



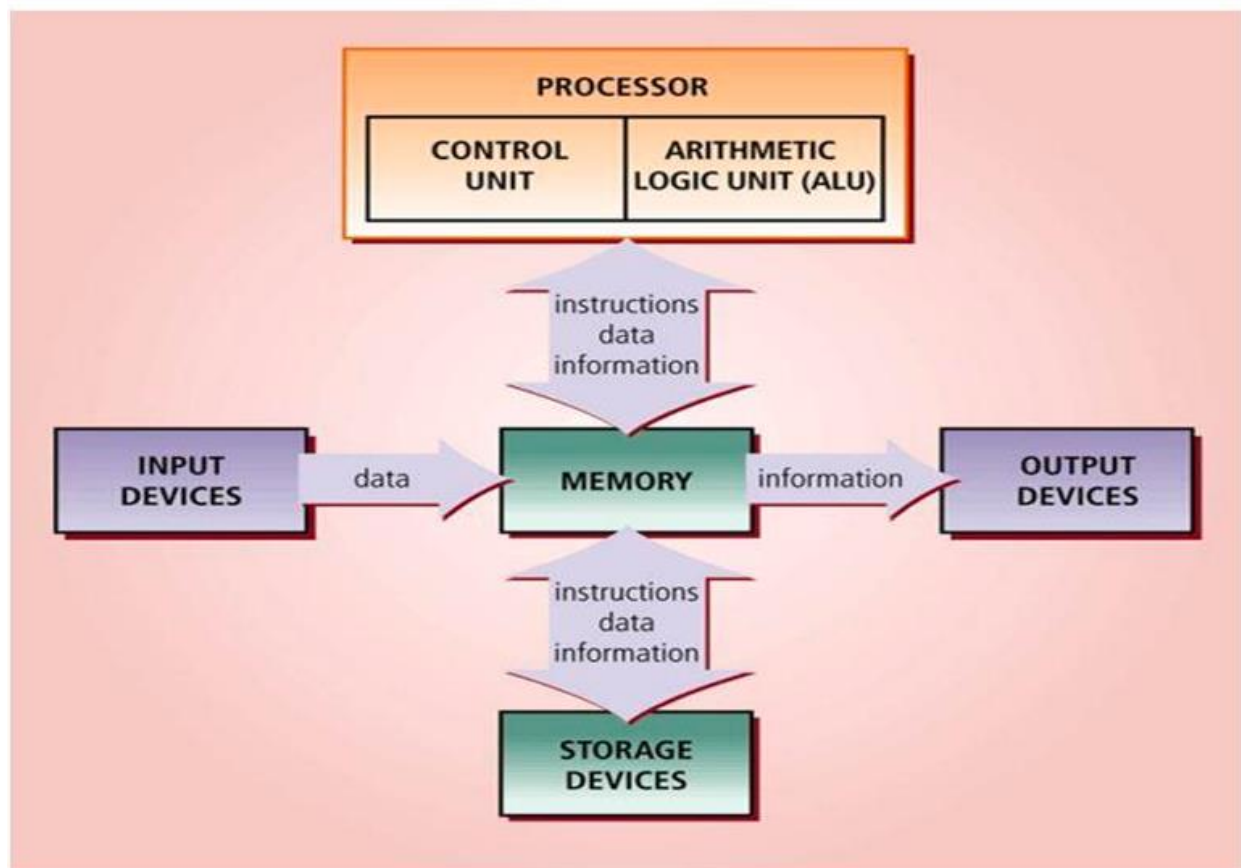
## The Processor

- 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.
- 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





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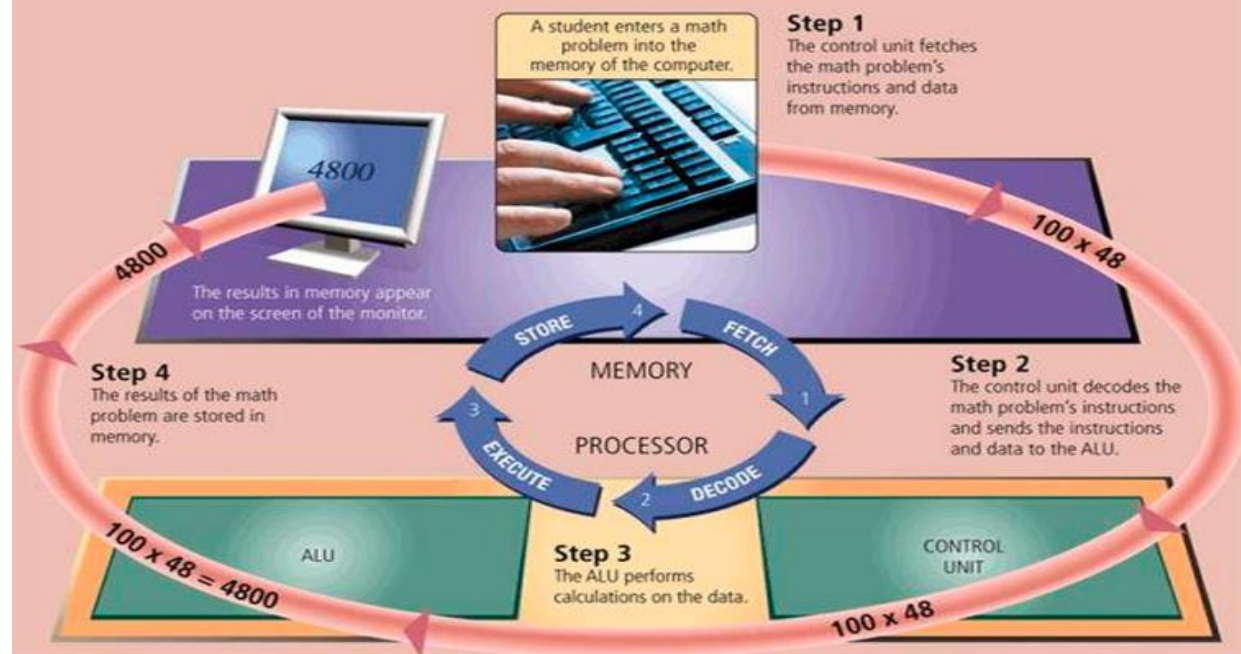
- **Contain a control unit and an arithmetic logic unit (ALU)**
  - **Control Unit:** Component of the processor that directs and coordinates most of the operations in the computer.
  - **Arithmetic Logic Unit:** Component of the processor that performs arithmetic, comparison, and other operations.



#### Machine Cycle

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

### The Steps in a Machine Cycle

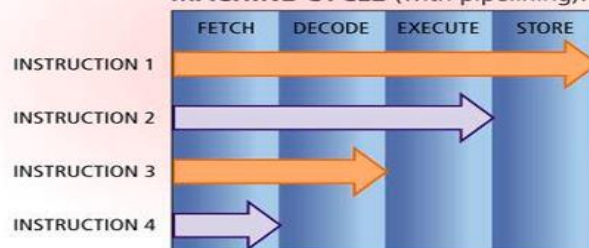


- With pipelining, the processor begins fetching a second instruction before it completes the machine cycle for the first

#### 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

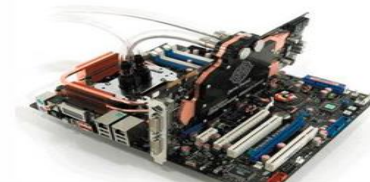
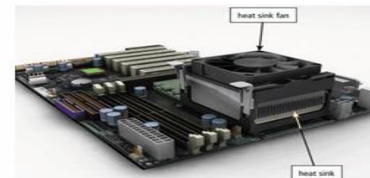
# Processor Cooling

- 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.

