COURSE CODE: *CSC 211*

COURSE TITLE: *Computer Science for Agricultural Students*

NUMBER OF UNITS: *2 Units*

COURSE DURATION: *2hours of Lecture and 1hour of Practical per Week*

COURES E DETAILS:

Course coordinator: **Dr. (Mrs.) O.'T. Arogundade B.Sc., M.Sc., PhD**

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Office Location: Room B201, COLNAS

Other Lecturers: Dr. Folorunso, Dr. Adekoya, Dr. Onashoga, Dr. Ajayi, Miss. Ikuomola, Mr. Aborisade

COURSE CONTENT:

Computer Hardware: History, Classifications, Configurations, Input devices and Output devices; **Computer Software**: Operating Systems (DOS, MS windows, Linux etc.). Software Packages

Problem solving Strategies, Concept and role of Algorithm in problem solving process, implementation strategies, concepts and properties of algorithm; the science of algorithm and concept of abstraction; algorithm representation and discovery, iterative and recursive structures.

Algorithmic Tools: pseudo code, Flowcharts; Introduction to programming.

Introduction to computer Applications in agriculture: Management Information Systems, Decision Support Systems, Geographic Information Systems, precision Farming and Mapping, Agricultural Information Dissemination Tool, etc.

COURSE REQUIREMENTS:

This is a compulsory course for all agricultural students with one year farm practical. In view of this the students are expected to participate in all the course activities and have minimum of 75% attendance to be able to write the final examinations.

READING LISTS:

1.Randell, B. The origins of Digutal computers. New York. Springer-verlag,1973.
2. Aho, A.V., Hpcroft J.E and Ullman J.D. The design and analysis of Computer Algorithms. Boston. Addison-Wesley, 2007.
3. Shi-Kuo Chang, Data Structures and Algorithm Singapore. World scientific, 2003

CHAPTER ONE

INTRODUCTION TO COMPUTER HARDWARE AND SOFTWARE

DEFINITION OF A COMPUTER SYSTEM

- Computer can be defined in various ways, but these definitions have the same meaning.
- A computer is an electronic machine, which is capable of accepting data as input, processing the data, to generate an output.
- A computer is an electronic device operating under the control of instructions stored in its memory, which can accept and store data, perform arithmetic and logical operations on the data without human intervention and produce result from the processing.
- A computer is an automatic device made up of mechanical, electromechanical and electronic components that can accept store and retrieve vast amount of data/information and also carry out operations (such as arithmetic or logic) under a stored program at high speed and subsequently come out with results in useful form (information).
- A computer is any machine or device which under the control of a stored program, can accept data in a prescribed form, process the data, and supply the results as information in a specified form.

BASIC OPERATIONS PERFORMED BY COMPUTER SYSTEMS

All computer systems perform the following five basic operations:

- **INPUT:** The process of entering data and instructions into the computer system.
- **STORAGE:** The computer system stores the data and instructions and makes them available for processing as and when required.
- **PROCESSING:** The computer performs arithmetic or logical operations on data and converts them into useful information.
- **OUTPUT:** This is the process of producing the results of processing to the user, such as a printed report or a report that can be viewed on the computer monitor.
- **CONTROL:** The computer controls the manner and sequence in which all the above operations are performed.

CHARACTERISTICS OF COMPUTERS

- **SPEED**: It has the ability to process at very fast rate. It can perform millions of operations in a second.
- **STORAGE**: The memory unit has the capacity to store large amount of information and to release information when needed. The large volume of data can be conveniently stored, accessed and altered.

- **ACCURACY**: Computer accuracy is very high. Due to the fact that it is an error detecting machine, error in computer are due to human rather than technological weakness. This brings in the notion of Gabbage In, Gabbage Out (GIGO). That is, if we feed the computer with wrong data, we will receive wrong result.
- **AUTOMATIC**: Computer is more than calculator where you need press the necessary keys before an operation is performed. Here you just need to write a program into the computer where instructions are transferred by the control unit for execution. The CPU follows these instructions one after the other until it meet an instruction that say stop execution.
- **DILIGENCE**: Being a machine, computer does not suffer from human traits of tiredness. It will still perform the last job with the same speed and accuracy as the first job.
- **VERSALITILITY:** The computer can perform four basic operation. It has the ability to (i) pass information between itself and the external world through I/O devices, (ii) moves data internally within the CPU, (iii) perform basic arithmetic operation, (iv) perform operation of comparism.
- **EFFICIENCY:** It is known for enhancing efficiency in data processing environments, offices, home etc. for its has the ability to process data quickly and produce reports professionally.

CLASSIFICATION OF COMPUTERS

Computer can be classified according to

(a) Nature of data processed (Type)

(b) Usage (Purpose)

(c) Physical Structure (size)

(d) Generation

(a) Classification according to Nature of data processed

This is generally the way in which data can be represented within computer. The three types are analog, digital and hybrid computers.

- **Analog computers**

Analog computers are computer that represent information in a continuous form. Examples are slide rule and speedometer. This type of computers measure physical magnitude such as temperature, pressure, voltage, speed, density, etc. The results are not always precise. Analog computers are used for scientific and engineering purposes.

- **Digital computers**

These are computer that represent information in discrete or digital or binary form i.e. by a coded set of electrical pulses. These computers represent numbers and letters as digits in a certain code and is the type used in commercial data processing. Digital computers are popular for both business and scientific data processing.

- **Hybrid**

The computer that combines the features of both the digital and analog computers is called the hybrid computer. They are mostly used in scientific and technical application.

(b) Classification according to Usage

The digital computer system can further be subdivided into specific-purpose and general-purpose computer. These express the purpose for which they were designed.

- **Specific-Purpose**

These are computer developed for a specific task or job and the programs are in-built in the computer by the manufacturers. They cannot be used for any other jobs apart from the restricted jobs. Examples are computers designed for air traffic control, weapon guidance systems, robots, monitoring and control systems, satellite, space research control, etc.

- **General Purpose**

These are computer designed to solved a wide variety of problems and can be used to carry out different jobs or task. General purpose computer can perform any kind of jobs be it business application or scientific application with equal efficiency simply by changing the application programs stored in the main memory.

(c) Classification according to physical structure

Computer can be identified by their size namely:

- **Super computers :** are the largest, fastest, most powerful, most expensive computers. They are special purpose computers manufactured for applications in area like: Defense, space mission explorations, nuclear physic, weather forecasting, oil exploration. Examples: CRAY1, CRAY2, CRAY C, and CRAY X-MP.
- **Mainframe computers:** are usually sophisticated and large computer systems with high powered and high memory capacity of more than 32 megabytes. The disk storage capacity is usually in Gigabytes and the word size is between 48 and 64 bits. It uses a multi-user operating system and has no limit to the number of users it serves, as they can serve between 100 and 1000 users; they are very expensive and encourage multi-tasking. It is mostly used in large establishment such as Banks, Insurance companies, Hospitals, universities and Commercial establishments. Examples of mainframe computers are IBM-360/370 system, NCR V-8800 system.

- **Mini computer:** encourages multi-tasking and multi-user operating system; uses magnetic tape or disk and they are used by small firms and can accommodate about 100 users. Typical word size for mini computers is about 32 bits, the RAM memory size was about 2MB. Examples include HP 1000 and HP 3000, IBM 38, MV 400, PDP 11, VAX 750, VAX 6000, NCR 9300.
- **Microcomputer:** is a computer whose central processing unit (CPU) is based on a microprocessor. They are the most popular, easy to use and smallest in size. It is a single user system and single tasking; uses floppy disk and hard disk for storage. Examples are IBM PC, Apple Macintosh. Microcomputer can be further classified in four as follows: (i) Desktop computers, (ii) Laptop computers (iii) Notebook computers, (iv) Palmtop computers.

(d) Classification according to Generations

- **1st Generation computer (1946-1958)** : Makes use of vacuum tube or valve. It has very large size; power consumption was too high and a lot of heat was generated; very expensive to buy; slow in operation and often unreliable and required constraint maintenance; operation instruction had to be fed into it manually. Example: ENIAC.
- **2nd Generation computer (1959 – 1964):** The development of Transistor in Bell's Laboratory in U.S. led to the invention of computers in this generation. These use the transistor as the basic building block in the logic component. They are smaller, faster and cheaper; consumes less power and more reliable; have lower running cost and used more sophisticated English-like computer languages e.g. COBOL, FORTRAN; External storage on magnetic tape (or magnetic disks). Example: NCR 304.
- **3rd Generation computer (1964 – 1971):** They are built with Integrated Circuits (ICs) consisting of transistors, diode and resistor. It uses disk as storage media; introduce timesharing, multiprogramming and operating system; more powerful, cheaper and smaller in size; reduction in heat generation and require lesser power; their internal memory increased and compatibility was introduced. Examples are IBM S360-S370 series.
- **4th Generation computer (1971 –1983):** Uses microprocessor (an IC with Very Large Scale Integration); very small in size; much more powerful in processing speed and storage capacity; required minimal maintenance; uses menu-driven.
- **5th Generation computer:** makes use of artificial intelligence i.e. ability to process the natural language. The main attractions over previous computers are the speed and power.

COMPUTER ENVIRONMENTAL CONDITION

- **TEMPERATURE**: majority of computers are utilized between temperatures ranging from 30^0 to 35^0C. Examples are computer system used in process control e.g. mining, steel plant, etc.
- **HUMIDITY**: The presence of water vapour where computer is situated can affect the system.

- **DUST**: The presence of dust greatly affects the accuracy of the system, so it should be protected from dust.
- **SHOCK**: Due to the fragile nature of computer component and the computer itself, this exposes them to smallest shock.
- **POWER SUPPLY:** Fluctuating and failure of power supply greatly affect the computer system thereby resulting in lost of data in the main memory and also destroy the computer.
- **FIRE EXTINGUISHER:** This is provided in computer installation in case of fire outbreaks.

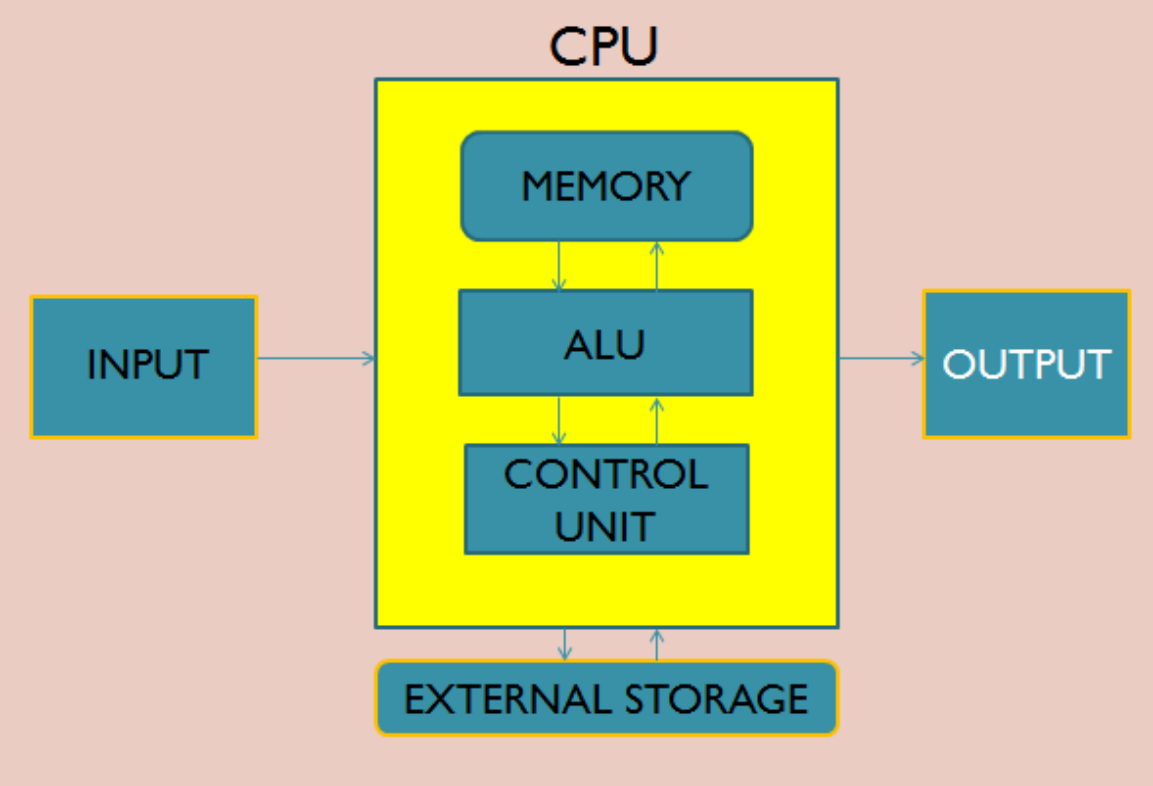
COMPUTER HARDWARE

Hardware is the physical part of the computer that can be seen, touched or handled. The hardware consists of the physical and internal components of the system.

The Hardware has the following basic components:

- Input Unit
- The Central Processing Unit
- Storage Unit
- Output Unit

HARDWARE COMPONENTS



INPUT UNIT

Input device, in this case, is the main source by which computer receive information. It is the Electro-mechanical system, which aids the transferring of data into the computer, that is, it is the medium through which data can be supplied to the computer. Examples are:

(a) Keyboard

(b) Mouse

(c) Joystick

(d) Trackball

(e) Light Pen and Stylus

(f) Graphic Tablet or Digitizer

(g) Touch Screen

(h) Scanner

(i) Audio input units or Voice Data Entry (VDE)

(j) Magnetic Tapes and Cassettes Readers

(k) Computer Disk and DVDs Readers

(l) Floppy and Hard Disk drives

(m) Optical Mark Reader (OMR)

(n) Optical Character Reader (OCR)

(o) Magnetic Ink Character Reader (MICR)

Devices (b) to (f) permit the user to select something on the screen by pointing to it and are thus referred to as pointing devices. The first nine (9) are only input devices whereas the next three (3) are storage media that are used for both input and output. The last three are source input devices used for mass data capture.

CENTRAL PROCESSING UNIT (CPU)

- This is otherwise known as the heart of the computer. That is, this is where all manipulations are done, or rather where the main operation is being carried out.
- The central processing unit consists of the arithmetic and logic unit, the control unit and the memory unit.

(a) The Arithmetic and Logic Unit (ALU)

This is the unit where arithmetic and logical operations are carried out. It perform arithmetic operation such as addition, subtraction, multiplication and division and logical operation (AND, OR, NOT) and relational operations (<, >, <=, >=, =, <>).

(b) The Control Unit

This unit coordinates and supervises all activities within the computer system. This unit controls all the operations of the central processing unit.

(c) Main Memory

- The main memory is also called Internal storage or primary storage/memory. It is used for storing software in the form of operating system, application programs and utility routines etc.
- In addition, the data input for processing is stored in the memory as one of the results of processing unit.
- Internal storage is complimented by external storage, that is, storage external to the processor, which is referred to as "BANKING STORAGE". This is used for mass storage whereas internal storage is used for immediate access requirements

Types of Internal Memory

(i) ROM

ROM stands for Read Only Memory. It is normally contains permanently stored instructions and programs for starting, testing and controlling the operations of the computer. The manufacturer already installs these instructions. The content of ROM is not destroyed when the computer is switched off i.e. ROM is a non-volatile storage. The content can only be read and not written onto hence, the name read-only.

There are different types of ROM, including

- **PROM**: Programmable Read Only Memory. This is a version of ROM that can be changed by the user. Once changed, it is permanent and can no longer be altered.
- **EPROM:** Erasable Programmable Read Only Memory. In this type of ROM, data or program can be erased by removing the device and exposed it to ultraviolet light. It can be reprogrammed using a specialized EPROM burner device.
- **EEPROM:** Electrical Erasable Programmable Read Only Memory. These allow information to be changed by software without removing the ROM chip from the computer. Data or program can be completely erased using a special device and new programs or new data can be stored in it.

(ii) RAM

RAM stands for Random Access Memory. This occupies a large part of the main memory. It is used to store application programs and data being worked upon. RAM stores temporarily as the content is destroyed when the computer is switched off. It is said to be volatile storage.

Difference between ROM and RAM

ROM	**RAM**
ROM is nonvolatile	RAM is volatile

ROM is cheaper than RAM	RAM is very expensive
The contents of ROM are always known and can be verified	The contents are not known
ROM cannot be updated or corrected	RAM can be updated and corrected
ROM serves as permanent data storage	RAM can serve as temporary data

STORAGE UNIT

- This unit is also known as Secondary storage, Auxiliary storage, Backing storage or External storage.
- Data coming to the computer are received by the memory and passed to a permanent storage device.
- This memory is used to store data not currently being operated on but which will be transferred to the main storage when required.
- Secondary storage is non-volatile and retains data even when the computer is turned off.
- There are many kinds of secondary storage; the most common ones are magnetic tape, magnetic disk, floppy disk, hard disk and compact disk.

OUTPUT UNIT

- An output unit is a medium, which a computer uses to produce out processed or computed results for users in readable form.
- Results are either soft copy or hard copy type.
- A software copy output is the result displayed on the monitor while hardcopy is the output printed on paper.
- Examples are:
  - ❑ Monitors
  - ❑ Printers
  - ❑ Plotters
  - ❑ Computer Output Microfilm (COM)
  - ❑ Voice Output

COMPUTER SOFTWARE

Software can be defined as the sets of instruction and procedures passed to the computer to perform certain activities or tasks. That is, it is the set of instruction directed to a computer

system to perform a specific task. It is often called computer program. It is the program, which direct the operations of computer systems. It is the invisible part of the computer system. Without the software, the computer system is useless.

There are two types of software namely:

- System software
- Application software

(a) SYSTEM SOFTWARE

System software is sets of one or more programs designed to control and supervise the operation and performance of a computer system. They are the software that acts as interface between the hardware and the user or computer resources. The overall control of the hardware operations and the user self-written programs is done by the system software. The computer manufacturer is responsible for the development of systems software and therefore, they cannot be modify or edit by the computer users.

The systems software may be divided into the following:

- Operating systems
- Utilities and service programs
- Translators
- Database Management System

(b) APPLICATION SOFTWARE

Application software or program is a computer program designed to help and users perform a certain kind of activity. Depending on the task(s) for which it was designed, an application program can manipulate text, numbers, graphics or a combination of these elements.

Application software consists of a number of programs designed to perform specific tasks for users.

Classification of Application Software

(i) Commercial Packages: These are packages developed by software houses. Commercially produced applications software falls into two main categories:

- **Application specific / special – purpose packages**: These are packages designed for a specific task such as a company payroll program used to store employee details and generates details of pay for each individual employee.

- **Generalized packages / General – purpose packages**: which may be used for a wide variety of purposes. An example of a general-purpose package is a word processor, a program which allows the computer to be used somewhat like an electronic typewriter and is therefore appropriate to numerous text processing tasks. Other examples are spreadsheets, databases, graphics package including desktop publishing (DTP), etc. What characterizes this software type as belonging to the category of general-purpose packages is that they have been designed to be very flexible and applicable to a wide range of different tasks. For instance, a spreadsheet can be used easily for simple accountancy procedures as for stock control; a database can be used with equal facility to store information on technical papers from journals, stock item details and personnel details for payroll purposes.

(ii) Users Programs: are programs written by professional programmers or programming expertise or by people within the organization for specific needs which cannot be satisfied by other sources of software. These program writers may be professional programmers employed by the organization, or other casual users with programming expertise. Examples of users programs are High Level Language such as BASIC, FORTRAN, COBOL, etc.

CHAPTER TWO

OPERATING SYSTEMS AND SOFTWARE PACKAGES

2.1 Disk operating system (DOS)

The operating system can be describe as a collection or a set of programs which operates the computer and allow a number of programs to be run on the computer without human intervention by an operator. It lies between the application software and the computer hardware. The operating system has three main functions:

1. Manage the computer's resources, such as the central processing unit, memory, disk-drives and printer.
2. Establish a user interface
3. Provide services or applications software.

Other related functions include:

i. Job scheduling and traffic controller operation
ii. Input/output programming
iii. Protecting itself from the user, protecting the user from other user
iv. Secondary storage management
v. Calling other program into the computer's memory
vi. To boot the computer system
vii. Communication with the computer operator usually by means of console typewriter

TYPES OF OPERATING SYSTEM

Single-user Operating System: This is a type of system that allows one user to work in a computer at a time e.g.

i. MS-DOS: Micro Soft Disk Operating system
ii. CP/M: Control Program for micro computer
iii. OS/2: Operating system 2
iv. PC/DOS: Personal Computer Disk Operating System

Multi-user Operating System: This is a type of system that allows two or more users to share the computer resources. i.e. Printer. Examples are:

i. PC/MOS: Personal Computer Multi-user Operating System
ii. AOS/DVS: Advance Operating System with Distributed Visual Storage
iii. XENIX: A Multi-user Multitasking Operating system developed by UNIX.

Network Operating System: This is an operating system that allows communication between two or more computer users. It can be describe as a group of computer devices

linked together over transmissions so that information and resources can be shared .e.g. Novel Netware.

It has its advantages which include:

i. NOS. supports data security
ii. NOS. supports troubleshooting i.e. Computer XY on the network failed to receive a message intended for it.
iii. NOS. supports administrative control i.e. tracks the on-line hour's numbers of message to and from each computer.

UTILITIES AND LIBRARY PROGRAMS

These are programs which enable one to carryout certain standard functions within the system such as copying files, sorting data, merging files, editing files, file maintenance e.t.c.

TRANSLATORS

These are programs used to convert programs written in other computer language into machine language. The assembler, compiler or interpreters are all type of translator.

Assembler: An assembler translates a source program written in assembly language into the machine language i.e.

Source program ⟶ Assembler program ⟶ Machine language

Compiler: A translator that converts the symbolic statements of a high-level language into computer executable machine language. It translates your entire program at one time, i.e.

Source program ⟶ Compiler ⟶ Object program ⟶ Executable prog

Interpreter: Is a program that accepts a source program written in that language as input and execute it. The difference between a compiler and an interpreter is that the interpreter does not produce an object program to be executed; it executes the source program itself. Also it translates the program line – by – line i.e.

Source program ⟶ Interpreter ⟶ Target program

Note: Debugging in programming means detecting, locating and correcting bugs (mistakes) usually by running the program.

2.2 Microsoft Windows

Starting up a Computer

The process of starting up a computer system is listed below:

- Connect all parts of the computer and ensure they are well connected
- Remove all secondary storage disks from the disk drives
- Switch on the power socket on the wall followed by the ON switch button on the computer and the monitor
- Wait for few seconds for the computer to complete the booting process.

Components of Windows Desktop

The Start Menu and Start Button are user interface elements used in the versions of the Microsoft Windows operating systems. The Start Button provides a central launching point for application and tasks.

Traditionally, the Start Menu provides a customizable nested list of programs for the user to launch, as well as a list of most recently opened documents, a way to find files and get help, and access to the system settings. Later enhancements via Windows Desktop Update included access to special folders like "My Documents," "Favourites" (browser bookmarks), etc. Windows XP's Start Menu was expanded to encompass various My Documents folders (including My Music and My Pictures), and transplanted other items like My Computer and My Network Places from the Windows desktop.

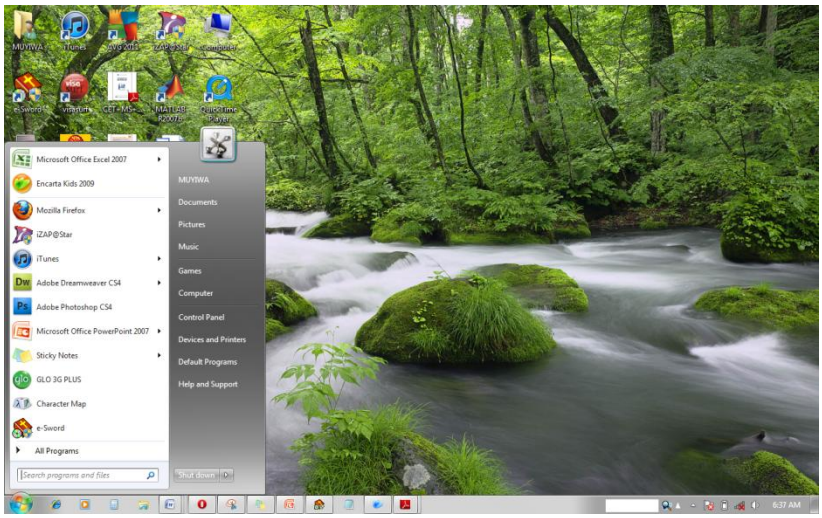


Figure 2.1: Windows Desktop Screen

Windows Desktop

The Desktop offers many features that make using your computer easier. You can easily start programs or applications, copy and move files from one place to another and drag and drop files and program where you want them on the computer or even on to a program's icon to open a file.

The start menu  starts programs, opens documents, and access most parts of the system. Windows Program can be customized as needed.

Icons

Icons (i.e. computer icon) are small pictures that represent a file, folder, program, or other object or function. Icons are graphical representations of files, programs, or shortcuts. You can find icons on the desktop, taskbar, Start menu, and throughout Windows.

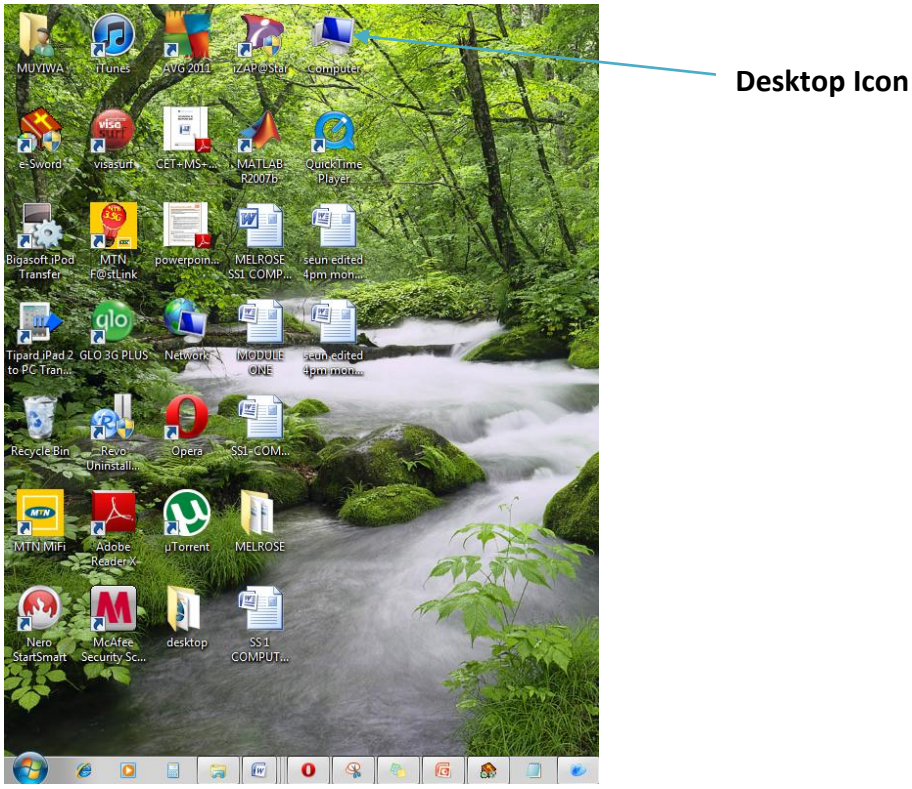


Figure 2.2: Window Screen Showing Icons

Mouse icon

Mouse Icon is an icon that appears when you do a right-click equivalent by pressing and holding the tablet pen on the screen.

Task Bar

The taskbar is the long horizontal bar at the bottom of your screen. Unlike the desktop, which can get obscured by the windows on top of it, the taskbar is visible almost all the time. It has four main sections:

- The Start button, which opens the Start menu.
- The Quick Launch toolbar, which lets you start programs with one click.
- The middle section, which shows you which programs and documents you have opened and allows you to quickly switch between them.
- The notification area, which includes a clock and icons (small pictures) that communicate the status of certain programs and computer settings.

Figure 2.3: Task Bar

The Task Bar performs the followings:

- displays the program running and windows open
    - to bring a program or window to the front, single click on the item on the taskbar or dock
    - right click in Windows to display a menu for the item
- the Window system tray on the right of the Taskbar displays indicators for certain tasks
- use Start/Settings/Taskbar to customize the Start menu properties to change the Dock properties

Windows Background

Desktop background (also called wallpaper) can be a digital picture from your personal collection or one that comes with Windows. You can also select a colour for your desktop background or use a colour to frame your background picture.

To change the desktop background:

- Click to open Desktop Background.
- Click the picture or colour you want for your desktop background.

If the picture you want to use is not in the list of desktop background pictures, click Browse to search for the picture on your computer. When you find the picture you want, double-click it. It will become your desktop background and appear in the list of desktop backgrounds.

- Under How should the picture be positioned, choose to have the picture fit the screen, tile, or be centred on the screen, and then click OK.

Running Application Programs

Almost everything you do on your computer requires using a program. For example, if you want to draw a picture, you need to use a drawing or painting program. To write a letter, you use a word processing program. To explore the Internet, you use a program called a web browser. Thousands of programs are available for Windows.

Starting a program

The Start menu is the gateway to all of the programs on your computer. To open the Start menu, click the Start button. 

The left pane of the Start menu contains a small list of programs, including your Internet browser, e‑mail program, and recently used programs. To start a program, click it.

Process of Shutting Down Computer

When you're done using your computer, it's important to turn it off properly—not only to save energy, but also to ensure that your data is saved and to help keep your computer more secure. Best of all, your computer will start quickly the next time you use it.

The process is to use the Power button on the Start menu:

To turn off your computer, click the Start button, and then click the Power button in the lower right corner of the Start menu.

When to shut down

Even though putting your computer to sleep is the fastest way to turn it off, and the best option for resuming work quickly, there are certain times when you should shut down instead. That is when:

- You are adding or upgrading the hardware inside your computer.

- You are adding a printer, monitor, external drive, etc. Shut down the computer before connecting the device.

To shut down your computer, click the arrow next to the Lock button, and then choose Shut Down.

Section Activity

1. Describe the booting process
2. State type of booting
3. Identify components of Windows Desktop
4. Run applications on computer

2.3 Linux

The idea of developing Linux is to develop an operating system that could run on many different types of hardware and free alternative to UNIX operating system.

Linus Torvalds, a young man studying computer science at the University of Helsinki, thought it would be a good idea to have some sort of freely available academic version of UNIX, and promptly started to code. He started to ask questions, looking for answers and solutions that would help him get UNIX on his PC. From the start, it was Linus' goal to have a free system that was completely compliant with the original UNIX.Two years after Linus' post the project Linux. The project, popular with hobbyists, grew steadily, all the while staying within the bounds of the POSIX standard. All the features of UNIX were added over the next couple of years, resulting in the mature operating system Linux has become today. Linux is a full UNIX clone, fit for use on workstations as well as on middle-range and high-end servers. Today, all the important players on the hard and software market each have their team of Linux developers.

Logging in, activating the user interface and logging out

In order to work on a Linux system directly, you will need to provide a user name and password. You always need to authenticate to the system. PC−based Linux systems have two basic modes for a system to run in: either in text console mode, which looks like DOS with mouse, multitasking and multi−user features, or in graphical console mode, which looks better but uses more system resources.

Graphical mode

This is the default nowadays on most desktop computers. You know you will connect to the system using graphical mode when you are first asked for your user name, and then, in a new window, to type your password.

To log in, make sure the mouse pointer is in the login window, provide your user name and password to the system and click OK or press Enter.

After entering your user name/password combination, it can take a little while before the graphical environment is started, depending on the CPU speed of your computer, on the software you use and on your personal settings.

The terminal window is your control panel for the system. Almost everything that follows is done using this simple but powerful text tool. A terminal window should always show a command prompt when you open one. This terminal shows a standard prompt, which displays the user's login name, and the current working directory, represented by the twiddle (~):

Figure 1: Terminal Window

Another common form for a prompt is this one:

```
[user@host dir]
```

In the above example, user will be your login name, hosts the name of the machine you are working on, and dir an indication of your current location in the file system.

To disconnect from the system in graphical mode, you need to close all terminal windows and other applications. After that, hit the logout icon or find Log Out in the menu.

Text mode

You know you're in text mode when the whole screen is black, showing (in most cases white) characters. A text mode login screen typically shows some information about the machine you are working on, the name of the machine and a prompt waiting for you to log in:

```
RedHat Linux Release 8.0

funaab login: _
```

The login is different from a graphical login, in that you have to hit the Enter key after providing your username, because there are no buttons on the screen that you can click with the mouse. Then you should type your password, followed by another Enter. You won't see any indication that you are entering something, not even an asterisk, and you won't see the cursor move. But this is normal on Linux and is done for security reasons.

Also in text mode: log in as root only to do setup and configuration that absolutely requires administrator privileges, such as adding users, installing software packages, and performing network and other system configuration. Once you are finished, immediately leave the special account and resume your work as a non−privileged user.

Logging out is done by entering the logout command, followed by Enter. You are successfully disconnected from the system when you see the login screen again.

Now that we know how to connect to and disconnect from the system, we're ready for our first commands

The commands

These are the quickies, which we need to get started;

Table 2.1: Quickstart commands

Command	**Meaning**
ls	Displays a list of files in the current working directory, like the dir command in DOS
cd	directory change directories
passwd	change the password for the current user
file filename	display file type of file with name filename
cat textfile	throws content of textfile on the screen
pwd	display present working directory
exit or logout	Leave this session
man command	Read man pages on command
info command	Read info pages on command

You type these commands after the prompt, in a terminal window in graphical mode or in text mode, followed by Enter.

Commands can be issued by themselves, such as ls. A command behaves different when you specify an option, usually preceded with a dash (−), as in ls −a. The same option character may have a different meaning for another command. GNU programs take long options, preceded by two dashes (−−), like ls −−all. Some commands have no options.

The argument(s) to a command are specifications for the object(s) on which you want the command to take effect. An example is ls /etc, where the directory /etc is the argument to the ls command. This indicates that you want to see the content of that directory, instead of the default, which would be the content of the current directory, obtained by just typing ls followed by Enter. Some commands require arguments, sometimes arguments are optional.

Using Bash features

Several special key combinations allow you to do things easier and faster with the GNU shell, Bash, which is the default on almost any Linux system. Below is a list of the most commonly used features; you are strongly suggested to make a habit out of using them, so as to get the most out of your Linux experience from the very beginning.

Table 2.2. Key combinations in Bash

Key or Key Combination	**Function**
Ctrl+A	Move cursor to the beginning of the command line
Ctrl+C	End a running program and return the prompt
Ctrl+D	Log out of the current shell session, equal to typing exit or logout.
Ctrl+E	Move cursor to the end of the command line.
Ctrl+H	Generate backspace character.
Ctrl+L	Clear this terminal.
Ctrl+R	Search command history
Ctrl+Z	Suspend a program
ArrowLeft and ArrowRight	Move the cursor one place to the left or right on the command line, so that you can insert characters at other places than just at the beginning and the end.
ArrowUp and ArrowDown	Browse history. Go to the line that you want to repeat, eventually edit details, andpress Enter to save time.
Shift+PageUp and	Browse terminal buffer (to see text that has "scrolled off" the screen).

Shift+PageDown	
Tab	Command or filename completion; when multiple choices are possible, the system will either signal with an audio or visual bell, or, if too many choices are possible, ask you if you want to see them all.
Tab Tab	Shows file or command completion possibilities.

The last two items in the above table may need some extra explanantions. For instance, if you want to change into the directory directory_with_a_very_long_name, you are not going to type that very long name, no. You just type on the command line cd dir, then you press Tab and the shell completes the name for you, if no other files are starting with the same three characters. Of course, if there are no other items starting with "d", then you might just as wel type cd d and then Tab. If more than one file starts with the same characters, the shell will signal this to you, upon which you can hit Tab twice with short interval, and the shell presents the choices you have:

```
your_prompt> cd st

starthere stuff stuffit
```

In the above example, if you type "a" after the first two characters and hit Tab again, no other possibilities are left, and the shell completes the directory name, without you having to type the string "rthere":

```
your_prompt> cd starthere
```

Of course, you'll still have to hit Enter to accept this choice.

In the same example, if you type "u", and then hit Tab, the shell will add the "ff" for you, but then it protests again, because multiple choices are possible. If you type Tab Tab again, you'll see the choices; if you type one or more characters that make the choice unambiguous to the system, and Tab again, or Enter when you've reach the end of the file name that you want to choose, the shell completes the file name and changes you into that directory − if indeed it is a directory name.

This works for all file names that are arguments to commands.

The same goes for command name completion. Typing ls and then hitting the Tab key twice, lists all the commands in your PATH that start with these two characters:

```
your_prompt> ls

ls lsdev lspci lsraid lsw

lsattr lsmod lspgpot lss16toppm

lsb_release lsof lspnp lsusb
```

Getting Help using the man pages

A lot of beginners' users fear the man (manual) pages, because they are an overwhelming source of documentation. They are, however, very structured, as you will see from the example below on: man man.

Reading man pages is usually done in a terminal window when in graphical mode, or just in text mode if you prefer it. Type the command like this at the prompt, followed by Enter:

```
yourname@yourcomp ~> man man
```

The documentation for man will be displayed on your screen after you press Enter. Browse to the next page using the space bar. You can go back to the previous page using the backspace key. When you reach the end, man will quit and you get the prompt back, or type q if you want to leave the man page before reaching the end.

Each man page usually contains a couple of standard sections:

The first line contains the name of the command you are reading about, and the id of the section in which this man page is located. The man pages are ordered in chapters. Commands are likely to have multiple man pages, for example the man page from the user section, the man page from the system admin section, and the man page from the programmer section. The name of the command and a short description are given, which is used for building an index of the man pages. Some commands have no options or no arguments. Optional options and arguments are put in between "[" and "]" to indicate that they can be left out.

A reference to other man pages is given in the "SEE ALSO" section. In between parentheses is the number of the man page section in which to find this command.

DOS versus Linux commands

In this section, we matched DOS commands with their Linux equivalent.

As an extra means of orientation for new users with a Windows background, the table below lists MS−DOS commands with their Linux counterparts. Keep in mind that Linux commands usually have a number of options. Read the Info or man pages on the command to find out more.

Table 2.3. Overview of DOS/Linux commands

DOS Commands	**Linux Commands**
<command>/?	man <command>
cd	cd
chdir	pwd
cls	clear
copy	cp
date	date
del	rm
dir	ls
exit	exit
ren	mv
time	date

A. Connecting and disconnecting

Determine whether you are working in text or in graphical mode.

I am working in text/graphical mode. (cross out what's not applicable)

- Log in with the user name and password you made for yourself during the installation.
- Log out.
- Log in again, using a non−existent user name

−> What happens?

B. Passwords

Log in again with your user name and password.

- Change your password into P6p3.aa! and hit the Enter key.

−> What happens?

- Try again, this time enter a password that is ridiculously easy, like 123 or aaa.

−> What happens?

- Try again, this time don't enter a password but just hit the Enter key.

−> What happens?

- Try the command psswd instead of passwd

−> What happens?

C. Directories

These are some exercises to help you get the feel.

- Enter the command cd blah

−> What happens?

- Enter the command cd ..

Mind the space between "cd" and ".."! Use the pwd command.

−> What happens?

- List the directory contents with the ls command.

−> What do you see?

−> What do you think these are?

−> Check using the pwd command.

- Enter the cd command.

−> What happens?

- .Repeat step 2 two times.

−> What happens?

- Display the content of this directory.
- Try the command cd root

−> What happens?

−> To which directories do you have access?

- Repeat step 4.

Do you know another possibility to get where you are now?

.

D. Files

- Change directory to / and then to etc. Type ls; if the output is longer than your screen, make the window longer, or try Shift+PageUp and Shift+PageDown.

The file inittab contains the answer to the first question in this list. Try the file command on it.

−> The file type of my inittab is .....

- Use the command cat inittab and read the file.

−> What is the default mode of your computer?

- Return to your home directory using the cd command.
- Enter the command file.

−> Does this help to find the meaning of "."?

- Can you look at "." using the cat command?
- Display help for the cat program, using the −−help option. Use the option for numbering of output lines to count how many users are listed in the file /etc/passwd.

E. Getting help

- Read man intro
- Read man ls
- Read info passwd
- Enter the apropos pwd command.
- Try man or info on cd.

−> How would you find out more about cd?

- Read ls −−help and try it out.

2.5 Microsoft word

Let us consider an office scene. Many letters are typed in the office. The officer dictates a letter. The typist first types a draft copy of the letter. The officer goes through it to check mistakes regarding spelling errors, missing words, etc. and suggests corrections. The typist

changes the letter as suggested by the officer. This is a simple example of word processing. First let us define Word processing and Word processor.

Word Processor: this is a software package that enables a computer user to create, edit, print and save documents for future retrieval and reference.
Word Processing: this is an act of using the computer or other electronic equipment for the manipulation of text which involves creation, editing, storage and printing.

There are several Word processor packages that can be used in Windows operating systems. They are:

- ✓ **Microsoft Office Word (MS Word)**
- ✓ **WordPerfect**
- ✓ **OpenOffice.org Writer**
- ✓ **Ability Write**
- ✓ **WordPad**

Features of Word Processors

Most Word Processor available today allows more than just creating and editing documents. They have wide range of other tools and functions, which are used in formatting the documents. The following are the main features of a Word Processor:

1. **Wordwrap**: automatic arrangement of text in lines of specified length without the necessity of touching the return key.
2. **Justification**: automatic alignment of text to both the left and right margins.
3. Indents: the setting of temporary margins within a document differing from the primary margins used.
4. **Insertion**: the entry of new text within previously typed material without erasing the existing material.
5. **Overstriking**: the substitution of new text for old by typing over the old text.
6. **Deletion**: erasure of text from the screen, or of whole documents from the disk.
7. **Search and Replace**: moving directly to specified words or parts of words within a document and replacing them with different words or word portions.

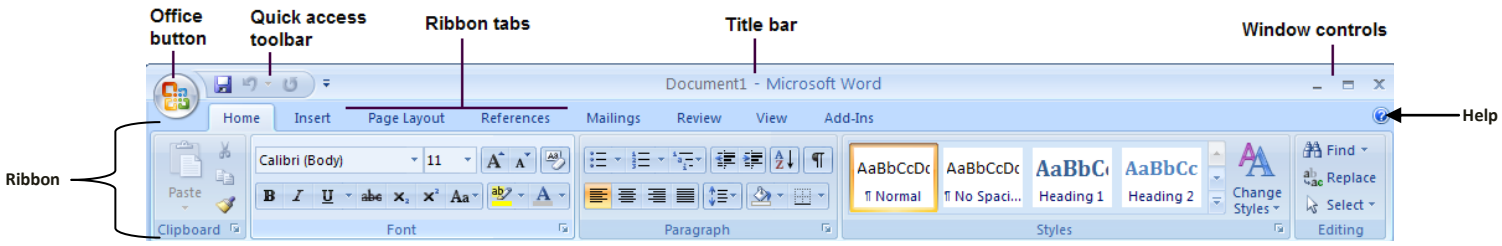
8. **Copying or Cutting**: the duplication or moving of blocks of text within a document.
9. **Pagination**: automatic division of a document into pages of specified numbers of lines.
10. **Page Numbering**: automatic sequential numbering of pages.

Using the Word Processing Package

We learnt previously, that there are various types of Word processing packages. Now we are going to learn how to use the Word processor. We will utilize the most commonly used word processor package called MS-Word 2007.

MS-Word 2007 Environment

The MS-Word 2007 environment has a very user-friendly environment. Its features are clearly named, organized and easily assessable. Microsoft Office 2007 also introduces a feature called "**Live Preview**", which temporarily applies formatting on the focused text or object when you place your mouse cursor over any formatting button. The temporary formatting is removed when the mouse pointer is moved from the button. This allows users to have a preview of how the option would affect the appearance of the object, without actually applying it.



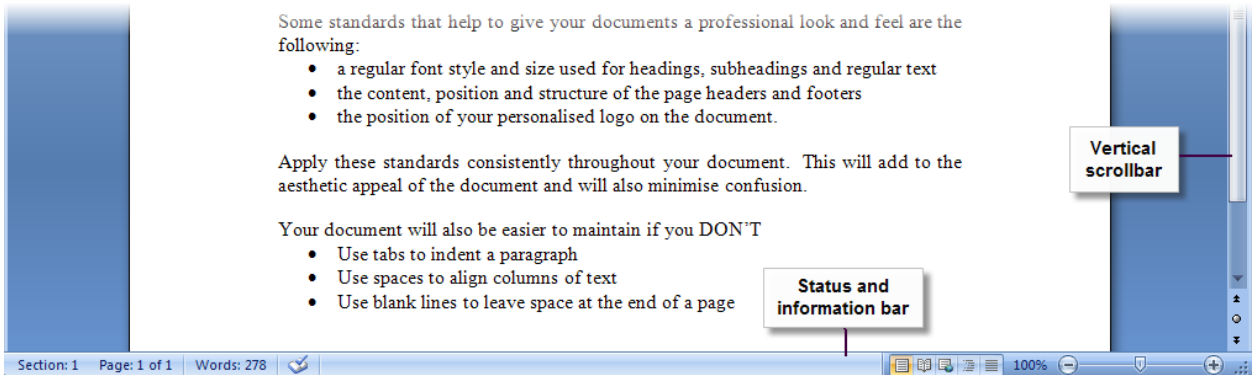


Figure: MS-Word 2007 Environment

The description of each of the feature of the MS-Word environment is explained below:

1. **Office Button**: it contains a menu of file-related commands. When you click the **Office Button** you will see the available commands such as New, Open, Save, Save As etc. To select a command, click on it.

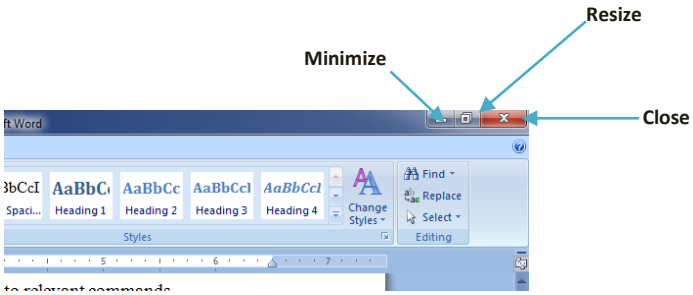
2. **Quick Access Tool Bar**: it provides a set of frequently used commands. The default options are to save a file, to undo the last action, and to repeat your most recent action. You can add other options by clicking on the drop down menu of beside the Quick Access Tool Bar.

3. **Ribbon**: it is a panel that houses a fixed arrangement of command buttons and icons. It organizes the commands as a set of tabs; each grouping into relevant commands.

4. **Ribbon Tabs:** it provide you with a set of tools that are relevant to what you are currently doing. In the example above, the **Home** tab contains formatting and editing options.

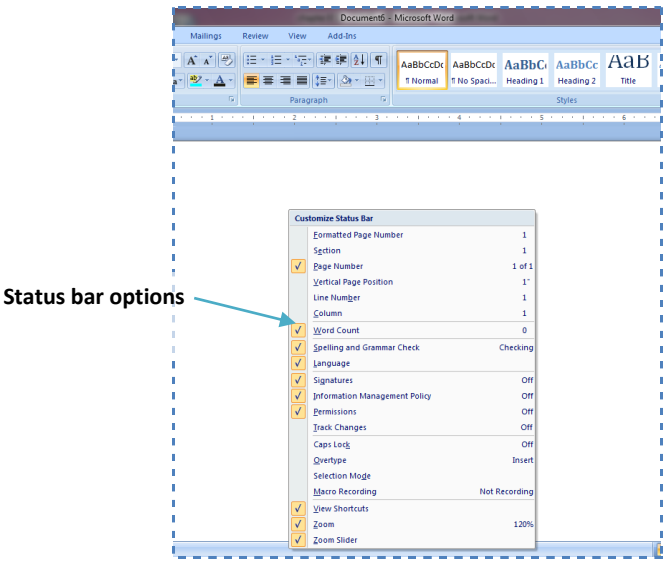
5. **Title Bar:** it displays the name of the program and the name of the current document. If you haven't named the document yet, then it will be called something like Document1.

6. **Window Controls:** they are used to minimize, resize or close a window. This feature is in every program that you open in windows. To minimize means to reduce the window unto the task bar. Resize changes the size of the window to fill the screen or to appear as part of the screen. You click close to end the program.



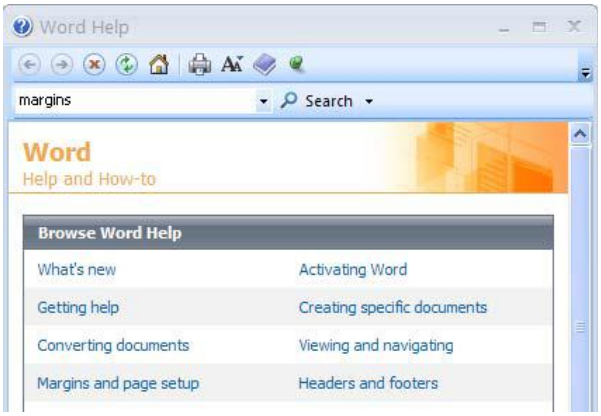
7. **Vertical Scroll Bar:** this is used to scroll up and down the page. You can also click on the little down arrow below the scrollbar to move down the page. If your page is wider than the screen display, then you will also see a Horizontal scrollbar across the bottom of the window.

8. **Status and Information Bar:** it displays useful information about your document, such as the page count and number of words. You can right-click the status bar to show u more options of more information you will like to view on the status bar. Check the items you want to see; uncheck those you don't want to see on the status bar.

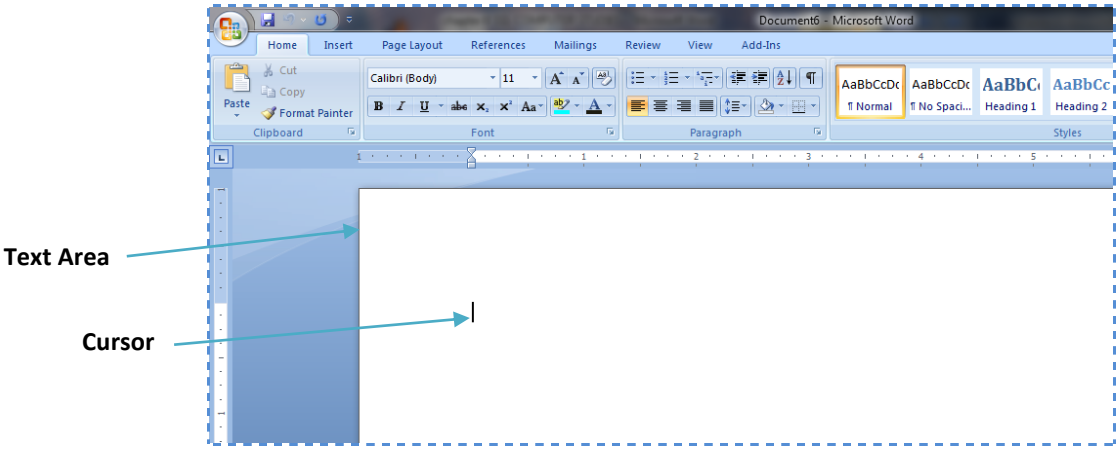


9. **Help:** at the top right corner of your MS Word screen, you'll see a small blue circle containing a question mark. Just click on the question mark to open the MS Word Help window. You can also access the Help window by pressing the [F1] key on your

keyboard. To get help on a specific topic, type a word or phrase in the blank area at the top of the window and then click the ***Search*** button; alternatively, you can click on any of the Help topics listed in the window. Click the X in the top right corner to close the Help window.



10. **Text Area**: Just below the ruler is a large area called the text area. You type your document in the text area. The blinking vertical line in the upper-left corner of the text area is the cursor. It marks the insertion point. As you type, your text displays at the cursor location.



Using MS-Word 2007

In this section you are going to learn how to use the MS-Word 2007 processor to perform the some tasks, as follows:

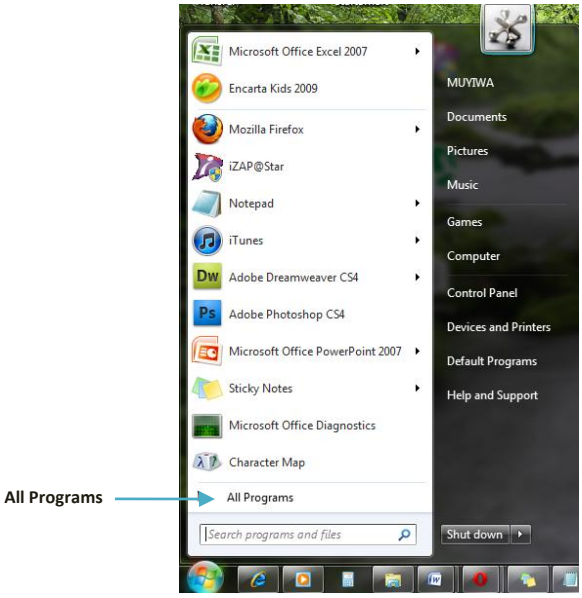
1. Open MS-Word 2007:

To start the MS-Word 2007 program, follow these steps:

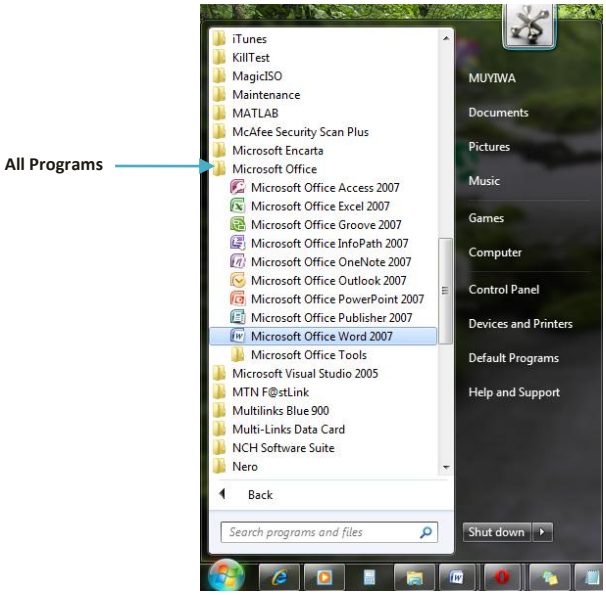
i. At the left corner of the task bar in the Windows Desktop, click the Windows **Start** Button.

Note that the illustration above was done in Windows 7. The Start button for other Windows Operating Systems like Windows XP and Windows Vista are located in the same place. So you can still follow the steps – they follow the same path.

ii. In the Start Menu, as shown below, click the entry for **All Programs**



iii. In the displayed list of all the programs in the computer, scroll down to **Microsoft Office** folder. Click it; and it will show you the list of all Microsoft packages installed in your system.



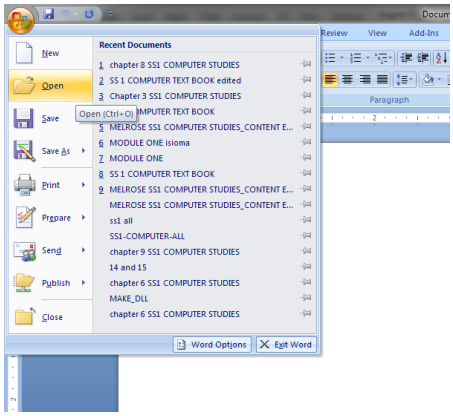
iv. Then click **Microsoft Office Word 2007**; and then, the program opens.

2. Create a Document

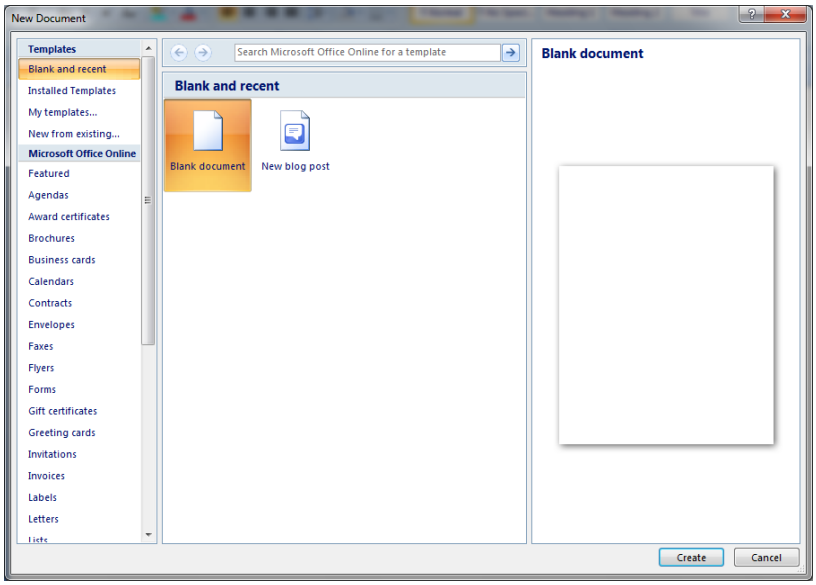
To create a new document in MS-Word 2007, follow these steps:

i. Click the office button.

ii. In the left pane of the displayed menu, click **Open.**



iii. A dialog box pops up. From the middle pane, choose **Blank document** from the two options: **Blank document** and **New blog post**.



iv. Now, click **Create** in the bottom of the right pane in the dialog box, and the new document opens.

3. Edit a Document:

In the newly opened document, type the following text.

The Office button, located on in the top-left of the window, replaces the File menu and provides access to functionality common across all Office applications, plus including opening, saving, grinding, printing, and sharing a file. It can also close the application.

Using the Office Button in MS-Word 2007:

i. Click in front of the word "**Office"** on the first line to insert the cursor.

ii. Press the space bar on the keyboard, and type "**2007"**.

iii. Insert the cursor in front of the word "**in**" on the first line and press Backspace, on the keyboard three times to remove the word and the space after it.

iv. On the third line, as seen above, click in after "**applications,**" and press Delete five times to remove the word "**plus**".

v. Double click the word "**grinding"** on the third line. The word is selected. Then press Delete on the keyboard.

vi. Afterwards, press together, the CTRL key and Z key on the keyboard i.e CTRL+Z to undo the action just performed. Alternatively click the blue arrow inside the Quick Access Tool Bar that turns backwards. To redo the action, i.e. in order for the

word "**grinding**" to be deleted again, click the blue arrow turning upwards in the Quick Access Tool Bar. The keyboard shortcut for redo is CTRL+Y.

vii. Click in front of "**Using the Office Button in MS-Word 2007:**" hold the SHIFT button on the keyboard and press the forward arrow button till you reach the "**2007:**" Right-click on the selected word. In the displayed menu, chose cut. Right-click in the beginning of the paragraph i.e. before "**The Office Button...**" and chose Paste. Note that Cut will delete the selected word; while copy will still leave the selected word in place.

viii. To select the whole paragraph, triple click any word in the paragraph.

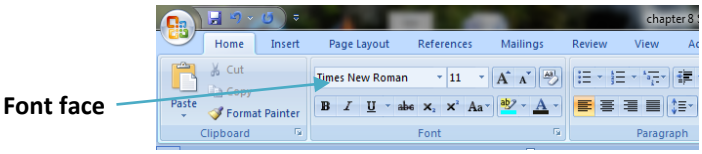
ix. To select a body of text containing several paragraphs, press CTRL+A on the keyboard.

4. Format Document

You may want to change the appearance of the text in the Word document to your taste. Formatting is the term used to describe this phenomenon. Carry out the following steps to learn formatting:

i. Select the text you wish to format.

ii. In the Ribbon, make sure that the Home tab is selected. Move your mouse pointer to the menu for changing the font style. Note that Font Style is the same as Font face.



iii. In the dropdown menu, move your mouse pointer over the different font faces, and the live preview feature of MS-Word 2007 will show you how each look. Pick any font of choice.

iv. In the same way you can change the size of your text when you click in the menu for font size, located just before the font face.

v. You can Bolden the selected text, italicize or underline when you click on **B, *I*** **and U** respectively. Also to draw a line across your text, click ~~**abc.**~~ These buttons are located just below the menu for font face.

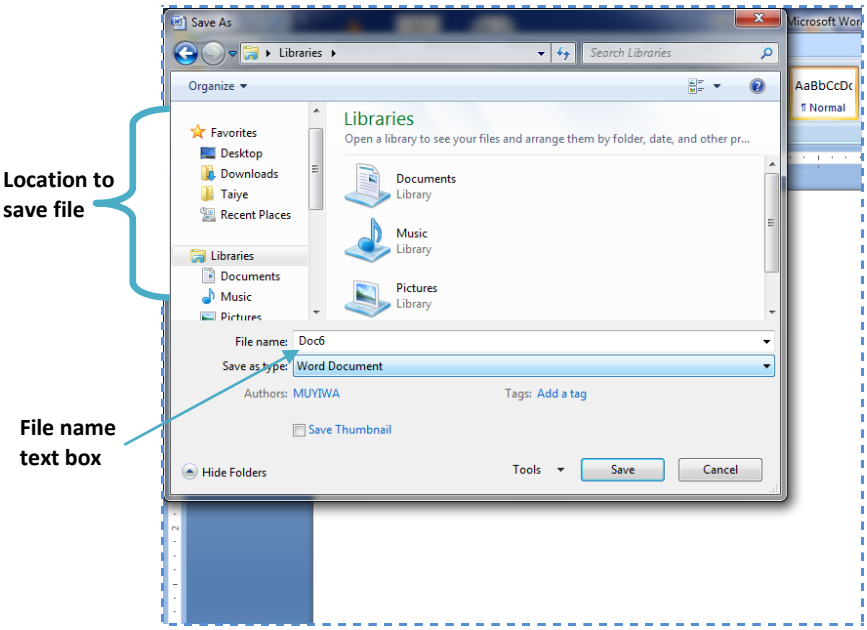
5. Save a Document

After you have finish editing and formatting your work in MS-Word, it will be very appropriate to save it in your computer or some external storage device; so that you can access it later. To do this:

i. Click the Office Button.

ii. In the displayed menu select Save As. Note that you will use **Save** option when you are working on a document that had been previously saved in your computer. On the other hand, you will use **Save As** either when you saving a new document that have been saved before or you want to save a copy of the document in another location.

iii. Once you click **Save As**, the Save As dialog box pops up as shown below:



iv. In the file name text box, type the name you want to use to save the document and in the left pane of the dialog box, you can choose the location to save you file.

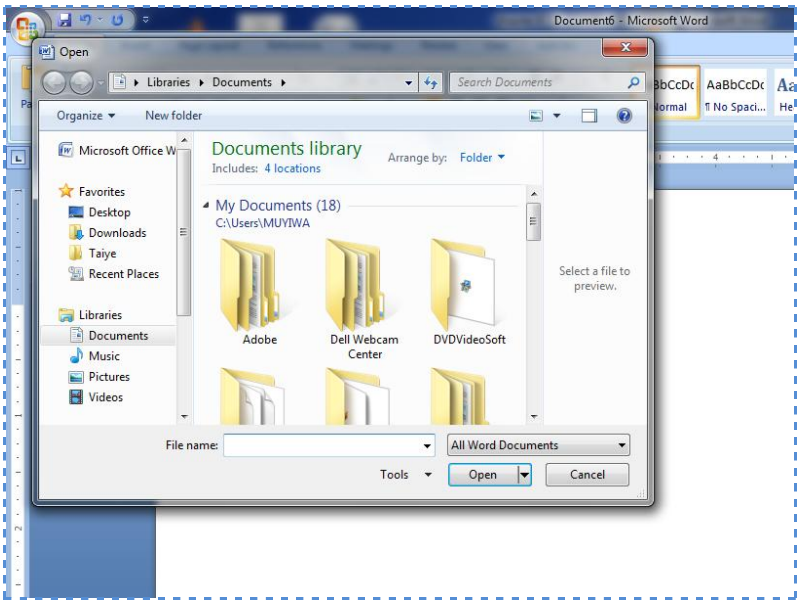
v. Then click save.

6. Retrieve a Document

In a situation whereby you need to open an existing word document that you have created before or that you collected from somebody, you can open such a document in MS-Word 2007 by following these steps:

i. Click the office button.

ii. In the displayed menu, Click Open. In the Open dialog box, click the location of the file from the file location section in the left pane. You may need to scroll down to see other locations.



iii. Once you have located the file, click on the file and then click Open in the right bottom section of the Open dialog box.

iv. Then the file opens.

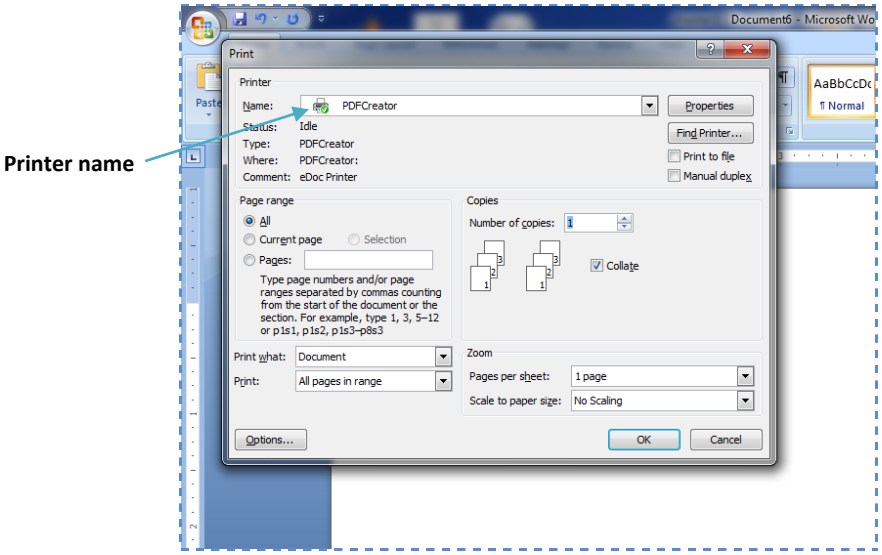
7. Print a Document

After you have finished working on your document, you may want to have the document as a hardcopy. Printing involves the following steps:

i. Click the Office Button.

ii. In the displayed menu, click print.

iii. In the Print dialog box that pops up, choose the available printer from the Printer name text box as labeled below:



iv. Then click OK to print.

8. Close MS-Word Document

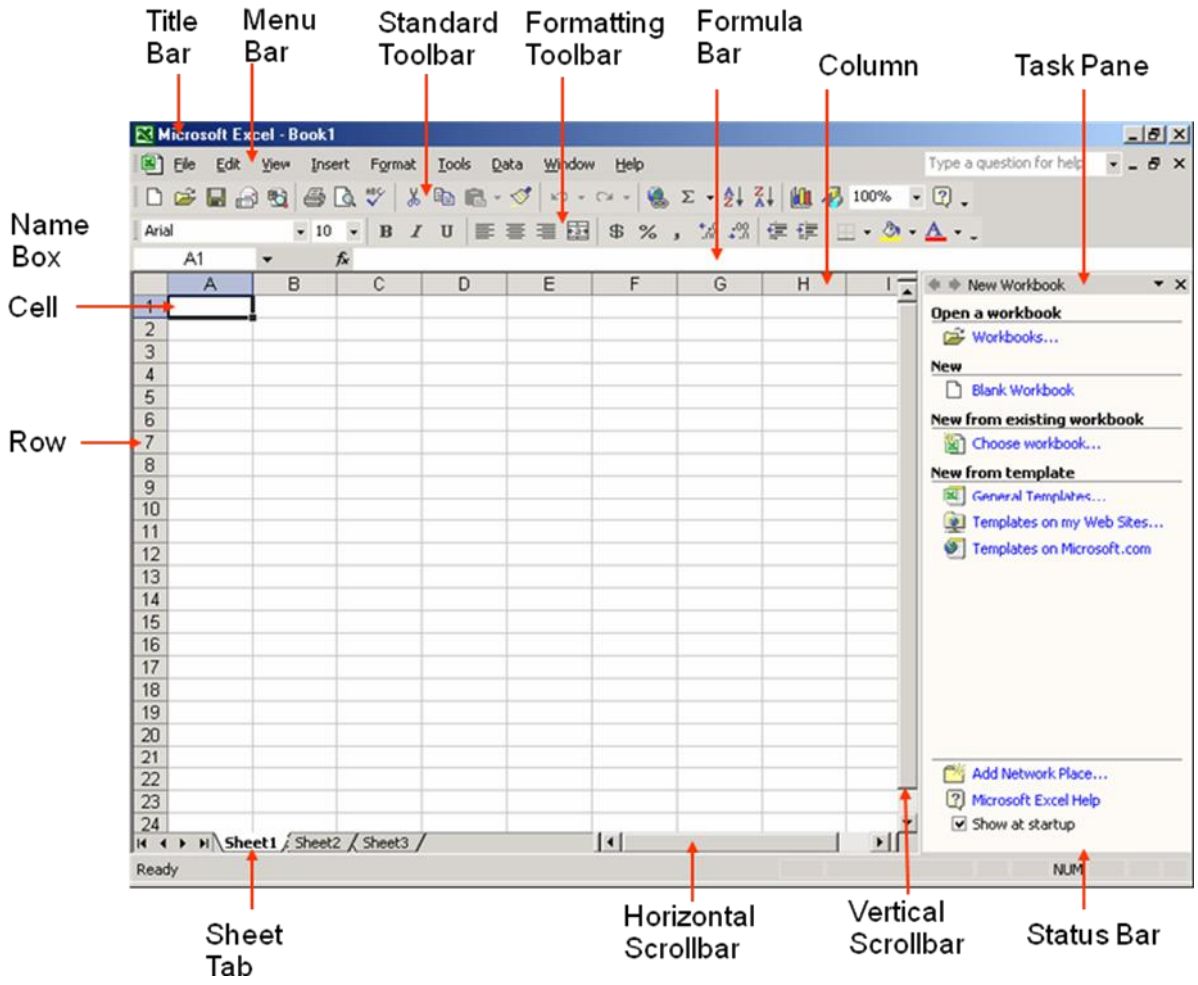
In this case you may want to close the present document you are working with, but do not want to close MS-Word 2007 program, take the following steps:

i. Click the Office button.

ii. In the displayed menu choose the last option in the left pane – **CLOSE.** Note that to close the program you should click on Exit Word on the bottom right pane of the menu displayed.

2.6 Microsoft Excel

- Definition of a Spreadsheet
    - A spreadsheet is a program that manipulates number and string data in rows and columns
- Advantages of a Spreadsheet
    - Main advantage of using a spreadsheet program is that it enables you to perform simple row-and-column arithmetic
- Introduction to Excel
    - Excel is a spreadsheet program with various components
    - Rows-are referenced by the row number
        - 1:1 is the reference to the first row
    - Columns-are referenced by the column name such as “A”
    - Cell-is an intersection of a row and a column
        - It can contain various types of data – numeric/character
        - A cell is referenced by the combination of a column and row name. E.g., first cell A1 is in column A and row 1
- Worksheet-contains rows and columns of cells. A sample worksheet is displayed

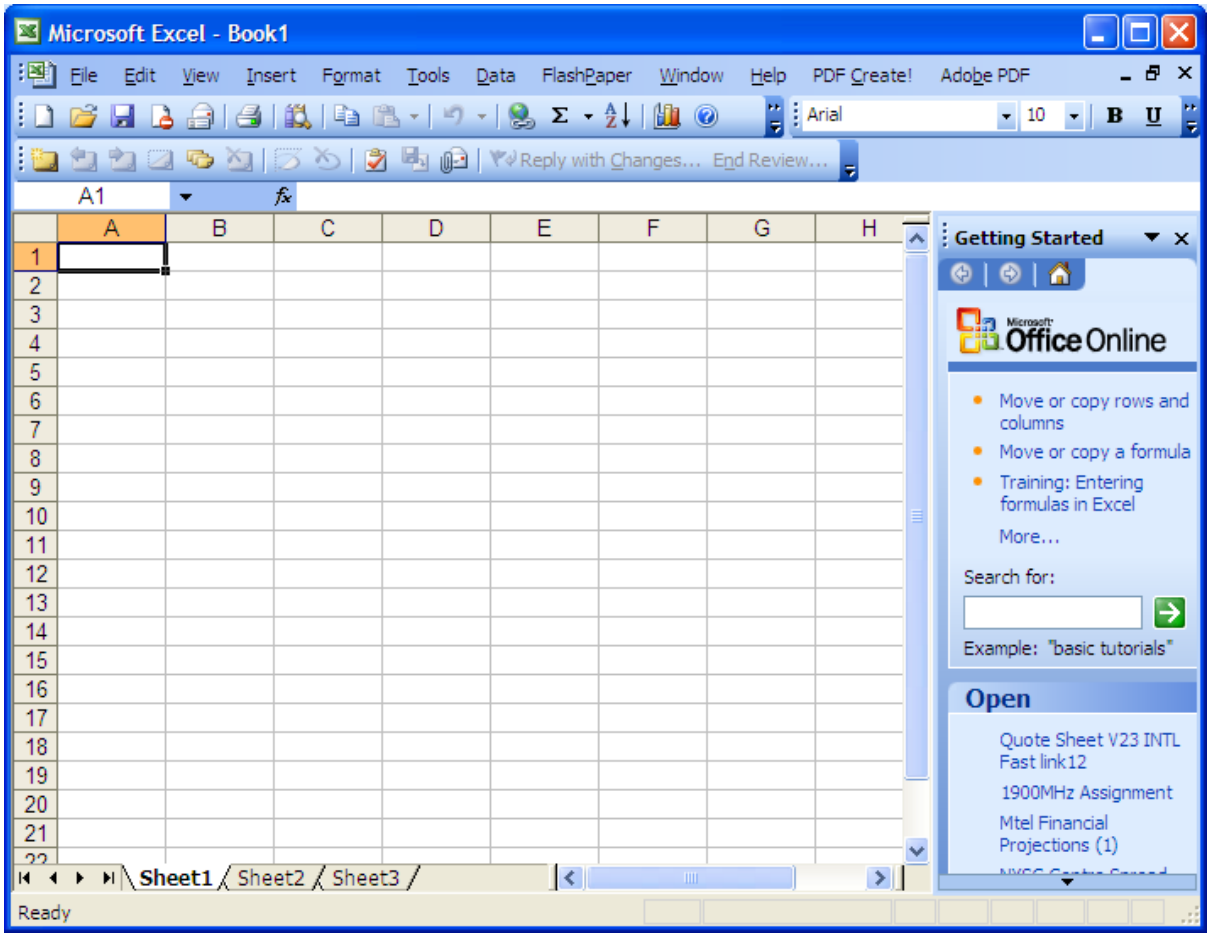


- The Microsoft Excel Window includes the following components:
  - **Rows**: Rows are referenced by the numbers.
  - **Columns**: Columns are referenced by the alphabets.
  - **Cell**: A cell is an intersection of a row and a column. Cells can contain various types of data. A cell is referenced by the name of the column and row. For example, the first cell A1 is in column A and row 1.
  - **Worksheet**: A worksheet contains rows and columns and their intersection forms the cells. A worksheet consists of 65,536 rows and 256 columns.
  - **Workbook**: A workbook consists of worksheets. It is also referred to as an Excel file. A workbook can be defined as a set of worksheets.
  - **Title bar**: A title bar displays the name of the current workbook.
  - **Menu bar**: A menu bar consists of various menus, such as File, Edit, and View.

- **Toolbar**: A toolbar contains buttons that provide easy access to the commands and functions of Excel.
- **Formula bar**: A formula bar contains tools for creating and editing formulas.
- **Name box**: A name box displays the name of a selected cell and a range of cells.
- **Task Pane**: A task pane serves as an additional navigation tool substituting the frequently used dialog boxes. The task pane appears each time you start Excel.
- **Horizontal scroll bar**: A horizontal scroll bar serves as a tool to view the left or right part of the worksheet that is not displayed on the screen.
- **Vertical scroll bar**: A vertical scroll bar serves as a tool to view the top or bottom part of the worksheet that is not displayed on the screen.
- **Sheet Tab**: A sheet tab helps to navigate between worksheets in a workbook.

Starting Excel

- To start Excel, we perform the following
  Click Start → Programs → Microsoft Excel
- A blank workbook is opened.



Creating a Workbook

- **Task 1**: Identify the type of data to be inserted in the worksheet
  - Before you decide the type of data to be inserted in the worksheet you should know about the methods of representing information in a worksheet
  - You can represent information in the following manner in a worksheet:
    - **Data** - includes normal text, numbers and date
    - **Charts** - graphically represent data in a worksheet
    - **Pictures** - pictorially represent data in a worksheet
- **Task 2**: Determine the type of data manipulation required
  - You can perform the following types of data manipulation:
    - Generate a series of data

- Perform calculations on data

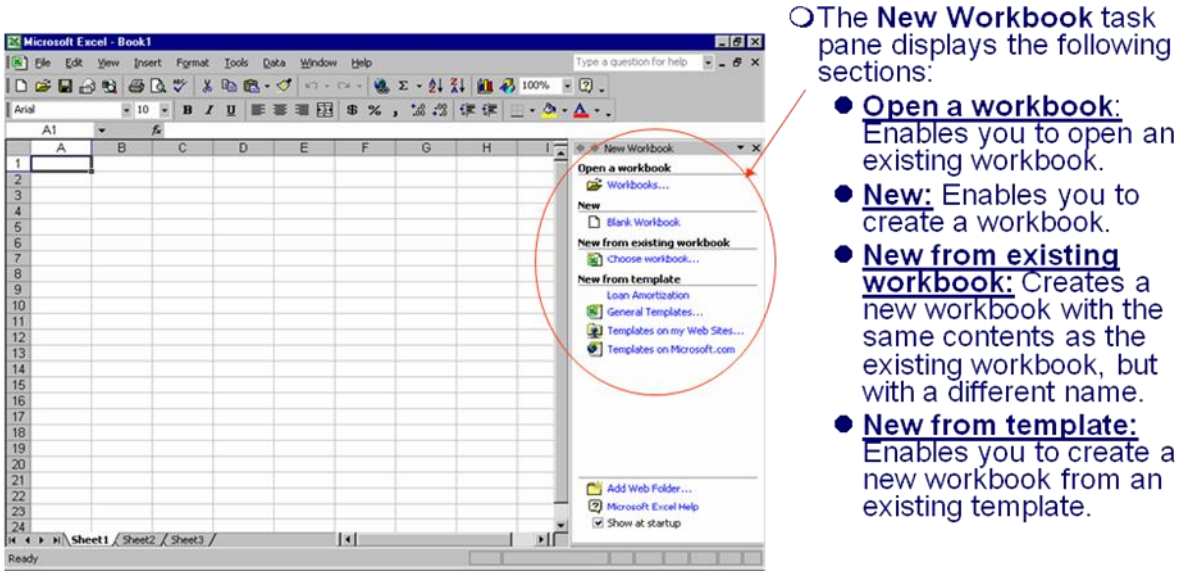
- **Task 3:** Determine whether you have to generate a series of data, e.g.,
  - Text - includes series like Product'1, Product2, Products
  - Number - includes series like 1, 2, 3
  - Date - includes series like Monday, Tuesday, Wednesday and January, February, March
- **Task 4**: Determine whether you have to perform calculations on data
  - Types of calculations include:
    - Mathematical - includes addition, subtraction, multiplication, and division
    - Statistical - includes finding average, maximum and minimum values
    - Financial

You can use formulas and functions to perform calculations in a worksheet

To Create a Workbook

- To create a workbook, perform the following steps:

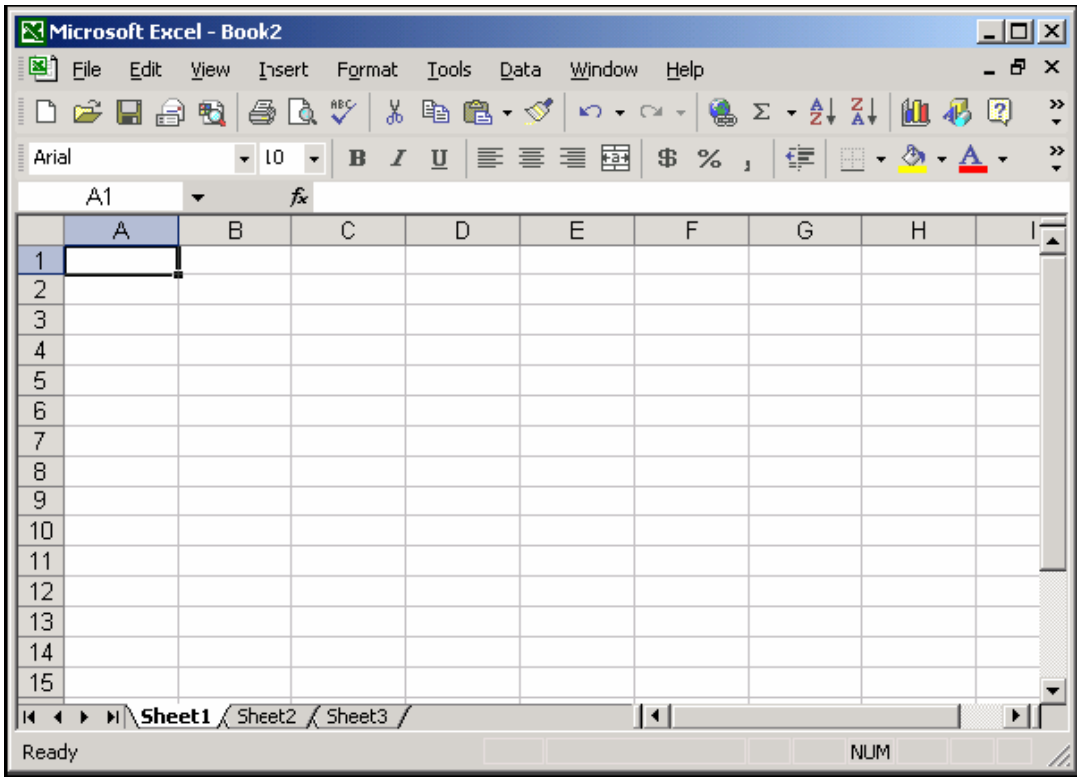
1. Select the **File → New** command (**New Workbook** task pane is displayed on the right-hand side of the screen)



2. Select the **Blank Workbook** option from the **New** section. This opens a new workbook, as shown:

- Alternatively, you can hold down the **Ctrl** key and press the **N** key to create a workbook.

By default, the first cell A1 in a new worksheet is active when you create a new workbook.

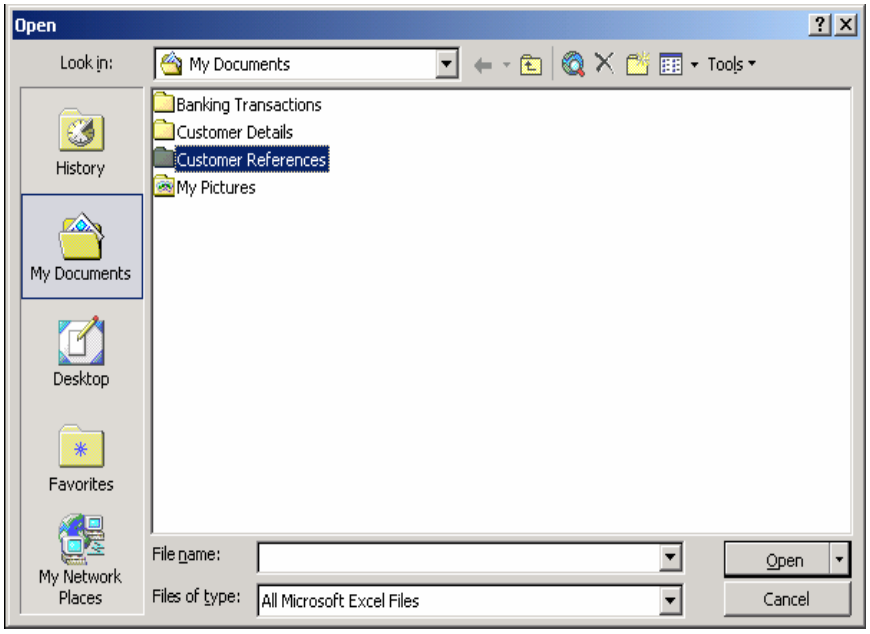


Opening a Workbook

- When you start Excel, it opens a blank workbook
- To open an existing workbook, perform the following steps:

    1. Select the **File → Open** command from **Microsoft Excel** Window to display the **Open** dialog box
    2. From the **Look in** drop-down list, select the folder that contains the file you want to open

An alternative way to browse to the required location of the file is to click the **Up one level** icon ()



3. Select the required file(s) from the list of files displayed in the dialog box
4. Click the **Open** button to open the selected file(s)

To open multiple adjacent files, select the first file in the block from the **Open** dialog box, press the **Shift** key, and select the last file

Saving the Workbook

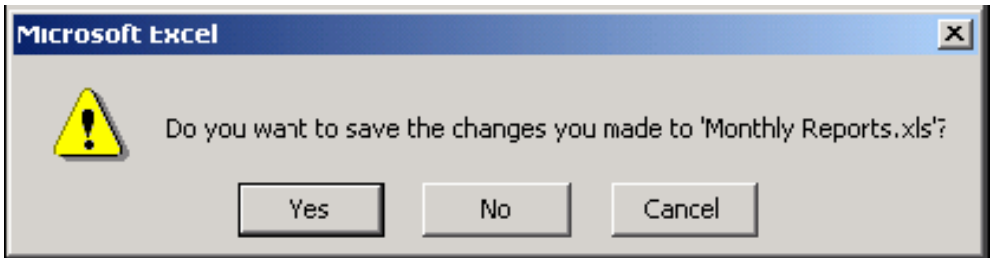
- Saving a workbook is similar as in saving any file in microsoft office (word, power point, etc)
- After adding data to a workbook, you need to save it for future use
- Steps to save a workbook

1. Select the **File → Save** command from the Microsoft Excel Window (**Save As** dialog box is displayed)
2. From the **Save in** list, select the folder in which you want to save the workbook
3. Enter a file name in the **File name** text box of the **Save As** dialog box
4. Select the type of file that has to be saved from the **Save as type** drop-down list
5. Click the **Save** button to save the workbook

Alternatively, you can hold down the **Ctrl** key and press the **S** key to save a workbook

Closing the Workbook

- You need to close a workbook after you finish working on it
- To close a workbook, perform the following steps:
    1. Select the **File → Close** command.
        - If the workbook has any unsaved changes, the **Microsoft Excel** message box appears as shown in the following figure:



    2. Click the **Yes** button to save the changes before closing the workbook. Click the **No** button to close the workbook without saving the changes. Click the **Cancel** button to return to the active worksheet without saving the workbook.

Performing Operations on Data

- You can perform the following operations on the data in worksheets and workbooks:
    - Entering data
    - Moving and Copying data
    - Deleting data
- You can enter text, numbers, and date and time entries in a worksheet
- **Entering Text and Numbers**
    - To enter text or numbers in a single cell, perform the following steps:
        1. Select cell in which you want to enter the text or number
        2. Type data in the cell
            - As you type in the cell, the contents of the cell also appear in the **Formula** bar
        3. Press the **Enter** key

- If you want to edit the data of the cell, double-click on the cell or press the **F2** key

❍ **Entering Date and Time**

- To enter date and time in a cell, perform the following steps:

    1. Select the cell where the date and time is to be entered and type the required date and time.

    2. There are many formats to enter the date, the most common are date with hyphen or slashes, for example, 08-10-2006 or 08/10/2006

- To enter the current date, select the required cell and hold down the **Ctrl** key and press the **;** key.

To enter the current time, select the required cell and hold down the combination of **Ctrl** and **Shift** keys and then press the **:** key.

❍ **Moving and Copying Data**

- You can move data from one location to another. You can move data by using the **Edit** menu or by using the shortcut key

- To move the contents of selected cells, perform the following steps:

    1. Select the range of cells having data to be moved

    2. Select the **Edit → Cut** command

        - In case the cell needs to be moved to a location across worksheet or across workbook, select the destination worksheet.

    3. Select the cell in the destination worksheet

    4. Select the **Edit → Paste** command to move the selected contents

- Alternatively, select the required cells, and drag the border of the selected cells to the desired location in the current worksheet

❍ **Copying Data in a Worksheet**

- When you want the same data to be present at several locations, it is best to copy this data rather than type it at each location

- You can copy data within a worksheet, across worksheets, across workbooks, or even to and from other applications

- You can copy a part of the cell's content or the entire cell. To copy the content you can use menu command or by using the shortcut key.

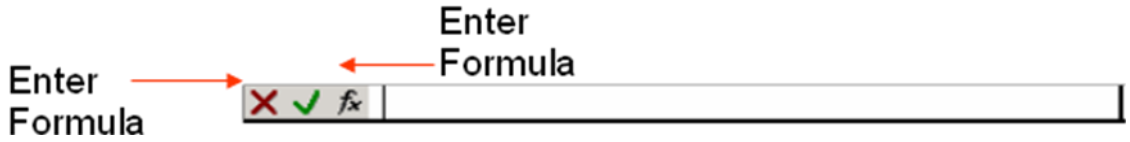
- The steps to copy data to another location in the same worksheet are:
    1. Select the range of cells to be copied
    2. Select **Edit → Copy** command to copy the contents of the selected range of cells
        - In case the cell needs to be pasted to a location across worksheet or across workbook, select the destination worksheet
    3. Select the cell in the destination worksheet
    4. Select the **Edit → Paste** command to copy the selected contents
- A **Paste Options** button will appear next to the pasted data

Alternatively, select the required cells, hold down the **Ctrl** key, and drag the selected cells to the desired location in the current worksheet

Using Formula and Functions

- At times there may be a need to perform some calculations on some numerical data that is represented in an Excel worksheet
- To perform calculations, a formula can be used
- Formulas in Excel begin with an equal sign (=)
- E.g., =A1+A2+A3 is a formula to add the contents of cells A1, A2, and A3

The Formula bar is a bar at the top of the Excel window that displays the formula of the active cell



- The Formula bar is displayed by default. You can choose not to view the Formula Bar

To stop viewing the Formula Bar, select **View → Formula Bar** command. You can later view the Formula Bar by selecting the same option.

- **Entering Formulas in a Worksheet**
    - A formula can be typed in a cell to calculate and display the result of the formula in that cell. Eg., in a cell A1 a formula given as =B4+C5 adds the cell contents of cell B4 and cell C5 and display the result in cell A1

- The formula specified must be preceded by an equal to (=) sign otherwise the calculation will not be performed
- Listed below are some examples of formulas:
  - =35 * 44
  - =23 ^ 2
  - =C5 -C3
  - =C1+C2+C3+C4+C5
  - =S3 - D6 * 44 / 3

- An important and useful feature of Excel is that it automatically recalculates the value of the cell that contains a formula if the values of the cells to which the formula refers to change. For example, the formula =C3+C4 in cell C5 is recalculated if the values of cells C3 or C4 change.

Functions

- Excel provides many functions - mathematical, statistical, logical, etc.
- Mathematical functions
  - Sum(), Product()
  - E.g, to calculate the sum of values stored in cells C1 to C5, use =**SUM(C1:C5)**.
- Statistical functions
  - Average(), Max(), Min(), Count(), Round()
  - Eg., to find the average of the values in cells C1 to C5, use =**AVERAGE(C1:C5)**.
- Date and time functions
  - Now(), Today(), Date(), Time()
  - Eg., =**TIME(9,0,0)** returns 9:00 A.M and =**TIME(20,15,30)** returns 8:15 P.M.
- Logical functions
  - If(), Not()

E.g., For the formula **=If(B2>70, “A”, “B”)**, a grade **A** is displayed if marks are above **70** and a grade **B** is displayed if marks are below or equal to **70**.

CHAPTER THREE

ALGORITHM CONCEPTS AND REPRESENTATION

3.1 Concept and Role of Algorithm

An algorithm is a sequence of actions whose task is to resolve a problem. An algorithm is composed of a sequence of actions, each organized in steps. Each step modifies the states of the set of information items. Each action corresponds to a step that the performer completes.

3.1.1 Algorithm and Program

What difference is there between an algorithm and a program? The first thing to underline is that an algorithm is meant in general to be performed by a human while the computer performs a program. Also, a program is a sequence of instructions, each of which causes an action. But does a sequence of instructions cause a sequence of actions? The answer is not only negative but we can point out that each sequence of actions causes dynamic sequences which are not only unknown beforehand but are in fact infinite the algorithm for a phone call is an example, assembly of an appliance another). In a program the static sequence (lexicographical sequence) describes multiple dynamic sequences (possible different executions). In short, associated with the instructions that cause the actions we need phrases or linguistic mechanisms that, according to whether a certain event is verified or not, drives the performer to carry out one sequence of actions rather than another. These instructions are called control instructions.

3.1.2 Control Structures

What kinds of control instructions are necessary in order to describe the algorithms? The definition of the dynamic sequences happens through linguistic mechanisms that implement three fundamental operations:
(a) **Sequence:** the instructions are performed in "sequence" that is in the order in which they were written.
(b) **Selection:** the instructions to be executed are selected according to whether a logical event is verified or not.
(c) **Iteration:** a block of instructions must be repeated; the execution and the repetition of the block are stopped when a logical event is verified or not.

3.2 Properties of Algorithm

The concept of algorithm, as one can guess, is one of the most important elements of computer science. It is useful to frame a problem and to transform it into a solution that is correct and efficient. This is the first property of an algorithm that forms a part of it. Correctness is the property reflecting the extent to which the algorithm is able to reach a solution without errors. Think for example of the sequence of actions necessary for the collection of a sum of money through ATM machines. The sequence of actions is, necessarily, prearranged and therefore any alteration of the sequence can cause an error jeopardizing its result (missing issue of banknotes, ejection of the card, etc.). The efficiency of an algorithm is the property that regards the rapidity by which a solution is reached. It is clear that, for instance, the assembly instructions of an appliance are often not even read by the installer. Why is that? Evidently the repetition of this activity, by the expert has conferred

to him such a speed that he is able to efficiently repeat the assembly much more quickly than someone doing it for the first time. On the other hand, the beginner may try their solution of the problem without reaching the solution immediately (some steps may need to be redone). The computer scientist should therefore seek or design algorithms that are both correct and efficient.
An algorithm should have numerous other properties that we will now list. Generality is the property that confers to the algorithm a fundamental value: it must be designed to solve a class of problems. The algorithm must be finite in terms of the sequence of actions to do and defined by these individual actions. Besides, it must be effective which means that each single action can be recognizable through its effect; in a word it should be reproducible. Finally the algorithm must be comprehensible by the one who performs it.
What we have said allows us to return to the concept of algorithm only to point out that it is not only known but also widely used in daily life. Make a phone call, make a coffee, get dressed, etc. are examples of algorithms and each of us carry them out in different ways. The algorithm therefore depends on the performer that can be, for example, a human or a computer. It must describe in all details, the actions and the entities necessary for the resolution of a problem. More generally in an algorithm there are static entities called objects. These could be of three types:

- input,
- output,
- algorithm,

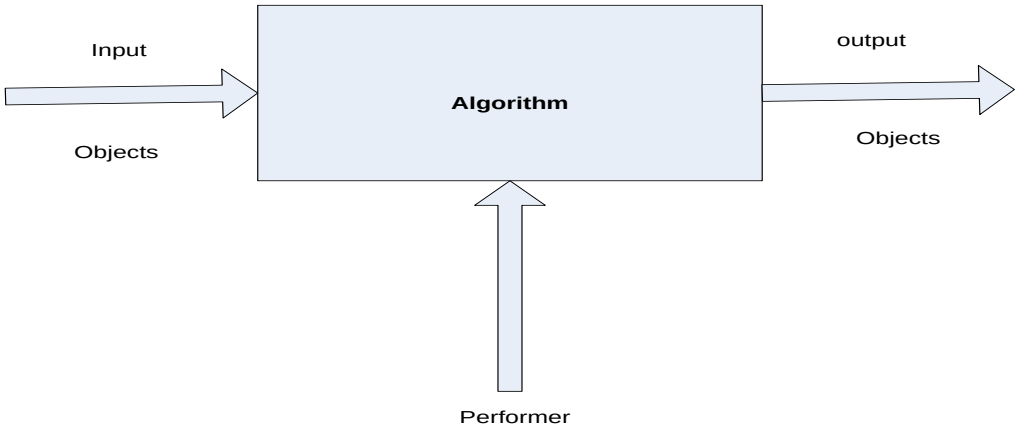


Fig. 3 The relationship between algorithm, input, output and performer.

3.3 Algorithm Representation and Discovery

3.3.1 Overview of Algorithm

Algorithm is a fundamental concept of computer programming. It is a prescribed set of well defined instructions for solving a problem in a finite number of steps. The problem solving steps starts with the problem specification and ends with a correct program.

The two most common representations are pseudo code and flowcharts. In this course, unless it is stated otherwise, you are free to use either one at your discretion.

3.3.2 Algorithm Representation

As mentioned previously, algorithms are generally represented by either pseudo code or a flowchart. We shall focus on the features our algorithm representation should have in order for it to be a meaningful and useful representation.

- Show the logic of how the problem is solved - not how it is implemented.
- Readily reveal the flow of the algorithm.
- Be expandable and collapsible.
- Lend itself to implementation of the algorithm.

3.3.3 Essential Elements of a Good Representation

1. **Show the Logic**

One of the most difficult things for people just learning problem solving - especially when it involves computer programming - is to clearly distinguish between the concept of problem logic and implementation logic. The former is independent of the details of how the problem solution is implemented. If you are trying to find the radius of a sphere having a specific surface area, then you need to find out what that area is, you need some means of dividing that area by 4pi, and you need some means of taking the square root of the result. It doesn't matter whether you are solving the problem with a C program, a Java program, a calculator, a pencil and paper, or in your head - those elements are part of the logic of solving the problem. The logic involved in taking the square root of a number, on the other hand, is germane primarily to the logic of how you are implementing your solution. In other words, for most purposes I can communicate the logic behind how to determine the radius of a sphere with a specific surface area by going into no more detail than to note that, at some point, it is necessary to take the square root of a number.

Your algorithm representation should focus on the logic of the problem, and not the logic of the eventual implementation. More specifically, the upper levels of your representation should, to the degree possible, be devoid of implementation details - these should be relegated to the lower levels of the representation.

2. **Reveal the Flow**

Most problems, especially if they are intended to be solved with the aid of a computer program, involve flow control. In the "structured programming" paradigm, this flow control consists of sequences, selections, and repetitions. This may not be readily apparent at the topmost level where the algorithm can be represented by a list of tasks that are to be performed one after another in a specific sequence. But at some point, as each of those tasks is developed, decisions will have to be made and different steps taken depending on the outcome of those decisions. The representation method used should be compatible with this and clearly show the points at which decisions are made and what the various courses of action are that can result.

3. Be Expandable and Collapsible

Our algorithm representation should be flexible and allow us to readily collapse it so as to show less detail and focus on the more abstract elements of the algorithm or to expand it so as to get as detailed as necessary in order to actually implement the solution. Unstated in this is an acknowledgement that, as we expand our algorithm and become more detailed, at some point we have to get into the logic of the implementation issues.

For instance, if we expand the step that says to take the square root of a number, we have to start describing the specific method that will be used to do this and that method is highly dependent on the eventual implementation. At that point, our algorithm is becoming "locked" to that particular implementation. This is perfectly acceptable. The reason that we should be asking for more detail on how to take the square root is because we are now dealing with implementation issues and therefore expect that the steps will be specific to the implementation.

If we have structured our representation properly, then we can always back up. If our original implementation was with a C program and now we want to implement the algorithm in java, then we simply collapse our algorithm until the implementation dependent portions are gone and then re-expand the high level logic that was left in such a way that it can now be implemented with java. If our high level logic is geared towards a particular implementation and our problem-oriented tasks are contained at lower levels, then this become very difficult to do.

4. Aid in Implementation

At the end of the day, the goal is usually to actually implement a solution to the problem being solved. If our method of representing our algorithm does not lend itself to an orderly implementation of that algorithm, then our method is seriously flawed. Conversely, if our method of representation lends itself to a systematic implementation of the algorithm, then our method is extremely useful.

By "systematic implementation" we mean that we should be able to take our represented algorithm and break it into easily identifiable fragments each of which can be readily translated into one of the structures, such as a while() loop or an if()/else block, available to us in our chosen implementation scheme be it a C program, java program or visual basic.

5. Implementation Independence

From this point forward, we will restrict the discussion to algorithms that are intended for eventual implementation using a computer program - but the concepts described can be readily generalized to any type of implementation and you should read them with the intent of grasping those generalized concepts.

Most texts maintain that the pseudocode or flowchart for a problem should represent the solution in a manner that is independent of how that solution will eventually be implemented and sufficiently complete such that the person developing the conceptual solution, who may have little if any programming background, can turn the material over to a programmer who could, in turn, decide what programming language to use and proceed to implement the solution without even understanding any of the conceptual goals behind the code being

written. For instance, I should be able to give you a flowchart for a function that accepts one value and that then uses that value to produce and return another value. If I have done my job adequately, you should be able to write the function to accomplish this task in any language you are familiar and comfortable with without ever knowing or caring that the function is actually implementing a particular task.

In point of fact, in the "real world" pseudocode and flowcharts are used in a variety of ways. But, flowcharts also commonly serve as formal documentation for the high level structure of programs and, when used as such, generally offer very little detail but, instead, illustrate the overall flow of the program.

However, the vast majority of cases falls somewhere between these two extremes. From a code development point of view, pseudocode and flowcharts are generally very informal and incomplete - their purpose is to guide the programmer's thoughts just far enough to enable them to proceed with the coding directly. This is particularly the case when the person writing the pseudocode and the person writing the source code are one and the same but it is also quite common even when one person (or team) is preparing the flowcharts and another person (or team) is writing the code, especially if there is good communication back and forth. It is not uncommon to see a flow chart that is very chaotic in that one section has virtually no detail while other parts are documented in excruciating detail. The sparse sections probably represent portions where the programmer is comfortable with the tasks and needs very little guidance while the highly detailed sections are probably where the programmer is unfamiliar with the concepts or having a difficult time getting correct results.

There are reasons for writing the pseudo code and drawing the flowchart of the particular problem. In addition to guiding your own code development efforts, what is submitted must also serve to satisfy the grader that you have an adequate understanding of the problem being solved and have a viable approach to its solution. Keep in mind that the grader's sole insight into whether you know how to perform a particular task is what you have presented. The grader is not a mind reader and is not expected to make any effort to become one. A useful guideline for how detailed your pseudocode or flowchart should be is that it should be reasonable for you to hand it to another student in the course who is about average in their performance and who has been keeping up with the material to date and expect them to be able to implement the code with little or no difficulty even if they have not seen the problem previously.

Keep in mind that pseudocode and flowcharts are not simply another way of expressing your program - they are to represent the logic behind how the problem is solved.

3.3.4 Pseudo Code

Pseudo code is an English language constructs modelled to look like statements available in most programming languages. It has some basic and peculiar attributes. They are:

- Steps are presented in a structured manner (numbered, indented, and so on)
- No fixed syntax for most operations is required
- Less ambiguous and more readable than natural language
- Emphasis is on process, not notation
- Well-understood forms which allow logical reasoning about algorithm behaviour
- It can be easily translated into a programming language.

To a much greater degree than programming style guidelines, there are very few commonly accepted standards for how pseudo code is written. This generally reflects the fact that it is used primarily as a rather short-term communication between members working on a specific project - the code itself and other documents are used for long-term archival purposes. Where those other documents use algorithm representations, flowcharts tend to be the preferred means because they convey structure much more effectively at that level. Therefore, pseudocode tends to be much more informal and a case of "whatever works". Some people choose to write their pseudocode very much as though it were a true programming language with very formal constructs. In fact, a common project in some software engineering courses is to devise a formal pseudocode and a translator that converts the pseudocode into actual code in some programming language. On the other end of the spectrum, some people write their pseudocode almost like a free-verse description of what the program needs to do.

3.3.4.1 A Recommended Pseudo code Format

To aid in communication - particularly between you and the reader of your pseudo code, it is recommended that the problem be decomposed into a set of hierarchical tasks. By beginning each line with one of the keywords discussed below, the chance for miscommunication between you and the reader is greatly diminished.

Documentation Keywords

Documentation keywords describe what needs to be done or provides information about why something is being done. You will quickly discover that, if you have done a decent job of writing your pseudo code, that these lines make very useful comment lines in your final code.

- TASK:

  A TASK statement is something that the program must perform but that is described at a level more abstract than what can be coded directly. One way to think of it is that you break a problem down into a set of TASKs. Each TASK can, in turn, be broken down into more narrowly defined TASKs. At some point, the TASK can be described in terms of steps that can be directly implemented. From one perspective, anytime a TASK: keyword is used, it means that there should (or at least could) be a subordinate level of the hierarchy which is the pseudocode for that TASK. In practice, that pseudocode need not be present if the TASK is sufficiently narrow that the person implementing it can go directly from the TASK description to the actual code without the benefit of the detailed steps.

- REM:

  A REM statement is merely a remark or comment. They are useful if the TASK statement proves to be insufficient to convey all the desired information or if the reason that something is done or why it works is not obvious..

Action Keywords

Action keywords are the lines that actually do the work. There are three basic actions that can be carried out: changing the value stored at some location in memory, getting input from some device, or generating output to some device. We will use the SET, GET, and PUT keywords for these actions respectively.

- SET:

  This is an "action" keyword that denotes performing some operation that changes a value in memory. The most common example would be the evaluation of some equation.

- PUT:

  This is an "action" keyword that denotes an output operation, generally to the screen. If the destination is anything other than the screen, such as a file or the serial port, then that should be explicitly stated.

- GET:

  This is an "action" keyword that denotes in input operation, generally from the keyboard. It is generally understood that there is an implied SET action involved where the value brought in gets stored in some memory location. If the source is anything other than the keyboard, such as a file or the serial port, then that should be explicitly stated.

Example: Pseudocode for computing average miles per litre

Step	Operations
1	Get values for litres used, starting mileage, ending mileage
2	Set value of distance driven (ending mileage – starting mileage)
3	Set value of average miles per litre to (distance driven – litres used)
4	Print the value of average miles per litre
5	Stop

3.3.5 Flowcharts

Flowcharts are a graphical means of representing an algorithm, as should be expected, they have advantages and disadvantages compared to pseudo code. One of their primary advantages is that they permit the structure of a program to be easily visualized - even if all

the text were to be removed. The human brain is very good at picking out these patterns and keeping them "in the back of the mind" as a reference frame for viewing the code as it develops.

Most programmers also find it easier to sketch flowcharts on a piece of paper and to modify them by crossing out connection arrows and drawing new ones that they would working with pseudocode by hand. By the same token, most programmers do not like to develop flowcharts in an electronic format because the overhead of creating and modifying it is generally more than they want to deal with while pseudocode lends itself to such electronic development.

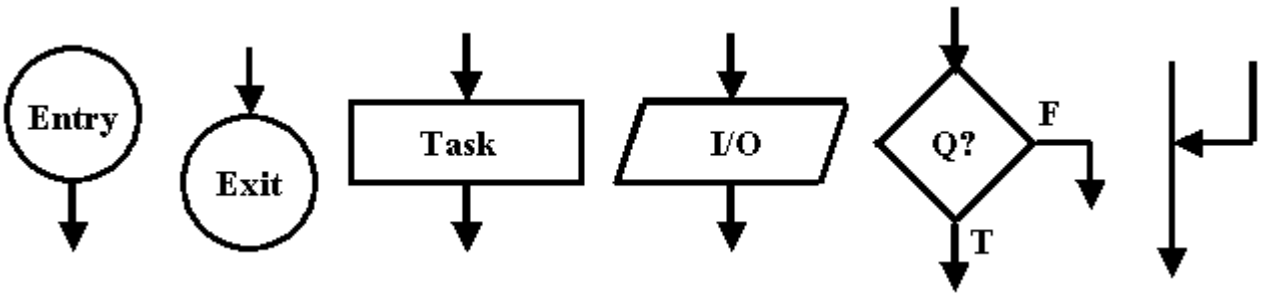
Furthermore, if the pseudocode is already in an electronic format that has been structured to lend itself to translation to the final language - then doing so can be a very simply matter of copying the pseudocode to a new file, overlaying the necessary syntax associated with the language, and compiling the result. This can be a powerful advantage of pseudocode over flowcharts where the entire source code still has to be typed by hand unless you are fortunate to have a tool that can take a flowchart - typically developed using that same tool - and translating it to directly to code. Such tools do exist - and they tend to be rather expensive.

Now that we have looked as some of the pros and cons of flowcharts relative to pseudocode, let's delve into flowcharting itself. The idea behind a flowchart is that it links together a series of blocks each of which perform some specific task. Each of these tasks is represented by a block and has exactly one arrow leading to it and, more importantly, one arrow exiting from it.

The shape of the block may convey additional information about what is happening. For instance, a rectangular block is frequently used to indicated that a computation is occurring while a slanted parallelogram is used to indicate some type of input or output operation. The diversity of shapes that can be used and what they mean is staggering - for instance a different shape can be used to indicated output to a tape drive versus to a hard disk or to indicate output in text format verses binary format. By using such highly specialized symbols, much of what is happening can be conveyed by the symbols themselves. But the power of using these distinctions is generally only useful to people that work with flowcharts continuously, professionally, and who are describing very large and complex systems. At our level, it is far better to restrict ourselves to a minimum number of shapes and explicitly indicate any information that otherwise might have been implied by using a different shape.

3.5.1 Basic Flowchart Shapes

The shapes we will use are the circle, the rectangle, the parallelogram, the diamond, and the arrows that interconnect them.



Circle - Entry/Exit Point

The circle indicates the entry and exit point for the program - or for the current segment of the program. The entry point has exactly one arrow leaving it and the exit point has exactly one arrow entering it. Execution of the program - or of that segment of the program - always starts at the entry point and finishes at the exit point.

Rectangle - Task

The rectangle represents a task that is to be performed. That task might be as simple as incrementing the value of a single variable or as complex as you can imagine. The key point is that it also has a single entry point and a single exit point.

Parallelogram - Input/Output

The parallelogram is used to indicate that some form in input/output operation is occurring. They must also obey the single entry single exit point rule which makes sense given that they are a task-block except with a slightly different shape for the symbol. We could easily eliminate this symbol and use the basic rectangle but the points at which I/O occur within our programs are extremely important and being able to easily and quickly identify them is valuable enough to warrant dealing with a special symbol.

Since a Task block can be arbitrarily complex, it can also contain I/O elements. Whether to use a rectangle or a parallelogram is therefore a judgment call. One way to handle this is to decide whether a task's primary purpose is to perform I/O. Again, that is a judgment call. Another option is to use a symbol that is rectangular on one side and slanted on the other indicating that it is performing both I/O and non-I/O tasks.

Diamond - Decision Point

The diamond represents a decision point within our program. A question is asked and depending on the resulting answer, different paths are taken. Therefore a diamond has a single entry point but more than one exit point. Usually, there are two exit points - one that is taken if the answer to the question is "true" and another that is taken if the answer to the question is "false". This is sufficient to represent any type of branching logic including both the typical selection statements and the typical repetition statements. However, most languages support some type of "switch" or "case" statement that allows the program to select one from among a potentially large set of possible paths. The basic two-exit-point diamond is fully capable of representing this construct, but it is generally cleaner and more useful to represent it using a as many exit points from the diamond as there are paths.

Arrow - Interblock Flow

The arrows simply show which symbol gets executed next. The rule is that once an arrow leaves a symbol, it must lead directly to exactly one other symbol - arrows can never fork and diverge. They can, however, converge and join arrows coming from other blocks.

3.4 Algorithmic Tools and Introduction to C++

3.4.1 Algorithmic tool: Pseudocode

A pseudocode is a procedure of the operations for accomplishing a task without details of any programming language syntax. It is another tool commonly used to represent an algorithm. Pseudocode presents an artificial and informal way for programmers to develop algorithms. It is a "text-based" detail (algorithmic) design tool. It must be noted that all statements like while, do, for, if, switch that show dependency are to be indented.

Example 1: To display information in terms of Age

```
If Customer Age is greater than or equal to 40
        Print “Adult“
Else
        Print “Youth"
```

Example 2: To find average of N exam score

```
Initialize total to zero
Initialize counter to zero
Input the first score
    while the user has not as yet entered the score
        add this score into the running total
        add one to the score counter
        input the next score
    if the counter is not equal to zero
        set the average to the total divided by the counter
        print the average
    else
        print 'no score is entered'
```

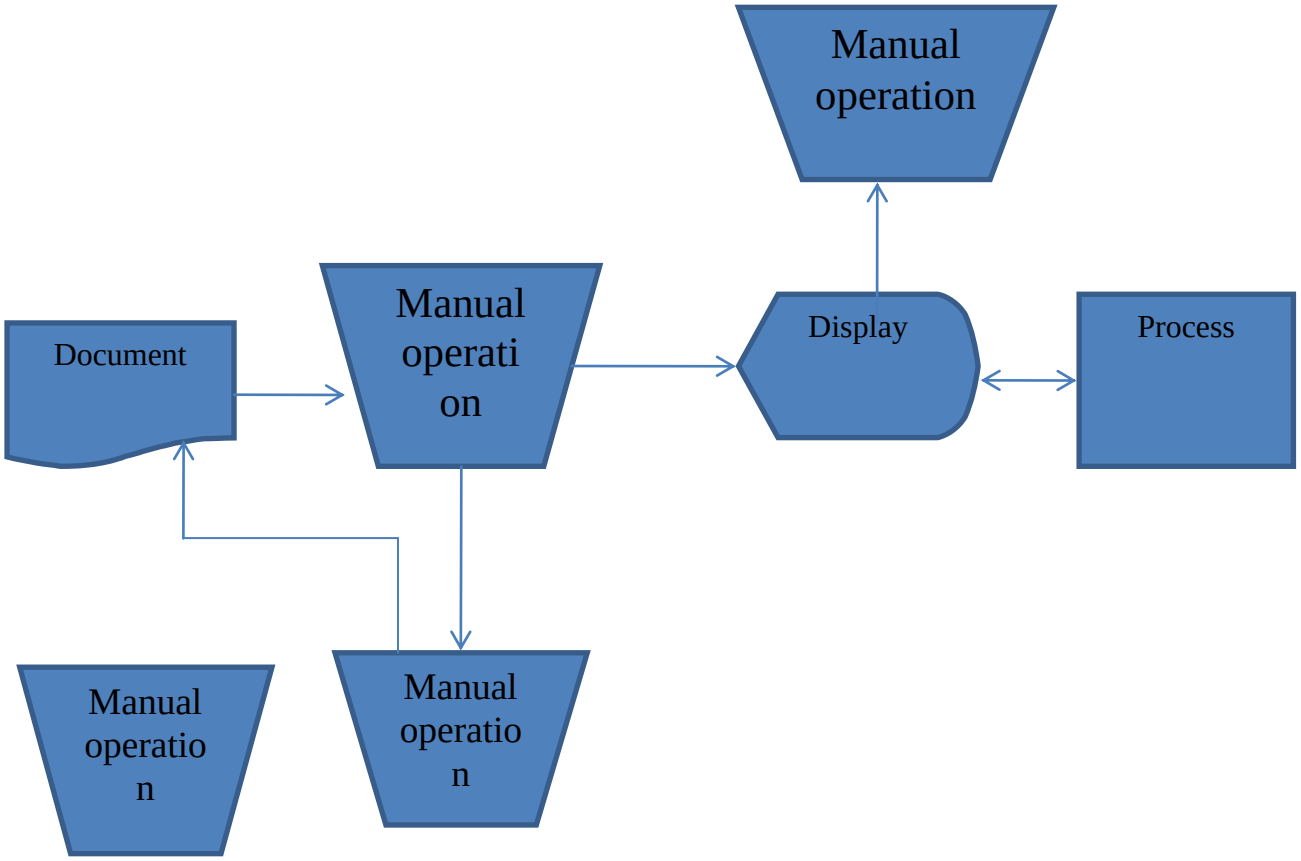
3.4.2 Algorithmic tool: Flowchart

Definition: A flowchart is a graphical representation of the step by step procedure for accomplishing a task. Symbols are used in flowchart to represent operations performed in an attempt to solve a problem. There are four types of flowcharts namely:

Document flowcharts: shows controls over a document-flow through a system.

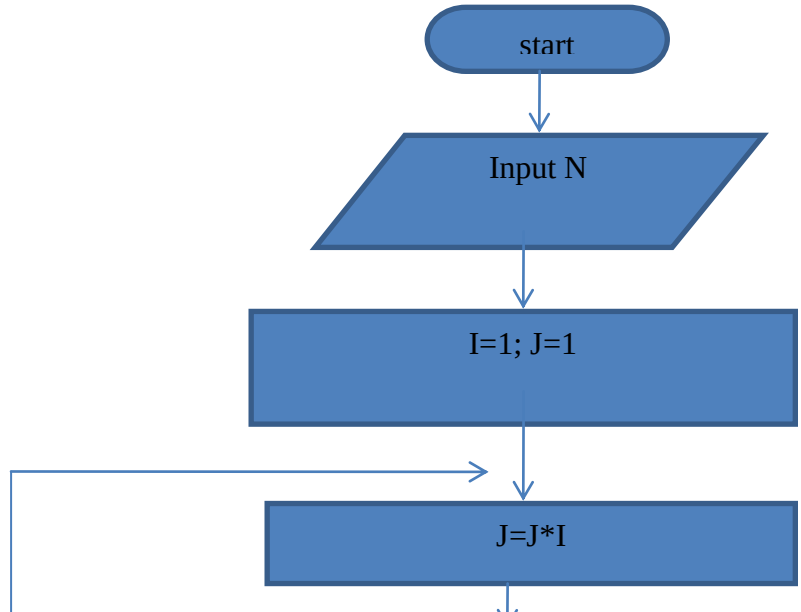
Data flowcharts: shows controls over a data-flow in a system.

System flowchart: A system flowchart is a concrete, physical model that documents, in an easily visualized, graphical form, the system's discrete physical components (its programs, procedures, files, reports, screens, etc.).



A typical diagram of a System flowchart

Program flowchart: is pictorial representation of an algorithm or program for solving a problem.



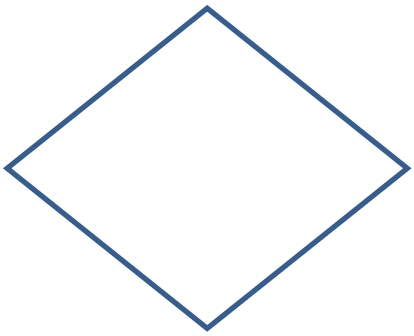
A typical Program Flowchart

Flowchart symbols and their meaning

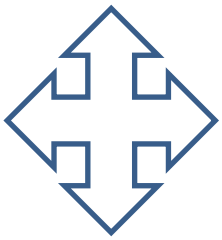
Input/Output symbol: is represented by a parallelogram shape. It is used to represent the accepting and displaying of data.

Processing symbol [illegible]pe. It is used to represent data processing operati[illegible]

Decision symbol: The decision box is always represented by a diamond shape. It is used to denote an operation for testing for a condition capable of giving Yes or No as the answer.



Data flow lines symbol: This is used to represent the direction of data flow when solving a problem. It can go left, right, up or down.



Terminal symbol is usually represented by oval shape. It represents the beginning (start) and end (end) of a programming process.

Examples

I. Compute the average of 3 grades (1-9); if anyone is 0 or negative, a message Bad data is printed

Solution:

Get values for *x*, *y*, *z*
If *x* < 1 or *y* < 1 or *z* < 1 then
Print message, .Bad data.
Else
Set *Average* to (*x* + *y* + *z*) / 3
Print the value of *Average*
Stop

2. **Compute the sum of *n* integers where *n* > 0**

Get value for *n*, the number of integers

Get values for *I1*, *I2*, ., *In*, a list of *n* integers
Set the value of *Sum* to 0
Set the value of *k* to 1
Repeat until *k* > *n*
Add *Ik* to *Sum*
Add 1 to *k*
End of the loop
Print the value of *Sum*
Stop

Introduction to C++Programming

Programming is an act of giving a computer a systematic set of coded instructions to accomplish a particular task. C++ programming is programming in an enhanced version of C programming language. C++ provides is an object-oriented programming language. It creates a linking bridge between the procedural and object-oriented family of C languages. C++ provides the user with an Integrated Development Environment (IDE) which comes with an in-built editor and a menu bar.

- C++ uses a compiler to translate source code to object code.
- A compiler is a language translator that converts a program source code to machine understandable code (or object code).
- A source code is the original set of coded instructions giving to a computer to solve a problem.
- An object code is the translated version of the original set of instruction giving to computer by the programmer.

Writing and Executing a C++ Program

- Open the C++ editor window with the steps below;
  - Click on the start button on the task bar
  - Click on Program option
  - Select the Dos prompt/ Command prompt
  - Navigate to the directory of your computer where C++ is installed
  - Type the necessary command at the prompt
  - Click on File on the menu bar

– Select New command button

- Type the program in the editor

- Save the program with an appropriate name with .cpp extension.
- Compile the program (source code) to generate the object code (with the .obj extension)
- Debug the program and compile again if there exist error.
- Link the object code file with the library files. If there is error, correct them and compile the code again to give the what we call the executable code usually contained in the executable code file (with the extension .exe).
- contained in the executable code file (with extension .exe)
- Run the program

A C++ Program Example

Example:

```
// Calculating sum and average of numbers
      #include<iostream.h>
       #include<conio.h>
  void main()
   {
 clrscr();
     float firstvalue, secvalue, sum, average;
    cout<<" Type the first value:";
    cin>> firstvalue;
    cout<< "Type the second value:";
    cin>>secvalue;
    sum=firstvalue+secvalue;
average= sum/2;
```

```
cout<< " The  Sum of " << firstvalue << " and " << secvalue << " is " <<

sum   << endl;

cout << " The Average of " << firstvalue << " and " << secvalue << " is "

<<

average;

getch();

 }
```

CHAPTER FOUR

INTERNET (as in CSC201)

CHAPTER FIVE

COMPUTER APPLICATIONS IN AGRICULTURE

MANAGEMENT INFORMATION SYSTEMS

1.1 Introduction

Data: Data is raw facts. Data is like raw material. Data does not interrelate and also it does not help in decision making. Data is defined as groups of non- random symbols in the form of text, images, voice representing quantities, action and objects.

Information: Information is the product of data processing. Information is interrelated data and is equivalent to finished goods produced after processing the raw material. The information has a value in decision making. Information brings clarity and creates an intelligent human response in the mind.

It is a most critical resource of the organization. Managing the information means managing future. Information is knowledge that one derives from facts placed in the right context with the purpose of reducing uncertainty.

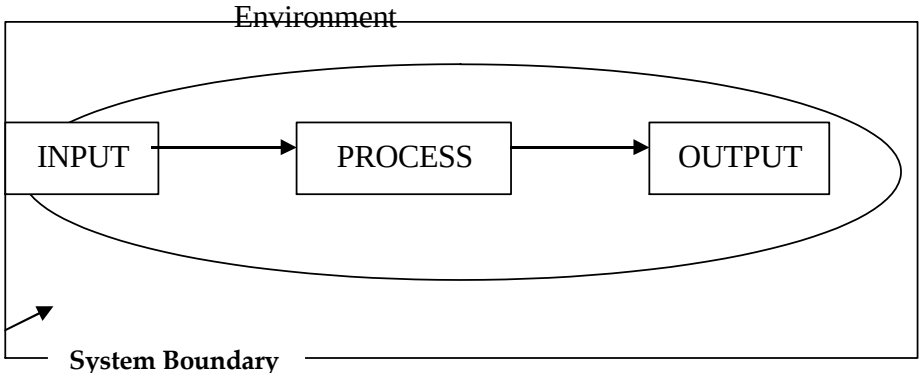
The parameters of a good quality are difficult to determine for information. Quality of information refers to its fitness for use, or its reliability. The essential characteristic features of good information include timeliness, accuracy, relevance, adequacy, completeness, explicitness and impartiality.

System: The word system is derived from the Greek word "system" which means an organized relationship among the different units or components. A system is an orderly grouping of interdependent components linked together according to a plan to achieve a specific goal. The word component may refer to physical parts (engine, wheels of cars), management steps (planning, organizing, controlling) or a sub subsystem in a multi-level structure. It is to be noted that a system is not a randomly arranged set. It is arranged with some logic governed by rules, regulation, principles and policies.

In MIS, we are usually concerned with man-made system involving input, process and output, as represented in figure. A system may have multiple inputs and multiple outputs.

All systems operate in an environment. The environment may influence the system in its design and performance. When a system is designed to achieve certain objective, it

automatically sets the boundaries for itself. The understanding of boundaries of the system is essential to bring clarity in explaining the system components and their arrangement.



A typical system

1.1.2 Characteristics of System

The following characteristics are present in all systems:

a) Organization

b) Interaction

c) Interdependence

d) Integration

e) Central Objective

Organization: Organization implies structure and order. It is the arrangement of components that helps to achieve objectives. Hierarchical relationship starting with the president on top and leading down ward to the blue collar worker represent the organization structure

Interaction: Interaction refers to the procedure in which each component interacts with other components of the system. In an organization, for example purchasing must interact with product, advertising with sales and payroll with personnel.

Interdependence: Independence is concerned with how a system is tied together; it is more than sharing a physical part or location. A unique function successful integration will typically produce a better request as whole rather than if each component works independently.

Central Objective: Objective may be real or stated. Objective is determined by higher management and user must be aware about the central objective well in advance.

Information System: An information system may be defined as a set of devices,

procedures and operating system designed around user-base criteria to produce information and communicating it to the user for planning control and performance.

1.1.3 Types of Information System

A business has several information systems. The major types of information systems are:

a) Formal Information System

b) Informal Information System

c) Computer Based Information System

Formal Information System: It is based on organizational chart represented by the organization.

Informal Information System: it is an employee based system designed to meet personal and vocational needs and to help in the solution of work-related problems. It also funnels information upward through indirect channels. It works within the framework of the business and its stated policies.

Computer-Based Information System (CBIS): This category of information system depends mainly on the computer for handling business applications. System analyst develops different types of information systems to meet variety of business needs. There is a class of system collectively known as computer-based information system. They can be classified as

a. Transaction Processing System (TPS)

b. Management Information System(MIS)

c. Decision Support System (DSS)

d. Office Automation System (OAS)

1.2 Management Information System (MIS)

Data processing by computers has been extremely effective because of several reasons. The main reason is that huge amount of data relating to accounts and other transactions can be processed very quickly. MIS are more concerned with levels of management with information essential to the running of smooth business including industrial, agricultural, production sectors. This information must be as relevant, timely, accurate, complete and concise as is economically feasible.

A management information system (MIS) provides information that is needed to manage organizations efficiently and effectively. Management information systems are not only

computer systems - these systems encompass three primary components: technology, people (individuals, groups, or organizations), and data/information for decision making. Management information systems are distinct from other information systems in that they are designed to be used to analyze and facilitate strategic and operational activities in the organization. Academically, the term is commonly used to refer to the study of how individuals, groups, and organizations evaluate, design, implement, manage, and utilize systems to generate information to improve efficiency and effectiveness of decision making, including systems termed decision support systems, expert systems, and executive information systems.

Its goal is to design and implement procedures, processes, and routines that provide suitably detailed reports in an accurate, consistent, and timely manner.

In a management information system, modern, computerized systems continuously gather relevant data, both from inside and outside an organization. This data is then processed, integrated, and stored in a centralized database (or data warehouse) where it is constantly updated and made available to all who have the authority to access it, in a form that suits their purpose.

1.2.1 Types of Management Information Systems

A management information system (MIS) is a computer-based system that provides the information necessary to manage an organization effectively. An MIS should be designed to enhance communication among employees, provide an objective system for recording information and support the organization's strategic goals and direction. The four types of MIS are listed below ascending order of sophistication.

a. Transaction Processing Systems

First introduced in the 1960s with the advent of mainframe computers. Transaction processing systems are used widely today. Banks use them to record deposits and payments into accounts. Supermarkets use them to record sales and track inventory. Most managers use these systems to deal with tasks such as payroll, customer billing and payments to suppliers.

b. Operations Information Systems

These systems were introduced after transaction processing systems. An operations information system gathers comprehensive data, organizes it and summarizes it in a form that is useful for managers. Most of these systems access data from a transaction processing system and organize it in a form usable by managers. Managers use operations information systems to obtain sales, inventory, accounting and other performance-related information.

c. Decision Support Systems (DSS)

A DSS is an interactive computer system that can be used by managers without help from computer specialists. A DSS provides managers with the necessary information to make intelligent decisions.

d. Expert Systems and Artificial Intelligence

These systems use human knowledge captured in a computer to solve problems that ordinarily need human expertise. Mimicking human expertise and intelligence requires that the computer (1) recognize, formulate and solve a problem; (2) explain solutions and (3) learn from experience. These systems explain the logic of their advice to the user; hence, in addition to solving problems they can also serve as a teacher. They use flexible thinking processes and can accommodate new knowledge.

1.2.2 Objectives of MIS

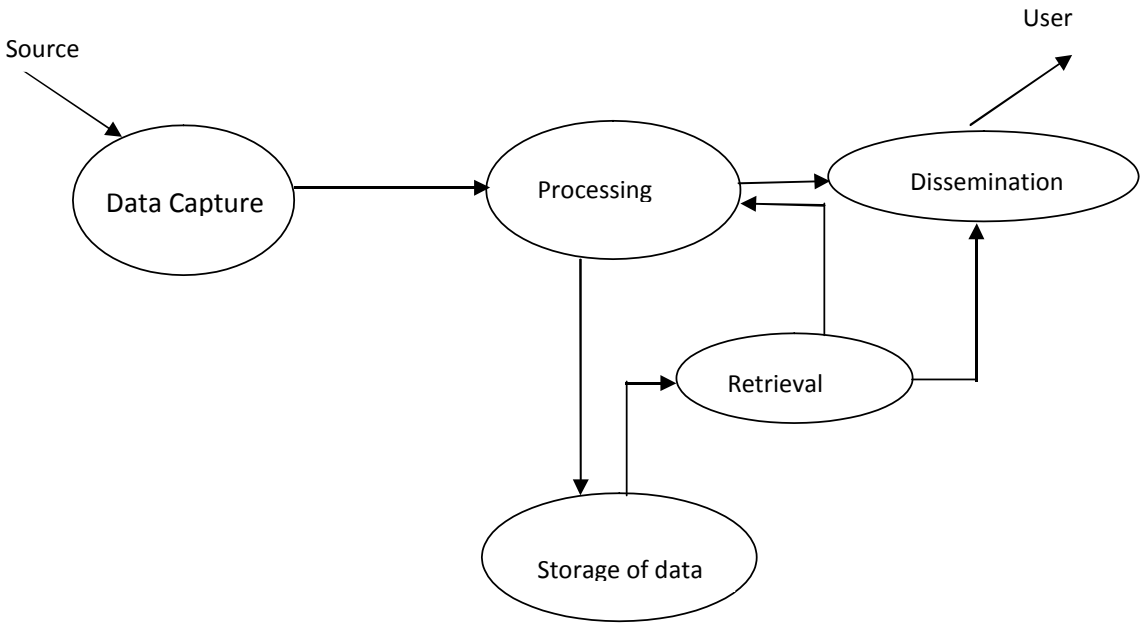
Data Capturing: MIS capture data from various internal and external sources of organization. Data capturing may be manual or through computer terminals.

Processing of Data: The captured data is processed to convert into required information. Processing of data is done by such activities as calculating, sorting, classifying, and summarizing.

Storage of Information: MIS stores the processed or unprocessed data for future use. If any information is not immediately required, it is saved as an organization record, for later use.

Retrieval of Information: MIS retrieves information from its stores as and when required by various users.

Dissemination of Information: Information, which is a finished product of MIS, is disseminated to the users in the organization. It is periodic or online through computer terminal.



Objectives of MIS

1.2.4 Characteristics of MIS

Systems Approach: The information system follows a systems approach. Systems approach means taking a comprehensive view or a complete look at the interlocking sub-systems that operate within an organization.

Management Oriented: Management oriented characteristic of MIS implies that the management actively directs the system development efforts. For planning of MIS, top-down approach should be followed. Top down approach suggests that the system development starts from the determination of management's needs and overall business objective. To ensure that the implementation of systems polices meet the specification of the system, continued review and participation of the manager is necessary.

Need Based: MIS design should be as per the information needs of managers at different levels.

Exception Based: MIS should be developed on the exception based also, which means that in an abnormal situation, there should be immediate reporting about the exceptional situation to the decision -makers at the required level.

Future Oriented: MIS should not merely provide past of historical information; rather it should provide information, on the basis of future projections on the actions to be initiated.

Integrated: Integration is significant because of its ability to produce more meaningful information. Integration means taking a comprehensive view or looking at the complete picture of the interlocking subsystems that operate within the company.

Common Data Flow: Common data flow includes avoiding duplication, combining similar functions and simplifying operations wherever possible. The development of common data flow is an economically sound and logical concept, but it must be viewed from a practical angle.

Long Term Planning: MIS is developed over relatively long periods. A heavy element of planning should be involved.

Sub System Concept: The MIS should be viewed as a single entity, but it must be broken down into digestible sub-systems which are more meaningful.

Central database: In the MIS, there should be common data base for whole system.

1.2.5 Advantages of MIS

a. Decentralization of Operations

Management information systems have changed the dynamics of running businesses efficiently. Decentralization is one of the biggest advantages; it allows monitoring of operations at low levels and frees up resources for departmental managers to devote time to strategic activities. Coordination of specialized projects and activities is much better and decision makers in the organization are aware of issues and problems in all departments.

b. Minimize Information Overload

MIS minimizes information overload which can be quite common with conventional businesses in the modern era.

c. Better Planning and Control

MIS has to be designed and managed in such way that it aggregates information, monitors the company's activities and operations and enhances communication and collaboration among employees. This ensures better planning for all activities and better ways to measure performance, manage resources and facilitate compliance with industry and government regulations. Control helps in forecasting, preparing accurate budgets and providing the tools and vital information to employees, top management and business partners.

d. Aid Decision Making

The purpose of MIS is to generate synthesized and processed information from computerized/automated and certain manual systems. Information distribution to all levels of corporate managers, professionals and key executives becomes quite seamless with streamlined MIS. Managers are able to make quick, timely and informed decisions. Top management and board members can take strategic decisions, plan future growth and business expansion activities based on the data and information generated by MIS.

Other benefits of MIS include

1. Improves personal efficiency
2. Expedites problem solving(speed up the progress of problems solving in an organization)
3. Facilitates interpersonal communication
4. Promotes learning or training
5. Increases organizational control
6. Generates new evidence in support of a decision

7. Creates a competitive advantage over competition
8. Encourages exploration and discovery on the part of the decision maker
9. Reveals new approaches to thinking about the problem space
10. Helps automate the Managerial processes.

1.2.6 Role of MIS in the Management of Agricultural Extension Programmes

National agricultural extension systems, especially in developing countries, tend to be very large. For example, in India, the national agricultural extension system employs about 125,000 people. Extension managers at various levels need relevant information in order to make effective decisions. In the absence of such information, they act only on the basis of their intuition and past experience. Data that have been processed, stored, and presented properly will aid them in analysing situations and to make effective decisions.

At every phase of the management process, managers need information in order to make effective decisions. This we call *management information.* It does not include purely functional information or technical information, such as packages of practices for rice or wheat cultivation. Management information is the information required by managers as they make their decisions, such as the number of extension personnel employed by category, their training requirements, career development plans, job descriptions, budgets, forecasts, benchmark surveys, reports on socioeconomic conditions of people served, and existing facilities (Ramesh Babu & Singh, 1987).

The main purpose of management information systems is to provide management information to decision makers at various levels in the organization. Specifically, in an agricultural extension organization, MIS is needed:

1. To plan the most effective allocation of resources, for example, the allocation of extension personnel under a T & V extension system, the need for communications and training equipment and facilities, mobility, the amounts of required operational resources

2. To choose between alternative courses of action, whether to conduct a study on the impact of the T & V system with the resources on hand or hire an expert to investigate

3. To control day-to-day operations, for example, comparing the actual results achieved and those planned under the T & V system.

1.2.7 Design of a MIS in an agricultural extension organization

The following are steps to follow when designing a MIS for a national agricultural extension system.

Step One: Assessing Information Needs for Planning, Monitoring, and Evaluation

An investigation needs to be conducted into the types of decisions that extension managers have to make. For example, village extension workers (VEWs) seek solutions to their

problems from their supervisors. In turn, supervisors need to be in a position to resolve these problems and to document how problems were solved for future reference.

State-level managers also need information to resolve problems. They are concerned with implementing extension programmes district by district. They need information on staffing, transport, research-extension linkages, staff training activities, and successes (or lack of them) in solving technical problems. Feedback is needed from field staff and farmers on farmer problems and on which recommended practices are helpful. State-level managers need to know something about the amounts, kinds, and combinations of media support (i.e., print, radio, television) that have been used for various efforts. They need to know if external factors have limited the success of particular efforts such as supply of credit or farm inputs and they need some assessment of farmers' responses to extension programmes.

Step Two: Deciding the Levels of Information Groups, Information Frequency, and Content

The number of information groups within an agricultural extension organization has to be decided because each group potentially will require a different type of information. As an example, in India, the reorganized national agricultural extension system can be grouped as shown in Table 1.

Data processing consists of identifying each item of data and systematically placing it within a scheme that categorizes data items on the basis of some common characteristic or feature. Data not organized into a meaningful pattern can serve almost no useful purpose to those who must use them to make decisions. A computer can help in processing the data effectively. Rao (1985) suggested the use of computers in agricultural extension in India. He proposed that computer programmes be focused on district and subdivisional levels. In that way, information collected can be viewed in terms of the crops that are likely to be grown, agroclimatic conditions, soil types, irrigation facilities, resources of the farmers, and availability of various farm inputs.

Documentation (storage and retrieval) involves storing items of information in an orderly manner. Storing information means recording it on storage media from which it can be made available when needed.

Storage media are materials such as ordinary office paper, magnetic tapes, magnetic disks, microfilms, film strips, and a few other devices. Once the information is recorded on these storage media, the system can generate, on demand, information required for making decisions, solving problems, or performing analyses and computations. Information retrieval refers to the ability to take different types of data in the storage media and to array information in some desired and meaningful format. A properly designed storage and retrieval system matches the related variables efficiently and accurately. In some cases, it even suggests alternative courses of action for management to take.

Presentation of information should be in a form and format suitable to the needs of extension managers. Generally, information is presented in reports, statistical summaries, analyses, and so forth in the form of text, figures, charts, tables, and graphs. The presentation of information should be precise, clear, and appealing.

Step Three: Ensuring System Flexibility and Adaptability

Flexibility means the ability to retrieve information from a system in whatever form it may be needed by decision makers. Therefore, data need to be collected in some detail so that they can be rearranged or summarized according to the needs of managers. But system design should not be too complex because it must first serve the needs of the lowest levels of management (i.e., subdistrict) that are likely to be instrumental in collecting important components of the original data. In addition, the system also must serve the needs of the district, regional, state or provincial, and national levels. Therefore, considerable care must be taken in assessing what types of information are required by management at the different levels. At the same time, effort must be made to ensure that the information collected meets acceptable standards of accuracy, timeliness, and coverage for each level.

1.2.8 **Factors Responsible for the development of MIS**

There are numerous factors that responsible for the development of MIS and these have been a prime concern for many Researchers and Practitioners. Both Inter and external factors must be taken into account when trying to understand and organization's criteria for deciding about technology. The following are the factors which are responsible for development of MIS:

1. External
2. Internal

1. External Factors: These are conditions that exist in organization's external environment. The factors can be found at the industry level or in national policies.

   (a) Industry level: At the industry level, we are looking at characteristics as

   degree of diffusion of certain technologies, the availability of external know-how, for example, technology suppliers, the degree of innovativeness of the industry, the requirements imposed by major customers and external markets and overall levels of competition and technology sophistication in the industry.

   (b) National Policies: For the external factors the national policies also affect the organization that indirectly affects the subsystems of the organization.

2. Internal Factors: Internal factors internal of the firm that may affect the development of MIS can be grouped into three categories:

   (a) Past Experience with Technology: The organizations past experience about the technology in terms of exposure and organizational learning ultimately affects its future in developing technology.

   (b) Organizational Characteristics: An organization's characteristic like size, influence the adoption of MIS application in organization. The adoption of certain technologies may appear more appropriate for the larger firms because of the large capital investments and the skilled human resources involve in the implementation and operation of such technologies. Smaller firms are less affected

by organizational inertia and they show a greater degree of involvement of organizational member's especially top management during implementation. Ready to use software and less expensive equipment of MIS application are more attractive to smaller firms.

(c) Organizational Pursued strategy : Internal factors deal with the organizations pursued strategy on both orientation and technology policy. An organization's strategy reflects its action with market and technology, which ultimately modify its experience and consequently its overall characteristics and capabilities. The need for a strong technology has been advocated by a number of authors and investments in MIS should therefore be closely aligned with overall corporate strategy.

Other Factors:

Customer Satisfaction: Development of MIS is affected by customer satisfaction. Customer of the services should be satisfied by the presented system.

Effective: Development should be effective in terms of organizational benefit and user satisfaction.

Efficient: Development should use all the resources and organizational values efficiently.

2. DECISION SUPPORT SYSTEM IN MIS

2.1 **Definition**

Decision support systems (DSS) comprises of information systems based on a network of computers. DSS also includes knowledge-based systems, which support the decision-making activities in an organization. DSS supports the management of an organization and helps them in decision making. These decisions might be changing rapidly and are not specified in advance.

A properly designed DSS is an interactive software-based system intended to help decision makers compile useful information from raw data, documents, personal knowledge, and/or business models to identify and solve problems and make decisions.

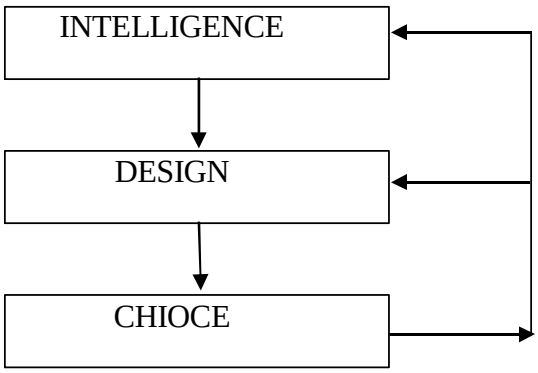
2.2 **Hebert Simon Model of DSS**

DSS is an application of Hebert Simon model. The model has three phases:

i) Intelligence

ii) Design

iii) Choice



Hebert Simon Model

Intelligence: In this phase MIS collects the raw data. Further the data is sorted and merged with other data and computation are made, examined and presented. In this phase, the attention of the manager is drawn to the entire problem situation, calling for a decision.

Design: Manager develops a model of problem situation on which he can generate and test, summarizing the different decision alternatives and test the feasibility of implementation. Assess the value of the decision outcome.

Choice: In this phase the manager evolves a selection criterion and selects one alternative as decision based on selection criteria.

In these three phases, if the manager fails to reach a decision, he starts the process all over again from intelligence phase where additional data and information is collected, the decision making process is refined, the selection criteria is changed and a decision is arrived at.

The DSS basically helps in the information system in the intelligence phase where the objective is to identify the problem and then go to the design phase for solution. The choice of selection criteria varies from problem to problem. It is, therefore, required to go through these phases again and again till satisfactory solution is found. These systems are helpful where the decision maker calls for complex manipulation of data and use of several methods to reach an acceptable solution using different analysis approach. The decision support system helps in making a decision and also in performance analysis. DSS can be built around the rule in case of programmable decision situation. The rules are not fixed or predetermined and require every time, the user to go through the decision-making cycle as indicated in Herbert Simon model.

2.3 Attributes of DSS

i) DSS should be adaptable and flexible.

ii) DSS should be interactive and provide ease of use.

iii) Effectiveness balanced with efficiency (benefit must exceed cost).

iv) Complete control by decision-makers.

v) Ease of development by (modification to suit needs and changing environment) end users.

vi) Support modelling and analysis.

vii) Data access.

viii) Standalone, integration and Web-based

2.4 DSS Characteristics

The following is a list of the characteristics of a DSS.

1. **Facilitation**. DSS facilitate and support specific decision-making activities and/or decision processes.
2. **Interaction**. DSS are computer-based systems designed for interactive use by decision makers or staff users who control the sequence of interaction and the operations performed.
3. **Ancillary**. DSS can support decision makers at any level in an organization. They are not intended to replace decision makers.
4. **Repeated Use**. DSS are intended for repeated use. A specific DSS may be used routinely or used as needed for ad hoc decision support tasks.
5. **Task-oriented**. DSS provide specific capabilities that support one or more tasks related to decision-making, including: intelligence and data analysis; identification and design of alternatives; choice among alternatives; and decision implementation.
6. **Identifiable**. DSS may be independent systems that collect or replicate data from other information systems OR subsystems of a larger, more integrated information system.
7. **Decision Impact**. DSS are intended to improve the accuracy, timeliness, quality and overall effectiveness of a specific decision or a set of related decisions.

2.5 Components of a Decision Support System

There are three basic components in a DSS:

- a database
- a model base
- a user interface

Depending on the system, each of these components may be very simple or highly elaborate. The database, or in advanced systems, a **database management system** (DBMS) or a data warehouse, consists of structured, real-life information, such as customer account records, product sales history, employee schedules, or manufacturing process statistics. The model base, or **model base management system** (MBMS), contains one or more models for the kind of analysis the system will perform. For example, if the purpose of the system is to

supply sales projections under different conditions, one model might be a linear regression formula derived from past sales and other factors. The **user interface** integrates the two into a coherent system and provides the decision maker with controls for—and possibly feedback about—managing the data and the models.

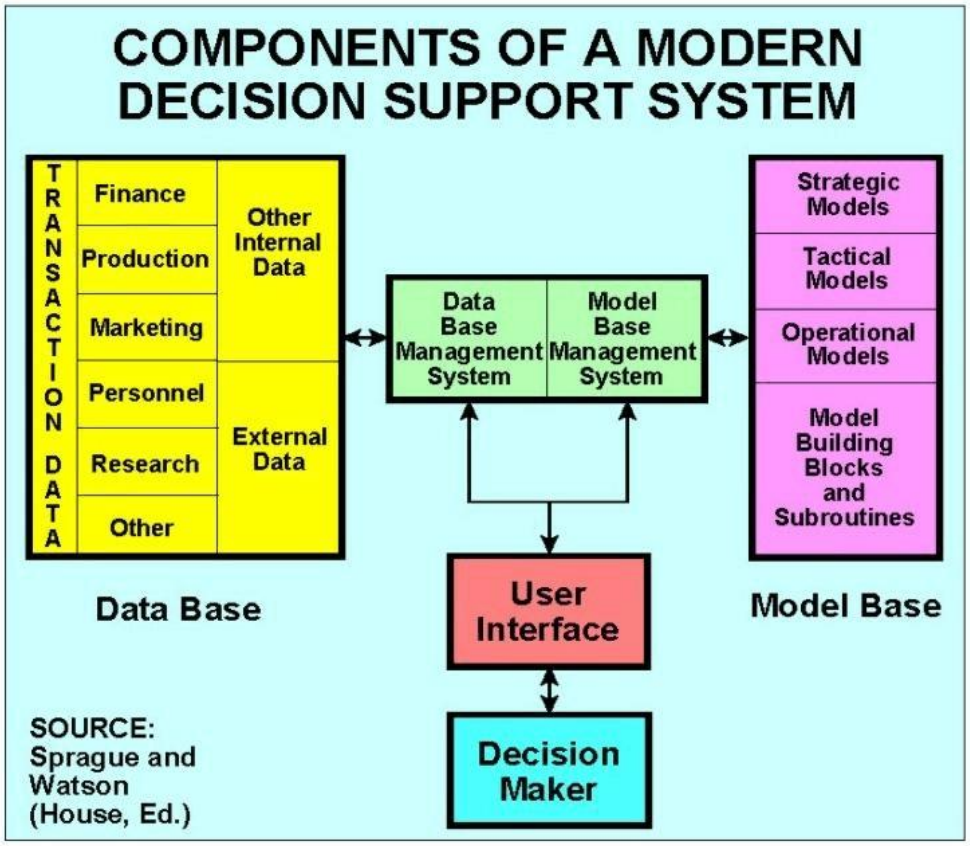


Figure 3 - Decision Support System

2.6 Benefits of DSS

There are many benefits of DSS both for the management and the organization as a whole. These benefits include:

1. It helps in saving time

Research has demonstrated that decision support systems help to reduce decision cycle time for an organization. DSS provides timely information, which is then used for decision making and results in enhanced employee productivity.

2. It improves efficiency

Another advantage of DSS is efficient decision making, resulting in better decisions. This is because use of DSS results in quick transfer of information, better data analyses, thus resulting in efficient decisions.

3. It boosts up interpersonal communication

Use of DSS in an organization helps to improve interpersonal communication between same level of employees and between management and employees.

4. It provides competitive advantage

Use of decision support system in an organization provides a competitive advantage over other organizations which do not use DSS.

5. It helps in reducing cost

Research and case studies reveal that use of DSS in an organization helps in making quicker decisions and reduce cost.

6. It results in high satisfaction among decision makers

In DSS computers and latest technology aids the decision making process. It thus results in higher satisfaction among decision makers, reduces frustrations among them, and form perceptions that superior information is being used. They gain a confidence and satisfaction that they are good decision makers.

7. It supports learning

The use of DSS in an organization results in two type of learning. First managers themselves learn new concepts. Secondly, there is better factual understanding of business as well as the decision making environment.

8. It leads to enhanced organizational control

Due to the use of DSS business transaction data is easily available for monitoring the performance of employees and ad hoc querying. It thus leads to enhanced understanding of business operations for the management.

3. GEOGRAPHICAL INFORMATION SYSTEMS

3.1 Definition

The use of GIS technology has greatly enhanced both the scope and quality of environmental management and planning, which has become more focused and goal oriented.

Geographic information system (GIS) is a system designed to capture, store, manipulate, analyze, manage, and present all types of geographical data. In the simplest terms, GIS is the merging of cartography, statistical analysis, and database technology.

A GIS can be thought of as a system—it digitally creates and "manipulates" spatial areas that may be jurisdictional, purpose, or application-oriented. Generally, a GIS is custom-designed for an organization. Hence, a GIS developed for an application, jurisdiction, enterprise, or purpose may not be necessarily interoperable or compatible with a GIS that has been developed for some other application, jurisdiction, enterprise, or purpose. What goes beyond a GIS is a spatial data infrastructure, a concept that has no such restrictive boundaries.

In a general sense, the term describes any information system that integrates, stores, edits, analyzes, shares, and displays geographic information for decision making. GIS applications are tools that allow users to create interactive queries (user-created searches), analyze spatial information, edit data in maps, and present the results of all these operations.]

3.2 Benefits of GIS

There is a growing awareness of the economic and strategic value of GIS. Geographic information system technology is widely used for scientific investigations, natural resource management such as forestry, agriculture, mining, oil and gas exploration and environmental impact assessment, urban planning, natural hazards, land cover and change detection, law enforcement, cadastre and habitat mapping. Hence, GIS benefits organizations of all sizes and in almost every industry. Also, GIS is a tool that manages, analyzes, and models data from our environment so that we can make decisions based on that information to better conserve its resources and protect its biodiversity.

The benefits of GIS generally fall into five basic categories:

a. Cost Savings and Increased Efficiency

GIS is widely used to optimize maintenance schedules and daily fleet movements. Typical implementations can result in a savings of 10 to 30 percent in operational expenses through reduction in fuel use and staff time, improved customer service, and more efficient scheduling.

b. Better Decision Making

GIS is the go-to technology for making better decisions about location. Common examples include real estate site selection, route/corridor selection, evacuation planning, conservation, natural resource extraction, etc. Making correct decisions about location is critical to the success of an organization.

c. Improved Communication

GIS-based maps and visualizations greatly assist in understanding situations and in storytelling. They are a type of language that improves communication between different teams, departments, disciplines, professional fields, organizations, and the public.

d. Better Recordkeeping

Many organizations have a primary responsibility of maintaining authoritative records about the status and change of geography. GIS provides a strong framework for managing these types of records with full transaction support and reporting tools.

e. Managing Geographically

GIS is becoming essential to understanding what is happening—and what will happen—in geographic space. Once we understand, we can prescribe action. This new approach to management—managing geographically—is transforming the way that organizations operate.

Other specific areas of usefulness of GIS are water and vegetation management. GIS is a powerful tool for developing solutions for water resources such as assessing water quality and managing water resources on a local or regional scale.

3.3 Agricultural Use of GIS for Precision Farming

Balancing the inputs and outputs on a farm is fundamental to its success and profitability. The ability of GIS to analyze and visualize agricultural environments and workflows has proven to be very beneficial to those involved in the farming industry. GIS and GPS technologies help farmers know how much seed to buy, where to plant, and how much compost or fertilizer to use.

From mobile GIS in the field to the scientific analysis of production data at the farm manager's office, GIS is playing an increasing role in agriculture production throughout the world by helping farmers increase production, reduce costs, and manage their land more

efficiently. Equally, GIS is an essential tool for inventorying habitats, studying endangered species, correlating species and geographic relationships, analyzing change over time, and evaluating the effectiveness of conservation practices and policies.

4. AGRICULTURAL INFORMATION SYSTEM

Agriculture is the mainstay of the economy of many countries in the Asia-Pacific region as nearly 60 percent of its population derives livelihood from agriculture. The region has several hot spots of rural poverty, as most farmers in the region are smallholders with diverse farming systems, which are highly risk prone. In addition, these farmers have poor access to support services such as extension and the agricultural markets, knowledge, technology and financial credit. Obviously, a revolution is needed not only to produce more food in the region, but also to enable participation of its farmers more equitably in innovations and markets to reduce rural poverty, generate better rural livelihoods and maintain quality of life and environment. This revolution could be termed as knowledge revolution and there are already some visible signs that Asia-Pacific rural agriculture is in midst of it. The new Information and Communication Technologies (ICT) are bringing about and sustaining this revolution by empowering the resource-poor farmers with up-to-date knowledge and information about agricultural technologies, best practices, markets, price trends, consumer preferences, sources of finance, weather, soil-moisture conditions and the environment. AIS can also be used to monitor the daily financial transactions of the farming activities. An example of this is the use of Spreadsheet application for the purpose of keeping financial records. (See the attached MS-Excel format)

5. EXPERT SYSTEMS (ES)

5.1 Concepts of Expert System

Expert system can be defined as a tool for information generation from knowledge. Information is either found in various forms or generated from data and/or knowledge. Text, images, video, audio are forms of media on which information can be found, and the role of information technology is to invent, and devise tools to store and retrieve this information. Statistical information is a good example of information generated from data while advises generated by an expert system is a good example of information generated from knowledge.

An ES is a computer application that performs a task that would otherwise be performed by a human expert. For example, there are expert systems that can diagnose human illnesses, make financial forecasts, and schedule routes for delivery vehicles. Some expert systems are designed to take the place of human experts, while others are designed to aid them. Expert systems are part of a general category of computer applications known as *artificial intelligence* . To design an expert system, one needs a *knowledge engineer,* an individual who studies how human experts make decisions and translates the rules into terms that a computer can understand.

In other words, an expert system is a computer program that simulates the judgement and behavior of a human or an organization that has expert knowledge and experience in a particular field. Typically, such a system contains a knowledge base containing accumulated experience and a set of rules for applying the knowledge base to each particular situation that is described to the program. Sophisticated expert systems can be enhanced with additions to the knowledge base or to the set of rules. Among the best-known expert systems have been those that play chess and that assist in medical diagnosis.

ES is considered as artificial intelligence based system that converts the knowledge of an expert in a specific subject into a software code. This code can be merged with other such codes (based on the knowledge of other experts) and used for answering questions (queries) submitted through a computer.

5.2 Components of Expert System

Expert systems typically consist of three parts.

i. A knowledge base which contains the information acquired by interviewing experts, and logic rules that govern how that information is applied;

ii. An Inference engine that interprets the submitted problem against the rules and logic of information stored in the knowledge base; and

iii. An Interface that allows the user to express the problem in a human language such as English. Despite its earlier high hopes, expert systems technology has found application only in areas where information can be reduced to a set of computational rules, such as insurance underwriting or some aspects of securities trading. Also called rule based system.

5.3 Advantages of Expert Systems

a. Permanence - Expert systems do not forget, but human experts may
b. Reproducibility - Many copies of an expert system can be made, but training new human experts is time-consuming and expensive
c. Efficiency - can increase throughput and decrease personnel costs
   - Although expert systems are expensive to build and maintain, they are inexpensive to operate
   - Development and maintenance costs can be spread over many users
   - The overall cost can be quite reasonable when compared to expensive and scarce human experts
   - Cost savings: Wages - (elimination of a room full of clerks) Other costs - (minimize loan loss)
d. **Consistency** - With expert systems similar transactions handled in the same way. The system will make comparable recommendations for like situations. Humans are influenced by
   - recency effects (most recent information having a disproportionate impact on judgment)

- primacy effects (early information dominates the judgment).

e. **Documentation** - An expert system can provide permanent documentation of the decision process
f. **Completeness** - An expert system can review all the transactions, a human expert can only review a sample.
g. **Timeliness** - Fraud and/or errors can be prevented. Information is available sooner for decision making.
h. **Breadth** - The knowledge of multiple human experts can be combined to give a system more breadth that a single person is likely to achieve.
i. **Reduce risk of doing business**
   - Consistency of decision making
   - Documentation
   - Achieve Expertise
j. **Entry barriers** - Expert systems can help a firm create entry barriers for potential competitors.
k. **Differentiation** - In some cases, an expert system can differentiate a product or can be related to the focus of the firm.
l. Computer programs are best in those situations where there is a structure that is noted as previously existing or can be elicited.

5.4 Need of Expert Systems in Agriculture

The need of expert systems for technical information transfer in agriculture can be identified by recognizing the problems in using the traditional system for technical information transfer, and by proving that expert systems can help to overcome the problems addressed, and are feasible to be developed.

Information Transfer Problems

Static Information: Examining the information stored and available in the agriculture domain revealed that this information is static and may not respond to the growers need. All extension documentations give general recommendations because there are many factors, if taken into consideration, so many different recommendations should be included in the document.

Specialties Integration: Most of the extension documents handle problems related to certain specialty: plant pathology, entomology, nutrition, or any other specialty. In real situations the problem may be due to more than one cause, and may need the integration of the knowledge behind the information included in the different extension documents and books.

Combination of more than one information source: Images may need sometimes an expert to combine other factors to reach an accurate diagnosis, and even if a diagnosis is reached, the treatment of the diagnosed disorder should be provided through extension document.

Updating: Changes in chemicals, their doses, and their effect on the environment should be considered. Updating this information in documents and distribute them takes long time. The same arguments can be made for audio tapes that are another form of extension documents but in voice instead of written

words. Video tapes are more stable than other media as the information provided through the tape describes usually well-established agricultural operations. However, if the tape includes information as what is commonly included in documents and audio tapes, this information should be updated.

Information unavailability: Information may not be available in any form of media. It is only available from human experts, extensionists, and/or experienced growers. In addition, the information transfer from specialists & scientists to extensionist and farmers, represents a bottle neck for the development of agriculture on the national level. The current era is witnessing a vast development in all fields of agriculture. Therefore there is a need to transfer the information of experts in certain domain to the general public of farmers, especially that the number of experts in new technologies is lesser than their demand.