

Arduino Workshop

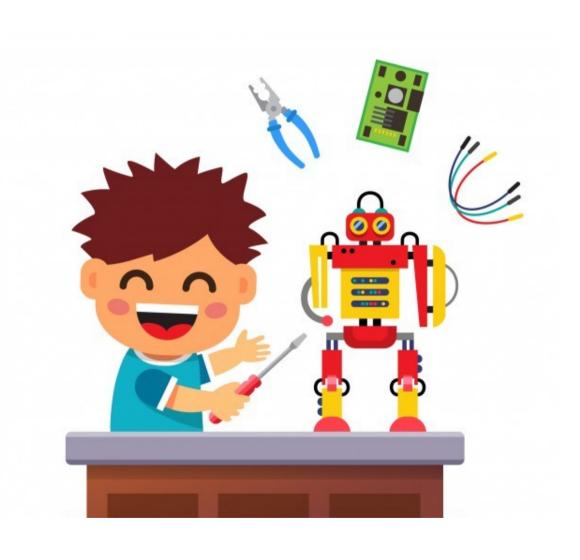
Arduino and embedded system introduction

Some Cool stuff

Arduino Projects

OpenClass

DIY (Do it yourself)



What is an embedded system?

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

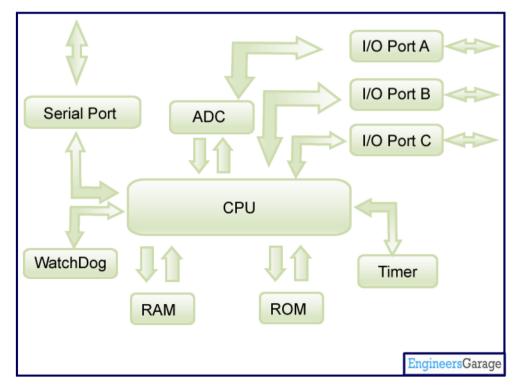
 An embedded system product is controlled by an internal microprocessor or microcontroller instead of some external control unit.

Embedded systems

Some exemples in our daily life :

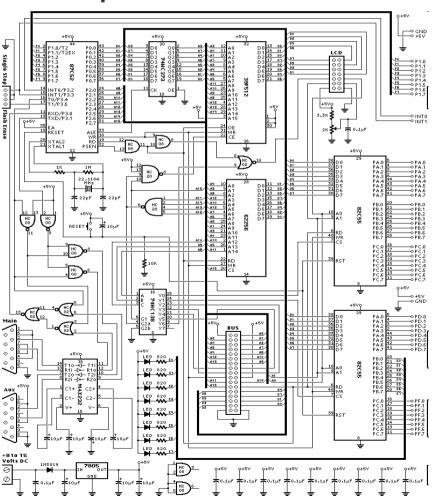


 A microcontroller (or MCU for microcontroller) unit) is a small computer on a single integrated circuit.

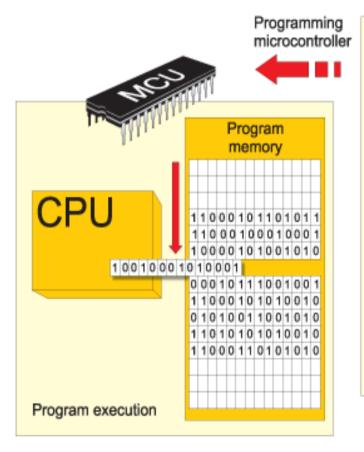


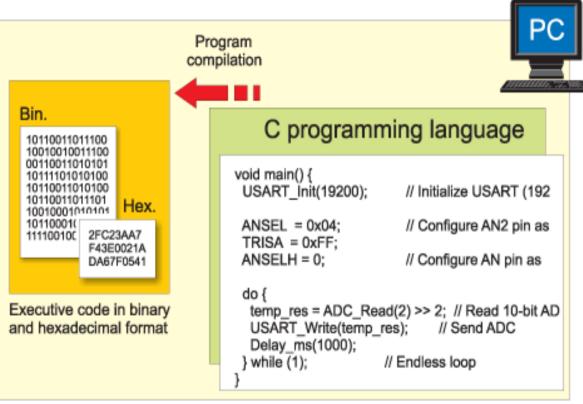
- · What makes embedded development difficult?
 - · Build tools
 - Software internals
 - Non standard hardware





To program it .

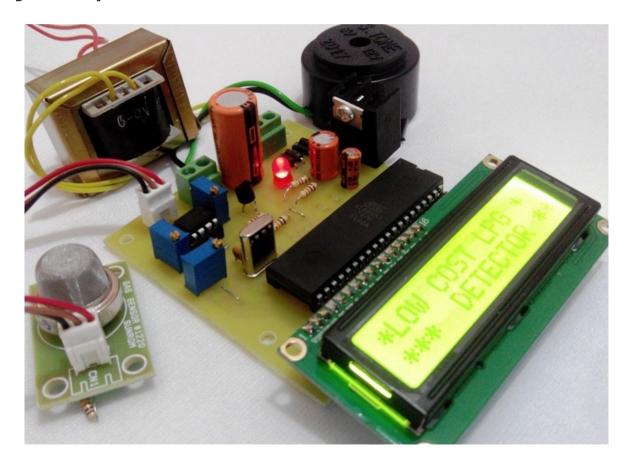




You will need this

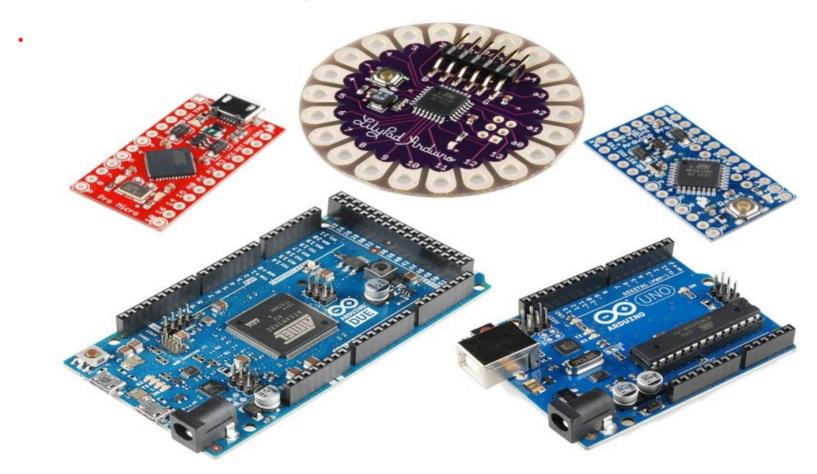


 You will need a PCB and you will need to soldering you parts too



What is arduino?

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

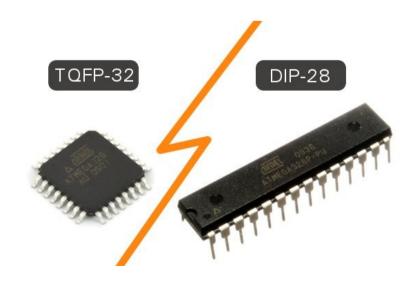


So why arduino?

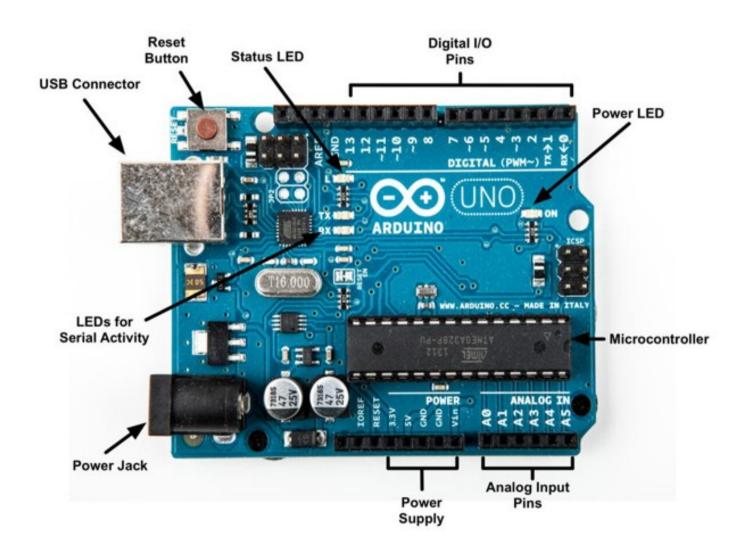
- It is flexible
- It is easy to use
- It is inexpensive
- It is an open-source project
- Arduino is backed up by a growing online community.

Arduino Hardware

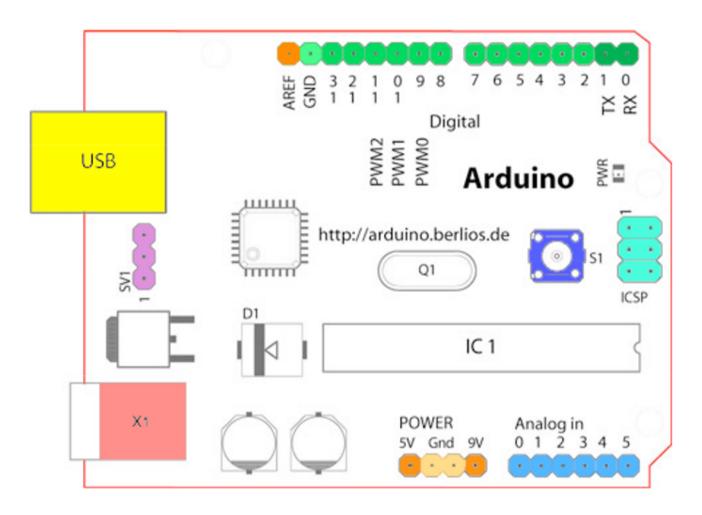
- "The Arduino board includes a microcontroller"
- For exemple Arduino Uno R3 contain Atmega328 :
 - Flash memory: 32KB nonvolatile memory.
 - SRAM memory: 2KB volatile memory.
 - EEPROM memory: 1KB nonvolatile memory.



Arduino Hardware



Arduino hardware



- Analog Reference pin (orange)
- Digital Ground (light green)
- Digital Pins 2-13 (green)
- Digital Pins 0-1/Serial In/Out <u>TX/RX</u> (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)

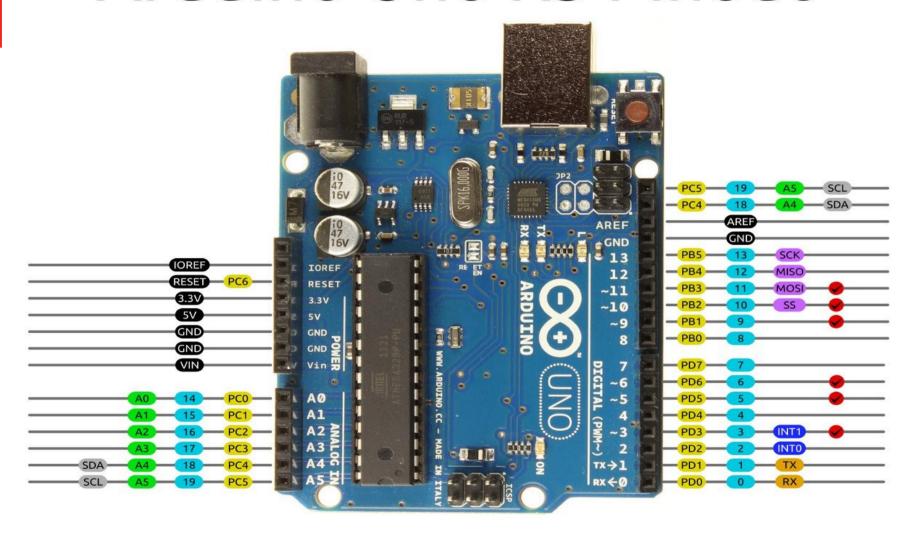
Arduino Hardware /Digital I/O:

ATmega328 Pin Mapping

Arduino functio	n .		Arduino function
reset	WHITE (PCINT14/RESET) PC6	→ PC5 (ADC5/SCL/PCINT13)	analog input 5
digital pin 0 (RX)	ORANGE (PCINT16/RXD) PD0 □2	27 PC4 (ADC4/SDA/PCINT12)	analog input 4
digital pin 1 (TX)	YELLOW (PCINT17/TXD) PD1 [3	26 PC3 (ADC3/PCINT11)	analog input 3
digital pin 2	(PCINT18/INT0) PD2 □ 4	≥ PC2 (ADC2/PCINT10)	analog input 2
digital pin 3 (PWM	(PCINT19/OC2B/INT1) PD3 ☐ 5	24 PC1 (ADC1/PCINT9)	analog input 1
digital pin 4	(PCINT20/XCK/T0) PD4 □ 6	23 PC0 (ADC0/PCINT8)	analog input 0
vcc	RED VCC 7	22 GND	GND
GND	BLACK GND	21 AREF	analog reference
crystal	(PCINT6/XTAL1/TOSC1) PB6 □ 9	≫ AVCC	vcc
crystal	(PCINT7/XTAL2/TOSC2) PB7 10	19 PB5 (SCK/PCINT5)	digital pin 13
digital pin 5 (PWM	(PCINT21/OC0B/T1) PD5 ☐ 11	18 PB4 (MISO/PCINT4)	digital pin 12
digital pin 6 (PWM	(PCINT22/OC0A/AIN0) PD6 12	17 PB3 (MOSI/OC2A/PCINT3)	digital pin 11 (PWM)
digital pin 7	(PCINT23/AIN1) PD7 ☐ 13	16 PB2 (SS/OC1B/PCINT2)	digital pin 10 (PWM)
digital pin 8	(PCINTO/CLKO/ICP1) PB0 ☐ 14	15 PB1 (OC1A/PCINT1)	digital pin 9 (PWM)

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.

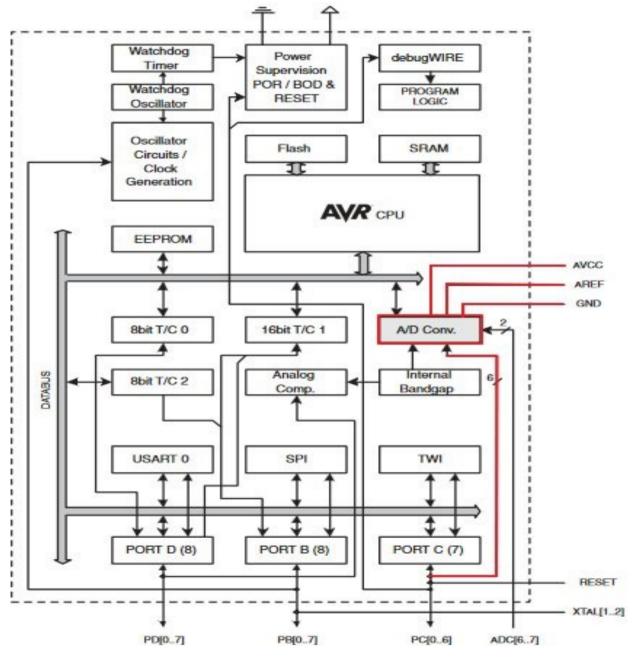
Arduino Uno R3 Pinout







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

```
sketch_dec05a | Arduino 1.8.5
File Edit Sketch Tools Help
  sketch dec05a
  // put your setup code here, to run once:
void loop() {
  // put your main code here, to run repeatedly:
                                                                    Arduino/Genuino Uno on /dev/ttyACM0
```

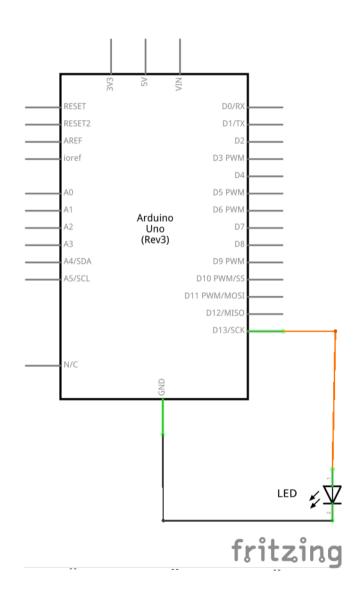
Arduino Programming

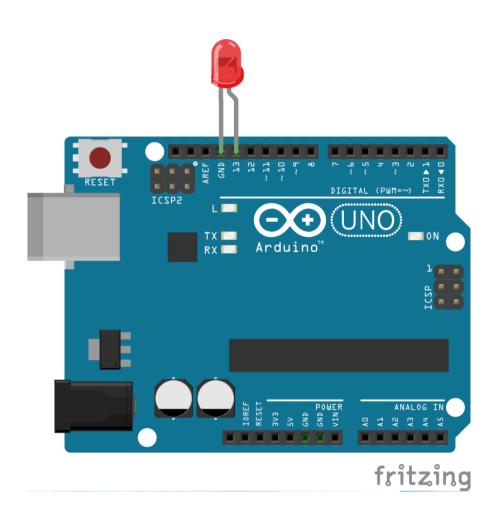
- Using arduino IDE C/C++
- Every sketch has these functions:
 - void setup()
 - Runs once at the very beginning
 - Set up your variables, peripherals
 - void loop()
 - Runs forever
 - Code that does actual work goes here

Arduino Programming

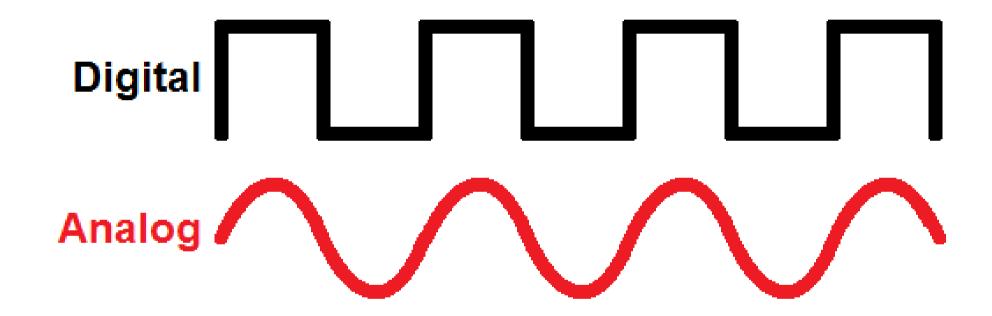
- Functions:
 - pinMode(pin, INPUT/OUTPUT)
 - digitalWrite(pin, HIGH/LOW)
 - delay(time in msec)

Lab 1: Blinking LED



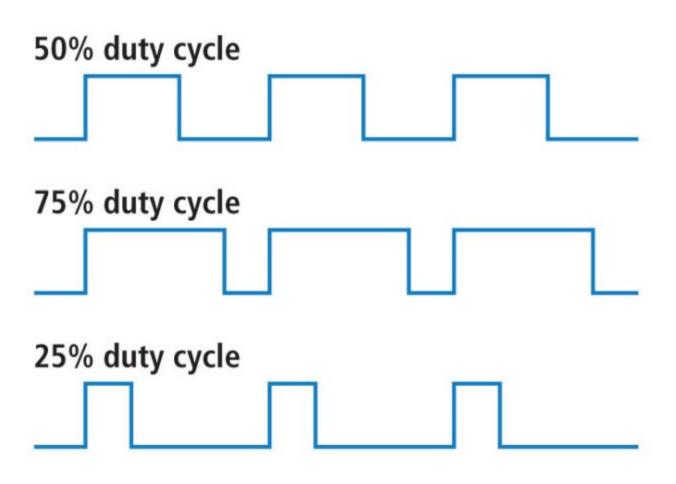


Analog vs Digital



PWM (Pulse Width Modulation)

Method to generate analog voltages from digital voltages.

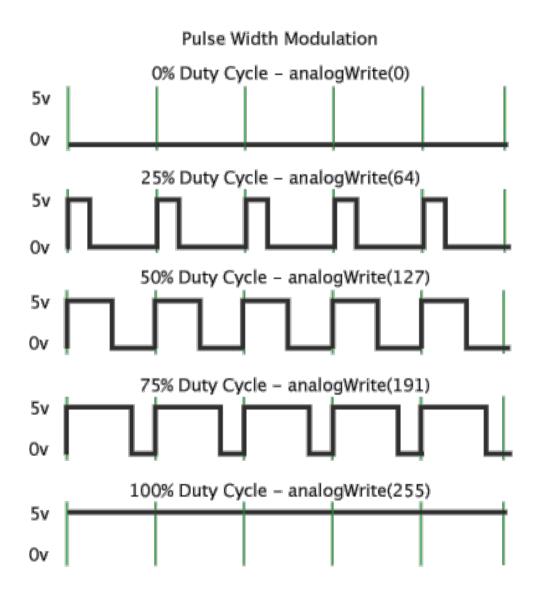


Arduino Programming

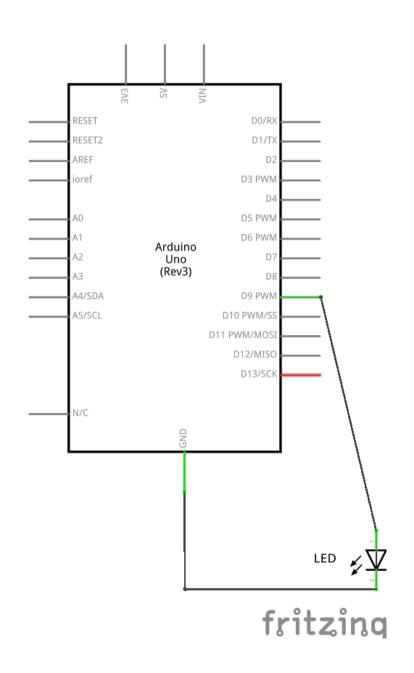
- Functions:
- analogWrite(pin, val)

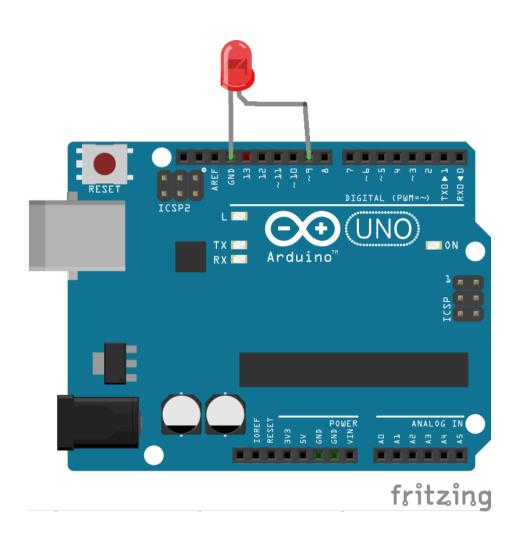
val = 0 to 255

Av= (ontime/T) * 5v



Lab 2: Fade an LED in and out

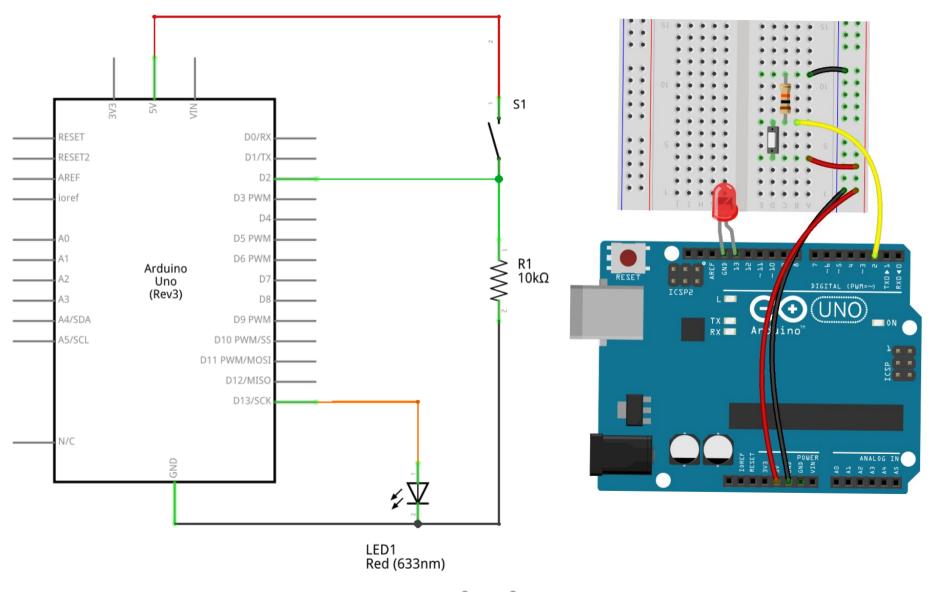




Arduino Programming

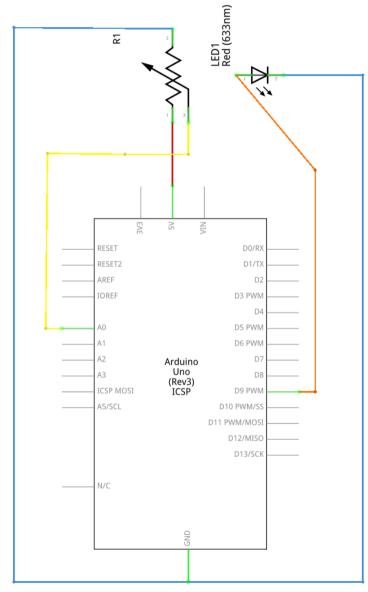
- · Functions:
 - digitalRead(pin): return a val 0 or 1
 - analogRead(pin): return a val between0 and 1023
 - ADC : v = (val /1023) * Vref(default : 5v)

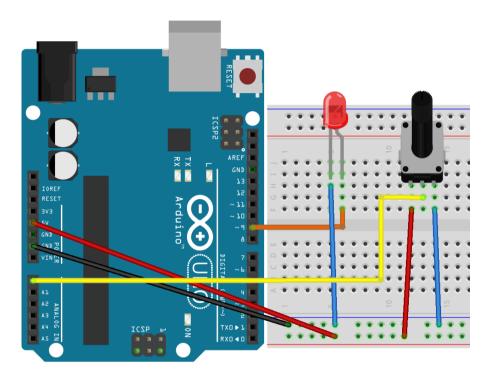
Lab 3: Turn a LED ON/OFF using button



fritzing

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

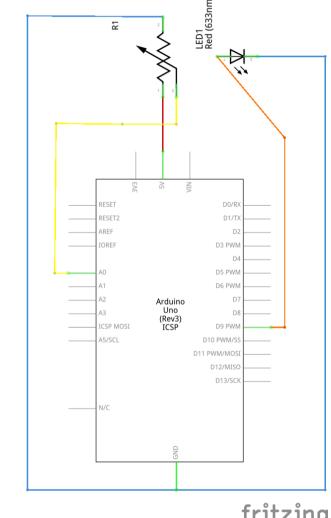


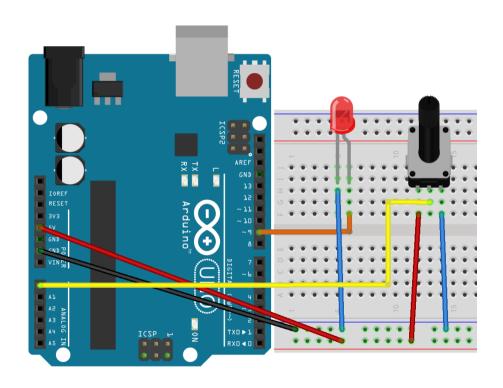


fritzing

Part1

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





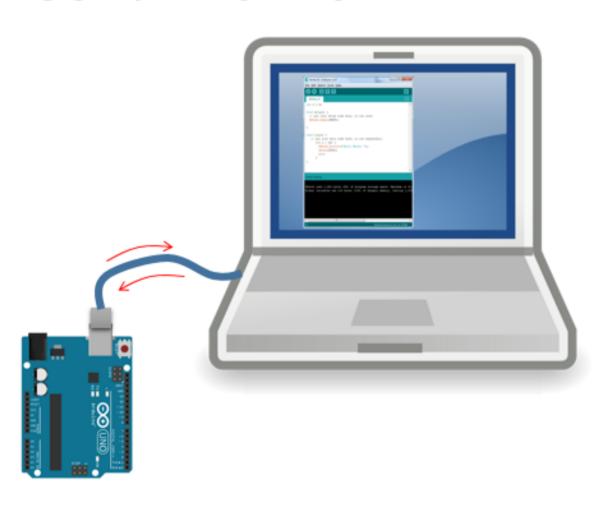
fritzing

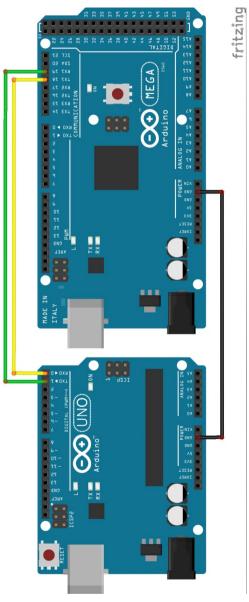
Arduino Programming

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

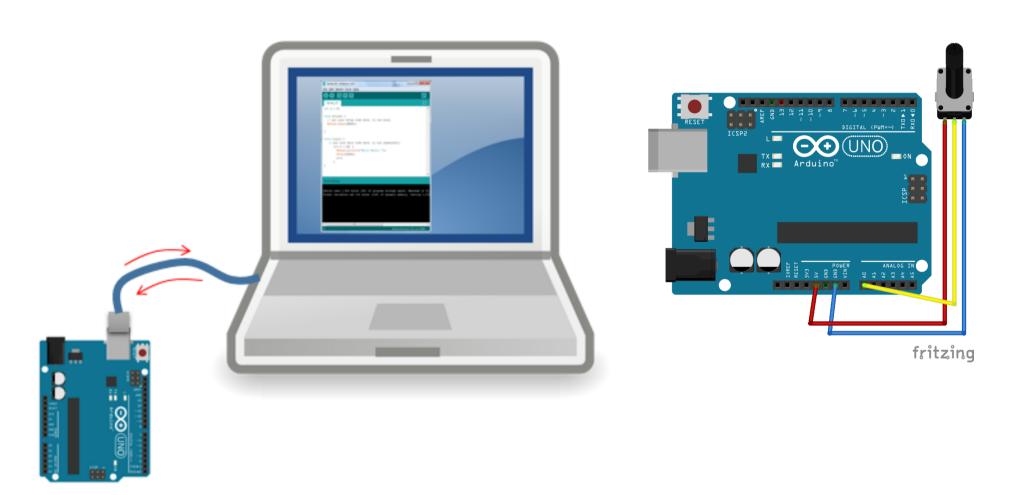
Lab 6: read a value from Serial port and prints the received data to the

Serial Monitor.





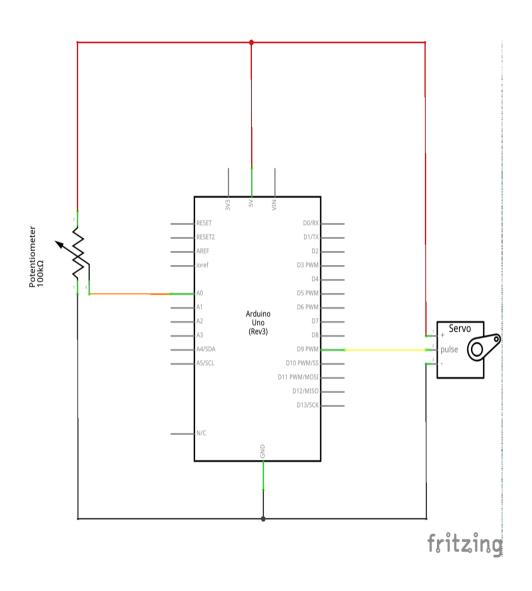
Lab 7: reading an analog value and prints the result to the Serial Monitor

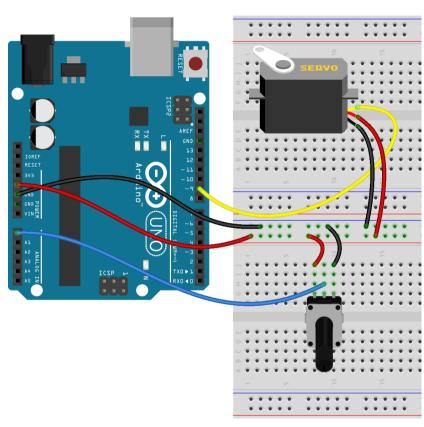


Arduino Programming

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

Lab 8 : Controll a Servo Motor



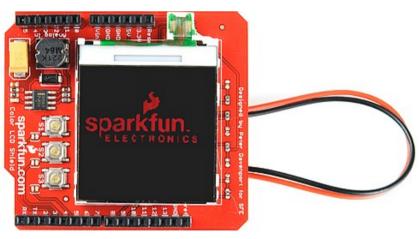


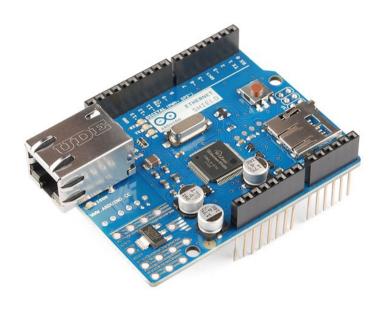
Arduino shields

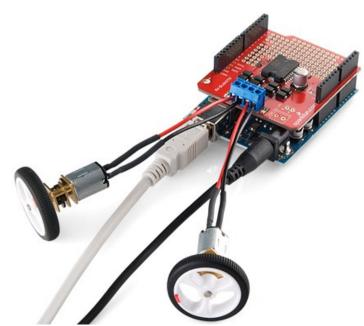


Arduino shields

• 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