

# 1.10.20

EE25BTECH11057 - Rushil Shanmukha Srinivas

**Question :** Find the direction cosines of the line passing through the two points  $(-2,4,-5)$  and  $(1,2,3)$ .

**Solution :**

Variable	Description	Values
A	Point	$(-2, 4, -5)$
B	Point	$(1, 2, 3)$

TABLE 0: Variables used

Let

$$\mathbf{A} = \begin{pmatrix} -2 \\ 4 \\ -5 \end{pmatrix}, \quad \mathbf{B} = \begin{pmatrix} 1 \\ 2 \\ 3 \end{pmatrix}. \quad (0.1)$$

Thus the direction (difference) vector of the line is

$$\mathbf{v} = \mathbf{B} - \mathbf{A} = \begin{pmatrix} 3 \\ -2 \\ 8 \end{pmatrix}. \quad (0.2)$$

The length of  $\mathbf{v}$  is

$$\begin{aligned} \mathbf{v}^T \mathbf{v} &= \begin{pmatrix} 3 & -2 & 8 \end{pmatrix} \begin{pmatrix} 3 \\ -2 \\ 8 \end{pmatrix} \\ &= 3^2 + (-2)^2 + (8)^2 \\ &= 9 + 4 + 64 = 77 \end{aligned}$$

Therefore, the norm of  $\mathbf{v}$  is

$$\|\mathbf{v}\| \triangleq \sqrt{\mathbf{v}^T \mathbf{v}} = \sqrt{77}$$

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

$$\frac{\mathbf{v}}{\|\mathbf{v}\|} = \frac{1}{\sqrt{77}} \begin{pmatrix} 3 \\ -2 \\ 8 \end{pmatrix}$$

Let  $\alpha, \beta, \gamma$  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

$$\cos \alpha = \frac{3}{\sqrt{77}}, \quad \cos \beta = -\frac{2}{\sqrt{77}}, \quad \cos \gamma = \frac{8}{\sqrt{77}}$$

Line passing through A and B with direction cosines

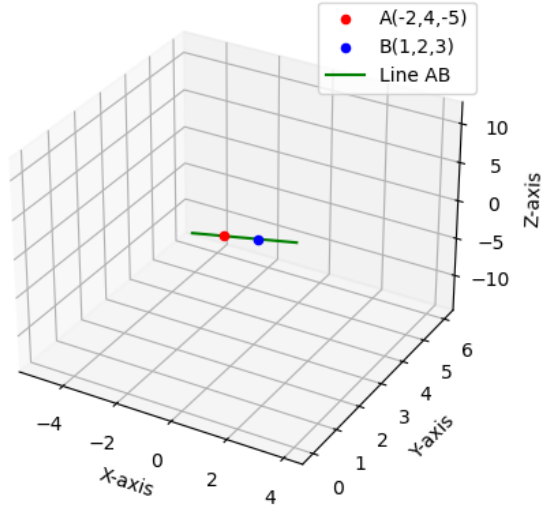


Fig : Vector  $v$