Assignment 1

Sachinkumar Dubey

Download all python codes from

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https://github.com/sachinomdubey/Matrix-theory/codes
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and latex-tikz codes from

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

$$\begin{pmatrix}3 & -4 & 16\\4 & 3 & 5\end{pmatrix} \xleftrightarrow{R_1 \leftarrow R_1/3} \begin{pmatrix}1 & -4/3 & 16/3\\4 & 3 & 5\end{pmatrix} \tag{2.0.5}$$

$$\xleftrightarrow{R_2 \leftarrow R_2 - 4R_1} \begin{pmatrix}1 & -4/3 & 16/3\\4 & 25/3 & -49/3\end{pmatrix} \tag{2.0.6}$$

$$\xleftrightarrow{R_2 \leftarrow R_2 \times 3/25} \begin{pmatrix}1 & -4/3 & 16/3\\0 & 1 & -49/25\end{pmatrix} \tag{2.0.7}$$

$$\xleftrightarrow{R_1 \leftarrow R_1 + 4/3 \times R_1} \begin{pmatrix}1 & 0 & 68/25\\0 & 1 & -49/25\end{pmatrix} \tag{2.0.8}$$

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

Plot of the two lines: