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.**

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1 PROBLEM

Solve: Problem set: Vector2, Example-2,2 Find the areas of the triangles the coordinates of whose angular points are respectively:

$$\mathbf{P} = \begin{pmatrix} 0 \\ 4 \end{pmatrix}, \mathbf{Q} = \begin{pmatrix} 3 \\ 6 \end{pmatrix} \text{ and } \mathbf{R} = \begin{pmatrix} -8 \\ -2 \end{pmatrix}$$

2 SOLUTION

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

$$\mathbf{Q} - \mathbf{P} = \begin{pmatrix} 3 \\ 6 \end{pmatrix} - \begin{pmatrix} 0 \\ 4 \end{pmatrix} \quad (2.0.1)$$

$$= \begin{pmatrix} 3 \\ 2 \end{pmatrix} \quad (2.0.2)$$

$$\mathbf{R} - \mathbf{P} = \begin{pmatrix} -8 \\ -2 \end{pmatrix} - \begin{pmatrix} 0 \\ 4 \end{pmatrix} \quad (2.0.3)$$

$$= \begin{pmatrix} -8 \\ -6 \end{pmatrix} \quad (2.0.4)$$

$$\because \text{Area of the Triangle} = \frac{1}{2} \|(\mathbf{Q} - \mathbf{P}) \times (\mathbf{R} - \mathbf{P})\| \quad (2.0.5)$$

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

$$\mathbf{A} \times \mathbf{B} = \begin{pmatrix} 0 & -a_3 & a_2 \\ a_3 & 0 & -a_1 \\ -a_2 & a_1 & 0 \end{pmatrix} \times \begin{pmatrix} b_1 \\ b_2 \\ b_3 \end{pmatrix} \quad (2.0.6)$$

Substituting values from equation (2.0.1) and (2.0.3) in above equation 2.0.6, we'll get:

$$(\mathbf{Q} - \mathbf{P}) \times (\mathbf{R} - \mathbf{P}) = \begin{pmatrix} 0 & 0 & 2 \\ 0 & 0 & -3 \\ -2 & 3 & 0 \end{pmatrix} \times \begin{pmatrix} -8 \\ -6 \\ 0 \end{pmatrix} \quad (2.0.7)$$

$$= \begin{pmatrix} 0 \\ 0 \\ -2 \end{pmatrix} \quad (2.0.8)$$

$$\therefore \|(\mathbf{Q} - \mathbf{P}) \times (\mathbf{R} - \mathbf{P})\| = \sqrt{0^2 + 0^2 + -2^2} = 2 \quad (2.0.9)$$

Substituting value from equation (2.0.9) in equation (2.0.5), we'll get area of triangle:

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