# Basics of Electronics

- Digital Output (eg. LED)
- Digital Input (eg. Buttons)
- Analog Output (PWM)
- Transistors (...to switch power on/off)
- Analog Input (Potentiometer)

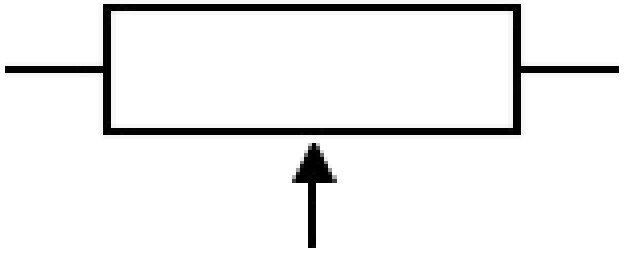
Pretty much everything else is a variation of the above.



**Slides available at: http://a9i.sg/vjc**

# Physical Dimmer Switch

- Today we will be using a Potentiometer as a variable resistor, or Rheostat, to recreate the effect with a physical switch...





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# Resistors & Variable Resistors

- What is electrical resistance?

a measure of the difficulty to pass an electric current through a circuit element



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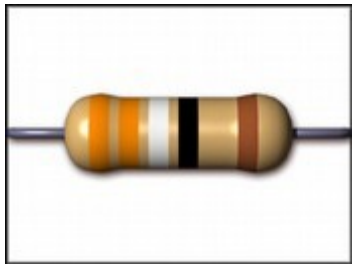
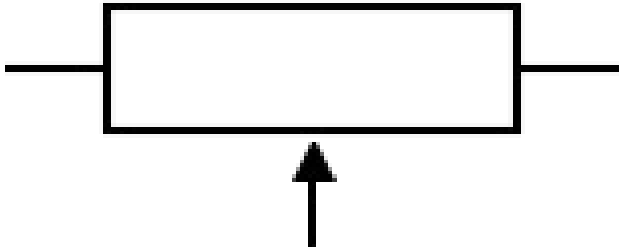
# Resistors & Variable Resistors

- Fixed Resistors have fixed resistance



- Variable Resistors have variable resistance





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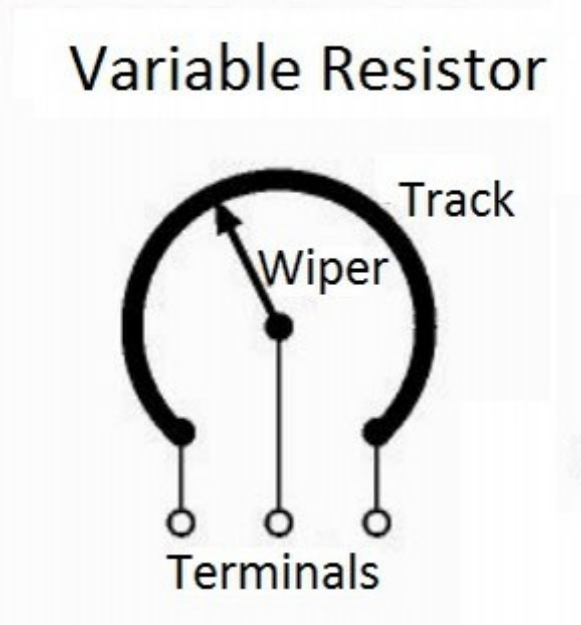
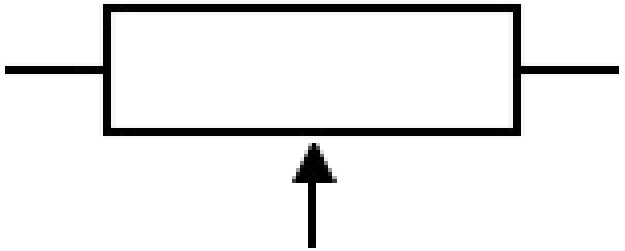
# Variable Resistors

- Inside there's a fixed resistor and a wiper that points between the minimum and maximum terminals of the resistor



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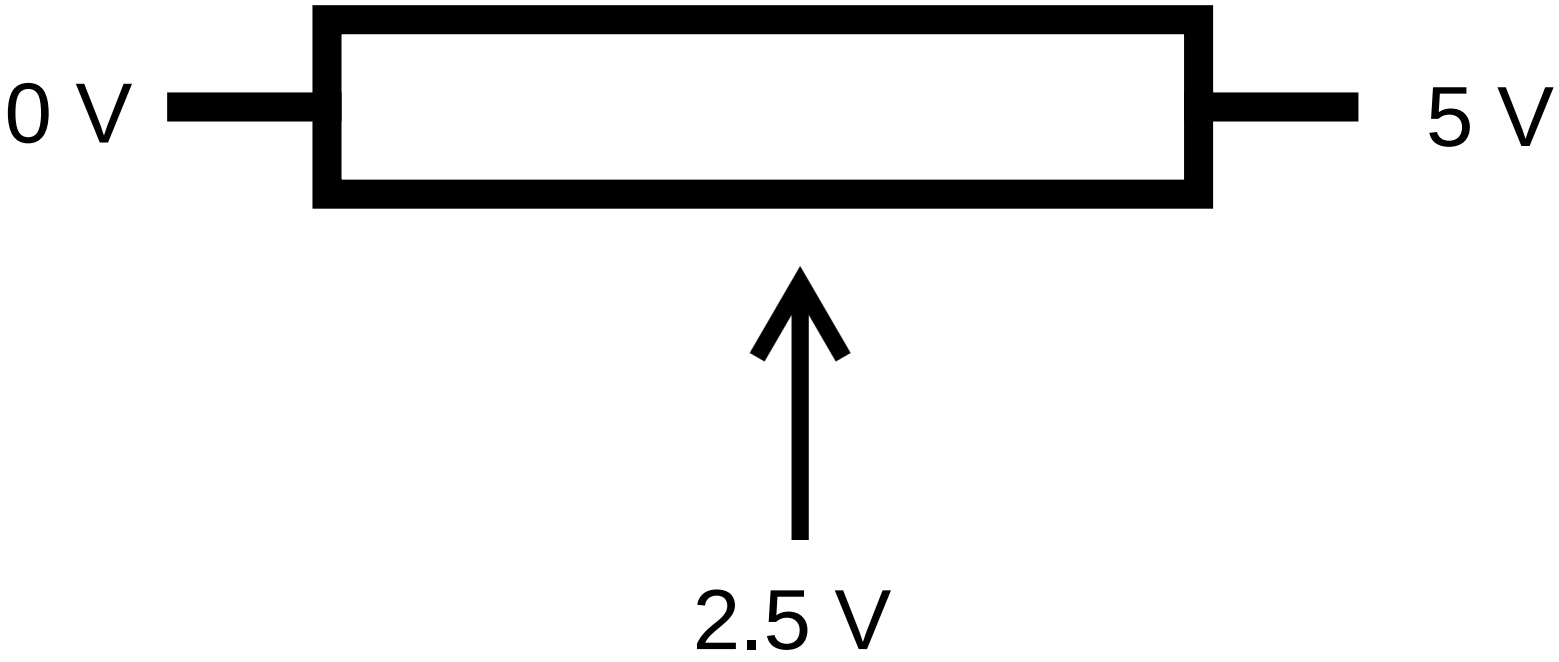
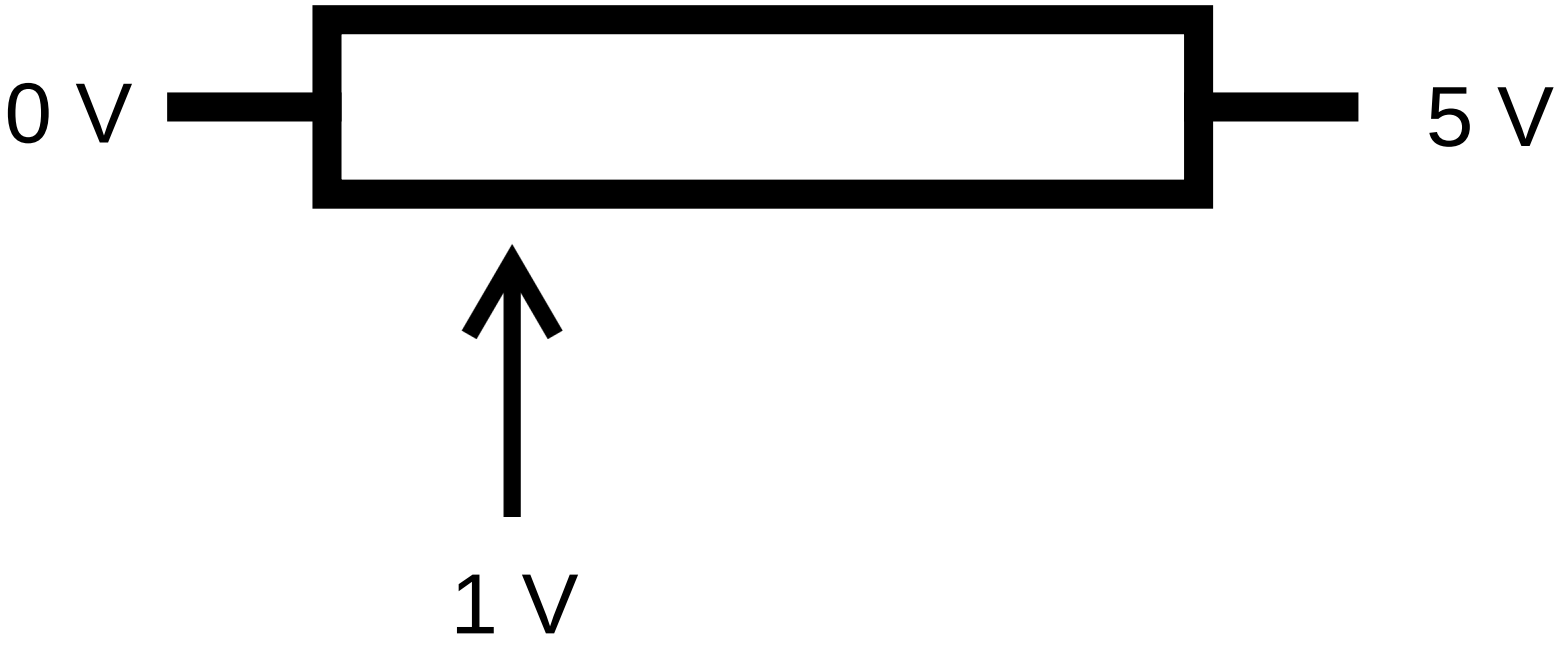


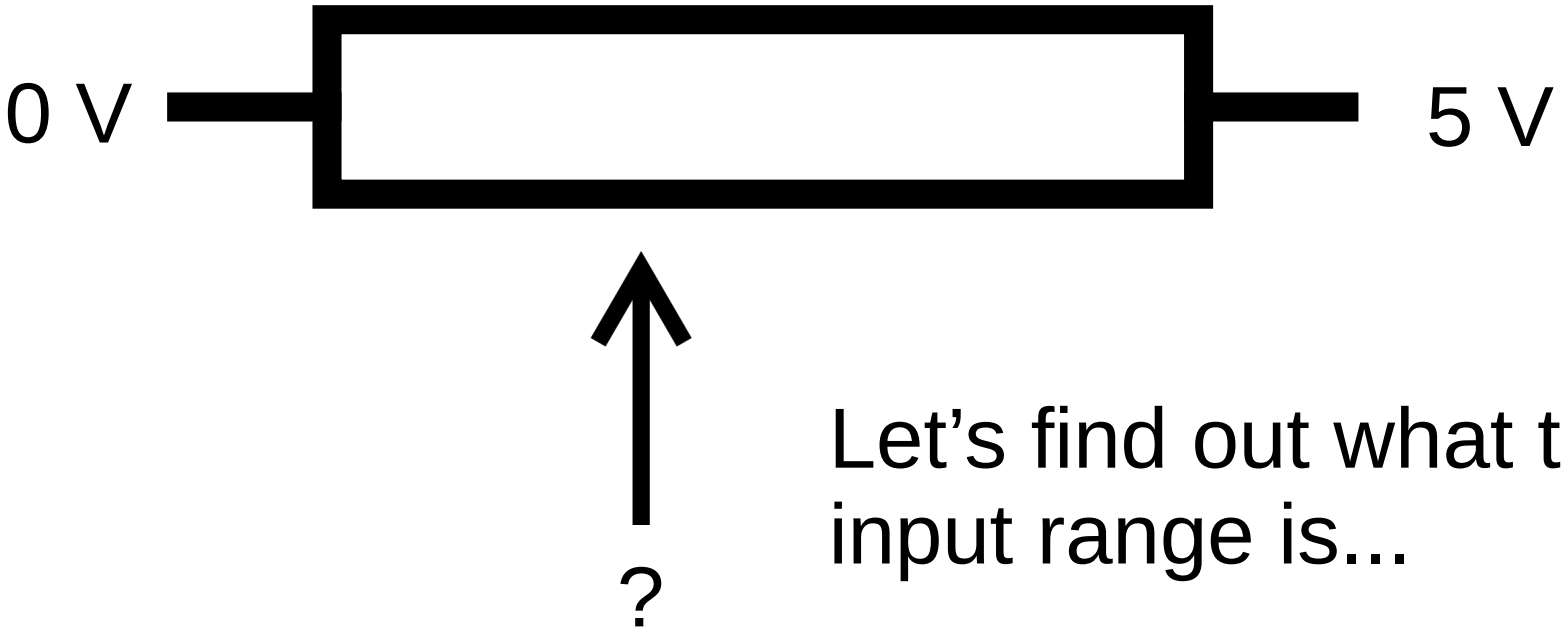
# Variable Resistors

- Resistance causes voltage to drop, so the potentiometer also behaves as a Voltage Divider

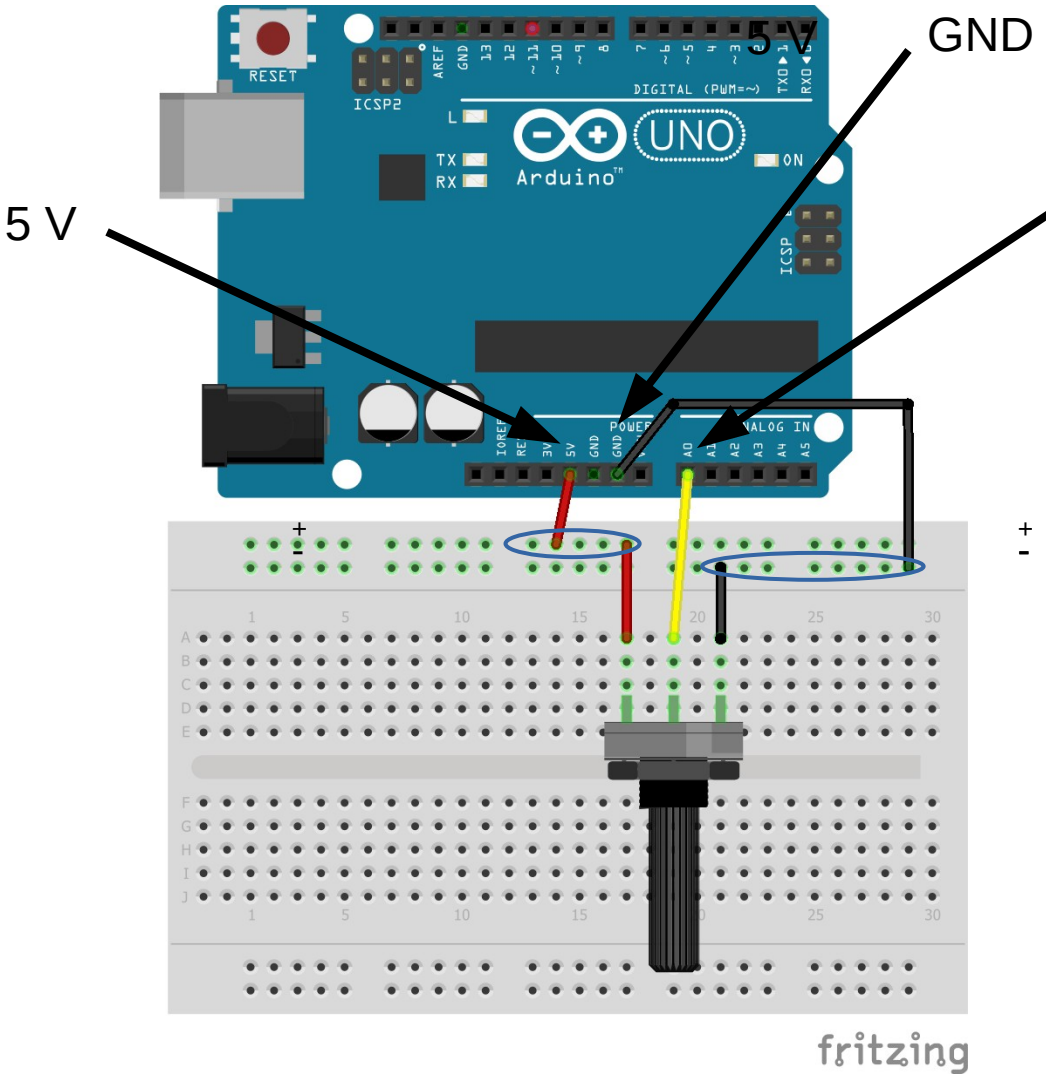


# Analog vs. Digital Input

- Unlike the digital pins which read either 0 or 1, analog inputs can read a range of values.



# Potentiometer Circuit




A0 port will read the Potentiometer wiper.

GND & 5v connected through long strips.

Leave room for the LED circuit!



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# Data Communication

- Arduino may need to communicate with other devices to send and receive data
- Examples:
  - Computer
  - Sensors
  - Actuators (eg. servo motors)

# Data Communication

- Analog data (ie. voltage level) is used by some devices, but is...
  - Slow to read / write
  - Loss of accuracy
  - Requires a lot of wires (...one per data channel)

- Digital data is generally better!

# BIG Three

| | |
|---|---|
| Serial (aka UART) | • Common for: Computers, Bluetooth, GPS<br>• Full duplex (send and receive simultaneously)<br>• Two wires (excluding ground)<br>• One-to-One |
| I2C (Inter-Integrated Circuit) | • Common for: Sensors (eg. gyro)<br>• Half duplex (send or receive, not simultaneously)<br>• Two wires (excluding ground)<br>• One-to-Many |
| SPI (Serial Peripheral Interface) | • Common for: Sensors (eg. rfid reader)<br>• Full duplex (send and receive simultaneously)<br>• Three wires (excluding ground)<br>• One-to-Many (...but require one extra wire per device) |

# Data Communication

- Special use
  - Hobby servo (aka RC servo)
  - Ultrasonic (HC-SR04)
  - One wire (temperature sensor)
  - Non-standard (eg. HD44780 LCD)

# Serial

- Initialize serial port...

```
Serial.begin(9600);
```

- 9600 is the baud rate (speed); both communicating devices must use the same setting

```
Serial.print(“hello”);
Serial.println(“world”);
```

- Send the string to the other device.
- “println” will add a newline to the end

# Serial

- Read from serial port...

```
if (Serial.available()) {
    aByte = Serial.read();
    aString = Serial.readString();
    anInt = Serial.parseInt();
    aFloat = Serial.parseFloat();
```

- “Serial.available()” check if there are data to read.
- “Serial.read()” reads a single byte, the rest reads multiple bytes and converts them into the requested type.

# Coding challenge

- Read from your potentiometer and output to the serial port

- Read from your potentiometer and use the value to control the motor speed
  **(Be sure to scale the value appropriately!)**

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