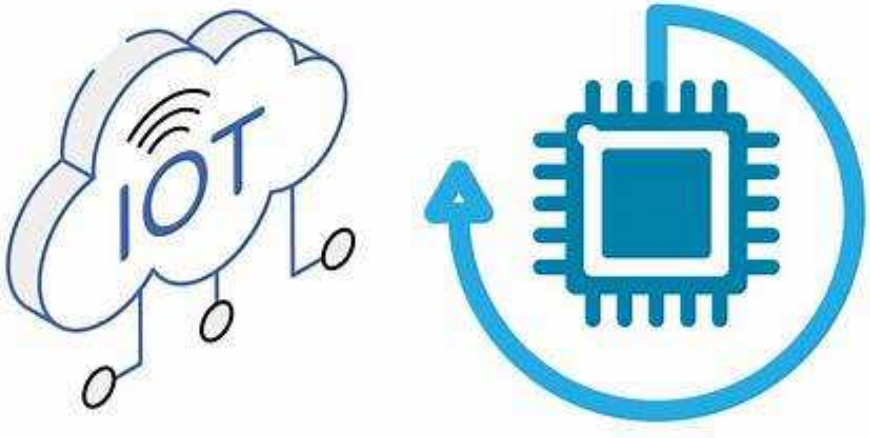
한국외국어대학교
HANKUK UNIVERSITY OF FOREIGN STUDIES

Internet of Things (IoT) Systems



Lecture 04

Microcontroller and Arduino

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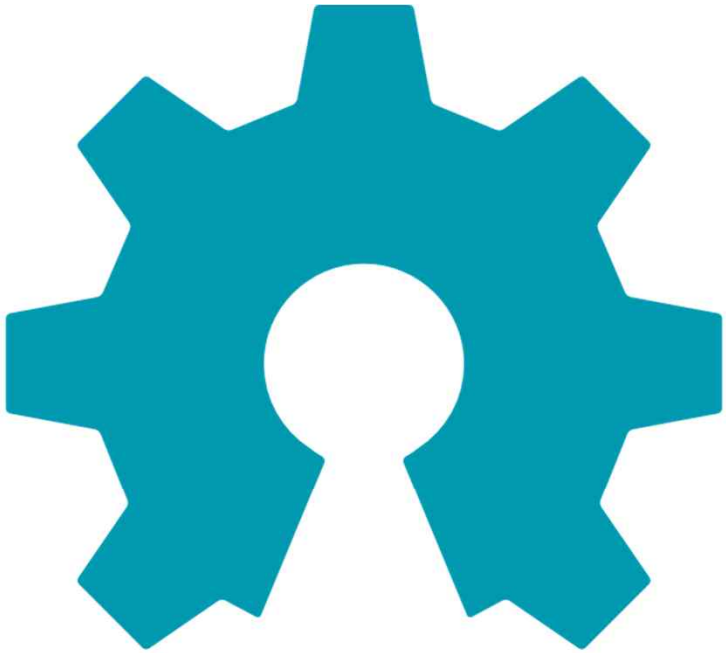
Department of Information and Communication Engineering
Hankuk University of Foreign Studies (HUFS)

Spring – 2025

Open-Source Hardware for IoT

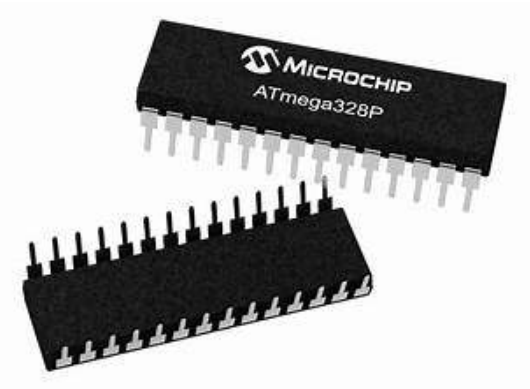
- Microcontrollers
- Arduino
- Raspberry Pi



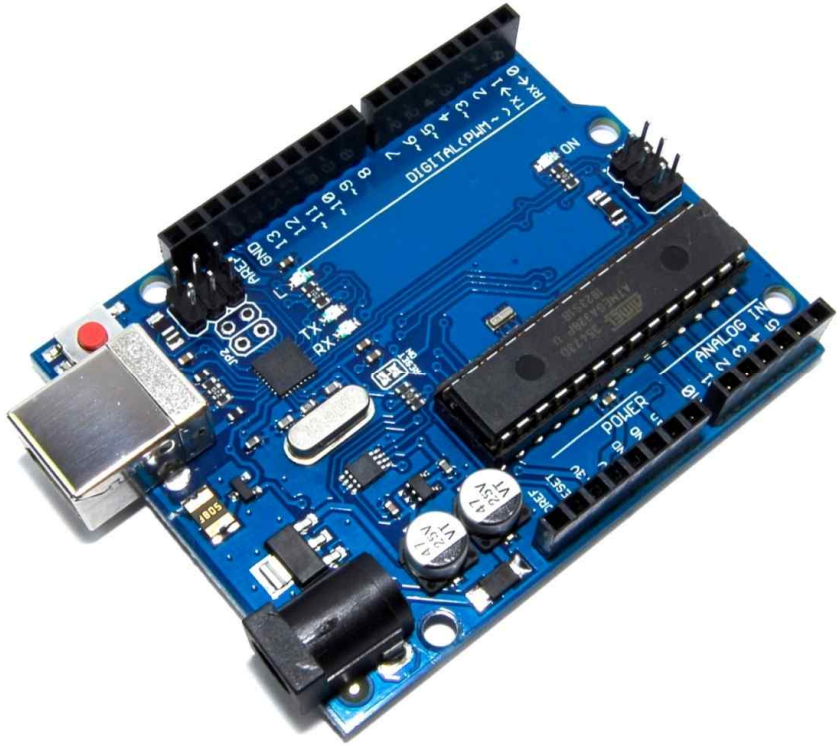
open source hardware

Microcontroller

- **A microcontroller** is a compact integrated circuit designed to govern a specific operation in an embedded system.
- A typical microcontroller includes a processor, memory and input/output (I/O) peripherals on a single chip.
- Sometimes referred to as an embedded controller or microcontroller unit (MCU).
- Microcontrollers are found in:
  - vehicles,
  - robots,
  - medical devices,
  - mobile radio transceivers,
  - vending machines
  - home appliances,
  - among other devices.



Microcontroller chip



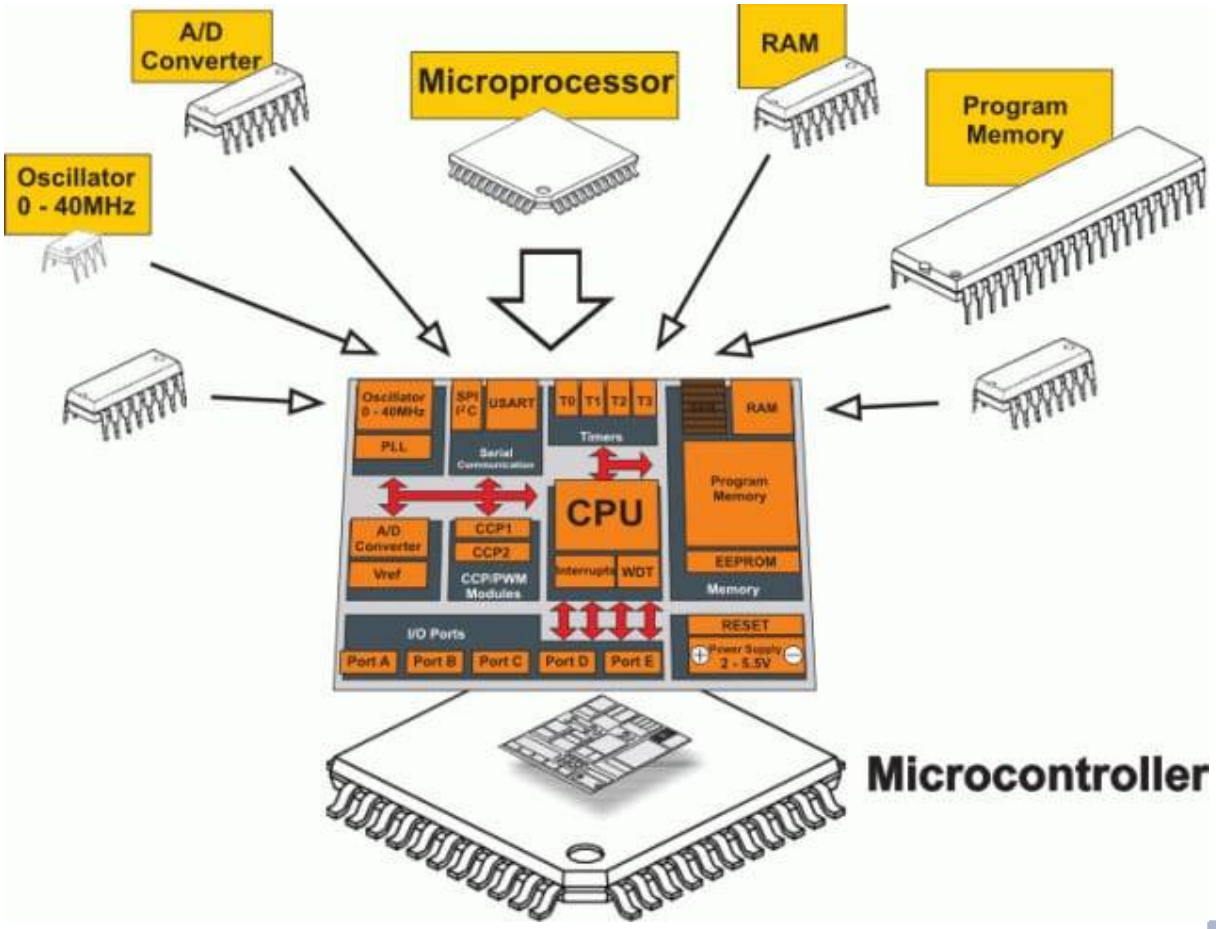
Microcontroller chip + board

https://www.techtarget.com/iotagenda/definition/microcontroller

Inside a Microcontroller: Essential Components

A microcontroller can be seen as a small computer, and this is because of the essential components inside of it;

- Central Processing Unit (CPU),
- Memory
  - Random-Access Memory (RAM),
  - Electrical Erasable Programmable Read-Only Memory (EEPROM).
- Flash Memory,
- Serial Bus Interface,
- Input/Output Ports (I/O Ports),

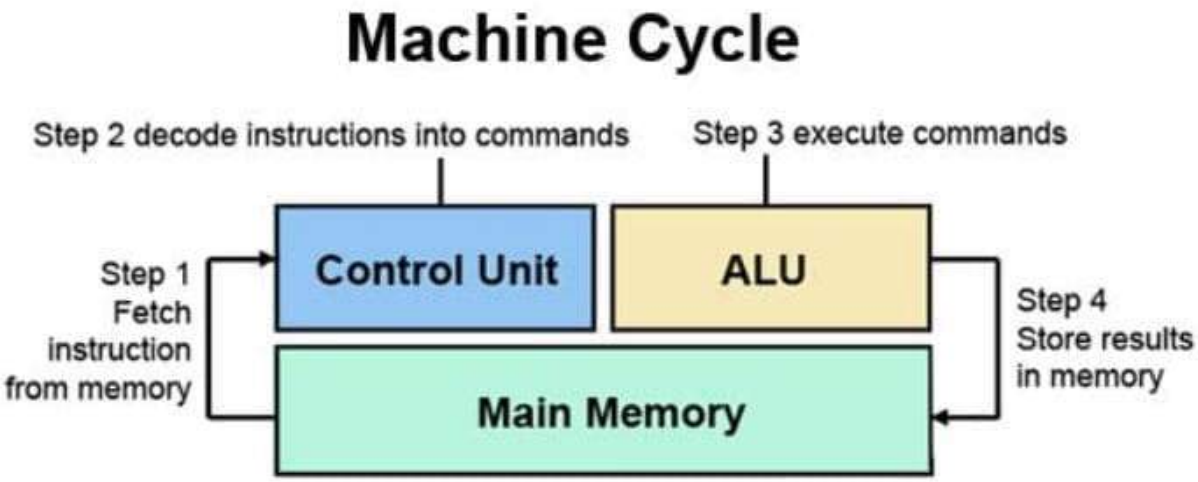


https://www.arrow.com/en/research-and-events/articles/engineering-basics-what-is-a-microcontroller

Inside a Microcontroller: Essential Components

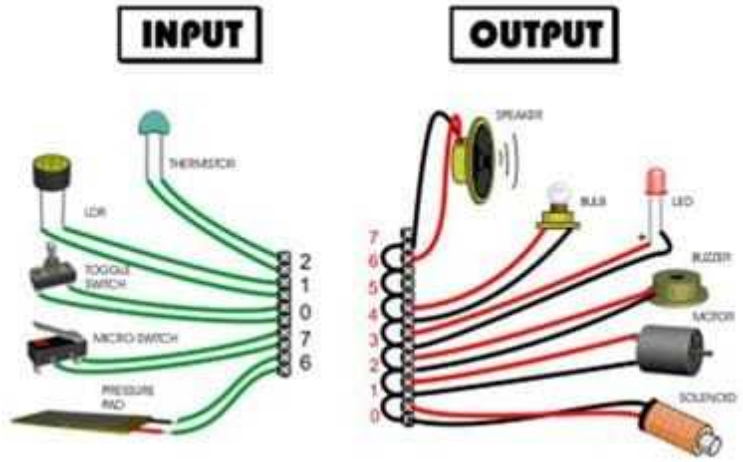
Design of Microcontroller CPU

- Processing all the data input it receives and executes the required instructions.
- ALU performs arithmetic and logical operations,
- Control Unit (CU), which handles all of the processor's instruction executions.

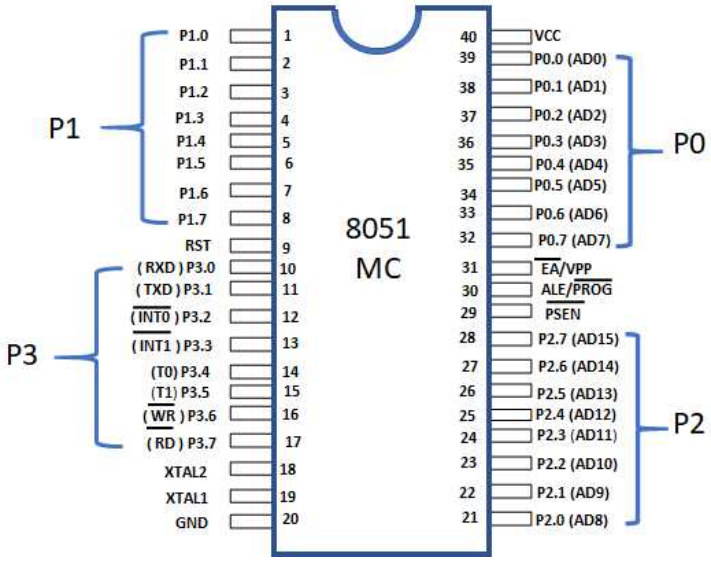


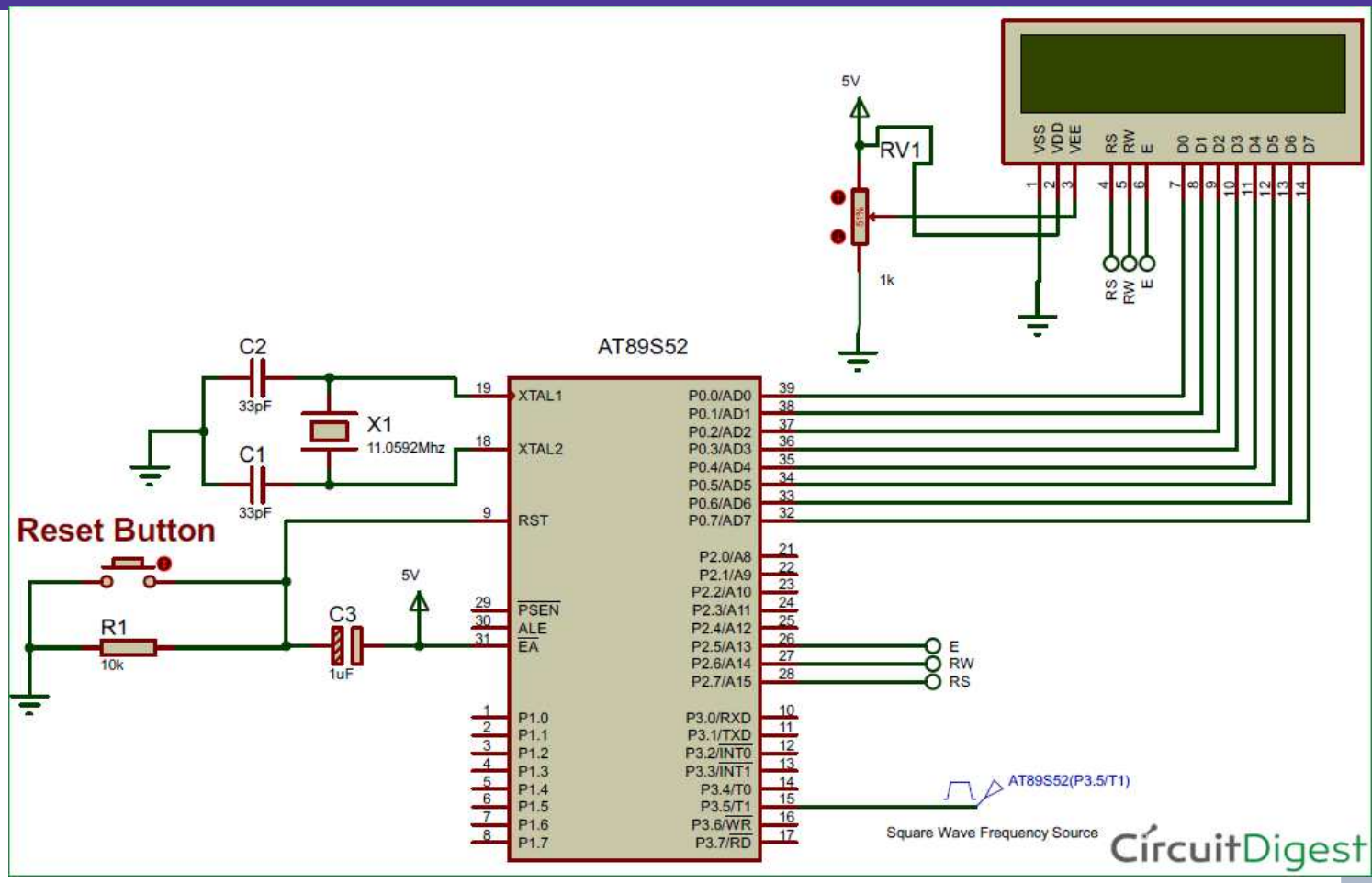
Microcontroller I/O Ports

- I/O ports are what the microcontroller uses to connect to real-world applications.
- Inputs such as temperature sensing, motion sensing, push buttons,……
- Output ports such as LED lights, LCD, running a motor, speaker, …..

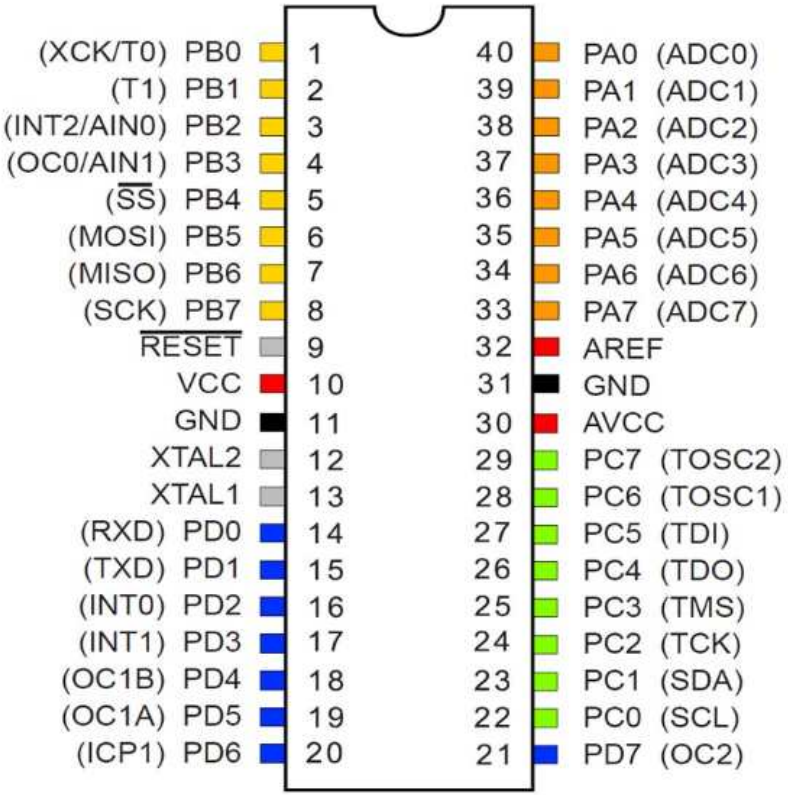


Simulation of the Microcontroller

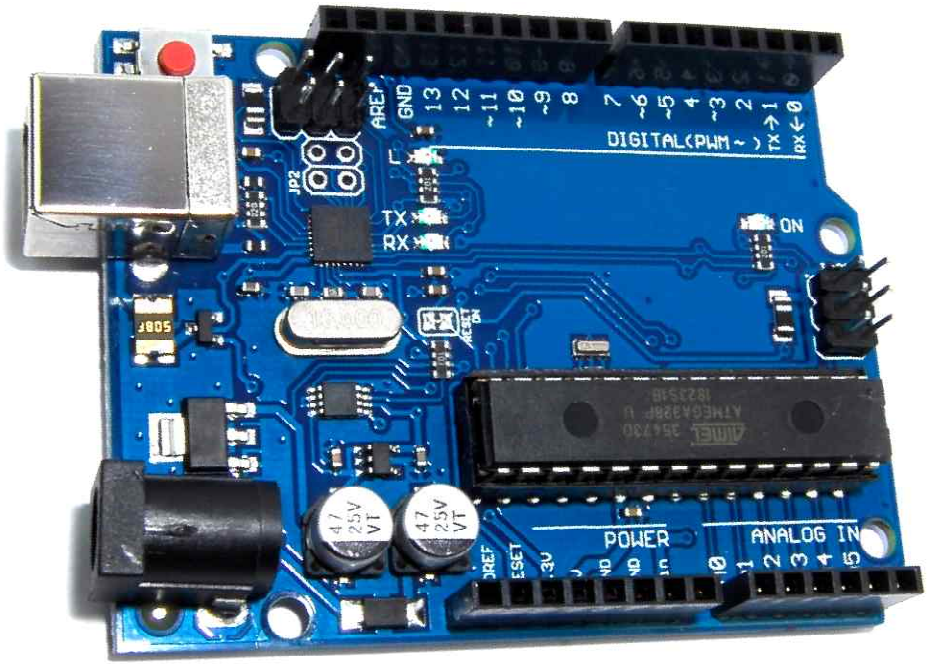




Types of the Microcontroller

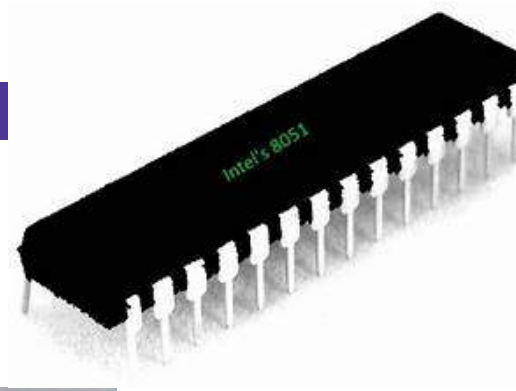


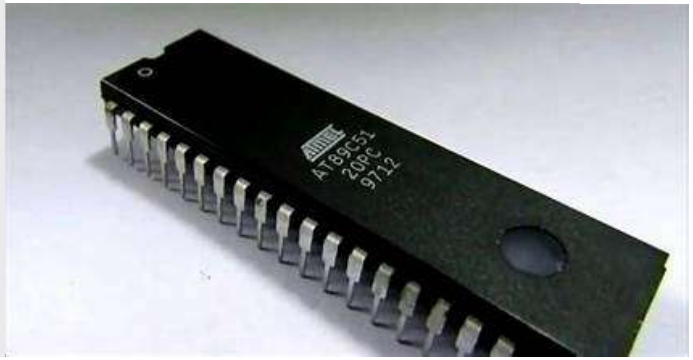
ATmega32A microcontroller which is 8-bit and 40 pin AVR chip.



ATmega32A microcontroller Board.

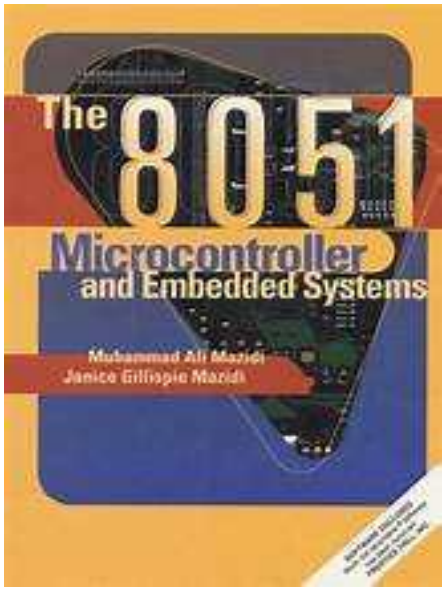
Types of the Microcontroller (SW/HD)

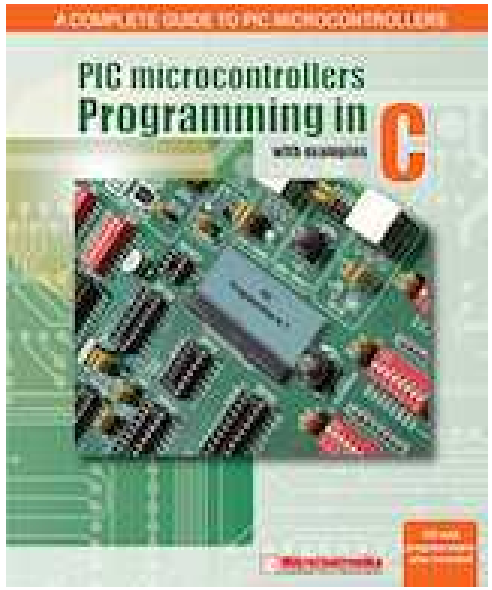


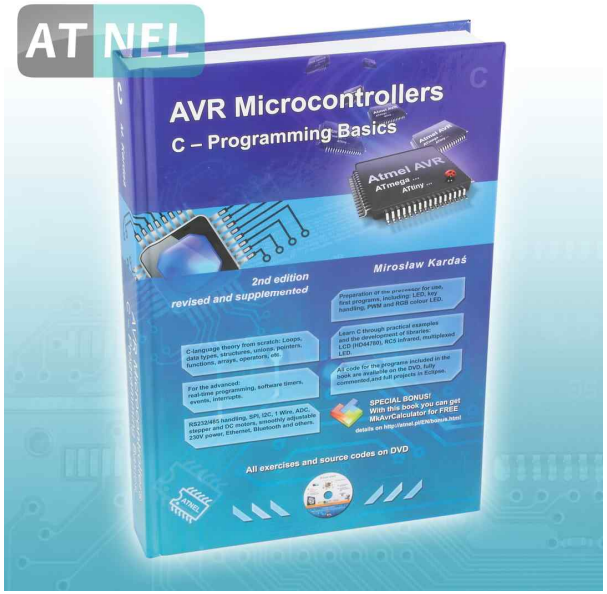


Language	Ease of Use	Performance	Memory Usage	Best For	Difficulty
C / C++	Moderate	High	Low	Complex embedded systems	Moderate to Difficult
Assembly	Difficult	Very High	Very Low	Performance-critical tasks	Very Difficult
Python (MicroPython)	Easy	Moderate	High	Prototyping, IoT, education	Easy to Moderate

References


The 8051
Microcontroller
and Embedded Systems
Muhammad Ali Mazidi
Janice Gillispie Mazidi


A COMPLETE GUIDE TO PIC MICROCONTROLLERS
PIC microcontrollers
Programming in C


ATMEL
AVR Microcontrollers
C – Programming Basics
Atmel AVR
ATmega ...
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Mirosław Kardaś
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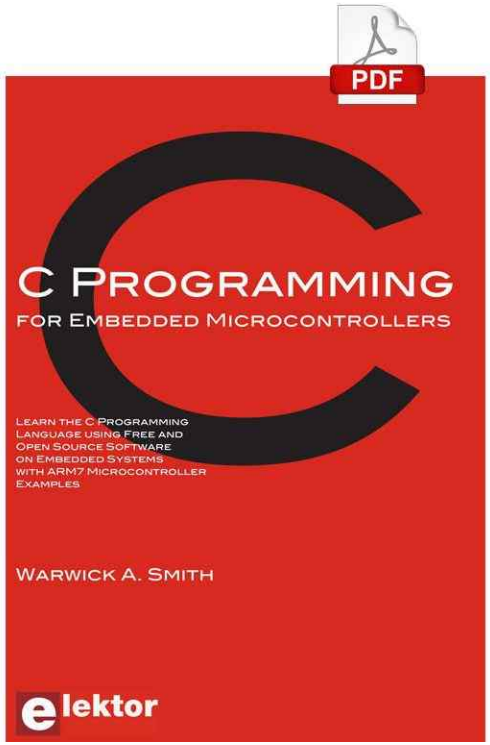
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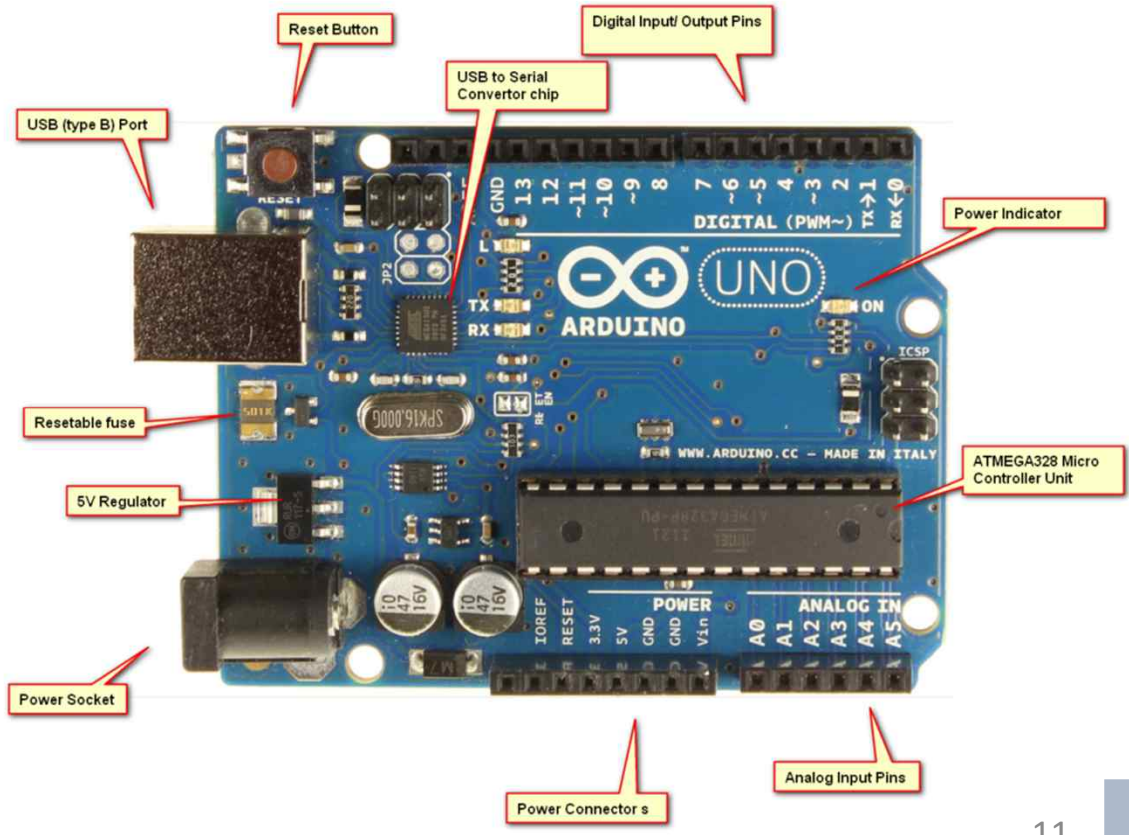
Arduino

Arduino

- Arduino is an open-source electronics platform based on easy-to-use hardware and software.

- Arduino boards are able to read inputs – light on a sensor, a finger on a button – and turn it into an output – activating a motor, turning on an LED, publishing something online.

- The Arduino project started in 2005 in Italy to make a low-cost and simple solution to create digital projects.



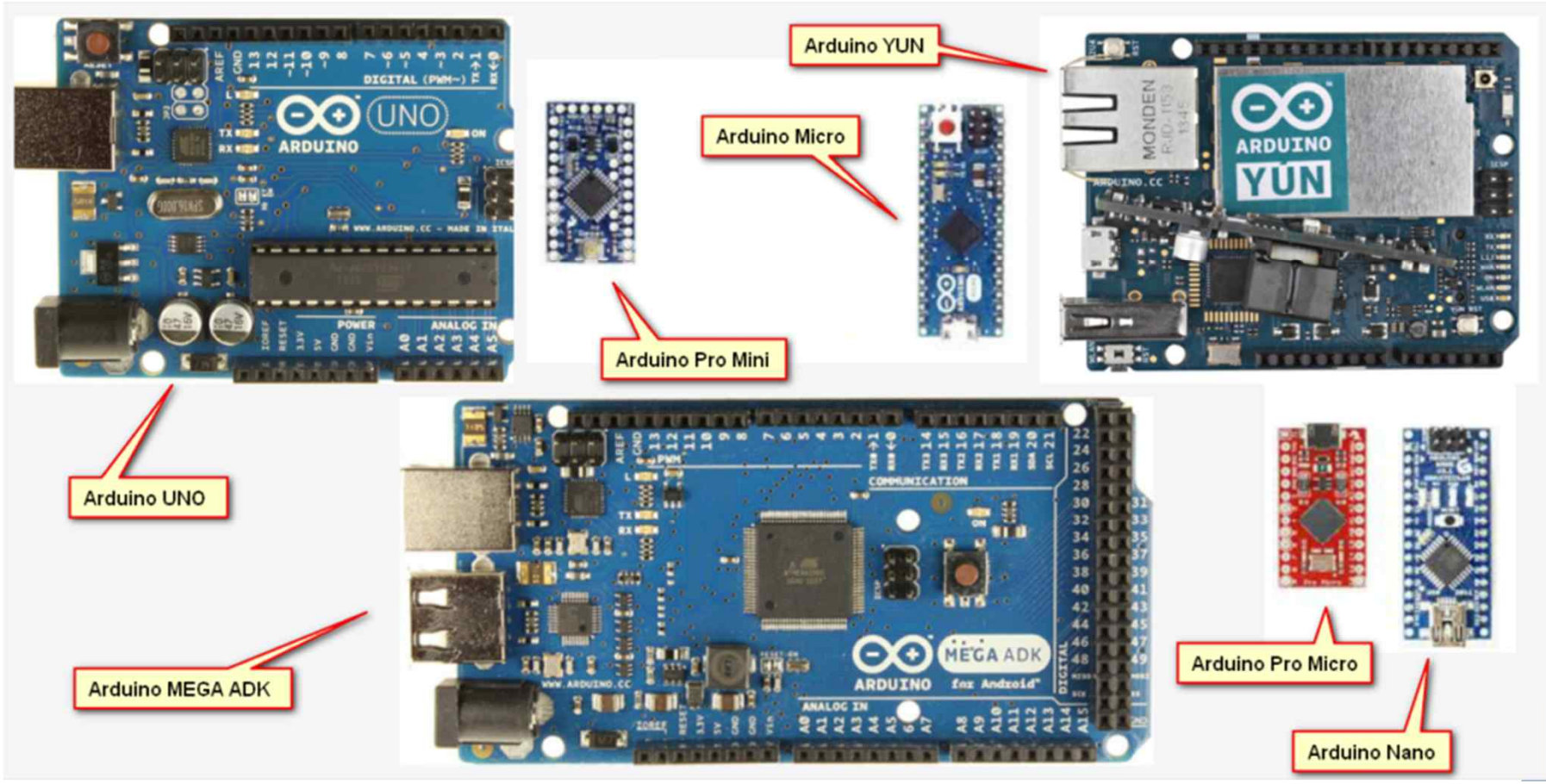
Arduino Hardware

The Arduino UNO, MEGA and ZERO are the best.

The Arduino UNO R3 is

- very easy to use,
- USB type-B port to connect with Computer
- Power socket
- fairly cheap.

It is compatible with most projects and code examples you will find on the internet.



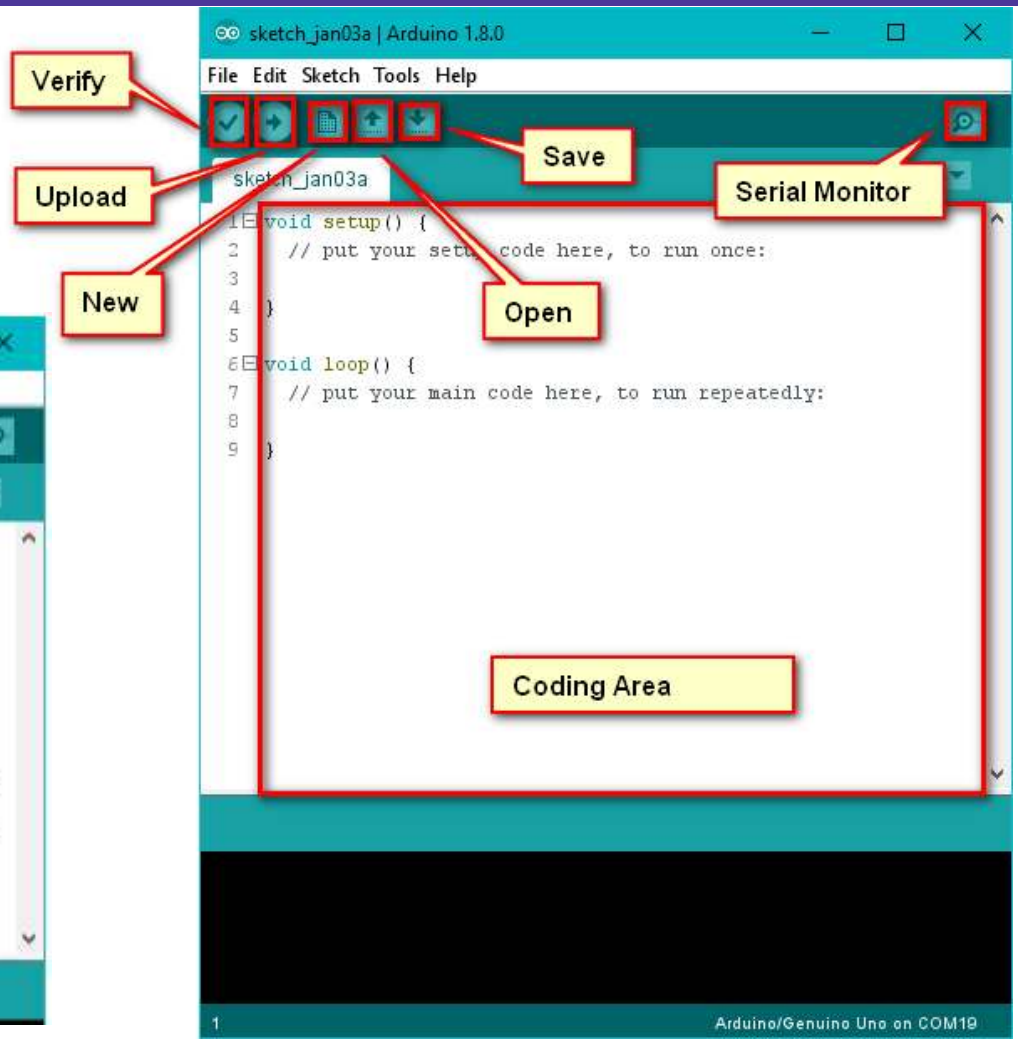
Arduino IDE software

As of January 4, 2017, ARDUINO 1.8.0 is the latest version of Arduino IDE.

https://www.arduino.cc/en/software

Arduino IDE software

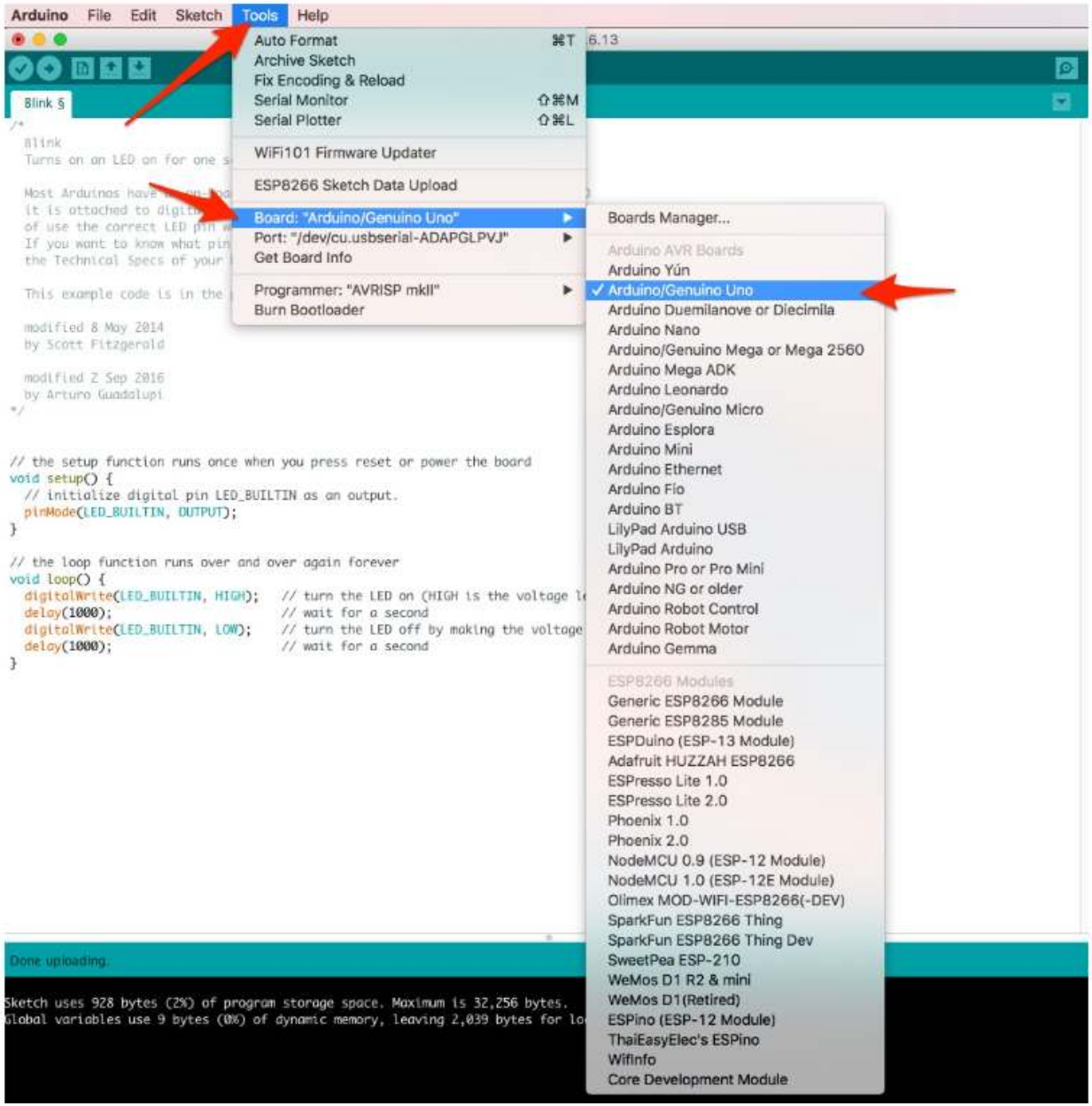
- After downloading and installing the software, you can open and run the IDE.
- You will see the following window on your computer.



Arduino IDE software

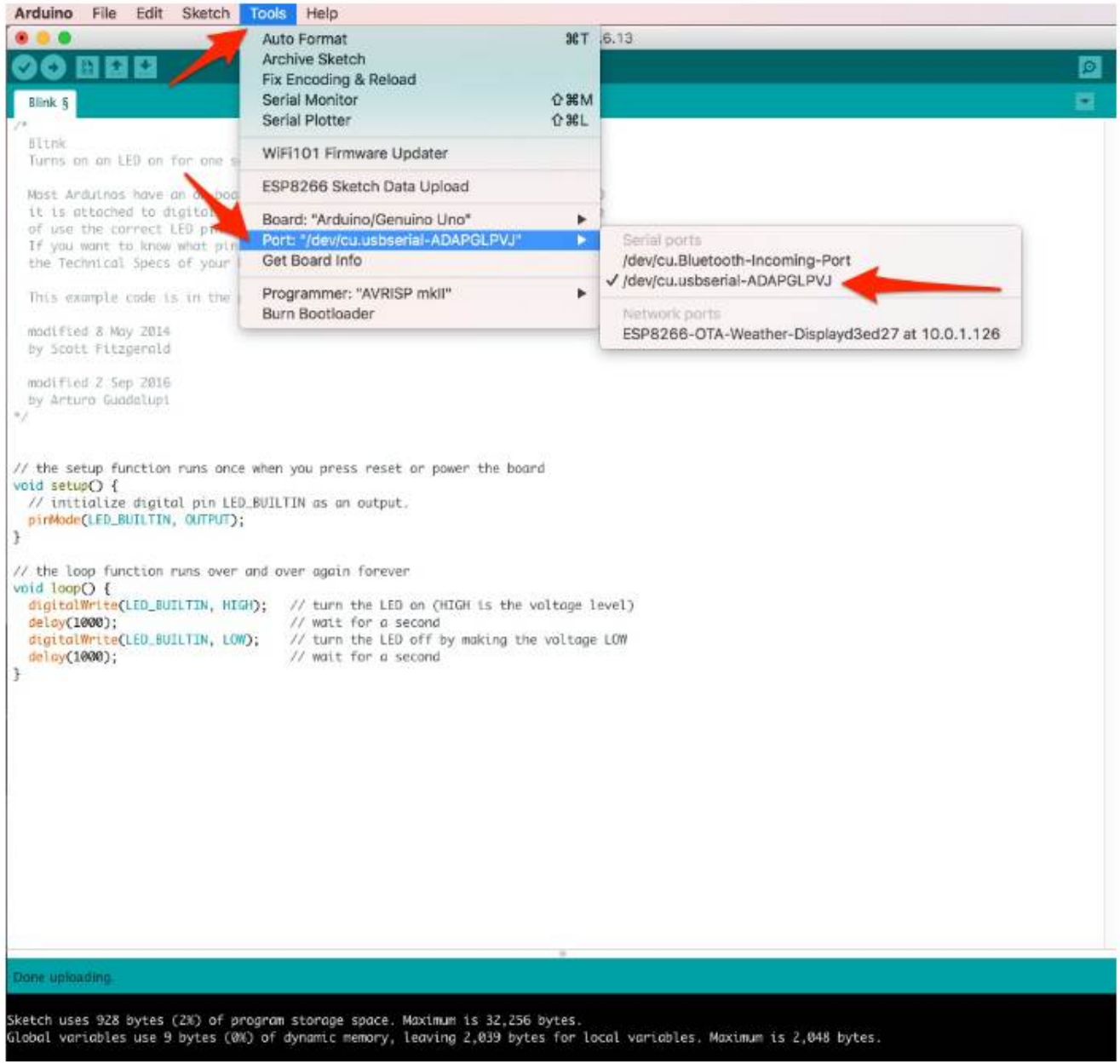
- Before we can upload the program, we need to get our Arduino board and Port configured in the IDE.

- First, Select **Tools** -> **Board** and click on the **Arduino/Genuino Uno**



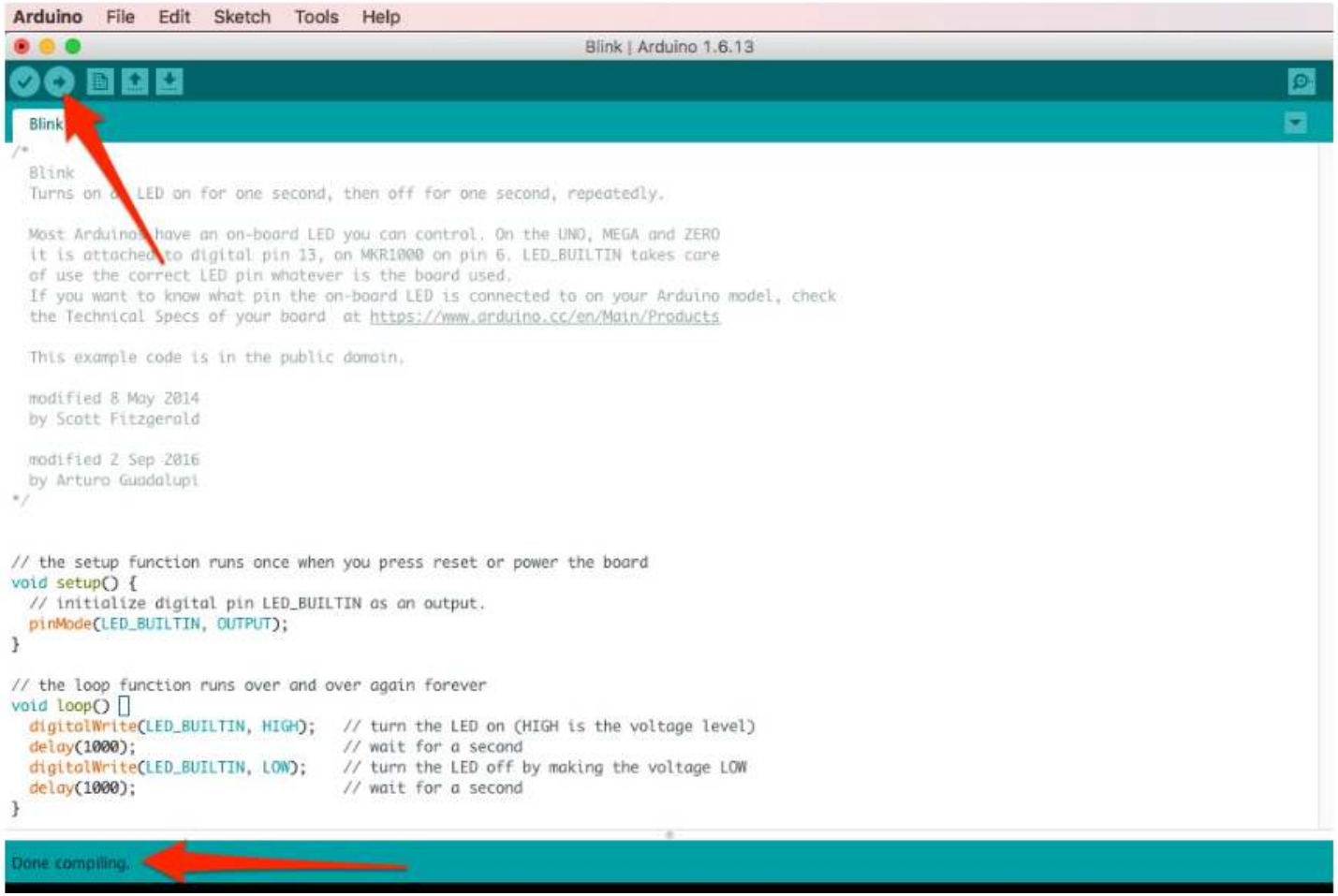
Arduino IDE software

Next, select the proper USB Port which will usual contain the words “usbserial” depending on your Operating System.



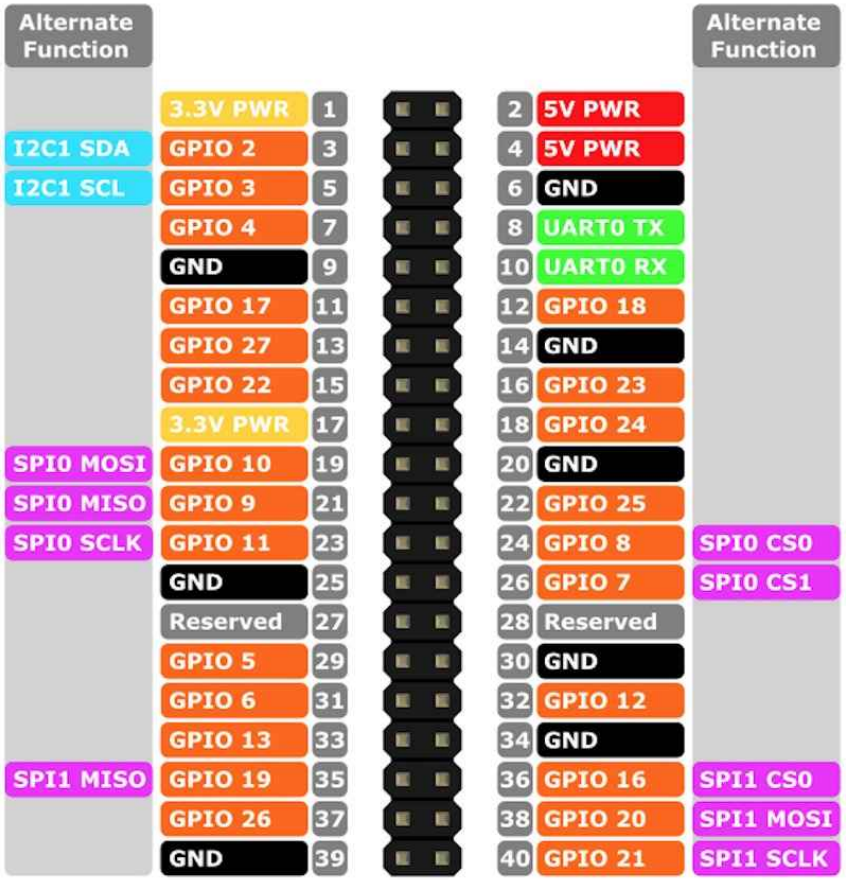
Arduino IDE software

Now you are ready to hit the upload button! This is commonly referred to as “Uploading the Sketch”



Raspberry Pi 3B+ Pin Layout

- **BCM Pin Numbering (Broadcom GPIO numbers)**
  This refers to the GPIO pins based on the Broadcom SoC (System on Chip) numbering scheme. Each pin is identified by its Broadcom GPIO number.
- **WiringPi Pin Numbering**
  This is a different numbering system used by the WiringPi library.
  WiringPi provides a simple interface for controlling the GPIO pins, and it uses its own numbering scheme, which may not match the BCM numbering or the physical pin numbering.
- **Physical Pin Numbering**
  This refers to the actual physical layout of the pins on the Raspberry Pi's GPIO header. It starts from pin 1 (top left corner) and counts across each row of pins. Pin numbers in this scheme are sequential, from 1 to 40.



https://pinout.xyz/pinout/3v3_power

Any Questions!