Question 1

Perform the following coordinate transforms by hand. You should be able to work these out directly, without doing any matrix arithmetic. Throughout these exercises, I will use subscripts on position vectors to indicate which coordinate frame I am referring to. In other words $[0\ 0\ 1]_g^T$ refers the position $(0, 0, 1)$ in the gripper coordinate frame. Distances are in meters.

- Assuming that $\Theta_s = 0°$ and $\Theta_e = 0°$,

  What is the location of $[0\ 0\ 0]_g^T$ in coordinate frame b? (0, 0, .41)

  What is the location of $[0\ 0\ 0]_b^T$ in coordinate frame g? (0 , 0 , -.41)

- Assuming that $\Theta_s = 90°$ and $\Theta_e = 0°$,

  What is the location of $[0\ 0\ 0]_g^T$ in coordinate frame b? (0, 0, .41)

  What is the location of $[0\ 0\ 0]_b^T$ in coordinate frame g? (0, 0, -.41)

- Assuming that $\Theta_s = 90°$ and $\Theta_e = 90°$,

  What is the location of $[0\ 0\ 0]_g^T$ in coordinate frame b? (-.18, 0, .23)

  What is the location of $[0\ 0\ 0]_b^T$ in coordinate frame g? (-.23, 0, .18)

  What is the location of $[.4\ 0\ 0]_g^T$ in coordinate frame b? (-.18, 0, .27)

  What is the location of $[.4\ 0\ 0]_b^T$ in coordinate frame g? (-.27, 0, .18)

Question 2

For this question, feel free to use the matrix "nicknames" from Figure 22 of the Jennifer Kay paper. You don't need to actually calculate the matrix products. For example, The solution for the simple arm in Figure 27 could be written as:

$$T_g^w = \text{Trans}(L1, 0, 0) \times \text{Rotz}(\Psi) \times \text{Trans}(L2, 0, 0).$$

This corresponds to the result presented in Figure 29.

- Show how to calculate T_b^g for PhantomX arm.

  Trans(0, 0 , .8) x Rotz(theta_s) x Trans(0, 0, .15) x Rotz(theta_e) x Trans(0, 0 , .18) x point you want to change

- Show how to calculate T_g^b.

  Trans(0, 0, .18) x Rotz(theta_e) x Trans(0, 0, .15) x Rotz(theta_s) x Trans(0, 0, .8) x point you want to change

Question 3

Download the file `kinematics_hw.py` from the course schedule page and complete the unfinished functions. Confirm that the output corresponds to your answers from Question 1.