1. Write the matrix product that will give the resulting rotation matrix for the following sequence of rotations. Do not perform multiplication.
   (a) Rotate by α about fixed $x-$axis
   (b) Rotate by β about current $z-$axis
   (c) Rotate by γ about fixed $y-$axis
   (d) Rotate by ϕ about current $y-$axis
   (e) Rotate by ψ about fixed $z-$axis
   (f) Rotate by θ about current $x-$axis

2. Coordinate frame $\{1\}$ is obtained from frame $\{0\}$ by the following sequence of rotations:
   (a) $-90°$ about the fixed $z-$axis
   (b) $90°$ about the current $y-$axis
   (c) $-90°$ about the fixed $x-$axis.

   Find the resulting rotation matrix C_1^0 and sketch frames $\{0\}$ and $\{1\}$ relative to each other.

3. Consider the rotation matrix

$$C_b^a = \begin{bmatrix} -0.3536 & 0.1268 & -0.9268 \\ 0.6124 & 0.7803 & -0.1268 \\ 0.7071 & -0.6124 & -0.3536 \end{bmatrix}.$$

   (a) What are the Roll-Pitch-Yaw angles (ϕ, θ, ψ) that describe the orientation of frame $\{b\}$ relative to $\{a\}$?
   (b) What is the angle-axis $(\theta, \vec{k})$ that describes the orientation of frame $\{b\}$ relative to $\{a\}$?
   (c) What is the quaternion $\bar{q}$ that describes the orientation of frame $\{b\}$ relative to $\{a\}$?

4. Given the Roll-Pitch-Yaw angles $(\phi, \theta, \psi) = (120°, 45°, -120°)$, find the rotation matrix that describes the same orientation.

5. Given the angle-axis $(\theta, \vec{k}) = (90°, \frac{1}{\sqrt{3}}[1, 1, 1]^T)$, find the rotation matrix that describes the same orientation.

6. Given the quaternion $\bar{q} = [0.5, -0.5, -0.5, -0.5]^T$, find the rotation matrix that describes the same orientation.

7. Consider the three coordinate frames $\{\alpha\}$, $\{\beta\}$, and $\{\gamma\}$ shown in the diagram below. Following the notation introduced in the class, find the following Cartesian position vectors (denoted by $\vec{r}$) and rotation matrices (denoted by C).

   (a) $\vec{r}^{\gamma}_{\gamma\alpha}$

   (b) $\vec{r}^{\gamma}_{\gamma\beta}$

   (c) $\vec{r}^{\alpha}_{\gamma\alpha}$

   (d) $\vec{r}^{\beta}_{\gamma\beta}$

   (e) C^{γ}_{α}

   (f) C^{γ}_{β}

   (g) C^{α}_{β}