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
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Download latex-tikz codes from

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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:

$$\mathbf{P}(5,2), \mathbf{Q}(-9,-3) \text{ and } \mathbf{R}(-3,-5)$$

2 Solution

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

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

$$\because \text{Area of the Triangle} = \frac{1}{2}\left\|(\mathbf{Q}-\mathbf{P})\times(\mathbf{R}-\mathbf{P})\right\| \tag{2.0.3}$$

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

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

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

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

$$\therefore \left\|(\mathbf{Q}-\mathbf{P})\times(\mathbf{R}-\mathbf{P})\right\| = \sqrt{0^2+0^2+58^2} = 58 \tag{2.0.6}$$

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

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