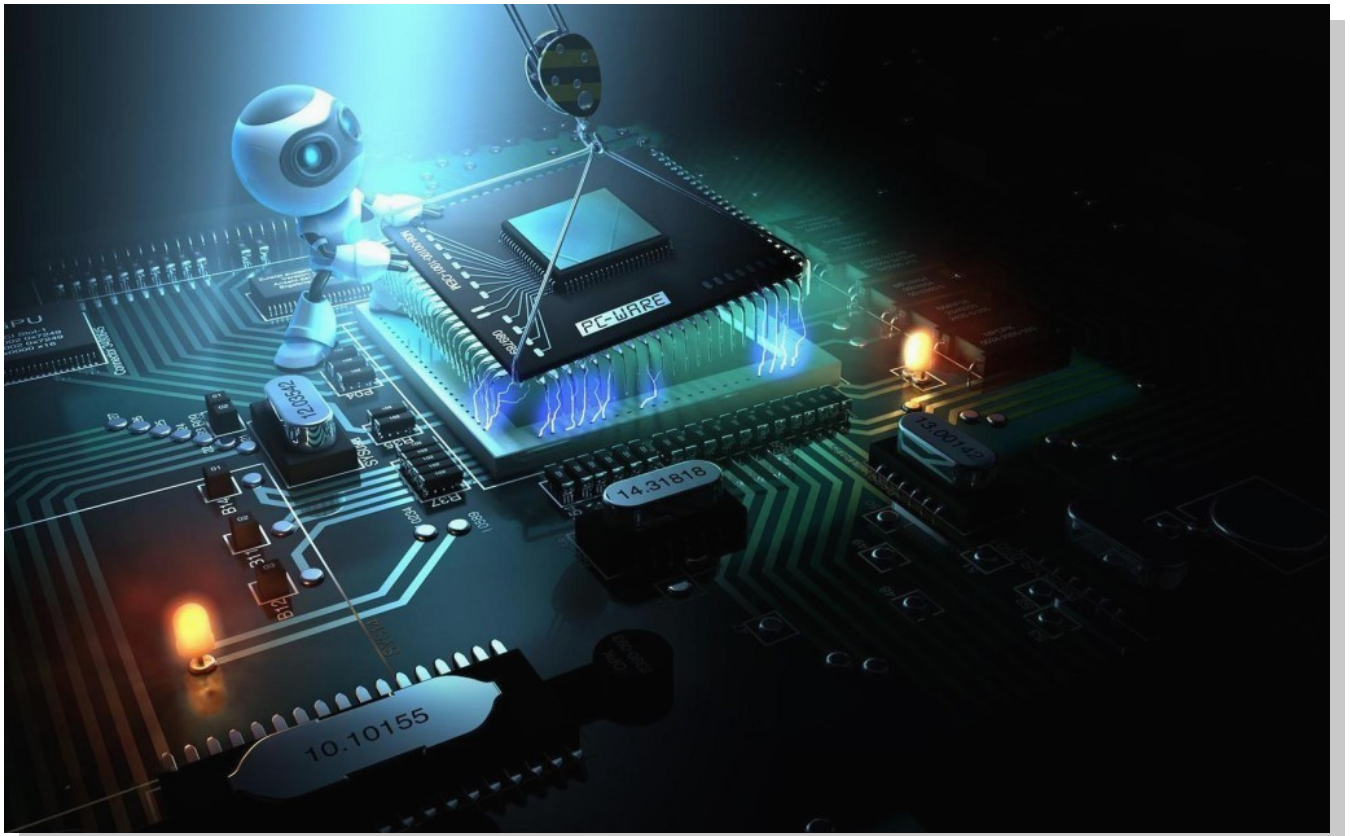
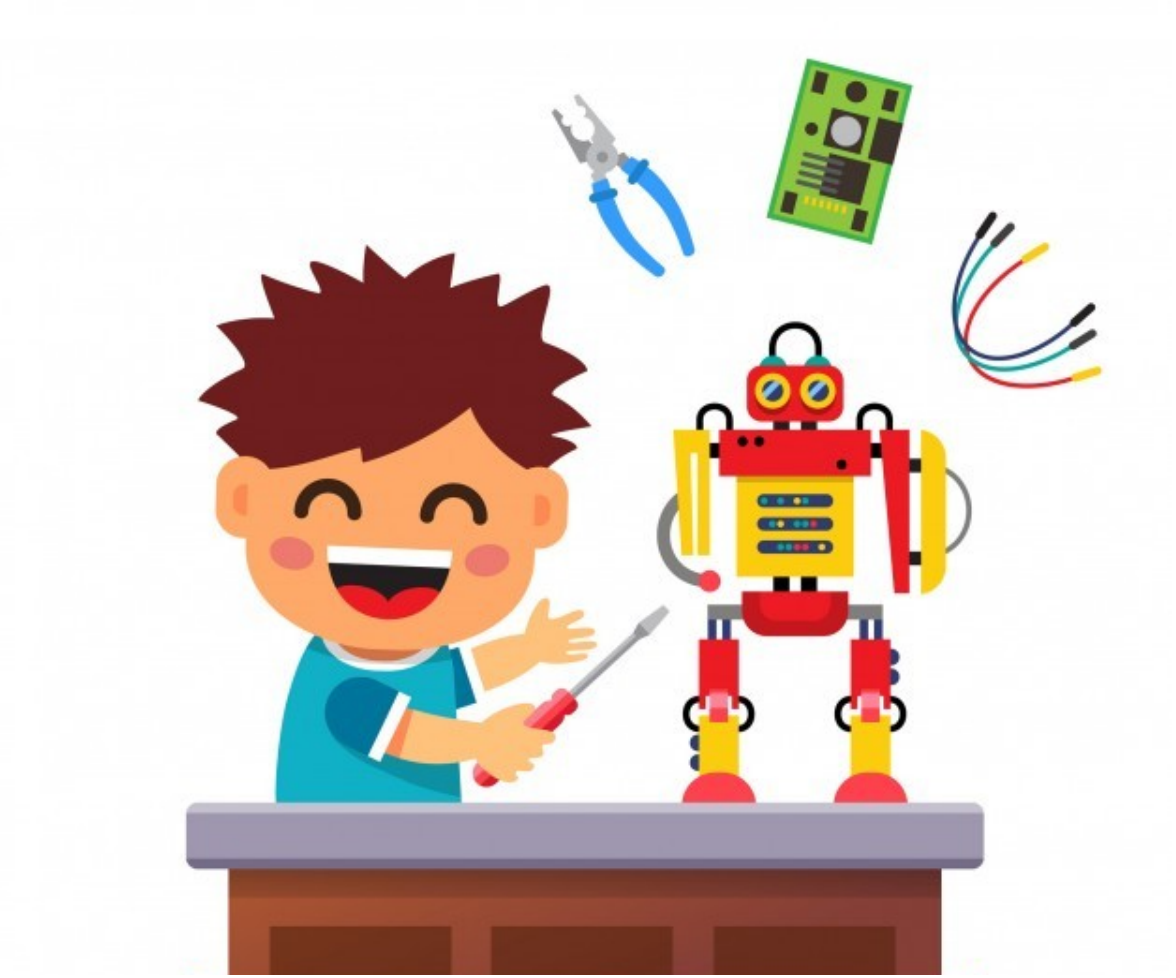


Arduino Workshop

Arduino and embedded system introduction

Some Cool stuff

DIY (Do it yourself)



What is an embedded system ?

- An embedded system is that system which has computer hardware with software embedded in it.

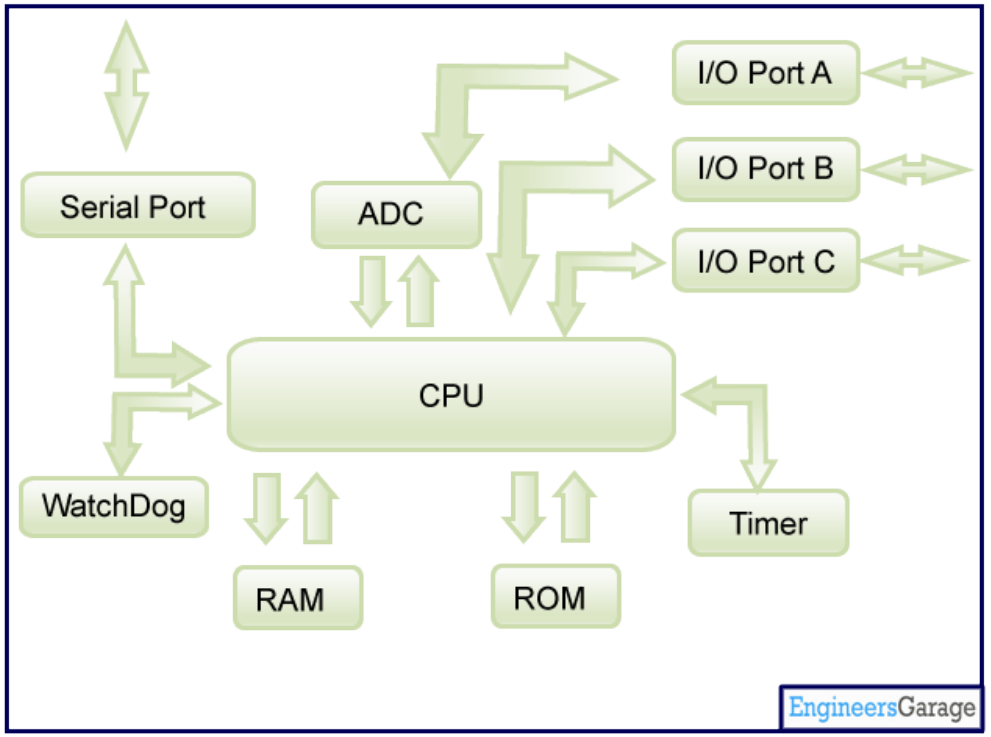
- An embedded system product is controlled by an internal microprocessor or microcontroller instead of some external control unit.

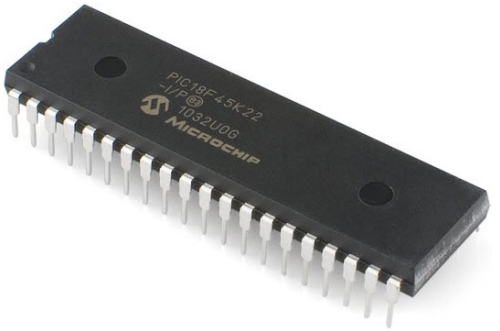
Embedded systems

- Some exemples in our daily life :

MicroController

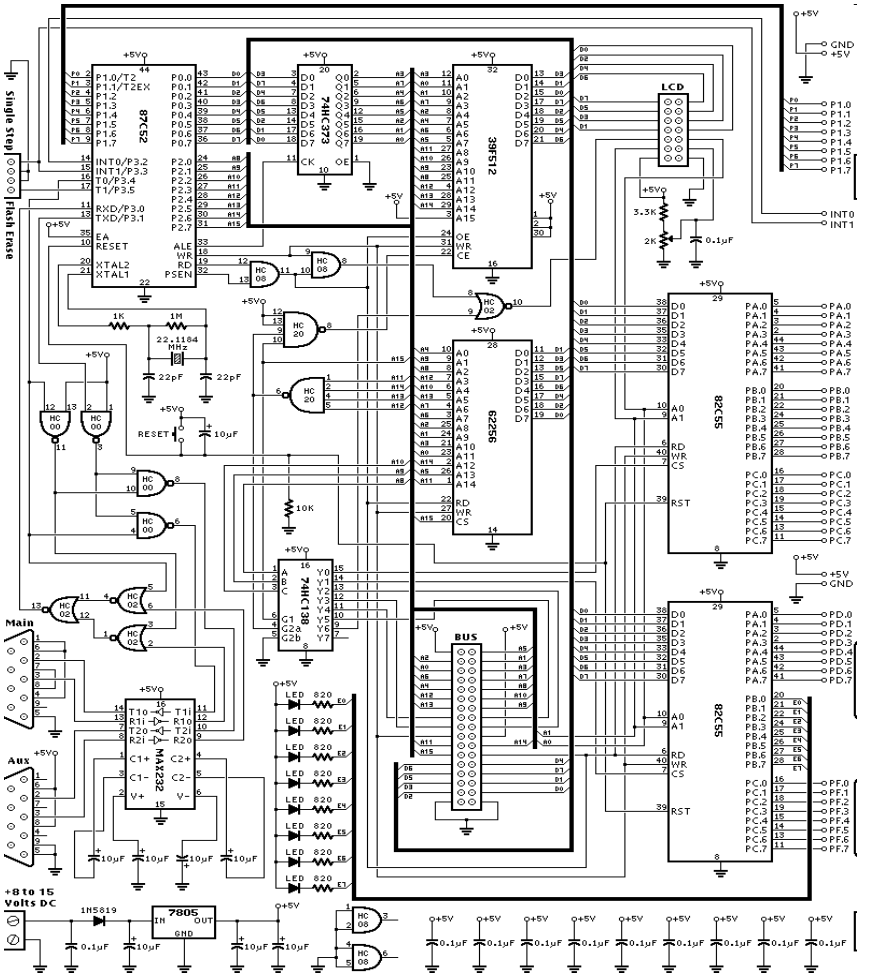
- A microcontroller (or MCU for microcontroller unit) is a small computer on a single integrated circuit.





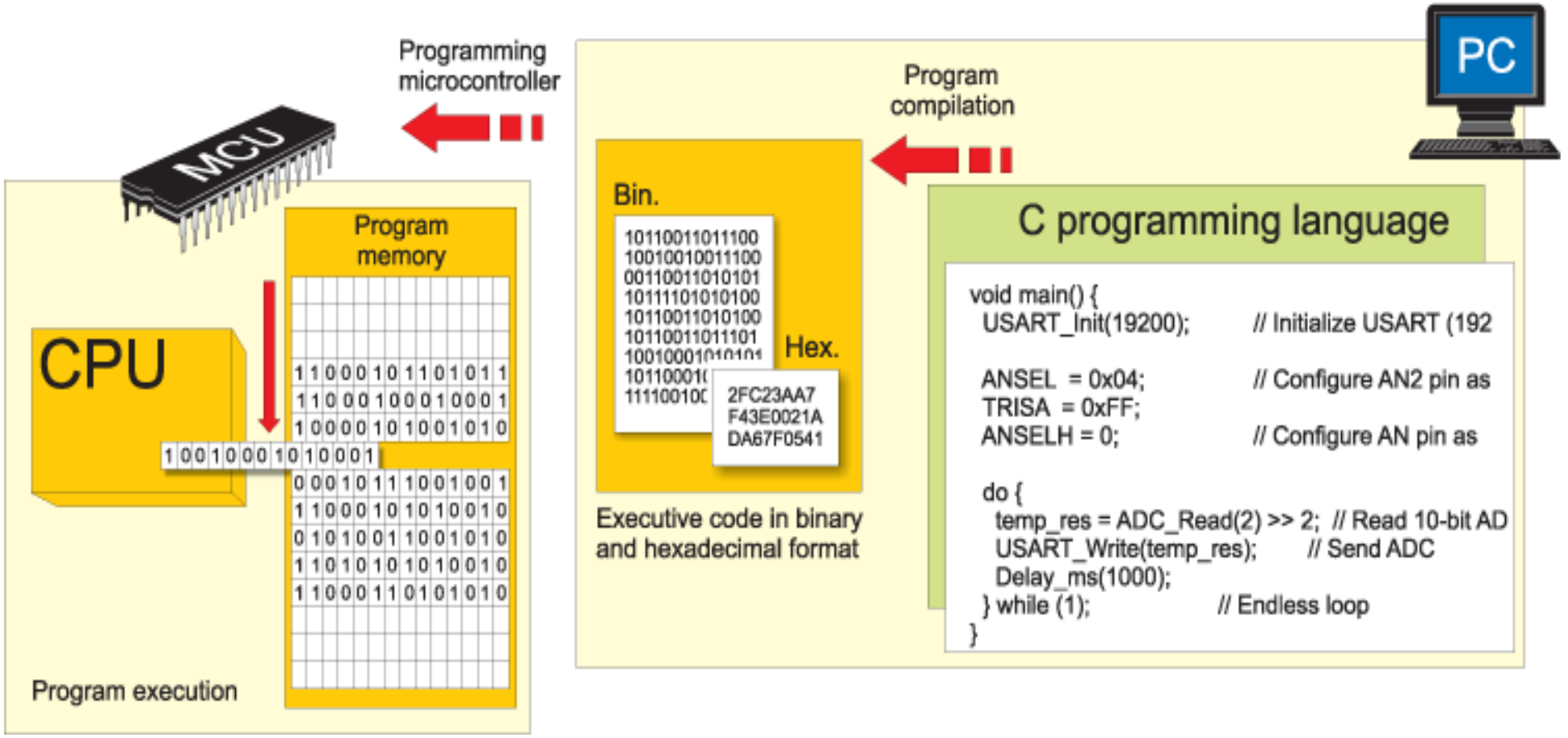
MicroController

- What makes embedded development difficult?
  - Build tools
  - Software internals
  - Non standard hardware



MicroController

- To program it .

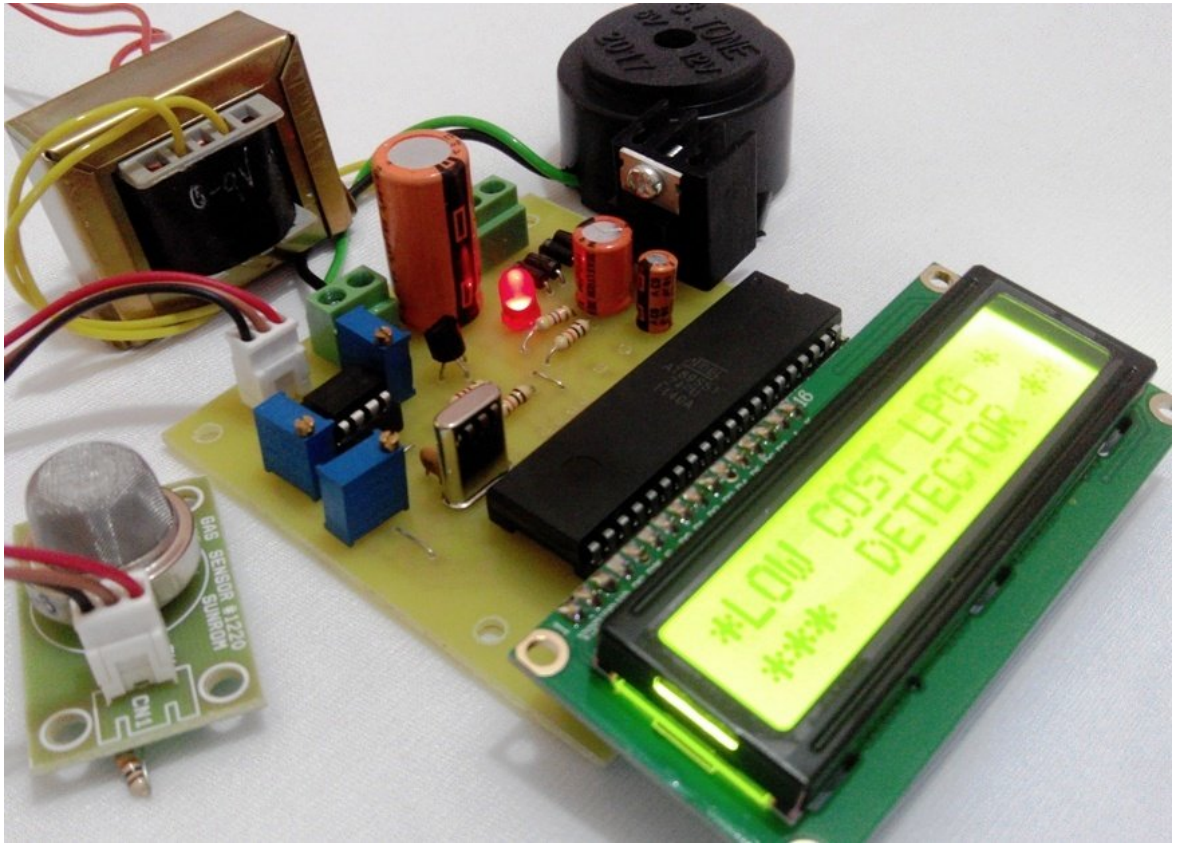


MicroController

- You will need this

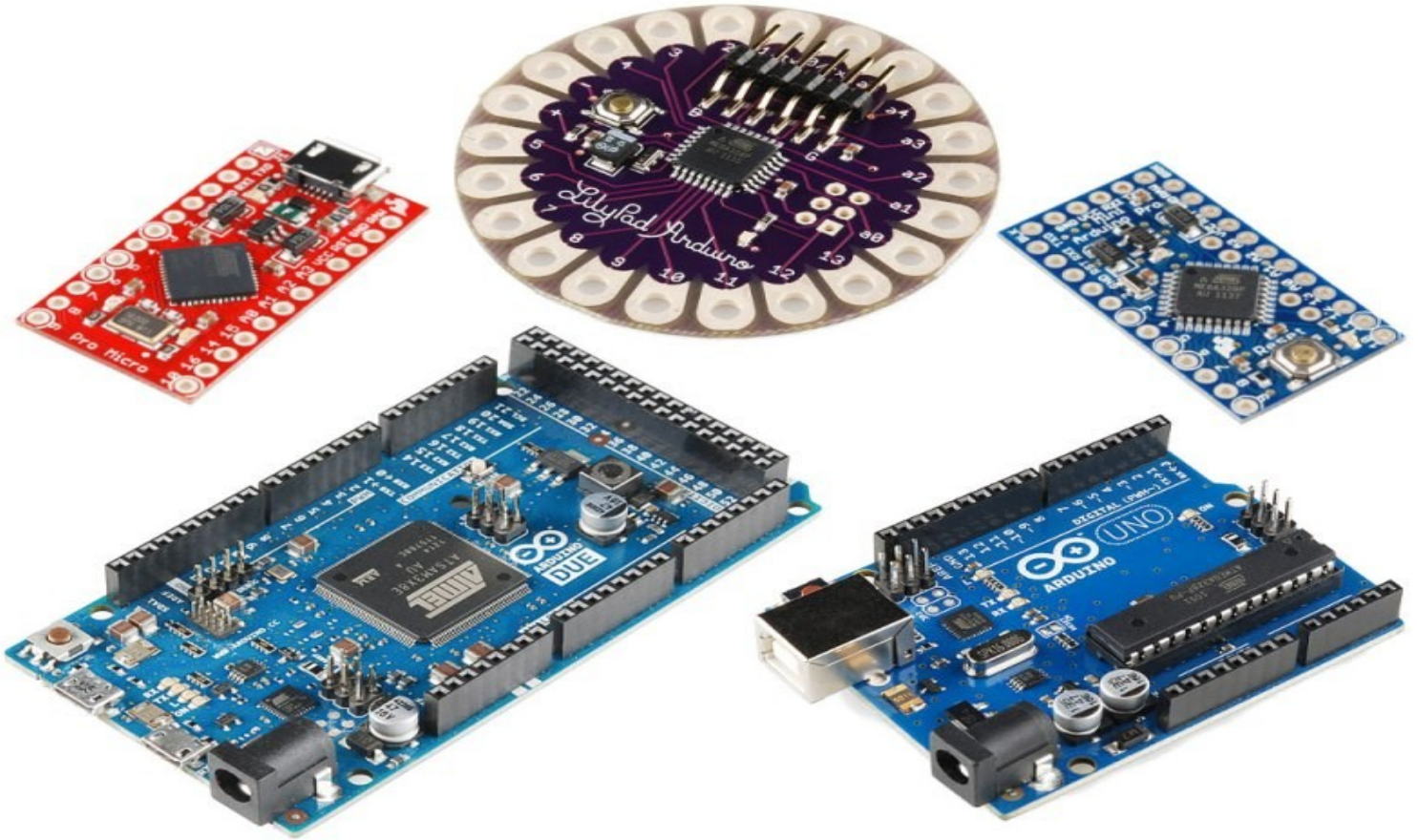
MicroController

- You will need a PCB and you will need to soldering you parts too



What is arduino ?

- Arduino is just a microcontroller on a circuit board which makes it easy to receive inputs and drive outputs .
-

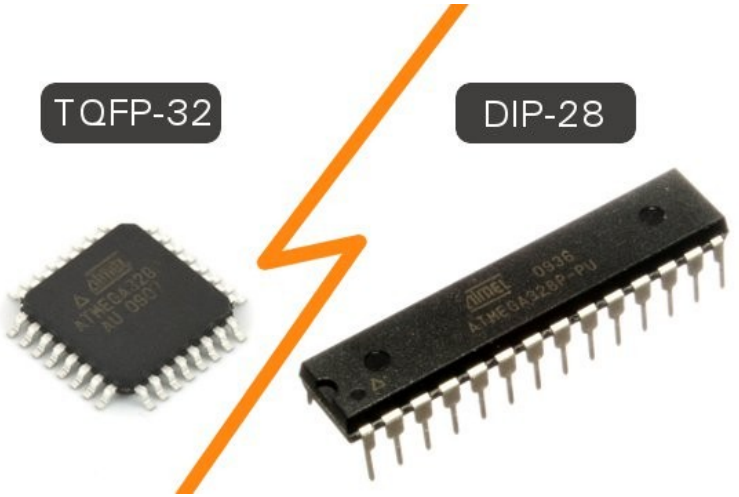


So why arduino ?

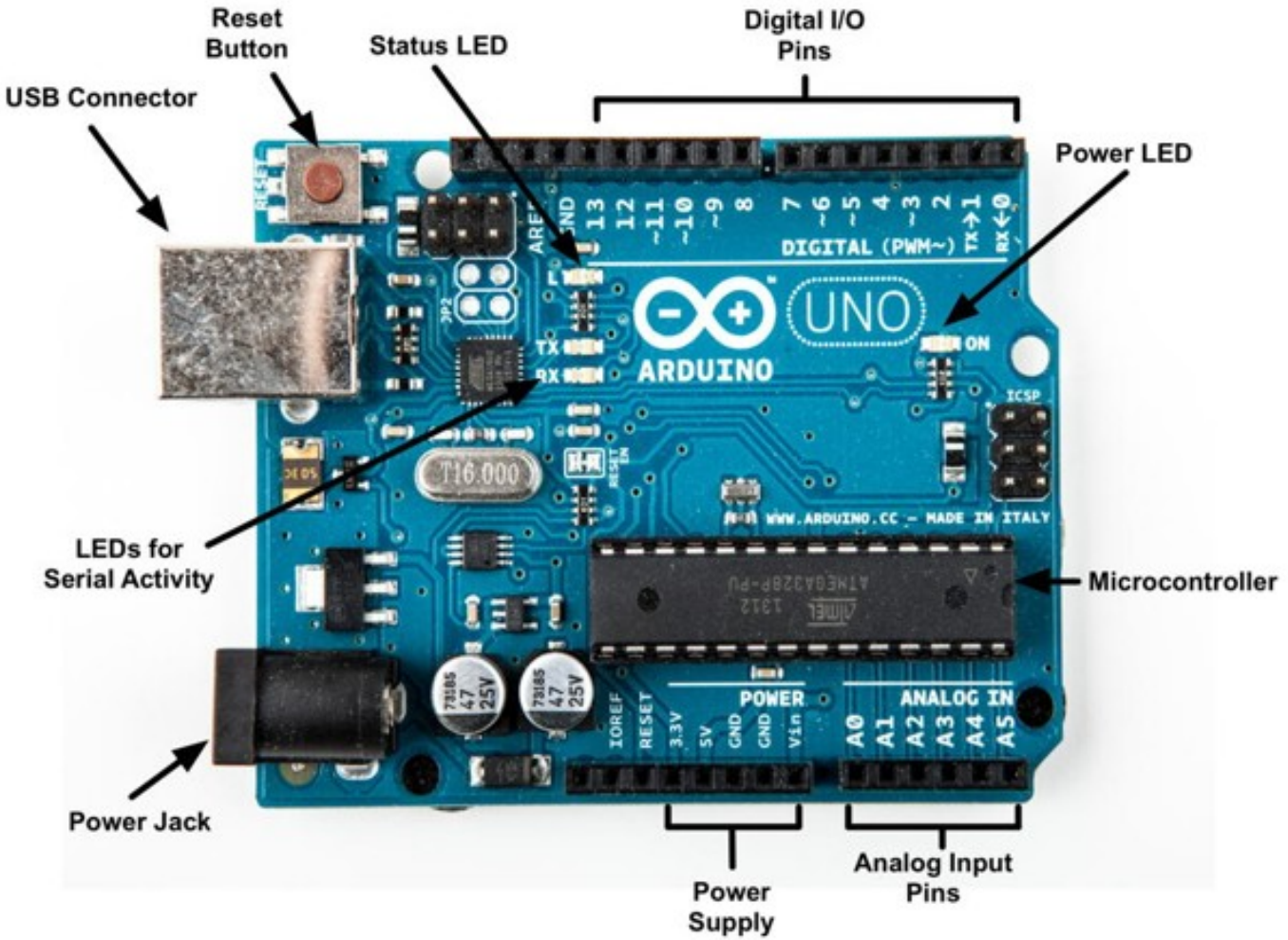
- It is flexible
- It is easy to use
- It is inexpensive
- It is an open-source project
- Arduino is backed up by a growing online community .

Arduino Hardware

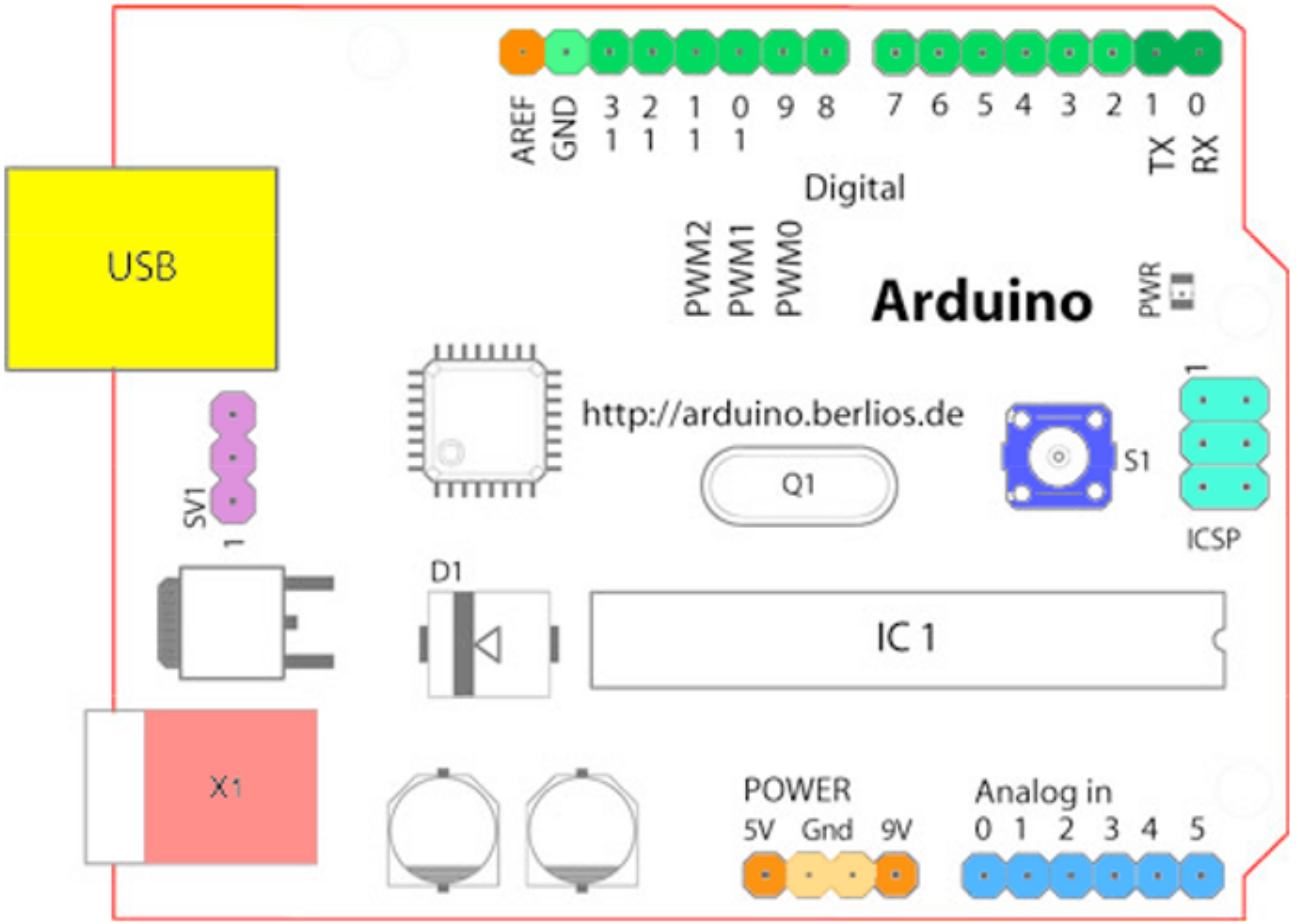
- “The Arduino board includes a microcontroller”
- For exemple Arduino Uno R3 contain Atmega328 :
  - Flash memory: 32KB nonvolatile memory.
  - SRAM memory: 2KB volatile memory.
  - EEPROM memory: 1KB nonvolatile memory.



Arduino Hardware

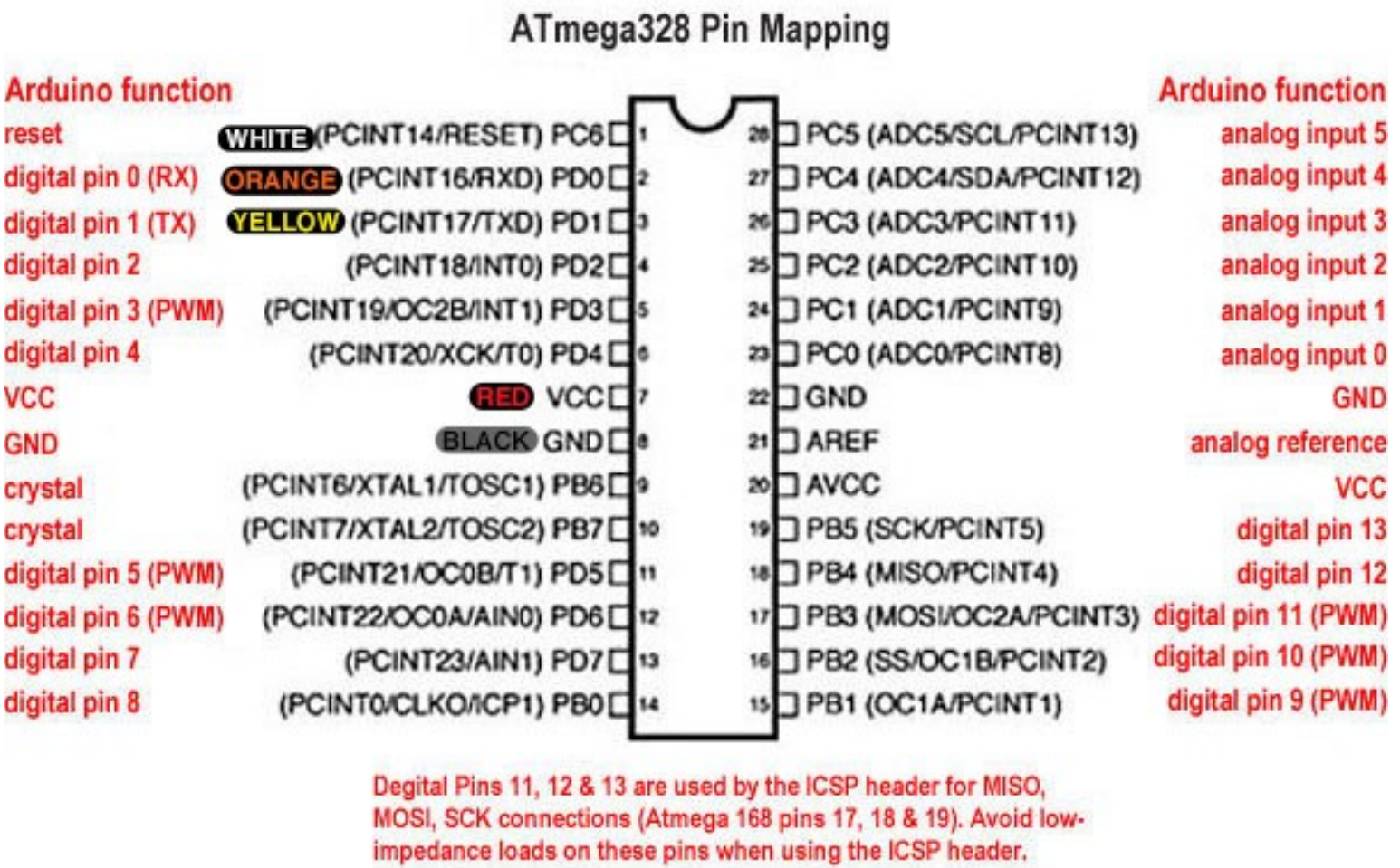


Arduino hardware



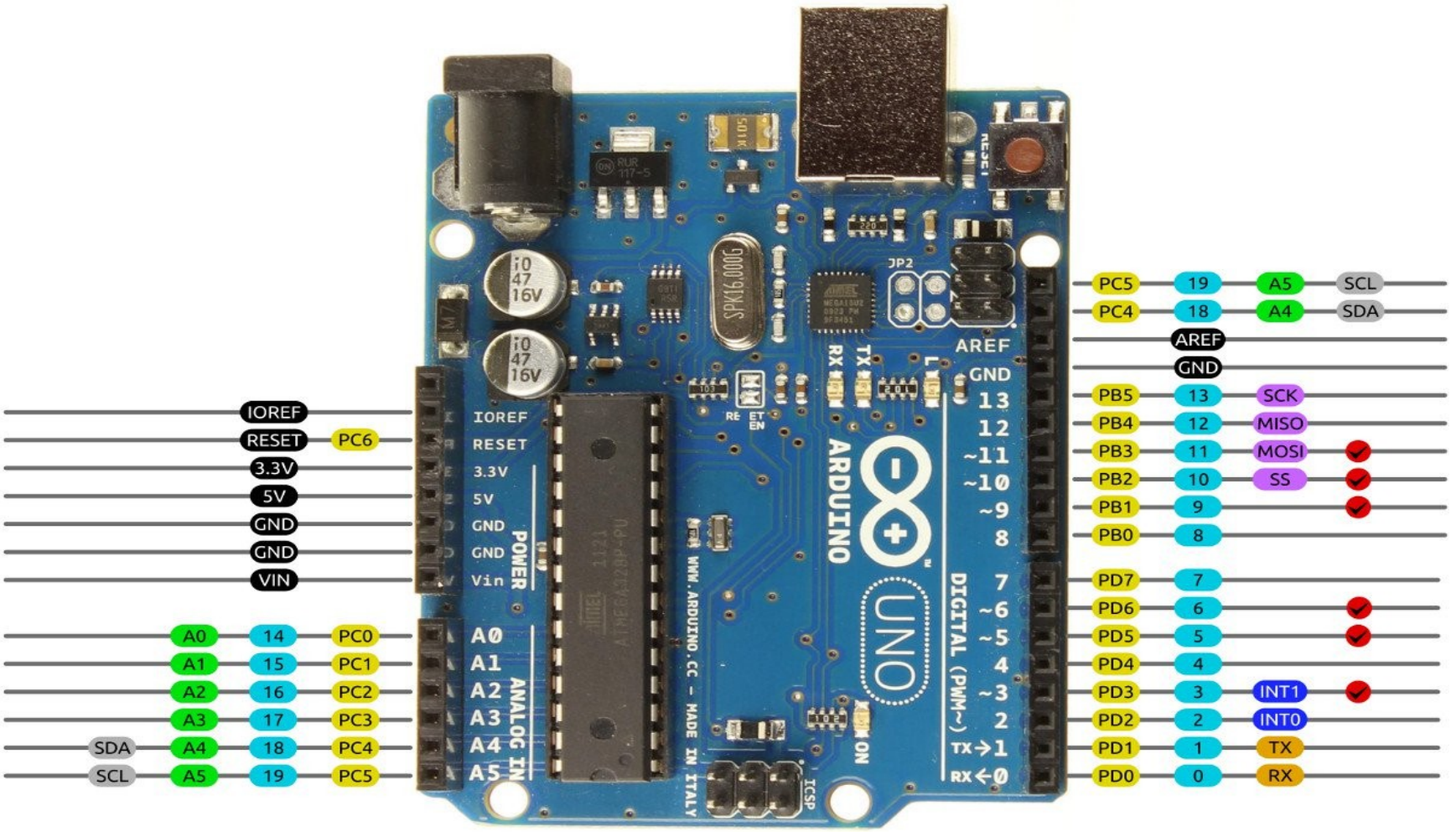
- Analog Reference pin (orange)
- Digital Ground (light green)
- Digital Pins 2-13 (green)
- Digital Pins 0-1/Serial In/Out TX/RX (dark green)
- Reset Button - S1 (dark blue)
- In-circuit Serial Programmer (blue-green)
- Analog In Pins 0-5 (light blue]
- Power and Ground Pins (power: orange, grounds: light orange)
- External Power Supply In (9-12VDC) - X1 (pink)
- Toggles External Power and USB Power - SV1 (purple)
- USB (yellow)

Arduino Hardware /Digital I/O:



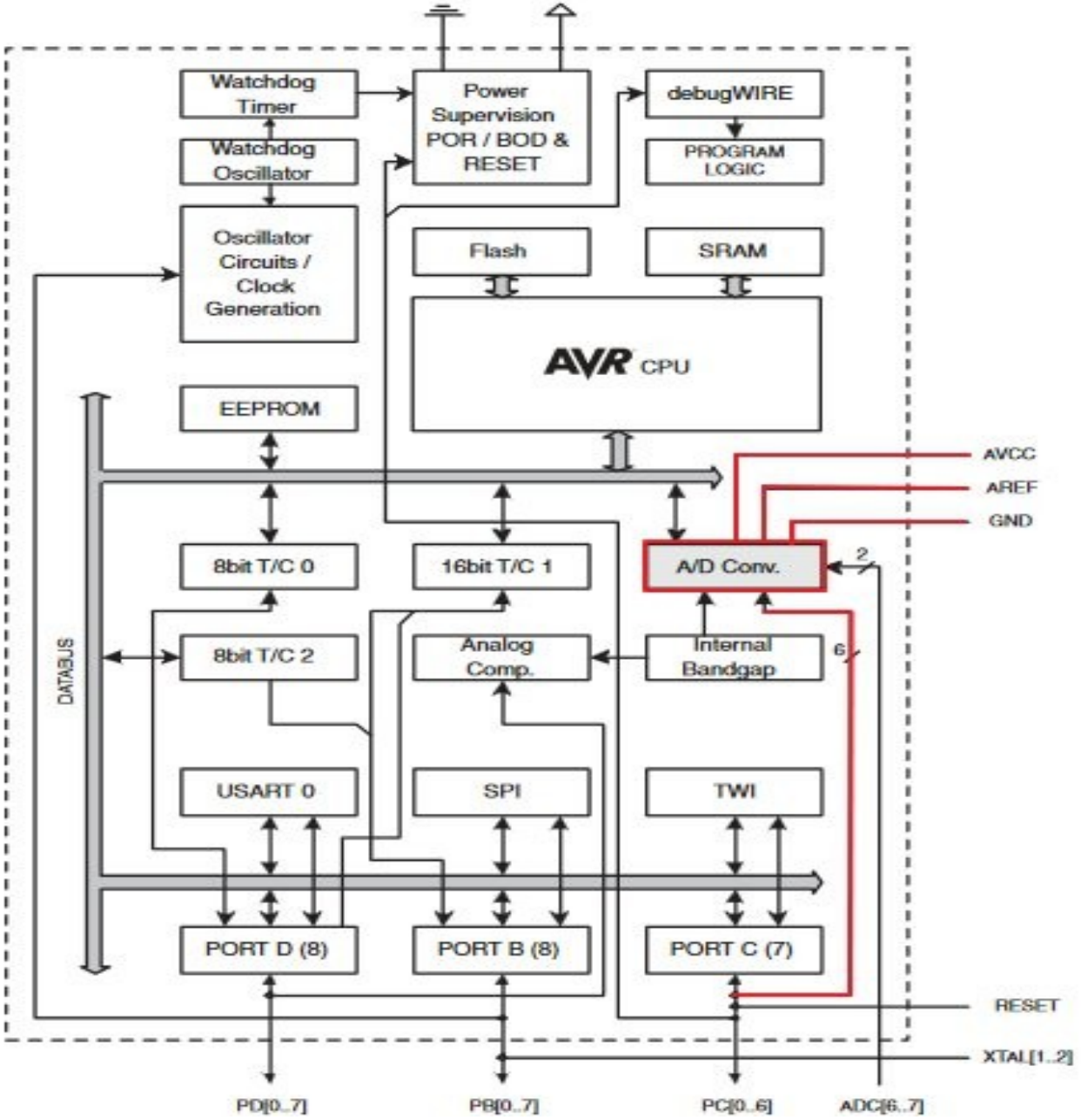
Degital Pins 11, 12 & 13 are used by the ICSP header for MISO, MOSI, SCK connections (Atmega 168 pins 17, 18 & 19). Avoid low-impedance loads on these pins when using the ICSP header.

Arduino Uno R3 Pinout



AVR DIGITAL ANALOG POWER SERIAL SPI I2C PWM INTERRUPT

Arduino Hardware : ADC Inputs



AVCC: The power pin for the A/D unit.

AREF: The input pin used optionally if you want to use an external voltage reference for ADC rather than the internal Vref.

Arduino Hardware

- UART : (Universal Asynchronous Receiver/Transmitter) is a serial interface .
- SPI : (Serial Peripheral Interface) is another serial interface.
- TWI : I2C or Two Wire Interface .
- ICSP (In-Circuit Serial Programming) Header .
- USB-to-UART Bridge .

Software

- Arduino IDE (Download and install): https://www.arduino.cc/en/Main/Software

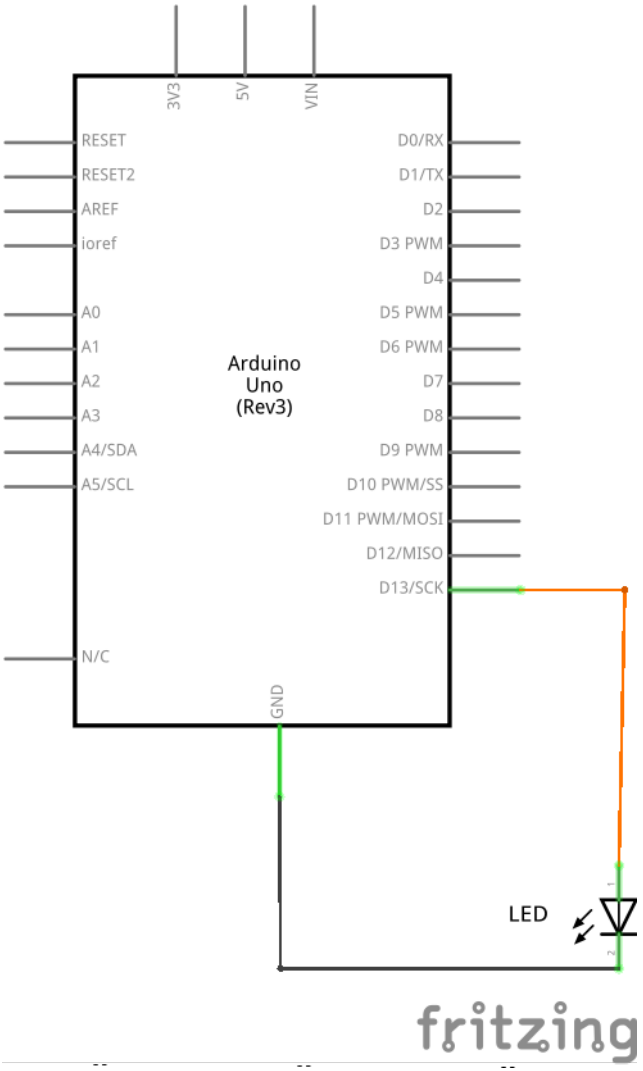
Arduino Programming

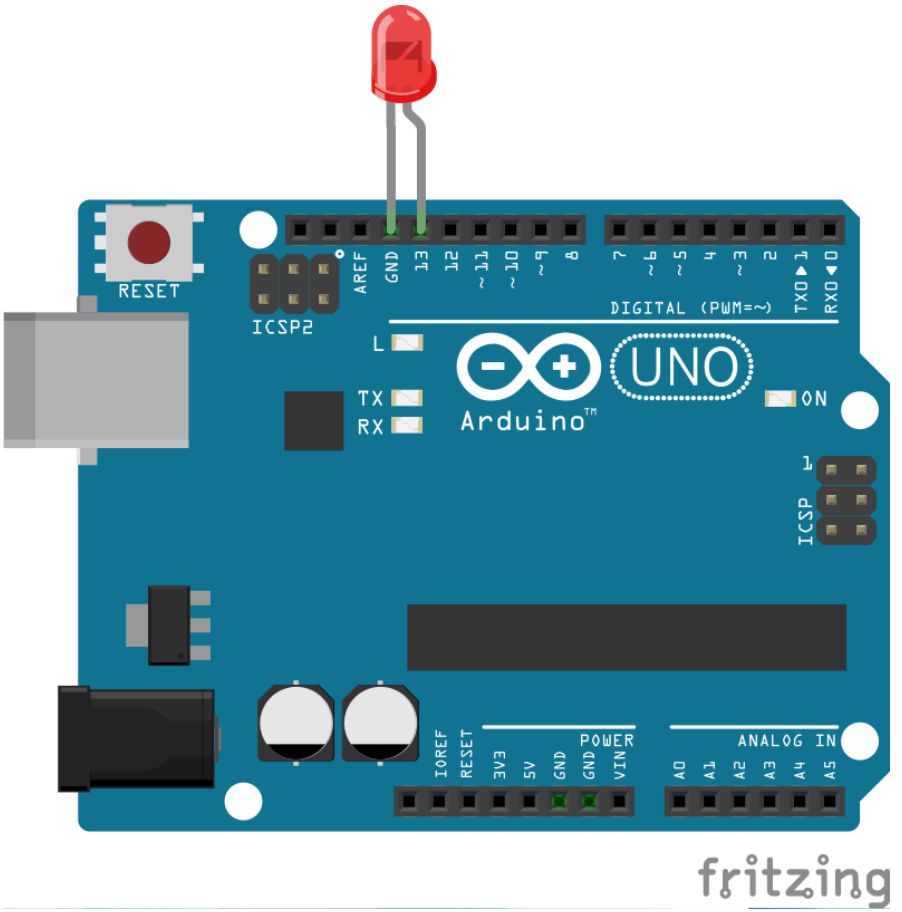
- Using arduino IDE C/C++
- Every sketch has these functions:
  - void **setup**()
    - Runs once at the very beginning
    - Set up your variables, peripherals
  - void **loop**()
    - Runs forever
    - Code that does actual work goes here

Arduino Programming

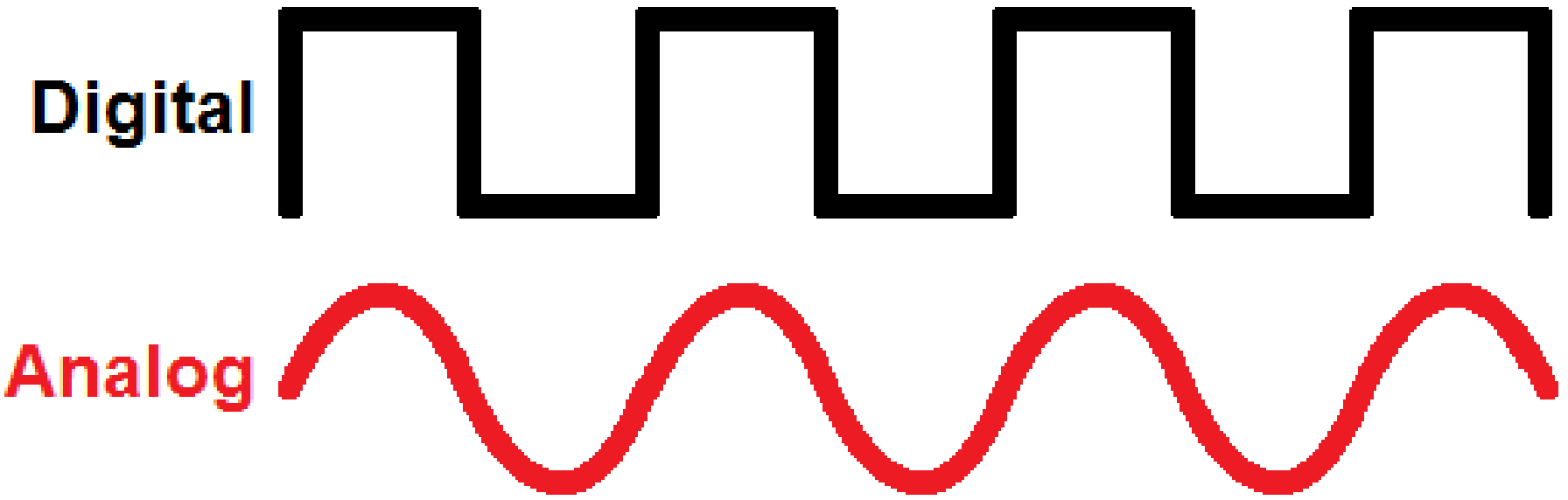
- Functions :
  - **pinMode**(pin, INPUT/OUTPUT)
  - **digitalWrite**(pin, HIGH/LOW)
  - **delay**(time in msec)

Lab 1 : Blinking LED



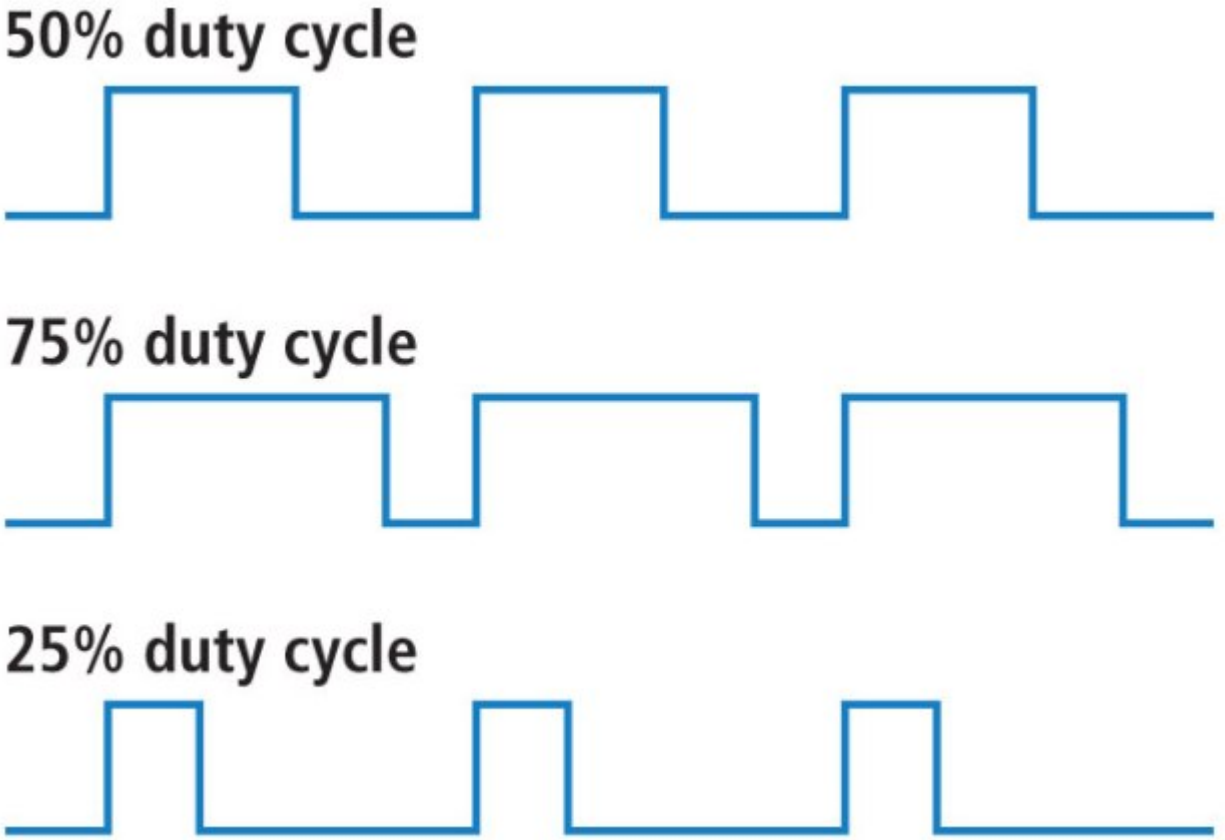


Analog vs Digital



PWM (Pulse Width Modulation)

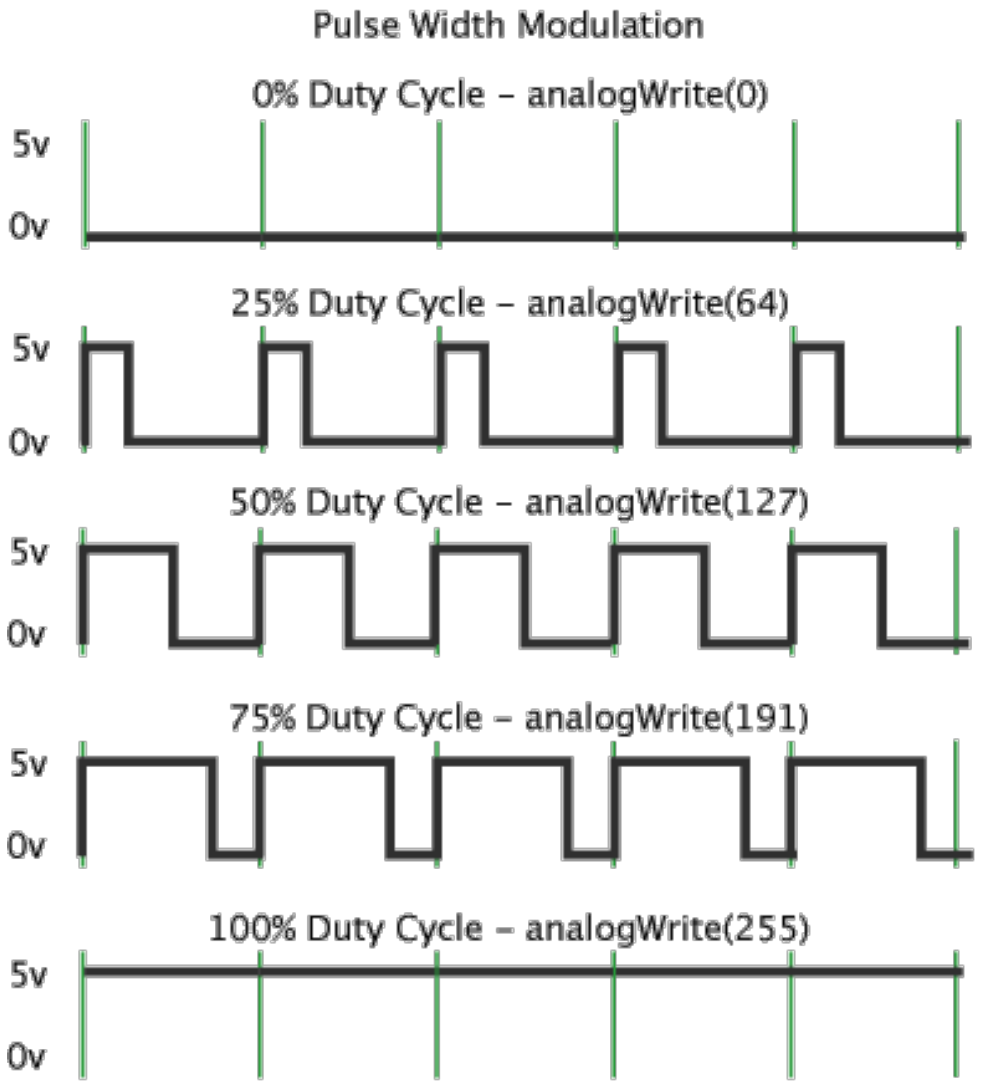
- Method to generate analog voltages from digital voltages .



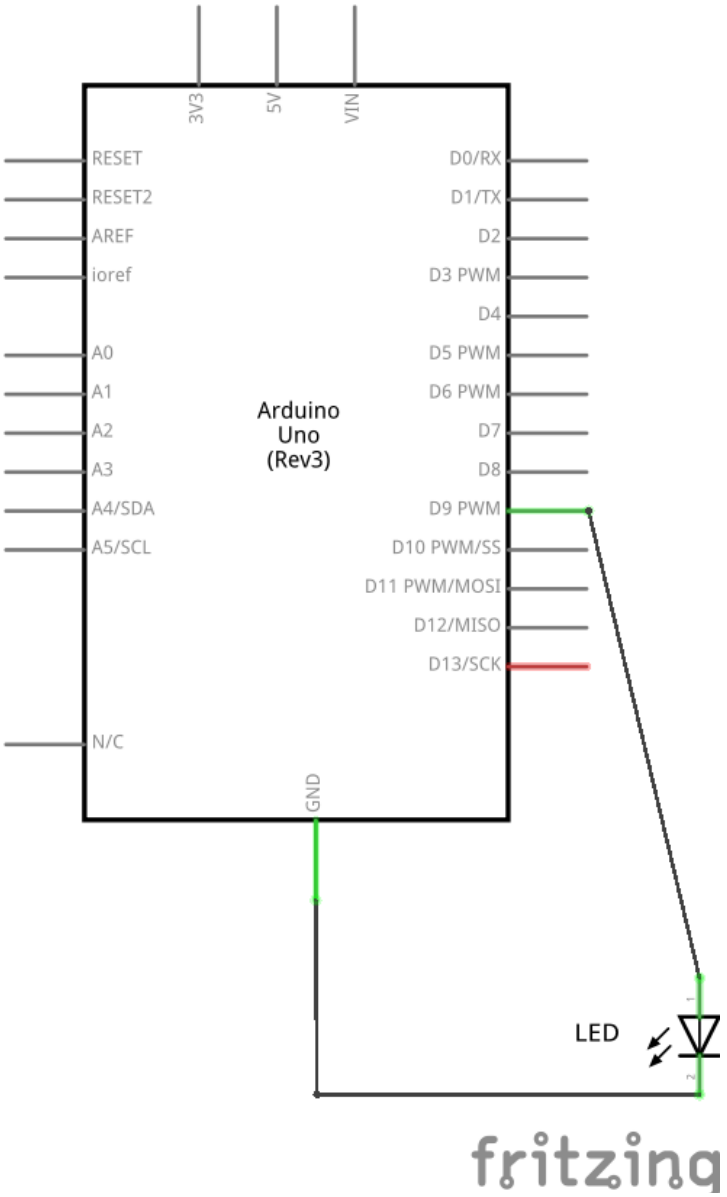
Arduino Programming

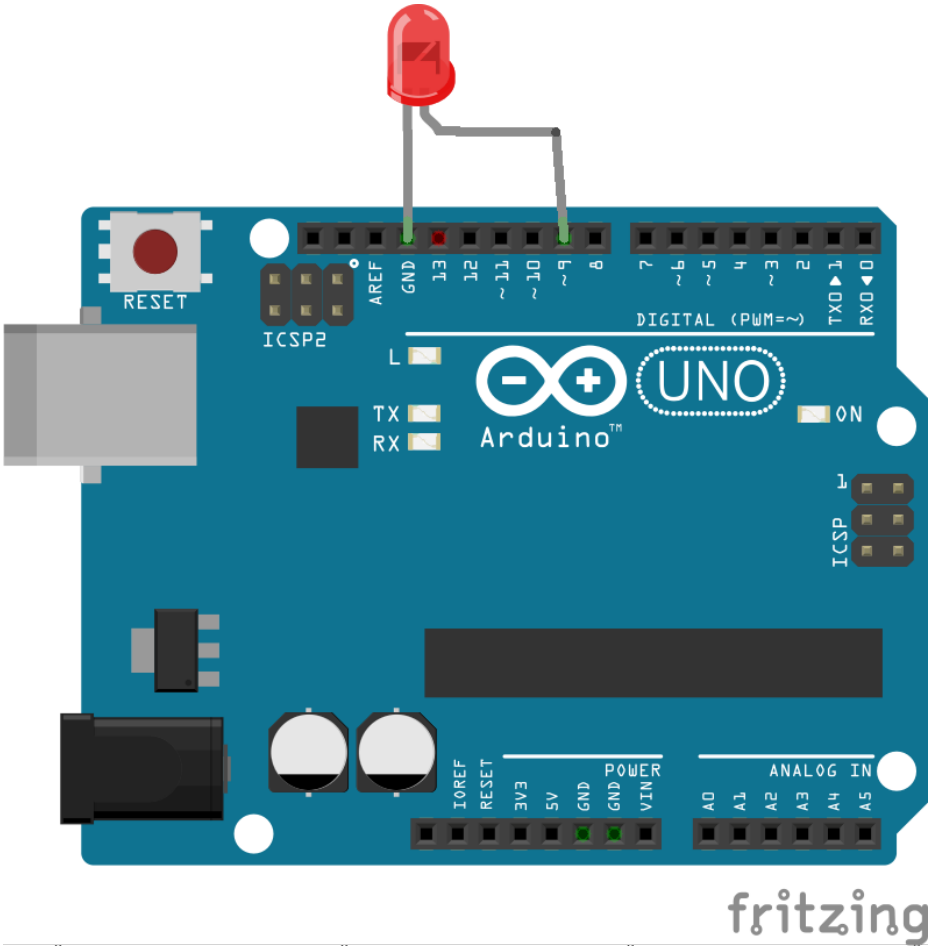
- Functions :
- **analogWrite**(pin, val)

  val = 0 to 255
- Av= (ontime/T) * 5v



Lab 2 : Fade an LED in and out

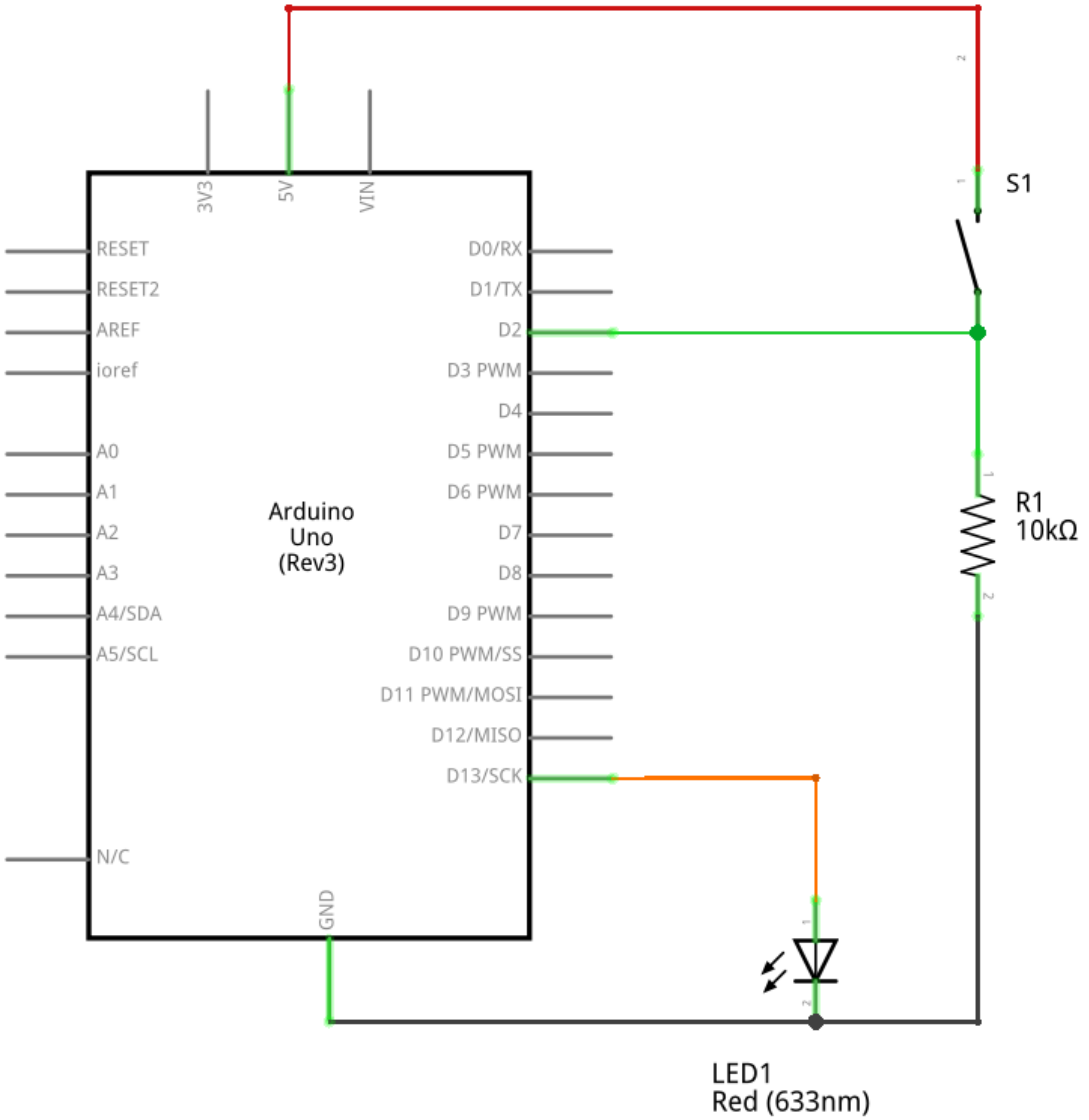


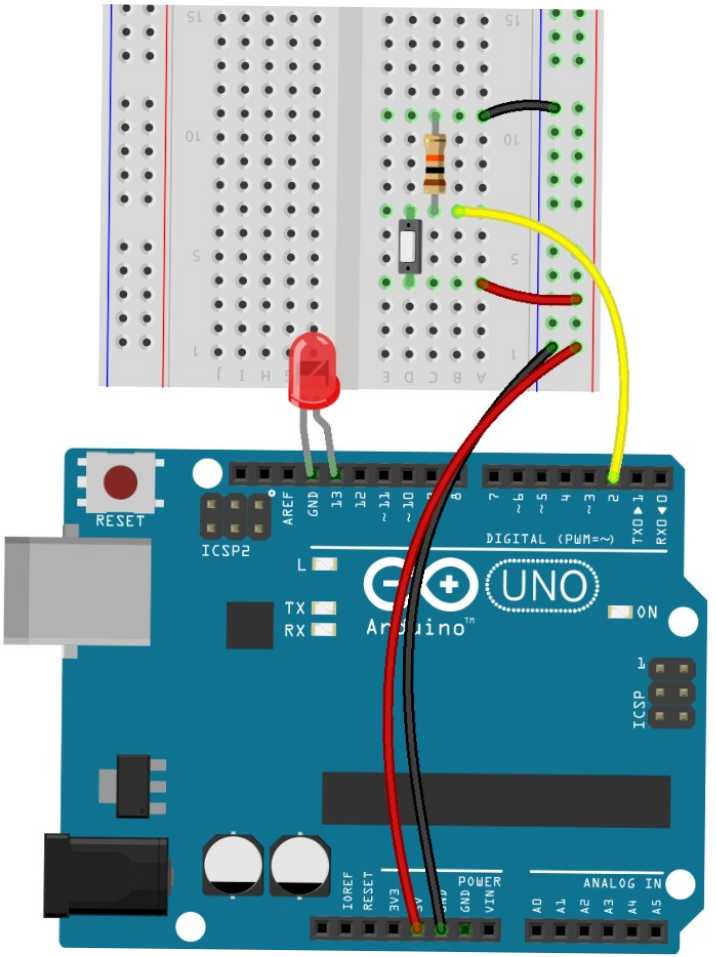


Arduino Programming

- Functions :
  - **digitalRead**(pin) : return a val 0 or 1
  - **analogRead**(pin) : return a val between 0 and 1023
    - ADC : v = (val /1023) * Vref(default : 5v)

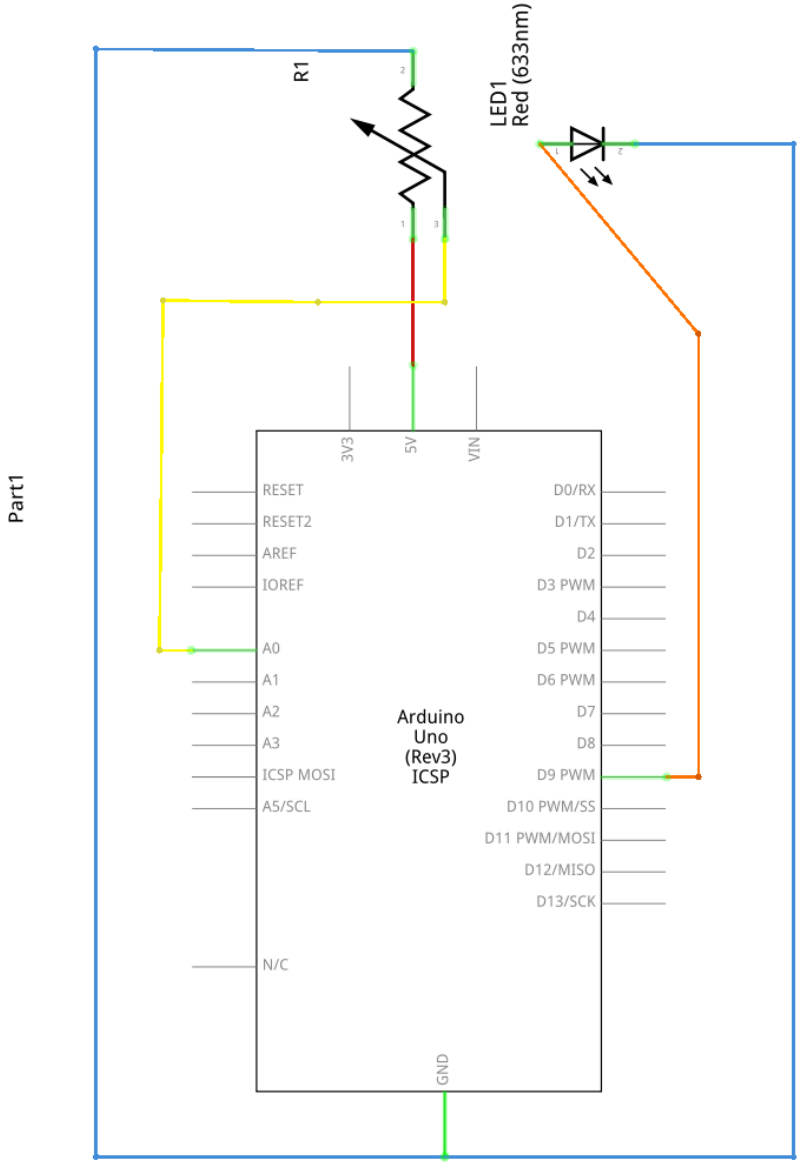
Lab 3 : Turn a LED ON/OFF using button

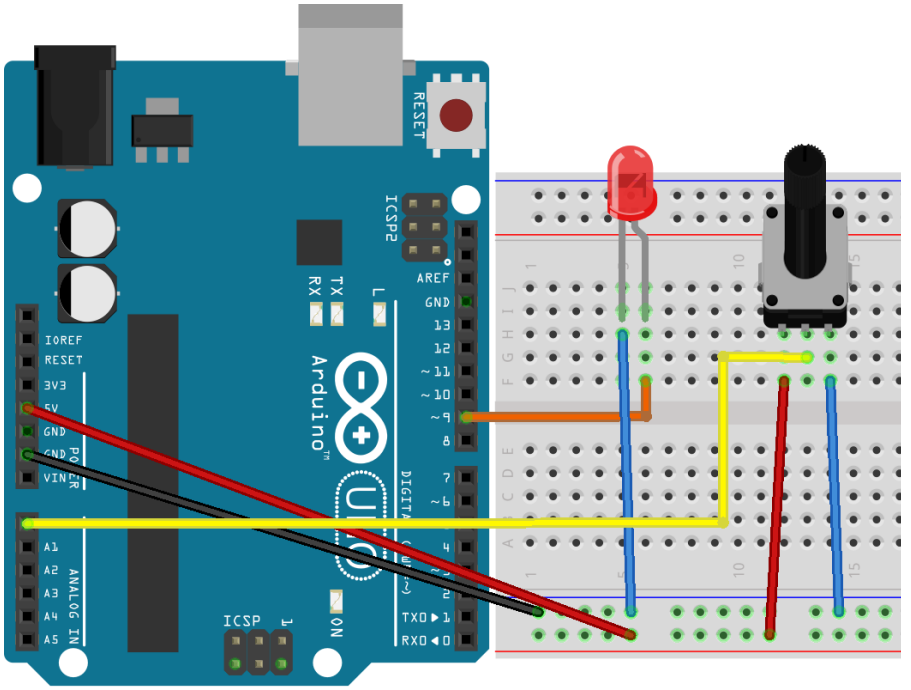




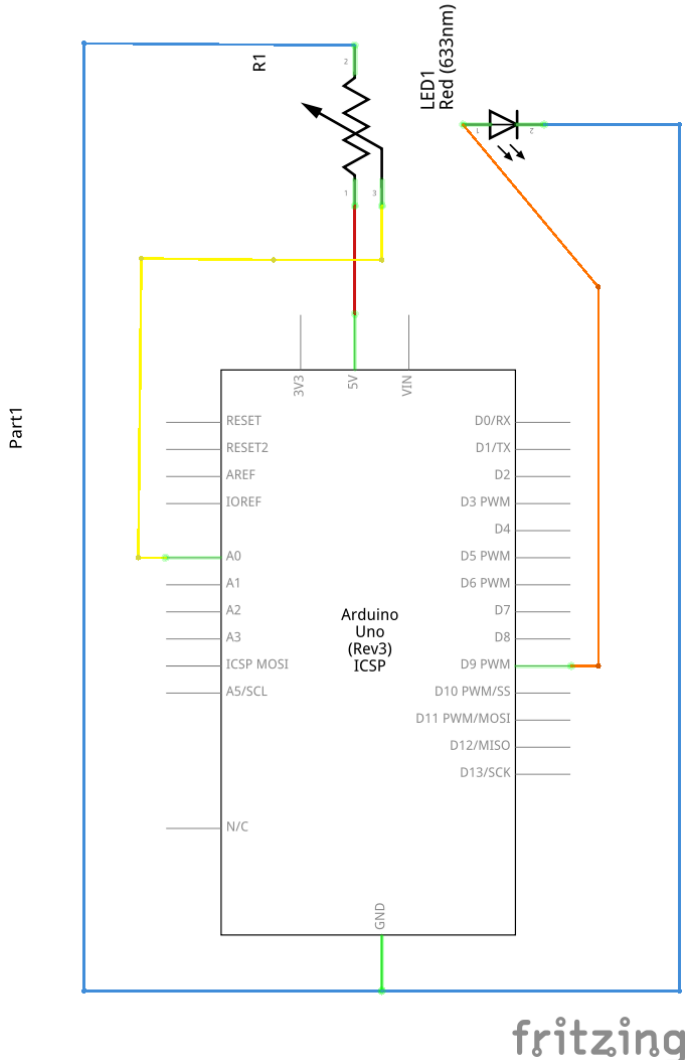
fritzing

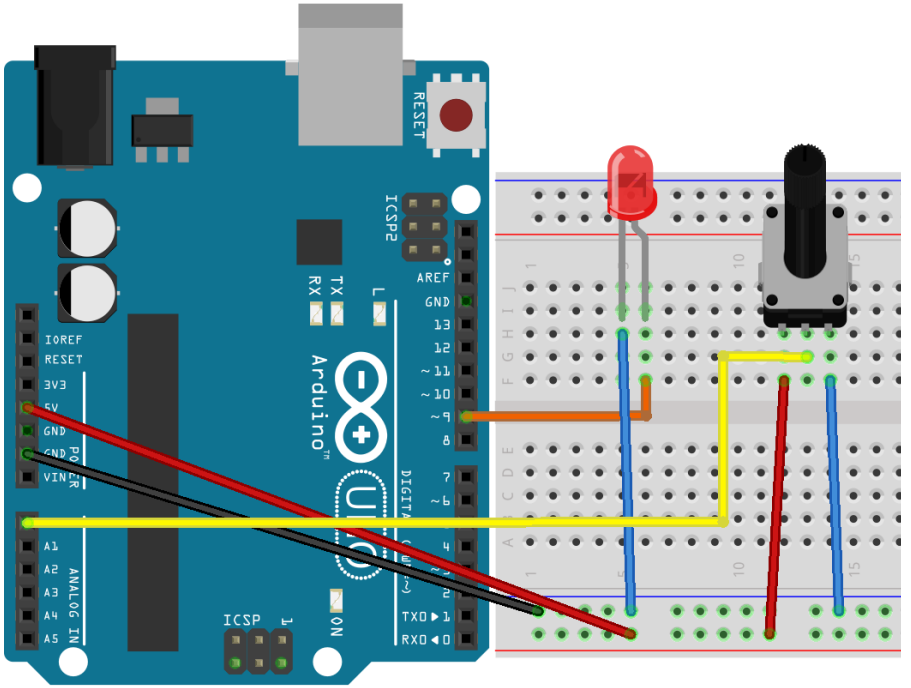
Lab 4 : Blink LED at a rate specified by the value of the analogue input





Lab 5 : Set the brightness of LED to a brightness specified by the value of the analogue input

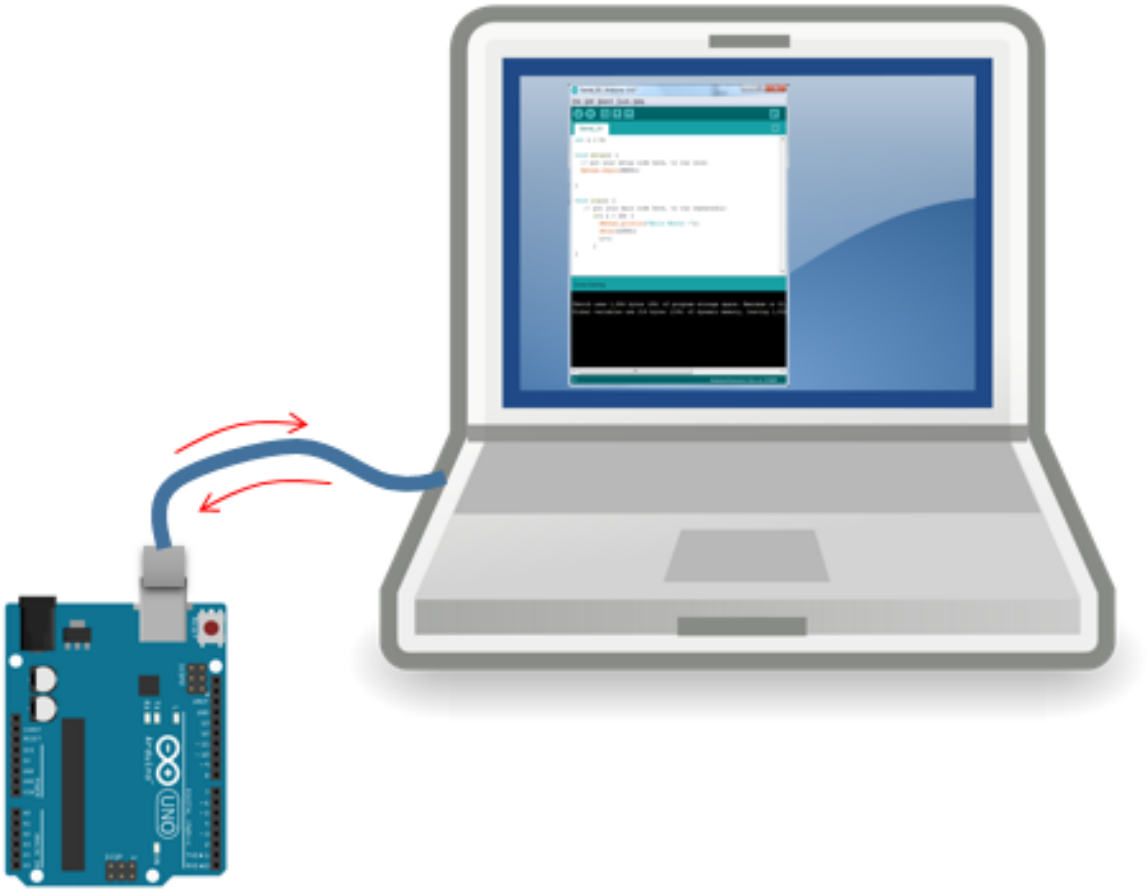


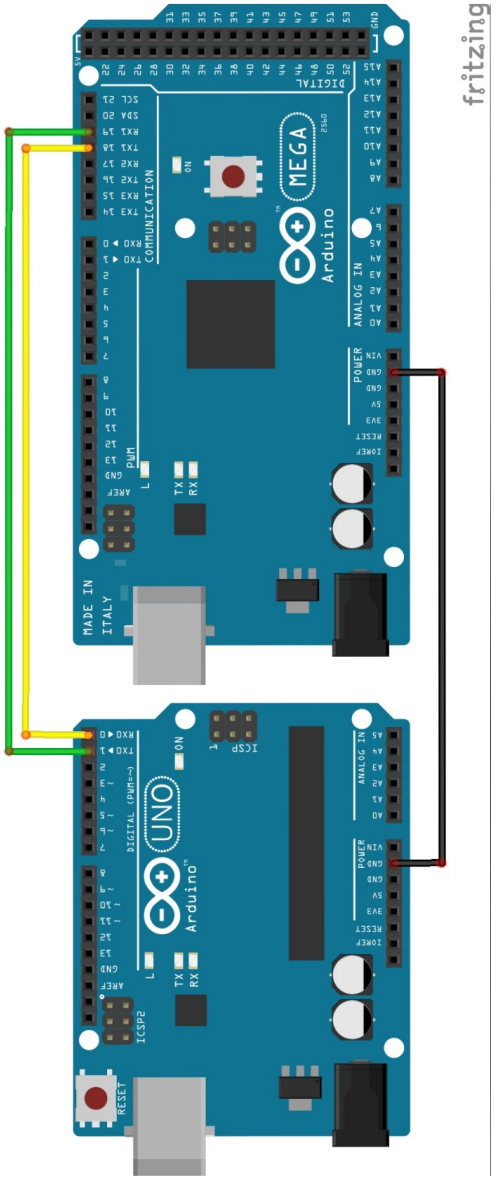


Arduino Programming

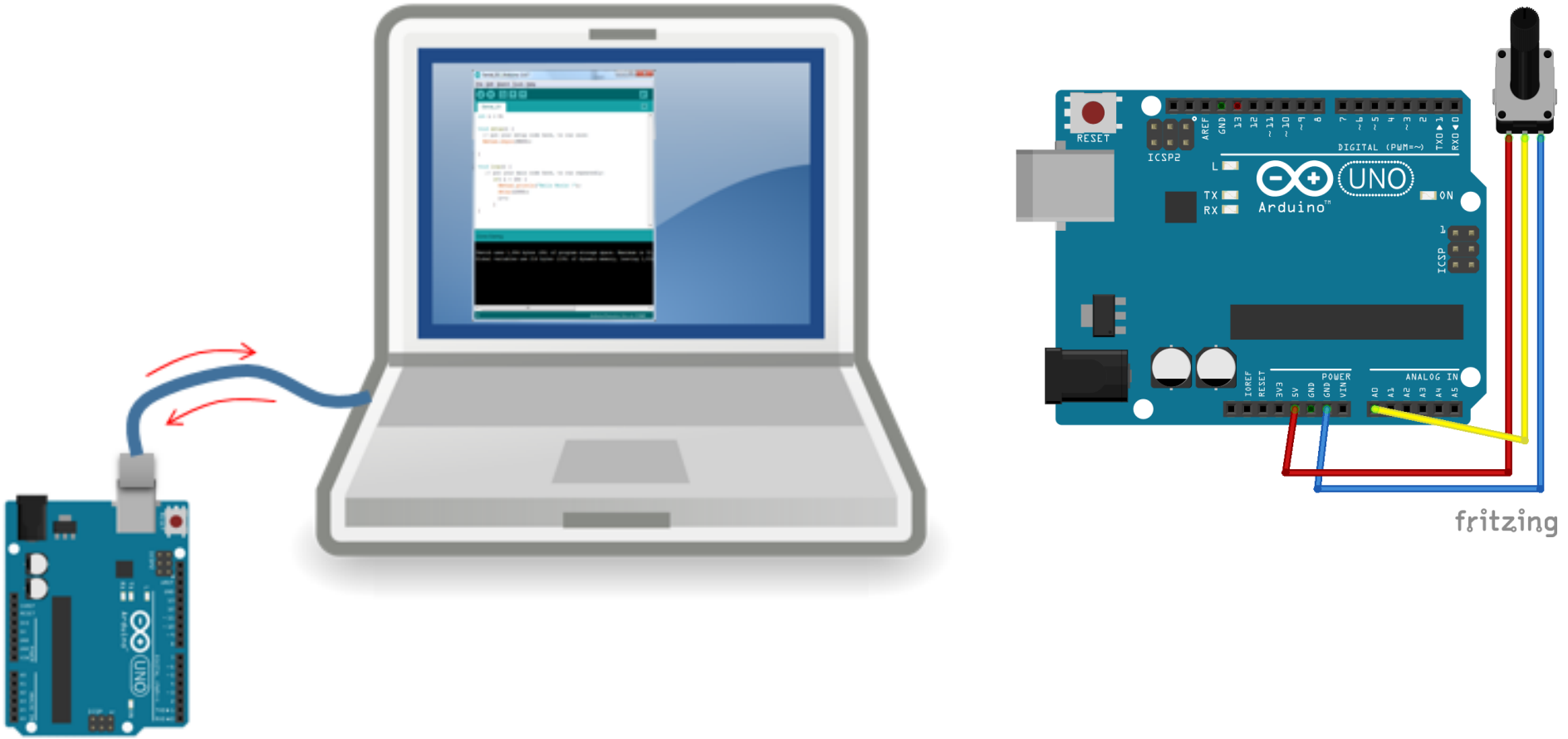
- Serial Communication
  - Functions :
    - **Serial.begin**(speed(bps))
    - **Serial.available**()
    - **Serial.print**(val)
    - **Serial.println**(val,format)
      - Format : DEC,HEX ...
    - **Serial.read**()

Lab 6 : read a value from Serial port and prints the received data to the Serial Monitor.





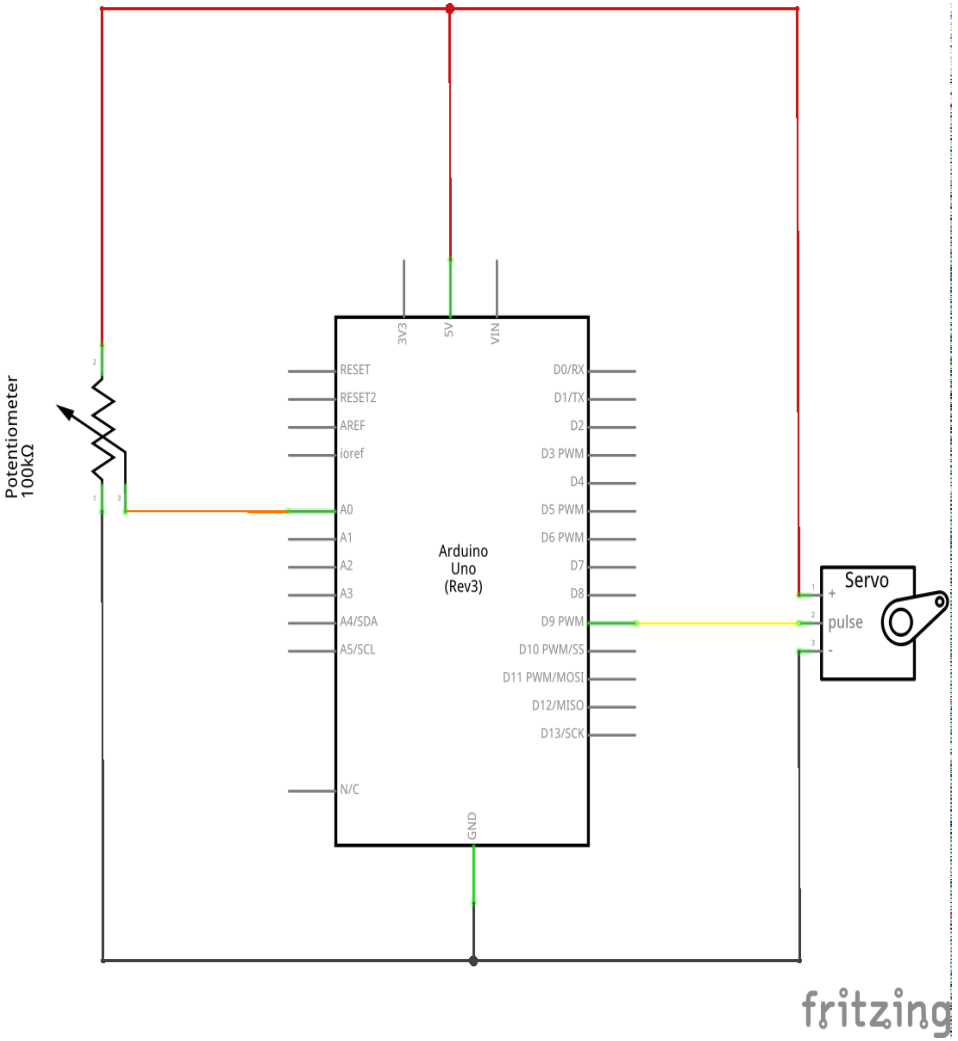
Lab 7 : reading an analog value and prints the result to the Serial Monitor

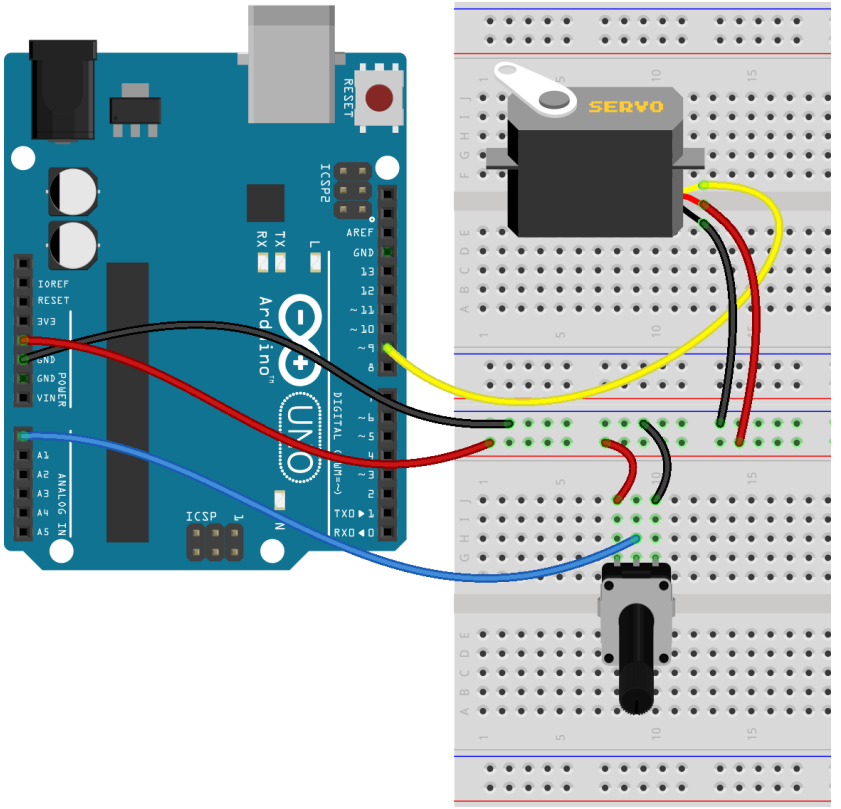


Arduino Programming

- Using libraries :
  - #include <libraryname.h>
    - For exemple :
      - #include <Ultrasonic.h>
      - #include <Servo.h>

Lab 8 : Controll a Servo Motor

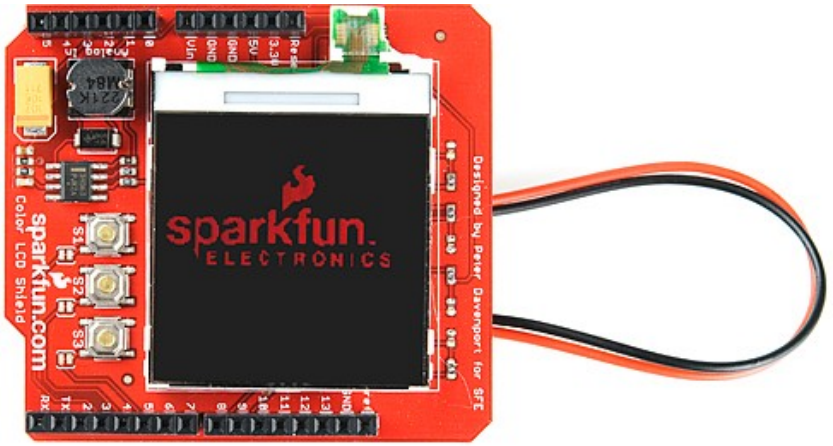


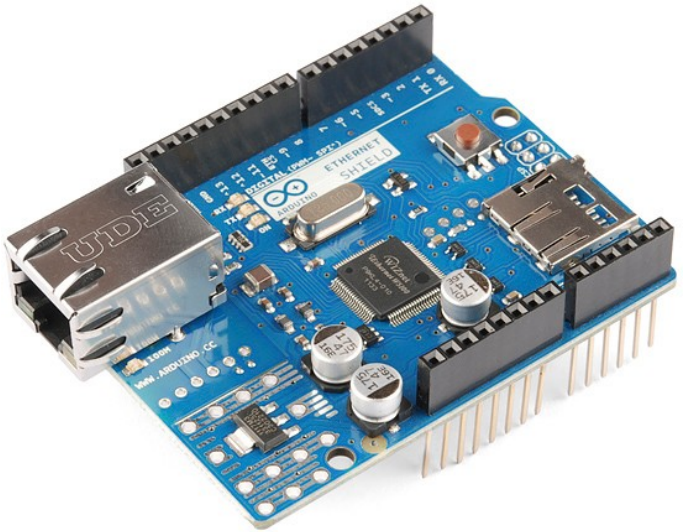


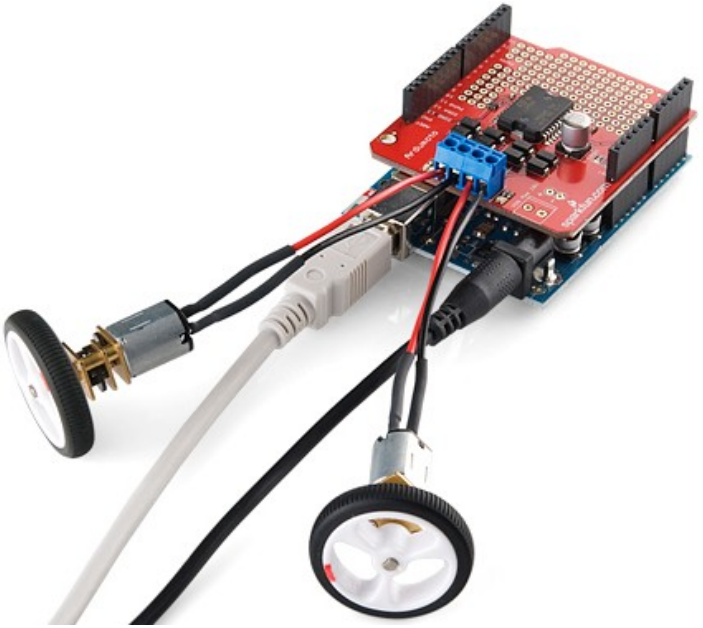
Arduino shields

Arduino shields

- Some examples :







Ressources and Sources

- https://playground.arduino.cc/
- https://www.arduino.cc/
- Arduino Workshop A Hands On Introduction with 65 Projects Book
- Getting started with arduino v2 book
- https://www.allaboutcircuits.com
- http://google.com/ (*_*)

The Pratical Workshop

Thank You