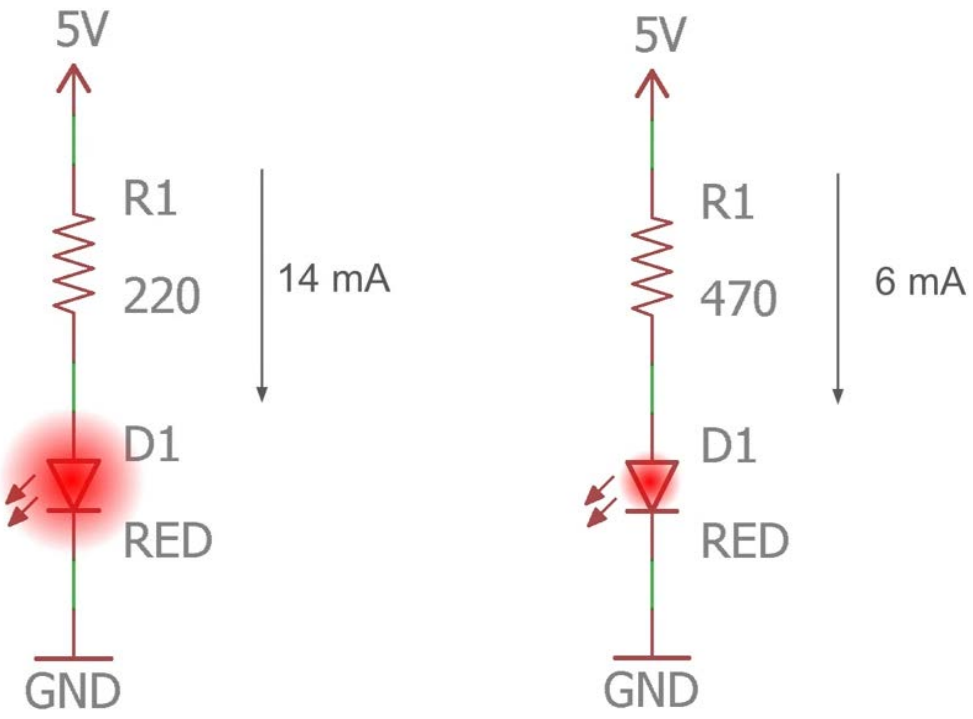
Engineering Technology (ENGR 101)

Arduino and dimming LEDs

Dimming an LED

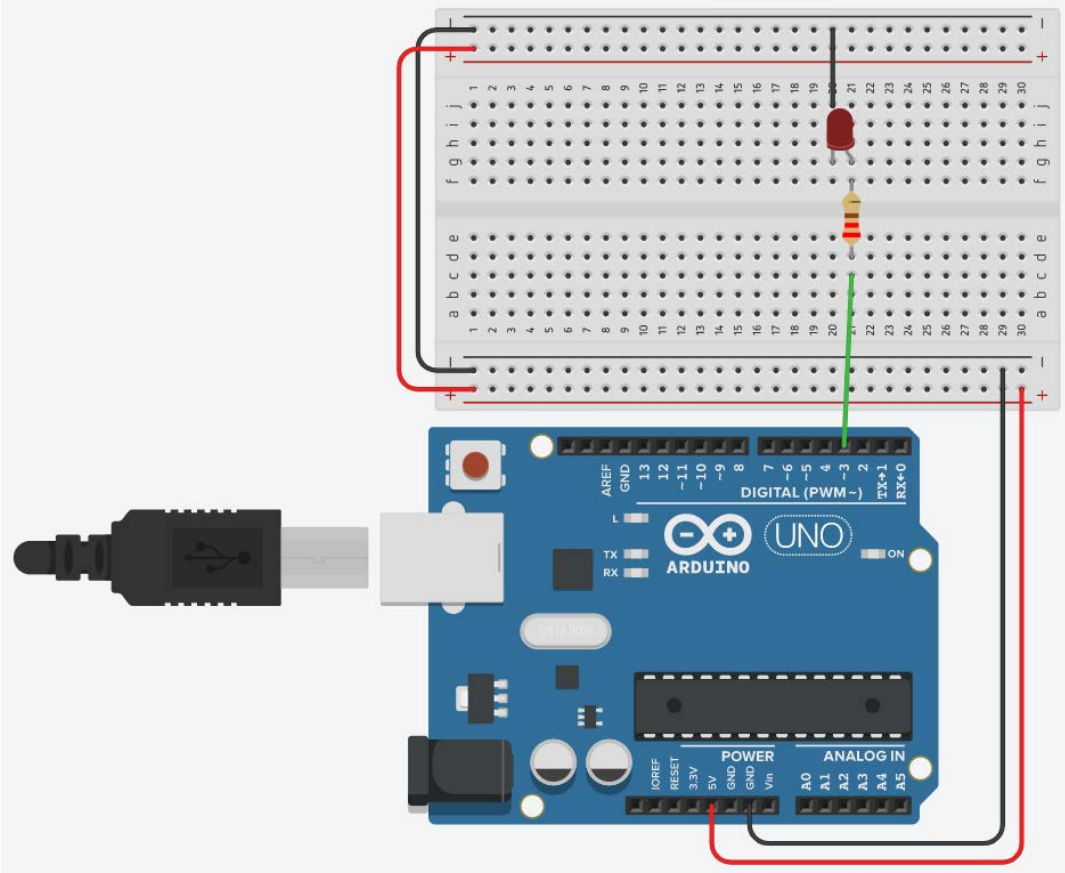
- Dimming an LED consists of changing amount of current flowing through it
- It needs complicated circuits
- There is an alternative way to fool our eyes into thinking an LED is a dimmer without using an extra hardware



Dimming an LED

```
const int led_1_pin = 3;

void setup() {
   pinMode(led_1_pin,OUTPUT);
}
void loop() {
   digitalWrite(led_1_pin, HIGH);
   delay(500);
   digitalWrite(led_1_pin, LOW);
   delay(500);
}
```



- Blinking the LED every 500 milliseconds

Dimming an LED

```
void loop() {
   digitalWrite(led_1_pin, HIGH);
   delay(50);
   digitalWrite(led_1_pin, LOW);
   delay(50);
}
```

The LED should blink fast

```
void loop() {
   digitalWrite(led_1_pin, HIGH);
   delay(5);
   digitalWrite(led_1_pin, LOW);
   delay(5);
}
```

The LED blinks too fast that your eyes cannot see it. Then the LED appears simply on.

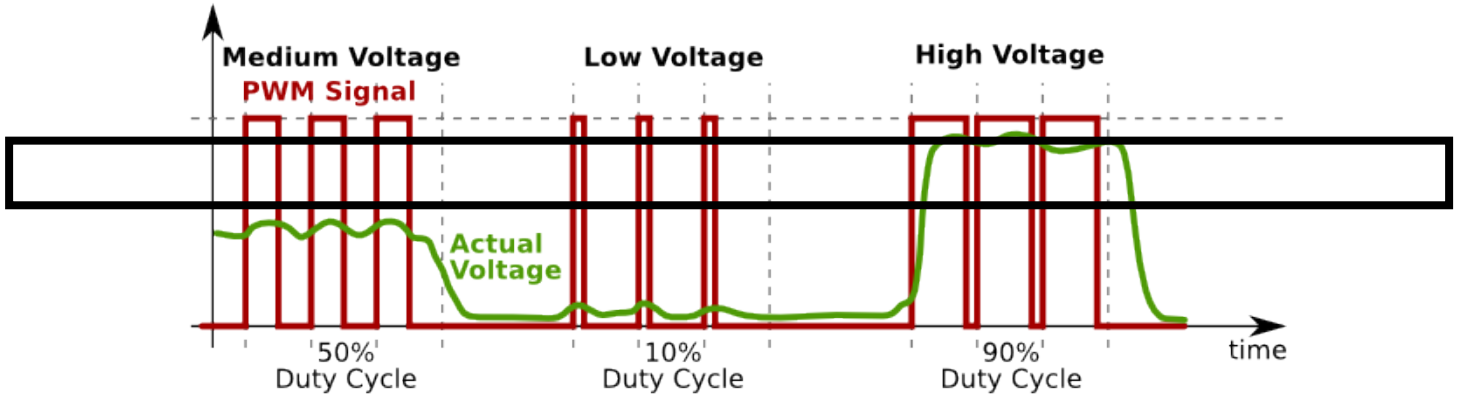
$$\frac{5ms\ (on)}{10ms\ (total\ time)} = 50\%\ duty\ cycle$$

```
void loop() {
   digitalWrite(led_1_pin, HIGH);
   delay(1);
   digitalWrite(led_1_pin, LOW);
   delay(9);
}
```

$$\frac{1ms\ (on)}{10ms\ (total\ time)} = 10\%\ duty\ cycle$$

Fading in and Fading Out (Analog or Digital?)

- Where the analogue input pins are designed to read analogue sensors (input), the Pulse-Width Modulation (PWM) pins are designed for output.
- PWM is a technique for obtaining analogue results with digital output.
- Since a digital output can be either on or off, to obtain the analogue output the digital output is switched between HIGH and LOW rapidly.
- The percentage of the time that the signal is high is called the **duty cycle**.



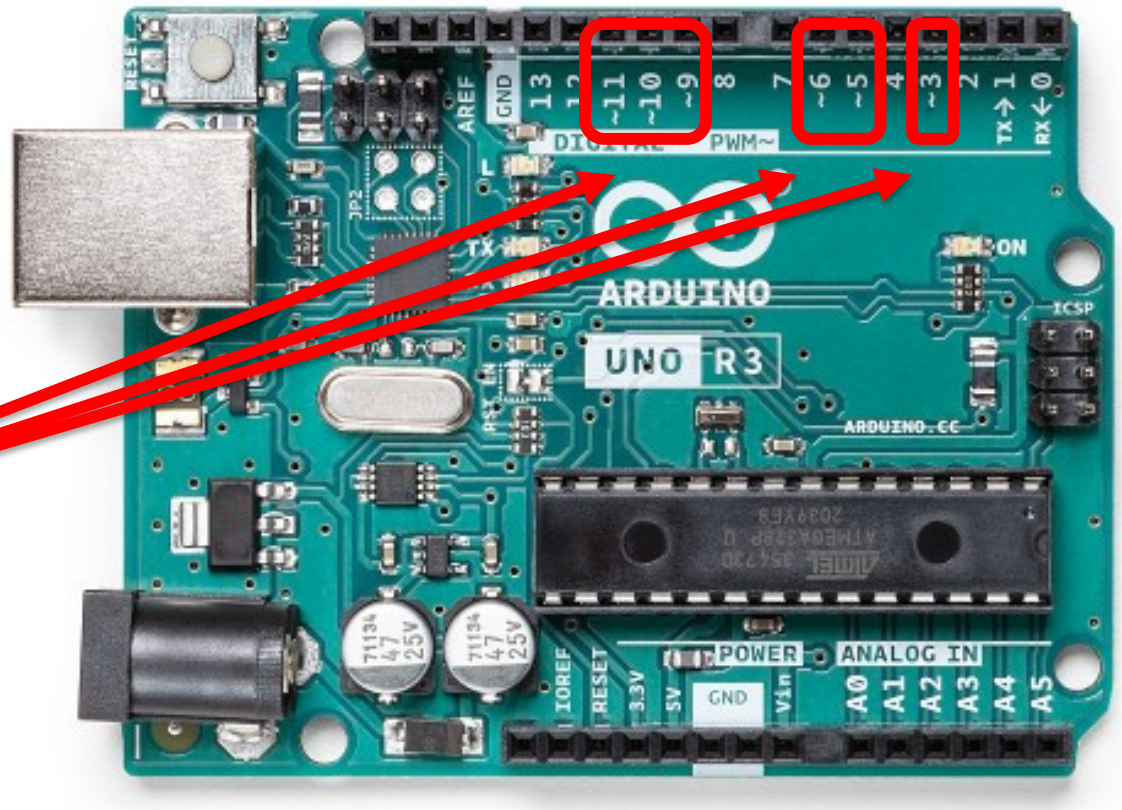
Analogue Output

int analogWrite(pin, value)

- Assigns the state of a Pulse-Width Modulation (PWM) pin labelled with the tilde (~)
- Assigns an integer from 0 to 255

- Example:
  - `analogWrite(9, 255);`

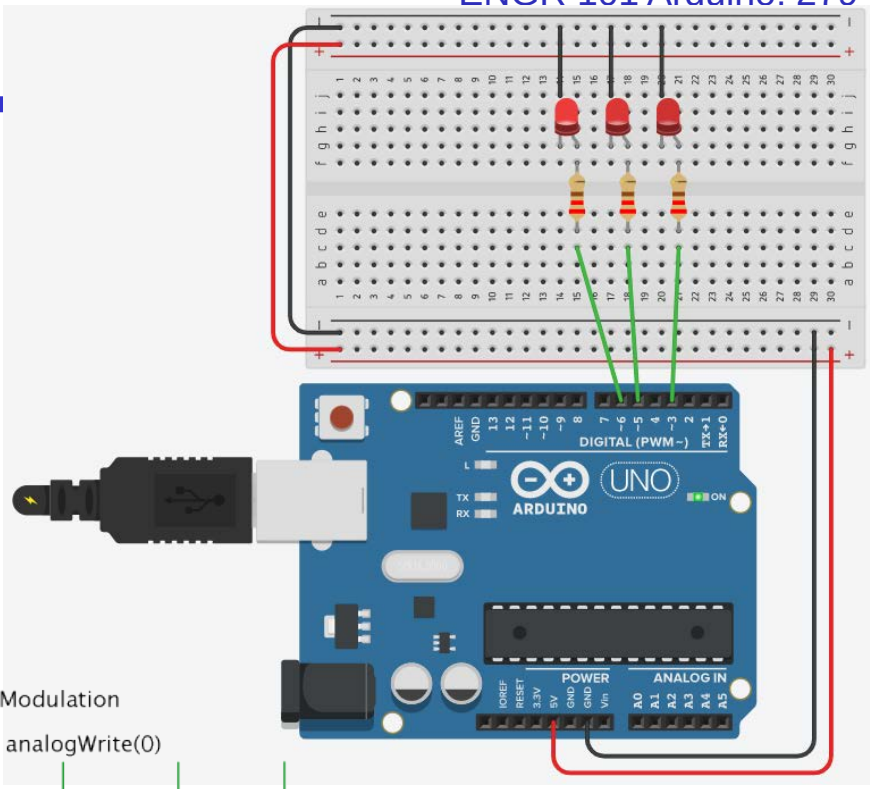
- pin must be a PWM pin (~)

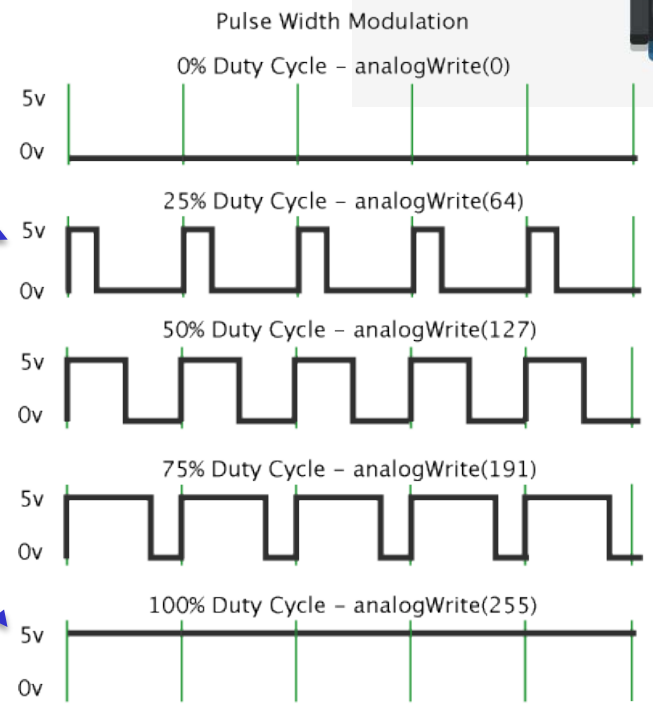


Dimming three LEDs

```
const int led_1_pin = 3;
const int led_2_pin = 5;
const int led_3_pin = 6;
void setup()
{
  pinMode(led_1_pin, OUTPUT);
  pinMode(led_2_pin, OUTPUT);
  pinMode(led_3_pin, OUTPUT);

  analogWrite(led_1_pin, 64);
  analogWrite(led_2_pin, 127);
  analogWrite(led_3_pin, 255);
}
void loop() {
}
```





Fading LED

```
int LED_pw_pin = 5;
int brightness = 0;
int fadeAmount = 5;
void setup() {
   pinMode(LED_pw_pin,OUTPUT);
}

void loop() {
   analogWrite(LED_pw_pin, brightness);
   brightness += fadeAmount;
   if(brightness<= 0|| brightness>= 255){
      fadeAmount = fadeAmount * -1;
   }
   delay(30);
}
```