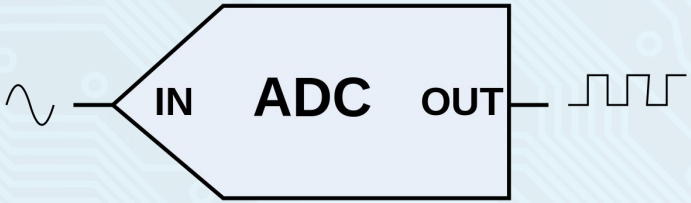
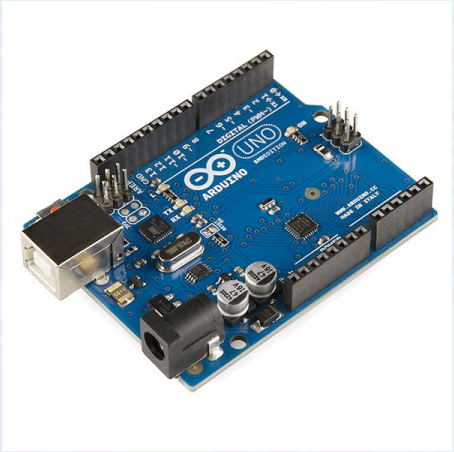
Virtual Workshop 2

Analog to Digital Conversion and Arduino





Penn State IEEE
Workshop 2
September 17, 2020

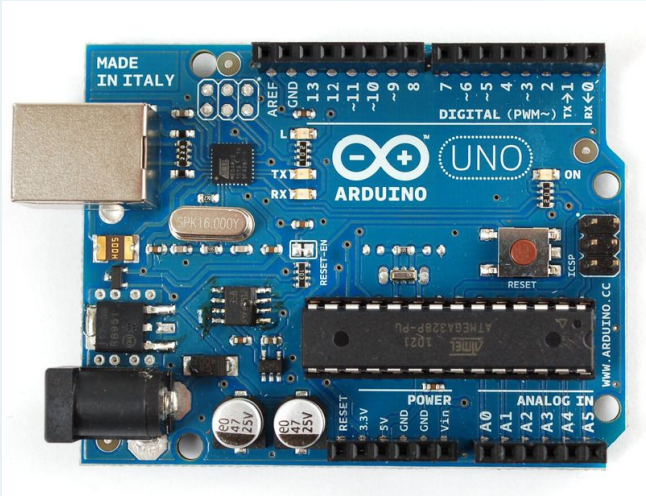
Arduino Basics

The Company

- Hardware and Software company
- Best known for their AVR-based boards
  - Uno
  - Nano
  - Mega
- Useful in many electronics projects

Arduino Basics

The Board



- Arduino Uno
- Digital and Analog Pins
  - Digital works with high/low signals
  - Analog works with “smooth” values
- Serial Monitor
  - Allows for communication between Arduino and other devices

Arduino Basics

Programming your Arduino

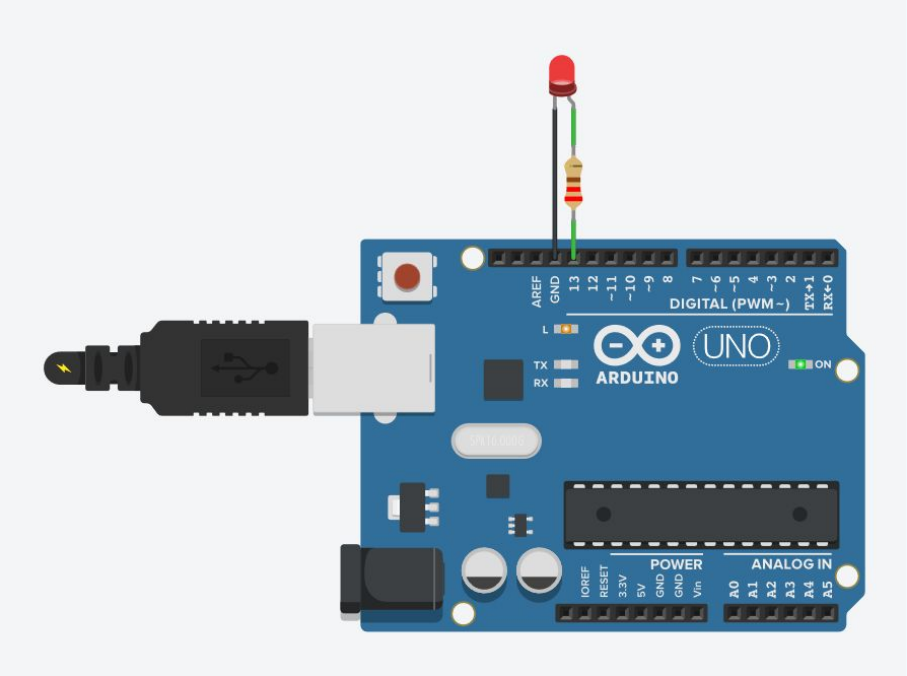
```
void setup()
{
  //Digital pin 13 will be used for output
  pinMode(13, OUTPUT);
}

void loop()
{
  // turn the LED on (HIGH is the voltage level)
  digitalWrite(13, HIGH);
  delay(1000); // Wait for 1000 millisecond(s)
  // turn the LED off by making the voltage LOW
  digitalWrite(13, LOW);
  delay(1000); // Wait for 1000 millisecond(s)
}
```

- Uses C++ syntax
- Must have a setup() and loop() function
  - setup() is run once
  - loop() is run after setup() and runs forever

Arduino Basics

Blink Example



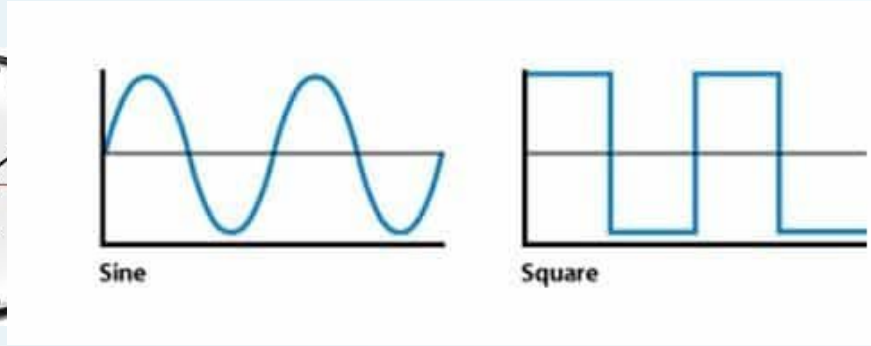
Analog vs. Digital

Analog

- Continuous signal
- Denoted by sine wave
- Represents physical, real-world data
- More detailed and refined
- Susceptible to noise
- Lower quality signal

Digital

- Segmented signal
- Denoted by square wave
- Represents binary, discrete data
- Easy for computers to read and process
- Less susceptible to noise
- Higher quality signal



What is ADC and how does it work?

What is ADC?

- ADC stands for Analog to Digital Converter
- Device which converts analog voltage to digital signal
- Allows for easy data collection/analysis by computers

How does it work in an Arduino?

1. Analog input voltage charges internal capacitor
2. Monitors how many clock cycles pass until fully discharged
3. Number of clock cycles returned by Arduino
4. Outputs number in binary (2^10 or 10 bit for Uno)
   - Technique is called successive approximation

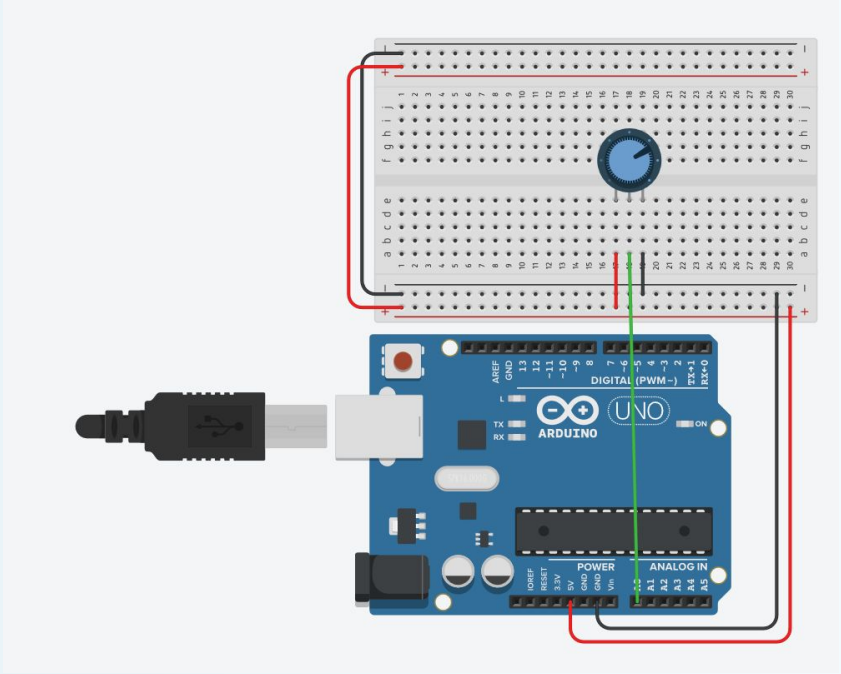
Numerical Output

Input voltage

$$\frac{1023}{5} = \frac{ADC\ Reading}{Analog\ Voltage\ Measured}$$

Arduino Basics

Pot to Percent Example



Arduino Basics

Pot to LED Example