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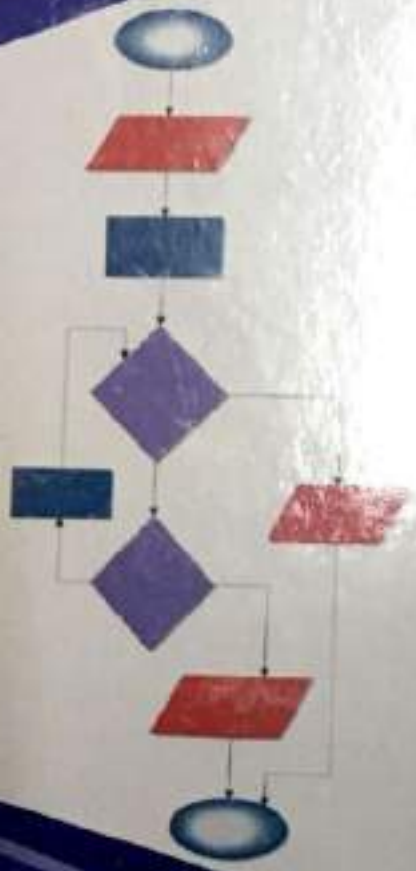
Senior Secondary

Computer Studies

Student's Book

Form 3



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EXCEL & SUCCEED

SENIOR SECONDARY

COMPUTER STUDIES

Student's Book
Form 3

Andrew Nasalangwa

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1: USING SPREADSHEETS

Core element

Application software

Outcome

The students will be able to use software in information processing, analysing, arrangement and presentation.

Success Criteria

By the end of this unit, you must be able to:

- ***Define a spreadsheet.***
- ***List types of a spreadsheet.***
- ***List features of a spreadsheet.***
- ***State benefits of spreadsheets.***
- ***Differentiate between work and worksheet.***
- ***Identify cells, columns and rows.***
- ***Differentiate between labels and values.***
- ***Differentiate between relative cells references and absolute cell references.***
- ***Start a spreadsheet programme.***
- ***Create a worksheet and a workbook.***
- ***Save a workbook.***
- ***Close a workbook.***
- ***Open a workbook.***
- ***Enter data in a worksheet.***
- ***Edit worksheet data.***
- ***Format a worksheet.***
- ***Protect workbooks.***
- ***Use shortcuts and commands in a worksheet.***
- ***Reference cells in a worksheet.***
- ***Freeze panes.***
- ***Hide and unhide columns.***
- ***Use some basic formulae.***
- ***Use built- in functions.***

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1 USING SPREADSHEETS

Chapter Outline

1.1 Introduction.
1.2 Definition and types of spreadsheets.
1.3 Components of spreadsheets.
1.4 Uses of spreadsheets.
1.5 Benefits of spreadsheets.
1.6 Getting started with Microsoft Excel
1.7 Features of the Excel spreadsheet application window
1.8 Spreadsheet data: labels, values
1.9 Cell referencing
1.10 Creating a worksheet and workbooks
1.11 Editing worksheets and workbooks
1.12 Formatting a worksheet and a workbook
1.13 Protecting workbooks
1.13 Keyboard shortcuts and commands in Excel
1.14 Freezing and unfreezing panes
1.15 Working with formulas and basic functions
1.16 Printing workbooks

1.1 Introduction

Many problems in mathematics, science, finance etc. require a person to work with numbers and manipulate them using formulas. For this, human beings have been struggling to come up with better methods and tools for handling figures. The simplest method of achieving this is to manually perform calculations using tables or calculators. Better still, numbers can be arranged in rows and columns (ledger sheets /worksheets) for easy manipulation. Such files are known as spreadsheets. Today, we have several computer applications used to analyse numerical data. One such application is the electronic spreadsheet. In this unit, we learn how to organise and manipulate data using electronic spreadsheets.

1.2 Definition and types of spreadsheets

In financial accounting, a spreadsheet is an accounting ledger book in which data is organised in rows and columns. However, spreadsheets can be classified into two broad categories namely:

1. Manual or traditional spreadsheets.
2. Electronic spreadsheets.

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Traditional spreadsheets

A manual (traditional) spreadsheet is made up of sheets of papers divided into rows and columns on which numerical data is entered manually. Figure 1.1 shows a sample section of manual spreadsheet.

Fig. 1.1: A sample manual spreadsheet

Creating manual worksheets

A manual worksheet is typically a ledger sheet within which values can be entered and arithmetic computations made manually on them. Figure 1.2 shows sample entries in a manual worksheet. This can be done by buying a ledger book and entering various values into the book, for example to account for cash received or spent.

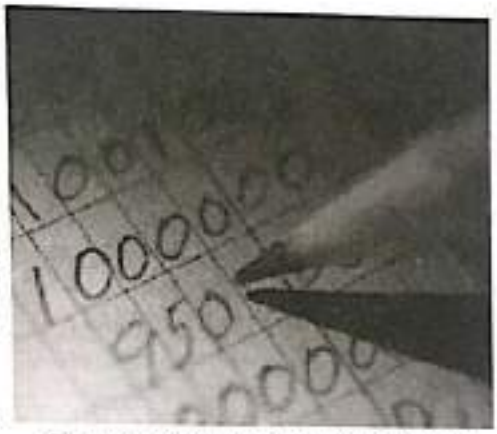

Fig. 1.2: A sample manual worksheet

For a long time, manual spreadsheets have been used for the following purposes:

- Organise data into tabular, for case of reading and calculations
- Book keeping in financial accounting whereby numeric figures are entered on income and expenditure
- Financial analysis in stock management where stock values are entered and organised for presentation.

Today, manual spreadsheets are being replaced by specialised accounting packages and electronic spreadsheets.

Electronic spreadsheets

An electronic spreadsheet is an application software consisting of rows and columns used to organise, calculate and analyse numerical data. The rows

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and columns are similar to the ones of a manual spreadsheet. Examples of electronic spreadsheets include *Microsoft Excel, OpenOffice Calc, Lotus 1-2-3* and *Corel Quattro Pro.*

Figure 1.3 shows a sample electronic spreadsheet created in Microsoft Excel.

	A	B	C	D	E	F	G	H
1	ST MARY'S HIGH SCHOOL							
2	FORM 3 TERM II YEAR 2011 TOTAL MARKS AND RANKING							
3	ADM NO.	NAME	ENGLISH	MATHEMATICS	PHYSICAL SCIENCES	COMPUTER STUDIES	TOTAL MARKS	POSITION
4	3200	Samuel Mphande	89	73	73	80	315	1
5	2834	Elizabeth Towera	89	74	69	71	303	2
6	2345	Patricia Banda	92	68	59	80	299	3
7	2465	Monica Chiuomo	84	61	72	81	298	4
8	2367	James Chapalapata	78	65	71	76	290	5
9	2500	Felix Waragwa	56	78	81	67	282	6
10	2671	Boaz Mayamiko	56	62	64	58	240	7
11								
12								

Fig. 1.3: A sample electronic spreadsheet

1.3 Components of electronic spreadsheet

An electronic spreadsheet consists of three main components namely worksheets, database and graphs.

Worksheet

A worksheet is the work area made up of rows and columns where data is entered. Rows are labelled with numbers (1,2,3...) while columns are labelled with letters (A, B, C...) as shown in the Figure 1.4.

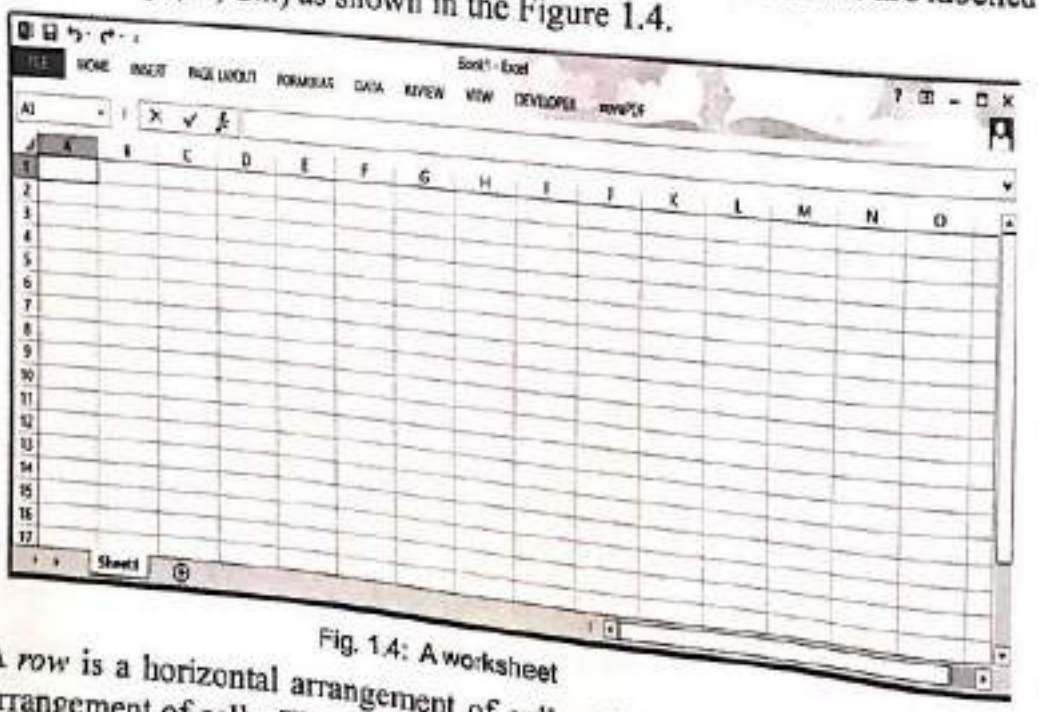

Fig. 1.4: A worksheet

A *row* is a horizontal arrangement of cells while a *column* is the vertical arrangement of cells. The intersection between row and column is called a *cell*. Each cell is identified using the column label followed by row label. In the worksheet on Figure 1.4 above, the active cell is A1.

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Database

A spreadsheet database is a list or collection of related data items or records on a worksheet. A record is made up of data elements called fields that together form an entity. An entity is something of interest such as a person, a place or an item. For example, a student is an entity of which we can create a record containing first name, last name, gender and date of birth fields. Assuming that the worksheet holds these details for many students row after row, the worksheet can be considered as a database consisting of records that may be organised by sorting, searching or querying. More on database management in spreadsheets is discussed later in this book. Figure 1.5 shows a sample worksheet database.

ST. PAUL'S SCHOOL

	A	B	C	D	E	F	G	H	I
1	ST. KAKOMBE SCHOOL								
2	TERM 1 TOTAL MARKS AND AVERAGE SCORE								
3									
4	ID. NO	NAME		ENG	MATHS	PHYSICS	BIOLOGY	TOTALS	MEAN
5	1020	Kakunda Lemba		60	90	70	65	285	71.25
6	1050	Mutende Mwewa		75	86	58	95	314	78.5
7	1080	Milimo Mapalo		85	74	93	80	332	83
8	1090	Kaweme Chola		98	87	74	68	327	81.75
9									
10									

Fig. 1.5: Worksheet database or list

Graphs

A graph is a pictorial representation of the relationship between two or more values on a worksheet. In some spreadsheets, graphs are referred to as *charts*. A chart enables the user to visually present numeric values from a worksheet in a simple, easy to understand format. Examples of charts include pie chart, line graph and bar chart. Figure 1.6 shows an example of a chart.

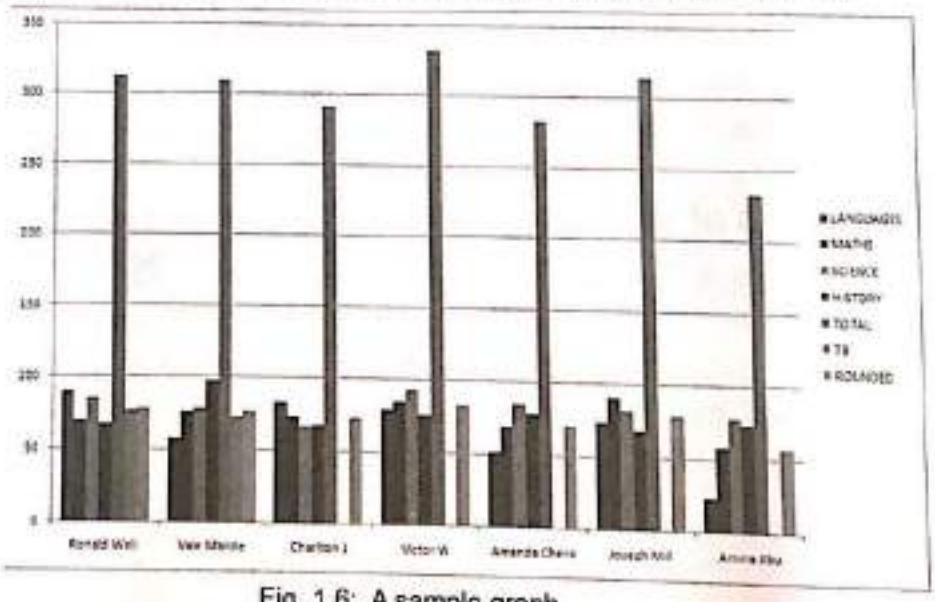

Fig. 1.6: A sample graph

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1.4 Uses of spreadsheets

Because an electronic spreadsheet is a general purpose application, it can be used for various numerical calculations from scientific computations to budget preparation. Some of the common uses of spreadsheets include:

Arranging Information

Since worksheets are made up of rows and columns, data can be entered and organised automatically into presentable tabular layout. Each row and column can be given labels to describe numeric data in them.

Preparation of budgets

A spreadsheet is a good tool that can be used to prepare budget. The ability to list items and manipulate numeric entries mathematically makes spreadsheets very popular in preparing budgets and other accounting documents like cash flows and expenditure statements. Some organisations rely on spreadsheets to do all their financial planning and accounting.

Interest calculations

Spreadsheets can be used to compute both simple and compound interest. The is done by entering the relevant formulae correctly in the spreadsheet in order to generate a series of expected cash flows over a period of time based on the interest rate and principal amount.

Statistical analysis

Most electronic spreadsheets provide a set of data analysis tools that may be used by scientists and other users to perform basic and complex statistical analysis. Simple analysis tasks include computation of mean, mode, standard deviation, sum, and product. Complex statistical analysis include computation of variance, cumulative distributions and regression analysis.

1.5 Benefits of electronic spreadsheets

Electronic spreadsheets offers the following advantages over manual spreadsheets:

1. Electronic spreadsheets utilise the powerful aspects of computers namely speed, accuracy and efficiency to enable the user easily perform numeric computations.

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2. Electronic spreadsheets offer a larger *virtual* sheet for data entry and manipulation. On the contrary, the largest possible paper ledger you can get may not exceed 30 columns and 51 rows. In an electronic spreadsheet, the least worksheet has at least 255 columns and 255 rows.

3. It is easy to enter data into a worksheet because most spreadsheets provide autocomplete and autocorrect features.

4. Electronic spreadsheets utilise the storage space on storage media to save and retrieve documents.

5. Electronic spreadsheets enable the user to produce neat work because the traditional paper, pencil, rubber and calculator are put aside. All the work is edited on the screen and a final clean copy is printed. With manual spreadsheets, neatness and readability depends on the writer's hand writing.

6. Electronic spreadsheets have better editing and formatting features.

7. Electronic spreadsheets have inbuilt formulae called *functions* that enable the user to quickly analyse numeric data.

8. Electronic spreadsheets automatically adjust the result of a formula if the values in a worksheet are changed. This is referred to as *automatic recalculation.* For a manual spreadsheet, changing one value requires erasing the result and writing the correct one again.

9. Graphs let the user provide visual representation of data from a worksheet for ease of interpretation.

Disadvantages of electronic spreadsheets

1. Startup costs including computer and software purchase may be high.
2. Learning how to use electronic spreadsheets require considerable effort and is mostly done at a cost.
3. Electronic spreadsheet files require to be protected against unauthorised access and malware like viruses.

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Review Questions 1.1

Part A

1. A_____ is a work area in a spreadsheet made up of rows and columns while a _____ is a collection of the same saved under the same name.
2. The _____ component of a spreadsheet used to manage related data in a worksheet list.
3. A _____ is a visual representation of numeric data on a worksheet.

Part B

1. Define the term electronic spreasheet.
2. List four examples of spreadsheet programs available in the market.
3. Lotus 1-2-3 denoted the three main components of an electronic spreadsheet program. Explain each of the component.
4. State five advantages of an electronic spreadsheet over the manual worksheet.

1.6 Getting started with Microsoft Excel 2013

Most electronic spreadsheets have common features. For consistency, w shall use Microsoft® Excel 2013 simply referred to as Excel in this unit. Exc is a member of Microsoft office suite. Earlier versions of Excel include Exc 97, Excel 2000, Excel XP/2002, Excel 2007 and Excel 2010.

Starting Microsoft Excel

There are a number of ways used to start Microsoft Excel. To launch Exc 2013 from the Start menu, proceed as follows:

1. Click the on the Start menu and point to Programs/All Programs.
2. Point to Microsoft Office, then click Excel 2013. Excel application window (Figure 1.7) opens.

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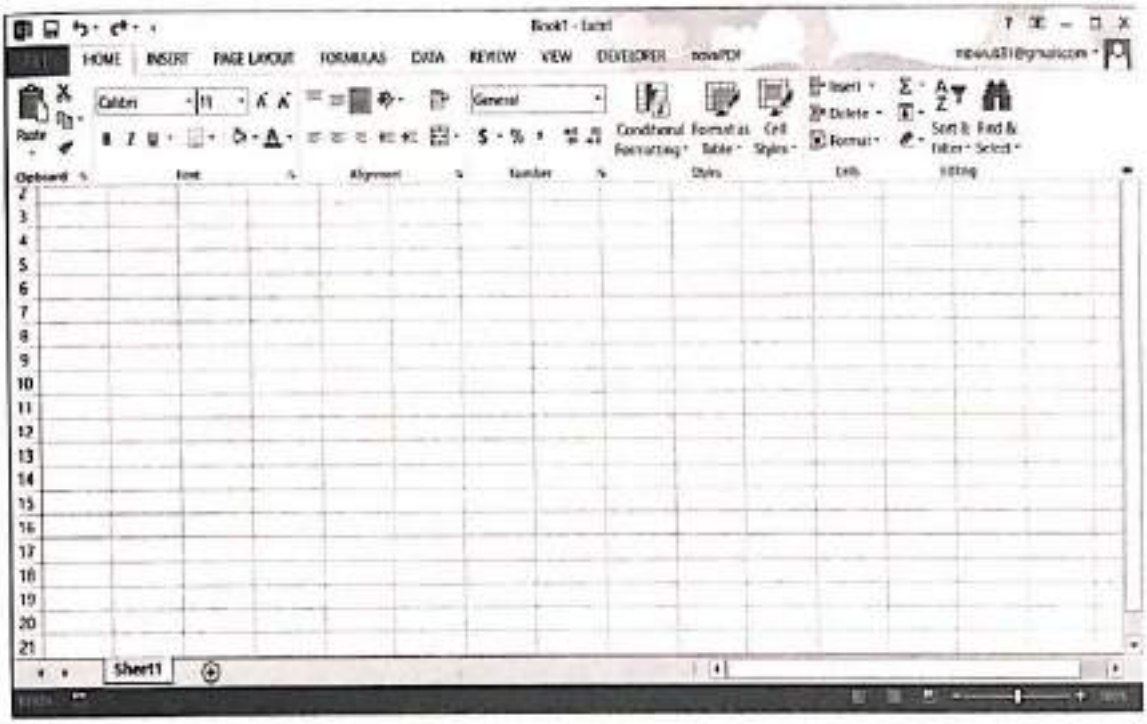

Fig. 1.7: The Microsoft Excel application window

1.7 Features of the Excel spreadsheet application window

Excel 2013 has a slightly different interface compared to earlier versions Excel 2003 and the previous versions. The main difference is that the menu bar has been replaced by menu tabs. Under each tab is a ribbon consisting of command that enable the user to quickly perform various tasks.

Rows

A row is a horizontal arrangement of cells in the worksheet. Rows are labelled using numbers 1, 2, 3, ...n in the worksheet.

Columns

A column is a vertical arrangement of cells in the worksheet. Columns are labelled using letters A, B, C, ... in the worksheet.

A cell

A cell is the intersection between a column and a row. A cell pointer indicates the current active cell. For example, in Figure 1.7, the active cell pointer is that highlighted with a bold outline.

Worksheets

As mentioned earlier, a worksheet is the work area made up of rows and

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columns where data is entered. The intersection between a row and a column forms a cell. The cell address is the combination of a column header and a row header that indicates the location of a specific cell. For example in Figure 1.7, the active cell address is **I2**.

Workbook

A workbook is a spreadsheet file that consists of one or more related *worksheets*. A worksheet may have one or more pages.

Labels

Columns and rows have labels. Column labels are letters A – Z, AA – AZ, IA – IZ. Rows labels are numbers 1, 2, 3, ... in the worksheet.

Cell address

Each cell in the worksheet has an address. The cell address is given by the column label followed by row number. For example, cell A1 is the cell address for a cell in column A, row 1 in the worksheet. The process of referring to a particular cell using its address is called *cell referencing*.

Name box

It displays the address of the current cell. The cell address is the one in which the cell pointer is currently located.

File tab

The File tab is similar to file menu in earlier versions of the Microsoft Excel apart from Excel 2007 which has Office button instead. Clicking the File tab displays the drop down File menu which has common commands like New, Open, Save as, Print, Close among others.

Command ribbons

Each menu tab has a ribbon and a set of command buttons displayed in related groups. For example, the Home tab has commands such as Paste, Copy, Cut, Bold, Underline, Sort and Find grouped into Clipboard, Font, Alignment, Number Styles, cells and Editing. Clicking any of the menu tabs displays ribbon commands used to accomplish various tasks.

Formula bar

The formula bar is an input box where a cell entry or a formula is displayed before it is inserted into the active cell.

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Worksheet tabs

Worksheet tabs are located at the bottom of a spreadsheet. They are labelled Sheet1, Sheet2 .... but can be renamed by right clicking each and then selecting the Rename command from the context menu. Once you select a worksheet by clicking its tab, you can navigate within its cells using the following methods:

1. Use the keyboard arrow keys to move from the current cell to the right, move one cell to the direction of the arrow left, top or bottom cells.
2. Use the tab key to move the cell pointer to the right of the active cell.
3. Directly move to a particular cell by clicking the desired cell using a pointing device or touch.
4. Press Ctrl + Home key move the cell pointer to the first cell labelled A1.

1.8 Spreadsheet data Entries

In this context, spreedsheet data refers to labels (text), numeric values, formulas and functions entered into a worksheet. In this section, we discuss types of data entered into worksheet cells. As you type data entry, it is displayed in the formula bar. To insert the content into the active cell, press the Enter key, an arrow key or click into another cell. Data entered into a worksheet can be classified into four categories namely:

1. Labels
2. Values
3. Formula
4. Function

Labels

The term label refers to alphanumeric characters entered into a cell. By default, labels are aligned to the left of the cell and cannot be manipulated mathematically. Labels are used as row or column headings to describe numeric content. If a column contain names of students for example, the label can be *student name*.

Sometimes, numeric values can be formatted so that they are used as labels. To achieve this, add an apostrophe just before the most significant digit in the number. For example to convert 1990 to a label, write it as '1990.

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Values

The term value refers to numerical data such as currency, numbers (0-9) and date that can be manipulated mathematically in a spreadsheet.

Formula

A formula is a mathematical expressions used to calculate and return a new value from numeric data. In Excel, a formula must start with an equal sign. For example, the formula = B3+D4 adds the contents of B3 and D4 and returns the sum in the active cell. Excel formulae use cell addresses and arithmetic operators; addition (+), subtraction (–), multiplication (*) and division (/).

Functions

A function is an inbuilt formulae that can be quickly used instead of having to create new ones each time a calculation has to be performed. Microsoft Excel has several functions that simplify calculations performed by spreadsheets. For, example, to add contents of cells say B3 upto E3 we use inbuilt sum function by typing: type = *Sum(B3:E3)*

1.9 Cell referencing

Using cell addresses also called *referencing*, enables Microsoft Excel to keep calculations accurate and automatically recalculates results of a formula in case the value in a referenced cell is changed. This is referred to as *automatic recalculation*. There are three types of cell referencing used when creating formulae and manipulating cell(s)content namely relative, absolute and mixed referencing:

Relative referencing

A relative reference is one that changes depending on its position of reference in the worksheet. When you copy a formula that contains a cell reference, say **A3,** the reference adjust to reflect the new location. For example if a formula **=A1+B1** in cell **C1** is copied to cell **C2,** the formula reference changes to **=A2+B2.**

Absolute referencing

In absolute cell referencing, reference is made to a specific address and does not change even if the formula is copied to another cell. In Excel, an absolute cell reference is made by placing a dollar sign before the column and/or row label e.g. A2. For example, if the result in **C1** is 170 and absolute reference is used, 170 will be copied to **C2.**

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Mixed cell referencing

This is a combination of relative and absolute referencing on a specific cell address to make the row or column relative or absolute. For example, in case of A$3 referencing, the column is absolute in the former while the row is relative.

1.10 Creating a workbook and worksheet

Creating a workbook involves starting the spreadsheet program and entering data in the cells of the current worksheet. However, the user can decide to create a worksheet either using the general format or from a preformatted worksheet called a *template.*

Using a blank worksheet

When a spreadsheet application is launched, it presents the user with a new blank template. If you wish to create another workbook while the application is still running,

1. Click the File tab, and select **New** from the drop down menu.
2. In the New Workbook dialog box, double click Blank Workbook icon (Fig. 1.8).

Fig. 1.8: Inserting a blank workbook

Using a predefined template

When Excel is installed, some of the templates are installed. However, some of these templates require online access in order to be able to use them because they may not have been copied onto the hard disk during installation.

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To create a workbook based on a predefined template:

1. Click the File tab, and select New.
2. In the New Workbook dialog box under Templates pane, click the Installed Templates. Select a template and replace the general data in the template with your own (Figure 1.9).

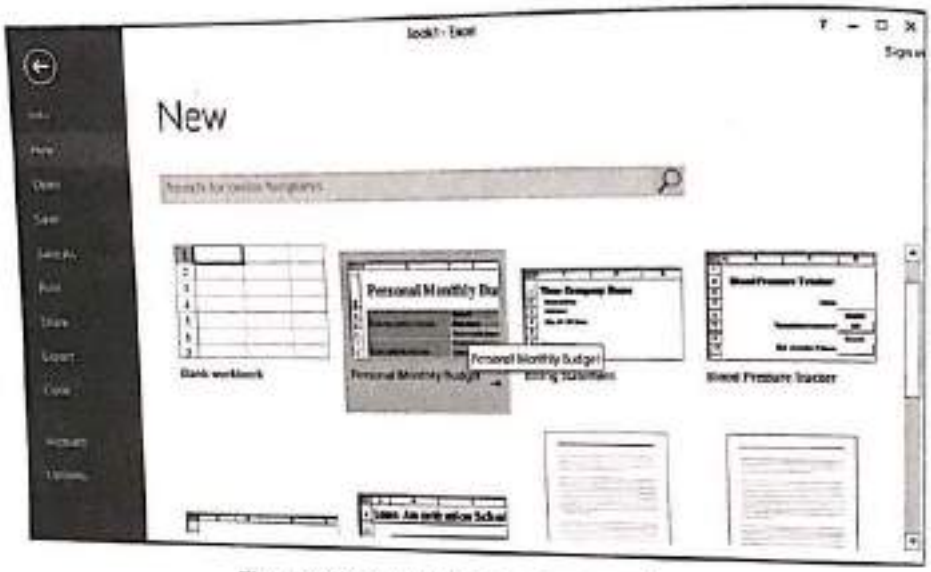

Fig. 1.9: Create workbook using templates

Saving a workbook

The procedure for saving a workbook is similar to that of saving a Word document (Discussed in Form 2).

To save a workbook;

1. Click the File tab then select Save As command. The Save As dialog box is displayed.
2. Select the location in which your workbook will be saved in the Save in box then type a unique name for the workbook in the File name box. Make sure that the option *Microsoft Excel Workbook* is selected under the *save as* type box. Excel saves the workbook with **.xlsx** extension.
3. Click Save button to save and close the dialog box.

Retrieving a workbook

To retrieve an existing workbook, use the procedure similar to one we learnt earlier in word processing.

1. On the File tab, click Open from the drop down menu.

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2. Select the location, drive or folder where the workbook was saved.
3. Double click the icon of the workbook you wish to open.

Closing a workbook and exiting Excel

Closing a workbook is the process of closing the current spreadsheet workbook without exiting the spreadsheet application. On the other hand, exiting Excel is the process of closing all open workbooks and exiting the spreadsheet application.

To close a workbook and exit Excel, proceed as follows:

1. On the File tab, click Close. Alternatively press Ctrl + F4.
2. To exit from Excel, proceed as follows:
3. On the File menu, click Exit. Alternatively press Alt + F4 on the keyboard.

Review Questions 1.2

1. Match the following statements with the correct answers.

Statements	*Answers:*
(a) Click this to reduce the Microsoft Excel windows size to an icon on the task bar.	A. Name box.
(b) Displays the current / active cell address.	B. Save command.
(c) Saves the file without changing its current location and name.	C. Save as command.
(d) Input box where you can edit the contents of a cell.	D. Minimize button.
	E. The row.
	F. Formula bar.

2. The _____ displays the address of the current cell while the _____ displays the contents of the current cell.
3. In order to move from cell G29 to A1, press combination of _____ keys once.
4. Give any two methods you would use to start Microsoft Excel 2013.
5. Differentiate between formula and function as used in spreadsheets.

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6. Write the following formula as absolute reference =F10+G20.
7. The formula =A1+C2 is initially typed in cell D1. How will it appear when copied to cell E1?
8. Differentiate between worksheet and workbook.
9. State the effect of pressing each of the following keys on the cell pointer:
   (a) Right arrow key (b) Shift+Tab (c) Ctrl + Home
10. Define each of the following terms as used in Spreadsheets
   (a) Cell (b) Row (c) Column
11. Outline the procedure for closing Microsoft Excel workbook without exiting from the application?
12. Write the cell reference G20 in R1C1 format.
13. Define the term workbook template. Explain how you would start a spreadsheet template in Microsoft Excel.
14. State four types of data entries in spreadsheets and explain each one of them.
15. (a) Differentiate between relative and absolute cell referencing.
   (b) Define the term range.

1.11 Editing workshe

Editing refers to ma
already been created.
replace as well as sp
to those discussed in
of performing them

Editing cell entrie

There are two meth

- *Using the For*
formula bar. C
Delete or insert
- *Double clickin*
or modify the

Deleting worksh

To delete workshe

1. Select the cel
2. Press Delete

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1.11 Editing worksheets and workbooks

Editing refers to making necessary modifications to a worksheet that has already been created. It involves deleting entries, copying, moving, find and replace as well as spell checking. Since most of these operations are similar to those discussed in word processing, we are only going to outline the steps of performing them in Excel.

Editing cell entries

There are two methods of editing a cell entry:

- *Using the Formula bar.* Click the cell to display its content on the formula bar. Click the formula bar to insert the insertion pointer in it. Delete or insert the required word or text and press the Enter key.
- *Double clicking a cell.* This places the insertion pointer in the cell. Type or modify the entry.

Deleting worksheet range

To delete worksheet range, proceed as follows:

1. Select the cell or range of cells.
2. Press Delete key on the keyboard. Alternatively, right click the range then select the Clear Contents on the shortcut menu.

Copying and moving cell contents

To copy cell(s) content,

1. Select the range of cells.
2. On the Home ribbon, click the Copy icon.
3. Click the cell where you want the content to be copied.
4. On Home ribbon, click Paste .

To move cell(s) content,

1. Select the range of cells.
2. On the Home ribbon, click the Cut button.
3. Click the cell where you want the content to be moved.
4. On the Home ribbon, click Paste .

Note: Use shortcut keys Ctrl+C to copy, Ctrl+X to cut and Ctrl+V to paste.

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Inserting rows/columns

To insert a new column or row, proceed as follows:

1. Position the cell pointer where the new row or column is to be inserted.
2. On the Home ribbon, click the down arrow on the Insert button in the Cells group.
3. On the drop down list displayed, do one of the following:
   - Click Insert **Sheet Rows**; or
   - Click Insert **Sheet Columns**

Deleting columns/rows:

1. Select the column or row to be deleted by clicking the column/row header.
2. On the Home ribbon, select Delete which is on the Cells toolbar.
3. On the drop down menu, click the appropriate command.

Inserting and deleting worksheets

To insert more worksheets, proceed as follows:

1. On the Home ribbon, click Insert which is on the Cells group.
2. On the drop down menu, click Insert Sheet.

To delete a worksheet:

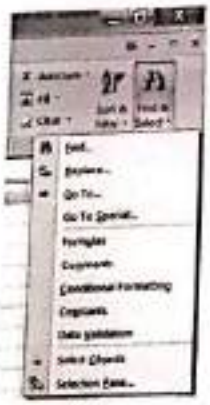
1. On the Home ribbon, select Delete which is on the Cells toolbar.
2. On the drop down menu, click Delete Sheet.

Find and replace

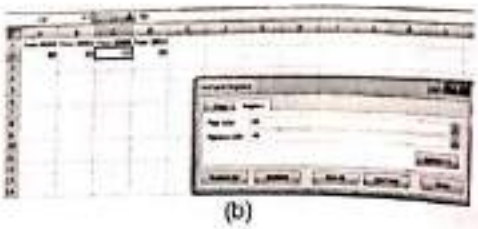
Microsoft Excel provides capability to find and replace data in a worksheet.

To search and replace a specified range:

1. On the Home ribbon, click **Find & Select** in the Editing group as shown in Fig 1.10 (a).



(a)



(b)

Fig. 1.10: (a) Click Find & Select (b) Replace dialog box

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4. Type the word to be
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1.12 Formatting work

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2. To find and replace, click Replace from the drop down menu.
3. In the "Find What" dialog box, type the word or phrase to find and the one that will replace it (Fig. 1.10 b).
4. Type the word to be used as replacement in the "Replace with" box
5. Click the Replace All or Replace button.

Correcting spelling mistakes

To spell check worksheet content:

1. Specify the worksheet range you want to check for spelling mistakes.
2. On the Review tab, in the Proofing group, click Spelling. Alternatively, press F7. The spelling checker dialog comes up (Fig. 1.11).

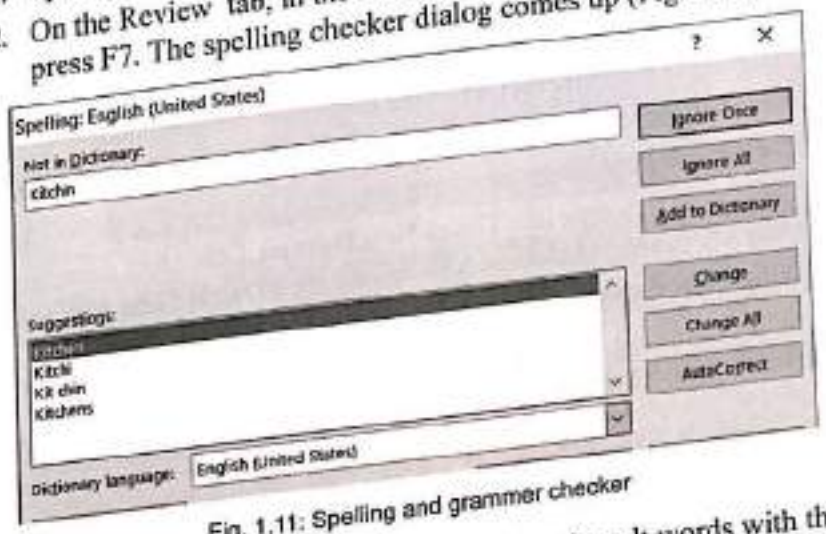

Fig. 1.11: Spelling and grammer checker

3. On the spelling dialog box, replace the misspelt words with the correct ones.

1.12 Formatting worksheets and workbooks

Worksheet formatting refers to enhancing the appearance of cell content to make it more readable and appealing to the reader. Appropriate formatting should be used to place emphasis, catch attention and reveal hidden detail of worksheet content.

The best practice in formatting is to use simple and clear formatting options. This essentially consists of changing background, text colour, typeface (font), size, style and alignment. In Microsoft Excel, when you format *cells* whether empty or not, their contents will acquire the set format automatically. The following sub section, outline the procedures for formatting fonts, numbers, cell borders and the entire workbook.

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To format a single cell, make it the active cell and then proceed as follows:

1. Click the Home tab.
2. Click the down arrow on the right of the format button in the Cells group.
3. In the drop down menu that appears, click Format Cells... Format cells dialog box is displayed.
4. In the Format cells dialog box, make the formatting options that you wish on numbers, alignment, font, cell borders or background colour.

Formatting Fonts

To format fonts in a worksheet, proceed as follows:

1. Highlight the cells that have the content to be formatted.
2. On the Home ribbon, click Format then Format Cells command.
3. Select the Font tab by clicking it.
4. Select the font type like **Times New Roman**. Other font formatting options like style, size, underline and colour are available and can be applied.
5. Click OK button to apply.

NB: Alternatively, use the formatting buttons in the Font group of the Home ribbon to apply the same format.

Formatting Numbers

To format numeric values in a worksheet, proceed as follows:

1. Highlight the cells that have the numbers to be formatted.
2. On the Home ribbon, click Format then Format Cells command.
3. Click the Number tab shown in the Figure 1.12.
4. Choose desired number formats explained in Table 1.1:

Number
General
Number
Currency
Accounting
Date
Time
Percentage
Text
Custom

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Fig. 1.12: Format cells dialog box

Table 1.1

	Meaning
Number	
General	Cells have no specific number format.
Number	Used for general display of numbers e.g. 2345.23.
Currency	For displaying monetary values e.g. $100, Ksh.10.
Accounting	Lines up the currency symbols and decimal points.
Date	Displays date in specified format.
Time	Displays time in specified format.
Percentage	Multiplies the value in a cell with 100 and displays it as percentage (%).
Text	Formats cells to be treated as text even when numbers are entered.
Custom	For a number format not predefined in Microsoft Excel, select custom then define a new format.

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Formatting borders

You may need to put a printable border around the worksheet or range of cells to make it more appealing. To put a border, proceed as follows:

1. Highlight the range you wish to insert *borders*. Select Format Cells command to display the Format Cells dialog box.
2. Click the Borders tab and specify the border options for left, right, top and bottom.
3. Select the type of line, colour and border style to be applied. Also select the presets options.
4. Click the OK button. The selected range will have a border around it.

Formatting rows and columns

Sometimes, data entered in a worksheet may not fit in the cell. Therefore, it becomes necessary to adjust the height of a row or the width of a column. The default width of a column in Microsoft Excel is 8.11 but can be adjusted to any size between 0 and 255. To change column width;

1. Move the mouse pointer to the border that separates column headers, for instance the border between A and B. Notice that the mouse pointer changes black cross with double-edged horizontal arrow.
2. Click the mouse button and hold it down so that you can now resize the width of the column by dragging to desired size. After dragging to the required size, release the mouse button.

To resize a column using the Format cells command, proceed as follows:

1. On the Home ribbon, click Format button then Column Width.
2. Type a width in the dialog box (Figure 1.13), and then click OK to apply.

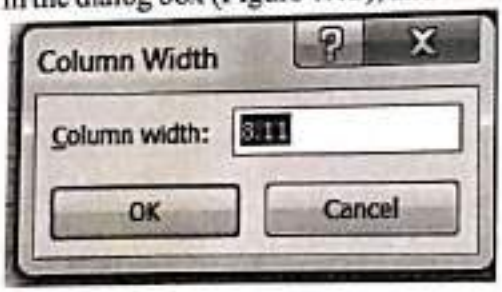

Fig. 1.13: Column width dialog box

To change row height, proceed as follows:

1. Point to the border that separates two row headers such as the border between row 1 and 2.
2. Once the arrow changes to black double-edged cross, drag to adjust the row height to desired size.

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Global worksheet formatting

The word *global* in this context refers to the entire worksheet. In order to format the whole worksheet, it must be selected as a whole. Two methods can be used to select the entire worksheet:

1. Clicking the triangular symbol at the intersection of column A and row 1
2. Pressing Ctrl + A on the keyboard.
3. Once the entire worksheet is selected, use the Format cells dialog box to format the content.

Using Autoformat command

Autoformat command allows the user to apply predefined format on selected range of cells.

To apply autoformat, proceed as follows:

1. Select a range, for instance B1:G7 to make it active.
2. On the Home ribbon, click the down arrow on **Format as Table** button in the Styles group.
3. Select a predefined format and to be applied to the selected cells in the worksheet as shown in Figure 1.14 below.

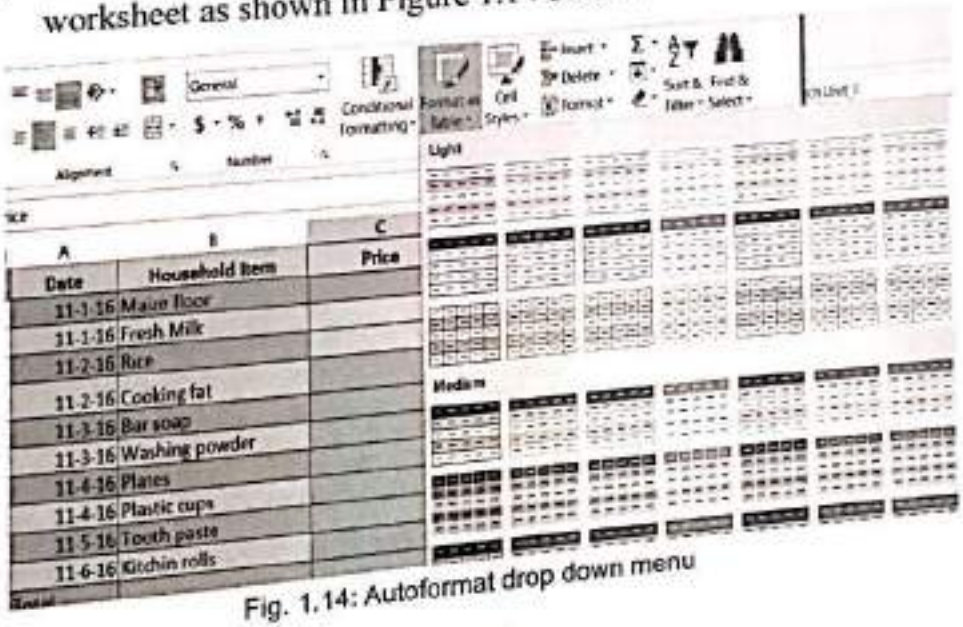

Fig. 1.14: Autoformat drop down menu

Formatting an entire workbook

Sometimes, it becomes necessary to apply the same format to the entire workbook. To achieve this, you must select all the worksheets then apply the desired options. Whatever is applied on the first worksheet will be reflected on all the other worksheets in the workbook.

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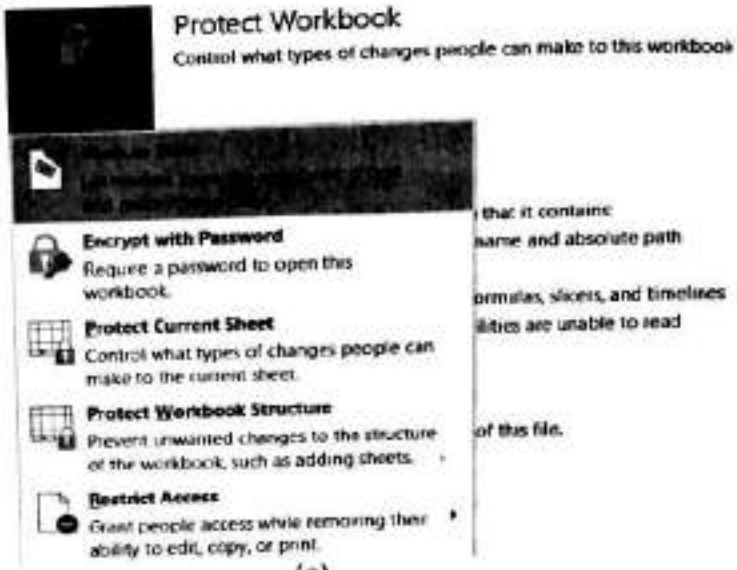
2. On the drop down menu, select **Mark as Final** option. A message indicates that the workbook will be marked as final appears as shown in Figure 1.16.



(a)

Fig. 1.16: Setting workbook as read-only

NB: If you select Restrict permission on the menu you must be connected to the internet in order to access Microsoft Rights Management Server. The server allows you to add or remove users authorized to access the protected workbook.

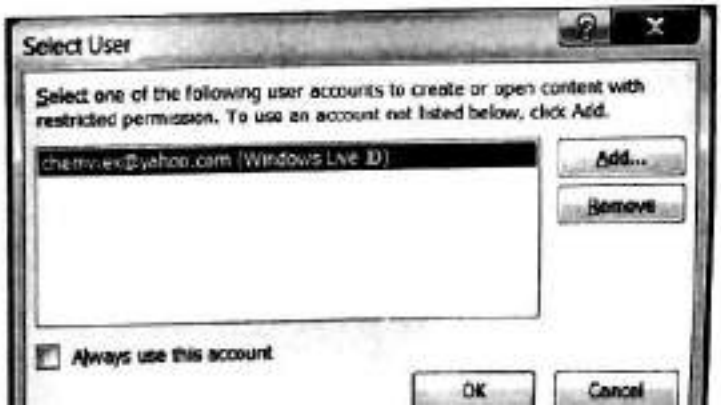


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Table 1.2		
	Keyboard key combination	***Function***
1.	CTRL + O	Open File
2.	CTRL + N	New File
3.	CTRL + S	Save File
4.	Esc	Exit current dialog
5.	CTRL + X	Cut selected text or object
6.	CTRL + C	Copy selected text or object
7.	CTRL + B	Bold selected text
8.	CTRL + I	Italicise selected text
9.	CTRL + U	Underline selected text
10.	CTRL + T	Insert Table
11.	CTRL + F4	Close current file
12.	ALT + F4	Close Excel
13.	CTRL + Z	Undo the most recent action
14.	CTRL + Y	Redo the most recent undone action
15.	CTRL + P	Print
16.	F4	Repeat the last action
17.	F1	Open online Help documentation
18.	CTRL + F1	Hide/unhide commands ribbon
19.	Shift + Arrow	Highlight cells
20.	CTRL + Space bar	Select current column

1.15 Freezing and unfreezing panes

When working with large worksheets that cannot fit on the screen, it becomes necessary to keep on scrolling. However, scrolling also moves the column or row headings of the screen making it difficult for the user to track what the data in a particular row or column stands for. You can freeze or lock the first row or column from scrolling with the rest of the rows or columns.

To freeze a pane:

1. Move the cell pointer into the cell you want to freeze rows above it or columns on its right e.g D7.

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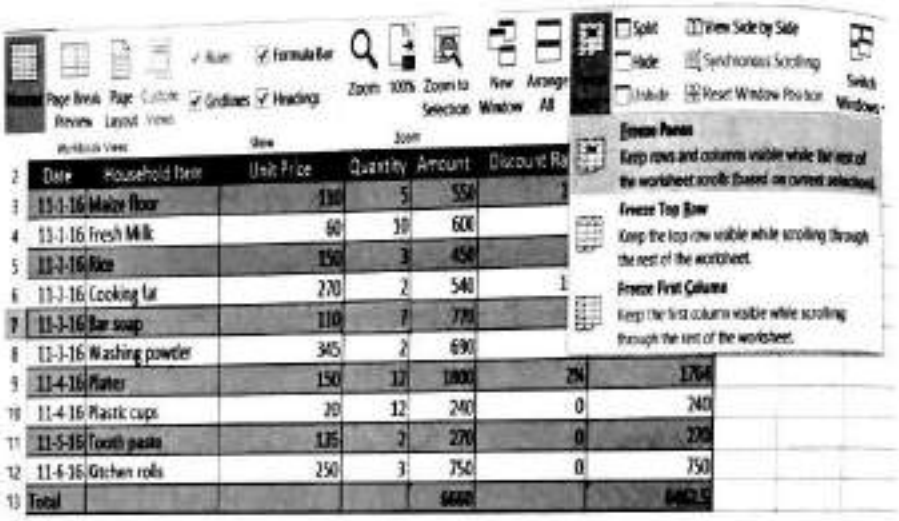
2. On the View ribbon in the **Window group**, click Freeze Panes as shown in Figure 1.18.
3. Scroll horizontally and vertically to view other parts of the worksheet while the frozen pane remains visible.



(b)

Fig. 1.18: Freezing panes

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Performing calculations on worksheet data involves selecting a range of cells or worksheet table. A range of cell is specified by name or the address of its top left and bottom right cells.

To select a range of contiguous cells, proceed as follows:

1. Click the top left cell of the range to be selected,
2. Hold down the Shift key, and then click the bottom right cell of the range. The range will be highlighted.

To select a range of non-contiguous cells, proceed as follows:

1. Click the top left cell of the range to be selected,
2. Hold down the Ctrl key, and then click individual cells columns or rows to be selected.

To create a named range of cells proceed as follows:

1. Select the range to be named.
2. Click inside the Name box, replace the cell address by typing a name for the range and then press Enter Key.

   Press the Enter key to apply. Figure 1.19 shows a range named **Foodstuff** that has values used in a formula to give the sum in cell D6.

Foodstuff | 01-11-2016

Foodstuff
Table1

	B	C	D	E	F	G
	Home Monthly Budget for Year 2015					
2	Date	Household Item	Unit Price	Quantity	Amount	Discount Rate	Amount Payable
3	11-1-16	Maize floor	110	5	550	10%	495
4	11-1-16	Fresh Milk	60	10	600	5%	570
5	11-2-16	Rice	150	3	450	5%	427.5
6	11-2-16	Cooking fat	270	2	540	10%	486
7	11-3-16	Bar soap	110	7	770	0	770
8	11-3-16	Washing powd	345	2	690	0	690
9	11-4-16	Plates	150	12	1800	2%	1764
10	11-4-16	Plastic cups	20	12	240	0	240
11	11-5-16	Tooth paste	135	2	270	0	270
12	11-6-16	Kitchen rolls	250	3	750	0	750
13	Total				6660		5462.5

Fig. 1.19: Named cell range

Creating formulae

A formula must start with an equals sign (=) while cell addresses are used as operands instead of values. Therefore, the three elements that make up a user-defined formula are the = sign, operands and operators. In the following section, we briefly discuss types of operators used to create formulae.

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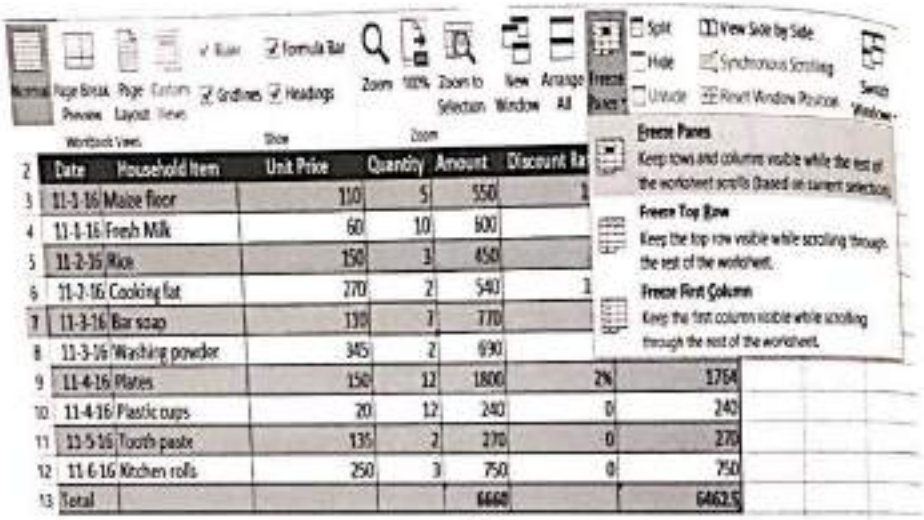
2. On the View ribbon in the Window group, click Freeze Panes as shown in Figure 1.18.
3. Scroll horizontally and vertically to view other parts of the worksheet while the frozen pane remains visible.



(b)

Fig. 1.18: Freezing panes

NB: You can also choose to freeze the first row or column instead of freezing a pane.

To unfreeze the pane:

1. Click the view tab to display its ribbon.
2. In the Window group, click Freeze panes, then select Unfreeze panes command.

Hide/unhide columns or rows

To hide or unhide columns or rows.

1. Select the columns or rows that you wish to hide.
2. On the Home ribbon, click Format in the Cells group.
3. Select the command to **hide** or **unhide** rows or columns.

1.16 Working with formulas and functions

A formula is a mathematical expression used to perform calculations while a function is an inbuilt or predefined formula. In Excel, a formula or function must start with equals sign (=).

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To select a range of contiguous cells, proceed as follows:

1. Click the top left cell of the range to be selected,
2. Hold down the Shift key, and then click the bottom right cell of the range. The range will be highlighted.

To select a range of non-contiguous cells, proceed as follows:

1. Click the top left cell of the range to be selected,
2. Hold down the Ctrl key, and then click individual cells columns or rows to be selected.

To create a named range of cells proceed as follows:

1. Select the range to be named.
2. Click inside the Name box, replace the cell address by typing a name for the range and then press Enter Key.

   Press the Enter key to apply. Figure 1.19 shows a range named **Foodstuff** that has values used in a formula to give the sum in cell D6.

Foodstuff | 01-11-2016

Foodstuff
Table1

	B	C	D	E	F	G
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2	Date	Household Item	Unit Price	Quantity	Amount	Discount Rate	Amount Payable
3	11-1-16	Matre floor	110	5	550	10%	495
4	11-1-16	Fresh Milk	60	10	600	5%	570
5	11-2-16	Rice	150	3	450	5%	427.5
6	11-2-16	Cooking fat	270	2	540	10%	486
7	11-3-16	Bar soap	110	7	770	0	770
8	11-3-16	Washing powd	345	2	690	0	690
9	11-4-16	Plates	150	12	1800	2%	1764
10	11-4-16	Plastic cups	20	12	240	0	240
11	11-5-16	Tooth paste	135	2	270	0	270
12	11-6-16	Kitchen rolls	250	3	750	0	750
13	Total				6660		6462.5

Fig. 1.19: Named cell range

Creating formulae

A formula must start with an equals sign (=) while cell addresses are used as operands instead of values. Therefore, the three elements that make up a user-defined formula are the = sign, operands and operators. In the following section, we briefly discuss types of operators used to create formulae.

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concept of BODMAS. This means that whatever is in parenthesis is evaluated first. Multiplication and division are evaluated from left to right while addition and subtraction are evaluated last.

Table 1.3

Symbol	Description	Example
/	Division	= A2/B2
*	Multiplication	= A2*B2
+	Addition	= A2+B2
–	Subtraction	= B2–A2

Relational operators

A relational operator returns either true or false depending on the absolute value of the operands being evaluated. Table 1.4 gives a summary of relational operators.

Table 1.4

Symbol	Description	Example
=	Equal to	= A2=B2
>	Greater than	= A2> B2
<	Less than	= A2< B2
<>	Not equal to	= B2<>A2
<=	Less than or equal to	= A2<= B2
>=	Greater than or equal to	= A2>= B2

Operator Precedence

If several operators are used in a formula, Microsoft Excel performs the operations in the order shown in Table 1.5. If a formula has operators of the same precedence like multiplication and division, the expression is evaluated from left to right. Enclosing part of the formula in parentheses alters the order of operation by making makes that part to be evaluated first.

1. -
2. %
2. ^
3. * and /
4. + and -
6. =, <>, >,

Creating user

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formulas:

1. = C2 + D4
2. = B4*0.2
3. = F5*1.2
4 = (G6/4)*

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Creating user-defined formulae

A user defined formula is created by the user to manipulate numeric data in the worksheet. First click the cell in which you wish to get the results of the formula then type the formula. The following are examples of user-defined formulas:

1. = C2 + D4	(Adds the contents of cells C2 and D4)
2. = B4*0.2	(displays 20% of the value in cell B4)
3. = F5*1.2	(increases the value in cell F5 by 20%)
4 = (G6/4)*5 + 6* (3-1)	(will be evaluted using precedence rule)

Using in-built functions

In Excel, a function must also start with an (=) sign followed by the *function name* and *arguments*. Arguments are cell addresses, numeric, logical or text values enclosed in parenthesis. For example, in = SUM (A3:F3), SUM is the function name while the range A3 to F3 is the argument.

In Excel 2013, functions are categorised according to the nature of calculations they perform. In this section, we discuss the following categories of in-built functions:

- Math & Trig
- Statistical
- Logical, and
- Date and Time

To use a function from any of these categories, proceed as follows:

1. On the Insert menu, click Function. Alternatively, click the ***fx*** button on the standard toolbar.

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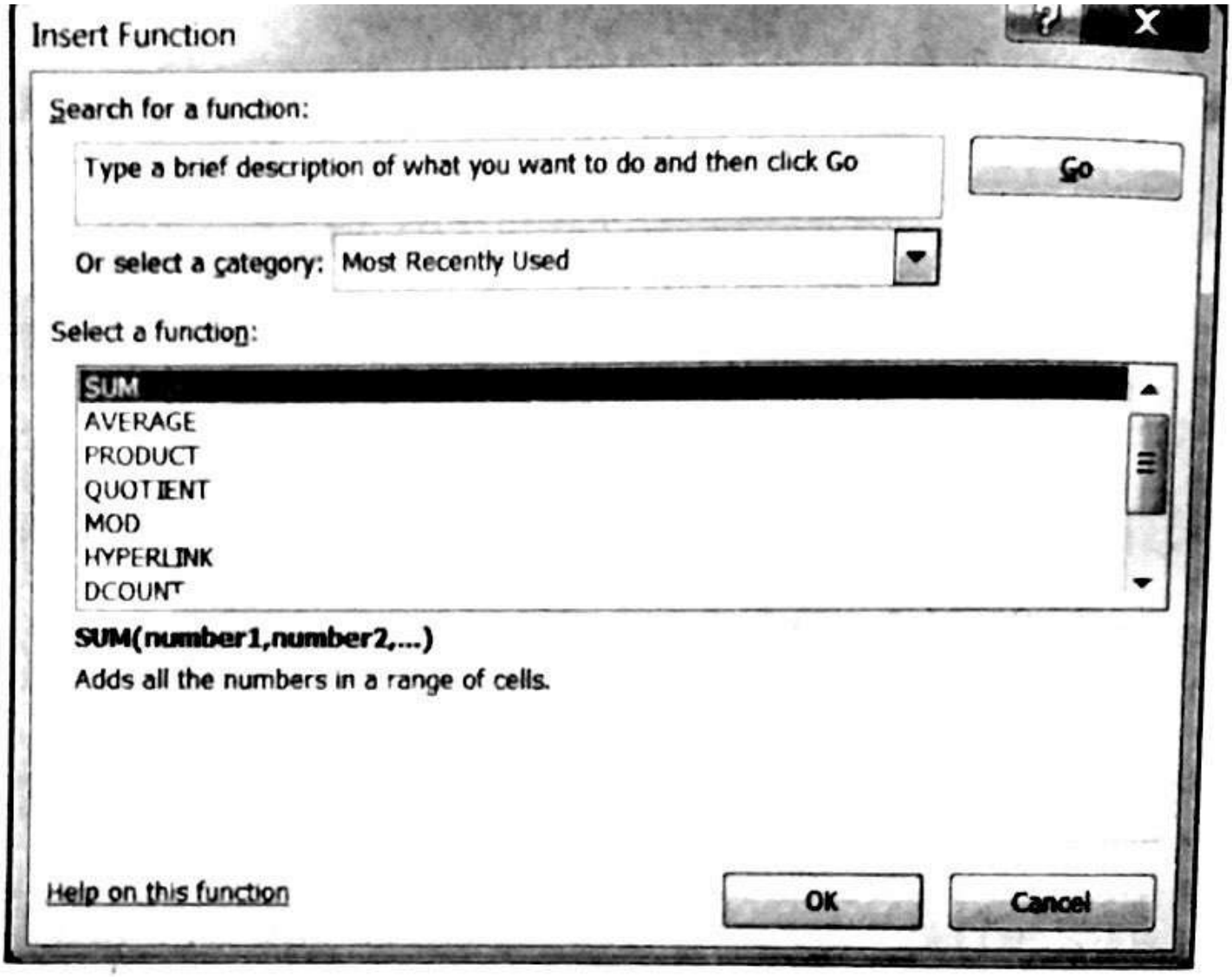

Fig. 1.20: Function dialog box

Trig functions

nym Math & Trig stands for Mathematics and Trigonometry. egory contains functions used to perform mathematical ons such as sum as well as trigonometric computations such as n angle.

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Statistical functions

The following are some of the commonly used statistical functions:

- *AVERAGE( ).* Returns the arithmetic mean of its arguments. For example, if A3, B3 and C3 contains 20, 50 and 80 respectively, =AVERAGE (A3:C3) returns 75.
- *COUNT( ).* Counts the number of cells that contain numeric values within a range. If a cell contains non-numeric value, it is ignored. For example, = COUNT (A3:C3) returns 3.
- *MAX( ).* Returns the largest number from a range of cells. For example, =MAX(A3:C3) in a range containing 20,35,80,68 and 79.
- *MIN( ).* Returns the smallest number from a range of cells. For example, =MIN(A3:C3) on 20, 35, 80, 68 and 79 returns 20 as the minimum value.

Logical functions

Logical functions return either true or false from an expression. Examples of logical functions include IF, COUNTIF, AND, OR, and NOT.

- *IF ( ).* Returns a value or a label if a condition you specify evaluates to TRUE and another if it evaluates to FALSE.

  For example, if C5 holds a mean score then if we wish to display a comment PASS if mean is greater than 50 or FAIL if otherwise then we can use IF(C5>50, "PASS", "FAIL"). Let us take another example. If A3, B3, C3, D3, and E3 contain a set of marks 35, 50, 80, 60 and 45 and grades are to be awarded as follows:

80 to 100	A
60 to 79	B
40 to 59	C
Below 40	Fail,

To assign a grade use,

=IF (A3>=80,"A", IF (A3>=60,"B", IF (A3>=40,"C","Fail")))

- *COUNTIF( ).* Counts the number of cells within a range that satisfies a certain criteria. For example, =COUNTIF(A1:D5,">50") returns the number of cells in the range that have a value greater than 50.
- *SUMIF( ).* Calculates the sum of values in a range of cells that satisfy a certain criteria. For example =SUMIF(A1:D5, ">1000") selects cells that have values greater than 1000 and calculate the sum.

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and Eng categories respectively.

- *AND( )*. Returns true if both expressions in a comma separated list of arguments evaluates to true. For example, =AND(3 + 2 = 5, 2 + 2 = 4) returns true.
- *OR( )*. Returns true if one of the expressions in the comma separated list of arguments evaluates to true. For example, =OR(3 + 2 = 7, 2 + 2 = 4) returns true.
- *NOT( )*. This is unary operator that reverses the value of a boolean expression from true to false and vice versa. For example, =NOT(3 + 2 = 5) returns false.

Date and Time functions

Some date and time functions include:

- *TODAY()*. Returns a number that represents today's date. This function takes no arguments. For example, by the time of writing this function, =TODAY( ) returned 07/02/2016.
- *NOW( )* Returns the current date and time formatted as date and time. It takes no arguments. For example,=NOW ( ) returned 07/12/2016 16:21 by the time of writing this book.
- *DATE ( )*. Returns a serial number that represents a particular date. Ms Excel uses year 1900 as serial number 1. For example, =DATE(107, 1, 4) returns January 4, 2007. Year = (1900 + 107), month =1, day = 4.
- *HOUR( ), MINUTE ( )* or *SECOND ( )* Functions return the current hour as number 0 to 23, minute from 0 to 59 and seconds from 0 to 59 respectively.

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Review Questions 1.4

1. Arithmetic operators include _____ , _____ , _____ , _____ while relational operators include _____ , _____ , _____ , _____ and _____.
2. A _____ returns the number of cells in a range that contains values.
3. The _____ logical function returns true if one of the arguments is true, while the _____ logical function returns true only if both arguments are true.
4. The _____ function returns a maximum value in a range of cells.
5. The _____ function returns the current date and time.
6. Differentiate between the following terms:
   (a) Formula and function.
   (b) Relative, and absolute cell referencing.
   (c) Relational, and arithmetic operators.
   (d) DATE( ) and TODAY( ) functions.
7. The formula $A1 + B$1 was entered in cell C1. How would the formula appear if copied to F2?
8. Explain the arithmetic operator precedence.
9. Describe two ways of protecting a worksheet or workbook.
10. Why do we need to freeze panes?
11. Describe the process of setting a password to protect a workbook from unauthorised access.
12. How would you increase the value 50 by 30% in Excel worksheet?
13. Describe the procedure for specifying list of users who can open, modify, copy or print a protected worksheet

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Practical Activity 1.2

The Dean of Studies of St Cecilia Secondary school has requested you to prepar the worksheet shown in Figure 1.21.

B12 fx Average

	A	B	C	D	E	F	G	H	I	J
1				ST JOSEPH SECONDARY SCHOOL						
2				TERM ONE MATHEMATICS AND SCIENCES TOTAL MARKS AND AVERAGE						
3										
4	REG NO	NAME	MATHS	PHYSICS	CHEMISTRY	BIOLOGY	TOTAL	AVERAGE	MODERATED	POSITION
5	234	Monica Tiwonge	96	65	66	78	305	76.25	80.75	
6	334	Sam Chimango	78	95	66	60	299	74.75	79.25	
7	445	Christy Wema	89	73	65	66	293	73.25	77.75	
8	123	James thembiso	56	55	90	49	250	62.5	67	
9	128	Ruth Tafadzwa	52	34	45	80	211	52.75	57.25	
10	768	Bernard Ngema	43	40	82	66	231	57.75	62.25	
11										
12		Average	68	60.33	69	66.5				
13										

Fig. 1.21: Worksheet list

Create a workbook **Final Exam** and enter the above data into a worksheet. Centre the titles across columns, 18 pts Georgia bold and apply grey shading to the totals column.

1. Calculate total and mean score marks for each student.
2. Find the minimum and maximum average mark from the class.
3. Assuming that each student's average score is to be raised by adding 3 marks, perform the following:
   (a) Enter a value 3 in an empty cell below the worksheet.
   (b) Using the cell containing value 3, calculate moderated average score for each student.
   (c) Round off the moderated mark for each student to an integer.
   (d) Insert a column named GRADE between ROUNDED and POSITION.
4. Using the grading system given below, assign grades based on the moderated mark.

80 – 100	A	70 – 79	B
60 – 69	C	50 – 59	D
40 – 49	E	Below 40	Fail

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Page setup

Page setup refers to the way page margins, orientation, size and other page oriented features are applied to the page. These options can be changed and applied using the Page Setup commands found on the Page Layout tab.

Print preview

Print preview displays the worksheet, chart or selected range exactly the way it would look like when printed.

To print a worksheet, chart or selected range, proceed as follows:

1. On the File tab, click Print to display the Print Window.
2. The worksheet will be displayed in the print preview window with the print properties displayed on the left pane.
3. To make any page adjustments to the document, click the Page Setup hyperlink and do the following:
   (a) Click the Page tab to set page orientation, scaling and paper size
   (b) Click the Margins tab to specify the page
   (c) Click Header/Footer to insert headers and footers on each printed page
   (d) Use the Sheet tab to set up options such as print column and row headers, gridlines and order in which multiple sheets are to be printed. Figure 1.22 shows Sheet setup options that you can apply before printing.

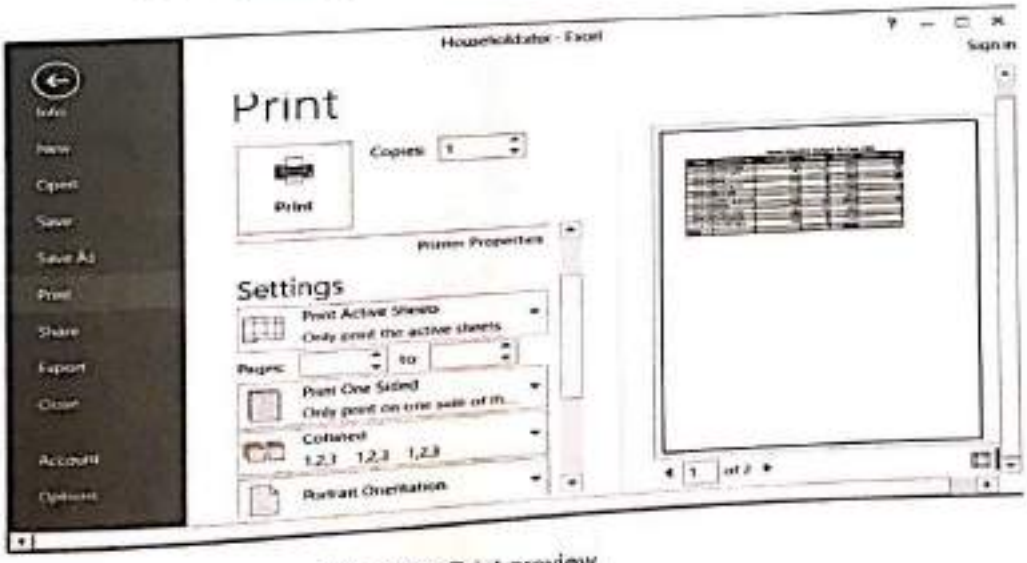

Fig. 1.22: Print preview

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2. Under Printer, clickk the down arrow to select the printer that will be used to print the worksheet. All the printers that are installed on the computer will be displayed.

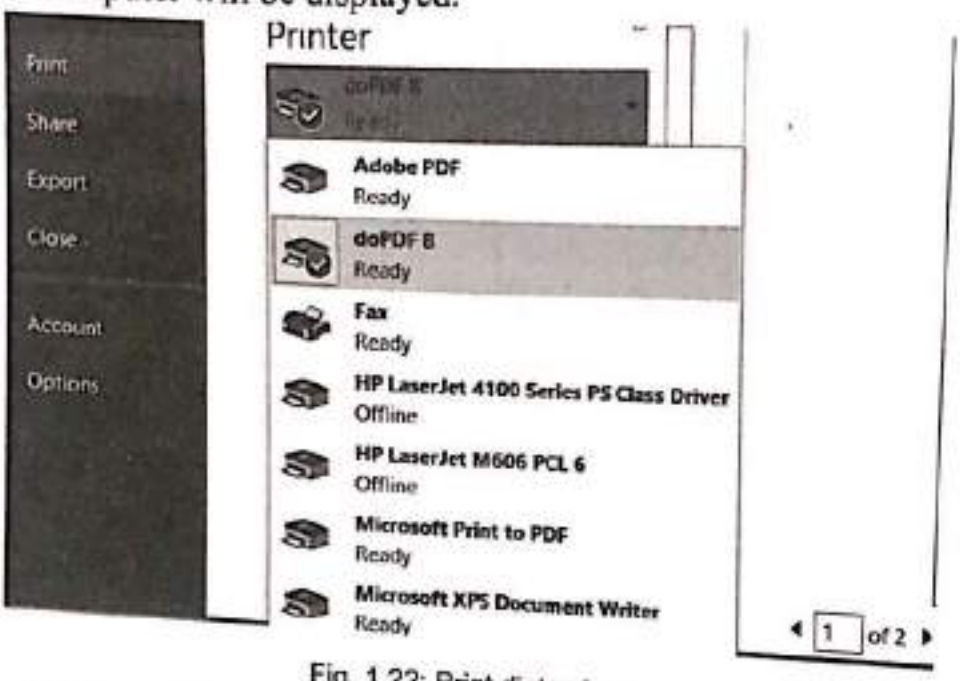

Fig. 1.22: Print dialog box

3. Under settings, specify the worksheet to be printed, pages, orientation, paper size, margins and scaling.
4. Finally, click the print button to send the print job to the printer.

Review Questions 1.5

1. How can you print a chart that is embedded on a worksheet without printing cell entries?
2. Differentiate between printing a worksheet and a workbook
3. Apart from a worksheet and workbook, what else can you print in a spreadheet?

Practical Activity 1.3

1. Open the **Bluechip** workbook and print the column/bar graph and a section of the worksheet.
2. Open **FinalExam** and print the worksheet.

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Revision Exercise 1

1. A _____ accepts user data in rows and columns and allows the user to manipulate the data mathematically.
2. A _____ is an intersection between a row and a column.
3. A _____ shows the position of the current cell in the worksheet.
4. Components of a spreadsheet program include a _____ , _____ and _____.
5. A spreadsheet entry may be classified as either a _____, _____, _____ or _____ .
6. The _____ is a feature in spreadsheets that facilitates entry of data and formulae in the active cell.
7. The _____ functions calculates the sum of the range A1 to C6.
8. The function =MAX(A1:F10) can be made absolute by typing it as _____.
9. Formatting a number as _____ makes it to be handled as a label in Excel.
10. _____ panes makes some rows and columns to be locked against scrolling while _____ columns makes the affected columns to be hidden from user view on the screen.
11. Describe two ways of completing data entry into a cell.
12. How does Microsoft Excel determine that an entry is a formula?
13. Outline the procedure for clearing contents of a cell.
14. Explain how you would copy a formula using absolute cell referencing.
15. Explain how you would print a worksheet in landscape orientation.
16. Outline the steps you would follow to insert rows in Excel worksheet.
17. Differentiate between copying and moving data in a worksheet.
18. Explain the importance of Autoformat command.
19. Explain the term filter. How is a filter different from hide command?
20. Why are forms important in Microsoft Excel.
21. Give two examples of charts available in Excel.
22. Define the term chart as used in spreadsheets.
23. Explain the concept of subtotals.
24. Explain three types of number formats available in Microsoft Excel.
26. Explain two ways of changing the font size in Microsoft Excel.

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By the end of this unit, you must be able to:

- ***Install an operating system, device drivers and application software***
- ***Upgrade an operating system, device drive drivers and application software worksheet***

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2 SOFTWARE INSTALLATION

Chapter Outline

2.1 *Introduction*
2.2 *Fundamentals of Software Installation*
2.3 *Installing an Operating System*
2.4 *Installing Ubuntu Version 14*
2.5 *Installing drivers and application*
2.6 *Installing application software*

2.1 Introduction

Having learnt about various computer hardware devices and software, it is important to have some basic skills on how to install computer software. In this chapter, we discuss how to install computer software starting with operating systems. Later, we demonstrate how to install device drivers and application programs.

2.2 Fundamentals of Software installation

Software installation, also referred to as program setup refers to copying a program into computer storage in a form that it can be executed. The number of computer programs installed on a computer is only limited to its processing power and available disk space. Today, most GUI-based software installations are wizard driven hence requires minimal input from the user. Common operations performed during software installation process include creation or modification of program folders and subfolders, configuration of Windows registry as well as copying of files, environment variables and shortcut icons.

Factors to consider before software installation

Before installing any software whether an operating system, device drivers or application software, you need to consider the following:

1. System configuration particularly the type and speed of the processor, amount of RAM and hard disk space.
2. Reading the installation manual to get details on the minimum system requirements, warnings and user license agreement.
3. Identify the software that will meet specific user needs to avoid installing unnecessary software that end up taking valuable storage space.

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Having considered specific system software, drivers, utility programs and application programs to be installed, you can proceed with the installation process starting with the operating system. In the following section, we demonstrate how to install proprietary and open source operating systems.

2.3 Installing an Operating System

Before installing an operating system, read the manual, provided on the Internet or in the CD/DVD disk that comes with the operating system. The manual contains details on the minimum hardware requirements a computer must meet.

Installing Windows operating systems has largely become a wizard driven process. Microsoft has moved from FAT32-based used in earlier operating systems such as Windows 98 and Me to NTFS file systems. In this section, we provide the procedure for installing Windows 7; an NTFS-based operating system from Microsoft.

NB: For installation details of later versions of Microsoft Windows or other operating systems such as Macintosh and Linux, read the installation guide that come with the operating system.

Installing Microsoft Windows 7

The process of installing Windows 7 is not different from earlier versions of Windows. The two methods of installing Windows 7 are upgrading from a previous versions, and fresh installation. In particular, installing Windows 7 afresh is performed by first creating and formatting a primary partition before the installation process starts. However, upgrading from a previous Windows version is relatively simple. Once you insert a DVD into the optical drive, the computer initialises the DVD and displays a screen prompting the user to select configuration options. If you choose upgrade, the rest of the process is managed by the installation wizard.

To install a fresh copy of Windows 7, the computer should be setup to boot from DVD. Once the computer has been setup to boot from DVD, proceed as follows:

1. Insert Windows 7 DVD into the optical drive and start the computer. After the power on self-test (POST) the computer initialises the boot process. After a few seconds Windows 7 installation screen shown in Figure 2.1 is displayed. Select the preferred language and set the Time Zone. In our case, choose Central Africa Time (CAT) zone.

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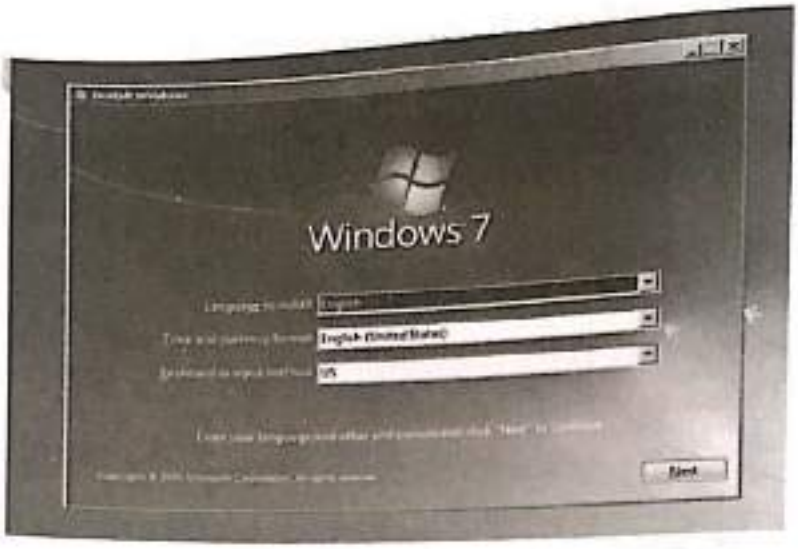

Fig. 2.1: INstalling Windows 7

2. After clicking Install Now, a screen that contains the license terms is displayed. Read Microsoft User-licence agreement terms and then click the box against "I accept the license terms" shown in Figure 2.2.

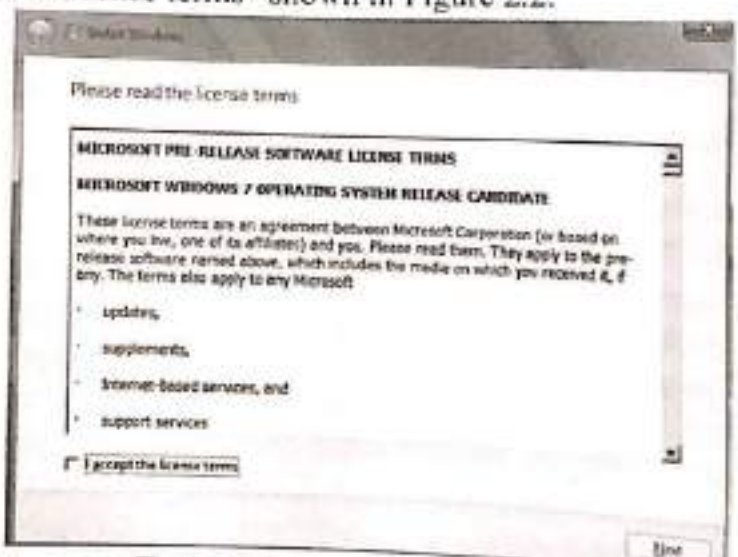

Fig. 2.2: Windows 7 License Agreement

3. To install Windows afresh, in the next dialog box displayed, click Custom (advanced) as shown in Figure 2.3.

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Where do you want to install Windows?

Name	Total Size	Free Space	Type
Disk 0 Partition 1: System Reserved	100.0 MB	86.0 MB	System
Disk 0 Partition 2	13.6 GB	13.6 GB	Primary
Disk 0 Unallocated Space	6.3 GB	6.3 GB	

Refresh Delete Format New

Load Driver Extend

Next

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6. After the copy process is complete, you will be prompted to enter the such as username, password and the product licence key. You must enter the license key that came with the product to install a genuine copy of Windows 7!

7. Follow the Windows 7 installation process, providing necessary information required to continue. This process is generally wizard driven and only requires minimal interactions where necessary.

8. Once Windows 7 is successfully installed, connect to the Internet to install important updates or skip the update procedure and enter the password to login to the desktop as shown in Figure 2.6.

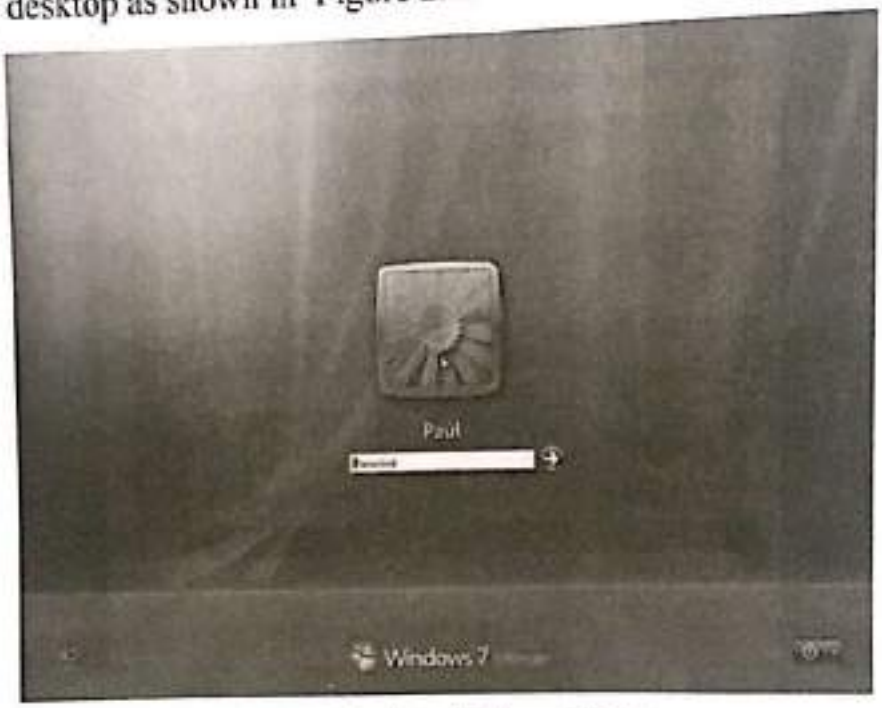

Figure 2.6: Login to Windows 7 Desktop

NB: One of the major steps in windows upgrade is using the same license to migrate from Windows 7 or 8 to current Windows 10. Take the opportunity provided free of charge by Microsoft.

Configuring Windows 7

Apart from working with files, folders and drives, Windows 7 provides the user with tools that can be used to customise the desktop. Such features include arranging multiple windows on the desktop, changing desktop background, setting screen resolutions, hiding the taskbar among other things. In this sub-section, we discuss some of the basic Windows 7 configuration options.

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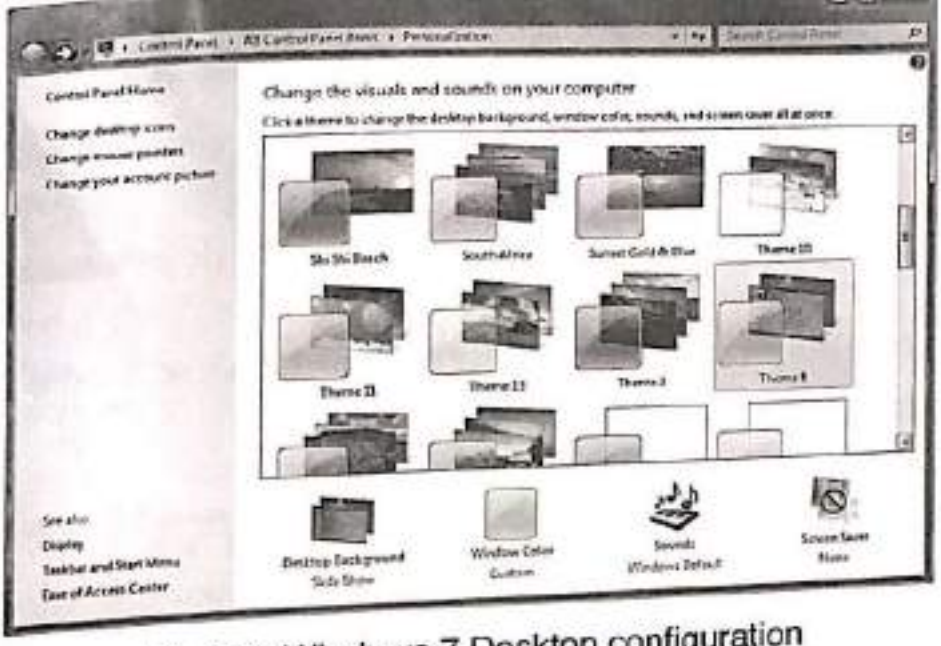

Fig. 2.7: Windows 7 Desktop configuration

Setting Theme and Background

To apply a new Theme or wallpaper, proceed as follows:

1. Make sure you are in **Change the visuals and sounds..** window
2. Inside the window, scroll down the list of **Themes** and select desired theme.
3. To change desktop background, click the **Background** icon at the bottom left. Select preferred background from displayed list.
4. Save the new theme and background changes before you close the dialog box.

Setting the screen saver

If the screen saver is set, moving patterns or objects are displayed on the screen if the computer is left idle for a period of time. To set a screen saver, proceed as follows:

1. In the Personalization window, click the **Screen Saver** icon at the bottom right side.
2. In the screen saver dialog box, select a Screen saver from the Screen saver list.
3. Set the wait time e.g. 10 minutes and click **On resume, display logon screen**.

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Buttons | Pointers | Pointer Options | Hardware

Button configuration

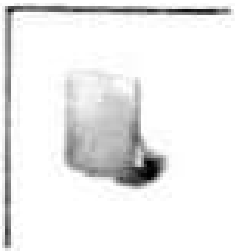
☐ Switch primary and secondary buttons

Select this check box to make the button on the right the one you use for primary functions such as selecting and dragging

Double-click speed

Double-click the folder to test your setting. If the folder does not open or close, try using a slower setting.

Speed: Slow ——— Fast



ClickLock

☐ Turn on ClickLock

Settings...

Enables you to highlight or drag without holding down the mouse button. To set, briefly press the mouse button. To release, click the mouse button again.

OK | Cancel | Apply

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3. On the colour list box, select colour quality.
4. Click Apply to view the changes before you close the dialog box.
5. Click OK to close the dialog box.

Hiding the Taskbar

To hide the taskbar, proceed as follows:

1. Right-click the Taskbar, and then click Properties.
2. Make sure the Taskbar tab is selected, then select **Auto-hide the taskbar** check box.
3. Click **Apply**, and then OK to close the dialog box.

Setting date and time

Setting system date and time is very important because some system tasks such as the scheduler depends on date and time to run.

To set date and time:

1. Click the Start button and point to the Control Panel. Alternatively click the Clock in system tray, then click **Change date and time settings**
2. In the control panel, click Date and Time. A dialog box shown in Figure 2.9 is displayed.
3. Change time and date or time zone settings. After making necessary changes click Apply, an then OK to close the dialog box.

Fig. 2.9: Time and Date settings

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Review Questions 2.1

1. Differentiate between theme and wall paper.
2. Explain why it is important to set display colours and screen resolution.
3. Explain the importance of screen saver.
4. Explain what you can achieve by using appearance tab in display properties dialog box.

Practical Activity 2.1

In Windows 7, configure the following desktop properties. In each case, outline the steps followed to carry out the task:

1. Change the current theme on the desktop to a theme of your choice for example Windows Classic.
2. Set screen saver to 3D text bearing the name of the school.
3. Desktop wallpaper should bear the picture of your school or any other favourite picture.
4. Hide the taskbar and the clock.

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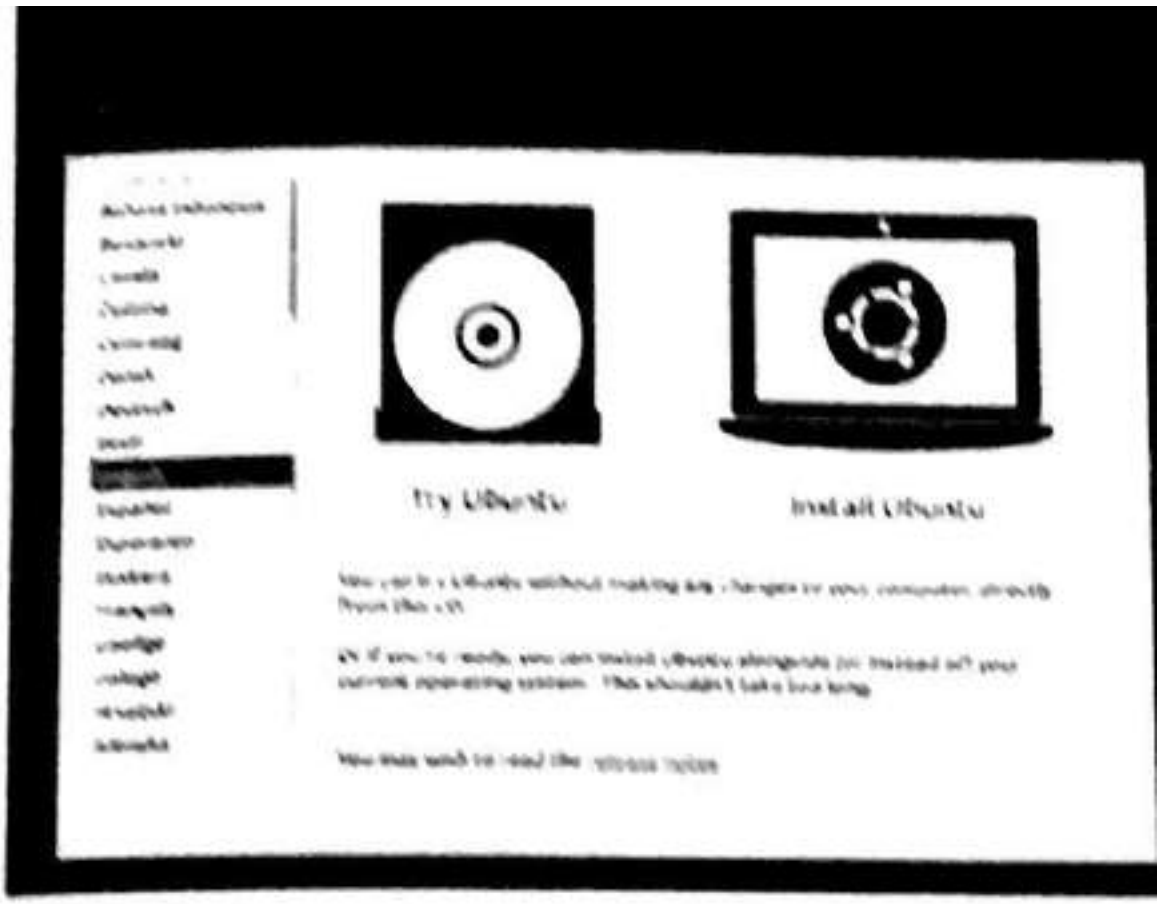

Fig. 2.10: Ubuntu Welcome Screen

NB: If the computer does not automatically display this scree
display the boot menu, but be careful not to hold it down.

2. If internet is available, connect the computer to the netv
gets the latest updates while installing. Figure 2.11 shows t
from which you can choose the type of internet connect
LAN. If you do not want to setup internet connectivity
button.

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3. On the displayed dialog box of Figure 2.12, select the type of installation. In this case, install Ubuntu alongside Microsoft Windows 7 operating system. This means that Ubuntu will be installed as a duo-boot option in Windows.

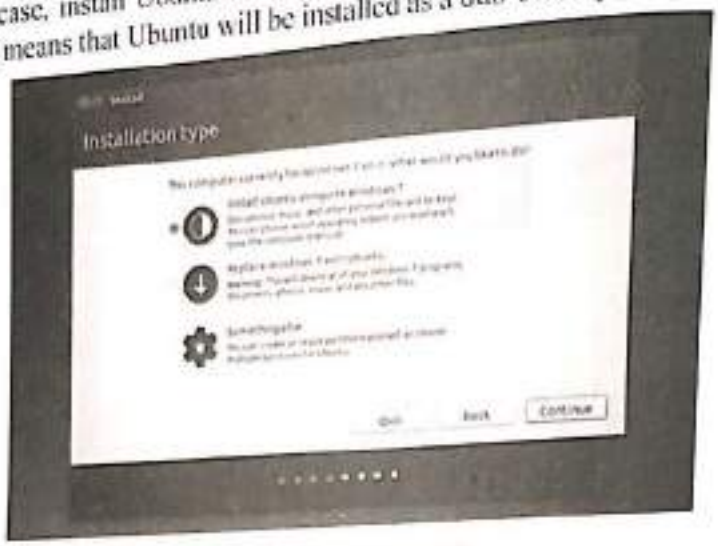

Fig. 2.12: Installing type window

4 Depending on the type of installation selected, verify that you have chosen the way in which you would like to install Ubuntu, and then click Continue button.

5 On the displayed dialog box (Fig. 2.13), click **Install Now** button. The installation process will begin when you click the Install Now button. Note that Ubuntu 14 requires about 4.8 GB to install, so add a few extra storage to allow for extra files. The rest of the process is automated.

Fig. 2.13: Installing Ubuntu alongside windows

6. The next screen that pops-up (Figure 2.14) is for you to set the location so that Ubuntu sets the correct time zone. For example Malawi uses Central Africa Time Zone that is (UTC+02:00). UTC stands for Universal Time Zone that

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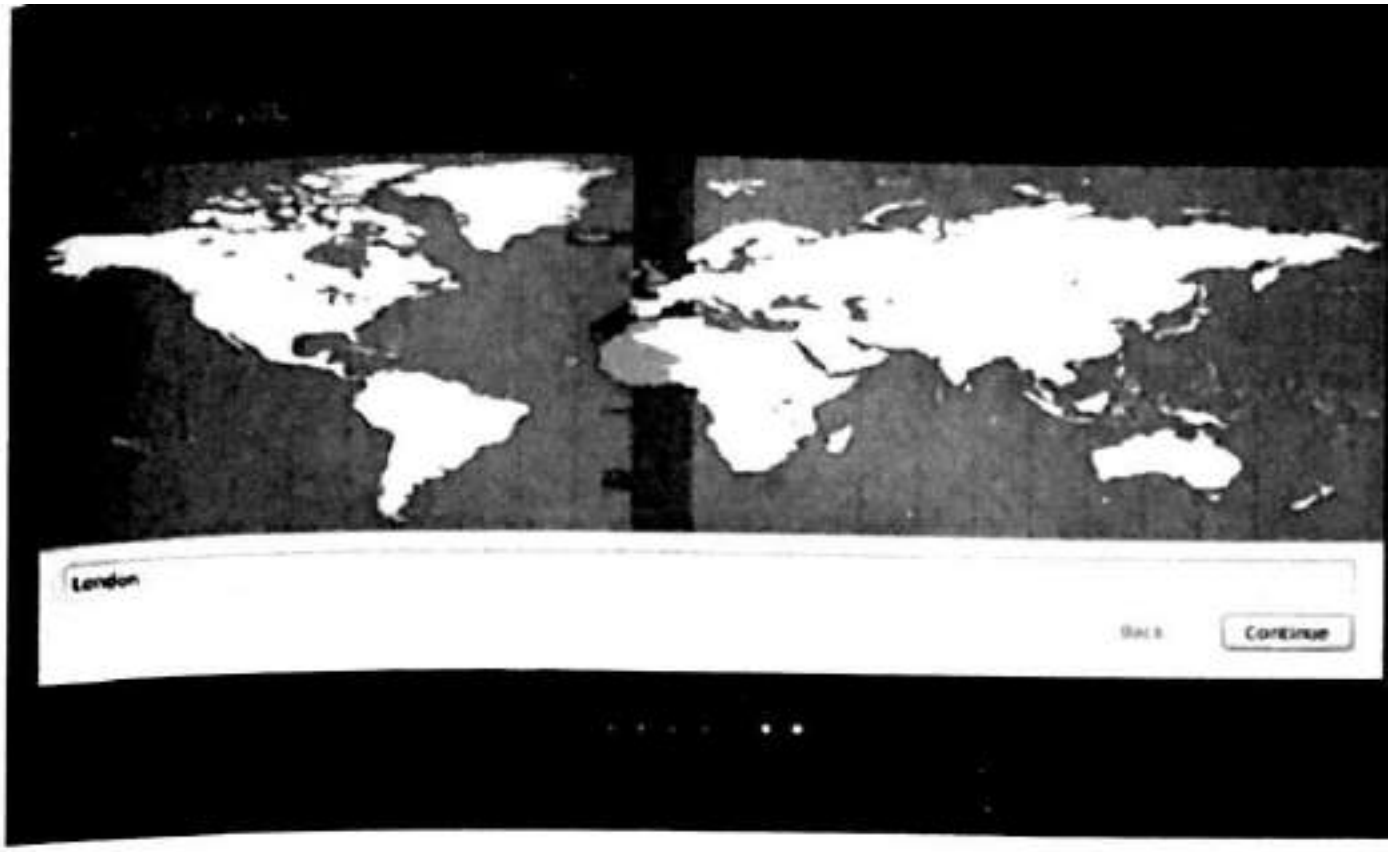
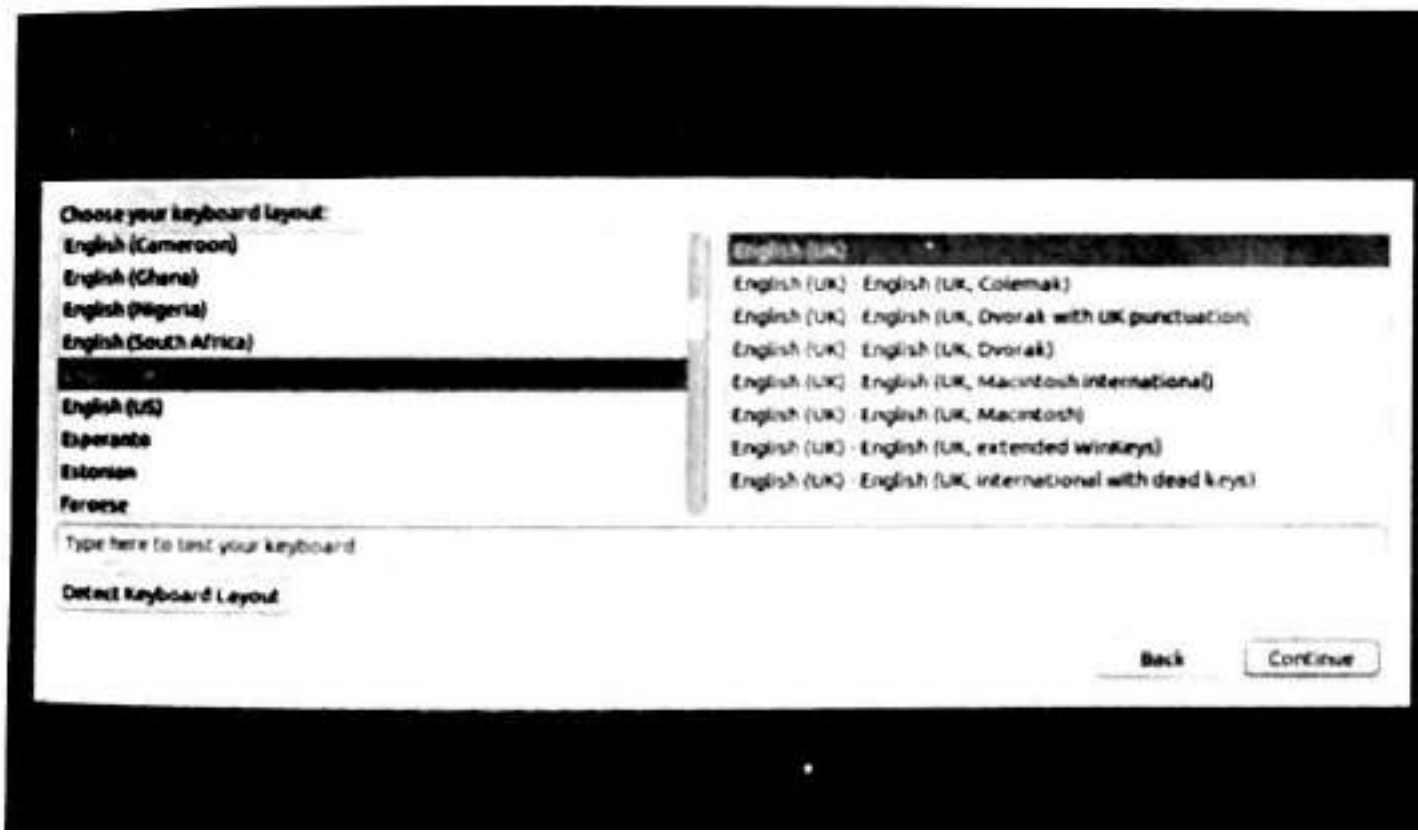


Fig. 2.14: Setting Location Setup

7. On keyboard layout screen shown in Figure 2.15, select preferre layout and language. In Malawi, the default layout is English UK also choose any other layout. Click Continue to proceed.



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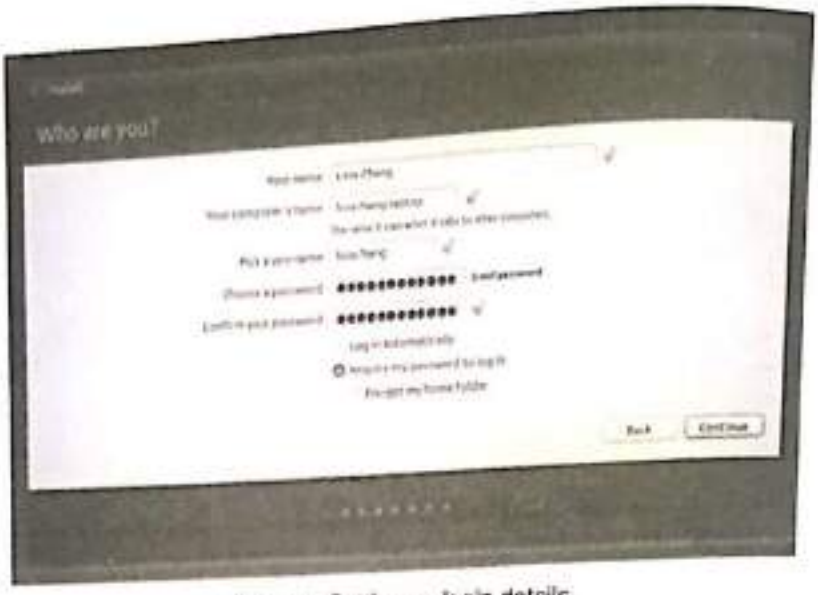

Fig. 2.16: Setting up login details

9. The rest of installation process continues without need for interaction displaying tips on how to make use of Ubuntu as shown in Figure 2.17. Learn more about Ubuntu while the system installs.

Fig. 2.17: Ubuntu Installation going on

10. Once the installation process is complete, click **Start Now** to restart the computer. During startup, a start up screen is displayed that lets a user boot from Windows or Ubuntu. Boot from Ubuntu to start enjoying Ubuntu – *The True African spirit of Humanity to All!*

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whether it has the recommended hardware, operating system and device drivers. If the computer passes the test, the relevant program files are copied into the target hard disk. However, some programs are designed to be installed simply by copying and pasting their files to the desired location, and there is no formal installation process. This was the case with the earlier versions that ran on command-line operating systems. In the following section, we describe how to install device drivers in Windows 7.

Installing Device drivers in Windows 7

Once you install Windows 7 regarded as the environment, you can now proceed installing the device drivers and other utility software such as antivirus software. A device driver is a utility program that controls a device installed in a computer. For a device such as a printer, a keyboard, a flash disk, a mouse and or a scanner to work; its drivers must be installed first. In a nutshell, a device driver acts as a translator between the device and programs that use the device. Each device has its own set of specialised commands that only its driver knows. Common devices such as the keyboards, mouse, monitor and flash disks are automatically recognised by most operating systems through a process known as *Plug and Play* (PnP).

Microsoft Windows 7 has a profile that contains pre-loaded device drivers of popular devices such as printers and memory cards. For new devices, you may need to setup the device using drivers that came with the device. In case the device is certified by Microsoft, the device drivers come pre-loaded in the latest Windows version or updates. If the device drivers are not available, you have to download or use the CD/DVD that came with the device. Windows automatically runs the disk and shows a list of installation options.

In Windows 7, there are many ways of installing the drivers but the most common is through an installation wizard. For example, to install printer drivers, proceed as follows:

1. If the printer drivers are not in Windows, insert the media that came with the printer. Figure 2.18 shows examples of printer drivers that are pre-loaded in Windows 7.

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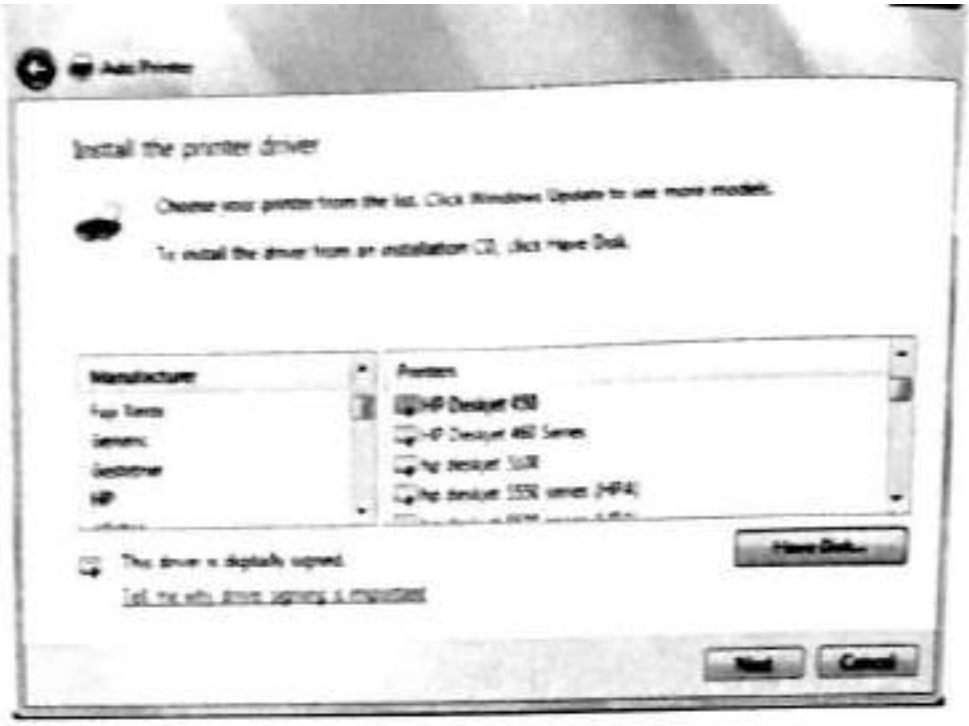
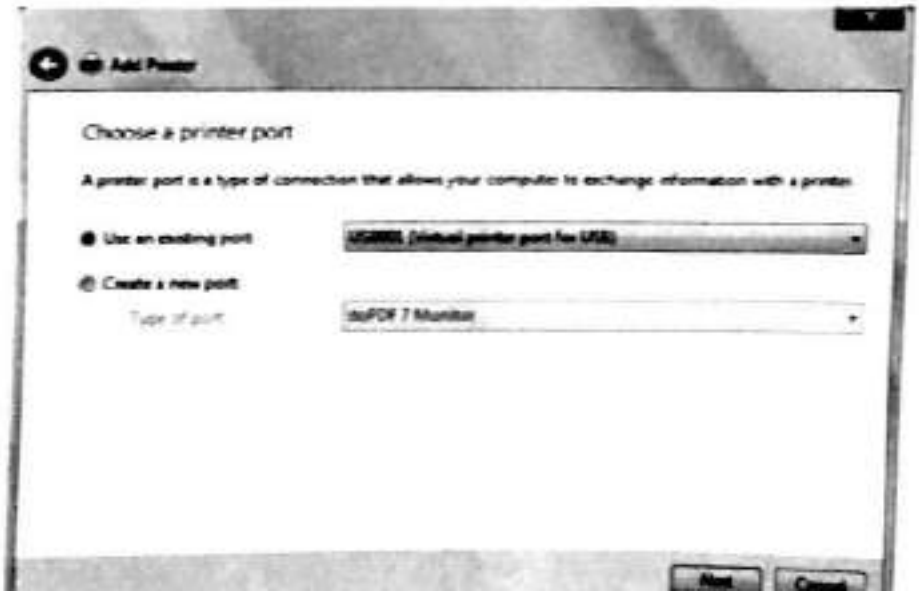


Fig. 2.18: Installing printer drivers

2. After verifying that the drivers are available in Windows 7, click Devices and Printers on the start menu.
3. In Devices and Printers window displayed, click Add Printer, and then Add local printer. Click Next to proceed
4. Under choose printer port, specify the port through which the printer will be connected as shown in Figure 2.19. This is very important because specifying a wrong port e.g. LPT1 instead of USB means the printer will not work!



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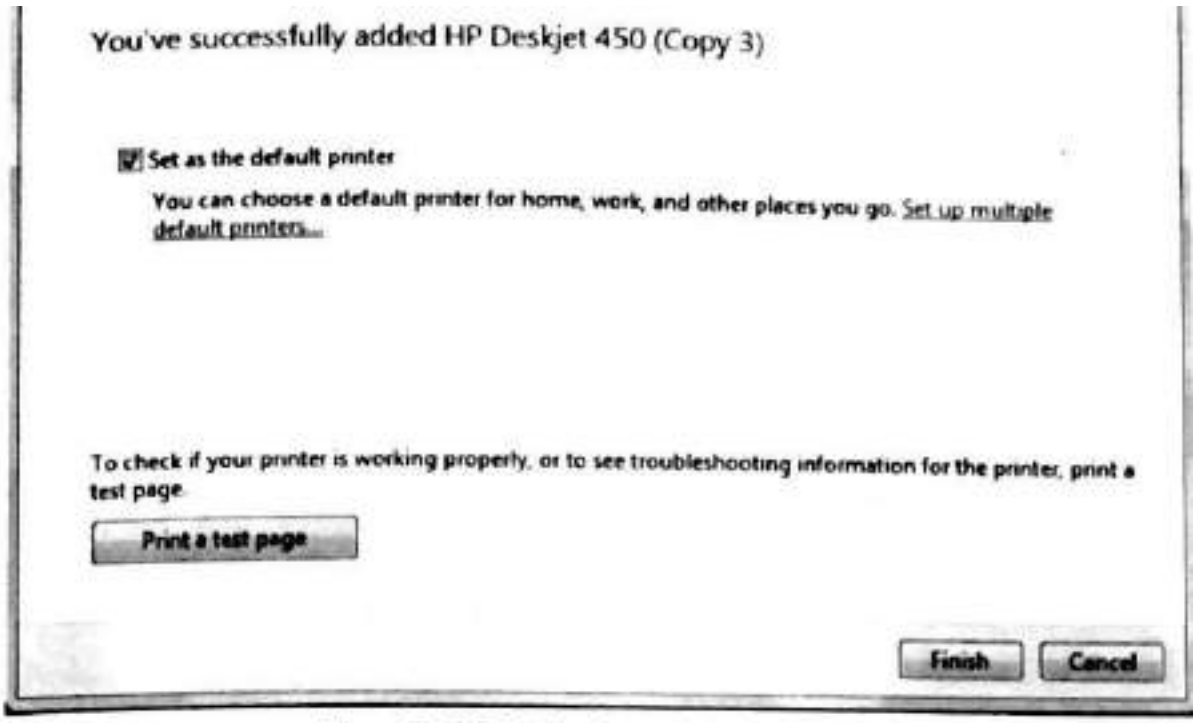

Fig. 2.20: Testing the printer

NB: For device driver installation process to be complet required to restart the computer. Make sure you save an before you click the restart button or alert.

2.5 Installing Application software

Installation of application software is only limited t configuration, operating system and license agreement. In can install thousands of application software but the mos

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General purpose application software

General purpose application software such as word processors, spreadsheets database and presentation software are packaged and made available for general use. Such programs are available mostly used to perform various tasks such as word processing, graphic editing, presentation and web development.

Special purpose application software

Specialised applications are application programs purposely designed to handle specialised tasks such as Desktop Publishing Software (DTPs), graphics editing software or presentation. Unlike general purpose software, these types of software can be used to perform dedicated tasks such as graphics design, video editing and financial accounting.

Installing Microsoft Office 2010

Since it is not possible to demonstrate how to install wide variety of application software, in this section we demonstrate how to install Microsoft Office 2010. Generally, installation of most application programs in Windows is the same. Therefore, with the knowledge you gain in this section, you can easily install other programs.

To install Microsoft Office 2010 suite, proceed as follows:

1. Insert the Microsoft Office 2010 DVD into the optical drive. Microsoft License agreement is displayed. To proceed, read the agreement and click the check box "I accept the terms of this agreement" as shown in Figure 2.21.

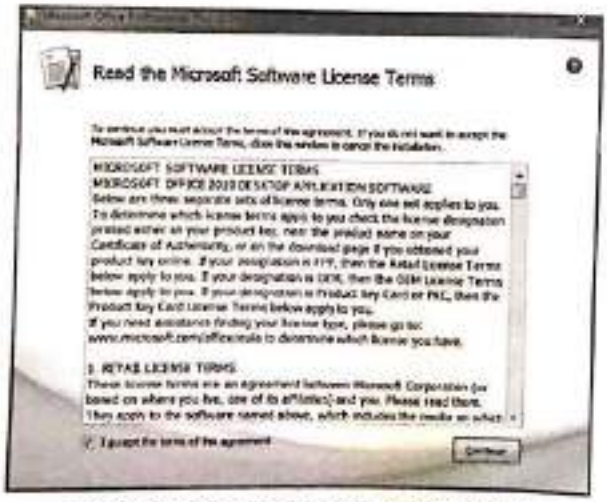

Fig. 2.21: Office 2010 License Agreement

2. Carefully read and agree to Microsoft agreement terms. The installation dialog box shown in Figure 2.22 is displayed to choose whether to upgrade an existing version.

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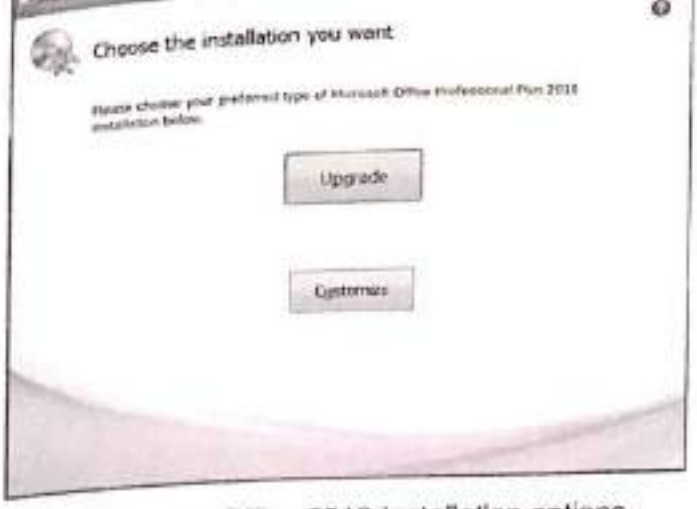

Figure 2.22: Office 2010 Installation options

3. Once you are prompted to provide the license, enter the product key provided at the back of the DVD casing that came with the software. Avoid installing a pirated copy!
4. To install office afresh, click the customize button and make sure the radio button *"Remove all previous versions"* is selected as shown in Figure 2.23. If you decide to keep previous copies, select the second option then click continue.

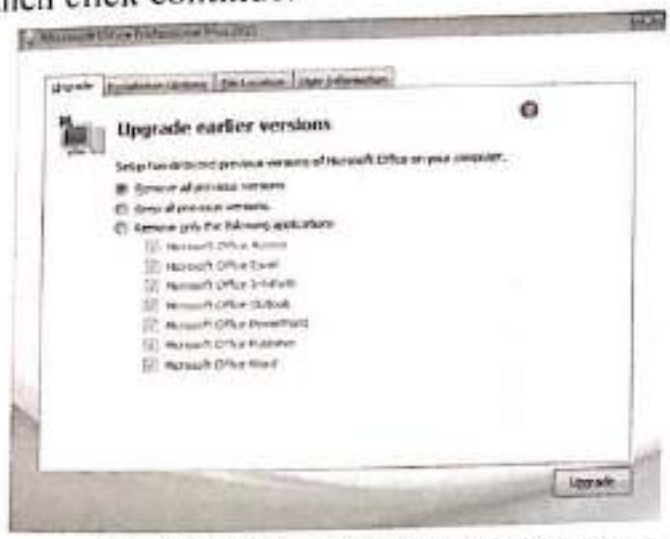

Fig. 2.23: Office 2010 License Agreement

5. After choosing the installation option, click Upgrade or Install Now to proceed. The rest of the process is wizard driven.
6. The installation process Figure 2.34 will take several minutes depending on the options selected and the computer hardware configuration. Once the installation is completed, you may be required to check for updates. If connected to Internet, ensure the "check web for updates checkbox" is enabled otherwise click Close.

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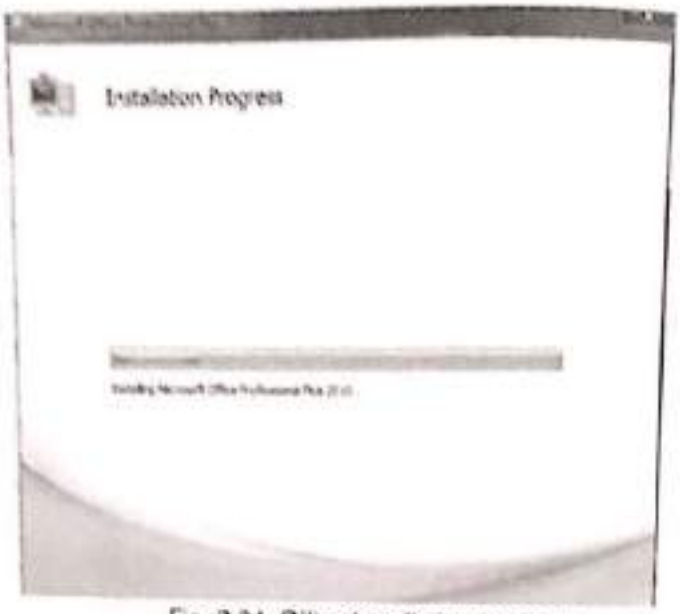

Fig. 2.24: Office Installation progress

7. After the installation progress is completed, you may be prompted to register and activate the product for online updates. This process ensures that you have a genuine copy of Microsoft Office.
8. To confirm that Office 2010 has been installed, display the Start menu and then point to All Programs/Programs. The list of applications including newly installed is displayed on the start menu.

NB: The steps outlined are specific to Microsoft Office 2010 and may vary depending on the version of Microsoft office and type of user license.

Revision Exercise 2

1. Explain the importance of reading the user manual before installing new software.
2. Outline the procedure you would follow to install the following software:
   (a) An operating system such as Windows 7 or 8.
   (b) Device drivers for a scanner.
3. State four factors you would consider before purchasing and installing application software.
4. State three limitations that would hinder the installation of Ubuntu Operating System.
5. Explain the importance of product key that comes with most proprietary software.

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Practical Activity 2.2

Assuming you have bought a new computer that has no software, demonstrate step by step how you would install the following software:

1. Microsoft Windows 10.
2. Kaspersky Internet Security 2016.
3. New Samsung Printer.

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Core element

Programming techniques and logical methods

Outcome

The students will be able to apply basic programming principles to solve problems.

Success Criteria

By the end of this unit, you must be able to:

- ***Define computer program, compiler, translator, assembler.***
- ***Describe the generations of programming languages.***
- ***State examples of programming languages.***
- ***Construct a computer program.***
- ***Compile a computer program.***
- ***Run a computer program.***
- ***Declare data types.***
- ***Initialise data variables.***
- ***Access data types.***
- ***Design programs that read from standard input and write to standard output.***
- ***Use arithmetic operators.***
- ***Use Boolean comparison operators.***
- ***Design programs that use control structures. debug programs.***
- ***Debug programs.***

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3 PROGRAMMING FUNDAMENTALS

Chapter Outlines

3.1 Introduction
3.2 Definition of terms used in programming
3.3 History of programming languages
3.4 Program development process
3.5 Programming a Visual Basic
3.6 Comments, declaration and statements
3.7 User defined data types
3.8 Operator procedure/hierarchy
3.9 Library functions
3.10 Control structures
3.11 Looping/iteration

3.1 Introduction

To process any type of data, a computer follows a set of well-designed instructions known as a program. Like in the construction industry, creating a good program requires the programmer to provide design of the program. While in construction a design is known as a *plan or blue print*, in programming, a program design is referred to as an *algorithm*. The process of designing a program is referred to as **algorithm design**. It is important to note that algorithm design is both a science and an art because scientific approach and creative thinking is required to come-up with a good design.

In this Chapter, we first introduce fundamentals of computer programming. LAter, we use algorithm design tools to demonstrate mathematical operations and logical flow of instructions in a program. Finally, we will use Microsoft Visual Basic to demonstrate how to implement an algorithm into a computer program.

3.2 Definition of Terms used in Programming

In computer programming, there are fundamental concepts that are used regardless of the programming language used. In this section, we highlight key terms that you are likely to encounter in computer programming.

Computer program

A computer program simply referred to as program is a set of instructions, written using a programming language to instructs a computer to perform a

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task. A program is like a recipe. It contains a list of ingredients referred to as variables and a list of instructions (statements) that instructs a computer what to do with the variables.

Programming languages

Just like in natural languages, a programming language is a formal language that specifies the syntax and semantic rules for writing computer programs. Some examples of programming languages include BASIC, C, C++, Java, Pascal, FORTRAN and COBOL, just to mention a few.

Computer programming

Computer programming is a process of writing a computer program using a programming language. The person who writes programs is referred to as a **programmer**. Other terms used to refer to a programmer at higher levels are **software developer** and **software engineer.**

Source code

The term source code refers to a set of instructions or statements written by a programmer that are not yet converted into machine-readable form. A source code is mostly a text file written using programming languages like BASIC, Pascal, C or C++.

Object code

Once a source code is written, it can be converted into machine readable form referred to as **object code**. To convert source code to object code, language processors such as assemblers, interpreters and compilers are used.

Assembler

An assembler converts *assembly language* program into machine readable form that a computer can understand and execute.

Interpreter

An *interpreter* converts the source code into machine code statement-by-statement allowing the CPU to execute one line at a time. The interpreted line is not stored in the computer memory. This means that every time the program is needed for execution, each line has to be interpreted. This method of interpreting programs was common in early computers that did not have enough memory to store the object code.

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Compiler

A compiler converts the entire source code into object code. The object code can be made into an executable file by carrying out another process known as *linking* which combines the object code with library files that are required for the execution of the program. After the linking process, an *executable file* (application file) is generated. In Windows, this file may be stored on a storage media such as a disk with a name and *.exe* extension such as hello.exe. Figure 3.1 illustrates how a compiler translates a source file into executable object file.

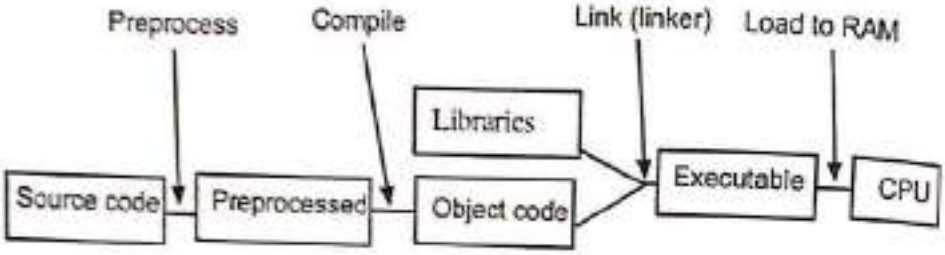

Fig. 3.1: How a compiler source code to executable file

The difference between the interpreters and compilers are summarised in Table 3.1:

Table 3.1

Intepreters	*Compilers*
1. Translates the source program one statement at a time.	1. Translates the entire source code at once before execution.
2. Translates the program each time it is run hence slower than compiling.	2. Compiled program (object code) can be saved on a storage media and run as required, hence executes faster than interpreted programs.
3. Interpreted object code takes less memory compared to compiled program.	3. Compiled programs require more memory as the object file are larger.

3.3 History of programming languages

Hundreds of programming languages have been developed over the years. These languages are classified into two broad categories:

1. Low-level languages
2. High-level languages

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the high-level has third generation to fifth generation languages.

Low-level languages

Low-level languages are classified as low because they can easily be understood by the computer since they require minimal effort to convert into computer object code. Low-level languages are hardware-oriented hence they are not portable i.e. a program written for one computer cannot be installed on another computer. Two types of low-level languages are the *machine* languages and *assembly* languages.

Machine languages (First generation languages)

In machine languages, instructions are written using *binary code*. Given that data and instructions are in binary form, many lines of code are needed to accomplish even a simple task like adding two numbers. A program written in machine language might look like one shown in Figure 3.2.

```
11100011    00000001    10000011
00011100    10001101    11100111
10001111    11111000    10000001
```

Fig. 3.2: A sample Machine Language Program

It is evident from the above code that it is hard for a person to understand what the program is all about unless they have knowledge in machine level programming. Furthermore, different CPU's understand different machine languages, e.g. the code for the *Intel Pentium* processors may differ from *Motorola processors*. Therefore, before writing machine code, a programmer has to know for which CPU the program is written. Such programs are hard to write and debug from the programmer's point of view, but very easy to execute from the computer's perspective.

Assembly languages (Second generation languages)

Assembly languages were developed in order to overcome the difficulties of understanding and using machine languages. These languages represented the first successful attempt to make computer languages readable. The languages allowed programmers to write programs as a set of symbolic operation codes called *mnemonics*. Mnemonics are basically shortened two or three letter words. A program written in assembly language may look like one shown in Fig. 3.3.

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```
MOV   AX,   15   (move 15 to register AX)
SUB   AX,   10   (subtract 10 from the value in AX)
```

Key: MOV – Move; SUB – Subtract; AX – data register

Fig. 3.3: Sample assembly language program

The first line in the code means move 15 into the processor register with the name AX. The second line instructs the computer to subtract 10 from the value in register AX.

Programs written in assembly languages require an *assembler* to convert them into machine codes that the computer can understand. Like machine languages, assembly languages are also machine dependent and therefore a program written for one computer cannot be used on another.

Advantages and disadvantages of low-level languages

Advantages

1. The CPU understands machine language directly with minimal or no conversion.
2. The processor executes low-level programs written in faster because complex instructions are already broken down into smaller simpler ones.
3. Low level languages are stable and hardly crash or break down once written.

Disadvantages

1. Low-level languages are difficult and cumbersome to use and learn.
2. Require highly trained programmers both to develop and maintain programs written in low-level languages.
3. Correcting errors (debugging) in low level language programs is difficult.
4. Low level programs are machine dependent i.e. they are not portable from one computer to another.

High-level languages

High-level languages are close to the human language hence they can be read and understood even by people who are not experts in programming. There are several types of high-level languages developed to address various problem domains. High-level languages are *machine independent* meaning that a programmer concentrates on problem solving a particular problem instead of understanding the architecture of the machine.

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High-level languages can be classified into five categories:

1. Third generation languages. (3 Gls)
2. Fourth generation languages. (4 GLs)
3. Fifth generation languages. (5 GLs)
4. Object oriented languages. (OOPs)
5. Web scripting languages.

Third generation languages (3 GLs)

Third generation languages (3 GLs) are also called structured or procedural languages. A procedural language makes it possible to break down a program into components called *modules*, each performing a particular task. The process of breaking down a program into modules or sub-program is referred to as structured programming. Structured programming approach emphasises the following:

1. Large programs should be broken down into smaller sub programs each performing a single task.
2. Use control structures in problem solving.

Structured programming offers many benefits because it is flexible, easier to read and modify. The following is a brief description of common examples of third generation programming languages.

Pascal: Pascal was initially developed as procedural language to help in the teaching and learning of structured programming.

FORTRAN: (FORmula TRANslator): This language was developed for mathematicians, scientists and engineers. It enables writing of programs that solve scientific, mathematics and engineering problems.

COBOL: (Common Business-Oriented Language): COBOL language is designed for developing programs that solve business problems such as computer-based inventory control systems.

BASIC: (Beginners All-purpose Symbolic Instructional Code): BASIC language was developed to enable students easily learn programming. Basic is a simple general purpose language used for developing business and educational applications. Because of its simplicity, it is a powerful tool for students who wish to learn programming.

C: This is a programming language used for developing system software such as the operating systems. It is one of the most popular and powerful high-level programming languages because of its ability to provide programmers with powerful features of low level languages and at the same time easily understandable as a high level language.

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Ada: This language was named after the first lady programmer, Ada Lovelace. Ada is suitable for developing *military, industrial* and *real-time* systems.

Sample 3GLs Program

In 3GLs programming languages, a simple source code known as "*Hello World*" may be used to introduce beginners into structured programming. Figure 3.4 is a sample Hello World program written in Pascal.

```
                                        HELLOWOR.PAS
                [■]
(1) ──→  (* displays Hello World on screen *)
(2) ──→  program HelloWord (output);

(3) ──→  Begin { main body}
(4) ──→    Writeln('Hello World');
(5) ──→  End.
```

Fig. 3.4: Sample hello world Program in pascal

Line 1: The first line enclosed in a combination of parenthesis and asterisk is known as *comment*. In programming, use of comments is considered a good practice in that it explains the purpose of a program or statement to other programmers.

Line 2: The second line is known as the *program header*. A Pascal program must start with the keyword "program" followed by the name of the program, in this case *HelloWorld*. The word **output** in the parenthesis is known as parameter and indicates that the program displays the output on the screen.

Line 3: The keyword *Begin* in the third line denotes the start of the executable statements. This is where we define the structure of the program using input, processing and output statements.

Line 4 *Writeln('Hello World')* is the most important statement in this program. Once the program is executed, **writeln** is a Pascal output function for instructing the computer to display *Hello World!* on the screen. Note the word **Writeln** is a short form of *Write line*. In programming, write means output while read means input. Therefore a statement that takes input in Pascal uses *Readln(value)*.

Line 5: The last statement *"End."* marks the end of the program. Once the computer encounters the End (with period), the program is terminated and unloaded from main memory.

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```
'displays Hello world on Screen
Module HelloWorld
    Sub Main() 'main body
        Console.WriteLine("Hello World")
        Console.ReadKey() 'press any key to continue
    End Sub
End Module
```

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Line 4 *Console.Writeln('Hello World')* statement is similar to write used in Pascal. The term console means screen. Therefore, on the program is executed, writeln instructs the computer to displ *HelloWorld!* on the screen.

Line 5 *Console.Readkey()* function is similar to readln used in Pasca However, in this program, it is used to pause the screen dispayin Hello World until the user presses any key.

Line 6 *End Sub* marks the end of Main method. Once the user presses an key and the End Sub and End Module are encountered, the progran returns control to the operating system to unload the program fron memory.

Fifth generation languages (5 GLs)

Fifth generation languages (5GLs) also known as *natural langtuages* are used to develop systems that solve problems using artificial intelligence. Artificial intelligence refers to computer systems that mimic human-like intelligence. Such intelligence include *visual (seeing) perception, speech recognition, decision making and movement*. In 5GL programming, the programmer only worries about contraints required for the problem to be solved but not designing the problem solving logic referred to as an *algorithm*. The term algorith is explained in details later in the chapter. Some examples of *5GLs* include *PROLOG, Mercury, LISP and OPS5*.

Object-oriented Programming

Currently, there is a paradigm shift from procedural programming championed in 1970s using 3GLs to Object-Oriented Programming (OOP). In OOP, a program may consist of *several objects that interact by sending messages to each*. This is similar to the way a person considered as an object sends a message to another person requesting for something to be done.

It is important to point out that, OOP is not classified as a separate generation because it is a shift in program development methodology. Most of the programming languages that supported structured programming like C have been enhanced to support object oriented programming.

In OOP, several objects are linked together through a method known as association to create a complete program. Some examples of object-oriented programming languages include *Java, Microsoft Visual Basic.Net, Objective-C, C++, C#, Python, Perl, Ruby, Delphi Pascal and Smalltalk*. It is important to point out that, OOP languages cuts across the three generations of high-level programming languages. Most of the programming languages

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that supported structured programming have been enhanced to support object oriented programming. The concept of object-oriented programming is discussed further in the section on Visual Basic programming.

Sample OOP Program

Figure 3.5 shows a sample Hello World written in GUI environment of Visual Basic. Net. The structure of the program is described later in the section on Visual Basic programming in order to appreciate use classes and objects.

```
Public Class frmHello

    Private Sub cmdOK_Click(ByVal sender As System.Object, ByVal e As System.EventArgs) Handles cmdOK.Click
        'This program displays Hell World on a Form
        txtHello.Text = "Hello, world!"
    End Sub
End Class
```

Fig. 3.6: Sample Hello world program in Visual Basic Net

Web development and scripting languages

Web development languages are used to develop or add functionalities on web pages. Web pages are hypertext documents created in a language called *Hypertext Markup Language (HTML)*. HTML consists of *tags* that are interpreted by the web browser software to display content when the file is opened on the browser. A tag is a word, symbol or character enclosed in angle brackets < > that a browser can interpret it as a command. For example, to create HTML document, one must use the *<HTML>* tag at the very top of the document. Other languages like Extended HTML (XML) have been derived as alternative to HTML with the only difference being that XML allows the user to define their own *tags* instead of using the standard HTML tags. Unlike programming languages, HTML does not have declaration part and *control structures* (to be covered later in the book). This is why it is not considered as programming language.

To enhance interaction and dynamism of HTML web pages, special types of web programming languages known as **scripting languages** are used. Examples of scripting languages include *JavaScript, VBScript* and *Hypertext Preprocessor (PHP)*. A script is a small program code written in a scripting language and then appended into the HTML program to add functionalities like sliding calender and form validation.

Most HTML elements have an opening and a closing tag. An opening tag is enclosed between < > while a closing one between </ >. The content to be displayed on the browser is enclosed between an opening and closing tags.

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For example, the statement <h2> Hello World </h2> will display the word "Hello World" in big bold text on the screen. Table 3.1 shows examples of HTML tags and their meanings:

Table 3.2

Tag	Meaning
<html> </html>	Marks the beginning and end of a HTML document. All other tags and text fall between these two tags.
<head> </head>	Marks the header part of the document.
<title> </title>	Gives title of the web page. Text between this tags appears in the title bar when the page is browsed.
<body> </body>	Marks the content part of the web page
<h1> </h1>	Sets size of text with H1 being the largest and h6 being the smallest size

Sample HTML Page

A simple structure of HTML is demonstrated using Figure 3.7 for a web page that displays Hello World on a browser. Although the code can be written using any text editor, the file must be saved with **.html** extension for the browser to display (render) the Hello World the screen. In this example, the browser displays Hello World using Heading1 text size and Greetings in the title bar of the browser.

Fig. 3.7: A hello World Program in HTML

Benefits and limitations of high-level languages

The following are some of the benefits and limitations of high-level programming languages.

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Benefits

1. High level languages are portable i.e. can be installed in more than one computer.
2. High level languages are user friendly, and easy to use and learn.
3. High level languages are more flexible. They enhance creativity and innovation of the programmer and increase productivity in the workplace.
4. It is easier to correct programs written in high level languages.

Limitations

1. Their nature encourages use of many instructions in a statement hence the size of these instructions cause slower program processing.
2. High-level language programs have to be interpreted or compiled to machine form before the computer can execute them hence need more hardware and software resources.
3. They require large computer memory to be executed.

Review Questions 3.1

1. Define the term computer program.
2. Define the term programming.
3. State three advantages of high level languages over low level languages.
4. List four examples of high level languages and for each, state its most appropriate application area.
5. Explain why an executable file is unique compared to source file.
6. (a) Differentiate between a compiler and an interpreter.
   (b) Explain why early computers worked well with interpreters.
7. List three examples of high-level programming languages per generation.
8. State three advantages of machine language over high-level languages.
9. Write the following in full:
   (a) HTML (b) OOP
10. Distinguish between source code and object code as used in programming.
11. Define the term encapsulation as used in object oriented programming.

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3.4 Program Development Process

Quite often like in mathematics, when students are given a programming problem, they have difficulties in analysing and providing a solution. The following are the guidelines on how to solve a programming problem:

1. Clearly define what a program is to do (problem definition).
2. Close your eyes and visualise the program running on the computer.
3. Write a pseudocode version (algorithm design) of the program.
4. Desk-check (dry-run) the pseudocode for any logical flow errors.
5. Write the program code on paper using a programming language.
6. Test the program on paper for any syntax and logical errors.
7. Write the source code using a programming such as Basic or C++.
8. Compile the program and correct any errors displayed by the compiler.
9. Run the program with test data for input to test for any logic errors.
10. Validate the results of program.

The guidelines outlined above may be summarised into five main phases of program development life-cycle (PDLC):

1. Problem definition.
2. Algorithm design.
3. Program coding.
4. Program testing and debugging.
5. Program review and maintenance.

Problem Definition

Problem definition refers to one's ability to identify a problem that need to be solved using a computer program. Like in mathematics, computer programming is a problem solving task. A creative programmer identifies problems and opportunities in the society and seeks to provide a computer-based solution. It is important to appreciate that computer software we enjoy using are as a result of skilled programming by people like you! For example, think of the person who after seeing the tedious task of typing using a manual typewriter decided to develop a word processing program. The following three situations may motivate a programmer to develop a computer program:

1. *Problems* or *undesirable situations* that prevent an individual or organisation from achieving their objectives.
2. *Opportunity* to improve the current system or delivery of services. It can be argued that any unexploited opportunity is a problem.

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3. *New directive* given by the management or government requiring change in the status quo.

Sample problem

Consider a mathematical problem such as calculating the area of a circle. In this case, the problem is finding the area of a circle. As a programmer, it is your responsibility to develop a program that can be used to calculate the area of any circle. For such a problem, a programmer must conceptualise the solution by first understanding the problem, then identify input, processing logic and the expected output. In this case, careful analysis of the problem reveals that the process of solving the problem is as follows:

1. Input: (a) Pie (π) which is a constant.
   (b) The radius of the circle.
2. Process: The formula for calculating area of a circle i.e $\pi \times$ radius $\times$ radius.
3. Output: Area of the circle (A).

The problem definition stage ends with documenting hardware and softwarerequirements necessary for solving the problem. It is this document that enables a programmer to design algorithms for implementing the solution.

Algorithm design

After the programmer analysises the problem, the next step is to design the solution to the problem known as algorithm. An algorithm is a set of well-defined steps for performing a task or solving a problem. The solution to the problem is expressed using *flowcharts, pseudocode* or *structured English statements*. For example, to calculate area of a circle, a programmer may use pseudocode to outline the steps followed by a computer program to calculate the area as shown in Figure 3.7. Before coding, an algorithm should be tested for logical error, a technique known as *"dry run"*.

```
Program: Calculate area of a circle
BEGIN
  SET as constant PI = 3.142
  PRINT "Enter Radius"
  READ radius
  area = PI * radius
  PRINT area
END
```

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LILONGWE

Fig. 3.7: Sample Pseudocode

The algorithm above starts with a declaration on the task to be performed by the program. The statement SET indicates that 3.142 is a constant represented

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using a symbolic name PI. The phrases within the BEGIN and END denote the executable statements for input, i.e., PRINT radius; process (area = PI * radius); and output, i.e., PRINT area.

Program coding

Programs can be written in different programming languages but the general trend today is to use high-level languages that are easy to learn and understand.

In order for a computer to execute instructions outlined in the algorithm, the statements must be written using a programming language such as Pascal, C, C++ or Java. To be executed, the source code must first be converted into object (binary) code. Generally, most high-level programming languages have common features such as *reserved words, operators, identifiers and variables.* The following subsection, highlights some of the elements common in most programming languages.

Reserved words

Reserved words also referred to as keywords have special meaning and can only be used for intended purpose. Some examples of reserved words in Pascal and C++ include; for, if, else, while and do.

Identifiers

Identifiers are programmer defined symbolic names used to identify elements like variables and constants in a program. For example, in a problem to calculate hourly pay; hours and rate are examples of identifiers.

Operators

Operators are used to perform arithmetic operations on pieces on unary or binary operands. Five commonly used operators are addition (+), subtraction (-), multiplication (*), division (/) and assignment (=). For example, a statement to calculate hourly pay can be expressed as:

```
wage = hours * rate;
```

Variables

In programming, a *variable is a named location in computer's memory for holding data.* The content of a variable may change during program execution unlike constants whose content doesn't change. For example, in the previous program for calculating hourly pay; wage, hours and rate are variables. The sample codes below shows a Pascal and C++ programs for calculating area of a circle.

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Program in Pascal

```
Program AreaCircle (input, output);
Const PI = 3.142;
Var radius, Area: real;

Begin
 Writeln ('Enter the radius');
 Readln (radius);
 Area: = Pi *Radius *Radius;
 Writeln ('The area is', Area)
End.
```

Program in C++

```
#include<iostream.h>
double radius, area;
double pi = 3.142;
main ()   {

 cout<<'Enter the radius';
 cin>>radius;
 area = pi*radius * radius
 cout<<'The area is', area;
 return 0;
 }
```

NB: Unlike Pascal, C++ is *case senstive*. This means that the read and write functions such as cin(console in) and cout (console out) should be in lower case. Note also that, the start of executable statements in, C++ starts with the main function written in lower case.

Program Testing and debugging

Testing is the process of tracing or checking whether a program has errors (bugs) while debugging refers to the process of correcting identified program errors. There are two types of bugs that may be encountered when testing a program. These are:

1. *Syntax errors*: These are errors that emanate from improper use of language rules e.g. grammatical mistakes, punctuation, improper naming of variables and misspelling of identifiers and *reserved* words. Syntax errors are detectable by a compiler or an interpreter and must be corrected before the program runs.
2. *Logical errors*: They are not detectable by the compiler or interpreter. The program runs but gives wrong output or halts during execution.

Tracing Program Errors

Tracing program errors requires careful step-by-step trace of input, processing and output statements. The test and debug strategy chosen must be good in order to thoroughly test an algorithm or program before coding. Hand tracing or dry run using trace tables is the first step that allows exhaustive testing of an algorithm or program on paper. The following is a three-step process of testing an algorithm or program for errors:

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1. *Dry-run (Desk check):* Dry-running involves using a trace table to check whether an algorithm or program has errors before writing it in the program editor. A good practice in using a trace table is to go through an algorithm line by line exactly as a computer would. This helps the programmer identify syntax and logic errors.
2. *Debugging:* Once a program is written in the program editor, the programmer uses debugging utilities to detect and correct syntax errors before compiling the source code into object code.
3. *Test data:* After the program compiles successfully, the programmer carries out trial runs using test data to check for logic and run-time errors. This is by entering valid and invalid data to test whether the program produces desired output.

Program review and maintenance

Review and maintenance refers to continuous update and fixing of program errors after installation. You may continue fixing and updating the program until it reaches a point where the program has to be replaced. At this point, maintenance stops and the program development life cycle starts all over again.

Characteristics of a good program

Before concluding this section, we briefly highlight important characteristics of a good computer program:

1. *Simplicity* – A program should be kept as simple and easy to understand.
2. *Integrity* – In programming, integrity refers to reliability and accuracy of data. Therefore, mathematical statements should be tested for accuracy of calculated output.
3. *Efficiency* – To enhance performance, good program design should aim at optimizing execution speed and memory utilization.
4. *Clarity* – For program to be readable, the statements and comments should be clearly written.
5. *Modularity* – Complex programs should be broken down into components known as modules, procedures or sub-programs.

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Review Questions 3.2

1. Give two advantages of compiling a program rather than interpreting it.
2. Explain five phases of program development in their respective order.
3. Highlight two disadvantages of monolithic programs.
4. State two advantages of modular programming.
5. At what stage of the development does program documentation fall? Justify your answer.
6. Differentiate between flowchart and pseudocode.
7. Define the term program bug.
8. Explain why it is important to test a program before implementing it.

3.5 Programming in Visual Basic

In programming, BASIC is an acronym for Beginner's All-purpose Symbolic Instruction Code. The foundation of most BASIC versions is the original BASIC language developed at Dartmouth College by John G. Kemeny and Thomas E. Kurtz in 1964. The philosophy behind introduction of BASIC

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1. It is an *event driven* programming language. An event is a response generated by the program when the user performs an action e.g. a mouse click. The response depends on the code of an event procedure. An event procedure is a group of self-contained statements that are executed by a computer when an action is performed. For example, a mouse click may cause a menu to be displayed on the screen.
2. It has a collection of tools that are used by programmers. These tools are called *controls*. The controls can be accessed easily by clicking their icons on the toolbox.
3. It has objects called *forms* that have a title bar at the top. The programmer can add controls such as menu bar, status bar, toolbars, buttons, and slide bars onto the form when creating an application.
4. It is an object-oriented programming language implemented using a framework known as .NET. This means that applications developed in VB.Net can also run on internet.

Basic syntax of VB.Net Program

VB.Net is an object-oriented programming language. In Object Oriented Programming, *a program consists of various objects that interact with each other by means of message passing*. Objects of the same type belongs to the same class just like human beings belong to class called animals. Therefore, a VB.Net program can be defined as a collection of objects that communicate with each other by sending messages via methods. Although object-oriented programming is relatively difficult but we gradually introduce them as we advance in VB programming. To start with, we only introduce basic concepts relevant to VB.Net programming at this level. These are:

- *Class* - A class can be defined as a template or collection of behaviour (methods) and state (variables) that defines a set of objects. For example, let's consider the "Form 3 students". We can define a template called "exam" with columns student name, marks and grade in which we can add or delete student's details. Such a blank template represents the concept "class" in object oriented programming.
- *Object* – An object is an instance of a class that has state (data) and behaviour functions. For example, a particular student in Form 3 is an object who has state or data such as surname, marks and grade. The student object also has behaviour or functions such as walking, eating that is not in plants class.

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- *Methods* - A method defines the behaviour or function to be performed by an object to manipulate data (state). For example, we can define a method to add, delete or modify student details in a class. The class must define methods that are common to all the objects that belong to that class. Therefore, it is in methods where the program statements that manipulate data are written.
- *Variables* - Each object has its unique set of variables that are used to hold data. Data values received by methods are assigned to these variables.
- *Comments* - These are set of statements used in the code to explain what a program or statement does. The comments are ignored by the compiler during execution. In Visual Basic, a comment starts with a single apostrophe (') followed by the statement. For example: *'calculates sum* is treated as a comment by the compiler.

Structure of VB Program

A VB.Net program consists of *namespace declaration*, a class or *module*, *one or more procedures, variables, executable statements and comments*. The program shown in Figure 3.9 is used to demonstrate the structure and syntax of a Visual Basic program in Microsoft Visual Basic 2010 Express.

```
frmHello                                                    f Click
Public Class frmHello

    Private Sub cmdOK_Click(ByVal sender As System.Object, ByVal e As System.EventArgs) Handles cmdOK.Clic
        'This program displays Hell World on a Form
        txtHello.Text = "Hello, world!"
    End Sub
End Class
```

Fig. 3.9: Structure of VB Program

Getting started with VB.Net 2010 Express

You can start Visual Basic.Net from the Programs menu by pointing to Microsoft Visual Studio and then selecting Microsoft Visual Basic 2010 Express.

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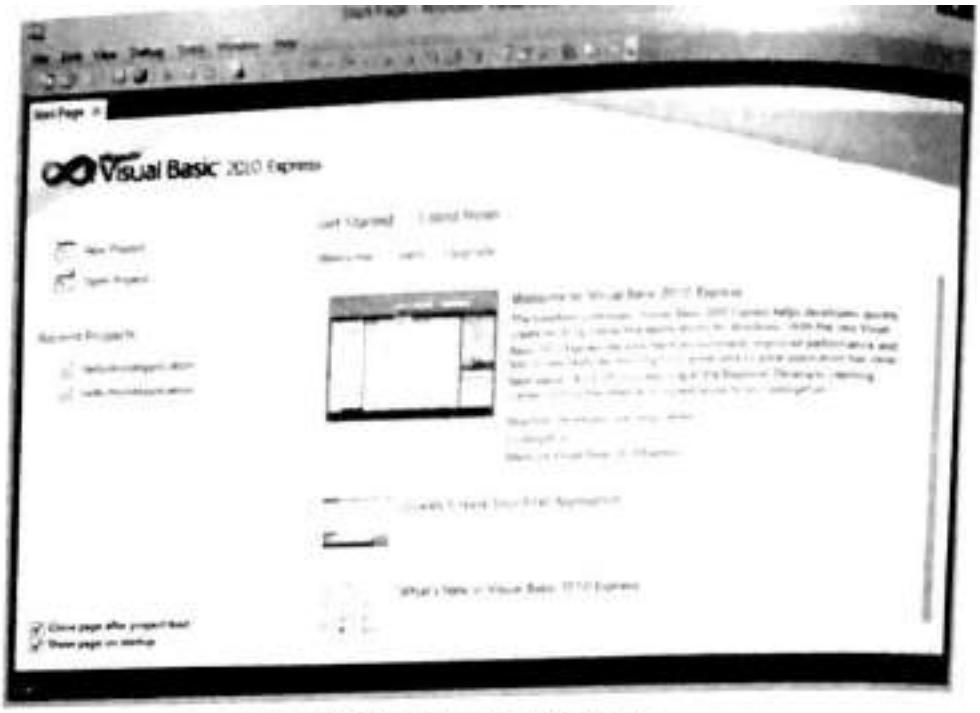
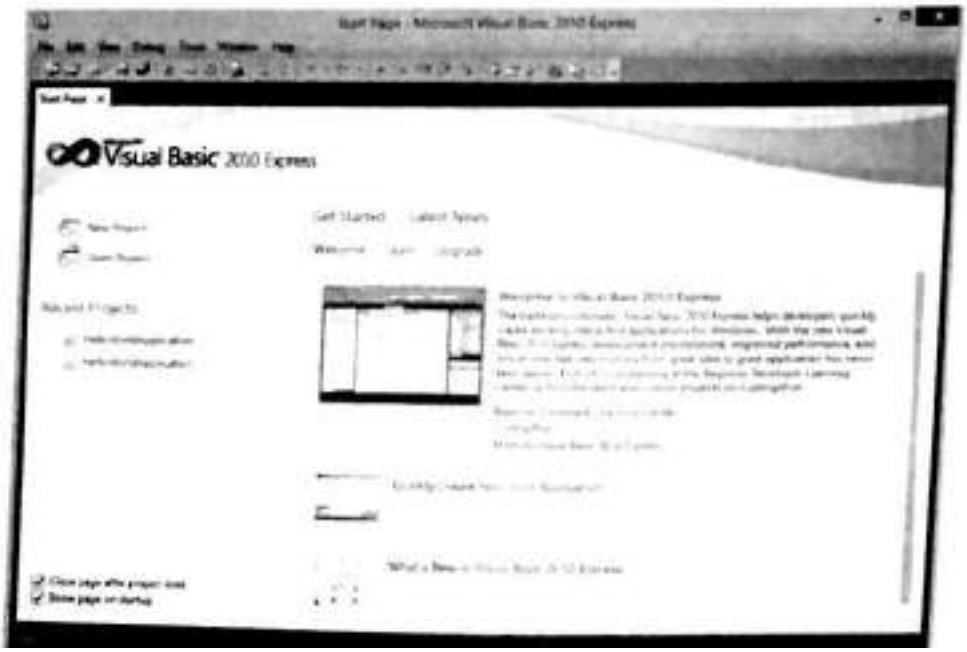


Fig. 3.10: VB.Net Startup Window

This window lets the programmer create a new project or open an existing Visual Basic application. In Visual Basic, an application is referred to as a project because it comprises of several files. To create a new Project i.e. Visual Basic application proceed as follows:

1. On the Start page window, click the New Project icon on the top left-hand side to display several types of projects identified by different icons as shown in Figure 3.11.



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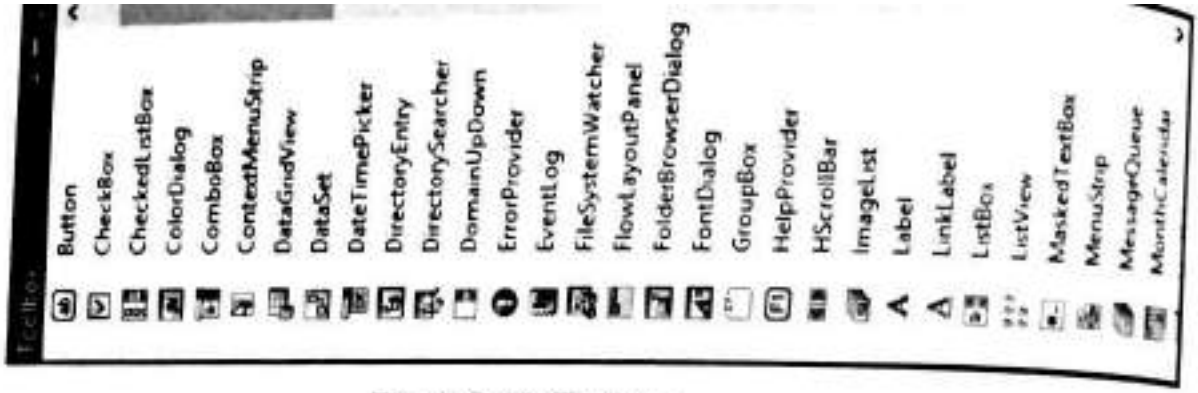

Figure 3.13: Toolbox

The following is a list of tools that you can use to create a program by placing their **controls** on the form. In object oriented programming, a control is an *instance* of an object that appears on the form. For example, Save button is an instance of command button.

- *Button:* This tool is used to place command button instances on the form. Such command buttons include OK, Save, Exit, Close etc. This are the buttons we use to interact with an application.
- *CheckBox:* When used on a form, the check box control provides a way of choosing from multiple values by clicking on check boxes.
- *ComboBox:* A combo box is a type of list box that combines the capabilities of a text box and a list box input. A combobox displays a list of items to select from during program execution. Items can also be added into the combo box.
- *DateTimePicker:* This tool is used to place a control on the form that a user can click to display a dropdown calendar from which to choose current day, month or year.
- *HScrollBar:* This tool is used to place a horizontal scroll bar such as the one you use at the bottom of most applications to scroll left and right.
- *Label:* Label tool is used to place controls that explain the content of other controls on the form. For example, if a text box contain surnames, a label

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a small arrow pointing down which when clicked displays a list you can scroll to select an item .

- *Shape tool:* Although not shown on the illustration above, the shape tool is used to draw circles, ellipses, squares and rectangles within forms.
- *TextBox:* Although not shown on the illustration, TextBox tool is one of those frequently used tools to draw text boxes in which the user provide input. Text and labels are used hand-in-hand to guide the user on what to enter as input.

In this chapter, our emphases is on basic programs that uses the most of the tools highlighted above. However, as a programmer, creativity requires more than using these basic tools. Explore further to discover the full potential of Visual Basic.Net.

Solution Explorer

The solution Explorer shown on the top right of the IDE window displays a list of objects associated with the open project such as forms and modules.

Properties

The properties window shown in Figure 3.14 is used to define properties of each object in an application. After you place an instance of an object, you must define its properties such as name, colour, caption etc. Note that the list of properties depends on the object.

Figure 3.14: Properties list

For example, the figure above shows the properties for a command button named **Button1**. Always remember to change the default name and caption to reflect the purpose of the button such as OK, Save, Close etc. Notice that once you change the caption, the change is reflected on the property window.

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after double clicking Button1. This is the environment we write the source code that instructs the program what to do such as displaying Hello World on the form .

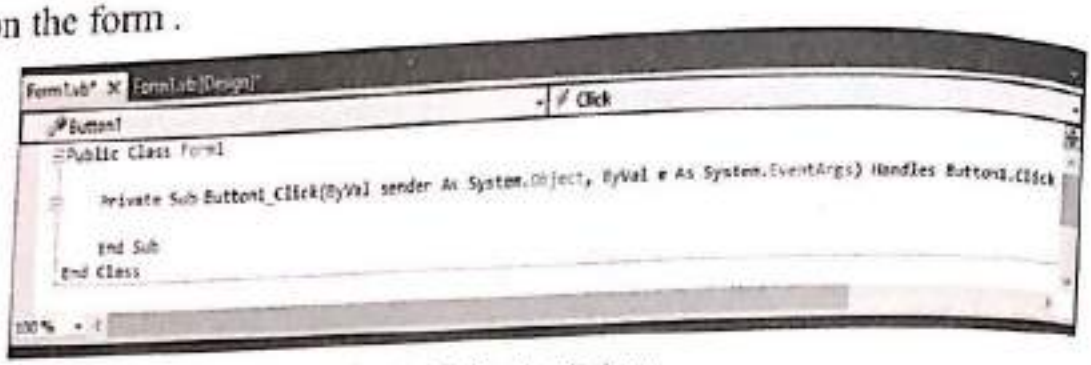

Figure 3.15: Code window

Activity 3.1: Hello World

To create the Hello World project shown earlier, proceed as follows:

1. Start Visual Basic and choose New project on the Start window. A project dialog box is displayed.
2. From the list of Projects, select Windows Forms Application, and then type the name of the project as HelloWorldApplication in the Name box.
3. Once you type the name of the project, click the OK button. A blank form will be displayed.
4. Using the Toolbox, draw a label, text box and a command button on the form as shown in Figure 3.16. If the toolbox is not displayed, click the icon that resembles a cross made of a hammer and spanner on the right-hand of the standard toolbar.

Fig. 3.16: Drawing a label, text box and a command button

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6. In the Properties Window, change the form, label, text box and command buttons name and caption properties as shown in Table 3.2. Make sure the name properties have no space and starts with a prefix such as **frm** that denotes the type of object. For example, the name of the form should be **frmHello**, the label **lblHello**, the text box **txtHello** and the command button to **cmdOK**. This prefixes are conventions used to identify the type of objects in Visual Basic programming.

Table 3.3

Object	*Property*	*Settings*
Label1	Name Text	lblHello Greetings
Text1	Name Text	txtHello (blank)
Form1	Name Text	frmGreetings Hello World
Button1	Name Text	cmdOK OK

8. Double click the command button. A code window is displayed where you type the code to be executed once the user clicks the OK button. The code starts with a class definition called **frmHellow**, followed by a statement starting with private sub cmdOK... Because VB.Net is object oriented, the IDE starts by creating a class within which are methods declared using a keyword **Sub** followed by the name of the method e.g. **cmdOK**. Your complete code should be as shown in Figure 3.17.

```
Public Class frmHello

    Private Sub cmdOK_Click(ByVal sender As System.Object, ByVal e As System.EventArgs) Handles cmdOK.Click
        'This program displays Hell World on a Form
        txtHello.Text = "Hello, world!"
    End Sub
End Class
```

Figure 3.17: A code window

NB: The only code that you are required to type in between the **Private Sub** and **End Sub** is the following:

```
'This program displays Hell World on a Form
txtHello.Text = "Hello, world!"
```


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Figure 3.18: Greetings displayed

Running the program

To execute the HelloWorldApplication and display the Greetings on the form, proceed as follows:

1. Switch to form display by clicking the Form Design tab on the project explorer pane.
2. On the toolbar, click the Debugging icon shown in Figure 3.19. Alternatively, press F5 key on the keyboard. HelloWorld Application is executed with Hello World displayed inside the text box as shown in Figure 3.16 above.

Fig. 3.19: Debugging button

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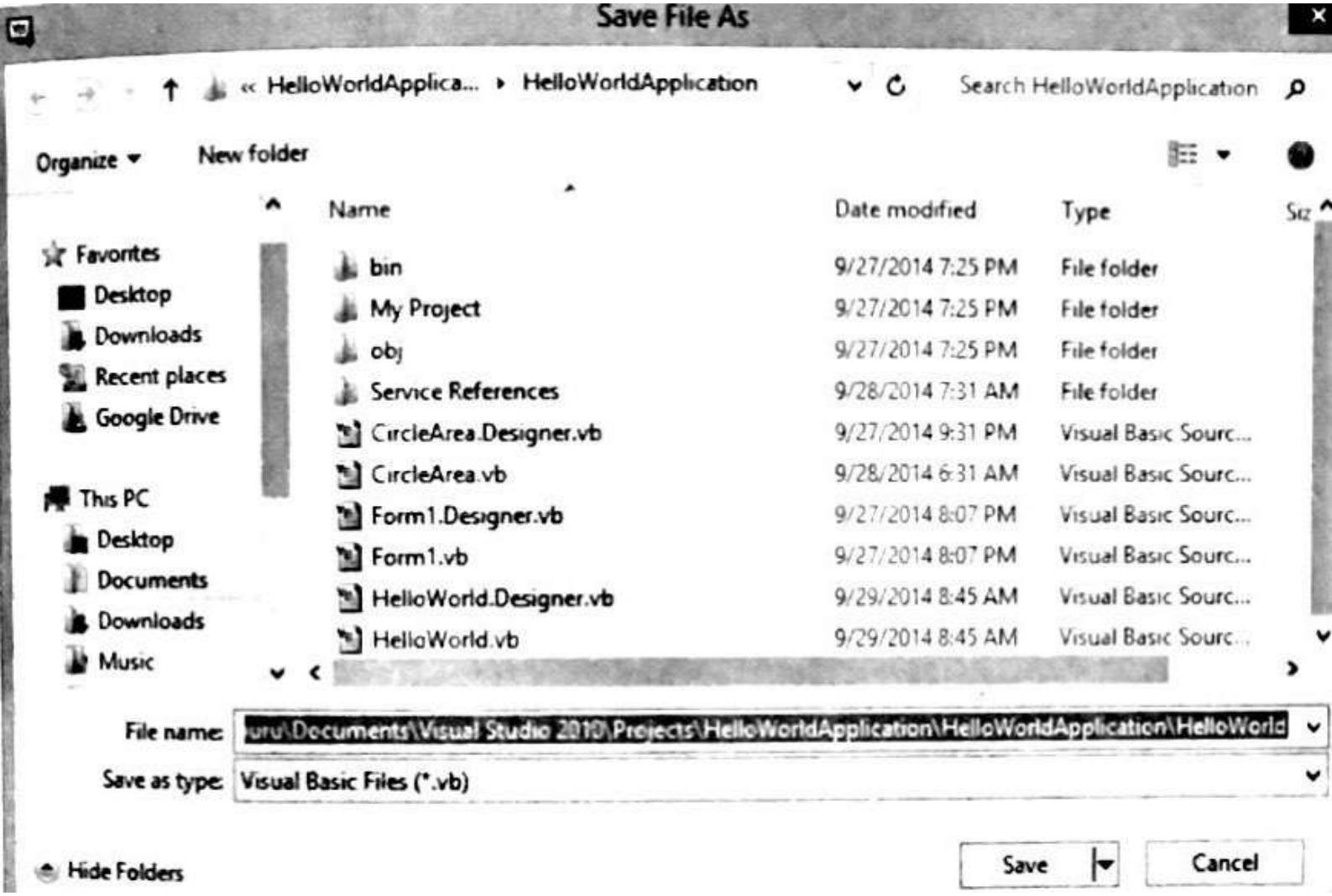

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from which you can select the project you wishto open. ...ect dialog box appears

Adding new forms

Visual Basic project may require the use of more than one form. To add a form to a project, the following procedure is followed:

1. On the Project menu, click **Add Windows Form**. A dialog box is displayed
2. In the dialog, click Windows Form icon and then click the **Add** button to insert the new form in design view and save it with your preferred file name.
3. Save the new form with your preferred filename and vb extension.
4. To make the new form executed after running the program, click Project Properties on the Project menu.
5. Set the new form as the Startup form as shown in Figure 2.21 and close the properties window.

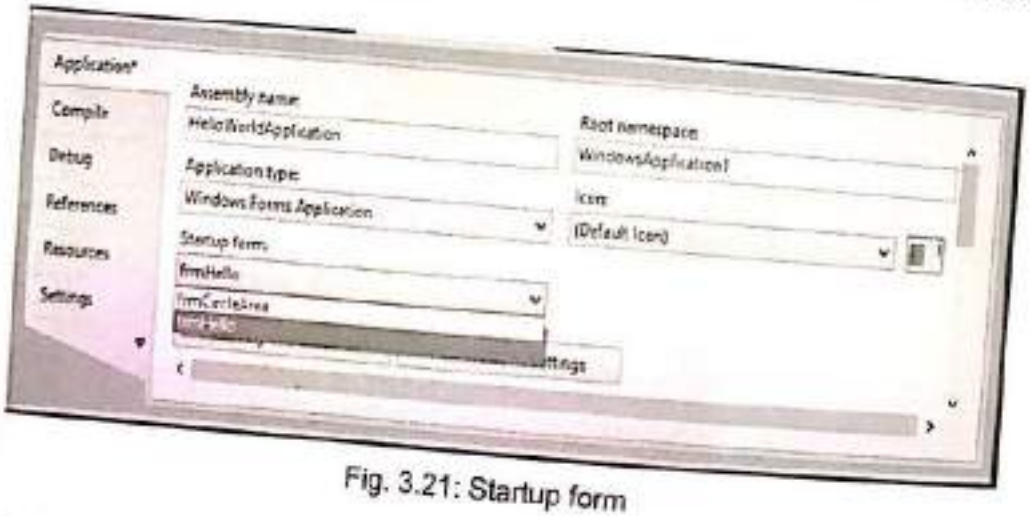

Fig. 3.21: Startup form

Comments, declaration and executable statements

Before going further into detailed discussion on how to write programs in Visual Basic, it is important to highlight some of the building blocks of a Visual Basic program. Later in this section, we demonstrate use of **comments, declaration** and **executable** statements using worked examples.

Comments

Comments are a set of statements included in the code to explain the purpose of the program or statements to other programmers or reference in case of future modification program. In Visual Basic, comments are not executed when the program is run. A comment must start with an apostrophe (') followed by the comment statement. For example, the following is a

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comment to indicate the statement Hello Word is displayed in a text box:

txtHello.Text *'display Hello World in the textbox on the form*

Declaration

In programming declaration is an instruction to the compiler to reserve memory enough to store input or output from a computer program. For a computer to reserve enough memory, you have to specify the type of data to be held in specific memory address. In this sub section, we discuss data type declaration in Visual Basic.

Variables

A variable is a name or identifier that is used to represent a memory location whose content may change during program execution. When a variable is declared, the computer sets aside memory space to hold a value in the variable. In Visual Basic, the following rules should be followed when declaring variables:

1. The variable name must not have more than 255 characters.
2. The variable name must start with a letter.
3. The variable may be declared using mixed, lower or upper case because VB is not case sensitive.
4. A variable name must not be a *reserved* word. A reserved word is a keyword that has special meaning or function in Visual Basic and cannot be used for any other purpose. Examples of reserved words are Case, Else, Dim, etc.
5. Variable names should not have spaces. If two or more words are to be used to create a variable, use underscore or combine them with each word starting in upper case

In Visual Basic, a variable is declared using the reserved word *Dim*. Dim is the short form of the word dimension. It is used to associate a variable with specific data type. For example, to declare a variable that stores radius of a circle we use:

Dim Radius As Integer

This statement instructs the compiler to reserve memory location named **Radius** that stores an integer. Variables should be explicitly declared using the following data types:

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Data type	Description
Integer	A whole number with no fractional part. Integers range from -32768 to 32767.
Long integer	Numbers which are integers but have a bigger value and range. They range from -2,147,483,648 to 2,147,483,647.
Single	A single precision real constant includes a fractional part. The largest value is 3.4×10^{38}
Double	It includes a fractional part but has far much larger magnitude than the single real number constant. However, it cannot be larger than 1.2×10^{308}
String	Characters enclosed in quotation marks.
Boolean	Data types that have only two logical states i.e. true or false.

Variants

In Visual Basic if a variable type is not explicitly declared, the compiler uses variant as data type. A variant is a special type used if the programmer does not declare a variable data type *to be integer, string or* the other types discussed above. In this case, the actual data type is determined by the value held by the variable. This type of variables are called variant-type because their data type keeps on changing depending on the values they hold by the variable. Although this may not be a good programming practice, use of variant is important where the type of data to be processed is not known until runtime; i.e. during the program execution.

Constants

A constant is a value such as PI (3.14) that does not change during execution of a program. In VB the keyword *Const* that comes before PI is used to declare the value as a constant e.g. *Const* PI *As* Double = 22/7, means that PI is a symbolic name that holds quotient of 22/7 which is of the type double. Generally, constants can be classified into three types: string, numeric and named constants.

String constants

A string is a sequence of characters enclosed in double quotation marks. Strings are used to write alphanumeric values that cannot be manipulated mathematically such as phone numbers, addresses and names. The following are examples of strings:

"Holiday season" , "345678", "Computer", "MW7 200"

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Example 3.1: Area of a Circle

Create a program that calculates area of a circle given that PI = 22/7. To write the program, declares PI as constant of double type and radius to be an input variable of single type. The program should display the calculated area in a textbox.

Solution

1. Start Visual Basic and choose New project on the Start Page. Alternatively, add a new form onto an existing project.
2. From the toolbox, use the label, textbox and button tools to design the form.
3. Change the name and text (caption) properties of the controls as shown in Table 3.4.

Table 3.4

Object	*Property*	*Settings*
Label1	Name Text	lblRadius Radius
Text1	Name Text	txtRadius (blank)
Text2	Name Text	txtArea (blank)
Form1	Name Text	frmCircleArea Circle Area
Button1	Name Text	cmdCalculate Calculate

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4 Double click the button and insert the code below in between the Private Sub and End Sub. Note that the dashes (....) indicates that there is ommited par of the Private Sub method.

```
Private Sub ..... Handles cmdCalculateArea.Click
    Dim Radius As Integer
    Dim Area As Double
    Const PI As Double = 22 / 7
    Radius = Val(txtRadius.Text) 'convert radius to a numeric value
    Area = PI * Radius * Radius
    txtCircleArea.Text = Str(Area)
End Sub
```

5 Run the program, enter 7 into Radius textbox and then click the calculate button. The result of the calculation is displayed in the Area text box as shown in Fig 3.22.

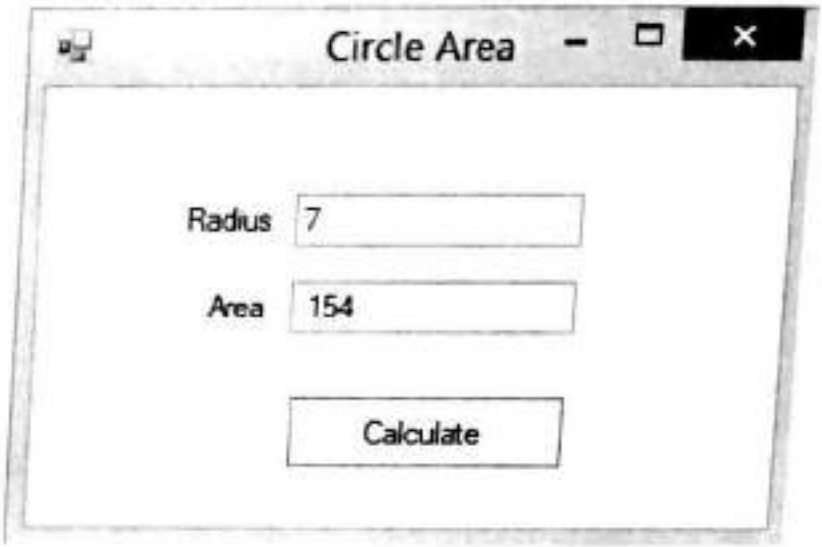

Fig. 3.22: Calculating Area of Circle

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1. Private Dim X As Integer
2. Public Dim Y As String

In the first declaration, the private variable X can only be accessed in the module within which it is declared. In the second example, the variable Y is public hence it can be accessed by other methods or modules in the application.

3.7 User-defined data types

Sometimes, a programmer may want to have a single variable that can store several variables of the same or different data types. Such data type made up of multiple variables components are referred to as *user-defined data types*. Some examples of user defined data types are *records, arrays, enumerated types and lists*. Each element or member of a user-defined type can be accessed using a period between the variable name of the user-defined type and specific member of the type. For example, if a record known as schoolrecord has a member identified as name to access a value in the name, awe use *schoolrecord.name* in the code.

Declaration using suffixes

Suffixes are special symbols added at the end of a variable or constant in order to associate it with a particular data type. This makes programming easier and faster. Table 3.5 summarises some common suffixes.

Table 3.5

Suffix	Data type	Long declaration	Short declaration
%	Integer	Dim A As Integer	A %
!	Single	Dim X As Single	X !
$	String	Dim Q As String	Q $
&	Long integer	Dim C As Long Integer	C &
#	Double	Dim P As Double	P #

VB.Net Operators

In order to write correct mathematical expressions, you need to understand some of the operators used in Visual Basic. These include *arithmetic, relational* and *logical* operators.

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expressions ... it is also possible to carry out other mathematical operations using other operators. Table 3.6 shows a summary of symbols used in arithmetic operations:

Table 3.6

Symbol	Name	Operation
+	Plus sign	Addition
-	Minus sign	Subtraction
*	Asterisk	Multiplication
/	Slash	Division
^	Caret	Raise a number to power of
\	Integer division	Integer division
MOD	Integer remainder	Integer remainder

NB: The last two rows in the table can be explained as follows:

1. In an integer division using \ operator, each of the numbers being divided is first rounded to become an integer then the quotient is truncated to an integer. For example, 2.4\3.5 will result in 2\4 being evaluated.
2. The MOD operator returns the remainder of an integer division. For example, 4 MOD 3 returns 1 and 5MOD3 returns 2.

Example 3.2

Write a program that prompts a user to enter two numbers a and b, calculates and then display sum and average of the two numbers.

Solution

1. Start Visual Basic and choose New project on the Start up Window. Alternatively, add a new form in to an existing project.
2. On the toolbox, use the Label, Textbox and button tools to design the form
3. Change the name and text properties of the controls appropriately to identify the two numbers, sum and average.

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3. Once you double click the command button, enter the co between Private Sub and End Sub that calculates and displays sum a average of the two numbers.

```
Dim Num1, Num2, Sum As Integer 'declare 3 variables as integer
Dim Average As Double 'declare average as double due to division
'convert input in textboxes to numeric values
Num1 = Val(txtNumber1.Text)
Num2 = Val(txtNumber2.Text)
Sum = Num1 + Num2
Average = Sum / 2
'display the sum and average in textboxes
        txtSum.Text = Str(Sum)
txtAverage.Text = Str(Average)
```

4. If you run the program, the form such as shown in Figure 3.23 displayed.

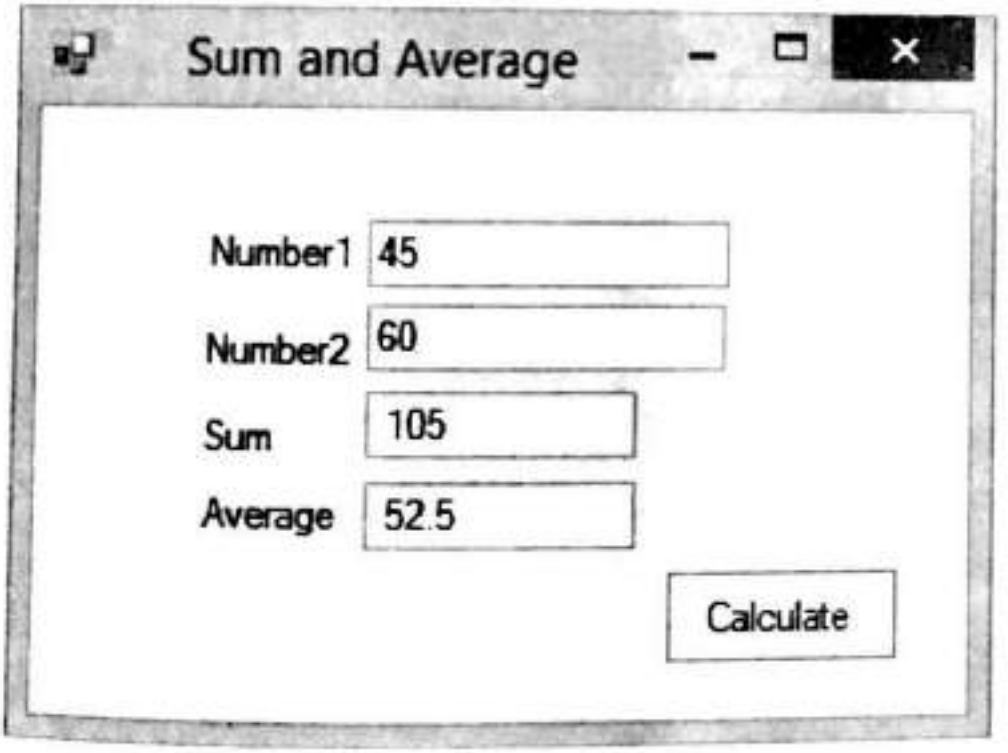

Fig. 3.23: Using arithmetic operators

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Relational operators

A relation operator is used in an expression that returns a true or false value when evaluated. The operators can compare numeric variables, constants or expressions. Table 3.8 shows a summary of relational operators used in Visual Basic.

Table 3.8

Operator	Name
=	Equal to
<>	Not equal to
>	Greater than
<	Less than
<=	Less than or equal to
>=	Greater than or equal to

The following are examples of relational expressions that return true or false

1. Y <> 100 2. y > 60 3. S <= (G + V)
3. Loss = (Expenses – Profit)

The expression in 1 above will evaluate to true if y is not equal to 100 otherwise it evaluates to false. A selection statement in a program based on a relational expression would execute depending on the outcome of the evaluation.

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Logical operators

Logical operators are special form of relational operators used to compare simple or complex relational expressions to form compound expressions that return true or false. Table 3.9 summarises four types of logical operators used in Visual Basic.

Table 3.9

Operator	*Operation*
And	Results in a condition that is true if both expressions are true.
Or	Results in a condition that is true if one of the conditions is true or both are true.
Xor	Results in a condition that is true if one of the conditions is true and the other is false.
Not	Negates the value of a logical expression.

The following are examples of compound expressions that demonstrates use of logical operators:

1. (x = 30) And (student = "John"): returns true only if value of x =30 and student name is John
2. (x = 20) And (y = 30): returns true if value of x = 20 and y is 30
3. (x=20) Or (y<10): returns true if x is 20 and the value of y is less than 10.

VB.Net Assignment statements

An assignment statement is an executable statement that assigns whatever is on the right of the assignment operator to the variable on the left. In Visual Basic, the assignment operator is the equal sign(=). A variable can be assigned a value as follows:

Variable = Value or Expression

Examples of assignment statements are:

1. P = 0.25 2. E = M•C^2 3. Area = 1/2 * base* height
4. X = X + 1

NB: The last statement on the right (X = X + 1) does not make mathematical sense but this is the beauty of the assignment statement in programming. The statement can be interpreted as: *Add 1 to the original value of X and then assign the new value to X*. In other words, increment the value of X by 1.

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Example 3.3: Area of Triangle

Write a program that prompts the user to enter height and base length, a right angled triangle. The program should then calculate the area the displays results.

Solution

1. Start Visual Basic and choose New project on the Start Page. Alternatively, add a new form in an existing project.
2. Use the Label, Textbox and button tools on the toolbox to design the form.
3. Change the name and text properties of the form, labels, textboxes and command button appropriately.
4. Click Calculate Area button, and then write the following code that computes and displays area of a right-angled triangle.

```
Private Sub cmdCalculateArea_Click.....cmdCalculateArea.Click
    Dim Base, Height As Integer 'declare 2 input variables
    Dim Area As Double 'declare Area as double
    Base = Val(txtBase.Text)
    Height = Val(txtHeight.Text)
    Area = 1 / 2 * Base * Height 'calculate area
    'display thearea of triangle
    txtArea.Text = Str(Area)
End Sub
```

5. Once you run the program enter a value for base length and height and then click the Calculate button. The result of calculation like the one shown in Figure 3.24 is displayed on the form.

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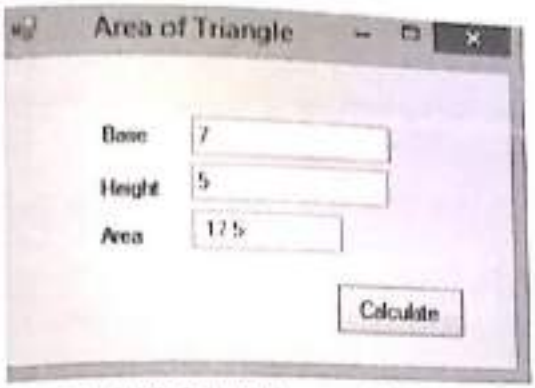

Fig. 3.24: Calculating area of a triangle

Library functions

Library functions also known as in-built functions are methods that have been pre-defined and included in Visual Basic. A library function performs a task such as calculating a mathematical expression and returns a single value. A function will usually have a name that can be called when needed to perform a particular task.

A library function is accessed by its name followed by the information that must be supplied to the function enclosed in parenthesis. This process is called *calling a function*. The variables held in the parenthesis are called *arguments*. When the function is called, it uses the arguments to perform an operation and *return a value*. For example, to perform a mathematical operation, VB has library functions that starts with *Math*, followed by the function name after the period e.g. *Math.Sqrt ( )*. Table 3.10 shows a summary of common Math functions.

Table 3.10

Function	*Function Call*	*Description*
Round	z = Math.Round ( )	Returns the current date
Exp	z= Math.Exp(w)	Returns the exponential value of e^w
Sqr	z = Math.Sqr(w)	Returns the square root of w
Log	z = Math.Log(w)	Returns the natural logarithm of w
Str	z = Math.Str(w)	Converts value to string e.g Str(6.80) = "6.80"
Cos	z = Math.Cos(w)	Returns the cosine of w
Abs	z = Math.Abs(w)	Returns absolute value of w e.g Abs(-8) = 8
PI	z = Math.PI	Returns constant PI of 22/7 = 3.142...

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NB: The dollar sign may be used with the format function depending on the type of output required. In the last row of Table 3.11 above, the formatted output is displayed on a label.

Converting numeric string to value

If you enter a number in a text box it is treated as a string in Visual Basic. The best way to convert it from string into numeric value is to use the *Val* function. The *Val* function operates on the string and returns a numerical value. For example, if the name property of a text box is set to txtLength, then the input typed in it can be read converted into a numeric value and assigned to variable x as follows:

```
x = Val(txtLength.Text)
```

Converting numeric value to string

To convert a number to string (text) format, use Str( ) a particular variable

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Example 3.4: Quadratic function

Write a program complete with comments in VB that calculates and prints the roots of a quadratic equation using the formula:

Solution

1. Start Visual Basic and choose New project on the Start Page. Alternatively, add a new form in an existing project.
2. Use the Label, Textbox and button tools on the toolbox to design the form.
3. Change the name and text properties of the controls appropriately using a, b, c, root1 and root2:
4. Double click the OK button and insert the code between the Private Sub and End Sub as shown below:

```
Private Sub cmdOK_Click(.......) Handles cmdOK.Click
    Dim a, b, c, determ As Integer
    Dim root1, root2 As Single
    'convert coefficients a, b and c input to numeric values
    a = Val(txtCoeffa.Text)
    b = Val(txtCoeffb.Text)
    c = Val(txtCoeffc.Text)
    'first compute the value of the determinant
    determ = (b ^ 2) - (4 * a * c)
    root1 = (-b + Math.Sqrt(determ)) / (2 * a) 'use Sqrt function
    root2 = (-b - Math.Sqrt(determ)) / (2 * a) 'use Sqrt function
    'Assign the roots to the output textboxes after rounding off
    txtRoot1.Text = Math.Round(root1, 2) 'Round function to 2dp
    txtRoot2.Text = Math.Round(root2, 2)
End Sub
```

5. Once you run the program, the form such as shown in Figure 3.25 is displayed. Note that if the program tries to find square root of a negative value, the program displays NaN. This means Not a Numeral which in mathematics means; it is impossible. Such requires operation validation using control structure known selection discussed later.

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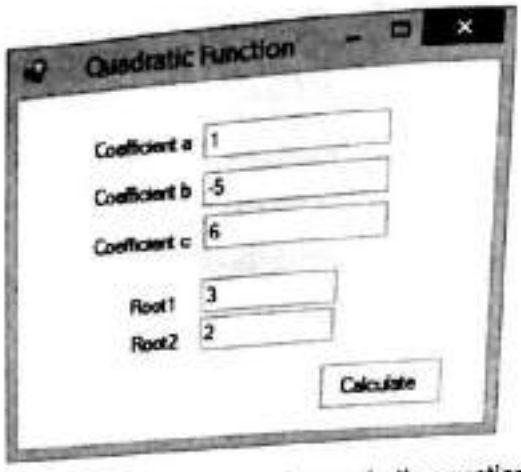

Fig. 3.25: Calculating roots of a quadratic equation

NB: According to precedence rule, b ^ 2 is evaluated first, followed by 4 * a * c. The difference in the brackets is finally divided by the product of 2 * a

Review Questions 3.3

1. Define the term variable as used in Visual Basic programming.
2. Explain why variables are important in a program.
3. Explain how the number 23 can be formatted for display to appear as 23.00.
4. Write a Visual Basic statement that rounds off the integer to the nearest the numeric value 2.67.
5. Define the following terms.
   (a) Variant.
   (b) String.
   (c) Argument.
   (d) User-define data type.
6. Explain how you would declare **A** as a variable for storing 6.789 in memory.
7. Define the term library function.
8. Convert the following statement to a comment: *IF statement makes decision.*
9. Explain the difference between using a comma (,) and a semi colon (;) in Print statement.
10. Write down how the following number will look like when the statement is executed: Print format $(sQuantity,"##,###")
11. Differentiate between numeric and string constants.
12. How can you declare the value 3.14 as a numeric constant in Visual Basic?

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13. Differentiate between Integer and Single data types.
14. Differentiate between procedural, and event-driven programming paradigms.
15. Explain the purpose of Visual Basic files that have the following extensions:
    (a) .vbp
    (b) .frm

3.10 Control Structures

In programming, control structures are constructs that determine the logical flow of execution of program statements. In this section, we discuss three types of control structures supported by most programming languages such as Visual Basic, Pascal and C++. These are sequence, selection and iteration (looping).The following section demonstrates how to write Visual Basic programs that implement the three control structures.

Sequence

In sequence control structure, the computer reads instructions from a program file starting from the first statement sequentially moving down to the last statement. Sample programs illustrated earlier in this unit are sequential program. Figure 3.26 shows how such programs executes statements one after another.

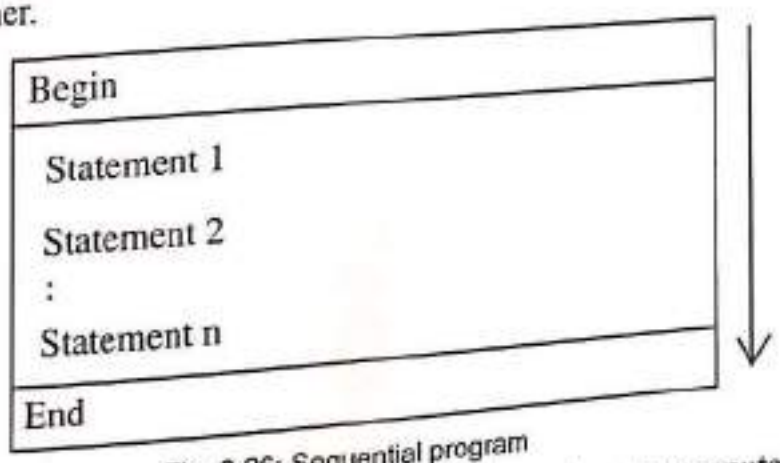

Fig. 3.26: Sequential program

Most programs that solve real world problems gives a computer ability to make a decision or execute statement(s) until a certain conditions is satisfied. In programming, making decision is referred to as selection while repeated execution of statements is referred to as iteration or looping.

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returns true or false. *evaluation* where the output is a boolean value true or false. Generally, there four types of selection statements used in Visual Basic programming:

1. IF ... THEN
2. IF ... ELSE
3. Nested IF.
4. Select .. case.

In the following sub section, we learn how to implement each of these selection constructs using pseudocodes, trace tables and sample Visual Basic programs.

IF Selection

IF ... THEN selection evaluates the statement within the selection body if the boolean value returned is true. In these case, if the boolean value is false, the statements are ignored. For example, in a school, the administration may decide to reward only those students who attain a mean mark of 80% and above. If a student scores 80% and above, he or she is rewarded while the rest are ignored. The general structure of IF...THEN selection is:

```
IF <condition> THEN
    <statements if true>
END IF
```

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```
Private Sub cmdOK_Click(.......) Handles cmdOK.Click
    Dim score As Integer
    Dim comment As String
    'convert the score in the textbox to values
    score = Val(txtScore.Text)
    If score >= 50 Then
        comment = "Pass"
        'display the remark pass or nothing
        txtRemark.Text = comment
    End If
End Sub
```

Once you run the program, the form such as shown in Figure 3.27 is displayed. Note that when you enter a score below 50, nothing is displayed in the Remarks textbox.

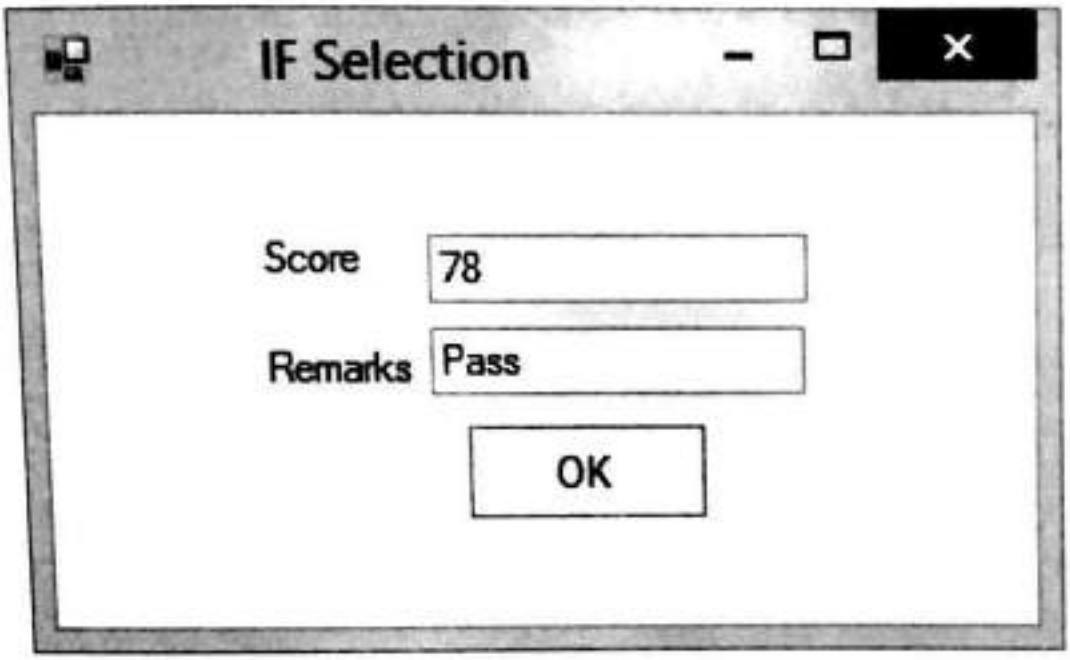

Fig. 3.27: IF selection

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Example 3.6: Decision on division

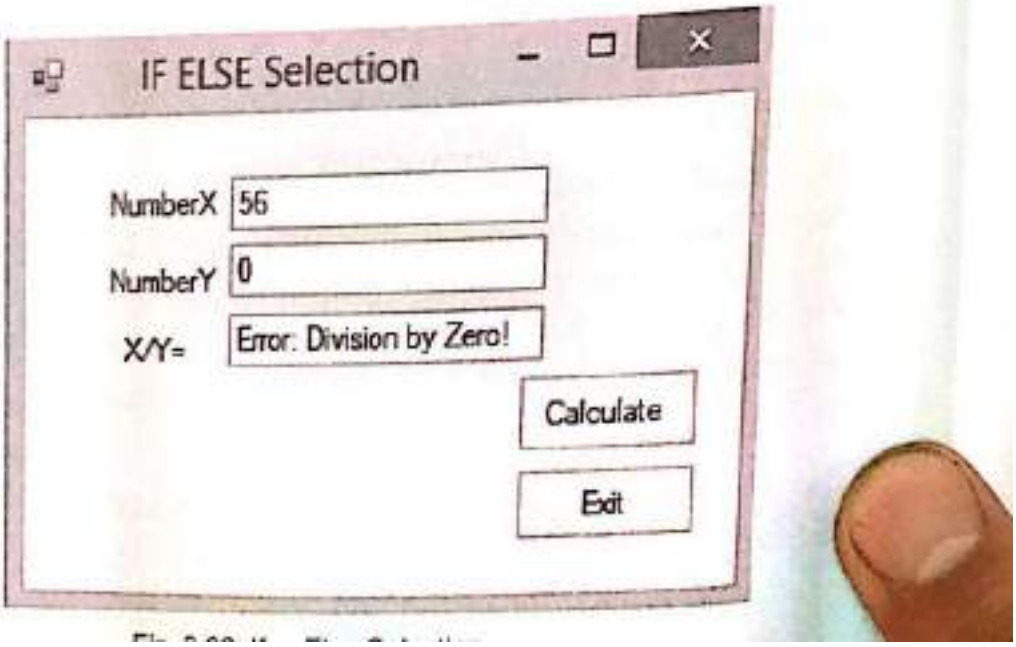
Write a program that prompts a user to enter two numbers x and y. The program then divides x by y as long as y is not zero. To avoid division by zero, if y is 0, the program should display an error message "Sorry: Division by Zero".

Solution

The following is a sample VB.Net program code that tests whether y is zero to avoid division by zero runtime error.

```
Private Sub cmdOK_Click(.......) Handles cmdOK.Click
    Dim num1, num2, sum As Integer
    Dim quotient As Single
    'convert the numbers in the textbox to values
    num1 = Val(txtX.Text)
    num2 = Val(txtY.Text)
    'compute the sum and average of num1 and num2
    If num2 = 0 Then
        'display an error message in the text boxes
        txtQuotient.Text = "Error: Division by Zero!"
Else 'if y is not zero, divide the number
        quotient = num1 / num2
        txtQuotient.Text = Str(quotient) 'convert to string
    End If
End Sub
```

Once you run the program, the form such as shown in Figure 3.28 is displayed



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Nested IF selection

Nested IF or the IF..ELSE...IF selection is used where two or more options have to be considered to make a selection. The general structure of the nested IF... THEN..ELSE selection is:

```
IF <condition> THEN
   <statements>
ELSE IF <condition> THEN
   <statements>
ELSE IF <condition> THEN
   <statements>
ELSE <condition> THEN
   <statements>
END IF
```

Example 3.7: Marks and Grade

The class teacher of Form 3 requested programming students to write a program that would be used to assign grades in five subjects. Using Visual Basic, write a program that would be used to perform the following tasks:

(a) Enter the names of each student and marks obtained in 5 subjects namely Mathematics, English, Biology, Chemistry and Computer Studies.

(b) After entering each subject mark, the program should calculate the total and average marks for each student.

(c) Depending on the average mark obtained, the program should assign grade as follows.

(i) Between 80 and 100: A

(ii) Between 70 and 79: B

(iii) Between 60 and 69: C

(iii) Below 60: D

(d) The program should then display the student's name, average mark and grade.

Solution

The following is a sample VB.Net program that implements nested IF selection to assign grade depending on average score obtained in five subjects. Note that the dashes indicates omitted arguments.

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```
    Dim maths, eng, bio, chem, comp
    Dim score As Single
    Dim Grade As Char
    'convert the inputs in the textboxes to values
    maths = Val(txtMaths.Text)
    eng = Val(txtEng.Text)
    bio = Val(txtBio.Text)
    chem = Val(txtChem.Text)
    comp = Val(txtComp.Text)
    'calculate total and average score
    total = maths + eng + bio + chem + comp
    score = total / 5
    'assign grade based on average score
    If score >= 80 Then
        Grade = "A" 'assign the grade to A
    ElseIf score >= 70 Then
        Grade = "B" 'assign the grade to B
    ElseIf score >= 60 Then
        Grade = "C" 'assign the grade to C
    Else
        Grade = "D"  'assign the grade to D
    End If
    'display total, average and grade
    txtTotal.Text = Str(total)
    txtAvg.Text = Str(score)
    txtGrade.Text = Grade
End Sub
```

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Once you run the program, the form such as shown in Figure 3.29 is displayed

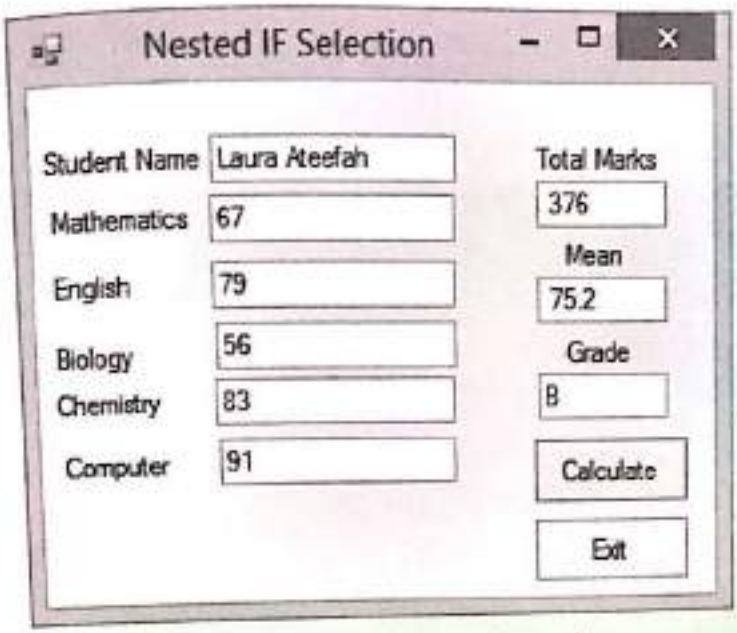

Fig. 3.29: Nested If selection to assign grade

Example 3.8: Employee's Payslip

The gross salary of employees of Balaka Bookshop is based on the basic salary and additional benefit as follows:

(a) Employees who have worked for the company for more than 10 years receive additional pay of 5% to their basic salary.

(b) Monthly salary bonus based on monthly sales of books as follows:

Monthly sales	Bonus Rate (%)
Above 500 000	15
Between 250 000 and 500 000	10
Below 250 000	5

Solution

The following is a sample VB.Net program that implements the program for calculating bonuses. Note that unlike the nested IF example for assigning grades, in this solution, the inner IF is embedded within if and else parts of the outer IF.

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```
Private Sub cmdCalc_Click()
    Const experience_rate As Double = 0.05
    Dim basicpay, gross, bonus, goodwill, sales As Double
    Dim experience As Single
    Dim Employee As String
    'convert the inputs in the textboxes to values
    Employee = txtName.Text
    basicpay = Val(txtBasic.Text)
    experience = Val(txtExperience.Text)
    sales = Val(txtSales.Text)
    'use nested if selection to determine gross pay}
    If experience > 10 Then 'check if experience is >10yrs
      If (sales > 500000) Then
        bonus = sales * 0.15
        goodwill = basicpay * experience_rate
        gross = basicpay + bonus + goodwill
      ElseIf (sales >= 250000) Then
        bonus = sales * 0.1
        goodwill = basicpay * experience_rate
        gross = basicpay + bonus + goodwill
      Else
        bonus = sales * 0.05
        goodwill = basicpay * experience_rate
        gross = basicpay + bonus + goodwill
      End If
    Else 'if experince < 10 years process gross pay here
      If (sales > 500000) Then
        bonus = sales * 0.15
        gross = basicpay + bonus
      ElseIf (sales >= 250000) Then
        bonus = sales * 0.1
        gross = basicpay + bonus
      Else
        bonus = sales * 0.05
        gross = basicpay + bonus
      End If
```

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```
End If
txtTotal.Text = Str(gross)
txtCommision.Text = Str(bonus)
txtExp.Text = Str(goodwill)
End Sub
```

Once you run the program, the form such as shown in Figure 3.30 is displayed

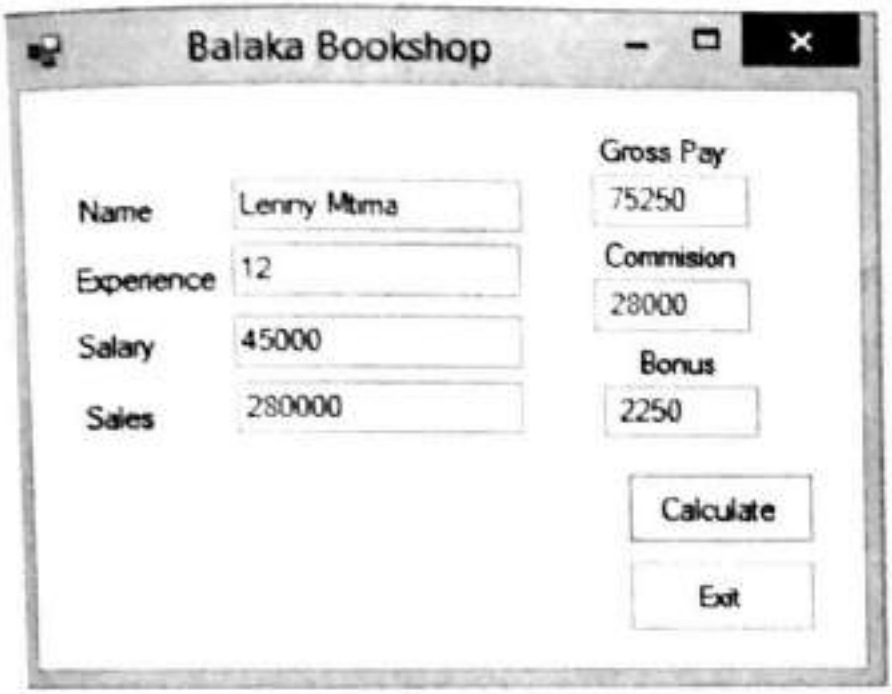

Figure 3.30: Nested if selection to compute bonus

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Example 3.9: Exam performance

Using Select Case control, write a program that displays the the following remarks depending examination grade awarded:

A: Comment = 'Excellent!'
B: Comment = 'Good'
C: Comment = 'Fair'
D: Comment = 'Poor'

Solution

The following is a sample VB.Net program that implements Select Case to assign remarks depending on grade obtained.

```
Private Sub cmdOK_Click(.......) Handles cmdOK.Click
    Dim comment As String
    Dim Grade As Char
    Grade = txtScore.Text  'assign score in textbox to Grade
    Select Case Grade
      Case "A", "a" 'takes care of uppercase and lower case
        comment = "Excellent" 'assign comment excellent
      Case "B", "b"
        comment = "Good" 'assign comment Good
      Case "C", "c"
        comment = "Fair" 'assign comment Fair
      Case "D", "d"
        comment = "Poor" 'assign comment Poor
      Case Else
        comment = "Invalid grade"
    End Select
    'display the remark to pass or fail
    txtRemark.Text = comment
  End Sub
```


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Looping

Many real world programs require a statement or group of statements to be executed several times until a condition is satisfied. This repeated execution of program statement(s) is referred to as looping or iteration. In other words, a loop is a control structure that causes program statement or statements to be executed several times.

For example, assume that you are writing a program that calculates cummulative sum of five subjects for five students. To calculate the total score for each student, the program repeatedly reads each student marks in five subject and then calculates the total. Visual Basic language has five types of looping control structures:

(a) Do While....Loop
(b) While ... Wend
(c) Do....Loop While
(d) Do Until....Loop
(e) For.. Next

Do WHILE ....loop

The Do While loop is used if a condition has to be met before the statements within the loop are executed. This type of loop uses a pre-test condition to determine if statements are to be executed zero or more times. For example, in

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Example 3.10: Cummulative sum and average

Write a Visual Basic program that displays total count of the first ten numbers (0,2, ...9), their sum and average using the Do While ... Loop.

Solution

1. Start Visual Basic and choose New project on the Start Page. Alternatively, add a new form in existing project.
2. From the toolbox, use the Label, Textbox and button tools to design the form
3. Change the name and text properties of the textboxes and command button
4. Double click the button and insert the code below in the Private Sub section.

```
Private Sub cmdCount_Click(.....) Handles cmdCount.Click
Dim number As Integer
Dim sum As Integer
Dim Average As Double
number = 0 'assign initial value as 0
sum = 0 'initial value of sum is 0
Do While number < 10 'test if true
    sum = sum + number
    number = number + 1
    txtCount.Text = Str(number)
```

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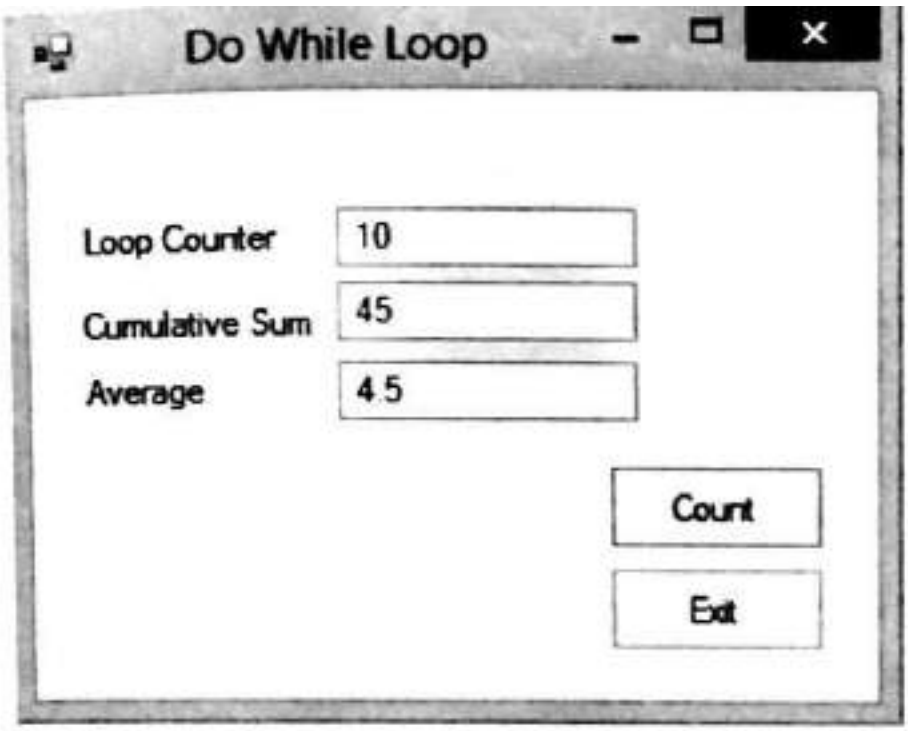

Figure 3.32: Do While Loop

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Practical Activity 3.1

1. Rewrite the program for counting the first ten numbers, and then displays their sum and average using While ...Wend.
2. Rewrite the program for counting the first ten numbers, and then displays their sum and average using the Do Until...Loop construct

Do ... Loop While

Unlike the While loop, Do..Until loop executes the statements within the loop at least once. This is because, this type of loop uses a post-test condition at the end of the loop block. For example, in the case of an ATM cash withdrawal, if Do .. Loop Until is used and the customer balance was zero, the machine

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Example 3.11: Sum and Average

Using the Do.. Loop While control structure, write a program that displays total count of the first ten numbers (0,2, ...9), their sum and average in seperate text boxes.

Solution

1. Start Visual Basic and choose New project on the Start Page. Alternatively, add a new form in to an existing project.
2. From the toolbox, use the Label, Textbox and button tools to design the form
3. Change the name and text properties of the textboxes and command button
4. Double click the count button and then insert the code below in the Private Sub section.

```
Private Sub cmdCount_Click(.....) Handles cmdCount.Click
    Dim number As Integer
    Dim sum As Integer
    Dim Average As Double
    number = 0 'assign initial value as 0
    sum = 0 'initial value of sum is 0
    Do 'the loop starts her
      sum = sum + number
      number = number + 1
      txtCount.Text = Str(number)
    Loop While number < 10 'truth condition tested here
    Average = sum / number
    'display count, sum and average
    txtSum.Text = Str(sum)
    txtAverage.Text = Str(Average)
  End Sub
```

5. Once you run the program, the form such as shown previously in Figure 3.32

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predefined as 10. The loop executes the statements within the loop ten times before the total sum is displayed. The general format of the For.. Next loop is:

```
For index = lowerlimit To upperlimit   STEP <index>
    <statements>
Next index
```

Note that the STEP part controls the looping such that you can count in increments of 1, 2, 3 etc, For example, to set count to even counts starting from zero, use the following STEP index:

```
For count = 0 To 9 STEP 2
    <statements>
Next index
```

Generally, the For ..Next loop that executes the statements within the loop ten times functions as follows:

1. A variable e.g. count is first initialised to the lower limit, e.g. Index is assigned to Ø.
2. The lower limit is then tested against the upper limit e.g. 9.
3. If the lower limit is less than or equal to the upper limit, the program executes the statements inside the body of loop.
4. If the lower limit is less than the upper limit, the count variable is incremented by 1 and assigned to count, i.e. *count = count + 1* .
5. If the lower limit is tested against the upper limit and found to be greater, the program exits from the loop.

Worked Example 3.12: Sum and Average

Using the For.. Next construct, write a program that displays 50 natural numbers on the form i.e (0,2, ...49), their sum and average.

Solution

1. Start Visual Basic and choose New project on the Start Page. Alternatively, add a new form in to an existing project.
2. From the toolbox, use the Label, Textbox and button tools to design the form
3. Change the name and text properties of the textboxes and command button
4. Double click the count button and insert the code below in the Private Sub section:

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```
Private Sub cmdCount_Click(.....) Handles cmdCount.Click
    Dim number As Integer
    Dim sum As Integer
    Dim Average As Double
    sum = 0 'initial value of sum is 0
    For x = 0 To 49 'step is ignored so increments by 1
        sum = sum + number
        number = number + 1
    txtCount.Text = Str(number) 'diplay count
    Next
    Average = sum / number
    'display count, sum and average
    txtSum.Text = Str(sum)
    txtAverage.Text = Str(Average)
End Sub
```

5. Once you run the program, the form such as shown in Figure 3.33 is displayed.

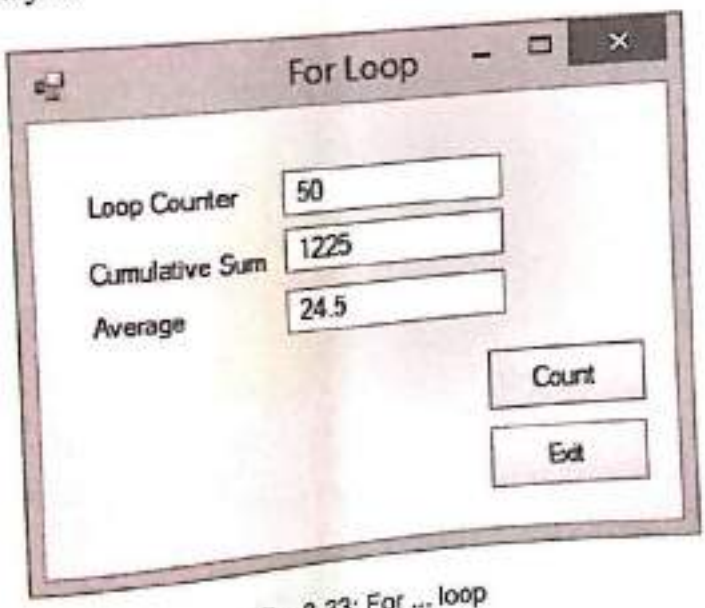

Fig. 3.33: For ... loop

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Review Questions 3.4

1. Define the term selection in relation to program control structures.
2. State three types of control structures used in programming.
3. Differentiate between looping and selection.
4. In what circumstance does looping control depend on decision?
5. List four types of selection controls used in Visual Basic programming.

Revision Exercise 3

1. Define the term reserved word.
2. Explain why Visual Basic belongs to the fourth generation programming language.
3. List three examples of fourth generation programming languages.
4. Describe the features of fifth generation languages.
5. Define the term visual programming.
6. (a) State two reasons for documenting all the stages of program development.
   (b) Give three types of program documentation in reference to programming.
7. Write general syntax showing the structure of the following:
   (a) Nested IF.
   (b) For loop.
   (c) Repeat ..Until.
9. Write a program that would enable the user to enter student marks. The program should then determine whether the mark entered is a pass or fail given that the pass mark is 50.
10. Write a program that prompts for **n** numbers, accumulates the sum and then computes average. The program output should be the total sum and average.
11. Write a program that reads temperature in degrees celcius for each day of the week. The program converts the celsius into fareinheits, calculates the average weekly temperature and displays the results in degrees fareinheits.

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Fensani deposited [illegible] in a bank at an interest rate of 11% per annum. At the end of each year, the interest earned is added to the principal and the new amount becomes the principal amount for the next year. Write a program that calculates principal amount and interest after seven years.

Mesi took a loan of 1,200,000 Kwacha from a bank at an annual interest rate of 12% payable in four years. To develop a computer program that will keep track of monthly repayments:

(a) Identify the input, processing and output requirements for the program.
(b) Write a program in Visual Basic that would be used to track monthly repayments.

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4: INTRODUCTION TO COMMUNICATION TECHNOLOGIES

Core element

Communication Networks

Outcome

The students will be able to apply the knowledge and skills of communication technologies in their daily lives.

Success Criteria

By the end of this unit, you must be able to:

- *Define the term, communication, data communication, telecommunication and network*
- *Trace the history of the telephone, cellular and internet communication technologies*
- *Outline the uses of networks*
- *State the elements of communication systems*
- *List network devices*
- *Explain how data signals are transmitted*
- *Discuss data transmission media*
- *Differentiate parallel and serial data transmission techniques*
- *Explain simplex, half duplex and full duplex*

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Chapter Outline

4.1 *Introduction*
4.2 *Definition of terms*
4.3 *History of the telephone and the internet*
4.4 *Uses of networks*
4.5 *Advantages of networks*
4.6 *Limitations of networks*
4.7 *Elements of communication systems*
4.8 *Network devices*
4.9 *Data signal transmission*
4.10 *Data transmission media*
4.11 *Data transmission modes*

ntroduction

lumans are social beings and hence they have an inherent need to

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Data communication

Data communication refers to the process of transmitting data signals from one point to another through communication channel. If all aspects relating to data communication are taken into consideration, computer networking is the most recent, efficient and reliable means of transmitting data.

Telecommunication

Telecommunication is the use of technology to enable exchange of messages in form of data and information over a wired or wireless communication media. Telecommunication technologies include use of telegraph, telephone, radio, television and computers.

Telecommunication network

A telecommunication network is an interconnection of telecommunication equipment like telephones, mobiles, radios, televisions and computers using transmission media or links. The network enables the flow of data or information from the source to destination.

Computer network

A computer network is an interconnection of computers using transmission media and networking devices to enable exchange of data and information.

Information and communication technology

Information and communication technology (ICT) refers to the convergence of computer networks with telecommunication networks like telephone, mobiles, radio, television to provide a communication platform through which people can share information. Today, ICT provides all forms of ubiquitous electronic communication such as mobile internet, electronic commerce, instant messaging, electronic mail, internet radio and digital television broadcasts.

43 History of telephone and internet

History of telephones

Telephone was invented after the telegraph. Telegraph that had been in use for a while used a series of dots and dashes (beeps) coded as electrical signals to transmit text characters over long distances. Alexander Graham Bell who had been working to improve the telegraph announced invention of the telephone in 1876. After Bell's invention, the historical evolution of

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the telephone can be traced back using models that have come up over time. We shall generalise this evolution under the following three categories:

1. Rotary dial telephones.
2. Touch tone dial telephone.
3. Mobile telephone.

Rotary dial telephones

Rotary dial telephones were the first phones to be manufactured and were used from around 1919 upto 1990's. To use the phone, one had to use a rotary dial. Although they have virtually become obsolete, it is not uncommon to find them in some government offices and homes. The pictures in Figure 4.1 below shows examples of rotary dial phones.

(a) (b) (c)

Fig. 4.1: (a) 102 series phone: 1927 (b) Mediterranian phone: 1972
(c) Model 500: 1949

Touch tone dial telephone

Touch tone phones do not have a rotary dial but push button key pads. They came to the scene in the 1950s and are in use even today. They are called touch tone dial phones because each button produces a unique sound when pressed, a feature which is common in mobile phones. The pictures in Figure 4.2 depict some examples of touch tone dial phones.

Fig. 4.2: Touch tone phones

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on the network. Currently, there are several types of mobile phones that may be classified into four categories:

1. *Basic/conventional mobile phone:* These are mobile phones designed just to make calls and send text messages but it may have a few monochrome games. Basic phones are characterised by small, low resolution screen, physical keypad, limited memory capacity and low processing power. However, some of the advanced basic phones may have colour screen, low resolution camera, QWERTY keypad and ability to access internet. Figure 4.3 shows examples of basic mobile phones.

Fig. 4.3: Examples of basic phones

2. *Touch screen feature phones:* Touch screen feature phones have wide touch screen and ability to process graphics in full colour. A feature phone can connect to high speed internet because it has higher memory capacity, and powerful processor than basic phones. Touch screen phones also have better resolution screens with higher resolution cameras. Figure 4.4 shows some examples of touch screen feature phones.

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Fig. 4.4: Touch Screen Feature Phone

3. *Smartphone*: Smartphones have advanced features that make them operate like portable computers. Generally, smartphones are characterised by:

   (a) Powerful processor and large touch screen.

   (b) Powerful operating system which makes the phone operate like a computer. This is why Android, iOS and Windows phones have ability to run advanced applications like office documents, PDF readers, video, games and maps.

   (c) It has a high memory capacity enabling processing of memory intensive programs and data. Has ability to access high speed Internet and stream online videos.

   (d) High resolution cameras with ability to take high definition pictures and videos.

Figure 4.5 shows an example of a smartphone. Note that, smartphones also have touch sensitive screens.

Fig. 4.5: Smartphone

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4. *Tablets:* A tablet is one of the latest mobile devices that falls between a smartphone and a computer in terms of size and processing power. This is why it is regarded as a portable computer that uses touch sensitive screen to interact with the user. Most tablets have a slot where a SIM card can be inserted in order for it to support mobile communications like voice calls, text messaging and internet access over mobile networks. Generally, tablets are characterised by the following features:
   (a) A large touch screen, bigger that of a smartphone.
   (b) Large internal memory capacity.
   (c) Powerful processor, more powerful than that of smartphones.
   (d) Ability to run several applications and connect to high speed internet.
   (e) High resolution screen and camera capable of taking high quality pictures and videos. Fig. 4.6 shows an example of a typical 10" Screen tablet.

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Fig. 4.6: Tablets.

History of internet

The idea of the internet started in the 1960's among a few visionaries at the Massachusets Institute of Technology (MIT) and University of Carlifornia, Los Angeles (UCLA). It was Leonard Kleinrock of MIT and later UCLA who suggested a global network of computers based on packet switching technology in his PhD work. He called the network the "galactic network" and envisioned a globally interconnected computer networks that would enable people to access data and programs worldwide. J.C.R. Licklinder of UCLA who knew about this proposal joined the Department of Defenese to spearhead the Defense Advanced Research Projects Agency (DARPA) which later became Advanced Research Project Administration (ARPA) that created ARPANET in 1969. This was the first internet based packet switching network connecting UCLA, University of California Santa Barbara (UCSB), Stanford Research Institute and University of Utah.

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... high speed backbone network system (vBNS) but NSF continued to pursue internet research. Since then, the internet spread quickly to the rest of the world. By 2001, we had approximately 110,000,000 internet hosts. Currently, ITU estimates that the internet has approximately 1.3 billion hosts globally. The number of internet users globally is approximately 3 billion and growing rapidly as businesses and individuals connect to enjoy e-Commerce, instant messaging, social networks, telecommuting, email etc.

4.4 Uses of networks

Computer networks support many services and applications in the modern society. Some of the uses of networks include electronic banking (e-banking), internet access at home and work, point of sale (POS) applications, mobile

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Fig. 4.7: ATM Machine

2. Internet banking

   Customers can perform transactions and view their statements online. Usually, the user can register with an organisation like VISA or Mastercard in order to perform online transactions on internet.

3. Mobile banking

   Mobile phones can now be used to access the bank account of a customer to withdraw, deposit and transfer cash. Furthermore, mobile to mobile cash transfer is also possible without necessarily having to access the bank account.

Internet access at home and work

Computer networks have enabled access to information held on the internet both at home and work place. Using computers, laptops, tablets and mobile phones, more people are able to access internet using physical and wireless means. This supports research, access to e-health services, and electronic commerce.

E-commerce

The spread of computer networks and internet has enabled e-commerce whereby people buy and sell goods and services online. If mobile phone is used to access electronic commerce services, it is called mobile commerce (m-commerce)

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Point-of-sale (POS) services

Computer networks enable people to pay for goods purchased in retail stores using electronic money at the point of sale. Using mobile cash transfer or bank cards like VISA, Mastercards etc, a cashless transfer can be made by the buyer to pay for goods and services.

Mobile communications

Mobile networks can be viewed as wireless computer networks. Note that a mobile phone is a special purpose computer whose task is to enable communication. Therefore, mobile networks facilitates communications and delivery of services like voice, data and money transfers.

Electronic government

Computer networks are enabling governments to deliver electronic services to the citizens e.g. payment of taxes, international trade, applications for government documents, electronic identities and passports. This access to citizens and companies data is enabling governments to offer efficient services to the citizens.

4.5 Benefits of networks

Some of the benefits of using computer networks include: *resource sharing, remote communication, distributed processing facilities, cost effectiveness* and *reliability*.

Resource sharing

A resource in the network environment means chat, files, printers, modems, communication links, storage devices, fax machines, programs and other component that can be shared on the network. Resource sharing enables sharing of files, exchange of mails, sending faxes and printing. Centralised access to data and information leads to less waste of time and hence greater

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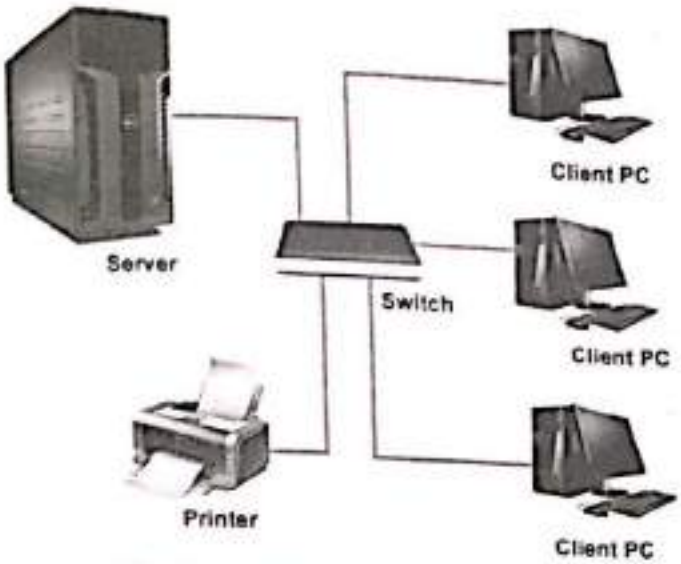

Fig. 4.8: A server on a network

Imagine the benefits of a user being able to directly fax a document from the softcopy rather than having to print it out, then feed it into the fax machine.

In computer networks, shared resources may be attached to a network server. The other computers on the network that send requests to the server are referred to as clients or workstations. Network server runs a special program called the *server software* which controls computers on the network and *listens to* client is request to be served. For example, a print server gives permission for a particular client to print documents on the network printer.

Remote communications

In the present computing environment, computer engineers are faced with two problems.

1. Roaming of officers who by virtue of their work keep on covering long distances away from the workplace.
2. Solving the problem of remote access to the organisation's information so that they can have up-to-dated content or update the information on servers with data collected from the field.

The problem of roaming has been addressed by development of portable computers like laptops. But the problem of access to the network has been addressed by *remote communication*. Remote communication refers to the transmission of data signals between two communication devices located in different geographical. A computer that tries to access resources from another computer on the network is called a *remote client* while the computer being accessed is called a *remote server*. Remote communication has been made possible by use of wireless communication media such as radio waves,

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microwave, and satellite discussed in details later.

It is through remote communication that people can be able to share information and pass messages over the Internet. This is because remote communications give a lot of freedom to the network users which translates to more productivity. Imagine continuing to work from home just as if you were in your office.

Distributed processing

Distributed processing refers to processing of data by interconnected computers located in different geographical locations. In distributed processing, users may not realize that processing is distributed but will think that everything is taking place on their own computers. The output can then be transmitted to another computer or the central server on an organisations network. Before the advent of distributed processing, many organisations had centralised systems of management. This meant that data or information was sent from the *dumb terminal* (workstation with no processing power) for processing and storage by a central server.

With distributed processing, files reside on the user's computer rather than on a central server. This makes it possible for branch offices in a large organisation have their own servers that store data, information and other resources required for the daily operations. This servers would then periodically update the central computer. This model of data processing has a number of advantages:

1. The failure of the central computer does not affect the operations of the other terminals.
2. Processing load is shared equally hence no time wastage.

Cost-effectiveness

Networks are cost effective in the organisation. Although the initial purchase and laying down of network components may be expensive, savings experienced and the value added to service delivery make them suitable for managers.

One good thing about a network is that it greatly increases the efficient use of scarce resources. Imagine a large organisation that has stand alones computers only. In such a case, the management has to buy a printer for each computer. However, with a computer network, only one printer is sufficient. The same applies to other resources like fax machines, optical drives, files and applications.

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It should also be noted that computer networks have enhanced daily communication by providing a paperless communication environment. Users can send electronic messages and mail to each other instead of having to bear the cost of stamp duty or physical delivery charges. On the same note, company executives may not need to travel across continents to hold meetings. They can hold *video conferences* instead and save on travelling expenses.

Reliability

A computer network is reliable in two ways especially when communicating or accessing information:

1. Data can be transferred with minimal or no error from source to destination.
2. In case one computer breaks down, the user can still access data and information from other computers using other devices such as on the tablets and mobile phones.

4.6 Limitations of networks

Although computer networks have several advantages, they also offer many challenges that are associated with implementation and sociocultural factors. Some of the limitations and disadvantages of networks include *security issues, high initial installation cost, moral and cultural effects, spread of terrorism, and drug trafficking, and over reliance on networks.*

Security issues

Data and information transmitted over a computer network is prone to illegal access than if the computer was not on the network. For example, a stand alone computer may be accessed by only few people at home or in the office environment. However, once the computer is connected to the network, especially internet, many people can access its content. Apart from this, when information is sent over the network from source to destination, it can be tapped by unauthorised users.

Some organisations find it very challenging to secure information systems from constant threats of illegal access. One of the common methods of data protection in a networked environment is *encryption*. Encrypted data cannot be understood by people who illegally access it unless they have the decryption key.

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High initial cost

The initial cost of buying network hardware and software may be very high. In fact, most academic institutions that have not set up their networks will more often than not quote cost as the limiting factor.

Sociocultural effects

The Internet has chatrooms and messaging services that enable under age children to meet peers and adults on the *internet* some of whom may be morally spoiled. Access to pornographic and other negative material has also made the fight against social problems such as HIV/AIDS, pre-marital sex, as well as drugs and substance abuse more complicated.

Spread of terrorism and drug trafficking

Internet provides a good environment for the spread of illegal activities such as terrorism and drug trafficking. The easy flow of information from one place to another make even those who are on the wrong side of the law communicate easily. Terrorists and drug traffickers use information networks for their business communications. However, many countries have come up with methods of policing the Internet to try and break such syndicates.

Over-reliance on networks

Most organisations today have phased out manual operations This means that their business processes depend on computer networks. The disadvantage of this overeliance is that, if by any chance the network fails or goes down, all systems in the organisation are brought to a halt!

Review Questions 4.1

1. List four types of network systems that are not computer-based networks.
2. Define the following:
   (a) Communication network
   (b) Computer network
   (c) Information communication technology.
3. Define the term data communication.
4. Briefly highlight the historical development of telephones.
5. State four uses of communication networks.

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6. Give two disadvantages of computer networks.
7. Differentiate between network server and a workstation.
8. Explain the concept of distributed processing in networking.
9. Why is a network more reliable than stand alone computers?
10. Explain the three most common types of computer networks in use today.
11. What is a "resource" in networking?
12. Differentiate between rotary dial and push button phone.
13. What is a touch tone phone?
14. Write the following in full: (a) ARPANET (b) Internet
15. In which year was electronic mail and web services made available on the internet?

4.7 Elements of communication systems

A communication system consists of terminal devices, communication channels, and transmission media that enable exchange of messages between users of the system. A communication system has the following elements:

1. Message source
2. Transmitter
3. Communication channel
4. Receivers
5. Message user

Message source

This is the person who wants to send the message across the communication system. The message source may want to make a telephone call, send email, chat etc.

Transmitter

Transmitter refers to a terminal equipment that receives a message from the source and converts it to a format that can be transmitted on the channel A transmitter could be a computer, radio or TV transmitter station in broadcasting stations.

Communication channel

A communication channel is a transmission media through which data and

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over long distances.

Receivers

A receiver is a terminal equipment that gets the transmitted message from the channel and decodes it before presenting it to the user. It could be a computer, mobile phone, radio tuner etc.

Message user

This is the person who is the target recipient of the message. The message is important to the user. Figure 4.9 is a block diagram depicting the elements of a communication system.

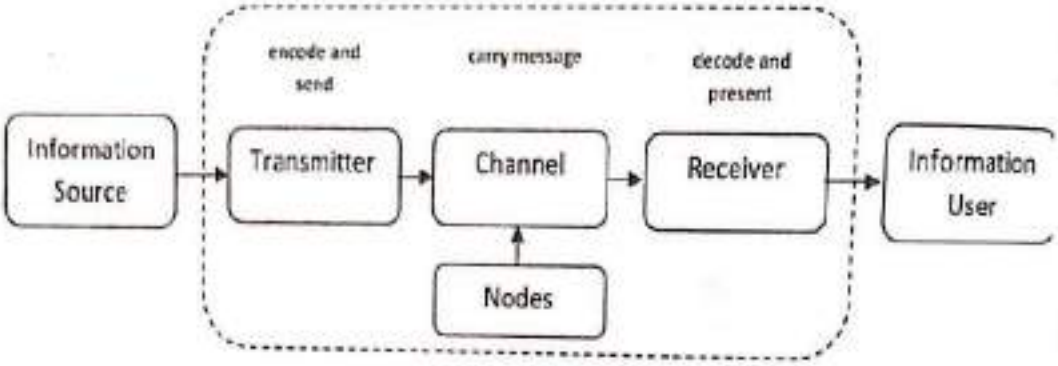

Fig. 4.9: Communication system

4.6 Networking devices

A communication network is made up of several devices. These devices are enable transmission of data signals from the source to the destination. Generally, devices connected to data communication medium on a computer network can be classified into two broad categories:

1. Terminal Equipment (DTE)
2. Data Circuit-terminating Equipment (DCE).

Data Terminal Equipment

Data terminal equipment (DTE) is a device at both ends of the communication network that converts user information into signals at the source or reconvert signals received at the destination. Examples of DTEs, include desktop computers, mobile phones, laptops, tablets and personal digital assistants (PDAs).

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Data Circuit-terminating Equipment

Data Circuit-terminating Equipment (DCE) also known as Data Communication Equipment refers to devices used to establish, maintain and terminate communication sessions between DTE (data source) and its destination. In other words, DCE is an interface between data terminal equipment and communication media. Some examples of DCEs include *network interface cards (NIC), modems and codecs, hubs, bridges, repeaters, routers, gateways, switches* and *access points*. In this section, we briefly discuss some of these DCEs.

Network interface cards

Network interface cards (NIC) create a physical connection between the computer and the transmission media. An network interface cards is plugged into an empty expansion slot on the motherboard. However, most computer motherboards today come ready with an onboard network interface controller. The network interface cards has ports at the back in which the terminated end of a network cable can be plugged. Figure 4.10 shows an illustration of a network interface card.

Fig. 4.10: Network interface card

Modems and codecs

Modems and Codecs are important devices in the world of communication. ... from digital to analog form before transmission

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convert the signal to original form. A modem can be *external*, an *add-on* card or built on the motherboard. Figure 4.11 shows examples of external modems.

External modem

3G wireless modem

Fig. 4.11: External modem and wireless modem

Hubs

A hub also called a concentrator is a component that connects computers on a local area network and is able to relay signals from one computer to another. A hub usually connect networks that have common *architecture* i.e. one that has the same set of communication software called *protocols*. Protocols refers to set of rules that govern communication between devices on a network. Figure 4.12 shows an illustration of the hub.

Fig. 4.12: Hub

A hub transmits signals by broadcasting them to all the computers on the network. After the signal is broadcasted, the computer whose address is on the message picks the message from the network that is part of the broadcast domain. Some hubs called *intelligent hubs* are able to monitor the way computers are communicating on the network and keep the information in a small database of their own called *management information base (MIB)*. The network server can then use this information to fine-tune the network performance. *Intelligent hubs* can be able to manage a network by isolating computers that are not functioning properly. Several hubs can be connected together one after another to expand a network. However, this increases the broadcast range which may lead to *broadcast storms* on the network. The term broadcast storm refers to a condition where a network is overwhelmed with message broadcasts due to malfunctioning of network interface cards or hub related problems.

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Bridges

A bridge is a network device that determines the appropriate network segment for which a message is meant for delivery through address filtering. A bridge can divide a busy network into segments to reduce network traffic. The purpose of using a bridge is to:

1. Extend the length and number of stations that a segment can support.
2. Reduce overall traffic flow by allowing broadcasts only in the data destination segment of the network.

A bridge makes sure that packets that are not meant for a particular segment are not broadcasted in that segment. Figure 4.13 shows a network that is segmented by a bridge.

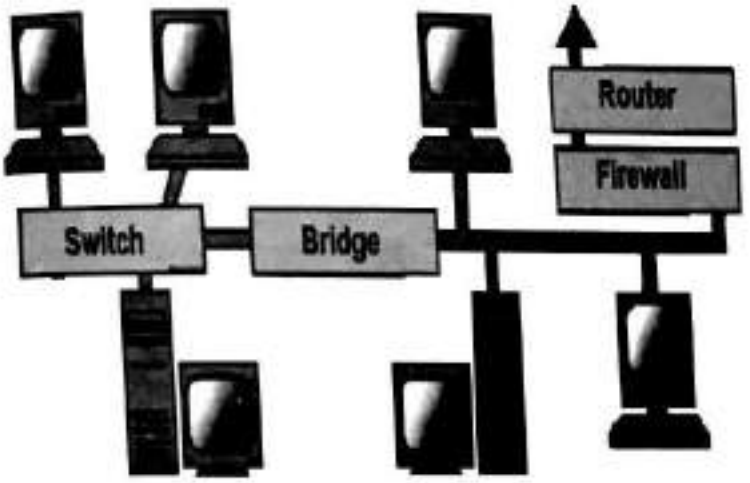

Fig. 4.13: Network segmented by a bridge

Repeaters

A repeater receives data signal from one segment of a network, cleans it to remove any distortion, boosts it and then sends it to another segment. Using repeaters is the simplest way to expand a network because they broadcast the same message to other network segments. However, repeaters should be used with some reservation because they expand the broadcast domain, which may lead to broadcast storms on the network. A broadcast storm is a condition whereby the network is is oversaturated with messages making communication impossible. Nevertheless, use of repeaters enable the network to eliminate attenuation problems.

Routers

A router is a device that interconnects different networks and directs the transfer of data packets from source to destination. Routing depends on

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network addresses. Each network has a unique identifier or address called the *network address*. All the computers on the same network have the same network address but different host numbers. The router receives a packet from a device on the *network* and checks the destination's network address. If the address is the same as the one on which the router is, it passes the data packet to the destination by reading the host address otherwise the packet is routed to the specified network address. Figure 4.14 shows an example of a router. Some devices called **brouters** combine the functionality of a bridge and a router.

Fig. 4.14: Router

Gateways

A gateway is a device that is configured to provide access to devices on wide area network or Internet. One such device is the router in which gateway software is installed. Because of this reason most people confuse a gateway with a router but a gateway may not be necessarily be a router. It may be a computer configured to access the Internet. A gateway is the most powerful internetwork device because of its ability to convert data across different network architectures and protocols. Figure 4.15 shows a logical diagram of a local area network connected to a wide area network via gateways.

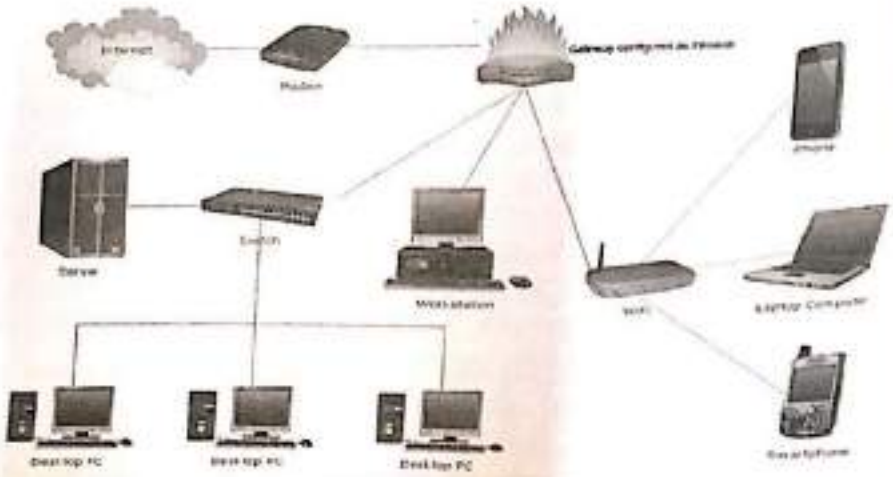

Fig. 4.15: Gateway

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Switches

A switch is a device that forwards a packet directly to addressed node without broadcasting. A node refers to a data terminal equipment such as a workstation or a computer on the network. A switch transmits data by connecting two nodes *point-to-point* as if they were linked by a cable directly. This reduces the broadcast problems on the networks. It is important to note that some hubs also incorporate switching mechanisms. Such a hub is referred to as a *switching hub*.

Typically, switches are more expensive than ordinary hubs. This means that one switch may be used as a bridge to connect several hubs in order to reduce collision problems caused by broadcasts. Figure 4.16 shows how a switch can be used to connect computers in a local area network.

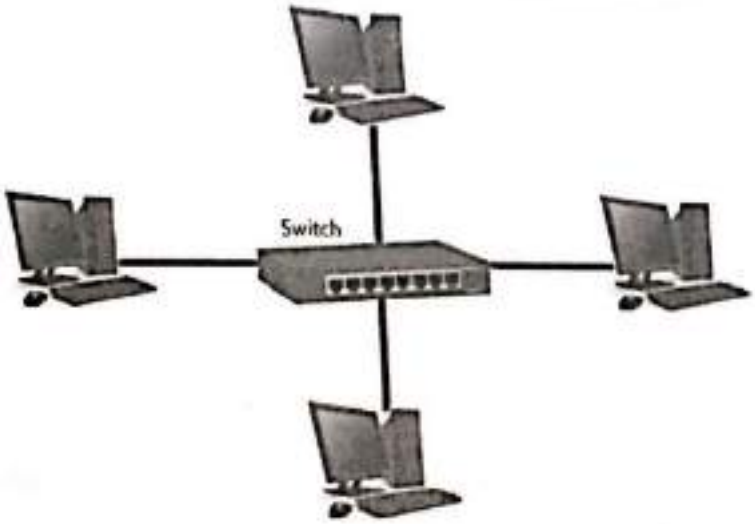

Fig. 4.16: Diagram of a switch

Wireless communication devices

For a long time, networks have been implemented using physical transmission media like cables. However, as the cost of wireless technology goes down and the quality of service increases, it is becoming cost-effective for companies and individuals to extend the capability of wired networks by integrating wireless segments into their communications. Some of the most common devices used in wireless communication include wireless access points, and the antenna.

Wireless access points

Wireless access point shown in Fig 4.17 is one of the most common network components (See Figure 4.17) used to extend local area network. As its name suggests, it is an access point to a wired network for people who have

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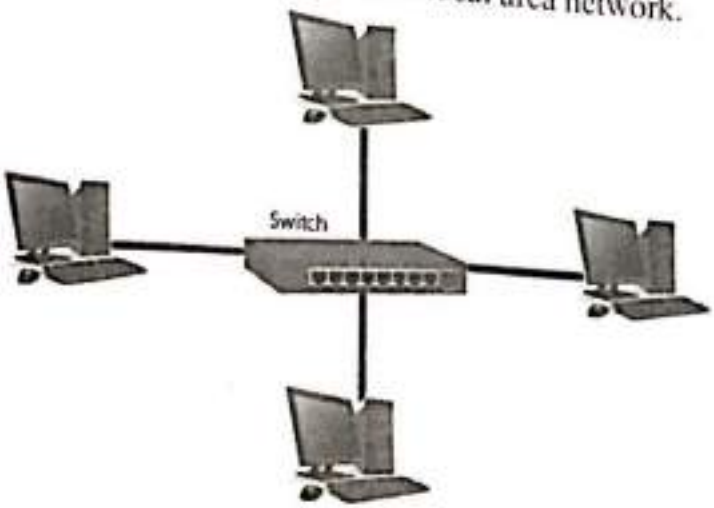

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wireless devices such as smartphones, personal digital assistants (PDA), laptops and desktop computers.

Fig. 4.17: Wireless access point

Wireless antennae

Wireless antenna such as nano station is a device mounted indoors or outdoo to extend wireless network to the surrounding buildings. It is used to propaga radiowaves, microwave or infrared waves that carry data to be received b access points in the surrounding.

PCMCIA card

A *personal computer memory card international association* (PCMCIA adapter is an add-on card inserted into a device such as personal digit assistants or a laptop in order to enable wireless communication between th devices and a wired network server. Figure 4.18 shows a sample PCMCI adapter for connecting a laptop to RJ 45 cable connector.

Fig. 4.18: PCMCIA Adapter

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4.9 Data signal transmission

Terms used in data signal transmission

Some of the terms used in data communication include: *data signal, signal modulation and demodulation, multiplexing, bandwidth, baseband, broadband transmission and attenuation.*

Data signal: A data signal refers to a voltage level in the circuit which represents the flow of data. In data communication, data signals can either be *analog* or *digital* in nature. Analog data is made up of continuous waveform while digital data is made up of a non-continuous discrete signal.

Figure 4.19(a) shows a digital signal represented graphically as a square wave, while Figure 4.19(b) shows an analog signal represented as a continuous sine wave.

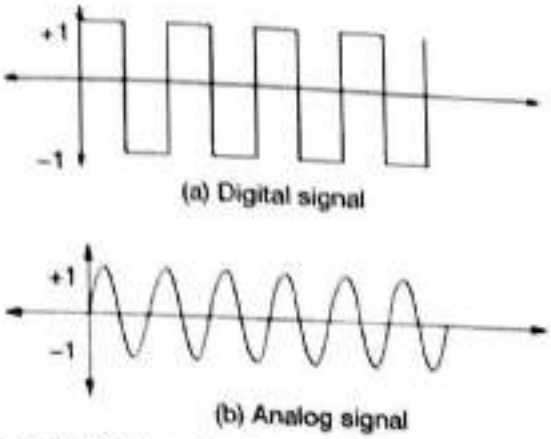

Fig. 4.19: Digital and analog data representation

Looking at Figure 4.19 (a), you will observe that a digital signal rises suddenly to a peak amplitude of +1, holds for sometime then suddenly drops to −1 level. On the other hand an analog signal rises to +1 and falls to −1 in a continuous version (Figure 4.19 (b)).

Although the two graphs look different in their appearance, notice that they repeat themselves at equal time intervals. Electrical signals or waveforms of this nature are said to be *periodic*. Generally, a periodic wave representing a signal can be described using the following parameters.

1. Amplitude (A)
2. Frequency (f)
3. Periodic time (T)

Amplitude (A): Amplitude is the maximum displacement that the waveform of an electrical signal can attain. For example, the amplitude of the electrical signals in Figure 4.19 is 1.

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signals to and from a form that is suitable for transmission over a transmission medium. A *modem* converts a digital signal by superimposing it on an analog carrier signal which can be transmitted over analog telephone lines. This process is called *modulation*. At the receiving end, another modem converts back analog signal to digital form through a process known as *demodulation*.

Figure 4.20 shows how data is modulated and then transmitted via the telephone line from the sending computer to a receiving computer.

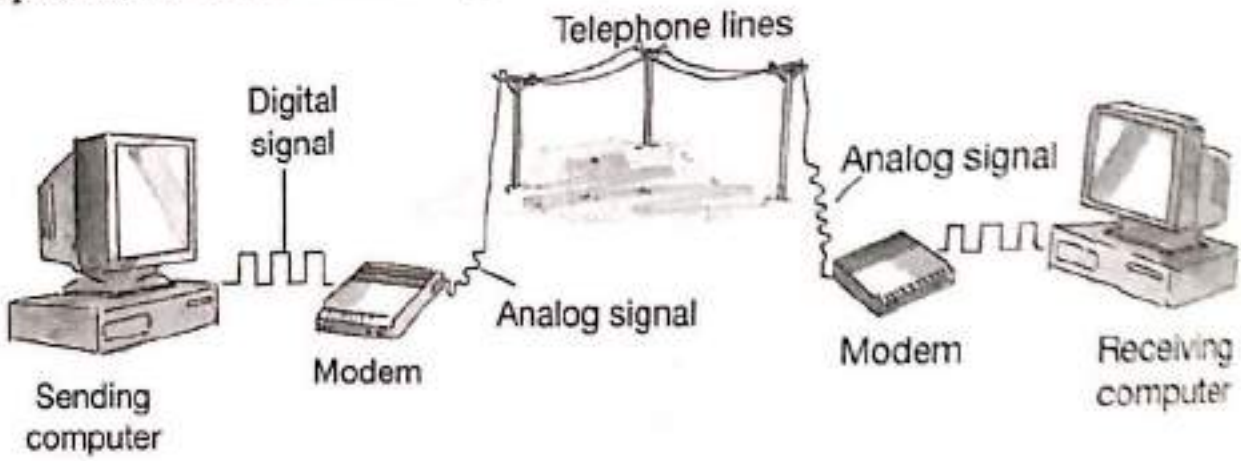

Fig. 4.20: Sending data via a telephone line

Multiplexing: Multiplexing is the process of sending *multiple data* signals over the *same medium* (a channel can be made to carry several data signals either simultaneously or at different times). *Demultiplexing* is the process of separating the multiplexed signals at the receiving end. Imagine a situation where one hundred computers in town A want to communicate with others of equal number in town B. If multiplexing is not used, each of the computers in town A will need a direct cable linking it to another in town B. However, with multiplexing, the computers can be made to share a single cable laid between the two towns hence save cost. Figure 4.21 shows a multiplexed link. Different data signals are made to have different frequencies on the cable hence they do not interfere with one another. These different frequencies create what is called different *logical channels* on the medium.

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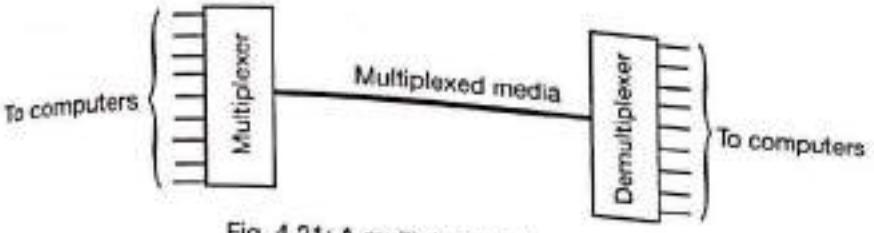

Fig. 4.21: A multiplexed link

Bandwidth: Bandwidth is the maximum amount of data that a transmission channel can carry at any one time. For example, a certain cable transmitting *100 Mbps* (Mega bits per second) is said to have *100 Mbps* bandwidth.

Baseband signal: Baseband signal is a digital signal that is generated and fed into a transmission medium without modulation. The signal takes the form of voltages of different magnitudes applied to the medium. A baseband signal utilises the full capacity of the transmission medium, hence at any one time, only one signal can be sent. However, multiple signals can be sent at different times if they are multiplexed.

Broadband transmission: In broadband transmission, analog signals are transmitted over the transmission medium using different frequencies. This means that several data signals can simultaneously be sent through the same medium at different frequencies. Frequency bands between these data signals prevent them from overlapping.

Attenuation: This is decrease in magnitude and energy of a signal as it progressively moves along a transmission medium. If the signal is not boosted, it is totally lost along the way and may never reach the destination. Attenuation is usually minimized by placing amplifiers also called *repeater stations* along the medium at appropriate distances.

Classification of communication networks

Communication networks can be classified as either *circuit switched*, *packet switched*, or *message switched*.

Circuit switched network

Circuit switched network is a dedicated circuit that has to be set up before data is sent from source to destination. All the data is sent through the dedicated connection. Examples of such networks are the telephone network and the dial-up network. The

Advantages of circuit switching

1. Communicating entities enjoy dedicated connection

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2. Data is sent through the same path from source to destination.

Disadvantages of circuit switching

1. Inefficient utilisation of communication channels since even when the link is underutilised, other devices cannot use it.
2. Circuit switching communication is expensive in terms of set-up cost and bandwith utilization.
3. Lack of error localisation means a broken link means the entire communication breaks down.

Packet switched network

In packet switched networks, a message is broken down into small tokens called packets, serialised then sent over the network to the destination. Each packet follows its own route to the destination and there is no dedicated connection hence many users can use the same link at a go.

Advantages of packet switching are:

1. Efficient utilisation of communication channels since many users can share the same channel.
2. Cheaper communication costs because no setup cost is required.
3. Errors to messages are localised, i.e., if a packet becomes damaged, only that packet needs to be resent. Also if a link breaks, the packets can be rerouted through available channels.

Disadvantages of packet switching:

1. Routing of the packets from source to destination is required.
2. Assembling of packets at the destination node requires computing effort.

Message switched networks

In message switching, an entire message is sent from one node to the next, then forwarded to the next, until the message reaches the destination. Nodes have special memories called buffers for storing messages then forwarding them.

Advantages of message switching

1. Transmission efficiency is greater since messages can share channel.
2. Message priorities can be set on the network.
3. Since the next route is determined from the current node, more efficient routing of messages is possible.

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Review Questions 4.2

1. Define the term communication channel.
2. Differentiate between a router and a gateway.
3. Why is a switch preferred to a hub on the network?
4. Compare and contrast a brouter and a router.
5. Highlight two advantages of packet switching
6. Describe at least five devices used in data communications.
7. What is the function of a repeater on a network?
8. Give three disadvantages of a hub on a network.
9. Give one application area of infra-red transmission.
10. What is a wireless access point?.
11. Explain the importance of a gateway on a network.
12. State two disadvantages of circuit switching.
13. Give one disadvantage of message switching.
14. Explain how you can reduce broadcast storm on a network that uses hubs.
15. Identify a device that can be inserted in a laptop to connect it to wireless network
16. Explain the function of a network interface card (NIC).
17. Draw a diagram depicting elements of a communication system.
18. Differentiate between DTE and DCE.
19. Differentiate between remote client and remote host
20. Define the term bandwidth.

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4.10 Data transmission media

Data signal cannot be sent from one place to another without medium of communication. A communication medium is physical or wireless channel used for transmitting data and information from one point to another. The communication medium will more often than not determine the type of signal used to transmit a message. In networking, data communication media can be divided into two broad categories:

1. Communication using cable (physical media)
2. Wireless communication (wireless media)

Communication using cables (physical media)

The main distinguishing characteristic of physical media is that data is transmitted from the source to destination through a *physical channel* such as copper cables. For example, if the cable is a copper conductor, the data signal which may be in form of an electrical signals is propagated through the cable from the source to the destination. Degradation of the signal as it travels through the medium is referred to as signal loss. There are several types of physical transmission media but the most common ones are:

1. Two wire open lines cables.
2. Twisted pair cables.
3. Coaxial cables.
4. Fibre optic cables.

Two-wire open line

Two-wire open line cable is made up of two parallel copper wires separated by a plastic insulator as shown in Figure 4.22. They are mostly used in telecommunication network to transmit voice signal.

Fig. 4.22: Two wire open lines cables

Although the plastic insulator is meant to reduce interference called *crosstalks* their linear nature allows an electromagnetic field to build around them during heavy data transmission which may cause interference to the signal. The wires also capture environmental frequencies e.g. radiowaves hence causing *noise* in the transmission channel. In data communications, the word noise refers to unwanted signals picked up by the channel.

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Twisted pair cables

A twisted pair cable is made up of two solid copper wires twisted around each other in a double helix manner as shown in Fig. 4.23 (a) and (b). The winding of the wires is meant to reduce the build-up of an electromagnetic field around the two wires as they transmit data. Twisted pair cables are mostly used to transmit both voice and data signals. The two common types of twisted pair cables are the unshielded twisted pair (UTP) and shielded twisted pair (STP) shown in Figures 4.23 (a) and (b).

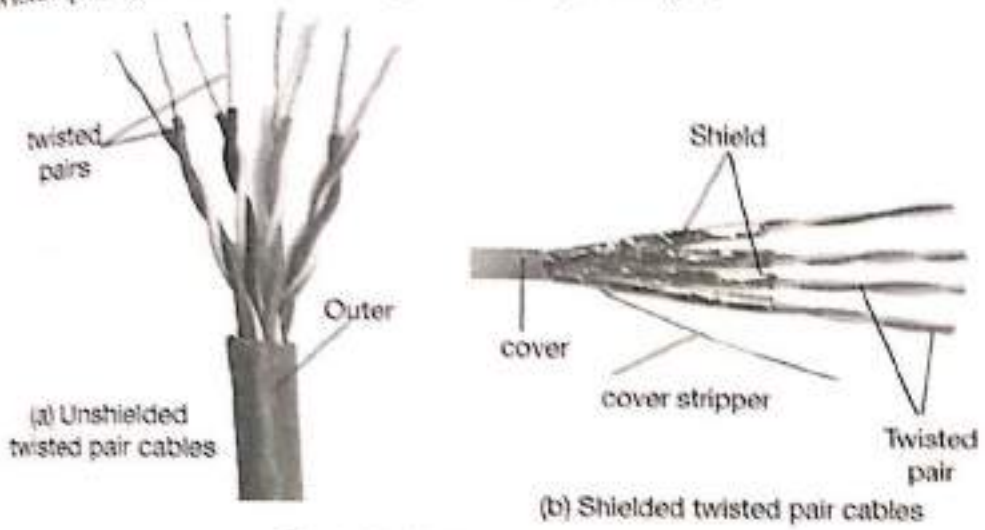

Fig. 4.23: Twisted pair cables

The Notice that unlike STP, UTP cable pairs cables do not have a shield that prevents electromagnetic interference (EMI) from the environment. The cable is therefore susceptible to noise and signal interference. Noise may come from lightening sparks, radio frequency or radiations from spark plugs in motor vehicles. Unshielded twisted pair is therefore not suitable for environments that are electrically "noisy". The alternative is to use STP that has cable pairs. Shielded twisted pair (STP) is similar to unshielded twisted pair except that a wrapped around the wires to protect them from noise.

Generally, twisted pair cables are categorised into groups according to the type of data transmitted and maximum rate of transmission, as shown in Table 4.1.

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Category	Suitable for transmitting	Speed (max. limit)
Cat 1	Voice	Less than 1 Mbp
Cat 2	Data	1 Mbps
Cat 3	Data	16 Mbps
Cat 4	Data	20 Mbps
Cat 5	Data	100 Mbps
Cat 6	Data	200 Mbps

Most organisations today use Cat 5 and Cat 6 twisted pair cables to set up *local area networks*.

Example 4.1

A student typed an e-mail to send over the Internet at a speed of 100 Mbps. Calculate the maximum number of characters that can be sent per second if each character consists of 8 bits.

Solution

Characters per second $= \frac{100 \times 1 \times 10^6}{8} = \frac{100 \times 1\,000\,000}{8}$

$= 12\,500\,000$ characters per second

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The disadvantages of twisted pair cabling include:

1. UTP connection suffers high attenuation rate.
2. It is sensitive to electromagnetic interference and eavesdropping.
3. It has low data transmission rate as compared to fibre optic cables.

Coaxial cables

A coaxial cable resembles the cable that is used to connect television antenna to a television set. It is called coaxial cable because it has a copper core (coax) which may be of solid copper wire surrounded by a *dielectric material* as shown in Fig 4.24 (a). The dielectric material is then surrounded by mesh conductor which is covered by a shield making the cable more resistant to electromagnetic interference than the twisted pair cable.

The mesh conductor is made of copper or aluminium and serves as the earthing for the carrier copper core. Together with the insulation and any foil shield, the shield protects the core from radio frequency interference (RFI) and electromagnetic interference (EMI). Although the cable has better protection against electrical interference than the twisted pair cables, it has a moderate protection against magnetic interference. The diameter of the centre core determines the attenuation rate. The thinner the core, the higher the attenuation rate. Data is carried on coax in form of *direct current* (d.c).

Coaxial cables have bandwidths of upto 1Gbps (Gigabits per second) hence, they are used as *network backbone*. A good example where these cables are used is connecting different networks between buildings and routing trunk calls in telecommunication. There are two types of coaxial cables:

1. Thin coaxial cable also known as thinnet that has one dielectric insulator as shown in Figure 4.24 (a).
2. Thick coaxial cable also known as thicknet that has two dielectric insulators around the core and is thicker than the thinnet (Figure 4.24 (b)).

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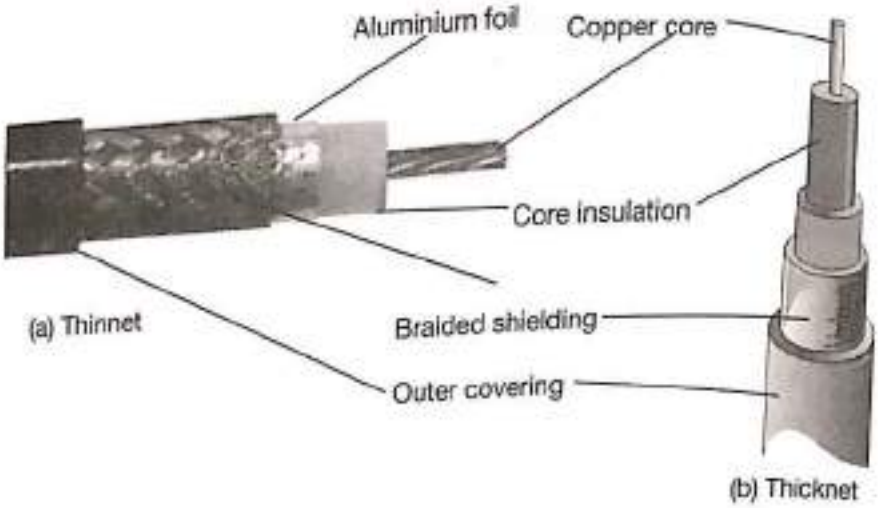

Fig. 4.24: Thinnet and Thicknet coaxial cables

Advantages of coaxial cables include:

1. They are stable even under high transmission loads.
2. They have high bandwidth compared to twisted pair cables.
3. They are capable of carrying voice, data and video signal simultaneously.
4. They are more resistant to radio, and electromagnetic interference than twisted pair cables.

Disadvantages of coaxial cables include:

1. Thick coaxial cable is hard to work with.
2. Coaxial cables are relatively more expensive to buy and to install as compared to twisted pair.
3. Local area network established using coaxial cables is difficult to troubleshoot and maintain. This has made coaxial cabling unpopular in LANS hence the wide usage of twisted pair cables.

Fibre optic cables

Fibre optic is one of the latest physical transmission media to be used in local and wide area networks. Instead of transmitting data signals using electronic signals, fibre optic cable uses visible light to transmit data from one point to another on the network. The electrical signals from the source are converted to light signals, then propagated along the cable. To convert electrical signal to light, the source has a transmitter system made of light emitting diode (LED). At the receiving end, a *photosensitive* device is used to convert the light back to electric signals. The fibre optic cable is made up of the *core, cladding, buffer, strength members* and the *jacket*.

- *Core:* The core is the central part of the cable and is made of a hollow transparent plastic or glass.

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- *Cladding:* This is a single protective layer surrounding the core. It has some light bending characteristics in that, when the light tries to travel from the core to the cladding, it is redirected back to the core. This is why even if a fibre optic cable is bent into coils and a light signal is inserted at one end it will still be seen coming out from the other end.
- *Buffer:* The buffer surrounds the cladding and its main function is to strengthen the cable.
- *Jacket:* It is the outer covering of the cable.

Types of fibre optic cables

Fibre optic cables can be classified into two categories namely *single mode* and *multimode* fibre optic cables.

The **single mode** fibre cable has a very narrow centre core (Figure 4.25 (a)). The light in the cable can therefore take only one path through it. Because of this, it has a very low attenuation rate and is preferred for long distance transmission. It has a bandwidth of 50 Gbps which is higher than that of the twisted pair's 100 Mbps. Single mode fibre is very expensive and requires very careful handling during installation.

Multimode fibre cable has a thicker core than the single mode (Figure 4.25 (b)). It allows several light rays to be fed in the cable at an angle. Because of multiple light signals navigating the cable at the same time, distortion of the signal is possible. Multimode cables have a high attenuation rate and are usually used for shorter distances than single mode.

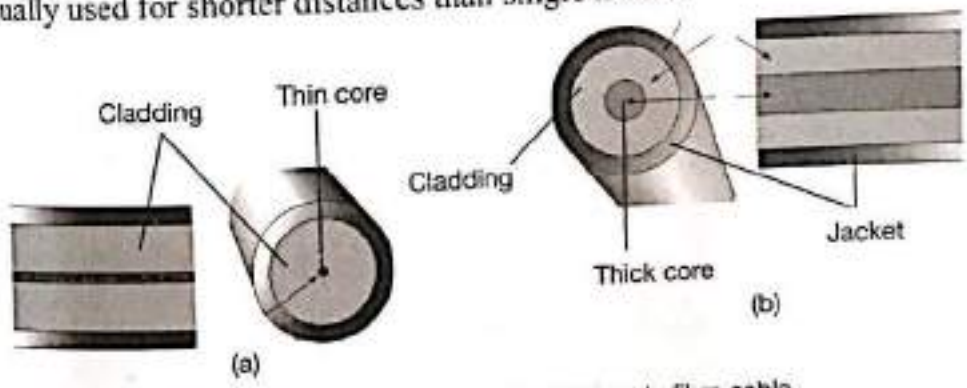

Fig. 4.25 (a) Single mode fibre cable (b) Multimode fibre cable

In fibre optic cables, data signal travels as light through the core, due to *total internal reflection*. Total internal reflection occurs when light travels from optically dense medium such as glass to less optically dense medium such as air. The phenomenon that causes total internal reflection is called *refraction*. When light travels from optically dense medium, it is refracted away from the normal to a point that the ray deviates so far away from normal making it *reflected* rather than being *refracted*. Therefore, when light signal is fed into

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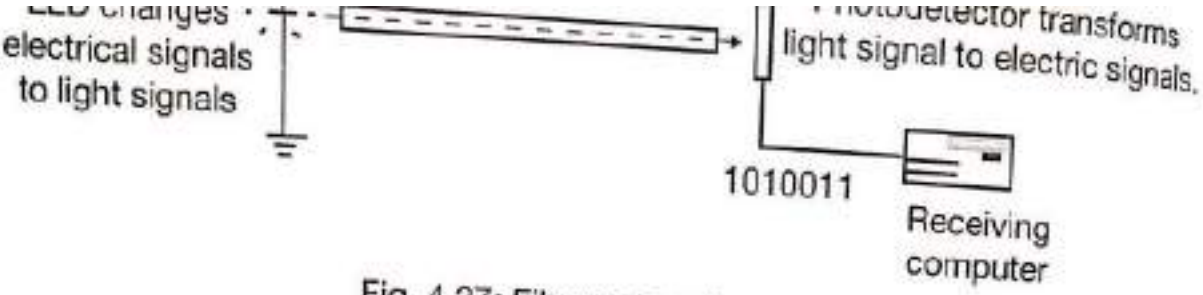

Fig. 4.27: Fibre network

The advantages of fibre optic cabling include:

1. Fibre optic cable is immune to electromagnetic interference and eavesdropping.
2. Fibre optic cables supports high bandwidth.
3. It can be used as backbone in wide area networks because it has low attenuation.
4. Can be used in highly flammable places because they do not generate electrical signal.
5. Fibre optic cable is smaller and lighter than copper cables hence good for space between ceiling and looftop.

The disadvantages of fibre optic cabling include:

1. Installation on configuration of fibre optic network devices and the media are expensive.
2. Installation is difficult because the cable is dedicated.
3. Fibre optic network is difficult to troubleshoot and complex to configure.

Wireless communication

Wireless transmission medium is used to transmit data from one point to another *through non-physical channel*. Examples of wireless transmission

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different frequencies of the electromagnetic spectrum shown in Figure 4.28.

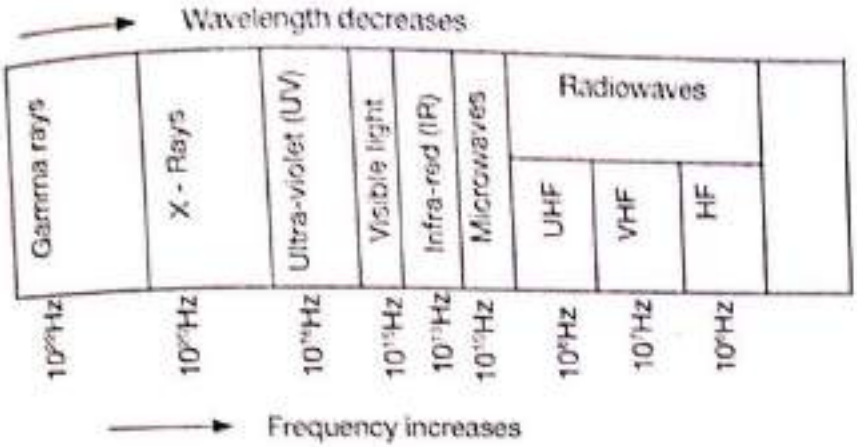

Fig. 4.28: The electromagnetic spectrum

In this section, we discuss three types of wireless transmission media namely; microwaves, radiowaves and infrared waves.

Microwave transmission

Microwave frequencies range from about 3GHz to 40GHz on the electromagnetic spectrum. Due to small wavelength, microwaves easily release energy in water as heat hence they are also used in making microwave ovens used as domestic appliances. In networking, microwaves are suitable for *point to point* transmissions. This means that, a signal is directed through a sharp beam from transmitter to receiver station. Figure 4.29 shows an illustration of point-to-point transmission in microwaves connecting two local area networks in different buildings.

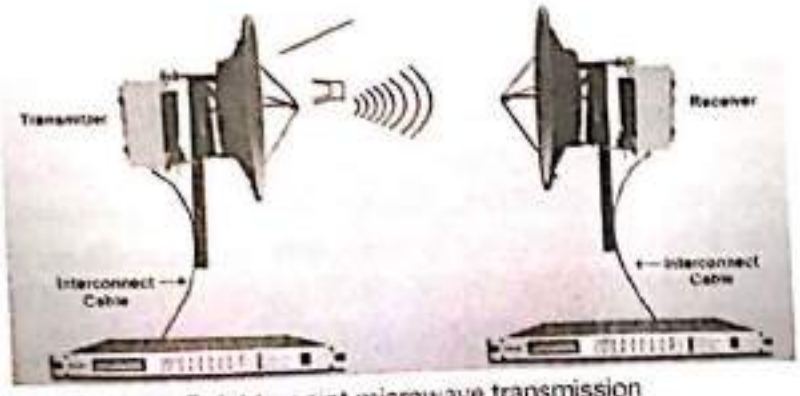

Fig. 4.29: Point to point microwave transmission

Satellite communication

A satellite is a special type of microwave relay station in space. The satellite earth stations are microwave dishes with antenna used for relaying data using microwaves to the satellite in space. A satellite transmission system has three main components:

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1. *Transmitter earthstation* that has uplink frequency for transmitting data to the satellite.
2. *Satellite* that is a relay station in the orbit that receives, amplifies and transmits the signal to a receiver earth station via a *downlink* frequency that is different from the uplink frequency.
3. *Receiver earthstation* that receive data signals from the satellite. Figure 4.30 shows an illustration of a satellite system.

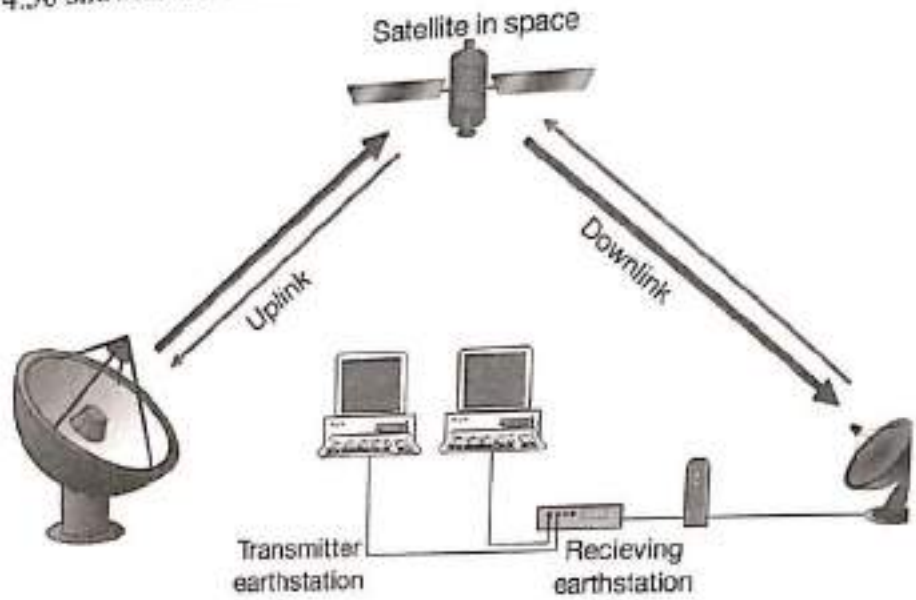

Fig. 4.30: Satellite transmission system

Communication satellite used for data transmission is usually launched into space about 36 000 km above the earth in such a manner that its rotational speed is relatively equal to that of the earth. An observer on earth will therefore, see as if the satellite is stationary in space. These type of satellites are called *geostationary* satellites. They are convinient because they eliminate the task of moving parabolic dishes in a bid to track the line of sight. A geostationary satellite offers a large constant line of sight to earthstations. The area where the line of sight can easily be located is called the *satellites footprint*. The satellite transmits the signal to many earthstations to form a *point to multipoint* transmission. In multipoint transmission the transmitted signal scatters in all directions forming a cell of access radius.

New trends in microwave transmission systems is seen the use of *very small aperture terminal (VSAT)* technology. Very small aperture terminal refers to a small satellite dish used in data, radio and TV communication. In recent times, most organizations have mounted VSAT in order to access satellite communication directly instead of having to go through state owned gateways. Figure 4.31 shows how VSAT is used to connect two locations to communicate

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network set up to enable two laptops in geographically disperate locations to communicate.

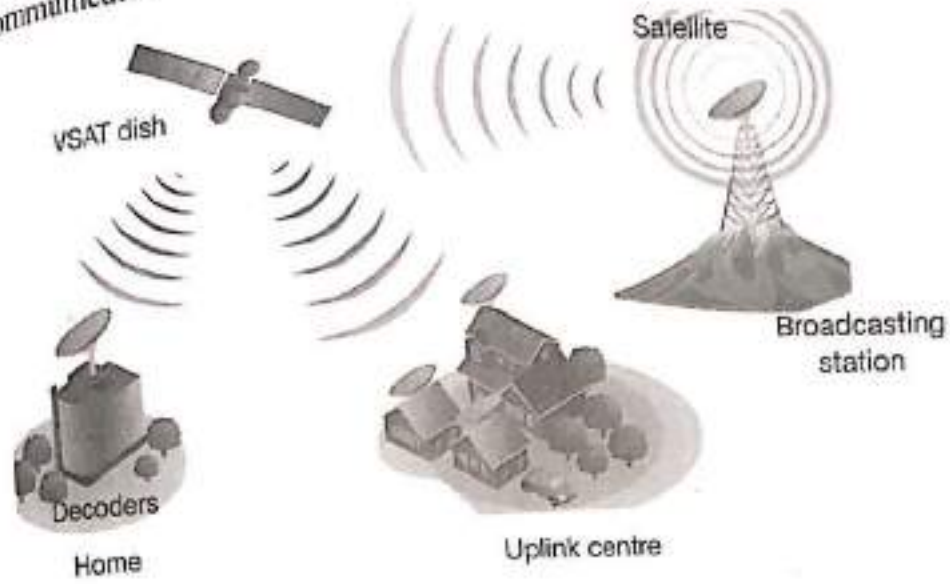

Fig. 4.31: VSAT technology

In VSAT setup, a satellite produces strong signals that can be received by a dish of only 2 metres in diameter. The signals are decoded using a decoder which is plugged directly to a television set or a computer.

Radio communication

Radio waves travel just like surface water waves, i.e. they are *omnidirectional*. This means that radiowaves start from a central point and spread outwards in all directions. As they travel outwards, the energy emitted by the waves spreads outwards over the covered area. The waves are radiated into the atmosphere by a radio frequency antenna at constant velocity. Radio waves are not visible by human eye. Figure 4.32 shows how radio waves are propagated between the transmitting station and the receiving station.

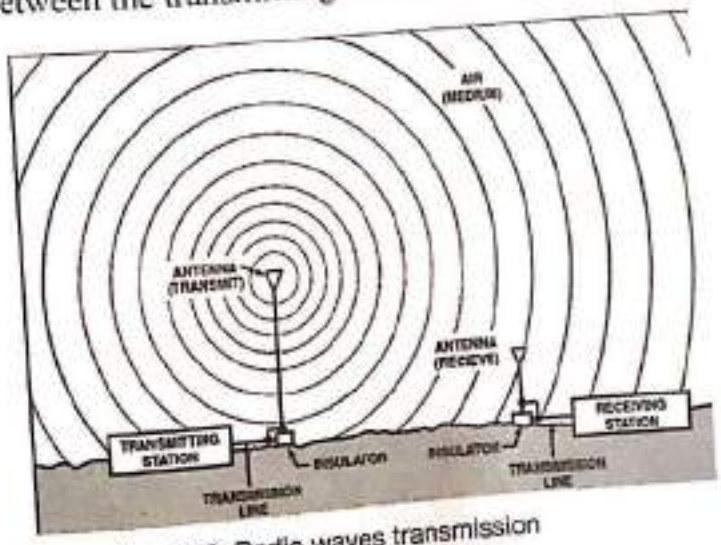

Fig. 4.32: Radio waves transmission

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Radio waves are used in radio and television broadcasts. Data can also be transmitted over radiowaves communication channels. For example, instead of installing telephone cables between two distant towns, radiowaves can be used to connect the two towns. Radiowaves can be of *high frequency*, *very high frequency* or *ultra-high frequency*.

The *high frequency* (HF) radio waves signal is propagated by directing it to the *ionosphere* of the earth as shown in Fig 4.33. The ionosphere reflects it back to the earth's surface and the receiver picks the signal. Before invention of satellite communication, high frequency radio transmission was preferred mode of communication in marine transport to direct ships and other maritime objects. However, the main drawback in use of high frequency communication is the danger of signal interception by unauthorised parties.

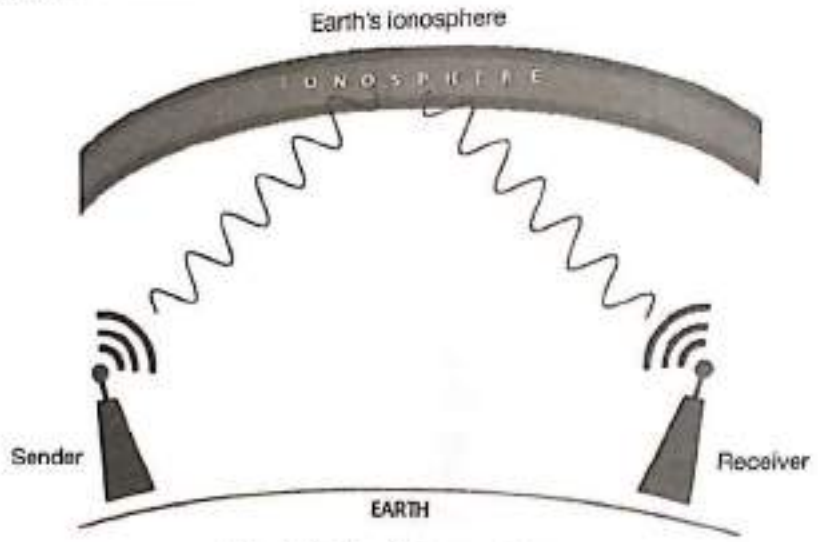

Fig. 4.33: HF radio transmission

Very high frequency (VHF) radio waves are transmitted along the earth's surface. Due to shape of the earth, the signal attenuates mostly at the horizon. This means that repeater stations have to be placed strategically to maintain a line of sight in order to receive, amplify and propagate the signal. Very high frequency is mostly used on hand held radio devices like "walkie-talkie" radios. The range of VHF is limited but it is preferred to high frequency where no major obstructions are encountered. This is because with very high frequency, it is possible to make the radiowave follow narrow and more precise or focussed path to the receiver. To overcome the obstructions by the earth surface like mountains and buildings, repeater stations are built on high grounds like hills and mountains.

Ultra high frequency (UHF) radiowaves are like very high frequency when it comes to the *line of sight principle*. This means that there should be no barrier

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between the sending and the receiving stations. Notice that the television aerial for very high frequency is bigger than the one for ultra high frequency radiowaves. This is because UHF radiowaves can be made to follow very narrow and precise path to the receiver than VHF radiowaves. Therefore, ultra high frequency is popular for horizon limited broadcasts.

Bluetooth transmission

One of the latest short range radio transmission technologies is called *bluetooth*. Bluetooth is short range radio transmission that enables devices located within a limited geographical location communicate and share resources such as files. The main objective of bluetooth communication is to define a common standard that allows most devices regardless of their architectural or software differences to share data and other resources. The main component in bluetooth is a small *low power* two-way radio transceiver, small enough to be inserted in small devices. A network of bluetooth-enabled devices is called a *wireless personal area network (WPAN) or piconet* because bluetooth networks are best suited for handheld devices. This has made radio transmission has become popular in mobile communication and Internet connectivity. Figure 4.34 shows a piconet between a mobile phone and a portable computer.

Fig. 4.34: A piconet of two devices

Infrared transmission

Infrared waves fall below visible light on the electromagnetic spectrum. Like the radiowaves, infrared waves are not visible to the human eye. Communication through infrared is achieved by having transmitters and receivers *(transceivers)* within a line of sight because infrared rays do not penetrate obstacles like walls. However, the signal can be reflected by surfaces like walls and ceiling before they are received.

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2. Wireless networks can span [illegible]
3. Wireless communication can take place via satellite even in remote areas that do not have physical infrastructure like telephone lines.

Some of the disadvantages of wireless communications include:

1. It is relatively difficult to establish or configure.
2. The initial set up cost may be high.

4.11 Data transmission modes

Data transmission can be classified into five modes. The following are the most common modes of data transmission:

1. Parallel transmission mode.
2. Serial transmission mode.
3. Simplex transmission mode.
4. Half duplex transmission mode.
5. Full duplex transmission mode.

Parallel transmission

In parallel transmission, a set of data lines (buses) are used to transmit data from one device to another simultaneously. The speed of data transmission on the bus is determined by its width and the frequency of the clock that controls it. Parallel transmission mode is common in the following:

1. Communication between components that are connected to the motherboard e.g. transfer of data from the memory to the processor.

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2. Transfer of data from the computer to some peripheral devices e.g. the printer.

Because, most external transmission is serial in nature, there is always need to convert data signals from parallel to serial when sending data on networks.

Serial transmission

In serial transmission data is sent as a string of series of 0 s and 1s, over the communication channel. Once a computer receives data from the network, it usually converts it from serial to parallel mode. This is usually achieved using special memories called buffers which store the data temporalily as it arrives. The data stored in the buffer is then read from these memories by the computer in parallel mode.

Simplex transmission

In simplex transmission mode, there is only one way transmission of data on the communication channel. The transmitter sends the data but the recipient cannot send a response back to the sender over the link. Example of simplex communication are the one-way radio e.g. the typical radio receivers and television sets.

Half duplex transmission

In half duplex transmission, two way communication is possible over the communication channel but not simultaneously. The transmitter send the message then after finishing, the receiver is allowed to send back response. One example of half duplex transmission is the two-way press to talk radios e.g. walkie talkies. The sender speaks and has to give an audio indication at the end of every message e.g. "over" and press a button for the recipient to know that the channel is now free to make a response.

Full duplex transmission

In this mode of transmission, data can travel on the channel in both directions simultaneously. Two devices communicating on the system can send messages to each other simultaneously. Examples of full duplex transmission include computers communicating on the network e.g. sending email, instant messaging and conversion over a mobile phone.

In summary, Figure 4.35 shows differences in simplex, half duplex and full duplex transmission systems. Notice the direction of the arrow (s) between the transmitter and the receiver.

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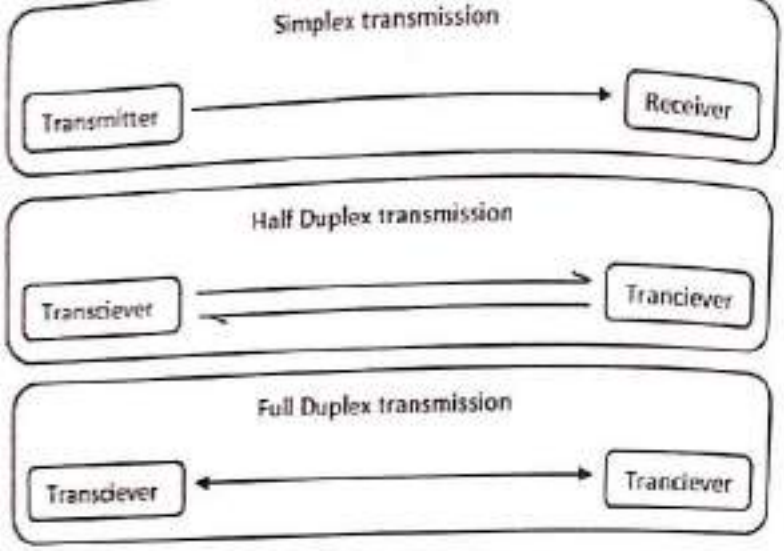

Fig. 4.35: Simplex, half duplex, full duplex transmission modes

Revision Exercise 4

1. Define the term transmission media.
2. State two differences between single mode and multimode fibre optic cable.
3. If you wanted to link networks separated by long distance, what fibre optic cable would you select and why?
4. Satellite communication relies on _____ and _____ stations.
5. Describe waves available in electromagnetic spectrum.
6. Highlight two advantages of satellite communication system.
7. What type of radio communication relies on the earths ionosphere?
8. Describe one technology that can be used to set up piconet.
9. Name the parts of a twisted pair cable.
10. State one application area where coaxial cables are used.
11. Give two advantages of fibre optic cables over UTP.
12. Define the term double helix as used in twisted pair cabling.
13. Give two advantages of coaxial cables.
14. Differentiate between single mode and multimode fibre cables.
15. Describe the VSAT technology.
16. Explain the concept of a geostationary satellite.

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5.1 Introduction

The term troubleshooting refers to the process of diagnosing and resolving hardware and software related problems. When using a computer, you may experience some hardware or software related problems. In unit, we discuss how to troubleshoot some of the following common hardware and software problems:

1. Failure to load the operating system during booting process.
2. Computer failure to respond (hanging).
3. Abnormal restarting of a computer.
4. Failure of the monitor to display.
5. Failure of operating system due to device drivers problems

5.2 Hardware problems

The following are problems that you may experience as a result of failure of basic hardware components.

Computer Boot failure

When a computer is started, BIOS perform a power on self-test (POST) to check for the status of basic input and output components. If any error is found during POST, it is typically indicated using error messages on the screen or by series of beeps. If the computer produces beep sounds, count the beeps and listen to whether they are long or short. Typically, one beep indicates that all components have passed the POST. Depending on the type of BIOS, a computer may display error codes starting with error code such as code 120 that indicates a problem with the motherboard or code 162 for

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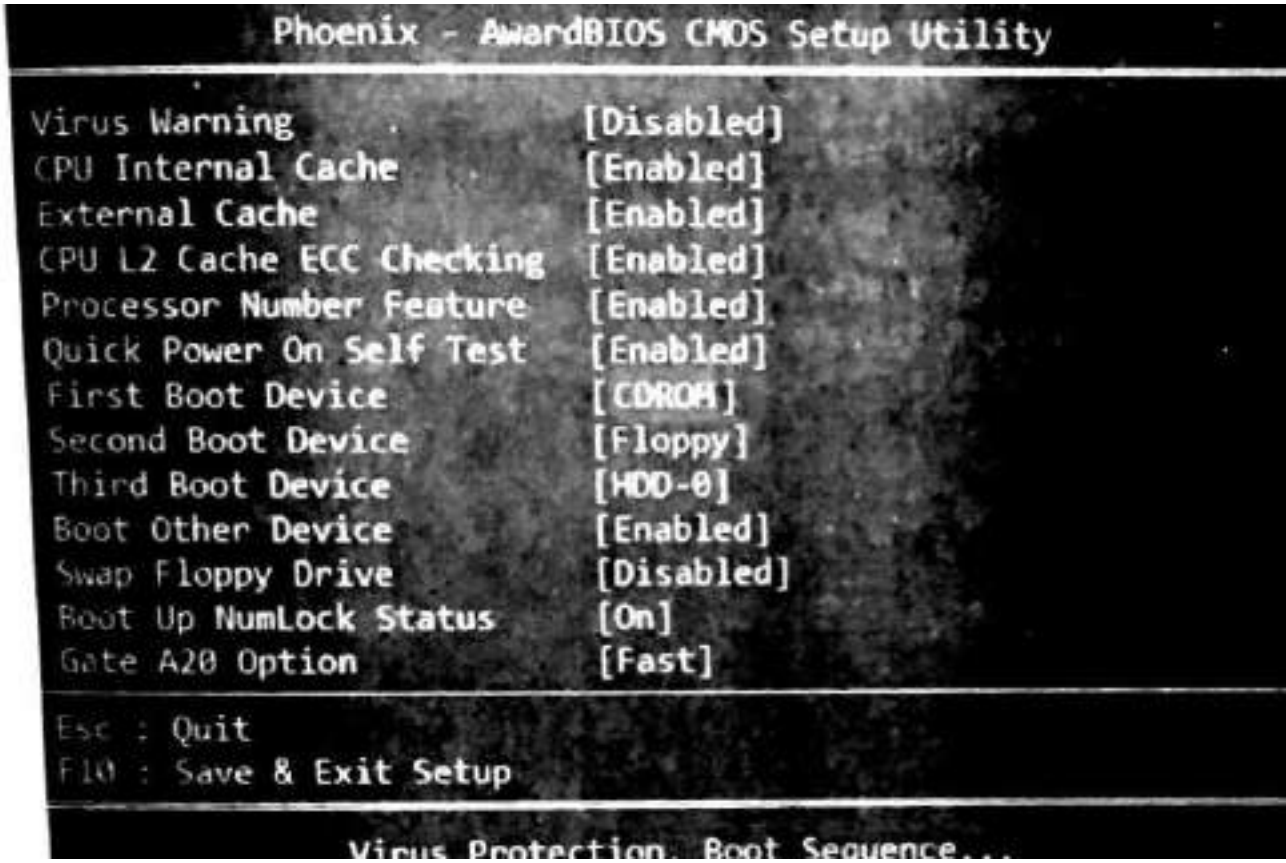

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1. Disconnect the computer from power and open up the system unit and locate the slots where the RAM modules are plugged in such as shown in Figure 5.2.

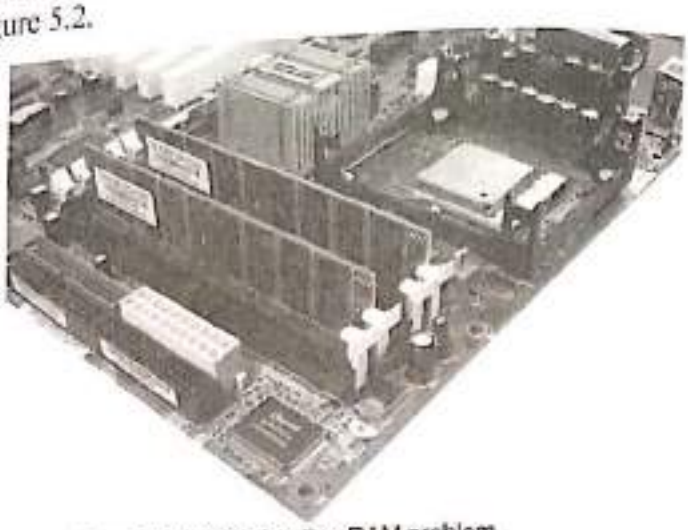

Fig. 5.2: Troubleshooting RAM problem

2. Discharge static electricity that might have built up on your body using a wrist member.
3. Check whether the memory modules are firmly plugged into the slots. If they are, connect the computer to power and restart.
4. If the problem persists, you need to replace the RAM modules with new ones. The memory modules may be damaged.

Failure of power supply unit

Power supply unit such as shown in Figure 5.3 may fail due to power surge or failure of the cooling fan inside it. To resolve power supply unit problems, do one of the following:

1. Check to make sure that the power supply is properly connected to power socket or UPS.
2. Check the power selector to ensure that it has the right power rating. For example, in most countries, the rating for domestic power is 240V while in US the rating is 110V.
3. Open the casing and check whether the power cable that connects to the motherboard is properly attached.
4. If the problem persists, replace the power supply unit with a new one. Never try to repair a power supply unit because it may cause serious body harm.

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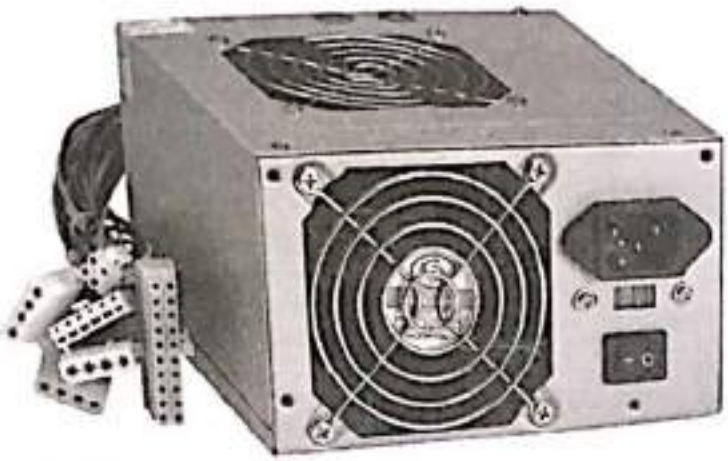

Fig. 5.3: Troubleshooting Power supply problem

Failure of cooler fans

A computer may have several cooling fans such as that of power supply unit, microprocessor and the chassis. The fans protect delicate computer components from the damage caused by overheating. When a fan begins to wear out, it makes a whining or grinding noise. To protect fans from failure, do one of the following:

1. Place the computers in a dust free place or if the computer is in a dusty place, always remember to cover it.
2. Always use a blower to blow out dust that may have settled on computer parts.
3. In case one of the fan happens to fail, turn off the computer, unclip it and replace it with a new one.

Abnormal restarting of a computer

If a computer is restarting or shutting down abnormally, the problem might be due poor operating system configuration, hardware failure or virus attack. If the problem is serious, the computer may display a blue screen with a message such as *"Fatal exception error has occurred..."* To resolve this problem, do the following:

1. Confirm that all hardware devices and drivers are properly installed or configured using device manager shown in Figure 5.4.

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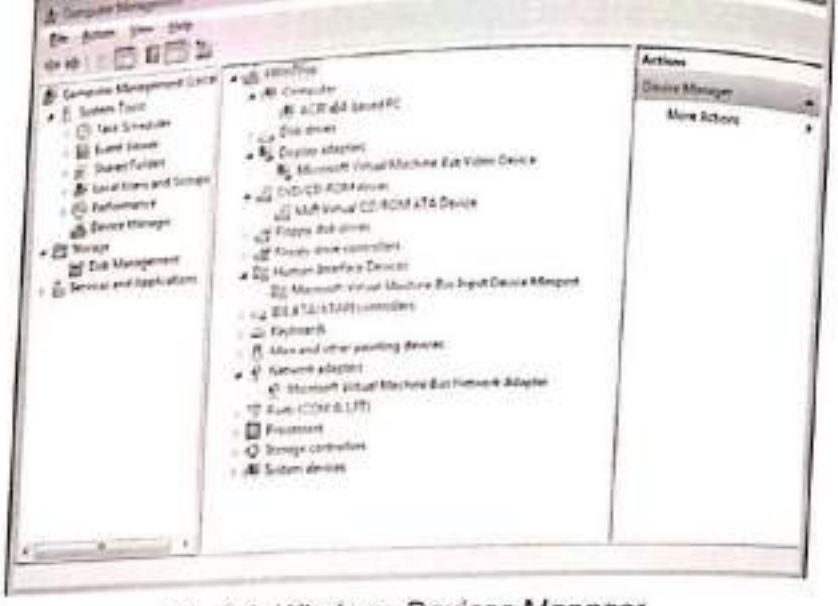

Fig. 5.4: Windows Devices Manager

2. If the problem is related to operating system, follow this procedure:
   (a) Press combination of keys (Ctrl+Alt+Del) to restart the computer.
   (b) During the reboot process, and before Windows is loaded, press F8 to display the Safe mode startup screen shown in Figure 5.5.
   (c) Choose safe mode to load Windows with minimal settings. Scan the drives or check for any hardware or software related problems in device manager.

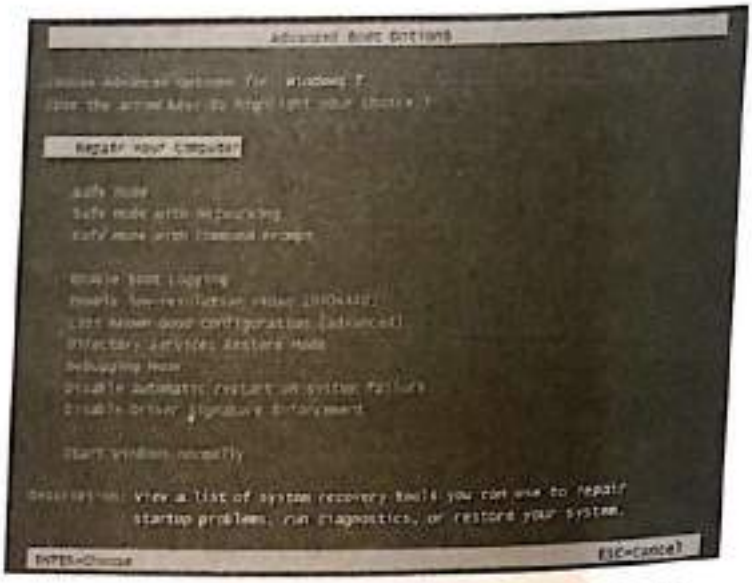

Fig. 5.5: Troubleshooting configuration problems

3. If the problem persists, the Operation system may be corrupted by a malware. In such a case, you may need to use up-to-date antivirus software to scan the boot sector for viruses.

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2. If the error message persists, the disk platter(s) may have crashed. Consider replacing it with a new one.

Display problems on screen

Display problems may cause health related problems such as eyestrain, fatigue and headaches. To minimize such health risks, CRT monitors have been replaced by LCD and TFT flat panel displays that are safer and more comfortable to use.

Continuous beeping Sound

This is an indication of a missing monitor or faulty video adapter. Check to ensure that the monitor is properly attached to the video card through the VGA or HDMI port.

No display or Flickering Monitor

If a monitor fails to display and does not issue an error code, the first thing you should do is to move the mouse or press any key on the keyboard. Most computers use power management modes that cause the screen to go on standby or sleep mode. On the other hand, flickering may be caused by a poor refresh rate or failing monitor. The refresh rate determines how often the display on the screen gets redrawn. To resolve such display problems, try one of the following:

1. Make sure the monitor is plugged into power outlet and turned on. Also, ensure that the brightness is set at adequate level.
2. If this step does not solve the problem, check whether the monitor is properly plugged to the VGA or HDMI port usually at the back of the system unit.
3. If the problem is not related to power or interface, you may need to test the monitor using another computer before declaring it dead!
4. Replace the monitor with a new one, preferably a TFT flat panel display.

Repeated display on screen

Repeated display of elements is due to poor colour and resolution settings. This setting results in multiple copies of the same image. To resolve this problem, use display setting properties to change the colour resolution settings.

Keyboard and mouse failure

Keyboard and mouse problems may be due to improper connection of

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the device, poor handling or even mechanical failure of the device itself. For example, irregular movement of the mouse pointer across the screen suggests dirty mouse ball or LED contact. Note that current trends in mouse technologies is to replace mechanical ball and rollers with optical LED contact at the bottom. For a keyboard that has failed completely or some keys fail to function, the only option is to replace the underlying circuit board or entire keyboard.

Problem with Sound output

Components that make up a computer audio system are the sound controller, speakers and device drivers. If a computer does not produce sound, try the following:

1. Adjust the volume to adequate level. In addition, check to make sure that they are plugged into the sound interface.
2. Ensure that the speakers power cable is properly plugged into power outlet and the speakers are turned on.
3. If the speakers and the interface cables are not faulty, turn your attention to the sound adapter drivers.
4. If the problem is still not resolved, open the computer and make sure that the sound adapter is available or properly plugged.

Note: There may be other hardware related problems that depend on the type of computer and operating system. We recommend that you use the manual that came with the computer or operating system to diagnose and troubleshoot any hardware or software problems.

3 Software problems

In this section, we discuss some of the problems you may experience before installation or use of a computer running on most versions of Windows operating system:

Missing operating system

After POST, a computer searches for the presence of an Operating System (OS) on the hard drive. If an OS is not installed, the error message "missing operating system" may be displayed. This means that you have to follow the procedure for installing the operating system described earlier. If you are sure the operating system is installed, the problem may be due to boot sector or hard disk related problems. A boot sector is where the booting instructions are stored once you install an operation system. To resolve this problem, do one of the following:

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Fig. 5.7: Repairing Windows

Corrupted system registry

In Windows, registry is the database that keeps record of all system and application software installed on the computer. If the registry is corrupted, the computer may fail to boot. For example, failure to load the desktop may be due to infection by malware or corrupted system registry files.

To troubleshoot problems relating to corrupted registry, try the following:

1. Repair the registry using emergency recovery disk or restore the registry backup if you created one. If all these fail, reinstall the operating system.
2. If the system can start in safe mode, locate the malfunctioning device in the device manager and disable it.

Windows protection error

Windows protection error is displayed during startup before the desktop is displayed. This problem occurs when critical Windows drivers fails to load.

To deal with this problem, do the following:

1. Restart the computer in safe mode as outline above. If Windows does not load, use the recovery disk to repair the operating system.

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Non-responding system commonly refers to a program that is failing to respond to commands. To resolve the problem, do one of the following:

1. Press Ctrl+ Alt+Del keys to display the Task Manager shown in Figure 5.8.

Fig. 5.8: Terminating processes

2. In the Task Manager window, click the Process tab, and then select the non-responding process e.g. explore.exe.
3. Click **End Process** button to terminate the application.

NB: For more on troubleshooting, re-installation and repairing of operating system related problems, read online manual that comes with the operating system.

5.4 Printer-related problems

A printer is one of the most commonly used peripheral devices to produce hard copies. In order to troubleshoot printing-related problems, you need to understand how a printer works and how to properly set it up. In the topic on output devices, types of printers and their printing mechanism was discussed. In this section, we explain how to handle printing related problems.

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that the computer cannot properly communicate with the printer. Ensure that the correct printer is selected and turned on. If this does not work, you may be forced to reinstall the printer drivers.

Paper jam

Paper jam usually stop the current print job until the jam is completely cleared. If paper jams in the printer, locate the paper and gently try to remove it. If the printer continues to jam at frequent intervals, try using a different papers. Printers work best with a particular weight of paper, hence if you use a paper that is too light or too heavy, paper jam may occur frequently.

Poor printout quality

Quality related problems is easily resolved by replacing ink, toner, or laser head/drum. However, quality problems may be due to failures within the device's print process. If a printer produces garbage, this may be due to communications problem between the computer and printer. Make sure that appropriate drivers are properly installed.

Toner/Ink Cartridge problem

Most printers give warning of low toner or ink level before it is completely used up. In such a case, be ready to replace or refill the cartridge. By refilling used cartridge, make sure it is tested to avoid possibility of using faulty cartridge.

Smudged printout

If a dot matrix printer produces smudged printouts, check on the printer head. Stuck pins may cause printouts to have a smudged appearance as they drag across the page. In laser printers, smudged printouts may be as a result of the drum failure to fuse the toner onto the paper. For inkjet printers, smudges are mostly due to touching the printout before the ink dries up. To troubleshoot this problem, do one of the following:

1. In case of a dot matrix printer, replace the print head. If this doesn't solve the problem, it could indicate worn-out printer head or poor ink ribbon. Simply replace the head or the ribbon.
2. For laser printers, consult the user-guide that may be helpful in locating the problem especially relating to the fuser. Because the fuser is a sensitive component that gets very hot it is advisable for it to be handled by an experienced technician.

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Revision Exercise 5

1. Identify symptoms associated with failure of RAM modules.
2. A user complains that the mouse pointer does not move smoothly on the screen. Explain the reason why.
3. When a user tried to access a hard drive, he received *"Invalid Drive"* error. Explain the possible cause of the problem.
4. A customer complains that her computer spontaneously reboots and sometimes does not start at all. Which device is most likely causing this problem?
5. When a customer's computer was first configured after buying, it was playing audio and video CDs and DVDs, but after sometime, it produces no sounds at all. What might be the problem?

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6: USING DESKTOP PUBLISHING SOFTWARE

Core element

Application software

Outcome

The students will be able to use software in information processing, analysis, management and presentation.

Success Criteria

By the end of this unit, you must be able to:

- *Define desktop publishing*
- *Explain the benefits of desktop publishing*
- *State examples of desktop publishing software*
- *Describe common features of desktop publishing software*
- *Create a publication*
- *Edit text in a publication*
- *Format a publication*
- *Save a publication*
- *Close a publication*
- *Open a saved publication*
- *Insert tables, objects and graphics in a publication*
- *Print a publication*
- *State examples of publications*
- *Design examples of publications*
- *Move graphics in publications*
- *Resize graphics in publications*
- *Flip graphics in publications*
- *Rotate graphics in publications*
- *Crop graphics in publications*
- *Export publications to other file formats*
- *Print publications*

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6.1 Introduction

Publishing is the process of selecting, collecting, preparing and producing of printed or electron work in the form of books, newspapers, magazines, scientific papers, pictures, music, movies, documentaries and electronic books. In early days, publishing was done by hand artists learnt that repetitive tasks performed using templates created from stone and wood. This led to invention of more sophisticated printing machines or printing press. However, the age of the printing press has been rendered obsolete by emergence of the personal computers and desktop publishing software. Today, design and printing of artwork that was done using offset printers is now done by a personal computer that has digital printer attached to it hence the term desktop publishing.

6.2 Definition of desktop publishing

Desktop Publishing (DTP) refers to *the process of designing publications of professional quality such as newspapers, invitation cards, posters, fliers, journals and books using a specialised DTP software.* Desktop publishing software popularly known as DTP is a special purpose software used to create publications of professional quality such as shown in Figure 6.1. Some examples of DTPs include *Adobe PageMaker, Microsoft Publisher, QuarkXpress, Adobe InDesign, Adobe Illustrator, CorelDraw, Serif PagePlus and Apple Page 2.* Before selecting a particular DTP software, it is important to identify the operating system environment in which the application will be run.

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More young people infected with HIV

Under-30s becoming an at-risk group, with 96 of them diagnosed last year

THE number of young people in Singapore diagnosed with HIV has doubled in the past seven years, according to Ministry of Health statistics.

Published yesterday on its website, they reveal that almost 100 people aged 29 and younger tested positive last year, compared with about 50 in 2005.

In all, 461 people tested positive last year. While more people in general have become infected in recent years, teenagers and young adults represent an increasingly at-risk group.

Seven years ago, the under-30 group made up one in six new cases. Last year, the figure was one in five.

Doctors said more young people could be going for tests due to greater awareness of the disease and efforts by advocacy groups to promote the practice.

Last December, non-government group Action for Aids (AIA) rolled out a mobile-testing van.

HIV can cause Aids as it destroys immune systems. As of last December, 1,493 infected people have died.

But others have noted that more young people are having sex and many do not protect themselves by using condoms.

A survey by Singapore Planned Parenthood Association, whose findings were released last month, found that half the 1,790 respondents had lost their virginity by the time they were 20.

In a smaller 1000 survey, only 3 per cent of those aged 12 to 20 had had sex. While the association acknowledged the latest survey may not be representative, Mr John Vijayan Vasavan, its board member and ex-president, said it suggested that young people now throw caution to the wind.

A spokesman for the Department of Sexually Transmitted Infections Control (DSC) Clinic said young people may have reckless sex due to factors such as increased access to the Internet and social media, where they may contact like-minded people.

Mr Donovan Lo, AIA's executive director, said young gay and bisexual men were likely fuelling the alarming trend.

Last year, more homosexual and bisexual men were diagnosed with HIV than heterosexual men for the first time since 1990.

Mr Lo said younger men are less afraid of the virus because they do not see the "death and misery" it wrought in the 1990s.

New medications can keep infected people in relatively good health for years though there is still no cure for Aids.

"Infected people rarely inform their sexual partners of their status. Gay men do not talk about HIV because of the stigma and discrimination," he added.

It is an offence if someone infected with the virus does not inform the sex partner before sexual intercourse. Those convicted can be jailed for up to 10 years and/or fined a maximum of $50,000.

One barrier to safe-sex campaigns is the ban on TV advertisements that feature or refer to contraceptives.

While the Education Ministry and Health Promotion Board run HIV awareness programmes for the young, a DSC Clinic spokesman said that parents should also educate teens about responsible sexual behaviour.

"Leave age-appropriate resources for them to pick up on their own and read," she said. "Most importantly, let your children know that you will always be there for them if they need someone to confide in."

2011 HIV INFECTIONS

More young people diagnosed

Age	2007	2008	2009	2010	2011
0-14	2	0	0	2	0
15-19	9	7	3	6	4
20-29	55	69	65	71	97
30-39	106	130	125	116	124
40-49	134	125	128	128	106
50-59	87	82	82	68	78
60 and older	30	43	60	50	57
Total	423	456	463	441	461

By gender

Men: 430

Women: 31

By sexual mode

Heterosexual	213
Homosexual	195
Bisexual	41

Source: MOH

ST GRAPHICS

Fig. 6.1: A sample publication.

Benefits of desktop publishing

Although word processors can be used to create professional publicat

DTP software offers the following benefits:

1. Every item on a page is contained in a frame hence can be edit formatted independently.
2. DTPs provide more control on how text and graphics can be ar and formatted.

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3. Frames containing text or graphics need not flow in logical sequence. For example, a story on page 1 may be continued on page 8.
4. DTPs provide master pages used to set a common layout which may be repeated on several pages.
5. In DTPs, publications can be printed in a form suitable for commercial digital or offset printing using colour separations.
6. Most DTPs have predefined templates such as brochures, booklets, posters and business cards is available.
7. Multiple stories from different authors can be handled with ease.
8. DTP enhances visual communication to different audience.
9. DTP ensures files print properly in their true colors, fonts and measurements.

6.4 Types of DTP software

Generally, DTP software can be classified into two broad categories namely; graphic-based and layout-based DTPs.

Graphic-based DTPs: These DTPs are specifically used to edit and format graphic objects such as pictures and vector drawings. Vector drawings are freehand drawings such as those drawn by fine artists. Examples of graphic-based DTP software include *Adobe Photoshop*, *Adobe Illustrator* and *CorelDraw*. These software have superior graphics handling capabilities such as setting resolution, brightness, contrast, cropping and filling images with colours. It is important to note that some graphic-based software like CorelDraw and Adobe Illustrator may be also used for page layout design.

Layout-based DTPs: These types of DTPs are specifically used to design page layout for text and gaphics. Have you ever wondered how the complicated front page of a newspaper is developed? It is difficult to achieve such without a good layout-based DTP software. Examples of layout-based DTP softwares include Adobe PageMaker, Microsoft Publisher and Adobe InDesign.

Purpose of desktop publishing software

Desktop Publishing programs are very popular in publishing; because they give the person designing publications a lot of control on:

- *Graphic design*: Using a desktop publishing software such as CorelDraw or Illustrator, one can design vector images using the drawing tools. Image editing such as in Adobe Photoshop lets the user manipulate graphics such as pictures.
- *Page layout design*: The reason why we prefer DTPs to word processors is because of page design. DTPs are used to design a page layout by

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setting consistent picture and object locations, dividing a page in a number of newspaper columns and adding *layers*. A layer can be viewed as the arrangement of objects on top of each other with each object being on its own layer.

- *Printing*: Printing is the main goal of publication. Desktop publishing software therefore offer more flexibility in printing, like in image colour separation.

Examples of publications

There are many examples of publications that can be created using DTP software. The following are just a few examples:

1. *Newspapers:* These are daily publications bearing news, sports etc for the readers
2. *Magazines:* A magazine is a publication containing news, features, specialist knowledge etc that has many pictures and illustrations targeting a particular audience.
3. *Book:* A book is a publication in a particular subject area or featuring a particular story.
4. *Calender:* This is a publication showing the dates and days of a week, month and year.

Features of DTP software

Most DTPs provide the user with a variety of tools for designing, manipulating and editing a publication. The following tools are common in most DTPs:

- *Select tool* — Used to select, move and resize images and text.
- *Text tool* — Used to draw text frames, insert and manipulate text.
- *Shapes tools* — For drawing basic shapes like rectangles and for importing objects.
- *Zoom tool* — This tool is used for magnifying publications view.
- *Rotate tool* — This tool is used for rotating text or graphics.

6.5 Getting started with Microsoft Publisher

Microsoft Publisher simply known as Publisher is one of the most common DTP software that is installed together with other Microsoft Office applications.

To launch Publisher 2013 from Start menu, proceed as follows:

1. On the Start menu, click Microsoft Office 2013, then Publisher 2013.

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Printable area

Pasteboard

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pages. For a large document such as a book or project, you need to set u common layout using master pages. To view master pages in Publisher 20 on View menu, click Master Page or simply press Ctrl + M. You will see I Master Pages tool bar appear among the task panes.

Design tools

Publisher 2013 has a set of tools used to design and manipulate text a graphical objects. Table 6.1 gives a summary of important tools availa in the Home, Page Design and Insert ribbons used to create and manipul a publication.

Table 6.1

Tool	Purpose	Ribbon
Draw Text Box	Tool for inserting text within a textbox. In Publiser each textbox is a frame that can be manipulated as an object.	Home and Insert
Pictures	Tool used for inserting graphical objects such as pictures and cliparts from local drive or Internet	Home and Insert
Table	This tool is used for inserting tables into a publication	Home and Insert
Shapes	Contains tools for drawing different types of shapes such as lines, squares, rectangles and circles	Home and Insert
Select	Tool purposely used for selecting graphical object to be manipulated	Home and Insert
Page	This is the first button on Insert ribbon used to add pages into a publication	Insert
Picture Placeholder	Used to draw a picture frame that reserves space for a picture to be inserted later	Insert
Page Parts	Tool used to insert preformatted content such as headings and quotes.	Insert
WordArt	Tool used for inserting aristic letters or words in a publication	Insert
Insert File	This tool is used for importing content from existing document files saved on your computer.	Insert

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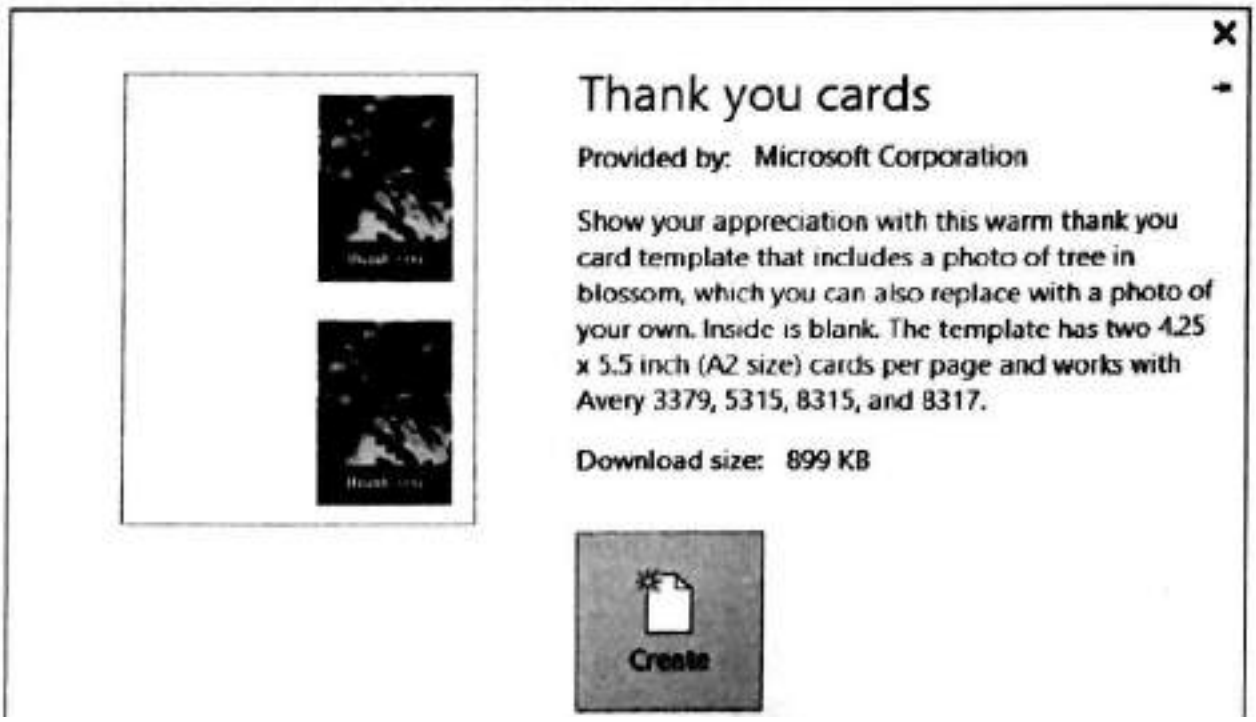
Object	Used for inserting content from an external source and placing it in your publication as an embedded or linked object.	Insert
Page Number	This is the tool to use if you wish to insert page numbers on multi-paged publications such as newsletters and books.	Insert
Change Template	This tool is used for changing or applying predefined templates on a publication.	Page Design
Orientation	Tool used to change orientation of a publication into portrait or landscape.	Page Design
Master Pages	Tool used for designing master pages that contains common layout to be applied other pages of the publication.	Page Design

6.6 Creating Publications

Once Publisher starts, the Startup screen is displayed. It is on this startup window that you can select the type of publication you wish to create such as Thank you Cards shown in Figure 6.3.



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Notice the Built-in Publication templates Window. You can click any of the templates thumbnail to display available templates in the Built-in types page. In our case, let us start from scratch by clicking Blank 8.5 x 11" thumb nail.

Designing a publication

Before entering text and pictures in a publication, it is important to design it first. The following are key factors you need to consider when designing a publication:

1. Decide the type of publication. Is it a newspaper? How many columns per page? Is it a book? What paper size will be used?
2. Decide the layout of the publication. This will enable you to select appropriate template or to use master pages to create common layout.
3. Decide on about the colour scheme, fonts, margins, orientation, graphics etc and make sure the page is properly setup.

Setting up new publication

Sometimes, it is necessary to change setup options of a publication. Such options include page size, margins and orientation.

To set up a publication proceed as follows:

1. On the File tab, click Page Setup. A dialog box shown in Figure 6.5 appears.
2. Specify the following page setup options:

(a) In the Blank Page Sizes box, select a page size.
(b) On the right of the dialog box select margin settings and then adjust them to desired size.
(c) Click Advanced button to specify more settings.
(d) Click OK to effect the changes.

Setting up a publication using master pages

To create a publication that has several pages such as a book or a report, it is important that you design a common layout for all pages using master pages. With master pages, you can create, modify, and delete content that appear in the rest of the pages. Master page settings apply to all pages in the publication until you specify otherwise and they cannot be renamed or deleted from the publication. To switch to master pages view click the master page icon(s).

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To set up a publication in Publisher using master pages:

1. On View ribbon, click Master Page button.
2. Use Master Page tools or menu tabs shown in Fig 6.4 to edit or define Master Pages(s) layout.
3. Click the Close Master page button to switch back to other pages of the publication.

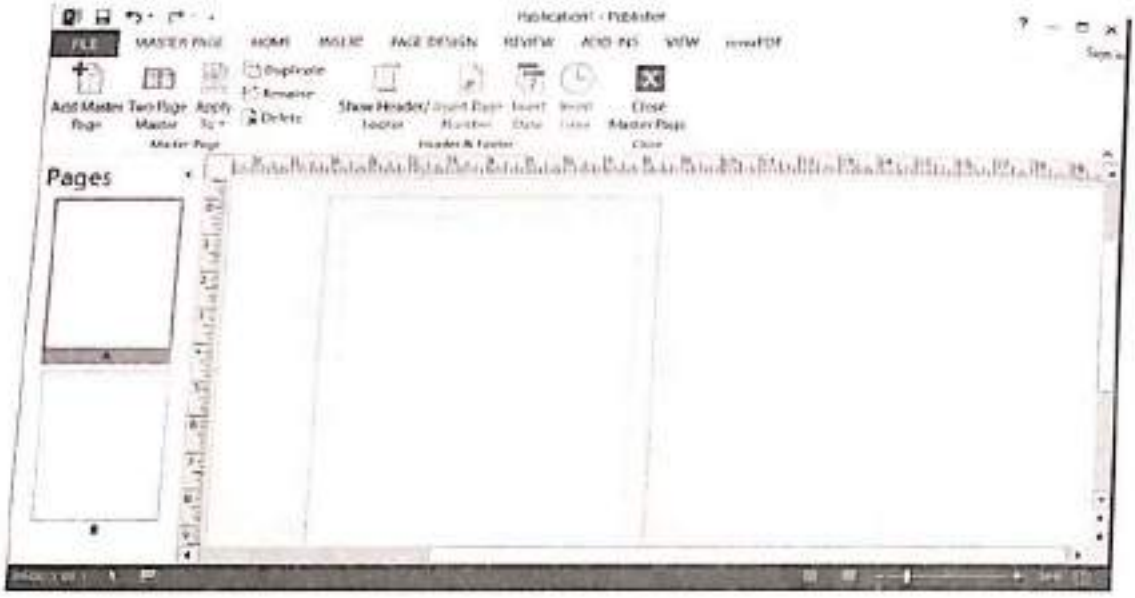
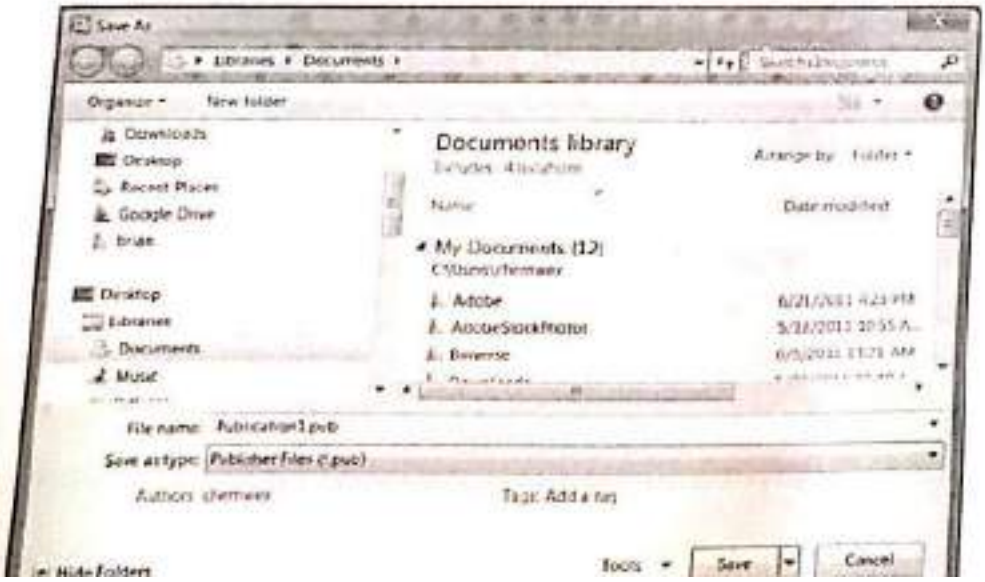


Fig. 6.4: Master pages view

Saving a publication

To save a publication, proceed as follows:

1. From File tab, click Save As.
2. In the Save as dialog box, select the drive or folder to save in, enter the file name and select the file type as shown in Figure 6.5.
3. Click the OK button.



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Review Questions 6.1

art A

. DTP stands for _____.

. The_____ are used to create common layout that appear on all pages of the publication.

3. The _____defines where the printer reads and prints a publication.

4 The _____ process specifies paper size, margins, orientation etc.

5 The _____ tool enables drawing of elipses while _____ tool enables drawing of rectangular shapes.

Part B

1. Define the following terms:

   (a) Publication

   (b) Master pages

   (c) Page orientation

2. Highlight four features that distinguish DTP software from word processing software.

3. List four examples of desktop publishing software available in the market today.

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4 Describe five tools on insert ribbon used to design and manipulate a publication.

5 List five types of publications you can create using DTP software.

6. Outline the procedure for creating a publication that has the following dimensions:

   (a) Paper size is A3

   (b) Page orientation is portrait

   (c) Double sided facing pages

Practical Activity 6.1

Open a DTP software such as Publisher and identify the various features of application window such as:

1. Text tool
2. Rulers
3. Master pages
4. Printable area
5. Page margins

6.7 Inserting text, graphics and tables

Having learnt how to create, save and open a publication in Publisher, we now demonstrate how to:

- Insert text, graphics and tables into a publication.
- Edit text and graphical objects in a publication.
- Format text and graphical objects in a publication
- Print a publication.

In most DTPs, you add text into a publication using the text tool or text frame tool. In PageMaker, use either the text tool (T) or any of the text frame tool (rectangle, ellipse or polygon tools)

Inserting text into Publication

To add text using text or frame tool in PageMaker or Publisher, proceed as follows:

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1. Click the Text tool from the tool box.
2. On an empty area on the pasteboard or printable area, drag to define the text block.
3. Type the text.

Note:

You can create artistic text using the Word Art frame tool.

Resizing and moving text

Text may not fit in the defined text frame. Publisher displays ... on one of the edges of the text frame when you select it.

To resize the text block, proceed as follows:

1. Click the text block using the pointer tool.
2. Position the pointer on the selection handle and drag to resize.

To move the text block, proceed as follows:

1. Click the text block using the pointer tool.
2. Position the pointer on the object and hold down the left mouse button.
3. Drag the text object to a new location.

Importing text from a word document

Instead of typing, you can import text from an existing document. To import text from a word processor document, proceed as follows:

1. On the Insert ribbon, click Insert File.
2. In the dialog box that appears, Figure 6.6, select the file then click OK.
3. The text is pasted onto the printable area.

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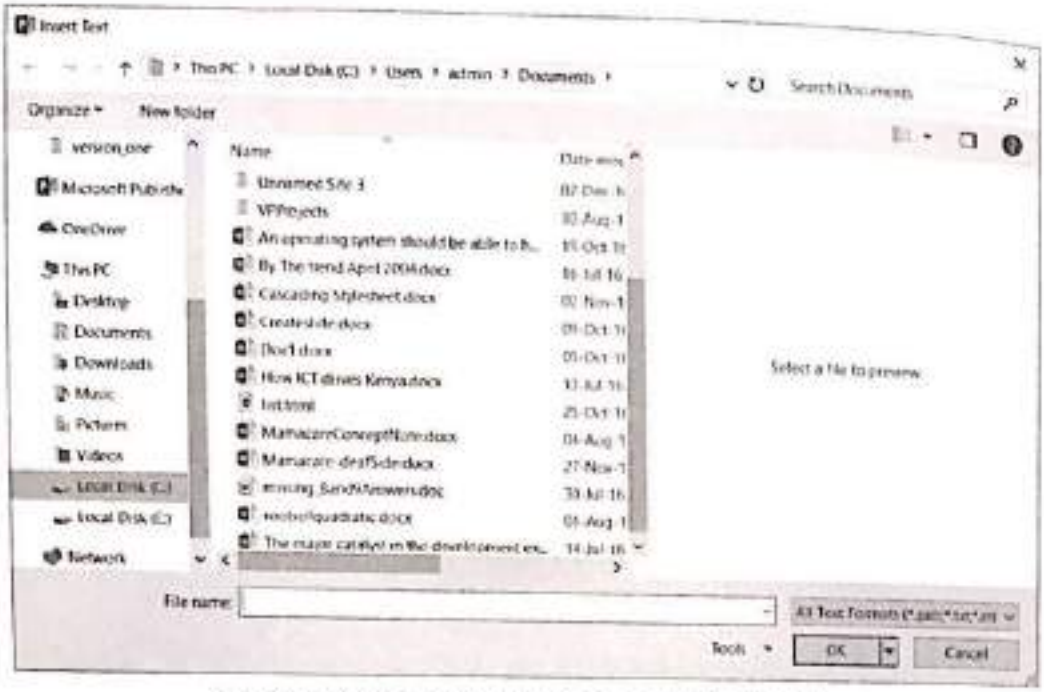

Fig. 6.6: Importing a word processor file in Publisher

Linking Text frames

In Publisher, when text in a frame spills overs to another page or column, a plus sign appearing at the top or bottom of the frame means that it is connected to a previous or next page or column means. This is referred to as threading. If you add or delete text in a frame, the rest of the story is pushed or moved to occupy the empty space. Once text frames are threaded, you can easily redirect the flow of text in them than you can with unthreaded textboxes.

To thread text frames, proceed as follows:

1. Click the first textbox to activate the Text Box Tools tab.
2. On the Textbox Tools ribbon, click **Create Link** button located in the Linking Group.
3. Click the text box you want to connect to the first one. Text boxes that are connected will display the link icon as shown in Figure 6.7.

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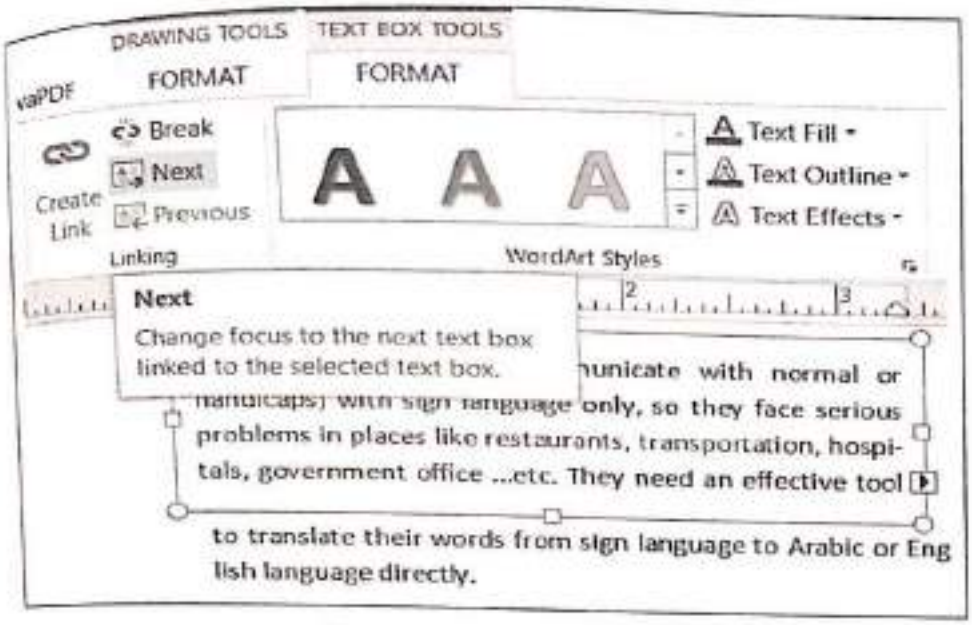

Fig. 6.7: Linking textboxes

Use connected text boxes to continue a story or move overflow text into the next text box. Notice that text that could not fit in the first text frame flows to the second.

Creating basic shapes

Publisher allows the user to create basic shapes such as lines, ellipses, rectangles and other polygons using the drawing tools on the insert tab. To display shape drawing tools, click Insert tab, then click the Shapes button in the Illustrations group. See Figure 6.8.

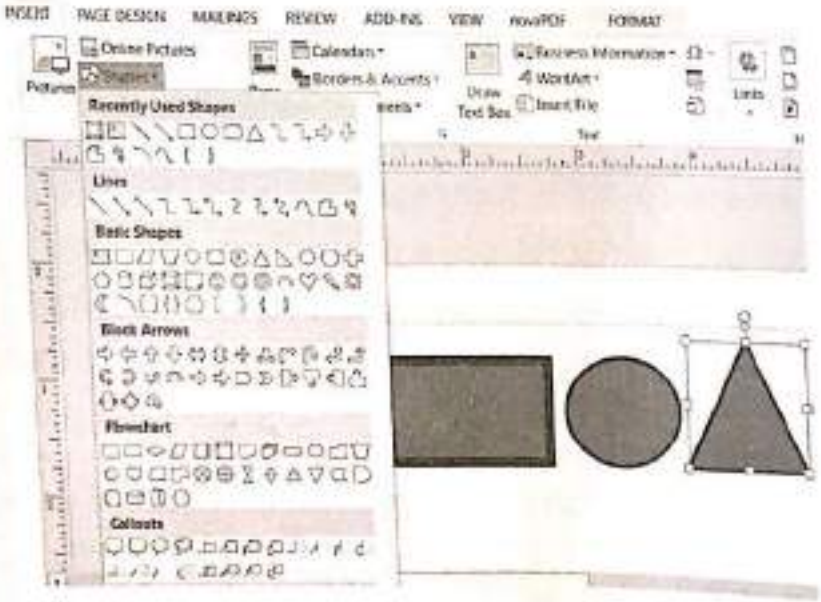

Fig. 6.8: Inserting basic shapes - autoshapes

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On the Format Autoshape dialog box, you can apply the following formats:

1. Set the style and thickness of the shapes outline.
2. Set the background colour or pattern
3. Set the transparency of the autoshape
4. Set the size and scaling of the drawing.
5. Layout, position and wrapping options.

Inserting pictures

To insert a picture in Publisher, proceed as follows:

1. On the Insert tab, click Picture button to display Insert picture dialog box.
2. In the dialog box, select the drive or folder where the picture file is located.
3. Double click the file or click the File then Insert .

Object Linking and Embedding

In Desktop Publishing, object linking and embedding (OLE) refers to importing an object or existing file into a publication. An OLE can be manipulated as part of the publication or as a shared image between the source and current document.

If an object is linked to the source application, any changes applied to the source object are reflected in linked images within a publication. This is because the destination file stores an image or copy of the source file.

On the other hand, if an object is embedded, no direct link exists. The embedded object becomes part of the publication and updates on the source file do not affect the embedded object.

To embed or link an object, proceed as follows:

1. On the Insert tab, click Insert File in the Text group.
2. In the Insert Object dialog box that appears, click **Create from file** option.
3. Click the Browse button to select the file you want to link or embed.
4. To create a *link*, make sure the checkbox labelled *Link* is checked as shown in Figure 6.9. For embedding, leave the box unchecked.
5. Click OK to insert the object.

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Fig. 6.13: Formatting toolbar

Superscript and subscript

To format text to superscript or subscript in Publisher:

1. Highlight the text to formatted as subscript or supers
2. On the Home ribbon, click the Font launcher icon to
   box.
3. In Font dialog box, check superscript or subscript
   6.14.
4. Click OK button.

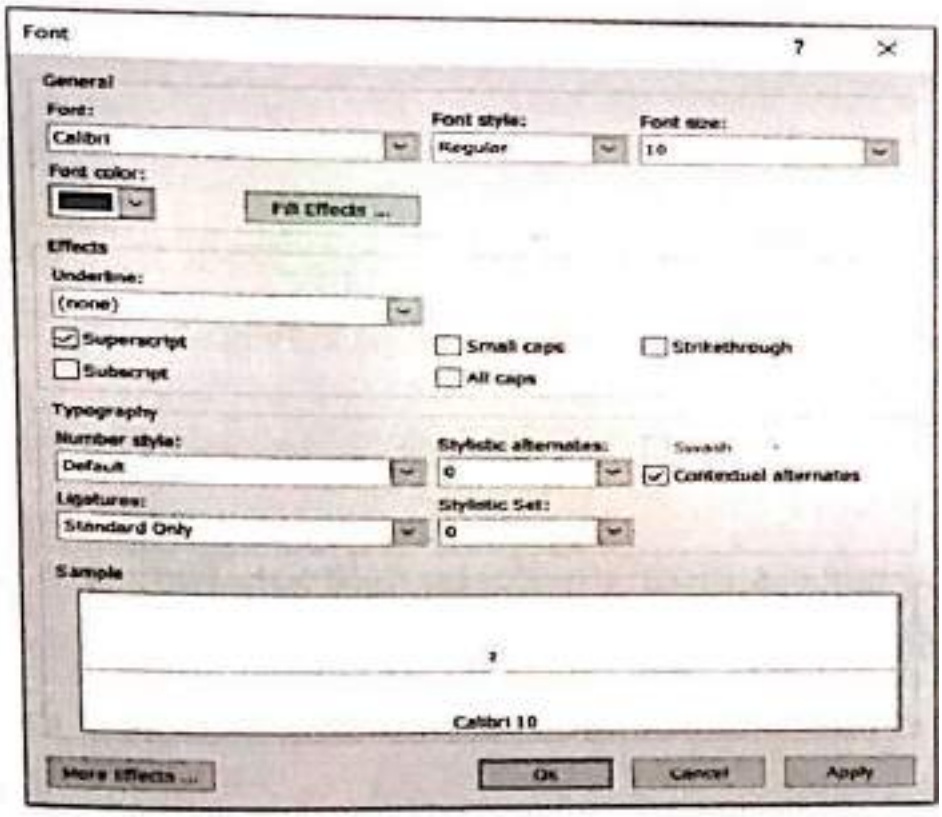

Fig. 6.14: Superscript or subscript

Paragraph and page formatting

Paragraph and page formatting involves aligning text, column guides, inserting headers and footers.

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Text alignment

Text can be aligned to the left, right, centre or justified along the left and right margins.

To align text in Publisher, proceed as follows:

1. Highlight the text.
2. On the Home ribbon, click left, center, right or justify button in the paragraph group.

To set tabs and indents in Publisher, proceed as follows:

1. On the Home ribbon, click the Paragraph Launcher icon to display paragraph dialog box shown in Figure 6.15.
2. In the dialog box, clilck Tabs and then set the required tab stop.
3. To indent, click Indents and spacing tab to specify required indentation.

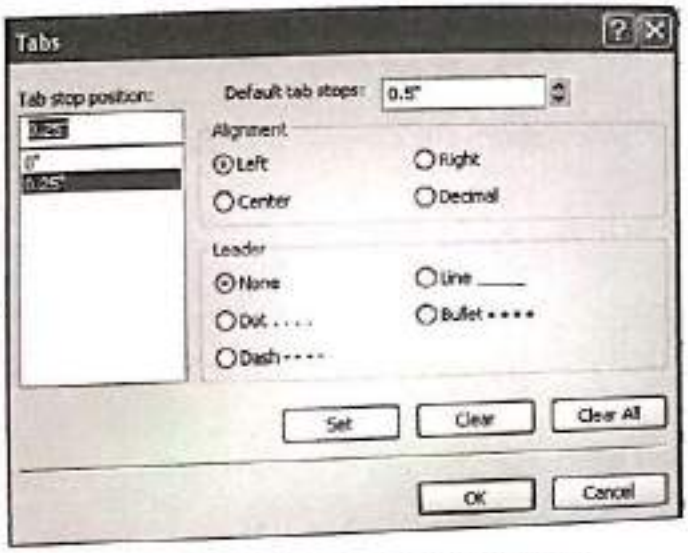

Fig. 6.15: Setting tab stops in Publisher.

Inserting column guides

By default, a page is made up of one column. To divide the page into more than one column, proceed as follows:

1. On the Home ribbon, click the column button in the paragraph group.
2. Select the number of columns from the dropdown list that appears.
3. In case you want to divide the page into more than 3 columns, click More Columns... at the bottom of the list. In the dialog box displayed (Figure 6.16) specify the number of columns.

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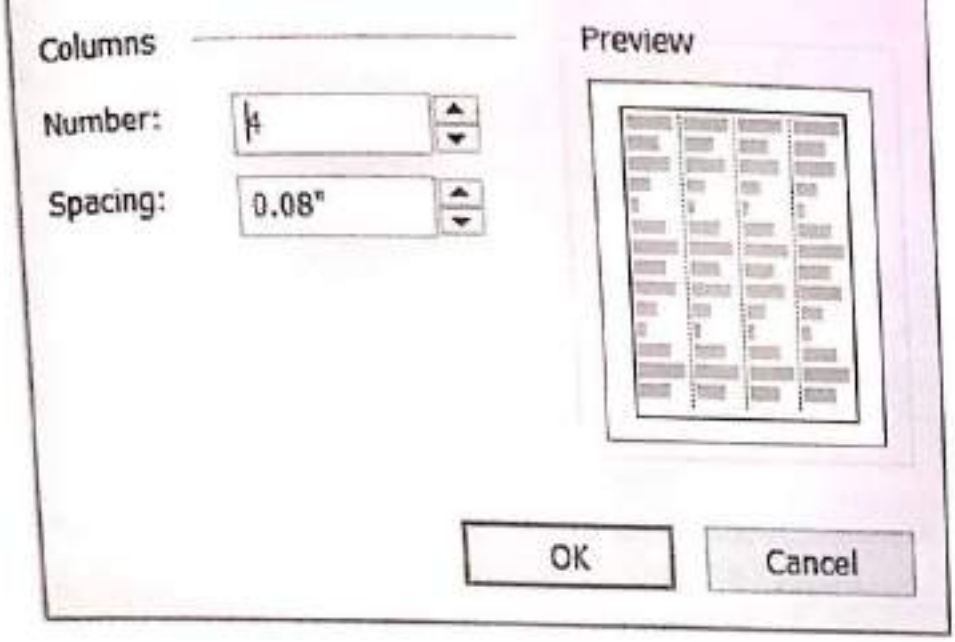

Fig. 6.16: Column guides in Publisher.

Inserting Headers and footers

Headers are lines of text, page numbers or date that appear at the top of every page. Footers on the other hand appear at the bottom of every page.

To insert headers and footers in Publisher, proceed as follows:

1. Click view tab and then Master Page button to switch to master pages view.
2. On the Master Page ribbon, click Show Header/Footer button.
3. To insert page numbers, click Insert Page Number button.
4. To insert text, type the content in the header or footer text frame.

Formatting shapes and graphical objects

Once you add a drawing or picture into your publication, you may want to format it to make it more appealing. In this section, we demontrate how to format shapes and graphical objects.

Fill and stroke

Filling refers to applying a solid colour or patterns to a drawn shape while stroke refers to the outline or line style.

To fill background and change stroke in Publisher, proceed as follows:

1. Select the object to activate the Format ribbon, under Drawing Tools.

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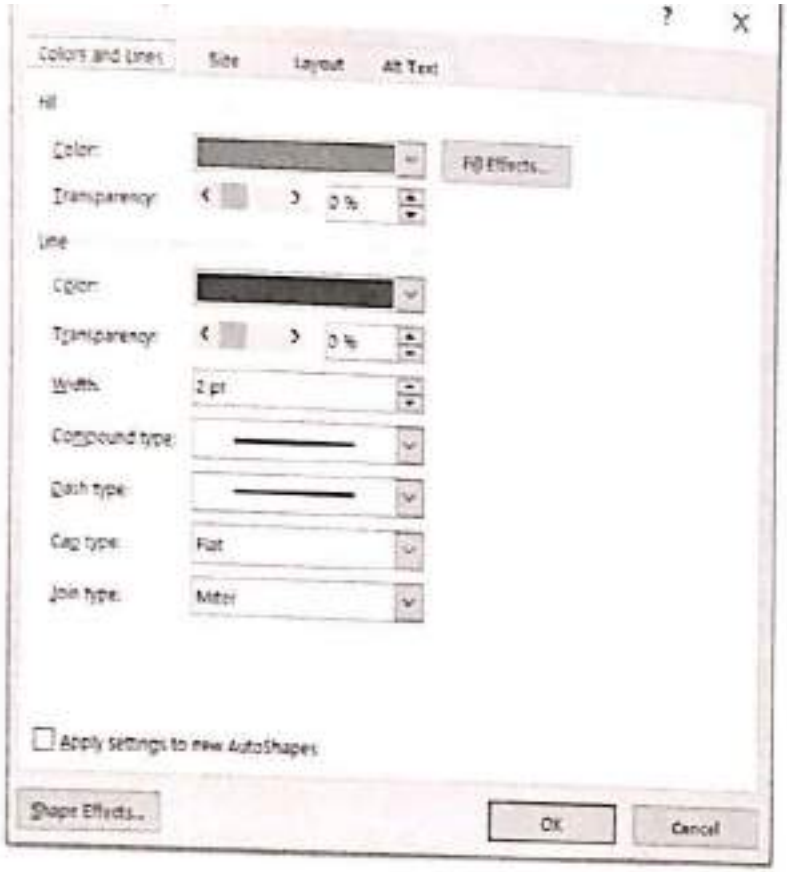

Fig. 6.17: Fill and stroke in Publisher

Note: To make the fill transparent, slide the transparency button or press Ctrl+T.

Rotating objects

To rotate an object in Publisher, proceed as follows:

1. Select the object.
2. Hold down Ctrl key and drag the rotation handle that appears above the object. Alternatively, Format ribbon, click Rotate. On the dropdown list that appears, select the rotation or flip option.
3. Rotate the handle in clockwise or anticlockwise direction.

To arrange objects in Publisher, proceed as follows:

1. Select the objects while pressing Shift + Tab.
2. On the Format ribbon, click **Bring Forward**, or **Send Backward** to select arrange option from the list (Figure 6.18).

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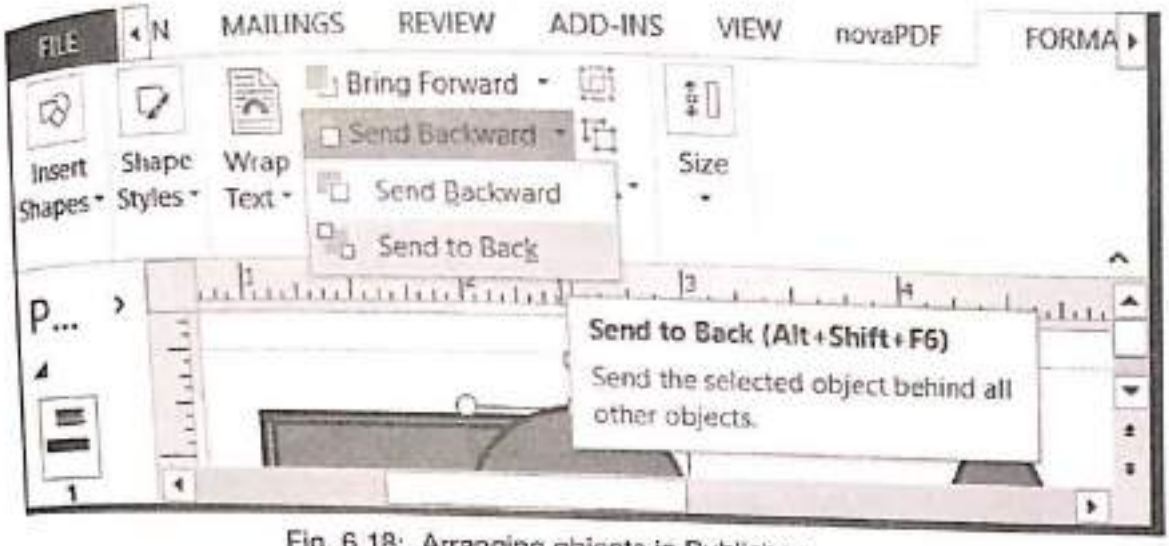

Fig. 6.18: Arranging objects in Publisher

Cropping graphical objects

Cropping is hiding unwanted parts of a graphical object particularly a picture. Figure 6.19(a) shows a picture before cropping while 6.19(b) is the same image after cropping.

(a) Image before cropping

(b) Image after cropping

Fig. 6.19: Cropping graphical objects

To crop an object in Publisher, proceed as follows:

1. Select the object to activate Format ribbon under Picture Tools.
2. From the Format ribbon, click the crop button under group group.
3. Position the cropping pointer over a placeholder on the object and drag inwards to crop.

Grouping objects

If you have several objects in a publication, you may want to group them together.

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To group objects in Publisher, proceed as follows:

1. Hold down the Shift key as you click each object.
2. Right click the selections then click Group on the context menu.

Note:

You can ungroup using the same procedures only that you select Ungroup command.

Wrapping text around an object

Text may be wrapped around an object as shown in Figure 6.20.

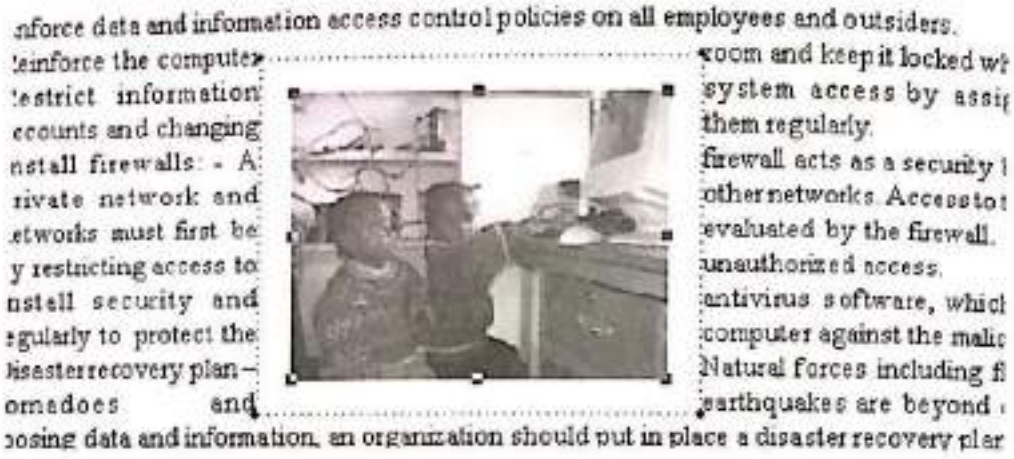

Fig. 6.20: Wrap text around an object.

To wrap text around a graphical object, proceed as follows:

1. Double click the object to activate the Format ribbon.
2. On the Format ribbon, click the *Wrap Text* button to display dropdown list shown in Figure 6.21.
3. Select wrapping option such as the square, Tight or Through from the list.

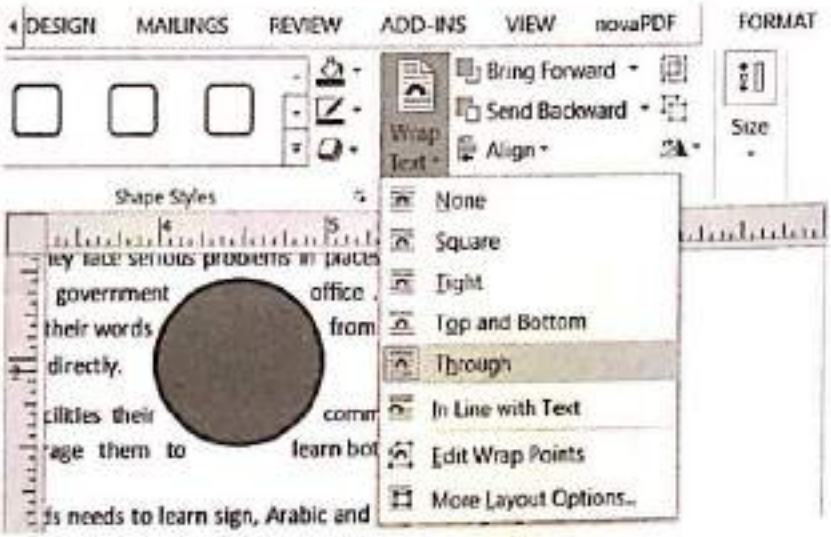

Fig. 6.21: Wrapping text in Publisher

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Review Questions 6.4

Part A

1. _____ refers to applying special effects or attributes to the layout, text and graphical objects.
2. _____ is making the first character in a paragraph occupy more than one line down the text.
3. To insert page numbers in PageMaker press_____.
4. The _____ aligns text to the right of a page.
5. The _____ are non-printable lines used to divide a page.

Part B

1. Define the term *story* as used in DTP
2. Differentiate between the following terms.
   (i) Ruler guides and column guides.
   (ii) Headers and footers.
   (iii) Fill and stroke.
   (iv) Rotate and flip.
3. Explain how you would insert page numbers in Publisher.
4. Outline the procedure for applying drop cap to the first letter of a paragraph.
5. Outline the procedure for inserting running headers and footers in Publisher.
6. Outline the procedure for wrapping text around a graphical object.

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Practical Activity 6.4

1. Design a sample cover page of a college newsletter. Use one of the commercial news prints as a reference to your design. In the design, take into account the following:
   - The title should be in background filled with blue colour.

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- The publication should have the college logo at the top left corner of the cover page.
- Apply three (Newspaper) columns in the content section.
- Insert a picture of the school on the right column of the page with text wrapping around the picture.
- Make the first letter of the publication drop cap occupying three lines below the first one.

  Save the publication as ***NoticeBoard***.

6.10 Printing a publication

Unlike in other application programs discussed so far, printing in DTPs is much more technical. This is because you may prefer to print a picture in separate colours referred to as colour separation. You can also insert crop marks and other details required for commercial printing.

To print a Publication in Publisher 2013, proceed as follows:

1. On the File tab, click Print.
2. Under Printer option, click Printer Properties hyperlink to set print options in the dialog box shown in Figure 6.22.

Fig. 6.22: Print options in Publisher

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3. To specify advanced Print properties such as inserting crop marks, click the arrow on the right of Printer button, then click Advanced Output Settings from the dropdown list.

4 In the dialog box that appears (Figure 6.23), use tabs such as Marks and Bleeds to specify advance print options.

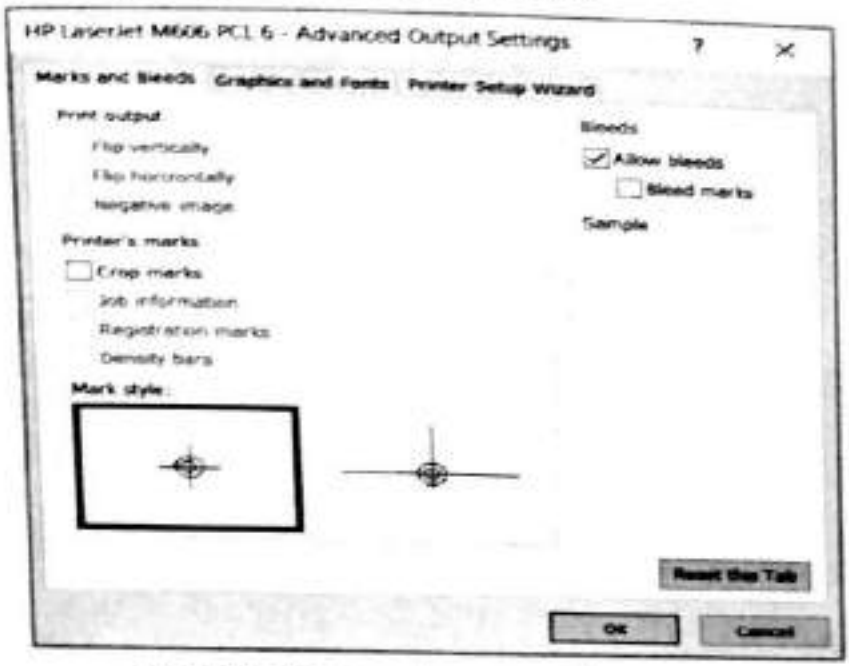
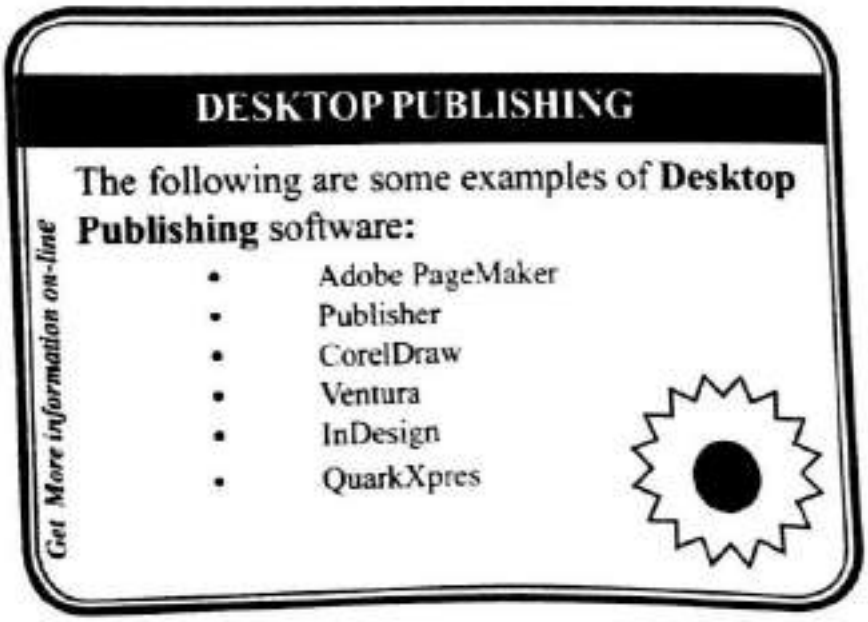


Fig. 6.23: Process colour separations

5. Click the Print button to start printing.

Practical Activity 6.5

1. Design the publication shown below and print it.



Open Benefits2 and NoticeBoard publications and print them.

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2. Use a sample coloured picture taken using a digital camera to perform the following tasks:

   (a) Insert the publication into a blank publication.

   (b) Using the print option, separate the picture into four colours; cyan, yellow, magenta and black.

Review Exercise 6

Revision Questions

Part A

1. _____ is making the first character in a paragraph occupy more than one line down the text.
2. _____ can be used to divide a page into several sections.
3. A _____ tool is the toolbox used to magnify a publication view.
4. OLE stands for_____.
5. Pages used to set a common publication layout are referred to as _____.
6. A character that appears above other characters in the same line is referred to as _____ while that which appears below is referred to as_____.
7. To rotate an object at intervals of 45°, press and hold _____ key.
8. In Publisher, the work area where a designer places objects for manipulation before inserting them into the printable area is called_____.

Part B

1. Define the term desktop publishing.
2. State five advantages of DTP software over word processors.
3. Explain how you would add ruler guides on a publication in Microsoft Publisher.
4. Differentiate between object linking and object embedding.
5. Explain how you would insert a linked image of a graphical object in Publisher 2013.
6. Explain three types of non-printable guidelines guides available in a DTP software.
7. Differentiate between crop marks and cropping a graphical object.
8. Differentiate between offset printing and digital printing.

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MSCE

END OF YEAR COMPUTER STUDIES EXAMINATION (FORM 3)

Combined Paper (100 marks)

Instructions

1. Answer all questions in this paper
2. Section A is theory and B is both practical (that requires a computer) and descriptive practical, requiring no computer.
3. The work done on the computer should be saved on a removable disc and be printed properly.
4. Hand in the saved work and print out to your teacher or invigilator for marking

SECTION A: THEORY

1. State the two types of spreadsheets you know *(2mrks)*
2. How is a worksheet different from a workbook? *(1mrk)*
3. In trying to compute the final grade of students at Damasi Demonstration Secondary School, a computer studies teacher created the following formula and dragged it in the column from the top student to the bottom student = (D1 + E1)/2.
   (a) What type of cell referencing is this? *(1mrk)*
   (b) Explain your answer to (3a) above. *(3mrks)*
   (c) In what three ways is the teacher making his work easier than doing it on a manual spread sheet? *(3mrks)*
   (d) Explain any three disadvantages of depending on spread sheets for daily work. *(6mrks)*
4. (a) Explain any three factors that should be considered when you want to install any software on a given computer. *(6mrks)*
   (b) Describe the first four steps you would follow to install Ubuntu Version 14 operating system assuming that there is internet access *(8mrks)*
5. (a) Differentiate between a computer program and computer programming *(2mrks)*

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(b) Explain why each of the following 3rd generation languages were developed

(i) Pascal *(2mrks)*

(ii) FORTRAN *(2mrks)*

(iii) BASIC *(2mrks)*

(c) Describe four characteristics of a good program *(8mrks)*

(d) Study the following program and use it to answer the questions that follow:

```
# Include < iostream.h>
double radius area;
double pi = 22/7 ;
Main ( )
{
Count <<'Enter the radius';
C in >> radius;
Area = pi* radius* radius
Count <<*The area is", area;
Return ie ha O
}//end of program
```

(i) Dry run the program above and detect the errors and write down the errors *(4mrks)*

(ii) Explain how you can debug it *(5mrks)*

(iii) What type of programming language has been used to write the program *(1mrk)*

6. When a computer was switched on, it showed an error message starting with 16** followed by other characters.

(a) What does the message mean? *(2mrks)*

(b) Explain two possible ways of troubleshooting this problem. *(4mrks)*

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SECTION: B

7. You are asked to design a marriage engagement invitation card with the following appearance.

(a) Launch a DTP program and design the engagement card using an existing template. *(2mrks)*

(b) Type in the text required. *(2mrks)*

(c) Insert the graphics shown on the card. *(2mrks)*

(d) Edit the card and add some more relevant graphics. *(3mrks)*

(e) Save the modified card in a removable disk. *(1mrk)*

(f) Print the card *(1mrk)*

8. Describe five networking devices. *(10mrks)*

9. (a) Define the term algorithm. *(2mrks)*

   (b) Outline 4 steps of an algorithm that can solve the problem of sum and average in visual basic. *(8mrks)*

10. Describe any three logical operators. *(6mrks)*

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Computer program: set of instructions written using a programming language to instruct a computer to perform a specified task.

Constant: value that does not change during the execution of the program such as PI whose value must be 22/7.

Desktop Publishing (DTP): the process of designing publications of professional quality such as newspapers, invitation cards, posters, fliers, journals and books using a specialised DTP software

Device driver: utility program that controls a device installed in a computer.

Full duplex: A mode of transmission where data can travel on the channel in both directions simultaneously.

Object code: source code that has been translated into machine-readable form.

Receiver: a terminal equipment that gets the transmitted message from the channel and decodes it before presenting it to the user.

Row: horizontal arrangement of cells while a

Simplex: A mode of transmission where there is only one way transmission of data on the communication link. The sender sends the data and the recipient receives it. The recipient cannot send a response back to the sender over the link.

Source code: set of instructions or statements written by a programmer that are not yet translated into machine-readable form.

Spreadsheet: an accounting ledger in which data is organised in rows and columns.

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ransmitter:	A terminal equipment that receives the message from the source and converts it to a format that can be transmitted on the channel (coding).
Ubuntu:	Linux-based open source operating system that is available freely and can be installed in various devices from desktop computers to mobile phones.
Variable:	named storage location in computer's memory for temporarily holding input or output data.
Workbook:	spreadsheet file that consists of one or more related worksheets.
Worksheet:	the work area made up of rows and columns where data is entered.

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