Section 1

MANE 3351

Subsection 1

Lecture 5

Classroom Management

Agenda

- Arduinos
- Lab 2

Subsection 2

Resources

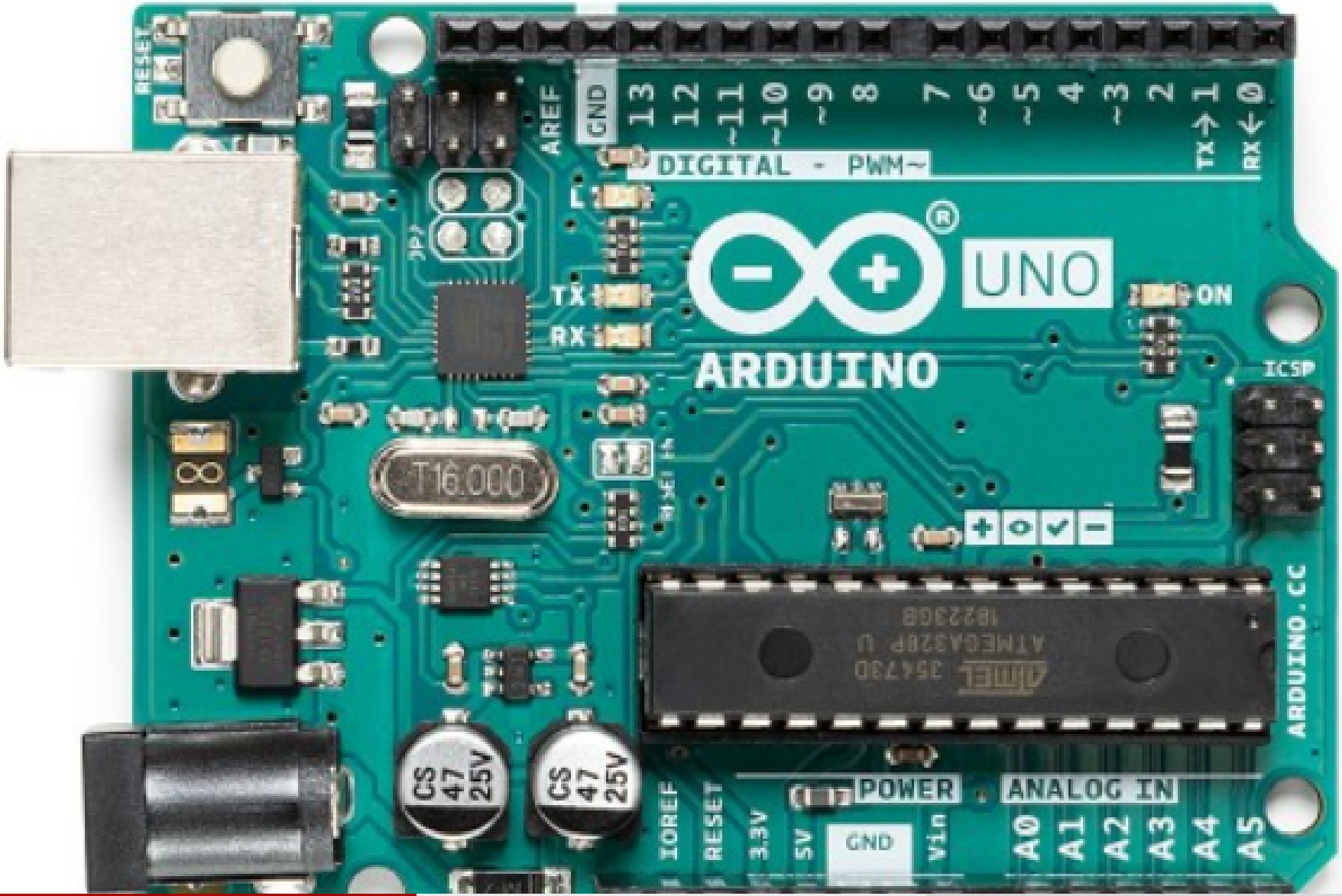
Handouts

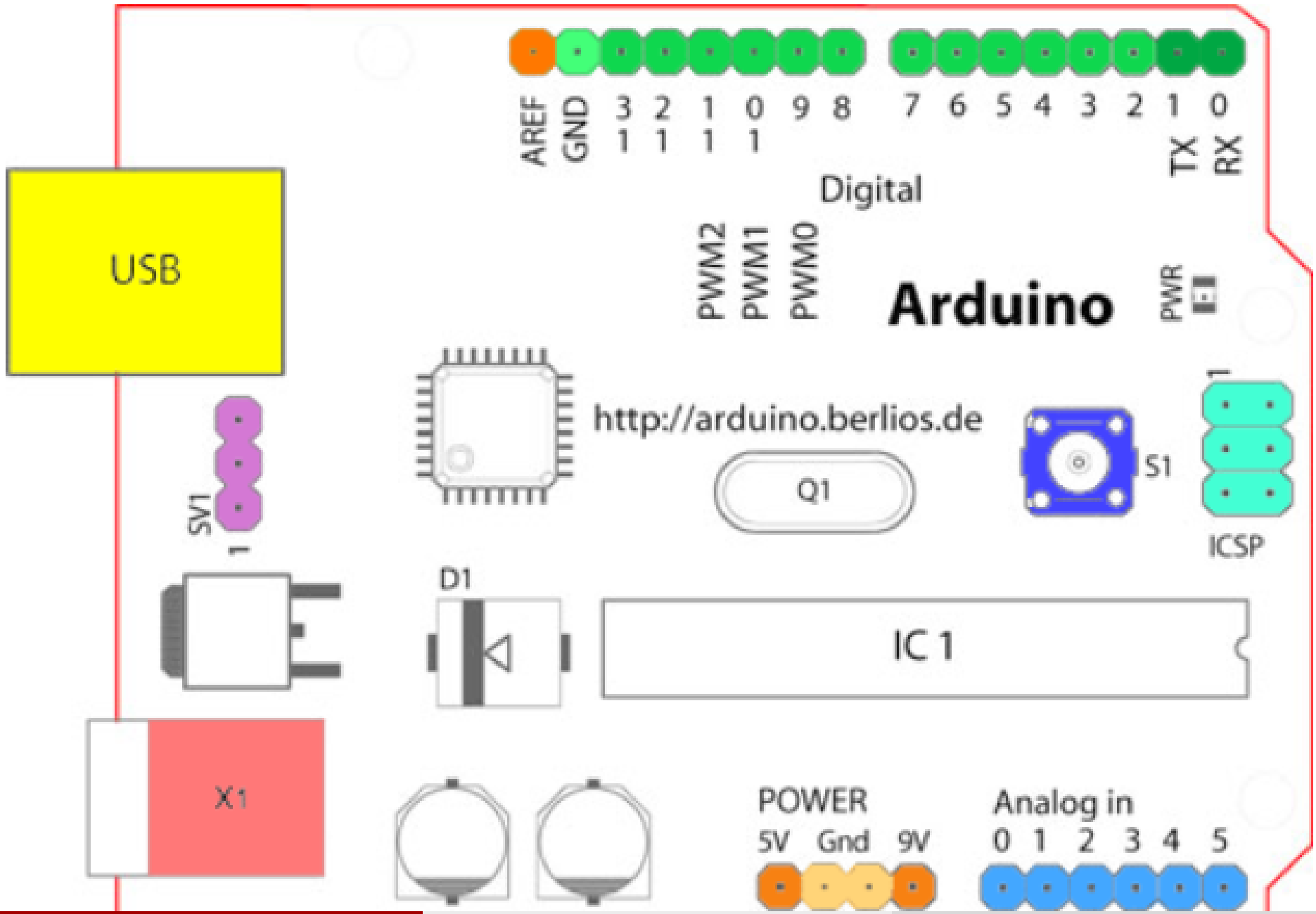
- Lecture 5 Slides
- Lecture 5 Marked Slides

Assignments

- Lab 2 (assigned 9/11/2024, due 9/18/2024 (before 2:00pm))

Arduino Uno


RESET
AREF
GND
13 12 ~11 ~10 ~9 8 7 ~6 ~5 4 ~3 2 TX→1 RX←0
DIGITAL - PWM~
UNO
ON
TX
RX
ARDUINO
ICSP
T16.000
ARDUINO.CC
POWER
ANALOG IN
IOREF
RESET
3.3V
5V
GND
Vin
A0 A1 A2 A3 A4 A5

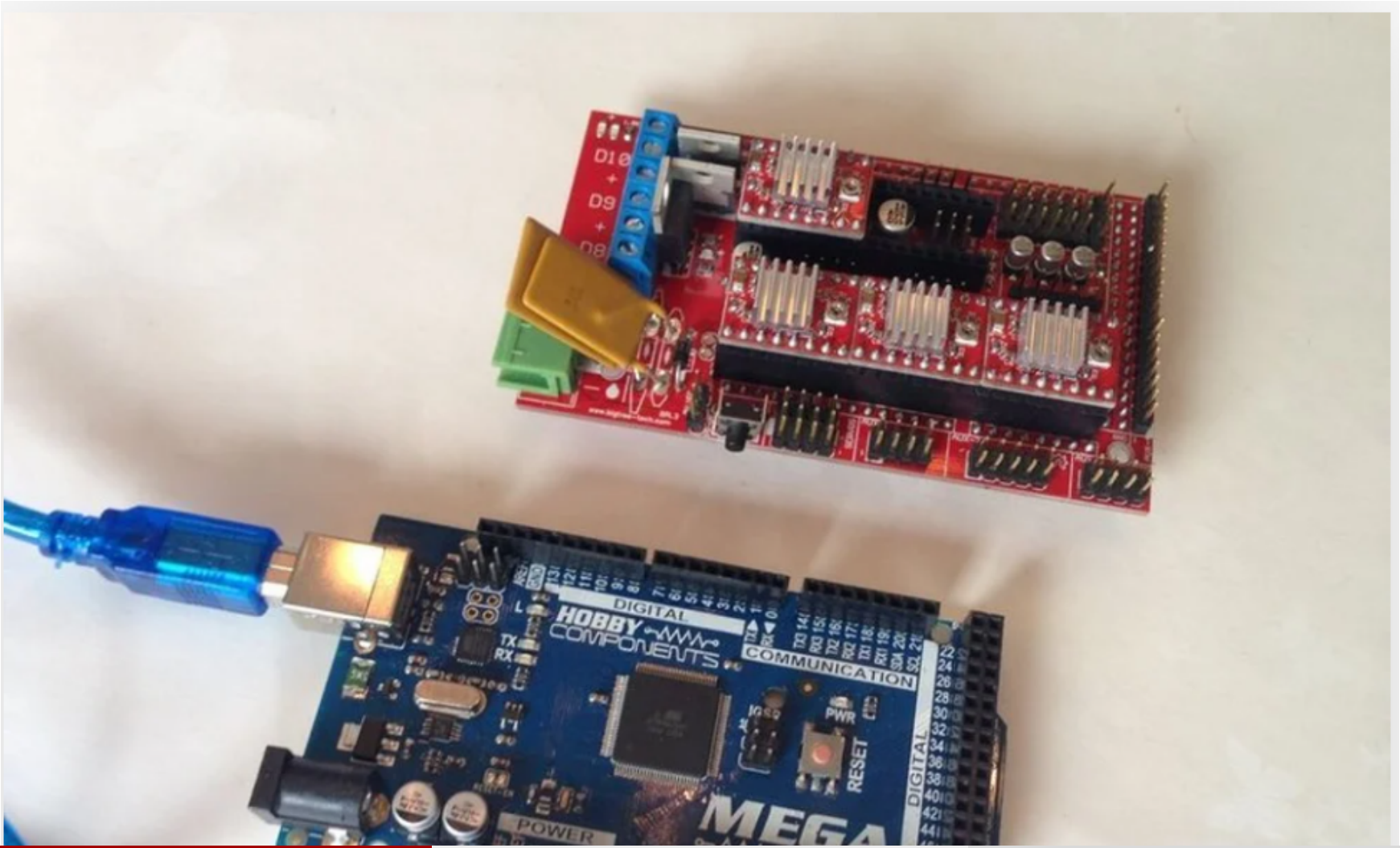

AREF
GND
13
12
11
10
9
8
7
6
5
4
3
2
1
0
TX
RX
Digital
PWM2
PWM1
PWM0
Arduino
PWR
USB
http://arduino.berlios.de
Q1
S1
ICSP
SV1
D1
IC 1
X1
POWER
5V
Gnd
9V
Analog in
0
1
2
3
4
5

Input/Output

- **Voltages** - 5V pin and 9V pin are present on the board as well as ground pins (0v)
- **Digital Pins** - multiple digital pins are provided on an Arduino board that can be used for general purpose input and output via the **pinMode()**, **digitalRead()**, and **digitalWrite()** commands
- **Analog Pins**- the analog input pins suport 10-bit analog-to-digital conversion using the **analogRead()** function
- **Other Pins** - A reference voltage and reset functionality are also available

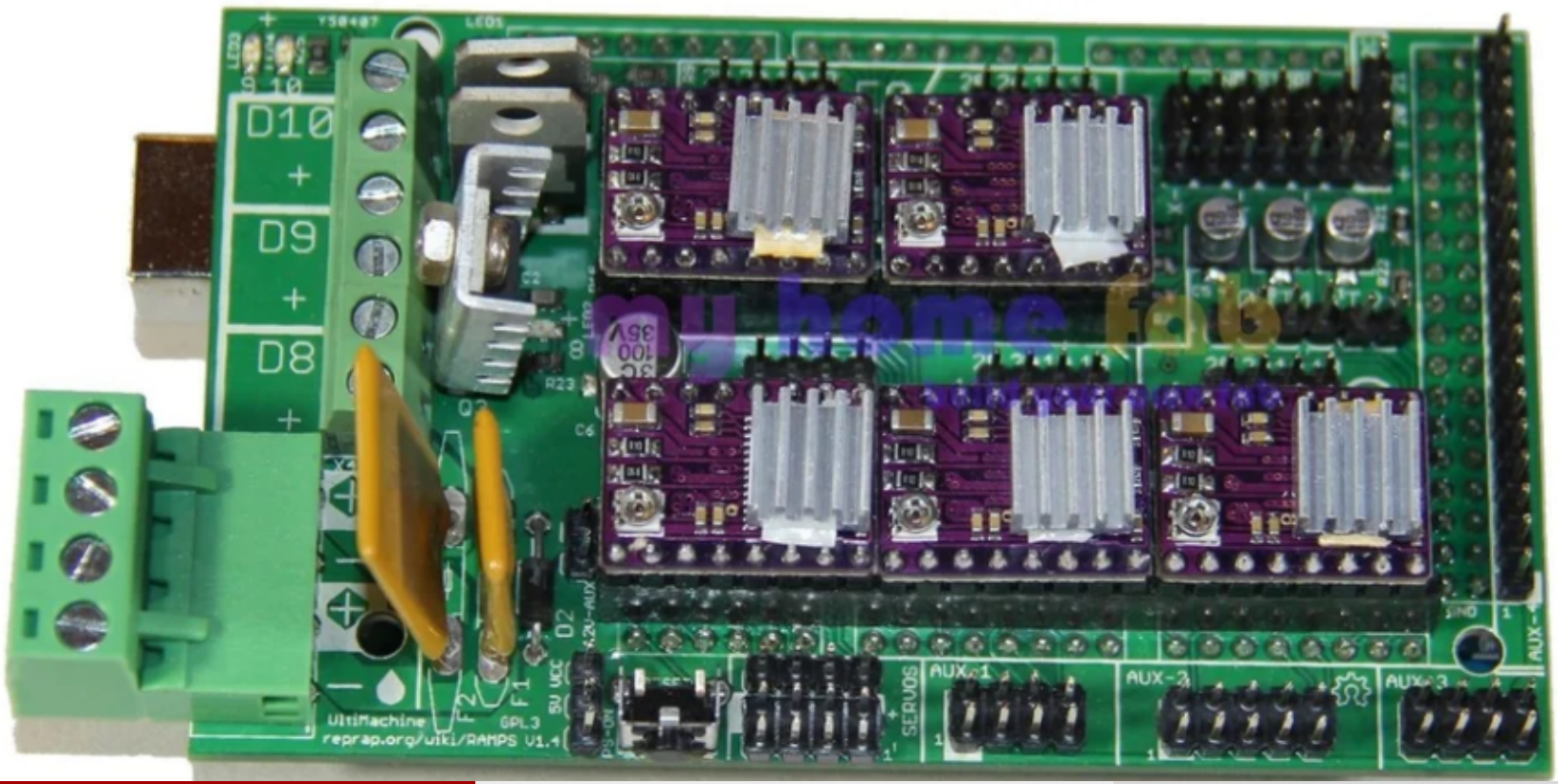
Arduino Mega

- There are multiple versions of Arduino boards.
- The Arduino Mega is often combined with a RAMPS shield to construct homemade Reprap 3D-printers

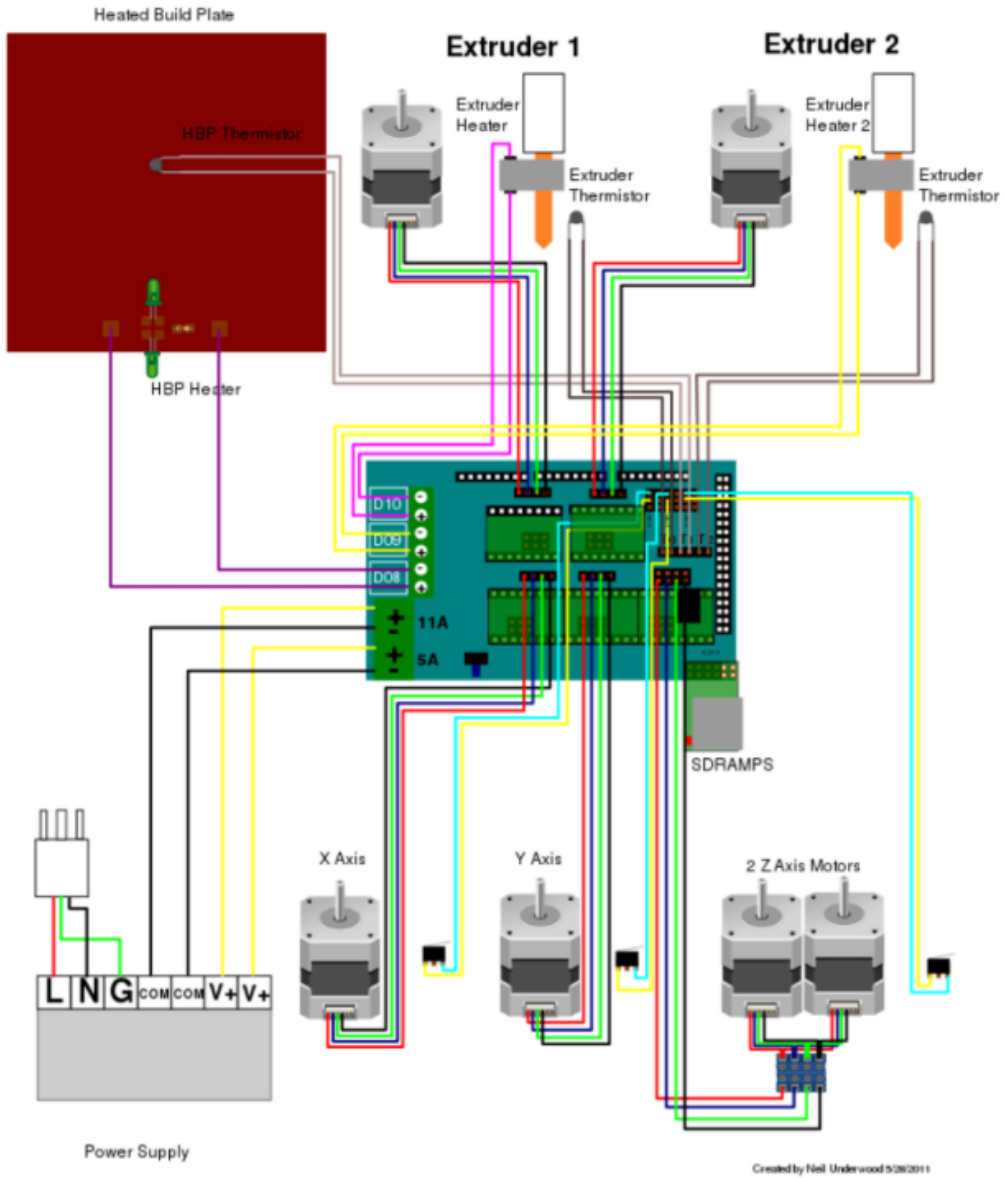


RAMPS Shield

- Circuit board that plugs into Arduino Mega for build 3D printers
- Typically includes drivers for stepper motors shown below
- Schematic for 3D printer is also provided below
- Both images taken from All3DP website



RepRap Arduino Mega Pololu Shield 1.4



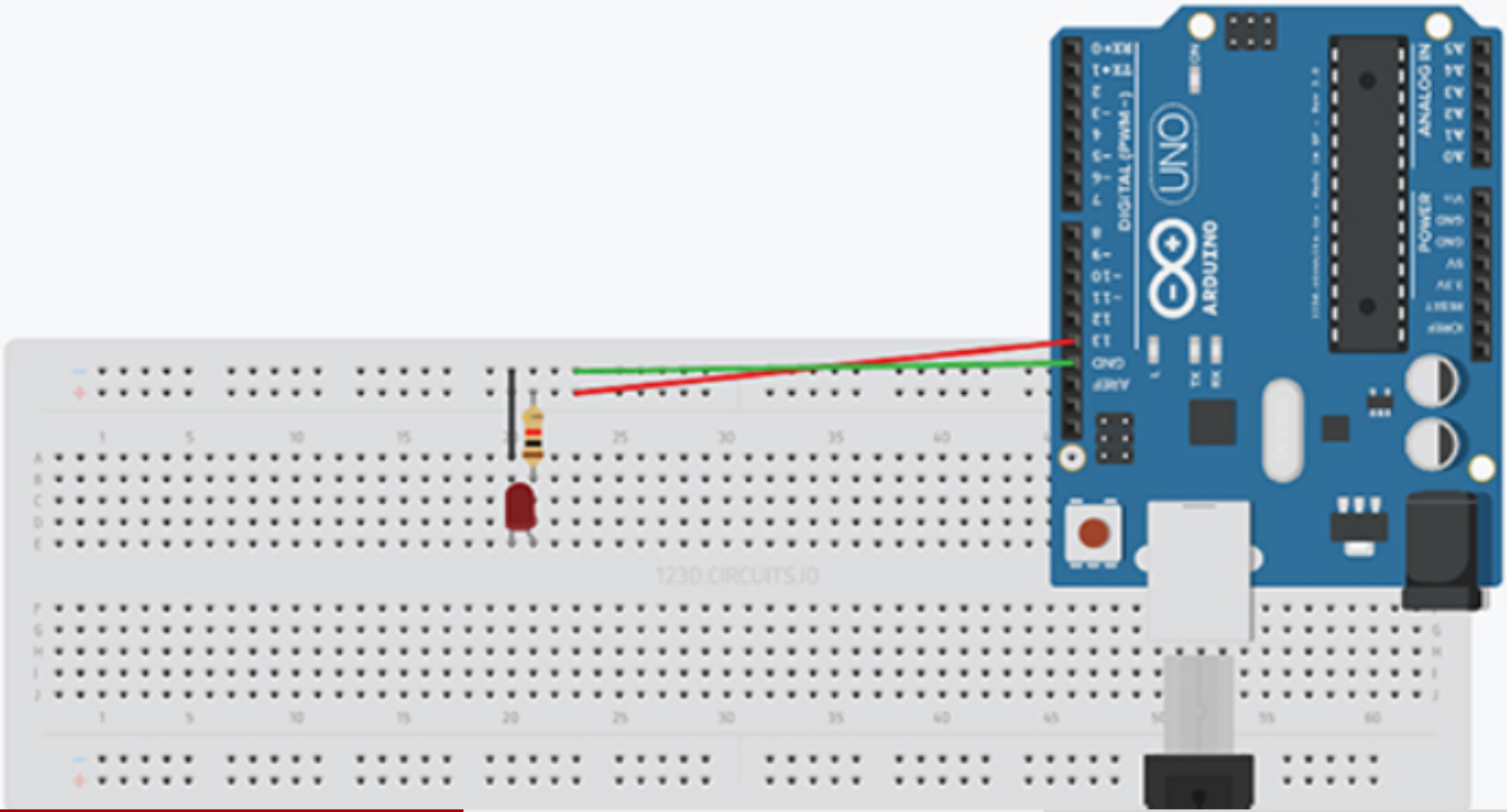
Programming Arduino

- Written in the Arduino Integrated Development Environment
- Arduino programming language is based on a very simple hardware programming language called processing, which is similar to the C language
- Programs for Arduinos are called **sketches**
- Sketches must be uploaded to Arduino (via USB cable)
- Arduino IDE installed on Raspberry Pi

Source: Programming Arduinos

Example 1: Blinking an LED

- First example is to an LED (same as with the Raspberry Pi)



Example 1: Sketch

```
int LED =13; // The digital pin to which the LED is connected


void setup ( )
{


pinMode (LED, OUTPUT); //Declaring pin 13 as output pin


}


void loop( ) // The loop function runs again and again
{

digitalWrite (LED, HIGH); //Turn ON the LED
delay(1000); //Wait for 1sec
digitalRead (LED, LOW); // Turn off the LED
delay(1000); // Wait for 1sec

}
```

Code for Blinking an LED

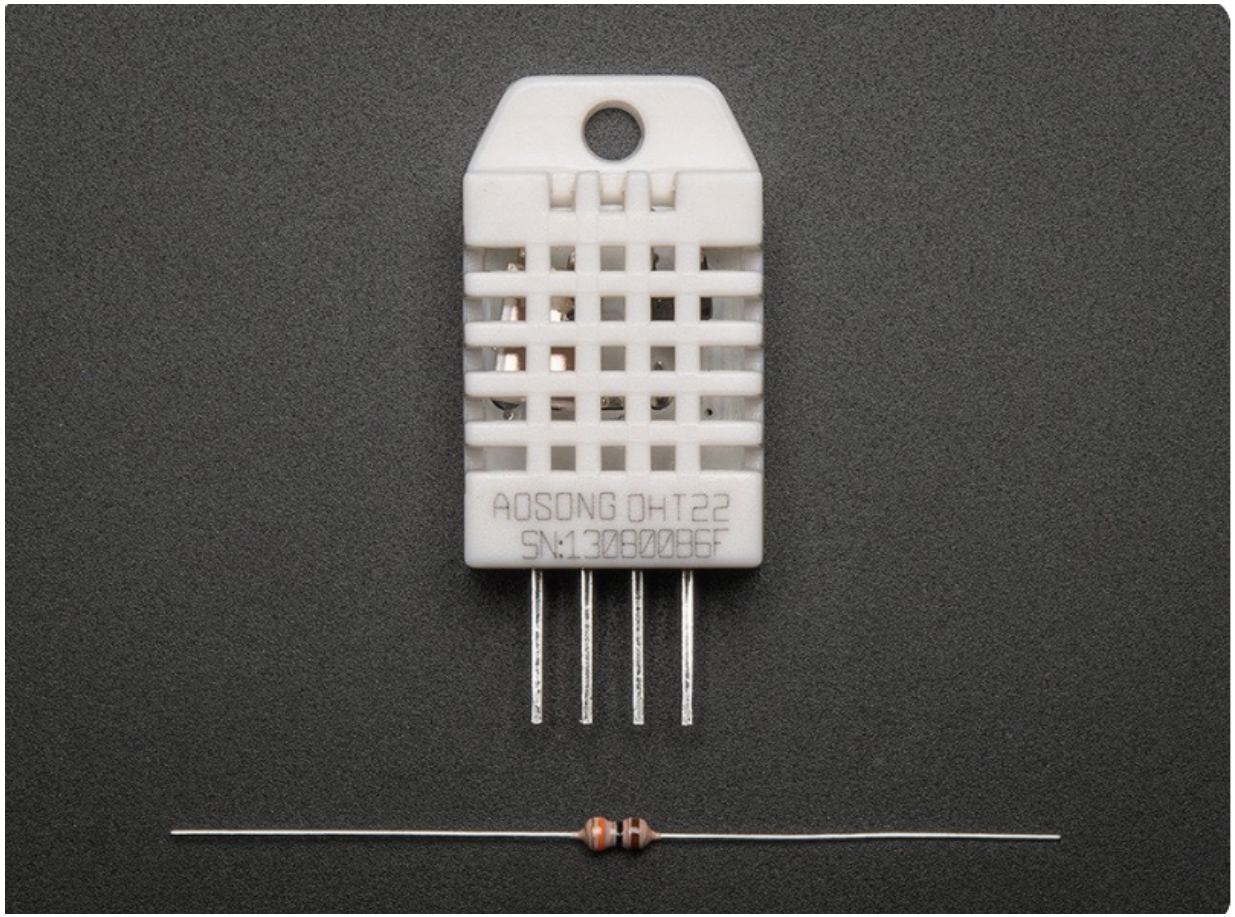
```
int LED = 13; // the digital pin to which the LED is connected

void setup ()
{
pinMode (LED,OUTPUT); //Declaring pin 13 as output ping
}

void loop () //The loop function runs again and again
{
digitalWrite (LED,HIGH); //Turn ON the LED
delay (1000); //wait for 1 second
digitalWrite(LED,LOw); //Turn OFF the LED
delay(1000); //wait for one second
}
```

Warning

- Arduinos store the last program in EEPROM and will start running that program as soon as the power is provided
- Cautious Approach:
  - Do not connect circuit board to Arduino until after the Sketch is loaded
  - Afterwards, connect hardware

Arduino Demonstration 1

DHT22 Sensor



DHT22 temperature-humidity sensor + extras

Product ID: 385

$9.95

Discontinued

Why not check out the DHT20 - AHT20 Pin Module - I2C Temperature and Humidity Sensor?

Description

Technical Details

Figure 8: dht2sensor

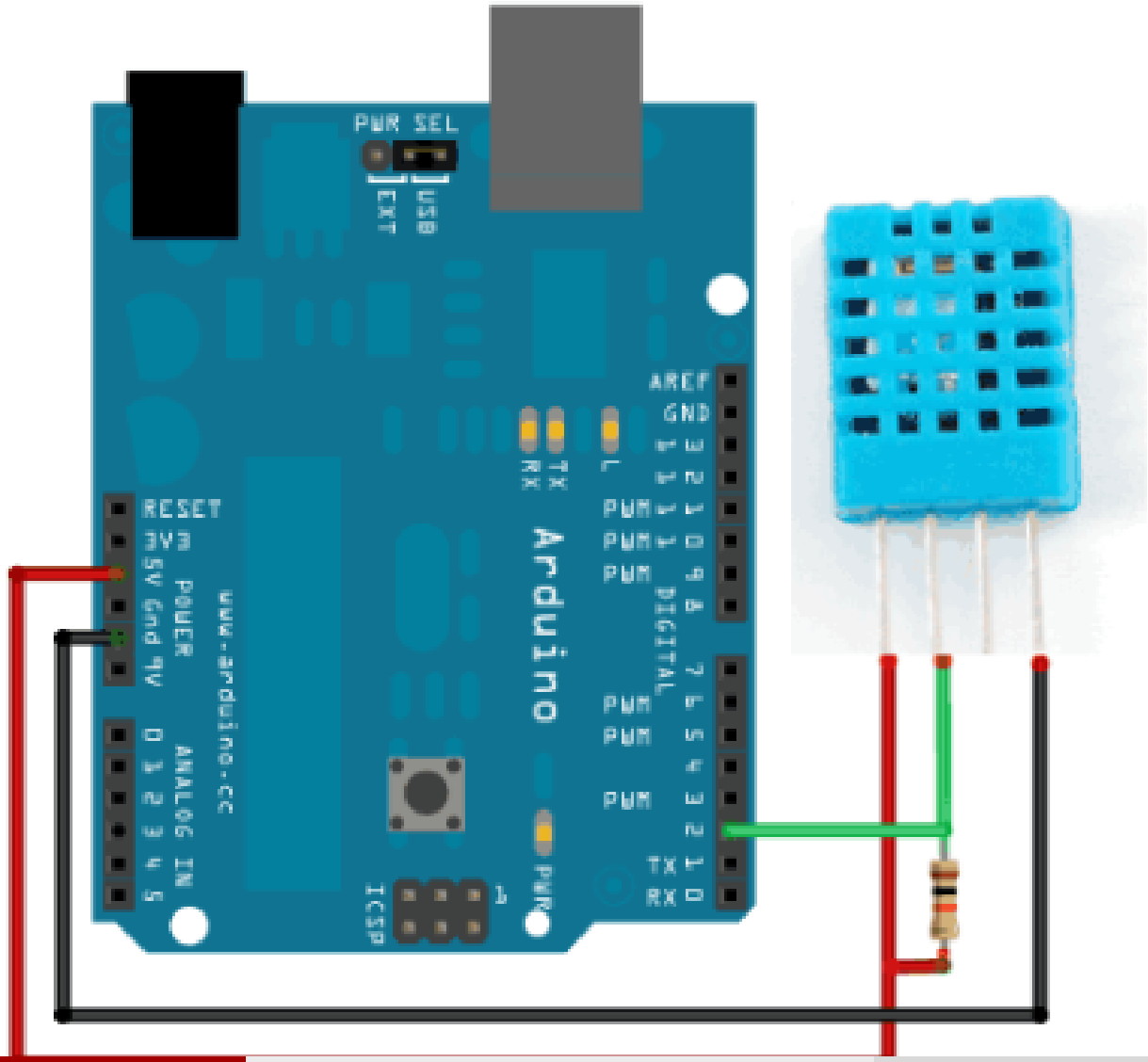
Technical Details of DHT11 Sensor

Technical Details

- Low cost
- 3 to 5V power and I/O
- 2.5mA max current use during conversion (while requesting data)
- Good for 0-100% humidity readings with 2-5% accuracy
- Good for -40 to 80°C temperature readings ±0.5°C accuracy
- No more than 0.5 Hz sampling rate (once every 2 seconds)
- Body size 27mm x 59mm x 13.5mm (1.05" x 2.32" x 0.53")
- 4 pins, 0.1" spacing
- Weight (just the DHT22): 2.4g

Figure 9: dht22 details

Arduino Circuit



Arduino Sketch

DHTtester

```
// Example testing sketch for various DHT humidity/temperature sensors
// Written by ladyada, public domain

// REQUIRES the following Arduino libraries:
// - DHT Sensor Library: https://github.com/adafruit/DHT-sensor-library
// - Adafruit Unified Sensor Lib: https://github.com/adafruit/Adafruit_Sensor

#include "DHT.h"

#define DHTPIN 2     // Digital pin connected to the DHT sensor
// Feather HUZZAH ESP8266 note: use pins 3, 4, 5, 12, 13 or 14 --
// Pin 15 can work but DHT must be disconnected during program upload.

// Uncomment whatever type you're using!
//#define DHTTYPE DHT11   // DHT 11
#define DHTTYPE DHT22   // DHT 22  (AM2302), AM2321
//#define DHTTYPE DHT21   // DHT 21 (AM2301)

// Connect pin 1 (on the left) of the sensor to +5V
// NOTE: If using a board with 3.3V logic like an Arduino Due connect pin 1
// to 3.3V instead of 5V!
// Connect pin 2 of the sensor to whatever your DHTPIN is
// Connect pin 3 (on the right) of the sensor to GROUND (if your sensor has 3 pins)
// Connect pin 4 (on the right) of the sensor to GROUND and leave the pin 3 EMPTY (if your sensor has 4 pins)
// Connect a 10K resistor from pin 2 (data) to pin 1 (power) of the sensor

// Initialize DHT sensor.
// Note that older versions of this library took an optional third parameter to
// tweak the timings for faster processors.  This parameter is no longer needed
// as the current DHT reading algorithm adjusts itself to work on faster procs.
DHT dht(DHTPIN, DHTTYPE);

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

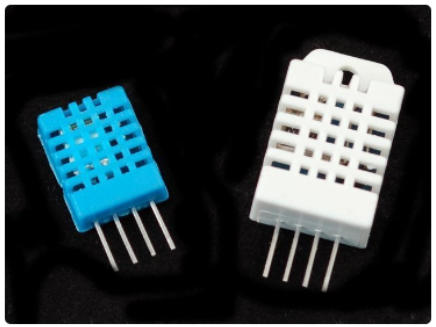
Arduino Sketch, continued

```
void loop() {
  // Wait a few seconds between measurements.
  delay(2000);

  // Reading temperature or humidity takes about 250 milliseconds!
  // Sensor readings may also be up to 2 seconds 'old' (its a very slow sensor)
  float h = dht.readHumidity();
  // Read temperature as Celsius (the default)
  float t = dht.readTemperature();
  // Read temperature as Fahrenheit (isFahrenheit = true)
  float f = dht.readTemperature(true);

  // Check if any reads failed and exit early (to try again).
  if (isnan(h) || isnan(t) || isnan(f)) {
    Serial.println(F("Failed to read from DHT sensor!"));
    return;
  }

  // Compute heat index in Fahrenheit (the default)
  float hif = dht.computeHeatIndex(f, h);
  // Compute heat index in Celsius (isFahreheit = false)
  float hic = dht.computeHeatIndex(t, h, false);

  Serial.print(F("Humidity: "));
  Serial.print(h);
  Serial.print(F("%  Temperature: "));
  Serial.print(t);
  Serial.print(F("°C "));
  Serial.print(f);
  Serial.print(F("°F  Heat index: "));
  Serial.print(hic);
```

DHT Library

learn.adafruit.com/dht/using-a-dhtxx-sensor

DHT11, DHT22 and AM2302 Sensors > Using a DHTxx Sensor



DHT11, DHT22 and AM2302 Sensors

By lady ada

Basic temperature & humidity sensors

Using a DHTxx Sensor

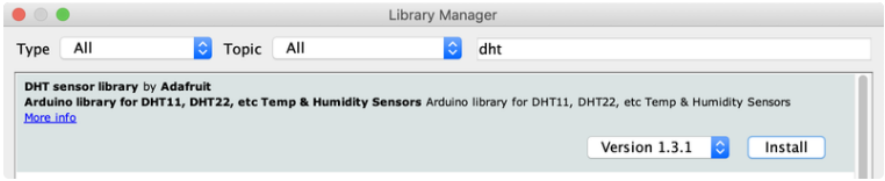
Save Subscribe

To test the sketch, we'll use an Arduino. You can use any micrcontroller that can do microsecond timing, but since its a little tricky to code it up, we suggest verifying the wiring and sensor work with an Arduino to start.

You should have the Arduino IDE software running at this time. Next it's necessary to install our DHT library, which can be done though the Arduino Library Manager:

Sketch→Include Library→Manage Libraries...

Enter "**dht**" in the search field and look through the list for "**DHT sensor library** by **Adafruit**." Click the "Install" button, or "Update" from an earlier version.



IMPORTANT: As of version 1.3.0 of the DHT library you will also need to install the **Adafruit Unified Sensor** library, which is also available in the Arduino Library Manager:

DHTest Code

```
// Example testing sketch for various DHT humidity/temperature
// Written by ladyada, public domain

// REQUIRES the following Arduino libraries:
// - DHT Sensor Library: https://github.com/adafruit/DHT-senso
// - Adafruit Unified Sensor Lib: https://github.com/adafruit/

#include "DHT.h"

#define DHTPIN 2     // Digital pin connected to the DHT senso
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// Uncomment whatever type you're using!
//#define DHTTYPE DHT11   // DHT 11
#define DHTTYPE DHT22   // DHT 22  (AM2302), AM2321
```

Demonstration 2 - Temperature/Humidty Sensor