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Assignment-4

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Problem Statement:

Slope of a line passing through P(2,3) and intersecting the line x+y=7 at a distance of 4 units from P .

SOLUTION:

Given:

Equation of line is x+y=7

$$P = (2, 3) \tag{1}$$

To Find

Slope of the line passing through P(2,3)

STEP-1

Let $\mathbf{A}$ be any point on the line and the coordinates are,

$$\mathbf{A} = \begin{pmatrix} 4 \\ 3 \end{pmatrix} \tag{2}$$

From given, we know that point $\mathbf{P}$

$$\mathbf{P} = \begin{pmatrix} 2 \\ 3 \end{pmatrix} \tag{3}$$

Let $\mathbf{m}$ be the directional vector

$$\mathbf{m} = \begin{pmatrix} 1 \\ -1 \end{pmatrix} \tag{4}$$

Given distance from point $\mathbf{P}$ to the line is 4

STEP-2

The distance from a point $\mathbf{P}$ to the line is given by,

$$d(\lambda) = \|\mathbf{A} + \lambda\mathbf{m} - \mathbf{P}\| \tag{5}$$

Squaring on both the sides

$$d^2(\lambda) = \|\mathbf{A} + \lambda\mathbf{m} - \mathbf{P}\|^2 \tag{6}$$

STEP-3

After substituting $\mathbf{A}$, $\mathbf{P}$ and $\mathbf{m}$ in the above equation and solving (6) we get

$$\lambda = 1.64, -3.64 \tag{7}$$

Using equation (7) any point on the line

$$\mathbf{x} = \mathbf{A} + \lambda\mathbf{m} \tag{8}$$

substituting $\mathbf{A}$ and $\mathbf{m}$ in (8) we get

$$\mathbf{x1} = \begin{pmatrix} 0.36 \\ 6.64 \end{pmatrix} \tag{9}$$

and

$$\mathbf{x2} = \begin{pmatrix} 5.64 \\ 1.36 \end{pmatrix} \tag{10}$$

The equation of line with normal vector $\mathbf{n}$ and passing through point $\mathbf{A}$ is given by

$$\mathbf{n}^\top(\mathbf{x} - \mathbf{A}) = 0 \tag{11}$$

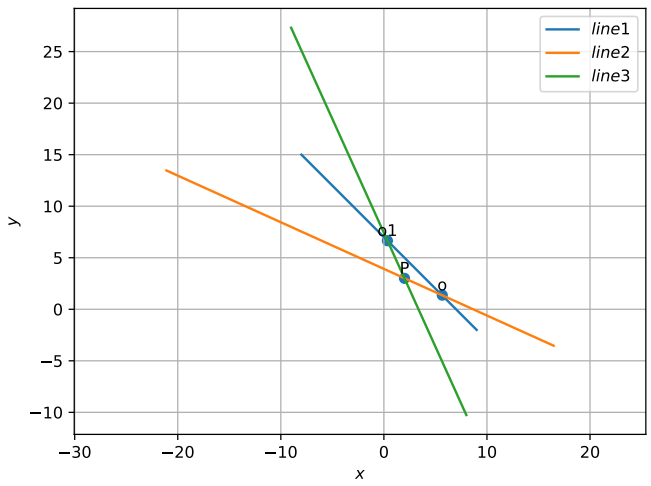
$$\mathbf{n} = \begin{pmatrix} -2.21 \\ 1 \end{pmatrix} \tag{12}$$

$$\mathbf{A} = \begin{pmatrix} 2 \\ 3 \end{pmatrix} \tag{13}$$

after substituting $\mathbf{n}$,$\mathbf{A}$ and $\mathbf{x}$ in (11) we get

$$2.21x + y = 7.42 \tag{14}$$

$$x + 2.21y = 8.66 \tag{15}$$



Construction

vertex	coordinates
P	$\begin{pmatrix} 2 \\ 3 \end{pmatrix}$

Download the code
Github link: Assignment-4.