Intro to Arduino

Bailey Steinfadt

Prairie.Code() 2019

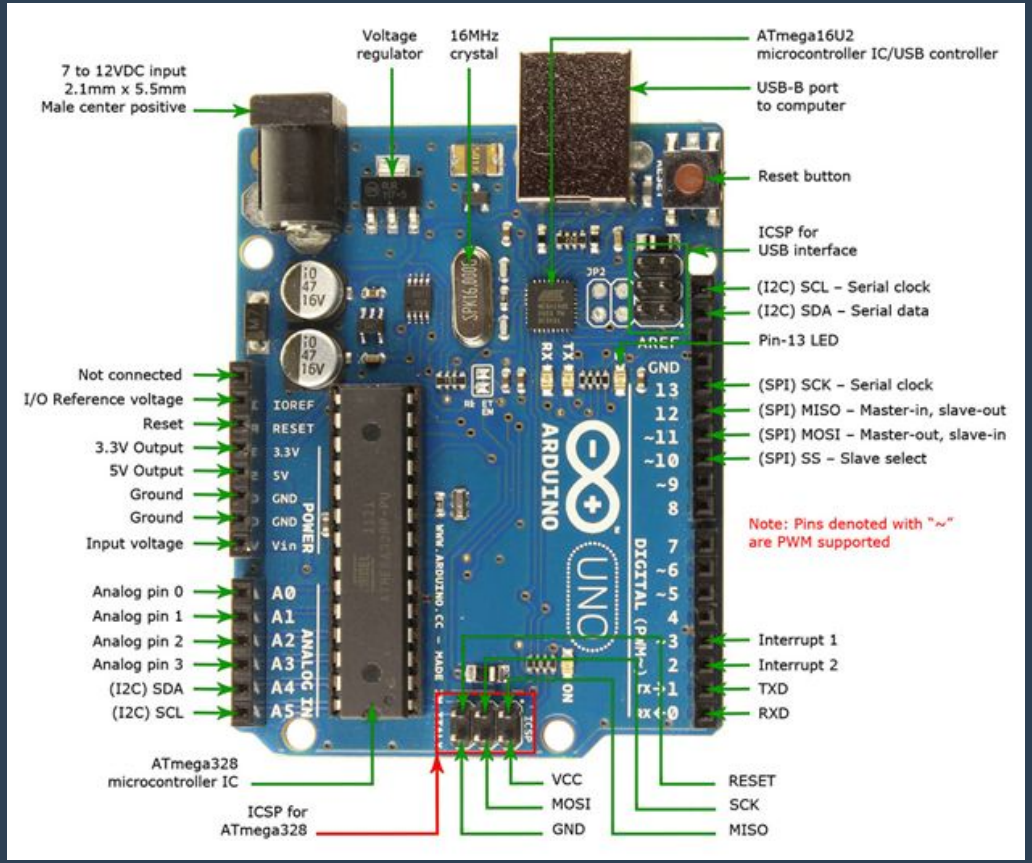
Thank You to our Sponsor!

- Kits for today's workshop were generously supplied by Embedded Artistry
- https://embeddedartistry.com/

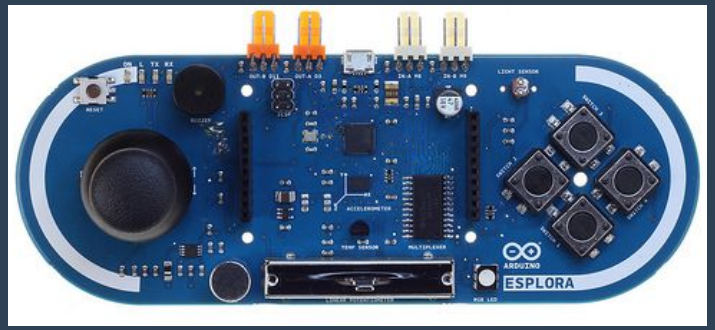
EMBEDDED ARTISTRY

Let’s get set up

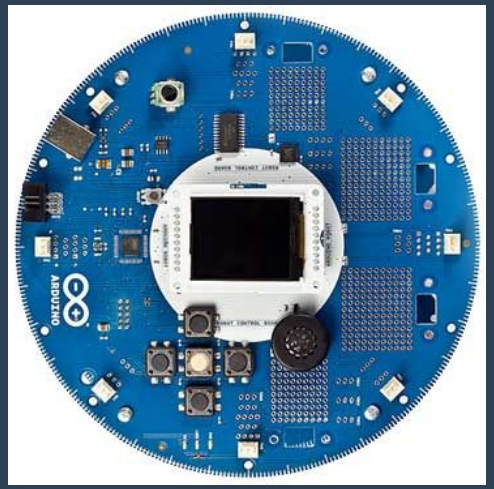
Each board will have the same basic set of components, though they may be arranged differently.

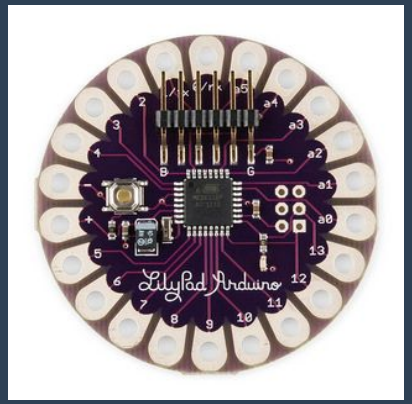


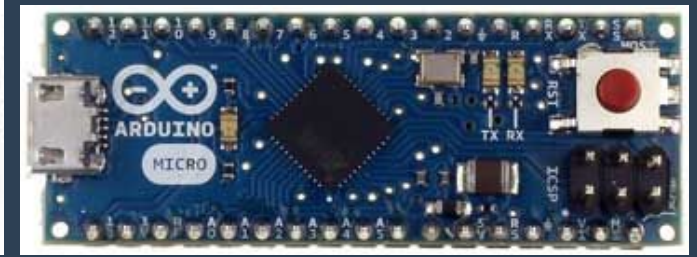
Examples of types of boards



Pictures from arduino.cc

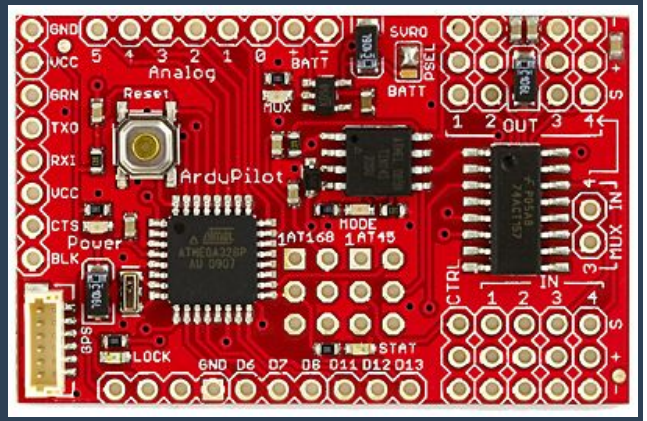


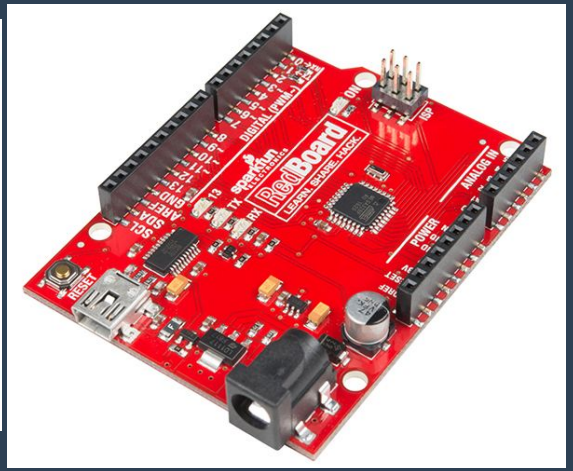


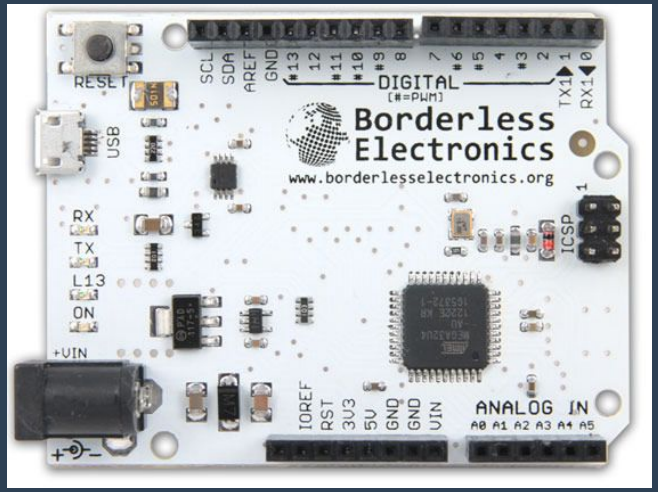


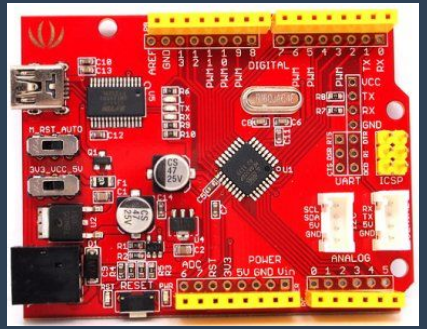
Attack of the Clones

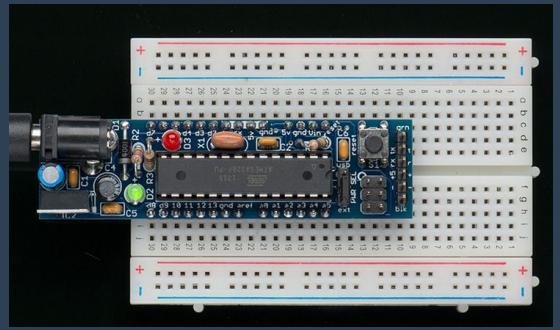
Pictures from vendors' websites

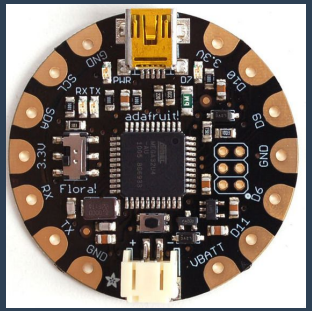




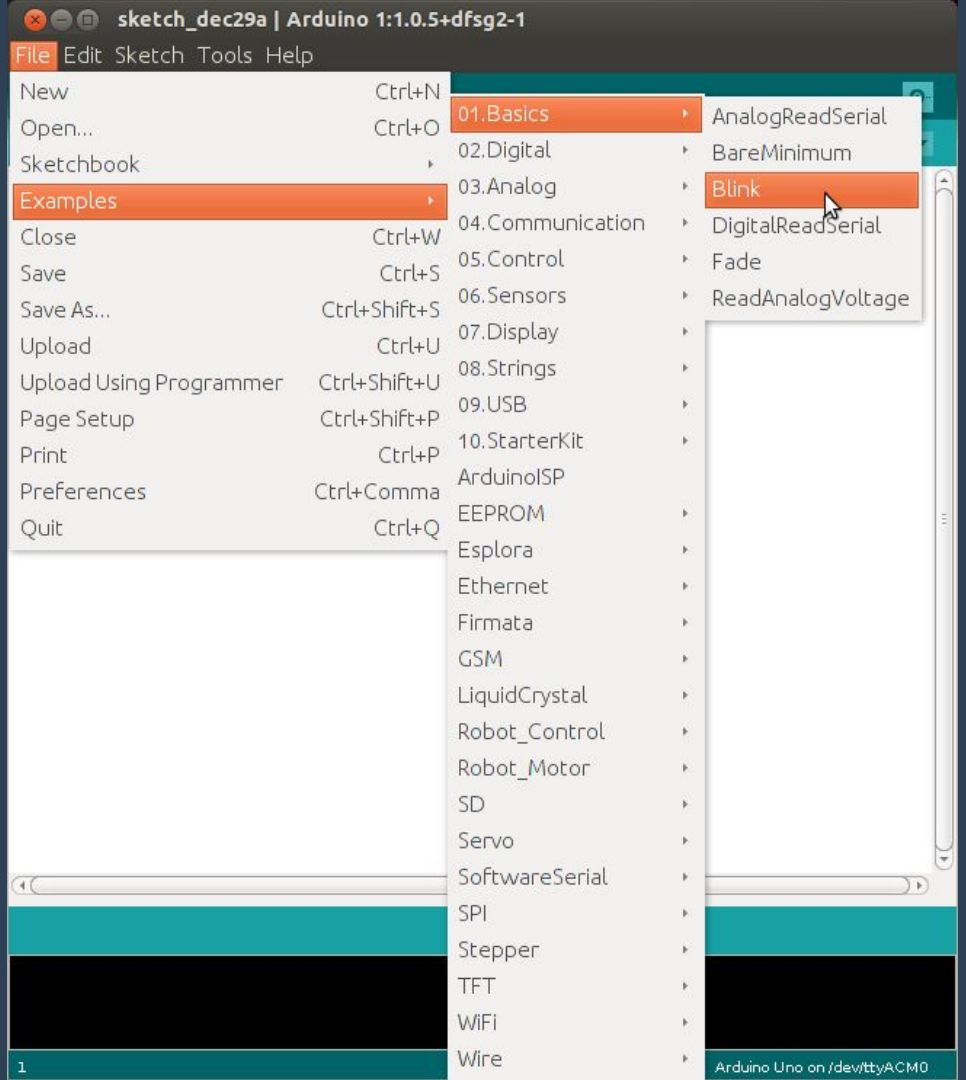








Let’s Blink!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Sketchbook
Examples
Close Ctrl+W
Save Ctrl+S
Save As... Ctrl+Shift+S
Upload Ctrl+U
Upload Using Programmer Ctrl+Shift+U
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Print Ctrl+P
Preferences Ctrl+Comma
Quit Ctrl+Q
01.Basics
02.Digital
03.Analog
04.Communication
05.Control
06.Sensors
07.Display
08.Strings
09.USB
10.StarterKit
ArduinoISP
EEPROM
Esplora
Ethernet
Firmata
GSM
LiquidCrystal
Robot_Control
Robot_Motor
SD
Servo
SoftwareSerial
SPI
Stepper
TFT
WiFi
Wire
AnalogReadSerial
BareMinimum
Blink
DigitalReadSerial
Fade
ReadAnalogVoltage
1
Arduino Uno on /dev/ttyACM0

Some notes about Arduino coding...

Functions in EVERY Arduino sketch:

```
void setup( ){
    //code goes here
}
void loop( ) {
    //code goes here
}
```

Some notes about Arduino coding...

Setting pin mode:

- input: A pin mode that intakes information.
- output: A pin mode that sends information.

Setting pin state:

- HIGH: Electrical signal present
  - 5V or 3.3V for Uno
  - Also ON or TRUE in boolean logic.
- LOW: No electrical signal present
  - 0V
  - Also OFF or FALSE in boolean logic.

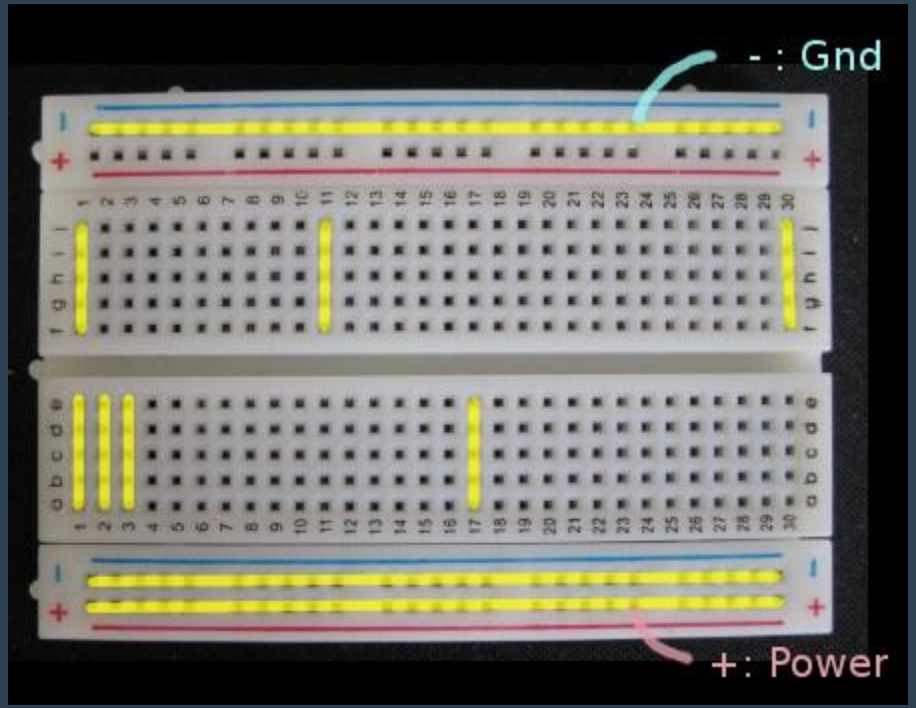
Some notes about Arduino coding...

The main four I/O functions:

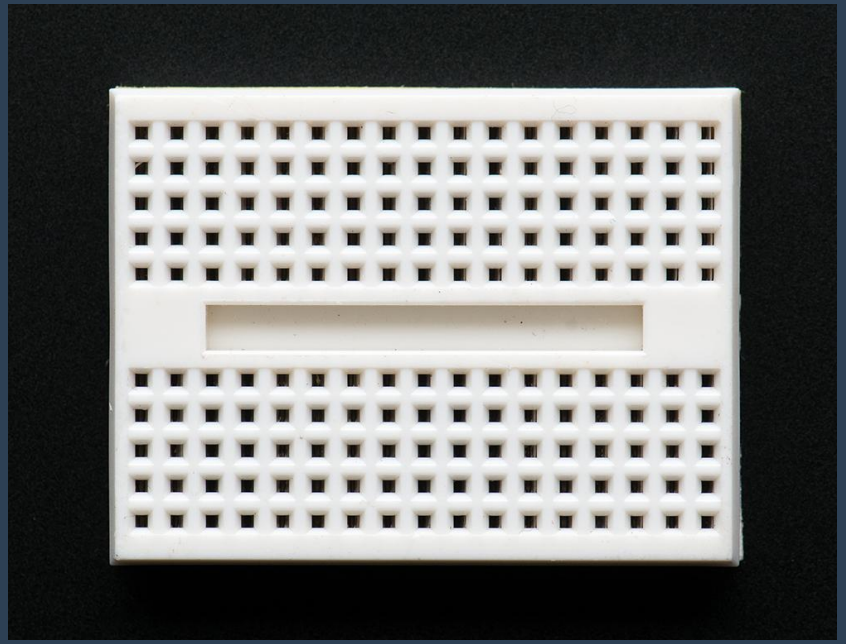
- digitalRead: Get a HIGH or LOW reading from a pin already declared as an input.
- digitalWrite: Assign a HIGH or LOW value to a pin already declared as an output.
- analogRead: Get a value between or including 0 (LOW) and 1023 (HIGH). This allows you to get readings from analog sensors or interfaces that have more than two states.
- analogWrite: Assign a value between or including 0 (LOW) and 255 (HIGH). This allows you to set output to a PWM value instead of just HIGH or LOW.

Breadboards

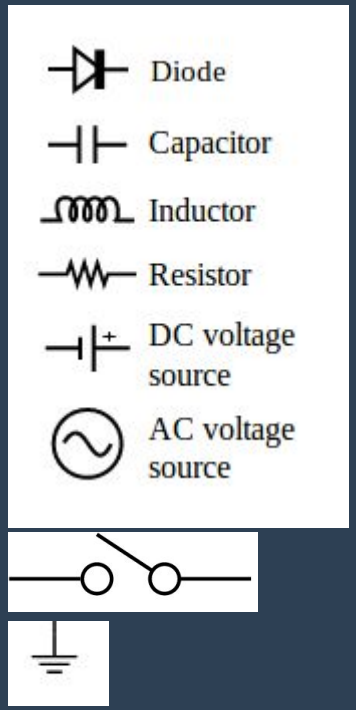
- Picture from shallowsky.com



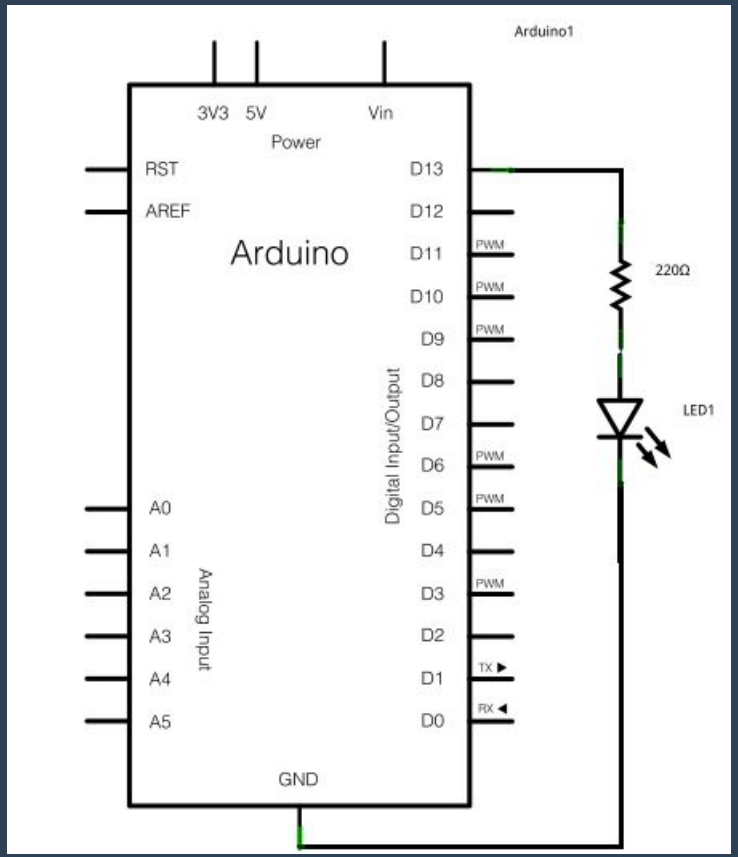
Picture from Adafruit.com



Let’s review a bit about electricity!



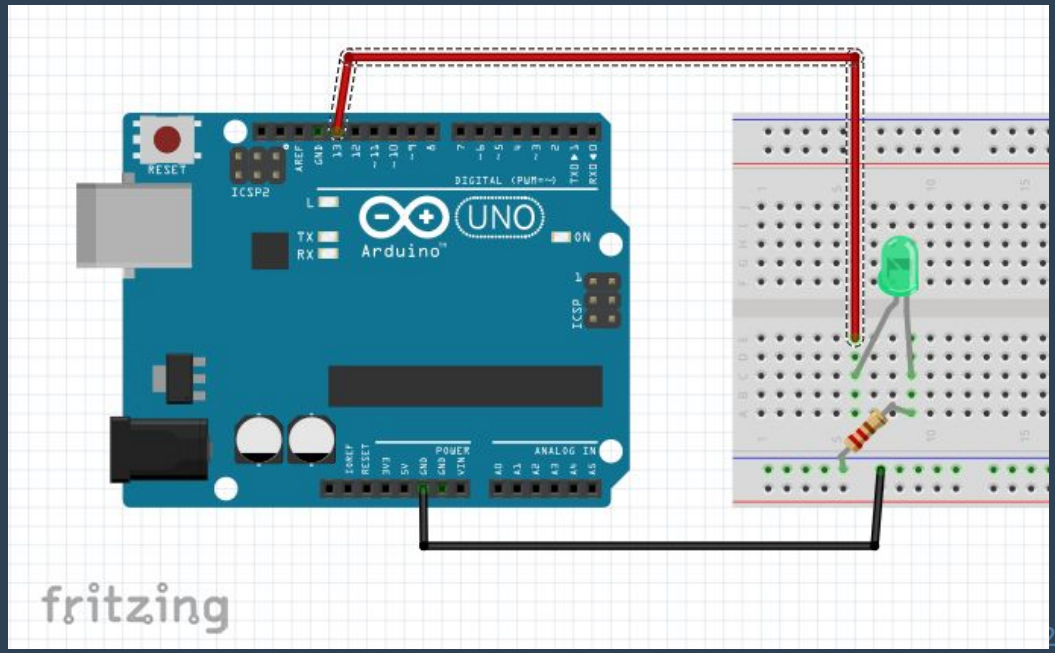
$$V = IR$$



Pictures from
http://en.wikipedia.org/wiki/Electronic_symbol and arduino.cc

LEDs and Resistors

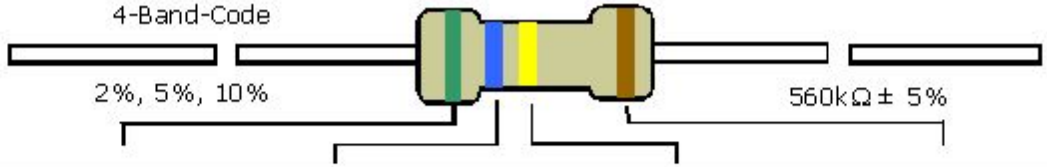
- LED = light emitting diode
- LEDs are directional, resistors are not.



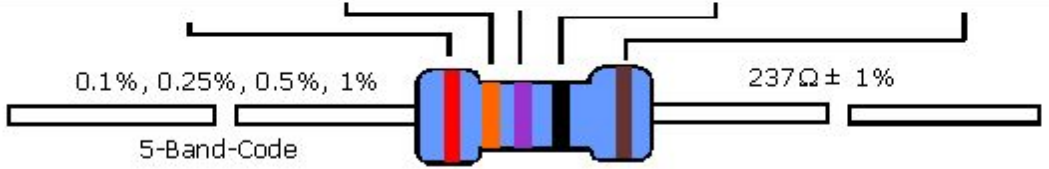
Resistor Codes

Picture from elexp.com

Want a fun way to memorize these?
Go here for games:
https://www.adafruit.com/mhosresistance/



COLOR	1st BAND	2nd BAND	3rd BAND	MULTIPLIER	TOLERANCE
Black	0	0	0	1Ω	
Brown	1	1	1	10Ω	± 1% (F)
Red	2	2	2	100Ω	± 2% (G)
Orange	3	3	3	1KΩ	
Yellow	4	4	4	10KΩ	
Green	5	5	5	100KΩ	±0.5% (D)
Blue	6	6	6	1MΩ	±0.25% (C)
Violet	7	7	7	10MΩ	±0.10% (B)
Grey	8	8	8		±0.05%
White	9	9	9		
Gold				0.1	± 5% (J)
Silver				0.01	± 10% (K)

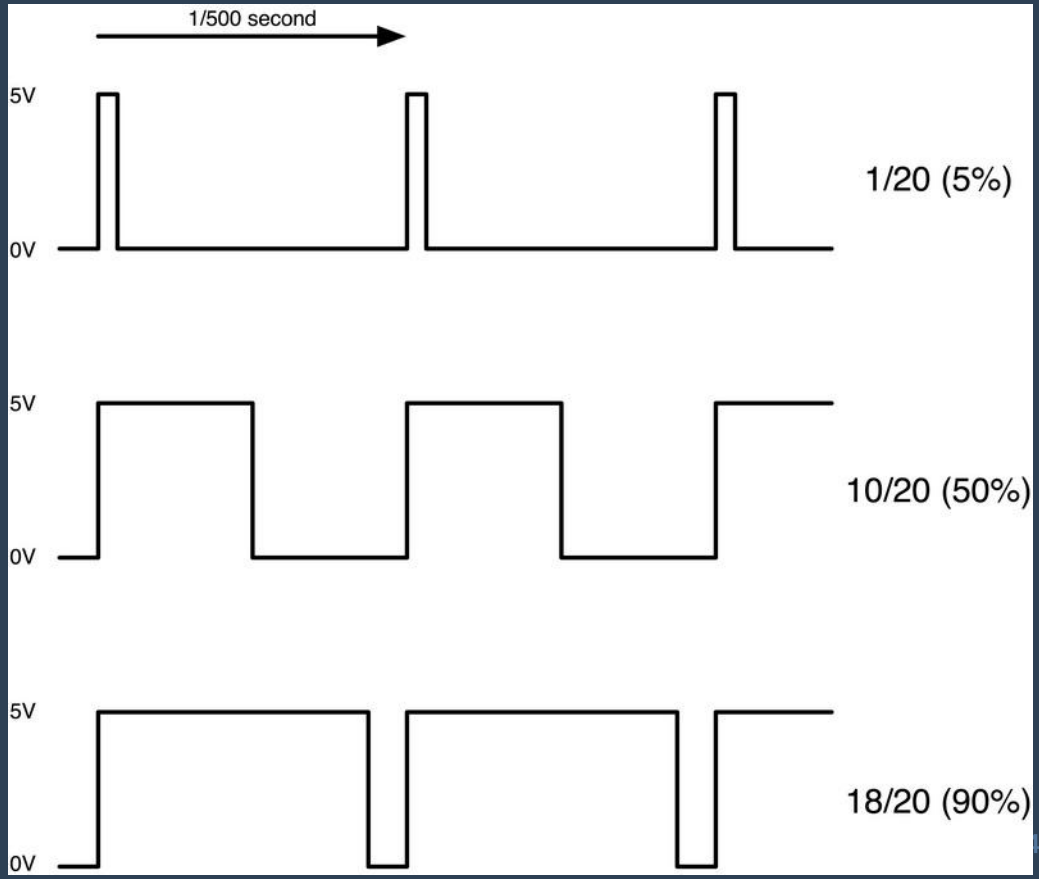


Electronix Express / RSR
http://www.elexp.com

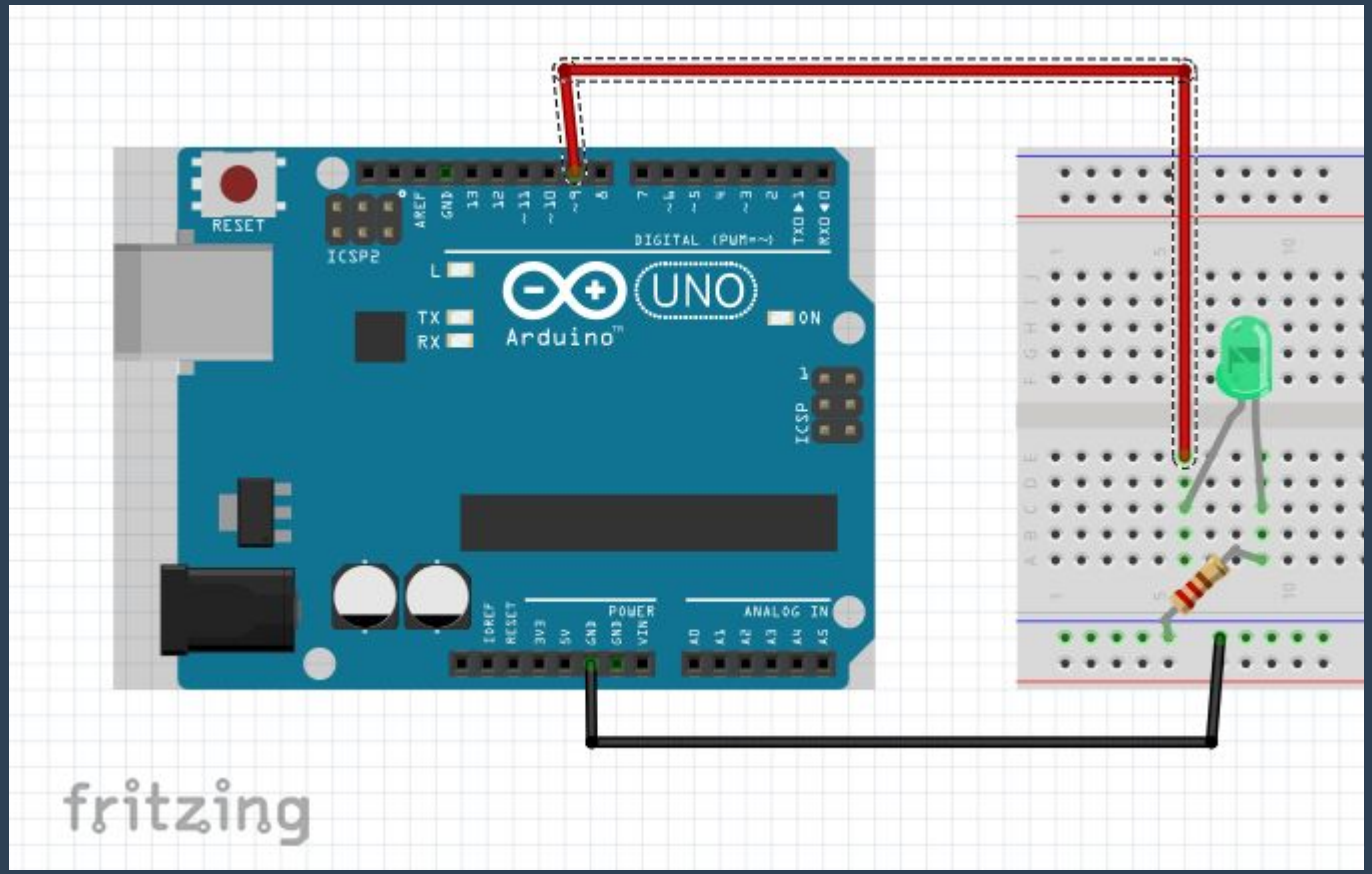
1-800-972-2225
In NJ 732-381-8020

PWM - Pulse Width Modulation

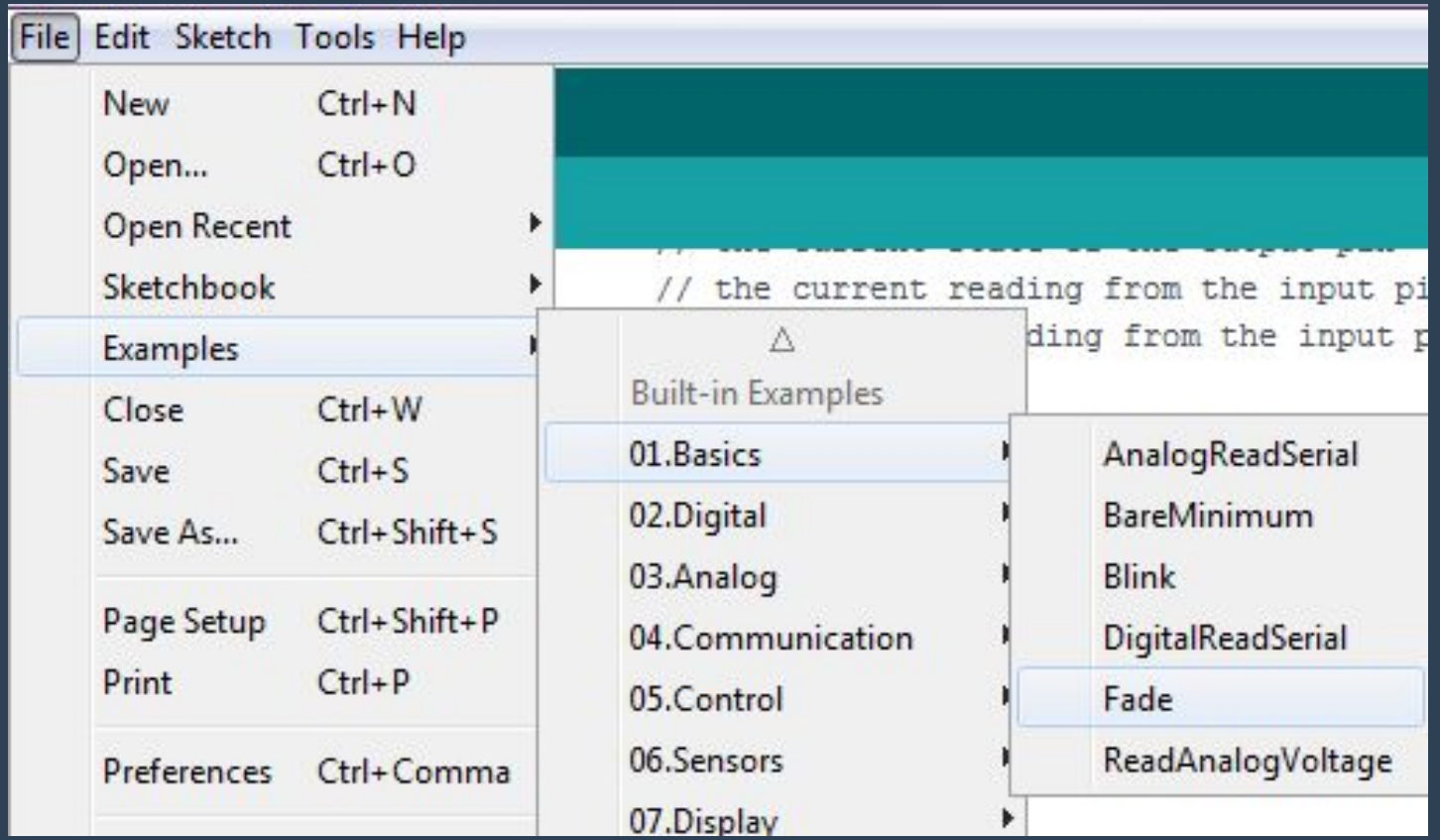
Picture from learn.adafruit.com



Let’s Fade!


RESET
ICSP2
DIGITAL (PWM~)
UNO
Arduino
TX
RX
ON
ICSP
POWER
ANALOG IN
fritzing

Let’s Fade!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// the current reading from the input pi
ding from the input p
Built-in Examples
01.Basics
02.Digital
03.Analog
04.Communication
05.Control
06.Sensors
07.Display
AnalogReadSerial
BareMinimum
Blink
DigitalReadSerial
Fade
ReadAnalogVoltage

Let's Fade!

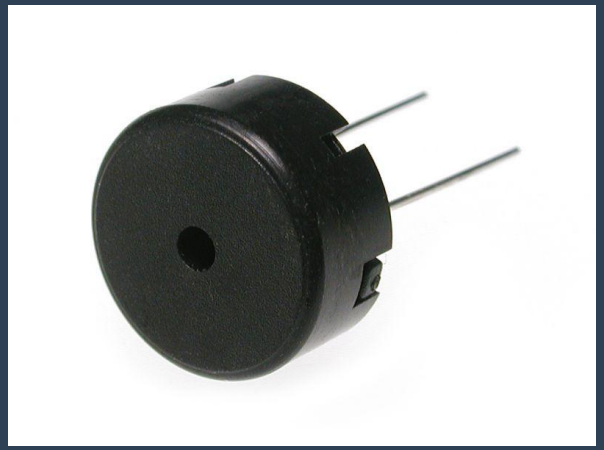
```
int led = 9;           // the pin that the LED is attached to

int brightness = 0;    // how bright the LED is
int fadeAmount = 5;    // how many points to fade the LED by

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

void loop()  {
  // set the brightness of the LED on 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);
}
```

Fade Explanation

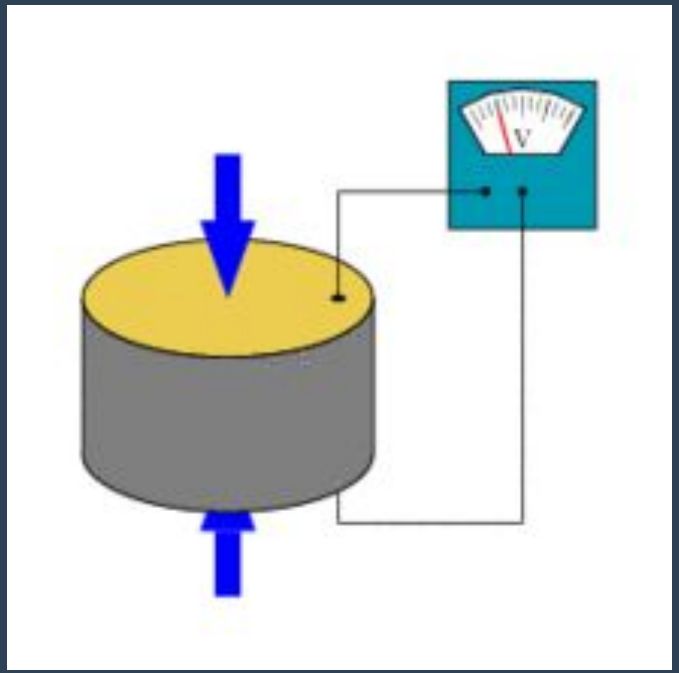
	A	B
1	brightness	fadeAmount
2	0	5
3	5	5
4	10	5
5	15	5
6	20	5
52	...	...
53	250	5
54	255	-5
55	250	-5
56	245	-5
103	...	...
104	10	-5
105	5	-5
106	0	5
107	5	5
108	10	5
109	...	...

Let’s Make Some Noise!

- Piezoelectricity
  - electricity generated from mechanical stress
  - process works both ways!



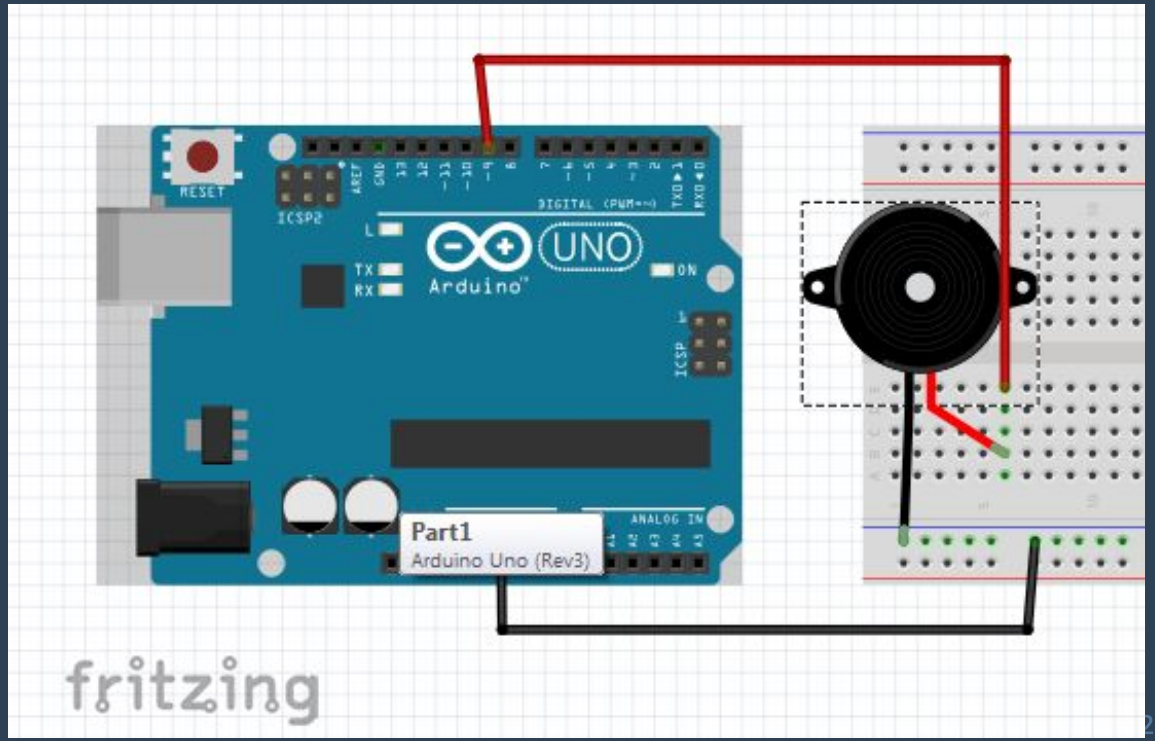
Picture from solarbotics.com



Picture from http://en.wikipedia.org/wiki/Piezoelectricity

Let’s Make Some Noise!

- http://www.arduino.cc/en/Tutorial/PlayMelody



Further Explorations With Outputs

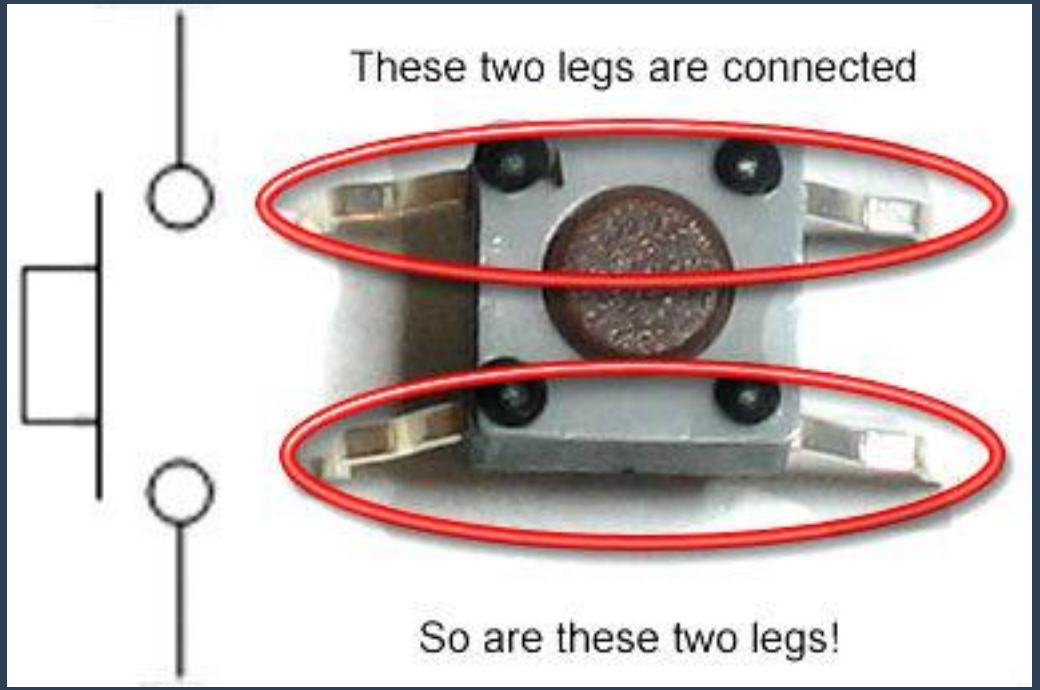
Some Ideas:

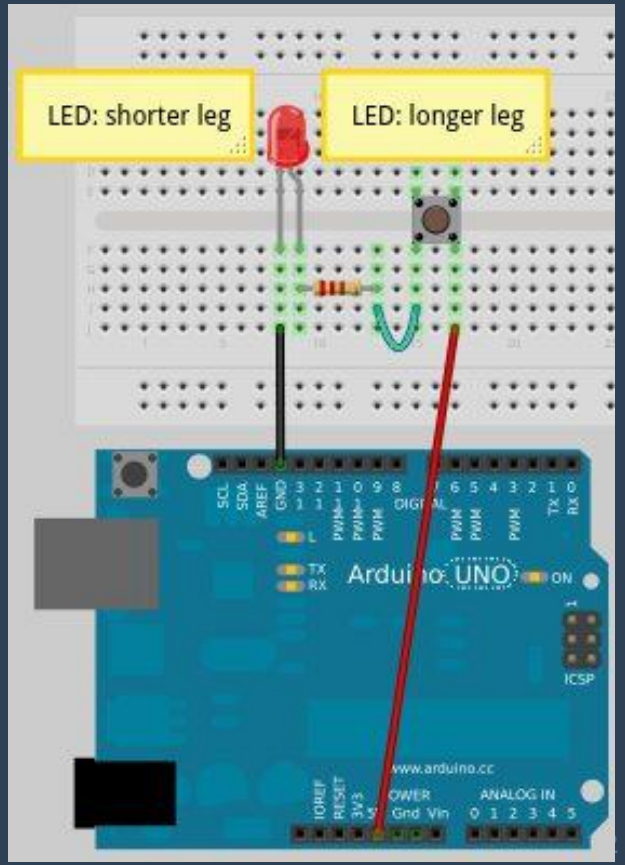
- Find out how to play songs with your piezo speaker
- Change how the LEDs fade
- Have your LEDs flash out messages in morse code or patterns
- Have your program generate a random number in setup().
  - random(10); //number will be between 0 and 9 (10 numbers total)
- Make the output do different things based on the number

- Did anyone bring anything else fun?

Let’s Push Your Buttons!

Picture from shallowsky.com





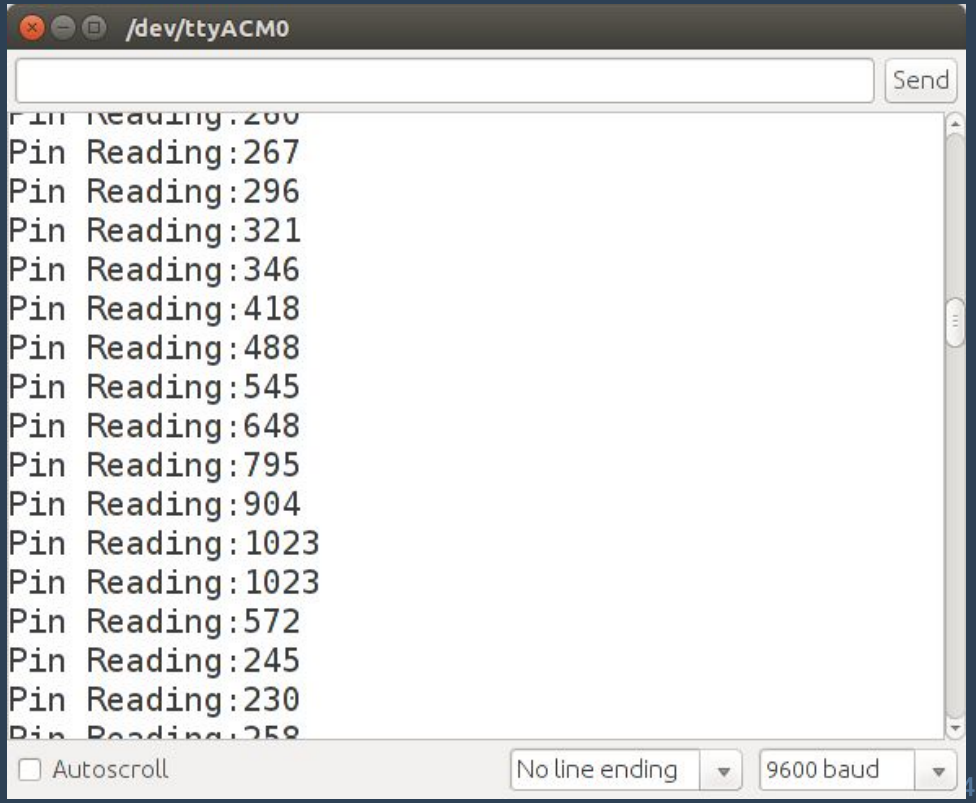
Electromagnetic Interference

```
int inPin = 5;
int val = 0;
void setup() {
  pinMode(inPin, INPUT);
  Serial.begin(9600);
}
void loop() {
  val = analogRead(inPin);
  Serial.println(val);
 delay(100);
}
```

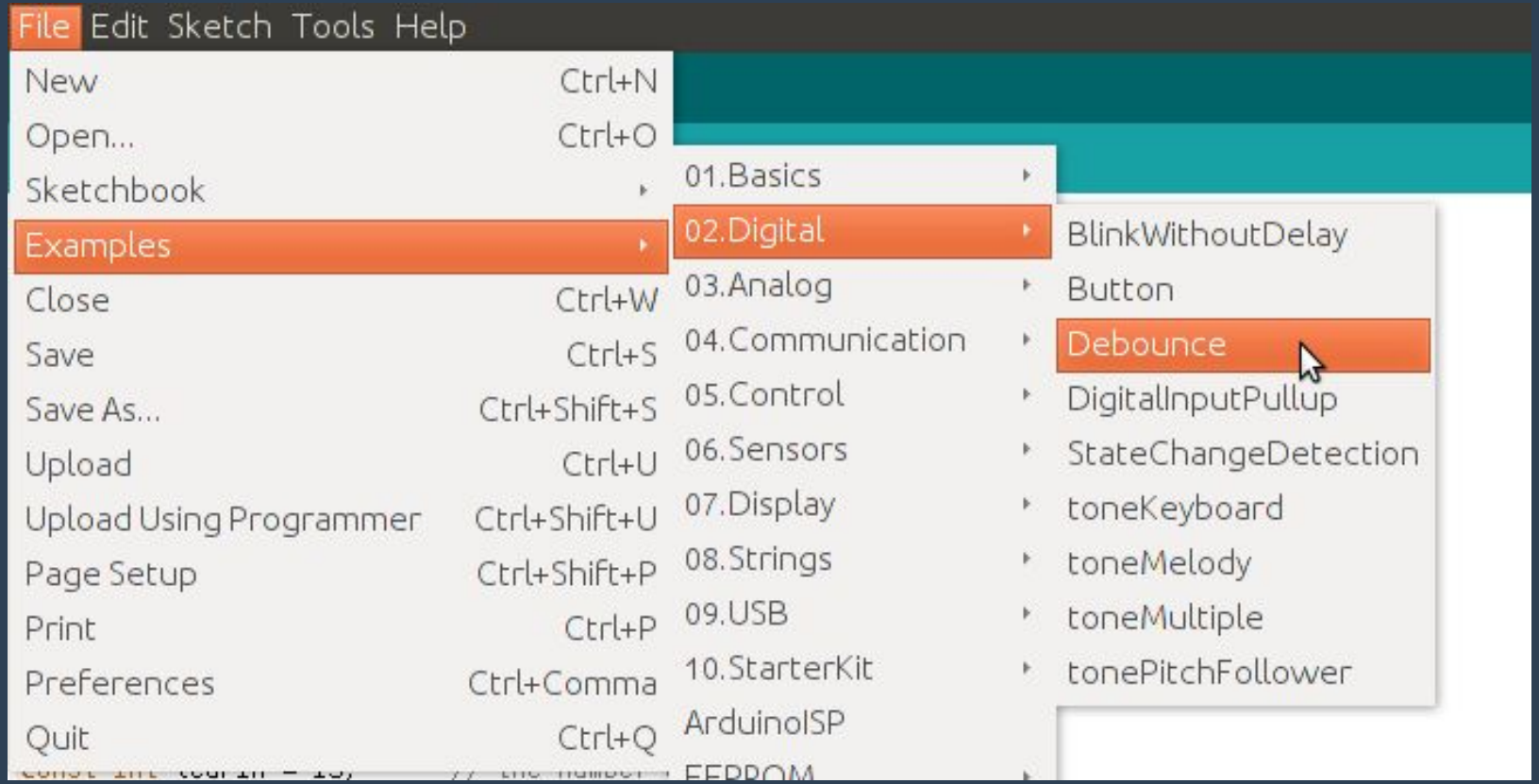
Serial Monitor

Let your device talk to your laptop

Ctrl + Shift + M



Debouncing


File Edit Sketch Tools Help
New Ctrl+N
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Examples
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Upload Using Programmer Ctrl+Shift+U
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01.Basics
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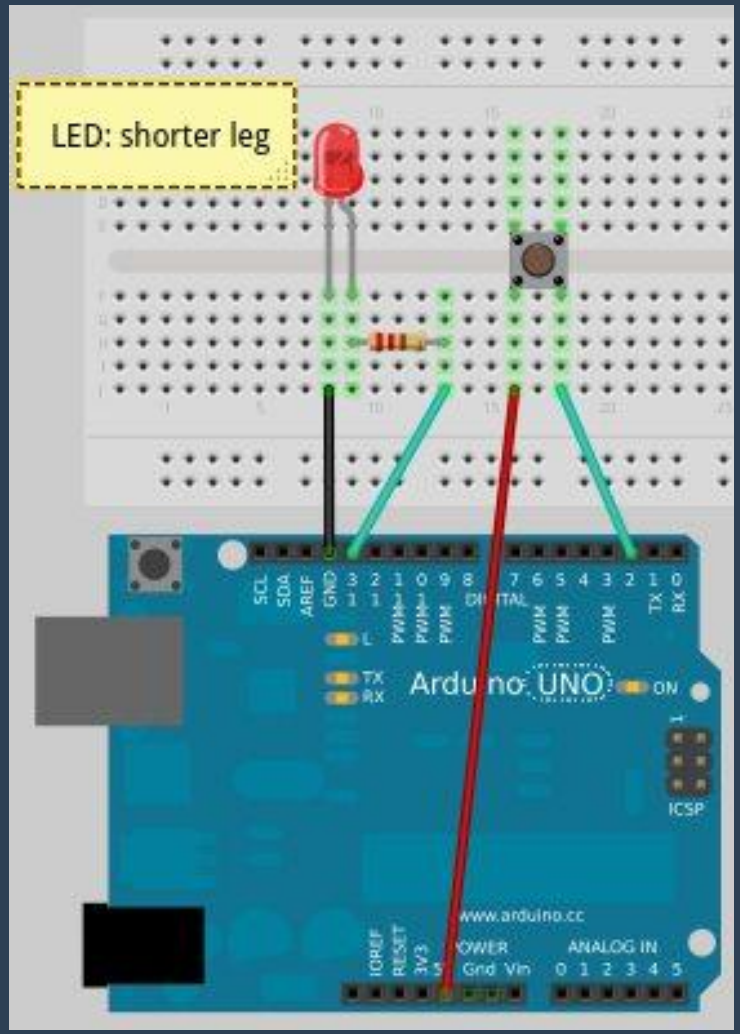
08.Strings
09.USB
10.StarterKit
ArduinoISP
BlinkWithoutDelay
Button
Debounce
DigitalInputPullup
StateChangeDetection
toneKeyboard
toneMelody
toneMultiple
tonePitchFollower

Let’s Review

Make your LED blink when the button is pushed.

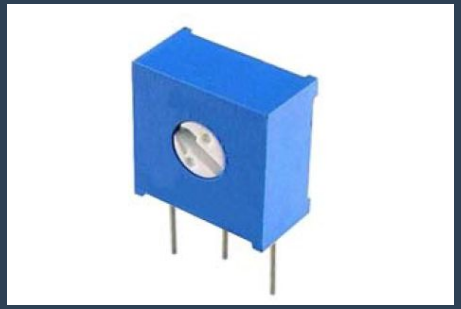
LED: pin 13 and ground

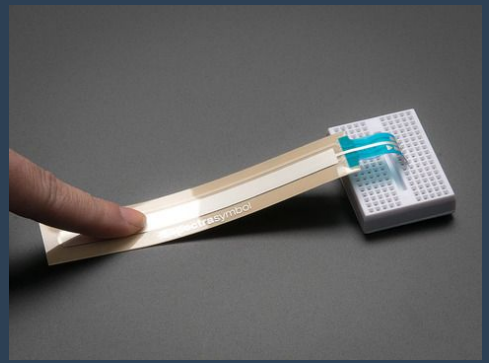
Button: power and pin 2

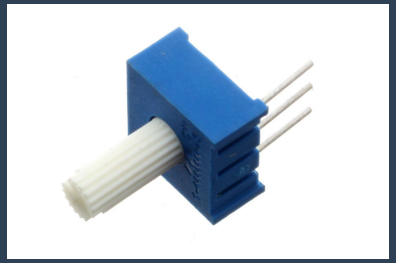


Variable Resistors

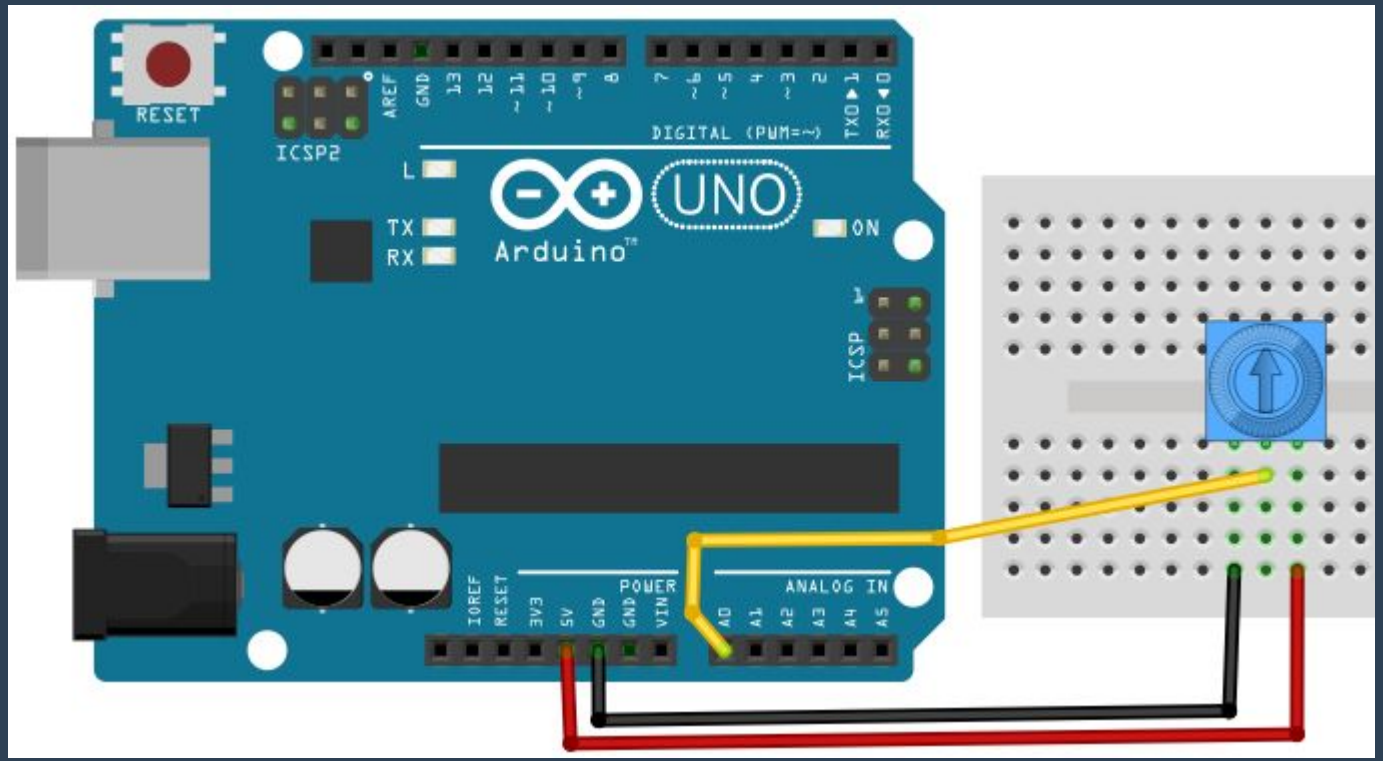
- Potentiometers



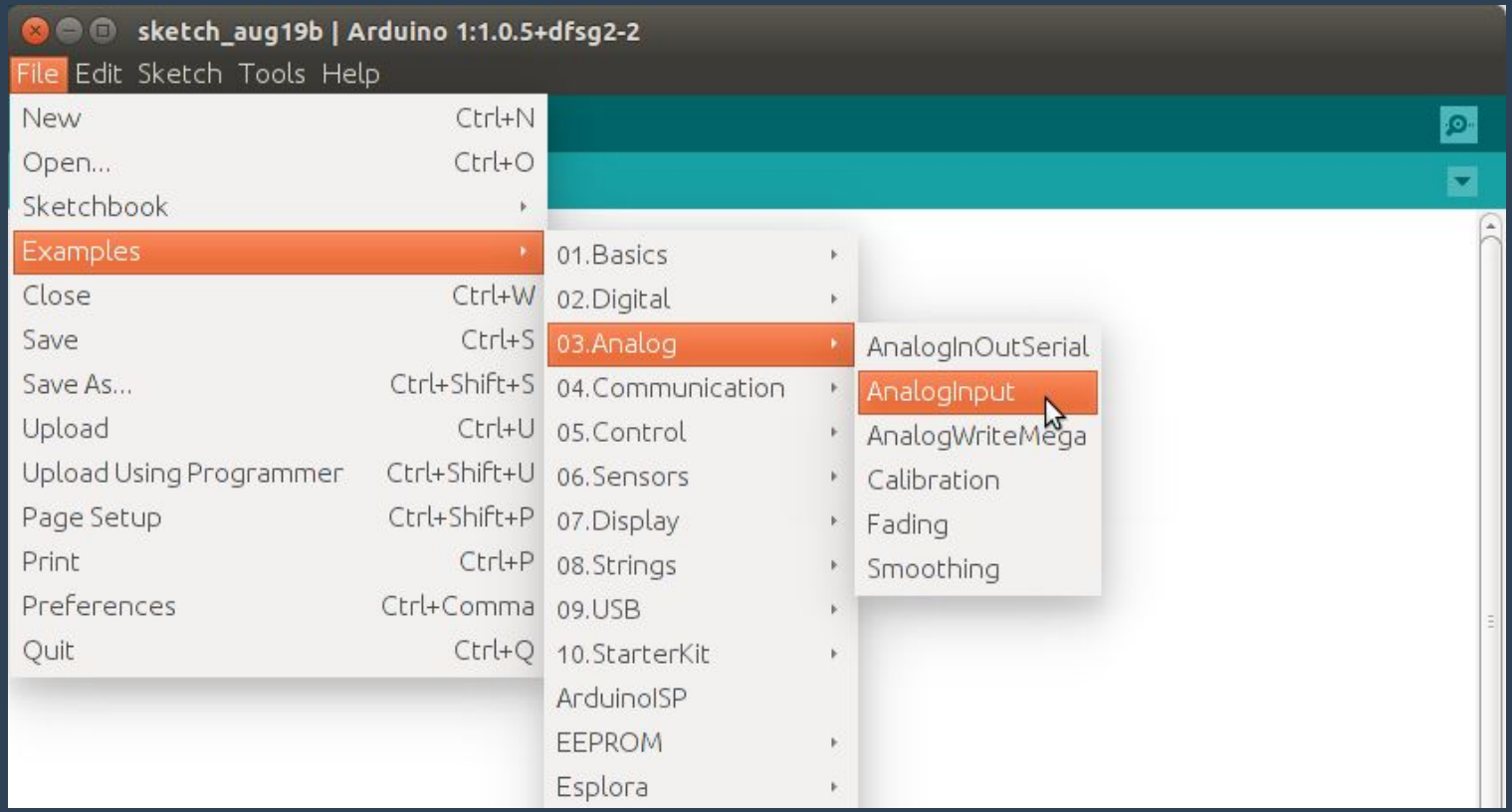




Let’s Take Control!



Let’s Take Control



Let’s Measure Something

- Sensors often work just like the variable resistors

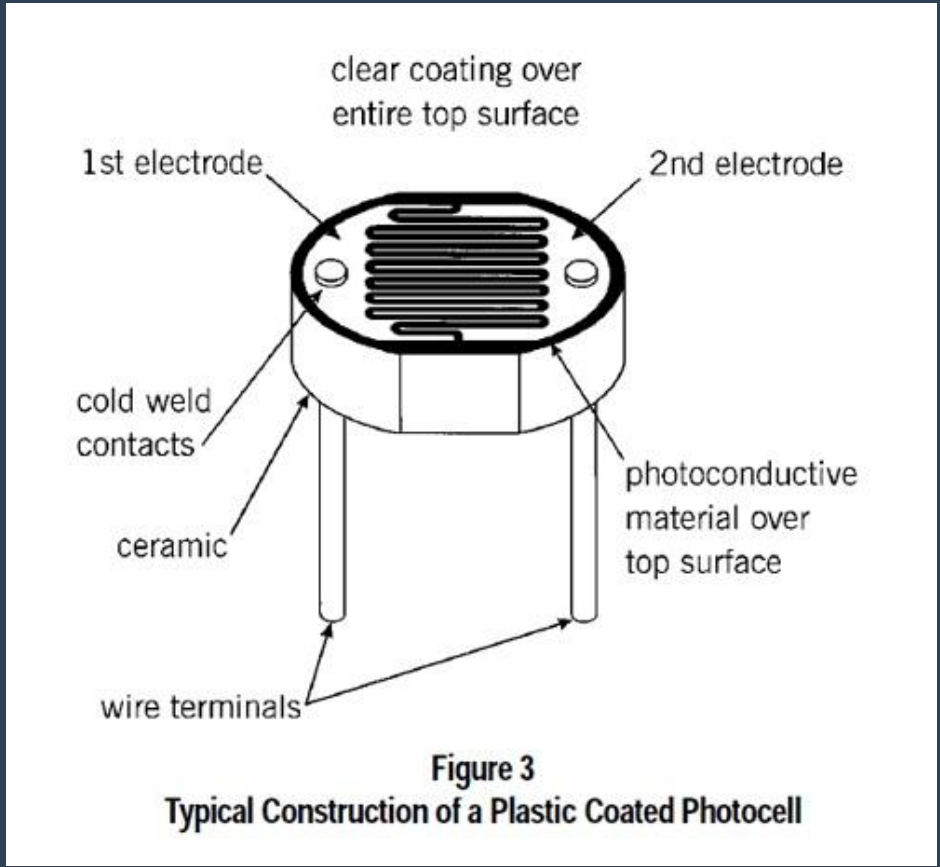
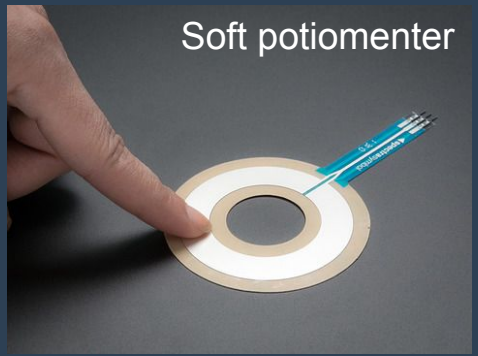


Figure 3
Typical Construction of a Plastic Coated Photocell

A TINY Selection of sensor types



Datasheets

- PN 2222
- 74HC595
- L2930

Datasheets

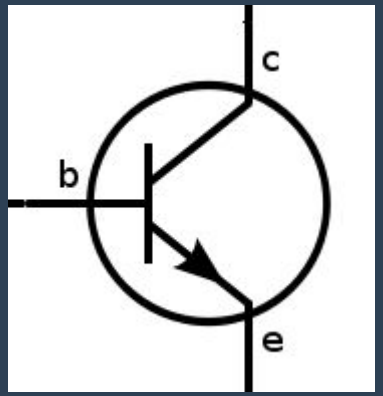
- https://www.onsemi.com/pub/Collateral/PN2222-D.PDF

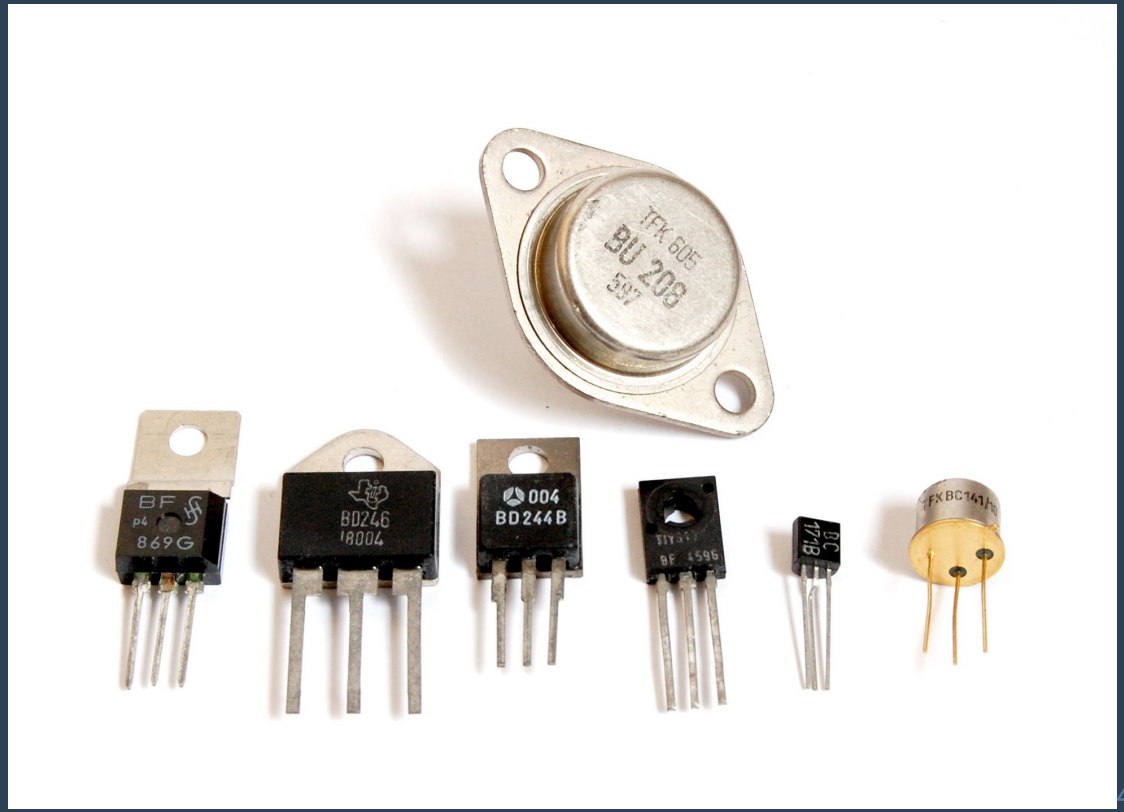
GREAT Write-up on how to read datasheets:

- https://www.sparkfun.com/tutorials/223

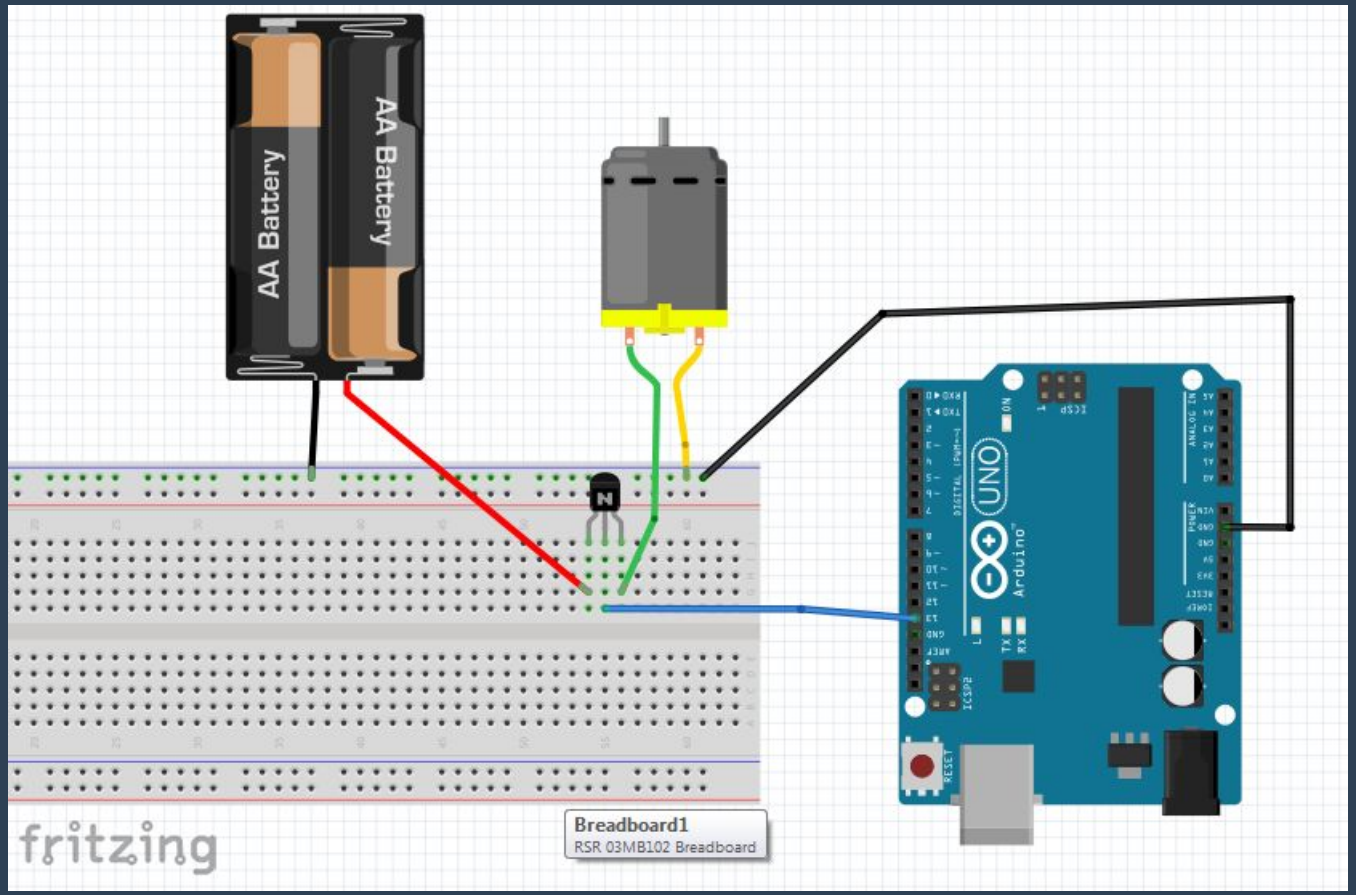
Transistors

- Electronic Switches





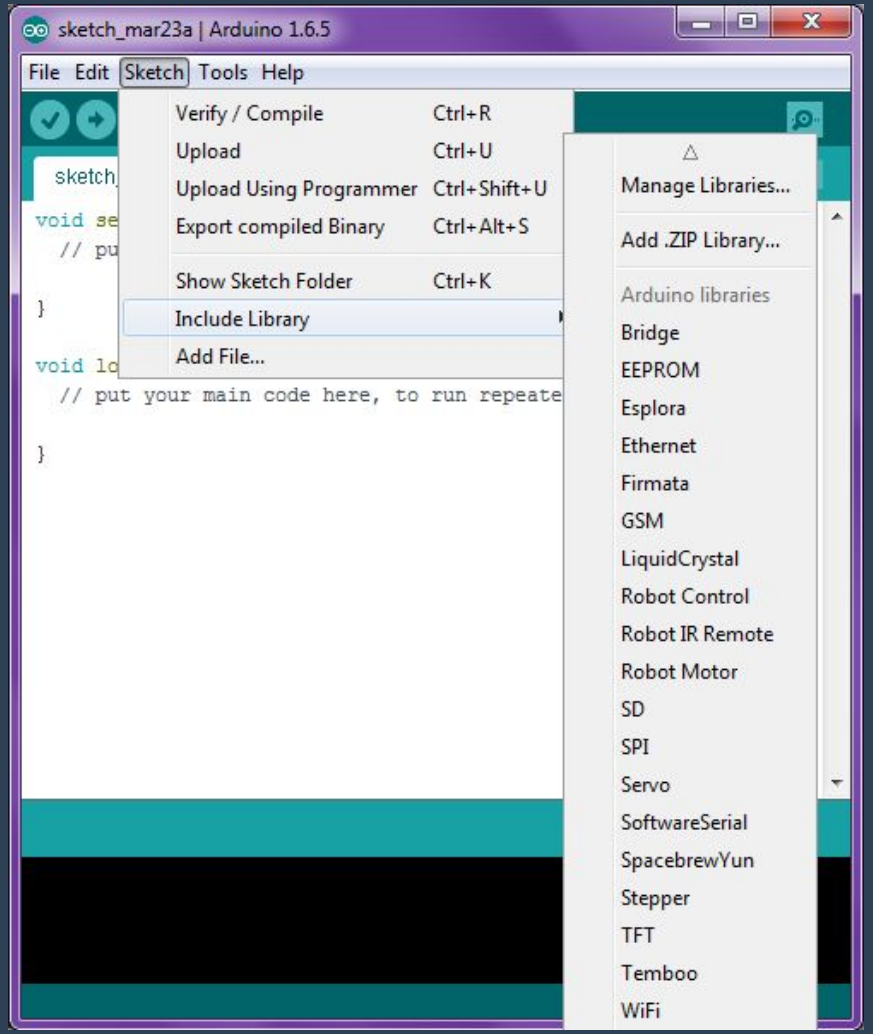
Let’s Harness The Power!



Let’s Do More!

- Functions
- Libraries
- Shields
- Co-Processors

(Check out “Beyond Blinky” on Friday!)



Let’s Hear About Your Projects!

- Add shields!
- Connect to the internet!
- Find new sensors and actuators!
- Build Robots!

- What are you going to build?

“Office Hours”

Area515 hosts a robot and electronics club at 7pm on second Thursdays. Come ask questions and share your progress. FREE!!

To learn more about Area515 or ask questions about Robot Night, email: education@area515.org

Upcoming Dates:

September 19th (I moved it this month so you could come!)

October 10th

Resources

Places to purchase good kits: Adafruit, Sparkfun, Evil Mad Scientists, SeeedStudio, Elegoo, Pololu

Places to purchase ALL THE THINGS: DigiKey, Mouser, Arrow

Places to learn: Adafruit, Sparkfun, Instructables, Arduino, Embedded Artistry, embedded.fm

Notes from this class: https://github.com/baileysage (search for “Intro to Arduino Slides”)