new

KEYBOARD

Windows 10 and MS Office 2016

Sangeeta Panchal
Alka Sabharwal

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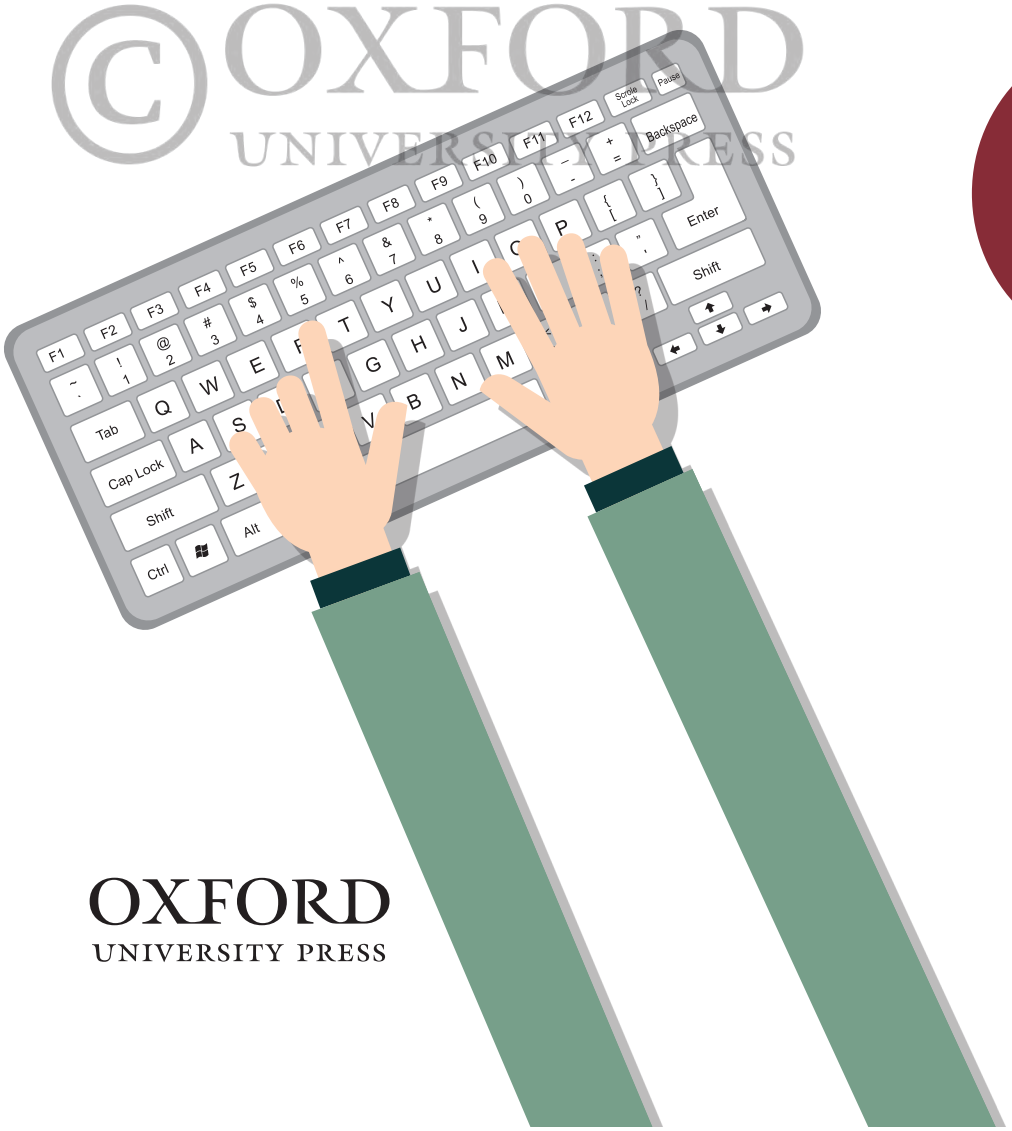

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Preface

Computers have become an essential part of our everyday lives, and computer science is today an all-encompassing subject with unbounded scope for creative application. This makes it almost necessary to familiarize children with this fascinating field at the primary level itself. An introduction to computer science should aim to impart the basics of the subject to students, while simultaneously giving them opportunities for exploration and self-learning.

Keyboard Windows 10 and MS Office 2016 is the latest edition of the **Keyboard** series. This edition too, in the manner of its predecessors, strives to make learning computer science a lively, interesting, and interactive experience.

The series follows a well-balanced approach towards theory and practice. The content coverage incorporates the most recent feedback from teachers. Further, the latest developments in information technology are addressed, keeping in mind the constantly evolving nature of the subject and its wide-ranging potential. The series encourages children to engage with technology, and understand the science behind the digital world. Comic strips, cartoon characters, and illustrations make the teaching-learning interaction an enjoyable process.

A detailed description of the main features of the series is given in the **Key Features** spread spanning pages 4 and 5.

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The primary level books introduce children to computers and their numerous applications in varied domains. Books 1 and 2 cover the various parts of a computer, their functions, **WordPad**, and **Paint**. **Rapid Typing Tutor** and **The MagicBook** develop and fine-tune their motor skills for working more efficiently on the computer.

Books 3 to 5 cover **Word 2016**, **Excel 2016**, and **PowerPoint 2016**, along with the basics of **operating systems**, **data storage**, and the **Internet**. This level also enables a glimpse into **programming fundamentals** through **Scratch**.

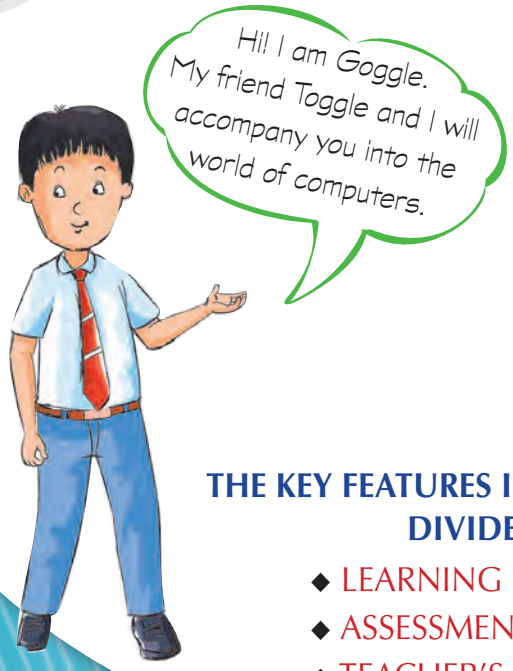
Books 6 to 8 explain advanced topics of **Excel 2016**, introduce **RDBMS** through **Access 2016**, command line programming through **MS Small Basic**, high-level programming through **C++**, and **web designing** through **HTML5**. Creating animations in **Animate CC**, editing images in **Photoshop CC**, and making movies in **OpenShot** expose students to an exciting area of the subject. The amazing world of **apps** gives a new dimension to this journey of learning. An insight into the captivating branches of **augmented and virtual reality**, **artificial intelligence**, **internet of things**, **big data analytics**, and **machine learning** is also included.

We welcome constructive comments and suggestions for improving the course in future editions.

Sangeeta Panchal
Alka Sabharwal

Key Features

Each chapter in this book is introduced through two delightful characters, Goggle and Toggle.



THE KEY FEATURES IN THIS SERIES CAN BE DIVIDED INTO:

- LEARNING RESOURCES
- ASSESSMENT RESOURCES
- TEACHER'S RESOURCES

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LEARNING RESOURCES

FAST FORWARD! Reveals keyboard shortcuts for menu commands, to help users save time while performing routine operations

Fast Forward!

Inserting a frame	F5
Inserting a keyframe	F6
Inserting a blank keyframe	F7

TOP TIP Gives useful tips on the options available for different operations

Top Tip

You can also right-click the frame in the Timeline and select Insert Frame or Insert Keyframe from the shortcut menu.

DID YOU KNOW? Conveys interesting facts on the topic being covered

Did You Know?

The term weblog was coined by John Barger in 1997. In 1999, programmer Peter Merholz shortened weblog to blog. College student Justin Hall, created the first blog links.net, in 1994. At that

PRACTICE TIME Provides situational exercises along with their solutions, after every major topic, to reinforce learning

Practice Time

The mathematics teacher has given a task to the class monitor to draw 3D models of a cube, a cone, a sphere, and a cylinder on the canvas so that they can be shown in the class for better understanding of these shapes. She also wants to group the objects so that they can be moved or resized all together. Help her complete the task.

SOLUTION

1. Open **Paint 3D**.
2. Select **3D shapes**. The **3D shapes** pane appears on the right.

ASSESSMENT RESOURCES

Exercises
Test learners on all aspects of conceptual theory covered in a chapter through objective and descriptive questions

Application Based Questions
A special analytical section within Exercises to encourage students to evaluate and reason based on a situation

In the Lab
Challenges students to apply the concepts learned to real-life situations

Test Papers
Assess students on conceptual understanding through alternative question pattern recommendations of various school boards

TEACHER'S RESOURCES

Oxford Educate

- **Oxford Educate,** our much-appreciated, award-winning digital teaching aid, integrates in a single resource an e-book with interactive teaching tools and learning materials.
- The accompanying **Test Generator** is an innovative, easy-to-use assessment tool, designed to aid teachers in generating test papers for evaluation.

InstaTest, a very useful alternative test generator, facilitates creation of quick objective-type tests that are auto-evaluated instantaneously.

The course is also supported by:

- **Teacher's Notes** Provide important information and suggestions within the coursebook on creative approaches to a chapter or a topic
- **Teacher's Manuals** Include lesson plans, the complete answer key to the coursebook, worksheets, and test papers

LEARNING nuggets with interactive exercises cover each chapter in a child-friendly manner. These are included in Oxford Educate and Oxford Areal, and are also available for download from India.oup.com/orcs/9780199490783

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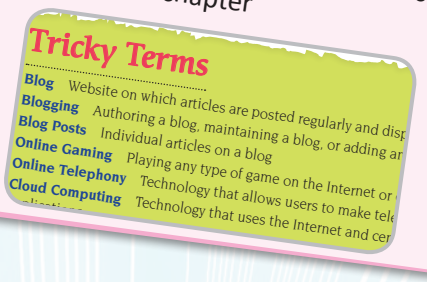
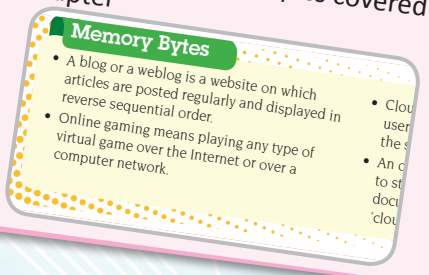
COMPUTER MANNERS Explains computer etiquette through cartoon strips

TRICKY TERMS Lists important terms along with their definitions for easy reference, at the end of each chapter



MEMORY BYTES Provides a quick recapitulation of all the topics covered in that chapter



Oxford Areal provides linked, digital support through:

- **Interactive versions** of the questions marked with the Oxford Areal icon
- **Demo videos** of one of the Practice Time questions in software chapters
- **Animations** for select chapters

With Oxford Areal

See inside cover

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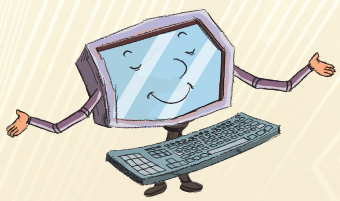

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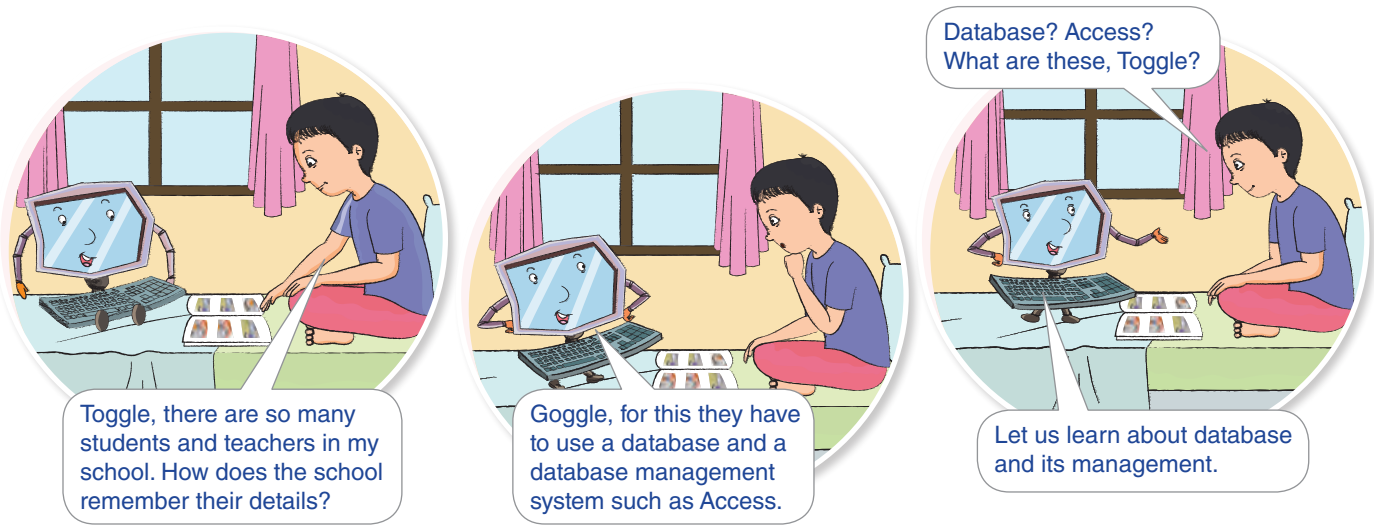
1 Introduction to Access 2016



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IN THIS CHAPTER

- What is a Database?
- Database Management System
- Introducing Access 2016
- Creating a Database
- Setting Data Types
- Modifying Table Design
- Opening an Existing Database
- Totaling, Sorting, Filtering and Searching Data

Most students keep their schoolbooks and notebooks in a cupboard or a study table at home. If these notebooks are not kept in a proper way, it becomes difficult to locate them before a test or an examination. Now, imagine a large organization that has several people working for it. It would have a large amount of data to handle. In order to make handling of large data systematic, a *database* and a *database management system (DBMS)* are used. In this chapter, we will learn about databases and a popular database management application—Access 2016.

WHAT IS A DATABASE?

Every organization has to maintain data related to its business, its employees, and so on. For example, a school maintains data on their students' personal details, their academic and co-curricular achievements, and on the details of their teachers and administrative staff. This data needs to be available to a user easily and promptly. Also, this data needs to be updated regularly. Therefore, it is preferable to organize the data. A database is used for this purpose.

A *database* is simply an organized collection of data. Databases arrange information in such a way that any specific piece of information can be easily accessed. A good database removes

duplicate or unnecessary data, reduces the size of the data, increases the efficiency of the user, and also helps in maintaining the accuracy of data.

Elements of a Database

There are four different types of databases: (i) Hierarchical, (ii) Network, (iii) Relational, and (iv) Object-oriented.

Of these, the **relational database** model is the most popular. This database stores data in the form of **tables**. A table organizes data into rows called *records* and columns called *fields*. Records and fields together make a table. Each **record** defines information about one entity and gives complete details about it. Each **field** defines information of a certain type for all records. Tables, fields, and records form the **elements** of a relational database. For example, Table 2.1 shows a sample table with fields and records.

Fields

Records

AdmissionNo	Name	FatherName	Mobile	Email
A0012018	Sukriti Gupta	Nishant Gupta	9899xxxx12	nishant_g@email.com
A0022018	Siddhant Jain	Gaurav Jain	9999xxxx23	gaurav_j@email.com

Table 2.1 *Admission* table with fields and records

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It has two records that contain information about two entities, *Sukriti Gupta* and *Siddhant Jain*. It has five fields that contain information of the same type for these two entities. For example, the field *Email* contains the email address of each entity.

The other elements that we are going to learn about in this chapter are **keys** and **data types**.

DATABASE MANAGEMENT SYSTEM

Database management involves creating, modifying, deleting, and adding data in a database. The software that performs these functions is called a *Database Management System*. *Access*, *MySQL*, and *Oracle* are some popular DBMS software.

Functions of a DBMS

When a large amount of data is stored in various files, there is a possibility of issues such as data redundancy, data inconsistency, and data inaccuracy. A DBMS provides an easy solution to all these problems as it allows centralized control over data.

A DBMS provides the following benefits:

Reduces data redundancy Data redundancy means duplication of data. Redundant data may be data that is repeated in another table, or can be calculated, so it does not have to be stored. For example, a table may have a date of birth and age. The age can be calculated by subtracting the date of birth from today's date. Redundant data increases the database file size. Using a DBMS, the data can be stored at a single place in the database, thereby reducing or eliminating data duplication.

Controls data inconsistency Suppose, addresses of students of a school are stored in two files: *'Bus Information'* and *'Fees Information'*. A student informs the bus incharge about a change in his/her address. Now, the new address will be reflected in the *'Bus Information'* file, but the same change may not be made in the *'Fees Information'* file. Hence, the two files would have two different addresses for the same student. This will not happen in a properly maintained database.

Facilitates sharing of data Different users can use the same database to extract data depending on their individual needs.

Enforces standards A DBMS makes it possible to apply certain standards in data representation. These standards could be an organization's own standards or national/international standards.

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Ensures data security In a DBMS, the database administrator has complete control over the database and ensures that the data is accessible only to authorized people. Different categories of users can be given different permissions. Some may have the authority to only view the data, while others may have the authority to modify the data, too.

Maintains integrity A DBMS supports database integrity. Suppose a database contains information about the marks scored by the students in an examination. If the maximum marks are 100, you can have rules to make sure that the database accepts numbers only in the range of 0 to 100.

Did You Know?

In a DBMS, standards may be defined for names and formats of data elements, display formats, report format, etc. Standards in a centralized database environment are applied more easily than in an environment where each group has control over its own files.

INTRODUCING ACCESS 2016

Microsoft Access is one of the popular DBMS applications. Its latest version is **Access 2016**. It is a relational database, where data is stored in the form of tables. A relational database uses multiple tables to organize data and creates relationships between these tables to retrieve data. Each specific piece of information in a table is called a **value**. A value is located at the intersection of a column and a row. The total number of values in a table is the number of rows multiplied by the number of columns.

Records in a table are arranged according to a common reference value known as the **primary key** or the **key field**. *A primary key is one (or more) column(s) whose values uniquely identify every row in a table*. The value in the primary field is different for every record and thus helps to identify records uniquely. For example, in a table containing information about admission of students, the column *AdmissionNo* behaves as the primary key as every student has a unique admission number.

Elements of Access 2016

Access 2016 includes a new user interface (Fig. 1.1) as compared to the previous version.

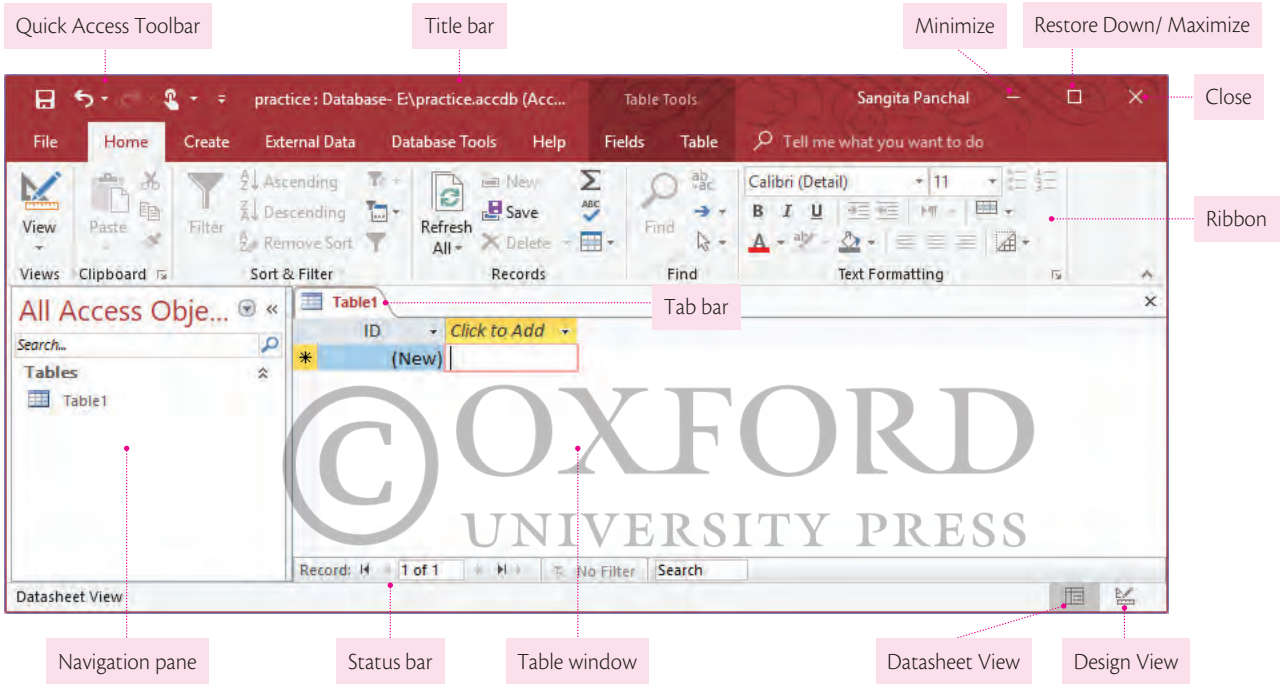

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Fig. 1.1 Access 2016 interface

The elements of Access 2016 are:

Title bar It appears at the top of the window and displays the name of the active database and, by default, displays the path to the folder where it is stored.

At the left end of the Title bar is the Quick Access Toolbar (Fig. 1.2). By default, the Quick Access Toolbar displays the **Save**, **Undo**, and **Redo** buttons. You can customize it to displaty more commands of your choice.

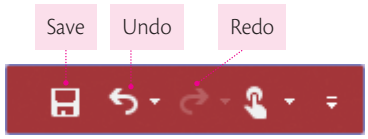

Fig. 1.2 **Quick Access** Toolbar

The control buttons (Fig. 1.3) are present at the right end of the Title bar. **Minimize**, **Restore/Maximize**, and **Close** buttons are used to minimize, restore, and close the window, respectively. Click the **Help** tab to open Access Help where you can search for any information.

Fig. 1.3 Control buttons

Ribbon This is the area below the Title bar. The top of the ribbon has a set of tabs. Clicking the tab displays its associated set of commands. Commands are organized into groups. The main tabs are **File**, **Home**, **Create**, **External Data**, and **Database Tools**. When you click and type in the **Tell me what you want to do** box, Access will attempt to help you in your task.

File tab It has commands that help manage Access and Access databases. Click the **File** tab to open the **File** menu (Fig. 1.4) and the **Backstage** view. The main commands available in the **File** menu are **Info**, **New**, **Open**, **Save**, **Save As**, **Print**, **Close**, **Account**, and **Options**. You can go back to the database and the ribbon by clicking the back arrow on top.

Fig. 1.4 **File** menu

Navigation pane This is the area on the left of the window and it displays your database objects within the current database. It has a **Tables** window in which you can view and edit the database content. When you open a database, or create a new one, the names of the database objects appear in the Navigation pane.

Tabbed document Database objects appear as tabbed documents. The tabs can be seen on the Tab bar.

Status bar This bar is present at the bottom of the window. It displays information about the current database and includes buttons to change views.

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Table window The Table window provides two possible views of the database:

i. **Datasheet View**—It displays the data within the database and allows you to enter and edit data, but does not allow you to change the format of the database.

ii. **Design View**—It displays the format of the database and allows you to change the format of the database objects.

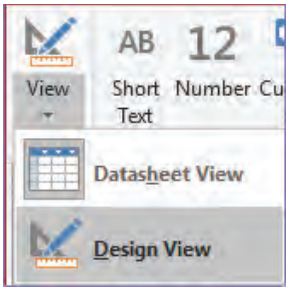

Fig. 1.5 **View** icon

To choose the view of an opened table:

1. Select the **Home** tab.
2. Click the **View** icon (Fig. 1.5) in the **Views** group, then choose a view option. For example, choose **Design View**.
3. The **Design View** opens in the **Table** window (Fig. 1.6). Note that the **Design** tab has become automatically selected.

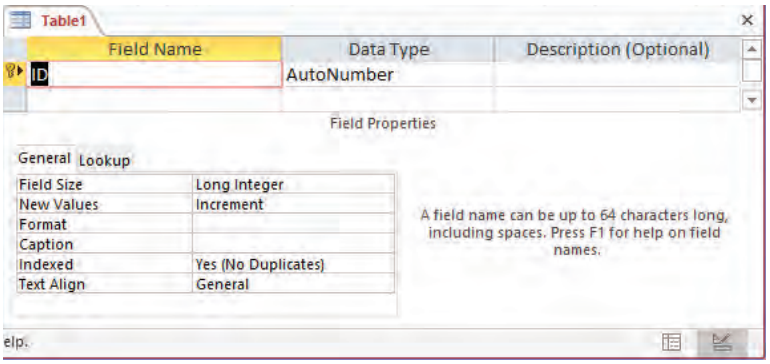

Fig. 1.6 Design View

Database Objects

An **object** in a **database** could be any of the following:

Table It stores the data in a database.

Form It lets you enter and display data in a customized format.

Query It retrieves data from one or more tables based on a selection criterion

Report It displays data in an easy-to-read format for printing.

Macro It automates tasks that are performed often.

Module It contains programming statements written in VBA programming language.

Of these objects, we will learn about **tables**, **forms**, **queries**, and **reports** in this class.

Starting Access 2016

To start Access 2016, select **Start** and then click **Access 2016** application in the **Start** menu (Fig. 1.7). This will display the Start screen of Access 2016 (Fig. 1.8).

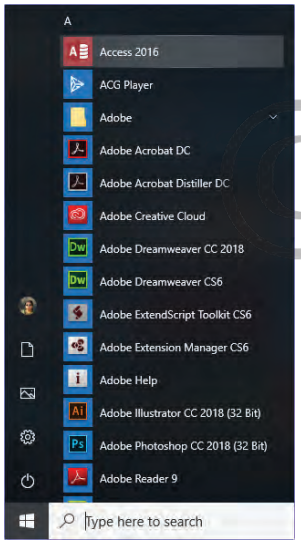

Fig. 1.7 Access 2016 application in **Start** menu

Fig. 1.8 Start screen of Access 2016

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CREATING A DATABASE

To create a new database, you can choose an Access template that has various built-in tables, queries, forms, and reports that are ready to use. You can also search online for more templates. You may also create a database from scratch.

Creating a Database Using a Template

In order to create a database using pre-defined templates, follow these steps:

1. In the Access 2016 Start screen, click a template, say, **Contacts** (Fig. 1.9). You can also

perform an online search of the template or click categories. You can see the complete list of all categories in the Right pane. There are also hyperlinks, which you can click to reveal the templates within each category.

2. Enter a name and location of the file in the dialog box that appears. Click the **Create** button (Fig. 1.10).
3. A Welcome screen appears. It provides a brief description of the database and also offers assistance (Fig. 1.11).

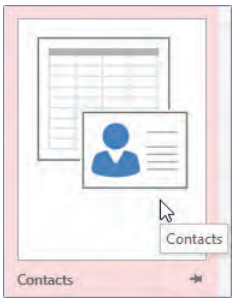

Fig. 1.9 **Contacts** template

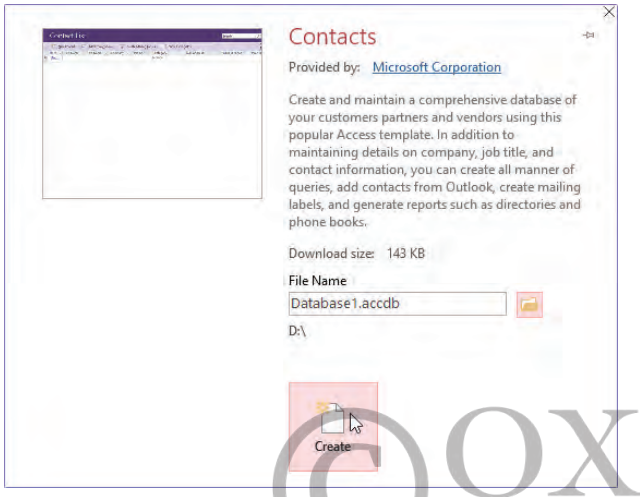

Fig. 1.10 Contacts template dialog box

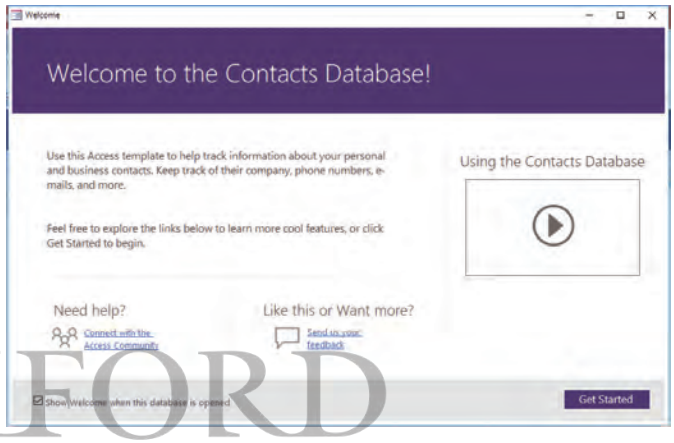

Fig. 1.11 Welcome screen

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4. Click the arrow to watch an online video demonstrating how to use this database.
5. Click the **Get Started** button to open the database. Access creates the database and displays the table in Datasheet View (Fig. 1.12).

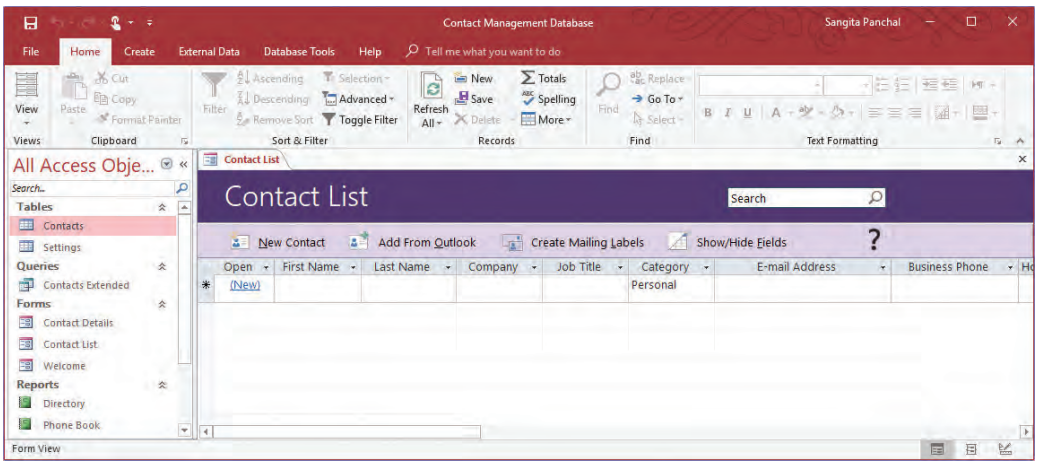

Fig. 1.12 **Contact List** table in Datasheet View

The Navigation pane displays all the objects. In case a secuirty warning is displayed, click the **Enable Content** button to use all features (macro-code functions) of the database.

Create a Database from Scratch

If none of the existing templates fits your needs, you can start with a blank database. The steps to create a blank database are:

1. Click **Blank database** (Fig. 1.8). A dialog box opens with default name for the database and a default location on your computer. The default name is **Database*n*.accdb** (where *n* is a numeral: 1, 2, 3,…, and so on).
2. You can either use the suggested defaults or type a name for your database in the **File Name** box (Fig. 1.13) and choose a folder.

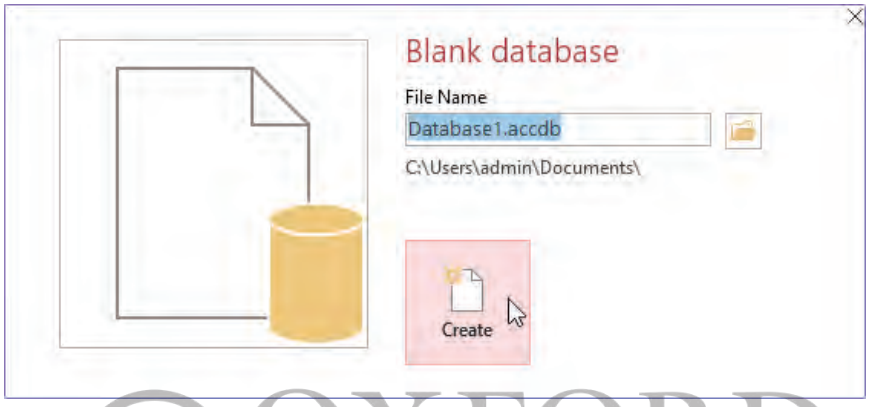

Fig. 1.13 Blank database

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3. Click the **Create** button to complete the creation of the new database at your chosen location. The database will now open in the Access user interface. You will see a blank table — Table1 — in Datasheet View where you can add data (Fig. 1.14). Access automatically creates a field called ID, which can be renamed or deleted to suit your requirement, and provides a *Click to Add* header that prompts you to add more fields.

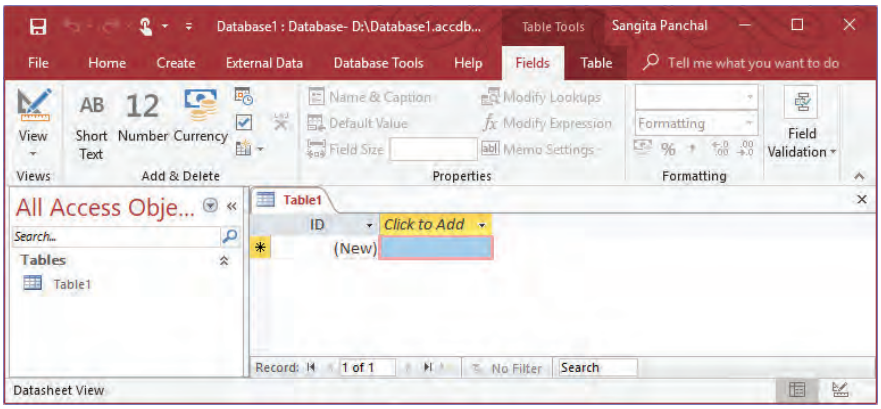

Fig. 1.14 Table1 in Datasheet View

The field ID is the **primary key**, an entry that will uniquely identify each record in the table. No two records in this table can have the same value for the primary key field. It is incremented automatically. You do not have to enter a value in it.

Adding Fields in Datasheet View

Access 2016 provides two methods for adding fields to a table.

First method

1. Click the **Click to Add** field header (Fig. 1.15).
2. Select a data type for that field from the drop-down list that appears. A new field named *Field1* is inserted (Fig. 1.16).
3. Type the field heading title (e.g., Model) to replace the default heading (Fig. 1.17).

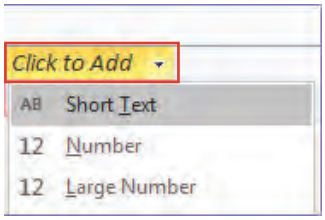

Fig. 1.15 **Click to Add** field

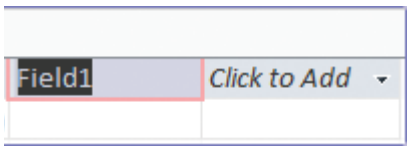

Fig. 1.16 Default heading

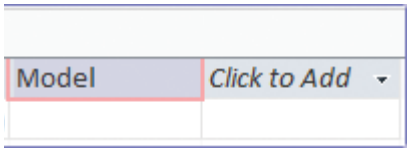

Fig. 1.17 Changed field heading

Second method

1. Click the column header to the right of which you want to add a field with the required data type. Let us click on the column header 'Model'.
2. Under **Table Tools**, click the **Fields** tab.
3. Select a data type for that field from the **Add & Delete** group (Fig. 1.18).
4. A new field named *Field1* is inserted. Type a field heading title (e.g., Cost) to replace the default heading (Fig. 1.19).

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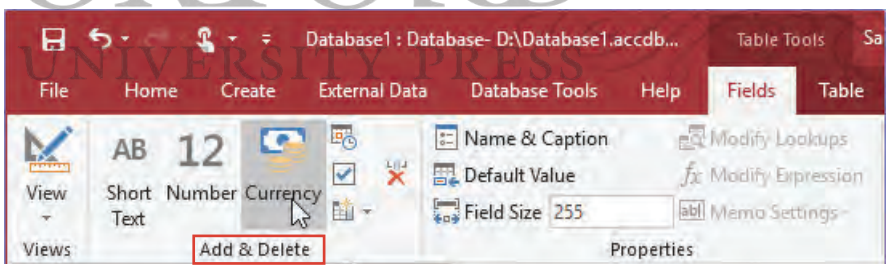

Fig. 1.18 **Add & Delete** group

Fig. 1.19 Changing the default heading to Cost

5. Select the empty cell below the field *Model* and type the text. Then, press the Tab key to move to the next field (Fig. 1.20). The value **1** appears in the **ID** field.

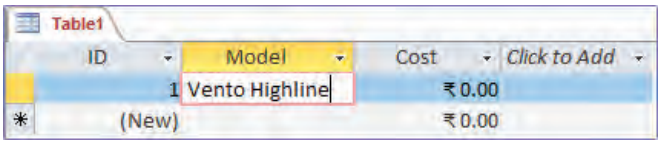

Fig. 1.20 Entering the value in the first cell

Did You Know?

You can also rename the field names by double-clicking and typing the new name.

Top Tip

If you do not save the first record, Access increments the ID value every time you add a new field to the record. For example, if you add seven fields, Access assigns the value 7 to the ID field of the first record. To avoid this problem, you simply click the **Pencil** icon in the record selector after you enter your first value in the first record. This saves the record with the value 1 assigned to the ID field, and subsequent records will be numbered sequentially.

6. You can save the table by clicking the **Save** icon on the Quick Access Toolbar.
7. Under **Table Name**, enter a name (e.g., *Cars*), and then click **OK** to close the table (Fig. 1.21). It gets added to the **Tables** group in the Navigation pane (Fig. 1.22).

Fig. 1.21 **Save As** dialog box

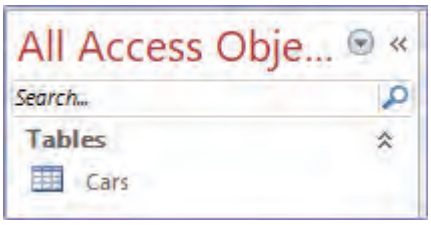

Fig. 1.22 Cars table added to Navigation Pane

Top Tip

You can rename or delete a closed table by right-clicking it in the Navigation pane and then selecting the required option.

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Rules for Naming a Field

The rules for naming a field are as follows:

- A field name can be 1 to 64 characters long. However, it is advisable to use at most 10 characters so that the field name is easy to remember and you make no errors while typing.
- A field name can include letters, numbers, and some special characters. The underscore (_) sign is allowed and is commonly used.
- A field name cannot have a period (.), an exclamation mark (!), brackets ([ ]), or the grave accent (`).
- A field name can be in upper case, lower case, or mixed case.

Top Tip

You can change the field name at any time even if the table contains data.

SETTING DATA TYPES

Using a right data type for a field helps control what you can enter in a field. Table 2.2 lists the data types available in Access 2016.

Table 2.2 Data types in Access 2016

Data Type	Description
Short Text	It is used to store text, combinations of text and numbers (such as addresses), and numbers that will not be used in calculations (such as phone numbers and postal codes). It can store up to 255 characters.
Long Text	It is used to store long text, such as notes and descriptions. It can store up to 65,535 characters.
Number	It is used for numeric data that will be used in calculations.
Large Number	It is used for numeric data of very large numbers that will be used in calculations.
Date/Time	It stores date and time values. You can display the dates and times in various formats.
Currency	You can specify various currencies and display them in different formats.
AutoNumber	It stores an integer that increments automatically as you add records. If the table does not have a primary key, then AutoNumber uniquely identifies the records. If you delete a record, its AutoNumber value is not reused, and remaining records are not updated. The ID field in a new table is automatically assigned the **AutoNumber** datatype.
Yes/No	This can have only one of two values, True or False. You can adjust the format setting to display as Yes/No or True/False.
OLE Object	This stores graphics or objects such as a Microsoft Excel worksheet or Microsoft Word document.
Hyperlink	This is a clickable path to a folder on your hard disk, a network location, or a website.
Attachment	This is used to attach a file to a record in the same way you attach a file to an email.
Calculated	It is used to store the results of a calculation based on other fields in the same table.

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MODIFYING TABLE DESIGN

In Datasheet View, you can add, delete, rename, move, and change the data type of a field using the **Fields** tab under **Table Tools**.

Deleting a Field

1. To delete a field, click its column header.
2. Then, click **Delete** in the **Add & Delete** group.
3. Click **Yes** in the message box that appears, to permanently delete the field(s) (Fig. 1.23).

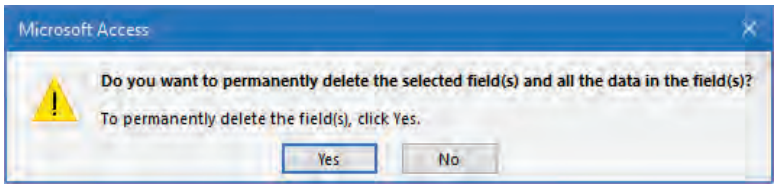

Fig. 1.23 Message box

Moving a Field

1. Click the column header that you want to move.
2. Drag it to the left or right. Notice the thick line that appears on dragging. Release the mouse button (Fig. 1.24).

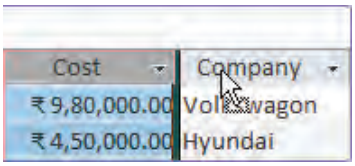

Fig. 1.24 Moving a field

Hiding/Unhiding Fields or Columns

1. Click the column header. If you want to select more than one column, press the Shift key.
2. Click the **Home** tab. In the **Records** group, click the **More** button and then click **Hide Fields** (Fig. 1.25). Now you cannot see the hidden fields in Datasheet View.
3. In the **Records** group, click the **More** button and click **Unhide Fields** to open the **Column** dialog box (Fig. 1.26). You can select and clear check boxes to control which fields should be visible.

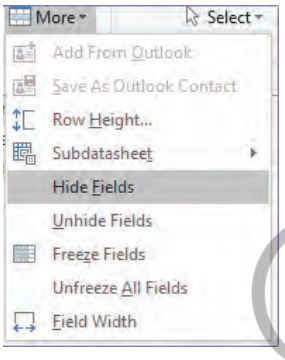

Fig. 1.25 **Hide Fields** option

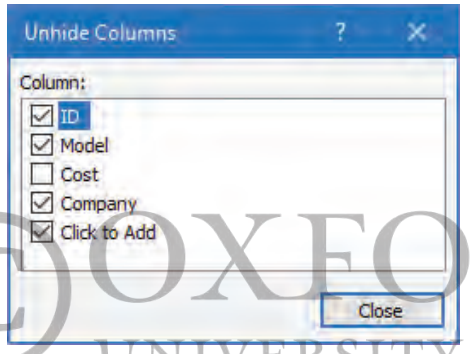

Fig. 1.26 **Column** dialog box

Top Tip

The commands to hide, unhide, freeze, and unfreeze columns are also available in the context menu that opens when you right-click a field name.

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Freezing/Unfreezing Fields

If you have a number of fields in a table, you will not be able to see the entire set of fields until you scroll to the right. You can freeze the required fields you want to see.

1. To freeze the fields, click the column header.
2. Click the **Home** tab. In the **Records** group, click the **More** button and then click **Freeze Fields** (Fig. 1.25). Now you can see all the frozen fields on the right while scrolling.
3. To restore the fields to their previous state, click the **Unfreeze All Fields** option.

Changing the Data Type

To change the data type, follow these steps:

1. Click the field header whose data type you want to change.
2. In the **Formatting** group on the **Fields** tab, click the drop-down menu arrow of the **Data Type** option. Select the required data type from the drop-down list that appears (Fig. 1.27).

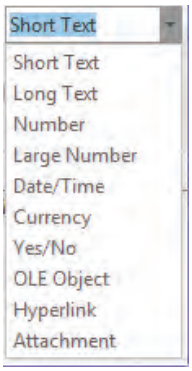

Fig. 1.27 Data types

Changing a Field's Format

1. Click the column header.
2. On the **Fields** tab, click the arrow next to the **Format** text box in the **Formatting** group.
3. Select the required format (Fig. 1.28).

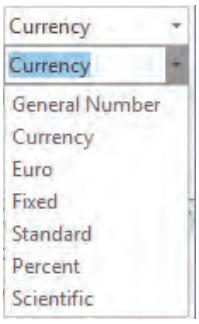

Fig. 1.28 Format drop-down list

Did You Know?

Format list may be unavailable for some fields (for example, Text) depending on the data type of the field.

Practice Time

Gaurav works in a computer shop. He has created a table called *Items* (given below) in a blank database. Create a similar table and then make the following changes:

i. Rename the field name *Qty* to *Quantity*.

ii. Move the field *Quantity* after the field *Cost*.

iii. Hide the field *Total* and then unhide it.

iv. Finally, delete the field *Total*.

Items

ItemNo	ItemName	Qty	Cost	Total
1	Keyboard	5	₹ 900.00	₹ 4,500.00
2	Mouse	10	₹ 450.00	₹ 4,500.00
3	Speaker	2	₹ 1,200.00	₹ 2,400.00
4	Monitor	8	₹ 1,500.00	₹ 10,500.00

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SOLUTION

1. Open a blank database and create the given table.
2. To rename the field *Qty*, double-click the column header and type in the new name *Quantity*.
3. To move the field *Quantity* to the right of the field *Cost*:
   a. Click the column header *Quantity*.
   b. Keeping the mouse button pressed, drag the selected column to the right after the field *Cost*.
   c. Release the mouse button.
4. To hide the field *Total*:
   a. Click the column header.
   b. Click the **Home** tab. In the **Records** group, click the **More** button and then click **Hide Fields**. Now, you cannot see the field in Datasheet View.
5. To unhide the field *Total*:
   a. Click the **Home** tab. In the **Records** group, click the **More** button and then click **Unhide Fields**.
   b. This opens the **Unhide Columns** dialog box. Select the check box to make the field visible.
6. To delete the field *Total*:
   a. Click the column header.
   b. On the **Fields** tab, click **Delete** in the **Add & Delete** group.
   c. A message box will appear. Click **Yes** to permanently delete the field.

OPENING AN EXISTING DATABASE

You can open an existing database in Access 2016 by following these steps:

1. Click the **File** tab. In the Backstage view, click **Open**. If the database appears in the **Recent** list, click to open it.
2. On the **Open** page that appears (Fig. 1.29), select **This PC** in the center pane. Then, click on **Browse**. You can open a file by selecting **OneDrive**.
3. In the **Open** dialog box that appears, choose the drive and folder that contains the database. Select the required database and then click on the **Open** button (Fig. 1.30).

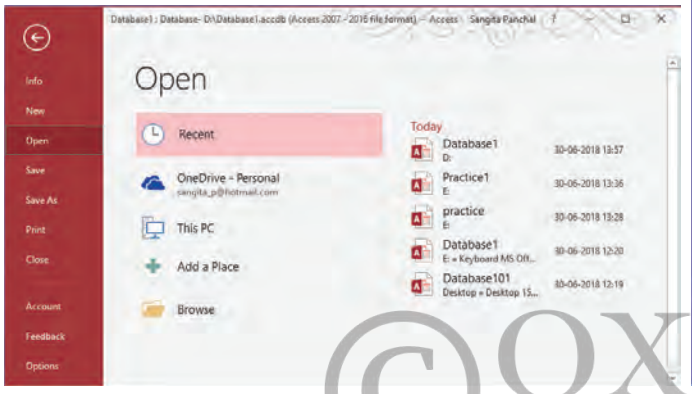

Fig. 1.29 **Open** page

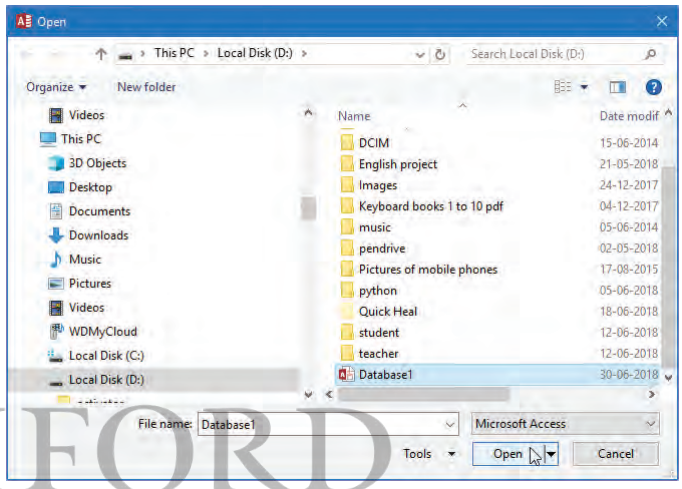

Fig. 1.30 **Open** dialog box

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TOTALING, SORTING, FILTERING, AND SEARCHING DATA

You have learnt how to sum, sort, and filter data in Excel. You can do the same in Access, too.

Calculations in Datasheet View

Access 2016 has a feature called **Totals** that makes it easier to perform mathematical calculations with data. This feature lets you find out the sum, count, average, and so on, for your data.

1. Let us create a table called *Employee* in Datasheet View as shown in Figure 1.31.
2. Now, in the **Records** group on the **Home** tab, click **Totals** (Fig. 1.32).
3. This creates *Total* row at the bottom of the table. In the *Total* row, click the cell in the column *Salary*. An arrow button will appear in the selected cell. Click the arrow button to open a drop-

Employee

EmployeeID	EmpName	DeptNo	Salary
1001	Monika Jain	10	₹ 50,000.00
1002	Suresh Tuli	20	₹ 45,000.00
1003	Deepak Kumar	30	₹ 40,000.00
1004	Govind Arora	30	₹ 52,000.00
1005	Sarika Sharma	20	₹ 55,000.00
1006	Divya Puri	10	₹ 60,000.00
1007	Jeevan Kumar	10	₹ 65,000.00
1008	Garima Jain	30	₹ 58,000.00

Fig. 1.31 *Employee* table

Fig. 1.32 **Totals** option

down menu of function options (Fig. 1.33). Select the desired function to see the result appear in the selected cell.

4. Here, select Sum to get the sum of all entries in *Salary* (Fig. 1.34).

Fig. 1.34 Sum of salary

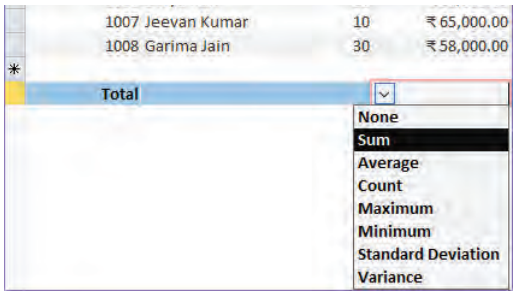

Fig. 1.33 **Sum** function

Sorting Data

You can sort the information stored in a table based on the values in one or more fields in either ascending or descending order.

1. In the Navigation pane, double-click *Employee* to open the table in Datasheet View.
2. Click the drop-down menu arrow of the *Salary* field to display a menu of sorting and filtering options (Fig. 1.35).
3. Click **Sort Smallest to Largest** to rearrange the records in ascending order of *Salary* (Fig. 1.36).

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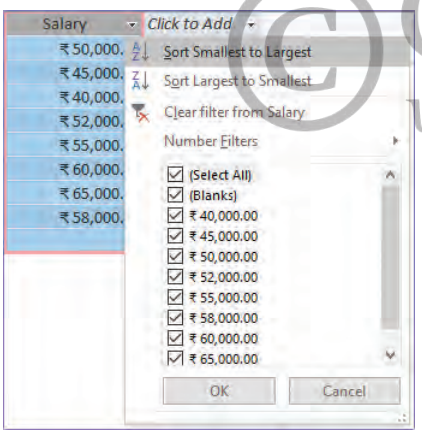

Fig. 1.35 Sorting and Filtering options

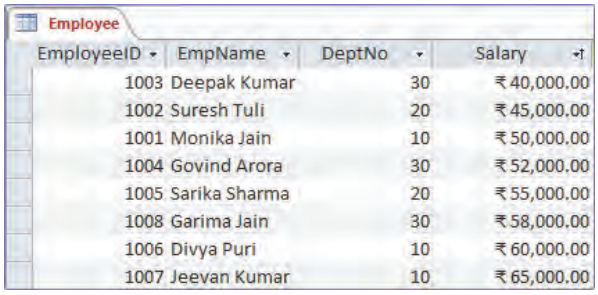

Fig. 1.36 Data arranged in ascending order of Salary

4. The upward pointing arrow to the right of the **Salary** field indicates that the table is sorted in the ascending order on this field.
5. To undo the sorting, click the **Home** tab. In the **Sort & Filter** group, click the **Remove Sort** button (Fig. 1.37).
6. Click **Sort Largest to Smallest** to rearrange the records in descending order of *Salary*. The downward pointing arrow to the right of the *Salary* field indicates that the table is now sorted in the descending order on this field (Fig. 1.38).

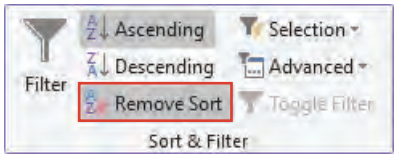

Fig. 1.37 **Remove Sort** button

Employee

EmployeeID	EmpName	DeptNo	Salary
1007	Jeevan Kumar	10	₹ 65,000.00
1006	Divya Puri	10	₹ 60,000.00
1008	Garima Jain	30	₹ 58,000.00
1005	Sarika Sharma	20	₹ 55,000.00
1004	Govind Arora	30	₹ 52,000.00
1001	Monika Jain	10	₹ 50,000.00
1002	Suresh Tuli	20	₹ 45,000.00
1003	Deepak Kumar	30	₹ 40,000.00

Fig. 1.38 Data sorted in descending order of *Salary*

Top Tip

You can also click **Ascending** or **Descending** button in **Sort & Filter** group on **Home** tab to arrange the records in ascending or descending order, respectively.

Filtering Data

To filter data, follow these steps:

1. In the column that you want to filter, click the drop-down arrow to the right of the column header (e.g., *DeptNo*) and clear the **Select All** check box.
2. Now, select the department number that you want to see in your datasheet. You can select as many as you need. For example, let us select 10 (Fig. 1.39).
3. Access 2016 will display the rows with the corresponding value you have selected and will hide the rest (Fig. 1.40).

   Note: You are not deleting any data, just hiding it.
4. After you click **OK**, an icon appears to indicate that the column has filtered data.

   If you point at the icon, Access 2016 will display the filter criteria (Fig. 1.40).
5. To remove the filter, click the **Toggle Filter** button in the **Sort & Filter** group on the **Home** tab (Fig. 1.37). The datasheet will go back to the original state.

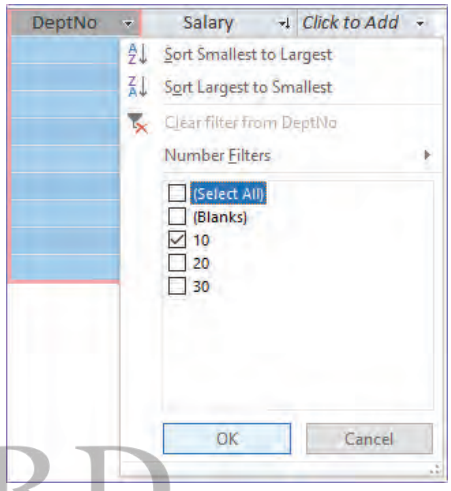

Fig. 1.39 Filtering data

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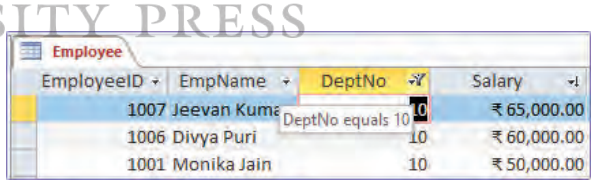

Fig. 1.40 Filtered data with filter criteria

Top Tip

You can also click the column header and then click the **Filter** button in the **Sort & Filter** group on the **Home** tab to apply a filter.

Advanced Filtering

To apply advanced filtering in Access 2016, follow these steps:

1. Click the arrow to the right of the *Salary* column header. You can also select the column header and click the **Filter** button in the **Sort & Filter** group on the **Home** tab. From the menu that appears, click **Number Filters**, and click **Between** in the submenu (Fig. 1.41).
2. The **Between Numbers** dialog box appears. Type 50000 in the **Smallest** text box and 60000 in the **Largest** text box. Click **OK** (Fig. 1.42).

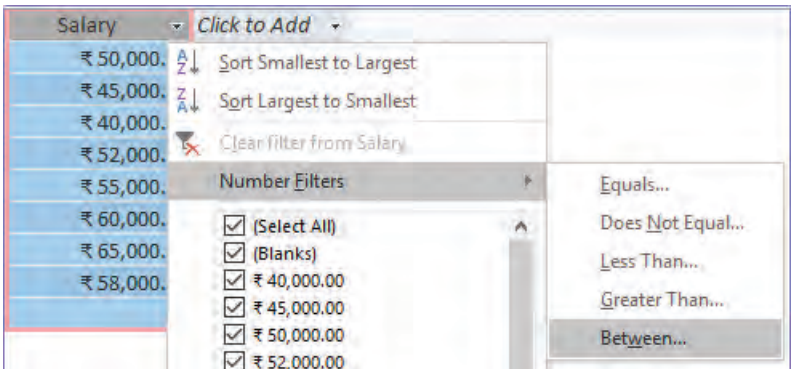

Fig. 1.41 Number Filters

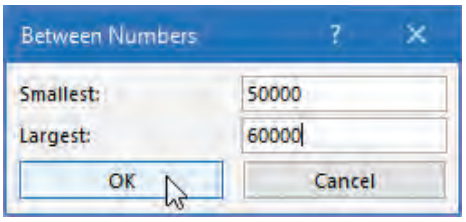

Fig. 1.42 **Between Numbers** dialog box

3. You will now see only records of those employees whose salary is in the range of 50000 to 60000 (Fig. 1.43).
4. If you bring the mouse pointer over the filtered icon on the right of the column header, the filter criteria will appear (Fig. 1.44).

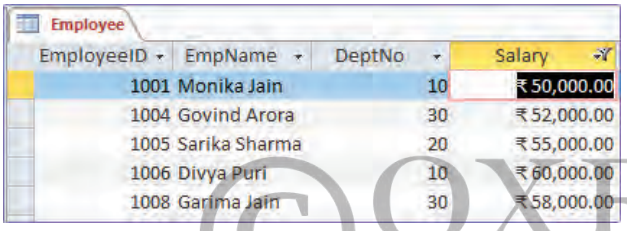

Fig. 1.43 Filtered records

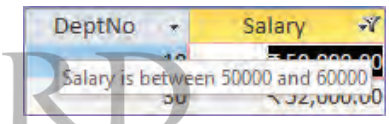

Fig. 1.44 Filtered criteria

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5. To remove the filter, click **Toggle Filter** in the **Sort & Filter** group on the **Home** tab. If you click the **Toggle Filter** button again, the current filter will be reapplied.

Filtering by Selection

Let us filter the records of *Salary* between 50000 and 60000 by selection. The steps are:

1. Click the cell containing the data you want to filter.
2. Click the **Home** tab. In the **Sort & Filter** group, click the **Selection** option. From the drop-down list that opens, click **Between** (Fig. 1.45).

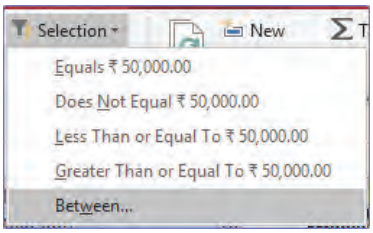

Fig. 1.45 **Between** option in the **Selection** drop-down list

3. The **Between Numbers** dialog box appears. Type 50000 and 60000 in the respective text boxes. Click **OK**.

Searching for Data

To search for data quickly, use the **Search** box at the bottom of the Access screen.

1. Type a word, phrase, date, or number in the **Search** box and press the Enter key. For example, let us type *Kumar* in the **Search** box.

2. Access 2016 highlights the corresponding characters in the first record that matches your search (Fig. 1.46).
3. To find the next matching record, press the Enter key again. Access finds all records that match your search data, anywhere in your datasheet.

Employee

EmployeeID	EmpName	DeptNo	Salary
1001	Monika Jain	10	₹ 50,000.00
1002	Suresh Tuli	20	₹ 45,000.00
1003	Deepak Kumar	30	₹ 40,000.00
1004	Govind Arora	30	₹ 52,000.00
1005	Sarika Sharma	20	₹ 55,000.00
1006	Divya Puri	10	₹ 60,000.00
1007	Jeevan Kumar	10	₹ 65,000.00
1008	Garima Jain	30	₹ 58,000.00

Fig. 1.46 Searching for data

Practice Time

Geeta has created a table *Electricity Bill* (given below) in Access to store the details of electricity consumption at her home. Create a similar table and then do the following tasks:

Electricity Bill

Bill_No	Days	Units	Amount
101	32	1045	7880
102	32	393	1830
103	31	936	7040
104	32	1153	8850
105	35	787	6120
106	35	524	3880

i. Find the average of *Amount*.
ii. Sort the table in ascending order of *Units*.
iii. Remove the sorting.
iv. Sort the table in descending order of *Amount*
v. Remove the sorting.
vi. Filter the records having *Amount* less than or equal to 5000.
vii. Remove the filtering.
viii. Search the records having days equal to 32.

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SOLUTION

1. Create the table *Electricity Bill* in Datasheet View.
2. To find the average amount paid as electricity bill:
   a. In the **Records** group on the **Home** tab, click **Totals**. This will show the *Total* row at the bottom of the datasheet.
   b. In the *Total* row, select the **Total** field under the **Amount** column. Then, from the drop-down list that appears, select the **Average** function. You will get the average of all the values in the column.
3. To sort the table in ascending order of *Units*:
   a. Click the arrow to the right of the *Units* column header.
   b. Click **Sort Smallest to Largest** in the drop-down list to sort the data in ascending order.
4. To remove the sorting, click the **Home** tab. In the **Sort & Filter** group, click the **Remove Sort** button.
5. To sort the table in descending order of *Amount*:
   a. Click the arrow to the right of the *Amount* column header.
   b. Click **Sort Largest to Smallest** in the drop-down menu to sort the data in descending order.
6. To remove the sorting, click the **Home** tab. In the **Sort & Filter** group, click the **Remove Sort** button.

7. To filter all the records of *Amount* less than or equal to 5000:
   a. Click the arrow to the right of the *Amount* column header.
   b. Select **Number Filters** and then **Less Than** from the submenu.
   c. The **Custom Filter** dialog box appears. Type 5000 in the text box and click **OK**. You will now see only those records where *Amount* is less than or equal to 5000.
8. To remove the filter, click the **Home** tab. In the **Sort & Filter** group, click **Toggle Filter**.
9. To search for the record where *Days* is equal to 32:
   a. Type 32 in the **Search** box at the bottom of the Access screen and press the Enter key. Access highlights the first record that matches the search keyword, 32.
   b. Press the Enter key for the next record.

Computer Manners

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Take printouts of important documents only. It is not a good practice to print everything. This causes wastage of resources.

Tricky Terms

Database An organized collection of data

Database management system A software that allows creating, modifying, deleting, and adding data in a database

Record Information about an entity stored in a row

Field A column in a table that contains information of a certain type for all records

Primary key One or more fields whose values uniquely identify every record in a table

Datasheet View Displays the data and allows the user to enter and edit it

Design View Displays the format of the database

Memory Bytes

- Microsoft Access 2016 is a DBMS application that can store and manage a large volume of data in the form of tables.
- An object in a database could be a table, form, query, report, macro, and module.
- A data type specification for a field controls what you can enter in that field.
- The Datasheet View is for entering data in a table. You can also insert, delete, rename, move, hide and freeze columns, change the data type of a column, search, filter, and sort data.
- The Design View is for designing the table, that is, field name, data type, and rules and formatting applied while entering the data.

Exercises

Objective Type Questions

1. Fill in the blanks with the correct words.

Double-click **Field** **ID** **Sort & Filter** **Tables**

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a. A relational database stores data in the form of ..... .

b. A new database opens a table 'Table1' with one column named ..... with AutoNumber data type.

c. To remove the sorting, click the **Remove Sort** button in the..... group on the **Home** tab.

d. A ..... contains a certain type of information for all records.

e. To rename a field name, ... it and type a new name.

2. Write T for the true statement and F for the false one.

a. A row in a table is the information about one entity. ☐

b. You can also enter data in Design View. ☐

c. The Yes/No data type can have only one of two values. ☐

d. Once data type is assigned, you cannot change it. ☐

e. The upward pointing arrow to the right of the column header indicates that the table is sorted in descending order of the field. ☐

3. Choose the correct option.

a. Which one is not a DBMS software?

i. MySQL ii. Access iii. Internet Explorer iv. Oracle

b. What is the extension of database?

i. .accdb ii. .xlsx iii. .docx iv. None of these

c. The number of characters stored in a Short Text.

i. 25 ii. 255 iii. 550 iv. 65535

d. This data type uniquely identifies the record and increments number automatically.

i. Number ii. Large Number iii. AutoNumber iv. Currency

e. To apply filter

i. Click the drop-down arrow on right of the column header.

ii. Click the column header. Then, click the **Filter** button in the **Sort & Filter** group on the **Home** tab.

iii. Press Ctrl + K

iv. Both i and ii

Descriptive Type Questions

Answer the following.

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1. What are the benefits of a good database?
2. What is a primary key?
3. Name the two views of the table in database.
4. Name any three objects in a database.
5. What are the two ways of adding fields in Datasheet View?

APPLICATION BASED QUESTIONS

1. Look at the table given here and answer the following:

a. How many records and fields are there in the table?

b. What is the data type of ID field? Do you think it is a primary key?

c. How are the numbers 1, 2, …, etc, entered in the ID field?

Cars

ID	Model	Cost	Company
1	Vento Highline	₹9,80,000.00	Volkswagon
2	Santro XO	₹4,50,000.00	Hyundai

2. Aman wants has to create a table with following fields:

PlayerID, PlayerName, Date of Birth, SportsPlayed, Indian_Nationality, International_Player, Remarks.

a. What will be the appropriate data type of all the fields?

b. Which one will be the primary key?

3. **Saurabh has created a table and applied a filter criteria. But later, he forgot about the criteria that he had applied. Is there any way to see the filter criteria?**

4. **When you sort a table according to a particular field in any order, you notice an arrow on the right of the column header. What is the meaning of the following arrows?**
   a. Upward arrow b. Downward arrow

IN THE LAB

1. Manan wants to create a table *StudentDetails*, to store information about admissions in a college, with the following fields: AdmissionNo, StuName, DateOfBirth, Course (BCA, B.Tech., B.Sc.), and Fees. Create the table and do the following:
   a. Decide suitable data types of the fields. Which one will be the primary key?
   b. Enter 5 records.

2. A Senior Citizens Club maintains the data of all members. Surbhi, a caretaker, wants to create a table with the fields given alongside: Create the table and enter 5 records.

Field Name	Data Type	Constraints
MemberNo	Short Text	M1001, M1002… (Primary Key)
MemberName	Short Text	
DOB	Date/Time	
Indian	Yes/No	
Yoga	Yes/No	
Meditation	Yes/No	
Indoor Games	Yes/No	
Fees	Currency	

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3. Create the table *Accounts* as given here and do the following:
   a. Find the total of *Balance*.
   b. Filter the records of Savings account (S).

Accounts

CustomerID	AccountNo	AccoutType	DateOpenec	Balance
8876	1001	S	09-01-2018	₹4,000.00
6854	1002	C	08-12-2017	₹5,000.00
1003	1002	S	23-01-2018	₹4,500.00
9982	1003	S	03-10-2017	₹10,000.00
6600	1003	C	24-08-2017	₹4,500.00
8872	1004	C	21-07-2017	₹6,500.00
5642	1004	S	29-11-2016	₹8,000.00

4. A teacher has created a table of the grade obtained by her students as shown here. Create a similar table and do the following:
   a. Sort the table in descending order of CGPA.
   b. Search all the records of *StuName* that start with D. (*Hint*: Type D* in the search box)

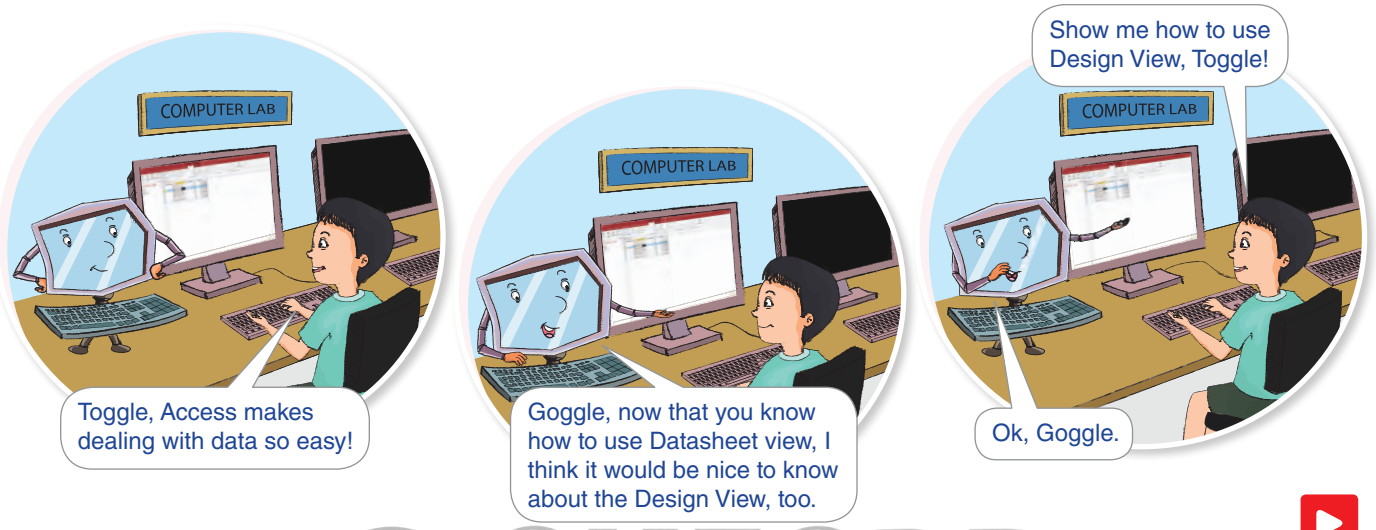
Students

RollNo	StuName	CGPA
1	Ritika	10.0
2	Varun	9.2
3	Deepak	9.6
4	Saumya	9.8
5	Neeraj	10.0
6	Nishant	9.6
7	Yogesh	9.8
8	Malini	9.6
9	Sarika	10.0
10	Deepu	9.8

Teacher's Notes

- Discuss the advantages of databases with the students. Use real-life examples.
- Explain the importance of having a primary key in a table.
- Explain the differences between Excel and Access.
- Discuss the two views of table in detail and their uses and requirements.

2 Access 2016: Design View, Queries, Forms, and Reports



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IN THIS CHAPTER

- Creating a Table in Design View
- Queries
- Forms
- Reports

A table in MS Access can be created in two ways — using the Datasheet View or the Design View. In the previous chapter, we learnt about the Datasheet View, and how to work with tables using it. The Design View gives us more control in setting the properties for tables, forms, and so on. Note that although you can create a table in the Design View, data can be added only in the Datasheet View. Let us learn more about how to work using the Design View.

In a database with thousands of records, finding information is difficult. Access provides features such as **forms**, **queries**, and **reports** to make this job easier.

Forms can provide an easy-to-use method for entering and editing data for those who are not familiar with Access.

Queries allow you to select data from a table or tables as per your requirement. They allow you to change and re-arrange data, and then use it as a source for **forms** and **reports**.

Reports give us data in a printer-friendly format. We will discuss these features in this chapter.

CREATING A TABLE IN DESIGN VIEW

To create a table in Design View, let us first open the table *Database1* created in the previous chapter (Fig. 2.1).

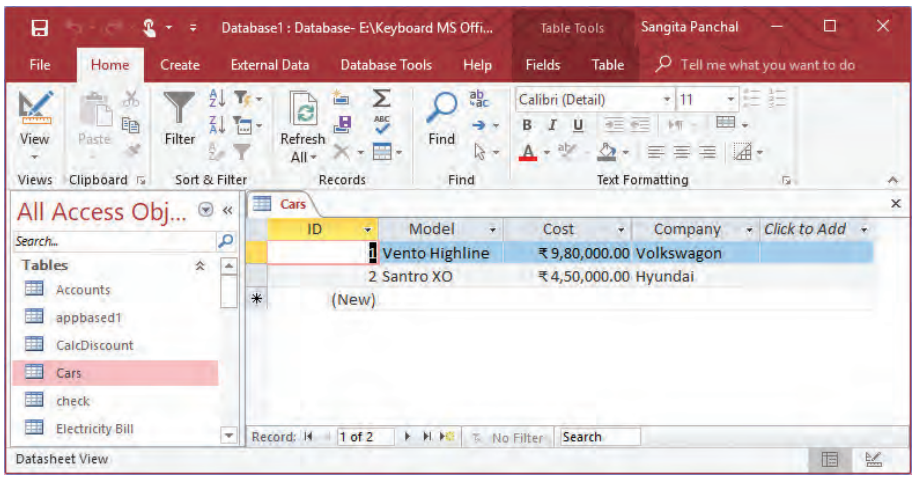

Fig. 2.1 *Database1*

To add more tables to the above database, click the **Create** tab. Using the **Tables** group, you can create a table in the following two ways:

- Click the **Table** button to open a table in Datasheet View (discussed in the previous chapter).

OR

- Click the **Table Design** option (Fig. 2.2) to see a new empty table open in Design View. The **Table Design** screen consists of two parts (Fig. 2.3):

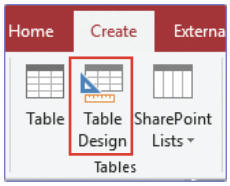

Fig. 2.2 **Tables Design** option

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1. **Field Definition Grid** It allows us to specify field names, data types, and optional description for each field. It consists of the following:
   - **Field Selector** Click on any field selector to select a field. You can then insert a row above the selected field, delete a row, or drag a row up or down to re-position the field in the table. The field selector box also identifies the primary key field of the table by displaying the **Primary Key** icon.
   - **Field Name** Here, you can list the field names for the table you want to create.
   - **Data Type** Here, you specify the type of data that the field can contain. When you add a new field in Design View, it is assigned the Short Text data type, by default. You

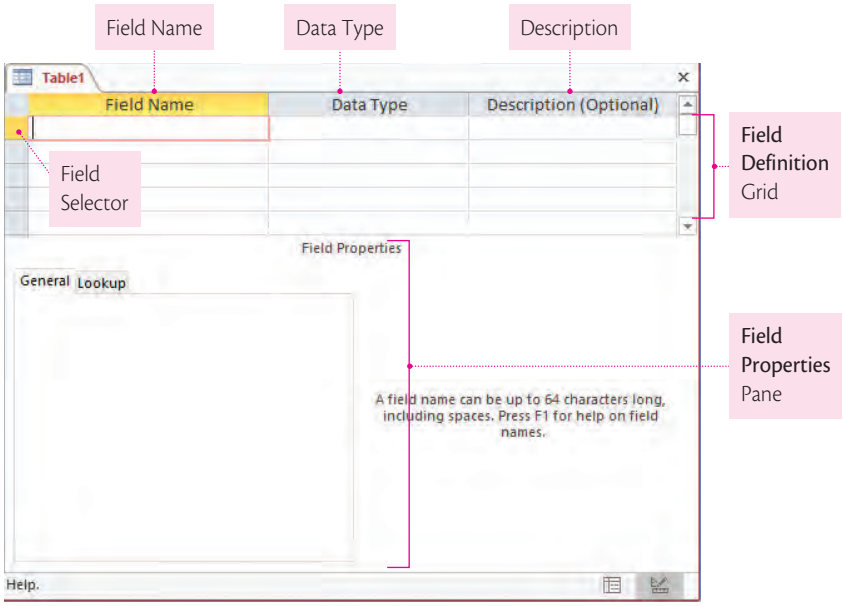

Fig. 2.3 Design View

can change a field's type by clicking on the arrow next to the entries in the **Data Type** column. Select a new data type from the list that appears.

- **Description** It contains an optional description of the field.

2. **Field Properties Pane** It allows us to enter more details for each field, such as field size, format, validation rule, and validation text.

Let us now create a table having the following fields: *RollNo*, *StuName*, and *StuTotalMarks*.

1. Type the title *RollNo* under *Field Name*.
2. Press the Tab key to move to the *Data Type* column.
3. Click the drop-down arrow. Choose an appropriate data type from the drop-down list that appears (Fig. 2.4).
4. Press the Tab key to move to the *Description* column.
5. Type a brief description of the field. You may also leave it blank.
6. Repeat steps 1 to 5 and add two fields—*StuName and StuTotalMarks*—with datatypes Short Text and Number, respectively (Fig. 2.5).

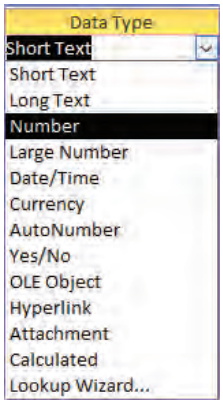

Fig. 2.4 List of Data Types

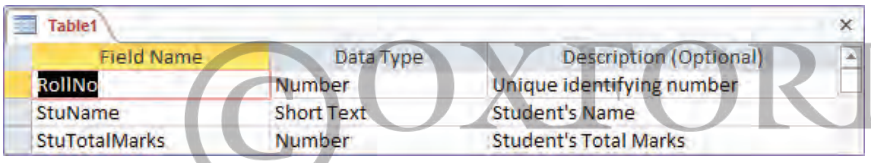

Fig. 2.5 Adding the fields *StuName* and *StuTotalMarks*

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7. There are two ways to set *RollNo* as the primary key.
   - Click the field name *RollNo*. Select the **Design** tab, if not already selected. Then, click the **Primary Key** button in the **Tools** group (Fig. 2.6).

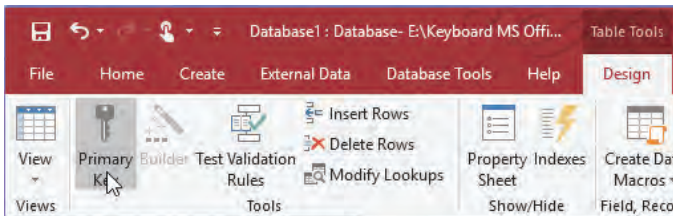

Fig. 2.6 **Primary key** button

Top Tip

To insert a row in Design View, select the field above which you want to insert a row, and click **Design** ▶ **Tools** ▶ **Insert Rows** (Fig. 2.6). To delete a row, select the field you want to delete, and click **Design** ▶ **Tools** ▶ **Delete Rows**.

You can also right-click the field and select option **Insert Rows** or **Delete Rows** from the context menu.

Or, right-click the field name *RollNo* and select the **Primary Key** option from the context menu that appears (Fig. 2.7).

8. A key icon now appears in the row selector to denote that the field has now been set as the primary key (Fig. 2.8).

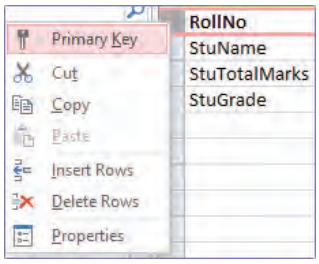

Fig. 2.7 Primary key option

9. Now, click the **Save** icon on the Quick Access Toolbar. The **Save As** dialog box appears (Fig. 2.9). Enter the Table Name as *StudentDetails* and click **OK**.

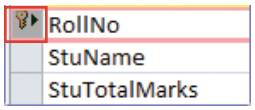

Fig. 2.8 Key icon in the row selector

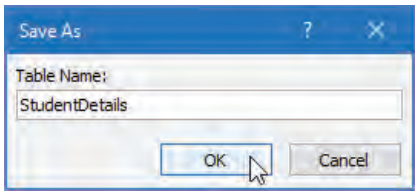

Fig. 2.9 **Save As** dialog box

10. To add data in a table, you must switch from Design View to Datasheet View. For this, click the **Design** tab. Then, in the **Views** group, click the **View** drop-down arrow. Select **Datasheet View**.

Top Tip

It is possible to use more than one field as the primary key. To add another primary key, hold down the Ctrl key while setting a primary key.

Removing the Primary Key

To remove the primary key, click **Primary Key** in the **Tools** group or in the context menu. The key icon on the row selector will disappear. The **Primary Key** button works as a toggle to turn key fields **ON** or **OFF**.

Top Tip

Access does not allow you to delete a primary key field once set. However, if you wish to delete a primary key field, first remove the primary key icon, and then delete the field.

To Add a Lookup Field

A **lookup field** is a field with a list of values from which a user can choose the desired value. Rather than typing individual values, the values appear in a drop-down list. Let us add a new field *Grade* in the *StudentDetails* table, whose data type will be set to Lookup field.

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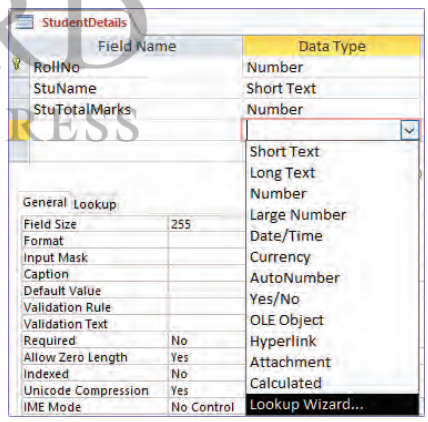

Fig. 2.10 **Lookup Wizard** option

1. In the Design View, select an empty field that you want to become a Lookup column.
2. Click the drop-down menu arrow in the *Data Type* column and choose the **Lookup Wizard** option (Fig. 2.10).
3. This will open the **Lookup Wizard** screen 1 of 3 (Fig. 2.11). Click **I will type in the values that I want** and then click **Next**.
4. The **Lookup Wizard** screen 2 of 3 appears (Fig. 2.12). Specify the number of columns you want to include in the Lookup column. Leave the **Number of columns** set to 1 and click in the first cell in the *Col1* column. Enter the data and press the Tab (not Enter) key after each one to move to the next row. Click **Next**.

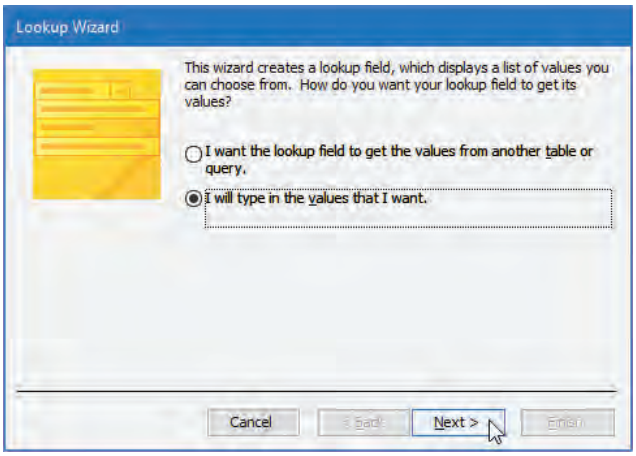

Fig. 2.11 **Lookup Wizard** screen 1 of 3

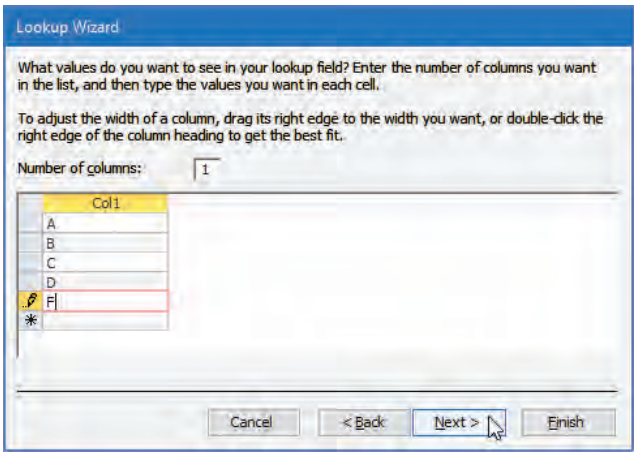

Fig. 2.12 **Lookup Wizard** screen 2 of 3

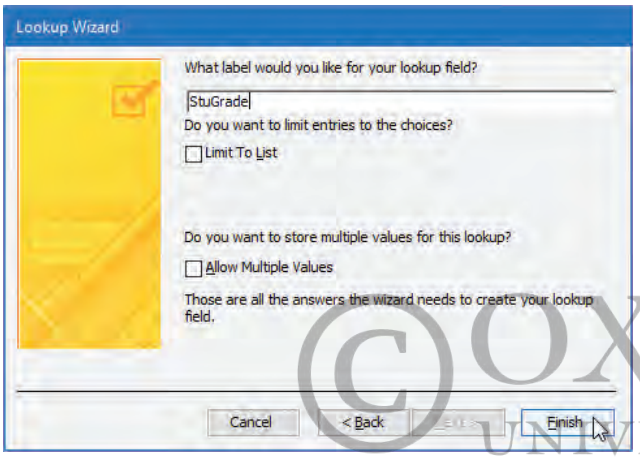

Fig. 2.13 **Lookup Wizard** screen 3 of 3

5. The **Lookup Wizard** screen 3 of 3 appears (Fig. 2.13). Type a name for your Lookup Column. Click **Finish**.
6. The column *StuGrade* appears below the *StuTotalMarks* field in the Design View (Fig. 2.14).

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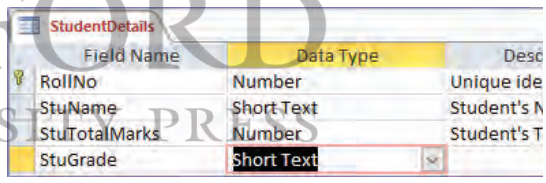

Fig. 2.14 Design View of the table

7. To enter data, just click in the cell. A drop-down menu arrow appears. On clicking the arrow, you will get the list of values you had entered earlier. Click the value you want in the field (Fig. 2.15).

If you want to change the list of values, click the **Edit List Items** icon (Fig. 2.15). This will open the **Edit List Items** dialog box (Fig. 2.16). After making changes in the list of values, click **OK.**

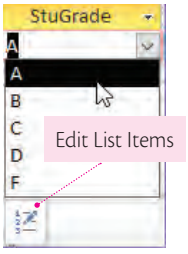

Fig. 2.15 Lookup Field column

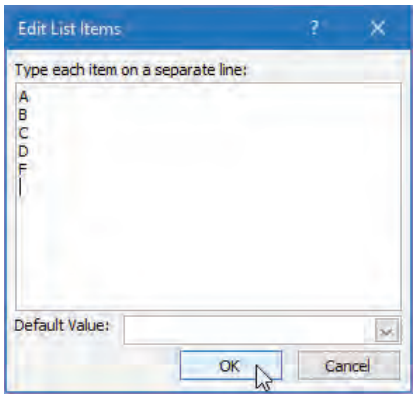

Fig. 2.16 **Edit List Items** dialog box

Field Properties Pane

In the Design View, the **Field Properties** pane appears in the lower half of the screen. You can use it to control data entered in a field and the appearance of data on screen. It allows you to specify certain field characteristics, for example, size, format, and validation rules.

Field Size

This is the maximum size for data stored in the Text or Number fields.

- For Text data, the field size determines the maximum number of characters. The Short Text data type has a maximum of 255 characters.
- For Number data, field size determines the range and bytes that can be used for storage.

Format

This specifies how data will be displayed.

- **Number and Currency Formats** You can choose from the following seven pre-defined formats: General Number, Currency, Euro, Fixed, Standard, Percent, and Scientific. You can also create custom formats.
- **Date and Time Formats** You can select from the pre-defined formats: General Date, Long Date, Medium Date, Short Date, Long Time, Medium Time, and Short Time.
- **Logical Formats** The default display is Yes/No. Other pre-defined formats for logical data are True/False and On/Off.

Input Mask

This facilitates data entry and controls what the user enters in the field. For example, the input mask for a phone number could be (.....).....– .....

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Caption

This is an alternative name for the field to make the field name more explanatory. It can contain up to 2048 characters.

Default Value

This value is automatically filled in the field when you add a new record to the table.

Validation Rule

A validation rule limits the value that the field will accept. For example, if the validation rule for a field is <= 100, it means that the field must contain a value less than or equal to 100. If you enter a value greater than 100, you will get an error message.

Top Tip

You can also enter a validation rule in the Datasheet View by clicking the **Validation** button in the **Field Validation** group on the **Fields** tab under **Table Tools**.

Validation Text

This is the error message that appears when the validation rule is violated.

Required

This property is set **Yes** if the field should always receive a value during data entry. The default value of it is **No**, which means that the field can be left blank.

Allow Zero Length

This property is used for Text and Memo data types. If **Required** is **Yes** and **Allow Zero Length** is **No**, data must be entered in the field during data entry. If both properties are set to **Yes**, the field can be left empty.

Practice Time

The computer operator in ABC Store has to document the following information in the store's computer for later use:

Field Name	Data Type	Properties
PurchaseID	Short Text	Primary Key Field Size – 5
Amount Purchased	Number	Format – Currency Required – Yes Validation Rule - >= 1 and <= 25000 Validation Text – Enter amount purchased in the range 1 to 25000
Mode of Payment	Lookup Field	Cash, Credit Card, Debit Card, Gift Voucher
Discount	Number	Format – General Number Default Value - 0
Discounted Amount	Calculated	[Discount] / 100 * [Amount Purchased] Format - Currency
Amount Paid	Calculated	[Amount Purchased] – [Discounted Amount] Format - Currency

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1. Create a table with field name, data type, and properties as given here. Save it as *CalcDiscount*.
2. Enter five records in Datasheet View.

SOLUTION

1. Create a new database. The new database will open with the table *Table*1 in Datasheet View. Now, click the **View** drop-down arrow and select **Design View**. Save the table as *CalcDiscount*.
2. Now, in the Design View, for all the fields, type the Field Name, select the Data Type, and enter the Description.
3. To set *Purchase*ID as the primary key, click its field selector, and in the **Tools** group on the **Design** tab, click **Primary Key**. Then, in the **Field Properties** pane, click the **Field Size** text box and change the size from 255 to 5.
4. Select the field selector of *Amount Purchased* and do the following:
   a. Select **Yes** as the value of **Required**. Now, this field cannot be left blank when you enter data.
   b. Select the **Format** as Currency.
   c. Click the **Validation Rule** text box and type >=1 *and* <= 25000.
   d. Click the **Validation Text** text box and type *Enter amount purchased in the range* 1 *to* 25000.
5. For the field *Mode of Payment*, select the data type as **Lookup Wizard** and do the following:
   a. In the first screen, click **I will type in the values that I want** and click **Next**.
   b. In the second screen, click in the blank row below *Col*1, type the grades and then press the Tab key or the Down Arrow key. After entering all the values, click **Next.**

c. In the third screen, click **Finish**.

6. Select the field selector of *Discount* and do the following:
   a. Set the **Default Value** as 0.
   b. Set the **Format** as General Number.
7. Select the field selector of *Discounted Amount* and do the following:
   a. In the **Expression** text box, type [*Discount*] / 100 * [*Amount Purchased*]
   b. Set the **Format** as Currency.
8. Select the field selector of *Amount Paid* and do the following:
   a. In the **Expression** text box, type [*Amount Purchased*] – [*Discounted Amount*]
   b. Set the **Format** as Currency.
9. To save the table, click the **Save** icon on the Quick Access Toolbar. The **Save As** dialog box appears. Type the file name as *CalcDiscount* and click **OK**.
10. Click to close the table.
11. Now, click the **Design** tab. In the **Views** group, click the **View** button. Select **Datasheet View**. This opens the table in Datasheet View allowing you to enter records. Enter five records as follows:

CalcDiscount

PurchaseID	Amount Purchased	Mode of Payment	Discount	Discounted Amount	Amount Paid
S001	₹10,000.00	Credit Card	5	₹500.00	₹9,500.00
S002	₹384.00	Gift Voucher	3	₹11.52	₹372.48
S003	₹5,000.00	Cash	0	₹0.00	₹5,000.00
S004	₹12,500.00	Debit Card	4	₹500.00	₹12,000.00
S005	₹21,453.00	Credit Card	5	₹1,072.65	₹20,380.35

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Notice that you can enter PurchaseID, which is a unique text. You can enter Amount Purchased in the range 1 to 25000 and it is a mandatory. Otherwise, you will get an error message.

The Mode of Payment is a lookup field, so values are entered by choosing from a drop-down list. The default value of Discount is 0.

The Discounted Amount and Amount Paid are calculated automatically.

QUERIES

An Access **query** is a method to retrieve a set of records from one or more tables according to the criteria you provide. Here, we will be working with a simple query based on a single table. For example, a list of students who got grade A1 in all five subjects.

Access saves each query as a new query in the database. A saved query can be run again at any time in the future.

There are two methods of creating a query: using Query Wizard and using Query Design. Let us understand the concept by using the table *StudentDetails* (Fig. 2.17).

StudentDetails

RollNo	StuName	StuTotalMarks	StuGrade
1	Shashank Kumar	451	A
2	Garima Tuli	399	B
3	Gaurav Arora	356	B
4	Dishant Jain	410	A
5	Mrinal Suri	255	C
6	Govind Kumar	365	B
7	Aditi Jain	305	B
8	Seema Arora	440	A
9	Mohini Tuli	410	A
10	Disha Singh	295	C

Fig. 2.17 *StudentDetails* table in Datasheet View

Using Query Wizard

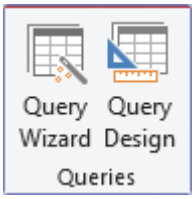

Fig. 2.18 **Queries** group

If you want to create a query using Query Wizard, follow these steps:

1. Click the **Create** tab. In the **Queries** group, click **Query Wizard** (Fig. 2.18).
2. The **New Query** dialog box appears (Fig. 2.19). Select **Simple Query Wizard** and click **OK**.
3. **Simple Query Wizard** screen 1 of 3 appears (Fig. 2.20). In the **Tables/Queries** box, select the table that contains your data and then add the fields that you want to see in the query results. Use the arrows as shown in Figure 2.20 to **add** or **remove** fields.
   - To add a field, select it in the **Available Fields** list and then click **>**, or just double-click the field name.
   - Remove fields by selecting them in the **Selected Fields** list and clicking **<**.
   - Click **Next** after selecting the fields.
4. **Simple Query Wizard** screen 2 of 3 appears (Fig. 2.21). Select **Detail** and click **Next**.

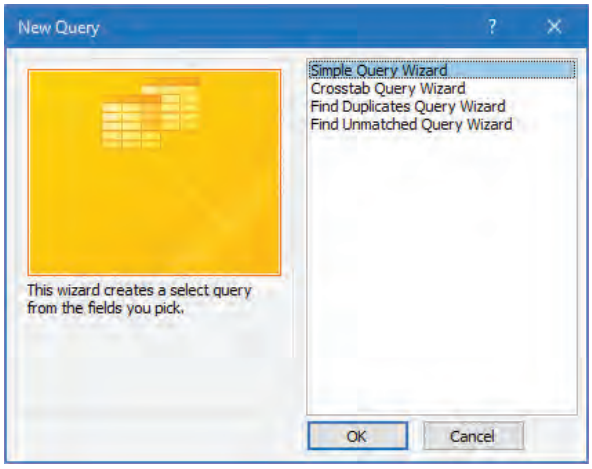

Fig. 2.19 **New Query** dialog box

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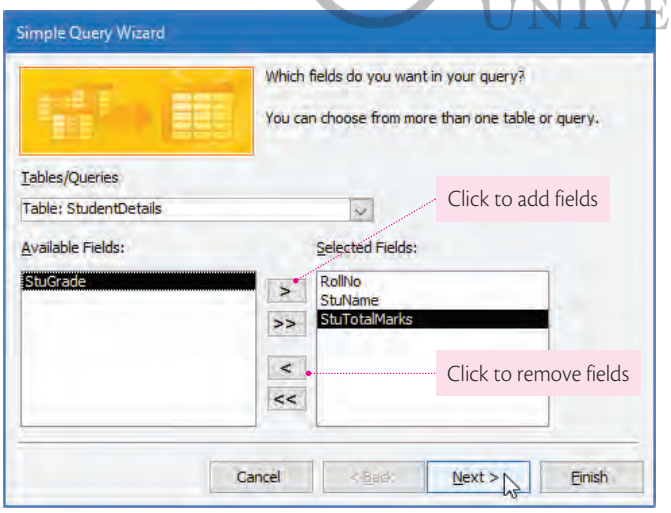


Fig. 2.20 **Simple Query Wizard** screen 1 of 3

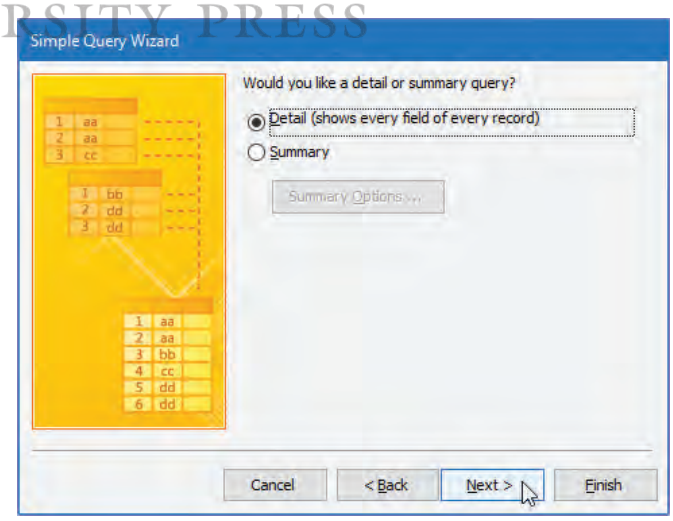


Fig. 2.21 **Simple Query Wizard** screen 2 of 3

If you have included a field that uses a number-based data type, you can make Access calculate the sum, average, minimum, or maximum for that field. To do this, click the **Summary** button, then click **Summary Options** (Fig. 2.22). The **Summary Options** box appears (Fig. 2.23). Check one or more boxes to have the function performed on a field. Click **OK**. The **Simple Query Wizard** screen 2 appears again (Fig. 2.22). Click **Next**.

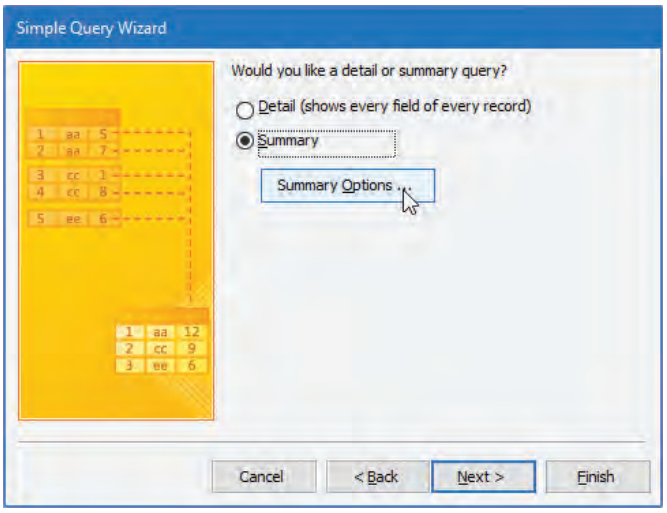


Fig. 2.22 **Summary** button and **Summary Options**

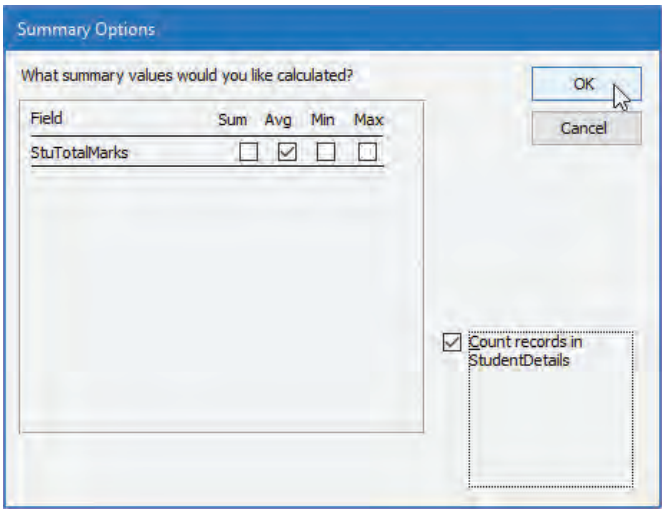


Fig. 2.23 Choosing functions

5. **Simple Query Wizard** screen 3 of 3 appears (Fig. 2.24). Type a query name in the text box, select **Open the query to view information**, and click **Finish**. The query result will appear in Datasheet View (Fig. 2.25).

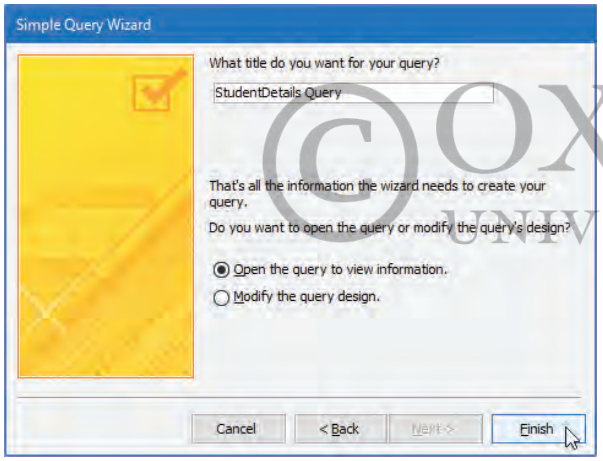
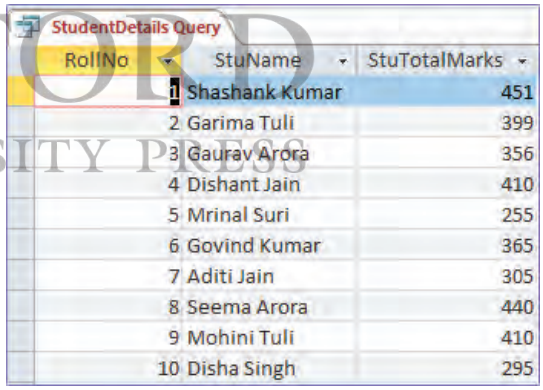


Fig. 2.24 **Simple Query Wizard** screen 3 of 3



StudentDetails Query

RollNo	StuName	StuTotalMarks
1	Shashank Kumar	451
2	Garima Tuli	399
3	Gaurav Arora	356
4	Dishant Jain	410
5	Mrinal Suri	255
6	Govind Kumar	365
7	Aditi Jain	305
8	Seema Arora	440
9	Mohini Tuli	410
10	Disha Singh	295

Fig. 2.25 Query result in Datasheet View

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Using Query Design

To create a query in Query Design, follow these steps:

1. Click the **Create** tab. Click **Query Design** in the **Queries** group (Fig. 2.18).
2. The **Show Table** dialog box appears. Here, you can choose tables (Fig. 2.26). Select the table you will use and then click **Add**, or just double-click the table. You can repeat this step to add several related tables.
3. Click **Close** when you finish adding the tables. The **Query Design** screen appears (Fig. 2.27).

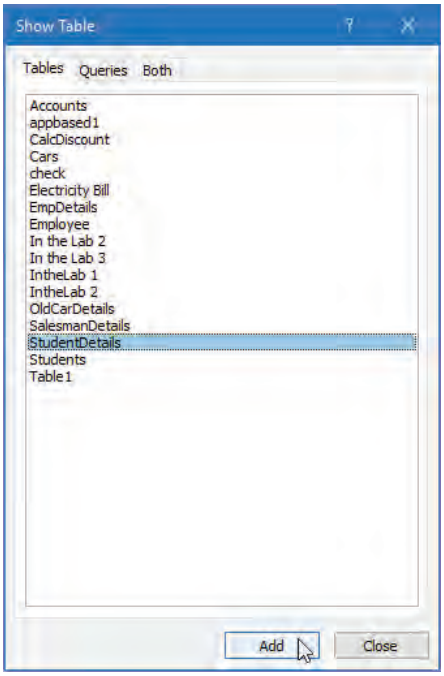

Fig. 2.26 **Show Table** dialog box

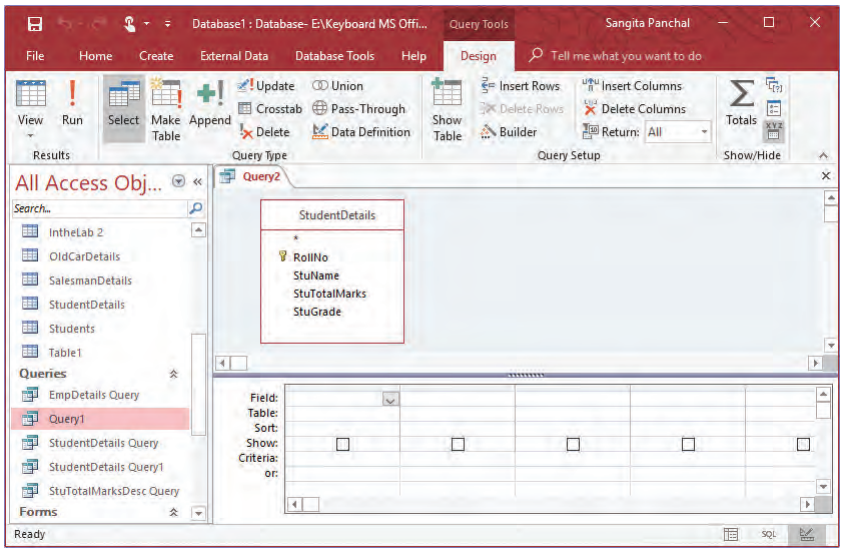

Fig. 2.27 **Query Design** screen

4. Here, you can select the fields to be included in query by using one of the following ways:
   - Double-click the field. It will be placed in the first vacant column of the grid.
   - Click the field and drag it to the required column in the grid.
   - Type the field name directly in the required column in the grid.
   - Double-click the asterisk (*) to include all the columns of the table.

   Figure 2.28 shows the grid with the selected fields.

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5. You can arrange the fields in the order you want them in the query results. To change the order, select the entire column and drag it to the new position (Fig. 2.29).

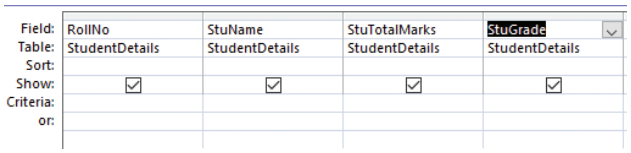

Fig. 2.28 Fields included in a query

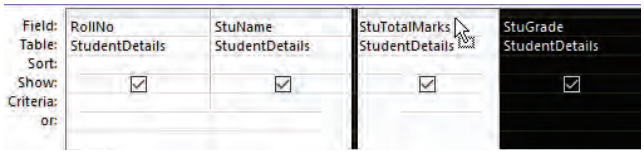

Fig. 2.29 Dragging a field in the **Query Design** grid

6. To hide one or more columns, clear the **Show** checkbox for those columns. Figure 2.30 shows the check box cleared for the *StuName* field.

8. Choose the field to sort by and choose **Ascending** or **Descending** from the corresponding **Sort** box (Fig. 2.31). For example, here we have chosen *StuGrade* as the sort field and **Ascending** as the sorting option.

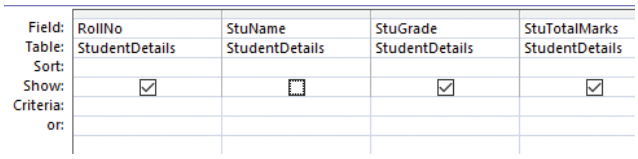

Fig. 2.31 Hiding a column in the **Query Design** grid

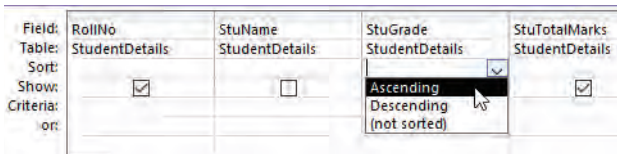

Fig. 2.32 Sorting in the **Query Design** grid

8. Now, choose *StuTotalMarks* as the sort field and **Descending** as the sorting option.
9. In the **Criteria** of *StuTotalMarks* field, type *>=300* so that only the records of students having total marks equal to or greater than 300 are displayed (Fig. 2.32).

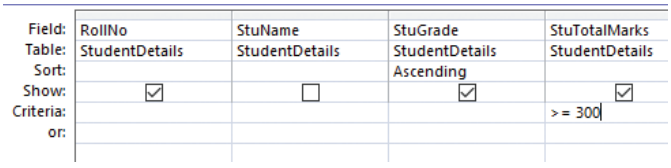

Fig. 2.32 Sort and Criteria for StuTotalMarks

Running a Query

To run a query, follow these steps:

1. Click **Run** in the **Results** group on the **Design** tab (Fig. 2.33). The output for the query will be displayed in Datasheet View as shown in Figure 2.34.
2. To close the query, click in the **Query Design** screen.

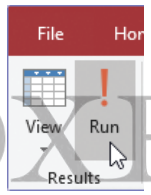

Fig. 2.33 **Run** option

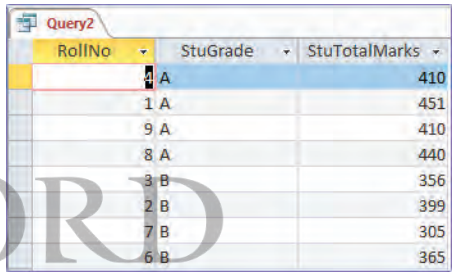

Fig. 2.34 Query output in Datasheet View

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Saving a Query

To save a query, follow these steps:

1. Click the **Save** icon on the Quick Access Toolbar.
2. When you save a query for the first time, the **Save As** dialog box appears. Type the Query Name and click **OK** (Fig. 2.35).

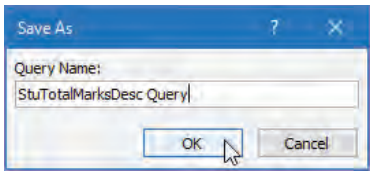

Fig. 2.35 **Save As** dialog box

FORMS

Forms provide an easy way to enter, edit, delete, and view data in a table. Microsoft Access provides many ways to create a form, such as using the **Form**, **Split Form**, and **Form Wizard** options. Let us use the *StudentDetails* table created earlier to create forms using these methods.

Using the Form Command

You can create a form using the **Form** command as follows:

1. Click the table *StudentDetails* in the Navigation pane.
2. On the **Create** tab, click **Form** in the **Forms** group (Fig. 2.36).

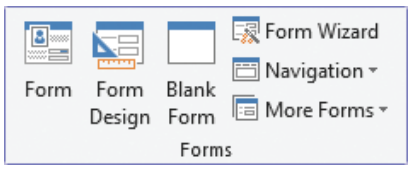

Fig. 2.36 **Forms** group

This method creates a simple form that uses all the fields in the table. It displays the form in Layout View (Fig. 2.37). The **Design**, **Arrange**, and **Format** tabs appear on the ribbon under **Form Layout Tools**.

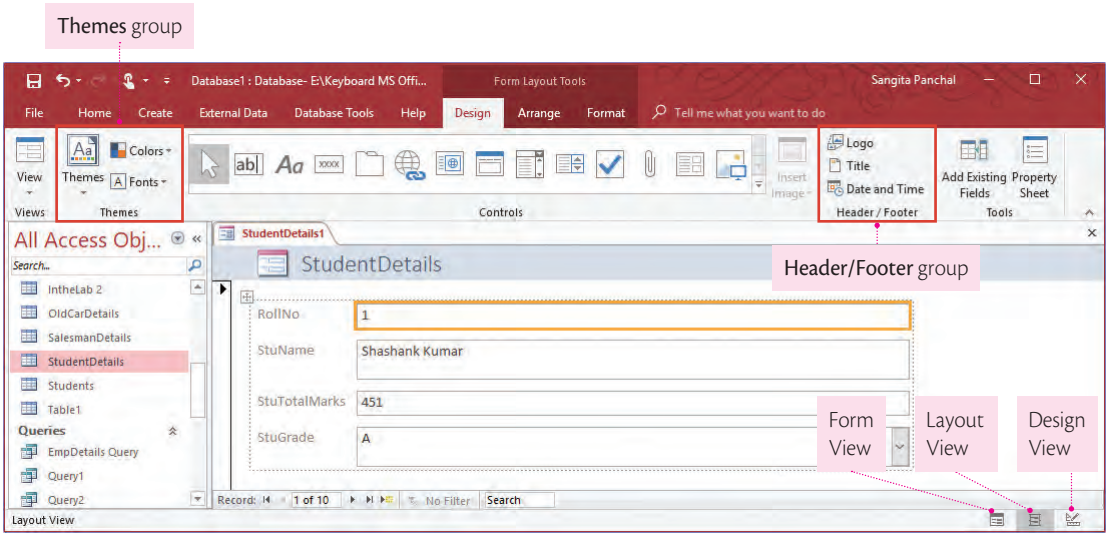

Fig. 2.37 Form design using the **Form** command in Layout View

3. Select the text box and resize it.
4. On the **Design** tab, do the following:
   a. Click **Logo** in the **Header/Footer** group (Fig. 2.37). The **Insert Picture** dialog box appears (Fig. 2.38). Select a picture and click **OK**.
   b. Click **Title** in the **Header/Footer** group. Type *Student Information* as the title of the form.
   c. Click **Date and Time** in the **Header/Footer** group. A **Date and Time** dialog box appears, select a format and click **OK** (Fig. 2.39).
   d. Click the **Themes** button in the **Themes** group (Fig. 2.37) and select a required theme.

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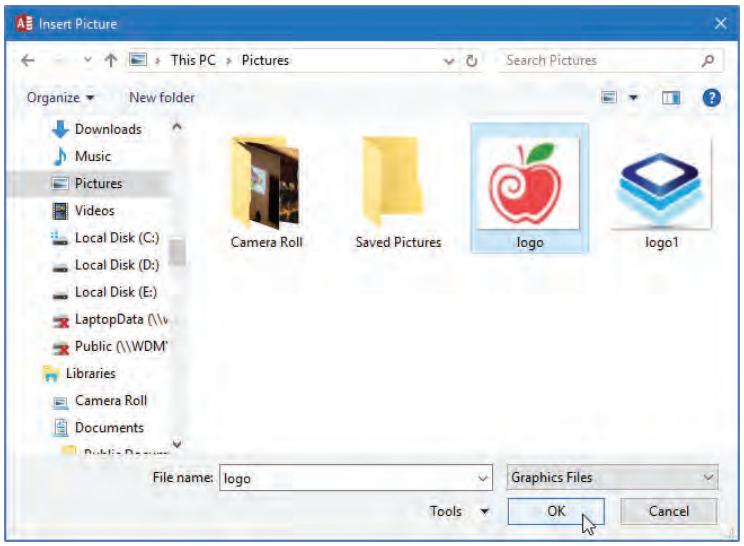

Fig. 2.38 **Insert Picture** dialog box

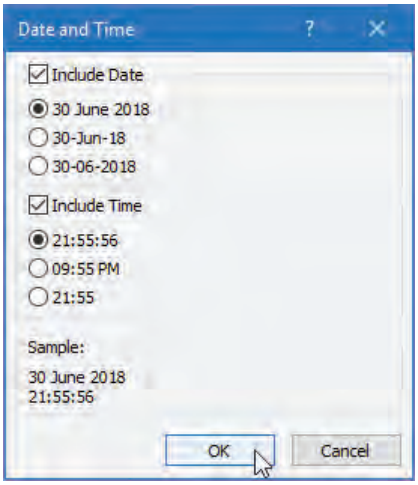

Fig. 2.39 **Date and Time** dialog box

5. Select the **Format** tab and do the following:
   a. Select the label and using the **Font Color** button in the **Font** group (Fig. 2.40), change the text color to blue.
   b. Click anywhere inside the blank area of the form.
   c. Click the **Shape Fill** button in the **Control Formatting** group (Fig. 2.41). Select a color from the color palette. The color of the form changes.
6. Click the **Save** icon of **Quick Access Toolbar**. This will open the **Save As** dialog box. Type the form name and click **OK**.

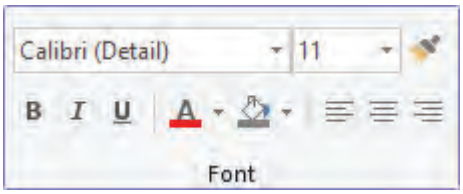

Fig. 2.40 **Font** group

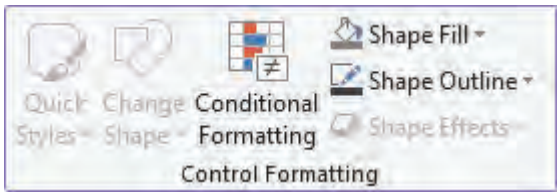

Fig. 2.41 **Control Formatting** group

Using Split Form

You can also create a form using the **Split Form** option as follows:

1. Click the **Create** tab.
2. Click the **More Forms** drop-down arrow in the **Forms** group. Select **Split Form** from the list that appears (Fig. 2.42).
3. Access creates the form in the upper half of the window, and displays the table in Datasheet View in the lower half (Fig. 2.43). The two views are separated by a bar. It can be used to resize the height of the two views.

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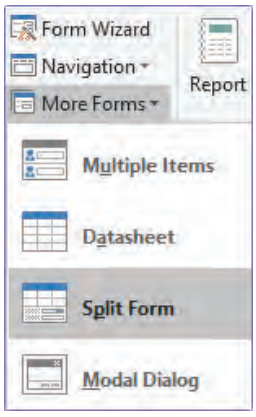

Fig. 2.42 **Split Form** option

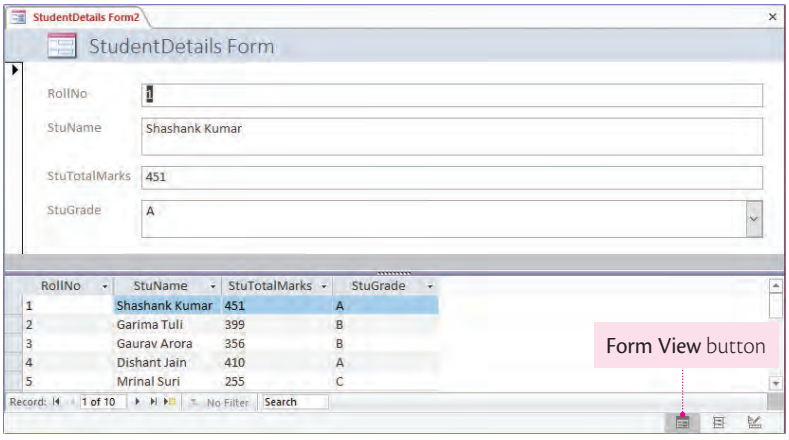

Fig. 2.43 Split form

4. Click the **Form View** button at the bottom-right end of the Status bar to enter or change data. You can use either the upper or the lower half. Both parts of the window activate the same field and the same record at the same time.

5. Click the **Layout View** to format the form.

Using the Form Wizard

To use the Form Wizard, follow these steps:

1. Click the **Create** tab. Click **Form Wizard** in the **Forms** group (Fig. 2.36).
2. **Form Wizard** screen 1 of 3 appears (Fig. 2.44). Select the table from the **Tables/Queries** drop-down menu and select the fields you want in the form. Click **Next**.
3. **Form Wizard** screen 2 of 3 appears (Fig. 2.45). Select a form layout. The default selection is **Columnar**. (You can change it, if required). Click **Next**.

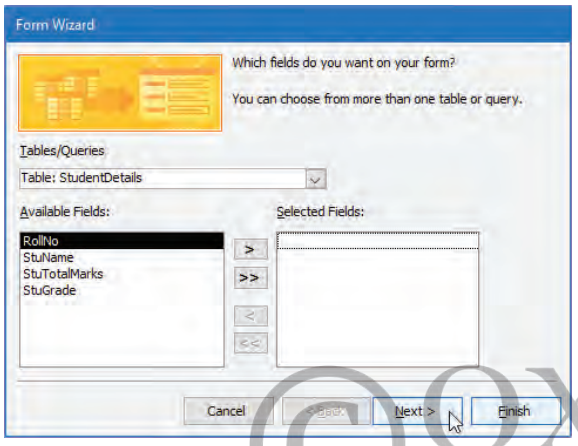

Fig. 2.44 **Form Wizard** screen 1 of 3

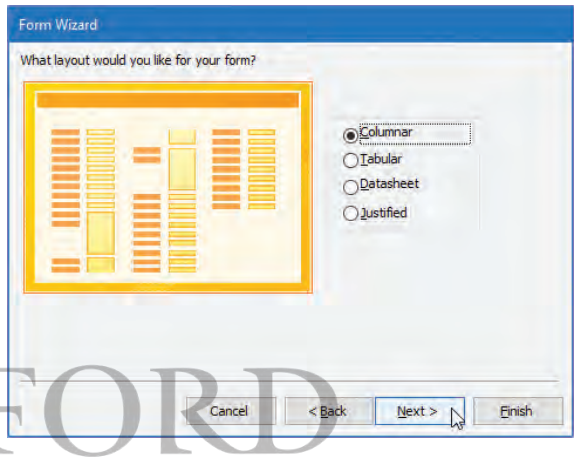

Fig. 2.45 **Form Wizard** screen 2 of 3

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4. **Form Wizard** screen 3 of 3 appears (Fig. 2.46). Give a name to the form. Select the option **Open the form to view or enter information**. Click **Finish** to create the form.
5. The formatted form will appear on the screen. You can now add more records to your form or view already existing records (Fig. 2.47)

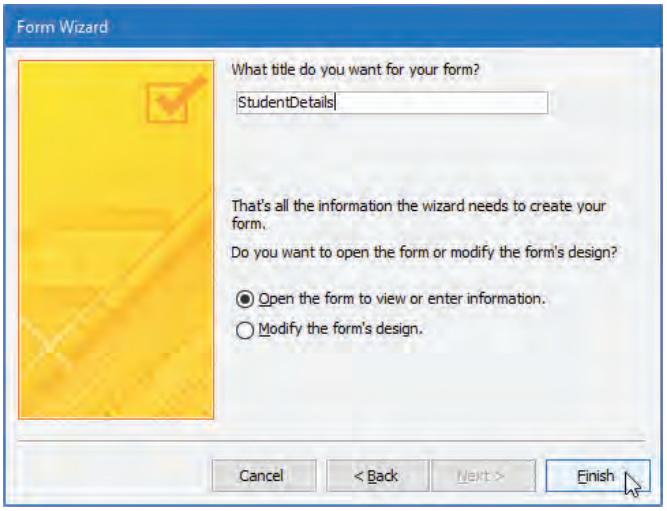

Fig. 2.46 **Form Wizard** screen 3 of 3

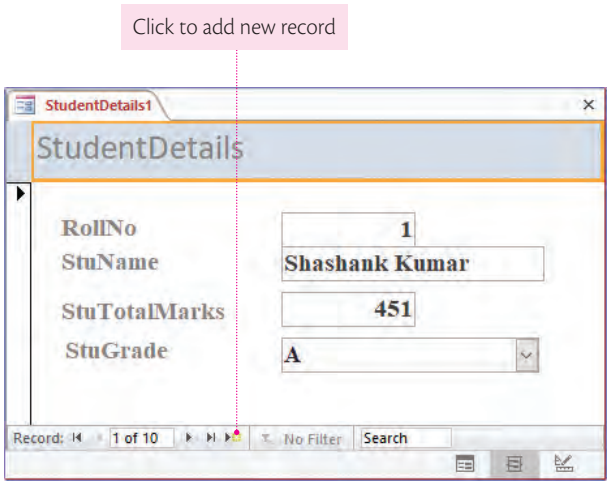

Fig. 2.47 Formatted form

REPORTS

Reports are an effective way to present your data in printed format. You can control the size and appearance of every element on a report. Thus, you can display the information the way you want to see it. Microsoft Access provides many ways to create a report. The two main ways are using the **Report** command and the **Report Wizard**.

Using the Report Command

To use the **Report** command, follow these steps:

1. Open the database. Select the base table or query in the Navigation pane.
2. Click the **Create** tab. In the **Reports** group, click **Report** (Fig. 2.48) to display the report on the screen.
3. Click the **Layout View** button to format the report. For example, in the report shown in Fig. 2.49, the heading has been changed to *Student Details*. Click the **Print Preview** button to see how the report will look when printed on paper.

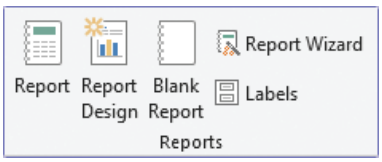

Fig. 2.48 **Reports** group

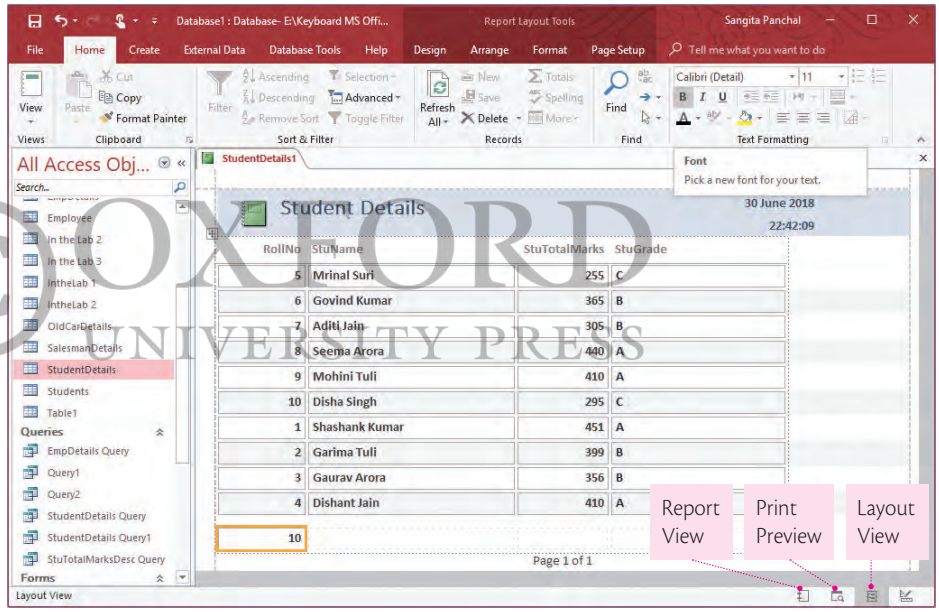

Fig. 2.49 Report created using the **Report** button

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Using the Report Wizard

To use the **Report Wizard**, follow these steps:

1. Click the **Create** tab. In the **Reports** group, click the **Report Wizard** option (Fig. 2.48).
2. **Report Wizard** screen 1 of 5 appears (Fig. 2.50). Choose the table or query, add the fields that you want to see in the report results, and click **Next**.
3. **Report Wizard** screen 2 of 5 appears (Fig. 2.51). Select the grouping level within the report and click **Next**. Here, the grouping level *StuTotalMarks* is selected.

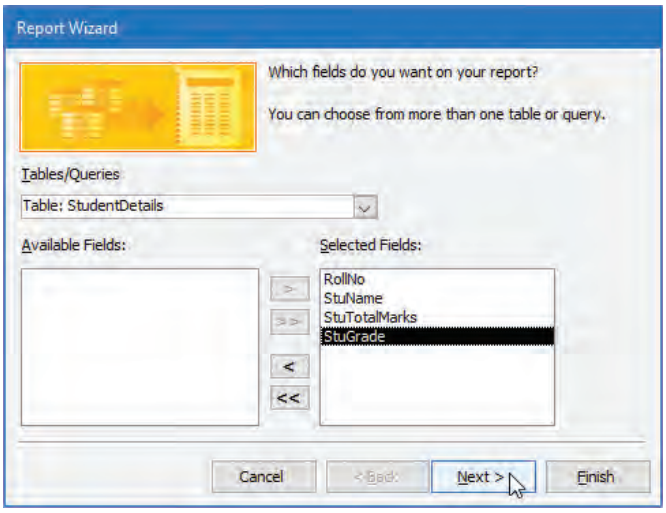

Fig. 2.50 **Report Wizard** screen 1 of 5

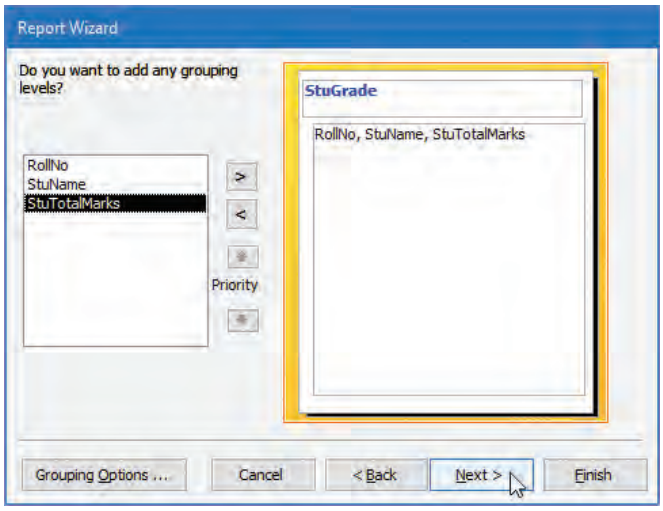

Fig. 2.51 **Report Wizard** screen 2 of 5

4. **Report Wizard** screen 3 of 5 appears (Fig. 2.52). In this screen, you can set the sort order and the summary options. You can sort data by up to four fields. Here, it is being sorted only by one field, *StuTotalMarks*. By default, sorting is in the ascending order. Click the **Ascending** button to change it to **Descending**. Click **Next**.
5. **Report Wizard** screen 4 of 5 appears (Fig. 2.53). Select the type of **Layout** within the report. In the **Orientation** section, select either **Portrait** or **Landscape**. Click **Next**.

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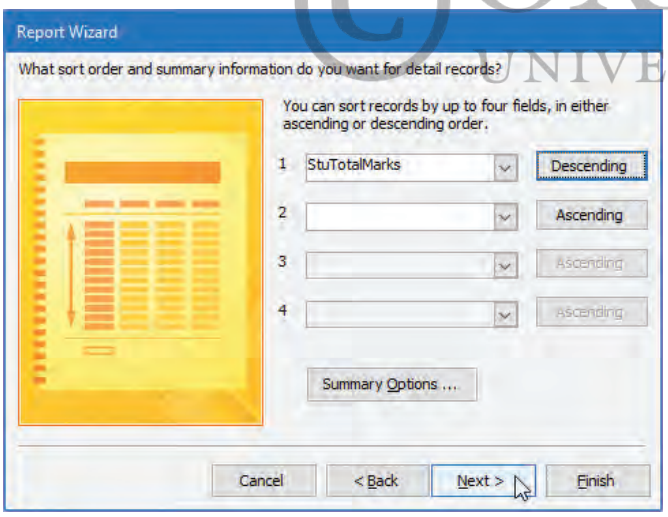

Fig. 2.52 **Report Wizard** screen 3 of 5

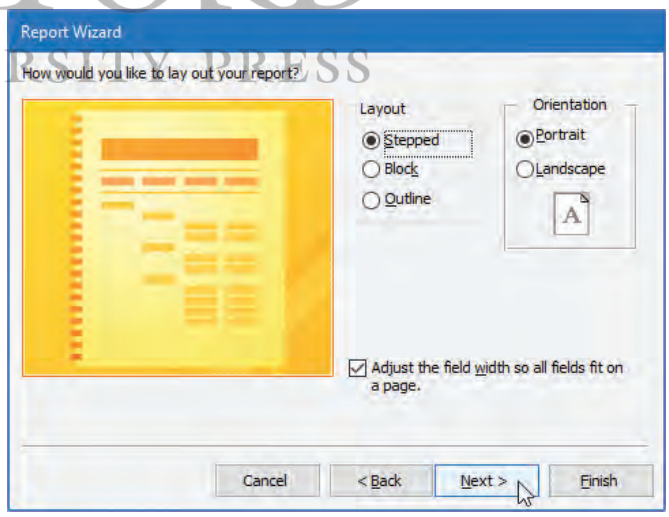

Fig. 2.53 **Report Wizard** screen 4 of 5

6. **Report Wizard** screen 5 of 5 appears (Fig. 2.54). Type a title for the report, which will also be the name assigned to the report. Select **Preview the report** and click **Finish**. The report will appear on the screen (Fig. 2.55).

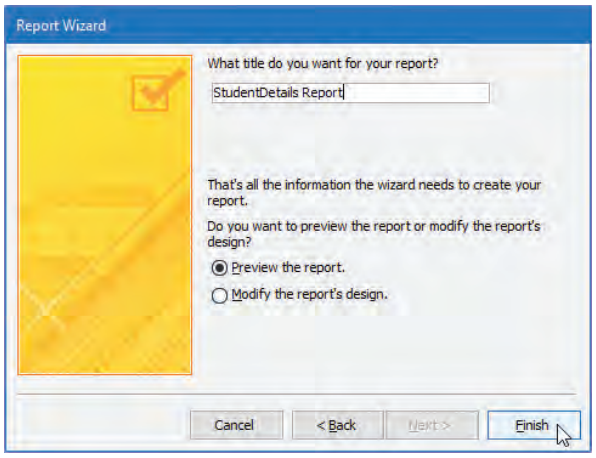

Fig. 2.54 **Report Wizard** screen 5 of 5

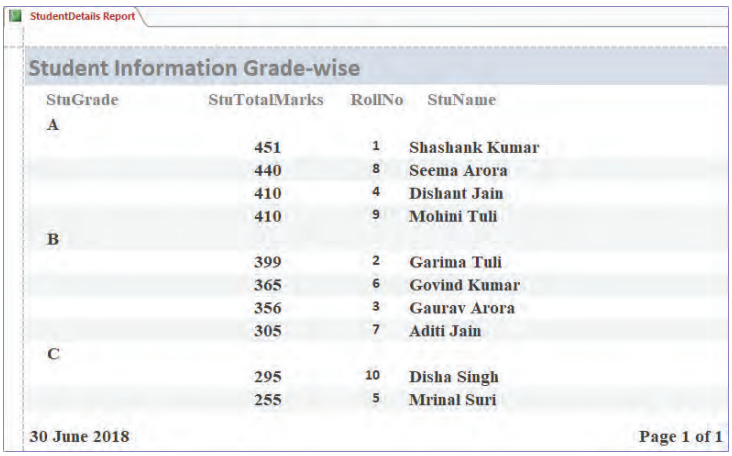

Fig. 2.55 Final report

Printing a Report

1. Click the **Print Preview** button (Fig. 2.49). The ribbon changes as shown in Figure 2.56.

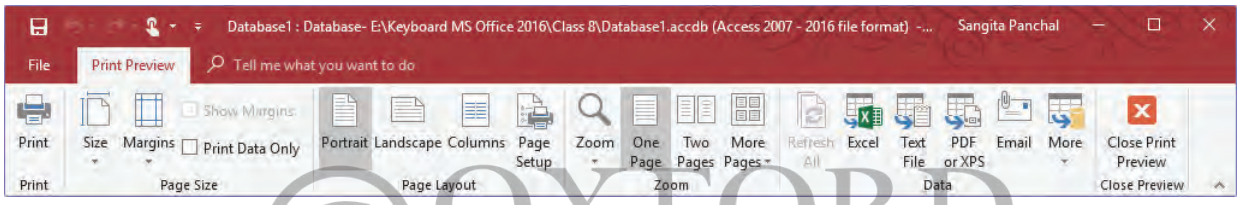

Fig. 2.56 **Print Preview** tab

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2. Select the desired options and click **Print**. This will open the **Print** dialog box (Fig. 2.57).

   OR

   Click the **File** tab. Select the **Print** option in the **File** menu. The **Print** dialog box appears (Fig. 2.57).

Select the required options and click **OK**.

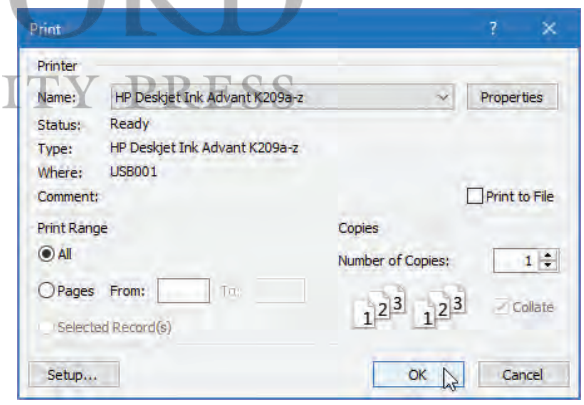

Fig. 2.57 **Print** dialog box

Practice Time

ABC Corporation maintains the details of all the employees working on their projects and documents. It also records whether they are able to complete their projects or not. The details of the table *EmpDetails* with the fields are given here.

Field Name	Data Type	Description
EmpId	Short Text	Primary Key
EmpName	Short Text	Name of the employee
EmpDOB	Date/Time	Format – Short Date
EmpProjAssigned	Lookup Field	Proj1, Proj2, Proj3, Proj4
EmpProjGrade	Lookup Field	A, B, C
ProjCompleted	Yes/No	

Using data from the given table, do the following:

a. Create a form to enter the data. Format it along with a logo and add 8 records.

b. Create a query to display the details of the employees who completed their projects.

c. Create a report for the query created in the previous step and print the report.

SOLUTION

1. Create a new database. The new database will open with one table, *Table*1, in Datasheet View. Now, click the **View** drop-down arrow and select **Design View**.
2. This will open the table in Design View. Type in the field names, select the required data type, and enter the descriptions. Select the *Emp*ID field and click the **Primary Key** button in the **Tools** group on the **Design** tab, to make it the primary key field.
3. Click **Save** icon on Quick Access Toolbar. Save the table as *EmpDetails* and click **OK**.
4. Click **Form** in the **Forms** group on the **Create** tab to create a form. The form will appear on the screen in Layout View.
   a. Click the **Design** tab.
   b. Click **Logo** in the **Header/Footer** group. The **Insert Picture** dialog box appears. Select a suitable logo and click **OK**.
   c. Click **Title** in the **Header/Footer** group and type a new title.
   d. Click **Date and Time** in the **Header/Footer** group. Select a suitable format and click **OK**.
   e. Click **Themes** in the **Themes** group and select a theme of your choice.
   f. Click **Fonts** in the **Themes** group and select a font you prefer.
   g. Now, select the **Format** tab.
   h. Click **Shape Fill** in the **Control Formatting** group. Select a desired color from the color palette that appears.
   i. Click **Save** icon on the Quick Access Toolbar. The **Save As** dialog box appears. Type *EmpDetails Form* and click **OK**. The form will be created [Fig. A].

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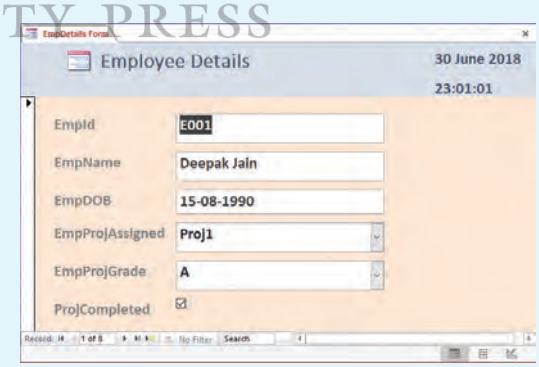

Fig. A

5. Now, to create a query, click **Query Design** in the **Queries** group on the **Create** tab. The **Show Table** dialog box appears. Select the *EmpDetails* table. Click on **Add** and then click on **Close**.
6. Drag the fields from the table to the **Query Design Grid**.
   a. Select the **Criteria** option of the *ProjCompleted* field as **Yes.**
   b. Click **Run** in the **Results** group on the **Design** tab to run the query.
   c. Save the query as *EmpDetails Query* [Fig. B].

EmpDetails Query

EmpId	EmpName	EmpDOB	EmpProjAssigned	EmpProjGrade	ProjCompleted
E001	Deepak Jain	15-08-1990	Proj1	A	☑
E002	Govind Desai	27-11-1986	Proj2	B	☑
E006	Shefali Puri	20-02-1989	Proj3	C	☑
E008	Nishant Tuli	11-07-1986	Proj1	B	☑

Fig. B

7. Now, select the query *EmpDetails Query* in the Navigation pane. Click **Report** in the **Reports** group on the **Create** tab. The report will appear on the screen.
   a. Save the report as *EmpDetailsProjCompleted Report* [Fig. C].
   b. If you wish to print the report, click **File** and select **Print** in the menu that opens.
   c. Select **Print Preview** in the center pane if you want to see how the report will look on paper, or click **Print**.
   d. In the **Print** dialog box that appears, select the required options, and click **OK**.

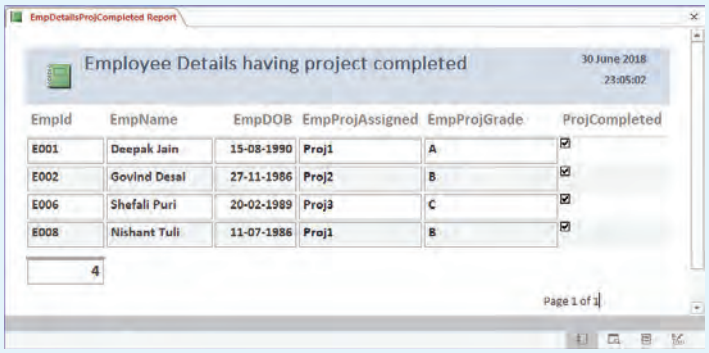

Fig. C

Tricky Terms

Query A method to retrieve a set of records from one or more tables according to the criteria provided

Report Data presented in an easy-to-read, printable format

Validation rule Limits the value that a field can accept

Validation text Error message that appears when a validation rule is violated

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Memory Bytes

- The **Design View** window is made up of two parts: the **Field Definition Grid** and the **Field Properties** pane.
- The **Field Definition Grid** consists of the **Field Selector**, and the **Field Name**, **Data Type**, and **Description** columns.
- You can select multiple fields by pressing the Ctrl key and clicking the Field Selector.
- A primary key field should have unique values. Access displays an error message if you attempt to enter a value that is already present.
- In the **Field Properties** pane, you can specify the following field characteristics: Field Size, Format, Input Masks, Field Caption, Default Value, Validation Rule, Validation Text, Required, and Allow Zero Length.
- There are two methods of creating a query: using **Query Wizard** and using **Query Design**.
- Access provides many ways to create a form, such as using the **Form**, **Split Form**, and **Form Wizard** options.
- Access provides many ways to create a report. The two main ways are using the **Report** command and the **Report Wizard** option.

Exercises

Objective Type Questions

1. Fill in the blanks with the correct words.

Description	Forms	Input mask	Lookup field	Report

a. ..... provide an easy-to-use method for entering and editing data for those who are not familiar with Access.

b. ..... give us data in a printer-friendly format.

c. Entering data in ..... column of Field Definition Grid is optional.

d. A ..... is a column with a list of values from which a user can choose the desired value.

e. The ..... property facilitates data entry and controls what the user enters in a field.

2. Write T for the true statement and F for the false one.

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a. Queries can be used as source for forms and reports. ☐

b. The Primary key icon resembles a keyboard key. ☐

c. You can enter data in Design View also. ☐

d. If the Required property is set Yes, it is mandatory to enter data in a field. ☐

e. To run a query, click the **Run** button in the **Results** group on the **Design** tab. ☐

3. Choose the correct option.

a. This displays a form in the upper half of the window and displays the table in the lower half.

i. Multiple Items ii. Datasheet iii. Split Form iv. Model Dialog

b. This is automatically filled in a field when you add a new record to a table.

i. Validation Rule ii. Caption iii. Default Value iv. Field Size

c. This is the error message that appears when you enter a value prohibited by the validation rule.

i. Caption ii. Format iii. Validation Text iv. Field Size

d. This limits the values that a field can accept.

i. Input Mask ii. Validation Rule iii. Caption iv. Default Value

e. This tab has the options to create queries, forms, and reports in Access.

i. Home ii. File iii. External Data iv. Create

Descriptive Type Questions

Answer the following.

1. Name the two parts of a **Table Design** screen.
2. What are the two ways of a setting a field as Primary key?
3. Name the four parts of the Field Definition Grid.
4. Which property will you use so that a user can enter only 1 to 100 number in a column in a table, otherwise an error message "Enter number in the range 1 to 100" gets displayed? Explain the steps.
5. Explain the two ways of creating a query.
6. What are the different ways of adding fields in a Query Design Grid?
7. Name the three view options that appear on the bottom-right when you create a form.
8. Name the three tabs that appear when you view a form in the Layout view.
9. Write the steps that you will follow to print a report.

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APPLICATION BASED QUESTIONS

A. Look at the table given below and answer the following questions:

SNo	StuName	DOB	Points	AdmDone
S1	Monika	15-09-2014	75	☑
S2	Siddharth	29-04-2015	80	☐
S3	Yatharth	20-10-2014	70	☑

i. How many rows and columns are there in the above table?

ii. Identify the Primary key in the table.

iii. Identify the data type of fields in the table.

B. Look at the Query Design Grid given below of a table called *Item*.

Field:	ItemNo	ItemName	Qty	Cost	
Table:	Items	Items	Items	Items	
Sort:					
Show:	☑	☑	☑	☑	☐
Criteria:					
or:					

Write the steps to do the following:

i. Display records with fields—*ItemNo*, *ItemName*, and *Cost*.

ii. Display all the fields in a record in ascending order of *Cost*.

iii. Display all the fields in a record where *Qty* is greater than 10.

C. When you create a form, three view options appear on the bottom-right corner of the screen. Name the three views. Answer the following:

i. Which view is used for formatting the form?

ii. Which view is used for entering and editing data in the form?

iii. Which view is used for designing the form?

IN THE LAB

1. Manan has created a table *SubjectDetails* in Design view with the following specifications:

Field Name	Data Type	Specifications
AdmissionNo	Short Text	Field Size – 5, Primary Key
Stream	Short Text	Lookup Field – Medical, Non-Medical
Sub1, Sub2, Sub3, Sub4, Sub5	Short Text	Lookup Field – English, Maths, Physics, Chemistry, Biology, Computer Sc., Engg. Drawing, Physical Education, Economics, Psychology, Home Science

Create a similar table using the data given below.

AdmissionNo	Stream	Sub1	Sub2	Sub3	Sub4	Sub5
A01	Non-Medical	English	Maths	Physics	Chemistry	Computer Sc.
A02	Medical	English	Maths	Physics	Chemistry	Biology
A03	Non-Medical	English	Maths	Physics	Chemistry	Economics
A04	Medical	English	Physical Education	Physics	Chemistry	Biology
A05	Medical	English	Psychology	Physics	Chemistry	Biology

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2. Gaurav has to create a table *SalaryDetails* of all employees in his organization. Using it, he has to calculate the DA, TA, CCA, and Total based on the Basic pay. He created the table in Design View with the following specifications:

Field Name	Data Type	Specifications
EmpNo	Short Text	Field Size – 5, Primary Key
EmpName	Short Text	Field Size – 30
Basic	Number	
DA	Calculated	40% of Basic
TA	Calculated	10% of Basic
CCA	Calculated	12% of Basic
Total	Calculated	Basic + DA + TA + CCA

Create a similar table using the data given below.

EmpNo	EmpName	Basic	DA	TA	CCA	Total
E01	Monika Desai	10000	4000	1000	1200	16200
E02	Nishant Ghai	12000	4800	1200	1440	19440
E03	Govind Jain	15000	6000	1500	1800	24300
E04	Rakesh Arora	11000	4400	1100	1320	17820
E05	Jeevan Tuli	16000	6400	1600	1920	25920

3. Shikha works at a coaching center. She has created a form *frmTeacherDetails* in Access for entering the data of the teachers. She created a table *TeacherDetails* with the following specifications:

Field Name	Data Type	Specifications
TNo	Short Text	Field Size – 4, Primary Key
TName	Short Text	Field Size - 25
Subject	Lookup Field	Maths, Physics, English, Chemisty, Computer, Accounts, Economics, Business Studies, Geography, Political Science
Department	Lookup Field	Science, Arts, Commerce
Phone	Short Text	Input Mask – (AAAA) AAA - AAA
Gender	Lookup Field	Male, Female

Create a similar table and enter the data in the form as given below.

TNo	TName	Subject	Department	Phone	Gender
T01	Monika	Maths	Science	(9899)XXX-342	Female
T02	Saurabh	Physics	Science	(9999)23X-XXX	Male
T03	Dipanshu	Geography	Arts	(8887)8XX-XXX	Male
T04	Seema	English	Commerce	(7877)23X-XXX	Female
T05	Garima	Computer	Commerce	(8888)562-XXX	Female

Also, create a query *qryFemaleDetails* in Access to display the details of female teachers.

4. The Sales Manager of a company has created a table to maintain the details of salespersons as given below. Create a similar table and do the following:

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SalespersonNo	SalespersonName	Zone	SalesAmount
S001	Dhruv Wadhawan	East	₹5,40,000.00
S002	Ruhi Arora	North	₹7,00,000.00
S003	Jyoti Jain	South	₹10,50,000.00
S004	Jyant Singh	North	₹8,00,000.00
S005	Nishant Jain	East	₹7,50,000.00
S006	Gaurav Arora	West	₹8,00,000.00
S007	Rohit Sharma	North	₹12,00,000.00
S008	Rijul Jain	South	₹9,00,000.00
S009	Raunak Arora	North	₹6,70,000.00
S010	Samyak Jain	West	₹5,50,000.00

a. Decide your own suitable data types and create a table *SalespersonDetails* in Design View as shown above.
b. Enter the data in Datasheet View.
c. Create a query *qrySalesAmount* to display the details of salespersons having *SalesAmount* greater than 10 Lakhs.
d. Create a report *rptZonewiseto* display the data group by Zone and in descending order of *SalesAmount*.

5. A company selling used cars maintains its data in table named *OldCarDetails* as follows.

OldCarDetails

SNo	Company	Model	Color	Kms travelled	Year
1	Volkswagon	Vento	Blue	23689	2014
2	Hyundai	Santro	Black	5984	2005
3	Hyundai	Creta	Red	25601	2016
4	Lamborghini	Murcielago	White	15987	2013
5	Ford	Mustang	Silver	10382	2012
6	Fiat	Punto	Silver	50168	2010
7	Aston Martin	Vantage	Gray	14279	2011
8	Mercedes	SLK 350	Red	29123	2014
9	Audi	R8	Silver	35001	2010
10	Koenigsegg	Agera	White	45968	2009

Using the given data, do the following:

a. Create a form and enter the data.

b. Create a query *qryKmsTravelled* to display the car details of those cars that have travelled less than 10,000 kilometres.

c. Create a report *rptGroupYear*. Group the data by year and in ascending order of *Kms travelled*.

d. Print the report.

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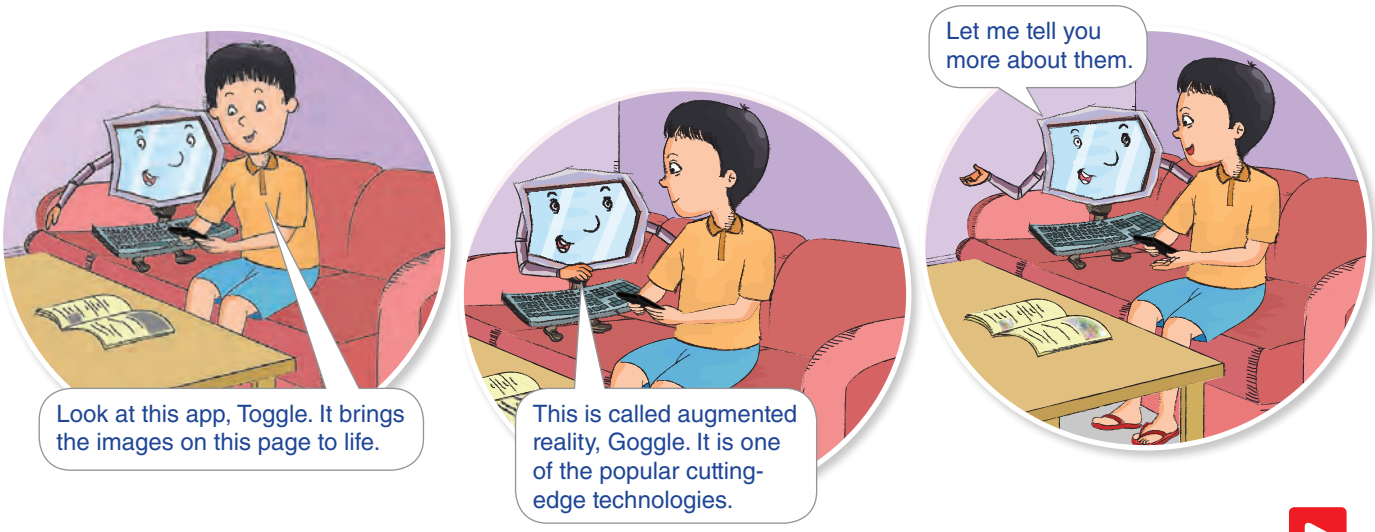
Teacher's Notes

- Explain the uses of a primary key in a table using examples.
- Demonstrate how to set the properties in the **Field Properties** pane, and the results obtained by selecting different options.
- Spend some time discussing the working of the validation rule and validation text, and their importance.
- Discuss with students regarding the usefulness of the query, form, and report features in Access.

3 Cutting-Edge Technology



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IN THIS CHAPTER

- Augmented Reality
- Virtual Reality
- Artificial Intelligence
- Internet of Things
- Big Data Analytics

Computers are evolving at a rapid pace and their use is now no longer limited to booking train or flight tickets and online banking. We are surrounded by several innovative uses of cutting-edge technologies that are capable of changing the world we live in. Cutting-edge technology commonly refers to the latest computer and electronic technology that uses the most current and advanced IT developments. In this chapter, we will discuss some of the most popular cutting-edge technologies in detail.

AUGMENTED REALITY

The term 'augmented reality' implies adding certain elements to reality in order to augment or improve its quality. Augmented reality (AR) involves adding computer-generated content to the real world, so that the content looks as if it is also a part of that world (Fig. 3.1).

Fig. 3.1 An example of augmented reality

AR uses a virtual object superimposed on a real environment in real-time to create a composite view. The computer-generated content can be an animation, an image, or a sound overlaid onto the real world, thus augmenting the way we see, hear, and feel.

Did You Know?

The first AR technology was developed in 1968 by Ivan Sutherland. He is an American computer scientist and an Internet pioneer. He created an AR head-mounted display system. He is regarded as the "father of computer graphics".

Types of Augmented Reality

AR is of four types: (i) Markerless AR, (ii) Marker-based AR, (iii) Projection-based AR, and (iv) Superimposition-based AR.

Let us try to understand how each of these works.

Markerless Augmented Reality

Markerless AR is position-based or location-based. To work, it needs a device with GPS that can provide data based on your location. Most smartphones use this location-detection technology to provide you information about the traffic, or restaurants, hospitals, shopping malls, and other such facilities in your vicinity (Fig. 3.2). Several cab services use this feature so that cabs booked by you can locate and reach you. It can generate maps and directions to help you reach a location of your choice from your current location.

Fig. 3.2 Markerless AR

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Marker-based Augmented Reality

Marker-based AR is also known as image recognition. To work, it needs a device with a camera, and a visual marker. When the camera reads the visual marker, the content linked to that marker gets displayed (Fig. 3.3). This technology is widely used to read QR codes, or to view digital content such as animations or three-dimensional (3D) models.

Fig. 3.3 Marker-based AR

Projection-based Augmented Reality

Projection-based AR involves projecting artificial light onto a real-world physical surface. The user can interact with this projected light. The AR senses any interaction by detecting changes in the projected light.

For example, a projector keyboard device projects a virtual keyboard onto a desk, detects the keys pressed by the user by sensing the position of the user's fingers on the virtual keyboard, and responds accordingly (Fig. 3.4).

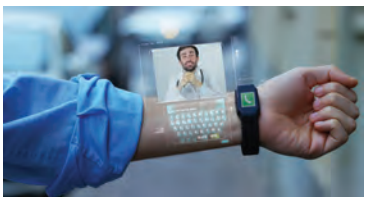

Fig. 3.4 Projection-based AR

Superimposition-based Augmented Reality

Superimposition-based AR involves replacing the original view of an object partially or fully with an augmented view of the same object. For superimposition-based AR to work, object recognition plays an important role. If an object cannot be accurately identified, it cannot be replaced with AR.

For example, some gaming apps for smartphones use the camera of the phone to capture the real-world scene and show computer-generated characters in it. You can also use this technology to check how a piece of furniture would look in your room (Fig. 3.5).

Fig. 3.5 Superimposition-based AR

Applications of Augmented Reality

Augmented reality can be used to cater to the unique needs of several major industries. A few applications of AR are as follows:

- AR finds varied applications in gaming. Several innovative games are being developed using AR that provide better experiences to the player because of added excitement and thrill. Some games provide a real-time experience to the users and may even require them to move around and be physically active.
- AR is being actively used in education to create interactive models and simulations to teach various subjects, especially science.
- AR is used in the military for advanced navigation and for obtaining real-time data of threats and targets.
- AR is used as visualization aid to explain complicated surgical procedures to medical students as well as patients.
- Smartphones use GPS to detect the user's location; they then use AR to provide location-based data regarding facilities in the area. They can also generate maps and guide the user by giving out directions in real-time to a specified location.
- Several businesses now use AR technology to market their products (such as furniture, watches, and even clothes) by generating their 3D models on smartphones. This gives the user a realistic idea of the products' appearance and utility.
- AR can also be used while travelling and sightseeing. Using certain AR apps, tourists can scan the site they are visiting. Interesting facts about the site are displayed on their phone screens as overlay.
- In many industries, simple AR simulations are used to train technicians on maintenance and repair of complex equipment.

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VIRTUAL REALITY

Virtual reality (VR) refers to a near-reality, computer-generated environment that a user can explore and interact with. This computer-generated world is 3D in nature, and allows the user to interact with it. The user can perform actions and handle objects in virtual reality just as he/she would in the real world.

Virtual reality works by blocking out the user's vision of the real world by using a head-mounted display (Fig. 3.6). Usually, the user can get a 360-degree view of the virtual world by moving his/her head and can interact with most or all objects. VR also employs other tools such surround-sound headphones to virtual audio so that the virtual environment becomes more believable for the user. Special gloves or controllers, such joysticks, maybe used to interact with the objects of the virtual world and provide feedback to the user through vibration.

Fig. 3.6 Virtual reality

Applications of Virtual Reality

There are a wide variety of applications for virtual reality. Some important applications are:

- VR is used for training people for jobs that are hard to do in the real world. It finds its most important application in creation of simulations for astronauts, pilots, and surgeons. Almost all branches of the military now use VR to train pilots to fly in battle.
- VR is being applied to visualize and understand complex scientific experiments.
- VR is now being used in telemedicine. It involves a surgeon in one location connected on a VR control panel, performing a surgery in another location through a robot. VR technology is also being used to treat patients having different types of phobias.
- Architects and engineers use VR to construct computer models and prototypes of their designs to visualize what the end product would look like and what possible changes could be made to make the design better. Several automobile manufacturing companies now use VR technology to allow engineers to study designs of proposed automobiles before they are actually manufactured.
- VR can be used to enable students to view and experiment on 3D models to get better understanding of concepts. Students can interact with each other on VR platforms. Excursions to industrial sites and other places of educational importance can also be conducted using VR to make learning fun.
- VR is extensively used in movies these days to enhance the viewing experience of movie-goers. VR is especially used to make action or horror movies more real for the viewers and by providing additional thrill.

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- VR technology is making its presence felt in the gaming industry. Several action-packed games such as racing games and sports games can now be played using VR technology.

Augmented Reality versus Virtual Reality

Augmented reality and virtual reality are different from each other in the following ways:

Augmented Reality	Virtual Reality
1. In AR, only the objects are computer-generated.	1. In VR, the objects as well as the whole environment are computer-generated.
2. Virtual objects are superimposed over the real world to enhance reality.	2. Virtual objects are placed in a virtual world.
3. The real world is visible to the user.	3. The real world is not visible to the user.

AR and VR are similar to each other in the following ways:

- In both AR and VR, a screen is used to show the virtual objects and virtual world.
- Devices such as headphones, controller, and microphone may be used.

ARTIFICIAL INTELLIGENCE

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Artificial intelligence (AI) is a field of study in computer science that aims to create intelligent machines that think and react to situations in the same way as human beings. These machines could be a computer, a robot, or a software. Some features that a computer with artificial intelligence would be designed to have include speech recognition, learning, reasoning, problem-solving, and self-correction.

An important example of AI technology is **machine learning**. Machine learning is a feature by which a computer is able to study a situation and act without programming. It focuses on designing computers that can make decisions and predictions and perform a task based on data instead of being programmed to do that particular task in a specific manner.

AI is a challenging field because for machines to act and behave like human beings, we need to feed a large amount of information about the world into them. Introducing the concepts of common sense, problem-solving, and reasoning are difficult tasks. The research associated with AI is highly technical and advanced. Some people believe that creating machines that are as intelligent as human beings might prove to be dangerous to humanity, if left unsupervised.

Applications of Artificial Intelligence

AI technology is popular and finds a large number of unique applications in several fields:

- Many modern cars have AI-based features such as self-parking and advanced cruise controls. AI is being used by some major automobile manufacturers to develop self-driving cars.

- AI is being used by the military to develop computers that can assist a pilot in battle by using the data available at that time and calculating the best-possible solution. AI is also being used to develop intelligent autopilots for aircrafts that can mimic the behavior of a human pilot even in cases of emergencies.
- AI is being used to develop natural language processing (NLP) that can enable a computer to understand and communicate in human language. This technology is used in developing automated online assistants that can hold simple conversations with customers.
- A few AI-based robots have been developed that can teach students subjects such as biology and computer science. AI will find significant applications in the field of education in the near future.
- AI is also widely used in Finance for making trading decisions, market analysis, handling personal finances, and managing investments. Computer programs that use AI to offer advice and make decisions are called expert systems.
- Several countries such as China, Japan, and USA use AI-based robots in heavy industries for jobs that are either too mechanical or too dangerous for humans (Fig. 3.7).
- AI-based technology is being extensively used in medicine to assist doctors in diagnosing various diseases and in performing surgeries. AI is also being used in cancer research.

Fig. 3.7 Robots working in a factory

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- AI is used in gaming to determine the behavior of various characters in a computer game on the basis of how a player plays. Several toy manufacturers have also developed simple AI-based toys for young children that are able to understand and hold simple conversations with them.

INTERNET OF THINGS

The Internet of Things (IoT) refers to the linking of physical devices around us to the Internet and to each other so that they can collect and exchange data. Using easily available processors and wireless networks, any device can be made a part of IoT. The device could be a cellphone, a refrigerator, a washing machine, or a coffee maker. Once such a device is made a part of IoT, it is able to collect and transfer data over a network without manual intervention.

For example, if your alarm clock and geyser are both connected through IoT, after your alarm clock wakes you up in the morning, it can send a notification to the geyser to start heating water for your bath. Using IoT, we would be able to know when things need to be repaired or replaced, thus preventing wastage or loss and saving time and money. However, there are also

concerns about using IoT to create smart homes as this may leave homes and offices open to hackers and may also breach the privacy of users. The way IoT works is shown in Figure 3.8.

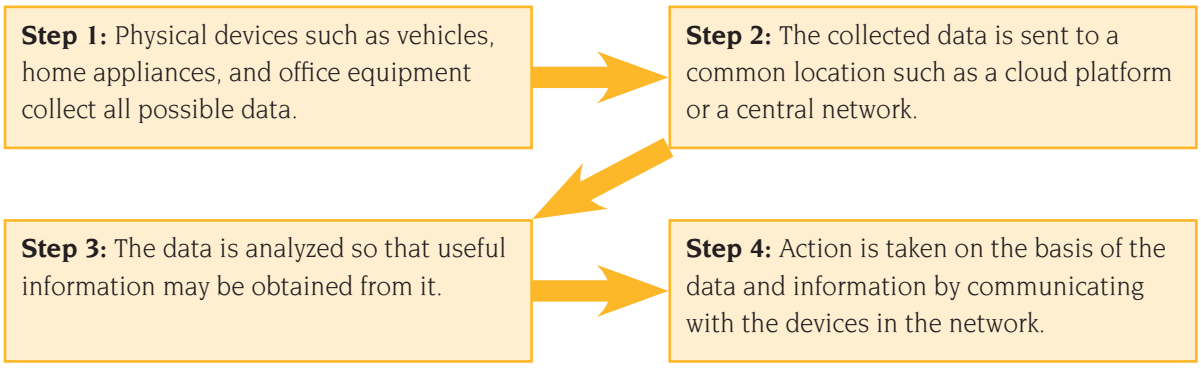

Fig. 3.8 Working of IoT

Applications of IoT

IoT has a wide range of applications in our lives. Let us look at some examples:

- IoT devices are being used to create smart homes and smart offices where even the smallest devices are connected to ensure that functions such as heating, airconditioning, and lighting are automated.
- Smart watches and wearable health trackers (Fig. 3.9) are also examples of IoT devices which collect and share data with the manufacturer and help in monitoring the health and physical activity of the user.
- IoT technology is being used to develop smart infrastructure such as bridges and railway lines that can be monitored and updated continuously without human intervention.

Fig. 3.9 Health tracking using IOT

- Smart meters are used to monitor the energy usage in certain appliances. They also supervise system performance and stability and alert the user or manufacturer about any damages.
- IoT-based smart classrooms collect data regarding different aspects of a classroom environment (such as lighting and heating) to ensure a comfortable experience for students and teachers. They can also be used to improve the quality of education by taking in students' feedback regarding the way each class is conducted.
- IoT-based devices can be used for the construction of smart cities. They are also used by the military to collect data and information from sensitive border areas.
- IoT devices can also be used for monitoring the environment—checking air quality, detecting presence of toxic substances in water.

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- IoT-based devices can also be used to monitor factors such as soil conditions, temperature, rainfall, humidity, and pests to help farmers plan their crops better.
- IoT devices can be used to remotely monitor the health and well-being of elders at home.

BIG DATA ANALYTICS

Big data refers to large volumes of complex data that cannot be processed using the usual data-processing applications. **Big data analytics** is the process of examining big data, to analyze market trends, understand customer preferences, and obtain other useful information. The advanced tools used in big data analytics can provide valuable information to business organizations about user needs and preferences. This helps organizations make better business decisions.

Did You Know?

Every day, we create 2.5 quintillion bytes of data—so much that 90% of the data in the world today has been created in the last two years alone.

Features of Big Data Analytics

The following are the features of big data analytics:

- Volume—A large volume (or amount) of data can be handled effectively, unlike traditional data-processing applications that are not equipped to do so
- Velocity—The speed at which big data is processed is extremely fast
- Variety—Different types of data (such as text, numbers, image, audio, and video) can be processed and stored

These are also called the 3V's of big data analytics.

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Advantages of Big Data analytics

Companies are adopting big data analytics because it provides the following advantages:

- Improved customer service
- Better performance analysis
- Better management of large amount of data
- Identification of risk or fraud

Applications of Big Data Analytics

Big data analytics are used in the following ways:

- Search engines use data analysis to deliver the best result for a searched query in a fraction of a second.
- When you search for any product on the internet, you get similar products from billions of products based on previous searches for other users.

- When you upload your image with friends on social media, you start getting suggestions to tag your friends.
- Several games use analytics technique and help the player to move to a higher level. In motion gaming also, your opponent (computer) analyzes your previous moves and accordingly shapes up its game.
- You can compare the price of any product from multiple vendors at one place with the help of price comparison websites.
- Many logistics companies use big data analytics to improve their operational efficiency. Using data analytics, these companies discover the best routes to ship, the best suited times for delivery, and the best mode of transport to reduce cost.

Tricky Terms

Augmented reality Adding computer-generated content to reality to improve its quality

Virtual reality A near-reality, computer-generated environment that a user can explore and interact with

Artificial intelligence A field of study in computer science that creates intelligent machines

Internet of things Linking of physical devices around us to the Internet and to each other so that they can collect and exchange data

Big data analytics The process of examining, analyzing, and understanding big data to obtain useful information

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Memory Bytes

- Augmented Reality is of four types: markerless, marker-based, projection-based, and superimposition-based.
- Virtual Reality works by blocking out the user's vision of the real-world by using a head-mounted display.
- Machine learning is a feature by which a computer is able to study a situation and act without programming.
- Once a device becomes a part of IoT, it is able to collect and transfer data over a network without manual intervention.

Exercises

Objective Type Questions

1. Fill in the blanks with the correct words.

Augmented	Big	Virtual	Human beings	Variety

a. ..... reality involves adding computer-generated content to the real world.

b. ..... reality refers to a near-reality, computer-generated environment that a user can interact with.

c. Artificial intelligence aims to create machines that are as intelligent as ..... .

d. ..... data is the term used for large or complex data sets.

e. The features of big data analytics are Velocity, Volume, and ..... .

2. Write T for the true statement and F for the false one.

a. Cutting-edge technology is an ancient form of technology. ☐

b. AR uses a virtual object superimposed on a real environment in real-time. ☐

c. Marker-based AR is also called image recognition. ☐

d. NLP can enable a computer to understand and communicate in human language. ☐

e. Big data can be easily handled by using traditional data-processing applications. ☐

3. Choose the correct option.

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a. Which of the following refers to the viewing of the physical world with computer-generated information added to it?

i. Augmented reality ii. IoT

iii. Virtual reality iv None of these

b. Which of the following types of AR is used to read QR codes?

i. Markerless AR ii. Marker-based AR

iii. Projection-based AR iv. Superimposition-based AR

c. Which of the following technologies do search engines use to deliver the best result for a searched query in a fraction of a seconds?

i. IoT ii. Artificial intelligence

iii. Big data analytics iv. None of these

d. Which of the following is a feature of IoT?

i. Collection of data ii. Communication over a network

iii. Analysis of data and action iv. All of these

e. Which of the following is an advantage of big data analytics?

i. Improved customer service ii. Better performance analysis

iii. Faster data processing iv. All of these

Descriptive Type Questions

Answer the following:

1. List the different types of augmented reality. Explain the working of any two.
2. What is the difference between augmented reality and virtual reality?
3. Write any three applications of Internet of things.
4. What is big data? What do you mean by big data analytics?
5. Why is artificial intelligence a challenging field? Why is it seen as a potential threat by some people?

APPLICATION BASED QUESTIONS

1. **Sanya's sister wanted to buy a new pair of sunglasses but she did not have the time to go to a store. Sanya suggested a few websites where she could try on sunglasses sitting at home without having to go to the store. Which technology is being used by these websites?**
2. **Rameez wanted to purchase a new mobile phone. He checked and compared the prices of the phone that he wanted as sold by different sellers on a price comparison website. Which technology is being used here?**
3. **Recently, a robot was developed by a Hong-Kong based company. It would speak to people, answer questions, and hold simple conversations. Which technology is used in creating this robot?**

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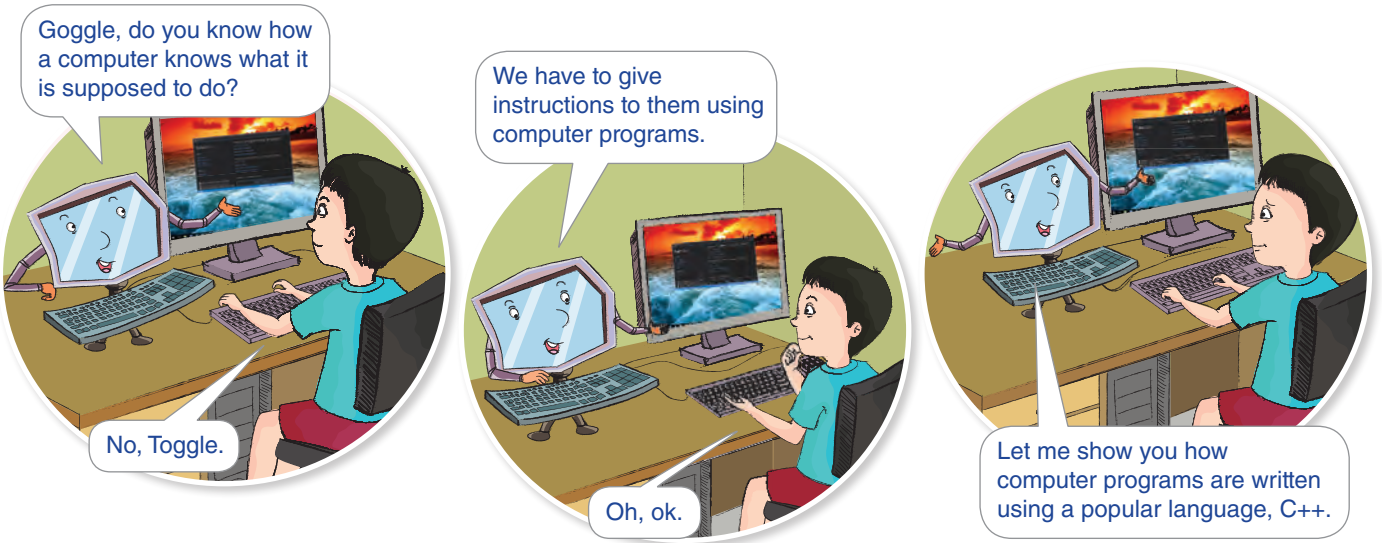
IN THE LAB

1. Radha collected pictures of the applications of AR and VR, and created a collage. Collect at least 10 such pictures and create a similar collage.
2. Amina wants to make a chart on the applications of Artificial Intelligence. Search the Internet for information on this topic and make a similar chart.
3. Lucy has made a list of common electronic devices that can be connected and used through IoT technology. Make a simiilar list of five physical devices around you. Imagine how they could be useful to you if they are connected to IoT. Create a PowerPoint presentation (5 slides) to show this.

Teacher's Notes

- Explain the distinction in augmented reality and virtual reality by taking suitable examples.
- Explain why traditional method of storage and searching technique is now obsolete.

4 Introduction to C++



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IN THIS CHAPTER

- Turbo C++ Basics
- Structure of a C++ Program
- Comments
- C++ Character Set and Tokens
- Constants/Literals
- Standard I/O Stream Objects
- C++ Operators
- Arithmetic Expressions
- Precedence of Operators

C++ is one of the most popular programming languages. It is usually considered to be a middle-level language as it has characteristics of both high-level and low-level languages. In this chapter, we will learn the basics of C++ programming. The C++ compiler used here for demonstration of the programs is Turbo C++ 3.2. (You can download it from http://www.developerinsider.in/turbocpp/.)

TURBO C++ BASICS

Turbo C++ provides an Integrated Development Environment (IDE) for writing, editing, compiling, and running C++ programs. It has a text editor that works like a word processor.

Did You Know?

C++ was developed by a German computer scientist Bjarne Stroustrup at AT&T Bell Laboratories (USA). He began developing C++ in the year 1979.

Starting Turbo C++

The steps to start Turbo C++ are:

1. Double-click the shortcut icon located on the desktop. The **Turbo C++** window appears on the screen (Fig. 4.1).

2. Click **Start Turbo C++**. The **Turbo C++ IDE** screen appears (Fig. 4.2).

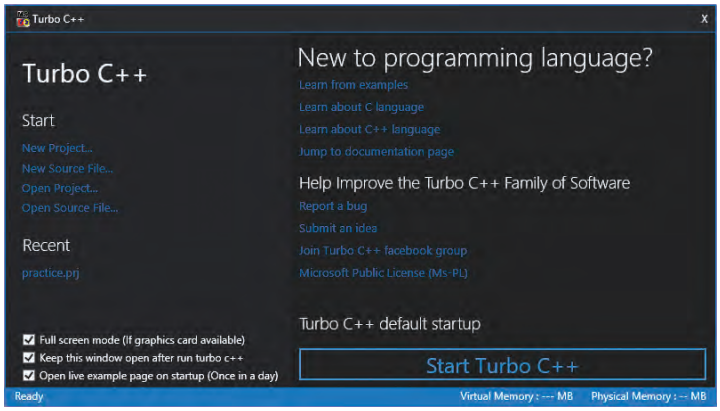

Fig. 4.1 **Turbo C++** window

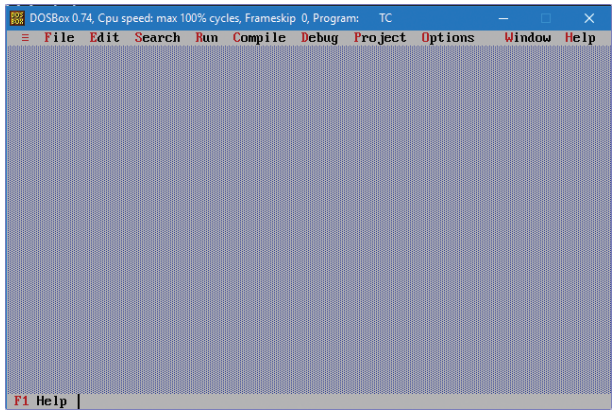

Fig. 4.2 **Turbo C++ IDE** screen

To create a new file, select **File ▶ New** (Fig. 4.3). An **Edit** window appears inside the first window (Fig. 4.4).

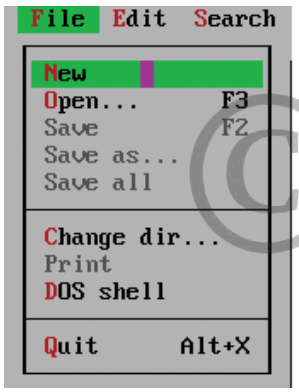

Fig. 4.3 **File** menu

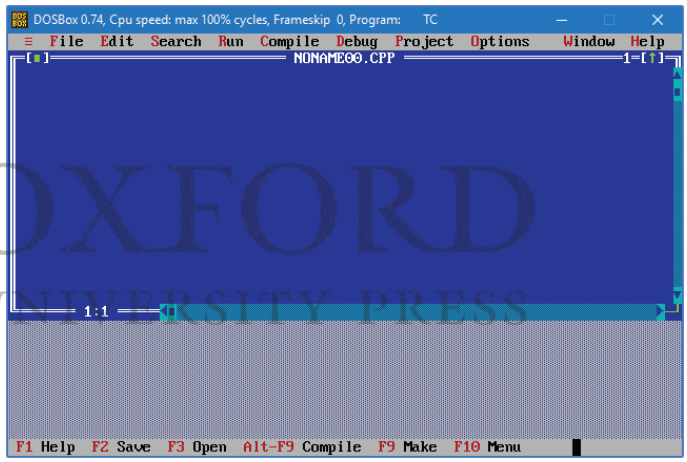

Fig. 4.4 **Edit** window

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In the **Edit** window, type the program shown in Figure 4.5. The file you create is given the name 'NONAME00.CPP' by default. It appears at the top of the **Edit** window. As you type in the program, you will notice that Turbo C++ uses different colors for different portions of the program. This automatic color-coding is called *syntax highlighting*.

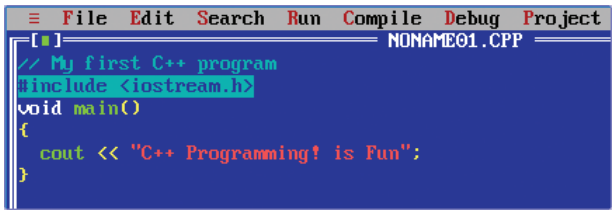

Fig. 4.5 C++ program

Saving a File

To save a program source file, follow these steps:

1. Select **File ▶ Save**.

   OR

   Select **File ▶ Save As**.

Fast Forward!

Save F2

2. The **Save File As** window appears with the **File Name** box highlighted (Fig. 4.6). The current file name NONAME00.CPP will appear in the box. Start typing the new filename (e.g., Message). The old name will be replaced. You can also specify a directory to store this file. Click **OK**.

Your program source file will be saved by the name *message.cpp*. If you do not write a file extension, the system will automatically add the file extension '.cpp' (short for C plus plus) to your file name.

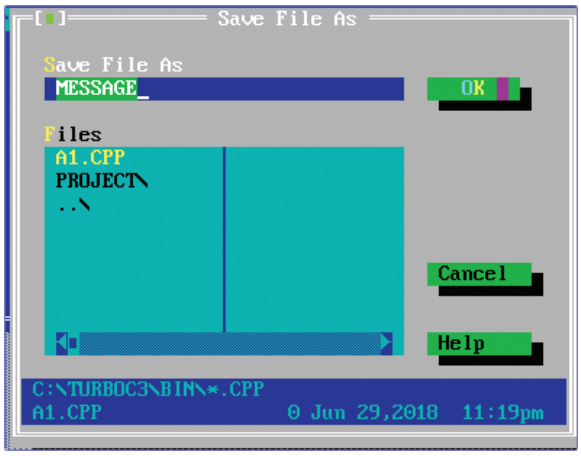

Fig. 4.6 **Save File As** window

Fast Forward!

Compile	Alt + F9
Run	Ctrl + F9

Compiling a Program

To compile a program, follow these steps:

1. Select **Compile** ▶ **Compile** (Fig. 4.7).
2. The **Compiling** screen will appear (Fig. 4.8). If your program is correct, no errors will be reported and the compilation will be successful. Press any key on the keyboard to continue.

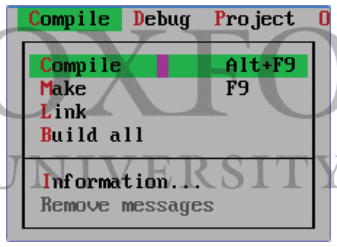

Fig. 4.7 **Compile** menu

Fig. 4.8 **Compiling** screen

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Running a Program

To run your program after compilation, select **Run** ▶ **Run** (Fig. 4.9). The program starts running and the output is displayed on the output screen (Fig. 4.10).

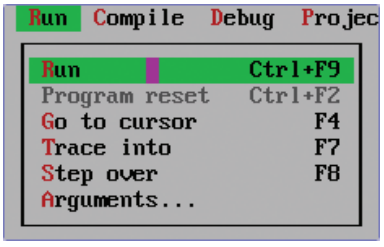

Fig. 4.9 **Run** menu

Fig. 4.10 Output screen

Note: The cursor stays in the output window until you enter the input to a program. When you press the Enter key, the cursor comes back to the **Edit** screen. If you do not have any input to the program, after execution, it comes back to **Edit** screen immediately.

Fast Forward!

To move to the output screen, select **Window** ▶ **Output**, or press Alt + F5.

To close the output window, select **Windows** ▶ **Close**.

Printing a Program

To print a program, select **File** ▶ **Print** (Fig. 4.3).

Quitting Turbo C++

To quit Turbo C++, do one of the following:

- Click the ✕ button on the top right corner of the **Turbo C++** window (Fig. 4.2).

  OR

- Select **File ▶ Quit**.

Fast Forward!

Quit	Alt + X

STRUCTURE OF A C++ PROGRAM

Often, the best way to learn a programming language is by writing programs and understanding the meaning of every statement in a program. Let us take a look at the various parts of our first program (Fig. 4.5) which printed the message 'C++ programming! is Fun' on the screen.

```
// My first C++ program
```

A line beginning with two slash signs '//' is called the *comment line*. Comment lines are used by the programmers to include short explanation within the source code for better understanding and better readability of the program. Comment lines are not translated by the compiler into machine language. The compiler simply ignores them.

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```
#include <iostream.h>
```

A line beginning with hash sign '#' is called *pre-processor directive*. It tells the pre-processor (before compilation) to include the file *iostream.h* with the source code (i.e., your C++ program). *iostream.h* is one of the many header files provided by the Turbo C++ IDE. A header file provides many necessary components (tokens and functions) of a program. *iostream.h* provides several input–output functions such as *cout*.

```
void main()
```

This line marks the beginning of the *main* function. A C++ program is nothing but the *main* function. The *main* function is the point where all other C++ functions are executed. The word *main* is always in small letters and is followed by a pair of parentheses *()*. After the parentheses, lies the body of the *main* function enclosed in a pair of curly braces { }. These curly braces contain statements that are translated by the C++ compiler into executable machine code.

```
cout << "C++ programming! is Fun";
```

This line is an executable C++ statement. It actually produces the output of the program. 'cout' represents the standard output stream in C++. It inserts a sequence of characters (e.g., 'C++ programming! is Fun') into the standard output stream (which is usually the monitor screen). 'cout' is declared in the *iostream.h* standard header file. Therefore, this header file is included in the source code at the beginning of the program through the preprocessor directive.

COMMENTS

C++ supports two styles of inserting comments in a program:

i. **Line comment:** A *line comment* starts with a pair of slash sign (//). The compiler ignores everything from the pair of slash signs (//) until the end of that line.

ii. **Block comment:** A *block comment* includes more than one line between the /* and */ characters. The compiler ignores all the statements between these characters.

Look at the program with comments given alongside.

```
/* Program in C++ with comments
spread on multiple lines */
#include <iostream.h>
void main()
{
  cout << "Hello!"; // prints Hello!
  cout << "C++ programming! is Fun"; //prints on screen
```

C++ CHARACTER SET

Every language has a well-defined set of alphabets (called character set) using which it is written. The character set of C++ using which C++ programs are written include:

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Letters	A, B, C,..., X, Y, Z, a, b, c,..., x, y, z		
Digits	0, 1, 2, ..., 9		
Special symbols			
~	Tilde sign	|	Pipe
"	Quotation mark	\	Backslash
!	Exclamation mark	{	Opening curly brace
#	Hash	}	Closing curly brace
%	Percentage	[	Opening square bracket
^	Caret	]	Closing square bracket
&	Ampersand	:	Colon
*	Asterisk	;	Semicolon
(	Opening parentheses	'	Apostrophe
)	Closing parentheses	<	Less than
_	Underscore	>	Greater than
-	Minus	,	Comma
+	Plus	.	Decimal point
=	Equal to	?	Question mark
		/	Slash

C++ TOKENS

The smallest individual units in a C++ program are known as *C++ tokens* (similar to words in natural languages such as Hindi and English). C++ tokens can be classified into the following categories: (i) Keywords, (ii) Identifiers, (iii) Constants, (iv) Operators, (v) Strings, and (vi) Special symbols such as brackets [], braces {}, parentheses (), comma (,), semicolon (;), double quotes (“ ”), and hash (#).

Keywords

Keywords are reserved words that have a predefined meaning to the language compiler. Here is the list of reserved words in C++:

asm	continue	float	new	signed	try
auto	default	for	operator	sizeof	typedef
break	delete	friend	private	static	union
case	do	goto	protected	struct	unsigned
catch	double	if	public	switch	virtual
char	else	inline	register	template	void
class	enum	int	return	this	volatile
const	extern	long	short	throw	while

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Variables and Identifiers

A *variable* is a named portion of memory used to store a value. The name of a variable is called an *identifier*. For example, *total*, *employee_name*, and *salary* are the identifiers that can be used as variable names. The following are some rules for writing an identifier:

1. A valid identifier is a sequence of one or more letters (a to z or A to Z), digits (0 to 9), or underscore ‘_’ character. Spaces, punctuation marks, and symbols cannot be used.
2. Identifiers should begin with a letter. They can also begin with an underscore ‘_’ character, but some such identifiers are reserved for compiler-specific keywords. An identifier cannot begin with a digit.
3. The rest of the characters in the identifier can be letters, underscore, or digits.
4. C++ is case sensitive. Upper-case and lower-case letters are distinct (e.g., ‘abc’,‘Abc’, and ‘ABC’ are three distinct identifiers, different from each other).
5. Keywords cannot be used as identifiers.

Table 4.1 lists some valid and invalid identifiers.

Table 4.1 Valid and Invalid Identifiers

Valid Identifiers	Reasons
Stu_Name	No violation of any rule. The identifiers are beginning with alphabet or underscore. They do not contain any special character or space. None of them are C++ reserved words.
Address1	
_EmpSalary	
Integer	
Grade	
Invalid Identifiers	**Reasons**
1Score	Cannot start with digit
int	Cannot be a reserved word
Student Name	Cannot have space
A$, #Telephone, One&Two	Special characters ($, #, &) not allowed

Data Types

Every variable must be of a given data type. The *data type* of a variable determines the kind of data that can be stored in the variable. Data types in C++ can be classified under various categories as shown below (Fig. 4.11).

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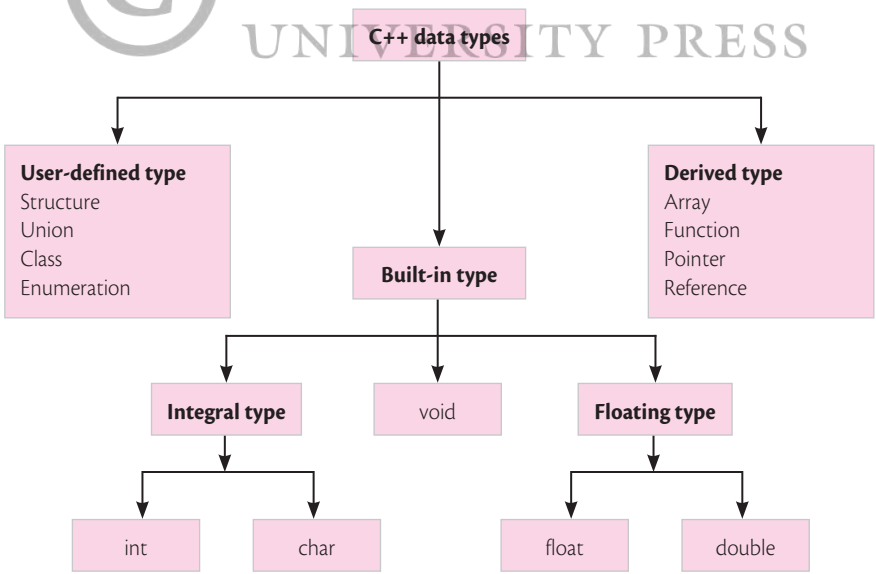

Fig. 4.11 C++ data types

In this chapter, we will discuss only *Built-in* (or *Fundamental*) *data types*.

Built-in/Fundamental Data Types

Table 4.2 shows a summary of the built-in/fundamental data types in C++ with the range of values that can be stored in each one.

Table 4.2 Fundamental data types in C++

Name	Size	Range	Description
char	1 byte	signed: –128 to 127 unsigned: 0 to 255	Character or small integer
short int	2 bytes	signed: –32768 to 32767 unsigned: 0 to 65535	Short integer
int	2 bytes	signed: –32768 to 32767 unsigned: 0 to 65535	Integer
long int	4 bytes	signed: –2147483648 to 2147483647 unsigned: 0 to 4294967295	Long integer
bool	1 byte	true or false	Boolean value
float	4 bytes	3.4e – 38 to 3.4e + 38 (7 digits)	Floating point number
double	8 bytes	1.7e – 308 to 1.7e + 308 (15 digits)	Doubles precision floating point number
long double	10 bytes	3.4e – 4932 to 1.1e + 4932 (7 digits)	Long double precision floating point number

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Declaration of Variables

You need to declare a variable before you can use it in your program.

For example, consider the code shown alongside. The first line declares a variable of type *int* with the identifier *age*. The second line declares a variable of type *float* with the identifier *amount*.

```
int age;
float amount;
```

You can declare the identifiers on separate lines, or all in a single statement by separating them with commas. Both formats are correct.

For example, both the sets of codes shown alongside declare three identifiers—*a*, *b*, and *c*—as *int* type variables.

```
int a, b, c;
```

OR

```
int a;
int b;
int c;
```

Initialization of Variables

```
int a = 50;
```

Storing a value in a variable for the first time is known as *initialization* of the variable. Initialization may be done at the time of declaration itself, as shown alongside. Here, variable *a* is not only declared, but also initialized with value *50* in one statement.

CONSTANTS/LITERALS

Constants or *literals* refer to the sequence of characters representing fixed values. For example,

```
a = 5; // Here, 5 is a constant because its value cannot be changed.
```

Constants can be classified as integer, floating-point, character, and string.

Integer Constant

Integer constant represents a whole number. The following rules apply to an integer constant:

- It consists of digits 0 to 9.
- It does not include commas and blank spaces.
- It can be preceded by a single plus (+) or minus (–) sign, if required. The absence of any sign indicates a plus sign.

For example, the following constants are valid integer constants: `1960  -653`

Floating-point Constant

Floating-point constant represents a real number, that is, a number with decimal point. The following rules apply to a floating-point constant:

- It consists of digits 0 to 9.
- It does not include commas and blank spaces.
- It can include a decimal point, an e (exponential) character, or both a decimal point and an e character.
- It can be preceded by a plus (+) or minus (–) sign, if required. The absence of any sign indicates a plus sign.

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For example, the following constants are all valid floating-point constants:

```
3.1415                          -12.0 // meaning -12.0
8.45e23 // meaning 8.45 x 10^23    1.3e-18 // meaning 1.3 x 10^-18
```

Character and String Constants

A *character constant* represents a single character enclosed within a pair of single quotes (‘ ’).

A *string constant* generally consists of more than one character enclosed within a pair of double quotes (“ ”).

For example, in the following three statements, the first expression represents a character constant; the second and third expressions represent string constants, which are composed of several characters.

```
‘s’ //This is a character
“S” //This is a string of two characters - S and a null (not visible)
“Hello!” //This is a string of 7 characters – 6 characters and a null (not
visible)
```

Escape Sequence Code

These are special non-graphical characters preceded by a backslash (\). Table 4.3 lists some escape sequence codes.

Table 4.3 Escape sequence codes

Escape sequence	Meaning	ASCII value	Escape Sequence	Meaning	ASCII value
\n	newline	010	\t	tab	009
\r	carriage return	013	\v	vertical tab	011
\b	backspace	008	\f	form (page) feed	007
\a	alert (beep)	007	\'	single quote (')	039
\"	double quote (")	034	\?	question mark (?)	063
\\	backslash (\)	092	\0	null	000

Examples:

```
'\n' // When printed the cursor moves to the next line
'\t' // When printed the cursor moves a tab space
"Respect\tYour\tElders"    // Respect    Your    Elders
"Love\nyour\ncountry"      /* Love
                           your
                           country */
```

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Defining Constants

You can also declare a constant with the *const* keyword. For example, consider the code written alongside. Here, *height* and *tab* are two constants declared as *int* and *char* type, respectively. They act like variables except that their values cannot be modified within the program.

```
const int length = 34;
const char tab = '\t';
```

STANDARD I/O STREAM OBJECTS

Standard Output (cout)

The standard output device refers usually to the monitor screen and the corresponding standard C++ output object defined is *cout*. The operator << (two 'less than' signs without any space) is known as the *insertion operator*.

Examples:

```
cout << "Name"; // prints Name on screen
cout << 24; // prints number 24 on screen
cout << a; // prints the value of variable a on the screen
```

The insertion operator (<<) 'inserts' the data that follows it onto the screen. In the example codes above, it inserts the constant string *Name*, the numerical constant *24*, and the value stored in the variable **a** into the standard output stream *cout*.

Notice that the word *Name* in the first insertion is enclosed in double quotes because it is a string constant. Consider the following C++ statements:

```
cout <<"Salary"; // prints Salary
cout << Salary; // prints the content of Salary variable
```

The first statement prints the word *Salary* on the screen and the second statement prints the value of the variable *Salary* on the screen.

The insertion operator (<<) may be used more than once in a single statement. For example:
`cout << "Hello!, "<< "How are you?";`

This statement prints the message *Hello!, How are you?* on the screen.

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If you want to print the constants and variables in the *cout* statement, consider the following C++ code where the value of variable *Name* is Nishant: `cout << "My name is " << Name;`

The output of the statement will be: My name is Nishant

It is important to note that *cout* does not add a line break unless we explicitly do so. Consider the following code where two output statements are used:

```
cout << "First statement.";
cout << "Second statement.";
```

The output of the statements will be: `First statement. Second statement.`

The output does not show a line break because it is not mentioned explicitly. The newline character *\n* is used for line break in the output. Consider the following code and the output shown alongside:

```
cout << "First statement. \n";
cout << "Second statement. \nThird statement.";
```

```
First statement.
Second statement.
Third statement.
```

Alternatively, you can add a new line using the *endl* manipulator, also. The following code and its output shows the use of *endl*.

```
cout << "First statement." << endl;
cout << "Second statement.";
```

```
First statement.
Second statement.
```

Standard Input (cin)

The standard input device is usually the keyboard and the standard C++ input object defined is *cin*. The operator >> (two 'greater than' signs) is known as the extraction or *get from* operator. It takes the value from the keyboard and assigns it to the variable on the right.

For example, consider the code shown alongside. The first statement declares a variable *amount* of type *int* and the second statement waits for an input from *cin* (the keyboard) to store it in this integer variable. After entering the value from the keyboard, the user must press the Enter key.

```
int amount;
cin >> amount;
```

You can use *cin* to get more than one number of data from the user. For example, consider the codes shown alongside.

```
cin >> num1 >> num2;
```

```
cin >> num1;
cin >> num2;
```

Both the codes are equivalent. In both cases, the user must provide two data items, one for variable *num1* and another for variable *num2*. The input values may be separated by a space, a tab character, or a newline.

C++ OPERATORS

An *operator* is a symbol that works on one or more variables and/or constants or both to produce a new value. The variables and constants on which operators' work are called *operands*. Operators and operands together form an *expression*.

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Operators that require only one operand are called *unary operators* while the ones that require two operands are called *binary operators*. The operators in C++ can be classified into arithmetic operators, relational operators, logical operators, assignment operators, increment and decrement operators, and conditional operator.

Arithmetic Operators (+, -, *, /, %)

Arithmetic operators are called binary operators as they require two operands. Table 4.4 lists the five arithmetic operators used in C++.

Following rules must be noted:

- If any one of the operands is a real number, the result will also be real.
- Modulus operation gives remainder, therefore, it requires an integer value; with a non-integer operand, it will generate an error.

Table 4.4 Arithmetic operators in C++

Operators	Meaning	Example	Output
+	Addition	10 + 2 5.6 + 4	12 9.6
-	Subtraction	12 - 4 6.7 - 3	8 3.7
*	Multiplication	8 * 5 4.9 * 2	40 9.8
/	Division	13 / 3 14. 8 / 4	4 3.7
%	Modulus	23 % 5	3

Relational Operators (==, !=, >, <, >=, <=)

Relational operators are used to compare two expressions. The result of a relational operation is a Boolean value (either *true* or *false*). Table 4.5 lists the relational operators used in C++.

Table 4.5 Relational operators used in C++

Relational Operator	Meaning	Example	Output
==	Equal to	15==12	0
!=	Not equal to	84 != 23	1
>	Greater than	12 > 9	1
<	Less than	10 < 8	0
>=	Greater than or equal to	34 >= 30	1
<=	Less than or equal to	12 < 16	1

Logical Operators (!, &&, | |)

C++ language supports three logical operators: ! (NOT), && (AND), and ||(OR). They are used with one or more relational expressions and result in either *true* or *false*. These operators are evaluated in the order !, &&, and then ||. Table 4.6 shows their use with examples.

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Table 4.6 Logical operators used in C++

Logical operators	Meaning	Example	Output
&&	*True* if both its conditions are *true*, and *false* otherwise	(7 = = 7) && (12 > 15) (23 >= 15) && (13 != 25)	0 1
||	*True* if either one of its two conditions are *true*, and *false* otherwise	(12 = = 12) || (13 > 16) (54 >= 55) || (8 = = 10)	1 0
!	*False* if condition is *true*, and *true* if its condition is *false*.	!(10 == 10) !(9 <= 5) ! ((8 = = 8) && (5 > 9)) !((8 = = 7) || (19 > 12))	0 1 1 0

Assignment Operator (=)

The assignment operator (=) is used to assign (store) a value to a variable. For example:

A= 5;	It assigns the value 5 to the variable A.
A = B;	It assigns the value of variable B to variable A. The value stored in variable A previously, if any, is lost.
A = C * 2	It assigns the value of variable C multiplied with 2 to variable A.

It should be noted that the = operator (one equal sign) is different from the operator == (two equal signs). The first one is an assignment operator, that is it assigns the value present at its right to the variable on its left. The other one (==) is an equality operator that compares if the two expressions on its either side are equal to each other, resulting in either *true* or *false*.

Compound Assignment Operators (+=, -=, *=, /=, %=)

Compound assignment operators are used to perform operations with the value currently stored in a variable and store the new value in the same variable.

Expression	Is equivalent to
amount += 10	amount = amount + 10;
age -= 5	age = age – 5;
num1 /= 10	num1 = num1 / 10
price *= qty + 10;	price = price * (qty + 10);
number %= 3	number = number % 3;

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Increment and Decrement Operators (++,- -)

The increment and decrement operators are unary operators as they require only one operand. The increment operator (++) increases the value stored in a variable by one, whereas the decrement operator (--) decreases the value stored in a variable by one.

The three statements listed alongside are all equivalent to each other; they increase the value of variable *a* by one.

```
a++;
a += 1;
a = a + 1;
```

The increment and decrement operators can be used as a prefix (before the operand) or a suffix (after the operand). Thus, increment and decrement operators can be written as:

a++; or ++a; both being equivalent to a = a + 1;

a--; or --a; both being equivalent to a = a – 1;

Pre-increment or **pre-decrement** (++a or --a) operators first carry out the increment/ decrement operation and then deliver the new value.

Post-increment or **post-decrement** (a++ or a--) operators first deliver the value and then carry out the increment /decrement operation.

Let us understand the concept by considering some examples.

Example 1
`int A, B;`
`A = 10;`
`B = A++;`
`cout << "A = " << A << "B = " << B <<endl;`
	The initial value of variable A is 10. It first assigns the value to variable B and then increments itself to 11.
	It displays: A = 11 B = 10.

Example 2
`int A, B;`
`A = 10;`
`B = ++A;`
`cout << "A = " << A << "B = " << B <<endl;`
	The initial value of variable A is 10. It first increments its value to 11 and then assigns to variable B.
	It displays: A = 11 B = 11.

Example 3
`int A, B;`
`A = 10;`
`B = A--;`
`cout << "A = " << A << "B = " << B <<endl;`
	The initial value of variable A is 10. It first assigns its value to variable B and then decrements itself to 9.
	It displays: A = 9 B = 10.

Example 4
`int A, B;`
`A = 10;`
`B = --A;`
`cout << "A = " << A << "B = " << B <<endl;`
	The initial value of variable A is 10. It first decrements its value to 9 and then assigns to variable B.
	It displays: A = 9 B = 9.

Example 5
`int A, B;`
`A = 10;`
`B = ++A + 5;`
`cout << "A = " << A << "B = " << B <<endl;`
	The initial value of variable A is10. It first increments its value to 11, adds 5 to it, and then assigns to variable B.
	It displays: A = 11 B = 16.

Example 6
`int A, B;`
`A = 10;`
`B = A-- * 5;`
`cout << "A = " << A << "B = " << B <<endl;`
	The initial value of variable A is 10. It multiplies with 5 and then assign to variable B. After that, it decrements its value to 9.
	It displays: A = 9 B = 50

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Conditional Operator (?:)

The conditional operator (?:) evaluates a conditional expression. If the expression evaluated is *true* the value placed just after ? mark is returned. If the expression is found to be *false* then the value following : mark is returned. Thus, in the following code:

```
condition ? result1 : result2
```

if *condition* is *true*, the expression will return *result1* and if *condition* is *false*, it will return *result2*. Consider the following examples of C++ statements:

Expression	Output
`(8 = = 10) ? 5 : 10`	10
`(a > b) ? a : b`	Whichever is greater a or b

ARITHMETIC EXPRESSIONS

Arithmetic expressions are the expressions that produce a numerical value after execution. Table 4.7 shows how arithmetic expressions are written in C++.

Table 4.7 Arithmetic expressions in C++

Algebraic Expression	C++ Expression
a = b x c	a = b *c
$a^2 + b^2 + c^2$	a*a + b*b + c*c
ab/d	(a*b)/d

PRECEDENCE OF OPERATORS

An expression may contain more than one operators. Which operator will be executed first is governed by the *precedence order* of the operators. Highest precedence operator is executed first. Recall, how BODMAS (Bracket, Off, Division, Multiplication, Addition, and Subtraction) is used in evaluating an arithmetic expression in Mathematics. C++ operators are executed in the following order (parentheses first, subtraction last):

1. parentheses ()
2. unary operators (+, -)
3. multiplication (*), division (/), modulus (%)
4. addition (+), subtraction (-)

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Note: There is no symbol of exponent in C++. The function pow() is used for this purpose.

The expression is solved from left to right. In case of equal precedence, the operator that appears first is solved first. Consider the following examples:

1. Evaluate the expression: `10 + 12 % 4 - (5 * 3) + 11 - 2`

	Expression	Highest Precedence
	10 + 12 % 4 – (5 * 3) + 11 – 2	Parentheses
=	10 + 12 % 4 – 15 + 11 – 2	Modulus
=	10 + 0 – 15 + 11 – 2	Addition (Left)
=	10 – 15 + 11 – 2	Subtraction (Left)
=	–5 + 11 – 2	Addition
=	6 – 2	Subtraction
=	4	

2. Execute the following statement and evaluate the expression:

```
int a, b = 5, c = 10
a = b / 2 * (c - 2) + 8 % 5 / 2
```

	Expression	Highest Precedence
a =	b / 2 * (c – 2) + 8 % 5 / 2	
=	5 / 2 * (10 – 2) + 8 % 5 / 2	Replacing variables with the value stored in it
=	5 / 2 * 8 + 8 % 5 / 2	Parentheses
=	2 * 8 + 8 % 5 / 2	Division
=	16 + 8 % 5 / 2	Multiplication
=	16 + 3 / 2	Modulus
=	16 + 1	Division
=	17	Addition

Practice Time

Priya wants to write a program to input marks in three subjects out of 100, and calculate and display the total marks and percentage. How should she do this task?

SOLUTION

1. Open Turbo C++ edit window.
2. Select **File** ▶ **New** to open a new window.
3. Type the programming code shown in the Figure A.
4. Select **File** ▶ **Save As** to open the **Save As** dialog box. Type the file name as *pt1.cpp* and click **OK**.
5. Select **Compile** ▶ **Compile** to compile the code.
6. Select **Run** ▶ **Run** to run the code. The output window appears. Enter the marks in three subjects.
7. Select **Alt** + **F5** or **Window** ▶ **Output** to open the output window as shown in Figure B.

```
PT1.CPP
#include <iostream.h>
#include <conio.h>
void main()
{
 float marks1, marks2, marks3, total, percentage;
 cout << "Enter the marks in three subjects ";
 cin >> marks1 >> marks2 >> marks3;
 total = marks1 + marks2 + marks3;
 percentage = total * 100 / 300;
 cout << "Total = " << total << endl;
 cout << "Percentage = " << percentage;
}
```

Fig. A Program code

```
File  Edit  Search  Run  Compile  Debug
Output
Enter the marks in three subjects 78 56 69
Total = 203
Percentage = 67.666664_
```

Fig. B Output

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PROGRAM EXAMPLES

EXAMPLE 1: A grocery store announces a discount of 7.5% on all the items in the store. Write a program to input the purchase amount, and calculate and display the discounted amount and the amount to be paid (net amount).

SOLUTION: Look at the program given in Figure 4.12(a).

Explanation: The input is stored in a variable *amount*. Discount is 7.5 which is stored in a variable discount. Then, the discounted *amount* is calculated in a variable *disc_amount*. The net amount, i.e., the amount to be paid is calculated and stored in a variable *net_amount*. The output of the program is shown in Figure 4.12(b).

EXAMPLE 2: Write a C++ program to input a dividend and divisor, and calculate and display the quotient and remainder.

Solution: Look at the program given in Figure 4.13(a).

Explanation: The user enters two numbers which are stored in variables *a* and *b*. The quotient and remainder are calculated using arithmetic operators / and %. The value stored in variables *quotient* and *remainder* are displayed on the screen. The output of the program is shown in Figure 4.13(b).

EXAMPLE 3. Write a C++ program to input the base and height of a triangle, and calculate and display the area of a triangle as ½ bh.

SOLUTION: Look at the program given in Figure 4.14(a).

Explanation: The user enters the base and height of a triangle. It calculates the area of a triangle and stores it in a variable *area*. The value of *area* is displayed on the screen with a message.

The output of the program is shown in Figure 4.14(b).

```
EXAMPLE1.CPP
#include <iostream.h>
void main()
{
  float amount, discount, disc_amount, net_amount;
  cout << "Enter the purchase amount ";
  cin >> amount;
  discount = 7.5;
  disc_amount = amount * discount / 100;
  net_amount = amount - disc_amount;
  cout << "Discount " << disc_amount << endl;
  cout << "Amount to be paid " << net_amount;
}
```

(a) Program

```
DOSBox 0.74, Cpu speed: max 100% cycles, Frameski
Enter the purchase amount 12000
Discount 900
Amount to be paid 11100
```

(b) Output

Fig. 4.12 Program and output for Example 1

```
EXAMPLE2.CPP
#include <iostream.h>
void main()
{
 int a, b, quotient, remainder;
 cout << "Enter two numbers";
 cin >> a >> b;
 quotient = a / b;
 remainder = a % b;
 cout << "Quotient = " << quotient << endl;
 cout << "Remainder = " << remainder;
}
```

(a) Program

```
DOSBox 0.74, Cpu speed: max 100%
Enter two numbers 34 14
Quotient = 2
Remainder = 6
```

(b) Output

Fig. 4.13 Program and output for Example 2

```
EXAMPLE3.CPP
#include <iostream.h>
void main()
{
 float base, height, area;
 cout << "Enter the base of a triangle";
 cin >> base;
 cout << "Enter the height of a triangle";
 cin >> height;
 area = float(1)/2 * base * height;
 cout << "Area of a triangle = " << area << endl;
}
```

(a) Program

```
Enter the base of a triangle 9.8
Enter the height of a triangle 7.6
Area of a triangle = 37.240002
```

(b) Output

Fig. 4.14 Program and output for Example 3

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EXAMPLE 4: Write a C++ program to accept a number and display whether it is divisible by 2 and 3 or not.

SOLUTION: Look at the program given in Figure 4.15(a).

Explanation: The user enters the number. The divisibility of the number is checked by modulus operator. The *and* operator is used. If both conditions are *true*, it is *true* otherwise *false*. The conditional operator checks the result. If it is *true*, it executes the statement after ?, otherwise it executes the statement after :. The output of the program is shown in Figure 4.15(b).

```
EXAMPLE4.CPP
#include <iostream.h>
void main()
{
 int n;
 cout << "Enter the number ";
 cin >> n;
 (n % 2 == 0 && n % 3 == 0) ? cout << "Divisible" : cout << "Not divisible";
 cout <<" by 2 and 3" << endl;
}
```

(a) Program

```
Enter the number 60
Divisible by 2 and 3
```

```
Enter the number 45
Not divisible by 2 and 3
```

(b) Output

Fig. 4.15 Program and outputs for Example 4

EXAMPLE 5. Write a C++ program to accept two numbers and display the smallest number.

SOLUTION: Look at the program given in Figure 4.16(a).

Explanation: The user enters two numbers which are stored in variable *num1* and *num2*. The conditional operator checks the condition and stores the smaller value in a variable *small*. It displays the value stored in the variable *small* with a message. The output of the program is shown in Figure 4.16(b).

```
EXAMPLE5.CPP
#include <iostream.h>
void main()
{
 int num1, num2, small;
 cout << "Enter two numbers  ";
 cin >> num1 >> num2;
 small = (num1 < num2) ? num1 : num2;
 cout << "Smaller number is " << small;
}
```

(a) Program

```
Enter two numbers  34 65
Smaller number is 34
```

(b) Output

Fig. 4.16 Program and output for Example 5

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Practice Time

Rashid wants to write a program to input the length and breadth of a rectangle, and calculate and display its area and perimeter. How should he do this task?

SOLUTION

1. Open Turbo C++ edit window.
2. Select **File ▶ New** to open a new window.
3. Type the program shown in the Figure A.
4. Select **File ▶ Save As** to open the **Save As** dialog box. Type the file name as *pt2.cpp* and click **OK**.

```
PT2.CPP
#include <iostream.h>
#include <conio.h>
void main()
{
 float length, breadth, area, perimeter;
 cout << "Enter the Length and Breadth of a rectangle ";
 cin >> length >> breadth;
 area = length * breadth;
 perimeter = 2 * (length + breadth);
 cout << "Perimeter = " << perimeter << endl;
 cout << "Area = " << area;
}
```

Fig. A Program code

5. Select **Compile** ▶ **Compile** to compile the code.
6. Select **Run** ▶ **Run** to run the code. The output window appears. Enter the length and breadth.
7. Select **Alt** + **F5** or **Window** ▶ **Output** to open the output window as shown in Figure B.

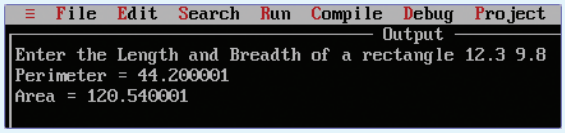

Fig. B Output

Tricky Terms

Syntax highlighting A feature of Turbo C++ that uses different colors to display different portions of a program

Comment Short explanation within the source code for better understanding

Tokens Smallest individual units in C++ program

Keywords Reserved words that have predefined meaning to the compiler

Variable A named portion of memory used to store a value

Identifier Name of a variable

Constants Fixed values that do not change during the execution of a program

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Memory Bytes

- The `cout` statement is used to get the output on the screen. It is used with the insertion operator <<.
- C++ supports two types of comments—line comment and block comment.
- All lines beginning with two slash signs '//' are considered comment lines . Comment lines are not translated by the compiler and are used by programmers to include short explanations within the source code.
- A line beginning with a hash sign '#' is called pre-processor directive.
- 'void main()' marks the beginning of the main function.
- The `cin` statement is used to get user input through the keyboard. It is used with the extraction operator >>.
- The five arithmetic operators supported by C++ are +, -, *, /, and %.
- An assignment operator assigns a value to a variable.
- C++ supports operators ++ and -- for incrementing and decrementing the integral and floating-point values.

Exercises

Objective Type Questions

1. Fill in the blanks with the correct words.

:	#	%	Logical	Relational

a. &&, ||, ! are the examples of ..... operators.

b. In a conditional operator, statement after ..... is executed if the condition is *false*.

c. A line beginning with ..... is called a pre-processor directive.

d. The ..... operator can work with integer numbers. With a non-integer opearnd, it will generate an error.

e. The == is a ..... operator.

2. Write T for the true statement and F for the false one.

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a. Each C++ statement is terminated by comma.

b. A multi-line comment should be enclosed in /* .... */

c. Emp-Name is a valid variable.

d. The statement A+=10 means the value of A is previous value plus 10.

e. The expression 4.5 % 5 will result in 0.9.

3. Choose the correct option.

a. A single line comment in C++ begin with

i. / ii. //

iii. : iv. ;

b. What is the output of the expression 12 + 8 * 3?

i. 36 ii. 60

iii. 40 iv. 12

c. Which of the following expressions can be used to increase the value of A by 1?

i. A++ ii. A+= 1

iii. ++A iv. All of these

d. A compound statement is enclosed in

i. ( )
ii. [ ]
iii. { }
iv. “ “

e. Which of the following is not a C++ data type?

i. int
ii. float
iii. INT
iv. Char

Descriptive Type Questions

1. What is comment in C++ program? What are the two types of comments? Give one example of each.
2. What are C++ tokens? How are they classified?
3. What are the rules for naming a variable?
4. What is an escape sequence? Give any two examples.
5. What is an operator? How are operators classified? Give one example of each category.

APPLICATION BASED QUESTIONS

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1. Aanya's teacher has asked her to write a C++ statement to display each word of the sentence "Just Believe in yourself" using a single cout statement. Write the required C++ statement.

2. Robin has assigned the data type to three variables a, b, c as follows:

```
int a;
int b;
int c;
```

Write another way of doing the same task.

3. Himanshu, has written the following statement to increase the value of variable A by 10.

```
A = 5
A = A + 10
```

Write another statement to do the same task.

4. Drishti has written the following statement? What will be its output?

```
int A = 10, B = 20;
C = A > 5 && B !=10 ;
D = B < 10 || A == 5;
cout << "C = " << C << "D = " << D;
```

5. Vidya has written the following statements for a C++ program. Will they give the same output?

i. `A = 20; ++A; cout << A;`

ii. `A = 20; A++; cout << A;`

IN THE LAB

1. Write a C++ program to input two numbers and display its sum, difference, multiplication, division, and remainder with an appropriate message.
2. Write a C++ program to input the three sides of a triangle and display whether it forms a right-angled triangle. (Note. if $a^2 + b^2 = c^2$, it forms a right-angled triangle. It is also called as Pythagoras theorem.)
3. Write a C++ program to input the side a of a cube, calculate and display its volume and surface area. (Note. Volume = a^3, Surface area = $6a^2$)
4. Write a C++ program to input the principal amount (P), rate of interest (R) and time in years (T), calculate and display the simple interest S as PRT/100.
5. An aptitude test was held in a school. It had three papers—Analytical, Logical, and General Knowledge. Each part was of 50 marks. The total marks obtained by a student is calculated according to the following weightage: 40% of Analytical + 30% of Logical + 30% of General Knowledge. Write a C++ program to input the marks obtained in the three parts (each out of 50), calculate, and display the total marks of a student, with an appropriate message.

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Teacher's Notes

- Demonstrate how to dry run a program. Dry run refers to checking the flow of the program on paper with a hypothetical set of input values.
- Demonstrate the working of Turbo C++ compiler.
- The concept of data types should be explained with examples.
- A presentation could be made to explain *cout* and *cin* statements.
- Make the students familiar with the general syntax of C++ program.
- Demonstrate the concept of different types of operators with examples.