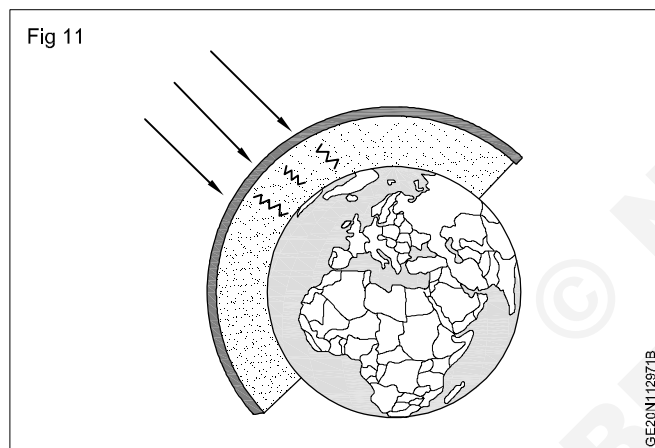
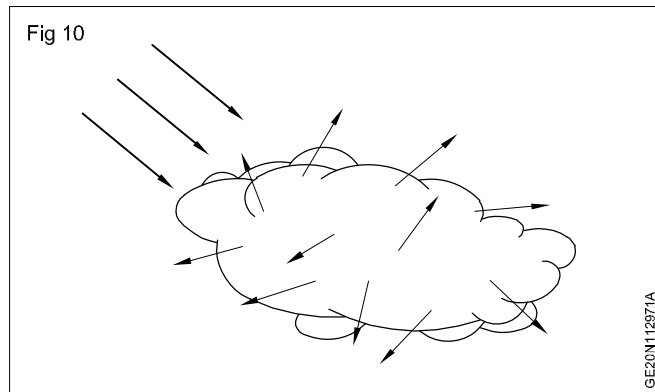
Rayleigh scattering occurs when particles are very small compared to the wavelength of the radiation. These could be particles such as small specks of dust or nitrogen and oxygen molecules. Rayleigh scattering causes shorter wavelengths of energy to be scattered much more than longer wavelengths. Rayleigh scattering is the dominant scattering mechanism in the upper atmosphere. The fact

that the sky appears "blue" during the day is because of this phenomenon. As sunlight passes through the atmosphere, the shorter wavelengths (i.e. blue) of the visible spectrum are scattered more than the other (longer) visible wavelengths. At **sunrise and sunset** the light has to travel farther through the atmosphere than at midday and the scattering of the shorter wavelengths is more complete; this leaves a greater proportion of the longer wavelengths to penetrate the atmosphere. (Fig 8 & 9)



Mie scattering occurs when the particles are just about the same size as the wavelength of the radiation. Dust, pollen, smoke and water vapour are common causes of Mie scattering which tends to affect longer wavelengths than those affected by Rayleigh scattering. Mie scattering occurs mostly in the lower portions of the atmosphere where larger particles are more abundant, and dominates when cloud conditions are overcast.

The final scattering mechanism of importance is called **nonscattering**. This occurs when the particles are much larger than the wavelength of the radiation. Water droplets and large dust particles can cause this type of scattering. Nonscattering gets its name from the fact that all wavelengths are scattered about equally. This type of scattering causes fog and clouds to appear white to our eyes because blue, green, and red light are all scattered in approximately equal quantities (blue+green+red light = white light). (Fig 10 & 11)

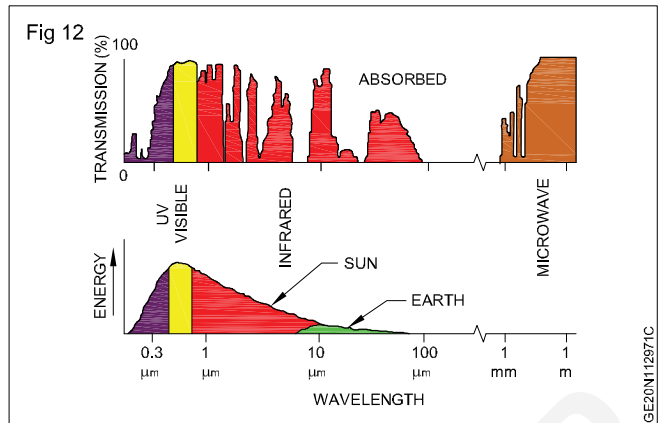


Absorption is the other main mechanism at work when electromagnetic radiation interacts with the atmosphere. In contrast to scattering, this phenomenon causes molecules in the atmosphere to absorb energy at various wavelengths. Ozone, carbon dioxide, and water vapour are the three main atmospheric constituents which absorb radiation.

Ozone serves to absorb the harmful (to most living things) ultraviolet radiation from the sun. Without this protective layer in the atmosphere our skin would burn when exposed to sunlight.

You may have heard **carbon dioxide** referred to as a greenhouse gas. This is because it tends to absorb radiation strongly in the far infrared portion of the spectrum - that area associated with thermal heating - which serves to trap this heat inside the atmosphere. Water vapour in the atmosphere absorbs much of the incoming long wave infrared and shortwave microwave radiation (between 22µm and 1m). The presence of water vapour in the lower atmosphere varies greatly from location to location and at different times of the year. For example, the air mass

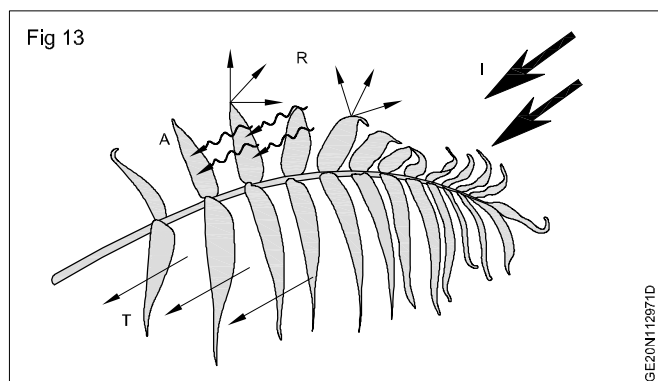
above a desert would have very little water vapour to absorb energy, while the tropics would have high concentrations of water vapour (i.e. high humidity). (Fig 12)



Because these gases absorb electromagnetic energy in very specific regions of the spectrum, they influence where (in the spectrum) we can “look” for remote sensing purposes. Those areas of the spectrum which are not severely influenced by atmospheric absorption and thus, are useful to remote sensors are called **atmospheric windows**. By comparing the characteristics of the two most common energy/radiation sources (the sun and the earth) with the atmospheric windows available to us, we can define those wavelengths that we can use **most effectively** for remote sensing. The visible portion of the spectrum, to which our eyes are most sensitive, corresponds to both an atmospheric window and the peak energy level of the sun. Note also that heat energy emitted by the Earth corresponds to a window around 10 µm in the thermal IR portion of the spectrum, while the large window at wavelengths beyond 1 mm is associated with the microwave region.

Now that we understand how electromagnetic energy makes its journey from its source to the surface (and it is a difficult journey, as you can see) we will next examine what happens to that radiation when it does arrive at the Earth’s surface.

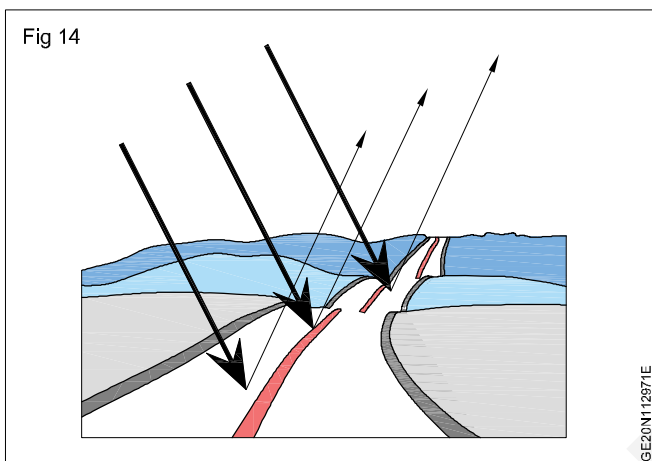
Interaction of EMR with Earth’s surface features: Absorption, Transmission, Reflection (Fig 13)



Radiation that is not absorbed or scattered in the atmosphere can reach and interact with the Earth’s surface. There are three (3) forms of interaction that can take place when energy strikes, or is **incident (I)** upon the surface. These are: **absorption (A)**; **transmission (T)**;

and **reflection (R)**. The total incident energy will interact with the surface in one or more of these three ways. The proportions of each will depend on the wavelength of the energy and the material and condition of the feature.

Absorption (A) occurs when radiation (energy) is absorbed into the target while transmission (T) occurs when radiation passes through a target. Reflection (R) occurs when radiation “bounces” off the target and is redirected. In remote sensing, we are most interested in measuring the radiation reflected from targets. We refer to two types of reflection, which represent the two extreme ends of the way in which energy is reflected from a target: **specular reflection** and **diffuse reflection**.(Fig 14)

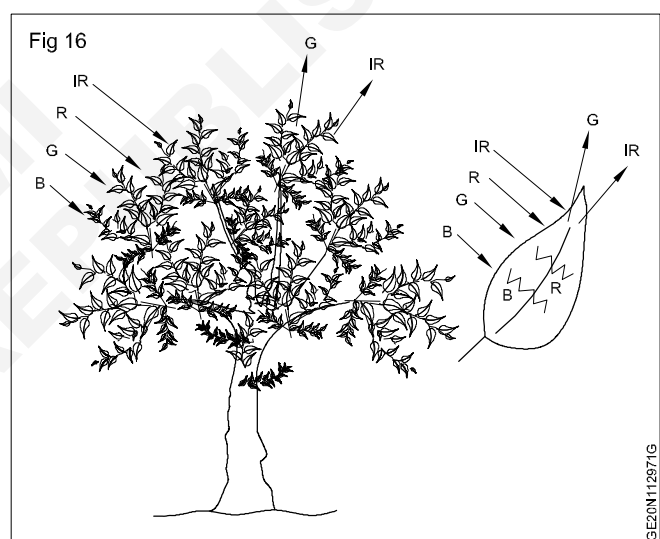
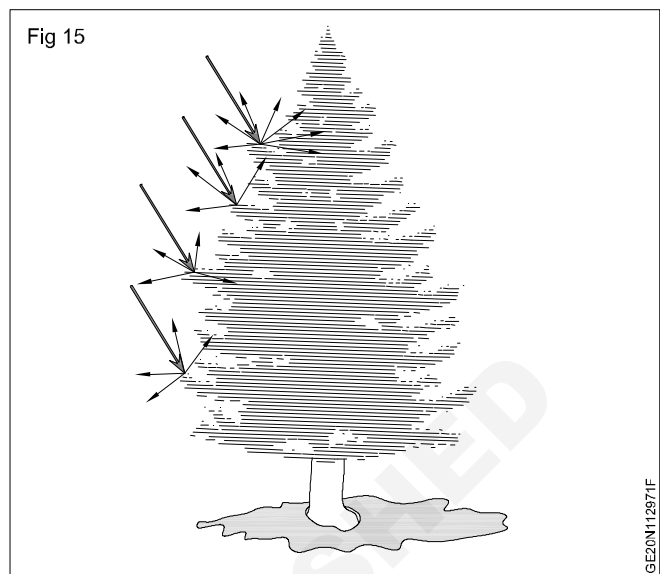


When a surface is smooth we get **specular** or mirror-like reflection where all (or almost all) of the energy is directed away from the surface in a single direction. **Diffuse** reflection occurs when the surface is rough and the energy is reflected almost uniformly in all directions. Most earth surface features lie somewhere between perfectly specular or perfectly diffuse reflectors. Whether a particular target reflects specularly or diffusely, or somewhere in between, depends on the surface roughness of the feature in comparison to the wavelength of the incoming radiation. If the wavelengths are much smaller than the surface variations or the particle sizes that make up the surface, diffuse reflection will dominate. For example, fine-grained sand would appear fairly smooth to long wavelength microwaves but would appear quite rough to the visible wavelengths.

Let’s take a look at a couple of examples of targets at the Earth’s surface and how energy at the visible and infrared wavelengths interacts with them.

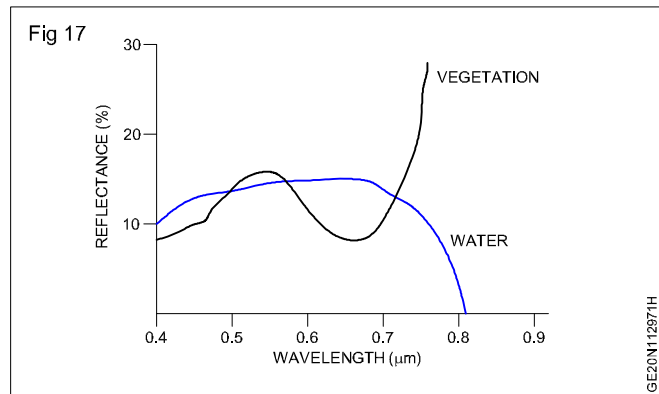
Leaves (Fig 15 & 16) : A chemical compound in leaves called chlorophyll strongly absorbs radiation in the red and blue wavelengths but reflects green wavelengths. Leaves appear “greenest” to us in the summer, when chlorophyll content is at its maximum. In autumn, there is less chlorophyll in the leaves, so there is less absorption and proportionately more reflection of the red wavelengths, making the leaves appear red or yellow (yellow is a combination of red and green wavelengths). The internal structure of healthy leaves act as excellent diffuse reflectors of near-infrared wavelengths. If our eyes were sensitive to near-infrared, trees would appear

extremely bright to us at these wavelengths. In fact, measuring and monitoring the near-IR reflectance is one way that scientists can determine how healthy (or unhealthy) vegetation may be.



Water: Longer wavelength visible and near infrared radiation is absorbed more by water than shorter visible wavelengths. Thus water typically looks blue or blue-green due to stronger reflectance at these shorter wavelengths, and darker if viewed at red or near infrared wavelengths. If there is suspended sediment present in the upper layers of the water body, then this will allow better reflectivity and a brighter appearance of the water. The apparent colour of the water will show a slight shift to longer wavelengths. Suspended sediment (S) can be easily confused with shallow (but clear) water, since these two phenomena appear very similar. Chlorophyll in algae absorbs more of the blue wavelengths and reflects the green, making the water appear more green in colour when algae is present. The topography of the water surface (rough, smooth, floating materials, etc.) can also lead to complications for water-related interpretation due to potential problems of specular reflection and other influences on colour and brightness. (Fig 17)

We can see from these examples that, depending on the complex make-up of the target that is being looked at, and the wavelengths of radiation involved, we can observe very different responses to the mechanisms of absorption, transmission, and reflection. By measuring the energy that is reflected (or emitted) by targets on the Earth's surface over a variety of different wavelengths, we can build up a **spectral response** for that object. By comparing the response patterns of different features we may be able to distinguish between them, where we might not be able to, if we only compared them at one wavelength. For example, water and vegetation may reflect somewhat similarly in the visible wavelengths but are almost always separable in the infrared. Spectral response can be quite variable, even for the same target type, and can also vary with time (e.g. "green-ness" of leaves) and location. Knowing where to "look" spectrally and understanding the factors which influence the spectral response of the features of interest are critical to correctly interpreting the interaction of electromagnetic radiation with the surface.



Atmospheric windows

The places where energy passes through are called "atmospheric windows". or An atmospheric window is a range of wavelengths of the electromagnetic spectrum that can pass through the earth's atmosphere. We use these "windows" in remote sensing to peer into the atmosphere from which we can obtain much information concerning the weather.

Platforms and Satellite Orbit

Objectives : At the end of this lesson you shall be able to

- define platforms
- explain satellite orbits.

Definition platforms, Sensors

Platform is hardware and software architecture that acts as foundation or base upon which other applications, processes, or technologies are developed.

Sensors are devices used for making observations. These consist of mechanisms, usually sophisticated lenses with filter coatings to focus the area observed on a plane in which the detectors are placed. These detectors are sensitive to a particular region in which the sensor is designed to operate and produce outputs which are representative of the observed area.

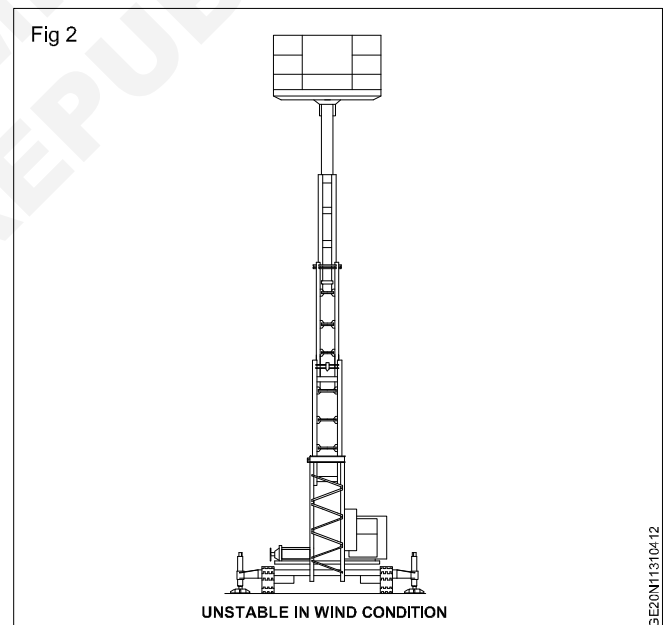
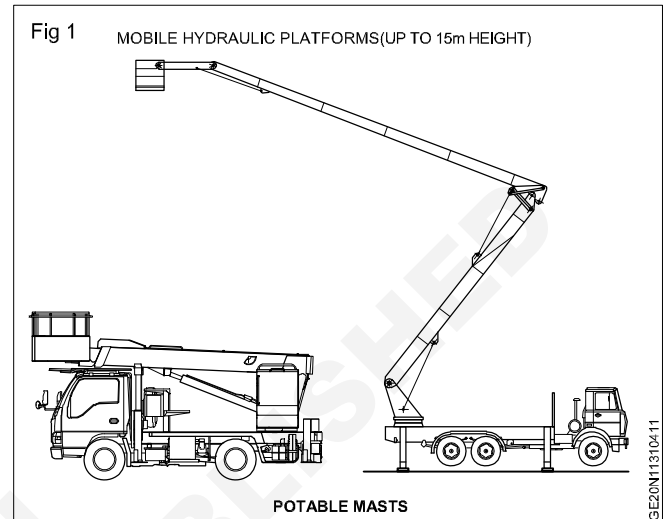
Remote sensing platforms: Ground based, Airborne, Space borne

Remote sensing platforms can be defined as the structures or vehicles on which remote sensing instruments (sensors) are mounted. For remote sensing applications, sensors should be mounted on suitable stable platforms. These platforms can be ground based air borne or space borne based. As the platform height increases the spatial resolution and observational area increases. Thus, higher the sensor is mounted; larger the spatial resolution and synoptic view is obtained. The types or characteristics of platform depend on the type of sensor to be attached and its application. Platforms for remote sensors may be situated on the ground, on an aircraft or balloon (or some other platform within the Earth's atmosphere), or on a spacecraft or satellite outside of the Earth's atmosphere.

Typical platforms are satellites and aircraft, but they can also include radio-controlled aeroplanes, balloons kits for low altitude remote sensing, as well as ladder trucks or 'cherry pickers' for ground investigations.

Types of platforms

- 1 **Ground-borne platforms:** Ground borne platforms are used to record detailed information about the surface which is compared with information collected from aircraft or satellite sensors i.e. for ground observation. Ground observation includes both the laboratory and field study, used for both in designing sensors and identification and characterization of land features. Ground observation platforms include – handheld platform, cherry picker, towers, portable masts and vehicles etc. Portable handheld photographic cameras and spectro-radiometers are largely used in laboratory and field experiments as a reference data and ground truth verification. (Fig 1 & 2)

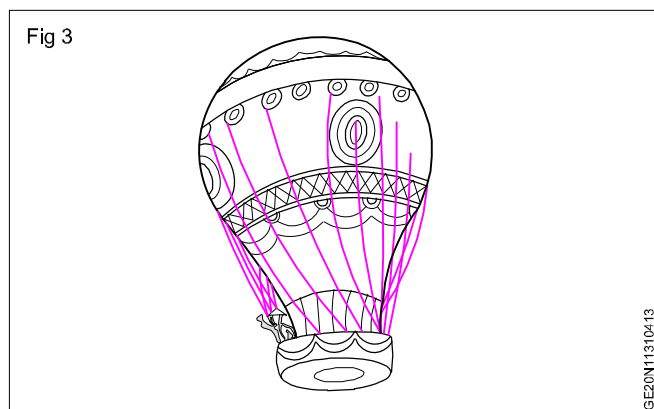


- 2 **Air-borne platforms:** Airborne platforms are used to collect very detailed images and facilitate the collection of data over virtually any portion of the Earth's surface at any time. Airborne platforms were the sole non-ground-based platforms for early remote sensing work.

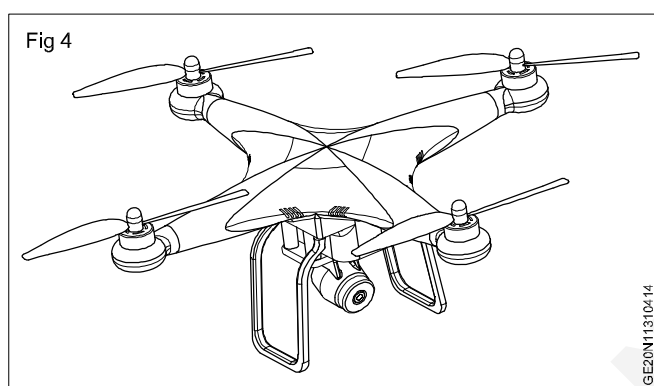
Balloon

Balloons are used for remote sensing observation (aerial photography) and nature conservation studies. The first aerial images were acquired with a camera carried aloft by a balloon in 1859. Balloon floats at a constant height of about 30 km. The balloon is governed by the wind at the floating altitude. Balloons are rarely used today

because they are not very stable and the course of flight is not always predictable, although small balloons carrying expendable probes are still used for some meteorological research. (Fig 3)



Drone (Fig 4)

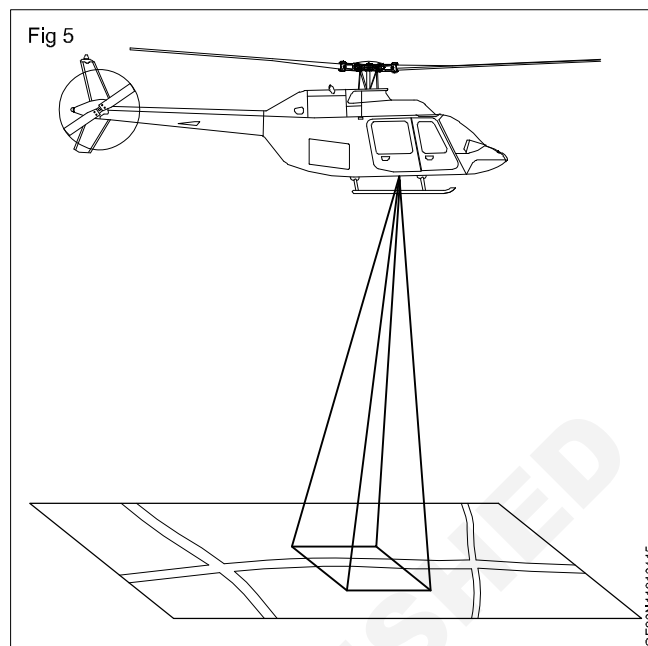


Drone is a miniature remotely piloted aircraft. It is designed to fulfill requirements for a low cost platform, with long endurance, moderate payload capacity and capability to operate without a runway or small runway. Drone includes equipment of photography, infrared detection, radar observation and TV surveillance. It uses satellite communication link. An onboard computer controls the payload and stores data from different sensors and instruments. Drone was developed in Britain during World War-II, is the short sky spy which was originally conceived as a military reconnaissance. Now it plays important role in remote sensing. The unique advantage is that it could be accurately located above the area for which data was required and capable to provide both night and day data.

Aircraft (Fig 5)

Special aircraft with cameras and sensors on vibration less platforms are traditionally used to acquire aerial photographs and images of land surface features. While low altitude aerial photography results in large scale images providing detailed information on the terrain, the high altitude smaller scale images offer advantage to cover a larger study area with low spatial resolution. Beside aerial photography multi spectral, hyperspectral and microwave imaging is also carried out by aircraft. Aircraft platforms offer an economical method of remote sensing data collection for small to large study areas with cameras, electronic imagers, across-track and along-track scanners, and radar and microwave scanners. AVIRIS

hyperspectral imaging is famous aircraft aerial photographic operation of USGS.



High Altitude Sounding Rockets

High altitude sounding rocket platforms are useful in assessing the reliability of the remote sensing techniques as regards their dependence on the distance from the target is concerned. Balloons have a maximum altitude of approximately 37 km, while satellites cannot orbit below 120 km. High altitude sounding rockets can be used to a moderate altitude above terrain. Imageries with moderate synoptic view can be obtained from such rockets for areas of some 500,000 square kilometers per frame. The high altitude sounding rocket is fired from a mobile launcher. During the flight its scanning work is done from a stable altitude, the payload and the spent motor are returned to the ground gently by parachute enabling the recovery of the data. One most important limitations of this system is to ensure that the descending rocket not going to cause damage.

1 Space-borne platforms

In space-borne remote sensing, sensors are mounted on-board a spacecraft (space shuttle or satellite) orbiting the earth. Space-borne or satellite platform are onetime cost effected but relatively lower cost per unit area of coverage, can acquire imagery of entire earth without taking permission. Space borne imaging ranges from altitude 250 km to 36000 km.

Spaceborne remote sensing provides the following advantages:

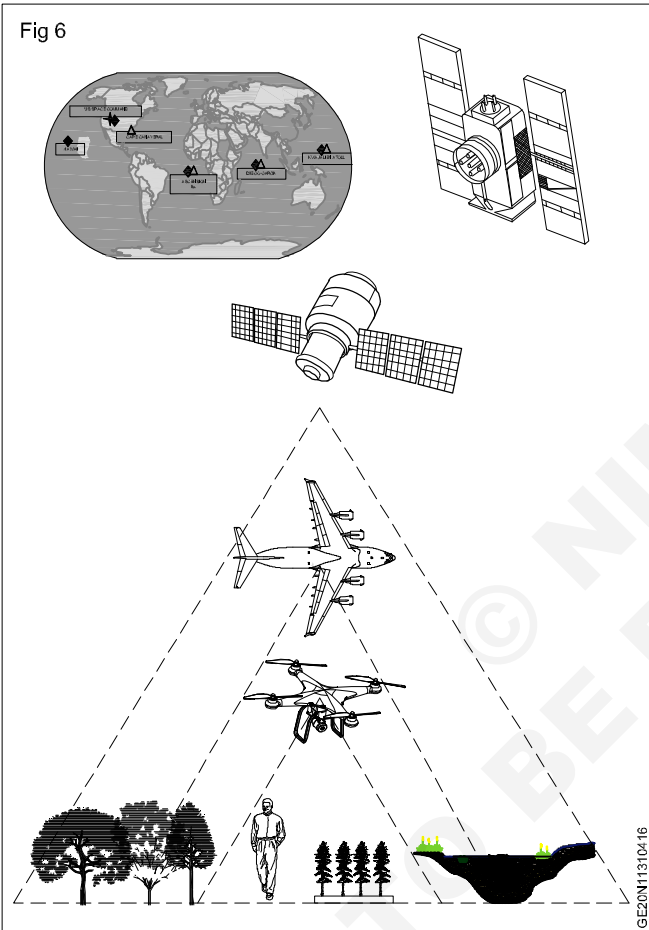
Large area coverage;

- Frequent and repetitive coverage of an area of interest;
- Quantitative measurement of ground features using radio metrically calibrated
- Sensors; Semi-automated computerized processing and analysis;

- Relatively lower cost per unit area of coverage.
- There are two types of well recognized satellite platforms- manned satellite platform and unmanned satellite platform.

Manned Satellite Platforms: Manned satellite platforms are used as the last step, for rigorous testing of the remote sensors on board so that they can be finally incorporated in the unmanned satellites. This multi-level remote sensing concept is already presented. Crew in the manned satellites operates the sensors as per the program schedule.

Unmanned Satellite Platforms (Fig 6)



Landsat series, SPOT series and IRS series of remote sensing satellite, NOAA series of meteorological satellites, the entire constellation of the GPS satellites and the GOES and INSAT series of geostationary environmental, communication, television broadcast, weather and earth observation satellites etc are examples of unmanned satellite category.

Types of satellite orbit: Geostationary Orbit, Near polar Orbit, Sun-synchronous orbit

Satellite: Satellite is any object man made or natural that revolves around the earth.

Orbit: An orbit is the curved path that an object in space (such as a star, planet, moon, asteroid or spacecraft). The satellite path in space is called satellite orbit.

Types of satellite orbit

1 Geo stationary orbit

Satellites in geostationary orbit (GEO) circle Earth above the equator from west to east following Earth’s rotation – taking 23 hours 56 minutes and 4 seconds – by travelling at exactly the same rate as Earth. In order to perfectly match Earth’s rotation, the speed of GEO satellites should be about 3 km per second at an altitude of 35 786 km.

- The satellite placed in this orbit is stationary with respect to the earth
- View the same area of the earth at all times

Geostationary orbit is useful for meteorological observation and also for commercial broadcast and communication purpose. Low resolution and less information is obtained

2 Near polar Orbit

Satellites in polar orbits usually travel past Earth from north to south rather than from west to east, passing roughly over Earth’s poles. Satellites in a polar orbit do not have to pass the North and South Pole precisely; even a deviation within 20 to 30 degrees is still classed as a polar orbit. Polar orbits are a type of low Earth orbit, as they are at low altitudes between 200 to 1000 km.

3. Sun-synchronous orbit

Sun-synchronous orbit is a particular kind of polar orbit. Satellites in SSO, travelling over the polar regions, are synchronous with the Sun. This means they are synchronised to always be in the same ‘fixed’ position relative to the Sun. This means that the satellite always visits the same spot at the same local time.

This means that the satellite will always observe a point on the Earth as if constantly at the same time of the day, which serves a number of applications; for example, it means that scientists and those who use the satellite images can compare how somewhere changes over time.

This is because, if you want to monitor an area by taking a series of images of a certain place across many days, weeks, months, or even years, then it would not be very helpful to compare somewhere at midnight and then at midday – you need to take each picture as similarly as the previous picture as possible. Therefore, scientists use image series like these to investigate how weather patterns emerge, to help predict weather or storms; when monitoring emergencies like forest fires or flooding; or to accumulate data on long-term problems like deforestation or rising sea levels.

Satellite Sensors

Objectives : At the end of this lesson you shall be able to

- explain different types of sensors
- explain different remote sensing data products
- state different earth observation satellites.

Sensors: Imaging Sensors, Non imaging sensors, Active, passive MSS(Multi Spectral Scanner) TM (Thematic Mapper), ETM+ (Enhanced Thematic Mapper+), LISS (Linear Imaging Self Scanning), PAN (Panchromatic), HRV (High Resolution Visible), SAR (Synthetic Aperture Radar), WiFS(Wide Field Sensor) AWiFS (Advanced Wide Field Sensor) AVHRR (Advanced Very High Resolution Radiometer), OLI (Operational Land Imager)

Sensors: Imaging sensors and non-imaging sensors

Another distinction is between imaging and non-imaging sensors. A non-imaging sensor measures the radiation received from all points in the sensed target, integrates this and registers a single response value, hence no image can be made from the data. This may be considered a type of “point” data as only a single value is obtained for a single observation point. A hand-held doppler radar used by police forces to measure the speed of a vehicle is an example of an active, non-imaging sensor: it emits pulses of radiation (i.e. provides an energy source) and the readout is simply the speed of the vehicle (i.e. there is no image).

Imaging sensors measure radiation at different points on the target and this information can be processed in order to obtain an image. This is necessary when spatial information about the target is needed, in the form of a map.

Active and passive sensors

Fundamentally, there are two types of sensor depending on the source of energy. Active sensors provide their own energy source for illumination. This means that measurements can be obtained at any time, regardless of the time of day or season. Such sensors may also allow examination of wavelengths that are not sufficiently provided by the sun (microwaves) and also provide better control of the way that a target is illuminated.

Passive sensors, by contrast, measure energy that is naturally available. They therefore are constrained by a requirement for sunlight or radiation emission from ground objects and offer limited control over the way that a target is illuminated.

MSS (Multi Spectral Scanner)

MSS sensors were line scanning devices observing the Earth perpendicular to the orbital track. The cross-track scanning was accomplished by an oscillating mirror; six lines were scanned simultaneously in each of the four

spectral bands for each mirror sweep. The forward motion of the satellite provided the along-track scan line progression.

The first five Landsats carried the MSS sensor which responded to Earth-reflected sunlight in four spectral bands. Landsat 3 carried an MSS sensor with an additional band, designated band 8, that responded to thermal (heat) infrared radiation.

An MSS scene had an Instantaneous Field Of View (IFOV) of 68 meters in the cross-track direction by 83 meters in the along-track direction (223.0 by 272.3 feet respectively).

The Multi Spectral Scanner (MSS) instrument was carried aboard the Landsat-1 to 5 missions between 1972 and 2013. Global MSS acquisitions ended in 1999, even though Landsat-4 and 5 were still active.

TM (Thematic Mapper)

TM sensor was carried onboard Landsats 4 and 5 from July 1982 to May 2012 with a 16-day repeat cycle, referenced to the Worldwide Reference System-2. Very few images were acquired from November 2011 to May 2012. The satellite began decommissioning activities in January 2013.

Landsat 4-5 TM image data files consist of seven spectral bands (See band designations). The resolution is 30 meters for bands 1 to 7. (Thermal infrared band 6 was collected at 120 meters, but was resampled to 30 meters.) The approximate scene size is 170 km north-south by 183 km east-west (106 mi by 114 mi).

ETM+ (Enhanced Thematic Mapper+)

The Enhanced Thematic Mapper Plus (ETM+) instrument is a fixed “whisk-broom”, eight-band, multispectral scanning radiometer capable of providing high-resolution imaging information of the Earth’s surface. It detects spectrally-filtered radiation in VNIR, SWIR, LWIR and panchromatic bands from the sun-lit Earth in a 183 km wide swath when orbiting at an altitude of 705 km.

The primary new features on Landsat 7 are a panchromatic band with 15 m spatial resolution, an on-board full aperture solar calibrator, 5% absolute radiometric calibration and a thermal IR channel with a four-fold improvement in spatial resolution over TM.

Landsat 7 collects data in accordance with the World Wide Reference System 2, which has catalogued the world’s land mass into 57,784 scenes, each 183 km wide by 170 km long. The ETM+ produces approximately 3.8

gigabits of data for each scene. An ETM+ scene has an Instantaneous Field Of View (IFOV) of 30 meters x 30 meters in bands 1-5 and 7 while band 6 has an IFOV of 60 meters x 60 meters on the ground and the band 8 an IFOV of 15 meters. Please visit the L7 Science Data Users Handbook for a detailed description of ETM+ spatial characteristics.

The Enhanced Thematic Mapper Plus (ETM+) is the main instrument on board Landsat-7 and has been operational since 1999.

LISS (Linear Imaging Self Scanning)

This is an Indian remote sensing sensor. This sensor is configured to provide imageries in three visible bands as well as in shortwave infrared band. The resolution and swath for visible bands are 23.5 m and 142 km, respectively. The detector is a 6000 element CCD based linear array with a pixel dimension of 10 μ m by 7 μ m. The detector is placed at the focus of a refractive type optical system consisting of eight lens elements, which provides a focal length of 360 mm. The processing of the analogue output video signal is similar to that of PAN. For this camera, a 7-bit digitization is used which gives an intensity variation of 128 levels.

PAN (Panchromatic)

The PAN sensor is configured to provide the imageries of the Earth in visible spectrum, in a panchromatic band (0.5-0.75 μ m) with a geometric resolution of greater than 10 m and a swath of 70 km. The camera uses an off-axis reflective type optics system consisting of three mirrors for providing the required focal length. A 7 μ m pixel sized CCD is being used as the detector element. Using three linear array charge-coupled detectors covers the total swath of 70 km and each of these detectors covers a swath of about the central detector is offset from the other two detectors by a distance in focal plane that corresponds to 8.6 km on the ground. The other two detectors cover swath of 24 km each adjacent to the central CCD. These two detectors are aligned with an accuracy of 30 arc sec⁻¹. The overlap of the central swath with the side swaths is 600 m on the ground. Each of the detectors provides four analogue outputs, which are independently processed by video chains, converted to digital and providing a data handling system for formatting. For a PAN data compatible with the expected signal to noise ratio, a 6-bit digitization is used which gives 64 radiometric gray levels. Characteristics of PAN camera Geometric resolution from altitude of 817 km 5.8 m Effective focal length for optics 980 mm Swath 70 km Field-of-view for optics $\pm 2.5^\circ$ (across track) $\pm 0.3^\circ$ (along track) Spectral band 0.5-0.75 μ m.

HRV (High Resolution Visible)

This is a French remote sensing sensor. Each SPOT 1 and SPOT 2 satellite carries two HRV sensors, constructed with multi-linear array detectors, operating in a cross-track direction. The SPOT 4 satellite carries two HRVIR detectors. The HRVIR is similar to the HRV, except that HRVIR has an additional short wave infrared (SWIR) band, and the wavelength bandwidth of the

panchromatic mode for HRVIR is narrower than that for HRV. The position of each HRV or HRVIR entrance mirror can be commanded by ground control to observe a region of interest not necessarily vertically beneath the satellite. Thus, each HRV or HRVIR offers an oblique viewing capability, the viewing angle being adjustable through $\pm 27^\circ$ relative to the vertical. This off-nadir viewing enables the acquisition of stereoscopic imagery and provides a short revisit interval of 1 to 3 days.

SAR (Synthetic Aperture Radar)

SAR is a type of active data collection where a sensor produces its own energy and then records the amount of that energy reflected back after interacting with Earth. While optical imagery is similar to interpreting a photograph, SAR imagery requires a different way of thinking in that the signal is based on surface characteristics like structure and moisture.

The spatial resolution of radar data is directly related to the ratio of the sensor wavelength to the length of the sensor's antenna. For a given wavelength, the longer the antenna, the higher the spatial resolution, from a satellite in space operating at a wavelength of about 5 cm (C-band radar), in order to get a spatial resolution of 10 m, you would need a radar antenna about 4,250 m long. (That's over 47 football fields).

Synthetic aperture radar, or SAR, which uses the microwave region of the electromagnetic spectrum, is ideal in that it can penetrate cloud cover and "see through" darkness and weather, allowing a unique view of flood inundation, land cover changes, and modifications of the Earth's surface from landslides, earthquakes, and background tectonic motion.

WiFS (Wide Field Sensor)

This sensor operates in two bands B3: 0.62 μ m to 0.68 μ m (Red) and B4: 0.77 μ m to 0.86 μ m (NIR). Each band uses a 2048 element CCD with an element size of 13 μ m by 13 μ m. A wide-angle refractive optics system with 8-lens elements is used with a focal length of about 56 mm. This payload required to cover a ground swath of 770 km with a resolution of 188 m. This ground swath with the selected 817 km orbit can provide the required repetivity for the intended application. To cover the 770 km, two separate band assemblies are used for each band. Thus the entire swath in each band is covered by two detectors. Each of the detectors covers half of the swath. The signal processing chain is similar to LISS-3 wherein the analogue video signal is converted to 7 bits and given to data handling system for formatting. The spectral resolution is in band-3 0.62-0.68 μ m, in band-4 0.77-0.86 μ m, the resolution is 188.3 m, Swath is 810 km. Radiometric resolution 7 bits Band-to-band registration ± 0.25 pixel.

AWiFS (Advanced Wide Field Sensor)

RESOURCESAT-2A carries the Advanced Wide Field Sensor (AWiFS). Advanced Wide Field Sensor (AWiFS) camera operating in three spectral bands in VNIR and one band in SWIR with 56 m spatial resolution. There was improved radiometric accuracy from 10 bits to 12

bits for AWIFS. Spectral bands (μm) is B2: 0.52-0.59, (green), B3: 0.62-0.68, (red), B4: 0.77-0.86, (NIR) and B5: 1.55-1.70 (SWIR), Swath width is 740 km and Data quantization is 10 bit.

AVHRR (Advanced Very High Resolution Radiometer)

Advanced Very High Resolution Radiometer (AVHRR) sensor is carried on the Polar Orbiting Environmental Satellites (POES), a constellation of polar orbiting satellites.

The Advanced Very High Resolution Radiometer (AVHRR) is a cross-track scanning system with five spectral bands having a resolution of 1.1 km and a frequency of earth scans twice per day (0230 and 1430 local solar time). There are three data types produced from the POES AVHRR. The Global Area Coverage (GAC) data set is reduced resolution image data that is processed onboard the satellite taking only one line out of every three and averaging every four of five adjacent samples along the scan line; the Local Area Coverage (LAC) data set is recorded onboard at original resolution (1.1 km) for part of an orbit and later transmitted to earth.

The objective of the AVHRR instrument is to provide radiance data for investigation of clouds, land-water boundaries, snow and ice extent, ice or snow melt inception, day and night cloud distribution, temperatures of radiating surfaces, sea surface temperature and vegetation classification and greenness, through passively measured visible, near infrared and thermal infrared spectral radiation bands.

The AVHRR provides a global (pole-to-pole) on-board collection of data from 4 to 5 spectral channels. At an 833 km altitude, the 110.8 degree scan equates to a swath 27.2 degrees in width (at the Equator), or 2,600 km, centered on the sub-satellite track. This swath width is greater than the 25.3 degree separation between successive orbital tracks, providing overlapping coverage (side-lap).

OLI (Operational Land Imager)

The Operational Land Imager (OLI), built by the Ball Aerospace & Technologies Corporation, measures in the visible, near infrared, and short wave infrared portions of the spectrum. Its images have 15-meter (49 ft.) panchromatic and 30-meter multi-spectral spatial resolutions along a 185 km (115 miles) wide swath, covering wide areas of the Earth's landscape while providing sufficient resolution to distinguish features like urban centers, farms, forests and other land uses. The entire Earth will fall within view once every 16 days due to Landsat 8's near-polar orbit.

OLI provides two new spectral bands in respect to the Landsat-7 ETM+ instrument, one tailored especially for detecting cirrus clouds (band 9, new Near Infra-Red (NIR) band) and the other for coastal zone observations (band 1, new deep blue visible channel). It measures in the visible, NIR, and Shortwave Infra-Red (SWIR) portions of the electromagnetic spectrum and offers 15 m

panchromatic, and 30 m multi-spectral (VIS/NIR/SWIR) spatial resolution. The scene size is 185x180 km.

Remote sensing data products: Hard Copy Maps, Natural Colour Composite (NCC), False Colour Composite (FCC)

An analog map is any tangible map production that has a continuous appearance and may be viewed directly (generally called a hard copy map). Traditional drawn or printed productions (ordinarily referred to as maps) fall into this classification, along with map like aerial photographic productions or the end output of some other kind of remote sensing, also maps generated employing tools controlled by computers, block diagrams and related drawings, and relief models and globes built to portray some part or all of the surface of the earth. A hard copy system or image output system is used to produce an analog image on paper or a film from digital image data. Depending on the system, the recording media, resolution, gray level, output size, output rate, cost and stability, are different as compared.

Natural Colour Composite (NCC)

A natural or true color composite is an image displaying a combination of visible red, green and blue bands to the corresponding red, green and blue channels on the computer.

The resulting composite resembles what would be observed naturally by the human eye, vegetation appears green, water dark is blue to black and bare ground and impervious surfaces appear light grey and brown. Natural color images can be low in contrast and somewhat hazy due the scattering of blue light by the atmosphere.

False Colour Composite (FCC)

In FCC the feature colours are not in true by natural. False color images are a representation of a multi-spectral image produced using bands other than visible red, green and blue as the red, green and blue components of an image display. False color composites allow us to visualize wavelengths that the human eye cannot see (i.e. near-infrared). Using bands such as near infra-red increases the spectral separation and often increases the interpretability of the data. There are many different false colored composites which can highlight many different features.

Earth Observation Satellites- IRS, LANDSAT, SPOT, IKONOS, Quick Bird Types & characteristics of sensors on satellites, resolution, swath etc.

Earth observation satellites or Earth remote sensing satellites are satellites used or designed for observe the planet Earth from space for several purposes. Earth observation satellites from orbit, including spy satellites and similar ones intended for environmental monitoring, meteorology, cartography, and others. Earth Observation (EO) satellites help us to monitor and protect our environment, manage our resources, respond to global humanitarian disasters and enable sustainable development. They provide essential information on a vast

number of areas, including; ocean salinity, ice thickness, crop health, air quality and so on.

IRS

India's remote sensing program was developed with the idea of applying space technologies for the benefit of humankind and the development of the country. The program involved the development of three principal capabilities. The first was to design, build and launch satellites to a sun synchronous orbit. The second was to

establish and operate ground stations for spacecraft control, data transfer along with data processing and archival. The third was to use the data obtained for various applications on the ground.

India's remote sensing programme under the Indian Space Research Organization (ISRO) started off in 1988 with the IRS-1A, the first of the series of indigenous state-of-art operating remote sensing satellites, which was successfully launched into a polar sun-synchronous orbit on March 17, 1988.

Table -1

| Serial No. | Satellite | Date of Launch | Launch Vehicle | Status |
|------------|---------------------------------------|----------------|-----------------|--|
| 1 | IRS-1A | 17 Mar 1988 | Vostok, USSR | Mission Completed |
| 2 | IRS-1B | 29 Aug 1991 | Vostok, USSR | Mission Completed |
| 3 | IRS-P1 | 20 Sep 1993 | PSLV-D1 | Crashed, due to launch failure of PSLV |
| 4 | IRS-P2 | 15 Oct 1994 | PSLV-D2 | Mission Completed |
| 5 | IRS-1C | 28 Dec 1995 | Molniya, Russia | Mission Completed |
| 6 | IRS-P3 | 21 Mar 1996 | PSLV-D3 | Mission Completed |
| 7 | IRS 1D | 29 Sep 1997 | PSLV-C1 | Mission Completed |
| 8 | IRS-P4 (Oceansat-1) | 27 May 1999 | PSLV-C2 | Mission Completed |
| 9 | Technology Experiment Satellite (TES) | 22 Oct 2001 | PSLV-C3 | Mission Completed |
| 10 | IRS P6 (Resourcesat-1) | 17 Oct 2003 | PSLV-C5 | Mission Completed |
| 11 | IRS P5 (Cartosat 1) | 5 May 2005 | PSLV-C6 | Mission Completed |
| 12 | IRS P7 (Cartosat 2) | 10 Jan 2007 | PSLV-C7 | Mission Completed |
| 13 | Cartosat 2A | 28 Apr 2008 | PSLV-C9 | In Service |
| 14 | IMS 1 | 28 Apr 2008 | PSLV-C9 | Mission Completed |
| 15 | RISAT-2 | 20 Apr 2009 | PSLV-C12 | In Service |
| 16 | Oceansat-2 | 23 Sep 2009 | PSLV-C14 | In Service |
| 17 | Cartosat-2B | 12 July 2010 | PSLV-C15 | In Service |
| 18 | Resourcesat-2 | 20 Apr 2011 | PSLV-C16 | In Service |
| 19 | Megha-Tropiques | 12 Oct 2011 | PSLV-C18 | Mission Completed |
| 20 | RISAT-1 | 26 Apr 2012 | PSLV-C19 | Mission Completed |
| 21 | SARAL | 25 Feb 2013 | PSLV-C20 | In Service |
| 22 | Cartosat-2C | 22 June 2016 | PSLV-C34 | In Service |
| 23 | ScatSat-1 | 26 Sep 2016 | PSLV-C35 | In Service |

| Serial No. | Satellite | Date of Launch | Launch Vehicle | Status |
|------------|--------------------|----------------|----------------|--|
| 24 | RESOURCE-SAT-2A | 07 Dec 2016 | PSLV-C36 | In Service |
| 25 | Cartosat-2D | 15 Feb 2017 | PSLV-C37 | In Service |
| 26 | Cartosat-2E | 23 June 2017 | PSLV-C38 | In Service |
| 27 | Cartosat-2F | 12 Jan 2018 | PSLV-C40 | In Service |
| 28 | RISAT-2B | 22 May 2019 | PSLV-C46 | In Service |
| 29 | Cartosat-3 | 27 Nov 2019 | PSLV-C47 | In Service |
| 30 | RISAT-2BR1 | 11 Dec 2019 | PSLV-C48 | In Service |
| 31 | EOS-1 (RISAT-2BR2) | 07 Nov 2020 | PSLV-C49 | In Service |
| 32 | EOS-3 (GISAT-1) | 12 Aug 2021 | GSLV-F10 | Crashed, due to launch failure of GSLV |
| 33 | EOS-4 (RISAT-1A) | 14 Feb 2022 | PSLV-C52 | In Service |

Panchromatic Camera (PAN) (Table - 2)

Data in the panchromatic region is useful in geological studies for mapping geological and geomorphological features.

The higher spatial resolution is useful for urban planning studies and detecting urban fringe growth.

PAN Instrument Specifications - Table - 2

| | |
|------------------------------|--|
| Spectral range | 0.5 - 0.75 μm |
| Spatial resolution | = 10 m (5.6 m at nadir) |
| Swath width | 70 km nadir view(91 km swath for the most inclined cross-track view) |
| Off-nadir viewing capability | $\pm 26^\circ$ swath steering range(with this a revisit cycle of 5 days is achieved) |
| Repetition cycle | 24 days |
| Data quantization | 6 bit |

Linear Imaging Self-Scanning Sensor-III (LISS-III)

Continuous service of multispectral imagery. Application: Land and water resources management.

The pushbroom camera uses refractive optics in four spectral bands (separate optics and detector array for each band). (Table 3, 4)

LISS-III Instrument Specifications (Table - 3)

| | |
|-------------------------------|---|
| Spectral bands (4) | B2: 0.52 - 0.59 μm (Green) B3: 0.62 - 0.68 μm (Red) B4: 0.77 - 0.86 μm (NIR) B5: 1.55 - 1.75 μm (SWIR) |
| Spatial resolution | 23.5 m (VNIR) and 70.5 m (SWIR) |
| Swath width | 142 km (VNIR) and 148 km (SWIR), FOV= $\pm 5^\circ$ |
| Repetition cycle | 24 days |
| Focal length of optics system | 346 mm for each VNIR band, 300 mm for SWIR band |
| Data quantization | 7 bit (resolution of 128 grey levels) |
| Integration time | 3.55 ms for VNIR, 10.65 ms for SWIR |

Specifications of LISS-IV (Table - 4)

| | |
|--------------------|--|
| Spatial resolution | 5.8m |
| Spectral Bands | B2 0.52-0.59 B3 0.62-0.68 B4 0.77-0.86 |
| Swath | 23.9 km (Mx) 70 km (Mono) |
| Quantization | 10 Bits |
| Revisit | 24 days |

Wide Field Sensor (WiFS) (Table - 5)

The WiFS camera is similar to LISS-1. Application: Vegetation index mapping. The camera provides two spectral bands in the VNIR range.

WiFS Instrument Specifications (Table -5)

| | |
|----------------------------|--|
| Spectral bands | 0.62 - 0.68 μm , (Red) 0.77 - 0.86 μm , (NIR) |
| Spatial resolution | 188 m |
| Swath width | 810 km |
| Repetition cycle | 5 days |
| SNR at saturation radiance | >128 |
| Data quantization | 7 bit (radiometric resolution of 128 grey levels) |
| Integration time | 28.42 ms |

LANDSAT

The Landsat program is the longest-running enterprise for acquisition of satellite imagery of Earth. It is a joint NASA / USGS program. On 23 July 1972, the Earth Resources Technology Satellite was launched. This was eventually renamed to Landsat 1 in 1975. The most recent, Landsat 9, was launched on 27 September 2021.

The instruments on the Landsat satellites have acquired millions of images. The images, archived in the United States and at Landsat receiving stations around the world, are a unique resource for global change research and applications in agriculture, cartography, geology, forestry, regional planning, surveillance and education, and can be viewed through the U.S. Geological Survey (USGS) "EarthExplorer" website. Landsat images are usually divided into scenes for easy downloading. Each Landsat scene is about 185 kilometers long and 185 kilometers wide.

Table - 6

| Instrument | Launched | Terminated | Duration | Notes |
|------------|-----------------|------------------|--------------------------------|---|
| Landsat 1 | 23 July 1972 | 6 January 1978 | 5 years, 6 months and 14 days | Originally named Earth Resources Technology Satellite 1. Landsat 1 carried two vital instruments: a camera built by the Radio Corporation of America (RCA) known as the Return Beam Vidicon (RBV); and the Multi spectral Scanner (MSS) built by the Hughes Aircraft Company. |
| Landsat 2 | 22 January 1975 | 25 February 1982 | 7 years, 1 month and 3 days | Nearly identical copy of Landsat 1. Payload consisting of a Return Beam Vidicon (RBV) and a Multi spectral Scanner (MSS). The specifications of these instruments were identical to Landsat 1. |
| Landsat 3 | 5 March 1978 | 31 March 1983 | 5 years and 26 days | Nearly identical copy of Landsat 1 and Landsat 2. Payload consisting of a Return Beam Vidicon (RBV) as well as a Multi spectral Scanner (MSS). Included with the MSS was a short-lived thermal band. MSS data was considered more scientifically applicable than the RBV which was rarely used for engineering evaluation purposes. |
| Landsat 4 | 16 July 1982 | 14 Dec- 1993 | 11 years, 4 months and 28 days | Landsat 4 carried an updated Multi Spectral Scanner (MSS) used on previous Landsat missions, as well as a Thematic Mapper. |
| Landsat 5 | 1 March 1984 | 5 June 2013 | 29 years, 3 months and 4 days | Nearly identical copy of Landsat 4. Longest Earth-observing satellite mission in history. Designed and built at the same time as Landsat 4, this satellite carried the same payload consisting of a Multi Spectral Scanner (MSS) as well as a Thematic Mapper. |
| Landsat 6 | 5 October 1993 | 5 October 1993 | 0 days | Failed to reach orbit. Landsat 6 was an upgraded version of its predecessors. Carrying the same Multi spectral Scanner (MSS) but also carrying an Enhanced Thematic Mapper, which added a 15m resolution panchromatic band. |

| Instrument | Launched | Terminated | Duration | Notes |
|------------|-------------------|--------------|-------------------------------|---|
| Landsat 7 | 15 April 1999 | Still active | 23 years and 22 days | Operating with scan line corrector disabled since May 2003. The main component on Landsat 7 was the Enhanced Thematic Mapper Plus (ETM+). Still consisting of the 15m-resolution panchromatic band, but also includes a full aperture calibration. This allows for 5% absolute radiometric calibration. |
| Landsat 8 | 11 February 2013 | Still active | 9 years, 2 months and 26 days | Originally named Landsat Data Continuity Mission from launch until 30 May 2013, when NASA operations were turned over to United States Geological Survey (USGS) Landsat 8 has two sensors with its payload, the Operational Land Imager (OLI) and the Thermal InfraRed Sensor (TIRS). |
| Landsat 9 | 27 September 2021 | Still active | 7 months and 10 days | Landsat 9 is a rebuild of its predecessor Landsat 8. |

Landsat 1-5 Multispectral Scanner (MSS) (Table -7)

| Landsat 1-3 | Landsat 4-5 | Wavelength (micrometers) | Resolution (meters) |
|-------------|-------------|--------------------------|---------------------|
| Band 4 | Band 1 | 0.5-0.6 | 60 |
| Band 5 | Band 2 | 0.6-0.7 | 60 |
| Band 6 | Band 3 | 0.7-0.8 | 60 |
| Band 7 | Band 4 | 0.8-1.1 | 60 |

Landsat 4-5 Thematic Mapper (TM) images consist of seven spectral bands with a spatial resolution of 30 meters for Bands 1 to 5 and 7. Spatial resolution for Band 6 (thermal infrared) is 120 meters, but is resampled to 30-meter pixels. Approximate scene size is 170 km north-south by 183 km east-west (106 mi by 114 mi).

Landsat 4-5 Thematic Mapper (TM) (Table - 8)

| Landsat 4-5 | Wavelength (micrometers) | Resolution (meters) |
|-------------|--------------------------|---------------------|
| Band 1 | 0.45-0.52 | 30 |
| Band 2 | 0.52-0.60 | 30 |
| Band 3 | 0.63-0.69 | 30 |
| Band 4 | 0.76-0.90 | 30 |
| Band 5 | 1.55-1.75 | 30 |
| Band 6 | 10.40-12.50 | 120 (30) |
| Band 7 | 2.08-2.35 | 30 |

Landsat 7 Enhanced Thematic Mapper Plus (ETM+) images consist of eight spectral bands with a spatial resolution of 30 meters for Bands 1 to 7. The resolution for Band 8 (panchromatic) is 15 meters. All bands can

collect one of two gain settings (high or low) for increased radiometric sensitivity and dynamic range, while Band 6 collects both high and low gain for all scenes. Approximate scene size is 170 km north-south by 183 km east-west (106 mi by 114 mi).

Landsat 7 Enhanced Thematic Mapper Plus (ETM+) (Table - 9)

| Landsat 7 | Wavelength (micrometers) | Resolution (meters) |
|-----------|--------------------------|---------------------|
| Band 1 | 0.45-0.52 | 30 |
| Band 2 | 0.52-0.60 | 30 |
| Band 3 | 0.63-0.69 | 30 |
| Band 4 | 0.77-0.90 | 30 |
| Band 5 | 1.55-1.75 | 30 |
| Band 6 | 10.40-12.50 | 60 (30) |
| Band 7 | 2.09-2.35 | 30 |
| Band 8 | .52-.90 | 15 |

Landsat 8 Operational Land Imager (OLI) and Thermal Infrared Sensor (TIRS) images consist of nine spectral bands with a spatial resolution of 30 meters for Bands 1 to 7 and 9. New band 1 (ultra-blue) is useful for coastal and aerosol studies. New band 9 is useful for cirrus cloud detection. The resolution for Band 8 (panchromatic) is 15 meters. Thermal bands 10 and 11 are useful in providing more accurate surface temperatures and are collected at 100 meters. Approximate scene size is 170 km north-south by 183 km east-west (106 mi by 114 mi). The instruments on Landsat 9 are improved copies of those on Landsat 8. (Table - 10)

Landsat 8-9 Operational Land Imager (OLI) and Thermal Infrared Sensor (TIRS) (Table - 10)

| Bands | Wavelength (micrometers) | Resolution (meters) |
|-------------------------------------|--------------------------|---------------------|
| Band 1 - Coastal aerosol | 0.43-0.45 | 30 |
| Band 2 - Blue | 0.45-0.51 | 30 |
| Band 3 - Green | 0.53-0.59 | 30 |
| Band 4 - Red | 0.64-0.67 | 30 |
| Band 5 - Near Infrared (NIR) | 0.85-0.88 | 30 |
| Band 6 - SWIR 1 | 1.57-1.65 | 30 |
| Band 7 - SWIR 2 | 2.11-2.29 | 30 |
| Band 8 - Panchromatic | 0.50-0.68 | 15 |
| Band 9 - Cirrus | 1.36-1.38 | 30 |
| Band 10 - Thermal Infrared (TIRS) 1 | 10.6-11.19 | 100 |
| Band 11 - Thermal 2Infrared (TIRS) | 11.50-12.51 | 100 |

SPOT

SPOT (French: Satellite Pour 'Observation de la Terre, "Satellite for observation of Earth") is a commercial high-resolution optical Earth imaging satellite system operating from space. It is run by Spot Image, based in Toulouse, France. It was initiated by the CNES (Centre national d'études spatiales – the French space agency) in the 1970s and was developed in association with the SSTC (Belgian scientific, technical and cultural services) and the Swedish National Space Board (SNSB). It has been designed to improve the knowledge and management of the Earth by exploring the Earth's resources, detecting and forecasting phenomena involving climatology and oceanography, and monitoring human activities and natural phenomena. The SPOT system includes a series of satellites and ground control resources for satellite control and programming, image production, and distribution. Earlier satellites were launched using the European Space Agency's Ariane 2, 3, and 4 rockets, while SPOT 6 and SPOT 7 were launched by the Indian PSLV.

- SPOT 1 launched February 22, 1986 with 10 panchromatic and 20 meter multispectral picture resolution capability. Withdrawn December 31, 1990.
- SPOT 2 launched January 22, 1990 and deorbited in July 2009.

- SPOT 3 launched September 26, 1993. Stopped functioning November 14, 1997.
- SPOT 4 launched March 24, 1998. Stopped functioning July, 2013.
- SPOT 5 launched May 4, 2002 with 2.5 m, 5 m and 10 m capability. Stopped functioning March 31, 2015.
- SPOT 6 launched September 9, 2012.
- SPOT 7 (Azersky) launched on June 30, 2014.

SPOT 1, 2, and 3 4

Since 1986 the SPOT family of satellites has been orbiting the Earth and has already taken more than 10 million high quality images. SPOT 1 was launched with the last Ariane 1 rocket on February 22, 1986. Two days later, the 1800 kg SPOT 1 transmitted its first image with a spatial resolution of 10 or 20 meters. SPOT 2 joined SPOT 1 in orbit on January 22, 1990, on the Ariane 4 maiden flight, and SPOT 3 followed on September 26, 1993, also on an Ariane 4.

The satellite loads were identical, each including two identical HRV (High Resolution Visible) imaging instruments that were able to operate in two modes, either simultaneously or individually. The two spectral modes are panchromatic and multispectral. The panchromatic band has a resolution of 10 meters, and the three multispectral bands (G, R, NIR) have resolutions of 20 metres. They have a scene size of 3600 km² and a revisit interval of one to four days, depending on the latitude.

Because the orbit of SPOT 1 was lowered in 2003, it will gradually lose altitude and break up naturally in the atmosphere. Deorbiting of SPOT 2, in accordance with IADC (Inter-Agency Space Debris Coordination Committee), commenced in mid-July 2009 for a period of two weeks, with a final burn on 29 July 2009. SPOT 3 is no longer functioning, due to problems with its stabilization system.

SPOT 4

SPOT 4 launched March 24, 1998 and stopped functioning July, 2013. In 2013, CNES lowered the altitude of SPOT 4 by 2.5 km to put it on a phased orbit with a five-day repeat cycle. On this orbit, SPOT4 was programmed to acquire a time-lapse series of images over 42 sites with a five days revisit period from February to end of May 2013. The data set it produced is aimed at helping future users of the Sentinel-2 mission to learn working with time-lapse series. The time-lapse series provided by SPOT4 (Take5) have the same repetitiveness as those that will be delivered by the Sentinel-2 satellites, starting in 2015 and 2016.

SPOT 5

SPOT 5 was launched on May 4, 2002 and has the goal to ensure continuity of services for customers and to improve the quality of data and images by anticipating changes in market requirements.

SPOT 5 has two high resolution geometrical (HRG) instruments that were deduced from the HRVIR of SPOT 4. They offer a higher resolution of 2.5 to 5 meters in panchromatic mode and 10 meters in multispectral mode (20 metre on short wave infrared 1.58 – 1.75 μm). SPOT 5 also features an HRS imaging instrument operating in panchromatic mode. HRS points forward and backward of the satellite. Thus, it is able to take stereopair images almost simultaneously to map relief.

SPOT 6 and SPOT 7

SPOT 6 was launched by India's Polar Satellite Launch Vehicle on flight C21 at 04:23 UTC on 9 September 2012, while SPOT 7 was launched on PSLV flight C23 at 04:42 UTC on 30 June 2014. They form a constellation of Earth-imaging satellites designed to provide continuity of high-resolution, wide-swath data up to 2024. EADS Astrium took the decision to build this constellation in 2009 on the basis of a perceived government need for this kind of data. Spot Image, a subsidiary of Astrium, funded the satellites alone and owned the system (satellites and ground segments) at time of launch. In December 2014, SPOT 7 was sold to Azerbaijan's space agency Azercosmos, who renamed it Azersky.

The architecture is similar to that of the Pleiades satellites, with a centrally mounted optical instrument, a three-axis star tracker, a fiber-optic gyro (FOG) and four control moment gyros (CMGs).

SPOT 6 and SPOT 7 are phased in the same orbit as Pléiades 1A and Pléiades 1B at an altitude of 694 km, forming a constellation of 2-by-2 satellites - 90° apart from one another.

Image product resolution:

- Panchromatic: 1.5 m
- Colour merge: 1.5 m
- Multi-spectral: 6 m
- Spectral bands, with simultaneous panchromatic and multi-spectral acquisitions:
 - Panchromatic (450 – 745 nm)
 - Blue (450 – 525 nm)
 - Green (530 – 590 nm)
 - Red (625 – 695 nm)
 - Near-infrared (760 – 890 nm)
- Footprint: 60 km × 60 km
- Responsive satellite tasking, with six tasking plans per day, per satellite
- Capacity to acquire up to 3 million km² daily

IKONOS

IKONOS was a commercial Earth observation satellite, and was the first to collect publicly available high-resolution imagery at 1- and 4-meter resolution. It collected multispectral (MS) and panchromatic (PAN) imagery. The capability to observe Earth via space-based telescope has been called "one of the most significant developments in the history of the space age", and IKONOS brought imagery rivaling that of military spy satellites to the commercial market. IKONOS imagery began being sold on 1 January 2000, and the spacecraft was retired in 2015.

IKONOS originated under the Lockheed Corporation as the Commercial Remote Sensing System (CRSS) satellite. In April 1994 Lockheed was granted one of the first licenses from the U.S. Department of Commerce for commercial satellite high-resolution imagery. On 25 October 1995 partner company Space Imaging received a license from the Federal Communications Commission (FCC) to transmit telemetry from the satellite in the eight-gigahertz Earth Exploration Satellite Services band. Prior to launch, Space Imaging changed the name of the satellite system to IKONOS. The name comes from the Greek word eikōn, for "image".

Two satellites were originally planned for operation. **IKONOS-1** was launched on 27 April 1999 at 18:22 UTC from Vandenberg AFB Space Launch Complex 6, but Athena II rocket's payload fairing did not separate due to an electrical malfunction, resulting in the satellite failing to reach orbit and falling into the atmosphere over the South Pacific Ocean.

IKONOS-2 was built in parallel with and as an identical twin to IKONOS-1. Completion of its construction was projected for July 1999 with a January 2000 launch. In reaction to the loss of IKONOS-1, the spacecraft was renamed IKONOS and its processing accelerated, resulting in a launch on 24 September 1999 at 18:22 UTC, also from Vandenberg aboard an Athena II rocket. The company began selling IKONOS imagery on the market on 1 January 2000.

In December 2000, IKONOS received the "Best of what's New" Grant Award in Aviation & Space from Popular Science magazine. The acquisition of Space Imaging and its assets by Orbimage was announced in September 2005 and finalized in January 2006. The merged company was renamed GeoEye, which was itself acquired by Digital Globe in January 2013.

DigitalGlobe operated IKONOS until its retirement on 31 March 2015. During its lifetime, IKONOS produced 597,802 public images, covering more than 400 million km² (154 million sq mi) of area.

Table - 11

| Sr. No | Specifications | Properties |
|--------|------------------------|---|
| 1 | Spatial resolution | 0.8 m PAN 4 m MSS |
| 2 | Spectral resolution | PAN - 0.45-0.90 μm MSS - 0.445-0.516 μm 0.506 - 0.595 μm 0.632-0.698 μm 0.757 - 0.853 μm |
| 3 | Temporal resolution | 3-5 days off - nadir 144 & days true - nadir |
| 4 | Radiometric resolution | 11 - bit |
| 5 | Swath | 11 km \times 11 km (single scene) |

Quick Bird (Table -12)

QuickBird was a high-resolution commercial Earth observation satellite, owned by DigitalGlobe, launched in 2001 and reentered after orbit decay in 2015. QuickBird used Ball Aerospace's Global Imaging System 2000 (BGIS 2000). The satellite collected panchromatic (black and white) imagery at 61 centimeter resolution and multispectral imagery at 2.44- (at 450 km) to 1.63-meter (at 300 km) resolution, as orbit altitude is lowered during the end of mission life.

At this resolution, detail such as buildings and other infrastructure are easily visible. However, this resolution is insufficient for working with smaller objects such as a license plate on a car. The imagery can be imported into remote sensing image processing software, as well as into GIS packages for analysis.

Contractors included Ball Aerospace & Technologies, Kodak and Fokker Space. Original plans called for a constellation of three Quick Bird satellites scheduled to be in orbit by 2008. In the end, two QuickBird satellites, QuickBird I and II, made it to launch pad. However, only QuickBird II made it successfully into orbit (QuickBird I suffered launch failure). Thus QuickBird II satellite is usually referred to simply as Quick Bird, and by the name Quick Bird is usually meant the satellite QuickBird II.

Table -12

| Satellite | Bands (nm) | Spatial Resolution (at nadir-m) | Swath width (KM) |
|-----------|-----------------|---------------------------------|------------------|
| QuickBird | 445-900 (pan) | 0.61 | 16.5 |
| | 450-520 (blue) | 2.44 | |
| | 520-600 (green) | | |
| | 630-690 (red) | | |
| | 760-900 (NIR) | | |

Digital Image Processing

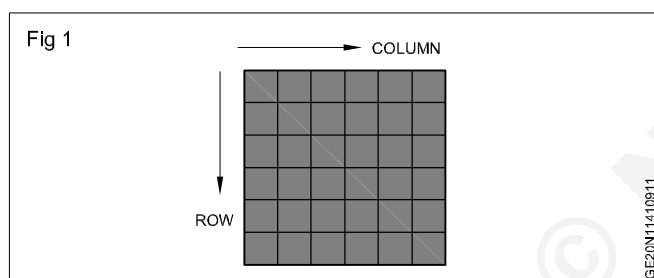
Objectives : At the end of this lesson you shall be able to

- explain digital image, digital data format, LUT
- explain radiometric and geometric correction of data
- explain image enhancements techniques
- state thematic information extraction procedures.

Digital Image, Digital Data Format, LUT. Radiometric Correction of Data Geometric Correction of Data

An image is a two-dimensional representation of objects in a real scene. Remote sensing images are representations of parts of the earth surface as seen from space. The images may be analog or digital. Aerial photographs are examples of analog images while satellite images acquired using electronic sensors are examples of digital images.

A digital image is a two-dimensional array of pixels. Each pixel has an intensity value (represented by a digital number) and a location address (referenced by its row and column numbers). (Fig 1)



A digital image comprises of a two dimensional array of individual picture elements called pixels arranged in columns and rows. Each pixel represents an area on the Earth's surface. A pixel has an intensity value and a location address in the two dimensional image.

Digital Data Format

A digital data format for encoding data for storage in a computer file. File formats are intended to store particular kinds of digital information: the JPEG format, for example, is designed only to store still images, while the GIF format supports storage of both still images and simple animations. The most well-known formats have file specifications that describe exactly how the data is to be encoded.

Since files are seen by programs as streams of data (0s and 1s), a method is required to determine the format of a particular file within the file system. One popular method is to determine the format based on the final portion of the filename, known as the filename extension.

The standard greyscale images use 256 shades of grey from 0 (black) to 255 (white). With color images, the situation is more complex. For a given number of pixels, considerably more data is required to represent the image and more than one color model is used.

Some examples of the data format

- JPEG
- TIFF
- BMP
- PNG
- IMG
- SVG

LUT (Look-Up Table)

Look-Up Tables or LUTs are fundamental to many aspects of image processing. An LUT is simply a table of cross-references linking index numbers to output values. The most common use is to determine the colors and intensity values with which a particular image will be displayed, and in this context the LUT is often called simply a colormap.

The idea behind the colormap is that instead of storing a definite color for each pixel in an image, for instance in 24-bit RGB format, each pixel's value is instead treated as an index number into the colormap. When the image is to be displayed or otherwise processed, the colormap is used to look up the actual colors corresponding to each index number. Typically, the output values stored in the LUT would be RGB color values.

There are two main advantages to doing things this way. Firstly, the index number can be made to use fewer bits than the output value in order to save storage space. For instance an 8-bit index number can be used to look up a 24-bit RGB color value in the LUT. Since only the 8-bit index number needs to be stored for each pixel, such 8-bit color images take up less space than a full 24-bit image of the same size. Of course the image can only contain 256 different colors (the number of entries in an 8-bit LUT), but this is sufficient for many applications and usually the observable image degradation is small.

Secondly the use of a color table allows the user to experiment easily with different color labeling schemes for an image.

Radiometric Correction of Data

As any image involves radiometric errors as well as geometric errors, these errors should be corrected. Radiometric correction is to avoid radiometric errors or distortions, while geometric correction is to remove geometric distortion.

When the emitted or reflected electro-magnetic energy is observed by a sensor on board an aircraft or spacecraft, the observed energy does not coincide with the energy emitted or reflected from the same object observed from a short distance. This is due to the sun's azimuth and elevation, atmospheric conditions such as fog or aerosols, sensor's response etc. which influence the observed energy. Therefore, in order to obtain the real irradiance or reflectance, those radiometric distortions must be corrected.

Radiometric correction is classified into the following three types

1 Radiometric correction of effects due to sensor sensitivity

In the case of optical sensors, with the use of a lens, a fringe area in the corners will be darker as compared with the central area. This is called vignetting. Vignetting can be expressed by $\cos^n \theta$, where θ is the angle of a ray with respect to the optical axis. n is dependent on the lens characteristics, though n is usually taken as 4. In the case of electro-optical sensors, measured calibration data between irradiance and the sensor output signal, can be used for radiometric correction.

2 Radiometric correction for sun angle and topography

a Sun spot

The solar radiation will be reflected diffusely onto the ground surface, which results in lighter areas in an image. It is called a sun spot. The sun spot together with vignetting effects can be corrected by estimating a shading curve which is determined by Fourier analysis to extract a low frequency component.

b hading

The shading effect due to topographic relief can be corrected using the angle between the solar radiation direction and the normal vector to the ground surface.

3 Atmospheric correction

Various atmospheric effects cause absorption and scattering of the solar radiation. Reflected or emitted radiation from an object and path radiance (atmospheric scattering) should be corrected for.

Geometric Correction of Data

The transformation of a remotely sensed image into a map with a scale and projection properties is called geometric correction.

Image Enhancements Techniques

Image enhancement can be defined as conversion of the image quality to a better and more understandable level for feature extraction or image interpretation.

On the other hand, feature extraction can be defined as the operation to quantify the image quality through various parameters or functions, which are applied to the original image.

Typical image enhancement techniques include *image contrast, gray scale conversion, histogram conversion, color composition*, etc., which are usually applied to the image output for image interpretation.

Contrast enhancement techniques expand the range of brightness values in an image so that the image can be efficiently displayed in a manner desired by the analyst. The density values in a scene are literally pulled farther apart, that is, expanded over a greater range. The effect is to increase the visual contrast between two areas of different uniform densities. This enables the analyst to discriminate easily between areas initially having a small difference in density. Contrast enhancement can be effected by a linear or non linear transformation.

Gray scale conversion is one of the simplest image enhancement techniques. Gray scale conversion can be performed using the following function.

$$y = f(x)$$

where x : original input data, y : converted output data

Histogram conversion is the conversion of the histogram of original image to another histogram. Histogram conversion can be said to be a type of gray scale conversion.

There are two typical histogram conversion techniques.

a Histogram equalization

Histogram equalization is to convert the histogram of an original image to equalized histogram. As a first step, an accumulated histogram should be made. Then the accumulated histogram should be divided into a number of equal regions. Thirdly, the corresponding gray scale in each region should be assigned to a converted gray scale.

The effect of histogram equalization is that parts of the image with more frequency variation will be more enhanced, while parts of an image with less frequency will be neglected.

b Histogram normalization

Generally a normal distribution of the density in an image would create an image that is natural for a human observation. In this sense the histogram of the original image may be sometimes converted to the normalized histogram. However in this conversion, pixels with same gray scale should be reallocated to other pixels with different gray scales, in order to form a normalized histogram.

Therefore such a gray scale conversion is not a 1:1 conversion and thus enables no reverse conversion. Histogram normalization may be applied, for example, to an unfocused image of a planet with a low dynamic range, though it is not be very much popular for ordinary remote sensing data.

Color display of remote sensing data is of importance for effective visual interpretation. There are two color display methods; color composite, to generate color with multi-band data and pseudo-color display, to assign different colors to the gray scale of a single image.

a Color Composite

A color image can be generated by composing three selected multi-band images with the use of three primary colors. Different color images may be obtained depending on the selection of three band images and the assignment of the three primary colors.

b Pseudo Color Display

Different colors may be assigned to the subdivided gray scale of a single image. Such a color allocation is called pseudo-color. For example, a pseudo-color image of a thermal infrared image will give a temperature map. If one wishes to produce a continuous color tone, three different functions of three primary colors should be applied.

Band Ratios

Use band ratios to enhance the spectral differences between bands and to reduce the effects of topography. Dividing one spectral band by another produces an image that provides relative band intensities. The image enhances the spectral differences between bands. A band ratio is very simple and powerful technique in the remote sensing. Basic idea of this technique is to highlight or exaggerate the anomaly of the target object.

Vegetation Indices

Vegetation Indices (VIs) are combinations of surface reflectance at two or more wavelengths designed to highlight a particular property of vegetation. They are derived using the reflectance properties of vegetation. Each of the VIs is designed to accentuate a particular vegetation property.

Vegetation indices are an important parameter of crop development analytics. Among numerous advantages of vegetation indices in remote sensing, data precision and miles-away control are the key drivers to adopt the handy technology.

As sensors advance, Earth-observing satellites provide remote sensing experts with new data to fuel their research and improve the existing analysis.

Normalized Difference Vegetation Index (NDVI)

Among the typical spectral vegetation indices, NDVI is one of the most suitable to track crop development dynamics since it measures photosynthetically active biomass in plants. However, this vegetation index is quite sensitive to soil brightness and atmospheric effects, mitigated in other indices like EVI, SAVI, ARVI, GCL, or SIPI.

Formula: $NDVI = (NIR - RED) / (NIR + RED)$

NDVI is the most common vegetation index in remote sensing. It can be used throughout the whole crop production season except when vegetation cover is too scarce, so its spectral reflectance is too low.

NDVI values are the most accurate in the middle of the season at the stage of active crop growth.

Red-Edge Chlorophyll Vegetation Index (ReCI)

The ReCI vegetation index is responsive to chlorophyll content in leaves that is nourished by nitrogen. ReCI shows the photosynthetic activity of the canopy cover.

Formula: $ReCI = (NIR / RED) - 1$

Because chlorophyll content directly depends on nitrogen level in plants, responsible for their "greenness", this vegetation index in remote sensing helps detect areas with yellow or shed foliage.

ReCI values are most useful at the stage of active vegetation development but are not suitable for the season of harvesting.

Normalized Difference Red Edge Vegetation Index (NDRE)

The NDRE index combines the Near-infrared (NIR) spectral bands and a specific band for the narrow range between the visible red and the red-NIR transition zone (the so-called red-edge region). For the best data precision, it is recommended to use NDRE in combination with NDVI.

Formula: $NDRE = (NIR - RED\ EDGE) / (NIR + RED\ EDGE)$

The given vegetation index applies for high-density canopy cover.

NDRE is typically used to monitor crops that have reached the maturity stage.

Modified Soil-Adjusted Vegetation Index (MSAVI)

The MSAVI vegetation index is designated to mitigate soil effects on crop monitoring results. Therefore, it is applied when NDVI can't provide accurate values, particularly, with a high percentage of bare soil, scarce vegetation, or low chlorophyll content in plants.

Formula: $MSAVI = (2 * Band\ 4 + 1 - \sqrt{(2 * Band\ 4 + 1)^2 - 8 * (Band\ 4 - Band\ 3)}) / 2$

Since MSAVI is adjusted to soil effects and is sensitive to early vegetation in the field, it works even when the earth is hardly covered with crops.

MSAVI is useful at the very beginning of crop production season – when seedlings start to establish.

Green Normalized Difference Vegetation Index (GNDVI)

The GNDVI index is a modification of NDVI and it also uses near-infrared but substitutes VIS green for VIS red (540 to 570 nm).

Formula: $GNDVI = (NIR - GREEN) / (NIR + GREEN)$

GNDVI measures chlorophyll content more accurately than NDVI.

to detect wilted or aging crops and to measure nitrogen content in leaves when an extreme red channel is not available, monitor vegetation with dense canopies or at maturity stages.

Soil Adjusted Vegetation Index (SAVI)

The SAVI was introduced to mitigate the impact of soil brightness. Its creator Huete added a soil adjustment factor L to the equation of NDVI in order to correct for soil noise effects (soil color, soil moisture, soil variability across regions, etc.), which tend to impact the results.

Formula: $SAVI = ((NIR - RED) / (NIR + RED + L)) * (1 + L)$

L varies from -1 to +1, depending on the green vegetation density in the questioned area. In areas with high green vegetation L= 0, and in this case, SAVI is the same as NDVI. Conversely, L = 1 for low green vegetation zones. Most typically, L is set to 0.5 to adjust to most land cover.

for analysis of young crops; for arid regions with sparse vegetation (less than 15% of total area) and exposed soil surfaces.

Optimized Soil Adjusted Vegetation Index (OSAVI)

The OSAVI vegetation index is a modified SAVI and also uses reflectance in the NIR and red spectrum. The difference between the two indices is that OSAVI takes into account the standard value of the canopy background adjustment factor (0.16).

Formula: $OSAVI = (NIR - RED) / (NIR + RED + 0.16)$

The adjustment allows greater soil variation in OSAVI compared to SAVI when canopy cover is low. OSAVI has a better sensitivity to canopy cover exceeding 50%.

to monitor the areas with low-density vegetation with bare soil areas through the canopy.

Atmospherically Resistant Vegetation Index (ARVI)

This is the first vegetation index, relatively insensitive to atmospheric factors (e.g., aerosols). As the formula shows, Kaufman and Tanre corrected NDVI to mitigate atmospheric scattering effects by doubling the red spectrum measurements and adding blue wavelengths.

Formula: $ARVI = (NIR - (2 * RED) + BLUE) / (NIR + (2 * RED) + BLUE)$

Compared to other indices, ARVI is also more insensitive to relief effects, being particularly useful to monitor tropical mountainous regions often covered with soot due to slash-and-burn agriculture.

for regions with high content of atmospheric aerosol (e.g. rain, fog, dust, smoke, air pollution).

Enhanced Vegetation Index (EVI)

Liu and Huete introduced the EVI vegetation index to adjust NDVI results to atmospheric and soil noises, particularly in dense vegetation areas, as well as to mitigate saturation in most cases. The value range for EVI is -1 to +1, and for healthy vegetation, it varies between 0.2 and 0.8.

Formula: $EVI = 2.5 * ((NIR - RED) / ((NIR) + (C1 * RED) - (C2 * BLUE) + L))$

EVI contains coefficients C1 and C2 to correct for aerosol scattering present in the atmosphere, and L to adjust for soil and canopy background. Beginner GIS analysts may be confused by what values should be used and how to calculate EVI for different satellite data. Traditionally, for NASA's MODIS sensor (which the EVI vegetation index was developed for) C1=6, C2=7.5, and L=1. In case you're wondering how to see Enhanced Vegetation Index using Sentinel 2 or Landsat 8 data, use the same values or simply use EOS Crop Monitoring, which also allows downloading the results.

For analyzing areas of Earth with large amounts of chlorophyll (such as rainforests), and preferably with minimum topographic effects (non-mountainous regions).

Resolution Merge Techniques for Image Fusion

Image fusion (IF) is an emerging field for generating an Informative image with the integration of images obtained by different sensors for decision making. The analytical and visual image quality can be improved by integrating different images. Effective image fusion is capable of preserving vital Information by extracting all important Information from the images without producing any inconsistencies in the output image. After fusion, the fused image is more suitable for the machine and human perception.

Remote sensing image fusion is an effective way to use a large volume of data from multisensory images. Most earth satellites such as SPOT, Landsat 7, IKONOS and QuickBird provide both panchromatic (Pan) images at a higher spatial resolution and multispectral (MS) images at a lower spatial resolution and many remote sensing applications require both high spatial and high spectral resolutions, especially for GIS based applications. An effective image fusion technique can produce such remotely sensed images. Image fusion is the combination of two or more different images to form a new image by using a certain algorithm to obtain more and better information about an object or a study area than. The image fusion is performed at three different processing levels which are pixel level, feature level and decision level according to the stage at which the fusion takes place. There are many image fusion methods that can be used to produce high resolution multispectral images from a high resolution pan image and low resolution multispectral images.

The classical image fusion techniques include intensity-hue-saturation transform technique (IHS). IHS is a common way of fusing high spatial resolution, single band, pan image and low spatial resolution, multispectral remote sensing image. The R, G and B bands of the multispectral image are transformed into IHS components, replacing the intensity component by the pan image, and performing the inverse transformation to obtain a high spatial resolution multispectral image.

The Brovey transform image fusion technique The BT uses a mathematical combination of the MS bands and PAN band. Each MS band is multiplied by a ratio of the PAN band divided by the sum of the MS bands.

The Principle Component Analysis (PCA) image fusion technique PCA transformation is a technique from statistics for simplifying a data set. The aim of the method is to reduce the dimensionality of multivariate data whilst preserving as much of the relevant information as possible. It translates correlated data set to uncorrelated dataset. By using this method, the redundancy of the image data can be decreased.

Thematic Information Extraction Procedures: Multi-spectral patterns, Spectral Discrimination and Signature Bank, Supervised and Unsupervised Classification Methods, Multi-date –Data Analysis and change detection processes. Accuracy assessment.

The classification process is designed to thematic information extract useful information from remotely sensed data. The imagery itself does not provide information. It provides data from which information is extracted.

The aim of image classification is to categorize all pixels in a digital image map which describes one or several land cover classes. The resulting thematic image shows the pixels that belong to similar spectral patterns or features.

Multi-spectral patterns

Multispectral remote sensing is the collection and analysis of reflected, emitted, or back-scattered energy from an object or an area of interest in multiple bands of regions of the electromagnetic spectrum. Subcategories of multispectral remote sensing include hyperspectral, in which hundreds of bands are collected and analyzed, and ultraspectral remote sensing where many hundreds of bands are used. The main purpose of multispectral imaging is the potential to classify the image using multispectral classification. This is a much faster method of image analysis than is possible by human interpretation.

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Digital Image Classification

Objectives : At the end of this lesson you shall be able to

- define different classification methods
- explain multi-data
- explain data analysis
- explain change detection process
- state accuracy assessment.

Image classification

Supervised and Unsupervised image classification

Image classification refers to the task of extracting information classes from a multiband raster image. The resulting raster from image classification can be used to create thematic maps. Depending on the interaction between the analyst and the computer during classification. Image classification is assigning pixels in the image to categories or classes of interest. Examples: builtup areas, water body, green vegetation, bare soil, rocky areas, cloud, shadow etc. In order to classify a set of data into different classes or categories, the relationship between the data and the classes into which they are classified must be well understood.

The 2 main image classification techniques in remote sensing are:

- Supervised image classification
- Unsupervised image classification

Unsupervised (calculated by software) and supervised (human-guided) image classification are the two most common approaches. However, object-based classification has gained more popularity because it's useful for high-resolution data.

Supervised classification

Supervised classification uses the spectral signatures obtained from training samples to classify an image. Supervised image classification is a procedure for identifying spectrally similar areas on an image by identifying 'training' sites of known targets and then extrapolating those spectral signatures to other areas of unknown targets. It requires training data which are typical and homogeneous and the application of a set of methods, or decision rules.

Training/site selection

Good quality training data are needed to 'teach' the computer to recognise similar patterns in the imagery. These represent only a small sample of the entire image/region to be classified. Training data can be selected based on:

- Field visits
- High spatial resolution data
- Previous maps

- Investigator knowledge
- Any or all of the above

The goal is to select multiple areas for each land cover type throughout the image. The choice of training data can significantly affect the classification results.

The aim is to provide a quantitative description of the appearance of each thematic (land use) class of interest in the image. The first step must therefore be to define the classes of interest, which requires thinking carefully about the aim of the study.

The number of training pixels required to make up a sample depends on the variability and distinctiveness of the spectral response of the class. As a rule of thumb, at least 100 sites per class should be used, or at least 10 times the number of spectral bands in the image.

It is best to acquire the overall number of sample pixels from many small areas around the image rather than from just one or two areas. This allows all possible variations in the image to be accounted for.

The image processing software system is then used to develop a statistical characterization of the reflectance for each information class. This stage is often called "signature analysis" and may involve developing a characterization as simple as the mean or the range of reflectance on each band, or as complex as detailed analyses of the mean, variances and covariance over all bands.

Finally, the last step would be to use the signature file to run a classification. From here, you would have to pick classification algorithms such as:

- Maximum likelihood
- Minimum-distance
- Parallel piped or Box approach

Maximum likelihood classification

The maximum likelihood classifier is one of the most popular methods of classification in remote sensing, in which a pixel with the maximum likelihood is classified into the corresponding class.

Minimum-distance classification

The minimum distance classifier is used to classify unknown image data to classes which minimize the distance between the image data and the class in multi-

feature space. The distance is defined as an index of similarity so that the minimum distance is identical to the maximum similarity.

Parallel piped or Box approach

The Box classifier is the simplest classification method: In 2-D space, rectangles are created around the training feature vector for each class; in 3-Dimension they are actually boxes (blocks).

The position and sizes of the boxes can be exactly around the feature vectors (Min-Max method), or according to the mean vector (this will be at the center of a box) and the standard deviations of the feature vector, calculated separately per feature (this determines the size of the box in that dimension).

Unsupervised classification

Unsupervised classification is where the outcomes (groupings of pixels with common characteristics) are based on the software analysis of an image without the user providing sample classes. The computer uses techniques to determine which pixels are related and groups them into classes. The user can specify which algorithm the software will use and the desired number of output classes but otherwise does not aid in the classification process. However, the user must have knowledge of the area being classified when the groupings of pixels with common characteristics produced by the computer have to be related to actual features on the ground (such as wetlands, developed areas, coniferous forests, etc.).

The steps for running an unsupervised classification are:

- 1 Generate clusters
- 2 Assign classes

Generate clusters

In this step, the software clusters pixels into a set number of classes. So, the first step is to assign the number of classes you want it to generate. In addition, you have to identify which bands you want it to use.

Iso Cluster

The Iso Cluster uses a modified iterative optimization clustering procedure, also known as the migrating means technique. The algorithm separates all cells into the user-specified number of distinct unimodal groups in the multidimensional space of the input bands. This is most often used in preparation for unsupervised classification.

K-mean cluster classification

K- means clustering: K-means algorithm is an iterative algorithm that tries to partition the dataset into K pre-defined distinct non-overlapping subgroups (clusters) where each data point belongs to only one group. It tries to make the

inter-cluster data points as similar as possible while also keeping the clusters as different (far) as possible. It assigns data points to a cluster such that the sum of the squared distance between the data points and the cluster's centroid (arithmetic mean of all the data points that belong to that cluster) is at the minimum. The less variation we have within clusters, the more homogeneous (similar) the data points are within the same cluster.

The way k means algorithm works is as follows:

- 1 Specify number of clusters K.
- 2 Initialize centroids by first shuffling the dataset and then randomly selecting K data points for the centroids without replacement.
- 3 Keep iterating until there is no change to the centroids. i.e assignment of data points to clusters isn't changing.
 - Compute the sum of the squared distance between data points and all centroids.
 - Assign each data point to the closest cluster (centroid).
 - Compute the centroids for the clusters by taking the average of the all data points that belong to each cluster.

Multi-date –Data Analysis and Change detection processes

Change detection is a process that measures how the attributes of a particular area have changed between two or more time periods (multi date- data). Change detection often involves comparing aerial photographs or satellite imagery (multi data) of the area taken at different times or multi date- data. Change detection has been widely used to assess shifting cultivation, deforestation, urban growth, impact of natural disasters like tsunamis, earthquakes, and use/land cover changes etc.

Accuracy assessment

Accuracy assessment is an important part of any classification project. It compares the classified image to another data source that is considered to be accurate or ground truth data. Ground truth can be collected in the field; however, this is time consuming and expensive. Ground truth data can also be derived from interpreting high-resolution imagery, existing classified imagery, or GIS data layers.

The most common way to assess the accuracy of a classified map is to create a set of random points from the ground truth data and compare that to the classified data in a confusion matrix. Although this is a two-step process, you may need to compare the results of different classification methods or training sites, or you may not have ground truth data and are relying on the same imagery that you used to create the classification.

Digital Image Resolution, Characteristics and Interpretation

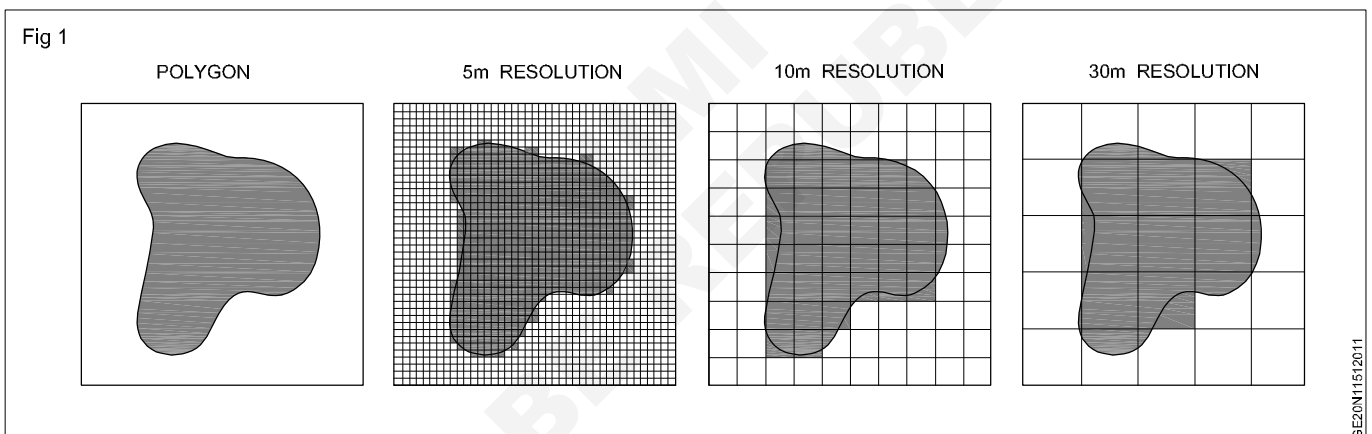
Objectives : At the end of this lesson you shall be able to

- explain factors affecting image interpretation
- state digital image, resolution spectral spatial
- state radiometric, temporal true colour image, false colour image
- explain spectral signature and there significance in remote sensing
- state image characteristics & there preparation
- explain various elements of image interpretation
- explain method & techniques of image interpretation
- state types of interpretation.

Digital image Resolution: Spectral Spatial, Radiometric, Temporal. True colour image, False colour image

Image resolution is the detail an image holds. The term applies to raster digital images, film images, and other types of images. Higher resolution means more image detail. In remote sensing we refer to four types of resolution: spatial, spectral, radiometric and temporal.

Spatial resolution refers to the size of the smallest feature that can be detected by a satellite sensor or displayed in a satellite image. It is usually presented as a single value representing the length of one side of a square. For example, a spatial resolution of 250m means that one pixel represents an area 250 by 250 meters on the ground. (Fig 1)



Spectral Resolution refers to the ability of a satellite sensor to measure specific wavelengths of the electromagnetic spectrum. The finer the spectral resolution, the narrower the wavelength range for a particular channel or band. Spectral Resolution describes the ability of a sensor to define fine wavelength intervals. This refers to the number of bands in the spectrum in which the instrument can take measurements. Higher Spectral resolution = better ability to exploit differences in spectral signatures.

Radiometric resolution refers to the number of possible data file values in each band (indicated by the number of bits into which the recorded energy is divided). It is the ability of a sensor to detect differences in energy magnitude. Sensors with low radiometric resolution are able to detect only relatively large differences in the amount of energy received, sensors with high radiometric resolution are able to detect relatively small differences in the amount of energy received.

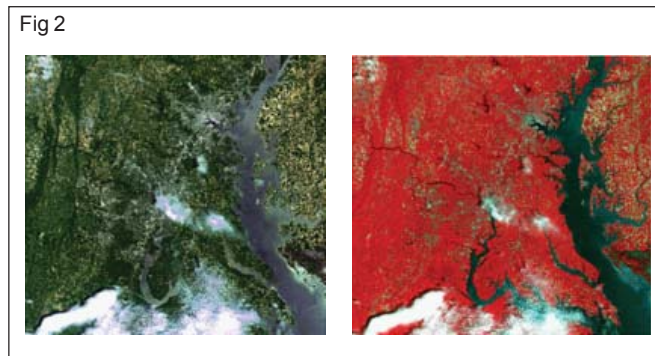
Temporal resolution refers to the time between images. The capability for satellites to provide images of the same geographical area more frequently has increased dramatically since the dawn of the space age.

True colour image, False colour image

The concept behind true color can help in understanding false color. An image is called a true-color image when it offers a natural color rendition, or when it comes close to it. This means that the colors of an object in an image appear to a human observer the same way as if this same observer were to directly view the object: A green tree appears green in the image, a red apple red, a blue sky blue, and so on. When applied to black-and-white images, true-color means that the perceived lightness of a subject is preserved in its depiction.

False color (or pseudo color) refers to a group of color rendering methods used to display images in color which were recorded in the visible or non-visible parts of the electromagnetic spectrum. A false-color image is an image that depicts an object in colors that differ from those a

photograph (a true-color image) would show. In this image, colors have been assigned to three different wavelengths that our eyes cannot normally see. (Fig 2)



Two Landsat satellite images showing the same region

This true-color image shows the area in actual colors, e.g., the vegetation appears in green. It covers the full visible spectrum using the red, green and blue / green spectral bands of the satellite mapped to the RGB color space of the image. The same area as a false-color image using the near infrared, red and green spectral bands mapped to RGB – this image shows vegetation in a red tone, as vegetation reflects most light in the near infrared.

Spectral Signature, spectral reflectance curve, Significance of spectral signature in remote sensing Spectral Signature for Vegetation Soil, Water, Snow

Spectral Signature

Spectral signature is the variation of reflectance or emittance of a material with respect to wavelengths. The spectral signature of stars indicates the composition of the stellar atmosphere. The spectral signature of an object is a function of the incidental EM wavelength and material interaction with that section of the electromagnetic spectrum.

The measurements can be made with various instruments, including a task specific spectrometer, although the most common method is separation of the red, green, blue and near infrared portion of the EM spectrum as acquired by digital cameras. Calibrating spectral signatures under specific illumination are collected in order to apply a correction to airborne or satellite imagery digital images.

Across any range of wavelengths, the percent reflectance values for landscape features such as water, sand, roads, forests, etc. can be plotted and compared. Such plots are called “spectral response curves” or “spectral signatures.” Differences among spectral signatures are used to help classify remotely sensed images into classes of landscape features since the spectral signatures of like features have similar shapes.

Spectral Reflectance

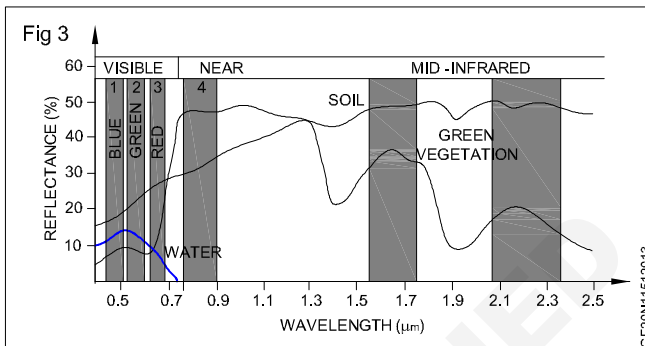
The reflectance characteristics of earth surface features expressed as the ratio of energy reflected by the surface to the energy incident on the surface, measured as a function of wavelength is called spectral reflectance, R_λ.

It is also known as albedo of the surface. It may vary from 0-100%.

$$\text{Spectral reflectance} = E(\lambda) / E_i(\lambda) * 100$$

$$\frac{\text{Energy of wavelength } \lambda \text{ reflected from the object}}{\text{Energy of wavelength } \lambda \text{ incident on the object}} * 100$$

Spectral Reflectance Curve (Fig 3)



The graphical representation of the spectral response of an object over different wavelengths of the electromagnetic spectrum is termed as spectral reflectance curve. The reflectance characteristics of the surface features are represented using these curves.

These curves give an insight into the spectral characteristics of different objects, hence used in the selection of a particular wavelength band for remote sensing data acquisition.

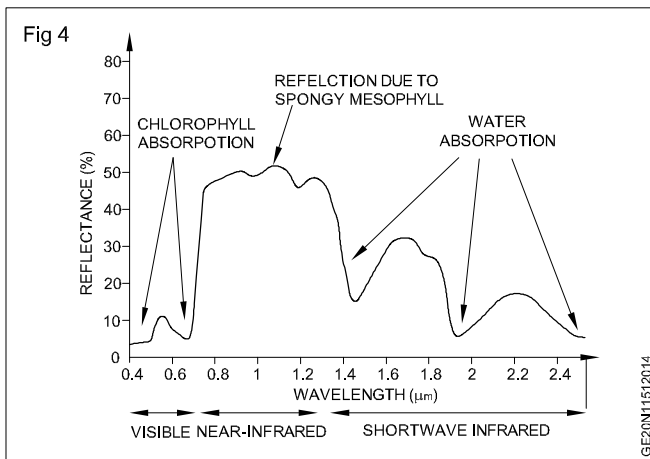
The graph is drawn between various wavelengths (im) of EM spectrum on x-axis & the amount of reflectance (%) recorded by the R.S. system on the y-axis. Spectral reflectance curve exhibits the “peak-and-valley” configuration. High amount of reflectance of a wavelength from a particular feature may result in peaks in the graph & low reflectance results in a dip or valley in the curve. In other words, the peaks indicate strong reflection of incident energy and the valleys indicate predominant absorption of the energy in the corresponding wavelength bands.

Significance of spectral signature in remote sensing Spectral Signature for Vegetation Soil, Water, Snow

Spectral Signature for Vegetation or Spectral Reflectance Curve for Vegetation (Fig 4)

Spectral reflectance curve for healthy green vegetation exhibits the “peak-and-valley” configuration as illustrated in Fig.1. It can be studied in three categories viz. wavelength region (0.4-0.7im), (0.7-1.3im) & beyond 1.3im.

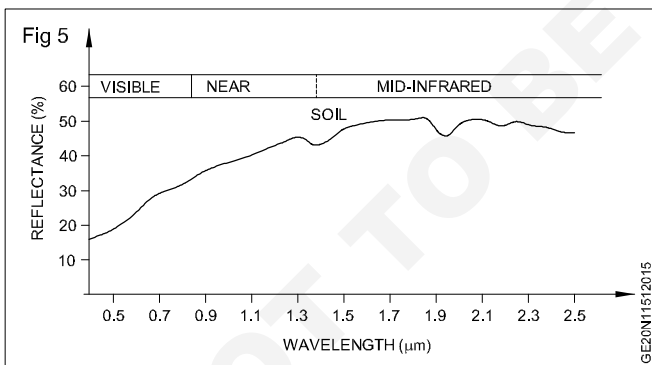
In general, healthy vegetations are very good absorbers of electromagnetic energy in the visible region (0.4-0.7im). The absorption greatly reduces and reflection increases in the red/infrared boundary near 0.7 im. The reflectance is nearly constant from 0.7-1.3 im and then decreases for the longer wavelengths.



Spectral Signature for Soil

Some of the factors effecting soil reflectance are moisture content, soil texture (proportion of sand, silt, and clay), surface roughness, presence of iron oxide and organic matter content. These factors are complex, variable, and interrelated.

The presence of moisture in soil decreases its reflectance. This effect is greatest in the water absorption bands at 1.4, 1.9, and 2.1 micrometers. On the other hand, similar absorption characteristics are displayed by the clay soils. Clay soils have hydroxyl ion absorption bands at 1.4 and 2.2 micrometers. Soil moisture content is strongly related to the soil texture. For example, coarse, sandy soils are usually well drained, resulting in low moisture content and relatively high reflectance. On the other hand, poorly drained fine textured soils generally have lower reflectance. In the absence of water, however, the soil itself exhibits the reverse tendency i.e., coarse textured soils appear darker than fine textured soils. (Fig 5)



Two other factors that reduce soil reflectance are surface roughness and the content of organic matter. Presence of iron oxide in a soil also significantly decreases reflectance, at least in the visible region of wavelengths.

Spectral Signature for Water

Water provides a semi-transparent medium for the electromagnetic radiation. Thus the electromagnetic radiations get reflected, transmitted or absorbed in water. The spectral responses vary with the wavelength of the radiation and the physical and chemical characteristics of the water.

In the visible region between 0.4 micrometers and 0.7 micrometers, around 0.6 micrometers water in the liquid form shows high reflectance. Wavelengths beyond 0.7 micrometers are completely absorbed (i.e. no curve formed beyond 0.7 micrometers). Thus clear water appears in darker tone in the NIR image. Locating and delineating water bodies with remote sensing data is done more easily in reflected infrared wavelengths because of this absorption property.

For example, the next Fig. shows a part of the Krishna River Basin in different bands of the Landsat ETM+ imagery. The water body appears in dark colour in all bands and displays sharp contrast in the IR bands.

Spectral Signature for Snow

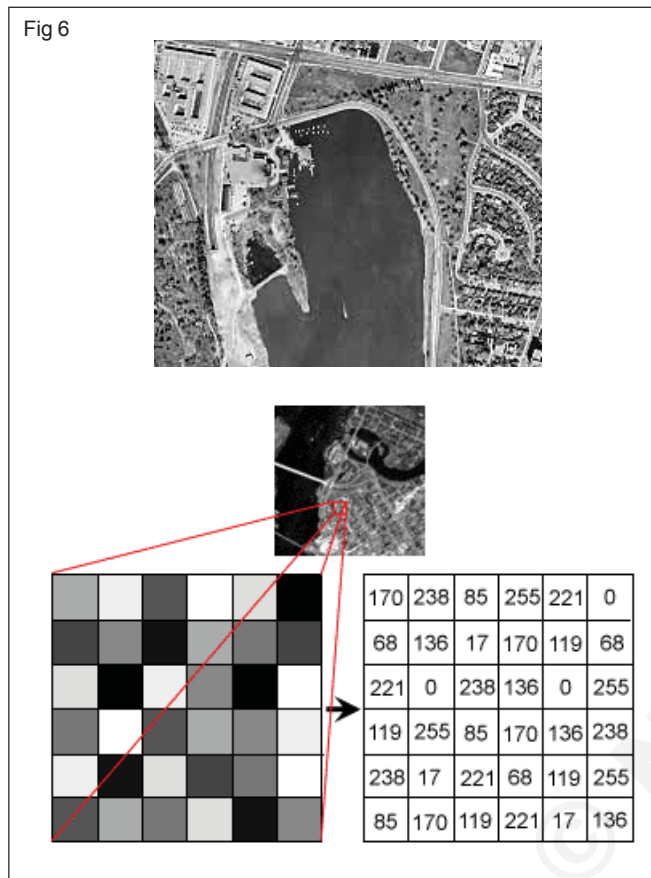
Spectral reflectance of water varies with its physical condition. In the solid phase (ice or snow) water give good reflection at all visible wavelengths. On the other hand, reflection in the visible region is poor in case of water in liquid stage. This difference in reflectance is due to the difference in the atomic bond in the liquid and solid states. For both ice and liquid water the real component of the refractive index varies slightly across the spectral range 400-2500nm.

Image characteristics and preparation of image interpretation keys Elements of Image interpretation Basic Principle of Image Interpretation, Visual image Interpretation: tone, shape, size pattern, texture, shadow and association.

Electromagnetic energy may be detected either photographically or electronically. The photographic process uses chemical reactions on the surface of light-sensitive film to detect and record energy variations. It is important to distinguish between the terms images and photographs in remote sensing. An image refers to any pictorial representation, regardless of what wavelengths or remote sensing device has been used to detect and record the electromagnetic energy. A photograph refers specifically to images that have been detected as well as recorded on photographic film. The black and white photo in fig.1, of part of the city of Ottawa, Canada was taken in the visible part of the spectrum. Photos are normally recorded over the wavelength range from 0.3 micrometers to 0.9 micrometers - the visible and reflected infrared. Based on these definitions, we can say that all photographs are images, but not all images are photographs. Therefore, unless we are talking specifically about an image recorded photographically, we use the term image.

A photograph could also be represented and displayed in a digital format by subdividing the image into small equal-sized and shaped areas, called **picture elements** or **pixels**, and representing the brightness of each area with a **numeric value** or **digital number**. Indeed, that is exactly what has been done to the photo to the left. In fact, using the definitions we have just discussed, this is actually a **digital image** of the original photograph. The photograph was scanned and subdivided into pixels with each pixel assigned a digital number representing its relative brightness. The computer displays each digital value as different brightness levels. Sensors that record

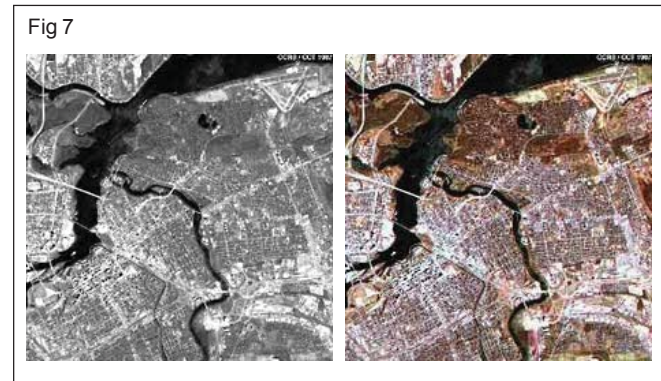
electromagnetic energy, electronically record the energy as an array of numbers in digital format right from the start. These two different ways of representing and displaying remote sensing data, either pictorially or digitally, are interchangeable as they convey the same information (although some detail may be lost when converting back and forth). (Fig 6)



In previous sections we described the visible portion of the spectrum and the concept of colours. We see colour because our eyes detect the entire visible range of wavelengths and our brains process the information into separate colours. Can you imagine what the world would look like if we could only see very narrow ranges of wavelengths or colours? That is how many sensors work. The information from a narrow wavelength range is gathered and stored in a **channel**, also sometimes referred to as a **band**. We can combine and display channels of information digitally using the three primary colours (blue, green, and red). The data from each channel is represented as one of the primary colours and, depending on the relative brightness (i.e. the digital value) of each pixel in each channel, the primary colours combine in different proportions to represent different colours. (Fig 7)

When we use this method to display a single channel or range of wavelengths, we are actually displaying that channel through all three primary colours. Because the brightness level of each pixel is the same for each primary colour, they combine to form a black and white image, showing various shades of gray from black to white. When we display more than one channel each as a different primary colour, then the brightness levels may be different

for each channel/primary colour combination and they will combine to form a colour image.



Preparation of image interpretation

Image interpretation is the process of examining images and identifying and judging their significance by considering their location and extent.

Visual interpretation and digital image processing techniques are two important techniques of data analysis to extract resource related information either independently or in combination with other data. Visual interpretation methods have been the traditional methods for extracting information, based on the target characteristics on aerial photograph or satellite imagery. A human interpreter uses various parameters of object recognition and interprets objects / phenomena, spatial and spectral patterns etc.

Image interpretation is defined as 'the art of examining images for the purpose of identifying objects and judging their significance. Interpreters study remotely sensed data and attempt through logical processes in detecting, identifying, classifying, measuring and evaluating the significance of physical and cultural object, their patterns and spatial relationships. Image interpretation is a complex process of physical, physiological activities occurring in a sequence begins with the detection and identification of images and later by their measurements. Different aspects of image interpretation are listed below in a simpler form most of these have overlapping function.

Detection and Identification

An interpreter studies remotely sensed data and attempts through logical process to detect, identify, measure and evaluate the significance of environmental and cultural objects, patterns and spatial relationships. It is an information extraction process. Anyone who looks at a photograph or imagery in order to recognize an image is an interpreter. A soil scientist, a geologist or a hydro geologist, a forester or a planner, trained in image interpretation can recognize the vertical view presented by the ground objects on an aerial photograph or a satellite image, which enables him or her to detect many small or subtle features. An interpreter is, therefore, a specialist trained in the study of photograph or imagery, in addition to his or her own discipline. The present discussion mainly pertains to the techniques of visual interpretation, the application of various instruments and the extraction of information.

Recognition

It is a process of classification or trying to distinguish an object by its characteristics or patterns which are familiar on the image. It preceded the process of detection. Sometimes it is also termed as photo reading e.g. vegetation, water bodies, built-up land etc.

Analysis

It is a process of resolving or separating a set of objects or features having similar set of characteristics. In analysis 'lines of separation' are drawn between groups of objects and the degree of reliability of these lines can also be indicated e.g. vegetation as that of built-up land, water bodies with that of waste lands etc.

Classification

It is a process of identification and grouping of objects or features resolved by analysis. It arranges 'features of recurrence' in the same class or group to which the feature belongs. Any wrong identification and analysis may often lead to misclassification.

Deduction

Deduction may be directed to the separation of different groups of objects or elements and deducing their significance based on covering evidence. The evidence is derived from mainly visible objects or from invisible elements, which give only partial information on the nature of certain correlative indications. Deduction as regard to the identification of objects made without proper pre-interpretation checks in the field may often be misleading and result in wrong classification. For complicated interpretation, therefore, it is advisable to affect the separation under this process and leave the deduction of the identity till after the clarification.

Idealization

It is a process of drawing ideal or standard representation from what is actually identified and interpreted from the image or map with standard symbols and colors.

Key Elements of Image interpretation or Basic Principle of Image Interpretation or Visual image Interpretation: tone, shape, size pattern, texture, shadow and association.

Recognizing targets is the key to interpretation and information extraction. Observing the differences between targets and their backgrounds involves comparing different targets based on any, or all, of the visual elements of tone, shape, size, pattern, texture, shadow, location, association and height. Some of these elements are interconnected and are classified into three orders viz. Basic or First order elements (Tone), Second order (Texture, shape, size, pattern) and Third order (Location, Association, Shadow and Height). Visual interpretation using these elements is often a part of our daily lives, whether we are conscious of it or not. Examining satellite images on the weather report or following high speed chases by views from a helicopter are all familiar examples of visual image interpretation. Identifying targets in remotely sensed images based on these visual elements

allows us to further interpret and analyze. The nature of each of these interpretation elements is described below, along with an image example of each.

A Basic, first order elements of image interpretation

- 1 **Tone/Colour** - Tone refers to the relative brightness of objects in an image. Generally, tone is the fundamental element for distinguishing between different targets or features. Variations in tone also allow the elements of shape, texture, and pattern of objects to be distinguished. Colour may be defined as each distinguishable variation on an image produced by a multitude of combinations of hue, value and chroma. Therefore tone refers to the relative brightness or colour of objects on an image. (Fig 8).

Fig 8



Colour Variations

Many factors influence the tone or colour of objects or features recorded on photographic emulsions. Human interpreter can distinguish between ten to twenty shades of grey, but can distinguish many more colours (figure 2). Some authors state that interpreters can distinguish at least 100 times more variations of colour on colour photography than shades of gray on black and white photography. (Fig 9)

Fig 9



Tonal variations

B Second order — Geometric Arrangements of Objects

- 1 **Size** –The size of objects can be important in discrimination of objects and features (single family vs. multi-family residences, scrubs vs. trees, etc.). In the use of size as a diagnostic characteristic both the relative and absolute sizes of objects can be important. Size can also be used in judging the significance of objects and features (size of trees related to board feet which may be cut; size of agricultural fields related to water use in arid areas, or amount of fertilizers used; size of runways gives an indication of the types of

aircraft that can be accommodated) as shown in figure 3. It is important to assess the size of a target relative to other objects in a scene, as well as the absolute size, to aid in the interpretation of that target. (Fig 10)

Fig 10



Size as parameter for visual interpretation

- 2 Shape - Shape refers to the general form, structure, or outline of individual objects. Shape can be a very distinctive clue for interpretation. Straight edge shapes typically represent urban or agricultural (field) targets, while natural features, such as forest edges, are generally more irregular in shape, except where man has created a road or clear cuts. Similarly, roads can have right angle turns, rail lines do not. play grounds, large buildings, parks etc. have specific shapes and can easily be identified shown in fig 11.

Fig 11



Shape as parameter for visual interpretation

- 3 Texture: It refers to the arrangement and frequency of tonal variation in particular areas of an image. The visual impression of smoothness or roughness of an area can often be a valuable clue in image interpretation. Rough textures would consist of a mottled tone where the grey levels change abruptly in a small area, whereas smooth textures would have very little tonal variation as shown in figure 5. Smooth textures are most often the result of uniform, even surfaces, such as fields, asphalt, or grasslands. A target with a rough surface and irregular structure, such as a forest canopy, results in a rough textured appearance. Similarly, various density of scrub vegetation shows different texture. Uniform fields of crops, water bodies etc gives smooth texture. (Fig 12)
- 4 Pattern: Pattern is the spatial arrangement of objects. Pattern can be either man-made or natural. Pattern is a macro image characteristic. It is the regular arrangement of objects that can be diagnostic of features on the landscape. Arrangements of complex drainage in the form of ravines can be identified easily. Likewise, the network or grid of streets in a sub-division or urban area can aid identification and aid in problem solving such as the growth patterns of a city. Pattern

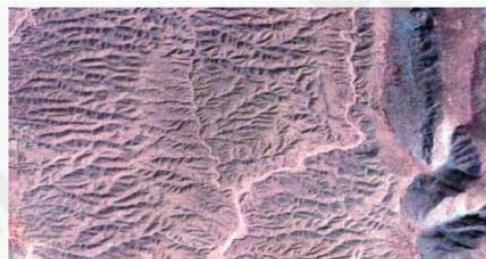
can also be very important in geological or geomorphological analysis. Drainage pattern can tell the trained observer a great deal about the lithology and structural patterns in an area (figure 6). Dendritic drainage patterns develop on flat bedded sediments; radial on/over domes; linear or trellis in areas with faults or other structural controls. (Fig 13)

Fig 12



Textural variations

Fig 13



Pattern variations

C Third order — Location or Positional Elements

- 1 Shadow: It is useful in interpretation as it may provide an idea of the profile and relative height of a target or targets which may make identification easier. However, shadows can also reduce or eliminate interpretation in their area of influence, since targets within shadows are much less (or not at all) discernible from their surroundings. Shadow is also useful for enhancing or identifying topography and landforms (Fig 14).

Fig 14



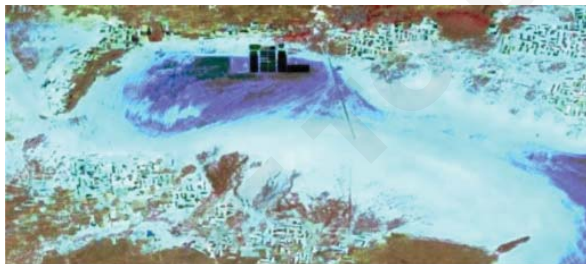
Shadow used for identifying topography in imagery

- 2 Location: How objects are arranged with respect to one another; or with respect to various terrain features, can be an aid in interpretation. Aspect, topography, geology, soil, vegetation and cultural features such as salt pans, settlements, industrial establishments etc. on the landscape are distinctive factors that the interpreter should use when examining a site. The relative importance of each of these factors will vary with local conditions, but all are important. Just as

some vegetation grows in swamps others grow on sandy ridges. Agricultural crops may like certain conditions. Man made features may also be found on rivers (e.g. power plant) or on a hill top (observatory or radar facility).

- 3 Association: It takes into account the relationship between other recognizable objects or features in proximity to the target of interest. The identification of features that one would expect to associate with other features may provide information to facilitate identification. Some objects are so commonly associated with one another that identification of one tends to indicate or confirm the existence of another. Smoke stacks, step buildings, cooling ponds, transformer yards, coal piles, railroad tracks = coal fired power plant. Arid terrain, basin bottom location, highly reflective surface, sparse vegetation = playa. Water body surrounded by salt pond and saline patches = salt production units (figure 8). Association is one of the most helpful clues in identifying man made installations. Aluminium manufacture requires large amounts of electrical energy. Absence of a power supply may rule out this industry. Cement plants have rotary kilns. Schools at different levels typically have characteristic playing fields, parking lot and cluster of building in urban area.
- 4 Height: Height can add significant information in many types of interpretation tasks; particularly those that deal with the analysis of man-made features. How tall a tree is can tell something about board feet. How deep an excavation can tell something about the amount of material that was removed (in some mining operations excavators are paid on the basis of material removed as determined by photogrammetric analysis). High rise buildings with symmetry of windows and parking arrangements shows residential (Fig 15 & 16).

Fig 15



Salt patches and salt production unit

Fig 16



High rise buildings with parking arrangements

Methods and techniques of image interpretation, Methods Visual and DIP, Types of interpretation Qualitative and Quantitative, Visual image interpretation, Digital Image interpretation.

Photo or visual interpretation is the art and science of examining photographs to identify the objects portrayed on them and evaluates their significance. Principles of photo interpretation were initially developed for aerial photographic work. They are now extended to all remote sensing digital image products, including processed and unprocessed images.

There are basically two techniques that people tend to follow when searching for imagery. One is logical search and the other can be termed the "fishing expedition". In the latter, the fishing expedition, the interpreter searches the imagery in a random fashion attempting to find recognizable features or object that will lead to whatever the interpretation goal happens to be. At some point even this type of interpretation begins to logically converge. Patterns of anomalous vegetation may lead to looking for water sources, which may lead to looking for transportation systems, illegal growing etc. Logical search is a more systematic method of analysis most often used by interpreters.

The logical search involves these things

- 1 The interpreter should always keep in mind the basic qualities of the imagery they are dealing with, e.g. film filter combination, the season and time of day of acquisition, and the image scale, etc. In addition the interpreter should always remember to examine all the titling information on an image.
- 2 Interpretation should begin with the general and proceed to the specific. After gaining an overall impression of the photograph the interpreter should begin to examine the physical features (e.g. water bodies, mountains, forests, etc.) and cultural features (e.g. urban areas, farms, road networks etc.). The interpreter should then move to more specific questions e.g. what type of trees makes up the forest? What types of roads are present?
- 3 Interpretation should be conducted logically one step at a time. Following from 2 above it is good to go from a detailed examination of landforms to vegetation, to hydrology and so on. Then address cultural features in the same fashion. What types of urban features are present single family residences, multi-family residences, industries, retail districts and so on.

Two main methods of interpretation of data: a qualitative and quantitative analysis.

Qualitative Interpretation

Qualitative data analysis can be summed up in one word – categorical. With qualitative analysis, data is not described through numerical values or patterns, but through the use of descriptive context (i.e., text). Typically, narrative data is gathered by employing a wide variety of person-to-person techniques. In this interpretation we can

categorize the features into different classes. Identify and recognize the different land use / land cover, on the imagery based on image characteristics, for correct classification of land use, refer classification system.

Quantitative Interpretation

If quantitative data interpretation could be summed up in one word (and it really can't) that word would be "numerical." Quantitative analysis refers to a set of processes by which numerical data is analyzed. More often than not, it involves the use of statistical modeling such as standard deviation, mean and median. In this interpretation we can know the

area of the features and length of the features and number of the features into different categorizes.

- i Calculate area of different land use / land cover categories either using a millimeter Polythene graph sheet and / or a planimeter.
- ii For better consistency and accuracy of area calculation, repeat the operation at least thrice and select the average of the two nearest values.
- iii Compute the area both in square km and in hectares, also calculate percentage.

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Essentials of Map Making, Types

Objectives : At the end of this lesson you shall be able to

- explain essentials of map making
- state types and series of maps, topo sheets numbering system.

Essentials of map making: Scale, type of scales, coordinate system, map projection, map generalization and symbolization, map designing

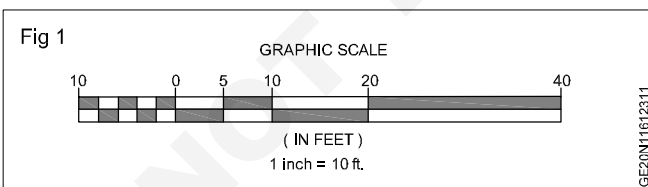
Scale

By necessity, the process of representing geographic features on a sheet of paper involves the reduction of these features. The ratio between the reduced depiction on the map and the geographical features in the real world is known as the map scale that is the ratio of the distance between two points on the map and the corresponding distance on the ground.

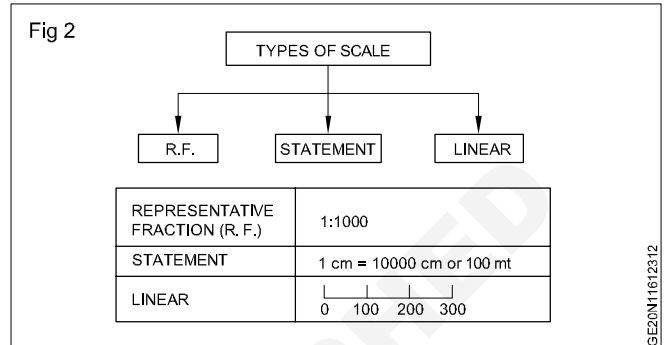
Type of scales

Fractional scale: If two points are 1 km apart in the field, they may be represented on the map as separated by some fraction of that distance, say 1 cm. In this instance, the scale is 1 cm to a kilometer. There are 100,000 cm in 1 km; so this scale can be expressed as the fraction or ratio of 1:100,000. Many topographic maps of the United States Geological Survey have a scale of 1:62,500; and many recent maps have a scale of 1:31,250, and others of 1:24,000. In India, commonly used fractional map scales are 1:1,00,000,00; 1 :250,000, 1 :50,000; 1 :25,000 and 1 :10,000. The method of representing this type of scale is called **Representation Fraction (RF)** method.

Graphic scale: This scale is a line printed on the map and divided into units that are equivalent to some distance such as 1 km or 1 mile. The measured ground distance appears directly on the map in graphical representation. A linear scale, also called a bar scale, scale bar, graphic scale, or graphical scale, is a means of visually showing the scale of a map. (Fig 1)



Verbal scale (Fig 2): This is an expression in common speech, such as, “four centimeters to the kilometer”, “an inch to a mile”. This common method of expressing a scale has the advantage of being easily understood by most map users. Or **Statement scale:** The scale of a map may be indicated in the form of a written statement. For example, if on a map a written statement appears stating 1 cm represents 10 km, it means that on that map a distance of 1 cm is representing 10 km of the corresponding ground distance.



Coordinate system

We have two types of coordinate systems. They are geographical and projectional. A geographic coordinate system (GCS) is a reference framework that defines the locations of features on a model of the earth. It's shaped like a globe—spherical. Its units are angular, usually degrees. A projected coordinate system (PCS) is flat.

Map projection

Maps are a simplified representation of the three-dimensional surface of the earth on a plane sheet of paper. The transformation of all-side curved-geoidal surface into a plane surface is another important aspect of the cartographic process. Such a radical transformation introduces some unavoidable changes in directions, distances, areas and shapes from the way they appear on a geoid. A system of transformation of the spherical surface to the plane surface is called a map projection. Hence, the choice, utilisation and construction of projections is of prime importance in map-making.

Projection is the method of transferring the graticule of latitude and longitude on a plane surface.

or

Map projection: It is the system of transformation of the spherical surface onto a plane surface.

or

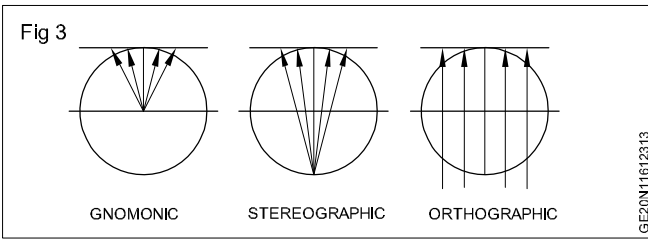
The 3D convert into 2D is called map projection.

In order to 3D surface of a round body on a two-dimensional flat plane, that can be cut and flattened onto a plane without stretching or creasing. At that time the properties of map projections are distortion: **distance, shape, area and direction.**

Distance between any given points of a region; Shape of the region; Area of the region in accuracy; Direction of any one point of the region bearing to another point. In

any projection something (distance, shape, area and direction) will always be distorted.

Types of projections (Fig 3)



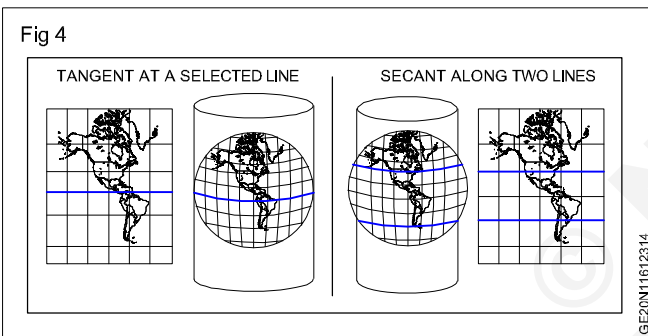
Based on source of light : On the basis of location of source of light, projections may be classified as gnomonic, stereographic and orthographic.

Orthographic: the light is at infinity. Gnomonic: The light is at the center of the ellipsoid. Stereographic: The light is at the surface of the ellipsoid.

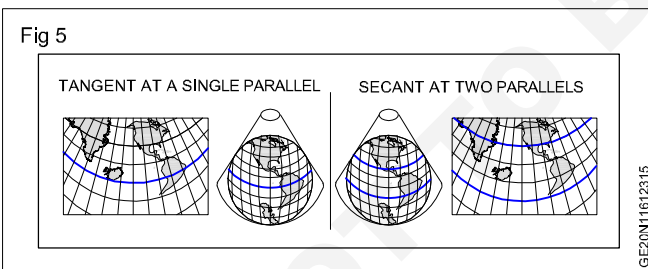
Based on shape or based on developable surface

A developable surface is a geometric shape that can be laid out into a flat surface without stretching or tearing. They are:

Cylindrical (Fig 4)



Conic or Conical (Fig 5)



Planar or Azimuthal or zenithal

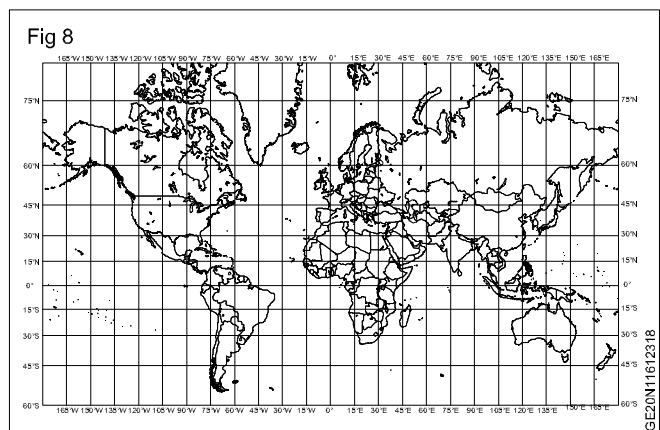
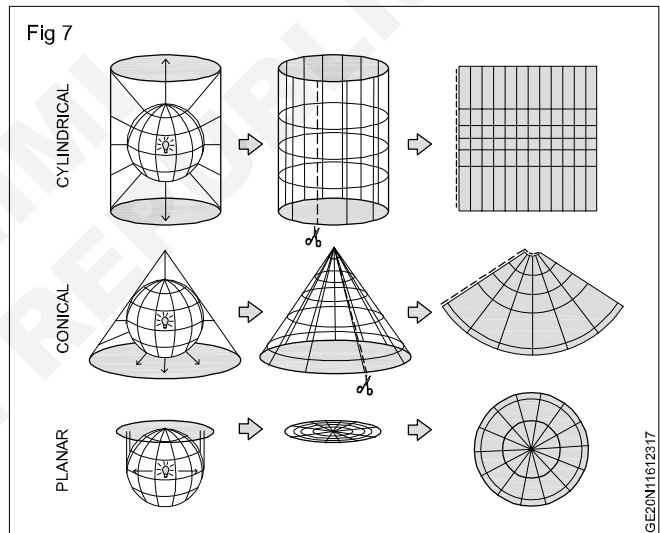
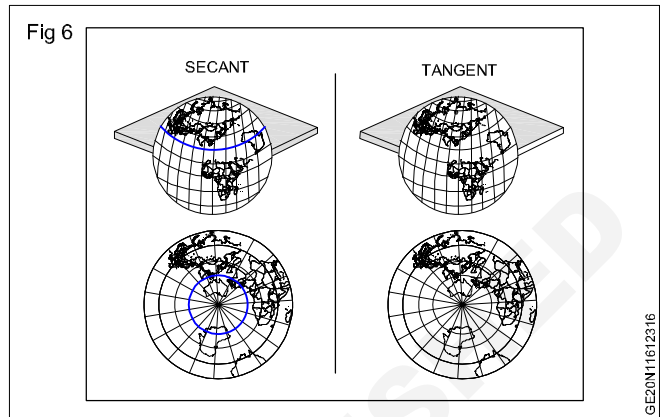
Universal Transverse Mercator (UTM)

UTM divides the earth between 84°N and 80°S into 60 zones, each of which covers 6 degrees of longitude. Zone 1 begins at 180° W longitude. Each UTM zone is projected separately and have Metric units (meters).

Map generalization (Fig 6 to 8)

Cartographic generalization, or map generalization, includes all changes in a map that are made when one derives a smaller-scale map from a larger-scale map or map data. It is a core part of cartographic design. Whether done manually by a cartographer or by a computer or set

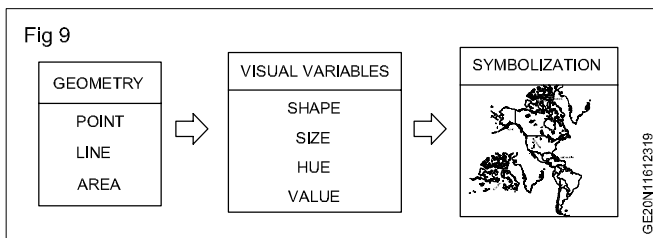
of algorithms, generalization seeks to abstract spatial information at a high level of detail to information that can be rendered on a map at a lower level of detail. For example, we might have the outlines of all of the thousands of buildings in a region, but we wish to make a map of the whole city no more than a few inches wide. Instead of throwing out the building information, or trying to render it all at once, we could generalize the data into some sort of outline of the urbanized area of the region.



Symbolization (Fig 9)

Symbolization is a graphical device used to visually represent a real-world feature on a map, working in the same fashion as other forms of symbols. Map symbols may include point markers, lines, regions, continuous

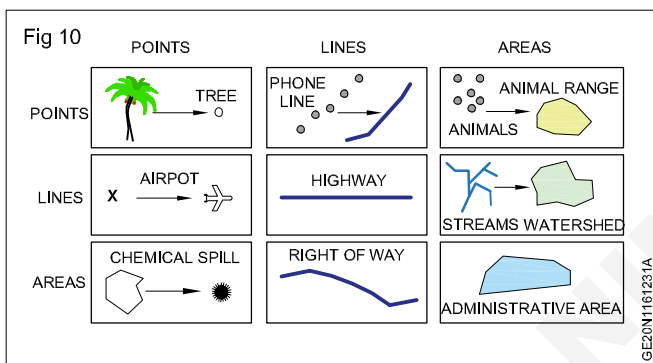
fields, or text; these can be designed visually in their shape, size, color, pattern, and other graphic variables to represent a variety of information about each phenomenon being represented.



We look at two key components of symbolization: geometry and visual variables. Per the figure below, these components all work together to make map symbolization.

Geometry (Fig 10)

Most map symbols are essentially variations on three simple geometric features: the point, the line, and the polygon.



Points are typically used for discrete features, such as a tree or the location of a store. Lines are often used to represent roads, telephone lines, or other long, continuous features. Areas or polygons are typically used to represent boundaries such as counties or parks, but they can also be used to help generalize data such as the concentration of many individual animals. It is very common for all three of these geometric objects to be used in a single map, such as the map of Montreal below which contains the locations of roads (lines), cities (points), and parks (areas).

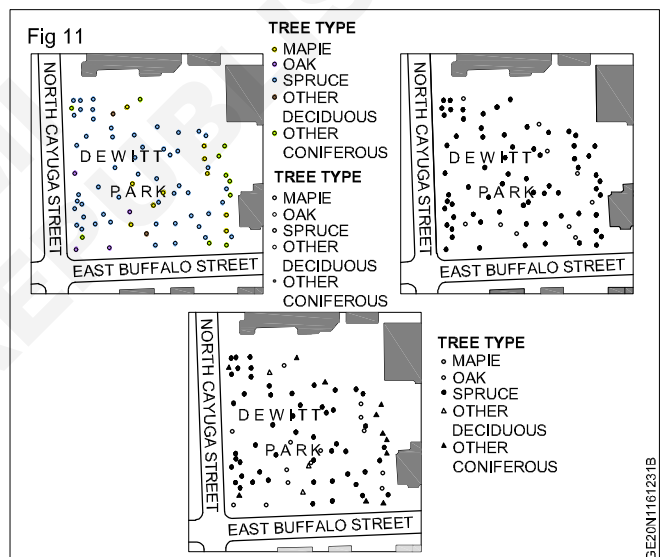
Visual Variables (Table -1)

We can modify the appearance of basic geometries of maps (points, lines, and polygons) in many ways. The modifications or variation of these points, lines, and polygons are referred to as visual variables because they describe how a given visual entity, like a line, for example, varies from dark to light or big to small. Visual variables are important in displaying both qualitative and quantitative data. The four main visual variables that are commonly manipulated on maps are shape, size, hue, and value. The figure below highlights the main tenants of these visual variables as well as what types of data they are best suited for.

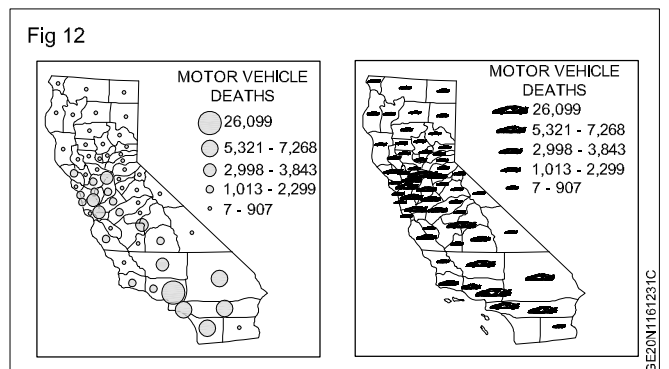
Table -1

| Visual Variable | What type of data is it used for? |
|-----------------|-----------------------------------|
| Shape | Qualitative |
| Size | Quantitative |
| Hue | Qualitative |
| Value | Quantitative |

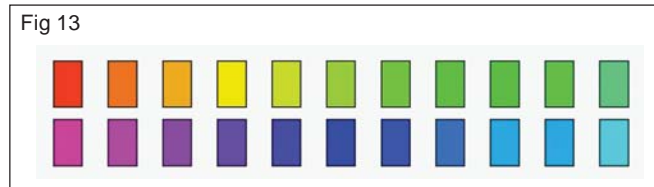
Shape: Shapes often indicate differences in kind, so they are good for qualitative data. There are certain conventions of shape use, such as an airplane for an airport, or a cross for a hospital. Shapes can also have much more specific representations. A wildlife map might show simple pictures of different species of animals to show the location of their habitats. Corporate logos can also be used, indicating the locations of dealerships for different models like Honda or Ford, or someone looking for a nearby fast food restaurant can easily distinguish between the locations of a McDonald's or a Burger King. (Fig 11)



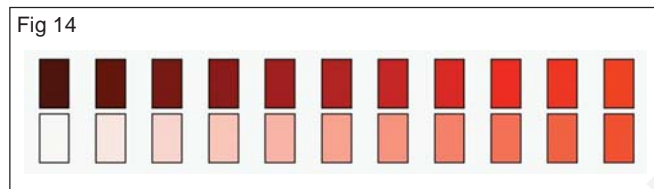
Size: Size is a visual variable especially well-suited for quantitative attributes. Large sizes are often understood to represent something of high value or importance, while small sizes represent low or less important values. Size is limited by the ability of the map audience to estimate the difference between sizes. (Fig 12)



Hue (Fig 13): When people speak about color on a map they usually refer to what is technically known as hue. Hue is most commonly used to distinguish between qualitative data. Decisions are based on psychological and social factors because we associate certain colors with certain real-world things: blue (water), green (forest), and red (fire or heat). It is also common for red to be used to signify intensity or importance while calming colors such as blue or grey help to signify something of less intensity.



Value (Fig 14): Value refers to the lightness or darkness of a hue. It is most commonly used for quantitative data as it can demonstrate relative importance or amount on a continuous scale. While the distinction between light and dark is fairly obvious, be careful not to use too many different values on a map. The human eye has difficulty distinguishing more than about eight values on a map.



Map designing

Cartographic design or map design is the process of crafting the appearance of a map, applying the principles of design and knowledge of how maps are used to create a map that has both aesthetic appeal and practical function.

Map

Maps are thus the cartographer's representation of an area and a graphic representation of selected natural and man-made features of the whole or a part of the earth's surface on a flat sheet of paper on a definite scale.

Types and series of maps

Based on scale

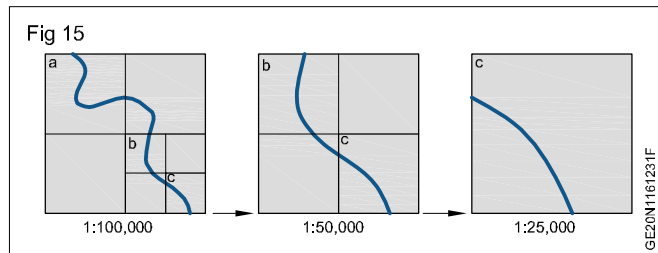
Based on the scale maps are two types. They are Large scale maps and Small scale maps.

Based on the scale, maps can be classified into two types. The large scale maps represent large amounts of detail, but of a smaller area, and small scale maps represent a small amount of detail, but can show a large area. See below figear and easy to understand the large scale map amd small scale map. 1:100,000 map is small scale map and 1:25,000 map is large scale map.

Based on theme

Thematic Maps focus on a specific theme. It pulls together relevant information of the subject (say, health, election, income, etc.) and represents it spatially to

understand the relationship between these themes and their locations.(Fig 15)



Choropleth Map

The choropleth map is one of the most frequently used maps. It is a type of thematic map in which we use colour to represent statistics of an attribute feature we are interested proportionally to its location — for example, the unemployment rate of each county. Choropleths are good at displaying densities using colours.

Dot Map

A dot distribution map, or dot density map, is a thematic map type that uses dots (variation of marks) to display the presence or absence of a feature. Typically, one point is assigned to represent a larger quantity. For example, in the below map, one dot represents 100 indigenous people in Australia.

Graduated Symbol Map

Graduated maps are an alternative to choropleth maps. The difference is instead of using colour to indicate feature attributes or statistics; Graduated symbol map uses points. The data is likely stored in Polygons and then converted to centroid points for these areas. We use this type of map when we intend to visualise quantities rather than densities in Choropleth map.

Heat Maps

Heat maps display the density of points on a geographic map and can effectively visualise the intensity of the variable through a colour scale. A heat map shows hot spots or concentrations of points. This technique is often used when geographic boundaries are not that much important.

Chorochromatic map

A Chorochromatic map also known as an area-class, qualitative area, is a type of thematic map that portray regions of categorical or nominal data using variations in color symbols. Chorochromatic maps are typically used to represent discrete fields, also known as categorical coverages.

Topo sheets numbering system

The numbering of sheets in India is based on the number system of maps of india and these series bears the numbers like 1,2,3,4 ...upto 136 consisting of the segments that cover only land area. these 136 such sheets cover India and adjacent countries and these numbers are known as index number of the area.

GPS Signal, Survey Methods and Measurements

Objectives : At the end of this lesson you shall be able to

- **define GPS**
- **state coordinate and time system**
- **explain satellite & conventional geodetic system**
- **explain GPS, signal, code and biases**
- **state gps survey method**
- **explain ground support equipment**
- **types of receiver**
- **state modes of measurement**
- **explain GPS accuracy & there application.**

Introduction to Global positioning System GNSS

The Global Positioning System was conceived in 1960 under the auspices of the U.S. Air Force, but in 1974 the other branches of the U.S. military joined the effort. The first satellites were launched into space in 1978. The System was declared fully operational in April 1995.

The Global Positioning System consists of 24 satellites, that circle the globe once every 12 hours, to provide worldwide position, time and velocity information. GPS makes it possible to precisely identify locations on the earth by measuring distance from the satellites. GPS allows you to record or create locations from places on the earth and help you navigate to and from those places. Originally the System was designed only for military applications and it wasn't until the 1980's that it was made available for civilian use also.

Coordinate and Time system

GPS coordinates are a unique identifier of a precise geographic location on the earth, usually expressed in alphanumeric characters. Coordinates, in this context, are points of intersection in a grid system. GPS (global positioning system) coordinates are usually expressed as the combination of latitude and longitude. Latitude is a measure of degrees of distance from the equator, which is 0 degrees. The north and south poles are at 90 degrees in either direction. The prime meridian is 0 degrees longitude and the locations are measured according to 90 degrees east or west from that point.

GPS Time (GPST) is a continuous time scale (no leap seconds) defined by the GPS Control segment on the basis of a set of atomic clocks at the Monitor Stations and onboard the satellites. It starts at 0^h UTC (midnight) of January 5th to 6th 1980 (6.⁰⁰). GPS time is a continuous time scale and does not adjust for leap second insertions. It therefore diverges from UTC at the introduction of each leap second.

UTC and Local Time Scales

Time is represented in different ways. Local time is the current time in your locale or region. It is affected by your locations time zone and daylight saving time.

Local time is calculated from UTC time, but is adjusted for time zone and daylight saving offsets.

UTC, or Universal Coordinated Time, is not affected by time zones or daylight saving. It is the same anywhere on Earth, regardless of location. UTC is periodically adjusted to accommodate leap second insertions.

The GPS Atomic Time Scale

The GPS system consists of a constellation of Earth orbiting satellites. Each satellite is fitted with a highly accurate atomic clock, which is periodically synchronized by a ground control station located at USNO, Colorado. GPS time is the atomic time scale maintained by GPS satellites and the ground control stations used to synchronize the GPS system.

Satellite and conventional geodetic system

The World Geodetic System (WGS) is a standard for use in cartography, geodesy, and satellite navigation including GPS. This standard includes the definition of the coordinate system's fundamental and derived constants, the normal gravity Earth Gravitational Model (EGM), a description of the associated World Magnetic Model (WMM), and a current list of local datum transformations.

The latest revision is WGS 84 (also known as WGS 1984, EPSG:4326), established and maintained by the United States National Geospatial-Intelligence Agency since 1984, and last revised in January 2021 (G2139). Earlier schemes included WGS 72, WGS 66, and WGS 60. WGS 84 is the reference coordinate system used by the Global Positioning System.

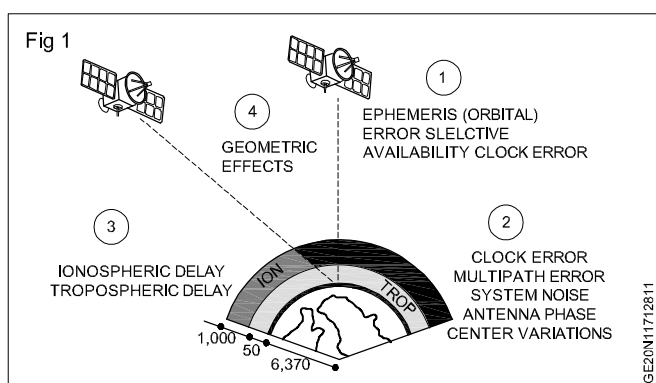
GPS, Signal, code and Biases

There are four GPS signal specifications designed for civilian use. In order of date of introduction, these are: L1 C/A, L2C, L5 and L1C. L1 C/A is also called the legacy signal and is broadcast by all currently operational satellites. L2C, L5 and L1C are modernized signals, are only broadcast by newer satellites (or not yet at all), and as of January 2021, none are yet considered to be fully operational for civilian use. In addition, there are restricted signals with published frequencies and chip rates but encrypted coding intended to be used only by authorized

parties. Some limited use of restricted signals can still be made by civilians without decryption; this is called codeless and semi-codeless access, and is officially supported.

The original GPS design contains two ranging codes: the coarse/acquisition (C/A) code, which is freely available to the public, and the restricted precision (P) code, usually reserved for military applications.

GPS pseudo range and carrier phase measurements are both affected by several types of random errors and biases (systematic errors). These errors may be classified as those originating at the satellites, those originating at the receiver, and those that are due to signal propagation (atmospheric refraction). Fig 1 shows the various errors and biases.



The errors originating at the satellites include ephemeris, or orbital errors, satellite clock errors, and the effect of selective availability. The later was intentionally implemented by the U.S. department of defense to degrade the autonomous GPS accuracy for security reasons. It was, however, terminated at midnight (eastern daylight time) on May 1, 2000. The errors originating at the receiver include receiver clock errors, multipath error, receiver noise, and antenna phase center variations. The signal propagation errors include the delay of the GPS signal as it passes through the ionospheric and tropospheric layers of the atmosphere. In fact, it is only in a vacuum (free space) that the GPS signal travels, or propagates, at the speed of light.

In addition to the effect of these errors, the accuracy of the computed GPS position is also affected by the geometric locations of the GPS satellites as seen by the receiver. The more spread out the satellites are in the sky, the better the obtained accuracy.

GPS Ephemeris Errors

Satellite positions as a function of time, which are included in the broadcast satellite navigation message, are predicted from previous GPS observations at the ground control stations. Typically, overlapping 4-hour GPS data spans are used by the operational control system to predict fresh satellite orbital elements for each 1-hour period. As might be expected, modeling the forces acting on the GPS satellites will not be perfect, which causes some errors in the estimated satellite positions, known as ephemeris errors. Nominally, an ephemeris error is

usually in the order of 2m to 5m, and can reach up to 50 m under selective availability. According to, the range error due to the combined effect of the ephemeris and the Satellite clock errors is of the order of 2.3m.

An ephemeris error for a particular satellite is identical to all GPS users worldwide. However, as different users see the same satellite at different view angles, the effect of the ephemeris error on the range measurement, and consequently on the computed position, is different. This means that combining (differencing) the measurements of two receivers simultaneously tracking a particular satellite cannot totally remove the ephemeris error.

Precise ephemeris data is based on GPS data collected at a global GPS network coordinated by the IGS (International GPS Service for Geodynamics). At the present time, precise ephemeris data is available to users with some delay, which varies from 12 hours for the IGS ultra rapid orbit to about 12 days for the most precise IGS precise orbit. The corresponding accuracies for the two precise orbits are in the order of a few decimeters to 1 decimeter, respectively. Users can download the precise ephemeris data free of charge from the IGS center.

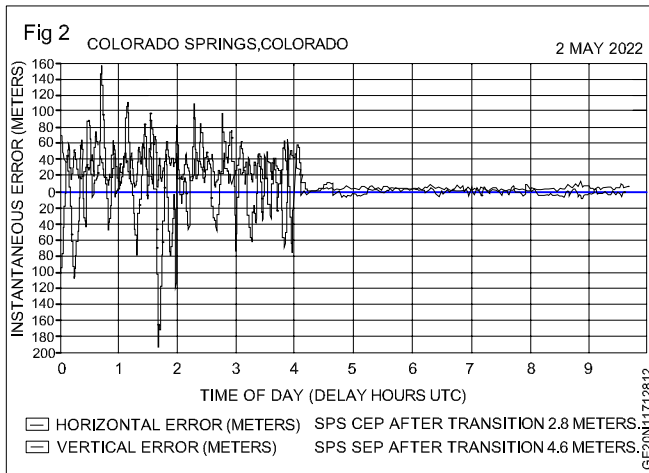
Selective Availability

GPS was originally designed so that real-time autonomous positioning and navigation with the civilian C/A code receivers would be less precise than military P-code receivers. Surprisingly, the obtained accuracy was almost the same from both receivers. To ensure national security, the U.S. department of defense implemented the so called selective availability (SA) on Block II GPS satellites to deny accurate real time autonomous positioning to unauthorized users. SA was officially activated on March 1990.

SA introduces two types of errors. The first one, called delta error, results from dithering the satellite clock, and is common to all users worldwide. The second one, called epsilon error, is an additional slowly varying orbital error. With SA turned on, nominal horizontal and vertical errors can be up to 100m and 156 m, respectively, at the 95% probability level.

Fig 2 shows how the horizontal position of a stationary GPS receiver varies over time, mainly as a result of the effect of SA. Like the range error due to ephemeris error, the range error due to epsilon error is almost identical between users of short separations. Therefore, using differential GPS would overcome the effect of the epsilon error. In fact, DGPS provides better accuracy than the standalone P-code receiver due to the elimination or the reduction of the common errors, including SA.

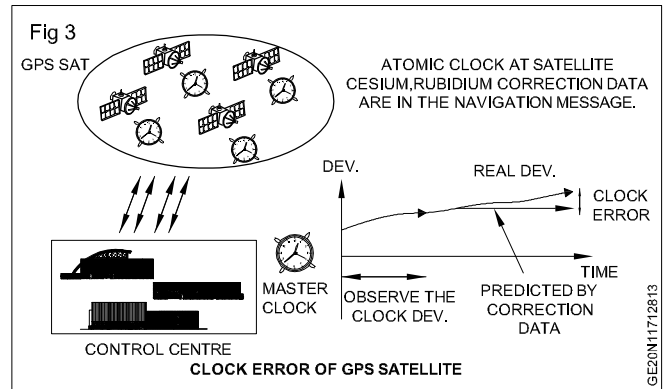
Following extensive studies, the U.S. government discontinued SA on May 1, 2000, resulting in a much improved autonomous GPS accuracy. With the SA turned off, the nominal autonomous GPS horizontal and vertical accuracies would be in the order of 22m and 33m.



Satellite and Receiver Clock Errors

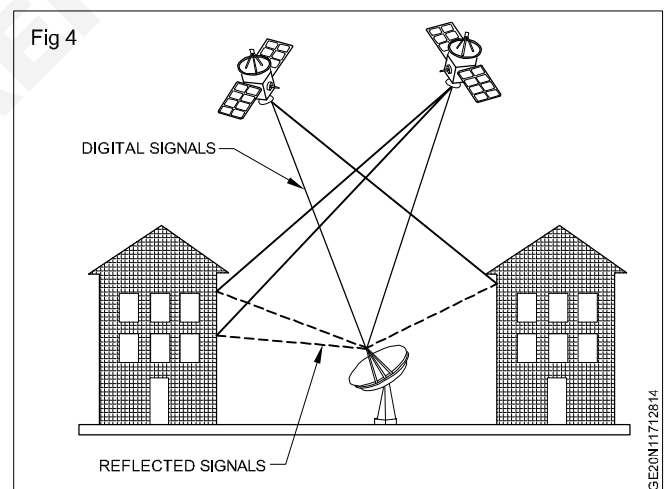
The clocks in the satellite are very accurate (to about 3 nano seconds), they do sometimes drift slightly and cause small errors, affecting the accuracy of the position. The US department of defense monitors the satellite clocks using the Control Segment and can correct any drift that is found. Each GPS Block II and Block IIA satellite contains four atomic clocks, two cesium and two rubidium. The newer generation Block IIR satellites carry rubidium clocks only. One of the onboard clocks, primarily a cesium for Block II and IIA, is selected to provide the frequency and the timing requirements for generating the GPS signals. The others are backups. The GPS satellite clocks, although highly accurate, are not perfect. Their stability is about 1 to 2 parts in 10¹³ over a period of one day. This means that the satellite clock error is about 8.64 to 17.28 ns per day. The corresponding range error is 2.59m to 5.18m, which can be easily calculated by multiplying the clock error by the speed of light. Cesium clocks tend to behave better over a longer period of time compared with rubidium clocks. In fact, the stability of the cesium clocks over a period of 10 days. The performance of the satellite clocks is monitored by the ground control system. The amount of drift is calculated and transmitted as a part of the navigation message in the form of three coefficients of a second-degree polynomial. Satellite clock errors cause additional errors to the GPS measurements. These errors are common to all users observing the same satellite and can be removed through differencing between the receivers. Applying the satellite clock correction in the navigation message can also correct the satellite clock errors. This, however, leaves an error of the order of several nano seconds, which translates to a range error of a few meters (one nano second error is equivalent to a range error of about 30 cm). GPS receivers, in contrast, use inexpensive crystal clocks, which are much less accurate than the satellite clocks. As such, the receiver clock error is much larger than that of the GPS satellite clock.

It can, however, be removed through differencing between the satellites or it can be treated as an additional unknown parameter in the estimation process. Precise external clocks (usually cesium or rubidium) are used in some applications instead of the internal receiver clock. Although the external atomic clocks have superior performance compared with the internal receiver clocks. (Fig 3)



Multipath Error

Multipath error is one of the predominant error sources in all GPS applications. Particularly the multipath error has to be precisely estimated in the Global Navigation Satellite Systems (GNSSs) as it is the major error source (2 - 4 m) that limits the GPS receiver's performance. Whenever, a signal is transmitted from a GPS satellite it follows a "multiple" number of propagation "paths" on its way to receiving antenna. These multiple signal paths are due to the fact that the signal gets reflected back to the antenna off surrounding objects, including the earth's surface. The GPS receiver tracks both the direct and reflected signal components. The radio wave transmitted from a satellite radiates in all directions, these radio waves including reflected waves that are reflected off due to various obstacles, diffracted waves, scattering waves, and the direct wave from the satellite to GPS receiver (Fig 4)



In this case, since the path lengths of the direct, reflected, diffracted, and scattering waves are different, the time each takes to reach the GPS receiver will be different. In addition the phase of the incoming wave varies because of reflections. As a result, the receiver receives a superposition consisting of several waves having different phase and times of arrival. The generic name of a radio wave in which the time of arrival is retarded in comparison with this direct wave is called a delayed wave. Then, the reception environment characterized by a superposition of delayed waves is called a multipath propagation environment. In a multipath propagation environment, the received signal is sometimes intensified. This phenomenon is called multipath fading and the signal level of the received wave changes from moment to moment.

Multipath is a major error source for both the carrier-phase and pseudo range measurements. It occurs when the GPS signal arrives at the receiver antenna through different paths. These paths can be the direct line of sight signal and reflected signals from objects surrounding the receiver antenna. Multipath distorts the original signal through interference with the reflected signals at the GPS antenna. It affects both the carrier-phase and pseudo range measurements; however, its size is much larger in the pseudo range measurements. The size of the carrier-phase multipath can reach a maximum value of a quarter of a cycle (about 4.8 cm for the L1 carrier phase). The pseudo range multipath can theoretically reach several tens of meters for the C/A-code measurements. However, with new advances in receiver technology, actual pseudo range multipath is reduced dramatically. Examples of such technologies are the Strobe correlated (Ashtech, Inc.) and the MEDLL (NovAtel, Inc.). With these multipath mitigation techniques, the pseudo range multipath error is reduced to several meters, even in a highly reflective environment. Under the same environment, the presence of multipath errors can be verified using a day-to-day correlation of the estimated residuals. This is because the satellite-reflector-antenna geometry repeats every sidereal day.

However, multipath errors in the undifferenced pseudo range measurements can be identified if dual-frequency observations are available. A good general multipath model is still not available, mainly because of the variant satellite reflector antenna geometry. There are, however several options to reduce the effect of multipath. The option is to select an observation site with no reflecting objects in the vicinity of the receiver antenna. Another option to reduce the effect of multipath is to use a chock ring antenna (a chock ring device is a ground plane that has several concentric metal hoops, which attenuate the reflected signals). As the GPS signal is right handed circularly polarized while the reflected signal is left handed, reducing the effect of multipath may also be achieved by using an antenna with a matching polarization to the GPS. The disadvantage of this option, however, is that the polarization of the multipath signal becomes right handed again if it twice reflected.

Antenna phase center variation

A GPS antenna receives the incoming satellite signal and then converts its energy into an electric current, which can be handled by the GPS receiver. The point at which the GPS signal is received is called the antenna phase center. Generally, the antenna phase center does not coincide with the physical (geometrical) center of the antenna. It varies depending on the elevation and the azimuth of the GPS satellite as well as the intensity of the observed signal. As a result, additional range error can be expected.

The size of the error caused by the antenna phase center variation depends on the antenna type, and is typically in the order of a few centimeters. It is, however, difficult to model the antenna phase center variation and, therefore, care has to be taken when selecting the antenna type. For short baselines with the same types of antennas at

each end, the phase center error can be canceled if the antennas are oriented in the same direction. Mixing different types of antennas or using different orientations will not cancel the error. Due to its small size, this error is neglected in most of the practical GPS applications. It should be pointed out that phase center errors could be different on L1 and L2 carrier phase observations. This can affect the accuracy of the ionosphere free linear combination, particularly when observing short baselines. As mentioned before, for short baselines, the errors are highly correlated over distance and cancel sufficiently through differencing. Therefore, using a single frequency might be more appropriate for short baselines in the static mode.

Receiver measurement noise

The receiver measurement noise results from the limitations of the receiver's electronics system. A good GPS system should have a minimum noise level. Generally, a GPS receiver performs a self test when the user turns it on. However, for high-cost precise GPS systems, it might be important for the user to perform the system evaluation. Two tests can be performed for evaluating a GPS receiver (system) a. zero baseline and b. short baseline tests.

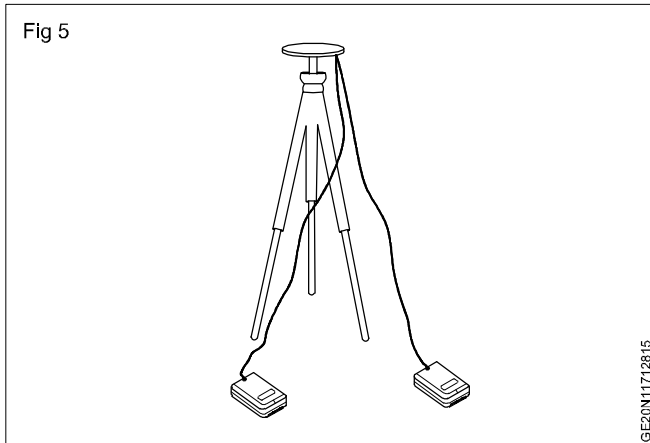
A zero baseline test is used to evaluate the receiver performance. The test involves using one antenna/preamplifier followed by a signal splitter that feeds two or more GPS receivers (see Figure.5). Several receiver problems such as inter channel biases and cycle slips can be detected with this test. As one antenna is used, the baseline solution should be zero. In other words, any nonzero value is attributed to the receiver noise. Although the zero baseline test provides useful information on the receiver performance, it does not provide any information on the antenna/preamplifier noise. The contribution of the receiver measurement noise to the range error will depend very much on the quality of the GPS receiver. Typical average value for range error due to the receiver measurement noise is of the order of 0.6m.

To evaluate the actual field performance of a GPS system, it is necessary to include the antenna/preamplifier noise component. This can be done using short baselines of a few meters apart, observed on two consecutive days (see Figure.5). In this case, the double difference residuals of one day would contain the system noise and the multipath effect. All other errors would cancel sufficiently. As the multipath signature repeats every sidereal day, differencing the double difference residuals between the two consecutive days eliminates the effect of multipath and leaves only the system noise.

Ionospheric delay

At the uppermost part of the earth's atmosphere, ultraviolet and X-ray radiations coming from the sun interact with the gas molecules and atoms. These interactions result in gas ionization: a large number of free "negatively charged" electrons and "positively charged" atoms and molecules. Such a region of the atmosphere where gas ionization takes place is called the ionosphere. It extends

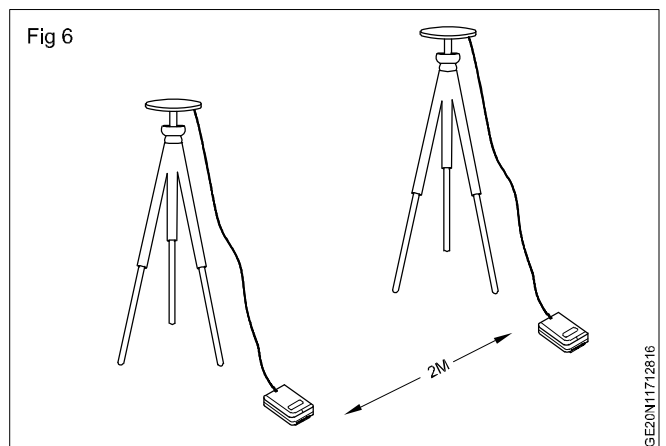
from an altitude of approximately 50 km to about 1,000 km or even more (Fig 5).



In fact, the upper limit of the ionospheric region is not clearly defined. The electron density within the ionospheric region is not constant; it changes with altitude. As such, the ionospheric region is divided into sub regions, or layers, according to the electron density. These layers are named D (S0-90 km), E (90-140 km), F1 (140-210 km), and F2 (210-1,000 km), respectively, with F2 usually being the layer of maximum electron density. The altitude and thickness of those layers vary with time, as a result of the changes in the sun's radiation and the Earth's magnetic field. For example, the F1 layer disappears during the night and is more pronounced in the summer than in the winter.

The ionosphere is a dispersive medium, which means it bends the GPS radio signal and changes its speed as it passes through the various ionospheric layers to reach a GPS receiver. Bending the GPS signal path causes a negligible range error, particularly if the satellite elevation angle is greater than 5°. It is the change in the propagation speed that causes a significant range error, and therefore should be accounted for. The ionosphere speeds up the propagation of the carrier phase beyond the speed of light, while it slows down the PRN code (and the navigation message) by the same amount. That is, the receiver-satellite distance will be too short if measured by the carrier phase and too long if measured by the code, compared with the actual distance. The ionospheric delay is proportional to the number of free electrons along the GPS signal path, called the total electron content (TEC). TEC, however, depends on a number of factors: (1) the time of day (electron density level reaches a daily maximum in early afternoon and a minimum around midnight at local time); (2) the time of year (electron density levels are higher in winter than in summer); (3) the 11-year solar cycle (electron density levels reach a maximum value approximately every 11 years, which corresponds to a peak in the solar flare activities known as the solar cycle peak-in 2001 we are currently around the peak of solar cycle number 23), and (4) the geographic location (electron density levels are minimum in mid latitude regions and highly irregular in polar and equatorial regions). As the ionosphere is a dispersive medium, it causes a delay that is frequency dependent.

The lower the frequency, the greater the delay; that is, the L2 ionospheric delay is greater than that of L1. Generally, ionospheric delay is of the order of 5m to 15m, but can reach over 150m under extreme solar activities, at midday, and near the horizon. This discussion shows that the electron density level in the ionosphere varies with time and location. It is, however, highly correlated over relatively short distances, and therefore differencing the GPS observations between users of short separation can remove the major part of the ionospheric delay. Taking advantage of the ionosphere's dispersive nature, the ionospheric delay can be determined with a high degree of accuracy by combining the P-code pseudo range measurements on both L1 and L2. Unfortunately, however, the P-code is accessible by authorized users only. With the addition of a second C/A-code on L2 as part of the modernization program, this limitation will be removed. The L1 and L2 carrier-phase measurements may be combined in a similar fashion to determine the variation in the ionospheric delay, not the absolute value. Users with dual-frequency receivers can combine the L1 and L2 carrier phase measurements to generate the ionosphere-free linear combination to remove the ionospheric delay. The disadvantages of the ionosphere-free linear combination, however, are: (1) it has a relatively higher observation noise, and (2) it does not preserve the integer nature of the ambiguity parameters. As such, the ionosphere-free linear combination is not recommended for short baselines. Single-frequency users cannot take advantage of the dispersive nature of the ionosphere. They can, however, use one of the empirical ionospheric models to correct up to 60% of the delay. The most widely used model is the Klobuchar model, whose coefficients are transmitted as part of the navigation message. Another solution for users with single-frequency GPS receivers is to use corrections from regional networks. Such corrections can be received in real time through communication links.



Tropospheric delay

The troposphere is the electrically neutral atmospheric region that extends up to about 50 km from the surface of the earth. The troposphere is a nondispersive medium for radio frequencies below 1S GHz. As a result, it delays the GPS carriers and codes identically.

That is, the measured satellite to receiver range will be longer than the actual geometric range, which means that a distance between two receivers will be longer than the actual distance. Unlike the ionospheric delay, the tropospheric delay cannot be removed by combining the L1 and the L2 observations. This is mainly because the tropospheric delay is frequency independent. The tropospheric delay depends on the temperature, pressure, and humidity along the signal path through the troposphere. Signals from satellites at low elevation angles travel a longer path through the troposphere than those at higher elevation angles. Therefore, the tropospheric delay is minimized at the user's zenith and maximized near the horizon. Tropospheric delay results in values of about 2.3m at zenith (satellite directly overhead), about 9.3m for a 15° elevation angle, and about 20-28m for a 5° elevation angle. Tropospheric delay may be broken into two components, dry and wet. The dry component represents about 90% of the delay and can be predicted to a high degree of accuracy using mathematical models. The wet component of the tropospheric delay depends on the water vapor along the GPS signal path. Unlike the dry component, the wet component is not easy to predict. Several mathematical models use surface meteorological measurements (atmospheric pressure, temperature, and partial water vapor pressure) to compute the wet component. Unfortunately, however, the wet component is weakly correlated with surface meteorological data, which limits its prediction accuracy. It was found that using default meteorological data (1,010 mb for atmospheric pressure, 20°C for temperature, and 50% for relative humidity) gives satisfactory results in most cases.

User equivalent range error

It has been shown that the GPS positioning accuracy is measured by the combined effect of the unmodeled measurement errors and the effect of the satellite geometry. The unmodeled measurement errors will certainly be different from one satellite to another, mainly because of the various view angles. In addition, the ranging errors for the various satellites will have a certain degree of similarity. To rigorously determine the expected GPS positioning accuracy, we may apply an estimation technique such as the least squares method. The least squares method estimates the user's position (location) as well as its covariance matrix. The latter tells us how well the user's position is determined. In fact, the covariance matrix reflects the combined effect of the measurement errors and the satellite geometry.

A more simplified way of examining the GPS positioning accuracy may be achieved through the introduction of the user equivalent range error. Assuming that the measurement errors for all the satellites are identical and independent, then a quantity known as the UERE may be defined as the root sum square of the various errors and biases. Multiplying the UERE by the appropriate DOP value produces the expected precision of the GPS positioning at the one sigma (1- σ) level. To obtain the precision at the 2- σ level, sometimes referred to as

approximately 95% of the time, we multiply the results by a factor of two. For example, assuming that the UERE is 8m for the standalone GPS receiver, and taking a typical value of HDOP as 1.5, then the 95% positional accuracy will be $8 \times 1.5 \times 2 = 24\text{m}$.

GPS segment organization

GPS is a Global Navigation Satellite System. GPS have 3 segments. they are Space segment, Control segment and User segment.

The **Space segment** consists of 24 satellites, each in its own orbit 20,200 kilometers above the Earth. The nominal GPS Operational Constellation consists of 24 satellites that orbit the earth in 12 hours. There are often more than 24 operational satellites as new ones are launched to replace older satellites. The satellite orbits repeat almost the same ground track once each day. The orbit altitude is such that the satellites repeat the same track and configuration over any point approximately each 24 hours (4 minutes earlier each day). There are six orbital planes with nominally four satellites in each, equally spaced (60 degrees apart). This constellation provides the user with between five and eight satellites visible from any point on the earth.

The **Control segment**: The control segment tracks the satellites and then provides them with corrected orbital and time information. The control segment consists of four unmanned control stations and one master control station. The four unmanned stations receive data from the satellites and then send that information to the master control station where it is corrected and sent back to the GPS satellites.

The **User segment**: The user segment consists of the users and their GPS receivers. The number of simultaneous users is limitless.

GPS Survey Methods Basic geodetic co-ordinate

There are three methods of GPS survey

1 Static GPS Baseline

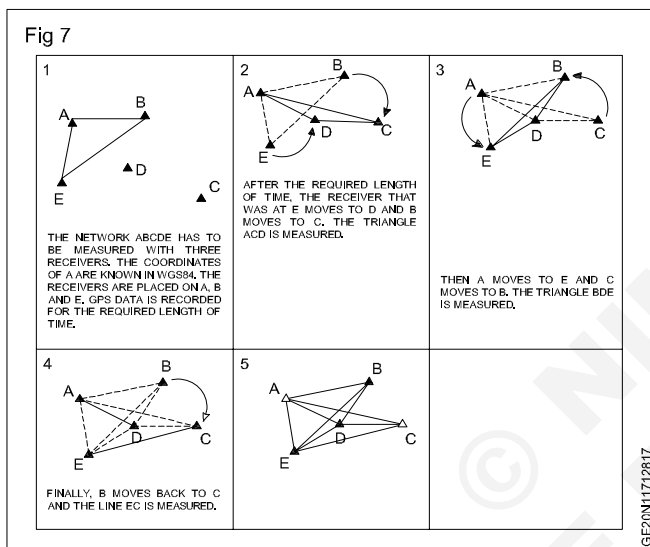
A Static GPS Baseline is a technique used to determine accurate coordinates for survey points. by simultaneously recording GPS observations over a known and unknown survey point for at least 20 minutes. Baseline measurements achieve this by recording GPS observations over time, then processing that data to provide the most accurate result.

This was the first method to be developed for GPS surveying. It can be used for measuring long baselines (usually 20km (16 miles) and over). One receiver is placed on a point whose coordinates are known accurately in WGS84. This is known as the Reference Receiver. The other receiver is placed on the other end of the baseline and is known as the Rover. Data is then recorded at both stations simultaneously. It is important that data is being recorded at the same rate at each station.

The data collection rate may be typically set to 15, 30 or 60 seconds. The receivers have to collect data for a certain

length of time. This time is influenced by the length of the line, the number of satellites observed and the satellite geometry (dilution of precision or DOP). As a rule of thumb, the observation time is a minimum of 1 hour for a 20km line with 5 satellites and a prevailing GDOP of 8. Longer lines require longer observation times.

Once enough data has been collected, the receivers can be switched off. The Rover can then be moved to the next baseline and measurement can once again commence. It is very important to introduce redundancy into the network that is being measured. This involves measuring points at least twice and creates safety checks against problems that would otherwise go undetected. A great increase in productivity can be realized with the addition of an extra Rover receiver. Good coordination is required between the survey crews in order to maximize the potential of having three receivers. An example is given below. (Fig 7)



2 Real-Time Kinematic Observations

Real-Time Kinematic or RTK Observations are similar to baseline methods in that they are used to measure distances between a base station and a second receiver. The difference, however, is that instead of measuring the location of two points over a long period of time, RTK Observations use multiple points in quick succession.

Like the baseline method, the RTK method uses two receivers, one being a static base station. The other receiver is the Rover Station, which moves to multiple positions during the measurement period. The position of the Rover Station is collected within a few seconds and stored. Once the measurement period is complete, this data is stored and used as survey data.

RTK observations are nearly as accurate as the baseline technique, though they are limited to a range of about 20 kilometers. This method maintains a high level of accuracy by collecting data at the Base Station and the Rover Station simultaneously and correcting data in real time — the exact position of the Base Station is known, so any variations can be used to correct the position of the Rover Station in real time. This method, therefore, can quickly gather survey data for smaller areas.

The Rover may then move freely. The user can record positions at a predefined recording rate, can record distinct positions, or record a combination of the two. This part of the measurement is commonly called the kinematic chain. A major point to watch during kinematic surveys is to avoid moving too close to objects that could block the satellite signal from the Rover receiver.

3 Continuously Operating Reference Stations

Continuously Operating Reference Stations or CORS operate using the same principles as the other measurement techniques described. The primary difference is that the base station is installed in a permanent known location. This allows measurements to be taken at any point in the district using the permanent base station as a starting point.

With a CORS-based system, receivers can be placed anywhere in the local area to collect data. When data collection is complete, the surveyors can combine the collected data with data from the CORS to calculate positions, correcting any anomalies to obtain an accurate position. In some cases, if multiple CORS are available, receiver data may be compared to the data of multiple CORS to achieve even more accurate results.

CORS are commonly used for major engineering projects that require continuous surveying over a long period of time — some examples include local government projects, mining sites and tectonic plate studies for scientific organizations.

Basic Geodetic Co-ordinate

Geodetic coordinates are a type of curvilinear orthogonal coordinate system used in geodesy based on a reference ellipsoid. They include geodetic latitude (north/south), longitude (east/west), and ellipsoidal height (also known as geodetic height). The triad is also known as Earth ellipsoidal coordinates.

The Global Positioning System uses the World Geodetic System (WGS84) as its reference coordinate system. It's made up of a reference ellipsoid, a standard coordinate system, altitude data, and a geoid.

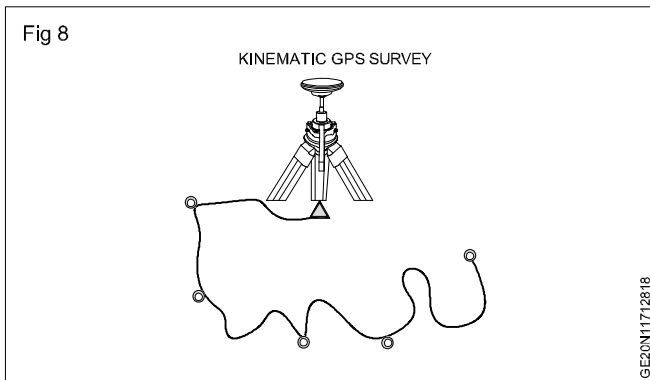
Ground Support Equipment

Ground support equipment (GSE) is the support equipment found at an airport, usually on the apron, the servicing area by the terminal. This equipment is used to service the aircraft between flights. As the name suggests, ground support equipment is there to support the operations of aircraft whilst on the ground. The role of this equipment generally involves ground power operations, aircraft mobility, and cargo/passenger loading operations.

GPS Receiver Types (Fig 8)

1 Multi-Constellation

The expansion of satellite navigation systems brought on the multi-constellation receivers. These receivers have a strong focus on compatibility. They take in signals and data from multiple sources to bring more exact calculations.



Each satellite constellation works with a set of communication parameters. There is a core set of communication that allows satellites to work together. Refining these parameters led to the development of multi-constellation receivers. These receivers have a focus on mobility, able to take in a variety of constellations regardless of where the receiver is. They can work in any position restriction.

2 Multi-Frequency

Similar to the multi-constellation receivers, multi-frequency servers instead work from multiple frequencies from each satellite to refine accuracy. Each GNSS signal has a dedicated frequency. The multi-frequency processing takes in a wide variety of signals, regardless of their frequency, and uses the influx of data to correct common errors in signals.

This kind of processing can come in a particular receiver or can find integration into other types of receivers.

3 Augmentation

Augmentation receiver types specialize in storing information to make continuous updates and corrections to incoming data. The stored data can come from nearby receivers, manual input, or calculating previous information. These augmentation systems have a massive variety in scope. They also come with the highest level of maintenance, depending on how much manual input comes in.

4 Differential

The differential receiver types take the augmentation design and enhance it a step further. The differential systems use one or more reference stations to calculate 'corrections' that can be transmitted to and then applied by a GNSS receiver for use in a local area of navigation. These corrections can then be used to calculate a more precise user position.

5 Assistance

The assistance system, or Assisted-GNSS (A-GNSS) of receivers takes in additional data to perform one of two aspects. The first is improving acquisition speed. An assistance network of various servers and information relays makes this work. To improve acquisition speed, an assistance network of various servers and information relays come into play.

The receivers take in the almanac and ephemeris data right to the receiver, skipping over slow initial processes. This means the initial search via the satellites can happen faster.

The second is improving processing and computation within the server. The receiver offloads the heavier to process data to the assistance system. The assistance system is more efficient at processing data, allowing the receiver to focus on taking in more data.

6 Software Receivers

Software receivers take the intake systems and processing power of a hardware receiver and place it in digital forms. They still use the physical antennas and front end systems. Placing the processing into a digital format gives a number of benefits. The first is the wider variety of potential processors, as now any microprocessor could be a potential receiver.

Modes of measurements and Post processing of data

Using GPS you can measure the area of a place or polygons, You can also measure the length or distances between locations and along paths and you can know the elevation of a place.

The Post Processing method of involves downloading of complete survey data and processing in office. Depending on the technique used, postprocessed differential correction (postprocessing) can deliver GPS data accurate to a few meters in moving applications and to a few centimeters in stationary situations, and these levels of accuracy are now easier than ever to achieve.

Differential correction is a method of removing the errors, both man-made and natural, that affect GPS measurements.

Postprocessing techniques require raw GPS base data to be stored in digital files that are later processed (by postprocessing software such as GPS Pathfinder Office or GPS Analyst) against raw GPS rover files.

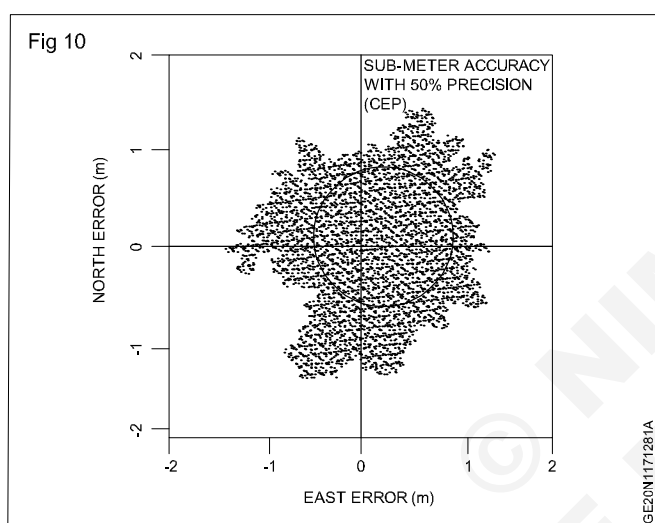
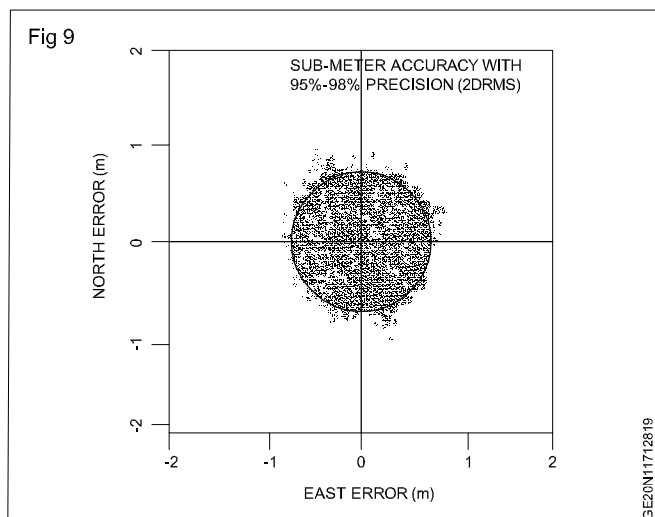
Accuracy can be submeter and better, but this depends on the capabilities of the rover receiver and the postprocessing software used. To postprocess data, the type of roving receiver and base receiver must be collecting GPS data at the same time, and must have at least four satellites in common.

Measuring accuracy

A GPS receiver calculates its position once every second but because each measurement is subject to introduced errors, each position is slightly different from the previous one, even if the receiver is static at one location.

Over time a 'scatterplot' of GPS positions is built, from which measure of the receiver's absolute accuracy can be derived, using a Root Mean Square (RMS) calculation. RMS is the standard statistical measure for specifying GPS accuracy. The HRMS value represents the horizontal distance from truth (a fixed location where coordinates have been accurately measured using survey techniques) within which at least 63% of the recorded positions fall.

Accuracy of GPS measurements and application of GPS (Fig 9 & 10)



Over time, any stationary GNSS/GPS receiver will plot multiple positions for a given point. This happens because of errors caused by variables in the satellites, the surrounding physical environment, and the ionosphere.

Modern geospatial technology has made huge progress in correcting for those errors, but a receiver's real-time accuracy is dependent on its ability to process those corrections. The points plotted by a stationary receiver eventually form a scatter plot like the ones below:

It is helpful to differentiate between accuracy and precision in these images.

Accuracy refers to the radius of the circle of unknown around a true point. The smaller the radius, the higher the accuracy. A receiver with sub-meter accuracy can plot a position within a sub-meter radius of the true point. Both of the images above show sub-meter accuracy.

Precision refers to repeatability or how frequently a receiver can plot a point inside the circle of accuracy and whether or not that circle is centered over the true point. In the first image, the receiver has sub-meter accuracy with 95–98% precision. That is, 95–98% of the time, it will plot a point within one meter of the true point. In the second image, the receiver has sub-meter accuracy with 50%

precision, i.e., the points fall within the meter radius 50% of the time.

Vertical Accuracy

Most receiver manufacturers do not provide a vertical (altitude) accuracy specification. The vertical accuracy of GNSS/GPS receivers is typically 1.7 times the horizontal accuracy. For example, a receiver with 1 m 2DRMS horizontal accuracy would likely provide 2 m vertical accuracy.

This estimate is based on general observation of several different receivers, not thorough testing of any one receiver.

Application of GPS

Your imagination is the only limitation to the possibilities of Global Positioning System (GPS) technologies. GPS systems are extremely versatile and can be found in almost every sector. Today, GPS is used to map forests, help farmers harvest their fields and airplane pilots navigate on the ground or in the air. Positioning systems are integral to military applications and for emergency crews to locate people in need of assistance. GPS technologies are often working in many areas that we do not normally consider.

1 Aviation

Most of the modern aircraft use GPS receivers to provide the pilots and passenger with real-time aircraft position. They also provide a map of various destinations depending on where the aircraft operates. This application is also used by the airline operators to decide which route is the fastest, safest, and most fuel-efficient among the destinations. They also use the app to track the aircraft and direct the pilot in the case where there is a change in the weather conditions or any other issue that may arise.

2 Marine

Highly accurate navigation app is needed by boat captains to enable them to navigate through waters to their destinations. These applications ensure that the channels are clear and there are no obstacles that can hinder their navigation. They are also required in the marine departments since they are used to map and position dredging operations in rivers, sandbars, and wharves to ensure that other boats are aware of how deep they should get.

3 Farming

Farmers have a specific season for planting, weeding, and harvesting, and due to the repeat in the seasons, they put the GPS receiver on their tractors and other farming equipment. This allows them to map their plantations and ensure that they return to precisely the same time when planting or weeding in the next season. This strategy is effective especially in seasons when it's foggy with less visibility since the machine will still operate since its GPS and not visual reference guides it. More so, its high accuracy makes it suitable for use in mapping soil sample locations, and the farmers can locate the areas that have soils suitable for farming.

5 Surveying

Surveying is one of the uses of GPS that are essential especially since it is used in mapping and measuring various measures on the earth surface and underwaters. It is used in determining land boundaries, mapping sea floors, and highlighting the changes in the shape of structures. The best thing about high accuracy GPS app is that the surveyors can set it up over a single point and establish a reference marker. They can also use it in a moving configuration to map the boundaries of particular features. With the data obtained from the application, they can easily key in the details into a software that will help them offer their customers with a detailed chart.

6 Military

The US Department of Defense was the first to develop the GPS app system, and since then the system has been adopted by numerous military forces around the world. Other countries have even decided to develop their satellite navigation networks as a defense mechanism during war times. Today, there has been a diverse use of the app, and it can be used to map the location of vehicles and other machinery such as missiles during a war. This is a technique used purposely to protect the soldiers and also manage resources.

7 Financial Services

Financial organizations such as banks use this app to schedule and determine local and international money transfers. They are also using it to provide audit trails of financial transactions. More so, since more than 80% of the transactions are made through debit and credit cards, it has been easier to provide a higher level of timing accuracy. The GPS satellite is necessary for the financial field since it allows for data and time stamps of Electronic Funds Transfers.

8 Telecommunications

Telecommunications especially the mobile telephones use this app to provide its users with accuracy, reliability, and stability of their operations. Although other clocks can provide this, the GPS supports the derivation of synchronized time zones with the help of the satellite signals.

9 Heavy Vehicle

Heavy tack machines used in mining and constructions also use this technology. For example in highway

construction, the marker pegs and surveyors have been replaced by the improvised in-cabin vehicle guidance and control systems. This makes the work easier since the driver only needs to follow the surveyor's pre-programmed site plan. Thus, with this app, the constructors can achieve close tolerance for position, gradient, and level.

10 Road Transportation

Majority of users of this technology are taxi services, emergency vehicle location, commercial fleet management and freight tracking, public transport monitoring, dispatch, and navigation. Private car owners also use the app, and most of the new car models come with a factory-fitted GPS.

12 Locating Positions

GPS navigation system is commonly used to designate positions. It is used by travelers, researchers and the everyday citizens. More so, you can use it to locate websites that offer certain services in your country. Certain websites block access by people from a specific location. For example, if you are looking for a website that offers academic assistance in your area such as online custom writing service, then as long as your GPS location is allowed into the website, you will get a list of recommendable website.

13 Tracking for Law Enforcement

The police also use it during investigations to catch suspects and criminals. They also use it to keep track of people who feel that their lives may be in danger.

14 Locating Your Pets and Wildlife Management

Pets such as cats and dogs can easily get distracted and go missing. A GPS microchip will help you locate your pet's whereabouts.

GPS is well known for its accuracy and ability to show the exact position of any target. In this case, GPS is used to trace the movements of wildlife and their activities over time.

15 Fire Control

Wildfires have been reported from time to time with their known destruction to the environment and property. Thanks to GPS this disaster is controlled in such a way that, it creates maps that help the personnel on the ground to assess the damages done. GPS is used to locate the possible hot spots within a few minutes which is then transmitted to the personnel on the ground.

DGPS Components, Survey Methods, Open Source Software

Objectives : At the end of this lesson you shall be able to

- **define DGPS**
- **explain components of DGPS**
- **explain types of DGPS**
- **state errors in DGPS**
- **explain survey methods in DGPS.**

Differential Global Positioning System (DGPS)

Introduction to DGPS

A Differential Global Positioning System (DGPS) is an enhancement to the Global Positioning System (GPS) which provides improved location accuracy, in the range of operations of each system, from the 15-metre nominal GPS accuracy to about 1–3 centimetres in case of the best implementations.

DGPS involves 2 receivers, i.e., 1 stationary and 1 roving. The stationary/reference receiver is put on a point that's been very accurately surveyed. The reference station receives the same signals as roving receiver but instead of working like a normal GPS receiver it performs the equations backwards.

Components of DGPS

- Master Base Station or receiver and rover
- Master receiver is kept at known point
- Antenna with pre-amplifier
- Sensor to sense the data
- Memory and display panel
- Keyboard
- Precision oscillator (clock)-quartz
- Power supply- battery
- Computer with supporting software for data download and processing

Receiver

The front view of the Trimble R8 GNSS receiver. The front panel on the Trimble R6 GPS receiver is identical. The panel contains the three indicator light emitting diodes (LEDs), and the power button.

The power button controls the receiver's power on or off functions. The indicator LEDs show the status of power, satellite tracking, and radio reception.

The Power button controls the receiver's power on or off functions.

The following image shows the receiver lower housing, which contains the two serial ports, one TNC radio antenna or GSM antenna connector.

Lower housing

The lower housing of the Trimble R8 GNSS receiver. The lower housing on the Trimble R6 GPS receiver is identical. The lower housing contains the two serial ports, one TNC radio antenna or GSM antenna connector (depending on the internal communication module ordered), the removable battery compartment and the 5/8-11 threaded insert.

External UHF or GSM antenna

Depending on which module you have purchased, use this TNC connection for an external antenna to enhance the UHF or GSM. The UHF antenna is approximately 16.5 cm (6.5 inches) long, and round. The GSM antenna is approximately 16.5 cm (6.5 inches), and flatter than the UHF antenna. Make sure that you use the correct antenna or the signal will be degrade.

DGPS tripod

A tripod is a portable three-legged frame or stand, used as a platform for supporting the weight and maintaining the stability of some other object.

Range pole

To mount the receiver on a range pole: 1. Thread the receiver onto the range pole. 2. Attach the controller bracket to the pole. 3. Insert the controller into the controller bracket.

Types of DGPS

DGPS methods are commonly known as augmentation schemes and are generally divided into two types depending upon the size of the geographic area covered by the system. These DGPS augmentation systems are (1) wide area augmentation systems (WAAS) and (2) local area augmentation systems (LAAS).

The WAAS system consists of a master station (WMS), several reference (monitoring) stations (WRS), and a number of geostationary communication satellites (GEO). The reference stations all continuously track the GPS and GEO satellites and relay tracking information (via land links) to the master station. Error corrections are determined by calculation and are relayed to users via the GEO. In this system, the corrections are transmitted on one of the GPS carrier frequencies.

LAAS augmentation involves a multitude of receivers, each serving a local area. Errors detected by these receivers are then transmitted to all users in the vicinity of that receiver. LAAS, if implemented, should yield much higher accuracy than WAAS, although it will require a larger infrastructure investment.

Errors in DGPS

- Satellite Clock Error
- Ephemeris Error
- Residual Ionospheric/Tropospheric Delay Error
- Receiver Noise
- Receiver Interchannel Bias
- Multipath
- UERE (RMS)
- RMS Horizontal Position Error
- RMS Vertical Position Error
- Satellite Clocks

The atomic clocks in the GNSS satellites are very accurate, but they do drift a small amount. Unfortunately, a small inaccuracy in the satellite clock results in a significant error in the position calculated by the receiver. For example, 10 nanoseconds of clock error results in 3 metres of position error.

The clock on the satellite is monitored by the GNSS ground control system and compared to the even more accurate clock used in the ground control system. In the downlink data, the satellite provides the user with an estimate of its clock offset. Typically, the estimate has an accuracy of about ± 2 metres, although the accuracy can vary between different GNSS systems. To obtain a more accurate position, the GNSS receiver needs to compensate for the clock error.

Orbit Errors

GNSS satellites travel in very precise, well known orbits. However, like the satellite clock, the orbits do vary a small amount. Also, like the satellite clocks, a small variation in the orbit results in a significant error in the position calculated.

The GNSS ground control system continually monitors the satellite orbit. When the satellite orbit changes, the ground control system sends a correction to the satellites and the satellite ephemeris is updated. Even with the corrections from the GNSS ground control system, there are still small errors in the orbit that can result in up to ± 2.5 metres of position error.

Ionospheric Delay

The ionosphere is the layer of atmosphere between 80 km and 600 km above the earth. This layer contains electrically charged particles called ions. These ions delay the satellite signals and can cause a significant amount of satellite position error (Typically ± 5 metres, but can be more during periods of high ionospheric activity).

Ionospheric delay varies with solar activity, time of year, season, time of day and location. This makes it very difficult to predict how much ionospheric delay is impacting the calculated position.

Ionospheric delay also varies based on the radio frequency of the signal passing through the ionosphere. GNSS receivers that can receive more than one GNSS signal, L1 and L2 for example, can use this to their advantage. By comparing the measurements for L1 to the measurements for L2, the receiver can determine the amount of ionospheric delay and remove this error from the calculated position.

Tropospheric Delay

The troposphere is the layer of atmosphere closest to the surface of the Earth. Variations in tropospheric delay are caused by the changing humidity, temperature and atmospheric pressure in the troposphere.

Since tropospheric conditions are very similar within a local area, the base station and rover receivers experience very similar tropospheric delay. This allows Differential GNSS and RTK systems to compensate for tropospheric delay.

GNSS receivers can also use tropospheric models to estimate the amount of error caused by tropospheric delay.

Receiver Noise

Receiver noise refers to the position error caused by the GNSS receiver hardware and software. High end GNSS receivers tend to have less receiver noise than lower cost GNSS receivers.

Multipath

Multipath occurs when a GNSS signal is reflected off an object, such as the wall of a building, to the GNSS antenna. Because the reflected signal travels farther to reach the antenna, the reflected signal arrives at the receiver slightly delayed. This delayed signal can cause the receiver to calculate an incorrect position.

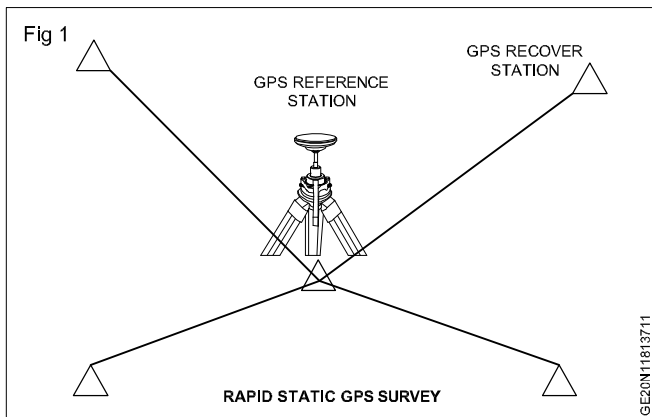
The simplest way to reduce multipath errors is to place the GNSS antenna in a location that is away from the reflective surface. When this is not possible, the GNSS receiver and antenna must deal with the multipath signals.

Long delay multipath errors are typically handled by the GNSS receiver, while short delay multipath errors are handled by the GNSS antenna. Due to the additional technology required to deal with multipath signals, high end GNSS receivers and antennas tend to be better at rejecting multipath errors.

Survey Methods in DGPS: Rapid static method, Traverse method, and Triangulation Method

Rapid static method

Rapid Static - Used for establishing local control networks, Network densification etc. Offers high accuracy on baselines up to about 20km and is much faster than the Static technique. (Fig 1)



In Rapid Static surveys, a Reference Point is chosen and one or more Rovers operate with respect to it. Typically, Rapid Static is used for densifying existing networks, establishing control etc. When starting work in an area where no GPS surveying has previously taken place, the first task is to observe a number of points, whose coordinates are accurately known in the local system. This will enable a transformation to be calculated and all hence, points measured with GPS in that area can be easily converted into the local system. At least 4 known points on the perimeter of the area of interest should be observed. The transformation calculated will then be valid for the area enclosed by those points.

The Reference Receiver is usually set up at a known point and can be included in the calculations of the transformation parameters. If no known point is available, it can be set up anywhere within the network. The Rover receiver(s) then visit each of the known points. The length of time that the Rovers must observe for at each point is related to the baseline length from the Reference and the GDOP.

The data is recorded and post-processed back at the office. Checks should then be carried out to ensure that no gross errors exist in the measurements. This can be done by measuring the points again at a different time of the day. When working with two or more Rover receivers, an alternative is to ensure that all rovers operate at each occupied point simultaneously. Thus allows data from each station to be used as either Reference or Rover during post processing and is the most efficient way to work, but also the most difficult to synchronize. Another way to build in redundancy is to set up two reference stations, and use one rover to occupy the points.

With the advent of new Technology, the classical methods of providing control points for survey i.e. Triangulation has been replaced by GPS Surveys, however the areas where GPS Surveys are not feasible due to non-availability of clear sky i.e. in the valleys Triangulation or traverse is carried out based on GPS bases observed.

Triangulation Method

Triangulation is the process of measuring the angles of a chain or network of triangles formed by stations marked on the surface of the ground. It is an elementary

trigonometric proposition that if the angles of a triangle and the length of one side are known, the lengths of all the other sides can be computed and if direction of one side is known with reference to some system of co-ordinates, it is possible to calculate the co-ordinates of all the other points.

According to its quality, a triangulation is classified as primary, secondary or tertiary. There is also a fourth category known as exploratory 'triangulation. In some countries this classification is known as first- order, second- order, third- order and fourth- order.

Primary or First – order triangulation is the highest grade of triangulation and is employed for the determination of the shape and figure of the earth and other geodetic investigation. It also constitutes the basic precise framework for mapping and for less precise triangulation. As it is independent of external checks, all possible precautions and refinements are taken in the observations and their education. The length of a base –line in primary triangulation is about 8 to 12km on the average and the side of the triangulation range from 16 to 150km. The average triangulation error (or discrepancy between the sum of the measured angles in a triangle and 180° plus the spherical excess of the triangle) must not be greatly in excess of 1". The probable error of computed distance should lie between about 1 in 50,000 and 1 in 250,000.

Secondary or second-order triangulation is either one which was planned to be primary, but did not attain the standard of accuracy of that class due to difficulties of observation, or one designed to connect two primary series and thus furnish points closer together than those of primary triangulation. The average triangulation error in secondary triangulation should not normally exceed 3". The probable error of distance will vary from 1 in 20,000 to 1 in 50,000.

Tertiary or Third –order (departmentally known as topographical) triangulation is run between the stations of the primary and secondary series and forms the immediate control for topographical surveys. The average triangular error may range from 3" to 15" and the probable error of the compound sides usually lies between 1 in 5,000 to 1 in 20,000.

Traverse method

Traverse is a method in the field of surveying to establish control networks. It is also used in geodesy. Traverse networks involve placing survey stations along a line or path of travel, and then using the previously surveyed points as a base for observing the next point.

There are mainly two types of traverse:

Closed traverse: either originates from a station and returns to the same station completing a circuit, or runs between two known stations.

Open traverse: neither returns to its starting station, nor closes on any other known station.

Open source Software QGIS, postgres, Geo server

QGIS is a free and open-source cross-platform desktop geographic information system (GIS) application that supports viewing, editing, printing, and analysis of geospatial data. QGIS supports raster, vector and mesh layers. QGIS supports shapefiles, personal geodatabases, dxf, MapInfo, PostGIS, and other industry-standard formats. Web services, including Web Map Service and Web Feature Service, are also supported to allow use of data from external sources.

QGIS integrates with other open-source GIS packages, including PostGIS, GRASS GIS, and MapServer. Plugins written in Python or C++ extend QGIS's capabilities. Plugins can geocode using the Google Geocoding API, perform geoprocessing functions.

Gary Sherman began development of Quantum GIS in early 2002, and it became an incubator project of the Open Source Geospatial Foundation in 2007. As of 2017, QGIS is available for multiple operating systems including Mac OS X, Linux, Unix, and Microsoft Windows. A mobile version of QGIS was under development for Android as of 2014.

Postgres

PostgreSQL also known as Postgres, is a free and open-source relational database management system (RDBMS) emphasizing extensibility and SQL compliance. It was originally named POSTGRES, referring to its origins as a successor to the Ingres database developed at the University of California, Berkeley. In 1996, the project was renamed to PostgreSQL to reflect its support for SQL. After a review in 2007, the development team decided to keep the name PostgreSQL and the alias Postgres.

GeoServer

In computing, GeoServer is an open-source server written in Java that allows users to share, process and edit geospatial data. Designed for interoperability, it publishes data from any major spatial data source using open standards. GeoServer has evolved to become an easy method of connecting existing information to virtual globes such as Google Earth and NASA World Wind as well as to web-based maps such as OpenLayers, Leaflet, Google Maps and Bing Maps. GeoServer functions as the reference implementation of the Open Geospatial Consortium Web Feature Service standard, and also implements the Web Map Service, Web Coverage Service and Web Processing Service specifications.

GeoServer aims to operate as a node within a free and open Spatial Data Infrastructure. Just as the Apache HTTP Server has offered a free and open web server to publish HTML, GeoServer aims to do the same for geospatial data.

Services- WMS, WFS, WCS

WMS (Web Map Service), WFS (Web Feature Service), and WCS (Web Coverage Service) are three web service standards from the Open Geospatial Consortium (OGC).

These allow web clients to query and receive geographic information in the form of image, vector, or coverage data.

A **Web Map Service (WMS)** is a standard protocol developed by the Open Geospatial Consortium in 1999 for serving geo-referenced map images over the Internet. These images are typically produced by a map server from data provided by a GIS database.

The Open Geospatial Consortium **Web Feature Service (WFS)** Interface Standard provides an interface allowing requests for geographical features across the web using platform-independent calls.

The Open Geospatial Consortium **Web Coverage Service** Interface Standard (WCS) defines Web-based retrieval of coverages – that is, digital geospatial information representing space / time-varying phenomena.

A WCS provides access to coverage data in forms that are useful for client-side rendering, as input into scientific models, and for other clients. The WCS may be compared to the OGC Web Feature Service (WFS) and the Web Map Service (WMS). As with WMS and WFS service instances, a WCS allows clients to choose portions of a server's information holdings based on spatial constraints and other query criteria.

Introduction to Bhuvan

Bhuvan (means Earth in Sanskrit) is a Geoportal of ISRO, to evince the Indian Earth Observation capabilities from the Indian Remote Sensing (IRS) series of satellites. It is an interactive versatile Earth-Browser which showcases multi-sensor, multi-platform and multitemporal images with capabilities to overlay thematic information, interpreted from such imagery as a vector layer, along with near real-time information from Automatic Weather Stations (AWS), Potential Fishing Zone (PFZ) information, disaster support related information like forest fire alerts, periodic agricultural drought assessment etc.

The content which the utility serves is mostly restricted to Indian boundaries and is offered in 4 regional languages. The content includes thematic maps related to disasters, agriculture, water resources, land cover and also processed satellite data of ISRO. Bhuvan is known for its association with various sections of Government of India to enable the use of Geospatial technology. Bhuvan has since its inception enabled Indian government to host public geospatial data as Information layers for visualisation and public consumption. Examples of the types of geospatial layers include Toll Information System for National Highways Authority of India, Islands information System for MHA, Cultural heritage sites for Ministry of culture etc. The information for the platform is obtained from the government of India sources or through Crowd sourcing.

Introduction to Google Earth

Google Earth is a browser-based animation tool for Google Earth's 3D and satellite imagery. Google Earth has a massive store of 2D and 3D Earth data, from large-scale geographical features to individual city buildings.

Google Earth is a computer program that renders a 3D representation of Earth based primarily on satellite imagery. The program maps the Earth by superimposing satellite images, aerial photography, and GIS data onto a 3D globe, allowing users to see cities and landscapes from various angles. Users can explore the globe by entering addresses and coordinates, or by using a keyboard or mouse. The program can also be downloaded on a smartphone or tablet, using a touch screen or stylus to navigate. Users may use the program to add their own data using Keyhole Markup Language and upload them through various sources, such as forums or blogs. Google Earth is able to show various kinds of images overlaid on the surface of the earth and is also a Web Map Service client. In 2019, Google has revealed that Google Earth now covers more than 97 percent of the world, and has captured 10 million miles of Street View imagery.

In addition to Earth navigation, Google Earth provides a series of other tools through the desktop application, including a measure distance tool. Additional globes for the Moon and Mars are available, as well as a tool for viewing the night sky. A flight simulator game is also included. Other features allow users to view photos from various places uploaded to Panoramio, information provided by Wikipedia on some locations, and Street View imagery. The web-based version of Google Earth also includes Voyager, a feature that periodically adds in-program tours, often presented by scientists and documentarians.

Google Earth has been viewed by some as a threat to privacy and national security, leading to the program being banned in multiple countries. Some countries have requested that certain areas be obscured in Google's satellite images, usually areas containing military facilities.