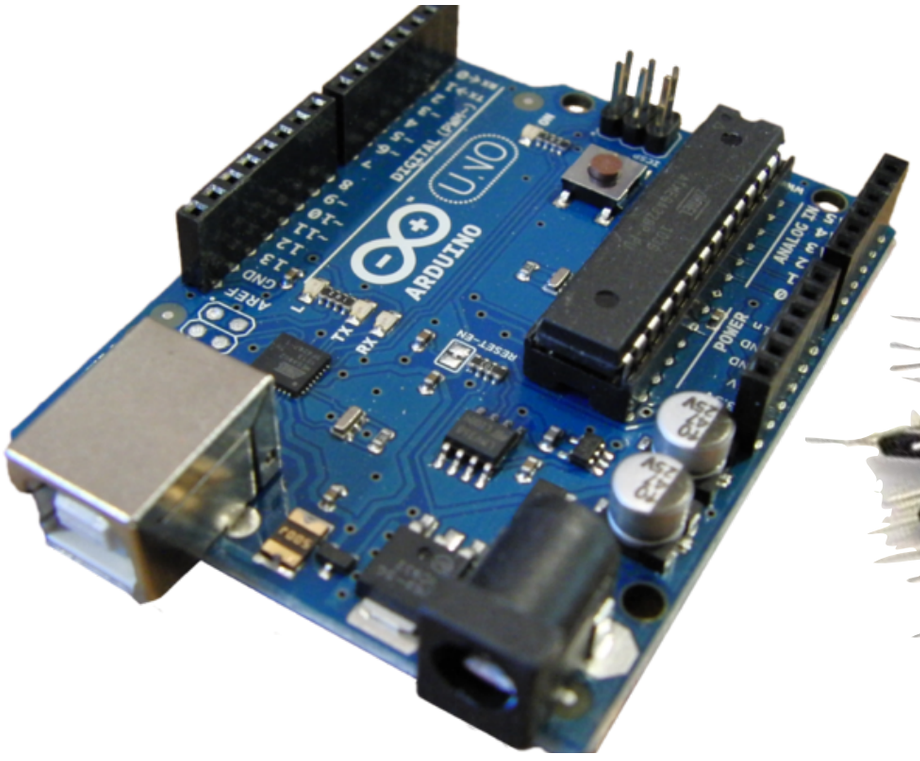
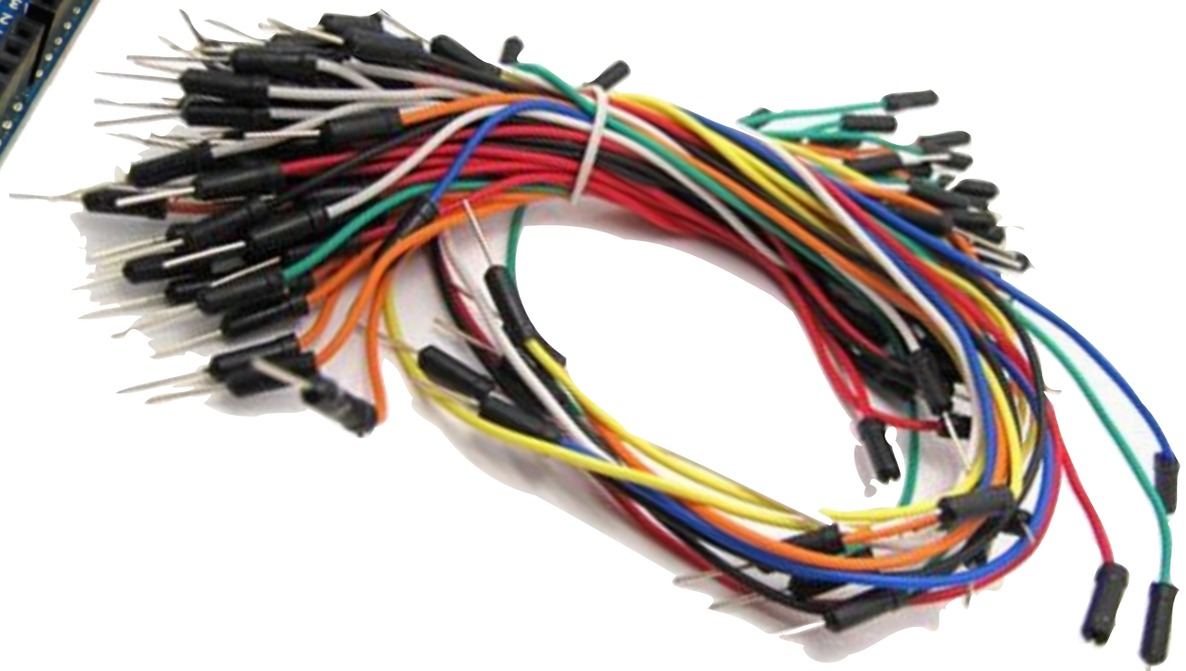
ARDUINO DAYS 2024

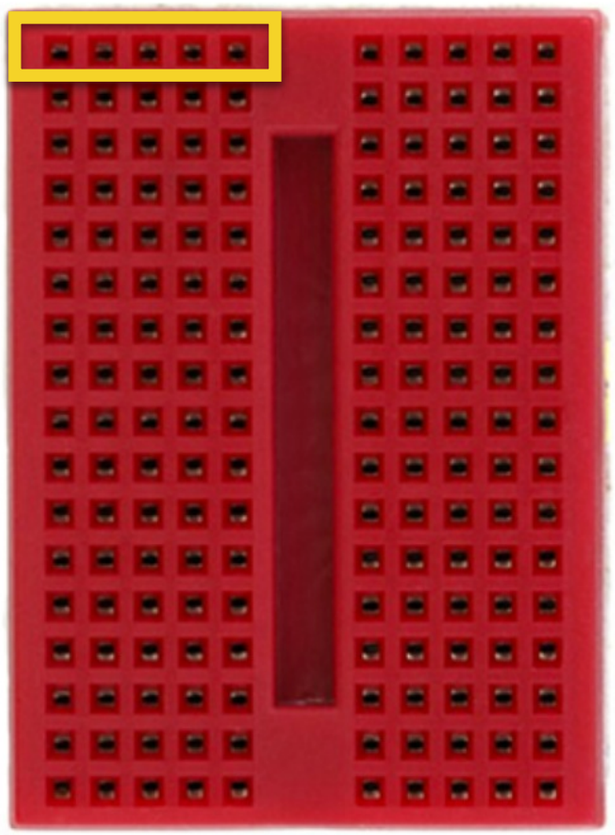
ICTP SCI FAB LAB SCIENTIFIC FABRICATION LABORATORY

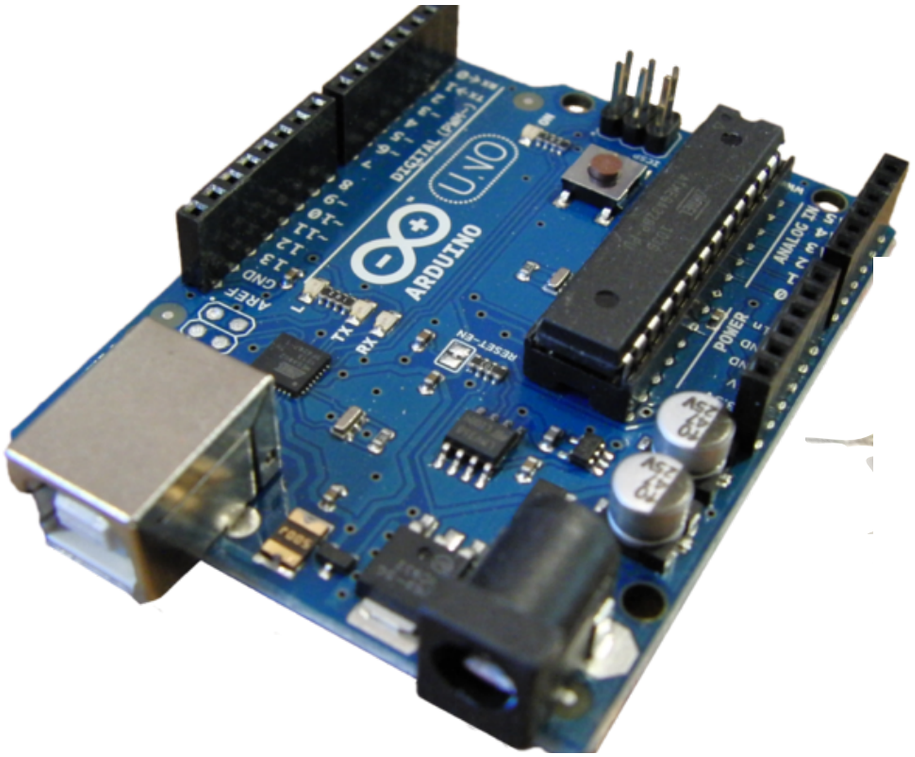
scifablab.ictp.it

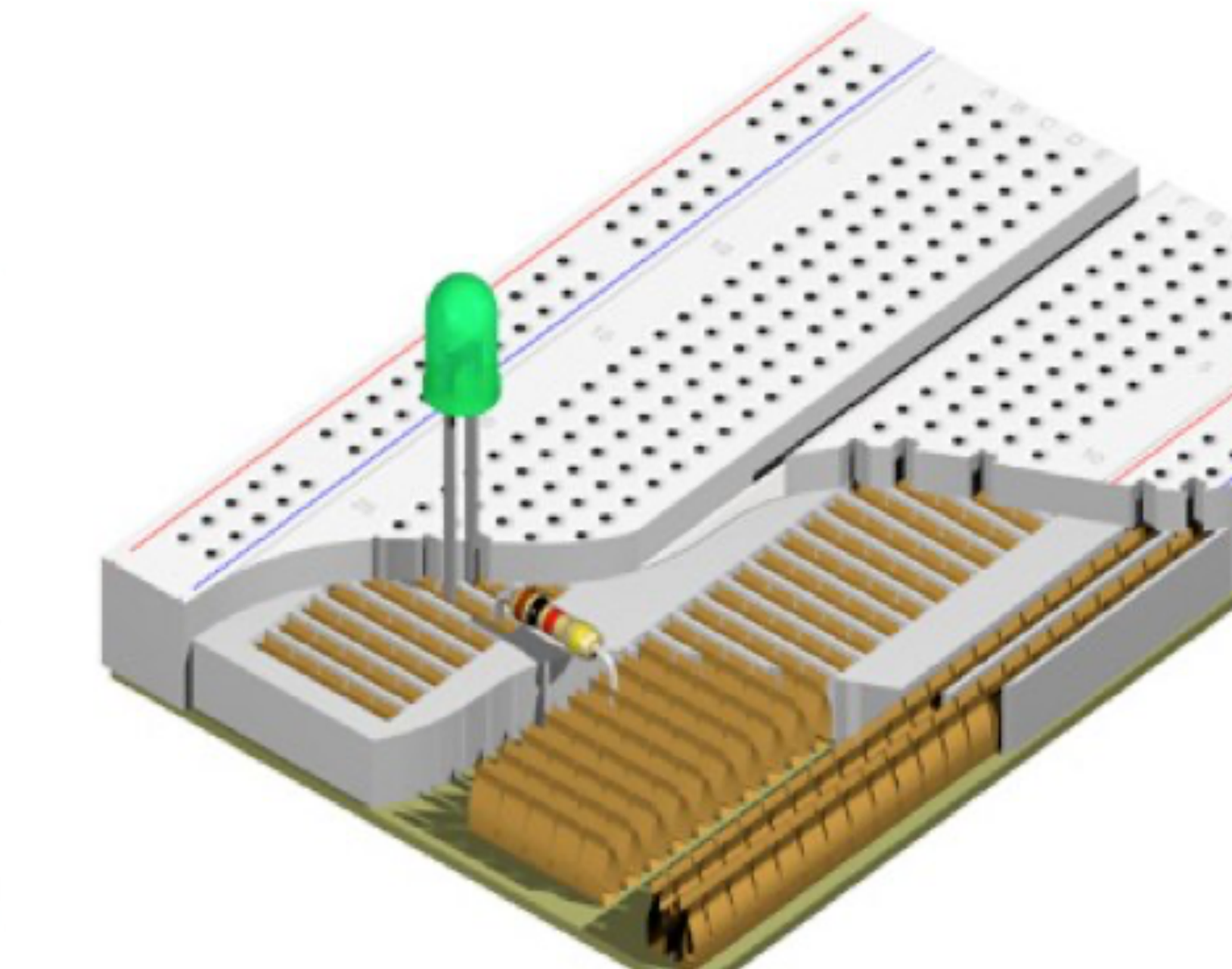
1 2 3 ARDUINO

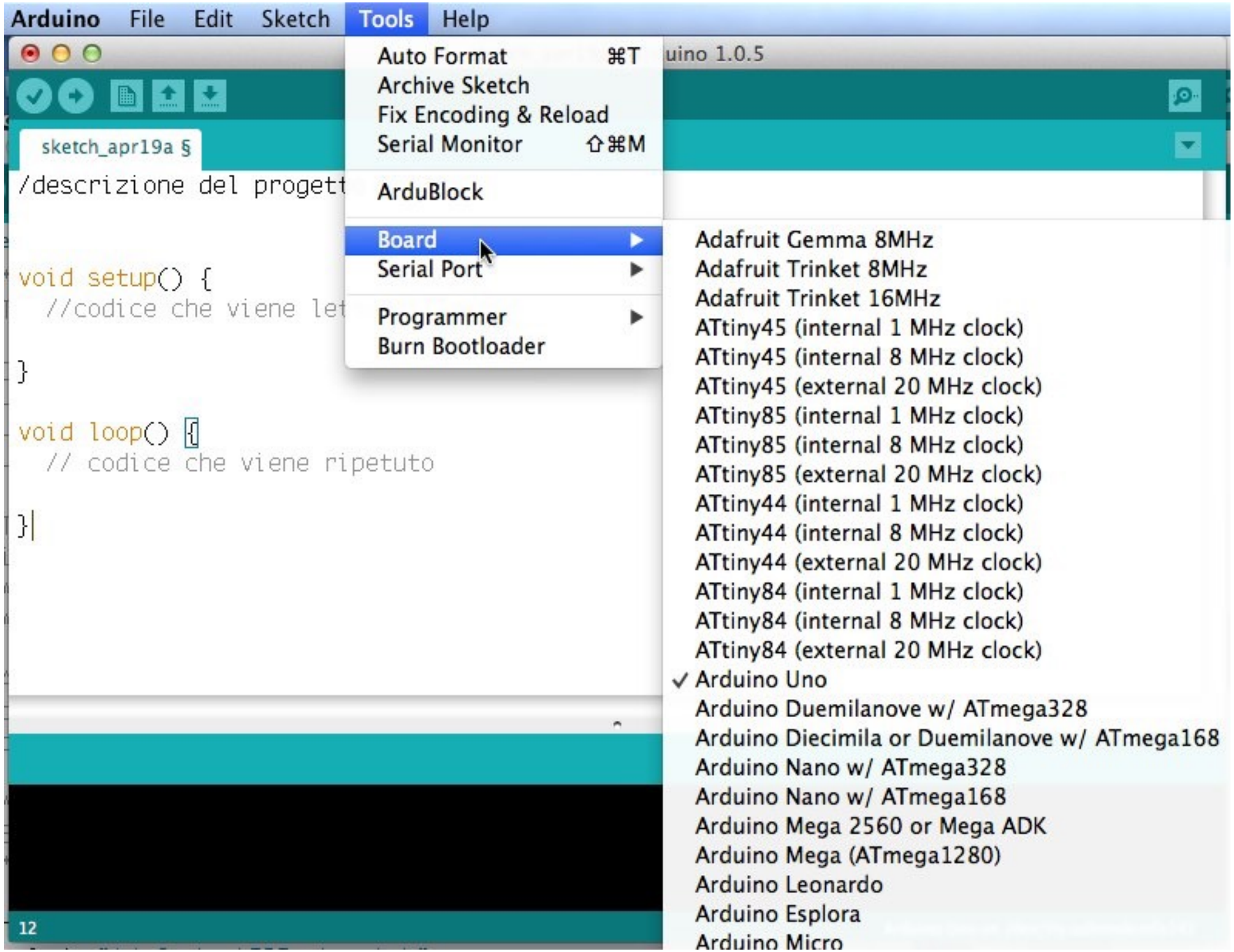

UNO
ARDUINO
DIGITAL (PWM~)
POWER
ANALOG IN

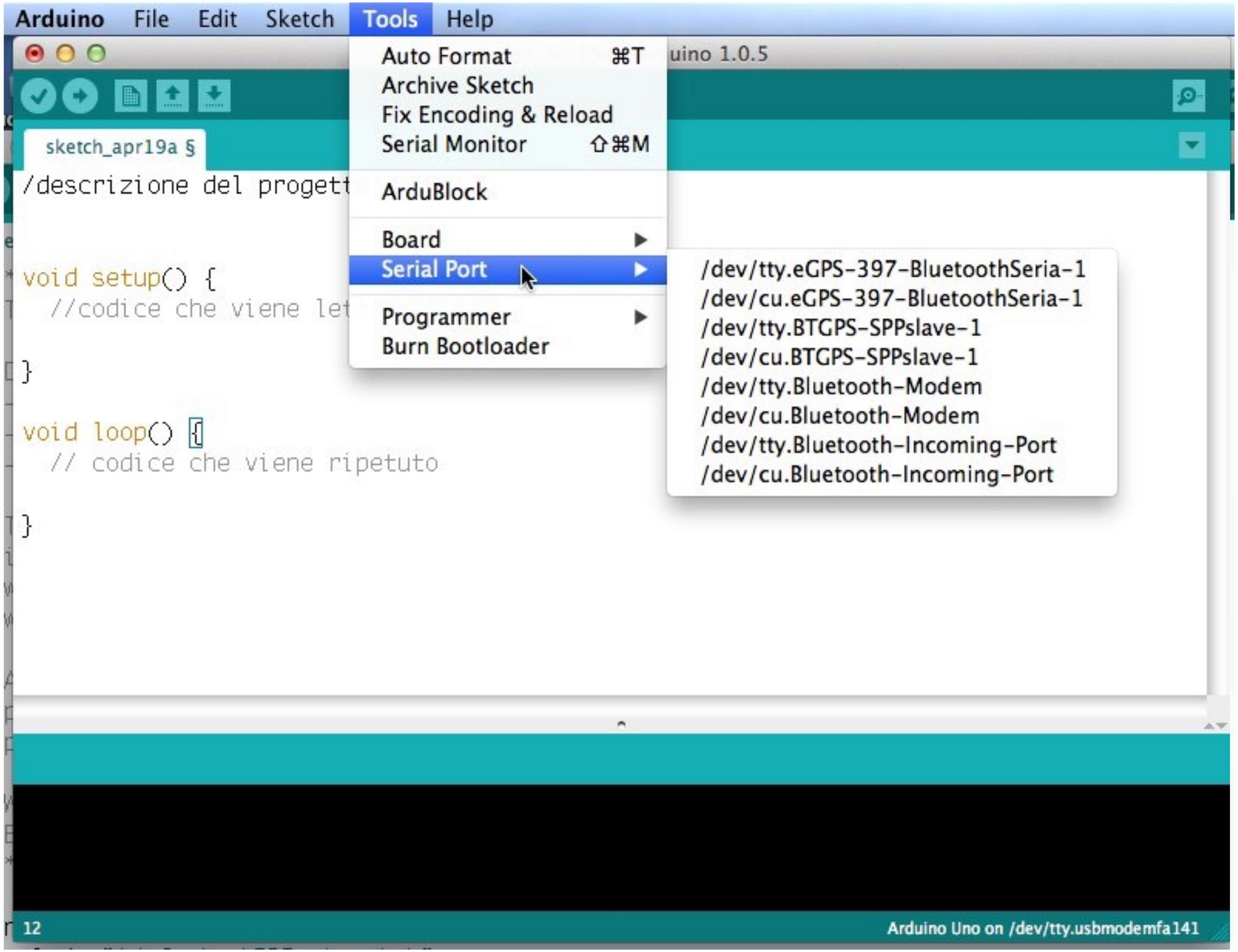


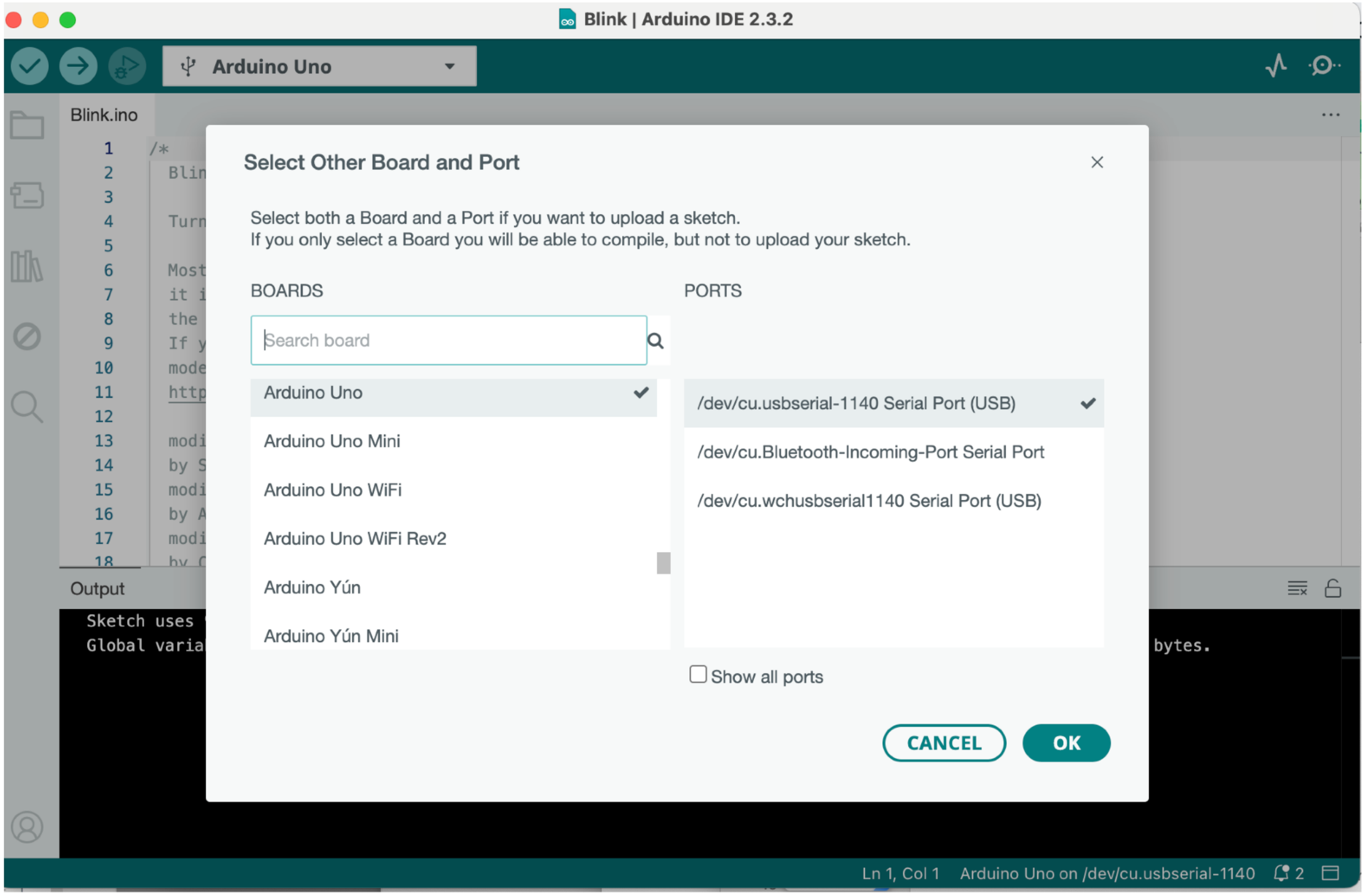



UNO
ARDUINO
DIGITAL (PWM~)
ANALOG IN
POWER
RESET-EN
AREF
GND
TX
RX

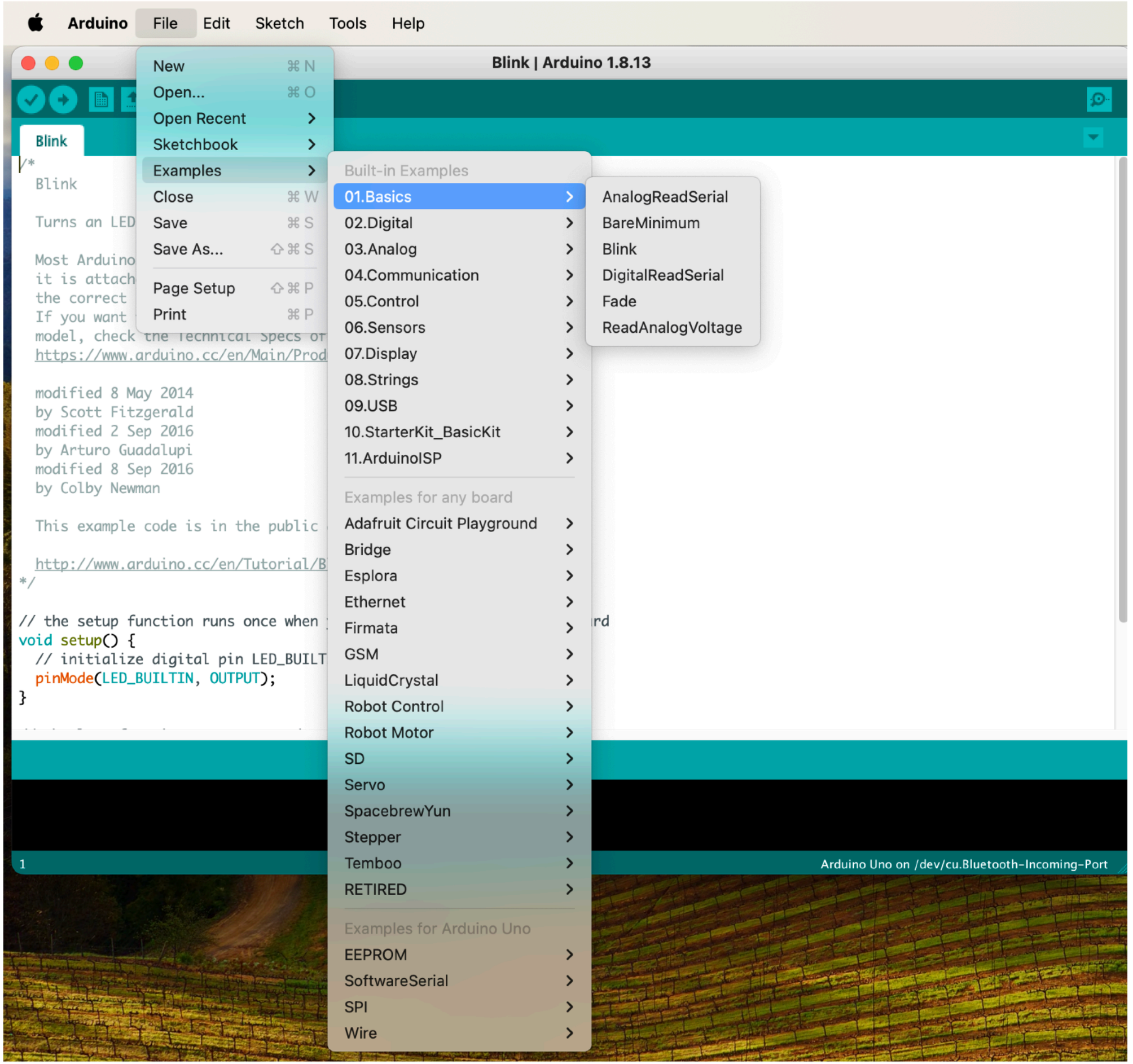



Arduino File Edit Sketch Tools Help
uino 1.0.5
sketch_apr19a §
/descrizione del progett
void setup() {
//codice che viene let
}
void loop() {
// codice che viene ripetuto
}
Auto Format ⌘T
Archive Sketch
Fix Encoding & Reload
Serial Monitor ⇧⌘M
ArduBlock
Board
Serial Port
Programmer
Burn Bootloader
Adafruit Gemma 8MHz
Adafruit Trinket 8MHz
Adafruit Trinket 16MHz
ATtiny45 (internal 1 MHz clock)
ATtiny45 (internal 8 MHz clock)
ATtiny45 (external 20 MHz clock)
ATtiny85 (internal 1 MHz clock)
ATtiny85 (internal 8 MHz clock)
ATtiny85 (external 20 MHz clock)
ATtiny44 (internal 1 MHz clock)
ATtiny44 (internal 8 MHz clock)
ATtiny44 (external 20 MHz clock)
ATtiny84 (internal 1 MHz clock)
ATtiny84 (internal 8 MHz clock)
ATtiny84 (external 20 MHz clock)
Arduino Uno
Arduino Duemilanove w/ ATmega328
Arduino Diecimila or Duemilanove w/ ATmega168
Arduino Nano w/ ATmega328
Arduino Nano w/ ATmega168
Arduino Mega 2560 or Mega ADK
Arduino Mega (ATmega1280)
Arduino Leonardo
Arduino Esplora
Arduino Micro
12


Arduino File Edit Sketch Tools Help
Auto Format ⌘T
Archive Sketch
Fix Encoding & Reload
Serial Monitor ⇧⌘M
ArduBlock
Board
Serial Port
Programmer
Burn Bootloader
/dev/tty.eGPS-397-BluetoothSeria-1
/dev/cu.eGPS-397-BluetoothSeria-1
/dev/tty.BTGPS-SPPslave-1
/dev/cu.BTGPS-SPPslave-1
/dev/tty.Bluetooth-Modem
/dev/cu.Bluetooth-Modem
/dev/tty.Bluetooth-Incoming-Port
/dev/cu.Bluetooth-Incoming-Port
uino 1.0.5
sketch_apr19a §
/descrizione del progett
void setup() {
//codice che viene let
}
void loop() {
// codice che viene ripetuto
}
12
Arduino Uno on /dev/tty.usbmodemfa141



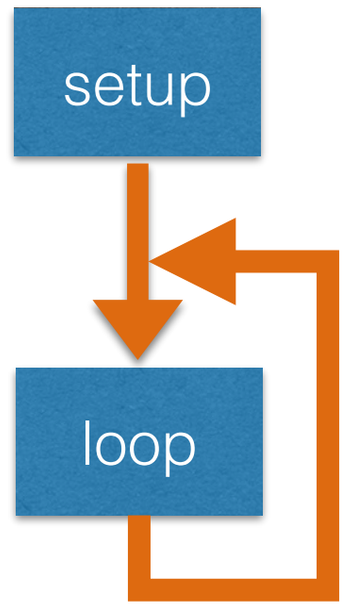
CH341 Driver (Windows 10)	https://www.cytron.io/p-maker-uno-simplifying-arduino-for-education
CH341 Driver (Mac OS)	


Arduino
File
Edit
Sketch
Tools
Help
Blink | Arduino 1.8.13
New ⌘ N
Open... ⌘ O
Open Recent
Sketchbook
Examples
Close ⌘ W
Save ⌘ S
Save As... ⇧ ⌘ S
Page Setup ⇧ ⌘ P
Print ⌘ P
Built-in Examples
01.Basics
02.Digital
03.Analog
04.Communication
05.Control
06.Sensors
07.Display
08.Strings
09.USB
10.StarterKit_BasicKit
11.ArduinoISP
AnalogReadSerial
BareMinimum
Blink
DigitalReadSerial
Fade
ReadAnalogVoltage
Examples for any board
Adafruit Circuit Playground
Bridge
Esplora
Ethernet
Firmata
GSM
LiquidCrystal
Robot Control
Robot Motor
SD
Servo
SpacebrewYun
Stepper
Temboo
RETIRED
Examples for Arduino Uno
EEPROM
SoftwareSerial
SPI
Wire
Blink
/*
Blink
Turns an LED
Most Arduino
it is attach
the correct
If you want
model, check the Technical Specs of
https://www.arduino.cc/en/Main/Prod
modified 8 May 2014
by Scott Fitzgerald
modified 2 Sep 2016
by Arturo Guadalupi
modified 8 Sep 2016
by Colby Newman
This example code is in the public
http://www.arduino.cc/en/Tutorial/B
*/
// the setup function runs once when
rd
void setup() {
// initialize digital pin LED_BUILT
pinMode(LED_BUILTIN, OUTPUT);
}
1
Arduino Uno on /dev/cu.Bluetooth-Incoming-Port

BareMinimum | Arduino 1.0.5

BareMinimum §

```
/*descrizione del progetto
fine descrizione
*/

//definzione delle variabili

void setup() {
  // codice che viene eseguito una volta all'avvio

}

void loop() {
  // codice che viene eseguito ripetutamente

}
```



11

Arduino Uno on /dev/tty.usbmodemfa141

Digital I/O

pinMode(pinNumber, pinState);

0-13

OUTPUT
INPUT

Digital I/O

digitalWrite(pinNumber, pinState);

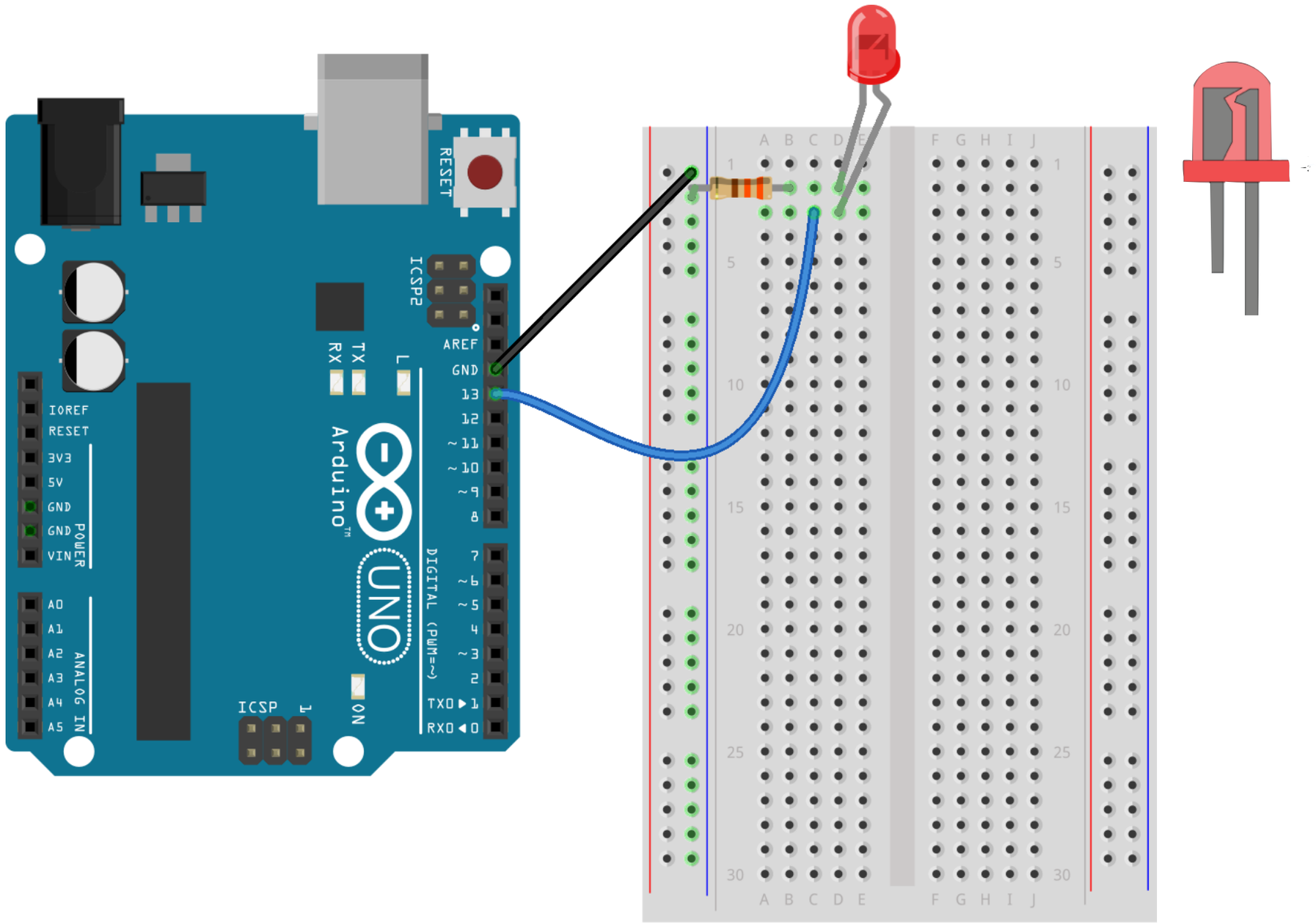
0-13

HIGH
LOW

DIGITAL I/O


```
/*
  Blink
 */

int led = 13;

void setup() {

  pinMode(led, OUTPUT);
}

void loop() {
  digitalWrite(led, HIGH);   // turn the LED on
  delay(1000);               // wait for a second
  digitalWrite(led, LOW);    // turn the LED off
  delay(1000);               // wait for a second
}
```

LED X 1

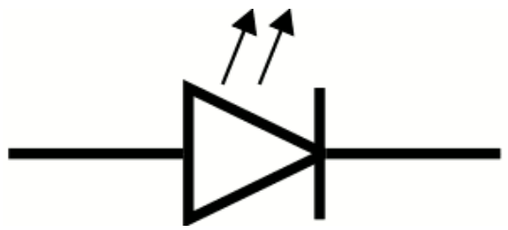


arancio 3

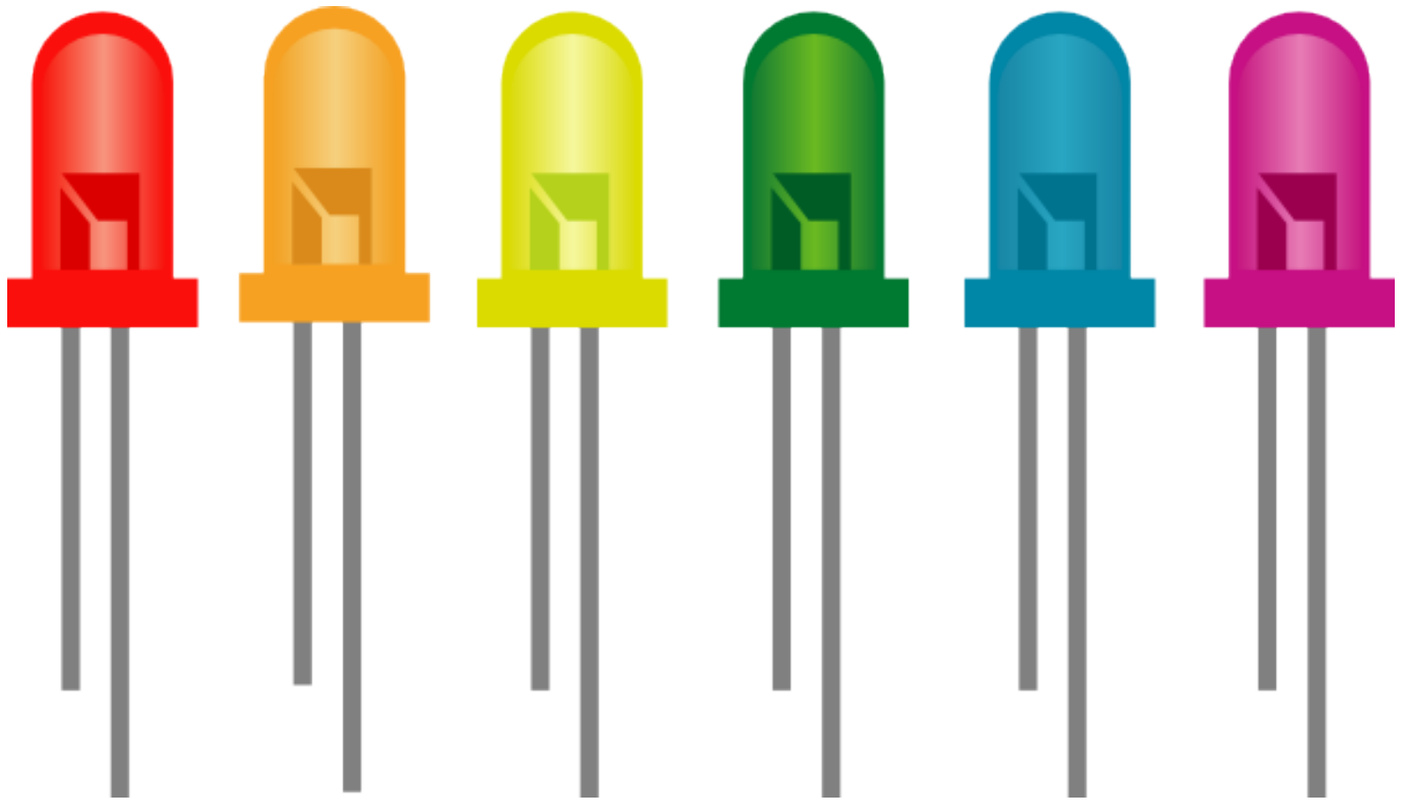
arancio 3

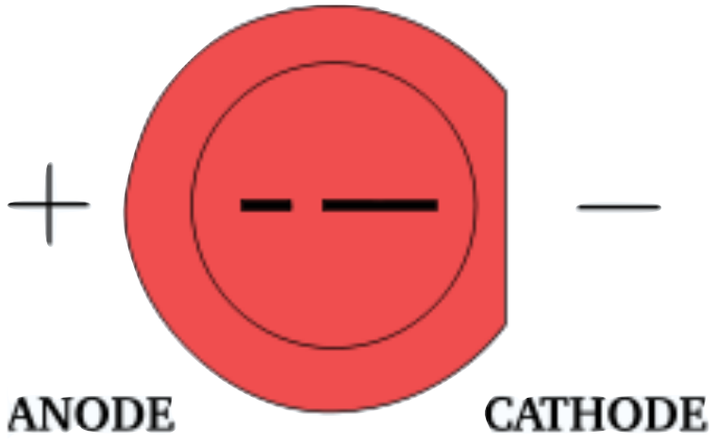
marrone x10

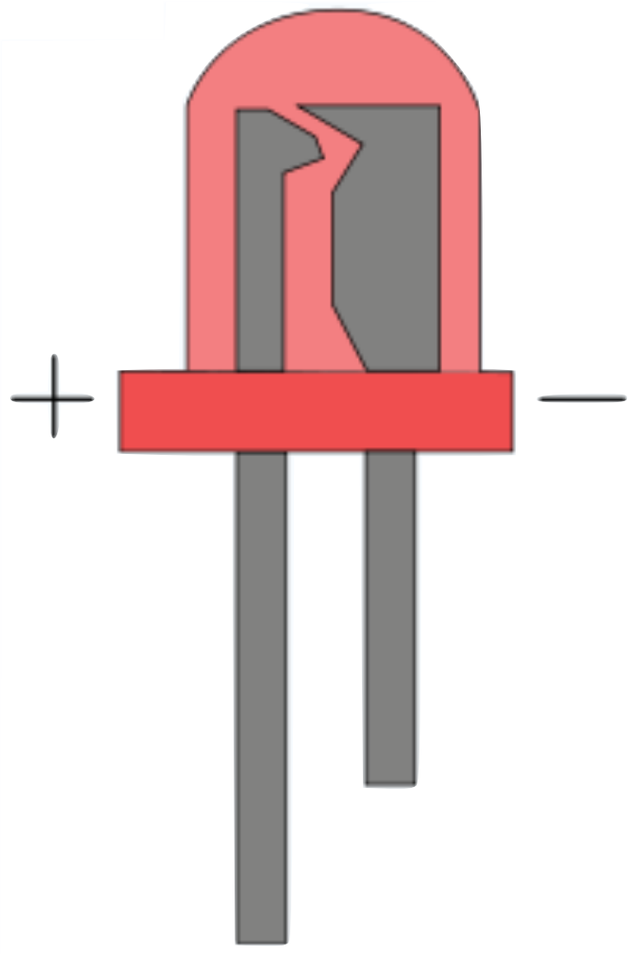
oro ±5%



LIGHT EMITTING DIODES




+
−
ANODE
CATHODE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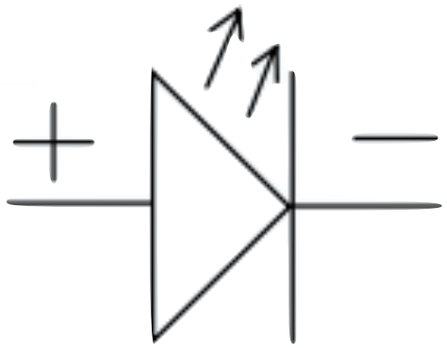
+
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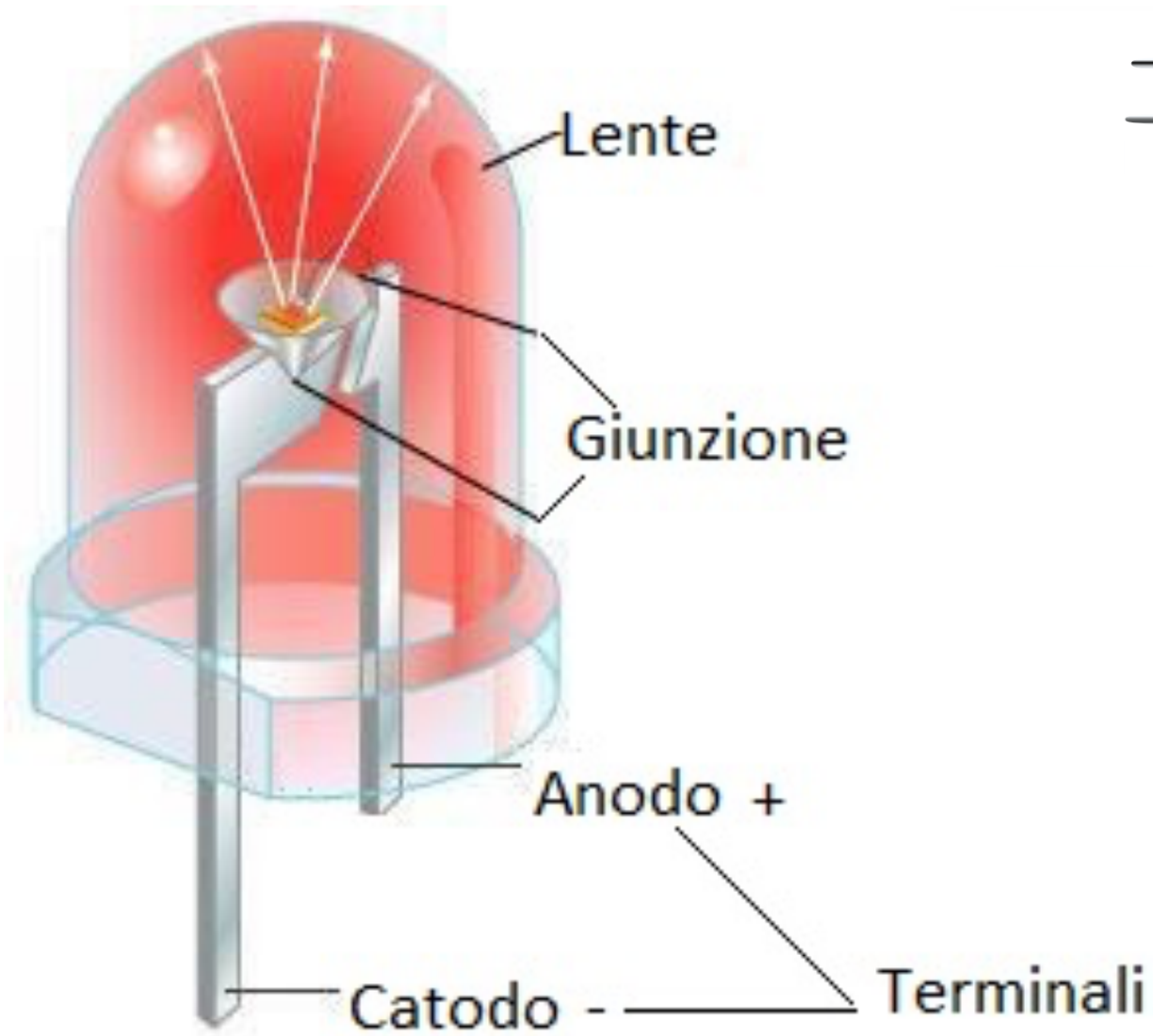
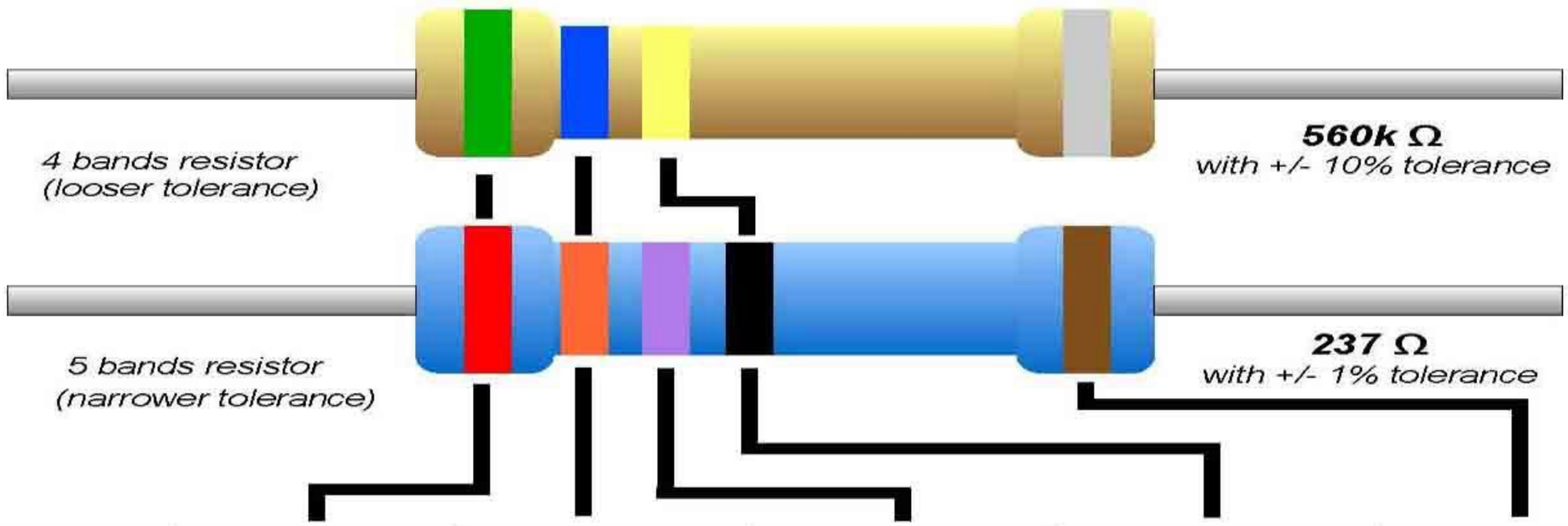

Lente
Giunzione
Anodo +
Catodo -
Terminali

	Lunghezza d'onda (nm)	Nome colore	Tensione diretta (Vf @ 20ma)	Intensity 5mm LEDs	Viewing Angle	LED Dye Material
	940	Infrared	1.5	16mW @50mA	15°	GaAIAs/GaAs -- Gallium Aluminum Arsenide/Gallium Arsenide
	880	Infrared	1.7	18mW @50mA	15°	GaAIAs/GaAs -- Gallium Aluminum Arsenide/Gallium Arsenide
	850	Infrared	1.7	26mW @50mA	15°	GaAIAs/GaAs -- Gallium Aluminum Arsenide/Gallium Aluminum Arsenide
	660	Ultra Red	1.8	2000mcd @50mA	15°	GaAIAs/GaAs -- Gallium Aluminum Arsenide/Gallium Aluminum Arsenide
	635	High Eff. Red	2.0	200mcd @20mA	15°	GaAsP/GaP - Gallium Arsenic Phosphide / Gallium Phosphide
	633	Super Red	2.2	3500mcd @20mA	15°	InGaAIP - Indium Gallium Aluminum Phosphide
	620	Super Orange	2.2	4500mcd @20mA	15°	InGaAIP - Indium Gallium Aluminum Phosphide
	612	Super Orange	2.2	6500mcd @20mA	15°	InGaAIP - Indium Gallium Aluminum Phosphide
	605	Orange	2.1	160mcd @20mA	15°	GaAsP/GaP - Gallium Arsenic Phosphide / Gallium Phosphide
	595	Super Yellow	2.2	5500mcd @20mA	15°	InGaAIP - Indium Gallium Aluminum Phosphide
	592	Super Pure Yellow	2.1	7000mcd @20mA	15°	InGaAIP - Indium Gallium Aluminum Phosphide
	585	Yellow	2.1	100mcd @20mA	15°	GaAsP/GaP - Gallium Arsenic Phosphide / Gallium Phosphide
	4500K	"Incandescent" White	3.6	2000mcd @20mA	20°	SiC/GaN -- Silicon Carbide/Gallium Nitride
	6500K	Pale White	3.6	4000mcd @20mA	20°	SiC/GaN -- Silicon Carbide/Gallium Nitride
	8000K	Cool White	3.6	6000mcd @20mA	20°	SiC/GaN - Silicon Carbide / Gallium Nitride
	574	Super Lime Yellow	2.4	1000mcd @20mA	15°	InGaAIP - Indium Gallium Aluminum Phosphide
	570	Super Lime Green	2.0	1000mcd @20mA	15°	InGaAIP - Indium Gallium Aluminum Phosphide
	565	High Efficiency Green	2.1	200mcd @20mA	15°	GaP/GaP - Gallium Phosphide/Gallium Phosphide
	560	Super Pure Green	2.1	350mcd @20mA	15°	InGaAIP - Indium Gallium Aluminum Phosphide
	555	Pure Green	2.1	80mcd @20mA	15°	GaP/GaP - Gallium Phosphide/ Gallium Phosphide
	525	Aqua Green	3.5	10,000mcd @20mA	15°	SiC/GaN - Silicon Carbide / Gallium Nitride
	505	Blue Green	3.5	2000mcd @20mA	45°	SiC/GaN - Silicon Carbide / Gallium Nitride
	470	Super Blue	3.6	3000mcd @20mA	15°	SiC/GaN - Silicon Carbide / Gallium Nitride
	430	Ultra Blue	3.8	100mcd @20mA	15°	SiC/GaN - Silicon Carbide / Gallium Nitride

http://www.radio.walkingitaly.com/radio/radiosito/tutorial/diodi/d_led/d_led1.htm

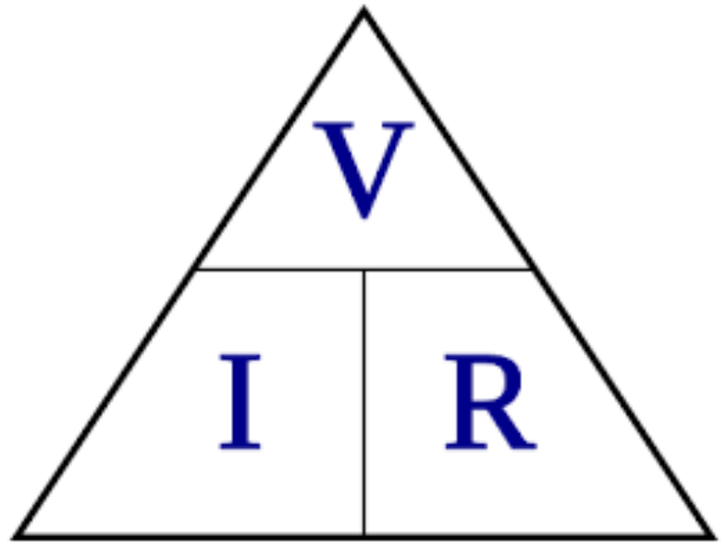
E LA SUA RESISTENZA

R1
470Ω



Color	1st Band	2nd Band	3rd Band	Multiplier	Tolerance
Black	0	0	0	x 1 Ω	
Brown	1	1	1	x 10 Ω	+/- 1%
Red	2	2	2	x 100 Ω	+/- 2%
Orange	3	3	3	x 1K Ω	
Yellow	4	4	4	x 10K Ω	
Green	5	5	5	x 100K Ω	+/- .5%
Blue	6	6	6	x 1M Ω	+/- .25%
Violet	7	7	7	x 10M Ω	+/- .1%
Grey	8	8	8		+/- .05%
White	9	9	9		
Gold				x .1 Ω	+/- 5%
Silver				x .01 Ω	+/- 10%

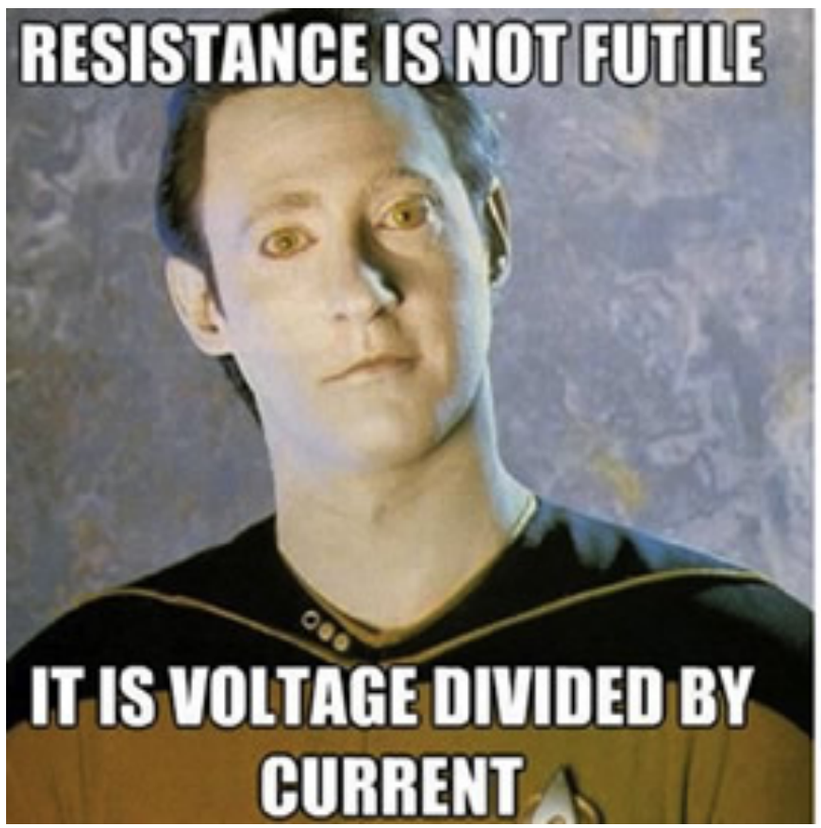
Legge di Ohm: $V = i \cdot R$ $R = \frac{V}{i}$

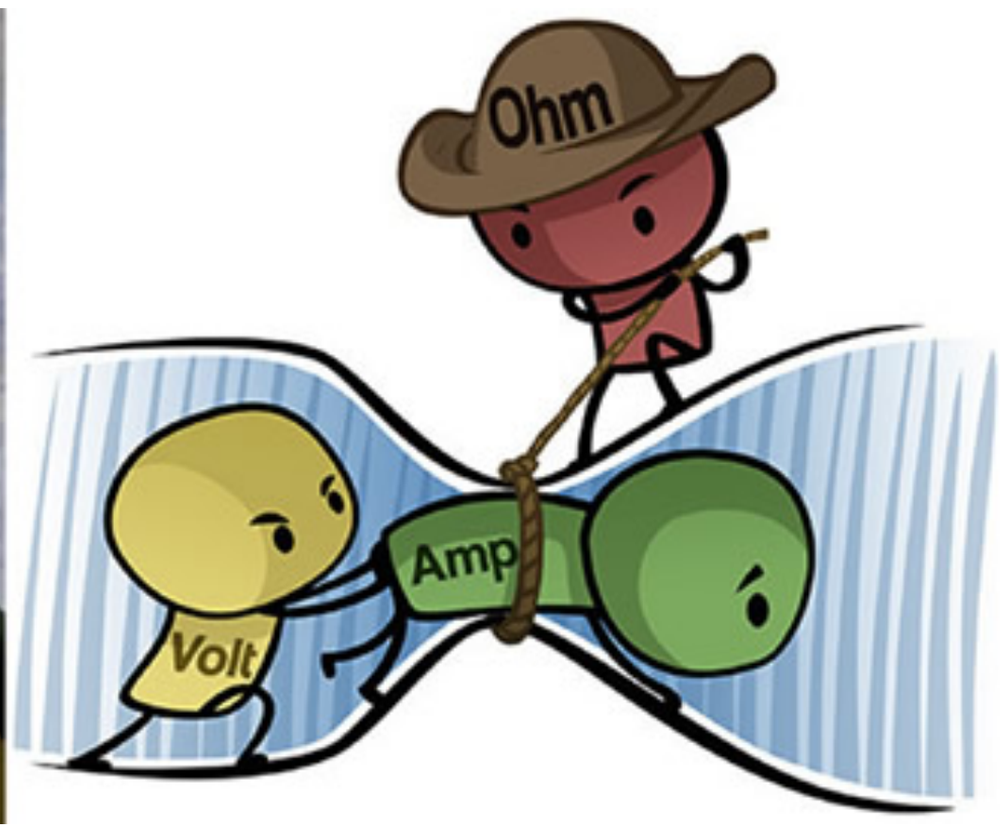


Se la batteria ha 5V, e il LED 2V / 20mA

$$R = \frac{V_{batteria} - V_{LED}}{A_{LED}}$$

150 Ohm



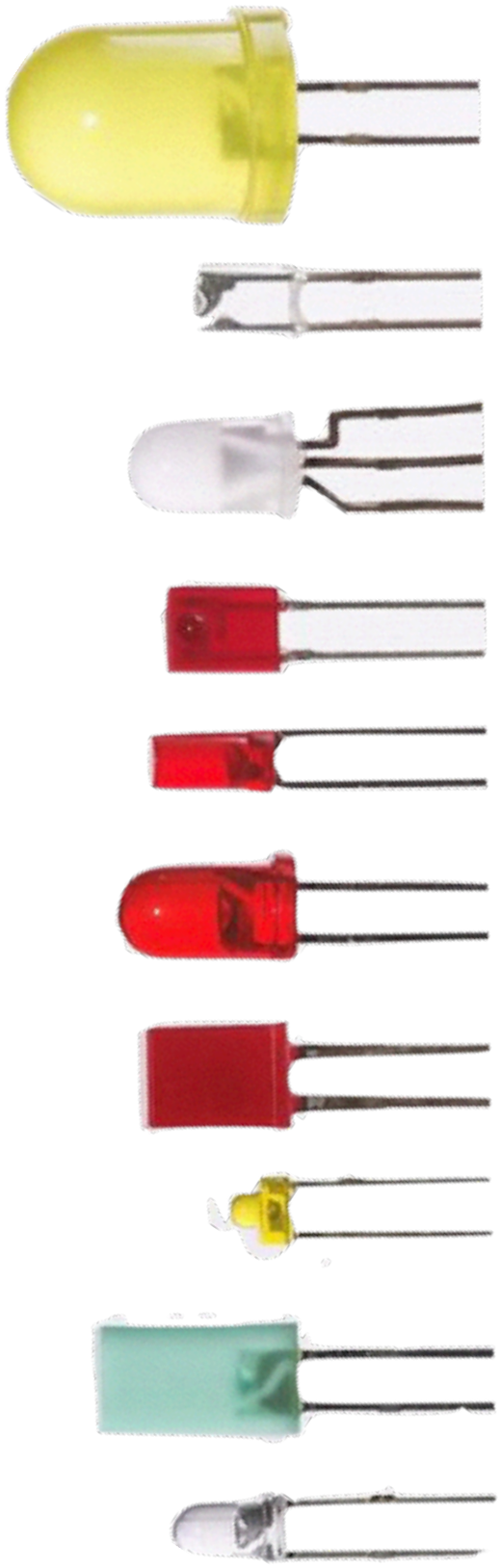


CHANGE THE CODE!

- Test different patterns
- Send an SoS

  … - - - …
- Heartbeat mode ❤️
- Try 10msec for both values

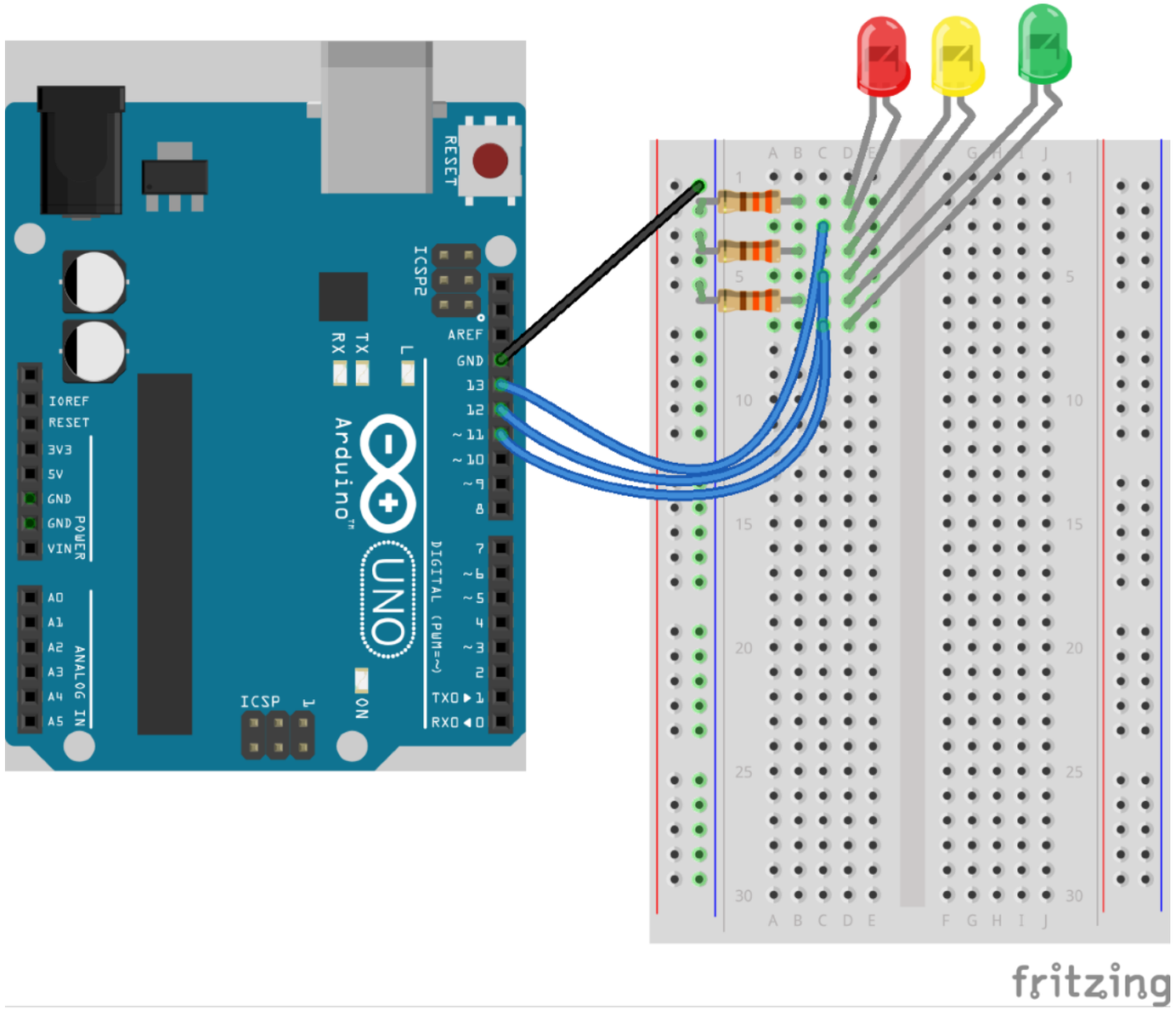
1,2,3 AND SO ON

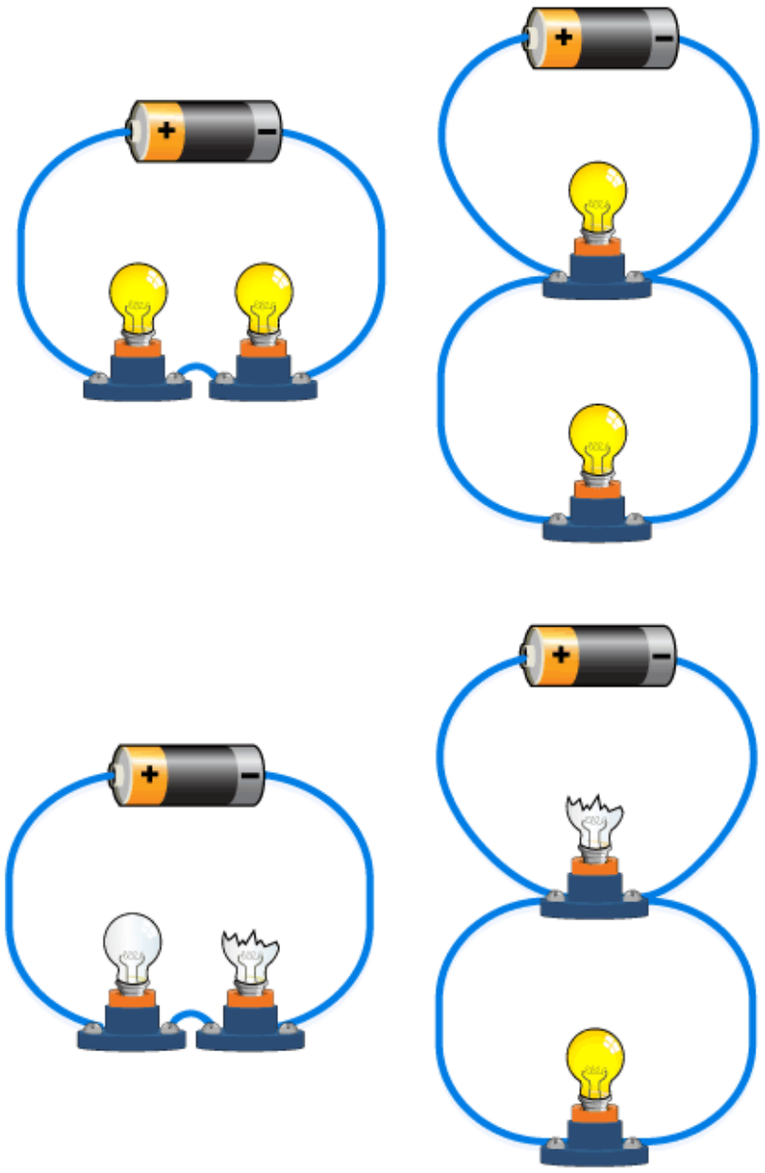


esp2_3LedaPWM

```
int led_1 = 13;
int led_2 = 12;
int led_3 = 11;

void setup()
{
  pinMode(led_1, OUTPUT);
  pinMode(led_2, OUTPUT);
  pinMode(led_3, OUTPUT);
}

void loop()
{
  digitalWrite(led_1, HIGH);
  digitalWrite(led_2, LOW);
  digitalWrite(led_3, LOW);
  delay(1000);

  digitalWrite(led_1, LOW);
  digitalWrite(led_2, HIGH);
  digitalWrite(led_3, LOW);
  delay(1000);

  digitalWrite(led_1, LOW);
  digitalWrite(led_2, LOW);
  digitalWrite(led_3, HIGH);
  delay(1000);
}
```

1,2,3 AND SO ON


RESET
ICSP2
AREF
GND
13
12
~11
~10
~9
8
7
~6
~5
4
~3
2
TX→1
RX←0
IOREF
RESET
3V3
5V
GND
GND
VIN
POWER
A0
A1
A2
A3
A4
A5
ANALOG IN
L
TX
RX
ON
ICSP
Arduino™
UNO
DIGITAL (PWM=~)
A B C D E F G H I J
1
5
10
15
20
25
30
fritzing



K.I.T.T.

```
void setup(){
  pinMode(13, OUTPUT);
  pinMode(12, OUTPUT);
  pinMode(11, OUTPUT);
  pinMode(10, OUTPUT);
  pinMode(9, OUTPUT);
  pinMode(8, OUTPUT);
}
```

```
void loop(){
  digitalWrite(13,HIGH);
  delay(200);
  digitalWrite(13,LOW);
  digitalWrite(12,HIGH);
  delay(100);
  digitalWrite(12,LOW);
  digitalWrite(11,HIGH);
  delay(100);
  digitalWrite(11,LOW);
  digitalWrite(10,HIGH);
  delay(100);
  digitalWrite(10,LOW);
  digitalWrite(9, HIGH);
  delay(100);
  digitalWrite(9,LOW);
  digitalWrite(8, HIGH);
  delay(200); // tempo di accensione più lungo sul pin 1
  digitalWrite(8, LOW);
  digitalWrite(9,HIGH);
  delay(100);
  digitalWrite(9,LOW);
  digitalWrite(10,HIGH);
  delay(100);
  digitalWrite(10,LOW);
  digitalWrite(11,HIGH);
  delay(100);
  digitalWrite(11,LOW);
  digitalWrite(12,HIGH);
  delay(100);
  digitalWrite(12,LOW);
  digitalWrite(13,HIGH);
  delay(100);
}
```

for (int i = 1; i <= 10; i++) {…}

esp2_3Ledfor

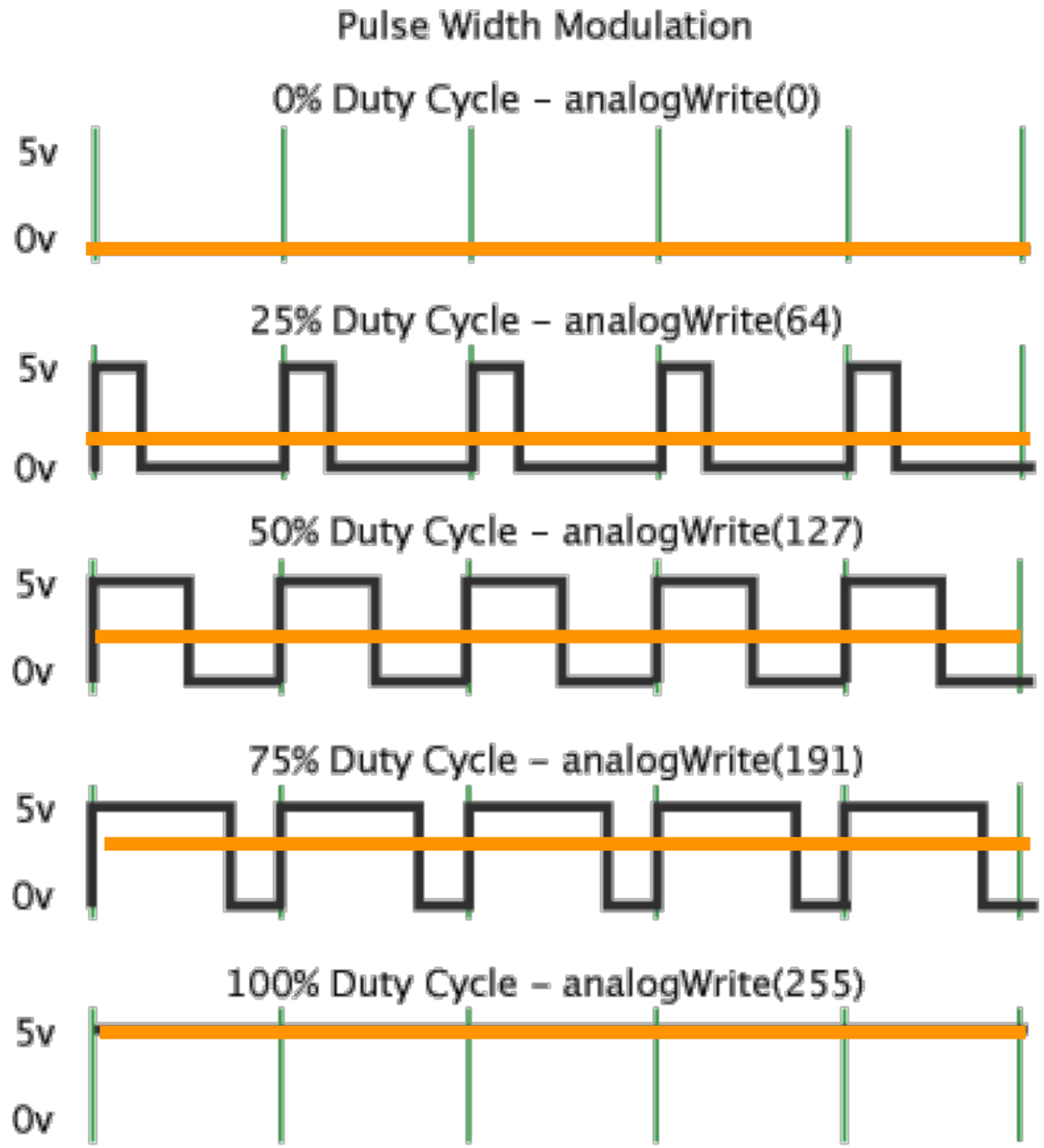
```
//Loop

int timer = 100;           // tempo

void setup() {
  // inizializza tutti i pin come OUTPUT
  for (int LEDpin = 10; LEDpin <= 13; LEDpin++) {
    pinMode(LEDpin, OUTPUT);
  }
}

void loop() {
  // loop dal primo all'ultimo
for (int LEDpin = 10; LEDpin <= 13; LEDpin++) {
    // accende
    digitalWrite(LEDpin, HIGH);
    delay(timer);
    // spegne
    digitalWrite(LEDpin, LOW);
  }

  // loop dall'ultimo al primo

  for (int LEDpin = 13; LEDpin >= 10; LEDpin--) {
    // accende
    digitalWrite(LEDpin, HIGH);
    delay(timer);
    // spegne
    digitalWrite(LEDpin, LOW);
```

Supercar

PWM

It can emulate an analog signal on a digital port

analogWrite(PWMpin, 0-255);



To vary LED brightness using POV effect
To change the speed of rotation of a motor
As an anagogic output, filtering it you obtain a voltage between 0 and 5V

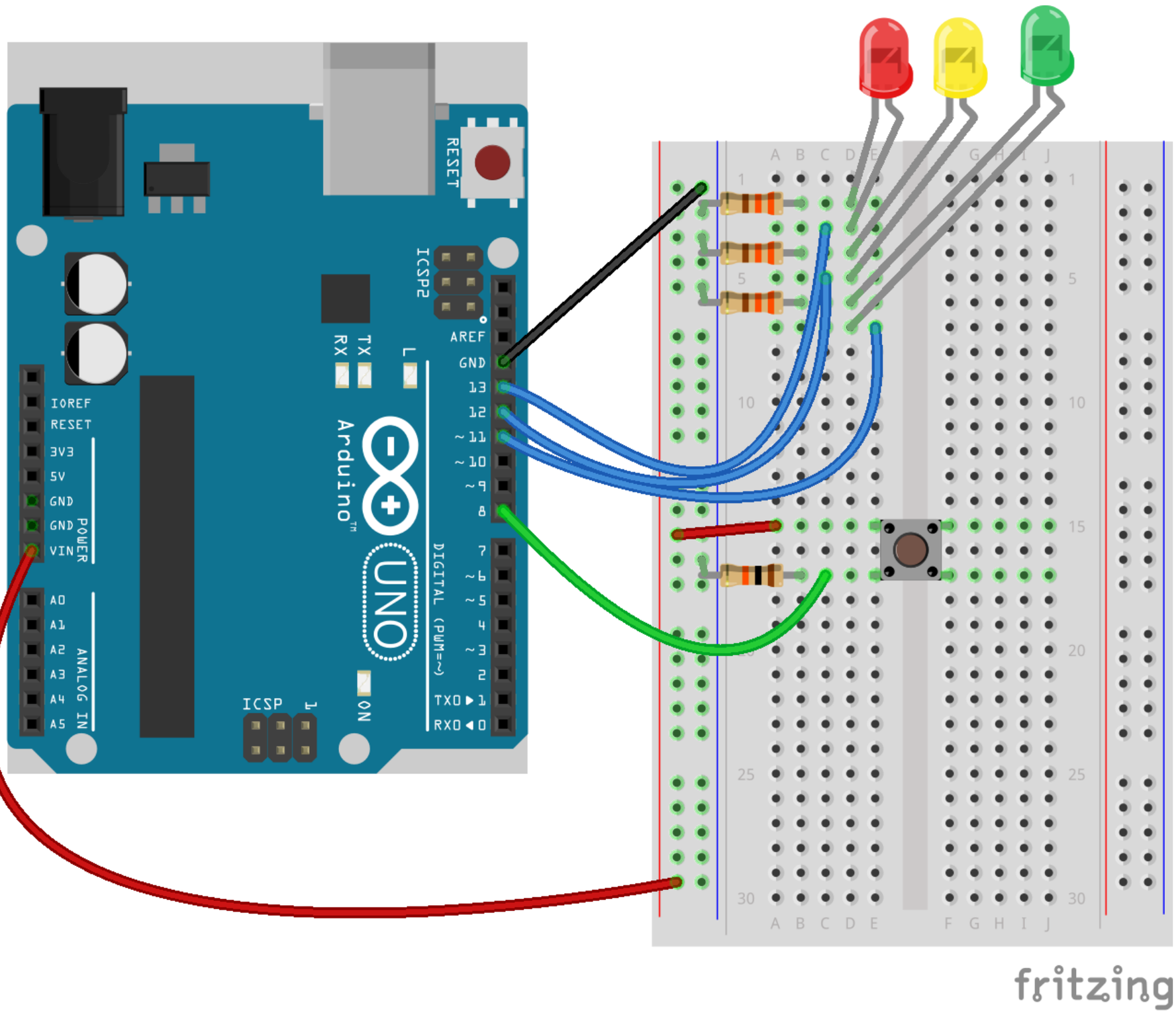
for (int i = 1; i <= 10; i++) {…}

esp2_3Ledb

```
//pulsazione
int ledPin = 11;
int luminosita = 0;
int timer = 10;           // tempo

void setup() {
}

void loop() {
    for (int luminosita = 0; luminosita <= 255; luminosita++) {
  analogWrite(ledPin, luminosita);
  delay(timer);
    }

    for (int luminosita = 255; luminosita >= 0; luminosita--) {
  analogWrite(ledPin, luminosita);
  delay(timer);
    }
}
```

Supercar

1,2,3 AND SO ON

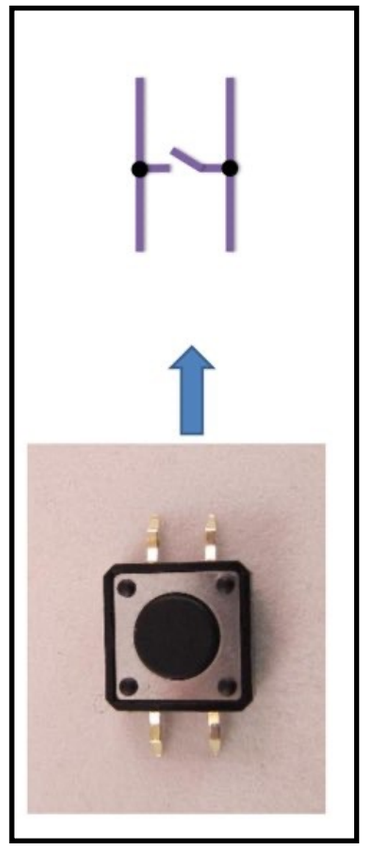


OFF:

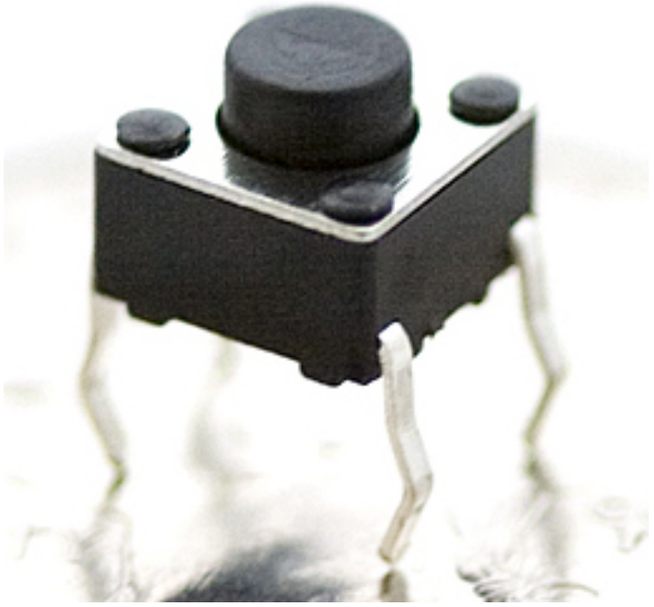
pin8>resistenza>Ground

ON:

pin8>5V>Ground



LED pulsante



if (switchstate == LOW) {…}
else {…}

esp3_button

```
int led1 = 13;
int led2 = 12;
int led3 = 11;
int bottone = 8;
int switchstate = 0; //variabile di stato del bottone

void setup(){
  pinMode(led1,OUTPUT);   //led1
  pinMode(led2,OUTPUT);   //led2
  pinMode(led3,OUTPUT);   //led3
  pinMode(bottone,INPUT); //bottone
}

void loop(){

  switchstate = digitalRead(bottone); //legge lo stato del bottone

  // se il bottone NON è premuto
  if (switchstate == LOW) {
    digitalWrite(led1, HIGH); //  accende il led1
    digitalWrite(led2, HIGH); //  accende il led2
    digitalWrite(led3, HIGH); //  accende il led3
  }
  // se il bottone è premuto
  else {
    digitalWrite(led1, LOW);  //spegne il led1
    digitalWrite(led2, LOW);  //spegne il led2
    digitalWrite(led3, LOW);  //spegne il led3
  }
}
```

Fading

```
/*
 Fading
 */

int ledPin = 11;

void setup()  {
}

void loop()  {
     analogWrite(ledPin, 250);
  }
```

Done Saving.

analogWrite(PWMpin, 0-255);

E_pulsazione

```
//pulsazione
int ledPin = 11;
int luminosita = 0;
int timer = 3;           // tempo

void setup() {
}

void loop() {
for (int luminosita = 0; luminosita <= 255; luminosita++) {
    analogWrite(ledPin, luminosita);
    delay(timer);
  }

for (int luminosita = 255; luminosita >= 0; luminosita--) {
    analogWrite(ledPin, luminosita);
    delay(timer);
  }


}
```

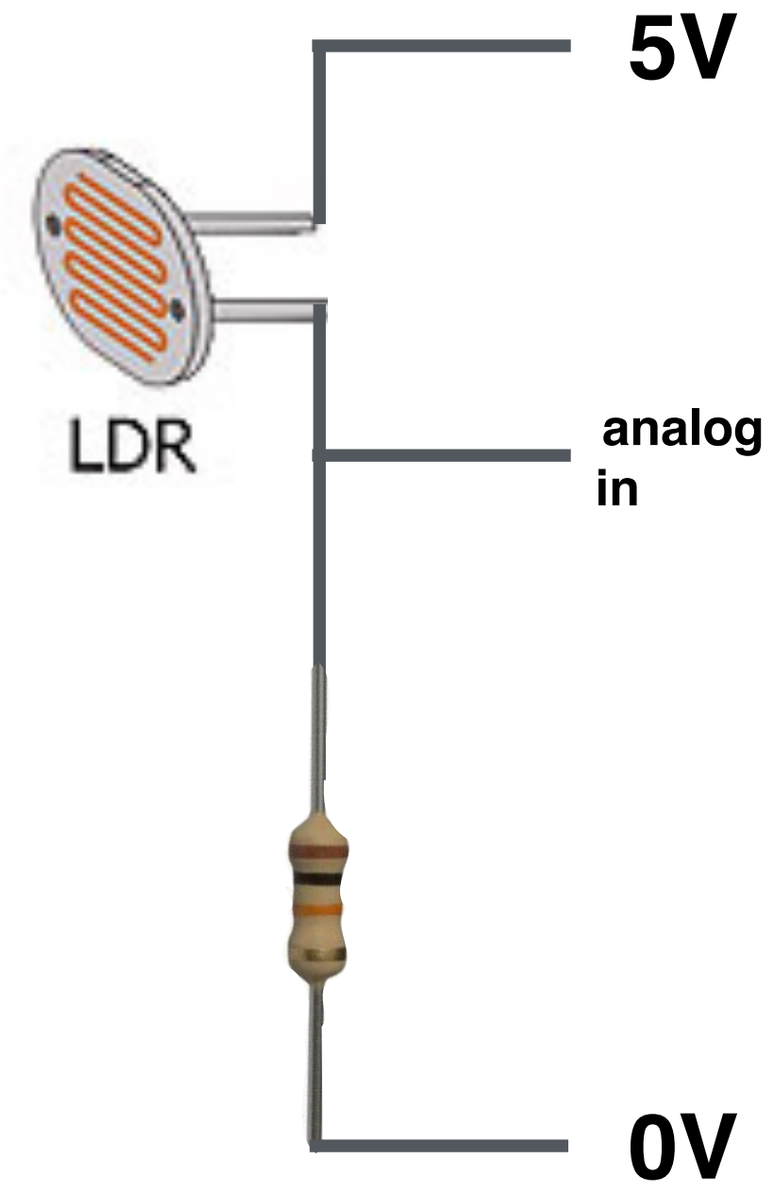
Done Saving.

Photoresistor

alla luce: ~2KΩ
al buio: > 2MΩ

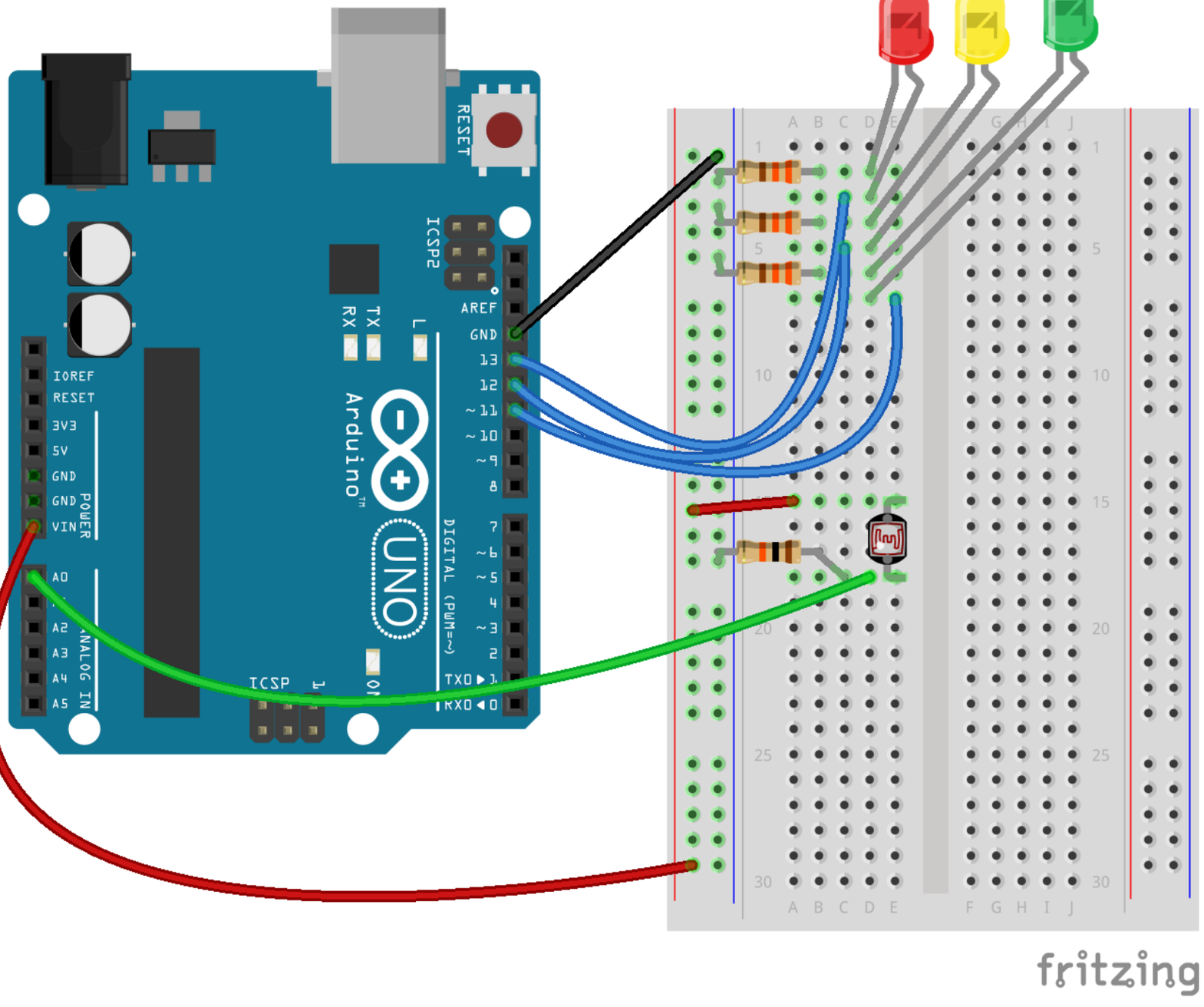
marrone	1
nero	0
arancio	x1000
oro	±5%

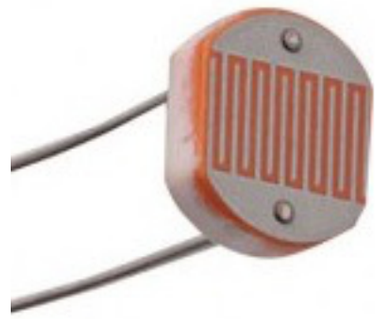
10KΩ = 10000Ω

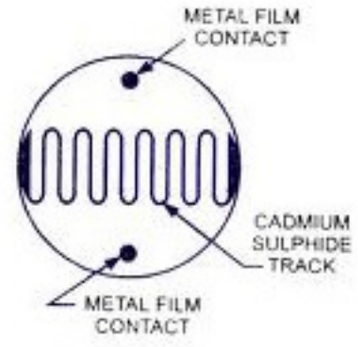


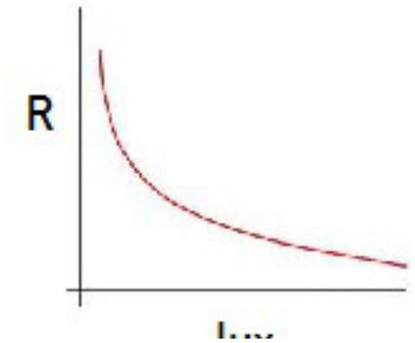
partitore di tensione

1,2,3 LIGHT AND SHADOW









SERIAL MONITOR

esp5_LDR1

```
int sensorPin = A0; // select the input pin for LDR
int sensorValue = 0; // variable to store the value coming from the s

void setup()
{
  Serial.begin(9600); //sets serial port for communication

}
void loop()
{
  sensorValue = analogRead(sensorPin); // read the value from the ser
  Serial.println(sensorValue); //prints the values coming from the se

  delay(100);
}
```

If

Else

esp5_LDRTreshold

```
int sensorPin = A0;   // select the input pin for ldr
int sensorValue = 0;  // variable to store the value coming from the sensor
int Led3 = 11;
void setup() {
  pinMode(Led3, OUTPUT); //pin connected to the relay
  Serial.begin(9600); //sets serial port for communication
}

void loop() {
  // read the value from the sensor:
  sensorValue = analogRead(sensorPin);
  Serial.println(sensorValue); //prints the values coming from the sensor on the screen

  if(sensorValue < 80) //setting a threshold value
  digitalWrite(Led3,HIGH); //turn  ON

  else digitalWrite(Led3,LOW); //turn  OFF

  delay(100);
}
```

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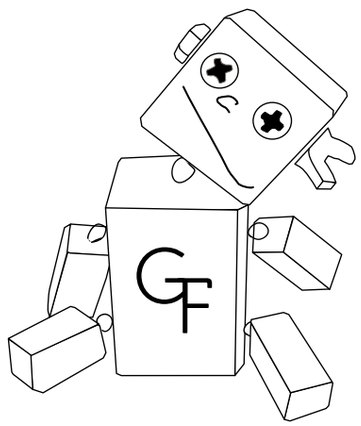

Gaia Fior