into a single system and gave it a name UNIX System III. Many new features and advancements were brought out by Bell Laboratories in this version. It was given the name UNIX System V. The people at University of California at Berkeley developed a variant to the UNIX System. Its recent version is called 4.3 BSD for VAX machines. It provided many new and interesting features.

By the beginning of 1984, UNIX system was installed at about 1,00,000 different computer sites. It ran on a wide range of computers ranging from a minicomputer to a mainframe. No other operating system can make such a claim. Many of the programs of the UNIX Operating System are written in C. However, the UNIX system can support many other languages also like Fortran, Basic, Pascal, Ada, Cobol, Lisp and Prolog.

Features of UNIX

UNIX is such an operating system that can be run on a wide range of machines, from micro-computers to mainframes. There are a variety of reasons that have made UNIX an extremely popular operating system.

(*i*) **Portability.** As of today, there are innumerable computer manufacturers through out the world. Therefore, the hardware configurations also keep varying from one vendor to another. The positive and strong thing about UNIX is that it is running successfully on all these computers. The reason behind UNIX's portability is that it is written in a high-level language that has made it easier to read, understand and change. Its code can be changed and compiled on a new machine. PCs, Workstations, Minicomputers, Super Computers and Mainframes run the UNIX operating system.

(*ii*) **Machine Independent.** The UNIX system does not make the machine architecture transparent to the user. Thus, it becomes very easy to write applications that can run on micros, minis or mainframes.

(*iii*) **Multi-user Capability.** As discussed earlier, UNIX is a multi-user system. A multi-user system is a system in which the same computer resources like hard disk, memory, etc. can be used or accessed by many users simultaneously. Each user is given a terminal (a keyboard and a monitor). Each terminal is an input and an output device for the user. All the terminals are connected to the main computer. So, users sitting at any terminal can not only use the data or the software of the main computer but also the peripherals like printers attached to it. In UNIX terminology, the main computer is called the server or the console.

(*iv*) **Multitasking Capability.** UNIX has the facility to carry out more than one job at the same time. This feature of UNIX is called Multitasking. You can keep typing in a program in its editor while at the same time OS execute some other command given earlier like copying a file, displaying the directory structure, etc. The

latter job is performed in the background and the earlier job in the foreground.

(*v*) **Software Development Tools.** UNIX offers an excellent environment for developing new software. It provides a variety of tools ranging from editing a program to maintenance of software.

(*vi*) **Built in Networking.** UNIX has got built in networking with a large number of programs and utilities. It also offers an excellent media for communication with other users. The users have the liberty of exchanging mail, data, programs, etc. You can send your data at any place irrespective of the distance.

(*vii*) **Security.** UNIX supports a very strong security system. It enforces security at three levels. Firstly, each user is assigned a login name and a password. So, only the valid users can have access to the files and directories. Secondly, each file is bound around permissions (read, write, execute). The file permissions decide who can read or modify or execute a particular file. The permissions once decided for a file can also be changed from time to time. Lastly, file encryption comes into picture. It encodes your file in a format that cannot be very easily read. So, if anybody happens to open your file, even then he will not be able to read the text of the file. However, you can decode the file for reading its contents. This is called decryption.

The following features make UNIX a unique operating system:

- UNIX is the only operating system that is written in a high-level language. This gives it the benefit of machine independence and portability. It becomes very easy to understand, change and move it to other machines

- It was the first operating system to bring in the concept of hierarchical file structure. It becomes very easy to organise and search for different files

- It uses a uniform format for files. This makes the application programs to be written easily. This file format is called the byte stream. UNIX treats every file as a stream of bytes. Therefore, the user can manipulate his file in the manner he wants

- It provides primitives that allow the more complex and complicated programs to be built from simpler ones

- It has a very simple user interface that has the power to provide all the services the users want

- It hides the machine architecture from the user. This helps the programmer to write different programs that can be made to run on different hardware configurations

- It provides a simple, uniform interface to peripheral devices

- It is a multi-user, multiprocessing operating system.

System Structure of UNIX

The interaction between the user and the hardware happens through the operating system. The operating system interacts directly with the hardware.

It provides common services to programs and hides the hardware intricacies from them. The high level architecture of the UNIX system has been shown in figure 7.3.
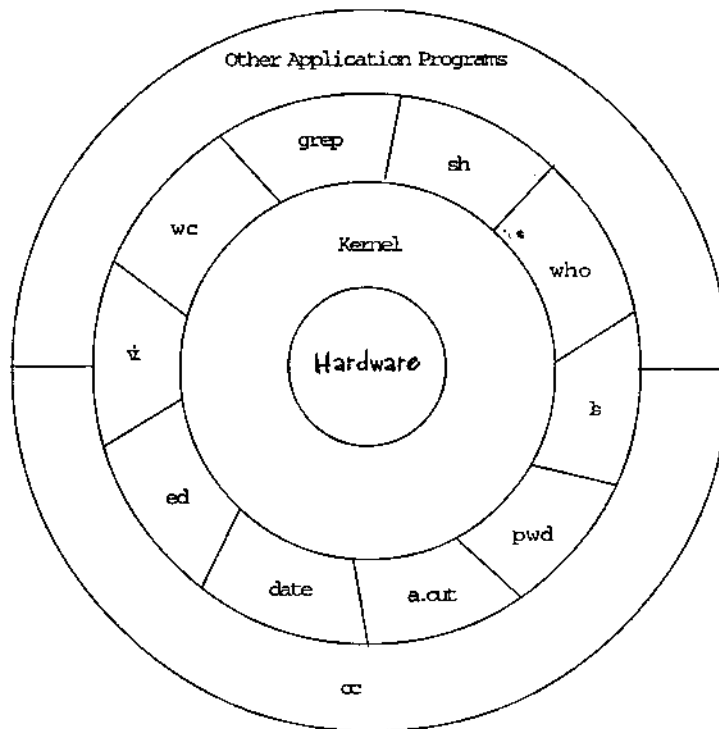
Fig. 7.3: System Architecture of UNIX

The hardware of a UNIX system is present in the centre of the diagram. It provides the basic services such as memory management, processor execution level, etc. to the operating system. The UNIX system seems to be organised as a set of layers. The system Kernel is actually the operating system. The user programs are independent of the hardware on which they are running. Therefore, it becomes very easy to run programs on UNIX system running on different hardware if the programs do make special assumptions. The programs such as the shell and editors like (ed and vi) interact with the Kernel by invoking a well-defined set of system calls. The system calls get various actions done from the Kernel for the calling program. They interchange data between the Kernel and the program. There are many other programs in this layer which form a part of the standard system configurations. These programs are known as commands. But there are several other user created programs present in the same layer. It is shown by the program whose name is a.out. 'a.out' is the standard name for all the executable files produced by the C compiler. The outer most layer contains other application programs, which can be built on top of lower level programs. For instance, the C compiler, cc, appears in the outermost layer of the figure. It invokes a C preprocessor, compiler, assembler and link loader. These are all separate lower level programs. The programming style offered by the UNIX system helps us to fulfill a task by combining the existing programs.

The UNIX System V offers somewhere around 64 system calls. However, only 32 system calls are frequently used. These system calls carry very simple options with them. So, it becomes easy to make use of these system calls. The body of the Kernel is formed by the set of system calls and the internal algorithms that implement them. Thus, the Kernel provides all the services to the application programs in the UNIX system. In the UNIX system, the programs don't have any knowledge of the internal format in which the Kernel stores file data.

Services Provided by Kernel. The services provided by the operating system are infact provided by the Kernel. The Kernel performs various operations and acts as a user interface. The services provided by the Kernel are given below:

1. It controls the running of various processes such as their creation, termination and suspension.

2. The Kernel allocates main memory for an executing process. The Kernel allows the processes to share portions of their address space. It keeps the private space of processes secure and doesn't allow tampering from other processes. However, if the free memory is low with the system, then the Kernel frees out some memory. It then writes a process temporarily to secondary memory. In a case, if the Kernel writes all the processes to the secondary memory, then it is called a swapping system. However, only if the pages of memory are written onto the secondary memory, then it is called the paging system.

3. The Kernel schedules processes for execution on the CPU. The time-sharing concept allows the processes to share the CPU. When the time of a process has finished, the Kernel suspends it. Therefore, the Kernel puts some other process for execution in the CPU. It is again the work of the CPU to reschedule the suspended process.

4. The Kernel permits different processes to make use of the peripheral devices such as terminals, tape drives, disk drives and network devices.

5. The Kernel allocates the secondary memory for efficient storage and retrieval of user data. The Kernel allocates secondary storage for user files, organises the file system in a well planned manner and provides security to user files from illegal access.

The services provided by the Kernel are absolutely transparent to the user. For instance, the Kernel formats the data present in a file for internal storage. However, it hides the internal format from user processes. Similarly, it makes a distinction between the regular file and a device but hides the distinction from user processes. Finally, the Kernel provides the services so that the user level processes can support the services they must provide. For instance, the Kernel provides the services that the shell requires to act as a command interpreter. Therefore, the Kernel allows the shell to read terminal input, to create pipes and to redirect I/O. The computer users can also create

private versions of the shell so that they can create an environment according to their own requirements without disturbing the other users.

User mode and Kernel Mode. Whenever the user on the UNIX system executes a process, then it is divided into two levels: User and Kernel. So, as and when a system call is executed by a process, then the execution mode of the process changes from the User mode to Kernel mode. The Kernel tries to process the requests made by the user. It returns an error message if the process fails. However, if no requests are given to the operating system to service, then also the operating system keeps itself busy with other operations such as handling interrupts, scheduling, processes, managing memory and so on. The main differences between the User mode and the Kernel mode are given below:

1. Process in a User mode can access their own instructions and data but they cannot access the instructions and data of the Kernel. But all the processes present in the Kernel can have the access to both the Kernel and the user addresses.

2. Some machine instructions give an error message when executed in User mode. For instance, a machine may contain an instruction that manipulates the processor status register; processes executing in User mode should not have this capability.

It is very true that the system runs in either the User mode or the Kernel mode. However, the Kernel runs on behalf of the user process. The Kernel is not a separate process running parallel to user processes. The Kernel forms a part of each user process.

Interrupts and Exceptions. The UNIX system allows devices such as I/O peripherals or the system clock to interrupt the CPU abruptly. Whenever the Kernel receives the interrupt, it saves the current work it is doing and services the interrupt. After the interrupt is processed, the Kernel resumes the interrupted work and proceeds as if nothing had happened. The hardware gives a priority number according to the order in which the interrupts should be handled. Thus, when the Kernel looks into an interrupt, it keeps the lower priority interrupt waiting and services the higher priority interrupt.

The term exception is different from the term interrupt. An exception is a condition in which a process causes an unexpected event. For instance, dividing a number by zero, address illegal memory, etc. Exceptions occur in the middle of the execution of an instruction. The system tries to start the instruction again after handling the exception. However, interrupts are considered to happen between the execution of two instructions. The system continues working on the next instruction after servicing the interrupt.

Program Execution Levels. Sometimes, the Kernel must stop the interrupt from occurring during critical activity. This could corrupt the data being handled. For instance, the Kernel might not want to handle an interrupt when it is working with linked lists because handling the interrupt at this point of time might lead to corruption of pointers. Therefore, a better technique has been worked out. The processor execution levels can be set

with the help of certain instructions. If you set the processor execution level to certain value, then it can keep away the interrupt from that level and lower levels. It will only allow the high level interrupts to disturb the process.

7.7. Overview of Windows

We have discussed the role of an operating system in managing the operations of a computer. Most microcomputers use DOS as an operating system. Although DOS is essential to operate a computer, but the user interface with DOS is not user-friendly. In order to operate the computer, one must learn DOS commands. The user is expected to memorise all DOS commands and understand their correct syntax (rules for writing statements of a language). Therefore, only DOS environment is not considered sufficient for running present day applications on PCs. Most of the present day applications related to management and other fields need a graphics-based user interface that is easy to operate. Such a graphics based user interface, that incorporates pull down menus and icons (small pictorial representations of files, programs, storage devices etc.) is known as Graphical User Interface (GUI). For example, as we have discussed earlier, the operating system of Mac PCs provide graphical user interface (GUI). In IBM-compatible PCs, GUI is provided by an operating environment/ system — 'Windows'.

Windows is the most popular system software, that provides graphical user interface. Windows provides an interface, which is similar to the Macintosh user interface. In such interface, each active application is displayed in a window on the screen as shown in figure 7.4. The application window can be closed, opened, hided, displayed, moved, resized, minimised or maximised. The user can run several applications simultaneously, each in its own window. Windows allow the user to share data among different applications. Windows provides an interactive environment, where the user is engaged in continuous dialog with the computer. In Windows, although both keyboard and mouse are used as input device, themouse is the primary tool for selecting and running window applications.

The different versions of Windows are Windows 1.x, Windows 2.x, Windows 3.0, Windows 3.1, Windows 3.11, Windows for Workgroups 3.11, Windows 95, Windows 98, Windows 2000, Windows XP and Windows NT. Windows 1.x, 2.x and 3.0 were the earlier attempts from Microsoft, Inc. for creating graphical user interface but were not very successful. Windows 3.1 and higher versions provide powerful and multifeatured GUI capabilities. Windows NT may appear to you user same as Windows 3.1, but it is based on entirely a different concept.

Windows 3.1/3.11 & Windows for Workgroups 3.11

Windows 3.1 is generally misunderstood as an operating system, but actually it is not an operating system. Windows 3.1 is a graphics-based operating environment that replaces the DOS interface. In order to run Windows 3.1, DOS must be installed on the computer. Windows 3.1 has all the basic features of other GUIs. It also provides non-preemptive multitasking

features, which allow users to run several programs at once. Non-preemptive multitasking means the programs must voluntarily give up control to the computer for getting their turn. Windows 3.11 is the successor of Windows 3.1, with a trivial difference.
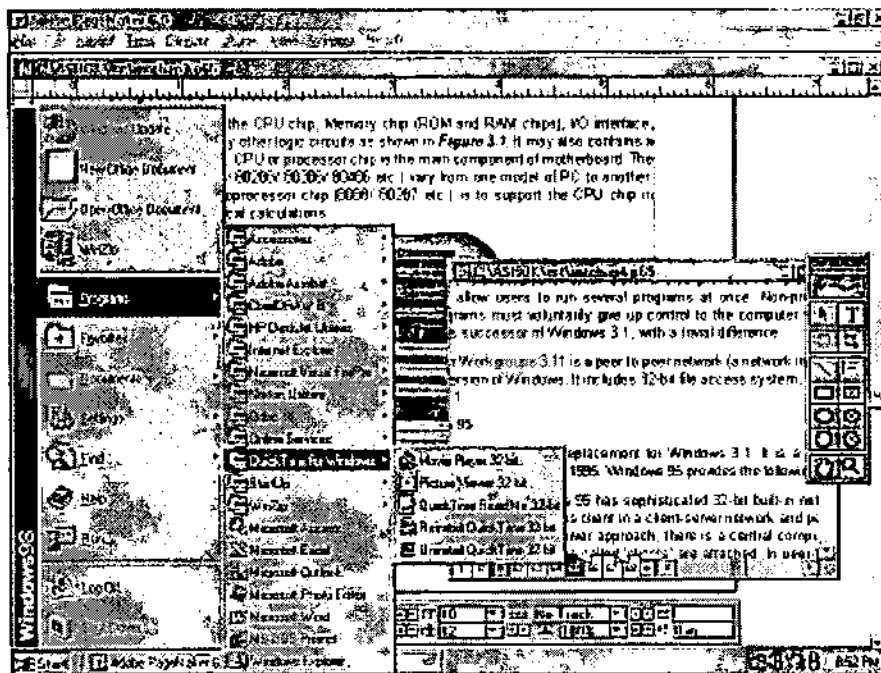
Fig. 7.4: A window screen showing many active applications

Windows for Workgroups 3.11 is a peer to peer network (a network in which any computer can be server) version of Windows. It includes 32-bit file access system, which is not provided by Windows 3.11. Various versions of window 3.x series have become obsolete now and have been replaced by Windows 95 & higher versions.

Windows 95

Windows 95 is a much-awaited replacement for Windows 3.1. It is a 32-bit operating system from Microsoft, released in 1995. Windows 95 provides the following important features:

(i) **Built-in Networking.** Windows 95 has sophisticated 32-bit built-in network components, that allows it to operate both as client in a client-server network and peer-to-peer network operating system. In client-server approach, there is a central computer acting as a file server, with which workstations called 'clients' are attached. In peer-to-peer networking, every computer connected with network can work as a file server and therefore can share files and printers with other computers.

(ii) **Multimedia functions.** Windows 95 provides all multimedia controls and functions. Multimedia is the way of disseminating information in form of text, audio, graphics/animated graphics and

full-motion video.

(*iii*) **Preemtive Multitasking.** Windows 95 provides preemtive multitasking features, which are found in operating systems like OS/2 and Windows NT. In preemtive multitasking, operating systems dictate the time slice for each program, resulting in smoother control and fewer crashes.

(*iv*) **Memory Protection.** Memory protection feature of Windows 95 ensures that one application do not crash other applications in memory.

(*v*) **'Plug and Play'.** Windows 95 automates the hardware configuration process, by knowing the kind of printer, mouse and other peripherals. This feature is known as 'Plug and Play'.

(*vi*) **OLE (Object Linking and Embedding).** OLE is the key technology for Windows 95. Object Linking and Embedding is the Microsoft's standard for creating compound documents (compound document is a document made from different programs) in Windows. OLE permits seamless integration of applications in Windows.

Windows 98

Windows 98 is the next upgrade of Microsoft Windows operating system. It makes our computer easier to use by providing new and enhanced features. The major features of Windows 98 are:

(*i*) **Faster than Windows 95.** Windows 98 is a faster operating system. Without adding new hardware, the computer runs faster in Windows 98 as compared to Windows 95. The maintenance wizard of Windows 98 checks the hard disk for problems and frees its space so that the programs run faster.

(*ii*) **Web Integration.** It provides improved web features by combining the power of the computer with the interactive content of the Internet.

(*iii*) **Improved Reliability.** It improves computer reliability by introducing new utilities, wizards and resources which help in running the computer smoothly and efficiently. The new web-based resource site automates driver and system file updates, and provides up-to-date technical support. The system file checker of Windows 98 restores the critical files if they are changed. In Windows 98, scandisk runs automatically if the computer is shut down improperly.

(*iv*) **Multiple Display.** In Windows 98, we can use several monitors simultaneously to run different programs on separate monitors.

(*v*) **Power Management.** Windows 98 improves the startup time of the computer. In Windows 98, we can start the computer in just a few seconds. Windows 98 restore all the programs in their last saved positions.

(*vi*) **More Entertaining.** Windows 98 provides new features such as enhanced television, video playback and Web TV for Windows that makes our computer more entertaining. Using Web TV for Windows, we can receive and view searchable television program listings provided we have an Internet connection and a TV tuner card installed on our PC.

Window NT

NT stands for new Technology. Windows NT is a 32-bit version of the Windows operating system that supports preemptive multitasking. It is a network operating system that offers networking capabilities. It is divided into 2 parts—Windows NT Server and Windows NT workstation. Windows NT Server operates as a network server and domain controller. Windows NT workstation serves as a network client and desktop OS. The major features of Windows NT are:

(*i*) **Client/Server Architecture.** Entire OS is designed as divided into smaller units, which can communicate with each other by passing well defined messages to each other. The unit that need services is called client while the one that provide services is called server. Each small portion of OS run in its own protected memory space.

(*ii*) **Portability Windows NT.** Windows NT can be parted on a new processor architecture. Portability of Windows NT is implemented using a software that interface between hardware and rest of OS, which is called Hardware Abstraction Layer (HAL).

(*iii*) **Compatibility.** Windows NT can interacts with other OS such as DOS, Windows, etc.

(*iv*) **32-bit Memory Model.** Windows NT offers 32-bit memory model and hence has addressing limitation of 4 GB.

(*v*) **Protected Memory Model.** Every process running in Windows NT processes its own memory space which minimises system crashes and provides higher security to the system.

(*vi*) **Kernel and User Modes.** Windows NT has two modes—Kernel and User. Critical pieces of system viz. I/O Managers, Process Manager etc, run in Kernel mode while any program not running in Kernel mode runs in User mode. Windows NT has micro-kernel which means that kernel has been designed with basic features only to perform necessary function.

(*vii*) **Pre-emptive Multitasking.** Micro-Kernel of Windows NT provides time-slicing for the CPU for each process. Once allotted time is over, the running process is pre-empted and control is passed to next process.

(*viii*) **Scalability.** It is the characteristic of a network that make it possible for network administrator to add many additional modes without the need to redesign the basic system. Scalability in Windows NT is implemented using SMP (Symmetric Multi-processing). In SMP, processors are exactly control operations.

Windows 2000

Windows 2000 is a line of desktop and NetWare operating systems, which was designed to replace Windows NT. It is built upon the NT Kernel and Provides an interface that closely resembles Windows NT and Windows 98. Windows 2000 line of OS includes the following parts:

(i) **Windows 2000 Professional.** It was designed to replace Windows NT workstation 4.0. It provides improved security, special features for mobile users, and better performance.

(ii) **Windows 2000 Server.** It was designed to replace Windows NT server 4.0. It provides improved functional and up to two-way symmetric multi-processing (SMP).

(iii) **Windows 2000 Advanced Server.** It was designed to replace Windows NT 4.0 Enterprise Edition. It provides large physical memories and up to four-way symmetric Multi-processing (SMP).

(iv) **Windows 2000 Data Center Server.** It is most powerful server operating system ever offered by Microsoft. It provides up to 64 GB of physical memory and up to 16-way SMP.

7.8. Key Point Summary

- An operating system manages the operation of a computer.
- The evolution of modern operating systems begin with the introduction of program loaders and punched cards, followed by Input/Output Control System (IOCS). After this, there was a shift from machine language to high-level languages and support of new features. Later on, the Job Control Language and the modern operating systems with multiprogramming concept were developed.
- The basic three types of functions performed by an operating system are—(a) Essential Functions, (b) Monitoring Functions, and (c) Service Functions.
- The role of an operating system can also be categorised into as a Resource Manager, a Processor Manager and an Information Manager.
- As a resource manager, the operating system manages programs, memory, input/output devices and interprets commands.
- As a processor manager, the operating system processor a user job at three levels—(a) Job Scheduling, (b) Program Initiation, and (c) Process Scheduling.
- As an information manager, the operating system functions as Physical IOCS (Input/Output Control System), Logical IOCS and File System.
- The common techniques used in different operating system are Multiprogramming, Multiprocessing and Multitasking.
- Operating systems can be classified into single-user and multi-user operating systems.
- Operating systems can also be classified into Batch Processing, Multiprogramming, Time-sharing and Real-time operating systems.

- The major functions of a multiprogramming operating system are Processor Management, Storage Management and I/O Management.
- The major functions of a time-sharing operating system are Processor Management and Storage Management.
- Operating systems can also be classified into native and non-native operating systems.
- MS DOS is the most popular, single-user operating system for PCs.
- MS DOS is partitioned into three layers—(a) BIOS, (b) Kernel, and (c) Shell.
- Unix is the most popular, multi-user operating system for all types of computer.
- Unix offers many useful features such as Portability, Machine Independent, Multi-user Capability, Multi-tasking Capability, Software Development Tools, Built-in-Networking and Security.
- The system architecture of Unix is organised as a set of four layers— (*a*) Hardware, (*b*) Kernel, (*c*) Commands, and (*d*) Other application programs.
- The kernel is actually the operating system that provides all the services.
- Whenever the user on the Unix system executes a process, it is divided into two levels—User and Kernel.
- Windows is the most popular multi-user operating system for PCs that provide Graphical User Interface (GUI).
- Various versions of Windows are Windows 3.1/3.11, Windows 95, Windows 98, Windows 2000 and Windows XP.

7.9. Review Questions

1. What is an operating system ? What are the functions of an operating system ?

2. Explain the following terms :

   (a) Batch monitor   (b) Turn-around time

   (c) Throughput   (d) Job control language

   (e) Storage fragmentation

3. Differentiate :

   (a) Preemptive and non-preemptive scheduling

   (b) FCFS and SJN scheduling techniques

   (c) Batch Process and Real-time Processing

   (d) Single-user and Multi-user operating systems

   (e) Multiprogramming and Time-sharing operating systems

4. Describe the advantages and disadvantages of time-sharing operating system.

5. (*n*) Why is password essential in a UNIX system while it is optional in a system running under DOS ?

(b) What are the 'Kernel' and 'User' modes of operation in UNIX ?

6. Is multiprogramming and multitasking mutually exclusive ? Explain your answer briefly.

7. What are the functions of an Information Manager ?

8. What are GUIs and what are their functions ?

9. (a) Explain the features of Windows in general.

   (b) How Windows operating system is different from DOS and UNIX ? Discuss.

10. How does an operating system :

    (a) run several programs concurrently on a single CPU ?

    (b) allow several programs to use a single printer simultaneously ?

11. Describe briefly the history and evolution of operating systems.

12. Discuss the role of an operating system as a resource manager.

13. How does an operating system process a user job ? Explain briefly.

14. Explain the following concepts :

    (a) Time-slicing

    (b) Swapping

15. Differentiate between Native and Non-native operating systems.

16. Discuss briefly the structure of :

    (a) MS DOS

    (b) UNIX

17. Write a short note on history of UNIX.

18. Compare the following versions of Windows :

    (a) Windows 3.1/3.11 and Windows 95

    (b) Windows 98 and Windows 2000.

Unit–8

Operating Systems

Structure

8.1. Introduction

In the very first chapter we discussed that computer has no intelligence of its own and each and every instruction should be given to it for performing any task. The set of instructions given to computer to process the data or perform certain task is called a *Program*. Programming is the technique for writing the programs. The programming process is a set of activities that are carried out to develop and implement a program. You must understand this process in order to become a programmer. Programming is required at all levels from manufacturing of the computer to its operation by the user. Programming, which is done at systems level for developing systems software, is known as Systems *Programming* (Systems Software Development). Systems Programs are written in low level languages like Machine/Assembly Language and some high level languages like C, C++, etc. Programming, which is done at the user level, for development of application software, is known as *Applications Programming* (Applications Software Development) or simply Programming. Application Software are generally developed using high level languages, DBMSs or Front End Tools.

There are two approaches used in programming — a traditional approach, Procedure Oriented Programming and a latest approach, Object Oriented Programming. You must be aware of the advantages and disadvantages of both approaches of programming. In this chapter, you will study these approaches of programming, steps in programming and various types of computer languages.

J.R.

8.2. Procedure Oriented Programming

Procedure oriented programming is the traditional way of programming, where an application problem is viewed as a sequence of steps (algorithms). As per the algorithm, the problem is broken down into many modules (functions) such as data entry, reporting, querying modules etc. as shown in figure 8.1. There are two types of data, which are associated with these modules—one is global and another is local data. *Global data items* are defined in main program, whereas local data is defined within associated functions. Many of the functions share global data, as this kind of data is available to all functions. Procedure oriented programming is the conventional approach of programming for developing application software. High level languages like COBOL, Pascal, BASIC, Fortran, C etc. are based on procedure oriented approach, and hence are also called *Procedural Languages*.
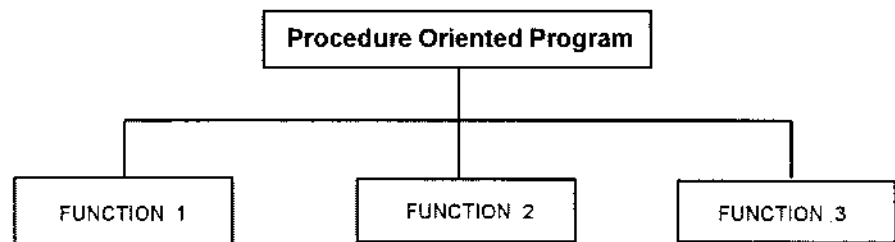
Procedure Oriented Program

FUNCTION 1 **FUNCTION 2** **FUNCTION 3**

Fig. 8.1: Generalised structure of a procedure oriented program

Benefits of Procedure Oriented Programming

The main benefits of procedure oriented programming are –

- It is easy to port programs as compilers for procedural languages are easily available.
- It is easier to learn procedure oriented programming than new ways of programming.

Drawbacks of Procedure Oriented Programming

Although procedural oriented programming is the conventional approach of programming, it has certain drawbacks. The main disadvantages of this approach are:

- As most of the functions share global data, this data is freely available to all functions. Although this freely available data is easily accessed by any function, it can create certain problems. When a new function is written for analysing this data in different way it is possible that data may be changed accidentally or deliberately. Therefore, there is no security of data in procedure oriented programs.
- Another problem is that whenever data structure is required to be changed, all the functions using that data must also be changed. So, procedure oriented programs (especially for complex applications) are extremely difficult to modify and maintain.
- Procedure oriented programming does not model the real world problem.

8.3. Object Oriented Programming

Object oriented programming is the latest approach of programming. It attempts to eliminate most of the drawbacks of procedure oriented programming by incorporating new concepts. It is a new way of organising programs, which is not dependent upon any particular language. In object oriented programming, a problem is viewed not as a sequence of steps to be done, but as a collection of different units (called objects) that models the real world things. The structure of an object-oriented program is shown in Figure 10.2.

The 'Object oriented' concept can be better understood by discussing about the definitions of an object and its related terms. So, let us discuss the basic terminology used in Object Oriented Programming (OOP).
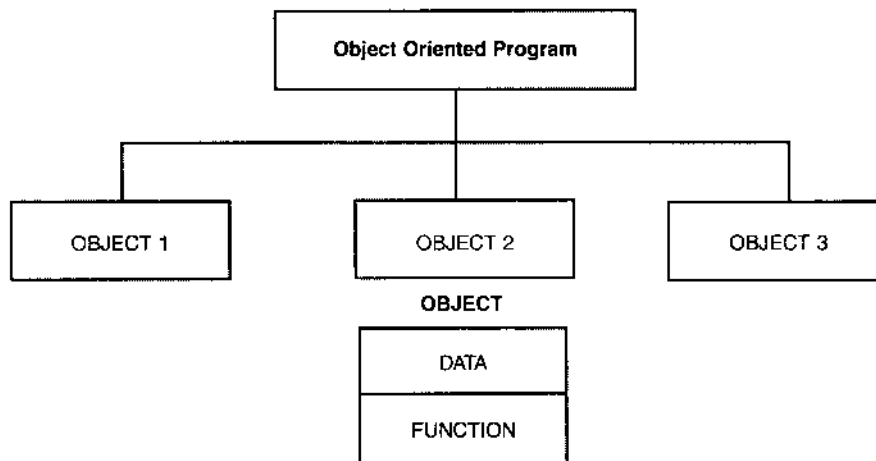

Fig. 8.2: Generalised structure of an object oriented program

Basic Terminology Used in OOP

Object. The fundamental idea behind OOP is to store the data and functions operating on that data into a single unit, called an object. An object may represent a person, a student, an employee, an account, an examination or any item that closely resembles the objects of real world.

Class. A class is a collection of similar objects. For example, if 'Car', 'Bus' etc. are different objects then 'Vehicle' is a class.

Encapsulation. The wrapping of data and functions in an object or class is known as encapsulation.

Data Hiding. Data hiding is the important feature of objects, by which data is not accessible by other functions outside the objects.

Data Abstraction. The act of representing essential features of the objects without giving details is known as data abstraction. Classes use this concept and represent essential properties of the objects.

Inheritance. An object of one class (base class) can inherit the properties of another class (derived class) by a process, called inheritance. For example

'Petrol Vehicle', is one class that inherits the properties of another class 'Vehicle'.

Polymorphism. The ability of objects to exhibit different behaviours in different instances is known as polymorphism. For example, an additional function of an object generates a sum if the data is in numeric form or it concatenates the strings if the data is in character form.

Benefits of Object Oriented Programming

Object oriented programming offers several benefits over the procedure oriented approach. The main advantages of using object oriented approach in software development are described as follows:

- Reusability of the code is the major benefit of object oriented programming. Redundant code can be eliminated through inheritance feature of OOP. The generation of windows, menus, dialog boxes etc. are few examples of programming codes that can be reused. So, a lot of time of programmers is saved during development of application software.

- In object oriented programming, as the emphasis is on data rather than algorithms, a program can easily be broken down into objects, which model truly the real world objects.

- The programs and data are more secure due to data hiding feature of OOP.

- New data types can be easily created through data abstraction feature of OOP.

- Object oriented programming is very useful in application areas like real-time, artificial intelligence, expert systems, computer aided manufacturing/designing, office automation and decision support systems.

Drawbacks of Object Oriented Programming

Although the object oriented approach is the latest and most widely accepted programming approach, it has certain drawbacks as described below:

- Although object oriented software are easier to upgrade and maintain, first time development process is more difficult than procedure oriented software. This drawback can be solved by using latest programming tools.

- All languages cannot easily implement object oriented approach. So, object oriented programming is limited to few languages (object oriented languages).

8.4. Role of Systems Analyst and Programmers

Software development project is not managed by a single person, but it is a teamwork. Software project is managed by a person called, project leader. The project leader is generally a system analyst, who analyses and designs the complete software. Programs are developed by software professionals,

called Programmers. System Programmers develop system software while application programmers are involved in development of application software.

System analyst and programmers play a vital role in development of an application or a system software. The analyst plays the role of a specialist in computer-based applications. Programmers are responsible for coding, editing, testing and debugging the programs. System analyst and programmers work together as a team.

Role of System Analyst

A system analyst is a person who is overall responsible for development of software He is the computer professional charged with analysing, designing and implementing computer-based information system. He is the crucial interface among users, programmers and MIS managers. He performs the following roles for the organisations:

(*i*) **Investigation of Problem.** The analyst studies the problems and needs of an organisation during development of a system. He visits the various departments of the organisation and interviews the users. He analyses the problems of the current system and collects their requirement.

(*ii*) **Solving the Problem.** The analyst solves the problems of the current system faced by the users. He determines how people, method and technology can improve the current system. He presents the system proposal to the management and after acceptance of proposal develop the system along with his team consisting of analysts, programmers and users.

(*iii*) **Managing the Project.** The analyst monitors the development and implementation of software in relation to quality, cast and time. He works with the project team for managing the project properly.

(*iv*) **Motivation.** The analyst motivates users to participate in development and implementation of the proposed system.

Role of Programmers

Programmers are the members of a project team. They perform the following roles during development of a system:

(*i*) **Development of System.** As per the design prepared by analyst, the programmers design the data structures and write the programs. During database design, the programmers create, organise and maintain data files depending upon the requirement specification, hardware configurations and the features of programming language and DBMS used. During program design, the programmers write programs (called coding of programs) as per the logic developed by analyst. Programmers also enter/edit programs using a text editor, compile execute and debut programs.

(ii) **Testing of System.** The programmers play a vital role during testing of complete system. They prepare the test data with the help of users and test programs using various techniques.

(iii) **Implementation and Maintenance of System.** The tested software is implemented at the user's place by the analyst along with the help of programmers. The programmers with the help of technical writers prepare the manuals, conduct training programmers and convert data files from old to new system during implementation. Maintenance of system is also undertaken by programmers as per guidance of analyst.

8.5. Programming Process

Having understood the importance of programming in developing a system, we are now in a position to discuss the steps of the programming process carried out by each programmer. A program is developed in the following steps:

1. **Understanding the Problem.** As the analyst assigns the programs to different programmers module-wise, the programmers understand the problem to be solved by studying the structure charts of the system especially the assigned modules. The programmers define the problem of each program on a document and proceed for the next step.

2. **Understanding the Requirements.** After understanding the problem definition, the programmers study the input, output and processing requirements of the program, Software Requirements Specification (SRS) document and various tools of structured analysis, which forms the basis for program requirements analysis. The programmers study the SRS document and obtain the input, output and processing requirements for the programs to be written. They also study the data flow diagrams, data dictionary and process descriptions (structured English statements, decision tools and decision tables) for obtaining the program requirements. The programmers also review the database design before proceeding for the next step.

3. **Developing the Algorithm.** After defining the problem and understanding the requirements, the next step of a programming process is to develop algorithm. This is the most time consuming and crucial part of a programming process. An algorithm is a step-by-step procedure for solving a programming problem. The algorithm develops and designs the logic of a program. The common tools for developing an algorithm are :

   (i) *Flowcharts.* Graphical representation of the program are called Flow Charts.

   (ii) *Pseudocodes.* Descriptive representations of the program are called Pseudocodes.

These tools are generally called Program Tools. We will discuss these tools with few examples in the subsequent part of this Chapter.

4. **Checking the Algorithm.** The algorithm must be complete and correct in order to ensure the efficient execution of the program. Therefore, it becomes mandatory to check the algorithm before coding it. There are many methods to check the algorithm. Some of them are –

   (i) *Dry Run.* Manual way of checking algorithm by finding the values of each variable after every step of algorithm is called Dry Run.

   (ii) *Review.* Studying the logic and comparing it with specifications is called Review.

   (iii) *Structured Walk Through.* Presentation of algorithm to the team members is called Structured Walk Through.

5. **Coding the Program.** After checking the algorithm and its final approval, the programs start coding. Coding involves writing of program as per the algorithm using a programming language and database environment specified in the SRS document. The programmers may do the coding manually or by using application generators and CASE tools. Screen generators, menu generators and report generators are widely used application and CASE tools for generating program codes. Although, code generators may generate many lines of program statements, they cannot generate the whole code. The programmers still require to modify the generated code and write new code manually.

6. **Entering the Code.** After writing of the program, it is entered into the computer using a text editor. Text editors are used to create, edit and print the programs. The interpreters and compilers of most programming languages (such as Turbo C, C++, Pascal, Foxpro, etc.) have inbuilt text editors.

7. **Translating Program.** After entering the program into the computer, it is required to be translated to a machine code using language translators such as interpreters and compilers.

8. **Executing and Testing the Program.** After translating, the program is executed and tested with a test data. The test data is prepared as per the requirement specifications of the program. The test data is fed into the computer and outputs are compared with the required reports. The program is tested for the following aspects:

   • The data entry should be user-friendly with all possible errors messages.

   • Online help should be provided throughout the time of execution.

   • The execution speed should be as per the requirements.

- The output should be as per required formats.
- The modifications and deletions should be easy and correct.
- The database must be maintained as per the requirements.

Besides the above guidelines, there may be many more aspects for testing. However, the basic aim of testing is that the program should run efficiently, correctly and according to the specifications given in SRS document and guidelines of the analyst.

9. **Debugging the Program.** During the testing, the program may have some bugs (errors)4, which must be connected. The bugs of a program are removed by a programming technique called debugging. During debugging the program code and algorithm is reviewed and corrected. The debugging program is entered into computer again, translated, executed and tested unless it is found cent percent error-free.

10. **Document the Program.** After the final approval of the program testing, the program algorithm and code is properly documented. A program code is documented as per the documentation techniques of programming. A project report is prepared by the programmer and submitted to the analyst or project leader. The documentation of program is a major part of systems documentation.

8.6. Program Tools

The tools that are used by programmers for developing the logic of a program are called program tools. There are two major types of program tools—Program Flowcharts and Pseudocodes. Programmers use both of these tools to design the program logic.

Program Flowcharts

A program flowchart, simply called a *flowchart*. A program flowchart is the graphical representation of the steps followed for solving any programming problem or for accomplishing a task. It is the best tool to develop the program logic. It includes all necessary steps of a program. It is called flowchart, because it charts the flow of a program. It is a symbolic representation of each input, output and processing step. Besides being a good method of writing down the algorithm, it is also a part of program documentation and helps in understanding, debugging and maintaining programs.

Before coding a program in any programming language, the programmers are always advised to draw the flowcharts first. In the flowcharting technique, operations are represented by drawing appropriate symbols for the actions. The important symbols used in a flowchart are shown in Figure 8.3. These flowchart symbols are connected by arrows to illustrate the sequence of operations. Let us briefly discuss the significance of these symbols.
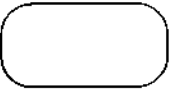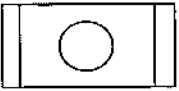
Symbol	Explanation
	Terminator – Used in start and end of a flowchart.
	Input/output – Used to accept the data or display/print the output.
	Process – Used to show the activity or processing to be performed on data.
	Flow lines – Used to connect other symbols in a flowchart for showing the sequence of their execution. The default direction of execution is from top to bottom and from left to right for reverse directions the arrow must be used.
	Decision Box – Used to check a condition whether it is true or false. Depending upon the condition, the program branches in two directions.
	Connector – Use to connect two parts of a flowchart.
	Predefined Process – Used to represent a module of a program.

Fig. 8.3: Symbols used in a flowchart

(i) **The Input/Output Symbol.** This symbol is used to represent the input/output operations (I/O operations) such as read and write. This is illustrated in figure 8.4.

Read Empno   Write Empno

Fig. 8.4: The input/output symbol

(ii) **The Process Symbol.** This symbol is used to represent process like assigning a value to a variable or adding a number. It has one arrow going inside to denote the input data to the process and another arrow leaving it to denote the processed data leaving this process. In other words, it has one entry and one exit. Figure 8.5 illustrates this.
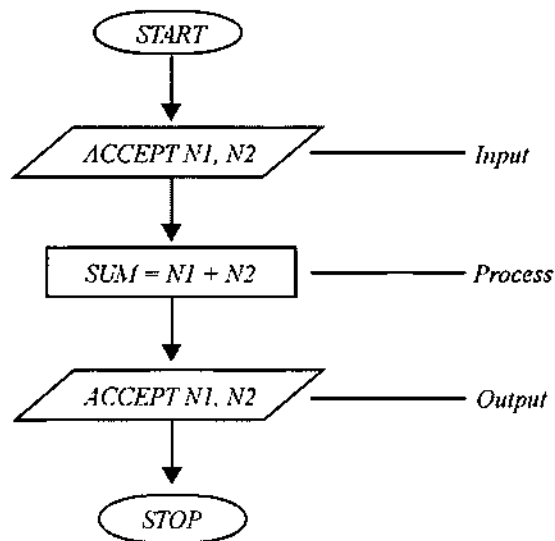
Fig. 8.5: Flowchart to add two numbers

In Figure 8.5, "Sum = N1 + N2" is a process, which adds the two numbers and stores the result in Sum. For this process, the input is numbers flowing in (represented by in-going arrow from the process).

(iii) **The Terminal Symbol.** This symbol indicates the beginning or the end of a flowchart as shown in figure 8.6.

Fig. 8.6: The terminal symbol
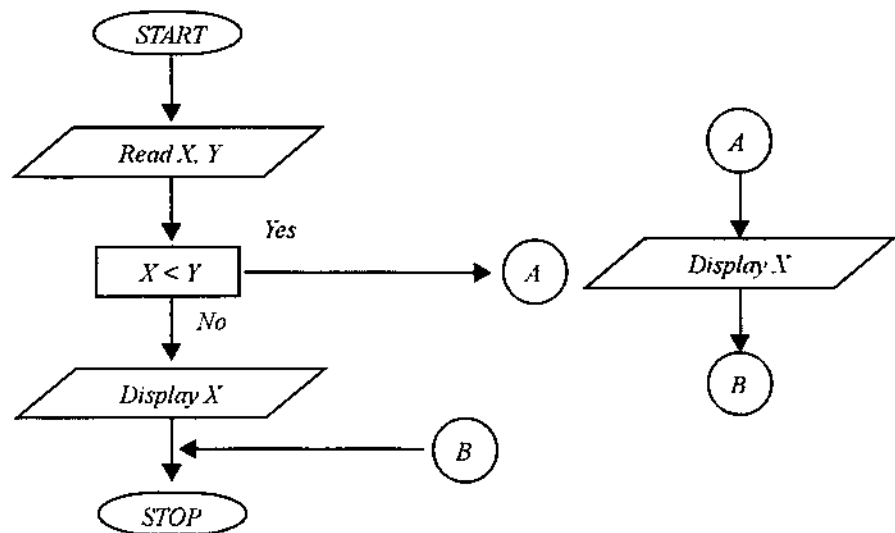
Fig. 8.7: Flowchart showing the connector symbol

(iv) **The Connector Symbol.** The connector symbol is used to maintain links between two or more flowcharts when the flowchart runs

longer than one page or when the same diagram is continued at different locations of the same page. If the same flowchart is continuing on the next page, then at the end of the first page this symbol is used with a marker, which can be an alphabet or a number. The same symbol is used, with the same marker as was used in the first page, at the beginning of the second page. figure 8.7 illustrates this.

(*v*) **The Flowline Symbol.** This symbol represents the direction of the flow of data in a flowchart. These are straight lines with arrow heads. They are normally drawn from top to bottom and left to right.

Problem :

A student appears for a test in 3 subjects. Each test is out of 100 marks. The percentage of each student has to be calculated and depending on the percentage calculated, grades are given as under:

Percentage	Grade
$\Rightarrow$ 90	E+
80-90	E
70-79	A+
60-69	A
50-59	B+
<50	FAIL

Draw a flowchart for the stated problem.

Solution: Flowchart for the same is given in figure 8.8.

Pseudocode

Pseudocode is the another way for developing the logic of a program. In contrast to a flowchart, the pseudocode uses simple English statements to represent the program logic. Some programmers prefer to write pseudocode than to draw flowcharts. The reason for this is that writing the logic of program sometimes become easier than drawing the diagrams. Some programmers use both tools, first they draw flowcharts and then write pseudocodes. Although, using both tools is time-consuming, it is the best way to develop a best program logic design.

Some of the conventions, which are used while writing pseudocodes are as follows :

- All statements in a loop should be indented
- All alphanumeric values should be enclosed in single or double quotes.
- The beginning and end of a pseudocode is marked with keywords like 'start' and 'end' respectively.

- All statements must include certain keywords, which denote an operation.
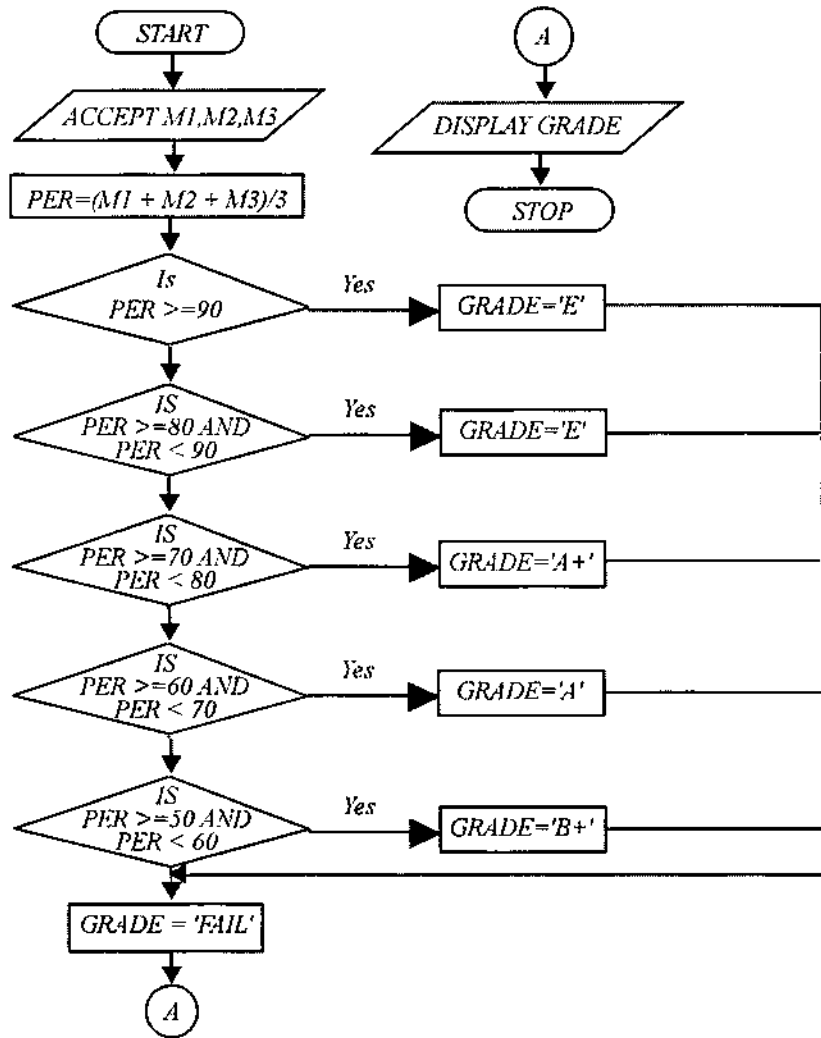
Fig. 8.8: Flowchart showing the calculation of percentages and grade

Some books follow the convention of ending each statement with a semicolon. Let us briefly discuss some of these conventions:

(*i*) **The Input Statement.** The following verbs can be used to accept or input data from the keyboard or from an existing form like a file :

Accept or Read

Example :

Accept Name

Read Name

(*ii*) **The Output Statement.** The following verbs can be used to output data :

Write or Display

Example :

Write Grosspay

Display Grosspay

Problem :

A student appears for a test in 3 subjects. Each test is out of 100 marks. The percentage of each student has to be calculated and depending on the percentage calculated, grades are given as under:

Percentage	Grade
$\Rightarrow 90$	E+
80-90	E
70-79	A+
60-69	A
50-59	B+
<50	FAIL

Solution:

START

ACCEPT M1, M2, M3

PR = (M1 + M2 + M3) /3

IF PER > = 90

   GRAD = 'E+'

ELSE

IFPER >= 80 AND PER < 90

   GRADE = 'E'

ELSE

   IF   PER > = 60 AND PER < 70

         GRADE = 'A'

   ELSE

        IF PER > = 50 AND PER < 50

            GRADE = 'B+'

        ELSE

            GRADE = 'FAIL'

        ENDIF

   ENDIF

 ENDIF

ENDIF

ENDIF

DISLAY GRADE

END

8.7. Types of Computer Languages

One man communicates with another in a language, which another man can understand. Similarly, man communicates with computer in a language which machine can understand. This language, which consists of a set of commands, understandable by computer directly or after translating, is known as Computer Programming Language. There are many types of computer languages, which can be categorised into following four types :

(*a*) Low-level Languages (First & Second Generation Languages)

(*b*) High-level Languages (Third Generation Languages)

(*c*) User-Friendly Languages (Fourth Generation Languages)

(*d*) Object Oriented Languages (Fifth Generation Languages)

Let us discuss these in detail with examples.

Low-level Languages

In early days of computers, only those languages were used for programming, which could be directly executed on computer. Languages, which computer can understand directly and are machine dependent, are called Low-level Languages. For example, Machine Language and Assembly Language are two important low-level languages. Machine language is the oldest and most difficult of all the languages. It is also known as First Generation Language. In Machine Language, all the instructions are given to computer in binary digits, and hence are directly understood by the computer. On the other hand, Assembly Language is easier than machine language, and is known as Second Generation Language. In Assembly Language, instructions are given using mnemonic operation codes (such as ADD, MUL etc.) instead of binary digits as shown in figure 8.9. Low-level languages are mainly used for development of systems software.

Reasons for learning Assembly Language. We learn Assembly language due to the following reasons:

• Although programmers prefer high level languages (such as C or Pascal) to Assembly language for developing application software, they use Assembly language combined with a high level language to speed up certain time dependent routines.

• Assembly language helps us to understand the computer architecture. The intimate knowledge of computer helps us to write very efficient programs both in assembly and high level languages.

• Assembly language does not impose many rules and restrictions for writing a program. On the other hand high level language imposes many rules. Therefore, Assembly language is mostly used to write system programs, which are difficult to develop using HLL. For example, we can easily write a program to change hardware setting (such as Monitor Display Mode, Keyboard Characters Set, etc.) in assembly language, which is difficult to write in high level language particularly COBOL, BASIC, Fortran, etc.

```
; Program to add 2 numbers which are 16 bit each

; The number are stored in memory locations N1 and N2

; The result is stored in TOT

STACK SG SEGMENT STACK

        DW 32 DUP (O); DW (Define Word)

;The above statement defines 32 words initialized to zero

STACKSG ENDS

DATA  SG SEGMENT

        N1 DW 16h; First no stored in N1

        N2 DW 39; Second no stored in N2

        TOT DW? Result is stored in TOT

DATA SG SEGMENT

        ASSUME CS:CODESG, DS:DATASG, SS:STACKSG

START:

        MOV AX, DATASG; Initialize data Segment

        MOV DS, AX; Initialize DS Register

        MOV AX, N1; AX=N1

ADD AX, N2; AX=AX+N2

MOV TOT, AX; TOT=AX

MOV AX, 4Cooh; Requests  normal exit

2Ih; Return to DOS

CODESG ENDS

END START
```

Fig. 8.9: An example of assembly language program showing use
of mnemonic operation codes

- In assembly language, the code of programs is much smaller than that of HLL programs. This is due to the fact that many lines of instructions written in a high level language can be written using simple one-line instructions of assembly language.
- As assembly language is a low-level language, each line of the source program corresponds to one machine instruction. So, the program code is smaller and hence program runs faster

High-level Languages

Development of applications using low level languages requires a deep understanding of the hardware. In order to facilitate the programmers to write programs without knowing the internal details of computer components, many languages were developed. These languages use common English

words and are translated into low-level languages before processing by the computer. These languages, which computer cannot understand directly and are not machine dependent, are called High-level Languages (HLL). These languages are also known as Third Generation Languages. Various high-level languages are described below:

(*i*) **BASIC (Beginners All Purpose Symbolic Instruction Code).** BASIC is the first programming language to be made standard with personal computers. It was first developed by John Kemessy and Thomas Kurtz, two professors from Dartmouth College, U.S.A in 1964. It was primarily developed to teach programming to students of Dart- mouth college, but later, it became so popular that today it is being taught in primary classes of most of the schools for learning programming. This is because that BASIC is very easy to learn and use as it uses common English words as shown in Figure 8.10.

```
PROGRAM TO CALCULATE PERCENTAGE OF MARKS OBTINED
10 REM
20 INPUT "Enter your Name", N$
30 INPUT "Enter you Marks obtained:, MO
40 INPUT "Enter your Maximum Marks", MM
50 LET P=(MO * 100)/MM
60 PRINT "YOUR PERCENTAGE IS", P
70 END
```

Fig. 8.10: An example of a basic program showing use of common English words

Features of BASIC. The BASIC programming language offers the following features:

• The programming is in easy language i.e., in everyday English.

• Program if contains any error, can be edited easily.

• This language can be used for both mathematical and commercial problems.

• It can be used on both small (microcomputers-PCs) and large computers.

• The BASIC programs can be run on different computers with little or no modifications.

• Using BASIC, you can easily make graphics and computer games.

Versions of BASIC. BASIC is available in interpreter and compiler versions, the former being more popular for beginners. The different versions of BASIC language are:

1. ANSI BASIC. It is an interpreter-based version of BASIC, standardised in 1978 by the American National Standards Institute.

2. BASICA (Advanced BASIC). The interpreter-based version of BASIC, which was developed by Microsoft corporation for the IBM PC Compatible computers.

3. GW-BASIC (Gee Whiz BASIC). It is the BASIC Interpreter that accompanied with MS-DOS in versions prior to 5.0.

4. QBasic. It is the BASIC interpreter that accompanied with MS-DOS and PC-DOS version 5.0. It supersedes GW-BASIC and includes a program REMLINE.BAS that can convert GW-BASIC programs to QBASIC code.

5. Quick BASIC. It is the popular BASIC compiler from Microsoft that adds advanced features to the BASIC language.

6. Visual BASIC. It is the most popular version of QUICK BASIC for developing of Windows-based applications. It is considered a new programming language and environment (developed in 1990), which is based on BASIC language.

(*ii*) **COBOL (Common Business Oriented Language).** COBOL has been the most popular high-level language for developing business applications mainly a mainframes and minis. It was developed in around 1960 and is still being used for developing business applications that typically run on mainframes. One time, COBOL was also popular on PCs but now it has become obsolete on microcomputer's environment. There are different versions of COBOL-COBOL ANSI'74, COBOL 85 and Microsoft COBOL. The ANSI'74 version of COBOL was standardised in 1974 by American National Standards Institute. COBOL 85 and Microsoft COBOL has been the most popular versions of COBOL.

COBOL is the most structured programming language because its instructions can be read and understood easily by the programmers who have not written them as shown in figure 8.11. All COBOL programs are divided into four parts, called divisions. The first division, called IDENTIFICATION DIVISION, documents the program's name, author, date-written, etc. The second division, called ENVIRONMENT DIVISION specifies the hardware and software environment of the program. The third division, called DATA DIVISION, defines the names and formats of the files and variables used in the programs. The last division is the PROCEDURE DIVISION, which describes the step-wise instructions and statements of the program.

Although COBOL programs are lengthy in coding, they follow the rules of structured programming techniques. So, if you can learn COBOL, you can learn any programming language very easily.

```
*  PROGRAM TO COPY A DATA FILE
   IDENTIFICATION DIVISION.
   PROGRAM-ID. COPY-A-FILE.
   AUTHOR. ASHOK ARORA.
   INSTALATION. EXAM CENTRE.
   DATE-WRITTEN. JULY 6, 2001
   DATE-COMPILED. JULY 6,2001.
   SECURITY. FOR DEMO ONLY.
   ENVIRONMENT DIVISION.
   CONFIGURATION SECTION.
   SOURCE-COMPUTER. PENTIUM-III.
   OBJECT-COMPUTER. PENTIUM-III.
   INPUT-OUTPUT SECTION.
   FILE-CONTROL.
            SELECT INPUT-FILE ASSIGN DISK
            ORGANIZATION IS LINE SEQUENTIAL.
            SELECT OUTPUT-FILE ASSIGN DISK
            ORGANIZATION IS LINE SEQUENTIAL
   DATA DIVISION.
   FILE SECTION.
   FD INPUT-FILE
            LABEL RECORDS ARE STANDARD
            VALUE OF FILE-ID IS "EXAM.DAT".
   01 INREC PICTURE X (80).
   FD OUTPUT-FILE
            LABEL RECORDS STANDARD
            VALUE OF FILE-1D IS "EXAM1.DAT".
   01 OUTREC PICTURE X(80).
   WORKING-STORAGE SECTION.
   01 EOF PIC X VALUE 'N'.
   PROCEDURE DIVISION.
   MAIN-PARA.
            OPEN INPUT INPUT-FILE OUTPUT OUTPUT-FILE.
            READ INPUT FILE AT END MOVE 'Y' TO EOF.
            PERORM FILECOPY-PARA UNTIL EOF ='Y'
            CLOSE INPUT-FILE OUT-FILE.
            STOP RUN.
   FILECOPY-PARA.
            MOVE INREC TO OUTREC
            WRITE OUTREC.
            READ INPUT-FILE AT END MOVE 'Y' 60 EOF.
```

Fig. 8.11: An example of a COBOL program for copying a data file

(iii) FORTRAN (Formula Translator). FORTRAN is the first high-level programming language, developed by John Backus of IBM during 1956-57. Although it was originally designed to express mathematical formulas and is used occasionally for business applications, it is still the most popular language for developing scientific and engineering applications to solve mathematical problems as shown in figure 8.12.

```
C ** PROGRAM TO CONVERT CENTIGRADE TO FAHRENHEIT
C ** CT STANDS FOR CENTIGRADE TEMPERATURE
C ** FT STANDS FOR FAHRENHEIT TEMPERATURE
        READ * , CT
        FT = 1.8 * CT + 32.0
        PRINT * , CT, FT
        STOP
        END
```

Fig. 8.12: An example of a FORTRAN program converting Centigrade to Fahrenheit

Version of Fortran: The popular versions of FORTRAN are FORTRAN II, FORTRAN IV, FORTRAN 77 and FORTRAN V. FORTRAN II was the first version of FORTRAN used during 1950-60. FORTRAN IV was standardised, by ANSI in 1966. In 1977, an updated version of FORTRAN IV was announced which is called FORTRAN 77 and was standardised in 1978 by ANSI. FORTRAN V is the latest version of FORTRAN.

(iv) **ALGOL (ALGOrithmic Language).** ALGOL is a high level programming language that was developed as an international language for the expression of algorithms between people and machines in 1960. Algol-60 was a turning point in language development since it was designed to reflect mathematical algorithms.

(v) **Pascal.** Pascal is a high-level programming language developed by a Swiss Professor Niklaus Wirth in the early 1970s. It was named after Blaise Pascal, a French mathematician who built the first desk-calculator type adding machine in the seventeenth century. Pascal is a structured programming language like COBOL, but it is not only used for developing business applications but also for scientific applications. In fact, you can write program for any application in Pascal as shown in figure 10.13. Pascal is a compiler-based language, built upon ALGOL by simplifying syntax and adding data types and structures such as files, records and sets.

```
{Program to calculate perimeter of a circle}
PROGRAM calperi (OUTPUT);
{The following statements declare constant}
CONST
        pi = 3.14159;
{The following statements declare variables}
VAR
        rad, peri :REAL;
{Beginning of program block}
BEGIN
        WRITE ('Enter radius');
        READLN(rad);
        peri := a* pi * rad;
        WRITELN ('Perimeter=', peri)
END.
{END of program block}
```

Fig. 8.13: An example of a Pascal program for calculating perimeter of a circle

Turbo Pascal: There are many versions of Pascal programming language, but Turbo Pascal, developed by Borland International in 1983 is the most popular one. There are also different versions of Turbo Pascal viz. 1.0, 2.0, 3.0, 4.0, 5.0, 5.5 and 6.0. Turbo Pascal 6.0, developed in 1990, is the latest version of Turbo Pascal.

(*vi*) **C.** C is the most powerful high-level language, developed by Dennis Ritchie at AT&T's Bell Laboratories of USA in 1972. It was developed to replace the popular language of that time like ALGOL, PL/I, PL/M etc. The statements of C are very similar to those of Pascal as shown in figure 8.14.

```
/* Program to calculate perimeter of a circle */
#include <stdio.h>
main ()
{
        float pi = 3.14159
        float rad, peri;
        printf ( "Enter radius");
        scanf ( "%f", &rad);
        peri = 2* pi * rad;
        printf ( "perimeter = %f", peri);
}
```

Fig. 8.14: An example of a C program for calculating perimeter of a circle

Historical Development of C. The history of developing C started in 1960, when ALGOL language was developed by an international committee for searching a language, which can program all types of application. ALGOL 60 did not become popular, as it was very abstract and general. Later on, in 1963, a new language called CPL (Combined Programming Language) was developed at Cambridge University. As CPL was hard to learn and more difficult to implement, in 1967, Martin Richards at Cambridge University modified CPL and developed a new language called BCPL (Basic Combined Programming Language). But BCPL could deal with only specific problems and was not accepted. In 1970, Ken Thompson at AT & T'S Bul Laboratories developed language called B. But again B language could deal with only specific problems. Finally, in 1972, Dennis Ritchie developed the C language.

Feature of C. C language offers features of both low-level (2nd generation) and High-level (3rd Generation) languages as discussed below:

1. Pointers. In C, we can refer the memory locations by its internal address, called pointers. Pointers is one of the features of Low-level languages.

2. Dynamic Allocation of Memory. In C, the programs during execution can request operation system to release memory for its use, which is called Dynamic Allocation of Memory. This is again one of the features of Low-level language.

3. Bit Manipulation. In C, data can be manipulated in its lowest form of storage i.e., BITS, which is again one of the features of Low-level language.

4. Recursion. In C, one function may call itself again and again, which is called Recursion. Recursion is a feature of high-level language.

Uses of C. As C provides features of both low and high level languages, it can be used to develop both system and application software. C can be used to develop operating systems, compilers, interpreters and other system software. You can also use C to develop both commercial and business application software.

Versions of C: There are many versions of C viz. ANSI C, Microsoft C and Turbo C. Turbo C is the most popular one among them.

(*vii*) **LOGO.** LOGO is a high-level programming language, created by Seymour Papert in the mid 1960s for teaching programming to young children for making drawing. LOGO is so simple to learn that children studying in First class can use it. Using Logo, children can create simple to complex patterns on screen very easily. Logo is also called Turtle graphics as you can create patterns consisting of lines rectangles, squares, circles etc. by moving turtle (a triangular shaped cursor) with simple commands as shown in Figure 8.15.

```
FD 50
RT 90
FD 25
RT 90
FD 20
RT 90
FD 25
```

Fig. 8.15: Logo Program to draw a flag

(*viii*) **Ada.** Ada is a high-level language, based on concepts developed in Pascal language. It was designed for embedded application, where a computer forms part of a speicalized system such as a cruise missile. It was developed as a result of search for a new programming language organised by the US Department of Defense in the late 1970s. Ada was named after August Ada Byron (1815-1852), counters of Lovelance and daughter of Lord Byron. Lady Ada was a mathematician and colleague of Charles Babbage (Father of computers), who built a digital computer, called Analytical engine. As the software for the Analytical Engine was developed by lady Ada, therefore she is known as the Word's First Programmer. The language Ada is named in her honour.

(*ix*) **LISP (Lisp Processing).** LISP is a high-level language, developed in the early 1960s by John McCarthy. LISP was designed mainly for the manipulation of List and tree structures of various kinds. LISP

is used in Artificial Intelligence application and compiler creations. It is available both in interpreter and compiler versions.

(x) **PL/I (Programming Language I) and PL/M (Programming Language for Microcomputers.** PL/I is a high-level language developed by IBM during 1964-69. It was designed to bring together the key features of FORTRAN, COBOL and ALGOL along with introducing new concepts like multitasking. PL/I did not become popular as it was very complex.

Later on, in the early 1970, Intel corporation modified PL/I and developed a new language for microcomputers, called PL/M, which was mainly used for developing operating system.

At one time, High-level languages were widely used for applications development, but most of them are now outdated due to popularisation of 4GLs. The uses of different 3GLs are summarised in table 8.1.

Table 8.1: Uses of 3GLs

Language	Uses
BASIC (Beginner's All Purpose Symbolic Instruction Code)	Used for all purposes (Commercial, Scientific, Educational, Graphics etc.) by beginners.
COBOL (Common Business Oriented Language)	Mainly used for development of commercial applications on all types of computers.
FORTRAN (Formula Translator)	Used for development of scientific (mathematical) applications.
ALGOL (ALGOrithmic Language)	Used to reflect mathematical algorithms.
Pascal (Name of a Mathematician)	Used for both commercial and scientific applications.
C (No full form)	Very powerful language for development of both system and application software.
LOGO	Used by young children for making drawings on computer.
ADA (Name of a Programmer)	Used to develop embedded applications for defense.
LISP (LISt Processing)	Used to develop artificial intelligence applications.
PL/I and PL/M (Programming Language I and Programming Language for Microcomputers)	Used to develop system software mainly operating systems.

User-friendly Languages

Although high-level languages are simpler to codify than low-level languages, they still require a lot of time to learn programming syntax. Hence,

these languages are beyond the reach of many computer users, who do not want expertise in programming. Therefore, a new category of languages have been developed which are user-friendly, very easy to codify and simplest to learn. These languages are called User-friendly Languages and popularly known as 4GLs (Fourth Generation Languages). Fourth generation languages may be classified into two categories-Xbase and Structured Query Language.

PROGRAMMING EXAMPLE

Write a program to input Student Name, Marks Obtained & Max. Marks. Calculate percentage and display the result. Store the data in following DBF structure:

Field Name	Type	Width	Decimal
NAME	Character	20	
MO	Numeric	4	
MM	Numeric	4	
PERC	Numeric	6	2
RESULT	Character	1	

SOLUTION

Step 1 Load dBASE and Create a DBF file with given structure by giving command CREATE STUD & save it. (Don't enter records)

Step 2 Type MODIFY COMMAND RESULT at dBASE command prompt, type program & save it.

Step 3 RUN the program by typing the command, DO STUD at dBASE command prompt.

PROGRAM

```
    PROGRAM TO ENTER DATA OF STUDENTS
CLOSE ALL
USE STUD
CLEAR
@ 1,30 SAY "DATA ENTRY SCREEN"
@ 3,10 SAY "STUDENT NAME"
@ 5,10 SAY "MARKS OBT"
@ 7,10 SAY "MAX. MARKS"
@ 9,10 SAY "PERCENTAGE"
@11.10 SAY "RESULT"
STORE SPACE(20) TO MNAME
STORE 0 TO MMO, MMM, MPERC
STORE SPACE(1) TO MRESULT
ANSWER = 'Y'
DO WHILE ANS = 'Y'
        @ 3,30 GET MNAME
        @ 5,30 GET MMO PIC "9999"
        @ 7,30 GET MMM PICT "9999"
        READ
        MPERC = MMO*100/MMM
        @ 9,30 SAY MPERC PICT "999.99"
        IF MPERC = 40
                MRESULT = 'P'
        ELSE
                MRESULT = 'F'
        ENDIF
        @ 11,30 SAY MRESUTL
        APPEND BLANK
        REPLACE         NAME         WITH         MNAME
        REPLACE         MO           WITH         MMO
        REPLACE         MMM          WITH         MMM
        REPLACE         PERC         WITH         MPERC
        REPLACE         RESULT       WITH         MRESULT
        @ 13,10 SAY " DO YOU WANT TO CONTINUE" GET ANSWER PICT "Y"
        READ
        @ 3,30 CLEAR TO 11,60
ENDDO
CLOSE ALL
CLEAR
RETURN
```

Fig. 8.16: A programming example in dBASE

(*i*) **Xbase.** Xbase is generic term denoting any of the programming environment based on the original dBASE programming language. Xbase languages include dBASE, FoxBase, Clipper and FoxPro, Fox Base, Clipper and FoxPro out of which the FoxPro is still being used by programmers while others are outdated.

(a) *dBase.* dBase is the first popular fourth generation language, on which the other Xbase languages (Foxbase, Clipper and FoxPro) are based. It is a relational database management system (DBMS) for PCs, developed by Borland. dBase is an interpreter based language, but its programs can be compiled with Clipper. You can write program for any type of application such as preparation of the results of students in dBase as shown in figure 8.16.

Version of dBase. Various versions of dBase are:

- Vulcan: dBase was originally named Vulcan by Wayne Ratliff, who created it to manage a company football pool.
- DBase II: Hal Lashlee and George Tate renamed Vulcan with dBase II in 1981 and formed Ashton-Tate company to market it. In 1991, Ashton-Tate company was acquired by Borland.
- DBase III: In 1984, dBase II was upgraded to dBase III.
- DBase III plus: In 1986, new features are added to dBase III and dBase III plus was introduced.
- DBase IV. It is a major upgrade of dBase III plus with features like report/screen generation, SQL (Structured Querry Language) and QBE (Querry By Example) interfaces.

(b) *FoxBase.* FoxBase is Xbase development system from Microsoft, which is similar to dBase. FoxBase was originally developed by Fox software for DOS. FoxBase+ is the most popular version of FoxBase, which gained a reputation for its higher speed and more compatibility than dBase III plus. As programming in FoxBase III+ was quite similar to that in dBase III+, programmers preferred the former due to its higher speed.

(c) *Clipper.* Clipper (latest version 5.2) is the most popular dBase-compatible application development system. It was first developed by Nantucker Corp, which was acquired by Computer Associates in 1992. Originally, it was being used as a dBase compiler for programmers, but later on it became a stand-alone development system with many unique features. Although, now nobody uses clipper, earlier, it was very popular among dBase programmers due to its following features:

- Clipper is a flexible Xbase language for writing efficient, encapsulated, and reusable program modules.
- It provides a powerful, flexible and replaceable database engine.
- It provides the simplest and efficient way to develop sophisticated and friendly user interface.

(d) *FoxPro:* FoxPro is the dBase IV compatible Xbase language from Microsoft. FoxPro is an enhansed version of FoxBase, which includes GUI (Graphical User Interface) SQL (Structured

Querry language) and QBE (Querry By Example) interfaces. Various versions of FoxPro include FoxPro 1.0, FoxPro 2.0, FoxPro 2.6 for DOS /Window and Visual FoxPro 3.0/5.0/6.0. Visual FoxPro 6.0, the latest version of FoxPro is currently very popular among programmers for application development due to object-oriented of features and client/server support.

(*ii*) **Structured Query Language.** Structured Query Language (SQL), developed by IBM, is a standard data definition and data manipulation language (DDL/ DML) of relational databases. It is designed to define, access, querry, organise and update the data and information in relational databases. It is now provided with most RDBMS and non-relational DBMS. SQL is generally hidden by user-friendly interfaces in an end-user environment. It is an English-like query language, intended for interactive use by untrained end users and was originally spelled SEQUEL (Structured English Query Language). Although SEQUEL consists of basic vocabulary of English-like words like SELECT, INSERT, DELETE actually it has not much resemblance with English language. Therefore, now, it is generally pronounced as SQL. SQL has now become the favourite among programmers who write programs that access relational databases. We would continue our discussion with some of the common statements of SQL in brief.

SQL Statements. SQL statements are grouped into the following three categories:

(*a*) DDL (Data Definition Language) statements

(*b*) DML (Data Manipulation Language) statements

(*c*) DCL (Data Control Language) statements

Some of the important SQL statements of the above three categories are described in Table 8.2. Using these statements, data in an RDBMS can be defined, manipulated and controlled.

To create a table of Supplier Database in SQL, the following statement is used:

```
CREATE TABLE SUPPLIER
        (SUPPNO CHAR(3)         NOT NULL,
SUPPNAME                CHAR(20),
CITYCODE                NUMBER(2),
CITYNAME                CHAR(3));
```

To query the database, the following statement is used:

```
SELECT SUPPNO, SUPPNAME, CITYCODE, CITYNAME
        FROM SUPPLIER
        WHERE SUPPNO = 'S01';
```

Table 8.2: Important SQL statements

Command	Description
SQL DDL Statements	
CREATE table	Create a database table
CREATE INDEX	Create an index for a table
ALTER TABLE	Alters the definition of a table
DROP	Delete a table or index from the database
RENAME	Changes the name of a table
SQL DML Statements	
SELECT	Retrieves data from one or more tables
DELETE	Delete one or more rows from a table
INSERT	Inserts one or more rows into a table
UPDATE	Updates existing rows in a table
SQL DCL Statements	
GRANT	Grants security access rights to the database
REVOKE	Revokes security access rights

The uses of different 4GLs are summarised in table 8.3.

Table 8.3: Uses of 4GLs

Language	Uses
dBASE	Used for development of mainly single user DOS based database appliactions.
FoxBase	Used for development of both single and multiuser DOS based database applications.
FoxPro	Used for development of both DOS and Windows based database applications.
Clipper	Used for development of both single and multiuser DOS based database applications.
SQL (Structure Querry Language)	Used to define, access quarry, organised and update data in relational database.
PL/SQL (Procedural Language/ Structured Query Language)	Used as a development tool that extends the facilities of oracle's SQL database language
PRO * C	Used to generate native C code by embedding SQL commands.

8.8. Object Oriented Languages

We have discussed that the object oriented programming is the latest

approach in programming. The languages which are based on object oriented programming (OOP) approach, are called as Object Oriented Languages. They may be classified into Fifth Generation Languages. Object oriented languages are specially useful for development of GUI (Graphical User Interface) applications. These languages also offer a unique feature of Reusable Code. Some of the popular object oriented languages are Smalltalk, C++, Object COBOL, Object Pascal, Simula, Eiffel, Java and Visual J++. C++ and Java J++, which are widely used now-a-days for development of Window-based applications are described below:

(a) C++. C++ is an object-oriented version of C. It was developed by Bjarne strougtrup at Bell Labs in the early 1980s. It has become very popular because it incorporates Object-Oriented Programming (oop) features in traditional C programming. So, C++ is a superset of C. The structure of a C++ program resembles with that of C with few changes in syntax as shown in figure 10.17. The popular version of C++ is Turbo C++ (latest version 6.0).

```
// Program to calculate the perimeter of a circle
# include <iostream.h>
void main()
{         float pi = 3.14159'
          float rad, peri;
          cont << "Enter radius"
          cin >> rad;
          peri = 2* pi * rad;
          cont << "perimeter "<< peri;

}
```

Fig. 8.17: An example of a C+ program for calculating perimeter of a circle

(b) Java. Java is an object-oriented programming language from the Java Soft division of Sun. Java is mainly used for developing Internet and Intranet applications. Using Java, you can develop client/server applications for the World Wide Web. Although Java is similar to C, C++ and Objective C, it is not based on any of these languages.

Features of Java: Java language offers the following features:

• Java is an interpreter-based language. The source code of a java pogram is converted into byte code, which is then converted into machine code during execution by the Java interpreter, called Java Virtual Machine. With Java Virtual Machine, Java programs can be run on any computer and hence they are hardware independent.

• Java is a difficult-to-learn language. So, it is not meant for the beginners.

• Java provides a special class called Java Applet, which can be run by an already running Java application such as a Web browser. Java applets can be downloaded and run on any Web browser (e.g., Internet Explorer, Netscate Navigator, etc.) capable of interpreting Java.

• Java provides a reusable object called Java Bean. A Java Bean is similar to an Active controls, which execute only on computers supporting

OLE (Object Linking and Embedding) at the operating system level. Using Java Beans, the developer can quickly create applications.

The uses of different object oriented languages are summarised in table 10.4.

Table 8.4: Uses of object-oriented languages

Language	Uses
Smalltalk	Used for development of mainly graphical applications.
C++	Used for development of all types of object oriented applications
Object COBOL	Used for development of object oriented applications on mainframe computer.
Object PASCAL	Used for general object oriented applications.
Simula	Mainly used in a research environment.
Eiffel	Used for general object oriented applications.
Visual J++	Very popular for development of Windows based applications.

Object Based Languages. There are certain languages, which support most of the features of object oriented programming except inheritance. These languages are not pure object oriented languages and are known as Object Based Languages. For example, Ada, an high level language designed for process control is an object based language.

8.9. Key Point Summary

- There are two approaches used in programming—Procedure Oriented and Object Oriented.
- In procedure oriented programming, an application problem is viewed as a sequence of steps while in object oriented programming, it is viewed as a collection of different units, called objects.
- Object oriented programming uses the Concepts of Classes, Encapsulation, Data Hiding, Data Abstraction, Inheritance and Polymorphism.
- A software development project is managed by a team of system analysts and programmers.
- A system analyst performs the role of a problem investigator, problem solver, manager and motivator.
- Programmers are responsible for development, testing, implementation and maintenance of the system.
- Various steps of a programming process are—(*a*) Understanding the problem, (*b*) Understanding the requirements, (*c*) Developing the algorithm, (*d*) Checking the algorithm, (*e*) Coding the program, (*f*) Entering the code, (*g*) Translating program, (*h*) Executing and testing the program, (*i*) Debugging the program, and (*j*) Document the program.

- The two major types of program tools are program flowcharts and pseudocodes.
- Program flowchart is a symbolic representation of each step of program and is the best tool to develop the program logic.
- The different symbols of flowchart are Input/Output, Process, Terminal, Connector and Flowline symbols.
- Pseudocode uses simple English statements to represent the program logic.
- The programming languages are classified into four types—(a) Low-level, (b) High-level, (c) User-friendly, and (d) Object-oriented languages.
- The computer languages are also classified into five generations based on their historical development.
- Machine language and Assembly language are low-level languages.
- Machine language is a first generation while assembly language is a second generation language.
- Basic, Cobol, Fortran, Algol, Pascal, C, Logo, Ada, Lisp, PL/I and PL/M are various high-level languages (Third Generation Languages).
- dBase, FoxBase, Clipper, FoxPro, SQL, PL/SQL and PRO*C are various user friendly languages (Fourth Generation Languages).
- C++, Smalltalk, Object Cobol, Object Pascal, Simula, Eiffel and Java/ Visual J++ are various object-oriented languages (Fifth Generation Languages).

8.10. Review Questions

1. Discuss the different programming approaches by giving suitable examples.
2. Define the following terms :

   (a) Object   (e) Inheritance

   (b) Class   (f) Polymorphism

   (c) Encapsulation   (g) Data Abstraction

   (d) Data Hiding   (h) OOP

3. Discuss the role of systems analyst and programmers in the development of software.
4. Why do we need object oriented programming approach ? Discuss.
5. Discuss the programming process in detail.
6. What are program tools ? Explain the difference between flowchart and pseudocode with suitable examples.
7. Draw and explain different symbols used in drawing a flowchart.
8. Draw the flowcharts to solve the following problems :

   (a) To add N natural numbers

   (b) To determine the smallest number out of given N numbers.

   (c) To print first 10 fibonacci series i.e., 1, 1, 2, 3, 5, 8, 13, 21, 34, 55.

9. Write pseudocode statements :

    (*a*) To add first 10 even numbers

    (*b*) To find out the perimeter of a rectangle where Perimeter = 2 * (Length + Breadth).

10. What do you mean by computer languages ? Differentiate among High-level, Assembly and Machine language.

11. List the salient features and typical application areas of the following high level languages :

    (*a*) C   (*b*) Basic

    (*c*) Cobol   (*d*) Fortran

12. What are fourth generation languages ? Why are they called user-friendly languages ?

13. Explain the difference between the following :

    (a) Low level and High-level Languages

    (b)Third and Fourth Generation Languages

14. Classify the following languages into First, Second, Third, Fourth and Fifth Generation Languages and write their uses :

    (*a*) Cobol   (*f*) C++

    (*b*) Ada   (*g*) Smalltalk

    (*c*) PL/I   (*h*) Machine

    (*d*) dBase   (*i*) Assembly

    (*e*) SQL   (*j*) Pascal

15. Mention three factors that make high-level languages more advantageous than machine level languages.

16. What do you understand by the following and give examples to justify your answer :

    (*a*) Scientific-purpose Languages

    (*b*) Business-purpose Languages.

Unit-9

Modern Information Technology

Structure

9.1. What is Networking
9.2. Types of Networks
9.3. Network Topologies
9.4. Key Point Summary
9.5. Review Questions

9.1. What is Networking

Network is a group of computers and peripherals, connected by a communications channel. It is capable of sharing files and other resources such as printers, drives, etc. among many users. It ranges from local area networks to wide area networks.

Components of Networking

The typical hardware in networking consists of the following components:

(*i*) **Computers.** They may include mainframes, minis and micros.

(*ii*) **Peripherals.** Printers, Scanners, Plotters, etc. are the peripherals connected to the network.

(*iii*) **Data Communications Equipment.** Modem is the main data communication equipment in a network.

(*iv*) **Cables.** Various types of cables viz. Twisted-pair, Coaxial, Fiber optic, etc. are used for transmission of data in a network.

(*v*) **Network Interface Cards.** It is a PC expansion board that plugs into a personal computer or server and works with the network operating system to control the flow of information over the network. It is connected to the network media, which in turn connects all the network interface cards in the network.

(*vi*) **Hubs.** They are used to extend a network so that additional workstations can be attached.

(*vii*) **Switches.** They are devices capable of forwarding data packets directly to the ports associated with particular network addresses.

(*viii*) **Repeaters.** They are hardware devices that move all packets from

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one network segment to another by regenerating, re-timing and amplifying the electrical signals.

(*ix*) **Bridges.** They are hardware devices used to connect local are networks so that they can exchange data. They work with networks that use different network protocols or wiring.

(*x*) **Routers.** They are intelligent connecting devices that can send packets to the correct local area network segments to take them to their destination. They link network segments at the network layer of the ISO/OSI model for data communications.

(*xi*) **Brouters.** They are networking devices that combine the characteristics of bridges and routers. A brouter routes one or more specific protocols and bridges all others.

(*xii*) **Gateways.** Gateways are shared network connections between local area networks and larger networks whose communication protocols are different.

Uses of a Network

A network is used for a wide range of purposes, some of which are:

- The network provides an intelligent switching capability between the peripheral devices such as printers, scanners, etc. for purpose of sharing.
- The network enables the creation of a large buffer where data accumulates from various computing devices. In case of printer sharing, the buffer activates as a queue on a special device called print server.
- In a typical office environment, a network provides the facilities of terminal access to central computing machine such as mainframe.
- A network enables access to external and remote devices.
- A network enables access to database located centrally on a mainframe computer or distributed on client/server machines.
- The environments like Point Of Sales (POS) in retail outlets are not possible without networking.
- Automatic Teller Machines (ATMs) of the banks work on a network.
- Centralised railway and airlines reservation is not feasible without a network of computers.
- Internet is a very big network of networks, which have brought a revolution in the IT.

9.2. Types of Networks

Networks can be divided into the following five categories:

1. Local Area Network (LAN)
2. Wide Area Network (WAN)
3. Metropolitan Area Network (MAN)
4. Wireless Network

5. Internetwork

Let us discuss these.

Local Area Network (LAN)

Local Area Network (LAN) connects several computers within a confined geographical area with permanently installed cables and dial-up-lines. A typical LAN consists of a server, workstations, a network operating system (such as Windows NT) and a communication link (such as Modem). File Server is a host computer of the network that holds data/ programs and makes access to files, printing and other services available to users of the network. Typically, a server has a more advanced CPU with more memory and storage capacity than a workstation. Large networks may have more than one file servers. Workstation is a user's machine (other than server) that can also function as a stand alone computer. Workstations are also called the terminals of a LAN. They are interconnected and connected to the file server. The significant feature of a LAN is that its workstations are intelligent terminals with a capability of distributed processing. This is unlike in a mainserver or miniframe centralised server based environment where the connected terminals are dumb without their own processing power. The Peer-to-Peer network is a type of local area network in which all the resources of each PC is available to other PCs on the network.

The network connecting devices such as hubs, switches, repeaters, bridges, routers and gateways are generally applied whenever expansion of a LAN is required. A local area network is needed to be expanded mainly for following two reasons:

(*i*) Firstly, two or more LAN systems are needed to be integrated for sharing of peripherals and data resources.

(*ii*) Secondly, LAN may be needed to expand beyond geographic limits of optimum performance.

Advantages of LAN. A local area network provides the following advantages to an organisation or a computer user:

- Using a LAN, expensive resources such as disk, files, printers, plotters, modems and software can be easily shared among many users.
- Data management in a LAN environment is more efficient than the centralised processing systems.
- Workstations of a LAN provided security and virus protection by not allowing to download important data from server or uploading unwanted software.
- LANs are more flexible and modular as they can be expanded easiliy by adding more workstations with the support of networking software. If more disk storage is required, you can install another hard disk or connect other fileserver in a LAN. Even you can bridge more than one LAN for sharing and transmitting data.
- Most LANs have fault-tolerant capabilities. So, in the case of power failures, they can safeguard data by disk mirroring and disk duplexing. Disk mirroring is a fault-tolerant technique that stores the

same information simultaneously either on two hard disks or two partitions of a hard disk using the same disk controller. Disk duplexing is similar to disk mirroring but uses a different disk controller to provide greater dedundancy.

Wide Area Network (WAN)

As contrast to LAN, Wide Area Network (WAN) connects users across large distances, often crossing the geographical boundaries of cities or states. Thus, WANs are much bigger than LANs. A WAN may consist of several LANs. The individual LANs inside the WANs are generally referred as sub-networks.

Wide area network contains a collection of machines, called hosts, which run user programs. The hosts are connected by a communication subnet, which carries messages from host to host. In most WANs, the subnets consist of to distinct components— channels and switching elements. The channels are the transmission lines, which move data between machines. The switching elements are the specialised hardware devices that connect two or more channels. They are also called data switching exchanges, packet switching nodes or routers.

Types of WAN Subnets. There are two types of WAN subnets—Point-to-Point and Wireless.

(*a*) *Point-to-Point Subnets.* In point-to-point subnet, the network contains numerous cables, each one connecting a pair of switching elements. The two switching elements that do not share a cable communicates via other switching elements. There are several types of topologies possible for point-to-point subnets viz. Ring, Star, Tree, etc. These topologies are discussed in the subsequent part of the chapter.

(*b*) *Wireless Subnets.* In a wireless subnet, networks of WAN are connected through satellite or ground radio systems. In this system, each switching element of subnet has an antenna through which it can send and receive data. In some systems, the switching elements may be connected to a substantial point-to-point subnet.

Difference between LANs and WANs. Wide are networks differ from local area networks in many ways as described in table 9.1.

Table 9.1: Differences between LANs and WANs

Wide Area Networks	Local Area Networks
1. They are spread over distances up to thousands of kilometers.	1. They are spread within a local area upto few kilometers.
2. They use complex protocols and extensive error recovery methods.	2. They use simple protocols and do not employ extensive error recovery methods.
3. The data is generally transmitted as analog signals.	3. The data is generally transmitted as digital signals.

4. Number of terminals in a WAN is unlimited.	4. The number of terminals in a LAN is limited.
5. The data transmission rate is slow (9.6 kbps to 1 Mbps)	5. The data transmission rate is fast (1 to 16 Mbps)

Metropolitan Area Network (MAN)

Besides LANs and WANs, there are certain networks which are bigger than LANs but smaller than WANs. These networks extend beyond the confines of a LAN but do not spread over in a wide area. These networks, which are usually confined to a single metropolitan city are known as Metropolitan Area Networks (MANs). A MAN operates at 100 megabits per second or faster and is capable of voice and data transmission over a distance of up to 80 kilometers. A MAN has only one or two cables and does not contain switching elements. The key feature of a MAN is that it uses a communication standard, called Distributed Queue Dual Bus (DQDB) or 802.6 (an IEEE standard). DQDB consists of two unidirectional cables or buses to which all computers of the network are connected

Wireless Network

A wireless network connects portable computers such as laptops and palmtops to the main desktop computer. This network can be in many forms, such as a Wireless LAN or a cellular network. In a wireless LAN, computers communicate directly in digital form within a confined geographical area. In a cellular network, the computers are connected using a cellular phone with a traditional analog modem. Although wireless networking and mobile computing are related, they are not identical. In mobile computing, portable computers are sometimes wired when you connect them with telephone lines. However, in wireless networking portable computers are never wired.

Uses of Wireless Network. A wireless network is used for the following purposes:

- Portable office for sending and receiving telephone calls, faxes, electronic mails, files, etc.
- Rescued workers at disaster sites where there is no telephone system.
- Military for exchanging confidential information.

Internetwork

A collection of interconnected networks is called an internetwork or internet. A collection of LANs connected by a WAN is a common form of internet. It is important to mention here that the term 'internet' (with lowercase i) is not same as the term 'Internet' (with uppercase i). The term 'internet' refers to a network in general sense while the term "Internet' refers to a specific worldwide internet, which is the world's largest network of networks. An internetwork is formed when distinct networks such as a LAN and a WAN or two LANs are connected together.

9.3. Network Topologies

The layout of the cabling in connecting devices in order to form a network is called topology of the network. The structured topology makes the process of addition and deletion of a node in the network easier. The common network topologies are Mesh, Bus, Star, and Ring. Let us discuss these.

Mesh Network

In the mesh network, the nodes are connected randomly using the communications links. The mesh network is either fully connected or connected with partial links. In fully connected mesh topology, each node is connected to every other node as shown in figure 9.1. So, there is no need of any routing protocol as nodes are directly connected. However, in a partially connected mesh topology, each node is not connected to every other node. So, a router protocol or procedure is used to transfer information among widely scattered nodes, which are not directly connected.
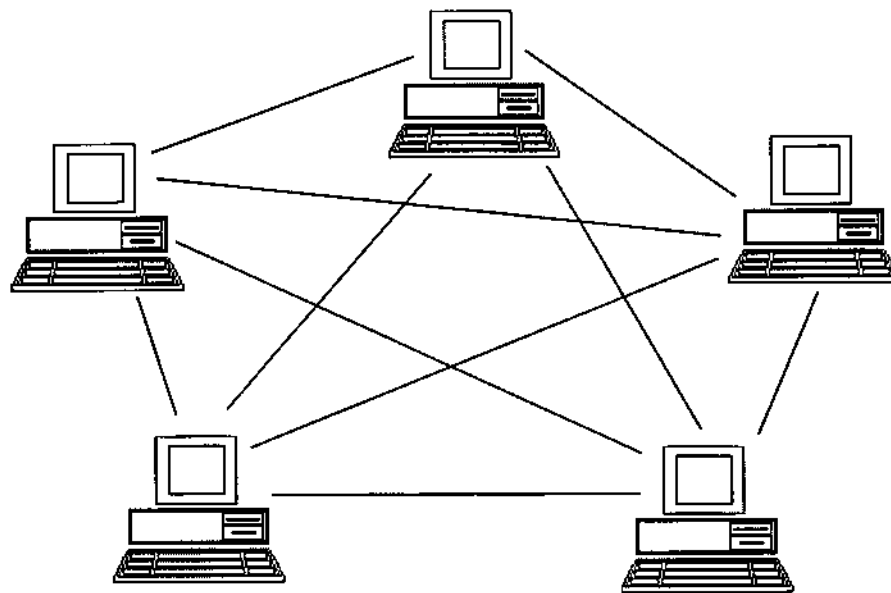

Fig. 9.1: Mesh network

Advantages of Mesh Network. Fully connected mesh networks are very reliable, as alternate paths are always available if direct link between two nodes is disconnected. Partially connected mesh networks are very useful for WANs as their nodes are widely scattered.

Disadvantages of Mesh Network. Fully connected mesh networks are very expensive as adding a node requires installation of new links and one more extra interface in each node. Partially connected mesh networks are less reliable as compared to fully connected mesh networks.

Bus Network

The bus network consists of a single communication channel to which each node is connected. Each node has a device that sends messages along the bus in either direction as shown in figure 9.2. A given message contains data, error-checking code, the address of the node that sends the message, and the address of the node that receives the message. When a message passes through each node, that node checks the message for its address. If the node finds its address in a message, it reads the data along with error checking code and sends a message to the sender that data has been received.
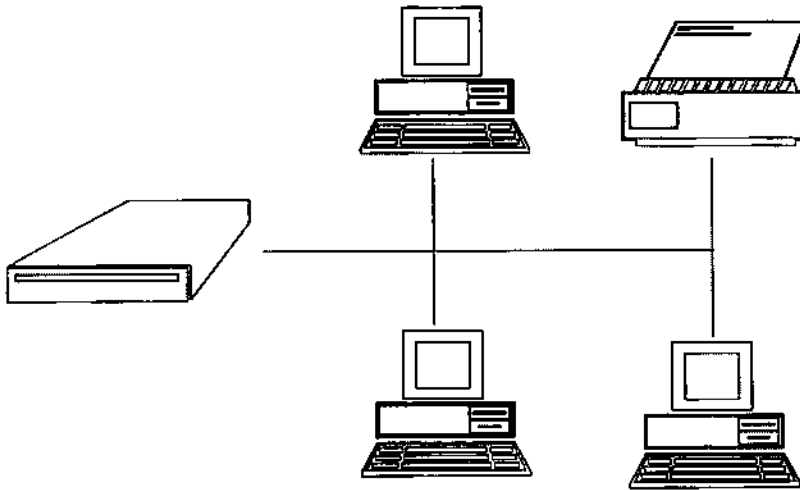
Fig. 9.2: Bus network

Advantages. The bus network is simple in layout and ease in connectivity. So, it is easier to find errors in locating cable faults in bus network. The bus network is ideal for one to many data transmissions.

Disadvantages. A problem occurs with a bus network when two or more nodes send messages at the same time. This creates an interference pattern, and when one of the node on the network detects this pattern, it stops all transmissions. Another problem with a bus network is that a broken connection along the bus brings the whole network down.

Star Network

Star network is an improvement over the bus topology. In a star network, each node is connected via its own path to a central hub which acts as a switching station as shown in figure 9.3. The hub reads the addresses of messages sent by the nodes and routes the messages accordingly.

Advantages. In the star network, the hub prevents data collisions. When a given node's connection to the network is broken, the rest of the network can remain operational.

Disadvantages. Wiring costs for star network is higher than other topologies, because each node requires its own individualcable. The major problem of star network is that in case the hub fails the entire network is halted.
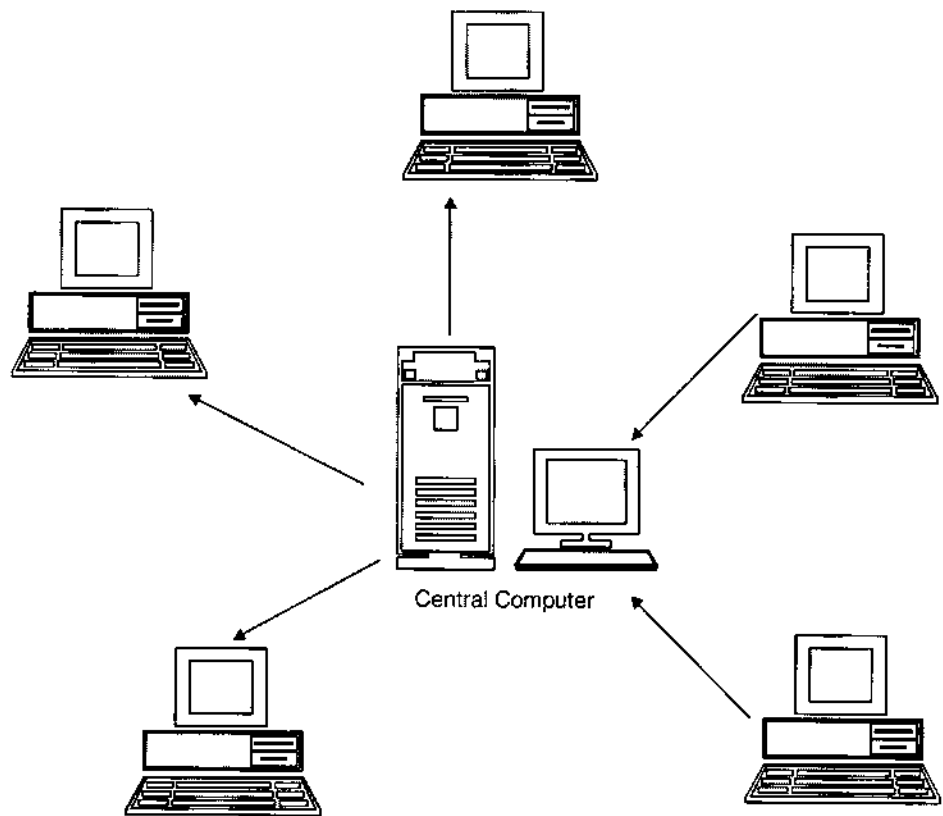
Fig. 9.3: Star network

Ring Network

In a ring network, each node is connected on a circular path as shown in figure 9.4. Unlike bus topology, in a ring network the data transmission is unidirectional. In ring network, a token (a code indicating that the network is clear) circulates continuously around the network until a given node sends a message. When a node sends a message, it intercepts the token, changes it to indicate that the network is in use. The message includes data, error checking code, and the address of the node receiving the message. The message passes around the circular path until it reaches its addresses. The node that receives the message copies it and then passes it back along the path until it reaches the sender. The sender then removes the message from the network and changes the token back to its original state.

Advantages. The ring network does not have any routing problem as every node on the ring receives the data. As every generated packet eventually returns to the sender node, so there is no need of acknowledgment of successful data transmission. Ring network also avoids data collisions.

Disadvantages. Like bus network, the ring network will go down if a single connection is broken.
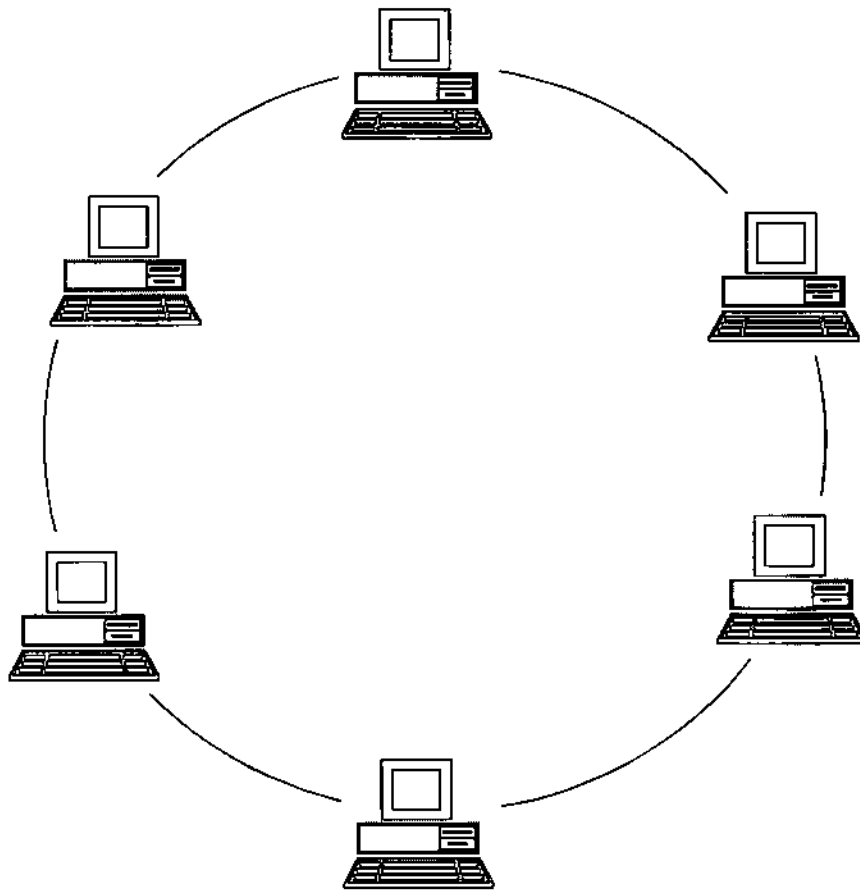
Fig. 9.4: Ring network

9.4. Key Point Summary

- The typical hardware in networking consists of Computers, Peripherals, Modem, Cables, Network Interface Cards, Hub, Switches, Repeaters, Bridges, Routers, Brouters and Gateways.
- Various types of networks are LAN, WAN, MAN, Wireless Network and Internetwork.
- A LAN connects several computers within a confined geographical area, such as a building; a MAN is confined to a single city; while a WAN connects users across cities and countries.
- The term 'Internetwork or Internet' refers to a network of networks in general sense while the term 'Internet' refers to a specific worldwide network of networks.
- The common network topologies are mesh, bus, star and ring.

9.5. Review Questions

1. What is LAN ? What is the difference between a Star LAN and a Bus LAN ?

2. Explain the difference among a LAN, a MAN and a WAN.

3. What is a Router ? How is it different from a Gateway and a Bridge.

Unit–10

Overview of Internet

Structure

10.1. Introduction

10.2. What is Internet

10.3. History of Internet

10.4. Applications of Internet

10.5. Modes of Connecting to Internet

10.6. Internet Tools and Services

10.7. Addressing System on Internet

10.8. Key Point Summary

10.9. Review Questions

10.1. Introduction

Telecommunication refers to the electronic transmission of all forms of information, including digital data, voice, sound and video from one location to another over some form of transmission medium. This transmission medium may be a telephone line or microwave signal. The importance of telecommunication in businesses and personal purposes is increasing very rapidly with new developments and technologies. ISDN (Integrated Services Digital Network), E-mail, Internet, Intranet, Video Conferencing, Paging and Cellular technologies have become very popular during last few years. In this chapter, we are discussing the overview of most widely used data communication and telecommunication technology—Internet.

10.2. What is Internet

Internet is the most recent telecommunication technology, which have brought a technological revolution not only in offices but also in homes. Internet is the world's largest computer network, which connects several computers of different types belonging to various networks all over the globe. Internet can also be defined as a technology for linking local area networks (LANs) into a huge global computer network. So, Internet is a network of networks.

Differences between Internet and Online Services

Online services are commercial networks that are owned by different agencies, while there is no owner of Internet. Online services charge users for

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access while no one pays for using Internet. Online services are profit making firms that offer current news, chat rooms and other information to their subscribers over standard telephone lines. They also provide Internet access. Internet, on the other hand, is a large network of networks that facilitates data communication services. The commercial networks that charge user for access are:

- America On Line (AOL)
- CompuServe
- Prodigy
- Genie

Authorities Governing Internet

Internet is not governed by a single authority. There are many authorities as shown in figure 10.1 that control the Internet today. They are:

(*i*) **Internet Society (ISOC).** It is a voluntary membership organisation, which promotes global interchange of information on Internet.

(*ii*) **Internet Service Provider (ISP).** It sells Internet subscriptions to the public.

(*iii*) **Internet Architecture Board (IAB).** It provides addresses for computers on the Internet and sets rules for naming addresses

(*iv*) **Internet Engineering Task Force (IETF).** The technical and operational problems on Internet are solved by Internet Engineering Task Force.
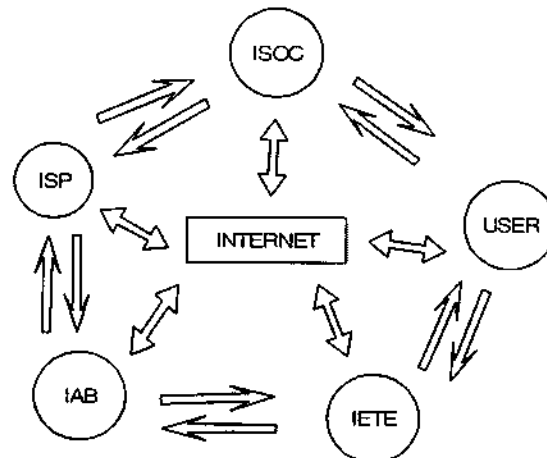

Fig. 10.1: Various authorities governing Internet

10.3. History of Internet

The history of Internet began in 1957 when USSR launched the first artificial earth satellite – Sputnik and US formed the Advanced Research Projects Agency (ARPA) within the Department of Defense (DOD). In 1969, USA set up a network called ARPANET for research into networking. The need for such a network arose because a few resourceful computer scientists

wanted to share files among people working on the same or similar projects. In 1972, Ray Tomlinson of BBN (Bolt Beranek and Newmann, Inc.) developed an E-mail program to send messages across a distributed network. In 1974, the design of TCP (Transmission Control Protocol) was specified in detail by Vint Cerf and Bob Kahn. BBN also started the commercial version of ARPANET – Telnet.

In 1981, a cooperative network was started at the City University of New York, which was called BITNET. BITNET is the acronym for "Because It's Time NETwork". A protocol suite, TCP/IP (*Transmission Control Protocol/ Internet Protocol*) was established by INWG (InterNetworking Working Group) in 1982. In 1983, ARPANET disintegrated into ARPANET and MILNET (MILitary NETwork). ARPANET became a network for research and educational purposes while MILNET was integrated with Defense Data Network for defense purposes. The *Domain Name System (DNS)* was introduced in 1984. Organisations during 1980s generally had LAN and UNIX based systems, which communicated very well with ARPANET as they supported Internet Protocol (IP). In 1986, NSF (National Science Foundation) constructed its own network, called *NSFNET*. This network had five supercomputing centres, which were interconnected. The speed of data transfer on this network was 56 Kbps. In 1987, NSF signed a cooperative agreement with Merit Network, Inc. for managing the NSFNET backbone. In 1989, NSFNET backbone upgraded to T1 NSFNET, which provided speed of 1.544 Mbps. In 1992, it was further upgraded to T3 NSFNET, which provided speed of 44.736 Mbps. In the same year, WWW (World Wide Web) was released and ISOC (Internet SOCiety) was founded.

10.4. Applications of Internet

Internet is the world's largest computer network, which connects several computers of different types belonging to the various networks all over the globe. Internet is very popular among millions of users worldwide because there is no application area left where Internet is not helping us. Various applications of Internet are –

- Internet helps people to communicate with each other sitting at any corner of the world. Using E-mail services, people can send messages to any part of world within few minutes.
- Internet is the major media for creating and viewing any kind of information related with Science, Art, Music, History, Computers, Engineering, Medicine, Management, Religion, Movies, Games, etc. We can see our horoscope on Internet. We can also watch news, sports and movies on Internet.
- Internet is the vast virtual market place for advertising and selling products through the latest concept of E-commerce.
- It helps organisations to link their wide spread offices and employees.
- It helps people to learn and to find suitable jobs for them.
- It helps people to chat with each other, so that they can talk with their old friends and make new friends across anywhere in the world.

- It provides all types of entertainment to people such as movies, games etc.
- It helps people to share any information through conferencing. We can do audio and video conferencing on Internet.
- Web publishing (Electronic Publishing) is the new approach of publishing, which is replacing paper books with electronic books.
- Internet Banking and WAP (Wireless Applications Protocol) are the latest developments of Internet applications. Through Internet Banking, you can avail many banking services without going to your bank. Using WAP, you can avail Internet facilities on your mobile phone.

These are just few areas where Internet is helping us. In fact, there is no limit of Internet applications.

10.5. Modes of Connecting to Internet

Connecting to the Internet through the host machine by providing user name and password is called Logging In. There are four modes of connecting to the Internet, which are:

(*a*) Host/Terminal Connection

(*b*) Individual Computer TCP/IP Link or Dial-up Networking

(*c*) Dedicated Access

(*d*) Dial-up Access through LAN

Let us discuss these.

Host/Terminal Connection

Host/Terminal Connection is the least expensive type of Internet access. In this method, our computer is not really connected to the Internet but we are using it as a terminal, which is remote to an Internet host or server. This method requires a modem and a phone line. Using host/terminal connection, only text base applications can be accessed on the Internet and we cannot access graphical applications. As using this method we get access to the shell of a UNIX computer, it is also called Shell Access Connection. Host/Terminal Connection offers the following advantages:

- Ideal for University and College students as it is more economical.
- Provides good speed for accessing text only documents.

Individual Computer TCP/IP Link or Dial-up Networking

TCP/IP is an abbreviation of two Internet protocols—Transmission Control Protocol (TCP) and Internet Protocol (IP). TCP permits two Internet-connected computers to get a reliable connection. IP is responsible for routing the data packets to a desired destination address. TCP/IP link requires a modem or an ISDN adapter and an analog phone line or an ISDN line. With this link, the user computer is assigned a temporary IP address and is directly connected to the Internet.

TCP/IP links can either be SLIP or PPP links. The differences between SLIP and PPP links are listed in table 10.1.

Table 10.1: Differences between SLIP link and PPP link

SLIP Link	PPP Link
1. SLIP stands for Serial Line Internet Protocol.	1. PPP stands for Point of Point Protocol.
2. SLIP is an older protocol.	2. PPP is a new protocol.
3. It is slower in speed.	3. It is faster in speed.

Individual Computer TCP/IP Link or Dial-up Networking offers the following advantages :

- Most suitable for Internet cafes because using a phone line and a hub, many computers can be simultaneously connected to Internet with cheaper cost.
- Most suitable for homes as a single PC can be easily connected to Internet using a modem and telephone line. Moreover, the Internet & phone line charges per hour is also not very high.
- Using ISDN line, the Internet access becomes cheaper and faster.

Dedicated Access

Dedicated link connection is a permanent Internet connection. It allows the user's computer to remain connected to the Internet round the clock. It can be set up over a telephone line using a router or a modem. A router is an electronic device that examines each data packet on receiving and provides the way to send it towards its destination. So, router transmits data from one network to another. We can also use a modem in place of a router. A router provides higher transmission speed while a modem provides low speed. Dedicated link offers the following advantages :

- Dedicated link connections are generally used by big organisations providing on line Internet services to their customers. It is ideal for big organisations needing Internet with permanent connection.
- Ideal for institutes providing on-line education through Internet.
- Ideal for E-commerce and web publishing due to highest speed and round the clock access.

Dial-up through LAN

Dial-up through LAN is an intermediate type of connection between TCP/IP link and Dedicated link as it provides some features of both these connections. It is set between LAN and Internet servers. It is generally used to exchange a large volume of E-mail messages on a little Internet traffic. Dial-up Access through LAN is ideal for those organisations which need to send large volume of E-mails to their branch offices and customers on daily basis because this mode provides a high speed.

The differences among various ways of connecting to Internet are shown in table 10.2.

Table 10.2: Differences among various ways of connecting to Internet

Host/ Terminal Connection	Individual Computer TCP/IP Link	Dedicated Access	Dial-up Access through LAN
1. No direct connection with Internet.	1. Direct Temporary connection.	1. Direct Permanent connection.	1. Direct Temporary connection.
2. Requires a modem and a phone line.	2. Requires a modem/ISDN adapter and a phone line/ ISDN line.	2. Requires a modem/Router and a phone line.	2. Requires a LAN, modem and a phone line.
3. Limited Access with slow speed.	3. Average access with average speed.	3. High access with high speed.	3. Average access with speed.
4. Does not provide GUI interface.	4. Provides GUI Interface.	4. Provides GUI interface.	4. Provides GUI interface.
5. Used by students on UNIX machines.	5. Used by individuals & Internet cafes at home or small offices.	5. Used by big organisations for all Internet applications.	5. -Used by organisation to exchange large volume of E-mails.

10.6. Internet Tools and Services

Internet provides the following important tools and services:

1. Browsers
2. Search Engines
3. Electronic Mail
4. File Transfer Protocol
5. Usenet
6. Telnet
7. Internet Relay Chat
8. Other Tools

Let us discuss these.

Browsers

Surfing refers searching information on Internet without knowing what we are searching. Surfing on Internet is done by programs, which are called browsers. Browsers help non-technical people to work on Internet because they are very user-friendly. You need not have to remember the commands. Browsers help you always while surfing the Internet. The differences between a text only browser and a graphical browser are shown in table 10.3.

Table 10.3: Differences between a text only browser and a graphical browser

Text Only Browser	Graphical Browser
1. It shows web pages with text only without graphics and animation	1. It shows complete web pages with text, graphics, animation and sound.
2. It is comparatively very slow.	2. It is very fast.
3. Example: Lynx	3. Examples: Netscape Navigator, Internet Explorer and NCSA Mosaic.

The popular browsers are as follows:

(i) **World Wide Web (WWW).** World Wide Web (WWW) is the most popular browser of Internet. It is a series of servers that are interconnected through hypertext and hyperlinks. It is the most favorite means of searching the Internet. It is simply known as the Web. It is very popular because:

- It is very easy to use.
- It is attractive in screen layouts
- It provides information to any one interested
- It provides user a simplified way to access text, graphics, animation, sound and other forms of information.

Hypertext, Hypermedia and Hyperlinks. Hypertext is the text that contains connections within the text to other documents besides the regular text. It is actually a way of presenting information on the web. Using hypertext, the user can jump from one page to another by clicking on the underlined or highlighted words called hyperlinks as shown in figure 10.2.
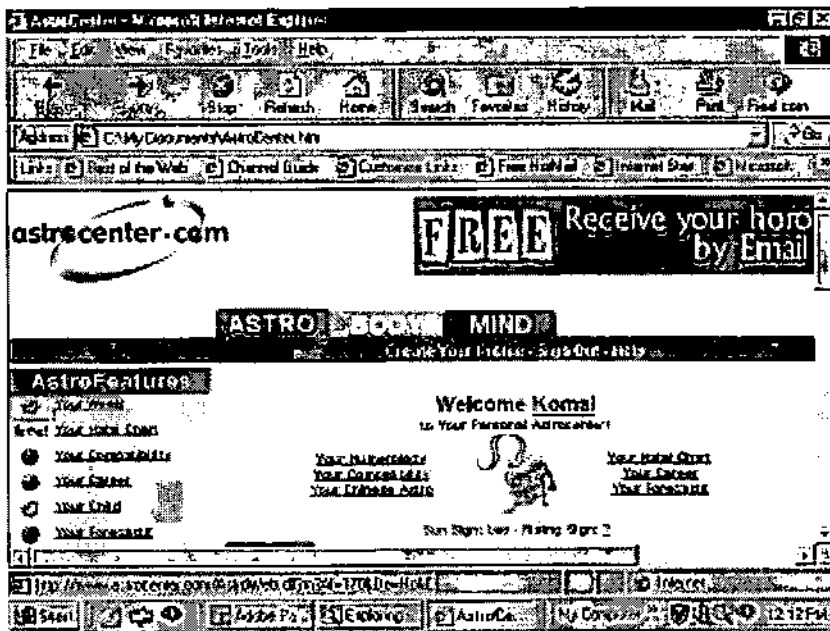

Fig. 10.2: A web page showing hyperlinks

Hypermedia is higher version of hypertext that contains links not only to text but also to other forms of information such as sound movies, pictures etc. It enables user to retrievemultimedia resources on Internet.

HTML. HTML stands for hypertext markup language. It is the encoding scheme used to create and format a Web page. It is an improved version of Standard Generalised Mark up Language (SGML). HTML is a versatile language and can be used on any platform. It can be used to display any type of document on the host computer, which can be geographically at a different location. HTML provides tags to make the Web page look attractive. We can use graphics, colors, fonts, etc. to enhance the presentation of Web page using HTML. HTML allows the creation of hyperlinks to any limit.

(*ii*) **Gopher. Gopher is a browser for locating information on the Internet.** It enables the user to locate all textual information stored on Internet servers through a series of easy to use, hierarchical menus. Internet has thousands of gopher servers around the world. Each gopher site has thousands of listings, which are orgainised in form of menus and submenus. We browse the Internet by selecting various items from these menus. Gopher is based on the concept of clients and servers. Clients are the software that requests information for a user. Servers are the software that provide information to clients. When the user initiates the Gopher software for surfing and selects an item from the menu, the server transfers the user to the appropriate file on the selected server. Now, the user jumps to another server and in this way the process continues and user move from one site to another while surfing on Internet. The salient features of Gopher are :

- It is an Internet based document retrieval system.
- It displays a set of resources on Internet in the form of menus.
- It is very simple to operate as we need not know the address of sites and UNIX commands.
- Using Gopher, we can gather information in the form of text, images and sound.
- With Gopher we can also access services in the form of Telnet connections.

Gopherspace. It is the universe of Gopher servers connected to the Internet throughout the world. Each Gopher server has an Internet address and port number of its own. It also has links to other Gopher servers.

(*iii*) **Microsoft Internet Explorer.** Microsoft Internet Explorer as shown in figure 10.3 is the most popular browser for Internet. It is based on MCSA Mosaic. It is distributed under a licensing agreement with Spyglass Inc. It is shareware software that can be downloaded from Internet. It enables us to connect to the Internet for gaining

access to the huge volume of information on millions of computers connected with Internet.
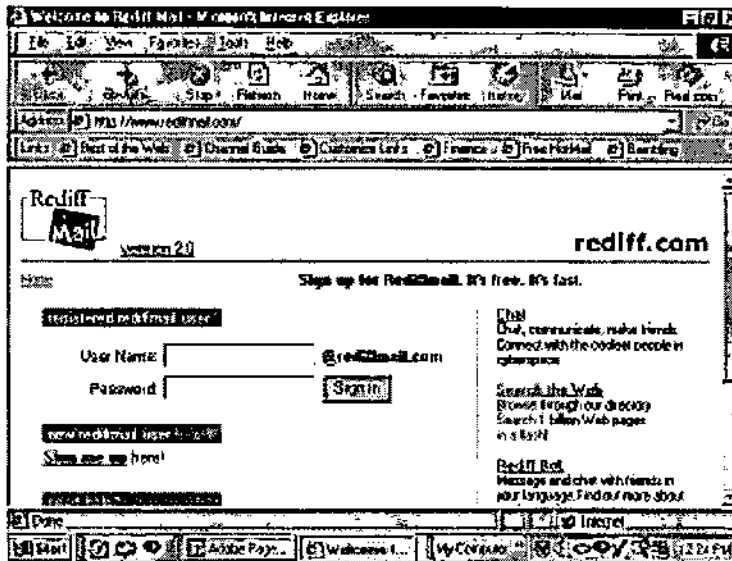
Fig. 10.3: The opening screen of Microsoft Internet Explorer

Microsoft Internet Explorer offers the following features:

- It offers channels by which the latest web contents are automatically delivered to us from the world's best content providers. We can view these channels on right side of our computer monitor screen (desktop).

- We can subscribe to our favourite sites so that the contents are automatically updated. Updated web sites can be downloaded in the background while we are doing other things on our PC.

- We can add a web page to our list of favourites for easy access.

- We can search the web sites using explorer bar that appears in the left side of the browser window, when we click the 'Search' button on the toolbar.

- We can view web pages in many languages.

- Microsoft Internet Explorer offers a feature AutoComplete by which we can type first few characters of URL and Internet Explorer writes the complete address.

- We can browse the web safely in Microsoft Internet Explorer as there are different levels of security for different areas of the web to protect our PC.

(*iv*) **Netscape Navigator.** Netscape Navigator is another popular graphical browser for Internet, which is somehow similar to Microsoft Internet Explorer. We can download it free of cost from the site http://home.netscape.com.

Search Engines

Search engine is an Internet accessible search service that enables us to search for information on the Internet using a browser. The commonly used Search Engines are–

- Yahoo
- Rediff
- Infoseek
- Lycos
- Webcrawler

Electronic Mail

E-mail is the most common service available on Internet. E-mail stands for Electronic Mail. Using E-mail, we can send mail to any part of world in the form electronic documents, which can include both text and graphics. The users of Internet create their own E-mail accounts along with giving the passwords so that no unauthorised person can access their mails. E-mail is becoming so popular that people prefer it to postage mail.

E-mail Server and E-mail Client. The E-mail server differs from E-mail client as discussed in table 10.4.

Table 10.4: Differences between E-mail Server and E-mail client

E-mail Server	E-mail Client
(*i*) It runs on the computer of Internet Service Provider (ISP) viz. VSNL, Mantra etc.	(*i*) It run on the computer of Internet user.
(*ii*) It receives the mail sent by user and send it to its destination over the Internet	(*ii*) It enables the user to read the mails received, to compose new mails and to sent them to E-mail server.

E-mail Protocols. E-mail protocols are communication standards of E-mail. Various E-mail Protocols are:

(*a*) *SMTP.* SMTP stands for Simple Mail Transfer Protocol. It specifies the procedure for sending and receiving text messages over Internet by the E-mail servers. It also specifies the format of E-mail message.

(*b*) *POP or POP3.* POP stands for Post Office Protocol. In this protocol, the E-mail server stores the incoming messages only temporarily. When messages are downloaded by E-mail client, they are deleted from the server.

(*c*) *IMAP or IMAP4.* IMAP stands for Internet Message Access Protocol. It stores messages on the mail server rather than facilitating downloading to the user's computer. It is more convenient that POP3 as all of user's mail is kept in one central location where it can be organised and achieved.

Downloading

Downloading refers to copying software from a remote computer to your computer through Internet. Using FTP (File Transfer Protocol), Internet users can copy any file from remote computer to their computer. You can download the required information from the web pages using the popular browser of Internet—WWW.

Web Page and Portal. A Web page is a document containing single unit of information that is available via World Wide Web (WWW). It may contain text, graphics, images, pictures, sound, video, animation, hypertext, hypermedia and hyperlinks. Using hypertext and hypermedia, you can move from one page to another by clicking on hyperlinks (the underlined or highlighted words). Portal is a website that contains hyperlinks to many other websites based on the required information. For example, Yahoo, Rediff, MSN India, Indya, JobsDB, Top-education, etc. are some of the popular portals. There are two types of portals—Horizontal Portals and Vertical Portals.

    (a) *Horizontal Portals (Hortals).* These are websites, which contain links to information on a broad range of subjects such as education, sports, music, health, jobs, sex, romance, religion, etc.

       Examples :

- Yahoo (http://www.yahoo.com)
- Rediff (http://www.rediff.com)
- MSN India (http://msn.co.in)
- Indya (http://indya.com)
- India.com (http://www.india.com)

    (b) *Vertical Portals (Vortals).* These are websites, which contain links to information on a particular subject.

       Examples :

- Jobs (http://jobs.com)
- Tourism (http://tourism.com)
- Sports (http://sports.com)
- Science (http://science.com)
- Travel (http://travel.com)

File Transfer Protocol

File Transfer Protocol (FTP) is a tool of Internet used for copying files from one Internet host to another. Copying a file from any remote server to our host computer is called downloading. There are two types of FTP—Regular FTP and Anonymous FTP. In Regular FTP, Internet users can transfer files from those remote computers only where they have their own account and identification using passwords. In Anonymous FTP, files are available to all Internet users for downloading. In this method of FTP, Internet users log on by entering the words 'anonymous', 'guest' or 'ftp' instead of a user name and provide their E-mail addresses as their passwords. Anonymous FTP is

the easiest way for upload and download files, however users are restricted by the security system of the remote computer. Anonymous sites permit us to access their files without establishing an account with them. By using anonymous FTP, we can access public archives on the Internet. There are two modes for transferring flies in FTP—ASCII mode and Binary mode. In ASCII mode, we can download mainly plain text and postscript files. However most files in Internet are transferred in binary mode. For example, zip, jeg, mpeg, com, exe and gif files are transferred in binary mode. Program files such as .c and .h files are transferred in ASCII mode.

Using FTP Internet users can also transfer files to servers and save them to a directory on remote computer. This is called uploading.

Usenet

Usenet is a world wide computer based discussion system on Internet. It consists of special groups set up by Internet user on a range of topics from entertainment activity to scientific research. These groups of topics in Usenet are called newsgroups. Usenet consists of thousands of newsgroups, each of which consists of articles send by Internet Users.

Accessing the Usenet. A special type of program called a newsreader accesses Usenet, which helps us to handle the volume of news available on Usenet. With newsreader, we can select the news, which we want to read or discard the news, which we don't.

Newsgroups. Various groups of topic in Usenet are called Newsgroups. Usenet is a forum in which people share news on a defined topic through large electronic bulletin-boards on Internet. Usenet newsgroups are organised into various categories called hierarchies. These hierarchies include the following three sub-categories:

(a) *Standard Newsgroups*. These include high quality discussions, which can not be established without a formal voting procedure. The top-level standard newsgroup hierarchies are described in Table 10.5.

Table 10.5: The top level newsgroups hierarchies

Hierarchy Name	Description
Comp	Every thing related to computers
Sci	Discussions on science and Engineering
Soc	Social groups
News	News about Usenet
Rec	Recreational subjects such as sports, aviation, music, arts, etc.
Talk	Random discussions on controversial subject including sex, politics, religion, etc.
Misc	Other topics viz. health, law, hooks, etc.

(b) *Alt Newsgroups.* These include discussions, which can be established by anyone with the requisite technical knowledge.

(c) *Biz Newsgroups.* These include discussions for commercial uses.

Telnet

Telnet is an Internet exploration tool that is used for logging on remote computers on the Internet. Using Telnet, we can communicate with a wide range of remote systems with which we have an account. Telnet is mainly used to access databases on other systems. It is frequently used by libraries. Using telnet, we can use our computer from anywhere in the world. Telnet is actually an Internet standard protocol for remote terminal connection service. Telnet is one of the simplest tool on Internet. With telnet, employees of branch office can access data on the computer in the head office. Using telnet, we can also log on to and use third party computers that have been made assessable to the public. For example, using telnet we can read the catalog of the United States library of congress. We can also use telnet to obtain other services such as Gopher and Web servers.

Differences among E-mail, FTP and Telnet. Various differences among E-mail, FTP and Telnet are listed in table 10.6.

Table 10.6: Differences among E-mail, FTP and Telnet

E-mail	FTP	Telnet
1. E-mail (Electronic Mail) is the most common service on Internet, which is used to send mail to any part of world in the form of electronic documents.	1. FTP (File Transfer Protocol is an Internet tool used for copying files from one Internet host to another.	1. Telnet is an Internet exploration tool used to log on remote computers on the Internet.
2. E-mail is similar to postage mail.	2. FTP is entirely different than postage mail.	2. Telnet is also not related to postage mail.
3. Each Internet user requires an E-mail address and password to use an E-mail service.	3. FTP works in two modes—in one mode user requires ID and password on remote machine while in another user can be anonymous or guest.	3. Telnet also works in two modes - one requiring the user identification and another does not require user ID and user ca be anonymous or guest.
4. E-mail service offers an address book containing addresses of E-mail users.	4. FTP does not provide any address book or other database.	4. Telnet helps users to access database on remote machines.

Internet Relay Chat

Internet Relay Chat (IRC) is most popular tool on Internet used by people

to talk to each other using the computer. It is the only place where we can go and talk to people from anywhere in the world in the form of exchanging text and audio. It is used by people sitting at their homes anywhere in world to talk to each other electronically using computer. It is generally called chatting. In chatting, each participates discussions are displayed on the screens of all the other taking part in a conversation as shown in figure 10.4. We can either join an existing conversation or start our own conversation on any topic. There are no constraints on the topics that may be discussed. We can discuss sports, religion, health, sex education, etc. Now-a-days chatting has become a great fun. People spend hours in Cyber-Café for chatting. They make new friends, some fall in love and few evn marry. Chatting has become the most interesting tool on Internet.
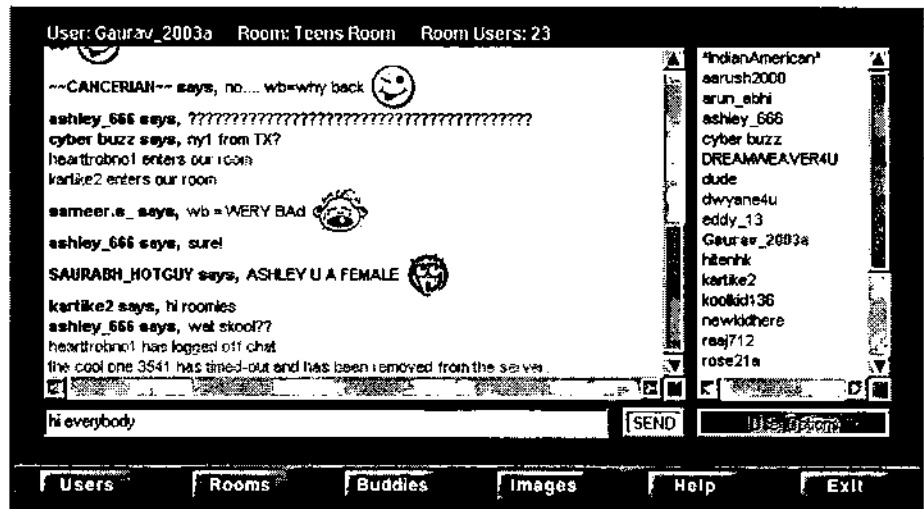

Fig. 10.4: A chatting screen

Other Tools

Besides the above discussed tools and services of Internet, there are some other tools, which are:

(*i*) **VERONICA.** VERONICA stands for Very Easy Rodent Oriented Net-wide Index to Computer Archives. It is index of Internet Gopher items and titles which provides keyword searches of Gopher items and titles. It is menu-driven and hence is very easy to operate.

(*ii*) **WAIS.** WAIS stands for Wide Area Information System. It searches text documents containing the specified keywords. It identifies documents, which are most closely related to the topic specified.

(*iii*) **Archie.** It is an Internet search program used to locate files and directories on anonymous FTP servers on the Internet.

10.7. Addressing System on Internet

The addressing system on Internet is called Uniform Resource Locator (URL). It has the following two forms :

(*a*) Letter Addressing system or Domain Name System (DNS)

(*b*) Number Addressing System or Internet Protocol (IP) Addressing System

Let us discuss these.

Letter Addressing System or Domain Name System (DNS)

Domain name is a readable computer address that identifies the location of a computer on the Internet. Domain Name System is the conceptual system of naming domains that form the hierarchical organisation of the Internet. This system is also called Letter Addressing System. The general format of this system is:

Name-of-user@Name-of-host.subdomain.domain

where,

Name-of-user is the name of Internet account for logging into the host computer

Name-of-host is the name of each computer on the Internet.

Subdomain is generally the name of organisation.

Domain is a group of computers that are administered as a unit in Internet letter addressing system, which is easily understood by a person.

There are two types of domains– Geographic and Non-geographic domains.

(*i*) **Geographic Domain.** The last part of domain name indicates the name of the country where the computer is located. This is called Geographic Domain. The examples of few geographic domains are listed in table 10.7.

Table 10.7: Examples of geographic domains

Domain Name	Country
.au	Australia
.ca	Canada
.cu	China
.in	India
.jp	Japan
.uk	Great Britain
.us	USA

(*ii*) **Non-geographic Domain.** The part of domain name that indicates the type of organisation where computer is located is called Non-geographic Domain. The examples of non-geographic domains are listed in table 10.8.

Table 10.8: Examples of non-geographic domains

Domain Name	Type of organisation
.gov	Government Agencies
.edu	Educational Institutions
.com	Commercial
.mil	Military
.net	Network
.org	Organisations other than
	Educational & Commercial

Number Addressing System or Internet Protocol (IP) Addressing System

In this system, a unique 32-bit address is assigned to each computer that is connected to the Internet. It is given in four-part decimal number (e.g. 132.116.42.51). Each part represents 8 bits of the 32-bits address, which cannot exceed 255. The 32-bit address is called a doted quad while each 8 bit part is called an octet. The 32-bit address is also called IP address or Internet Address. For example, 5.232.59.82 is an IP address where 5,232,52 and 82 are octets. IP address identifies the location of a particular computer on the Internet. IP addresses are organised from left to right and consist of sequence of domain and sub-domain codes. This system of addressing on Internet is also called Number Addressing System. It is directly understood by the machine.

10.8. Key Point Summary

- Internet is the world's largest computer network.
- Online services are owned by different agencies, while there is no owner of Internet.
- Various authorities that govern Internet are ISOC, ISP, IAB and IETF.
- The history of Internet began in 1957.
- ARPANET, BITNET, MILNET and NSFNET are the various networks developed during the historical advancement of Internet.
- Various applications of Internet are in the areas of E-mail, Banking, E-Commerce, Web Publishing, Education, Business, Entertainment, etc.
- Various modes of connecting to the Internet are Host/Terminal Connection, Dial-up Networking, Dial-up Access through LAN and Dedicated Access.
- The important tools and services of Internet are Browsers, Search Engines, Electronic Mail, File Transfer Protocol, Usenet, Telnet and Internet Relay chat.
- Browsers help non-technical people to work on Internet without remembering the commands.

- The popular browsers are World Wide Web (WWW), Gopher, Microsoft Internet Explorer and Netscape Navigator.
- Yahoo and Rediff are the popular search engines for searching any information on the Internet.
- Electronic mail is used to send mails electronically.
- Various E-mail protocols are SMTP, POP or POP3 and IMAP or IMAP4.
- Using FTP (File Transfer Protocol), Internet users can copy any file from remote computer to their computer.
- There are two types of FTP—Regular and Anonymous.
- There are two types of Portals (Websites)—Horizontal and Vertical.
- Usenet is a world wide computer based discussion system on Internet.
- Newsgroups (groups of topics in Usenet) are of three types—Standard, Alt and Biz.
- Telnet is used for logging on remote computers on the Internet.
- Internet Relay Chat (IRC), populary called chatting is used by people to talk to each other using the computer.
- URL (Uniform Resource Locater) is the addressing system an Internet, which is of two forms:
- (*a*) Domain Name System, and (*b*) Internet Protocol (IP) Addressing System.
- There are two types of domains—Geographic and Non-geographic.

10.9. Review Questions

1. (*a*) Define the Internet and discuss. Why is it so popular ?

   (*b*) Describe briefly the various applications of Internet.

2. Differentiate the Internet from online services. Name three online services.

3. What are TCP/IP ? Discuss their role in Internet.

4. What is IP address ? What is its significance for computers ?

5. What is logging In ? Explain the various modes of connecting to Internet.

6. What are the various tools and services available on Internet ? Explain them briefly.

7. What is Surfing ? Name three popular browsers used to surf the Internet.

8. Explain the following terms :

   (*a*) WWW   (*e*) FTP

   (*b*) Usenet   (*f*) Upload

   (*c*) Newsgroups   (*g*) Download

   (*d*) Telnet   (*h*) Search Engine

9. What are E-mail Protocols ? Explain them briefly.

10. What is a Domain Name System ? Explain the different types of domains.

11. Name the four authorities that govern Internet.

12. Discuss briefly the historical development of Internet.

13. Differentiate between the following :

    (*a*) Hypertext, Hypermedia and Hyperlink

    (*b*) Hortal and Portal

    (*c*) Standard, Alt and Biz Newsgroup

    (*d*) E-mail, FTP and Telnet

14. Write the full form of following abbreviations :

    (*a*) Arpanet   (*f*) WWW

    (*b*) Irc   (*g*) Bitnet

    (*c*) Url   (*h*) Iab

    (*d*) Smtp   (*i*) Tcp

    (*e*) Pop   (*j*) Ftp

Unit-11

Multimedia and Computer Graphics

Structure

11.1. Introduction
11.2. What is Multimedia
11.3. Applications of Multimedia
11.4. Components of Multimedia
11.5. Hardware for Multimedia
11.6. Software for Multimedia (authoring Tools)
11.7. Graphics files
11.8. Key Point Summary
11.9. Review Questions

11.1. Introduction

Multimedia is the most exciting and extremely useful computer technology. It has now become an essential part of your computer. All present day PCs are multimedia computers. Multimedia is a woven combination of text, graphics, sound, animation and video.

Computer graphics is the most predominant component of a multimedia application. It is a human nature that a subject is better explained to them when represented in pictorial or graphical form, instead of textual matter. So, graphics are used more often than text to explain a concept besides providing visual effects of information. In this chapter, we will discuss all the basic concepts and applications of multimedia and computer graphics.

11.2. What is Multimedia

Multimedia means many media. Medium is a vehicle for communication, such as text, graphics, speech, still photography, etc. The technology that uses some combination of various media like text, images, sound and movement is called multimedia. When the end user or viewer is allowed to control what and when the elements are delivered, it is called interactive multimedia.

In the past few decades only newspapers, radio and television were the sources of communication. They were actually called media at that time. Newspapers were generally consisted of textual data or some black and white pictures without ant presentation. Audio and video were the sources of communication for radio and television respectively. So, all the sources of communication could provide information only in single medium.

J.R.

With the advancement in technologies in computers, multimedia came into existence, which gave birth to those applications having number of media involved. Newspapers used attractive fonts, colored pictures and good presentations. Television used computer software, high-resolution cameras for accurate pictures and good sound recorders. These advancements led to new technologies in the field of multimedia, which we are observing today.

Multimedia System

A multimedia system makes use of many different ways of communication, which include text, data, graphics, image, voice and video. It can be defined as follows:

Multimedia system is a computer platform, communications network or software tool if it supports the interactive use of at least one of the types of information like audio, video, still images in addition to text and graphics.

Various media in a multimedia system can be divided into the following three types:

(a) *Print*. This is a static media type, which includes text, graphics and natural image.

(b) *Audio*. This is a dynamic media type, which includes natural and synthetic sound, speech and the music.

(c) *Video*. This is also a dynamic media type, which includes natural and synthetic image sequences, giving motion to an application.

The important question arises now whether multimedia is a computer itself or a computer software product. In practical sense, it is the combination of both. A multimedia computer must have a specific configuration like appropriate motherboard, CPU, RAM, CD-ROM, sound card, video capture card, speakers, etc. Besides these, the general multimedia software currently available in the market such as CorelDraw, PhotoShop, Macromedia Director, Flash, 3D Studio MAX and Dreamweaver must also be present on your computer.

Advantages of Multimedia System

A multimedia system is an interactive and non-linear media in comparison to a conventional form of media such as broadcast television. It offers the following advantages to the computer user:

• The interaction between the user and the information makes multimedia a very powerful media for activities that require the process of communicating information for purposes such as education and training, business presentations, manuals, multimedia databases, advertising and electronic publishing.

• Due to interactive feature of multimedia, the user can request the broadcaster the type of information required. For example, in a multimedia version of news bulletin you can request the broadcaster the type of news you are interested in and when you want to hear it by clicking the mouse button.

- Hypermedia, which includes hyperlinks among various media, provides user the easiest way of interaction in a multimedia system.
- With multimedia systems, you can experience the applications of virtual reality such as modeling objects and their behaviour in virtual environments with man-machine devices.

11.3. Applications of Multimedia

Can you imagine the growth of information technology without multimedia? At one time, when PCs became popular during 1980 decade, the information, which you could obtain from your PC, was mainly textual (single medium). Now, the information, which you get on your PC, is a combination of text, graphics, sound, animation and video. Internet applications are developed using multimedia. Most games you play on your PC are multimedia games. The movies (video or animation) that you watch on your PC are also the result of multimedia. If there would be no multimedia, the technologies of computer and information would have been same like 1980 decade and hence there would not have any remarkable growth. Without multimedia, you can not imagine to develop Web sites for Internet. So, perhaps there would not be any Internet without multimedia and if Internet would have emerged, it would be able to provide you only textual information.

The advancement in multimedia technology has opened up new fields for the application development. One such field of multimedia having tremendous potential is Virtual reality. It is primarily used in applications for entertainment industry and is a useful tool for performing simulative, remote control applications. A broad categorisation of multimedia applications in various fields as shown in figure 11.1 is discussed belo.
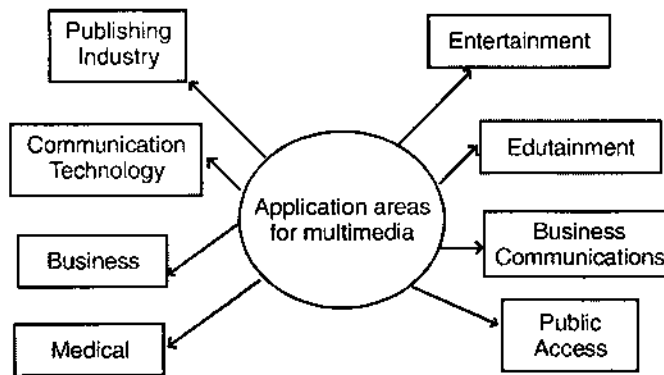

Fig. 11.1: A broad categorisation of multimedia applications

Entertainment

Creating real life games, graphics, sound and animation are applications of multimedia in entertainment. The special technologies of multimedia such as Virtual Reality have made all these applications the mirror images of real life. For example, a flight simulator gives you a feeling of real environment

to fly airplanes. Virtual goggles, helmets, special gloves and bizarre human interfaces attempt to visulaise you a real life experience. Wide varieties of multimedia games are now available for your PCs. For example, Car racing, Cricket, Prince, etc. are popular multimedia games as shown in figure 11.2.
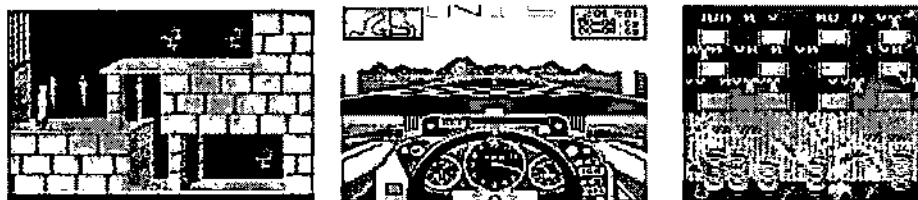

Fig. 11.2: Some popular multimedia games

Edutainment

Edutainment is the new application area that refers to imparting education through entertainment. Many computer software such as 3D Studio Max, Flash, Photoshop, etc. are available now with focus on education. These help you to develop your own applications for edutainment. Using such software you can convert your own ideas into desired applications. Many software development companies are now providing the online tutorials for educating users for using their products. Multimedia is enjoying widespread use in training programs as shown in figure 11.3. Flight attendants get training to manage international terrorism and security through simulation. Mechanics learn to repair engies.
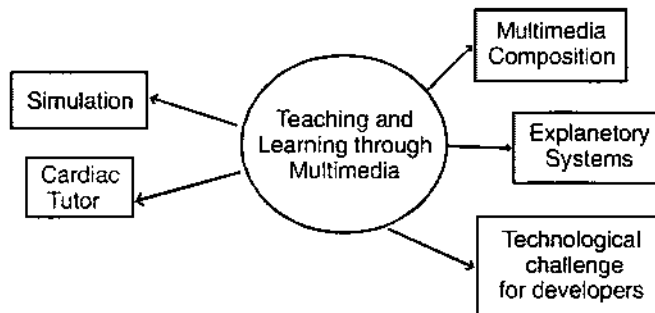

Fig. 11.3: Multimedia in edutainment

An interesting use of multimedia in schools involves the students themselves to learn by following ways:

- They can create their interactive magazines & newsletters.
- They can make original art using graphics software.
- They can interview students, teachers, coaches, artists and leaders by developing interactive software for conducting interviews.
- They can make quick time animation and video movies.

Business

Multimedia is a very powerful tool for enhancing the quality of business communications by sending the data and information in the form of text,

graphics, audio and video among geographically spread offices of the organisation. Business applications for multimedia include presentations, online training programs, software for marketing, advertising on Internet, software for product demonstrations, multimedia databases, electronic catalogues and business websites. Most presentation software packages allows you to add audio and video clips to the slide show. Voice mail and video conferencing are becoming popular on networks using Internet protocols.

To grow one's business up to new heights, multimedia applications as shown in figure 11.4 can definitely play an important role. The following multimedia and communication facilities have changed the outlook of the whole businss:
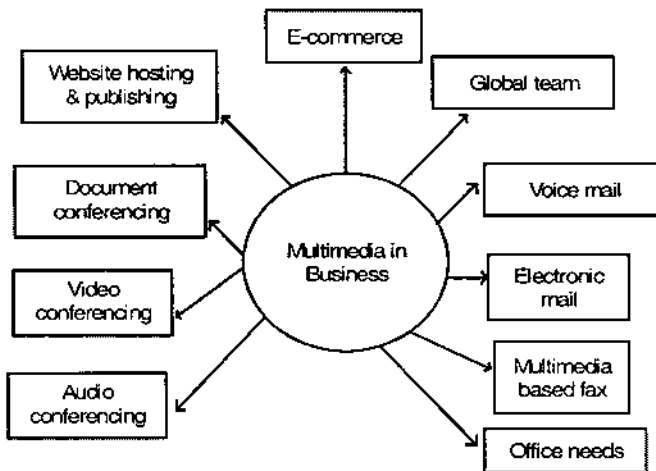

Fig. 11.4: Multimedia in business

(*i*) **Global Team.** The multimedia technology along with communication technology has opened the door for formation of global work groups. Today, the team members who may be working anywhere can work for various companies, no matter whether they are in different cities/ countries or speak different languages. Thus, the work place for business has become global.

(*ii*) **Voice Mail.** It is a tool, which send voice over a communication line. It can handle only audio information, which is sufficient for quick and simple exchange of information. Although the voice mail is time and location independent, it is non-interactive. If you want to get a reply, then you have to wait for the voice mail to come. However, you can send and receive voice mail quickly.

(*iii*) **Electronic Mail (E-Mail).** It is preferred to voice mail to exchange information in the form of text and graphics.

(*iv*) **Multimedia Based Fax.** As we know Facsimile (Fax) is used when exactly similar information has to be transmitted. It is more accepted then E-mail as it can handle graphics information easily and provides an exact photocopy of the information.

(v) **Conferencing.** The activities in an office such as meetings, group discussions and training programmes are some areas where conferencing facilities are needed. For real time meetings that involve geographically disperse group of people, the management and employees of an organisation can avail the benefits of the following types of conferencing:

(a) *Audio Conferencing.* It is an effective means of communication for reporting about a project status through voice. It can be used to solve business problems quickly. It can be used by a group of people who need to meet frequently whatsoever is the physical distance among them.

(b) *Video Conferencing.* Video conferencing is successfully being used by several organisations in India and abroad. It resembles an office meeting, where the participants sitting at geographically separated offices can not only send/receive voice but can also see other participants with the help of multimedia PCs connected by a network (such as WAN or Internet). Video conferencing brings people together naturally and tries to simulate a real life meeting environment. However, it is not easy to use, as the participant has to continuously look at the camera on the top of the monitor.

(c) *Document Conferencing.* It is also called as audio-graphic conferencing technology. It allows people to meet using their PCs and phone lines. After connection, they can share audio information and the data they have stored in their PC. In addition, it allows on line editing of a document by several participating people in the conference.

(vi) **E-commerce based Applications.** Electronic commerce (E-commerce) is an emerging technology of selling and merchandising, where buyers are able to participate in all phases of purchasing process by stepping through electronically rather than the traditional ways of business. The processes in E-commerce include enabling a customer to access product information, to select items to purchase, to purchase items securely and to make payments electronically through online facilities like Internet. During development of E-commerce based applications, the multimedia technology plays a remarkable role in presentation of information.

Public Utilities

Multimedia is emerging as a new boom in the public places. Railway Platforms, Airports, Hotels, Cricket Grounds, Shopping Malls and Museums are the places to be visited by public and you can see how they are transforming themselves to look attractive with the help of Multimedia. Whether it is a Railway Timetable enquiry or screens displaying scores and replays on cricket grounds, you can see applications of multimedia there.

At the public places, multimedia is becoming available as stand-alone terminals or kiosks for providing online information and help using graphics, audio and video. Such installations not only replace traditional information booths but also add value and can work round the clock, even in the mid-night. Hotel kiosks list nearby restaurants, road maps of the city, train and air schedules and other guest services such as automated checkout information. Printers can be connected to these multimedia machines so users can walk away with a printed copy of the information.

Medical

Besides commercial and educational applications, multimedia is playing an important role in health care. A distributed multimedia based project like MEDNET, provides the following services for health care:

(*i*) **Real-time Monitoring of Patients.** The intra-operative monitoring places a real-time control about the condition of the patient.

(*ii*) **Online Consultation by Doctors.** The patients can consult the doctors online using multimedia and Internet technologies.

(*iii*) **Collaboration of Doctors during Surgical Operations.** Through MEDNET technology during complex surgery, the consulting neurophysician (normally difficult to find) whose presence is not necessity may remotely monitor the case along with few other cases. During surgery, the neurophysician can see and listen to the responses of the monitoring equipments on the computer monitor and in case of any problem, he can advice the surgeon who is performing the surgery.

The use of Internet and multimedia technologies for providing high-quality health care to patients in remote areas is called Telemedicine. In telemedicine, a remote centre is equipped with high-resolution video imaging equipment and is linked to distant doctors using a network connection such as Internet. Telemedicine provides specialised expertise at low cost to remote areas where doctors normally do not want to go.

Publishing

With advancements in multimedia technologies, the publishing industry is changing drastically today. Besides publishing books in a traditional way on paper, publishers are bringing books on CDs and Web, which is called E-Publishing (Electronic Publishing). The publications which are generally meant for family and children such as newspapers, magazines, science fiction books, encyclopaedias, general books, etc. are readily available on-line in multimedia form and give you real time experiences. The on-line news clippings are not only textual but also associated with attractive video clipping and images.

For children the publishing has changed tremendously with the advent of multimedia. Today many encyclopedia and books are available that provide a sort of edutainment (education and entertainment side by side). For example, a dictionary meant for children not only shows the meaning

of the words but also show its characteristics with pictures. These kinds of media are more entertaining and provide better learning environment for children as compared to the traditional media. In fact multimedia is the best tool available today for increasing general awareness of a child.

For academicians and authors, today many products are available on CDs and Internet for reference and research. Compact discs and web sites contain a large amount of information on most of the topics in multimedia form.

Advantages of Electronic Publishing. Electronic publishing offers the following benefits to the readers :

- Searching a topic on any subject is easier on Web sites and CDs as compared to searching them in books, which are not easily available.
- Reading materials electronically is much cheaper than buying books.
- Any information is available instantly through electronic books and journals, which is not possible through traditional paper books.

Home Services

The advances of computing, communication and multimedia technologies have lead to the beginning of an era where people get multimedia facilities at home. These facilities may be in the form of an Interactive TV or through Internet, which mainly include:

- Basic Television Services
- Interactive Entertainment
- Digital Audio and Video
- Home Shopping through E-mail
- Financial Transaction using E-commerce
- Interactive Single and Multi-user Games
- Digital Multimedia Libraries
- Electronic Versions of Newspapers and Magazines

Cable TV, Telephone, Dot Com and Publishing companies are the main infrastructure providers for these facilities.

11.4. Components of Multimedia

The major components of multimedia are :

1. Textual Information
2. Images
3. Animation
4. Audio
5. Video

Let us discuss these in detail.

Textual Information

Textual information is the main component of multimedia. All

multimedia productions contain some text and some products contain a large amount of text like encyclopedia. The text can have various types of fonts and sizes to suit the professional presentation of the multimedia software. The text is represented in ASCII (American Standard Code for Information Interchange) format in computer memory.

Images

Unlike text that is represented in universal ASCII format, images are represented in either of following two ways:

(*i*) Bitmaps

(*ii*) Vectors

Although both types of images look same, their representations in memory are different. Let us discuss these.

(*i*) **Bitmap Images.** A bitmap image consists of dots called pixels on the screen. The size and quality of such image depends on the pixel density and number of colours it uses. A bitmap needs a lot of storage area because each dot is represented in memory as 8 bits. So, the size of a bitmap file will be very large if the images use more colours or complex graphics. The software packages, which are normally used for creation of bitmap images, are called paint programs. For example, 'Paint accessories' in Windows and 'Corel PHOTO-PAINT' are popular paint programs. Although the bitmap image represents true picture, it blurs when zoomed.

(*ii*) **Vector images.** In this format, an image is formed as a set of straight or curved lines instead of dots or pixels. A line or curve can be represented by mathematical equations, whose number can be stored as a set of binary codes. So, a vector image needs very less storage space as compared to a bitmap image. The software packages, which are normally used for creation of vector images, are called drawing programs. For example, 'CorelDRAW' and 'AutoCAD' are popular drawing programs. An important feature of vector image is that it uses same storage space whether it is small or big. The other advantage of vector image is that unlike bitmap image it does not blur on zooming. The drawback of vector image is that as it needs software to perform calculations on the stored number to draw it, it is displayed slowly on the screen.

Animation

Animation is another vital component of multimedia. It is a continuous series of still images that are displayed in a sequence. There are mainly two types of animations used in multimedia—2D and 3D animations.

(*i*) **2D Animation.** It is the most common kind of animation where flat images are drawn one frame at a time. This process is very time consuming but result obtained is spectacular in nature. 2D animation is also known as Cell Animation.

Tweening Facility. Many animation packages are now equipped with tweening facility, which involves the automatic creating of a series of graphic frames between two key-frames (the first and the last frame of the action). The animation packages also involve some special effects such as morphing and warping. Morphing takes two images and seamlessly changes one image to another. The second image actually seems to grow out of the first one. Warping is variation of the morphing where one image is used to show various changes that take place. It uses the key points of one image to create different effects, unlike mixing up two images as in morphing.

(*ii*) **3D animation.** In 3D animation, images are drawn using 3 axes. 3D animation follows mainly following three steps:

(*a*) *Modeling.* Modeling is the design phase where a 3D object is created. In 2D animation an object can move up sideways in x-y plane, but in case of 3D model, a third axis is used, depth or z-axis. Once an object is created along these three axes, colour, shading and light source can be added to the image to make it more realistic.

(*b*) *Animation.* In second phase, the 3D image is moved along a motion path, which is defined using key-frames of the animation sequence. These key-frames are used to create the in-between frames in the sequence automatically by tweening facility.

(*c*) *Rendering.* In the final stage the entire sequence is rendered to create a 3-D animation. Rendering involves mixing up of all the colours, texture maps, light sources and surface attributes in each frame of the 3D sequence to form a final file of supported extensions (like .avi, .gif, etc.).

Audio

An application having only textual information, graphics and animation but no sound is not a multimedia application in a real sense. It will be like a silent movie, which have no sound. Audio is the critical component of multimedia. Sound is heard and transmitted in air as analog signals. The microphone of a multimedia PC converts sound into electrical signals that can be processed by the computer. The entire process of converting analog or electrical signals of audio to computer data file in the digital format is called digitisation.

Sound can also be recorded and reproduced using digital signals and the unwanted sounds can be reduced drastically in digital recording of the sound. For replaying the sound, audio has to be converted into digital form to produce digital audio. The storage space required for digital audio is huge that is around 1 MB for one minute of audio. A common digital sound file existing in personal computers is known as WAV file. Digital sound is used for music CDs. In digital audio system, the entire digitised audio is reconverted into analog form, which can be heard on the speaker.

MIDI versus Digital Audio. MIDI (Musical Instrument Digital Interface) is a communication standard developed in the early 1980's for electronic musical instruments and computers. It allows communication between music and sound synthesisers from different manufacturers by sending messages through connected cables. It provides protocols for details of music such as notes, sequence of notes and name of instrument playing these notes. Unlike digital audio MIDI data is not digitised sound. It is the shorthand representation of music stored in numeric form.

The size of MIDI file is quite smaller than equivalent digital file and MIDI data is device dependent. Playback of MIDI will only be accurate if the MIDI playback device is similar to the device used for its production. Because of the small size, MIDI files are used in Web pages as they are faster in downloading. In some cases MIDI sound is better than digital sound if the MIDI sound source, which you are using, is of high quality.

Video

In the introduction of chapter, we have defined multimedia as a woven combination of text, graphics, sound, animation and video elements. Out of five major elements, we have already discussed first four. Multimedia is incomplete without the fifth element i.e., video. Video can be defined as a movie that gives the illusion of smooth and continuous action, consisting of a series of frames (still photographs) that are flashed on screen at a rapid rate (minimum 24 frames per second).

Video is displayed on a multimedia with the help of video capture cards. A video capture card accepts analog or digital video signals and transforms them into digital data. Digitising and storing 10 second clip of a motion picture on your computer requires large amount of data to be transferred in a very short time approximately 30-35 MB per second and 30 seconds of video requires a full gigabyte of hard disk. Therefore, in digital systems, the video signal is first digitised as a single frame and then data is compressed before it is written to the disk. Different compressing techniques (such as MPEG, P*64, DVI/Indeo, JPEG, RealVideo, VDOwave, etc.) are used to compress a video for delivery and then decode them in real-time for fast playback. MPEG (Moving Pictures Expert Group) is the most popular compression technique, which can compress video data by as much as 100 to 1. The MPEG standard compression system allows video sequence of 45 seconds to be fit on a 1.4 MB Floppy Disk. MPEG may become the method of choice for encoding motion images because it has become widely acceptable for both Internet and DVD-Video.

11.5. Hardware for Multimedia

The hardware of a typical multimedia computer usually comprises CD-ROM, sound card, speakers or microphone and sometimes video capture card or digital camera besides CPU, common I/O devices (Keyboard, Mouse, Speakers, Microphone, Scanner and Printer) and storage devices as shown in figure 11.5. A MIDI interface for playing digital instrument through PC

interface may also present on the motherboard of multimedia PC. Let us discuss about special hardware components o a multimedia PC in detail.
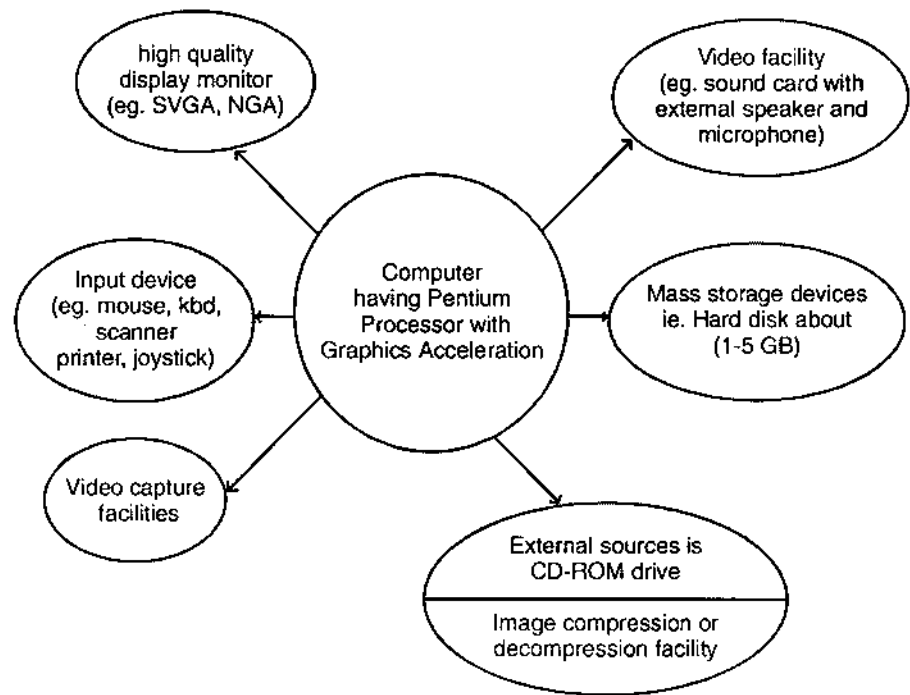

Fig. 11.5: Hardware of a typical multimedia computer

CPU

Pentium processor is the recommended CPU for multimedia computer. However, Apple Macintosh and Silicon Graphics have their own set of powerful processors for multimedia. The math co-processor should be installed in a multimedia PC to avoid poor response time. The powerful co-processor chip is added for supporting graphics and therefore it is called Graphics Accelerator. Although the memory capacity (RAM) for a multimedia PC should be at least 8 MB, more memory (16, 32 or 64 MB) enhances the performance of multimedia machine. Now a days for running very advanced multimedia software, 128 MB to 256 MB RAM is recommended.

Monitor

The multimedia PC should be equipped with a monitor having either SVGA (Super Video Graphics Array) or AGP (Accelerated Graphics Port) video card. The basic advantage of using these cards is that they have a better resolution thus, the display will be of better quality for the graphics, animation or video. The current standard display for a multimedia PC is SVGA monitor with a resolution of either 1024 × 768 or 1280 × 1024 pixels. The advanced SVGA cards can display resolution of 1600 × 1200 pixels but you need to equip your video card with 8 MB of Video RAM (VRAM). The AGP card is more advanced than SVGA card as it transfers data much more quickly than

the standard PCI (Peripheral Component Interconnect) interface. Therefore, it is the best video card for multimedia computers.

Digital Camera

Digital camera is a device, which captures and stores real pictures or videos into memory of multimedia PC. The main function of camera is to capture images, like scanners and fax machines. Generally a good photograph is one, which have high image quality, colour fidelity and resolution. For capturing such photograph, you need an analog still-image camera. But now a days, digital cameras can also produce quality images. Generally a digital camera takes images in either of the two resolutions, 640 × 480 pixels or 1280 × 1024 pixels. In either case, it captures them in 24-bit colour. Little image compression can also be achieved i.e., the image file can be compressed to occupy less space then usual, in the memory.

Using a Digital Camera. To produce really good images, a digital camera requires a good lens system, high memory and high processing power. An uncompressed 1280x1024, 24-bit image file occupies 3.75 MB. The highest quality images, which these camera generates are JPEG files, which occupy less than 1 MB. A digital still image camera works in the following way:

1. A digital camera uses a CCD (Charge-Compiled Device) element to capture the image through the lens when the photographer releases the shutter in the camera.

2. The image captured by the camera can be transferred to the PC in the following two ways, depending upon how the camera store them:

    (*a*) If the camera stores the images on the floppy disk, you can simply insert the floppy disk in your PC disk drive and copy to the hard disk.

    (*b*) If the image, which a digital camera captures, is stored on a SmartMedia memory card inserted into the camera, you can connect a serial cable between the camera and a PC. Using suitable software on your PC, you can download pictures from the camera.

Besides still image photography, digital cameras can take short video clips, or capture a brief audio recording to associate with each still image. You can also use digital cameras in video or Voice E-mail/ Chatting on Internet.

Video Capture Card

Video capture card is a digitiser card specially designed to capture TV or VCR or camera images (or video signals) and store them into the computer in digital format. This card has a dual function for both audio and video conversion. As we know, generally all TV or VCR signals are analog. The process of converting analog video signal to digital format is called Sampling. Using this process, the video capture card placed in the system converts the analog video signals into digital data streams so that these signals can be

stored in the binary data structure format of 1s and 0s. The digital data file is then compressed to a considerable amount using some compressing program (like Windows WinZip). Once the conversion and compression process is complete, the file can be played back on the computer screen. These digitised files can also be edited according to requirements using various video editing software (such as Adobe Photoshop, Adobe Premiere, Corel PHOTO-PAINT, etc.).

Storage Devices

Multimedia uses digitised audio and video, which not only takes huge amount of storage space, but also requires high-speed storage media. The storage devices for multimedia must be able to send large amount of data back and forth quickly to keep recording and playing audio and video smoothly. Because of this requirement, most of the multimedia PCs use hard disk and compact disk drive drives, which provide high storage capacity, speed and data throughput. Let us discuss about common storage devices of a multimedia PC in brief.

(*i*) **Hard Disk Drive.** It is fixed inside the PC and has plenty of storage like 40 GB or more. Sometimes, two or more hard disk drives are used as an array to work together so that they act like a single hard drive. All the multimedia software are installed on the hard disk.

(*ii*) **CD ROM.** CD ROM (Compact Disk Read Only Memory) is now widely used as a multimedia storage and distribution medium. One CD ROM (simply called CD) can hold up to one and half an hour of digital audio or around fourty to fifty minutes of video or 700 to 750 MB of computer data. It has a very high immunity from damage. A CD ROM stores information using billion of microscopic pits that resides on its surface. As data is read using laser beam, it is very easy to locate information in CD ROMs. The CD ROM drive is used to read information on a CD. The information is stored or written on CDs using an expensive drive, called CD Writer.

(*iii*) **DVD ROM.** DVD ROM (Digital Video Disk Read Only Memory) is a digital optical disk capable of storing up to 4.7 GB of data and transferring data at higher speeds. It is a cohesion of multimedia and digital video player, movies and interactivity. DVD is designed for use with a video player and television. DVD is more than just a high quality video formatting. It can combine hours of stunning video, audio and music with computer data and instructions. It offers high quality, high capacity media rich games, with specialised educational and entertainment programs, software libraries, training programs, digitised photo collections and high quality interactive encyclopedias all on a single disk. A single-sided, single layer DVD can contain up to 140 minutes of video enough to handle 96% of all movies without the interruption of flipping the disk over or changing disks. The information on a DVD ROM is read by the DVD ROM drive. Although DVD ROM looks like a CD-ROM as its

diameter and thickness are same with those of CD ROM (120 mm and 1.2 mm respectively), it differs with latter in many ways as shown in table 11.1.

Table 11.1: Differences between CD ROM and DVD ROM disks

	CD ROM Disk	DVD ROM Disk
1. Data capacity	0.65 GB	4.7 GB
2. Layers	1	1,2 or 4
3. Laser wavelength	780 nm	640 nm
4. Minimum pit length	0.83 μm	0.4 μm

Laser Disk: Laser disk is mainly used to record and play back high quality digital audio files. Like CD ROM, laser disk uses the same recording media. However, it differs from CD ROM in many ways as shown in Table 11.2.

Table 11.2: Differences between CD-ROM and laser disks

	CD ROM Disk	Laser Disk
1. Storage Form of Video Analog	Digital	
2. No. of channels that it can play back at a time	4 (2 digital & 2 analog)	2
3. No. of sides where digital data is stored	1	0
4. No. of sides where analog data is stored	1	2

11.6. Software for Multimedia (authoring Tools)

As we know movies, sound, text, graphics and animation are the integral part of multimedia. To produce or support these media elements, various software are available in the market. Some of the popular software used for developing multimedia applications are listed in table 11.3.

Table 11.3: Popular multimedia software

Software	Use
PhotoShop	Industry standard digital image editing software
Paint	Drawing program for creating simple diagrams & pictures
CorelDRAW	Drawing program for creating high-quality graphics
Flash	Vector-based 2D animation tools package
3D-studio Max	Vector-based 3D animation package
Sound Edit	Sound capture and editing software
Director	Authoring tool for combining different multimedia components

Premiere	Digital video and post-production tool.
FrontPage applications	Authoring tool for intranets and the world wide web
Alias/wave front	3D tool for developing games and films

Some multimedia software are used to create highly interactive applications with a little or no programming experience as they are very easy to learn and use. Such software are called authoring tools. Authoring can be defined as creating highly interactive applications in which the information can flow in both the directions i.e., from application to user and from user to applications. Multimedia Authoring tools help in creating higher quality audio and video applications with very little expensive. Using authoring tools does not require a team of programmers, instructors, corporate communications and context specialists. Using such software anyone with no previous programming experience can develop multimedia applications easily. Macromedia Director and FrontPage are popular authoring programs.

Types of Authoring Tools

Authoring tools can be divided into the following four types:

(*i*) **Time-based Authoring Tools.** They use time scale to decide duration of message on the screen. Some of the authoring tools in this category are Macromedia Action, Animation Works, etc. Time-based authoring tools are used for developing multimedia applications for business purposes.

(*ii*) **Card-based or Page-based Authoring Tools.** These tools allow information to be put in as stack of cards or pages. These pages and cards can further be linked with each other in predefined sequences. Even the cross linkages along with branching facility are also possible in such packages. Hyper Card by Apple, Asymmetric Tool Book and many presentation software are card-based or page-based authoring tools. Such authoring tools are used for developing applications for both educational and business purposes.

(*iii*) **Icon-based Authoring Tools.** These tools allow creation of an Icon based flow script, which is then converted to an application. Macromedia Authoring Professional, Icon Author, etc. are Icon-based authoring tools. Such authoring tools are also used for developing multimedia applications for both business and educational purposes.

(*iv*) **Theatrical Authoring Tools.** These types of tools refer to media elements, as independent cast members, which are assembled using score which is sequential in terms of time, linking and animation. Complex visual effects can be applied on these scores to create powerful presentations. Macromedia Director is one of such package. Theatrical authoring tools are used for developing multimedia applications for educational and entertainment purposes.

Important Authoring Tools

A few important authoring tools are :

(*i*) Everest Authoring System

(*ii*) Macromedia Director

(*iii*) Quick Time

Let us discuss these in detail.

(*i*) **Everest Authoring System.** This system is best suited for the developers of CBT applications who seek a powerful but easy-to-use window based authoring environment. Its main features are visual programming with icons, direct manipulation of interface elements and procedural programming.

The Everest development environment opens with multiple views of an application. In Everest's application creation, the user starts off with a library and names an initial screen. Dragging a layout object icon from the tool set onto that screen provides the basis for the first screen. Interface and media object icons like list and combo boxes, edit boxes, text displays, bitmap placeholders, sliders and gauges, buttons of all types, video and audio, OLE and animation can also be dragged on to the screen. Once the screen design is accepted to the user, Everest provides an easy method of scripting, navigation and control flow.

(*ii*) **Macromedia Director.** Macromedia Director (simply called Director) is more suited for development of interactive movies, multimedia presentations and games than CBT or interactive catalogs that require more database work. Using Director, you can integrate graphics, music, narration, sound effects and digital video into your multimedia application. Macromedia Director provides the following features:

- A central screwing component that provides precise timing control
- Cross-platform compatibility
- Strong and intuitive animation features
- Extensive architecture to add functionality

The application in Director's user interface is a movie, the playback screen is the stage, and the various elements in the movie are cast members. A Director movie consists of frames that comprise many separate, individual channels, each of which can hold a sprite or sound, custom palette, etc. Each sprite is an instance of a cast member such as a piece of text, a bit-mapped image, or a digital video clip. As all of the sprites can be accessed during each frame of the movie, an ultimate time-based control can be achieved. Director has 48 separate sprite channels available in each frame. Sprites are only copies of the cast members so their look can be modified in a particular frame without affecting the original copies.

Each channel number represents on stage layer so the sprites can be moved between layers by simply surfing them up and down.

Director can import an impressively broad range of graphics formats. When a file is imported, it automatically becomes a cast member and receives a number. It has the ability to mix with sound files sampled at different rates and sizes. However, it is not possible to mix AIF and WAV files with the audio in digital movie clips. Animation features are also one of the strongest features that can allow to set the sprites in motion differently.

(iii) **Quick Time.** It is a software developed by Apple that supports time based media on the Macintosh. It has also been ported for Windows applications. An example of time-based media is video where a sequence of images is displayed on screen to create the illusion of motion. The images are time based because to retain synchronisation with a sound track, the images must be displayed at the correct time in relation to the sound track. Different development environments relate to Quick time for developing an application form scratch as shown in figure 11.6.
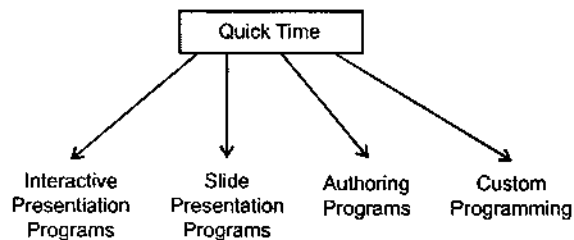

Fig. 11.6: Relationship of quick time with different multimedia development environments

Quick time supports almost all type of video, animation and sound on Macintosh since its introduction. It has many other features but the two most important are— Compressors and Timing Mechaism. The compressors enable the program to reduce the frames to a manageable size, so the computer can stream the information from the disk. The timing mechanism ensures that multiple tracks maintain synchronisation.

Features of Authoring Tools

Authoring software are generally menu-driven systems intended to be easy to use by the multimedia developer. They do not require the trainer to get involved with program code. Authoring systems vary widely in orientation, capabilities and learning capabilities of the user. Most of the authoring systems require some basic knowledge of heuristic thinking and algorithm design. Authoring actually is just a speed-up form of programming, although you need not know the intricacies of a programming language. Various features of authoring software are as follows:

(*i*) **Integrated Multimedia Elements.** Authoring software support a wide area of file format with different media elements. Add-on boards and peripheral devices to play multimedia support the authoring software. Authoring software provide developers with a greater degree of control over each multimedia element than presentation programs. Now, they are geared towards education and training application besides business presentations.

(*ii*) **Script Language Programs.** Authoring software offers the user an ability to write scripts. This feature results in writing new programs, which are not supported by the software itself. Script language programs create multimedia presentations using a series of programming style commands linked together in a word processing typescript. Scripting is closest in the form to traditional programming. The scripting specifies multimedia elements, sequencing hotspots, synchronisation, etc. Besides allowing powerful interactivity, in such languages, program editing of elements (video, audio, etc) tends to be minimal or non-existent.

Although the scripting supports better and more complex media interactivity, it takes longer time in development and can be difficult to learn. As most scripting languages are interpreted instead of compiled, the runtime speed over other authoring methods is reduced.

(*iii*) **Icon Based Programs.** Icon based programs are actually object oriented development tools where individual multimedia elements are represented by icons rather them script commands. They try to make development of multimedia applications easier by using graphical icons as the control features of authoring program. The main features of Icon based programs are:

- They are easier to learn than scripting program
- Editing elements in a presentation requires only clicking on its corresponding icon.
- They are suited for rapid prototyping and short development time projects.

(*iv*) **DLLs for Extending Features.** Advanced authoring program can call on special features included in Windows Dynamic Linking Libraries (DLLs). DLLs can be called on for special functions that may not be available in the authoring software program. Object-oriented programming languages such as C++ allow users to create their own DLLs for enhanced function.

(*v*) **Supporting CD ROM or Laser Disk Source.** Authoring software allow full control of CD drives to integrate audio, video and computer files. Multimedia presentations that depend on large amount of sound or video clips require excessive amounts of hard disk space. CD ROM, Laser Disk or DVD Disk helps in providing sources for video, audio or image clips.

(*vi*) **Supporting Videos for Windows.** Audio/Videos captured through TV tuner card or digital camera are easily stored in the hard disk. Most authoring software have the capability to support most multimedia elements (such as Video for Windows) on your disk. They help in developing projects having clippings of videos from TV turner card and digital camera.

(*vii*) **Cross-platform Capability.** Authoring software can be ported from one platform (e.g., Windows) to another (e.g., Macintosh) with appropriate planning and changes. They have capabilities to be altered for presentation on Macintosh or other hardware/ software platform. Certain tools are used for transforming and converting file formats and programs while porting from one platform to another.

(*viii*) **Hypertext.** Hypertext is non-linear or non-sequential text so that one can easily jump around from topic to topic. It is simple textual data having capabilities to link graphics, some animation and other text. Hypertext programming interfaces of authoring software allows users to select individual highlighted or underlined words on a screen, which are then linked to additional pages and layers of text. The highlighted or underlined words in hypertext are called hyperlinks. A hyperlink connects two nodes and it directly points one node (called anchor node) to another (destination node). The 'Help' system of Windows and web pages on Internet are very good examples of hypertext. Hypertext systems are useful when presenting and referencing large amounts of textual information. Some hypertext authoring programs provide graphical links for animations, sound and video besides text. The basic elements of hypertext as shown in figure 11.7 are described below:

(*a*) *Nodes*. A node is a collection of data organised around a specific topic and related or linked to another document.

(*b*) *Links*. Links are the other fundamental units of hypertext. Link is an information embedded in a node that connects it in some way to another node.

(*c*) *Annotation*. It is a special link to a small, additional amount of information. It is quite similar to the footnote in traditional text.

(*d*) *Button*. It is a visual clue in a node that alerts a user that a link exists. It is actually a visual representation of a link in a node.

(*e*) *Editor*. An editor is the part of the hypertext systems that enables a user to create a node and link it into the network.

(*f*) *Browser*. A hypertext browser is a program that can display a diagram of a network of nodes. In a network browser each node would be designated only once and lines should be drawn to show all of the links among all of the nodes.

(*g*) *Trail*. It is a record of the nodes that a user has accessed while viewing a hypertext document.

(*h*) *Built in programming language.* It is used to customise the hypertext system to fit one's specific needs. Several hypertext systems have built-in programming languages like HyperCard, HyperTalk and KnowledgePro, which can enable you to build expert systems.

(*ix*) **Run Time Player for Distribution.** The Run Time software is often included in authoring software to run your final product by packaging playback software with the content. Such software can help in synchronisation between the audioand video, which you have included in the application.
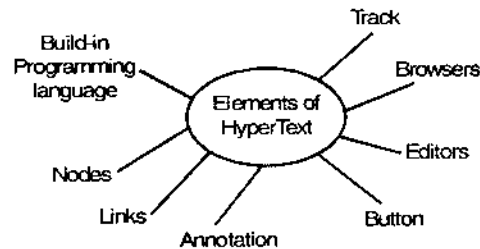

Fig. 11.7: Basic elements of hypertext

11.7. Graphics files

Most of the times you need to create graphics in one program and then use them or edit them in another program. For instance, you may create a painting or drawing in a program such as paint or CorelDraw and then want to place it in a page layout created in PageMaker.

All graphics programs enable you to save files in a native format-one that is read by that application. In addition, however, there are a number of standard graphics file formats in which you can save the graphics. Saving a graphic in a standard file format is called exporting the graphic. While placing a graphic in a standard file format into another document or file is called importing the graphic.

Various graphics file formats are described below:

1. **Object-based Vector Graphics.** Encapsulated PostScript (EPS) is the format most widely used for vector-based graphics such as those produced by drawing programs. This format is based on the PostScript page description language used by laser printers and professional image-setters.

2. **Bitmap or Raster Graphics.** BitMap (BMP) is a format widely used bitmap graphics on IBM PCs and compatibles. The PICTure, or PICT, is a format widely used for bitmap graphics on Macintosh computers. Tag Image File Format, or TIFF, is a bitmap graphics format widely used on Macintoshes and on IBM PCs and compatibles. This format is normally used for photographs.

3. **Compressed Bitmap Graphics.** Joint Photographic Experts Group file format, (JPEG) is a format for compressed bitmap graphics.

This format is widely used for Internet graphics and photo editing applications. Graphic Interchange Format, or GIF, is another common format for compressed bitmap graphics that is widely used on the Internet.

The secondary names for various graphics file formats are listed in table 11.4.

Table 11.4: Secondary names for various graphics file formats

Graphic File format	Secondary Name *
Encapsulated Post Script	.eps, .epsf
BitMap	.bmp
Picture	.pic, .pict
Tag Image File Formal	.tiff
Joint Photographic Experts Group	.jpg, .jpeg
Graphics Interchange format	.gif

* *IBM PCs and compatibles use 3 letter secondary name while Macintoshes use 3 or 4 letters.*

Sources of Computer Graphics

You can either create your own new graphics or make use of pre-existing collection of graphic images by editing them if required. Various sources of computer graphics are:

(*i*) **ClipArt Collections.** Many companies produce artwork that has been saved as files on disk, CD ROM or DVD ROM which is called ClipArt. ClipArt images are categorised into various subject areas such as Education, Business, Travel, People, Sports, etc. You can purchase the ClipArt disk or CDs and make use of various images.

(*ii*) **Photographs.** You can take photographs with a conventional camera and scan the photographs with scanner. These scanned photographs can be edited using a graphics software like Adobe photoshop or Corel Photopaint and hence be used in your application or document.

(*iii*) **Drawings.** You can also draw graphics or diagrams using a DTP software such as Corel DRAW or paint accessory program of Windows.

(*iv*) **Digital Images.** You can take photographs with digital cameras too which capture image in a digital format. So, you do not require a scanner and directly download the photographs to your PC.

11.8. Key Point Summary

- Multimedia is a woven combination of text, graphics, sound, animation and video.

- Various types of media in a multimedia system are Print, Audio and Video.
- A multimedia system is an interactive and non-linear media in comparison to a convential form of media.
- Multimedia applications are categorised into various areas such as Entertainment, Edutainment, Business, Public Utilities, Medical, Publishing and Home Services.
- Creating real life games, graphics, sound and animation are applications of multimedia in entertainment.
- Edutainment refers to imparting education through entertainment.
- Business applications for multimedia include presentations, online training programs, software for marketing, advertisement on Internet, Audio/Video Conferencing, etc.
- Multimedia is available as stand-alone terminals or kiosks for providing online information and help at various public places such as Hotels, Airports, etc.
- Multimedia plays an important role in health care for real-time monitoring of patients, online consultation by doctors, telemedicine, etc.
- Using multimedia, publishers can bring books on CDs and Web through E-Publishing.
- Multimedia facilities are also available at home in the form of basic television services, interactive entertainment, etc.
- The major components of multimedia are textual information, images, animation, audio and video.
- The text is represented in ASCII format.
- Images are represented in either bitmap or vector forms.
- There are mainly two types of animations used in multimedia—2D (Cell Animation) and 3D animations.
- Animation packages are equipped with techniques like Tweening Facility, Morphing and Warping.
- The three steps of 3D animation are Modeling, Animation and Rendering.
- Digital sound in the form of 'WAV file' is used for music CDs.
- MIDI (Musical Instrument Digital Interface) data provides protocols for details of music such as notes, sequence of notes and name of instrument playing these notes.
- Video is a movie that consists of a series of frames that are flashed on screen at rapid rate.
- The hardware of a typical Multimedia Computer comprises CD ROM, Sound Card, Speakers or Microphone, Video Capture Card, Digital Camera besides the basic devices of computer.
- The monitor of a multimedia PC should have either SVGA or AGP video card.
- Digital camera generates JPEG files, which occupy less than 1 MB.

- Video capture card converts analog video signal to digital form by a process called sampling.
- The common storage devices of a multimedia PC are Hard disk, CD ROM, DVD ROM and Laser Disk.
- Authoring tools are the software of multimedia.
- Various types of authoring tools are Time-based, Card-based (Page-based). Icon-based and Theatrical authoring tools.
- A few important authoring tools are Everest Authoring System, Macromedia Director and Quick Time.
- Various features of authoring software are Integrated Multimedia Elements, Script Language Programs, Icon Based Programs, DLLs, Supporting CD ROM, Supporting Video, Cross-platform capability, Hypertext and Run Time Player.
- Various graphic file formats are Object-based Vector Graphics, Bitmap or Raster Graphics and Compressed Bitmap Graphics.
- Various sources of computer graphics are ClipArt, Photographs, Drawings and Digital Images.

11.9. Review Questions

1. (*a*) What is multimedia ? What are the various media in a multimedia system ?

   (*b*) Discuss various advantages of multimedia system.

2. Discuss the various applications of multimedia in the following areas :

   (*a*) Entertainment   (*b*) Edutainment

   (*c*) Business   (*d*) Medical

3. How does multimedia helps you at various public places ? Discuss.

4. What is E-Publishing ? What are its benefits to the users ?

5. What are the major components of multimedia ? Discuss.

6. Explain the differences between the following :

   (*a*) Bitmap and Vector Images   (*b*) 2D and 3D animation

   (*c*) Morphing and Warping   (*d*) MIDI and Digital Audio

7. What are the main hardware components of a multimedia PC ? Discuss.

8. (*a*) What are Authoring Tools ? Discuss various types of authoring tools.

   (*b*) Write short notes on any two authoring tools.

9. Discuss the various features of Authoring Tools.

10. Differentiate between the following :

    (*a*) EPS, BMP and JPEG

    (*b*) CD ROM and DVD ROM

(c) SVGA and AGP Cards

(d) Modeling, Animation and Rendering

11. (a) Write the secondary name of the following Graphic File Formats.

    (i)   Encapsulated Post Script

    (ii) Bitmap

    (iii) Tag Image File

    (iv) Graphics Image Format

  (b) What are the various sources of computer graphics ? Explain briefly.

12. Write short notes on :

  (a) Virtual Reality

  (b) Video Conferencing

  (c) E-Commerce

  (d) Telemedicine

  (e) Sampling

13. (a) What are the hypertext and hyperlink ?

  (b) What are the basic elements of hypertext ?

14. What is a Digital Camera ? How does it work ?