CERTIFICATE COURSE ON DIGITAL LIBRARY

Paper I

ICT in Libraries

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INTRODUCTION

The course *"ICT in Libraries"* is designed to provide a comprehensive understanding of the role, applications, and implications of Information and Communication Technology (ICT) in contemporary library and information services. In the digital era, ICT serves as the foundation for efficient information organization, access, and dissemination, transforming traditional libraries into technology-driven knowledge centres. This course aims to equip learners with the theoretical knowledge and practical skills required to plan, implement, and manage ICT-based systems and services in libraries and information centres.

The course begins with an exploration of the concept, evolution, and scope of ICT in the field of Library and Information Science. It introduces the fundamental components of ICT including hardware, software, and networking, it also highlights how their integration supports library operations. Students gain insights into the classification and architecture of computer systems, including input–output devices, storage mechanisms, and the functioning of key units such as the arithmetic logic and memory components.

We will also study application and system software relevant to libraries, including office productivity tools such as word processors, databases, and spreadsheets that enhance information handling and service delivery. The sections on networking concepts and topologies explain the structure, functioning, and advantages of computer networks LAN, MAN, WAN, and VPN and their significance in library automation, resource sharing, and digital connectivity. The course also covers core internet technologies, protocols and introduces fundamental website development concepts, including hosting, protocols and the emerging role of artificial intelligence in website design and maintenance.

The security and integrity of library networks are given special focus through discussions on cybersecurity principles, encryption, authentication systems, and institutional data protection measures. The inclusion of metadata and bibliographic standards such as MARC 21 and Dublin Core enables learners to understand the significance of metadata in digital resource management and interoperability.

A central component of the course examines Integrated Library Management Systems (ILMS), their evolution, structure, and core modules like acquisition, cataloguing, circulation, serials, and OPAC emphasizing the importance of automation in modern library operations. The course also delves into search engines, discovery systems, and advanced search strategies, including the use of Boolean logic and AI-enabled retrieval systems. Emerging web technologies and the concept of Library 2.0 are studied to understand the participatory and user-driven approaches to library services through social media and collaborative tools.

The concluding units address collaborative services and ethical issues surrounding ICT in libraries. Topics such as user-generated content, community engagement, open access policies, copyright, licensing, and institutional ICT governance provide a holistic understanding of the legal and ethical framework guiding technology use in libraries. Upon completion, learners will possess the conceptual foundation and applied competence necessary to design, implement, secure, and evaluate ICT-based library systems capable of meeting the information needs of modern academic and research environments.

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UNIT 1: FOUNDATIONS OF ICT IN LIBRARIES

UNIT STRUCTURE

1.1 Learning Objectives
1.2 Introduction
1.3 Concept and Evolution of ICT
1.4 Scope of ICT in LIS
1.5 Components of ICT
1.6 Let Us Sum Up
1.7 Answers to Check Your Progress
1.8 Probable Questions
1.9 Further Readings

1.1 Learning Outcome

After going through this unit, learners will be to

- Know about the concept and importance of ICT in Library
- Know about the different components of ICT and their use in Library

1.2 Introduction

The rise of Information and Communication Technology (ICT) forms one of the most significant changing forces in the present global society, significantly improving the ways by which individuals and institutions create, receive, and distribute knowledge. ICT innovations have made things more efficient, easy access to more people, as well as encourage levels of collaboration and information sharing that have never been seen before and is clearly seen healthcare, education, business, and government. Digital tools and their connectivity are now essential for success in every field and libraries are no exception. It has completely changed libraries from places where one could only find printed materials to places where a lot of digital information can now be found. Libraries today are able to connect the real world with the digital world by using computers, software, networks, and digital resources. Works that used to be done manually with a long time such as cataloguing, circulation, acquisitions, and reference services, are now automated, quick, and often available online Digital platforms and metadata standards make access more equal, allowing everyone, no matter where they are or where they come from, to engage with a world of scholarly and cultural content. Libraries employ ICT to build large digital collections, promote interactive learning, exchange and protect rare resources, and forms services to individual needs using data-driven insights. ICT also helps libraries share resources to work together, make the most use of their resources. This makes sure that libraries stay useful, strong, and flexible in a world that is changing quickly. In the end, the most important thing about ICT in libraries is that it can help the library do its main job better: giving everyone equal access to knowledge. It can also create new chances for people to learn, discover, and get involved in their communities. Understanding the foundations of ICT in libraries is therefore essential for professionals and learners seeking to advance library services, foster digital inclusion, and support lifelong learning in the digital era.

1.3 Concept and Evolution of ICT

Definition and Meaning of ICT

ICT stands for Information and Communication Technology, including all the technological activities involving information: collection, processing, its storage, collaborating, presenting as well communicating. ICT has evolved from merely supporting information tasks (IT) to enabling communication and collaboration on a large scale. Computers, email, robots, digital TV, and other electronic and digital products and systems that store, retrieve, manipulate, transmit, or receive information are all examples of ICT. It combines communication technology with informatics technology and is used for both work and learning. ICT is seen as a building block of modern society and is important for education along with basic skills like reading and writing. International organizations, like UNESCO, stress the importance of ICT literacy for being part of knowledge societies. They publish curricular frameworks for using ICT in different levels of education The fast growth of ICT means that the curriculum needs to be updated all the time and professionals need to keep learning.

Principles and Components

- Technology is never alone; its usefulness depends on how it is used, where it is used, how it is set up, and how it is managed.
- The idea of ICT changes depending on the local culture, resources, and system integration. It can mean anything from simple tools for certain tasks (like publishing or processing transactions) to full systems that help with learning, problem-solving, and working together.
- ICT is a collection of devices, services, tools, and ways of doing things that let people collect, process, store, and share information.

Implementation, Curriculum, and Professional Development

To use ICT well in Libraries and information centres, the curriculum of LIS needs to be updated regularly with new ICT use and innovations and librarians and staff need to keep learning. Library and information science professionals, as well as other professionals, must progress through different levels of ICT adoption, starting with learning basic digital skills and moving on to developing integrated and reflective practices. Also, making the right budgets and planning policies is important for the successful use of ICT. This makes sure that the right resources, infrastructure, comfortable workspaces, and hardware and software are all available.

Evolution of ICT

The development of ICT started in the middle of the 20th century with big mainframe computers like UNIVAC I. These computers were mostly utilized by governments, universities, and big businesses for scientific research, census processing, and other big data

jobs. These machines were exceedingly expensive, took up whole rooms, and could only be used by experts, so only a few firms had access to a lot of computing power. In the 1970s and 1980s, computers began to be used in business. Mainframes and then minicomputers were used to automate tasks like accounting, banking, inventory management, and manufacturing. Tools like CAD (Computer-aided design) and early management information systems made these tasks much more efficient and accurate. The personal computer revolution of the 1980s then brought ICT from specialized computer rooms to homes and desks. IBM and Apple's cheap PCs, as well as their easy-to-use operating systems and productivity software (including word processors, spreadsheets, databases, and presentations), made computers a part of everyday life for small businesses, schools, and offices. Telecommunications changed from analog to digital, fiber-optic cables boosted bandwidth, and mobile phones came out. This made a high-capacity communication infrastructure that would enable worldwide data networks. The internet was made possible by the merging of computing and telecommunications. It started with ARPANET and established protocols like TCP/IP. The World Wide Web made it easier for regular people to access and exchange information through browsers and websites.

The internet made it possible for e-mail, web browsing, e-commerce, online banking, digital publishing, and new business models including online marketplaces and search-based advertising to start in the 1990s. Smartphones and tablets, along with 3G and 4G networks, put powerful, always-connected computers in people's pockegoingts in the 2000s and 2010s. This made mobile devices the main means to communicate, get information, use social media, and access digital services. Cloud computing changed ICT even more by letting people and businesses rent computing power, storage, and software over the internet instead of having to buy their own hardware. This made it easier for people to work together from anywhere.

Today, ICT is still changing with new technologies like 5G networks, artificial intelligence, machine learning, the Internet of Things, and new fields like virtual and augmented reality and quantum computing in the future. These changes are making ICT more common, smart, and a part of the real world. They are changing the way people communicate, learn, do business, govern, and solve issues. They are also generating new questions about digital inequality, privacy, security, and the future of labour.

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1.4 Scope of ICT in LIS

ICT has important role in transforming libraries from manual or traditional ways or document centric units to hybrid and digital libraries or knowledge hubs with increased reach, visibility, quick service and more user centric service. It covers practically every part of a modern library, from back-end tasks to user services, networking, and new jobs for library workers.

ICT in Housekeeping and Management operation: ICT makes it possible to fully or partially automate acquisition, cataloguing, classification, serials management, circulation, and stock verification. Integrated Library Systems (ILS/Library Management Software) like

KOHA, SOUL and OPAC/webOPAC make work easier, cut down on manual effort, and make management reports that help in decision-making.

ICT in Information access and digital collection: One of the main goals of ICT is to make it possible for people to access e-books, e-journals, online databases, digital archives, and institutional repositories, whether they are on campus or not. Digital libraries and repositories let you save things for a long time, find them using metadata, and access a wide range of resources in text, image, audio, and video formats 24/7.

ICT in User service and learning support: ICT adds online OPAC search, virtual reference, current awareness, and selective transmission of information through email, the web, and social media to traditional reference and information services. Libraries also employ ICT to teach people how to use information through online tutorials, webinars, video guides, and interactive learning modules**.**

ICT in Networking, resource sharing and outreach: Libraries can join consortia, share catalogs, subscribe to shared e-resources, and employ interlibrary loan and document delivery more effectively thanks to networking technologies. Websites, social media, and mobile apps let the library reach more people, promote outreach programs, and interact with users who are far away or have disabilities.

ICT in Administration, analytics, and new technologies: For better management, ICT tools help with planning, budgeting, usage statistics, and data-driven evaluations of collections and services. People are looking for new tools like cloud services and AI/ML for tailored suggestions, automated routines, and better resource management. However, these solutions come with problems like cost, training, and privacy.

1.5 Components of ICT

1.3.1 Hardware Components: These are the physical devices and tools that make up ICT and perform things like input, processing, storage, output, and communication. This includes:

Computers and peripheral devices: Desktops, laptops, and servers are utilized for data processing and application execution; servers facilitate centralized storage and multi-user access. Peripheral devices such as external disks, printers, and scanners. are those that increase functionality for jobs like printing, scanning, and backup,

Mobile devices: Wearables, tablets, and smartphones that offer internet connectivity, app-based services, and portable computing etc.

Networking equipment: This includes routers, switches, modems, and firewalls that link devices, send data, and keep them safe.

1.3.2 Software Component: The software and directives that operate on hardware, enabling users to execute tasks, manage data, and regulate the system. This includes:
Operating system: Example includes Linux, Windows, android etc. that manages hardware resources and provides an interface for applications.

Application software: These includes programs that do specific activities, like word processing, spreadsheets, library automation, or systems that are only for a certain area.

Utility software: These are the tools for keeping the system running smoothly, backing it up, keeping it safe, and making it run faster, for example the antivirus software and disk management tools etc.

Development software: These includes programming languages and integrated development environments that are used to make, code, test, and distribute new apps.

1.3.3 Networking Units: These includes the communication infrastructure that connects devices and enables data transfer in both local and global level. These includes:

Internet: It is the global network that enables worldwide access to information, communication, e-services, and online applications.

Local Area Network (LAN): This facilitates connection of devices within a limited area such as home, office, school to share resources and services.

Wide Area Network (WAN): It connects multiples LANs across large geographic regions for a long-distance communication.

Intranets and extranets: These are private organizational networks facilitating internal users (intranet) and selected external partners (extranet) with controlled or limited access to resources and services.



Check Your Progress

A. Fill in the Blanks.

a) ICT stand for_____.
b) Device such as routers, switches, modems and firewalls are called_____
c) LAN and WAN stand for_____ and _____.
d) _____ is an example of application software used in libraries to keep track of services and collection.

1.6 Let Us Sum Up

Information and Communication Technology (ICT) has totally revolutionized how libraries work. It employs digital instruments like computers, software, and networks to gather, store, analyze, and distribute information. ICT has changed old-fashioned, print-based libraries into hybrid and digital libraries where people may get both physical and electronic resources at any time and from any place. It speeds up important tasks like buying books, cataloging them, checking stock, and circulating them. It also makes it easier to get to e-books, e-journals,

databases, and digital archives. ICT also makes services better for users by letting them search the catalog online, get virtual reference help, stay up to date on current events, and learn how to use information through tutorials, webinars, and videos. Libraries can share resources, reach users who are far away, and increase outreach through networking, consortia, and online platforms. Overall, ICT helps libraries better manage their resources, look at how people use them, incorporate new technologies like cloud and AI, and most significantly, make knowledge more widely available, more equally, and more centered on the user.

1.7 Answers to Cheek Your Progress

A. Fill in the Blanks

a) Information and communication technology
b) Networking equipment
c) Local Area Network and Wide Area Network
d) KOHA

1.8 Probable questions

A. Short Answer Type Questions:

a) Define ICT.
b) What are the different components of ICT**.**

B. Long Answers Type Question

a. Discuss the Evolution of ICT.
b. Explain the scope of ICT in Library and Information Centres with reference to housekeeping operations, user services, and networking/resource sharing.

1.9 Further readings

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UNIT 2: COMPUTER SYSTEMS FOR LIBRARIES

UNIT STRUCTURE

2.1 Learning Objectives

2.2 Introduction

2.3 Generations and Classification of Computers

2.4 Basic components of Computer

2.5 Let Us Sum Up

2.6 Answers to Check Your Progress

2.7 Probable Questions

2.8 Further Readings

2.1.Learning Outcomes

After going through this unit, learners will be able to

- Learn about the many generations and types of computers and how they can be used in libraries.
- Explain the main parts of a computer system and how they help libraries run automatically.

2.2.Introduction

In order to successfully manage library resources, services, and user needs, computer systems are necessary. Computers have changed a lot throughout the years, with each new generation bringing advantages like smaller sizes, more storage space, and faster speeds. Early computers relied on bulky vacuum tubes, while today's systems use advanced processors and innovative technologies like artificial intelligence. There are different types of computers, such as microcomputers, minicomputers, mainframes, and supercomputers. Each type is made for a certain job based on its size and features.

A modern computer system is made up of both hardware and software. The CPU, memory unit, and other input-output devices including keyboards, displays, printers, and scanners are the most important parts of the hardware. The arithmetic logic unit in the CPU carries out calculations and commands. The memory unit, on the other hand, stores data and programs both temporarily and permanently. Input devices let people enter information, output devices show outcomes, and secondary storage keeps a lot of information safe for a long time.

2.3.Generations and classifications of computers

Computer generations talk about how computer hardware has changed over time, whereas computer classifications classify computers into groups based on their size, capability, and function. These ideas help us understand how current systems came to be and how different types of computers meet varied user needs.
Generations of computers:

First generation (1940s–1950s): These computers employed vacuum tubes as the main electronic component, were quite large, consumed a lot of power, and were largely used for scientific and defence applications. Input was through punched cards and paper tape, and machine language was used for programming. Examples: **ENIAC, UNIVAC I, IBM 650, and IBM 701.**

The second generation (1950s–1960s): They saw the switch from vacuum tubes to transistors. This made computers smaller, faster, more dependable, and less power-hungry. High-level languages were created, and more and more businesses and scientists began to use systems for data processing. Examples **IBM 1401, Honeywell 400, IBM 7094, UNIVAC 1108 and CDC 1604 (Control Data Corporation).**

Third generation (1960s–1970s): Integrated circuits (ICs) made it possible to make things even smaller and faster, and they also gave computers a lot more storage space. Monitors, keyboards, and operating systems became popular, allowing for time-sharing and multi-programming. Examples: **IBM 360, IBM 370, PDP-11, UNIVAC 1108.**

Fourth generation (1970s to now): Microprocessors put thousands or millions of parts on one chip, which led to personal computers, laptops, and networks. This generation is known for being fast, cheap, portable, and widely used in schools, households, and offices. Examples: **IBM PC (1981), Apple Macintosh (1984), Dell, HP, Lenovo desktops and laptops, Intel Pentium series processors, AMD Ryzen processors, Smartphones and tablets (modern examples of microprocessor-based devices)**

Fifth generation (now and in the future): New and current systems are focused on AI, sophisticated parallel computing, and very high-density VLSI/ULSI technology (Very Large-Scale Integration/ Ultra Large-Scale Integration). Some of the goals are natural language interface, expert systems, robotics, and smart decision support. Examples: **Watson, Google DeepMind (AlphaGo), Siri, Alexa, Google Assistant, ChatGPT and other AI models, Quantum computers (IBM Quantum, D-Wave**)

Classification of Computers:

Based on electronic signals

Analog computers: Analog computers deal with physical quantities that change all the time, like voltage or mechanical motion. They are mostly utilized in scientific and industrial control

scenarios. One such use is in flight simulators, where pilot commands are turned into changing physical circumstances that are quite similar to real flying.

Digital Computers: Digital computers use binary numbers 0 and 1 to represent data and do all their work by switching electrical states between ON and OFF. These systems are the most used for business, science, and general computing, and most people use the word "computer" to mean a digital computer.

Hybrids Computers: Hybrid computers have the ability to measure like analog systems and count and do logic like digital systems. For example, a modem that changes digital impulses to analog and back again, or systems that measure biological signals (like ECG) in analog form and subsequently turn them into digital data for analysis.

Based on memory

Microcomputers: Microcomputers are the slowest and have the least storage space. They have a microprocessor as the CPU. Desktops and laptops are two examples of personal computers (PCs) that offer numerous input and output devices for each user.
Examples: IBM PC, PC-AT etc.

Minicomputers: Minicomputers can be used by more than one person at a time, and they are faster and have more storage space than microcomputers. They are used for processing in departments, multi-user systems, and as servers in local area networks. Examples include DEC PDP-11, HP 3000 and the IBM AS/400 etc.

Mainframe computers: Mainframes are strong 32-bit (or higher) computers that can store a lot of data and do a lot of work at once. You usually find them in centralized databases and as controlling nodes in wide area networks. Examples: DEC, ICL and IBM 3000 series

Supercomputers: Supercomputers are the most powerful and expensive computers. They frequently have multiple processors connected to each other to make them work very quickly. People use them for a lot of jobs that require a lot of computing power. Examples: CRAY YMP, CRAY2, NEC SX 3, CRAY XMP and PARAM from India.

2.4. Basic components of a computer

2.4.1 `Arithmetic Logic Unit

The arithmetic logic unit (ALU) is the part of the central processing unit (CPU) that does math and logic on data. This is why it is often termed the "computational brain" of the computer. It uses electronic logic circuits to do things like addition, subtraction, and comparisons very quickly with binary values.

Arithmetic Logic Unit (ALU) is a digital circuit within the CPU that executes arithmetic operations including addition, subtraction etc. and logical operations such as AND, OR, NOT on binary data. It receives the input data from the CPU registers and performs the specified functions and send the outcome back to the registers or the memory for further use.

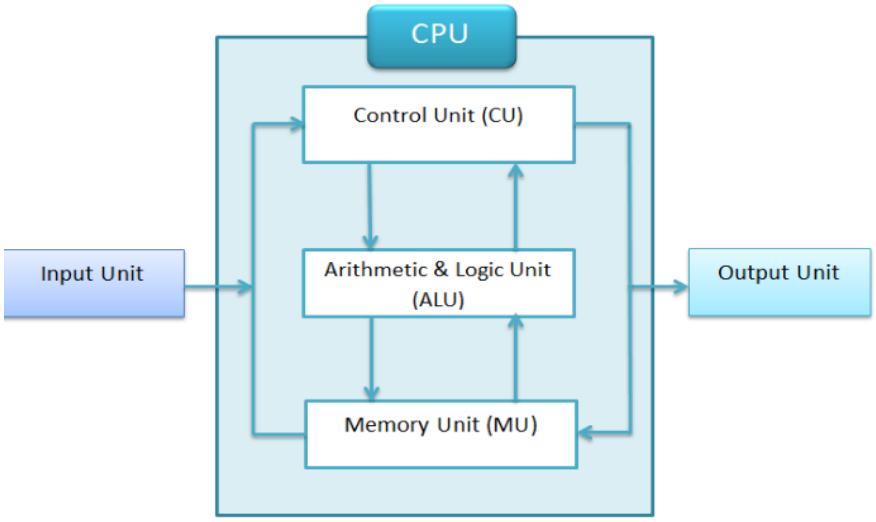


Fig 1: Illustration of ALU

Function of ALU:

- **Basic Mathematical Functions:** It does math like adding, subtracting, and multiplying. It might have X and Y as possibilities for carry-in or carry-out. This happens when the result can't fit in a 1-bit binary structure. It can also subtract B from A or the other way around, with the difference at Y and the carry-in or carry-out.
- **Advanced Mathematical Functions:** The ALU can also do more complicated things, such adding and subtracting. This is an increment when the output shows the new value after X or Y is raised by 1. When X or Y is dropped by 1, the output shows the new value, which is the same as decrement.

- **Logic Operations:** It executes logical operations such as AND, OR, X-OR, NOT, etc. These are essentially instructions or rules that help the ALU determine whether something is true or false given a set of conditions. 'AND' and 'OR' functions allow the arithmetic logic unit to understand how two conditions work together. It also plays an important role in logic calculations, such as fuzzy logic.

- **Bit Shift Operations:** This function is for ALU shift operations, which let you move the X (or Y) operand left or right and print the new operand. In most cases, simple ALUs can only move the operand by one bit. Barrel shifters are used in

complex ALUs, which let processors move the operand by a set number of bits in one operation.

- **Data Checks through special value:** ALUs can also give different outputs. They make diverse signals that are often used to control how programs branch. Z (zero), C (carry), N (negative), and V (signed carry) are some of the most common ones. These numbers could give you a lot of useful information. For example, both integers must be the same if their difference is 0. This also works for calculations that are more than or less than.
- **Transferring data to and from registers:** The arithmetic logic unit accepts the accumulator or temporary register's inputs. Additionally, the result is stored in the accumulator (the temporary register). Lastly, it delivers outcome states to the signal register.

- **Specially Programmed Operations:** Engineers can also program the ALU to do any task they choose, like with supercomputers. The ALU, on the other hand, gets significantly more expensive as the operations get more complicated since it makes more heat and takes up more space on the CPU. So, the expense of ALU needs to be in line with how strong and complicated it is. The main reason faster CPUs cost so much more is that their ALUs use more power and create more heat.

2.4.2 Memory Unit

The memory unit of a computer stores data, instructions, and results so that the CPU can function quickly. It uses a hierarchy of very fast, compact registers at the top and huge, slow secondary storage at the bottom. It lets quickly get to the information one uses often and also stores applications and user data for a long time. It is the part of the computer that stores all the information it needs to process, such as software instructions and data. It also controls how this information moves to and from the CPU, which helps keep speed, stability, and data integrity while the program is running.

Types of Memory

Registers: Very small, very fast locations inside the CPU that store currently used data and instructions.

Cache memory is a type of high-speed memory that sits between the CPU and the main memory. It retains data that has been used lately or often to speed up access time.

Main (primary) memory, or RAM: It is the CPU's main workspace. It temporarily stores programs and data that are running.

Secondary memory: *It* is external storage like hard drives, SSDs, optical disks, and so on. It is used to store huge amounts of data permanently and for a long time.

Memory Hierarchy: registers → cache → main memory → secondary storage is sorted from quickest and most expensive per bit to slowest and cheapest with the most space. This hierarchy lets the system store important data in faster memory and less important data in slower memory, which keeps costs down while still getting good performance

2.4.3 Input and Output devices

Input and output devices are pieces of hardware that let people provide data and instructions to the computer and get the results back in a form that they can utilize. Keyboards and scanners are common ways to input data, while monitors and printers are common ways to output data. Secondary storage elements are used to store data for a long time without losing it.

- Input devices send data or commands from the user to the computer (e.g., keyboard, mouse, scanner).
- Output devices present the results of processing in a human-readable form (e.g., monitor, printer, speakers).
- Some devices act as both input and output devices (hybrid devices), such as a touchscreen, USB flash drive, or external hard disk

2.4.3.1 Keyboards: The keyboard is the most common and widely used input device for entering data and commands into a computer system. It follows a layout similar to a traditional typewriter, but includes additional keys for performing special operations and controlling programs.

Most computer keyboards use the QWERTY layout, derived from mechanical typewriters, where the character keys for letters and numbers are arranged in a familiar pattern. Earlier PC keyboards generally had 84 or 101/102 keys, while modern Windows and Internet keyboards typically provide 104 or more keys (such as 108) to accommodate extra function and control keys.

Major groups of keys

- Numeric keys: A numeric keypad, usually a block of 17 keys on the right side, is used to enter numbers quickly and to move the cursor using keys like arrows, Home, End, PgUp, and PgDn when Num Lock is off.
- Typing keys: These are the main alphanumeric keys consisting of letter keys A–Z and number keys 0–9 arranged in the QWERTY format for text entry.
- Control keys: These keys help control the pointer, text, and screen; they typically include the four arrow keys, Home, End, Insert, Delete, Ctrl, Alt, and the Esc (Escape) key.
- Special keys: Keys such as Enter, Shift, Caps Lock, Num Lock, Tab, and Print Screen provide formatting, mode switching, or system-related functions.

- Function keys: A row of 12 keys labelled F1 to F12 at the top of the keyboard is used as shortcuts for various commands, context-sensitive help, and application-specific operations.

2.4.3.2 Monitors

A monitor, often called a Visual Display Unit (VDU), is an output device that shows text, pictures, and videos on a screen.

Types of Monitors:

CRT: (Cathode Ray Tube) monitors are old, big displays that use electron beams. They have good color and depth, but they are hefty and use a lot of power.

Flat-panel displays: They are thin, light screens. Some common varieties include:

LCD: (Liquid Crystal Display) uses liquid crystals and a backlight. It is common in laptops and desktops.

LED: monitors are a form of LCD that uses LED backlighting. They are slimmer, brighter, and use less energy.

OLED: (Organic LED) is a type of display where each pixel gives out its own light. It has deep blacks, great contrast, and a quick response time.

2.4.3.3 Printers

A printer is an output device that makes a hard copy of text or pictures from a computer on paper.

Types of printers:

Impact printers: They print by hitting a ribbon with pins or typeface. They are loud but can generate carbon copies.

- **Dot matrix printer**: Uses a grid of pins; cheap; used for invoices and forms with several parts.
- **Daisy wheel /line printers: They** are older impact printers that can print characters or lines.

Non-impact printers don't touch anything; they're quieter and faster.

Inkjet printers spray small drops of ink. They are suitable for color photographs and for use at home or at work.

Laser printers use lasers and toner to print text quickly and with good quality. They are great for offices.

LED printers work like laser printers, but they utilize LEDs instead. They are reliable and use less energy.

Thermal printers employ heat on specific paper. They are used for receipts, labels, and point-of-sale systems.

Solid ink printers use solid ink sticks and are employed in graphic arts because they have good color fidelity.

Printers for special tasks:

3D printers make 3D things out of plastic, metal, or resin by adding layers to them.

Plotters make lines that don't stop; they are utilized for big maps and technical drawings.

2.4.3.4 Scanners:

A scanner is an input device that changes physical documents (including text, photographs, and graphics) into digital form.

Types of scanners:

- Flatbed scanners
- Sheet fed scanner
- Handheld scanner
- Drum scanner
- Portable scanner

2.4.3.5 Secondary storage elements

Secondary storage is a long-term, non-volatile place to store data that active applications don't need or use very often. It costs less and can hold more than primary memory, thus it's good for backups, archives, and storing big data.
Difference Between Primary and Secondary storage:

Feature	Primary Storage	Secondary Storage
Speed	Fastest	Fast (but slower than primary)
Data Availability	Critical (active programs)	Non-critical (backup/archive/cold data)
Data Durability	Yes (volatile/non-volatile)	Not always required (non-volatile)
First Byte Retrieval	Milliseconds	Sub second

Feature	Primary Storage	Secondary Storage
Likely Storage Type	Flash/SSD	HDD, tape, spinning disk
Cost	More expensive	Less expensive

Types of secondary storage:

Magnetic storage: Devices like floppy disks, tape drives, and hard drives (HDDs). They read, write, and store data using magnets.

Optical Storage: Includes CDs, DVDs, and Blu-ray discs, which use lasers to read and write data on physical disks.

Solid state Storage: Flash-based devices such as solid-state drives (SSDs), USB flash drives, and memory cards, offering high speed and reliability with no moving parts.



Check Your Progress

Q1. Which generation of computers is characterized by the use of microprocessors leading to personal computers, laptops, and modern networks?

Q2. Fill in the blanks

a. The part of the CPU that performs arithmetic and logical operations on binary data is called the _____.
b. Devices such as keyboard, mouse, and scanner that send data or commands from the user to the computer are known as _____.
c. CRT stands for_____.

2.5. Let Us Sum Up

The computers have progressed through five generations from vacuum tube machines to today's AI and quantum systems, continually becoming faster, smaller, and more efficient. Computers are classified by signal type (analogue, digital, hybrid) and size (micro, mini, mainframe, supercomputer), each serving different functions. A modern computer consists of hardware and software. Key hardware components include the CPU, memory unit, and input/output devices. The Arithmetic Logic Unit (ALU) performs arithmetic and logical operations, the memory unit stores data and instructions through a hierarchy (registers,

cache, RAM, secondary storage). Input devices like keyboards and scanners provide data, while output devices such as monitors and printers display results. Secondary storage such as HDDs, SSDs, optical and magnetic media offers long-term, non-volatile data retention. The computer systems combine processing power, storage capacity, and user interfaces to perform complex tasks across various sectors, including libraries and information management.

2.6. Answers to Check Your Progress

Ans to Q1 Fourth

Ans to Q2. a Arithmetic Logic Unit (ALU)

b.input devices

c. Cathode Ray Tube

2.7. Probable questions

Short questions

Q1. Explain the function of Arithmetic Logic Unit.

Q2. Name any two types of secondary storage devices.

Long questions

Q1. Explain the five generations of computers in terms of key technologies used, major characteristics, and one example for each generation.

Q2. Discuss the different classifications of computers based on electronic signals and size, giving suitable examples.

Q3. Describe the main components of a modern computer system and explain the specific functions of each with appropriate examples.

2.8. Further readings

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UNIT 3 APPLICATION AND SYSTEM SOFTWARE IN LIBRARY CONTEXT

UNIT STRUCTURE

3.1. Learning Objectives
3.2. Introduction
3.3. Types of Software
3.3.1 System Software
3.3.2 Application Software
3.3.3 Service Software
3.4. Office and Productivity Tools
3.5. Let Us Sum Up
3.6. Answers to Check Your Progress
3.7. Probable Questions
3.8. Further Readings

3.1. Learning Outcomes

After going through this unit, learners will be able to

- Learn about main types of software: system software, application software, and service/utility software.
- Recognize and utilize fundamental office and productivity applications, including word processors, spreadsheets, and presentation software, for routine academic and professional activities.

3.2. Introduction

Software is the set of programs and data that informs a computer how to do certain tasks and manage its hardware. A program is a set of instructions that a computer can understand and carry out. Together, many of these programs make up the software environment of a computer system. Software interacts with technology, data, people, and procedures in any information system to turn raw data into useful information for consumers. Broadly, software can be grouped as system software, application software and various support or service software such as utilities and security tools. Learners can choose and use the right software for studying, working, and running a business if they know these categories and popular office productivity tools.

3.3. Types of Software

There are many methods to group software in a computer-based information system, but a basic and useful way is to divide it into system software, application software, and service or utility software. System software controls hardware resources and gives programs a place to run. Application software handles specific user problems, and service software keeps everything running smoothly by making sure performance, security, and storage are all good.

3.3.1 System Software

System software is a collection of programs designed to operate, control and extend the processing capabilities of the computer itself. It acts as an intermediary between hardware and application programs, handling low-level details such as device control, memory management and basic input–output operations. Important categories of system software include operating systems, language translators and system utilities.

a) **The operating system:** An operating system (OS) is a group of programs that controls the hardware of a computer, makes sure that application programs run in the right order, and gives users a way to interact with the machine. It does important things like managing processes, memory, files, devices, security, and networking, which makes the computer easy and quick to operate. Microsoft Windows, Linux distributions, macOS, Android, and iOS are all common operating systems for computers and phones.

b) **Language Translators**: Central processing unit (CPU) only understands machine language, therefore programs written in assembly or high-level languages need to be translated before they can be run. Language translators like assemblers, compilers, and interpreters turn source code that is easy for people to read into machine code that the processor can load into memory and run. An assembler turns assembly language mnemonics into machine instructions. A compiler turns whole high-level programs into object code all at once. An interpreter turns and runs statements one line at a time.

c) **Utility programs:** Utility programs are system-support software that helps keep the computer running smoothly by doing routine maintenance and diagnostic work. Disk defragmenters, backup tools, antivirus scanners, file compression tools, disk check programs, and system performance monitors are all common utilities. These tools assist find mistakes, reorganize storage, get rid of viruses, clean up temporary files, and generally keep the system running smoothly and reliably.

3.3.2 Application Software

Application software is made up of applications that do certain tasks for the user or another application. It could be a single tiny tool, like a text editor, a package, like a spreadsheet or graphics application, or a big set of tools, like an office package or an enterprise resource planning system. Word processors, spreadsheets, database management systems, accounting software, media players, web browsers, social media apps, and specific business apps like payroll, inventory, and reservation systems are all examples.

Most of the time, application software is written in high-level languages and needs system software to work with hardware and provide fundamental services. Many modern companies utilize application suites that have a single user interface and are tightly integrated. This makes

it easier for users to move data between word processing, spreadsheets, presentations, and databases.

3.3.3 Service Software

Service software refers to programs that provide supporting services to the operating system and application software to keep the system secure, efficient and reliable. Many of these tools are categorized as utility software and are supplied either with the operating system or by third-party vendors.

Some common forms of service software are:

Disk management *programs* include disk defragmenter, disk cleaner, scan disk, and partition tools let you restructure data, clear up space, and find physical or logical disk issues.

Backup and recovery tools are programs that make copies of important files or whole drives and then restore them after data loss or a system crash.

Antivirus and anti-malware software are programs that find, stop, and remove viruses, worms, Trojans, spyware, and other harmful code using methods like signature-based, heuristic, and behaviour-based detection.

Compression tools are programs that make files smaller so they can be stored and sent.

System profiling and monitoring tools are programs that show you the hardware setup, resource use, and performance metrics of your system to help you fix problems and make it run better.

These service applications can operate either on demand or in the background. They help both system and application software run smoothly.

3.4 Office and Productivity Tools

Office and productivity tools are computer programs that help people and businesses work more efficiently with papers, calculations, presentations, and communication. A lot of people in schools, governments, and businesses use them to write reports, analyze data, preserve records, and work together. Effective use of these office and productivity tools enables managers, professionals and students to prepare high-quality documents, analyze data, communicate efficiently and support decision-making.

Below are some common groups.

a) Word Processing Tools

Word processors are used to create, edit, format and print text documents such as letters, reports, notices and manuals. Features typically include text entry and editing, spell check, formatting, tables, images, mail merge and page layout options. Popular word processing tools include Microsoft Word, Google Docs and similar programs in office suites.

b) Spreadsheet Software

Spreadsheet programs organize data in rows and columns and provide built-in formulas and functions to perform calculations, analysis and charting. They are often used for making

budgets, analyzing finances, doing statistical work, what-if analysis, and showing data in graphs. Microsoft Excel, Google Sheets and other spreadsheet applications are typical examples.

c) Presentation Software

Presentation tools enable users to prepare slide shows combining text, images, charts, audio and video for lectures, meetings and seminars. They offer slide layouts, design templates, animations and transitions to enhance efficient communication. Common tools are Microsoft PowerPoint and similar applications in various office suites or online platforms.

d) Database Management Tools

Users can make structured data files, set up relationships, and do things like store, retrieve, update, and query records with database management systems (DBMS). At office level, small DBMS tools facilitate management of student records, membership lists, inventory and other routine data. Examples include desktop databases bundled into office suites and server-based systems used in organizations.

e) Email and Communication Tools

Email clients and web-based mail services provide facilities to compose, send, receive and organize electronic messages. Along with instant messaging and video conferencing software, they support collaboration, file sharing and online meetings across locations. Integration of calendars, contacts and task lists further boosts personal productivity.

f) Web Browsers and collaboration Platforms

Web browsers are application programs that allow users to access information and services on the World Wide Web using standard protocols and markup languages. They work together with web-based office suites, learning management systems and cloud storage to support collaborative document editing and anytime-anywhere access to resources.



Check Your Progress

Q1. Fill in the blank

a. Software that controls hardware resources and provides an environment for programs to run is called _____.

b. A program that translates high-level language into machine code all at once is called a _____.

c. Programs like disk defragmenter and disk cleaner are examples of _____ software.

d. The tool used to create and edit letters and reports is a _____ processor.

e. Software used to organize data in rows and columns and perform calculations is called a _____.

3.5 Let Us Sum Up

This lesson has presented software as the logical equivalent of hardware. Software is made up of programs and related data that control how a computer works and help users solve problems. There are three primary types of software: system software (including operating systems, language translators, and utilities), application software (which helps users do their duties), and service software (which keeps performance, security, and storage up to date). It has been explained what operating systems do for resource management and user interaction, as well as how important translators and utilities are. Application software was shown to be a wide range of programs, from tools for personal productivity to big packages for businesses. Lastly, typical office and productivity technologies like word processors, spreadsheets, presentation software, database tools, email, browsers, and collaboration platforms were said to be essential for modern information processing in business and education.

3.6 Answers to Check your Progress

Ans to Q1. a. System
b. Compiler
c. Utility
d. Word
e. Spreadsheet

3.7 Probable questions

Short questions

1. What is system software and what are its main categories?
2. Define application software and give example.
3. What are office and productivity tools and why are they important?

Long questions

1. Explain the three main types of software, with suitable examples.
2. Describe the role of the operating system, language translators and utility programs as parts of system software.
3. Discuss different categories of office and productivity tools and explain how they help in improving work efficiency.

3.8 Further Readings

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UNIT 4 NETWORKING CONCEPTS AND LIBRARY CONNECTIVITY

UNIT STRUCTURE

4.1 Learning Objectives
4.2 Introduction
4.3 Evolution
4.4 Need, and advantages of Computer Networking in Libraries
4.5 Types of Networks: LAN, MAN, WAN, VPN
4.6 Components of computer networking
4.7 Let Us Sum Up
4.8 Answers To Check Your Progress
4.9 Probable Questions
4.10Further Readings

4.1 Learning Objectives

After ging through this unit, learner will be able to,

- Explain in simple terms the basic concept of computer network, their need and advantage
- Identify and briefly describe about different components of computer network including servers, clients, switches, routers, gateways, and modems, etc

4.2 Introduction

Communication technology facilitates the swift transmission of data and information across far places and permits the interconnection of computers instead of their operation as separate stand-alone systems. As firms acknowledged the significance of information and service exchange, computer networks arose and progressively became essential to contemporary work and communication settings. Early packet-switched networks, exemplified by ARPANET, illustrated the effective communication of geographically distributed computers, hence facilitating the evolution of the Internet and protocol suites such as TCP/IP. In a computer communication network, numerous computers or nodes are interconnected via transmission medium, enabling users to access services on any connected system as though it were local. Digital signals can be transmitted over terrestrial lines, satellite channels, ISDN, or wireless technologies, facilitating speech, data, video, and several other communication modes. Computer networking fundamentally denotes a collection of networked systems that share resources via a unified communication route.

4.3 Evolution

The evolution of computer networking began with early experimental networks and gradually led to today's global internet. Over time, networks became more powerful, reliable, and widely accessible, supporting many modern services. The first major step was ARPANET, developed in 1969 by the US Advanced Research Projects Agency (ARPA) and the Department of Defense. It linked a small number of computers at universities and research institutions so they could share data, send electronic messages, and support remote collaboration. ARPANET proved that packet switching could work in practice and showed how multiple computers could communicate over long distances. It is widely recognized as the direct technical ancestor of today's internet. In the mid-1980s, the National Science Foundation created NSFNET, a higher-capacity research network that connected supercomputing centers and many universities. Its original purpose was academic and scientific communication, not commercial use. As networking needs grew, many private and regional networks interconnected with ARPANET and NSFNET, forming a larger infrastructure. Together, these public and private networks created the initial backbone on which the modern internet was built. When ARPANET, NSFNET, and various private networks were linked, a "network of networks" emerged, known as the Internet. This global system used TCP/IP so that computers of different types and operating systems could exchange data reliably. The internet quickly became a universal platform for services such as e-mail, web browsing, file transfer, online conferencing, streaming media, social networking, e-commerce, and online banking. It turned networking from a research tool into an essential part of everyday life and business. More recent developments include software environments like interspace, which support rich, interactive communication among multiple users in a client–server model. Such systems allow sharing and interaction with text, audio, video, and data files in real time over the internet. These advances represent the latest stage in the evolution of networking, moving from simple data exchange to complex, multimedia, and collaborative applications that connect people and systems worldwide.

4.4 Need and Advantages of Computer Networking in Libraries

Need of computer Networking:

In modern day libraries, in order to improve information flow, to facilitate resource sharing and to provide efficient service to its users, computer network plays an important role. Libraries can now evolve from isolated, stand-alone systems to a shared information environment where users can access local and remote resources transparently without having to worry about the underlying protocols, software, or hardware thanks to networking. This translates into a unified discovery experience for users by allowing a library's OPAC, digital repository, and subscribed databases to work with external networks like consortia and the Internet. In order to provide services like online databases, union catalogs, interlibrary loan management, and web-based user services, libraries are depending more and more on internetworking to link local area networks with national and international information networks. Since the web in particular has taken over as the primary information distribution channel, strong network connectivity is a prerequisite for efficient reference, support for e-learning, and remote user support. In order for many client workstations within the library and across campuses to access centralized servers (for ILS/LMS, IR systems, authentication,

and storage), networking is also necessary to enable the client-server architecture that underpins the majority of modern library systems. Libraries can create scalable infrastructures to satisfy increasing needs for digital services thanks to advancements in communication technologies (such as fiber-optic LANs, wireless LANs, leased lines, and satellite linkages).

Advantages of Computer Networking in Libraries

- Allows several users to quickly share catalogs, full-text documents, multimedia, printers, and scanners, saving time and enhancing daily service.
- Increases storage and dependability by safeguarding user records, digital collections, catalogs, and data on central or distant servers with frequent backups.
- Extends library services beyond physical walls and operating hours by offering remote access to OPACs, e-journals, databases, and repositories from home or mobile devices.
- Enhances user and staff collaboration by supporting extensive user services like online forums, video-based consultations, and email references.
- Lowers the cost of software and resources by using centralized software management, joining library networks or consortia for cooperative cataloguing, and sharing subscriptions.

4.5 Types of Networks

A Computer network can be classified into four categories based on

- Geographical area
- Transmission medium
- Communication type
- Based on ownership

Types of Networks based on Geographical area: It includes

PAN (Personal Area Network), a very short-range network around one user connecting personal devices etc. Example: Syncing a mobile phone and Laptop.

LAN (Local Area Network): Network within a building or a campus for high-speed sharing of files. Example. Wi-Fi network

MAN (Metropolitan Area Network): High-bandwidth applications are supported throughout a metro area by a city-scale network that connects several LANs for establishments such as municipal departments or universities.

WAN (Wide Area Network): It is country to global scale network that uses leased lines, satellite links or internet to connect distant office etc.

Types of Networks based on Transmission medium: It includes

Wired networks: Use fiber optics or copper (coaxial, Ethernet/twisted pair), which are frequently found in offices and data centers and are usually faster, more stable, and more secure.

Wireless Networks: Use radio or infrared signals; they include cellular, Wi-Fi, and Bluetooth; they are adaptable and simple to expand, but they are more vulnerable to interference and call for robust security.

Types of Networks based on Communication type: It includes

***Point to Point*:** A dedicated connection between precisely two devices (such as a computer and printer or a leased line between two offices) increases privacy and prevents accidents**.**

***Multipoint*:** A single connection is shared by several devices; it is less expensive and requires less cabling, but because bandwidth is shared, performance suffers with numerous simultaneous transmissions.

***Broadcast*:** TV, radio, and some local network broadcasts use one-to-many transmission, in which all devices get the same data and process it if necessary.

***VPN*:** Encrypted tunnel over a public network that provides private, secure remote access to internal systems and protects identity and data in transit.

Types of Networks based on Ownership: It includes

Private network: Owned or managed by a single entity (company, institution, or government) and safeguarded internally through security measures like firewalls and encryption.

Public network: It has less built-in security but is accessible to everyone (the internet) enabling widespread connectivity and information sharing.

Hybrid network: Balances security and reach by combining private and public segments; public networks are used for noncritical access while sensitive workloads are kept private.

4.6 Components of Computer Networking

Hardware components:

This includes the followings:

- **Server:** High-performance computer that controls user network services and keeps shared resources (databases, OPAC, digital library)
- **Client:** PCs used by users or employees that connect to the server via a network to access resources and services.
- **Network Interface Card:** A computer or other device is physically or logically connected to the network via an electronic card or built-in circuitry.
- **Connecting devices: This includes**
    - **Hubs**: A straightforward gadget that broadcasts data to all ports and links several PCs in a local area network.

- **Switch:** Sends data to the appropriate port, increasing speed and lowering collision rates.
- **Router:** Connects different networks (e.g., library LAN to the Internet) and chooses the best path for data.
- **Gateway:** Connects networks employing various architectures or protocols and carries out the required conversions.

- **Repeater:** Extends the network's range by regenerating signals.
- **Wireless Access Point:** Enables mobile devices and computers to connect wirelessly.

- **Modem:** It Transforms digital signals into analog and back again when connecting over telephone or comparable lines.
- **Storage device:** Network-attached storage or disk arrays utilized for the retention of extensive catalogs, electronic resources, and backups.

Transmission Media: This includes

- **Wired/ Guided media:**
  - **Twisted-pair cables:** Prevalent copper cables utilized in numerous Local Area Networks (LANs).
  - **Coaxial cable:** A shielded cable utilized in some networks.
  - **Optical fiber**: A high-speed wire utilizing light, appropriate for backbone connections and campus networks.
- **Wireless/ Unguided media:**
  - **Radio waves and microwaves:** Utilized in Wi-Fi, point-to-point wireless connections, and satellite communication.

Software and Protocol:

- **Network Operating System (NOS):** System software (e.g., Windows Server, Linux with networking services) that administers network resources, users, permissions, and security protocols.
- **Client software:** It refers to applications on user devices (such as browsers, OPAC interfaces, and mail clients) that solicit services from servers.
- **Protocols:**
  - **TCP/IP:** Fundamental protocol suite that regulates the packaging, addressing, transmission, and reception of data.
  - **HTTP/HTTPS, FTP, and similar protocols:** Elevated protocols utilized for online access, file transmission, and various services.
- **Security software:** This includes firewalls, antivirus programs, and authentication/authorization systems that safeguard network resources and regulate access.

Check Your Progress

Q1. State True or False.

a. Computer networking allows multiple computers or nodes to be interconnected.
b. A Personal Area Network typically covers a very short range around a single user and can connect devices like a mobile phone and a laptop.
c. ARPANET and NSFNET were purely commercial networks created for business transactions and online shopping.
d. A router is used only within a single LAN segment and cannot connect different networks such as a library LAN and the internet.

4.7 Let Us Sum Up

Computer networking facilitates rapid and dependable communication between interconnected computers and devices, allowing for the efficient sharing of data, services, and resources. It progressed from first experimental networks such as ARPANET and NSFNET into the contemporary global Internet, which employs TCP/IP to connect diverse devices over extensive distances and facilitate many applications including email, the web, and multimedia collaboration. Networking in libraries has become crucial for enhancing information dissemination, facilitating resource sharing, and providing user-centered services. Networked environments provide seamless access to OPACs, digital repositories, databases, and consortial resources both within the library and remotely. Contemporary networks are categorized in various manners: by geographical extent (PAN, LAN, MAN, WAN), by transmission medium (wired and wireless), by communication type (point-to-point, multipoint, broadcast, VPN), and by ownership (private, public, hybrid). Essential elements comprise hardware (servers, clients, network interface cards, hubs, switches, routers, gateways, access points, modems, storage), transmission media (twisted pair, coaxial, fiber optic, radio, and microwave links), and software with protocols (network operating systems, client applications, TCP/IP, HTTP/HTTPS, FTP, and security tools). Collectively, these components establish a robust, scalable framework for contemporary library and information services.

4.8 Answers To Check Your Progress

Ans to Q1. a. True
b. True
c. False
d. False

4.9 Probable Questions

Short questions

1. What is computer networking, and how does it support the sharing of resources in libraries?
2. Briefly describe the difference between LAN and WAN based on geographical area and typical usage.

Long answer type questions

1. Explain the evolution of computer networking from ARPANET and NSFNET to the present-day internet. How these developments changed the nature of communication and online services.
2. Discuss the need and advantages of computer networking in libraries. Illustrate your answer with examples.
3. Describe the major types of computer networks based on geographical area, transmission medium, communication type, and ownership. Give examples for each category.

4.10 Further Readings

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UNIT 5 NETWORK TOPOLOGIES AND MEDIA

UNIT STRUCTURE

5.1 Learning Objective
5.2 Introduction
5.3 Overview of Physical and Logical Network Structures
5.4 Switching Technologies: Circuit, Packet, and Cell Switching, Transmission Media.
5.5 Let Us Sum Up
5.6 Answer to Check Your Progress
5.7 Probable Questions
5.8 Further readings

5.1 Learning Objective

After going through this unit, learner will be able to-

- Distinguish between physical and logical network topologies and comprehend their unique functions in network operations.
- Explain standard physical topologies like star, bus, ring, tree, and mesh, along with their respective merits and limitations.

5.2 Introduction

Network design relies on two independent but interconnected concepts: physical and logical topologies. While these topologies work together to maintain network performance, they perform unique functions in network development and data transfer. A comprehensive understanding of these topologies, as well as the switching technologies and transmission media that support them, is crucial for developing efficient and dependable communication systems. We will study the physical configuration of networks, the logical routes data traverses, and the essential mechanisms like circuit, packet, and cell switching that enable data transmission. Also analyse the diverse guided and unguided transmission media that function as the physical channels for information.

5.3 Overview of Physical and Logical Network Structures

Network architecture depends on two independent yet interconnected concepts: physical and logical topologies. Although they collaborate to maintain network functionality, they fulfil distinct roles in the construction of a network and the transmission of data within it.

5.3.1 Physical Topology:

Physical topology describes the actual physical layout of the network hardware, including the nodes and the cables that connects them. It is the tangible "map" of the network that one can see. The choice of physical topology affects the ease of installation, reconfiguration, and troubleshooting.

Fully Connected (Mesh) Topology:

In a completely connected or mesh architecture, each computer is directly linked to every other computer inside the network. This configuration offers the utmost redundancy and reliability. If a single link breaks, communication may persist via alternative available routes. This topology is costly and challenging to scale, as the number of necessary linkages increases exponentially with the quantity of devices.

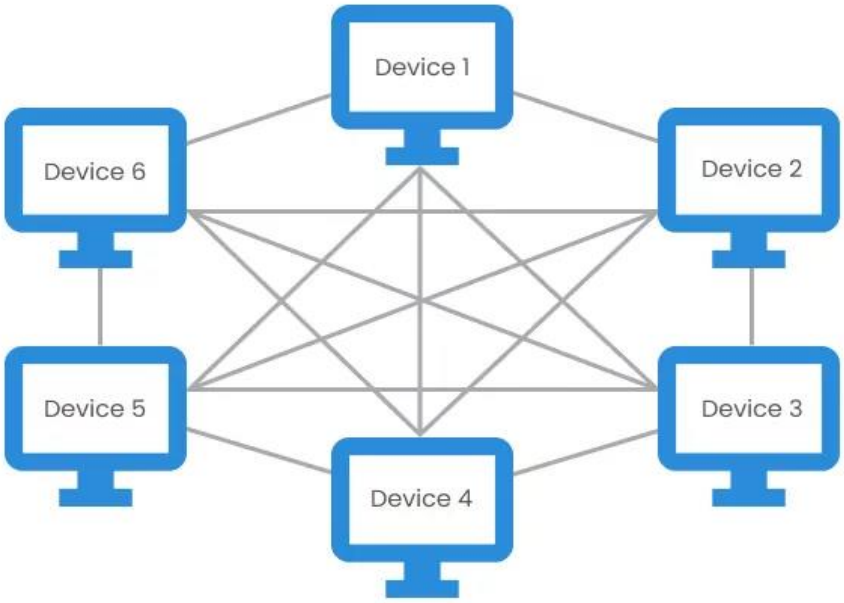


Fig. 5.1 Illustration of fully connected topology

Star Topology

The star topology is the predominant physical configuration for contemporary LANs. In this configuration, all computers are linked to a central device, referred to as a hub or switch, through point-to-point connections. The central unit functions as an intermediary; when one computer intends to transmit data to another, the signal traverses the central device. This architecture is straightforward to install, administer, and diagnose due to each device possessing a dedicated cable. In the event of a cable failure, only the connected device is impacted, while the remainder of the network remains functional. Nonetheless, the central device constitutes a singular point of failure; should the hub or switch malfunction, the entire network becomes inoperative.

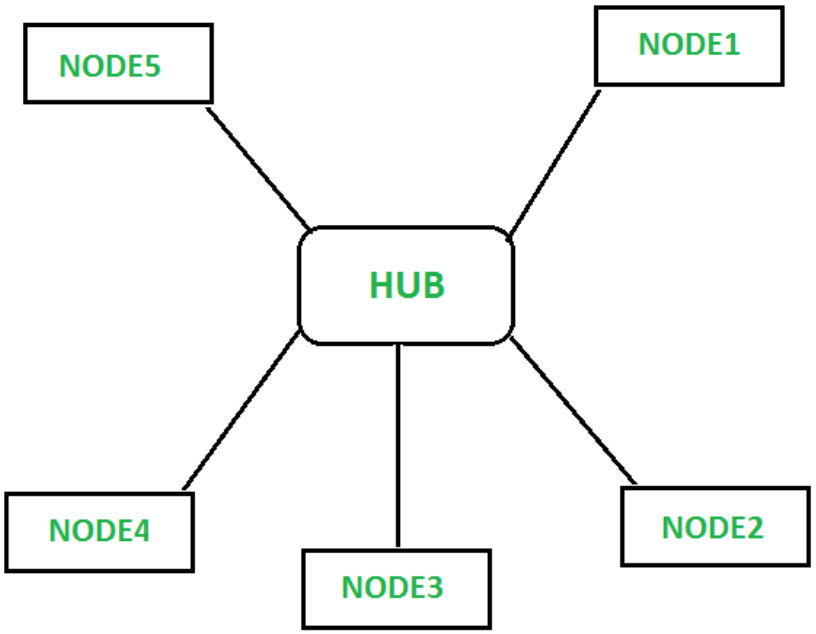


Fig. 5.2 Illustration of star topology

Bus Topology

The bus topology has a singular central cable, referred to as the bus or backbone, to which all computers are linked by taps or connectors. The coaxial cable must be terminated at both ends to avert signal reflection. When a device transmits data, the signal propagates via the backbone and becomes accessible to all other devices. This design is straightforward and necessitates less wiring than a star topology, rendering it economical for small networks. Nonetheless, troubleshooting is challenging, and any disruption in the primary cable might incapacitate the entire network.

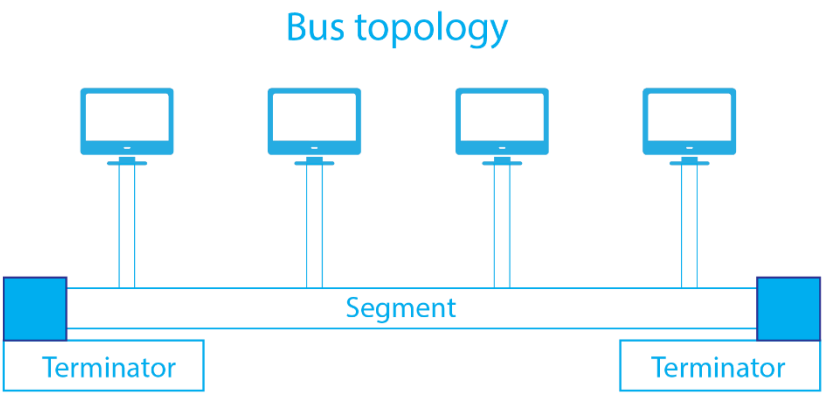


Fig. 5.3 Illustration of bus topology

Ring Topology

In a ring topology, each computer is linked to two neighbouring computers, creating a closed circuit. Data propagates unidirectionally from node to node. Every node acquires the signal, amplifies it, and transmits it to the subsequent node. The active involvement of nodes implies that a failure in a single node or cable rupture can compromise the entire ring. To enhance reliability, a dual ring architecture can be employed, wherein data circulates in opposing directions on two distinct rings (e.g., FDDI). Although ring networks manage substantial traffic sequentially without accidents, they are typically more challenging to establish and operate compared to star networks.

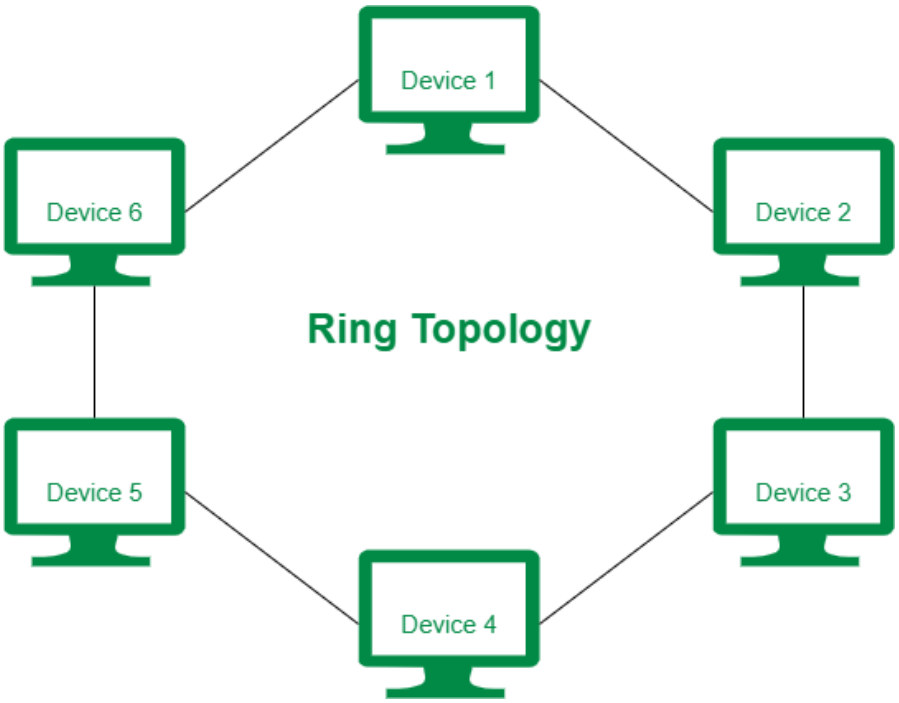


Fig. 5.3 Illustration of bus topology

Tree Topology

Tree topology, or hierarchical topology, organizes nodes in a hierarchy that resembles an inverted tree. A root node is positioned at the apex, with branch nodes and leaf nodes linked at subordinate levels. Communication traverses the hierarchical structure. This configuration is frequently employed to link many star networks or in extensive enterprises with separate departmental tiers. It is scalable and facilitates straightforward fault separation; but, akin to the star topology, it is significantly dependent on the root and branch nodes for communication.

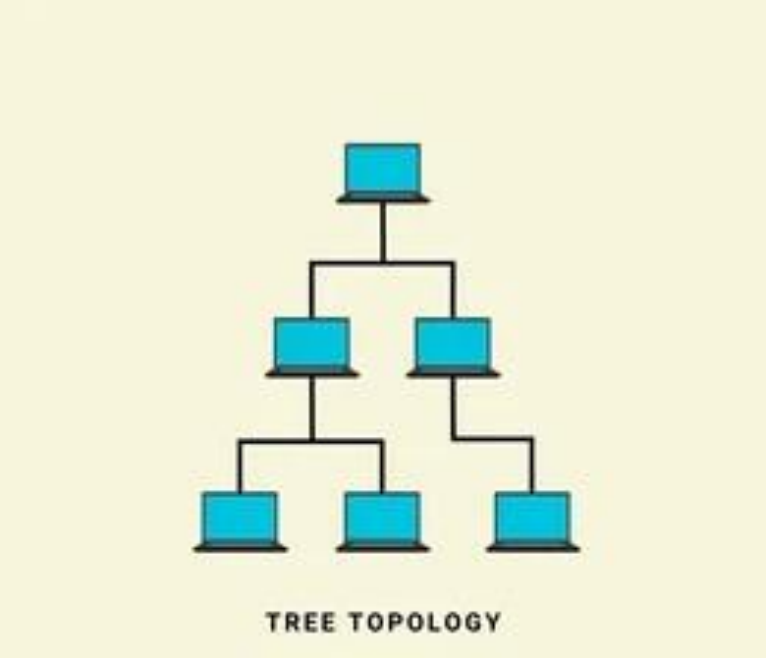


Fig. 5.3 Illustration of bus topology

3.8.1 Logical Topology

Physical topology pertains to the arrangement of wires, whereas logical topology delineates the actual route that data traverses within the network. It delineates the regulations and standards governing data transmission, irrespective of the physical connectivity of the devices.

A network often exhibits a physical topology that contrasts with its logical topology. A network may be physically configured as a star topology, with all connections converging at a central hub, while functioning logically as a bus or ring topology. In a hub-based Ethernet network, the physical configuration is a star, yet the hub disseminates the signal to all ports, emulating the functionality of a logical bus. A Token Ring network employs a central Multi station Access Unit (MSAU) that appears star-shaped, however operates by circulating a "token" in a logical ring configuration to regulate access.
The logical topology is defined by the Media Access Control (MAC) protocols employed. In a logical bus (Ethernet), nodes vie for access through Carrier Sense Multiple Access with Collision Detection (CSMA/CD), allowing any node to transmit when the medium is unoccupied. In a logical ring (Token Ring), access is regulated by a token transmitted progressively, hence preventing collisions.

5.4 Switching Technologies: Circuit, Packet, and Cell Switching, Transmission Media.

Switching refers to the transfer of data between ports within a network to achieve a specific destination. It enables the efficient sharing of communication resources across several devices. The three primary switching technologies are circuit switching, message switching (which has often evolved into packet switching), and packet switching. The primary distinction exists between circuit-based and packet-based methodologies, with "cell switching" representing a particular high-speed variety.

5.4.1 Circuit Switching

Circuit switching is a connection-oriented method traditionally employed in telecommunication networks. Prior to data transfer, a specific physical pathway or "circuit" must be created between the sender and the recipient. This procedure comprises three separate stages:

- Circuit establishment
- Data transfer
- Circuit disconnects

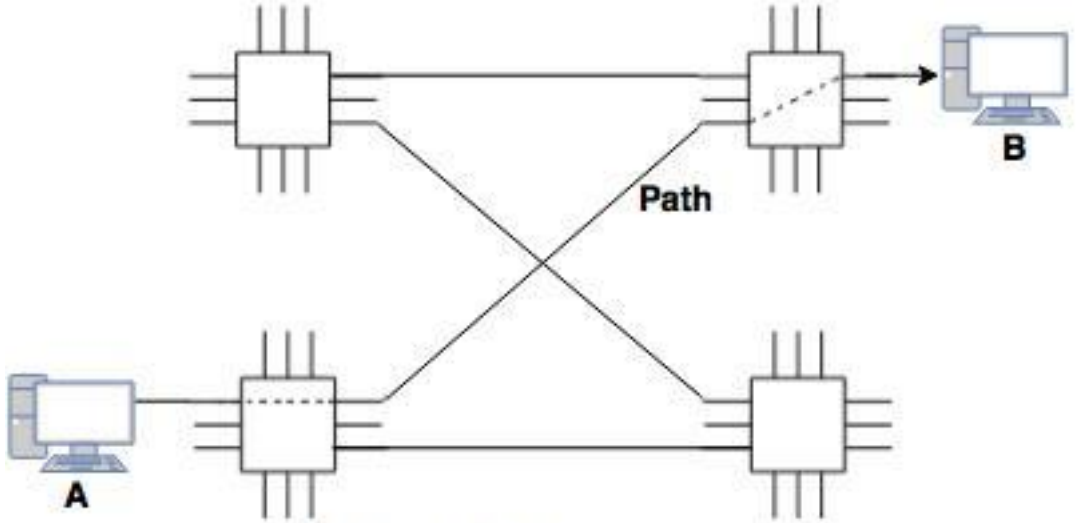


Fig: Circuit Switching

Advantages and Disadvantages

The primary benefit of circuit switching is its assurance of performance; once the circuit is established, there is no delay, rendering it optimal for real-time audio communications. Nonetheless, it is exceedingly inefficient for data transfer. The reserved path results in bandwidth being squandered during intervals of silence or inactivity. Moreover, the initial configuration duration can be considerable.

5.4.2 Packet Switching

Packet switching was devised to address the inefficiencies inherent in circuit switching for data transmission. This strategy involves decomposing messages into smaller components known as packets. Each packet comprises a header containing control information, including the source and destination IP addresses and sequence numbers. Packet switching, in contrast to circuit switching, does not necessitate a dedicated pathway. Packets traverse the network autonomously, frequently utilizing diverse pathways to arrive at the destination, where they are subsequently reassembled. This method is referred to as a "store-and-forward" mechanism, wherein intermediary devices (routers/switches) receive a packet, temporarily store it, and subsequently transmit it to the next destination.

It is classified into Two types:

- Datagram Packet switching: Packets are processed autonomously, without a predetermined pathway. Each packet may traverse a distinct route, perhaps arriving in a non-sequential manner. This is the functioning of the Internet Protocol (IP).

- Virtual Circuit Packet switching: A logical path is defined prior to transmission, similar to circuit switching, however resources are not solely allocated. Packets

traverse the identical route, guaranteeing sequential arrival, although the physical connections remain concurrently utilized by other traffic.

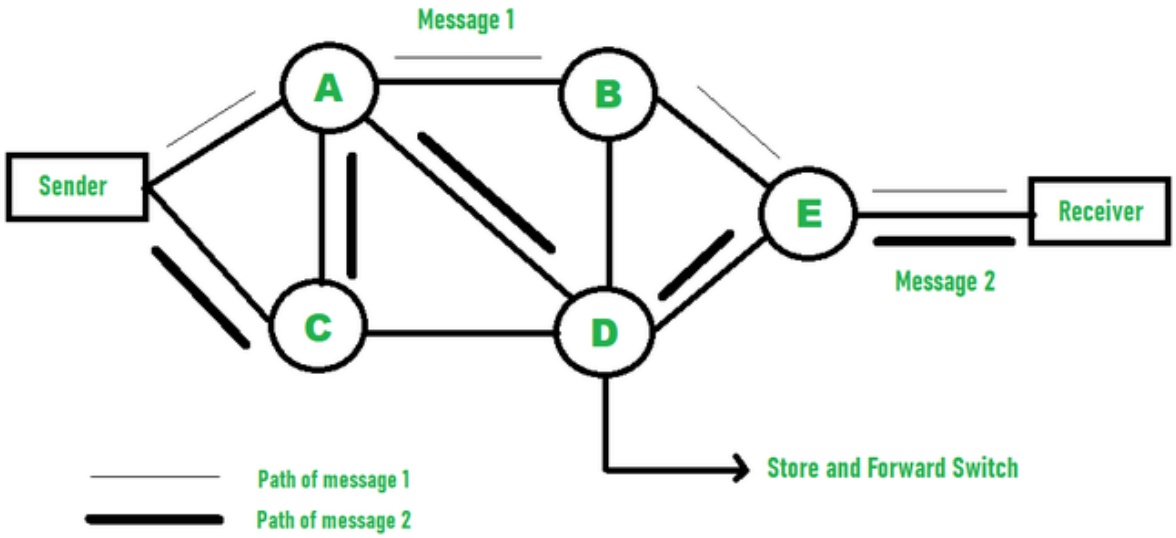


Fig: Packet switching

Advantage and Disadvantage:

Packet switching is exceptionally efficient due to the dynamic sharing of bandwidth. If a user is inactive, others may utilize the available capacity. Nevertheless, due to resource sharing among packets, they may encounter fluctuating delays (jitter) or packet loss during periods of congestion, necessitating intricate protocols for management.

5.4.3 Cell Switching (Asynchronous Transfer Mode)

Cell switching is a hybrid technique that integrates elements of circuit and packet switching. It segments data into fixed-length units known as "cells" (usually 53 bytes), in contrast to the variable-length packets employed in conventional packet switching. This constant dimension enables hardware switches to process data at exceptionally high speeds with consistent latencies. Cell switching is primarily linked to Asynchronous Transfer Mode (ATM). It is engineered to concurrently manage various forms of traffic—voice, video, and data—across the same network. Utilizing small, fixed cells, ATM can reduce the latency that substantial data packets may introduce to time-sensitive voice traffic. Although less prevalent in LANs nowadays owing to advancements in high-speed Ethernet, cell switching principles continue to be essential in telephony and backbone networks.

5.4.4 Transmission Media

Transmission media denotes the physical conduit utilized for transmitting data from a transmitter to a receiver. The choice of media is contingent upon considerations such as bandwidth needs, distance, cost, and vulnerability to interference. Media is categorically divided into two types: Guided (Wired) and Unguided (Wireless).

5.4.4.1 Guided Media: Guided media utilizes physical cables to direct and restrict signals along a designated pathway. The three primary categories are twisted pair, coaxial cable, and fiber optic cable.

5.4.4.1.1 Twisted Pair Cable: This is the predominant transmission medium, comprising two insulated copper wires twisted together. The twisting mitigates electromagnetic interference (EMI) and crosstalk from neighbouring pairs.

- **Unshielded Twisted Pair (UTP):** Prevalent in telecommunication and Ethernet networks. It is cost-effective, adaptable, and simple to install; yet, it is vulnerable to external noise.

- **Shielded Twisted Pair (STP):** Features a metallic foil or braided shield encasing the wires to provide protection against electromagnetic interference (EMI). It facilitates superior data speeds compared to UTP, although is costlier and more cumbersome to manage owing to its thickness.

5.4.4.1.2 Coaxial Cable

Coaxial cable ("coax") has a center copper conductor encased in a dielectric insulator, a metallic shield, and an external plastic sheath. The shield safeguards the transmission from external interference and mitigates signal loss. Coaxial cable provides superior bandwidth compared to twisted pair and is extensively utilized for cable television (CATV) and broadband internet services. It can operate in two modes: baseband (dedicated digital signals) and broadband (analog signals divided into frequency ranges).

5.4.4.1.3 Fibre Optic Cable

Fiber optic cable conveys data as light pulses through slender filaments of glass or plastic. It operates on the principle of total internal reflection to retain light within the core. Fiber provides the greatest capacity and transmits data across extensive distances with negligible attenuation. Ideally, it is impervious to electromagnetic interference and possesses a high level of security due to its resistance to interception.

5.4.4.2 Unguided Media:

Unguided media carries electromagnetic signals in free space without a physical conductor. This constitutes the basis of wireless communication.

Radio waves

Radio waves (3 kHz to 1 GHz) are omnidirectional, meaning they travel in all directions from the source antenna. Sending and receiving antennas do not need to be aligned. Radio waves can penetrate buildings and obstacles, making them suitable for wide-area broadcasting like AM/FM radio and television. However, this also makes them susceptible to interference from other signals.

Microwaves

Microwaves (1 GHz to 300 GHz) are unidirectional and necessitate line of sight transmission. The transmitting and receiving antennas must be meticulously aligned.

Terrestrial Microwave: Employs ground-based towers to transmit signals over extensive distances. It serves as a cost-efficient substitute for cabling in challenging terrains, although is influenced by environmental factors such as precipitation.

Satellite Microwave: Utilizes an orbital satellite to receive, amplify, and retransmit signals between terrestrial stations. This facilitates worldwide coverage and is utilized for GPS, mobile communication, and meteorological forecasts.

Infrared

Infrared (300 GHz to 400 THz) is utilized for extremely short-range communication, including television remote controls and wireless peripherals (mouse, keyboard). Infrared signals are unable to traverse walls, so averting interference among equipment in separate rooms, however constraining their application to line-of-sight scenarios within an enclosed space.



Check Your Progress

A. Answer the followings

a. What are the three phases of circuit switching?
b. What are the differences of Physical and logical topology?
c. What is BUS Topology?

5.5 Let Us Sum Up

Network architecture is influenced by two interrelated concepts; physical and logical topologies, where the former delineates the observable configuration of nodes and cables (including mesh, star, bus, ring, and tree arrangements), and the latter establishes the pathways and regulations governing data transmission independent of physical structure. Physical topologies affect installation and fault management, but logical topologies rely on MAC protocols such as CSMA/CD or token passing to govern transmission. Switching technologies facilitate data transmission across networks and encompass circuit switching, which establishes a dedicated pathway; packet switching, which segments data into independent packets through datagram or virtual circuits; and cell switching (ATM), which employs fixed-size cells for rapid, low-latency communication. Transmission medium that conveys data signals can be categorized as guided—such as twisted pair cables, coaxial cables, and fiber optics—or unguided, including radio waves, terrestrial and satellite microwaves, and infrared. Each kind varies in bandwidth, range, cost, and vulnerability to interference.

5.6 Answer to Check Your Progress

A. Answer the Followings

a. Circuit Establishment, Data Transfer, and Circuit Disconnect.

b. Physical topology denotes the tangible arrangement of wires and equipment, whereas logical topology illustrates the route data follows during transmission across the network.

c. The bus topology features a singular central cable, referred to as the bus or backbone, to which all computers are linked via taps or connectors. The coaxial cable must be terminated at both ends to avert signal reflection. When a device transmits data, the signal traverses the backbone and becomes accessible to all other devices. This design is straightforward and necessitates less wiring than a star topology, rendering it economical for small networks. Nonetheless, troubleshooting is challenging, and any interruption in the primary connection might incapacitate the entire network.

5.7 Probable Questions

B. Short Answer Type Questions

a. Which topology necessitates the most amount of cabling for a fully interconnected network?

b. What are the two types of twisted paired cables?

C. Long Answer Type questions

a. Briefly describe about different types of network topology.

b. What constitutes Transmission Media? Explain the distinction between Guided (Wired) and Unguided (Wireless) media, and provide two instances for each category.

5.8 Further readings

1. *Unit 2: Transmission Media and Switching Transmission Media*. (n.d.). Retrieved December 12, 2025, from https://prasadkoyande.in/downloads/dcc/DCC_notes_chap2.pdf
2. *UNIT 8 NETWORK TOPOLOGY*. (n.d.). Retrieved December 12, 2025, from https://egyankosh.ac.in/bitstream/123456789/35793/5/Unit-8.pdf

UNIT 6 INTERNET TECHNOLOGY AND PROTOCOLS

UNIT STRUCTURE

6.1 Learning Objectives

6.2 Introduction

6.3. Internet Architecture

6.4 TCP/IP Protocol Suite and IP Addressing

6.5 Domain Naming Systems

6.6 URLs and Web Hosting

6.7 Let Us Sum Up

6.8 Answer to Check your Progress

6.9 Probable Questions

6.10 Further Readings

6.1 Learning Objectives

After going through this unit, learners will be to-

- Define the layered architecture of the Internet and delineate essential components including routers, hosts, and backbones.
- Explain the roles of the four layers of the TCP/IP protocol suite and differentiate between the reliable transport method (TCP) and the unreliable transport method (UDP).
- Define URLs and compare several types of web hosting services (Shared, VPS, Dedicated, Cloud) according to their characteristics and applications.

6.2 Introduction

The Internet has transformed communication, information sharing, and commerce, becoming a global "network of networks" that links billions of devices globally. This unit offers a thorough examination of the essential technologies and protocols that facilitate this extensive interconnectedness. We will study the foundational architecture of the Internet, analyzing how diverse elements such as hosts, routers, and Internet Service Providers (ISPs) interact to enable data transmission.

The TCP/IP protocol suite is fundamental to this discussion, serving as the global language of the Internet that regulates the packaging, addressing, and routing of data across various networks. We will examine the essential technologies that enhance Internet usability, including the Domain Name System (DNS), which converts human-readable names into machine-readable IP addresses, as well as the principles of Web Hosting and URLs that facilitate the World Wide Web. By comprehending these fundamental concepts, you will have a greater respect for the intricate digital infrastructure that underpins our contemporary interconnected world.

6.3. Internet Architecture

The Internet is a worldwide network of interconnected computers and networks that exchange information using established protocols. Its architecture comprises a complex system of interconnected components, engineered to be resilient, scalable, and decentralized. The architecture is frequently characterized as a "network of networks" due to its interconnection of millions of private, public, academic, business, and governmental networks.

The architecture of the Internet is structured as a layered model, frequently depicted as an hourglass. This configuration illustrates the design philosophy wherein a minimum, universal protocol (IP) occupies the central position, facilitating a broad spectrum of applications (such as email, web, and streaming) at the upper tier to operate over a diverse array of physical network technologies (including fiber, Wi-Fi, and satellite) at the lower tier. The "narrow waist" architecture is essential for the Internet's adaptability and expansion, as it facilitates the independent development of new applications and transmission methods without necessitating modifications to the fundamental Internet Protocol.

Core Components: The Internet's physical architecture comprises several essential elements:

Hosts: These are devices with which users interact, including personal computers, smartphones, and servers. They operate software such as web browsers and email clients.

Routers: These are specialized apparatuses that transmit data packets between disparate networks. They ascertain the optimal route for data transmission from the source to the destination.

Communication Links: These are the physical mediums that interconnect hosts and routers, comprising fibre-optic cables, copper wires, and wireless connections (radio, satellite).

Internet Service Provider: Internet Service Providers (ISPs) facilitate access to the Internet. They are structured hierarchically, with local ISPs linking consumers to regional ISPs, which subsequently connect to global backbone networks.

Backbone: The Internet's foundation comprises high-speed, high-capacity networks that link various locations and prominent ISPs. The backbones are interconnected at Network Access Points (NAPs).

6.4 TCP/IP Protocol Suite and IP Addressing

TCP/IP Protocol Suite

To facilitate communication among various devices and networks, the Internet employs a standardized set of regulations known as protocols. The essential collection of protocols is the Transmission Control Protocol/Internet Protocol (TCP/IP) suite. It is the language of the Internet, delineating the methods by which data is formatted, addressed, transferred, routed, and received.

The TCP/IP concept is typically segmented into four levels, each designated for particular functions:

Application Layer: This is the highest layer where network applications function. It encompasses protocols like as HTTP (for web browsing), SMTP (for email), and FTP (for file transfer).

Transport Layer: This layer ensures reliable data delivery between applications on different hosts. The two main protocols are:

- **TCP (Transmission Control Protocol):** Provides reliable, connection-oriented communication. It breaks data into segments, ensures they arrive in order, and retransmits lost data. It is used for applications where accuracy is critical, like web browsing and email.
- **UDP (User Datagram Protocol):** Provides unreliable, connectionless communication. It sends data without establishing a connection or guaranteeing delivery, making it faster and suitable for real-time applications like video streaming or online gaming.

Internet Layer (Network Layer): This layer handles logical addressing and routing. The primary protocol is IP (Internet Protocol), which is responsible for addressing data packets and routing them across the network to their destination.

Network Interface Layer (Link Layer): This layer pertains to the physical transmission of data across the network media (cable, Wi-Fi). It encompasses protocols such as Ethernet and Wi-Fi standards.

IP Addressing

Each device connected to the Internet must possess a distinct identification to transmit and receive data. This designation is referred to as an IP address. An IP address fulfils two primary roles: identifying the host or network interface and providing location addressing.

IPv4 Addressing: The predominant variant of IP addressing is IPv4 (Internet Protocol version 4). An IPv4 address is a 32-bit numeral, commonly expressed in "dotted-decimal"

format. It comprises four decimal integers (varying from 0 to 255) delineated by periods, for instance, 192.168.1.1. Give IMAGE

IPv4 addresses are categorized into classes according to network size:

Class A: Intended for extensive networks. The initial byte designates the network, while the subsequent three bytes provide the hosts.

Class B: Intended for medium-scale networks. The initial two bytes designate the network.

Class C: Intended for diminutive networks. The initial three bytes designate the network.

Class D: Designated for multicast groups.

Class E: Designated for experimental purposes

IPv6 Addressing: The swift expansion of the Internet has led to the depletion of accessible IPv4 addresses. A new version, IPv6 (Internet Protocol version 6), was created to address this issue. IPv6 addresses consist of 128 bits, providing an effectively limitless quantity of addresses. They are expressed in hexadecimal format, delineated by colons, for example, 2001:0db8:85a3:0000:0000:8a2e:0370:7334.

6.5 Domain Naming Systems

Computers utilize numeric IP addresses for identification; however, humans struggle to recall lengthy sequences of digits such as 172.217.166.14. The Internet use the Domain Name System (DNS) to address this issue. DNS functions as the "directory" of the Internet, converting human-readable domain names (such as www.google.com) into the IP addresses utilized by computers for identification purposes.

Working of DNS:

Upon a user entering a URL into a browser, the subsequent process take place:

Request: The browser requests the operating system to retrieve the IP address linked to the domain name.

Resolver: The operating system verifies its local cache. If absent, it requests a DNS resolver, often supplied by the Internet Service Provider.

Hierarchy Lookup: If the resolver lacks the IP address, it requests the root server, which subsequently leads it to the Top-Level Domain (TLD) server (e.g., for .com).

Authoritative server: The TLD server instructs the resolver to the authoritative name server for the designated domain.

Response: The authoritative server provides the accurate IP address to the resolver, which subsequently transmits it to the browser. The browser can thereafter establish a connection to the web server.

Domain Hierarchy:

The DNS is a hierarchically organized distributed database.

- **Root Domain:** The apex of the hierarchy, denoted by a dot (often implicit).
- **Top-Level Domain (TLD):** The terminal segment of a domain name. There are two primary categories:
    - **Generic Top-Level Domains (gTLDs):** Examples include .com, .org, .net, .edu.
    - **Country Code Top-Level Domains (ccTLDs):** Two-letter designations allocated to nations, exemplified by .in (India) and .uk (United Kingdom).
- **Second-Level Domain:** The distinct name registered by an entity or individual (e.g., google in google.com).

- **Subdomain:** A prefix denoting a particular segment of the domain (e.g., mail in mail.google.com).

6.6 URLs and Web Hosting

URL:

Accessing material on the World Wide Web necessitates a standardized method for locating resources and a repository for their storage. This is where URLs and web hosting are relevant.

A URL (Uniform Resource Locator) is the universal address for documents and other resources on the World Wide Web. It delineates the position of a resource and the protocol employed for its access. A standard URL appears like http://www.example.com/index.html.

A URL comprises multiple components:

- **Protocol:** Denotes the technique employed to access the resource, typically http or https (the secure variant).
- **Domain Name:** The identifier of the server that hosts the resource (e.g., www.example.com).
- **Path:** The exact path of the file or page on the server (e.g., /products/item1.html).

Web Hosting:

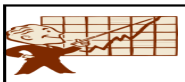
Web hosting is a service that enables individuals and companies to publish a website or web page on the Internet. A web host, or web hosting service provider, is an enterprise that offers the technology and services necessary for a website or webpage to be accessible on the Internet. Websites are kept on specialized computers known as servers.

Internet users access your website by entering your domain name into their browser. Their machine will subsequently connect to your server, and your websites will be transmitted to them via the browser.

Categories of Web Hosting:

Various hosting services are offered to accommodate diverse requirements.

- **Shared Hosting:** Numerous websites utilize the same server resources (CPU, RAM). It is economical and appropriate for small websites or personal blogs.
- **Virtual Private Server (VPS) Hosting:** A physical server is partitioned into several virtual servers. Every user receives allocated resources, providing enhanced control and performance compared to shared hosting**.**
- **Dedicated Hosting:** A complete physical server is rented to one client exclusively. This provides optimal control, performance, and security, ideal for large enterprises with substantial traffic.
- **Cloud Hosting:** Utilizes a network of virtual servers that access a resource pool. It is very scalable and dependable, as a failure of one server prompts another to assume its responsibilities.



Check Your Progress

A. Answer the followings:

a. What does DNS Stands for?

b. What are Ip and URL?

c. How many bits are there in IPv4 and IPv6?

6.7 Let Us Sum Up

In this section, we learned about the essential infrastructure that underpins the Internet. We examined its architecture, conceptualizing it as a network of interconnected networks in which hosts, routers, and ISPs cooperate within a stratified framework to enable worldwide connectivity. A primary emphasis was placed on the TCP/IP protocol suite, the fundamental communication protocol of the Internet, wherein we differentiated between the dependable TCP and the rapid UDP transport protocols, and examined the architecture of IPv4 and IPv6 addressing schemes. We also examined the user-facing technologies that facilitate Internet navigation. This encompassed the Domain Name System (DNS), which functions as a decentralized directory that converts human-readable names into IP addresses. Finally, we defined URLs as universal resource locators and compared Web Hosting services—Shared, VPS, Dedicated, and Cloud—to analyse how content is stored and distributed. Together, these concepts constitute the foundation of the contemporary digital landscape.

6.8 Answer to Check your Progress

Ans to A. a) Domain Name System

b) Internet Protocol, Uniform Resource Locator

c**)** 32 and 128- bits

6.9 Probable Questions

Short Questions

a) What is the primary function of a router in the Internet architecture?
b) What is the primary distinction between TCP and UDP.?
c) Define URL and its components.

Long Questions

a) Describe the fundamental elements of Internet Architecture.
b) Explain the four layers of the TCP/IP Protocol Suite.

6.10 Further Readings

1. Bagdasaryan, E. (n.d.). *CS 5450: INTERNET ARCHITECTURE*. https://cs5450.github.io/lectures/internet-arch.pdf
2. *BLOCK 3 WEBSITE DEVELOPMENT AND HOSTING*. (n.d.). Retrieved December 12, 2025, from https://egyankosh.ac.in/bitstream/123456789/72090/1/Block-3.pdf
3. Domain Name System(DNS). (2018). *Egyankosh.ac.in*. http://egyankosh.ac.in//handle/123456789/59207
4. *UNIT 1 TCP/IP PROGRAMMING CONCEPTS*. (n.d.). Egyankosh.ac.in. Retrieved 2025, from https://egyankosh.ac.in/bitstream/123456789/11785/1/Unit-1.pdf
5. *UNIT 6 STRUCTURE OF INTERNET*. (n.d.). Retrieved December 12, 2025, from https://egyankosh.ac.in/bitstream/123456789/26320/1/Unit-6.pdf

UNIT 7: BASIC OF WEBSITE DEVELOPMENT

UNIT STRUCTURE

7.1 Learning Objectives

7.2 Introduction

7.3 Concept and evolution of website,

7.4 Types of websites

7.5 Protocols: HTTP & HTTPS

7.6 Website development: requirements

7.7 Role of AI in website development

7.8Let us Sum Up

7.9Answer to Check your Progress

7.10 Probable Questions

7.11 Further Readings

7.1 Learning Objectives

After going through this unit, learners will be able to

- Understand the concept and evolution of website, website usage, types etc.
- Know about the steps and requirements of website development

7.2 Introduction

Websites are generally focused on a specific subject or objective, such as news, education, commerce, entertainment, or social networking. Hyperlinking between web pages facilitates site navigation, which frequently begins with a homepage. Users are able to access websites across a variety of devices, including workstations, laptops, tablets, and smartphones. The software application utilized on these devices is known as a web browser. Web development pertains to the creation and ongoing management of websites. It essentially involves the behind-the-scenes efforts to ensure a website appears visually appealing, operates efficiently, and delivers optimal performance with a seamless user experience. Website development is carried out by web developers utilizing various programming languages, which depend on the specific duties they are executing and the platforms on which they operate. This unit

elucidates the significance, origin, and applications of websites, as well as the procedures and components necessary for website development.

7.3 Concept and evolution of website

A website is a collection of web pages and related content that is identified by a common domain name and hosted on at least one web server. A website, also referred to as a web site, is a compilation of web pages and Related content that is recognized by a shared domain name and hosted on at least one web server. Notable examples include wikipedia.org, google.com, amazon.com, and www.ignou.ac.in. The software program utilized on these devices is designated as a web browser. Essentially, for a layperson, a website is a collection of data and information concerning a specific subject that is accessible on the Internet. Websites can serve a variety of functions, including personal websites for individual businesses or professions, corporate websites for companies, government websites for governmental organizations, and other organizational websites, among others.

The evolution of the World Wide Web is intimately related to the history of websites. Tim Berners-Lee at CERN suggested the Web in 1989 as a means of exchanging hypertext documents via the Internet. HTML (Hypertext Markup Language), HTTP (Hypertext Transfer Protocol), and URLs are the three fundamental technologies he introduced. Early websites in the 1990s were primarily text-based, with a few pictures and straightforward design. The content was fixed in files on the server and only changed when the developer made changes to them, therefore they were static.

The release of graphical web browsers like Mosaic in 1993 and Netscape Navigator in 1994 marked a significant turning point. These browsers supported graphics and simple multimedia and made it simpler for users to visit webpages with point-and-click navigation. Because of this, the number of websites increased rapidly, and businesses started to view the internet as a helpful tool for communication and information. Websites began utilizing increasingly sophisticated server-side technologies and scripting in the late 1990s and early 2000s. This enabled the provision of online purchasing, user account support, and dynamic web page generation from databases, among other things.

Websites grew more user-centered and interactive throughout the Web 2.0 era. On blogs, wikis, and social media sites, users could produce and distribute material. Responsive web design, which modifies a website's layout to fit various screen sizes, emerged as smartphones and tablets became more popular. These days, a lot of websites function like programs, mixing data from several sources, real-time communication, and intricate client side scripts. Search engine optimization, usability and accessibility guidelines, and the requirement to provide safe communication and data security have all had a significant impact on web development.

7.4 Types of websites

Authority Website: An authoritative website is a dependable and trustworthy information source. The authority website acts as the company's internet presence. Here, prospective

clients can view the company's accomplishments and learn how to contact a representative for services and offline leads. The website is visited by those who are already familiar with the business and are looking for additional information. In this case, the website acts as an online stand-in, lending the company greater credibility in the eyes of clients. Example includes, in case of news & media, the New York Times, in health and fitness, Healthline etc.

Lead generation website: As the name suggests, the main purpose of this kind of website is to create leads via its online presence. Targeted marketing strategies and search engine optimization are essential for drawing in new clients. The real sales transactions, however, typically happen offline. Users with high buying intent—that is, those who are already inclined to make a purchase and just require confirmation that the company is the best option—usually find such websites. One online customer support product that can be used as a lead generation tool is Live Chat, which offers chat services, help desk capabilities, and web analytics.

Sales website: These websites are made to use e-commerce platforms to offer goods and services. A website is classified as a sales website if it has a shopping cart feature. Because lead generation and sales transactions are conducted entirely online, these websites are very popular. Even when the service is provided in person, a business website that provides online scheduling and payment options may also be classified as a sales website. Amazon.com, Flipkart.com, and Myntra.com are a few examples of sales websites where customers can buy goods and services online based on their needs.

Utility Website: A utility website functions more like an online tool than a traditional website. For these kinds of businesses, the website is the center of their activities. Facebook and Airbnb are two instances of useful websites. These platforms are digital services that are freely available to anyone who wishes to use them, rather than being primarily focused on lead generation or direct online sales.

7.5 Protocols: HTTP & HTTPS

HTTP: The main application-level protocol utilized on the Internet is called Hypertext Transfer Protocol (HTTP). It specifies how a resource is requested from a server by a client, often a web browser, and how the server reacts. The browser establishes a connection with the server and makes an HTTP request when a user inputs a URL that begins with http. The method (such as GET or POST), resource path, and HTTP version are all specified in the request line. After processing the request, the server sends back an HTTP response with the requested content, if it is accessible, and a status code, such 200 for success or 404 for not found.

HTTP typically uses port 80 and operates on top of the TCP transport protocol. HTTP is stateless in its most basic form, which means that every request is handled separately.

Cookies and other techniques are used to preserve context between consecutive requests in order to enable sessions. Newer versions of HTTP, such HTTP/1.1 and HTTP/2, offer persistent connections and more effective use of network resources than earlier versions, which started a separate TCP connection for each request.

HTTPS: An enhancement of HTTP, Hypertext Transfer Protocol Secure (HTTPS) offers enhanced identity verification and encryption. The communication between the browser and the server is encrypted using Transport Layer Security (TLS). In order to agree on encryption keys and validate the server certificate, the browser and server first conduct a handshake when a URL begins with https. HTTP requests and responses are sent over an encrypted channel after a secure channel has been created.

Port 443 is usually used by HTTPS. By making sure that the information shared cannot be read or changed by outside parties, it guards against tampering and eavesdropping. As long as the certificate has been properly issued and validated, it also assists users in confirming that they are connected to the authentic website. When non-HTTPS websites handle forms or passwords, many contemporary browsers flag them as insecure. HTTPS is practically required for online banking, e-commerce, and any website that handles private or sensitive data. Because of this, more and more websites are now using HTTPS by default.

7.6 Website development: requirements, hosting

Planning, designing, implementing, testing, and maintaining a website are all steps in the systematic process of website development. The website's objectives, target market, and primary features are determined during the planning phase. This results in a sitemap that displays the basic information architecture and page order. Layout, color palettes, fonts, and navigation components are selected throughout the design phase. The intention is to make it easy for users to find what they're looking for by combining usability with aesthetic appeal.

There are a number of technical requirements that must be fulfilled. The site must be created and hosted using hardware and software resources. Computers with the appropriate operating systems, a text or code editor, or an integrated development environment, and testing browsers are usually included in this for development. Database systems and server-side frameworks are utilized for websites that are interactive or have a lot of content. Developers utilize JavaScript for client logic, CSS for display, and HTML for structure on the client side. In order to accommodate users with varying devices and abilities, accessibility rules and adaptable design strategies are essential. Testing is done to make that the site loads in a reasonable amount of time and that links, forms, multimedia, and scripts all work as intended.

After a website is launched, it needs to be maintained continuously. Software components need to have security patches installed, broken links fixed, and content updated. Feedback and visitor statistics are utilized to improve the content or structure. A content management system (CMS) is frequently utilized for larger websites in order to provide non-technical workers with a controlled interface via which they may add or edit information. Reliability and error recovery are supported by backup protocols and version control.

Elements Needed to Develop a website:

Clean Navigation: allows visitors to rapidly locate necessary information without wasting time and navigate between pages with ease.

Beautiful Typography: improves readability and aesthetic appeal by using appropriate font choices, color, size, spacing, and alignment.

White Space: The impact of the message is increased, clutter is avoided, and clarity is improved with appropriate spacing between content pieces.

Logical Layout: allows for flexible navigation while providing consumers with seamless navigation by arranging items in a sensible sequence.

Design with a Purpose: emphasizes simplicity, making sure that each design component fulfills a specific purpose without being overly distracting.

Speed: Rapid processing and page loading are crucial since users detest delays and may abandon websites that take too long.

Detail: offers enough readily available information, including contact information, product and service specifics, to answer user questions.

Multiple Feedback Channels: provides a range of contact channels, including social media, live chat, email, and phone, to facilitate user involvement.

Web Hosting:

Web hosting is a service that enables individuals and companies to publish a website or web page on the Internet. A web host, or web hosting service provider, is an enterprise that offers the technology and services necessary for a website or webpage to be accessible on the Internet. Websites are kept on specialized computers known as servers.

Internet users access your website by entering your domain name into their browser. Their machine will subsequently connect to your server, and your websites will be transmitted to them via the browser.

Categories of Web Hosting:

Various hosting services are offered to accommodate diverse requirements.

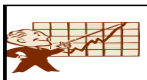
- **Shared Hosting:** Numerous websites utilize the same server resources (CPU, RAM). It is economical and appropriate for small websites or personal blogs.
- **Virtual Private Server (VPS) Hosting:** A physical server is partitioned into several virtual servers. Every user receives allocated resources, providing enhanced control and performance compared to shared hosting**.**

- **Dedicated Hosting:** A complete physical server is rented to one client exclusively. This provides optimal control, performance, and security, ideal for large enterprises with substantial traffic.
- **Cloud Hosting:** Utilizes a network of virtual servers that access a resource pool. It is very scalable and dependable, as a failure of one server prompts another to assume its responsibilities.

7.7 Role of AI in website development

In web development, artificial intelligence (AI) refers to the automation and improvement of web development processes through the use of technologies like machine learning (ML) and natural language processing (NLP). In comparison to traditional web development, AI facilitates tasks like code generation, testing, deployment, content production, SEO, and security, allowing for quicker development, fewer errors, cost effectiveness, and an enhanced user experience.AI-powered web development provides automated workflows, real-time personalization, intelligent mistake detection, scalable systems, and ongoing security monitoring, in contrast to traditional web development, which mostly depends on manual coding, testing, and generic designs. AI-powered solutions shorten development times and resource requirements while making websites more user-centric, safe, accessible, and adaptive. AI is frequently utilized in web development for a variety of purposes, including chatbots and virtual assistants, content creation, SEO and analytics, security and fraud detection, automated code generation, UI/UX design optimization, testing, and deployment. Productivity and user engagement are greatly increased by tools like GitHub Copilot, Wix ADI, Uizard, Figma AI, Dialogflow, Dynamic Yield, and Surfer SEO. Faster website development, less human error, improved user experience through personalization, cost effectiveness, and scalable personalization are the main advantages of AI in web development. By automating tedious and time-consuming processes, AI frees developers to concentrate on strategic work. AI coding assistants (GitHub Copilot, Tabnine), no-code/low-code platforms (Wix ADI, Bubble AI), UI/UX design tools (Uizard, Galileo AI, Figma AI), testing tools (Testim, Applitools), personalization platforms (Dynamic Yield, Adobe Target), machine learning frameworks (TensorFlow, PyTorch), content creation tools (Jasper AI, Copy.ai), and chatbot frameworks (Dialogflow, Rasa).

The development of low-code and no-code platforms, intelligent design systems, hyper-personalized user experiences, automated testing and deployment, and integration with cutting-edge technologies like Web3 and AR/VR are all anticipated in the future of web development using AI. Web development will continue to change as a result of AI's ability to make it more user-focused, inclusive, intelligent, and efficient.



Check Your Progress

a. Tim Berners-Lee suggested the World Wide Web in _____ at CERN.
b. HTTP usually operates on port _____.

c. Artificial Intelligence in web development uses technologies like machine learning and _____ language processing.
d. The software application used to access websites is called a _____ _____.

7.8 Let us Sum Up

Websites are collections of linked web pages created for certain uses, including social networking, education, commerce, entertainment, and information exchange. On gadgets like PCs, tablets, and smartphones, they can be viewed via web browsers. Web development is the process of planning, building, and managing websites to guarantee their usability, security, aesthetic appeal, and effective performance. Tim Berners-Lee's 1989 introduction of the World Wide Web is intimately associated with the development of websites. Websites were initially text-based and static, but as time went on, new features like databases, images, and responsive design made them more dynamic and user-focused. With distinct purposes, websites can be generically categorized as authority websites, lead generation websites, sales websites, and utility websites. Protocols like HTTP and HTTPS are essential to web communication, with HTTPS offering encrypted and secure data transit. Planning, designing, implementing, testing, and maintaining a website are all steps in a methodical process. By automating coding, testing, content production, SEO, personalization, and security, artificial intelligence has revolutionized web development, resulting in quicker development, fewer errors, better user experience, and scalable, intelligent websites.

7.9Answer to Check your Progress

a. 1989. **b.** 80**, c.** Natural, **d.** Web Browser

7.10 Probable Questions

A. Short Answer Type Question

a. Define Website.

b. What are HTTP and HTTPS.

c. What are the steps for website development.

B. Long Answer Type questions

a. Briefly discuss about different types of websites with examples.

b. Briefly discuss the concept of website development

c. What is the role of AI in Website development.

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UNIT 8 NETWORK SECURITY IN LIBRARY

UNIT STRUCTURE

8.1 Learning Objectives

8.2 Introduction

8.3 Fundamentals of Cybersecurity in Library Networks

8.4 Type of Cyberthreats: Malware, Phishing, Ransomware, Dos Attacks,

8.5 Firewalls, Encryption, Authentication Systems

8.6 Institutional Data Protection, Privacy and Backup

8.7 Let Us Sum Up

8.8 Answers to Check your Progress

8.8 Probable questions

8.9 Further Readings

8.1 Learning Objectives

After going through this unit, learner should be able to:

- Know the basic principles of cybersecurity and its vital significance in a library setting.
- Identify and explain the typical online dangers that libraries face, such as ransomware, phishing, malware, and Denial-of-Service (DoS) attacks.

8.2 Introduction

In the contemporary day, libraries have evolved from simple storage facilities for physical books into vibrant digital knowledge centres. They offer access to extensive online databases, e-journals, and digital archives, predominantly utilizing interconnected networks and the internet to service its users. This digital transition, albeit advantageous, subject libraries to numerous cybersecurity threats that were absent in the pre-digital era. Information security has transitioned from safeguarding physical cabinets to protecting electronic domains. Libraries already oversee sensitive user information, such as personal identification and borrowing records, rendering them appealing targets for attackers.

Cybersecurity within a library context include not just the protection of computers but also the preservation of knowledge integrity, the assurance of patron privacy, and the maintenance of service availability. As libraries progressively depend on digital technologies for their functions, the necessity to safeguard networks, devices, and data from unwanted access becomes critical. A breach may result in the loss of irreplaceable heritage collections, theft of intellectual property, and considerable reputational harm. Consequently, comprehending the principles of network security is crucial for library professionals to establish a secure environment for both personnel and patrons.

8.3 Fundamentals of Cybersecurity in Library Networks

The principles of cybersecurity focus on safeguarding information and information systems from illegal access, utilization, disclosure, interruption, alteration, or destruction. In the library context, this entails guaranteeing the continuous availability of digital services to users, the accuracy of accessed data, and the confidentiality of personal information.

The fundamental principles of information security are encapsulated in three essential attributes, commonly known as the CIA Triad: Confidentiality, Integrity, and Availability.

Confidentiality guarantees that information is available solely to individuals who are authorized to access it. This pertains to patron records, staff personnel files, and internal administrative data within a library. If an unauthorized individual accesses a user's reading history or personal information, confidentiality is compromised.

Integrity entails preserving the precision and reliability of data. It guarantees that information remains unaltered by unauthorized individuals. If a hacker alters the library catalog to modify book titles or erase records, the integrity of the library's information resource is compromised.

Availability guarantees that authorized users can access information and resources as required. When a library's network is incapacitated by a cyberattack, obstructing user access to the catalog or databases, the principle of availability is undermined.

Libraries must also contemplate Authenticity, which ensures that the content or user is legitimate. This is essential for thwarting fraud, such as a someone impersonating a valid user to gain access to restricted resources. Moreover, non-repudiation guarantees that a sender cannot refute having sent a message, and a receiver cannot contest having received it, which is crucial for digital transactions and formal interactions.

Executing these concepts necessitates a holistic strategy. Libraries should create policies that limit data collection to essential information, thereby mitigating the risk in the event of a breach. They must also promote robust cybersecurity protocols within their host institutions and ensure that third-party providers comply with stringent security standards.

8.4 Type of Cyberthreats: Malware, Phishing, Ransomware, Dos Attacks

Libraries encounter a varied array of cyber dangers that are more sophisticated. Comprehending these risks is the initial stage in establishing a formidable defence.

Malicious software

Malicious software, commonly referred to as malware, encompasses any software specifically engineered to inflict damage on a computer, server, or computer network. This encompasses viruses, worms, Trojans, and spyware. A computer virus latches onto an uninfected file and disseminates to more files, possibly compromising the system's fundamental operations. Worms propagate over networks autonomously, depleting bandwidth and impairing the library's internet connectivity. Spyware operates covertly in the background, gathering user data such as passwords and browsing behaviors, posing significant risks on public library computers.

Phishing

Phishing is a fraudulent tactic in which perpetrators dispatch misleading messages, typically through email, that seem to originate from a credible source. The objective is to deceive the recipient into disclosing confidential information such as login passwords or credit card numbers. In a library context, a staff member may get an email purportedly from the IT department requesting a password reset. Should the staff member click the link and provide their information, the attacker acquires access to the library's network. Phishing attacks represent a significant avenue for early system compromise.

Malware that encrypts data to extort a ransom

Ransomware is a malicious software that encrypts and locks a victim's data, requiring a ransom for access restoration. A ransomware assault can be catastrophic for libraries. It can render the complete digital catalog and user database inaccessible, thereby halting library operations. The recent assault on the British Library underscored the gravity of this issue, since perpetrators not only encrypted data but also exfiltrated sensitive personal information.

Denial of Service Attacks

A Denial-of-Service (DoS) attack seeks to incapacitate a machine or network, rendering it unavailable to its designated users. Attackers achieve this by inundating the target with traffic or transmitting data that induces a crash. A DoS attack on a library could incapacitate the library's website or catalogue server, hindering patrons from looking for books or accessing their accounts.

8.5 Firewalls, Encryption, Authentication Systems

To mitigate these dangers, libraries must adopt a multifaceted security strategy employing many technological instruments and protocols.

Network security systems

A firewall serves as a barrier between a trusted internal network and an untrusted external network, such as the internet. It supervises incoming and outgoing network traffic and determines whether to permit or obstruct specific traffic according to established security protocols. Firewalls may exist as either physical devices or software applications. A firewall at a library safeguards internal systems from external intruders while permitting staff and patrons secure internet access. It effectively eliminates harmful data packets prior to their arrival to the library's computers.

Encryption

Encryption is the procedure of transforming information or data into a coded format, mostly to avert unlawful access. It guarantees confidentiality by rendering data incomprehensible to anybody lacking the decryption key. Libraries ought to implement encryption for both data in transit and data at rest. The library website must implement HTTPS to secure the communication between a user's browser and the library server, safeguarding the confidentiality of their search queries and login credentials. Encryption is essential for safeguarding sensitive user data within the library management system.

Authentication Mechanisms

Authentication is the procedure of confirming the identification of a user or system. Robust authentication methods are essential for regulating access to library resources. The predominant method employed is password usage; however, libraries are progressively implementing Multi-Factor Authentication (MFA). Multi-Factor Authentication (MFA) necessitates users to present two or more verification factors to access a resource, such as a password in conjunction with a code transmitted to their mobile device. This provides an additional layer of security; even if a password is compromised via phishing, the assailant cannot get access to the account without the second factor. Libraries must have stringent password policies, mandating the use of complicated passwords that are updated frequently.

In addition to urgent technical safeguards, libraries must implement institutional policies and processes to guarantee sustained data protection and privacy.

Institutional Data Safeguarding

Libraries function as guardians of extensive collections of information. Institutional data protection entails categorizing data according to its sensitivity and implementing suitable security measures. Public catalog information necessitates distinct safety standards in contrast to private patron records. Libraries ought to adopt the "principle of least privilege," guaranteeing that staff members possess access solely to the data essential for their designated job responsibilities. Routine security audits and vulnerability assessments facilitate the identification of weaknesses in the institutional infrastructure prior to exploitation.

Confidentiality

Privacy constitutes a fundamental principle of librarianship. In the digital era, safeguarding user privacy entails maintaining the confidentiality of their digital footprint comprising their

reading habits, search queries, and accessed content. Libraries ought to limit the accumulation of personal data and store it solely for the duration required. For instance, upon the return of a book, the association between the patron and the object should preferably be anonymized in the active transaction records. Privacy entails transparency with consumers regarding the data collected and its utilization. All library websites and digital services must possess a transparent and accessible privacy policy.

Data backup

Data backup involves duplicating data to a secondary place to facilitate restoration in the event of data loss resulting from an accident or cyberattack. Backups serve as the paramount safeguard against ransomware; if data is compromised by attackers, the library can eradicate the affected computers and recover data from an untainted backup without remitting the ransom. Libraries must to adhere to the "3-2-1 rule" for data backup: maintain a minimum of three copies of data, utilize two distinct media types, and ensure at least one copy is maintained offsite or in the cloud. Consistent verification of backups is crucial to confirm that data can be restored when required.8.6 Institutional Data Protection, Privacy and Backup



Check Your Progress

A. Fill in the Blanks

a. The three core principles of information security, referred to as the CIA Triad, represent Confidentiality, _____ and Availability.
b. _____is a deceitful activity wherein attackers dispatch phony emails that seem to originate from respectable sources to manipulate recipients into disclosing critical information.
c. A _____serves as a security barrier between a trusted internal network and an untrusted external network, overseeing traffic according to security protocols.
d. _____ is a special sort of malicious software that encrypts a victim's data and demands payment to restore access.

8.7 Let Us Sum Up

Library network security is a complex field necessitating a blend of technical instruments, stringent rules, and user education. We have examined the essential tenets of the CIA triad Confidentiality, Integrity, and Availability which function as the foundational objectives for all security initiatives. We defined the essential elements of the computer infrastructure requiring protection, encompassing physical hardware, software, and the data stored within.

We also analysed the various risks confronting libraries today, including malware, phishing, ransomware, and Denial-of-Service assaults. To address these issues, libraries must provide

defense mechanisms such as firewalls to filter traffic, encryption to safeguard data confidentiality, and robust authentication systems to validate user identities.

Ultimately, we examined the overarching institutional obligations pertaining to data protection, the ethical obligation of user privacy, and the essential requirement for routine data backups. By incorporating these components into a holistic security policy, libraries may maintain their role as secure, reliable, and robust access points to information in the digital realm.

8.8 Answers to Check your Progress

A. Fill in the blanks

a. Integrity, b. Phishing, c. Firewall, d. Ransomware

8.8 Probable questions

A. Short Answer Type Questions

- **a.** Explain the distinction between a virus and a worm, as well as their potential impact on library systems.
- **b.** What are the optimal strategies for developing and sustaining secure passwords in a library setting?

B. Long Answer Type Questions

a. Explain the function of a firewall in safeguarding a library's internal network.
b. What makes data backup an essential safeguard against ransomware attacks?

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UNIT 9 METADATA AND BIBLIOGRAPHIC STANDARDS

UNIT STRUCTURE

9.1 Learning Objectives

9.2 Introduction

9.3 Metadata Concepts and Types

9.4 MARC 21 Standards: Structure, Tagging, and Encoding,

9.5 Dublin Core Metadata Elements for Digital Resources

9.6 Metadata for Interoperability

9.7 Let Us Sum Up

9.8 Probable Questions

9.9 Further Readings

9.1 Learning Objectives

After going through this unit, learners will be able to

- Describe metadata and discuss its significance in the digital world.
- Distinguish between the three primary categories of metadata: administrative, structural, and descriptive.
- Recognize the MARC 21 standard's structure and purpose for bibliographic records.
- Determine the Dublin Core Metadata Element Set's (DCMES) 15 essential components and how they are used.

9.2 Introduction

The way we access, store, and handle information has changed dramatically in the digital age. The main resource for locating books at a library used to be actual card catalogs. Today, there is a greater need than ever for effective organization and retrieval due to the proliferation of electronic resources, including websites, e-books, digital photos, and databases. Metadata enters the picture here. Metadata, often referred to as "data about data," is the organized information that identifies, describes, explains, and facilitates the retrieval of an information resource.

Metadata offers crucial information about a digital object, such as its title, creator, subject, file format, and rights, so that both humans and machines can comprehend what it is and how to utilize it, much like a label on a can of soup tells you what's inside without you having to open it. A digital file would be nothing more than an enigmatic collection of bits without

metadata. The basic ideas of metadata, the various kinds utilized in libraries and information centers, and the important standards like MARC 21 and Dublin Core that guarantee uniformity and compatibility across various systems are all covered in this lesson. We will also examine how metadata facilitates the smooth movement of information between various computer systems by enabling them to "talk" to one another.

9.3 Metadata Concepts and Types

In the digital era, metadata serves as the foundation for information organisation. An information resource is described by structured information, which enables its discovery, management, and long-term preservation. Although the word “metadata” may sound technical, the idea is not that new. One type of metadata is a standard library catalog card, which offers details about a book (author, title, subject) apart from the book itself. Metadata has a similar function in the digital sphere, but it can be processed by computers to assist users in finding and retrieving certain items because it is machine-readable.

Metadata serves several critical functions:

- Resource Discovery: It allows users to find resources using search criteria like title, author, subject, or keywords.
- Organization: It helps organize electronic resources by grouping them based on shared characteristics.
- Identification: It uniquely identifies a resource on the network (e.g., using a DOI or URL).
- Archiving and Preservation: It provides information needed to ensure the resource remains accessible over the long term, such as file format and migration history.

Type of Metadata

Based on its purpose, metadata is typically divided into three primary categories:

i. **Descriptive Metadata:** The most common kind among library patrons is this one. Its main objective is to provide a description of a resource so that it may be found and recognized. It provides a response to the query, “What is this?”

   Examples include Title, Author, Abstract, Keywords, Subject Headings, and ISBN.

   Use: It is employed for database and catalog indexing and searching. You are looking at the descriptive metadata when you search for a book by “Title” in a library’s OPAC.

ii. **Administrative Metadata:** This kind offers info to aid in resource management. “How was this created?” “Who owns it?” and “How can it be used?” are all addressed. Frequently, administrative metadata is separated into:

- **Technical metadata:** It includes information on the digital file's size, creation date, compression format, and type (e.g., JPEG, PDF). Knowing what software is required to view the file is essential.
- **Rights management metadata:** Intellectual property rights, copyright status, and licensing terms are all covered by rights management metadata. It indicates to users what they are permitted to do with the resource (such as "All Rights Reserved" or "Creative Commons Attribution").
- **Preservation metadata:** it includes information on format migrations (such as converting a Word 95 file to a PDF) that ensures the resource may be archived and preserved while still being readable in the future.

iii. **Structural Metadata:** This type shows the construction of composite objects. It explains a resource's internal organization so that the user can see it correctly. "How are the parts related?" is the question it addresses.

Examples: Structural metadata in a digital book guarantees that pages are shown in the right order and connects the image of a particular page to its associated chapter. A digital book would be nothing more than a jumbled collection of picture files without structural metadata.

9.4 MARC 21 Standards: Structure, Tagging, and Encoding,

Libraries have been sharing bibliographic data in a common format for decades, which eliminates the need for each library that owns a book to re-catalog it. Machine-Readable Cataloging, or MARC, is the standard in question. The most recent version of this standard, MARC 21, is extensively used worldwide for the machine-readable representation and transmission of bibliographic and related data. All of the data from a catalog card (and more) is contained in a computer file called a MARC record, which is arranged in a certain way that computers can understand. It enables library systems to store complex data in the background and present information that is easy to understand.

MARC Record Structure:

Three primary components make up a MARC record:

- **Record structure:** The data is stored in this framework. It functions as a container and complies with international standards (ANSI Z39.2 and ISO 2709).
- **Content Designation:** These are the codes and conventions (subfield codes, indications, and tags) that specifically identify the data items in a record. A tag instructs the computer, for instance, "This line is the Title."
- **Data Content:** This is the real data (book title, author name) as established by outside standards such as RDA (Resource Description and Access) or AACR2 (Anglo-American Cataloguing Rules).

Tagging and Encoding:

Tags: A three-digit identifier known as a tag is used to identify each field in a MARC record.

0XX: Control data, codes, and numbers (e.g., 020 for ISBN).

1XX: The primary entry (personal author, for example, 100)

2XX: Titles, edition, and imprint (for example, Title, 245).

3XX: Physical description (e.g., 300 for dimensions and pages).

4XX: Series Statement fields

5XX: Note Fields

6XX: Subject access fields (Subject Headings, for example, 650).

7XX: New entries (authors, etc.). It organizes data using a system of tags, indications, and subfields.

Indicator: The two-character places that come after the tag are known as indicators; they can be either a blank or the numbers 0–9. They give the computer precise instructions on how to handle or present the data. For instance, an indicator may instruct the system to disregard the term "The" when sorting titles alphabetically in the Title field (245).

Subfields: Each field is separated into smaller data sets known as subfields. A delimiter (often a dollar sign $ or a double dagger ‡) is followed by a lowercase letter or number to form a subfield code.

For instance, subfields $a and $b represent the primary title and subtitle, respectively, in the 245 field (Title).

The Field of MARC 856

As digital resources became more prevalent, MARC 21 added the 856 field to enable "Electronic Location and Access." The information required to find and retrieve an electronic resource, most frequently the URL (Uniform Resource Locator), is contained in this field.

Subfield $u: The actual URL (http://www.example.com, for example) is contained here.

The first indicator, which is 4 for HTTP, indicates the access method. The second indicator, which is 0 for the resource itself and 1 for a version of the resource, explains the relationship.

9.5 Dublin Core Metadata Elements for Digital Resources

Although MARC 21 is strong and comprehensive, using it is difficult and calls for skilled professionals. A more straightforward metadata standard that non-catalogers may employ to describe digital resources became necessary as the web expanded. As a result, the Dublin Core Metadata Initiative (DCMI) was created.

The 15 essential elements that make up the Dublin essential Metadata Element Set (DCMES) are intended to be straightforward, adaptable, and broadly used. Because it captures the most crucial information required to describe nearly any resource, it is frequently referred to as the "lowest common denominator" of metadata. Web resources, open access publications, and digital repositories all make extensive use of it**.**

Dublin Core's ability to be immediately incorporated into web pages using HTML tags is one of its main advantages. This makes it simple for tools and search engines to get information about the page.

For instance: <meta name="DC.Title" content="History of India">

<meta name="DC.Creator" content="Sharma, R.K.">

The 15 core elements:

- **Title:** The resource's name (such as "Introduction to Metadata").
- **Creator:** The entity principally in charge of creating the content (e.g., "Smith, John").
- **Subject:** The resource's subject, usually represented by keywords or classification codes.
- **Description:** A summary of the material, like a table of contents or abstract.
- **Publisher:** The organization in charge of providing the resource (such as "Oxford University Press").
- **Contributor:** an organization in charge of contributing to the content (such as an editor or illustrator).
- **Date:** a date connected to a resource's life cycle event (e.g., creation date, 2025-05-14).
- **Type:** The content's type or genre (e.g., "text", "image", "software").

- **Format:** The digital or physical representation (e.g., “application/pdf”, “45 MB”).

- **Identifier:** A clear citation to the source (e.g., URL, ISBN, DOI).

- **Source:** a reference to a resource that is the source of the current resource.

- **Language:** The content’s language (for example, “en” for English).

- **Relation:** An allusion to a relevant resource (for example, “IsPartOf” refers to a broader collection).

- **Coverage:** The theme of the resource’s space or time (e.g., “19th Century”, “India”
- **Rights:** Details regarding the resource’s rights (such as “Copyright 2023”).

9.6 Metadata for Interoperability

The ability of various systems, running on various hardware, software, data formats, or interfaces, to interchange data while minimizing the loss of functionality and content is known as interoperability. It enables different resources to work together efficiently to create a shared service or product in a distributed service environment like the Web without requiring users to comprehend how each module works internally. Standardization, which offers a common platform or specification that permits the smooth exchange of services and communication between separate systems, is the foundation of this partnership.

Need of interoperability:

Interoperability is crucial for sharing bibliographic data in the field of library and information science utilizing standards like ISO 2709 and MARC21. It permits “federated searching,” which enables cross-standard searches across a variety of metadata schemas, including Dublin Core, EAD, and GILS, via search engines or library portals. Without interoperability models, different local specifications would make it impossible to exchange data between diverse systems, such as dispersed digital repositories or Electronic Health Records (HER) in hospitals.

Interoperability Protocols

In order to manage various metadata standards, particular protocols have been created to enable cross-platform searching in a distributed environment**:**

Z39.50: This long-standing client-server protocol is mostly used for real-time information retrieval from dispersed databases and searching Online Public Access Catalogues (OPACs).

ZiNG (Z39.50-International Next Generation): It is a web-based version of Z39.50 that includes SRW (Search and Retrieve Web Service), which uses SOAP XML packets, and SRU (Search and Retrieve URL Service), which uses HTTP GET.

OAI-PMH: The Open Archives Initiative Protocol for Metadata Harvesting, or OAI-PMH, is an HTTP-based protocol that enables service providers to "harvest" (extract and store) metadata from remote repositories in advance of user queries instead of doing real-time searches**.**



Check your Progress

A. Fill in the Blanks

a. Metadata is often referred to as "_____" .
b. ____, _____ & _____ are the types of Metadata.
c. In the DCMI, the element used to identify the entity primarily responsible for making the content of the resource is called the _____.
d. 5XX and 7XX tags are for_____.

9.7 Let Us Sum Up

Large electronic resources have replaced physical card catalogs as the primary method of storing information in the digital age, requiring efficient management. Known as "data about data," metadata is the organized information that characterizes, clarifies, and makes it easier to retrieve these digital assets. It provides important information like the title, creator, and format without requiring you to open the file, much like a label on a can. Three forms of metadata are distinguished: structural (used to organize complicated items), descriptive (used for discovery), and administrative (used for management and rights). For comprehensive bibliographic entries, standards such as MARC 21 are employed to guarantee consistency, whereas Dublin Core provides a more straightforward set of 15 elements for more general online resources. Lastly, with protocols like OAI-PMH and Z39.50, interoperability enables easy data interchange between disparate systems, facilitating cross-platform "federated searching" and guaranteeing sustained access to international information networks.

9.8 Answers to Check Your Progress

A. Fill in the Blanks

a. Data about Data**, b.** Descriptive, Administrative & Structural

c. Creator **d.** Note Fields & New entries (authors, etc.). ARC organizes data using a system of tags, indications, and subfields.

9.9 Probable Questions

A. Short Answer Type Questions

a. What do you understand by Metadata.

b. What are the different types of Metadata.

c. What are MARC21 and DCMI.

B. Long Answer Type Questions

a. Briefly discuss about 76ublin core metadata and its core elements.

b. Briefly discuss about metadata, its types, advantage and interoperability and related protocols.

9.10 Further Readings

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UNIT 10 INTEGRATED LIBRARY MANAGEMENT SYSTEMS (ILMS)

UNIT STRUCTURE

10.1. Learning Objectives

10.2. Introduction

10.3. Concept, definition, and purpose of ILMS

10.4. Evolution of library automation and management systems

10.5. Modules

10.6. Role of ILMS in managing print and digital resources.

10.7. Let Us Sum Up

10.8. Answers to Check Your Progress

10.9. Probable Questions

10.10. Further Readings

10.1 Learning Objectives

After going through this unit, learners will be able to

- Explain the idea, definition, and objective of an Integrated Library Management System (ILMS).
- Explore the progression of library automation and the many generations of management systems.
- Explain the fundamental modules of an Integrated Library Management System (ILMS), encompassing acquisition, cataloguing, circulation, serials control, and the Online Public Access Catalog (OPAC).

10.2 Introduction

An Integrated Library Management System (ILMS) is an enterprise resource planning (ERP) system utilized by libraries to monitor owned goods, placed orders, settled invoices, and customers who have borrowed materials. It is an all-encompassing software system that automates and unifies the diverse tasks of a library, encompassing acquisitions, cataloging, circulation, serials administration, and the public catalog. The fundamental premise of an ILMS is the utilization of a centralized database to oversee all tasks, hence optimizing

workflows, minimizing data redundancy, and improving services for both library personnel and consumers.

10.3. Concept, definition, and purpose of ILMS

An Integrated Library Management System, or Automated Library System, is a software package that use a central relational database to oversee the various operations of a library. The system's "integrated" character signifies that its several functional modules, such as acquisitions, cataloguing, and circulation, are interconnected. Any modification or data input in one module automatically refreshes the pertinent information in other associated modules. When a book is obtained and catalogued, its record is created once and is promptly accessible for circulation workers to check out and for patrons to peruse in the online catalogue. This communal database eradicates data redundancy and guarantees uniformity throughout all library operations.

The principal objective of an ILMS is to automate and optimize the library's administrative functions, yielding several significant advantages. It markedly enhances operational efficiency by alleviating professional staff from mundane clerical duties, enabling them to concentrate on user-oriented services. This automation enhances library services by improving speed and quality, exemplified by expedited check-in and check-out operations and more precise inventory control. A web-enabled Integrated Library Management System eliminates the physical constraints of the library, enabling users to access the catalogue and additional services at any time and from any location. Moreover, the system functions as an effective decision-making instrument for library administrators by producing comprehensive reports and statistics on collection utilization, circulation patterns, and budgetary expenditures, thereby facilitating strategic planning and resource distribution.

10.4. Evolution of library automation and management systems

The history of library automation chronicles ongoing technological progress, transitioning from basic mechanization to intricate, web-scale systems. This evolution can be examined through several "ages" of automation and their associated "generations" of software development.

The Five Ages of Library Automation

The First Automation Age: This initial phase was characterized by the computerization of discrete library activities through either proprietary or commercial software. These systems were generally autonomous and non-integrated. A notable accomplishment of this period was the establishment of shared copy-cataloguing, enabling libraries to collaborate and minimize redundant efforts.

The Second Automation Age: A pivotal advancement of this era was the emergence of the Online Public Access Catalogue (OPAC), which supplanted the conventional card catalogue. This period witnessed significant progress in online access to abstracting and indexing databases, as well as the establishment of resource-sharing networks.

The Third Automation Age: This era is defined by comprehensive access to electronic documents over high-speed communication networks, propelled by the emergence of the internet as a worldwide publication medium. Web-based library automation became standard, facilitating resource access from any location.

The Fourth Automation Age: Also referred to as the networked information revolution, facilitates an extensive array of digital material and services. Digital libraries, multimedia databases, and virtual libraries are the primary successes, with systems able to combine and personalize services to particular user demands.

The Fifth Automation Age: The present generation employs interactive, collaborative, and participatory platforms utilizing Web 2.0 techniques. This period is characterized by the seamless integration of Linked Open Data (LOD) with local library resources and the emergence of cloud-based, web-scale management systems functioning on a global scale.

Categorisation of ILMS:

1. Categorisation by Distribution Policy

This is the principal classification approach, categorizing software according to its licensing and distribution to libraries.

A. Proprietary Software

In this arrangement, the software's source code is confidential and not disclosed to the user. The library is unable to access or alter the internal programming logic. This category is additionally separated into two types:

a. Commercial Integrated Library Management Systems

These are commercial products. Libraries are required to pay a one-time licensing cost (capital expenditure) and generally an Annual Maintenance Contract (AMC) price.

LibSys: Created by LibSys Corporation, New Delhi, in 1984. It is the prevailing software in well-funded academic libraries in India. It is available in multiple editions, including LibSys 7 (flagship), LSEase (designed for smaller libraries), and LSAcademia (an ERP system). It adheres to standards such as MARC21 and Unicode.

SOUL (Software for University Libraries): Created by the INFLIBNET Centre. It is customized for libraries of Indian universities and colleges. SOUL 2.0 use MS-SQL or MySQL as its backend and adheres to MARC 21 and NCIP 2.0 standards. It is recognized for its affordability and user-friendliness for Indian institutions.

SLIM (System for Library Information Management): Created by Algorhythms Consultants, Pune. It is prevalent throughout Western India. Available versions comprise SLIM 21 (enterprise level) and SLIM++ (basic version). It provides modules for acquisition, categorization, and circulation, and facilitates biometric integration.

Virtua ILS: A premium international software developed by VTLS Inc., USA. It is utilized by esteemed organizations such as the National Library of India. It is distinguished by its utilization of UNIX and Oracle RDBMS, guaranteeing superior stability and scalability. It comprehensively endorses sophisticated bibliographic frameworks such as FRBR (Functional Requirements for Bibliographic Records).

b. Freeware Integrated Library Management Systems

These packages are offered at no charge; yet, akin to commercial software, their source code remains concealed. Libraries may utilize them but are prohibited from altering them.

e-Granthalaya: Created by the National Informatics Centre (NIC), Government of India. It is extensively utilized in governmental and public libraries. It operates on the Windows platform and utilizes MS-SQL. Although the software is complimentary, reliance on proprietary Microsoft technologies (such as Windows Server and SQL Server) may incur additional expenses.

ABCD: An extensive automation suite utilizing ISIS database technology, created by BIREME (Brazil). It is distinctive since it facilitates the management of non-bibliographic databases as well. Although web-enabled, it faces challenges with comprehensive Unicode (especially Indic script) support when compared to modern SQL-based systems.

WEBLIS: A web-based system developed on the CDS/ISIS engine, accessible via UNESCO. It is uncomplicated and appropriate for smaller libraries necessitating fundamental web OPAC and loan capabilities.

B. Open-Source Software (OSS)

This strategy offers free software acquisition and publicly accessible source code. Libraries can tailor the code to meet their particular requirements, however they may require technical expertise or external assistance to accomplish this.

Koha: The inaugural and most renowned open-source Integrated Library System, originally developed in 1999 by Katipo Communications for the Horowhenua Library Trust in New Zealand. It employs a "web-centric" architecture (Perl, MySQL, Apache), indicating that it necessitates only a web browser on client devices. It is exceptionally feature-laden, accommodating functionalities ranging from fundamental circulation to "OPAC 2.0" capabilities such as tagging and reviews.

NewGenLib (NGL): The inaugural Indian open-source Integrated Library System, created by Verus Solutions. It employs Java and PostgreSQL. It is distinguished by its robust endorsement of international standards and a specialized tablet/mobile interface (NGL Touch).

Evergreen: Initially developed for the Georgia Public Library Service in the United States. It is specifically designed for large consortia (groups of libraries sharing a catalog) and is very scalable.

PMB: An open-source French system that is highly facile to deploy utilizing XAMPP architecture. It is appropriate for small to medium-sized libraries; however, it is less prevalent in English-speaking areas compared to Koha.

2. Classification by Geographic Origin

This classification examines the location of software development, which frequently determines its support framework and appropriateness for regional requirements.

Foreign Origin: Systems such as Virtua (USA) or Alice for Windows (UK). These typically incur substantial licensing fees and support expenses, yet provide exceptional stability and adherence to standards.

Indigenous Origin: Systems created locally. LibSys and SOUL serve as exemplary instances. These are frequently more aligned with Indian library workflows and financial limitations.

Historical/Derived: Initial Indian systems developed upon foreign platforms, primarily UNESCO's CDS/ISIS. Examples are SANJAY (an enhanced version of CDS/ISIS produced by DESIDOC) and CATMAN (developed by INSDOC). These facilitated the development of contemporary indigenous software.

3. Classification by Dimensions and Extent

Ultimately, ILMS can be categorized based on the intricacy of the library they are intended to support.

Extensive Library Systems: Pertaining to university networks and national libraries. Examples include Virtua, LibSys 7, and Koha (when optimized for extensive configurations).

Medium Range Systems: Designed for academic institutions and research organizations. Illustrations: SOUL, SLIM 21, NewGenLib.

Minor Library Systems: Intended for educational institutions and rural libraries. Instances: e-Granthalaya, ABCD, WEBLIS.

10.5. Modules

An ILMS is a modular system, with each module tailored to manage a distinct array of library housekeeping functions. Although they serve different purposes, all connect with the core database to maintain data consistency and optimize operations throughout the library.

The Acquisition module streamlines the complete process of acquiring new materials for the library's collection. Its functions encompass the management of vendor and publisher databases, budget and fund accounting, generation of purchase orders, order tracking, and invoice processing. An essential characteristic is its capacity to avert duplicate orders by verifying the current catalogue. Upon receipt of an item, its bibliographic information,

recorded during the ordering process, is efficiently sent to the Cataloguing module for subsequent processing, therefore minimizing unnecessary data entry.

The Cataloguing module is regarded as the central component of the ILMS, tasked with the creation and management of descriptive data for all library materials. This module adheres to national and international bibliographic data standards, including MARC 21 (Machine-Readable Cataloguing), facilitating data sharing and comprehension among libraries and systems. Cataloguers utilize this module to enter comprehensive information regarding an object, encompassing its title, author, publication specifics, and subject classifications. Contemporary cataloguing modules facilitate authority control, standardizing names and subjects to maintain search consistency, and can interface with external data sources such as Linked Open Data to enhance records.

The Circulation module oversees all actions associated with the loaning of library resources to patrons. This involves managing the patron database and processing check-outs, returns, and renewals of goods. The module autonomously computes penalties for late items, oversees user-initiated holds and reservations, and produces overdue notifications. The circulation module, being coupled with the catalogue, offers real-time status updates for each item, enabling both patrons and staff to instantly ascertain if a book is available, checked out, or on hold. Numerous contemporary systems further facilitate patron self-service functionalities, like self-checkout kiosks and online account administration.

The Serials Control module is explicitly engineered to address the intricacies of managing publications such as journals, magazines, and newspapers. In contrast to books, which are generally obtained as individual things, serials are distributed as an ongoing series of issues. This module streamlines subscription management by automating order placement and renewal processing. It offers a method, typically utilizing a digital Kardex, for logging each new issue upon arrival and immediately generating claims for absent issues. The module oversees the consolidation of disparate issues into cohesive volumes for enduring preservation and offers comprehensive financial accounting for.

The Online Public Access Catalog (OPAC) serves as the public interface of the Integrated Library Management System (ILMS). It is the platform via which library patrons explore and access the library's resources. A conventional OPAC enables users to search by author, title, and subject matter. Modern Web-OPACs, often termed "OPAC 2.0," provide a significantly enhanced, interactive experience. They include sophisticated search functionalities, faceted navigation, and may incorporate social elements such as user ratings, reviews, and tagging. The Web-OPAC functions as a portal to the library’s digital resources, offering access to e-books, online articles, and more web content, so serving as a primary discovery platform for all library assets, both physical and digital.

10.6. Role of ILMS in managing print and digital resources.

Role in a Hybrid Library Context

- **Unified Discovery:** Contemporary Integrated Library Management Systems (ILMS) have advanced to provide a cohesive discovery experience, overseeing a variety of resources such as physical books, e-books, digital journals, multimedia content, and institutional repositories**.**
- **Blurring Boundaries:** The gap between conventional automated library systems and digital library systems is progressively diminishing as Integrated Library Management Systems (ILMS) evolve to encompass all content types harmoniously.

Managing Print resources

Fundamental Control: The ILMS is the crucial instrument for inventory regulation and access oversight of physical collections.

Lifecycle Automation: It automates the complete lifecycle of physical things, encompassing initial acquisition, cataloguing, circulation, and final withdrawal from the collection.

Technology Integration: Technologies such as barcodes and RFID are included into the ILMS to optimize procedures including check-out/check-in, shelving, and inventory verification.

Public Access: The OPAC serves as a portal to the physical collection, enabling visitors to view the library's holdings and their current shelf availability.

Managing Digital Resources

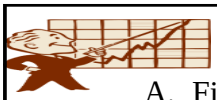
Electronic Resource Management (ERM): Integrated Library Management Systems (ILMSs) now incorporate ERM components to manage the intricate lifespan of licensed electronic materials, typically hosted by external suppliers rather than being physically situated within the library.

License and Access Monitoring: ERM modules are engineered to oversee license conditions, administer access rights, and aggregate usage data for digital subscriptions.

Digital Media Archiving (DMA): Numerous platforms integrate DMA modules to oversee locally generated or held digital assets, like digitized historical documents or institutional research.

Deep Access: These modules frequently facilitate full-text searching, granting consumers enhanced access to content in contrast to basic metadata entries.

Seamless Integration: The ILMS facilitates the discoverability of both purchased and owned digital assets through the same interface as the print collection by merging these capabilities.



Check Your Progress

A. Fill in the Blanks

a. ILMS stands for_____.

b. _____ is the first ILMS, originally developed in New Zealand, by_____.

c. The _____ module of an ILMS is responsible for managing periodical subscriptions.

d. Modern ILMS use ____ module to manage the life cycle of licensed e resources like journals.

10.7. Let Us Sum Up

Unit 10 examines the concept and functionality of Integrated Library Management Systems (ILMS), characterizing them as comprehensive software suites that employ a centralized database to automate essential library functions. The principal objective of an ILMS is to consolidate many functions such as acquisitions, cataloguing, circulation, serials management, and the Online Public Access Catalogue (OPAC) into a cohesive workflow. This connection eradicates data redundancy, augments operational efficiency, and boosts service delivery by assuring that a singular bibliographic record efficiently supports all modules. The unit delineates the progression of these systems across five "ages" of automation, transitioning from basic standalone tools to advanced, web-scale platforms that utilize cloud computing and open standards.

The unit additionally classifies ILMS software according to distribution models (Commercial, Freeware, and Open Source), regional provenance (Indigenous versus Foreign), and operational scale. It emphasizes notable instances such as LibSys, SOUL, and Koha to exemplify these themes. The unit underscores the essential function of contemporary Integrated Library Management Systems in a hybrid library setting. In addition to overseeing physical inventories using barcodes and RFID, modern systems increasingly integrate Electronic Resource Management (ERM) and Digital Media Archiving (DMA) components. This innovation enables libraries to provide a cohesive discovery experience, allowing clients to access both physical books and digital resources through a singular interface, thereby obscuring the conventional distinctions between automated and digital library systems.

10.8. Answers to Check Your Progress

A. Fill in the blanks

a. Integrated Library Management Software

b. KOHA, Katipo communication

c. Serial Control

d. Electronic Resource Management

10.9. Probable Questions

A. Short Answer Type Question

a. Define ILMS and its primary purpose.

b. Differentiate between commercial and open source ILMS

c. What is OPAC and its function.

B. Long Answer Type Question

a. Trace the progression of library automation through the "Five Ages" and examine how software generations have evolved from isolated systems to cloud-based platforms.

b. Explain the function of an Integrated Library Management System (ILMS) within a hybrid library context, emphasizing its capability to administer both print and digital assets.

10.10. Further Readings

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UNIT 11 SEARCH ENGINES AND DISCOVERY SYSTEMS

UNIT STRUCTURE

11.1 Introduction

11.2 Learning Objectives

11.3 Search Engine

11.4 Types of Search engines

11.5 Specialized Academic Search and Discovery Portals

11.6 Search Strategies: Keyword and Phrase Search, Keyword and Subject Search, Boolean Logic, Truncation Search, Proximity Search, Limiting Search, Range Search Field Searching

11.7 AI Based Search Tools

11.8 Let Us Sum Up

11.9 Answers To Check your Progress

11.10 Probable questions'

11.11 Further Readings

11.1 Learning Objectives

After going through this unit, learners will be able to

- Understand the core principles, objectives, and historical development of search engines as instruments for information retrieval.
- Differentiate among various categories of search tools, including General Search Engines, Subject Directories, Meta-Search Engines, and specialized Discovery Systems employed in library settings.
- Identify the evolving function of Artificial Intelligence within search technology and acknowledge essential AI-driven tools that support academic research and literature review.

11.2 Introduction

The digital era has radically altered the domain of information storage and retrieval. Historically, the aggregation of human knowledge was predominantly tangible, stored in

libraries, archives, and individual collections. Finding a specific piece of information necessitated physical navigation perusing card catalogues, traversing stack rooms, and engaging reference librarians who acted as the principal middlemen between the user and the collection. Currently, the World Wide Web has evolved into an extensive, dynamic, and continuously expanding repository of information that surpasses the capacity of any physical library. The exponential proliferation of digital content has engendered a paradox: whereas information is more accessible than ever, locating pertinent and high-quality information has become progressively challenging due to the overwhelming number of data available. This issue, commonly known as information overload, requires robust tools that can filter, organize, and retrieve data effectively.

Search engines have become indispensable navigational instruments in the digital age. A search engine is engineered to retrieve information stored within a computer system, predominantly the World Wide Web. It operates as an automated information retrieval system that methodically navigates the internet, catalogues the content it discovers, and enables users to search this index for specific documents, photos, or data. In the absence of search engines, the internet would resemble a disordered library, with books haphazardly strewn across the floor; search engines furnish the necessary index that makes it functional. They serve as the conduit for researchers, students, and the general public to access the visible web, the segment of the internet that is openly indexed and accessible to conventional crawlers.

Nonetheless, the functionalities of broad search engines such as Google or Bing are constrained. A substantial segment of the internet, referred to as the "Invisible Web" or "Deep Web," comprises information concealed behind search forms, subscription paywalls, and dynamic databases. This encompasses the predominant majority of scholarly resources: peer-reviewed journals, various digital repositories, and technical reports. The academic community frequently experiences frustration when depending exclusively on general search engines, as significant scholarly content is often inaccessible or obscured by commercial results. To resolve this, libraries and academic institutions employ Specialized Academic Search Engines and Discovery Systems. These sophisticated technologies are engineered to access the deep web, consolidating content from numerous subscription databases and library catalogues into a singular, cohesive search experience. They connect the disordered open web with the organized, credible realm of scholarly communication.

The advancement of these tools has been swift and ongoing. It commenced in 1990 with "Archie," a rudimentary instrument developed by Alan Emtage to catalogue FTP archives, succeeded by Gopher and Veronica. These initial tools were limited to searching filenames, excluding the information within files. The mid-1990s witnessed the emergence of full-text crawlers such as WebCrawler, culminating in Google's supremacy, which transformed search methodologies with its link-analysis algorithms. Today, we are observing a significant transformation with the incorporation of Artificial Intelligence (AI). Contemporary AI-driven search engines transcend mere keyword matching; they utilize Natural Language Processing (NLP) and Machine Learning (ML) to comprehend the intent of a query, condense intricate materials, and produce immediate responses. This transition signifies a shift from basic

"information retrieval" to "knowledge discovery," when the system functions as an astute research helper rather than merely a complex index.

This section will examine the inner processes of these systems, encompassing the fundamental architecture of a web crawler and the sophisticated algorithms that rank search results. We shall analyse the many categories of search tools, differentiating between general search engines, subject directories, and meta-search engines. We will examine the various tactics researchers can utilize such as Boolean logic and truncation to proficiently navigate these tools. Ultimately, we will examine the very edge of search technology, exploring how AI is transforming our interaction with information.

11.3 Search Engine

A search engine is an information retrieval system engineered to assist users in locating information contained within a computer system. Within the scope of the World Wide Web, search engines are automated systems that methodically crawl, organize, and retrieve web pages in response to user queries. They function as the principal entry point to the extensive repository of information accessible on the internet, systematically filtering and organizing content to deliver pertinent results. The primary function of a search engine is to compare a user's query typically composed of a set of keywords against its indexed repository of web pages. When a user submits a search query, the engine's algorithms analyse the input and retrieve the most pertinent documents from its index, presenting them on a Search Engine Results Page (SERP).

Architecture of Search Engine:

Components of Search Engine:

- **Web Crawler (Spider or Robot):** The web crawler is an automated software that systematically traverses the internet, accessing web pages to analyze their content. It traverses connections from one webpage to another, resembling a spider weaving a web. The crawler collects data including the page's textual content, images, and metadata such as titles and descriptions. Common examples encompass Googlebot (Google), Slurp (Yahoo!), and Bingbot (Bing). The crawler's responsibility is to persistently identify new and revised content to ensure the search engine's database remains up to date.

- **Metadata Storage (Indexing):** Once the crawler gathers information, it is stored within a comprehensive database referred to as the index. This procedure entails examining the content and structuring it for efficient retrieval. The system retrieves metadata (information about data), including the author, file type, keywords, and publication date. Rather than storing the complete web page each time, the index constructs a map indicating the locations of particular words and phrases. This architecture enables the search engine to efficiently identify all pages containing a particular keyword without necessitating a real-time scan of the entire web.

- **Search Agent (Query Processor):** The search agent serves as the intermediary between the user and the database. When a user submits a query, the search agent analyses it employing multiple algorithms to interpret the underlying intent. It enforces orthography correction rules (e.g., "Did you mean..."), manages Boolean operators (AND, OR, NOT), and filters results according to relevance. The search agent subsequently retrieves the relevant records from the index and displays them to the user, generally ordered by significance.

Technical Process: Crawling, Indexing, and Ranking:

- **Crawling:** The spider bots carefully search the web to locate relevant documents. They begin with a compilation of recognized URLs and proceed to follow hyperlinks to identify additional ones.
- **Indexing:** The identified data is processed and archived. This stage is essential because a page must be indexed to be displayed in search results. The index functions as a library catalogue for the internet.
- **Ranking:** When a search is conducted, the engine must determine which of the millions of matching pages to display first. Ranking algorithms assess web pages by considering numerous factors, such as keyword density, domain authority, page load performance, and the volume of hyperlinks from other websites. Google's PageRank is a well-known algorithm that assesses the significance of web pages based on the quantity and quality of incoming links.

11.4 Types of Search engines

Search tools may be classified according to their scope, indexing methodology, and the nature of the content they retrieve. The three principal categories are General Search Engines, Search Directories, and Meta-Search Engines.

11.4.1 General Search Engine:

These are the most frequently utilized instruments for comprehensive information retrieval on the internet. They employ automated web crawlers to compile extensive indexes of web pages.

Examples include Google, Bing, Yahoo! Etc.

Characteristics: They are most effective for rapidly locating specific information. They depend on sophisticated ranking algorithms to order results by relevance. They encompass a wide array of subjects but may provide a combination of both accurate and unreliable information.

Unlike search engines that employ robots, search directories are systematically arranged collections of links curated and classified by human editors.

Examples: Yahoo! Directory (historical), Librarians' Internet Index (lii.org), DMOZ (Open Directory Project).

Characteristics: These are hierarchical frameworks in which websites are organized under subject categories (e.g., Science > Biology > Genetics). They are ideal for perusing and discovering high-calibre, carefully curated websites within a wide-ranging subject area. Since human evaluation of the entries is conducted, the quality is typically superior; however, the index size remains significantly smaller compared to that of a general search engine.11.4.2 Search Directories or subject directories

11.4.3 Meta search engine

Meta-search engines lack their own dedicated database or web crawler. Instead, they transmit the user's query to several alternative search engines concurrently and compile the results into a unified list.

Examples include Dogpile, MetaCrawler, and Yippy.

Characteristics: They offer a comprehensive overview of available resources across the internet by utilizing the indices of leading search engines such as Google and Bing. They are valuable when a single engine is unable to retrieve pertinent results or when seeking a "second opinion" on a search query.

11.5 Specialized Academic Search and Discovery Portals

For researchers and students, general search engines frequently yield an excessive amount of commercial content or irrelevant information.

11.5.1 Google Scholar

Google Scholar is a freely accessible web search engine that indexes the complete text or metadata of scholarly literature across a wide range of publishing formats and disciplines. It encompasses peer-reviewed journal articles, theses, books, abstracts, and publications from academic publishers, professional societies, preprint repositories, and universities.

Features:

Citation Tracking: It indicates the number of times an article has been cited and identifies the citing sources, enabling researchers to trace the development and influence of an idea.

Library Links: It can be configured to display links to full-text resources within a user's institutional library (e.g., "Get it @ Oxford").

Ranking: It evaluates the content of each article, along with the author, publication source, and citation frequency, to assess relevance.

11.5.2 Microsoft Academic

Although Windows Live Academic was an initial incarnation, Microsoft has persisted in refining its academic search tools, which have now developed into Microsoft Academic Graph and are integrated into platforms such as Bing.It encompasses scholarly journals, conference proceedings, and author profiles.

Features: It enables categorization by author, journal, conference, and date. It frequently establishes more profound semantic relationships between subjects and authors compared to conventional keyword matching.

11.5.3 Scirus

Scirus was an extensive, science-focused search engine developed by Elsevier. Although it is no longer operational, it functions as a quintessential example of a vertical search engine. It encompassed more than 250 million science-related web pages, including preprint repositories and patent archives.

Features: It excluded non-scientific websites and was capable of indexing various file formats such as PDF and PostScript, commonly encountered in scientific repositories.

11.5.4 Semantic Scholar

Semantic Scholar is an AI-powered search engine for scholarly publications created by the Allen Institute for AI.

It encompasses millions of publications within the fields of computer science and biomedicine (and continues to expand).

Features: It employs natural language processing techniques to interpret the context of a scholarly article. It identifies the most impactful citations (beyond merely the quantity) and extracts essential figures and tables for efficient preview.

11.6 Search Strategies

To utilize search engines effectively, it is essential to comprehend a variety of search techniques. These techniques assist in refining queries to obtain more accurate and pertinent results.

11.6.1 Keyword and Phrase Search

Keyword Search: This is the fundamental search approach in which users input key terms associated with their subject (e.g., digital library). The engine searches for documents that include these words throughout the entire text. It typically exhibits high recall (identifying numerous documents) but lower precision.

Phrase Search: To locate an exact sequence of terms, the query should be enclosed within quotation marks (e.g., "digital library"). This compels the search engine to locate pages containing these terms in the precise sequence, thereby markedly enhancing accuracy.

11.6.2 Keyword and Subject Search

Keyword Search: Conducts a search for the specified terms across the entire record, including the title, abstract, and full text. It is more comprehensive and advantageous when the precise terminology is uncertain.

Subject Search: Limits the search exclusively to the "Subject" or "Descriptor" fields within a database. This necessitates familiarity with the specific controlled vocabulary, such as Library of Congress Subject Headings, employed by the database. It produces highly pertinent results but necessitates greater user expertise.

11.6.3 Boolean Logic

Boolean operators enable users to integrate keywords to form intricate queries.

AND: Restricts the scope of the search. Library AND Automation retrieves records that include both terms.

OR: Expands the scope of the inquiry. College OR University retrieves records containing either term or both. This is advantageous for identifying synonyms.

NOT: Terms are excluded. Virus NOT The computer retrieves records pertaining to biological viruses but excludes those related to computer viruses.

11.6.4 Truncation Search

Truncation facilitates the search for the root form of a term in order to identify all its variations. It is generally denoted by an asterisk (*) or a question mark (?).

Right Truncation: Librar* will identify Library, Libraries, Librarian, Librarianship.

Left Truncation: *Physics may encompass Astrophysics, Geophysics, and Metaphysics.

11.6.5 Proximity Search

This indicates that two keywords must be located in proximity within the text, suggesting a stronger association than merely co-occurring within the same document.

Near Operator: Library NEAR/5 Automation identifies documents in which "Library" and "Automation" are located within five words of each other.

Benefits: It offers greater precision than a basic AND operator while providing more flexibility than an exact phrase search.

11.6.6 Limiting Search

Most search tools enable users to refine or restrict results based on specific criteria to effectively manage extensive result sets. Typical restrictions encompass:

Date: (e.g., published within the past five years).

Language: (e.g., English exclusively).

File Type: (e.g., PDF only).

Domain: (e.g., restrict search to sites ending in .edu or .gov)

11.6.7 Range Search

This is intended for representing numerical data. It enables users to perform a search for a value within a defined range.

Example: Conducting a search for articles published within the period from 2010 to 2020 or products priced between $50 and $100.

11.6.8 Field Searching

Field searching limits the query to a designated section of the record, such as the Title, Author, or URL.

Example: title: "climate change" will exclusively retrieve documents in which "climate change" appears within the title, typically signifying that the document primarily addresses that subject.

Field Codes: Various databases employ distinct coding conventions (e.g., au: for author, ti: for title).

11.7 AI Based Search Tools

The incorporation of Artificial Intelligence (AI) has transformed search technology. AI-powered search tools extend beyond basic keyword matching; they employ Natural Language Processing (NLP) and Machine Learning (ML) to interpret the underlying intent of a query and the contextual nuances of the content.

Characteristics:

- **Semantic Comprehension**: Rather than merely matching keywords, AI interprets the meaning of words and their contextual relationships (e.g., recognizing that "jaguar" may refer to an animal or a vehicle depending on the context).
- **Natural Language Queries:** Users are able to pose complete queries (e.g., "What is the impact of AI on library services?") instead of relying on keyword-based searches such as "AI AND library services."
- **Personalization:** These tools analyze user behavior to customize outcomes according to individual preferences.

- **Summarization:** Numerous AI tools produce concise answers or summaries of multiple documents, thereby reducing the need for users to navigate through numerous links.

Examples

Perplexity AI: An AI-driven response system that delivers precise, referenced answers to intricate inquiries. It conducts real-time web searches and consolidates information into a cohesive response, citing sources with footnotes.

Elicit: Developed as an AI research assistant. It is capable of identifying pertinent papers without requiring exact keyword matches, summarizing essential insights from particular studies, and extracting data into tables for comparative analysis.

Typeset.io (SciSpace): Assists researchers in comprehending intricate scholarly texts. Users may emphasize ambiguous text, and the AI will provide an explanation in clear, straightforward language. It also provides functionalities such as "Chat with PDF".

Consensus: An advanced search engine utilizing artificial intelligence to locate answers within scientific research. If you pose a yes/no query (for example, "Does creatine enhance cognitive function?"), it will review pertinent research and deliver a summary of the consensus based on the evidence.



Check Your Progress

Q1. Answer the following.

a. Earliest tool developed for Internet searching, devised in 1990 by Alan Emtage, was named ____.

b. _____is a search strategy that enables users to locate all permutations of a word's root (e.g., retrieving "librarian" and "libraries" from "librar") by employing symbols such as an asterisk (*).

c. In a search engine's architecture, the _____ is the element tasked with methodically traversing the internet to discover and retrieve web pages for indexing.

11.8 Let Us Sum Up

This unit looked at the landscape of search engines and discovery systems, which serve as essential instruments in the information age. We commenced by defining search engines and analysing their architecture, which comprises crawlers, indices, and search agents. We differentiated among generic search engines, subject directories, and meta-search engines,

highlighting the specific applications for each. A substantial segment of the unit was dedicated to specialized academic search tools such as Google Scholar and Semantic Scholar, which serve to bridge the distance to the "Deep Web" of scholarly literature. We also analysed discovery systems, which have transformed library access by offering a consolidated search experience for both physical and digital collections. We outlined fundamental search techniques including Boolean logic, truncation, and field-specific searching that enable users to construct accurate and effective queries. Finally, we examined the emerging domain of AI-driven search tools, which are advancing beyond simple keyword matching to encompass semantic comprehension and answer generation, heralding a future of more intuitive and effective information retrieval.

11.9 Answers to Check your Progress

a. Archie, **b**. Truncation, **c.** Web Crawler

11.10 Probable questions

A. Short Answer Type Questions

a. Define a Web Crawler and describe its function within a search engine.

b. What distinguishes a general search engine from a meta-search engine?

c. Clarify how Boolean operators (AND, OR, and NOT) are used to refine search queries.

B. Long Answer Type Questions

a. Define Search engine. Describe a search engine's design in detail, highlighting the roles played by its three primary parts.

b. What are the different types of search strategies. What are the characteristics of AI driven search engine.

11.11 Further Readings

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UNIT 12: WEB 2.0, WEB 3.0, LIBRARY 2.0 AND SOCIAL MEDIA INTEGRATION

UNIT STRUCTURE

12.1 Learning Objectives

12.2 Introduction

12.3 World Wide Web

12.3.1 Evolution of Web

12.3.2 Generations of Web

12.4 What is Web 2.0?

12.4.1 Characteristics

12.4.2 Tools of Web 2.0

12.5 What is Web 3.0?

12.5.1 Characteristics

12.5.2 Tools of Web 3.0

12.6 What is Library 2.0?

12.6.1 Characteristics

12.6.2 Tools used in Library 2.0

12.6.3 Advantages

12.6.4 Disadvantages

12.7 Social Media Integration

12.7.1 Social Media Integration in Libraries

12.7 Concept of Library 3.0

12.9 Let us Sum Up

12.10 Answers to Check Your Progress

12.11 Further Readings

12.2 Probable Questions

12.1 Learning Objectives

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

- Define Web, Web 2.0, Web 3.0 and the concepts
- Characteristics and Core technologies of Web 2.0
- Major features and technologies of Web 3.0
- Concept of Library 2.0 and 3.0
- Social Media Integration in Libraries

12.2 Introduction

The advent of the Web in traditional society has completely transformed the lives of people. The way of living, learning and communication has undergone a drastic change and it can be considered as a completely different world than it used to be. It can be called a revolution, a change, the arrival of a new era of Technosphere, faster communication, easier lifestyle etc. World Wide Web or just Web started in the early 1990s and since then it has kept on evolving more and more aiming the world to be smarter, faster, connected and accessible. We are basically now in the transition period from Web 2.0 to Web 3.0. The use of tech, social media is on its peak and most importantly libraries need to walk side by side with the rapid evolution. This unit will help you to learn about the Web, its advancement to Web 2.0, 3.0, concept of Library 2.0 and social media integration.

12.3. World Wide Web (WWW)

World Wide Web (WWW) or in short 'Web' was invented by a British computer scientist known as Sir Tim Berners-Lee who worked at The European Organization for Nuclear Research (CERN) in Switzerland. In the year 1989, Sir. Lee proposed the idea of the web as a system for easy transmission of information among scientists. In the year 1990, he worked on developing the first website, web browser and web server. And finally, The World Wide Web (WWW) was made public in the year 1991. The main goal behind this invention was to make information easily accessible, data to be easily shared among researchers around the globe.

12.3.1 Evolution of WWW:

The emergence of the World Wide Web in the world that was traditionally working its way came as a dream that was happening in reality. Until then, the tech world, robots, and digital ideas existed as theories. The first version, the original Web 1.0 can be called 'Static Web' or 'Read-Only Web'. It started in the 1990s and existed till the early 2000s. It was simple, text-based and contained read only websites. Basic HTML code was used for one way communication. People can only consume information unlike nowadays interactive digital platforms. The rise of browsers like Mosaic and Netscape Navigator helped users to access

information. The goal of Web 1.0 was to just provide information to the people. Search engines ‘Google’ and ‘Yahoo’ emerged in the late 1990s in the late Web 1.0 era. ‘Amazon’ started as an online bookstore in the Web 1.0 era and now it's one of the most popular and successful e-commerce platforms in the world.

12.3.2 Generations of WEB:

World Wide Web has three main generations:

- Web 1.0 (1991- 2004)
- Web 2.0 (2004 - 2016)
- Web 3.0 (2016 - present)

12.4 WORLD WIDE WEB 2.0

The second version of Web 1.0 or the internet emerged around the early 2000s that shifted its goal from only providing information to the people to allowing people to interact. Also known as ‘participatory web’ or ‘Social Web’ this web version allowed users to collaborate rather than just read and thus the social networking and community started, content creation, social media platforms emerged. The very popular social media platforms like Facebook, Instagram etc where people were allowed to interact by commenting on others content, posting their own content like sharing photos and videos, could publish articles without having any proper skills of web development. It was not just a technical upgrade but a major shift from a static web to user generated content, social media engagement and networking, collaboration, interactive and participatory platform for users. Examples: Blog, Facebook, Instagram, Twitter, YouTube etc.

12.4.1 Characteristics of Web 2.0

- Participation and interaction of users: In the first version of WWW, users were able to only read and gather information but with the upgrade to Web 2.0 as ‘Read-Write Web', a major shift happened and users got the full opportunity to have interactive and collaborative experiences.

- Collaboration: People were able to work together and it became possible to collaborate through shared tools and platforms i.e. Google docs, Wikis etc.

- Social Media Communities: For worldwide interaction, connection and sharing of personal experiences, platforms for communities came into existence that allowed for massive, online, worldwide communication and interaction.

- Dynamic Content: The content in web 2.0 is very dynamic. It changes, or gets updates or responds automatically to user actions.

12.4.2 Tools of Web 2.0

- Blogs: Blogs are websites where individuals or groups regularly write articles and shares on various topics like travel, food reviews, news or it can be any topic. Blogs were very popular at one point of time but currently the popularity is decreasing. Examples: Wordpress, Blogger, Medium, Tumblr, Squarespace etc.

- Wikis: These are collaborative websites where users are allowed to edit or add content to it. Example: Wikipedia

- Social Networking Sites or SNS: These are platforms for sharing, communicating and connecting with people around the world. These platforms are attractive where people post their photos, share videos, maintain trends etc. Examples: Facebook, Instagram, Twitter now known as X, LinkedIn etc

- Video sharing sites: Some platforms are only for uploading and sharing creative videos. Users can both watch and share videos. Examples: Youtube, Tiktok, Vimeo etc

- Podcast Tools: These tools are prepared for people to audio record and share with people, listen to songs etc Examples: Spotify, Soundcloud, Apple Podcasts etc.

- Really Simple Syndication (RSS Feeds): Also known as Rich Site Summary is a tool that helps users by automatically sending notifications or updates from blogs, news pages, websites helping the user to not visit each site manually. Subscribing to it allows users to get all the information at one place automatically. Examples: Feedly, The Old Reader, NewsBlur, Inoreader etc.

12.5 WORLD WIDE WEB 3.0:

The third version of the internet is Web 3.0 also referred to as Semantic Web or Intelligent Web aimed at upgrading a bit more from only reading, writing, interactive to smarter, more personalized and decentralized. Technologies like artificial intelligence, machine learning, blockchain, Internet of Things (IoT) etc. plays a huge role in this third generation of the Web. It focuses mainly on data by meaningfully understanding it, focuses on personalized services and also aims at providing secure experiences and is working on making a connected, intelligent and transparent web where users can enjoy more control, have solid privacy and have ownership of their data. It came around in the year 2016 and is evolving till present.

12.5.1 Characteristics of Web 3.0

- Artificial Intelligence (AI): One of the main characteristics of web 3.0 is the usage of artificial intelligence. AI is making the web to think, understand and learn from data on its own. The web is getting smarter and is now able to analyze and give proper intelligent outputs.

- Decentralized Quality: The data now in the web is stored in various systems like 'blockchain technology' rather than stored in one place like it used to before.

- Personalization Power: This characteristic of Web 3.0 is attracting most of the users as it gives personalized results to users. The web learns a user's personal preferences, behaviors and choices and analyses it and provides personalized outcomes.

- Semantic Interpretation: This characteristic helps in getting more accurate and context-based results as both humans and machines have the ability to understand the data.

12.5.2 Tools of Web 3.0

- Artificial Intelligence and Machine Learning Tools: this tool of web 3.0 helps to understand data and respond automatically to its users. Examples: ChatGPT, Alexa, Siri, Google Assistant, Gemini etc.

- Semantic Web Tools: These tools help machines/computers to understand the meaning of data. Examples: Resource Description Framework (RDF), SPARQL etc.

- Internet Of Things (IoT): This tool helps in automatic connection of devices to share data in real time. Examples: Fitness bands, Smart devices at home, smart devices in cars etc.

- Decentralized Apps: These tools run on blockchain technology instead of traditional servers, Examples: OpenSea, MetaMask, Uniswap etc.

- Blockchain technology: This tool provides safety to data by storing it in various systems then just providing it to one single owner. Examples: Bitcoin, Ethereum etc.

- Big data and Cloud Computing: This tool helps in storing a huge amount of data and has the ability to process it quickly with personalized results. Examples: Google Cloud, Amazon Web Services etc.

- Virtual Reality (VR) and Augmented Reality (AR): This tool helps users by creating a 3D immersive world where they can experience various environments like being there in real life. Examples: Metaverse, Oculus VR etc.

12.6 CONCEPT OF LIBRARY 2.O

The age of traditional libraries has gone and now along with the evolution of the web, development of the world, libraries are working towards the upgradation of their traditional version as well. Library 2.0 is the modern library that is not limited to only traditional manual works but is fulfilling with various technologies for the betterment of user experiences. The concept of Library 2.0 is simply the modern, user centered library that applies web 2.0 principles and focuses on using interactive, social and collaborative tools to provide better services to the users and also allowing them to actively participate.

12.6.1 Characteristics of Library 2.0

- Participation of users: Users can participate by giving feedback, reviewing books, just new materials which are very helpful in improving services.
- Accessibility: Library 2.0 has provided digital materials that can be easily accessible to any user at any point of time at any place.
- Online Communication: For modern libraries online communication really helps in connecting with users and providing them services.
- Collaboration and community engagement: This supports and encourages community engagement among users and library professionals and also paves way for collaborative creations.

12.6.2 Tools of Library 2.0

- Online catalogs: OPAC helps users to quickly search and access resources according to their needs.
- RSS Feeds: This tool of library 2.0 helps users to receive updates automatically about all the new materials, resources, events or even announcements. It makes sure that the information richest to the right users properly and also helps increase engagement.
- Social media: This is one of the most important tools of library 2.0 as it helps the most to connect with people all around the world, help users to stay connected with any news related to library or any participation in discussions and also new material service sources. This tool helps the libraries in promoting services in taking feedback and reviews and also in engaging the community.
- Blogs: blocks are used by libraries to help users to learn about materials or resources or to provide research tips to inform about library events or programs and also allow users to interact through comments.
- Chatbots: Chatbots are another important tool of library 2.0 because it helps in getting instant assistance, can solve queries anytime and also helps in informing users and navigating library websites. Chat box has helped in reducing the workload of library staff and can efficiently provide service anytime.

12.6.3 Advantages of Library 2.0

- Improved user engagement
- Easy access to information
- Better Communication
- Saves Time and Cost
- Supports Learning and Innovation

12.6.4 Disadvantages of library 2.0

- Digital Divide
- Privacy and Security Issues
- Information Explosion
- Training of staff is mandatory
- Maintenance Cost

12.7 SOCIAL MEDIA INTEGRATION

Social media integration or SMI simply means engaging with social media platforms for communication, collaboration, promotion and interaction with users across the globe. In today's world, social media is on its peak and engaging with these platforms really turns out to be helpful in many ways. Libraries, in this case, are also fully utilizing the power of social media for the upliftment of library services. Engaging with social media has really helped libraries in reaching out users online, sharing of resources has become easy. Popular platforms for social media integration are Facebook, Instagram, Twitter/X, YouTube, Pinterest, LinkedIn etc.

12.7.1 Social Media Integration in Libraries

Library 2.0 is using social media integration for promoting library services like sharing updates about new arrivals, information about e-resources, workshops, events etc. Involving with social media really helps libraries to interact with users directly, get feedback from them and also helps to answer their queries. It also facilitates knowledge sharing and collaboration online like forming book clubs, discussions on topics etc. This simply means that with the help of social media libraries can reach to its users and their queries and preferences, helps libraries to provide better user centered services. We can find a number of library-based content on social media, some libraries have their own pages, some library professionals are sharing information regarding library collections, services with the help of online platforms, making videos giving library tours, we are able to know the beautiful libraries all around the world because of the existence of social media and users posting content on it.

12.8 CONCEPT OF LIBRARY 3.0

The next upgrade of Library 2.0 is library 3.0 that aims to work as a technologically-driven library system. This version of libraries involves artificial intelligence, semantic web, cloud system, virtual and augmented reality etc. This version is already getting in used by many

modern libraries around the world. Just like Web 3.0 and its characteristics and features, library 3.0 focuses to do a major transformation to reimagine libraries from just simple repositories to centers for learning, innovation etc and to meet the demands of the ever-evolving digital world.

Examples of Library 3.0:

- Modern libraries include cloud-based library systems that have elevated the process of getting information. Users can access information, e-journals, e-books at any time with ease.

- We can find AI Chatbots or virtual reference assistants helping users find the information according to their preferences and also answering their queries efficiently.

- Internet Of Things or IoT devices like Smart ID cards, RFID systems, smart shelves, sensors to track book locations etc are being used in libraries.

- Virtual Reality and Augmented reality being used for library tours or interactive sessions with users not physically present in the place.



Check Your Progress

A. Fill in the Blanks

a. Library 2.0 applies Web 2.0 technologies to make library services more _____ and _____.
b. Devices connected to the Internet that collect and exchange data automatically are known as _____ devices.
c. A smart library system that uses AI to provide personalized recommendations is an example of _____.
d. Blockchain technology ensures data _____ and _____ in digital library systems.
e. In Library 3.0, services are driven by emerging technologies such as _____, _____ and _____.

12.9 Let us sum up

The world is evolving in terms of tech rapidly. We are living in a digital world where everything is influenced by technology. From the basic device that we carry anytime anywhere called ‘Smartphones’ to social media, smart watches, artificial intelligence like Chat GPT, Alexa, Siri, computers etc has become an integral part of human lives. Once it was a dream for the world and now the world is living that dream. In seconds, messages can be

transferred, information can be acquired, from manual to digital, time has been saved for the human kind. The invention of the internet or Web has been a revolution and a turning point in human history. Libraries, as an important part of society, need to cope up with the rapid evolution of the world. Along with change, users' expectations and demands change and to meet the demands of users, libraries need to incorporate technical upgradation for better user services.

12.10 Answers Check your progress

A**. Fill in the Blanks**

a. Interactive and Collaborative
b. Internet of Things
c. Library 3.0
d. Security and Transparency
e. Artificial Intelligence, Semantic Web, Internet of Things.

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12.12 Probable Questions:

A. Short Answer Type Questions

1. What is the main aim of Library 2.0 and Library 3.0?
2. How social media integration is helping modern libraries?
3. What are the advantages and disadvantages of Library 2.0?
4. Write about the evolution of the World Wide Web.
5. Name some tools of Web 2.0.

B. Long Answer Type Questions

6. 'The invention of the Web was not just a technological revolution, but a social transformation'- Justify this statement with reference to the evolution of Web 2.0 and 3.0
7. Define Internet of Things (IoT).
8. Give three characteristics of Web 3.0.

9. Why do you think libraries need to upgrade and how that upgrade will help users?
10. Explain Virtual and Augmented Reality and how it can be used in libraries.

UNIT 13: COLLABORATIVE SERVICES

UNIT STRUCTURE

13.1 Learning Objectives

13.2 Introduction

13.3 Meaning of Collaborative services

13.3.1 Collaboration services in libraries

13.3.2 Benefits of Collaboration services in Libraries

13.3.3 Collaborative tools used in libraries

13.4 User Driven Content in libraries

13.4.1 Types of user driven content

13.4.2 Importance of User Driven Content in Libraries

13.5 Social Engagement in Libraries

13.5.1 Ways of enhancing social engagement in Libraries

13.5.2 Libraries as social and community spaces

13.6. Library Outreach through Social Media

13.6.1 Social Networking Platforms used by Libraries

13.6.2 Objectives.

13.7 Multimedia tools for Library Outreach

13.7.1 Types of Multimedia Tools

13.7.2 Benefits of using multimedia tools in libraries

13.1 LEARNING OBJECTIVES

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

- Define collaborative library services and other participatory services
- Explain user-driven content
- Importance of social media engagement.
- Use of social networks and multimedia tools in Library Outreach.

13.2 INTRODUCTION

Traditional libraries of the society have undergone a massive transformation to modern libraries. They are no longer just mere building of books providing information to users, using manual methods etc. Modern libraries have adopted new ways to provide better services to the users. The new library aims to function as interactive, collaborative and user cantered knowledge. Collaborative services and social media tools play a very pivotal role in enabling libraries to actively engage users and encourage interactions.

13.3 MEANING OF COLLABORATIVE SERVICES

Collaborative services are those services or activities used by more than one institution or organization where they work together for resource sharing and for delivering better services to their users that they cannot achieve individually.

13.3.1 COLLABORATION SERVICES IN LIBRARIES

In terms of libraries, collaboration services help in collaboration and engagement where two or more libraries work together for providing better services to the users. The importance of collaboration is simply that when one institution finds it difficult to achieve, it can be achieved with team cooperation, joint efforts or partnerships leading to better and enhanced quality services. Examples of collaborative services in libraries are shared digital repositories, cooperative cataloguing, inter library loan (ILL), community-based programs etc.

13.3.2 BENEFITS OF COLLABORATION SERVICES IN LIBRARIES

- Better resource sharing: The use of collaborative services in libraries are beneficial mostly for enhanced resource sharing. Through this, collections, digital resources, staff expertise etc are shared that leads to more proper and efficient services and opportunities for the users. Users get more options, more varieties of materials, wider range of information etc.

- Increased user participation and engagement: Another benefit of using collaborative services is that it improves engagement with users and they get more options for participation such as content creation, feedback, reviews, decision making etc. The very idea of participation of users leads to user satisfaction and builds strong relationships between users and libraries.

- Enhanced Efficiency: These services also help in enhancing efficiency as through them, library staff, users, those institutions with whom they collaborate can work together more effectively leading to easier communication, planning, resource sharing, quick problem solving and decision making etc.

13.3.3 COLLABORATIVE TOOLS USED IN LIBRARIES

- **Blogs:** Blogs are platforms or can be called as online journals where people post articles. In terms of libraries, this tool can help library professionals in sharing news, updates or post articles and also users can comment and give feedback.

- **Wikis:** Wikis are collaborative websites where multiple people can create and edit content i.e. like very popular Wikipedia.

- **Social Networking Tools:** Social Media Platforms as collaborative tools can really be helpful as it allows them to reach people around the world and connect and share information. Examples: Facebook, Twitter (X), LinkedIn etc.

- **Virtual reference Tools:** These tools are those that provide reference assistance during and after library hours and also allows users to ask questions and get help from librarians easily and quickly. Example: 'Ask-a-Librarian'.

- **Cloud-Based Tools:** These tools are for storing and managing numerous data on the internet that can be accessed from anywhere. Data is secured in these online platforms and its usage helps in reducing need for physical storage and paper. Example: Google Drive, Microsoft OneDrive etc.

13.4 USER DRIVEN CONTENT IN LIBRARIES

User-driven content means the information, materials or opinions as well that are created, modified or shared by library users not only by library professionals. People are not only for consuming but for creating content and sharing. This refers to users creating content in any form like text, images, videos, audios etc and sharing.

13.4.1 TYPES OF USER DRIVEN CONTENT

- Blogs and Posts
- Comments and Feedback
- Reviews and Ratings
- Multimedia Contributions

- Tags and Folksonomies
- Wikis and Collaborative Documents

13.4.2 IMPORTANCE OF USER DRIVEN CONTENT IN LIBRARIES

User driven content is very important for libraries in this era. It is a game changer as it helps libraries in connecting with the community through engagement, helps in promoting their services and also helps in building a strong online presence. Users can create content, share experiences, and can make recommendations for books and resources that ultimately help others to discover new things. User driven content can help libraries to realise and identify the areas where they need improvement so that they can enhance their services and meet their user's needs.

13.5 SOCIAL ENGAGEMENT IN LIBRARIES

Social engagement in libraries helps in strengthening the relationship between libraries and their user communities. It helps in having meaningful interaction and promoting engagement through online discussion forums, virtual reference services, online programs etc. Strong social engagement helps in increasing the visibility of libraries and builds up trust between libraries and user communities.

13.5.1 WAYS OF ENHANCING SOCIAL ENGAGEMENT IN LIBRARIES

- Organizing events like book clubs, literary events.
- Workshops for skill enhancement.
- Community discussions and forums.
- Author meets and greet events.

13.5.2 LIBRARIES AS SOCIAL AND COMMUNITY SPACES

Libraries are spaces for people to learn, connect and grow. Unlike traditional libraries, modern libraries have turned into community hubs where information flows not only through printed resources. They are not just book repositories anymore, rather they have evolved into vibrant social hubs. From community events to studying in groups, from providing creative spaces for projects and innovation to organizing exhibitions of art, books fairs etc, libraries have grown a lot. The aim is to provide a proper environment and offer better and quality services with users as focus where they can participate and engage. Libraries as social and community spaces allow to build connections, enhancing learning and also boosting creativity.

13.6. LIBRARY OUTREACH THROUGH SOCIAL MEDIA

Social media is a very powerful tool for collaboration, interaction with communities and promotion for individuals or institutions. Library outreach refers to the events,

programmes, activities organized by libraries for connecting and reaching with people outside libraries, those people who are not users of the library services. As we are in the era of social media, creating content focusing on library services can be really helpful for connecting with communities around the world.

13.6.1 SOCIAL NETWORKING PLATFORMS USED BY LIBRARIES

- **Goodreads:** A platform loved by book lovers. People can give reviews of books, personal recommendations.

- **Blogs:** Blogs can be used for sharing information on any topic or providing any news of libraries.

- **Facebook:** Facebook is another important platform that really helps in growing interaction. Library professionals nowadays are very updated and active. It can be used for book recommendations, sharing updates and events etc.

- **Instagram:** Another widely popular platform that helps libraries to stay connected with the world. Helps in showing books, showing library works, behind the scenes, can share updates, promotion of events etc.

- **Youtube:** A video sharing platform. Very useful for libraries for providing tutorials, in depth library tours, events or programs coverage etc.

13.6.2 DISADVANTAGES OF USING SOCIAL MEDIA BY LIBRARIES

- **Privacy issues and data security:** Privacy issues and data security is really a concern in this social media era. Sharing things on social media may compromise user privacy. Personal information can be tracked, collected and misused by third parties.

- **Time Management:** Being active on social media really consumes time and it becomes very important for staying updated and regularly creating content, and monitoring user engagement which can increase workload.

- **Issue of Digital Divide:** Many people still do not have the privilege of having access to internet or social media, all users cannot equally access to the digital opportunities that leads to exclusion of certain users from accessing library services and communications.

13.7 MULTIMEDIA TOOLS FOR LIBRARY OUTREACH

Multimedia tools are those digital or electronic tools that combine various media forms such as text, images, audio, video, graphics and animation to communicate information in an interactive way. The use of these tools in library outreach really helps libraries in communication with the people, and helps in reaching a wider audience beyond those regular users of the library. Multimedia tools play an important role in libraries by enhancing visibility and accessibility, discovering library services. Different types of media formats help in attracting attention, making learning styles more fun, offers dynamic educational content and use of these tools also indicates how libraries are adapting and evolving along with the demands.

13.7.1 TYPES OF MULTIMEDIA TOOLS

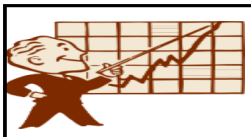
- **Podcasts:** These are audio programs of interviews available online and can be downloaded by users. Libraries can organize author podcasts on various topics or other interviews and upload it online. It becomes easily accessible for users to listen to them anytime and anywhere.

- **Videos:** Live visual presentations that are recorded and can be uploaded online. Libraries can upload videos of library tours and events. YouTube is the most famous video sharing platform with millions and millions of people joining it.

- **Webinars:** These are online seminars or workshops that are conducted through various platforms which allows people to join without the need of visiting the place physically. Platforms like Zoom, Google Meet etc. are the ones most in use.

13.7.2 BENEFITS OF USING MULTIMEDIA TOOLS IN LIBRARIES

- Through multimedia tools, libraries can connect with the users and communities in real time where they can share information or updates or any news related to events and programs.
- Various multimedia tools like podcasts, videos, digital storytelling, tutorials help learning to be more engaging and interesting which attracts users.
- Use of these tools also helps in getting reviews and feedback directly from users. Use of online surveys, social media allows libraries to know the opinions of the users and can work for improving services.
- Another important benefit is that it helps libraries to reach communities beyond the regular users. Through online platforms, they can reach out to people who are not aware of library services.



Check your progress

A. Fill in the Blanks

a. _____ are live visual presentations that are recorded and can be uploaded online.

b. Virtual reference tools are those that provide _____& during and after library hours

c. Content created by users is known as _____ content.

d. Social engagement strengthens _____ participation.

e. A platform loved by book lovers is _____.

13.8 Let Us Sum Up

Contemporary libraries have transformed from static archives into dynamic, collaborative community centres built on user-oriented knowledge. This transition depends significantly on collaborative services, wherein institutions collaborate to improve resource sharing and efficiency via tools such as wikis, digital repositories, and cloud platforms. A significant transformation is the emergence of user-generated content, enabling consumers to evolve from passive recipients to active contributors via reviews, blogs, and comments. Moreover, libraries today serve as dynamic social venues that promote interaction through events, workshops, and community initiatives. To broaden their influence beyond physical confines, libraries are progressively employing social networking platforms and multimedia resources such as podcasts, films, and webinars—for outreach and promotion. Although these digital tactics enhance accessibility and visibility, they also pose difficulties related to data privacy and the digital divide, requiring a balanced approach to the provision of contemporary information services.

13.9 Answers to Check Your Progress

Ans to A. a. Videos**, b.** Reference Assistance**, c.** User- driven**, d**. Relationship**,**

e. Goodreads

13.10 Further Readings

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2. Ubochi, Uchenna & PhD, Nwaigwe. (2024). *Socia lMedia and Community Engagement; the role of libraries and librarians.*
3. Cahill, K. (2009). *User-generated Content and Its Impact on Web- based Library Services.*

4. Lestari, A.,Mutia, F.,Atmi,R., Fahmi, F., & Yuadi,l. (2023). Collaborative Service in Public Libraries for Equal Information Access. 58-67.
5. Ubochi, Uchenna & PhD, Nwaigwe. (2024). *Social Media and Community Engagement; the role of libraries and librarians.*
6. Cahill, K. (2009). *User-generated Content and Its Impact on Web- based Library Services.*

13.11 Probable Questions

A Short Answer Type Questions

1. What do you mean by User driven Content? How is it beneficial for libraries?
2. How social media engagement is helping modern libraries?
3. Name some Multimedia Tools used by Libraries.
4. Write about the ways of enhancing social engagement in libraries.

B. Long Answer Type Questions

1. 'Libraries as social and community spaces. Explain.
2. Define Collaborative services. How does its use benefit libraries?
3. Mention three tools of collaborative services.
4. How does the use of social media help in library outreach?
5. What are the benefits of using multimedia tools in libraries?
6. What do you mean by podcasts? How can libraries use podcasts?

UNIT 14 ETHICAL POLICY

UNIT STRUCTURE

14.1 Learning Objective
14.2 Introduction
14.3 Legal and Ethical Aspects: Copyright, Licensing, and Open Access
14.4 ICT Policies for Academic and Research Libraries.
14.5 Let Us Sum Up
14.6 Answers to Check Your Progress
14.7 Further Readings
14.8 Probable Questions

14.1 Learning Objective

After going through this unit, learners will be able to

- Recognize the rights accorded to authors and the exceptions that libraries may receive under fair dealing. Gain an understanding of the nature, duration, and extent of copyright law.
- Explain what Open Access (OA) is, differentiate between green and gold OA models, and recognize the moral necessity of granting open access to research.

14.2 Introduction

Academic and research libraries are now active centres of digital information rather than just book repositories in the modern information society. The creation, storage, distribution, and accessibility of knowledge have all been transformed by the integration of information and communication technologies (ICTs). However, there are difficult moral and legal issues associated with this digital transformation. Libraries today have to deal with a situation where the ease of copying and distributing digital data conflicts with intellectual property rights, and where licensed access to digital resources is gradually replacing conventional ownership of physical items. In libraries, ethical policy serves as the moral compass that directs the profession rather than just being a bureaucratic obligation. It guarantees that libraries maintain their fundamental purpose of granting everyone access to information while upholding the law and the rights of creators. With an emphasis on copyright, licensing, open access, and the need for strong ICT policies, this unit examines the crucial ethical and legal foundations that guide contemporary librarianship. The foundation of library operations is copyright law, which gives authors the sole right to their creations. To prevent infringement while serving their users, librarians need to be aware of the subtleties of copyright, including exceptions like "fair dealing" that permit use for study and instruction. Another layer of complication has been introduced by the emergence of digital licensing, which has changed

the library's function from owner to licensee and frequently comes with restrictive terms that need careful negotiation. At the same time, the Open Access movement which promotes unfettered and free access to academic outputs has grown to be a potent ethical response to the commercialization of knowledge. Furthermore, in order to manage infrastructure, guarantee data security, and advance digital literacy, the implementation of ICT in libraries calls for extensive rules. An efficient ICT policy protects user privacy, ensures that digital tools are utilized responsibly, and links technology use with the institution's objectives. In order to give students a comprehensive grasp of the ethical environment of contemporary academic and research libraries, this course will explore these interrelated concepts.

14.3 Legal and Ethical Aspects: Copyright, Licensing, and Open Access

Information centres and libraries work at the nexus of granting access to knowledge and upholding the legal rights of content producers. Intellectual Property Rights (IPR), particularly copyright laws, licensing agreements, and the changing open access landscape, largely determine the ethical framework that governs this balance. To guarantee that information is distributed in an ethical and lawful manner, librarians and information specialists must negotiate these regulatory frameworks.

14.3.1 Copyright

The producers of original works, such as plays, novels, music, and artwork, as well as cinematograph films and sound recordings, are legally entitled to copyright. For a set amount of time, it grants the author complete control over how their work is utilized, duplicated, and shared.

Nature of copyright:

Instead of a single right, copyright is a "bundle of rights." It includes the rights to make copies of the work, distribute copies to the public, perform the work in public, disseminate the work to the public (for example, by broadcasting), and translate or modify it. Crucially, the expression of an idea rather than the concept itself is protected by copyright. A history book's exact wording, for instance, is protected, but the historical truths it contains are not.

Duration of copyright:

The typical term of copyright for literary, theatrical, musical, and artistic works in India is the author's lifetime plus 60 years, according to the Copyright Act, 1957. The period is 60 years from the year of publication for sound recordings, cinematograph films, and pictures.

Exception and Limitation (Fair Dealing)

Copyright rules incorporate "Fair Dealing" (or Fair Use in some jurisdictions) exclusions to balance artists' rights with the public's demand for information. Important for libraries, Section 52 of the Indian Copyright Act identifies several acts that do not constitute infringement**:**

- **Private Use and Research:** It is acceptable to reproduce for personal research or study.
- **Education**: It is acceptable for instructors or students to reproduce during class.
- **Use in Libraries:** If a book is not sold in India, libraries may print up to three copies of it for their collection. Additionally, they can preserve unpublished works by reproducing them.
- **Preservation**: If a book's physical copy is lost or destroyed and there isn't a substitute, libraries may choose to digitize it for future generations.

14.3.2 Licensing

The idea of "ownership" of library items has changed in the digital age to "access" through licensing. Libraries usually lease access to electronic resources, such as databases and e-journals, through a license agreement rather than owning the content.

Key Aspects of Licensing:

- **Contractual Agreements:** A license is an agreement between the publisher or vendor and the library. It outlines limits, allowed uses (like downloading and printing), and authorized users (such instructors and students).
- **Negotiation:** To make sure these licenses meet the needs of their patrons, librarians must negotiate them. This includes protecting the rights to text/data mining, remote access, and interlibrary loans (ILL).
- **Digital Rights Management (DRM):** To enforce license restrictions, publishers frequently employ DRM or technological measures (TPMs). Digital file sharing, printing, and copying may be prohibited by these systems. Even when done for justifiable reasons, getting over these restrictions can occasionally be a gray area in the law, but some laws provide libraries an exception.

14.3.3 Open Access

The goal of the Open Access (OA) movement is to remove both permission (copyright restrictions) and cost (subscriptions) obstacles from research results so they are freely accessible online. It is a moral solution to the "serials crisis," in which access to knowledge is restricted by growing journal costs**.**

Types of OA:

Green OA (Self-Archiving): When authors publish in a subscription publication, they also archive a pre-print or post-print version of the manuscript in an open repository (either subject based or institutional). This guarantees public access while upholding the publisher's rights.

Although the term "green open access" usually refers to an article's post-print, archiving policies specify three fundamental version types:

Pre-Prints: The author's copy of the work prior to the publisher's evaluation, also known as pre-review

Post-Prints: The author's version of the piece following review and correction, but prior to the publisher formatting it for publication.

Publisher's Version: prepared version that can be found online or in print is known as the publisher's version.

Gold OA: The article's final published version can be read for free right away on the publisher's website. Usually, the author or their organization pays an Article Processing Charge (APC) to support this.

Hybrid OA: a subscription journal where authors can pay to have their works made publicly available. differs from a Gold OA journal in that the publisher is essentially paid twice for the article—once through subscription and once through the APC to make it OAbecause a library or other subscriber is still paying for a subscription to the journal.

Diamond/Platinum: Journals that don't charge APCs but publish open access. Institutions, advertising, philanthropy, etc, fund these.

Bronze: Those that are freely accessible online but lack a license are typically not reusable.

Creative Commons (CC) licenses, which let authors define how their work can be used (e.g., CC BY permits use with attribution), are frequently used in open access (OA) works.

14.4 ICT Policies for Academic and Research Libraries

A strong information and communication technology (ICT) policy is crucial since libraries are depending more and more on ICT to provide services. An ICT policy offers a strategic framework for the purchase, administration, and utilization of technology in the library. It guarantees that investments in ICT are in line with the goals and moral principles of the library.

Objectives of ICT Policy:

A clear ICT policy accomplishes a number of important goals:

- **Strategic Alignment**: To make sure that the use of ICT advances the academic institution's overarching objectives, like improving research, teaching, and learning.
- **Access and Equity**: To give all user groups, including people with impairments, fair access to digital resources.
- **Standardization:** To guarantee compatibility and ease of maintenance, standards for network infrastructure, software, and hardware must be established.
- **Security:** To defend user privacy and the library's digital assets against online attacks.

- **Skill Development:** To determine what staff and users need to learn in order to use ICT resources efficiently.

Components of ICT Policy:

The following sections are usually included in a comprehensive policy:

- **Management of Infrastructure:**
    - Purchasing and replacing hardware (computers, servers, scanners) guidelines.
    - Network management guidelines, such as those pertaining to Wi-Fi access and bandwidth distribution.
    - Contracts for vendor support and maintenance schedules.

- **Development of E-Resource Collections:**
    - Selection and acquisition criteria for digital material (e-books, e-journals).
    - Principles of licensing (e.g., giving perpetual access precedence over leased access).
    - Allocating funds for print versus digital resources.

- **Acceptable Use and User Access:**
    - The Acceptable Use Policy (AUP) establishes precise guidelines for the proper use of library computers and the internet. This includes bans on hacking, accessing illicit content, and engaging in commercial activity.
    - Procedures for confirming a user's identity in order to grant them remote access to databases that are licensed (for example, using proxy servers or single sign-on) are known as authentication.

- **Preservation of Digital Content:**
    - Techniques for maintaining digitized and born-digital materials throughout time.
    - Plans for disaster recovery and backup procedures for digital data.

- **Digital literacy and staff training:**

    - Dedication to ongoing professional development so library employees may stay up to date with technology advancements.

- Initiatives to improve users' digital abilities and "copyright literacy" so they can utilize information in an ethical manner**.**

➢ **Data security and privacy:**

- Ethical standards for managing user data, such as search history and circulation records.
- Adherence to national data protection regulations to protect user privacy online**.**



Check Your Progress

A. Fill In the Blanks

a. For literary, theatrical, musical, and artistic works, copyright in India is generally defined as the author's lifetime plus _____ years.

b. . _____ The practice of authors publishing in a subscription publication but self-archiving a version of their work in an open repository is known as "open access."

c. _____ is the legal theory that authorizes restricted unapproved use of copyrighted content for news reporting, study, and criticism.

d. Publishers employ _____ technology to restrict access, copying, and printing of digital information in order to enforce license agreements.

14.5 Let Us Sum Up

The important ethical and legal foundations guiding contemporary academic and research libraries have been examined in this section. We looked at the fundamental function of copyright law, which gives authors the sole right to their works while providing important exceptions such as "Fair Dealing" that let libraries promote research and instruction without violating the law. It was noted that access to scholarly literature is now governed by license agreements and Digital Rights Management (DRM), highlighting the transition from physical ownership to digital licensing. We also contrasted the Green (self-archiving) and Gold (author-pays) models and talked about the Open Access (OA) movement as an ethical requirement to democratize information. In order to manage infrastructure, guarantee data security, and direct responsible technology use, the unit concluded by stressing the importance of a thorough ICT Policy. When taken as a whole, these regulations guarantee that libraries can successfully negotiate the challenges of the digital era while maintaining legal compliance and their primary goal of ensuring that all people have equal access to information.

14.6 Answers to Check Your Progress

A. Fill in the Blanks

Ans to A. a. 60 Years**, b.** Green**, c.** Fair Dealing**, d.** Digital Right Management.

14.7 Further Readings

1. Choudhuri, S. (n.d.). *Evolution of ICT in Academics and Research*. Retrieved December 16, 2025, from https://egyankosh.ac.in/bitstream/123456789/73823/1/Unit-11.pdf
2. *Libraries in Digital Skills Policies: Policy areas, mechanisms, practices.* (2020). https://www.ifla.org/wp-content/uploads/2019/05/assets/hq/topics/info-society/documents/libraries_in_digital_skills_policies.pdf
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7. WIPO. (2016). *Understanding Copyright and Related Rights*. https://www.wipo.int/edocs/pubdocs/en/wipo_pub_909_2016.pdf

14.8 Probable Questions

A. Short Answer Type Questions

a. Define "Ownership" and "Licensing" differently in relation to library collections.

b. Define Gold Open Access.

c. What is creative commons**.**

B. Long Answer Type Question

a. Briefly discuss about ICT Policy for libraries

b. Discuss about copyright and its types.

c. What is Open Access. Briefly discuss about its different types.