ASSIGNMENT 4

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QUESTION

Linear Forms/Q.2.11

Find the equation of the line parallel to the line

$$\begin{pmatrix} 3 & -4 \end{pmatrix} \mathbf{x} = -2 \qquad (0.0.1)$$

and passing through the point $\begin{pmatrix} -2 \\ 3 \end{pmatrix}$.

SOLUTION

From the equation of the line $\begin{pmatrix} 3 & -4 \end{pmatrix}\mathbf{x} = -2$, the normal vector is,

$$\mathbf{n_1} = \begin{pmatrix} 3 \\ -4 \end{pmatrix} \qquad (0.0.2)$$

The slope is

$$\mathbf{m_1} = \begin{pmatrix} 0 & -1 \\ 1 & 0 \end{pmatrix} \mathbf{n_1} \qquad (0.0.3)$$

$$\mathbf{m_1} = \begin{pmatrix} 4 \\ 3 \end{pmatrix} \qquad (0.0.4)$$

Parallel lines have the same slope.So direction vector of required line is $\mathbf{m} = \begin{pmatrix} 4 \\ 3 \end{pmatrix}$.

Hence the normal vector of required line is,

$$\mathbf{n} = \begin{pmatrix} 0 & -1 \\ 1 & 0 \end{pmatrix} \mathbf{m} \qquad (0.0.5)$$

$$\mathbf{n} = \begin{pmatrix} 3 \\ -4 \end{pmatrix} \qquad (0.0.6)$$

The point is $\mathbf{P} = \begin{pmatrix} -2 \\ 3 \end{pmatrix}$. The equation of the line in terms of normal vector is :

$$\mathbf{n}^\top (\mathbf{x} - \mathbf{P}) = 0 \qquad (0.0.7)$$

$$\begin{pmatrix} 3 & -4 \end{pmatrix}\left(\mathbf{x} - \begin{pmatrix} -2 \\ 3 \end{pmatrix}\right) = 0 \qquad (0.0.8)$$

The desired line is given by

$$\begin{pmatrix} 3 & -4 \end{pmatrix} \mathbf{x} = -18 \qquad (0.0.9)$$

The equation of the line is also obtained as,

$$\mathbf{x} = \mathbf{P} + \lambda \mathbf{m} \qquad (0.0.10)$$

$$\mathbf{x} = \begin{pmatrix} -2 \\ 3 \end{pmatrix} + \lambda \begin{pmatrix} 4 \\ 3 \end{pmatrix} \qquad (0.0.11)$$
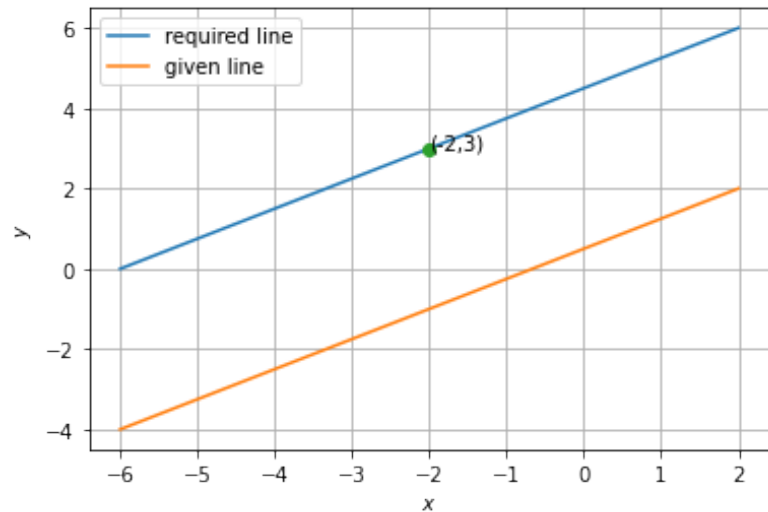

Fig. 1: graph