Tools for Digital Choreography

- Introduction to Arduino
- Capacitive sensing and sound
- Data and the Internet of Things

Introduction to Arduino

Coming up:

- Context –examples of artist's/designers use of sensing technologies
- Introduction to the Arduino Board
- Output – Acting in the world
- Input – Getting data from the World
- Movement – Making something move!

Laetitia Sonami
The Lady's Glove
1994 - 2001

https://www.youtube.com/watch?v=C8GqbS2w_Lg

Takehito Etani
Masticator
2005

Philips Design Probe – Bubbelle Dress

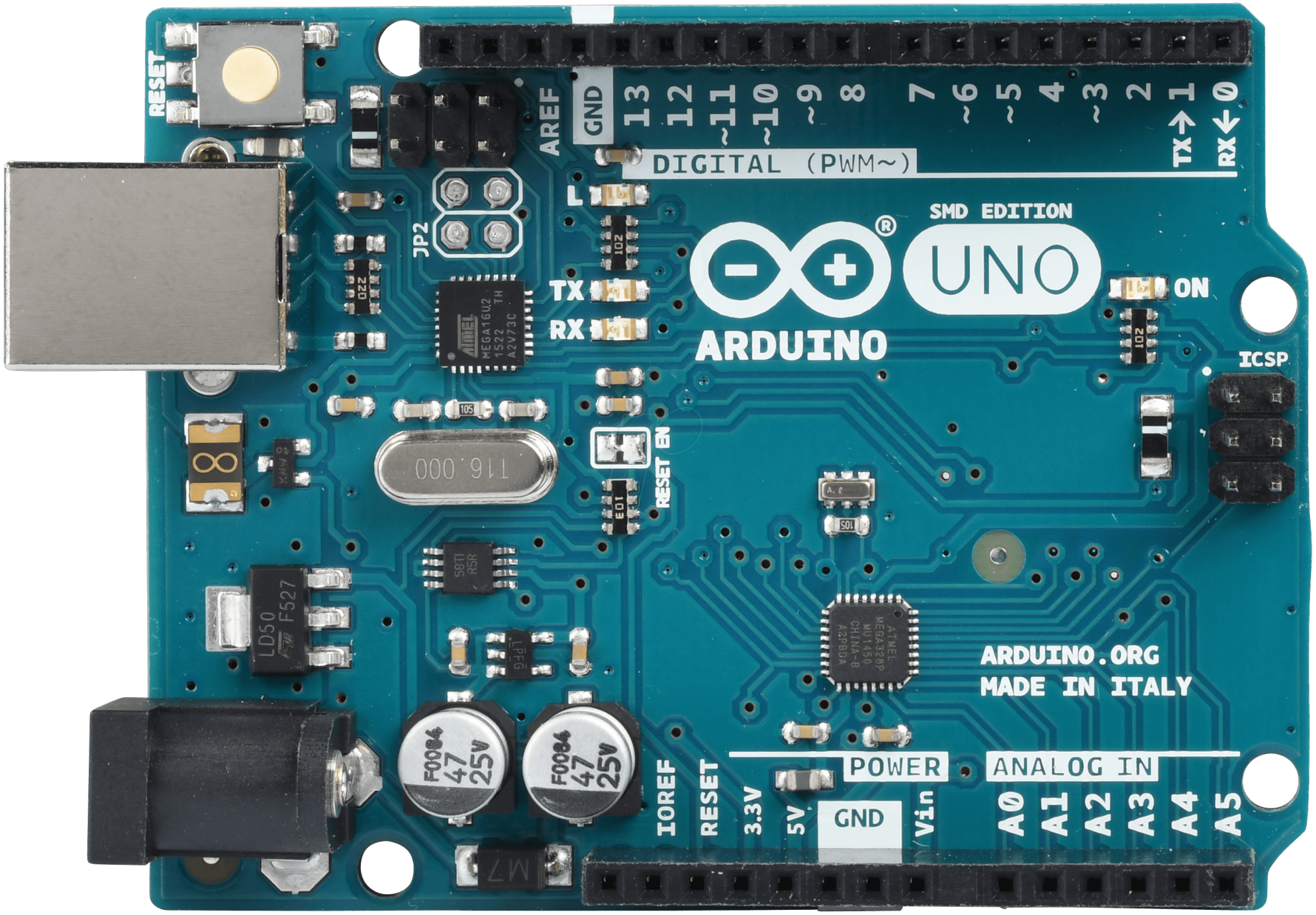
2007 -2020


SIGNS

Swarm Street
Acconci Studio
2013

https://github.com/JohnMechatronics

Introduction to the Arduino Board


RESET
AREF
GND
13
12
~11
~10
~9
8
7
~6
~5
4
~3
2
TX→1
RX←0
DIGITAL (PWM~)
SMD EDITION
UNO
ARDUINO
ON
ICSP
JP2
TX
RX
RESET EN
ARDUINO.ORG
MADE IN ITALY
POWER
ANALOG IN
IOREF
RESET
3.3V
5V
GND
Vin
A0
A1
A2
A3
A4
A5

Get going

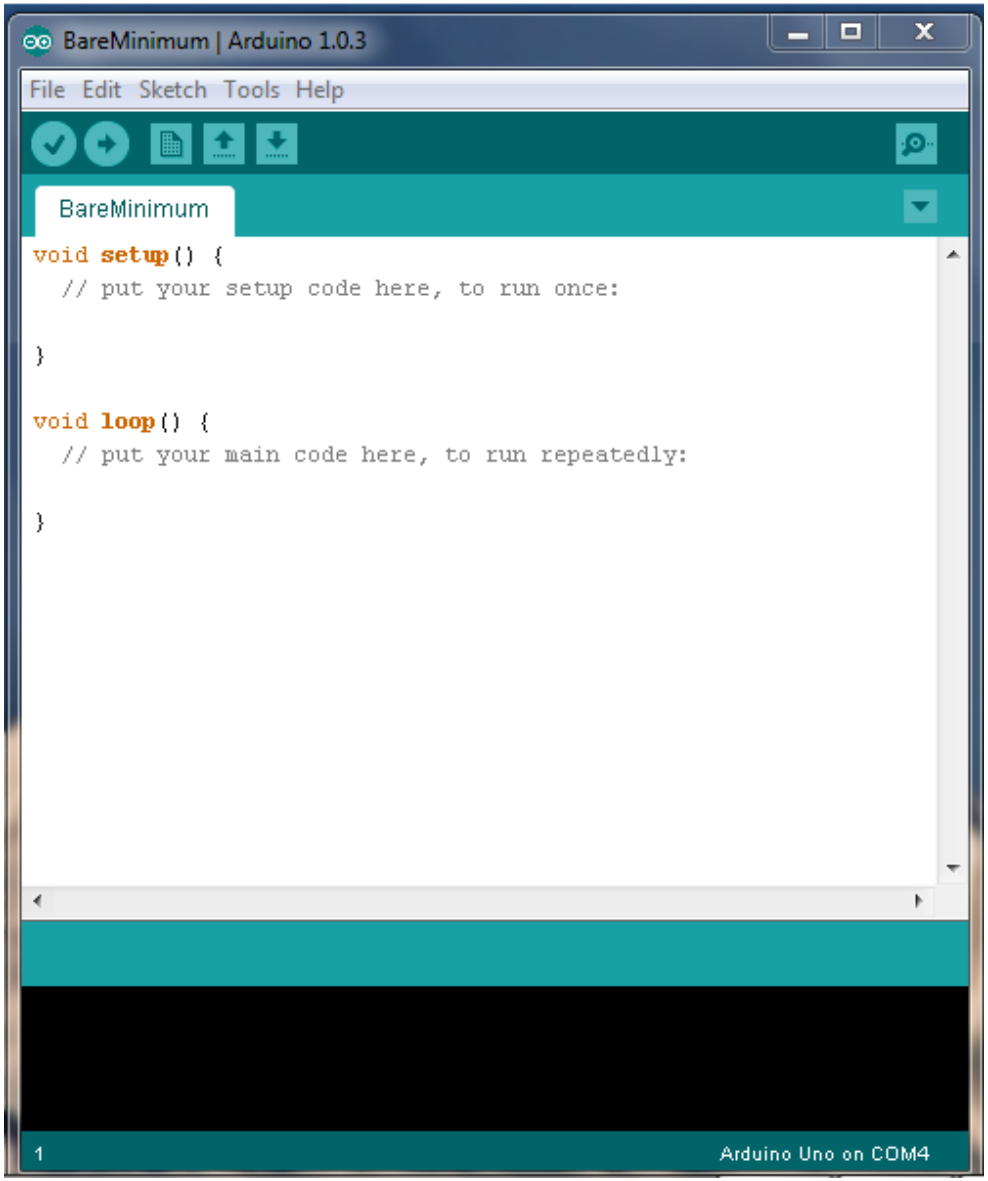
- In the IDE goto:

  Tools > Board > Arduino/Genuino Uno

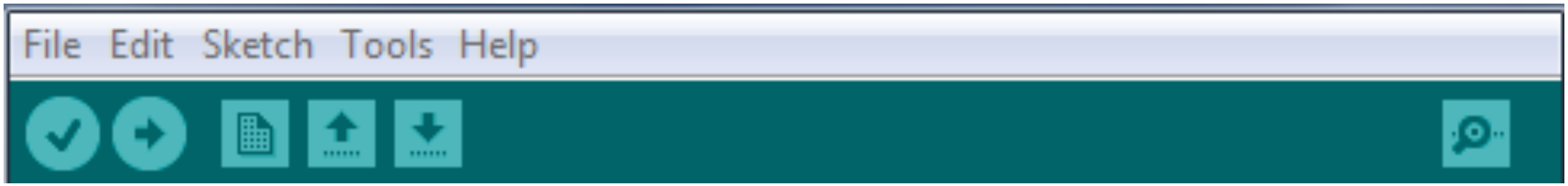
  Tools > Port > COM[!] Arduino/Genuino Uno

Arduino IDE

- integrated development environment



Hello World



File > Examples > 0.1 Basics > Blink

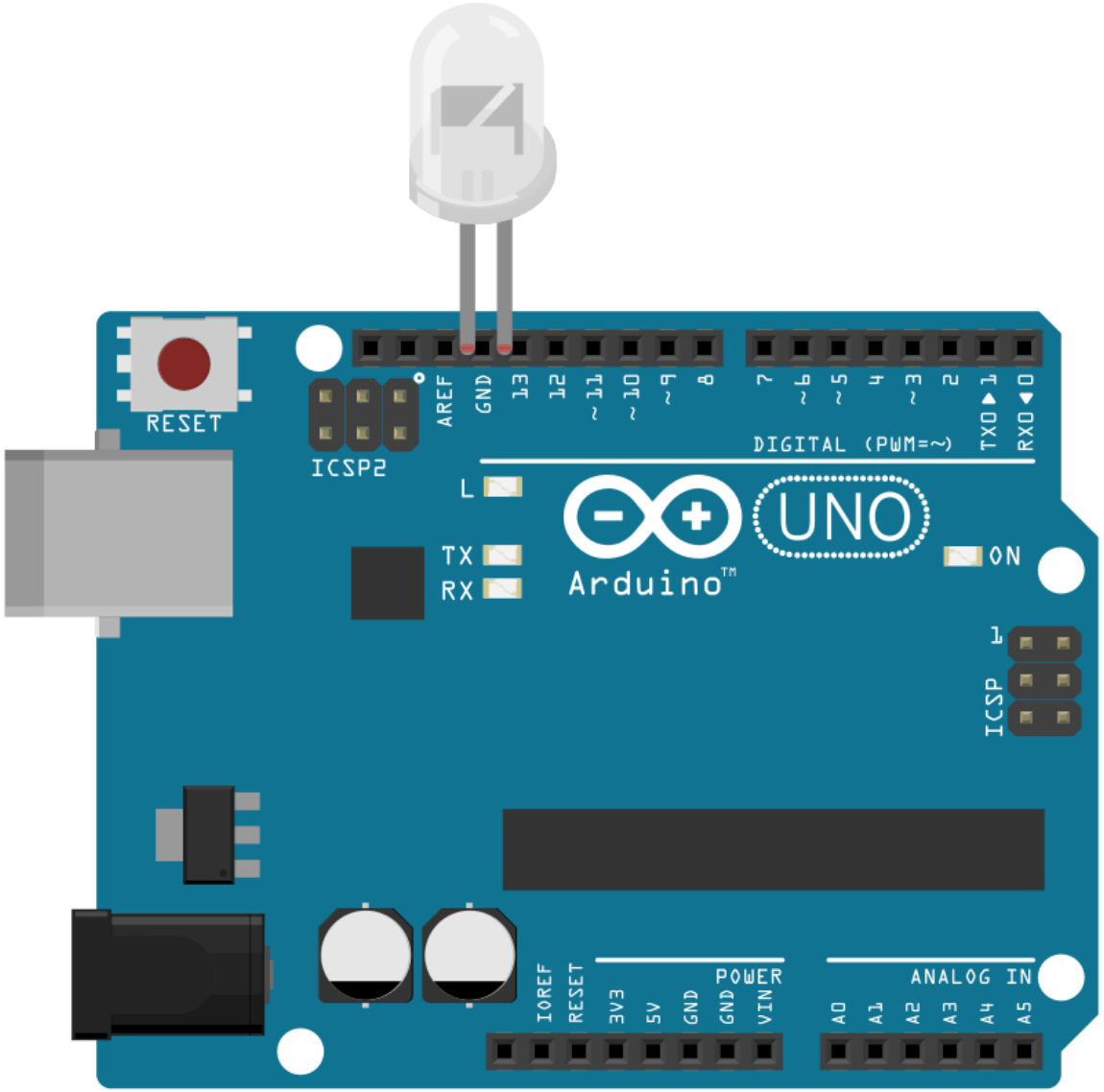

Blink §
void setup() {
// initialize digital pin LED_BUILTIN as an output.
pinMode(LED_BUILTIN, OUTPUT);
}
// the loop function runs over and over again forever
void loop() {
digitalWrite(LED_BUILTIN, HIGH); // turn the LED on (HIGH is the voltage level)
delay(1000); // wait for a second
digitalWrite(LED_BUILTIN, LOW); // turn the LED off by making the voltage LOW
delay(1000); // wait for a second
}
1
Arduino/Genuino Uno on COM1

digitalWrite()

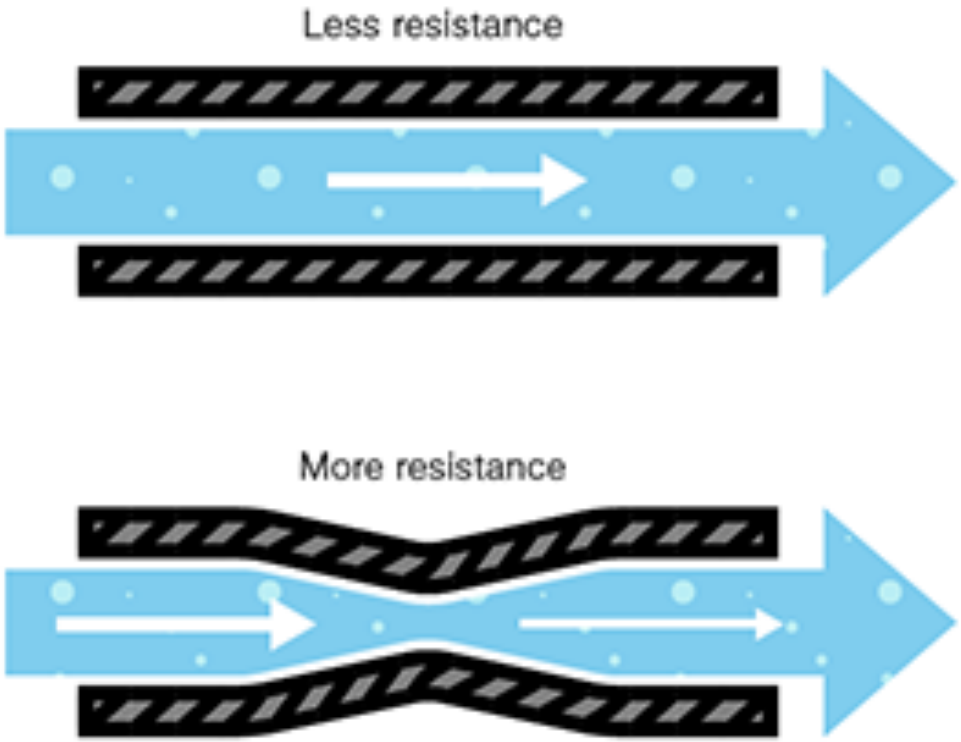
If the pin has been configured as
an OUTPUT with pinMode(), its voltage will be set to:

- 5V for HIGH
- 0V (ground) for LOW.

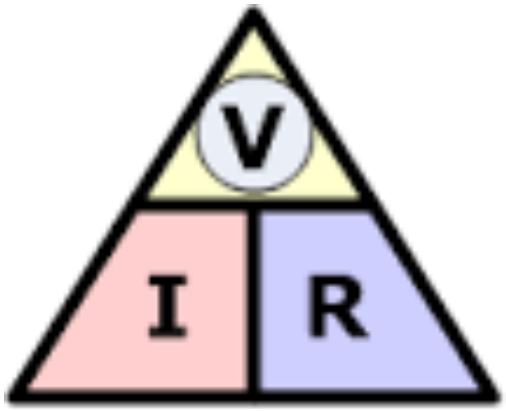

(anode)
+
(cathode)
GND


RESET
ICSP2
AREF
GND
13
12
~11
~10
~9
8
7
~6
~5
4
~3
2
TX→1
RX←0
DIGITAL (PWM=~)
L
TX
RX
Arduino™
UNO
ON
ICSP
IOREF
RESET
3V3
5V
GND
GND
VIN
POWER
A0
A1
A2
A3
A4
A5
ANALOG IN

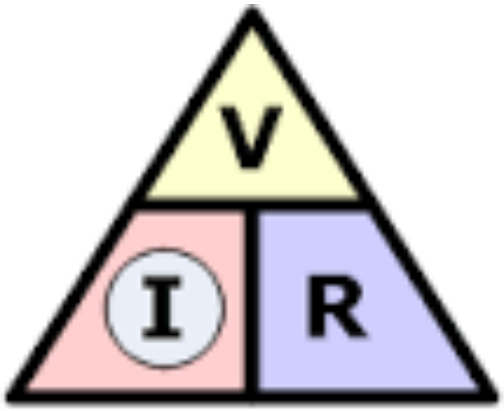
Resistance



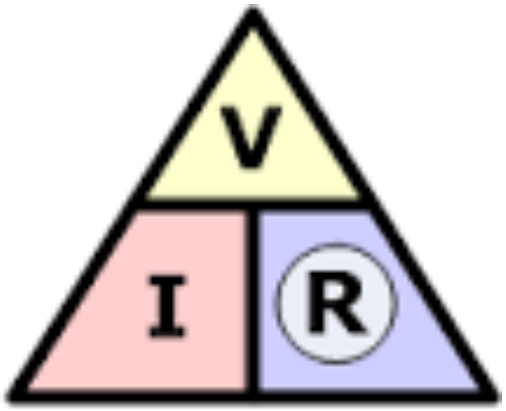
Ohm's law



$V = I \times R$



$I = \frac{V}{R}$

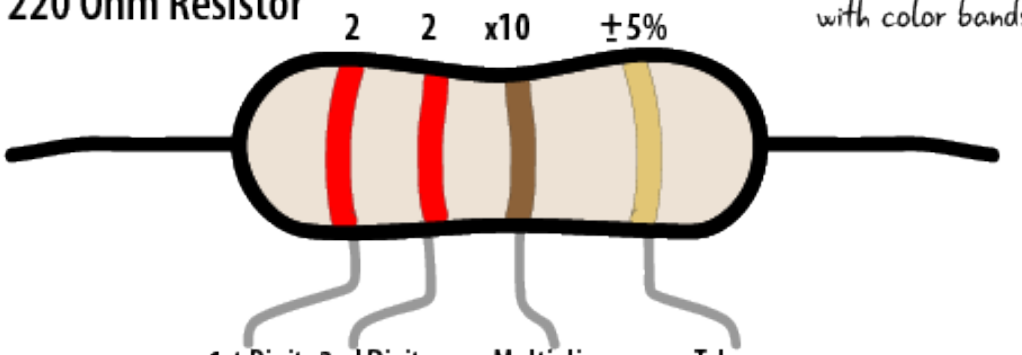


$R = \frac{V}{I}$

220 Ohm Resistor

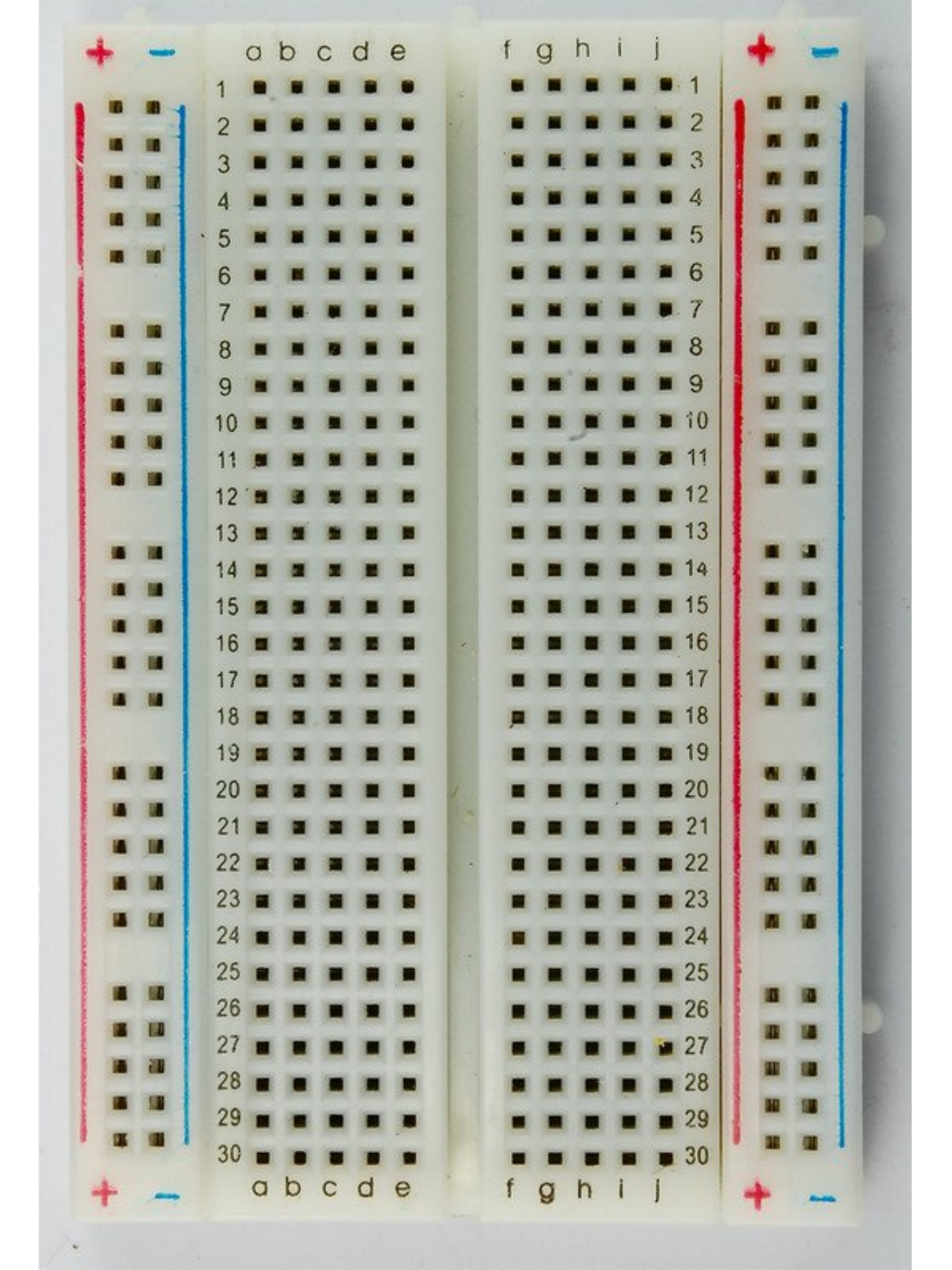
220 Ohm Resistor

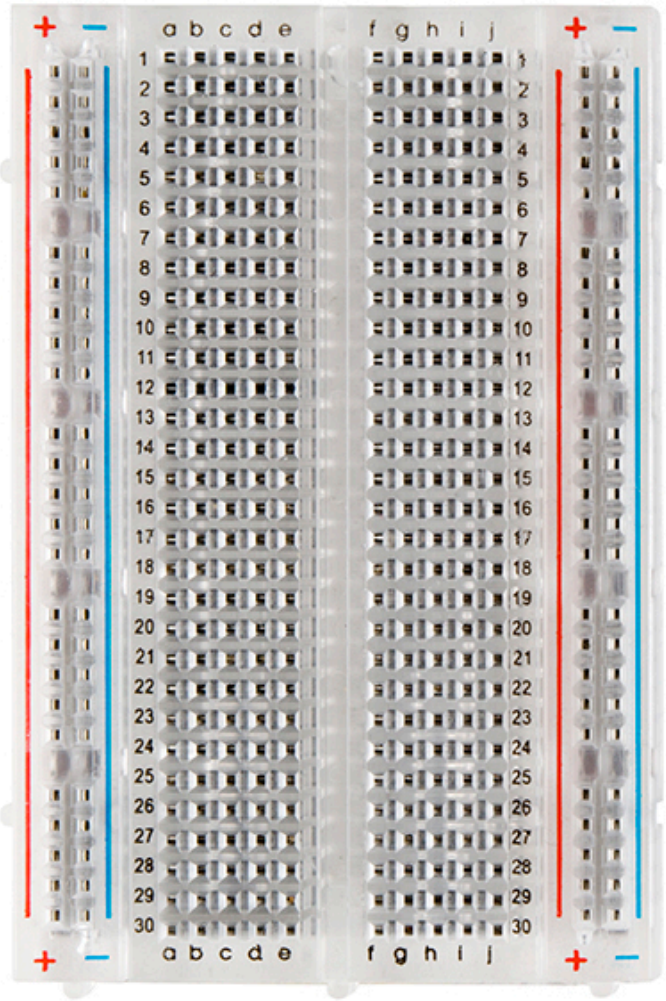
sample resistor with color bands

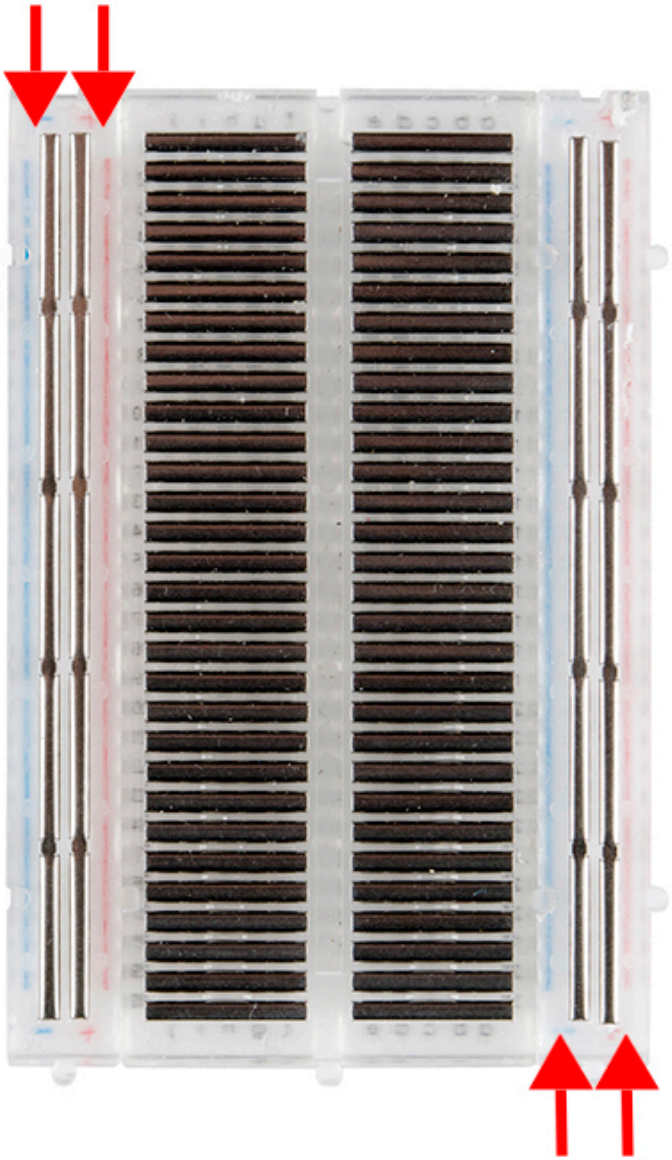


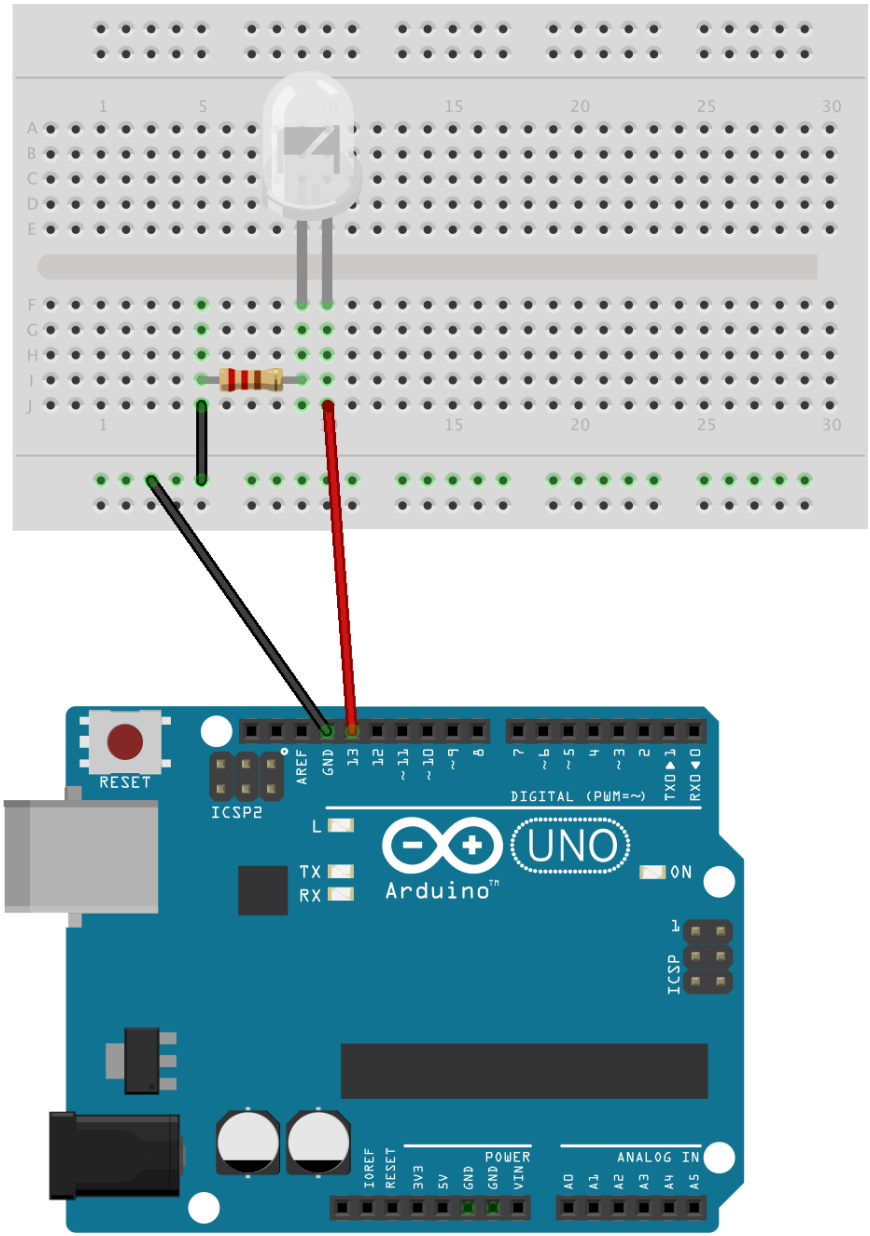
what the color bands represent on the resistor

	1st Digit	2nd Digit	Multiplier	Tolerance
Black	0	0	1	5% Gold
Brown	1	1	10	10% Silver
Red	2	2	100	
Orange	3	3	1,000	
Yellow	4	4	10,000	
Green	5	5	100,000	
Blue	6	6	1,000,000	
Purple	7	7		
Gray	8	8		
White	9	9		


a b c d e
f g h i j
1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26 27 28 29 30
a b c d e
f g h i j


a b c d e
f g h i j
1
2
3
4
5
6
7
8
9
10
11
12
13
14
15
16
17
18
19
20
21
22
23
24
25
26
27
28
29
30




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

```
int ledPin = 13;    // LED connected to digital pin 13

// the setup function runs once when you press reset or power the board
void setup() {
  // initialize digital pin LED_BUILTIN as an output.
  pinMode(ledPin, OUTPUT);
}

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

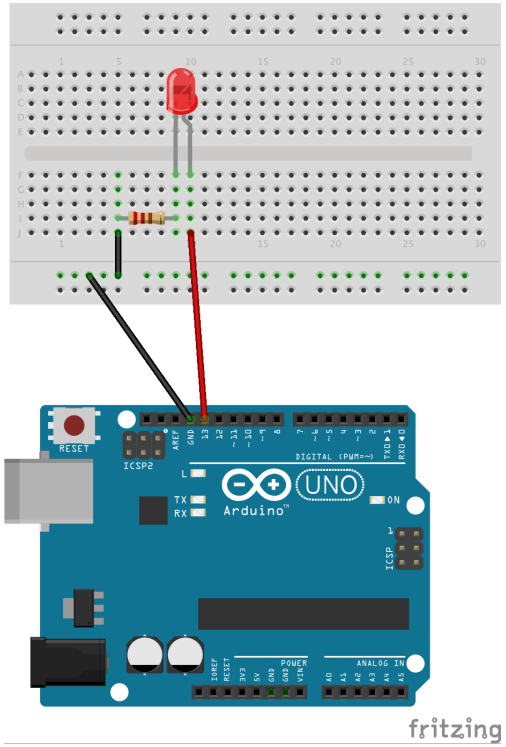
Variables

- A variable is a way of naming and storing a value for use by the program
- E.g. data from a sensor or value that will be transformed by a mathematical calculation.

```
int ledPin = 13;
digitalWrite(ledPin, HIGH);  -> digitalWrite(13, HIGH);
```

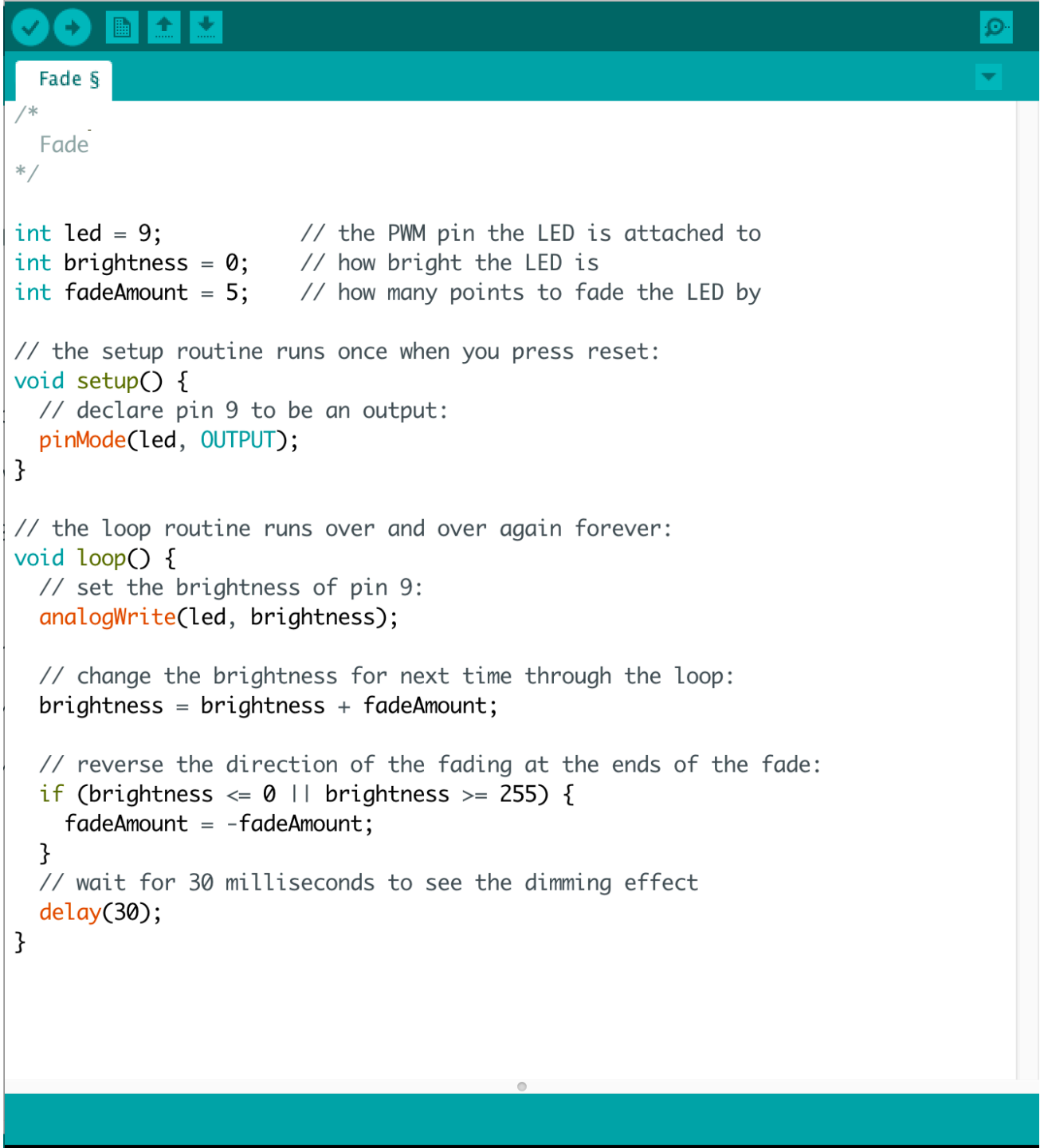
Task

- Test the circuit
- Can you alter the blink time?
- Try different rates



Fade

- Rewire the LED to pin 9
- From the Arduino IED open:
- File > Example > 01.Basics > Fade
- Upload the Code
- What does it do?


Fade §
/*
Fade
*/
int led = 9; // the PWM pin the LED is attached to
int brightness = 0; // how bright the LED is
int fadeAmount = 5; // how many points to fade the LED by
// the setup routine runs once when you press reset:
void setup() {
// declare pin 9 to be an output:
pinMode(led, OUTPUT);
}
// the loop routine runs over and over again forever:
void loop() {
// set the brightness of pin 9:
analogWrite(led, brightness);
// change the brightness for next time through the loop:
brightness = brightness + fadeAmount;
// reverse the direction of the fading at the ends of the fade:
if (brightness <= 0 || brightness >= 255) {
fadeAmount = -fadeAmount;
}
// wait for 30 milliseconds to see the dimming effect
delay(30);
}

analogWrite() v digitalWrite()

digitalWrite()

- Two states High or Low
- High - > 5v
- Low - > 0v

analogWrite()

- Set the intensity between 0 and 255

if

```
if (brightness <= 0 || brightness >= 255) {
    fadeAmount = -fadeAmount;
}
```

*Remember a – and a – make a +

if

- The if() statement allows you to make something happen or not, depending on whether a given condition is true or false. Eg:

```
if (someCondition) {
    // do stuff if the condition is true
}
```

if-else

```
if (someCondition) {
    // do stuff if the condition is true
} else {
    // do stuff if the condition is false
}
```

else-if

```
if (someCondition) {
    // do stuff if the condition is true
} else if (anotherCondition) {
    // do stuff only if the first condition is false
     // and the second condition is true
}
```

Comparison Operators

!= (not equal to)
< (less than)
<= (less than or equal to)
== (equal to)
> (greater than)
>= (greater than or equal to)

```
if (brightness <= 0 ||
brightness >= 255)
```

Boolean Operators

&& - and

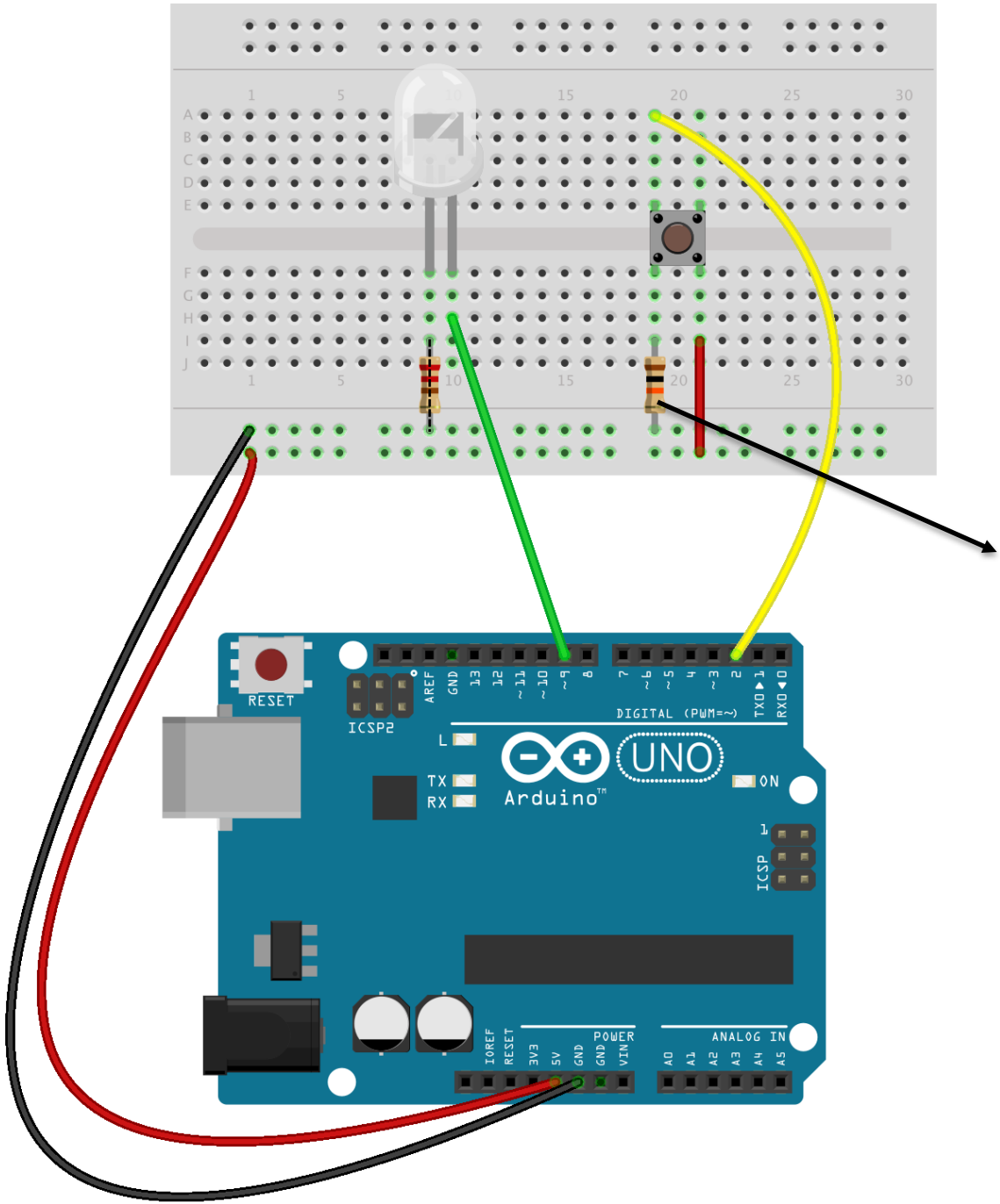
|| - or

```
if (brightness <= 0 || brightness >= 255)
```

Input - Sensing the World

Responding to a button press

- Light on off
- Code = LED-Button.ino


10K ohm resistor
RESET
ICSP2
AREF
GND
13
12
~11
~10
~9
8
7
~6
~5
4
~3
2
TX→1
RX←0
DIGITAL (PWM=~)
L
TX
RX
UNO
Arduino™
ON
ICSP
POWER
ANALOG IN
IOREF
RESET
3V3
5V
GND
GND
VIN
A0
A1
A2
A3
A4
A5

```
const int buttonPin = 2;
const int ledPin = 9;
int buttonState  = LOW;

void setup() {

  pinMode(ledPin, OUTPUT);
  pinMode(buttonPin, INPUT);
}

void loop() {

  buttonState = digitalRead(buttonPin);

  if (buttonState == HIGH) {
    digitalWrite(ledPin, HIGH);
  } else {
    digitalWrite(ledPin, LOW);
 }
}
```

LED-button.ino

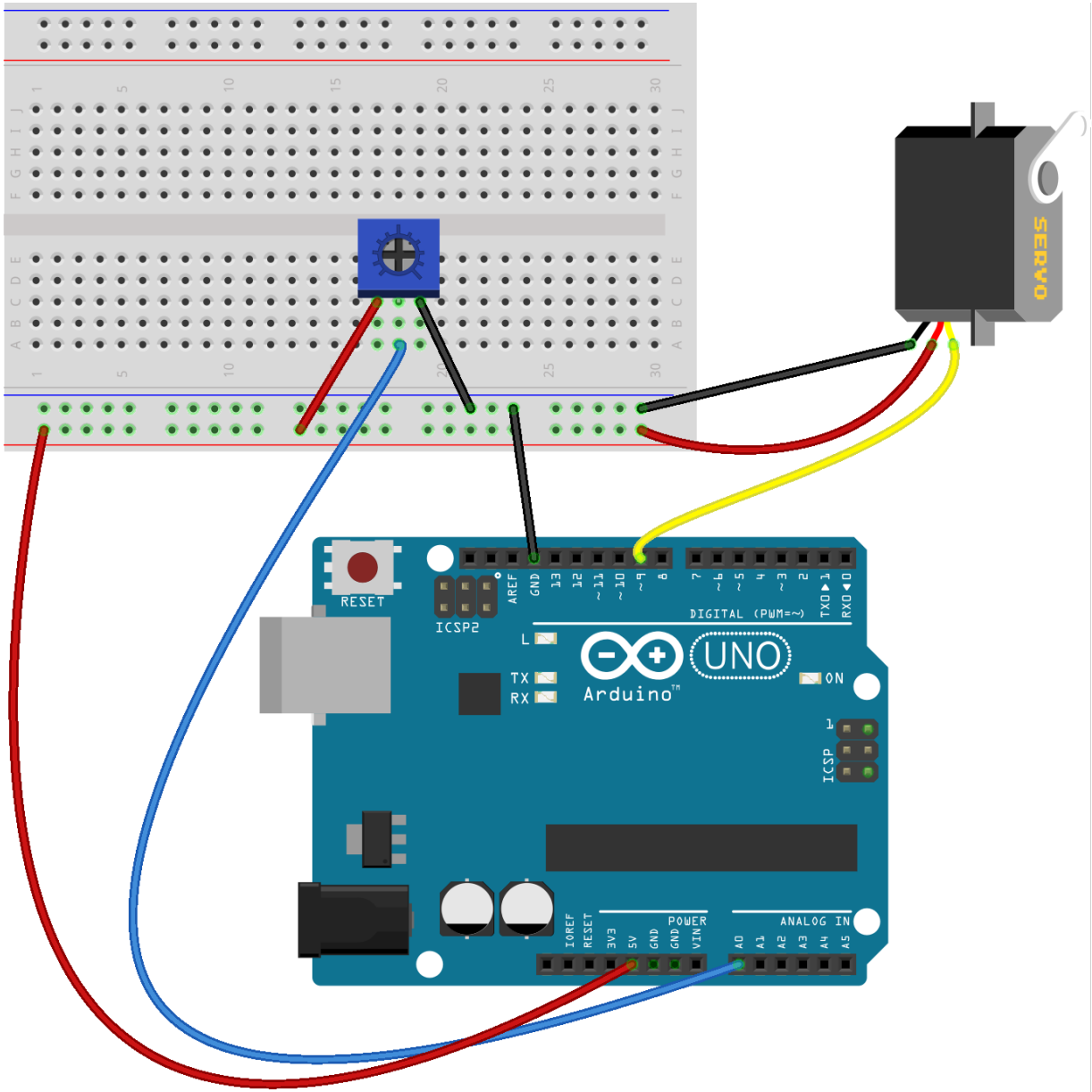
digitalRead()

```
buttonState = digitalRead(buttonPin);
```

- Reads the value from a specified digital pin
- Value will be stored in variable - buttonState
- The value will be either HIGH (5v) or LOW (0v).

Morse Code

- Swap the LED for the Piezo Buzzer


SERVO
RESET
ICSP2
AREF
GND
13
12
~11
~10
~9
8
7
~6
~5
4
~3
2
TX→1
RX←0
DIGITAL (PWM=~)
L
TX
RX
Arduino™
UNO
ON
ICSP
POWER
IOREF
RESET
3V3
5V
GND
GND
VIN
ANALOG IN
A0
A1
A2
A3
A4
A5

```
#include <Servo.h>

Servo myservo;

int potpin = 0;
int val;

void setup() {
  myservo.attach(9);
}

void loop() {
  val = analogRead(potpin);
  val = map(val, 0, 1023, 0, 180);
  myservo.write(val);
  delay(15);
}
```

File > Example > Servo > knob

analogRead()

Val = analogRead(potPin);

- Reads the value from the specified analog pin.
- It maps input voltages between 0 and 5 volts into integer values between 0 and 1023.
- resolution = .0049 volts (4.9 mV) per unit

analogRead() v digitalRead()

digitalRead()

- Two states High or Low
- High - > 5v
- Low - > 0v

analogRead()

- Reads a value between 0 and 1023.

Map()

```
val = map(val, 0, 1023, 0, 180);
```

- Re-maps a number from one range to another.
- Used here to map the pot range 0 – 123 to the servo range 0 - 180

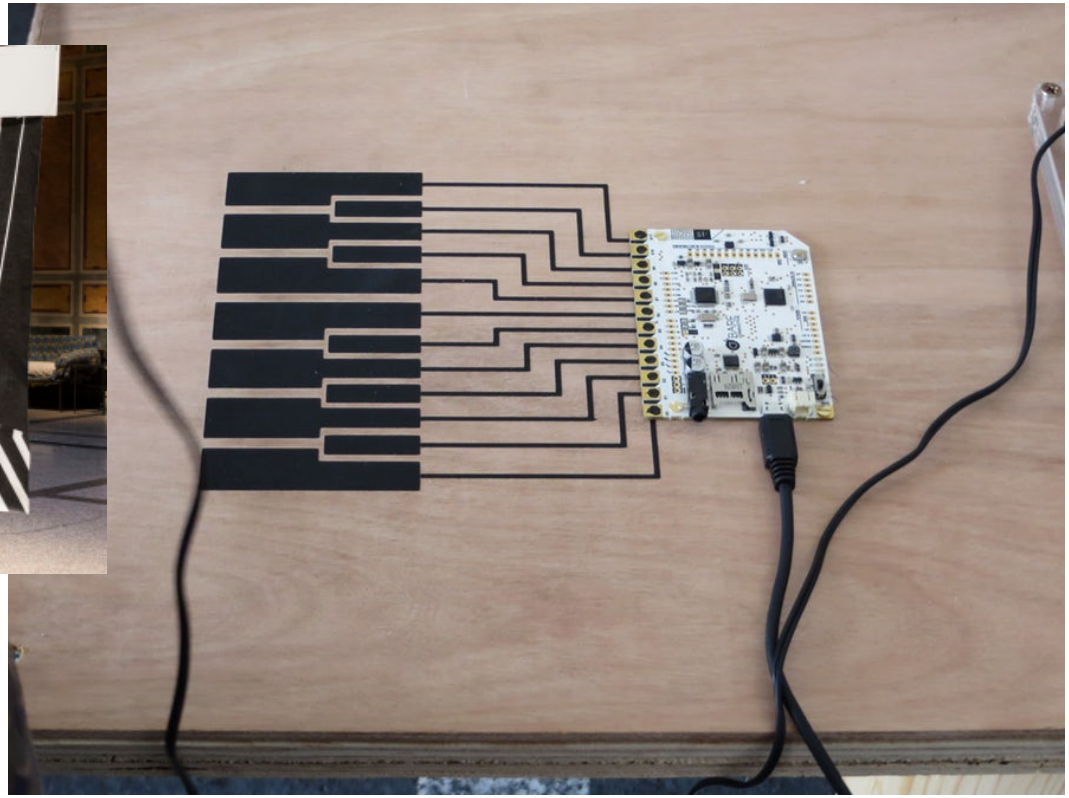
Task

- add an LED into the circuit
- Program it to fade in response to the potentiometer.

Conclusion

- We have learnt the two key methods of controlling devices connected to the Arduino:
  - digitalWrite()
  - analogueWrite()
- The two key methods of getting input into the Arduino:
  - analogRead()
  - digitalRead()
- And one of the main control methods:
  - if if-else else-if

Next Week



- Capacitive sensing and sound
- Introduction to the Bare Conductive Touch Board