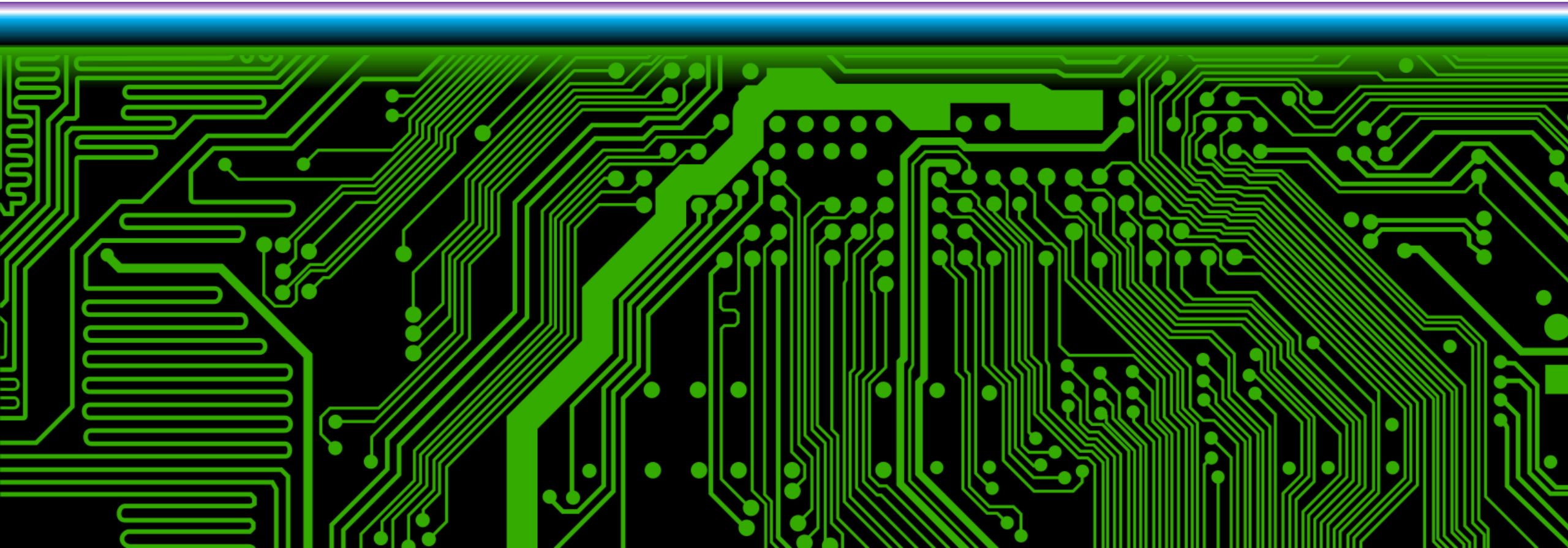


The Arduino

An introduction to the software/hardware interface



Goals:

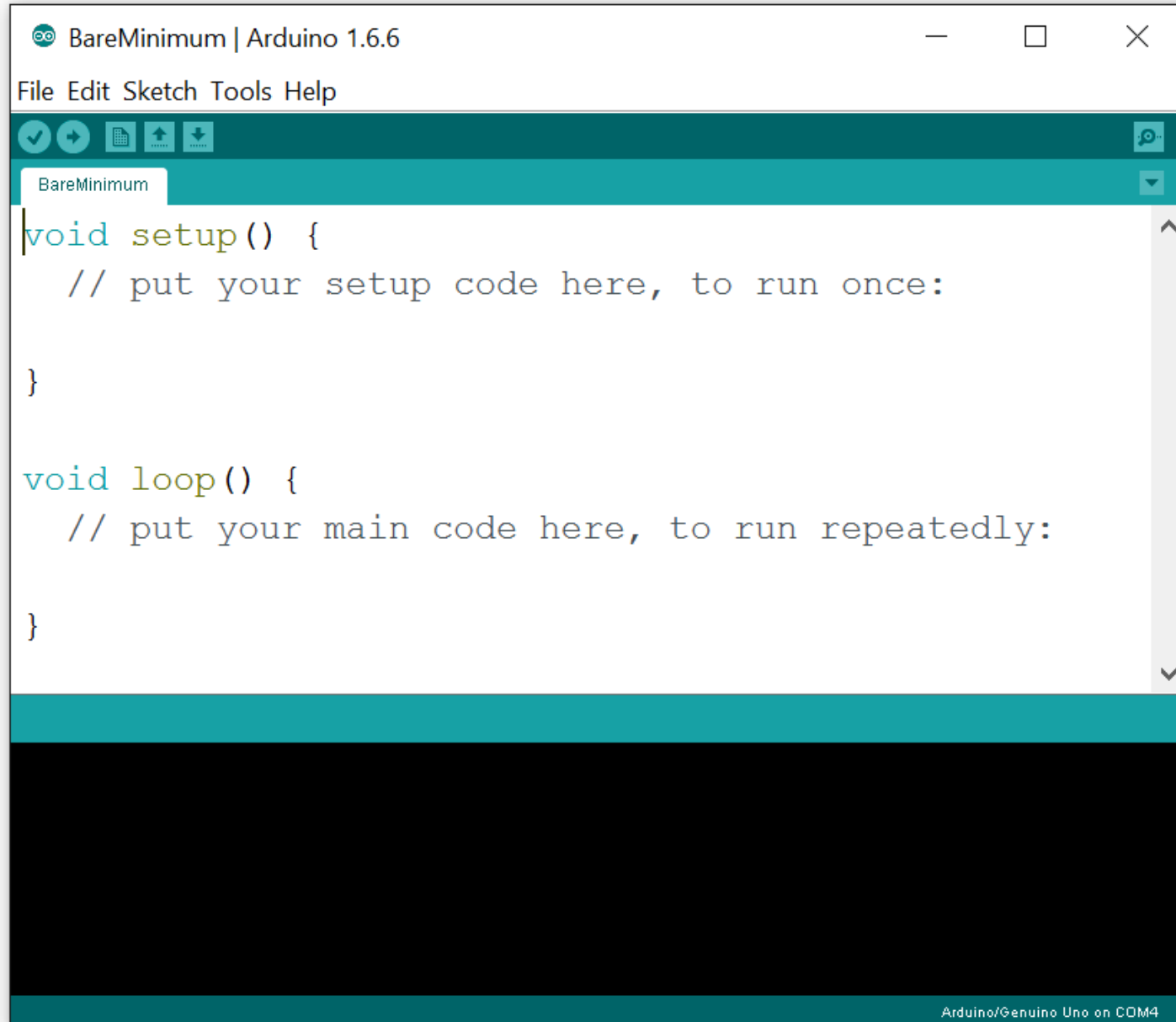
1. Explain the basics of programming and circuit design.
2. Describe the hardware/software interface and the benefits of Arduinos.
3. Build basic circuits using the Arduino system.

An Initial Question...

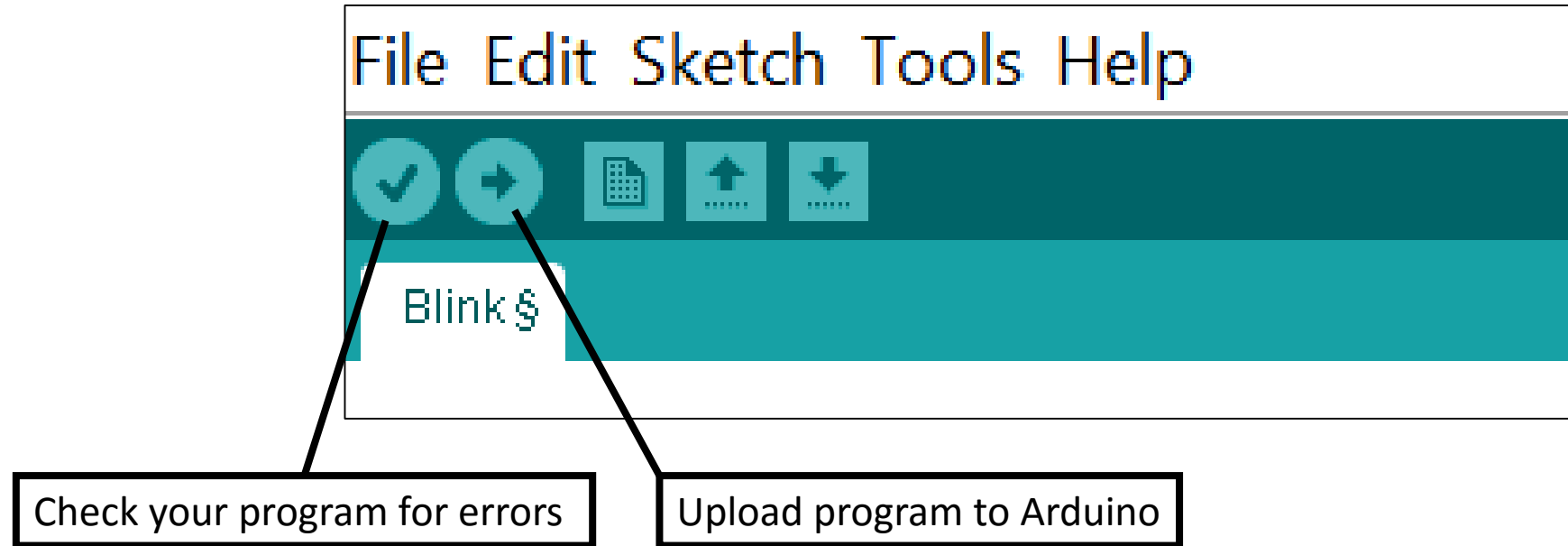
What is a Computer Program?

Disclaimer: This is NOT a programming class

Arduino Language



Arduino Language



Program I

```
int x =9;

void setup() {
  Serial.begin(115200);
}

void loop() {
  if x < 10{
    Serial.println("X is less than 10");
  }
}
```

Program II

```
int x =0;

void setup() {
    Serial.begin(115200);
}

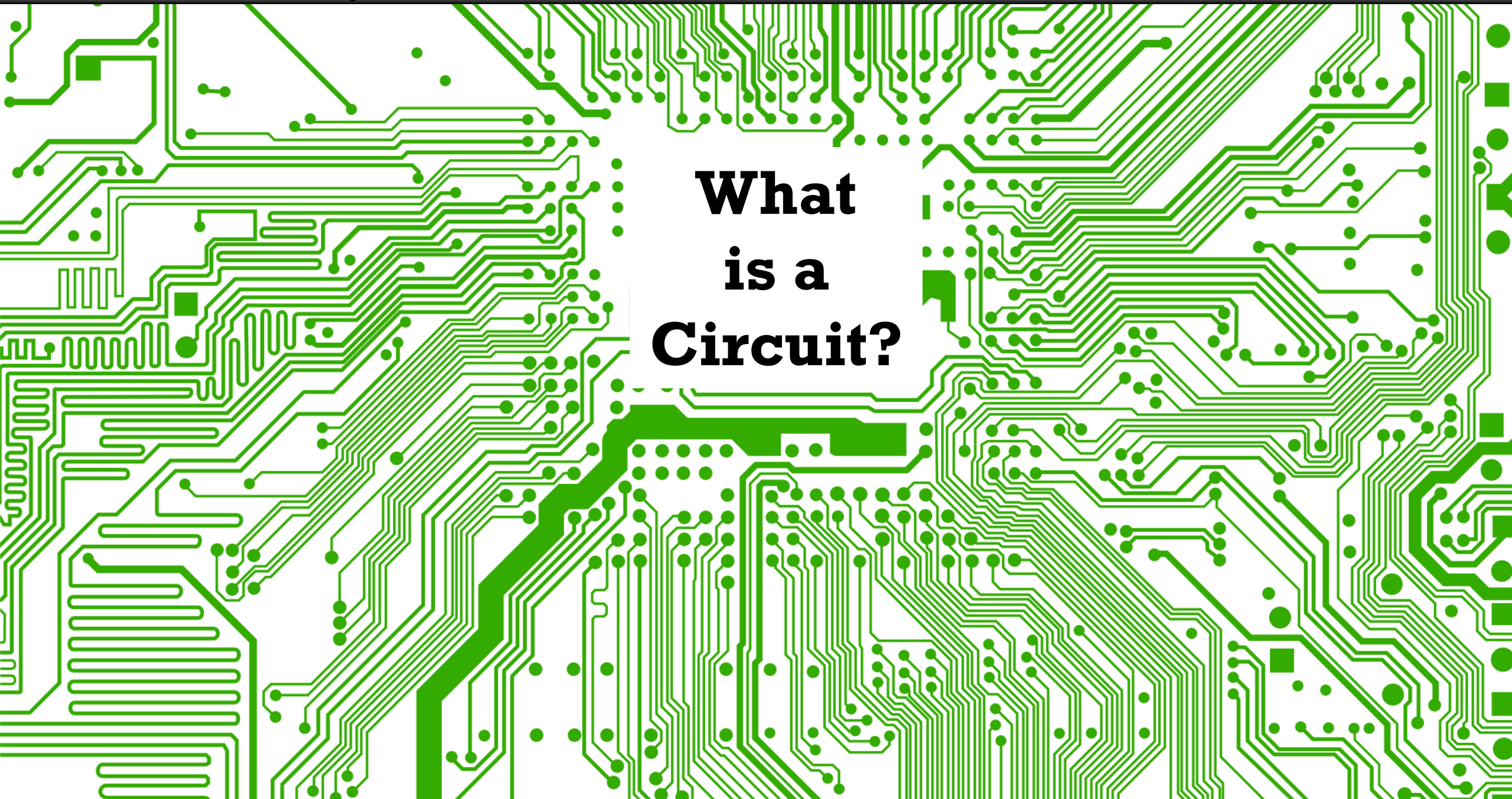
void loop() {
    if x < 10{
        Serial.print("X is less than 10: in fact, x is ");
        Serial.println(x);
    }
    x=x+1;
}
```

Program III

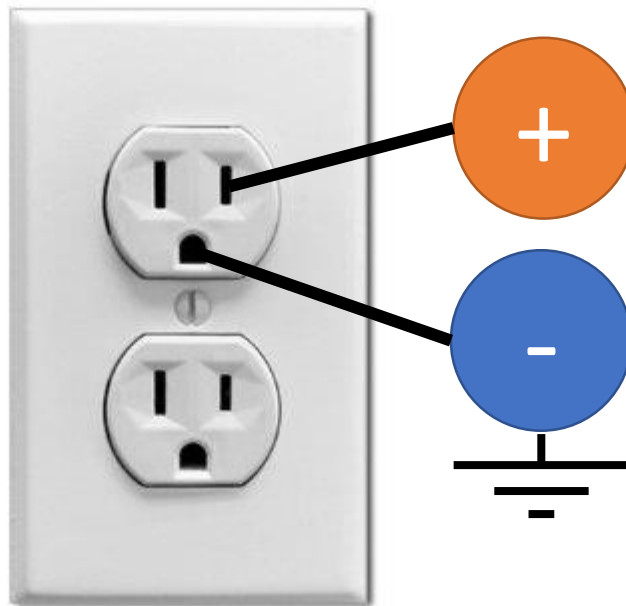
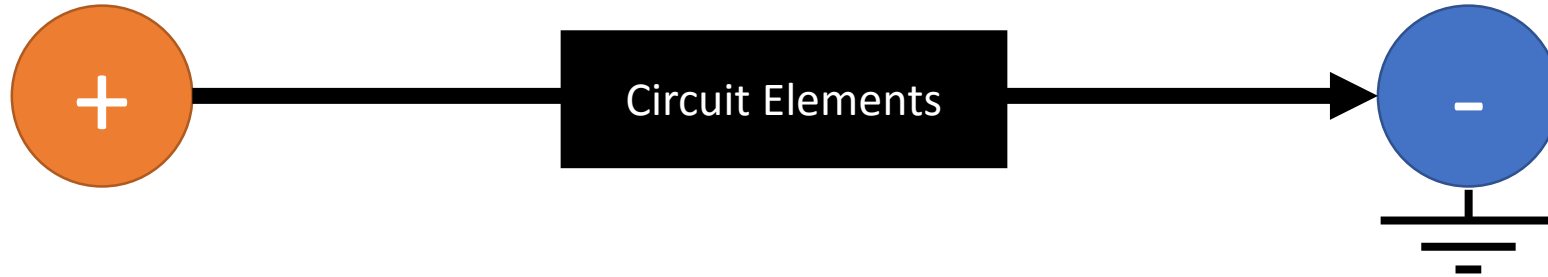
```
void setup() {  
    Serial.begin(115200);  
}  
  
void loop() {  
    for (int x=0; x < 10; x++) {  
        Serial.print("X is less than 10: in fact, x is ");  
        Serial.println(x);  
    }  
}
```


An Second Question...

**What
is a
Circuit?**



Circuits



Terminology

- V = Voltage = potential difference
- I = Current = flow of charge
- R = Resistance = opposition to the flow of current

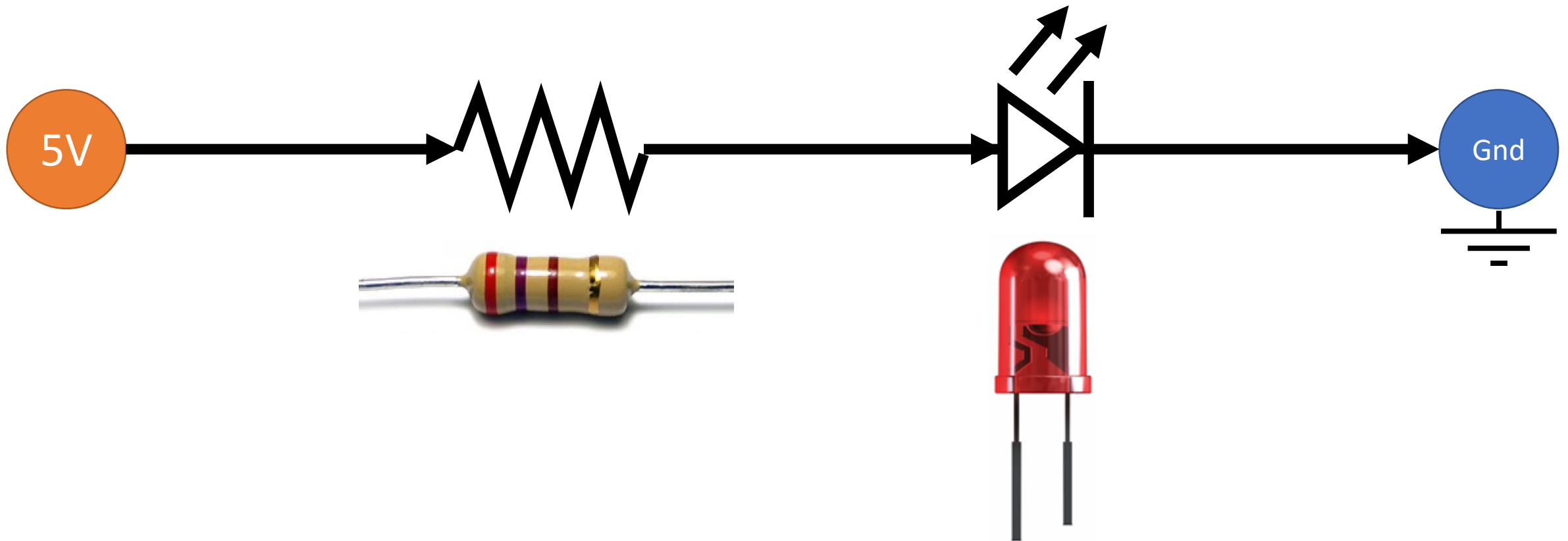
A Simple Circuit

Resistor

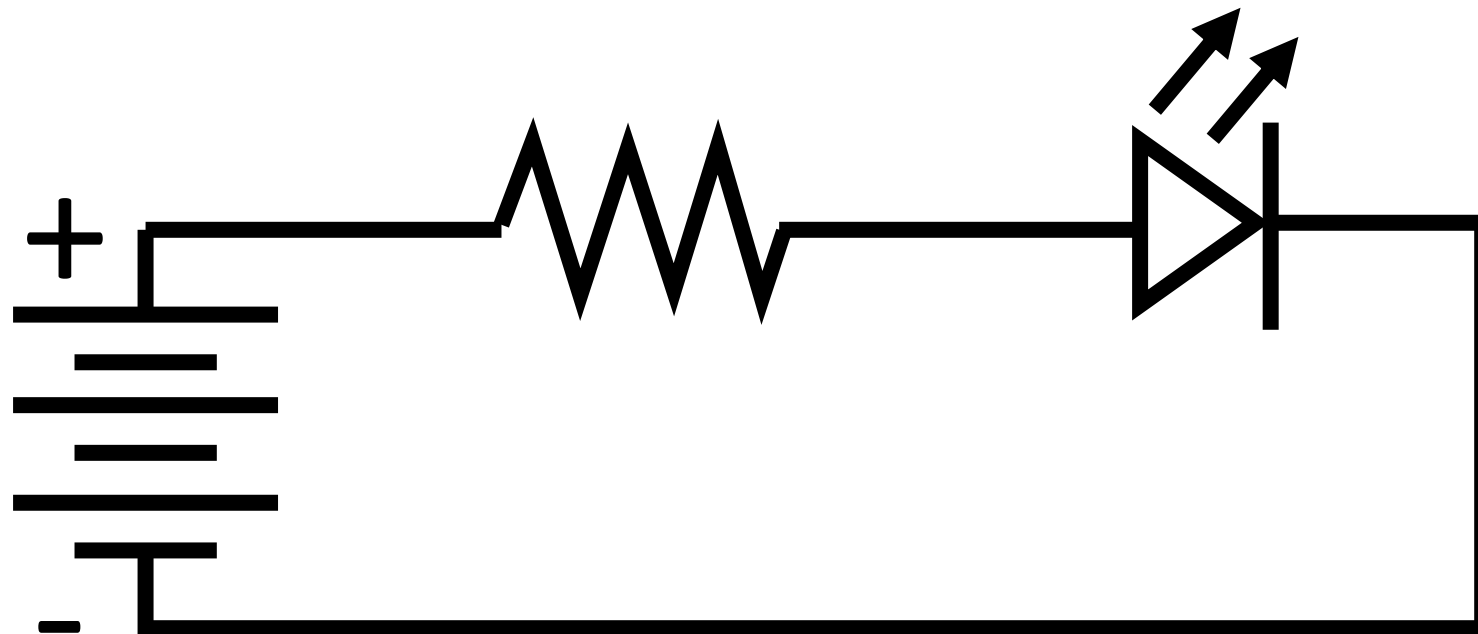
reduces voltage

LED

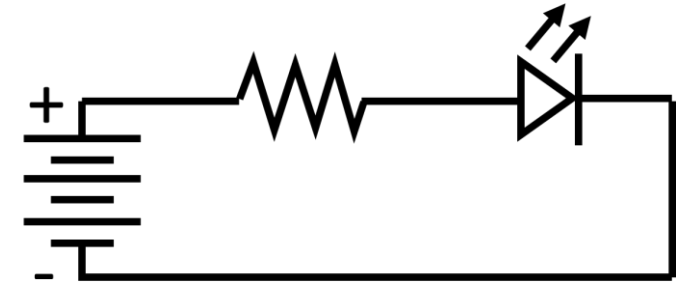
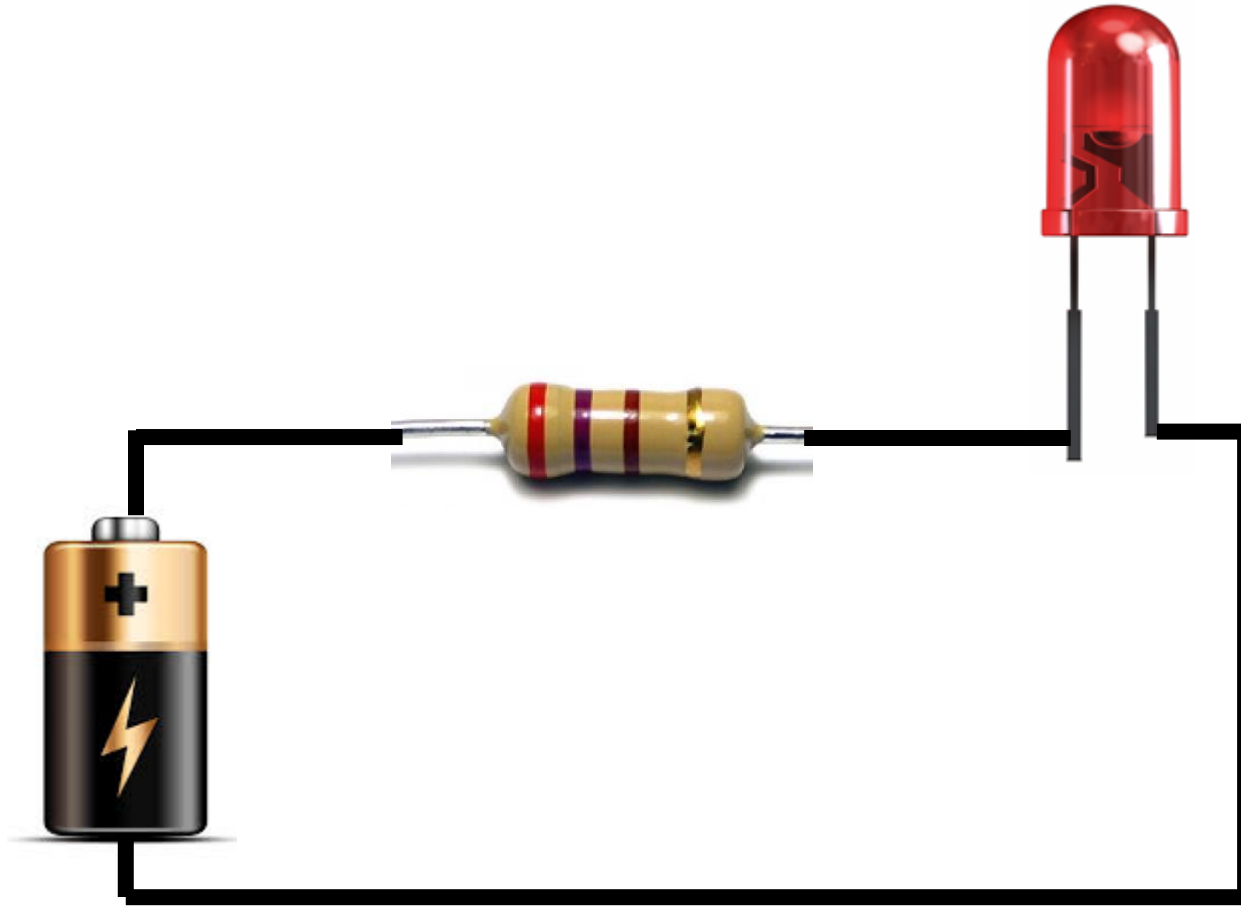
LED = light emitting diode
diode: passes current in one direction



A Simple Circuit



A Simple Circuit



Another Question...

**What
is an
Arduino?**

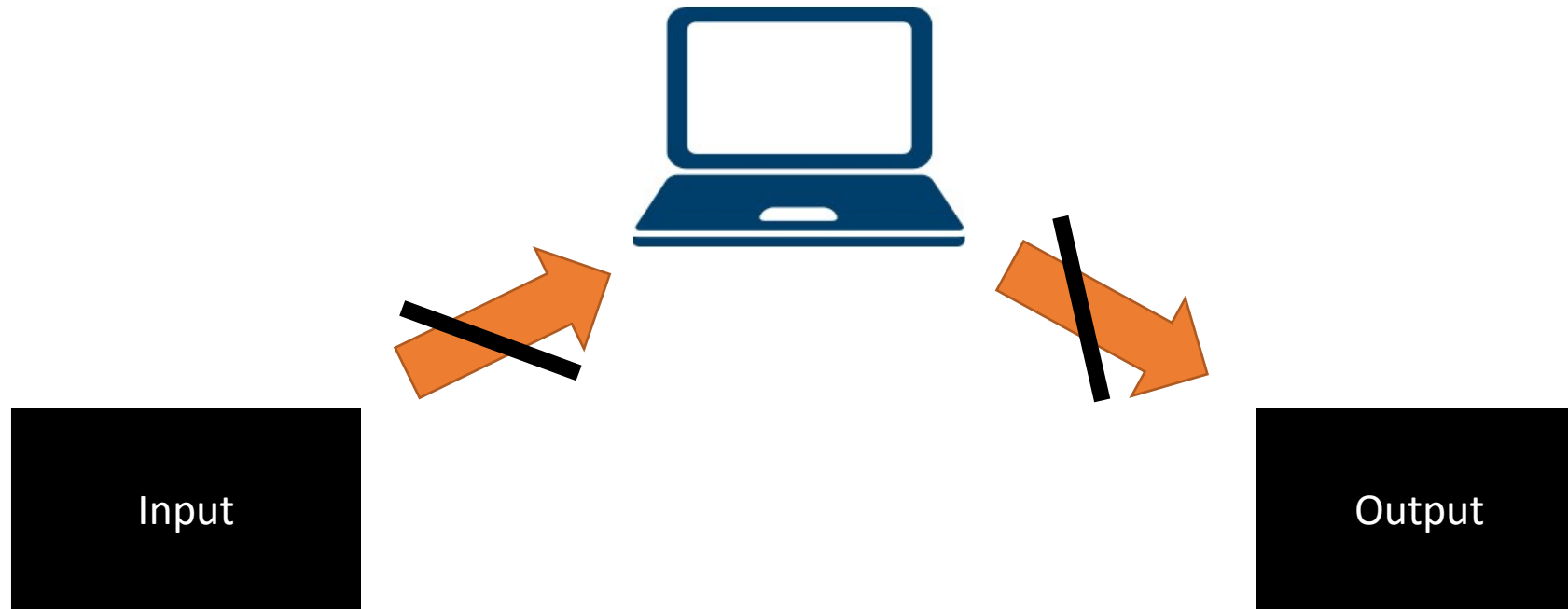
An Example System



Input

Output

An Example System



An Example System

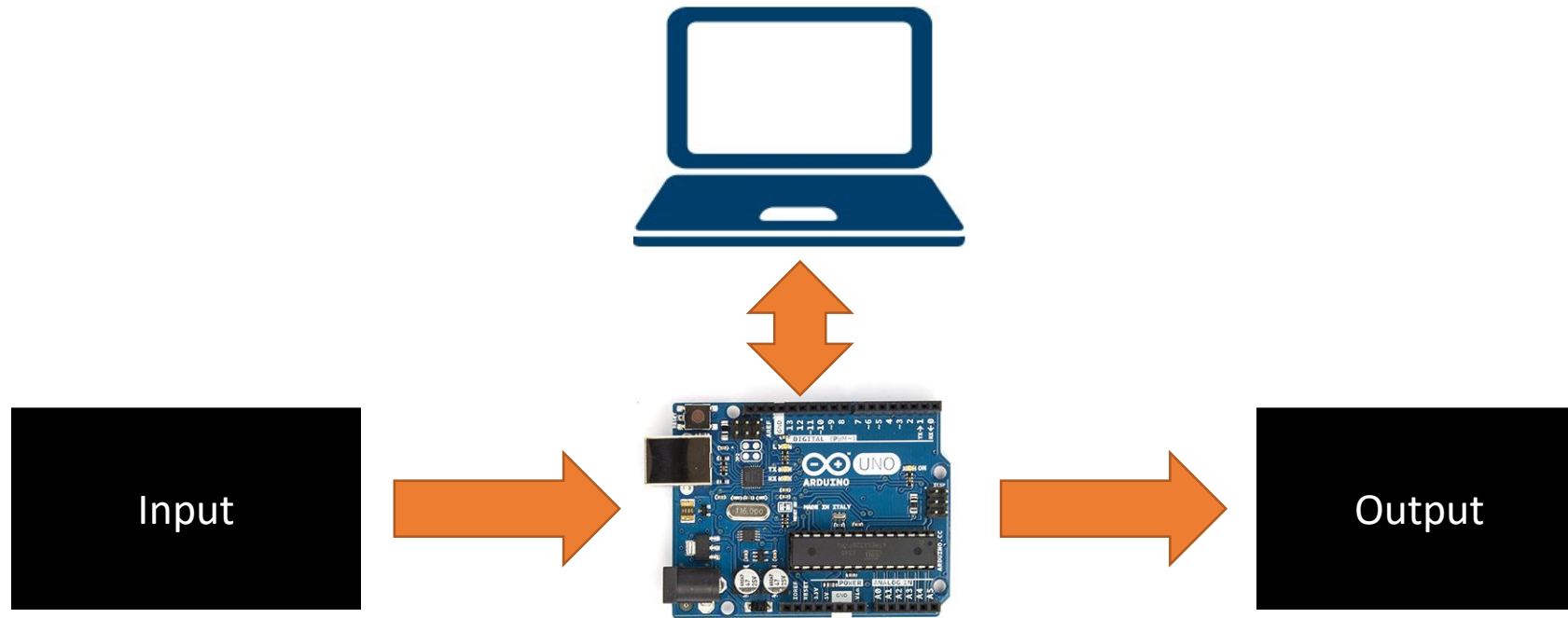


Input

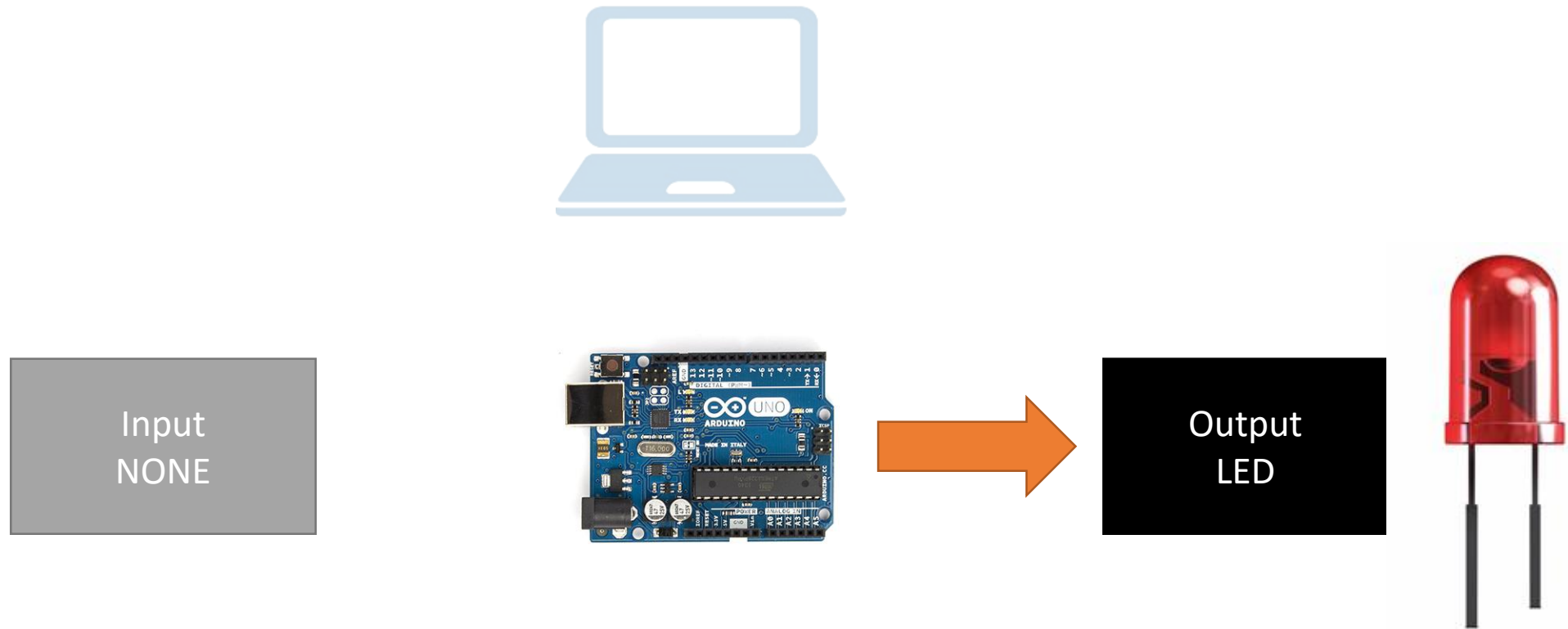


Output

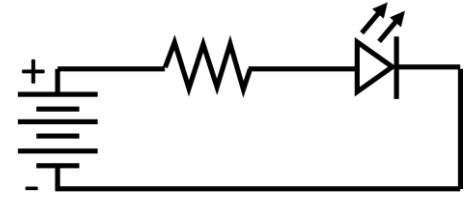
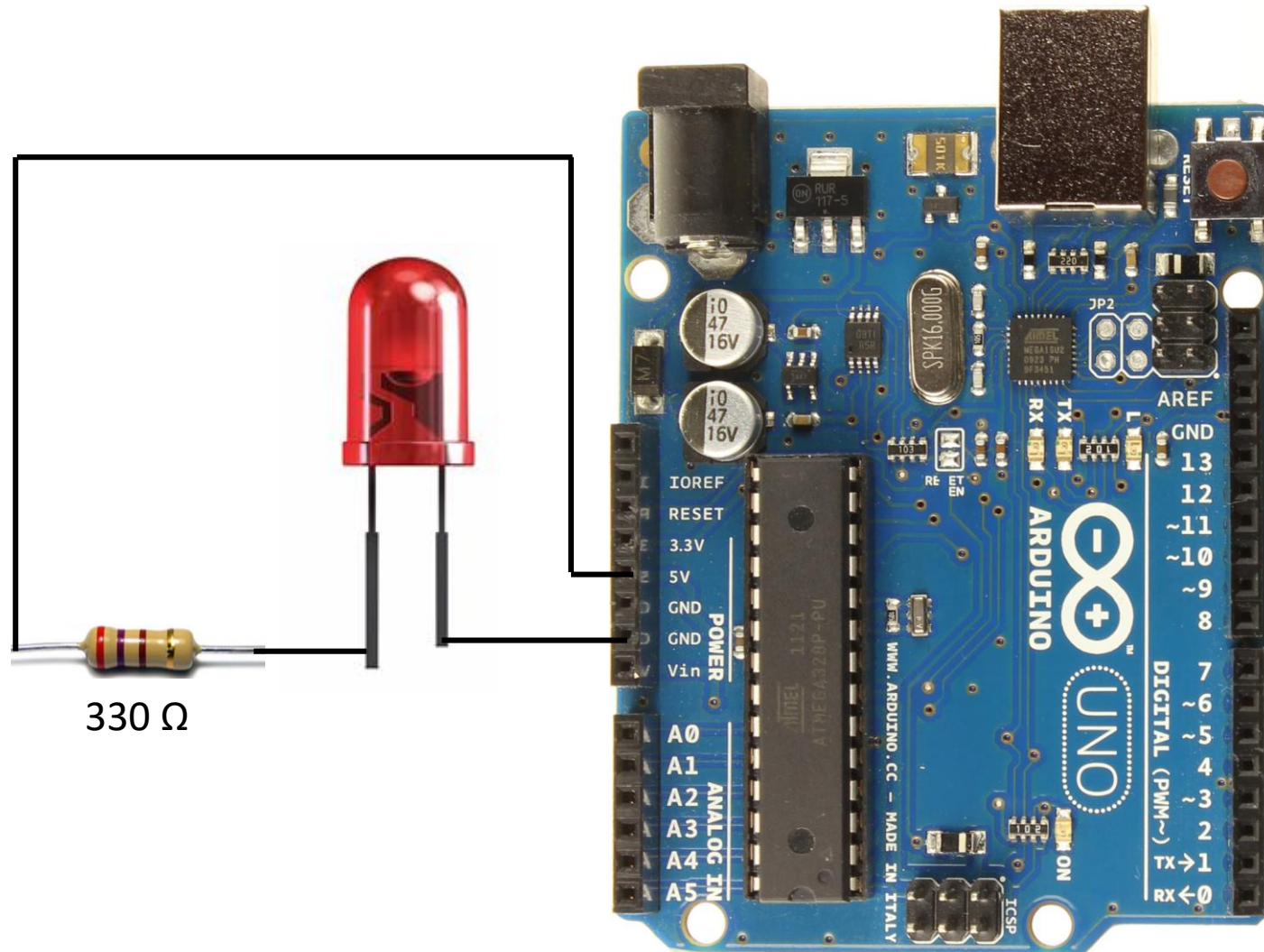
An Example System



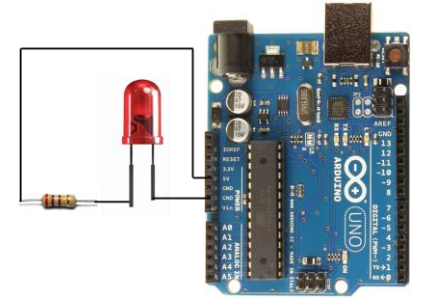
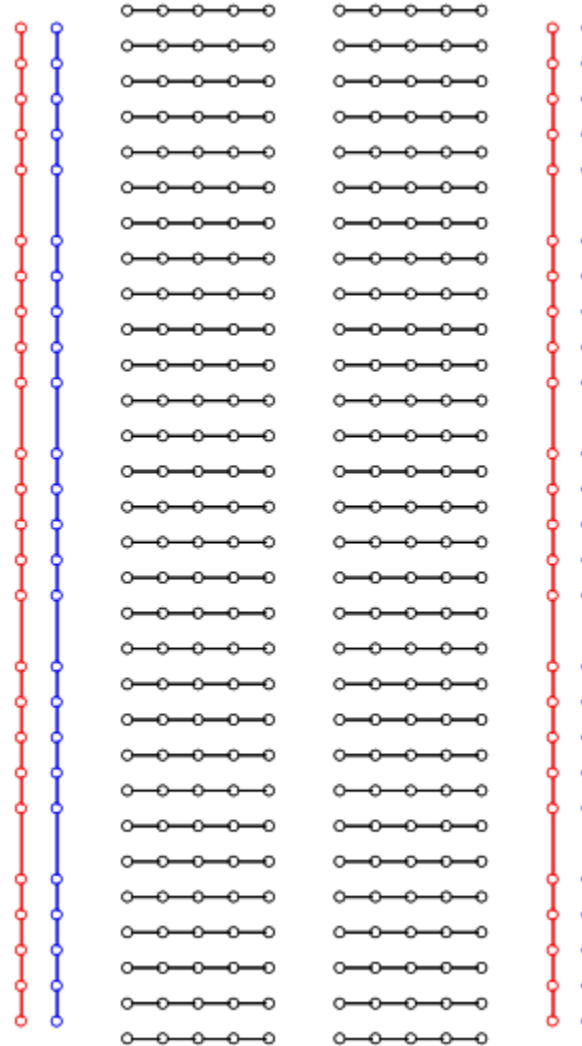
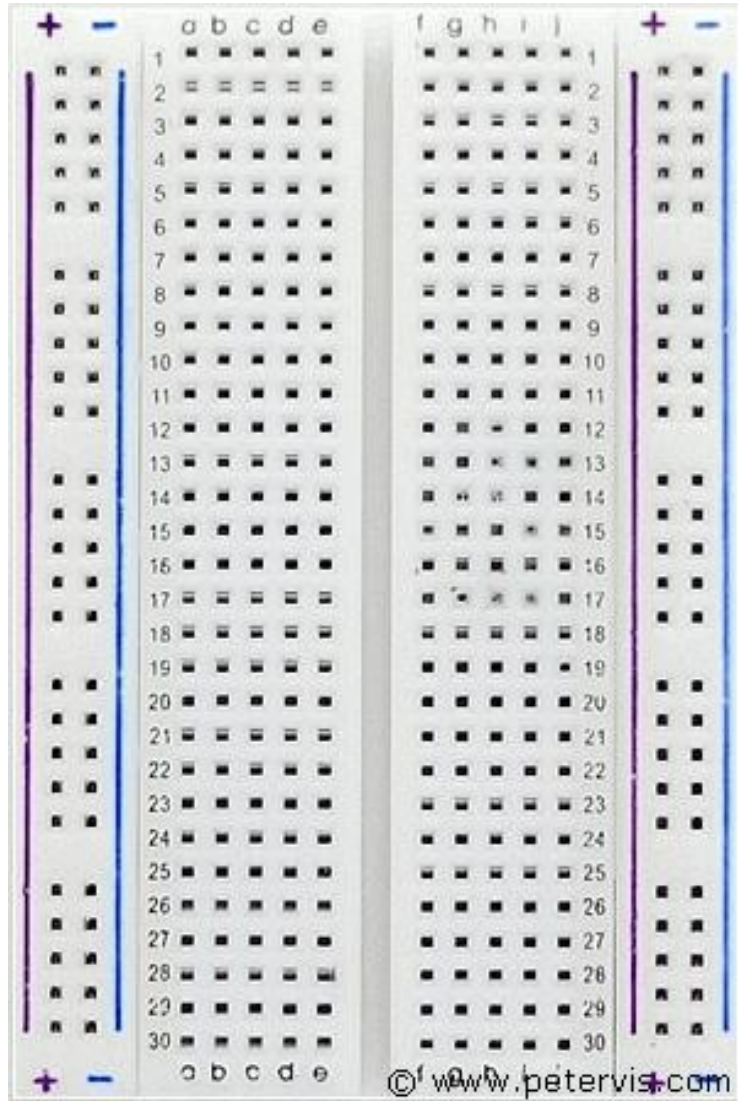
BUILD I: A Simple Circuit



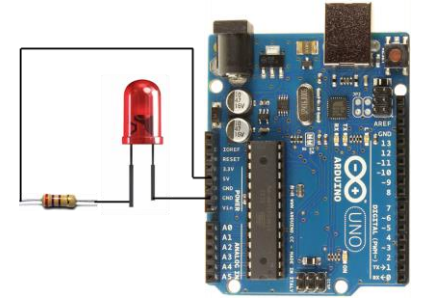
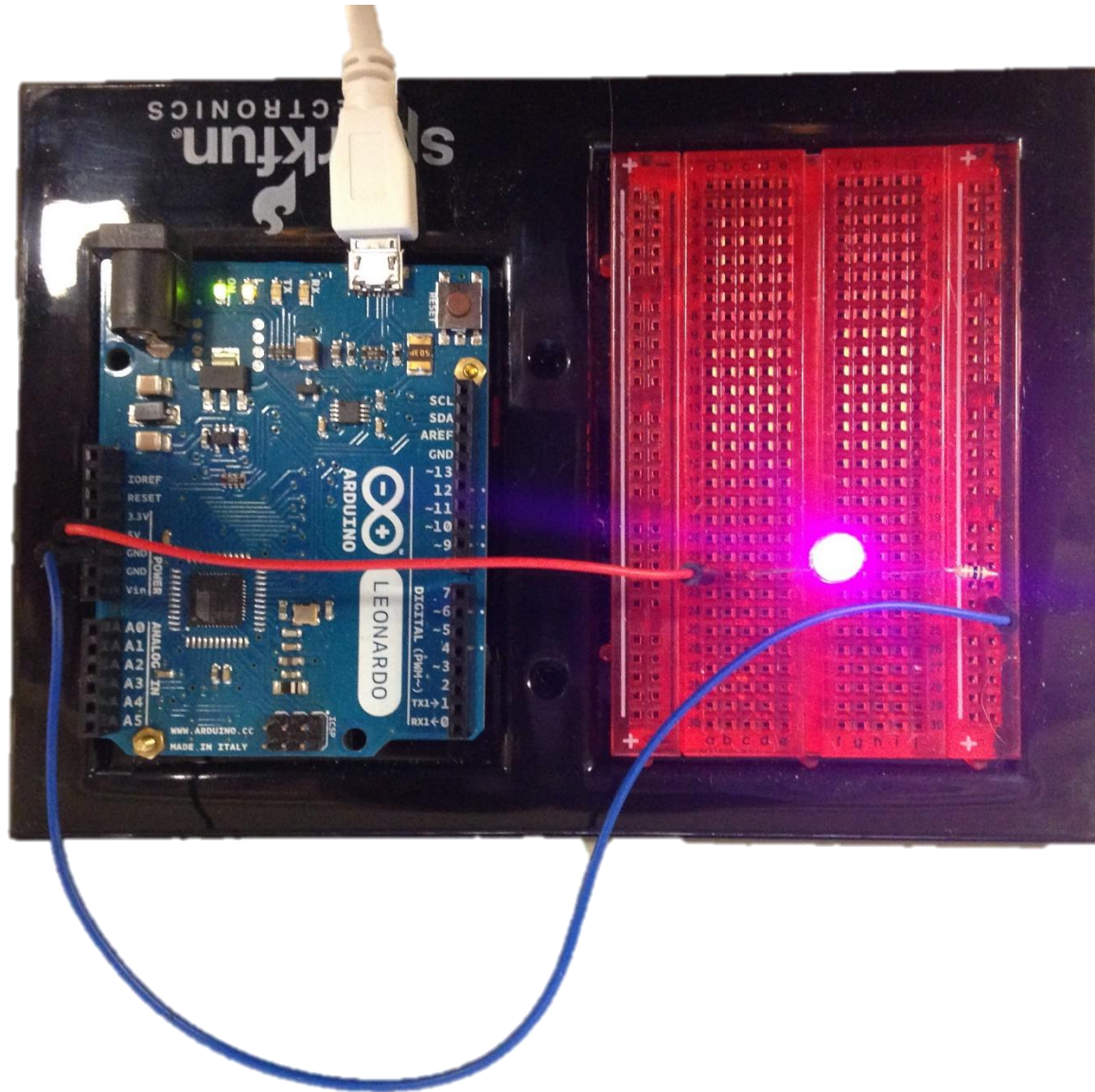
BUILD I: A Simple Circuit



BUILD I: A Simple Circuit



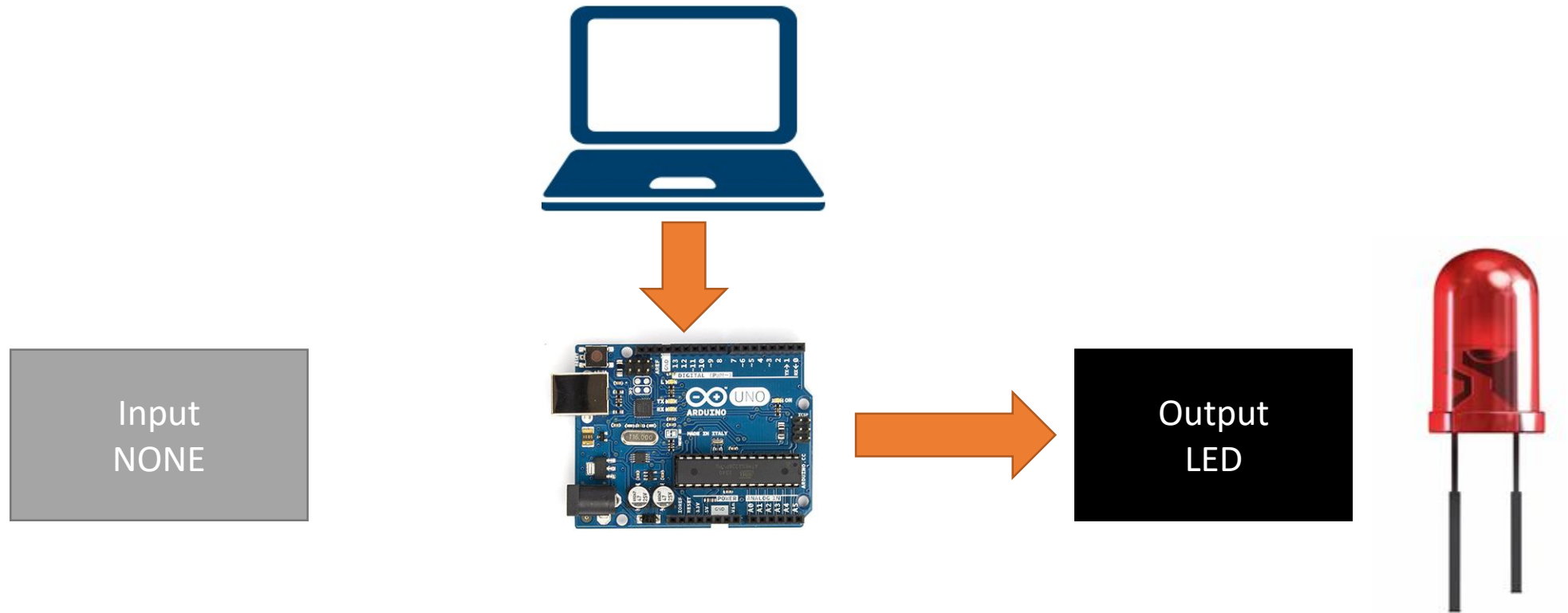
BUILD I: A Simple Circuit



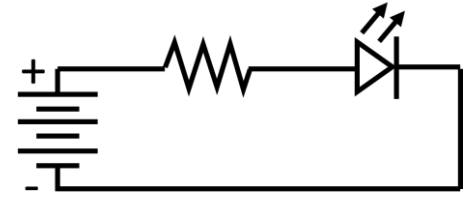
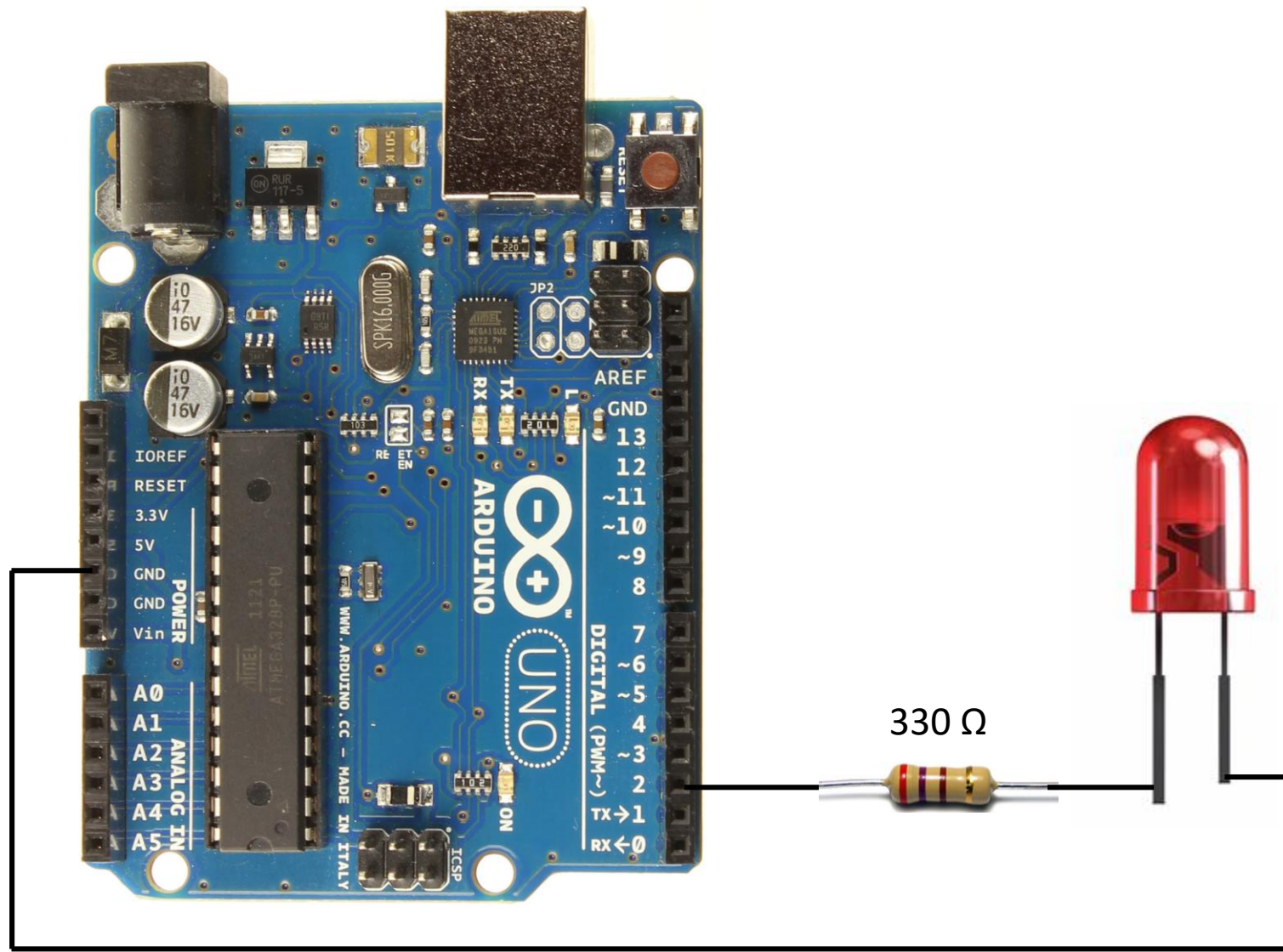
WARNINGS

- DO NOT connect the Arduino to the computer until I have verified your circuit.
- DO NOT connect ANYTHING directly to ground.
- DISCONNECT the Arduino from the computer before changing the circuit.

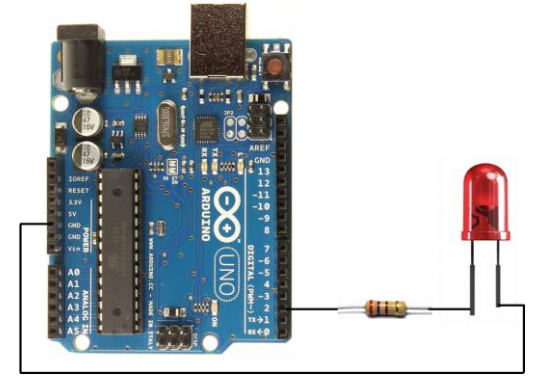
BUILD II: Blink



BUILD II: Blink



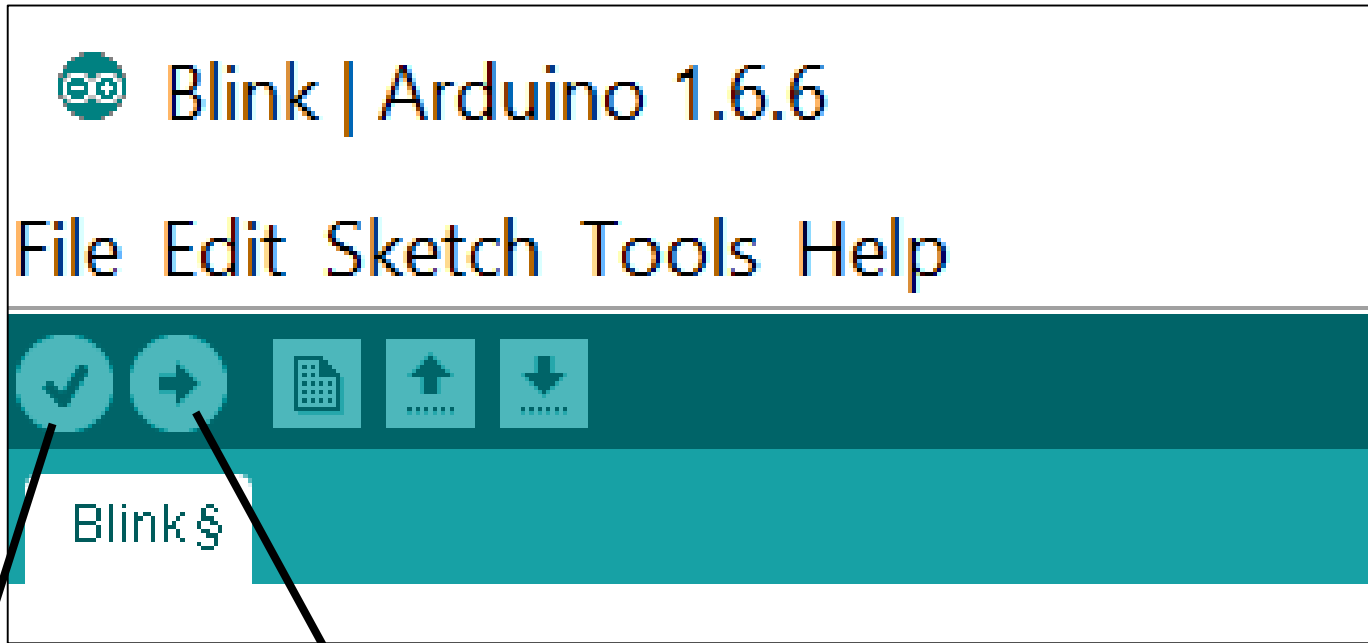
BUILD II: Blink



```
// the setup function runs once when you press reset or power the board
void setup() {
  // initialize digital pin 13 as an output.
  pinMode(2, OUTPUT);
}

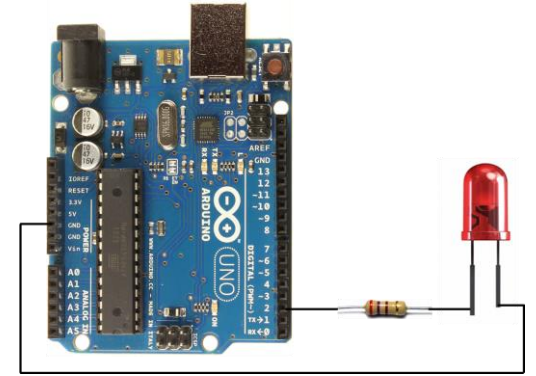
// the loop function runs over and over again forever
void loop() {
  digitalWrite(2, HIGH); // turn the LED on (HIGH is the voltage level)
  delay(1000);           // wait for a second
  digitalWrite(2, LOW);  // turn the LED off by making the voltage LOW
  delay(1000);           // wait for a second
}
```

BUILD II: Blink

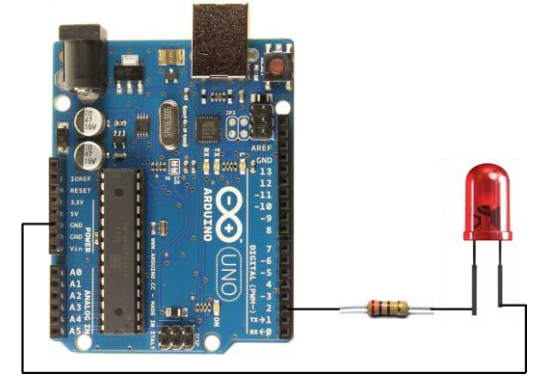
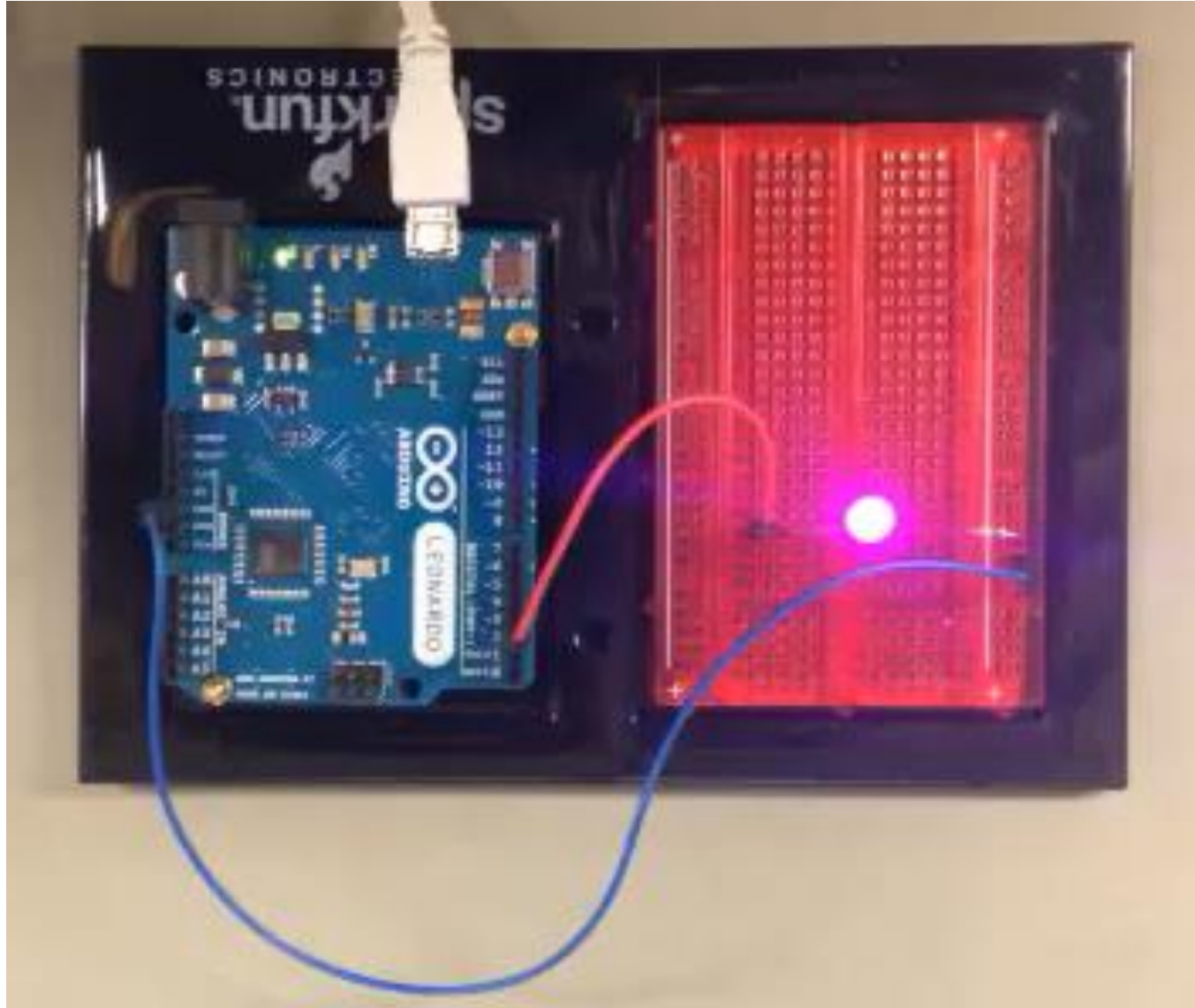


Check your program for errors

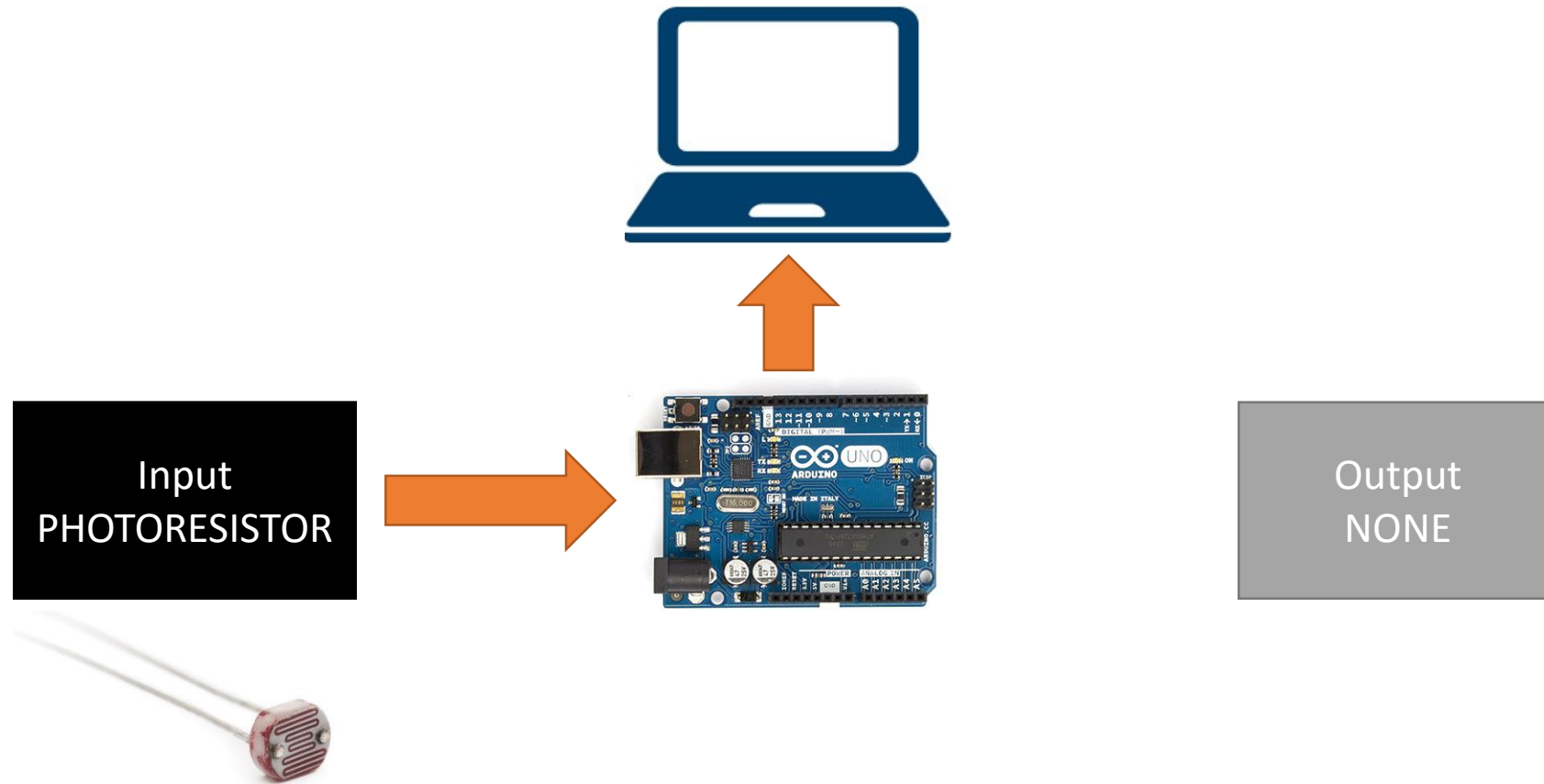
Upload program to Arduino



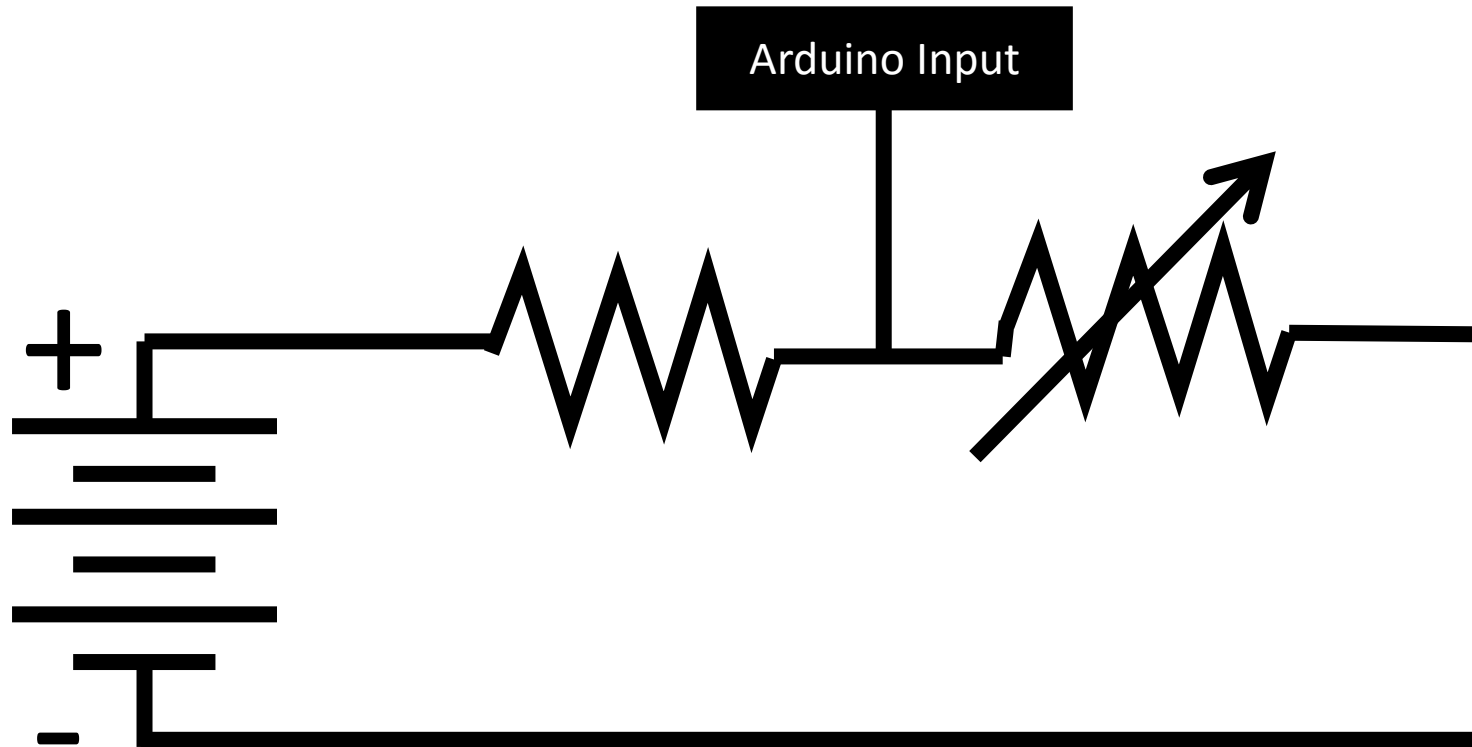
BUILD II: Blink



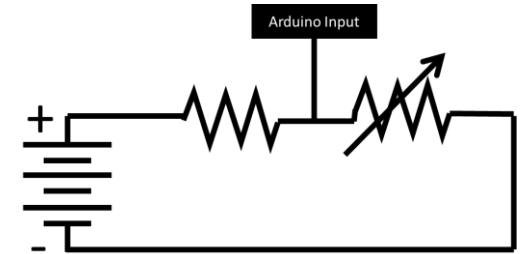
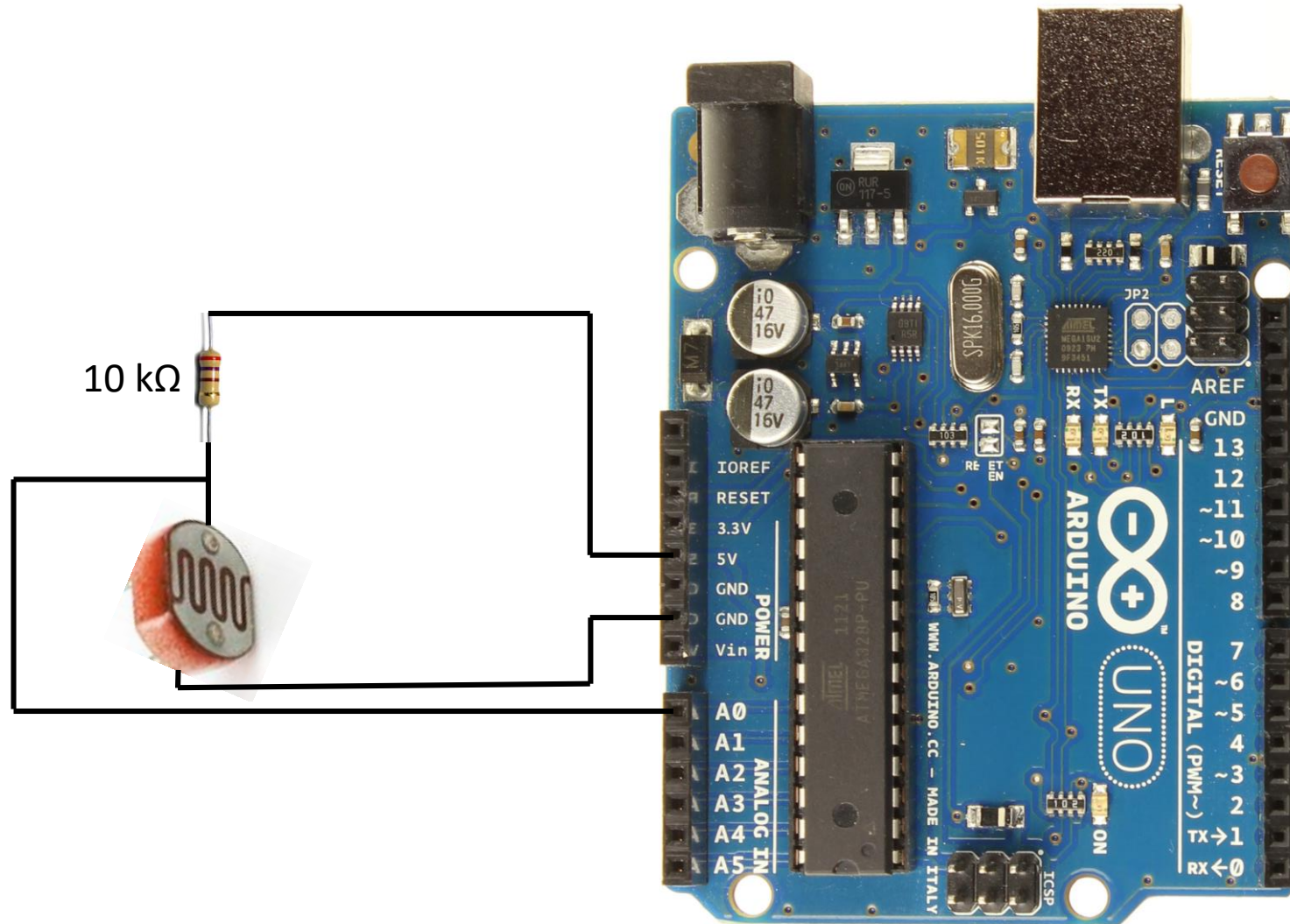
BUILD III: Sensor Input



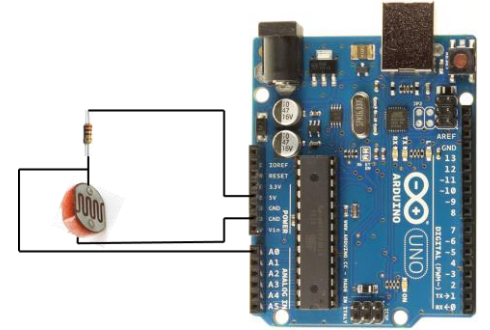
BUILD III: Sensor Input



BUILD III: Sensor Input



BUILD III: Sensor Input

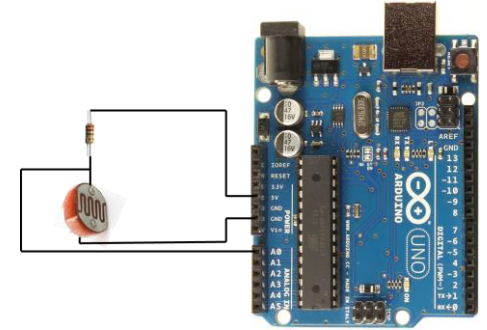
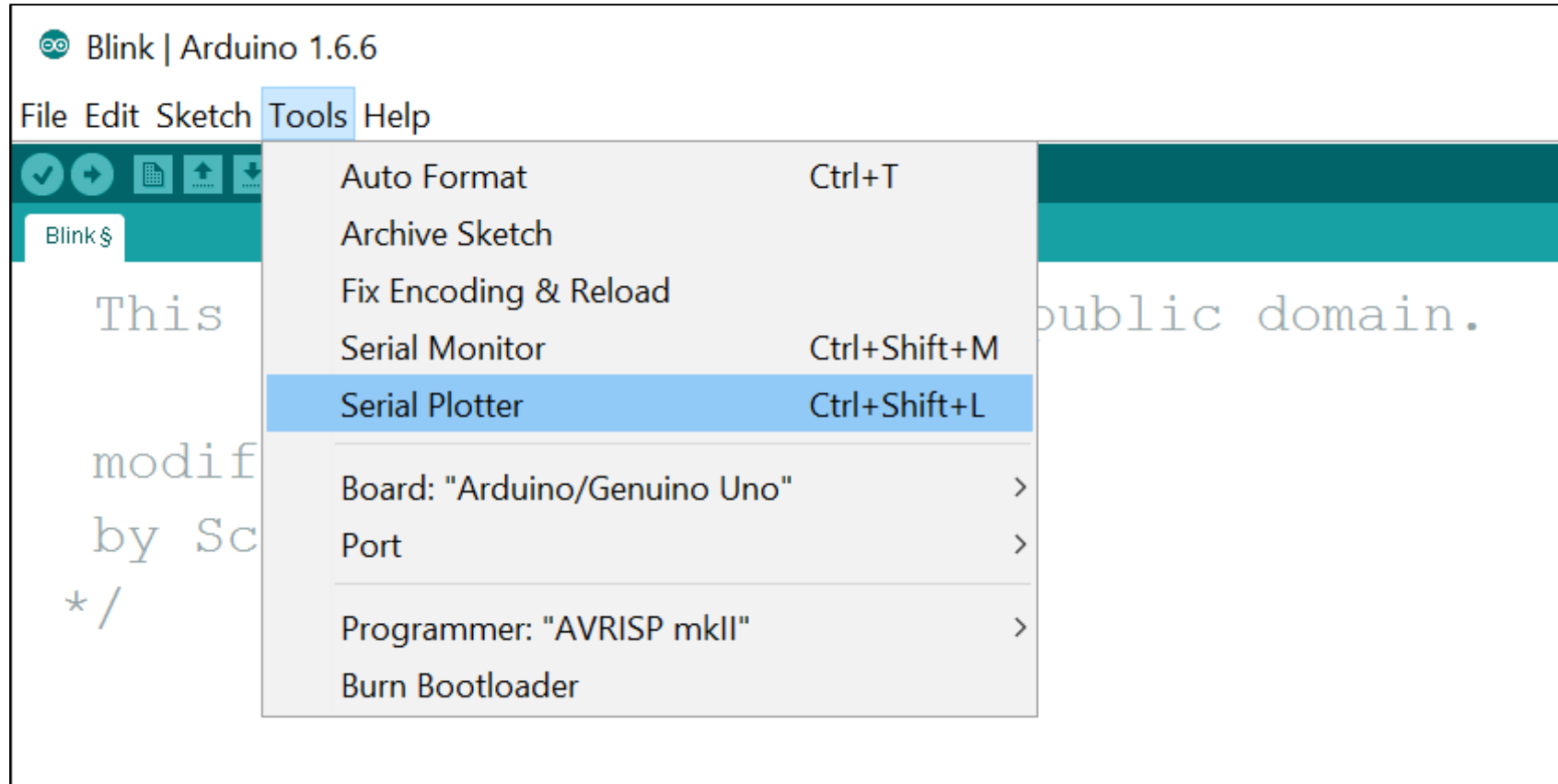


```
int sensorPin = A0;    // select the input pin
int sensorValue = 0;   // variable to store the value coming from the sensor
```

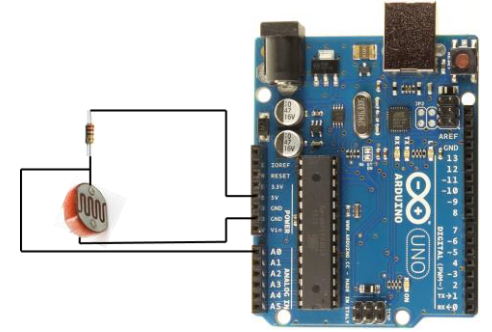
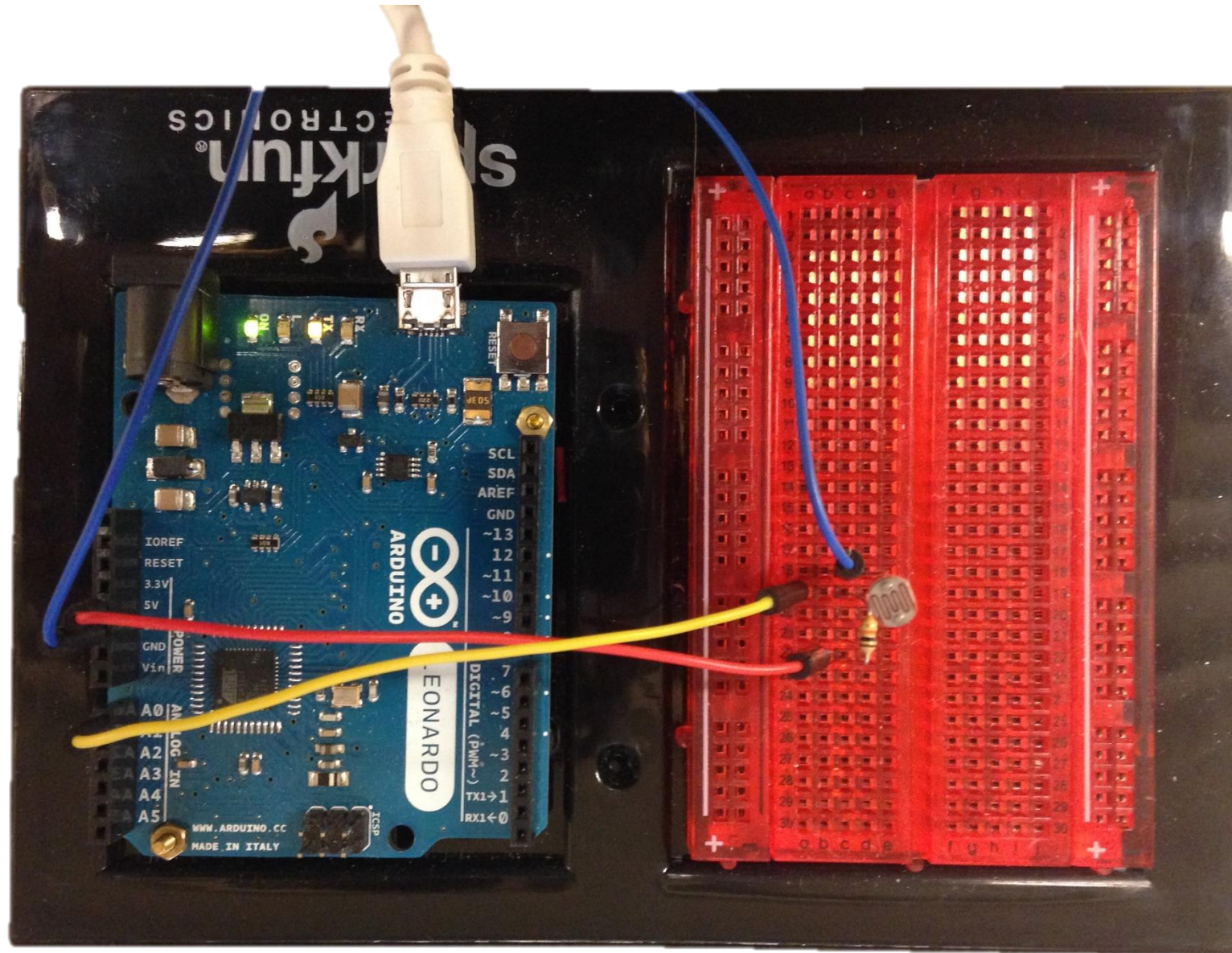
```
void setup() {
  // declare the sensorPin as an INPUT:
  pinMode(sensorPin, INPUT);
  Serial.begin(115200);
}
```

```
void loop() {
  // read the value from the sensor:
  sensorValue = analogRead(sensorPin);
  Serial.println(sensorValue);
}
```

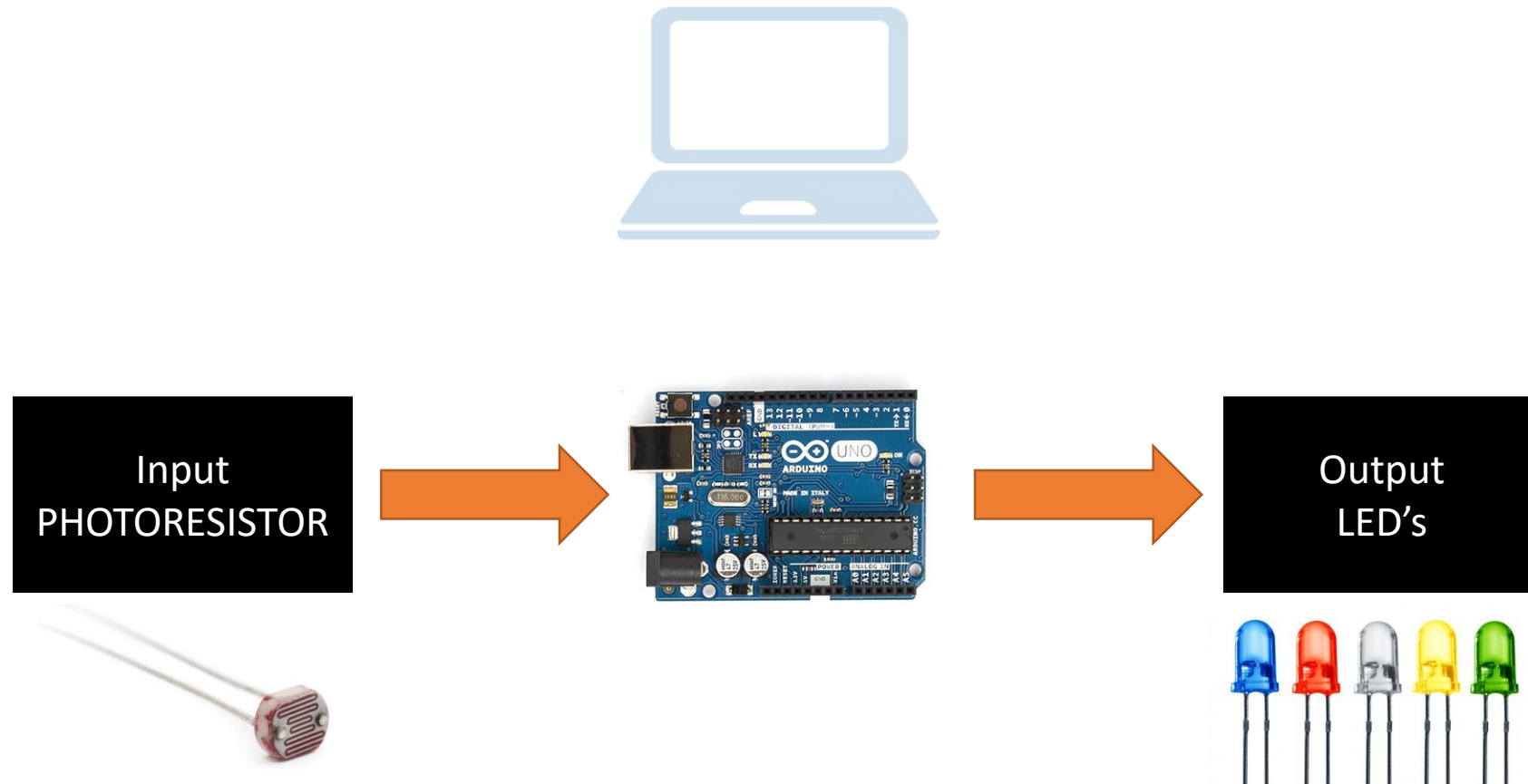
BUILD III: Sensor Input



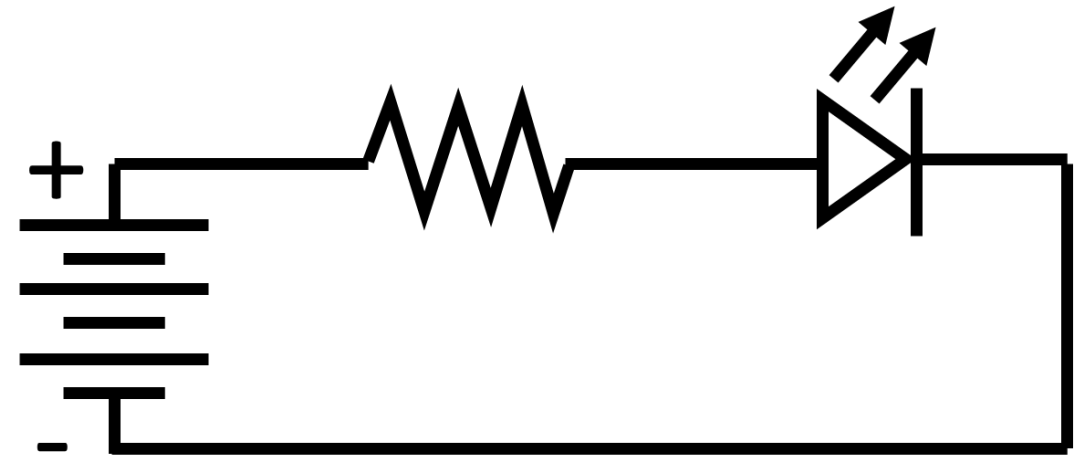
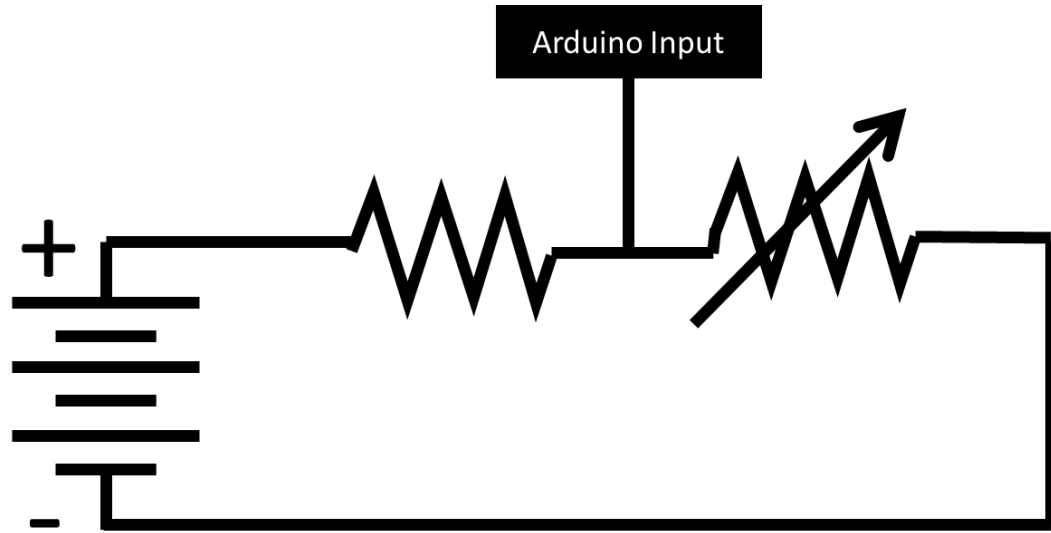
BUILD III: Sensor Input



BUILD IV: Sensor → LEDs

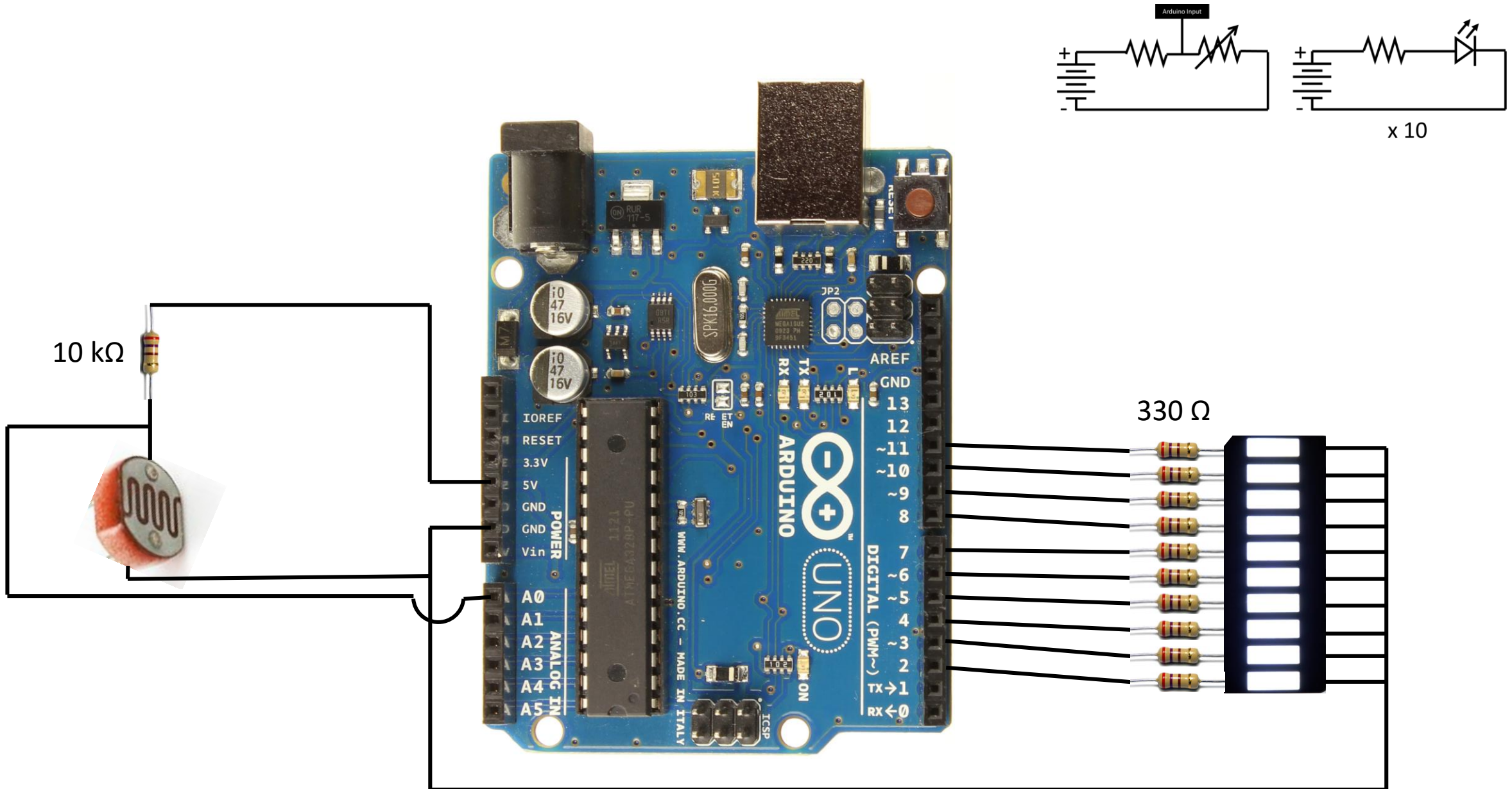


BUILD IV: Sensor → LEDs



x 10

BUILD IV: Sensor → LEDs



BUILD IV: Sensor → LEDs

```
int sensorPin = A0;
int ledPin1 = 2;
int ledPin2 = 3;
int ledPin3 = 4;
int ledPin4 = 5;
int ledPin5 = 6;
int ledPin6 = 7;
int ledPin7 = 8;
int ledPin8 = 9;
int ledPin9 = 10;
int ledPin10 = 11;

int sensorValue = 0;
// variable to store the value coming from the sensor
```

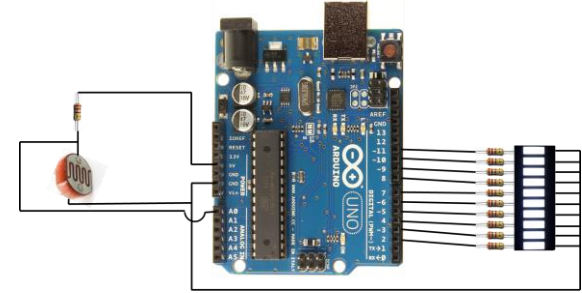
```
void setup() {
  // declare the ledPin as an OUTPUT:
  pinMode(ledPin1, OUTPUT);
  pinMode(ledPin2, OUTPUT);
  pinMode(ledPin3, OUTPUT);
  pinMode(ledPin4, OUTPUT);
  pinMode(ledPin5, OUTPUT);
  pinMode(ledPin6, OUTPUT);
  pinMode(ledPin7, OUTPUT);
  pinMode(ledPin8, OUTPUT);
  pinMode(ledPin9, OUTPUT);
  pinMode(ledPin10, OUTPUT);
  pinMode(sensorPin, INPUT);

  Serial.begin(115200);
}
```

```
void loop() {
  // read the value from the sensor:
  sensorValue = analogRead(sensorPin);
  Serial.println(sensorValue);

  digitalWrite(ledPin1, LOW);
  digitalWrite(ledPin2, LOW);
  digitalWrite(ledPin3, LOW);
  digitalWrite(ledPin4, LOW);
  digitalWrite(ledPin5, LOW);
  digitalWrite(ledPin6, LOW);
  digitalWrite(ledPin7, LOW);
  digitalWrite(ledPin8, LOW);
  digitalWrite(ledPin9, LOW);
  digitalWrite(ledPin10, LOW);

  if (sensorValue <= 100){
    digitalWrite(ledPin1, HIGH);
  }
  else if (sensorValue <= 200){
    digitalWrite(ledPin2, HIGH);
    digitalWrite(ledPin1, HIGH);
  }
  else if (sensorValue <= 300){
    digitalWrite(ledPin3, HIGH);
    digitalWrite(ledPin2, HIGH);
    digitalWrite(ledPin1, HIGH);
  }
  else if (sensorValue <= 400){
    digitalWrite(ledPin4, HIGH);
    digitalWrite(ledPin3, HIGH);
    digitalWrite(ledPin2, HIGH);
  }
}
```



BUILD IV: Sensor → LEDs

