The CPU

The CPU

The **Central Processing Unit**, or **CPU**, is the heart and brain of the computer. It is a set of electronic circuits that interprets and executes instructions from stored programs. It is designed to be general-purpose, i.e. it can run any sort of program.

The architecture of the CPU consists of three parts:

- the **Control Unit (CU)**, which controls the flow of data across the whole system by coordinating and organising all the operations of the computer. It is responsible for fetching the instructions that are stored in the primary storage, interpreting them, and then issuing commands to all the hardware units that are necessary to carry out the instructions;
- the **Arithmetic Logic Unit (ALU)**, which performs all the arithmetic and logic operations•;
- the **Immediate Access Store (IAS)**, also called **registers**, which is where the CPU holds all the data and programs that are being used.

The machine cycle

A **machine cycle** identifies the four steps performed by the CPU for each instruction received. This cycle includes reading and interpreting the instruction, executing the code and then storing the code. The four steps are the following:

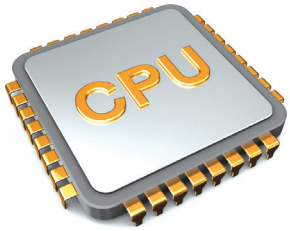
1. **fetch**, i.e. the CU fetches the instruction from the main memory (hard drive) and stores it in its temporary memory (IAS);
2. **decode**, i.e. the retrieved instruction is made ready for execution;
3. **execute**, i.e. the ALU carries out the instruction;
4. store, i.e. the results are sent to and written down in memory.

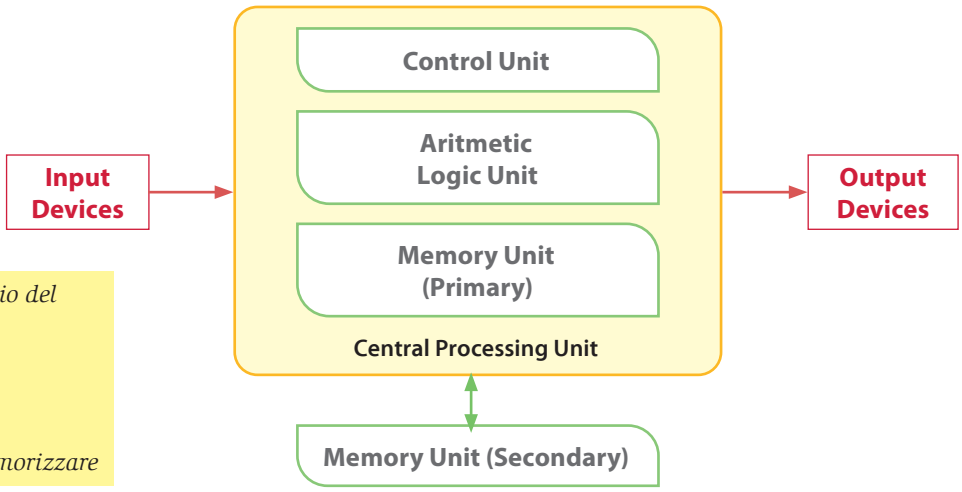
Steps 1 and 2 are called **I-time (instruction time)** and steps 3 and 4 are called **E-time (execution time).**

Speed of the CPU

The speed of the CPU depends on three factors:

- **clock speed**••, that is the speed at which the CPU carries out a machine cycle;
- **cores**, that is the number of instructions that can be processed at one time (1 core = 1 instruction); a CPU was traditionally made up of a processor with a single core, but modern computers have two or more cores•••.
- **cache**, that is a tiny block of memory built onto the processor for the most commonly used instructions. The bigger the cache, the more quickly the instructions and data can be retrieved into the processor and used.





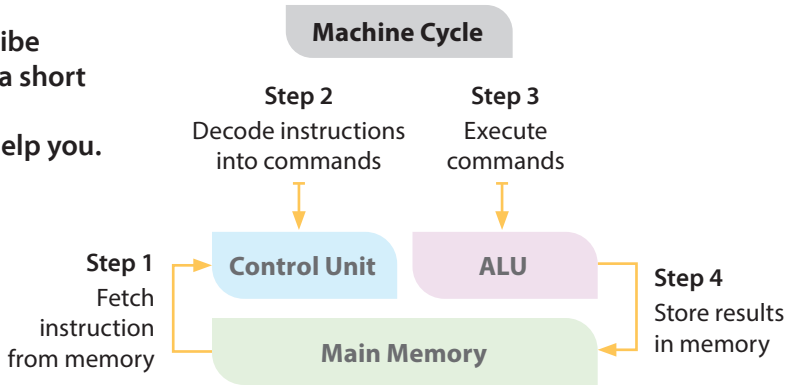
bootstrap: *programma di avvio del sistema operativo*
to fetch: *andare a prendere*
to hold: *tenere, trattenere*
to load: *caricare*
to retrieve: *recuperare*
to store: *immagazzinare, memorizzare*

1 Complete the table.

Sub-system/unit		Function(s)
Input device		• Converts data into electronic pulses • Passes the instructions into the memory
Memory unit (hard drive)		• Stores data and programs
CPU	Control unit	
	Arithmetic and logic unit	
	Immediate access store	
Output device		• Converts electronic pulses back into information • Presents information to the user

2 Look at the chart and describe the machine cycle orally. Then write a short text describing the machine cycle using the sentences below to help you.

The machine cycle is made up of... steps.
In the first/second/last step...
The first/second step is called...



3 Read the text and decide if the statements are true or false.

How Does a CPU Start Working?

The operating system is not immediately available when the computer is switched on, in fact it is dependent on another program to be initialised. A bootstrap or boot loader is a small program with limited functionality, but which can load enough other software for the operating system to start. It searches storage devices for a special section, the boot sector, to load the first small program from there. The bootstrapping process starts when the CPU executes the BIOS (Basic Input Output System) contained in the ROM (Read Only Memory) at a predefined address. The BIOS is special software whose main function is that of starting the operating system. Once the operating system has been loaded, the CPU receives the instructions on how to read the hard disk and can start working. The system initialises and the BIOS performs a power-on self-test (POST) for all the different hardware components in the system to make sure that everything is working properly.

	T	F
1. The complete operating system is always available in memory.	☐	☐
2. A boot loader is a small but complete operating system.	☐	☐
3. A CPU always looks for the same address when starting.	☐	☐
4. The boot loader executes the BIOS.	☐	☐
5. The boot loader executes a POST.	☐	☐
6. The POST is a test to check the functionality of hardware components.	☐	☐