Computer Hardware -CPU

In the Von Neumann architecture, the data _and instructions_ are held together in memory.

An Embedded system is a combination of hardware and software, _performing a specific task, placed within a larger system._

Characteristics of Embedded Systems
- Designed for one specific task
- Limited memory, low cost, fewer power consumptions
- Requires real time performance
- Offers high reliability and stability

Central Processing Unit
The purpose of CPU is to control the movement of data and process instructions.

Function of CPU
The CPU follows three steps in order to process data: It is known as the Fetch - Decode - Execute cycle

In the **FETCH stage,** the CPU fetches the data / instructions from main memory (RAM) and then stores them in its own temporary memory called 'registers'.
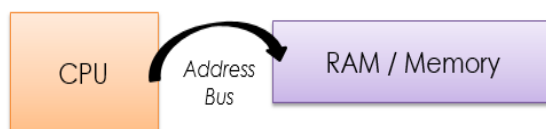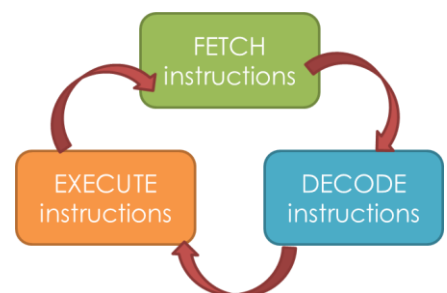
For this to happen, the CPU uses a hardware path called the 'address bus'. The address bus carries the address of the data/instruction that the CPU wants.

Data from the RAM to the CPU travels on another piece of hardware called the 'Data Bus'.

The **Decode stage** is where the CPU understands what the instruction it has just fetched from RAM, actually means and gets things ready for the execution of that instruction.
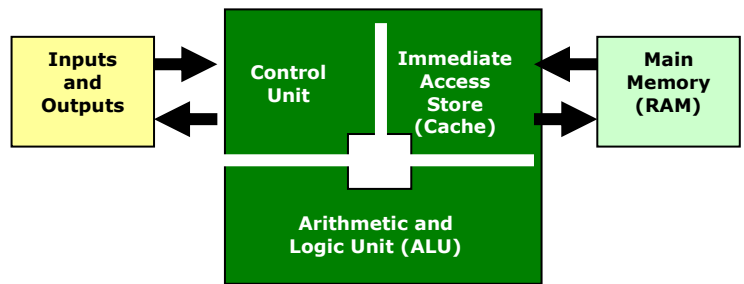
The **Execute stage** is where data processing happens. Instructions are carried out on the data.

Parts of a CPU.

The Control Unit
The Control Unit:
1. It manages movement of data during the Fetch-Decode-Execute cycle.
2. It manages and monitors hardware on the computer to ensure that correct data goes to the correct hardware.


Arithmetic and Logic Unit (ALU)
This is where the CPU actually carries out the maths and logic on the data (processes it).

Immediate Access Store (Cache)
This part stores the data which is to be immediately processed.

The CPU takes a chunk of data / instructions from the RAM and keeps it close so that it always has a constant supply of data to process.   This way the CPU doesn't waste time waiting for a delivery of data.

Registers are locations of computer memory within the CPU that provide extremely fast access.
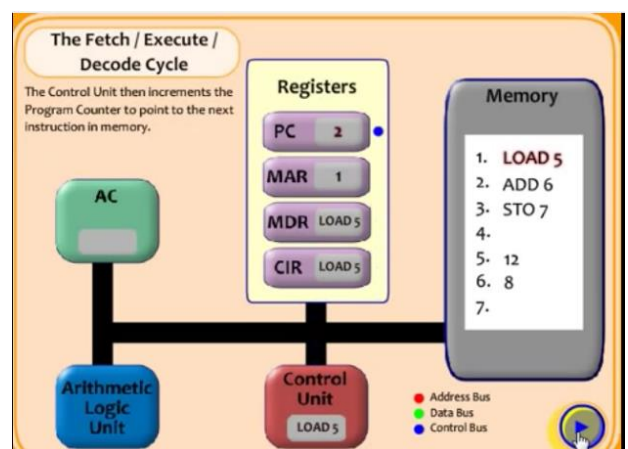
Register	Purpose
Current instruction register (CIR)	Holds the current instruction that the processor is executing
Memory address register (MAR)	Temporarily stores the memory addresses used when searching for data in RAM
Memory data register (MDR)	Temporarily holds the data (data values or instructions) that is being decoded or executed by the CPU
Program counter (PC)	Holds the address of the next instruction to be executed by the processor.
Accumulator (ACC)	Stores the result of any calculation made by ALU

The CPU performance depends on:
- Clock Speed
- Cores and
- Cache

Clock speed is the number of instructions (fetch-decode-execute cycle) a processor can carry out per second (Hz).

2GHz processor means the processor/computer can carry out two billion F-D-E cycles per second.

Multicore processor means more than one processor working independently in the CPU The more cores in a CPU generally means that more instructions can be carried out at once, so the CPU will work faster.

Parallel processing= more than one CPU work together on the <u>same program</u>
Multitasking= the cores can work on <u>different programs</u> at the same time
Pipelining= the processor to process <u>more than one instruction</u> at a time.