Assignment 4

Chirag Mehta - AI20BTECH11006

Download all latex-tikz codes from

https://github.com/cmaspi/EE3900/blob/main/Assignment−4/main.tex

1 Problem

(Matrix Q 2.40) Find the equation of the plane passing through the line of intersection of the planes

$$\begin{pmatrix}1 & 1 & 1\end{pmatrix}\mathbf{x} = 1 \text{ and} \tag{1.0.1}$$

$$\begin{pmatrix}2 & 3 & -1\end{pmatrix}\mathbf{x} = -4 \tag{1.0.2}$$

and parallel to x-axis

2 Solution

The equations of planes are

$$\mathbf{n_1}^T x = 1 \tag{2.0.1}$$

$$\mathbf{n_2}^T x = -4 \tag{2.0.2}$$

where

$$\mathbf{n_1} = \begin{pmatrix}1 & 1 & 1\end{pmatrix}^T \tag{2.0.3}$$

$$\mathbf{n_2} = \begin{pmatrix}2 & 3 & -1\end{pmatrix}^T \tag{2.0.4}$$

The line of intersection of the given planes will have a slope parallel to $\mathbf{n_1} \times \mathbf{n_2}$. Further we have to find a plane which contains this line and is parallel to x-axis.
Let

$$\mathbf{n_3} = \begin{pmatrix}1 & 0 & 0\end{pmatrix}^T \tag{2.0.5}$$

Assume a vector $\mathbf{a}$ lies on both the planes, this means that it lies on the intersecting line and on the required plane The normal vector of the desired plane is perpendicular to $\mathbf{n_1} \times \mathbf{n_1}$ and x-axis.

$$\mathbf{n} = \mathbf{n_3} \times (\mathbf{n_1} \times \mathbf{n_2}) \tag{2.0.6}$$

$$\mathbf{n} = \mathbf{n_1}\left(\mathbf{n_3}^T\mathbf{n_2}\right) - \mathbf{n_2}\left(\mathbf{n_3}^T\mathbf{n_1}\right) \tag{2.0.7}$$

$$\mathbf{n} = 2\mathbf{n_1} - \mathbf{n_2} \tag{2.0.8}$$

The equation of plane is given by

$$\mathbf{n}^T\mathbf{x} = c \tag{2.0.9}$$

$$\mathbf{n}^T\mathbf{a} = 2 + 4 = 6 \tag{2.0.10}$$

$$\begin{pmatrix}0 & -1 & 3\end{pmatrix}^T\mathbf{x} = 6 \tag{2.0.11}$$