MeEn 537 Homework #6

1. For the 3 link planar RRR robot from HW 5, make the robot in the robotics toolbox with gravity defined as g = [0, 9.81, 0] for a base frame with x along the horizontal and y in the vertical direction. Make sure to add the minimal necesary dynamic parameters as well - assume 1 kg masses for each link, rotational inertias I_{zz} of 0.01, and the COM at the geometric center of each link. Then do the following and turn in the associated code:

   (a) calculate the required torques for $q = [\frac{\pi}{4}, \frac{\pi}{4}, \frac{\pi}{4}]$, $\dot{q} = [\frac{\pi}{6}, -\frac{\pi}{4}, \frac{\pi}{3}]$,$\ddot{q} = [-\frac{\pi}{6}, \frac{\pi}{3}, \frac{\pi}{6}]$, using the recursive Newton Euler formulation we learned about in class

   (b) calcaulate the same torques using the toolbox function "rne" to see if it agrees with your calculations

   (c) now that you have code from part a), use it to calculate just the inertia matrix $D(q)$ for this same configuration and compare it to the "inertia" function from the toolbox.

   (d) do the same thing again to calculate the coriolis matrix $C(\dot{q}, q)$ for this same configurationa and compare it to "coriolis" function from the toolbox.

2. Navigate to `https://github.com/petercorke/robotics-toolbox-matlab/blob/master/%40CodeGenerator/CodeGenerator.m` and read the documentation at the top of the file. For some reason, this code was not included in the released version of the toolbox this year (probably a mistake). We will not use this in our class, but you should know it exists. Especially note in the "Notes" section where it says their methods may fail for robots with greater than 3 links. Sympybotics is another option for doing the same thing where our research group has used it for at least up to 7 degrees of freedom with no problems and very fast evaluation times (microseconds). In class, we'll look at some example sympybotics code and I'll post it for your future reference on Learning Suite. Although we won't use it directly in this class, I encourage you to at least look at it. Other resources for dynamic and kinematic modeling software libraries include the following link which is fairly extensive - `https://answers.ros.org/question/48326/urdf-to-lagrangian-equations-of-motion/`.