GSP1202/2202: ICT – Module 9

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Learning Objectives

After reading this module, students shall be able to:

• Define and explain the basic concept of computer and its structure

• Explicate various computer generations

• Explain basic computer organization

• Give an overview of the various components of computer system

• Appreciate different types of computer software

• Elucidate the functionalities of different application software packages

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Part 1: Introduction to Computer Systems

Part 2: Computer Hardware

Part 3: Computer Software

Part 1: Introduction to Computer System

1.1 What is a Computer?

A Computer is an electronic device that works under the control of a stored program, automatically accepts and processes data to provide information. Computer operates

- Automatic: it carries out instructions with minimum human intervention
- Re-programmable: it stores instruction (the program)
- A data processor: it carries out operations on data (numbers or words) made up of a combination of digits to produce information.

Data is the name given to facts. Information is the meaningful data that is relevant, accurate, up to date and can be used to make decisions. A processed data refers to information in a formalized manner suitable for communication, interpretation and processing. However, row data refers to un-processed information.

1.2 Evolution of Computer Technology

The origin of computer technology started far ahead of the 19th century evolution. People desired to have a machine that would carry out mathematical calculations for them. The **ABACUS** is considered to have been the first computer and was used to perform simple measurements and calculations.

In the 17th century, a scientist named Pascal developed a machine that could perform mathematical calculations. This machine comprised of a number of gears. The movement of gear mechanism was used to perform some calculations. He named the machine **PASCALINE**. Thus the Pascaline system is a mechanical computational device.

Over the last centuries, many scientists contributed towards the development of the computing technologies:

- **Charles Babbage** worked on the use of logic and loops in process execution. Based on the concept of logic and loops, Babbage envisaged two models for performing computations- Analytical Engine and Difference Engine. In those days, electronics was not developed. Therefore, the models proposed by Babbage existed only on paper.
- George Boolean developed the famous **Boolean Algebra** (Logic theorems) based on binary numbers. The computer system is a logical based on its hardware and software components.
- De Morgan put forward important fundamental Set theorems. These theorems are known as **De Morgan's Theorems** and form the foundation of the logical analysis.
- Lady **Ada** was said to have wrote the first working computer program.

The real application of computers began in the late **50**s. During that time computers were used for various applications such as **Census, Defense, R&D, Universities** etc.

1.3 Types of Computer

Computers can broadly be classified as either Analog or Digital. An analog computer is built from the fundamental component known as the "Vacuum Tube". Vacuum tube is both bulky and less efficient. Thus, while the Abacus computer was nearly the size of a room, its performance is far below today's standards. Following the invention of the digital electronics technologies, which use the "transistor" as a basic building-block, analog computers are rarely used today. Hence, today's digital computers are by far more efficient and portable compared to the analog types.

Today, computers are generally classified as either Single-user or Multi-user systems.

Single-user computers:

These are computer systems that can provide services to only one user at a point in time. They are generally employed as personal computers. Examples include:

  i.   Desktop computers
  ii.   Workstations
  iii. Notebook (or laptop) computers
  iv.   Tablet computers
  v.   Handheld computers
  vi.   Smart phones
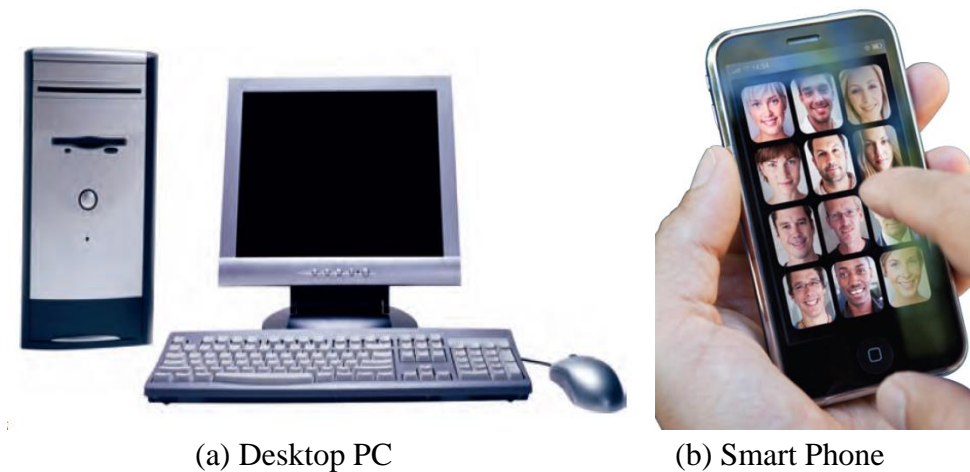
(a) Desktop PC   (b) Smart Phone
Figure 1: Single User Computer Systems

Although single-user machines are limited to servicing one user at a time, they generally support both *multi-user account* and *Multi-tasking* capabilities.

Multi-user computers

These are computer systems that can provide services to many users concurrently. Examples include:

i. **Network servers** – Typically used for dedicated services such a Library services, Students Registration/Record systems, Internet services etc. they can provide services to tens of thousands of users at the same time.

ii. **Mainframe computers** – These are higher level systems capable of responding to concurrent request from hundreds of thousands of users. Mainframes are typically used for online services such as for emails, search engines etc.

iii. **Supercomputers** – These are the highest performing computer systems. Their applications are mainly for advanced tasks in spaces exploration, defense systems, analysis of metrological data for weather predictions, etc. A single supercomputer is commonly run as a shared infrastructure by a group of large organizations. It is highly expensive to run due its high energy demand; its typical size is that of a farm land. The world's *Top 500 Supercomputers* annual rating gives a detail profile of the best performing computers on the planet.

(a) Network Server	(b) Mainframe
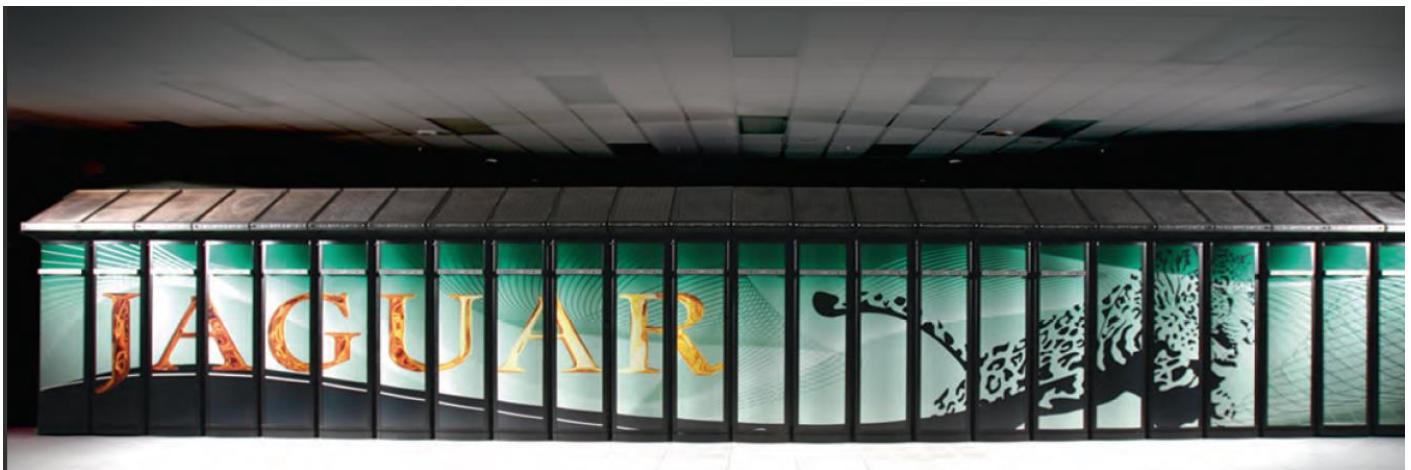
(c) Super Computer – Jaguar

Figure 2: Multi-user Computer

1.4 Basic Architecture of a Computer System

To understand the basic rudiments of the functioning of the computer refer to the basic block diagram of a computer as shown in Figure 1. This flow of information holds true for all types of computers such as

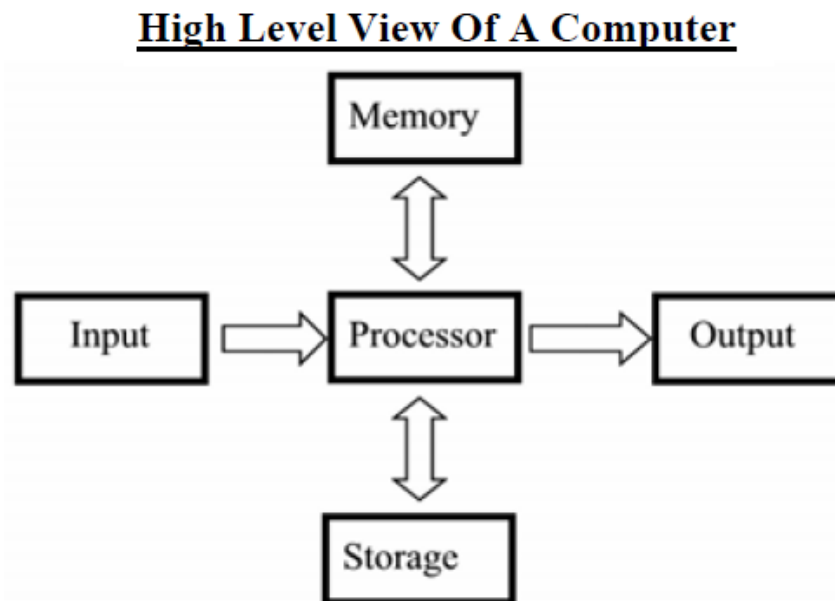Personal Computers, Laptops, Palmtops etc. In other words, the fundamental principle of working is the same.

High Level View Of A Computer

Figure 2: Computer Organizational Structure

There are four main building blocks in a computer system (see Figure 2):

i. **Input:** The data is entered through input devices like the **keyboard**, disks or mouse. These input devices help convert data and programs into the language that the computer can process.

ii. **Processor:** The data received from the keyboard is processed by the **CPU**, i.e. the Central Processing Unit. The CPU controls and manipulates the data that produce information.

iii. **Memory:** The processed data is either stored in the memory or sent to the output device, as per the command given by the user. The memory unit holds data and program instructions for processing data.

iv. **Output:** Output devices translate the processed information from the computer into a form that we can understand, such a display via a monitor or a print out through a printer.

Part 2: Computer Hardware

2.1 Components of a Computer System

In general, a computer system comprises of two main parts: **Hardware** and **Software**.

Hardware: This refers to the physical parts of the computer. Hardware is any part of the computer you can touch. Input and output devices, the system case, cables, and networking devices are all examples of hardware.

Software: This refers to the code that runs on the computer. A software is a set of instructions called program which enables the computer to perform some specific tasks.

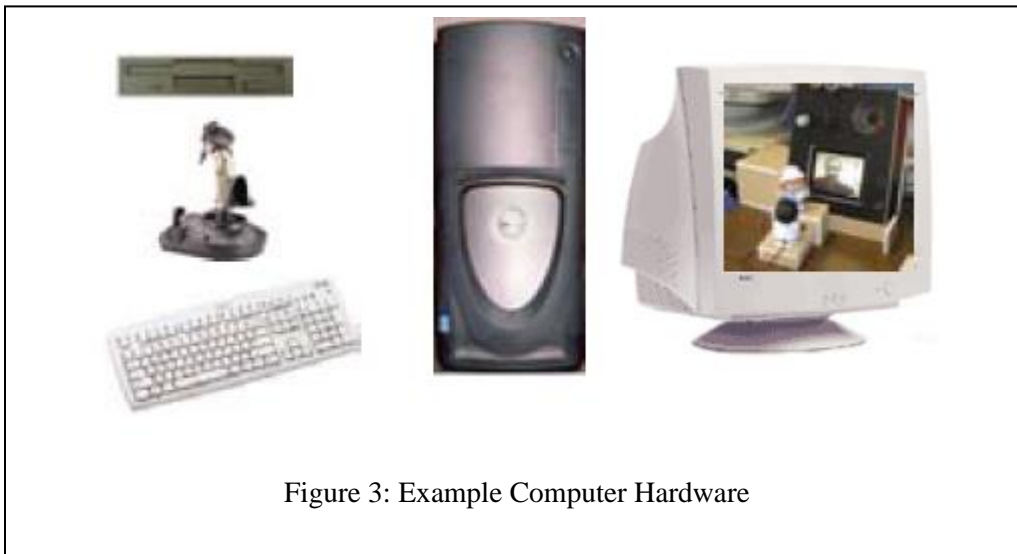<p style="text-align:center;">*"The piano is the hardware, the music is the software."*</p>

Figure 3: Example Computer Hardware

2.2 Key Hardware Components

All computers require the following hardware components:

Central Processing Unit (CPU): This is the central electronic component (chip) at the heart of a computer that enables it to process data. It is also known as a processor.

Memory: This is an area within a computer system that holds data waiting to be processed.

Storage Device: The place where a computer keeps all its data.

Input Devices: These are devices that can send data and/or instructions into a computer system. In other words, while the computer understands only logical (binary) language, input devices allow the computer to

understand the physical world by serving as interpreters. Examples include keyboard, mouse, scanner, mic, camera, etc.

Input: This refers to any resource required to for the functioning of a process, in the course of which it will be transformed into one or more inputs.

Output Devices: These are devices that allow information from a computer system to be represented in a form humans can understand. Examples include the visual display units such as Monitors and Projectors, printers, speakers, etc.

Output: This refers to the product of the transformation of inputs by a process.

Primary and Peripheral Devices: Besides the primary input/output devices which must be there for a computer to be operational, others such as printers, scanners, external disk drives, web cam, biometric scanners, etc. are regarded as peripheral devices.

Peripherals: Any piece of equipment in a computer system that is not actually inside the computer itself.

2.3 The Motherboard

Motherboard is the largest circuit board in a personal computer. It contains connectors and ports for hooking up all the other parts of a computer, from the CPU to the webcam on top of the monitor.

Figure 4: A Typical Desktop Computer Motherboard

1. Central Processing Unit (CPU):

The CPU is the brain of the computer system. It is at the center of all operations run by the computer. It is capable to surmount simple to complex operations with high efficiency. Its speed of operations is rated in running billions of instructions per second.
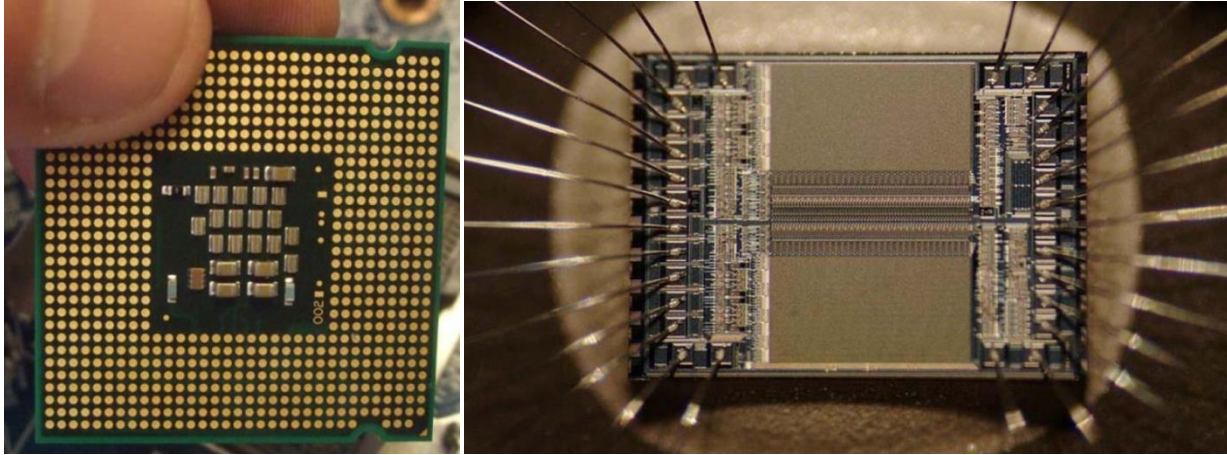

Figure 5: The Central Processing Unit (Processor) – Desktop Socket Processors

2. Memory:

Random Access Memory (RAM) is a temporary working area directly accessed by the computer's brain (processor). RAM is volatile – state is gone when power goes out. In fact, the traditional suggestion for saving any new changes to a document periodically is to avoid data loss due to volatility of the RAM. None the less, the memory is electronic in nature and as such it has a very fast speed of response. Interactions between CPU and RAM are carried out via direct addressing of memory locations as illustrated in the following Figure.

Figure 6: Random Access Memory (RAM) and its Addressing mode Analogy

3. Storage:

Computer storage is generally a persistent storage system used for keeping data permanently on computer. It is non-volatile in characteristics as such it preserved information even when not powered. Typical examples involve:

- Hard Drive: This stores bytes as a magnetic pattern on a spinning disk. When running (writing or reading) a high pitch spinning sound is produced.
- Flash Drive: This stores data in form of electrons in a chip. Examples are Flash memory, Solid State Disk (SSD), etc. Flash storage are characterized with no moving parts.

Flash storage forms include USB key, SD cards in camera, flash storage built into phones, tablets, PCs, etc. Flash used to be very expensive, so most computers tend to ship with Hard disks.

TABLE 1. UNITS OF MEASURE FOR COMPUTER MEMORY AND STORAGE

Unit	Abbreviation	Approximate Value (bytes)	Actual Value (bytes)
Kilobyte	KB	1,000	1,024
Megabyte	MB	1,000,000 (1 million)	1,048,576
Gigabyte	GB	1,000,000,000 (1 billion)	1,073,741,824
Terabyte	TB	1,000,000,000,000 (1 trillion)	1,099,511,627,776

Part 3: Computer Software

3.1 Software

The set of instructions that enable a computer to perform specific tasks is generically called a program or software. These instructions tell the machine's hardware components what to do; without a program, a computer could not do anything at all. When a computer uses a particular program, it is said to be running or executing that program.

Programming Language: An artificial set of rules, vocabulary and syntax used to instruct the computer to execute certain tasks.

Computer Program: A sequence of instructions that can be executed by a computer to carry out a process.

3.2 Types of Software

i. **System Software**
   a. **Firmware** is used to directly control hardware devices, such as keyboards, hard drives, and memory cards.
   b. **Operating system** tells the computer how to use its own components. An operating system is essential for any computer, because it acts as an interpreter between the hardware, application programs, and the user. Three of the most common operating systems are Microsoft's Windows, Apple Computer's Mac OS X, and Linux.
   c. **Network operating system** allows computers to communicate and share files and device resources across a network.
   d. **Utility** is a program that makes the computer system easier to use or performs highly specialized functions. Utilities are used to manage disks, troubleshoot hardware problems, and perform other tasks.

Operating System: This refers to a collection of software that allows a computer to function, understand itself and coordinate all operations.

ii. **Application Software**

This tells the computer how to accomplish specific tasks, such as word processing or drawing, for the user. Thousands of applications are available for many purposes and for people of all ages.

Type	Purpose
Document	Creating text-based documents such as newsletters, reports,

Publishing	articles, and brochures.
Spreadsheets	Creating numeric-based documents such as budgets or balance sheets and typically used in analysis of a research data.
Presentation	Creating and presenting electronic slides for interactive presentation.
Graphics	Designing illustrations or manipulating photographs, movies, or animations.
Multimedia authoring	Composing music and building digital movies that incorporate sound, video, animation and interactive features.
Business software	Managing inventories, client contacts, sales databases and accounting.
Education software	Teaching subjects to children and adults, groups or individual learners.
Internet applications	Designing Websites, surfing the Web, e-mailing, Chatting, and much more.
Games	Playing single-player, or multi-player games ranging from the simple to dazzlingly complex strategic games hosted on the Internet.

Note: Software programs are continually being written or upgraded to undertake certain tasks. As a result software can become obsolete quickly.

3.3 Word Processing Software

Word processing software is used for creating documents. Drafts, letters, reports, essays, write-ups etc can be created using word processing software. Earlier, Word Star was being used widely for this purpose. Sidekick and Word Perfect are also used for drafting letters. However, the most commonly used word processing package in the world is Microsoft Word.

Microsoft Word is Microsoft's word processing software. It was first released in 1983 bearing the name Multi-Tool Word for Xenix systems. Later, Versions for several other platforms including IBM PCs running DOS (1983), the Apple Macintosh (1984), SCO UNIX, OS/2 and Microsoft Windows (1989) were written. It is a component of the Microsoft Office system; however, it is also sold as a standalone product and included in Microsoft Works Suite.

3.3.1 MS Word Key Features

1. **User Friendly**: It is an easy and simple package for a general user.

2. **Features and Functionalities**: The features such as paragraph, font, symbols, spell check, table, drawing, bullets and numbering, page numbering provided by this package enable a user to develop a document in an error free format.

3. **Compatibility**: The text file generated by MS Word is .doc. This file can be used in other applications such as MS Excel, MS Visual Studio 6.0, MS Visual Studio.net, Web browser, pdf format etc.

4. **Key Features**: Some of the commonly used crucial features in MS Word include:

- Toolbar support
- Find and Replace
- Paste special
- Insert Objects
- Themes
- Multi-Column text
- Referencing and Citation
- Mailing
- Spelling and Grammar Checks, Thesaurus and Translators
- Review - Track Changes
- Flexible viewing capabilities, etc.

3.4 Spreadsheet Software

Spreadsheet is a computer application that simulates a paper worksheet. It displays multiple cells that together, make up a grid consisting of rows and columns, each cell containing either alphanumeric text or numeric values. Spreadsheets are frequently used for financial information because of their ability to re-calculate the entire sheet automatically after a change to a single cell is made.

Starting in the mid 1990s and continuing through the present, Microsoft Excel has dominated the commercial electronic spreadsheet market.

3.4.1 Microsoft Excel Basics

The intersection of a column and a row is known as a **cell**. Each cell has a name or a cell address. The cell address consists of the column letter and row number. For example, the first cell is in the first column and first row. First column name is A and first row number is 1. Therefore, the first cell address is A1. Similarly, the address of last cell is IV65536 i.e. column IV and row number is 65536.

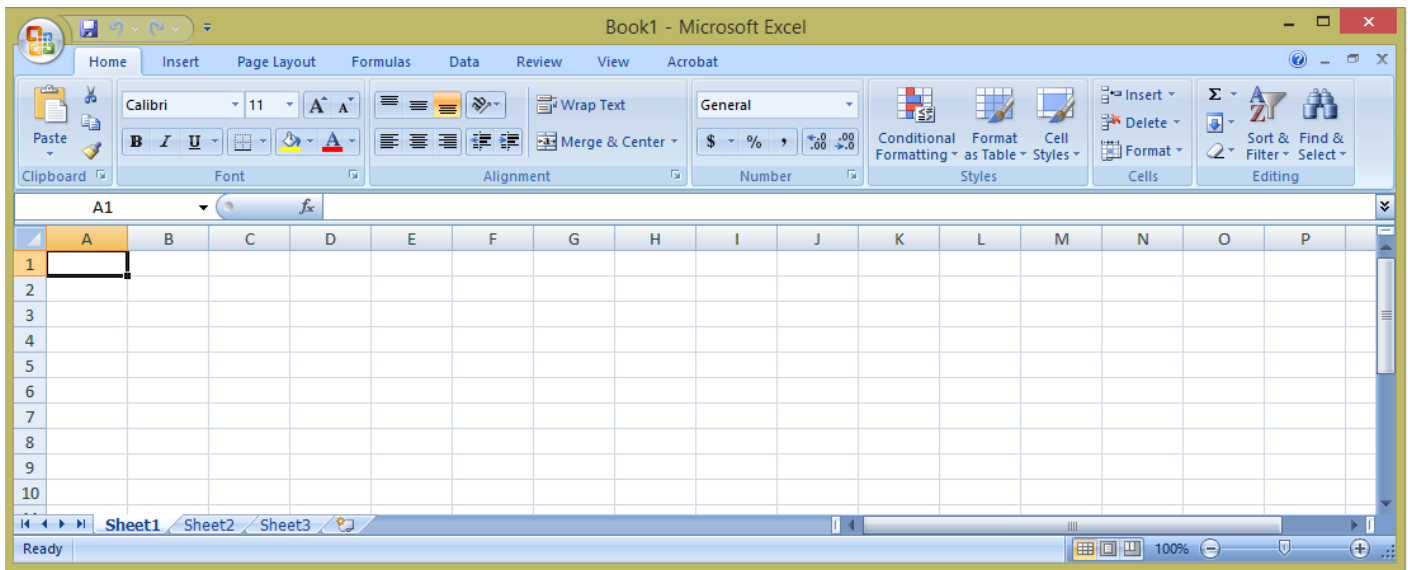The total cells in a worksheet are 256×65536.

Figure 3.1 A Microsoft Excel Window

Key Features:

- Title Bar
- Menu Bar
- Standard Tool bar
- Formatting Toolbar: Allows the user to give commands related to formatting cells and cell contents such as Bold, Underline, Font Style, Font Size, Colour etc.
- Name box
- Formula bar
- Colum and Row headers
- Current Cell
- Scroll Bars
- Sheet Tab
- Status Bar
- Auto Fill function

3.4.2 Formulae in MS Excel

The following snapshots show simple data processing in Excel using the formula function. Basic arithmetic operations, multiplication and addition, are presented.
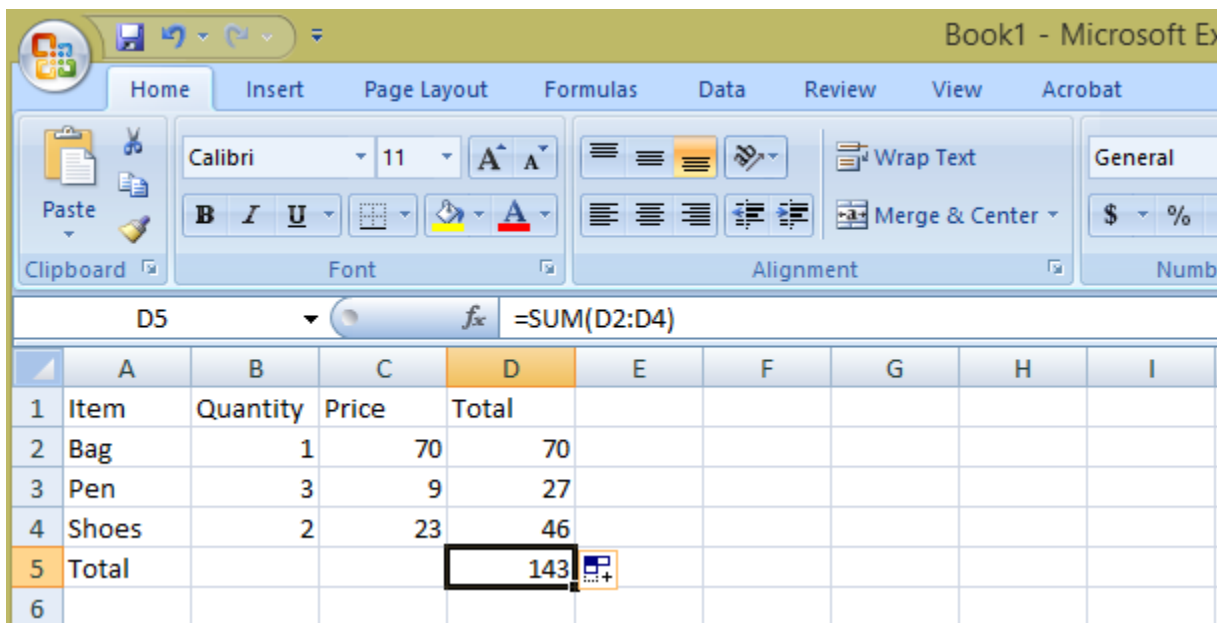
3.4.3 Charts in MS Excel

Charts are used to display series of numeric data in a graphical format to make it easier to understand large quantities of data and the relationship between different series of data.
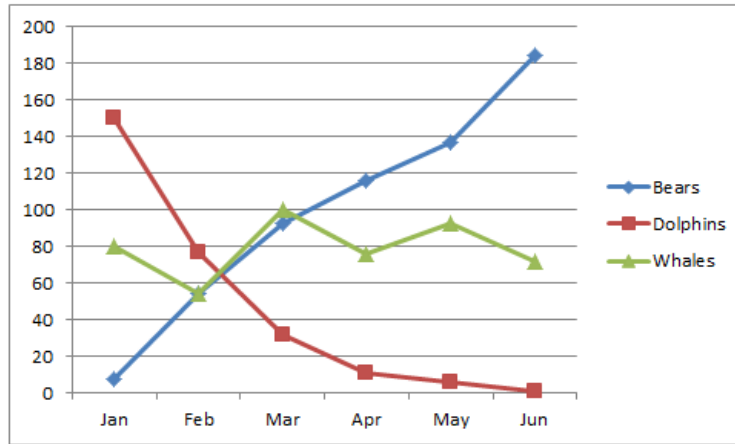
"A simple chart in Excel can say more than a sheet full of numbers..."
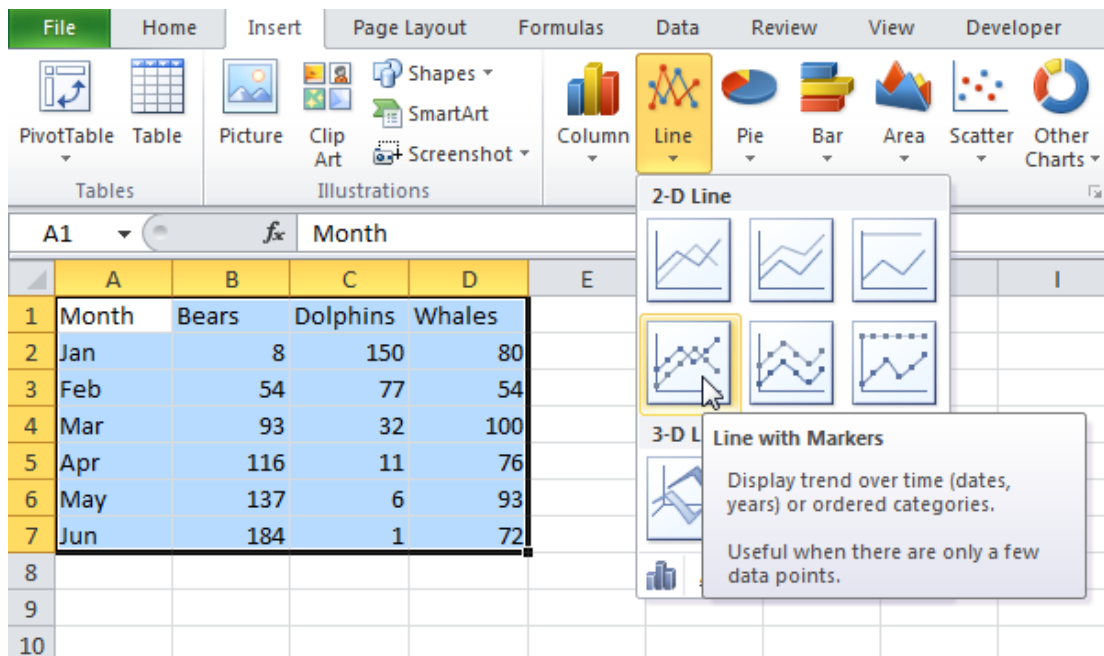
Creating an Excel Chart

To create the line chart above, execute the following steps.

    i.   Select the range A1:D7.
    ii.   On the Insert tab, in the Charts group, choose Line, and select Line with Markers.

3.5 Presentations Software

PowerPoint is widely used by business people, educators, students and trainers and is among the most prevalent forms of persuasive technology.

Microsoft PowerPoint is a presentation program developed by Microsoft. It is part of the Microsoft Office suite and runs on Microsoft Windows and Apple's Mac OS X computer operating systems.

Microsoft PowerPoint is a type of business software that enables users to create highly stylized images for slide shows and reports. The software includes functions for creating various types of charts and graphs and for inserting text in a variety of fonts. Most systems enable you to import data from a spreadsheet application to create the charts and graphs.

Similar to Excel, the PowerPoint screen has many elements as shown in the following.

3.5.1 Standard and Formatting Toolbars

PowerPoint has several toolbars. Toolbars provide shortcuts to menu commands. The most commonly used toolbars are the Standard and Formatting toolbars.

1. **Standard toolbar** provides functions such as open a file; save a file; print a file; check spelling; cut, copy, and paste; undo and redo; or insert a chart or table.
2. **Formatting toolbar** is used to change the font, font size or font color; bold, underline, or italicize text; left align, right align, center, or justify; bullet or number lists; highlight; or decrease or increase the indent.

3.5.2 Slide Show

Use the Slide Show view when you want to view your slides, as they will look in your final presentation. When in Slide Show view:

Esc	Returns you to the view you were using previously.
Left	Moves you to the next slide or animation effect.
Clicking	On reaching the last slide, you automatically return to the last view.

Right Clicking	Opens a pop-up menu. You can use this menu to navigate the slides; add speaker notes; select a pointer; and mark your presentation.