Assignment-8

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***Abstract*—This document contains the procedure to find the foot of the perpendicular from a point to the plane.**

Download the python code from

https://github.com/ankuraditya13/EE5609−Assignment8

and latex-file codes from

https://github.com/ankuraditya13/EE5609−Assignment8

1 Problem

Find the foot of the perpendicular from,

$$\mathbf{C} = \begin{pmatrix} 2 \\ 4 \\ 2 \end{pmatrix} \tag{1.0.1}$$

to the plane,

$$\begin{pmatrix} 3 & 2 & -6 \end{pmatrix} \mathbf{x} = 2 \tag{1.0.2}$$

2 Solution

The equation of plane is given as,

$$\mathbf{n}^T \mathbf{x} = c \tag{2.0.1}$$

$$\text{Let, } \mathbf{P} = \begin{pmatrix} x_1 \\ y_1 \\ z_1 \end{pmatrix} \tag{2.0.2}$$

Here, P is the foot of perpendicular drawn from **C** to the plane given by equation (1.0.2). Now the position vector from **C** to **P** is (**P**-**C**). And this position vector is perpendicular to the plane. Hence clearly the position vector (**P**-**C**) is parallel to the normal vector **n** of plane. Hence,

$$\therefore \mathbf{P} - \mathbf{C} = k\mathbf{n} \tag{2.0.3}$$

$$\implies \mathbf{P} = k\mathbf{n} + \mathbf{C} \tag{2.0.4}$$

$\because$ **P** lies on the plane,

$$\therefore \mathbf{n}^T \mathbf{P} = c \tag{2.0.5}$$

$$\tag{2.0.6}$$

Subsitituting the value of **P** from the equation (2.0.4) we get,

$$\implies \mathbf{n}^T (k\mathbf{n} + \mathbf{C}) = c \tag{2.0.7}$$

Now from equation (1.0.2) we have,

$$\mathbf{n} = \begin{pmatrix} 3 \\ 2 \\ -6 \end{pmatrix} \text{ and } c = 2 \tag{2.0.8}$$

Hence substituting this in equation (2.0.7),

$$k \begin{pmatrix} 3 & 2 & -6 \end{pmatrix} \begin{pmatrix} 3 \\ 2 \\ -6 \end{pmatrix} + \begin{pmatrix} 3 & 2 & -6 \end{pmatrix} \begin{pmatrix} 2 \\ 4 \\ 2 \end{pmatrix} = 2 \tag{2.0.9}$$

$$\implies 49k + 2 = 2 \tag{2.0.10}$$

$$\implies k = 0 \tag{2.0.11}$$

Substituting the value of k to the equation (2.0.4),

$$\mathbf{P} = \mathbf{C} = \begin{pmatrix} 2 \\ 4 \\ 2 \end{pmatrix} \tag{2.0.12}$$

Hence this shows that the plane given by equation (1.0.2) passes through the point $\mathbf{C} = \begin{pmatrix} 2 \\ 4 \\ 2 \end{pmatrix}$