Matrix Theory - Assignment 1

Name: Sri Harsha CH **Roll No:** AI20MTECH14007

Problem 1: Write down a unit vector in the xy-plane, making an angle of 30° with the positive direction of the x-axis ?

Solution: Let us consider a unit vector $\vec{a}$ in the xy-plane, and given this vector makes an angle of 30° with the positive direction of the x-axis.
With the angle given, we can find out the slope m and using this slope we can find the direction vector.
The slope(m) is given by:

$$m = \tan\theta$$

and the direction vector is obtained from slope as:

$$\begin{pmatrix} 1 \\ m \end{pmatrix}$$

Substituting $\theta = 30°$ in slope equation, we get:

$$m = \tan 30° = \frac{1}{\sqrt{3}}$$

and the direction vector is:

$$\vec{a} = \begin{pmatrix} 1 \\ \frac{1}{\sqrt{3}} \end{pmatrix}$$

To find a unit vector with the same direction as direction vector, we divide by the magnitude of the vector.

$$\hat{a} = \frac{\vec{a}}{|\vec{a}|}$$

$$|\vec{a}| = \sqrt{(1)^2 + \left(\frac{1}{\sqrt{3}}\right)^2} = \frac{2}{\sqrt{3}}$$

$\implies$ The unit vector is given by:

$$\hat{a} = \begin{pmatrix} \frac{1}{2} \\ \frac{1}{\sqrt{3}} \\ \frac{1}{\sqrt{3}} \\ \frac{2}{\sqrt{3}} \end{pmatrix}$$

$$\hat{a} = \begin{pmatrix} \frac{\sqrt{3}}{2} \\ \frac{1}{2} \end{pmatrix}$$

$$\implies \boxed{\hat{a} = \begin{pmatrix} \frac{\sqrt{3}}{2} \\ \frac{1}{2} \end{pmatrix}}$$