

An illustration featuring a green soft robot on the left with its arms raised, and a female scientist in a green lab coat on the right holding a clipboard. A large, hand-drawn black line forms a frame around the central text. The robot has a heart-shaped sensor on its chest and black joints at the knees. The scientist has her hair in a bun and is wearing glasses. The background is white with a light green ground shadow.

# **(Mini) Project 4: Soft Robots**

Due: Monday, April 18th

# Tasks

1

**Collect Data**

2

**Fit Models to Data**

3

**Grasp a Cube**



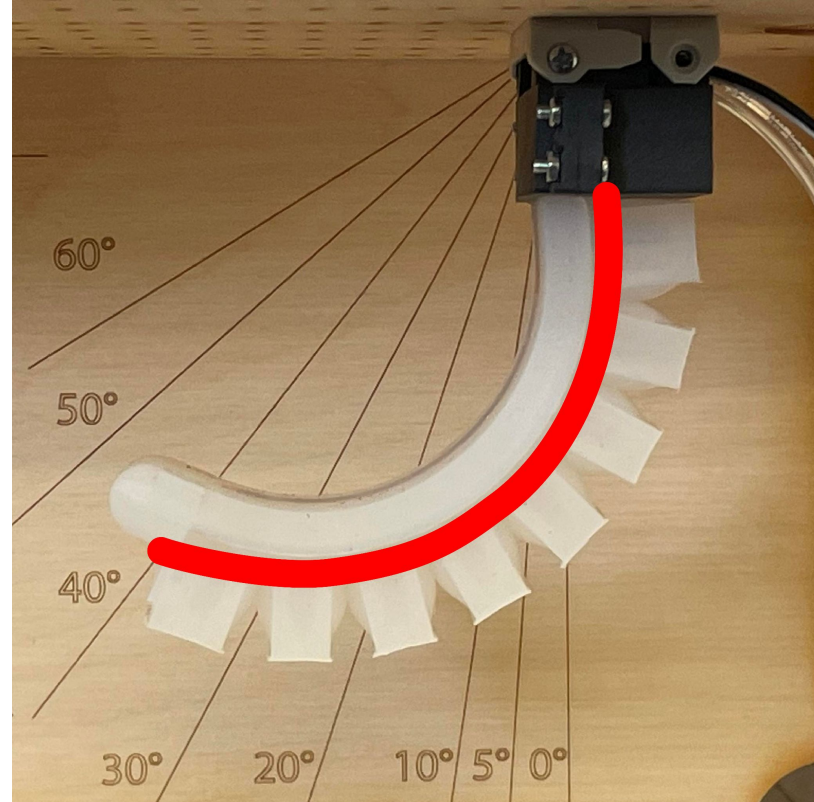
# Collecting Data

For each finger:

1. Send the finger a PWM value
2. Wait for it to stop moving
3. Approximate the steady state angle

Get at least 15 data points for each finger (the more the better!)

This is 40 degrees →



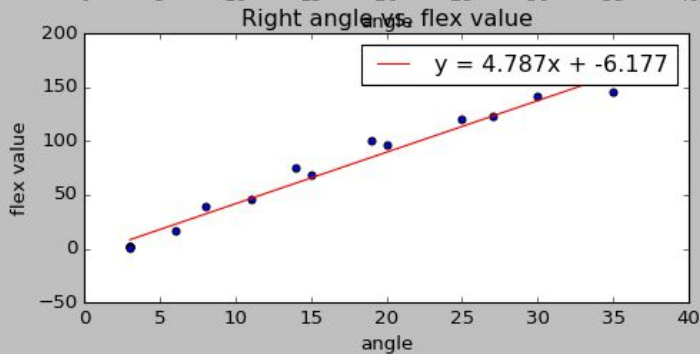
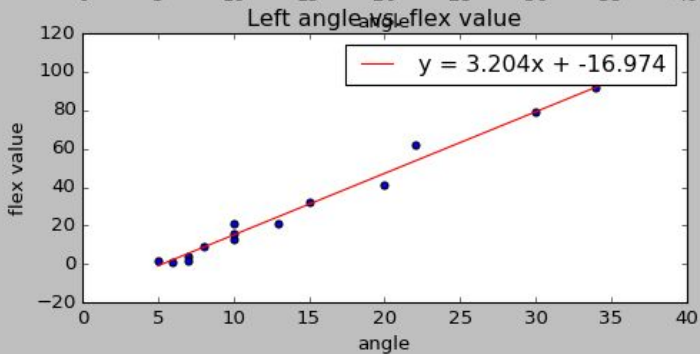
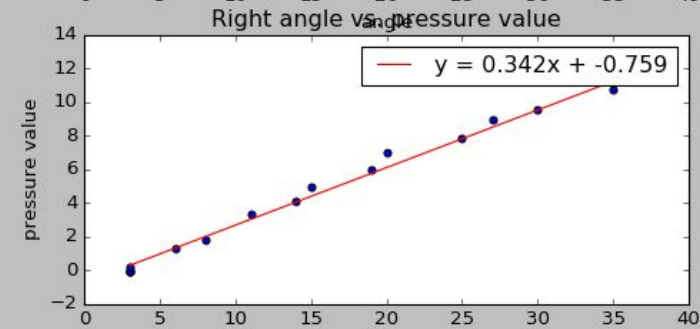
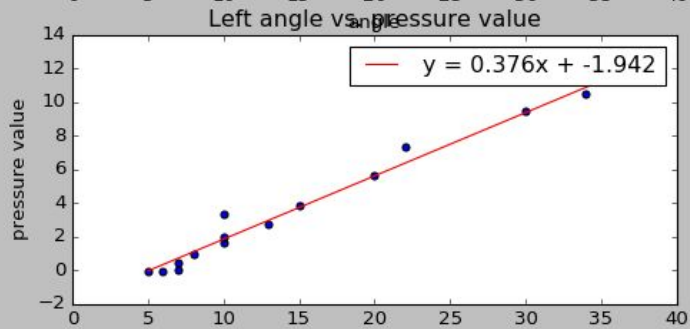
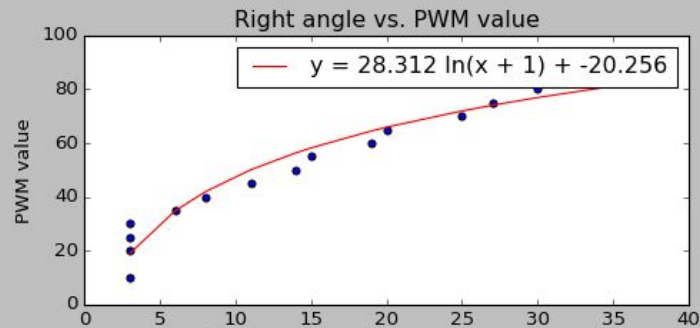
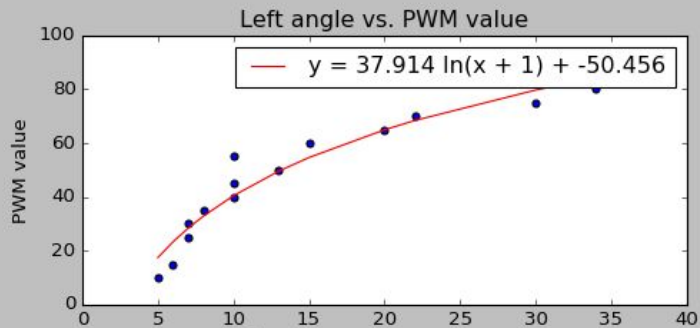
# Fitting the Model to the Data

Plot for each finger:

- Finger angle vs. PWM value
- Finger angle vs. pressure sensor value
- Finger angle vs. flex sensor value

For each plot, fit a model of your choice to the data

- Linear, Polynomial, Logarithmic, etc.



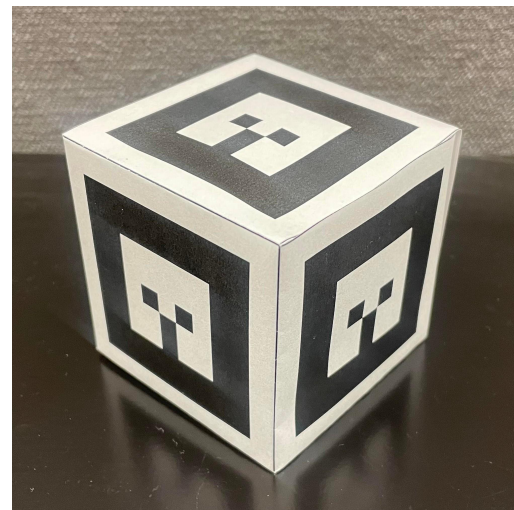
# Grasp the Cube

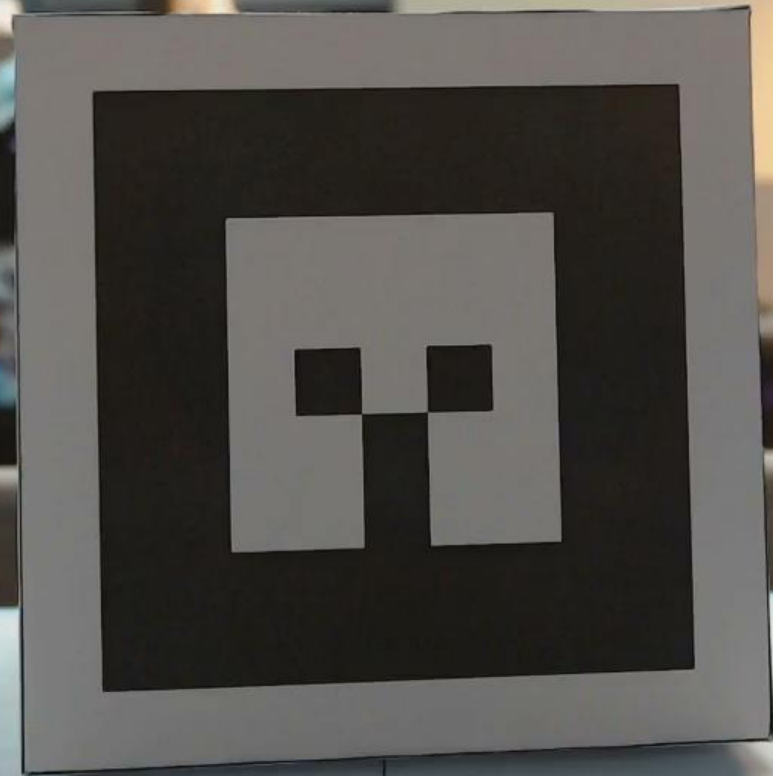
Grasping task:

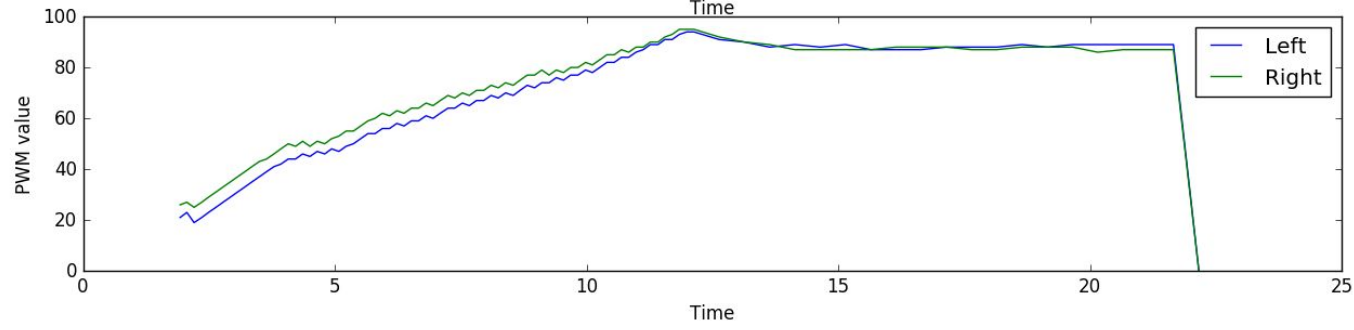
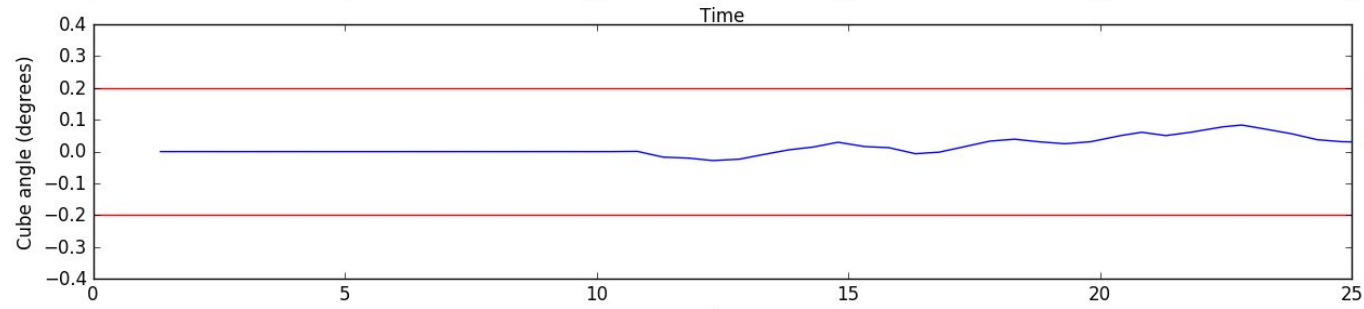
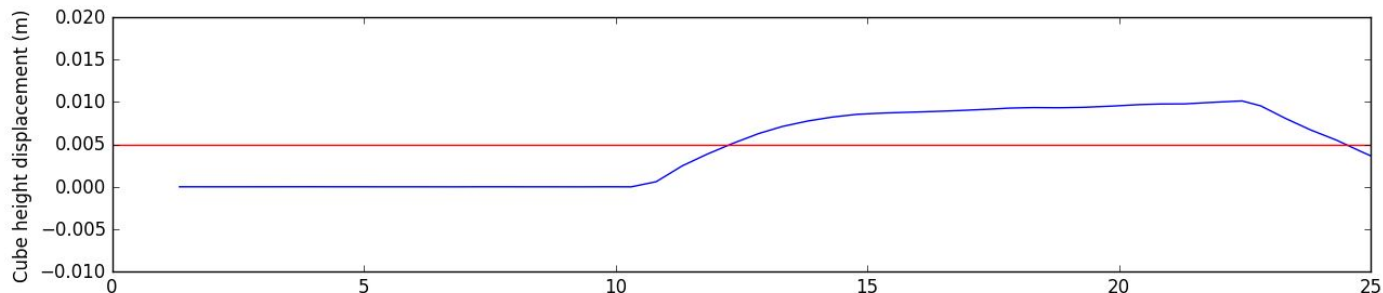
- (~10 s) Linearly ramp up both fingers from start angle to end angle
- (~10s) Continue to command both fingers to end angle

A successful grasp:

- The cube is lifted **at least 5 mm** above its starting position for **at least 5 seconds**
- The cube **never tilts more than 0.2 radians** around the z-axis from its starting orientation









# Robot Safety

- Don't set the PWM values to be higher than 100
- Be prepared to press the yellow "ON" button at any time
- Only turn on the power supply when do need it, and do not power the gripper with more than 12 V
- Handle the tubes and wires with care
- Do not touch the electronics, valves, or detach the webcam
- Use the computer attached to your assigned robot



# Starter Code (Tasks 1 and 2)

- **src/soft\_gripper\_user\_interface.py** - For collecting data and fitting models to it, takes in
  - a filename to save data to
  - a mode of operation
    - **play:** manually command the fingers with PWM values (have fun with this)
    - **record\_angles:** collect angle data
    - **display\_data:** get plots of data and models

# Starter Code (Task 3)

- **launch/soft\_gripper\_cube\_grasper.launch** - Launches the grasp controller and grasp plotter, takes in
  - a filename to save the cube data to
  - a starting angle
  - a ending angle
- **src/grasp\_controller.py** - Commands the grasp with the starting angle and ending angle, **your control input goes here**
- **src/grasp\_plotter.py** - Plots the grasp data, saves in bag file
  - run the command in the doc to make an mp4 of the grasp

# Deliverables

**Does NOT need to be IEEE conference format**

- Code
- Data and model plots
- Discussion of fitted models
- Grasp plots
- Grasp video
- Discussion of control input

# Final Tips

- Sign up for robots early
- Close one eye or stand back when collecting angle data
- Your control input doesn't have to be too complicated
- Feedback is your friend

