1.4.19

EE25BTECH11004 - Aditya Appana

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Question

Find the acute angle between the planes $\mathbf{r} \cdot (\hat{i} - 2\hat{j} - 2\hat{k})$ and $\mathbf{r} \cdot (3\hat{i} - 6\hat{j} + 2\hat{k})$

Solution

Let vectors be

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

$$\mathbf{Q} = \begin{pmatrix} 3 \\ -6 \\ 2 \end{pmatrix} \tag{2}$$

The formula to calculate the angle between the two planes is

$$\theta = \frac{\pi}{2} - \cos^{-1}\left(\frac{\mathbf{P}^T\mathbf{Q}}{|\mathbf{P}||\mathbf{Q}|}\right)$$

$$= \sin^{-1}\left(\frac{\mathbf{P}^T\mathbf{Q}}{|\mathbf{P}||\mathbf{Q}|}\right)$$

Substituting $\mathbf{P}, \mathbf{Q}$ in this formula :

$$= \sin^{-1}\left(\frac{\begin{pmatrix}1\\-2\\-2\end{pmatrix}^T\begin{pmatrix}3\\-6\\2\end{pmatrix}}{\left|\begin{pmatrix}1\\-2\\-2\end{pmatrix}\right|\left|\begin{pmatrix}3\\-6\\2\end{pmatrix}\right|}\right)$$

$$= \sin^{-1}\left(\frac{19}{|3||7|}\right)$$

$$= \sin^{-1}\left(\frac{11}{21}\right)$$

This is 31.58906757233914°

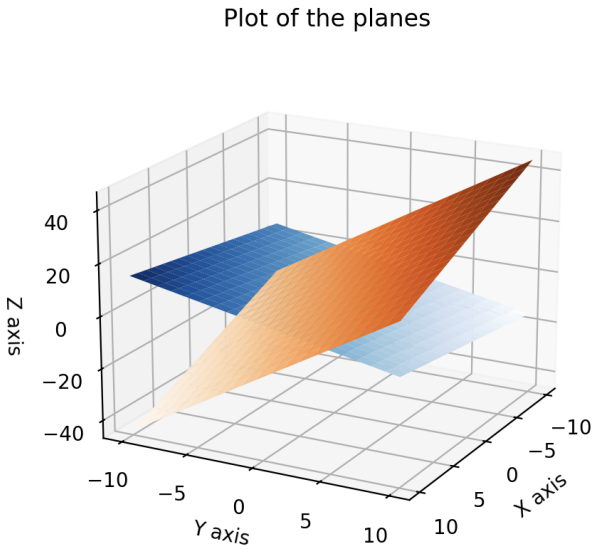

Figure 1: Plot

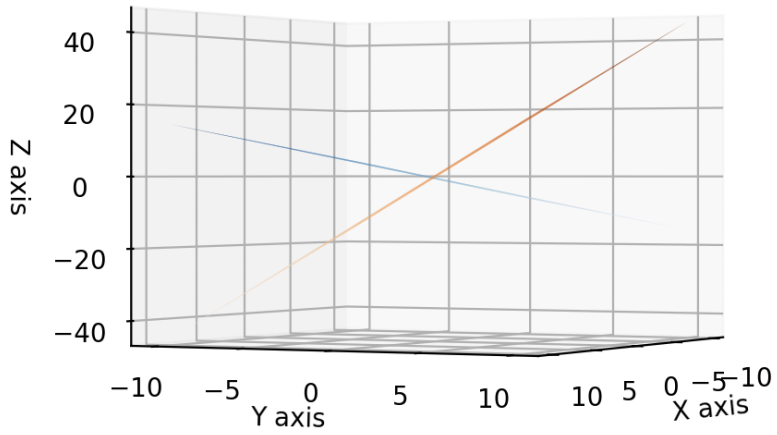

Figure 2: Plot