Lesson 1:
Introduction to Computer Science

Basics

Objectives

- To familiarize yourself with the most used terminology in computer science
- To learn how information is represented on a computer
- To show the functional units of a computer
- To introduce the definition of software, as well as the different types

Contents

- Definitions: computer science and computer
- Representation of information
- Basic structure of a computer
- Definition and type of software

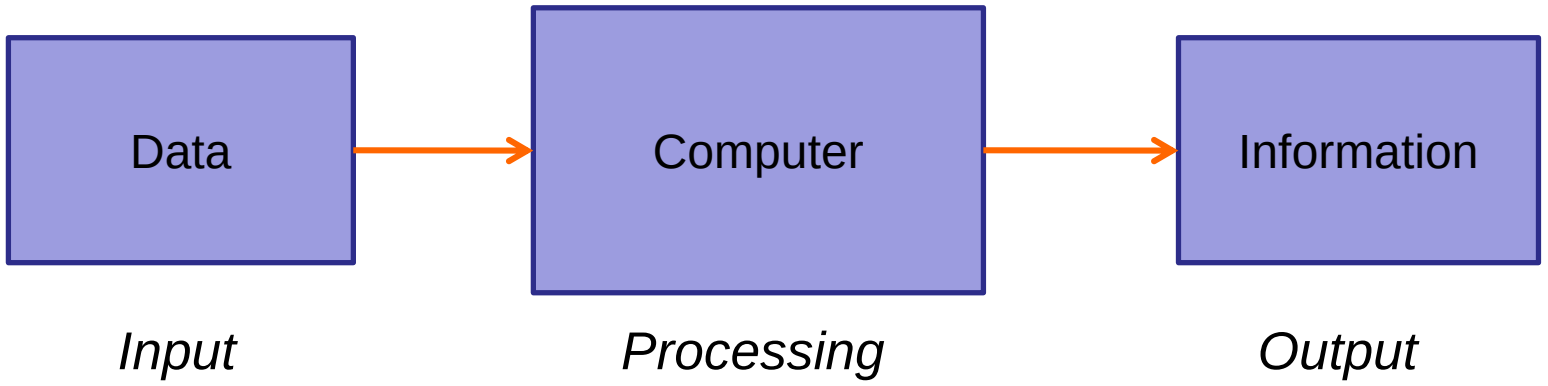
BASIC DEFINITIONS

Definitions

- Computer Science (*INFORMATICS = INFORMation + automÀTIC*)
  - A discipline that studies the algorithms, techniques and activities related to computational systems and the automatic treatment of data.
- Computer Engineering:
  - Related to the development of computational systems, composed of:
    - Hardware (physical components)
    - Software (logical or formal components, like programs).
- Data Engineering
  - Related to the development of (computer) systems to efficiently process and manipulate large volumes of digital data. It includes:
    1. Data obtention and extraction
    2. Mathematical and computational data representation
    3. Secure data transmission and storage
    4. Efficient processing of the information contained in the data
    5. The analysis and visualization of information
- Artificial Intelligence:
  - Simulation of human intelligence processes by machines, especially computer systems (e.g. expert systems, natural language processing, speech recognition, machine vision)

Computer

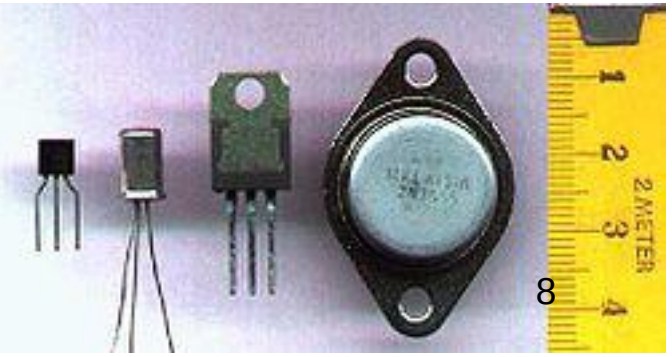
- A computer is a machine that manipulates data according to a list of instructions.
- A computer can also be defined as an electronic machine that accepts data (data), processes and issues results (information)



REPRESENTATION OF INFORMATION

Data Representation

- Data: set of symbols used to express a value, a fact, or an idea.
  - Text, numbers, images, sound, etc…
- How to represent these types of data?
  - The best solution is to find a uniform representation
- The bit is the minimum unit of information.
  - Its value can be 1 (on) or 0 (off).
- Why only two values?
  - The values 1 or 0 are the logical representation of the voltages emitted by the transistors



Storage Measures

- **Bit**: It is the minimum unit of information. It gives a value between two possible ones (usually 0 or 1).
- **Byte**: In compute science, a byte is a unit of measurement for storing information.

  A byte is equal to 8 bits and can be used to represent letters and numbers. For example, the number 01000001 is 8 bits long, and represents the letter A in ASCII[1] code.

  The storage capacity of information storage devices (memories, disks, etc.) is done with multiple byte units.

> *"640 kB ought to be enough for anybody"* (Bill Gates, 1981)
> (*640 kB haurien de ser suficients per a tothom*)

[1] The ASCII representation of characters and numbers will be shown in Lesson 3.

Storage Measures

Standard defined by the International Electrotechnical Commission (IEC):

- 1 Kibibyte (KiB) = 1024 bytes (2^{10} bytes)
- 1 Mebibyte (MiB) = 1024 KiB (2^{20} bytes)
- 1 Gibibyte (GiB) = 1024 MiB (2^{30} bytes)
- 1 Tebibyte (TiB) = 1024 GiB (2^{40} bytes)
- 1 Pebibyte (PiB) = 1024 TiB (2^{50} bytes)
- 1 Exbibyte (EiB) = 1024 PiB (2^{60} bytes)
- 1 Zebibyte (ZiB) = 1024 EiB (2^{70} bytes)
- 1 Yobibyte (YiB) = 1024 ZiB (2^{80} bytes)

The standard is based on the binary system and was defined by the IEC in 1998.The prefixes of the decimal system (Kilo-, Mega-, Giga-, etc.) are usually used, but their use is wrong: a Kilobyte (KB) should be 1000 bytes, not 1024 bytes.

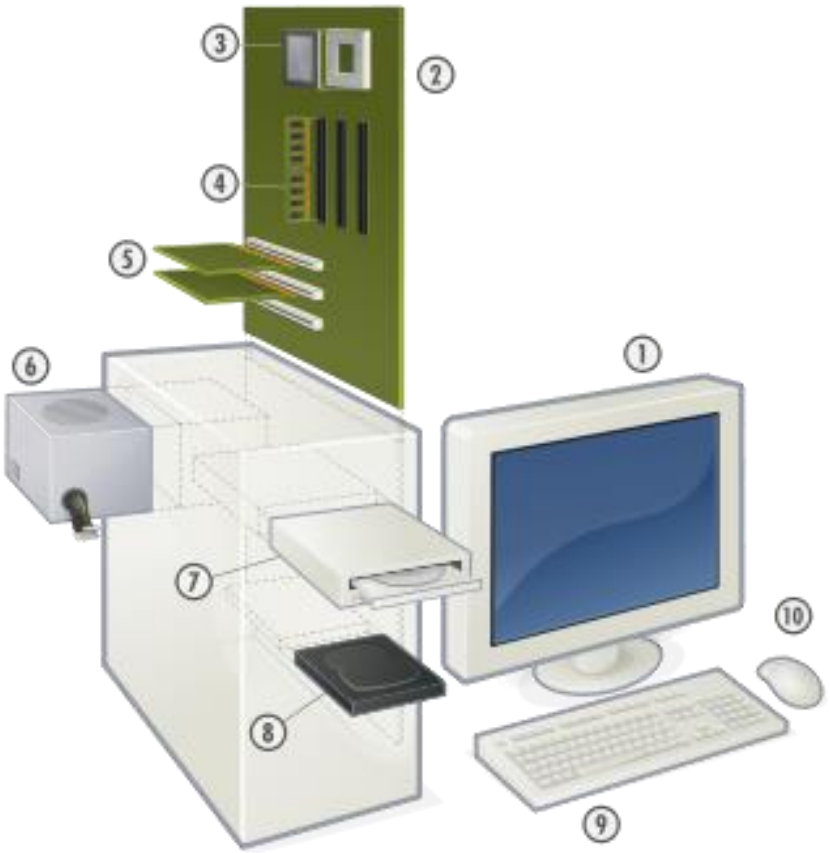
Data speed measurements

Today there are generally 2 ways to describe the speed of data transfer: in bits per second or in bytes per second. A lowercase "b" usually means bit, while a capital "B" represents a byte.

- **bps**: bits per second, bps was the main way to describe the speed of data transfer for several decades. Modems measured the speed in bauds, which was equivalent to bps.
- **Kbps**: kilobits per second, or 1000 bits per second.
- **Mbps**: 1,000,000 bits per second (usually used in the description of Internet download / upload speeds).
- **Gbps**: 1,000,000 kilobits per second or 1,000,000,000 bits per second. This term is the most used by local area networks, where the proximity of the machines allows a fast transfer of data.

BASIC STRUCTURE OF A COMPUTER

Structure of a computer



1. Monitor
2. Motherboard
3. CPU
4. RAM (memory)
5. Expansion card
6. Power supply
7. Optical disk drive
8. Hard disk
9. Keyboard
10. Mouse

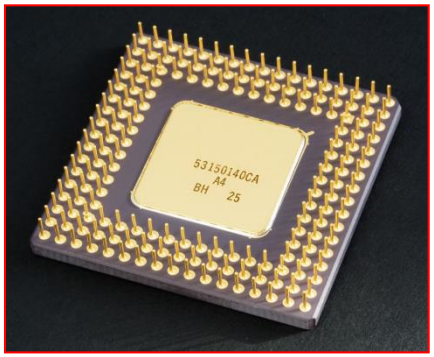
IMPORTANT!!! It is mainly classified by location (central or peripheral) and function (input, output, input-output, or storage).

Fundamental units of a computer

CPU: is the fundamental component of the computer, in charge of interpreting and executing instructions and processing data.

CU: Coordinates computer activities. Controls and synchronizes the computer process

ALU Performs arithmetic and logic operations (comparisons)



CPU Intel 80486-DX2

Memory

- RAM : *Random Access Memory*
  - It contains the **data** and the program **instructions**
  - It is **volatile** (it clears when the computer is turned off)

- ROM : *Read Only Memory*
  - Contains the initial instructions for starting a computer
  - It is permanent (non-volatile), and it cannot be modified (read-only)

Examples of RAM modules

Secondary storage

- Permanent data storage
  - Magnetic tape
    - Widely used in backups
    - Sequential access
  - Floppy disk
    - Magnetic Device
    - High portability
    - Low capacity (1-2MB)
  - Hard Disk
    - Fast access time
    - Large storage capacity
    - Current capacity (~18 Terabytes)

Secondary storage

- Permanent data storage
  - CD-ROM / DVD
    - To write on the disc, a laser beam burns tiny pits on the disc
    - To read the disc, the laser is directed onto the disc surface and a light sensor detects the reflections caused by the pits
    - CD-ROM: 700MB, DVD: 4.7-17GB

  - Solid State Storage (Flash memory)
    - Based on the famous transistor FAMOS (**F**loating-gate **A**valanche-injection **MOS**)
    - Very small devices
    - Variable storage capacity
      - Latest models: capacities of the order of TB

Input / Output devices

They allow communication between the computer and the user

- Input
  - Keyboard
  - Mouse
  - Camera
  - CD-ROM / DVD
  - Scanner
  - Modem






- Output
  - Monitor
  - Printer
  - Modem



DEFINITIONS AND TYPE OF SOFTWARE

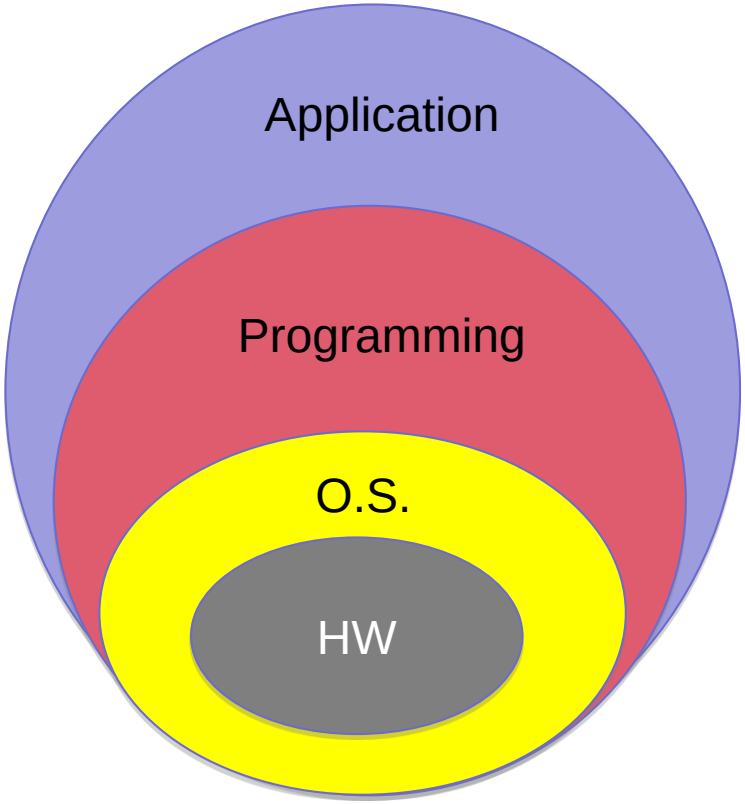
Definitions

- SOFTWARE
  - It is the set of computing **programs**, procedures, rules, **documentation**, and associated **data** that are part of the operations of a computer system.
- Program: A set of instructions that control a computer to produce a specific result.
- Programming: process followed to build a program.
- Programming language: A set of instructions available for building a program.

The term «software» was first used by John W. Tukey in 1957.

Software Classification

- It can be classified into three major groups:
  - System software (O.S)
  - Programming software
  - Application software



IMPORTANT!!! Each layer of software can only use the inner layers.

System software

- Its aim is to properly disassociate the user and programmer from the particular details of the computer being used. It especially isolates them from the processing related to internal features such as memory, disks, ports and communication devices, printer, display, or keyboard. It includes, among others:
  - Operating systems (O.S). It is the software that starts when the computer turns on, and that controls the execution of all other programs.
  - Device drivers
  - Diagnostic tools
  - Correction and optimization tools
  - Servers and utilities

NOTE!!! Firmware is the specific software that controls a device (a modem, a DVD drive, a microprocessor...)

Programming software

- It is the set of tools that allow the programmer to develop computer programs, using different alternatives and programming languages, in a practical way. It includes, among others:
  - Text editors
  - Compilers
  - Interpreter
  - Linkers
  - Debuggers
  - Integrated Development Environments (IDE).

Application software

- It allows users to perform one or more specific tasks, in any field of activity that can be automated or assisted, with special emphasis on business. It includes, among others:
  - Industrial control and automation system applications
  - Office applications
  - Educational software
  - Business software
  - Database software
  - Telecommunications (internet and all its logical structure)
  - Video games
  - Medical software
  - Numerical calculation software
  - Assisted design software (CAD)
  - Computer Aided Manufacturing Software(CAM)

Summary

- A computer is a machine for processing information and obtaining results based on input data.
  - Hardware: physical part
  - Software: logical part
- Today's computers are made up of
  - A processor (CPU): composed of a Control Unit and an Arithmetic Logic Unit.
  - Central Memory
  - Input / Output Devices
- Software can be classified in:
  - System software
  - Programming software
  - Application software