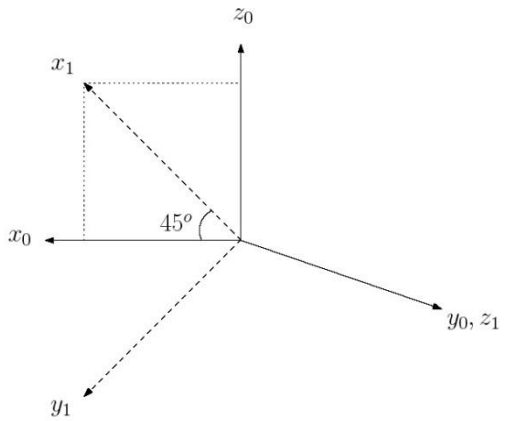
MAE 6245 (Spring 2020)

Robotic Systems

Assignment # 1

Total Points: 15

1) For the given frames (0 and 1), find the rotation matrix specifying the orientation of frame 1 relative to frame 0. [3 points]



2) Show that the dot product of two free vectors does not depend on the choice of frames in which their coordinates are defined. [Hint: use the definition of the dot product ($x^T x$)] [5 points]

3) Imagine two unit vectors, v_1 and v_2, embedded in a rigid body. Note that, no matter how the body is rotated, the geometric angle between these two vectors is preserved (i.e., rigid-body rotation is an "angle-preserving" operation). Use this fact to give a concise (four- or five-line) proof that the inverse of a rotation matrix must equal its transpose and that a rotation matrix is orthonormal. [5 points]

4) Indicate your term paper topic and team member (teams of 1-2 persons). [2 points]