

COURSE ON COMPUTER CONCEPTS

Based on the latest CCC syllabus by NIELIT

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*I dedicate this book to my family and my uncle, Mr B.L. Theraja,
who is a well-known author*

Oxford University Press

Preface

Computers are devices used to store, retrieve, transmit, and manipulate data. Today computers are used in almost every field, starting from education, medical, banking, construction, communication to defence, transportation, sports, manufacturing, marketing, etc. The list is literally unending. In a world driven by information technology (IT), it is difficult to fathom a field that does not make use of computers!

Information technology has revolutionized our lifestyle. In India, computers are now a part of millions of households. The use of computers has become so widespread that almost every electrical and electronic device (such as a washing machine or an air conditioner) has a small embedded computer within it. Even the mobile phones that we use are smartphones (phones with computing technology) that are connected to the Internet. Online banking and shopping are being preferred. Employees can work from home to save time commuting to their offices. Various digital financial devices (such as ATMs, PoS devices, etc.), services, and schemes (like Internet banking, mobile banking, Pradhan Mantri Jan Dhan Yojana, National Pension Scheme, etc.) have facilitated people residing across different countries, cities as well as remote areas get an easy access to their money and bank accounts, and help them save and appropriately invest their earnings.

Therefore, in today's scenario learning computers is not just a prerogative of students pursuing a career in engineering and technology; it is a must for everyone. Computing skills help one to be more productive and efficient. Therefore, a basic knowledge of computers and its technology will definitely pay rich dividends in the future.

About the Book

The book has been specifically designed as per the latest syllabus (2016) of Course on Computer Concepts (CCC) prescribed by NIELIT (formerly DOEACC). The book can be used by any common man who wants to become an IT literate.

The objective of the book is to help students learn the basics and applications of computers (such as organization, architecture, input output devices, and memory of computer), operating systems, computer networks, Internet, and web browsers. It makes the readers aware of the various digital financial services implemented by Government of India. The book also offers a hands-on experience of MS Word, MS Excel, MS PowerPoint, e-mails, and the World Wide Web (WWW). Thus, the book will make the readers proficient in using the computer for basic purposes such as documenting information, preparing letters, viewing information on

internet (the web), receiving and sending mails, preparing presentations, etc.


Key Features of the Book

One-to-one Mapping with Syllabus: The content of each chapter of the book completely conforms to the CCC syllabus designed by NIELIT.

Comprehensive Coverage: The book provides comprehensive coverage of important topics ranging from basic computers to advanced and recent technologies (i.e., digital financial services).

Pictorial Approach: Numerous well-labelled diagrams and screenshots are provided throughout the text for clear understanding of the concepts.

Practical Orientation: Several lab activities, examples, and chapter-end exercises in the form of objective-type (with answers) and practical questions are provided to enable students self-test and learn the implementation of concepts. Solutions to select lab exercises are provided on the


accompanying website of the book (*indicated with*  *in the text*).

Notes: Important concepts and tips are interspersed throughout the text for a quick recap.

Glossary and Summary: A point-wise summary and a list of key terms are provided at the end of each chapter to facilitate quick revision of important topics learnt.

List of Shortcut Keys: A list of shortcut keys used in MS Word, Excel, and PowerPoint are given for easy reference.

Lab Activities and Exercises: The book has interesting in-text lab activities and chapter-end lab exercises based on MS Office, MS Internet Explorer, Mozilla Firefox, Gmail, and Windows 7.

Solved and Unsolved Question Papers: 8 solved and 5 unsolved model questions papers have been incorporated in the book. Each question paper contains a set of 100 questions. Answers to the unsolved question papers are provided on the accompanying website of the book (*indicated with*  *in the text*).

Organization of the Book

The book contains eight chapters. A detailed organization of the book is presented here.

Chapter 1 starts with an introduction to computer, discussing its characteristics, applications, and components such as CPU, I/O devices, and memory. The chapter then highlights the differences between hardware and software (both system as well as application). Representing data in computer systems, concepts of data processing, and applications of IECT are also discussed in this chapter. An *annexure* including a lab session on exploring the various parts of a computer is given at the end of this chapter.

Chapter 2 discusses the basics of operating systems, user interfaces, and system settings. It also deals with some popular operating systems such as Windows and Linux. File and directory management is also included in this chapter.

Chapter 3 gives a hands-on experience on working with MS Word 2010, the word processing software. It begins with the basics of the MS Word window and then discusses the simple tasks such as opening, closing, saving, and printing documents performed by the software. It then explains creating, editing, formatting, manipulating, aligning, indenting, and bulleting text using MS Word. The chapter also discusses inserting header and footer, working with tables, and merging mails in a Word document.

Chapter 4 helps the reader to work with spreadsheets, MS Excel 2010. It begins with opening, closing, saving, and printing Excel sheets followed by discussions on entering and editing data and manipulating the size of rows and columns. Using various functions and formulas, working on charts, and application of macros are covered in detail in the chapter.

Chapter 5 elucidates the fundamental concepts of computer networks and the architecture and protocols of the Internet. It details the services provided on the Internet and the different techniques of accessing them (including ISP, broadband, dial-up, and WiFi connections). The chapter then discusses configuring web browsing software (such as MS Internet Explorer and Mozilla Firefox), using the search engines, and managing favorites.

Chapter 6 starts with the basics of e-mail, configuring e-mail client (such as MS Outlook 2010 and Gmail), creating an e-mail account, using it to store, forward, and reply to the senders. It also discusses advanced features such as using spell check, sending attachments, managing address book, adding emoticons, and handling spam messages.

Chapter 7 gives a practical exposure on developing attractive presentations using MS PowerPoint 2010. The chapter starts with creating a blank presentation, and saving and printing it. It then teaches how to insert text, pictures, movie, sound, and headers and footers in the slides. The chapter also discusses running slide shows, adding transitions and animations, using rehearse timings, and other advanced features that are widely used in real-world presentations these days.

Chapter 8 is all about application of digital financial services and discusses the need of saving and the drawbacks of keeping cash at home. It also highlights the importance of banks, different products, services (esp. online), and accounts offered by them to their customers. The chapter also details the

need for insurance and different types of schemes launched by the Government of India to ensure financial security to the masses. Latest trends in banking such as mobile wallets and mobile banking are also covered in this chapter.

Answers to chapter-end objective-type questions followed by *model question papers* are given at the end of the book.

Online Resources

To aid the faculty and the students using this text, the following resources are made available on the companion website at india.oup.com/orcs/9780199469390.

For Faculty

- Chapter-wise PPTs

For Students

- Test generator
- Answers to unsolved question papers given in the book
- Solutions to select laboratory exercises

Acknowledgements

The writing of this textbook was a mammoth task for which a lot of help was required from many people. Fortunately, I have had wholehearted support of my family, friends, and fellow members of the teaching staff and students at Shyama Prasad Mukherji College, New Delhi.

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Comments and suggestions for the improvement of the book are welcome. Please send them to me at reemathareja@gmail.com.

Reema Thareja

Syllabus

Let us explore the curriculum for Course on Computer Concepts (CCC) by NIELIT.

Aim of the Course

The aim of this course is to make the beginner-level students proficient in handling computers required for professional as well as day-to-day needs. The course is designed to provide a detailed theoretical background as well as practical knowledge of software/packages. After completing the course, the students will be digitally literate and will be able to:

- acquire confidence in using the available computer techniques;
- recognize the basic components of computers and terminology;
- learn the utility of operating systems;
- understand data, information and file management;
- create documents using Word Processor, Spreadsheet and Presentation software;
- understand computer networks, and browse the internet, content search, e-mail and collaborate with peers;
- use e-governance applications and use computer to improve existing skills and learn new skills;
- use internet for digital financial services.

The module on financial literacy, a new addition in the revised CCC syllabus (2016), will enable the individuals to understand the various financial services and be aware of the various schemes implemented by Government of India.

Course Duration

The course is to be completed in 80 hours including theory session for 25 hrs, practical session for 50 hrs, and tutorial for 5 hrs. This course can also be offered as 10-day full-time intensive course.

Course Contents and Allocation of Time for Each Module

The course contains 8 modules as listed in the table. Each module is accompanied with theory and practical sessions. Wherever required, tutorials are also provided. The time allocated for each module is also mentioned in the table.

SYLLABUS OUTLINE

S. No.	Chapter/Module	Theory Hours	Tutorial Hours	Practical Hours
1.	Introduction to Computer	2	1	4
2.	Introduction to GUI Based Operating System	3	-	8
3.	Elements of Word Processing	3.5	2	9
4.	Spreadsheets	3.5	2	10
5.	Introduction to Internet, WWW and Web Browsers	6	-	8
6.	Communication and Collaboration	2	-	2
7.	Application of Presentations	4	-	8
8.	Application of Digital Financial Services	1	-	1
Total Hours		25	5	50

The Book Contents vs The CCC Syllabus The book covers the CCC syllabus completely. The arrangement of the chapters in this book exactly matches the sequence of modules given under the CCC syllabus.

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Important Shortcut Keys

MS WORD 2010

Shortcut Keys	Usage
Ctrl + Shift + A	To convert the characters of the selected text into capital letters or vice versa
Ctrl + Shift + F	To open the Font dialog box
Ctrl + Shift + G	To open the Word Count dialog box
Ctrl + Shift + S	To open the Apply Styles task pane
Alt + R	To activate the Review tab
Alt + Ctrl + 1	To apply heading 1; Alt + Ctrl + 2 to apply heading 2; so on and so forth
Ctrl + Shift + I	To apply bullets
Ctrl + Shift + F5	To bookmark a page
Ctrl + B	To make the selected text bold
Ctrl + I	To italicize the selected text
Ctrl + U	To underline the selected text
Ctrl + Page Down	To go to the next page
Ctrl + E	To centre align the paragraph
Alt + Shift + F7	To open the dictionary
Ctrl + End	To move to the end of document
End	To move to the end of line
Ctrl + Shift + P	To select font size
Ctrl + Shift + .	To increase font size
Ctrl + K	To insert hyperlink
Ctrl + M	To apply indentation
Ctrl + J	To justify the paragraph
Ctrl + H	To replace
Ctrl + P	To print the document or pages in the document
Alt + Shift + Backspace	To redo
F12	To Save As
Ctrl + Shift + K	To convert the characters of the selected text into lower case or vice versa
Ctrl + Shift + M	To remove indent from the selected text

MS EXCEL 2010

Shortcut Keys	Usage
Tab	To move one cell to the right
Shift + Tab	To move to the previous cell
Ctrl + Tab	To switch to the next tab in the dialog box
Ctrl + Shift + Tab	To switch to the previous tab in the dialog box
Ctrl + 1	To open the Format Cells dialog box
Ctrl + Shift + L	To turn the filters on and off
Ctrl + Arrow keys	To select a group of cells
Alt + ES – Paste Special > Values	To use the Paste Special feature
F4	To repeat the last command or action
F2	To edit a cell or formula
Ctrl + K	To add hyperlink to link the pages to one another so that the sheets are accessible on a single click of the hyperlink
Ctrl + T	To insert a table in the worksheet
Ctrl + S	To save the sheet
Ctrl + W	To close a particular workbook
Ctrl + Page Down/Page Up	To navigate to sheets within the workbook
Ctrl + Shift + 1	To apply number format for two decimal places, thousands separator, and minus sign (-) for negative values
Alt F11	To open VBA editor
Ctrl F6	To switch to the next workbook window
Ctrl + Space bar	To select a particular column
Shift + Space bar	To select a particular row
Ctrl + Shift + Space bar	To select the entire sheet
ALT + =	To perform auto sum for a column
Ctrl + Shift + &	To apply outline border to the selected cell(s)

MS POWERPOINT 2010

Shortcut Keys	Usage	Shortcut Keys	Usage
Ctrl + M	To insert a new slide	Ctrl + H	To hide the pointer or pen
Ctrl + D	To duplicate the current side	Tab	To navigate to the next hyperlink
Ctrl + Shift + >	To increase font size	S	To stop or restart an automatic show
Ctrl + Shift + <	To decrease font size	1 + Enter	To return to the first slide
Ctrl + T	To open the Font dialog box	Slide number + Enter	To go to a particular slide number during presentation
Shift + F3	To change case	Ctrl + K	To insert hyperlink
Alt + Shift + 1	To use heading level 1	F1	To open the Help window
F5	To run the presentation	Shift + F5	To view the slide show from the current slide forward
Ctrl + P	To activate the Pen tool during a show	F7	To use the Spellcheck feature
E	To erase Pen tool drawings during a show	F12	To display the Save As dialog box
Esc	To turn off the Pen tool	Esc	To end the slide show
Ctrl + A	To change the pen to a pointer		

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1

Introduction to Computer

INTRODUCTION

We all have seen computers in our homes, schools, or colleges. In fact, in today's scenario we find computers in most aspects of daily life, and for some it is hard to even imagine a world without them. A computer is basically a machine that takes instructions and performs computations based on those instructions.

Nowadays computers come in different sizes. Their size may vary from very small to very large. In the past, computers were extremely large in size and required an entire room for installation. These computers consumed enormous amounts of power and were too expensive to be used for commercial applications. Therefore, they were used only for limited tasks, such as computing trajectories for astronomical or military applications. However, with technological advancements, the size of computers became smaller and their energy requirements lowered immensely. This opened the way for adoption of computers for commercial purposes.

These days, computers have become so prevalent in the market that all interactive devices such as cellular phones, GPS units, portable organizers, ATM machines, and gas pumps work with computers.

1.1 OBJECTIVES

In this chapter you will learn the definition and the characteristics of a computer and see how computer has evolved from a big machine used for scientific purposes to a small device which can even be used in a wrist watch. In the chapter you will read about the different areas where computer is being used in different areas of our day-to-day lives. You will get a complete picture about the basic organization of a computing device and the internal as well as the external components of the computer system. The chapter will also discuss important terms like data, information, hardware, software, and data processing. You will also get to learn the

application of Information Technology in e-governance, multimedia, and entertainment.

1.2 WHAT IS A COMPUTER?

A computer is an electronic machine that takes instructions and performs computations based on those instructions. Before going into details, let us learn some key terms that are frequently used in computers.

Data Data is a collection of raw facts or figures.

Information Information comprises processed data to provide answers to 'who', 'what', 'where', and 'when' type of questions.

Knowledge Knowledge is the application of data and information to answer 'how' part of the question (Refer Fig. 1.1).

Instructions Commands given to the computer that tells what it has to do are instructions.

Programs A set of instructions in computer language is called a program.

Software A set of programs is called software.

Hardware A computer and all its physical parts are known as hardware.



Figure 1.1 Data, information, and knowledge

1.2.1 History of Computers

History of computers can be understood by looking into five generations. With each new generation of computers, there had been advancement in computer technology. The circuitry became smaller with enhanced speed, less consumption of power, and efficient memory.

Therefore, each generation of computer is characterized by a major technological development that has drastically changed the way in which computers operate.

First Generation (1942–1955)

Hardware Technology First generation computers were manufactured using thousands of vacuum tubes. Vacuum tube (as shown in Fig. 1.2) is a device made of fragile glass.

Software Technology Programming was done in machine language or assembly language.

Used for Scientific applications

Examples ENIAC, EDVAC, EDSAC, UNIVAC I, IBM 701

Highlights

- They were the fastest calculating device of those times.
- Computers were too bulky and required a complete room for storage.
- Highly unreliable as vacuum tubes emitted a large amount of heat and burnt frequently.
- Required air-conditioned room for installation.
- Costly.
- Difficult to use.
- Required constant maintenance because vacuum tubes used filaments that had limited lifetime. Therefore, these computers were prone to frequent hardware failures.

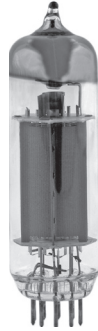


Figure 1.2 Vacuum tube

Source: Vladyslav Danilin/Shutterstock

Second Generation (1955–1964)

Hardware Technology Second generation computers were manufactured using transistors (as shown in Fig. 1.3). Transistors were reliable, powerful, cheaper, smaller, and cooler than vacuum tubes.

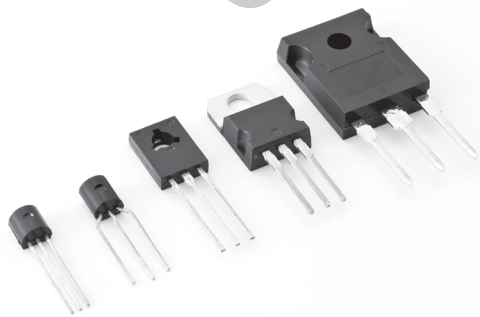


Figure 1.3 Transistors

Source: yurazaga/Shutterstock

Software Technology Programming was done in high level programming language.

Used for Scientific and commercial applications

Examples Honeywell 400, IBM 7030, CDC 1604, UNIVAC LARC

Highlights

- Faster, smaller, cheaper, reliable, and easier to use than the first generation computers.
- Consumed 1/10th the power consumed by first generation computers.
- Bulky in size and required a complete room for its installation.
- Dissipated less heat than first generation computers but still required air-conditioned room.
- Costly.
- Difficult to use.

Third Generation (1964–1975)

Hardware Technology Third generation computers were manufactured using integrated chips (ICs) as shown in Fig. 1.4. ICs consist of several components such as transistors, capacitors, and resistors on a single chip to avoid wired interconnection between components. These computers used SSI and MSI technology. Minicomputers came into existence.

Note: Initially, ICs contained 10–20 components. This technology was called Small Scale Integration (SSI). Later it was enhanced to contain about 100 components. This was called MSI (Medium Scale Integration).

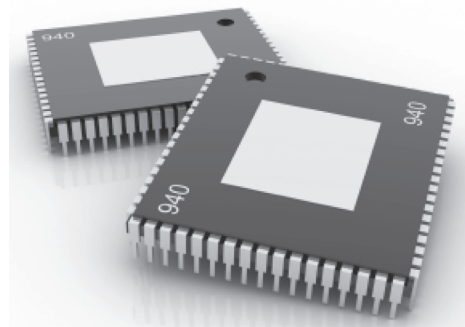


Figure 1.4 Integrated chip

Source: cooldesign/FreeDigitalPhotos.net

Software Technology Programming was done in high level programming language such as FORTRAN, COBOL, Pascal, and BASIC.

Used for Scientific, commercial, and interactive online applications.

Examples IBM 360/370, PDP–8, PADP-11, CDC6600

Highlights

- Faster, smaller, cheaper, reliable, and easier to use than the second generation computers.
- They consumed less power than second generation computers.
- Bulky in size and required a complete room for its installation.
- Dissipated less heat than second generation computers but still required air-conditioned room.

- Costly.
- Easier to use and upgrade.

Fourth Generation (1975–1989)

Hardware Technology Fourth generation computers were manufactured using ICs with LSI (Large Scale Integrated) and later with VLSI (Very Large Scale Integrated) technology as shown in Fig. 1.5. Microcomputers came into existence, and use of personal computers became widespread during this period. High speed computer networks in the form of LANs, WANs, and MANs started growing. Besides mainframes, supercomputers were also used.



Figure 1.5 VLSI

Note: LSI contained 30,000 components on a single chip and VLSI technology had about 1 million electronic components on a single chip.

Software Technology Programming was done in high level programming language like C, C++. Graphical user interface (GUI) based operating system (like Windows) was introduced. It had icons and menus among other features to allow computers to be used as a general purpose machine by all users.

Used for Scientific, commercial, interactive online, and network applications.

Examples IBM PC, Apple II, TRS-80, VAX 9000, CRAY-1, CRAY-2, CRAY-X/MP

Highlights Faster, smaller, cheaper, powerful, reliable, and easier to use than the previous generation computers.

Fifth Generation (1989–Present)

Hardware Technology Fifth generation computers were manufactured using ICs with ULSI (Ultra Large Scale Integrated) technology as shown in Fig. 1.6. Use of Internet became widespread. Very powerful mainframes, desktops, portable laptops, smartphones are being used commonly. Super computers use parallel processing techniques.

Note: ULSI contained about 10 million electronic components on a single chip.

Software Technology Programming was done in high level programming language such as Java, Python, C#.



Figure 1.6 ULSI

Used for Scientific, commercial, interactive online, multimedia (graphics, audio, video), and network applications.

Examples IBM notebooks, Pentium PCs, SUM workstations, IBM SP/2, Param supercomputer.

Highlights

- Faster, smaller, cheaper, powerful, reliable, and easier to use than the previous generation computers.
- Speed of microprocessors and the size of memory are growing rapidly.
- High-end features available on mainframe computers in the fourth generation are now available on the microprocessors.
- Consume less power than computers of prior generations.
- Air-conditioned rooms required for mainframes and supercomputers but not for microprocessors.

1.2.2 Characteristics of Computers

The important characteristics of a computer (as shown in Fig. 1.7) are given below:

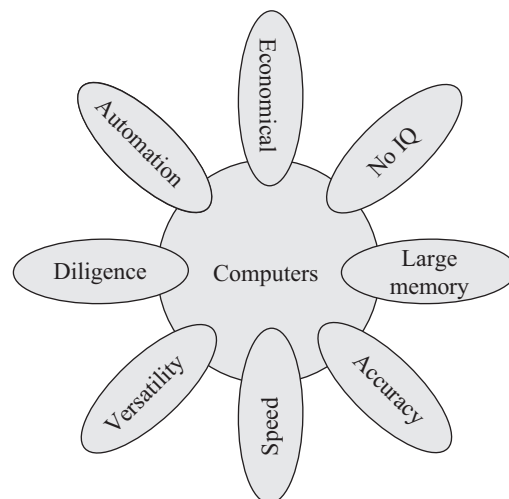


Figure 1.7 Characteristics of computer

Speed Computers can perform millions of operations in a single second. This means that a computer can process the data in blink of an eye which otherwise may take multiple days to complete. The speed of the computer is usually given in *nano second* and *pico second*, where

1 nano second = 1×10^{-9} second

1 pico second = 1×10^{-12} second

Accuracy Computers are a reliable electronic device. It never makes mistakes. It always gives accurate results provided that correct data and set of instructions are input to it. So in the advent of an error, only the user who has fed the incorrect data/program is responsible. If the input data is wrong, then the output will also be erroneous. In computer terminology, it is known as garbage-in garbage-out (GIGO).

Automatic Besides being very fast and accurate, computers are automatic devices that can perform without any user intervention. The user just needs to assign the task to the computer after which the computer automatically controls different devices attached to it and executes the program instructions one by one.

Diligence Computers can never get tired as humans do. It can continually work for hours without creating any error. If a large number of executions have to be made then each and every execution will require the same amount of time and accuracy.

Versatile Versatile means flexible. Today, computers are being used in our daily lives in different fields. For example, they are used as personal computers (PCs) for home use, for business-oriented tasks, weather forecasting, space explorations, teaching, railways, banking, medicine, etc. On the PC that you use at home, you may play a game, compose and send e-mails, listen to music, etc. Therefore, computers are versatile devices as they can perform multiple tasks of different nature at the same time.

Memory Similar to humans, computers also have memory. Human beings cannot store everything in their memory and need secondary media, such as a notebook to record certain important things. Similarly, computers have internal memory (storage space) as well as external or secondary memory. While the internal memory of computers is very expensive and limited in size, the secondary storage is cheaper and bigger in size.

The computer stores a large amount of data and programs in the secondary storage space. The stored data and programs can be used whenever required. Secondary memory devices include CD, DVD, hard disk, pen drives, etc.

Note: When data and programs have to be used they are copied from the secondary memory into the internal memory (often known as RAM).

No IQ Although the trend today is to make computers intelligent by inducing artificial intelligence (AI) in them, they do not have any decision-making abilities of their own, that is, their IQ level is zero. They need guidance to perform various tasks.

Economical Today, computers are considered as short-term investment for achieving long-term gain. Using computers also reduces manpower requirements and leads to an elegant and efficient way for doing tasks. Hence, computers save time, energy, and money. When compared to other systems, computers can do more work in lesser time. For example, using the conventional postal system to send an important document takes at least 2–3 days, whereas the same information when sent using the Internet (e-mail) will be delivered instantaneously.

1.2.3 Classification of Computers

Computers can be broadly classified into four categories based on their speed, amount of data that they can process, and price (refer to Fig. 1.8). These categories are as follows:

- Supercomputers
- Mainframe computers
- Minicomputers
- Microcomputers

Supercomputers

Among the four categories, the supercomputer is the fastest, most powerful, and most expensive computer. Supercomputers were first developed in the 1980s to process large amounts of data and to solve complex scientific problems. Supercomputers use parallel processing technology and can perform more than one trillion calculations in a second.

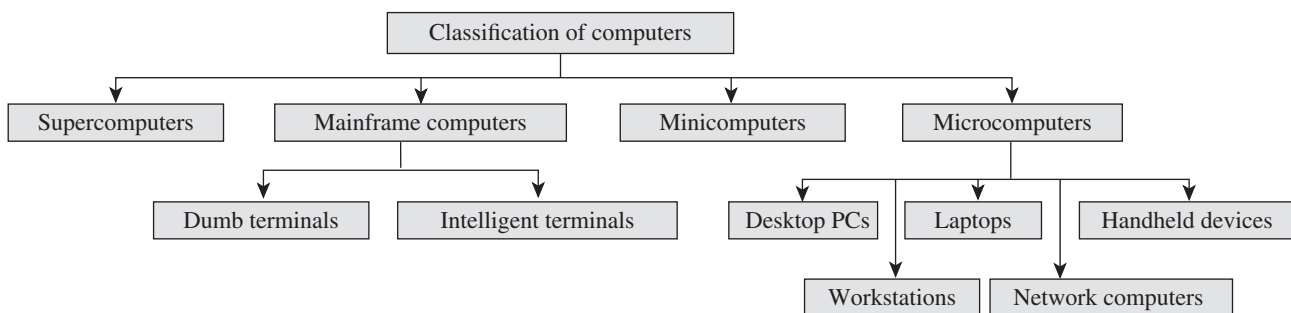


Figure 1.8 Classification of computers

A single supercomputer can support thousands of users at the same time. Such computers are mainly used for weather forecasting, nuclear energy research, aircraft design, automotive design, online banking, controlling industrial units, etc. Some examples of supercomputers are CRAY-1, CRAY-2, Control Data CYBER 205, and ETA A-10.

Mainframe Computers

Mainframe computers are large-scale computers (but smaller than supercomputers). These are very expensive and need a very large clean room with air conditioning, thereby making them very costly to deploy. As with supercomputers, mainframes can also support multiple processors. For example, the IBM S/390 mainframe can support 50,000 users at the same time. Users can access mainframes by either using terminals or via PCs.

Mainframe computers are typically used as servers on the World Wide Web. They are also used in organizations such as banks, airline companies, and universities, where a large number of users frequently access the data stored in their databases. IBM is the major manufacturer of mainframe computers. Some examples of mainframe computers include IBM S/390, Control Data CYBER 176, and Amdahl 580.

Minicomputers

As the name suggests, minicomputers are smaller, cheaper, and slower than mainframes. They are called minicomputers because they were the smallest computer of their times. Also known as *midrange computers*, the capabilities of minicomputers fall between mainframe and personal computers.

Minicomputers are widely used in business, education, hospitals, government organizations, etc. While some minicomputers can be used only by a single user, others are specifically designed to handle multiple users simultaneously. Usually, single-user minicomputers are used for performing complex design tasks.

As with mainframes, minicomputers can also be used as servers in a networked environment, and hundreds of PCs can be connected to it.

The first minicomputer was introduced by Digital Equipment Corporation (DEC) in the mid-1960s. Other manufacturers of minicomputers include IBM Corporation (AS/400 computers), Data General Corporation, and Prime Computer.

Microcomputers

Microcomputers, commonly known as PCs, are very small and cheap. The first microcomputer was designed by IBM

in 1981 and was named IBM-PC. Later on, many computer hardware companies copied this design and termed their microcomputers *PC-compatible*, which refers to any PC that is based on the original IBM PC design.

Another type of popular PC is designed by Apple. PCs designed by IBM and other PC-compatible computers have a different architecture from that of Apple computers. Moreover, PCs and PC-compatible computers commonly use the Windows operating system, while Apple computers use the Macintosh operating system (MacOS). PCs can be classified into the following categories:

Desktop PCs A desktop PC is the most popular model of PCs. The system unit of the desktop PC can be placed flat on a desk or table. It is widely used in homes and offices.

Laptops Laptops (Fig. 1.9) are small microcomputers that can easily fit inside a briefcase. They are very handy and can easily be carried from one place to another. They may also be placed on the user's lap (thus the name). Hence, laptops are very useful, especially when going on long journeys. Laptops operate on a battery and do not always have to be plugged in like desktop computers.

The memory and storage capacity of a laptop is almost equivalent to that of a desktop computer. As with desktop computers, laptops also have hard disk drives, USB drives, etc. For input, laptops have a built-in keyboard and a trackball/touchpad, which is used as a pointing device (as a mouse is used for a desktop PC).



Figure 1.9 Laptop

Source: You can more/Shutterstock

Today, laptops have the same features and processing speed as the most powerful PCs. However, a drawback is that laptops are generally more expensive than desktop computers. These computers are very popular among business travellers.

Workstations Workstations are single-user computers that have the same features as PCs, but their processing speed matches that of a minicomputer or mainframe computer. Workstation computers have advanced processors, more RAM and storage capacity than PCs. Therefore, they are more expensive and powerful than a normal desktop computer.

Although workstation computers are widely used as powerful single-user computers by scientists, engineers, architects, and graphic designers, they can also be used as servers in a networked environment.

Network Computers Network computers have less processing power, memory, and storage than a desktop computer. These are specially designed to be used as terminals in a networked environment. For example, some network computers are specifically designed to access data stored on a network (including the Internet and intranet).

Some network computers do not have any storage space and merely rely on the network's server for data storage and processing tasks. The concept of network computers had become popular in the mid-1990s when several variations of computers such as Windows terminals, NetPCs, and diskless workstations were widely used.

Network computers that are specifically designed to access only the Internet or intranet are often known as Internet PCs or Internet boxes. Some network computers used in homes do not even have a monitor. Such computers may be connected to a television, which serves as the output device. The most common example of a home-based network computer is Web TV, which enables the user to connect a television to the Internet. The other reason for the popularity of network computers is that they are cheaper to purchase and maintain than PCs.

Handheld Computers The mid-1990s witnessed a range of small personal computing devices that are commonly known as handheld computers, or mobile computers. These computers are called handheld computers because they can fit in one hand, while users can use the other hand to operate them. Handheld computers are very small in size, and hence they have small-sized screens and keyboards. These computers are preferred by business travellers and mobile employees whose jobs require them to move from place to place.

Some examples of handheld computers are as follows:

- Smartphones
- Tablet PCs

Smartphones These days, cellular phones are web-enabled telephones that have features of both analog and digital devices. Such phones are also known as smartphones because, in addition to basic phone capabilities, they also facilitate the users to access the Internet and send e-mails and faxes.

Tablet PCs A tablet PC (see Fig. 1.10) is a computing device that is smaller than a laptop, but bigger than a smartphone. Features such as user-friendly interface, portability, and touch screen have made them very popular in the last few years. These days, a wide range of high-performance tablets are available in the market. While all of them look similar from outside, they may differ in features such as operating system, speed of data connectivity, camera specifications, size of the screen, processing power, battery life, and storage capability.



Figure 1.10 Tablet

Source: bloomua/Shutterstock/OUP Picture Bank

Some operating systems that are used in tablets are Android Jellybean (an open-source operating system built by Google), Windows 8, and iOS (developed by Apple).

While users can easily type directly on the surface of a tablet, some users prefer a wireless or bluetooth-connected keyboard. These days, tablets also offer an optional docking station with keyboards that transforms the tablet into a full-featured netbook.

Uses The following are the uses of tablet PCs:

- Viewing presentations
- Videoconferencing
- Reading e-books, e-newspaper
- Watching movies
- Playing games
- Sharing pictures, video, songs, documents, etc.
- Browsing the Internet
- Keeping in touch with friends and family on popular social networks, sending emails
- Business people use them to perform tasks such as editing documents, exchanging documents, taking notes, and giving presentations
- Tablets are best used in crowded places such as airports and coffee shops, where size and portability become more important.

Note: Tablets may replace laptops if users don't have to perform heavy processing tasks and do not require a CD or DVD player.

1.2.4 Basic Applications of Computers

When the first computers were developed, they were used only in the fields of mathematics and science. In fact, the first

effective utilization of computers was for decoding messages in military applications. Later on, computers were used in real-time control systems, such as for landing on the moon. However, with the advancement of technology, the cost of a computer and its maintenance declined. This opened the way for computers extensively being used in business and commercial sector for information processing. Today, computers are widely used in different fields as discussed below.

Communication Internet which connects computers all over the world. Internet gives you access to enormous amount of information much more than you could have in a library. Then using electronic mail you can communicate in seconds with a person who is thousands of miles away. The chat software enables you to chat with another person in real-time (irrespective of the physical location of that person). Then, video conferencing tools are becoming popular for conducting meetings with people who are unable to be present at a particular place.

Desktop Publishing Desktop publishing software enables you to create page layouts for entire books.

Government Computers are used to keep records on legislative actions, Internal Revenue Service records, etc.

Traffic Control It is used by governments for city planning and traffic control.

Legal System Computers are being used by lawyers to shorten the time required to conduct legal precedent and case research. Lawyers use computers to look through millions of individual cases and find whether similar or parallel cases were approved, denied, criticized, or overruled. This enables the lawyers to formulate strategies based on past case decisions. Moreover, computers are also used to keep track of appointments and prepare legal documents and briefs in time for filling cases.

Retail Business Computers are used in retail shops to enter the order, calculate the cost, and print a receipt. They are also used to keep an inventory of the products available and a complete description about them.

Sports In sports, computers are used to compile statistics, identify weak players and strong players by analysing statistics, sell tickets, create training programs and diets for athletes, and suggest game plan strategies based on the competitor's past performance. Computers are also used to generate most of the graphic art displays flashed on scoreboards.

Computers are used in the control room to display action replays and insert commercial breaks on schedule. Moreover, sports shoes manufacturing companies, like NIKE, use computers for designing footwears. They calculate stress

points and then create the style and shape that offer maximum support for the foot.

Music Computers are used to generate a variety of sounds. Moreover, the background music in movies, television shows, and commercials are all generated electronically using computers.

Movies Computers are used to create sets, special effects, animations, cartoons, imaginary characters, videos, and commercials.

Travel and Tourism Computers are used to prepare ticket, monitor the train's or airplane's route, or guide the plane to a safe landing. They are also used to know about hotels in an area, reserve room, or rent a car.

Business and Industry In business and industry, computers are used mainly for entering and analysing data, pay roll processing, personnel record keeping, inventory management, etc.

Hospitals Hospitals use computers to record every information about a patient from the time of his admission till his exit. For example the date, time, reason of admit, the doctor being consulted, all prescribed medications, doctor visits, other hospital services, bill, etc. are all stored in computers. Moreover, computer-controlled devices are widely used to monitor pulse rate, blood pressure, and other vital signs of the patient and in an emergency situation an alarm is used to notify the nurses and other attendants.

Moreover, computers are used as an aid to physically handicapped people. For example, computers are used to develop more effective artificial limbs for amputees.

Simulation Computers enable the engineers to design aircraft models and simulate the effects that winds and other environmental forces might have on those designs. Even the astronauts at NASA are trained using computer-simulated problems that could be encountered during launch, in space, or upon return to Earth.

Geology Civil engineers use computers to evaluate the effects of an earthquake on the structure of buildings based on age, proximity to the fault, soil type, size, shape, and construction material.

Astronomy Spacecrafts are usually monitored using computers which not only keep a continuous record of the voyage and the records of the speed, direction, fuel, temperature, and such performance but also suggests a corrective action if the vehicle makes any mistake. The remote stations on the earth compares all these quantities with the desired values and in case these values need to be modified to enhance the performance of the space craft, signals are immediately sent which set in motion the mechanics to rectify the situation. With the help of computers, these are done within a fraction of seconds.

Weather Forecasting When computers are fed with mathematical equations along with data about air pressure, temperature, humidity, and other values, the solution of these equations gives an accurate prediction of weather in a particular area. For example, a Crax XMP Supercomputer installed at Mausam Bhavan in New Delhi is used to predict weather and climatic changes in the Indian sub-continent.

Education A computer is a powerful teaching aid and acts as another teacher in the classroom. Teachers use computers to develop instructional material. They may use pictures, graphs, and graphical presentations to easily illustrate an otherwise difficult concept. Moreover, teachers at all levels can use computers to administer assignments and keep track of grades of the students. Besides teachers, students also prefer to learn from an E-learning software rather than learning from a book. Students can also give online exams and get instant results.

Online Banking The world today is moving towards a cashless society, where you need not have money in your pocket to purchase anything. You can just have your credit card or debit card with you. The ATM machines (Automated Teller Machine) provides a 24×7 service and allows you to draw cash, check the balance in your account, and order a product.

Industry and Engineering Computers are found in all kinds of industries like thermal power plant, oil refineries, chemical industries, etc. for process control, computer aided designing, and computer aided manufacturing.

Computerized process control (with or without human intervention) is used to enhance efficiency in applications such as production of various chemical products, oil refining, paper manufacture, rolling and cutting steel to customer requirements, etc.

In *Computer Aided Design (CAD)*, the computers are used for automating the design and drafting process. It helps an engineer to design a part, analyse its characteristics, and then subject it to simulated stresses. In case a part fails the stress test, its specifications can be modified on the computer and retested. The final design specifications are released for production only when the engineer is satisfied that the part meets strength and other quality considerations.

Computer-aided manufacturing (CAM) phase comes up where CAD leaves off. In this phase, the metal or other materials are manufactured while complying with their specification. For this computer-controlled manufacturing tools are used to produce high-quality products.

Robots Robots are computer-controlled machines mainly used in manufacturing process in extreme conditions where humans cannot work. For example, in high temperature, high pressure conditions or in processes that demand very high level of accuracy.

Decision Support Systems Computers help managers to analyse their organization's data to understand the present

scenario of their business, view the trends in the market, and predict the future of their products. Managers also use decision support systems to analyse market research data, to size up the competition, and to plan effective strategies for penetrating their markets.

Expert System Expert systems are used to automate the decision-making process in a specific area like analysing the credit histories for loan approval and diagnosing a patient's condition for prescribing an appropriate treatment. Expert systems analyse the available data in depth to recommend a course of action. A medical expert system can provide the most likely diagnosis of a patient's condition.

Others Adding more to it, in today's scenario computers are used to find jobs on the Internet, find a suitable match for a boy or girl, read news and articles online, find one's batchmates, send and receive greetings pertaining to different occasions, etc.

1.3 COMPONENTS OF A COMPUTER SYSTEM

A computer is an electronic device which basically performs five major operations, which are as follows:

1. accepting data or instructions (input)
2. storing data
3. processing data
4. displaying results (output) and
5. controlling and coordinating all operations inside a computer

In this section, we will discuss all these functions and see how one component of a computer interacts with another unit to perform these operations using the block diagram of a computer as shown in Fig. 1.11.

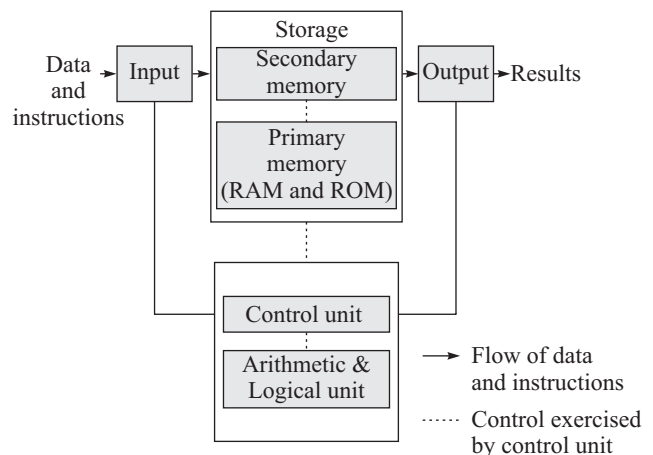


Figure 1.11 Block diagram of a computer

Input This is the process of entering data and instructions (also known as programs) into the computer system. The

data and instructions can be entered into the computer system by using different input devices such as keyboard, mouse, scanner, trackball, etc.

Note: Computers understand binary language which consists of only two symbols (0s and 1s). Therefore, it is the responsibility of the input devices to convert the input data into binary codes.

Storage Storage is the process of saving data and instructions permanently in the computer so that it can be used for processing. The computer storage space stores not only the data and programs but also the intermediate results and the final results of processing. A computer has two types of storage areas:

Primary Storage Primary storage also known as the main memory is that storage area which is directly accessible by the CPU at a very fast speed. It is used to store the data and program, the intermediate results of processing and the recently generated results. The primary storage is very expensive and therefore limited in capacity. Another drawback of main memory is that it is volatile in nature, that is, as soon as the computer is switched off, the information stored in it gets erased. Hence, it cannot be used as a permanent storage of useful data and programs for future use. For example, RAM (Random Access Memory).

Secondary Storage Also known as the secondary memory or auxiliary memory is just the opposite of primary memory. It basically overcomes all the drawbacks of the primary storage. It is cheaper, non-volatile and used to permanently store data and programs of those jobs which are not being currently executed by the CPU. Secondary memory supplements the limited storage capacity of the primary memory. For example, magnetic disk you store your data in C drive, D drive, etc. for future use.

Processing The process of performing operations on the data as per the instructions specified by the user (program) is called processing. Data and instructions are taken from the primary memory and are transferred to the Arithmetic and Logical Unit (ALU), a part of CPU, which performs all sorts of calculations. When the processing completes, the final result is transferred to the main memory.

Output Output is the reverse of input. It is the process of giving the result of data processing to the outside world (external to the computer system). The results are given through output devices like monitor, printer, etc. Now that the computer accepts data only in binary form and the result of processing is also in the binary form, the result cannot be directly given to the user. The output devices therefore convert the results available in binary codes into a human-readable language before displaying it to the user.

Controlling The function of managing, coordinating, and controlling all the components of the computer system is handled by the control unit, a part of CPU. The control unit decides the manner in which the instructions will be executed and the operations will be performed.

Let us now discuss the CPU and the other components of a computer system in detail.

1.3.1 Central Processing Unit (CPU)

Central Processing Unit can be called the brain of the computer system because the entire processing of data and execution of instructions is done here. It is made up of one or more than one microprocessors which consist of two main parts—arithmetic and logical unit (ALU) and control unit (CU).

Arithmetic and Logical Unit The ALU performs all kinds of calculations, such as arithmetic (add, subtract, multiply, divide, etc.), comparison (less than, greater than, or equal to), and other operations. The intermediate results of processing may be stored in the main memory, as they might be required again. When the processing completes, the final result is then transferred to the main memory. Hence, the data may move from main memory to the ALU multiple times before the processing is over.

Control Unit The main function of the CU is to direct and coordinate the computer operations. It interprets the instructions (program) and initiates action to execute them. The CU controls the flow of data through the computer system and directs the ALU, input/output (I/O) devices, and other units. It is, therefore, called the central nervous system of the computer system. In addition, the CU is responsible for fetching, decoding, executing instructions, and storing results.

1.3.2 VDU or Monitor, Keyboard, and Mouse

An input device is used to feed data and instructions into the computer. In the absence of an *input device*, a computer would have only been a display device. Correspondingly, any device that outputs/gives information from a computer is called an *output device*. Refer to Fig. 1.12 which shows some basic I/O devices that are generally connected with our computer system.

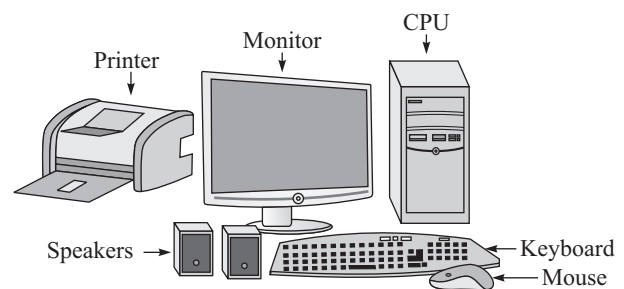


Figure 1.12 Basic parts of a computer system

Monitor The monitor, also known as visual display unit (VDU), is an output device. It looks similar to a television screen but displays information from the computer at a much higher quality. The monitor is connected to either a VGA or DVI port on a video card (in the mother board).

Monitors come in three variants—CRT, LCD, and Plasma (refer Fig. 1.13). While CRT monitors look much like traditional televisions as they also have deep backs, LCD monitors on the other hand are thinner offering equivalent graphics quality. But these days LCD monitors are replacing CRT monitors as they are cheaper and occupies less space on the desk. Most monitors range in size from 15" to 21" or more (where size is defined as a diagonal measurement from one corner of the screen to the other).



Figure 1.13 (a) CRT monitor (b) LCD monitor (c) Plasma monitor

Keyboard Keyboard is the main input device which looks very similar to the keyboards of typewriters, with some additional keys. With a keyboard (Fig. 1.14), the user can type a document, use keystroke shortcuts, access menus, play games, and perform numerous other tasks. Most keyboards have between 80 and 110 keys, which include typing keys, numeric keys, function keys, control keys, and arrow keys.

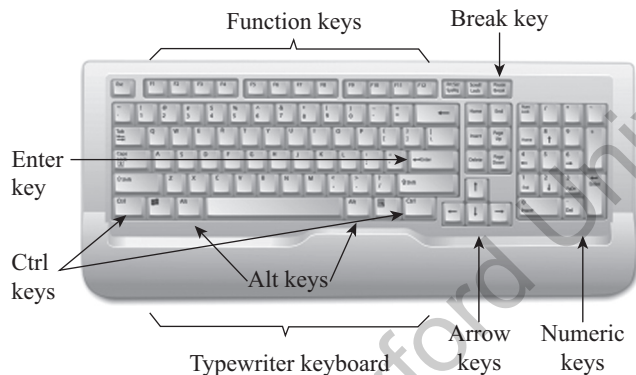


Figure 1.14 Keyboard

Source: digital art/FreeDigitalPhotos.net

The *typing keys* include the letters of the alphabet. The *numeric keys* include a set of 17 keys to speed up data entry of numbers. When the NUM LOCK is switched On, the user can type numbers, dot or use /, *, -, +. When the NUM LOCK is switched Off, the numeric keys can be used to move the cursor on the screen.

Function keys are used by applications and operating systems to perform specific commands. They are placed on the top of the keyboard in a single row. Function keys can be programmed so that their functionality can vary from one program to another.

Control keys are used to control the cursor and screen. Four *arrow keys* arranged in an inverted T-type fashion in between the typing keys and numeric keys are used to move the cursor on the screen in small increments. In addition to the arrow keys, there are other cursor keys (or navigational keys) such as:

- Home and End to move the cursor to the beginning and end of the current line, respectively
- Page Up and Page Down to see the previous page and the next page, respectively
- Insert to enter a character between two existing characters
- Delete to delete a character at the cursor position

Other common control keys on the keyboard include Control (Ctrl), Alternate (Alt), Escape (Esc), Print Screen key, Pause key, Windows or Start key (Microsoft Windows logo), and a shortcut key. The shortcut key has a menu with mouse pointer printed on it and is used to access the options available by pressing the right mouse button. Esc cancels the selected option and Pause key pauses a command in progress. Finally, the Print Screen captures everything on the screen as an image. The image can be pasted into any document.

Note: Keys like Shift, Ctrl, and Alt are called *modifier keys* because they are used to modify the normal function of a key. For example, Shift + Alphabet key makes the computer to print a capital alphabet.

Mouse Mouse is an input device that is used in a graphical user interface (GUI). The users can use mouse to handle the pointer easily on the screen to perform various functions like opening a program or file. With mouse, the users no longer need to memorize commands, which was earlier a necessity when working with text-based command line environment such as MS-DOS. Mouse is specially used to create graphics such as lines, curves, and freehand shape on the screen. It is connected to a serial port or USB port on the system unit.

The mouse has two buttons and a scroller (refer Fig. 1.15). Mouse can be held in hand and easily moved without lifting it along a hard flat surface to move the cursor to the desired location whether up, down, left, or right. Once the mouse is placed at the appropriate position, the user may perform the following operations:



Figure 1.15 Mouse

Point Place the mouse pointer over the word or the object on the screen by moving the mouse on the desk.

Click Pressing either the left or the right button of the mouse is called clicking. When you move the mouse pointer over an icon of an application say Internet Explorer, and double click on it, it opens that application for you.

Drag Drag means moving an object to the desired position by pressing the left button.

Scroll The scroll wheel, which is placed in between the left and the right button of the mouse, is used to vertically scroll through long documents.

1.3.3 Other Input Devices

In this section we will read about other input devices that are widely used by computer users to feed data or instructions to the computer.

Trackball A trackball is a pointing device which is used to control the position of the cursor on the screen. Trackballs are usually used in notebook and laptop computers where it is placed on the keyboard as shown in Fig. 1.16.



Figure 1.16 Trackball on keyboard

Source: Eugene Sergeev/Shutterstock

The trackball is nothing but an upside-down mouse that rotates in place within a socket. The user rolls the ball to position the cursor at an appropriate position on the screen and then clicks one of the buttons (identical to mouse buttons) near the trackball either to select objects or position the cursor for text entry.

Joystick Joystick (refer Fig. 1.17) is a cursor control device widely used in computer games and CAD/CAM applications. A joystick has one or more push-buttons, called switches, whose position can also be read by the computer.

The lever of the joystick moves in all directions to control the movement of the pointer on the computer screen. Though a joystick is similar to a mouse, but with the mouse, the cursor stops moving as soon as you stop moving the mouse. However, in case of a joystick, the pointer continues moving in the direction the joystick is pointing. To stop the pointer, the user must return the joystick to its upright position.



Figure 1.17 Joystick

Source: Viktor Kunz/Shutterstock

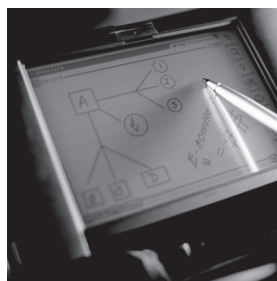


Figure 1.18 Stylus

Source: Photodisc/OUP Picture Bank

Stylus (Pen) A stylus (shown in Fig. 1.18) is a pen-shaped input device

used to enter information or write on the touch screen of a phone. Stylus is a small stick that can also be used to draw lines on a surface as input to a computer, choose an option from a menu, move the cursor to another location on the screen, take notes, and create short messages. The stylus usually slides into a slot built into the smartphone for that purpose.

Touch Screen A touch screen shown in Fig. 1.19 is a display screen which can identify the occurrence and position of a touch inside the display region. The user can touch the screen either by his finger or by using a stylus. The touch screen facilitates the users to interact with what is displayed on the screen in a direct way, rather than in an indirect way by using a mouse or touchpad. Such touch screen displays can be connected to computers, laptops, PDAs, cell phones, etc.



Figure 1.19 Touch screen

Source: Gareth Boden/OUP Picture Bank

Barcode Reader A barcode reader (or price scanner or point-of-sale scanner), shown in Fig. 1.20, is a hand-held input device used to capture and read information stored in a barcode. The barcode reader merely captures and translates the barcode into numbers and/or letters. To use the captured information, it must be connected to a computer for further processing. These days, bar codes and readers are widely used in the following areas:



Figure 1.20 Barcode reader

Source: Image courtesy of Vectorlie at FreeDigitalPhotos.net

- in supermarkets and retail stores as point-of-sale devices
- to take inventory in retail stores
- to check out books from a library
- to track manufacturing and shipping movement
- to sign in on a job
- to identify hospital patients
- to tabulate the results of direct mail marketing returns
- to tag honey bees used in research.

Scanner A scanner (shown in Fig. 1.21) is a device that captures images, printed text, handwriting from different sources (such as photographic prints, posters, magazines, etc.) and converts it into a digital image for computer editing and display.

Scanner has enabled users to store text documents as text files. Hence, the text

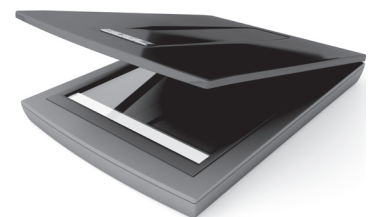


Figure 1.21 Flatbed image scanner

Source: Mile Atanasov/Shutterstock

files occupy much less storage space and can be easily edited. These days, they are used in the following areas:

- in libraries to digitize and preserve documents
- to process checks and credit card slips
- to sort letters for speeding up mail delivery.

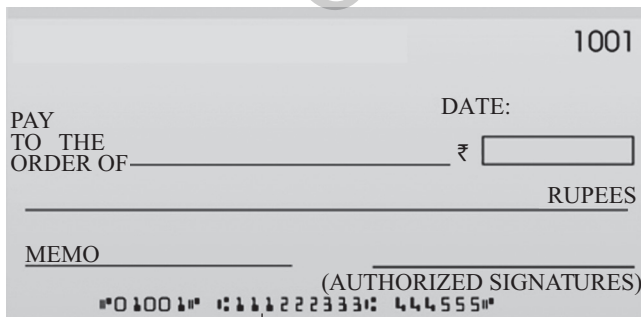
Optical Mark Recognition (OMR) OMR is the process of electronically extracting data from marked fields, such as checkboxes and fill-infields, on printed forms. The optical mark reader is fed with an OMR sheet that has a pen or pencil mark in pre-defined positions to indicate each selected response (like answers for multiple choice questions in an entrance examination).

The OMR sheet is scanned by the optical mark reader (Fig. 1.22) to detect the presence of a mark by measuring reflected light levels. The error rate for OMR technology is less than 1%. For this reason, OMR is widely used for applications in which large numbers of hand-filled forms have to be quickly processed with great accuracy, such as surveys, reply cards, questionnaires, ballots, or sheets for multiple-choice questions.



Figure 1.22 OMR reader

MICR MICR is used to verify the legitimacy or originality of paper documents, especially cheques. MICR consists of magnetic ink printed characters which can be recognized by high speed MICR devices (refer Fig. 1.23). The printed characters provide important information (like cheque number, bank routing number, checking account number, and in some cases the amount of the cheque) for processing to the receiving party.



Magnetic ink character recognition

Figure 1.23 A check containing magnetic ink characters printed on it

MICR is widely used to enhance security, speed up the sorting of documents, and minimize the exposure to check fraud. Let us take a real-world problem to understand how MICR reduces the risk of fraud. If a person gives a

cheque produced using a colour photocopying machine, the magnetic-ink line will either not respond to magnetic fields, or will produce an incorrect code when scanned using a MICR reader (Fig. 1.24). The MICR device even rejects the cheques issued by an owner of the account who has a history of writing bad cheques.

Audio Devices Audio devices are used to either capture or create sound. They enable computers to accept music, speech or sound effects for recording and/or editing. Microphones and CD players are examples of two widely used



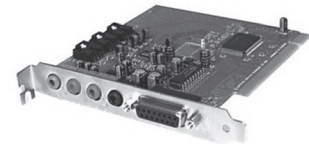
Figure 1.24 MICR reader

audio input devices. A microphone feeds audio input to the computer. However, the audio input must be converted into digital data before storing it in the computer. For this, the computer must have a sound card. The sound card is a hardware unit that converts analog signals generated through microphones into digital data so that it can be stored in the computer. When the user wants to hear the pre-recorded audio input, the sound card converts the digital data into equivalent analog signals and sends it to the speakers. This process is depicted in Fig. 1.25.



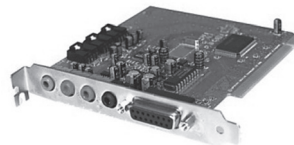
Microphone

The user speaks into the microphone



Sound card

The sound card converts analog signals into digital data so that it can be stored in the computer



Sound card

The sound card converts digital data stored in the computer into analog signals and sends it to the speakers so that users may hear the sound



Speakers

Figure 1.25 Recording and retrieving audio data

Digital Camera A computer with a microphone and speakers can be used to make telephone calls and do video-conferencing over the Internet.

Video Input Devices Video input devices are used to capture video from the outside world into the computer. Here, the term video means moving picture along with sound (as in television). Like we have sound cards to convert analog signals into digital data and digital data to analog signals, we also have video cards to convert analog signals to digital data

to store it in the computer (and vice versa). Digital camera and web camera are popular examples of video input devices.

Digital camera (shown in Fig. 1.26) is a hand-held and easily portable device used to capture images or videos. The data can then be transferred to the computer using a cable which connects the computer to the digital camera. Once the images or videos are transferred to the computer, they can be easily edited, printed, or transmitted (through e-mails).



Figure 1.26 Video input devices (a) Digital camera (b) Web camera

Like digital camera, *web cameras* also capture videos which can be transferred via Internet in real time. Web cameras are widely used for videoconferencing. Webcams are also used as security cameras as PC-connected cameras can be used to watch for movement and sound, recording both when they are detected. These recordings can then be saved in the computer and used to detect theft or any other crime.

1.3.4 Other Output Devices

We can classify the output devices in two categories as shown in Fig. 1.27.

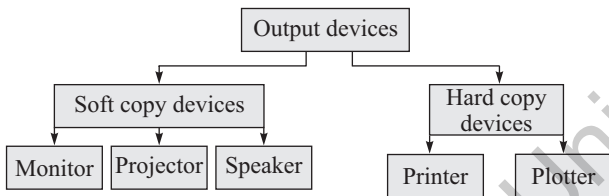


Figure 1.27 Classification of output devices

Soft copy output devices are those output devices which produce an electronic version of an output. For example, a file which is stored on hard disk, CD, pen drive, etc. and is displayed on the computer screen (monitor). Features of a soft copy output include:

- The output can be viewed only when the computer is switched On.
- The user can easily edit the soft copy output.
- Soft copy cannot be used by people who do not have a computer.
- Searching data in a soft copy is easy and fast.
- Electronic distribution of a soft copy is cheaper. It can be done easily and quickly.

Projector A projector (Fig. 1.28) is a device that takes an image from a video source and projects it onto a screen or other surface. These days, projectors are used for a wide range of applications varying from home theater systems for projecting movies and television programs



Figure 1.28 Projector
Source: olegbush/Shutterstock

onto a screen much larger than even the biggest TV available to organizations for projecting information and presentations onto screens large enough for rooms filled with people to see. Projectors also allow users to change/adjust some features of the image like brightness, sharpness, and color settings of the image, in the same way a standard television would.

Speaker With speakers, users can enjoy music, movie, or a game and the voice will be spread through the entire room. However, in case the user wants to enjoy loud music without disturbing the people around him, he can use a headphone. Headphones are small devices that fit in or on the ear, and give nearly the same quality and power of the sound only to the listener.

Users often use headphones to chat with people over the Internet. Another device called headset allows users to talk and listen at the same time while chatting over the Internet. See these devices in Fig. 1.29.

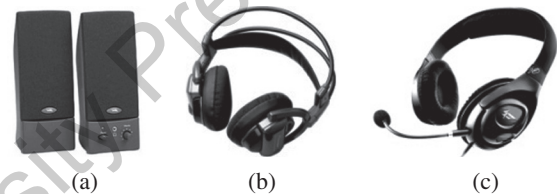


Figure 1.29 (a) Speakers (b) Headphones (c) Headset

Hard copy output devices are those output devices which produce a physical form of output. For example, the content of a file printed on a paper is a form of hard copy output. Features of a hard copy output include:

- Computer is not needed to see the output.
- Editing the hard copy is difficult.
- Hard copy output can be easily distributed to people who do not have a computer.
- Searching data in a hard copy is a tiring and difficult job.
- Distribution of a hard copy is not only costly but also slower.

Printer Printer is a device that outputs text and graphics information obtained from the computer and prints it on to a paper. Printers can be broadly classified into two groups: *impact printers* and *non-impact printers*. Refer Fig. 1.30.

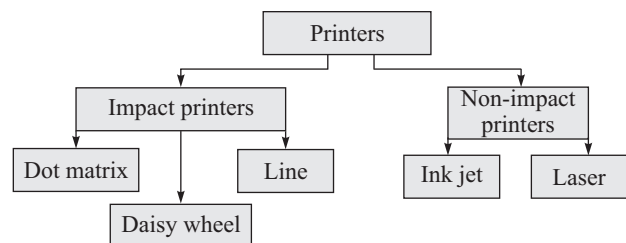


Figure 1.30 Classification of printers

Impact Printer Impact printers create characters by striking an inked ribbon against the paper. Examples of impact printers

include: dot-matrix printers, daisywheel printers, and most types of line printer. Refer to Table 1.1 for its advantages and disadvantages.

Table 1.1 Advantages and disadvantages of impact printer

Advantages	Disadvantages
Enables the user to produce carbon copies	Slow
Cheap	Poor print quality
	Noisy
	Graphics formed are of very poor quality
	Prints only using the standard font

Non-impact Printer Non-impact printers are much quieter than impact printers as their printing heads do not strike the paper. They offer better print quality, faster printing and the ability to create prints that contain sophisticated graphics. Non-impact printers use either solid or liquid cartridge-based ink which is either sprayed, dripped, or electrostatically drawn onto the page. The main types of non-impact printer are: inkjet printer, laser printer, and thermal printer. Refer to Table 1.2 for its advantages and disadvantages.

Table 1.2 Advantages and disadvantages of non-impact printer

Advantages	Disadvantages
Good print quality	Expensive
Noiseless	Ink cartridges are also costly
Good print quality of graphics	
Fast	
Can print text in different fonts	

Laser Printer A laser printer shown in Fig. 1.31 is a non-impact printer that works at a very high speed and produces high-quality text and graphics. It uses the photocopier technology. When a document is sent to the printer, the following steps take place:

- A laser beam ‘draws’ the document on a drum (which is coated with a photo-conductive material) using electrical charges.
- After the drum is charged, it is rolled in toner (a dry powder type of ink).
- The toner sticks to the charged image on the drum.
- The toner is transferred onto a piece of paper and fused to the paper with heat and pressure.
- After the document is printed, the electrical charge is removed from the drum and the excess toner is collected.



Figure 1.31 Laser printer
Source: restyler/Shutterstock

While colour laser printers are also available in the market, users prefer only monochrome printers because a color laser

printer is up to 10 times more expensive than a monochrome laser printer.

Plotter A plotter is a printing device which is usually used to print vector graphics with a high print quality. It is widely used to draw maps, in scientific applications, and in applications such as computer-aided design, computer-aided-manufacturing, and computer-aided-engineering. Architects use plotters to draw blueprints of the structures they are working on.

A plotter is basically a printer that interprets commands from a computer to make line drawings on paper with one or more automated pens. Since plotters are much more expensive than printers, they are used only for specialized applications. Hewlett-Packard is the leading vendor of plotters worldwide. There are two different types of plotters—drum and flatbed (refer Fig. 1.32).



Figure 1.32 Plotter
Source: Michal Vitek/Shutterstock

1.3.5 Computer Memory

Computer memory is an internal storage area in the computer used to store data and programs either temporarily or permanently. No processing is done in the computer memory. A computer memory can be broadly divided into two groups: primary (main) memory and secondary memory. While the main memory holds instructions and data when a program is executing, the secondary memory holds data and programs not currently in use and provides long-term storage. Refer to Table 1.3 to understand the key differences between primary and secondary memory.

Table 1.3 Differences between primary and secondary memory

Primary memory	Secondary memory
It is more expensive.	It is cheaper.
It is faster and more efficient than secondary memory.	It is slower and less efficient than secondary memory.
Directly accessed by the CPU.	Cannot be accessed directly by the CPU.
It is volatile in nature.	It is non-volatile in nature.
Storage capacity is limited.	It has large storage capacity.
It has no moving parts.	It has moving parts.
The memory is power dependent.	The memory is power independent.
The memory is integrated circuit based.	The memory is magnetic or optical based.
It consumes less power.	It consumes more power.
It stores data temporarily.	It stores data permanently.

There are two types of primary memory: RAM and ROM.

Random Access Memory (RAM) RAM is a volatile (stores data only when the power is On) storage area within the

computer typically used to store data temporarily so that it can be accessed by the CPU. The information stored in RAM is loaded from the computer’s hard disk, and includes data related to the operating system and applications that are currently being executed by the processor.

These days, the demand for system RAM has drastically gone up. For example, in the year 2000, a personal computer had only 128 MB of RAM, but in 2015 personal computers have a 1 or 2 GB of RAM installed.

Read Only Memory (ROM) ROM refers to computer memory chips containing permanent data. Unlike RAM, ROM is non-volatile, that is, the data is retained in it even when the computer is turned Off. Refer Table 1.4 to understand the key differences between RAM and ROM.

Table 1.4 Differences between RAM and ROM

RAM	ROM
Data can be read as well as written.	Data can only be read.
Data is stored temporarily.	Data is stored permanently.
Data is stored while the computer is being used by users to hold their data.	Data is stored during the time of fabrication.
It is required while computer is being used by users to run their applications.	It is required for starting the computer, and storing important programs.

Most computers contain a small amount of ROM that stores critical programs which are used to start the computer when it is turned On. Originally, ROM was actually read-only. So, in order to update the programs stored in ROM, the ROM chip had to be removed and physically replaced by the ROM chip that has a new version of the program. However, today ROM chips are not literally *read only*, as updates to the ROM chip are possible. The process of updating a ROM chip is a bit slower as memory must be erased in large portions before it can be re-written. Rewritable ROM chips include PROMs, EPROMs, and EEPROMs.

- **Programmable read-only memory (PROM)** also called one-time programmable ROM can be written to or programmed using a special device called a PROM programmer. The working of a PROM is similar to that of a CD-ROM recorder which enables the users to write programs just once but the recorded data can be read multiple times. Programming a PROM is also called *burning*.
- **Erasable programmable read-only memory (EPROM)** is a type of ROM that can be erased and re-programmed. The EPROM can be erased by exposing the chip to strong ultraviolet light typically for 10 minutes or longer and then rewritten with a process that again needs higher than usual voltage applied.
- **Electrically erasable programmable read-only memory (EEPROM)** allows its entire or selected contents to be

electrically erased, then rewritten electrically. The process of writing an EEPROM is also known as flashing.

1.4 MEMORY HIERARCHY

In contemporary usage, *memory* usually refers to random-access memory, typically DRAM (Dynamic-RAM) but *memory* can also refer to other forms of data storage. In computer terminology, the term *storage* refers to storage devices that are not directly accessible by the CPU (secondary or tertiary storage). Examples of secondary storage include hard disk drives, optical disc drives, and other devices that are slower than RAM but are used to store data permanently.

These days, computers use different types of memory which can be organized in a hierarchy around the CPU, as a trade-off between performance and cost. The memory at a higher level in the storage hierarchy has less capacity to store data, is more expensive, and is fastest to access as shown in Fig. 1.33.

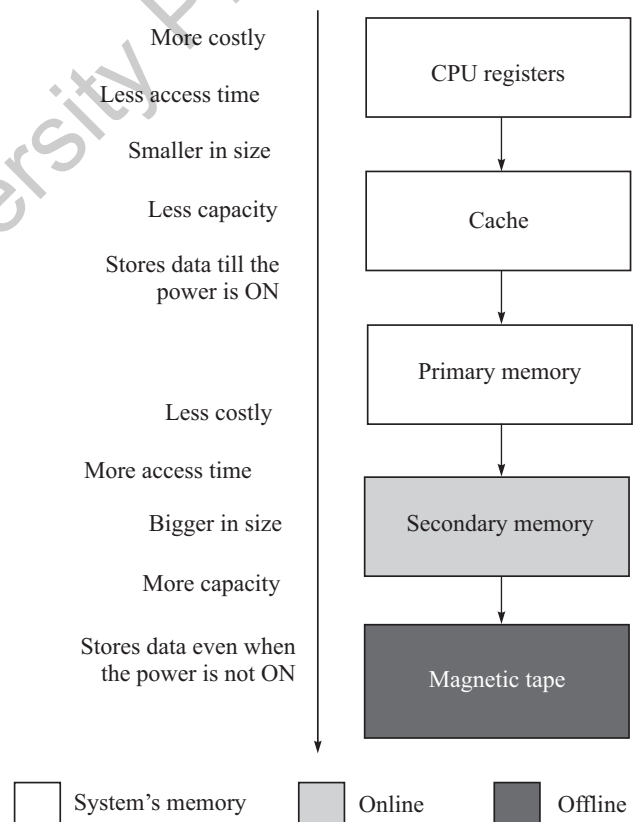


Figure 1.33 Memory hierarchy

CPU Registers CPU registers are located inside the processor and are therefore directly accessed by the CPU. Registers are the fastest of all forms of computer data storage.

Cache Memory Cache memory is an intermediate form of storage between registers and the primary memory. It is used to store instructions and data that are repeatedly required

to execute programs thereby improving the overall system speed and increase the performance of the computer. Keeping frequently accessed data and instructions in the cache avoids accessing the slower primary memory.

Working of the Cache Memory When a program is being executed and the CPU wants to read data or instructions, then the following steps will be performed:

CPU first checks whether the data or instruction is available in cache memory. If it is not present, the CPU reads the data or instructions from the main memory into the processor registers. The CPU also copies it into the cache memory. When the same piece of data/instruction is needed, the CPU reads it from the cache memory instead of the main memory.

Magnetic Tape Magnetic tape (shown in Fig. 1.34) is primarily used as an offline storage device on which the data is recorded and then physically removed or disconnected (off the computer, hence the name). In order to access data from an offline storage device, it must first be inserted in a computer.

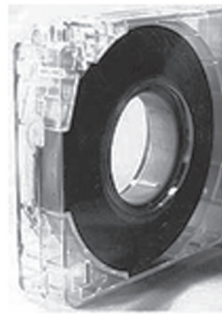


Figure 1.34 Magnetic tape

Off-line storage devices are widely used to keep a backup of important data. For example, if in case of a disaster, the original data gets destroyed, the data can be recovered from the offline devices which are usually stored in another distant place.

Hard Disk The hard drive is a part of the computer that stores all the programs and files. If the drive is damaged for some reason, all the data stored on the computer is lost. The hard disk provides relatively quick access to large amounts of data stored on an electromagnetically charged surface or a set of surfaces. The personal computers today come with a hard disk that can store gigabytes of data.

A hard disk is basically a set of disks stacked together like phonograph records, that has data recorded electromagnetically in concentric circles also known as tracks as shown in Fig. 1.35.

Compact Disk (CD) It uses laser technology to read and write data on the disc. A single CD (shown in Fig. 1.36) can store a large amount of data. They are easily portable from one computer to another and are therefore used to transfer data from one computer to another. The storage capacity of CD-ROM varies from 650 MB to 1 GB. Nowadays, most of the software products (like Microsoft Office, Windows Operating System, etc.) are available on the CDs.

Digital Video Disk or Digital Versatile Disc (DVD) It is an extremely high capacity optical disc with storage capacity from 4.7 GB to 17 GB. DVDs are widely used to store large databases, movies, music, complex software, etc.

Most of the DVDs are double-sided discs as they can store data on both the sides of the disc. Although a DVD resembles a CD in size and shape, it stores information in different manner. When data is recorded on a DVD, the laser starts on the inside of the disc and moves outward. The laser beam has a smaller wavelength and can be focused on two different layers on the disc.

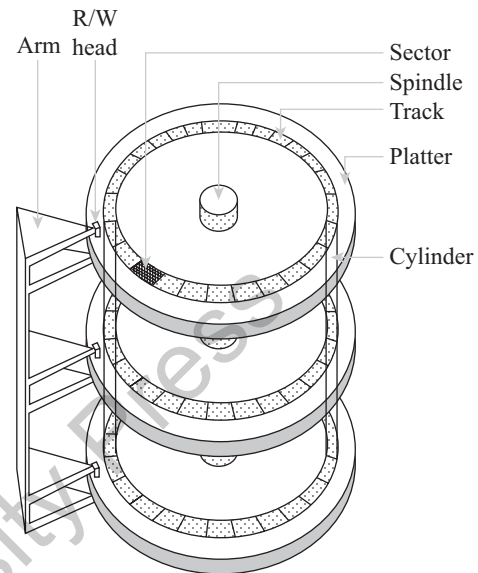


Figure 1.35 Hard disk



Figure 1.36 CD

Source: Italianphoto/Shutterstock/OUP Picture Bank

USB Flash Drive (Pen Drive) USB flash drives (shown in Fig. 1.37) are removable, rewritable, and physically much smaller

drives weighing even less than 30 g. The storage capacity of USB flash drives was as large as 256 GB. Such devices are a good substitute of floppy disks and CD-ROMs as they are smaller, faster, have thousands of times more capacity, and are more durable and reliable. Until approximately 2005, most desktop and laptop computers had a floppy disk drive, but nowadays floppy disk drives have been abandoned in favour of USB ports.



Figure 1.37 USB flash drive

Source: Coprid/Shutterstock/OUP Picture Bank

Memory Cards A memory card (sometimes called a *flash memory card* or a *storage card*) is a small device that can

store a wide range of files as shown in Fig. 1.38. They are easily portable from one place to another. A user can take a memory card, insert it into a computer, store files (such as text documents, pictures, audio files, and video files), and then remove the card and bring it to another computer where it can be again inserted to copy the files on the local disk of that computer.

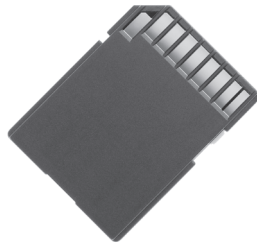


Figure 1.38 Memory card
Source: IlyaAkinshin/Shutterstock/
OUP Picture Bank

Memory cards are smaller, require less power, have higher storage capacity, are less prone to mechanical failures, allow immediate access to data and are portable among a greater number of devices. They are being widely used in the production of an increasing number of small, lightweight, and low-power devices. Although memory cards are far better than hard disks, they could not replace them because memory cards are quite expensive. For example, Compact Flash with a capacity of 192 MB typically costs more than a hard drive with a capacity of 40 GB.

Blue-ray Disc (BD) Blu-ray disk is a new optical disk developed by the Blu-ray Disc Association (BDA), which includes leading companies such as Apple, Dell, Hitachi, HP, JVC, LG, Mitsubishi, Panasonic, Pioneer, Philips, Samsung, Sharp, Sony, TDK, and Thomson. The format of a Blu-ray disk was specifically developed to bring forward a recordable, rewritable disk that can store large amount of data and display a high-definition video (HD).

Although a Blu-ray disk has the same size as that of a CD or a DVD, it can store much more data than a DVD.

A single-sided Blu-ray disk can store 25 GB of data and a dual-layer disk can store 50 GB of data. While CDs and DVDs use a red laser to read and write data, the Blu-ray disk on the other hand uses a blue-violet laser, hence the name Blu-ray. The advantage of using a blue laser with a shorter wavelength of 405 nm than the red laser (650 nm) is that it allows it to focus the laser spot with even greater precision. This means that data can be packed more tightly and therefore stored in less space. Moreover, the storage capacity of this disk is enough to store a continuous backup copy of most people's hard drives on a single disk.

A Blu-ray disk player is backwards compatible with CDs and DVDs and can therefore play a CD or a DVD despite the differences between the types of laser used. However, the Blu-ray disks will not play on CD and DVD players, because those players lack the blue-violet laser required to read the disks.

Blu-ray disks will soon replace the use of CDs and DVDs. They have already been supported by about 200 of the world's leading consumer electronics, personal computer, recording media, video game, and music companies. Besides this, they are also being supported by Hollywood studios and a number of smaller studios that have already announced that they will release new films on Blu-ray disks. Blu-ray disks are

also being used in physical distribution of video games for PlayStation 3, WiiU, PlayStation 4, and Xbox One. Sony's Playstation 3 has a Blu-ray drive installed in it.

Note: Very soon a Blu-ray disc having 20 layers and storing 500 GB of data will be available in the market.

External Hard Disks As the name suggests, an external hard disk (see Fig. 1.39) is a drive that is located outside the computer case in its own enclosure. It is used in addition to internal hard drives to store data. It has become quite popular because of its portability and high-storage capacity.



Figure 1.39 External hard disc

It is connected to the computer system with a high-speed interface cable, usually with plug-and-play interfaces such as USB or FireWire, and may also contain a fan for cooling. While with USB connections, data can move at a rate of 12 to 480 Mbps (megabits per second), FireWire on the other hand can transfer data at speeds ranging from 400 to 800 Mbps. The external hard drive can also be connected to the computer wirelessly.

External drives allow users to save sensitive, confidential, or otherwise important data on them and kept at separate (away from the computer) secure locations. As external hard drives are lightweight portable devices, they can be easily carried anywhere and also be stored in a safe, secure location to protect the data from theft or disaster. Moreover, some external devices come with security features like fingerprint recognition to prohibit other people from gaining access to the stored data.

External hard drives have high storage capacities. External hard disks with a storage capacity of 2TB are very common these days (1 TB = 1000 GB). Therefore, they are often used to back up numerous computer files or serve as a network drive to store shared content. They are extensively used by people who do audio/video editing. These media files require high-quality settings, and therefore consume a large amount of disk space.

1.5 CONCEPT OF HARDWARE AND SOFTWARE

You have a TV at home. When you purchase a TV, it is a box like device. A TV can be used only when it is able to display different programs. You can touch a TV but you cannot touch a program. Same is the concept in a computer. A computer system is made up of two parts—hardware and software.

1.5.1 Hardware

All the physical parts that can be touched are called hardware (refer Fig. 1.40). For example, all input and output devices, memory devices form the hardware part of the computer.

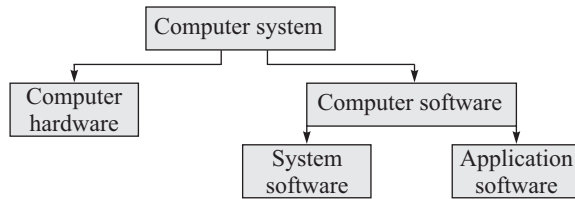


Figure 1.40 Parts of a computer system

If we think of computer as a living being, then the hardware would be the body that does things like seeing with eyes, lifting objects, and filling the lungs with air; the software would be the intelligence that helps in interpreting the images that come through the eyes, instructing the arms how to lift objects, and forcing the body to fill the lungs with air.

Since the computer hardware is a part of a machine, it can only understand two basic concepts: 'on' and 'off'. The 'on' and 'off' concept is called binary. Computer software was developed to tell the computer hardware what to do.

1.5.2 Software

The computer hardware cannot think and make decisions on its own. So, it cannot be used to analyse a given set of data and find a solution on its own. The hardware needs a software (a set of programs) to instruct what has to be done. A program is a set of instructions that is arranged in a sequence to guide a computer to find a solution for the given problem. The process of writing a program is called *programming*.

Computer software can be broadly classified into two groups: system software and application software.

Application Software

Application software is designed to solve a particular problem for users. Examples of application software include MS Word, Power Point, Excel, games, web browser, etc. Simply put, application software represents programs that allow users to do something besides simply run the hardware.

System Software

System software provides a general programming environment in which programmers can create specific applications to suit their needs. It represents programs that allow the hardware to run properly. It acts as an interface between the hardware of the computer and the application software. Fig. 1.41 illustrates the relationship between application software and system software. Table 1.5 illustrates the differences between application and system software.

Examples of System Software System software is computer software designed to operate the computer hardware and to provide and maintain a platform for running application software. The most widely used system software includes:

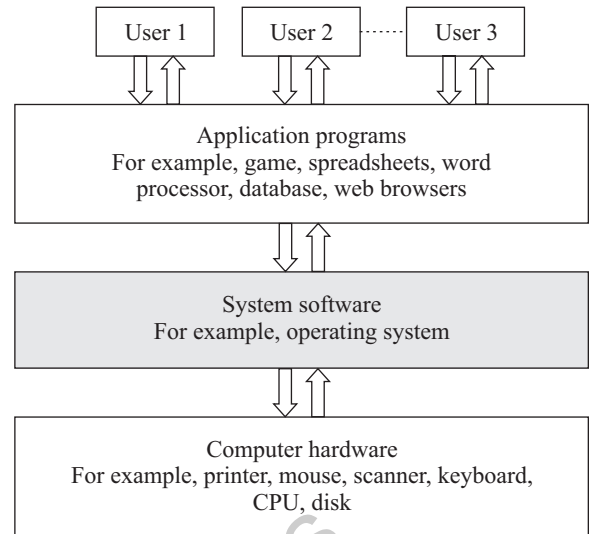


Figure 1.41 System software and application software

Table 1.5 Differences between application and system software

System software	Application software
It is a collection of programs that enable the users to interact with hardware components efficiently.	It is a collection of programs written for a specific application, like, we have library system, inventory control system, etc.
It controls and manages the hardware.	It uses the services provided by the system software to interact with hardware components.
It software is machine dependent.	It is machine independent.
The programmer must understand the architecture of the machine and hardware details to write a system software.	The programmer ignores the architecture of the machine and hardware details to write an application software.
It interacts with the hardware directly.	It interacts with the hardware indirectly through system calls provided by system software.
Writing a system software is a complicated task.	Writing application programs is relatively very easy.
Example: Compiler, operating system	Example: MS Word, Paint

Operating System The primary goal of an operating system is to make the computer system (or any other device in which it is installed like the cell phone) *convenient and efficient to use*. The operating system offers generic services to support user applications.

From the users, point of view the primary consideration is always convenience. Users should find it easy to launch an application and work on it. For example, we use icon which gives us a clue about which application it is. We have a different icon for launching a web browser, e-mail application

or even a document preparation application. In other words, it is the human computer interface which helps to identify and launch an application. The interface hides a lot of details of the instructions that perform all these tasks.

Similarly, if we examine the programs that help us in using input devices like keyboard/mouse, all the complex details of character reading program are hidden from the user. We as users simply press buttons to perform the input operation regardless of the complexity of the details involved. The details are handled by the operating system.

An operating system ensures that the system resources (such as CPU, memory, I/O devices, etc.) are utilized efficiently. For example, there may be many service requests on a web server and each user request need to be serviced. Similarly, there may be many programs residing in the main memory. Therefore, the system needs to determine which programs are active and which need to wait for some I/O operation. The programs that need to wait can be suspended temporarily from engaging the processor. Hence, it is important for an operating system to have a control policy and algorithm to allocate the system resources.

Compiler A compiler is a special type of program that converts source code written in a programming language (the *source language*) into machine language comprising of just two digits—1s and 0s (the *target language*). The resultant code in 1s and 0s is known as the object *code*. The object code is used to create an executable program. The work of a compiler is simply to translate human readable source code into computer executable machine code.

Interpreter Like the compiler, the interpreter also executes instructions written in a high-level language. A program written in a high-level language can be executed in any of the two ways. First, by compiling the program and second, by passing the program through an interpreter.

While the compiler translates instructions written in high-level programming language directly into the machine language, the interpreter translates one statement of high-level language program into machine language, and executes it. Usually, a compiled program executes faster than an interpreted program.

All in all, compilers and interpreters both achieve similar purposes, but inherently different as to how they achieve that purpose.

Assembler An assembler is a system software that converts the code written in assembly language into machine language

Loader A loader is a special type of program that copies programs from a storage device to the main memory, where they can be executed.

Examples of Application Software These days, we have a number of application software packages available in the market for a wide range of applications. The range of these applications vary from simple applications such as word processing, inventory management to complex and scientific applications such as weather forecasting, oil and natural gas

exploration. In this section we will discuss some popular application software.

Word Processing Software (MS Word) A word processor is a software package that enables its users to create, edit, print, and save documents for future retrieval and reference as shown in Fig. 1.42. The key advantage of using a word processor is that it allows the users to make changes to a document without retyping the entire document. Microsoft Word is the world's leading word processing application. Users can create a variety of documents such as letters, memos, résumés, forms, or any other document that can be typed and printed.

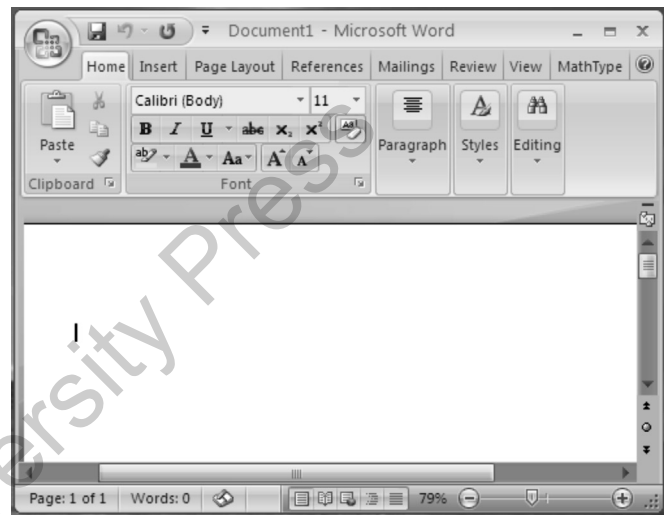


Figure 1.42 MS Word

Spreadsheet Program (Microsoft Excel) A spreadsheet software is the one in which data is stored into spreadsheet rows and columns, or 'cells' which can be formatted in various fonts or colours. Microsoft Excel is an example of a spreadsheet software (as shown in Fig. 1.43) that is basically used to store, organize, and manipulate data. The stored data can also be converted into graphs for analysis.

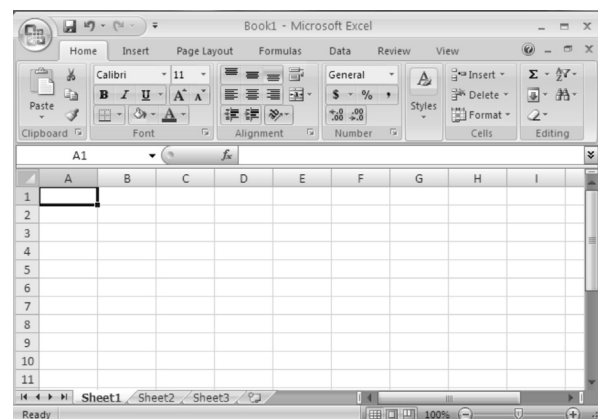


Figure 1.43 MS Excel

Microsoft Excel includes a number of simple as well as complex formulas and functions to calculate variables in the

data. Excel is therefore widely used in finance to automatically calculate variables such as profit, loss, or expenditure.

Presentation Software (Microsoft PowerPoint) Microsoft PowerPoint (as shown in Fig. 1.44) is used to create multimedia presentations and slide shows. When designing presentations on Microsoft PowerPoint, users can add effects on slide transitions, add sound clips, images, animations, or video clips to make the presentation even more interesting for the target audience.

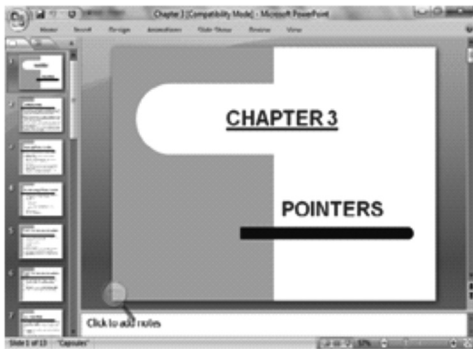


Figure 1.44 MS PowerPoint

In addition to slide shows, PowerPoint also offers printing options to facilitate the users to provide handouts and outlines for the audience as well as note pages for the speaker to refer to during the presentation.

All in all PowerPoint is a one-stop-shop for creating beautiful presentations for business and classrooms. It is also an effective tool for training purposes.

Database Software (Microsoft Access) Microsoft Access (as shown in Fig. 1.45) is a database application which is used to store data for reporting, and analysis.

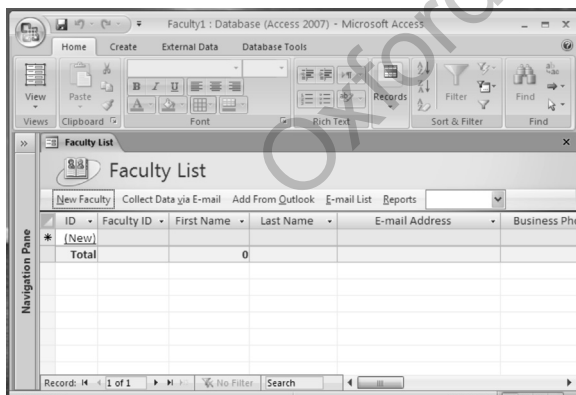


Figure 1.45 MS Access

Microsoft Access is equipped with query interface, forms to input and display data, and reports for printing. In addition to this, Access has features to automate repetitive tasks.

Microsoft Access is particularly appropriate for meeting end-user database needs and for rapid application development.

Graphics Software Graphics software or image editing software is a program that allows users to create and edit

digital images and illustrations. Examples of such software include Adobe Photoshop Illustrator, Paint Shop Pro, MS Paint, etc.

Most graphics programs have the ability to import and export one or more graphics file formats. Some of the graphics applications are given below:

Animation Software It simulates a movement by displaying a sequence of images in a fraction of a second.

CAD Software It is used by architects and engineers to create architectural drawings, product designs, landscaping plans, and engineering drawings. CAD software enables the designers to work much faster. The drawings that were created in several days can now be drawn in a few hours.

Desktop Publishing Software It facilitates users with a full set of word-processing features along with a fine control over placement of text and graphics. Using such an application, the users can easily create newsletters, advertisements, books, and other types of documents.

Multimedia Software Multimedia is a comprehensive term which means different types of media. It includes a combination of text, audio, still images, animation, video, and interactivity content forms.

Multimedia is used for creating exciting advertisements to grab and keep attention of the target audience. It is also used in business to design training programs. In the entertainment industry, multimedia is used to create special effects in movies and animations. It is also used in computer games and some video games that are a popular pastime.

Edutainment which combines education with multimedia entertainment is now emerging as a trend in school as well as higher education. This has made learning theories much simpler than ever before. Moreover, visually impaired or people with other kinds of disabilities can pursue their careers by using training programs specially designed for them.

Multimedia is used by engineers and researchers for modeling and simulation. For example, a scientist can look at a molecular model of a particular substance and manipulate it to arrive at a new substance. Even in medicines, doctors are now trained by looking at a virtual surgery.

Ability Media allows those with disabilities to gain qualifications in the multimedia field so they can pursue careers that give them access to a wide array of powerful communication forms.

1.6 PROGRAMMING LANGUAGES

A programming language is a language specifically designed to express computations that can be performed by the computer. Users write programs to solve a particular problem using a programming language. Some examples of programming language are BASIC, C, C++, COBOL, FORTRAN, Ada, and Pascal to name a few. Each of these languages has a unique set of keywords (words that it understands) and a special syntax for organizing program instructions.

While high-level programming languages are easy for humans to read and understand, the computer actually understands the machine language that consists of numbers only. Each different type of CPU has its own unique machine language.

However, irrespective of what language the programmer uses, the program written using any programming language has to be converted into machine language so that the computer can understand it. There are two ways to do this: compile the program or interpret the program.

1.6.1 Generation of Programming Languages

The concept of generation of programming languages (also known as levels) is closely connected to the advances in technology that brought about computer generations. The four generations of programming languages include machine language, assembly language, high-level language (also known as third generation language or 3GL), and very high-level language (also known as fourth generation language or 4GL).

First Generation—Machine Language This is the lowest level of programming language. The machine language is the only language that the computer understands. All the commands and data values are expressed using 1s and 0s, corresponding to the ‘On’ and ‘Off’ electrical states in a computer.

The main advantage of machine language is that the code can run very fast and efficiently, since it is directly executed by the CPU. However, on the down side, the machine language is difficult to learn and is far more difficult to edit if errors occur. Table 1.6 discusses the advantages and disadvantages of first generation programming languages.

Table 1.6 Advantages and disadvantages of first generation programming languages

Advantages	Disadvantages
Code can be directly executed by the computer.	Code is difficult to write.
Execution is faster and efficient.	Code is difficult for other people to understand.
Programs can be written to efficiently utilize memory.	Code is difficult to maintain.
	There is more possibility of errors to creep in.
	It is difficult to detect and correct errors.

Second Generation—Assembly Language It includes assembly language which is a symbolic programming language that uses symbolic notation to represent machine-language instructions. Assembly language uses symbolic codes also known as *mnemonic* codes that are easy-to-remember abbreviations. Examples of these codes include ADD for add, CMP for compare, MUL for multiply, etc.

An assembly language statement consists of a label, an operation code, and one or more operands. Labels are

optional, operation code (opcode) is a mnemonic that specifies the operation that has to be performed, such as *move*, *add*, *subtract*, or *compare*. The operand specifies the register or the location in main memory from where the data to be processed is located.

The following instructions are a part of assembly language code to illustrate addition of two numbers:

MOV AX,4 Stores the value 4 in the AX register of CPU

MOV BX,6 Stores the value 6 in the BX register of CPU

ADD AX,BX Add the contents of AX and BX register. Store the result in AX register

Table 1.7 discusses the advantages and disadvantages of second generation programming languages.

Table 1.7 Advantages and disadvantages of second generation programming languages

Advantages	Disadvantages
Easier to understand.	Code is machine dependent, thus non-portable.
Easier to write program.	The code cannot be directly executed by the computer.
Easier to detect and correct errors.	
Easier to modify.	
Less prone to errors.	

Third Generation—Programming Language It is a refinement of the second-generation programming language. The 3GL was introduced to make languages more programmer-friendly. They fall somewhere between natural languages and machine languages. 3GL includes languages such as FORTRAN (FORMula TRANslator) and COBOL (COMmon Business Oriented Language) that has made it possible for scientists and business people to write programs using familiar terms instead of obscure machine instructions.

While some high-level languages were specifically designed to serve a specific purpose (such as controlling industrial robots or creating graphics), other languages were flexible and considered to be general-purpose language. Most of the programmers preferred to use general purpose high-level languages like BASIC (Beginners’ All-purpose Symbolic Instruction Code), FORTRAN, PASCAL, COBOL, C++ or Java to write the code for their applications. Table 1.8 discusses the advantages and disadvantages of third generation programming languages.

Fourth Generation—Very High-level Language With each generation, programming languages started becoming easier to use and more like natural languages. However, 4GL is a little different from its prior generation. When writing code using a programming language, the programmer has to tell the computer how a task is done—add this, compare that, do this if the condition is true, and so on, in a very specific step-by-step manner. In striking contrast, while using a 4GL the programmers define only what they want the computer to do, without supplying all the details of how it has to be done.

Table 1.8 Advantages and disadvantages of third generation programming languages

Advantages	Disadvantages
Machine independent.	Code may not be optimized.
Easy to learn and use.	Less efficient code.
Less errors.	Difficult to program code that controls CPU, memory and registers.
Easy to document and understand code.	
Easy to maintain.	
Easy to detect and correct errors.	

A program written using 4GL comprises of instructions written in English-like sentences and is easier to maintain. A typical example of a 4GL is the query language that allows a user to request information from a database with precisely worded English-like sentences.

1.7 REPRESENTATION OF DATA/ INFORMATION

We have seen that computers store and process data to retrieve information. Here,

- *Data* refers to anything that has some interest to the user, and
- *Information* is the result of data processing

The term *data representation* refers to the technique used to represent data internally stored in the computer.

These days, computers store massive amounts of a variety of data such as numbers, text, images, audio and video (as shown in Fig. 1.46). Though all these types of data belong to a different class but internally they all are stored in the same simple format of 1s and 0s.

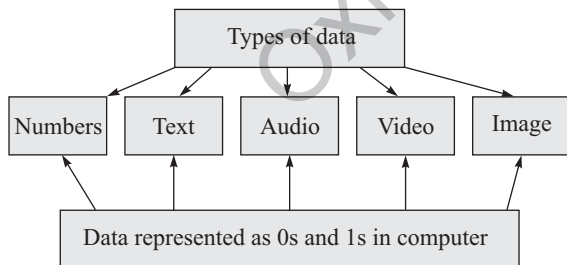


Figure 1.46 Different types of data

Computers are electronic machines which operate using binary logic. These devices use two different values to represent the two voltage levels (0 V for logic 0 and +5 V for logic 1). The two values 0 and 1, therefore, correspond to the two digits used by the binary number system.

The binary number system works like the decimal number system with the following exceptions:

- While the decimal number system uses a base 10, the binary number system on the other hand uses base 2.

- The decimal number system uses digits from 0 to 9 but the binary number system uses only two digits 0 and 1. Any other digit is considered to be invalid in this number system.

Some important terms in binary number system include (as shown in Table 1.9):

Table 1.9 Important terms in binary number system

Term	Size (bits)	Example
Bit	1	0
Nibble	4	1010
Byte	8	0101 1100
Word	16	0101 1100 0101 1100

Bit Bit is a short form of binary digit. It is the smallest possible unit of data. In computerized data a bit can either be 0 or 1.

Nibble Nibble is a group of four binary digits.

Byte Byte is a group of eight bits. A nibble is a half byte. Bits 0 through 3 are called the low order nibble, and bits 4 through 7 form the high order nibble as shown in Fig. 1.47.

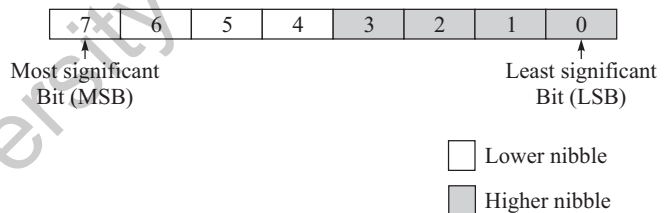


Figure 1.47 Lower and upper nibble

While a single bit can store two different values 2^0 (0 or 1), a byte comprised of 8 bits can store 2^8 or 256 different values.

Note: If a code has 128 different values, then it needs at least 7 bits to represent its values because $2^7 = 128$.

Besides bytes, data is also specified using the units shown in Table 1.10.

Table 1.10 Data units

Unit	Abbreviation	Equal to	Bytes	Power of 2
Byte	Byte	8 Bits	1	20 bytes
Kilobyte	KB	1024 Bytes	1024	210 bytes
Megabyte	MB	1024 KB	1048576	220 bytes
Gigabyte	GB	1024 MB	1073741824	230 bytes
Terabyte	TB	1024 GB	1099511627776	240 bytes

Word A group of two bytes is called a word. Bits 0 through 7 form the low order byte and bits 8 through 15 form the high order byte (refer Fig. 1.48). However, computers today have

redefined word as a group of 4 bytes (32 bits). With 16 bits, the computer can represent 216 (65536) different values.

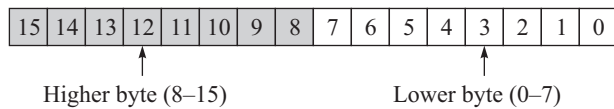


Figure 1.48 Lower and upper byte

Binary Representation with 2 Digits

We have seen that the number of values that can be encoded in binary depends on the number of binary digits. For example, if we have a single digit, we can represent only $2^1 = 2$ values 0 or 1. If we have two digits, we can represent $2^2 = 4$ values—00, 01, 10 and 11. Look at Tables 1.11 and 1.12, which summarize this concept.

Table 1.11 Data values using 2 bits

Number of digits—2	
Data values that can be represented = $2^2 = 4$	
0	00
1	01
2	10
3	11

Table 1.12 Data values using 3 bits

Number of digits—3	
Data values that can be represented = $2^3 = 8$	
0	000
1	001
2	010
3	011
4	100
5	101
6	110
7	111

1.8 CONCEPT OF DATA PROCESSING

Data processing is an activity that involves handling or manipulating data in some way to assign meaning to it. The main aim of processing is to transform data into information.

This means that data processing is the process in which facts and figures are collected, assigned meaning, displayed to users, and stored for future use. Thus, data processing involves a series of actions or operations that converts data into useful information.

From the above discussion, we see that data processing activities can be grouped in four functional steps—data input, data processing, data output, and data storage. These steps constitute a data processing cycle and can be described as follows.

Input Input refers to the set of activities that are performed to record data and to make it available for processing. While recording, data is checked, verified, and validated to avoid errors.

Processing Processing includes data manipulation techniques, such as classifying, sorting, calculating, summarizing, comparing, etc. Processing transforms data into information (refer Fig. 1.49).



Figure 1.49 Processing

Output Output refers to the set of activities that transmits the processed information to the user who needs it.

1.9 APPLICATION OF ICT

ICT or Information, Electronics and Communication Technology is used in various sectors to generate quality manpower. In this section, we will see the applications of ICT in e-governance, multimedia, and entertainment.

1.9.1 E-governance

The term governance means an activity of governing or controlling a country by its government, that is, by the representatives of its people. Taking forward this definition we can say that e-governance means governing a country or a state by using ICT. e-governance enhances the efficiency, effectiveness, transparency, and accountability of exchange of information and transaction:

1. between governments,
2. between government agencies,
3. between government and citizens,
4. between government and businesses.

Besides this, e-governance also aims to provide people the access to information. Government of India is working hard to transform the citizen–government interaction at all levels to the electronic mode (e-governance) by 2020.

India is a country where more than 50% of the population lives in rural areas. In order to improve and sustain the overall prosperity, growth and development, National e-governance Plan (NEGP) seeks to lay the foundation with various projects and provide impetus for long-term e-governance within the country. In fact, some of the schemes have already been introduced and have improved the government services immensely. Some of these schemes include: Mahatma Gandhi National Rural Employment Guarantee Act (MGNREGA), Online Income Tax, Online Central Excise, Unique ID, SETU Project, etc.

The advantages of using ICTs for e-governance include:

- These projects have not only provided better services to the citizens but also saved people as well as government's time and money.
- They ensure good governance, trust and accountability, citizen's awareness and empowerment, citizen's welfare, and nation's economic growth.

- They have sped up the flow of information and knowledge between governments and citizens.
- They have transformed the way in which governments and citizens interact.
- They have improved public services and socio-economic structure of communities.
- They have minimized the processing costs and increased transparency of rural people.

E-government and E-governance

- E-government refers to governments interacting, conducting business, and delivering services to their citizens and private companies electronically through the use of Information and Communications Technology (ICT). This means that ICT enables to realize e-government applications involving Government to Government (G2G), Government to Citizens (G2C), Government to Business (G2B), and Business to Citizen (B2C) transactions to name a few.
- Although both these terms- e-governance and e-government are widely used and often used interchangeably, these two terms are not the same. We must understand the difference between them to have a clear understanding (Table 1.13).

Table 1.13 Differences between e-government and e-governance

E-governance	E-government
A broader term that deals with the whole spectrum of the relationship and networks within government regarding the usage and application of ICT.	A narrower discipline that deals with development of online government services and business.
It defines and assesses the impact of technology on the practice and administration of government.	E-government means everything from 'online government services' to 'exchange of information and services electronically with citizens, businesses, and other arms of government'.
It assesses the relationship between public servants and elected bodies, NGOs or with private sector companies.	It is the use of ICTs for improving the efficiency of government agencies and providing government services online, interacting with citizens, business and enabling innovation in governance.
It lays the steps for implementing e-government services. It involves development, deployment, and enforcement of policies, laws, and regulations for developing cooperation, networking, and partnership between government bodies, citizens, and business.	E-government is the apparatus on which e-governance practices are implemented.
Example: Electronic consultation, electronic management, electronic administration	Example: Electronic voting, electronic service delivery, e-tax e-procurement, electronic transportation, electronic health

Advantages of E-governance

Speed With technology, communication becomes speedier.

Cost Reduction Government spends a lot in procuring stationary items. With e-governance, expenditure on such items is reduced.

Transparency With every piece of information available online, the government process has become transparent. Anybody can see this information anytime and from anywhere.

Accountability Since the governing process has become transparent, the government is automatically made accountable (answerable) to the citizens and thus more responsible.

Convenience It is more convenient to pay the bills or apply for an application sitting at home than standing in big queues. This is especially true for people living in remote areas.

Limitations or Risks Involved in E-governance

Cyber Crime

- Even though government guarantees the safety of citizens' personal data, the websites are still prone to attacks from hackers. Thus, personal data of citizens like home addresses and bank account information can be compromised due to lack of sound security measures.

Costly Infrastructure

- The concept of e-governance comes with a huge cost both for government as well as for its citizens. The citizens must have Internet-enabled devices, hardware such as routers, and a connection to connect to government websites. Government must also have advanced servers and security systems to manage a large amount of information and complex cyber threats. All these requirements make it a costly investment.

Inaccessibility

- The websites on the Internet are not accessible to everyone in a country like India where a major part of the population is illiterate, living below the poverty line or in remote areas where Internet and Internet-enabled devices are still not prevalent.

1.9.2 Multimedia and Entertainment

Multimedia and animation that combine still images, moving images, text, and sound in meaningful ways have become the most powerful aspects of computer technology. We all have seen cartoon movies which are nothing but an example of computer animation.

Note: Displaying a number of still images within a fraction of a second gives an animation effect. For example, displaying at least 30 still images in a second gives an effect of a moving image.

- Animation is an easy and effective way to show complex interactions or events. Thus, it is an excellent tool for educating the audience.
- These days animation is being used to replicate events.
- Using animation software, we can reproduce real-world phenomena such as fire, smoke, fluids, movement of chemicals through the air and ground, the respiratory system to name a few.
- A dynamic multimedia presentation (created using tools like MS PowerPoint) can make the message not only comprehensible but also effective.
- Multimedia presentation helps corporate people to share information or their ideas and graphically present information in a more comprehensible and persuasive manner.
- Multimedia presentations can be recorded and played or displayed dynamically depending on the user's inputs.
- Multimedia and animation are used to create computer games.
- A laser show is also an example of a multimedia application.
- Multimedia and animation are used to add special effects in movies.
- They are used to create advertisements.
- In education, multimedia is used to prepare training courses.
- In medicine, doctors and surgeons are trained by showing them a virtual surgery or by simulating how the human body is affected by diseases spread by viruses and bacteria. This would help them to develop techniques to cure those diseases.
- Students find it difficult to learn complex computer algorithms and data structures by just reading a textual explanation. However, they find it interesting by interacting with an animation of the algorithm.

Note: Edutainment is the combination of education and entertainment.

Electronic Encyclopedia

These days, several companies like Grolier, Compton's, and Microsoft have started distributing electronic encyclopedias. These encyclopedias are distributed on CD-ROM, and have a user interface that permits students to search for information and then either save relevant data to a disk or print a hard copy.

Electronic encyclopedias can be used in the same way as we use the printed ones with the added benefits of electronic support for organizing, copying, and printing material from them. Electronic encyclopedias have more text and illustrations than their printed variants. Most of them also have movies, sound, and audio to help you understand in a better way. For example, when you are studying about Swami Vivekananda, then besides reading his speeches you can also hear them.

Interactive Television

Interactive TV (iTV) is any television with a 'return path'. The term return path means that information flows not only from the broadcaster to the viewer, but also from the viewer to the broadcaster.

An iTV system offers its viewers a different choice of content. That is, viewers select which programs they want to view, which channels they would like to pay for, etc.

Besides this, viewers can participate in quizzes, surveys, and games while sitting at their homes. They can do home shopping (like order a pizza) without dialing a phone, pause live TV or record shows, rent a film and click on advertisements to find out more about the product. This means that iTV facilitates viewers to communicate with advertisers and programming executives. For example, BBC has split their news stories into themes such as 'sport', 'entertainment', 'weather'. The viewer can press the 'interactive' button on the remote control to select which video clips they want to watch on the topic of their choice.

Note: iTV is the integration of traditional television technology and data services.

Set top box is an important component of iTV. It is used to select the show, see the schedule, and give advanced options like ordering products shown in ads, as well as accessing e-mail and Internet.

The users of an iTV can send information back to the broadcaster. This path can be established using a cable, telephone lines or any data communication technology. The most widely used return path is a broadband IP connection. iTV aims to provide an engaging experience to the viewers. An iTV can also be controlled using devices other than the remote control, like mobile phones and tablets.

SUMMARY

- With each new generation of computers, there had been advancement in computer technology.
- Besides being very fast and accurate, computers are automatic devices which perform execution without any user intervention.
- The computer storage space stores not only the data and programs but also stores the intermediate results and the final results of processing.
- Application software is designed to solve a particular problem for users. Examples of application software include MS Word, PowerPoint, Excel, games, web browser, etc.

- A system software provides a general programming environment in which programmers can create specific applications to suit their needs.
- The primary goal of an operating system is to make the computer system (or any other device in which it is installed, like the cell phone) convenient and efficient to use.
- Compilers and interpreters are special types of programs that convert source code written in a programming language (*source*

language) into machine language comprising of just two digits—1s and 0s (*target language*).

- Multimedia includes a combination of text, audio, still images, animation, video, and interactivity content forms.
- A programming language is a language specifically designed to express computations that can be performed by the computer.
- Data processing is the process in which facts and figures are collected, assigned meaning, displayed to users, and stored for future use.

KEYWORDS

Assembler System software that converts the code written in assembly language into machine language.

Bit Short form of binary digit. It is the smallest possible unit of data. In computerized data a bit can either be 0 or 1.

Byte A group of eight bits.

Clicking Pressing either the left or the right button of the mouse.

Computer A machine that takes instructions and performs computations based on those instructions.

Data A collection of raw facts or figures.

Dragging Moving an object to the desired position by pressing the left button.

E-governance Governing a country or a state by using ICT.

Hard copy output devices Output devices that produce a physical form of output.

Information Processed data that provide answers to ‘who’, ‘what’, ‘where’, and ‘when’ types of questions.

Input The process of entering data and instructions into the computer system.

Instructions Commands given to the computer that tell what it has to do.

Knowledge The application of data and information to answer the ‘how’ part of the question.

Loader A special type of program that copies programs from a storage device to main memory, where they can be executed.

Memory An internal storage area in the computer used to store data and programs either temporarily or permanently.

Nibble A group of four binary digits.

OMR The process of electronically extracting data from marked fields.

Output The process of giving the result of data processing to the outside world.

Processing The process of performing operations on the data as per the instructions specified by the user.

Program A set of instructions that are arranged in a sequence to guide a computer to find a solution for the given problem.

Programming The process of writing a program.

Soft copy output devices Output devices that produce an electronic version of an output.

Software A set of programs.

Storage The process of saving data and instructions permanently in the computer so that it can be used for processing.

Word A group of two bytes.

MODEL QUESTIONS

Multiple Choice Questions

- A computer works on _____ given to it.
 - Computations
 - Instructions
 - Data
 - b and c
- In which of the following machine(s) are computers used?
 - GPS
 - ATM
 - Gas pumps
 - All of these
- Computer is a _____ machine.
 - Electrical
 - Mechanical
 - Electronic
 - Physical
- _____ is a collection of raw facts or figures.
 - Data
 - Information
 - Knowledge
 - Instructions
- _____ comprises processed data.
 - Data
 - Information
 - Knowledge
 - Instructions
- Commands given to the computer that tells what it has to do are _____.
 - Data
 - Information
 - Knowledge
 - Instructions
- A set of programs is called _____.
 - Hardware
 - Software
 - Instructions
 - Manuals
- Which generation of computers were used in the period 1955–1964?
 - First
 - Second
 - Third
 - Fourth
- Which of the following were used for manufacturing first generation computers?
 - Vacuum tubes
 - Transistors
 - Integrated chips
 - ULSI
- Select the computer(s) in the first generation of computers.
 - ENIAC
 - EDVAC
 - EDSAC
 - All of these

11. Which of the following were used for manufacturing first generation computers?
 - a. Vacuum tubes
 - b. Transistors
 - c. Integrated chips
 - d. ULSI
12. Select the computer(s) in the second generation of computers.
 - a. UNIVAC LARC
 - b. EDVAC
 - c. EDSAC
 - d. All of these
13. Which generation of computers were manufactured using ICs with LSI and later with VLSI technology?
 - a. First
 - b. Second
 - c. Third
 - d. Fourth
14. In which computer generation did microcomputers come into existence?
 - a. First
 - b. Second
 - c. Third
 - d. Fourth
15. Currently on which generation of computers are we working?
 - a. First
 - b. Fifth
 - c. Third
 - d. Fourth
16. Which type of software enables you to create page layouts for entire books?
 - a. Chatting
 - b. Word processing
 - c. Desktop publishing
 - d. Spreadsheet
17. Name an Indian supercomputer.
 - a. UNIVAC LARC
 - b. EDVAC
 - c. EDSAC
 - d. CRAY XMP
18. CRAY XMP is used for _____.
 - a. Education
 - b. Multimedia and entertainment
 - c. Weather forecasting
 - d. Banking
19. Which type of computer system is used by managers to analyse their business?
 - a. Robots
 - b. DSS
 - c. Expert system
 - d. Supercomputer
20. Which type of computer system is the best for analysing the credit histories for loan approval?
 - a. Robots
 - b. DSS
 - c. Expert system
 - d. Supercomputer
21. The process of entering data and instructions into the computer system is called _____.
 - a. Input
 - b. Output
 - c. Processing
 - d. Result
22. Computer understands only _____ language.
 - a. Assembly
 - b. Binary
 - c. High level
 - d. SQL
23. In which part of the CPU are all computations performed?
 - a. CU
 - b. MU
 - c. ALU
 - d. Registers
24. Which of the following is called the brain of the computer system?
 - a. CU
 - b. MU
 - c. ALU
 - d. CPU
25. _____ is the main input device.
 - a. Mouse
 - b. Joystick
 - c. Keyboard
 - d. Touch screen
26. Which keys are used by applications and operating systems to perform specific commands?
 - a. Function
 - b. Numeric
 - c. Arrow
 - d. Typing
27. Which key cancels the selected option?
 - a. Home
 - b. End
 - c. Page Up
 - d. Esc
28. Which key captures everything on the screen as an image?
 - a. Control
 - b. Function
 - c. Print screen
 - d. Insert
29. GUI stands for _____.
 - a. Graphical User Interface
 - b. Graphical User Input
 - c. Graphically Used Interface
 - d. Geometrical User Input
30. Name a cursor control device widely used in computer games and CAD/CAM applications.
 - a. Keyboard
 - b. Joystick
 - c. Mouse
 - d. Stylus
31. _____ is a pen-shaped input device used to enter information or write on the touch screen of a phone.
 - a. Keyboard
 - b. Joystick
 - c. Mouse
 - d. Stylus
32. Which input device will be used to convert a printout into its digital image?
 - a. Bar code reader
 - b. MICR reader
 - c. Scanner
 - d. OMR
33. Which of the following converts audio data into digital data?
 - a. Sound card
 - b. Video card
 - c. Headphone
 - d. Microphone
34. Digital camera and web camera are popular examples of a _____ input device.
 - a. Audio
 - b. Video
 - c. Graphics
 - d. Pointing
35. Which output device is used in home theater systems?
 - a. Printer
 - b. Plotter
 - c. Projector
 - d. Speakers
36. Which device allows users to talk and listen at the same time?
 - a. Speaker
 - b. Headphone
 - c. Microphone
 - d. Headset
37. A printer can print carbon copies of a document. Which printer are we talking about?
 - a. Laser
 - b. Inkjet
 - c. Dot matrix
 - d. Thermal
38. A printer can print only using the standard font. Which printer are we talking about?
 - a. Laser
 - b. Inkjet
 - c. Dot matrix
 - d. Thermal
39. If you want to print graphics of high quality, which printer would you use?
 - a. Inkjet
 - b. Band
 - c. Any of them
 - d. Both of them
40. Which device will you use to print vector graphics with a high print quality?
 - a. Laser printer
 - b. Projector
 - c. Plotter
 - d. Dot matrix printer
41. Which device will you use to draw maps?
 - a. Laser printer
 - b. Projector
 - c. Plotter
 - d. Dot matrix printer
42. _____ is the leading vendor of plotters worldwide.
 - a. Hewlett-Packard
 - b. Google
 - c. Microsoft
 - d. Nokia
43. Which memory holds data and programs not currently in use and provides long-term storage?
 - a. RAM
 - b. ROM
 - c. Primary memory
 - d. Secondary memory
44. Which memory contains permanent data?
 - a. RAM
 - b. ROM
 - c. Primary memory
 - d. Secondary memory

45. Which storage device will you use to back up large amount of data?
 a. Magnetic hard disk b. ROM
 c. RAM d. Magnetic tape
46. Identify the storage device—an optical disc with storage capacity from 4.7 GB to 17 GB.
 a. CD b. Blu Ray
 c. DVD d. Hard disk
47. Identify the storage device—an optical disc with storage capacity of 256 GB.
 a. CD b. Blu Ray
 c. Memory card d. USB flash drive
48. Which of the following enables the users to interact with hardware components efficiently?
 a. Application software
 b. Communication software
 c. Presentation software d. System software
49. Which of the following ensures that the system resources are utilized efficiently?
 a. Compiler b. Operating system
 c. Utility software d. Application software
50. Which of the following copies programs from a storage device to the main memory?
 a. Compiler b. Interpreter
 c. Assembler d. Loader
51. Which application software is used to write letters, memos, resumes, or forms?
 a. Microsoft Word b. Microsoft Excel
 c. Microsoft Access d. All of these
52. Which of the following has complex formulas and functions to calculate variables in the data?
 a. Microsoft Word b. Microsoft Excel
 c. Microsoft Access d. All of these
53. Which of the following is used for database queries and reporting?
 a. Microsoft Word b. Microsoft Excel
 c. Microsoft Access d. All of these
54. Adobe Photoshop Illustrator, Paint Shop Pro, and MS Paint are examples of _____ software.
 a. Word processing b. Spreadsheet
 c. Database d. Graphics
55. To display a sequence of images in a fraction of a second, you will need a _____ software.
 a. Graphics b. Animation
 c. Presentation d. Utility
56. Which software is used by architects and engineers to create architectural drawings, product designs, landscaping plans, and engineering drawings?
 a. Graphics b. CAD
 c. Presentation d. CAM
57. Code written in which language can be directly executed by the computer?
 a. Compiled b. Assembly
 c. Binary d. Interpreted
58. _____ is a mnemonic that specifies the operation that has to be performed.
 a. Operand b. Opcode
 c. Label d. Comment
59. Query language is an example of which generation programming language?
 a. First b. Second
 c. Third d. Fourth
60. A group of 4 binary digits is called a _____.
 a. Bit b. Nibble
 c. Byte d. Word
61. A group of 8 binary digits is called a _____.
 a. Bit b. Nibble
 c. Byte d. Word

True or False

- A computer can perform thousands of instructions in one second.
- First generation of computers required an entire room for installation.
- First generation of computers were used for commercial applications.
- Knowledge is the application of data and information.
- Computer and all its physical parts are known as software.
- 1942–1955 marks the second generation of computers.
- Machine/assembly language was used in first generation of computers.
- Vacuum tubes and transistors emit a large amount of heat.
- First generation of computers were expensive than third generation of computers.
- Third generation of computers were more difficult to install and maintain than the computers of first generation.
- In second generation of computers, high level programming languages were used.
- Computers of fourth generation are faster, smaller, cheaper, more reliable, and more powerful than the computers of first generation.
- SSI and MSI technology was used in fourth generation of computers.
- Pascal, COBOL, FORTRAN, and BASIC are all low level programming languages.
- High speed computer networks in the form of LANs, WANs, and MANs started growing in third generation of computers.
- Computer is a reliable machine.
- If input data is wrong, then the output will also be erroneous.
- When data and programs have to be used, they are copied from the primary memory into the secondary memory.
- Computers cannot make decisions on their own.
- Robots are computer-controlled machines.
- Robots cannot work in high temperature, high pressure conditions, or in processes which demand very high level of accuracy.
- Managers use DSS to plan effective strategies for penetrating their markets.
- Secondary memory is faster than primary memory.
- Your computer has more primary memory than secondary memory.
- CPU can directly access primary memory.
- Primary memory can be used for storing data permanently.
- ALU manages and controls all the components of the computer system.
- VDU is an input device.

29. Mouse can be used to create graphics such as lines, curves, and freehand shape on the screen.
30. Scanner is an input device.
31. OMR is used to verify the legitimacy or originality of paper documents.
32. A computer with a microphone and speakers can be used for videoconferencing.
33. Webcams are used for videoconferencing and as security cameras.
34. Soft copy output can be seen even when the computer is switched off.
35. Hard copy output cannot be used by people who do not have a computer.
36. Searching data is faster in a soft copy output.
37. Electronic distribution of a hard copy is cheaper, faster, and easier than soft copy.
38. You can change the brightness, sharpness, and colour settings of the image when using a projector.
39. Non-impact printers create characters by striking an inked ribbon against the paper.
40. Dot-matrix and daisywheel printers are examples of impact printers.
41. Laser printers cannot print text of different fonts.
42. Critical programs which are used to start the computer when it is turned on are stored in RAM.
43. Hard disk drive is an example of ROM.
44. A CD uses laser technology to read and write data on the disc.
45. CDs can store data on both sides of the disc.
46. Application software provides a general programming environment in which programmers can create specific applications to suit their needs.
47. Compiler and operating system is an example of application software.
48. MS Word and Paint are examples of application software.
49. Compiler translates one statement of high level language program into machine language and executes it.
50. A compiled program executes slower than an interpreted program.
51. Microsoft Excel is a word processing software.
52. Binary language programs can be written to efficiently utilize memory.
53. Labels are optional in assembly language.
54. Assembly language code is machine dependant.
55. A byte consists of 16 binary digits.
56. The main aim of data processing is to transform data into information.
57. Multimedia includes only text.
58. Animation involves displaying at least 30 still images in a fraction of a second.

ANNEXURE 1

LAB SESSION—INSIDE THE COMPUTER

As a part of this chapter, the instructor must show the parts of the computer to the students, as illustrated in Fig. A.1.

The following are some of the major parts of the computer:

CPU The CPU is the brain of the computer. It performs all calculations and controls the devices connected to the computer system. The faster the CPU, the quicker programs can process the instructions.

RAM A fast CPU is of no use if the computer does not have sufficient RAM. As discussed earlier, RAM is the computer's memory which stores information used by applications that are currently being executed by the CPU. More memory means more applications can be executed at the same time without degrading the system's performance.

Hard disk drive (HDD) The HDD of the computer is the secondary memory of the computer system where information is stored permanently. All types of data, documents, and programs are stored on the hard disk. The larger the hard disk, the more the amount of data that can be stored on the drive. Though the size of the HDD does not affect the speed of execution of the program, it does affect the speed at which the user can access his/her files.

Video card The video card is a board that plugs into the motherboard of the computer and generates images for display. Many video cards these days have their own RAM

and processor to enhance the speed of the graphics display. Many computers come with an in-built video chip. In such a computer, a separate video card is used only if the computer has to be used for high-end multimedia work or to play video games.

Sound card As with video cards, sound cards are expansion boards that are used to enable a computer to manipulate sound. For example, sound cards allow the users to plug in speakers and a microphone. Some sound cards also provide the jacks for hooking your computer up to a common stereo. These days, many computers come with a built-in sound chip, which makes it unnecessary to buy a separate card unless a higher quality of sound is needed.

Modem A modem (modulator–demodulator) is a device that enables the computer to use a telephone line to communicate and connect to the Internet.

Network card A network card is used to connect the computer either to other computers or to the Internet (in case you are using a fast Internet connection such as cable or DSL).

Fans There are one or more fans inside the computer to keep the air moving and the computer cool.

Cables There are multiple wires inside the computer that are flat, ribbon-like cables. They are used to provide power and communication to the various parts inside the computer.

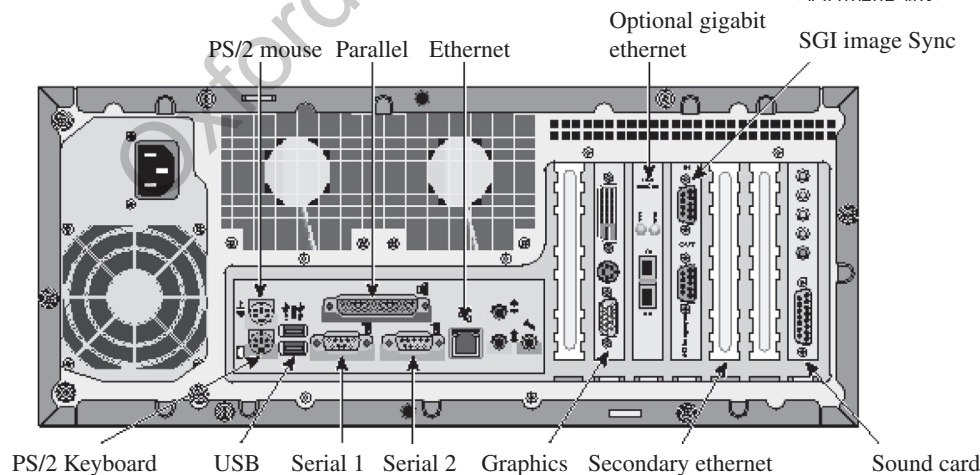


Figure A.1 Computer case and its parts

MOTHERBOARD

The motherboard, also known as the mainboard or the parent board (refer Fig. A.2), is the primary component of a computer.

It is used to connect all the components of the computer. The motherboard is a printed circuit that has connectors for expansion cards, memory modules, the processor, etc.

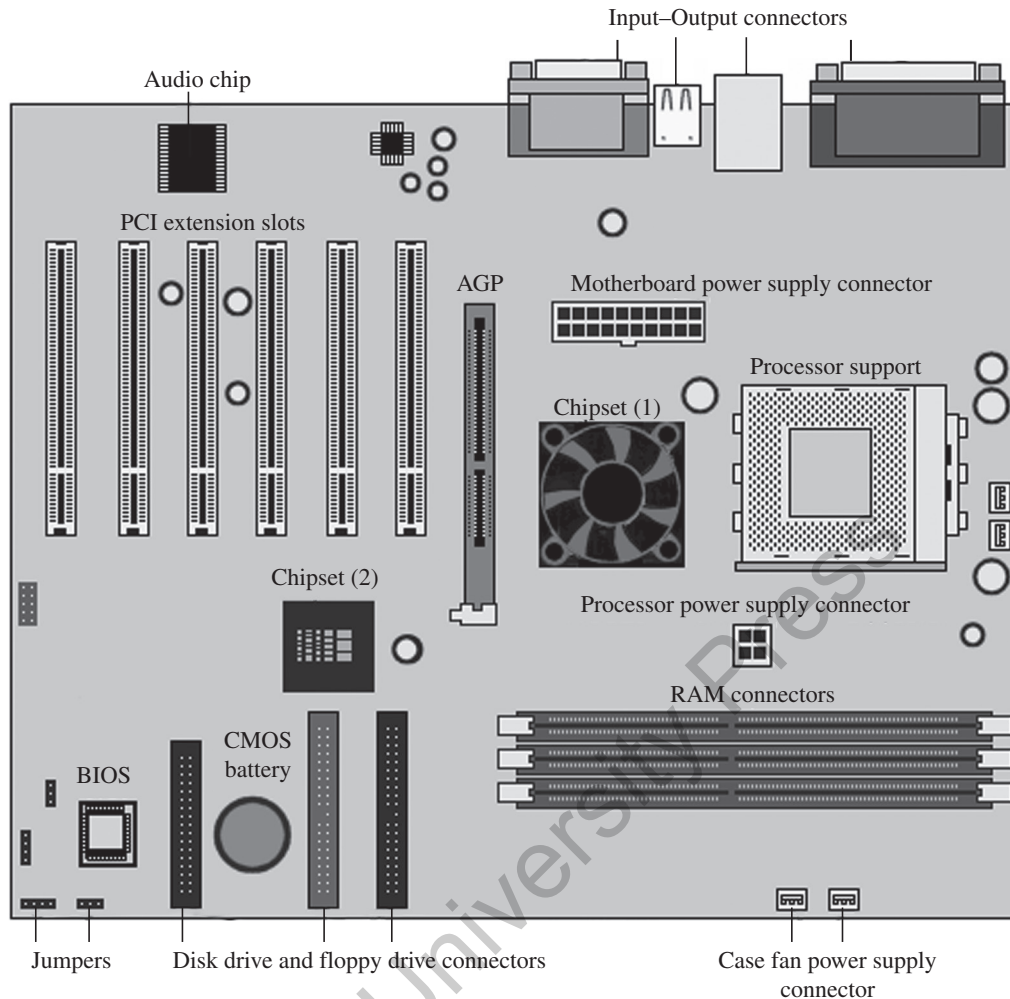


Figure A.2 Computer's motherboard

Characteristics of a Motherboard

A motherboard can be classified depending on the following characteristics:

- Form factor
- Chipset
- Type of processor socket used
- Input-Output connectors

Form factor Form factor refers to the motherboard's geometry, dimensions, arrangement, and electrical requirements. The industry has defined a few standards for the form factors, so that they can be used in different brands of cases.

Integrated components Some of the motherboard's components are integrated into its printed circuitry. These include the following:

- The chipset is a circuit that controls the majority of the computer's resources such as the bus interface with the processor, cache memory, RAM, expansion cards, etc.
- CMOS clock and battery
- BIOS
- System bus and expansion bus

In addition to these, the latest motherboards also have a number of onboard multimedia and networking devices (which can be disabled), such as integrated network card, integrated graphics card, integrated sound card, and upgraded hard drive controllers.

Chipset The chipset is an electronic circuit that basically coordinates data transfers between the different components of the computer (such as the processor and memory). In order to enhance the computer's upgradeability, one must choose a motherboard that has the latest chipset integrated in it. Some chipsets may include a graphics or audio chip, which makes it unnecessary to install a separate graphics card or sound card. However, in case you need very high quality of audio and visual capabilities, then you must disable the graphics/audio chip in the BIOS setup and install high-quality expansion cards in the appropriate slots.

CMOS clock and battery The real-time clock (or RTC) is a circuit that is used to synchronize the computer's signals. When the computer is switched off, the power supply stops providing electricity to the motherboard. You must have observed that when we turn on the system, it always displays the correct time. This is because an

electronic circuit, called the complementary metal-oxide semiconductor (CMOS) chip, saves some system information, such as the time, date, and other essential system settings.

The CMOS chip is powered by a battery located on the motherboard. Information on the hardware installed in the computer (such as the number of tracks or sectors on each hard drive) is stored in the CMOS chip. Since the CMOS chip is quite slow, some systems prefer to copy the CMOS chip's content into the RAM, which is a comparatively faster storage. This process of copying data into RAM is better known as *memory shadow*.

Have you noticed that, at times, the system time gets reset automatically, or the clock runs late? This indicates that you need to change the battery.

BIOS The basic input/output system (BIOS) is an interface between the operating system and the motherboard. The BIOS is stored in the read-only memory (ROM), which cannot be rewritten. The BIOS uses data stored in the CMOS chip to know about the system's hardware configuration.

To configure the BIOS, the user can use an interface known as *BIOS setup*, which can be accessed when the computer is booting. To enter BIOS setup, the user must press the DEL key. F1 and F2 keys can also be used.

Processor socket The processor (also called the *micro-processor*) is the brain of the computer. The processor is characterized by its speed or frequency, which is the rate at which it executes instructions. For example, an 800-MHz processor can perform 800 million operations per second.

The slot on the motherboard into which the processor is inserted is called the *processor socket* or *slot*. Irrespective of whether you use a slot or a socket, you must gently insert the processor, so that none of its pins are bent (it has hundreds of them). Usually, a concept called *zero insertion force* (ZIF) is used. The ZIF sockets allow the processor to be inserted very gently and easily.

When the computer is on, the processor is working and it releases heat, which must be dissipated to keep the circuits from melting. Therefore, the processor is generally

mounted on a cooler that is made of metal (such as copper or aluminum), which conducts heat well. In addition to the cooler, there is also a fan to improve air circulation around it and to improve the heat transfer. The fan vents hot air from the case and lets fresh air come in from outside.

RAM connectors RAM is the primary storage area that stores data while the computer is running. However, its contents are erased when the computer is turned off or restarted. While the hard disk can store data permanently, we still need RAM because it is extremely fast when compared to mass storage devices such as hard drives. Therefore, the fast processor accesses data from RAM and not from the hard disk. The data is transferred from the hard disk to the RAM, from where it is used by the processor. RAM is available in the form of modules that plug into motherboard connectors.

Expansion slots Expansion slots are compartments into which expansion cards can be inserted. Such cards render new features or enhance the computer's performance. For example, the AGP slot (also known as Accelerated Graphic Port) is a fast port used for graphics cards.

I/O connectors The motherboard has a number of input-output sockets (Fig. A.3) on its rear panel, some of which include:

- A serial port to connect some old peripherals.
- A parallel port to connect old printers.
- USB ports to connect more recent peripherals such as mouse and pen drive.
- RJ45 connector (also known as LAN or Ethernet port) to connect the computer to a network. It corresponds to a network card integrated into the motherboard.
- Video graphics array (VGA) connector to connect a monitor. This connector interfaces with the built-in graphics card.
- Audio plugs that include the *line in*, *line out*, and *microphone* to connect sound speakers, hi-fi system, or microphone. This connector interfaces with the built-in sound card.

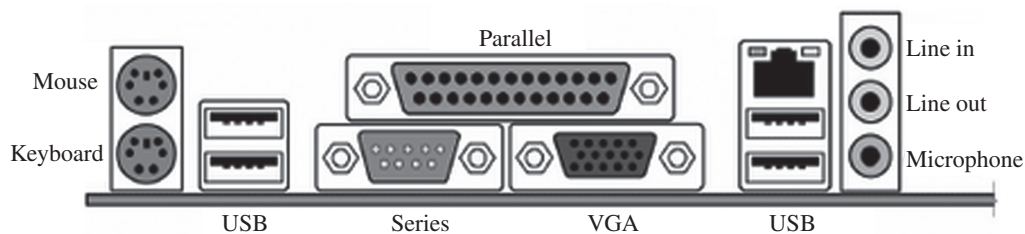


Figure A.3 I/O connectors