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ONE YEAR BACHELOR DEGREE IN LIBRARY AND INFORMATION SCIENCES

SEMESTER-I

FUNDAMENTAL OF ICT

Guru Prasad Das School of Interdisciplinary and Vocational Studies

KRISHNA KANTA HANDIQUI STATE OPEN UNIVERSITY

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COURSE INTRODUCTION

Welcome to "Fundamentals of ICT," a comprehensive course designed to equip you with the fundamental knowledge and skills necessary to understand and navigate the digital landscape. In today's technology-driven world, Information and Communication Technology (ICT) is a vital component in all sectors, including libraries and information centres. This course will take you through the basics of computer systems, hardware, software, networking, the internet, multimedia, and cybersecurity, providing a robust foundation in ICT concepts and tools. It is designed to equip students with the essential knowledge and skills required to understand and navigate the digital world.

We will begin by understanding the evolution of computers, examining the different generations and their applications in today's digital age. We'll gain insights into the internal components of computers, various types of memory, and operating systems, such as MS Windows. The course also covers the use of productivity tools like MS Word, Excel and introduces database management systems (DBMS) and multimedia systems. In the section on communication technology, we will gain an understanding of analogue and digital communication, data communication modes, and communication hardware. We will also study communication protocols, the components of Information and Communication Technology (ICT), and the challenges associated with ICT.

The course delves into computer networks, their types, topologies, and communication protocols that form the backbone of digital communication. We will also examine the Internet from its history and protocols to the various applications and services it offers, such as email, social networking, and e-commerce. The course will also address interactive and distributive services of the internet, including tools for video conferencing, social networking, e-learning platforms, virtual assistants, and cloud storage and file sharing. With an increasing reliance on online interactions, security becomes paramount, and this course will teach you about the various types of cyber threats and protection mechanisms, providing practical knowledge for safeguarding data and systems.

As part of the course, you will explore the impact of cybercrimes, digital forensics, and the role of ICT in contemporary issues such as privacy, identity theft, and online fraud. The module will also discuss the legal and preventative measures against cybercrime.

This course is designed for individuals seeking to build a solid understanding of computer systems, internet technologies, and digital security. Upon completion, students will have a comprehensive knowledge of these key areas and will be well-prepared to navigate the increasingly complex digital landscape.

UNIT- 1 : BASICS OF COMPUTER

UNIT STRUCTURE

1.1 Learning Objectives

1.2 Introduction

1.3 History of Computer

1.4 Generation of Computer

1.5 Components of Computer

1.6 Types of Computers

1.7 Advantages and Disadvantages of Computer

1.8 Application of Computer

1.9 Let Us Sum Up

1.10 Answer to check Your Progress

1.11 Further Readings

1.12 Model Questions

1.1 LEARNING OBJECTIVES

After going through this unit, you will be able to –

- Define a computer
- Learn about the evolution
- Discuss different types of computers
- Check out the advantages and disadvantages of a computer

1.2 INTRODUCTION

The word “computer” is derived from the word “compute”, which means to calculate. It is an electronic device that can perform a variety of operations according to a set of instructions called program. It is “a device that receives, processes and presents information” (McGraw Hill, 1997, p. 270). A computer is a device that solves problems by applying prescribed operation on data entered into it. (Encyclopaedia Britannica, 1991, p. 638).

A computer can also be defined as a set of interacting elements, responding to input so as to produce desire output.

1.3 HISTORY OF COMPUTER

Examples of early mechanical calculating devices included the abacus, the slide rule and arguably the astrolabe and the Antikythera mechanism (which dates from about 150-100 BC). The end of the Middle Ages saw a re-invigoration of European mathematics and engineering. Wilhelm Schickard's 1623 device was the first of a number of mechanical calculators constructed by European engineers. However, none of those devices fit the modern definition of a computer because they could not be programmed.

a) Abacus: The concepts of number and counting are believed to have been developed first by the herdsmen of ancient times, who sought to avoid animal losses. It can be traced back to 3000 BC. The herdsmen (or the Stone Age men) used small round stones (pebbles) for counting cattle. After counting with pebbles, the successor was a tool known as ABACUS, which is treated as the first mechanical computing device. The word "Abacus" is derived from the Greek word 'abakos' which means a board or calculating tables. Beads are strung on wires or strings held in a frame and they are slid along the wires counting, adding, etc. It was invented by the Chinese in 3000 BC, which was later improved by the Egyptians and the Greeks.

b) Napier's Bones: John Napier was the inventor of logarithms. He used his data tables and with the help of a mechanical device could do the necessary computing.

c) Pascal's Machine Arithmetique: In 1642 Blaise Pascal, a French mathematician invented a mechanical adding machine, a prototype of the digital calculating machine. This device was able to add and subtract directly, whereas multiplication and division were performed through repeated addition and subtraction respectively.

d) Leibnitz's Stepped Reckoner: Gottfried Withelm Von Leibnitz, a

German mathematician invented a more advanced calculating machine in 1671, which could not only add but also multiply, divide and extract square root. As the machine could make a series of repeated additions, it was called the Stepped Reckoner. The merit of Leibnitz's contribution is that he showed the advantage of binary system over decimal system in the operation of mechanical computer.

e) Punched Card: A French weaver's son named Joseph Marie-Jacquard made the next significant contribution in 1804. After observing how his father could make different weaving patterns on the loom, he thought of storing these patterns for future use. So, he developed a plate with multiple holes to control the weaving patters, not knowing that only day his idea of storing the weaving patterns would be used to store data and would be called the Punched Card. A Punched card is a thin rectangular card divided into 80 columns and 12 rows in which the various characters could be represented by punching holes in different rows and columns. On one card it is possible to punch 80 characters– one character per column, thus it is possible to store 80 characters of data.

h) Babbage's Difference and Analytical Engines: Charles Babbage, a professor of Mathematics, designed a computing machine in 1822 for the purpose of producing ballistic tables called the "Difference Engine". Then he conceived the idea of a new computing machine in 1833 and designed the machine in 1835 called Analytical Engine, which is the forerunner of the modern computer. It could be called as the first digital computer having the memory and the calculating units as well as sequential control with provision for automatic printout. Thus, Charles Babbage is widely regarded as the father of the computer. Due to limited finances, and an inability to resist thinking with the design, Babbage never actually built his Analytical Engine. (The Analytical Engine should not be confused with Babbage's Difference Engine which was a non-programmable mechanical calculator).

i) Lady Ada Lovelace: Lady Ada Lovelace, an amateur mathematician, and a friend of Babbage produced supporting material for the "Analytical Engine" in the form of programs, and explanatory documentation. As such, she is considered the first lady computer programmer. ADA is one of the

programming languages named after her.

j) Boole's Symbolic Logic: George Boole, the famous logician, discussed symbolic logic in 1859 in his work 'Treatise of differential equation'. The development of symbolic logic and the application of binary logic operation AND, OR, NOT is his main contribution to modern computer technology.

k) Hollerith's Punched Card Machinery: Dr. Herman Hollerith, an American statistician invented the punched card machinery in 1886. Large-scale automated data processing of punched cards was performed for the U.S. Census in 1890 by tabulating machines designed by Herman Hollerith and manufactured by the Computing Tabulating Recording Corporation, which later became International Business Machine (IBM) Corporation. The punched card invented by Hollerith is still used as the basic input medium to computers.

l) Aiken and MARK I: This computer is also known as automatic sequence controlled calculator, which was designed by Howard A. Aiken of Harvard University. It is also known as Harvard MARK I. It is the first fully electro-mechanical computer.

m) Stibitz's Machine, MARK II and SSEC: George R. Stibitz developed a large relay computer at Bell Telephone Laboratories in 1946. Aiken built the MARK II, the large relay computer in 1947. Another machine was also constructed by the people of IBM Corporation. It was known as the Selective Sequence Electronic Calculator (SSEC).

n) The Atanasoff-Berry Computer: This electronic machine was also known as ABC (Atanasoff-Berry Computer) as it was named after its founder Dr. John Atanasoff and his assistant Clifford Berry. The non-programmable Atanasoff–Berry Computer (1941) used vacuum tube based computation, binary numbers, and regenerative capacitor memory.

o) Colossus Computers: The secret British Colossus computers (1943) (Copeland, 2006), had limited programmability but demonstrated that a device using thousands of tubes could be reasonably reliable and electronically reprogrammable. It was used for breaking German wartime codes.

p) Z Machines: In 1941, Konrad Zuse's electromechanical "Z machines" (Z3) was the first working machine featuring binary arithmetic, including floating point arithmetic and a measure of programmability. In 1998, the Z3 was proved to be the world's first operational computer.

q) Bush and Memex: Memex is a device in which an individual stores all his books, records and communications, which is mechanized so that it may be consulted with exceeding speed
and flexibility. Dr. Vannevar Bush visualized the library of the future with mechanized services from housekeeping to operation.

Early Electronic Computer

a) ENIAC: (Electronic Numerical Integrator And Calculator): This computer was built by a team at the University of Pennsylvania, designed by a team of members from the USA headed by Professor J. Presper Eckert and John Mauchly. The U.S. Army's Ballistics Research Laboratory ENIAC (1946), which used decimal arithmetic, is sometimes called the first general purpose electronic computer (since Konrad Zuse's Z3 of 1941 used electromagnets instead of electronics). Initially, however, ENIAC had an inflexible architecture which essentially required rewiring to change its programming. Several developers of ENIAC, recognizing its flaws, came up with a far more flexible and elegant design, which came to be known as the stored program architecture or Von Neumann architecture. This design was first formally described by John Von Neumann in the paper "First Draft of a Report on the EDVAC", published in 1945. A number of projects to develop computers based on the stored program architecture commenced around this time, the first of these being completed in Great Britain. The first to be demonstrated working was the Manchester Small-Scale Experimental Machine (SSEM) or "Baby".

b) BINAC (Binary Automated Computer): Mauchly and Eckert established their own company and design the BINAC in 1950, which was the first machine to use self checking devices.

c) EDVAC (Electronic Discrete Variable Automatic Computer): Dr. John Von Neumann and the ENIAC group designed this computer. The device

could store both the instruction and the data in the binary form, instead of human readable words or decimal numbers.

d) EDSAC (Electronic Delay Storage Automatic Calculator): It was developed by the Britishers, headed by Professor Maurice V. Wilkes at the Cambridge University Mathematical Laboratory. It was much faster than EDVAC. EDSAC was one of the first computers to implement the stored program (Von Neumann) architecture. The EDSAC which completed a year after SSEM, was perhaps the first practical implementation of the stored program design. Shortly thereafter, the machine originally described by von Neumann's paper EDVAC was completed but did not see full-time use for an additional two years.

e) SEAC (Standard Eastern Automatic Computer): The US National Bureau of Standards constructed this computer following the design of EDVAC and was completed in 1950. It was the first stored-program American Computer.

f) Manchester Mark I (1948): This machine was designed by a group of scientists headed by Professor M. N. A. Newman.

g) UNIVAC I (Universal Automatic Computer): Mauchly and Eckert designed and built UNIVAC I. It was the first computer to handle both numerical and alphabetical information.

h) MARK III and IV: Aiken built MARK III with magnetic drum storage at Harvard in 1950 and MARK IV, an improved version of MARK III, in 1952.

Modern Electronic Computers

Modern electronic computers have a faster speed. A major breakthrough in the computer technology was made by introducing transistor in place of vacuum tubes during the early sixties. With the development of transistor it was possible to design printed circuit, integrated circuit and other miniaturization techniques in the structure of computer.

The first devices that resemble modern computers date to the mid-20th century (around 1940 - 1945), although the computer concept and various machines similar to computers existed earlier. Early electronic computers were the size of a large room, consuming as much power as

several hundred modern personal computers. Modern computers are based on tiny integrated circuits and are millions to billions of times more capable while occupying a fraction of the space. Today, simple computers may be made small enough to fit into a wristwatch and be powered from a watch battery. In 1946, ENIAC consumed an estimated 174 kW. By comparison, a typical personal computer may use around 400 W; over four hundred times less (Kempf, 1961). Early computers such as Colossus and ENIAC were able to process between 5 and 100 operations per second. A modern "commodity" microprocessor (as of 2007) can process billions of operations per second, and many of these operations are more complicated and useful than early computer operations.

1.4 GENERATIONS OF COMPUTERS

Computer generation means step by step changes and each major change or progress after a period of time. Since inception there are totally five generation of computers.

a) First Generation Computer (Up to 1950): ENIAC was the first valve based computer and taken as first computer of first generation of electronic digital computer. It was made by J. P. Eckert and John W. Mauchly in 1946. EDVAC, EDSAC, UNIVAC are some other examples of computer of this generation. This generation computer possessed the following characteristics:

i) Used thermionic valves or vacuum tube or electronic valve;

ii) Used Mercury line for storage and paper tapes and punched cards were also used;

iii) Computer programming was mainly done in machine language;

iv) All the computers were of very big size and so required very large space;

v) The computers were very costly;

vi) Limited programming capabilities, memory;

vii) Slow operating speed and restricted computing capacity;

viii) High power consumption (each vacuum tubes consumed about half a watt power);

ix) Vacuum tubes used filament as a source of electron; they have a limited life.

x) Large amount of heat generated from the vacuum tubes and so they needed air-conditioning.

b) Second Generation Computer: The invention of transistor (short names for transfer resistor) in 1948 led to the development of second generation of computer. Their main disadvantages were that the commercial productions of transistors were difficult and expensive; again, the manual assembly of individual components into a functioning unit
was required. Examples of second generation of computer include UNIVAC-1108, IBM 700, 1401, CDC 1604, 3600. The second-generation computers are characterized by the following:

i) Transistors replaced the vacuum tubes completely;

ii) Use of magnetic cores for memory storage. Magnetic drum, magnetic disc, punched card were also used for storage purpose;

iii) Use of high level language like FORTRAN, COBOL, Algol, SNOBOL etc.;

iv) Due to the use of transistors the sizes turned to be smaller;

v) Less costly in comparison to the first generation of computer;

vi) Memory capacities were about 100 Kilobyte;

v) Reduction in computation time from millisecond to microsecond;

vi) Transistors consume only a tenth of power as required by vacuum tubes;

vii) Transistors have no filament to burn as against the first generation of computer so they were more reliable;

ix) Less heat was generated due to the use of transistor but still needed air conditioning and frequent maintenance.

c) Third Generation Computer: The third generation began in 1965 with germanium transistors being replaced by silicon transistors (=integrated circuit). Integrated circuit is a circuit consisting of transistors, resistors and capacitors grown on a single chip of silicon eliminating wired interconnections between components. Highly sophisticated technology was required for the manufacture of the chips, but still commercial production become easier and not so expensive. Remote processing and time sharing

is also an added advantage of this generation of computer. Example: IBM 360 Series, ICL 1900 series, IBM 370/168, ICL 2900, Honeywell 6000 series.

This generation computer has the following characteristics

i) Use of integrated circuit;

ii) Use of semiconductor memories in addition to, and later instead of, ferrite core memory. The two main types of semiconductor memory are Read-Only Memory (ROM) and read-and-write memories called Random Access Memory (RAM);

iii) Extensive use of high level programming languages;

iv) Smaller size and better performance, more flexibility with input/output;

v) Less costly in comparison to the second generation of computer and become popular as mini computer and are quite portable;

vi) Memories improved to 4 Megabytes;

vii) Reduction in computational time from microseconds to nanoseconds;

viii) Lower heat generation and quite less power requirement;

ix) More reliable in comparison to the second generation of computer;

x) Air conditioning required in many cases;

d) Fourth Generation Computer: The fourth generation of computer may be identified by the advent of the microprocessor chip. The whole computer CPU except primary memory is placed on a single chip. This chip is known as microprocessor. Examples: Intel 4004, Apple series I and II, spectrum 7 etc.

This generation computer has the following characteristics:

i) Use of large scale and very large scale integrated circuits (VLSI) packing about 50,000 transistors in a chip;

ii) Magnetic core memories were replaced by semiconductor memories;

iii) Sophisticated programs and languages for special application. In the area of language “C” language became popular.

v) Increasing use of microcomputer;

v) Low cost;

vi) Increased storage;

vii) Considerably faster and smaller;

viii) Heat generated is negligible and even air conditioner is not always

required;

ix) Network of computers and distributed computer systems were developed;

x) Modular design, versatility and compatibility.

e) Fifth Generation Computer: The fifth generation of computer is in the process of full development. This computer is expected to be a new and unique of its kind having the artificial intelligence i.e. the ability to reason logically and with the real knowledge of the world, behaving almost like a human being in the sense of talking, seeing, hearing and utilizing human language.

1.5 COMPONENTS OF A COMPUTER

The computer unit is frequently called as the computer system because of its numerous parts, machinery units and complicated sequential operation. A computer system has three main parts i.e Hardware, Software and Human ware. A general-purpose computer has two main parts Hardware and Software.

A) Input Unit: The input devices are used to transfer the information into the memory unit of a computer. In simplest term, they bring information into the computer from the user's hand, i.e. input unit feeds data into the computer. It is thus a communication medium between the user and the machine.

Central Processing Unit (CPU): The CPU is the brain of any computer system; all major calculations and comparisons are made inside the CPU and it is also responsible for activating and controlling the operations of other units of a computer system. It guides, directs and controls a computer performance. It also executes the instruction given to it. The CPU consists of the ALU, control unit, registers, and basic I/O (and often other hardware closely linked with these). Early CPUs were composed of many separate components but since the mid-1970s CPUs have typically been constructed on a single integrated circuit called a microprocessor.

C) Output nit: An output device is any product or machine that is capable of bringing information for user view. It presents the processed data or information to the user. It can be a printed page, a picture in monitor, and so

on. Anything which comes out of a computer system is the output of it.

1.6 TYPES OF COMPUTERS

Computers can be classified in many different ways; some of them are discussed bellow

A) Based On Purpose and Use: Depending upon the purpose for which computers are used, it can be classified as follows

i) General Purpose Computer: This type of computer is so designed that it can be used to solve many kinds of problem or which permits the development of different stimulated models as needed. Eg. Model EA1-2000 (Electronic Association Inc).

ii) Special Purpose Computer: It has a fixed programme with a few or no permitted adjustment. It is generally built into or appended to the physical system it serves. Examples: Special Purpose Pneumatic Analog Computer, Model Foxboro 516 (Foxboro Co.).

B) Based On Interconnection: Based on interconnection computer can be Distributed and Parallel computer.

i) Distributed Computer: A configuration in which several workstation / PC is interconnected by a communication network is called a distributed computer system. A common use of distributed computer is the so-called client server computing.

ii) Parallel Computer: A set of computers connected together by a high speed communication network and programmed in such a way that they corporate to solve a single large problem is called a parallel computer. It can again be classified into two categories i.e Shared Memory Parallel Computer and Distributed Memory Parallel Computer.

C) Based on Programme: Based on programme computer can be

i)Embedded Computer: Embedded computers are small, simple devices that are used to control other devices. These are embedded within the circuitry of appliances such as fighter aircraft, industrial robots, digital cameras, children's toys, washing machines, wrist watches, etc. These computers are typically preprogrammed for a specific task.

ii) Programmable Computer : The user can create a new program for

his/her specific purpose in these types of computers. It can be used as notepads, scheduling system and address books. If equipped with a cellular phone it can also be connected to World Wide computer networks for exchanging information regardless of location.

D) Based On Technology / Design

a) Analog Computer: An analog computer receives inputs that are instantaneous representation of variable quantities and produce output results dynamically to a graphical display device, a virtual display device or, in case of a control system, a device which causes
mechanical motion.

b) Digital Computer: The digital computer works with numbers, words, and symbols expressed as digits which it manipulates and counts discretely.

c) Hybrid Computer: The flexibility of the electronic analog computer has allowed it to be augmented with interface channels to the electronic digital computer, so that during 1960s a third type of general computer i.e. the hybrid computer came into being. The hybrid computers combine the features of the other two types and utilize both analog and discrete representation of data. A few more computers are being made all over the world, which are in their developmental stages. They include

d) Optical Computer: Today's computers use the movement of electrons in-and-out of transistors to do logic. Photonic computing is intended to use photons or light particles, produced by lasers, in place of electrons. Compared to electrons, photons are much faster – light travels about 30 cm, or one foot, in a nanosecond – and have a higher bandwidth.

A completely optical computer (or photonic computer) requires that one light beam can turn another on and off. This was first achieved with the photonic transistor, invented in 1989 at the Rocky Mountain Research Centre. This demonstration eventually created a growing interest in making photonic logic componentry utilizing light interference.

e) Atomic Computer or Molecular Computer: Molecular computers, also called DNA computer, are massively parallel computers taking advantage of the computational power of molecules (specifically biological). Moletronic specifically refers to the sub-field of physics which addresses the

computational potential of atomic arrangements.

f) Biological Computer: DNA computing is a form of computing which uses DNA, biochemistry and molecular biology, instead of the traditional silicon-based computer technologies. DNA computing, or, more generally, molecular computing, is a fast developing interdisciplinary area.

g) Chemical Computer: A chemical computer, also called reaction diffusion computer, BZ computer or goo ware computer, is an unconventional computer based on a semi-solid chemical "soup" where the data is represented by varying concentrations of chemicals.

The computations are performed by naturally occurring chemical reactions. So far it is still in a very early experimental stage, but may have great potential for the computer industry.

h) Quantum Computer: A quantum computer is a device for computation that makes direct use of quantum mechanical phenomena, such as superposition and entanglement, to perform operations on data. The basic principle behind quantum computation is that quantum

properties can be used to represent data and perform operations on these data.

E) Based On Memory (Physical Size): Modern computer system varies in physical size from those that used to fill a room to those with CPUs that can rest on the nail of a person's little finger. Generally the larger the systems the greater are its processing speed, storage capacity, cost and ability to handle large number of powerful input and output devices.

a) Micro Computer: Micro computers are popularly known as Desktop computer. Microcomputers are the smallest unit. They may be tiny, special purpose devices dedicated to carrying out a single task or they may be the more visible and familiar personal computer ranging from note book size to desktop size that we can use in countless ways. The performance of some newer micros surpasses the capabilities of some older minis. Memory capacity upto 4 MB, now up to 64 MB. Eg. Acer's, Aspire, Compaq, etc.

b) Mini Computer: They are generally more powerful and more expensive than Micros. Memory Capacity ranges from 4-24MB, but now obsolete. In physical size mini computers vary from desktop models to unit that has the

size of a small cabinet. Eg. IBM-6000 model 580, CDC 4360, etc.

c) Mainframe Computer: Mainframe computers are the system that offers faster processing speeds and greater storage capacity than a typical mini. A whole series of mainframe models ranging from small to very large are usually lumped together under a family designation by mainframe vendors. Memory capacity 10 MB – 128 MB. Eg. CDC 2000, IBM ES-2, etc.

d) Super Computer: These are the largest, fastest and more expensive system in the world. Super computer is designed to process complex scientific jobs, to analyse large commercial databases, produce animated movies and play games such as Chess. Memory capacity is 256 MB onwards. A super computer is very expensive, prices range from about $ 4 million to over $ 17 million. Eg. Cray -1, Cray-2, Cray-3, ETA-10, X-MP, etc. The above classifications are arbitrary. The fact is that the size, cost, and performance capabilities of machines in different classifications are likely to overlap.

F) Based On Nature Of Use: All the above classifications are no longer relevant. Computers can only be classified as based on its use.

a) Home Computer / Personal Computer: Home computer was a class of personal computer entering the market in 1977 and becoming common during the 1980s. They were marketed to consumers as accessible personal computers, more capable than video game consoles. These computers typically cost much less than business, scientific or engineering-oriented desktop personal computers of the time, and were generally less powerful in terms of memory and expandability. Personal computers, in various forms, are icons of the Information Age and are what most people think of as “a computer”; however, the most common form of computer in use today is the embedded computer. A personal computer (PC) is any general-purpose computer whose size, capabilities, and original sales price make it useful for individuals, and which is intended to be operated directly by an end user, with no intervening computer operator. A personal computer may be a desktop computer, a laptop computer or a tablet computer.

i) Desktop Computer: A desktop computer is a personal computer (PC) in a form intended for regular use at a single location, as opposed to a

mobile laptop or portable computer. It can indicate a horizontally-oriented computer case usually intended to have the display screen placed on top to save space on the desk top. Most modern desktop computers have separate screens and keyboards.

ii) Laptop Computer: Also known as Notebook Computer or Portable computer. A laptop is a personal computer designed for mobile use and is small enough to sit on one's lap. A laptop integrates most of the typical components of a desktop computer, including a display, a keyboard, a pointing device (a touchpad, also known as a trackpad, and/or a pointing stick), speakers, and often including a battery, into a single small and light unit.

iii) Handheld Computer: A handheld computer is a pocket-sized computing device, typically having a display screen with touch input or a miniature keyboard.

iv) Personal Digital Assistance (PDA): A personal digital assistant (PDA) is a handheld computer, also known as a palmtop computer. Newer PDAs commonly have color screens and audio capabilities, enabling them to be used as mobile phones (smartphones), web browsers, or portable media players.

b) Work Station: The distinction between PC and Work station in the recent day concept is blurring. The principal reason is that microprocessor used in PCs are nowadays as powerful as many of those used in work stations.

1.7 ADVANTAGES AND DISADVANTAGES OF COMPUTERS

Computers have some strength, which makes them immensely useful and popular and also adorable for all. Some of its main characteristics are given below.

a) Accuracy: Computers can perform all the calculation and comparison accurately provided the hardware does not malfunction.

b) Automaticity: Computers are capable of doing certain level of automation provided they are programmed in that order. In the computer, once a task is initiated, it can perform on its own till its completion. It will execute the program in the correct sequence i.e. it will switch on/off the machine at the

appropriate time, monitor the operational parameter, send warning signals or take corrective actions if the parameters exceed the control level and so on.

c) Diligence / Reliability: The human being suffers from weaknesses like tiredness, lack of concentration etc. being constant and earnest in efforts and application. Humans also have feelings, so they become sad, depressed, bored and negligent and virtually it is reflected in the work they do. But the computers can perform the task repetitively for n numbers of times without any degradation in quality. So computers are more reliable than human beings.

d) Speed: Computers can calculate at a very high speed. A modern computer can execute millions of instructions in one second.

e) Storage: Computers can store a large amount of information in a very small space. The storage capacity of a computer is virtually unlimited.

f) Versatility: The computer can perform activities ranging from simple calculation to performing complex tasks in any field of knowledge and in different environment conditions, i.e. they can do hazardous jobs even in hospital environment. Being an electronic device the computers have certain limitations also, which can be summarized as follows:

i) Lack of Decision-Making Power: Computers cannot decide on their own; they are dependent on human instruction. Computers can only do what they are told to do.

ii) Zero IQ: Computers are dumb machines with zero IQ. They need to be told in each and every step, however minute it may be.

iii) No Heuristic: Heuristic refers broadly to learning from past experiences. If a computer commits an error once and the similar situation/ event occurs again, the computer will commit the same error again. i.e. it cannot learn from the past experiences.

1.8 APPLICATIONS OF COMPUTERS

Computer is used everywhere in the world in every field of life. It has a very big impact on our day-to-day life and increasingly it is becoming an integral part of our life. It is enhancing our efficiency and productivity in all

activities. It is used for a number of applications like education, research and development, entertainment, medical treatment, business, military services, space, etc. The application of computers in human life is virtually endless. A cursory account of it is given below:

i) **Education:** There are many uses of computer in schools, colleges and universities. For example, student details are stored into the computer system for subsequent operation on them. Multimedia, animations, graphics and charts could be used to teach the students and many boring topics can be made interesting by using multimedia. Students again could access internet for online help and courses for more information.

ii) **Health and Medicine:** Computers are helping immensely to monitor the extremely ill in the intensive care unit and provide cross-sectional views of the body. This eliminates the need for hired nurses to watch the patient twenty-four hours a day, which is greatly tiring and error prone.Doctors use computers in diagnosing certain diseases. Computers are now able to map, in exquisite details, the structure of the human coldvirus - the first step towards the common cold. Furthermore, computers are used greatly in managing patients, doctors, wards and medicine records, as well as for making appointments, scheduling surgeries,etc.

iii) **Agriculture:** Farmers use small computers to help themselves with billing, crop information, and cost per acre, feed combinations, and market price checks. Cattle ranchers can also use computers for information about livestock breeding and performance.

iv) **Banking:** Every bank is now using a computerized system because it is very fast and user friendly. ATM cards are used everywhere now which let us bank any time we want. PC banking (Personal Computer banking) allows us to see our bank balance, request transfers between accounts and pay bills electronically etc.

v) **Entertainment:** It is used to make cartoon movies, animated and special effects in movies, games, and so on.

vi) **Sports:** In sports computers are used widely in conjunction with video cameras. These are used to record the motion of all the sports men. 3D programs are used later on to help the trainers see their movements and to improve their style of playing.

vii) **Communication:** Internet is becoming an information superhighway with lots of facilities to communicate.

viii) **Traffic Light Control:** In traffic light control the computer is being employed to drive the traffic signals. There are some programmed codes like "turn off the red light" or "turn on the red light" to control the traffic signal and to carry out the instructions that follows.

ix) **Day to Day Life:** It is used in Railway ticket booking, air ticket booking, and son on.



CHECK YOUR PROGRESS

Q 1: Match the Following

a) First generation computer. i) Transistors are used.

b) Second generation of computer. ii) Use of Microprocessor.

c) Third generation computer. iii) Thermionic valves or vacuum tube or electronic valves\were used.

d) Fourth generation computer. iv) Integrated circuits are used.

Q 2: Find out True and False Sentences

a) A computer is a machine that manipulates data according to a set of instructions.

b) The CPU is the main brain of a computer system.

Q 3: Fill in the Blanks

a) ..... is the father of the computer.

b) ..... discussed symbolic logic in "Treatise of differential equation".



1.9 LET US SUM UP

A computer is a machine that processes data according to a set of instructions. The term "computer" was first used in 1613 to describe a person who performed calculations, and it remained in that sense until the mid-20th century. By the late 19th century, however, it began to refer to a machine that performs computations.

Modern computers almost universally follow the stored-program architecture, which has become the defining characteristic of computers today. While earlier devices might not meet this standard, they are still referred to as computers in a historical context. Though computer technology has evolved significantly since the first electronic general-purpose computers of the 1940s, many still follow the Von Neumann architecture, which made universal computing a reality. In the 1950s, vacuum tube-based computers were common, but by the 1960s, transistors replaced them. Transistors are smaller, faster, more reliable, cheaper, and consume less power than vacuum tubes.

In the 1970s, the introduction of integrated circuits and microprocessors, such as the Intel 4004, further reduced size and cost while improving speed and reliability. By the 1980s, computers had become small and affordable enough to replace simple mechanical controls in appliances like washing machines. This period also saw the rise of home computers and personal computers, which became as common as televisions and telephones in households. With the growth of the Internet, personal computers have become central to daily life.

Experts often disagree on how to classify computers because of the rapid pace of technological advancement. New systems can outperform older models in terms of performance and cost, making it difficult to define clear boundaries between generations. This is the Computer Age, and computers are increasingly shaping our lives. From cinemas to schools to libraries, we encounter computers daily, and they are an inescapable part of modern life. The world is flooded with computer-related advertisements, news, and hype, signalling the profound impact computers have on how we

think, live, and work.



1.10 ANSWERS TO CHECK YOUR PROGRESS

Ans to Q No 1:

a) First generation computer. a) Thermionic valves or vacuum tube or electronic

valves were used.

b) Second generation of b) Transistors are used computer.

c) Third generation computer. c) Integrated circuits are used.

d) Fourth generation computer. d) Use of Microprocessor.

Ans to Q No 2:

a) True b) True

Ans to Q No 3:

a) Charles Babbage.

b) George Boole.



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1.12 MODEL QUESTIONS

1. Define a computer.
2. Who is treated as the father of a computer?
3. What is the control unit of a computer? What are its functions
4. Write a short note on the evolution of a computer system.
5. Give a sketch of the different generations of computers.
6. What are the different components of a computer?
7. Write a short note on the types of computers.
8. Write a short note on the advantages and disadvantages of computers.
9. Describe the applications of computers.

*** *** ***

UNIT 2: INTRODUCTION TO HARDWARE

UNIT STRUCTURE

2.1 Learning Objectives

2.2 Introduction

2.3 Hardware of Computer

- 2.3.1 Input Unit
- 2.3.2 Central Processing Unit (CPU)
- 2.3.3 Output Unit
- 2.3.4 Auxiliary Storage Devices

2.4 Let Us Sum Up

2.5 Answer to check Your Progress

2.6 Further Readings

2.7 Model Questions

2.1 LEARNING OBJECTIVES

After going through this unit, you will be able to –

- understand the key components of a computer system
- learn about the functions and roles of the CPU's subcomponents
- explore different types of input and output devices
- gain knowledge of the various types of memory
- comprehend the significance of secondary storage devices

2.2 INTRODUCTION

In the previous unit we have studied the components of the computer, in this unit we will learn about the essential components that make up a computer system. These components include the input unit, central processing unit (CPU), output unit, and auxiliary storage devices, each playing a vital role in the functioning of the computer. We will explore how the input devices allow users to interact with the system, how the CPU

processes data, and how the output devices present the results. We will delve into the various types of memory and storage devices that support long-term data management. Understanding these components will give us a clear picture of how computers work and interact with users and other devices.

2.3 HARDWARE OF COMPUTER

The physical or mechanical parts of the computer system that can be seen and touched are known as hardware. It consists of a combination and collection of electro-mechanical and electronic components and devices, electronic circuits and microelectronic equipment assembled in metal boxes in the form of modules and cabinet. All these equipment and elements are interconnected by wiring and switching communication components like transistors, capacitors, resistors, diodes, printed circuits, integrated circuits, main and auxiliary storage systems, various types of magnetic media, communication media for carrying and transformation of data, coded instruction, etc. The different hardware parts are interconnected by busses, often made of groups of wires.

Any computer system has three important hardware parts. They are input device, central processing unit and the output device. The central processing unit itself has three parts, namely memory unit, control unit and arithmetic and logic unit. These three units along with the input and output devices form the five important components of any computer system. In addition to the above five parts mentioned, computers also have secondary storage devices, which are used for storing data or instruction on a long-term basis.

2.3.1 Input Unit

The input devices are used to transfer the information into the memory unit of a computer. In simplest term, they bring information into the computer from the user's hand, i.e. input unit

feeds data into the computer. It is thus a communication medium between the user and the machine. The input devices are of the following types.

i) Keyboard: Keyboards are the most commonly used input devices usually having 83-84 keys and enhanced with 101 keys or even more. The enhanced keyboards are more popular.

ii) Mouse: It is a hand-held pointing device that allows controlling the computer without having to type the instruction through keyboard. The Scrolling mouse is a small unit with a round ball at the bottom and with two depression switches at the upper top portion having again a scroll button. Nowadays cord less as well as without scroll ball-type of mouse is also used.

iii) Scanners: Scanners are used to store or feed an entire image/ data or page of other information into the computer system. Image scanner is a general-purpose device which digitizes a two-dimensional image.

iv) Track Ball: A trackball is just like a mouse lying on its back. It is stationary and does not need to move on any surface. To move the pointer only the ball should be rotated with the thumb / finger or with the palm. The buttons next to the ball are used just like mouse button.

v) Joystick: A joystick is an input device consisting of a stick that pivots on a base and reports its angle or direction to the device it is controlling. Joysticks are often used to control video games and they usually have one or more push-buttons whose state can also be read by the computer.

vi) Digitizing Tablet: A graphics tablet (or digitizing tablet, graphics pad, drawing tablet, pen pad or digitizer) is a computer input device that allows one to hand-draw images and graphics,
similar to the way one draws images with a pencil and paper. These tablets may also be used to capture data or handwritten signatures.

vii)Digital Camera: A digital camera (or digicam) is a camera that takes video or still photographs, or both, digitally by recording images via an electronic image sensor.

viii)Magnetic Ink Character Recognition (MICR): It allows the computer to recognize character printed using magnetic ink. MICR is widely used in banks to read the cheque number written on the bottom of the cheque. It is also used in the back of credit cards and bank debit cards and ID cards.

ix) Optical Character Recognition (OCR): An optical character reader is used to read character of special type fonts printed on conventional paper with conventional ink i.e. it involves reading text from paper, book or from a magazine articles but they still have difficulty with handwritten text.

x) Bar Code Reader: Bar code readers are photoelectric scanner that reads the bar codes or vertical zebra striped marks printed on the product container and the computer automatically tells the prices of the product at the terminals.

xi) Speech Recognition and Voice Response Devices: In this type of device the user speaks into a microphone which is attached to a digitizer. The digitizer convert the analog sounds waves to “0” and “1”s which can be easily understood by the computer. Speech recognition devices are necessary because spoken commands are much quicker than typing. It helps to give command to a remote computer over telephone. It helps the computer usable to the blind people. In computer assisted learning environment it helps in the interaction between the man and machine.

xii) Touchscreen: A touchscreen is a display that can detect the presence and location of a touch within the display area. The touchscreen has two main attributes. Firstly, it enables one to interact with what is displayed directly on the screen, where it is displayed, rather than indirectly with a mouse or touchpad. Secondly, it lets one do so without requiring any intermediate device such as a stylus that needs to be held in the hand. Such displays can be attached to computers or, as terminals, to networks.

xiii) Touchpad: A touchpad (also trackpad) is a pointing device consisting of specialized surface that can translate the motion and

position of a user's fingers to a relative position on screen. They are a common feature of laptop computers and are also used as a substitute for a computer mouse where desk space is scarce.

xiv) Light Pen: A light pen is similar to a mouse except that with a light pen one can move the pointer and select objects on the display screen by directly pointing to the object with the help of the pen.

xv) Optical Mark Recognition (OMR): Optical Mark Recognition is also called mark sensing. It is a technology where an OMR device senses the presence or absence of a mark such as pencil mark. OMR is used in test such as aptitude test.

2.3.2 Central Processing Unit (CPU)

The CPU is the brain of any computer system; all major calculations and comparisons are made inside the CPU and it is also responsible for activating and controlling the operations of other units of a computer system. It guides, directs and controls a computer performance. It also executes the instruction given to it. The CPU consists of the ALU, control unit, registers, and basic I/O (and often other hardware closely linked with these). Early CPUs were composed of many separate components but since the mid-1970s CPUs have typically been constructed on a single integrated circuit called a microprocessor.

a) Arithematic and Logic Unit (ALU): The input devices are used to transfer the information into the memory unit of a computer. Information from the memory can be transferred to the ALU where comparison and calculation are done and the results are sent back to the memory unit. The set of arithmetic operations that a particular ALU supports may be limited to adding and subtracting or might include multiplying or dividing, trigonometry functions (sine, cosine, etc) and square roots. Some can only operate on whole numbers (integers) whilst others use floating point to represent real numbers with limited precision. An ALU may also compare numbers and return

boolean truth values (true or false) depending on whether one is equal to, greater than or less than the other. Logic operations involve Boolean logic: AND, OR, and NOT. These can be useful both for creating complicated conditional statements and processing Boolean logic.

b) Control Unit: It acts as a manager which controls all activities being carried out within the computer. The control unit strictly obeys the instruction given by us, follows the instruction in the same sequence and executes them one after another until the entire set of instruction is exhausted. CU brings one instruction at a time from the memory, interprets it and obeys it by coordinating the working of all other units. The CU tells the input unit what is to be read and addresses the memory as to where it is to be stored. The CU ensures that according to the stored instruction the right operation is done on the right data at the right time. It manages and coordinates the entire computer system. The simplified descriptions of the steps that are performed by the Control unit are given below. Some of these steps may be performed concurrently or in a different order depending on the type of CPU

- Read the code for the next instruction from the cell indicated by the program counter (program counter is conceptually just an other set of memory cells, it can be changed by calculations done in the ALU);
- Decode the numerical code for the instruction into a set of commands or signals for each of the other systems;
- Increment the program counter so it points to the next instruction;
- Read whatever data the instruction requires from cells in memory (or perhaps from an input device). The location of this required data is typically stored within the instruction code;
- Provide the necessary data to an ALU or register;
- If the instruction requires an ALU or specialized hardware to complete, instruct the hardware to perform the ? Write the

result from the ALU back to a memory location or to a register or perhaps an output device

- Jump back to step one.

c) Memory Unit: It is the workspace area within the computer where the data and instructions are stored. It holds all data, instruction and results temporarily. It stores the data to be processed, the intermediate results and the final results until they are displayed. It contains the programs that are currently being run and the data the programs are operating on. In modern computers, the main memory is the electronic solid-state Random Access Memory (RAM). It is directly connected to the CPU via a "memory bus" and a "data bus". The arithmetic and logic unit can very quickly transfer information between a processor register and locations in main storage, also known as a "memory addresses". The memory bus is also called an address bus or front side bus and both buses are high-speed digital "superhighways". Access methods and speed are two of the fundamental technical differences between memory and mass storage devices. Main memories are of the following types:

i) Random Access Memory (RAM): It is the key working area of the memory. It is possible to select randomly and use any location of this memory. It is also called the read/ write memory because information can be read from RAM chip and can also be written into it. It is a volatile storage medium i.e. the contents of the memory are lost when power is switched off/cut, as it requires a steady flow of electricity to maintain its content. RAM is also quite expensive. RAM may be of VRAM, WRAM, NVRAM.

ii) Read Only Memory (ROM): It holds permanent data or instruction that can only be read. That information is permanently recorded and cannot be changed by the programmer. It is non-volatile in nature i.e. the contents of ROM are not lost when the computer is switched off. It contains instruction to get the computer started when the switch is on, holds instruction and data that control the various peripheral units of the computer such as graphic display, disk drives, etc. Most

personal computers contain a small amount of ROM that stores critical programmes, as it is expensive to produce. Typically, ROM must also be completely erased before it can be rewritten, making large scale use impractical, if not impossible.

ROM may be of the following types-

- **Programmable Read Only Memory (PROM):** A PROM is a memory chip on which set of instructions or information can be stored, but it cannot be modified or wiped out later on. Like ROM its memory is also non volatile. To write data on a PROM one will need a special device called a PROM programmer or PROM burner. The difference between a PROM and ROM is that PROM is manufactured as blank memory where ROM is programmed during the manufacturing process.
- **Erasable Programmable Read Only Memory (EPROM) :** EPROM is used widely in personal computers to enable the manufacturer to change the contents of PROM before the comPuter is actually skipped so that the bugs can be removed and new versions can be installed shortly before delivery. The EPROM is of two types - Electrically Erasable PROM (EEPROM), where high voltage electric pulses are used to erase the previous data or instruction and after that the disk can be reused and Ultra Violet Erasable PROM (UVEPROM), which retains its data or instruction until it is exposed to Ultra Violet light. The UV light clears its contents making it possible to reprogramme the memory. The difference between an EPROM and PROM is that while in PROM the data or instruction can be written only once and cannot be erased, in EPROM the content can be erased and reprogramming can be done

iii) Flash Memory: Many modern PCs have their Basic Input Output System (BIOS) stored on flash memory chip so that it can easily be

updated if necessary. Such type of BIOS is sometimes called flash BIOS. Flash memory is also important for modem as it enables the modem manufacturer to support new protocols as they become standardized. EEPROM is similar to flash memory (sometimes called flash EEPROM). The principal difference between the two is that EEPROM requires data to be written or erased in byte at a time whereas flash memory allows data to be written or erased in blocks. This makes flash memory faster.

iv) Cache Memory: It is a special type of internal memory used by many central processing units to increase their performance or "throughput". Some of the information in the main memory is duplicated in the cache memory, which is slightly slower but of much greater capacity than the processor registers, and faster but much smaller than main memory. Multi-level cache memory is also commonly used—"primary cache" being smallest, fastest and closest to the processing device; "secondary cache" being larger and slower, but still faster and much smaller than main memory.

2.3.3 Output Unit

An output device is any product or machine that is capable of bringing information for user view. It presents the processed data or information to the user. It can be a printed page, a picture in monitor, and so on. Anything which comes out of a computer system is the output of it. The common output devices are

i) Monitor [Video Display Unit (VDU) / Cathode Ray Tube (CRT)]: It looks like a television. The advantage of having a video display unit is that as we write we can see what is being fed into the computer and by this way we can spot the mistakes and make the necessary correction. It also helps to display the stored information inside the computer system.

ii) Liquid Crystal Display (LCD): CRT screens are relatively heavy and bulky, therefore unsuitable for small portable computer like note

book. Considering this the screen of a portable computer is effectively replaced by a flat panel LCD screen which is smaller in size and lighter in weight.

iii) Printer: A computer printer, or more commonly called the printer, is a device that produces a hard copy (permanent human-readable text and/or graphics) of documents stored in electronic form, usually on physical print media such as paper or transparencies. Many printers are primarily used a computer peripherals, and are permanently attached by a printer cable to a computer which serves as a document source. The latest technology is combining printers with a scanner and/or fax machine in a single unit. The world's first computer printer was a 19th-century mechanically driven apparatus invented by Charles Babbage for his Difference Engine.

iv) Plotter: A plotter is a vector graphics printing device which operates by moving a pen over the surface of paper. Plotters are used in applications such as computer-aided design, though they are being replaced with wide-format conventional printers.

v) Speaker: Speaker output the music or speech from the programme. A speaker or loudspeaker converts an electrical signal to sound. The speaker pushes a medium in accord with the pulsations of an electrical signal, thus causing sound waves to propagate to where they can then be received by the ear.

vi) Computer Output on Microfilm and Microfiche (COM): The output from the computer, instead of being printed is displayed on a high-resolution cathode-ray tube, and the output is obtained in microfilm or microfiche from which it is often used to store massive data in compact form. Then, when needed, with the help of a special microfilm reader it is used to read the output.

vii) Speech Output Unit: A speech output unit is one which reads string of character stored in a computer memory and converts it into spoken sentence. This type of speech output is very useful in many areas. Examples: A telephone where a message is given to

the caller when the number dialled does not exist, railway and airlines enquires.

2.3.4 Auxiliary Storage Devices

Auxiliary memory / storage devices or secondary storage supplements the main memory and it requires the computer to use its input/output channels to access the information. Secondary storage is also known as “mass storage devices”. It functions as back up device even if by some accident the computer is crashed and the data in it is unrecoverable. One can restore it from the backups. It acts both as input and output devices. The secondary storage devices are also used as a transport medium to transfer data or information from one computer system to another computer system. If we use keyboard as an input device we will waste a lot of valuable computer times because manual input is always slow. Secondary storage is also used for long-term storage of persistent information. Secondary storage device includes Magnetic tapes, Floppy disc, CD / DVD, Pen drive, External Hard Disc etc. The Floppy and Magnetic Tapes are now obsolete as secondary storage devices.

i) CD-ROM: CD-ROM is an abbreviation for Compact Disc Read-only memory. The standard CD-ROM holds 650 or 700 MiB of data. A “700 MB” CD has a nominal capacity of about 700 MiB. The CD-ROM is popular for distribution of software, especially multimedia applications, and large databases.

ii) DVD: It typically may contain at least 4.4 GiB of data, nearly 7 times the amount of a CD-ROM. DVD capacities are given in decimal units: A “4.7 GB” DVD has a nominal capacity of about 4.38 GiB.

iii) Pen Drive: A USB flash drive consists of a NAND-type flash memory data storage device integrated with a USB (Universal Serial Bus) interface. USB flash drives are typically removable and rewritable, much smaller than a floppy disk, and most weigh less

than an ounce (30 g). Storage capacities can range from 64 MB to 256 GB with steady improvements in size and price per capacity. Some allow 1 million write or erase cycles and have 10-year data retention, connected by USB 1.1 or USB 2.0.



CHECK YOUR PROGRESS

1. Fill in the blanks.

a. The three main hardware parts of a computer system are the _____, _____, and ____.

b. The _____ is considered the brain of the computer and is responsible for performing calculations and comparisons.

c. The CPU consists of three main parts- _____, _____, and _____.

d. The _____ is a non-volatile memory that contains permanent instructions for starting up the computer.

e. The _____ is an output device that displays text, images, and videos on the screen.

f. _____ is a secondary storage device that allows for fast data transfer and is typically smaller and more portable than traditional storage devices.



2.4 LET US SUM UP

A computer system is made up of several key components that work together to perform tasks. These essential parts include the input unit, central processing unit (CPU), output unit, and auxiliary storage devices. The input unit allows users to provide data and commands to the computer, while the CPU, consisting of the arithmetic and logic unit (ALU), control unit (CU), and memory unit, processes the data and executes instructions. The output unit displays or presents the results of the computer's work, and auxiliary storage devices serve as long-term storage for data and instructions. Together, these components enable a computer system to

process, store, and deliver information efficiently



2.5 ANSWERS TO CHECK YOUR PROGRESS

Ans to 1. a. input unit, central processing unit (CPU), output unit.

b.CPU

c. arithmetic and logic unit, control unit, memory unit.

d. Read Only Memory

e. monitor

f. Pen drive



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2.7 MODEL QUESTIONS

1. What is the function of the Arithmetic and Logic Unit (ALU)?
2. What is the main difference between RAM and ROM?
3. What is a plotter used for?
4. What is the role of the Output Unit in a computer system?

5. Explain the role of the Central Processing Unit (CPU) in a computer system. What are its three main components, and how do they function together?
6. Discuss the various types of input devices.
7. What is cache memory? Explain its importance in improving the performance of the computer system.
8. Explain the role of auxiliary storage devices in data management.

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UNIT 3: INTRODUCTION TO SOFTWARE

UNIT STRUCTURE

3.1 Learning Objectives

3.2 Introduction

3.2.1 Need of Software

3.3 System software

3.3.1 Types of System Software

3.3.2 Importance of System Software

3.4 Application software

3.4.1 Category based on their Licensing models and Accessibility to Source code

3.5 Open-Source Software

3.6 Let Us Sum Up

3.7 Answer to check Your Progress

3.8 Further Readings

3.9 Model Questions

3.1 LEARNING OBJECTIVES

After going through this unit, you will –

- Learn the basics of computer software
- Gain knowledge about software types
- Understand functions of software

3.2 INTRODUCTION

Software is a collection of programs, data, or instructions that tell a computer or electronic device how to perform specific tasks. It is intangible, meaning it doesn't have a physical form like hardware. Software can range from operating systems like Windows or macOS, which manage hardware

resources, to applications like web browsers, word processors, and games, which allow users to perform specific functions.

3.2.1 Need of Software

Software is essential because it makes computers and devices functional. Without software, the hardware (like the computer's processor and memory) wouldn't know what to do. Software tells the hardware how to perform tasks, from simple things like turning the device on to more complex actions like browsing the internet or running apps. It also automates repetitive tasks, saving people time and reducing mistakes in different tasks like calculating numbers. Software helps us interact with our devices, providing the interface to perform tasks. In everyday life, software boosts productivity, like in word processors where it helps us write and edit documents quickly. It also keeps us connected by allowing us to send emails, message friends, or video chat. Entertainment is powered by software from video games to music streaming services. Software helps organize and store information, like keeping track of library uses or managing the circulation desk. It plays key role in managing large volumes of data through various database management systems. Large data analysis for informed decision based on the insights derived from data. On top of that security software protects our devices from harmful threats like viruses or hackers. It is crucial for driving innovation, supporting new technologies such as artificial intelligence or robotics.

Software is typically divided into two broad categories:

a. System Software

b. Application Software

3.3 SYSTEM SOFTWARE

System Software: System software refers to a collection of programs and instructions that manage and control the hardware of a

computer system, allowing it to function efficiently and providing a platform for running application software. This includes operating systems (like Windows, macOS, or Linux) and utilities that help manage computer resources.

System software manages the computer hardware and provides an environment where application software can be executed. It coordinates and facilitates the interaction between hardware components and software applications, ensuring that the entire system functions smoothly.

The primary functions of system software include:

- It makes sure that the different parts of the computer (like the memory, processor, and hard drive) work together without getting in each other's way. It decides which part of the computer should do which task and when.
- System software keeps track of where your files are saved on the computer and how to find them. It organizes files in folders (like a filing cabinet), so when you need a document, you can easily find it.
- System software helps protect your computer from hackers and viruses. It controls who can use the computer and helps ensure only authorized people have access to sensitive information.
- System software provides a way for you to interact with the computer, whether it's through a mouse and keyboard (like on a desktop) or touch (like on a smartphone). It helps turn your clicks and taps into actions that the computer understands.

Resource Management: System software manages the computer's resources, such as memory (RAM), processor (CPU), storage devices (hard drives), and input/output devices (keyboard, mouse, printer). It ensures these resources are allocated efficiently so that programs and processes can run without conflicts.

Execution of Application Software: System software provides an environment for application programs to run. It helps execute application software like word processors, web browsers by providing necessary resources and managing their operation.

Memory Management: It controls the computer's memory, deciding which parts of memory are used by which programs at any given time. This ensures that programs don't overwrite each other's data and that memory is used efficiently.

File Management: System software organizes and manages files and directories on the computer's storage devices. It helps store, retrieve, and modify files. It also makes sure that files are not mixed up and remain in the correct location for easy access.

Security and Access Control: System software protects the system from unauthorized access by setting up user accounts, passwords, and encryption. It ensures that only authorized users can access certain files or perform specific tasks on the computer.

Error Handling and Recovery: System software detects and manages errors that may occur during the operation of the computer or while running programs. It helps recover from system crashes or program failures, ensuring that work is not lost or data corrupted.

Communication Between Hardware and Software: System software serves as a bridge between the hardware and the software. It makes sure that software can interact with the hardware properly and that hardware components work as intended.

Providing a User Interface: It provides the means through which users interact with the computer. This could be a Graphical User Interface (GUI) with icons, buttons, and windows (e.g., Windows or macOS) or a Command-Line Interface (CLI) (e.g., Linux terminal or Command Prompt). System software also provides a way for you to interact with the computer, whether it's through a mouse and keyboard (like on a desktop) or touch (like on a smartphone). It helps turn your clicks and taps into actions that the computer understands.

System Optimization and Performance Management: It optimizes the performance of the system by managing resources like CPU time, memory usage, and storage. System software may also run background tasks like disk cleanup and defragmentation to improve system speed and efficiency.

3.3.1 Types of System Software

System software is typically of the following categories:

a. Operating System (OS)

The operating system is the most essential and fundamental type of system software. It acts as an intermediary between the user and the hardware. Its main role is to create an environment where users can run programs in a simple and effective way. The operating system is a crucial part of the computer system because it establishes the framework for the application programs to operate. All software must be designed to interact with the operating system. It is the first software to be loaded into the computer's memory when the system is powered on. An OS is responsible for:

- **Task management**: It manages processes running on the computer, ensuring efficient execution.
- **Memory management**: It allocates and frees memory for different programs and processes.
- **File system management**: The OS organizes files into directories, ensuring users can easily store, access, and manage data.
- **Security and access control**: The operating system ensures that only authorized users and processes can access certain system resources.

Examples of operating systems include: Windows, Mac OS, Linux, Android.

Linux is an operating system built on a UNIX-based kernel, renowned for its security and reliability. It was developed by Linus Torvalds. It is often considered more complex to use compared to other platforms. As an open-source project, Linux allows both users and developers to freely access and modify its source code. Its efficiency enables exceptional performance, even on systems with limited hardware or smaller hard drives. A large and active community continuously contributes to the development and

improvement of the system. Despite its strengths, the server-oriented nature of Linux has led to fewer home users and its multimedia support remains limited.

Microsoft Windows is the most widely used operating system, it was developed by Microsoft Corporation, founded by Bill Gates and Paul Allen. Known for its compatibility and feature-rich environment, Windows 1.0 was released in 1985. Windows offers a vast selection of software applications, making it a popular choice for both personal and business use. Windows is proprietary software so comes in higher cost range. Despite its widespread adoption, Windows has earned a reputation for being insecure due to numerous security vulnerabilities, making it a prime target for hackers and malicious software, so Windows system are protected with internet access using reliable security software. With the release of Windows XP in 2001, Microsoft consolidated its various operating system editions under a unified structure. This trend continued with Windows 7 and the latest version, Windows 11, which features enhanced security measures and a broader range of applications.

MS DOS (Disk Operating System) earned its prominence by supporting both IBM-developed and Windows operating systems. It was the 1st operating system by Microsoft in 1981. Although less advanced than contemporary operating systems, DOS still provides several benefits. It is highly stable, with minimal risk of system crashes, and can display content on arcade monitors without requiring specialized hardware. Additionally, the use of batch files allows for extensive customization. While DOS continues to be used in some contexts, managing it has become more challenging due to the lack of ongoing support.

b. Device Drivers

Device drivers are specialized programs that enable the operating system to communicate with and control hardware devices, such as printers, graphics cards, keyboards, and storage devices. They translate high-level instructions from the OS into commands that

hardware can understand.

For example:

- A printer driver allows the operating system to send print jobs to a printer.
- A graphics driver enables communication between the OS and the computer's graphics card, allowing images to be rendered on the screen.

c. Utility Programs

Utility programs are designed to perform routine tasks and improve the efficiency and maintenance of the computer system. These programs often support the OS by handling tasks such as:

- **Disk management**: Utilities like disk defragmenters and disk cleanup tools help maintain the health and efficiency of storage drives.
- **Antivirus software**: These programs detect, remove, and protect against malicious software.
- **Backup and restore tools**: These utilities help in creating copies of the important data, ensuring recovery in case of system failure.

d. Linker and Loader: When you run a program on your computer, two important system software help to make it happen: the linker and the loader. They work together to make sure your program can run smoothly.

- Linker: Think of the linker as a "builder". After you write your program and it's broken into smaller pieces (called object files), the linker puts all these pieces together into one single file that can actually run on your computer. It also makes sure all the different parts of your program are connected properly, like making sure that when one part of your program needs to call another, it knows exactly where to find it.
- Loader: Once the linker creates the file that can run, the loader's job is to get that file into the computer's memory (RAM).

It's like a "delivery person" that takes the ready-to-go program and places it in the right spot in the computer's memory so that it can start running. Once it's in place, the loader kicks off the program and lets it run.

In simple terms, the linker gets everything ready to run, and the loader makes sure it's in the right place to actually work. Both are necessary steps for your program to run correctly.

e. Firmware

Firmware is a type of system software embedded directly into hardware devices. It is responsible for controlling the hardware at a very low level and provides essential instructions for the device to function correctly. Firmware is usually stored in non-volatile memory (such as ROM or flash memory) and is often updated to improve device functionality.

Examples of firmware include:

- The BIOS (Basic Input/Output System) in computers that initiates the hardware when the system is powered on.
- Embedded software in devices like printers, routers, or smart appliances.

e. Programming Language Translators

Programming language translators are tools that convert code written in one programming language into another. In general, it converts a source code written in a programming language into its corresponding machine code which can be directly executed by a computer. Here are the main types:

Compiler: A compiler translates source code written in one language into machine code without altering the program's meaning. It optimizes the target code for time and space efficiency. A compiler performs tasks like lexical analysis, parsing, semantic analysis, code optimization, and code generation. Examples include gcc (C), g++ (C++), and javac (Java).

Interpreter: Interpreter is also used to translate a source code

written in a high level programming language into its corresponding machine code. Unlike compilers, interpreters convert line-by-line of the source code into machine code and line-by-line execution of the source code is performed. Interpreters stop the conversion upon encountering errors until the error is fixed. It makes debugging easier. Examples include Ruby, Python, and PHP.

Assembler: An assembler converts assembly language code into machine code specific to a processor. It uses a straightforward one-to-one mapping from assembly instructions to binary machine code. While compilers handle high-level languages, assemblers focus on low-level languages specific to processors.

3.3.2 Importance of System Software

System software is crucial because without it, the computer would not be able to function. It handles the necessary background operations that allow users to run applications and interact with the hardware. For instance, without an operating system, users would not have a way to communicate with the computer, manage files, or run applications.

Some key benefits of system software include:

- **Efficient resource management**: System software helps optimize the use of hardware resources like memory and processing power.
- **User-friendly interaction**: By providing graphical interfaces or command-line tools, system software makes it easier for users to interact with the system.
- **Security and protection**: System software includes mechanisms for protecting data and resources from unauthorized access or corruption.

3.4 APPLICATION SOFTWARE

Application software refers to all types of computer programs that

enable a computer to carry out specific tasks or activities that are useful to the user, beyond just operating the computer hardware itself. Application software can commonly refer to as a software application, application program or simply an app.

A system software manages the computer's hardware and basic functions-integrating its capabilities and ensuring everything works together-it does not directly perform tasks that provide value to the user. Instead, system software acts as a foundation, supporting the application software, which directly serves the user's needs.

Examples of application software include programs like accounting software, enterprise resource planning (ERP) systems, graphic design tools, and office productivity suites. These applications are designed to perform specific functions such as managing finances, creating designs, playing audio and video or helping users with document editing, making them essential for accomplishing a wide range of tasks.

3.4.1 Category based on their Licensing models and Accessibility to Source code

Application software can be categorized based on their Licensing models and Accessibility to Source code. The following are two key categories:

a. Proprietary Software (Closed Source Software)

Proprietary software refers to computer programs that are licensed under the exclusive legal rights of the copyright holder. The license granted to users typically limits the use of the software to specific conditions, prohibiting actions such as modification, redistribution, sharing, reverse engineering, or studying the software. In most cases, the source code of proprietary software is not accessible to users. This type of software is designed to protect the intellectual property of the creator and restrict its use to predefined terms.

b. Commercial Off-The-Shelf Software (COTS)

Commercial Off-The-Shelf (COTS) software refers to pre-built

software that is developed by third-party vendors and made available for purchase, lease, or license to the general public. COTS software is ready-made for general use and can be used across multiple organizations without the need for custom development.

Advantages of COTS include:

- Cost-Effectiveness: The price of COTS software is generally lower than the cost of custom-built software due to its mass production and wide availability.
- Reliability: Since COTS applications are used by numerous organizations, their reliability is typically well-tested, making them more dependable than bespoke software solutions.
- Maintainability: COTS software often comes with comprehensive documentation, which makes maintenance easier for users and IT support teams.
- Higher Quality: The competitive market for COTS products encourages developers to improve the quality of their software, as competition drives continuous enhancements and innovation.
- COTS software tends to be more complex as it is developed by industry specialists with expertise in the field.
- The development of the application is driven by market demand rather than specific industry needs.
- The delivery timeline is typically shorter because the foundational operations and processes are already in place.

3.5 OPEN-SOURCE SOFTWARE

Open-source software refers to software that is made available under a license allowing users to freely access, use, modify and distribute both the software and its source code. This licensing model encourages collaboration and transparency, enabling individuals or organizations to adapt the software to their needs, improve it, and share the modifications with others. The primary principle behind open-source software is that its

source code is open and accessible to everyone, promoting innovation and community-driven development.

It encourages users to use the software and also be a contributor in its evolution, customize it for personal or professional task. Examples of open-source software: WordPress, LibreOffice, Linux, Koha etc.



CHECK YOUR PROGRESS

State true or false

a. Software is a collection of hardware components that allow a computer to perform specific tasks.

b. Open-source software allows users to modify and redistribute the source code freely.

c. The operating system is a type of application software that provides an interface for users to interact with the hardware.

2.Fill in the Blanks

a. Linux is an open-source operating system developed by _____.

b. _____ software is ready-made software that is developed by third-party vendors and sold to the public.

c. A _____ is responsible for combining smaller pieces of a program into a single executable file

3. Choose the correct answer.

a. What does proprietary software refer to?

i) Software that can be modified, redistributed, and shared freely

ii) Software licensed under exclusive rights with restrictions on modification, redistribution, and reverse engineering

iii) Software that is developed for public use with open access to source code

iv) Software that is free to use, modify, and distribute



3.6 LET US SUM UP

Computer software is like soul of the computer system. System software is the essential foundation that allows a computer to run, providing vital services and facilitating the operation of application software. It encompasses operating systems, device drivers, utility programs, and firmware, all of which work together to ensure that both the hardware and software of a computer system function effectively. Understanding system software is key to grasping how computers operate and interact with users, making it a fundamental area of study in computer science and information technology. Unlike application software, which is designed to perform specific tasks for the user (like word processing or gaming), system software works in the background to enable the overall operation of the computer. In short, software is what makes modern technology work, improving both our personal and professional lives.



3.7 ANSWERS TO CHECK YOUR PROGRESS

Ans to 1. a. False

b.True

c. False

Ans to 2. a. Linus Torvalds

b. COTS

c. linker

Ans to 3. ii) Software licensed under exclusive rights with restrictions on modification, redistribution, and reverse engineering.



3.8 FURTHER READINGS

- Bansal, R. (2019). *Computer basics and programming* (2nd ed.). Vikas Publishing House.
- Goel, A. (2014). *Computer fundamentals* (3rd ed.). Pearson India.

- Norton, P. (2014). *Introduction to computers* (8th ed.). Cengage Learning.
- Patel, M. (2016). *Basic computer applications* (3rd ed.). PHI Learning.



3.9 MODEL QUESTIONS

1. What is software?
2. What is the role of the operating system?
3. Define utility programs with an example.
4. What does a loader do?
5. What is proprietary software?
6. What is COTS software?
7. What is the main purpose of application software?
8. Describe the primary functions of system software in a computer system.
9. What is the main advantage of open-source software?
10. What is a compiler used for in programming?
11. What is an operating system? Discuss its major functions and provide examples of popular operating systems software and application software?
12. Discuss the importance of software in modern computing.

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UNIT 4: OFFICE TOOLS

UNIT STRUCTURE

4.1 Learning Objectives

4.2 Introduction

4.3 Word Processor Tool

4.4 Spreadsheet Tool

4.5 Presentation Tool

4.6 Cloud Storage and File Management Tool

4.7 Note Making

4.8 Email Communication tool

4.9 Calendar

4.10 Let Us Sum Up

4.11 Answer to Check Your Progress

4.12 Further Readings

4.13 Model Questions

4.1 LEARNING OBJECTIVES

After going through this unit, you will be able to –

- list different office tools
- describe the features of different office tools like word processor and spreadsheet tools
- describe the features of presentation and note making tools
- describe the features of cloud storage and file management tools
- describe the features of email and calendar tools

4.2 INTRODUCTION

Office tools are essential application software designed to assist users in performing various regular office tasks such as creating, updating and managing documents, they help in handling large sets of data, creating

presentations, and scheduling. These tools significantly enhance productivity by simplifying tasks that would otherwise be time-consuming and repetitive. When used effectively, office tools help save a considerable amount of time and effort, allowing individuals and organizations to work more efficiently. From document creation to complex data analysis, these applications play a crucial role in streamlining daily office operations and improving workflow. Some of the major types of office tools are described in the next few sections in detail.

4.3 WORD PROCESSOR TOOL

A word processor is a software application used for creating, editing, formatting and saving documents. It provides various features that make document creation and editing easier and more efficient.

Characteristics of Word processors:

a. Text Editing and Formatting

- Typing and Editing: Allows users to type, edit, and delete text with ease.
- Font Styles and Sizes: Users can change the font, size, and colour of the text.
- Bold, Italics and Underline: These formatting options help emphasize specific parts of the text.
- Text Alignment: Align text to the left, centre, right or justify it across the page.

b. Spell Check and Grammar Check

- Automatic correction or suggestion of spelling and grammatical errors as you type.
- Helps ensure the document is free from basic writing mistakes.

c. Paragraph and Line Spacing

- Users can adjust the spacing between lines and paragraphs for better readability.
- Allows for consistent and professional document formatting.

d. Page Layout and Margins

- Customize page orientation (portrait or landscape).

- Adjust margins to control the space around the text.
- Insert page breaks, section breaks, and headers/footers.

e. Inserting Objects

- Images: Pictures or graphics can be added to enhance the document.
- Tables: Create and manage tables for organizing data.
- Charts: Insert graphs and charts for visual representation of data.
- Hyperlinks: Insert clickable links to websites or other documents.

f. Styles and Templates

- Predefined styles (e.g., title, heading, body text) that help in consistent formatting.

g. Undo and Redo

- Allows users to quickly undo or redo actions, helping to fix mistakes or retrieve previous work.

h. Search and Replace

- Search for specific words or phrases within the document.
- Replace words, phrases, or formatting styles in bulk.

i. Tables of Contents and Indexing

- Automatically create a table of contents or index based on the document's structure, helping with navigation.

j. Document Security and Password Protection

- Set passwords to protect documents from unauthorized access or modification.

k. Collaborative Features

- Some word processors offer real-time collaboration, allowing multiple users to work on the same document simultaneously.

l. Multimedia Integration

- Insert audio, video, and other media types to enhance the content of the document.

m. Revision History

- Keeps a history of previous versions of the document, allowing you to revert to earlier drafts if needed.

Examples of Word Processor tools :

MS- Word

WordPad

WordPerfect

Google Docs

LibreOffice Writer

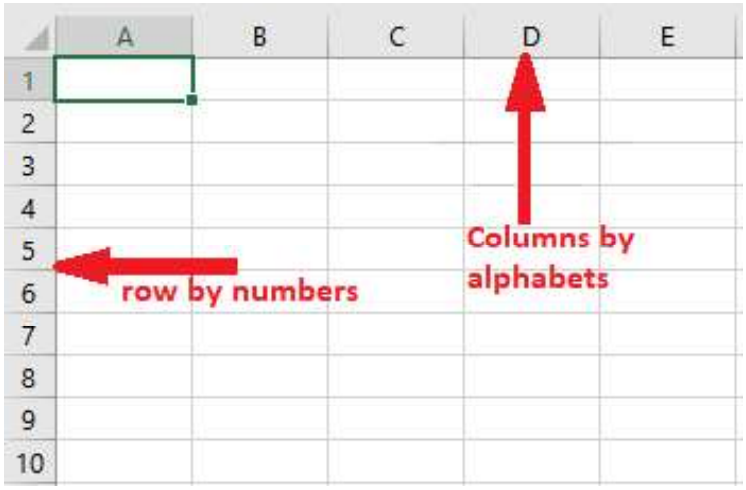
4.4 SPREADSHEET TOOL

A spreadsheet tools are application software designed for organizing, analyzing, and storing data in tabular form. It allows users to store data in rows and columns and manipulate data, perform calculations, and generate charts and graphs for data analysis and presentation. Spreadsheet tools are widely used in businesses, finance, education and preferred in other fields for tasks such as budgeting, data analysis, project management.

Characteristics of Spreadsheet tools:

a. Cells, Rows and Columns

- Cells: The cell is the basic unit in a spreadsheet where data is entered. Each cell can contain numbers, text, formulas or functions.
- Rows and Columns: Data is organized in horizontal rows and vertical columns. Each cell's position is identified by its row and column (e.g., A1, B3).



b. Formulas and Functions

- Formulas: Users can input mathematical expressions (e.g., =A1 + B1) to perform calculations within cells.
- Functions: Predefined operations (like SUM, AVERAGE, VLOOKUP, COUNT, etc.) that help with complex calculations and data analysis.

c. Data Sorting and Filtering

- Sorting: Organize data in ascending or descending order based on specific columns (e.g., sorting names alphabetically or numbers in order).
- Filtering: Hide certain data based on specified criteria to focus on relevant information.

e. Charts and Graphs

- Spreadsheet tools have feature to generate visual representations (such as bar charts, pie charts, line graphs) from the data to make trends and patterns more understandable.

f. Pivot Tables

- Pivot tables allow users to summarize, analyse and extract insights from large sets of data. They help in organizing and transforming data for easier interpretation.

g. Conditional Formatting

- This feature lets users apply specific formatting to cells based on certain conditions (e.g., change the colour of cells that meet a certain value or criteria).

h. Data Validation

- Data validation allows users to set rules on what type of data can be entered into specific cells (e.g., restricting entry to only numbers or dates).

i. Multiple Sheets (Tabs)

- Users can organize different sections of a project or data set into multiple sheets within a single file, making it easier to manage large datasets.

j. Collaboration and Sharing

- Modern spreadsheet tools allow multiple users to collaborate in real-

time, making changes and updates simultaneously. They also support sharing documents through cloud services.

k. Cell Referencing

- Absolute and Relative references allow users to refer to specific cells within formulas, ensuring consistency in calculations even when cells are copied or moved.

l. Protection and Security

- Users can protect specific cells, rows, or sheets to prevent accidental changes or restrict access to certain parts of the document.

m. Data Import and Export

- Spreadsheet tools allow importing data from various sources such as CSV files, databases, or external applications. Export options include saving the file in formats like CSV, PDF, or XLSX.

n. Templates

- Pre-designed templates are available for various use cases, such as budgets, project timelines, and financial reports, making it easier to get started with a specific task.

o. Integration with Other Software

- Spreadsheet tools often integrate with other applications, such as word processors, email platforms, and database tools, allowing for streamlined workflows and data sharing.

Examples:

- Microsoft Excel
- Google Sheets
- Apple Numbers
- LibreOffice Calc

4.5 PRESENTATION TOOL

A presentation tool is a software used to create and display visual presentations, they are made of text, images, audio, video, and animations. These tools help users present ideas, concepts and information in an

engaging and structured manner. Presentation tools are commonly used in business meetings, educational settings, and conferences.

Characteristics of Presentation Tools are:

a. Slide Creation and Editing
   - Users can create individual slides, which serve as the building blocks of the presentation. Each slide can contain text, images, graphs, and other media.
   - Editing options allow for the customization of the content on each slide (e.g., adjusting text size, colour, or position).

b. Templates and Themes
   - Most presentation tools come with a variety of pre-designed templates and themes for reference presentation.
   - Templates may include layouts for title slides, content slides, and conclusion slides, among others.

c. Text and Font Formatting
   - It allows to add and format text with options such as font styles, sizes, colours, bold, italics, underline, and bullet points.
   - Customizable text boxes and formatting tools help in structuring content clearly.

d. Inserting Media
   - Images: Add pictures and graphics to present in visual form.
   - Videos: Embed videos from files or online sources (e.g., YouTube) to illustrate points dynamically.
   - Audio: Include background music, sound effects or voice narration for a more engaging presentation.
   - Shapes, Icons and Charts: Insert visual elements like shapes, icons, and data charts to better explain ideas or data.

e. Slide Transitions and Animations
   - Transition effects control how one slide moves to the next (e.g., fade or slide).
   - Animations can be applied to elements on a slide (such as

text or images) to make them appear, move, or disappear in various ways, adding dynamic effects to the presentation.

f. Multimedia Integration
    - Many tools allow for seamless integration of multimedia such as audio, video, and interactive elements, enhancing the viewer's experience.

g. Collaboration and Sharing
    - Presentation tools allow multiple users to collaborate on the same presentation simultaneously in real-time, making it easier to work as a team.
    - Sharing options enable users to share presentations via email, cloud storage, or even present remotely through online platforms.

h. Slide Show Mode
    - Once the presentation is ready, it can be displayed in full-screen mode, where slides automatically change or can be manually changed.
    - Tools also provide options for adding presenter notes, which are visible only to the presenter during the presentation.

i. Cloud Integration and Accessibility

- Many modern presentation tools are cloud-based, enabling access to presentations from anywhere and on any device with internet connectivity.
- Real-time syncing ensures that changes are reflected across all devices in a collaborative setting.

Examples:

1. Microsoft PowerPoint
2. Google Slides – A cloud-based tool that allows for easy collaboration and access from any device.
3. Apple Keynote
4. Prezi
5. Canva
6. LibreOffice Impress.

4.6 CLOUD STORAGE AND FILE MANAGEMENT TOOL

Cloud storage software provide services that allow users to store, manage, and access their files and data over the internet, rather than relying solely on local storage (like a hard drive). These tools offer remote storage space, allowing users to save files and access them from any device connected to the internet. Cloud storage services often come with file management features that help organize, share, and collaborate on documents efficiently.

Characteristics of Cloud Storage and File Management Tools are:

a. File Storage
   - Store various types of files, including documents, images, videos, spreadsheets and more in a remote cloud environment.
   - Files are stored in secure data centres and are accessible from multiple devices like computers, smartphones, and tablets.

b. Access Anywhere, Anytime
   - Users can access their stored files from any device with an internet connection, providing flexibility and convenience.
   - Mobile apps for smartphones and tablets allow on-the-go access to documents.

c. File Synchronization
   - Cloud storage tools allow automatic syncing of files across all connected devices. When a file is updated on one device, it is updated across all other devices.
   - This ensures that the most recent version of the file is updated, even if the user switches devices.

d. File Sharing and Collaboration
   - Allow sharing files or folders with others by sending links. Permissions can be set to control who can view, edit, or comment on files.

- Real-time collaboration features allow multiple people to work on the same document at the same time (e.g., in Google Docs, Microsoft 365).

e. Automatic Backup and Versioning
   - Files stored in the cloud are often automatically backed up, reducing the risk of data loss due to device failure or power cut.
   - Many cloud storage tools also offer version history, allowing users to track changes made to a file and restore previous versions if needed.

f. Security and Encryption
   - Cloud storage services use encryption to protect data both during transit (while being uploaded or downloaded) and at rest (while stored in the cloud).
   - Users often have control over access permissions, adding another layer of security for sensitive files.

g. Search and Organization
   - Built-in search features help users quickly find specific files by name or type.
   - Cloud tools often include organization features such as file and folder structure, tagging, and sorting options to keep documents well-organized.

h. File Recovery
   - If files are accidentally deleted, many cloud storage tools offer a way to recover deleted files within a certain time period.

i. Cross-platform Compatibility
   - Cloud storage and file management tools are often compatible with a variety of platforms (Windows, macOS, Android, iOS), allowing seamless use across different devices and operating systems.

j. Sharing Large Files

- Cloud storage tools allow users to share large files easily, without the constraints of email attachment size limits. Files can be uploaded

and shared via a link.

Examples:

1. Google Drive
    - Offers 15 GB of free storage and integrates with Google Workspace (Docs, Sheets, Slides) for seamless collaboration.
2. Microsoft OneDrive
    - Part of the Microsoft 365 suite, OneDrive offers cloud storage and file management.
3. Dropbox
4. Apple iCloud
    - iCloud is integrated with Apple's ecosystem (iPhones, iPads, Macs) and provides seamless syncing of documents, photos, and app data across devices.
5. Amazon Drive

Benefits of Cloud Storage and File Management Tools:

- **Convenience**: Access your files from any device, anywhere, at any time.
- **Collaboration**: Simplify team collaboration through real-time editing, file sharing, and version control.
- **Security**: Enhanced security features such as encryption, two-factor authentication, and access control.
- **Automatic Backup**: Ensures your data is safe from device failures or local storage issues.

4.7 NOTE MAKING

They are software applications for capturing, storing notes, ideas, and information efficiently. Note-making tools typically used for quick entry of information and often offer features for categorizing, tagging, searching, and retrieving notes in an organized way. These tools are especially useful for students, professionals to keep track of important information, research, or thought.

Characteristics of Note-making:

1. Note Creation
    - Allows users to create text-based notes, which may include typed content, handwritten entries (in some cases) or voice recordings.
    - Supports various content types such as text, images, audio, web clippings, and even videos to create rich, multimedia notes.
2. Organization with Folders, Tags, and Labels
    - Notes can be organized into folders or notebooks based on topics, categories, or projects.
    - Users can tag notes with specific keywords or labels for easier searching and retrieval.
    - Hierarchical structures (notebooks, sub-notebooks, etc.) help organize notes systematically.
3. Search Functionality
    - Powerful search tools allow users to quickly find specific notes based on keywords, tags, or content, even within large note collections.
4. Synchronization Across Devices
    - Notes can be synced across multiple devices (smartphones, tablets, computers) so that they are accessible wherever the user is, provided they have an internet connection.
5. Task Management and To-Do Lists
    - Many note-taking tools include task management features like to-do lists, checkboxes, and reminders, making them useful for personal productivity and project management.
    - Users can organize tasks within notes and set deadlines or alerts.
6. Voice Notes and Handwriting Recognition
    - Some tools offer voice-to-text functionality, allowing users to record spoken notes that are automatically converted into text.

- Tools with handwriting recognition allow users to write notes by hand (using a stylus or touchscreen) and convert them into editable text.

Examples:

- Evernote
- Microsoft OneNote
- Google Keep
- Notion
- Apple Notes

Zoho Notebook

4.8 EMAIL COMMUNICATION TOOL

Email communication tools are a type of office tool designed to help individuals and organizations manage, send, and receive email messages. These tools are essential for efficient communication in modern business environments, allowing users to interact with colleagues, clients, and external stakeholders quickly and effectively. Email communication tools often come with a variety of features to improve productivity, security, and collaboration.

Key Features of Email Communication Tools:

1. Email Sending and Receiving
   - Compose and send emails: Allows users to write, format, and send messages to one or more recipients.
   - Inbox management: Organize received emails and keep track of important messages.
   - Attachments: Send and receive files such as documents, images, videos, and other file types.
2. Email Organization
   - Folders/Labels: Organize emails into folders or label them by topic, project, priority, etc., for easy retrieval.
   - Filters/Rules: Set up automatic rules to filter incoming messages into specific folders based on criteria like sender, subject, or keywords.

- Search Functionality: Allows users to search for emails by keywords, sender, date, etc., to quickly find specific messages.

3. Address Book and Contact Management
   - Contact list: Stores email addresses and contact information for easy access when composing emails.
   - Groups and Distribution Lists: Group contacts together for bulk sending to multiple people at once (e.g., for team communication).
4. Spam and Security Features
   - Spam filtering: Automatically detects and filters out unwanted or junk emails to keep the inbox clean.
   - Encryption: Some email tools offer encryption features to secure sensitive communications.
   - Authentication: Prevents unauthorized access to accounts through features like two-factor authentication (2FA).
5. Calendar and Scheduling Integration
   - Integrated calendar: Many email communication tools include a calendar feature for scheduling meetings and appointments directly from the inbox.
   - Meeting invitations: Send and receive calendar invites, sync with meeting scheduling apps, and set reminders for upcoming events.
6. Threaded Conversations
   - Email threads: Group related emails together in threads or conversations, making it easier to follow ongoing discussions.
   - Replies and Forwarding: Easily reply to or forward emails, maintaining continuity in communication.
7. Collaboration Tools
   - Collaborative tools: Many email services integrate with other collaboration tools (e.g., Google Drive, Microsoft Teams) for file sharing, collaborative document editing, and messaging.

8. Mobile Access
    - Mobile apps: Most modern email tools come with mobile applications, allowing users to manage their emails on smartphones or tablets when away from their desk.
    - Push notifications: Get immediate alerts for incoming messages, ensuring timely responses.
9. Analytics and Reporting
    - Read receipts: Some email tools can notify you when an email has been opened or read by the recipient.
    - Tracking links: Tools like Mailchimp or Outlook often allow users to track email links to monitor recipient engagement.
10. Archiving and Backup
    - Archiving: Emails can be archived for long-term storage, keeping the inbox organized while still preserving important information.
    - Backup: Some tools automatically back up email data to prevent loss.

Examples:

1. Microsoft Outlook
    - Used widely in businesses due to its deep integration with Microsoft 365 and other productivity apps.
2. Gmail
    - A widely-used free email service from Google, known for its user-friendly interface, powerful search functionality, and integration with Google Workspace (Docs, Sheets, etc.).
    - Offers labels, filters, and a variety of add-ons to enhance productivity.
3. Apple Mail
    - The default email application for Apple devices, offering integration with iCloud, a clean interface, and features like threaded conversations and intelligent sorting.
4. Yahoo Mail
    - Another popular email platform that offers a clean interface,

powerful spam filters, and customizable folders.

- Offers features like attachments, calendar integration, and a news feed.

5. Zoho Mail
    - Part of the Zoho suite, this email tool is designed for businesses and offers features like custom domain support, task management, and integration with other Zoho tools (CRM, Docs, etc.).
6. Mailchimp
7. Thunderbird

4.9 CALENDAR

Calendar is integrated into productivity suites that helps users schedule, organize, and manage appointments, meetings, events, and other time-sensitive tasks. Calendar tools are essential in office environments for coordinating schedules, ensuring timely communication, and helping individuals and teams stay organized.

Characteristics of Calendar

a. Event Scheduling and Management
    - Users can create, edit, and manage events or appointments by specifying the time, date, location, and other relevant details.
    - You can set recurring events (daily, weekly, monthly, etc.) for regularly scheduled meetings or tasks.
2. Time Zone Support
    - Calendars in office tools often support multiple time zones, making them ideal for global teams and remote work environments. They adjust event times based on the user's location.
3. Integration with Other Office Tools
    - Calendar tools are integrated with other productivity apps (like email, contacts, and task management tools), allowing users to seamlessly schedule meetings, send invitations,

and keep track of related tasks or emails.

- For example, in Google Calendar, you can create events directly from Gmail and automatically add the email participants as attendees.

4. Automatic Reminders and Notifications
    - Users can set reminders or notifications for upcoming events or deadlines, which helps ensure they don't forget important appointments.
    - Notifications can be sent via email, pop-up alerts, or mobile push notifications.
5. Shared Calendars
    - Many office calendar tools allow users to share calendars with colleagues, teams, or entire organizations.
    - Shared calendars enable team members to view availability, schedule meetings, and avoid double-booking resources or time slots.
6. Event Invitations and RSVP
    - Users can send event invitations to others, allowing them to accept, decline, or propose alternative times for the event.
    - This feature is particularly useful for scheduling meetings and appointments with multiple participants.
7. Task and To-Do List Integration
    - Calendars often have integrated task lists or to-do lists where users can create and track personal or work-related tasks.
    - Tasks can be assigned due dates, making it easy to visually track deadlines alongside scheduled events.
8. Colour Coding and Customization
    - Many calendar tools allow for colour coding events based on categories (e.g., work, personal, meetings) or priority.
    - Users can customize the calendar's appearance, notifications, and other settings to suit their preferences.
9. Integration with Video Conferencing
    - Calendar tools often integrate with video conferencing

platforms like Zoom, Google Meet, or Microsoft Teams, allowing users to schedule virtual meetings and include video links directly in the calendar event.

10. Views and Customization
    - Calendars typically offer different views to suit different needs, including daily, weekly, monthly, and agenda views.
    - Customizable settings may include adjusting the start of the week, changing date formats, or adding holidays.

Examples

- Google Calendar
- Microsoft Outlook Calendar
- Apple Calendar
- Zoho Calendar
- Outlook Web Calendar



CHECK YOUR PROGRESS

1. Fill in the blanks:

a. _____ allows users to perform calculations within cells in a spreadsheet.

b. In a calendar tool, _____ allows users to send event invitations and track responses.

c. A _____ tool is used to create and display visual presentations.

d. _____ is the basic unit in a spreadsheet where data is entered.

e. _____ is a feature in cloud storage tools that ensures the most recent version of a file is synced across all connected devices.

2. Which function helps with data organization in spreadsheets by arranging it in ascending or descending order?



4.10 LET US SUM UP

- Word processors, such as Microsoft Word and Google Docs, are software applications that allow users to create, edit, format, and save documents efficiently. Key features include text editing, font customization, spell check, paragraph formatting, and page layout adjustments. Users can insert images, tables, charts, and hyperlinks, and apply predefined styles for consistent formatting. Collaborative features allow multiple users to edit documents in real-time, while tools like search and replace, document security, and revision history enhance functionality.
- Spreadsheet tools, such as Microsoft Excel and Google Sheets, enable data organization in rows and columns. They offer powerful features like formulas, functions, data sorting, pivot tables, and chart generation. Users can also apply conditional formatting, filter data, and use multiple sheets for complex projects. Collaboration and real-time sharing make spreadsheets ideal for team work, while protection options secure sensitive data.
- Presentation tools, like Microsoft PowerPoint, facilitate creating visual presentations with text, images, videos, and animations. Features include slide templates, multimedia integration, transitions, and real-time collaboration. Cloud-based tools like Google Slides allow easy access and sharing.
- Cloud storage tools, such as Google Drive and Dropbox, enable remote file storage, synchronization across devices, and real-time collaboration. They also offer backup, security, and file recovery features.
- Email communication tools, such as Gmail and Outlook, allow efficient email management, organization, and integration with other tools for enhanced collaboration. Calendar tools help users schedule and manage events, with integration to other office tools and video conferencing platforms for seamless coordination.

4.11 ANSWERS TO CHECK YOUR PROGRESS

Ans to 1. a. Formulas

a. event scheduling

b. presentation

c. Cell

d. File Synchronization

Ans to 2. Sorting



4.12 FURTHER READINGS

- Gaskin, J., & Boulton, J. (2019). *Microsoft Office 365: The essential guide*. TechPress.
- Rouse, M., & Murdock, J. (2018). *Mastering office tools for productivity*. Wiley.



4.13 MODEL QUESTIONS

1. What application allows users to create and organize notes and ideas?
2. Which tool is integrated with office suites for managing time-sensitive tasks and events?
3. What feature in email tools allows users to store contact information for easy access?
4. Which feature in a word processor helps users revert back to previous actions?
5. What is the primary function of word processing software?
6. How does cloud storage help with file access and sharing?
7. Describe the purpose of sorting data in a spreadsheet.
8. How do spreadsheet functions support calculations and data analysis?
9. Explain how file recovery works in cloud storage tools.
10. Describe the main features of spreadsheet tools. How do they support data management, analysis, and presentation?

11. What are the key functionalities of email communication tools? How do features like spam filtering, attachments, and calendar integration improve communication and productivity?
12. How do note-making tools help in organizing and managing information? Discuss the features that make these tools useful for students and professionals.

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UNIT 5: DATABASE MANAGEMENT SYSTEM

UNIT STRUCTURE

5.1 Learning Objectives

5.2 Introduction

5.3 Database Management System

5.4 Types of DBMS

5.5 Characteristics of DBMS

5.6 Database Language

5.7 Advantages of DBMS

5.8 Disadvantages of DBMS

5.9 Database Modelling

5.10 Application of DBMS in Library

5.11 Let Us Sum Up

5.12 Answer to check Your Progress

5.13 Further Readings

5.14 Model Questions

5.1 LEARNING OBJECTIVES

After going through this unit, you will be able to

- define database
- describe the types of DBMS
- list characteristics of DBMS
- describe Database language
- describe the applications of DBMS in library

5.2 INTRODUCTION

In this unit, we will explore the core principles of DBMS and its applications in managing library resources. By understanding these concepts, we can see how a DBMS can revolutionize the way libraries

operate, improving both the efficiency of library management and the experience of library users.

5.3 DATABASE MANAGEMENT SYSTEM

A database is a structured collection of data that is organized and stored in such a way that it can be easily accessed, managed and updated. Databases allow users to store large amounts of data in an organized manner and perform various operations like retrieval, insertion, modification, deletion on that data.

A Database Management System (DBMS) software that helps in creating, managing, manipulating databases. It allows users to store, retrieve, update and delete data efficiently. A DBMS provides a structured way to organize data and ensures data security, consistency, and integrity. It also supports multiple users accessing the data simultaneously while maintaining data protection and consistency. Examples of DBMS include MySQL, Oracle, Microsoft SQL Server, and PostgreSQL.

Libraries in both the cases physical or digital, deal with large volumes of data that need to be organized, stored, and retrieved quickly. A well-designed DBMS helps automate and optimize various library functions, such as cataloguing books, tracking borrowings, and managing membership records. The primary goal of implementing a DBMS in a library is to ensure data integrity, security, and efficiency. With a DBMS, library staff can easily manage data updates, handle large datasets, and provide seamless access to library users. For example, when a library member searches for a book, the DBMS can quickly retrieve relevant data, such as the book's availability, location, and due date, without manually browsing through physical records.

5.4 TYPES OF DBMS

Based on the structure used to organise, store and manage data in database they are classified as -

a. Hierarchical DBMS: In a hierarchical DBMS, data is organized in a tree-like structure, where each record has a single parent, and each parent

can have multiple children (like a hierarchy).

b. Network DBMS: The network model uses a graph structure where records are connected through multiple relationships. Unlike the hierarchical model, a record can have multiple parent records.

c. Relational DBMS: In Relational Database Management System**,** data is structured into tables (also known as relations) consisting of rows and columns, with the relationships between the data is managed using primary and foreign keys.

RDBMS is a system used to manage relational databases. A relational database is made up of organized tables that allow for easy access to data. This type of database is widely used and consists of multiple tables, with each table having its own primary key to uniquely identify the data. Structured Query Language (SQL) is utilized to retrieve and manipulate the data. Examples include MySQL, Oracle, Microsoft SQL Server, and PostgreSQL.

d. Object-Oriented DBMS: Data is represented as objects, similar to object-oriented programming. Each object can contain both data and methods that operate on the data.

e. Object-Relational DBMS: This is a hybrid model that combines features of both object-oriented and relational models. It allows for complex data types to be stored alongside traditional relational data.

f. NoSQL DBMS: A NoSQL DBMS (Not Only SQL Database Management System) is a type of database designed to handle large amounts of unstructured or semi-structured data, which traditional relational databases may find difficult to manage. NoSQL databases are flexible and can store data in different formats such as key-value pairs, documents, graphs, or wide-column stores. This makes them ideal for handling big data, real-time applications, and distributed systems.

Unlike relational databases that use tables and SQL for querying, NoSQL databases use their own methods for managing and retrieving data, and they are designed to scale out across multiple servers, supporting high performance and large numbers of users.

Common types of NoSQL databases include:

- Document-based (e.g., MongoDB, CouchDB)
- Key-Value stores (e.g., Redis, DynamoDB)
- Column-family stores (e.g., Cassandra, HBase)
- Graph databases (e.g., Neo4j, ArangoDB)

5.5 CHARACTERISTICS OF DBMS

- DBMS can store different kinds of data in database.
- DBMS support properties of ACID (atomicity, consistency, isolation, durability). This ensures data consistency across multiple users and transaction.
- DBMS provides data abstraction, which means users can interact with data without worrying about how it is physically stored. It also offers data independence, allowing changes to the data structure without affecting application programs.
- DBMS enforces rules (such as constraints, primary keys, and foreign keys) to ensure data accuracy and consistency. This prevents incorrect or inconsistent data from being entered into the database.
- DBMS provides security mechanisms to control who can access and modify the data. It ensures that only authorized users can access sensitive information.
- DBMS minimizes data redundancy by storing data in one place and providing mechanisms to avoid unnecessary duplication, ensuring efficient storage and data management.
- DBMS allows multiple users to access the database simultaneously while maintaining data integrity and avoiding conflicts. It manages the concurrent access to data using locks, transactions, and isolation levels.
- DBMS includes features for data backup and recovery in case of system failure. Regular backups ensure data can be restored, preventing loss of important information.

- DBMS supports multi-user environments, allowing many users to interact with the database at the same time without interfering with each other's operations.
- DBMS uses query optimization techniques to process and retrieve data efficiently. It ensures that queries are executed in the most optimal manner, saving time and resources.

5.6 DATABASE LANGUAGES

Let us look at the different types of database languages.

1. Data Definition Language: Data Definition Language also known as DDL is used to define database structure through creation, alteration, deletion of tables, schemas, indexes, constraints.

Some of the commands are-

CREATE: To create database objects like tables.

ALTER: To modify structure of an existing table or object.

DROP: To delete table or objects.

TRUNCATE: Remove all records from a table but not the table itself.

2. Data Manipulation Language: Data Manipulation Language (DML) is used to manage and manipulate the data stored in the database. It allows users to insert, update, delete and retrieve data.

Some of the commands are-

SELECT: To retrieve data from one or more tables.

INSERT: To add new data into a table.

UPDATE: To modify existing data in a table.

DELETE: To remove data from a table.

3. Data Control Language: Data Control Language (DCL) is used to control access to data in the database. It includes commands for granting and revoking user privileges and permissions.

Some of the commands are-

GRANT: To assign specific privileges to users.

REVOKE: To remove or restrict previously granted privileges.

4. Transactional Control Language: Transactional Control Language (TCL) used to manage transactions in a DBMS, ensuring the integrity of

the database. It includes commands for committing or rolling back changes. Some of the commands are-

COMMIT: To save all the changes made during a transaction.

ROLLBACK: To undo changes made during a transaction, reverting the database to its previous state.

SAVEPOINT: To set a point within a transaction to which you can roll back.

Structured Query Language: Structured Query Language (SQL) is used to extract data from a relational database. It can be used for querying, updating data in the records, adding data, deleting data. The language belongs to the Fourth Generation Language. So it requires only high-level commands. SQL is a standard language for most relational databases and it can be used across many different types of database systems like MySQL, PostgreSQL, SQL Server, etc. Some of the common commands are SELECT for retrieving data, INSERT for adding new data, UPDATE for modifying the existing data, DROP for deleting database objects like tables from the database.

5.7 ADVANTAGES OF DBMS

Control of Data Redundancy: A DBMS minimizes data redundancy by storing data in one centralized location that can be accessed by multiple users or applications, thus preventing duplication across various files.

Data Integrity and Accuracy: A DBMS enforces rules like primary keys and foreign keys, ensuring the consistency and accuracy of data, thereby maintaining reliable information across the system.

Enhanced Data Security: A DBMS offers strong security features such as user authentication, encryption, and access controls, ensuring only authorized personnel can access sensitive data.

Efficient Data Retrieval: DBMSs are optimized to quickly retrieve data, utilizing indexing, query optimization, and caching to improve access speeds, especially for large datasets.

Backup and Recovery Capabilities: A DBMS ensures data protection by offering backup and recovery options, making it easier to restore data in case of system failure.

Data Independence: DBMS provides data independence, allowing changes to applications without altering the underlying data structure. This simplifies application maintenance and development.

Concurrency Control: DBMS enables multiple users to access the system simultaneously without data conflicts, using techniques like locking, transactions, and isolation levels.

Better Decision-Making: By organizing data systematically, a DBMS supports advanced querying and reporting, providing essential insights that aid in informed decision-making.

Optimized Storage Usage: A DBMS reduces the need for redundant data storage, saving disk space and improving overall storage efficiency by centralizing data.

Scalability: A DBMS is designed to scale with growing data needs, handling larger datasets and higher transaction volumes without significant loss of performance.

5.8 DISADVANTAGES OF DBMS

Cost: DBMS requires high-performance hardware (like high level processor, large storage capacity) and specialized software, which can be expensive for organizations.

Size: DBMS systems consume large amounts of disk space and memory for storing the data, indexing and managing logs and backup, making storage and management more complex.

Complexity: Setting up and maintaining a DBMS is complex, requiring specialized knowledge and continuous administration: data modelling, security management, transaction processing.

Impact of Failure: If the database fails due to issues like corruption or power outages, data loss and downtime can occur, affecting all operations.

Performance Overhead: The DBMS introduces extra layers of processing, which can slow down operations, especially with large datasets.

Security Risks: DBMS systems centralize data, making them an attractive target for cyberattacks. Although DBMS software provides security features, such as access control and encryption, vulnerabilities still exist. Maintenance Costs: Regular maintenance, including updates, backups, and tuning, requires time and dedicated resources, leading to additional costs.

Data Redundancy and Inconsistency: A DBMS is aimed to reduce redundancy but a poorly designed databases may lead to data redundancy and consistency issues.

Limited Scalability: Some DBMS systems struggle to scale effectively for very large or high-demand applications.

Vendor Dependency: Proprietary DBMS systems can create vendor lock-in, leading to dependence on specific vendors for support and updates.

5. 9 DATABASE MODELLING

Database modelling is the process of creating a conceptual framework or blueprint for organizing and structuring data within a database system. It involves defining the data elements, their relationships and how the data will be stored, accessed and managed in the database. The goal of database modelling is to ensure that data is structured efficiently, maintains integrity and can be accessed quickly and easily.

The components of Database Modelling include-

1. **Entities**: These represent objects or concepts within the domain of the application that you want to store data about. For example, in a library management system, entities could be Books, Authors, and Members.
2. **Attributes**: These are the properties or characteristics of an entity. For instance, an entity Book might have attributes like Title, Author, ISBN, Publication Year, and Genre.
3. **Relationships**: These represent the associations or connections between entities. For example, a Book might be associated with an Author or a member might have a relationship with Books through borrowing.

4. **Keys**: A primary key is a unique identifier for each record in an entity. A foreign key is used to establish relationships between entities. For example, a Book entity might have an Author ID as a foreign key that references the Author entity.
5. **Cardinality**: This defines the number of instances of one entity that can or must be associated with instances of another entity. Cardinality is represented in terms like one-to-one, one-to-many, or many-to-many relationships.

Types of Database Models

1. **Conceptual Data Model**: Provides a high-level view of the system and focuses on defining the data and its relationships in the context of the business or application. Tools can be Entity-Relationship Diagrams (ERD). For a university database, a conceptual model might define Students, Courses, and Professors, as well as how these entities are related.
2. **Logical Data Model**: This model defines the logical structure of the data, such as tables, columns, data types, and constraints, without being concerned with physical storage. Tools can be ER diagrams with more details, normalization techniques. In the university system, the logical model would describe how Students and Courses are stored in tables with foreign keys linking them.
3. **Physical Data Model**: Specifies how data will be physically stored in the database, including indexes, partitioning, and storage methods. The physical model would detail the data storage specifics, like indexing the Student ID for fast lookups or splitting large tables across multiple databases for performance.

Steps in Database Modelling

1. **Requirements Gathering**: Understand the business needs and the types of data the system will manage. This involves interacting with stakeholders (e.g. users, system administrators) to gather requirements.
2. **Conceptual Design**: Create a high-level conceptual model (e.g. an Entity-Relationship Diagram (ERD)) to define the entities, their

attributes and relationships.

3. **Logical Design**: Translate the conceptual model into a logical model, focusing on defining tables, keys, and relationships with normalized structures.
4. **Normalization**: Ensure that the logical model adheres to normalization rules to eliminate redundancy and ensure data integrity.
5. **Physical Design**: Define how the data will be stored on physical media, including indexing, partitioning, and optimizing performance for queries.
6. **Implementation**: Translate the physical model into actual database code, including SQL scripts for creating tables, defining constraints, and populating the database with data.

Importance of Database Modelling

- **Data Integrity**: Proper modelling ensures that data is stored in a way that maintains accuracy and consistency across the database.
- **Efficient Data Access**: Well-designed databases optimize query performance, ensuring that data can be retrieved quickly.
- **Scalability**: A well-modelled database can scale to handle larger datasets or increased traffic as the application grows.
- **Maintenance**: Database models serve as a blueprint, making it easier to update or modify the database schema when required.
- **Clear Understanding**: Provides a clear structure for developers and stakeholders to understand how data is organized and interrelated.

5.10 APPLICATION OF DBMS IN LIBRARY

During the acquisition process the unnecessary duplication of books or other material already available can be avoided. The exact accession no. can be known with the location. In classification and cataloguing, it enhances standardization and eliminates inconsistency. With the advent of Database management system, the catalogue can be shared.

Cataloguing and Classification of Resources

DBMS in libraries and information centres is used for cataloguing and classifying various resources such as books, journals, audio-visual materials, and digital resources. Resources are catalogued with detailed metadata like title, author, publisher, year of publication, subject, ISBN and location within the library. A DBMS helps organize resources systematically, allowing both staff and users to find and manage them efficiently, whether the material is in physical or digital format.

Book and Resource Search and Retrieval

DBMS in libraries is used for searching and retrieving resources. Users can search for books, journals or any other materials using various parameters like title, author, subject, ISBN, and even keywords. The DBMS enables users to quickly access resources by performing efficient, keyword-based searches, which improves the overall user experience and saves time.

User Management and Membership Records

A DBMS in libraries stores detailed user profiles and membership records, including name, contact information, membership type and borrowing history. It also manages user-specific information such as fees for overdue books and borrowing limits. The DBMS helps libraries efficiently manage memberships, track user activity, enforce borrowing rules, and personalize services based on user data.

Circulation Control

DBMS automates circulation control the process of managing the borrowing and returning of materials. The system logs when a resource is checked out and tracks the due dates. It also handles the return process, updating the inventory, applying late fees if necessary, and sending overdue reminders. Automates the management of circulation, ensuring the accurate tracking of borrowed materials and improving the efficiency of library operations.

Overdue Management and Notifications

DBMS systems help libraries track overdue items and send automated notifications to users regarding overdue books or fines. The system can generate reports on overdue items and notify users via email, SMS or printed

notices.

Reduces manual effort in tracking overdue materials and ensures timely notifications, improving compliance with library policies.

Inventory and Stock Management

DBMS is used for inventory management to track the total number of copies of each resource, their status (available, checked out, under maintenance), and location within the library. This helps to prevent the loss of resources and ensures efficient management of the collection. Helps library staff track the availability and condition of resources, ensuring efficient stock management and reducing the likelihood of missing items.

Reporting and Analytics

Libraries use the data stored in DBMS to generate reports and perform analytics for decision-making. Reports on book usage, circulation statistics, user activity, overdue books, and financial transactions (e.g., fines) can be easily generated. Provides insights into library operations, helping in resource planning, budgeting, and identifying trends to improve library services.

Inter-Library Loan Management

A DBMS in libraries can manage Inter-Library Loan (ILL) transactions, enabling libraries to lend or borrow books and materials from other libraries. The system keeps track of the materials sent and received, due dates, and borrowing history. Expands the range of available resources by facilitating access to materials from other libraries, improving user satisfaction.

Digital Resource Management

DBMS manages digital resources like e-books, online journals, and multimedia content. The system can handle digital access rights, download permissions, and user activity related to digital content. Manages digital resources efficiently, providing users with seamless access to e-materials while ensuring proper copyright compliance.

Security and Access Control

DBMS ensures the security of sensitive library data, such as user details, financial records, and inventory information. Access controls are implemented to ensure that only authorized users (library staff) can modify or view specific data.

Ensures data security, protects user privacy, and prevents unauthorized access to sensitive information.



CHECK YOUR PROGRESS

1. Fill-in-the-blank questions

a. The _____ DBMS is designed to handle large amounts of unstructured or semi-structured data and is often used for real-time applications and distributed systems.

b. The _____ DBMS is a hybrid model that combines features of both object-oriented and relational models.

c. The _____ in DBMS refers to the ability to manage data access and maintain control over who can modify and retrieve data.

d. The command used to create a database object such as a table is _____.

To modify the structure of an existing table in a DBMS, the command _____ is used.



5.11 LET US SUM UP

- Database Management System (DBMS) is an essential software tool that allows for the efficient creation, management, and manipulation of databases.
- The types of DBMS, such as Relational, NoSQL, and Object-Oriented DBMS, offer flexibility to manage various forms of data, from structured to unstructured.
- In environments like libraries, DBMS significantly improves the management of resources, cataloging, and member transactions, thus enhancing operational efficiency and user experience.
- While DBMS offers numerous advantages, including scalability and optimized data retrieval, it also presents challenges such as high costs, complexity, and potential security risks.

- The benefits of DBMS in ensuring streamlined data management, backup, recovery, and multi-user access make it an indispensable tool across various industries, particularly in sectors that require robust data handling and fast retrieval, such as libraries.
- The integration of DBMS technology can undoubtedly transform data management, improving both performance and decision-making processes.



5.12 ANSWERS TO CHECK YOUR PROGRESS

Ans to 1. a. NoSQL

b. Object-Relational

c. Data Control Language (DCL)

d. CREATE

e. ALTER



5.13 FURTHER READINGS

1) Date, C. J. (2004). *An introduction to database systems* (8th ed.). Pearson.
2) Elmasri, R., & Navathe, S. B. (2016). *Fundamentals of database systems* (7th ed.). Pearson.
3) Korth, H. F., Silberschatz, A., & Sudarshan, S. (2010). *Database system concepts* (6th ed.). McGraw-Hill
4) McCook, Kathleen de la Peña. Introduction to Public Librarianship,p. 65. Neal Schuman, 2011.



5.14 MODEL QUESTIONS

1. What is DBMS?
2. What type of DBMS handles unstructured data?

3. What are the main types of DBMS?
4. What is the difference between a Relational DBMS and a NoSQL DBMS?
5. Describe Data modelling and its components.
6. What is the role of a DBMS in library management?
7. What is the significance of SQL in a DBMS?
8. What are the major challenges of using a DBMS?

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UNIT 6: MULTIMEDIA SYSTEM

UNIT STRUCTURE

6.1 Learning Objectives

6.2 Introduction

6.3 Multimedia

6.4 Elements of Multimedia

6.5 Need of Multimedia

6.6 Types of Multimedia System

6.7 Multimedia forms in Libraries

6.8 Applications of Multimedia

6.9 Let Us Sum Up

6.10 Answer to check Your Progress

6.11 Further Readings

6.12 Model Questions

6.1 LEARNING OBJECTIVES

After going through this unit, you will be able to

- define the term multimedia
- explain the concept of multimedia
- describe the elements of multimedia
- describe the roles of multimedia system in libraries
- describe the components of Virtual Reality

6.2 INTRODUCTION

In today's digital age, libraries have evolved from traditional spaces focused primarily on books to dynamic information hubs that embrace a wide range of media formats. The integration of multimedia in libraries has revolutionized how information is accessed, stored, and shared. Multimedia in libraries encompasses various forms of content, including text, audio,

video, images, and interactive elements, all of which can be used to enhance learning experiences and facilitate better information dissemination. Libraries are increasingly adopting these technologies to serve diverse user needs, from educational resources to entertainment, and to support multimedia literacy in an ever-changing information landscape. This unit will explore the importance of multimedia in libraries, the types of multimedia resources available, and how libraries effectively integrate these tools into their services to benefit users across various demographics. By the end of this unit, learners will gain a deeper understanding of how multimedia enriches library collections, expands access to information, and fosters innovation in library services.

6.3 MULTIMEDIA

The term "multimedia" is widely attributed to Bob Goldstein, a singer and artist, who coined it in the 1960s. He used the term to describe his show "Lightworks at L 'Oursin" at Southampton, New York that combined multiple media forms, such as slides, audio, and films, which were used together in presentations.

Definition

Some of the definitions of Multimedia are as follows-

Bob Goldstein defined multimedia as "*A combination of several media, including slides, audio, and video, used together to present a cohesive experience or presentation*".

The Oxford English Dictionary defined it as "*Multimedia is the use of a variety of media in the presentation of information, such as text, images, sound, video, and animation, especially in interactive forms*".

Richard E. Mayer defined it as "*Multimedia refers to the presentation of material in more than one medium (e.g., visual, auditory) to enhance cognitive processing and facilitate deeper learning*"

6.4 ELEMENTS OF MULTIMEDIA

The elements of multimedia are the various components that are combined to create interactive and engaging experiences. These elements

work together to convey information in a way that is rich, dynamic, and accessible.

Elements of multimedia include the following-

Text: Text is the foundation of most multimedia presentations, providing essential information, context, and narrative. It can be used for titles, labels, captions, and descriptive content.

Audio: Audio includes sound effects, voiceovers, music, and other sound elements. It enhances the experience by providing an auditory dimension, reinforcing the message, or setting the tone of the presentation.

Video: Video combines moving images and audio to present dynamic content. Videos can capture real-world events, demonstrate processes, or provide visual storytelling that adds depth to multimedia projects.

Image: Images can include photographs, illustrations, graphics, or any visual content. They serve to illustrate ideas, evoke emotions, and break up text-heavy content, making it visually engaging.

Animation: Animation involves the creation of moving images through various techniques, such as 2D, 3D animation, or stop-motion. Animations are often used to explain complex concepts or add creativity and fun to presentations.

6.5 NEED OF MULTIMEDIA

Enhanced Learning Experience

Multimedia plays a vital role in enhancing the learning experience in libraries. By incorporating various media types including educational videos, animations and interactive learning tools, libraries can cater to diverse learning styles including visual, auditory and kinesthetics learners. The uses can watch video explanation of a complex concept, listen to an audio lecture and read accompanying text to reinforce their understanding. This multi-sensory approach promotes deeper engagement with the material and improves retention.

Expanding Information Access

Multimedia also significantly broadens the range of resources that libraries can offer. While text-based resources such as books and journals

have always been central to library collections, multimedia content such as audiobooks, podcasts, instructional videos, and interactive software provides additional access points for information. Libraries can use multimedia to make information accessible to users with varying needs, such as those with visual impairments, who may rely on audiobooks or captioned videos. This diverse array of media ensures that libraries serve a wider audience and accommodate different preferences.

Supporting Research and Education

For students, researchers and educators, multimedia offers invaluable tools that support research and enhance the educational experience. Complex concepts, particularly in fields like science, technology, and medicine, are often better understood through visual representations such as charts, diagrams, and animations. Multimedia resources like educational documentaries or interactive tutorials provide in-depth learning opportunities, while digital archives and databases allow for efficient research access. By offering these resources, libraries play an important role in advancing education and research.

Attracting a Broader Audience

The integration of multimedia helps libraries engage a wider and more diverse audience. Younger generations, particularly those in the digital age, often prefer dynamic and multimedia-rich content. Libraries can attract these users by offering interactive and engaging resources, such as educational games, animated e-books, and online learning platforms. Libraries can host multimedia-based programs like digital storytelling workshops, film screenings and podcast creation sessions, which appeal to various community groups, fostering a stronger connection between the library and its users.

Preservation and Digital Archives

Multimedia plays an important role in the preservation of both physical and digital collections. Libraries use multimedia tools to digitize and archive historical documents, photographs, audio recordings and videos ensuring their preservation for future generations. Digitization efforts enable libraries to maintain valuable collections while making them accessible to a

broader audience, regardless of location. Multimedia resources help enrich cataloguing systems by allowing libraries to create more diverse and comprehensive digital collections.

Fostering Digital Literacy

In today's increasingly digital world, libraries serve as critical spaces for promoting digital literacy. By providing access to multimedia tools and resources, libraries can help users develop essential digital skills, such as video editing, graphic design and website development. Multimedia-based workshops and tutorials teach users how to create content, edit media and navigate digital tools. Libraries can also promote responsible digital citizenship by offering resources on online safety, copyright laws and privacy concerns.

Cultural and Artistic Expression

Libraries have long been spaces for cultural and artistic engagement and multimedia further enhances this role. Libraries can offer virtual art galleries, digital music collections, and video art, providing users with access to cultural works from around the world. Libraries can empower users to engage in creative expression by offering tools for video production, podcasting, digital photography and graphic design. These resources foster creativity, allowing individuals to produce and share their own multimedia content.

Increased Engagement and Interaction

Multimedia makes libraries more interactive and engaging for users. Interactive e-books, simulations and virtual reality (VR) tools provide opportunities for participatory learning, allowing users to engage directly with content in new and exciting ways. Libraries can organize multimedia-based events such as film screenings, digital art exhibitions or music performances, attracting a wide range of participants and encouraging community engagement. These events help libraries establish themselves as dynamic spaces for creative and cultural activities. The characteristics of multimedia are the unique attributes that make it an effective tool for communication, learning, entertainment and more. These characteristics

distinguish multimedia from other forms of communication by combining various media elements to deliver richer, interactive and engaging content.

The key characteristics of Multimedia are-

- **Integration of Multiple Media Elements**: Multimedia involves the combination of different forms of media such as text, images, audio, video, and animation. The integration of these elements creates a more engaging and interactive experience compared to single media formats.
- **Interactivity**: One of the most important aspects of multimedia is its interactivity. Users can interact with multimedia content through actions like clicking buttons, navigating through menus or making choices. This interactivity makes multimedia more engaging and allows users to control their experience.
- **Multisensory Experience**: Multimedia stimulates multiple senses simultaneously. By using visuals (images, video), auditory elements (sound, music, speech), and sometimes tactile feedback (in VR or interactive devices), multimedia creates a more immersive and sensory-rich experience.
- **Dynamic Content**: Multimedia content is dynamic and can change in real-time. For instance, videos play in motion, animations evolve, and interactive elements respond to user input. This dynamic nature keeps the content lively and constantly engaging.
- **Non-linear Structure**: Unlike traditional media like books or TV shows, multimedia content often allows for a non-linear structure. Users can choose the path they take, explore different sections, or revisit content, allowing for a more personalized experience.
- **High Engagement and User Involvement**: Due to the interactive and dynamic nature of multimedia, users tend to become more involved in the content. This high level of engagement makes it effective for education, training, entertainment, and advertising.
- **Enhanced Communication**: By combining different media forms, multimedia helps convey complex information more clearly and

effectively. Graphics, animations, and videos can illustrate concepts that may be difficult to explain with text alone.

- **Customization and Personalization**: Multimedia systems often allow customization of content based on user preferences. This can include interactive lessons, personalized advertisements, or dynamic user interfaces that adapt to the user's choices and actions.
- **Real-time Feedback**: Many multimedia systems allow for immediate feedback. For example, in e-learning applications, quizzes and assessments provide instant feedback to the learner, helping them understand their progress and areas for improvement.
- **Storage and Distribution**: Multimedia content is typically stored in digital formats, making it easier to distribute through online platforms, cloud services, and digital media. This makes multimedia content widely accessible and easy to share.

6.6 TYPES OF MULTIMEDIA SYSTEM

Multimedia systems can be classified into different types based on their functionality, usage and the combination of media elements they use. Here are some common types of multimedia systems:

1. Linear Multimedia Systems

In linear multimedia systems, the content is presented in a pre-determined, sequential order, with no user interaction or navigation options. The user experiences the content in a fixed order. Common in traditional forms of media like movies and TV broadcasts, films and animated movies, television programs.

2. Non-Linear Multimedia Systems

Non-linear multimedia systems allow users to interact with and control the flow of content. The user can navigate through different sections and choose the order of content they want to access. They are interactivity and user controlled. Common in applications like interactive tutorials, websites and games, interactive websites, educational software or e-learning platforms.

3. Interactive Multimedia Systems

These systems involve user interaction with multimedia content, allowing the user to control the presentation, make choices or alter content according to their preferences. High user involvement and engagement. Allows dynamic responses based on user actions. Typically used for educational, entertainment and advertising purposes, interactive advertisements, Virtual tours and 3D environments.

4. Hybrid Multimedia Systems

Hybrid multimedia systems combine both linear and non-linear features. They offer the structured, fixed content of linear systems with the flexibility and interactivity of non-linear systems. User can follow a structured narrative but also has opportunities for interaction and exploration. Common in applications like interactive DVDs, educational software, multimedia and digital presentations.

5. Real-Time Multimedia Systems

Real-time multimedia systems involve the transmission or interaction with content that occurs live and is generated or modified in real-time. Content is generated or modified in response to user input or environmental factors. Often used for live streaming, video conferencing and gaming, video conferencing systems (e.g., Zoom, Microsoft Teams), live streaming platforms (e.g., YouTube).

6. Virtual Reality (VR) Multimedia Systems

These systems are a combination of various technologies designed to provide experience of immersion where the users are fully interactive, virtual environment where they can engage with simulated content using specialized hardware like VR headsets. The goal is to make users feel as though they are part of a computer-generated world. They are used for simulation, training and entertainment and VR gaming platforms (e.g., Oculus Rift, HTC Vive).

The components of VR system include-

Visual Media:

- **VR Headsets**: A primary component of VR systems is a headset that provides a display directly in front of the user's eyes. The headset

typically includes stereo displays (3D visuals), with each eye seeing a slightly different angle of the environment to create depth perception. The virtual environment is generated and updated in real time as the user moves their head or interacts with the environment. This allows the system to create realistic, dynamic scenes that respond to the user's actions.

Audio:

- **Spatial Audio**: It includes spatial or 3D sound. This means sounds in the virtual world are not only heard but also seem to come from specific locations, providing an immersive experience.
- **Headphones/Headsets**: These audio devices are used to deliver the 3D sounds directly to the user, enhancing the sense of immersion.

Tactile Feedback:

- **Haptic Technology**: Some VR systems include haptic feedback devices, such as gloves or suits, which provide physical sensations in response to actions within the virtual world.
- **Motion Controllers**: These handheld devices are tracked by the system and allow users to interact with the virtual environment. Some controllers are equipped with haptic feedback to give the sensation of touch or impact when interacting with virtual objects.

Tracking and Sensors:

- **Motion Tracking**: A VR system tracks the user's head, hand, and body movements to adjust the virtual environment in real time.
- **Eye Tracking**: Advanced systems might use eye-tracking technology to detect where the user is looking, which can be used to enhance the experience (e.g., adjusting the focus of the virtual world based on where the user is gazing).

7. Augmented Reality (AR) Multimedia Systems

Augmented reality (AR) systems overlay digital content (such as images, text, or 3D models) onto the real-world environment through devices like smartphones or AR glasses. AR systems blend real-world and virtual elements and provides additional context or information to enhance

real-world experiences. Unlike Virtual Reality (VR), which creates a fully immersive environment, AR supplements the real world with virtual elements, making it interactive and dynamic. Commonly used in Mobile apps with AR capabilities (e.g., Pokémon GO), AR-based navigation apps (e.g., Google Maps AR).

8. Web-Based Multimedia Systems

Web-based multimedia systems are accessed via web browsers and often involve dynamic content and interactivity. They are popular for entertainment, social networking, and e-commerce. Can be accessed from any internet-enabled device. Includes audio, video, text, and interactive features, Websites with rich media (e.g., YouTube, social media platforms), Online learning platforms (e.g., Khan Academy, Coursera).

9. Multimedia Information Systems (MIS)

These systems are designed to manage and organize multimedia content, allowing for the storage, retrieval, and manipulation of various types of media. Focuses on the management and efficient access to multimedia content. Commonly utilized in libraries, digital archives, and media production settings, digital libraries (such as JSTOR and Google Books) and media asset management systems are widely employed in production houses.

6.7 MULTIMEDIA FORMS IN LIBRARIES

In libraries various forms of multimedia are present for accessing information resources for users. Some examples of multimedia formats commonly available in libraries are-

1. CDs (Compact Discs)

- **Audio CDs**: Used for music collections, audiobooks and sound recordings. Libraries offer a wide variety of music genres, classical music, and even sound effects or language learning CDs.
- **Educational CDs**: Used for instructional content such as language learning, history lessons and educational programs.
- **Software CDs**: Some libraries still provide access to software and applications on CDs, especially for older programs or educational tools.

2. DVDs (Digital Versatile Discs)

- **Movies and Documentaries**: Libraries often have extensive collections of feature films, documentaries, and educational films on DVD, covering a wide range of genres and topics.
- **Educational DVDs**: DVDs with specialized content such as instructional videos on mathematics, science, technology, or art. These can be useful for learning purposes and research.
- **TV Shows and Series**: Libraries offer a collection of popular television shows, sometimes including past seasons of TV series, giving patrons access to entertainment and educational content.

3. Blu-ray Discs

- **High-Definition Movies**: Blu-ray discs provide high-quality video and audio for movie enthusiasts and those looking to watch films in HD.
- **Documentaries and Special Features**: Some blu-rays offer enhanced versions of documentaries, behind-the-scenes content, and other special features that are not available on standard DVDs.

4. Audio Cassettes

- **Vintage Audio**: Some libraries still maintain collections of audio cassettes for vintage or classic recordings of music, speeches, or books. While less common today, these cassettes can still be found in some libraries.

5. Flash Drives and USBs

- **Digital Media Storage**: Libraries may offer flash drives or USB sticks that store multimedia content like digital music, videos, and e-books. These allow patrons to easily transfer files to their personal devices.

6. Digital Video and Audio Downloads

- **Streaming Services**: Although not physical media, some libraries provide access to streaming platforms for movies, documentaries, and audio content, which can be accessed on computers or personal devices.
- **Downloadable E-books and Audiobooks**: Many libraries now offer

downloadable audio and e-books via platforms such as Overdrive, Libby, and Hoopla, which can be accessed through digital devices.

7. Interactive DVDs

- **Educational Programs with Interactivity**: Some DVDs contain interactive elements, allowing users to engage with the content in a way that traditional video formats cannot. These are often used for educational purposes, including teaching languages, art or history.

6.8 APPLICATIONS OF MULTIMEDIA

- **Education**: Multimedia applications are extensively used in classrooms through digital content like videos, animations and interactive quizzes. These resources help make learning more engaging and facilitate better understanding of complex concepts. Online learning platforms use multimedia to offer video lectures, interactive assignments, forums, and virtual classrooms to cater to students in different parts of the world.
- **Entertainment**: The entertainment industry relies heavily on multimedia, combining video, sound, special effects, and animation to create compelling storytelling experiences. Games use multimedia characteristics to provide immersive and captivating experiences.
- **Advertising and Marketing**: Commercial advertisement combine video, animation, sound, and graphics to communicate messages effectively and capture the attention of consumers.
- **Communication**: Social media platforms, virtual meetings, and messaging applications often combine text, video, and audio for effective communication.
- **News and Journalism:** News outlets use a mix of text, images, videos, infographics, and live streaming to create compelling and engaging news stories. Online journalism often integrates interactive maps, video reports, and audio clips, allowing readers to explore stories in depth through multimedia elements.

Application of Multimedia in Libraries are-

- **Digitization of Physical Artifacts**: Physical books, manuscripts and artwork are digitized into high-resolution formats, ensuring long-term

preservation and providing wider access without risking damage to the originals.

- **Preservation of Audio-Visual Materials**: Audio and video recordings, including oral histories and documentaries, are converted into digital formats, preventing deterioration of aging media formats like tapes or films.
- **3D Models and Virtual Reality**: Museums and institutions create 3D scans and virtual representations of artifacts or historical sites, preserving details while enabling virtual exploration. This is particularly useful for fragile or inaccessible objects.
- **Digital Archives and Repositories**: Multimedia content is stored in digital archives with proper metadata for long-term access. This ensures that images, videos, documents, and websites are preserved and easily retrievable for research and education.
- **Enhancing Access**: By digitizing rare or fragile items, libraries and museums provide global access to resources, helping protect original materials from excessive handling.
- **Language and Cultural Heritage**: Multimedia tools help preserve endangered languages and cultural practices by recording them in digital formats, making them accessible for future generations.



CHECK YOUR PROGRESS

Fill in the blanks:

a. The term “multimedia” was coined by _____ in the 1960s to describe his show “Lightworks at L’Oursin” which combined multiple media forms.

b. _____ multimedia systems allow users to interact with and control the flow of content.

c. One of the key elements of multimedia is _____, which includes sound effects, voiceovers, and music.

2. Match the columns:

Column A	Column B
1. Linear Multimedia Systems	a) Allows the user to interact and choose the order of content.
2. Interactive Multimedia Systems	b) Content is presented in a fixed sequence with no user control.
3. Virtual Reality (VR)	c) Uses specialized hardware like headsets to create immersive experiences.
4. Non-linear Multimedia Systems	d) Involves user interaction, making choices and altering content.
5. Augmented Reality (AR)	e) Overlays digital content onto the real world, enhancing user experience.



6.9 LET US SUM UP

- The integration of multimedia into libraries is no longer optional but a necessity for ensuring that libraries remain relevant and effective in the digital age.
- By embracing multimedia, libraries can enhance the learning experience, broaden access to information, foster research and creativity, and provide digital literacy opportunities.
- Through these efforts, libraries can continue to serve as community-cantered spaces that support education, innovation, and cultural expression.



6.10 ANSWERS TO CHECK YOUR PROGRESS

ANS to 1

a. Bob Goldstein

b. Non-linear

c. Audio

ANS to 2

1 - b) Content is presented in a fixed sequence with no user control.

2 - d) Involves user interaction, making choices and altering content.

3 - c) Uses specialized hardware like headsets to create immersive experiences.

4 - a) Allows the user to interact and choose the order of content.

5 - e) Overlays digital content onto the real world, enhancing user experience.



6.11 FURTHER READINGS

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6.12 MODEL QUESTIONS

1. What are the key elements of multimedia?
2. How does multimedia enhance the learning experience in libraries?
3. What is the difference between linear and non-linear multimedia systems?
4. How do libraries use multimedia for the preservation of historical materials?
5. What is Augmented Reality (AR) in multimedia systems?

6. Discuss the different types of multimedia systems with examples.
7. How does multimedia play a significant role in enhancing the learning experience in libraries
8. Describe the use of multimedia in the preservation of cultural and historical artifacts.
9. Discuss the characteristics of multimedia?
10. Describe the differences between Virtual Reality (VR) and Augmented Reality (AR) in multimedia systems.
11. How does the use of multimedia in libraries attract a broader audience, especially younger generations?

*** *** ***

UNIT 7: BASICS OF COMMUNICATION TECHNOLOGY

UNIT STRUCTURE

7.1 Learning Objectives

7.2 Introduction

7.3 Analog Communication

7.4 Digital Communication

7.5 Data Communication Modes

7.6 Communication Hardware

7.7 Communication Protocols/Standards

7.8 Information and Communication Technology (ICT)

7.9 Challenges in Information and Communication Technology (ICT)

7.10 Let Us Sum Up

7.11 Further Readings

7.12 Answer to check Your Progress

7.13 Model Questions

7.1 LEARNING OBJECTIVES

After going through this unit, you will be able to –

- define communication
- differentiate between Analog and Digital Communication
- describe about Communication Modes
- explain the concept of ICT
- list the challenges in ICT.

7.2 INTRODUCTION

The term **"communication"** has its origins in the Latin word **"communicare"**, which means "to share" or "to make common." The root word **"communis"** means "common," reflecting the idea of making

something shared or common between people. Over time, the concept has evolved to encompass the act of exchanging information, ideas and feelings between individuals or groups, whether through speaking, writing, gestures or other modern technological way.

The technological advancements have allowed communication to transcend geographical barriers and occur instantly across vast distances. The development of communication technologies like email, social media, mobile networks and video conferencing platforms has made communication more efficient, accessible, and dynamic than ever before.

The communication system can be classified in two types based on signal specification: a) Analog communication and b) Digital communication.

7.3 ANALOG COMMUNICATION

Definition

According to IEEE (Institute of Electrical and Electronics Engineers) “Analog communication is the process of transmitting information using a continuous waveform that varies in amplitude, frequency, or phase according to the information signal. It is often used for transmitting voice signals in traditional telephone systems and radio broadcasting”.

Analog communication refers to the process of transmitting information using continuous signals that vary in amplitude, frequency or phase to represent data. The transmitted signal is a direct, continuous representation of the original information, typically in the form of electrical signals.

The characteristics of analog signals are-

- **Continuous Signal:** Analog signals are continuous and can take any value within a range, making them ideal for representing natural and real-world phenomena (e.g., sound waves, light).
- **Waveform Transmission:** The information is encoded into a waveform, which varies over time to represent changes in data.

In analog communication, a sound or image is converted into an electrical signal using an analog-to-digital converter (ADC). This signal is transmitted

over a medium (such as cables, radio waves, etc.). On the receiving end, the signal is converted back into its original form using a digital-to-analog converter (DAC).

Advantages:

- Simple Technology: Analog systems tend to be simpler and easier to implement.
- Natural Representation: It is better suited to representing continuous and natural phenomena like sound and light.
- Efficiency in Low-Bandwidth Applications: For many low-bandwidth applications, analog communication is efficient and cost-effective.

Disadvantages:

- Noise Susceptibility: Analog signals are more susceptible to noise and interference, which can degrade the quality of the transmitted information.
- Limited Quality and Scalability**:** Analog communication is constrained by signal degradation over long distances, reducing its fidelity.

Examples: FM radio, analog telephones, traditional television broadcasts (before the transition to digital).

7.4 DIGITAL COMMUNICATION

Definition

According to IEEE (Institute of Electrical and Electronics Engineers) “Digital communication refers to the exchange of information between devices using signals that represent data in a binary format, where information is encoded as a sequence of 0s and 1s, typically using modulation techniques for transmission.”

Instead of using continuous signals, digital communication encodes information into binary data, which is transmitted in packets over a medium. Some of characteristics of digital communication are-

- **Discrete Signals:** Digital signals are discrete and consist of binary data (combinations of 0s and 1s), which represent the information in the form of electrical pulses or optical signals.

- **Error Detection and Correction:** Digital communication systems often use error detection and correction methods, ensuring that the information received is accurate.
- **Better Fidelity:** Digital communication offers higher quality and reliability, especially over long distances, compared to analog communication.

In digital communication, the information (voice, video or data) is first converted into a digital format (using an analog-to-digital converter). The digital data is then transmitted as a sequence of bits (0s and 1s) over a communication medium (e.g., fiber-optic cables, wireless networks). Upon receiving the data, a digital-to-analog converter (DAC) reconstructs it into its original form, ready for use.

Advantages:

- Resistance to Noise: Digital signals are less prone to degradation due to noise and interference, which allows for clearer communication.
- High Quality and Reliability: The error detection and correction methods used in digital systems help ensure more reliable and high-quality communication.
- Scalability and Flexibility: Digital communication allows for the easy integration of new technologies and supports large-scale communication networks (e.g., the internet).
- Compression: Digital signals can be compressed, which helps in reducing bandwidth requirements and makes data transfer more efficient.

Disadvantages:

- **Complexity:** Digital communication systems tend to be more complex and require sophisticated hardware and software for encoding, transmission and decoding.
- **Higher Bandwidth Requirements:** Digital systems often require more bandwidth, especially for transmitting large amounts of data (e.g., videos).

Examples: Smartphones; digital television and radio; Internet data transmission (emails).

Comparison between Analog and Digital Communication:

Feature	Analog Communication	Digital Communication
Signal Type	Continuous signal	Discrete signal (binary)
Noise Susceptibility	More susceptible to noise and interference	Less susceptible to noise and interference
Transmission Quality	Decreases over distance and time	Maintains high quality over long distances
Error Handling	No inherent error correction	Supports error detection and correction
Bandwidth Efficiency	Lower bandwidth efficiency	Higher bandwidth efficiency due to data compression
Complexity	Simpler and easier to implement	More complex, requiring encoding, decoding, and processing
Examples	AM/FM radio, analog TV broadcasts, traditional telephones	Cellular networks, Internet communication, digital radio/TV

While analog systems are simpler and more suited for natural, continuous signals, digital communication offers improved quality, error handling and efficiency. As technology advances, digital communication is becoming more dominant due to its resilience to noise, higher fidelity and ability to support modern applications like the internet, video conferencing, and streaming. In the modern world, digital communication is largely replacing analog communication, as it enables more efficient, secure, and scalable communication across networks, making it a key element of today's digital infrastructure.

7.5 DATA COMMUNICATION MODES

Data communication modes refer to the way in which the data is transmitted between the devices over a communication channel. These modes define direction of data flow, the timing of data transfer and how

devices interact with each other during the transmission process. The three primary modes of data communication are:

1. **Simplex Mode**: In simplex mode, data flows in only one direction, from the sender to the receiver, without any return communication. It is a one-way communication system. Example: Television broadcasting, where the signal is sent from the broadcast station to the viewers, but viewers cannot send data back to the station.
2. **Half-Duplex Mode**: Half-duplex mode allows data to flow in both directions, but not at the same time. The communication alternates between sending and receiving. One device sends data at a time, while the other device receives it and vice versa. Example: Walkie-talkies or two-way radios, where one person speaks while the other listens and then they switch roles.
3. **Full-Duplex Mode**: Full-duplex mode allows data to flow in both directions simultaneously. Both devices can send and receive data at the same time, making it the most efficient mode for communication. Example: Telephone systems, where both parties can talk and listen at the same time.

These data communication modes help determine the type of interaction between devices in a network or communication system.

7.6 COMMUNICATION HARDWARE

Communication hardware refers to the physical devices or equipment used for transmitting and receiving data in a communication system. These devices enable the transfer of information between two or more devices through a communication medium (like cables, radio waves or fibre optics). The primary components of communication hardware include:

- **Modems (Modulator-Demodulator)**: Modems are used to convert digital data from a computer into analog signals for transmission over communication lines (like phone lines) and convert incoming analog signals back into digital data for the computer.

- **Network Interface Cards (NICs)**: These are hardware components that allow computers or other devices to connect to a network. NICs enable the exchange of data over wired (Ethernet) or wireless (Wi-Fi) connections.
- **Routers**: Routers are the devices that direct data packets between networks. They route traffic based on the destination IP address and are essential for connecting devices within a local area network (LAN) or across wide area networks (WAN).
- **Switches**: Switches are used within networks to connect multiple devices (computers, printers, etc.) and manage the data flow by forwarding data packets to the correct destination within the network.
- **Repeaters**: Repeaters are devices that amplify or regenerate signals to extend the range of data transmission over long distances. They are used in networks where the signal strength needs boosting.
- **Hubs**: A hub is a basic networking device that connects multiple devices in a network. It broadcasts data to all connected devices, without filtering or directing traffic, unlike a switch.
- **Bridges**: Bridges connect two or more network segments and help manage the traffic between them. They are used to divide a network into smaller, manageable segments.

7.7 COMMUNICATION PROTOCOLS/STANDARDS

Communication protocols and standards define the rules and conventions for data transmission, ensuring that devices within a network can exchange data in an organized and standardized way. These protocols ensure the successful, error-free transfer of data between devices.

- **Transmission Control Protocol (TCP)**: TCP is one of the core protocols of the Internet Protocol (IP) suite. It ensures reliable, ordered delivery of data between applications. It breaks data into packets, ensures packets are received and reassembles them in the correct order at the destination.
- **Internet Protocol (IP)**: IP is responsible for addressing and routing

data packets to their destination across a network. It provides the unique IP addresses that devices need to send and receive information.

- **Hypertext Transfer Protocol (HTTP)**: HTTP is used for transferring web pages over the internet. It is a request-response protocol where a user requests a web page, and the server responds with the requested data.
- **File Transfer Protocol (FTP)**: FTP is used for transferring files between a user and a server over a network. It allows users to upload, download or manage files remotely.
- **Simple Mail Transfer Protocol (SMTP)**: SMTP is used to send and route emails over the internet. It is part of the email system, ensuring messages are transmitted between mail servers.
- **Ethernet**: Ethernet is a standard protocol for local area networks (LANs), defining the format for data packets and how devices in the network communicate over physical cables (typically twisted pair or fiber-optic cables).
- **Wi-Fi (Wireless Fidelity)**: Wi-Fi is a set of protocols that allow devices to communicate wirelessly over a network. It is based on the IEEE 802.11 standards and is widely used for internet access in homes, offices and public spaces.
- **Bluetooth**: Bluetooth is a short-range wireless communication protocol designed for exchanging data between devices over short distances (e.g., for connecting peripherals like keyboards, speakers, and headsets).
- **Secure Socket Layer (SSL)/Transport Layer Security (TLS)**: SSL and TLS are protocols used to secure data transmission over the internet. They encrypt data to ensure privacy and prevent unauthorized access, especially in web browsing (HTTPS) and online transactions.
- **Simple Network Management Protocol (SNMP)**: SNMP is a protocol used to monitor and manage network devices, such as routers, switches, and servers. It allows network administrators to

retrieve information about network status, performance, and troubleshoot issues.

Standards for Communication Protocols: Communication protocols are often developed and maintained by international organizations to ensure uniformity and compatibility across devices and systems. Some of the standardization organizations include:

- **Institute of Electrical and Electronics Engineers (IEEE)**: IEEE is responsible for developing many standards for telecommunications and networking technologies, including Ethernet (IEEE 802.3) and Wi-Fi (IEEE 802.11).
- **Internet Engineering Task Force (IETF)**: IETF is responsible for developing internet standards, including the widely used protocols TCP/IP, HTTP, and SMTP.

World Wide Web Consortium (W3C): W3C is responsible for setting standards for web technologies, including HTML, CSS, and other essential web protocols.

7.8 INFORMATION AND COMMUNICATION TECHNOLOGY (ICT)

Information and Communication Technology (ICT) is a broad term that refers to the integration of telecommunications, computers and other devices to store, retrieve, transmit and manipulate data. It encompasses all technologies used for handling telecommunications, broadcasting, audio-visual processing and transmission systems, intelligent building management systems, and network-based control systems.

In simple terms, ICT refers to the tools, systems and services that allow individuals and organizations to access, exchange and manipulate information. These include hardware, software, networks and internet services that enable users to interact with data, share information, and communicate efficiently.

Components of ICT:

1. **Hardware**: This includes the physical devices involved in communication such as computers, servers, routers, mobile

devices, and peripherals like printers, scanners, and monitors.

2. **Software**: The programs and applications that run on system and devices to process data, manage networks and perform specific functions like word processing, data analysis and communication (e.g., Microsoft Office).
3. **Telecommunications**: This includes all systems used for transmitting data, including mobile networks, internet connections (Wi-Fi) and satellite communications.
4. **Internet and Networks**: The networks, both wired and wireless, that connect computers and devices to facilitate information exchange. This includes Local Area Networks (LANs), Wide Area Networks (WANs), and the Internet.
5. **Data**: The raw facts and figures that are processed to produce information. ICT systems require the collection, storage, processing and dissemination of data.

Significance of ICT:

1. **Connectivity**: ICT has made the world more connected by enabling global communication through the internet, email and social media platform. The in real-time interaction, regardless of geographical location is possible.
2. **Efficiency and Productivity**: ICT tools streamline tasks and processes. Software applications can automate repetitive tasks, analyse data and support decision-making, increasing efficiency and productivity in businesses, library and healthcare.
3. **Access to Information**: With the help of ICT, vast amounts of information are available instantly through digital libraries, online databases and the internet. This facilitates learning, research and knowledge sharing.
4. **Economic Growth**: ICT plays a crucial role in economic development by promoting innovation, enabling e-commerce and providing access to digital platforms that support entrepreneurship.
5. **Education**: ICT tools have revolutionized education by offering online learning platforms, virtual classrooms and educational software. It

has made education more accessible to students around the world.

6. **Communication and Social Interaction**: ICT enables easy and fast communication through email, instant messaging, video calls and social media. This has transformed the way people interact both personally and professionally.
7. **Innovation**: ICT is at the heart of technological innovation. Fields like artificial intelligence (AI), machine learning and the Internet of Things (IoT) have emerged due to advancements in ICT.

Applications of ICT:

1. **Business**: From managing customer relationships (CRM software) to digital marketing and e-commerce platforms, ICT has transformed how businesses operate and interact with customers.
2. **Healthcare**: ICT enables telemedicine, electronic health records (EHRs), remote monitoring, and improved communication between healthcare professionals, leading to better patient care.
3. **Education**: ICT enhances traditional classroom learning by providing online resources, virtual classrooms, and e-learning platforms, making education more accessible and flexible.
4. **Government**: E-Government initiatives use ICT to provide public services online, improving accessibility, transparency, and efficiency in government functions.
5. **Entertainment**: Streaming services, digital content creation, online gaming, and social media have become significant parts of the entertainment industry, all powered by ICT.
6. **Agriculture**: ICT tools help farmers access real-time weather data, manage crops, and improve supply chain management, enhancing productivity in the agricultural sector.

essential web protocols.

7.9 CHALLENGES IN INFORMATION AND COMMUNICATION TECHNOLOGY (ICT)

1. **Digital Divide**: There is a gap between those with access to ICT and those without, leading to unequal opportunities for education, healthcare, and economic activities.
2. **Cybersecurity and Data Privacy**: With the increasing reliance on digital platforms, cybersecurity threats such as hacking, data breaches and identity theft are a growing concern.
3. **Technological Obsolescence**: Rapid technological advancements make it difficult for organizations and individuals to keep up, leading to outdated systems and higher maintenance costs.
4. **Lack of Skilled Workforce**: There is a shortage of qualified professionals in fields like coding, data analysis and cybersecurity, hindering technological progress.
5. **ICT Infrastructure and Connectivity**: Poor infrastructure, particularly in rural or underdeveloped areas, limits access to essential ICT services.
6. **Intellectual Property and Copyright Issues**: The easy duplication and distribution of digital content have raised concerns about piracy and copyright violations.
7. **Overreliance on Technology**: Heavy dependence on ICT can cause disruptions in case of system failures, power outages, or cyberattacks.
8. **Environmental Impact**: The production and disposal of electronic devices contribute to pollution and high energy consumption.
9. **Ethical and Social Implications**: ICT raises concerns about privacy, surveillance, online harassment and misinformation, affecting social behavior and individual rights.
10. **Cost of Implementation**: High costs of ICT infrastructure and maintenance can be a barrier, especially for developing countries and small businesses.
11. **Language and Cultural Barriers**: Language differences and cultural factors can limit access to digital platforms and content.
12. **Regulatory and Legal Issues**: The rapid evolution of ICT creates challenges for legal frameworks regarding data protection, digital rights, and international cybersecurity standards.



CHECK YOUR PROGRESS

1. Fill in the blanks:

a. The term “communication” comes from the Latin word “_____,” which means “to share” or “to make common.”

b. In digital communication, information is encoded into _____ data, typically represented by 0s and 1s.

c. The _____ is a hardware component that allows computers to connect to a network, enabling data exchange over wired or wireless connections.

d. _____ mode allows data to flow in both directions, but not at the same time, where communication alternates between sending and receiving.

e. The _____ protocol is responsible for addressing and routing data packets to their destination across a network.



7.10 LET US SUM UP

ICT is a transformative force that has fundamentally reshaped the way people live, work, and communicate. It integrates the functions of information management and communication technology to provide efficient, accessible, and flexible solutions to meet the needs of individuals, businesses, governments, and societies. With its growing role in various sectors, ICT continues to drive innovation, economic development, and social progress globally.

These challenges require collaborative efforts to ensure that the benefits of ICT are accessible, sustainable, and secure for all.

Today, communication encompasses a broad range of methods and technologies, and its study involves understanding how messages are sent, received, and interpreted through various channels, including verbal, non-verbal, written, and digital mediums.

Communication hardware and protocols are the backbone of any communication system. Hardware components like modems, routers, and

switches facilitate the physical transfer of data, while protocols and standards ensure that data is transmitted accurately and efficiently, following defined rules and structures. Without these components, modern communication systems such as the internet, wireless networks, and corporate networks would not function effectively.



7.11 FURTHER READINGS

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7.12 ANSWERS TO CHECK YOUR PROGRESS

Ans 1 a. communicare

b. binary

c. Network Interface Card

d. Half-Duplex

e. Internet Protocol (IP)



7.13 MODEL QUESTIONS

Short Questions

1.True or False:

a. Analog communication offers better quality over long distances

compared to digital communication.

b. Full-duplex communication allows data to flow in both directions simultaneously.

c. Wi-Fi is a protocol that allows wireless communication between devices over a network.

d. One challenge in ICT is the lack of skilled workforce in fields like data analysis and cybersecurity.

e. The transmission of data in Simplex Mode allows two-way communication at the same time.

2. Define analogue communication.

3. What are the main advantages of digital communication?

4. What is the key difference between Simplex, Half-Duplex, and Full-Duplex modes of communication?

5. What does the acronym “NIC” stand for, and what is its role in communication systems?

6. What is the primary function of a modem in a communication system?

7. What is the digital divide in ICT?

Long Questions

1. Compare analogue and digital communication in terms of signal type, noise susceptibility and error handling.
2. Describe the three primary modes of data communication: Simplex, Half-Duplex, and Full-Duplex.
3. Discuss the importance of communication protocols like TCP, IP, HTTP, and FTP in modern communication systems.
4. Discuss the role and components of Information and Communication Technology (ICT) in modern society.
5. Explain the challenges faced in ICT.
6. What are the advantages and disadvantages of digital communication over analog communication?

*** *** ***

UNIT 8: BASICS OF NETWORK TECHNOLOGY

UNIT STRUCTURE

8.1 Learning Objectives

8.2 Introduction

8.3 Types of Computer Networks

8.4 Client-Server Architecture

8.5 Topology

8.6 Network Techniques

8.7 Integrated Services Digital Network

8.8 Wireless technology

8.9 Let Us Sum Up

8.10 Further Readings

8.11 Answer to check Your Progress

8.12 Model Questions

8.1 LEARNING OBJECTIVES

After going through this unit, you will be able to –

- define computer network
- identify different network types
- explain client server architecture
- describe different network topologies
- explain the different network techniques

8.2 INTRODUCTION

A computer network is a system of interconnected computers and devices that can communicate with each other and share resources, information, service such as data, hardware and software applications. Networks can be physical such as wired connections like Ethernet cables, or wireless, using radio waves or other technologies like Wi-Fi or cellular

networks. The devices in a computer network are connected using communication protocols and hardware like cables, wireless signals and routers. These networks can range from small, local networks (such as a home or office network) to vast, global networks like the internet.

The key components of a Computer Network include-

1. **Devices (Nodes)**: These are the individual computers, servers, printers or other devices that connect to the network.
2. **Transmission Media**: This is the physical or wireless medium used for communication such as Ethernet cables, fibre-optic cables or Wi-Fi.
3. **Networking Devices**: These are hardware that facilitate communication and data transfer across computer network-
    - **Router**: Directs data between different networks.
    - **Switch**: Connects devices within a local network and manages data flow.
    - **Hub**: Similar to a switch but less efficient, often used in older networks.
    - **Modem**: Converts signals between digital data and analog signals for internet access.
4. **Protocols**: These are standardized rules that govern how data is transmitted and received. Common protocols include TCP/IP (Transmission Control Protocol/Internet Protocol) and HTTP (HyperText Transfer Protocol).

Need of computer Network

- Computer networks enable seamless communication between devices, supporting email, messaging, voice and video calls.
- They allow for the sharing of resources like printers, storage and internet connections, reducing costs and optimizing hardware usage.
- Networks provide easy access to and sharing of data, ensuring information is available across multiple devices.
- They support collaboration by enabling real-time file sharing and teamwork, especially in businesses.

- Centralized management allows for easier control of systems, data and security, improving efficiency and protection.
- Networks allow for easy scalability, enabling the addition of devices and systems as needed without major infrastructure changes.
- Remote access is facilitated by networks, allowing users to access systems and data from anywhere with an internet connection.
- By sharing resources, networks reduce the need for multiple devices, making them more cost-effective.
- Networks provide security features like encryption and firewalls to protect data and prevent unauthorized access.
- They are essential for modern applications, such as cloud computing, e-commerce, and social media, which rely on network connectivity.

8.3 TYPES OF COMPUTER NETWORKS

Computer networks can be divided in the following types-

1. **LAN (Local Area Network)**: A network that covers a small geographic area, like a home, office, or school.
   - Covers a small geographic area, typically within a building or campus.
   - Provides high-speed data transfer (usually 1 Gbps or more).
   - Supports resource sharing like printers, files, and internet access.
   - Cost-effective and easy to set up.
   - Devices are connected using Ethernet cables or Wi-Fi.
   - Generally managed by a single organization or individual.
2. **WAN (Wide Area Network)**: A network that spans a large geographic area, like a country or even globally and connects multiple LANs.
   - Spans large geographic areas, often covering cities, countries, or continents.
   - Lower data transfer speeds compared to LANs due to the larger coverage.

- Connects multiple LANs together through leased lines, satellite links or public networks.
- Can be expensive to establish and maintain.
- The internet is the largest example of a WAN.
- Used by large organizations to connect remote offices or branches.

3. **MAN (Metropolitan Area Network)**: A network that spans a city or a large campus and connects multiple LANs.
   - Covers a city or a large campus, typically connecting several LANs within the same geographic area.
   - Offers higher data transfer speeds than WAN but covers a broader area than LAN.
   - Typically operated by a single organization or a service provider.
   - Used to connect branches of businesses within a city or for government services.
   - Uses technologies like fibre optics or leased lines for connectivity.

4. **PAN (Personal Area Network)**: A small-scale network used for personal devices, typically within a range of a few meters, like connecting a smartphone to a laptop via Bluetooth.
   - Designed for personal devices such as smartphones, laptops and wearable technology.
   - Covers a very small area (typically up to 10 meters).
   - Uses wireless technologies like Bluetooth, infrared, or Wi-Fi.
   - Simple and low-cost setup.
   - Primarily for short-range communication, such as transferring files or connecting accessories (e.g., headphones, smartwatches).

Purposes of Computer Networks:

- **Resource Sharing**: Allows multiple devices to access shared resources (e.g., files, printers).

- **Communication**: Facilitates email, video conferencing, and instant messaging.
- **Data Exchange**: Enables fast data transfer across different devices and locations.
- **Centralized Data Storage**: Provides access to centralized databases and file servers.

Virtual Private Network (VPN)

It is a service that provide secure network that uses encryption to provide secure communication over a public network (such as the internet). It allows users to send and receive data as if their devices were directly connected to a private network, ensuring the privacy and security of their internet traffic. It allows remote users or branch offices to access a private network securely. Some features of VPN are listed below.

- **Encryption**: A VPN encrypts the user's data, which makes it unreadable to outsiders, even if it is intercepted.
- **Privacy**: It hides the user's IP address and location, making their online activities more anonymous.
- **Security**: VPNs protect users from potential threats like hackers, especially on unsecured networks such as public Wi-Fi.
- **Remote Access**: VPNs allow users to securely access a private network from remote locations, as if they were physically present in that network.
- **Bypassing Geo-restrictions**: VPNs can help users access content or websites that are blocked or restricted in certain countries or regions by masking their location.

8.4 CLIENT-SERVER ARCHITECTURE

The Client-Server Architecture is a fundamental concept in networking, where two distinct programs, the "client" and the "server," interact with each other to exchange data through a network.

- **Client**: The client is the device that initiates a request for a service or data. It typically runs on a user's computer and is often used to access services or resources from the server. For example, a web

browser (client) requests a web page from a web server. Clients are generally connected to the network or internet.

- **Server**: The server is the program that listens for requests from the client and responds by providing the requested data or service. It is usually installed on a more powerful computer, such as a host computer, which has large storage capacity, ample memory (RAM) and may even be a mini-computer or mainframe system. The server often operates in a centralized location and its primary function is to process requests, manage resources and provide services to clients.

The client and server communicate over a network, which could be the internet or a local network. This client-server model is particularly significant for the Internet. Many applications and services are built using this design, where millions of clients (like web browsers, apps or other devices) communicate with centralized servers that handle requests from numerous clients simultaneously.

The Client-Server model is often referred to as two-tier architecture because it has two main components: The client (user's computer) and the server (host computer providing the service). This setup allows resources such as files, data, and services to be shared across multiple devices connected to the network.

8.5 TOPOLOGY

Network topology refers to the arrangement or layout of the various elements (like computers, cables, and other devices) within a computer network. It defines how devices are connected and how data flows between them. The physical topology refers to the actual physical layout of the network devices and cables, while the logical topology refers to the way data moves through the network, regardless of the physical connections.

Types of Network Topologies-

1. **Bus Topology**: In this topology all devices are connected to a single central cable (the "bus"). Data is transmitted along the bus and each

device checks the data to see if it is intended for it. It is simple to set up, and cost-effective for small networks but difficult to troubleshoot, as if the central bus fails, the entire network goes down.

2. **Star Topology**: In this type all devices are connected to a central device, usually a switch or a hub. Data passes through the central device, which then directs it to the correct destination. It is easy to install and maintain, has centralized management, and failure in one device does not affect others. The central device (switch or hub) is a single point of failure. If it goes down, the whole network is affected.
3. **Ring Topology**: Devices are connected in a circular or ring shape and each device has two connections: one to the previous device and one to the next. Data travels in one direction (or sometimes two in a dual ring system) around the ring until it reaches its destination. Data is transmitted quickly and efficiently, with no data collisions. Failure in any single device or cable can break the entire network. Troubleshooting can be difficult. It doesn't need a network server to control the connections between computers. The process of transmitting data is straightforward since packets move in only one direction.
4. **Tree Topology**: Tree Topology or Hierarchical Topology is a hybrid topology that combines characteristics of bus and star topologies. It consists of groups of star networks connected to a central bus or backbone. Data flows from one device to another in a hierarchical structure. A central device manages data flow between different branches of the tree. Tree topologies facilitate the growth of an existing network and allows to set up a network according to their specific requirements. Its hierarchical structure makes it easier to manage large networks, centralized management. If the backbone fails, it can affect the entire network. It is complex to set up.

In practice, many networks are built using a combination of topologies to take advantage of the strengths of each. For example, a **Star-**

Bus hybrid topology could use a bus structure as the backbone but have star topology segments connected to it.

8.6 NETWORK TECHNIQUES

When a network is established, it consists of many nodes (devices like computers, servers or routers) that are located in different places and are connected to one another through various links. For data to be transmitted across this network, there must be dedicated connections between the end nodes (the devices that send and receive data). These connections ensure that the data can travel from one device to another in an organized and efficient manner.

In most cases, data is not sent all at once. Instead, it is broken down into smaller chunks called packets or frames. These packets are sent through physical connections (such as cables or wireless signals) between the devices. Each packet contains part of the overall data, along with information about where it came from and where it is going. This method of breaking data into packets helps the network handle large amounts of information more efficiently.

The process of sending data across a network and determining the best path for those packets to travel is known as switching. Switching ensures that data reaches its destination by taking different paths, depending on the network's configuration and the available connections. There are three primary types of switching techniques commonly used in networks:

1. **Circuit Switching**: This method establishes a dedicated communication path between the sender and receiver for the entire duration of the transmission. Once the path is set up, the data can travel along this exclusive route. Traditional phone networks often use circuit switching.
2. **Packet Switching**: In packet switching, data is divided into smaller packets, and each packet can take different routes to reach the destination. The packets are reassembled once they arrive at the receiver's end. The internet primarily uses packet switching because

it is more efficient for handling large amounts of data and is less reliant on a continuous connection.

3. **Message Switching**: This technique involves storing the entire message at an intermediate node before forwarding it to the next node. The message is sent in its entirety to the destination after it has been stored, which can lead to delays but may be useful in situations where real-time delivery is not critical.

Cell switching

Cell switching is a high-speed switching technology designed to address the speed limitations of traditional circuit and packet switching methods. It operates within a connection-oriented, packet-switched network, where data is transmitted in fixed-size cells. In the case of ATM (Asynchronous Transfer Mode), each cell is 53 bytes in size, consisting of 48 bytes for the payload and 5 bytes for the header. This contrasts with packet switching, which typically uses variable-sized packets.

Cell switching can be found in various technologies, such as DSL (Digital Subscriber Line) and ISDN (Integrated Services Digital Network), to improve data transmission speeds. Unlike packet switching, which uses variable-sized packets, cell switching ensures that the data is always transmitted in consistent, fixed-size cells, making it easier to manage and switch data efficiently across the network.

One of the primary advantages of cell switching is its ability to handle different types of data, such as voice, video and data, simultaneously. This feature makes it particularly effective for applications requiring real-time data transmission. Cell switching combines the best elements of circuit switching which guarantees reliable, continuous data delivery and packet switching, which is known for its efficiency in utilizing network resources. The limitation of cell switching is that it does not include flow control or error control mechanisms. This absence can lead to issues in networks if there are congestion or transmission errors, requiring additional protocols to manage these problems.

8.7 INTEGRATED SERVICES DIGITAL NETWORK

Integrated Services Digital Network (ISDN) is a set of communication standards for transmitting digital data over telephone networks. It was designed to replace the older analog telephone system, offering more reliable, higher-speed data transmission and better-quality voice calls. ISDN allows both voice and data to be transmitted simultaneously over the same network, which makes it more versatile compared to traditional analog systems.

The key characteristics of ISDN are-

1. **Digital Transmission**: ISDN transmits data digitally, which leads to improved clarity and reliability of voice and data communications.
2. **Simultaneous Voice and Data**: ISDN allows both voice calls and data (such as internet access) to be transmitted simultaneously over a single connection, making it more efficient.
3. **Faster Speeds**: ISDN offers faster data rates than analog systems. Basic rates typically support speeds of 64 Kbps per channel and the system can combine multiple channels to achieve higher speeds.
4. **Quality of Service** : ISDN offers better quality and more predictable performance compared to analog services, as it is less susceptible to interference.

The basic types of ISDN are-

- **Basic Rate Interface (BRI)**: Typically used for home and small office environments. It consists of two B-channels (Bearer channels) for voice or data transmission and one D-channel for signaling and control. Provides speeds of up to 128 Kbps (64 Kbps per B-channel).
- **Primary Rate Interface (PRI)**: Used by larger businesses and organizations that require higher bandwidth. Consists of 23 B-channels for data and voice; and one D-channel. It provides much higher speeds. PRI is often used for large-scale voice and data communications, such as in call centers or corporate networks.

Advantages of ISDN-

- **Simultaneous Voice and Data**: It allows make phone calls while using the internet or sending faxes.
- **Higher Quality**: Digital transmission reduces noise and static compared to analog systems.
- **Speed**: Faster data transmission rates than traditional analog lines.
- **Reliability**: Less interference compared to analog lines, resulting in more stable connections.
- **Scalability**: With PRI, organizations can scale the number of channels for more data or voice capacity as needed.

Limitations of ISDN-

- **Cost**: ISDN can be more expensive to install and maintain compared to simpler technologies, especially for small businesses or homes.
- **Limited Availability**: While widely available in some regions, ISDN may not be as accessible in others, especially in rural or remote areas.
- **Obsolescence**: As newer technologies like broadband internet (DSL, fiber, and cable) and VoIP (Voice over Internet Protocol) become more popular, ISDN is becoming less common and is gradually being phased out in many areas.

Application of ISDN include-

- **Voice Communications**: ISDN provides clear, high-quality voice calls, which makes it ideal for businesses with high volumes of phone traffic.
- **Data Communications**: It can be used for sending data, faxes and other digital communications.
- **Video Conferencing**: With its stable connection and high-quality transmission, ISDN was historically used for video conferencing.

Point-of-Sale (POS) Systems: Used for securely transmitting payment data and other transaction details.

8.8 WIRELESS TECHNOLOGY

Wireless technology refers to the use of electromagnetic waves such as radio waves, microwaves or infrared signals, to transmit data, voice, or video between devices without the need for physical cables or wires. This technology allows devices to communicate and share information over short or long distances, enabling mobile connectivity and making it possible for users to access networks and services remotely.

In wireless setups, devices use wireless equipment to connect and transmit data. A data card or USB modem can be used to access the internet. Wi-Fi, Bluetooth, cellularnetwork are some of examples of wireless technology.

Advantages of wireless technology include-

- No physical connections required, offering flexibility and mobility.
- It allows users to access the internet or communicate from virtually any location within a network's coverage area.
- Ideal for remote areas or places where wired connections are difficult to establish.

Challenges of wireless technology includes-

- Wireless signals can face interference or disruption from obstacles, like walls or other electronic devices.

Security issues, as wireless networks may be more susceptible to unauthorized access if not properly secured.



CHECK YOUR PROGRESS

1.Fill in the blanks

a. _____ cables are used for wired connections in computer networks.

b. A network that covers a small geographic area, like a home or office, is called _____.

c. A network in which data is transmitted in fixed-sized cells is called _____ switching.

d. A _____ provides secure communication over a public

network by using encryption.

e. The technology used in telephone networks to transmit both voice and data over the same line is called _____.

f. _____ allows users to access the internet wirelessly within a certain range, typically in homes or offices.

g. In _____ topology, all devices are connected to a single central cable called the bus.



8.9 LET US SUM UP

- A computer network is a system of interconnected devices that communicate with each other and share resources, such as data, hardware, and software, using communication protocols.
- Networks can be either wired (Ethernet) or wireless (Wi-Fi, cellular). Key components include devices (computers, servers), transmission media (cables, wireless signals), networking devices (routers, switches), and protocols (TCP/IP, HTTP).
- Computer networks facilitate communication, resource sharing, centralized management, and remote access, and are crucial for modern applications like cloud computing and e-commerce. They come in various types, such as LANs, WANs, MANs, and PANs, each serving different geographic areas and purposes.
- Key technologies include VPNs for secure remote access and wireless networks for mobility.
- Network topologies like bus, star, and ring define how devices are connected, and switching techniques like circuit, packet, and cell switching enable efficient data transmission across the network.



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8.11 ANSWERS TO CHECK YOUR PROGRESS

Ans to 1. a. Ethernet

b. LAN

c. cell

d. Virtual Private Network

e. ISDN

f. Wi-Fi

g. Bus



8.12 MODEL QUESTIONS

Short Type Question

1. What is a computer network?
2. What is the main function of a router in a computer network?
3. What is cell switching and how does it differ from packet switching?
4. What are the advantages of using wireless technology in a network?
5. Write full form of VPN.
6. What is Bus topology in networking?

Long Type Questions

1. Explain the concept of a computer network. Discuss its components, types, and importance in today's digital world.
2. Explain the Client-Server Architecture in computer networks. How does the interaction between a client and a server occur?

3. Discuss the various network topologies in detail.
4. What is a Virtual Private Network? Discuss its various applications and benefits.
5. Describe the process of packet switching.
6. What is ISDN? Explain its types and advantages.
7. How does cell switching improve upon the limitations of circuit switching and packet switching?

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UNIT 9: COMMUNICATION PROTOCOL

UNIT STRUCTURE

9.1 Learning Objectives

9.2 Introduction

9.3 Internet Protocol

9.4 Transmission Control Protocol

9.5 File Transfer Protocol

9.6 Simple Mail Transfer Protocol

9.7 Voice over Internet Protocol

9.8 Hypertext Transfer Protocol

9.9 User Datagram Protocol

9.10 Uniform Resource Locator (URL)

9.11 Let Us Sum Up

9.12 Answer to check Your Progress

9.13 Further Readings

9.14 Model Questions

9.1 LEARNING OBJECTIVES

After going through this unit, you will be able to –

- Define communication protocol
- Understand IP Address
- Describe Protocol Functions
- Understand URIs and URLs

9.2 INTRODUCTION

In any system where there need to exchange information, protocols play crucial role in ensuring that the exchange happens effectively and without errors. A protocol is a set of formalized rules and standards that govern how data is structured, transmitted and understood between different

devices. Be it human communication, software interactions or digital networking protocols ensure consistency, reliability and clarity in the exchange of information.

When we focus on communication protocols, we are specifically referring to the rules and procedures that govern how data is transmitted across networks, systems or devices. Communication protocols define the process of data exchange, including how the data should be formatted, how it will be delivered and what actions should be taken in response to the transmitted information. These protocols are essential for ensuring that different devices or systems, which may be from different manufacturers or use different technologies, communicate effectively and securely.

In the realm of networking and digital systems, communication protocols are fundamental for enabling everything from sending emails and browsing the web to real-time messaging and secure transactions. By establishing standardized methods of interaction, communication protocols allow different entities-such as computers, servers, and mobile devices-to understand each other, exchange data, and operate in harmony.

There are several types of communication protocols, each designed for different purposes. Some of the main categories include: Internet Protocol, Transmission Control Protocol, File Transfer Protocol, Simple Mail Transfer Protocol, Voice Over Internet Protocol, Hypertext Transfer Protocol and User Datagram Protocol.

9.3 INTERNET PROTOCOL

The development of Internet protocols began in the mid-1970s, initiated by DARPA (Defense Advanced Research Projects Agency) at Stanford University. These protocols were essential for creating a reliable and scalable communication system that would eventually become the foundation of the modern Internet. One of the most critical protocols developed during this time is the Internet Protocol (IP), which operates at the network layer (Layer 3) of the OSI model.

NOTE: The **OSI** (Open Systems Interconnection) model is a conceptual framework used to understand and describe how different networking protocols interact in a network. It divides the communication process into seven distinct layers, each with specific responsibilities. The layers from top to bottom are:

1. **Application Layer**: This is the top most layer where end-user software (like web browsers) operates. It provides network services directly to users, ex. HTTP, FTP, SMTP.
2. **Presentation Layer**: This layer is responsible for data translation, encryption, compression and other transformations to ensure that data is in a readable format for the application layer. It can also handle issues like character encoding, ex. SSL/TLS.
3. **Session Layer**: It manages the sessions or connections between applications. It establishes, maintains and terminates communication sessions, ex. NetBIOS, RPC.
4. **Transport Layer**: This layer is responsible for end-to-end communication and data flow control. It ensures that data is transferred reliably and in the correct order, ex. TCP, UDP.
5. **Network Layer**: This layer handles the routing of data packets across different networks. It is responsible for addressing, packet forwarding, and routing ex. IP, ICMP.
6. **Data Link Layer**: It is responsible for node-to-node data transfer and error detection/correction in the physical layer. It provides the means for data to be transferred between adjacent network nodes, ex. Ethernet, PPP, Wi-Fi.
7. **Physical Layer**: The lowest layer deals with the physical connection between devices and the transmission of raw data bits over a physical medium like cables, radio waves, or fibre optics, ex. Ethernet cables, optical fibres, wireless signals.

The Internet Protocol (IP) is responsible for sending data from one computer to another over the Internet. Every computer or device connected to the Internet has a unique identifier called an IP address, which is associated with its username and used for routing data to the correct destination.

An IP address is a unique numerical label assigned to each device connected to a network. It serves two primary functions:

- **Identification**: It identifies a device on the network.
- **Location Addressing**: It helps route data packets to the correct destination device.

The Internet Protocol (IP) is responsible for addressing and routing data packets across networks. It ensures that each packet is correctly addressed and can be sent from the source to the destination across various interconnected networks. IP contains both addressing information (such as the sender and receiver addresses) and control information that helps determine the best path for the packets to travel.

Some of the characteristics are-

- An IP address is a unique numerical label assigned to each device connected to a network.
- IP addresses are typically written as a series of numbers, separated by periods (IPv4) or colons (IPv6).

  IPv4 (Internet Protocol Version 4): Uses 32-bit addresses, represented in four decimal numbers (e.g., 192.168.1.1). It supports approximately 4.3 billion unique addresses. However, as the Internet grew, the number of available IPv4 addresses became insufficient, prompting the development of a new version, IPv6, in 1995.

  IPv6 (Internet Protocol Version 6): Uses 128-bit addresses, represented in eight groups of four hexadecimal digits (e.g., 2001:0db8:85a3:0000:0000:8a2e:0370:7334). It supports a vastly larger number of unique addresses, addressing the shortage of IPv4 addresses.
- IP addresses are inherently binary numbers; they are usually displayed in human-readable form.

- Data is divided into packets, each of which includes the sender's IP address (source) and the recipient's IP address (destination).Routers and other networking devices examine the destination IP address to determine the best path for the packet to take across networks. Once the packet reaches its destination, it is reassembled into the complete data.
- There are two types IP-

  Private IP: Used for local networks (e.g., within a home or organization) and not directly accessible from the internet. Examples: 192.168.x.x, 10.x.x.x.

  Public IP: Assigned to devices directly connected to the internet, allowing them to communicate across networks globally.

Functions of IP are-

- **Routing**: Directs data from the source to the destination.
- **Fragmentation**: Breaks down larger packets into smaller pieces for transmission and reassembles them at the destination.
- **Addressing**: Ensures that data is sent to the correct device by using unique IP addresses.

IP is documented in RFC 791, which was released as the DARPA Internet Program Protocol Specification in September 1981. This document outlined the technical specifications for how IP works and set the standards for how data should be transmitted across the Internet.

Together with the Transmission Control Protocol (TCP), which provides reliable data transfer, IP forms the core of the TCP/IP protocol suite the foundational communication model that drives the functioning of the Internet. While IP handles packet addressing and routing, TCP ensures that packets are delivered reliably and in the correct order. This combination of IP and TCP allows for efficient and robust communication on the Internet.

9.4 TRANSMISSION CONTROL PROTOCOL

TCP/IP (Transmission Control Protocol/Internet Protocol) was developed in 1974 by Robert Kahn of ARPANET and Vinton G. Cerf. It is the

suite of protocols that forms the backbone of the Internet, enabling computers to communicate with one another across networks. TCP/IP is a two-layer program, consisting of two main components:

1. **Transmission Control Protocol (TCP)**: This higher layer handles the assembly of messages or files into smaller packets. These packets are then transmitted over the Internet. Once the packets reach their destination, the TCP layer reassembles them into the original message or file.
2. **Internet Protocol (IP)**: This lower layer deals with the addressing of each packet. It ensures that packets are routed correctly across the Internet and reach the right destination.

TCP/IP operates on the client-server communication model, where a client (such as a user's computer) makes a request for a service and a server (another computer in the network) provides that service. For example, when you access a web page, your browser (the client) sends a request to a web server, which responds by sending the page back to you. HTTP, HTTPS, SMTP, POP3, IMAP, SSH, FTP, Telnet and a variety of other protocols are typically encapsulated in TCP.

Domain Names and IP Addresses

An IP addresses are the true identifiers of devices on the Internet, they are not always easy for humans to remember. To make navigation easier, domain names (like www.example.com) were introduced. A domain name acts as a pointer to the actual IP address, making it simpler for people to find web servers and access websites. Essentially, domain names serve as an easier-to-remember alias for the numerical IP addresses that uniquely identify servers on the Internet.

9.5 FILE TRANSFER PROTOCOL

The File Transfer Protocol (FTP) is a standard network protocol used to transfer files electronically between computers over the Internet. FTP is commonly employed to move large files, such as software and archives (compressed text files), from one computer to another. These

types of files are often referred to as archives due to their large size and bundled content.

FTP operates on a client-server model, where an FTP client connects to an FTP server to send or receive files. There are two main types of FTP connections:

Active Mode: The server opens a port to transfer data back to the client. The client connects to the server on port 21 for the control connection, then opens a random port for the server to connect to for data transfer. This can be problematic in environments with firewalls or NATs, as the server must initiate the data connection to the client, which is often blocked.

Passive Mode: The client opens a port for the server to transfer data to the client. The client connects to the server on port 21 for the control connection, and the server opens a random port for the client to connect to for data transfer. This mode is more firewall/NAT-friendly, as the client initiates both connections.

FTP operates similarly to other Internet protocols like HTTP (which transfers web pages and related content) and SMTP (which is used to send email). FTP is an application protocol that relies on the Internet's underlying TCP/IP protocols for communication.

FTP allows users to perform various file management tasks on a remote server. This includes the ability to delete, rename, move, and copy files on the server. This functionality makes FTP particularly useful for managing files on servers, especially when updating websites or transferring large amounts of data.

FTP can be accessed using a command-line interface (CLI) or through graphical user interface (GUI). The command-line method requires users to input specific text commands, GUI programs provide an easier, more user-friendly way to navigate file transfers. In either case, FTP provides a reliable and efficient method for downloading and uploading files between computers, making it a vital tool for web developers, system administrators, and everyday users who need to exchange files across the Internet.

9.6 SIMPLE MAIL TRANSFER PROTOCOL

Simple Mail Transfer Protocol (SMTP) is a communication protocol that facilitates the transmission of electronic mail (email) over the Internet. SMTP is primarily used by mail servers to send, route and receive emails between different hosts or systems. It serves as the standard protocol for transmitting emails from one mail server to another within networks, including different departments or organizations.

The protocol was updated in 2008 with the introduction of Extended SMTP (ESMTP), which is defined in RFC 5321. This updated version of SMTP is the version most widely used today. ESMTP improves upon the original SMTP protocol by supporting additional features, such as enhanced capabilities for handling attachments, larger emails, and improved error handling. ESMTP is used for both inter-server transport (sending emails between mail servers) and as a mail submission protocol, with specific restrictions on its behaviour when used by email clients.

In addition to SMTP, another protocol, Post Office Protocol (POP), is commonly used for managing emails. POP is used to download emails from the server to the client computer and allows users to access their emails locally. It can also support actions such as uploading emails or managing the mail stored on the server. Together, SMTP and POP play key roles in the process of sending, receiving, and managing email across the Internet.

9.7 VOICE OVER INTERNET PROTOCOL

Voice over Internet Protocol (VoIP) is a standardized method used to transmit audio data between computer systems over the Internet. VoIP allows voice communications such as phone calls, to be made using Internet connections rather than traditional telephone networks.

VoIP is often referred to by several other terms, including IP telephony, Internet telephony, voice over broadband (VoBB), broadband telephony, and broadband phone. These terms are used interchangeably

to describe the technology that enables voice communication over the Internet.

Internet telephony encompasses a range of communication services that use VoIP technology to transmit various forms of messages. This includes voice calls, fax, SMS (Short Message Service), and voice-messaging applications. Instead of relying on traditional telephone infrastructure, these services use the Internet to send and receive messages, offering an alternative that is often more cost-effective and flexible.

VoIP has revolutionized communication by enabling voice and multimedia services to be delivered through Internet-based systems, offering greater convenience and reduced costs compared to traditional telephony.

9.8 HYPERTEXT TRANSFER PROTOCOL

Hypertext Transfer Protocol or HTTP is the foundational protocol used for transferring hypertext documents across the web. It facilitates the exchange of data between servers and clients, enabling users to access web pages and other resources over the internet. HTTP is the technology that enables the transfer of web pages to a user's computer, and it plays a critical role in the World Wide Web.

One of the key features of HTTP is its ability to handle hypertext, which allows users to navigate between different documents or resources via clickable links. A word or phrase within a web page can contain a link that directs users to another web page, either on the same site or on a different site. This interconnectivity is made possible through hyperlinks, making it easier for users to explore a vast array of content online.

Web pages are typically written in HTML (Hypertext Markup Language), which is a markup language that structures the content on a web page. HTTP works in tandem with HTML to provide a seamless experience for users, as HTTP governs the process of requesting and transferring the HTML documents (along with associated multimedia files) from the server to the client.

HTTP governs the transfer of various types of files, including text, images, sounds, videos, and other multimedia content, across the internet. When a user wants to access a website, they typically use a web browser to interact with HTTP, though the user may not be aware of the underlying protocol.

The browser acts as an HTTP client and sends requests to web servers. When a user enters a website address (URL) in the browser's address bar or clicks on a hyperlink, the browser builds an HTTP request. This request is directed to the server associated with the URL's domain, which represents the destination website.

For example, if the user enters a URL, the browser sends an HTTP request to the server at the IP address specified by the URL. The server then processes this request, locates the required files (such as a web page, image, or video), and sends the requested resources back to the browser using HTTP. The browser then renders these resources, allowing the user to view the content on their screen.

Secure Hypertext Transfer Protocol

SHTTP (Secure Hypertext Transfer Protocol) is a protocol designed to provide security for web communications, particularly focusing on encryption and authentication. It was developed in the mid-1990s as an enhancement to the standard HTTP (Hypertext Transfer Protocol) to address the need for securing data transmitted over the internet.

SHTTP ensures that data transferred between a client (typically a web browser) and a server is encrypted, helping to protect it from eavesdropping and tampering. It can provide authentication mechanisms to ensure that the parties involved in the communication are who they claim to be. SHTTP was largely replaced by HTTPS (Hypertext Transfer Protocol Secure), which is more widely used today. HTTPS combines the HTTP protocol with SSL/TLS encryption to secure web communications. SHTTP is no longer commonly used, as HTTPS has become the standard for securing internet traffic.

Uniform Resource Identifier

URI stands for Uniform Resource Identifier. It is a string of characters

used to identify a resource on the internet or within a network. URIs provides a way to locate or reference resources, like web pages, files or services, in a consistent format.

A URI can be divided into two main types:

URL (Uniform Resource Locator): A specific type of URI that not only identifies a resource but also provides the means to locate it (typically including a protocol like HTTP), Example: https://www.example.com/index.html

URN (Uniform Resource Name): A type of URI that identifies a resource by name within a given namespace, without implying its location. Example: urn:isbn:0451450523 (an ISBN number for a book).

9.9 USER DATAGRAM PROTOCOL

UDP stands for User Datagram Protocol. It is communication protocol used in computer networks to send data packets between devices. UDP is one of the core protocols in the Internet Protocol (IP) suite and operates at the transport layer.

The key characteristics of UDP include:

1. **Connectionless**: UDP does not establish a connection before sending data. Each packet is sent independently and there is no process between sender and receiver.
2. **Unreliable**: UDP does not guarantee delivery, ordering or error checking. Packets might be lost, duplicate or arrive out of order. It's up to the application to handle these issues if needed.
3. **Low Overhead**: Because UDP does not involve error checking or flow control, it has lower overhead and is faster than protocols like TCP (Transmission Control Protocol).
4. **Use**:UDP is often used in real-time applications where speed is critical and some loss of data is acceptable. It is commonly used in streaming video and audio, online gaming, DNS (Domain Name System) queries.

9.10 UNIFORM RESOURCE LOCATOR

A URL (Uniform Resource Locator) also known as a web address is a reference or address used to access specific resources on the Internet. It is made up of a combination of words, letters, numbers and symbols that help users to browse websites and access content online. Each website on the Internet has its own unique URL, allowing users to find it easily.

The concept of the URL was standardized in 1994 by Tim Berners-Lee, the inventor of the World Wide Web, providing a consistent way to address resources on the Internet. This standardization has allowed the Internet to grow and evolve, making it easier for users to access websites and share information online.

A URL is typically divided into three main components:

1. **Protocol**: This indicates the method or protocol used to access the resource. Common protocols include HTTP (Hypertext Transfer Protocol) for web pages and FTP (File Transfer Protocol) for transferring files.
2. **Host Name**: This part specifies the domain name of the server where the resource is hosted. For example, in the URL "www.kkhsou.ac.in," "www.kkhsou.ac.in" is the host name.
3. **File or Page Name**: This is the specific resource or page on the website that the URL points to. For example, "about.html" is the file name in the URL "https://www.kkhsou.ac.in/web/about.html".

URLs are most commonly used for web pages that are accessed via the HTTP protocol, but they can also be used in other applications such as FTP for file transfers or Mailto for sending emails.



CHECK YOUR PROGRESS

1. Fill-in-the-Blanks Questions:

a. The Internet Protocol (IP) operates at the _____ layer of the OSI model.

b. IPv6 uses _____ bit addresses, represented in eight groups of four hexadecimal digits.

c. The two types of IP addresses are _____ IP and _____ IP.

d. _____ is a standardized method used to transmit audio data between computer systems over the Internet.

e. SHTTP was largely replaced by _____, which combines HTTP with SSL/TLS encryption to secure web communications.

2. Choose the correct option.

a. Who standardized the concept of URL in 1994?

i)Bill Gates

ii) Tim Berners-Lee

iii) Steve Jobs

iv) Larry Page

b. **Which of the following is an example of a protocol used in a URL?**

i) HTML

ii) FTP

iii) JavaScript

iv) CSS



9.11 LET US SUM UP

In essence, HTTP is a crucial protocol that powers the exchange of information on the web. We have discussed communication protocols that enable data transmission and interactions across digital networks and the internet. Protocols ensure the structured, secure and efficient exchange of data between devices. Among these, the Internet Protocol (IP) is vital for addressing and routing data across networks using unique numerical labels known as IP addresses, with IPv4 and IPv6 being the primary versions. The Transmission Control Protocol (TCP) works alongside IP to ensure reliable and ordered data delivery, forming the backbone of internet communication as part of the TCP/IP suite. The File Transfer Protocol (FTP) enables the transfer of large files between computers, typically in a client-server model, and is essential for managing

files on servers. For email transmission, the Simple Mail Transfer Protocol (SMTP) is used, facilitating the sending and receiving of messages between mail servers, while its extension, Extended SMTP (ESMTP), supports larger emails and attachments. Voice over Internet Protocol (VoIP) allows voice communications over the internet, offering an alternative to traditional telephone networks. Hypertext Transfer Protocol (HTTP) is crucial for transferring web pages and resources across the web and its secure version, HTTPS encrypts data for safe online interactions. User Datagram Protocol (UDP) is a communication protocol used in computer networks to send data packets between devices. Uniform Resource Identifiers (URIs), including URLs and URNs, are used to identify and locate resources on the internet. Together these protocols support the efficient functioning of the internet, enabling activities like web browsing, file sharing, email communication and voice calls.



9.12 ANSWERS TO CHECK YOUR PROGRESS

Ans to 1. a. network

b. 128

c. Public, Private

d. Voice over Internet Protocol

e. HTTPS

Ans to 2. a. i) Tim Berners-Lee

b. ii) FTP



9.13 FURTHER READINGS

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9.14 MODEL QUESTIONS

1. What is the main function of a protocol in networking?
2. What is the role of the Internet Protocol (IP) in data transmission?
3. What is FTP and how does it work?
4. How does Voice over Internet Protocol (VoIP) work.
5. What does HTTP stand for and what is its purpose in web communication?
6. What is the significance of a URL in internet browsing?
7. Explain the difference between a URL and a URI.
8. What is the role of communication protocols in ensuring effective data exchange in digital systems?
9. Explain the concept of the Internet Protocol (IP) and its functions in digital communication.
10. Describe the Transmission Control Protocol (TCP) and its significance in the TCP/IP protocol suite.
11. Discuss the importance of the File Transfer Protocol (FTP) in transferring large files over the Internet.
12. What is the Simple Mail Transfer Protocol (SMTP?
13. Explain the concept of Voice over Internet Protocol (VoIP).
14. What is Hypertext Transfer Protocol (HTTP), and how does it enable the transfer of web pages and multimedia content across the Internet?

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UNIT 10: BASICS OF INTERNET

UNIT STRUCTURE

10.1 Learning Objectives

10.2 Introduction

10.3 Definition

10.4 History

10.5 Components of Internet

10.6 Internet Protocol Address

10.7 Types of Internet Connections

10.8 Factors Affecting Speed of Internet Connectivity

10.9 Internet Based Services

10.10 Internet Browsing and Searching

10.11 Advantages and Disadvantage Of Internet

10.12 Let Us Sum Up

10.13 Answer to check Your Progress

10.14 Further Readings

10.15 Model Questions

10.1 LEARNING OBJECTIVES

After going through this unit, you will be able to –

- Know about the internet;
- Explain the components of the internet;
- Know different types of internet connections;
- Define different internet-based applications;
- Know about searching and browsing of the internet.

10.2 INTRODUCTION

Information technology consists of different components like electronics, computer hardware, software, and telecommunications.

Integration and application of the above technologies in information handling for efficient and effective information management is termed as information technology. By using it, we can obtain, process, store, transmit and output information in the form of voice, picture or text. A part of information technology is the Internet. If one has heard anything about computers, then he/she would have certainly heard about the Internet as well, as it is so popular that there is hardly anyone who has not come across the term.

Internet, a computer network, rather a network of networks, makes any information available at the touch of a button. The importance of internet lies on the fact that it is like a printing press of the technology era. It is like a huge central warehouse of data that can be accessed by people from all over the world. The internet represents one of the most successful examples of the benefits of sustained investment and commitment to research and development of information infrastructure. The internet today is a widespread information infrastructure, the initial prototype of what is often called the national (or global or galactic) information infrastructure comprising more than thousands of regional, national and international networks which connect people from all over the world. Internet has brought about drastic changes in social contact and tries to by pass physical face to face contact. Today, it is used daily by millions of people, who access it for a variety of purpose. There has been practically no technology being adopted at a rate similar to the internet. This unit will deal with the internet, the evolution of Internet, basics of Internet terms etc.

10.3 DEFINITION

On October 24, 1995 the FNC unanimously passed a resolution defining the term Internet. This definition was developed in consultation with the members of the internet and intellectual property right communities. "The Federal Networking Council" (FNC) agrees that the definition of the term "Internet" is reflect in the following expression: "Internet refers to the global information system that

a) is logically linked together by a global unique address space based on the Internet Protocol (IP) or its subsequent extension (follow-ons;

b) is able to support communication using the Transmission Control Protocol/ Internet Protocol (TCP/IP) Suits or its subsequent extension /follow-ons and / or other IP compatible protocol and

c) provides uses or makes accessible either publicly or privately high-level services layered on the communication and related infrastructure, described here in http://www.fnc.got/internet-res.html."

In simple term, the internet is an enormous network of millions of computers allowing constant communication throughout the world. It is a loose connection of related networks or a network of networks. It is made up of Local Area Network (LAN), Metropolitan Area Network (MAN) and huge Wide Area Network (WAN) of the whole world. It is a global information highway and a universal database of knowledge which itself collectively represents human society on a virtual life.

10.4 HISTORY

The first recorded description of the social interaction that could be enabled through networking was a series of memos written by J. C. R. Licklider of MIT, USA in August 1962 discussing his “Galactic network” concept. He envisioned a globally interconnected set of computers through which everyone could quickly access data and program from any site. The internet began to evolve when packet switching network came into operation in the 1960s. In Europe, when transmitted data is broken up into small packets and sent to its destination then the reassembled packet can also be compressed for speed and encrypted (converted into code) for security.

a) ARPANET: In 1968, a similar system as that of packet switching was developed in the USA. In 1969, Pentagon Commissioned Advanced Research Projects Agency Network (ARPANET) for research into networking. In the following year Vinton Cerf and others published their first proposal for protocol that would allow computer to “talk” to each other. Thus,

ARPANET began operating using the Network Control Protocol (NCP). The first host to host protocol, which went into operation at the US Defence Department's Advanced Research Projects Agency (ARPA) in 1969-1982. In 1974, Vinton Cerf joined Bob Kahn to present their "protocol for packet network interconnection" specifying the detailed design of Transmission Control Protocol (TCP), the basis of the modern internet. In 1978, TCP was split into TCP (now short for Transmission Control Protocol) an Internet Protocol (IP). When NCP was replaced by the new widespread Transmission Control Protocol / Internet Protocol (TCP/IP), a number of interconnected US military computers formed the first sizable internet for defence use (communication in the event of nuclear attack).

b) National Science Foundation: Internet really took off in the year 1980s when the National Science Foundation (NSF) used ARPANET to link its five regional super computer centres at major universities so that many users could share their work. Later on NSF created National Science Foundation Network (NSFNET), a series of networks for research and education communication. It was provided free to any US research and educational institution.

c) USENET: Usenet is actually a companion network to electronic mail started at Duke University and the University of North Carolina, USA and it also offers an unusual service called "Network News". Email was developed through ARPANET as did the Bulletin Board System (Usenet). Usenet, which began in 1979 contributes enormously to the internet's rapid expansion. Its spirit of information sharing and discussion was the hallmark of its system and was reflected in the Internet as a whole.

d) World Wide Web: By the end of 1980s the European Particle Research Laboratory (CERN) in Geneva was one of the premier internet sites in Europe. CERN desperately needed a better way of locating all the files, documents and other resources that now threatened to overwhelm it. Tim Berners Lee, a young British scientist working as a consultant for CERN, had found out an answer for the above problem. In 1991 his World Wide Web system assigned a common system of written addresses and hypertext link to all information. In 1991, the first www files were made available on

the internet for downloading using File Transfer Protocol (FTP). In October, 1993 there were around 200 known HTTP servers. In 1993, the National Centre for Supercomputer Application (NCSA) developed web browser (namely Mosaic) which took the internet by storm.

10.5 COMPONENTS OF INTERNET

The Internet consists of the WWW and all the hardware, software, protocols on which WWW runs. One of the main characteristics of Internet is that it is a decentralized system i.e there is no single person or organization that owns or control Internet, all who use Internet or supply material to it, have a role to play. However, there are organizations such as InterNIC, the National Science Foundation, the Internet Engineering Task Force, ICANN and the Internet Architecture Board which oversee and standardize what happens on Internet.

a) World Wide Web: The WWW is also called web. The WWW is a set of programs, standards, and protocols (set of rules) governing the way in which multimedia files (files containing a combination of text, graphics, photographs, audio, video) are created and displayed on the Internet. The difference between the Internet and the WWW is similar to the distinction between a computer and a multimedia program that runs on the computer. The Internet is a decentralized global network of computers that transfer information and the wiring that makes all these possible, whereas the web is a collection of documents or websites, that users can access using the Internet and a web browser.

b) Hardware: It means the computer (supercomputer, web server, and personal computer), modem (external or internal) and cables or telecommunication lines. The cables with jacks and rackets connect the modem with the computer and telephone. The users possess the terminal or the computer, modem, etc. The ISP procures the server that serves up web pages upon request.

i**) Modem:** Modem is a device that allows computers to communicate over telephone lines, it converts a digital signal to an analogue signal and vice versa.

c) Software: It includes the operating system and web browser.

i) Operating System: In case of Operating System, Windows, Linux or others will do. The higher versions of the OS are preferable because it has an inbuilt component to support internet connections.

ii) Web Browser: A web browser is the software program that is used to access the WWW or to visit web pages and display it in the computer screen, e.g. Internet Explorer, Google Chrome, Netscape Navigator, etc.

iii) Telecommunication Lines: The telephone companies own the equipment and cables that carry signals to the service providers.

d) Internet Protocol Suite: The Internet Protocol Suite [also known as Transmission Control Protocol / Internet Protocol (TCP/IP)] is the set of communication protocols used f or the Internet and other similar networks. It governs the way data travels from one machine to another across a network. It is named from two of the most important protocols in it: the Transmission Control Protocol (TCP) and the Internet Protocol (IP), which are the first two networking protocols defined in this standard.

The Internet Protocol Suite, like many protocol suites, may be viewed as a set of layers. Each layer solves a set of problems involving the transmission of data, and provides a well-defined service to the upper layer protocols based on using services from some lower layers. Upper layers are logically closer to the user and deal with more abstract data, relying on lower layer protocols to translate data into forms that can eventually be physically transmitted. The Internet Protocol Suite consists of four layers. From the lowest to the highest, these are the Link Layer, the Internet Layer, the Transport Layer, and the Application Layer.

In the application layer, the following are the common types of protocols

i) **HTTP:** Web pages are transferred between computers using Hyper Text Transfer Protocol.

ii) **ii) FTP:** Excluding web pages other types of files are transferred between computers by using FTP. It is a mechanism that allows placing and retrieving of files over the Internet. It allows anyone to download software, upgrading of downloaded softwares,

information and so on. It provides authorization of persons allowed to copy the files.

iii) Telnet Protocol: It is a simple programme created by National Centre for Supercomputer Application (NCSA) that uses TCP/IP to provide connection into another computer. Telnet allows a users' work station or terminal to behave as though it is directly connected to the machines where the user is logged in. It means that Telnet helps to operate remote computers from one's own desktop. The condition is that the user must have log-in account and passwords to access the remote computer.

i) Gopher Protocol: The University of Minnesota Microcomputer workstation centre created gopher to find information on the internet in a user-friendly way. It is a menu-driven programme that allows one to click with information server or "Gopher Holes" on the Internet to retrieve the information including text, sound and images. The gopher system is impressive owing to its simplicity volume and variety of information available. To retrieve information an indexing tool called Veronica is used that searches all gopher server using a set of keywords.

e) Internet Service Provider (ISP): An Internet service provider is an organization that provides some crucial portion of the Internet infrastructure to help connecting to the Internet. Sometimes the Internet Service Provider also responsible for telecommunication link i.e telephone connection to users' site, or in today's context Data Card providers and an internet account (username and password). The ISP provides the Internet connection to the user.

f) The Website: The Hyper Text Mark Up Language (HTML) is the commonly used language for creating the web documents or webpage. However, it is not the single one. A website is a set of related (linked through hypertext link) web pages, published by an organization or individual.

Normally it contains a home page along with other additional pages. The home page is the starting point or doorway to a website providing an overview of what could be found at the website. Home page is also known

as the index page or index. In Internet environment, the download refers to copying or saving the data, information from the internet to the local computer. Uploading is just the opposite of downloading. It is the sending of the data or information from the local computer to the Internet. The Online means staying connected to the Internet. The offline is just the opposite. Offline means that the user is no longer connected to a remote computer or the internet.

In Netscape Navigator, Bookmarks is a list of favourite web pages and Internet resources. One can add items to this menu at any time. Bookmarks are equivalent to favourite in Microsoft Internet Explorer.

10.6 INTERNET PROTOCOL ADDRESS

An Internet Protocol (IP) address is a numerical label that is assigned to devices participating in a computer network utilizing the Internet Protocol for communication between its nodes. An IP address serves two principal functions in networking: host or network interface identification and location addressing. The role of the IP address has also been characterized as a name that indicates what we seek. An address indicates where it is. A route indicates how to get there. The network portion of the IP address is allocated to the Internet Service Providers (ISP) by the InterNic under authority of the Internet Assigned Number Authority (IANA). ISPs then assign the host portion of the IP address to the machines on the network that they operate.

a) Uniform Resource Locator (URL): The location of a web page on the internet can be identified by a unique address which is called URL. Every single page of the hundreds of millions of pages stored on the web has a URL. The URL or the address tells the browser which document to fetch and exactly where to find it on a particular host computer some where on the internet.

b) Domain Naming System (DNS): The Internet uses an addressing scheme that employs the Domain Naming System (DNS). Domain names provided a system, an easy to remember internet address which can be translated by the Domain Names System (DNS) into the numeric address

(Internet Protocol Number). The internet protocol number is the numeric location of a particular computer so that it is an identifiable machine to all the other computers connected to the internet. The IP address is a 32 bit number divided into four octets and these octets are written in dotted decimal format eg. 11.245.196.212. Each octets numbers lie in between o and 255.

c) Internet Address: The Internet address is needed so that massage can be correctly routed to and from the machine over the network. Each part of the address goes from general to specific and consists of letters, numbers, and punctuation. The basic structure of URL is hierarchical. i.e Protocol:// Server name. Domain name. Top level domain name. port / Directory / File name. Eg: http://www.liswiki.com/wiki/index Protocol: The protocol is generally Hyper Text Transfer Protocol (HTTP). ://: It is a kind of separator that tells the browser that the next words will be actual URL.

10.7 TYPES OF INTERNET CONNECTIONS

The type of internet connection requirement depends on its uses. If the user wants an Internet mainly for sending e-mail, occasional chats, infrequent browsing then he should go for a dial-up connection. If the user is using the internet frequently for research, downloading or uploading a fair amount of data, play multi-player video games or live audio or video streaming, then he should look into other high speed accesses such as a cable modem or ISDN. The Internet connection generally can be categorized into the following

i) **Dial-up (analog up to 56k):** In a Dial-up, the telephone lines are used to connect to the Internet. Here to get connected, the user needs to specify a username, a password, and a telephone number.

ii) **Digital Subscriber Line (DSL):** DSL operates over normal telephone lines and it can be used simultaneously with the telephone. It can increase the connection speed by ten times from a standard dial-up modem.

iii) **Integrated Services Digital Network (ISDN):** ISDN involves the digitization of the telephone network so that voice, graphics, text, and other data can be provided to users from a single terminal over existing telephone wiring. It is four times faster than a Dial-up network.

iv) **Cable Internet:** A cable modem connects the user to the Internet through a cable television line. A cable modem will typically have two connections, one to the television outlet and the other to the computer. It is 10- 100 times faster compared to the dial-up modem and added interactivity to the television.

v) **Leased Line:** Leased line facility is provided via fiber optic or copper lines to provide data, voice and video links between two parties. It provides for a consistent amount of bandwidth. For example, T-1 Lines, T- 3 Lines, etc. It is especially useful for businesses connecting to the Internet and for Internet Service Providers (ISPs) connecting to the Internet backbone.

vi) **Internet over Satellite (IoS):** Here the data are transmitted via satellite to a dish antenna at the users' house. It allows a user to access the Internet via a satellite that orbits the earth. A satellite is placed at a static point above the earth's surface in a fixed position. Because of the enormous distances signals must travel from the earth up to the satellite and back again. IoS is slightly slower than high-speed terrestrial connections over copper or fiber optic cables.

i) **Wireless Internet Connections:** Wireless Internet or wireless broadband is one of the newest Internet connection types. Instead of using telephone or cable networks for your Internet connection, one can use radio frequency bands. Wireless Internet provides an always-on connection which can be accessed from anywhere- as long as one is geographically within a network coverage area. It is typically more expensive and mainly available in metropolitan areas.

Broadband is often called “high-speed” access to the Internet, because it usually has a high rate of data transmission. In general, any connection to the customer of 256 kbit/s (0.256 Mbit/s) or greater is more concisely considered broadband Internet access. The standard broadband technologies in most areas are DSL and cable modems.

Newer technologies in use include pushing optical fiber connections closer to the subscriber in both telephone and cable plants. Modems which use mobile phone lines [General packet radio service (GPRS), Universal Mobile Telecommunications System (UMTS), Wired Interoperability for Microwave Access (WiMax), etc.], are known as cellular modems. Cellular modems can be embedded inside a laptop or an appliance, or they can be external to it to access the Internet. External cellular modems are datacards and cellular routers. The datacard is a PC card or ExpressCard which slides into a Personal Computer Memory Card International Association (PCMCIA)/PC card/ ExpressCard slot on a computer.

10.8 FACTORS AFFECTING SPEED OF INTERNET CONNECTIVITY

a) Speed of the Modem: The speed of the modem greatly influences the speed of internet connectivity So, for getting higher speed one must procure a modem with a maximum speed of 56kbps or higher, if possible.

b) Quality of Phone Line: Noise on the phone line, running into the home, can disrupt internet connection with a modem. So, higher quality phone line should be used. If possible, ISDN should be implemented to solve the problem.

c) Internet Traffic: While hitting a popular site, one may be competing with the hundreds or thousands of others for the attention of that site server resulting in slow speed of access. The web traffic generally tends to expand throughout the day and peaks around the evening. So, for getting high speed one should try to change the time of the day he/ she is going for online.

d) Personal Computer: There are some other factors which are associated with personal computer. They are

i) **Processor:** For getting higher speed one should procure processors which have 650 MHZ or higher speed.

ii) **RAM:** Working with other software application at the time of browsing decreases the RAM capacity resulting in slow speed of access to the Internet. So, it is better to get higher RAM or avoid working with other software application while surfing.

iii) **Hard Disc:** A highly fragmented hard disc can slow down web surfing considerably. So, it is good to practice to keep the hard drive defragmented and optimized.

iv) **Browser's Cache:** Web browser's cache is a storage area on the computer's hard disc. As one surfs the browser stores the web pages that are already visited in the cache up to the disc space limit that one has set. When anyone tries to retrieve the same page after its first visit the browser displays the cached WebPages from the hard disc which is very fast and not from the Internet. So, if cache memory is small it slows down the access to the Internet. The solution is to increase the browser cache limit.

v) **Image Loading:** Today many files are very big and rich of data, picture, image, etc and so it takes longer time to download the images resulting in slow speed to Internet access. One can solve the problem by turning off image loading and java in the browser without affecting the content of a webpage. This can be done by selecting advanced Tab of Internet options in the Tool menu.

vi) **Working with Two or More Browser Windows at a Time:** To increase further surfing speed one can surf with two or more browser tabs or windows at a time. This will enable one to read the content of one page while allowing another page to load in the second windows. This may help to cut down the time lag and frustration.

10.9 INTERNET BASED SERVICES

Almost every protocol type available on the Internet is accessible on the web. There are many activities that can be performed online. Some

of the commonly used applications are only listed here in the following paragraphs

i) World Wide Web: It is a subset of Internet and it presents text, images, animation, video, sound, and other multimedia in a single interface. The operation of the web relies primarily on hypertext, as it is a means of information retrieval. Hypertext is a document containing words that connect to other documents and resources throughout the Internet.

ii) Email: Electronic mail or e-mail is a fast, easy, and inexpensive way to communicate with other internet users around the world. Email overcomes most of the problems and delays of getting a physical document from one person. It is one of the basic and earliest services of the Internet and the most used application on the Internet too.

iii) File Transfer Protocol (FTP): It is a system of rules and a software program that enables a user to log on to another computer and transfer information between it and his/her computer. FTP can be done using the command prompt, browsers, and various GUI based
FTP softwares such as CuteFTP and WS_FTP.

iv) Telnet: It allows a user to log on to a remote computer in such a way that a person may interact with another machine as if it is being used locally. The user's monitor displays what is taking place on the remote computer during the telnet session.

v) Chat: Chat programs allow the users on the Internet to communicate with each other by typing in real time. It is sometimes included as a feature of a website.

vi) Internet Telephony: Internet telephony is the use of Internet to exchange spoken or other telephonic information. The required hardware for Internet telephony generally consists of end devices (either traditional telephone or audio-equipped personal computers) and gatekeepers that provide call admission control, bandwidth management, addresses translation, authentication, and user location. There are many Internet telephony applications available, for example CoolTalk, NetMetting, etc.

vii) Video Conferencing: It enables direct face-to-face communication

across networks using audio, video, and the data. In video conferencing, web cameras, microphone, and other communication tools are necessary.

ix) E-Commerce: E-commerce refers to buying and selling goods and services online.

x) Mobile Commerce: M-commerce or mobile commerce refers to transactions through a mobile phone network and data connection that results in the transfer of value (monetary or otherwise) in exchange for goods and services.

xi) Mailing List (Listserver): It is a method of sending and receiving discussions via e-mail, organized around some topics within a large community.

10.10 INTERNET BROWSING AND SEARCHING

Searching or browsing in Internet environment is nothing but retrieving of relevant results from the Internet.

a) Browsing: In Internet environment, browsing refers to opening a website through the web browser that contains hyperlink and with the help of these hyperlinks, jumping to a new web document in the same or a new window. It is also known as navigating or surfing the web.

i) Working with Address box of the Browser: In the online mode one can use web browser for arriving at a particular address. In the “Address” box of the browser, typing the web site’s address (URL) and pressing the “Enter” button of the keyboard or by pressing “Go” button, the browser will open a particular website. When the web site opens, its home page is displayed. The keying appropriate URL in the address box of the browser is obligatory. The website or home page will contain links to other website or hyperlinks. By clicking on the highlighted words or links one can access other files of the same website or entirely a different website.

ii) Working with Mouse: While we are on a webpage, we can use the vertical or horizontal scroll bars to move around or through a document.

iii) Working with Keyboard Keys: We can use “Up” (?) and “Down” (?) arrow keys to move up or down one line. Pressing the “Page Up” (PgUp)

key moves up one window length, and pressing “Page Down” (PgDn) moves down one window length. Pressing “Ctrl+Home”
takes us to the beginning of the document and pressing “Ctrl+End” take us to the end of the document.

iv)Working with Hyperlink in the Document: A webpage contains many hyperlinks in the form of text as well as images. When you move your mouse cursor over the hyperlink it will take the form of a hand with a pointing index finger ( ). You can open the hyperlink by just clicking on it. You can also open a hyperlink by right clicking it and selecting the “Open” option from the shortcut menu, or by selecting the “Open in a New Window” option to open the link in a new window.

v)Working with Back, Forward button of the Browser: If you browse through several pages in a window, you can move backward and forward by clicking the “Back” (?) and “Forward” (?) button in the standard toolbar. These two options will only back or forward one page at a time. But you can also select from the list of pages by placing the mouse pointer over the “Back” button and then by clicking on the down arrow (?) besides the button, and then clicking on any site from the list of previously visited sites. Clicking on the “Stop” button stops whatever the browser is doing and will wait for your next instruction. It is particularly useful for undoing mistakes.

b**) Searching the Internet**: Internet is a huge collection of information so it needs the search query to be specific; otherwise, it will retrieve some irrelevant results. Searching means finding or locating information through some search engines, directories, databases, etc. Generally, all searching tools provide you an option in the form of search box to conduct a search. The search over Internet is interactive, provides post co-ordinate search facilities and produces more results at a higher speed at a reduced cost.

Some of the well-known search engines are Google (http://www.google.com), Bing (http://www.bing.com), and Ask/Aj/Ask Jeeves (http://www.ask.com). Most search tools have a similar structure. All will include in some form i) form for you to enter your keywords, ii) a button which will begin your search, iii) links to help pages and advanced

search tools, normally located near the search form, iv) special features and options, and v) subject categories (most).

i) Keyword Search: This is most generally used over the web. In this technique, the document available in the WWW is generally searched by using keywords in the search box of a search engine; use of preposition, articles and such other words are avoided in this type of search. E.g. searching for Mahatma Gandhi, India in Google (http:// www.google.co.in). Results from this method are often mixed and you may have to go through many results to find the site most useful to you. For keyword based search, the search strategy may include

identifying keywords by breaking down the topic into key concepts.

ii)Phrase Search: When a user is quite aware of all the words that occur in the same sequence in the relevant digital document, then he/she can use phrase (or proximity) search techniques. In such cases the search terms were down the search results considerably. Surrounding a group of words with double quotes tells the search engine to only retrieve documents in which those words appear sideby- side; e.g. “God of Small Things”, “Five Laws of Library Science”, (Five Laws of Library Science), etc.

iii) Wild Card / Truncation Search: When a user is aware only of some of the letters that are contained in the keywords then he / she can use wild card search technique to retrieve all the documents containing the words which again contain the particular letters stated

by the user. In wild card search techniques the known letters are followed by an asterisk “*” or sometimes by a “?” mark. The asterisk or question mark may be given in the left, right or in both sides of the known letters as the case or need may be; e.g. Cata*, to retrieve document containing the word “cataloguing”, “cataloguer”, “catalogues”, etc. i.e the search engine will find all the words that containkeying letters as prefix letter of a particular word. Wildcard features allow variations in spelling or word forms.

iii) Boolean Search: Most of the search engines use “and” “or” and “not” as boolean search query, some uses “*”, “+” and “-” for the same purpose.

Eg: Five laws of library science * S. R. Ranganathan, to retrieve all documents containing the words “Five laws of library
science” and “S. R. Ranganathan”. In most cases the Boolean operators “and” “or” and “not” are used to connect the key concepts.

iv) Natural Language Search: Some search engine uses natural language search queries i.e the user is free to use natural language query to retrieve the relevant result. The system will automatically ignore the unnecessary words. This is true in http://www.altavista;
http://www.askjeevas.com, etc. Eg.: Who is the Prime Minister of India, to retrieve the name of the Prime Minister of India or to retrieve thousands of pages not containing the word “Who”.

v)Complex Search: In this type, combinations of the above search techniques are used to retrieve more relevant results. For example, one can combine phrase searching with implied Boolean operator. E.g.: “Classified catalogue code” * “S. R. Ranganathan”.

vi) Field Search: A web page is composed of a number of fields, such as title, domain, host, URL, and link. So, field searching is one of the most effective techniques for narrowing results and getting the most relevant websites listed at the top of the result page.

vii)Meta Search: The content of search engines, indexes and databases generally vary. So, if the same search query is typed into several search engines then it is likely to produce different results. So, a user may often want to know to see the results from various
search engines. In such cases he/she can use the Meta search engine to get single input or query and to retrieve results from different search engines. Some example of Meta search engines are http://www.search.com, http://www.albany.net/allinone, etc.

viii) Database Searching: Searching the directory or database is entirely a new experience. One can search the directory or databases by the specific entry point, which the particular directory or database is using to search its records. In case of a database of books the access point can be the title of the article/document/author/editor/ accession no, etc. In the database

searching, one can also save his/her result in accordance to his/her requirement. Some common examples of databases are http://www.sciencedirect.com, http://www.jstor.org, etc.

10.11 ADVANTAGES AND DISADVANTAGE OF INTERNET

a) Advantages

i) Central Repository of Information: The Internet is like a huge central warehouse of data that can be accessed by people from all over the world.

ii) Direct Communication: Through email, chat, internet telephony, video conferencing, etc. one can directly communicate with others.

iii) Round the Clock Availability: Information on the internet is available to the user 24 hours a day and 365 days of the year.

iv) Cheapest Medium: Internet is perhaps the cheapest medium for online help, troubleshooting assistance, for getting specific information, etc.

v) Distance Learning: It provides the facility of learning remotely without physically coming in contact with the teacher, the school or university.

vi) No Barrier: In the internet environment any one can, be author /writer / publisher and users of the information. There is no barrier in this regard.

b) Disadvantages of Internet

i) Copyright: Digitization violates the copyright laws as the thought content of one author can be freely transferred to another without his acknowledgement.



ii) Incompatible Hardware and Software: The hardware and software are modified every day. So, a document that is available in one format may not be accessible in the days to come. So, one has to upgrade the hardware and software configuration as and when needed.

iii) Artificial Environment: The environment created by Internet is an artificial one.

iv)Volatile Information: The electronic environment though very exciting

and stimulating is also quite volatile.

CHECK YOUR PROGRESS

Q 1: Match the Following

a) Internet Explorer	a) Operating System.
b) Google Chrome	b) Web Browser
c) Windows	c) Domain name for non-profit rganization.
d) .org	d) Web Browser.
e) .com	e) Search engine.
f) .in	f) Domain name for commercial entities.
g) Google	g) Domain name for India.

Q 2: Expand the Following Abbreviations

a) ARPANET.

b) DNS.

c) FTP.

d) GPRS.

e) HTML.



f) HTTP.

g) IP.

h) ISP.

i) LAN.

j) MAN.

k) NCP.

l) NSF.

m) TCP/IP.

n) URL.

o) WAN.

p) WWW.

10.12 LET US SUM UP

Internet is the largest of all other networks connecting a large number

of smaller interconnected networks, so it is a computer based worldwide network connecting other smaller networks. It is a global network linking millions of computers and people cutting across all barriers and boundaries of countries, race, class or sex. Internet can also be described as a collection of government, academic, commercial and individual sites.



The launching of ARPA in 1957 by Sputnik, and European Particle Research Laboratory (CERN) are at the backend in the development of the Internet. The Internet mainly consists of the WWW and all the hardware, software, and protocols. To get connected to the internet, the user will need a computer, a modem (internal / external), and an Internet account with the ISP.

The usefulness of Internet lies in its characteristics of the Worlds Greatest Library where everybody will find it as a vast pool of information; it is the Wide Area Network, and much more. Besides, it also provides the latest information on any topic available round the clock and from a wide distance.

10.13 ANSWERS TO CHECK YOUR PROGRESS

Ans to Q No 1:

a) Internet Explorer	a) Web Browser.
b) Google Chrome	b) Web Browser
c) Windows	c) Operating System
d) .org	d) Domain name for non profit organization.
e) .com	e) Domain name for commercial entities.
f) .in	f) Domain name for India.
g) Google	g) Search engine.

Ans to Q No 2 :

a) ARPANET: Advanced Research Projects Agency Network.

b) DNS: Domain Naming System.

c) FTP: File Transfer Protocol.

d) GPRS: General packet radio service.



e) HTML: Hyper Text Mark Up Language.

f) HTTP: Hyper Text Transfer Protocol.

g) IP: Internet Protocol.

h) ISP: Internet Service Provider.

i) LAN: Local Area Network.

j) MAN: Metropolitan Area Network.

k) NCP: Network Control Protocol.

l) NSF: National Science Foundation.

m) TCP/IP: Transmission Control Protocol / Internet Protocol.

n) URL: Uniform Resource Locator.

o) WAN: Wide Area Network.



p) WWW: World Wide Web.

10.14 FURTHER READINGS

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10.15 MODEL QUESTIONS

1. Define Internet.
2. Write a brief history of Internet.
3. What are the different factors that affect the speed of Internet connectivity?
4. Write a descriptive note on the components of Internet.
5. Briefly describe the Internet protocol address.
6. What are the different types of Internet connections? Describe each of

them.

7. Describe the Internet applications.
8. Describe searching and browsing of Internet.

*** *** ***

UNIT 11: INTERNET APPLICATIONS

UNIT STRUCTURE

11.1 Learning Objectives

11.2 Introduction

11.3 Electronic Mail (Email)

11.4 Online Chat

11.5 World Wide Web

11.6 Search Engines

11.7 E-commerce

11.8 Online Discussion Forum

11.9 Let Us Sum Up

11.10 Answer to check Your Progress

11.11 Further Readings

11.12 Model Questions

11.1 LEARNING OBJECTIVES

After going through this unit, you will be able to –

- Know about Email and Chat
- Explain the use of Search Engine
- Know the use of online discussion

11.2 INTRODUCTION

Internet is the network of networks. It provides a base structure for different applications / services. Such applications may include Email, chat, discussion forum. Some of these applications are discussed here in this unit. Email can be defined as the process of exchanging messages electronically, through a communication network, using the computer. Using email, one can exchange messages with someone else on the internet. It reaches its addresses within seconds and the people at large using it. Chat

puts people online in a live conversation with other internet users around the globe. A search page is a web page where a search of the web can be conducted. If someone is good at framing the search queries, it will help them in finding exactly what they are looking for, anywhere on the web. Discussion forums are great ways to keep up with a subject. It broadens one's mind by displaying different points of view or perception on a single idea or concept.

11.3 ELECTRONIC MAIL (EMAIL)

The Electronic mail often abbreviated as Email, email, e-mail or simply mail. It enables us in exchanging digital messages. Electronic mail can be termed as the fastest post office which is the most commonly used service of the internet. The messages can be sent instantaneously to any individual who has an email address or to many persons at the same time. The foundation for today's e-mail service was created in the early ARPANET in extension to the File Transfer Protocol (FTP). An e-mail sent in the early 1970s looked very similar to one sent on the Internet today but today it is carried by the Simple Mail Transfer Protocol (SMTP).

a) Email Address: The email address has three basic components. The "username", the "@" sign and the "users' location or domain". Each Email address goes from the specific to the general. A typical example is "lis-forum@ncsi.iisc.ernet.in". Here

lis-forum: It is the user id.

@: It is a separator between user id and different organizational level of the institution.

Rest: The rest portions after "@" sign are the level of the domain name. Levels of the domains are nothing but different organizational levels. In the above example there are four levels to the domain name.

ncsi: It stands for National Centre for Scientific Information.

iisc: It stands for Indian Institute of Science. The National Centre for Scientific Information is a part of the Indian Institute of Science.

ernet: It stands for the Education and Research Network. The IISC is

covered under ERNET.

in: It stands for India.

The above one is a very complex example of email address. However, our mostly used email address has only three to five components. For example, in the rohit@gmail.com email id, “rohit” is the user id, “@” is the separator, “gmail” stands for Google Mail, which is the email service provider, and “.com” means Gmail is the commercial organization.

b) Anatomy of Email Message: Messages in an electronic mail consists of three major sections. The message header, the message body, and attachment. The first two form the email’s content.

i) Header: The message header contains control information, including, minimally, an originator’s email address and one or more recipient addresses. Usually, additional information is added, such as a subject header field structured into fields like summary, sender, receiver, and other information about the e-mail. The message header generally includes at least the following fields: From: It includes the e-mail address and, optionally, the name of the sender who sends the email. The field is filled up automatically when a message is sent.

To: Here the e-mail address(es) and, optionally, name(s) of the message’s recipient(s) is/are included. It indicates primary recipient (more than one allowed), for secondary recipients **Carbon copy (Cc) and Blind Carbon Copy (Bcc)** is used to make the data individual to other recipient. The “To:” field is similar to the addressing at the top of a conventional letter which is delivered according to the address on the outer envelope. Many e-mail clients will mark e-mail in the inbox differently depending on whether the addresses are in the “To:” or “Cc:” list.

The difference between the CC and BCC is that CC allows you to send a copy of email to one or more recipients, and all recipients can see who else received the email. BCC allows to send a copy of your email to one or more recipients without anyone else seeing their email addresses.

Subject: A brief summary of the message.

Date: The local time and date when the message were written. Many email

clients fill this in automatically when sending. The recipient's client may then display the time in the format and time zone local to her.

Message-ID: It is also an automatically generated field used to prevent multiple deliveries and for reference in "In-Reply-To". The In- Reply-To is used to link related messages together.

ii) Body: The e-mail clients generally allow the use of either plain text or HTML for the message body at the option of the user. HTML email messages often include an automatically-generated plain text copy as well, for reason of compatibility. The body sometimes contains a signature block at the end. This is exactly the same as the body of a regular letter. The header is separated from the body by a blank line.

Advantages of HTML extend to the ability to include inline links and images, to set apart previous messages in block quotes, wrap naturally on any display, use emphasis such as underlines and italics, and change font styles. Its disadvantages includes- the increased size of the email, privacy concerns about web bugs, abuse of HTML email as a vector for phishing attacks and the spread of malicious software. Mailing lists commonly insist that all posts to be made in plain-text for all the above reasons. Again, a significant number of readers using text-based e-mail clients. So, avoiding HTML can guarantee delivering the email.

iii) Attachments: The attachments are the files that are sent through the email. Many email systems do not allow the software or the file that contains "setup.exe" to be sent through email as attachments.

c) Advantages and Disadvantages of Email: There are numerous ways in which people have changed the way they communicate. E-mail is certainly one of them, particularly when others live at a distance. E-mail provides a way to exchange information between two or more people with no set-up costs and with little or no expense. With real time communication by meetings or phone calls, participants have to work on the same schedule, and each participant must spend the same amount of time in the meeting or call. E-mail allows each participant in controlling their schedule independently.

Most information or business workers today spend from one to two hours of their working day on e-mail: reading, ordering, sorting, and writing.

The advantages of email over post offices are –

i) Its high speed;

ii) No cost of paper envelops and postal system;

iii) The system provides surety of the delivery of mail because if the mail is not delivered due to some reason, then the undelivered mail bounces back to the sender, mostly within minutes.

iv) The email also allows to attach word processing document, picture, graphic, video etc.

The disadvantages of email are: it is a push technology i.e the sender controls who receives the information. Convenient availability of mailing lists and use of "copy all" can lead to people receiving unwanted or irrelevant information of no use to them. The other problems include Information overload, spamming (unsolicited commercial or bulk e-mail) computer viruses, e-mail bombardment (the intentional sending of large volumes of messages to a target address), phishing (the criminally fraudulent process of attempting to acquire sensitive information such as usernames, passwords and credit card details by masquerading as a trustworthy entity in an electronic communication), e-mail worms (using e-mail as a way of replicating themselves into vulnerable computers) and E-mail spoofing (when the header information of an email is altered to make the message appear to come from a known or trusted source. It is often used as a trick to collect personal information).



ACTIVITY

1) Open a Gmail account and use it to communicate with your friends.

2) Send an email to your friend informing him/her about the Certificate in Library and Information Science course of KKHSOU. Also, attach your biodata to him in the same email.



CHECK YOUR PROGRESS

Q 1 : Find out the True and False Sentences in the following

a) Gmail stands for Google Mail.

b) In the Email “In-Reply-To” is used to link related messages together.

c) Many email systems allow file that contains “setup.exe” to be sent through email as attachments.

d) In the Email environment, Cc means Carbon copy and Bcc means Blind Carbon Copy.

11.4 ONLINE CHAT

Online chat refers to the text-based (keying or type words) communication between two or more participants over the internet / intranet in real-time. Sometime it is also known as synchronous conferencing, or Instant messaging (IM). Online chat is also referred to as web chat. The expression online chat comes from the word “chat” which means “informal conversation”. In some chat program the users need to instal some specialized software whereas in some others, only the internet browser is necessary. There are also Graphical User Interface (GUI) for text-based chat rooms which allow users to select an identifying icon and to modify the look of their chat environment.

Synchronous conferencing or Real Time Chat is the formal term used particularly in computer-mediated communication, collaboration and learning, to describe online chat technologies. Today it is also occasionally extended to mean audio/video conferencing or instant messaging systems, provided that they also have a text-based multi-user chat function.

Synchronous conferencing protocols include Internet Relay Chat (IRC), Protocol for Synchronous Conferencing (PSYC), Secure Internet Live Conferencing protocol (SILC), Extensible Messaging and Presence Protocol (XMPP).

Chatiquette describes the basic rules of online communication. To avoid misunderstanding and to simplify the communication between the users in a chat these conventions or guidelines have been created. Chatiquette varies from community to community, generally describing basic courtesy; it introduces the new user into the community and the associated network culture. As an example, in Chatiquette it is considered rude to write only in UPPER CASE, because it looks as if the user is shouting.

a) Types of Online Chat: Based on the number of users that participate in the chat it can be of the following types

i) 1 – on – 1 Chat: 1-on-1 or private chat refers to an environment where only two people share their knowledge base.

ii) Group Chat: Here more than two people chat over an interface and share their thought.

Stranger Chat or anonymous chat is an environment where each other identity remains hidden.Chat can also be categorized based on cost factor as commercial or paid and free; based on type of software used as Open Source (eg. Adium), and Proprietary (eg. Digsby).

b) Importance of Chat: Internet chat allows one to connect with people all over the world in real time. The primary use of a chat room is to share information via text with a group of other users. New technology has enabled the use of file sharing and webcams to be included in some programs and almost all Internet chat or messaging services allow users to display or send to each other photos.



ACTIVITY

1) Invite your friends for chat in Gmail, accept the invitation from other friends and chat with them.

c) Examples: There are thousands of chat programs available over the web. In the following, some commonly used free chat services are listed. An expertise in two or three will be an added advantage for you. We recommend you to use Google Talk or chat that is integrated with your Gmail. To use this service, you can use your own Gmail id and password.



CHECK YOUR PROGRESS

Q2. What is Chat?

Q3. What is Chatiquette?

Q4. What do you mean by anonymous chat?

11.5 WORLD WIDE WEB

The World Wide Web (WWW), commonly referred to simply as the “web,” is a vast network of interconnected documents and other resources, linked by hyperlinks and URLs (Uniform Resource Locators). It is one of the most significant innovations in modern technology, allowing billions of people worldwide to access information, communicate, and share content in ways that were once unimaginable.

- WWW was invented by Tim Berners-Lee in 1989 at CERN (European Organization for Nuclear Research). The goal was to facilitate information sharing between researchers.
- Key technologies developed: HTML (HyperText Markup Language), HTTP (HyperText Transfer Protocol), URLs.
- The first website was launched in 1991.

How does WWW work for users?

- **Web Browsers**: Web browser (like Chrome, Firefox) used to access the web.
- **Web Servers**: Web servers store and deliver web pages to users.
- **Hyperlinks**: Hyperlinks are the links that connect web pages to one another.
- **Web Pages**: Web pages are created using HTML, CSS, and JavaScript.
- **Search Engines**: Search Engines are the tools (Google, Bing) for finding specific content on the web.

Impact of the Web

- It revolutionized global communication through email, social media, and messaging apps.
- E-commerce emerged with online shopping platforms like Amazon

changed global commerce.

- Online learning platforms made education more accessible.
- On-demand streaming services reshaped entertainment consumption.
- The web became a tool for social movements and activism.

Evolution of the Web

- **Web 1.0**: Basic, static websites for information sharing.
- **Web 2.0**: Interactive, user-driven web with social media, blogs, and wikis.
- **Mobile Web**: Increased mobile access and apps.
- **Web 3.0**: The rise of Artificial Intelligence (AI), Virtual Reality (VR), Augmented Reality (AR), and Decentralized Technologies.

Challenges

- **Privacy and Security**: Concerns over data protection and user privacy.
- **Cybersecurity**: Increased risks from hacking and cyberattacks.
- **Digital Divide**: Unequal internet access around the world.
- **Content Moderation**: Managing harmful or false information online.

11.6 SEARCH ENGINES

A search engine is a program or system designed to help retrieve information from databases stored on computers, which can be public servers on the web, corporate networks, or personal computers.

- **Archie (1990)**: Created by Alan Emtage, a student at McGill University, for searching anonymous FTP sites. Known as the grandfather of all search engines.
- **Veronica (1993)**: Developed by the University of Nevada System Computing Service group. It was similar to Archie but designed for searching gopher files, considered the grandmother of search engines.
- **World Wide Web Wanderer (1993)**: Created by Matthew Gray at MIT, it was the first web robot, generating an index called “Wandex”

to measure the size of the World Wide Web.

- **Aliweb (1993)**: The second search engine for the web, developed by Martijn Koster. Unlike others, it didn't use a web robot but relied on website administrators to notify it of index files in a specific format. Aliweb is no longer maintained.
- **Real-Time Search Technology (2003)**: In December 2003, Orase introduced its first version of real-time search technology, offering improved performance and new features.

a) Component of a Search Engine: A general search engine typically functions by considering three components.

i) Web Crawlers/Spiders/Robots: Web crawling is the process of locating, fetching, and storing web pages. A web crawler (or spider/robot) is a program that starts from a seed page, locates new pages by extracting hyperlinks, and stores these links in a FIFO queue for further retrieval. Crawling continues until the queue is empty or a set number of pages are downloaded. When a spider visits a page, it scans the text and follows all links. Some search engines, like Google, store the entire scanned page, while others, like Altavista, only store the words in an expanding database known as cached pages. The content is then analyzed, and URLs and words are catalogued in an index database for future queries.

Indexer: The indexer parses the downloaded content and transforms it into an inverted index, which makes the data compact and easily searchable. These indexes are regularly updated to ensure efficiency. Most search engine databases are created automatically by spiders or robots.

Query Processor: The query processor evaluates user queries and returns relevant pages. Users enter specific keywords, and the engine searches the index for matching results, providing a list of the most relevant pages along with a brief summary. The results are often sorted by relevance, and because databases are large, search engines can return thousands of results.

b) Site Ranking in Search Engines:

Ranking methods and the order of results vary between search engines and change over time. Google is widely regarded as one of the most effective

engines, but researchers at NEC Research Institute have improved Google's page rank technology. Their method uses web crawlers to find "communities" of websites by following links across pages. The algorithm indexes the number of cross-links, grouping pages into virtual communities based on these connections.

c) Types of Search Engine: Configurable Unified Search Index (CUSI) search engines, like All-in One Search Page and W3 Search Engines are pages which list search engines.

The search engines can be categorized based on the coverage as

i) Web Search Engine: It is used to search for information on the public Web.

ii) Enterprise Search Engines: They are used to search for information on intranets.

iii) Personal Search Engines: It is used to search for information within the contents defined by the user(s).

iv) Custom Search Engine: It is used to search for information within the contents defined by the user(s).

v) Meta Search Engine: The content of search engines indexes and databases will vary. So if the same query is typed into several search engines it is likely to produce different results, Because of this in searching a topic a user often wants to see results from various sources. One way to compare the results of several search engines is to type and retype a query into individual search engines one at a time. However, this can be very time consuming. A Meta searcher helps to make this task more efficient by providing a central location where the query is typed in once and the result can be obtained from multiple search engines. Meta Crawler, Search.Com (http://www.search.com), etc are examples of Meta search engines.

Based on the contents that are considered for search, search engine can be categorized into following types.

i) Web Search Engine: Search all types of contents over the web. E.g. Google (http://www.google.com).

ii) Discussion Group Search Engine: Search only discussion groups. For example Google groups (http://groups.google.co.in), Yahoo groups (http:/

/in.groups.yahoo.com/).

iii) Blog Search Engines: Search only Blogs. For example, Google blogs (http://blogsearch.google.co.in), etc

i**v) Image Search Engine:** Search images. For example, Google images (http:// images.google.co.in), etc.

v) Maps Search Engine: Search maps. For example, Google maps (http:/ / maps.google.co.in), etc.

vi) Video Search Engine: Search videos. For example, blinkx (http:// www.blinkx.com/), fooooo (http://en.fooooo.com/), Truveo (http:// in.truveo.com/), Google videos (http://video.google.com/), etc.

vii) Hypermail Search Engine: It searches for mailing lists.

viii) Hypernews Search Engine : It searches for USENET newsgroups.

i**x) News Search Engine:** It searches for news. For example, Google news (http://news.google.co.in).

x) Books Search Engine: It searches for books. For example, Google books (http://books.google.co.in).

xi) Subject Directory Search Engine: They search Web directories which are maintained by human editors. They include a keyword search option which usually eliminates the need to work through numerous levels of topics and subtopics. For example, DMOZ.org, Yahoo! (http://www.yahoo.com/), Looksmart (http:// www.looksmart.com/), etc.

Some other types of search engines are presented in the following points.

i) Crawler based Search Engine: WebCrawler that was launched in April 1994 was the first "robot" keyword search engine. Its robot program indexes the entire content of pages retrieved but not URLs embedded in those pages. WebCrawler acquired by America Online

in June 1995. World Wide Web Word was also a robot based search engine; it indexes only HTML document titles, text explaining page links and URL's.

ii) Human-Powered Search Engines: The Human-Powered Search engines search the pages or websites that are collected for index by the human. The examples of such type of search engine include: Anoox <http:/ /www.anoox.com/>, ChaCha <http://www.chacha.com/

>, Collarity <http://www.collarity.com/>, Earthfrisk <http:// earthfrisk.org/>, iRazoo <http://www.irazoo.com/>, Mahalo <http:// www.mahalo.com/>, Sproose <http://www.sproose.com/>, Wikia Search <http:// alpha.search.wikia.com/>, etc.

iii) Mobile Search Engines: The Mobile Search Engine is a search engine used in mobile devices (smartphone, tablet etc.). For example, Google mobile (http://www.google.com/mobile)

iv) Simultaneous Unified Search Engine (SUSI): The WebCompass acts as a personal SUSI search engine, where the user defines a set of search engines in a local database, defines a concept map of terms with associated search word, and then configure WebCompass to keyword search. A personal edition of WebCompass and other shareware packaged with similar capabilities are freely available. Other SUSI based services like SavvySearch or MetaCrawler search a range of search engines at a time. The drawback of SUSI is that their response time is slower.

v) Personalized Web Search: Google developed a personalized web search whereby the user can set up a profile and retrieve the results based on their interests.

vi) Grid Search Engine: A grid search engine can be defined as "a type of a parallel and distributed system that enables sharing, selection, and aggregation of geographically distributed autonomous resources dynamically at runtime depending on their availability, capability, performance, cost, and users' quality-of-service requirements". In a grid search engine, for each user query an individual crawl is started over the fresh copies of the Web document i.e the original one but not the cached one, and the relevant pages are selected. In this way, up-to date versions of the pages are evaluated and accuracy of the resulting answer set of pages is enforced. The grid search engines are sometimes known as Real Time Search Engine. For example, in December 2003, Orase published the first version of its new real time search technology.

vii) Natural Language Queries (Index Crawling): It refer to the ability of search engines or systems to understand and process queries in the form of natural, human language rather than relying on keyword-based searches.

For example, Altavista, Ask Jeevas.

viii) Freeware Search Software: Freeware Search Softwares are used via a WWW servers CGI, like freeways, Glimpse and SWISH (Simple Web Indexing System for Humans). In near future it is no doubt that some subject search engines will come out to overcome the problem of general search engines.

d) Importance of Search Engine: Search engines are the most popular destination on the internet. Again, the cached pages maintained by some search engines are very useful when the content of the web page has been updated and the search terms are no longer in it, or the web page is no longer available or the site's server is down. So, in such cases when a particular website is withdrawn one can search for cached pages for the data that may no longer be available elsewhere. Without search engine, to try to find what you need can be like finding a needle in a haystack. To use search engines effectively, it is essential to apply techniques that narrow the results and push the most relevant pages to the top of the results list.

e) Examples of Search Engine: Nowadays, we have thousands of search engines for searching over internet. Each of the search engines makes an appearance over the web; continues for some time, then the new one emerges and the old one falls to decay and disuse. Some of the popular types of search engines, which create new milestone in the origin and development of search engines, are discussed bellow

i) Lycos: Lycos (http://www.lycos.com/) was started at Carnegi Mellon University as a research project in 1994 and it was one of the first engines. It ceases crawling the web for its own listing in April 1999 and instead uses crawler based results provided by Fast i.e All the
Web.com. Now it is owned by Terra Lycos, a company formed with Lycos and Terra Networks merged in October 2000.

ii) Altavista: Altavista (http://www.altavista.com/) was originated in 1995. It was the first search engine to use natural language queries (index crawling), meaning a user could type in a sentence like "Who is the Prime Minister of India" and does not get a million pages containing the word "Who". AltaVista also offers a number of powerful search features not found elsewhere.

One very effective tool available on the Advanced Search page is the NEAR search. A NEAR search limits the results to pages where the keywords appear within 10 words of each other. This can be extremely helpful in situations where an AND search produces too many results and a phrase search (“”) produces too few results. Altavista also provides news and multimedia which was owned by Digital Equipment Corporation.



ACTIVITY

1) Search over Google for the term “KKHSOU” without quotes and check all the first ten links it retrieves.

iii) Google: Google (http://www.google.com) was originally a Stanford University project by student Larry Page and Sergey Brain called Back Rub. In 1998 the name had been changed to Google and the project jumped off campus and became private company. In around 2001 the Google search engines rose to prominence. Its success was based in part on the concept of link popularity and page rank which is very adept at returning the relevant results. Page rank is based on citation analysis that was developed in the 1950s by Dr. Eugene Garfield at the University of Pennsylvania. The page rank takes into consideration by how many other websites and web page linking pages and the number of links on these pages contribute to the page rank of the linked page. This makes it possible for Google to order its results by how many website links to each found page. Finally, unlike other search engines, Google offers a cached copy of each result.

iv) Yahoo: Yahoo (http://www.yahoo.com), the huge subject tree was started by two Stanford graduate students David Flo and Jerry Yang. They created a list of their favorite site. The list grew bigger and bigger and in time has becomes the Yahoo. In 2002, Yahoo acquired Inktomi and in 2003 Overtune, which owned All the web and Altavista. In 2004 Yahoo launched its own search engines based on the combined technologies of its acquisition and providing a service that gave pre-eminence to the web search engine over the directory. The other popular search engines include All the Web (http://

www.alltheweb.com/), HotBot (http://www.hotbot.com), Excite (http://www.excite.com/), etc.



CHECK YOUR PROGRESS

Q 5 : Find out the True and False Sentences in the following

a) Archie is the grandfather of all search engines.

b) The cached pages are the scan copies of the websites.

c) Meta Crawler is a personal search engine

d) DMOZ.org is a web search engine.

e) Google is a Meta Search engine.

f) Altavista uses natural language queries.

g) Larry Page and Sergey Brain developed Google.

11.7 E-COMMERCE

E-commerce, or electronic commerce, refers to the buying and selling of goods and services through the internet. It involves businesses, retailers, and brands using online platforms or their own websites to handle payments, process orders, and ship products directly to customers. Over time, e-commerce has grown into a multi-billion-dollar industry, revolutionizing how businesses and consumers interact.

History of E-commerce

E-commerce traces its roots back to the 1960s when businesses began using Electronic Data Interchange (EDI) to electronically exchange business documents. The first recorded e-commerce-like activity occurred in 1971 when students at Stanford University used ARPANET to buy and sell marijuana, although this was short-lived. In 1979, entrepreneur Michael Aldrich pioneered online shopping by connecting a modified television to a transaction-processing computer via a telephone line in the UK. The first commercial transaction, involving the sale of a Sting album, took place shortly thereafter. The 1990s marked the dawn of modern e-commerce. The first secure online transaction using a credit card occurred in 1994,

paving the way for secure digital payments. During this time, companies like Amazon and eBay emerged, fundamentally changing the online shopping experience.

Types of E-commerce

E-commerce can be categorized based on the parties involved in the transactions:

- Business-to-Business (B2B): Transactions between businesses.
- Business-to-Consumer (B2C): Businesses selling directly to consumers.
- Business-to-Government (B2G): Businesses engaging in transactions with government entities.
- Consumer-to-Business (C2B): Consumers offering products or services to businesses.
- Consumer-to-Consumer (C2C): Transactions between consumers, typically facilitated by online marketplaces.

Key Components of E-commerce

- Online Stores: Websites or apps where consumers browse and purchase products. Example: Amazon, Walmart.
- Payment Systems: Online payment methods, including credit cards, digital wallets like PayPal, google pay and cryptocurrencies.
- Logistics and Delivery: The process of shipping products from sellers to buyers, including shipping companies and tracking systems.
- Customer Service: Online support via chat, email, or phone to address consumer concerns.
- Security: Protection of user data and payment information through encryption and secure payment gateways.

Challenges in E-commerce

- Cybersecurity: Risk of hacking, data breaches, and fraud.
- Shipping and Delivery: Potential issues with delays, damaged goods, or high shipping costs.
- Customer Trust: Consumers may hesitate to make purchases from unfamiliar online stores.
- Returns and Refunds: Handling product returns and customer

dissatisfaction can be more complex than in physical stores.

- Competition: Intense competition among online stores, especially for popular products.

E-commerce has dramatically reshaped the retail industry by offering greater convenience, a broader selection of products, and more competitive pricing. It has given rise to new business models, including drop shipping and subscription services. The rise of mobile commerce and social commerce is further influencing the industry, with mobile transactions experiencing rapid growth.

11.8 ONLINE DISCUSSION FORUM

An online discussion forum is a web-based platform where users can engage in organized conversations by posting threads and replies. These forums are structured in a hierarchical manner, with topics (threads) containing multiple posts. Forums allow users to share content, ask questions, and participate in discussions, and some may include social network-like features such as personal galleries and chat systems.

Forums can range from simple text-based platforms to more advanced systems that support multimedia and formatting options. Unlike email lists, which deliver messages automatically, forums require users to visit the site to view updates. To keep users informed, many forums offer email notifications and web feeds for new posts.

Different from chat rooms, online discussion forums allow for asynchronous communication, meaning users don't need to be online at the same time to participate. Posts remain publicly accessible, fostering ongoing discussions. Forums are often integrated into websites, providing comment sections or dedicated spaces for online communities.

Features of Discussion Forum:

i) Registration: Most Internet forums, especially in the U.S. and Europe, require users to register before posting. Registration typically involves verifying age (usually 12 or older to meet COPPA guidelines), agreeing to terms of service, and sometimes accepting other documents. In some regions like China and Japan, registration may be optional, and anonymity

is encouraged, often using systems like tripcodes for identity verification. Unregistered users are known as guests and can usually read content but may be restricted from other features.

ii) Subscription Options: Forums often offer subscription features to notify users about new posts, either by email or upon returning to the site. Members can subscribe to individual threads, with unread posts marked accordingly. Many forums also generate RSS and ATOM feeds, allowing users to subscribe to updates, usually showing recent thread and post activity.

Note: RSS (Really Simple Syndication) is a web feed format used to deliver regularly updated content like news, blogs, or podcasts. It allows users to subscribe and get updates automatically.

ATOM: Another web feed format similar to RSS is used to syndicate content and offers more flexibility in structuring data, but its purpose is the same as RSS i.e. to deliver updates to users.

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iii) Rules and Policies on Forums: Forums are managed by a staff team, including administrators and moderators, who handle the forum's creation, maintenance, and policies. Most forums have a set of rules outlining the creators' guidelines and a FAQ section to help new users understand the forum's principles. Moderators enforce the rules, with users able to report violations through a reporting system.

iv) Thread: A thread (or topic) is a series of posts, typically displayed from oldest to newest, though sorting options are usually available. A thread is defined by a title, a description, and user comments. To participate, users

(or guests) must fill out a form with a username, password, email, CAPTCHA, and post content. A thread includes the original post (OP) and subsequent comments, which can come from any member, even consecutively from the same user.

Post: A post is a user-submitted message containing the user's details, along with the date and time of submission. Members can usually edit or delete their posts. Posts are grouped in threads, with the first post starting the thread (the original post or OP). Subsequent posts continue the discussion or reply to others, though discussions can sometimes go off-topic.

Discussion: Forums encourage open discussion on a wide range of topics, including questions, comparisons, polls, and debates.

Attachment: An attachment is a file uploaded to the forum's server. Forums typically have strict rules on file types and size limits for attachments.

v) Invitation: Most forums allow members to invite non-members to join. Some forums reward members who help grow the community.

vi) Administrator: Administrators manage the technical aspects of the forum, including promoting or demoting moderators, creating sections, enforcing rules, and performing database tasks. They may also make announcements and change the forum's appearance. Administrators often act as moderators and have full content control.

vii) Moderation Activity: Moderators oversee discussions, maintain order, and assist users. They have privileges like deleting, merging, moving, or locking posts, banning users, and managing polls. They also enforce rules by removing offensive content and issuing warnings.

Punishments to Members: Moderators enforce rules by issuing warnings, followed by temporary bans if ignored. Repeated offenses lead to longer bans, with continuous harassment resulting in a permanent ban. In extreme cases, an IP ban or range ban may be applied. Topics may be locked when answered or if requested to prevent problems, stopping further posts in the thread.

Deleting Thread: The old and not used topics may be deleted.

viii) Archive: Many discussion forums have online archive feature so that

if the discussions are old and not used at all it goes to the archive. The archive can be retrieved at any time using search features or browsing through categories and sub-categories.

i**x) Statistics Generation:** Most forums keep track of a user's post count. The post count is a measurement of how many **posts a certain user has made. The users with higher post counts are often** considered more reputable than the users with lower post counts. However, some forums have disabled post counts in the hopes that doing so will reduce the emphasis on quantity over quality of information. A thread's popularity is measured on forums in reply (total posts minus one – the opening post) counts. Some forums also track page views. Threads meeting a set number of posts or a set number of views may receive a designation such as "hot thread" and be displayed with a different icon compared to others threads. This icon may stand out more to emphasize the thread.

b) Concerns associated with Discussion Forum: Because of the volatile and random behaviour of forum, unsocial behaviour is easily sprouted as people lose temper, especially if the topic is controversial. Poor understanding of differences in values of the participants is a common problem on forums. Because replies to a topic are often wording aimed at someone's point of view, discussion will usually go slightly off into several directions as people question each other's validity, sources and so on. Circular discussion and ambiguity in replies can carry out arguments for several tens of posts of a thread eventually ending when everyone gives up or another similar debate takes it over. The main concerns are -

i) Troll: A troll is a user that repeatedly and intentionally breaches netiquette, often posting derogatory or otherwise inflammatory messages about sensitive topics in an established online community to bait users into responding, often starting flame wars.

ii) Sock Puppet: It refers to someone who is simultaneously registered under different pseudonyms on a particular message board or forum.

iii) Forum Spamming: It is a breach of netiquette where users repeat the same word or phrase over and over, but differs from multiple posting in that spamming is usually a willful act which sometimes has malicious intent.

iv) Double Posting: It is posting the same message twice. Users sometimes post versions of a message that are only slightly different, especially in forums where they are not allowed to edit their earlier posts. Multiple posting instead of editing prior posts can artificially inflate a user's post count. Multiple posting can be unintentional; a user's browser might display an error message even though the post has been transmitted or a user of a slow forum might become impatient and repeatedly hit the submit button.

v) Cross posting: A user may also send the same post to several forums, which is termed cross posting. The term derives from Usenet, where cross posting was an accepted practice; however, it causes problems in web forums.

vi) Bumping: When a member posts in a thread for no reason but to have it go to the top, it is referred to as a bump or bumping.

vii) Flame Wars: When the discussion becomes heated and sides do nothing more than complain and would not accept the differences in each other's point of view, the discussion degenerates into what is called a flame war. To flame someone means to go off-topic and
attack the person rather than their opinion. Likely candidates for flame wars are usually religion and socio-political topics, or topics that discuss pre-existing rivalries outside of the forum.

c) Examples of Discussion Forum: People participating in an Internet forum may cultivate social bonds. A sense of virtual community often develops around forums that have regular users. Some examples of Discussion Forum are presented in the following points.

i) 4chan (http://www.4chan.org/): 4chan is a simple image-based bulletin board where anyone can post comments and share images. Different boards are dedicated to different topics, from Japanese anime, manga, and culture to videogames, music, and photography. Users do not need to register a username before participating in the community.

ii) Gaia Online (http://www.gaiaonline.com/forum/): Gaia Online was founded in 2003. Gaia's forum is a place where millions of members gather to discuss random stuff, make new friends, complain about life,

argue about nothing, laugh at dumb pictures, discuss serious issues and/or curse like sailors.

iii) Something Awful (http://forums.somethingawful.com/): Something Awful, often abbreviated to SA, is a comedy website housing a variety of content, including blog entries, forums, feature articles, digitally edited pictures, and humorous media reviews. The site is home to a collection of Internet forums, which charge an initial registration fee of US$9.95 and fees ranging from US$4.99 to US$29.99 for additional features. If a user is banned by administrators, the fees for initial registration and all additional features are not reimbursed.



CHECK YOUR PROGRESS

Q 6 : Find out the True and False Sentences in the following

a) Mailing lists automatically deliver new messages to the subscribers.

b) An unregistered user of a site is commonly known as a guest or visitor.

c) OP means original post.

d) Posting same message over several forums is known as double posting.

Q7: What is Gaia Online primarily used for?

a) To buy and sell items.

b) To discuss various topics, make friends, and engage in random conversations.

c) To participate in online gaming tournaments.

d) To post images and videos only.



11.9 LET US SUM UP

- Email is a widely used tool for sending messages, documents, and multimedia to multiple recipients, transforming both personal and professional communication.

- Online Chat facilitates real-time text communication between users, including instant messaging, chat rooms, and chatbots for efficient interaction.
- World Wide Web is a network of interconnected documents and multimedia accessible via the internet, serving as the foundation for websites and online services.
- Search Engines are tools like Google and Bing that index and retrieve web content based on user queries, helping find relevant information quickly.
- E-commerce facilitates online buying and selling of goods and services driven by convenience and global reach.
- Online Discussion Forums provides platforms for posting questions, sharing knowledge, and engaging in discussions, fostering communities and user-generated content.



11.10 ANSWERS TO CHECK YOUR PROGRESS

Ans to Q No 1:

a) True b) True c) False d) True

Ans to Q No 2: Chat refers to the text-based communication between two or more participants over the internet / intranet in real-time.

Ans to Q No 3: Chatiquette means the basic rules or guideline of online communication. It avoids misunderstanding and simplifies the communication between the users.

Ans to Q No 4: Anonymous chat is an environment where each users identity remains hidden.

Ans to Q No 5 :

a) True. b) True. c) False. d) False. e) False. f) True. g) True

Ans to Q No 6 :

a) True. b) True. c) True. d) False.

Ans to Q No 7:

b) To discuss various topics, make friends, and engage in random conversations.



11.11 FURTHER READINGS

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11.12 MODEL QUESTIONS

1. What is Search Engine and what are its components?
2. What is a cached page of a search engine? What are their importances?
3. Who developed the citation analysis? Which popular search engine used it?
4. What is Email? What are the basic components of the Email id? Describe all of them.
5. Describe in details the anatomy of an email id.
6. What is a discussion forum? Describe different forum features.

*** *** ***

UNIT 12: INTERACTIVE AND DISTRIBUTIVE SERVICES OF INTERNET

UNIT STRUCTURE

12.1 Learning Objectives

12.2 Introduction

12.3 Videoconferencing

12.4 Social Network

12.5 E-learning Platform

12.5.1 e-PG Pathshala

12.6 Virtual Assistance

12.7 E-commerce Platforms

12.8 Cloud Storage and File Sharing

12.8.1 Cloud Storage

12.8.2 File Sharing

12.9 Let Us Sum Up

12.10 Answer to Check Your Progress

12.11 Further Readings

12.12 Model Questions

12.1 LEARNING OBJECTIVES

After going through this unit, you will be able to –

- Understand Interactive and Distributive Services
- Explore videoconferencing, e-learning platforms, virtual assistance
- Learn cloud storage and file sharing
- Analyze social network

12.2 INTRODUCTION

The internet has become a powerful platform that supports a wide array of services designed to enhance communication, collaboration and business processes. Interactive services involve platforms and tools that allow users to actively engage with content, other users or systems in real-time. Distributive services focus on the sharing, distribution and access to digital content or services. These services promote two-way communication and participation, meaning that users can not only consume information but also contribute, collaborate, and interact with others.

12.3 VIDEOCONFERENCING

Videoconferencing is a technology that allows real-time, two-way audio and video communication between multiple locations. This system enables participants to interact visually and audibly, facilitating collaboration without the need for physical presence. It is also referred to as “visual collaboration”. Videoconferencing is tailored to support group communication. It evolved from videotelephony, which was first commercially launched by AT&T in the early 1970s with their Picturephone technology.

The core functionality of videoconferencing systems relies on the digital compression of audio and video streams in real-time. Video conferencing allows people to have live meetings with others in different locations, making it possible to “meet” face-to-face even if you’re miles apart. By using the internet, video conferencing transmits audio, video, text, and presentations in real-time, making it easier for people to collaborate and communicate. It can be used for everything from team meetings and webinars to job interviews and product demos, helping individuals stay connected even when they can’t meet in person.

Videoconferencing system consists of several equipment that facilitate both audio and video communication:

- **Webcam:** This is the camera that captures your video and sends it to others in the meeting. Most laptops and desktops have built-in cameras.

- **Microphone:** Most of the devices might have a built-in microphone. An external microphone will provide clearer, more reliable sound, making sure that everyone can hear you without interruptions.
- **Internet Connection:** A fast, stable internet connection is crucial for smooth video and audio. Without it, the meeting could suffer from lags or poor quality.
- **Video Conferencing Platform:** There is a need of videoconferencing software like Zoom, Microsoft Teams, and features to help you communicate effectively.

Types of Videoconferencing Systems

Videoconferencing can be of the following types:

1. **Point to point:** In this type of videoconferencing one on one communication is made by directly linking the two locations. Only two parties can participate. It consumes minimal bandwidth, making it ideal for two party interaction. It ensures low latency, faster and responsive interaction. It is mostly used for private interaction.
2. **Multi point Video Conferencing:** It involves connecting multiple participants through a shared communication channel, allowing several people to interact simultaneously in the same virtual meeting. To support multiple audio and video streams at once, multipoint video conferencing requires higher bandwidth. Due to involvement of multiple participants delay and lag can be seen. It fosters group discussions and teamwork, making it ideal for team meetings, brainstorming sessions, and other collaborative efforts. It can accommodate larger number of participants, so it is well-suited for virtual events, webinars and conferences.

Desktop videoconferencing is the mechanism where participants can attend meeting from PC using software such as Zoom, Google Meet. Another term web conferencing is used for virtual events, often allow users to share screens, present documents, and collaborate on projects without the need for physical presence. It typically involves video, audio and chat capabilities, enabling participants from different locations to communicate and share information seamlessly.

Advantages of Video Conferencing

1. **Enhanced Collaboration**: It allows to share screens, present documents and collaborate on projects in real-time, even when they are in different locations. Fostering effective teamwork without the need for physical meetings.
2. **Cost Savings**: Video conferencing eliminates the need for travel, reducing costs associated with transportation, accommodation. Making it an affordable solution for businesses and individuals.
3. **Time Efficiency**: It allows meetings to be scheduled at convenient times and allow joining from anywhere that save the time.
4. **Increased Accessibility**: Video conferencing breaks down geographical barriers, enabling people to connect from different parts of the world, making it especially useful for global teams, clients, or events.
5. **Improved Communication**: Visual and audio elements improve communication clarity, reducing misunderstandings that can occur in written communication alone. Real-time interaction also enhances engagement and focus.
6. **Flexibility**: Web conferencing tools offer various features, such as chat, screen sharing, file sharing, and recording capabilities, which can be tailored to meet specific needs for meetings, training, or presentations.
7. **Environmentally Friendly**: By reducing the need for travel, video conferencing contributes to a decrease in carbon emissions, making it an eco-friendlier choice for meetings.
8. **Recordkeeping**: Many web conferencing platforms allow meetings to be recorded, providing a valuable resource for reviewing discussions, decisions, and shared content later on.

These benefits make video conferencing an essential tool for businesses, educational institutions, and individuals who need to communicate and collaborate remotely.

12.4 SOCIAL NETWORK

A social network or online community is an internet-based platform designed to enable people to connect, interact and share content with others who have similar interests, activities, or goals. These platforms create virtual spaces where users can form relationships, exchange ideas and collaborate in various ways. The central idea behind social networks is to facilitate communication and interaction among individuals, groups or organizations that might otherwise not have had the opportunity to connect in the real world.

Structurally, a social network is made up of “nodes,” which typically represent people, groupsor organizations. These nodes are connected by various forms of relationships or interdependencies such as shared values, ideas, business dealings, friendships, family ties. For example, a user might be connected to a friend through a mutual interest in music or a business could link up with other companies to collaborate on projects or share market insights.

Social networks can serve different purposes, depending on the interests of the users. For instance, some networks are focused on personal connections and socializing (like Facebook or Instagram), while others are designed for professional networking (such as LinkedIn), and some are dedicated to niche hobbies or interests (like Reddit or Discord communities).

Most social networks rely on content-sharing mechanisms, such as posts, messages, images, videos, allowing users to express themselves and engage with others in creative ways. Additionally, many social networks also integrate features like chat systems and event planning tools to enhance user interaction.

From a business model perspective, many social networks are free to join and use, but they generate revenue through advertisements. Platforms like Facebook, Instagram, and YouTube sell advertising space on their sites, allowing businesses to target specific audiences based on user data, interests and behaviours. Some social networks, on the other hand, may charge users for premium memberships or additional features,

offering a more exclusive experience or enhanced services.

Significance of Social Network

Social networks have become part of daily, some specific ways they hold significance include:

1. **Global Connectivity**: Social networks allow users to instantly connect with people worldwide, breaking down geographic barriers. Platforms like Facebook, Twitter, and Instagram enable real-time communication, helping friends, family, and colleagues stay in touch regardless of location.
2. **Niche Communities and Interest Groups**: Social networks provide spaces for individuals to join specialized communities based on their interests, whether related to hobbies, professional fields or personal passions. For example, Reddit hosts countless forums on topics from technology to mental health, allowing people to engage in meaningful conversations with like-minded individuals.
3. **Real-Time Information Sharing**: News and updates can spread rapidly on social media platforms, making them essential tools for disseminating information. Platforms like Twitter are often used for breaking news and during crises or emergencies; they serve as key tools for governments, organizations and individuals to keep people informed.
4. **Business Growth and Customer Engagement**: It is a vital tool for businesses to market products, engage with customers and build brand awareness. Companies use Facebook, Instagram and Twitter to run targeted advertising campaigns and interact with customers directly, fostering loyalty and increasing sales.
5. **Professional Networking**: LinkedIn is a prime example of how social networks are used for professional networking. It allows users to connect with colleagues, potential employers, and industry peers, offering opportunities for career advancement, partnerships, and job openings.
6. **Mental Health Support**: Social networks also provide platforms for users to seek emotional support and advice. Facebook groups

and Reddit communities often offer safe spaces for individuals facing mental health challenges to share experiences, find resources and connect with others who understand their struggles.

7. **Influencer and Content Creation Industry**: Platforms like YouTube and Instagram have created a new wave of influencers and content creators. These networks provide individuals with the tools to build personal brands, share creative content and even monetize their work through sponsorships, advertising or product collaborations.

Political Mobilization and Social Change: Social networks have become instrumental in organizing protests and campaigns.

12.5 E-LEARNING PLATFORM

E-learning refers to the use of electronic technologies to access educational content and engage in learning activities via the internet. An **e-learning platform** is a digital software application or online environment designed to facilitate the delivery, management and tracking of educational content and learning experiences. E-learning platforms provide tools for course creation, learner engagement, assessment and collaboration, allowing both educators and learners to interact in a flexible, accessible, and often self-paced manner. These platforms can be used for formal education, corporate training, skill development or personal learning.

It involves a wide range of digital tools and platforms, including websites, apps, videos, interactive modules and virtual classrooms, to deliver lessons, training, and educational resources to learners. E-learning allows individuals to study and learn at their own pace and convenience, often from remote locations, making it highly flexible and accessible-learning can encompass various types of learning, including self-paced courses, live webinars, virtual workshops, and collaborative group activities, across different fields such as formal education, professional development, and skill-building. It provides an opportunity for learners to gain knowledge and skills without the constraints of traditional, in-person classroom settings.

12.5.1 e-PG Pathshala

e-PG Pathshala is an e-learning platform. It is an initiative by the Government of India under the Ministry of Human Resource Development (MHRD), aimed at providing postgraduate (PG) education through online resources to students across the country. The platform offers free access to high-quality learning materials, including lectures, textbooks, and other resources, in various postgraduate subjects.

Some of the features of e-PG Pathshala are:

1. **Postgraduate Education**: e-PG Pathshala is specifically designed to offer postgraduate students in-depth content across a wide range of subjects, including arts, science, commerce, social sciences, and more.
2. **Access to Resources**: The platform provides various educational resources such as video lectures, e-books, tutorials, and study materials prepared by experts in each subject.
3. **Quality Content**: The content on e-PG Pathshala is curated by top educators and universities, ensuring that students receive reliable, well-researched, and accurate information.
4. **Free and Open Access**: The platform is freely accessible to students, making it an invaluable resource for learners, particularly those in remote or underserved areas.
5. **Multimedia Learning**: e-PG Pathshala includes interactive and multimedia-rich content to enhance the learning experience, offering students a flexible and engaging way to learn complex postgraduate subjects.
6. **Certification**: Upon completion of certain courses, students may be eligible to receive certificates, which can help in academic and professional advancement.

e-PG Pathshala is a part of India's larger push to promote digital learning and enhance the quality and accessibility of higher education across the country.

12.6 VIRTUAL ASSISTANCE

Virtual Assistance refers to the use of technology and are usually powered by artificial intelligence (AI) or human agents, to provide support and perform tasks remotely. Virtual assistants (VAs) can be software-based, like chatbots or AI-driven systems, or human professionals who work remotely to assist businesses and individuals with administrative, technical or creative tasks.

Types of Virtual Assistance

1. **AI-powered Virtual Assistants**: These are software systems that can interact with users, answer questions, manage tasks and execute actions based on voice or text commands. Examples include:
    - **Siri** (Apple)
    - **Google Assistant** (Google)
    - **Alexa** (Amazon)
    - **Cortana** (Microsoft)

These AI assistants are used for tasks like setting reminders, sending messages, playing music or even controlling smart home devices.

2. **Human Virtual Assistants**: These are remote professionals who assist businesses or individuals with tasks such as scheduling, managing emails, handling customer service, data entry, content creation. Human VAs provides personalized assistance tailored to specific business needs.

Key Characteristics of Virtual Assistance are:

1. **Time Management**: Virtual assistants can handle time-consuming administrative tasks, freeing up time for individuals and businesses to focus on more critical activities.
2. **Cost Efficiency**: Hiring a virtual assistant, especially a human VA, can be more cost-effective than hiring full-time, in-house staff. For AI assistants, there is no need for ongoing wages or training.
3. **24/7 Availability**: Virtual assistants, particularly AI-based ones, can operate around the clock, providing continuous support, answering

queries, or managing tasks, even outside of regular working hours.

4. **Scalability**: Virtual assistance can be easily scaled up or down depending on the workload. For businesses, this means they can adjust their virtual assistant needs without long-term commitments.
5. **Personalization**: Human virtual assistants provide a level of personal touch and adaptability, managing tasks according to the preferences and needs of their clients.
6. **Multitasking**: Virtual assistants can handle multiple tasks simultaneously, improving efficiency and productivity. For example, an AI assistant might set reminders, look up information, and control smart devices all at once.
7. **Integration with Other Tools**: Many virtual assistants can be integrated with other productivity tools, such as calendars, task managers, email systems, and communication platforms, to streamline workflows.

Few applications of Virtual Assistance include:

- **Personal Assistance**: AI assistants like Siri and Alexa can help with everyday tasks, such as setting reminders or checking the weather.
- **Business Support**: Human VAs help with administrative tasks such as managing emails, scheduling meetings, customer service, or social media management.
- **Customer Support**: AI chatbots on websites can answer customer questions, resolve issues, and provide information quickly, offering 24/7 service.
- **Automated Check-In/Check-Out**: Libraries can integrate virtual assistance with self-checkout systems to automate the borrowing and returning of books. Virtual assistants can guide users through the check-in/check-out process, answer questions about due dates and notify users of overdue materials or upcoming returns.
- **Personalized Recommendations**: By analyzing users' borrowing patterns and preferences, virtual assistants can provide personalized book or resource recommendations. These recommendations can be tailored to the user's research needs, interests, or academic

pursuits.

- **Language Support**: Virtual assistants can be used to provide language support for users who speak different languages. This is particularly useful in multilingual communities or academic institutions with international students, as VAs can assist users in multiple languages, making library resources more accessible.

12.7 E-COMMERCE PLATFORMS

E-commerce platforms are online software solutions that enable businesses to conduct buying and selling activities over the internet. These platforms provide the infrastructure and tools necessary to set up, manage, and operate online stores. They support various functions such as product listings, shopping cart management, secure payment processing, order fulfillment, and customer management.

Characteristics of E-commerce Platforms includes:

1. **Product Management**: E-commerce platforms allow businesses to list and manage their products easily. This includes features for adding product descriptions, images, prices, and variations (e.g., sizes, colors). Inventory tracking is also often integrated that helps the store owners to monitor stock levels and avoid over-selling.
2. **Shopping Cart and Checkout**: These platforms include shopping cart functionality, which allows customers to add products, review their selections and proceed to checkout. The checkout process typically involves providing shipping details, choosing payment methods, and confirming the order.
3. **Secure Payment Processing**: E-commerce platforms support a variety of payment gateways (like PayPal, card), enabling secure online transactions. They typically use encryption and other security measures to protect sensitive financial data.
4. **Order Management**: After an order is placed, e-commerce platforms help to manage the entire fulfilment process, from order confirmation to shipping and delivery tracking. Many platforms

integrate with logistics services, streamlining the shipping process.

5. **Customer Management**: E-commerce platforms often include customer relationship management (CRM) features, allowing businesses to track customer behaviour, manage profiles, send personalized marketing messages, and provide customer support.
6. **Mobile Compatibility**: Many modern e-commerce platforms are designed to be mobile-friendly, allowing customers to browse, shop, and make payments easily on smartphones and tablets.
7. **Search Engine Optimization (SEO) and Marketing Tools**: These platforms often come with built-in tools for SEO, email marketing, and social media integration, helping businesses attract more visitors and promote their products effectively.
8. **Analytics and Reporting**: E-commerce platforms provide data analytics features that allow businesses to monitor sales, track customer behaviour, and gain insights into their performance. This helps in making informed decisions to improve products, pricing, and marketing strategies.
9. **Customizability**: Many e-commerce platforms offer templates and themes to help businesses create a unique online store. Some platforms also provide advanced customization options for those with coding knowledge, allowing businesses to fully tailor their websites.

Types of E-commerce Platforms:

1. **Hosted E-commerce Platforms**: These are fully managed solutions where the e-commerce provider hosts the store. Examples include Shopify, BigCommerce. These platforms are user-friendly, as they handle all aspects of hosting, security, and software updates.
2. **Self-hosted E-commerce Platforms**: These platforms require businesses to host their own website and manage their server. Examples include WooCommerce (for WordPress). These platforms offer more flexibility and customization options but require more technical knowledge to set up and maintain.
3. **Marketplace Platforms**: These platforms enable businesses to

sell their products alongside other sellers in a shared marketplace. Examples include Amazon, eBay. Marketplace platforms offer a large customer base but usually charge fees or commissions on sales.

Advantages of E-commerce Platforms:

1. **Global Reach**: E-commerce platforms provide businesses with the ability to sell to a global audience, overcoming geographical limitations of physical stores.
2. **Convenience and Accessibility**: Customers can shop online at any time of day, from anywhere, making the buying process more convenient than traditional brick-and-mortar stores.
3. **Cost-Effective**: Setting up an online store is generally more affordable than opening a physical storefront. E-commerce platforms can save on overhead costs such as rent, utilities, and staffing.
4. **Scalability**: E-commerce platforms allow businesses to scale operations easily by adding new products, expanding to international markets, and integrating additional sales channels or marketing tools.
5. **Better Customer Insights**: E-commerce platforms provide detailed data on customer behaviour, helping businesses tailor their offerings, improve customer experiences, and implement targeted marketing strategies.

E-commerce platforms are vital for businesses looking to establish an online presence and engage in digital commerce. These platforms offer a range of features to simplify the buying and selling process, from product management and secure payments to customer engagement and analytics. With the continued growth of online shopping, e-commerce platforms are an essential tool for businesses of all sizes to reach a wider audience and maximize sales potential.

12.8 CLOUD STORAGE AND FILE SHARING

Cloud Storage and File Sharing refer to the online systems and services that allow users to store, access and share files and data over the internet, using remote servers hosted by third-party providers. These technologies enable individuals and businesses to store large volumes of

data without relying on physical storage devices like hard drives or USB drives and to easily share files across different locations and with multiple users.

12.8.1 Cloud Storage

Cloud storage is a model of data storage where digital data is stored on remote servers, rather than on a local hard drive or physical storage device. These servers are maintained, operated and managed by cloud service providers. Users can access their data over the internet, from any device with an internet connection. The key features of Cloud Storage:

1. **Remote Access**: Cloud storage allows users to access their files from anywhere, on any device, as long as they have an internet connection. This offers great flexibility, whether for personal or business use.
2. **Scalability**: Cloud storage services typically allow users to scale their storage needs up or down. Users can buy additional storage space as their needs grow, making it a flexible and cost-effective solution.
3. **Automatic Backups**: Many cloud storage services provide automatic backup features, ensuring that files are regularly backed up and reducing the risk of data loss.
4. **Data Security**: Cloud storage providers use encryption, secure access protocols, and data redundancy to keep stored data safe. However, users should always choose reputable providers and take additional steps to secure their accounts.
5. **Sync Across Devices**: Files stored in the cloud are often synced across multiple devices, allowing users to update and access their data from any device seamlessly.

Examples include Google Drive, Offers free storage with a Google account and integrates well with Google services; Dropbox**;** OneDrive; iCloud.

12.8.2 File Sharing

File sharing refers to the practice of distributing or providing access to digital files, such as documents, images, videos and software, typically through online platforms or networks. Cloud storage services often include file-sharing features, enabling users to share files with others securely and efficiently.

The characteristics of File Sharing:

1. **Ease of Sharing**: With file sharing, users can quickly share files with others, whether through direct links, email or social media. Shared files can be sent to multiple recipients at once.
2. **Permissions and Access Control**: File-sharing platforms typically allow users to control who can access shared files. Users can set permissions to specify whether recipients can view, edit, or comment on the files.
3. **Version Control**: Some file-sharing services allow multiple users to edit and update a file while keeping track of different versions. This is especially useful for collaborative work on documents or projects.
4. **File Collaboration**: File-sharing platforms often include collaboration tools that allow multiple users to work on the same file in real time. For example, Google Drive or Microsoft OneDrive allows for shared document editing and commenting.
5. **Security**: Most file-sharing services use encryption, password protection, and secure access settings to ensure that shared files remain private and protected from unauthorized access.

Advantages of Cloud Storage and File Sharing:

1. **Accessibility and Convenience**: Files can be accessed anytime, anywhere, from any device with an internet connection, providing significant flexibility and convenience for individuals and businesses.
2. **Collaboration**: Cloud storage and file-sharing platforms make it easier for multiple users to work together, offering shared

access, real-time collaboration, and version control on documents and other files.

3. **Reduced Risk of Data Loss**: Storing files in the cloud means that even if a device is lost or damaged, data remains safe on the cloud servers, reducing the risk of permanent data loss.
4. **Cost-Effectiveness**: Cloud storage eliminates the need for expensive physical storage hardware. Many services offer a free tier with a limited amount of storage, and paid tiers allow for scalable and affordable storage as needed.
5. **Security**: Trusted cloud storage and file-sharing providers use encryption, secure access controls, and backup solutions to protect data. Additionally, these platforms often have disaster recovery plans in place to ensure data integrity in case of technical issues.



CHECK YOUR PROGRESS

1.True and False Type Questions:

a.Multi-point video conferencing requires higher bandwidth due to the involvement of multiple participants.

b.e-PG Pathshala is a paid service that offers access to postgraduate education.

c.Social networks only allow users to post text-based messages, not images or videos.

d.AI-powered virtual assistants can operate around the clock, providing continuous support.

e.E-commerce platforms only support physical product sales and not digital products.

f.Social networks can help businesses grow by enabling targeted advertising.

g.Hosted e-commerce platforms require businesses to manage their own servers.

2. Choose the correct option.

a. **Who initiated the e-PG Pathshala platform?**

i) Ministry of Science and Technology

ii) Ministry of Human Resource Development (MHRD)

iii) University Grants Commission (UGC)

iv) National Institute of Education

b. **Which of the following is an example of an AI-powered Virtual Assistant?**

i) Data entry specialist

ii) Siri

iii) Social media manager

iv) Website developer

12.9 LET US SUM UP

Interactive services have revolutionizing how information is accessed, shared, and managed. Videoconferencing has become an essential tool for facilitating remote communication and collaboration across various sectors.Videoconferencing tools enable virtual library services such as remote reference support, webinars, and online training sessions, allowing libraries to engage with users regardless of their location. Social networks facilitate communication between libraries and their patrons, helping them share resources, announcements, and engage in community-building activities.

Virtual assistants are increasingly being used in libraries to automate tasks such as answering FAQs, providing book recommendations, and assisting with research inquiries, thus improving efficiency and user satisfaction. Meanwhile, cloud storage and file sharing allow libraries to manage digital resources and collaborate with other institutions by providing secure, scalable solutions for storing and distributing content.

Together, these technologies enhance library services, making information more accessible, improving user engagement, and supporting the efficient management of digital resources.



12.10 ANSWERS TO CHECK YOUR PROGRESS

Ans to 1 a. True

b. False

c. False

d. True

e. False

f. True

g. False

Ans to 2. a. ii) Ministry of Human Resource Development (MHRD)

b. ii) Siri



12.11 FURTHER READINGS

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12.12 MODEL QUESTIONS

1. What is the key equipment needed for a videoconferencing system?
2. What is the difference between point-to-point and multi-point videoconferencing?
3. What are the key features of AI-powered virtual assistants like Siri or Alexa?
4. What is the primary purpose of social networks like Facebook or LinkedIn?
5. Mention one advantage of e-commerce platforms for businesses.

6. Explain the concept of videoconferencing.
7. Discuss the significance of social networks in modern society,
8. What is an e-learning platform, and how does it benefit learners? Discuss the features of platforms like e-PG Pathshala.
9. Describe the role and types of virtual assistants. How do AI-powered and human virtual assistants differ.
10. Explain the key features of cloud storage.
11. Discuss the features and advantages of e-commerce platforms.
12. What is videoconferencing and how does it enhance collaboration?

*** *** ***

UNIT 13: COMPUTER SECURITY

UNIT STRUCTURE

13.1 Learning Objectives
13.2 Introduction
13.3 Computer Security
13.4 Malware
13.5 Computer Viruses
13.6 Worms
13.7 Other Threats
13.7.1 Trojan Horses
13.7.2 Spyware
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13.8.2 Deception Techniques
13.8.3 Working of Antivirus
13.9 Let Us Sum Up
13.10 Further Reading
13.11 Answers to Check Your Progress
13.12 Model Questions

13.1 LEARNING OBJECTIVES

After going through this unit, you will be able to:

- learn about computer security and its goals
- describe different threats related to computer security
- describe the classification of the threats
- describe measures of threats

13.2 INTRODUCTION

The advancement of computer networking and information technology has been explosive in recent times. This technology has been propagated around the world rapidly and has affected every aspect of day-

to-day life. Most computer facilities continue to protect their physical machine better than their data, but in reality the value of the data is greater than the value of the hardware. Throughout this chapter, the discussion of computer security emphasizes the problem of protecting information from unauthorized disclosure.

13.3 COMPUTER SECURITY

The state of being free from danger or threat is called security. So computer security means protection of the computer systems from theft or damage to its hardware or to its software or to the information it stores, as well as from disruption or misdirection of the services it provides. More precisely we can explain with the CIA triad of information security, which maintains these three security goals:

- **Confidentiality:** It means protecting the information from disclosure to unauthorized parties.
- **Integrity:** It means keeping the data pure and trustworthy by protecting system data from intentional or accidental changes
- **Availability:** It refers to ensuring that authorized parties are able to access the information when needed.

Let us describe a day-to-day example to understand this CIA triad. Suppose I own a bank account and I am not willing to share my ATM card number, PIN and bank statements. So, me and my bank is protecting the information, this is confidentiality. Suppose, one day I make a online transaction to a 3rd party for rupees 1000.00, but in the meantime somehow, someone tampered the information and changed the amount to 10000.00. I don't want to have such tampering with my confidential data. That is integrity. I want my bank account to be accessed and manipulated only by me not by others, my bank should protect my account from unauthorized attempt of access. This is an example of availability.

13.4 MALWARE

If we can ensure these goals for our system then we can say our system is protected and any threat to these goals is a threat to computer

security. The threats to computer security can be in the form of unauthorized access or deception or disruption to the services or data. Generally these violations to security are caused by some malicious software. A software is potentially malicious if it can be used to harm either the computer on which it is hosted or another computer. Software may also be considered malicious if it is designed to install itself on a computer without the permission of the owner of that computer, particularly if it does so in a way that may compromise the security of the computer. Malicious may be loosely interpreted. A piece of software may be considered malicious even though it may have been launched with the intention of providing an arguable benefit. These types of software are referred as malware (= malicious + software) in general.

Malware can be classified as

- **Transient -** They need a host to exist (Viruses, Trapdoors)
- **Resident -** They can exist on their own (Worms)

Most malicious software takes advantage of the vulnerability-exploit cycle in software development if it is not managed properly. Vulnerability is a system susceptibility or flaw, and vulnerability-exploit cycle is the continuous process of identifying, classifying, remediating, and mitigating vulnerabilities as they are discovered.

13.5 COMPUTER VIRUSES

A computer virus is an executable program that replicates itself or attached to a file where it infects the computer when the file is executed. Sometimes it may also replace an existing program. There are many techniques used by virus to spread or replicate or attach to a file, but the self replicating nature is the main criterion that distinguish a virus from other software. And not all viruses show harmful activities on system.

But why is such malicious software is termed with the biological term "Virus"? This is so because most computer viruses are parasitic like biological virus i.e.: they work by attaching themselves to a carrier object (e.g.: a file). And when this carrier object is transmitted to other systems the virus is also transmitted and it is activated when the host program is executed.

After activation the computer virus like its biological one search for another host and gets attached to it.

Working of a Computer Virus

A virus does not appear as an object in itself. A virus always resides hidden in some useful object and it may perform the main parts of a virus code which are the replication routine and the payload routine. A virus is not a virus without the replication routine, but the pay load routine for a virus is optional.

- **Virus replication:**

  The replication routine contains a code that locates suitable objects to attach the virus to and to copy the virus to these elements. There are different techniques for this purpose.

  Virus code can be executed when the object is executed. Viruses that infect program files may attach the virus code at the start or at the beginning of the program and patch the entry point so that when the program is run the virus code is executed first. The virus usually transfers control to the original program when it has finished its tasks. This ensures that the original program works properly and the virus avoids detection.

- **Payload Execution:**

  Payload routine of a virus is optional, some of the viruses may not have the payload routine which give them the efficiency to replicate more quickly. Payload part of the virus code generally contains the malicious activity such as slowing down the PC, deleting system files, making short cuts of every folder, swiping out the memory etc. The payload routine usually contains some activation criteria that must be met before the payload activates. This gives the virus some time to spread without detection. The activation criteria may be any data that can be found in computer like a particular date after infection or a lapse of time period or execution of certain application etc.

  From the above discussion one thing is clear: a virus always need a host to spread and it cannot spread on its own. It needs some activation

criterion to be fulfilled. Then only it can be executed or it can take over the computer resources. But there are some other types of malicious software commonly mistaken as virus but unlike the viruses. They can survive without a host. These malware are called worms.

13.6 WORMS

A worm is more independent than a virus. A pure worm works by itself as an independent object. The main feature that separates worms from viruses is that worms are self replicating. A worm can initiate network communication by itself and send copies to other computers. So there is no need for activation criteria or host process. As worms can spread rapidly across a network infecting every PC so they are the most notorious of malwares. There are some malicious software that resemble both viruses and worms.

One common example of this kind is mass mailing worms. They are attached to documents or other object like a virus, but uses email clients to mass mail themselves in a worm like way. This type of worm needs some kind of activation as for example, in mass mail worms can only activated when a receiver opens an attachment. It makes the worm slow but as it initiate the network by its own they are much faster transmitted than viruses. Worms and viruses are the most common wide-spread malicious software. There are some other programs also which work may not be so vicious like the virus or worm, but still they are malicious.



CHECK YOUR PROGRESS

1. What are the three security goals?
2. What is computer virus?
3. Differentiate between worm and virus.

13.7 OTHER THREATS

In this section we will briefly introduce malicious software other than virus and worm which may not exploit or damage the system like virus

or worms do, but may be a potential threat in point of view of security.

13.7.1 Trojan Horses

The term trojan horse comes from the tale of the Trojan horse from the Trojan war described in Greek mythological epic. In the Trojan War, the Greeks were unable to enter the city of Troy despite 10 years long siege and finally they constructed a large wooden horse and hid some soldiers in it. The citizens of Troy thought it was just a mere wooden horse and they let it in their city and in the night the soldiers inside the horse opened the city gates, which eventually became the downfall of their city. The wooden horse is coined as Trojan horse in the epic. The Trojan horses in computer security also serve the same purpose.

Trojan horses are applications which appear to be useful, legitimate applications, but run malicious, hidden code. The application may appear to perform tasks, such as scanning for spyware, but actually steal personal data from your system. Executing Trojans may result in changing desktop wallpaper, creating popups, or even deleting files. One of their most popular uses is creating backdoors to allow malicious users to gain access to files and information. Unlike viruses or worms, Trojans cannot infect other systems.

13.7.2 Spyware

Spyware are the software that collects user sensitive information like browsing and searching habit, password, social interactions without your knowledge and uses such information to gain profit. Information collection by spyware is done using technique like key logging, browser activity monitoring. Spyware is meant to make money by using personal information so it does not exploit the PC like other malware do. In fact, many spyware may be running in our PC without our knowledge.

13.7.3 Adware

Adware are the software that supports advertising. In general it is the entire program that downloads or displays unwanted banner advertisements in the software being used. Adware can be also used to collect user personal data and based on these data the adware shows up with classified advertisement. This type of software doesn't harm the system but collecting information and running advertisement without user knowledge is a threat.

13.7.4 Scareware

Scareware is a new type of attack, where a user is tricked into downloading a software that appears to be a useful one. After installing, it shows that the machine is infected and it can clean all the infection if you purchase the full license version of the software. These scareware applications are malware that hold the PC hostage until people don't pay the ransom. In most of cases, these scareware can't be uninstalled also.

13.8 COUNTER MEASURES

"Prevention is better than cure". To detect and eliminate security threat is always tougher than to prevent it. We can say a standalone system is more secure than any other. But it is not ideal scenario that a PC will never expose to security threats. A threat to computer security may be in many forms and hence we have to deploy different technique also to encounter them. But in this unit we will mainly focus on counter techniques for malware.

13.8.1 Antivirus

Malware uses different strategies for deception and replication. Hence, for detection and elimination of different malware involved, different techniques and tools are used which is impossible to be done manually. A special kind of software is developed for this

purpose commonly known as antivirus. So, antivirus software is a program or set of programs designed for searching, preventing, detecting and eliminating malware. The detection techniques of antiviruses are generally based on malware deception strategies. So let's go through a brief overview of different deceptions strategies used by the malware.

13.8.2 Deception Techniques

Different malicious software uses different strategies to spread or replicate them and exploit the system. Deception helps malware to stay in the system and replicate for a longer time by disguising as a part of the host program. Malware employ different kinds of deception to hide them such as–

- **Overwriting:** In this technique, the virus overwrites files with their own copy. It's a primitive technique but it is simple and easy to implement. This type of viruses can be disinfected from system simply by deleting the infected files.
- **Companion Infection:** In this approach the virus disguises itself as a companion of .exe file by naming it with same base name as the targeted program, but use a .COM extension instead of .EXE, because Windows gives priority to a file with the .COM extension over a file with the .EXE extension.
- **Appending:** In this method, a jump (JMP) or goto instruction is encoded at the start of the of the host program that will point at the end of the original host. And the starting of virus code is laid there.
- **Pre-appending:** In this strategy the virus code has been inserted at the front of host programs. This is a simple efficient method.
- **Cavity filling:** Here the virus tries to install itself in the empty space of the host while not damaging the actual program itself. An advantage of this technique is that the virus does not increase the length of the program but it also minimizes a number of possible

hosts. Cavity viruses are rare.

- **Compressing:** Generally after infection, size of the affected files increase, but by using compression techniques in this method size of the affected files has reduced so that change in file become negligible.
- **Encryption:** In this scenario the virus consists of a constant decryptor or set of decryptor, followed by the encrypted virus code, after decryption of the encrypted code with different decryptor yield different virus. This type of malware is called oligomorphic virus.
- **Boot Sector Execution:** Due to the executable nature of master boot record (MBR) and partition boot sector (PBS), if any executable code is present in these sections, it will execute when the machine is booted and hence bypass all the security measures.
- **Macros:** Macros are generally targeted for Microsoft word or similar products and damage only such documents. They are embedded in such application and while activation triggered some other application or insert unreadable character in the documents.
- **Malicious mobile code (MMC):** Mobile codes are lightweight programs that are downloaded from a server and executed with minimal or no user intervention on your local machine. JavaScript scripts, VB Script, and ActiveX controls are some of examples of mobile code that we encounter while browsing. These code are used to monitor browsing activities, getting unauthorized access to local file system, showing pop ups, adding unwanted browser add-ons etc. Spyware, adware, Trojan are such malware that uses MMC.

13.8.3 Working of Antivirus

Antivirus software scans all the file system and search for virus definition in there and tries to disinfect it by removing the malware code or deleting the infected file. Virus definition of a malware is signature by which the malware can be identified. The signature is determined based on the strategy adopt by the malware to replicate

themselves. These definitions are provided by the antivirus company. Antivirus program try to match the files with these definition. The basic searching methods used by the antivirus can be broadly classified into five categories. These are:

1. **Signature based detection:** Once a virus is detected, it is analyzed precisely and a unique sequence of bytes extracted from the virus code. This string is the signature of that virus. The antivirus engine scans the binary code of files to find these strings. If it encounters with a known pattern, it alerts detection of the matching virus. Some of commonly known signature based techniques are:

- **String Scanning method:** Searches for sequence of bytes (strings) that are unique to a specific virus but can't be found in other programs. In this process, a known virus is analyzed precisely and a unique sequence of bytes extracted from the virus code. For example a virus Die.448 has a unique bit string like B440 B9E8 0133 D2CD 2172 1126 8955 15B4 40B9 0500 BA5A 01CD in its code by which we can detect it.
- **Wildcards method:** Including a wild card character like ? or * allows skipping bytes or byte ranges of code in the signature code and try to match next which will enable the antivirus engine to detect slightly modified virus. For example: presence of a wildcard character * in the malware code means that scanner will try to match the next byte in the file.
- **Mismatches method:** This method allows a negligible number of bytes in a signature string to be of random values, regardless of their position. For example, virus X has signature string of 2A 80 4D 01 F6 and following strings contains the same signature values in different places and also mismatched by 2.

  11 2A 32 01 17 80 4D 24

  0A D9 1E 17 80 F6 24 AA

But using mismatched method we can still say that these two strings contains the virus X.

- **Generic Detection method:** This technique uses one common generic string as a signature string to detect several or all known variants of a family of viruses. When a virus has lots of its variant then the variants are analyzed to extract a common string that can identify the whole genre. This type of technique often uses the wildcard and mismatched technique to determine a common unique string.
- **Bookmarks method:** Bookmark method can ensure more reliable detection of viruses while it is used along with string scanning by negating the false positive. The byte distance between the start of the virus code and start the signature string vary in different viruses. So it can be used to bookmark particular viruses when string based scanning is used.
- **Smart Scanning:** Smart scanning optimizes the signature based detection. Some new variants of viruses try to hide their signature by inserting junk code or instruction in their code which have no effect in execution. Smart scanning skip junk instructions, such as NOPs (No Operation) in the host file to obtain the actual virus body.
- **Skeleton Detection:** The scanner parses the statements of a file line by line and drops all nonessential statements like statements which are not part of the virus or any blank gaps before actual procedure start and try to find essential virus code for execution of the virus which is called skeleton of the virus. An antivirus named Kaspersky uses this particular method very efficiently to detect macro viruses.

2. Heuristic Based Detection: This type of detection helps in detecting new unknown or altered version of malware, but it produces false positive often. So is used with along with signature based scanner. As the name suggest this detection mainly focus on heuristics (experimental trial and error methods) like analysis of file structure and the code organization of the virus or CPU emulation of

virus code. Some common heuristic based detection methods are:

- **Heuristics Analysis:** It is an expert based analysis that determines the susceptibility of a malware code by running it on virtual runtime environment and analyzing system towards particular risk using various decision rules or weighing methods. Multi Criteria Analysis (MCA) is one of the means of weighing.
- **Virus specific detection:** There are cases when the standard algorithm of the virus scanner cannot detect a particular malware. In such cases, a new detection code must be introduced to implement a virus specific detection algorithm to detect only specific malware. This method includes-

➢ **Filtering:** A virus only effects a particular type of known objects. So viruses can be classified according to its infection type. For example, executable viruses infect only programs such as .EXE and .COM, macro viruses only attack to files or that can perform macro statements. So whenever a particular set of files are scanned we have to check only the specific virus signature that is relevant to those files. Such filtering minimizes the searching time.

➢ **Static Decryptor Detection:** Some viruses encrypt their body to bypass string matching so they have a decryptor in the virus code. Detection of this decryptor code also result in efferent detection but it also produces false negative and false positive if not used with specific types of viruses which used that particular decryption. So this method is used after filtering of encrypted virus like oligomorphic virus.

➢ **XRay scanning:** This method tries to find the weakness in encryption algorithm of viruses. It is also virus specific and can be only used with encrypted viruses and give more suitable result than static decryptor detection as its tries to find the encryption strategy.

3. Behavioral Based Detection: When a malware attach to its host or execute its code some particular behavioral pattern or dynamic signature they exhibit is not common to other programs

and therefore by observing such signature we may detect them. But as these signatures are dynamic we need a continuous process for monitoring such abnormal behavior. A malware may produce dynamic signature like

- Opening an executable file, with both read and write permission.
- Reading the portion of the file header containing the executable's start address
- Writing the same portion of the file header.
- Seeking to the end of the file.
- Appending to the file.

This detection method monitors a running program's behavior in real time, watching for suspicious activity like the dynamic signature mentioned above. If any such activities are detected, it report to the antivirus engine that as a response prevents such operations from being executed or terminate the program. This detection method can only work when malware perform some malicious activity during runtime.

4. **Sandbox Detection or Emulation Detection:** This type of detection is also based on behavioral traits of the malware. Here the malware code under analysis is executed in an emulated environment or sandbox and the antivirus try to detect it during runtime based on behavioral traits. But unlike the Behavioral Based detection malware code, it is run in a virtual environment and not in real system and hence, minimizes the risk of being affected.

5. **Data mining techniques:** It is the recent technology used for detecting malware which uses data mining techniques like analyzing very huge sets of infected data and try to find out particular behavioral pattern or try to find out a common signature strings from a large number of different variants of malware and using this signature try to detect a known malware or to classify a code for malware.

After detection, antivirus program try to remove the malware code from host program. If it is not possible to remove the viral code and the host program is not so significant than, the antivirus delete the infected file itself. On the other hand, if the infected file is important from system point of view then it pushes it to quarantine.



CHECK YOUR PROGRESS

4. What are Trojan horses?
5. Differentiate between spyware and adware.
6. Define antivirus.



13.9 LET US SUM UP

- The basic goal of computer security is Confidentiality, Availability and Integrity.
- Violation of these goals leads to a security treats.
- Malware is a term for all malicious programs, such as viruses, worms, Trojan horses, spyware, adware and scareware which are designed to infect and perform malicious activity on computers.
- Antivirus software is designed to protect system against malware. It is available as a standalone product and is also included in most security software packages.
- They use different static and dynamic method to identify malware and neutralize them.



13.10 FURTHER READING

- Stallings, W. (2006). Cryptography and network security: principles and practices. Pearson Education India.
- Canavan, J. E. (2001). Fundamentals of network security. Artech House.

13.11 ANSWERS TO CHECK YOUR PROGRESS

Answer 1: The three security goals are

- **Confidentiality:** It means protecting the information from disclosure to unauthorized parties.
- **Integrity:** It means keeping the data pure and trustworthy by protecting system data from intentional or accidental changes
- **Availability:** It refers to ensuring that authorized parties are able to access the information when needed.

Answer 2: A computer virus is an executable program that **replicates itself** or attached to a file where it infects the computer when the file is executed.

Answer 3: A worm is more independent than a virus. A pure worm works by itself as an independent object. The main feature that separates worms from viruses is that worms are self replicating. A worm can initiate network communication by itself and send copies to other computers. So there is no need for activation criteria or host process. As worms can spread rapidly across a network infecting every PC so they are the most notorious of malwares.

Answer 4: Trojan horses are applications which appear to be useful, legitimate applications, but run malicious, hidden code. The application may appear to perform tasks, such as scanning for spyware, but actually steal personal data from your system. Executing Trojans may result in changing desktop wallpaper, creating popups, or even deleting files.

Answer 5: Spyware are the software that collects user sensitive information like browsing and searching habit, password, social interactions without your knowledge and uses such information to gain profit. Adware are the software that supports advertising. In general it is the entire program that downloads or displays unwanted banner advertisements in the software being used.

Answer 6: Antivirus software is a program or set of programs designed for searching, preventing, detecting and eliminating malware.



13.12 MODEL QUESTIONS

Q1. Define computer security?

Q2. What are the goals of computer security?

Q3. Give an example of computer virus. Explain its working principle.

Q4. What is the difference between computer virus and worms?

Q5. Why is scareware considered as malware?

Q6. Name any antivirus and explain how it works.

Q7. Briefly describe different detection mechanism used by antivirus software.

Q8. Why deception is needed for malware? Explain various deception strategy used by malwares.

Q9. Is deception strategy of malware and detection method of antivirus related to each other? Explain.

Q10. List out some of the common malware we encounter and list out whether they are viruses, worms, Trojan or any other malicious software.

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UNIT 14: CYBER CRIMES

UNIT STRUCTURE

14.1 Learning Objectives
14.2 Introduction
14.3 Cyber Crime
14.4 Hacking
14.5 Digital Forgery
14.6 Identity Theft
14. 7 Cyber Stalking
14.8 Cyber Terrorism
14.9 Cyber Defamation
14.10 Software Piracy
14.11 Information Technology Act, 2000
14.12 Let Us Sum Up
14.13 Further Reading
14.14 Answers to Check Your Progress
14.15 Model Questions

14.1 LEARNING OBJECTIVES

After going through this unit, you will be able to:

- learn what constitutes cyber crime
- describe hacking, digital forgery, cyber stalking
- define identity theft, cyber terrorism and defamation
- learn about different types of software piracy
- describe different offences under IT Act 2000

14.2 INTRODUCTION

In the previous unit you have been introduced to the concept of computer security. We have learned about different types of computer virus and worms. Different threats like malware, spyware, adware and Trojan horse were explored. Counter measures to deal with these threats like

antivirus software were also explored.

In the present unit you will be introduced to the concepts of cyber crime and how cyber crimes are committed against individuals, institutions and state. Cyber crimes like hacking, digital forgery, cyber stalking, and cyber terrorism are some of the cyber crimes introduced in this unit. The IT Act 2000 which criminalizes cyber crime is also discussed in this unit.

You will be made familiar with the different cyber crimes and laws against cyber crime in this unit, and then in the next unit you will be made familiar with the basics of computer hardware configuration. Different hardware configuration of computers, motherboards and processors will be covered in the next unit.

14.3 CYBER CRIME

Computers have become an essential part of our life. And along with the widespread growth of computers, internet use is also expanding. Although the use of internet and technology has made the life of people easier, it has also given rise to a new type of crime - cyber crime. The term cyberspace is used to represent the electronic medium of computer networks, in which online communication takes place. This term not only represents the internet but also includes computers, computer networks, the internet, data, software etc. Cyber crime can be defined as any crime that is performed using a computer and network either as a tool or as a target. Cyber crimes are often referred to as computer crimes.

According to a definition in the book ‘‘Cyber Crime and the Victimization of women, Laws, Rights and Regulations’’ Cyber crime can also be defined as "Offences that are committed against individuals or groups of individuals with a criminal motive to intentionally harm the reputation of the victim or cause physical or mental harm, or loss, to the victim directly or indirectly, using modern telecommunication networks such as Internet (Chat rooms, emails, notice boards and groups) and mobile phones (SMS/MMS)".

Some of the common cyber crimes are mentioned below :

- computer hacking
- digital forgery

- cyber stalking
- identity theft
- identity fraud
- cyber terrorism
- cyber defamation
- software piracy
- cyber pornography
- cyber bullying
- unwarranted cyber surveillance
- cyber warfare

We will look at some of these cyber crimes in detail in the next few sections.

Cyber crimes are generally divided into two categories depending on the use or activity of the computer. In the first category, the computer is the target of the cyber crime. Some examples of this category of cyber crime include hacking, virus attacks and denial of service attacks. In the second category, the computer is the tool used to perform the cyber crime. Some examples of this category include cyber frauds, cyber stalking and cyber terrorism.

Cyber crimes can also be divided into different categories depending on the target of the crime. The cyber crime performed can be committed against an individual, an institution or against a state. An example of cyber crime committed against an individual can be cyber stalking. Similarly, an example of cyber crime committed against an institution can be hacking their websites. An example of cyber crime committed against a state is cyber terrorism or cyber warfare.

14.4 HACKING

Hacking is one of the most common cyber crimes. It can be defined as an illegal intrusion into a computer system or network. This is a type of crime where an individual or institution's computer is broken into so that personal or sensitive information can be accessed. The act that is committed

towards breaking into a computer system or network is known as hacking.

The person who performs the act of hacking is known as a hacker. The hacker tries to find the vulnerabilities in a person's or in the institutions computer system or passwords to exploit the weakness and gain access into the system. The hackers are usually highly skilled computer professionals. Depending on the intent of the hackers, the hackers are classified into different groups.

The first category of hackers are ethical hackers. Ethical hackers are persons who hack into the computer system with an aim to identify the weaknesses present in the system and not for any personal gain. Because of this they are also called white hat hackers. Mostly, ethical hackers hack into computer systems on a request from the organization itself to test vulnerabilities present in the system.

The second category of hackers are crackers. Crackers are persons who hack into the computer system with an aim to gain unauthorized access to the system or network for personal gain. They aim to steal sensitive and important personal data, or corporate data or bank information. Both types of hackers use a variety of software to enter a person's computer. Most of the victims are sometimes not even aware that they had been hacked.

14.5 DIGITAL FORGERY

Digital forgery is the digitization of the process of forgery. Forgery in traditional systems is the crime of falsely and fraudulently making or altering a document and even possessing such a forged document. Digital forgery is the crime of falsely and fraudulently making or altering a documents and pictures in the digital domain. Examples of digital forgery include counterfeit currency notes, forgery of postage and revenue stamps, forgery of mark sheets etc. All of these acts of forgery are done by using computers and high quality scanners and printers.

There are different types of digital forgery. The most common types of digital forgery are mentioned below :

- **Document Forgery:** This type of forgery occurs when a legal document

is forged or replicated by another person using digital means. This also includes forgery of mark sheets and revenue stamps.

- **Counterfeit Money Forgery:** This type of forgery occurs when the legal currency of a nation is forged or replicated by using digital means.
- **Digital Signature Forgery:** This type of forgery occurs when the signature of an individual is forged or replicated by another person using digital means.
- **Art Forgery:** This type of forgery occurs when a piece of art is replicated and sold as the original art piece. Sometimes the whole painting is forged and sometimes only the signature of a famous painter is forged into the painting with an intention to get more money.

14.6 IDENTITY THEFT

Identity theft is one of the oldest crimes in human history. Identity theft can be defined as stealing personal information of a person and impersonating as that person. The terms identity theft and identity fraud are often used interchangeably. But they refer to different crimes. In identity theft, a criminal impersonates another person who actually exists. In identity fraud, a criminal creates a fictional person and assumes this fictional person's identity. The criminal in identity fraud creates a whole new person, with both personal and financial details.

Identity theft is a much more common crime than identity fraud. Most of the information stolen is in identity theft is financial in nature regarding bank account or credit card details. But according to the victim's need different personal or financial information may be stolen. For example information like name, address, passport number, PAN number, bank account details, bank passwords, and debit or credit card details.

While most of the identity thefts are done for financial gain, there are many identity thefts done with other intentions too. According to a non-profit Identity Theft Resource Center, identity theft can be categorized into five types depending on the intent. These categories are mentioned below:

- **Criminal Identity Theft:** In this type of identity theft, the criminal impersonates as another person as he/she is held accountable for a crime. The criminal identifies himself as another person to the state authority by using simple documents such as fake identity cards. This is usually done to get the police or court authorities off their back. The victim's of this identity theft may never come to know of these crimes done using their false impersonations.
- **Financial Identity Theft:** This is the most common type of identity theft. In this type of identity theft the criminal uses another person's identity to obtain money, loans or any other financial services using the victim's identity. These types of crimes are usually found out only when the debts mount or when it is time to pay off the loan installments.
- **Identity Cloning:** In this type of identity theft, the criminal impersonates another person to conceal their own identity. The criminals are mostly persons hiding from debt collectors or who want to became someone else for personal reasons.
- **Medical Identity Theft:** This is a new type of identity theft where the criminals steal the identity of the victim's for medical benefits. The criminals pose as another person to get medical care like medical insurances and high cost drugs.
- **Child Identity Theft:** This is another type of identity theft where the criminals target minor children for their personal gain. The criminals steal the social security numbers of children and use is information for their own benefit.



CHECK YOUR PROGRESS

1. Define cyber crime?
2. Differentiate between identity fraud and identity theft.
3. Who are the crackers?

14.7 CYBER STALKING

Stalking can be defined as an act of harassment targeting the victim. Stalking includes various acts such as following the victim, making harassing phone calls, vandalizing victim's property, leaving written messages or objects etc. Cyber stalking can be defined as the act of stalking done by using the means of computer systems or internet. The terms cyber stalking and cyber bullying are often used interchangeably. But there is a difference between these two terms, even though in essence both are crimes. The term cyber bullying is generally used when the parties involved are not adults and includes teenagers or children.

In most of the cases of cyber stalking, the victim is harassed by the criminal by sending repeated storm of online messages and emails. The criminals often harass the victims by posting messages on websites or discussion groups. The criminals often try to track every moment of the victim's daily activity using the help of social media. Cyber stalkers use social media sites like Facebook, Twitter, MySpace to keep track of the victim's activities and location. In most of the cyber stalking cases, the stalkers are known to the victims and they use internet to stalk the victims. Also, in many cases, if the criminals find that online stalking does not have their desired effect, they then resort to both online and offline stalking. This crime is punishable by law in India and in the first conviction for cyber stalking the person was sent to jail for three months.

14.8 CYBER TERRORISM

Cyber terrorism can be defined as an act of terrorism that is committed using computer systems and networks. Spreading terrorism through the means of internet has become an attractive option for modern terrorists. This is due to the fact that the terrorists prefer using the internet and other advanced technology in comparison to traditional methods because these machines can be accessed remotely. Another term that frequency comes when we speak of cyber terrorism is cyber warfare. Cyber warfare can be defined as the action by a nation or a state to penetrate another nation's computers or networks for the purpose of causing damage.

In cyber terrorism, the terrorists use the internet to conduct violent acts that may cause loss of life or bodily harm. The terrorists not only target human property and life but also try to cause deliberate failure of functioning of government services by targeting communication networks. Government services like electric and solar power plants, air and rail traffic systems, telecommunication systems, medical services, police and military services are targeted mostly to paralyze the victim country. Large scale disruptions of these services are caused by using tools like computer viruses, worms and other malicious software. Most of the government websites are brought down by performing denial-of-service (DOS) attacks. In 1998, cyber terrorism attack was done by ethnic Tamil guerrillas by disrupting the Sri Lankan embassies using DOS attacks. The Sri Lankan embassies were attacked by sending around 800 e-mails a day for over a two week period.

14.9 CYBER DEFAMATION

Cyber defamation can be defined as defamation done using digital media usually through the internet. When a person publishes defamatory matter about someone on a website or sends e-mails containing defamatory information to all of that person's friends, it is termed as cyber defamation. The defamation can be done using words spoken orally or in written form or by signs or similar visible representations.

In most cases of cyber defamation when it is done with no serious grudge, it can be stopped by a cease and desist letter and by removing the messages from the digital media. But, if it is done with serious intent then the law can be used to punish the criminal. Cyber defamation not only harms the individual victim but also his family, the individual's organization and sometimes even the state or country of the victim. This depends on who the victim is and on what position the individual is currently working on. In such cases, the target for cyber defamation is often chosen not for personal grudge but for damaging the image of the organization or the country of the individual. The harm that is caused in defamation by using digital media is widespread and often irreparable as the information is already out over the whole internet. Some of the digital media that is used to perform cyber

defamation are mentioned below :

- world wide web
- social networking sites
- email and messaging
- discussion groups
- bulletin boards

In India, there are two types of liability for defamation. The first category involves cases in which the liability is of the primary publishers of the defamatory content material. This category includes persons who has written the defamatory content material and then published this material in the cyber space. The second category involves cases in which the liability is of the internet service providers or bulletin board operators. This category includes persons who had authorized publication of the defamatory materials.

14.10 SOFTWARE PIRACY

Software piracy can be defined as the unauthorized copying or illegal distribution of copyrighted materials. Software piracy causes loss of revenue for the makers which in turn lads to the increased prices of software for the licensed consumers. Most of the software has an end user license agreement with the consumers. Violation of this agreement leads to software piracy.

Software piracy has been categorized into six categories. Let us look at each of these six software piracies.

- **Softlifting:** Softlifting or softloading is one of the most common types of software piracy. Softlifting is defined as sharing a program or software with someone who is not authorized to use that software in accordance with the licensing agreement. Most often a single licensed copy of the software is brought and but then it is loaded into multiple computer systems. Softloading is quite common in college campuses and businesses.
- **Internet piracy:** With the increasing number of internet users every year the number of persons committing internet piracy has grown

tremendously. Internet piracy occurs when software is downloaded from the internet. There are a lot of websites where software is available for free unlimited download without following any licensing agreements.

- **Software Counterfeiting:** Software counterfeiting is the illegal duplication, distribution and sale of copyrighted software material. In software counterfeiting it is common to make duplicate copies of the programs, the documentation and also the licensed agreements. Microsoft products are one of the most common products to be counterfeited.
- **Hard Disk Loading:** Hark disk loading software piracy occurs when new computers are sold with unauthorized software. This is done by hardware dealers to make their products more attractive to the buyers.
- **Renting:** Renting involves the process of renting software to another person temporarily who does not have the authorized permission or license to use the software.
- **Original Equipment Manufacturer (OEM) Unbundling:** In this type of software piracy, sellers sell standalone software which are originally meant to be included with some other licensed product.

14.11 INFORMATION TECHNOLOGY ACT, 2000

The Information Technology (IT) Act, 2000 is an Act of the Indian Parliament enacted with the prime objective to create an enabling environment for commercial use of information technology. The IT Act specifies the acts which have been made punishable by law regarding cyber crime and electronic commerce in India. The IT Act has amended various sections of the Indian Penal Code (IPC) of 1860, the Indian Evidence Act of 1872, the Bankers Book of Evidence Act of 1891 and the Reverse Bank of India Act of 1934 to include cyber crimes done using new technologies. A major amendment of the IT Act was made in the year 2008 to include penalties for offensive messages, child pornography, cyber terrorism and voyeurism. In 2013, another amendment was made to include the offence of cyber stalking. Let us look at the various offenses that have been made punishable under

the IT Act.

Some of the cyber crimes under the IT Act are mentioned below :

- Tampering with Computer source documents - Sec.65
- Hacking with Computer systems, Data alteration - Sec.66
- Sending any message that is offensive - Sec 66 A
- Publishing obscene information in electronic form - Sec.67
- Un-authorised access to protected system Sec.70
- Breach of Confidentiality and Privacy - Sec.72
- Publishing false digital signature certificates - Sec.73

Some of the cyber crimes under IPC are mentioned below :

- Cyber stalking - Sec 354D IPC
- Web-Hijacking - Sec. 383 IPC
- Bogus websites, cyber frauds - Sec 420 IPC
- Email spoofing - Sec 463 IPC
- Forgery - Sec 463 IPC
- Cyber defamation - Sec 499 IPC
- E-Mail Abuse - Sec.500 IPC
- Sending threatening messages by email - Sec 503 IPC



CHECK YOUR PROGRESS

4. What are the different types of software piracy?

5. Define cyber stalking.

6. What are the different types of medium used for cyber defamation?

7. What is the IT Act, 2000?



14.12 LET US SUM UP

- Cyber crime can be defined as any crime that is performed using a computer and network either as a tool or as a target.

- Hacking can be defined as an illegal intrusion into a computer system or network. This is a type of crime where an individual or institution's computer is broken into so that personal or sensitive information can be accessed. The person who performs the act of hacking is known as a hacker.
- Ethical hackers are persons who hack into the computer system with an aim to identify the weaknesses present in the system and not for any personal gain. Crackers are persons who hack into the computer system with an aim to gain unauthorized access to the system or network for personal gain.
- Digital forgery is the digitization of the process of forgery. Forgery in traditional systems is the crime of falsely and fraudulently making or altering a document and even possessing such a forged document. Digital forgery is the crime of falsely and fraudulently making or altering a documents and pictures in the digital domain.
- Identity theft can be defined as stealing personal information of a person and impersonating as that person. In identity theft, a criminal impersonates another person who actually exists. In identity fraud, a criminal creates a fictional person and assumes this fictional person's identity.
- Cyber stalking can be defined as the act of stalking done by using the means of computer systems or internet. The term cyber bullying is generally used when the parties involved are not adults and includes teenagers or children.
- Cyber terrorism can be defined as an act of terrorism that is committed using computer systems and networks. Cyber warfare can be defined as the action by a nation or a state to penetrate another nation's computers or networks for the purpose of causing damage.
- Cyber defamation can be defined as defamation done using digital media usually through the internet. When a person publishes defamatory matter about someone on a website or sends e-mails containing defamatory information to all of that person's friends, it is termed as cyber defamation.

- Software piracy can be defined as the unauthorized copying or illegal distribution of copyrighted materials.
- The Information Technology (IT) Act, 2000 is an Act of the Indian Parliament enacted with the prime objective to create an enabling environment for commercial use of information technology. The IT Act specifies the acts which have been made punishable by law regarding cyber crime and electronic commerce in India.
- A major amendment of the IT Act was made in the year 2008 to include penalties for offensive messages, child pornography, cyber terrorism and voyeurism.



14.13 FURTHER READING

- Chander, H. (2012). Cyber laws and IT protection. PHI Learning Pvt. Ltd..
- Singh, K. K. (2011). Information security and cyber law. kk singh.
- Godbole, N., & Belapure, S. (2011). Cyber Security: Understanding Cyber Crimes, Computer Forensic and Legal Perspective.



14.14 ANSWERS TO CHECK YOUR PROGRESS

Answer to 1: Cyber crime can be defined as any crime that is performed using a computer and network either as a tool or as a target.

Answer to 2: In identity theft, a criminal impersonates another person who actually exists. In identity fraud, a criminal creates a fictional person and assumes this fictional person's identity. The criminal in identity fraud creates a whole new person, with both personal and financial details whereas in identity theft, the criminal impersonates an already existing person.

Answer to 3: Crackers are persons who hack into the computer system with an aim to gain unauthorized access to the system or network for personal gain.

Answer to 4: There are six types of software piracy. They are - softloading, internet piracy, renting, software counterfeiting, hard disk loading and OEM unbundling.

Answer to 5: Cyber stalking can be defined as the act of stalking done by using the means of computer systems or internet. In most of the cases of cyber stalking, the victim is harassed by the criminal by sending repeated storm of online messages and emails. The criminals often harass the victims by posting messages on websites or discussion groups.

Answer to 6: The different types of media used for cyber defamation are world wide web, social networking sites, discussion groups, bulletin boards and using emails and messages.

Answer to 7: The Information Technology (IT) Act, 2000 was enacted with the prime objective to create an enabling environment for commercial use of information technology. The IT Act specifies the acts which have been made punishable by law regarding cyber crime in India.



14.15 MODEL QUESTIONS

Q1. What are the different types of cyber crime?

Q2. Define digital forgery. What are the different types of digital forgery?

Q3. Differentiate between cyber trolling and cyber bullying.

Q4. What is cyber warfare? Give an example.

Q5. Differentiate between identity fraud and identity theft?

Q6. Describe the different types of identity theft?

Q7. Describe the different categories of cyber defamation.

Q8. Define hacking. How are the ethical hackers different from crackers?

Q9. Define cyber stalking. How is the crime of cyber stalking performed?
Whch section of IT Act deals with cyber stalking?

Q10. Describe the laws related to cyber crime in India?

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