PART 1: Rotations

Exercise 1.1

Find the rotation matrix corresponding to the set of Euler angles ZXZ. Describe the procedure used to find the solution.

Exercise 1.2

Discuss the inverse solution for the Euler angles ZYZ in case $s_\theta = 0$.

Exercise 1.3

Discuss the inverse solution for Roll-Pitch-Yaw angles in the case $c_\theta = 0$.

Exercise 1.4⋆

Given a pair of unit vectors v and w (v =from and w =to, find the minimal rotation that brings v in w.
(SUGGESTION: use your knowledge on axis-angle representation)

Exercise 1.5

Answer the following questions with explanations:

- What is the quaternion q_1 that represents the rotation of 180 degree about the x-axis?

- What is the quaternion q_2 that represents the rotation of 180 degree about the z-axis?

- What rotation is represented by composite quaternion $q = q_1 q_2$? Answer by specifying its rotation angle and axis.

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Exercise 1.6

Compare the number of additions and multiplications needed to perform the following operations:

- Compose two rotation matrices.

- Compose two quaternions.

- Apply a rotation matrix to a vector.

- Apply a quaternion to a vector (as in Exercise 4).

Count a subtraction as an addition, and a division as a multiplication.