# Week 1 - Electrical / Software

# Overview

Welcome to the Electrical & Software Onboarding for the 2026-2027 school year!

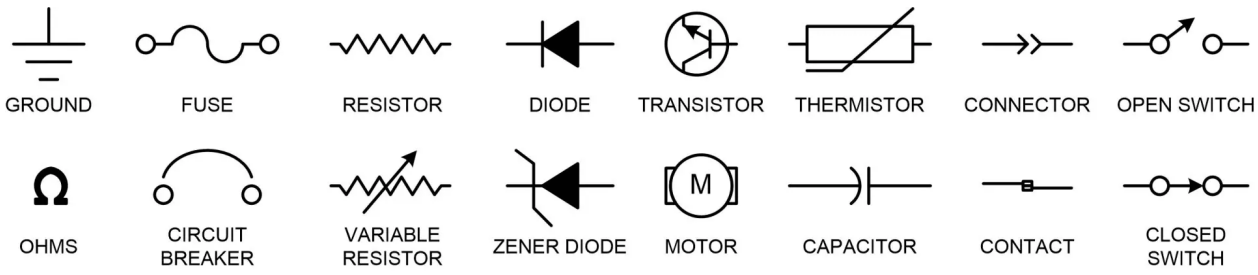
# Goals

- **Learning**
  - What is a Schematic / How to read a Schematic
  - How does a microcontroller control hardware?
- **Practical**
  - Breadboarding a circuit
  - Running and debugging Arduino/ C++ code
  - Managing software dependencies and reading software documentation

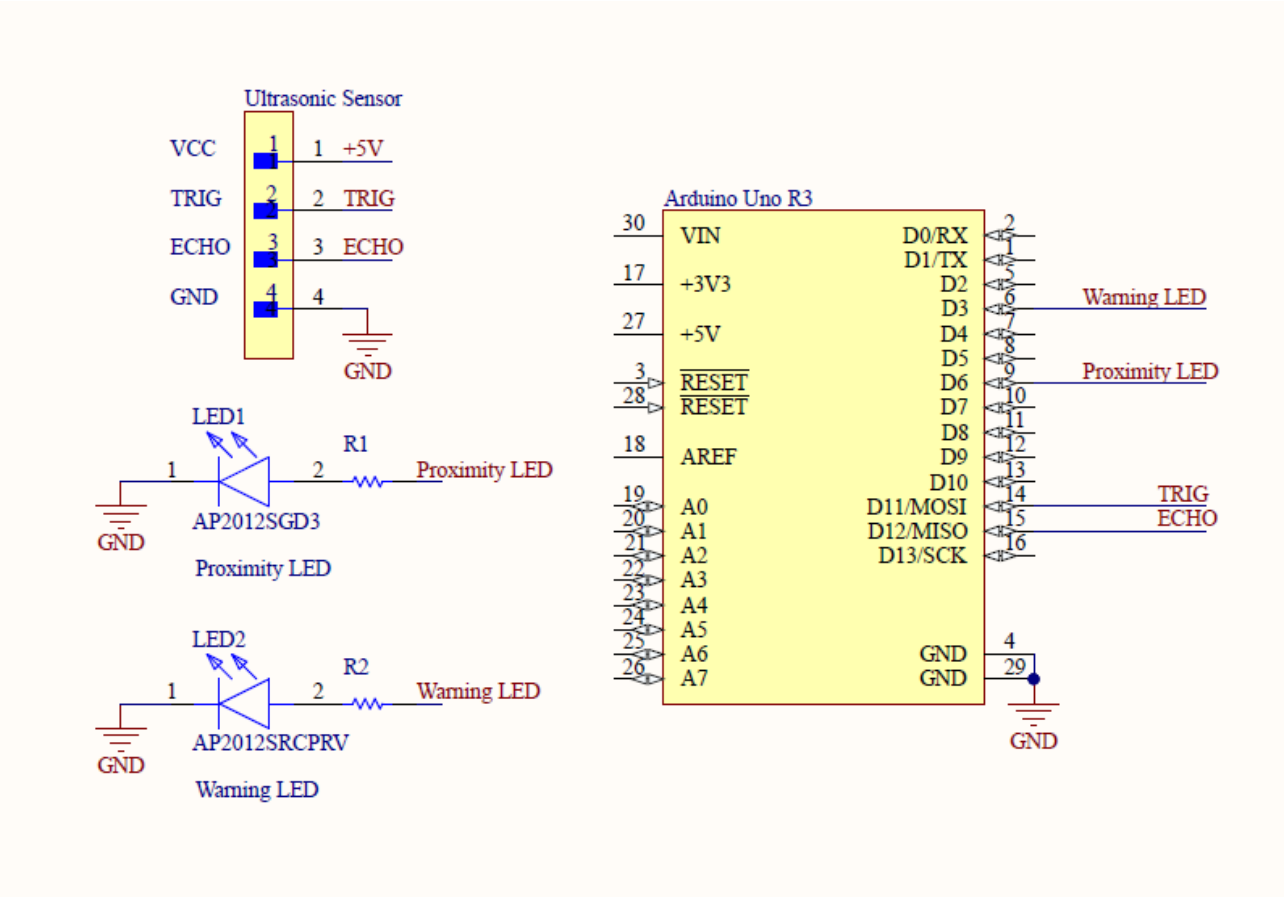
# Circuit Breadboarding

**Reading a Circuit Schematic:**

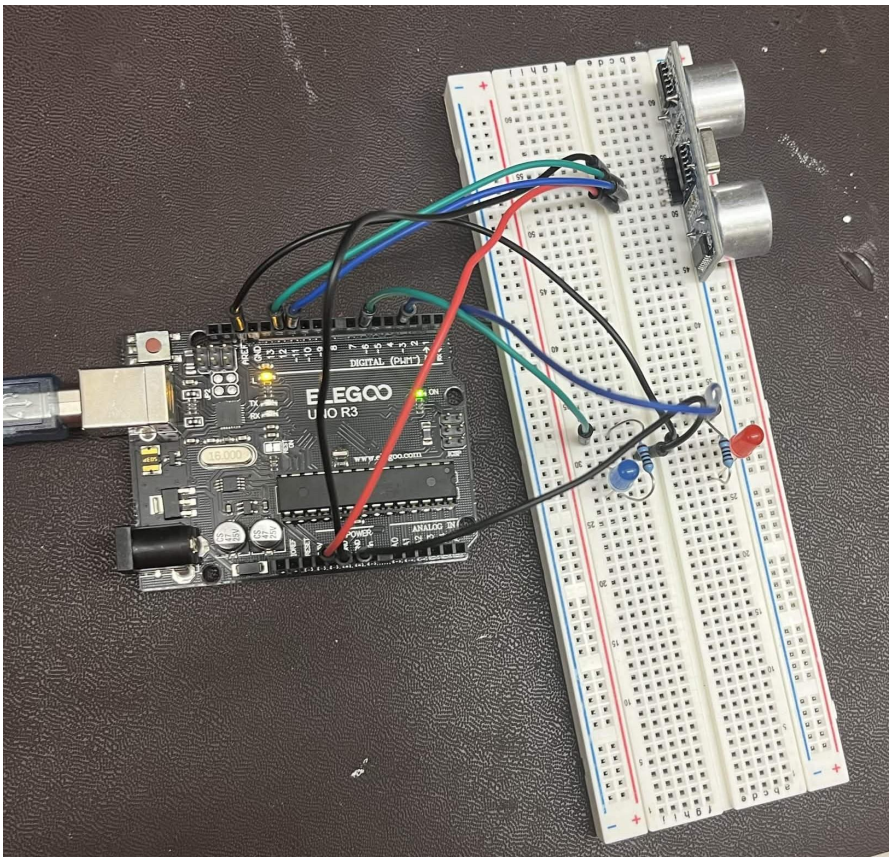
A schematic is just a logical and visual representation of the circuit. Below are a bunch of circuit symbols you may see on your schematic:




The schematic you'll be using to construct the project is found below:




Use the schematic to construct the circuit on your breadboard. Once completed, you should have something similar to below:



Once you have your circuit constructed, you're now ready to install and upload your project's firmware.

# Downloads

**Arduino:**

Go here and download the version of the arduino IDE for your operating system (Windows, OSX, linux).


**Pico board support:**

We'll be using the **Elegoo Uno R3** for onboarding. To develop on the uno, you need to add an additional board manager URL to the Arduino IDE.

Go here and scroll to the installation section. Follow the short directions there.

In the boards manager tab, search for these two libraries and install them

# Compilation

Select the Uno R3:

Use the Arduino IDE to select the Uno R3 as the compilation target.

[IMAGE]

Connect the Uno R3 to your computer using a micro-usb cable. You should see this drop down turn bold.

[IMAGE]

**Verifying Source Code:**

Copy this skeleton code into an arduino sketch file:

```
const int TRIG_PIN = 11;
const int ECHO_PIN = 12;
const int LED_PIN = 3;        // warning LED (on/off)
const int BRIGHT_LED_PIN = 6; // brightness LED (must be a ~ pin)
const int DISTANCE_THRESHOLD = 5;

float duration_us, distance_cm;
int brightness;

void setup() {
  Serial.begin(9600);
  pinMode(TRIG_PIN, OUTPUT);
  pinMode(ECHO_PIN, INPUT);
  // FIX ME #1
  pinMode(BRIGHT_LED_PIN, OUTPUT);
}

void loop() {
  // generate 10-microsecond pulse to TRIG pin
  digitalWrite(TRIG_PIN, HIGH);
  delayMicroseconds(10);
  digitalWrite(TRIG_PIN, LOW);

  // measure duration of pulse from ECHO pin
  duration_us = pulseIn(ECHO_PIN, HIGH);
  distance_cm = 0.017 * duration_us;

  // warning LED
  if (distance_cm < DISTANCE_THRESHOLD)
    digitalWrite(LED_PIN, HIGH);
```

```
  else
    digitalWrite(LED_PIN, LOW);

  // brightness LED — gets brighter as object gets closer
 brightness = map(distance_cm, 2, 30, 255, 0);
 brightness = constrain(brightness, 0, 255);
  analogWrite(BRIGHT_LED_PIN, brightness);

  Serial.print("distance: ");
  Serial.print(distance_cm);
  Serial.print(" cm  |  brightness: ");
  Serial.println(brightness);

  delay(500);
}
```

This file contains `const` declarations

Edit the `setup()` function and replace line 14 with the following:

```
pinMode(LED_PIN, OUTPUT);
```

Click the check mark at the top left of the IDE to check for compilation errors. If your program compiles correctly you should see this output.

[Need to Test] Flashing Pico 2:

Click the arrow at the top left of the IDE to flash the Pico 2. If flashing doesn't work, you may need to unplug the Pico 2 and hold the BOOTSEL button while reconnecting the micro-usb cable.

If your flash is successful, you should see this output, and LED1 should be turned on.

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