

AI1110 Assignment 1

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I. QUESTION 3 (A)

Question:

Simplify

$$\sin A \begin{pmatrix} \sin A & -\cos A \\ \cos A & \sin A \end{pmatrix} + \cos A \begin{pmatrix} \cos A & \sin A \\ -\sin A & \cos A \end{pmatrix} \quad (1)$$

Adding the matrices

$$\begin{pmatrix} \sin^2 A + \cos^2 A & -\sin A \cos A + \cos A \sin A \\ \sin A \cos A - \cos A \sin A & \sin^2 A + \cos^2 A \end{pmatrix} \quad (7)$$

Simplifying the elements finally gives

$$\begin{pmatrix} 1 & 0 \\ 0 & 1 \end{pmatrix} \quad (8)$$

Solution:

Let,

$$\mathbf{R}_\theta = \begin{pmatrix} \cos \theta & -\sin \theta \\ \sin \theta & \cos \theta \end{pmatrix} \quad (2)$$

The matrix expression in the question can be written as

$$(\mathbf{R}_A^\top (\mathbf{R}_{\frac{\pi}{2}} \mathbf{R}_0)) \begin{pmatrix} \sin A \\ \cos A \end{pmatrix} \quad (3)$$

$$= (\mathbf{R}_A^\top \mathbf{R}_{\frac{\pi}{2}} \mathbf{R}_0) \begin{pmatrix} \sin A \\ \cos A \end{pmatrix} \quad (4)$$

$$= \sin A (\mathbf{R}_A^\top \mathbf{R}_{\frac{\pi}{2}}) + \cos A (\mathbf{R}_A^\top \mathbf{R}_0) \quad (5)$$

Multiplying the matrices

$$\begin{pmatrix} \sin^2 A & -\sin A \cos A \\ \sin A \cos A & \sin^2 A \end{pmatrix} + \begin{pmatrix} \cos^2 A & \cos A \sin A \\ -\cos A \sin A & \cos^2 A \end{pmatrix} \quad (6)$$