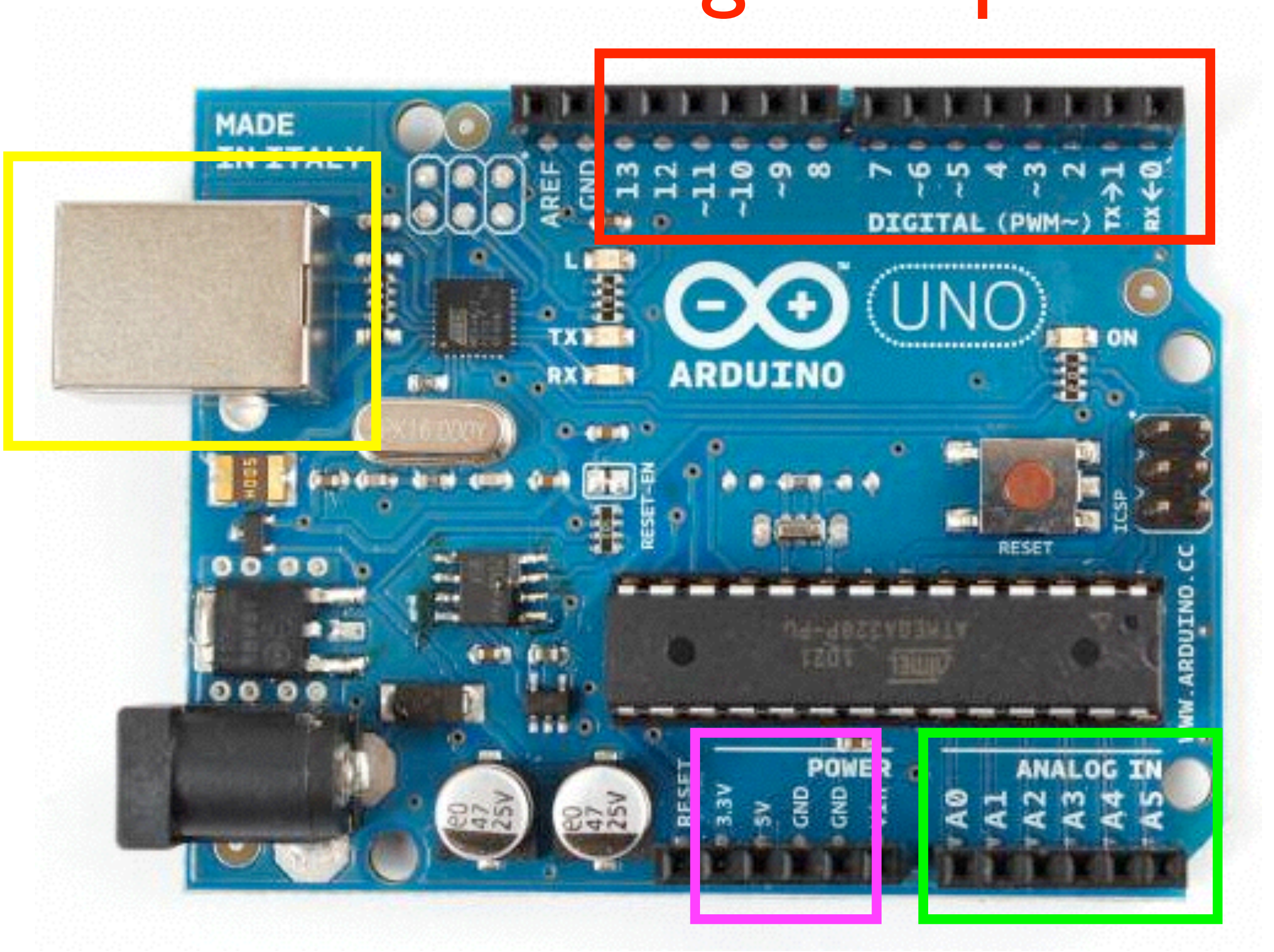
Arduino



Digital inputs/outputs

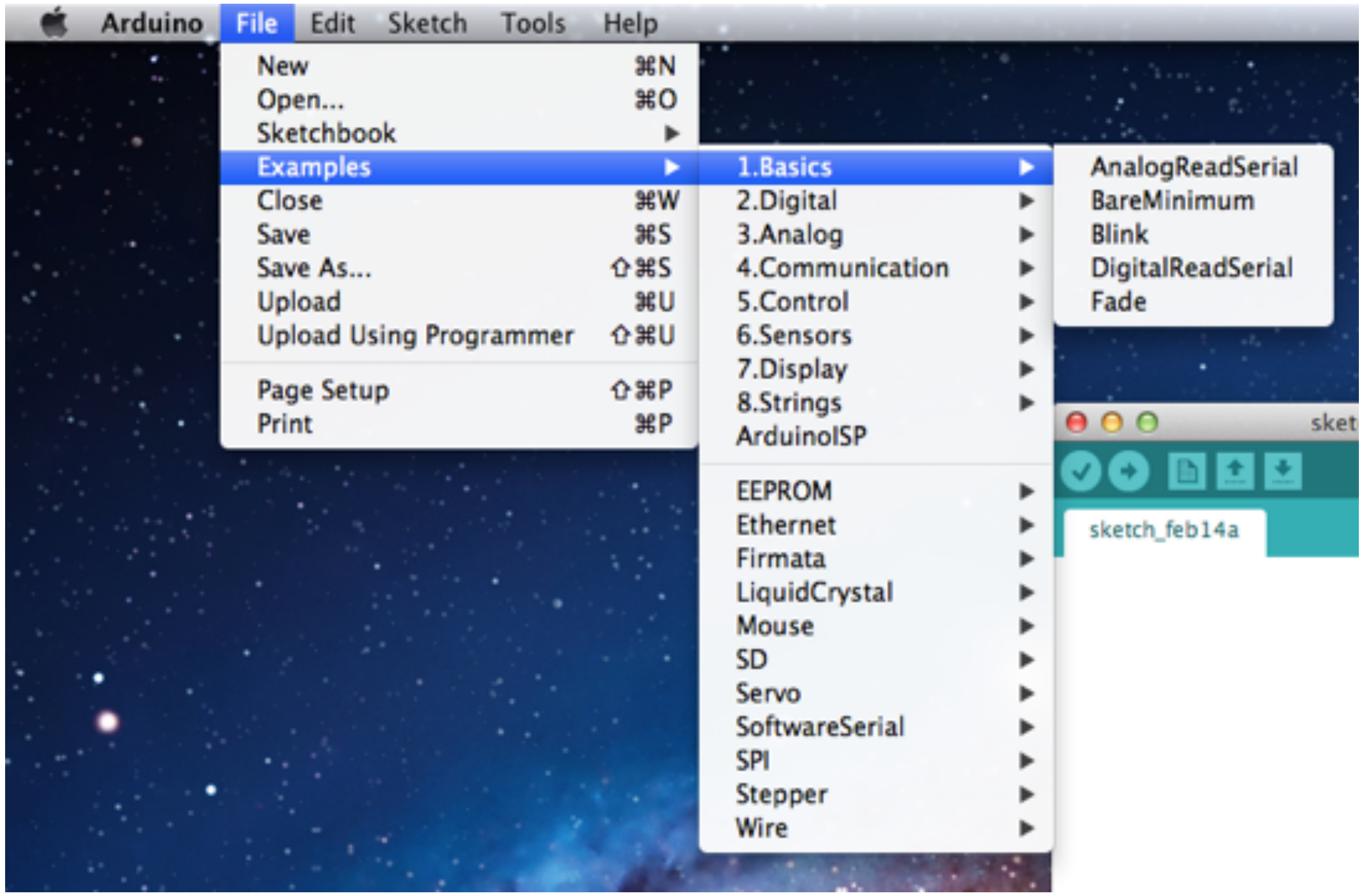
USB

Power / Ground

Analog inputs

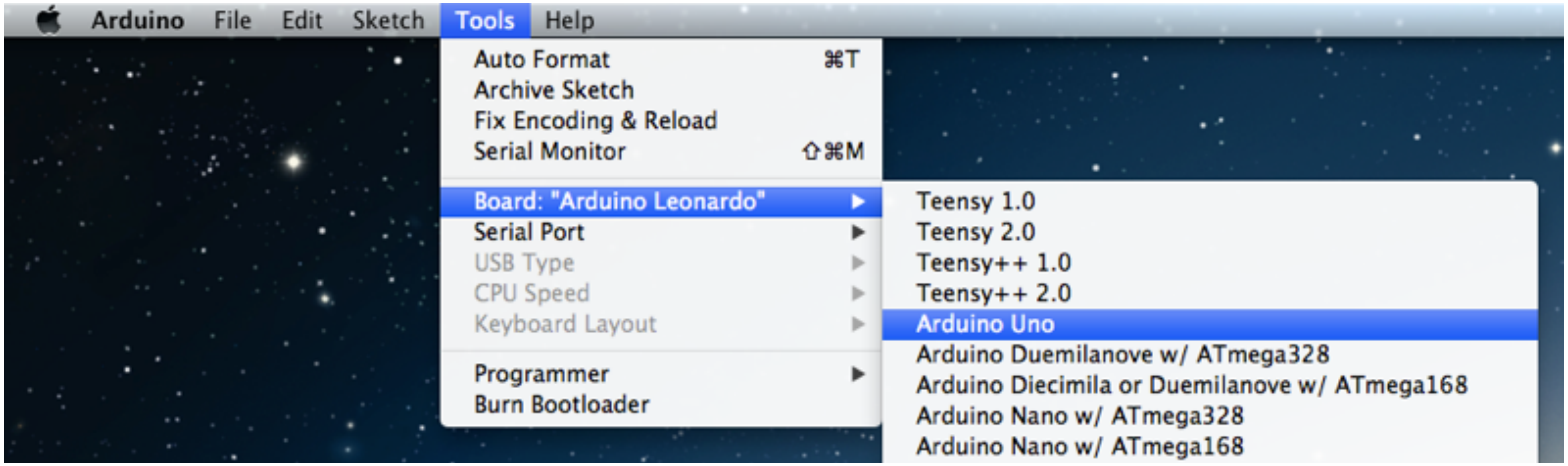
First project

1. Plug in Arduino to computer (USB)
2. Launch Arduino software
3. Open Blink example

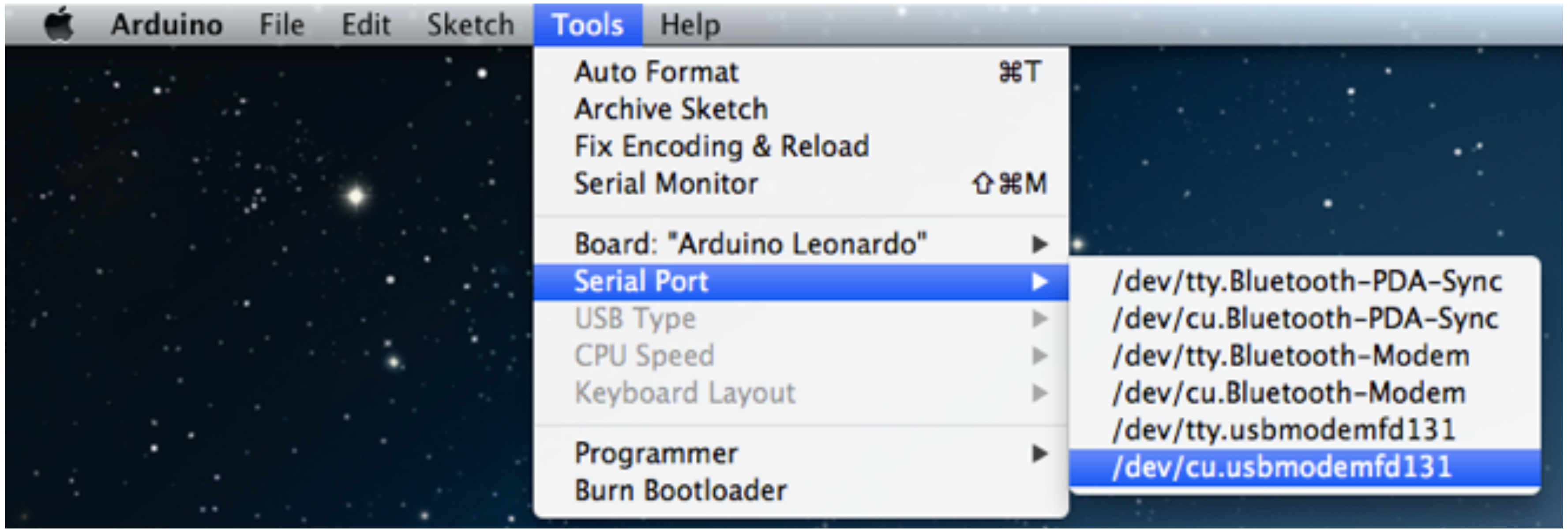


First project

4. Select Arduino Uno board
   (not "Leonardo" unless your board says so)

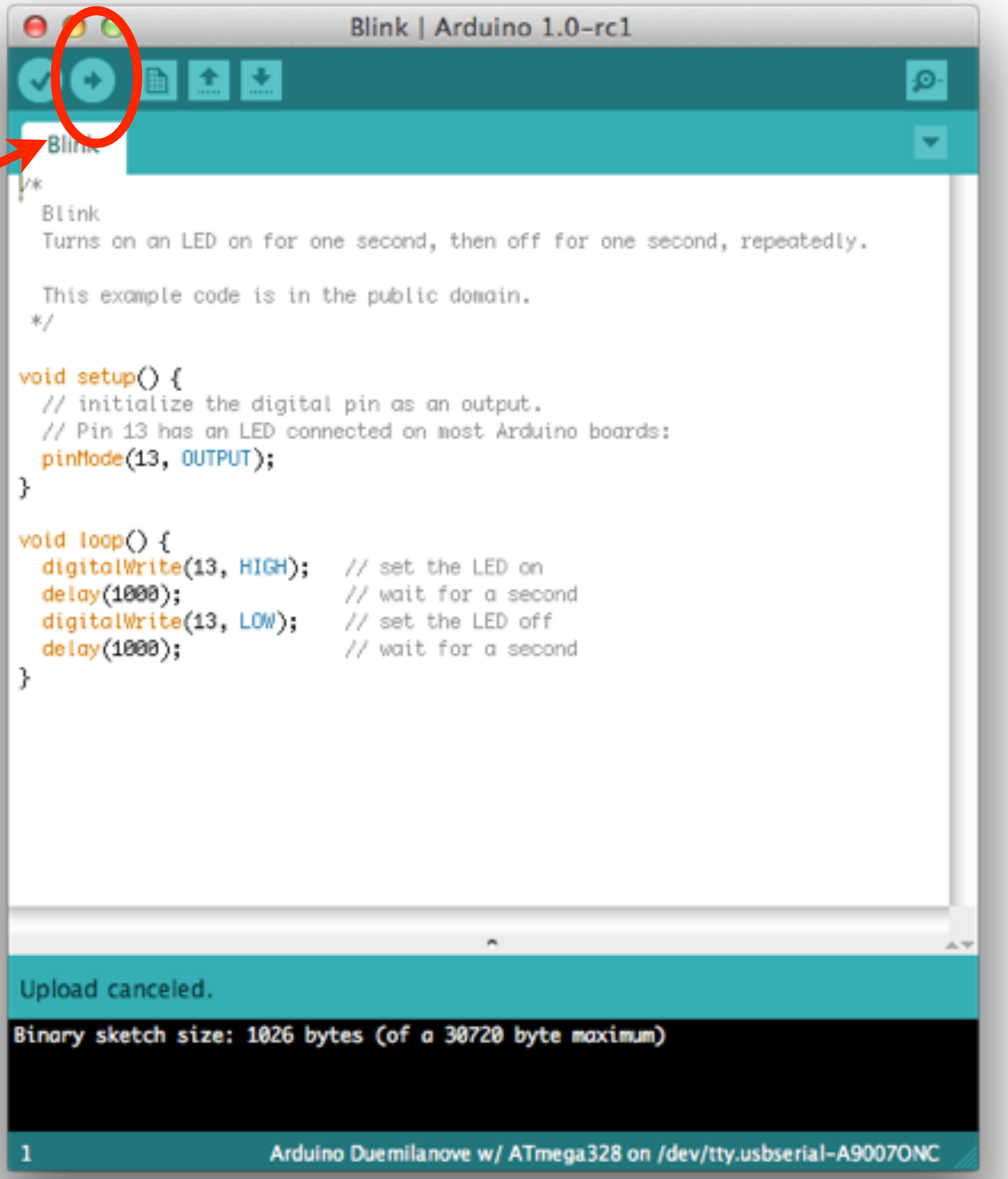


5. Select correct serial port: /dev/cu.usbmodem...



First project

6. Download sketch onto your Arduino



```
/*
  Blink
  Turns on an LED on for one second, then off for one second, repeatedly.

  This example code is in the public domain.
 */

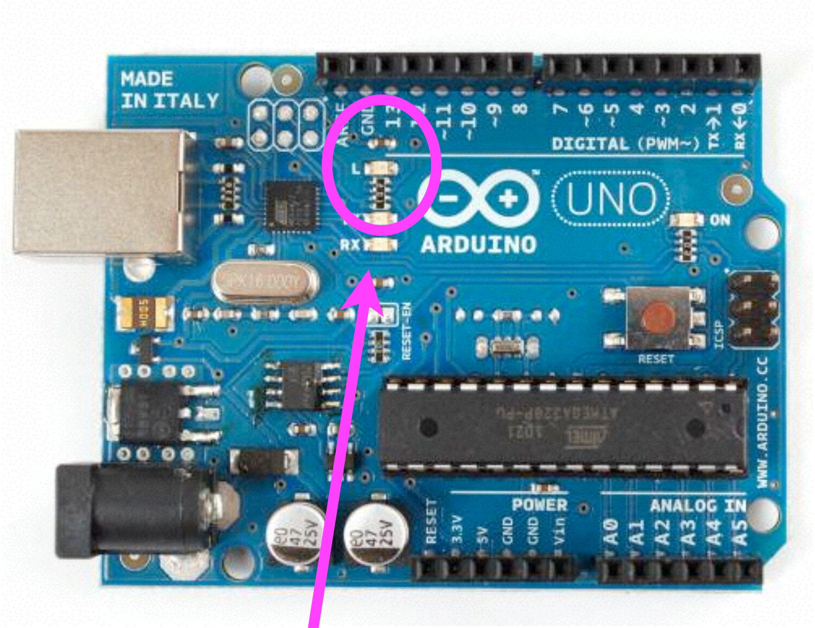
void setup() {
  // initialize the digital pin as an output.
  // Pin 13 has an LED connected on most Arduino boards:
  pinMode(13, OUTPUT);
}

void loop() {
  digitalWrite(13, HIGH);   // set the LED on
  delay(1000);              // wait for a second
  digitalWrite(13, LOW);    // set the LED off
  delay(1000);              // wait for a second
}
```

Upload canceled.

```
Binary sketch size: 1026 bytes (of a 30720 byte maximum)
```

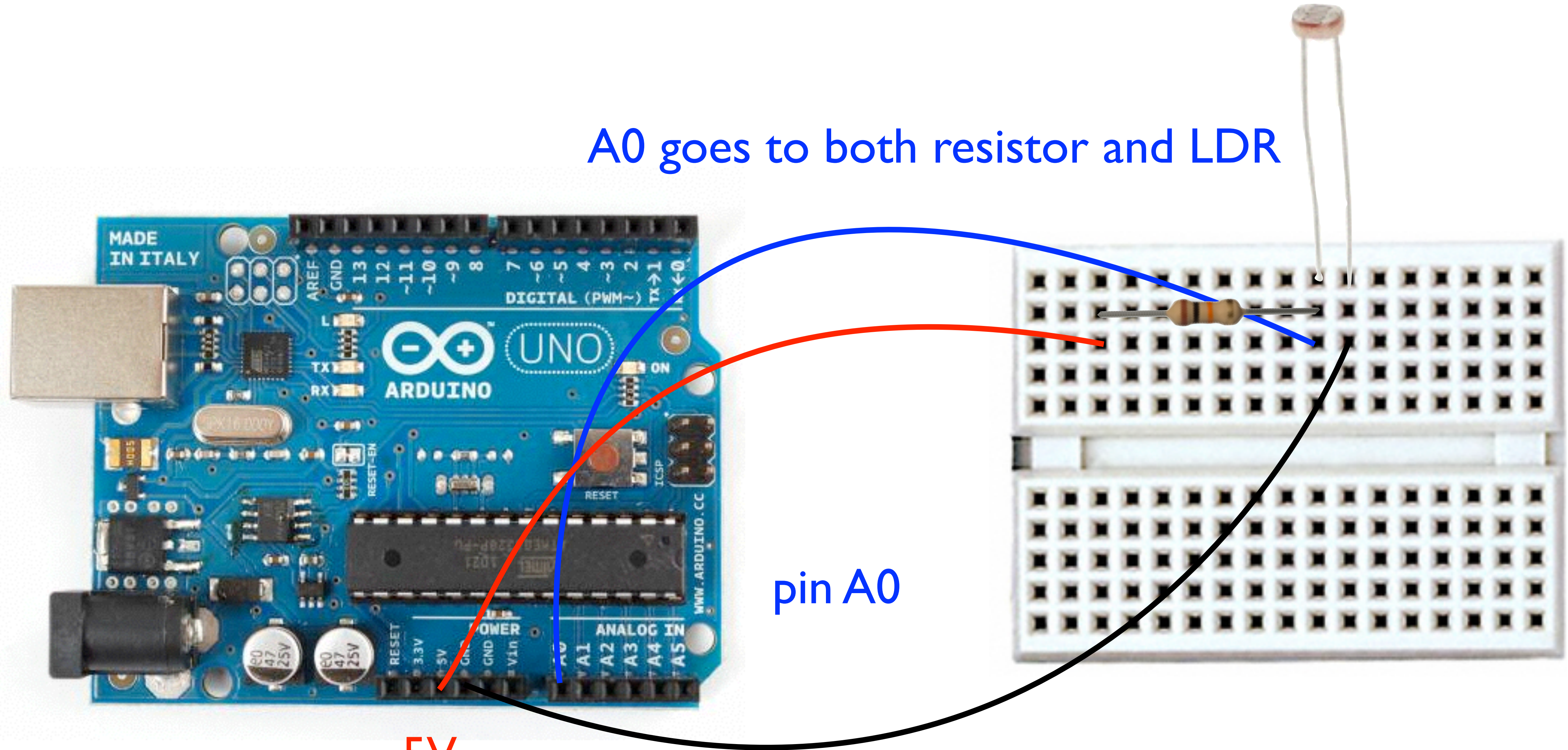
1 Arduino Duemilanove w/ ATmega328 on /dev/tty.usbserial-A9007ONC



Watch here!

Connect a LDR*

* Light-Dependent Resistor



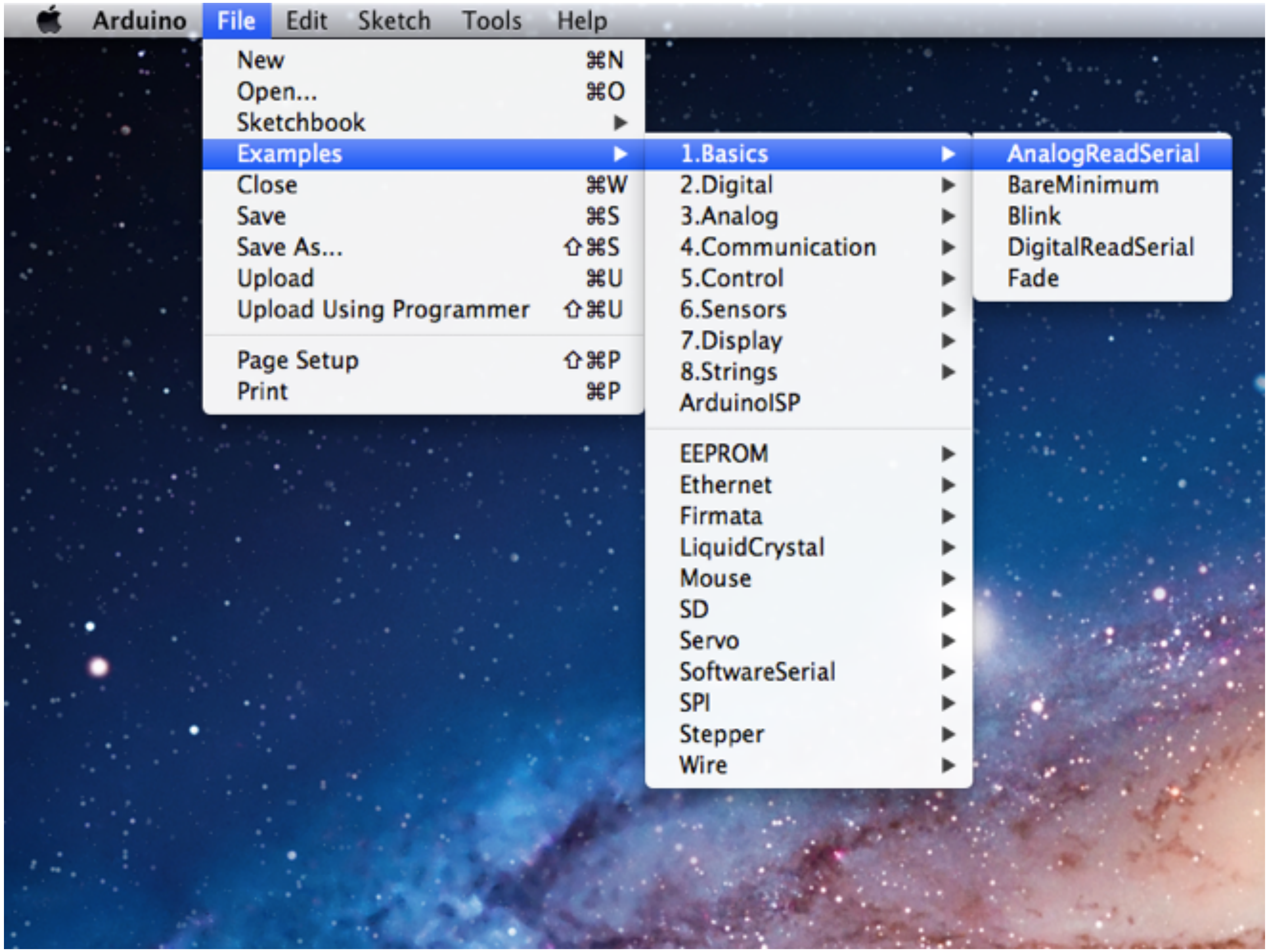
A0 goes to both resistor and LDR

pin A0

5V

GND (ground)

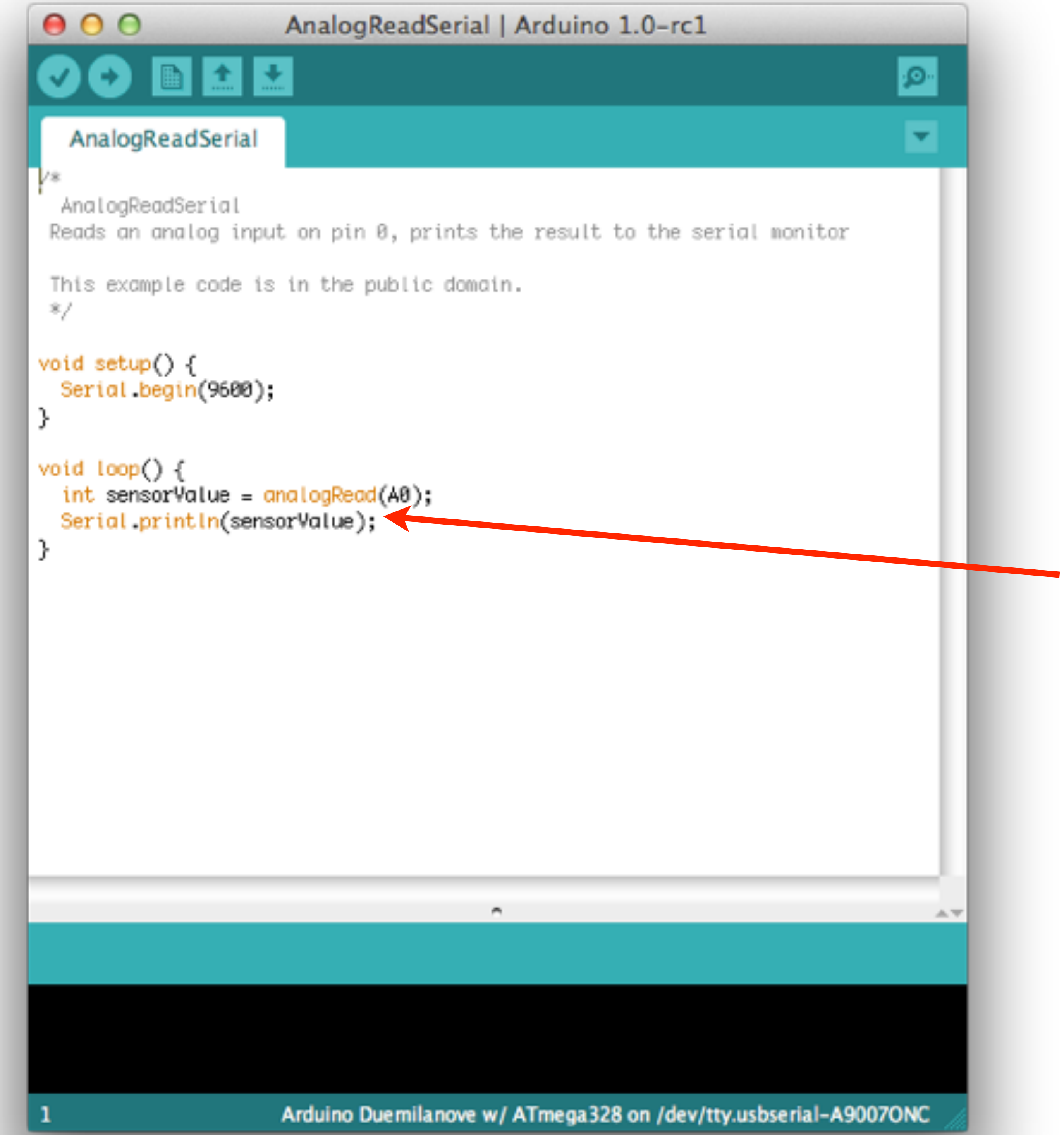
Back to this sketch...



Open AnalogReadSerial sketch

What is the range of possible values?

map() and constrain()


AnalogReadSerial | Arduino 1.0-rc1
AnalogReadSerial
1
Arduino Duemilanove w/ ATmega328 on /dev/tty.usbserial-A9007ONC

```
/*
  AnalogReadSerial
 Reads an analog input on pin 0, prints the result to the serial monitor
 
 This example code is in the public domain.
 */

void setup() {
  Serial.begin(9600);
}

void loop() {
  int sensorValue = analogRead(A0);
  Serial.println(sensorValue);
}
```

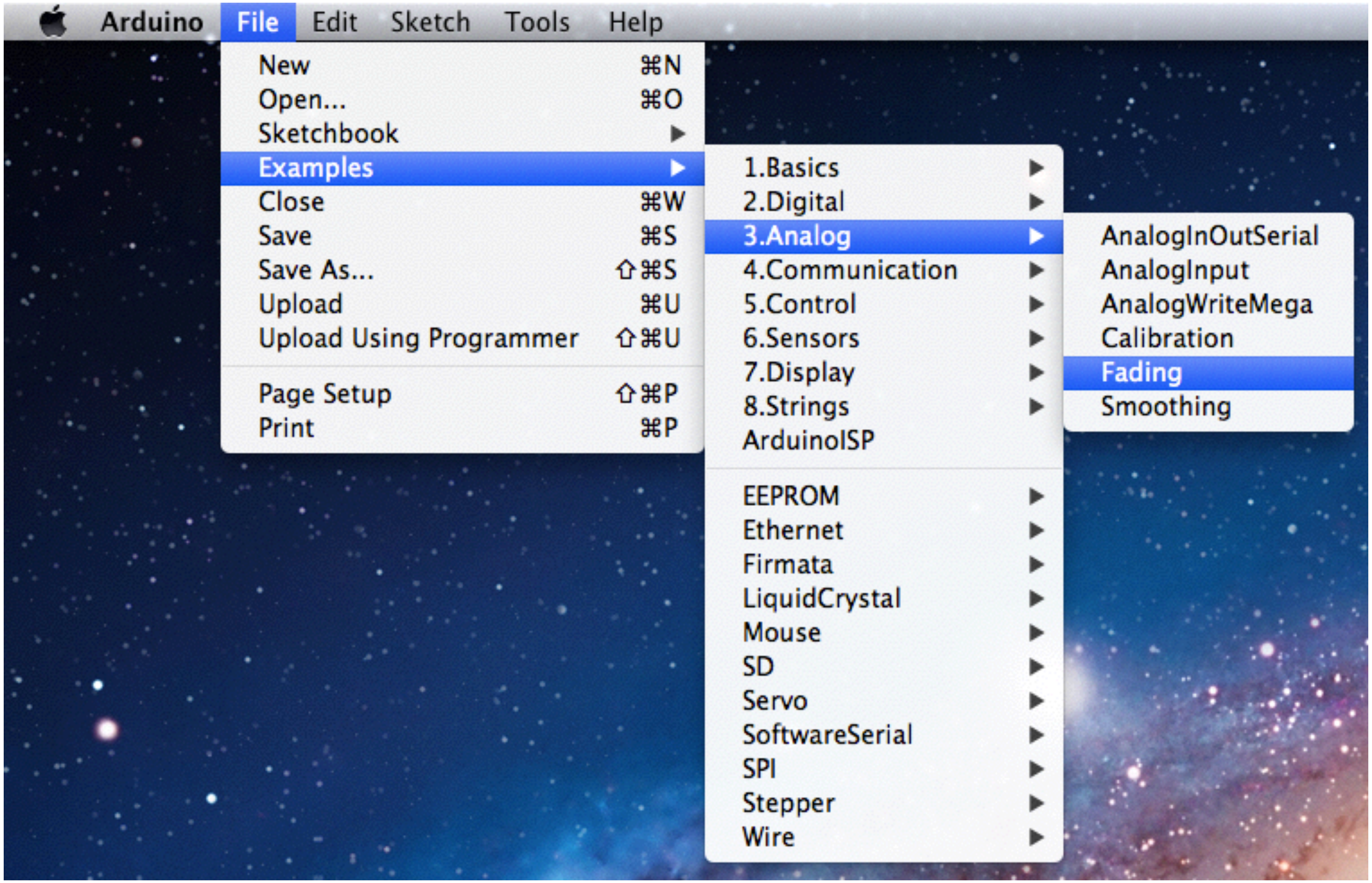
In here add:

```
int newValue = map(sensorValue,
    [...], [...], 0, 1023);
```

and change:

```
Serial.println(newValue);
```

Fading LEDs

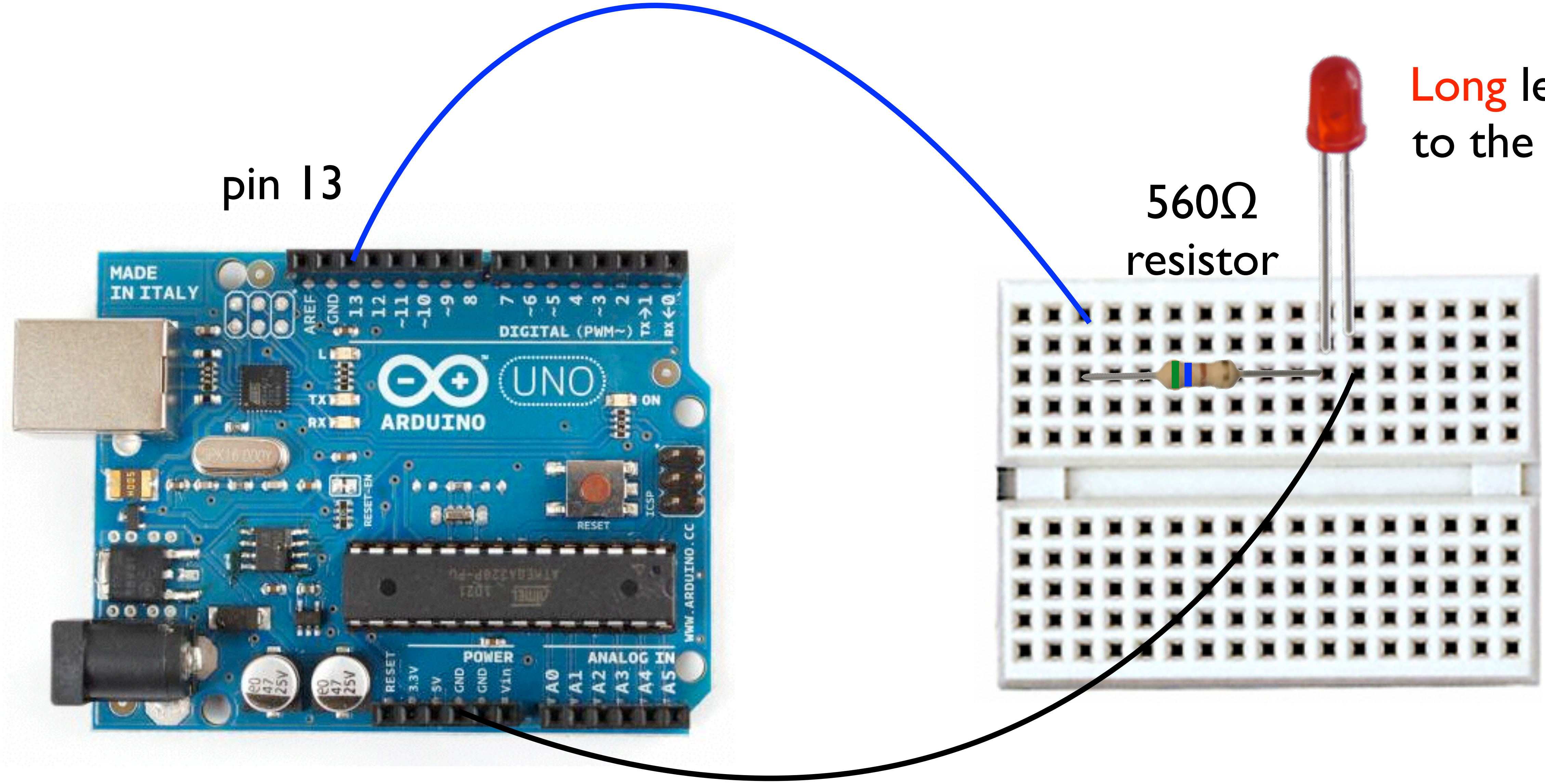


Open Fading sketch

Hook up the LED to pin 9

Connect an LED*

* Light-Emitting Diode



pin 13

560Ω resistor

Long lead goes to the resistor

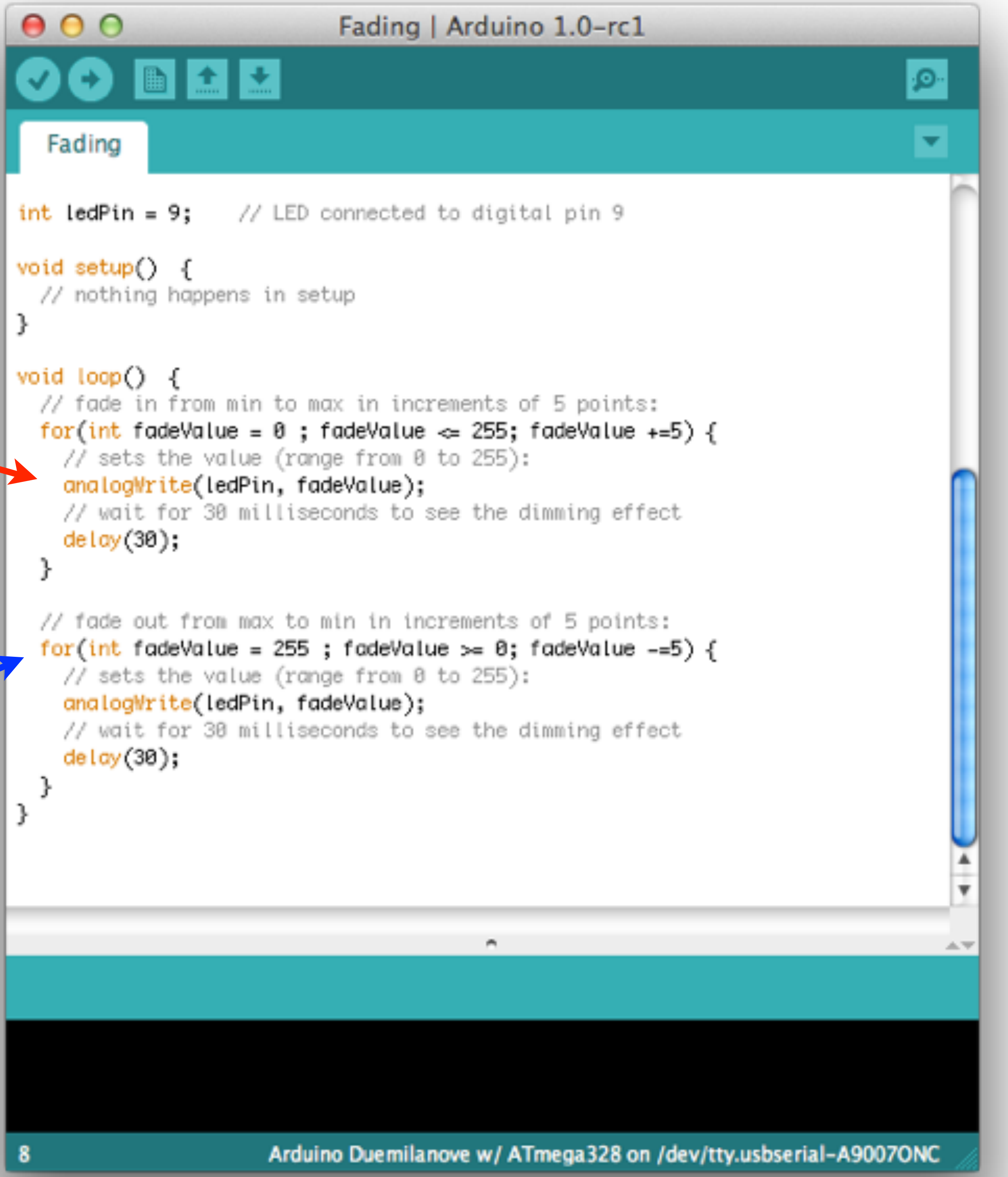
GND (ground)

Fading sketch

analogWrite()

What is the range of values?

```
for(start; finish; increment) {
  // stuff in the loop
}
```



```
int ledPin = 9;    // LED connected to digital pin 9

void setup()  {
  // nothing happens in setup
}

void loop()  {
  // fade in from min to max in increments of 5 points:
  for(int fadeValue = 0 ; fadeValue <= 255; fadeValue +=5) {
    // sets the value (range from 0 to 255):
    analogWrite(ledPin, fadeValue);
    // wait for 30 milliseconds to see the dimming effect
    delay(30);
  }

  // fade out from max to min in increments of 5 points:
  for(int fadeValue = 255 ; fadeValue >= 0; fadeValue -=5) {
    // sets the value (range from 0 to 255):
    analogWrite(ledPin, fadeValue);
    // wait for 30 milliseconds to see the dimming effect
    delay(30);
  }
}
```

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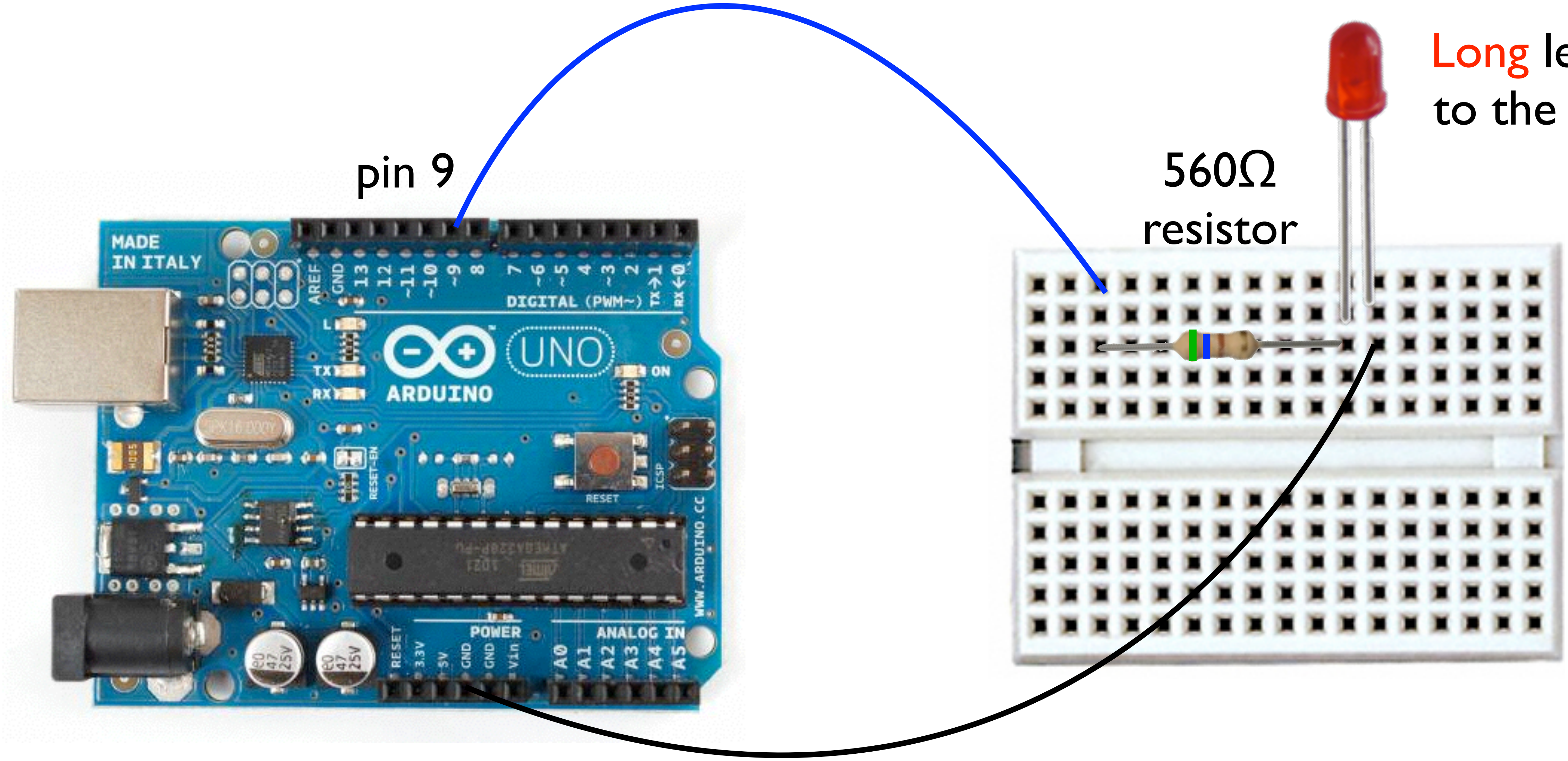
Arduino Duemilanove w/ ATmega328 on /dev/tty.usbserial-A9007ONC

Connect an LED*

* Light-Emitting Diode



pin 9

560Ω resistor

Long lead goes to the resistor

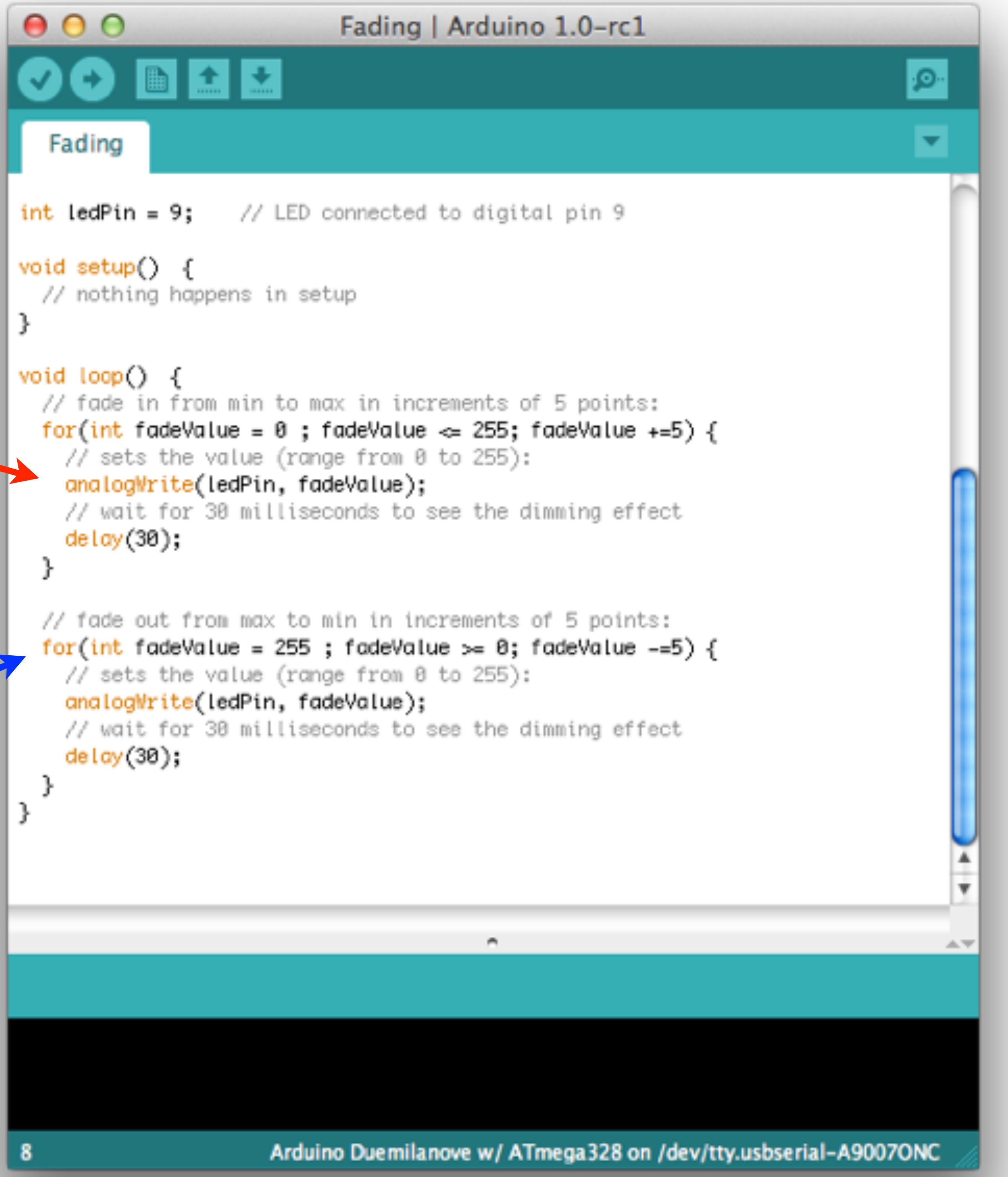
GND (ground)

Fading sketch

analogWrite()

What is the range of values?

```
for(start; finish; increment) {
  // stuff in the loop
}
```


Fading | Arduino 1.0-rc1
Fading
8
Arduino Duemilanove w/ ATmega328 on /dev/tty.usbserial-A9007ONC

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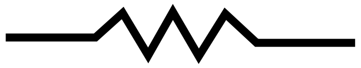
  }
}
```

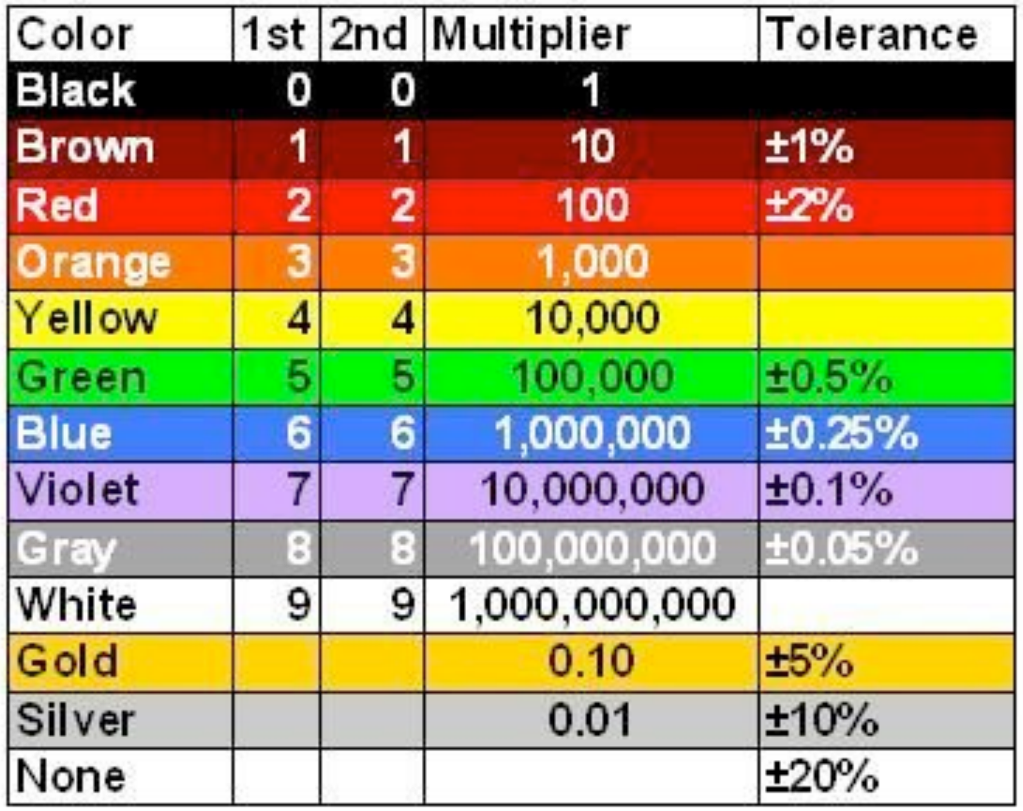
Resistors

...resist the flow of electric current



330Ω

Resistance is measured in ohms



Color	1st	2nd	Multiplier	Tolerance
Black	0	0	1	
Brown	1	1	10	±1%
Red	2	2	100	±2%
Orange	3	3	1,000	
Yellow	4	4	10,000	
Green	5	5	100,000	±0.5%
Blue	6	6	1,000,000	±0.25%
Violet	7	7	10,000,000	±0.1%
Gray	8	8	100,000,000	±0.05%
White	9	9	1,000,000,000	
Gold			0.10	±5%
Silver			0.01	±10%
None				±20%

Resistor Colour Code

Voltage and Current

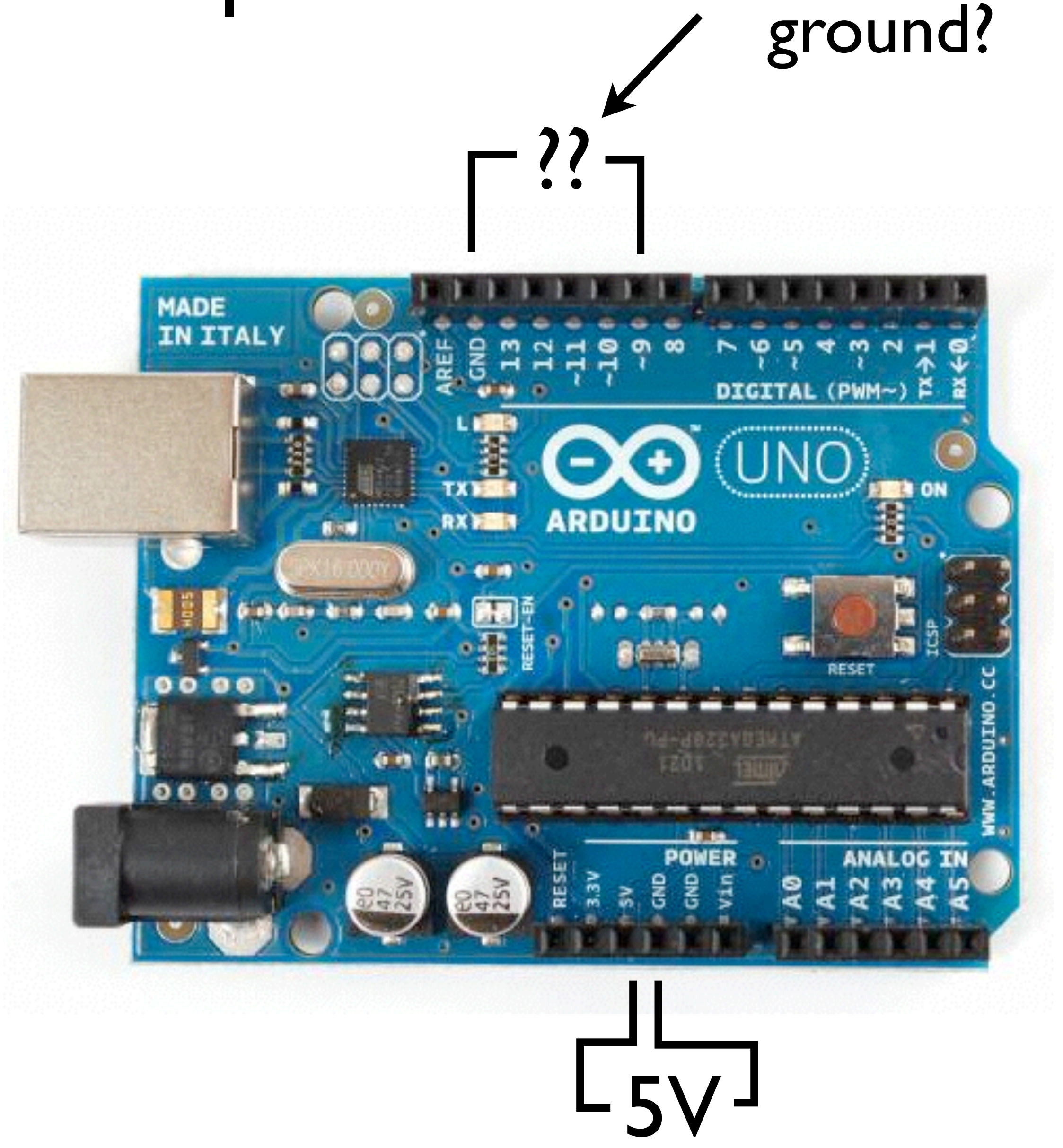
- Voltage = electric potential between two points
- Measured in volts (V)
- Ground = common reference point

9V

1.5V

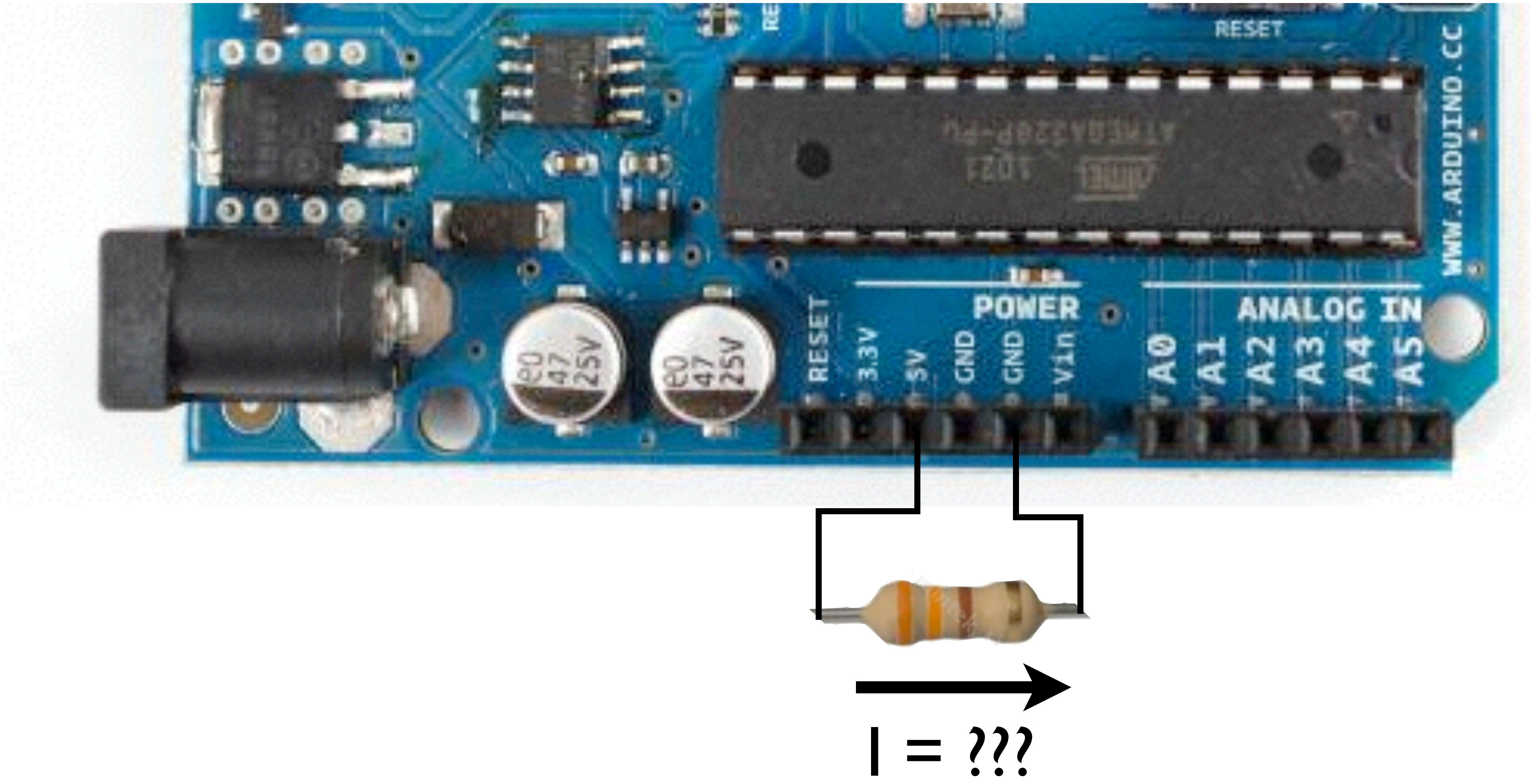
240V

What is the voltage between pin 9 and ground?



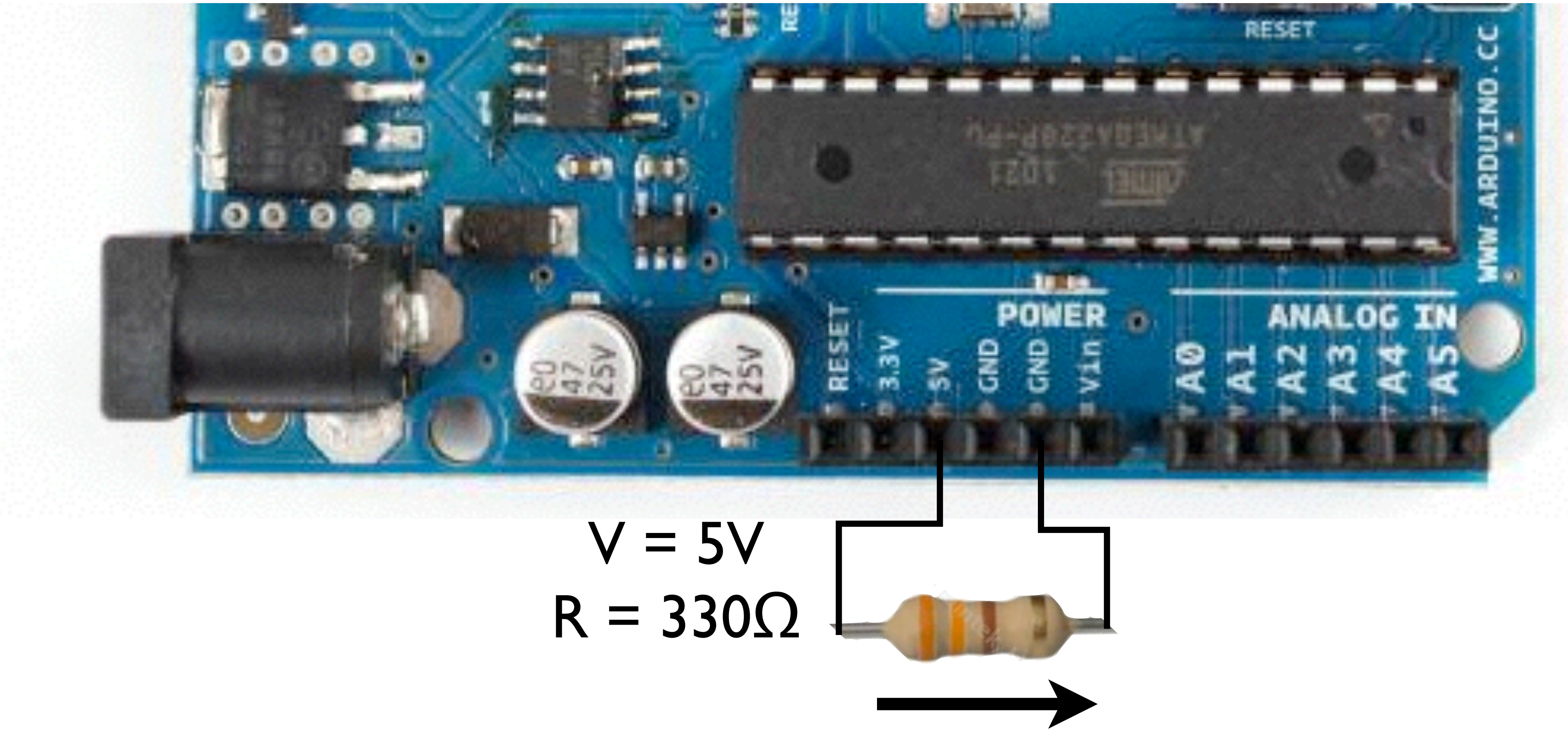
Voltage and Current

- Current = rate at which electric charge flows through a wire/circuit
- Measured in amps (A) or milliamps (mA)



V = IR

- Ohm's Law: voltage = current times resistance
- Equivalently: I = V/R



V = 5V

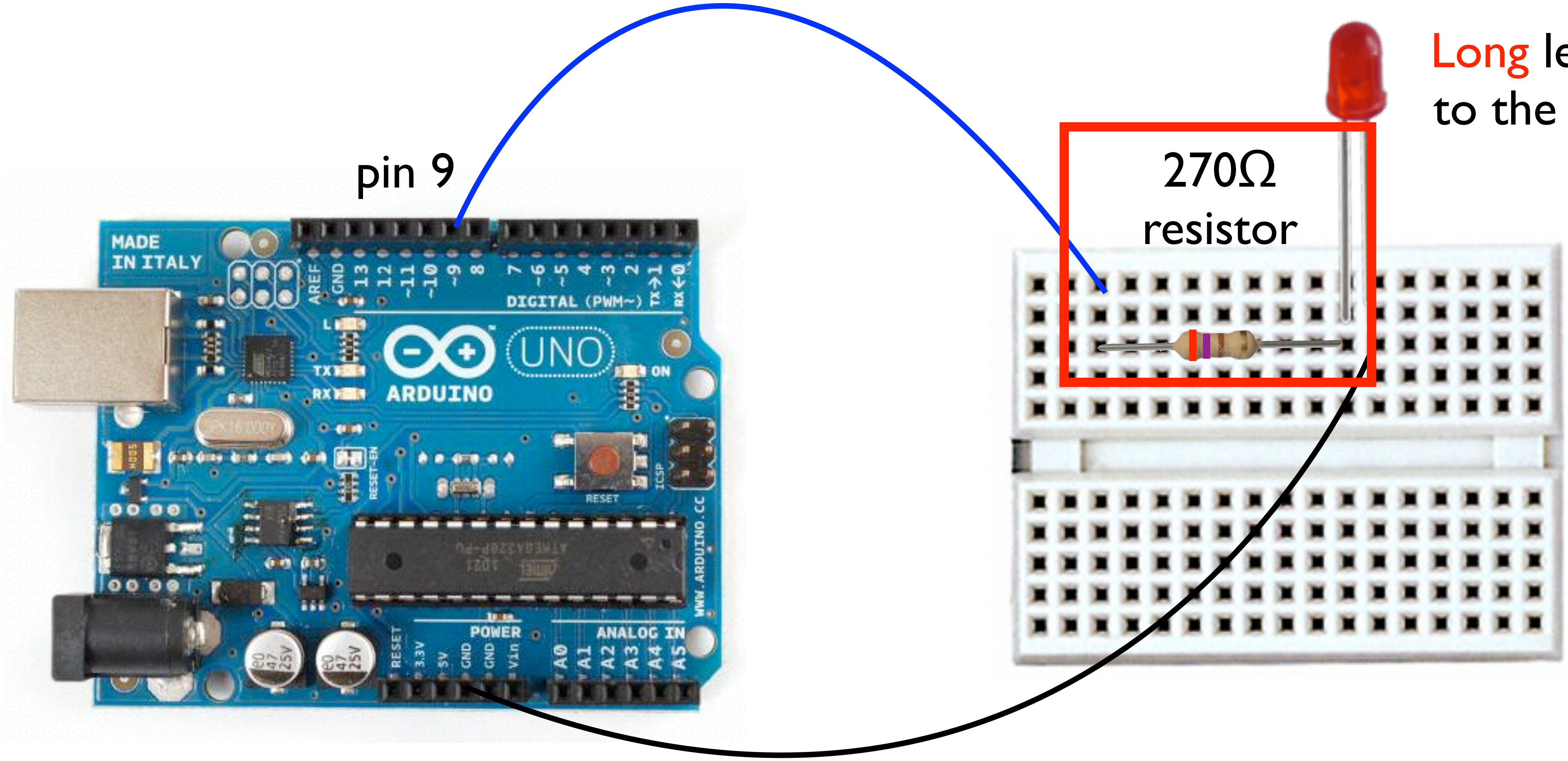
R = 330Ω

I = 5V / 330Ω

I = .015A = 15mA

Connect an LED*

* Light-Emitting Diode



pin 9

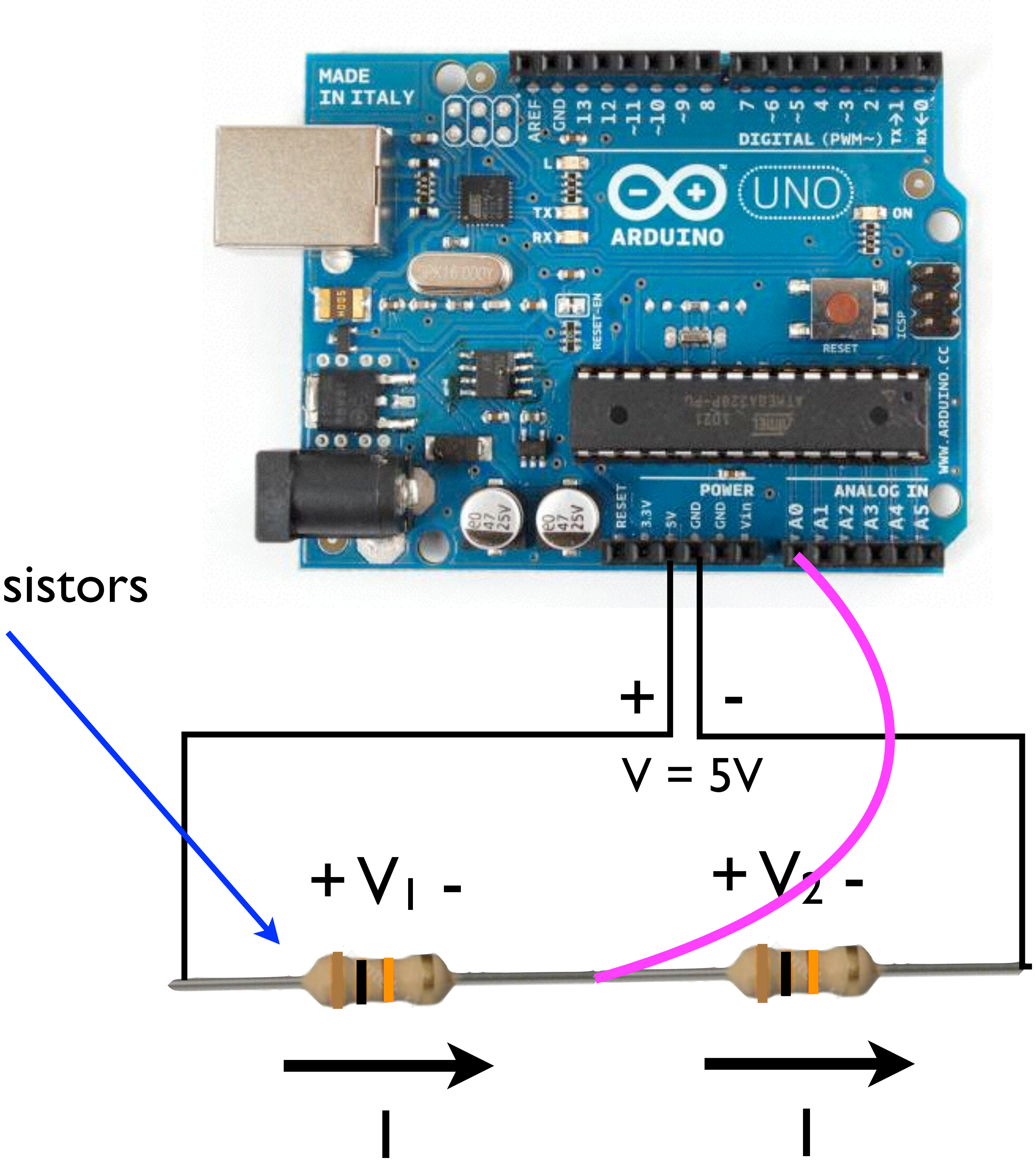
270Ω
resistor

Long lead goes
to the resistor

GND (ground)

Series and Parallel

Use 2 10kΩ resistors



$V_1 + V_2 = 5V$

...so what is V_2?

Series and Parallel

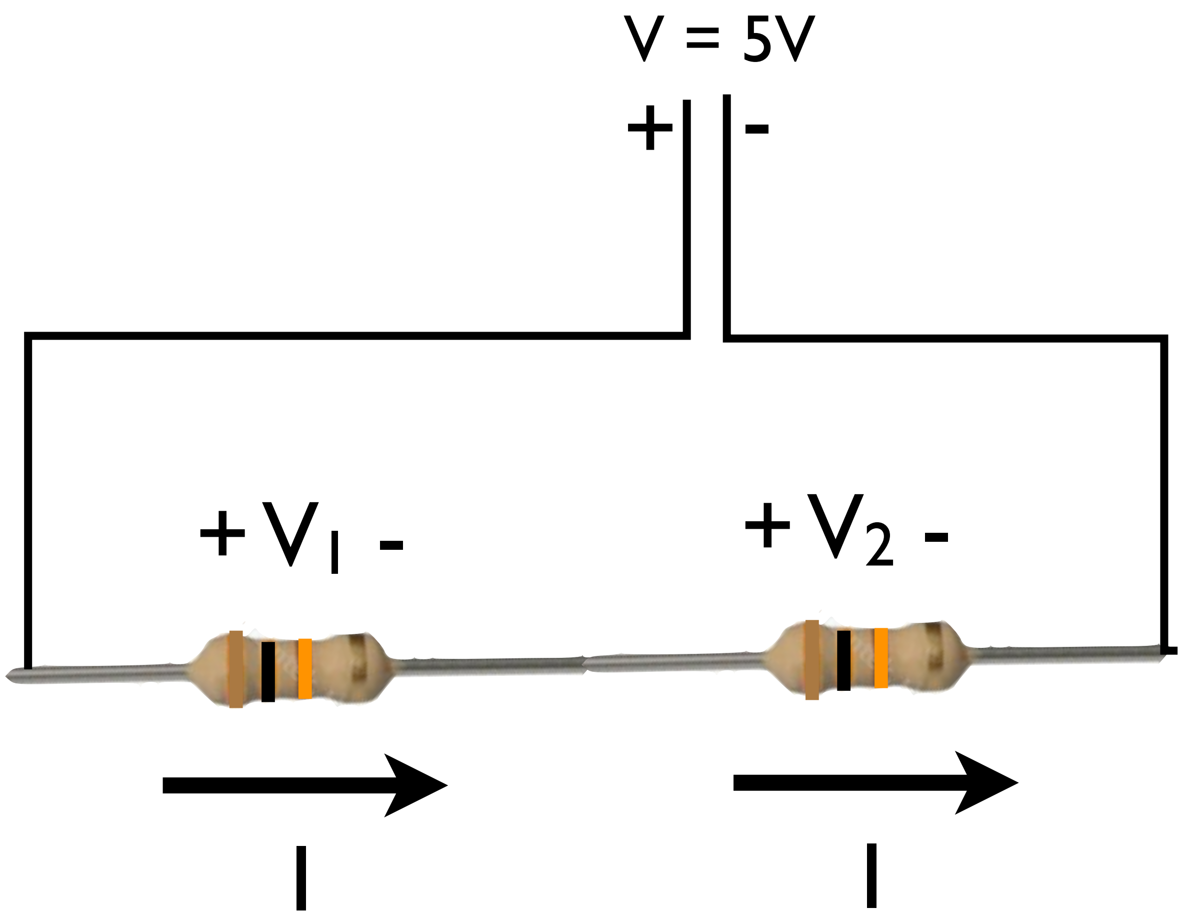
$$V = IR$$

$$V_1 + V_2 = 5V$$

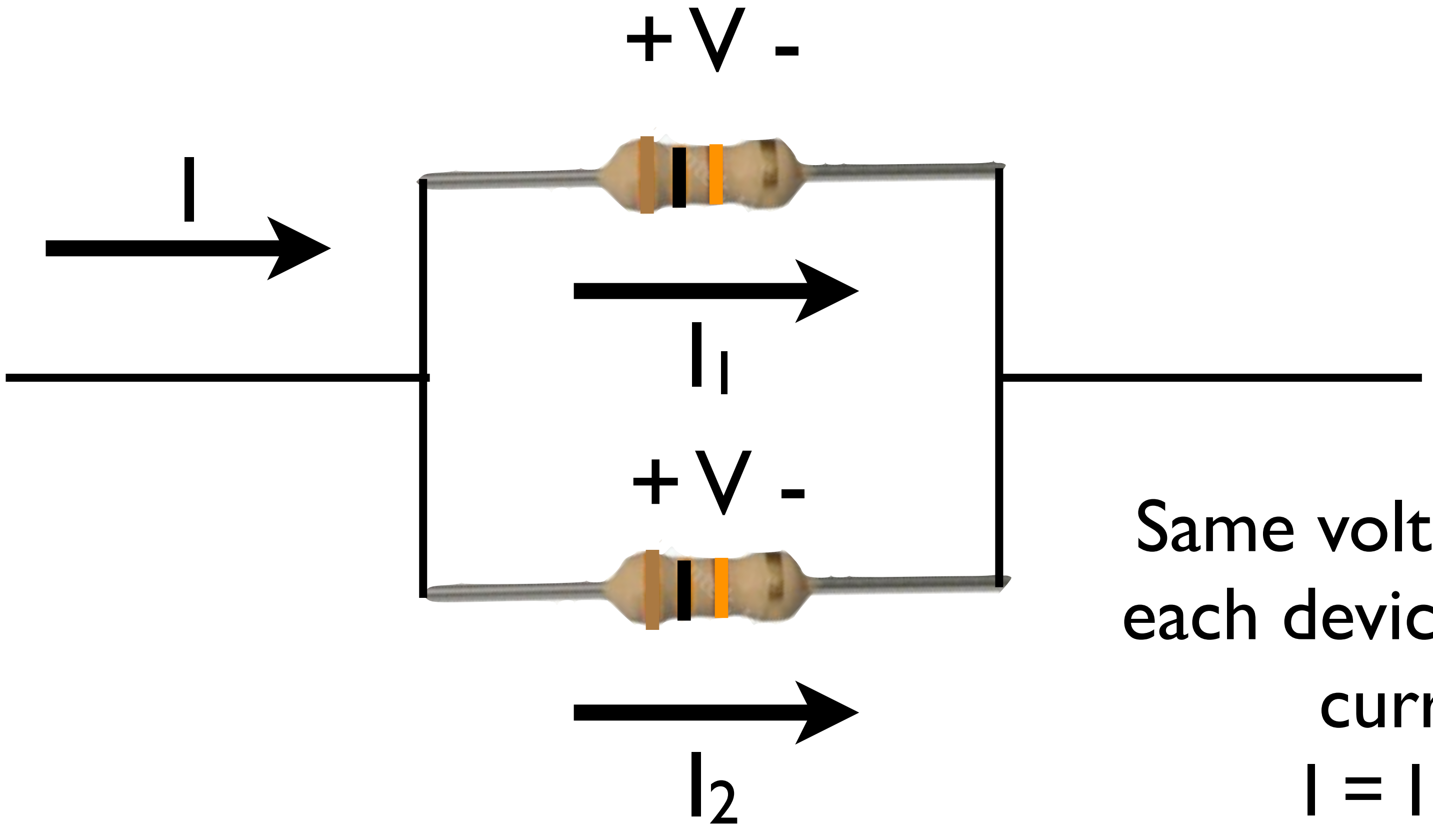
$$IR_1 + IR_2 = 5V$$

$$I = 5V / (R_1 + R_2) = 5V / 20k\Omega = 0.25mA$$

$$V_2 = IR_2 = 2.5V$$



Series and Parallel

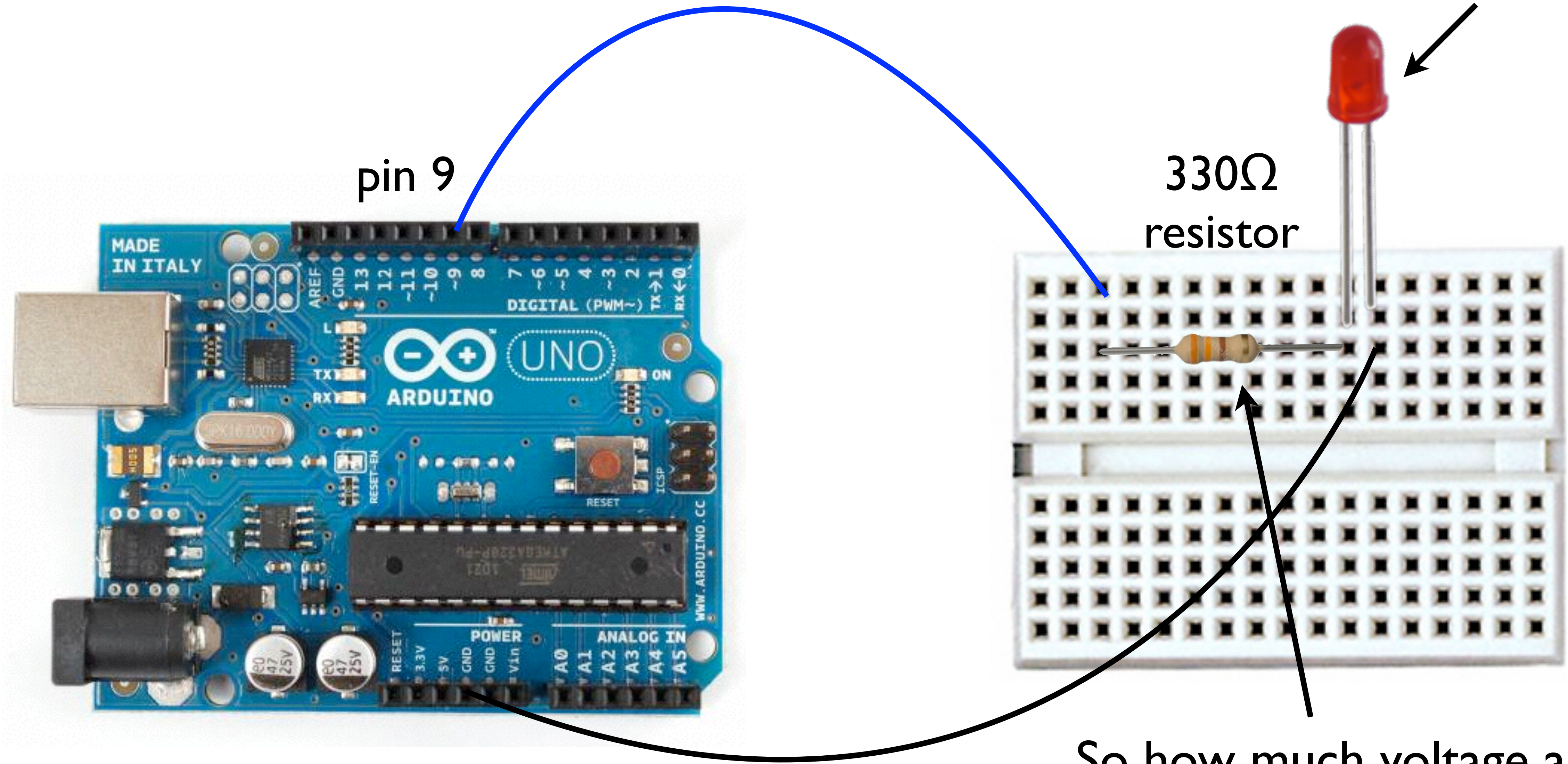


Same voltage across each device, different current:
$I = I_1 + I_2$

- Handy rules for series and parallel resistors:
  - In series: $R_{total} = R_1 + R_2$
  - In parallel: $R_{total} = (R_1 R_2) / (R_1 + R_2)$

Resistors and LEDs

For LEDs, always the same voltage drop across the device. About 1.7V for a red LED



pin 9

330Ω resistor

GND (ground)

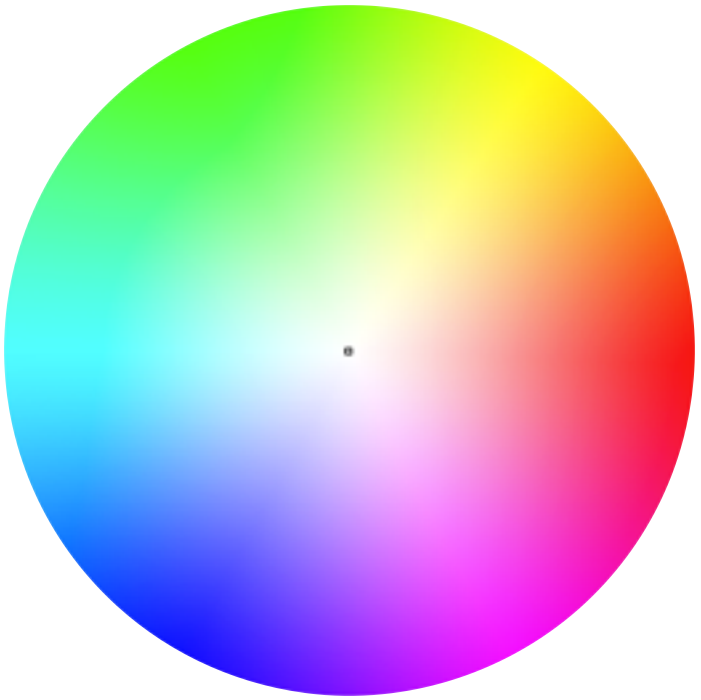
So how much voltage across the resistor if pin 9 is at 5V?

...and how much current?

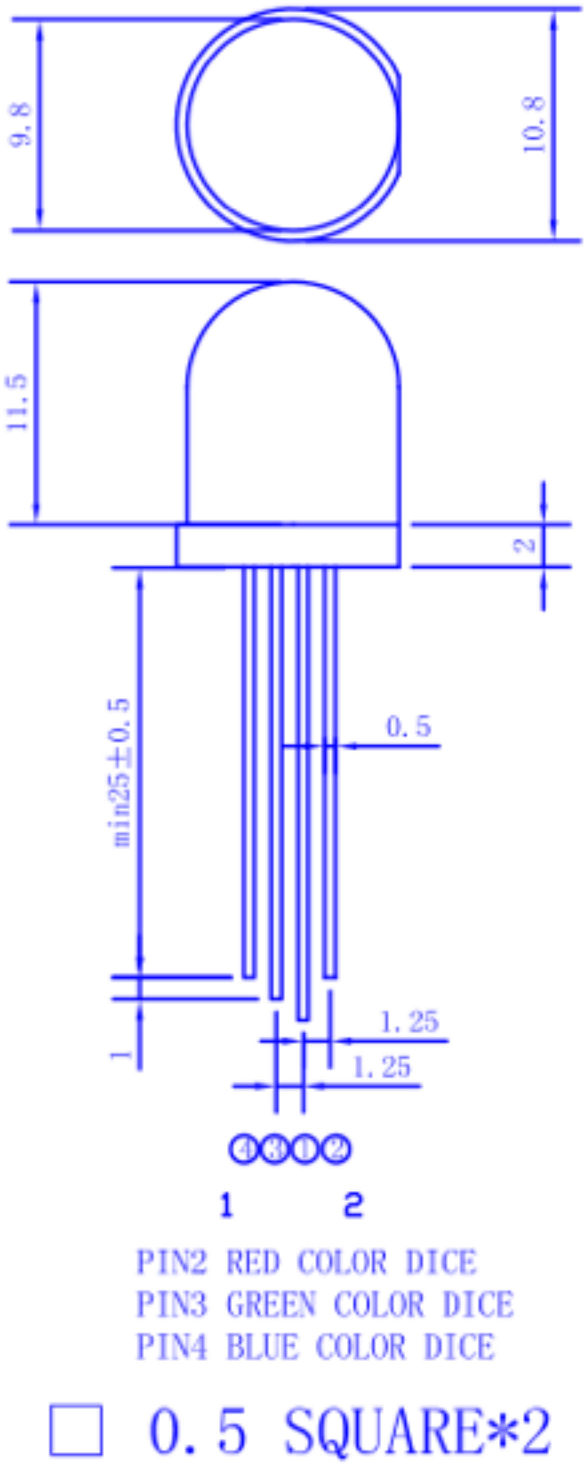
RGB LEDs

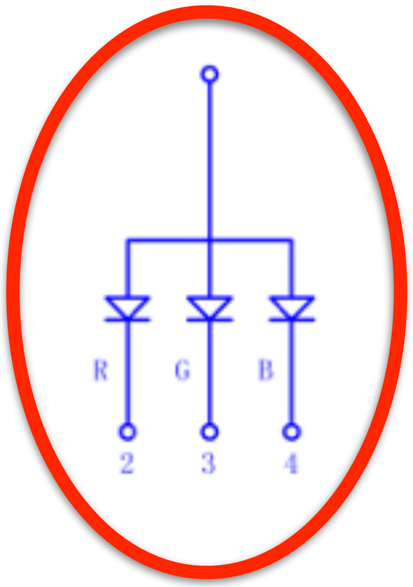
3 LED elements in one package:
Red, Green, Blue

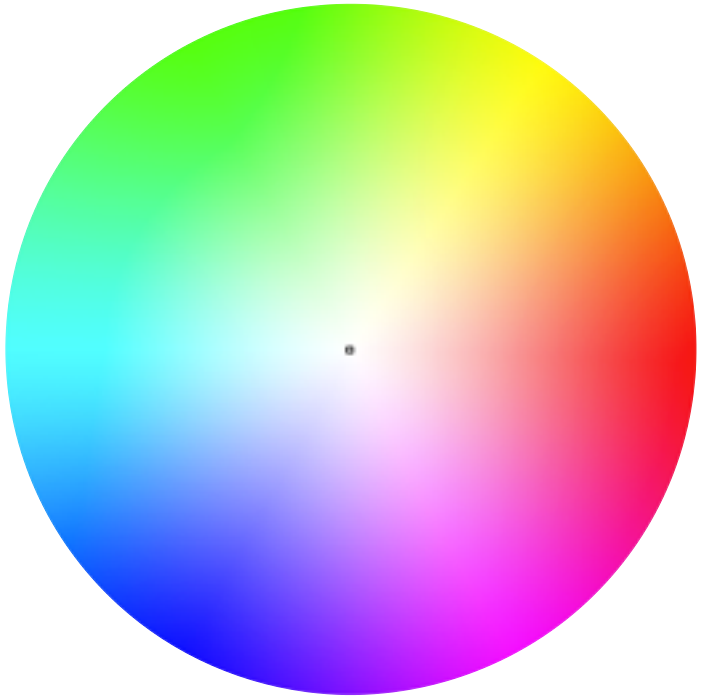
So where do we find the pinout?



RGB LEDs







Notice: common anode means the positive side of each LED is shared.

Using an FSR*

* Force-Sensing Resistor

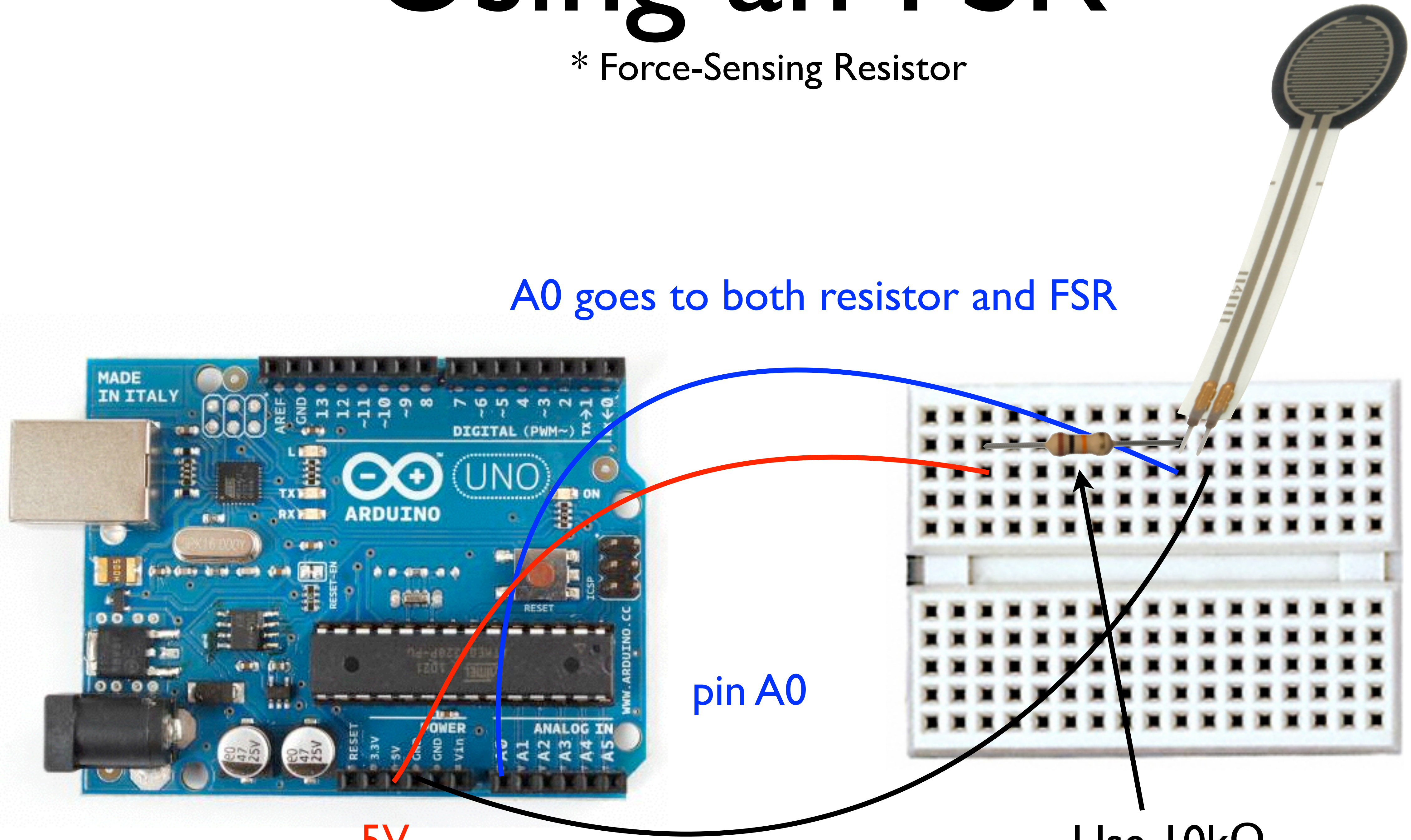
The FSR changes its resistance according to the amount of force exerted on it

How should we hook it up??

How should we hook it up so we get a changing voltage?

Using an FSR*

* Force-Sensing Resistor



A0 goes to both resistor and FSR

pin A0

5V

GND (ground)

Use 10kΩ

Use AnalogReadSerial sketch