microcontroller workshop part 2

Computational Craft Week 6

Fall 2013

agenda

What's on for today:

Quick shareout

Analog

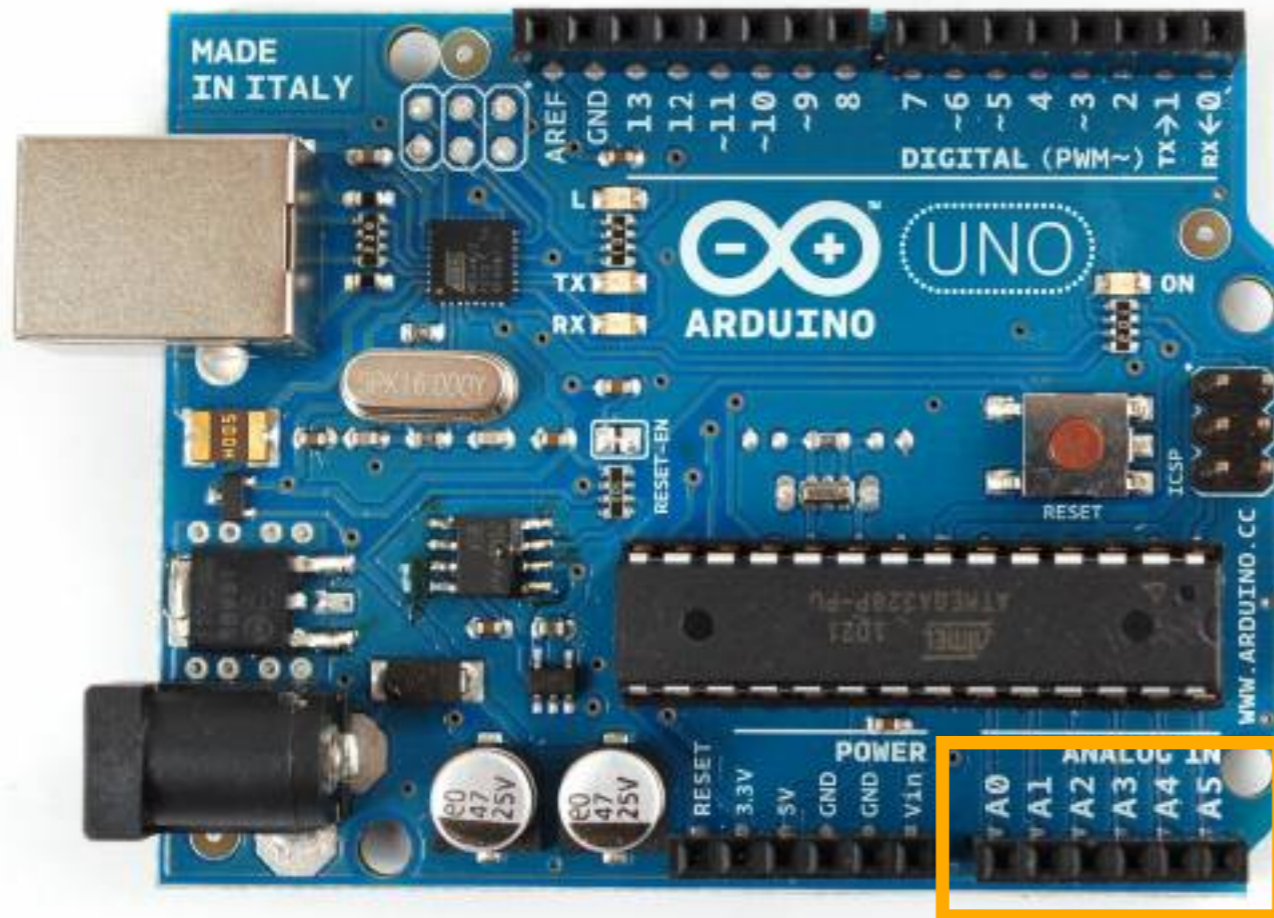//INPUT = Switches + Variable resistors

//OUTPUT = PWM

Capacitance Sensing

Sound

analog input

arduino

6 Analog Input pins

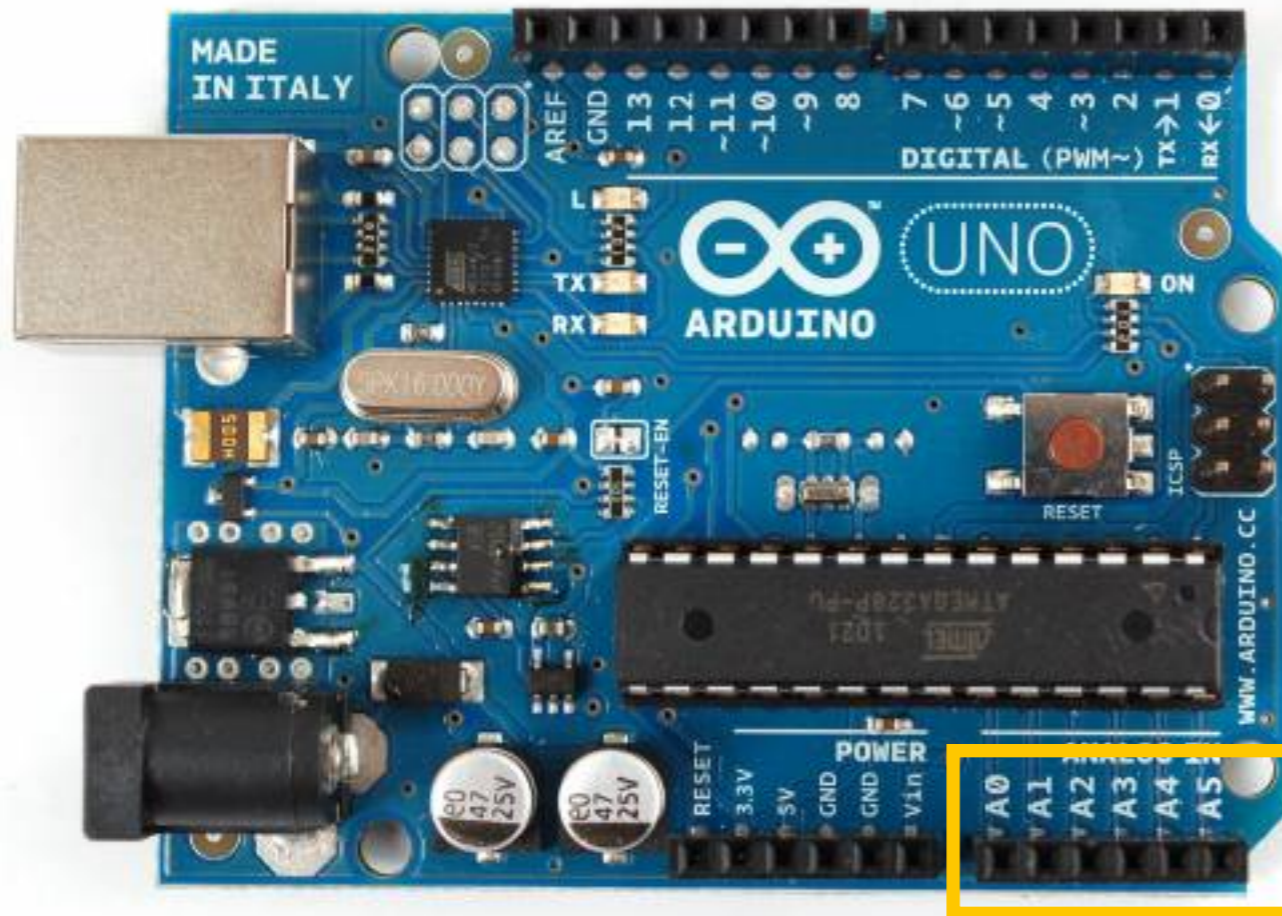You can read or write a wide range of values

Read	0 - 1023
Written	0 - 255

arduino

ANALOG INPUT PINS

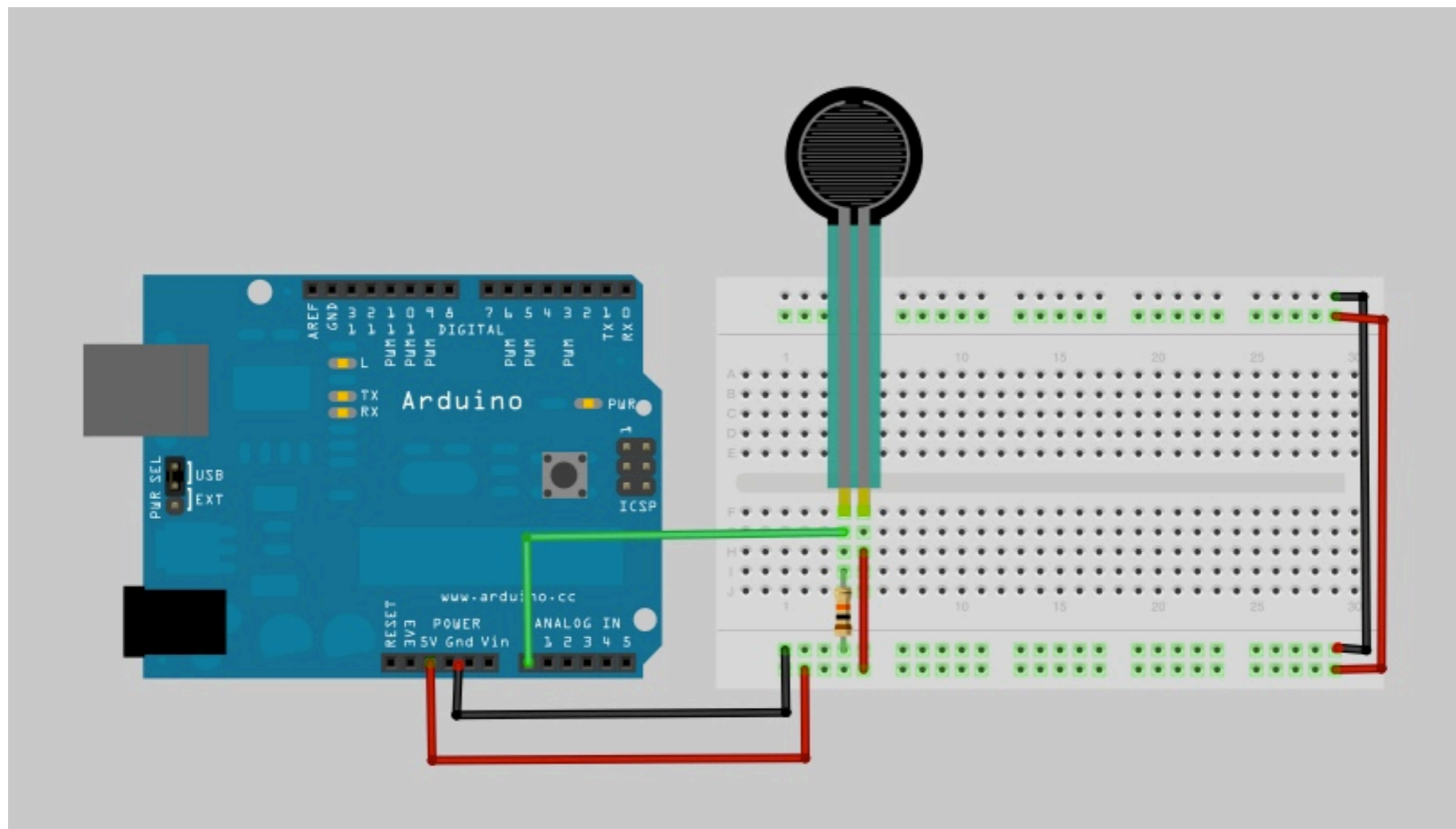## analogRead(pinNumber)

Reads value from specified
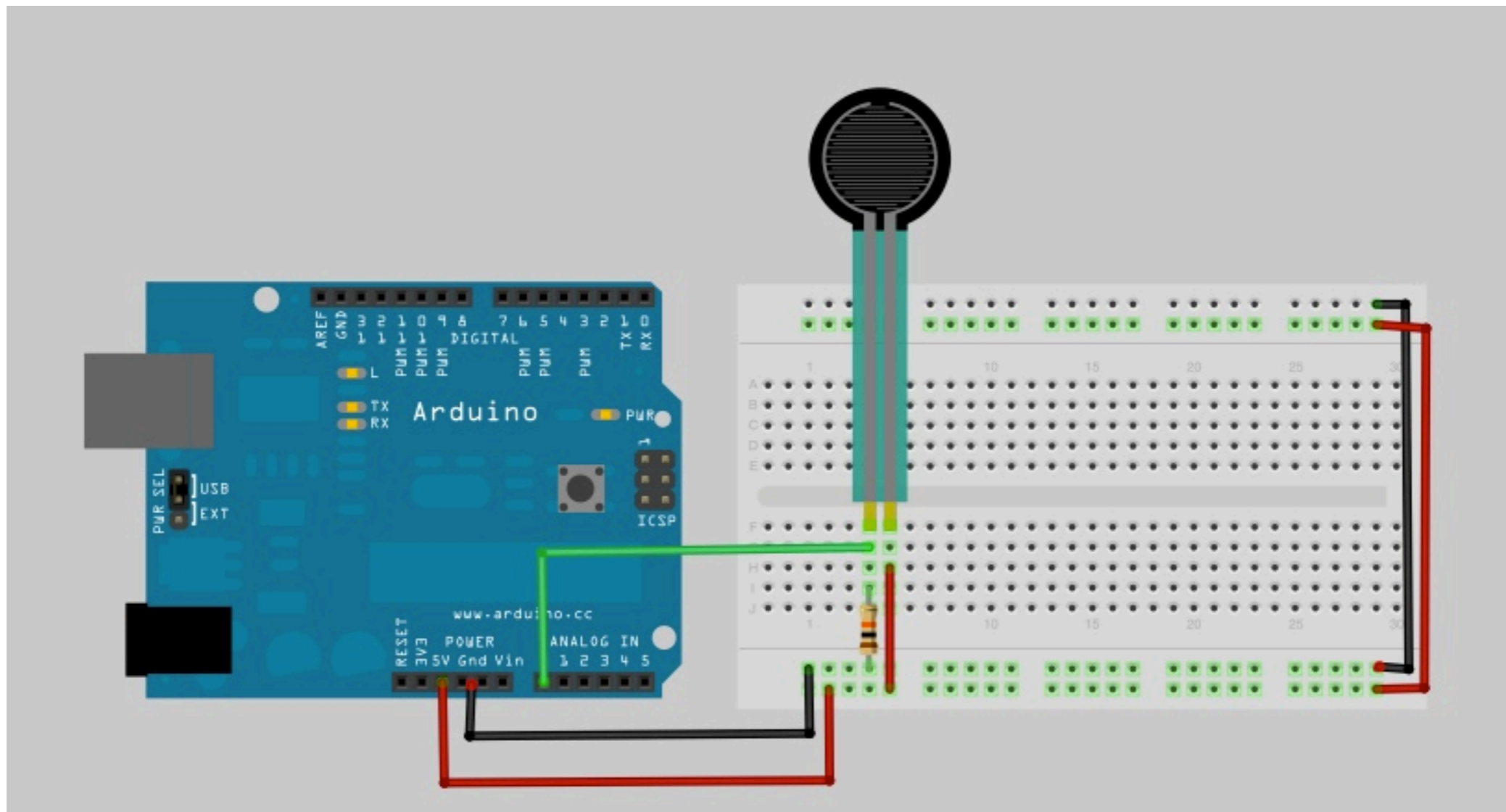analog in pin
For INPUT

arduino

Build a circuit using one of your sensors.

arduino

MAKE IT

Upload the
SensorValSketch_no_map

arduino

Build a circuit using one of your sensors.

Click the Serial Monitor button.

serial communication

If you want to read the values coming in from `analogRead()`, use the serial monitor.

Arduino usually communicates at a baud rate of 9600. This is the rate Arduino and the computer agree to exchange information.

This is also your best way to debug your program.

analog output

arduino

When we faded LEDs using analog means, we controlled the brightness of the LED by controlling the voltage.
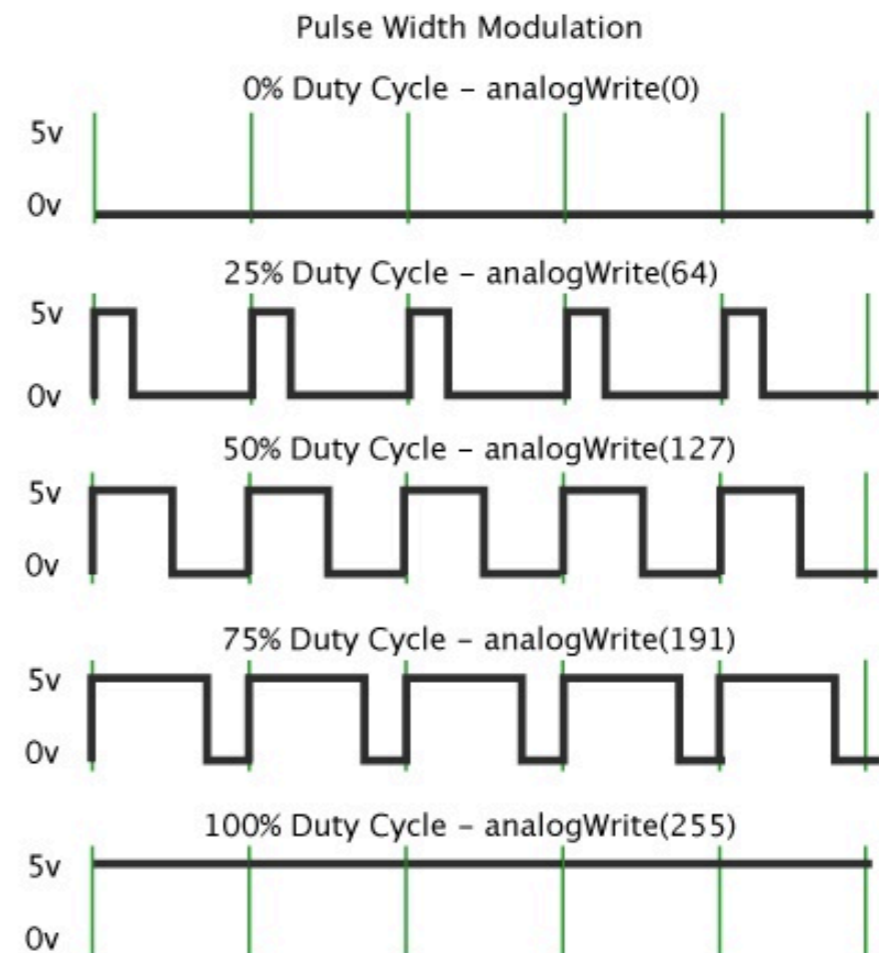
//Remember variable resistance?

arduino

When we fade an LED with Arduino, we don't actually change the voltage.

We simulate analog behavior by turning a signal on and off at different frequencies, because Arduino is not truly analog.

This is called Pulse Width Modulation.

Pulse Width Modulation

0% Duty Cycle – analogWrite(0)

25% Duty Cycle – analogWrite(64)

50% Duty Cycle – analogWrite(127)

75% Duty Cycle – analogWrite(191)

100% Duty Cycle – analogWrite(255)

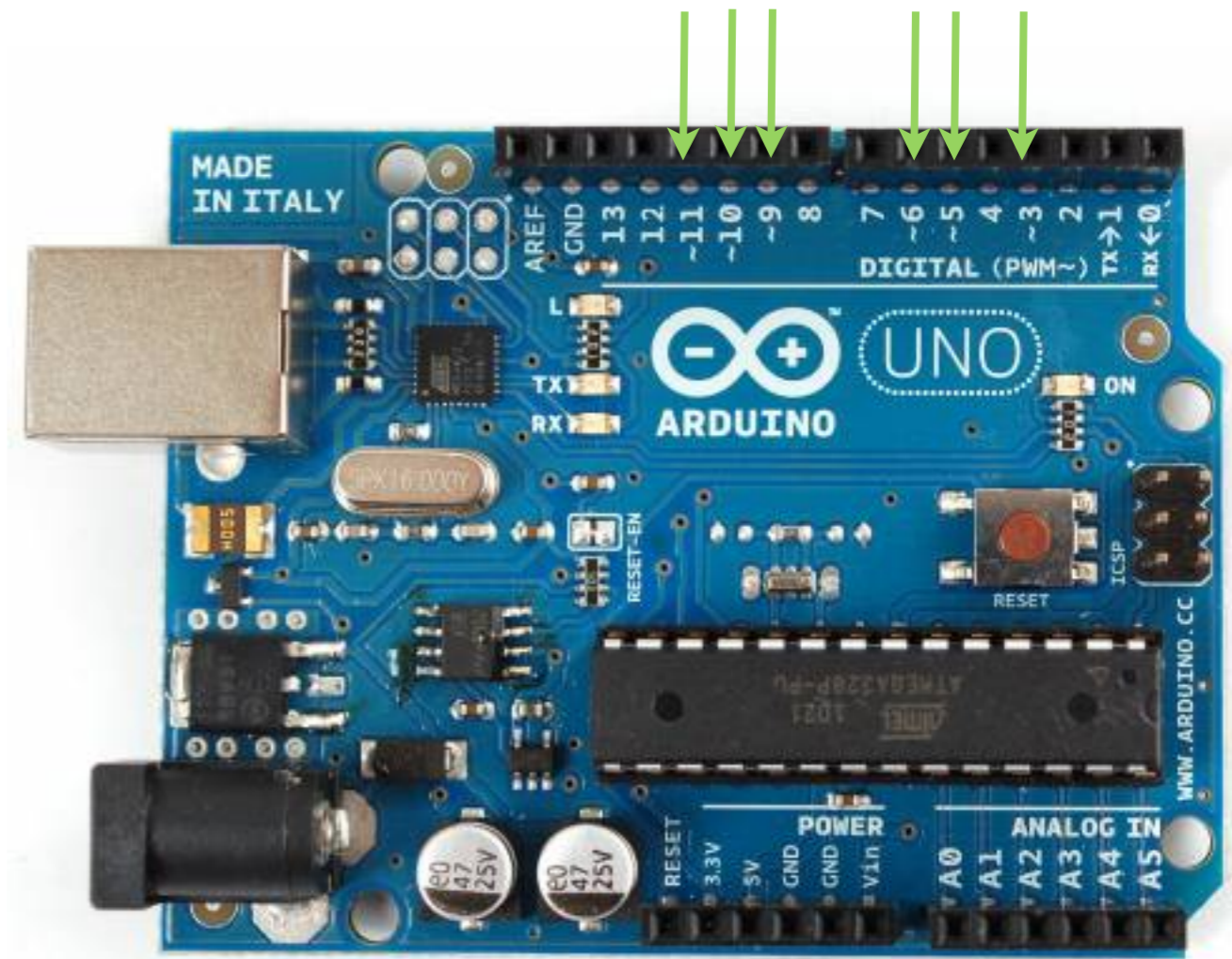# pulse width modulation

Only a few pins can execute this function: 3, 5, 6, 9, 10, and 11.
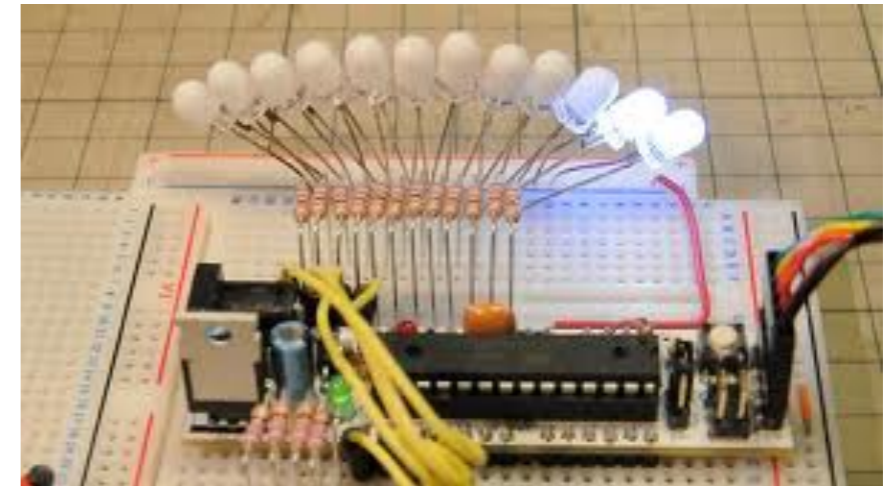
These are special because they can be digital I/O OR analog out.

pulse width modulation

ANALOG OUTPUT PINS

Let's see what this looks like.
Because fading is pretty.

Upload this sketch:
`File>Examples>Basics>Fade`

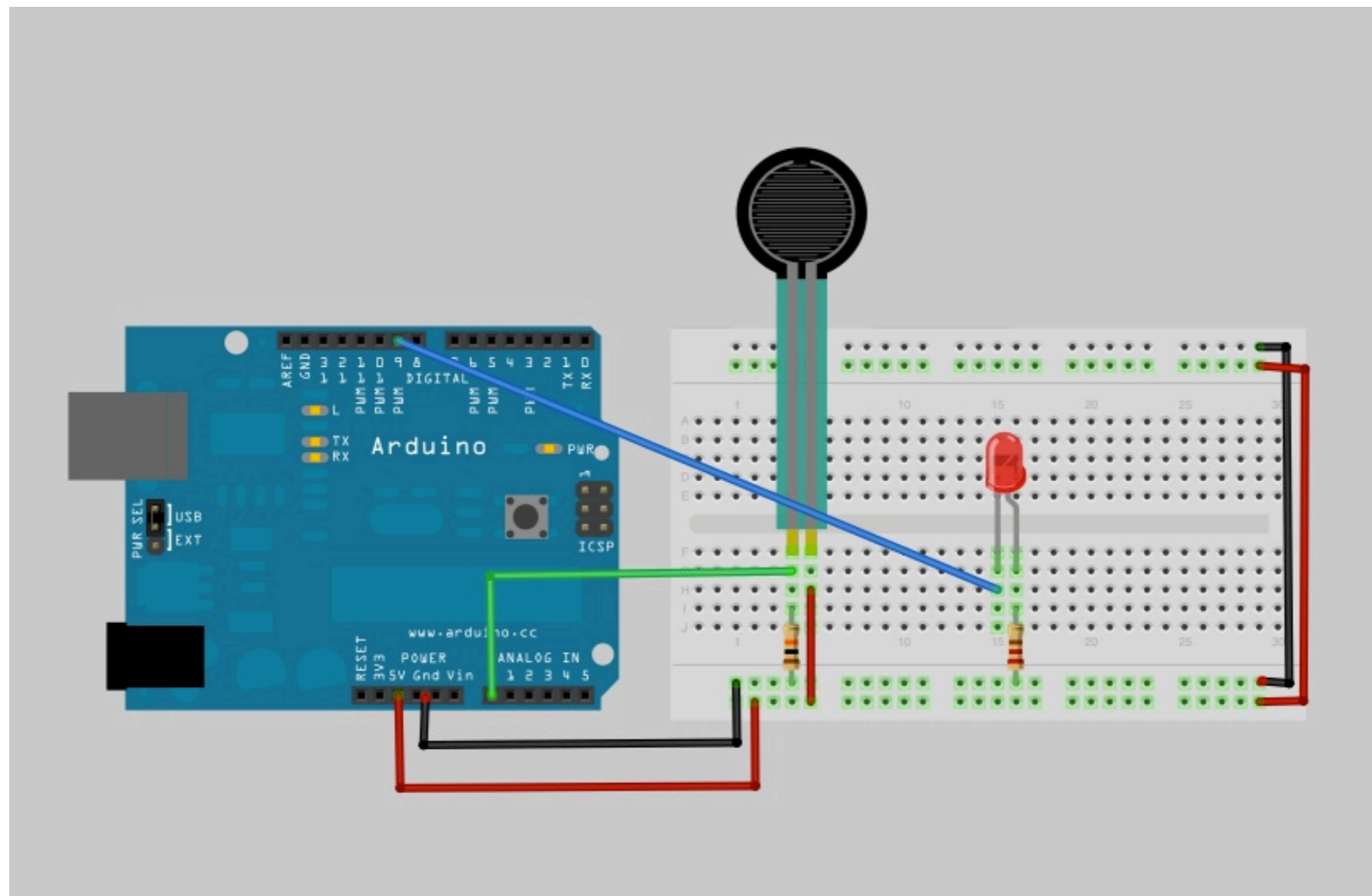Once you've done that, try this one:
`File>Examples>Analog>Fade`

Notice a difference?

Try changing the values to fade the LED at different speeds.

pulse width modulation

ANALOG OUTPUT PINS

Now add an LED to pin 9 and upload

`SensorValSketch_map`

pulse width modulation

ANALOG OUTPUT PINS

Add an LED to pin 9 (you should still have your sensor attached)

Upload the
`SensorValSketch_map`

This is where your
serial monitor
becomes important!

`analogWrite(pin,value)`

The value can be between 0 - 255.
For OUTPUT

`map(value, fromLow, fromHigh, toLow, toHigh)`

We can control the range of the values
by using this function.

capacitive sensing
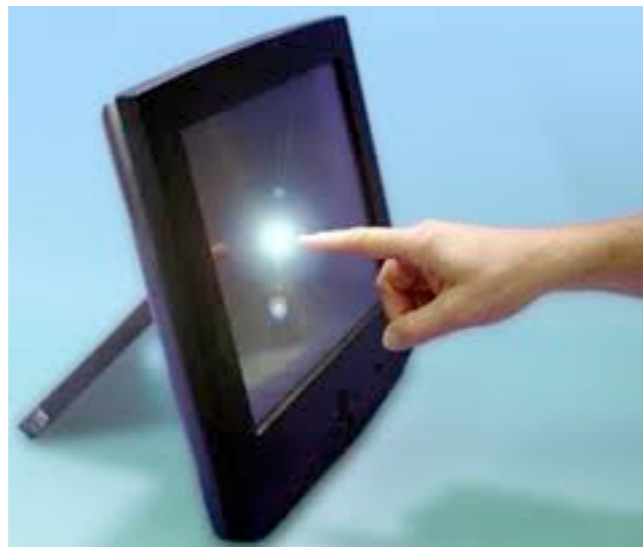
capacitance

Sensing the electrical capacitance of the body.

Capacitance = the ability to store a charge.

Used when little or no human touch or force is desired.

http://playground.arduino.cc//Main/CapacitiveSensor?from=Main.CapSense

capacitance

So what do we need?

Arduino
High value resistor (100 kilohm - 50 megohm)
CapSense Library
Conductive material
Insulating material

http://playground.arduino.cc//Main/CapacitiveSensor?from=Main.CapSense

capacitance

So what do we need?

Arduino
High value resistor (100 kilohm - 50 megohm)
CapSense Library
Conductive material
Insulating material

Send pin   Receive pin

C_{pin}

R

foil

C_{sensed}

http://playground.arduino.cc//Main/CapacitiveSensor?from=Main.CapSense
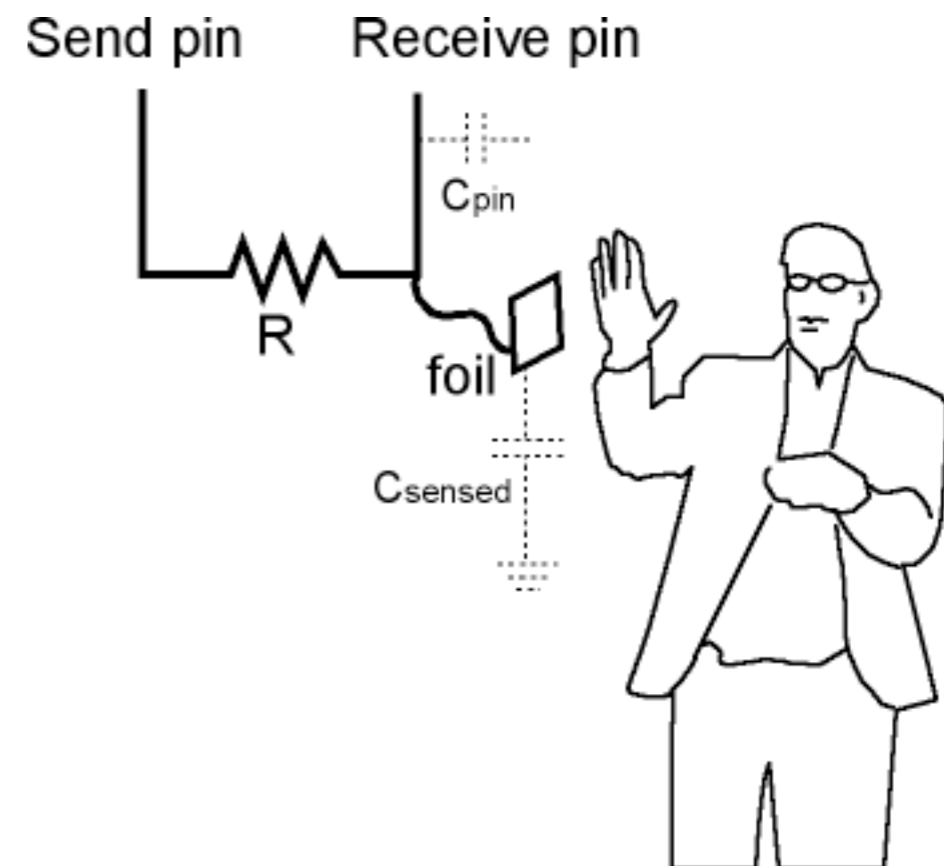
capacitance

Remember - these are all variables to experiment with!

Arduino
High value resistor (100 kilohm - 50 megohm)
CapSense Library
Conductive material
Insulating material

capacitance

Resistor values

1 megaohm - touch will activate
10 megaohm = 4-6 inches
40 megaohm - 12-24 inches
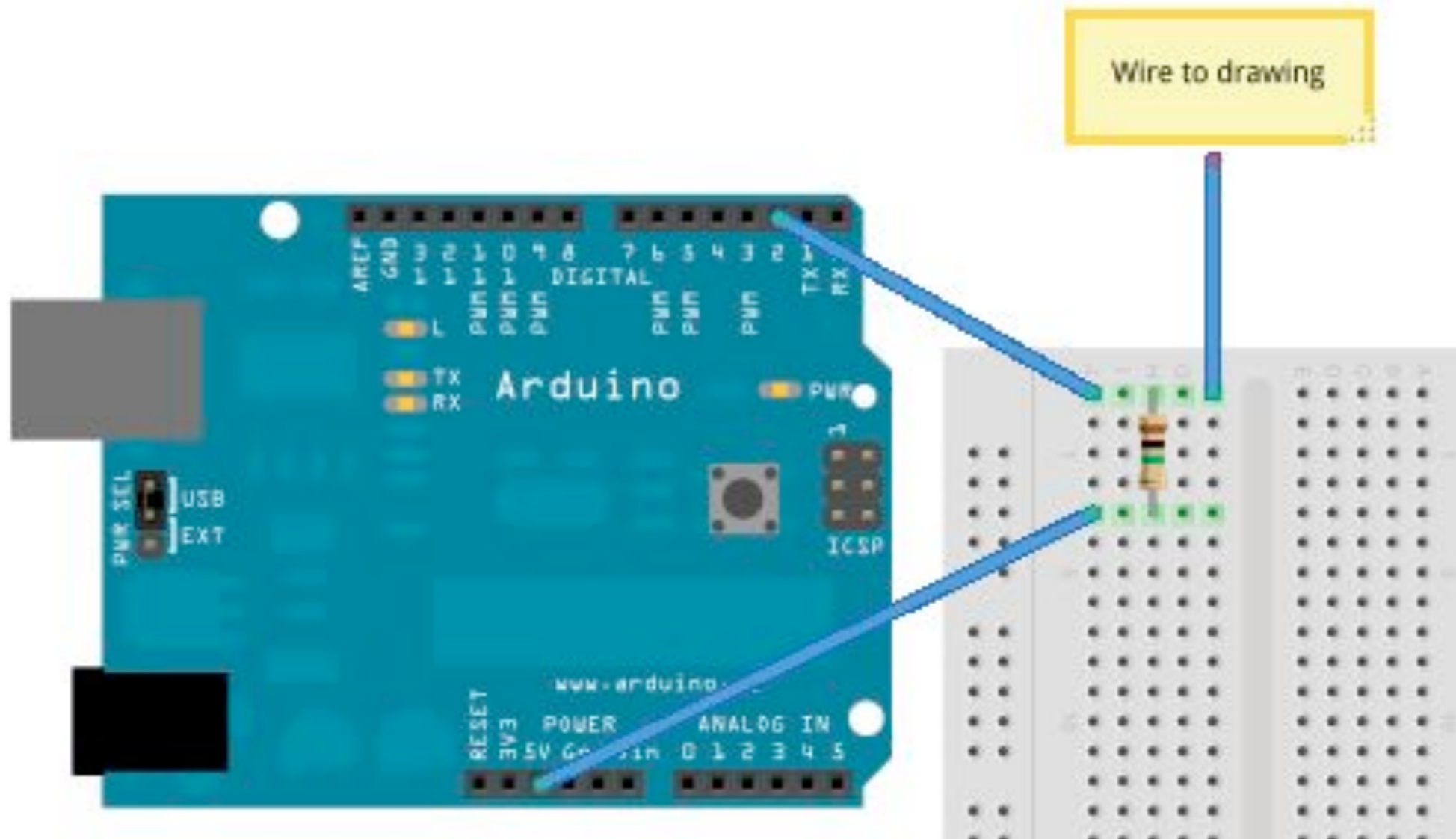40 + megaohm - >24 inches

Larger resistor = increased sensitivity
Larger resistor = slower response

http://playground.arduino.cc//Main/CapacitiveSensor?from=Main.CapSense

capacitance

Wire to drawing

http://playground.arduino.cc//Main/CapacitiveSensor?from=Main.CapSense

capacitance

Wire to drawing

Upload the CapacitiveSensorSketch in the Examples folder.

http://playground.arduino.cc//Main/CapacitiveSensor?from=Main.CapSense

capacitance

SWITCHING IT UP

Debugging.

A capacitive sensor attached to a laptop if the laptop is unconnected to a main power source can be jerky. (In many ways) The computer can become a sensor and affect the values.

Too unstable? Add a small capacitor (100 pF - .01 uF) to ground, on the sense pin

http://playground.arduino.cc//Main/CapacitiveSensor?from=Main.CapSense

sound

sound off

LOUD AND PROUD

We will hit sound hard in a few weeks.

This is just to whet your palette. And because playing sound is FUN.

sound off

LOUD AND PROUD

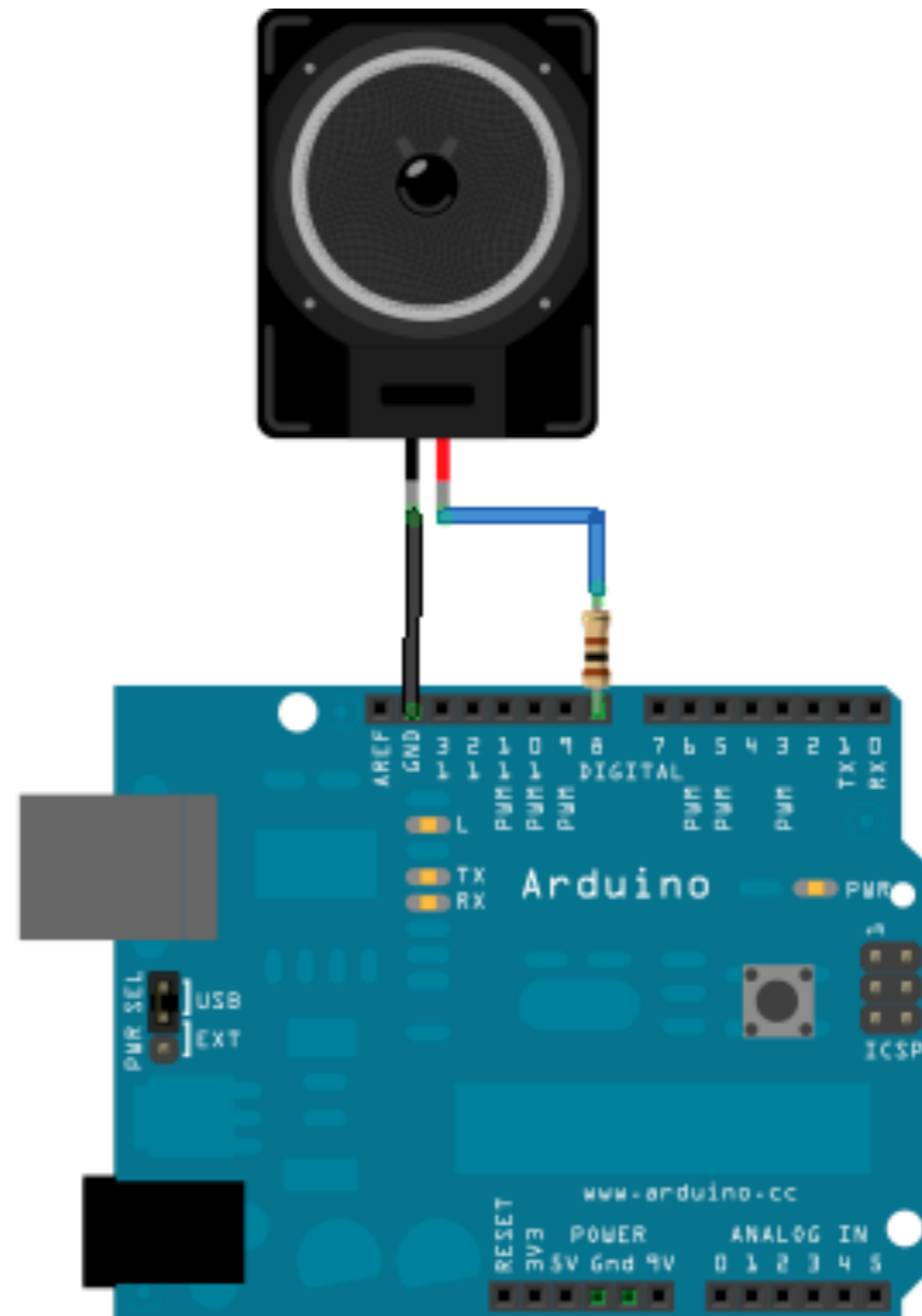## What you need:

Arduino
Breadboard
Wire
Speaker
100 ohm resistor

sound off

LOUD AND PROUD

What you do:

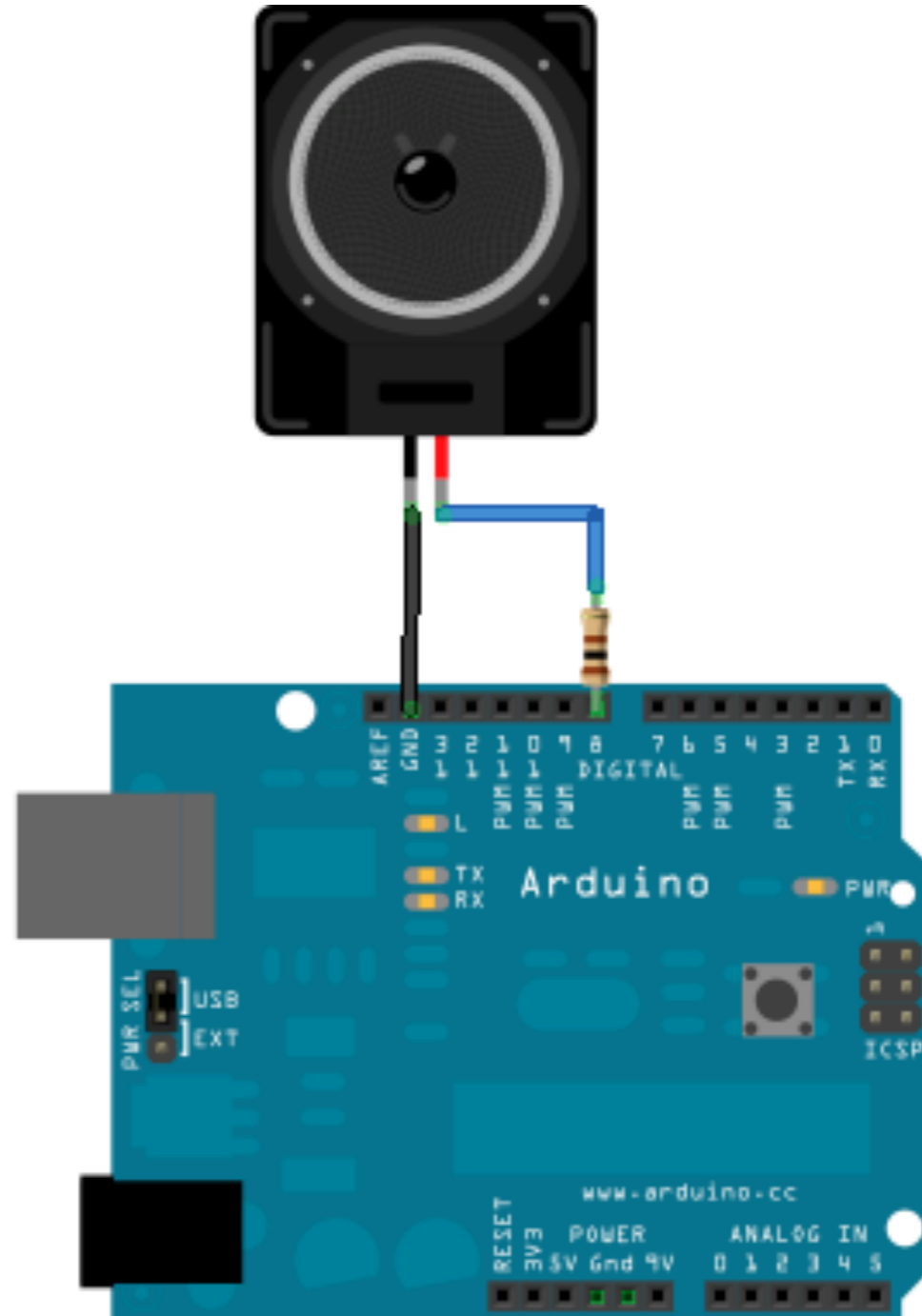Hook up one wire to pin 8 with a 100 Ohm resistor and the other to ground.

http://arduino.cc/en/Tutorial/Tone

sound off

What you do:

Hook up one wire to pin 8 with a 100 Ohm resistor and the other to ground.

Upload the toneMelody sketch in Examples>Digital Folder

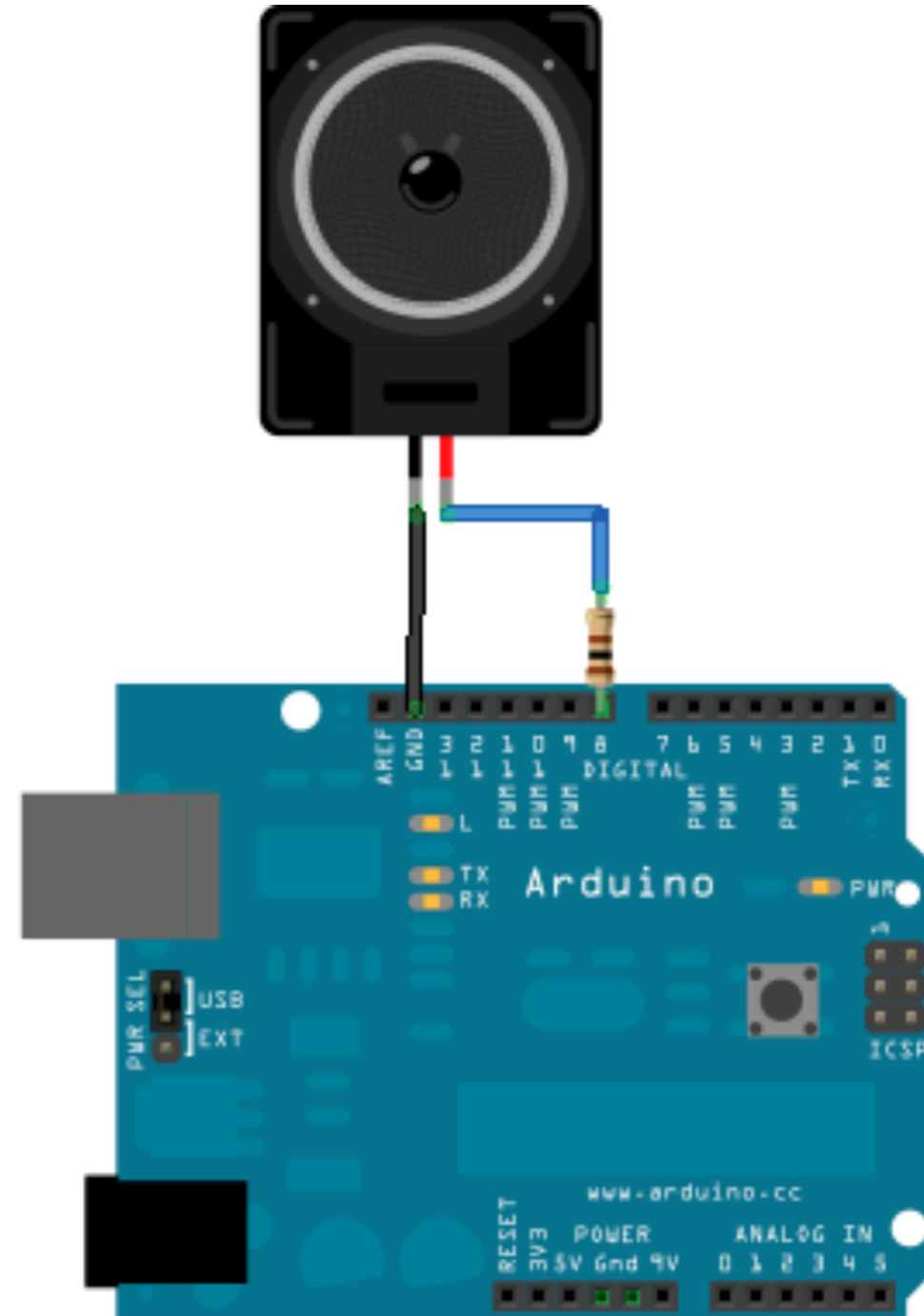http://arduino.cc/en/Tutorial/Tone

sound off

LOUD AND PROUD

Let's look at the code.

tone(pin, frequency)
tone(pin, frequency, duration)

pitches.h

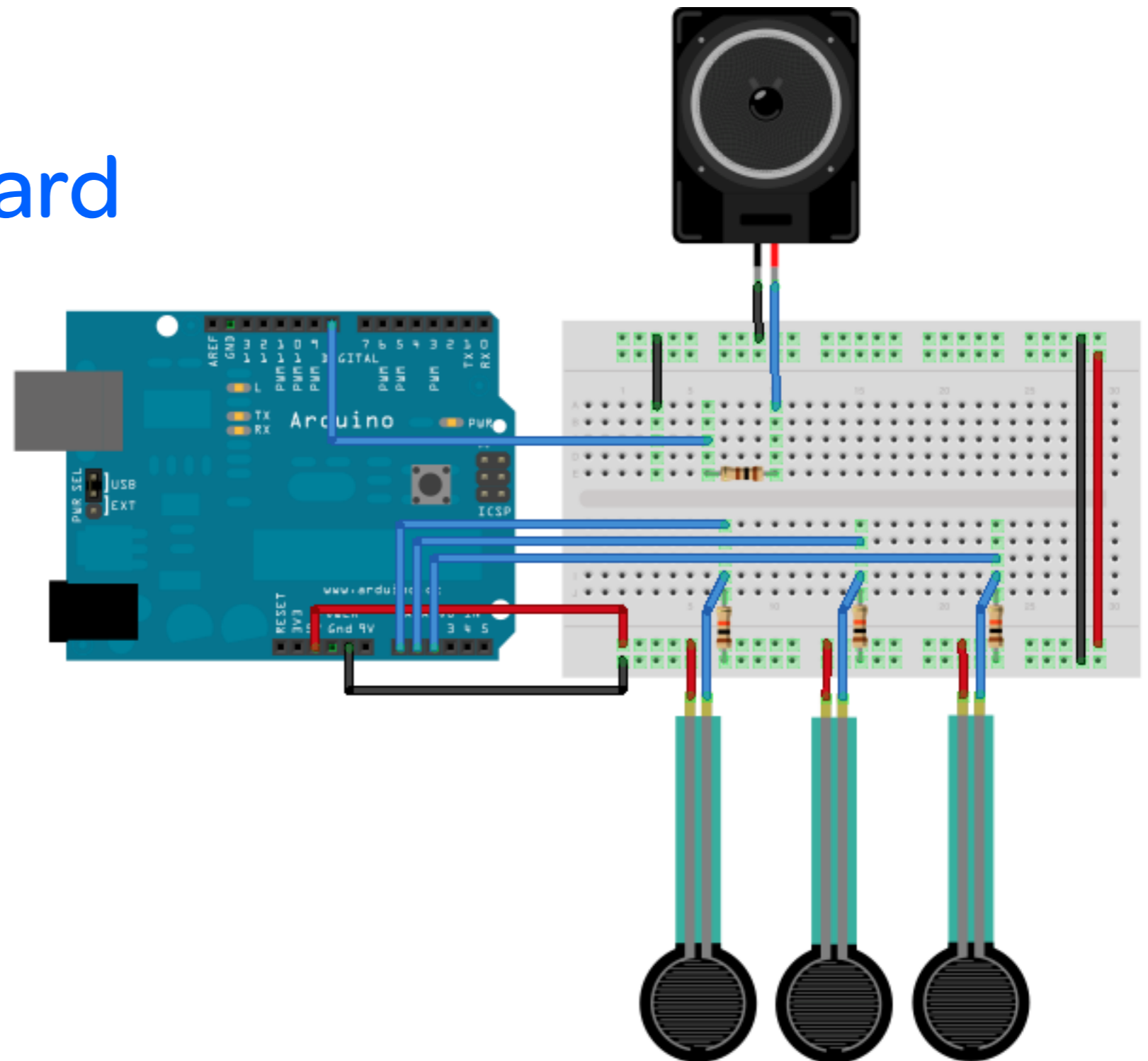http://arduino.cc/en/Tutorial/Tone

sound off

A few things:

1) Only ONE tone can be played at a time.

2) Use of the tone() function will interfere with PWM output on pins 3 and 11 (on boards other than the Mega).

3) If you want to play different pitches on multiple pins, you need to call noTone() on one pin before calling tone() on the next pin.

http://arduino.cc/en/Tutorial/Tone

sound off

Simple keyboard

Examples > Digital > toneKeyboard

http://arduino.cc/en/Tutorial/Tone

sound off

SO ARDUINO IS NOT THE BEST FOR SOUND

Other options for better sound:

Adafruit Wave Shield

http://learn.adafruit.com/adafruit-wave-shield-audio-shield-for-arduino/overview

Adafruit Tone Tutorial

http://learn.adafruit.com/adafruit-arduino-lesson-10-making-sounds/overview

Simple Audio Samples (only about 4 secs, but still cool)

http://hlt.media.mit.edu/?p=1963

Awesome but advanced: Mozzi Sound Synthesis Library

http://sensorium.github.io/Mozzi/

http://arduino.cc/en/Tutorial/Tone

capacitance

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