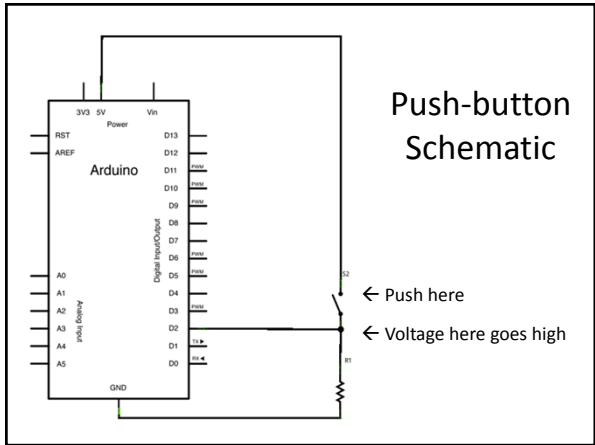


# Computer Inputs

CSE 102

- ## What Inputs Can You Think Of?
- Keyboard
  - Mouse
  - Camera
  - Joystick
  - Microphone
  - Photocell
  - Touch Screen
  - Button
  - Temperature Probe
  - iPod Click Wheel
  - Digital Crown
  - Trackball
  - Motion Sensor
  - Scale
  - Network

- ## Simplest Digital Input
- Push-button switch
    - Pressed = 1, HIGH, TRUE
    - Not-pressed = 0, LOW, FALSE
  - Electro-mechanical device
    - When button is pressed, electrical contacts conduct
    - When make/break contact, the contacts can bounce
    - This bouncing can happen over milliseconds
    - But software operates at microsecond scales
    - Even a simple push-button isn't so simple!



## Switch “Debouncing”

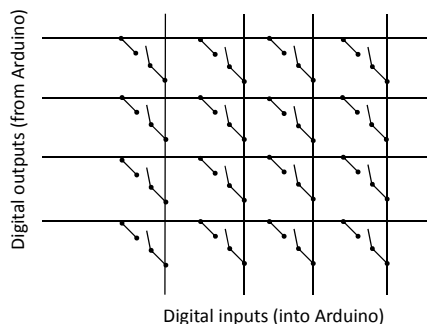
```

Read switch state
Wait enough time for switch to quit bouncing
Read switch state again
If two switch states agree
    Done
Else
    Start over
    
```

- ## Watch out for signaling convention!
- Switch between input pin and +5V
    - Input goes HIGH when switch is pressed
  - Switch between input pin and GND
    - Input goes LOW when switch is pressed
  - Why would one do the second option above?
  - Because the resistor is available, built into the processor



### What about many switches?

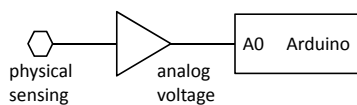


### Inputs from Physical World

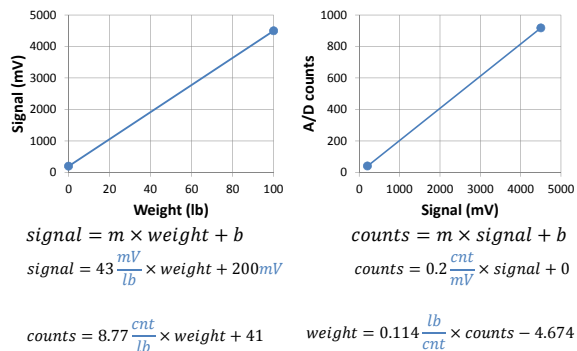
- Digital Inputs
  - Proximity detector
  - Garage door safety beam
- Analog Inputs
  - Fluid level in a tank
  - Pressure
  - Temperature

### Analog to Digital Conversion

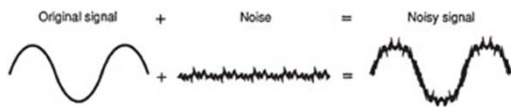
- Convert physical property to voltage signal
- A/D converter on Arduino converts voltage signal to digital representation
  - 10-bit A/D converter has range 0 to  $2^{10} - 1$  (0 to 1023) for voltage range 0 to  $V_{REF}$



### Understanding Ranges



### Noisy Analog Signals



- Noise is ever present in analog signals
- For stable signal, quick fix is to average several readings

$$avg = \frac{1}{N} \sum_{i=1}^N A/D\ input_i$$

### Studio 2

- Come to Urbauer 115
- Form groups of 2
- Do the exercises
  - Debounce a noisy push-button switch
  - Debounce a cleaner switch
  - Add pedestrian crosswalk signal to traffic light
  - Read temperature from probe
- Get signed out by Ben, Ed, or Roger