

VECTOR USING PYTHON

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IITH Future Wireless Communication (FWC)

ASSIGN-1

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1 Construction

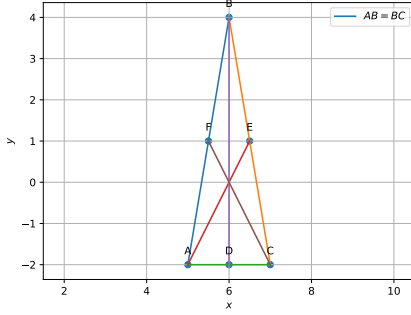


Figure of construction

2 Problem

Check whether $(5, -2)$, $(6, 4)$ and $(7, -2)$ are the vertices of an isosceles triangle. Show that the points $(5, -2)$, $(6, 4)$ and $(7, -2)$ are vertices of an isosceles triangle.

3 solution

3.1 method 1

Let the given points be $\mathbf{A}, \mathbf{B}, \mathbf{C}$ respectively. Then, the direction vectors of AB, BC and CA are

$$\mathbf{A} - \mathbf{B} = \begin{pmatrix} 5 \\ -2 \end{pmatrix} - \begin{pmatrix} 6 \\ 4 \end{pmatrix} = \begin{pmatrix} -1 \\ -6 \end{pmatrix} \quad (1)$$

$$\mathbf{B} - \mathbf{C} = \begin{pmatrix} 6 \\ 4 \end{pmatrix} - \begin{pmatrix} 7 \\ -2 \end{pmatrix} = \begin{pmatrix} -1 \\ 6 \end{pmatrix} \quad (2)$$

$$\mathbf{C} - \mathbf{A} = \begin{pmatrix} 7 \\ -2 \end{pmatrix} - \begin{pmatrix} 5 \\ -2 \end{pmatrix} = \begin{pmatrix} 2 \\ 0 \end{pmatrix} \quad (3)$$

$$\begin{aligned} (\mathbf{A} - \mathbf{B})^\top (\mathbf{B} - \mathbf{C}) &= \begin{pmatrix} -1 & -6 \end{pmatrix} \begin{pmatrix} -1 \\ 6 \end{pmatrix} \\ &= 37 \end{aligned} \quad (4)$$

$$\begin{aligned} (\mathbf{B} - \mathbf{C})^\top (\mathbf{C} - \mathbf{A}) &= \begin{pmatrix} -1 & 6 \end{pmatrix} \begin{pmatrix} 2 \\ 0 \end{pmatrix} \\ &= -2 \end{aligned} \quad (5)$$

$$\begin{aligned} (\mathbf{C} - \mathbf{A})^\top (\mathbf{A} - \mathbf{B}) &= \begin{pmatrix} 2 & 0 \end{pmatrix} \begin{pmatrix} -1 \\ -6 \end{pmatrix} \\ &= -2 \end{aligned} \quad (6)$$

From the above equations, (7)

$$(\mathbf{A} - \mathbf{B}) \perp (\mathbf{B} - \mathbf{C}) \quad (8)$$

$$\angle BCA = \angle CAB \quad (9)$$

Thus, the triangle is isosceles triangle.

3.2 method 2

Let the given points be $\mathbf{E}, \mathbf{F}, \mathbf{D}$ respectively. Then, the direction vectors of BD, CF, AE are

From the above, we find that midpoints

$$\mathbf{B} - \mathbf{C} = \begin{pmatrix} 6 \\ 4 \end{pmatrix} - \begin{pmatrix} 7 \\ -2 \end{pmatrix} = \begin{pmatrix} 13/2 \\ 1 \end{pmatrix} \quad (14)$$

$$\mathbf{C} - \mathbf{A} = \begin{pmatrix} 7 \\ -2 \end{pmatrix} - \begin{pmatrix} 5 \\ -2 \end{pmatrix} = \begin{pmatrix} 6 \\ -2 \end{pmatrix} \quad (15)$$

$$\mathbf{A} - \mathbf{B} = \begin{pmatrix} 5 \\ -2 \end{pmatrix} - \begin{pmatrix} 6 \\ 4 \end{pmatrix} = \begin{pmatrix} 11/2 \\ 1 \end{pmatrix} \quad (16)$$

$$(\mathbf{E} - \mathbf{A})^\top (\mathbf{C} - \mathbf{B}) = \begin{pmatrix} 3/2 & 3 \end{pmatrix} \begin{pmatrix} -1 \\ -6 \end{pmatrix} \quad (17)$$

$$\neq 0 \quad (18)$$

$$(\mathbf{F} - \mathbf{C})^\top (\mathbf{B} - \mathbf{A}) = \begin{pmatrix} 3/2 & 3 \end{pmatrix} \begin{pmatrix} 1 \\ 6 \end{pmatrix} \quad (19)$$

$$\neq 0 \quad (20)$$

$$(\mathbf{D} - \mathbf{B})^\top (\mathbf{C} - \mathbf{A}) = \begin{pmatrix} 0 & -6 \end{pmatrix} \begin{pmatrix} 2 \\ 0 \end{pmatrix} \quad (21)$$

$$= 0 \quad (22)$$

$$(\mathbf{B} - \mathbf{D}) \perp (\mathbf{A} - \mathbf{C}) \quad (23)$$

$$\angle BCA = \angle CAB \quad (24)$$

Thus, the triangle is isosceles triangle.