

# Introduction to AI and ML

## Matrix Project

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## Question

Q16 of JEE Main 2014 (Code G): Let PS be the median of the triangle with vertices  $P(2, 2)$ ,  $Q(6, -1)$  and  $R(7, 3)$ . The equation of the line passing through  $(1, -1)$  and parallel to PS is:

Given points in matrix form are:

$$P = \begin{bmatrix} 2 & 2 \end{bmatrix} \quad Q = \begin{bmatrix} 6 & -1 \end{bmatrix} \quad R = \begin{bmatrix} 7 & 3 \end{bmatrix}$$

The required line passes through the given point:

$$A = \begin{bmatrix} 1 & -1 \end{bmatrix}$$

# Solution

Midpoint  $S$  of the side  $QR$  of the triangle:

$$S = (Q + R)/2$$

$$S = [6.5 \quad 1]$$

Then,  $PS$  is a median. Its direction vector is:

$$S - P$$

Writing this in matrix form: Writing  $PS$  as:

$$PS = \begin{bmatrix} 2 & 6.5 \\ 2 & 1 \end{bmatrix}$$

Then:

$$S - P = \begin{bmatrix} 2 & 6.5 \\ 2 & 1 \end{bmatrix} \begin{bmatrix} -1 \\ 1 \end{bmatrix}$$

The direction vector of PS is:

$$d = \begin{bmatrix} 4.5 \\ -1 \end{bmatrix}$$

The unit direction vector is:

$$unit_d = d/||d||$$

Norm of direction vector,d is:

$$||d|| = \text{sqrt}((4.5)^2 + (-1)^2)$$

Then,value of unit vector is:

$$unit_d = \begin{bmatrix} 0.9761 \\ -0.2169 \end{bmatrix}$$

Consider a point  $X$  on the required line:

$$X = \begin{bmatrix} x \\ y \end{bmatrix}$$

Since, the line is parallel to  $PS$  and is passing through  $A$ , all points on the required line are of the form:

$$X = c * unit_d + A$$

where  $c$  is the parameter

$$\begin{bmatrix} x \\ y \end{bmatrix} = c \begin{bmatrix} 0.9761 \\ -0.2169 \end{bmatrix} + \begin{bmatrix} -1 \\ 1 \end{bmatrix}$$

This gives equation of the required line in matrix form.

The equation in algebraic form is:  $2x+9y+7$

