

# Assignment 1

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## Area of Triangle

**Abstract**—This document contains the solution to find the Area of a Triangle, given the coordinates of the vertices.

Download all python codes from

<https://github.com/AP1920/Assignment1/blob/main/assignment1.py>

Download latex-tikz codes from

<https://github.com/AP1920/Assignment1/blob/main/main.tex>

### 1 PROBLEM

Solve: Problem set: Vector2, Example-2,6

Find the areas of the triangles the coordinates of whose angular points are respectively: A(-1,2), B( 2,3) and C(4,-3)

### 2 SOLUTION

We will be using vectors for calculating the area of the triangle formed by above three points.

$$\mathbf{BA} = \begin{pmatrix} 2 \\ 3 \end{pmatrix} - \begin{pmatrix} -1 \\ 2 \end{pmatrix}$$

$$\mathbf{BA} = \begin{pmatrix} 3 \\ 1 \end{pmatrix} \quad (2.0.1)$$

$$\mathbf{CA} = \begin{pmatrix} 4 \\ -3 \end{pmatrix} - \begin{pmatrix} -1 \\ 2 \end{pmatrix}$$

$$\mathbf{CA} = \begin{pmatrix} 5 \\ -5 \end{pmatrix} \quad (2.0.2)$$

$$\therefore \text{Area of the triangle} = \frac{1}{2} |\mathbf{BA} \times \mathbf{CA}| \quad (2.0.3)$$

As the vector cross product of two vectors can also be expressed as the product of a skew-symmetric matrix and a vector.

$$\mathbf{P} \times \mathbf{Q} = \begin{pmatrix} 0 & -a_3 & a_2 \\ a_3 & 0 & -a_1 \\ -a_2 & a_1 & 0 \end{pmatrix} \times \begin{pmatrix} b_1 \\ b_2 \\ b_3 \end{pmatrix} \quad (2.0.4)$$

Substituting values from equation 2.0.1 and 2.0.2 in above equation 2.0.4, we'll get:

$$\mathbf{BA} \times \mathbf{CA} = \begin{pmatrix} 0 & 0 & 1 \\ 0 & 0 & -3 \\ -1 & 3 & 0 \end{pmatrix} \times \begin{pmatrix} 5 \\ -5 \\ 0 \end{pmatrix}$$

$$\mathbf{BA} \times \mathbf{CA} = \begin{pmatrix} 0 \\ 0 \\ -20 \end{pmatrix}$$

$$\therefore |\mathbf{BA} \times \mathbf{CA}| = \sqrt{0^2 + 0^2 + (-20)^2} = 20 \quad (2.0.5)$$

Substituting value from equation 2.0.5 in equation 2.0.3, we'll get area of triangle:

$$\Rightarrow \frac{1}{2}(20) = 10 \text{units}^2$$

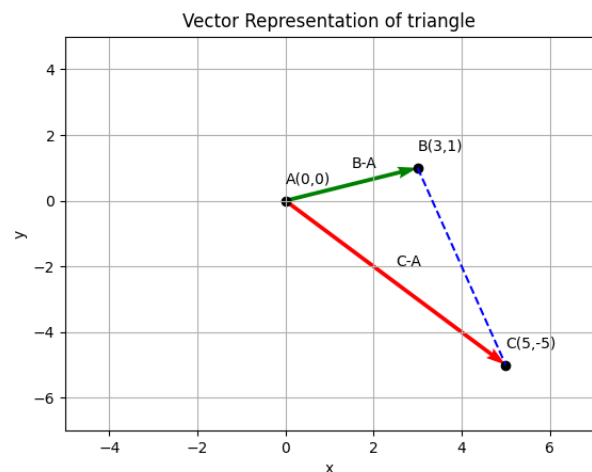


Fig. 1: Plot obtained from Python code