Assignment 1

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***Abstract*—This document explains how to find the point of intersection of a line and a plane.**

Download the python code from

https://github.com/vishalashok98/AI5006/tree/master/Assignment1

and latex-tikz codes from

https://github.com/vishalashok98/AI5006/tree/master/Assignment1

1 Problem

Find the co ordinates of the point when the line through $\begin{pmatrix}3\\-4\\-5\end{pmatrix}$ and $\begin{pmatrix}2\\-3\\1\end{pmatrix}$ crosses the plane $\begin{pmatrix}2\\-3\\1\end{pmatrix}^T \mathbf{x} = 7$ and perpendicular to the two lines

2 Explanation

Equation of the plane is

$$\begin{pmatrix}2\\-3\\1\end{pmatrix}^T \mathbf{x} = 7 \tag{2.0.1}$$

Direction vector of line passing through points $\begin{pmatrix}3\\-4\\-5\end{pmatrix}$ and $\begin{pmatrix}2\\-3\\1\end{pmatrix}$ is given by

$$\mathbf{m}=\begin{pmatrix}3\\-4\\-5\end{pmatrix}-\begin{pmatrix}2\\-3\\1\end{pmatrix}=\begin{pmatrix}1\\-1\\-6\end{pmatrix}$$

Equation of a line passing through the point $\mathbf{a}$ and having direction vector $\mathbf{m}$ is given by:

$$\mathbf{x} = \mathbf{a} + \lambda\mathbf{m} \tag{2.0.2}$$

where λ is some constant. Parametric equations of line passing through $\begin{pmatrix}3\\-4\\-5\end{pmatrix}$ and $\begin{pmatrix}2\\-3\\1\end{pmatrix}$ is

$$\mathrm{x} = \begin{pmatrix}2\\-3\\1\end{pmatrix} + \lambda\begin{pmatrix}1\\-1\\-6\end{pmatrix}$$

3 Solution

Since the line intersects plane, by substituting parametric equation of line in equation of plane we get

$$\begin{pmatrix}2\\1\\1\end{pmatrix}^T (\mathbf{a} + \lambda\mathbf{m}) = 7 \tag{3.0.1}$$

$$\begin{pmatrix}2\\1\\1\end{pmatrix}^T \mathbf{a} + \begin{pmatrix}2\\1\\1\end{pmatrix}^T \lambda\mathbf{m} = 7 \tag{3.0.2}$$

$$\begin{pmatrix}2\\1\\1\end{pmatrix}^T \begin{pmatrix}2\\-3\\1\end{pmatrix} + \begin{pmatrix}2\\1\\1\end{pmatrix}^T \begin{pmatrix}1\\-1\\-6\end{pmatrix}\lambda = 7 \tag{3.0.3}$$

$$\lambda = -1 \tag{3.0.4}$$

Substituting the value of λ in parametric equations we get point of intersection as [1,-2,7]

4 Plot

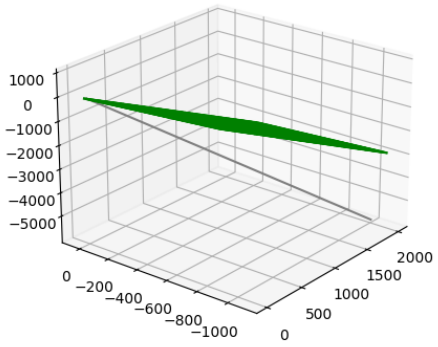

Fig. 0: Intersection of Plane and Line