

INTRODUCTION TO COMPUTER ORGANIZATION AND ARCHITECTURE

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Yoga Ari Tofan, S.Kom., M.Kom.

Program Studi Informatika, Fakultas Ilmu Komputer
UPN “Veteran” Jawa Timur

LEARNING OBJECTIVES

By the end of this session, students should be able to:

1. Distinguish computer architecture from organization.
2. Identify the main structure and functions of a computer.
3. Explain how a basic computer operates.

WHY STUDY COMPUTER ARCHITECTURE?

Software performance is constrained by hardware reality.

- Program instructions must be represented, fetched, decoded, and executed by hardware.
- Memory hierarchy affects latency, throughput, and cost.
- I/O and interconnection determine how systems communicate with the external world.
- Architectural choices shape operating systems, compilers, and application behavior.

Legends

-  Software layer
-   Interface and implementation of the processor layer
-   The underlying digital hardware

Application

Operating System

Compiler / Runtime

Instruction Set

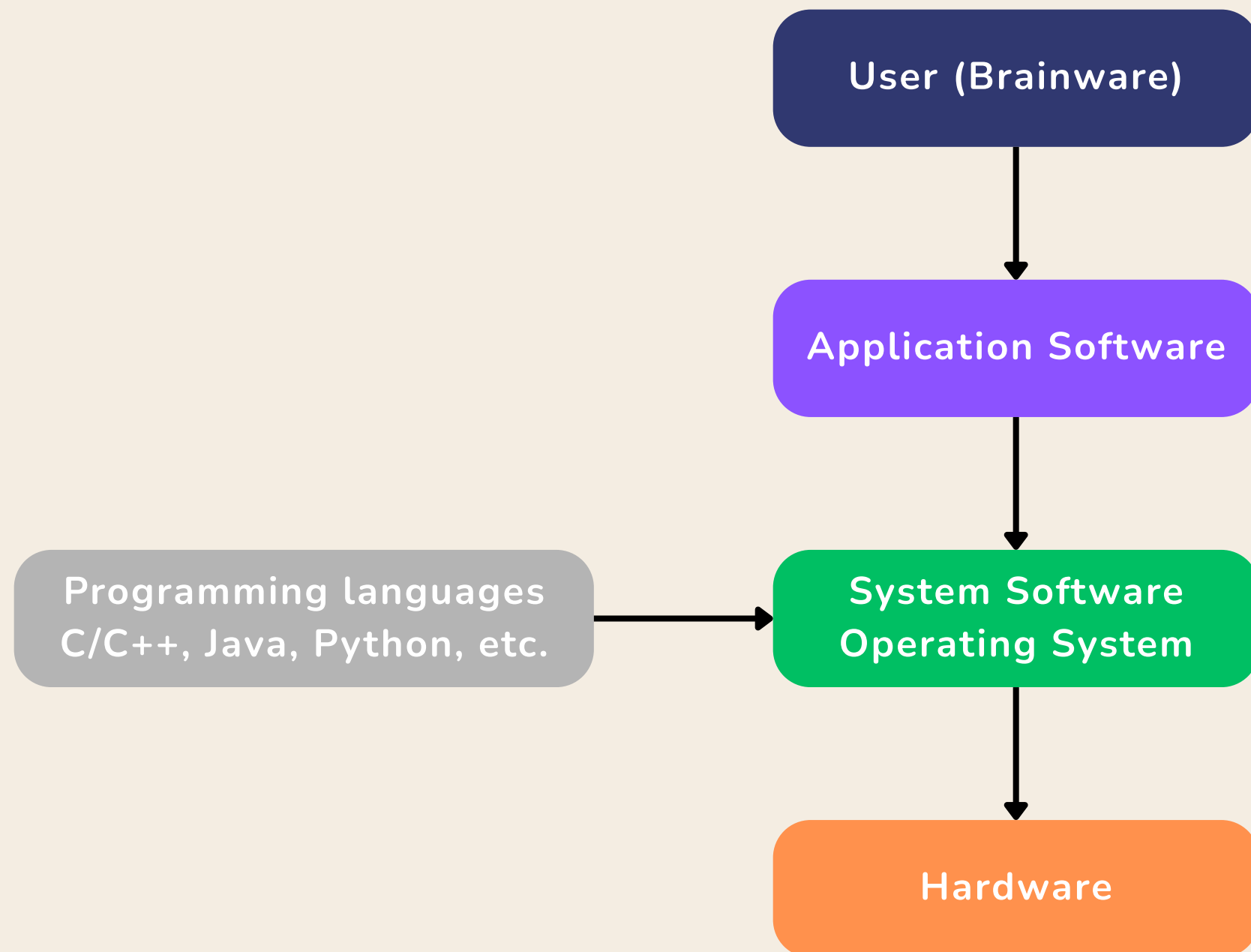
Microarchitecture

Digital Logic

Physical Hardware

COMPUTER AS A SYSTEM

A computer system is more than a physical machine. It combines hardware, system software, application software, and users.



Key

Higher layers rely on lower layers. Problems at one layer often affect the whole system.

TYPES OF COMPUTERS

Different form factors share the same fundamental model: input, processing, storage, output, and control.



Desktop / Tower



All-in-One PC



Laptop / Notebook



Tablet / Smartphone



Microcomputer / SBC



Server

COMPUTER ARCHITECTURE **VS.** COMPUTER ORGANIZATION

Computer Architecture

Attributes visible to programmers

Examples:

- Instruction set
- Arithmetic format
- Addressing techniques
- I/O mechanism

Focuses on conceptual design decisions

Computer Organization

Operational units and their interconnections

Examples:

- Hardware implementation
- Interfaces
- Memory technology
- Control signals

Focuses on how the architecture is realized

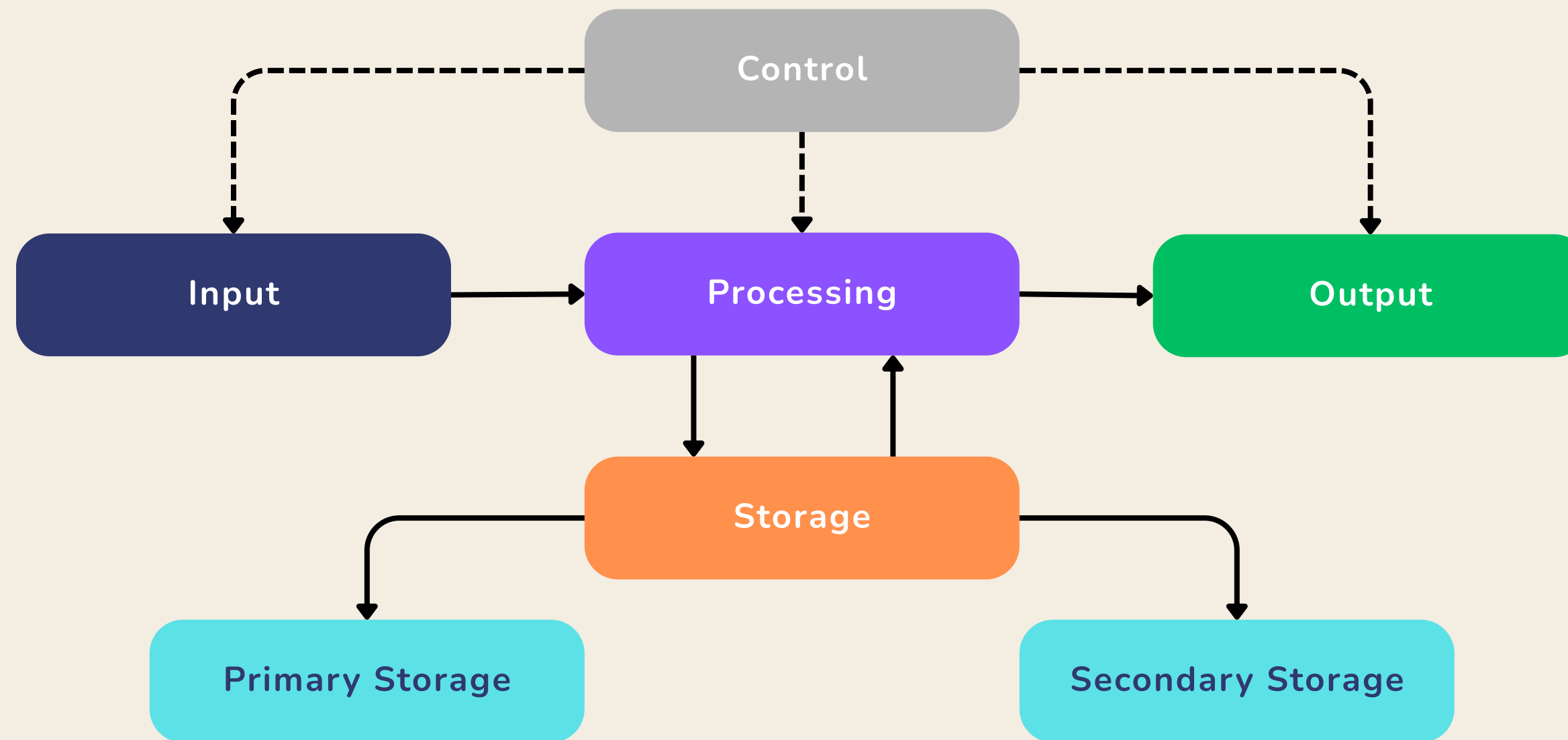
Simple analogy

Architecture is the contract; organization is the implementation.

COMPUTER AS A SYSTEM

Structure describes how components are arranged and connected.

Function describes what each component does.



FOUR BASIC FUNCTIONS OF A COMPUTER

1 Data Processing

Performs arithmetic and logical operations to transform data into information.

2 Data Storage

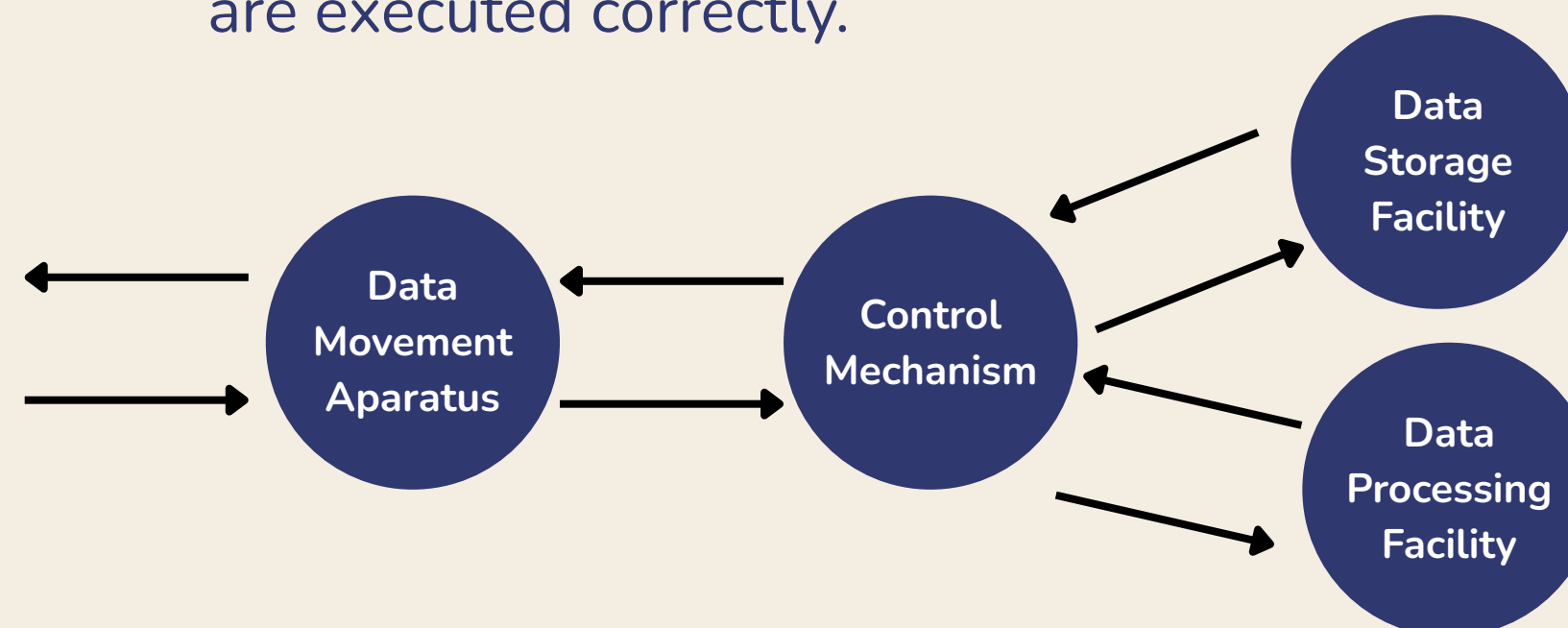
Stores data and instructions temporarily or permanently.

3 Data Movement

Transfers data within the computer and between external devices.

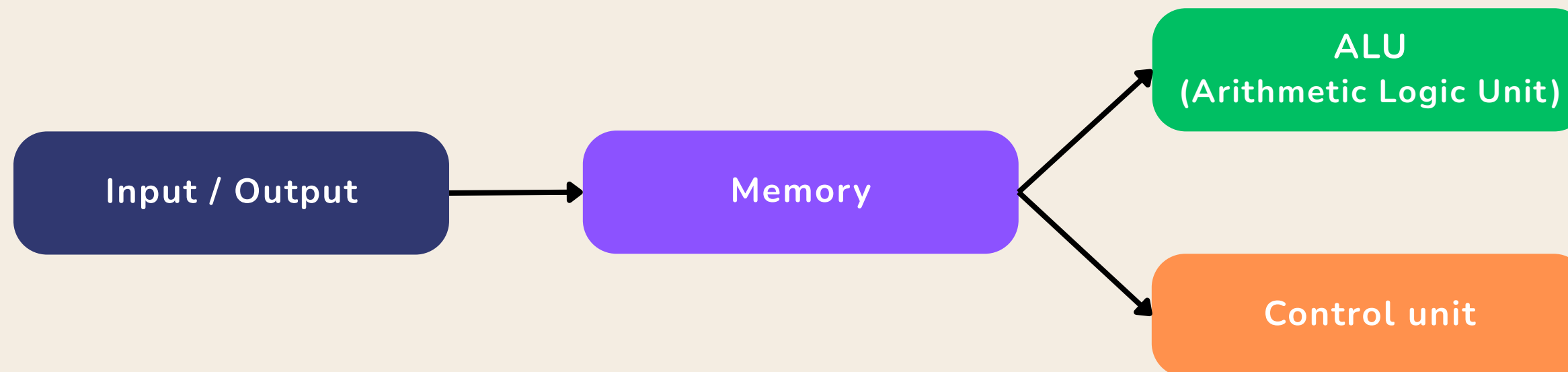
4 Control

Coordinates components so instructions are executed correctly.



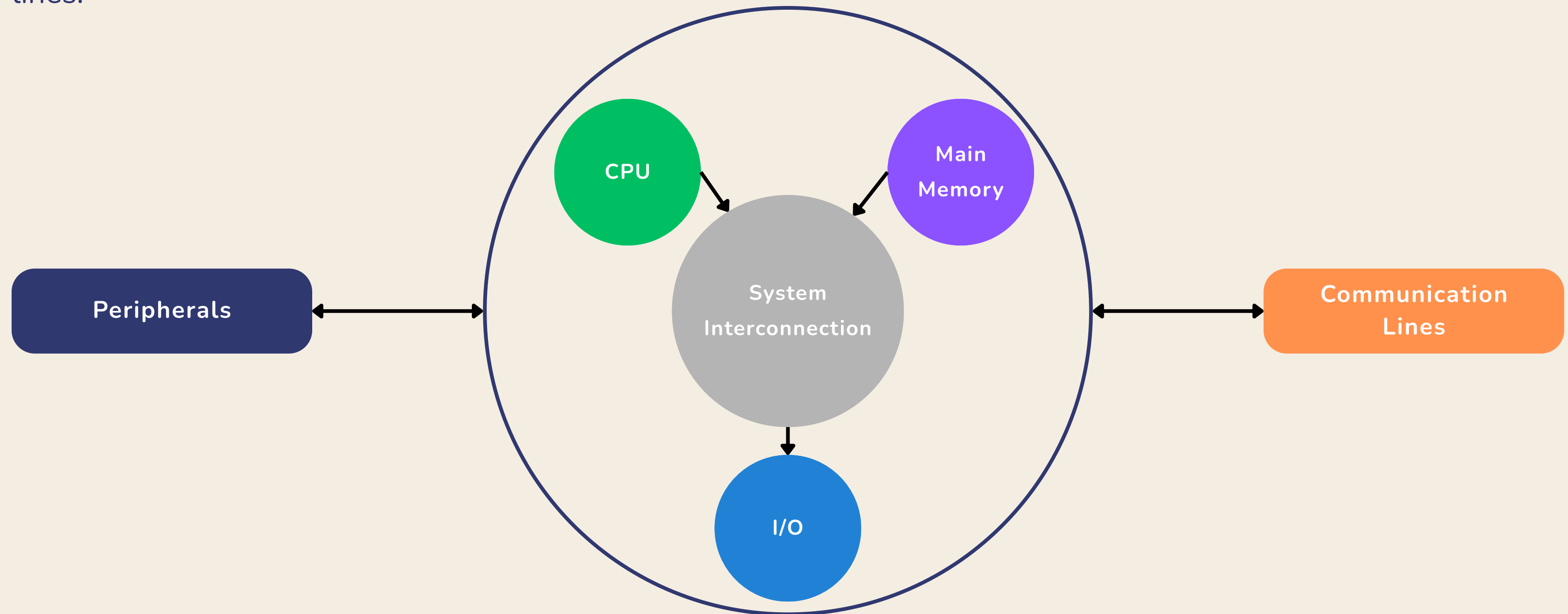
FUNCTIONAL UNITS OF A COMPUTER SYSTEM

1. Input/output moves data between the computer and the outside world.
2. Memory holds data and instructions during processing.
3. The ALU performs arithmetic and logic operations.
4. The control unit sequences operations and generates control signals.



TOP-LEVEL COMPUTER STRUCTURE

CPU, main memory, I/O, and system interconnection cooperate with external devices and communication lines.



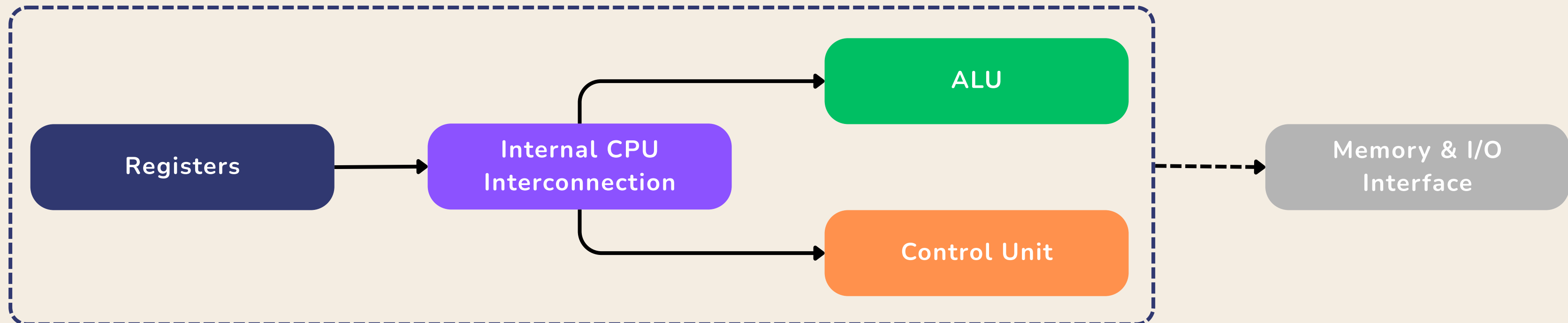
CPU STRUCTURE

Registers: small, high-speed storage inside the CPU.

ALU: arithmetic and logic operations.

Control Unit: coordinates instruction execution and data flow.

Internal interconnection: enables fast data exchange between CPU components.



CPU FORM FACTOR

- **Intel:** Core i3, i5, i7, i9; Core Ultra 5, 7, 9; Xeon
- **AMD:** Ryzen 3, 5, 7, 9; Threadripper; EPYC
- **Apple:** M-series, A-series. (SoC berbasis ARM)
- **Qualcomm:** Snapdragon X series (ARM)



CPU



Uninterruptible
Power Supply (UPS)



PC

WHERE IS THE CPU?

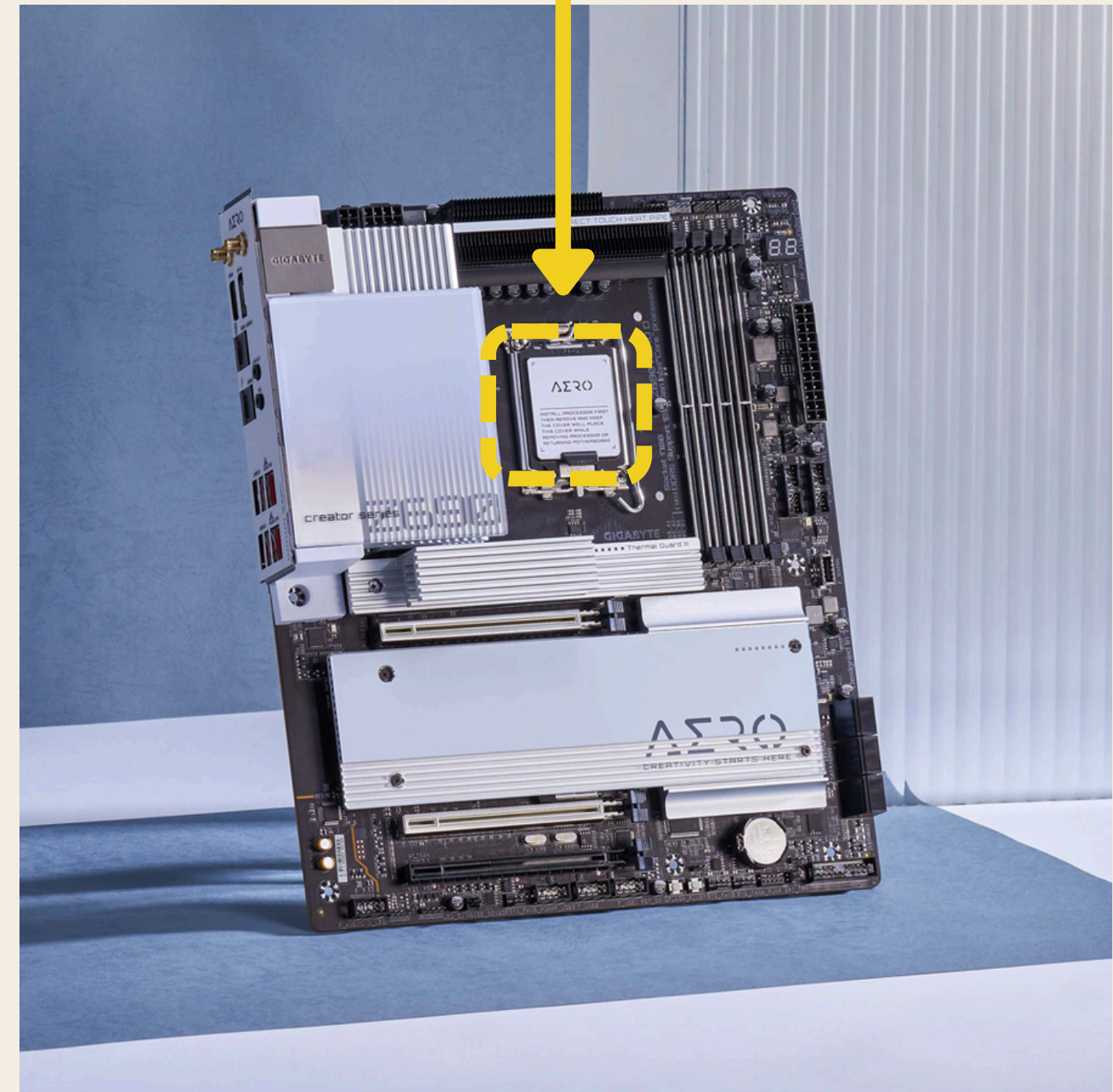
Physically, the CPU is installed in a processor socket on the motherboard. The socket connects the processor to memory, chipset, power delivery, and I/O paths.



Key

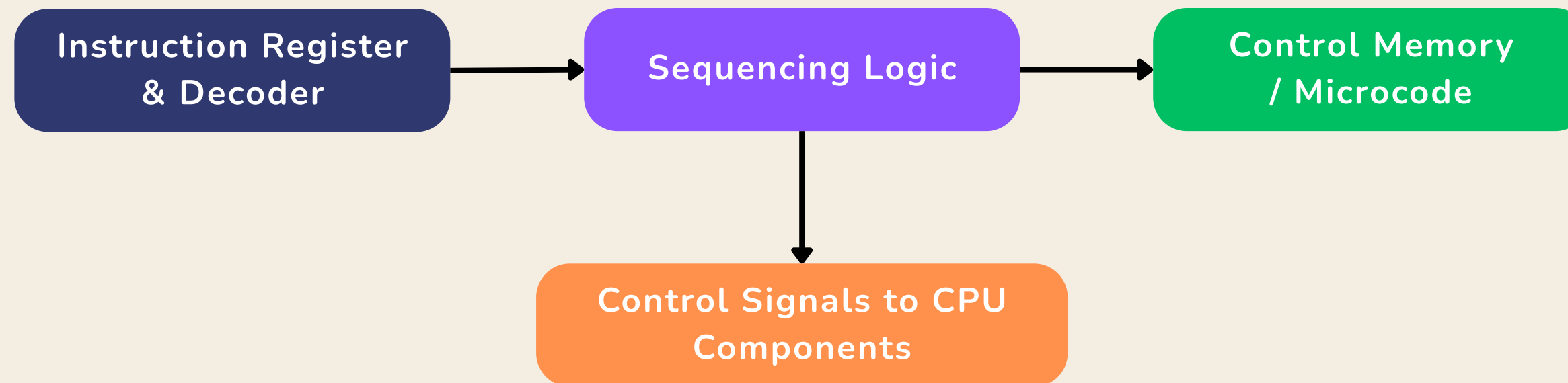
The CPU is not the whole computer. It is one central component within a larger system.

Processor Package
(CPU)



CONTROL UNIT STRUCTURE

- The control unit determines the sequence of instruction execution.
- It interprets instructions and produces the signals needed by registers, ALU, memory, and I/O.
- Control can be implemented using hardwired logic or microprogrammed control.



CONCLUSION

A computer can be understood as a hierarchy of layers and components. **Architecture** defines the programmer-visible model, while **organization** explains the operational implementation.



THANK YOU.

E: yoga.if@upnjatim.ac.id

P: 0813-3485-7761

L: Twin Tower B Lt.5 R.501