LINE EQUATION USING INTERCEPT POINTS

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FWC22098 IITH-Future Wireless Communications Assignment-matrices

Contents

1 Problem

A straight line through the point A(3, 4) is such that its intercept between the axes is bisected at A. Its equation is :

2 Solution

The input given

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

To prove **4x + 3y = 24**
The equation of a line is :

$$n^\top X = c$$
$$n^\top A = c$$
$$n^\top B = c$$
$$n^\top C = c$$
$$A = \frac{B+C}{2}$$

$$B + C = 2A \tag{1}$$

$$e_1^\top B = 0 \tag{2}$$

$$e_2^\top C = 0 \tag{3}$$

Here e_1 and and e_2 are standard basis vectors

$$e_1 = \begin{pmatrix} 1 \\ 0 \end{pmatrix}, e_2 = \begin{pmatrix} 0 \\ 1 \end{pmatrix}$$

In equation(1) ,multiply on both sides by $e_1^\top$

$$e_1^\top(B + C) = 2e_1^\top A$$
$$e_1^\top B + e_1^\top C = 2e_1^\top A$$
$$e_1^\top C = 2e_1^\top A$$
$$\mathbf{C} = \begin{pmatrix} 2e_1^\top A \\ 0 \end{pmatrix} = \begin{pmatrix} 6 \\ 0 \end{pmatrix}$$

In equation(1) ,multiply on both sides by $e_2^\top$

$$e_2^\top(B + C) = 2e_2^\top A$$
$$e_2^\top B + e_2^\top C = 2e_2^\top A$$
$$e_2^\top B = 2e_2^\top A$$

$$\mathbf{B} = \begin{pmatrix} 0 \\ 2e_2^\top A \end{pmatrix} = \begin{pmatrix} 0 \\ 8 \end{pmatrix}$$
$$\mathbf{m} = (C - A)$$
$$\mathbf{m} = \begin{pmatrix} 3 \\ -4 \end{pmatrix}$$

here m is a direction vector

$$\mathbf{n} = \begin{pmatrix} 0 & -1 \\ 1 & 0 \end{pmatrix} \mathbf{m}$$

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

Here n is a normal vector

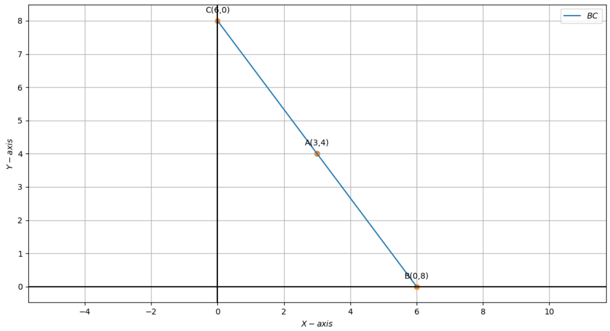
The equation of a line with normal vector n and passing through the point A formula :

$$n^\top(X - A) = 0$$
$$\begin{pmatrix} 4 & 3 \end{pmatrix} \left(\begin{pmatrix} x \\ y \end{pmatrix} - \begin{pmatrix} 3 \\ 4 \end{pmatrix} \right) = 0$$

Hence prove equation of line :

$$4x + 3y = 24$$

3 Construction



4 Software

Download the following code

https://github.com/dudekulauseni123/FWC0982022