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ee25btech11056 - Suraj.N

Question : If a line has direction ratios $2, -1, -2$, determine its direction cosines.

Solution :

Symbol	Value	Description
a	$\begin{pmatrix} 2 \\ -1 \\ -2 \end{pmatrix}$	vector

Table : Vector

The direction vector of the line is

$$\mathbf{a} = \begin{pmatrix} 2 \\ -1 \\ -2 \end{pmatrix}$$

The length of \mathbf{a} is

$$\begin{aligned} a^T a &= \begin{pmatrix} 2 & -1 & -2 \end{pmatrix} \begin{pmatrix} 2 \\ -1 \\ -2 \end{pmatrix} \\ &= 2^2 + (-1)^2 + (-2)^2 \\ &= 4 + 1 + 4 = 9 \end{aligned}$$

Therefore, the norm of a is

$$\|a\| \triangleq \sqrt{a^T a} = \sqrt{9} = 3$$

The unit vector in the direction of \mathbf{a} is

$$\frac{\mathbf{a}}{\|\mathbf{a}\|} = \frac{1}{3} \begin{pmatrix} 2 \\ -1 \\ -2 \end{pmatrix}$$

Let α, β, γ be the angles made by the line with the x, y, z axes respectively. Then, the direction cosines are the elements of the above direction vector

$$\cos \alpha = \frac{2}{3}, \quad \cos \beta = -\frac{1}{3}, \quad \cos \gamma = -\frac{2}{3}$$

Vector OA with direction ratios (2,-1,-2)

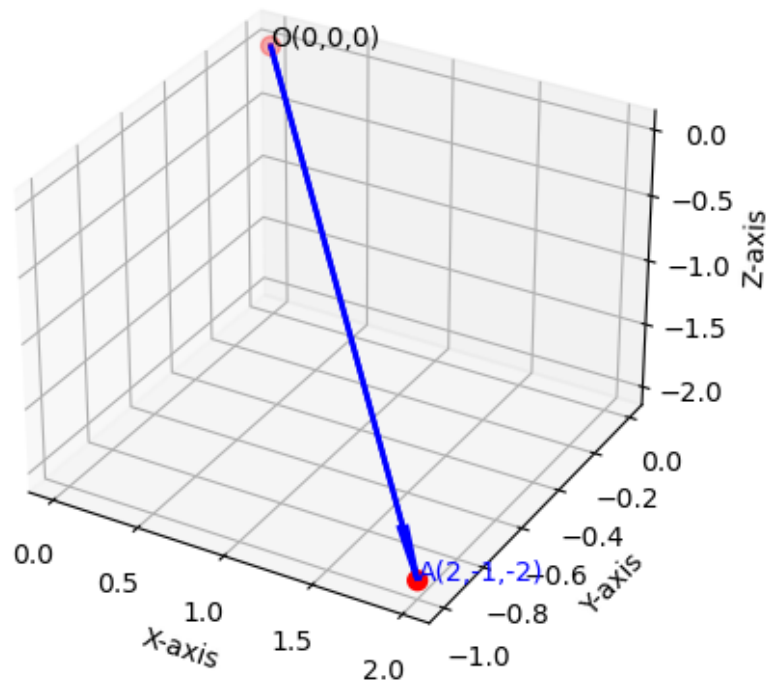


Fig : Vector a