Intro to Physical Computing

aka How to make Daft Punk Helmets 101.

CC Lab (Fall 2016)

Git

git pull

More…..

http://rogerdudler.github.io/git-guide/

Terminal for PowerUser

Zsh?!

Oh-My-Zsh?!

Iterm!?

Markdown

Readme.md

Markdown

Readme.md

Markdown

Windows -> MarkDownPad
Mac-> MacDown

Markdown

https://github.com/adam-p/markdown-here/wiki/Markdown-Cheatsheet

What’s an “Arduino”?

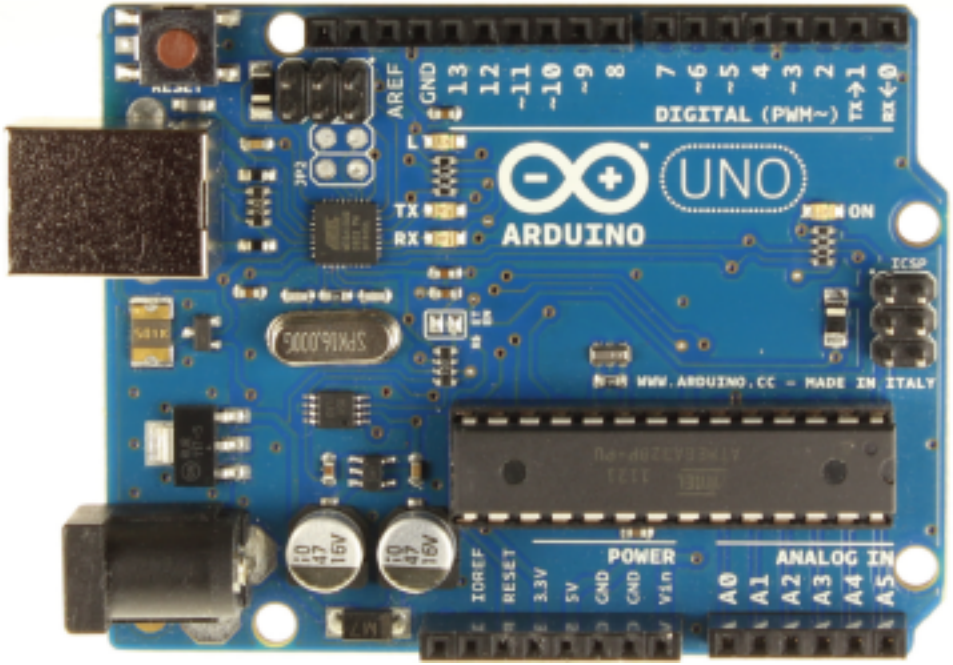
Microcontroller
- Input/Output machine

Made for rapid prototyping
- (without requiring custom boards design)

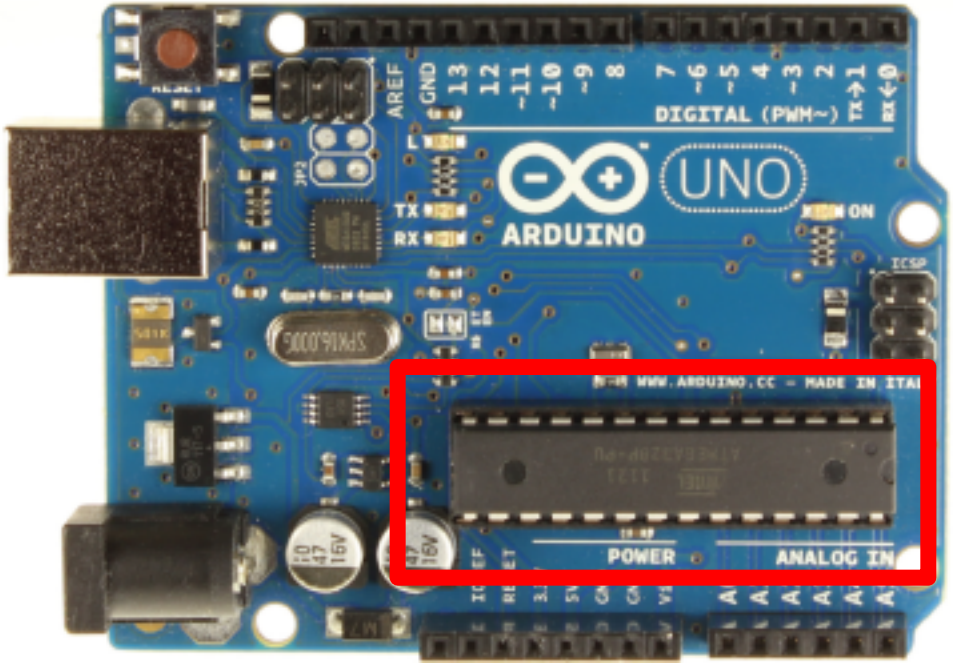
Open source

Large community to support it

What’s on the board?



The Brain - ATmega 328p chip



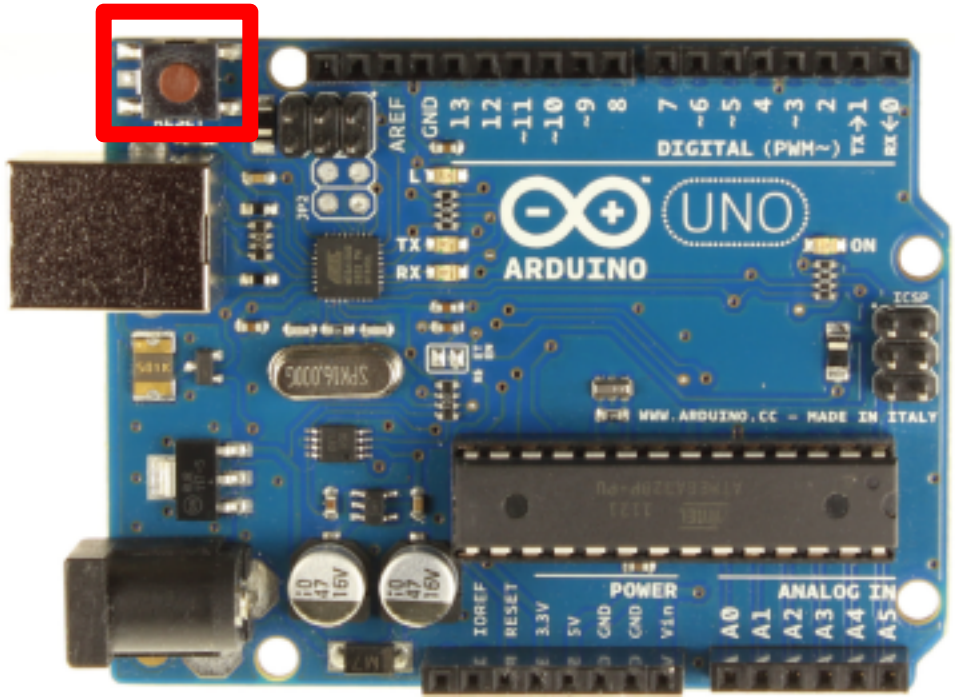
You can also pull it out.
Careful! Don't bend the pins

Digital Pins

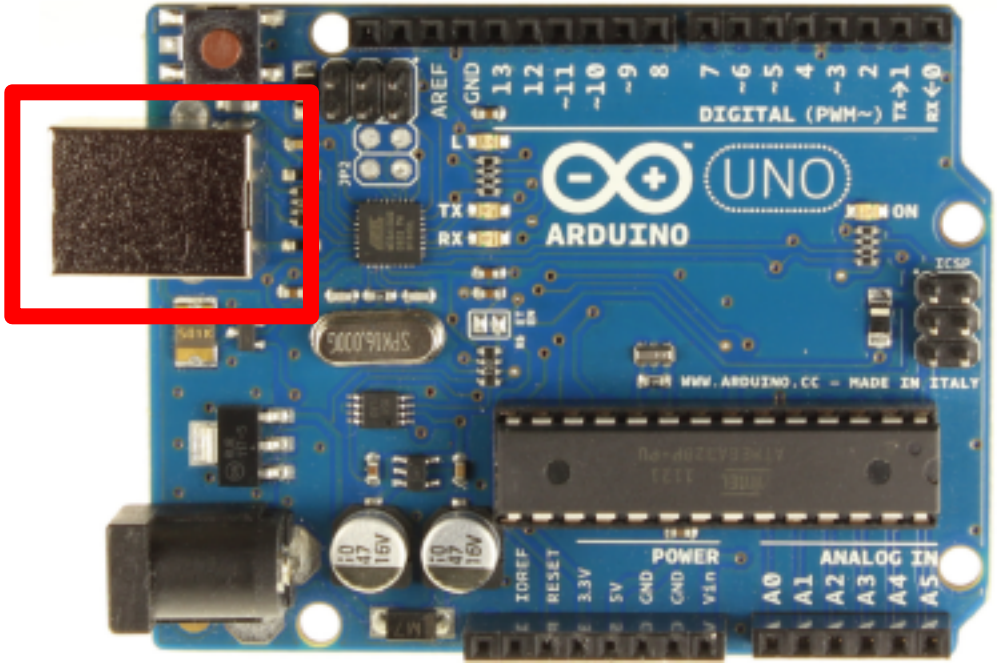
Analog Pins


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

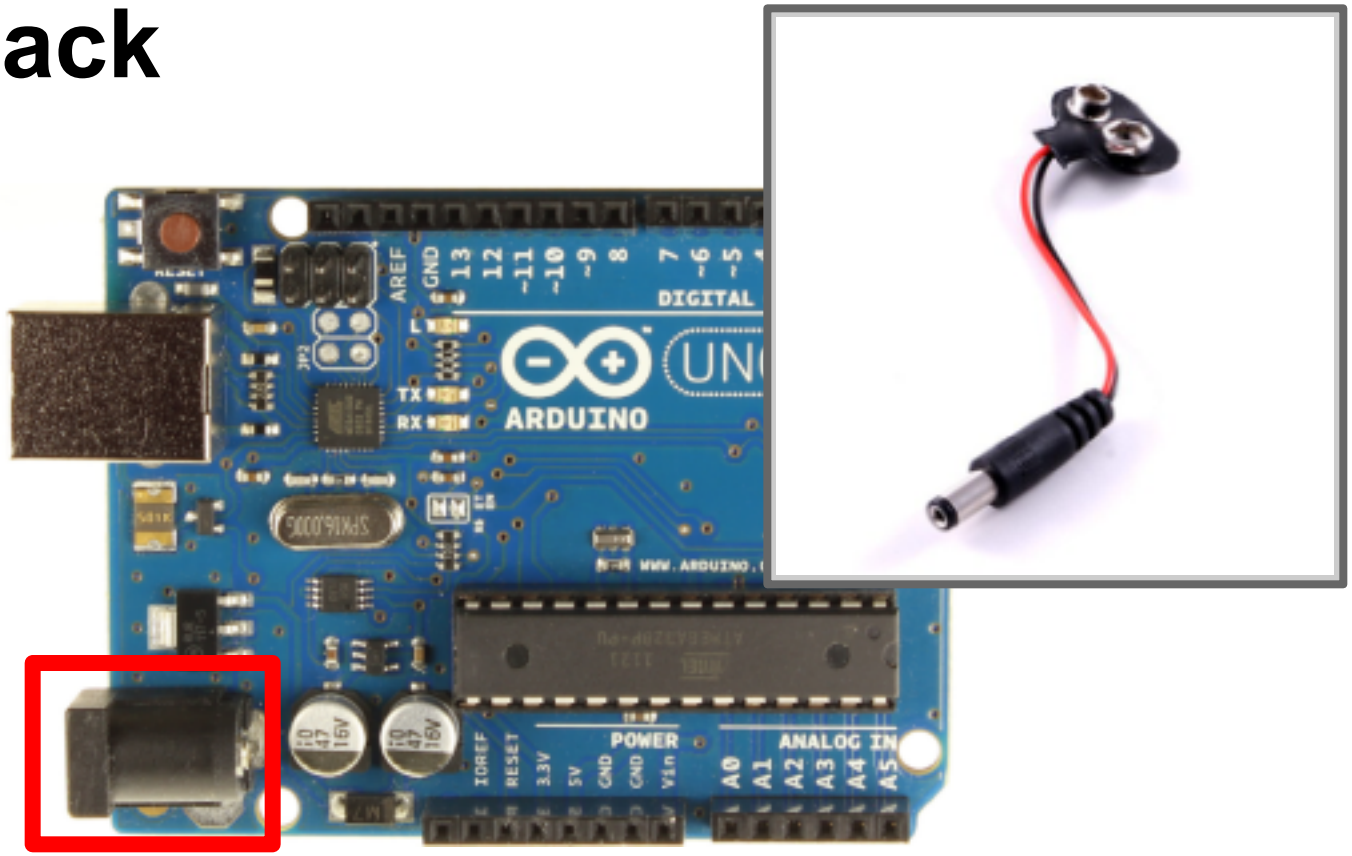
Reset Button



USB Port


DIGITAL (PWM~)
UNO
ARDUINO
ON
TX
RX
ICSP
WWW.ARDUINO.CC – MADE IN ITALY
POWER
ANALOG IN
IOREF
RESET
3.3V
5V
GND
GND
Vin
A0
A1
A2
A3
A4
A5

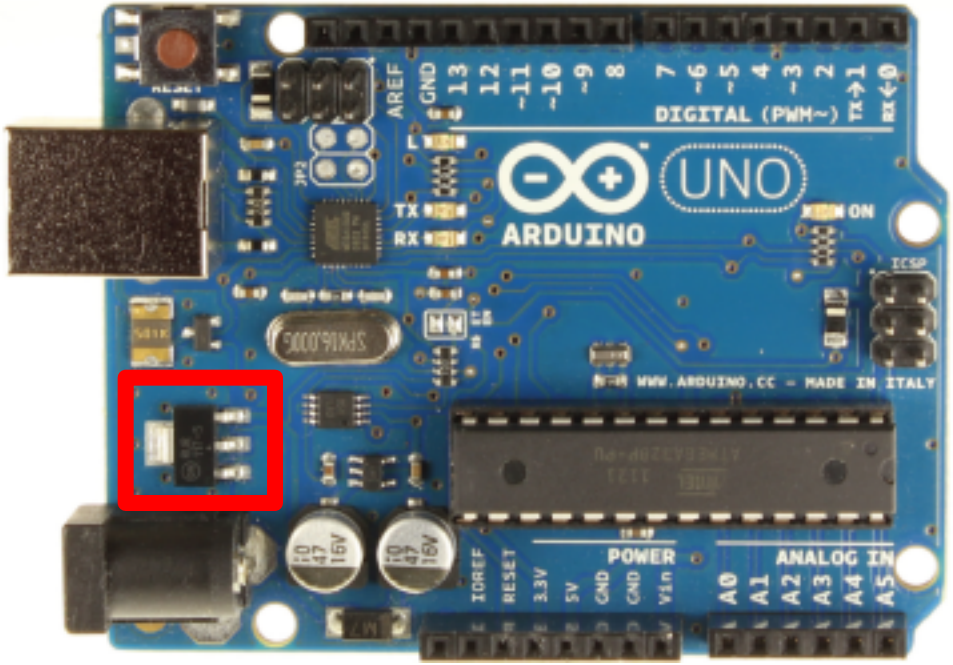
Power Jack



PRO-TIP: Buy one of these

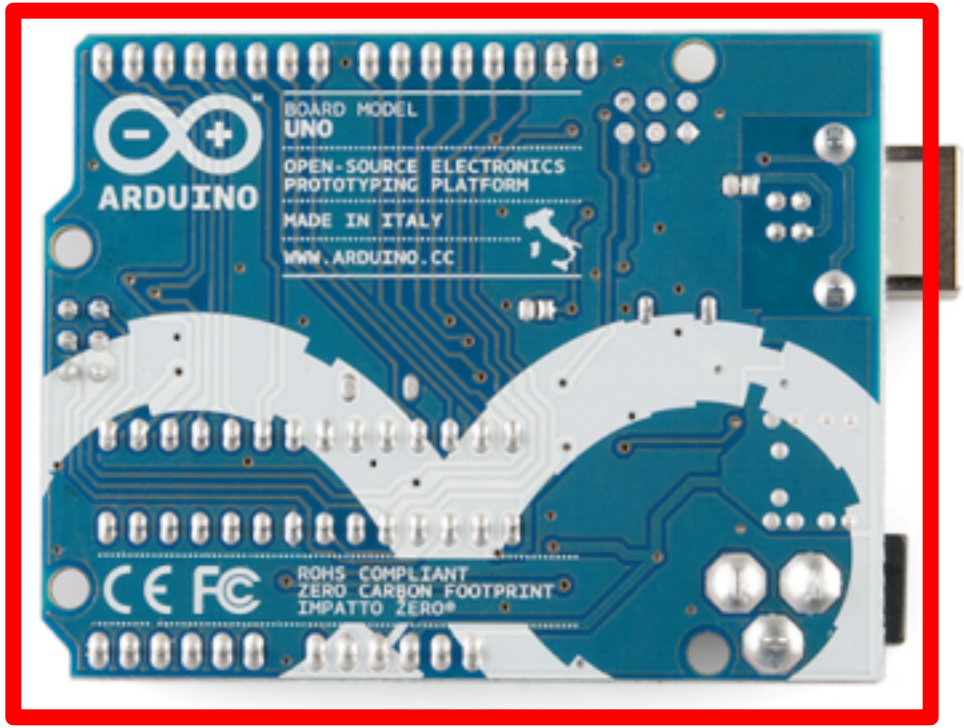
Specs: http://playground.arduino.cc/Learning/WhatAdapter

Voltage Regulator

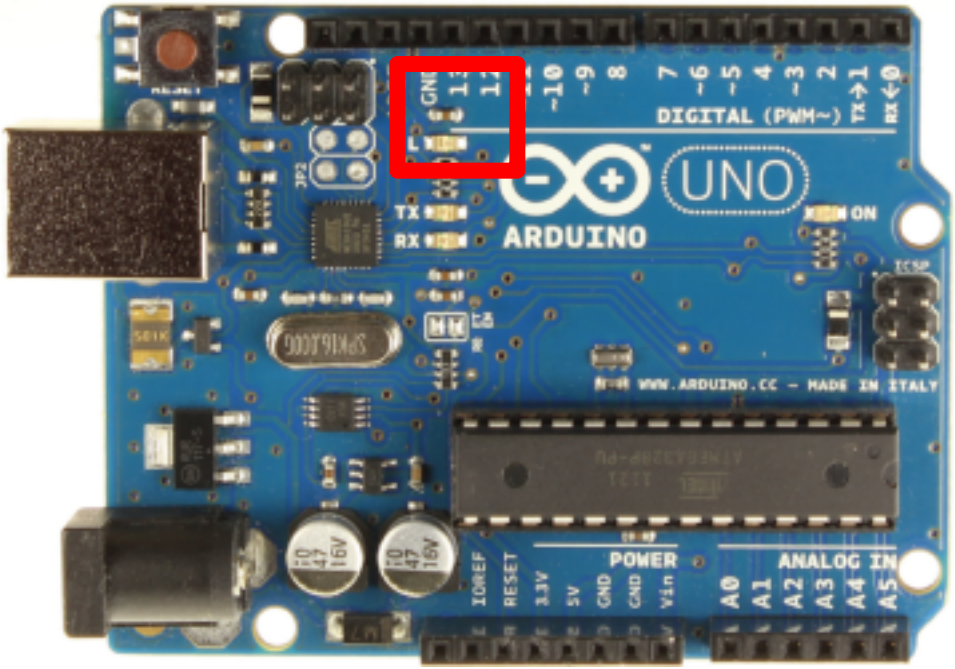


Vin, 5V, 3.3V, GND, Reset pins

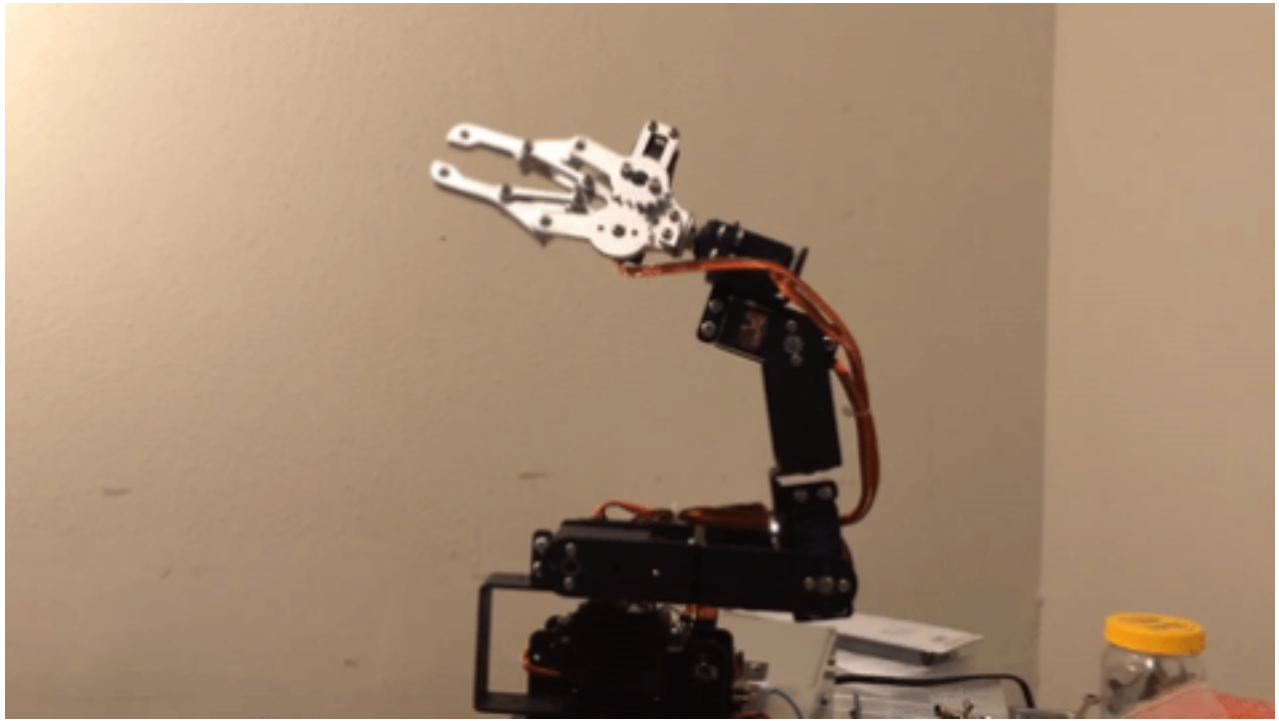
Back of Arduino



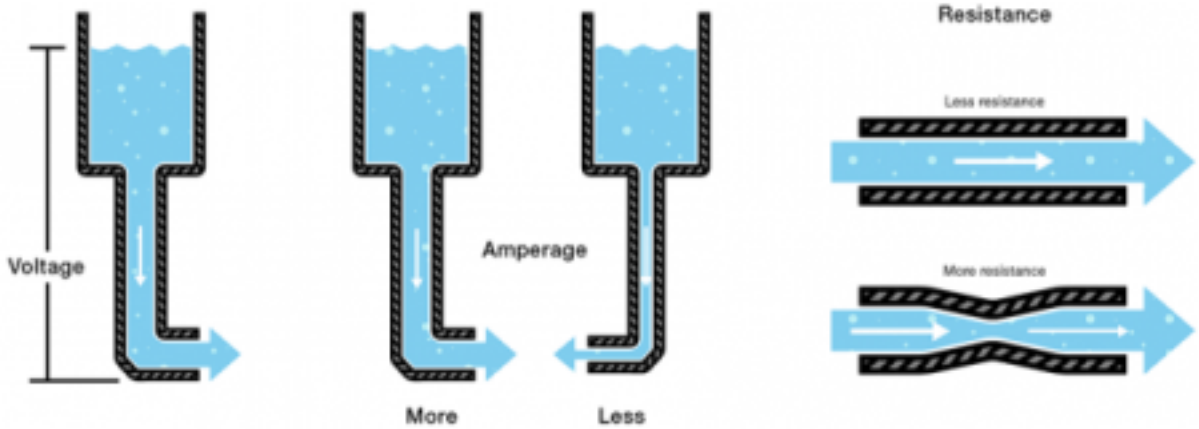
Internal LED



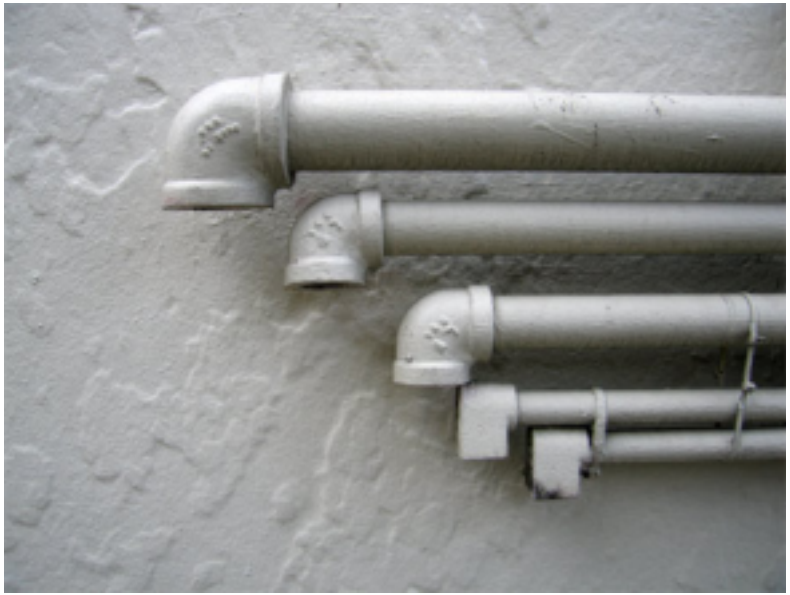
YAY ELECTRONICS!



Ohms Law:
V = IR

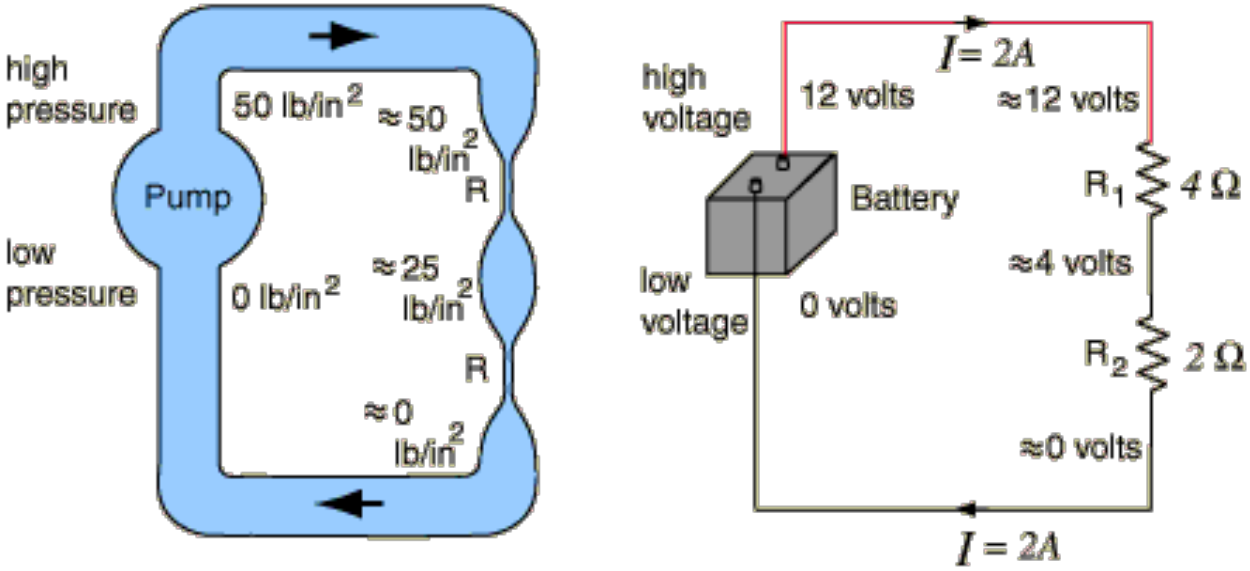

Voltage
Amperage
More
Less
Resistance
Less resistance
More resistance

Wires = Pipes



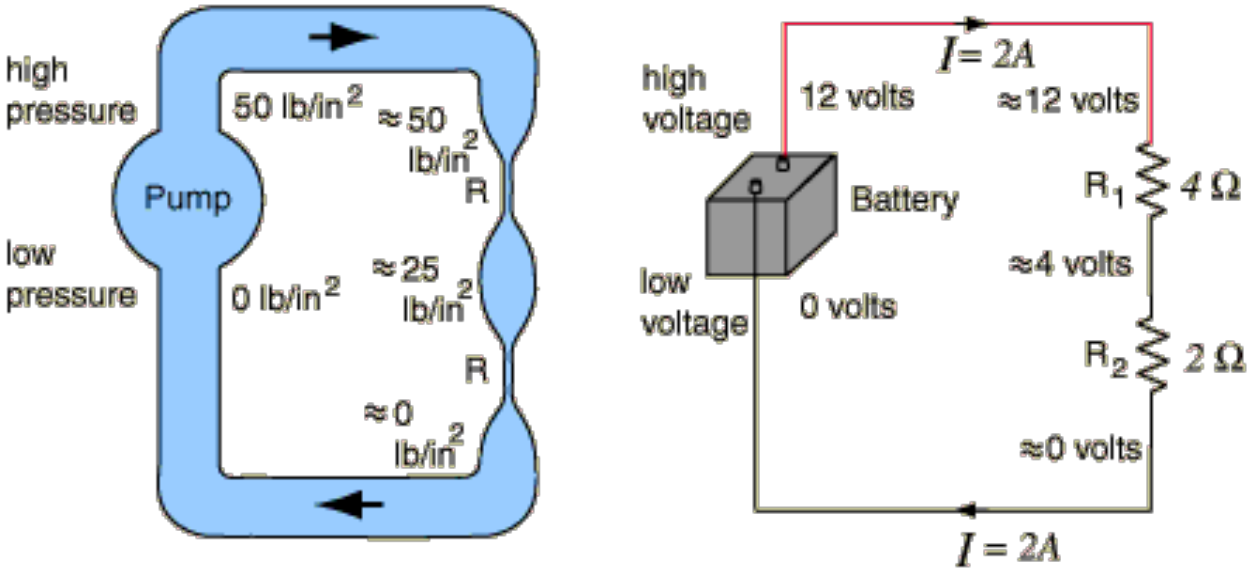
Battery = Water Pump

Voltage (V) = water pressure



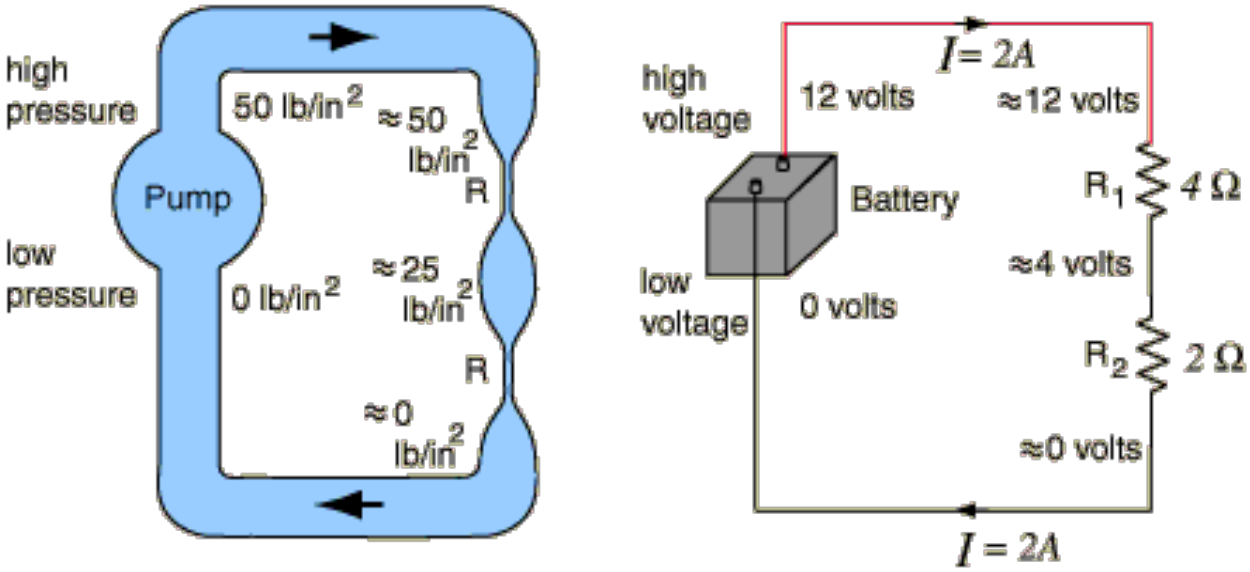
The force with which electrons are being pushed through the wire

Current (I) = how much water flow



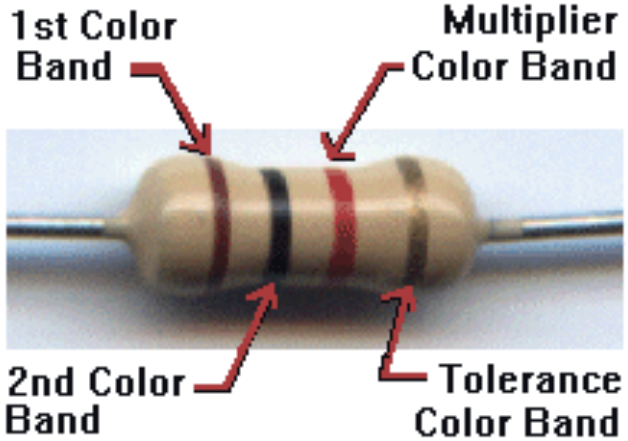
The amount of electrons moving through the wire at any given moment

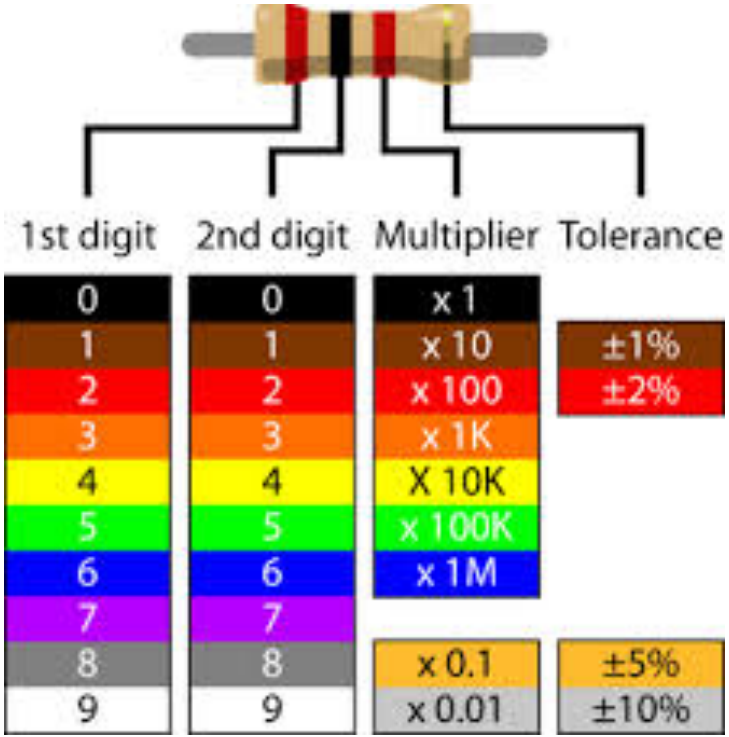
Resistance (Ohm or Ω) = Pinched pipe



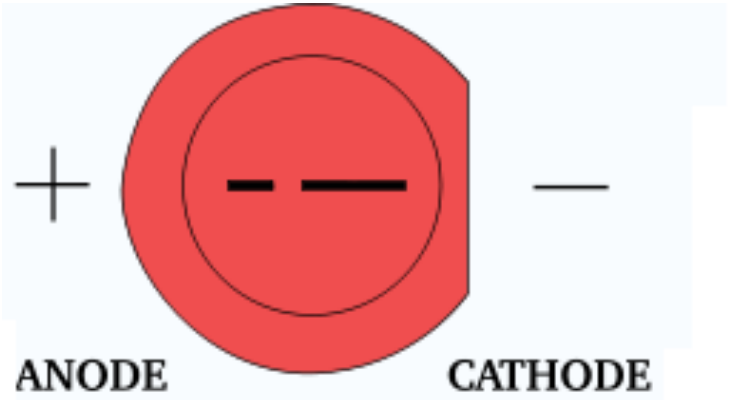
The amount of electrons moving through the wire at any given moment

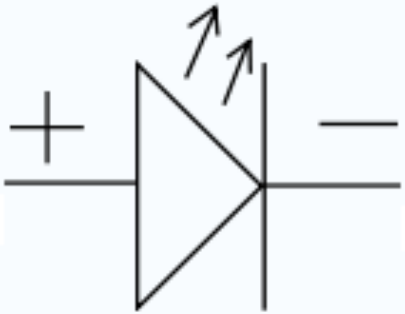
Resistors

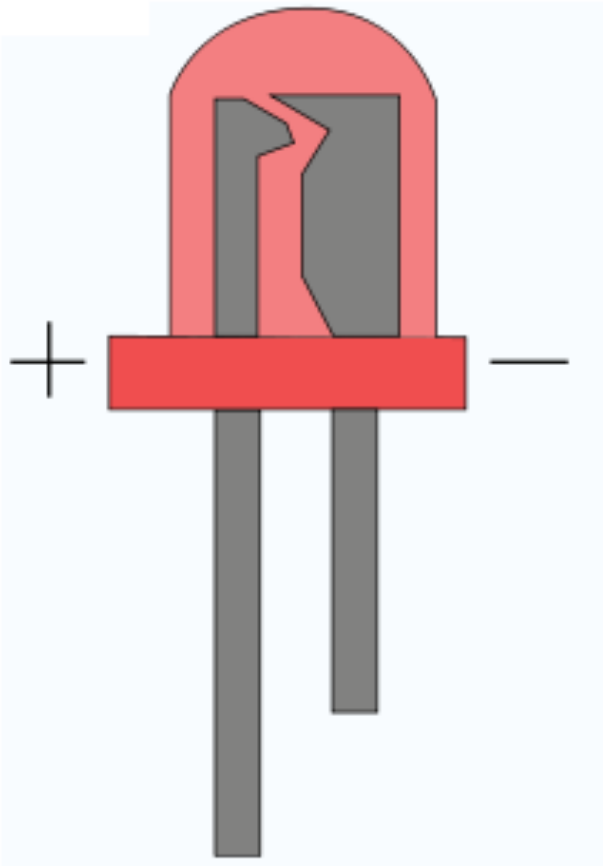

1st Color Band
Multiplier Color Band
2nd Color Band
Tolerance Color Band


1st digit
2nd digit
Multiplier
Tolerance
0
1
2
3
4
5
6
7
8
9
x 1
x 10
x 100
x 1K
X 10K
x 100K
x 1M
x 0.1
x 0.01
±1%
±2%
±5%
±10%

LEDs

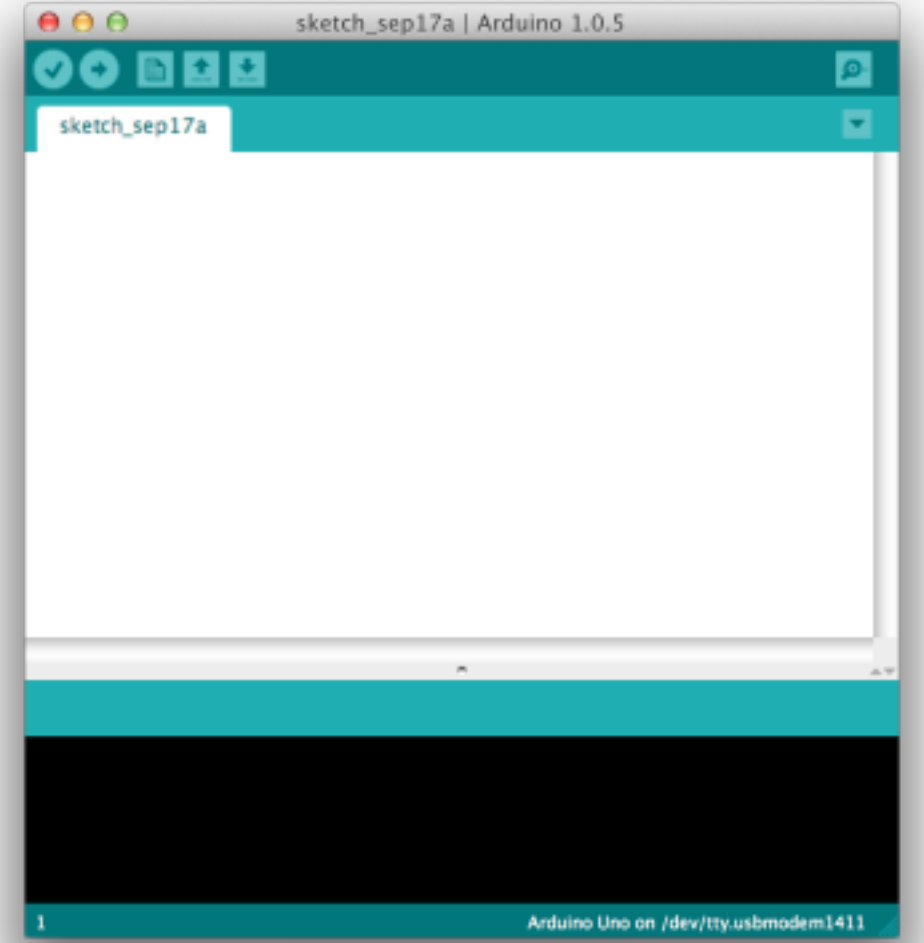






Arduino IDE

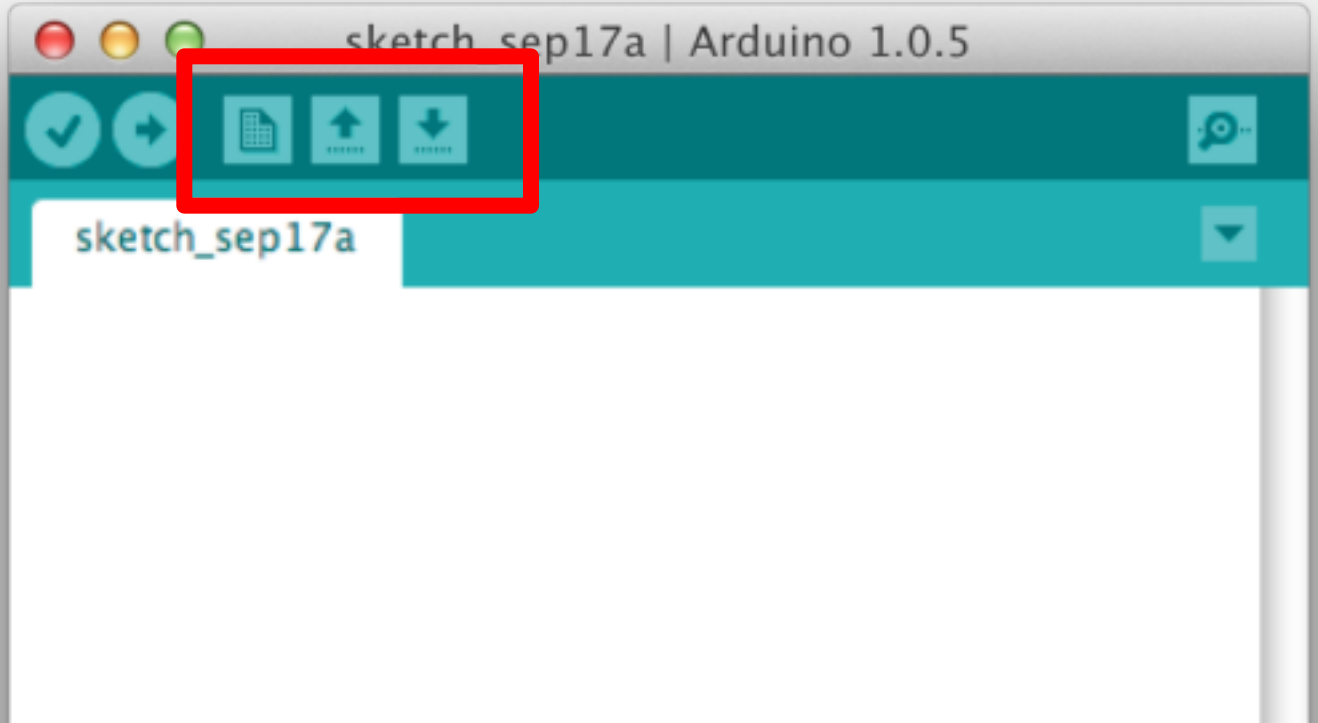
(Integrated Dev Environment)



Verify Button

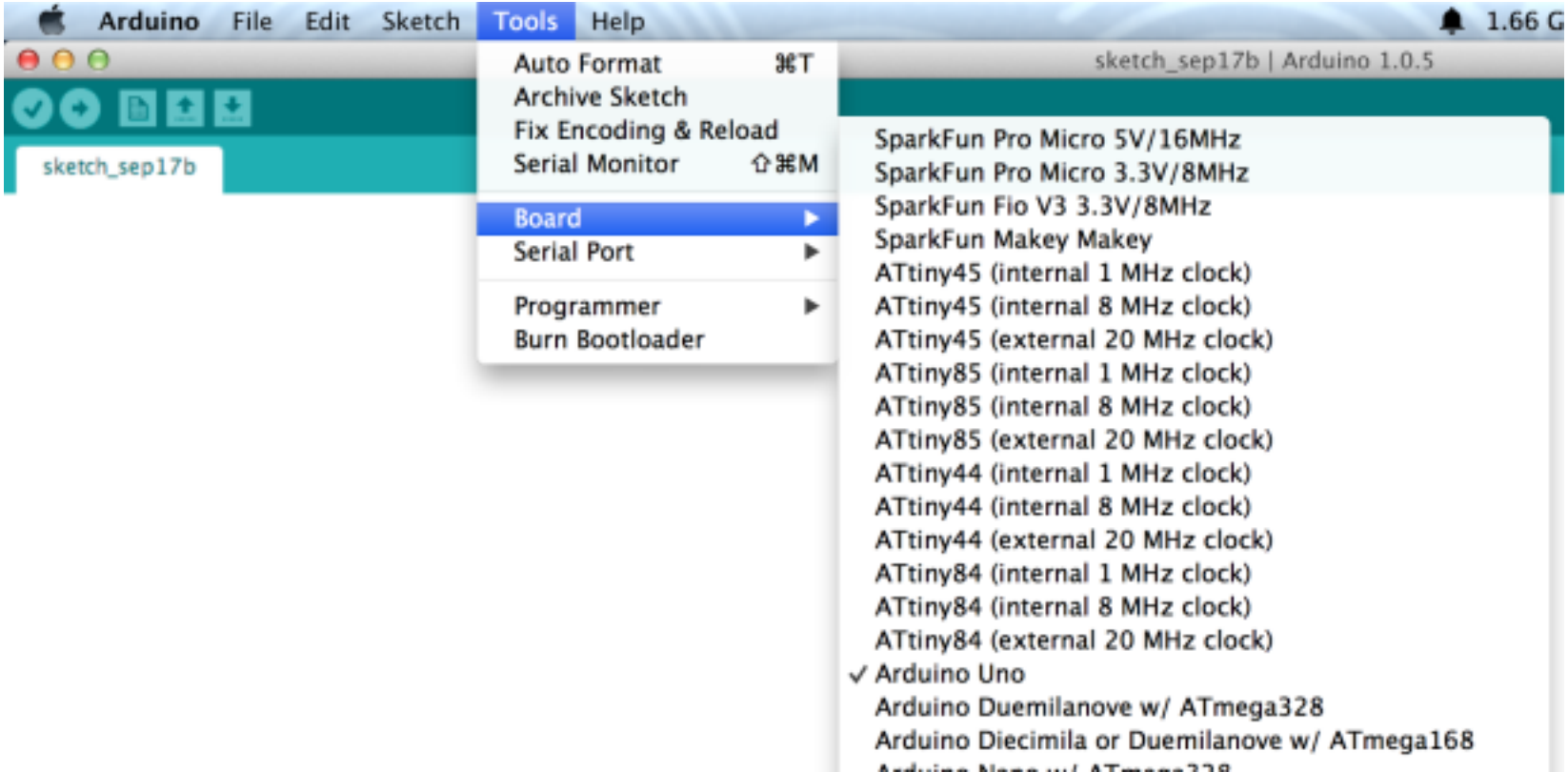
Upload Button

New, Open, Save...

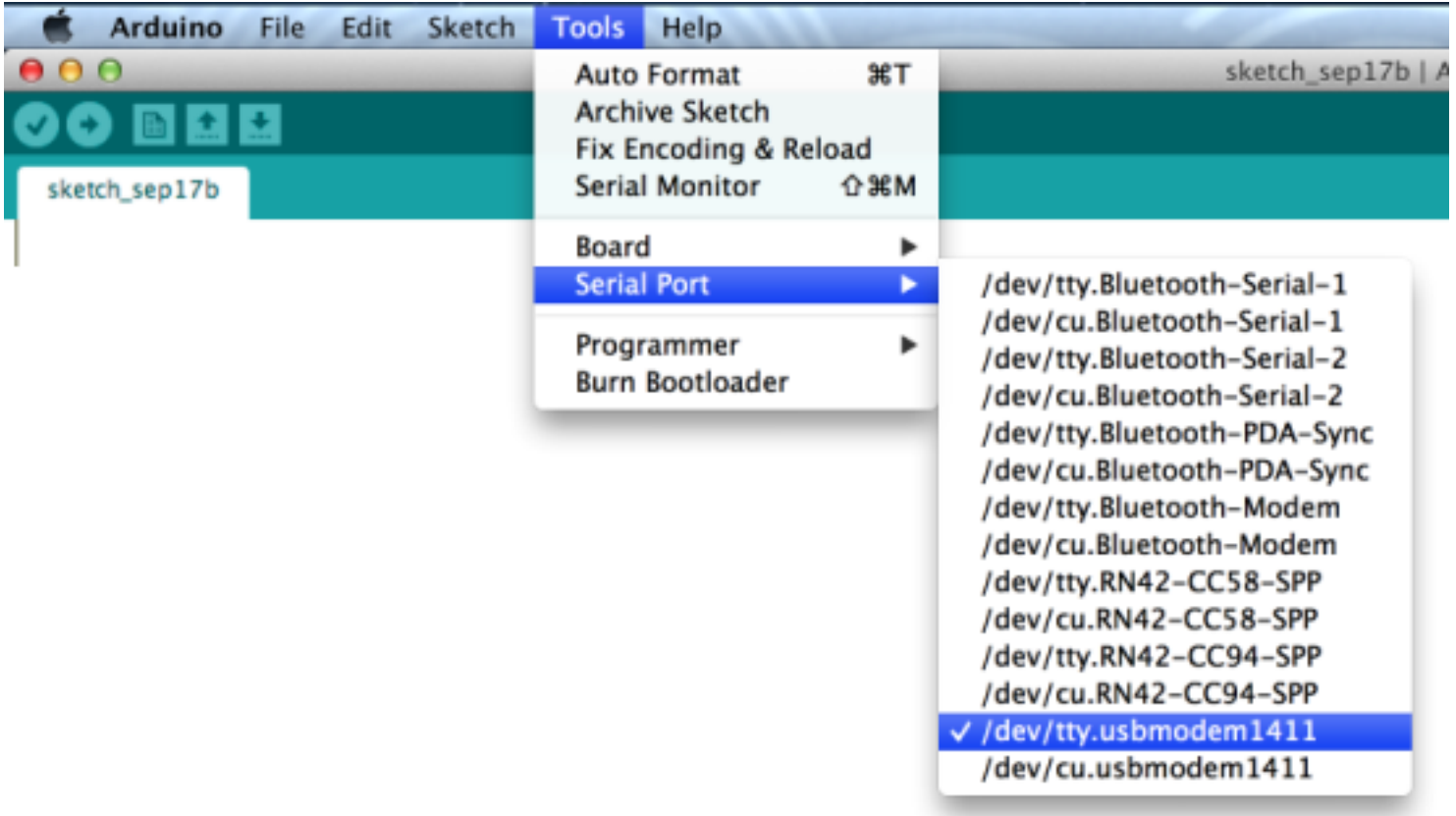


Serial Monitor

Tools > Board


Arduino
File
Edit
Sketch
Tools
Help
1.66 G
sketch_sep17b | Arduino 1.0.5
sketch_sep17b
Auto Format ⌘T
Archive Sketch
Fix Encoding & Reload
Serial Monitor ⇧⌘M
Board
Serial Port
Programmer
Burn Bootloader
SparkFun Pro Micro 5V/16MHz
SparkFun Pro Micro 3.3V/8MHz
SparkFun Fio V3 3.3V/8MHz
SparkFun Makey Makey
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

Tools > Serial Port



File > Examples > Basics > Blink sketch

```
// Pin 13 has an LED connected on most Arduino boards.
// give it a name:
int led = 13;

// the setup routine runs once when you press reset:
void setup() {
  // initialize the digital pin as an output.
  pinMode(led, OUTPUT);
}

// the loop routine runs over and over again forever:
void loop() {
  digitalWrite(led, HIGH);   // turn the LED on (HIGH is the voltage level)
  delay(1000);               // wait for a second
  digitalWrite(led, LOW);    // turn the LED off by making the voltage LOW
  delay(1000);               // wait for a second
}
```

File > Examples > Basics > Blink sketch

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  delay(1000);               // wait for a second
  digitalWrite(led, LOW);    // turn the LED off by making the voltage LOW
  delay(1000);               // wait for a second
}
```

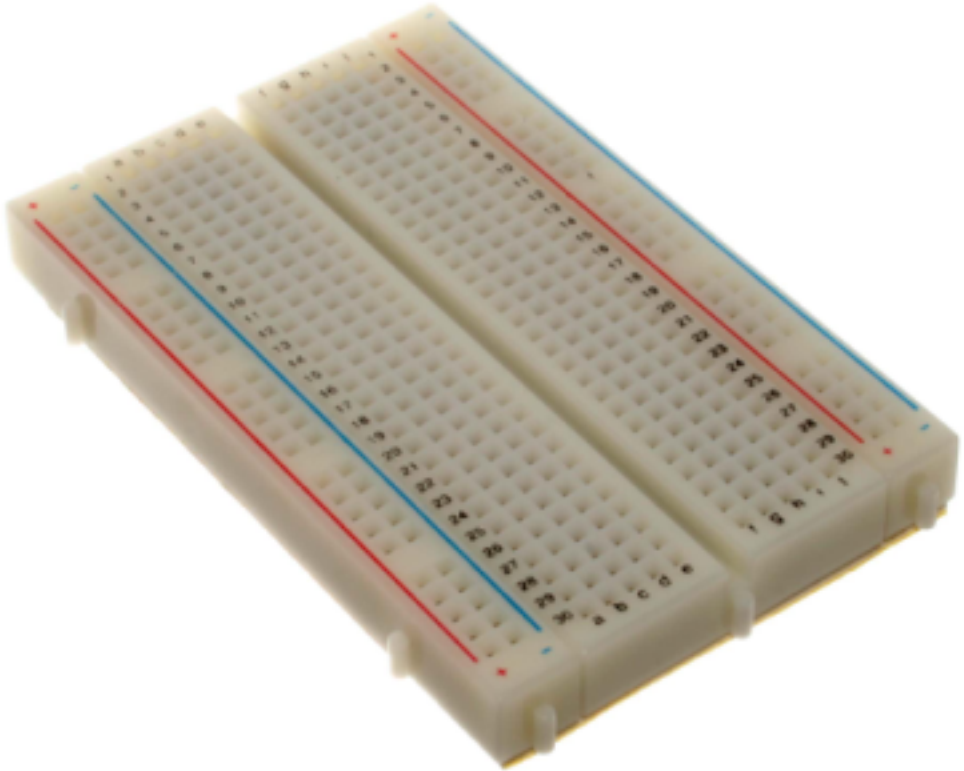
Add some “debugging” code

```
void setup() {
  //start the serial connection from Arduino back to computer
  Serial.begin(9600);

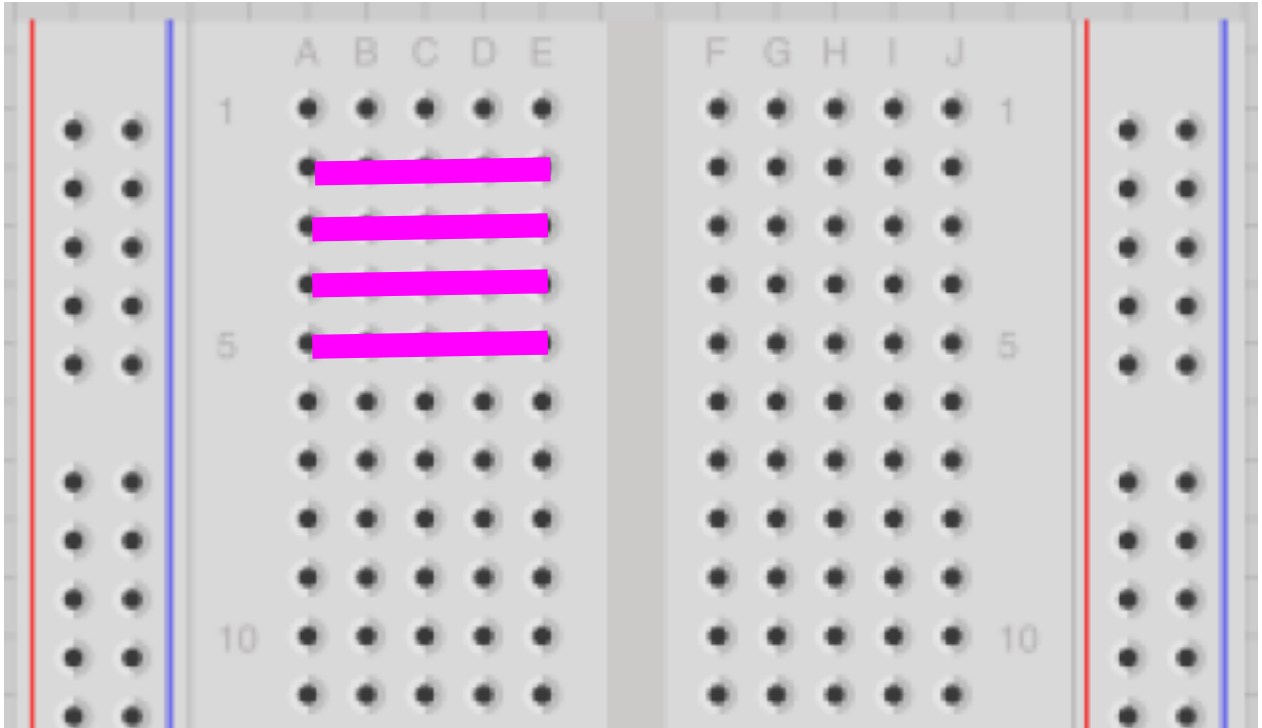
  // initialize the digital pin as an output.
  pinMode(led, OUTPUT);
}

// the loop routine runs over and over again forever:
void loop() {
  digitalWrite(led, HIGH);   // turn the LED on (HIGH is the voltage level)
  Serial.println("LED is On");
  delay(1000);               // wait for a second
  digitalWrite(led, LOW);    // turn the LED off by making the voltage LOW
  Serial.println("LED is Off");
  delay(1000);               // wait for a second
}
```

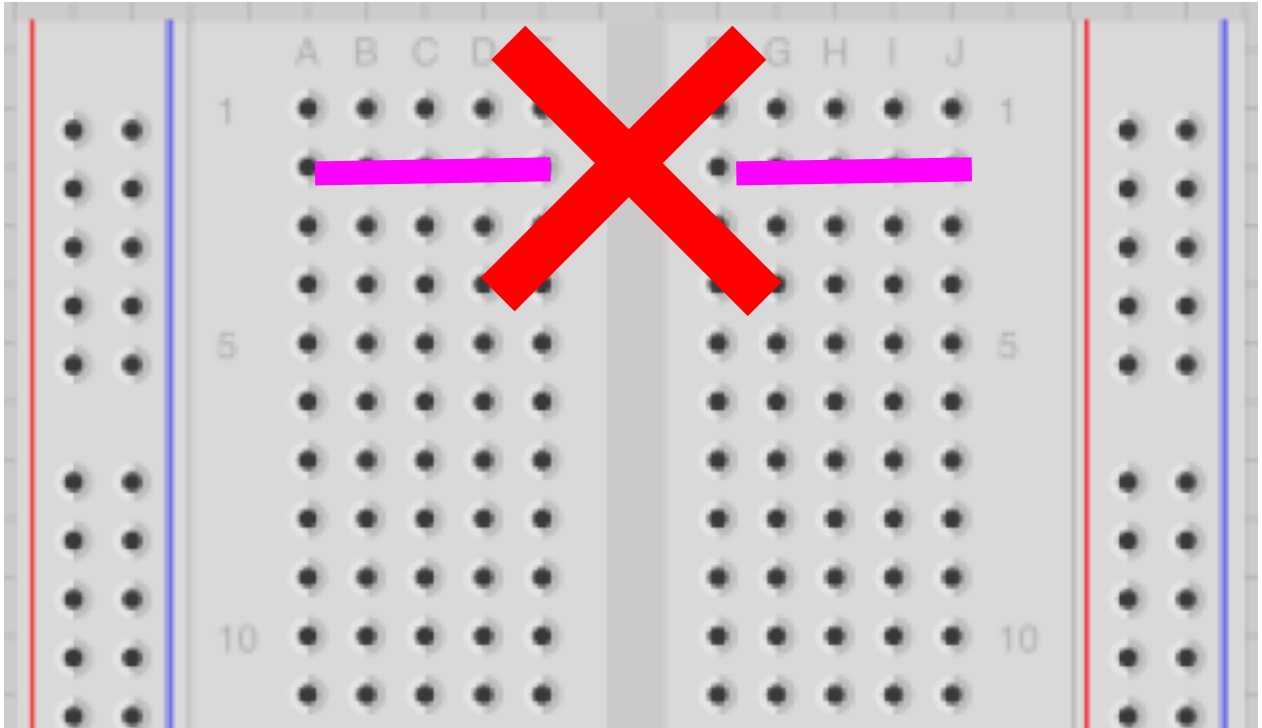
Breadboarding



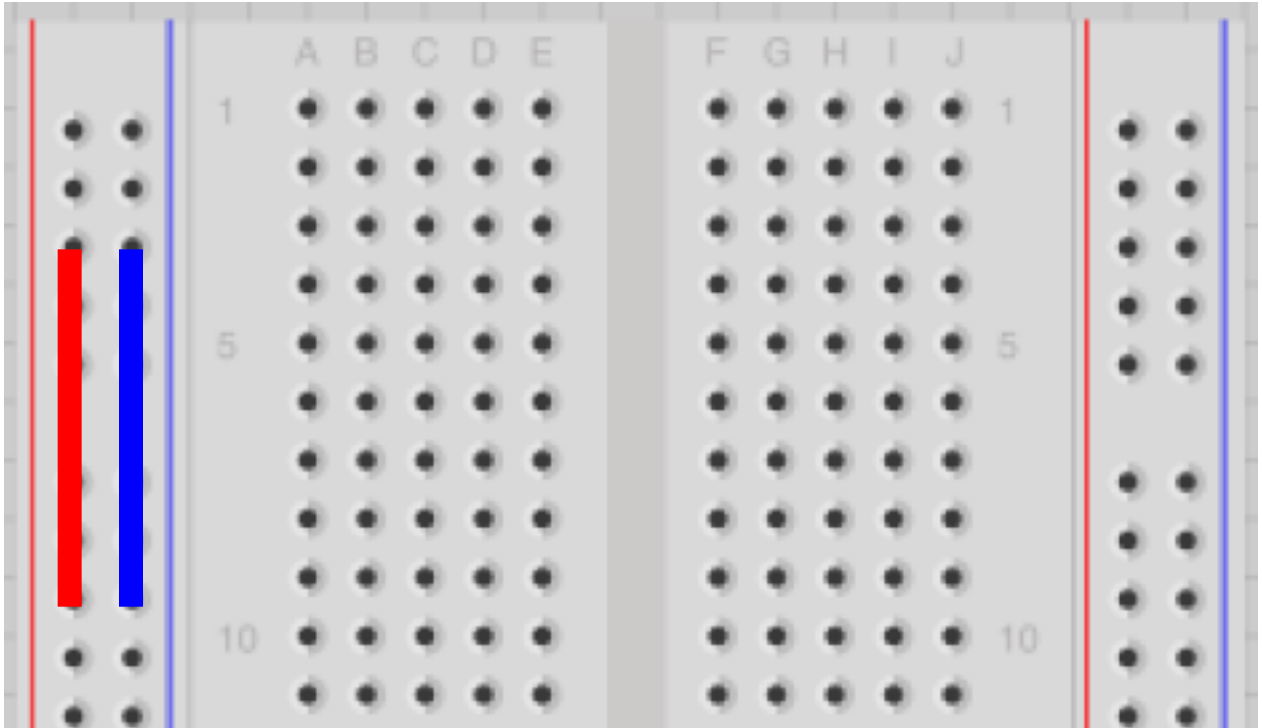
Breadboard Connections



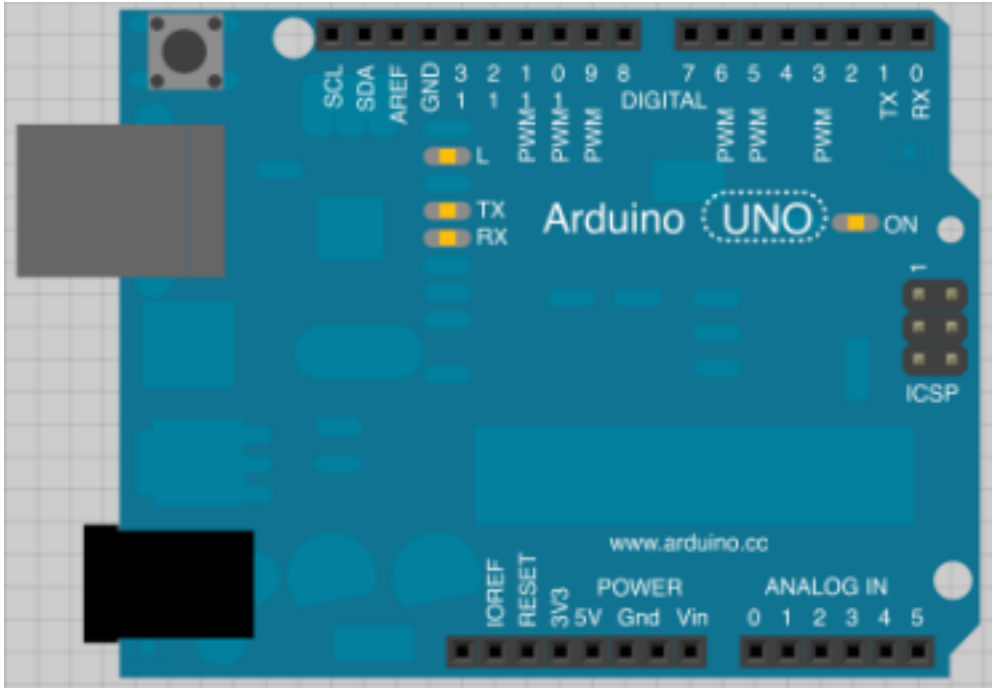
Breadboard Rows



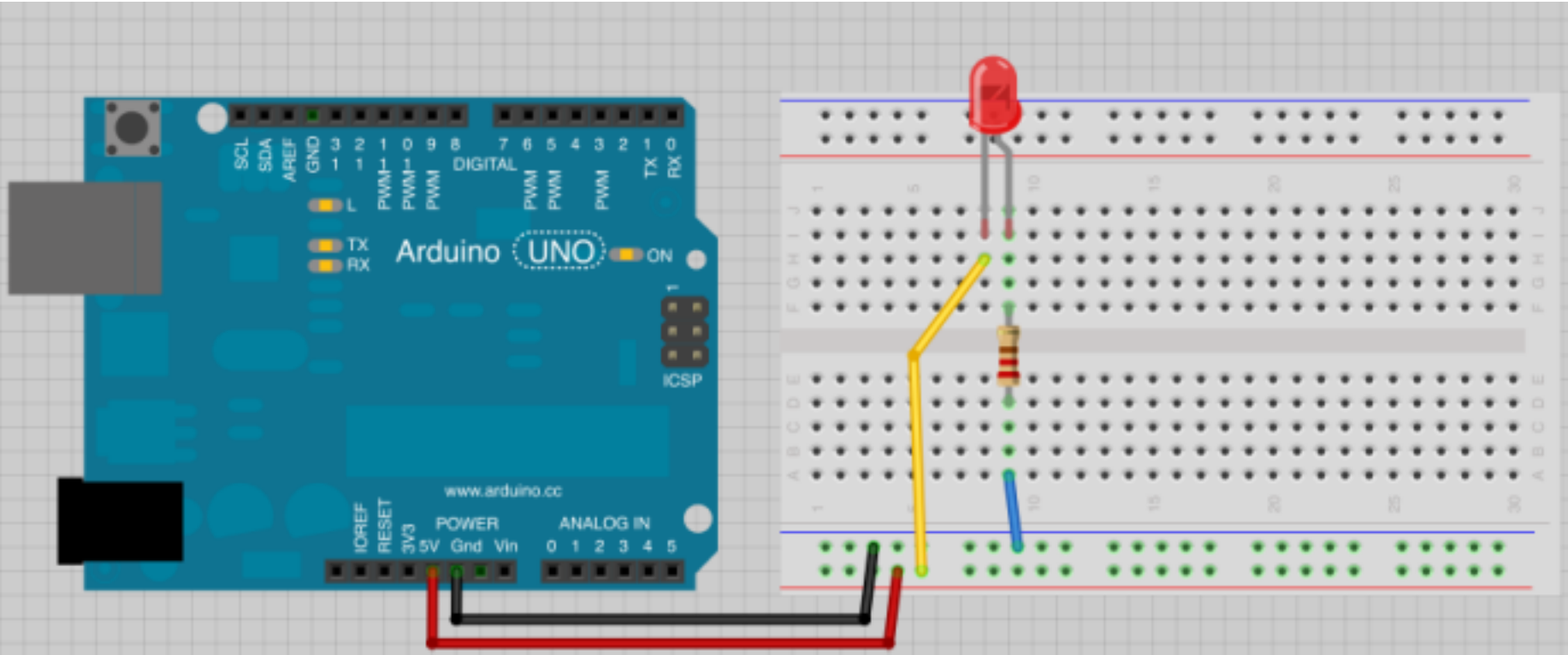
Breadboard Power/Ground “Rails”



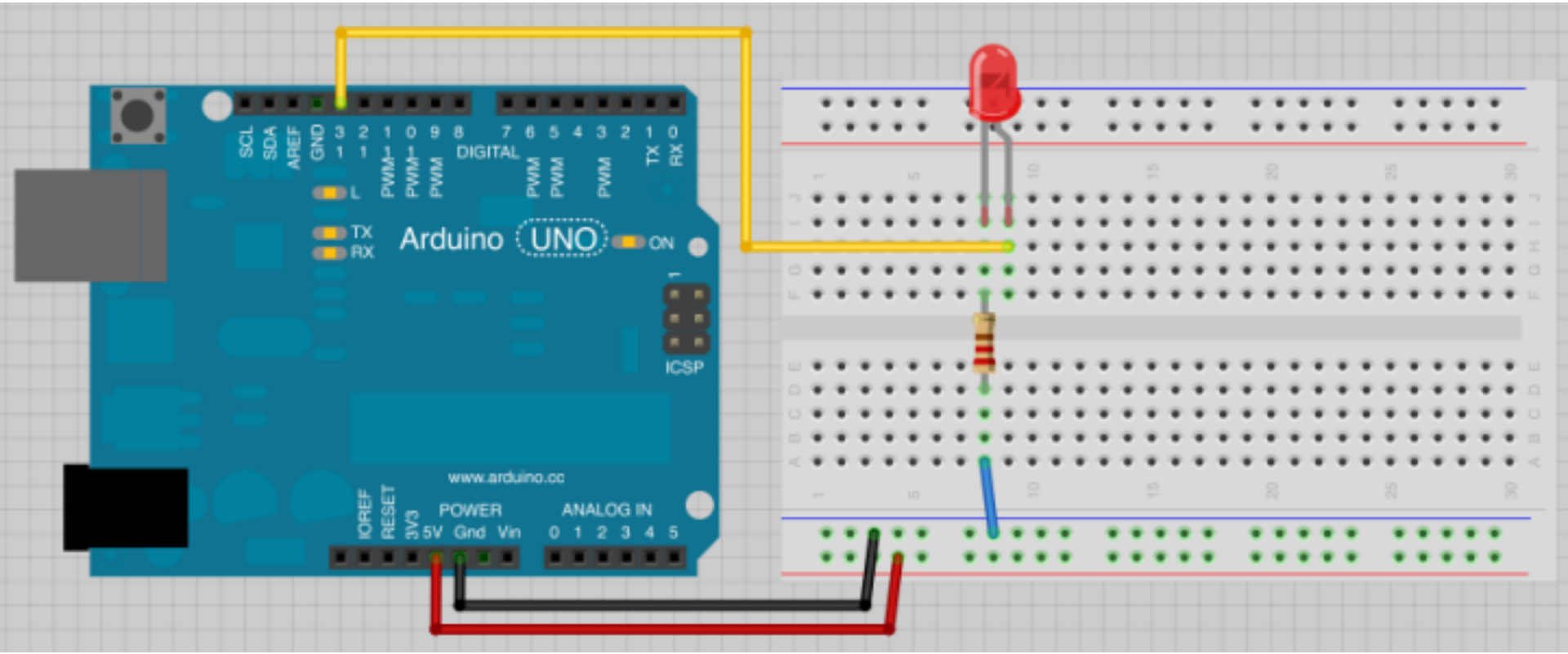
Connecting an LED



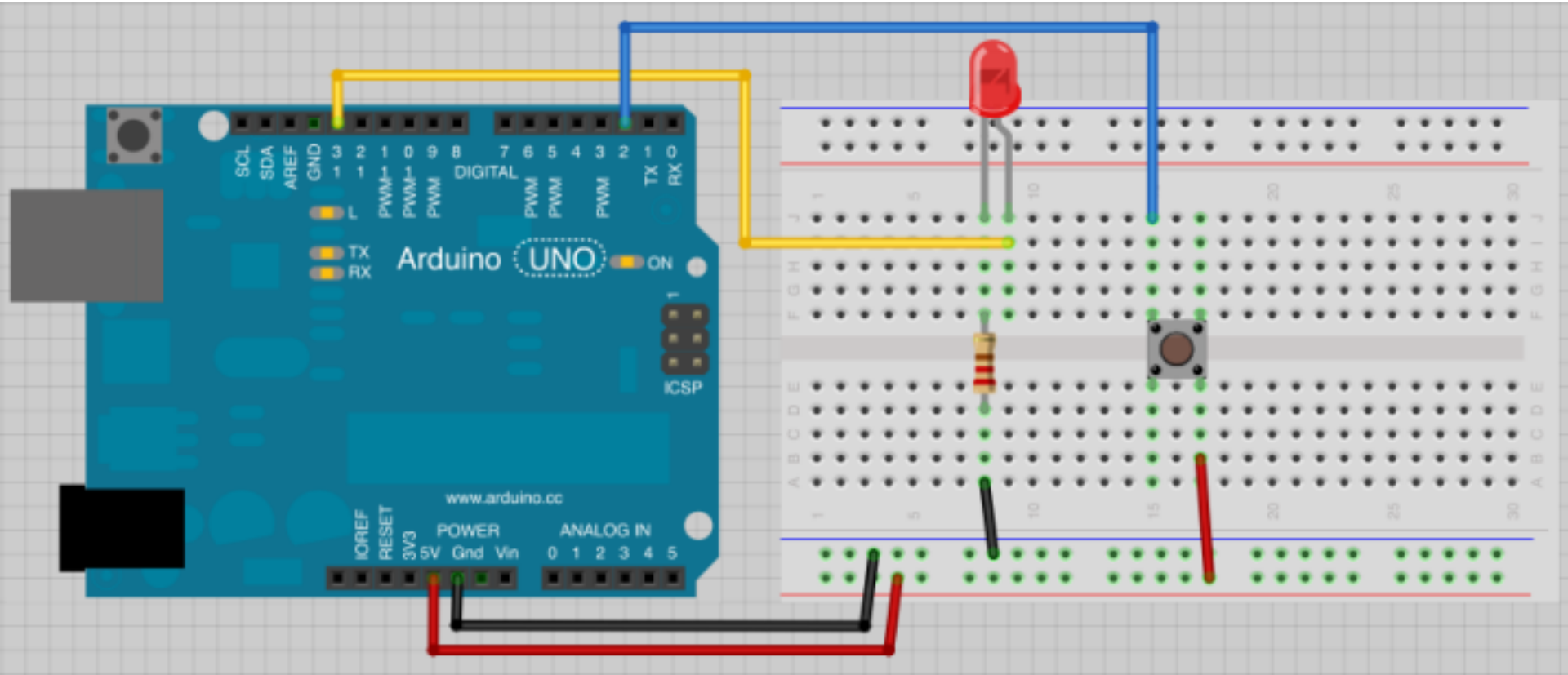
Connecting an LED



Control blink via Pin 13



Manually blink using push button.



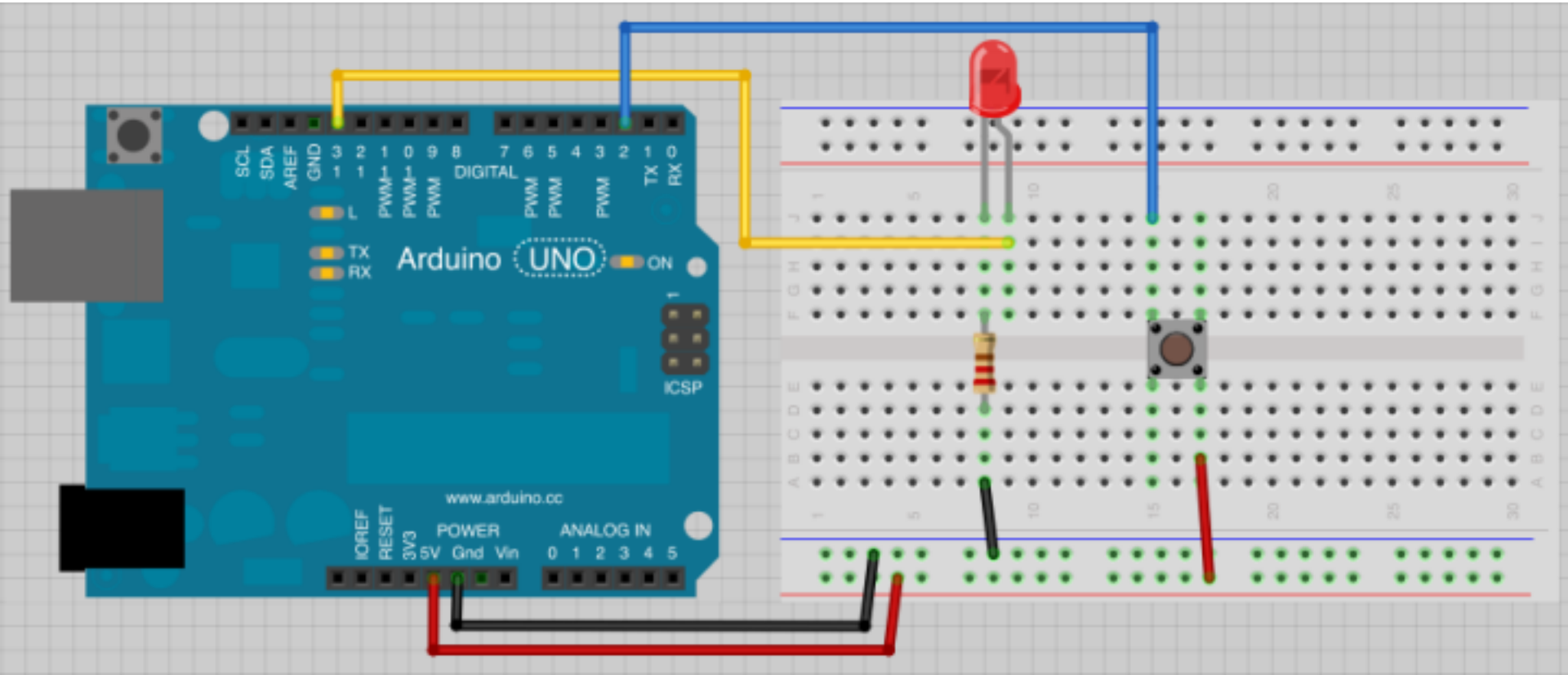
Read the button with code

```
int led = 13;
int buttonPin = 2;
int buttonState = 0;

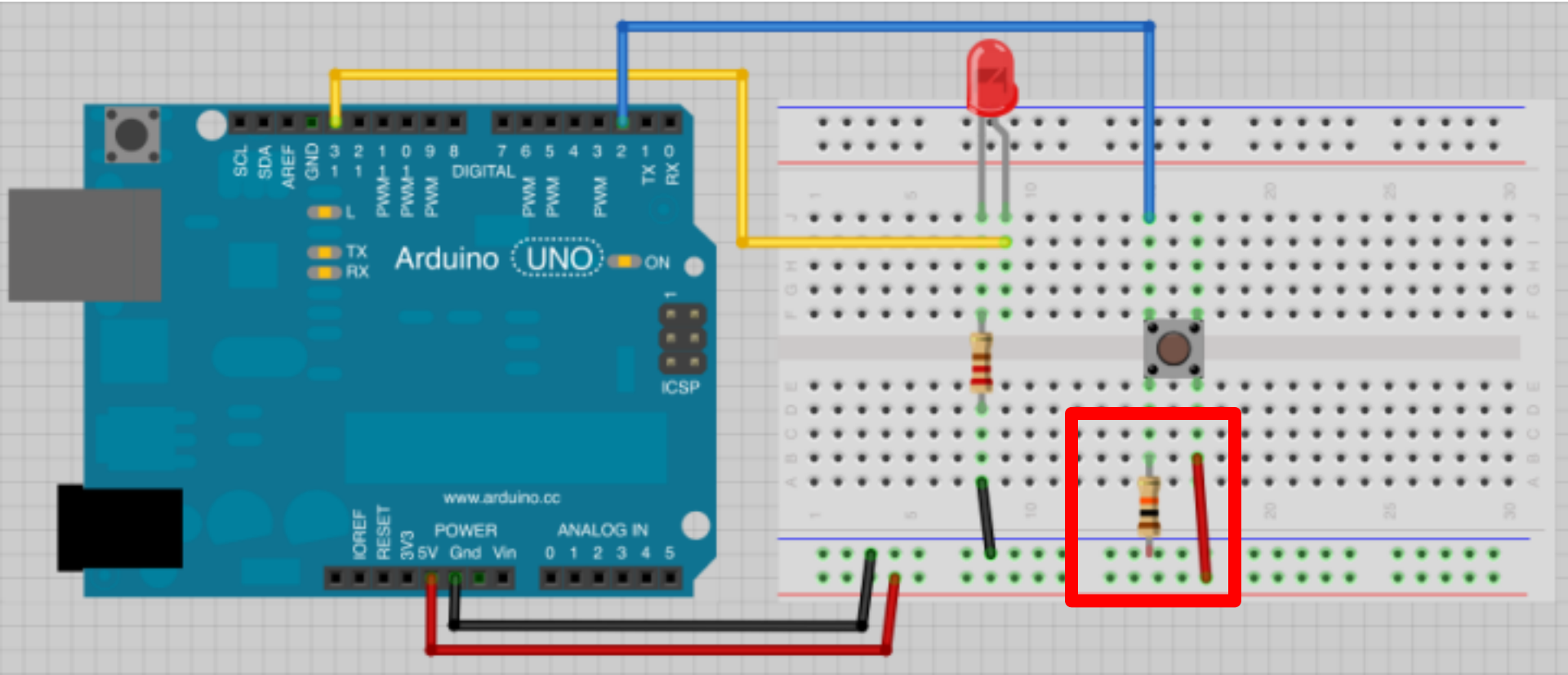
// the setup routine runs once when you press reset:
void setup() {
  // initialize the pinModes
  pinMode(led, OUTPUT);
  pinMode(buttonPin, INPUT);
}

// the loop routine runs over and over again forever:
void loop() {
  //read the button
  buttonState = digitalRead(buttonPin);
  //Perform different actions depending on the state of the button
  if(buttonState == HIGH){
    digitalWrite(led, HIGH);   // turn the LED on (HIGH is the voltage level)
    delay(1000);               // wait for a second
  } else {
    digitalWrite(led, LOW);    // turn the LED off by making the voltage LOW
    delay(1000);               // wait for a second
  }
}
```

Connecting a Button

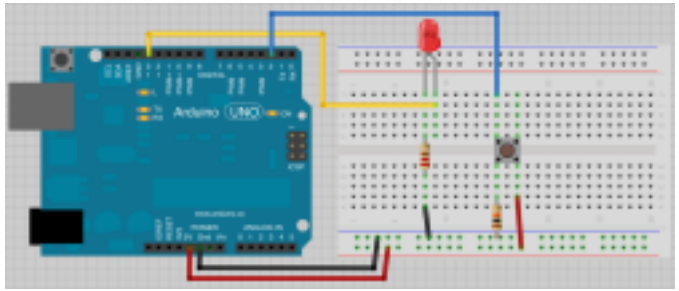


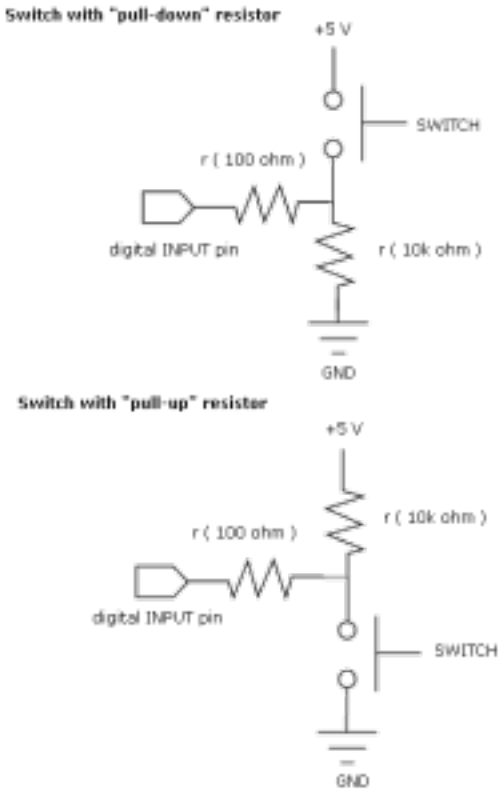
Add a “pull-down” resistor



Pull-Up / Pull-Down Resistors

ensure that the signal will be a valid logic level if external devices are disconnected

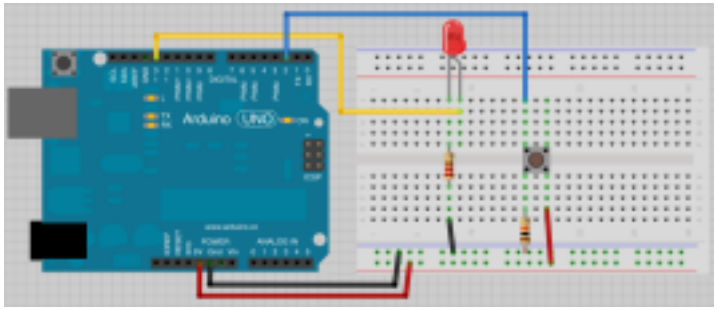




HOMEWORK-github folder structure

~ -> week1 -> index.html

HOMEWORK



Update your code so the button triggers a state change

For example: the LED stays on when you push it and turns off when the button is pressed again

Try out different blink patterns

Documentation:
Upload your code to github
Write an readme.md in your week4 folder with a link to the online video showing the stuff is working