Matrix theory - Assignment1

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***Abstract*—This document illustrates the distance of the point from the point of intersection of the line and the plain.**

Download all python codes from

https://github.com/upender20/EE5600/tree/master

1 Problem

Find the distance of the point $\begin{pmatrix}-1\\-5\\-10\end{pmatrix}$ from the point of intersection of the line x and the plane (1 -1 1).x = 5

$$\mathbf{x} = \begin{pmatrix}2\\-1\\2\end{pmatrix} + \lambda\begin{pmatrix}3\\4\\2\end{pmatrix} \tag{1.0.1}$$

2 Construction

We know that equation of the line passing through given a point and a plane

$$\mathbf{r} = \mathbf{a} + \lambda\mathbf{b} \tag{2.0.1}$$

Also we can find direction vector from the Cartesian form of equation

$$\frac{x - x_1}{a} = \frac{y - y_1}{b} = \frac{z - z_1}{c} \tag{2.0.2}$$

This can be expressed as

$$\begin{pmatrix}x\\y\\z\end{pmatrix} = \begin{pmatrix}x_1\\y_1\\z_1\end{pmatrix} + \lambda\begin{pmatrix}a\\b\\c\end{pmatrix} \tag{2.0.3}$$

where $\mathbf{a} = \begin{pmatrix}x_1\\y_1\\z_1\end{pmatrix}$ is a point on given line and $\mathbf{b} = \begin{pmatrix}a\\b\\c\end{pmatrix}$ is the direction vector.
Distance between the point and point of intersection.

$$D = \sqrt{(x2 - x1)^2 + (y2 - y1)^2 + (z2 - z1)^2} \tag{2.0.4}$$

3 Solution

Writing given equation (1.0.1) in vector form as

$$\begin{pmatrix}x\\y\\z\end{pmatrix} = \begin{pmatrix}2\\-1\\2\end{pmatrix} + \lambda\begin{pmatrix}3\\4\\2\end{pmatrix} \tag{3.0.1}$$

So the direction vector of equation given is

$$\mathbf{b} = \begin{pmatrix}3\\4\\2\end{pmatrix} \tag{3.0.2}$$

and the point on which line passes is

$$\mathbf{P} = \begin{pmatrix}-1\\-5\\-10\end{pmatrix} \tag{3.0.3}$$

Substituting (3.0.3) and (3.0.2) in (2.0.1) we get

$$\mathbf{r} = \begin{pmatrix}-1\\-5\\-10\end{pmatrix} + \lambda\begin{pmatrix}3\\4\\2\end{pmatrix} \tag{3.0.4}$$

which is the line parallel to line (1.0.1) and passes through point $\begin{pmatrix}2\\-1\\2\end{pmatrix}$.

Finally the distance between the point P = $\begin{pmatrix}-1\\-5\\-10\end{pmatrix}$ and intersection point $\begin{pmatrix}2\\-1\\2\end{pmatrix}$ = 13.

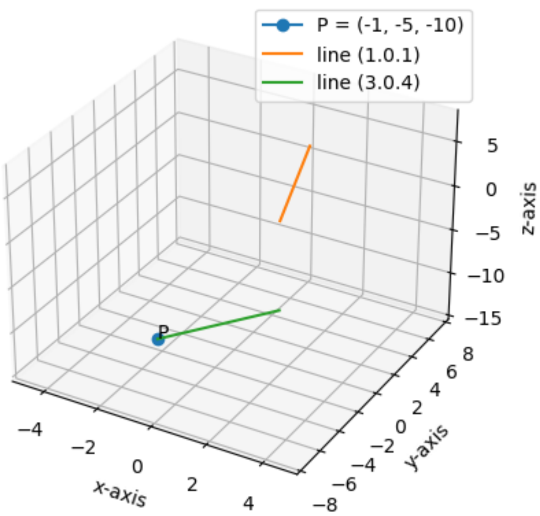

Fig. 0: Equation of line passing through point P and parallel to line (1.0.1)