Prepared By: Last Hope Study

Chapter # 1 (Smart Syllabus)
Introduction to Systems
Complete Notes (Short + Long)

SQ: Define a system. What are its basic components?
A system is a group of related components that work together to perform a specific function. All the components of a system are interconnected, and each component performs a specific task.
SQ: Define information system.
Information System A system that collects, stores, processes, and shares information is called information system. It helps people to perform various tasks quickly and easily
SQ: What is meant by systems theory?
Systems theory is the study of how different components of a system work together. It helps us to understand how the components of a system are interconnected and how they depend on each other.

Exercise Long Q 1: Define and describe the concept of a system. Explain the fundamental components, objectives, environment, and methods of communication within a system.

Concept of System
A system is described by its objective components, communication among components and the environment in which it works. The components of a system communicate with each other to achieve the system's objective in an environment. Systems can be simple, like a thermostat complex, like the human body or a computer network.
SQ: What are the components of a system?
Components are the building blocks of any system. Each component plays a specific role in the operation of a system. Understanding the role of each component is essential so that we can understand how the entire system works. It is essential for all system components to function smoothly and properly so that the system can fulfill its objectives.
SQ: What are the basic components of a computer system?
The basic components computer are as follows:

- **Input unit** enters data and instructions into the system.
- **CPU** processes data according to the instructions.
- **Output unit** provides the output of the system

SQ: What is meant by objective of a system? Give an example.
Every system has a purpose or goal that it wishes to fulfil. Analyzing a system's operation requires understanding its aim. This insight improves the efficiency and efficacy of the present system. For example, Objective of A computer system is to process data and provide useful information to users.
SQ: What is the environment of a system? What are different properties of a system's environment.
The environment of a system includes everything external to the system that interacts with it. It consists of all external factors that affect the system's operation; there are several properties of a system's environment that affect system design and its functionality. Two of these properties are

i) Static and dynamic
ii) Deterministic and non-deterministic

SQ: Explain the deterministic and non-deterministic properties of the system's environment.
Deterministic: The impact of a deterministic system's output on the environment is fully known and sure. For example, when you input 2 + 2 in calculator, the output is always 4. The result is already known and sure**.**
Non-Deterministic: The impact of a non-deterministic system's output on the environment is uncertain and random. For example, a weather forecasting system is a non-deterministic system because its predictions about the weather is uncertain**.**
SQ: What is the importance of communication among components of a system?
Communication and interaction between components of a system are very important for it to work properly. They help all the components work together in an organized and smooth way to reach the system's objectives. For example, in a computing system the CPU communicates with memory to fetch and store data.

SQ: What is the relationship between Science and the Systems?
Science is the study of the world around us. It helps us to understand how various systems work and how we can discover new systems to solve problems. Science can be divided into two main types: natural science and design science.
SQ: What is Natural Science? / What is the purpose Natural Science?
The purpose of natural science is to study existing natural systems in the natural world to understand their objectives and workings. It helps scientists to understand and describe natural phenomena, such as plants, animals, weather, or stars. To achieve this, scientists follow a process called the **empirical cycle.** For example, studying a forest ecosystem.

Exercise Long Q 7: Provide a detailed explanation of how a computer interacts with its environment. Include examples of user input, network communication, and power supply.

SQ: What is the environment of computer system?
The computer system environment includes any external devices that interact with the computer. For example:
Power Supply: Provides electrical power to allow the computer to work.
Network: Connects the computer to other systems and the Internet.
Peripherals: Include printers, scanners, and external discs that expand the computer's capabilities.
SQ: How does computer interact with environment?
A computer interacts with its environment to perform its functions. For examples:
User Input: A user types on the keyboard, and the computer processes the input to display text on the screen.
Network Communication: The computer sends and receives data over the internet to browse websites or download files.
Power Supply: The computer relies on a stable power supply to function correctly.

Exercise Long Q 6: Explain the key parts/components of Von Neumann Computer Architecture.

SQ: Von Neumann architecture

The Von Neumann architecture is a computer model that explains how a computer works from the inside. It was named after a famous scientist **John von Neumann**, who helped develop it in the 1940s. According to this model, a computer has **four main parts**: **memory**, **CPU**, **input devices**, and **output devices**. These parts work together to process data and run programs.

1. Memory

Memory stores **both the data and the instructions** needed by the CPU.

For example, when we open a program on the computer, it loads into **RAM** so the computer can work faster. Memory helps the CPU by giving it the information it needs for processing.

2. Central Processing Unit (CPU)

The CPU is the **brain of the computer**. It performs calculations like addition and subtraction and follows the instructions stored in memory.

The CPU has two main parts:

- **Arithmetic Logic Unit (ALU):**
  This part performs **mathematical** operations (like 2 + 2) and **logical** decisions.
- **Control Unit (CU):**
  This part **controls all activities inside the CPU**. It tells the ALU and the memory what to do and when to do it. For example, when you press numbers on a calculator app, the ALU does the calculation, and the CU manages the whole process.

3. Input Devices

Input devices allow us to **enter data and instructions** into the computer.

Examples: **keyboard, mouse, microphone**.

When we type something on the keyboard, it sends the information to the CPU for processing.

4. Output Devices

Output devices show us the **results** after the computer finishes processing the data.

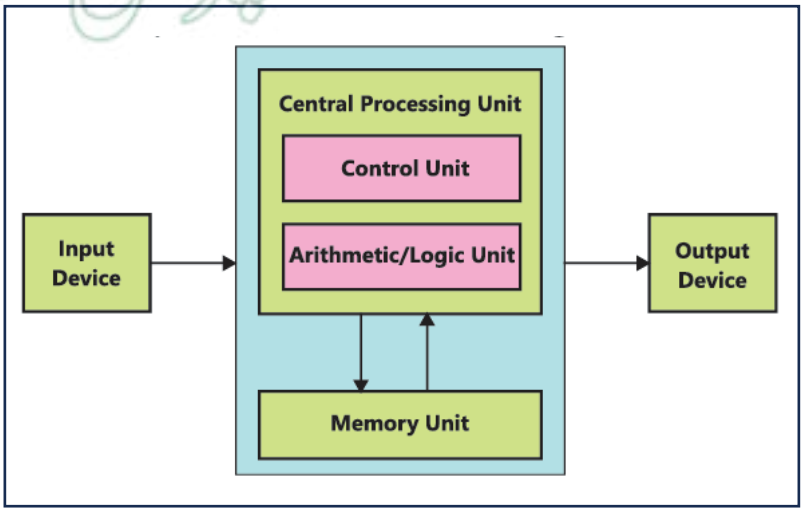
Examples: **monitor, printer**.

When the CPU completes its work, it sends the result to the monitor to display it on the screen.

System Bus

The system bus is a communication path that helps all parts of the computer **send and receive information**. It has three types:

- **Data Bus:** Carries the actual data.
- **Address Bus:** Carries the address where the data should go.
- **Control Bus:** Carries control signals to manage different operations.



Exercise Long Q 6: Explain the working (steps) of the Von Neumann Computer Architecture.

The Von Neumann architecture explains how the CPU works step by step to complete any instruction. It works in four main stages: **fetching**, **decoding**, **execution**, and **storing**.
To understand these steps, we can take the example of adding two numbers on a calculator app.

1. Fetching
In this step, the CPU **gets the instruction** from the computer's memory. This instruction tells the CPU what task it needs to perform.
Hardware Used:

- Memory
- CPU
- **Program Counter (PC)**
- **Instruction Register (IR)**

The **Program Counter (PC)** keeps the address of the *next* instruction.
The CPU uses this address to get that instruction from memory and places it inside the **Instruction Register (IR)**.
This is called the **fetch** stage.

2. Decoding
In this step, the Control Unit (CU) **reads and understands** the instruction.
Hardware Used:

- **Control Unit (CU)**

The CU looks at the **opcode** (operation code) to find out what action is needed—such as addition, subtraction, or data movement—and what data will be used.

3. Execution
Now the CPU **performs the instruction**.
If the instruction is a calculation, the **Arithmetic Logic Unit (ALU)** does the math.
If the instruction requires moving data, the **Control Unit (CU)** manages it.
Hardware Used:

- **ALU**
- **CU**

The **ALU** performs mathematical and logical operations.
The **CU** controls data movement and manages how the instruction is carried out.

4. Storing

In the final step, the result of the operation is **saved**. It is either stored back into memory or sent to an output device.

Hardware Used:

- Memory
- Output Device

The result may be kept in a specific location in memory or shown on an output device like a display screen.

Long Q: Write the characteristics, advantages, and disadvantages of the Von Neumann Computer Architecture.

SQ. Write the Characteristics of Von Neumann Architecture.

These are the main characteristics of the Von Neumann computer model:

1. Single Memory Store

In this architecture, **both the program instructions and the data** are kept in the **same memory space**.

Example: In a computer game, the game's code and the game's data (scores, levels, player positions) are all stored in the same RAM.

2. Sequential Execution

The CPU carries out instructions **one after another** in the given order.

Example: When a computer runs a program, it follows each step **one by one** exactly as written.

3. Stored Program Concept

Programs are stored inside memory and can be **changed or updated** whenever needed.

Example: When you install a software update, the new set of instructions replaces the old ones in memory.

SQ. Write the Advantages and Disadvantages of Von Neumann Architecture.

Advantages

1. Simplified Design

Since data and instructions are kept in **one memory**, the design of the computer becomes easier and simpler.

2. Flexibility

Programs can be easily changed just by updating the contents of memory.
This makes the system more flexible for users.

SQ. Write the Disadvantages of Von Neumann Architecture.

1. Von Neumann Bottleneck

Because there is **only one memory**, the CPU cannot quickly get both data and instructions at the same time.
This slows down processing and is called the **Von Neumann bottleneck**.

2. Security Risks

Since both data and instructions share the same memory area, one program might accidentally or intentionally change another program's instructions.
This can create **security problems**.

SQ. What is the importance of Von Neumann architecture?

The Von Neumann architecture is very important because it explains how many modern computers work.
It acts like a **recipe** that the computer follows to process both data and instructions correctly.
Even though it has some limitations, it has played a major role in the **development of computer technology**.
