ECE 4560
Assignment 3

Due: September 12th, 11:59pm

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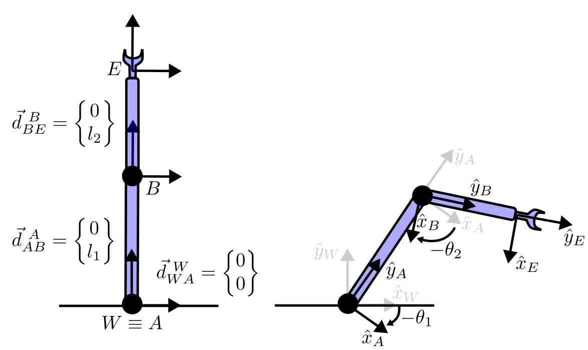
1. (0 points) Please denote the number of hours you spent on this homework (Feel free to also throw in a rating from 0-10). Please separate your time into homework vs. lab hours. I am *not* keeping track of effort per student, I just want to know if the homeworks are a reasonable length on average.

2. (9 points) This homework problem will explore writing code to illustrate the configuration of a robot. Explicitly, your job is to create code that produces a visualization of the robot from the last homework (shown below).



To do this, you should create a function that takes inputs of θ_1, θ_2, l_1 and l_2. The output should then be a figure showing the shape of the robot arm, with coordinate frame axes at each frame. You can assume that the base of the robot is at the origin. You should also the homogeneous representation of transformations in your code to compute the coordinates for each frame. While you can use any coding language to do this, I have provided a template pseudocode function in python that you may find helpful. This pseudocode includes functions for plotting the coordinate frame axes as well as a function for computing rotation matrices.

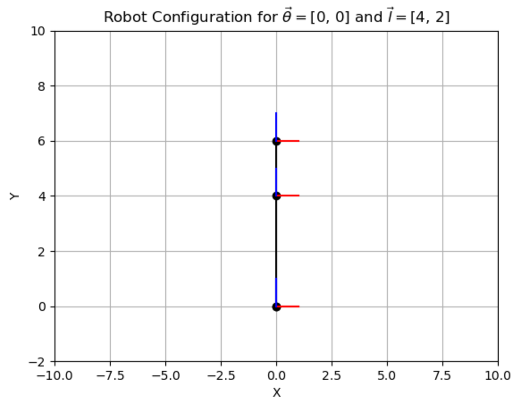
To receive full credit for this problem, please provide the code for your function as well as images of the robot at the following three configurations.

(a) $\vec{\theta} = (0, 0)$, $\vec{l} = (4, 2)$

(b) $\vec{\theta} = (-\pi/4, -\pi/2)$, $\vec{l} = (4, 2)$

(c) $\vec{\theta} = (\pi/8, -2\pi/3)$, $\vec{l} = (2, 3)$

The zero configuration for your robot (part a) should look like the image below.



3. (3 points) After completing Question 2, add to your code a print statement to print out the coordinates (position and orientation) of the end-effector frame. Using this print statement, what would the end-effector coordinates (position and orientation) be given the joint angles $\vec{\theta} = (\pi/3, -3 * \pi/4)$ and link lengths $\vec{l} = (3, 3)$? Please also include an image of your visualization for this new configuration of the robot.

4. **LAB COMPONENT:** This week the lab objective is to command your robot to go to a static position. The specific instructions for each project track are as follows:

   - New Robot Arm (SO-101): Follow the instructions for Assignment 3 on the course website.
   - Old Robot Arm: Command the Piktul planar robot arm to go to the home position using the 'testforwardkin.m' function provided and explained here. If you'd like to go one step further, run the entire script to see the robot move to several pre-programmed positions.
   - Mobile Robot: Move the turtlebot using the instruction provided here. Specifically, try running the 'draw_a_sqare.py' code provided here. For your submission, please upload a video of your robot moving.
   - Biped Project: Command the robot to go to the "zero" position, which should be it standing upright. If you want, try playing around with other configurations of the robot to see if you can achieve other standing positions that are statically stable. Instructions are provided here.

   I recommend going during the TA office hours so that the TAs can assist with any software/hardware issues.

   (a) (3 points) To document your effort towards lab this week, please provide a brief writeup of what you did and any issues you encountered. Please also include at least a photo of your robot at its static position. For the SO-101 track, please upload a youtube link (can be an unlisted video) showing the final movement of your robot.