Microcontrollers vs. Microprocessors

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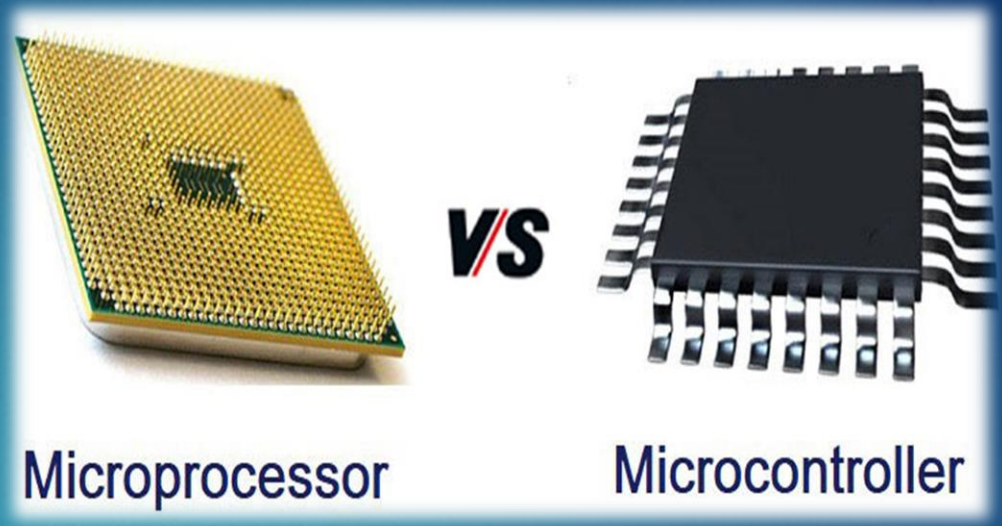
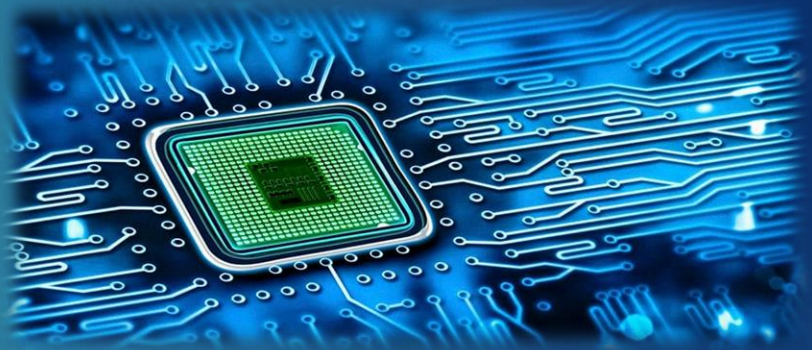
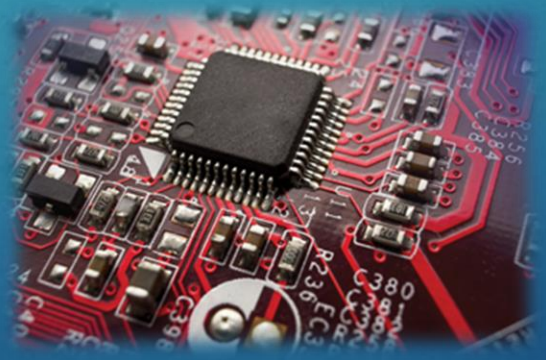
Topics:

- *What are **µControllers** & **µProcessors**?*
- *What are the differences between **µControllers** & **µProcessors**?*
- *PROs and CONs for **µControllers** & **µProcessors.***
- *Architectures (structure) for **µControllers** & **µProcessors**.*
- *Applications for **µControllers** & **µProcessors**.*

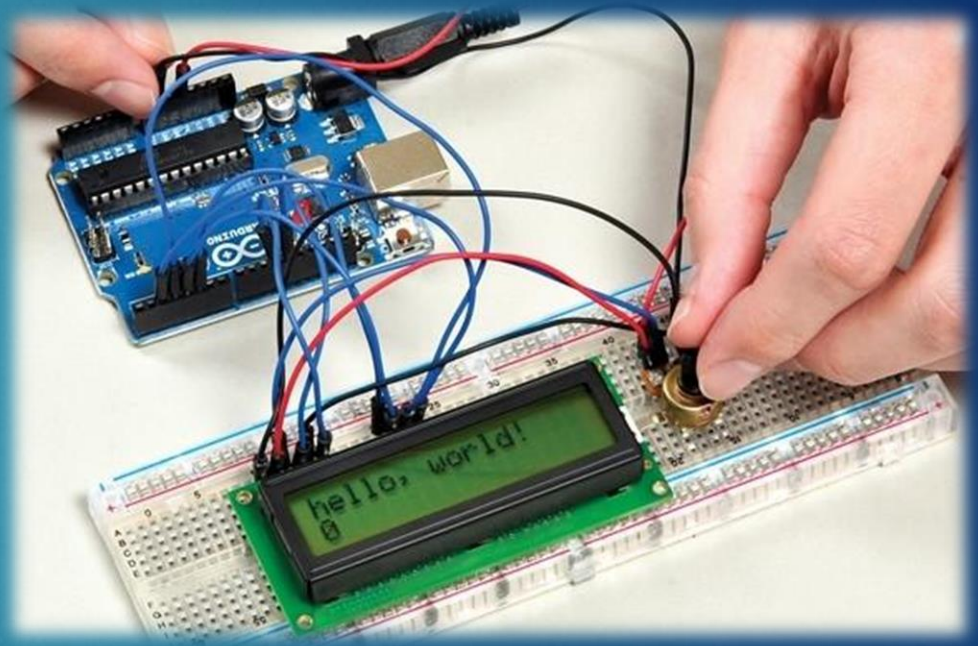






What is a ***microcontroller***?

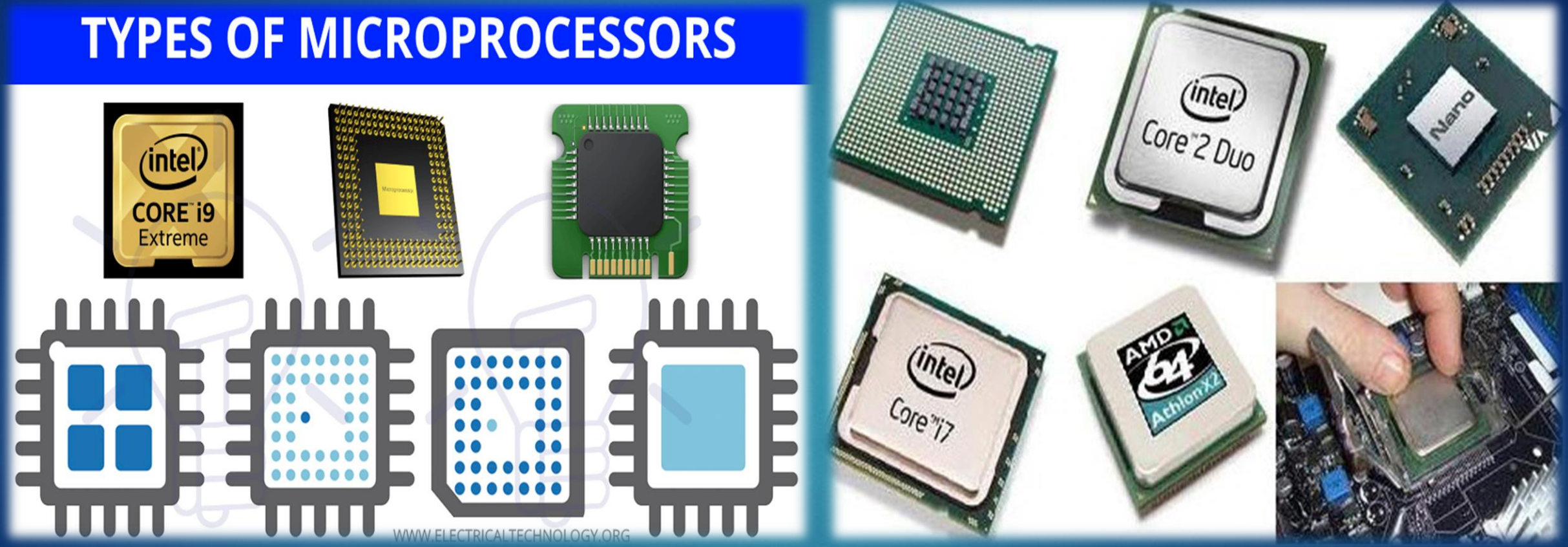
- A small computer!
- One specific task.
- Contains a CPU(s).
- Contains programmable peripherals.
- Embedded applications.
- All-in-one system!



Some common ***microcontrollers***.

What is a ***microprocessor***?

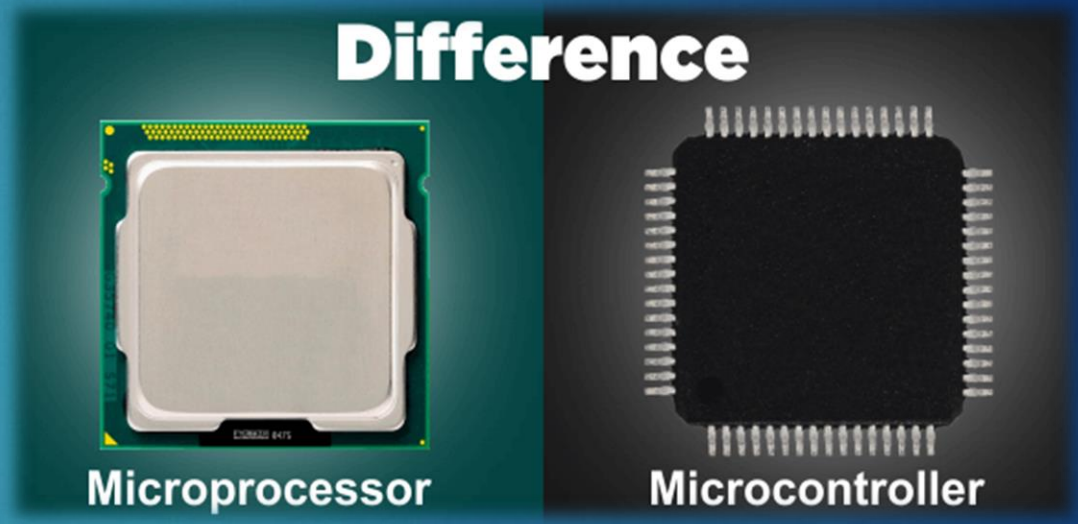
- Most important unit.
- Logical operations.
- Digital integrated circuit (IC).
- Number of instructions.
- Combinational logic & sequential logic.
- Operates based on the binary system (1s & 0s).



Some common ***microprocessors***.

Differences?

- Separate functions.
- No final say.
- Microprocessor: brain for your PC, user interaction.
- Microcontroller: tiny computer (system on a chip), no fancy OS, other limitations.
- Other differences…

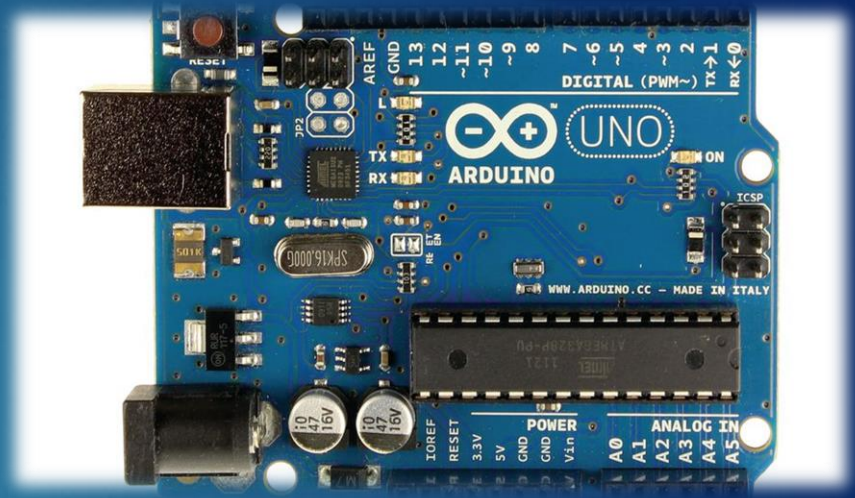


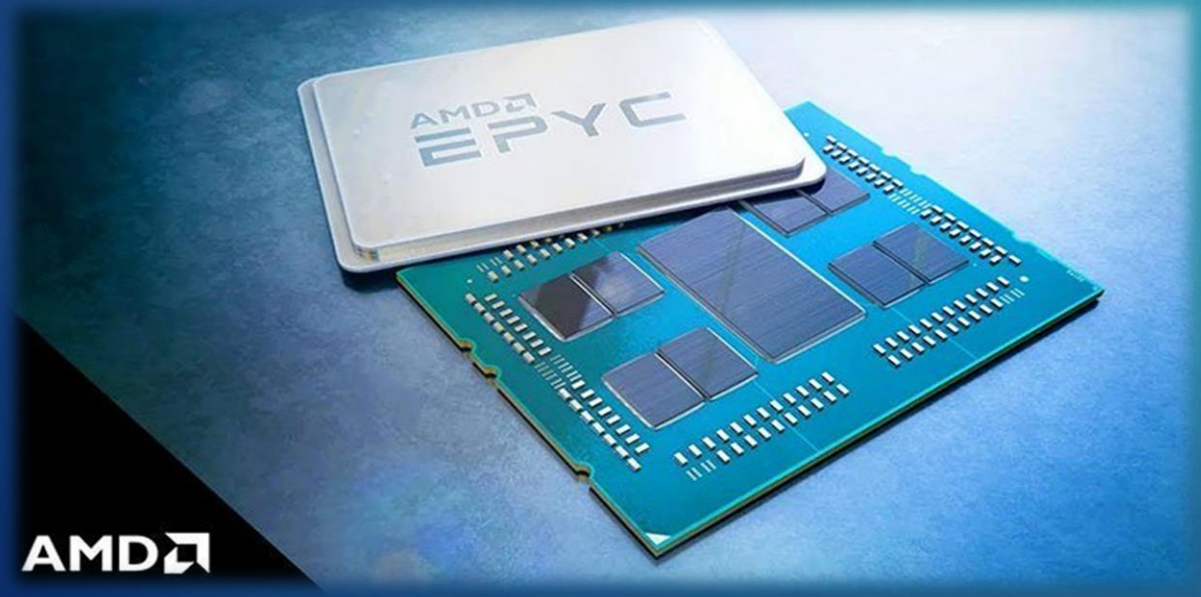
PROs & CONs?


CREATE, GAME AND MULTITASK
WITH LESS WAITING


intel
XEON
inside™

vs.


DIGITAL (PWM~)
UNO
ARDUINO
WWW.ARDUINO.CC – MADE IN ITALY
POWER
ANALOG IN


AMD
EPYC
AMD

PROs & CONs? (*Microcontrollers*)

PROs

- "All-in-one" type design.
- Can act as a micro computer.
- Easy-to-use.
- Easy to maintain.
- Easy to troubleshoot.
- Cheaper than microprocessors!

CONs

- Limited to specific tasks.
- Slightly more complex architecture.
- Limited to low-power devices directly (due to low-power design).
- Can't be used in high-powered devices directly.
- Can only program once.

PROs & CONs? (*Microprocessors*)

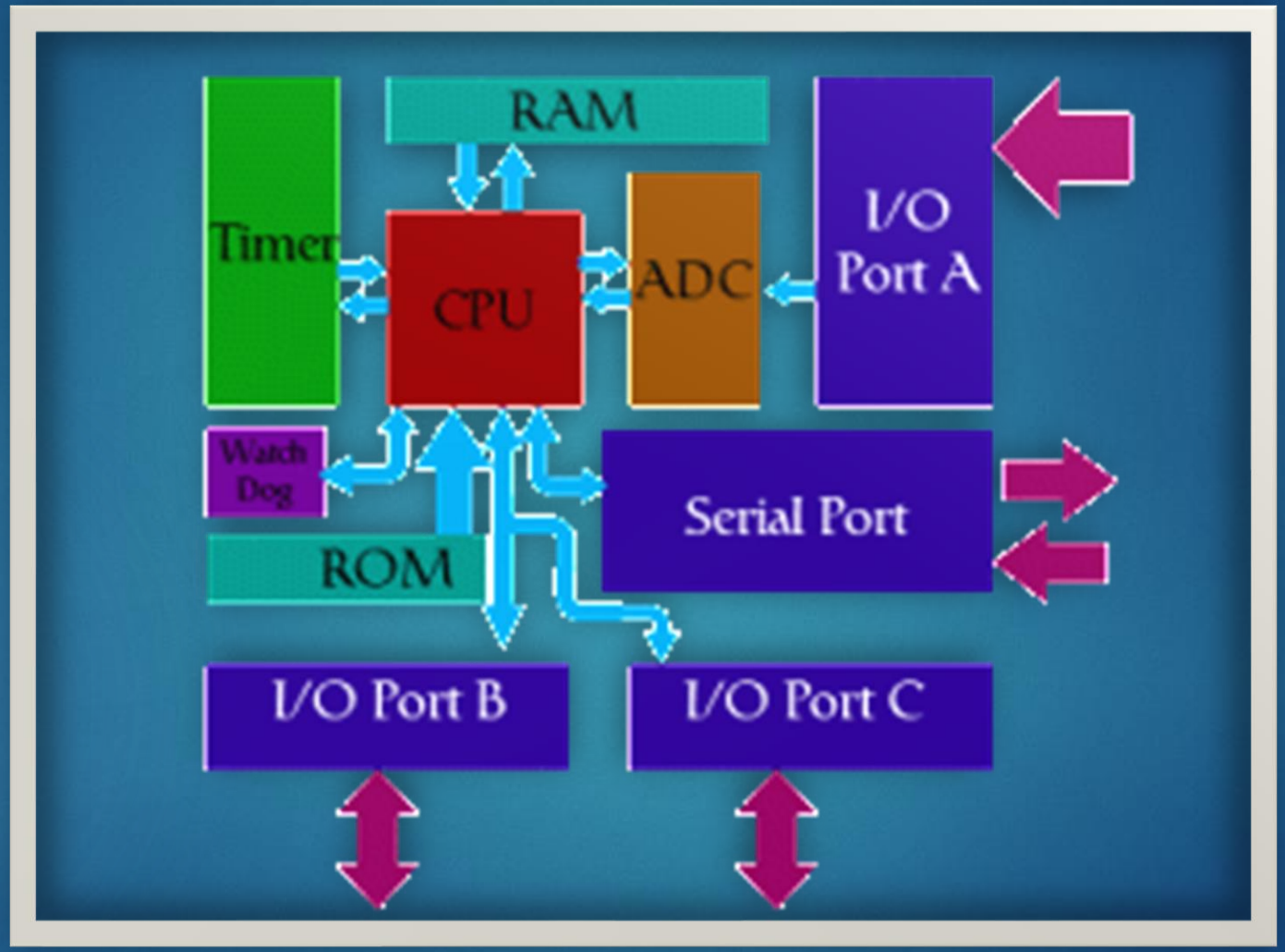
PROs

- Can be programmed to perform multiple tasks at once.
- Operates at very high clock speeds.
- (1GHz – 1 billion tasks-per-second!)
- Can be used in high-powered devices.

CONs

- Not a standalone device.
- Other peripherals are needed.
- (ROM, RAM, I/O not integrated like microcontroller)
- Much more expensive!
- Dissipates a lot more heat.

Architecture of a ***microcontroller***:

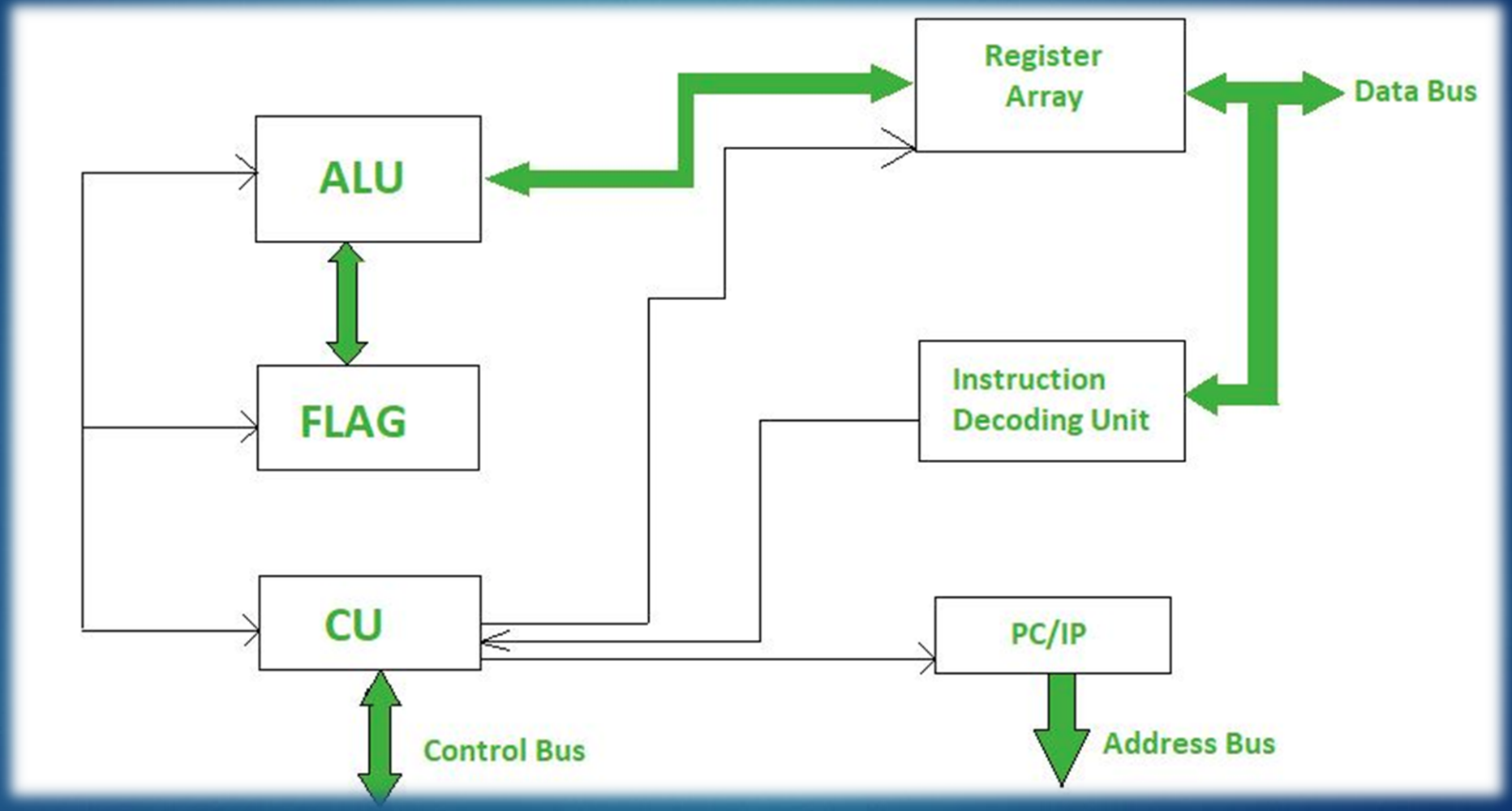


Basic architecture of a typical ***microcontroller***.

Architecture of a ***microcontroller***: (contd.)

- A central processing unit that consists of simple (4 bit) or complex (28 or 32 bit) processors.
- Particular bits are present in the microcontrollers that define the state (input or output) of every pin.
- Serial ports are present to perform input and output operations. Other input or output interfaces are connected to these ports.
- Other devices such as timers also may be connected to the microprocessor.
- A clock is also present within the microcontroller. If no external clock is connected to it then, the above-mentioned clock is used to time the various operations.
- It has a volatile memory (usually flash) to store the temporary data. Apart from it, a permanent memory is present as well.
- It may contain an analogue to digital converter.
- It contains mechanisms that support debugging of programs.

Architecture of a ***microprocessor***:



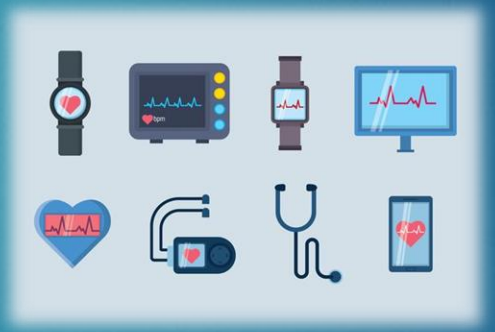
Basic architecture of a ***microprocessor***.

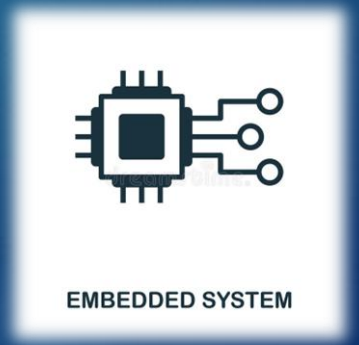
Architecture of a ***microprocessor***: (contd.)

- It performs some basic operations like addition, subtraction, multiplication, division and some logical operations using its **Arithmetic and Logical Unit** (ALU). New Microprocessors also perform operations on floating point numbers also.
- Data in Microprocessor can move from one location to another.
- It has a **Program Counter** (PC) register that stores the address of next instruction based on the value of PC, Microprocessor jumps from one location to another and takes decision.
- FLAG: The **Flag register** is a Special Purpose Register. Depending upon the value of result after any arithmetic and logical operation the flag bits become set (1) or reset (0).
- CU: The **control unit** controls and monitors communications between the hardware attached to the computer. It controls the input and output of data, checks that signals have been delivered successfully, and makes sure that data goes to the correct place at the correct time.
- Instruction decoding unit: The part of a microprocessor pipeline that decodes instructions that are sent to the microprocessor. It can decode and optimize the order of instructions before it sends them to the execution unit to be run.
- Register array: A register file is an **array of processor registers** in a central processing unit (CPU). The instruction set architecture of a CPU will almost always define a set of registers which are used to stage data between memory and the functional units on the chip.

Applications of ***microcontrollers***

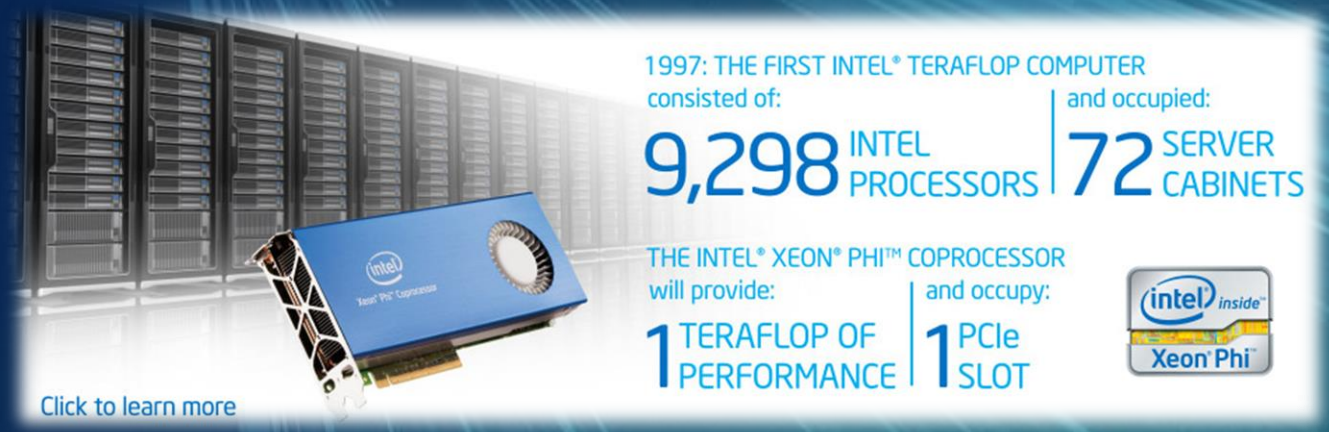
- <u>All the places they are found:</u>
- Vehicles
- Robots
- Office machines
- Medical devices
- Mobile radio transceivers
- Vending machines
- Home appliances
- Embedded systems
- *And way more devices!!!*

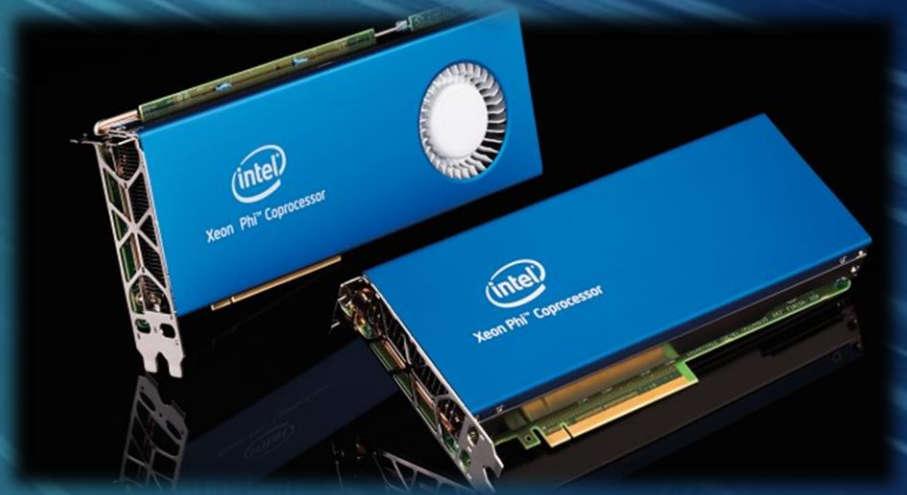




Applications of ***microprocessors***

- <u>All the places they are found:</u>
- Cars
- Boats
- Trucks
- Heavy Machinery
- Gasoline pumps
- Credit card processing units
- Traffic control devices
- Elevators
- *And way more devices!!!*





Thank you for listening!

MICROCONTROLLERS *VS*. MICROPROCESSORS