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1 PROBLEM

In triangle ABC with vertices $\mathbf{A} = \begin{pmatrix} 2 \\ 3 \end{pmatrix}$, $\mathbf{B} = \begin{pmatrix} 4 \\ -1 \end{pmatrix}$ and $\mathbf{C} = \begin{pmatrix} 1 \\ 2 \end{pmatrix}$, Find the equation and length of altitude from vertex A

2 SOLUTION

1) Direction vector of side BC

$$\mathbf{m} = \mathbf{B} - \mathbf{C} \quad (2.0.1)$$

$$= \begin{pmatrix} 3 \\ -3 \end{pmatrix} \quad (2.0.2)$$

Direction vector of side BC is normal of altitude from A

2) Equation of the altitude

$$\mathbf{m}^T (\mathbf{x} - \mathbf{A}) = 0 \quad (2.0.3)$$

$$\begin{pmatrix} 3 & -3 \end{pmatrix} \mathbf{x} = -3 \quad (2.0.4)$$

$$\begin{pmatrix} 1 & -1 \end{pmatrix} \mathbf{x} = -1 \quad (2.0.5)$$

3) Normal vector of line BC

$$\mathbf{n} = \begin{pmatrix} 1 \\ 1 \end{pmatrix} \quad (2.0.6)$$

4) Equation of line BC

$$\mathbf{n}^T (\mathbf{x} - \mathbf{B}) = 0 \quad (2.0.7)$$

$$\begin{pmatrix} 1 & 1 \end{pmatrix} \mathbf{x} = 3 \quad (2.0.8)$$

$$(2.0.9)$$

On comparing with $\mathbf{n}^T \mathbf{x} = c$,

$$c = 3 \quad (2.0.10)$$

5) Length of altitude

$$length = \frac{|\mathbf{n}^T \mathbf{A} - c|}{\|\mathbf{n}\|} \quad (2.0.11)$$

$$= \sqrt{2} \quad (2.0.12)$$

Parameter	Value	Description
A	$\begin{pmatrix} 2 \\ 3 \end{pmatrix}$	Vertex 'A' of the triangle
B	$\begin{pmatrix} 4 \\ -1 \end{pmatrix}$	Vertex 'B' of triangle
C	$\begin{pmatrix} 1 \\ 2 \end{pmatrix}$	Vertex 'C' of triangle

TABLE 5: Table

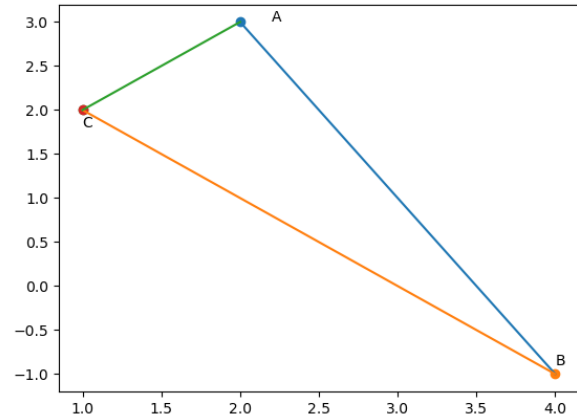


Fig. 5: Figure