

Fundamentals of Physical Computing

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Plan for Today

- Lab Review
- Creative Analog Devices
- Math Review
- Analog Output
- Servos & Sound
- Libraries
- Engagement
- Readings & Assignments

Lab Review

Creative Analog Device Results

Math



Computer Math

- Binary, Decimal, Octal, Hexadecimal
 - Why?
 - Understanding computers
 - Programming helper, communications essential
 - What?
 - It's all notation

Decimal

- Place system
- Powers
- Adding and carries
- Finger counting, but is that base 10?

Binary

- Place system
- Notation: %010 010b 0b10
- Powers
- Adding and carries
- Finger counting!

Octal

- Place system
- Notation **073**
- Powers
- Adding and carries
- Finger counting, not really

Hexadecimal

- Place system
- Notation: extra digits, 0x10, #FFFFFF
- Powers
- Adding and carries
- Finger counting?
- Switches yes: 0xFF = 1111 1111 and 0x3C = 0011 1100

PWM

Pulse Width Determines Position

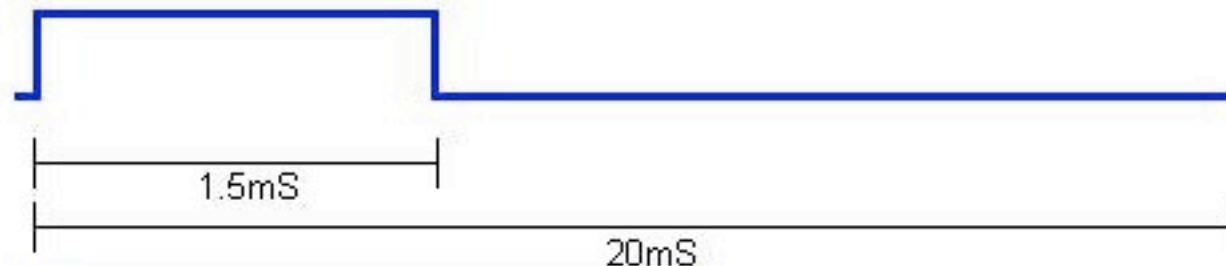
Position Pulse Width

Example Pulse

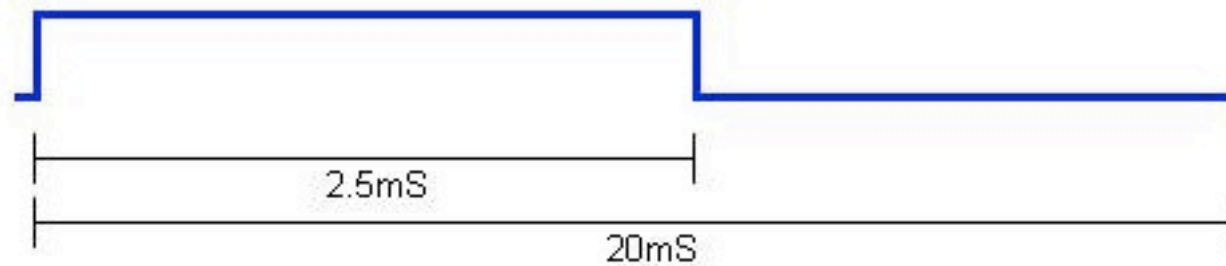
Minimum 0.5mS



Center 1.5mS



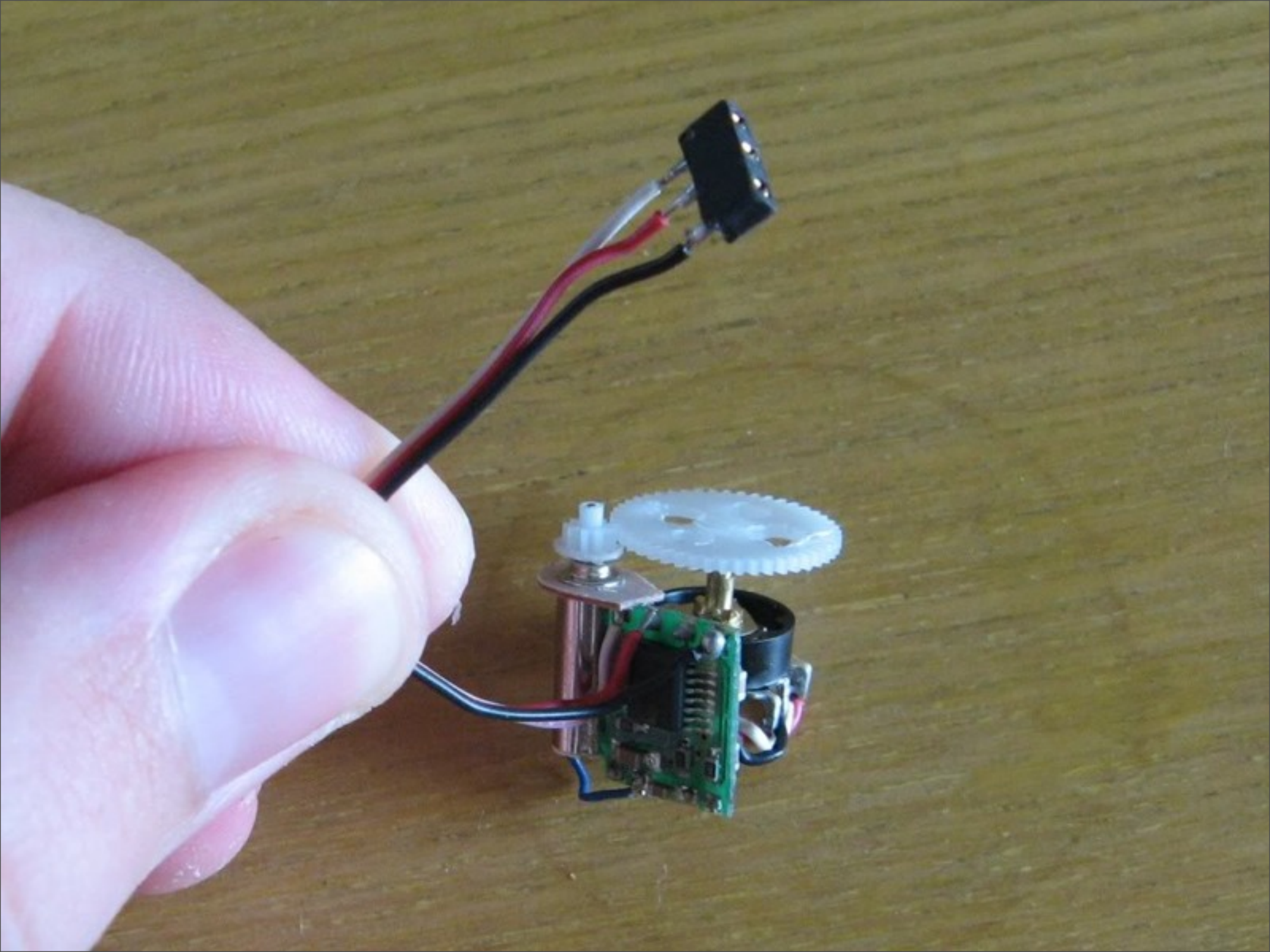
Maximum 2.5mS

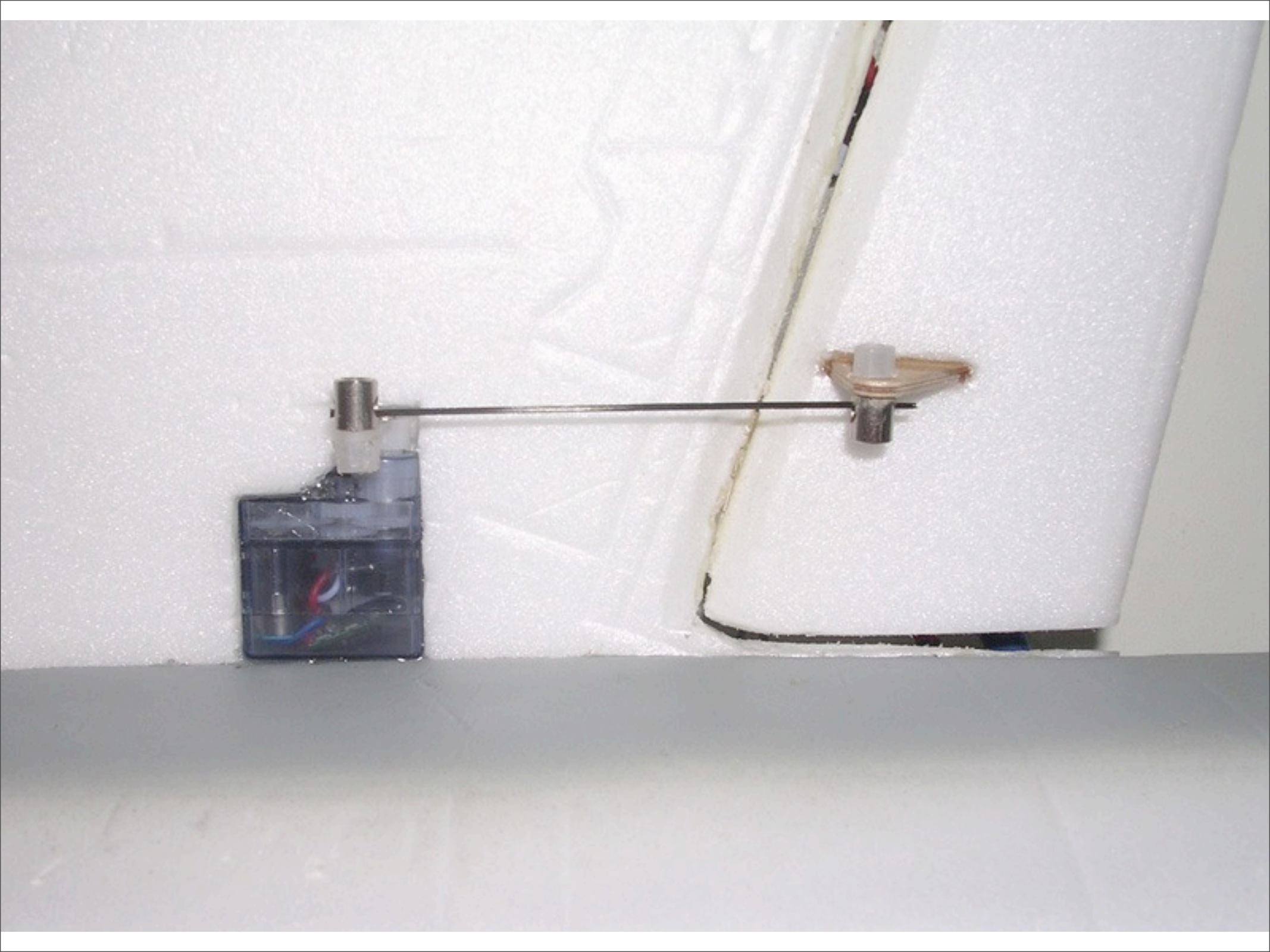


Servos

Servo Motors

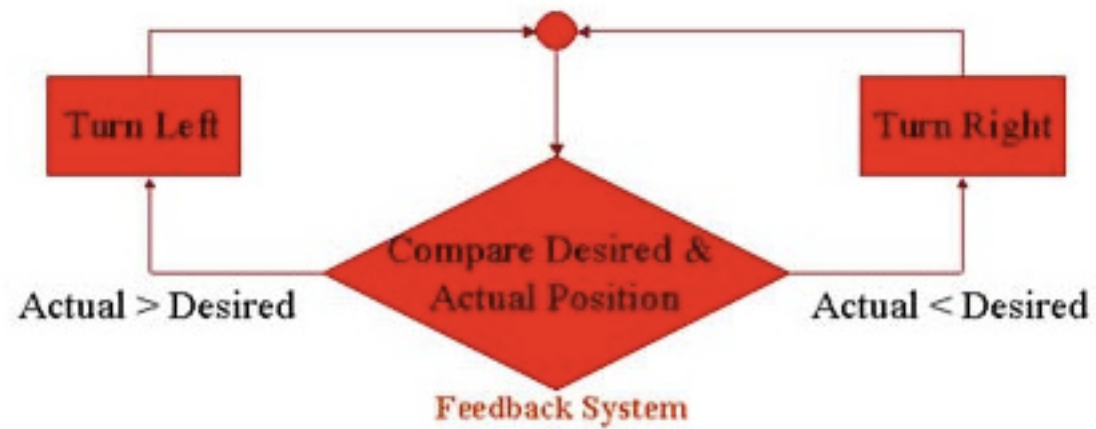






Motor + Potentiometer + Microcontroller

Feedback (negative)

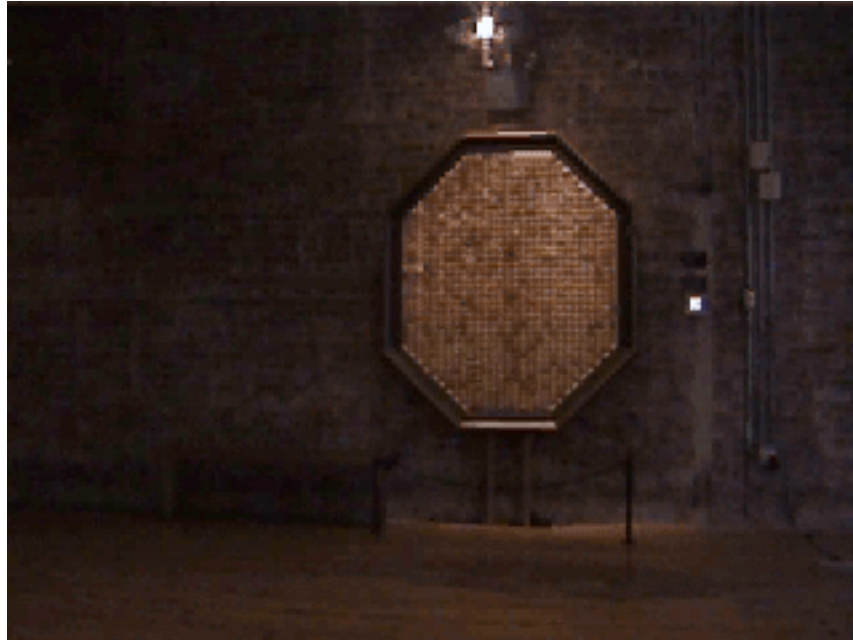


Model Airplanes



Danny Rozin

Danny Rozin



Libraries



Web Reference

Arduino

[Buy](#) | [Download](#) | [Getting Started](#) | [Learning](#) | [Reference](#) | [Hardware](#) | [FAQ](#) [Blog »](#) | [Forum »](#) | [Playground »](#)

[Reference](#) | [Language \(extended\)](#) | **[Libraries](#)** | [Comparison](#) | [Changes](#)

Libraries

To use an existing library in a sketch, go to the Sketch menu, choose "Import Library", and pick from the libraries available. This will insert one or more **#include** statements at the top of the sketch and allow it to use the library.

Because libraries are uploaded to the board with your sketch, they increase the amount of space it takes up. If a sketch no longer needs a library, simply delete its **#include** statements from the top of your code.

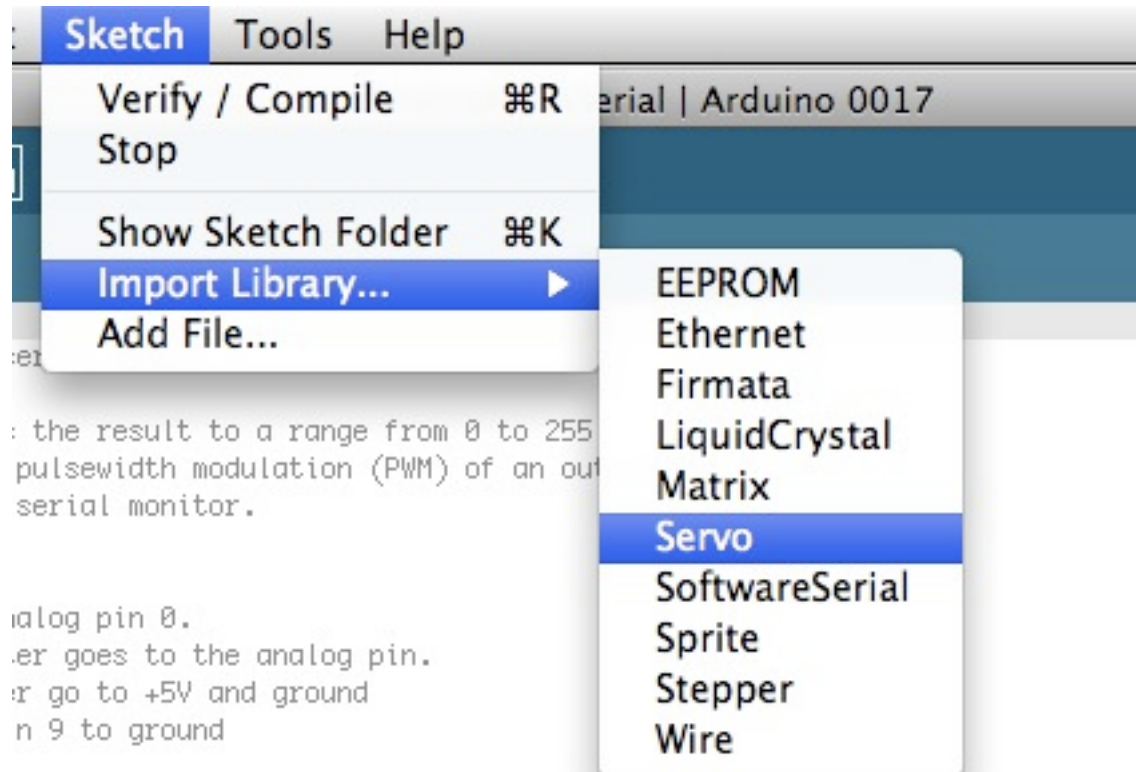
Standard Libraries

- [EEPROM](#) - reading and writing to "permanent" storage
- [Ethernet](#) - for connecting to the internet using the Arduino Ethernet Shield
- [Firmata](#) - for communicating with applications on the computer using a standard serial protocol.
- [LiquidCrystal](#) - for controlling liquid crystal displays (LCDs)
- [Servo](#) - for controlling servo motors
- [SoftwareSerial](#) - for serial communication on any digital pins
- [Stepper](#) - for controlling stepper motors
- [Wire](#) - Two Wire Interface (TWI/I2C) for sending and receiving data over a net of devices or sensors.

Using Libraries

- path to libraries starting with Arduino 17:
Documents/Arduino/libraries
- including the library:
`#include <library.h>`
- declaration:
`Object myinstance;`
- setup
`myinstance.enable(7);`
- commands
`myinstance.dostuff(27, 3);`

Adding from menu



Servo Library

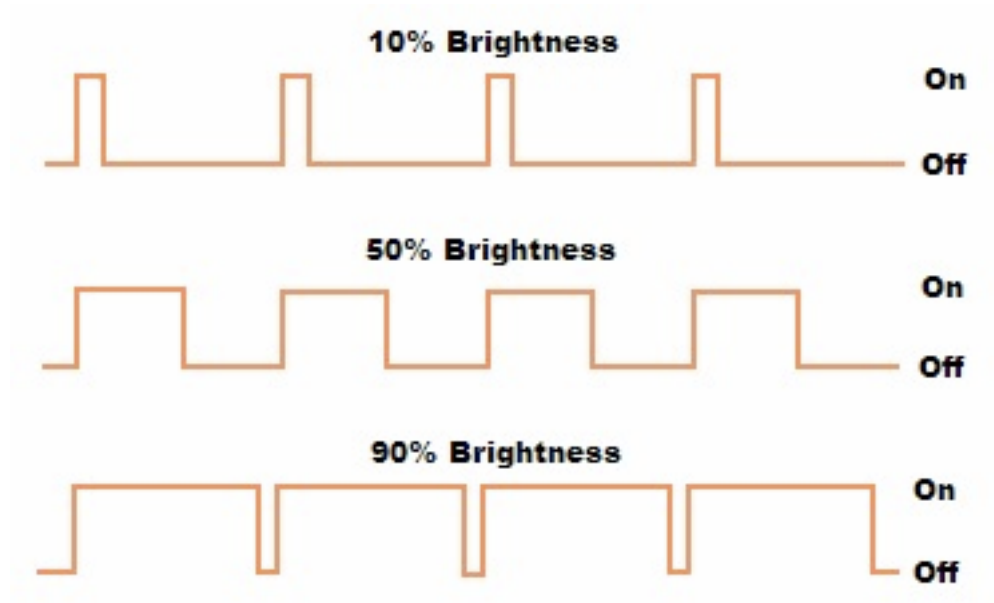
Servo

- including the library:
`#include <servo.h>`
- declaration:
`Servo myservo;`
- setup:
`myservo.attach(9);`
- commands:
`myservo.write(110);`

Tone Library

PWM and Sound

- Why won't PWM make tones?



Tones

- `#include <Tone.h>`
- `Tone tone1;`
- `tone1.begin(13);`
- `tone1.play(1000, 2500);`
- `tone1.stop()`

Engagement

List of things that make engaging interactions

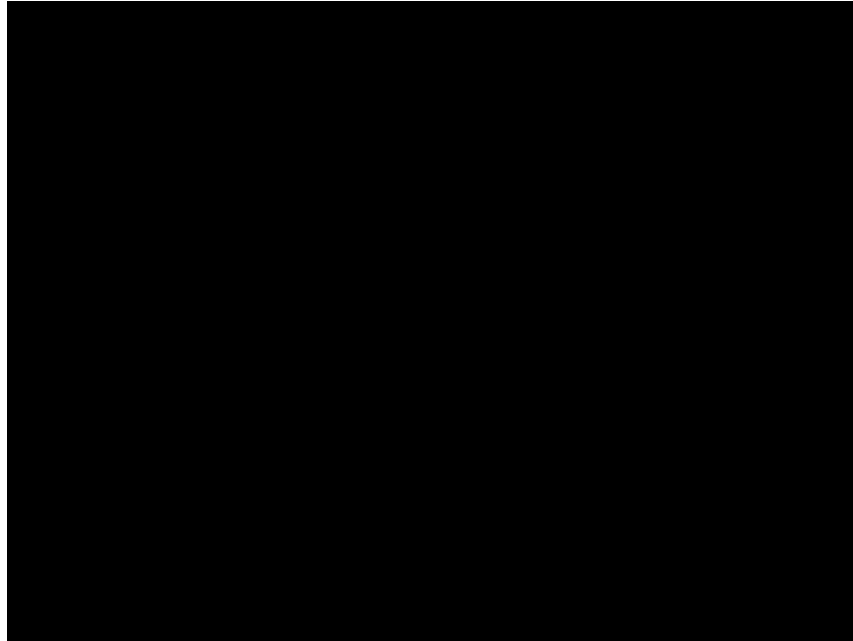
- ...

Engaging

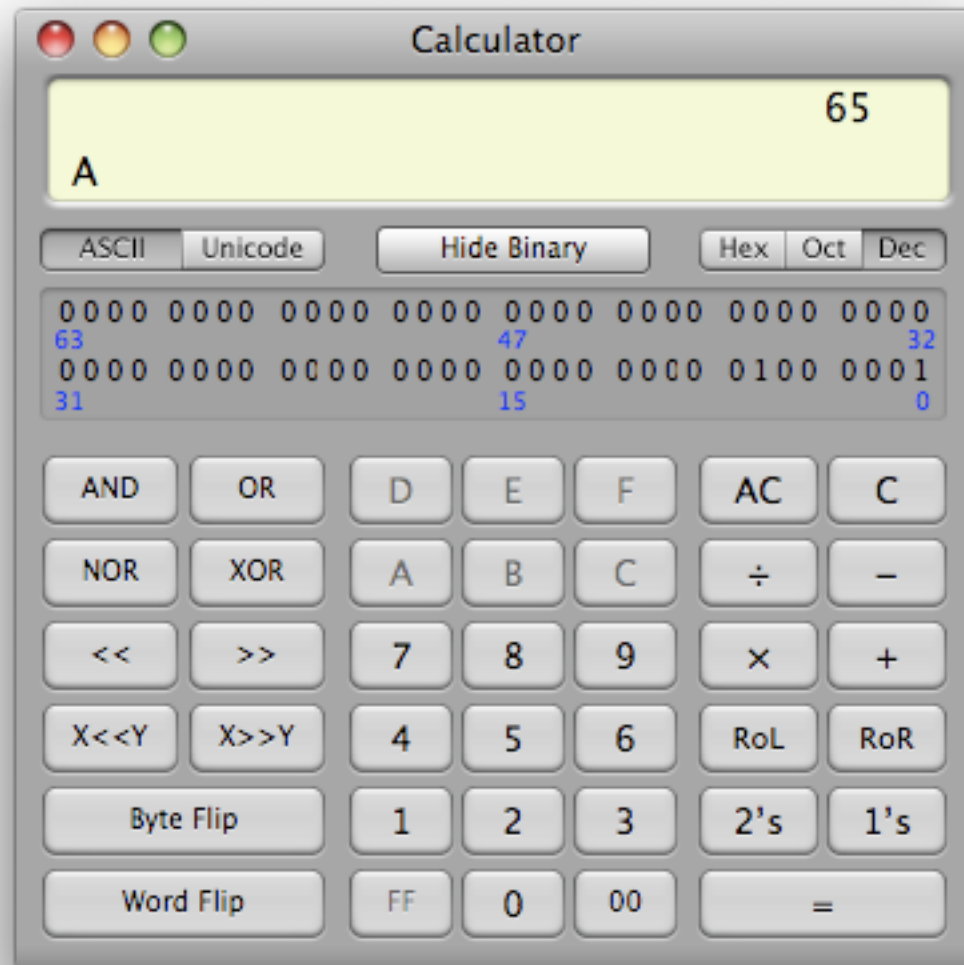
- Sound
- Physicality
- Surprise
- Beauty
- Learning
- Depth
- Discovery
- Feedback
- Mapping
- Control
- Richness, multiple senses

Kelly Dobson

Kelly Dobson



Math Fun



Readings and Assignments

- Readings
 - Physical Computing, chapter 6
 - Arduino, chapter 5
- Assignment
 - Analog Output Lab