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UNIVERSITY OF GLOBAL VILLAGE (UGV), BARISHAL

THE UNIVERSITY FOR HI-TECH AND HUMANITY

AMARTYA KUNDU DURJOY

LECTURER

DEPARTMENT OF CSE,(UGV)

Introduction to Computer Studies

Course Code:	ICT-0611-1204	Credits:	02
		CIE Marks:	60
Exam Hours:	02	SEE Marks:	40

Course Learning Outcome (CLOs): After Completing this course successfully, the student will be able to…

CLO1	Understand the fundamental concepts of computer systems, including the components of a computer, computer organization, and how data is represented and processed by a computer.
CLO2	Identify and use common computer software applications, including word processing, spreadsheets, and presentation software.
CLO3	Demonstrate proficiency in using computer hardware and peripherals, including input and output devices, storage devices, and networking equipment.
CLO4	Apply problem-solving and critical thinking skills to troubleshoot common computer issues, perform basic maintenance tasks, and effectively communicate technical information to a non-technical audience.
CLO5	Apply knowledge of operating systems by understanding their functions, booting process, reboots, dual-booting, and various OS types, while also protecting systems from security threats by learning about computer viruses, their infection mechanisms, and the role of antivirus programs in preventing malware..

Summary of Course Content

Sl. No.	COURSE CONTENT	HRs	CLOs
1	Introduction to Computers: This section covers the basics of computing including a brief history of computers, hardware and software components, input/output devices, and the role of operating systems.	2	CLO1, CLO2 & CLO3
2	Computer Arithmetic: This section covers the fundamental concepts of computer arithmetic including binary and hexadecimal number systems, binary arithmetic, signed numbers, and floating-point arithmetic.	2	CLO2
3	Computer Programming: This section covers the basics of programming including algorithms, flowcharts, data types, variables, expressions, and control structures.	2	CLO4
4	Concept of Operating systems and security	2	CLO5
5	Computer Networks: This section covers the basics of computer networks including network architecture, network topologies, communication protocols, and internet basics. It also includes an overview of network security and management.	2	CLO3

1. "Computer Fundamentals" by P.K. Sinha
2. "Computer Organization and Design" by David A. Patterson and John L. Hennessy
3. "Operating System Concepts" by Abraham Silberschatz, Greg Gagne, and Peter B. Galvin
4. "Introduction to Algorithms" by Thomas H. Cormen, Charles E. Leiserson, Ronald L. Rivest, and Clifford Stein
5. "Computer Networks" by Andrew S. Tanenbaum and David J. Wetherall

Assessment Pattern

Bloom's Category Marks (out of 90)	Tests (30)	Assignments (10)	Quizzes (10)	Attendance (10)
Remember	04	02		
Understand	05	02	04	
Apply	06	03	03	
Analyze	05	01		
Evaluate	05	02	03	
Create	05			

SEE- Semester End Examination (40 Marks)

Bloom's Category	Test
Remember	05
Understand	05
Apply	13
Analyze	07
Evaluate	05
Create	05

Course Plan

Week no	Topics	Teaching Learning Strategy(s)	Assessment Strategy(s)	Alignment to CLO
1	Introduction to Computers and Their Components	Lecture, multimedia, discussions	Feedback, Q&A, assessment	CLO1 & CLO2
2	Computer Memory	Lecture, discussions	Q&A, assignments	CLO1
3	Input Devices	Lecture, multimedia	Midterm assessments	CLO3
4	Output Devices	Lecture, multimedia	Midterm assessments	CLO3
5	Central Processing Unit (CPU)	Lecture, Practical implementation	Feedback, Q&A, assessment	CLO1 & CLO3
6 & 7	Number System	Lecture, Practical implementation	Q&A, assignments	CLO1
7 & 8	Boolean Algebra	Lectures, discussions	Midterm assessments	CLO1 & CLO2
9 & 10	Mid-Semester Examination	Mid-term exams	Mid-term assessment	CLO1 – CLO3
11	Logic Gates	Lecture, Practical implementation	Q&A, assignments	CLO1 & CLO3
12	Introduction to Basic Networking Concepts	Lecture, multimedia, discussions	Ethical analysis, Midterm assessments	CLO3, CLO5
13	Operating Systems	Interactive lectures, examples from real-world applications	Final term assessments	CLO5
14	Computer Security: Viruses, Infection Mechanisms, and Antivirus Protection	Lecture, multimedia, discussions	Final term assessments	CLO5
15 & 16	Core Programming Concepts: Algorithms, Flowcharts, and Pseudocode	Interactive lectures, examples from real-world applications	Feedback, Q&A, assessment	CLO4
17	Final Topics Review and Discussion: Integration of Concepts	Revision through Q&A, group activities	Participation, group evaluation	CLO1 - CLO5

Week - 1
Lecture : 1

Introduction to Computers and Their Components

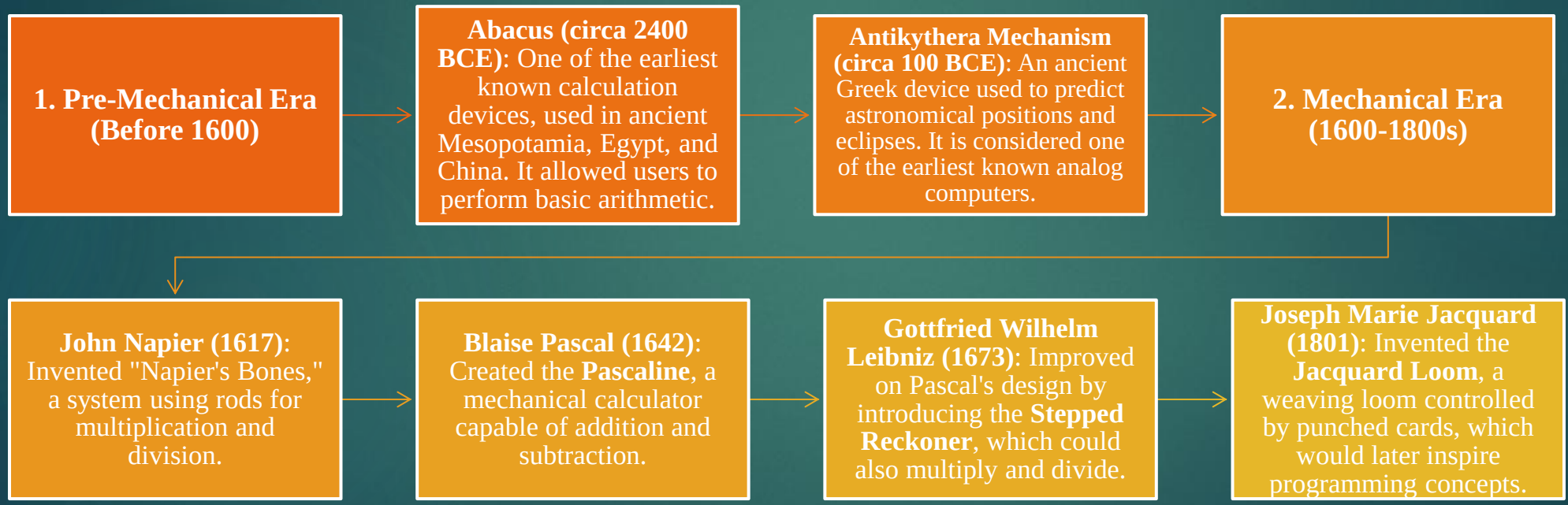
Key Points:

- Defining the computer and its characteristics
- Explaining block structure of a computer
- Explaining various types and generations of computer
- Understanding the basic software issue

What does computer stand for?

- In the language of a layman, a computer is a fast-calculating device that can perform, arithmetic operations.
- The computer can perform any kind of work involving arithmetic and logical operations on data.
- Again, a computer is an input device, operating under the control of instructions stored in its own memory that can accept data(input), process the data according to the specified rules, produce information(output), and store the information for future usage.
- Computers process data under the control of sets of instructions called computer programs

History of Computers: A Journey Through Time



History of Computers: A Journey Through Time (Cont'd)

1800-1900s

3. Early Electronic Era

1837

Charles Babbage (1837): Conceptualized the Analytical Engine, often regarded as the first general-purpose computer. It had input (via punched cards), a "mill" (CPU), and memory.

1843

Ada Lovelace (1843): Considered the world's first programmer, she wrote algorithms for the Analytical Engine and understood its potential for general-purpose computation.

1890

Herman Hollerith (1890): Invented the Tabulating Machine for the U.S. Census, which used punched cards to store and process data. His company later became IBM.

1900-1930s

4. Electro-Mechanical Era

1936

Alan Turing (1936): Proposed the concept of the Turing Machine, a theoretical model for computation that underpins modern computer science.

1938

Konrad Zuse (1938): Built the Zuse Z3, the world's first programmable, fully automatic digital computer.

1944

Howard Aiken & Grace Hopper (1944): Developed the Harvard Mark I, an electromechanical computer used during World War II for ballistic calculations.

Generations of Computers

Zeroth Generation (1642 – 1945) - Pascaline

Second Generation (1955 – 1965) - Transistor

Fourth Generation (1971 – 1980) - Microprocessors

1945–1955

1966–1970

1980 to present

1642–1945

1955–1965

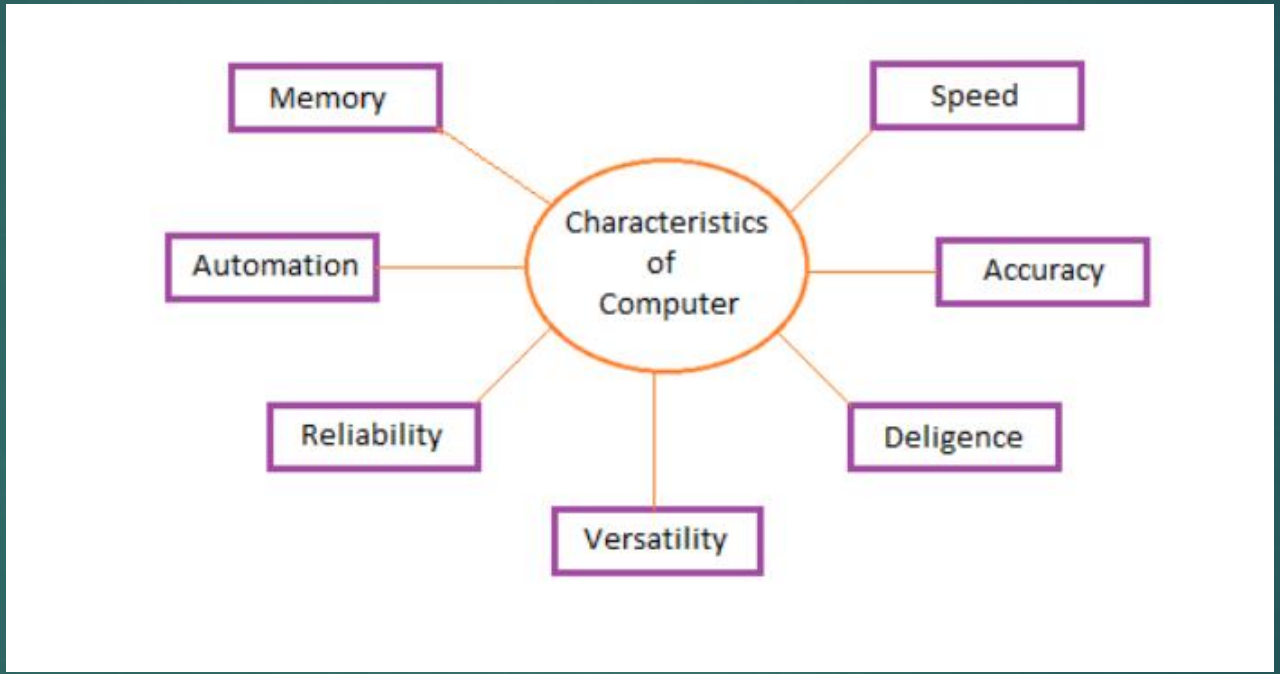
1971–1980

First Generation (1945 – 1955) – Vacuum Tubes

Third Generation (1966 – 1970) – Integrated Circuits

Fifth Generation (1980 to present) – AI and modern era

Characteristics of Computer



Characteristics of Computer

1. Speed:

Executing mathematical calculation, a computer works faster and more accurately than human. Computer operations are performed in micro and nano seconds. The speed of a computer is measure in terms of Gigahertz and Megahertz.

2. Diligence:

A human cannot work for several hours without resting, yet a computer never tires. A computer can conduct millions of calculations per second with complete precision without stopping. A computer can consistently and accurately do millions of jobs or calculations. There is no weariness or lack of concentration. Its memory ability also places it ahead of humans.

Characteristics of Computer

3. Reliability

A computer is reliable. The output results never differ unless the input varies. the output is totally depend on the input. A computer produces consistent results for similar sets of data, if we provide the same set of input at any time we will get the same result.

4. Automation

AI (Artificial Intelligence)-based technology. A computer may conduct tasks automatically after instructions are programmed. By executing jobs automatically, this computer feature replaces thousands of workers. Automation in computing is often achieved by means of a program's batch processing

Characteristics of Computer

5. Versatility

Versatility refers to a capacity of computer. A computer can perform multiple tasks at the same time this is known as versatility. For example, while listening to music, we may develop our project using PowerPoint and WordPad, or we can design a website.

6. Memory

A computer can store millions of records. these records may be accessed with complete precision. Computer memory storage capacity is measured in Bytes, Kilobytes(KB), Megabytes(MB), Gigabytes(GB), and Terabytes(TB). A computer has built-in memory known as primary memory.

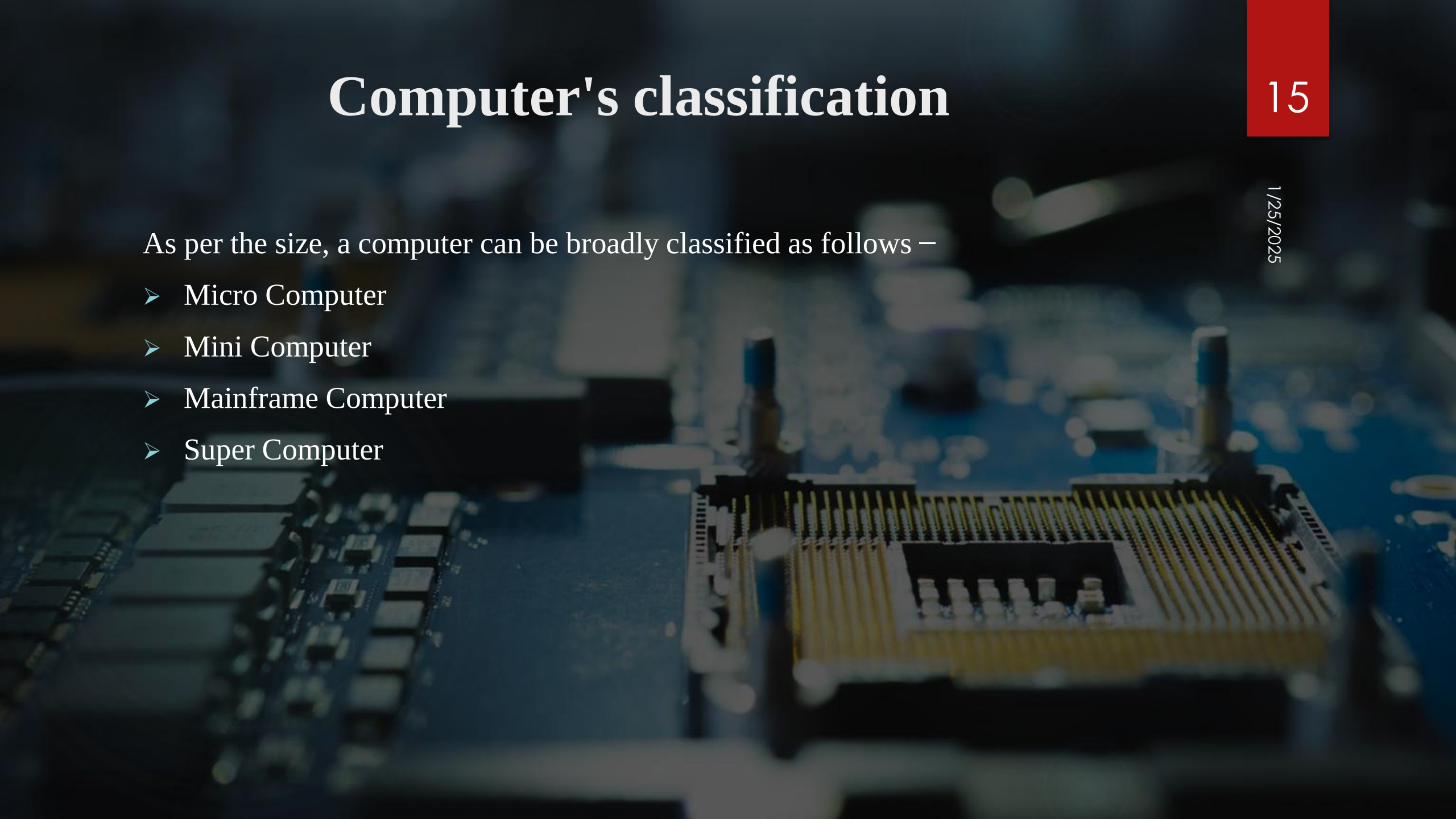
7. Accuracy

When a computer performs a computation or operation, the chances of errors occurring are low.

Computer's classification

As per the size, a computer can be broadly classified as follows −

- Micro Computer
- Mini Computer
- Mainframe Computer
- Super Computer



Micro Computer

- Microcomputers, also known as personal computers (PCs)
- They are distinguished by their compact dimensions, small size, processing power, compatibility, internet connectivity, portability, low price, and versatility.

Minicomputer

- A minicomputer is a type of computer that is smaller in size than large computers.
- It possesses all the capabilities of a large computer. Hence, it is a midsize multi-processing system capable of supporting up to 250 users simultaneously.
- **Uses of Minicomputers** − Minicomputers are most widely used in scientific computations, engineering, business transaction processing, file handling, and database management.

Mainframe computer

- The mainframe is very large and is an expensive computer capable of supporting hundreds or even thousands of users simultaneously. The mainframe executes many programs concurrently and supports simultaneous execution of programs.
- **Why a mainframe computer?**
- The processing capacity of mainframes is frequently measured in MIPS (million instructions per second) or other units. This enables them to process a large volume of transactions and perform extensive data processing.
- **Uses of the Mainframe** − Most widely used in finance, government, healthcare, and more.

Supercomputer

- A special type of computer that is more powerful and capable of high-performance computing.
- **Why Supercomputer?**
  - Processing speed is exceptional and can perform billions of calculations per second. Multiple processors work in parallel mode to execute tasks
  - Specially built using specialized hardware like GPUs (Graphics Processing Units) or TPUs (Tensor Processing Units), which are used in graphics rendering or machine learning tasks.
- **Uses of the Supercomputer** − Most widely used in scientific research, data analysis, weather forecasting, scientific simulations, graphics, fluid dynamic calculations, nuclear energy research, electronic design, and the analysis of geological data.

Computer's classification (Cont'd)

As per the capacity, a computer can be broadly classified as follows –

- Analog Computer
- Digital computer
- Hybrid computer

Analog Computer

A COMPUTER THAT USES PHYSICAL MEANS LIKE MECHANICAL OR HYDRAULIC COMPONENTS TO DO THE COMPUTATION RATHER THAN ELECTRONIC CIRCUITS IS CALLED AN ANALOGUE COMPUTER.

THESE COMPUTERS WORK WITH CONTINUOUS DATA AND CAN MANAGE PHYSICAL QUANTITIES EFFICIENTLY.

IN LIEU OF NUMBERS, AN ANALOGUE COMPUTER PERFORMS ARITHMETIC OPERATIONS BASED ON MEASURABLE QUANTITIES, SUCH AS MECHANICAL MOVEMENT OR THE ROTATION OF GEARS.

IN ANALOGUE COMPUTERS, DATA IS PROCESSED AS CONTINUOUS SIGNALS FOR ITS OPERATION, WHEREAS IN DIGITAL COMPUTERS, DATA IS TRANSMITTED AS DISCRETE SIGNALS (OR DISCONTINUOUS SIGNALS).

Digital Computer

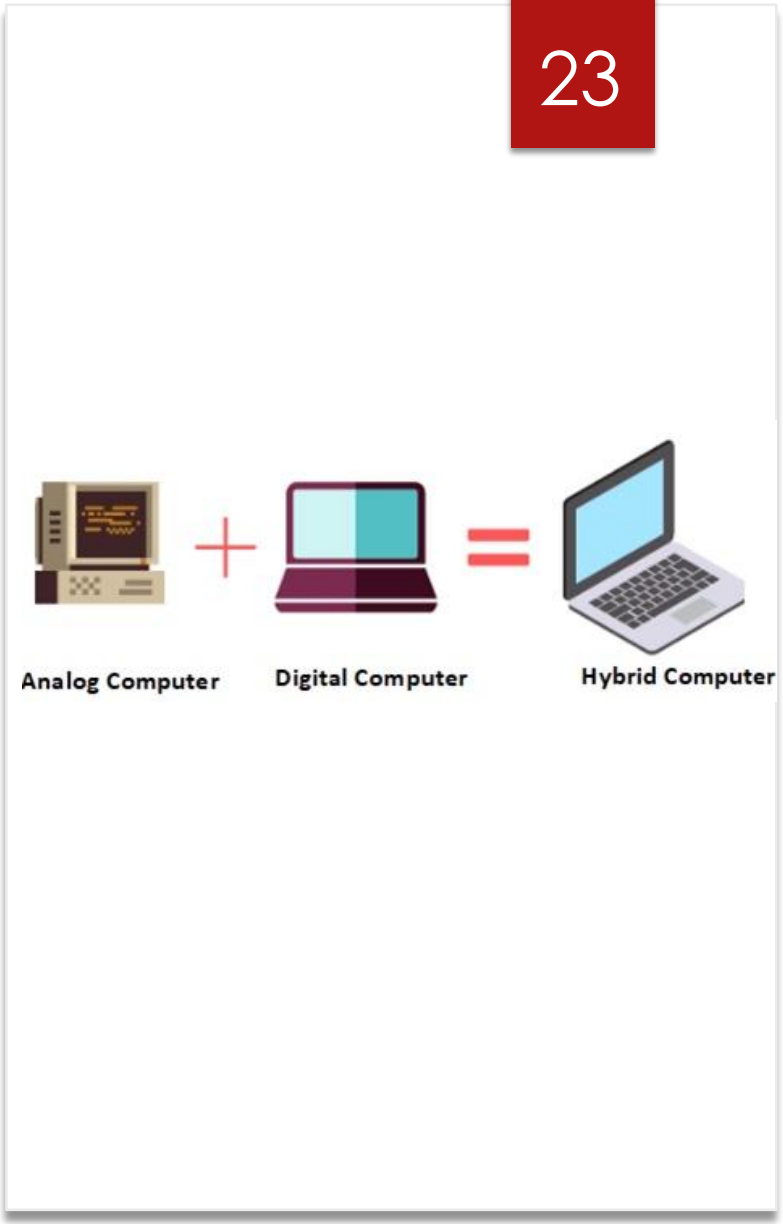
A digital computer is a type of computer that represents and processes data using discrete, distinct values.

In digital computers, data is processed using binary numbers 0 and 1.

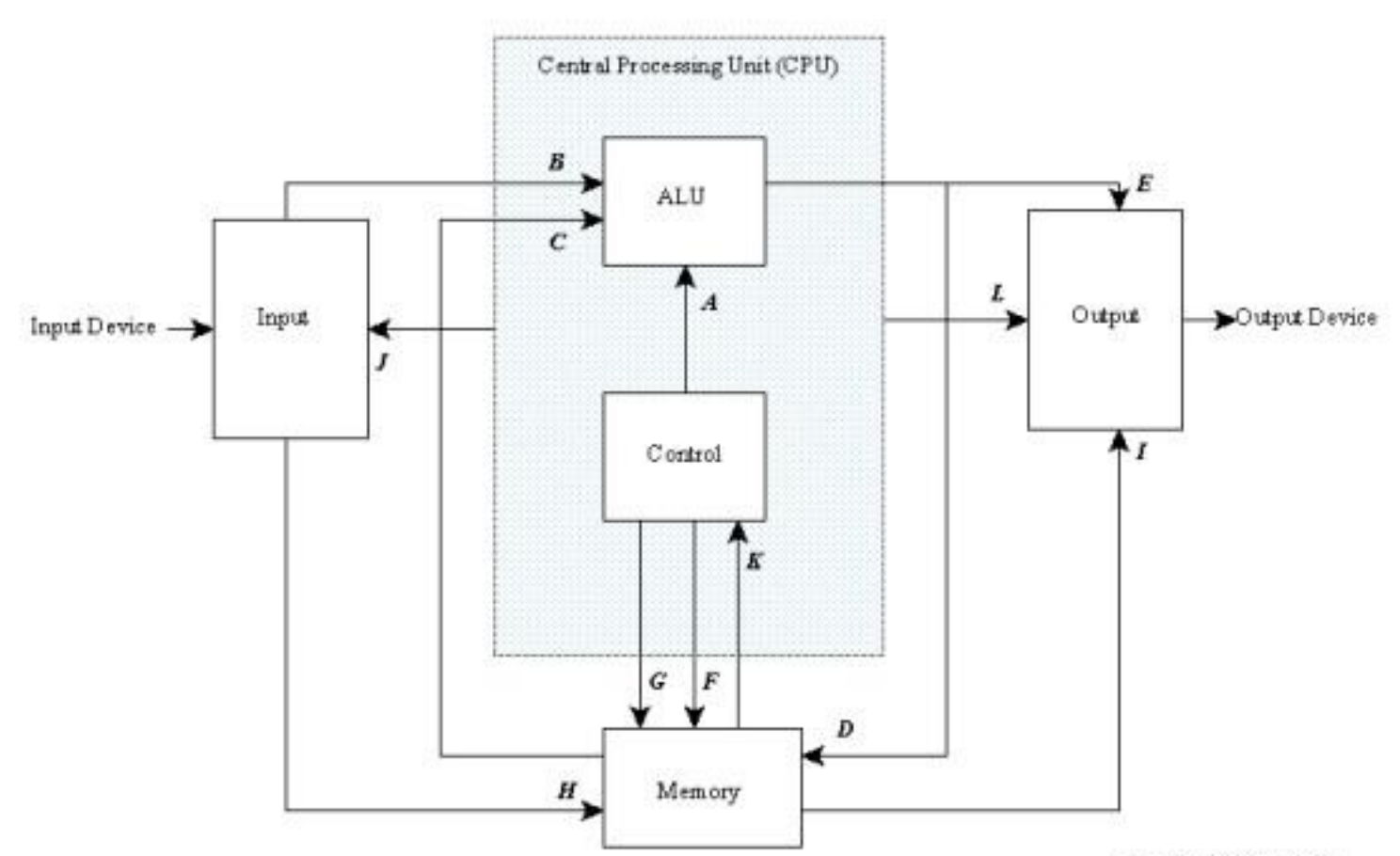
These computers are designed to perform arithmetic calculations and complex data processing and manipulation. The main components of a digital computer are input, processing, and output.

Hybrid Computer

- A hybrid computer is a type of computer system that integrates the features and capabilities of both analogue and digital computers.
- This integration allows the hybrid computer to perform various tasks efficiently by leveraging the strengths of both digital and analogue technologies.

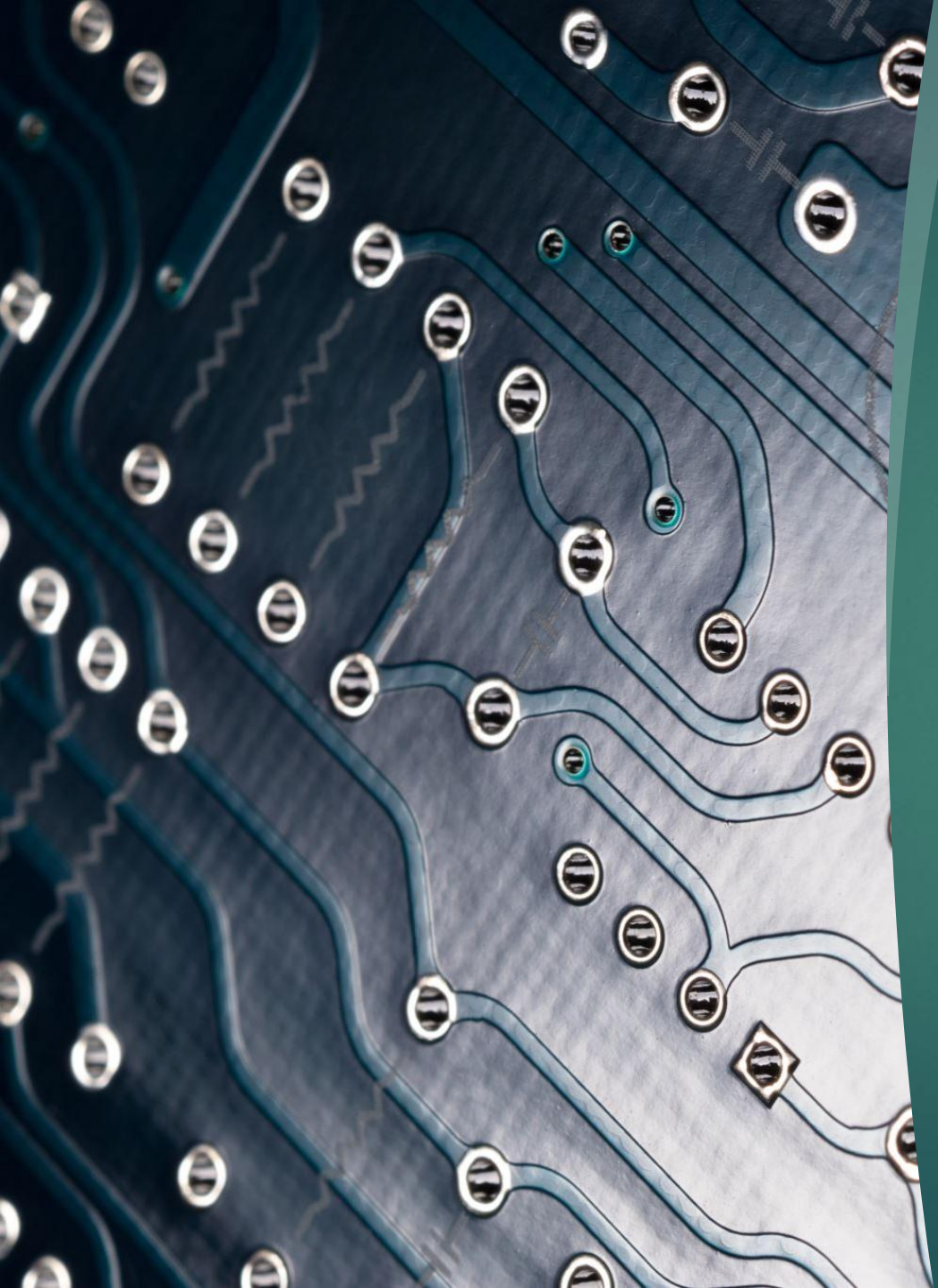


Computer Architecture



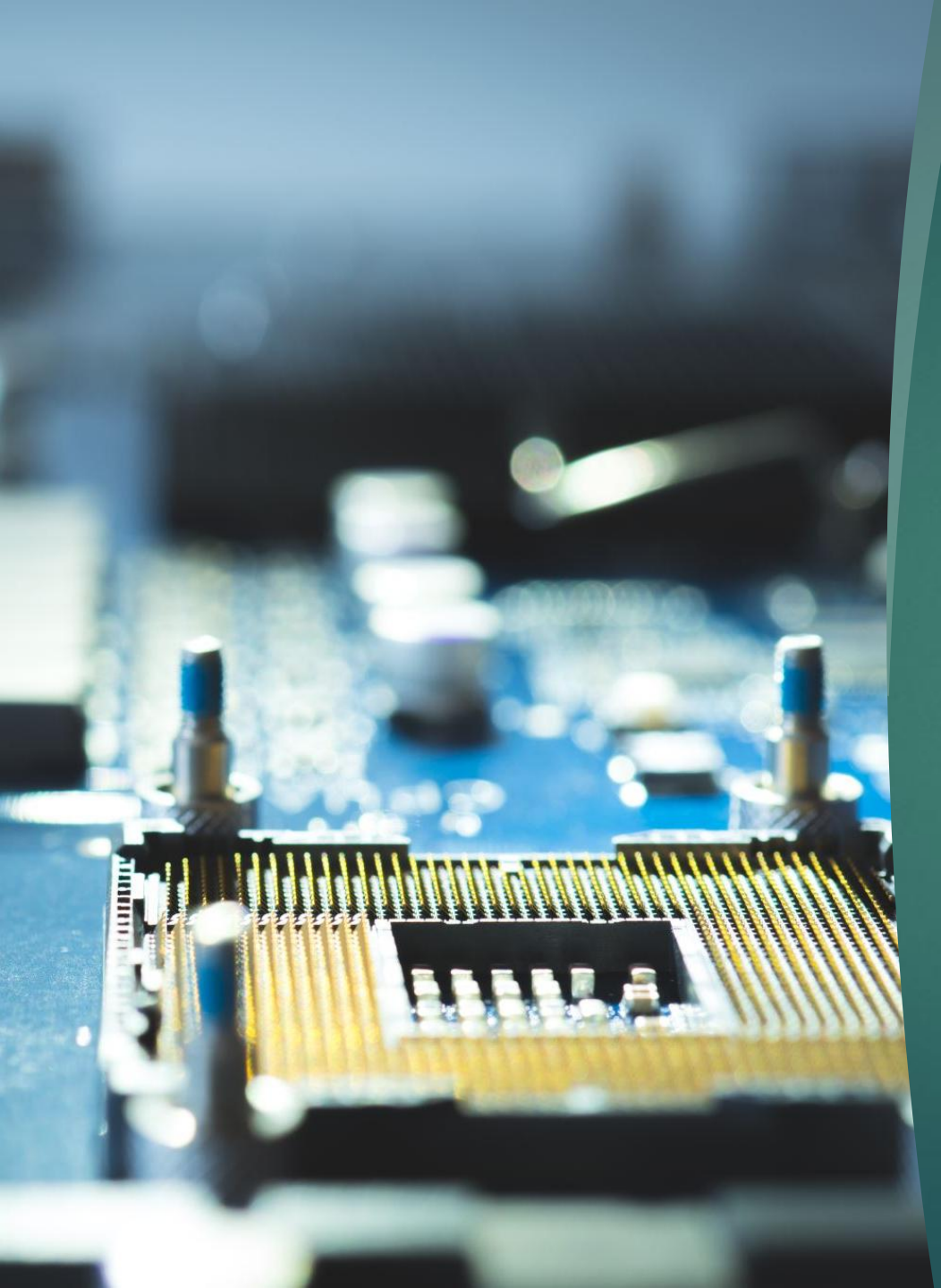
Computer Software

- Software refers to the intangible components of a computer system, which consist of the programs and applications that instruct the hardware on what tasks to perform. There are two main categories of software:
  - System Software
  - Application Software



System Software

- The system software is a collection of programs designed to operate, control, and extend the processing capabilities of the computer itself.
- These software products comprise programs written in low-level languages, which interact with the hardware at a very basic level. System software serves as the interface between the hardware and the end users.
- System software includes :
  - **Operating System:** The OS is the software that manages all other software and hardware on the computer. Examples include Windows, macOS, Linux, and Android.



System Software (Cont'd)

- **Device Drivers**: This software operates or controls a particular type of device that is attached to a computer. Each device needs at least one corresponding device driver because a computer typically has at least one input device and at least one output device but may need more than one device driver.
- **Utility Programs**: Software that performs maintenance tasks, such as disk cleanup, antivirus scans, and file management.

Application Software

- These are programs designed to help users perform specific tasks. Examples include:
- **Productivity Software**: Applications like Microsoft Office, Google Docs, and spreadsheet programs that help users create documents, presentations, and manage data.
- **Multimedia Software**: Programs like Photoshop, video editors, and audio editing tools used for creating and editing media.
- **Web Browsers**: Applications like Chrome, Firefox, and Safari that allow users to browse the internet.

Data vs. Information

Data is a representation of a fact or idea

Number
Word
Picture
Sound

examples of data

3547 Ahmad Kuala Lumpur Malaysia

examples of information

Roll No. 3547 Name-Ahmad City-Kuala Lumpur

Country-Malaysia

Information is data that has been organized or presented in a meaningful.

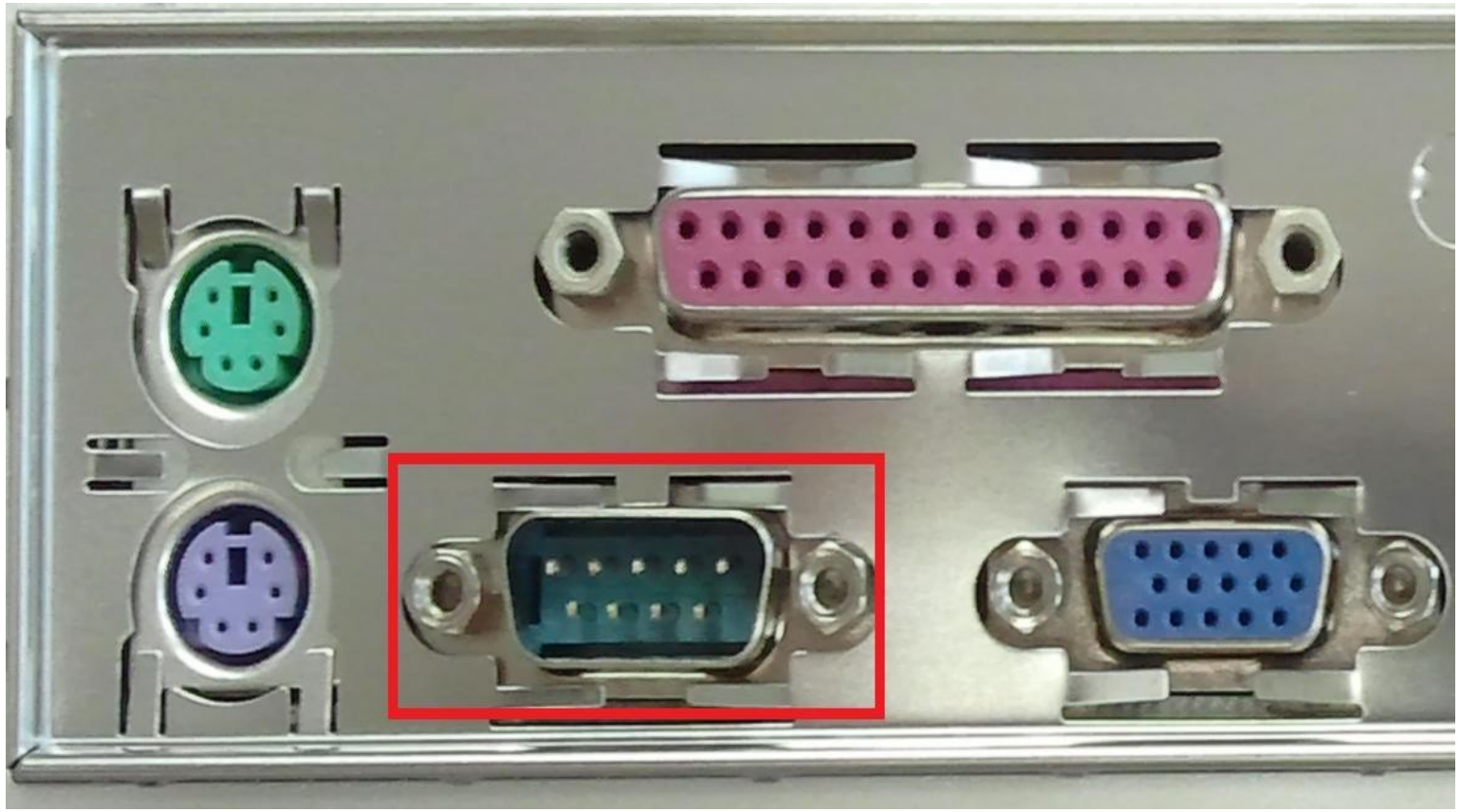
PC Connection Method

The various PC connection methods are:

- Ports
- Personal Computer Connections
- Serial Connections
- Parallel Connections
- Universal Serial Bus (USB) Connections
- IEEE 1394 and FireWire Connections
- Small Computer Systems Interface (SCSI) Connections
- Parallel ATA (PATA) Connections
- Serial ATA (SATA) Connections

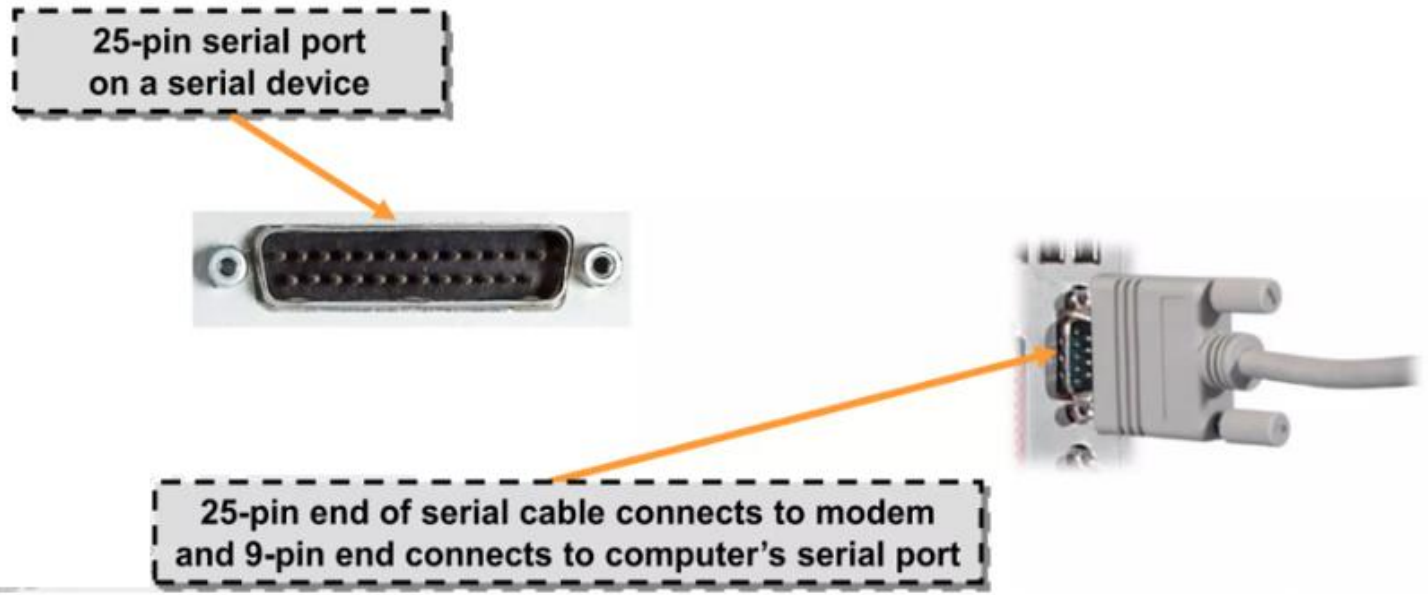
Ports

- The computer ports are physical docking points of a computer that facilitate users to connect required external devices to the computer or computer network.
- A connection point that acts as an interface between the computer and external devices like a mouse, printer, modem, etc. is called a port. Ports are of two types −
- **Internal port** − It connects the motherboard to internal devices like hard disk drives, CD drives, internal modems, etc.
- **External port** − It connects the motherboard to external devices like modem, mouse, printer, flash drives, etc.



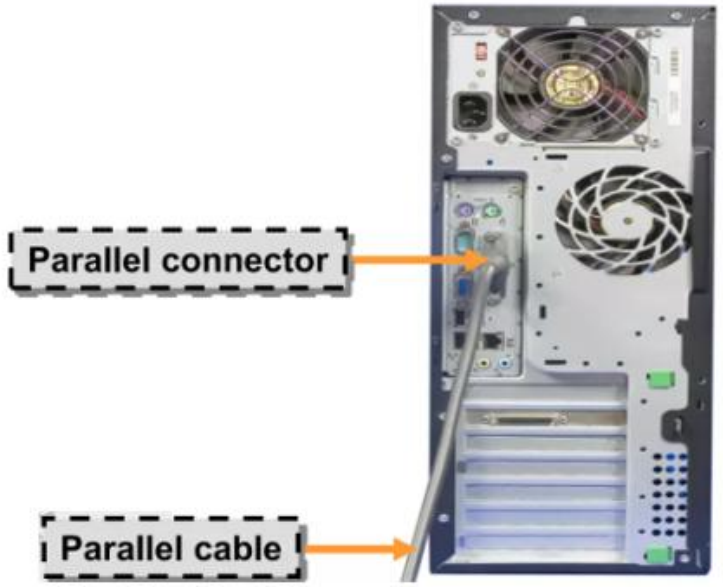
Serial Connection

A ***serial connection*** is a personal computer connection that transfers data one bit at a time over a single wire.



Parallel Connection

A ***parallel connection*** is a personal computer connection that transfers data eight bits at a time over eight wires and is typically used to connect a printer to a system unit.



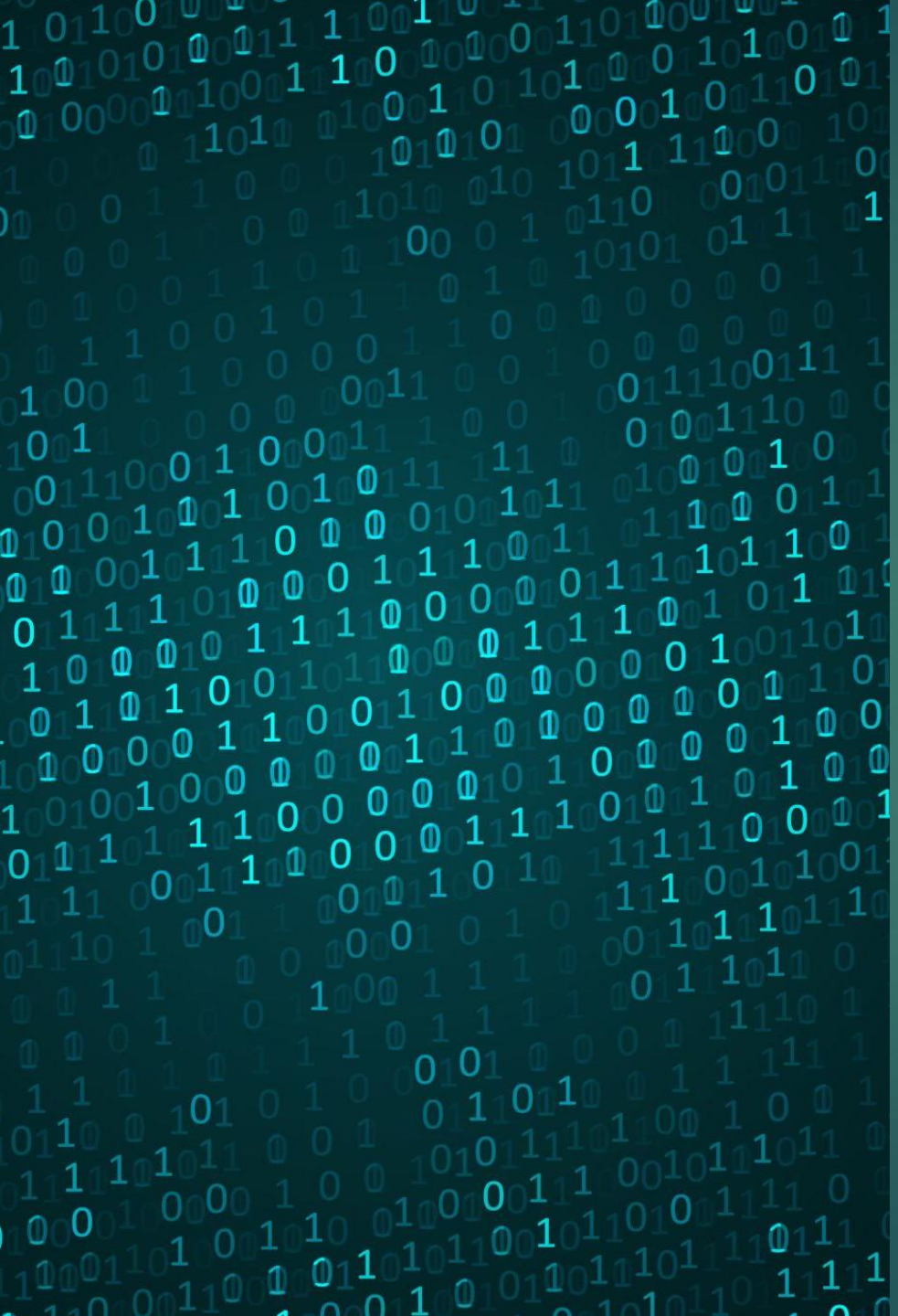
Universal Serial Bus (or USB) Port

- USB stands for Universal Serial Bus. It is the industry standard for short-distance digital data connection. There are different types and sizes of USB ports, such as micro-USB, USB-A, USB-B, and USB-C.
- Data travels at 12 megabits per second.

Self study

- All Pc connection methods.

Measuring Units



- **Bit:**
- Bit stands for binary digit.
- A bit can have only one of two values: **0** or **1**. These values represent the binary system, which is the foundation of all computer processing.
- **Byte:**
- A Byte is a group of 8 bits.
- It is the standard unit of data used to represent information such as a single character (like a letter, number, or symbol) in a computer's memory.

Unit	Symbol	Size in Bytes
Bit	b	0 or 1 (not a multiple of bytes)
Byte	B	8 bits
Kilobyte	KB	1,024 bytes
Megabyte	MB	1,024 KB (1,048,576 bytes)
Gigabyte	GB	1,024 MB (1,073,741,824 bytes)
Terabyte	TB	1,024 GB (1,099,511,627,776 bytes)
Petabyte	PB	1,024 TB (1,125,899,906,842,624 bytes)
Exabyte	EB	1,024 PB (1,152,921,504,606,846,976 bytes)
Zettabyte	ZB	1,024 EB (1,180,591,620,717,411,303,424 bytes)
Yottabyte	YB	1,024 ZB (1,208,925,819,614,629,174,706,176 bytes)

Measuring Units

Thank you

Week - 2
Lecture : 2

Computer Memory

Key Points:

- Defining the computer memory and its characteristics
- Explaining the various types of memory

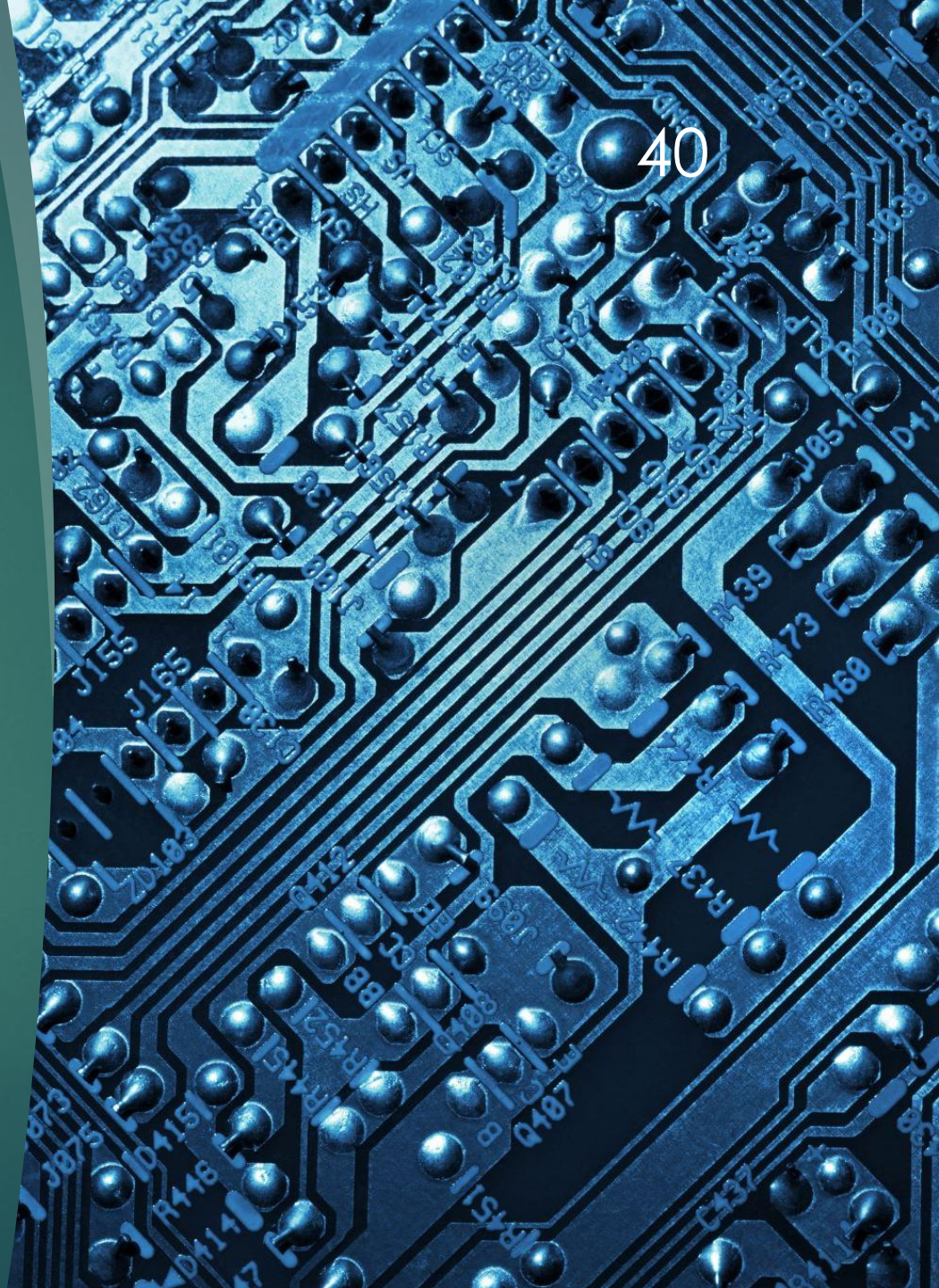
Introduction

Computer Memory Is Just Like The Human Brain.

It Is A Data Storage Unit Or A Data Storage Device Where Data Is To Be Processed And Instructions Required For Procesprocessed,stored.

It Can Store Both The Input And Output Can Be Stored Here.

The Memory Is Divided Into Large Number Of Small Parts Called Cells. Each Location Or Cell Has A Unique Address Whichexample,m Zero To Memory Size Minus One. For Example If Computer Has 64k Words, Then This Memory Unit Has 64 * 1024=65536 Memory Locations. The Address Of These Locations Varies From 0 To 65535.



CHARACTERISTICS OF MEMORIES

- Volatility

o Volatile {RAM}

o Non-volatile {ROM, Flash memory}

- Mutability

o Read/Write {RAM, HDD, SSD, RAM, Cache, Registers…}

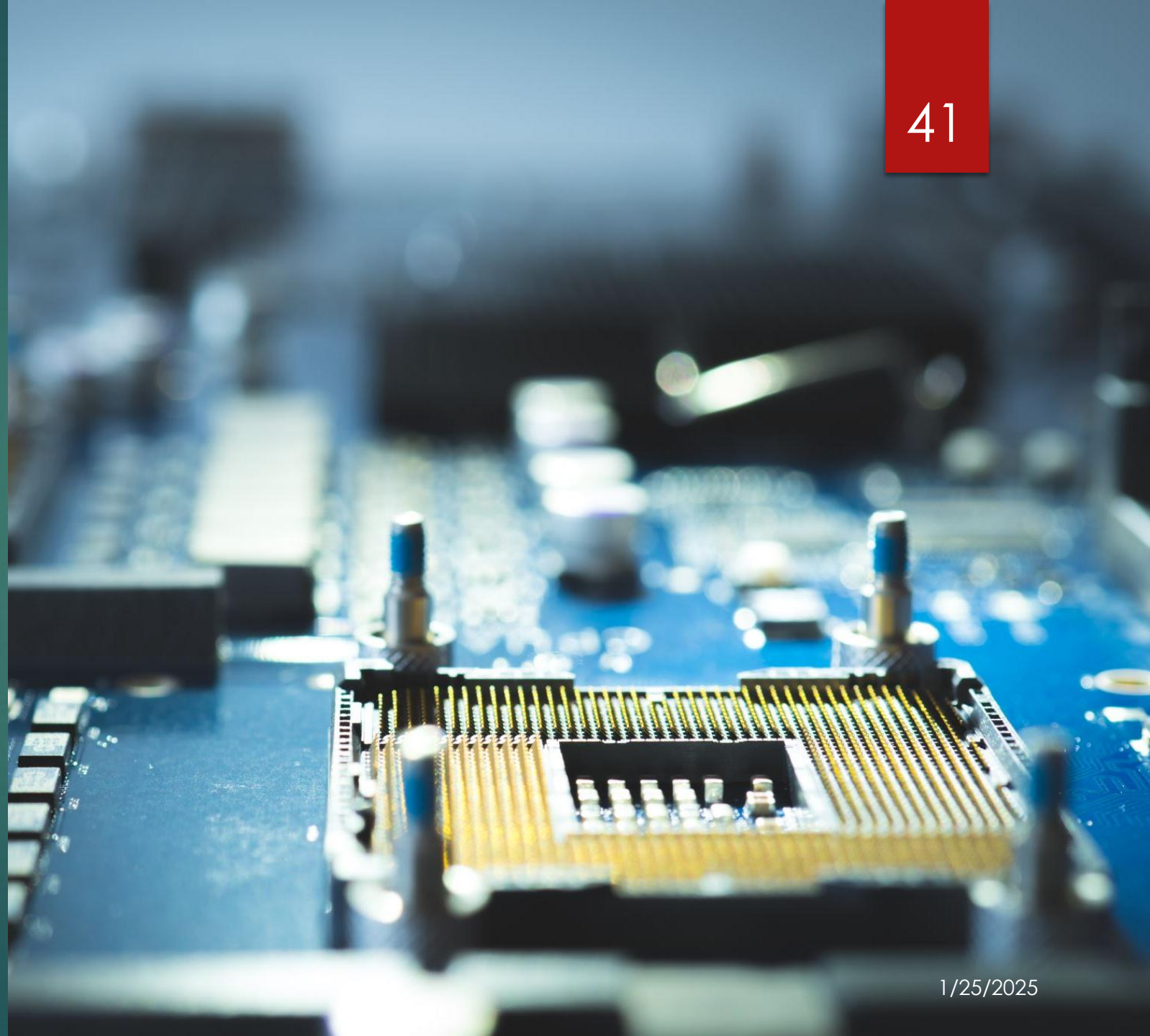
o Read Only {Optical ROM (CD/DVD…), Semiconductor ROM}

- Accessibility

o Random Access {RAM, Cache}

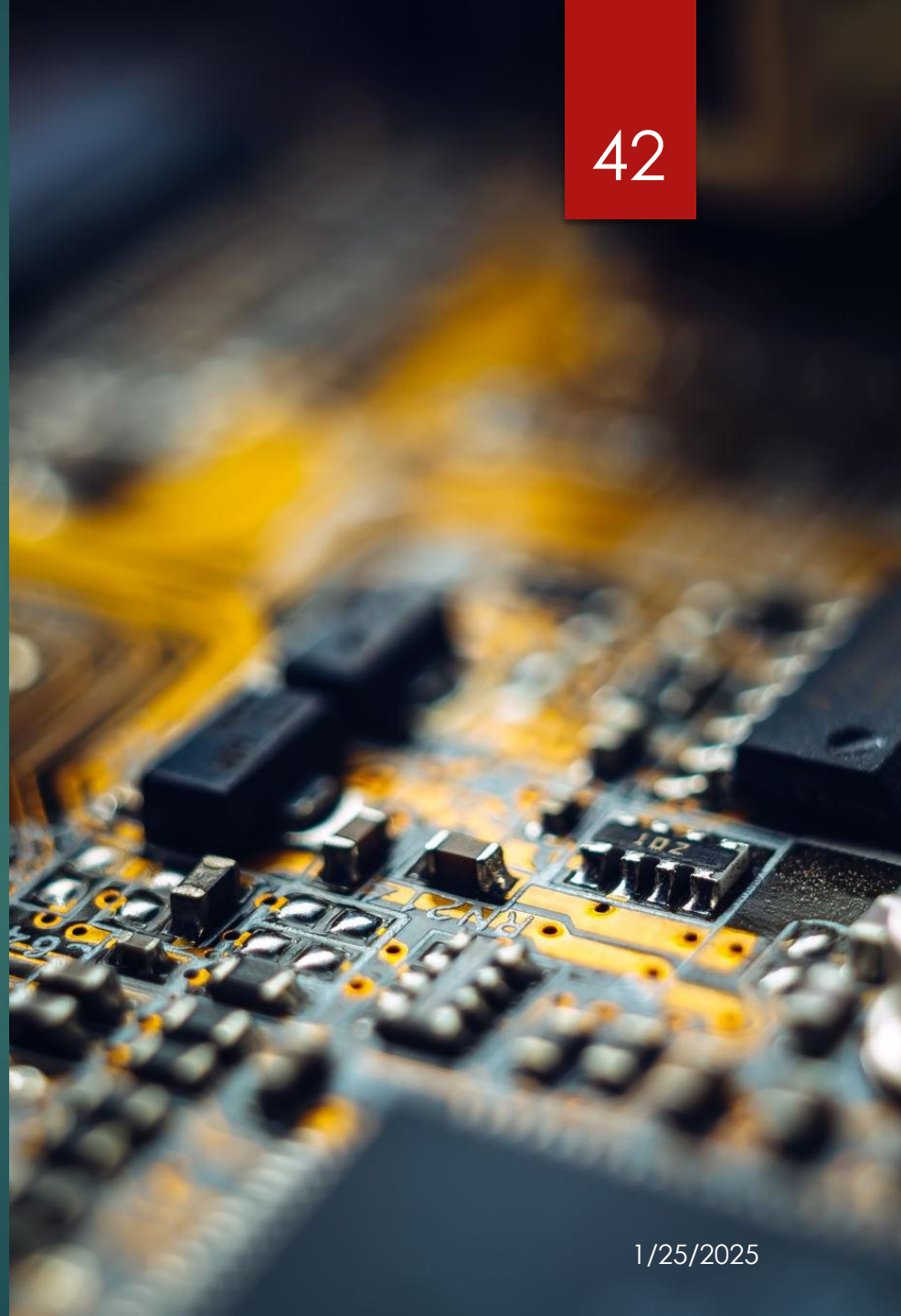
o Direct Access {HDD, Optical Disks}

o Sequential Access {Magnetic Tapes}



Types

- Computer memory is of three types:
- Primary memory
- Secondary memory
- Cache memory



Primary memory

- It is also known as the main memory of the computer system.
- It is used to store data and programs or instructions during computer operations.
- Primary memory is of two types:
  - RAM
  - ROM

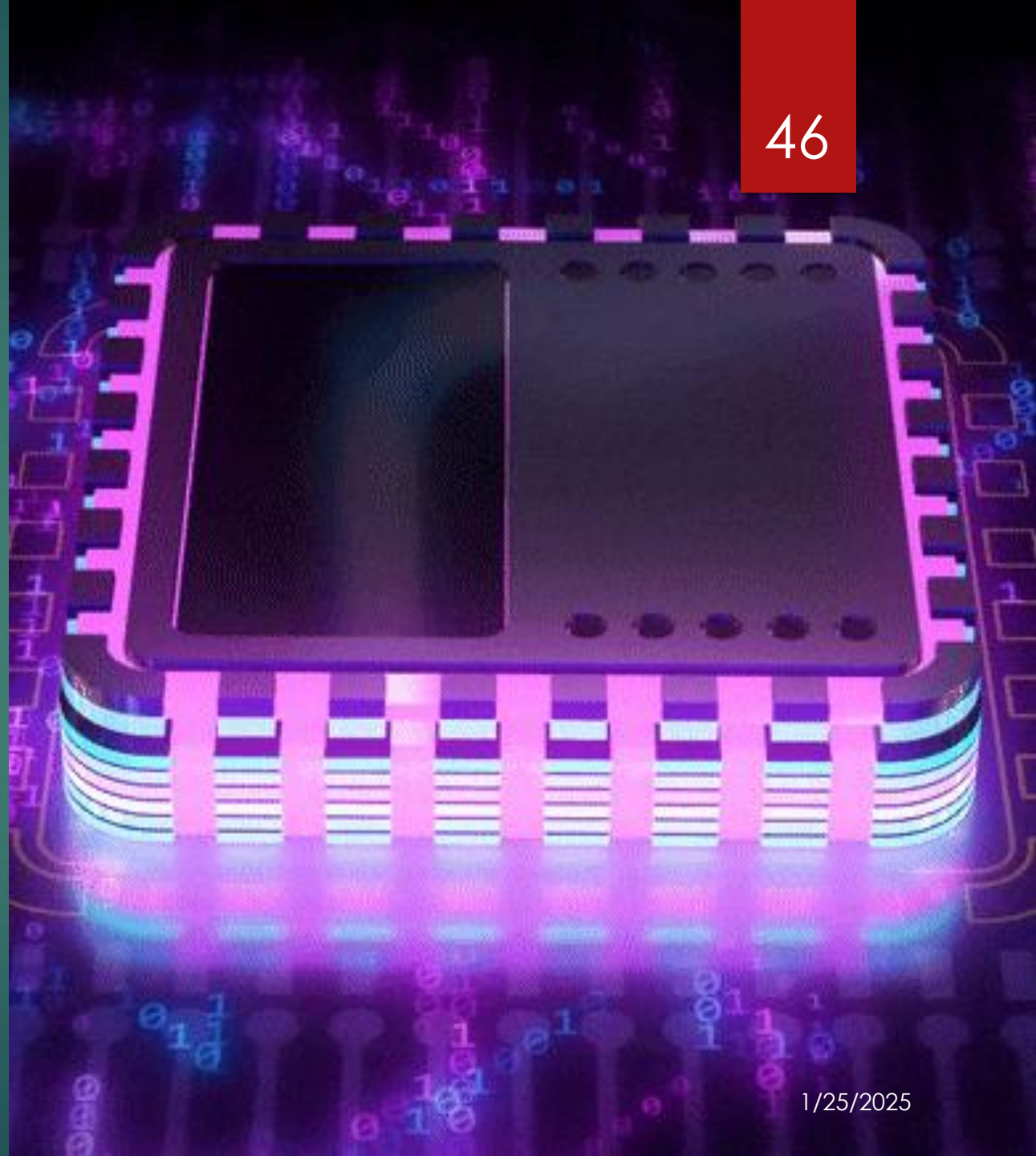
RAM (Random Access Memory)

- RAM stands for Random Access Memory, which means that the CPU can access any part of the memory directly and almost instantly, without needing to go through other data sequentially.
- RAM is volatile memory, meaning that all data stored in it is lost when the computer is turned off.
- Ram holds – the active part of an operating system.
- RAM is of two types.

- **SRAM** (Static RAM): Static RAM (SRAM) operates based on a flip-flop circuit for each memory cell consisting of six transistors.
- **DRAM** (Dynamic RAM): DRAM uses capacitors and transistors and stores the data as a charge on the capacitors. They contain thousands of memory cells. It needs refreshing of charge on capacitor after a few milliseconds. This memory is slower than S RAM.

ROM (Read Only Memory)

- It is a non-volatile memory.
- Non-volatile memory stores information even when there is a power supply failed/ interrupted/stopped.
- ROM is used to store information that is used to operate the system.
- The information stored in the ROM in binary format. It is also known as permanent memory.
- ROM comes with pre-written by the computer manufacturer to hold the instructions for booting-up the computer.



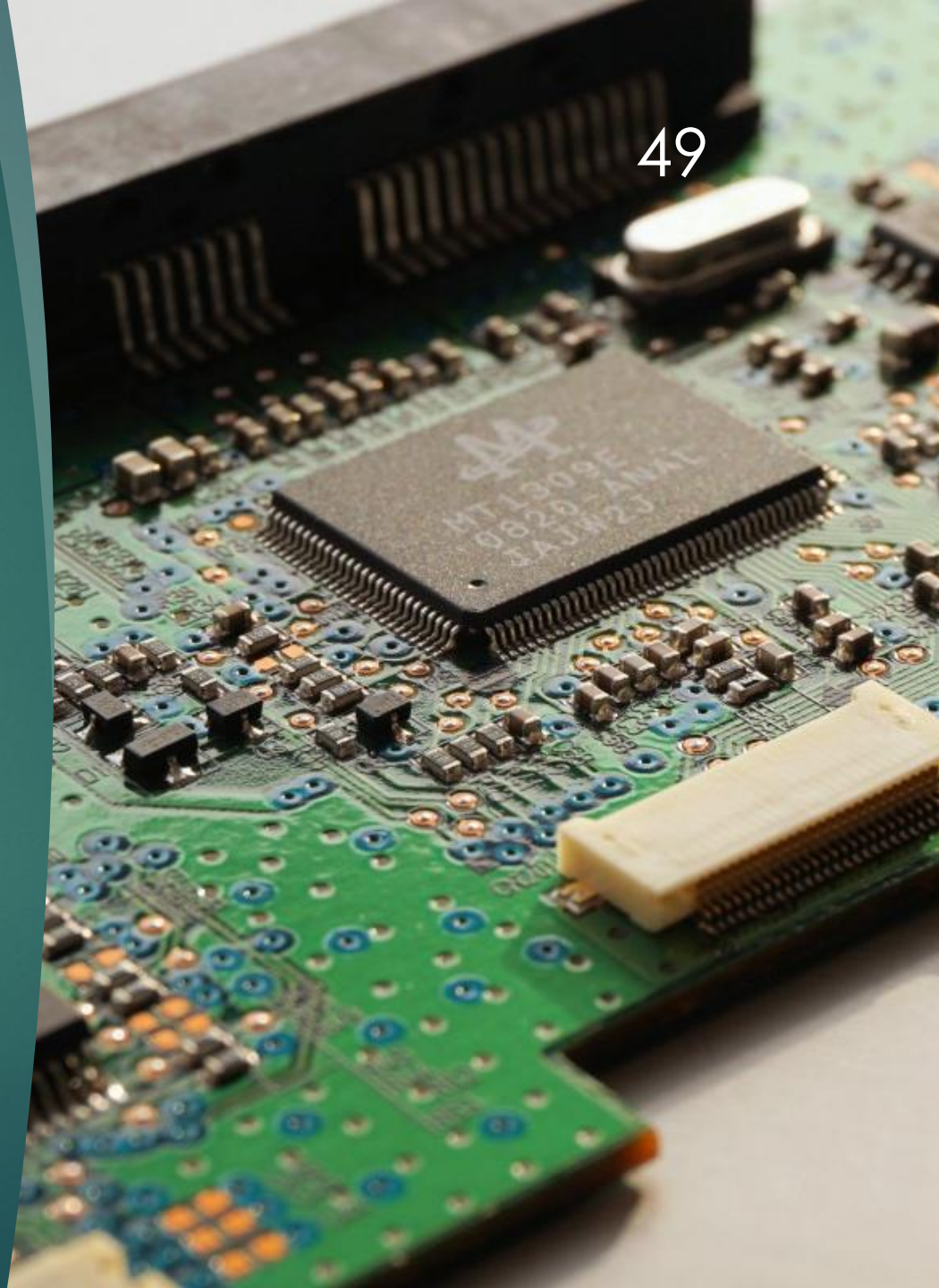
- ROM is of four types:
  - MROM
  - PROM
  - EPROM
  - EEPROM

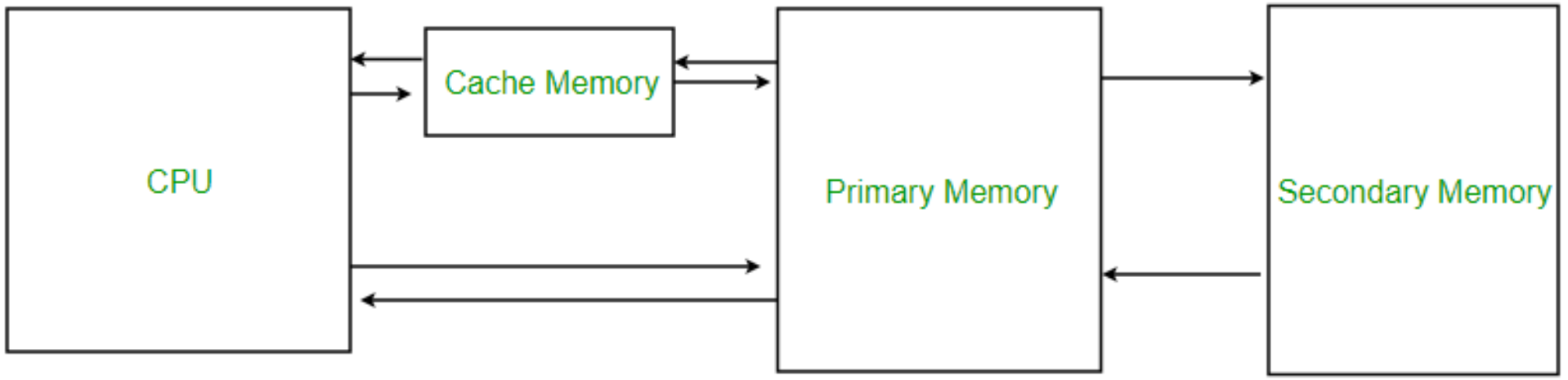
Assignment

- What is secondary memory?
- Write down the characteristics of secondary memory?
- What makes secondary memory different from the main memory in a computer, like how fast it is and how much it can store?
- How to erase data in EPROM?

Cache Memory

- Cache memory is an extremely fast memory type that acts as a buffer between RAM and the CPU.
- Cache Memory holds frequently requested data and instructions so that they are immediately available to the CPU when needed.
- Cache memory is costlier than main memory or disk memory but more economical than CPU registers.

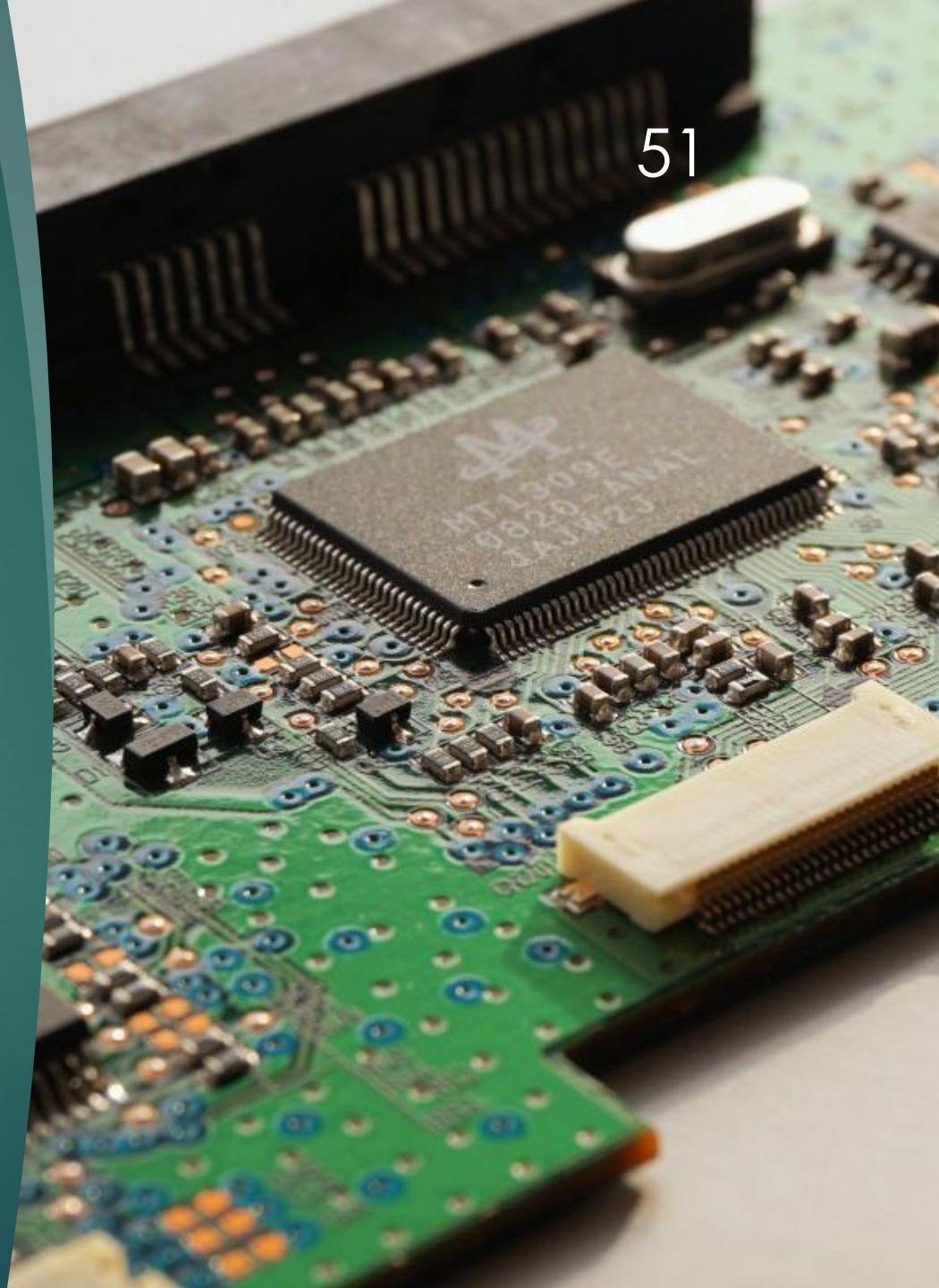




Memory interfacing Architecture

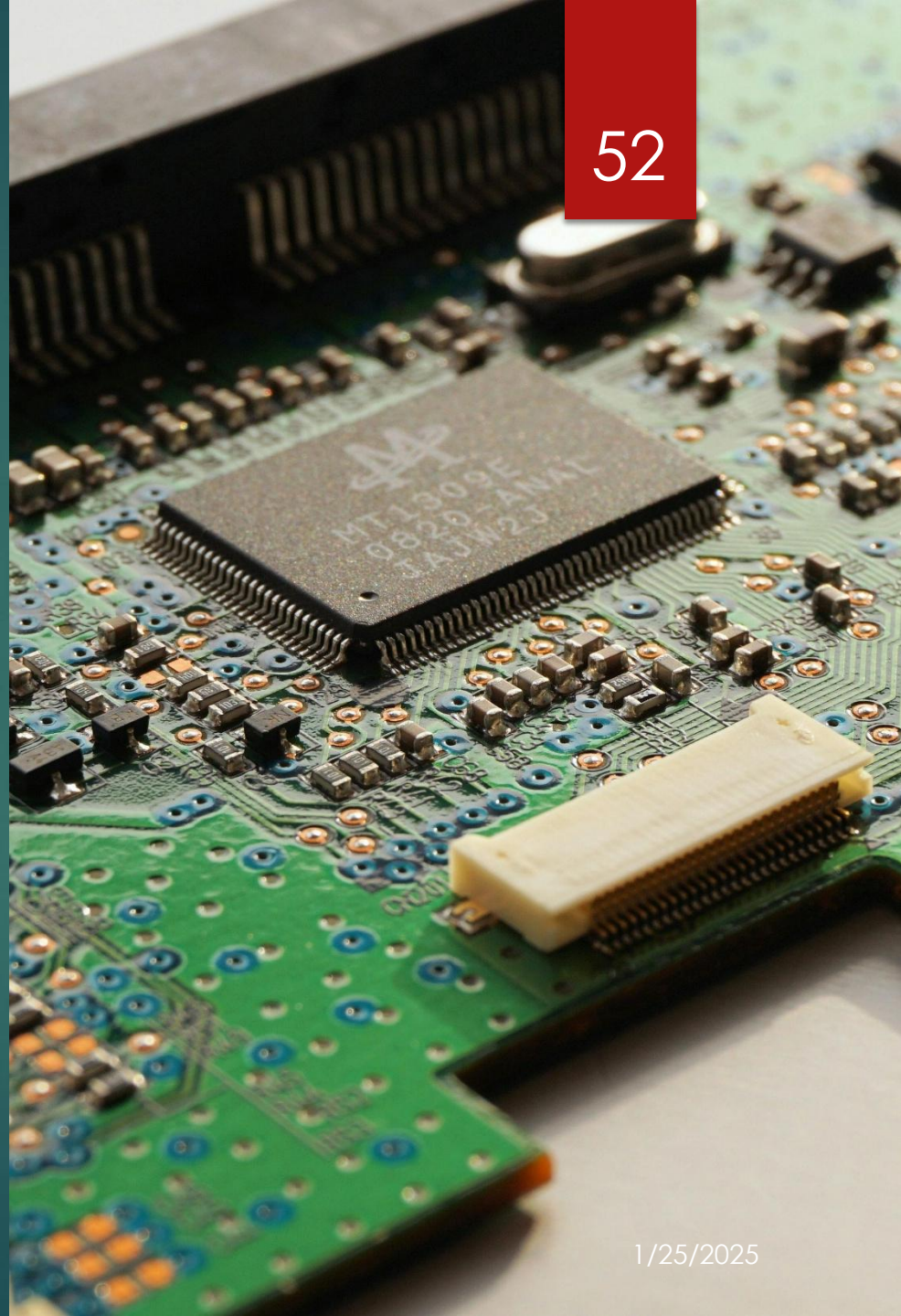
Cache Memory (Cont'd)

- The transformation of data from the MM to cache memory is referred to as mapping process, three types of mapping procedures are of practical interest when considering the organization of cache memory are:
- 1. Associative Mapping
- 2. Direct Mapping
- 3. Set-Associative Mapping.



Cache Memory Technique

- **What is a Cache Hit and a Cache Miss?**
- **Cache Hit:** When the CPU finds the required data in the cache memory, allowing for quick access. On searching in the cache if data is found, a cache hit has occurred.
- **Cache Miss:** When the required data is not found in the cache, forcing the CPU to retrieve it from the slower main memory. On searching in the cache if data is not found, a cache miss has occurred



Cache related math

A memory capacity is a way of specifying how many bits can be stored in a particular memory device or complete memory system. The capacity of memory depends on **two** parameters, **the number of words**(m) and **the number of bits per word** (n).

Memory capacity = (number of word) × (number of bits per word)

= m (word) * n (bits)

= m*n bits

EX:- A certain memory chip is specified as 2K × 16

1. How many words can be stored on this chip?
2. What is the words size?
3. How many total bits can this chip store?

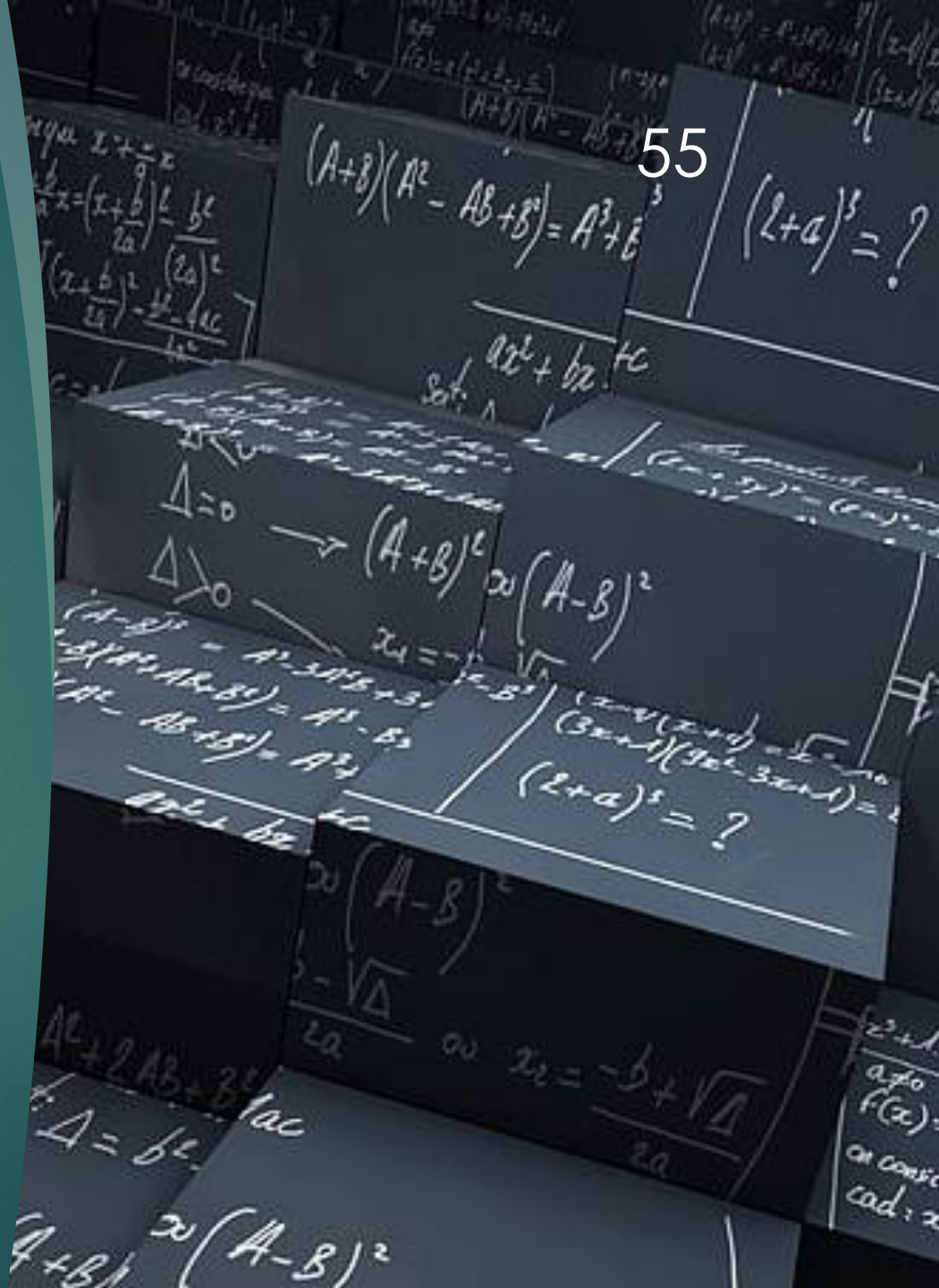
Solution:-

1. 2K = 2 × 1024 = 2048 words
2. The word size is 16-bits(2 byte).
3. Capacity = 2048 * 16 = 32,768 =23 KB.

Cache related math

- **How many 128 * 8 memory chips are required for a memory capacity of 4096*16?**
- Number of chips required = Required RAM size/ Available chip capacity

  = (4096 * 16)/(128 * 8) = 64



Thank you

Week - 3
Lecture: 3

Input Devices

Key Points:

- Defining input devices and their characteristics
- Mechanism of input devices.

Concepts Of Input Devices

- Data is inputted into the computer system in raw format, which is then translated into a computer-understandable form using input devices; after that, it is processed using a central processing unit, which produces output.
- Input devices are used to input data, information, and instructions into the RAM.

Typing Input Devices

- Keyboard is the main typing input device.
- It contains 3 types of keys – alphanumeric keys, special keys
- Alphanumeric keys are used to type all alphabets, numbers, and special symbols like $, %, @, , etc. Special keys such as <Shift>, <Ctrl>, <Alt>, <Home>, <Scroll Lock>, etc., are used for special functions. Function keys such as <F1>, <F2>, <F3>, etc., are used to give special commands depending on the software being used.

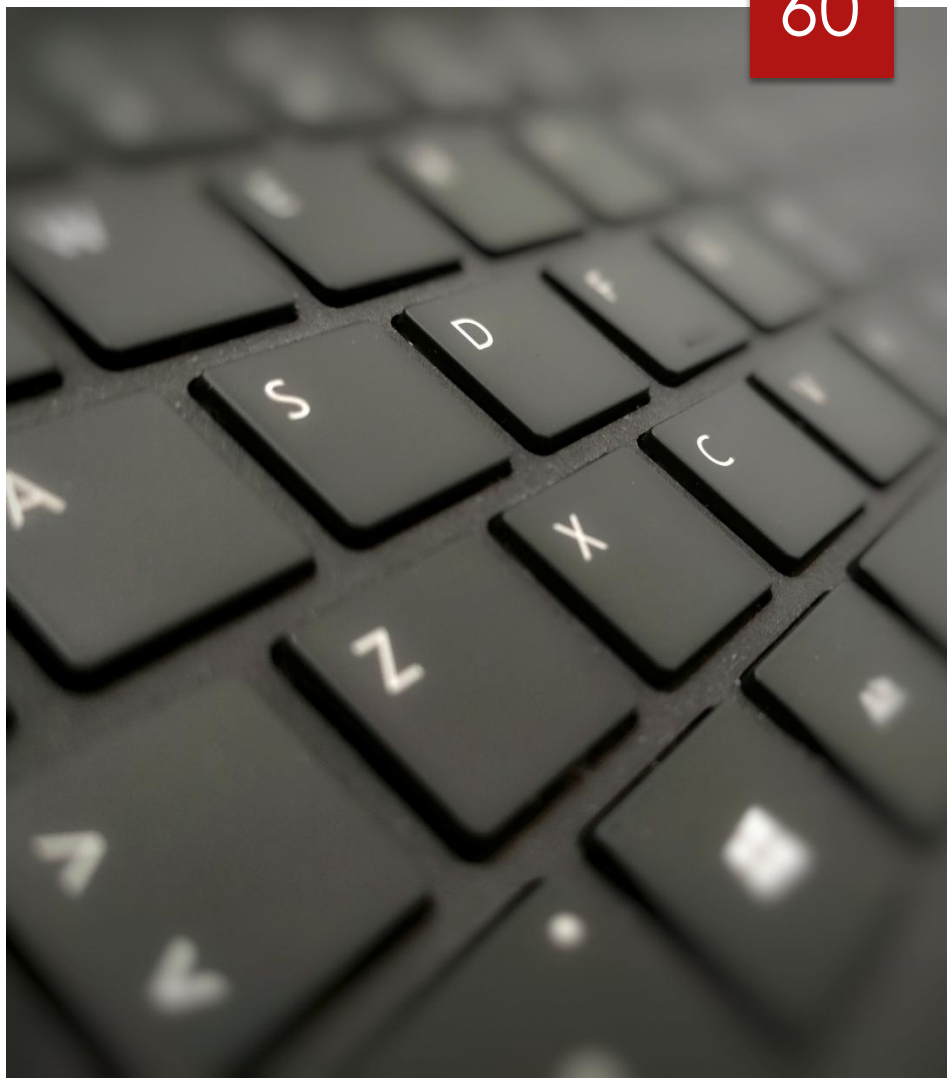
Keyboard

Keyboard switches:

When a key is pressed, a switch is activated to generate signals for communication.

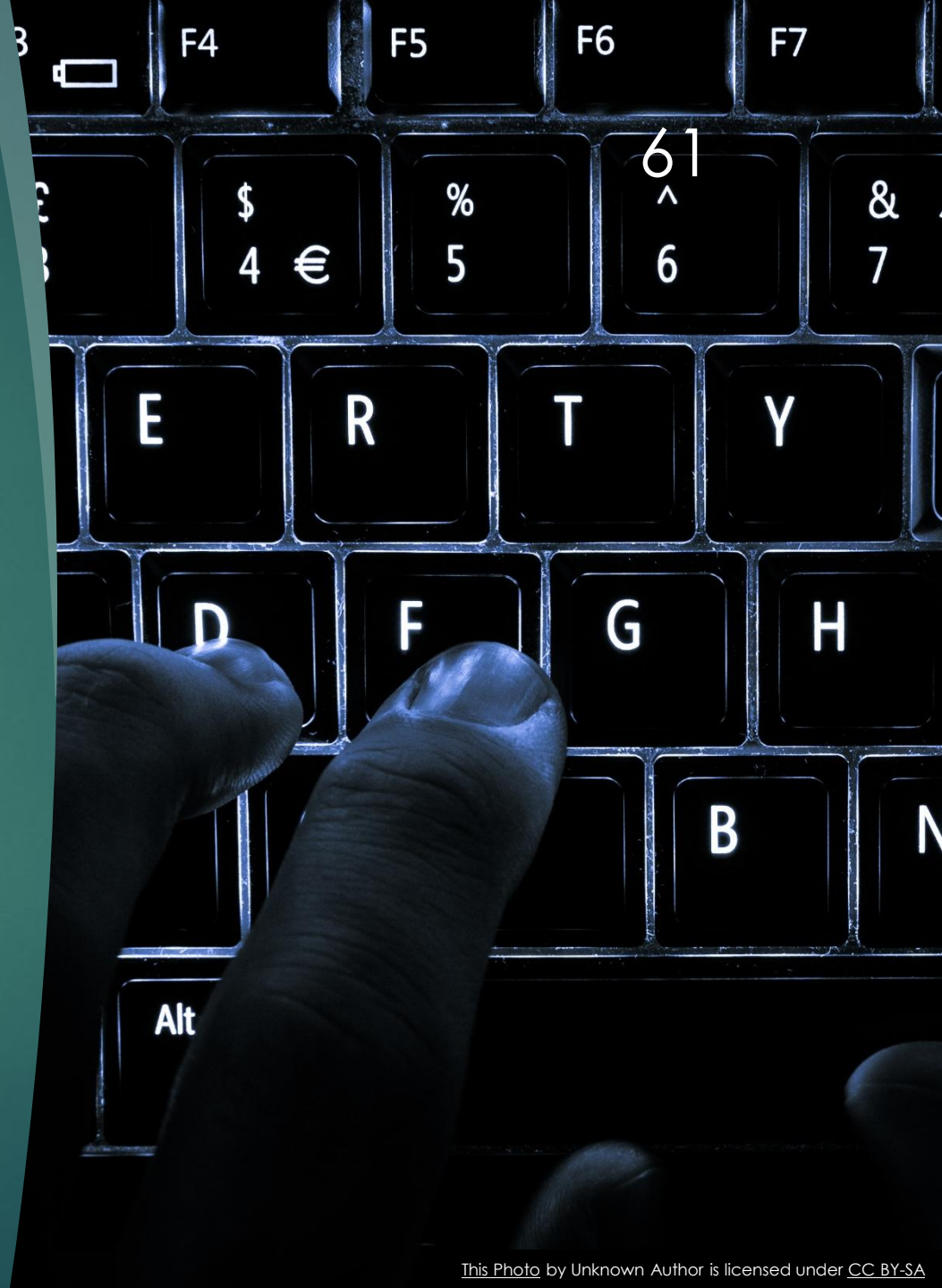
Several switches are used:

- Capacitive switch
- Mechanical switch
- Membrane switch
- Hall effect switch



Keyboard

- **Capacitive Switch:**
- Has two small metal plates.
- When key is pressed two plates are brought close to each other and the capacitance between two plates is changed.
- The change in capacitance is detected and converted to logic level to indicate the key action.
- **Advantage:** They do not have metal contacts and do not get oxidized.
- Requires a special circuit employing oscillator, PLL (phase lock loop), and a comparator to convert the switch action into logic signals.

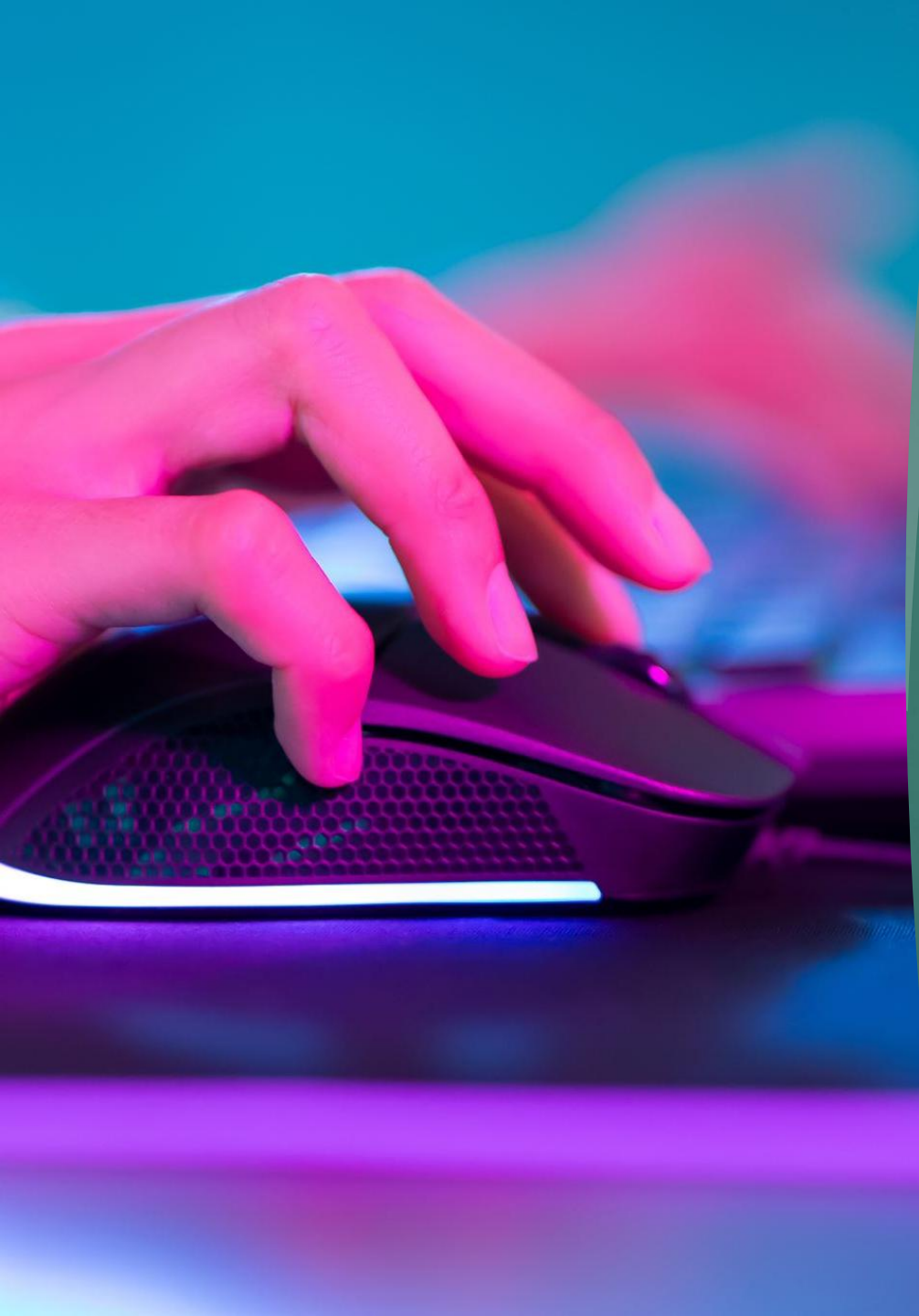


Keyboard

- **Mechanical Switch:**
- Has a metal contact, which is closed and opened on key action.
- When switch is in the normal position, the contact is open and when key is pressed, the contact is closed.
- The key contains springs to return back the contact to its original position when the key is released.
- **Problem1:** Key bouncing (5ms or less).
- **Solution1:** By employing a key debouncing technique.
- **Problem2:** Contacts get oxidized over a period of time.
- **Solution2:** Can be used gold plated contacts.

Pointing Input Devices

- Pointing devices are the most commonly used input devices today. A pointing device is any human interface device that allows a user to input spatial data to a computer.
- Types of pointing devices include:
- Mouse
- Touchpad
- Pointing Stick
- Touchscreen
- Trackball
- Light Pen



Mouse

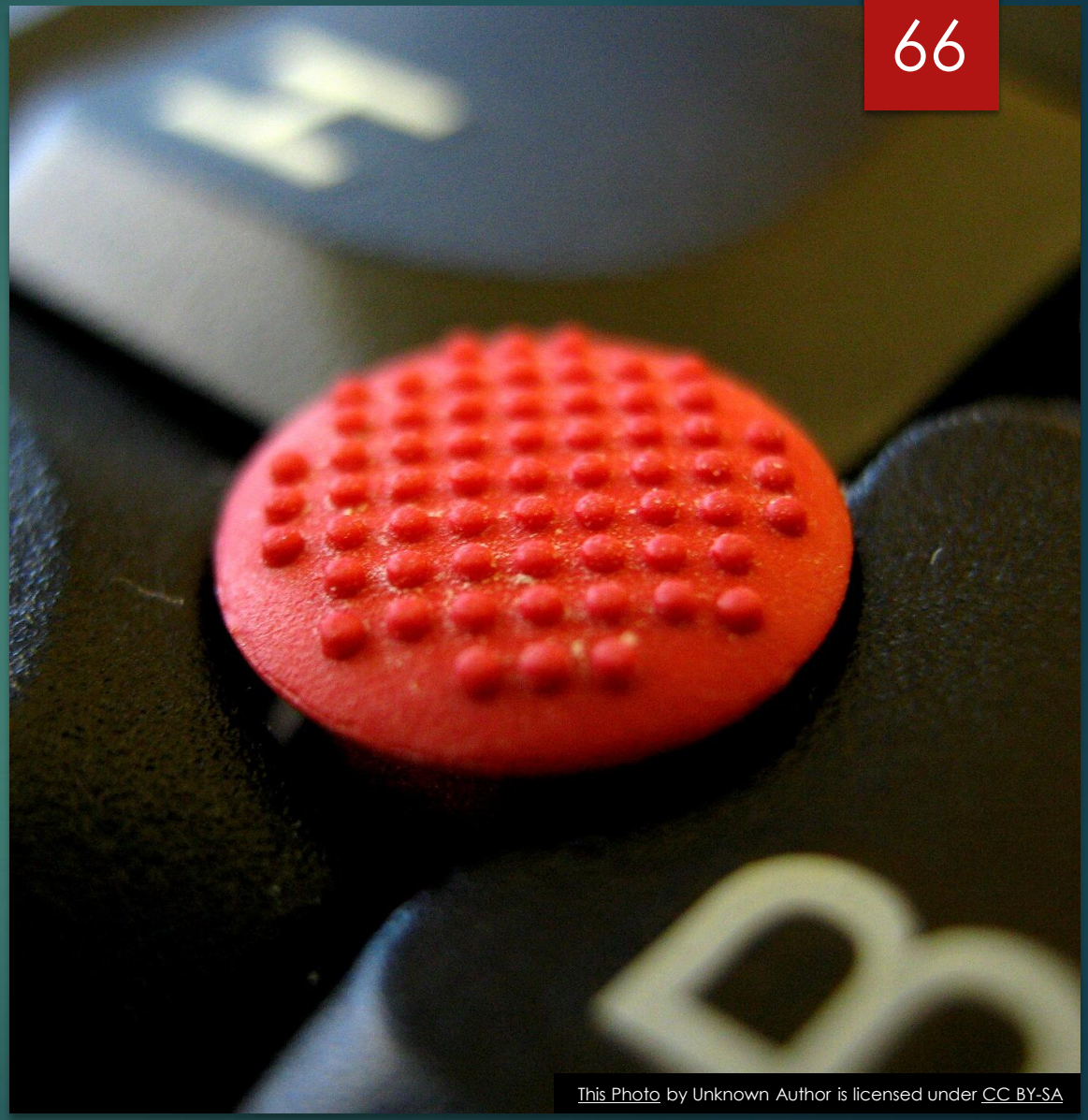
- Mouse is another important input device.
- It is a pointing device used to move the cursor, draw sketches/diagrams, and select text, objects, or menu items on the monitor screen while working in a graphical operating environment like Windows.
- A mouse is a small, palm-sized device containing three buttons and a ball.
- On the basis of buttons, a mouse can be classified as:
  - Two-buttoned mouse
  - Three-buttoned mouse

Mouse

- **On the basis of working mechanism and architecture, a mouse can be classified as:**
  - **Mechanical Mouse**: It contains a rubber ball and a pair of rotating wheels. When the mouse is moved on the table, the ball rotates, causing the wheels to rotate, which generates electronic signals.
  - **Opto-mechanical Mouse**: This type of mouse contains both mechanical and electronic components, combining the features of a mechanical mouse with optical technology.
  - **Optical Mouse**: An optical mouse operates using the reflection of light. It is easier to use but is generally considered less reliable than a mechanical mouse.

Pointing Stick

- A pointing stick is an isometric joystick used as a pointing device, similar to a touchpad or trackball, typically mounted in a computer keyboard.
- The pointing stick senses applied force using two pairs of resistive strain gauges. It can be operated by pushing it with the fingers in the direction the user wants the cursor to move. The velocity of the pointer depends on the applied force, so increasing pressure causes faster movement. The relationship between pressure and cursor speed can be adjusted, similar to how mouse speed is adjusted.



Touchscreen

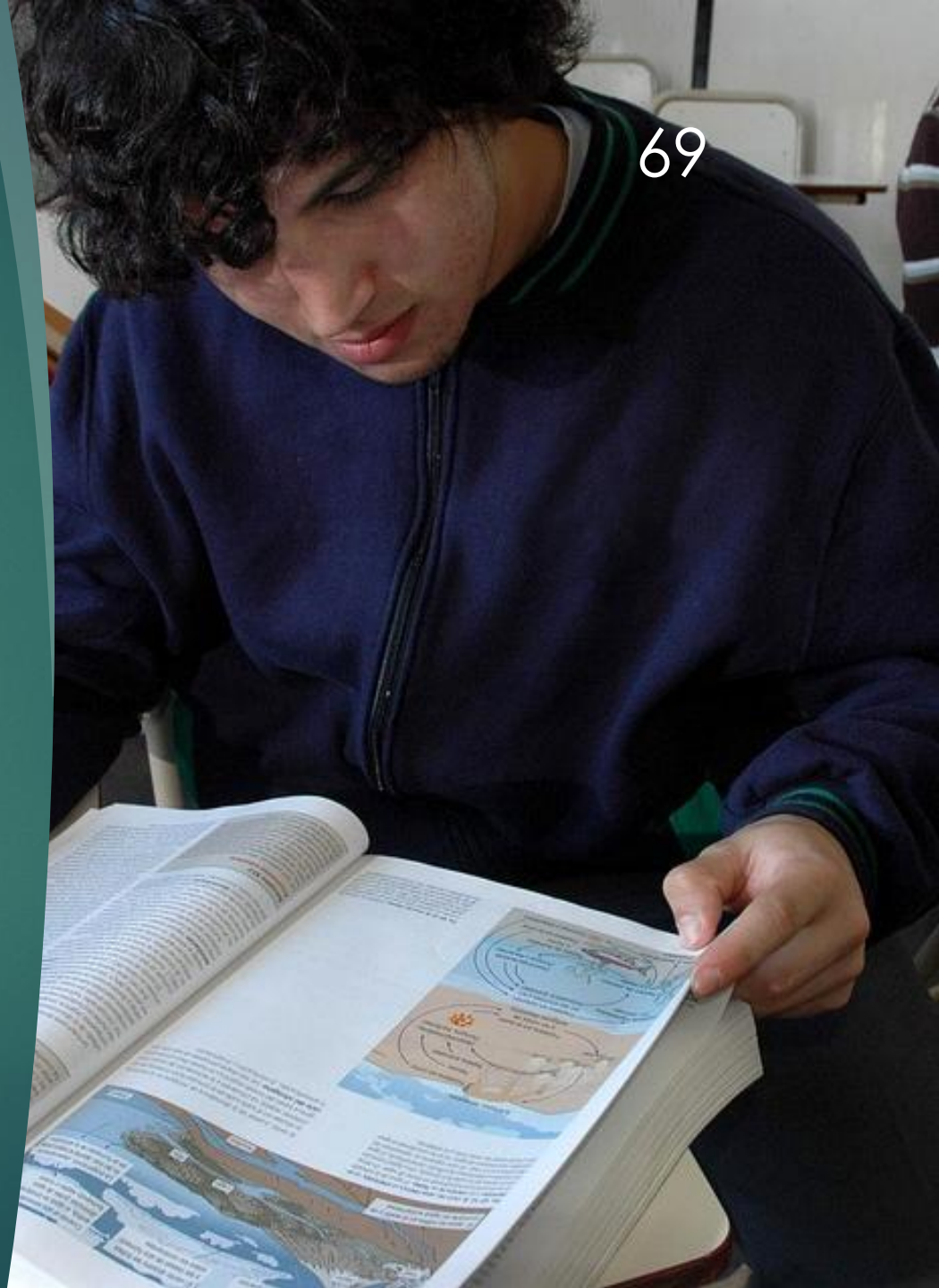
- A touchscreen is an input and output device typically layered on top of an electronic visual display of an information processing system.
- Some special VDU (Visual Display Unit) devices have touch-sensitive screens that respond to human fingers, functioning as tactile input devices.
- Using a touchscreen, users can make selections directly on the screen instead of pressing keys.
- Touchscreens help users access information quickly and are commonly used in places like hotels and airports to convey information to visitors.

Trackball

- A trackball looks like a mouse, but the roller is on the top with selection buttons on the side.
- It is also a pointing device used to move the cursor and works similarly to a mouse.
- To move the cursor in a particular direction, the user spins the ball in that direction.
- A trackball is sometimes considered better than a mouse because it requires less arm movement and occupies less desktop space. It is generally used with portable computers.

Self Study

Difference Between Mouse And Trackball



Scanning Input Devices

- Scanning devices translate images of text, drawings, photos, and similar content into digital form. Scanning devices include:
- Barcode Readers
- Mark-and-Character Recognition Devices
- Fax Machines
- Imaging Systems

- Scanner used for reading (decoding) bar-coded data
- Bar codes represent alphanumeric data by a combination of adjacent vertical lines (bars) by varying their width and the spacing between them
- Scanner uses laser-beam to stroke across pattern of bar code. Different patterns of bars reflect the beam in different ways sensed by a light-sensitive detector
- Universal Product Code (UPC) is the most widely known bar coding system

Barcode Readers

- MICR is used by banking industry for faster processing of large volume of cheques
- Bank's identification code (name, branch, etc.), account number and cheque number are pre-printed (encoded) using characters from a special character set on all cheques
- Special ink is used that contains magnetizable particles of iron oxide
- MICR reader-sorter reads data on cheques and sorts them for distribution to other banks or for further processing

Magnetic-Ink Character Recognition (MICR)

Electronic Card Reader

- Electronic cards are small plastic cards having encoded data appropriate for the application for which they are used
- Electronic-card reader (normally connected to a computer) is used to read data encoded on an electronic card and transfer it to the computer for further processing
- Used together as a means of direct data entry into a computer system
- Used by banks for use in automatic teller machines (ATMs) and by organizations for controlling access of employees to physically secured areas

Audio Input Devices

- Audio input devices allow a user to send audio signals to a computer for processing, recording, or carrying out commands.
- Examples of types of audio input devices include:
  - Microphones
  - MIDI keyboard or other digital musical instruments

Microphones

- A microphone is an acoustic-to-electric transducer or sensor used to convert sound signals into electrical signals.
- It was originally invented by Emile Berliner in 1877, and allows you to record voices or sounds and store them on computers, typically as a wave file.

MIDI Keyboard

- A MIDI keyboard is typically a piano-style user interface keyboard device used for sending MIDI signals or commands over a USB or MIDI cable to other devices connected and operating on the same MIDI protocol interface.
- This could also be a personal computer running software such as a Digital Audio Workstation (DAW) that listens to and sends MIDI information to other MIDI devices connected by cable or operating internally within the computer system. The basic MIDI keyboard does not produce sound.

Thank you

Week - 4
Lecture: 4

Output Devices

- Key Points:
- Defining output devices and their characteristics
- Mechanism of output devices.

Concepts Of Output Devices

- Output devices are **peripheral hardware** connected to computers using **cables or wireless networks**.
- They **display, print, or project the results** of the computer's processing.
- The major output devices are:
- VDT (Video Display Terminal)
- Monitors
- Printers
- Plotters
- Voice response system

Types of Output Devices

- Two types –

a. Soft-copy output:

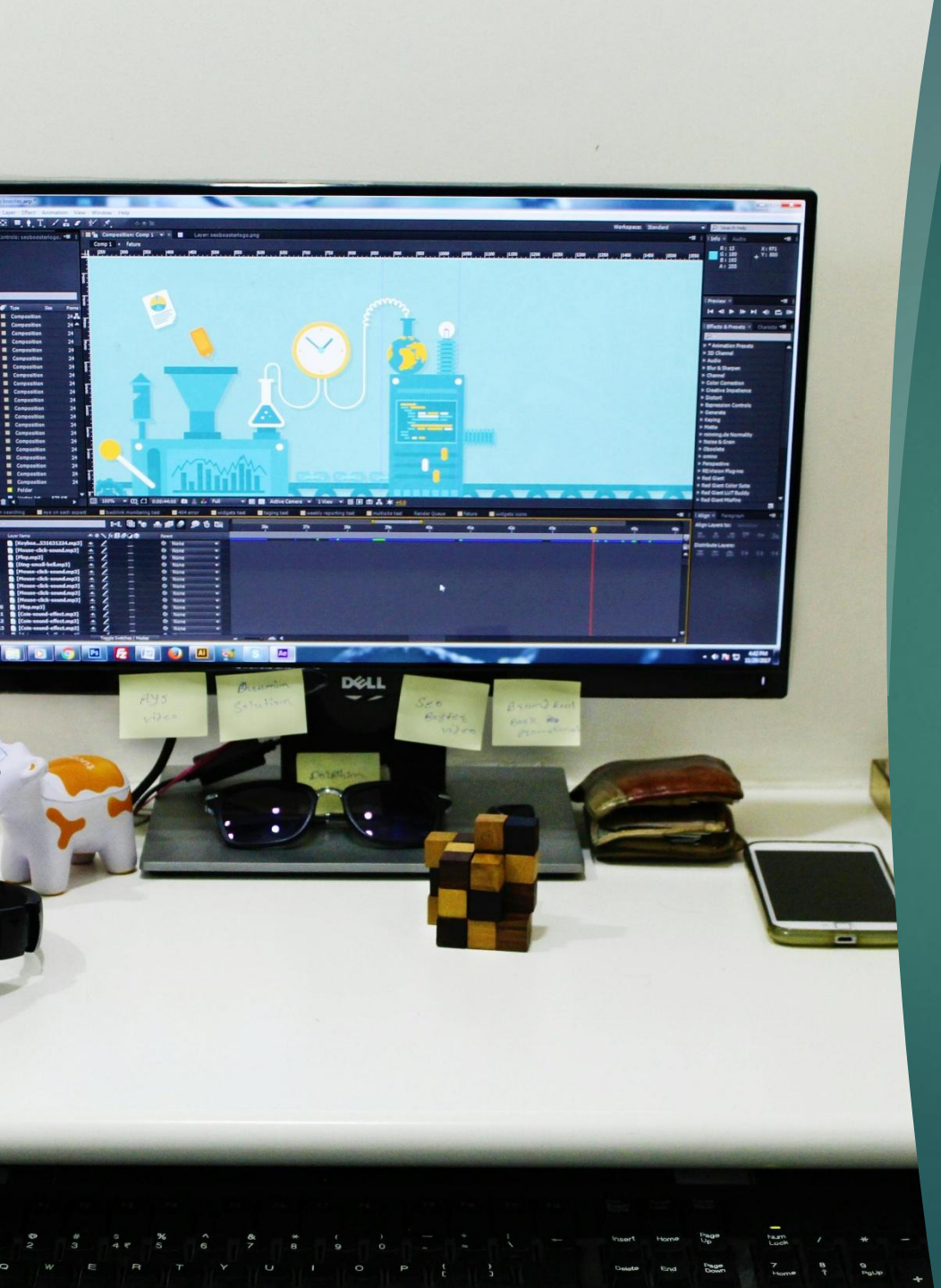
b. Hard-copy output:

a>

- Softcopy devices provide screen-displayed output, which is lost when the computer is turned off.
- Allow users to view, correct, and rearrange materials to meet specific needs. Examples of softcopy devices include monitors, PCs, projectors, and VDTs (Video Display Terminals).

b>

- Hardcopy devices provide output in a physical form. The output is permanent.
- hardcopy output devices include printers and plotters, as they print the output on paper.



Monitor

- A computer display, also called a display screen or Video Display Terminal (VDT), and sometimes referred to as a Visual Display Unit (VDU), is a screen used to display output.
- Images on monitors are represented by individual dots called pixels.
- The density of these dots determines the clarity of the images, which is referred to as the screen's resolution.

Types of VDU

- Two types-

a. Cathode Ray Tubes (CRTs)

b. Flat Panel Display.

Cathode Ray Tubes (CRTs)

- A CRT (Cathode Ray Tube) is a vacuum tube used as a display screen for a computer output device.
- While 'CRT' technically refers to the tube itself, it is often used to refer to the entire monitor.
- Two types:

1. Monochrome Monitors
2. Color Monitors

Flat Panel Display

- Portable computers, such as laptops, use flat panel displays because they are more compact and consume less power than CRTs.
- **Liquid Crystal Displays (LCDs)**
- **Description**: LCDs create characters using reflected light and are widely used in digital watches and laptops.
- **Advancement**: LCDs replaced LEDs (Light Emitting Diodes) because they consume less power.
- **Drawback**: They are difficult to read in strong light because they do not emit their own light. To address this, brighter and easier-to-read backlit LCDs are now used.

Flat Panel Display.

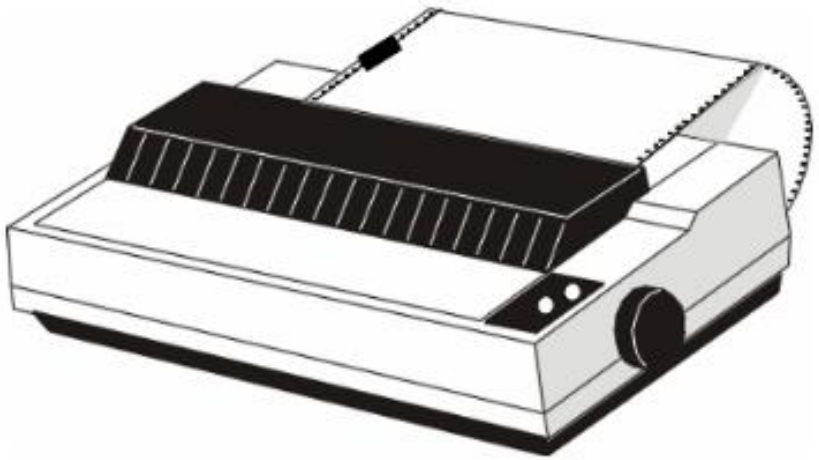
- **Light Emitting Display (LED)**
- **Description**: Unlike LCDs, LED technology actively emits light at each pixel when electrically charged.
- **Advantage**: LEDs provide a sharper, clearer image with a wider viewing angle.
- **Comparison**: The EL (Electroluminescent) display type of flat panel is considered superior to LCDs in terms of image quality and clarity.

Printer

- A printer is an output device that produces a hard copy of data. The resolution of printer output is expressed as DPI (dots per inch).
- Types:-
- **Serial Printers**
- **Also Known As**: Character Printers
- **Printing Method**: Prints one character at a time.
- **Features**:
  - Inexpensive.
  - Slow in printing speed.
  - Commonly used for simple printing tasks.

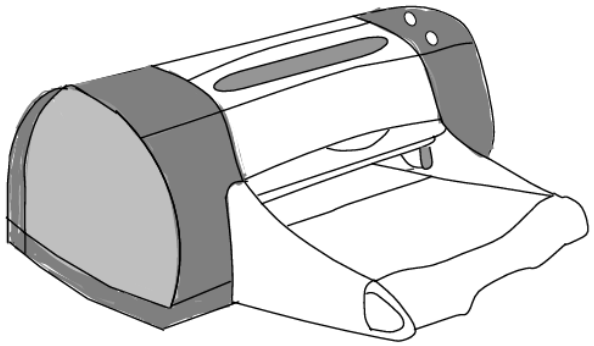
Printer

- **Line Printers**
- **Printing Method**: Prints an entire line at a time.
- **Features**:
  - •Expensive.
  - •Very fast, making them suitable for high-volume printing.
  - •Uses mechanisms such as bands, chains, or drums to print entire lines at once.
- **Page Printers**
- **Also Known As**: Laser Printers
- **Printing Method**: Prints an entire page at a time.
- **Features**:
  - •Uses a laser to produce the image on the page.
  - •Provides the best print quality compared to other types of printers.
  - •Slightly expensive, but the cost of personal laser printers has been decreasing.



- Character printers that form characters and all kinds of images as a pattern of dots
- Print many special characters, different sizes of print and graphics such as charts and graphs
- Impact printers can be used for generating multiple copies by using carbon paper or its equivalent
- Slow, with speeds usually ranging between 30 to 600 characters per second
- Cheap in both initial cost and cost of operation

Dot Matrix Printer

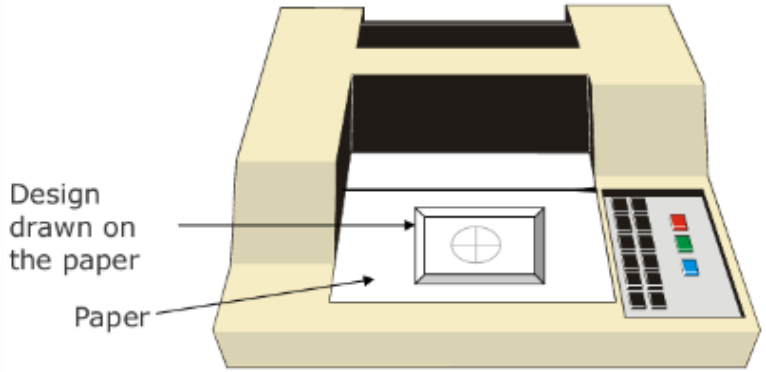


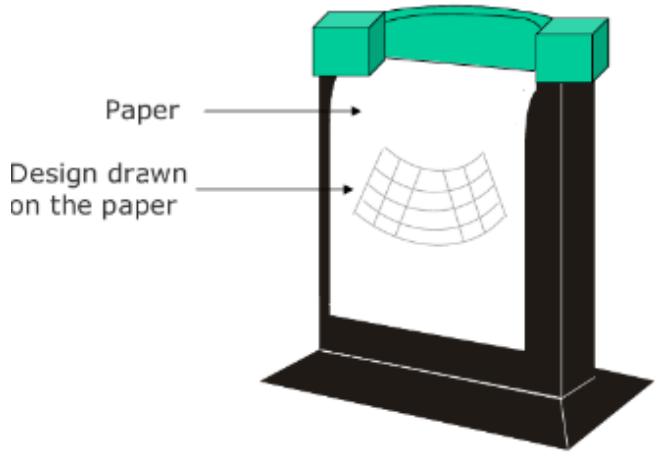
- Character printers that form characters and all kinds of images by spraying small drops of ink on to the paper
- Print head contains up to 64 tiny nozzles that can be selectively heated up in a few micro seconds by an integrated circuit register
- To print a character, the printer selectively heats the appropriate set of nozzles as the print head moves horizontally
- Can print many special characters, different sizes of print, and graphics such as charts and graphs

Inkjet Printer

Plotters

- Plotters are an ideal output device for architects, engineers, city planners, and others who need to routinely generate high-precision, hard-copy graphic output of widely varying sizes
- Two commonly used types of plotters are:
  - *Drum plotter*, in which the paper on which the design has to be made is placed over a drum that can rotate in both clockwise and anti-clockwise directions
  - *Flatbed plotter*, in which the paper on which the design has to be made is spread and fixed over a rectangular flatbed table





Thank you

Week - 5
Lecture: 5

Central Processing Unit (CPU)

Key Points:

- Understand the concept of CPU
- Explain the flowchart of CPU operation
- The mechanism of ALU
- Know how to choose processor speed

The CPU– Theory 📖

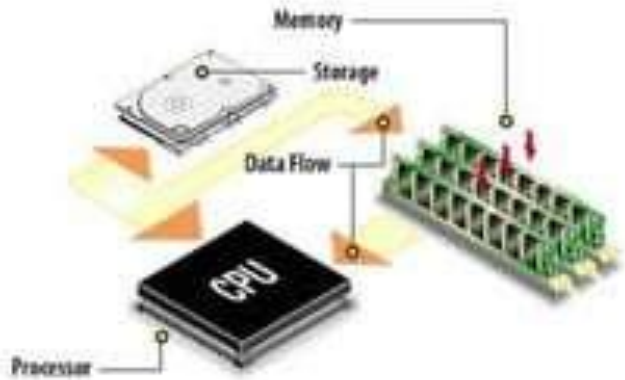
- The **CPU** (Central Processing Unit) is hardware that executes programs and manages the rest of the computer system. It sits underneath the heat sink on the motherboard and is made up of millions of electrical switches called transistors.
- All data is stored within a computer as electronic signals in micro-circuits. There are only 2 types of signal -on or off. A micro-circuit can either carry an electrical signal or not. This will lead to our discussion of **binary** later in the course.
- The CPU is often known as the "brains" of the computer and its purpose is to process data. It does this by performing functions such as calculating, decision making and moving data around.
- Our computers would not work if not for the CPU, similar to us not functioning without our brain!
- Think of all the tasks our computer does. Write a list of 10 jobs.
- Eg. Perform a function on a spreadsheet…

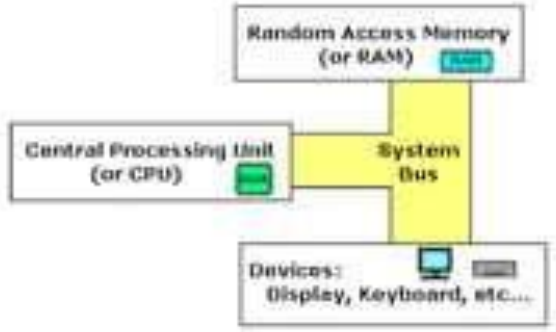
The CPU

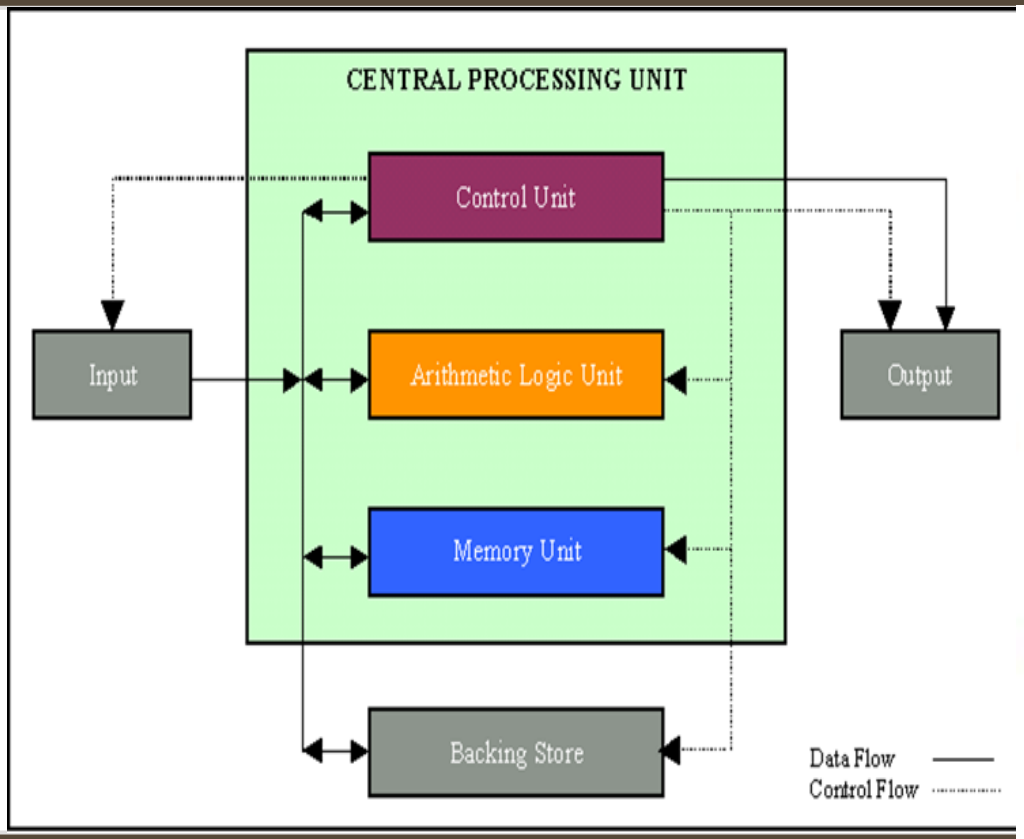
- ...the CPU will deal with all the data processing, without it none of your tasks will be performed.
- The first CPU chip was invented in 1971 - a 4 bit processor designed for a calculator! This is where our story starts...
- Processor speed has doubled over time while a second processor has resulted in the phrase dual-core which is a double processor - doubling the speed.
- It doesn't stop there, quad-core, hexa-core and octa-core offer the next steps to power our machines even faster.
- Software running on our systems have to be designed to take full advantage of all these new progressions.
- Current mobile devices will carry mobile processors; small versions without fans to keep it cool.

How it all fits together

- You **input** information and commands using the mouse and keyboard.
- You see/hear the results on the **output** devices- screen and speakers
- The CPU ("processor") is the working brain of the computer, that does all the **processing** and computation
- The memory ("RAM") is where the CPU keeps information it is working with (the information in the RAM is lost when the computer is switched off)
- **Storage** (e.g. hard-disks, USB data sticks) is where the computer keeps information for longer periods (not lost when the computer is off)

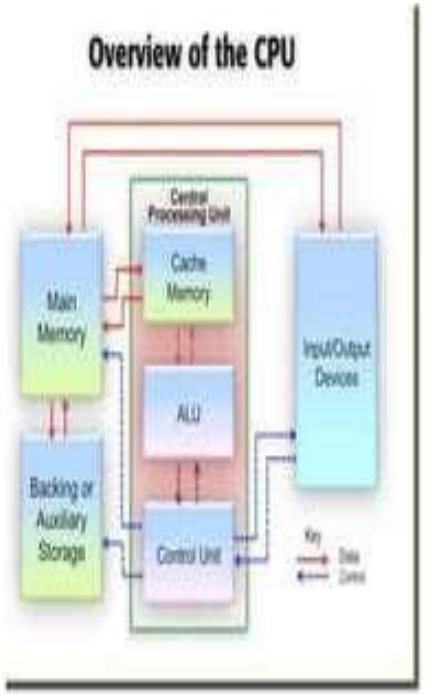






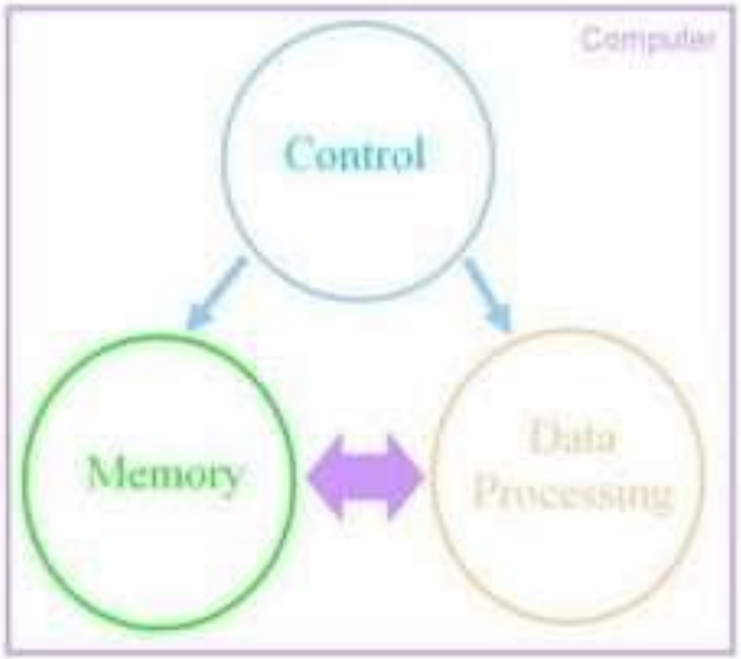
Elements of the CPU

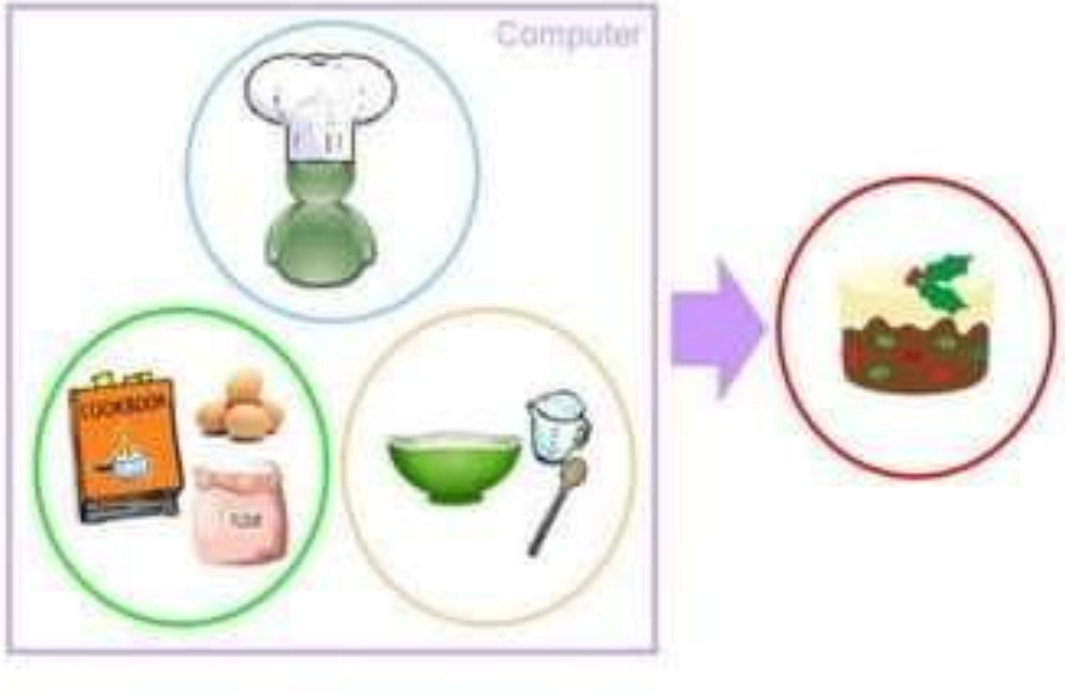
- The CPU consists of 3 major components:
  - The Arithmetic and Logic Unit (ALU)
  - The Memory Unit
  - The Control Unit (CU)
- The **ALU** - carries out mathematical tasks rapidly, performs calculations and logic operations in binary form 1/0 on data from the memory unit. The ALU transforms the digital data and outputs the resulting value.
- The **Memory Unit** consists of a small number of memory **registers** which will store items of data and send them to the ALU for processing. The result of the processing will be copied back to the memory unit for storage.
- The **CU** - is in charge of processing. It interprets the software instruction and sends the right data and operation to the ALU. It accepts the result of the processing from the ALU and sends it back to the memory unit. The CU will keep track of the sequence of instructions and the location of each item of data and software instruction in the memory unit.



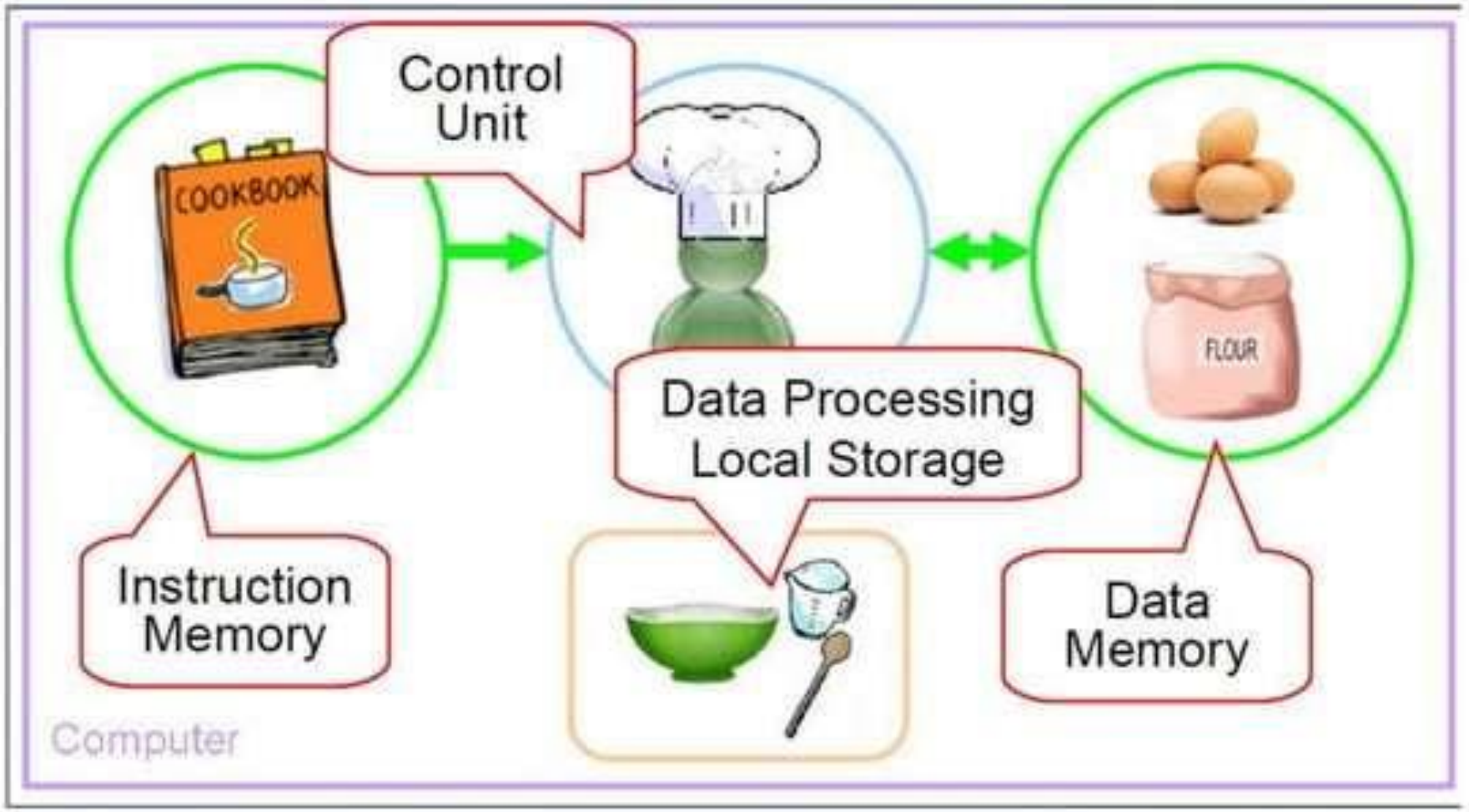
What does a computer do?

- It runs a computer program
- What is a program?
- Program : the sequence of instructions stored in 'memory' required to solve a specified problem
- Computer architecture:



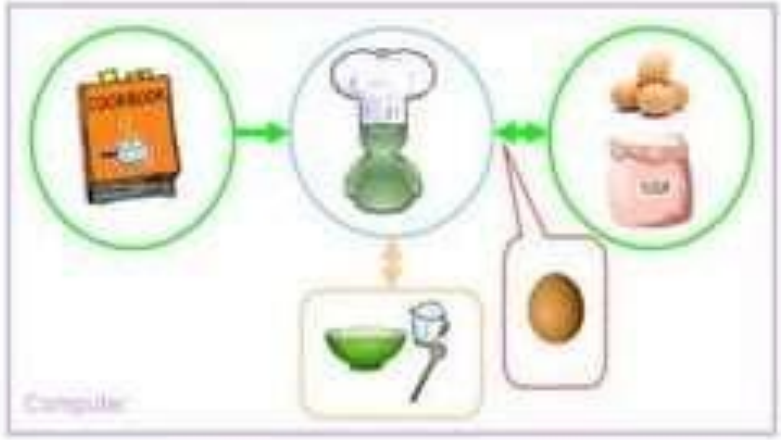


An Analogy

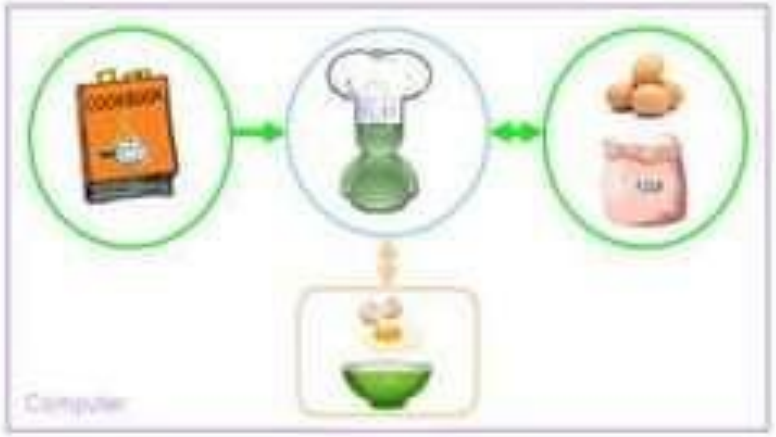

Control Unit
COOKBOOK
FLOUR
Data Processing
Local Storage
Instruction Memory
Data Memory
Computer

Fetch-Execute Cycle Analogy

Fetch : read instruction from cook book.

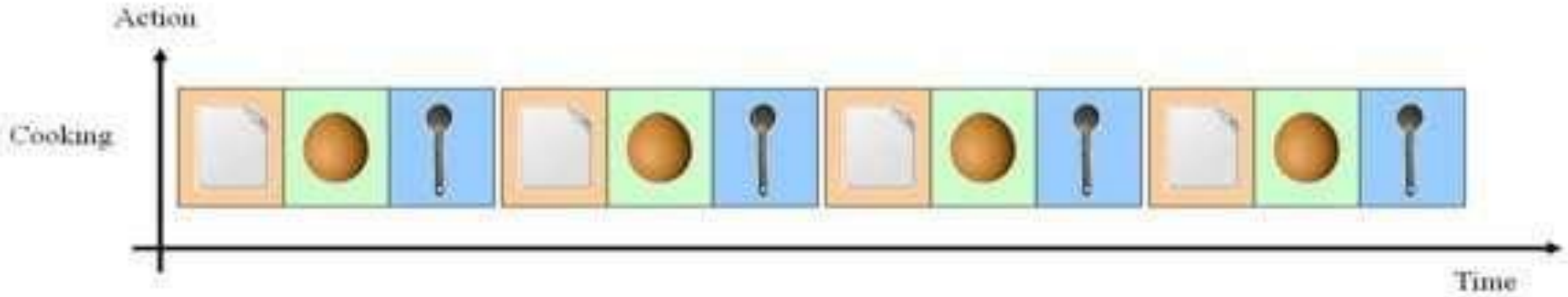


Decode : understand instruction and get ingredients from store

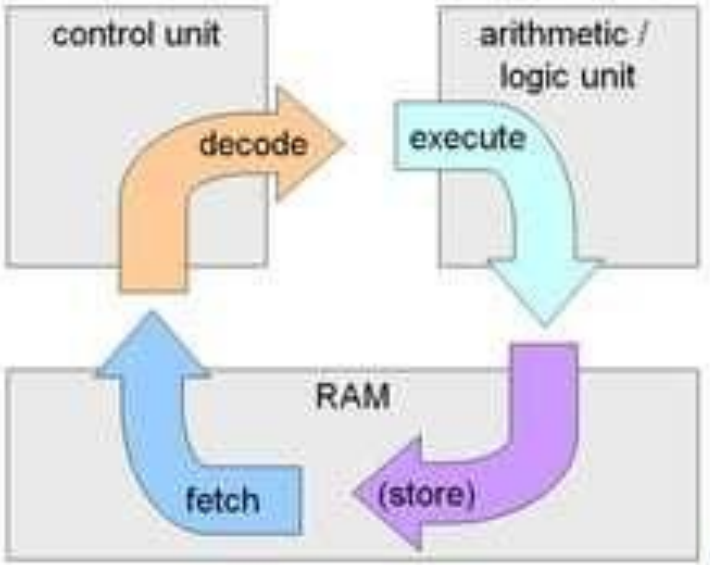


Execute : crack egg into bowl.

Fetch-Execute Cycle



- **The CPU will typically perform the following execution cycle:**
- The CU **fetches** a single instruction and data from the main memory
- The instruction is **decoded.**
- The ALU **executes** the instruction
- The ALU sends the result of the processing back to the control unit - this is stored in the memory unit.



Thank You

Week – 6 & 7
Lecture: 6 & 7
Number System

Key Points:

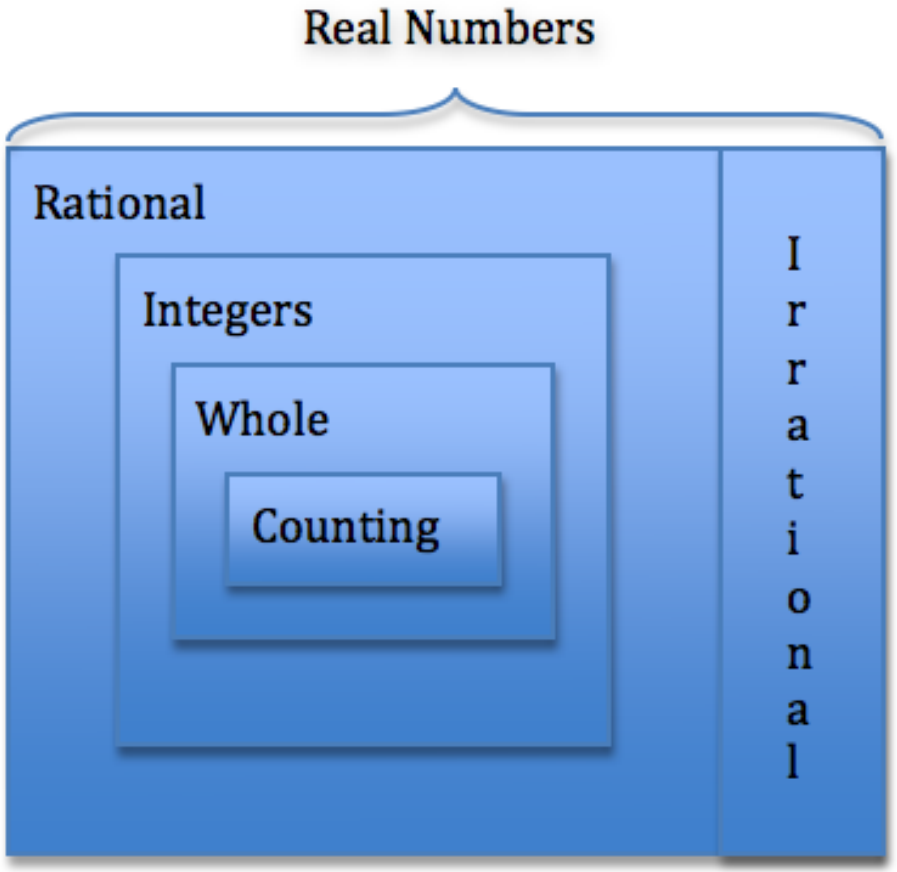
- The concept of base in number system
- The conversion of number system

Introduction

- A digital computer is an interconnection of digital modules.
- A digital computer manipulates discrete elements of information and that these elements are represented in the binary form.
- Data processing is carried out by means of binary logic elements using binary signals.
- Quantities are stored in binary storage elements.

Number System Types

- Two types of number systems are:
- Non-positional number systems
- Positional number systems



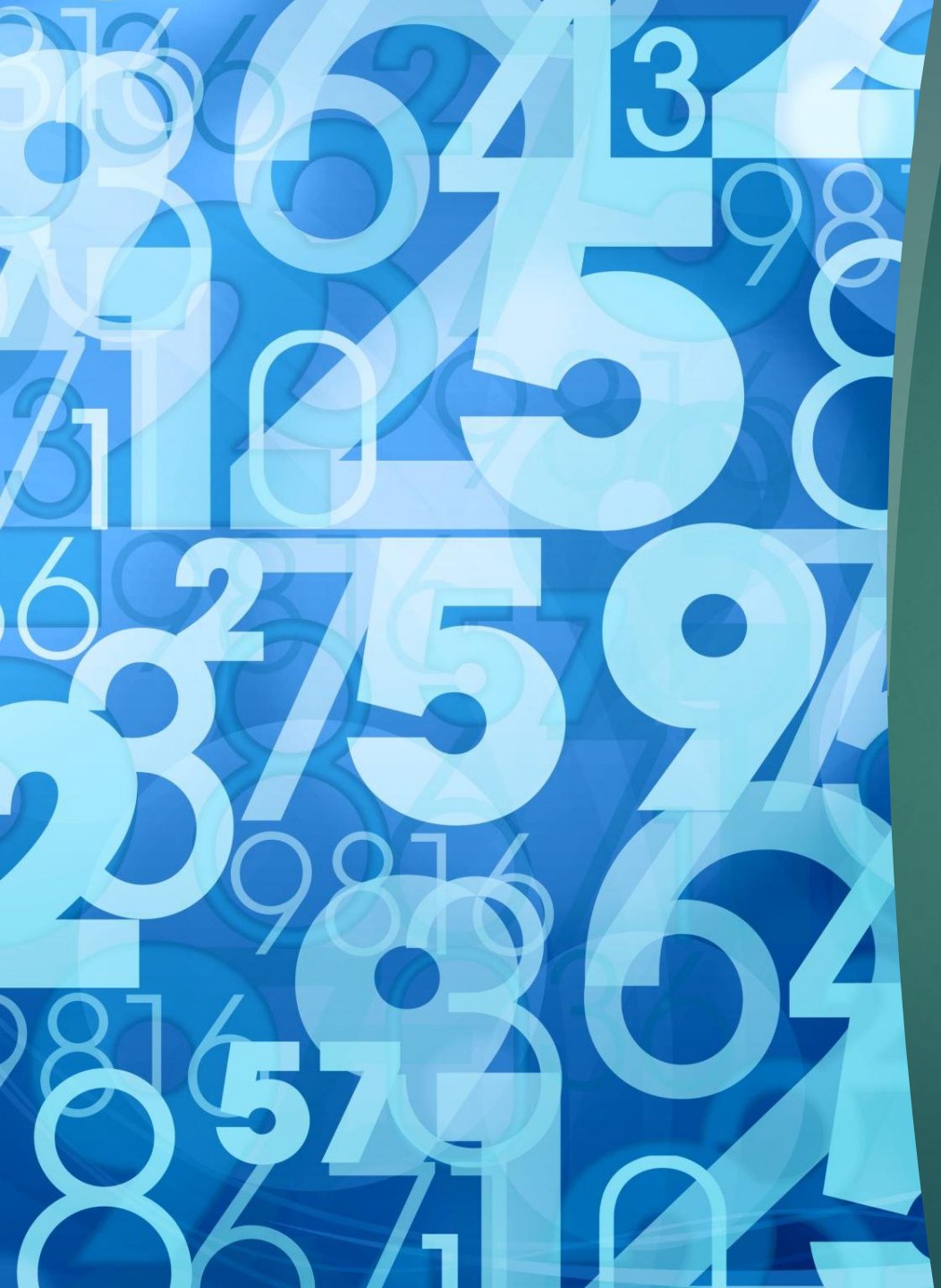
Non-positional Number Systems

Characteristics

- Use symbols such as I for 1, II for 2, III for 3, IIII for 4, IIIII for 5, etc.
- Each symbol represents the same value regardless of its position in the number
- The symbols are simply added to find out the value of a particular number

Difficulty

- It is difficult to perform arithmetic with such a number system



Positional Number Systems

Characteristics:

- Use only a few symbols called digits
- These symbols represent different values depending on the position they occupy in the number

Positional Number Systems

The four common types of Number System are:

- Decimal Number System
- Binary Number System
- Octal Number System
- Hexadecimal Number System

Decimal Number System

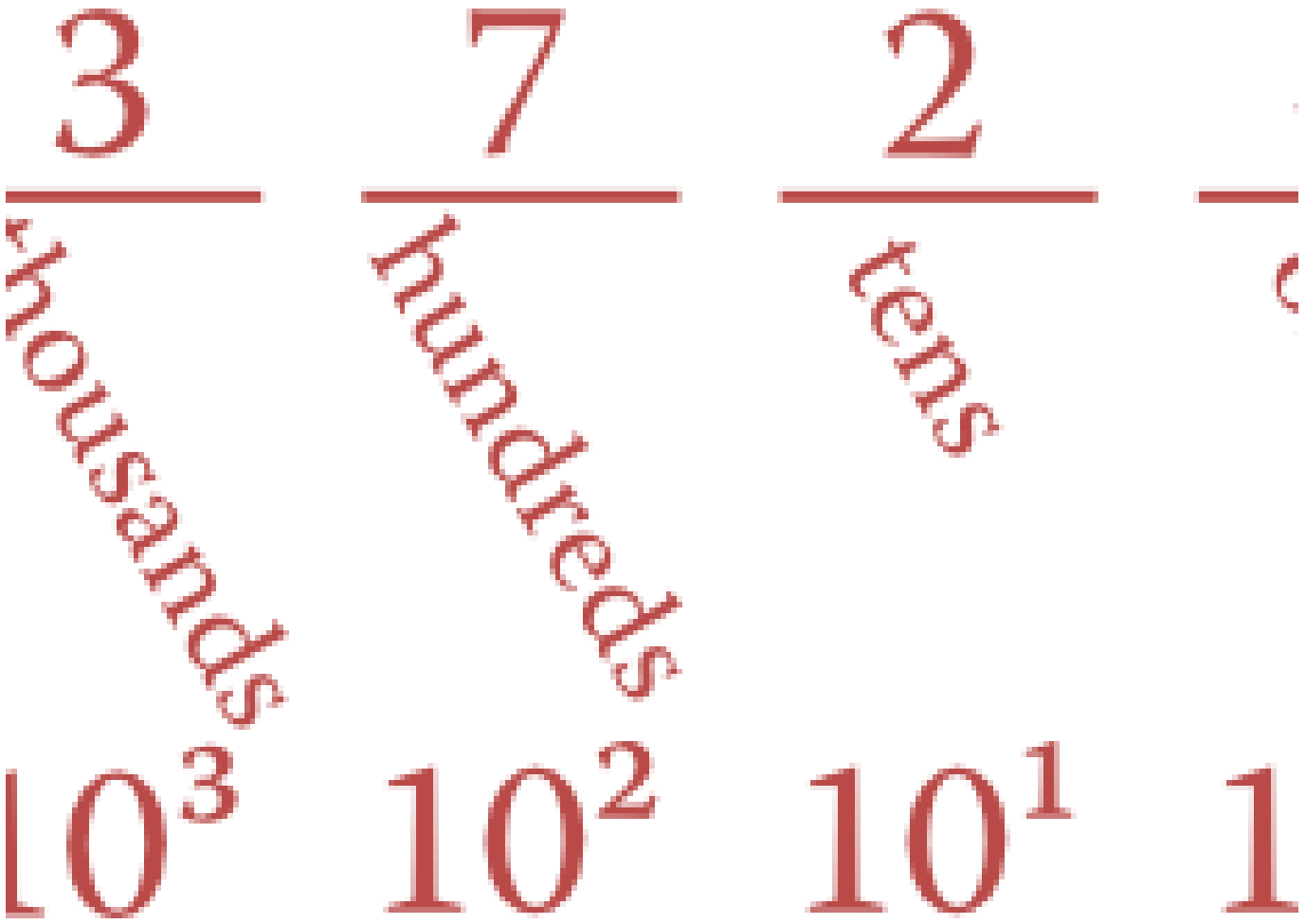
- Each position represents a specific power of the base (10).
- The place value is termed from right to left as first place value called units, second to the left as Tens, so on Hundreds, Thousands, etc.
- Example: 10285 has place values as

$(1 \times 10^4) + (0 \times 10^3) + (2 \times 10^2) + (8 \times 10^1) + (5 \times 10^0)$

$1 \times 10000 + 0 \times 1000 + 2 \times 100 + 8 \times 10 + 5 \times 1$

$10000 + 0 + 200 + 80 + 5$

10285



Binary Number System

- Number System with base value 2 is termed as Binary number system. It uses 2 digits i.e. 0 and 1 for the creation of numbers.
- In this number system, there are only two types of electronic pulses; absence of electronic pulse which represents '0'and presence of electronic pulse which represents '1'. Each digit is called a bit.
- Example:
- Binary Number: 10101_2

Representation of a Binary Number

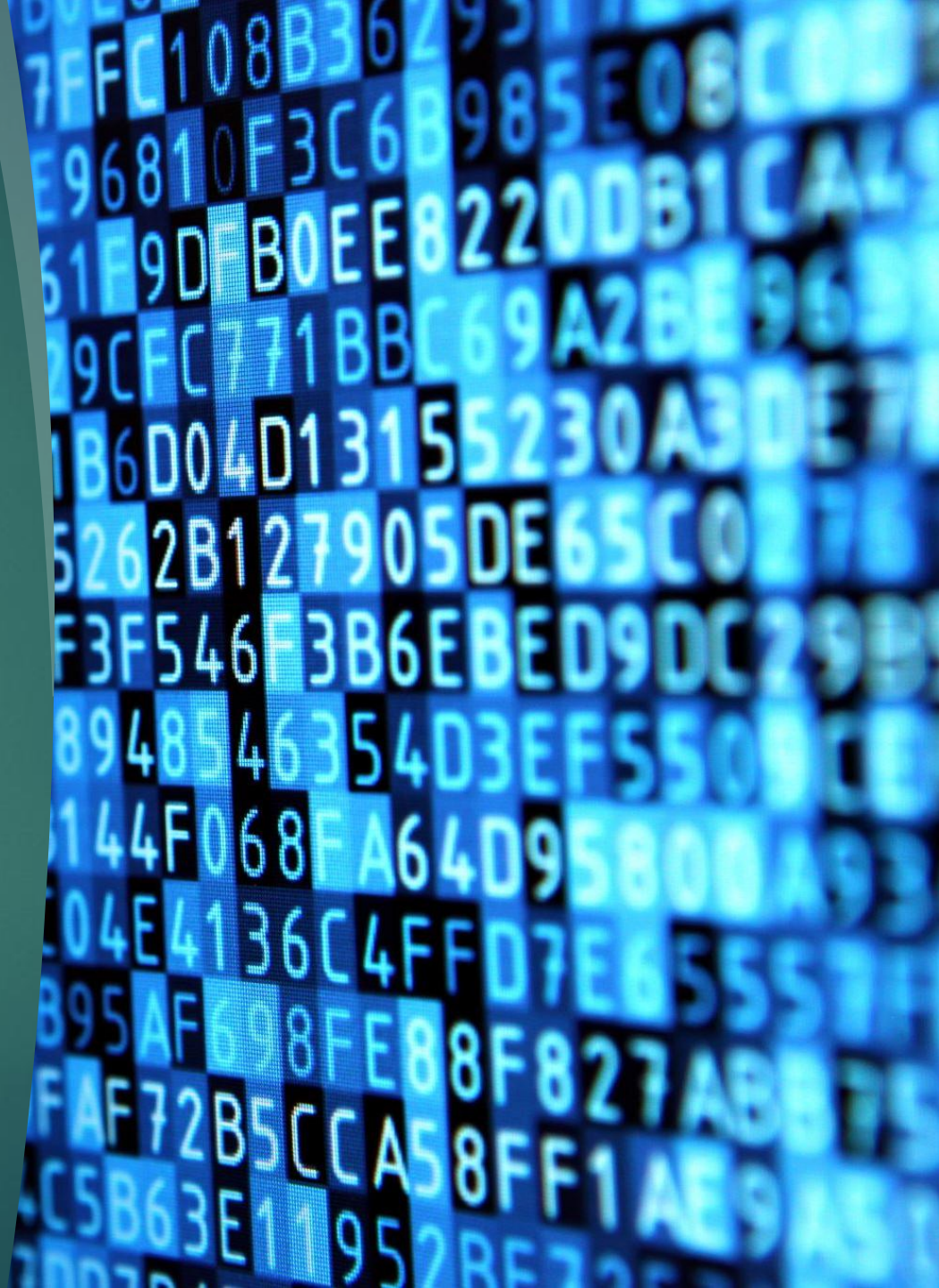
MSB	Binary Digit							LSB
2^8	2^7	2^6	2^5	2^4	2^3	2^2	2^1	2^0
256	128	64	32	16	8	4	2	1

Octal number system

- Octal Number System is one in which the base value is 8. It uses 8 digits i.e. 0-7 for creation of Octal Numbers.
- Also called as base 8 number system
- Example:
- $(135)_{10}$ can be written as $(207)_8$

Hexadecimal Number System

- Number System with base value 16 is termed as Hexadecimal Number System.
- It uses 16 digits for the creation of its numbers. Digits from 0-9 are taken like the digits in the decimal number system but the digits from 10-15 are represented as A-F i.e. 10 is represented as A, 11 as B, 12 as C, 13 as D, 14 as E, and 15 as F. Hexadecimal Numbers are useful for handling memory address locations.
- Example:
- $(255)_{10}$ can be written as $(FF)_{16}$
- $(1096)_{10}$ can be written as $(448)_{16}$



Conversion of Number Systems

- Conversion between numbers systems is quite an easy task. These are the types of conversions that happen from one number system to another:
- Decimal to Other Number Systems
- Binary to Other Number Systems
- Octal to Other Number Systems
- Hexadecimal to Other Number Systems

Conversion from Decimal to Other Number Systems

Step 1: Divide the Decimal Number with the base of the number system to be converted to. Here the conversion is to binary, hence the divisor will be 2.

Step 2: The remainder obtained from the division will become the least significant digit of the new number.

Step 3: The quotient obtained from the division will become the next dividend and will be divided by base i.e. 2.

Step 4: The remainder obtained will become the second least significant digit i.e. it will be added in the left of the previously obtained digit.

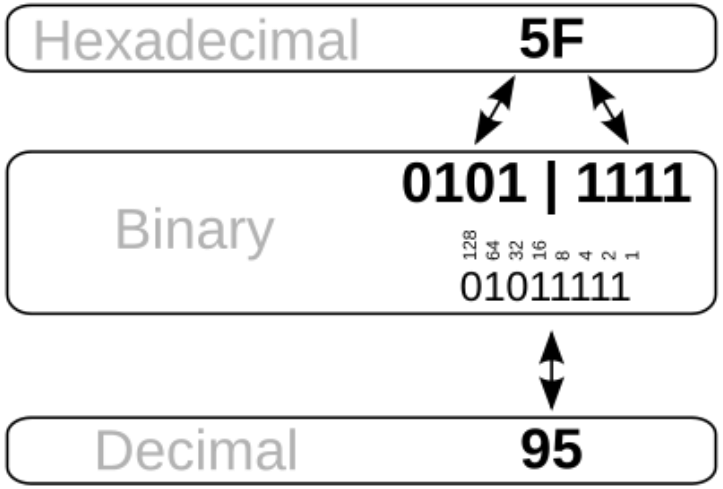
Converting a Number of Another Base to a Decimal Number

Method-

Step 1: Determine the column (positional) value of each digit.

Step 2: Multiply the obtained column values by the digits in the corresponding columns.

Step 3: Calculate the sum of these products.



Example

$4706_8 = ?_{10}$

$4706_8 = 4 \times 8^3 + 7 \times 8^2 + 0 \times 8^1 + 6 \times 8^0$

Common values multiplied by the corresponding digits

$= 4 \times 512 + 7 \times 64 + 0 + 6 \times 1$

$= 2048 + 448 + 0 + 6$ ← **Sum of these products**

$= 2502_{10}$

Conversion

Given binary number is 10101110.

- Using the conversion formula,

$10101110 = (1 \times 2^7) + (0 \times 2^6) + (1 \times 2^5) + (0 \times 2^4) + (1 \times 2^3) + (1 \times 2^2) + (1 \times 2^1) + (0 \times 2^0)$

$= 128 + 0 + 32 + 0 + 8 + 4 + 2 + 0.$

$= 174.$

Conversion

$$(1010.011)_2 = 2^3 + 2^1 + 2^{-2} + 2^{-3} = (10.375)_{10}$$

$$(630.4)_8 = 6 \times 8^2 + 3 \times 8 + 4 \times 8^{-1} = (408.5)_{10}$$

Conversion

- Convert $(0.6875)_{10}$ to binary.

	integer		*fraction*	*coefficient*
$0.6875 \times 2 =$	1	+	0.3750	$a_{-1} = 1$
$0.3750 \times 2 =$	0	+	0.7500	$a_{-2} = 0$
$0.7500 \times 2 =$	1	+	0.5000	$a_{-3} = 1$
$0.5000 \times 2 =$	1	+	0.0000	$a_{-4} = 1$

answer: $(0.6875)_{10} = (0.a_{-1}\, a_{-2} a_{-3}\, a_{-4})_2 = (0.1011)_2$

Convert $(41.6875)_{10}$ to binary.

Conversion

Convert $(0.513)_{10}$ to octal.

$$0.513 \times 8 = 4.104$$
$$0.104 \times 8 = 0.832$$
$$0.832 \times 8 = 6.656$$
$$0.656 \times 8 = 5,248$$
$$0.248 \times 8 = 1.984$$
$$0.984 \times 8 = 7.872$$

The answer, to seven significant figures, is obtained from the integer part of the products:

$$(0.513)_{10} = (0.406517 \ldots)_8$$

Conversion

- $(10\ 110\ 001\ 101\ 011\ .\ 111\ 100\ 000\ 110)_2 = (26153.7406)_8$
- $(673.124)_8 = (110\ 111\ 011.001\ 010\ 100)_2$

Example

$545_6 = ?_4$

Solution:

Step 1: Convert from base 6 to base 10

$$545_6 = 5 \times 6^2 + 4 \times 6^1 + 5 \times 6^0$$
$$= 5 \times 36 + 4 \times 6 + 5 \times 1$$
$$= 180 + 24 + 5$$
$$= 209_{10}$$

Converting a Number of Some Base to Number of Another Base

Step 2: Convert 209_{10} to base 4

4	209	Remainders
	52	1
	13	0
	3	1
	0	3

Hence, $209_{10} = 3101_4$

So, $545_6 = 209_{10} = 3101_4$

Thus, $545_6 = 3101_4$

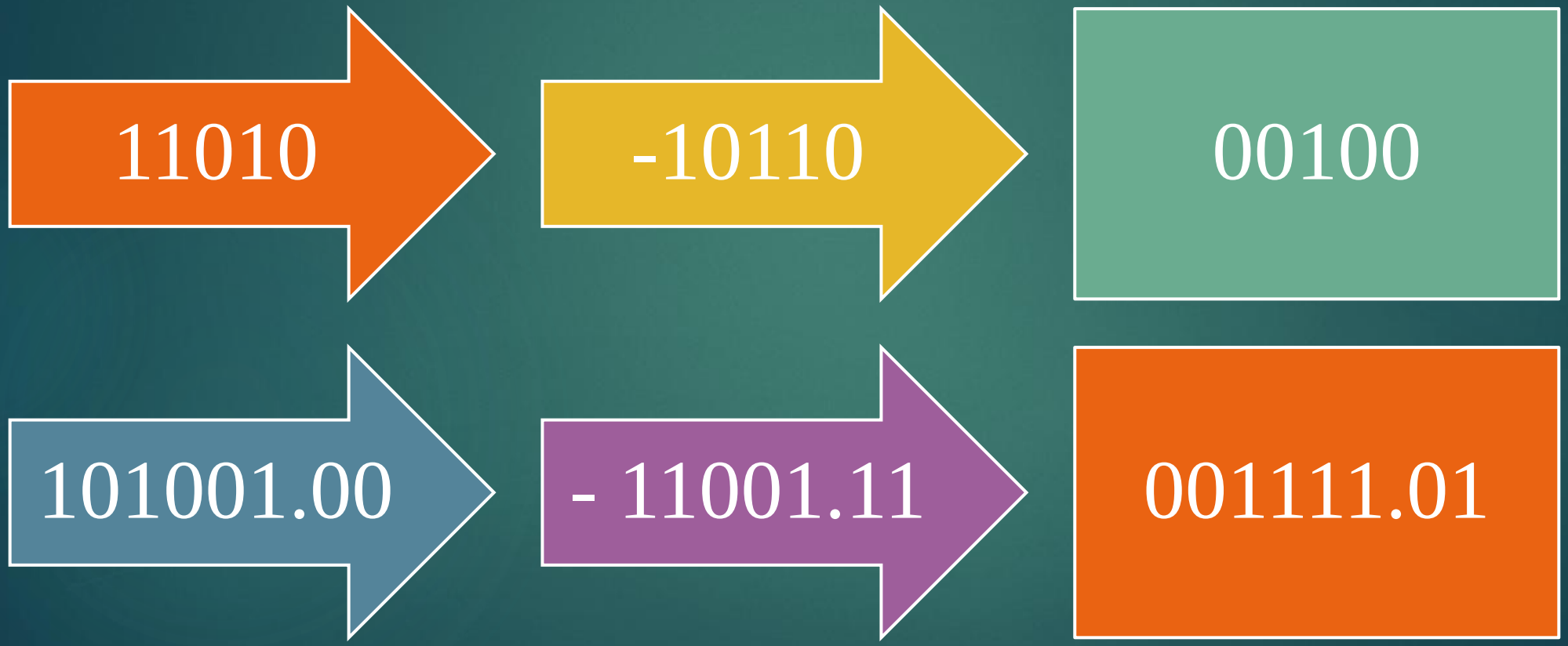
Binary Calculation

- Binary Addition:
- 0 + 0 = 0 Sum of 0 with a carry of 0
- 0 + 1 = 1 Sum of 1 with a carry of 0
- 1 + 0 = 1 Sum of 1 with a carry of 0
- 1 + 1 = 0 Sum of 0 with a carry of 1

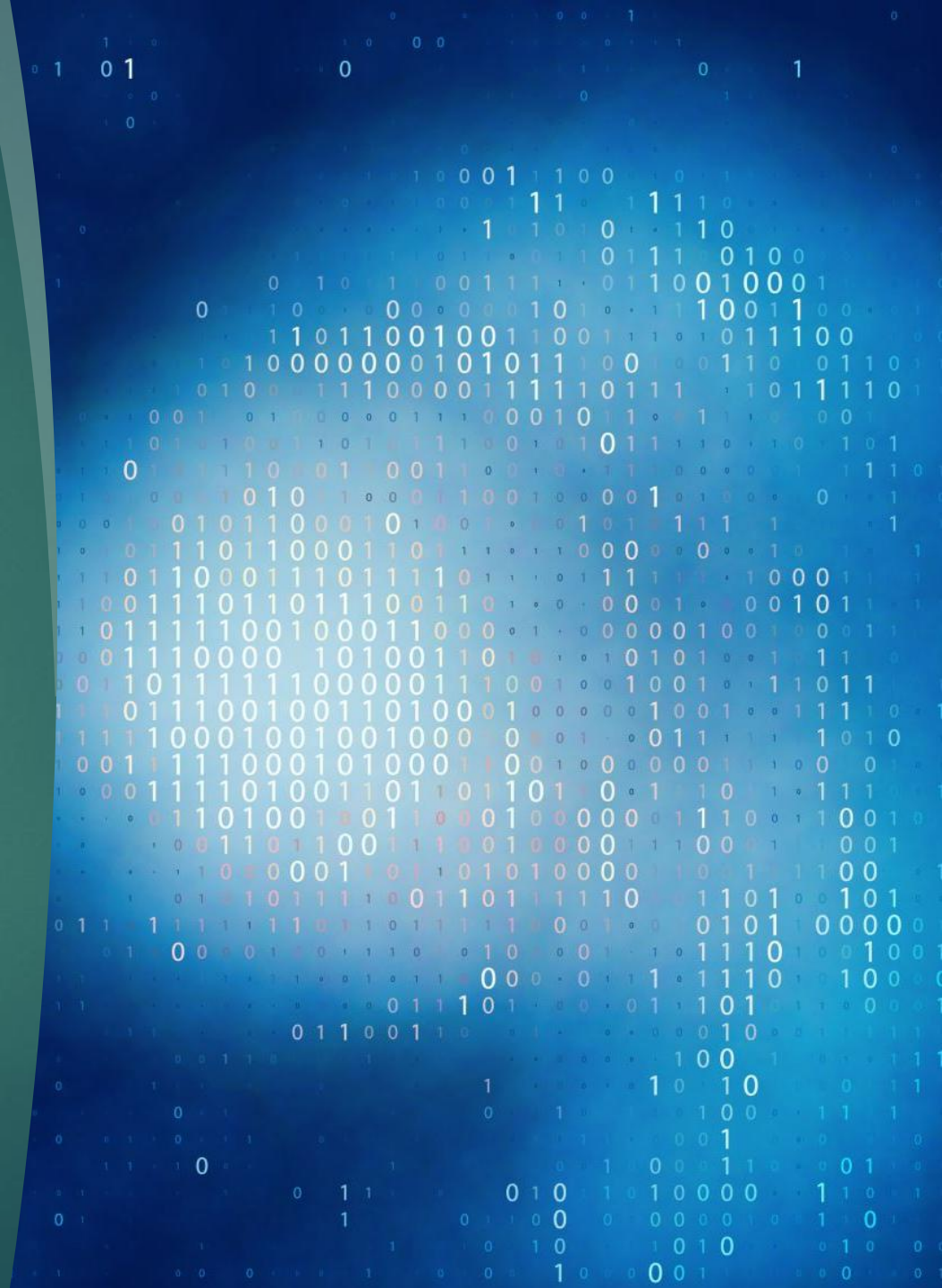
Example (Binary Addition)

1001	+ 1001	1 0010 Carry
11011	+ 10100	1 01111 Carry

Example (Binary Subtraction)



- Binary Subtraction:
- 0 – 0 = 0
- 1 – 1 = 0
- 1 – 0 = 1
- 0 – 1 = 1 with a borrow of 1



Example (Binary Subtraction)

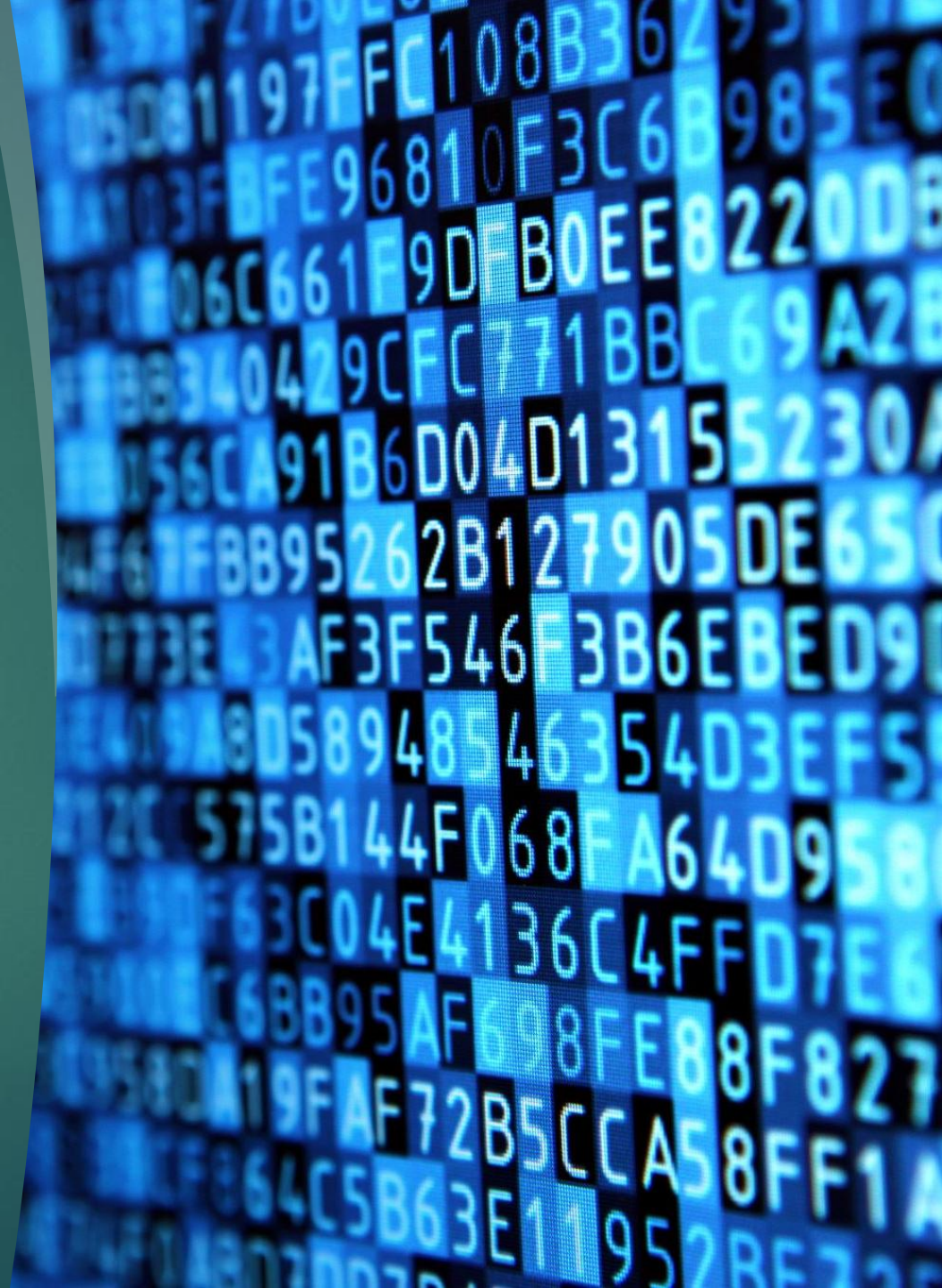
1010.101100

-1.101110

1000.11111

Binary Multiplication

- The basic rules of binary multiplication are as below:
- $0 \times 0 = 0$
- $0 \times 1 = 0$
- $1 \times 0 = 0$
- $1 \times 1 = 1$



Example (Binary Multiplication)

- 110

X 101

11110

Question: 1011.01 × 110.1

Solution:

```
    1 0 1 1.0 1
      1 1 0.1
  ---------------
    1 0 1 1 0 1
  0 0 0 0 0 0
  ---------------
    0 1 0 1 1 0 1   ..... First Intermediate sum
  1 0 1 1 0 1
  ---------------
    1 1 1 0 0 0 0 1 ..... Second Intermediate Sum
  1 0 1 1 0 1
  ---------------
  1 0 0 1 0 0 1.0 0 1 ..... Final Sum
```

Thank you

Week – 8
Lecture: 8
Boolean Algebra

Key Points:

- Understand the concept of Boolean Algebra
- Explain the laws of Boolean algebra
- The mechanism of simplifying literals

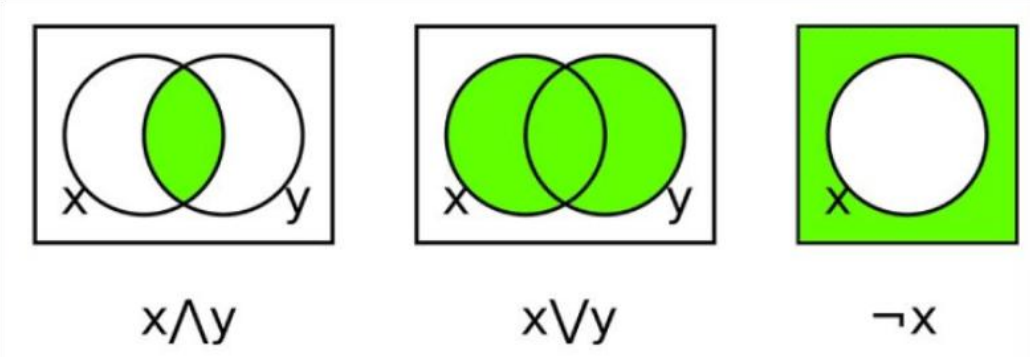
Boolean Algebra Operations

- The basic operations of Boolean algebra are as follows:

Conjunction or AND operation

Disjunction or OR operation

Negation or Not operation



Laws for Boolean Algebra

Law	OR form	AND form
Identity Law	P + 0 = P	P.1 = P
Idempotent Law	P + P = P	P.P = P
Commutative Law	P + Q = Q + P	P.Q = Q.P
Associative Law	P + (Q + R) = (P + Q) + R	P.(Q.R) = (P.Q).R
Distributive Law	P + QR = (P + Q).(P + R)	P.(Q + R) = P.Q + P.R
Inversion Law	(A')' = A	(A')' = A
De Morgan's Law	(P + Q)' = (P)'.(Q)'	(P.Q)' = (P)' + (Q)'

Boolean Laws and Identities

Reduce the boolean function $F = X\,Y\,Z + \overline{X}\,Y + X\,Y\,\overline{Z}$

$F = X\,Y\,(Z + \overline{Z}) + \overline{X}\,Y$ (Distributive and Commutative Laws)

$F = X\,Y\,(\cancel{Z + \overline{Z}}) + \overline{X}\,Y$ (Identity)

$= 1$

$F = X\,Y + \overline{X}\,Y$

$F = (X + \overline{X})\,Y$ (Distributive Law)

$F = (\cancel{X + \overline{X}})\,Y$ (Identity)

$= 1$

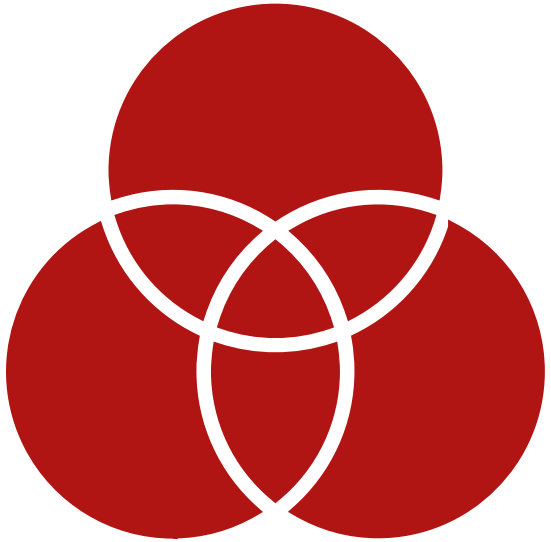
$\boxed{F = Y}$

Advanced Boolean Laws

Here are some advanced laws of boolean algebra that can be directly applied to the reduction of boolean functions.

$$X + X\,Y = X$$
$$X\,Y + X\,\overline{Y} = X$$
$$X + \overline{X}\,Y = X + Y$$
$$X\,(X + Y) = X$$
$$(X + Y)(X + \overline{Y}) = X$$
$$X\,(X + \overline{Y}) = X$$

Example



- Simplify the following Boolean functions to a minimum number of literals.
  - zx + zx′y

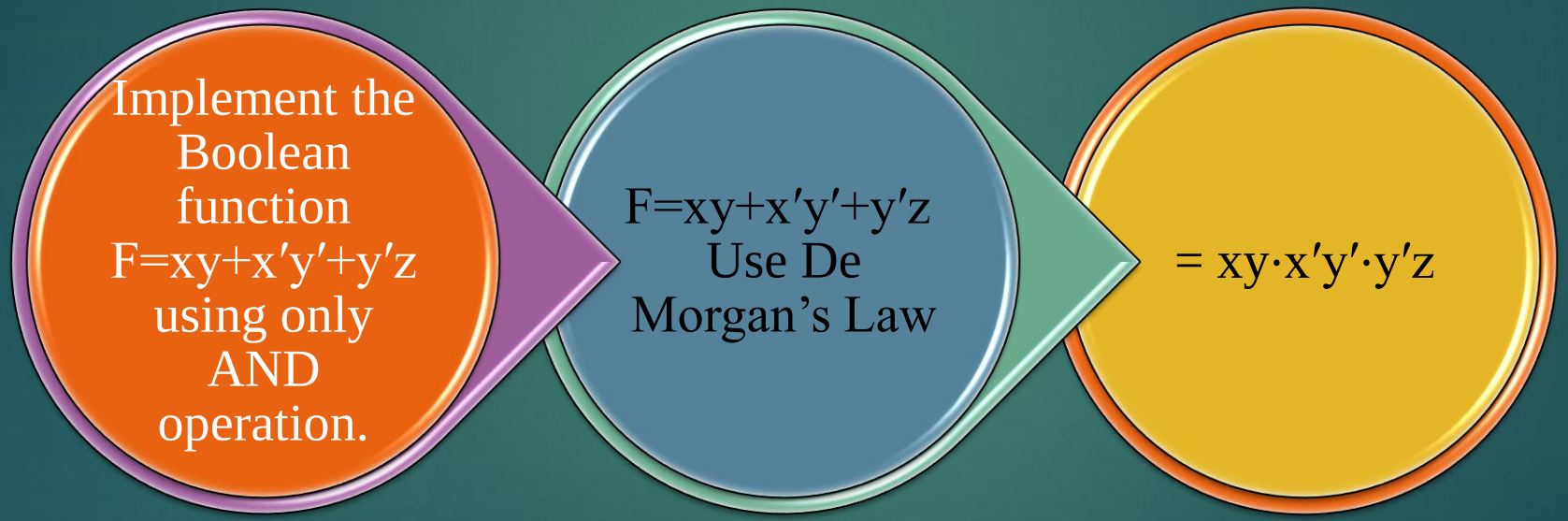
    = z(x+x′y)

    = z(x+y)

    x+x′y

    = x(1+y)+x′y

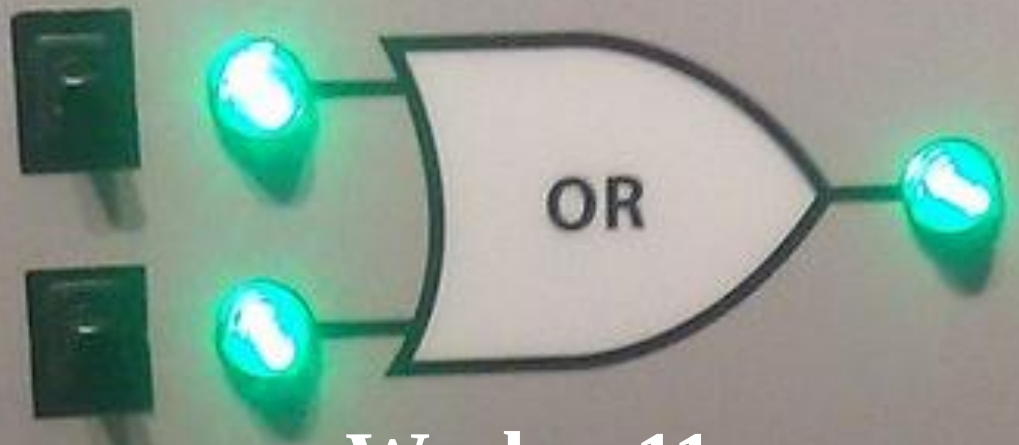
    = x+y

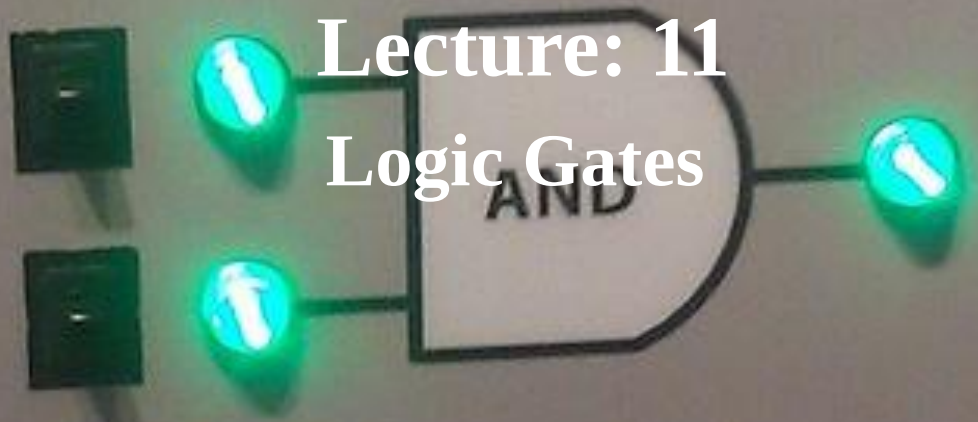

Implement the Boolean function F=xy+x′y′+y′z using only AND operation.
F=xy+x′y′+y′z
Use De Morgan's Law
= xy·x′y′·y′z

Thank you

Week 9 & 10

Mid Exam





Week – 11
Lecture: 11
Logic Gates

Key Points:

- Understand the concept of Logic Gates
- Explain the laws of Logic gates
- The mechanism of constructing literals

Digital Logic Gates

Boolean functions are expressed in terms of AND, OR, and NOT operations.

There are only ten functions left to be considered as candidates for logic gates.

Each gate has one or two binary input variables designated by x and y and one binary output variable designated by F.

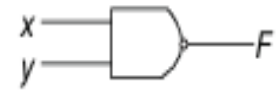
Name	Graphic symbol	Algebraic function	Truth table
AND		$F = xy$	x y | F 0 0 | 0 0 1 | 0 1 0 | 0 1 1 | 1
OR		$F = x + y$	x y | F 0 0 | 0 0 1 | 1 1 0 | 1 1 1 | 1
Inverter		$F = x'$	x | F 0 | 1 1 | 0

AND, OR and NOT gate

NAND and NOR

- The NAND function is the complement of the AND function.
- The NOR function is the complement of the OR function.

NAND



$F = (xy)'$

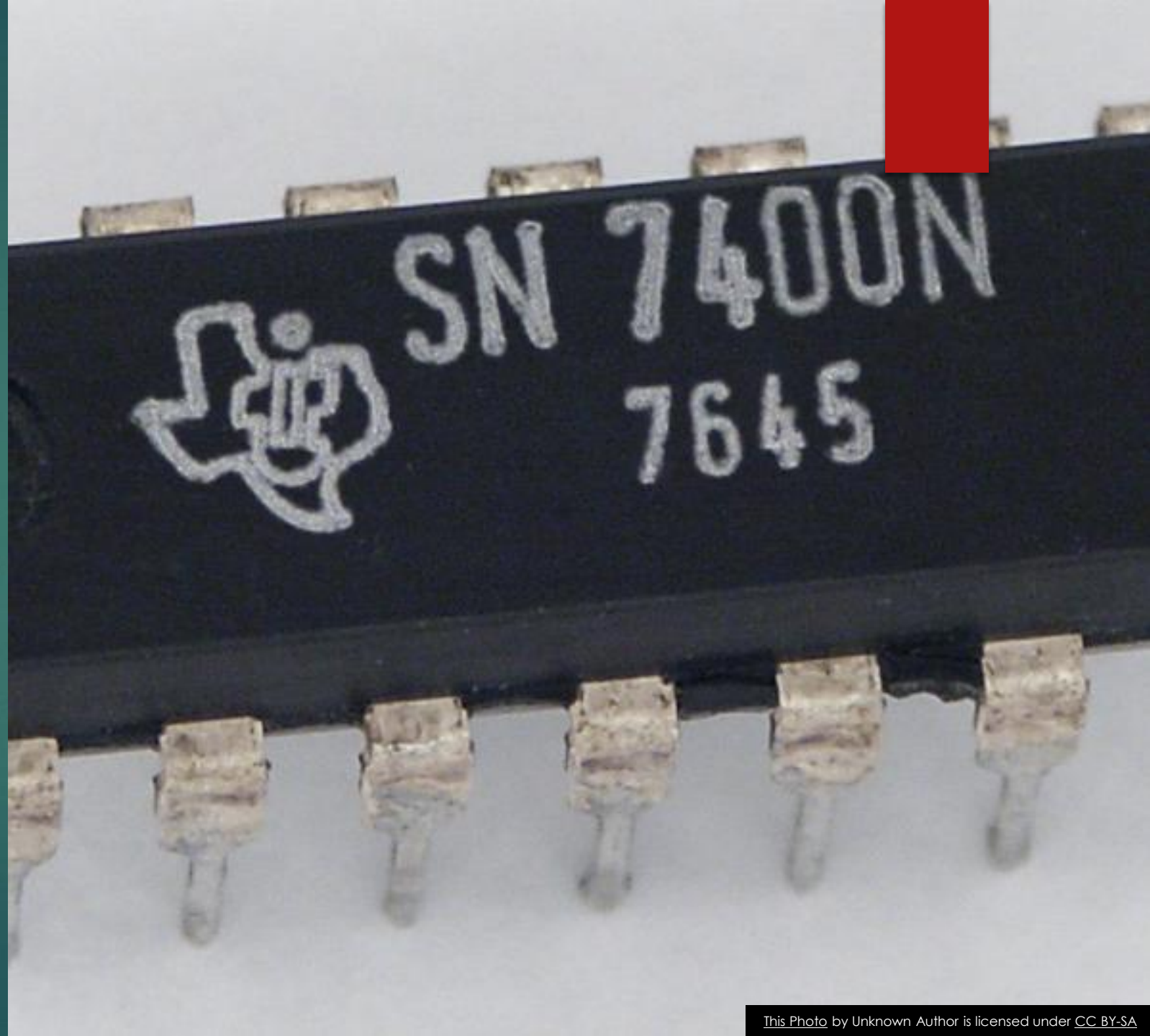
x	y	F
0	0	1
0	1	1
1	0	1
1	1	0

NOR

$F = (x + y)'$

x	y	F
0	0	1
0	1	0
1	0	0
1	1	0

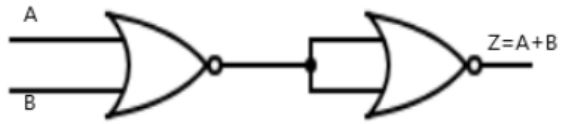
- In Boolean Algebra, the **NAND** and **NOR** gates are called **universal gates** because any digital circuit can be implemented by using any one of these two i.e. any logic gate can be created using NAND or NOR gates only.



OR gate using NOR operation

Boolean formula: $Z = \overline{Y} = \overline{\overline{A + B}} = A + B$

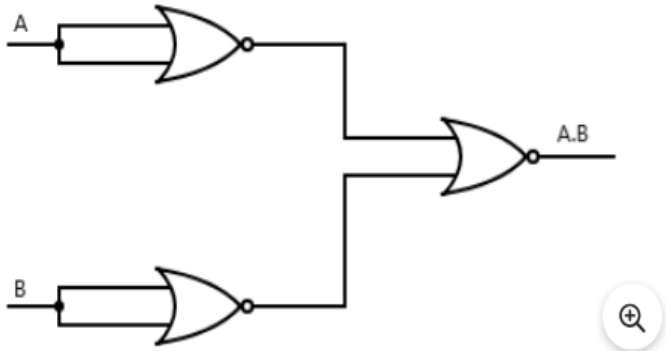
A	B	Y	Z
0	0	1	0
0	1	0	1
1	0	0	1
1	1	0	1



AND gate using NOR operation

Boolean formula: $Z = NOR\left(\overline{AB}\right) = \overline{\overline{A} + \overline{B}} = \overline{\overline{A}} \cdot \overline{\overline{B}} = A \cdot B$

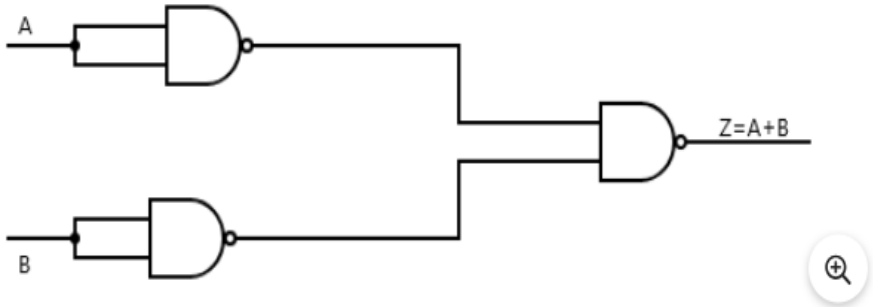
A	B	$\overline{A}$	$\overline{B}$	Z
0	0	1	1	0
0	1	1	0	0
1	0	0	1	0
1	1	0	0	1



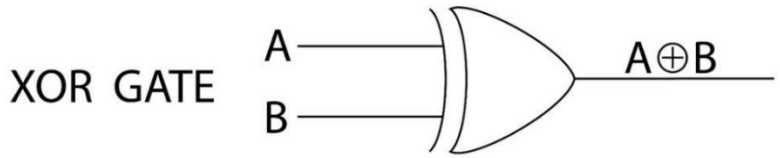
OR gate using NAND operation

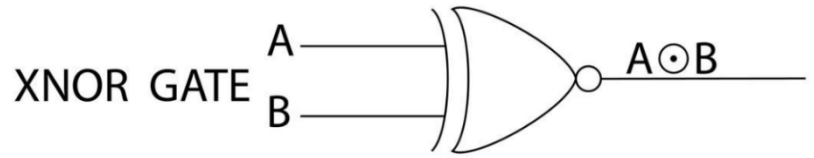
Boolean formula: $Z = \overline{\overline{Y_1} \cdot \overline{Y_2}} = \overline{\overline{A} \cdot \overline{B}} = \overline{\overline{A}} + \overline{\overline{B}} = A + B$

A	B	Y_1	Y_2	Z
0	0	1	1	0
1	0	0	1	1
0	1	1	0	1
1	1	0	0	1

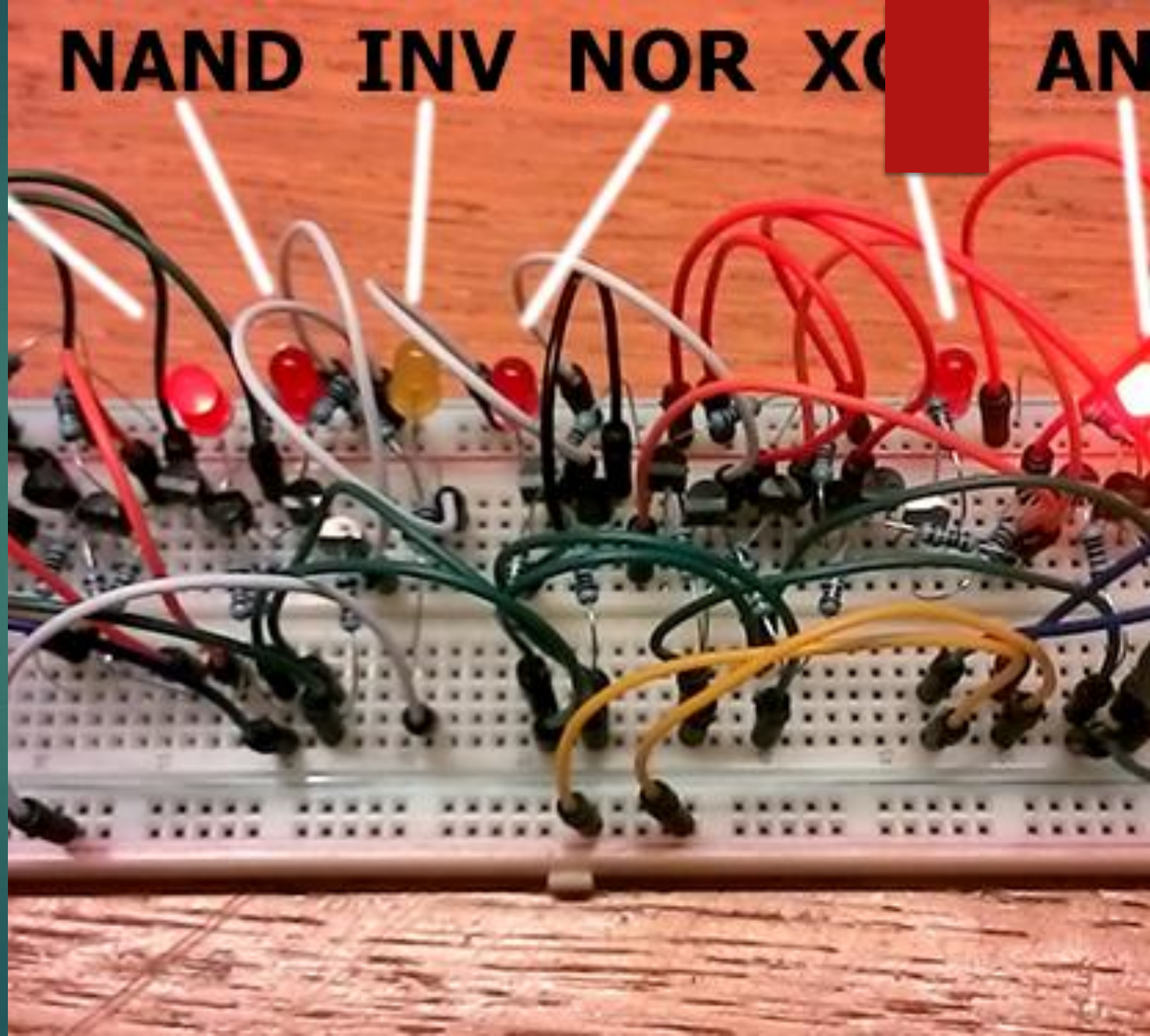


XOR and XNOR gate



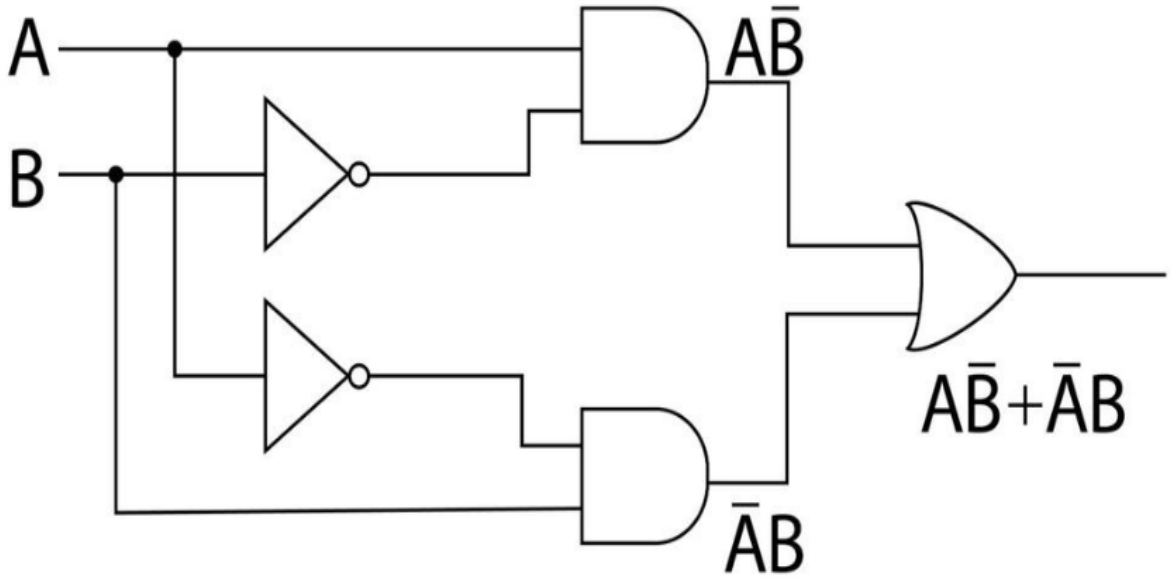


- **Why is it called Exclusively OR gate?**
  - It is called so because the gate is similar to a standard OR gate. In the OR gate, the output is true if at least one value in the input is true. However, in XOR gate the output value will be true only when an odd number of input values are true, hence the term “exclusive”.
- **Why is it called Exclusively NOR Gate?**
  - It is called so because it is similar to the XOR gate but just the inverse of it. The NOT gate is added next to the XOR gate to make it “exclusively NOR or XNOR” gate.



A	B	OUTPUT
0	0	0
0	1	1
1	0	1
1	1	0

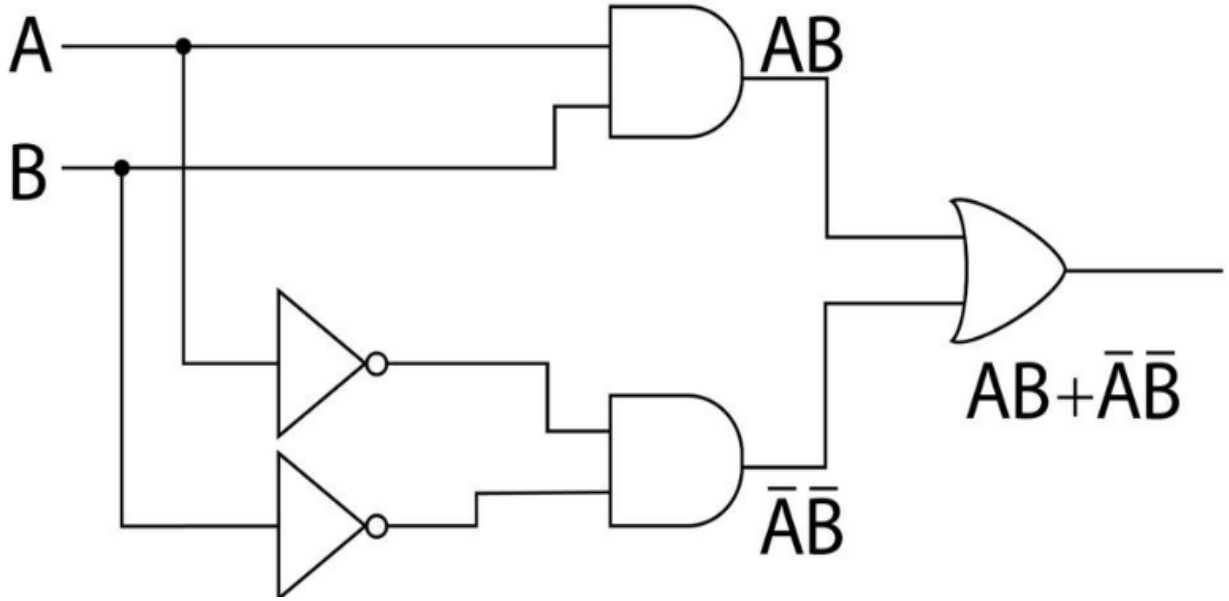
Truth table of XOR Gate



XOR

A	B	OUTPUT
0	0	1
0	1	0
1	0	0
1	1	1

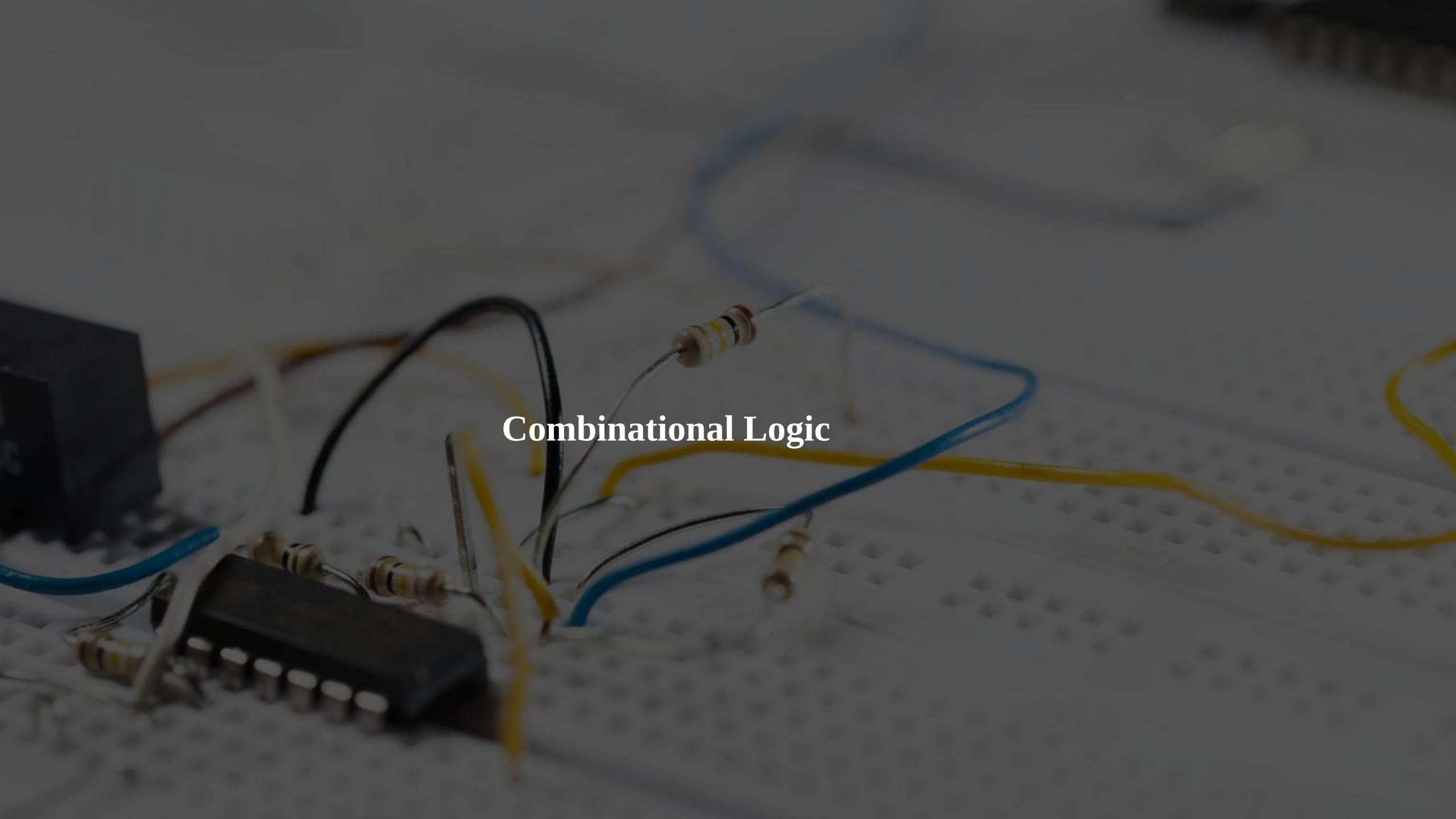
Truth table of XNOR Gate



XNOR

Assignment

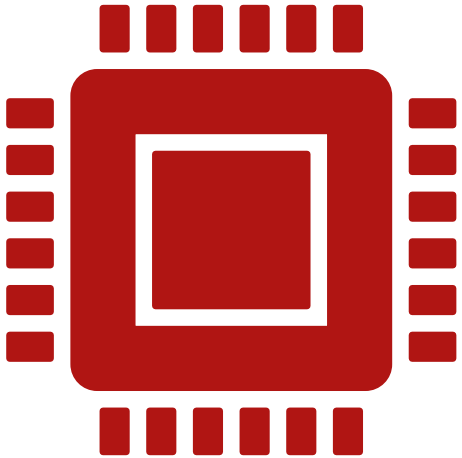
- Construct XOR and XNOR gate for 3 inputs.
- Draw logic diagram of EX-OR and EX-NOR gate using NAND gate and proof it using Boolean equation and truth table.
- Draw a logic diagram of EX-OR and EX-NOR gate using NOR gate and proof it using Boolean equation and truth table.



Combinational Logic

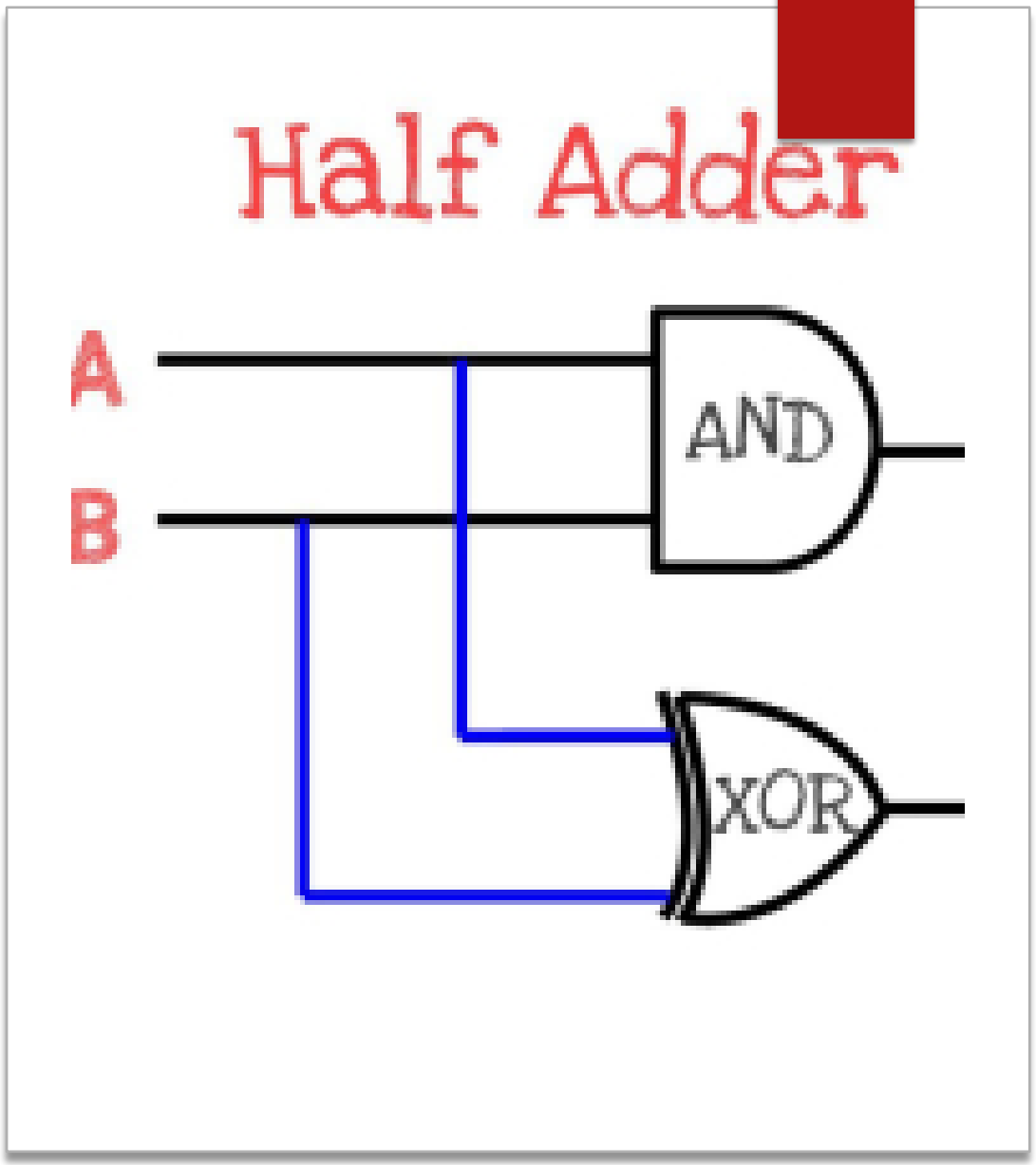
Introduction

- A combinational circuit consists of input variables, logic gates, and output variables.
- Both input and output data are represented by binary signals.
- The n input binary variables come from an external source; the m output variables go to an external destination.
- For n input variables, there are 2n possible combinations of binary input values.
- A combinational circuit can be described by m Boolean functions, one for each output variable. Each output function is expressed in terms of the n input variables.



Adders

- The most basic arithmetic operation, no doubt, is the addition of two binary digits.
- The binary sum consists of two digits.
- The higher significant bit of this result is called a carry.
- A combinational circuit that performs the addition of two bits is called a half-adder.
- One that performs the addition of three bits (two significant bits and a previous carry) is a full-adder.

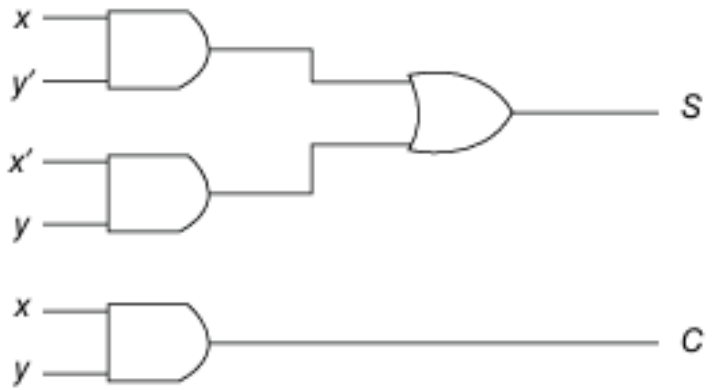


Half-Adder

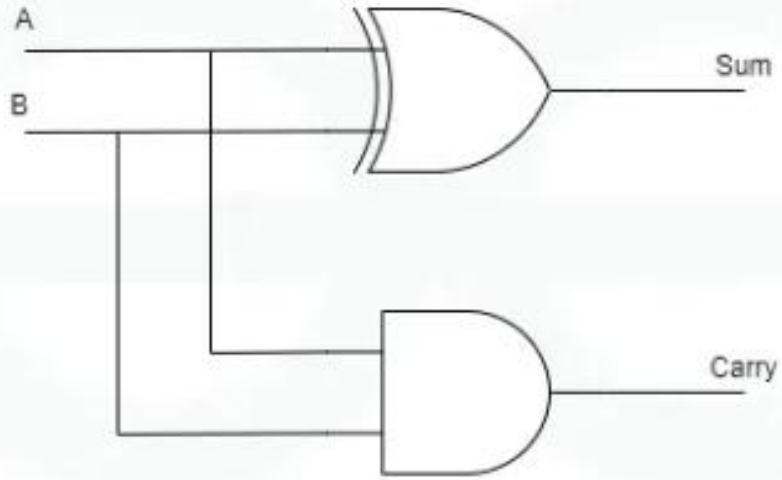
- We arbitrarily assign symbols x and y to the two inputs and S (for sum) and C (for carry) to the outputs.
- S = x′y + xy′ (Sum) C = xy (Carry)

x	*y*	*C*	*S*
0	0	0	0
0	1	0	1
1	0	0	1
1	1	1	0

Truth table of half adder



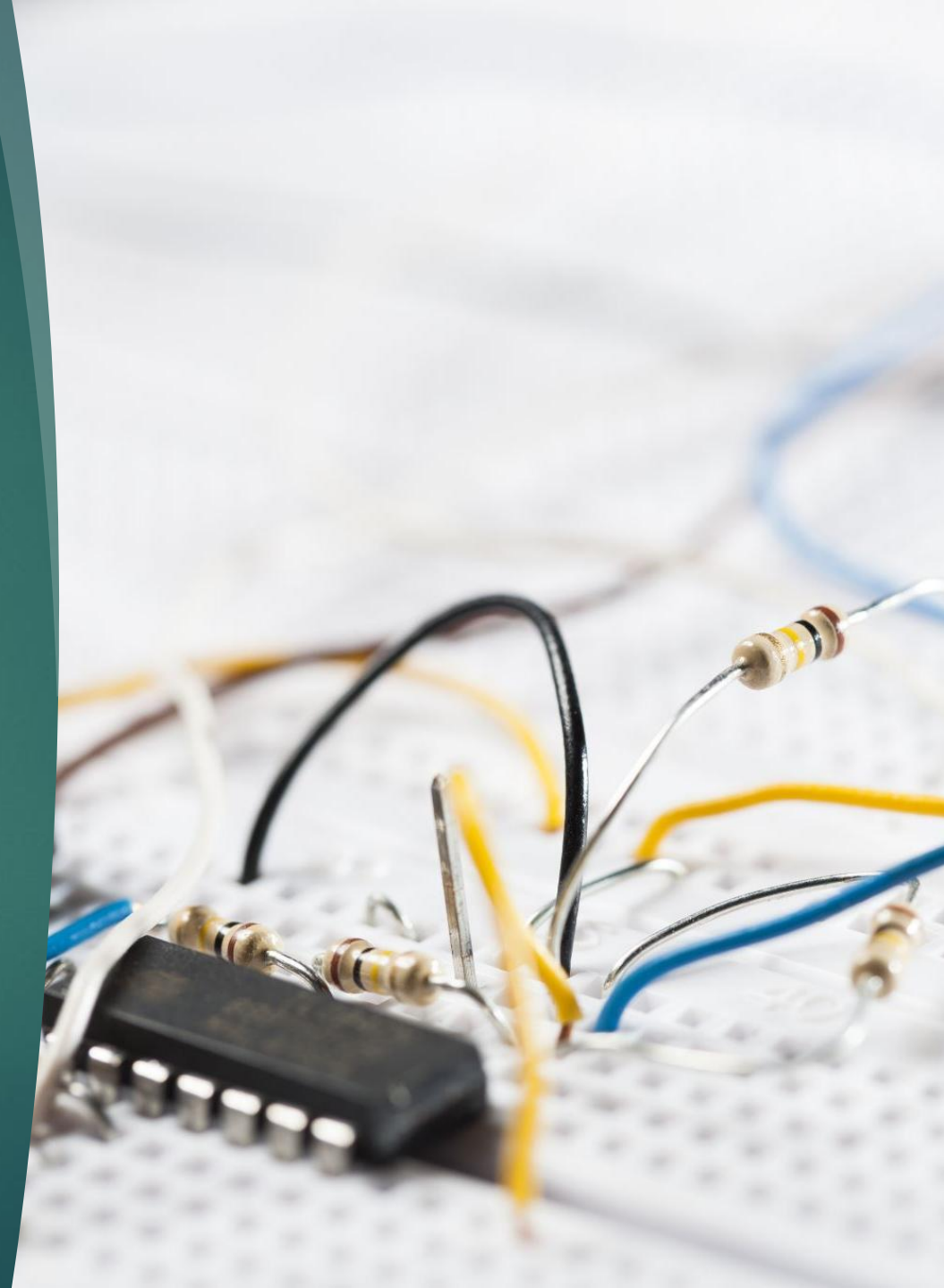
(a) $S = xy' + x'y$
$C = xy$



HALF ADDER

Full-Adder

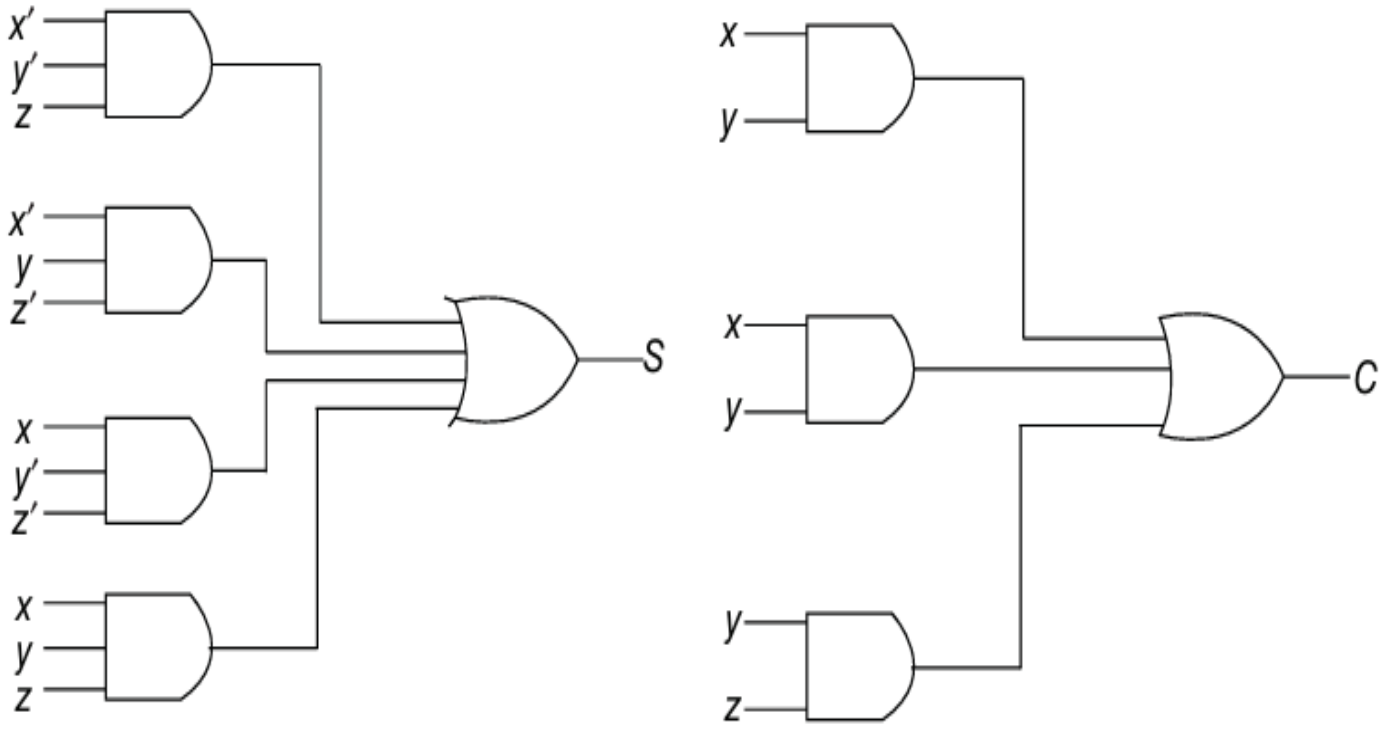
- A full-adder is a combinational circuit that forms the arithmetic sum of three input bits.
- It consists of three inputs and two outputs. Two of the input variables, denoted by x and y represent the two significant bits to be added. The third input, z represents the carry from the previous lower significant position.
- $S = x'y'z + x'yz' + xy'z' + xyz$ (Sum)
- $C = xy + xz + yz$ (Carry)

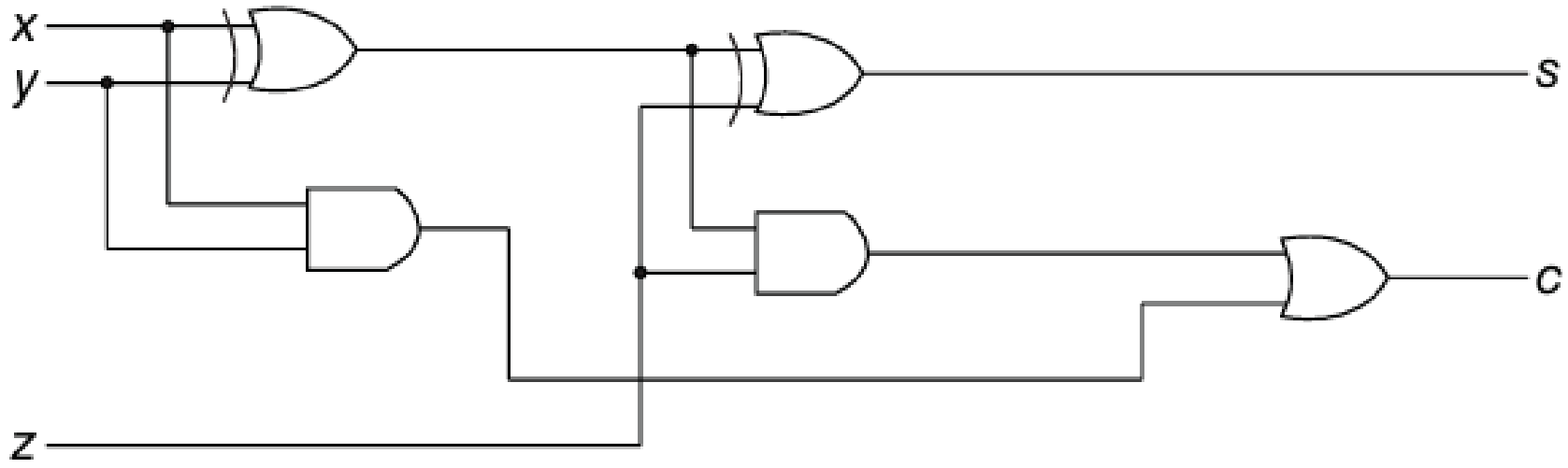


x	y	z	C	S
0	0	0	0	0
0	0	1	0	1
0	1	0	0	1
0	1	1	1	0
1	0	0	0	1
1	0	1	1	0
1	1	0	1	0
1	1	1	1	1

Truth table of full adder

Full-Adder





Implementation of full-adder with two half-adders and an OR gate

Thank you

Week - 12
Lecture: 12

Introduction to Basic Networking Concepts

Key Points:

- Understand the concept of Networking
- Explain the data transmission mode
- The concept of topology

Week - 12
Lecture: 12

Introduction to Basic Networking Concepts

Key Points:

- Understand the concept of Networking
- Explain the data transmission mode
- The concept of topology

Data communication:

Data communications are the exchange of data between two devices via some form of transmission medium such as a wire cable. For data communications to occur, the communicating devices must be part of a communication system made up of a combination of hardware (physical equipment) and software (programs).

Basic Elements of Communication System:

A data communications system has five components

- ✓ Message: The message is the information (data) to be communicated. Popular forms of information include text, numbers, pictures, audio, and video.
- ✓ Sender: The sender is the device that sends the data message. It can be a computer, workstation, telephone handset, video camera, and so on.
- ✓ Receiver: The receiver is the device that receives the message. It can be a computer, workstation, telephone handset, television, and so on.
- ✓ Transmission medium: The transmission medium is the physical path by which a message travels from sender to receiver. Some examples of transmission media include twisted-pair wire, coaxial cable, fiber-optic cable and radio waves.
- ✓ Protocol: A protocol is a set of rules that govern data communications. It represents an agreement between the communicating devices. Without a protocol, two devices may be connected but not communicating, just as a person speaking French cannot be understood by a person who speaks only Japanese.

Data transmission modes:

Simplex:

- ✓ The communication is unidirectional, as on a one-way street. Only one of the two devices on a link can transmit, the other can only receive.
- ✓ Keyboards and traditional monitors are examples of simplex devices. The keyboard can only introduce input; the monitor can only accept output.
- ✓ The simplex mode can use the entire capacity of the channel to send data in one direction.

Half Duplex:

- ✓ Each station can both transmit and receive, but not at the same time, When one device is sending, the other can only receive, and vice versa.
- ✓ The half-duplex mode is like a one-lane road with traffic allowed in both directions. When cars are traveling in one direction, cars going the other way must wait.

- ✓ In a half-duplex transmission, the entire capacity of a channel is taken over by whichever of the two devices is transmitting at the time.
- ✓ Walkie-talkies and CB (citizens band) radios are both half-duplex systems. The half-duplex mode is used in
  cases where there is no need for communication in both directions at the same time, the entire capacity of the channel can be utilized for each direction.

Full Duplex:

- ✓ Both stations can transmit and receive simultaneously. The full-duplex mode is like a two-way street with traffic flowing in both directions at the same time.
- ✓ In full-duplex mode, signals going in one direction share the capacity of the link: with signals going in the other direction. This sharing can occur in two ways: Either the link must contain two physically separate
  transmission paths, one for sending and the other for receiving; or the capacity of the channel is divided between signals traveling in both directions.
- ✓ One common example of full-duplex communication is the telephone network. When two people are communicating by a telephone line, both can talk and listen at the same time.
- ✓ The full-duplex mode is used when communication in both directions is required all the time. The capacity of the channel, however, must be divided between the two directions.

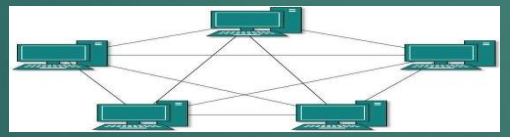
Networks:

A network is a set of devices (often referred to as *nodes)* connected by communication links. A node can be a computer, printer, or any other device capable of sending and/or receiving data generated by other nodes on the network.

Categories of topology:

Topology refers to the way in which a network links its nodes (computer or other communication devices)

Mesh topology:

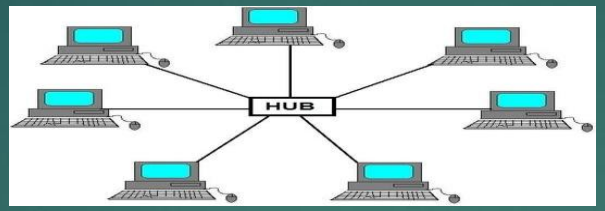


- ✓ Completely connected network.
- ✓ In a mesh topology, every device has a dedicated point-to-point link to every other device. The term *dedicated*
  means that the link carries traffic only between the two devices it connects.
- ✓ To find the number of physical links in a fully connected mesh network with n nodes, we first consider that each node must be connected to every other node. Node 1 must be connected to n - 1 nodes, node 2 must be connected
  to n - 1 nodes, and finally node n must be connected to n - 1 nodes. We need $n(n - 1)$ physical links. However, if each physical link allows communication in both directions (duplex mode), we can divide the number of links by
  2. In other words, we can say that in a mesh topology, we need $n(n -1) /2$ duplex-mode links. To accommodate that many links, every device on the network must have n - 1 input/output ports to be connected to the other n - 1
  stations.
- ✓ Advantage:
  - Use of dedicated links guarantees that each connection can carry its own data load, thus

- If one link becomes unusable, it does not incapacitate the entire system.
- Third, there is the advantage of privacy or security. When every message travels along a dedicated line, only the intended recipient sees it.
- Point-to-point links make fault identification and fault isolation easy.

✓ Disadvantage:
- Every device must be connected to every other device so cost, installation and reconnection are difficult.

Star topology:



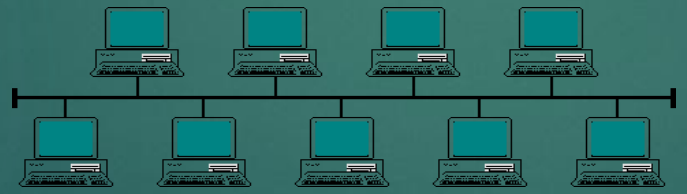
✓ Each device has a dedicated point-to-point link only to a central controller, usually called a hub i.e. multiple nodes connected to a host node.

✓ The devices are not directly linked to one another. Unlike a mesh topology, a star topology does not allow direct traffic between devices. The controller acts as an exchange i.e. host node performs routing function and centrally controls communication between any two other nodes by establishing logical path between them.

✓ Advantage:
- Minimal cost because only n-1 lines are required for connecting n nodes.
- If one link fails, only that link is affected. All other links remain active.
- Easy fault identification and fault isolation as long as the hub is working.

✓ Disadvantage
- Dependency of the whole topology on one single point, the hub. If the hub goes down, the whole system is dead.

Bus topology:



✓ Multi-access bus network, where a single transmission medium is shared by all nodes i.e. all computers are attached to the same communication line (channel).

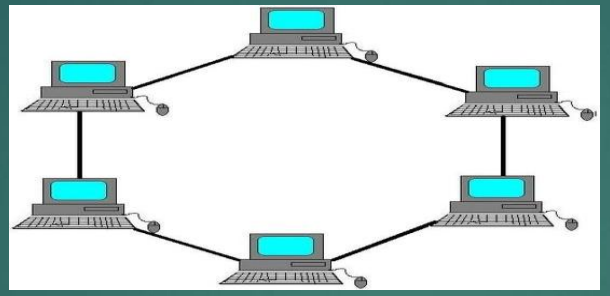
✓ When a computer wants to send a message to another computer, it appends the destination address to the message and checks whether the communication line is free. As soon as the line becomes free, it broadcasts the message on the line.

✓ As the message travels on the line, each computer checks whether it is addressed to it. The message is picked up by the addressee computer, which sends an acknowledgement to the source computer and frees the line.

✓ Is multipoint. One long cable acts as a backbone to link all the devices in a network.

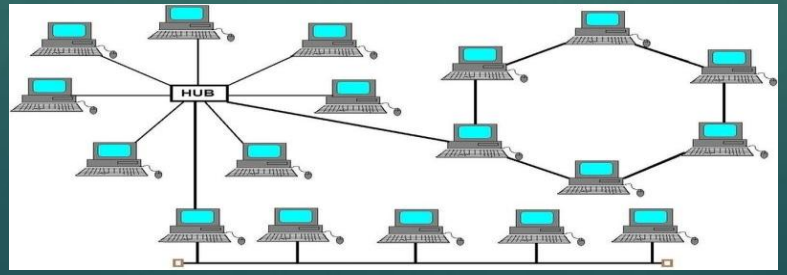
- ✓ Nodes are connected to the bus cable by drop lines and taps. A drop line is a connection running between the device and the main cable.
- ✓ Advantage
  - Helps in reducing the number of physical lines.
  - Failure of a computer does not affect the communication among other computers in the network.
  - Addition of new computers to the network is easy.
- ✓ Disadvantage
  - If communication line fails, the entire system breaks down.

Ring Topology



- ✓ Each device has a dedicated point-to-point connection with only the two devices on either side of it.
- ✓ A signal is passed along the ring in one direction, from device to device, until it reaches its destination.
- ✓ Each device in the ring incorporates a repeater. When a device receives a signal intended for another device, its repeater regenerates the bits and passes them along.
- ✓ Each device is linked to only its immediate neighbors (either physically or logically). To add or delete a device requires changing only two connections.
- ✓ Advantage
  - Works well where there is no central-site computer system.
  - More reliable then star network because communication is not dependent on a single host computer.
  - If a link between any two computers breaks down, or if one of the computers breaks down, alternate routing is possible.
- ✓ Disadvantage
  - Communication delay is directly proportional to the number of nodes in the network.
  - Requires more complicated control software than star network.

Hybrid:



Different Types of Network:

Today when we speak of networks, we are generally referring to two primary categories: local-area networks and wide-area networks. The category into which a network falls is determined by its size. A LAN normally covers an area less than 2 mi; a WAN can be worldwide. Networks of a size in between are normally referred to as metropolitan area networks and span tens of miles.

Local Area Network (LAN):

- ✓ LAN is usually privately owned and links the devices in a single office, building, or campus.
- ✓ Depending on the needs of an organization and the type of technology used, a LAN can be as simple as two PCs and a printer in someone's home office; or it can extend throughout a company and include audio and video peripherals. Currently, LAN size is limited to a few kilometers.
- ✓ LANs are designed to allow resources to be shared between personal computers or workstations. The resources to be shared can include hardware (e.g., a printer), software (e.g., an application program), or data.
- ✓ A common example of a LAN, found in many business environments, links a workgroup of task-related computers, for example, engineering workstations or accounting PCs. One of the computers may be given a large capacity disk drive and may become a server to clients. Software can be stored on this central server and used as needed by the whole group.
- ✓ Data transmission rates are usually much higher in LANs than in WANs.
- ✓ LAN generally experience fewer data transmission errors than WAN do.
- ✓ Common communication links used in LANs are twisted pair, coaxial cable and fiber optics. Communication links used in WANs are telephone lines, microwave links, and satellite channels.

Wide Area Network (WAN):

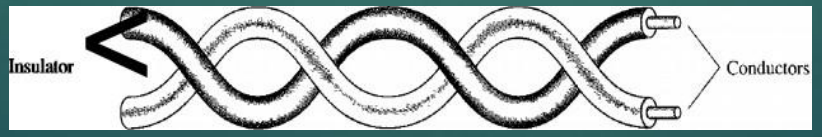
- ✓ WAN provides long-distance transmission of data, image, audio and video information over large geographic areas that may comprise a country, a continent, or even the whole world.

Metropolitan Area Network

- ✓ MAN is a network with a size between a LAN and a WAN.
- ✓ It normally covers the area inside a town or a city.
- ✓ It is designed for customers who need a high-speed connectivity, normally to the Internet, and have endpoints spread over a city or part of city.

Communication Media:

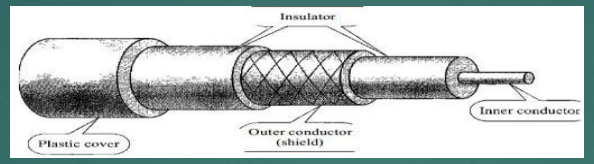
Twisted-Pair Wire:



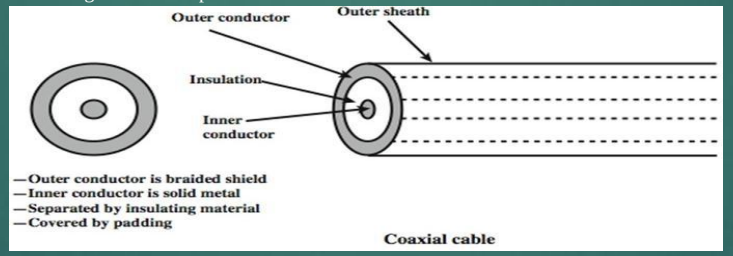
- ✓ Consists of two conductors (normally copper), each with its own plastic insulation, twisted together (Unshielded Twisted Pair-UTP).

- ✓ UTP is called because plastic coating around the two individual branches of copper wires, nothing shields it from outside interference.
- ✓ UTP cables are commonly used in local telephone communication and short distance (up to 1 km) digital data transmission.
- ✓ UTP cables are an inexpensive, easy to install and use. However, UTP is subject to external electromagnetic interference, including interference from nearby twisted pair and from noise generated in the environment
- ✓ Shielded Twisted Pair (STP)
  - Metal braid or sheathing that reduces interference
  - Provides better performance at higher data rates.
  - More expensive
  - Harder to handle (thick, heavy)

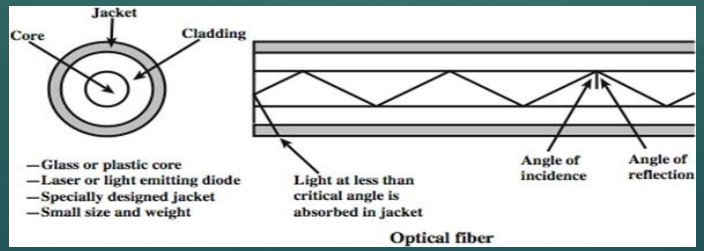
Coaxial Cable:



- ✓ Carries signals of higher frequency ranges than those in twisted pair cable, in part because the two media are constructed quite differently.
- ✓ Has a central core conductor of solid or stranded wire (usually copper) enclosed in an insulating sheath, which is, in turn, encased in an outer conductor of metal foil, braid, or a combination of the two.
- ✓ The outer metallic wrapping serves both as a shield against noise and as the second conductor, which completes the circuit. This outer conductor is also enclosed in an insulating sheath, and the whole cable is protected by a plastic cover.
- ✓ Offer cleaner and crisper data transmission without distortion or loss of signal.
- ✓ Used in long distance telephone lines and cable for cable TV.



Optical Fiber:



- ✓ Optical fiber is a thin, flexible medium capable of guiding an optical ray.
- ✓ Various glasses and plastics can be used to make optical fibers.
- ✓ An optical fiber cable has a cylindrical shape and consists of three concentric sections: the core, the cladding, and the jacket.
- ✓ The **core** is the innermost section and consists of one or more very thin strands, or fibers, made of glass or plastic.
- ✓ Each fiber is surrounded by its own **cladding**, a glass or plastic coating that has optical properties different from those of the core. The interface between the core and cladding acts as a reflector to confine light that would otherwise escape the core. The outermost layer, surrounding one or a bundle of cladded fibers, is the **jacket**.
- ✓ The jacket is composed of plastic and other material layered to protect against moisture, abrasion, crushing, and other environmental dangers.
- ✓ Optical fiber already enjoys considerable use in long-distance telecommunications, and its use in military applications is growing.

Microwave System:

- ✓ Electromagnetic waves having frequencies between 1 and 300 GHz are called microwaves.
- ✓ Use very high frequency radio signals to transmit data through space.
- ✓ At microwave frequencies, the electromagnetic waves cannot bend or pass obstacles like hill.
- ✓ Curvature of the earth, mountains, and other structures often block the line-of-sight.
- ✓ Microwave propagation is line-of-sight. Since the towers with the mounted antennas need to be in direct sight of each other, towers that are far apart need to be very tall. The curvature of the earth as well as other blocking obstacles do not allow two short towers to communicate by using microwaves.
- ✓ Signals become weaker after travelling a certain distance and require further amplification so repeaters are often needed for long distance communication.
- ✓ Several repeater stations are required for long distance transmission.

Communications Satellite:

- ✓ Microwave relay station placed in outer space.
- ✓ Launched either by rockets or space shuttles, and are precisely positioned 36,0000 kms above the equator with an orbit speed, which exactly matches the earth's rotation speed.
- ✓ Satellite is positioned in a geosynchronous orbit, it is stationary relative to earth, and always stays over the same point on the ground. This allows a ground station to aim its antenna at a fixed point in the sky.

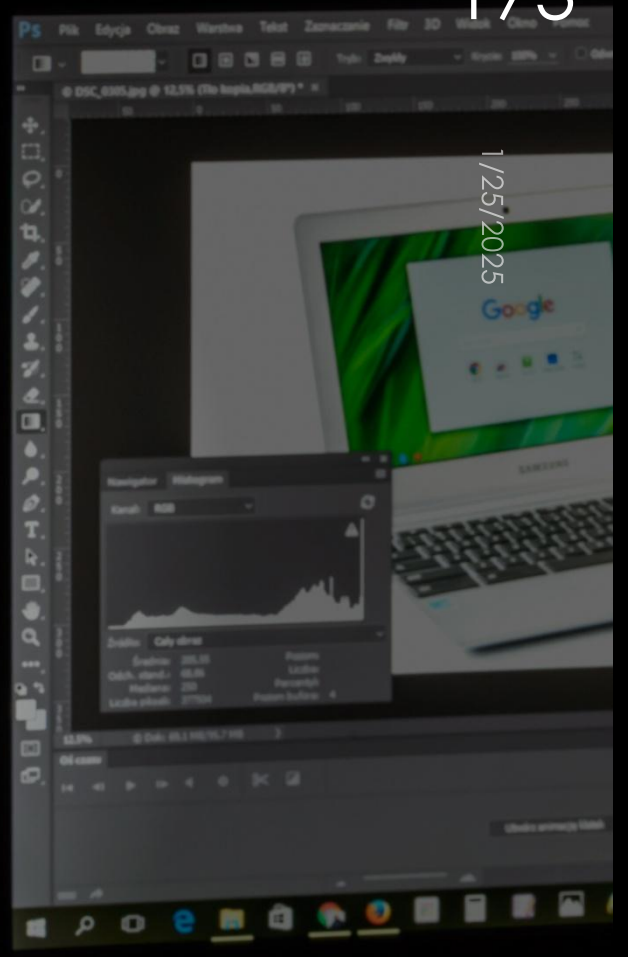
Thank you

Week - 13
Lecture: 13

Operating Systems

Key Points:

- Understand the concept of Operating System
- Explain the process & thread



What is an Operating System?

A program that acts as an intermediary between a user of a computer and the computer hardware.

Operating system goals:

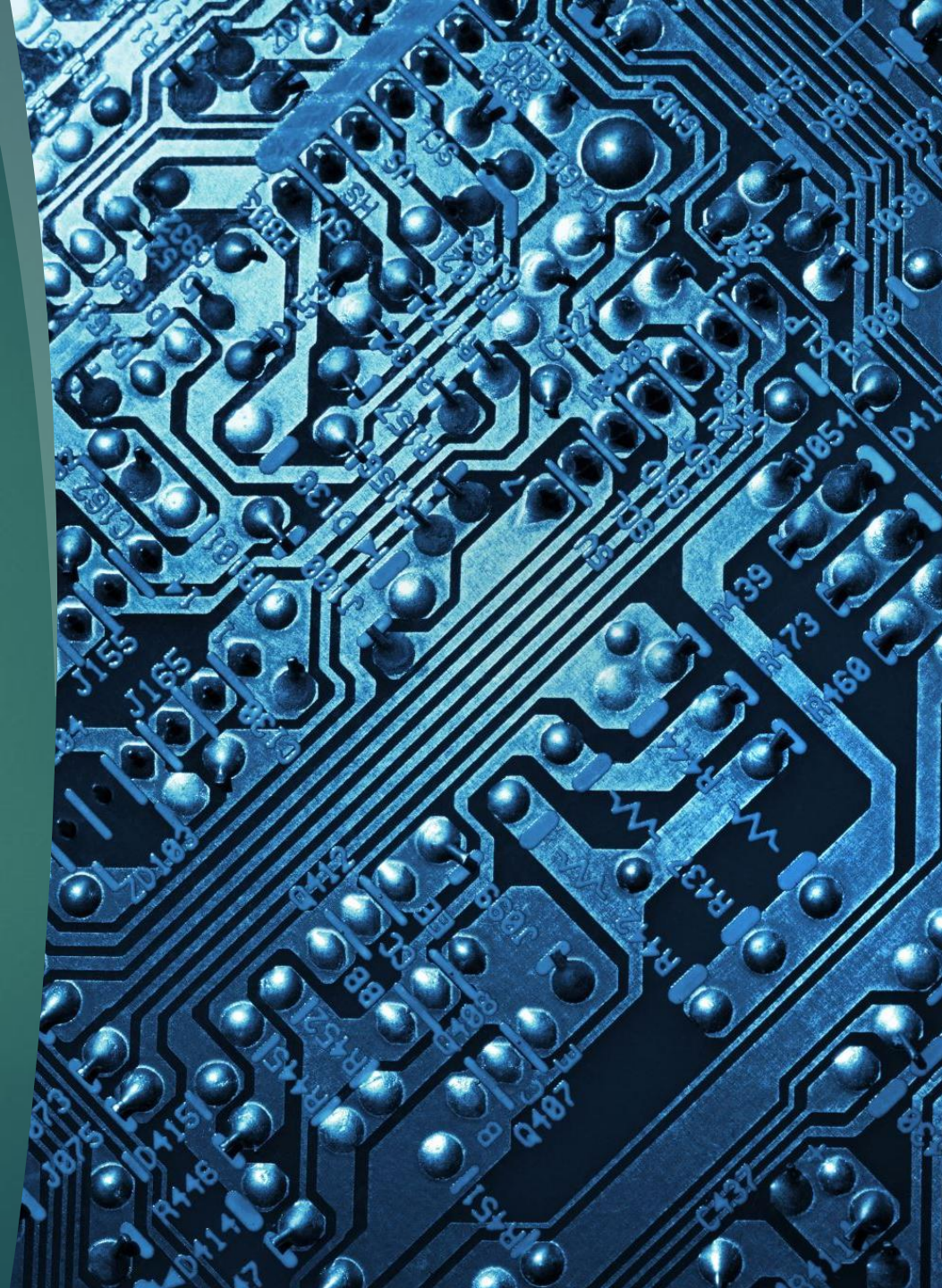
- Execute user programs and make solving user problems easier.
- Make the computer system convenient to use.

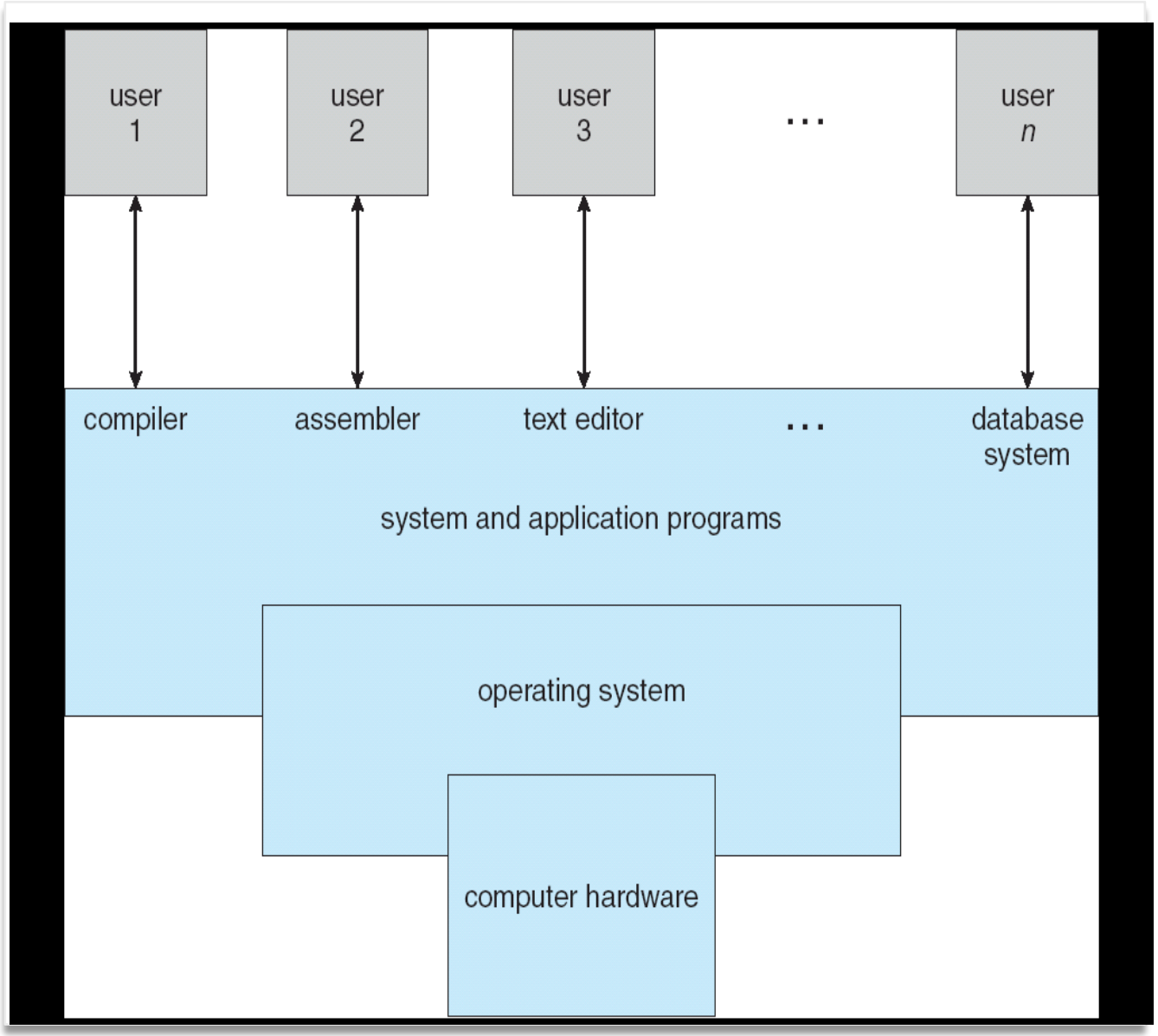
Use the computer hardware in an efficient manner.

Provides its users with an interface or virtual machine that is more convenient to use than the bare machine

Computer System Structure

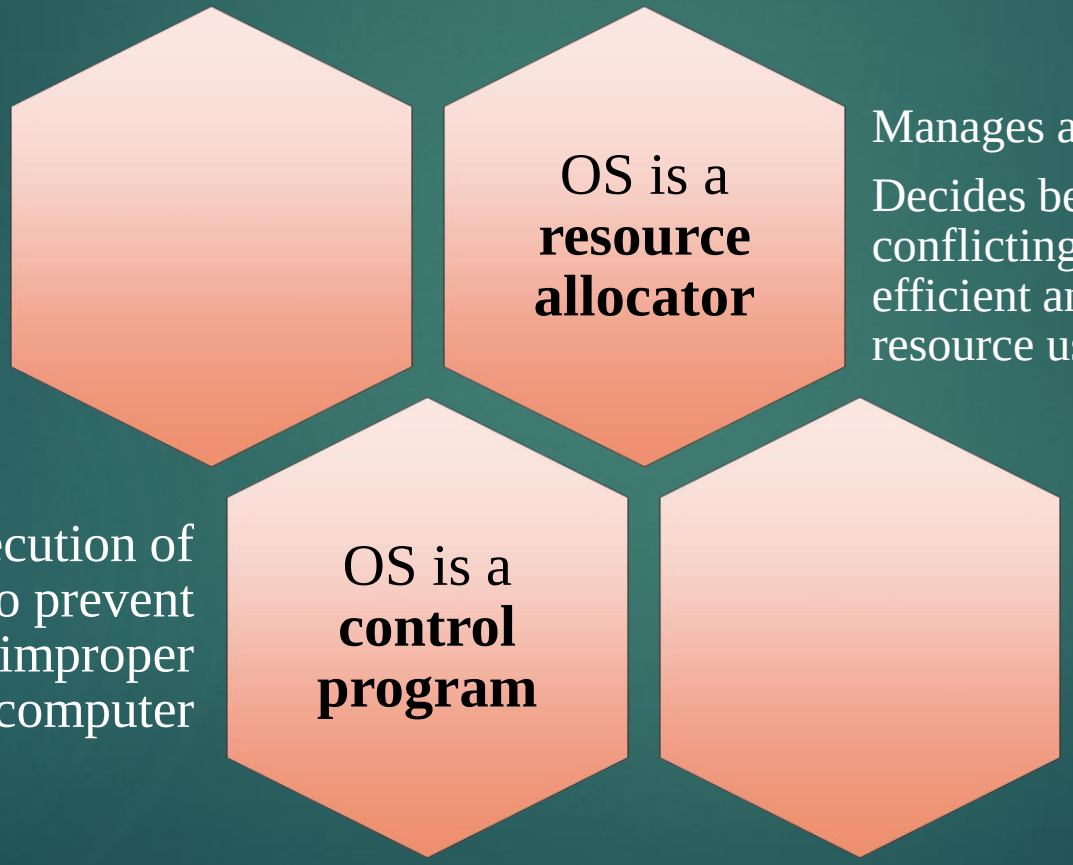
- Computer system can be divided into four components
  - Hardware – provides basic computing resources
    - CPU, memory, I/O devices
  - Operating system
    - Controls and coordinates use of hardware among various applications and users
  - Application programs – define the ways in which the system resources are used to solve the computing problems of the users
    - Word processors, compilers, web browsers, database systems, video games
  - Users
    - People, machines, other computers





Four Components of a Computer System

Operating System Definition



Manages all resources

Decides between conflicting requests for efficient and fair resource use

Controls execution of programs to prevent errors and improper use of the computer

Operating Systems

Main Functions of an OS

- Process management
- Memory management
- File management
- Security
- Command interpretation

Parameters for measuring system performance

- **Throughput:** Amount of work that the system is able to do per unit time
- **Turnaround time:** Interval from the time of submission of a job to the system for processing to the time of completion of the job
- **Response time:** Interval from the time of submission of a job to the system for processing to the time the first response for the job is produced by the system

Process Concept

An operating system executes a variety of programs:

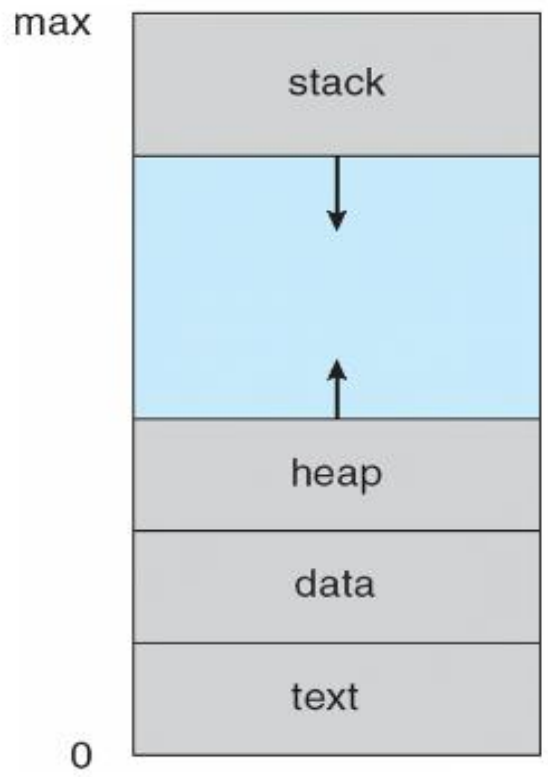
- Batch system – **jobs**
- Time-shared systems – **user programs** or **tasks**

Textbook uses the terms ***job*** and ***process*** almost interchangeably

Process – a program in execution; process execution must progress in sequential fashion

Multiple parts

- The program code, also called **text section**
- Current activity including value of **program counter**, processor registers
- **Stack** containing temporary data
  - Function parameters, return addresses, local variables
- **Data section** containing global variables
- **Heap** containing memory dynamically allocated during run time



Process in Memory

Process Management And Mechanism

Process management manages the processes submitted to a system in a manner to minimize *idle time* of processors (CPUs, I/O processors, etc.) of the system

- **Manual loading mechanism:** Jobs were manually loaded one after another in a computer by the computer operator
- **Batch processing mechanism:** Batch of jobs was submitted together to the computer and job-to-job transition was done automatically by the operating system
- **Job Control Language (JCL):** Control statements were used to facilitate job loading and unloading

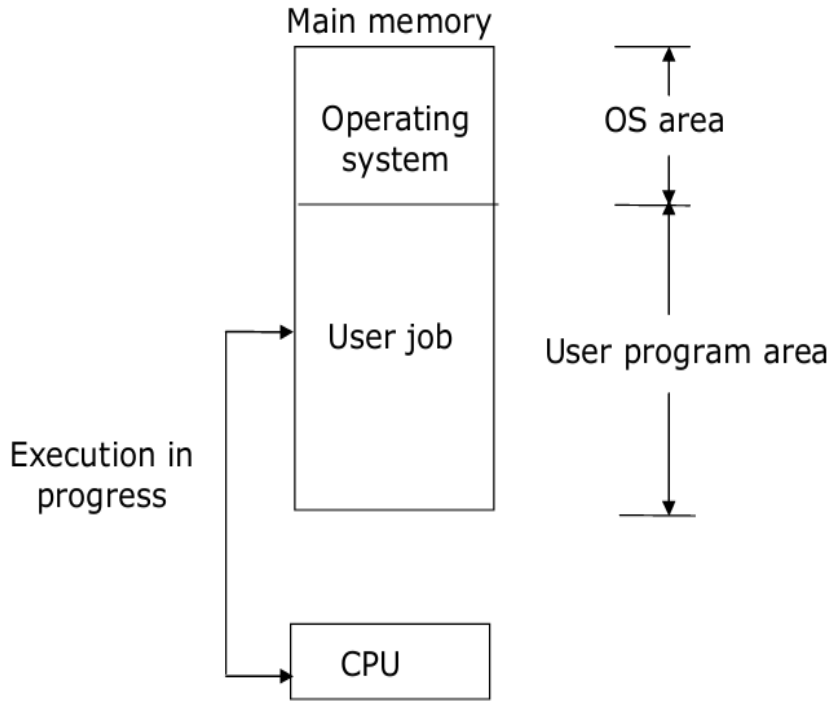
Multiprogramming

- **Uniprogramming:** Only one job is processed at a time and all system resources are available exclusively for the job until its completion
- **Multiprogramming:** Interleaved execution of two or more different and independent programs by a computer
- Types of Multiprogramming:
  - *Multiprogramming with fixed tasks (MFT)*: Fixed number of jobs can be processed concurrently
  - *Multiprogramming with variable tasks (MVT)*: Number of jobs can vary
- Area occupied by each job residing simultaneously in the main memory is known as a **memory partition**

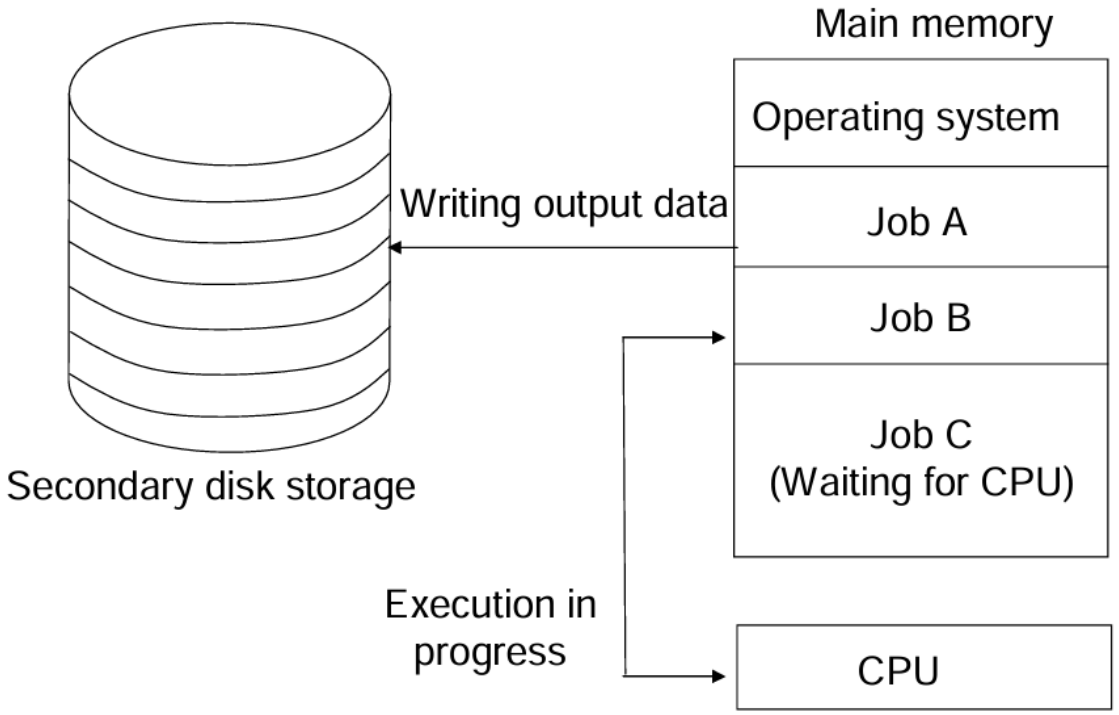
- **CPU bound:** Mostly perform computations with little I/O operations. Scientific and engineering computations usually fall in this category
- **I/O bound:** Mostly perform I/O operations with little computation. Commercial data processing applications usually fall in this category

Job

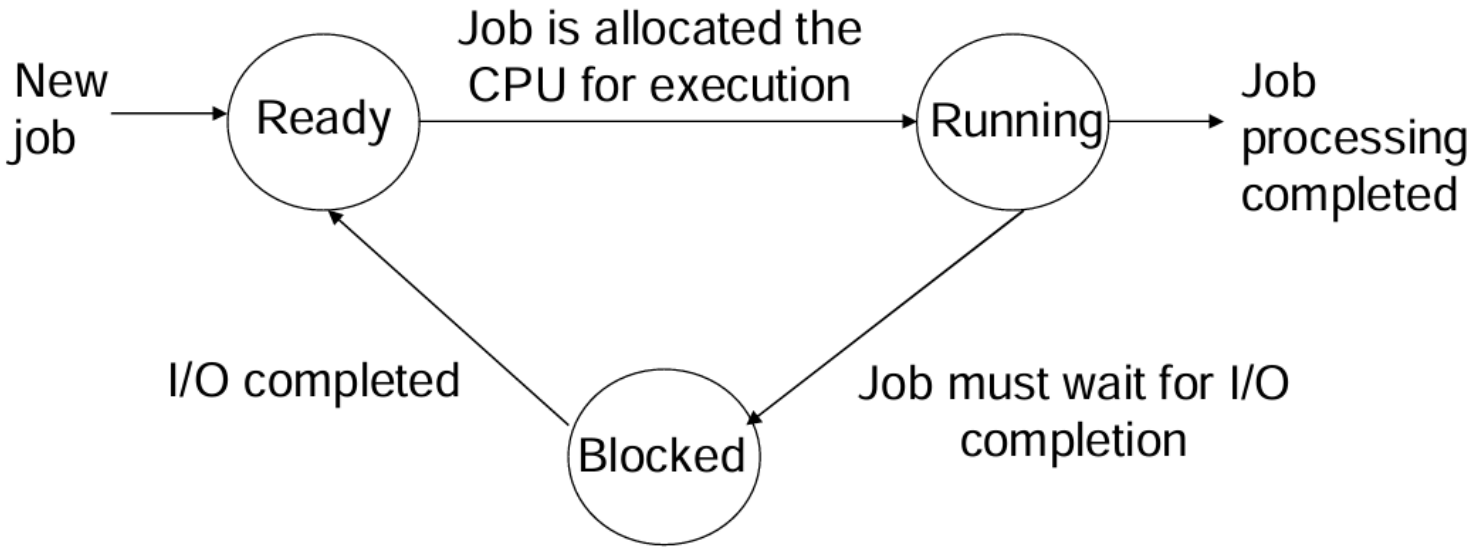
Uniprogramming System



Only one job is processed by the system at a time and all the system resources are exclusively available for the job until it completes



Multiprogramming System



Process States in Multiprogramming

- Large memory
- Memory protection
- Job status preservation
- Proper job mix (CPU and I/O bound jobs)
- CPU scheduling

Requirements of Multiprogramming Systems

Process State

- As a process executes, it changes **state**
  - **new**: The process is being created
  - **running**: Instructions are being executed
  - **waiting**: The process is waiting for some event to occur
  - **ready**: The process is waiting to be assigned to a processor
  - **terminated**: The process has finished execution

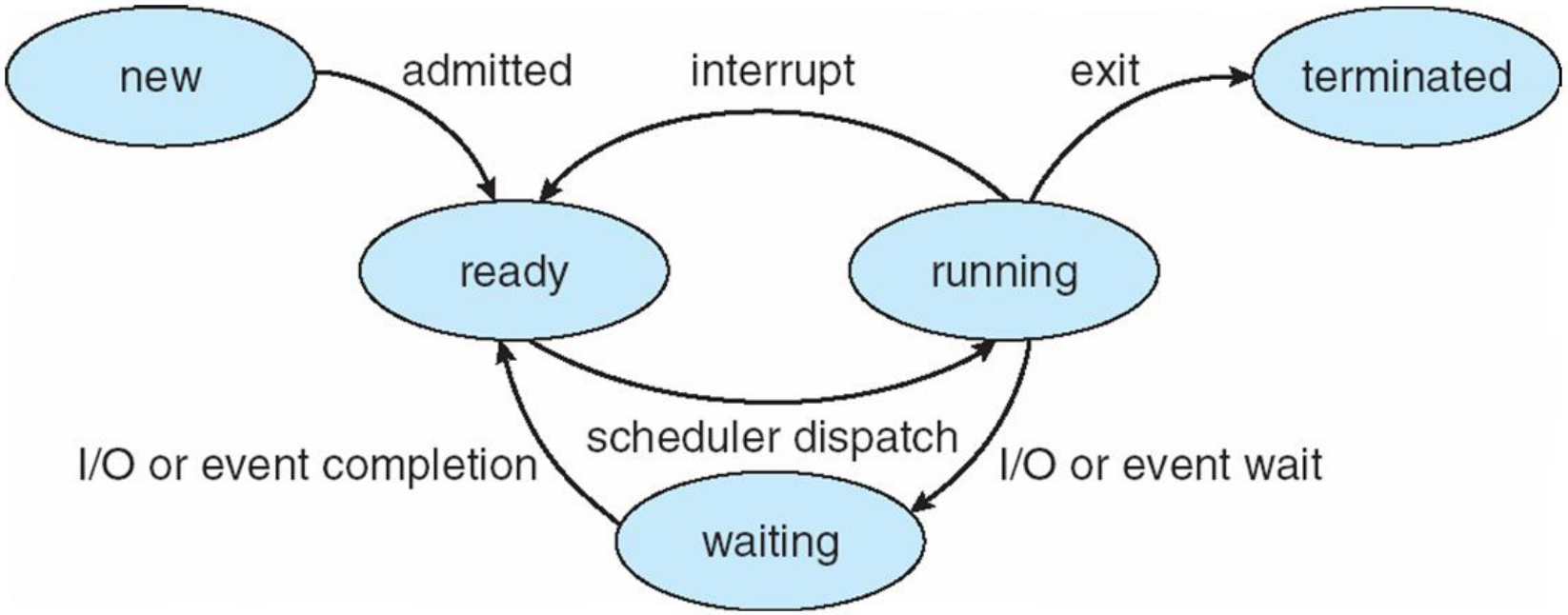


Diagram of Process State

Time-sharing

- Simultaneous interactive use of a computer system by many users in such a way that each one feels that he/she is the sole user of the system
- User terminals connected to the same computer simultaneously
- Uses multiprogramming with a special CPU scheduling algorithm
- Short period during which a user process gets to use CPU is known as time slice, time slot, or quantum
- CPU is taken away from a running process when the allotted time slice expires

Threads

In Operating Systems (OS), **threads** are the smallest unit of processing that can be scheduled by an OS.

They allow a program to perform multiple tasks simultaneously, making efficient use of the CPU by improving responsiveness and potentially speeding up the execution of programs that perform multiple operations.

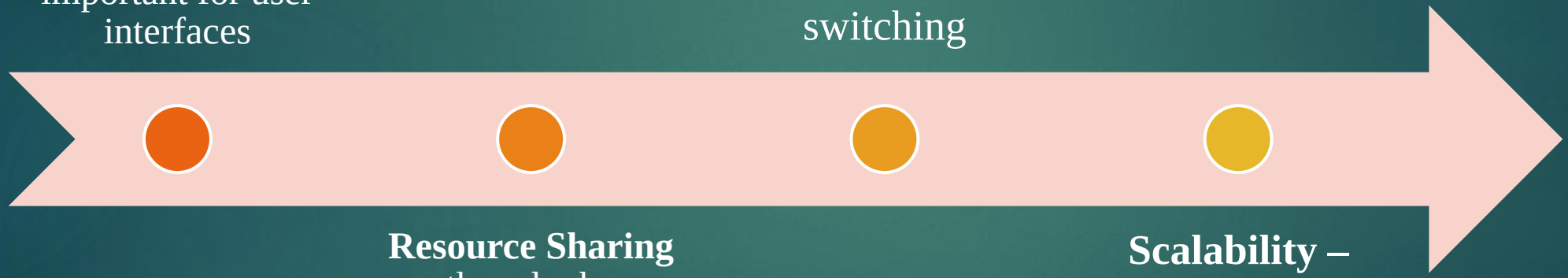
Benefits of Threads

Responsiveness – may allow continued execution if part of process is blocked, especially important for user interfaces

Resource Sharing – threads share resources of process, easier than shared memory or message passing

Economy – cheaper than process creation, thread switching lower overhead than context switching

Scalability – Can take advantage of multiprocessor architectures



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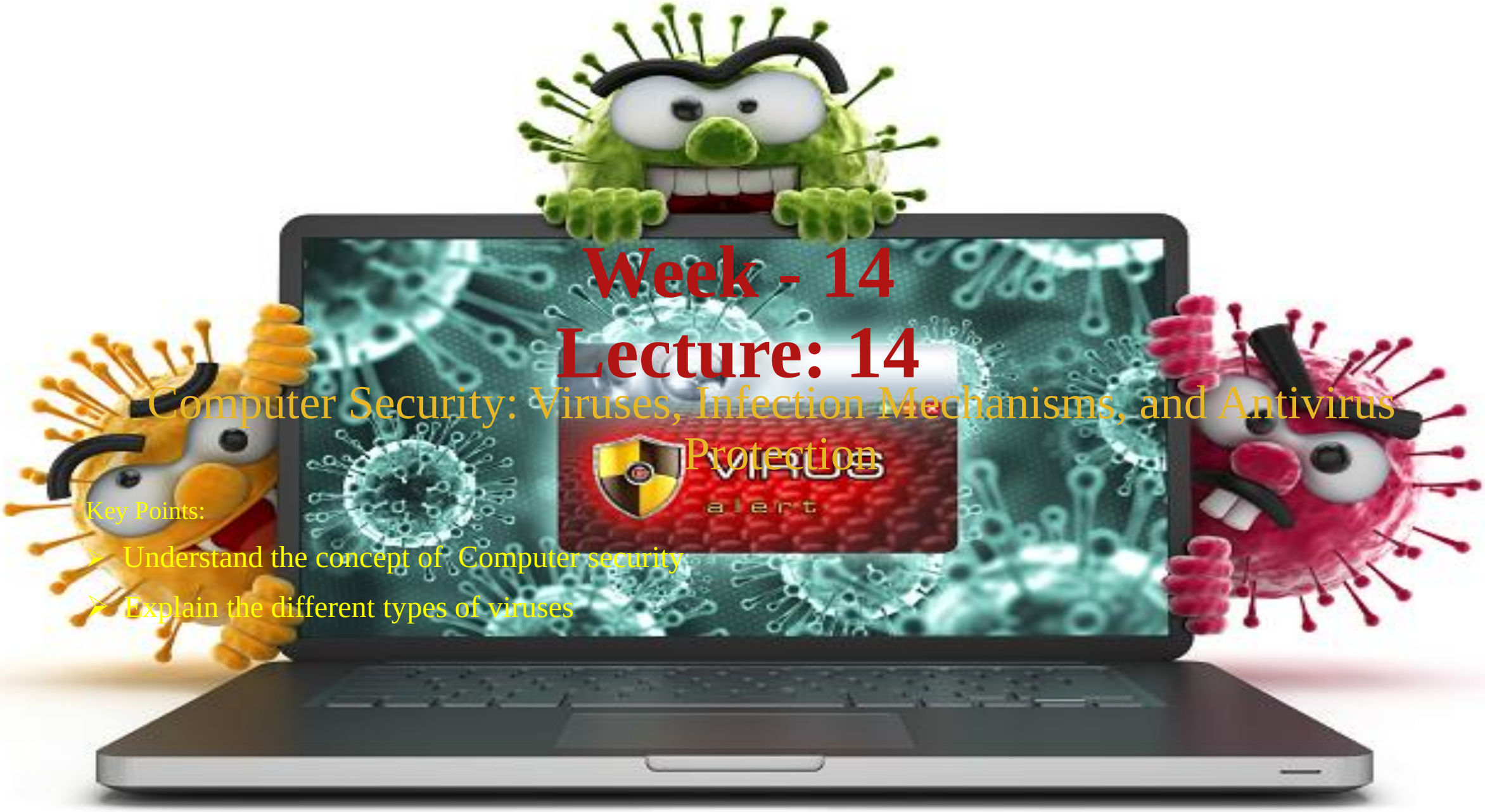


Week - 14

Lecture: 14

Computer Security: Viruses, Infection Mechanisms, and Antivirus Protection

Key Points:

- Understand the concept of Computer security
- Explain the different types of viruses

Malicious Web

- A malicious website is a site that attempts to install malware (a general term for anything that will disrupt computer operation, gather your personal information or, in a worst-case scenario, gain total access to your machine) onto your device

- Requires user action like visiting a website, giving permission to access cookies, etc.
- Malicious websites often look like legitimate websites

Malicious Software

Malware

- Malware short for malicious software, is any software used to disrupt computer operation, gather sensitive information, or gain access to private computer systems.
- Malware is defined by its malicious intent, acting against the requirements of the computer user, and does not include software that causes unintentional harm due to some deficiency.

Malicious Software

Botnet

- A botnet is a network of zombie computers that have been taken over by a robot or bot that performs large-scale malicious acts for the creator of the botnet.

Virus

- Computer Viruses are programs that can replicate their structures or effects by infecting other files or structures on a computer. The common use of a virus is to take over a computer to steal data.

Malicious Software

Worms

- Computer worms are programs that can replicate themselves throughout a computer network, performing malicious tasks throughout.

Ransomware

- Ransomware is a type of malware which restricts access to the computer system that it infects, and demands a ransom paid to the creators of the malware in order for the restriction to be removed.

Malicious Software

Trojan Horse

- A Trojan horse, commonly known as a Trojan, is a general term for malicious software that pretends to be harmless, so that a user willingly allows it to be downloaded onto the computer.

Key-Logger

- Key-Logger, Keystroke logging, often referred to as keylogging or keyboard capturing, is the action of recording (logging) the keys struck on a keyboard

Denial of Service Attacks

- A denial-of-service attack (DoS attack) or distributed denial-of-service attack (DDoS attack) is an attempt to make a computer resource unavailable to its intended users.
- Another way of understanding DDoS is seeing it as attacks in cloud computing environment that are growing due to the essential characteristics of cloud computing.
- Although the means to carry out, motives for, and targets of a DoS attack may vary, it generally consists of the concerted efforts to prevent an Internet site or service from functioning efficiently or at all, temporarily or indefinitely.

Phishing

- Phishing is an attack which targets online users for extraction of their sensitive information such as username, password and credit card information.
- Phishing occurs when the attacker pretends to be a trustworthy entity, either via email or web page.
- Victims are directed to fake web pages, which are dressed to look legitimate, via spoof emails, instant messenger/social media.
- Often tactics such as email spoofing are used to make emails appear to be from legitimate senders, or long complex subdomains hide the real website host.

Computer Virus

- A piece of software that can infect other programs by modifying them
- Modification includes injecting the original program with a routine to make copies of the virus program which can then go on to infect other programs
- In it's instructional code, virus carries instructions to make perfect copies of itself
- Generally viruses embed themselves into a program

Parts of a Computer Virus

- **Infection Mechanism**: The means by which virus spreads, enabling it to replicate. The mechanism is also referred to as **Infection Vector**.
- **Trigger**: The event or condition that determines when the payload is activated or delivered.
- **Payload**: What the virus does besides spreading. The payload may involve damage or may involve benign but noticeable activity.

Antivirus Approaches

- **Detection**: Once the infection has occurred, determine that it has occurred and locate the virus.
- **Identification**: Once detection has been achieved, identify the specific virus that has infected a program.
- **Removal**: Once the specific virus has been identified, remove all traces of the virus from the infected program and restore it to its original state. Remove the virus from all infected systems so that the virus cannot spread further.

Thank you

Week - 14
Lecture: 14

Core Programming Concepts: Algorithms, Flowcharts, and Pseudocode

Key Points:

- Understand the concept of Programming concept
- Explain the Algorithms, Flowchart & Pseudocode

Purpose of Program Planning

To write a correct program, a programmer must write each and every instruction in the correct sequence

Logic (instruction sequence) of a program can be very complex

Hence, programs must be planned before they are written to ensure program instructions are:

- Appropriate for the problem
- In the correct sequence

Algorithm

Refers to the logic of a program and a step-by-step description of how to arrive at the solution of a given problem

In order to qualify as an algorithm, a sequence of instructions must have following characteristics:

- Each and every instruction should be precise and unambiguous
- Each instruction should be such that it can be performed in a finite time
- One or more instructions should not be repeated infinitely. This ensures that the algorithm will ultimately terminate
- After performing the instructions, that is after the algorithm terminates, the desired results must be obtained

Sample Algorithm (Example 1)

THERE ARE 50 STUDENTS IN A CLASS WHO APPEARED IN THEIR FINAL EXAMINATION. THEIR MARK SHEETS HAVE BEEN GIVEN TO YOU.

THE DIVISION COLUMN OF THE MARK SHEET CONTAINS THE DIVISION (FIRST, SECOND, THIRD OR FAIL) OBTAINED BY THE STUDENT.

WRITE AN ALGORITHM TO CALCULATE AND PRINT THE TOTAL NUMBER OF STUDENTS WHO PASSED IN FIRST DIVISION.

Sample Algorithm (Example 1)

Step 1: Initialize Total_First_Division and Total_Marksheets_Checked to zero.

Step 2: Take the mark sheet of the next student.

• Step 3: Check the division column of the mark sheet to see if it is FIRST, if no, go to Step 5.

Step 4: Add 1 to Total_First_Division.

Step 5: Add 1 to Total_Marksheets_Checked.

Step 6: Is Total_Marksheets_Checked = 50, if no, go to Step 2. Step 7: Print Total_First_Division.

Step 8: Stop.

Sample Algorithm (Example 2)

- There are 100 employees in an organization. The organization wants to distribute annual bonus to the employees based on their performance. The performance of the employees is recorded in their annual appraisal forms.
- Every employee's appraisal form contains his/her basic salary and the grade for his/her performance during the year. The grade is of three categories – 'A' for outstanding performance, 'B' for good performance, and 'C' for average performance.
- It has been decided that the bonus of an employee will be 100% of the basic salary for outstanding performance, 70% of the basic salary for good performance, 40% of the basic salary for average performance, and zero for all other cases.
- Write an algorithm to calculate and print the total bonus amount to be distributed by the organization.

Sample Algorithm (Example 2)

(contd…)

Step 1: Initialize Total_Bonus and Total_Employees_Checked to zero.

Step 2: Initialize Bonus and Basic_Salary to zero.

Step 3: Take the appraisal form of the next employee.

Step 4: Read the employee's Basic_Salary and Grade.

Step 5: If Grade = A, then Bonus = Basic_Salary. Go to Step 8.

Step 6: If Grade = B, then Bonus = Basic_Salary x 0.7. Go to Step 8.

Step 7: If Grade = C, then Bonus = Basic_Salary x 0.4.

Step 8: Add Bonus to Total_Bonus.

Step 9: Add 1 to Total_Employees_Checked.

Step 10: If Total_Employees_Checked < 100, then go to Step 2.

Step 11: Print Total_Bonus.

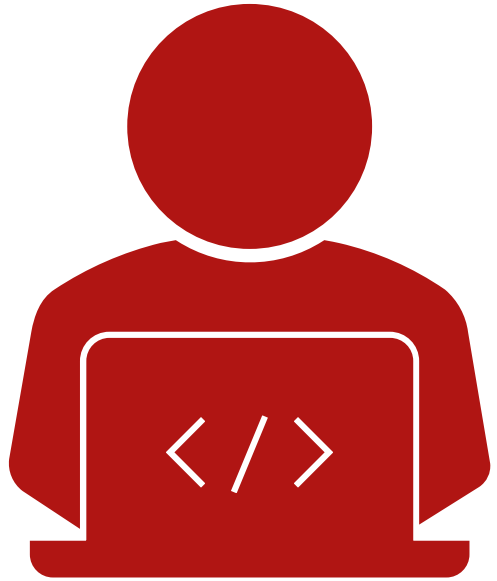
Step 12: Stop.

Representation of Algorithms

- As programs
- As flowcharts
- As pseudocodes

When an algorithm is represented in the form of a programming language, it becomes a program

Thus, any program is an algorithm, although the reverse is not true



Flowchart

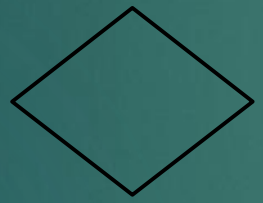
- *Flowchart* is a pictorial representation of an algorithm
- Uses symbols (boxes of different shapes) that have standardized meanings to denote different types of instructions
- Actual instructions are written within the boxes
- Boxes are connected by solid lines having arrow marks to indicate the exact sequence in which the instructions are to be executed
- Process of drawing a flowchart for an algorithm is called *flowcharting*

Basic Flowchart Symbols

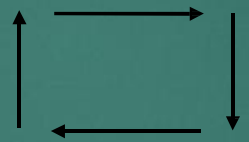
Terminal

Input/Output

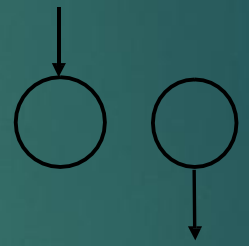
Processing



Decision

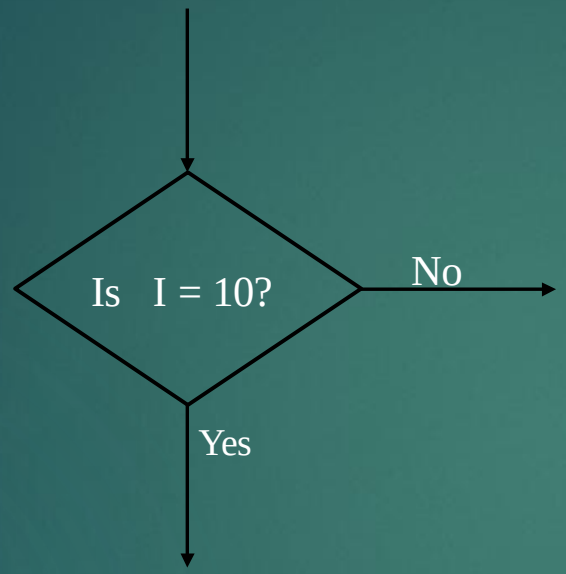


Flow lines

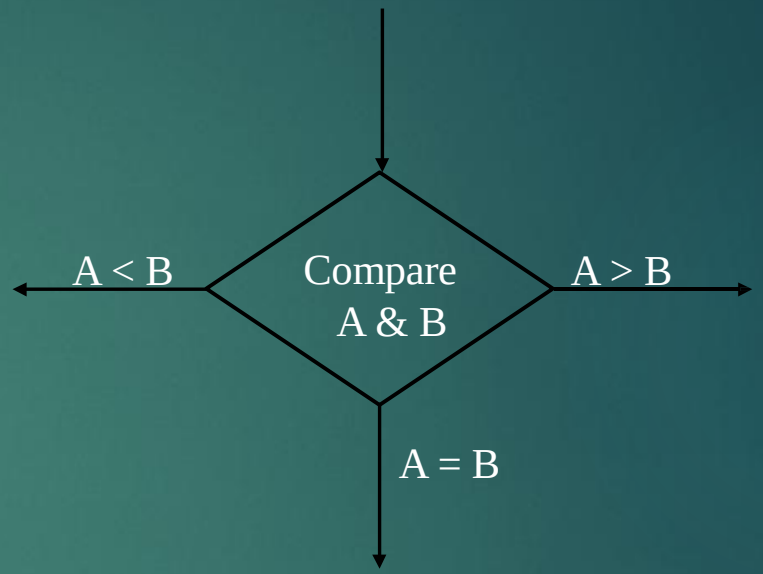


Connectors

Examples of Decision Symbol



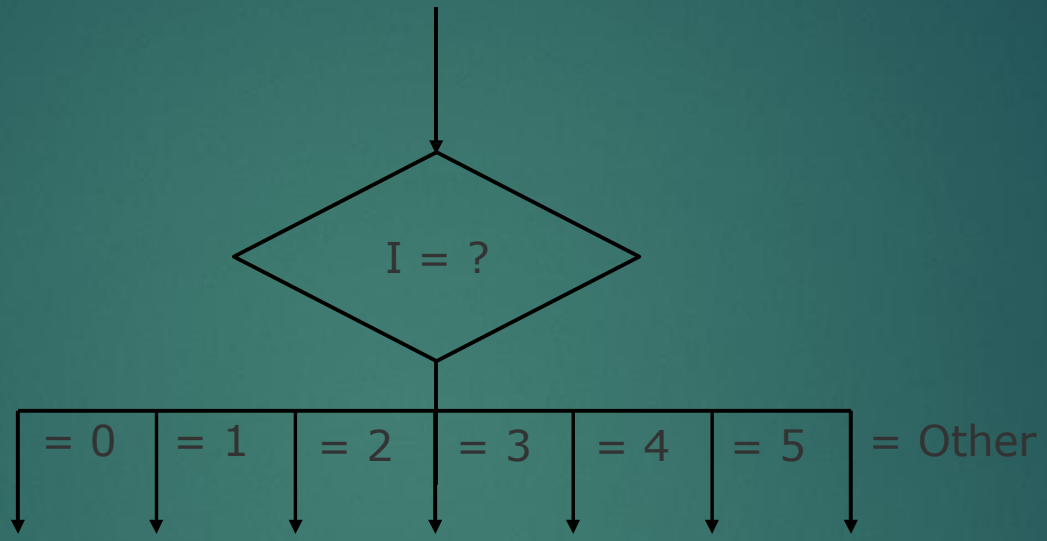
(a) A two-way branch decision.



(b) A three-way branch decision

Examples of Decision Symbol

(contd…)



(c) A multiple-way branch decision.

Sample Flowchart (Example 3)

A student appears in an examination, which consists of total 10 subjects, each subject having maximum marks of 100.

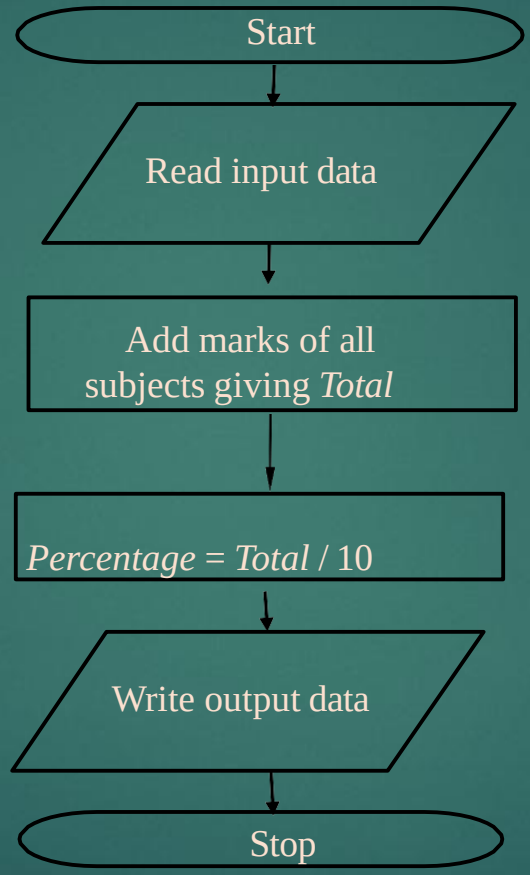
The roll number of the student, his/her name, and the marks obtained by him/her in various subjects are supplied as input data.

Such a collection of related data items, which is treated as a unit is known as a record.

Draw a flowchart for the algorithm to calculate the percentage marks obtained by the student in this examination and then to print it along with his/her roll number and name.

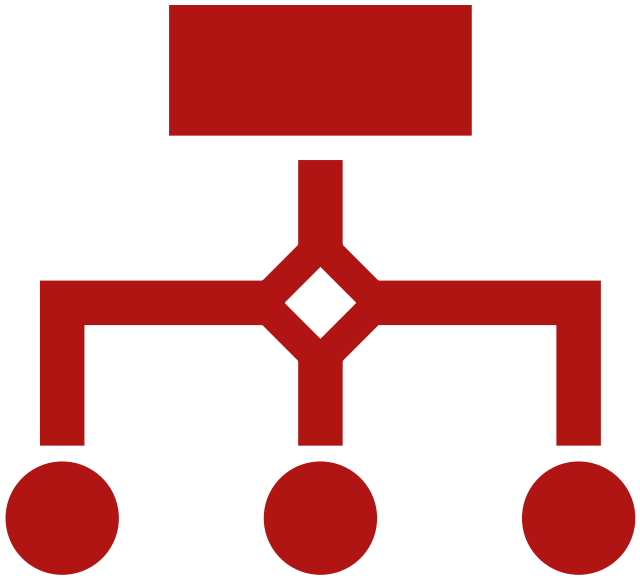
Sample Flowchart (Example 3)

(contd…)



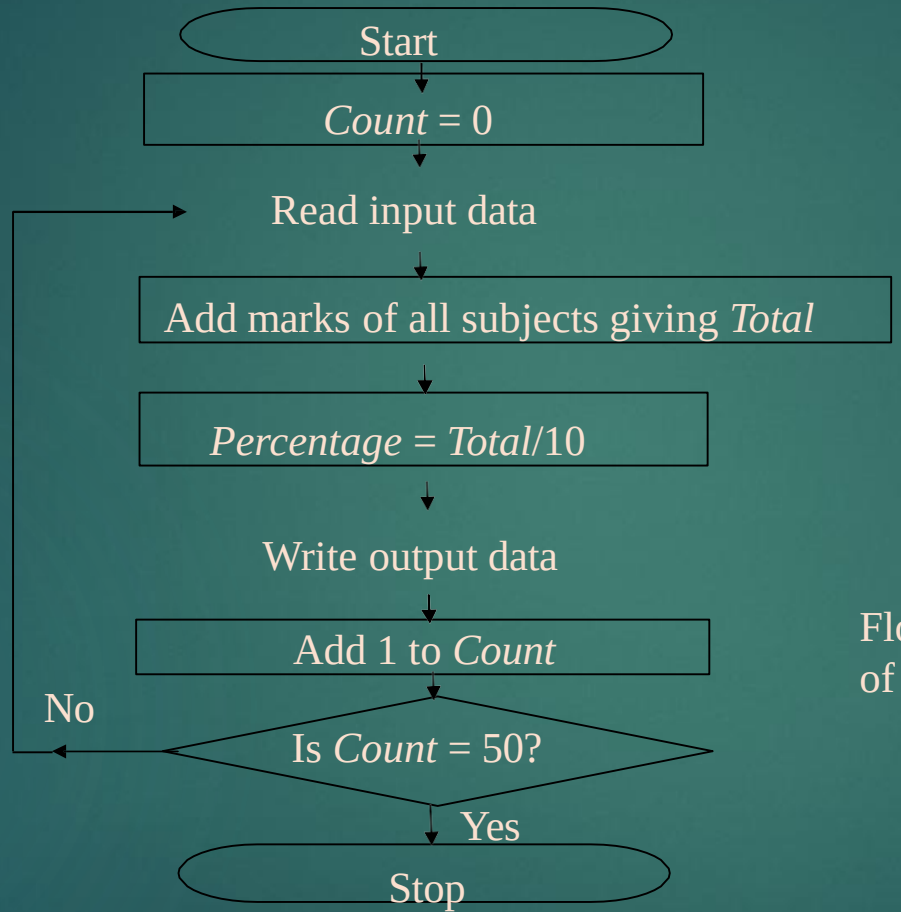
Sample Flowchart (Example 4)

- 50 students of a class appear in the examination of Example 3.
- Draw a flowchart for the algorithm to calculate and print the percentage marks obtained by each student along with his/her roll number and name.



Sample Flowchart (Example 4)

(contd…)



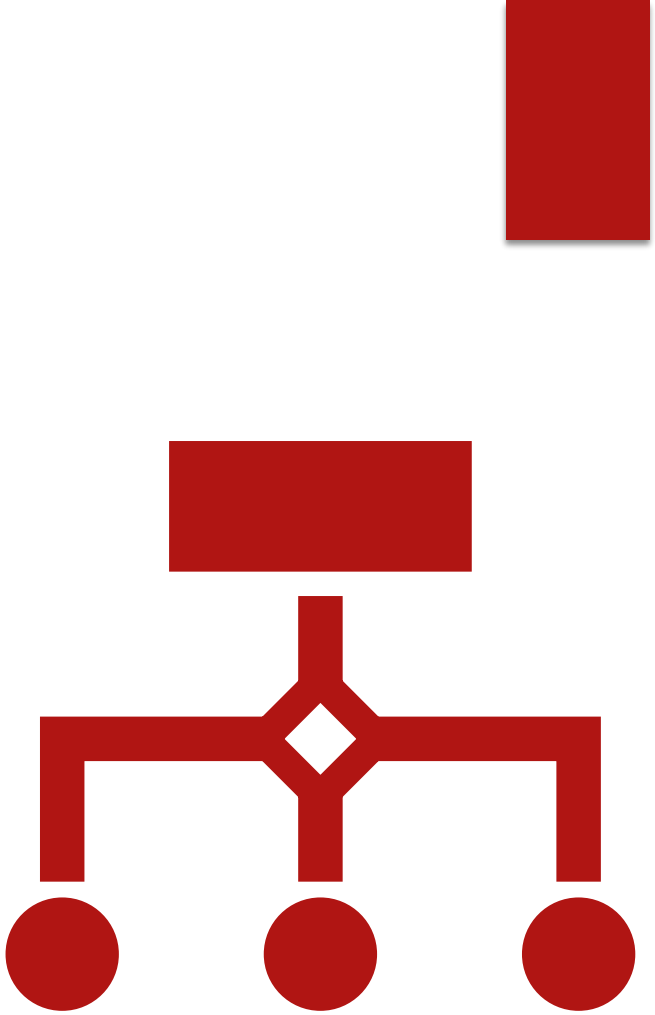
Flowchart for the solution of Example 4.

Sample Flowchart (Example 5)

- For the examination of Example 3, we want to make a list of only those students who have passed (obtained 30% or more marks) in the examination.
- In the end, we also want to print out the total number of students who have passed.
- Assuming that the input data of all the students is terminated by a trailer record, which has sentinel value of 9999999 for Rollno, draw a flowchart for the algorithm to do this. Do it myself.

Flowcharting Rules

- First chart the main line of logic, then incorporate detail
- Maintain a consistent level of detail for a given flowchart
- Do not chart every detail of the program. A reader who is interested in greater details can refer to the program itself
- Words in the flowchart symbols should be common statements and easy to understand



Flowcharting Rules

(contd ...)

- Be consistent in using names and variables in the flowchart
- Go from left to right and top to bottom in constructing flowcharts
- Keep the flowchart as simple as possible. Crossing of flow lines should be avoided as far as practicable
- If a new flowcharting page is needed, it is recommended that the flowchart be broken at an input or output point.
- Properly labeled connectors should be used to link the portions of the flowchart on different pages

Advantages of Flowchart

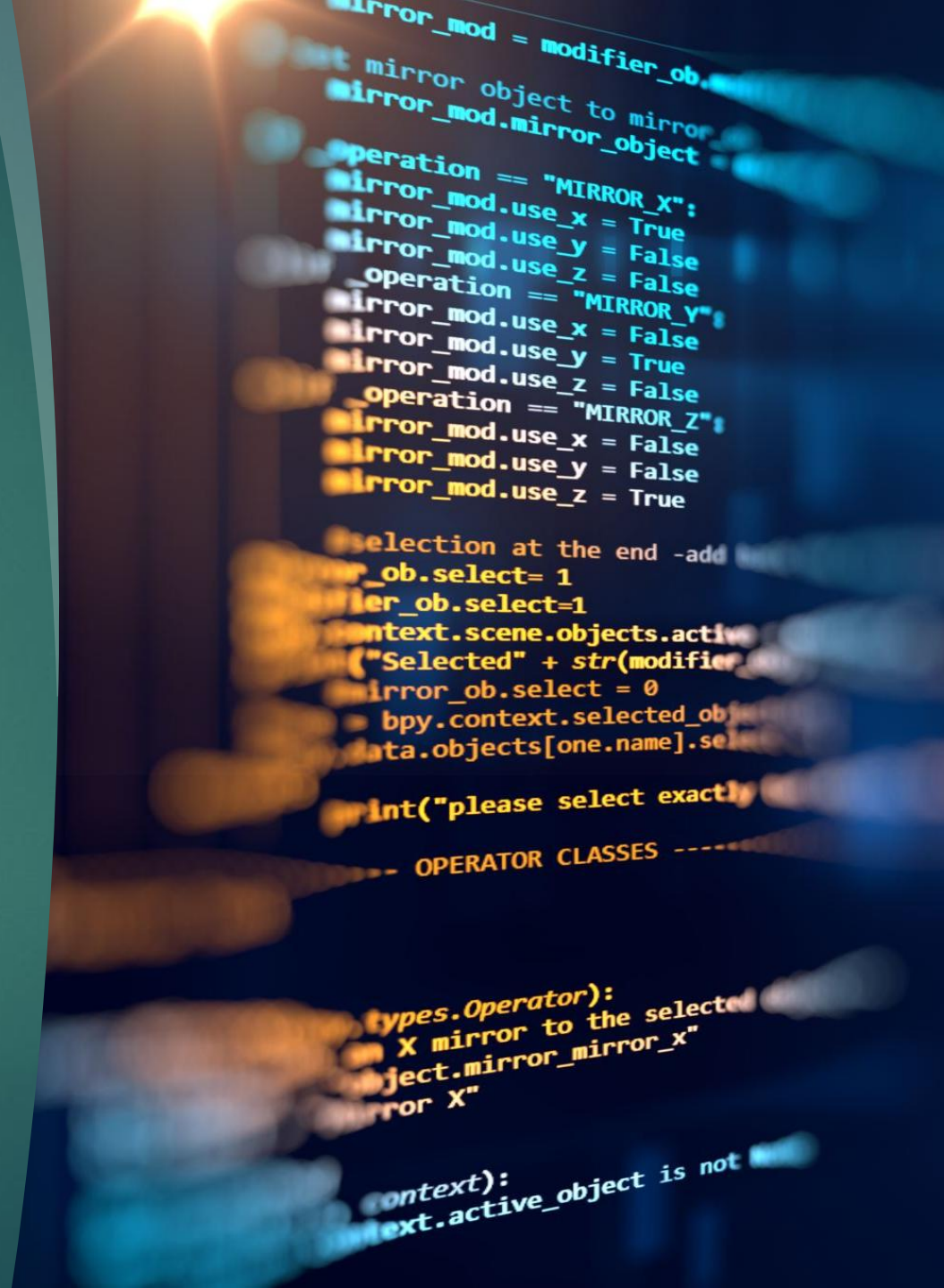
- Better Communication
- Proper program documentation
- Efficient coding
- Systematic debugging
- Systematic testing

Limitations of Flowchart

- Flowcharts are very time consuming and laborious to draw (especially for large complex programs)
- Redrawing a flowchart for incorporating changes/ modifications is a tedious task
- There are no standards determining the amount of detail that should be included in a flowchart

Pseudocode

- A program planning tool where program logic is written in an ordinary natural language using a structure that resembles computer instructions
- “ Pseudo” means imitation or false and “ Code” refers to the instructions written in a programming language. Hence, pseudocode is an imitation of actual computer instructions
- Because it emphasizes the design of the program, pseudocode is also called Program Design Language (PDL)



Basic Logic (Control) Structures

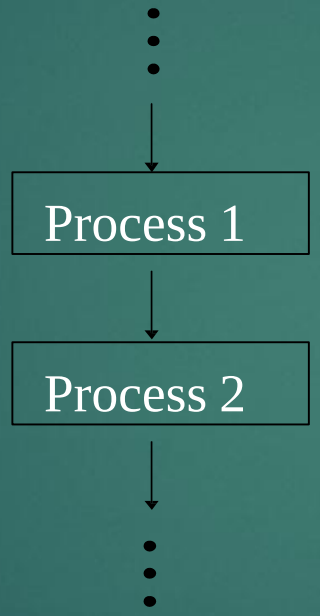
Any program logic can be expressed by using only following three simple logic structures:

- Sequence logic,
- Selection logic, and
- Iteration (or looping) logic

Programs structured by using only these three logic structures are called ***structured programs***, and the technique of writing such programs is known as ***structured programming***

Sequence Logic

It is used for performing instructions one after another in sequence.



(a) Flowchart

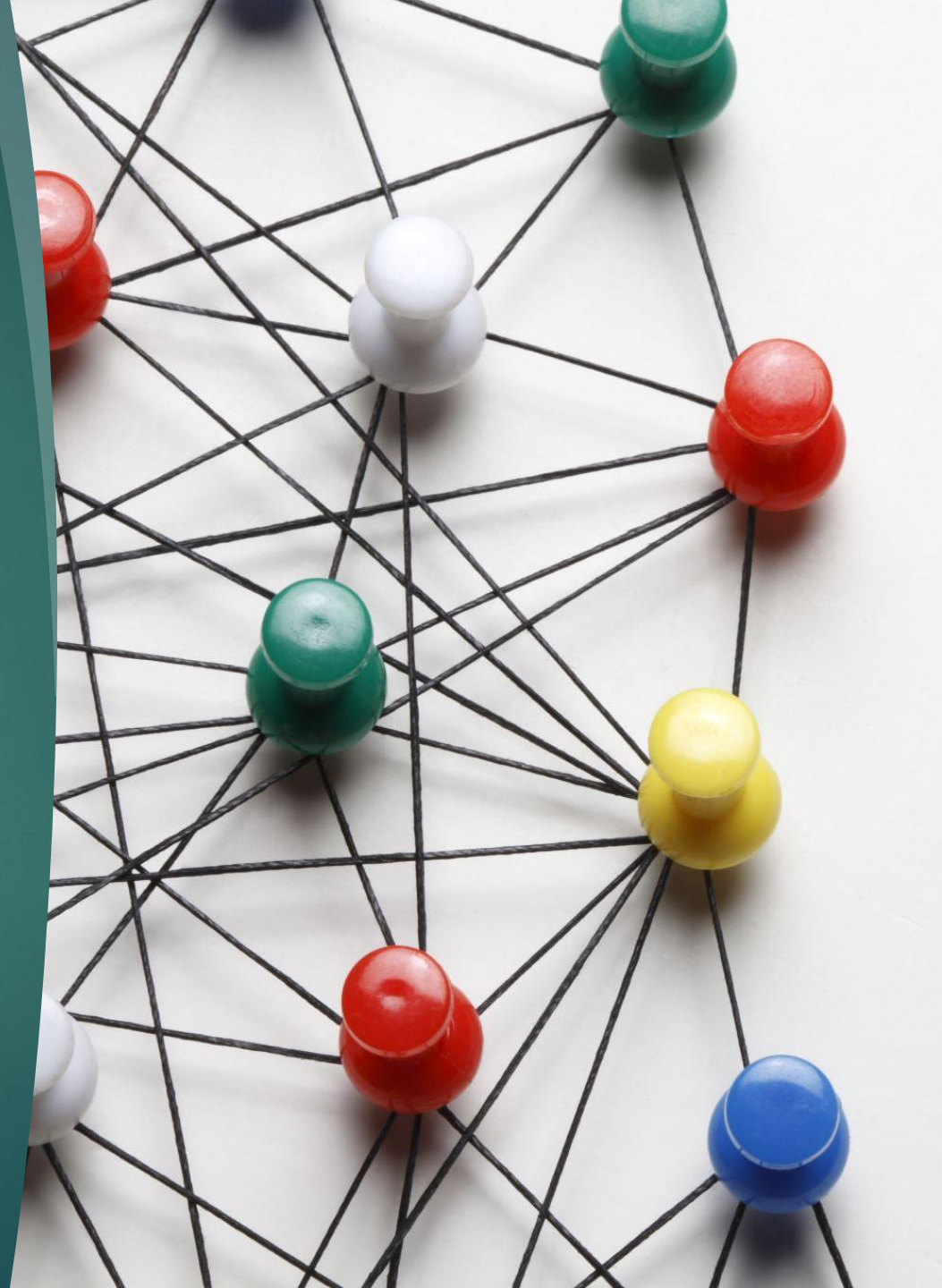
Process 1

Process 2

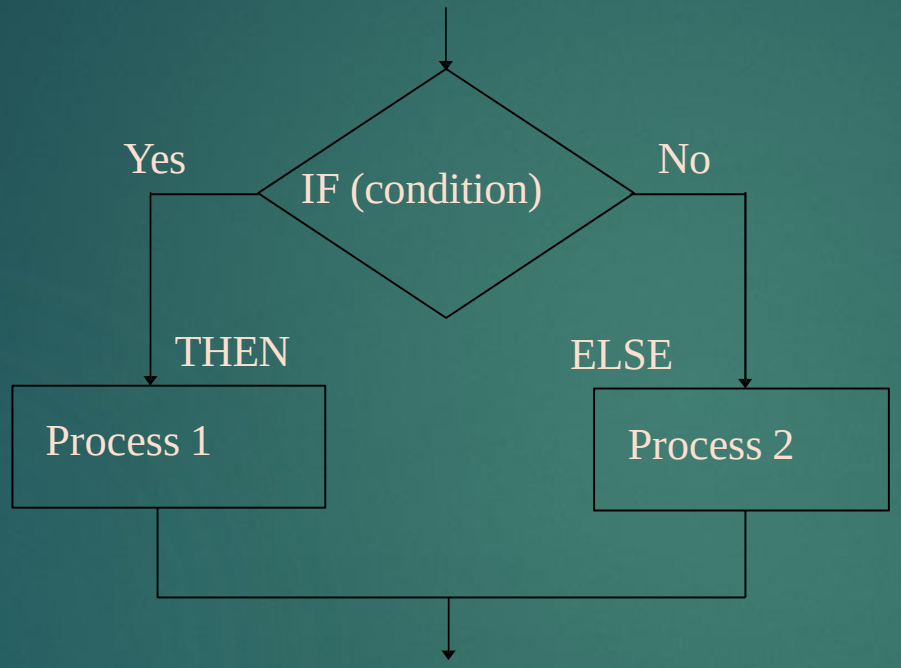
(b) Pseudocode

Selection Logic

- Also known as decision logic, it is used for making decisions
- Three popularly used selection logic structures are
  - IF…THEN…ELSE
  - IF…THEN
  - CASE



Selection Logic (IF…THEN…ELSE Structure)



(a) Flowchart

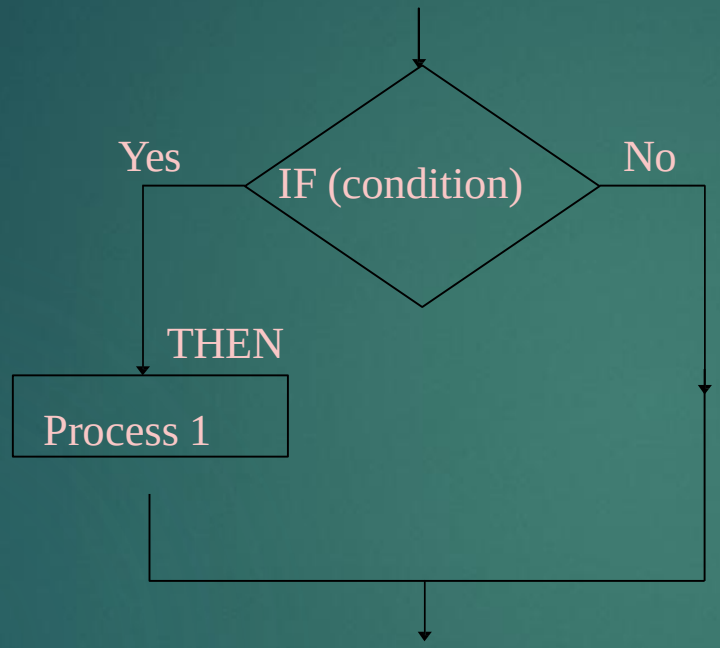
```
:
IF Condition

    THEN    Process 1
    ELSE    Process 2

ENDIF
:
```

(b) Pseudocode

Selection Logic (IF…THEN Structure)

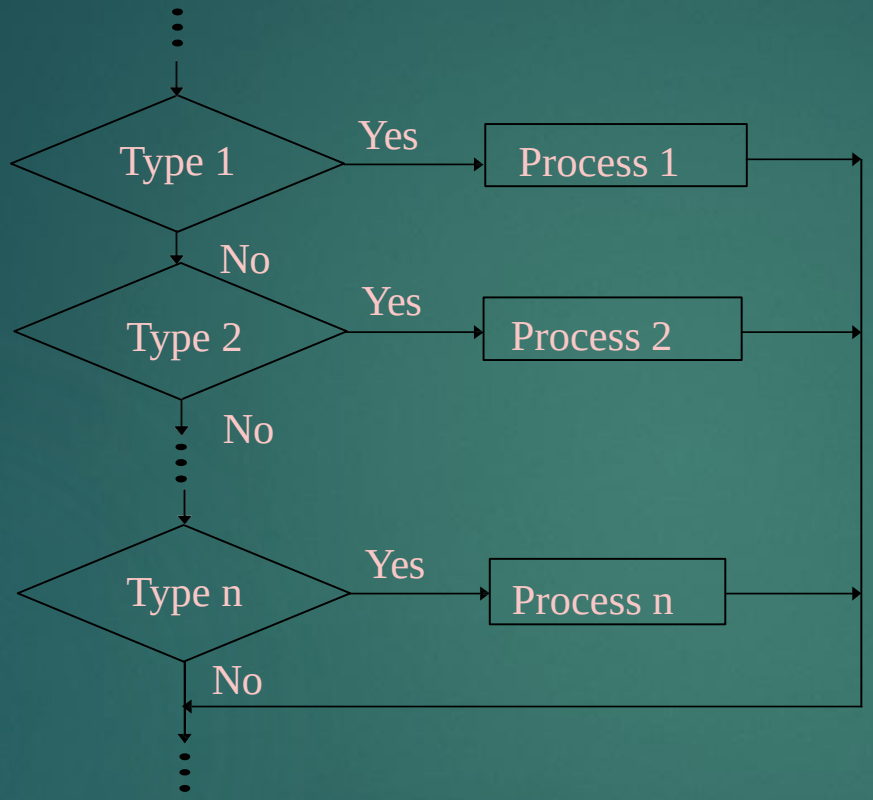


(a) Flowchart

```
IF Condition
    THEN    Process 1
ENDIF
```

(b) Pseudocode

Selection Logic (CASE Structure)



(a) Flowchart

CASE *Type*

Case Type 1: Process 1

Case Type 2: Process 2

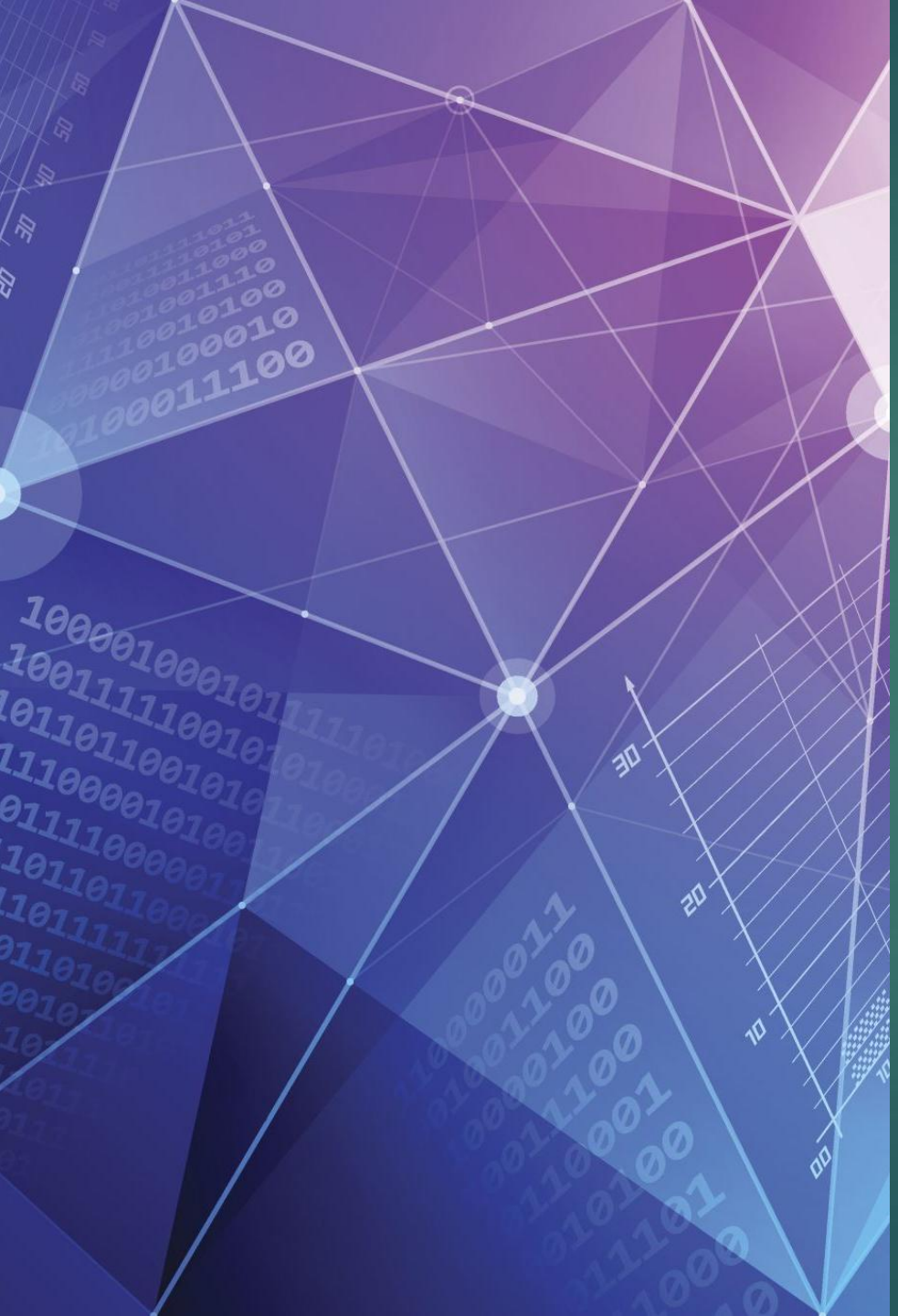
Case Type n: Process n

ENDCASE

(b) Pseudocode

Advantages of Pseudocode

- Converting a pseudocode to a programming language is much easier than converting a flowchart to a programming language
- As compared to a flowchart, it is easier to modify the pseudocode of a program logic when program modifications are necessary
- Writing of pseudocode involves much less time and effort than drawing an equivalent flowchart as it has only a few rules to follow



Limitations of Pseudocode

- In case of pseudocode, a graphic representation of program logic is not available
- There are no standard rules to follow in using pseudocode
- Different programmers use their own style of writing pseudocode and hence communication problem occurs due to lack of standardization
- For a beginner, it is more difficult to follow the logic of or write pseudocode, as compared to flowcharting

Thank you