Homework 2

Intro to Robotics

(Due 23:59, September 30, 2020)

Submission Instruction: Create a directory called HW2. Then create subdirectories called Q1, Q2 and so on. Place the answers of each question in the corresponding directories. Finally, zip the HW2 directory and submit.

1. (10 pts) Let $k = \frac{1}{\sqrt{3}}(1,1,1)^T$, $\theta = 90°$. Find $R_{k,\theta}$.

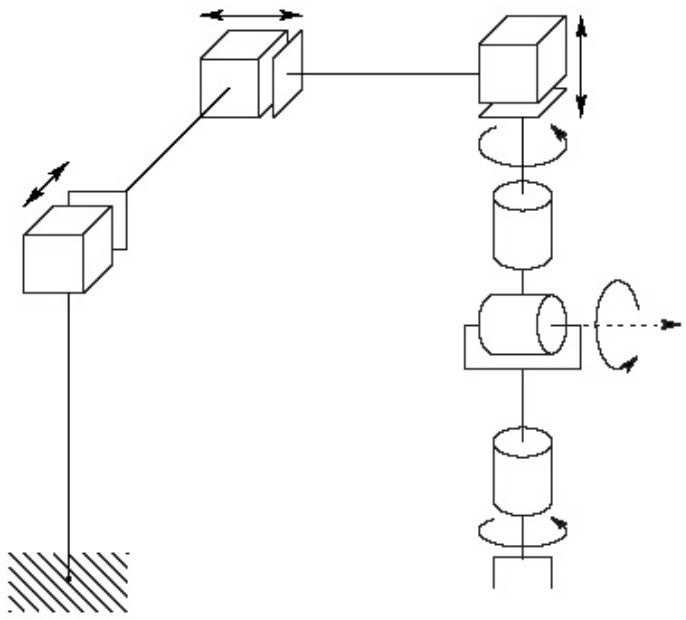
2. (10 pts) Compute the unit vector k for the axis of rotation, and the angle of rotation about k to achieve this rotation matrix:

$$\begin{bmatrix} 0 & 0 & 1 \\ \frac{\sqrt{2}}{2} & \frac{\sqrt{2}}{2} & 0 \\ -\frac{\sqrt{2}}{2} & \frac{\sqrt{2}}{2} & 0 \end{bmatrix}$$

3. (30 pts)

a. (15 pts) Assign seven coordinate systems to the following robot based on the DH convention.

b. (15 pts) Produce the DH parameter table for the following robot.



For the following programming questions, you should use Python.

4. (15 pts) Program functions to compute rotation matrices. You should have the following functions:
R=RotX(theta) – rotation matrix around X axis
R=RotY(theta) – rotation matrix around Y axis
R=RotZ(theta) – rotation matrix around Z axis

5. (15 pts) Program functions to compute the two combination of rotations for Euler Angle rotation and Roll-Pitch-Yaw rotation. You should have the following functions:
R=Euler(theta1, theta2, theta3), and
R=RPY(theta1, theta2, theta3)

6. (20 pts) Program a function to compute the forward kinematic matrix based on robot's DH parameters. You should have the following function:
A=FK(DH)
-- DH contains all the DH parameters