

# 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/vishu1302/Introduction\\_to\\_AI-ML.git/Assignment\\_1.ipynb](https://github.com/vishu1302/Introduction_to_AI-ML.git/Assignment_1.ipynb)

Download latex-tikz codes from

[https://github.com/vishu1302/Introduction\\_to\\_AI-ML.git/main.tex](https://github.com/vishu1302/Introduction_to_AI-ML.git/main.tex)

### 1 PROBLEM

Solve: Problem set: Vector2, Example-2,3

Find the areas of the triangles the coordinates of whose angular points are respectively: (5,2), (-9,-3) and (-3,-5)

### 2 SOLUTION

$$\begin{aligned}\mathbf{Q} - \mathbf{P} &= \begin{pmatrix} -9 \\ -3 \end{pmatrix} - \begin{pmatrix} 5 \\ 2 \end{pmatrix} \\ &= \begin{pmatrix} -14 \\ -5 \end{pmatrix}\end{aligned}\quad (2.0.1)$$

$$\begin{aligned}\mathbf{R} - \mathbf{P} &= \begin{pmatrix} -3 \\ -5 \end{pmatrix} - \begin{pmatrix} 5 \\ 2 \end{pmatrix} \\ &= \begin{pmatrix} -8 \\ -7 \end{pmatrix}\end{aligned}\quad (2.0.2)$$

$$\therefore \text{Area of the Triangle} = \frac{1}{2} \|(\mathbf{Q} - \mathbf{P}) \times (\mathbf{R} - \mathbf{P})\| \quad (2.0.3)$$

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

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

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

$$\begin{aligned}(\mathbf{Q} - \mathbf{P}) \times (\mathbf{R} - \mathbf{P}) &= \begin{pmatrix} 0 & 0 & -5 \\ 0 & 0 & 14 \\ 5 & -14 & 0 \end{pmatrix} \times \begin{pmatrix} -8 \\ -7 \\ 0 \end{pmatrix} \\ &= \begin{pmatrix} 0 \\ 0 \\ 58 \end{pmatrix}\end{aligned}\quad (2.0.5)$$

$$\therefore \|(\mathbf{Q} - \mathbf{P}) \times (\mathbf{R} - \mathbf{P})\| = \sqrt{0^2 + 0^2 + 58^2} = 58$$

(2.0.6)

Substituting value from equation 2.0.6 in equation 2.0.3, we'll get area of triangle:

$$\Rightarrow \frac{1}{2}(58) = 29 \text{units}^2$$