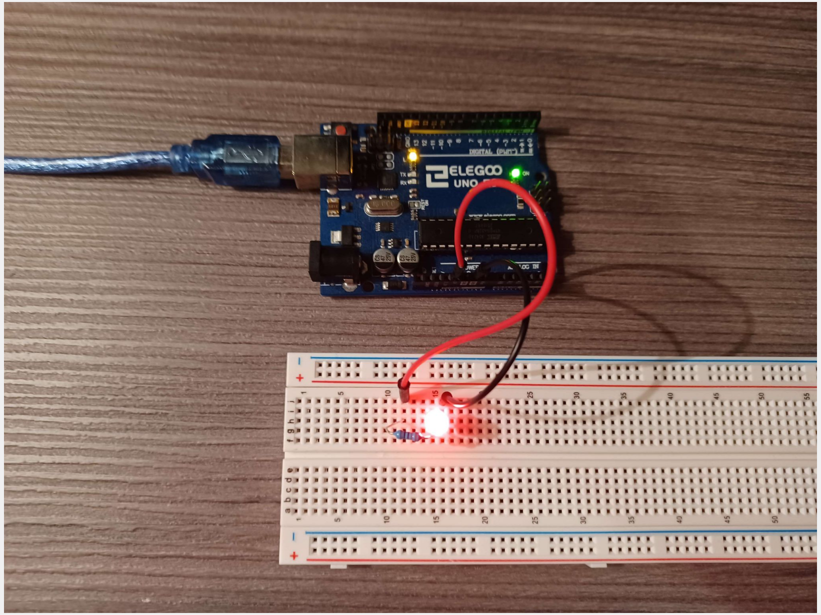
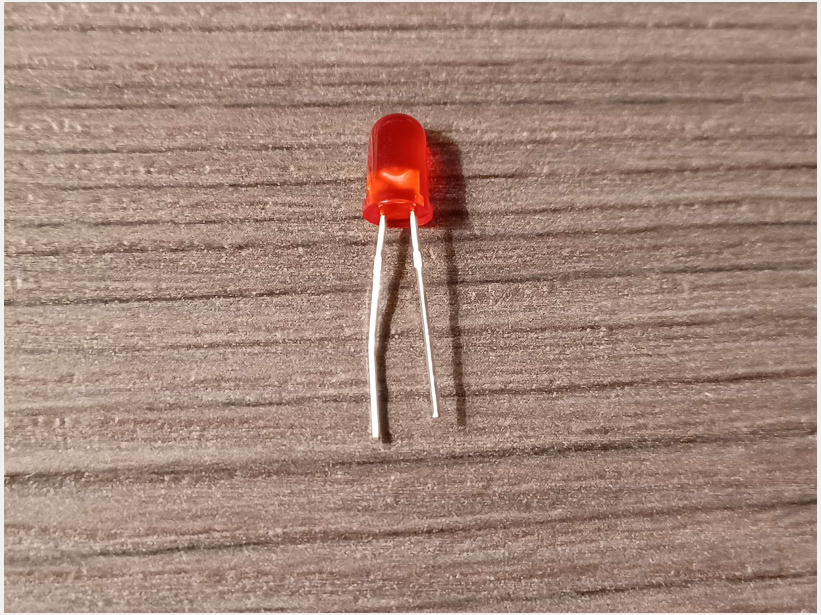
Introduction to Arduino



Input vs. Output

Input devices send data to a computer. Examples: keyboards, mice, buttons, analog sticks (joysticks)

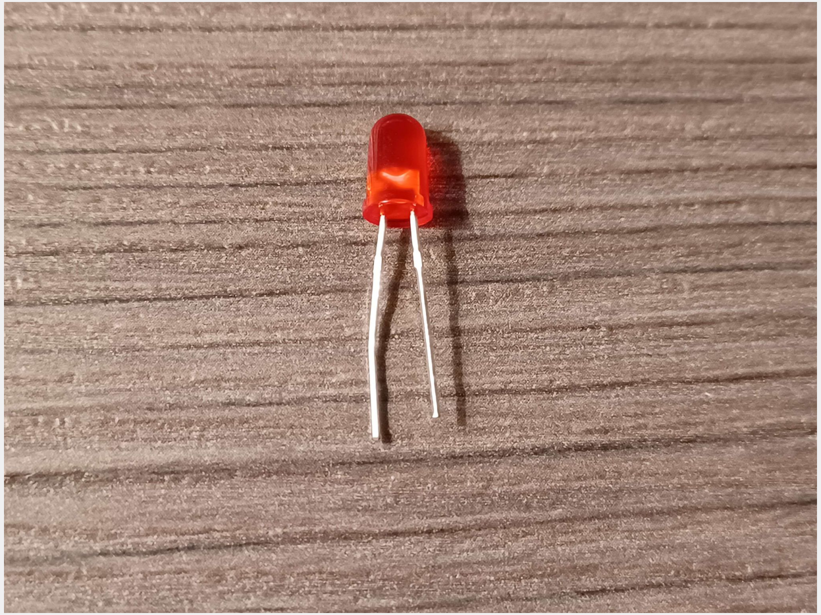
Output devices receives data from a computer. Examples: monitors, printers, headphones



Digital vs. Analog

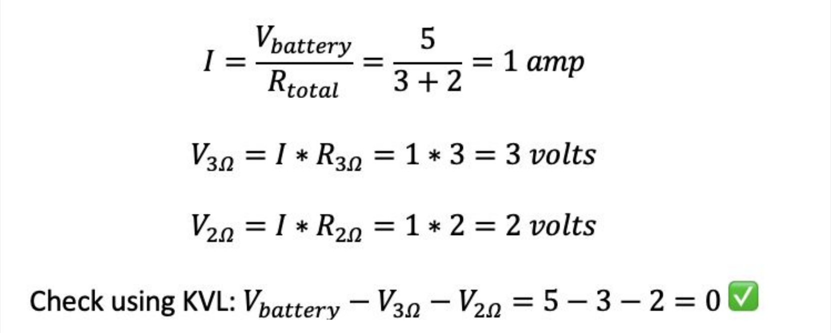
Digital signals signals that are discrete. When an arduino reads a digital signal, it reads a value of either 1 or 0.

Analog signals signals that have a continuous/gradual signal. When an arduino reads an analog signal, it reads a value from 0 to 1023, representing 2^10 discrete states. It writes a value from 0 to 255.



Ohm’s Law

- Certain materials obey Ohm’s Law:
- V = I • R
  - Where V is voltage in volts, I is current in amps, and R is resistance in ohms
- Voltage and current are directly proportional
- In the circuit to the right:

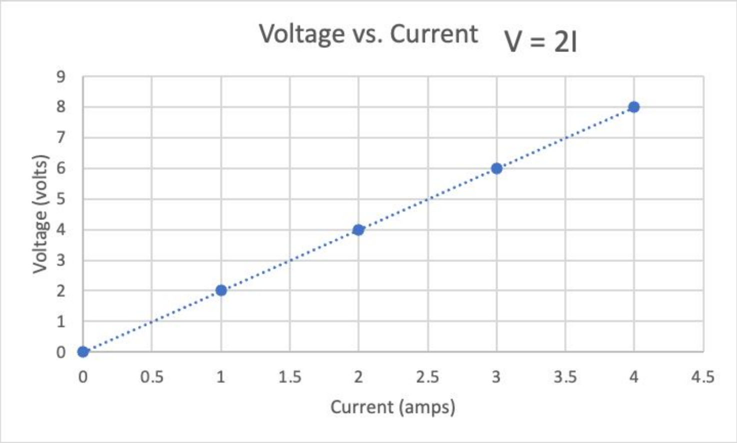


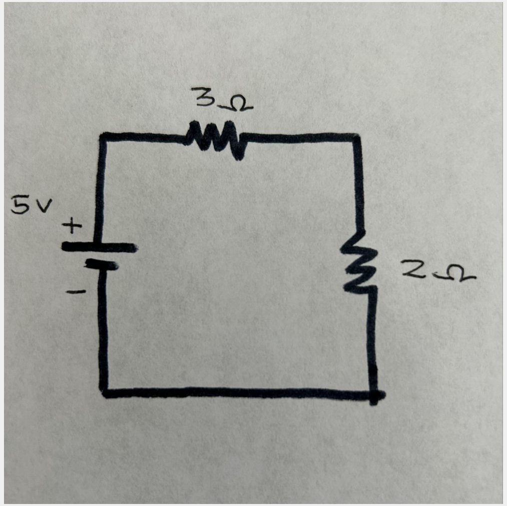
$$I = \frac{V_{battery}}{R_{total}} = \frac{5}{3+2} = 1\ amp$$

$$V_{3\Omega} = I * R_{3\Omega} = 1 * 3 = 3\ volts$$

$$V_{2\Omega} = I * R_{2\Omega} = 1 * 2 = 2\ volts$$

Check using KVL: $V_{battery} - V_{3\Omega} - V_{2\Omega} = 5 - 3 - 2 = 0$ ✅





3 ways of implementing an LED

1. Implementing with only hardware
2. digitalWrite (software and hardware)
3. analogWrite (software and hardware)

Demo!!!!!!!

1. Hardware implementation

The red wire is connected to **5V** and the black wire connects to GND. A 330Ω resistor connects the 5V LED and the LED is connect to the GND.

Which way is the LED orientated?

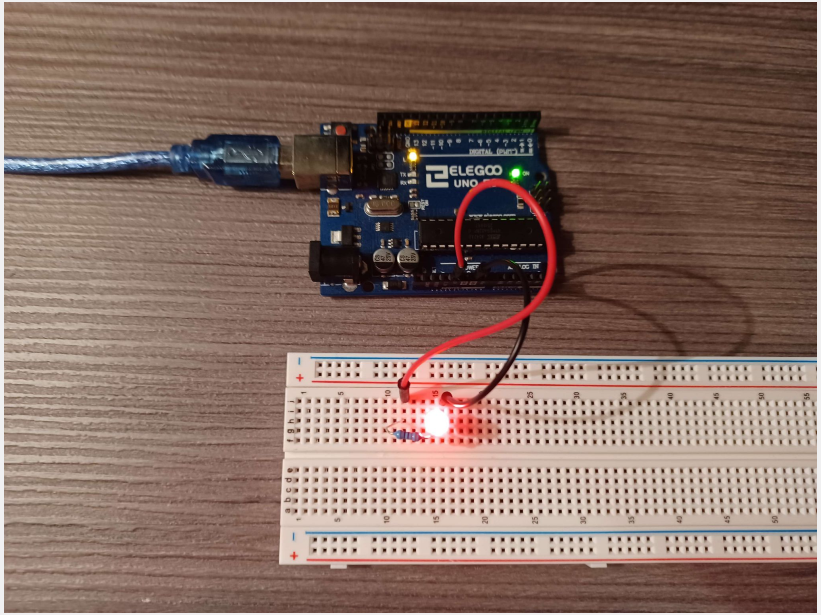
Long lead to 5V, short lead to GND.

If a 330 resistor is used, what is the current flowing through the resistor?

I = V / R

I = 5V / 330Ω = 0.015A

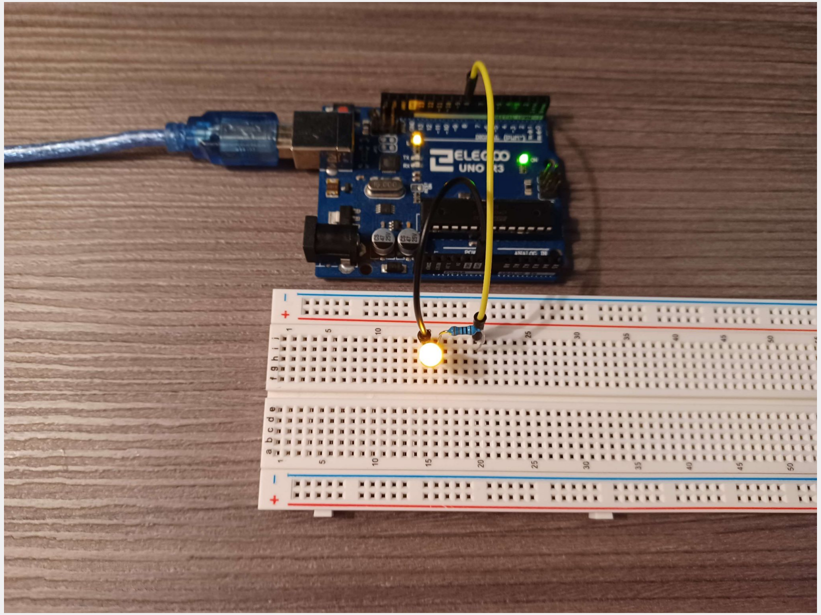
The LED also acts as a resistor and there is a tolerance (measure of accuracy) within the resistor, so the nominal value (0.015A) will differ from the experimental value (current can be measured with an ammeter).



2. digitalWrite

The yellow wire is connected to **digital pin 8** and the black wire is connected to GND. A 330Ω resistor connects the 5V LED and the LED is connect to the GND.

When all the hardware is plugged in, the LED does not light up. This is because there is no voltage input; we have to create a program to write to the LEDPin with 5V.

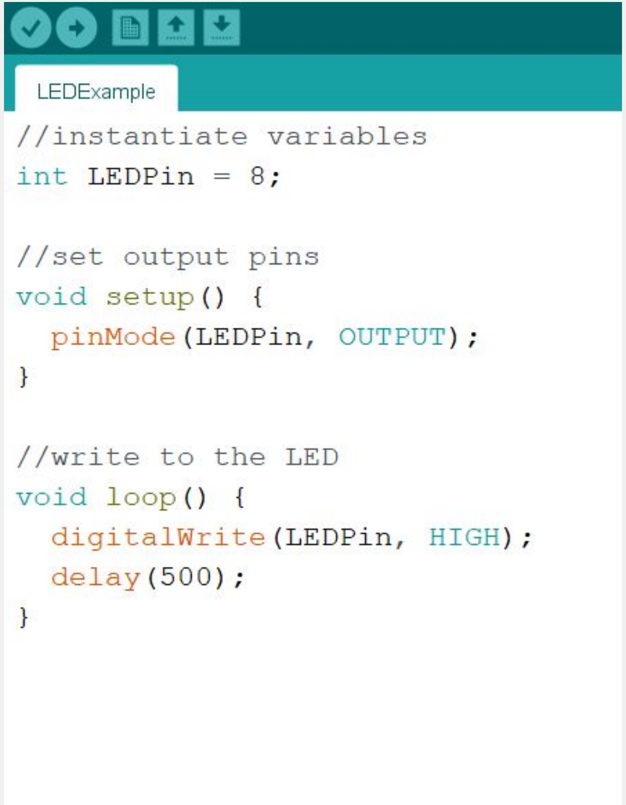


2. digitalWrite

int LEDPin = 8; instantiates an integer variable and assigns it the value of 8. This means the yellow wire should be connected to the 8th digital pin.

pinMode(LEDPin, OUTPUT); This tells the program that the LEDPin digital pin should act like an output. We are outputting a 5V source.

digitalWrite(LEDPIN, HIGH); This tells the program to write to the LEDPin with 5V.



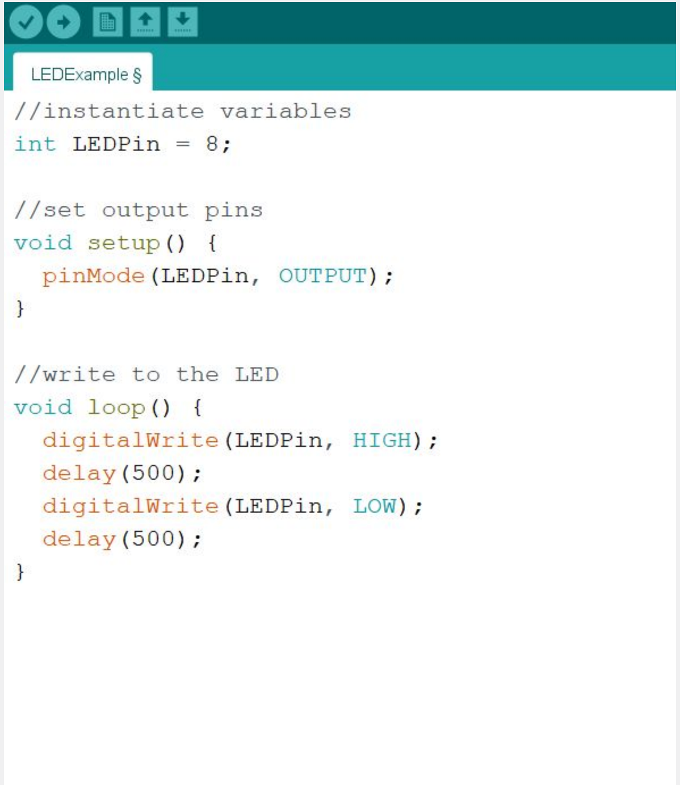
```
//instantiate variables
int LEDPin = 8;

//set output pins
void setup() {
  pinMode(LEDPin, OUTPUT);
}

//write to the LED
void loop() {
  digitalWrite(LEDPin, HIGH);
  delay(500);
}
```

2. digitalWrite

This code can be modified to turn off the LED. This edited code will turn on the LED for 500ms, turn off the LED for 500ms, and repeat (since the code is written in **void loop()**).

delay(500); This causes a 500 millisecond delay before the next command.

digitalWrite(LEDPIN, LOW); This tells the program to write to the LEDPin with 0V.



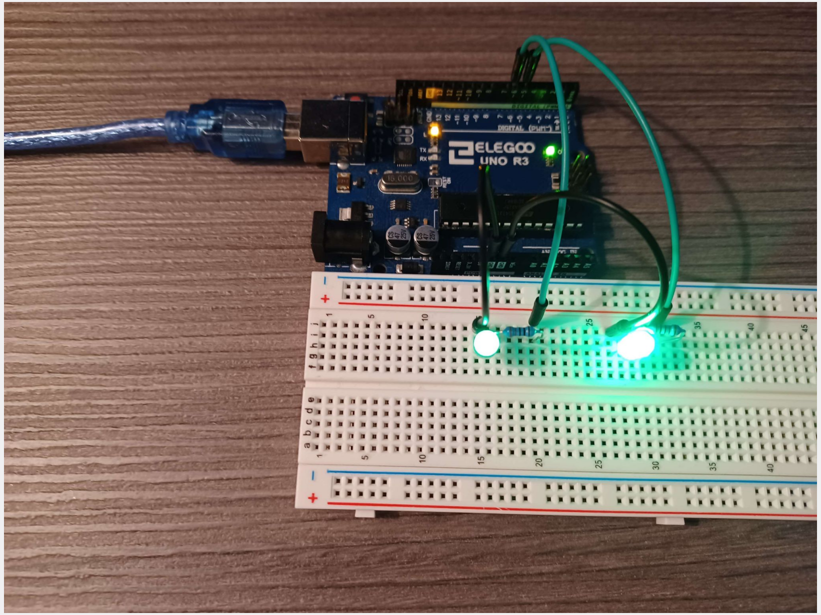
```
//instantiate variables
int LEDPin = 8;

//set output pins
void setup() {
  pinMode(LEDPin, OUTPUT);
}

//write to the LED
void loop() {
  digitalWrite(LEDPin, HIGH);
  delay(500);
  digitalWrite(LEDPin, LOW);
  delay(500);
}
```

3. analogWrite

The left green wire is connected to **pin ~6,** the right green wire is connected to **pin ~5**, and the black wire is connected to GND. A 330Ω resistor connects the 5V LED and the LED is connect to the GND.

We are using 2 LEDs to show that the light can be dimmed, instead of being either on or off.

The green wires should be connected to a **PWM capable pin, which have a ~ symbol.**

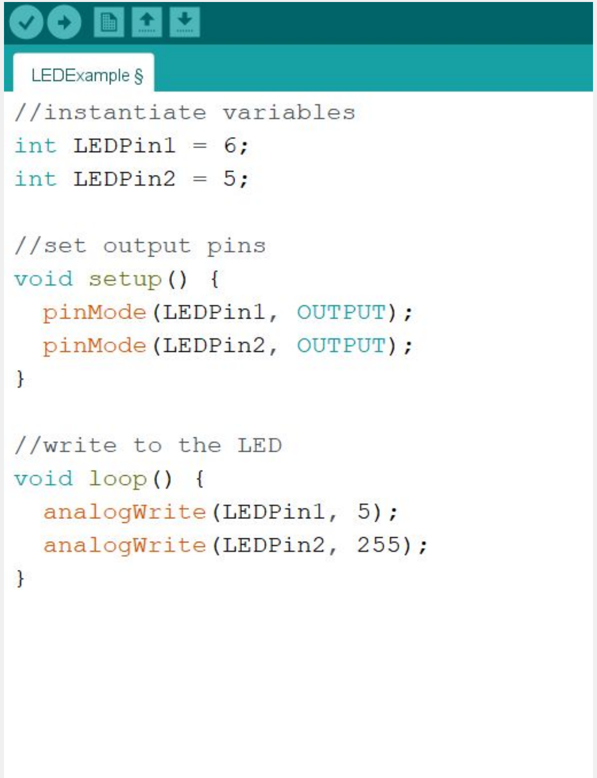


3. analogWrite

The second parameter in the analogWrite command ranges from 0 to 255, corresponding to 0V to 5V (due to the value being stored in an 8-bit register, 2^8 = 256).

analogWrite(LEDPin1, 5); This tells the program to write to the LEDPin with 0.098V (This is calculated by 5V * (5 / 256)).

analogWrite(LEDPin2, 255); This tells the program to write to the LEDPin with 5V. This is equivalent to digitalWrite(LEDPin, HIGH); from the digitalWrite method.



```
//instantiate variables
int LEDPin1 = 6;
int LEDPin2 = 5;

//set output pins
void setup() {
  pinMode(LEDPin1, OUTPUT);
  pinMode(LEDPin2, OUTPUT);
}

//write to the LED
void loop() {
  analogWrite(LEDPin1, 5);
  analogWrite(LEDPin2, 255);
}
```

Assignment: Blink the word “REV” in morse code using an LED! Everytime the word is blinked, flash a dimmed signal on a second LED.