

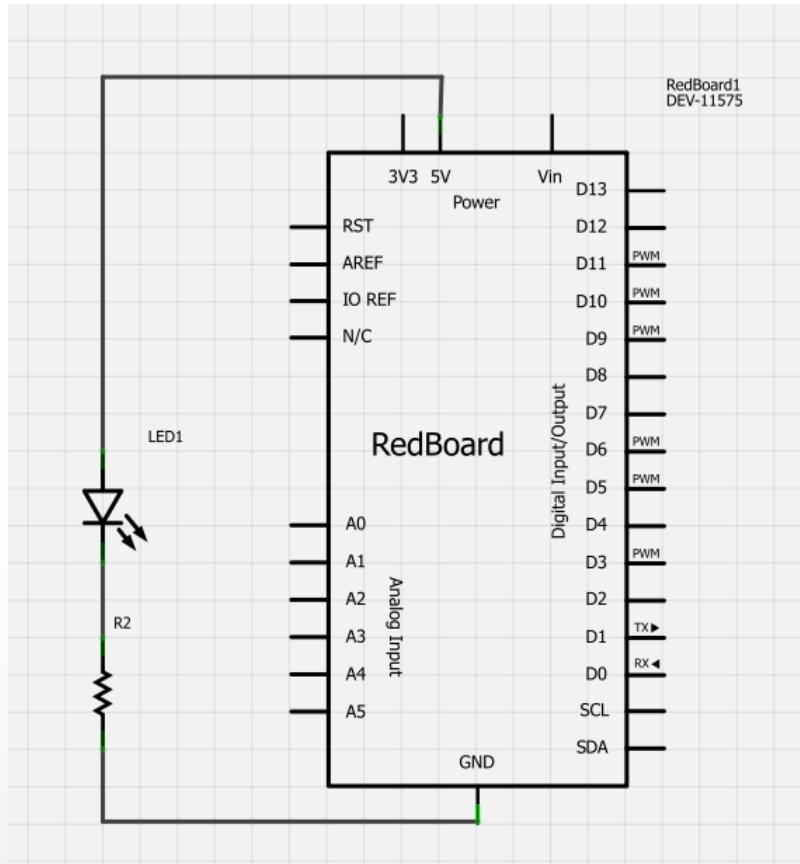
Break Time

www.ust.ac.kr





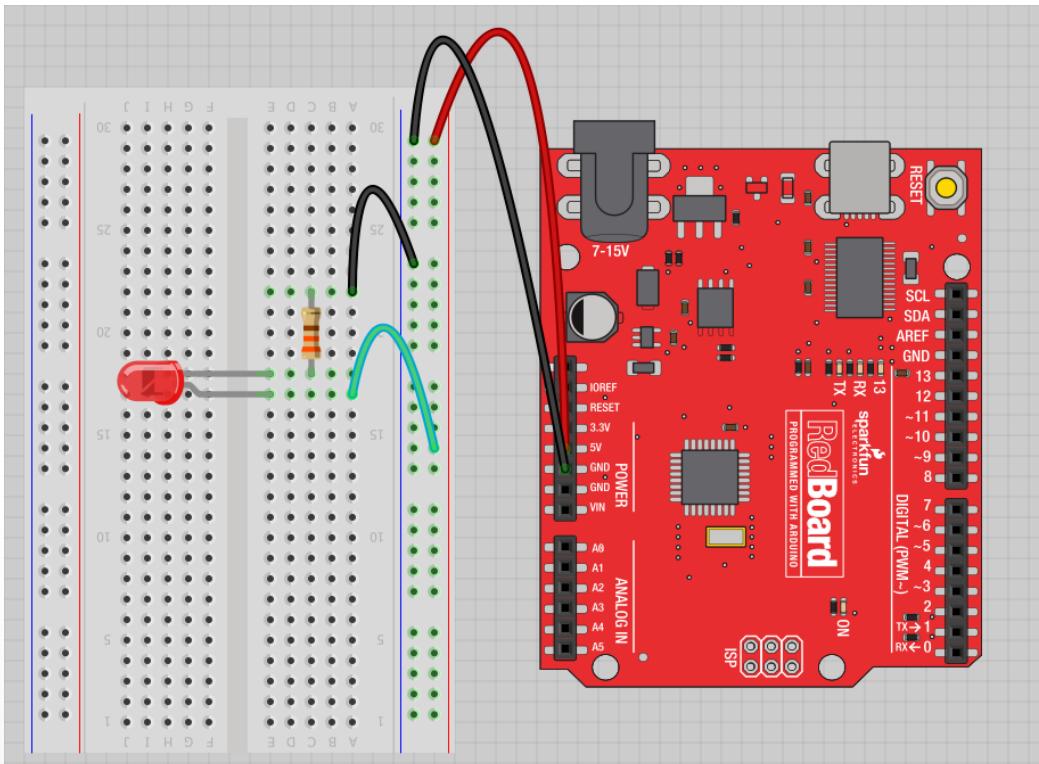
Using the Breadboard to built a simple circuit



- Use the breadboard to wire up a single LED with a 330 Ohm Resistor (Orange-Orange-Brown).

Note: the longer leg on the LED is the positive leg and the shorter leg is the negative

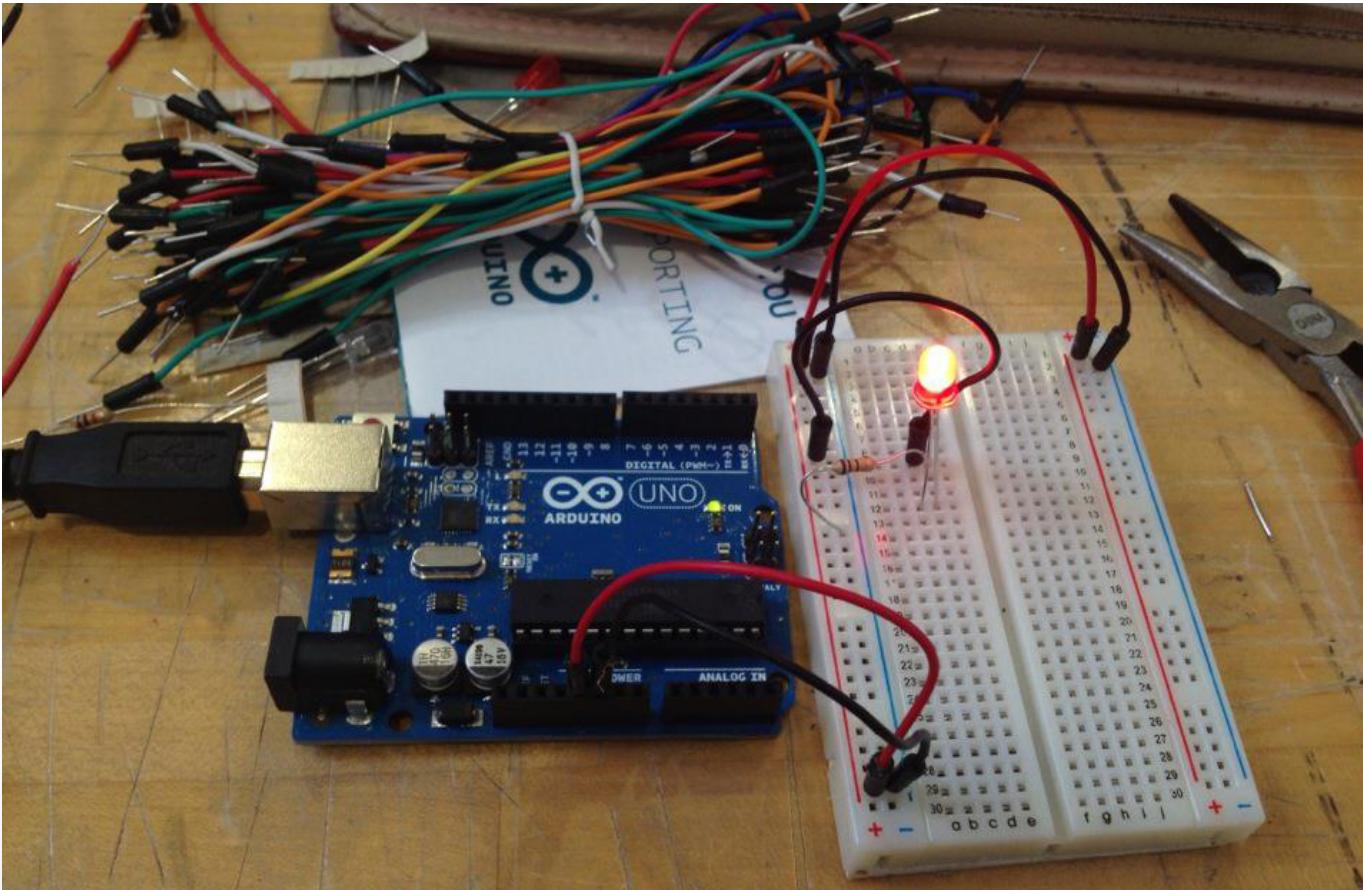
Fritzing View of Breadboard Circuit

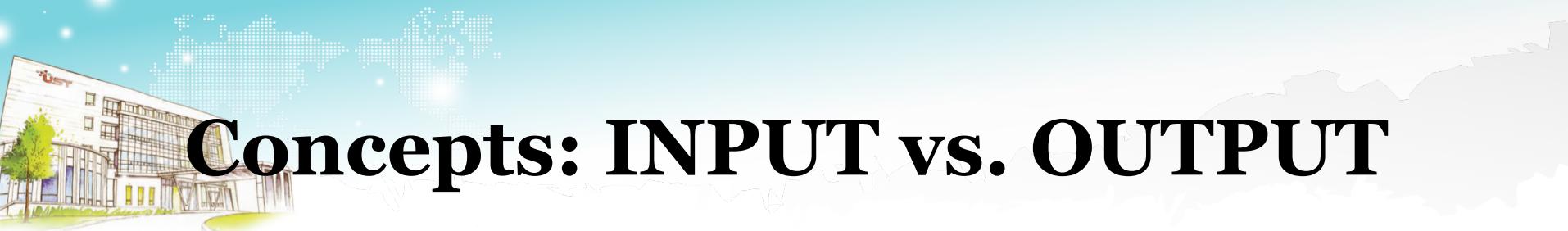


- What happens when you break the circuit?
- What if you wanted to add more than one LED?



Adding control – let's use the Arduino and start programming!!!

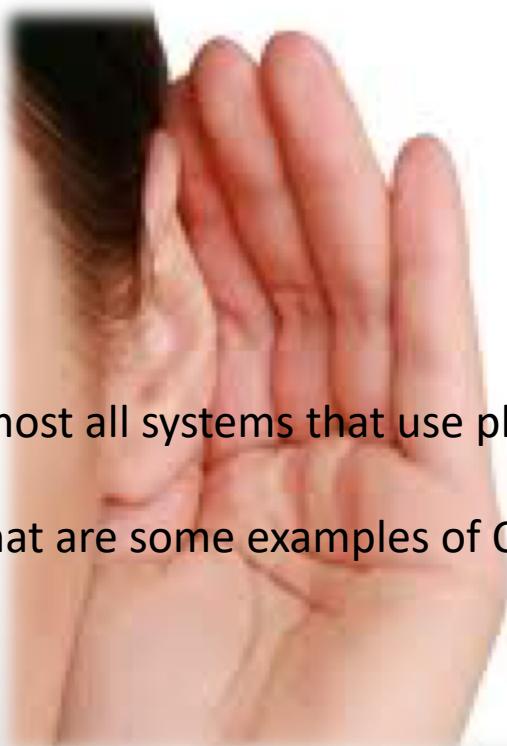




Concepts: INPUT vs. OUTPUT

Referenced from the perspective of the microcontroller (electrical board).

Inputs is a signal / information going into the board.

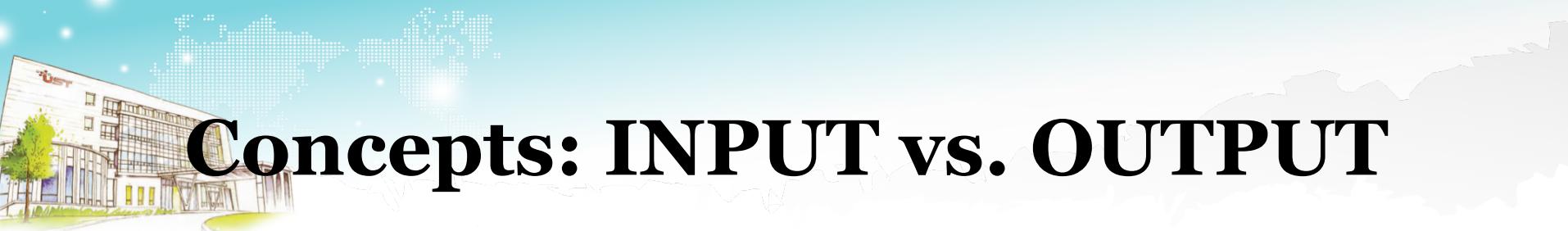


Output is any signal exiting the board.



Almost all systems that use physical computing will have some form of output

What are some examples of Outputs?



Concepts: INPUT vs. OUTPUT

Referenced from the perspective of the microcontroller (electrical board).

Inputs is a signal / information going into the board.

Output is any signal exiting the board.

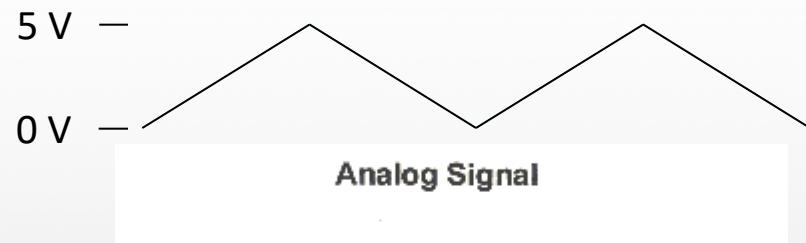
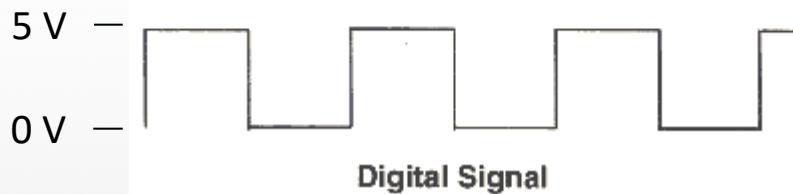
Examples: Buttons, Switches, Light Sensors, Flex Sensors, Humidity Sensors, Temperature Sensors...

Examples: LEDs, DC motor, servo motor, a piezo buzzer, relay, an RGB LED



Concepts: Analog vs. Digital

- Microcontrollers are **digital** devices – ON or OFF. Also called – discrete.
- **analog** signals are anything that can be a full range of values. What are some examples? More on this later...





Setting up Arduino

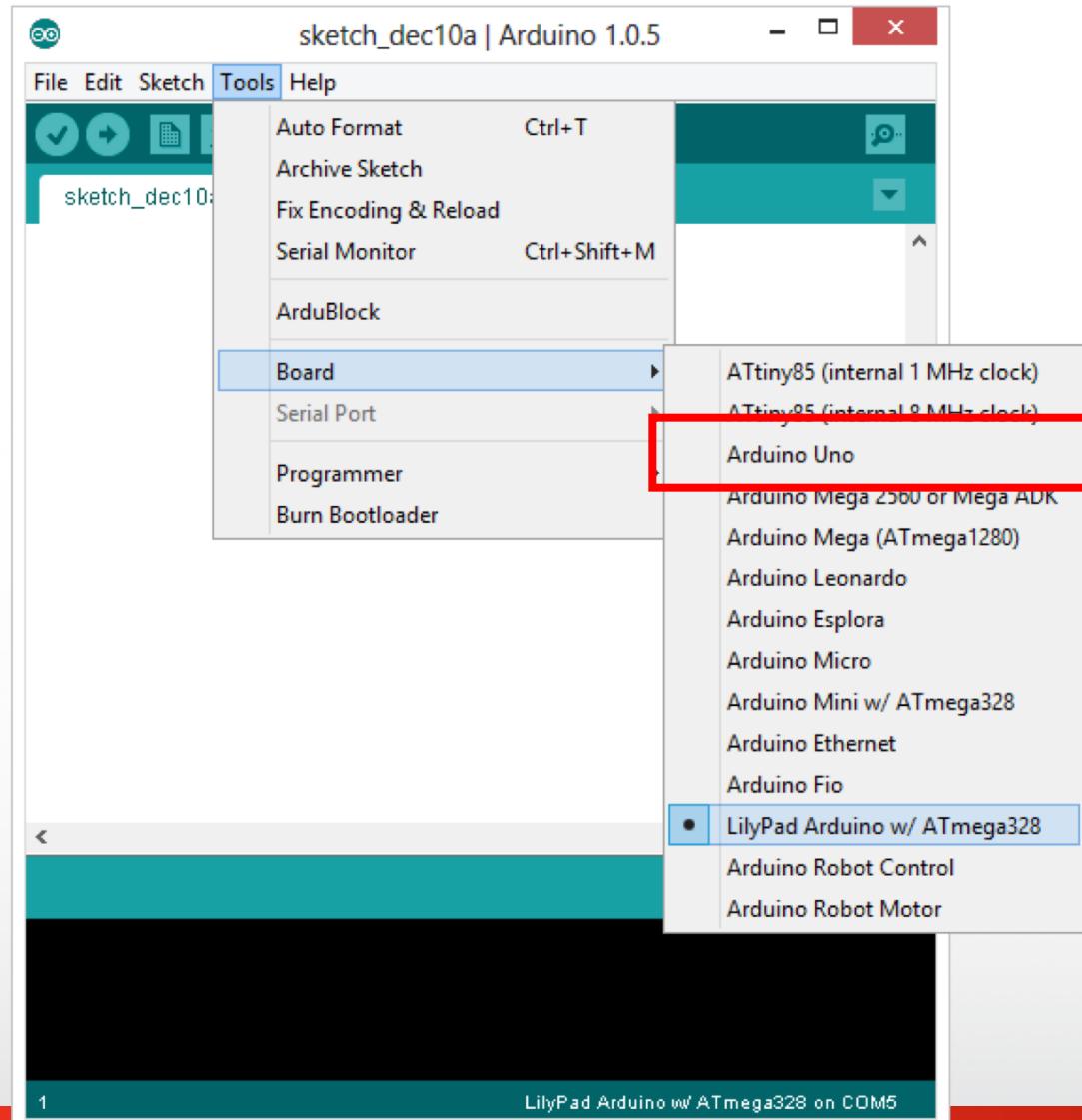
1. Setup Board

- Arduino Uno

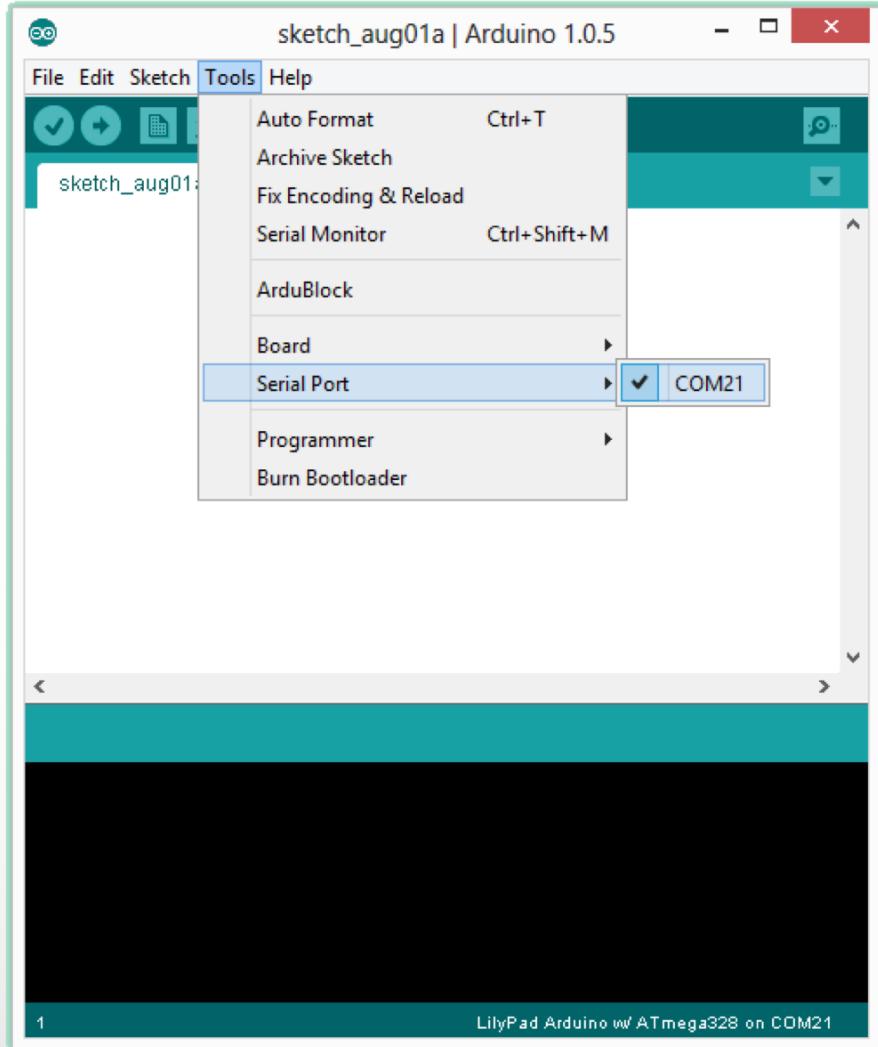
2. Setup COM Port

- PC – Highest COM #
- Mac – /dev/tty.usbserial-A#####xXx

Tools → Board → Arduino Uno Setup Board



Tools → Serial Port Setup COM Port



PC –
Highest COM #

Mac –
**/dev/tty.usbserial-
A####xxx**



Anatomy of code

General syntax:

- Case-sensitive
- Semi-colons
- Curly-brackets

→ ;

```
void functionName ()
```

```
{  
}
```



Just the basics

Turning an LED on and off...



The screenshot shows the Arduino IDE interface with the following details:

- Title Bar:** MakerScience01__blink | Arduino
- Toolbar:** Includes icons for upload, download, and other functions.
- Sketch Menu:** File, Edit, Sketch, Tools, Help.
- Sketch Name:** MakerScience01__blink
- Sketch Description:** Blink. Turns on an LED on for one second, then off for one second, repeatedly.
- Code Content:**

```
// Simple Blink Example

int ledPin = 13;
// int delayTime = 1000;

void setup()
{
    pinMode(ledPin, OUTPUT);
}

void loop()
{
    digitalWrite(ledPin, HIGH);
    delay(1000);
    digitalWrite(ledPin, LOW);
    delay(1000);
}
```
- Notes:** This example code is in the public domain.
- Bottom Status Bar:** Arduino Uno on /dev/tty.usbmodemfd131

Programming Concepts: Variables

ProtosnapProMiniExample2 \$

```
// Comments go here  
// Written by: Joesephine Jones  
// Date: April 12, 2013  
  
int sensorValue;  
int ledPin;  
  
void setup()  
{  
    // put your setup code here, to run once:  
    int setupVariable;  
  
}  
  
void loop()  
{  
    // put your main code here, to run repeatedly:  
    int loopScopeVariable  
}
```

Variable Scope

- *Global*

- ----

- *Function-level*



Programming Concepts: Variable Types

- **Variable Types:**



8 bits

byte
char



16 bits

int
unsigned int



32 bits

long
unsigned long
float



Comments, Comments, Comments

- Comments are for you – the programmer and your friends
...or anyone else human that might read your code.

```
// this is for single line comments
```

```
// it's good to put a description
```

```
/* this is for multi-line comments
```

```
Like this...
```

```
And this....
```

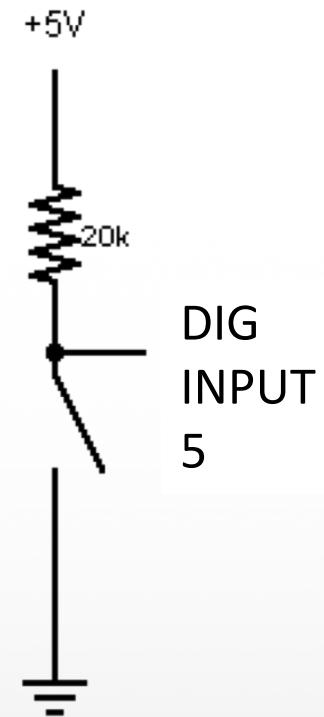
```
*/
```



Programming: Conditional Statements

if ()

```
void loop()
{
    int buttonState = digitalRead(5);
    if(buttonState == LOW)
    {
        // do something
    }
    else
    {
        // do something else
    }
}
```





Boolean Operators

| <Boolean> | Description |
|------------|-----------------------|
| () == () | is equal? |
| () != () | is not equal? |
| () > () | greater than |
| () >= () | greater than or equal |
| () < () | less than |
| () <= () | less than or equal |



Three commands to know...

pinMode(pin, INPUT/OUTPUT) ;

ex: **pinMode**(13, OUTPUT) ;

digitalWrite(pin, HIGH/LOW) ;

ex: **digitalWrite**(13, HIGH) ;

delay(time_ms) ;

ex: **delay**(2500) ; // delay of 2.5 sec.

// NOTE: -> commands are CASE-sensitive

Project #1: Wiring Diagram

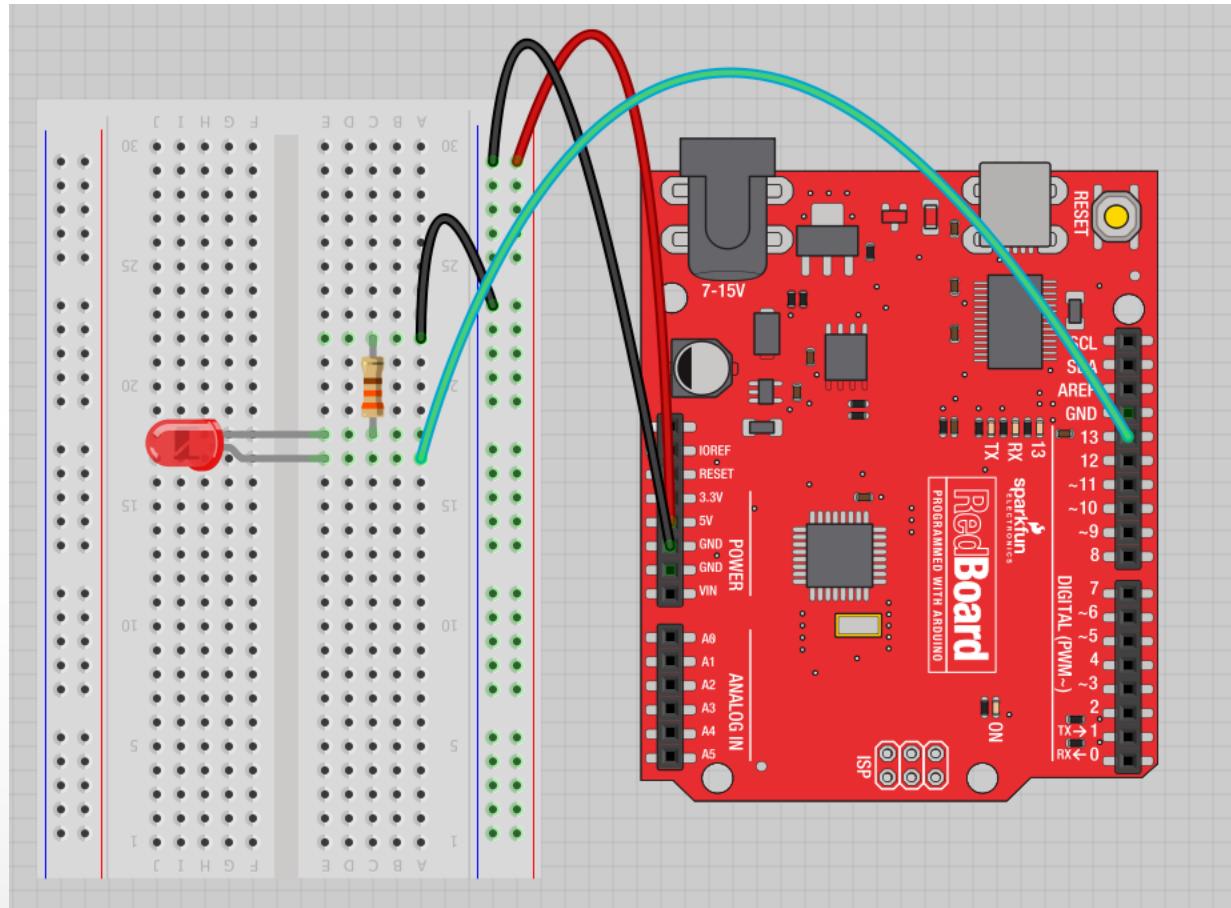


Image created in Fritzing

Move the green wire from the power bus to pin 13 (or any other Digital I/O pin on the Arduino board).



LED Control

1. Attach 7 LEDs, Turn on and off 7 LEDs sequentially.

Hint :

```
for(int i=2; i<9; i++){ //iterating through pin 2 to 8  
    Something to do;  
}
```

2. Turn on and off 7 LEDs randomly.

Hint : <https://www.arduino.cc/reference/en/>

```
int signal=int(random(0,2)); //generate random number between 0 to 1
```



Fading in and Fading Out (Analog or Digital?)

- A few pins on the Arduino allow for us to modify the output to mimic an analog signal.
- This is done by a technique called:
Pulse Width Modulation (PWM)



Concepts: Analog vs. Digital

- To create an analog signal, the microcontroller uses a technique called PWM. By varying the duty cycle, we can mimic an “average” analog voltage.

