

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-Assignment7>

and latex-file codes from

<https://github.com/ankuraditya13/EE5609-Assignment7>

1 PROBLEM

Find the foot of the perpendicular from,

$$\mathbf{C} = \begin{pmatrix} 2 \\ 4 \\ 2 \end{pmatrix} \quad (1.0.1)$$

to the plane,

$$(3 \ 2 \ -6)\mathbf{x} = 2 \quad (1.0.2)$$

2 SOLUTION

The equation of plane is given as,

$$\mathbf{n}^T \mathbf{x} = c \quad (2.0.1)$$

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

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,

$$\therefore \mathbf{P} - \mathbf{C} = k\mathbf{n} \quad (2.0.3)$$

$$\implies \mathbf{P} = k\mathbf{n} + \mathbf{C} \quad (2.0.4)$$

$\therefore \mathbf{P}$ lies on the plane,

$$\therefore \mathbf{n}^T \mathbf{P} = c \quad (2.0.5)$$

$$(2.0.6)$$

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

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

Now from equation (1.0.2) we have,

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

Hence substituting this in equation (2.0.7),

$$k(3 \ 2 \ -6) \begin{pmatrix} 3 \\ 2 \\ -6 \end{pmatrix} + (3 \ 2 \ -6) \begin{pmatrix} 2 \\ 4 \\ 2 \end{pmatrix} = 2 \quad (2.0.9)$$

$$\implies 49k + 2 = 2 \quad (2.0.10)$$

$$\implies k = 0 \quad (2.0.11)$$

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

$$\mathbf{P} = \mathbf{C} = \begin{pmatrix} 2 \\ 4 \\ 2 \end{pmatrix} \quad (2.0.12)$$

Hence this shows that the plane given by equation

(1.0.2) passes through the point $\mathbf{C} = \begin{pmatrix} 2 \\ 4 \\ 2 \end{pmatrix}$