

How a CPU Works:

Overview:

The central processing Unit or CPU is the brain of the computer. In every CPU there is a particular wire that turns on and off at a steady rate to help keep everything in sync - That wire is called the clock. Modern CPU's operate at speeds measured in gigahertz (GHz), meaning billions of cycles per second. The video talks about Scott CPU - the model of CPU given in the book "But how do it know by John Scott".

Components:

The CPU is placed in the motherboard, allowing it to interface with other components like RAM and storage.

RAM (Random Access Memory):

It temporarily holds data and instructions for the CPU. It is organized as addresses, each holding specific data. The RAM address just consists of a series of ones and zeros - on and off wires.

RAM waits until the CPU activates the enable wire to respond. When it is on, RAM sends the data at the specified address back to the CPU. This is repeated again and again. To save data to RAM, the CPU sends an address, outputs the data and activates set wire.

Data types in RAM:

- Instructions - tell the CPU what operations to perform
- Numbers - for computation and comparison
- Addresses: reference to other memory locations
- Characters: represent text using binary encoding.

Instruction Set:

Load: transfers data from RAM to the CPU

Add: Adds numbers together

Store: saves results back to RAM

Compare: Compares two values

Jump: Alters execution sequence based on conditions

IN/Out: Handles data input/output with peripherals.

These instructions were explained using an illustration of a growing game.

CPU's internal Components:

Control Unit: Directs operations by decoding instructions and orchestrating other CPU components.

ALU (Arithmetic Logic Unit): Performs arithmetic (eg: addition) and logical (eg: comparison) operations. Uses flags (like "equal" or "greater") to indicate result of comparisons.

Registers: General purpose: store intermediate results.

Instruction: holds the current instruction

Flags: tracks outcomes of operations (ex: comparison)

Instruction address: tracks address of next instruction

Temporary: Holds interim values for the ALU.

Memory address: tells RAM what mem address CPU wants ^{next.}

Bus System: Connects internal components and facilitates data transfer. Address bus: specifies memory locations

Data bus: transfers data b/w CPU, RAM and peripherals.

Control bus: sends signals to coordinate actions.

I/O and Storage:

The CPU communicates with external devices (eg: keyboard, monitor) using input (IN) and output (OUT) instructions.

RAM is volatile; it loses data when power is off. Permanent storage (like a hard drive) is used to retain data and programs across sessions.