ASSIGNMENT 1

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Download all python codes from

https://github.com/vaibhavchhabra25/EE3900-course/blob/main/Assignment-1/codes/figure.py

and latex-tikz codes from

https://github.com/vaibhavchhabra25/EE3900-course/blob/main/Assignment-1/main.tex

1 Problem

(Vectors-2.19) Find the ratio in which the line segment joining the points $\begin{pmatrix}4\\8\\10\end{pmatrix}$ and $\begin{pmatrix}6\\10\\-8\end{pmatrix}$ is divided by the YZ plane.

2 Solution

Let $\mathbf{A} = \begin{pmatrix}4\\8\\10\end{pmatrix}$ and $\mathbf{B} = \begin{pmatrix}6\\10\\-8\end{pmatrix}$.

Let $\mathbf{P}$ represents points lying on the YZ plane. Since $\begin{pmatrix}1\\0\\0\end{pmatrix}$ is the normal vector to the plane and the origin($\mathbf{O}$) lies on the YZ plane, vector equation of YZ plane is

$$\begin{pmatrix}1 & 0 & 0\end{pmatrix}(\mathbf{P}-\mathbf{O}) = 0 \tag{2.0.1}$$

$$\implies \begin{pmatrix}1 & 0 & 0\end{pmatrix}\mathbf{P} = 0 \tag{2.0.2}$$

Let the ratio in which $\mathbf{P}$ divides $\mathbf{AB}$ be $k:1$.
Then,

$$\mathbf{P}-\mathbf{A} = k(\mathbf{B}-\mathbf{P}) \tag{2.0.3}$$

Multiplying with vector $\begin{pmatrix}1 & 0 & 0\end{pmatrix}$ both sides,

$$\begin{pmatrix}1 & 0 & 0\end{pmatrix}\mathbf{P}-\begin{pmatrix}1 & 0 & 0\end{pmatrix}\mathbf{A} = k\begin{pmatrix}1 & 0 & 0\end{pmatrix}\mathbf{B} - k\begin{pmatrix}1 & 0 & 0\end{pmatrix}\mathbf{P} \tag{2.0.4}$$

Using (2.0.2)

$$0-\begin{pmatrix}1 & 0 & 0\end{pmatrix}\mathbf{A} = k\begin{pmatrix}1 & 0 & 0\end{pmatrix}\mathbf{B} - 0 \tag{2.0.5}$$

$$\implies -\begin{pmatrix}1 & 0 & 0\end{pmatrix}\begin{pmatrix}4\\8\\10\end{pmatrix} = k\begin{pmatrix}1 & 0 & 0\end{pmatrix}\begin{pmatrix}6\\10\\-8\end{pmatrix} \tag{2.0.6}$$

$$\implies -4 = 6k \tag{2.0.7}$$

$$\implies k = -2/3 \tag{2.0.8}$$

So, YZ plane divides line segment $\mathbf{AB}$ externally in the ratio 2:3.

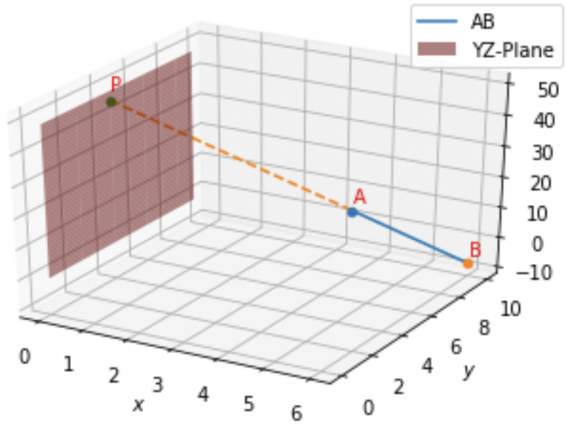

Fig. 0: 3D plot