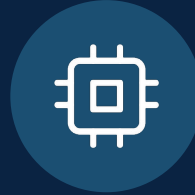


Basic Structure of Computers

Week 1

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What is a Computer?



A fast electronic machine that accepts data, processes it using stored instructions (programs), and produces results.

Key Terms

Programs

Lists of instructions telling the computer what to do

Memory

Internal storage where programs and data reside

Data

Input information that gets processed into results

Types of Computers



Personal Computers

Homes, schools, offices — most common type



Notebooks

Compact, portable versions of PCs for mobile use



Workstations

High-performance for engineering & design work



Enterprise Systems

Large-scale business data processing

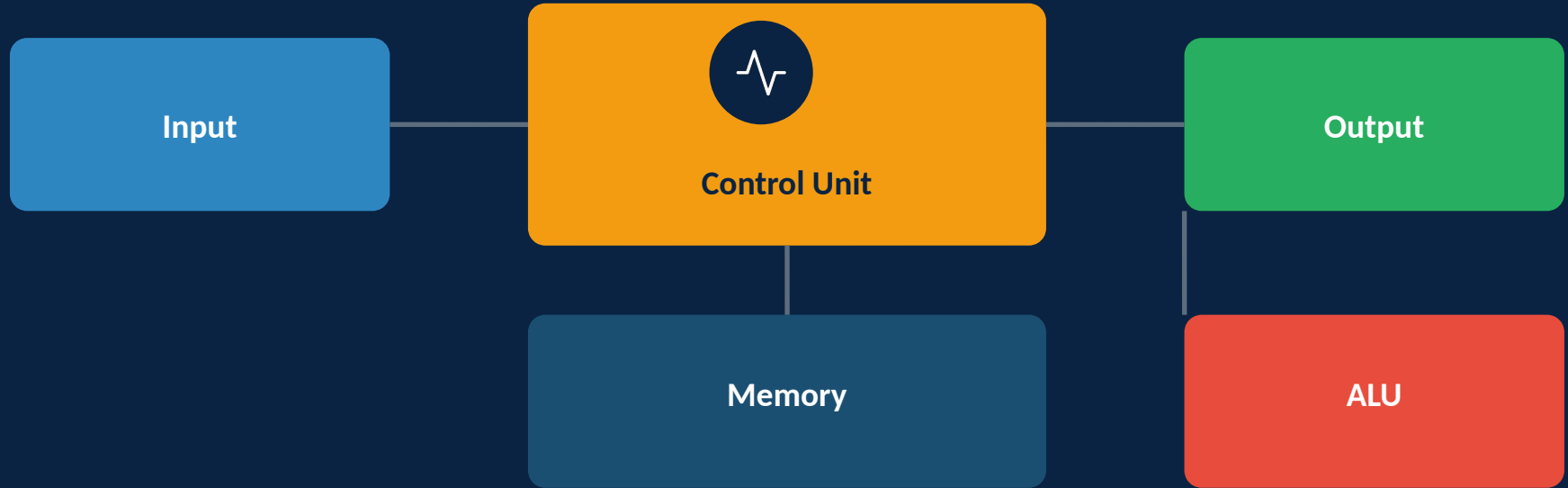


Super-computers

Massive calculations like weather forecasting

Five Functional Units

Every computer has these 5 core parts working together



Input & Output Units



Input Unit

Accepts coded information and feeds it to the processor or memory.

Examples:

- Keyboard
- Mouse, Trackball
- Scanner, Joystick



Output Unit

Sends processed results to the outside world.

Examples:

- Monitor / Display
- Printer
- Speakers

Memory Unit

Stores programs and data — two main categories



Primary Memory

RAM — Read/Write, volatile,
fast random access

ROM — Read-only, stores
operating system

Cache — Fastest, sits on
the processor chip



Secondary Memory

Hard disks, SSDs, USB drives

Larger capacity but slower

Non-volatile — data persists
when power is off

Memory — Key Concepts

01

Word

A group of bits processed together. Word length = number of bits.

02

Address

A unique number identifying each memory location for easy access.

03

Access Time

Time required to read one word from memory.

04

Cache

Small, ultra-fast RAM on the processor chip for high-speed access.

Arithmetic Logic Unit

The ALU performs all calculations and logical operations inside the processor.

Operations

Addition, subtraction,
multiplication, division,
logical comparisons

Registers

High-speed storage
elements inside ALU
for fast data access

Speed

ALU + Control Unit are
much faster than
external devices



ALU

The brain's
calculator

Control Unit

The nerve center — coordinates all other units



Input



Control
Unit



ALU



Memory



Output

Sends timing signals to coordinate data transfer
between input, processor, memory, and output units.

Inside the Processor

Key registers that make execution possible

PC

Program Counter

Holds address of the next instruction to fetch

IR

Instruction Register

Holds the instruction currently being executed

MAR

Memory Address Register

Holds address of memory location being accessed

MDR

Memory Data Register

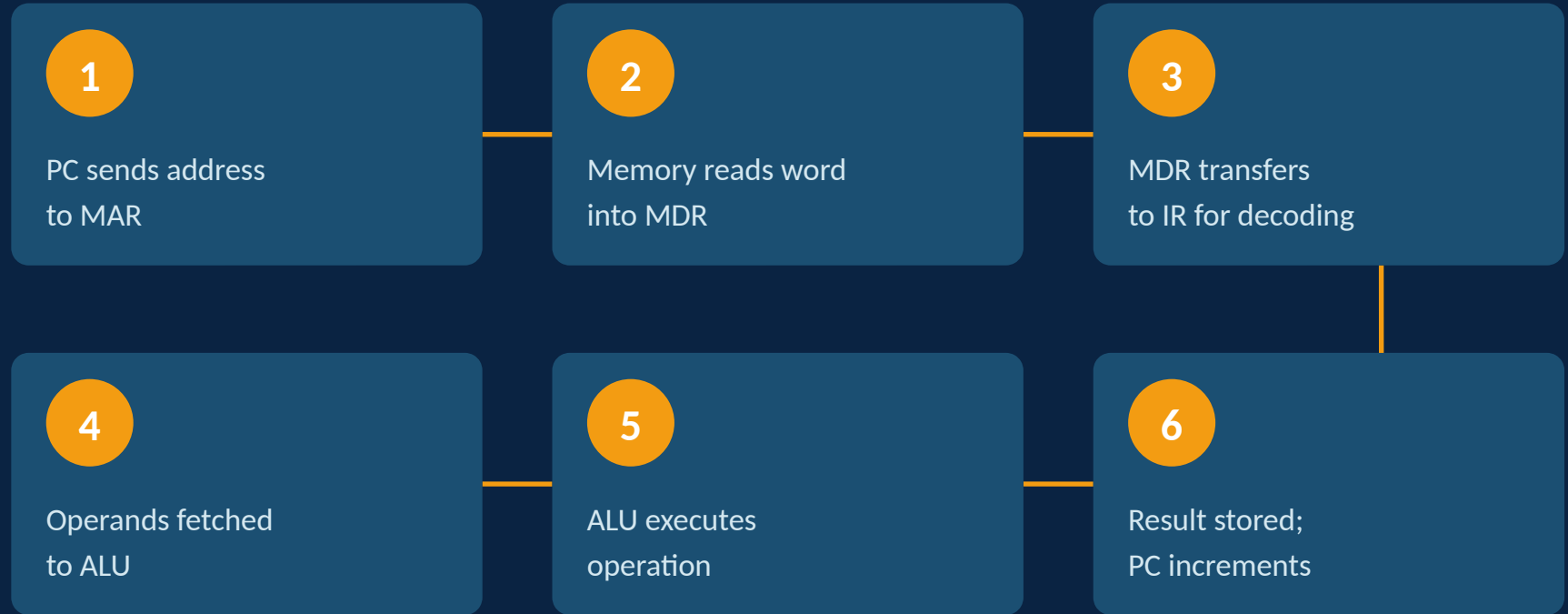
Holds data being read from or written to memory

R0-Rn

General Purpose

Registers for temporary data during computation

How Instructions Execute



Interrupts



An interrupt is a request signal from an I/O device asking the processor to pause and handle an urgent task.

1

Save State

Processor saves its current state to memory

2

Handle Request

Executes the interrupt service routine for the device

3

Restore & Resume

Restores saved state and continues the original program

Bus Structure

Buses connect all computer parts — like a highway for data



Single Bus

Low cost, flexible, one transfer at a time

Multiple Bus

Higher performance but more expensive

Buffers

Bridge speed gaps between fast and slow devices

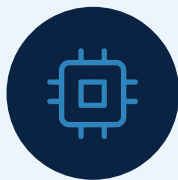
Performance

What determines how fast a computer runs programs?



Elapsed Time

Total time to run a full program — depends on processor, disk, and all devices



Processor Time

Time spent only on instruction execution — depends on processor + memory speed



Cache Effect

Frequently used data stored close to CPU — dramatically reduces access time

Cache Memory & Speed

Memory Hierarchy — Speed vs Capacity

← FASTER

Registers

Fastest, smallest

Cache (L1/L2)

Very fast, on-chip

Main Memory (RAM)

Fast, volatile

LARGER →

Secondary Storage (Disk/SSD)

Slow, large, non-volatile

Cache keeps frequently used instructions and data close to the CPU, so programs in loops execute much faster without hitting main memory.

Week 1 — Summary



5 types of computers from PCs to supercomputers



5 functional units: Input, Output, Memory, ALU, Control



Processor uses registers (PC, IR, MAR, MDR) to execute instructions



Fetch → Decode → Execute cycle drives every operation



Buses connect all parts; cache speeds up access

Thank You