Assignment 1

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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:

$$\mathbf{n} = \begin{pmatrix} 4 \\ 3 \end{pmatrix} \tag{2.0.1}$$

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

$$\mathbf{n}^T(\mathbf{x} - \mathbf{A}) = 0 \tag{2.0.2}$$

$$\begin{pmatrix} 4 & 3 \end{pmatrix} \mathbf{x} = 5 \tag{2.0.3}$$

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

$$\begin{pmatrix} 3 & -4 \\ 4 & 3 \end{pmatrix} \mathbf{x} = \begin{pmatrix} 16 \\ 5 \end{pmatrix} \tag{2.0.4}$$

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

$$\begin{pmatrix} 3 & -4 & 16 \\ 4 & 3 & 5 \end{pmatrix} \tag{2.0.5}$$

$$R_1 \leftarrow R_1/3 \tag{2.0.6}$$

$$\begin{pmatrix} 1 & -4/3 & 16/3 \\ 4 & 3 & 5 \end{pmatrix} \tag{2.0.7}$$

$$R_2 \leftarrow R_2 - 4R_1 \tag{2.0.8}$$

$$\begin{pmatrix} 1 & -4/3 & 16/3 \\ 4 & 25/3 & -49/3 \end{pmatrix} \tag{2.0.9}$$

$$R_2 \leftarrow R_2 \times 3/25 \tag{2.0.10}$$

$$\begin{pmatrix} 1 & -4/3 & 16/3 \\ 0 & 1 & -49/25 \end{pmatrix} \tag{2.0.11}$$

$$R_1 \leftarrow R_1 + 4/3 \times R_1 \tag{2.0.12}$$

$$\begin{pmatrix} 1 & 0 & 68/25 \\ 0 & 1 & -49/25 \end{pmatrix} \tag{2.0.13}$$

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

Plot of the two lines: