Assignment 1

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Download all python codes from

https://github.com/sachinomdubey/Matrix−theory/codes

and latex-tikz codes from

https://github.com/sachinomdubey/Matrix−theory

1 Question No. 42

Find the coordinates of the foot of the perpendicular from the point $\begin{pmatrix}-1\\3\end{pmatrix}$ to the line

$$\begin{pmatrix}3 & -4\end{pmatrix}\mathbf{x} = 16. \tag{1.0.1}$$

2 Explanation

The normal vector to the perpendicular drawn from point (-1 3) is same as the direction vector of the given line:

$\mathbf{n}=\begin{bmatrix}4\\3\end{bmatrix}$

The equation of the drawn perpendicular in terms of the normal vertor is then obtained as

$$\mathbf{n}^T(\mathbf{x}-\mathbf{A}) = 0$$

$$\begin{pmatrix}4 & 3\end{pmatrix}\mathbf{x} = 5$$

The above two line equations can be expressed as the matrix equation

$$\begin{bmatrix}3 & -4\\4 & 3\end{bmatrix}\mathbf{x} = \begin{bmatrix}16\\5\end{bmatrix}$$

The augmented matrix for the above equation is row reduced as follows

$$\begin{bmatrix}3 & -4 & 16\\4 & 3 & 5\end{bmatrix}$$

$$\xleftrightarrow{R_1\leftarrow R_1/3}$$

$$\begin{bmatrix}1 & -4/3 & 16/3\\4 & 3 & 5\end{bmatrix}$$

$$\xleftrightarrow{R_2\leftarrow R_2-4R_1}$$

$$\begin{bmatrix}1 & -4/3 & 16/3\\4 & 25/3 & -49/3\end{bmatrix}$$

$$\xleftrightarrow{R_2\leftarrow R_2\times 3/25}$$

$$\begin{bmatrix}1 & -4/3 & 16/3\\0 & 1 & -49/25\end{bmatrix}$$

$$\xleftrightarrow{R_1\leftarrow R_1+4/3\times R_1}$$

$$\begin{bmatrix}1 & 0 & 68/25\\0 & 1 & -49/25\end{bmatrix}$$

Thus, The foot of the perpendicular is at point (68/25 , -49/25) i.e. (2.72, -1.96)