How 2 blink LEDs

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About me

- Computer Engineer, ‘19
- Cybersecurity Club - Secretary
- STICs Facilitator - CMSC389R
- Bitcamp Organizer - Hardware

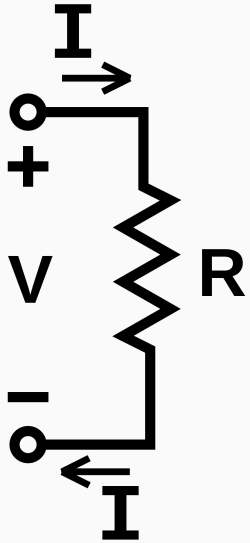
Follow Along

- Code and slides available at https://github.com/jsfleming/bitcamp-led-workshop

Electronics Fundamentals

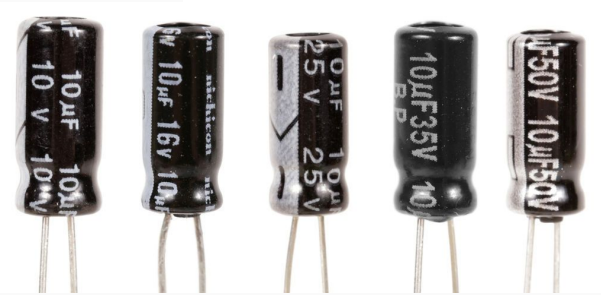
- Voltage: “force” to drive current through components
- Current: flow of charge through components
- Resistance: “force” against current

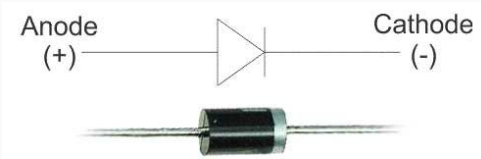
- V = I x R



Types of components

- Resistors: devices that add resistance in a circuit
  - Necessary to prevent too much current
  - Too much current = smoking, fire, explosions, etc
- Capacitors: devices that can store charge temporarily
  - As long as a voltage difference is applied, capacitors will fill with charge
  - Discharge as voltage difference decreases
- Diodes: allow current to flow only one way
  - LEDs are diodes that light up!



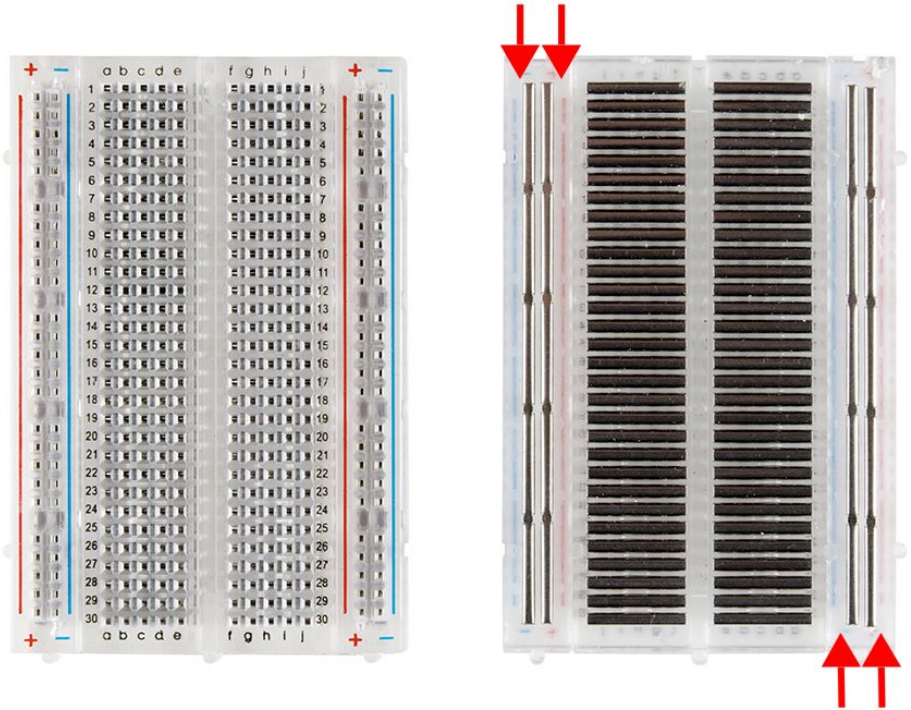


Types of components

- Sensors: detect physical properties and convert to something usable in a circuit
  - Photoresistor: resistor that decreases as light increases
  - Thermister: resistor that decreases as heat increases
  - Proximity sensor: detects proximity to device and represents as voltage, resistance, number, etc (dependent on sensor)

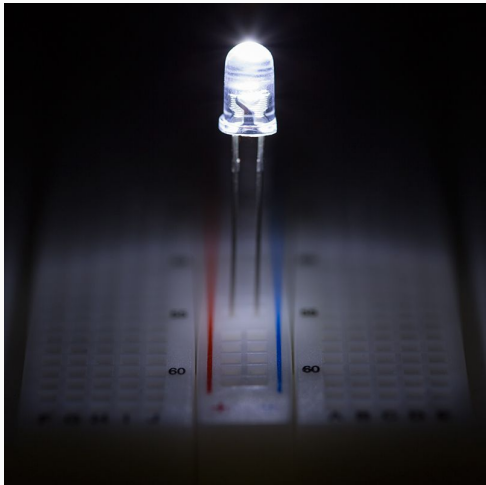
Types of components

- Breadboard
  - Connect stuff together
  - Power rails vertical
  - Main board rails horizontal



Turning on an LED

- Voltage difference across LED will make it glow
- CAUTION: diodes don’t stop current from flowing
  - Put a resistor in between LED and voltage source
  - Can actually explode an LED w/ too much current



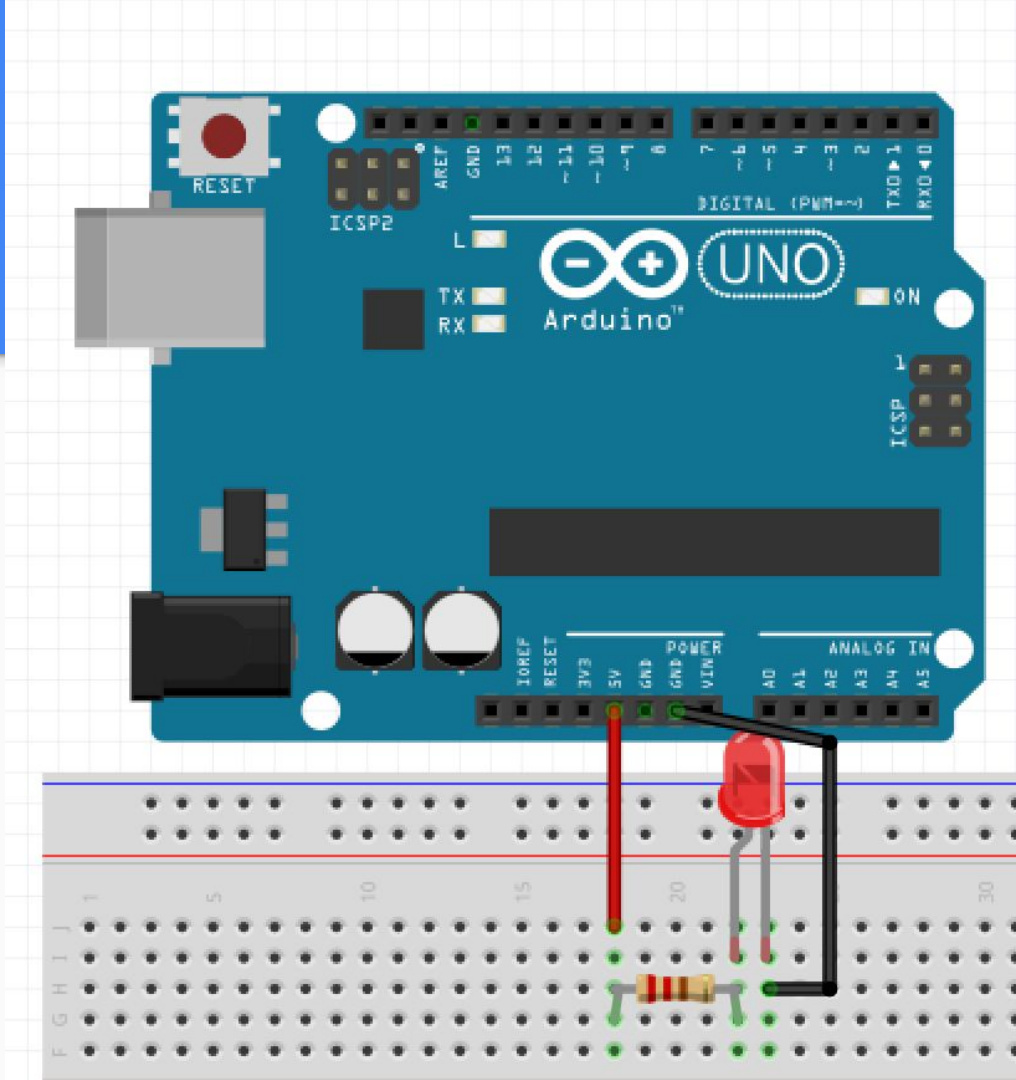
Onto the circuits!

Basic circuit

- We’ll be using the Arduino for our power source (for now)
- Plug in the Arduino to your computer
- Share with others who have a kit!

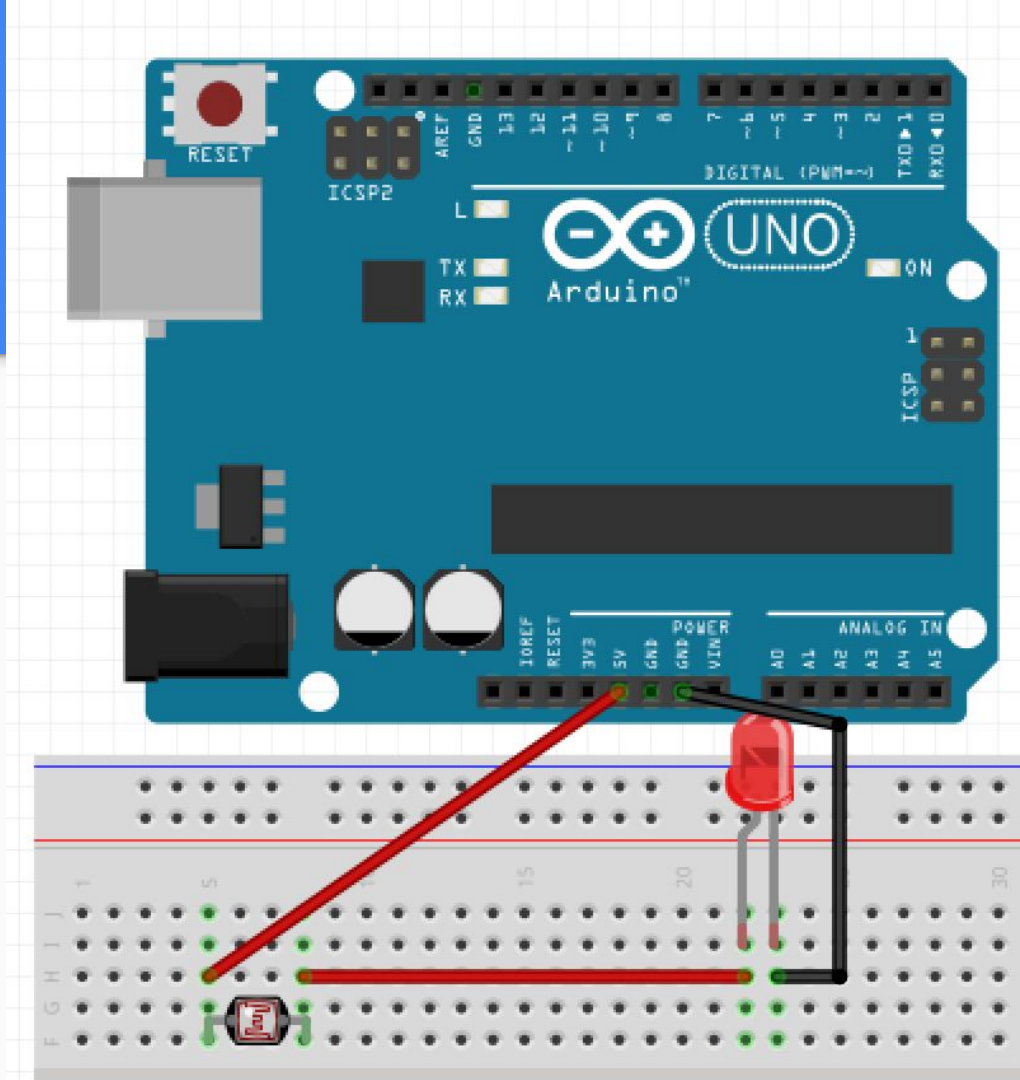
Basic circuit

- LED
  - Longer leg = higher voltage
  - Shorter leg = lower voltage
- Resistor



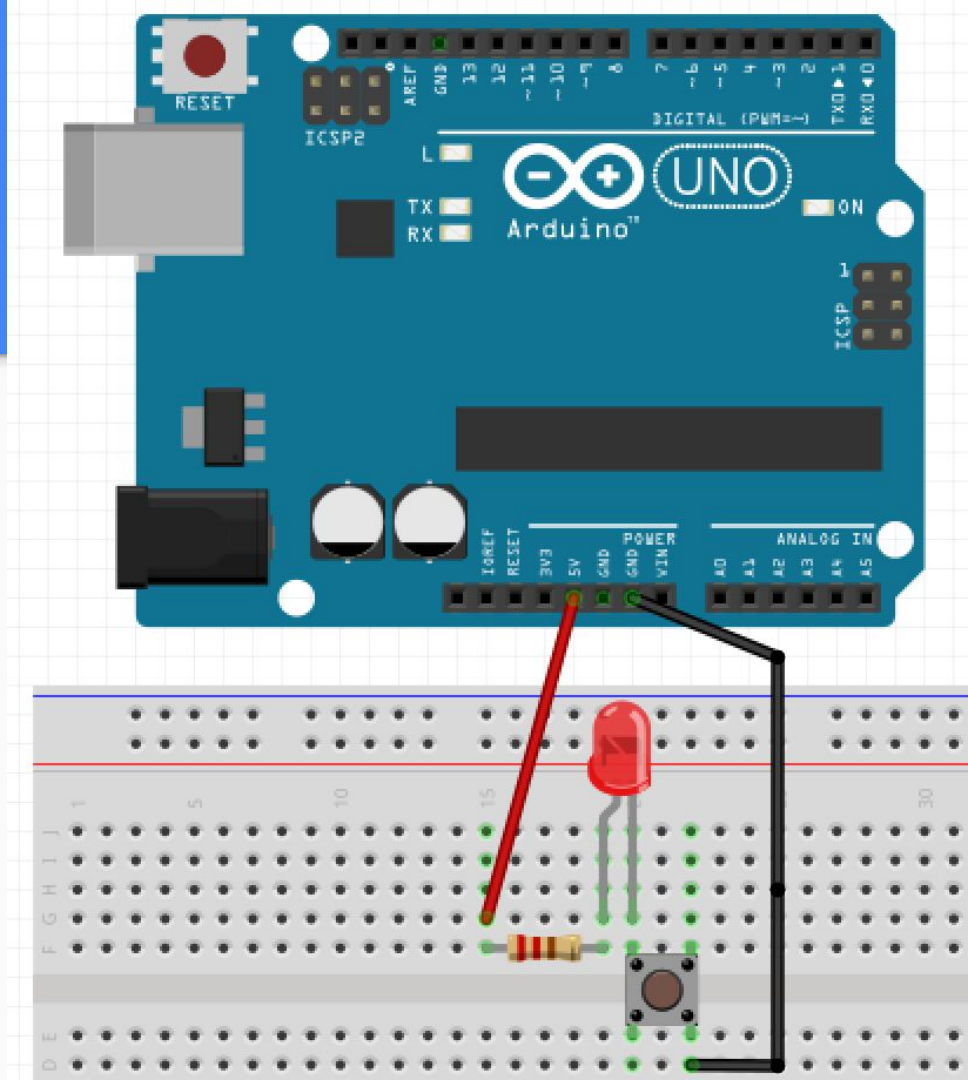
Fancy circuit

- LED
  - Longer leg = higher voltage
  - Shorter leg = lower voltage
- Photoresistor
  - LED strength changes with light
  - Shine your phone's light against the photoresistor to see the LED brightness change!
  - Keep this a bit farther away from LED to see the changes



Button circuit

- LED
  - Longer leg = higher voltage
  - Shorter leg = lower voltage
- Resistor
- Button
  - Terminals connected diagonally when button pressed
  - i.e. top left -> bottom right, etc



Controlling with Arduino!

Arduino Programming

- Uses a C-like language
- Basic, easy to pick up
- Lots of libraries to make writing code faster and easier

Arduino Fundamentals

- void setup()
  - This function runs once
  - Use to set variables to initial values
- void loop()
  - This function runs indefinitely
  - Program body will go here
- Declare variables outside of functions

```
#include "some_library.h"

int number;

void setup() {
  number = 0;
}

void loop() {
  number = number + 1;
}
```

Arduino Fundamentals

- pinMode(PIN, MODE)
  - Use to declare pins on Arduino to receive input or to send outputs
  - PIN is pin number
  - MODE is either INPUT or OUTPUT
- Digital pins: 0, 1, 2, 3, … 13
  - Pins with ~ can use PWM
  - PWM is “fake” analog using digital pins -- can write values from 0 to 255
- Analog pins: A0, A1, …, A5
  - Read values from 0 to 1023
  - Analog pins can ONLY be input

Arduino Fundamentals

- digitalRead(PIN) - returns HIGH or LOW from pin PIN
- digitalWrite(PIN, HIGH or LOW) - writes HIGH or LOW to pin PIN
- analogRead(PIN) - returns value from 0 to 255
- analogWrite(PIN, VALUE) - writes a value VALUE from 0 to 255 to pin PIN

- Serial.begin(BAUD_RATE) - sets up printing on Serial console
  - Tools > Serial Monitor
- Serial.print(STUFF) - prints STUFF to Serial console
- delay(MILLISECONDS) - pause code execution for some MILLISECONDS
  - 1s = 1000ms

Arduino Fundamentals

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- digitalWrite(PIN, HIGH or LOW) - writes HIGH or LO
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```
int digitalPin = 2;
int analogPin = A3;
int pwmPin = 11;

int val;
int num;

void setup() {
  pinMode(digitalPin, INPUT);
  pinMode(analogPin, INPUT);
  pinMode(pwmPin, OUTPUT);
  Serial.begin(9600);
}

void loop() {
  val = digitalRead(digitalPin);
  num = analogRead(analogPin);
  digitalWrite(pwmPin, HIGH);
  delay(100);
  digitalWrite(pwmPin, LOW);
  analogWrite(pwmPin, 135);

  Serial.print("Digital Value:\n");
  Serial.print(val);
  Serial.print("Analog Number:\n");
  Serial.println(num);
}
```

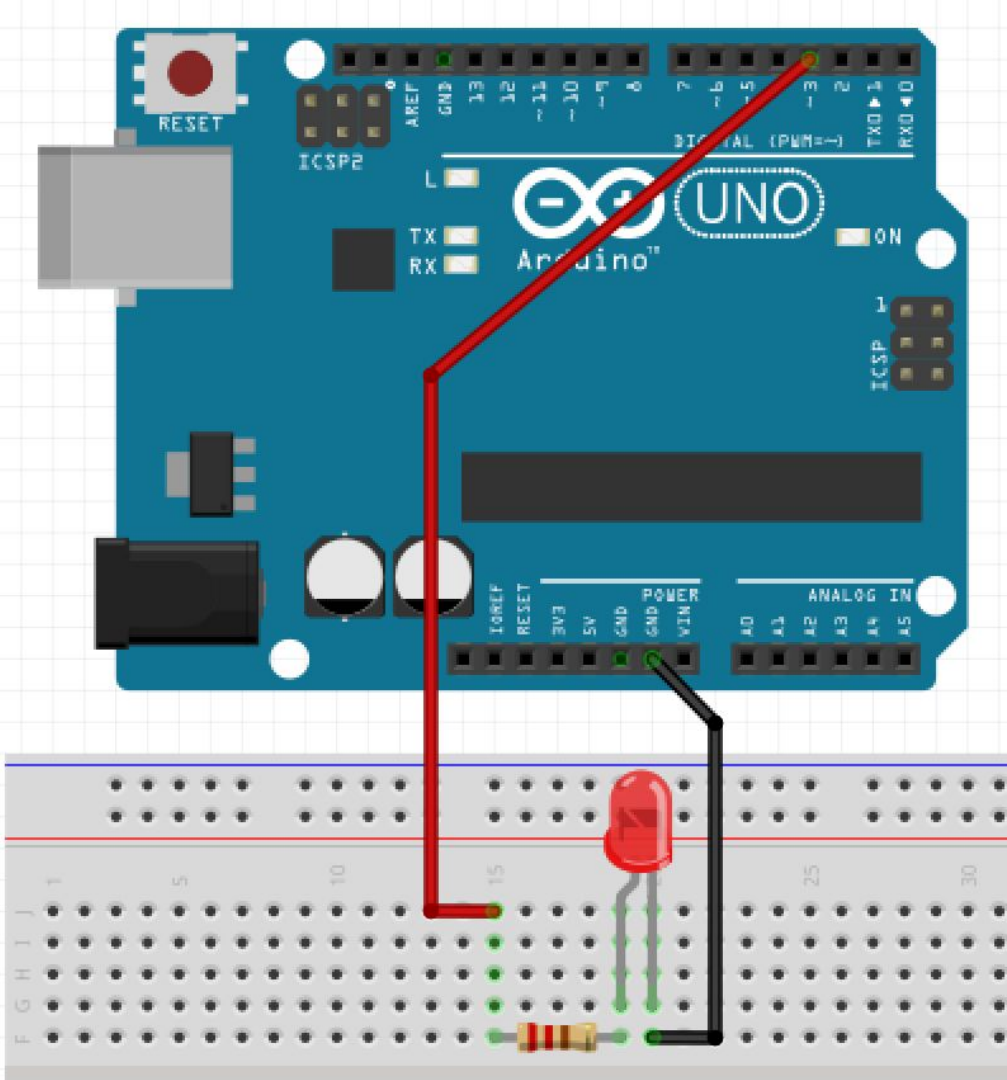
Circuits with Arduino!

Essence of Arduino Projects

- Figure out what you want to do
- Determine what parts you need
  - Which parts generate something? (motors, speakers, lights, etc)
  - Which parts detect something? (sensors, buttons, switches, scanners, etc)
- Use Arduino to control external components
  - digital/analog write for outputs (motors, speakers, lights, etc)
  - digital/analog read for inputs (sensors, buttons, switches, scanners, etc)
- Write program to perform task
  - What does something
  - When to do something
  - How long to do something

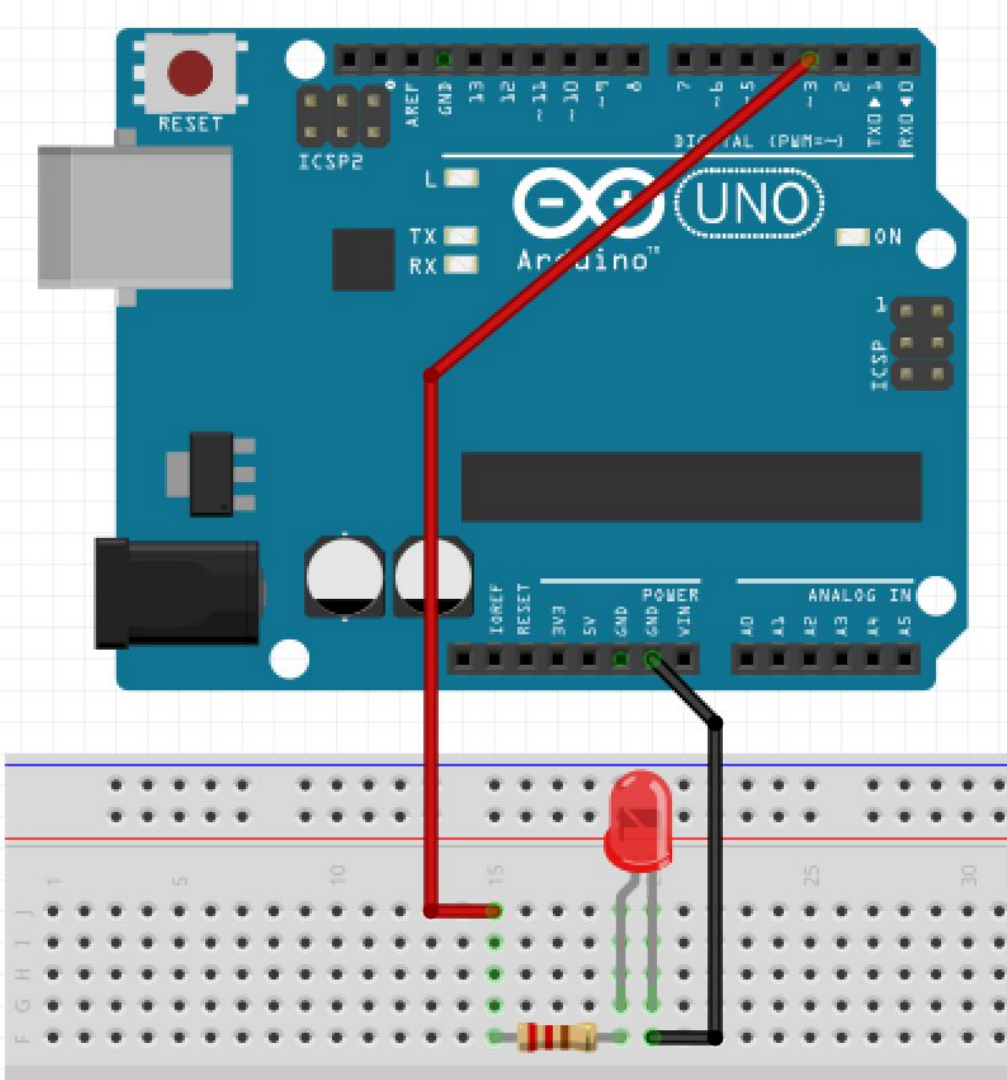
Blinky Circuit

- Arduino
- LED
  - Longer leg = higher voltage
  - Shorter leg = lower voltage
- Resistor
- Controlled from pin 3
  - digitalWrite



Fancy Blinky Circuit

- Arduino
- LED
  - Longer leg = higher voltage
  - Shorter leg = lower voltage
- Resistor
- Controlled from pin 3
  - analogWrite



Proximity Blinky Circuit

- Arduino
- LED - pin 3
  - Longer leg = higher voltage
  - Shorter leg = lower voltage
- Resistor
- Distance Sensor
  - Pin 9 -> TRIG
  - Pin 10 -> ECHO
  - 5V -> VCC
  - GND -> GND