2.10.49

EE25BTECH11020 - Darsh Pankaj Gajare

September 21, 2025

Question:
The unit vector which is orthogonal to the vector $3\hat{i} + 2\hat{j} + 6\hat{k}$ and is coplanar with vectors $2\hat{i} + \hat{j} + \hat{k}$ and $\hat{i} - \hat{j} + \hat{k}$ is

(A) $\frac{2\hat{i} - 6\hat{j} + \hat{k}}{\sqrt{41}}$ (B) $\frac{2\hat{i} - 3\hat{j}}{\sqrt{13}}$ (C) $\frac{3\hat{i} - \hat{k}}{\sqrt{10}}$ (D) $\frac{4\hat{i} + 3\hat{j} - 3\hat{k}}{\sqrt{34}}$

Solution: Given:

Table: Given data

Vector	**matrix**
A	$\begin{pmatrix} 2 \\ 1 \\ 1 \end{pmatrix}$
B	$\begin{pmatrix} 1 \\ -1 \\ 1 \end{pmatrix}$
C	$\begin{pmatrix} 3 \\ 2 \\ 6 \end{pmatrix}$

To find: **P**

$$\mathbf{P} = \alpha\mathbf{A} + \beta\mathbf{B} \tag{0.1}$$

$$\mathbf{P}^T\mathbf{C} = 0 \tag{0.2}$$

$$\begin{pmatrix}\mathbf{A} & \mathbf{B}\end{pmatrix}^T \mathbf{C} \begin{pmatrix}\alpha \\ \beta\end{pmatrix} = 0 \tag{0.3}$$

$$\begin{pmatrix}\mathbf{A}^T\mathbf{C} & \mathbf{B}^T\mathbf{C}\end{pmatrix} \begin{pmatrix}\alpha \\ \beta\end{pmatrix} = 0 \tag{0.4}$$

$$\begin{pmatrix}\mathbf{A}^T\mathbf{C} & \mathbf{B}^T\mathbf{C}\end{pmatrix} = \begin{pmatrix}14 & 7\end{pmatrix} \tag{0.5}$$

$$2\alpha + \beta = 0 \implies \beta = -2\alpha \tag{0.6}$$

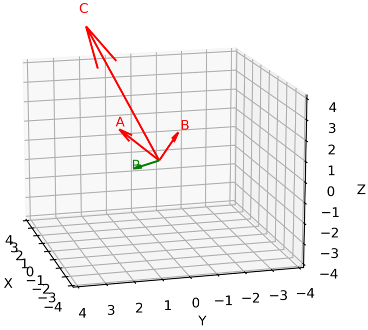
$$\mathbf{P} = \begin{pmatrix} 2\alpha + \beta \\ \alpha - \beta \\ \alpha + \beta \end{pmatrix} \tag{0.7}$$

Therefore,

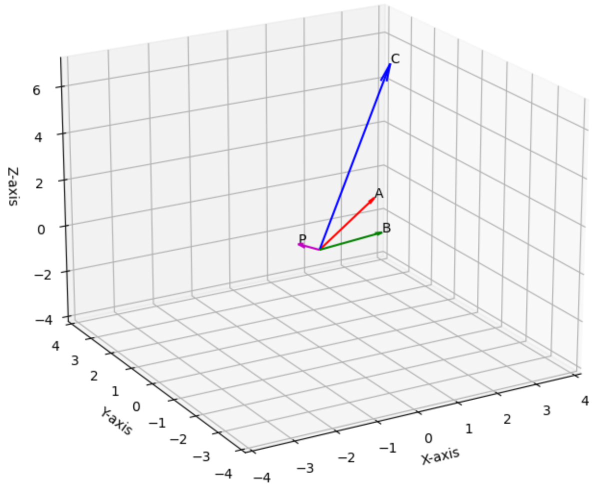
$$\mathbf{P} = \alpha \begin{pmatrix} 0 \\ 3 \\ -1 \end{pmatrix} \tag{0.8}$$

Normalizing,

$$\mathbf{P} = \pm \frac{1}{\sqrt{10}} \begin{pmatrix} 0 \\ 3 \\ -1 \end{pmatrix} \tag{0.9}$$



Plot using C functions


C
A
B
P
Z-axis
6
4
2
0
−2
−4
Y-axis
4
3
2
1
0
−1
−2
−3
−4
X-axis
−4
−3
−2
−1
0
1
2
3
4

Plot using Python