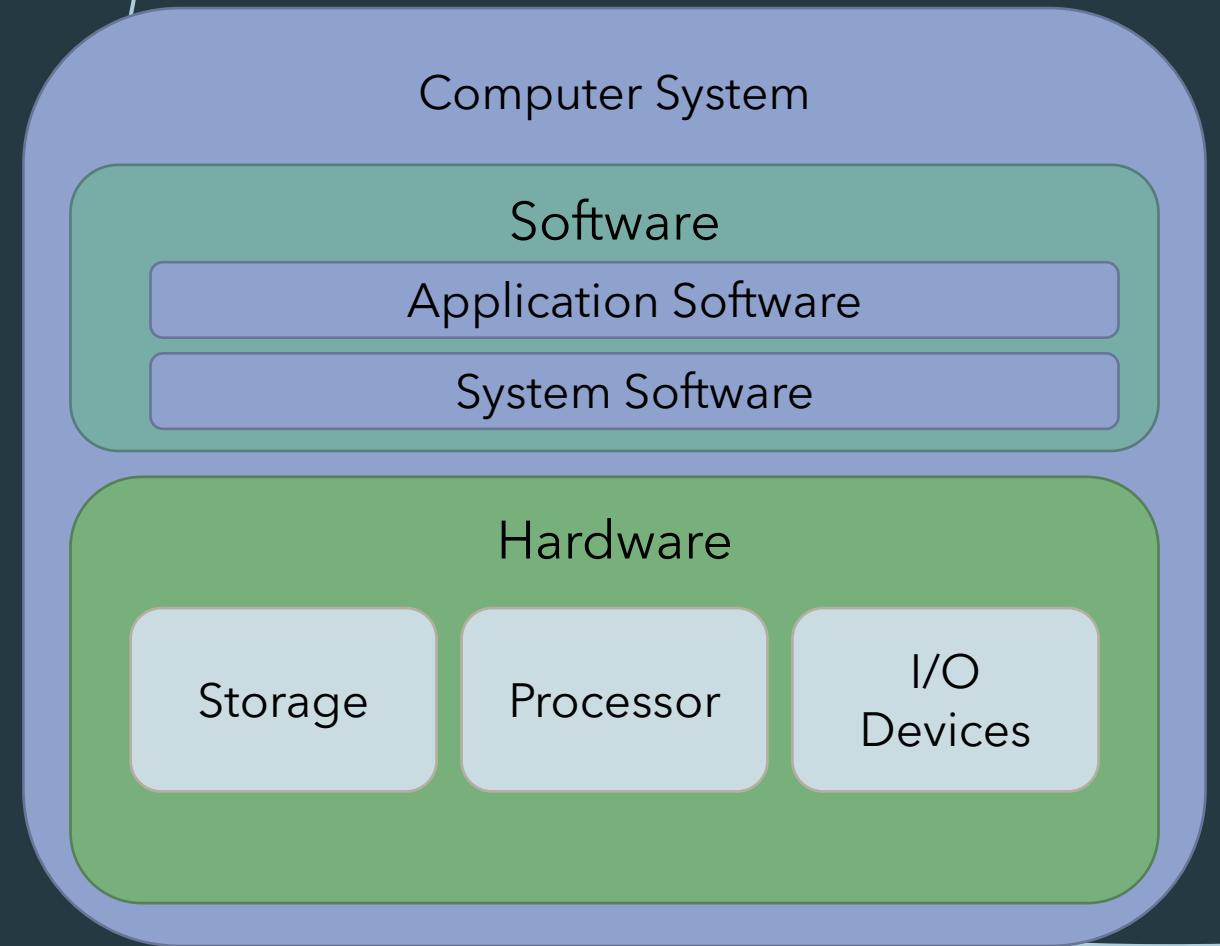# Computer Hardware Components

Recall

- A computer uses hardware and software to process data into information.
  - **Hardware** includes processor, storage, input and output devices
  - **Software** includes application software and system software

Inside the case (1)

The system unit or chassis
refers to the case that contains
and protects the motherboard,
hard disk drive, memory, and
other hardware components.

Video: Inside a Computer
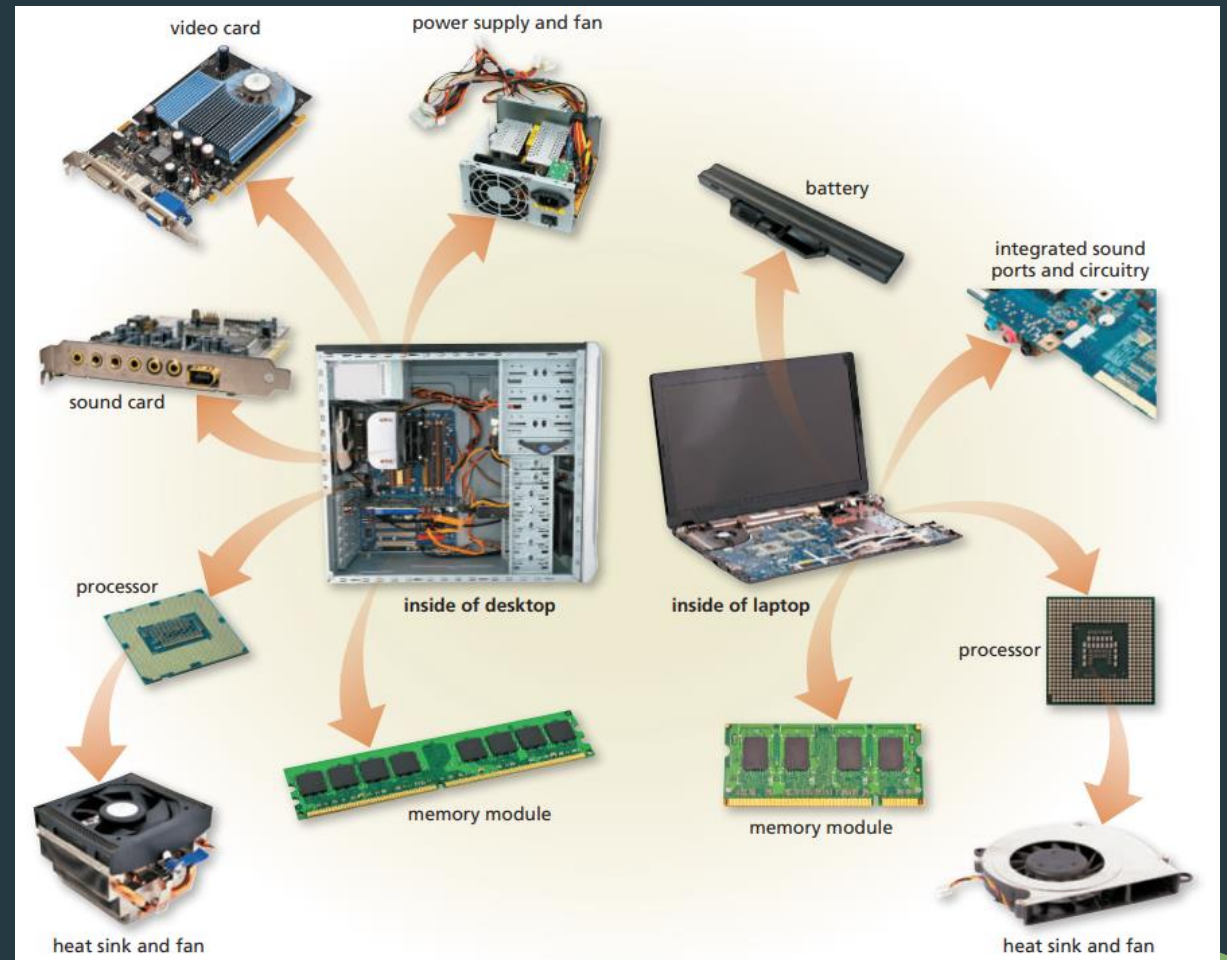
Inside the case (2)

- The motherboard, sometimes called a system board, is the main circuit board of the computer. Many electronic components, such as the processor and memory, are attached to the motherboard; others are built into it.

- The central processing unit (CPU), also called a processor, is sometimes called *the brain of the computer*. It is usually a silicon chip about the size of a thumbnail. It fits into the motherboard's CPU socket, which is covered by the *heatsink* that absorbs heat from the CPU and *fan* to dissipate the heat.

- The chipset controls the communication between the CPU, memory, storage, and other peripherals (e.g. keyboard, mouse, or monitor). The chipset determines how many high-speed components or devices the motherboard can support.

Inside the case (3)

- The random access memory (RAM), also called the main memory, temporarily stores data whenever the computer performs operations. Contents of the memory disappears when the computer is turned off.

- The hard disk drive, is a long-term storage that holds data even when the computer is turned off. In some computers, specially laptops, a solid-state drive is used.

- The power supply unit, or laptop AC adapter, converts electricity from the outlet (AC 120 or 220 volts) to a type of power (DC 5 to 15 volts) that the computer can use. Different motherboards and computers require different wattages on the power supply. In desktop computers, power supply has built-in fans that keeps the power supply cool.

Inside the case (4)

- Most motherboards have built-in video, sound, network capabilities. However, in certain cases, the user might want to improve the performance and capabilities of a computer.. In such cases, motherboards have expansion slots that allows users to add various types of expansion cards or adapter cards. Examples of expansion cards are
    - Bluetooth adapter – enables Bluetooth connectivity
    - MIDI – connects to musical instruments
    - Modem – connects to transmission media, e.g., television or phone lines
    - Network – provides network connections, such as an Ethernet port
    - Sound – connects to speakers or microphone
    - USB – connects to high speed USB ports
    - Video – usually have a GPU (graphics processing unit) to enhance computer graphics capabilities such as accelerated processing or to connect to an additional monitor

Inside the case (5)

- The Peripheral Component Interconnect, or PCI, is the input/output pathway that connect the CPU, via the expansion slots, to the peripheral devices.

- The Serial Advance Technology Attachment, or SATA, is a computer bus interface used to connect drive disk controllers or host bus adapters with mass storage devices like optical drives and hard disk drives.

- The Complementary Metal Oxide Semiconductor, also known as CMOS battery, is responsible for keeping all the information intact when the entire system us shutdown. This prevents reconfiguration when the PC is powered off.
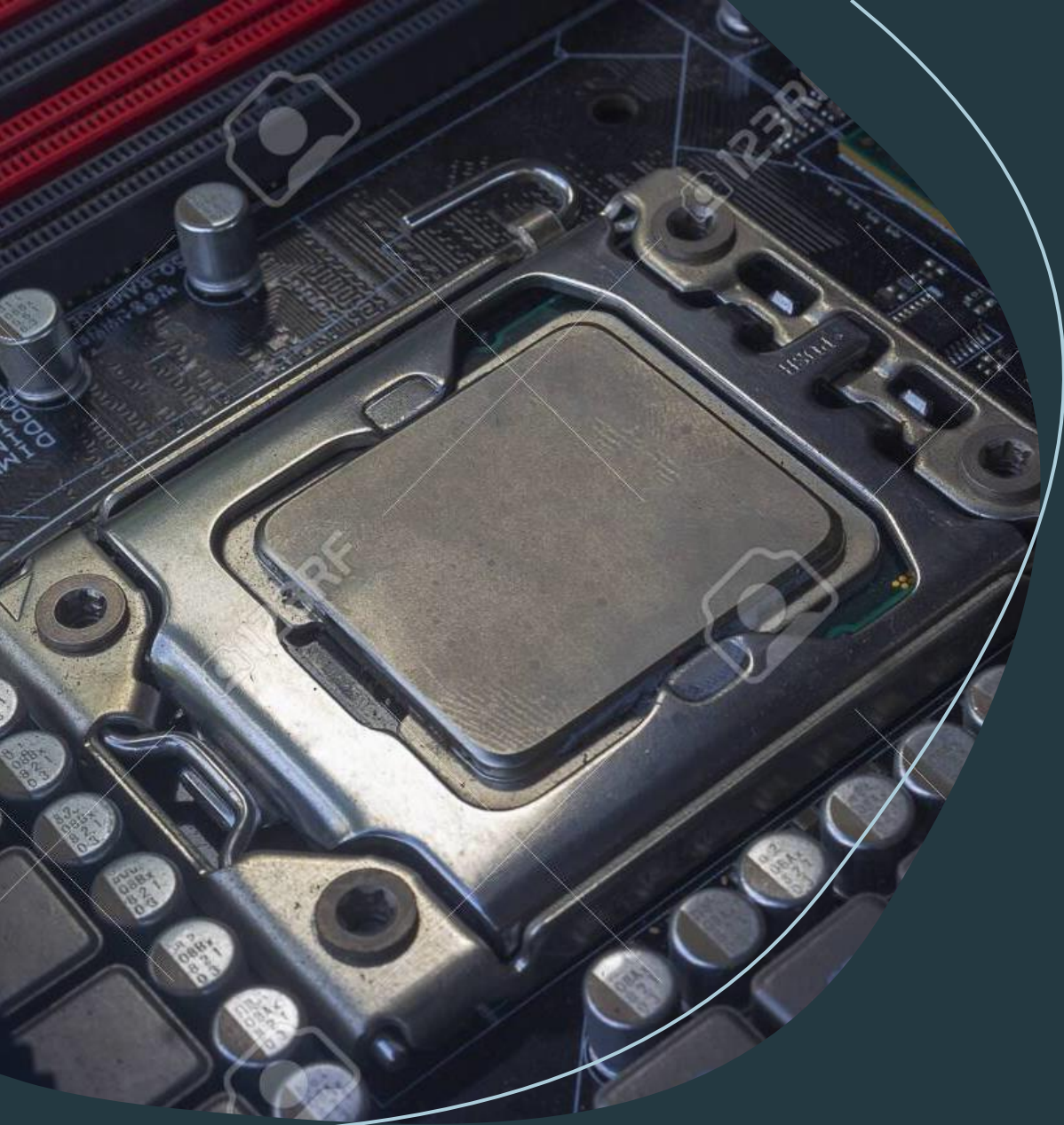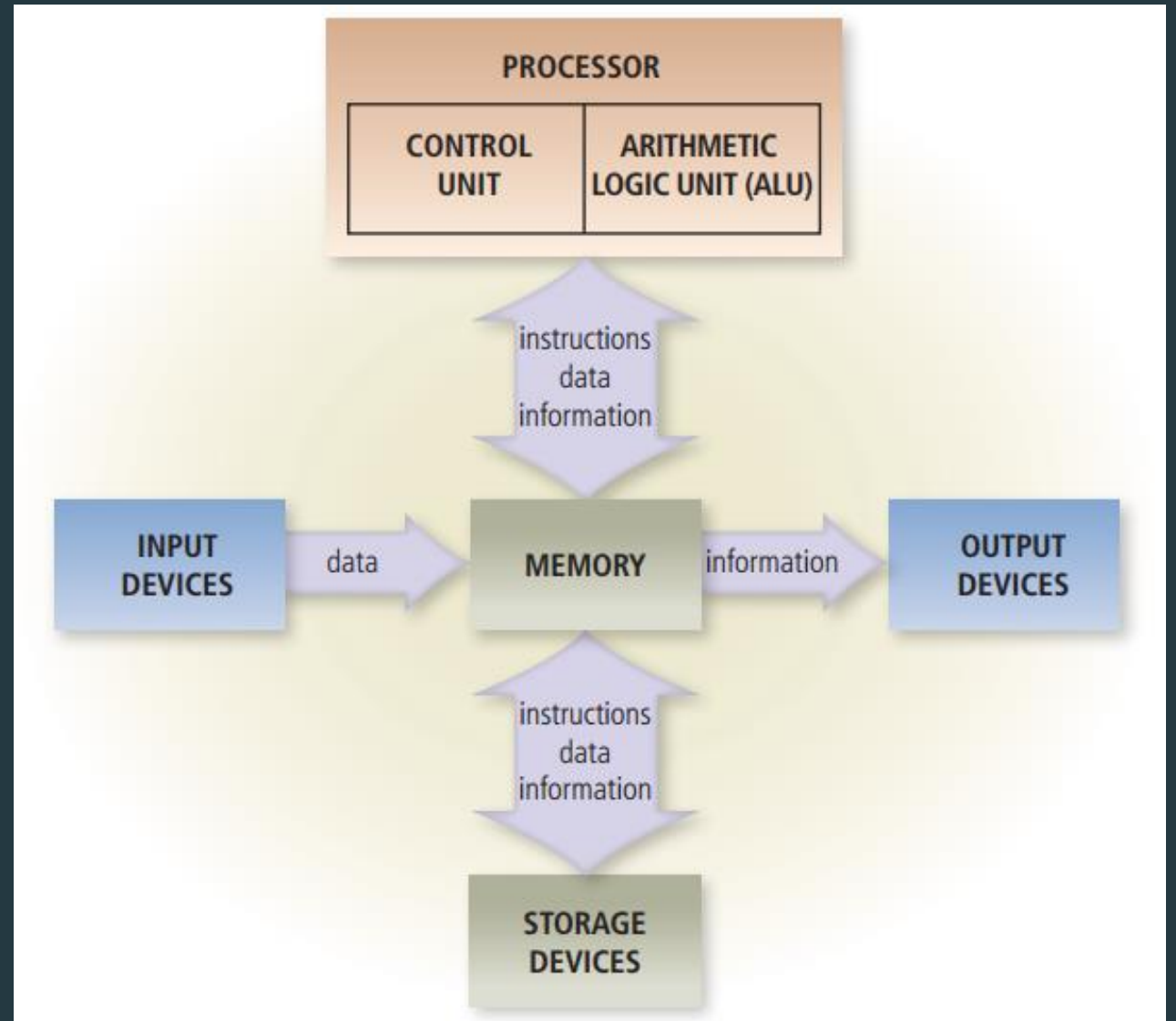
Processors

Processor (1)

- The processor interprets and carries out basic instructions that operate a computer.
  - On large computer systems, such as mainframes and supercomputers, the various functions performed by the processor extend over many separate chips and multiple circuit boards.
  - On a personal computer system, all functions of the processor usually are on a single chip, called microprocessor.
- A processor core contains the circuitry necessary to execute instructions. The operating system views each processor core as a separate processor.
- A multicore processor is a single chip with two or more processor cores.

Video: How multicore works

Processor (2)

- **Control Unit** is the component of the processor that directs and coordinates most of the operations in the computer. It interprets each instruction issued by a program and then initiates the appropriate action to carry out the instruction.

Processor (3)

- **Arithmetic Logic Unit** is the component of the processor that performs arithmetic and logic operations.
  - Arithmetic operations include addition, subtraction, multiplication, and division.
  - Logic operations include comparison operations like greater than, less than, or equal to.
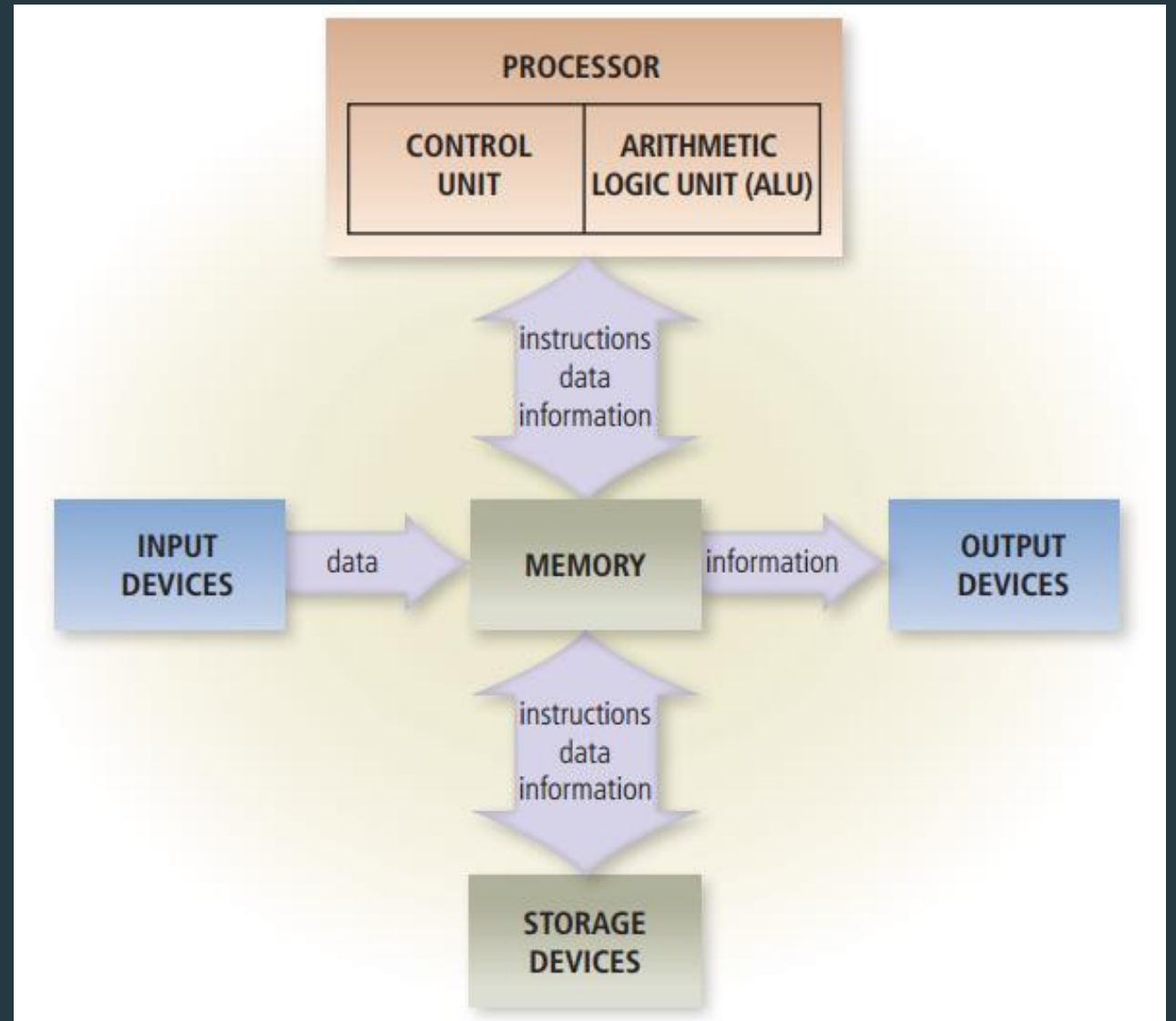
Machine Cycle

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

(1) Fetching is the process of obtaining a program instruction or data item from memory.

(2) Decoding refers to the process of translating the instruction into signals the computer can execute.

(3) Executing is the process of carrying out the commands.

(4) Storing means writing the results back to the memory

The Steps in a Machine Cycle

Using a calculator app, a student enters a calculation. The app sends the calculation to the computer's memory for processing.

Step 1
The control unit fetches the calculation's instructions and data from memory.

4800

100 x 48

The results in memory appear on the screen of the monitor.

Step 4
The results of the calculation are stored in memory.

STORE 4

FETCH

MEMORY

Step 2
The control unit decodes the calculation's instructions and sends the instructions and data to the ALU.

3

1

EXECUTE

PROCESSOR

DECODE 2

100 x 48 = 4800

ALU

Step 3
The ALU performs calculations on the data.

CONTROL UNIT

100 x 48

Other processor components

- A processor contains small, high-speed storage called registers that temporarily hold data and instructions.

- There are several types of registers inside the processor. For example:
  - Register for storing the location from where the instruction was fetched,
  - Register for storing an instruction while the control unit decodes it,
  - Register for storing data while the ALU calculates it,
  - Register for storing the results of a calculation.

System Clock

- The processor relies on a small quarts crystal circuit called the system clock to control the timing of all computer operations.

- The system clock generates regular electronic pulses, or *ticks*, that set the operating pace of components of the system unit. Each tick is equivalent to a clock cycle.

- Processors today are superscalar, which means that they can execute more than one instruction per clock cycle.

Clock Speed

- The pace of the system clock, called the clock speed, is measured by the number of ticks per second.

- Current processors can reach clocks speeds in the *gigahertz* (billions of cycles per second) range.

- The faster the clock speed, the more instructions the processor can execute per second.

Video: Fetch-Decode-Execute Cycle