Embedded Systems

Arquitecturas

It has only one door for data to pass through.	von Neumann
It has one port for data and another for instructions.	Harvard

Bits (Word size)

- Turn on lights, read a button, move a small motor
  - They can only load one number from 0 to 255 (2**8) at a time.
    - 8 bits (1 Byte)
- They use less battery power and have good processing capabilities
  - 16 bits (4GB)
- Wi-Fi, sound processing, moving color screens
  - They can load numbers up to 4 billion (2**32) in a single move.
    - 32 bits
    - 64 bits

Bits (Binary digit) is the smallest unit of information
- A bit can only have the value 0 or 1

Embedded Programming

Programming Languages

C	It uses little memory and is very fast
C++	There are many libraries, but it's a bit heavier than C.
Phyton	It is a language interpreted by the chip's translator

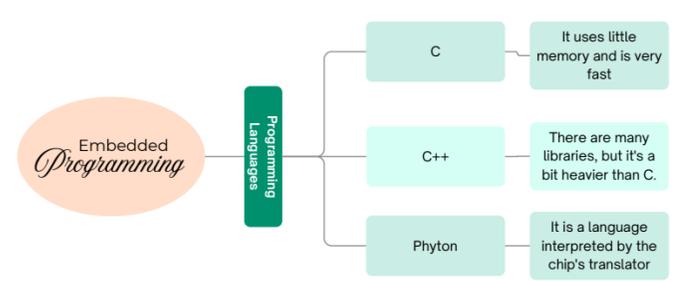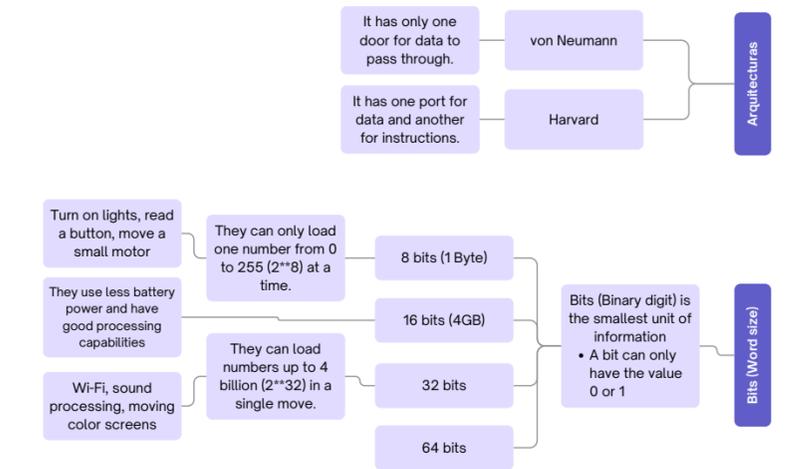
Embedded systems
Brain of the object with a specific activity → For example, everything a computer needs to perform the actions it has to carry out.

Processor (brain)

Main chip on the board → reads and executes the instructions

Inputs (Las Entradas)
They convert a physical phenomenon into an electrical signal (sensors, buttons)

Types

- Communication
- Internal
- Digital
  - Simple
  - 1 o 0
  - Has energy or not
- Analogic
  - Power range
  - Requires analog inputs

- Buttons and switches
- Magnetic sensors (something is open or closed)

- Light, temperature, or force sensors
- Potentiometers (audio volume or light intensity)

The processor must have specific inputs to read the analog signals.

Outputs (Salidas /Acciones)
They convert the electrical signal into a physical, visual, or auditory action.

LEDs, motors, buzzers, screens

Types

- Digital
  - Maximum voltage state (5V) or zero (GND)
    - LEDs
    - Passive buzzer (single beep)
    - Relays: For quickly turning things on (your house lights)
- Simulated (PWM)
  - Pulse Width Modulation (It's like a switch that moderates the outgoing power)
    - LED brightness
    - Servomotors (Indicates the correct angle)
    - Motor speed
- Communication
  - They send data
    - Serial Monitor: Send text to your computer screen.
    - LCD or OLED Screens: Display numbers, graphs, or icons.
    - Wi-Fi/Bluetooth Modules: Send data to a website or your mobile phone.
- DAC

Microprocesadores
They have no memory or storage → They need to connect to external chips

Laptops, cell phones, servers, video game consoles.

Microcontrollers
CPU, RAM and memory all on one chip

Examples of use: Washing machines, microwaves, TV remotes

GPU
Rapid Processing Unit → Makes several small tasks easy at the same time

Video games, video editing, and artificial intelligence

Microcontroller families
- ESP32
- AVR (Arduinos)
- RP (Raspberry phy)
- ARM (SAMD, STM32)

Individual assignment:
Browse through the datasheet for a microcontroller
Write and test a program for an embedded system using a microcontroller to interact (with local input &/or output devices) and communicate (with remote wired or wireless connections)