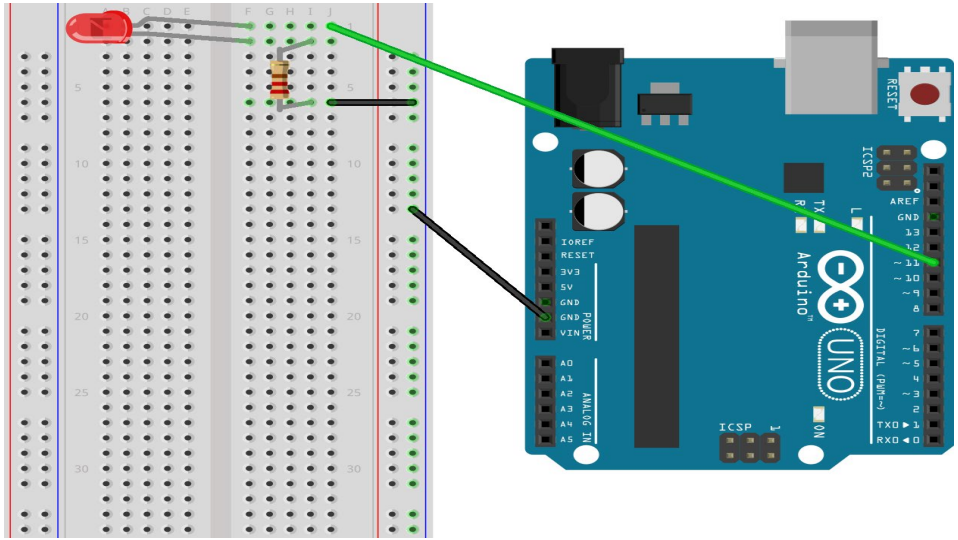
CG1111
Arduino Workshop

Hello World! - Blinky

- A blinky program is the “Hello World!” program of Physical computing
- Write a program to blink an LED connected to a digital pin in the Arduino Uno
- Commands/functions you need to know
  - pinMode - to initialize a pin as input or output
    - pinMode(pin_number, OUTPUT); // or INPUT
  - digitalWrite - to write a voltage level to the output pin
    - digitalWrite(pin_number, HIGH); // or LOW
  - delay - to provide a time delay

How to connect the components?



Blinky Program

```
/*
  Blink
  Turns on an LED on for one second, then off for one second, repeatedly.

  This example code is in the public domain.
 */

// Pin 13 has an LED connected on most Arduino boards.
// give it a name:
int led = 13;

// the setup routine runs once when you press reset:
void setup() {
  // initialize the digital pin as an output.
  pinMode(led, OUTPUT);
}

// the loop routine runs over and over again forever:
void loop() {
  digitalWrite(led, HIGH);   // turn the LED on (HIGH is the voltage level)
  delay(1000);               // wait for a second
  digitalWrite(led, LOW);    // turn the LED off by making the voltage LOW
  delay(1000);               // wait for a second
}
```

Let’s go further!

How will the program need to be modified for the following cases?

- Use a different pin for connection to LED
- Make LED blink faster
- Make LED blink slower
- Turn ON LED for twice the duration of OFF time
- Any cool “codes” you can produce using an LED?

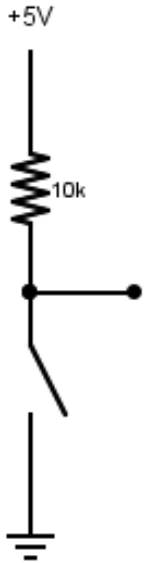
Digital Input

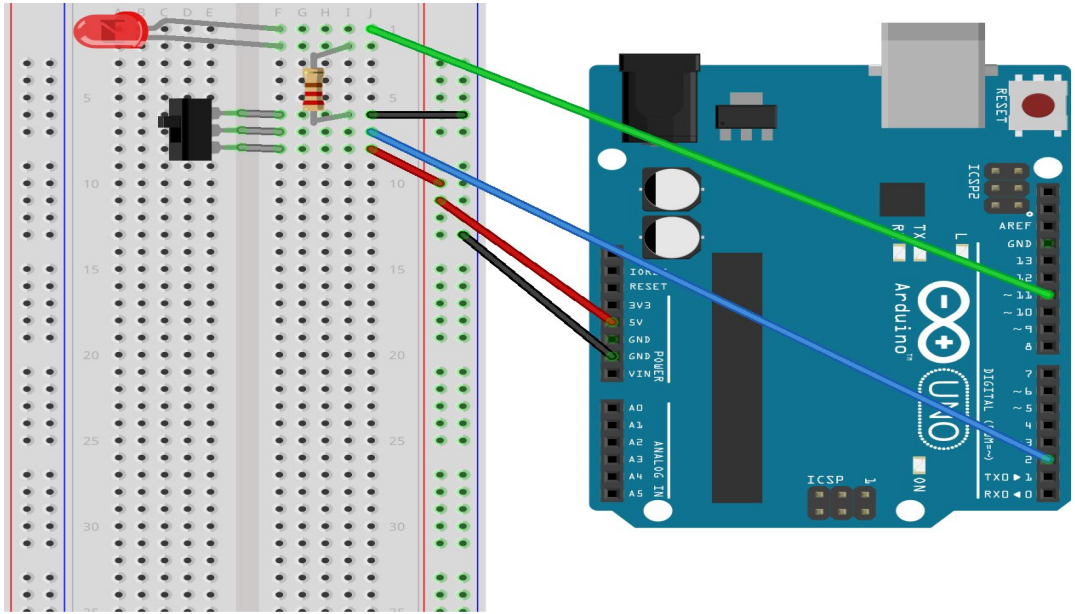
- Digital sensors are (more) straight forward (than Analog)
- No matter what the sensor there are only two settings: On and Off
- Signal is always either HIGH (On) or LOW (Off)
- Voltage signal for HIGH will be 5V (more or less) on Arduino Uno. Other Arduinos could use different voltages!
- Voltage signal for LOW will be 0V on most systems

Digital Input - Switch

- Write a program to read a Switch state and turn ON/OFF the LED
- Commands you need to know
  - pinMode - set pin as INPUT
    - pinMode(pin_number, INPUT);
  - digitalRead - read state of digital pin
    - pin_state = digitalRead(pin_number);
  - conditional execution
    - if statements
- Connect switch to any of the digital pins

How to connect the components?





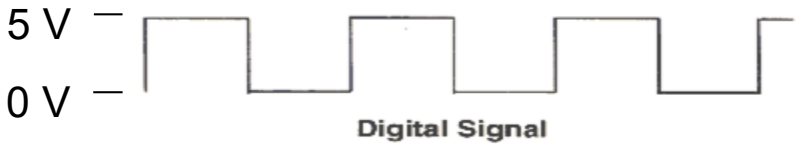
Digital I/O Program

```
// constants won't change. They're used here to set pin
numbers:
const int buttonPin = 2;     // the number of the pushbutton
pin
const int ledPin =  13;      // the number of the LED pin

// variables will change:
int buttonState = 0;         // variable for reading the
pushbutton status

void setup() {
  // initialize the LED pin as an output:
  pinMode(ledPin, OUTPUT);
  // initialize the pushbutton pin as an input:
  pinMode(buttonPin, INPUT);
}
```

```
void loop(){
  // read the state of the pushbutton value:
  buttonState = digitalRead(buttonPin);

  // check if the pushbutton is pressed.
  // if it is, the buttonState is HIGH:
  if (buttonState == HIGH) {
    // turn LED on:
    digitalWrite(ledPin, HIGH);
  }
  else {
    // turn LED off:
    digitalWrite(ledPin, LOW);
  }
}
```

Analog vs Digital

- Arduinos are digital devices - ON or OFF. Also called discrete
- Analog signals are anything that can be a full range of 0V to 5V



- How to create the effect of analog using digital?
    - Hint: PWM (Pulse Width Modulation)

Analog Output

- Write a program to vary the brightness of the LED
  - increases gradually to brightest and then fades to lowest brightness
- Commands you need to know
  - analogWrite(pin_number, value);
  - pin_number - limited to pins - 3, 5, 6, 9, 10 and 11, denoted by a ~ signal
  - Value is of range 8 bits
    - What is the minimum and maximum magnitude that value can take?
- No new connections different from digital I/O exercise if choice of pin is suitable for analog output

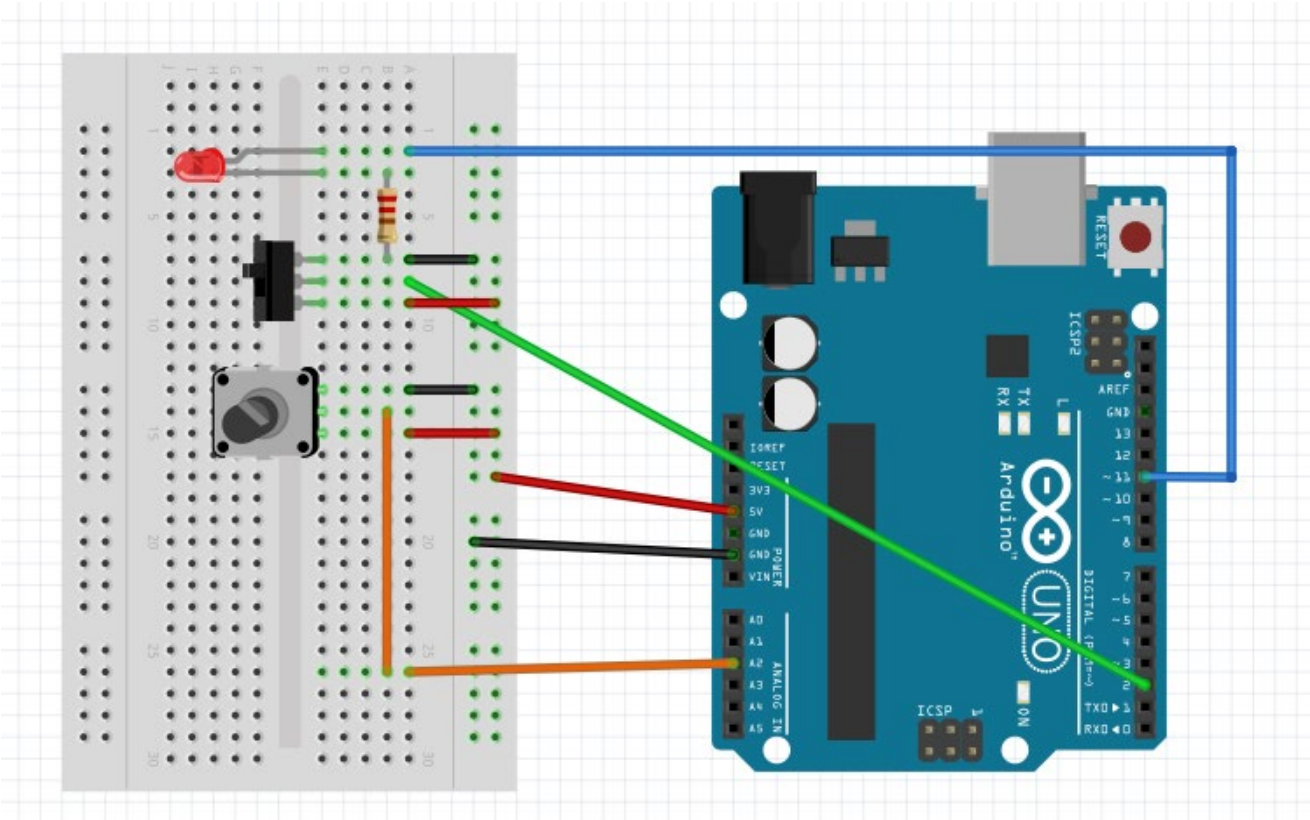
Analog Output Program

```
int ledPin = 11; // select the pin for the LED

void setup()
{
  // declare the ledPin as an OUTPUT:
  pinMode(ledPin, OUTPUT);
}

void loop()
{
  // increase the brightness gradually
  for(int i = 0; i<=255; i++)
  {
    analogWrite(ledPin, i);
    delay(10);
  }

  // decrease the brightness gradually
  for(int i = 255; i>=0; i--)
  {
    analogWrite(ledPin, i);
    delay(10);
  }
}
```

Analog Input

- Arduino uses a 10-bit Analog to Digital converter
    - What is the maximum 10-bit input value?
- The input values from 0 to Max are mapped to 0V to 5V
- Write a program to control blinky LED’s delay based on the resistance value in a potentiometer
- commands you need to know
    - int analog_input = analogRead(pin_number);

How to connect the components?



Analog I/O program

```
int sensorPin = A0;    // select the input pin for the potentiometer
int ledPin = 13;      // select the pin for the LED
int sensorValue = 0;  // variable to store the value coming from the sensor

void setup() {
  // declare the ledPin as an OUTPUT:
  pinMode(ledPin, OUTPUT);
}

void loop() {
  // read the value from the sensor:
  sensorValue = analogRead(sensorPin);
  // turn the ledPin on
  digitalWrite(ledPin, HIGH);
  // stop the program for <sensorValue> milliseconds:
  delay(sensorValue);
  // turn the ledPin off:
  digitalWrite(ledPin, LOW);
  // stop the program for for <sensorValue> milliseconds:
  delay(sensorValue);
}
```

Challenge Yourself!!!

1. Learn to translate a schematic diagram to a breadboard prototype
2. Develop neat bread-boarding techniques
3. Develop a simple Arduino-based application