METR4202 -- Robotics
Tutorial 4 – Week 4:
Robot Arm Torques & Trajectory Generation

Reading
Please read/review chapter 9 of Robotics, Vision and Control.
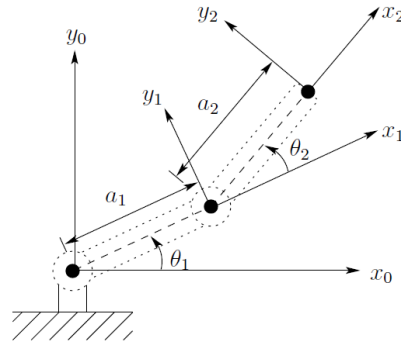
Questions

Figure 1: Two DOF Robot manipulator

1. Write the full equation of motion for the 2R arm above (i.e., τ_1 and τ_2 as a function of θ_1 and θ_2 and its derivatives)

Challenge Question:

2. Inverse Kinematics & Trajectory Generation

A small humanoid robot is being programmed to place a hat on its head. The objective is to place the hat in the position shown by the dashed outline in the figure below. Assume that the arm is composed of 3 revolute joints and is constrained to move in the plane of the page. The arm consists of 3 links with dimensions: $L_1=0.4$, $L_2=0.3$, $L_3=0.1$.

In order to place the hat on its head, assume that we must place the edge of the hat brim at a location 0.5m above its shoulder joint. The hat brim should be in a horizontal position and is gripped at its edge by the hand and is aligned with the last link of the arm. Please calculate/plot valid workspace (e.g., from the frame located at the right-most end of the brim where the robot is grasping it) and joint trajectories to place the hat correctly.