

Lecture. 3

The processor

The processor

- Also called the central processing unit (CPU), interprets and carries out the basic instructions that operate a computer.
- A CPU is brain of a computer. It is responsible for all functions and processes. Regarding computing power, the CPU is the most important element of a computer system.



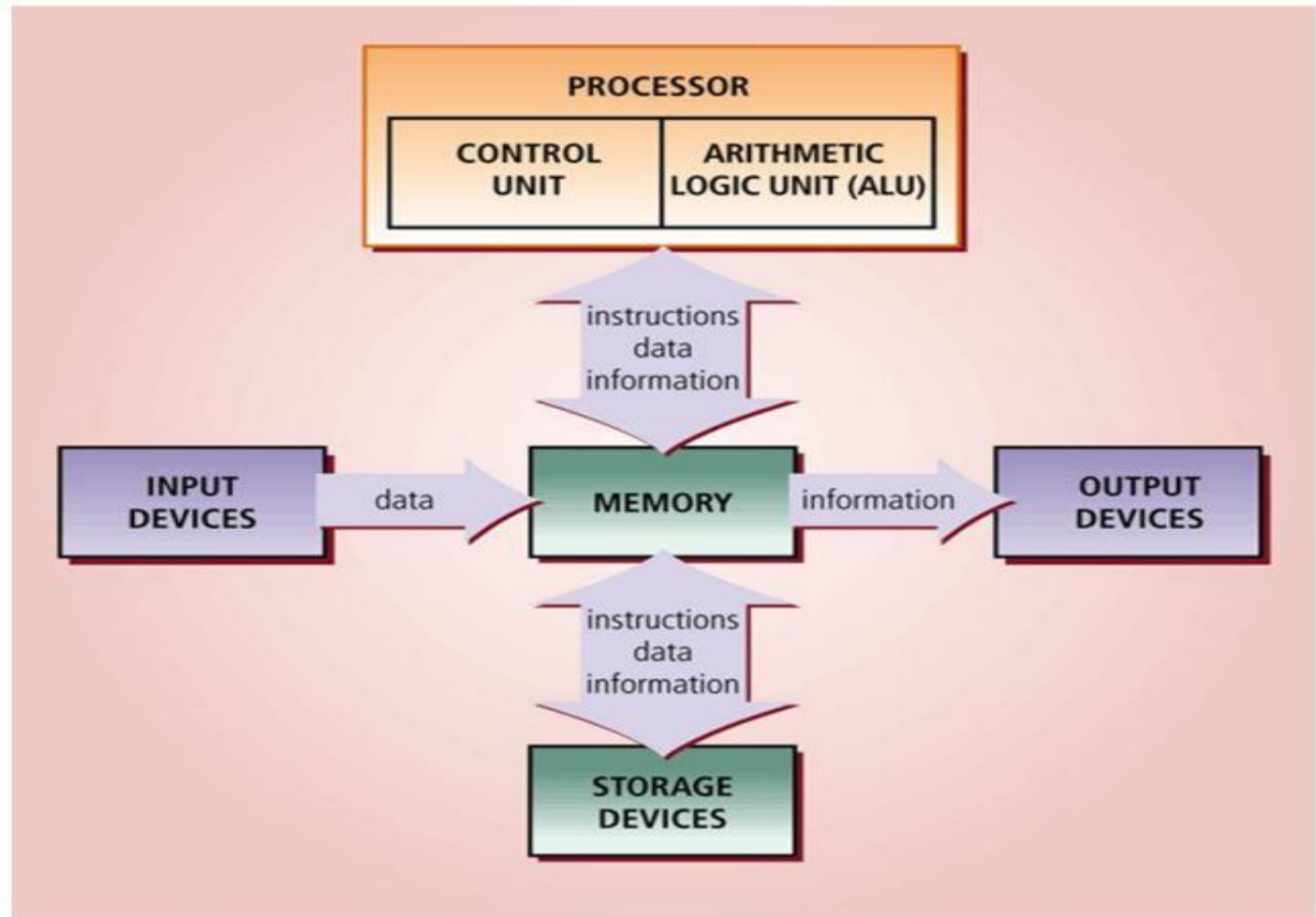
The processor

- Most processor chips manufacturers offer multi-core processors, single chips with two or more separate processor cores.
 - Dual-core: 2 cores
 - Quad-core: 4 cores
- Each core runs at a slower clock speed than a single core processor, but still increase the overall performance.

The CPU is comprised of three main parts

- Arithmetic Logic Unit (ALU)
- Control Unit (CU)
- Registers

The processor



The CPU is comprised of three main parts

- Contain a control unit and an arithmetic logic unit (ALU)
 - Control Unit: Component of the processor that directs and coordinates most of the operations in the computer.
 - Arithmetic Logic Unit: Component of the processor that performs arithmetic, comparison, and other operations.

Machine Cycle

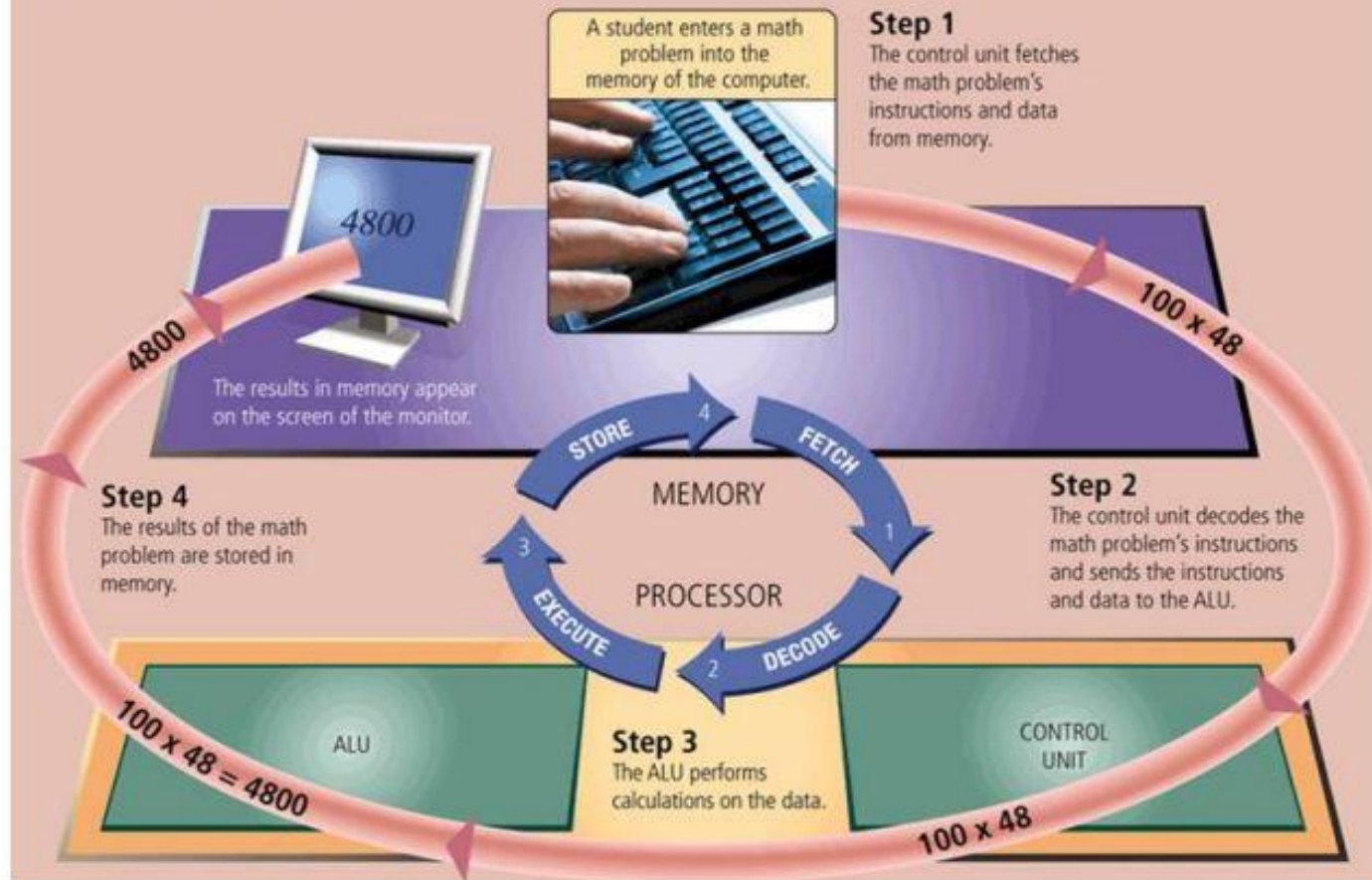
- For every instruction, a **processor** repeats a set of four basic operations, **which comprise a machine cycle**

Machine Cycle

- **Fetching:** Process of obtaining a program instruction or data item from memory.
- **Decoding:** Process of translating the instruction into signals the computer can execute.
- **Executing:** Process of carrying out the commands.
- **Storing:** Writing results to memory.

Machine Cycle

The Steps in a Machine Cycle



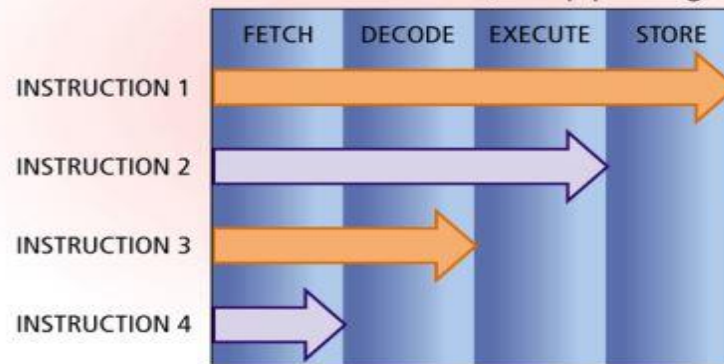
Machine Cycle

- With pipelining, the processor begins fetching a second instruction before it completes the machine cycle for the first

MACHINE CYCLE (without pipelining):



MACHINE CYCLE (with pipelining):



Registers

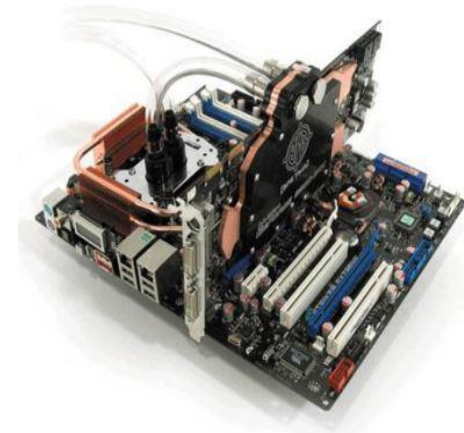
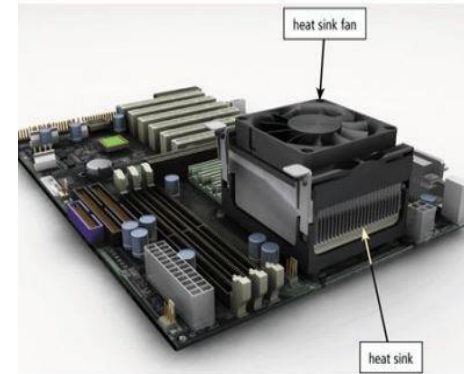
- Small, high-speed storage locations that temporarily hold data and instructions.
- A part of the processor, itself

Processor Cooling

- Processors generate heat which could cause the chip to burn up.
- The computer fans generate airflow, but the processor requires additional cooling.
- Heat sinks/pipes and liquid cooling are often used to dissipate processor heat

Processor Cooling

- A heat sink
- Liquid Cooling Technology



Parallel Processing

- A method that uses multiple processors simultaneously to execute a single program or task.
- A single problem is divided into portions and multiple processors work on their assigned portion at the same time.
- Special software is needed to divide the problem and bring the results back together again.
- **Super computers** use massive parallel processing for applications such as **artificial intelligence** and **weather forecasting**.

Data Representation

- Most computers are digital, meaning they recognize two discrete states: on and off.
- This is due to the two states of electrical switches.
- Two digits, 0 and 1, represent off and on respectively, which is the basis for the binary system.

Data Representation

- Binary that represents characters are defined by patterns called coding schemes.
- ASCII (American Standard Code for Information Interchange) is the most widely used coding scheme.

ASCII	SYMBOL	ASCII	SYMBOL
00110000	0	01001110	N
00110001	1	01001111	O
00110010	2	01010000	P
00110011	3	01010001	Q
00110100	4	01010010	R
00110101	5	01010011	S
00110110	6	01010100	T
00110111	7	01010101	U
00111000	8	01010110	V
00111001	9	01010111	W
01000001	A	01011000	X
01000010	B	01011001	Y
01000011	C	01011010	Z
01000100	D	00100001	!
01000101	E	00100010	
01000110	F	00100011	#
01000111	G	00100100	\$
01001000	H	00100101	%
01001001	I	00100110	&
01001010	J	00101000	(
01001011	K	00101001)
01001100	L	00101010	*
01001101	M	00101011	+

Data Representation

- Unicode is a 16-bit coding scheme that has the capacity of representing more than 65,000 characters.
- It is large enough to fit almost all of the world's current written language as well as classic languages, even reserving 30,000 codes for future expansion

Data Representation

- ASCII and Unicode standards make it possible for components in computers to communicate.

