

# **Smart Textiles Techniques**

Week 4: “Analog Output”

# Analog Output

Analog output is really a form of digital output being cycled at a very fast, controlled rate.

This is also known as Pulse Width Modulation.

But first...

# A Few Things About Analog Output

3 (peculiar) things about analog output:

- Range is 0~255, not 0~1023.
- no `pinMode()` necessary.
- Only digital pins prefixed with a ~ are usable.

# Pulse Width Modulation (PWM)

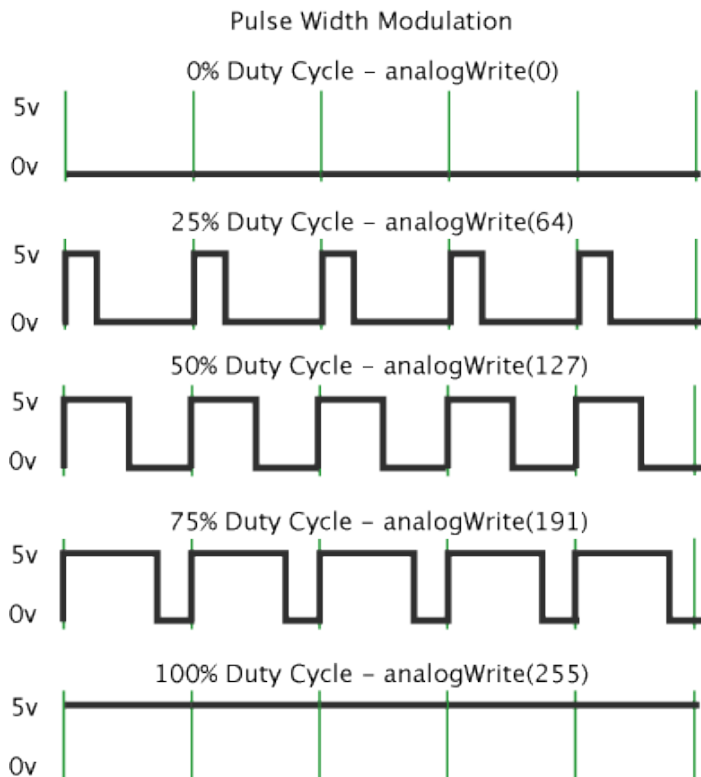
PWM is a way to get an analog signal using digital means.

The HIGH LOW pattern of a digital signal can simulate the full range of voltages between 0-5V by changing the relationship of when the signal is HIGH to when it is LOW.

The duration of time when it is HIGH is called the pulse width.

# Duty Cycle

A complete segment of the HIGH LOW duration is referred to as a duty cycle.



If you imagine the high points in the square waves to the left as being the amount of time when an LED is on, and the low points being when it is off, you can get a good sense of how a duty cycle works.

The more the LED is on, the brighter it will appear.

# Tonight's Code

Tonight's code can be found on the class Github repository.

Check the class site for a link.

# Circuit Diagrams

Extending your breadboard's power busses

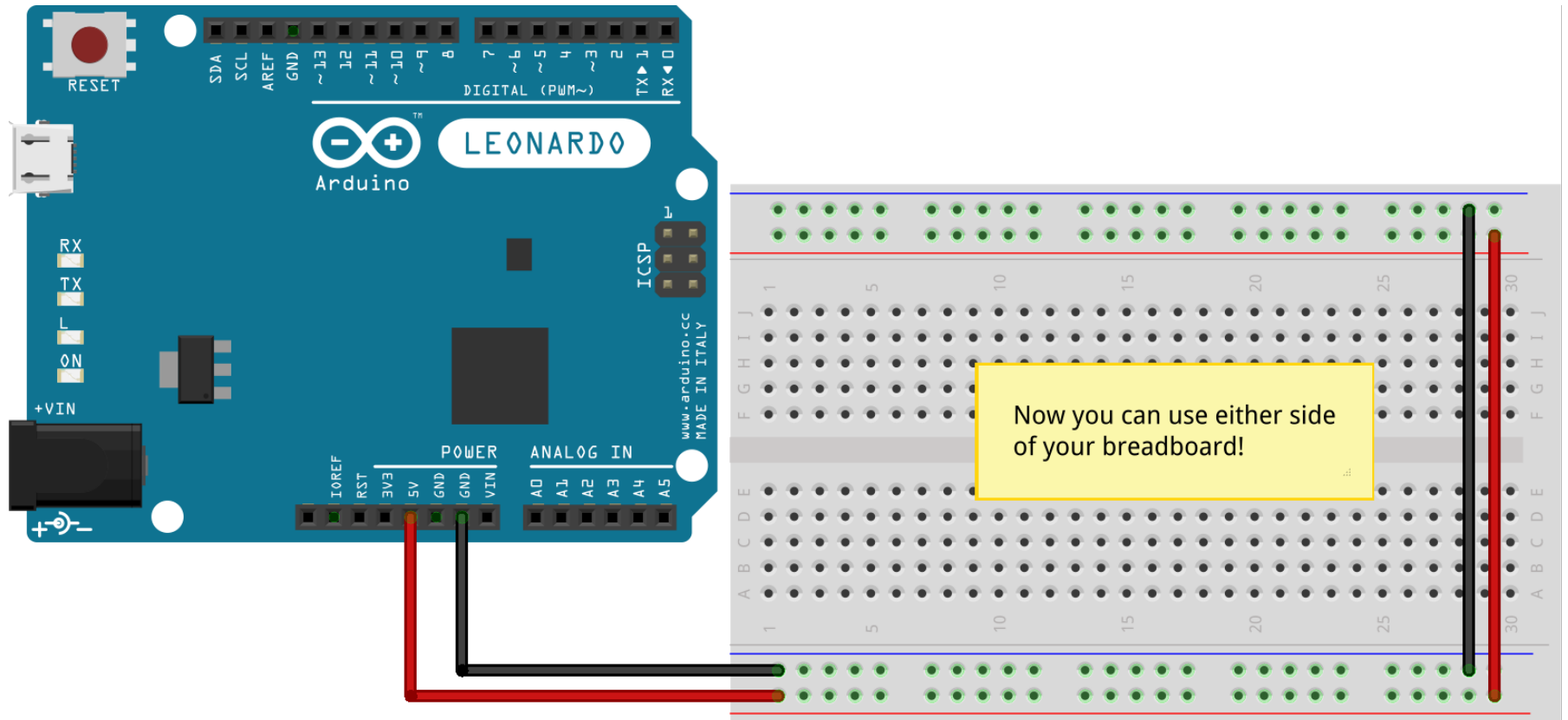
Connecting an LED to a PWM pin.

Analog input + analog output

Connecting an RGB LED

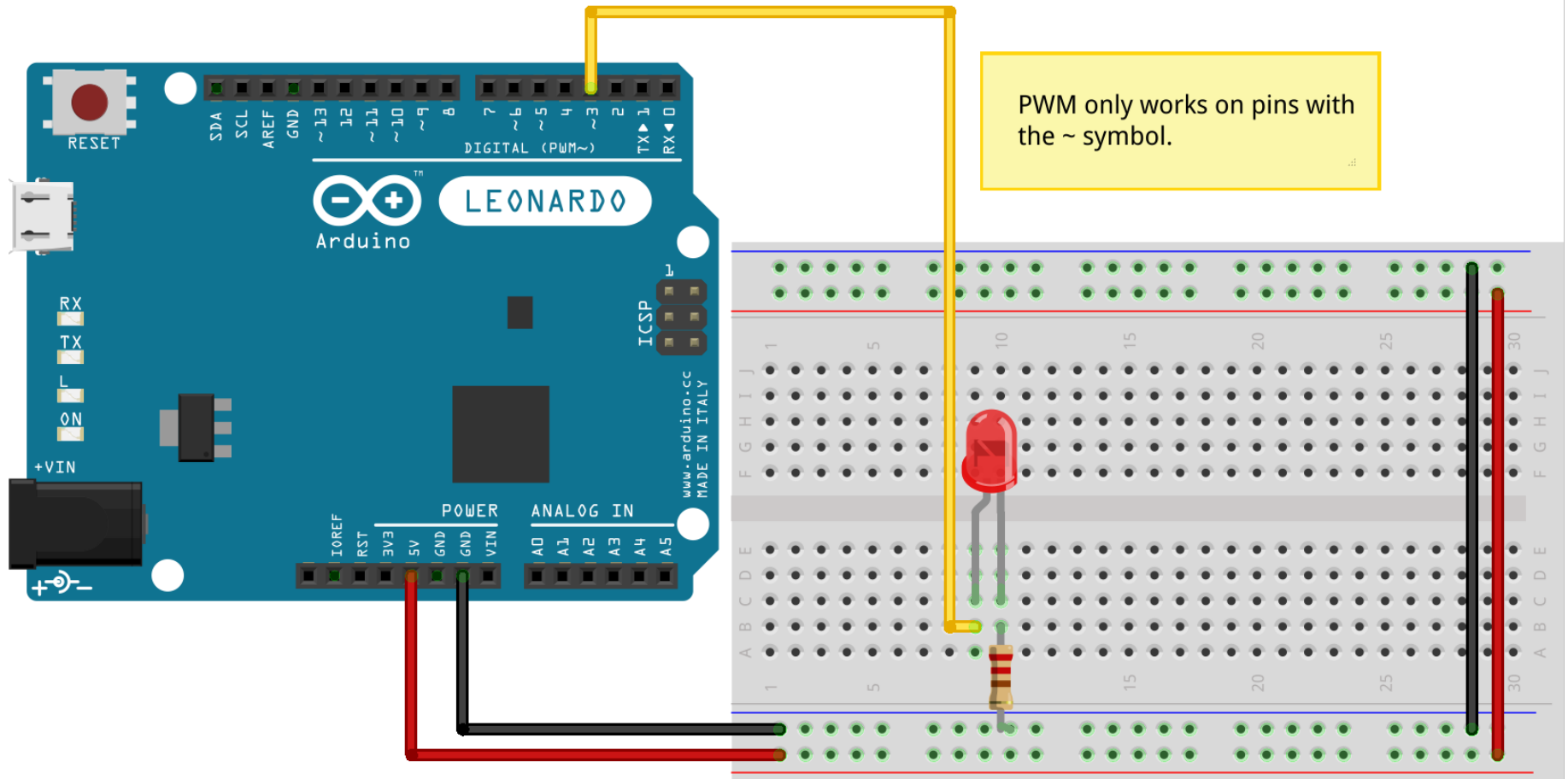
Connecting a piezo buzzer

# Extending power

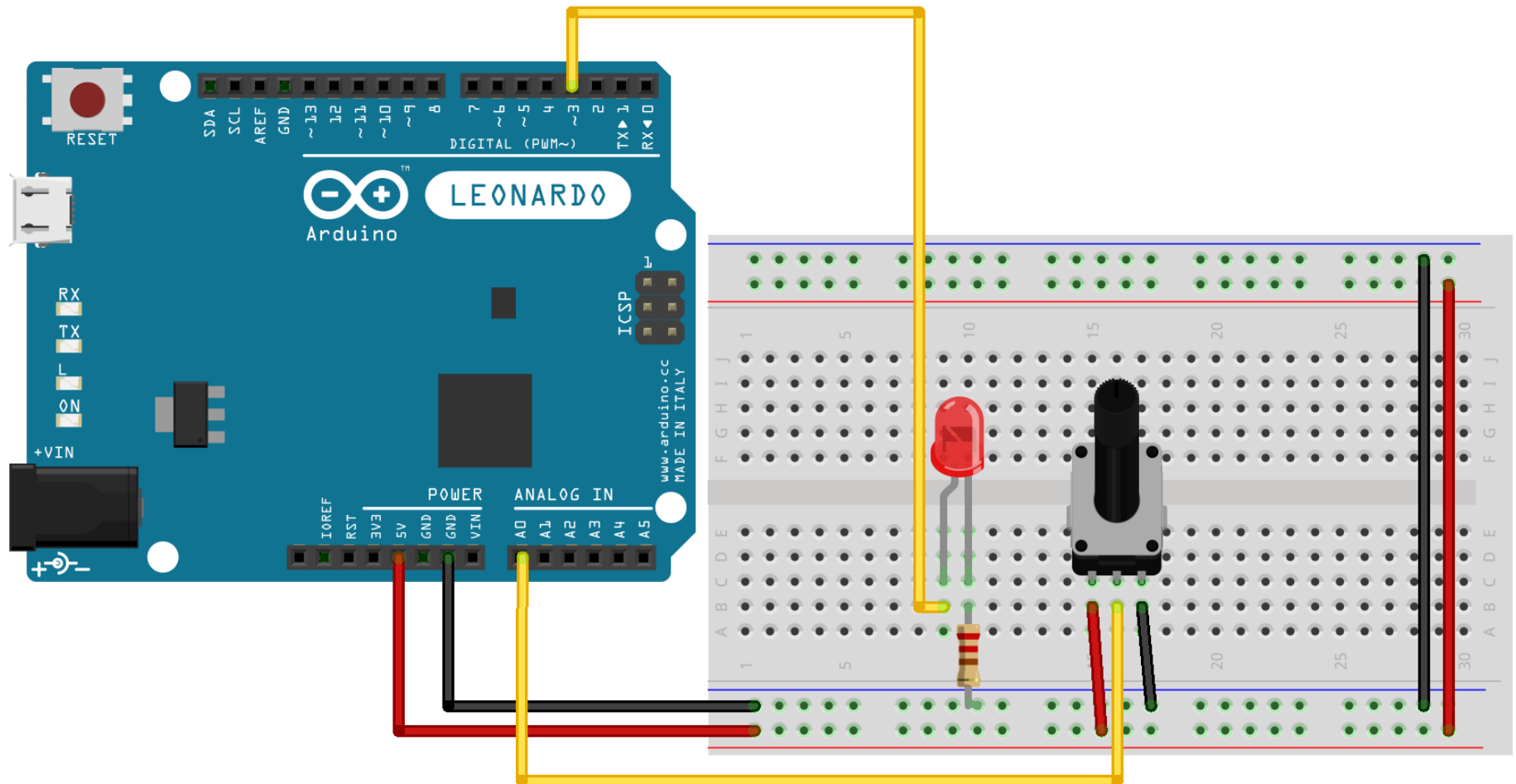




# Connecting an LED for PWM



# Analog Input + Analog Output



# RGB LED

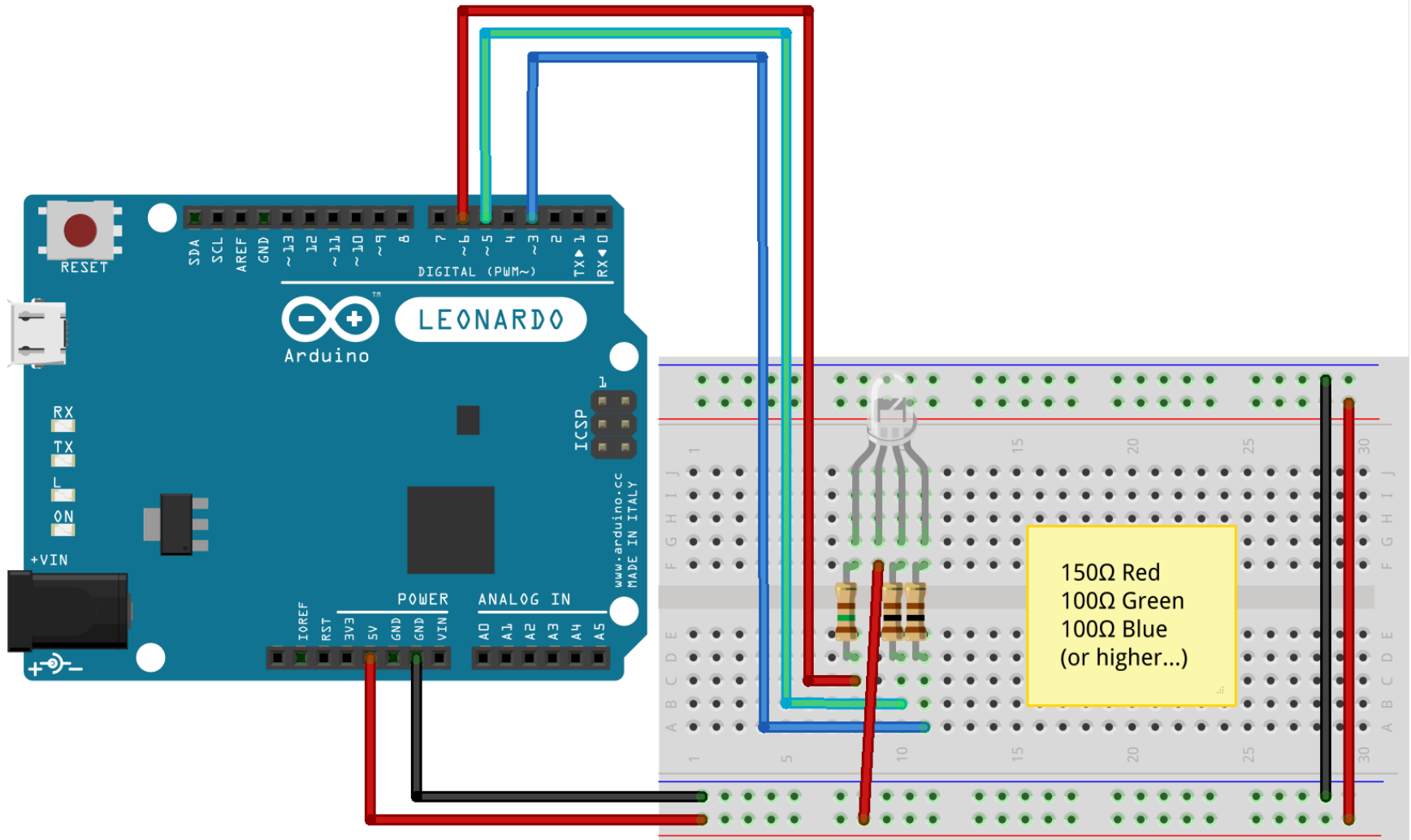
RGB LEDs contain a die for all three colors which can be controlled individually like normal LEDs.



The longest leg on our RGB LED is a “shared anode” which should be connected directly to 5V.

The other legs control the individual colors and must be connected to the your output using appropriate resistors.

# Connecting an RGB LED



# Connecting a piezo buzzer

