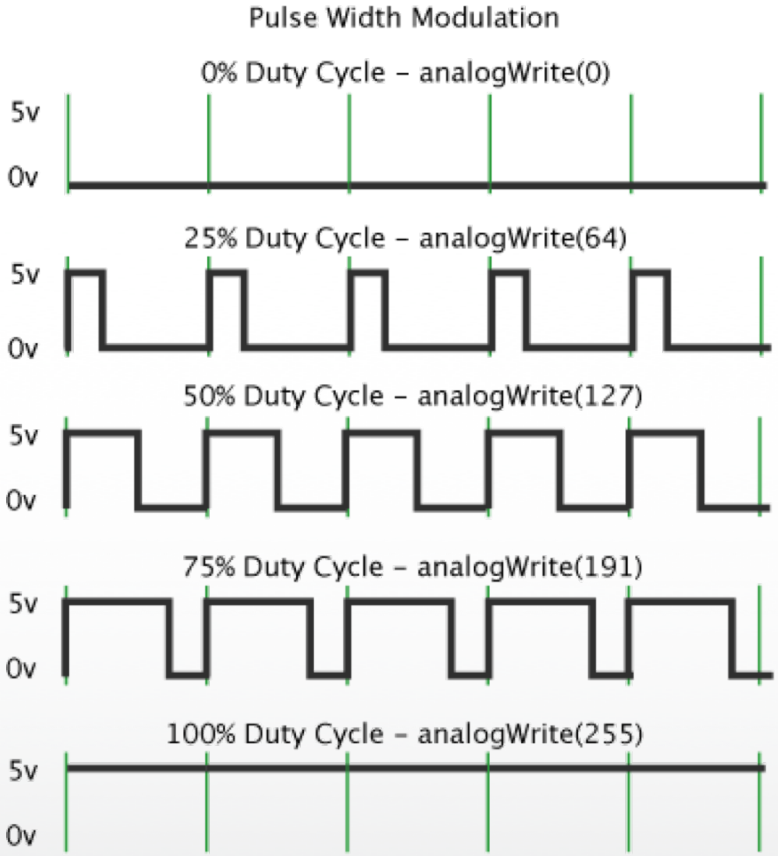
Project #2 – Fading
Introducing a new command…

```
analogWrite(pin, val);
```

pin – refers to the OUTPUT pin (limited to pins 3, 5, 6, 9, 10, 11.) – denoted by a ~ symbol

val – 8 bit value (0 – 255).

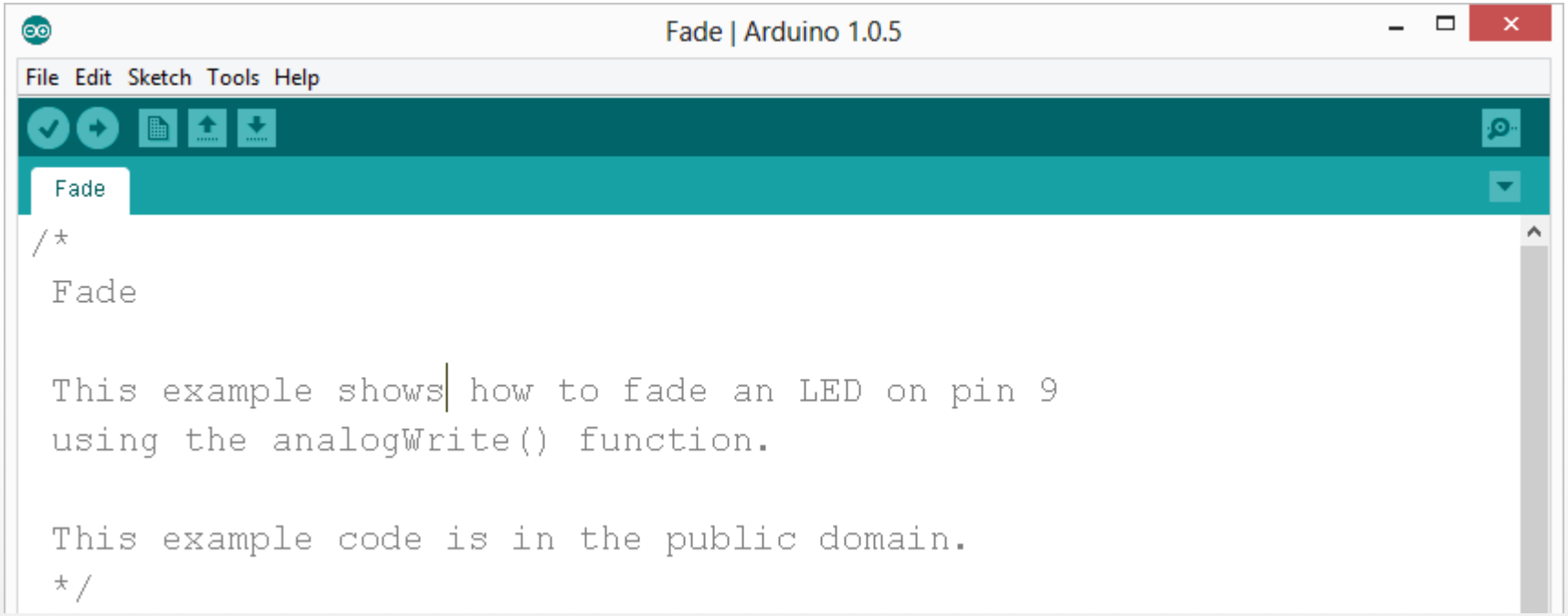
0 => 0V | 255 => 5V



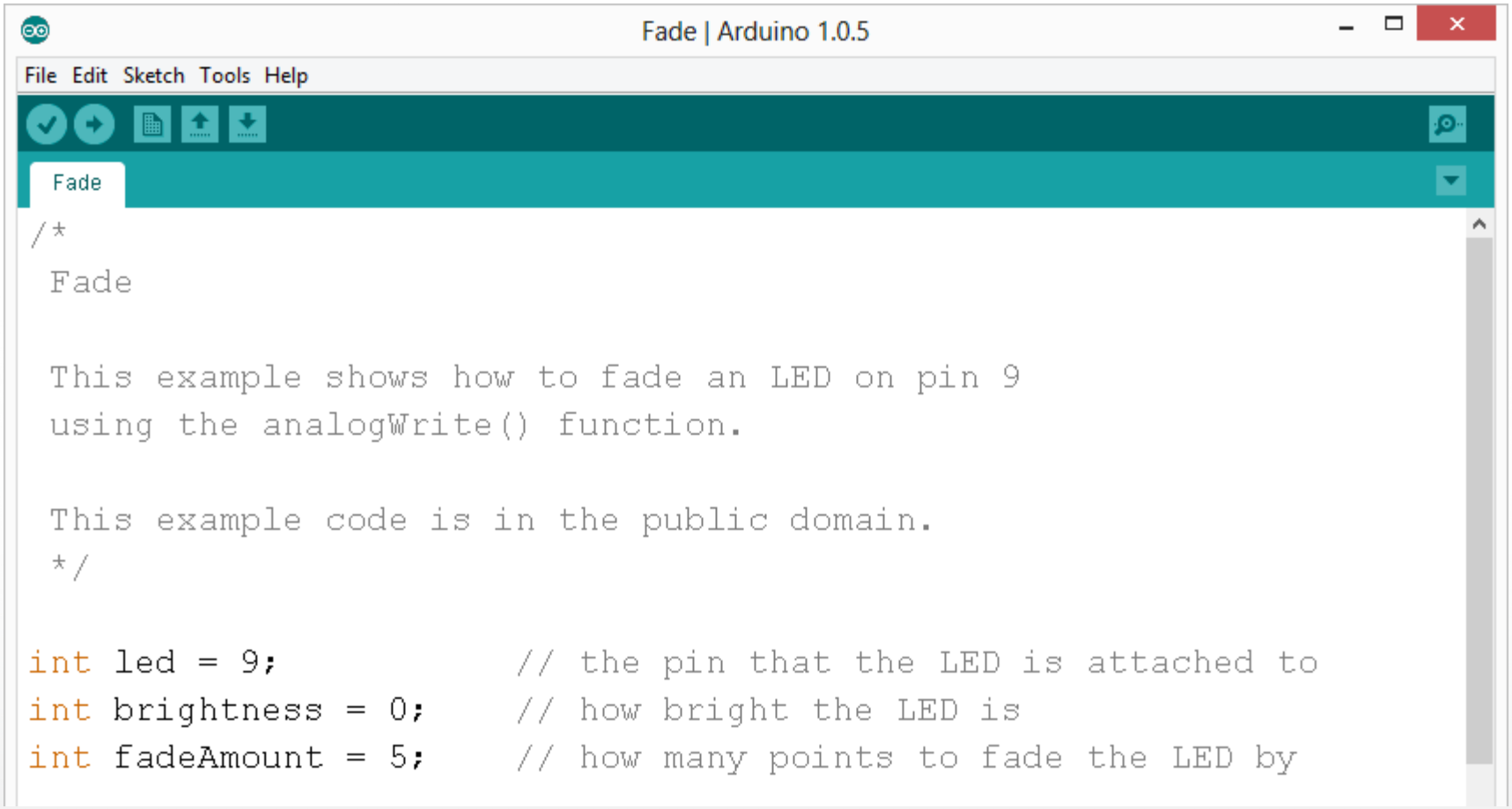
Move one of your LED pins over to Pin 9

In Arduino, open up:

File → Examples → 01.Basics → Fade



Fade - Code Review



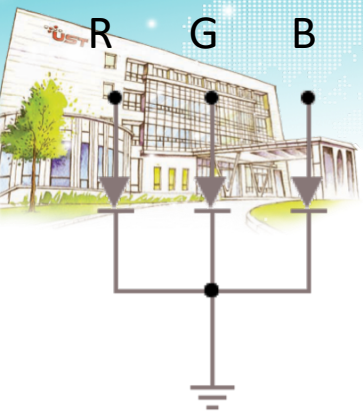
Fade - Code Review

```
void setup()  {
  // declare pin 9 to be an output:
  pinMode(led, OUTPUT);
}

// the loop routine runs over and over again forever:
void loop()  {
  // set the brightness of pin 9:
  analogWrite(led, brightness);

  // change the brightness for next time through the loop:
  brightness = brightness + fadeAmount;

  // reverse the direction of the fading at the ends of the fade:
  if (brightness == 0 || brightness == 255) {
    fadeAmount = -fadeAmount ;
  }
  // wait for 30 milliseconds to see the dimming effect
  delay(30);
}
```

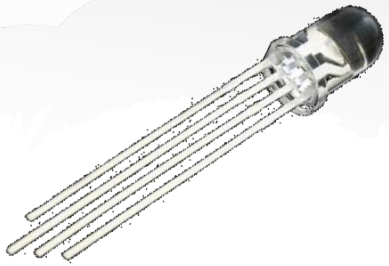
A few simple challenges# 2 -- Fading

- **Challenge 2a** –
  Change the rate of the fading in and out.

- **Challenge 2b** – Use 2 (or more) LEDs – so that one fades in as the other one fades out.

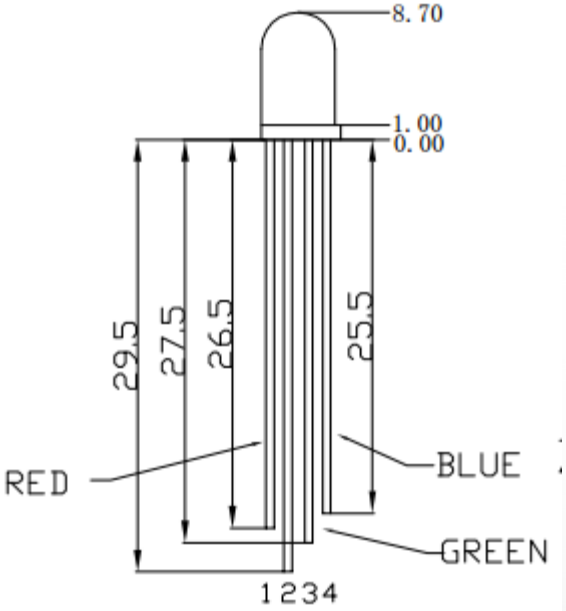


Color Mixing
Tri-color LED

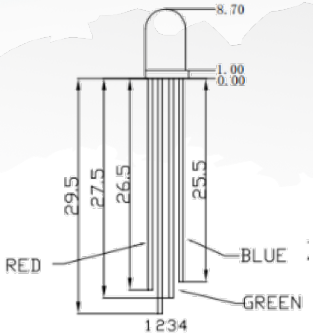


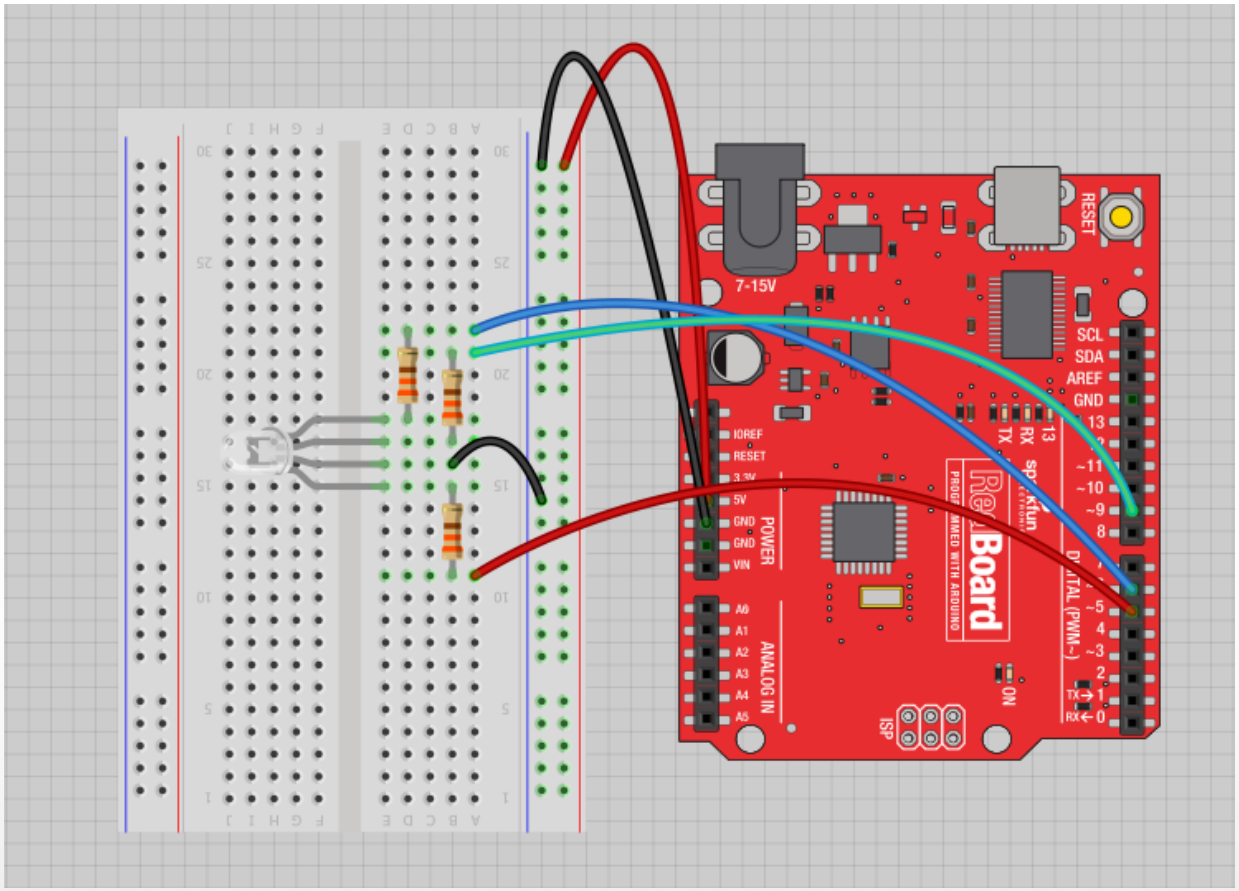
Common Cathode LED

This means the negative side of the LED is all tied to Ground.



Project 3 – RGB LED



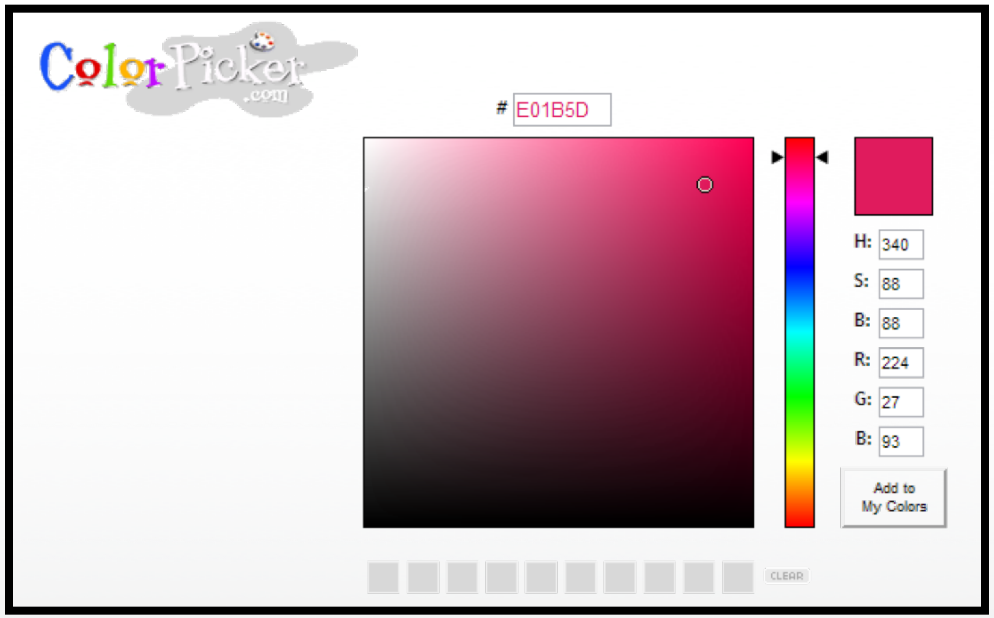


Note: The longest leg of the RGB LED is the Common Cathode. This goes to GND.

Use pins 5, 6, & 9

How many unique colors can you create?

$$\#\ of\ unique\ colors = 256 \cdot 256 \cdot 256$$
$$= 16{,}777{,}216\ colors!$$



Use Colorpicker.com or experiment on your own.

Pick out a few colors that you want to try re-creating for a lamp or lighting display...

Play around with this with the `analogWrite()` command.

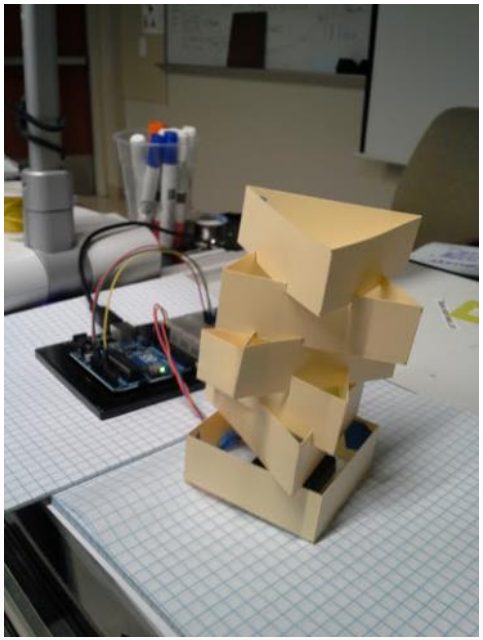
RGB LED Color Mixing

```
int redPin = 5;
int greenPin = 6;
int bluePin = 9;

void setup()
{
        pinMode(redPin, OUTPUT);
        pinMode(greenPin, OUTPUT);
        pinMode(bluePin, OUTPUT);
}
```

RGB LED Color Mixing

```
void loop()
{
        analogWrite(redPin, 255);
        analogWrite (greenPin, 255);
        analogWrite (bluePin, 255);
}
```

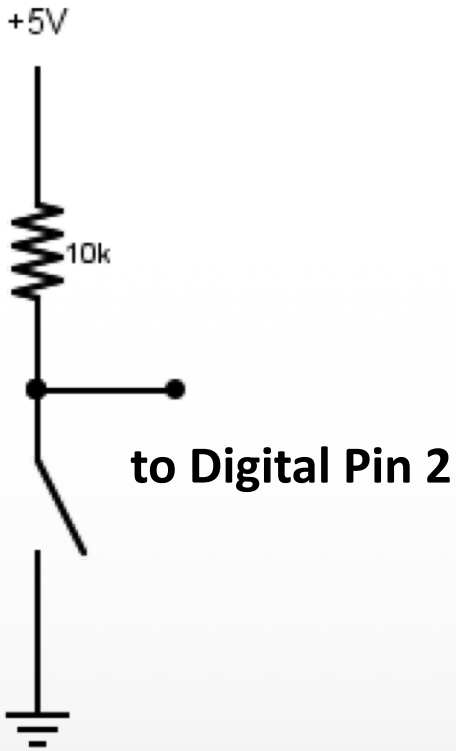
Project: Mood Lamp / Light Sculpture

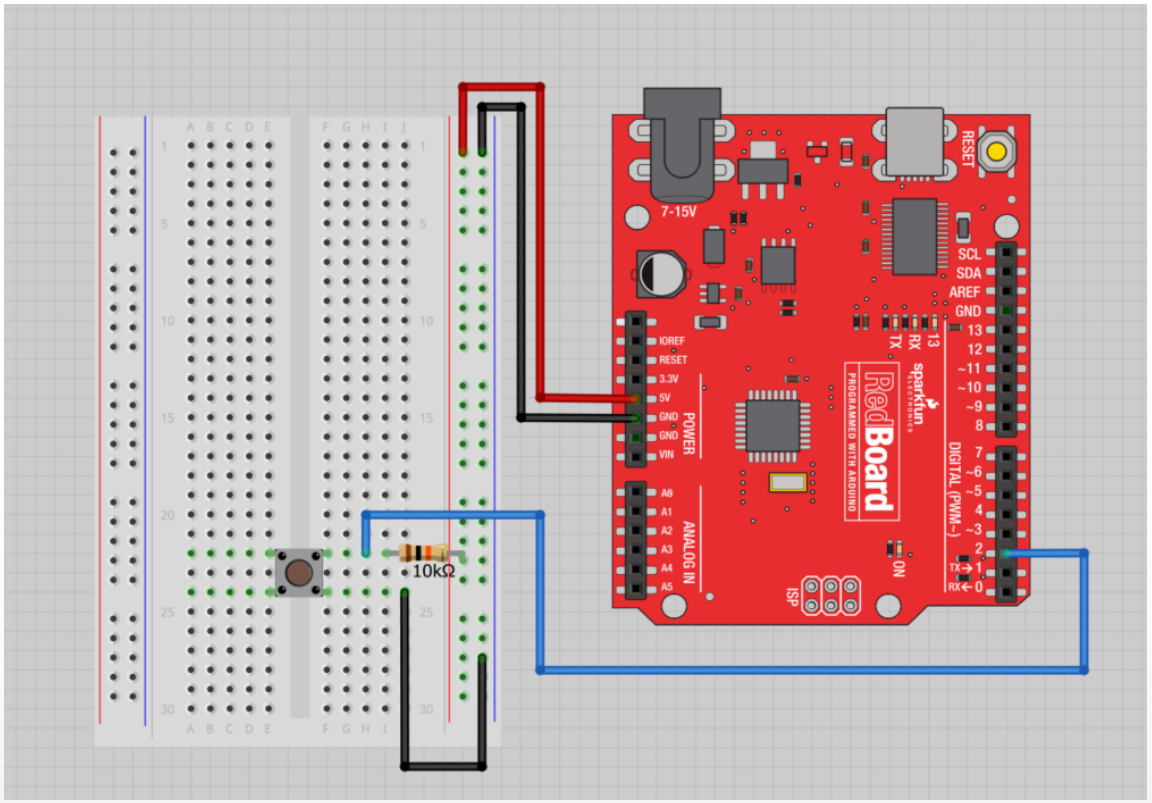


Project #4 – Digital Input

- In Arduino, open up:
- File → Examples → 02.Digital → Button

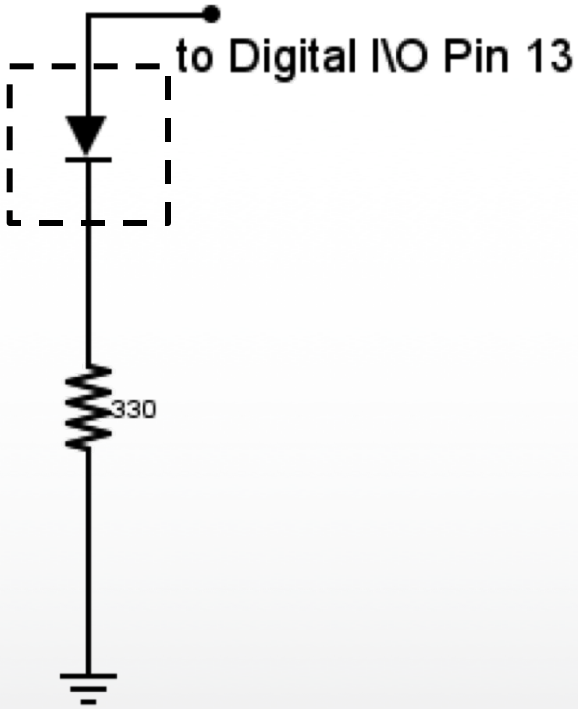
Digital Sensors (a.k.a. Switches)
Pull-up Resistor (circuit)

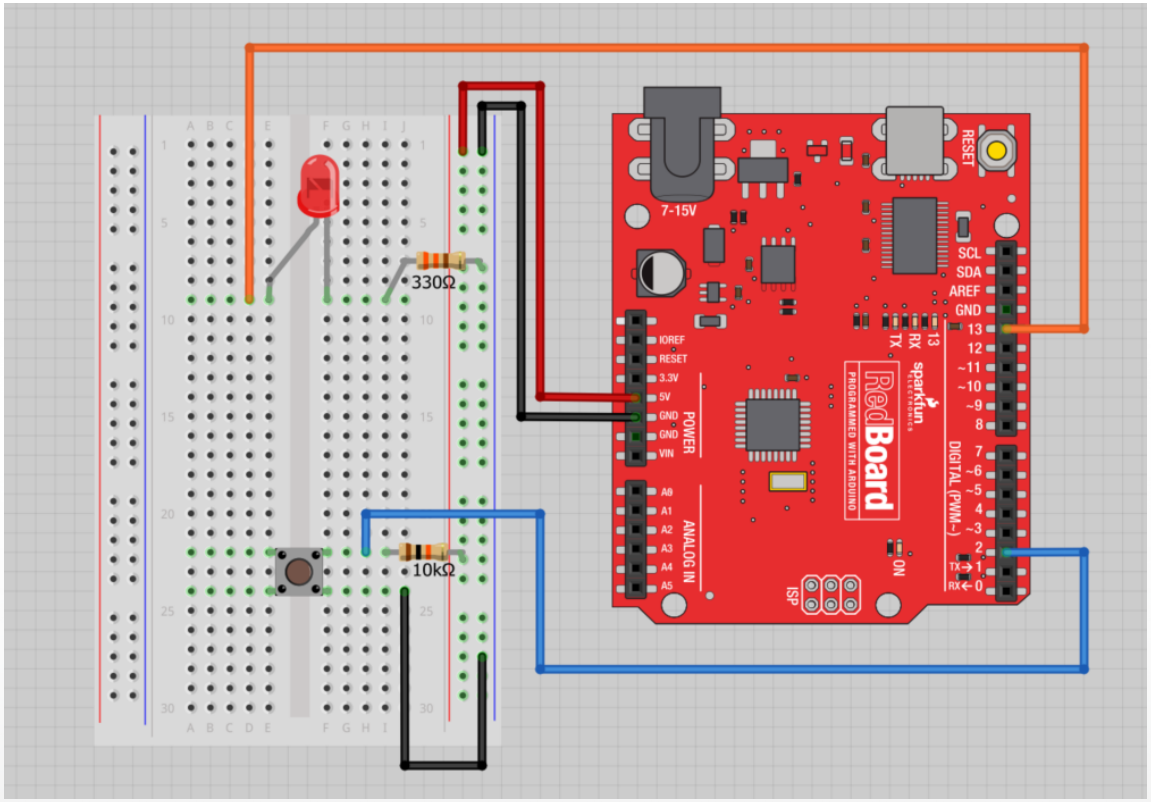




Digital Sensors (a.k.a. Switches)
Add an indicator LED to Pin 13

This is just like our 1st circuit!





Digital Input

- Connect digital input to your Arduino using Pins # 0 – 13 (Altho ugh pins # 0 & 1 are also used for programming)
- Digital Input needs a `pinMode` command:
- ```
  pinMode (pinNumber, INPUT);
  ```
- *Make sure to use ALL CAPS for **INPUT***
- To get a digital reading:
- ```
  int buttonState = digitalRead (pinNumber);
  ```
- Digital Input values are only **HIGH** (On) or **LOW** (Off)

Digital Sensors

- Digital sensors are more straight forward than Analog
- No matter what the sensor there are only two settings: On an d Off
- Signal is always either HIGH (On) or LOW (Off)
- Voltage signal for HIGH will be a little less than 5V on your Un o
- Voltage signal for LOW will be 0V on most systems

We set it equal to the function digitalRead(pushButton)

The function digitalRead() will return the value 1 or 0, depending on whether the button is being pressed or not being pressed.

We declare a variable as an integer.

```
int buttonState = digitalRead(pushButton);
```

We name it buttonState

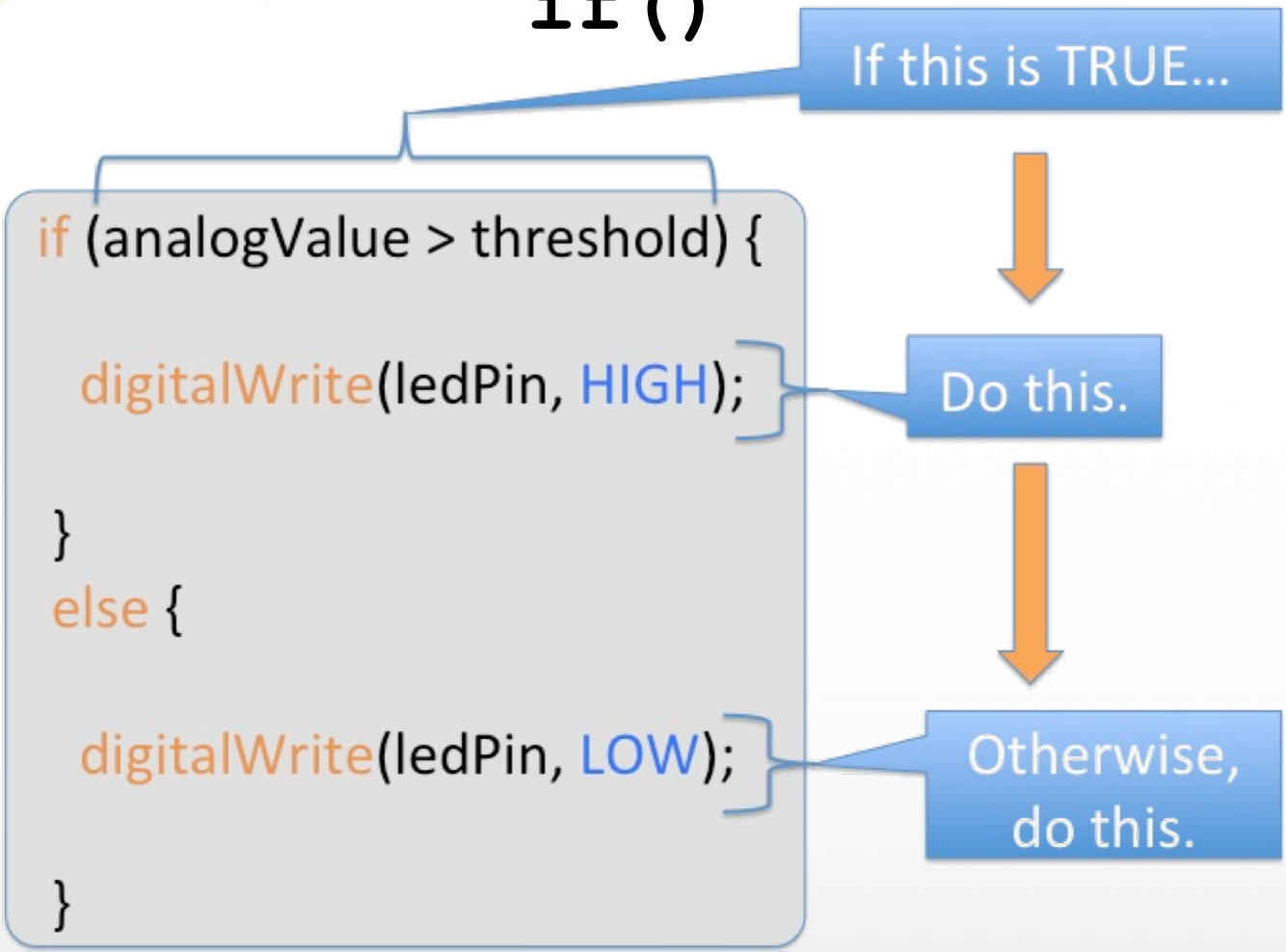
Recall that the pushButton variable stores the number 2

The value 1 or 0 will be saved in the variable buttonState.

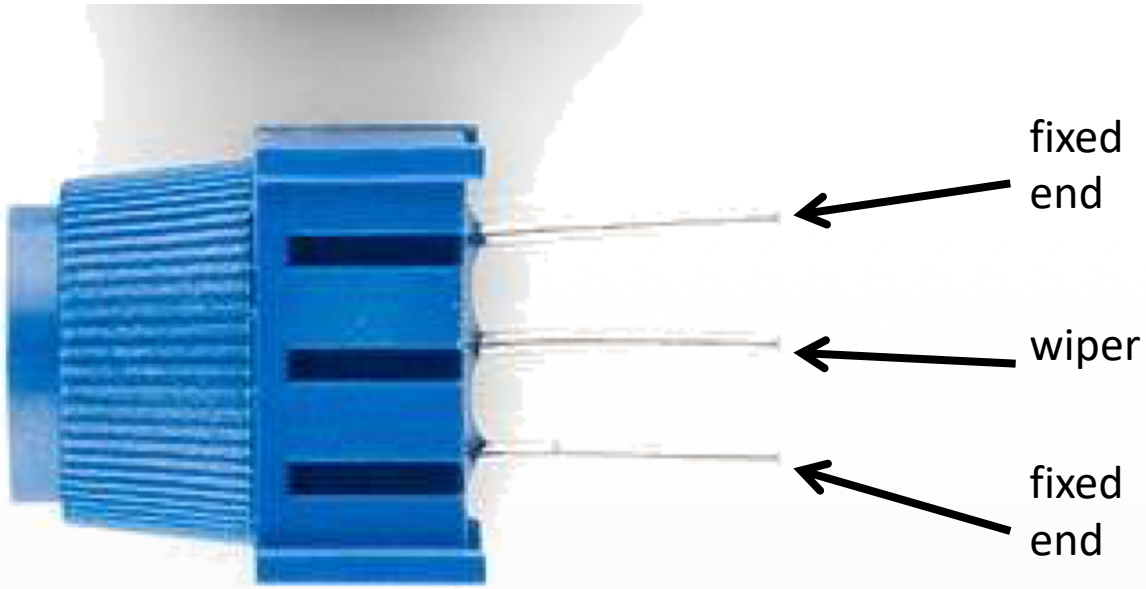
http://opensourcehardwarejunkies.com/tutorial-03-digitalread-and-serial-port-communication/

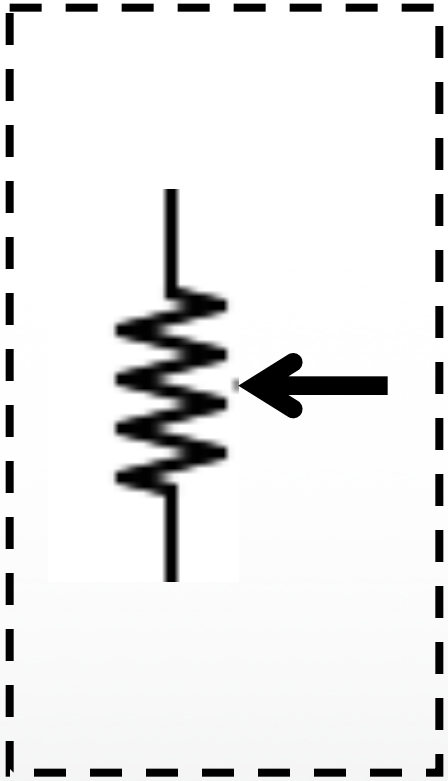
Programming: Conditional Statements

if()



Trimpot (Potentiometer) Variable Resistor

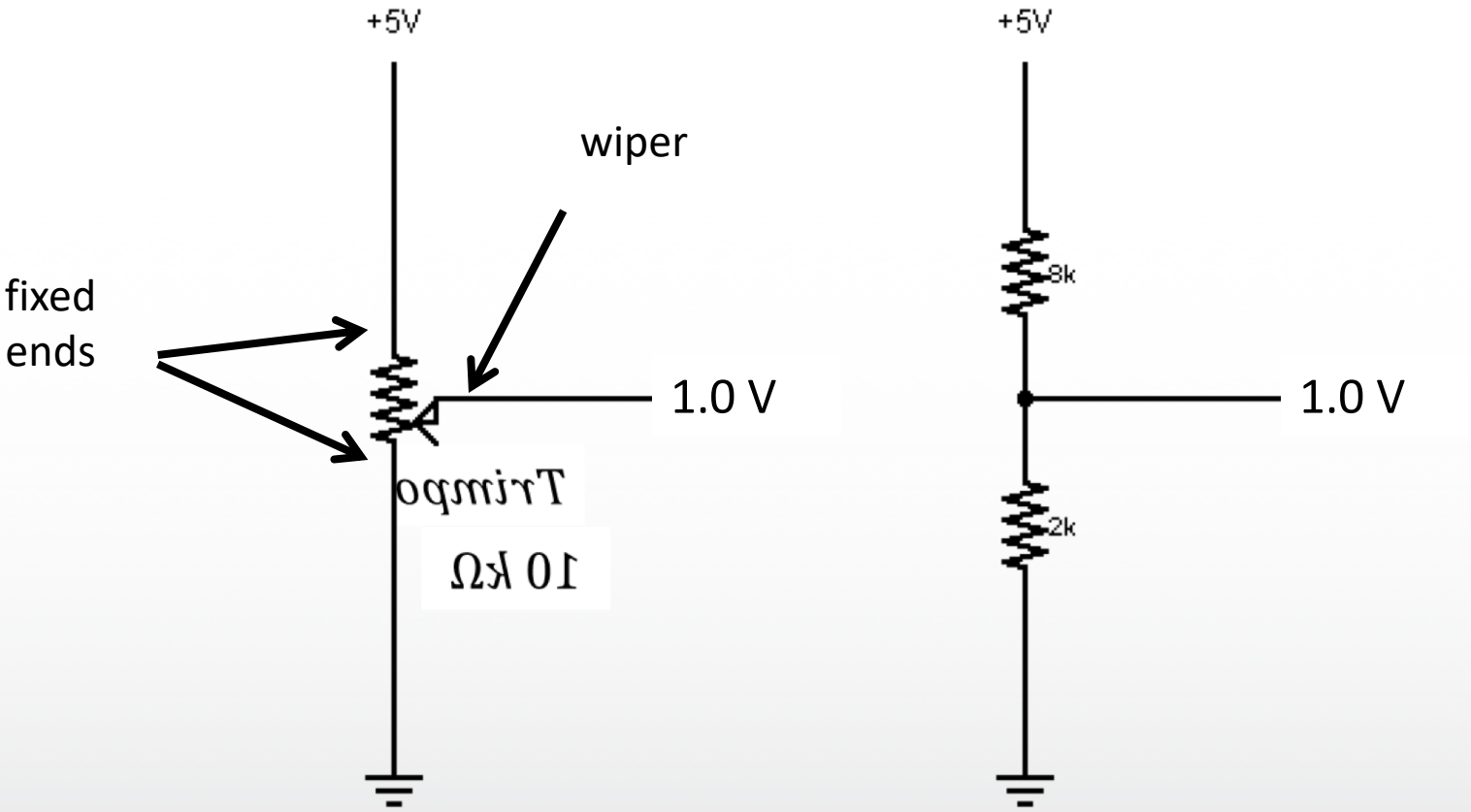




Analog Sensors

3 Pin Potentiometer = var. resistor (circuit)

a.k.a. Voltage Divider Circuit



Ohms Law… (just the basics)
Actually, this is the “voltage divider”

$$V_{R1} = V_{CC} \cdot \left(\frac{R_1}{\mathrm{R}_{Total}} \right)$$

$$V_{R2} = V_{CC} \cdot \left(\frac{R_2}{\mathrm{R}_{Total}} \right)$$

$$R_{Total} = R_1 + R_2$$

analogRead()

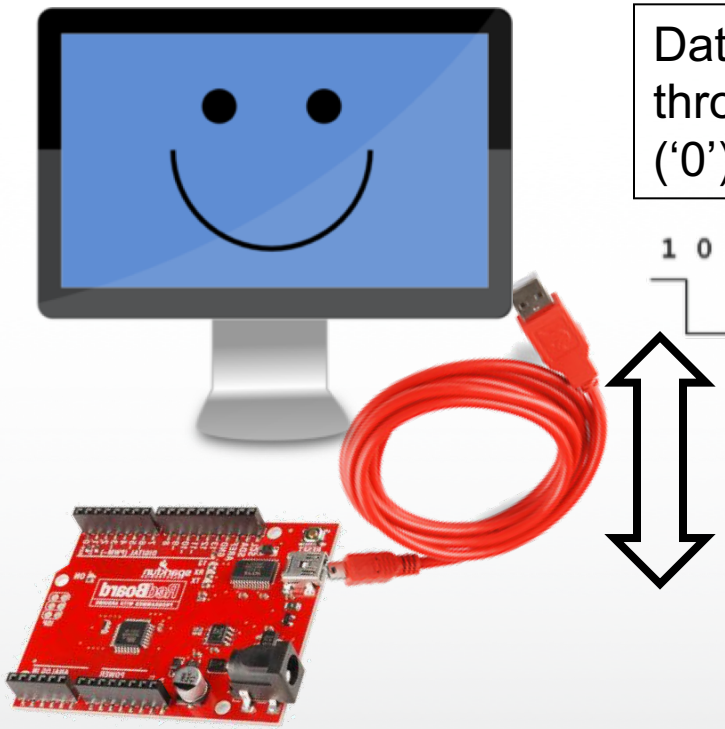
- Arduino uses a 10-bit A/D Converter:
- this means that you get input values from 0 t o 1023
  - 0 V → 0
  - 5 V → 1023

•Ex:

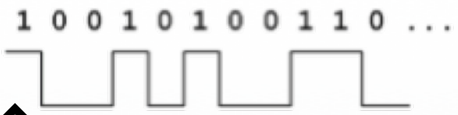
```
int sensorValue = analogRead(A0);
```

Using Serial Communication

Method used to transfer data between two devices.



Data passes between the computer and Arduino through the USB cable. Data is transmitted as zeros (‘0’) and ones (‘1’) sequentially.



Arduino dedicates Digital I/O pin # 0 to receiving and Digital I/O pin #1 to transmit.

Serial Monitor & analogRead()

Initializes the Serial Communication

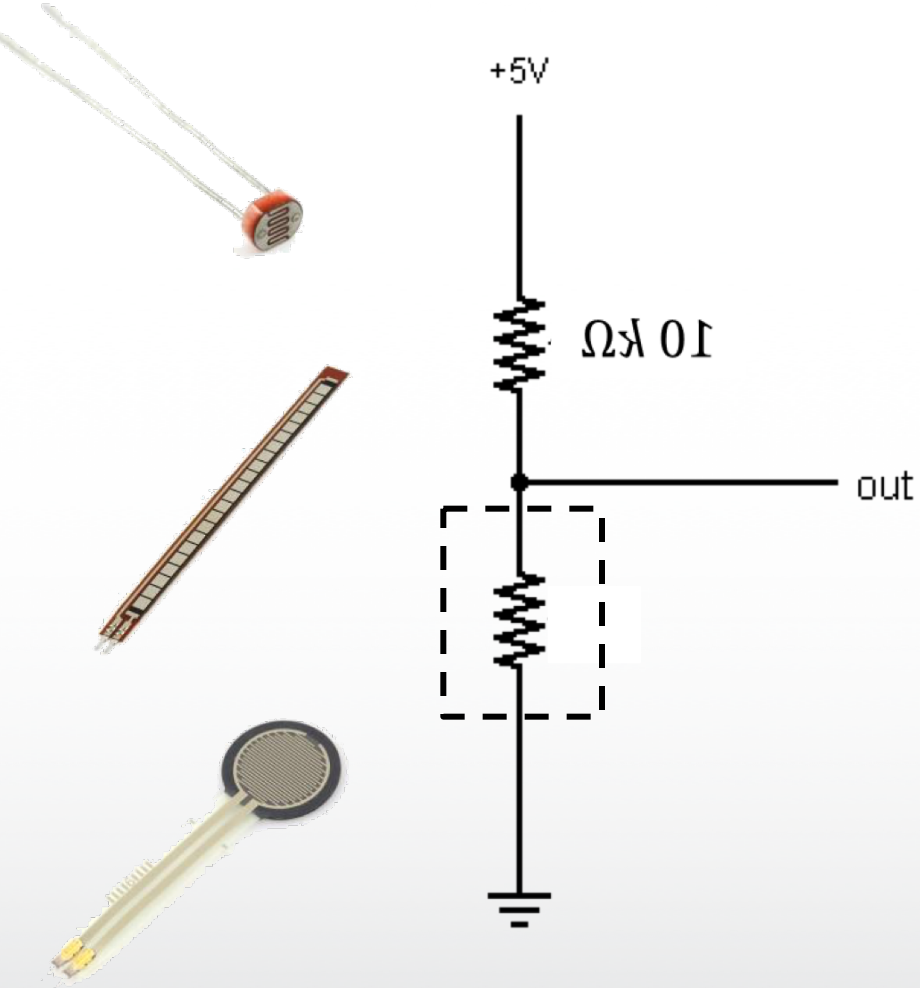
9600 baud data rate

prints data to serial bus

Serial Monitor & analogRead()

Opens up a Serial Terminal Window

Analog Sensors
2 Pin Analog Sensors = var. resistor



- Take two sensors -- Use the Serial Monitor and find the range of input values you get for each sensor.

- MaxAnalogRead = _____

- MinAnalogRead = _____

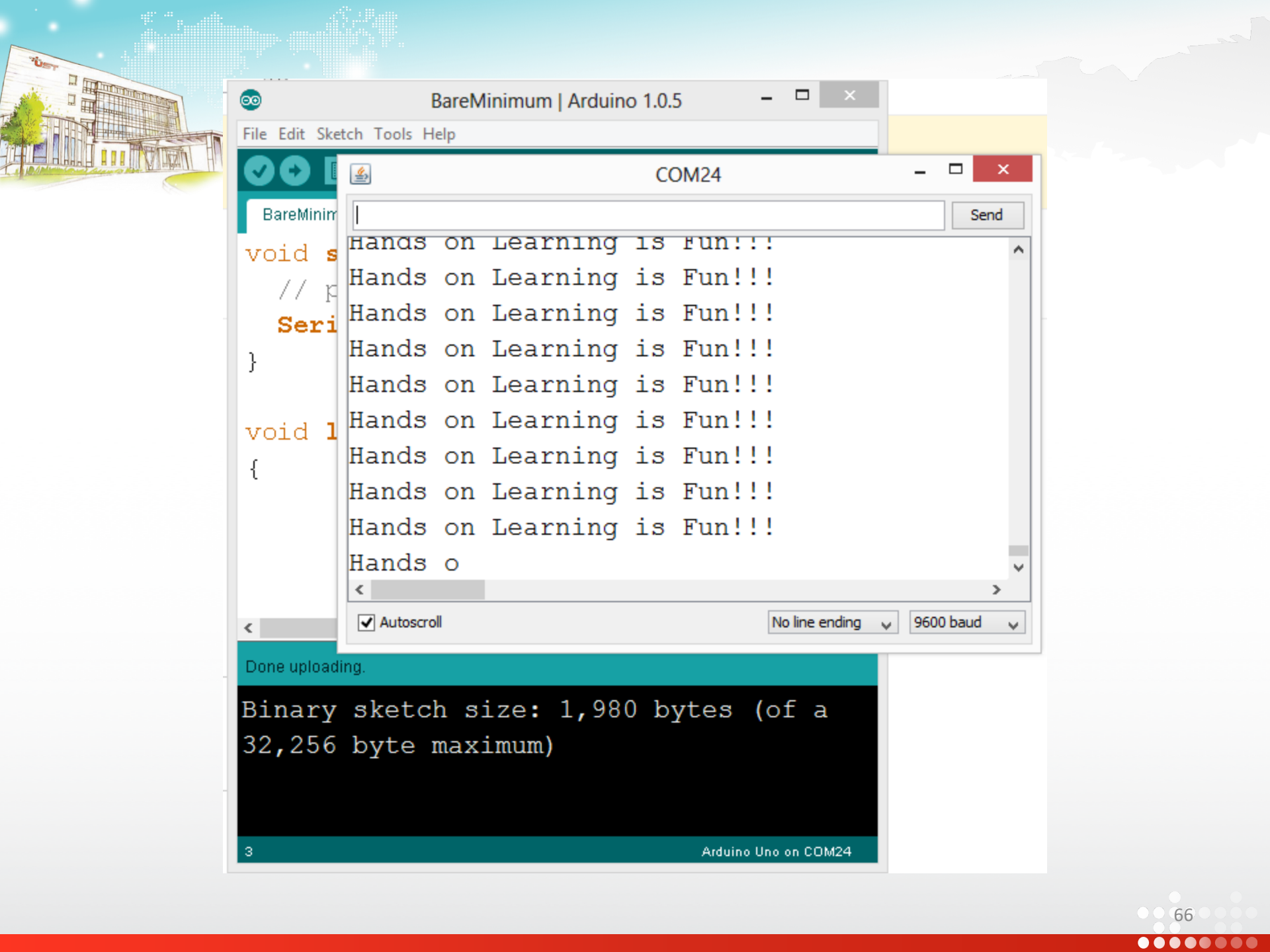
Analog Sensors

Examples:

Sensors	Variables
Mic	soundVolume
Photoresistor	lightLevel
Potentiometer	dialPosition
Temp Sensor	temperature
Flex Sensor	bend
Accelerometer	tilt/acceleration

Additional Serial Communication Sending a Message

```
void loop ( )
{
  Serial.print("Hands on ") ;
  Serial.print("Learning ") ;
•    Serial.println("is Fun!!!") ;

}
```


BareMinimum | Arduino 1.0.5
File Edit Sketch Tools Help
BareMinim
void s
// p
Seri
}
void l
{
COM24
Send
Hands on Learning is Fun!!!
Hands on Learning is Fun!!!
Hands on Learning is Fun!!!
Hands on Learning is Fun!!!
Hands on Learning is Fun!!!
Hands on Learning is Fun!!!
Hands on Learning is Fun!!!
Hands on Learning is Fun!!!
Hands o
Autoscroll
No line ending
9600 baud
Done uploading.
Binary sketch size: 1,980 bytes (of a 32,256 byte maximum)
3
Arduino Uno on COM24