Computer Organization

Lecture Four

Central Processing Unit (CPU)

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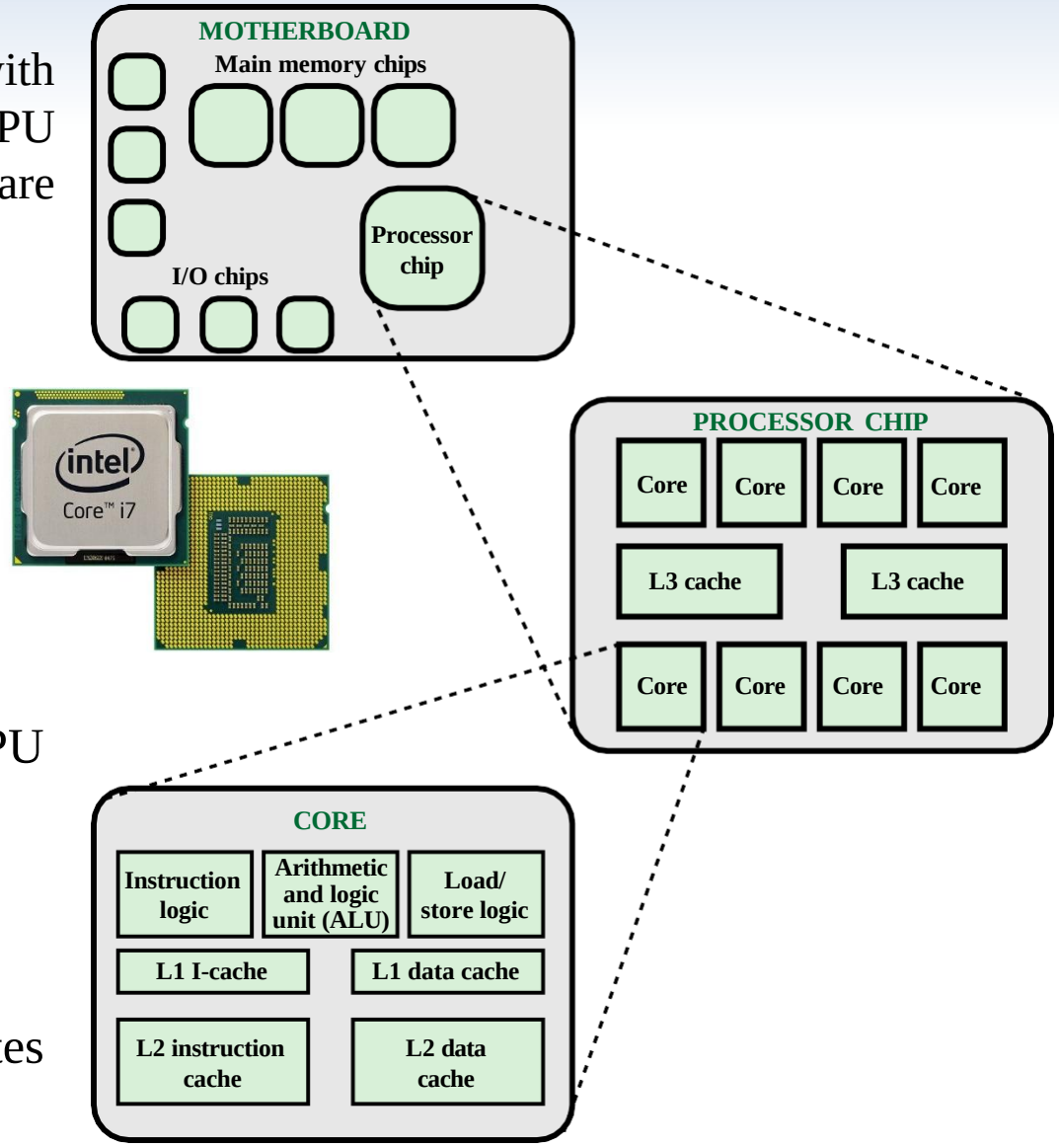
CPU

A **processor** is also called the CPU, and it works hand in hand with other circuits known as main memory to carry out processing. The CPU is the "brain" of the computer; it follows the instructions of the software (program) to manipulate data into information.

- **Central processing unit (CPU)**
  - Portion of the computer that fetches and executes instructions
  - Consists of an ALU, a control unit, and registers
  - Referred to as a processor in a system with a single processi unit
- **Core**
  - An individual processing unit on a processor chip
  - May be equivalent in functionality to a CPU on a single-CPU system
  - Specialized processing units are also referred to as cores
- **Processor**
  - A physical piece of silicon containing one or more cores
  - Is the computer component that interprets and executes instructions
  - Referred to as a multicore processor if it contains multiple cores



Simplified View of Major Elements of a Multicore Computer

CPU

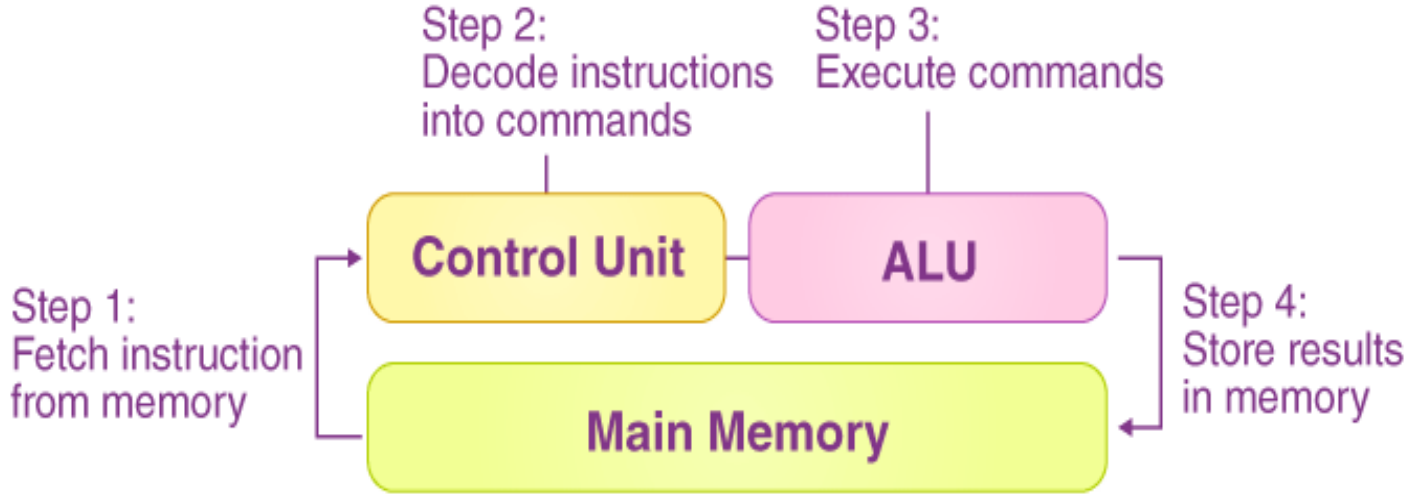
The CPU consists of three parts:

1. Control Unit (CU)
2. Arithmetic/logic unit (ALU), which both contains
3. Registers, or high speed storage areas.

All are linked by a kind of electronic "roadway" called a bus.

1. The Control Unit - for directing electronic signals: The control unit deciphers each instruction stored in it and then carries out the instruction. It directs the movement of electronic signals between main memory and the arithmetic/logic unit. It also directs these electronic signals between main memory and the input and output devices. For every instruction, the control unit carries out four basic operations, known as the machine cycle. In the machine cycle, the CPU:

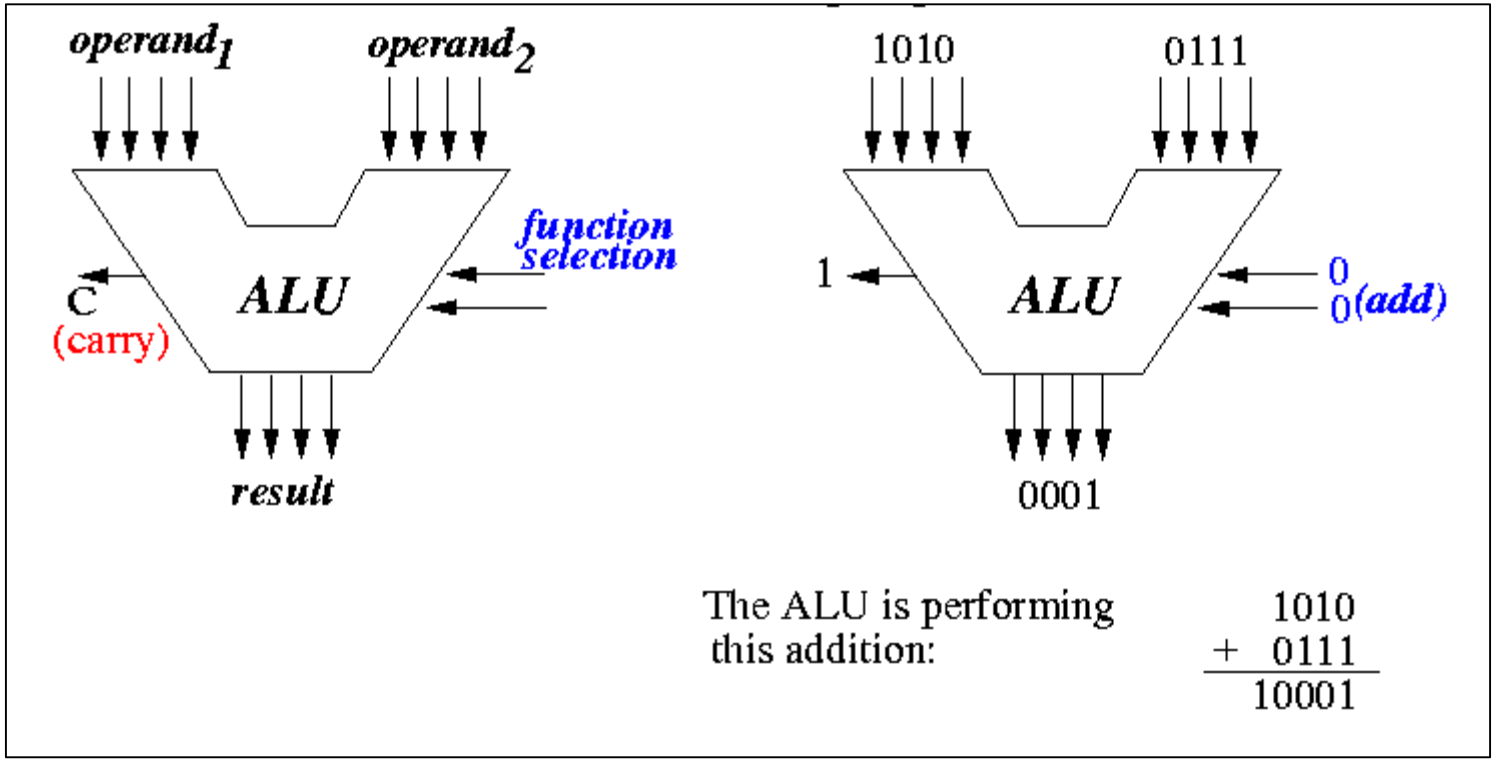
a) Fetches an instruction.
b) Decodes the instruction.
c) Executes the instruction.
d) Stores the result.



CPU Architecture

CPU

2. Arithmetic/logic unit for arithmetic and logical operations: The ALU performs arithmetic operations and logical operations and controls the speed of those operations. As you might guess, arithmetic operations are the fundamental math operations: addition, subtraction, multiplication, and division. Logical operations are comparisons. That is, the ALU compares two pieces of data to see whether one is equal to (=), greater than (>), or less than (<) the other. (The comparisons can also be combined, as in "greater than or equal to" and "less than or equal to").



Arithmetic Logic Unit

CPU

3. Registers -special high-speed storage areas: The control unit and the ALU also use registers, special areas that enhance the computer's performance.

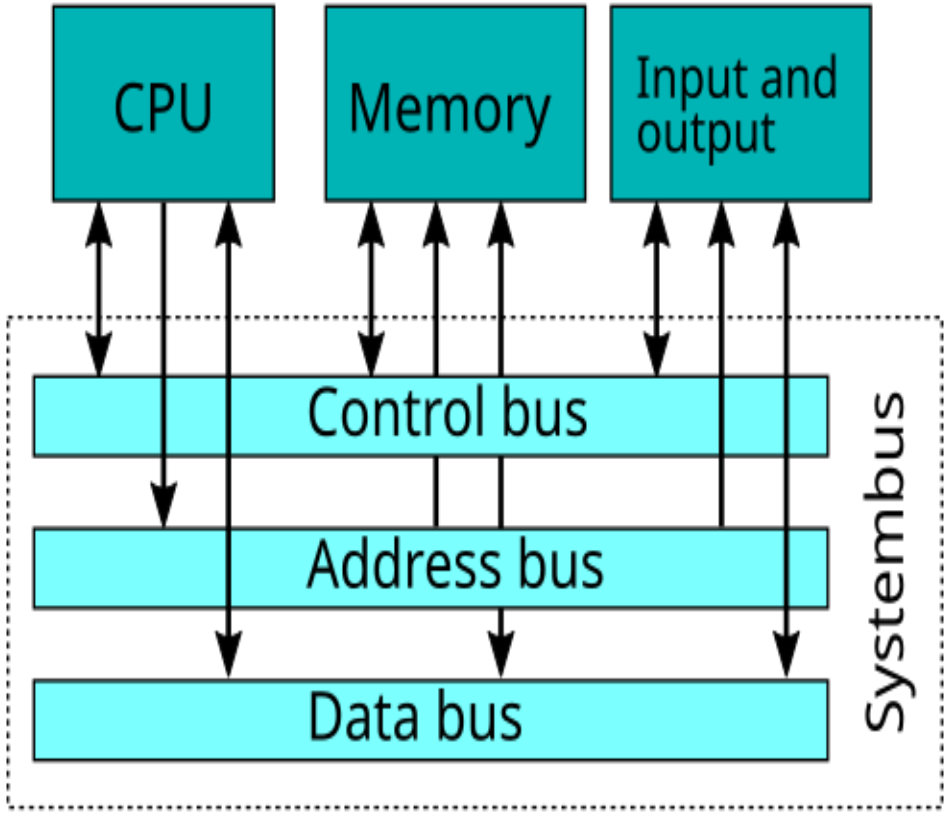
Registers are high-speed storage areas that temporarily store data during processing. They may store a program instruction while it is being decoded, store data while it is being processed by the ALU, or store the results of a calculation. the most important register are:

1. Program Counter (PC): It contains the address of the next instruction to be executed.
2. Instruction Register (IR): It contains the instruction being executed.
3. Address Register (AR) or memory Address Register (MAR): holds the address of memory location.
4. Accumulator (A): it is register that holds the data to be used in arithmetic and logic operation and also holds the results of processing operations.
5. (B, C, D, E, F, H, and L) register: these registers contain the data to execute the operation.

CPU

Buses -data roadways: Buses or bus lines, are electrical data roadways through which bits are transmitted within the CPU and between the CPU and other components of the motherboard. A bus resembles a multilane highway: The more lanes it has, the faster the bits can be transferred. The old-fashioned 8-bit-word bus of early microprocessors has only eight pathways.

Data is transmitted four times faster in a computer with a 32-bit bus, which has 32 pathways, than in a computer with an 8-bit bus. There are several principal expansion bus standards, or "architectures," for microcomputers. The various components of the CPU are connected together with lines called Internal lines (Internal Buses). The lines connected the CPU to the reminder of the computer components are called External lines (External Buses). A computer main memory is interfaced to the CPU through three groups of lines or buses: Data bus, Address bus, Control bus.



Example of a single system computer bus