2.5.1

EE25BTECH11047 - RAVULA SHASHANK REDDY

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Question:

Check whether the points $(7, 10)$, $(-2, 5)$, $(3, 4)$ form an isosceles right triangle.

Solution:

Given:

$$\mathbf{A} = \begin{pmatrix} 7 \\ 10 \end{pmatrix} \tag{1}$$

$$\mathbf{B} = \begin{pmatrix} -2 \\ 5 \end{pmatrix} \tag{2}$$

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

Side vectors:

$$\mathbf{A} - \mathbf{B} = \begin{pmatrix} 7 \\ 10 \end{pmatrix} - \begin{pmatrix} -2 \\ 5 \end{pmatrix} = \begin{pmatrix} 9 \\ 5 \end{pmatrix} \tag{4}$$

$$\mathbf{A} - \mathbf{C} = \begin{pmatrix} 7 \\ 10 \end{pmatrix} - \begin{pmatrix} 3 \\ 4 \end{pmatrix} = \begin{pmatrix} 4 \\ 6 \end{pmatrix} \tag{5}$$

$$\mathbf{B} - \mathbf{C} = \begin{pmatrix} -2 \\ 5 \end{pmatrix} - \begin{pmatrix} 3 \\ 4 \end{pmatrix} = \begin{pmatrix} -5 \\ 1 \end{pmatrix} \tag{6}$$

Squared lengths:

$$\|\mathbf{A} - \mathbf{B}\|^2 = (\mathbf{A} - \mathbf{B})^T(\mathbf{A} - \mathbf{B}) = 9^2 + 5^2 = 106 \tag{7}$$

$$\|\mathbf{A} - \mathbf{C}\|^2 = (\mathbf{A} - \mathbf{C})^T(\mathbf{A} - \mathbf{C}) = 4^2 + 6^2 = 52 \tag{8}$$

$$\|\mathbf{B} - \mathbf{C}\|^2 = (\mathbf{B} - \mathbf{C})^T(\mathbf{B} - \mathbf{C}) = (-5)^2 + 1^2 = 26 \tag{9}$$

Since all are distinct not Isosceles.

Right angle check:

For a right angle, the dot product of two sides must be zero.

$$(\mathbf{A}-\mathbf{B})^T(\mathbf{A}-\mathbf{C}) = (9)(4) + (5)(6) = 66 \neq 0 \tag{10}$$

$$(\mathbf{A}-\mathbf{B})^T(\mathbf{B}-\mathbf{C}) = (9)(-5) + (5)(1) = -40 \neq 0 \tag{11}$$

$$(\mathbf{A}-\mathbf{C})^T(\mathbf{B}-\mathbf{C}) = (4)(-5) + (6)(1) = -14 \neq 0 \tag{12}$$

Hence, the given points forms neither an isosceles nor a right-angled triangle.

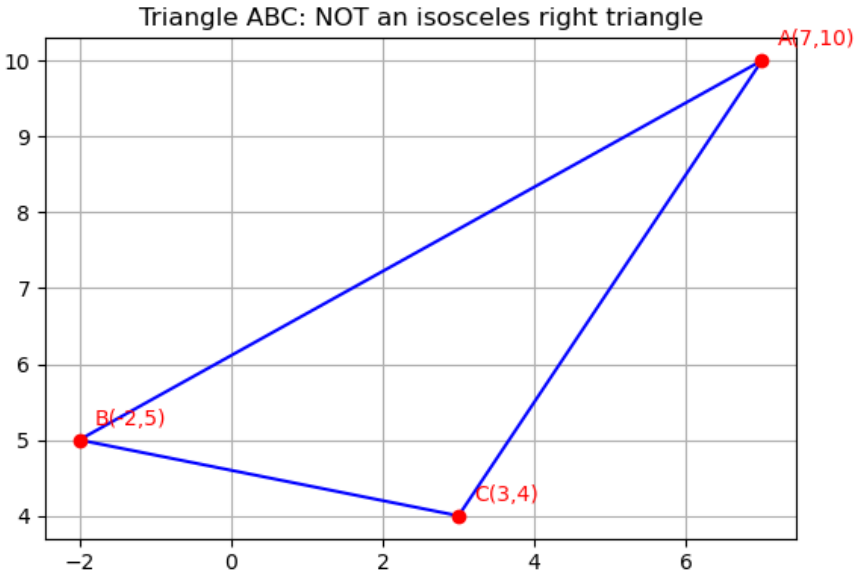
Triangle ABC: NOT an isosceles right triangle
A(7,10)
B(-2,5)
C(3,4)
10
9
8
7
6
5
4
−2
0
2
4
6

Figure 1