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:

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

The required line passes through the given point:

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

Solution

Midpont S of the side QR of the triangle:

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

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

Then,PS is a median.It's 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:

$$||d|| = sqrt((4.5)^2 + (-1)^2)$$

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:

$$X = c * unit_d + A$$

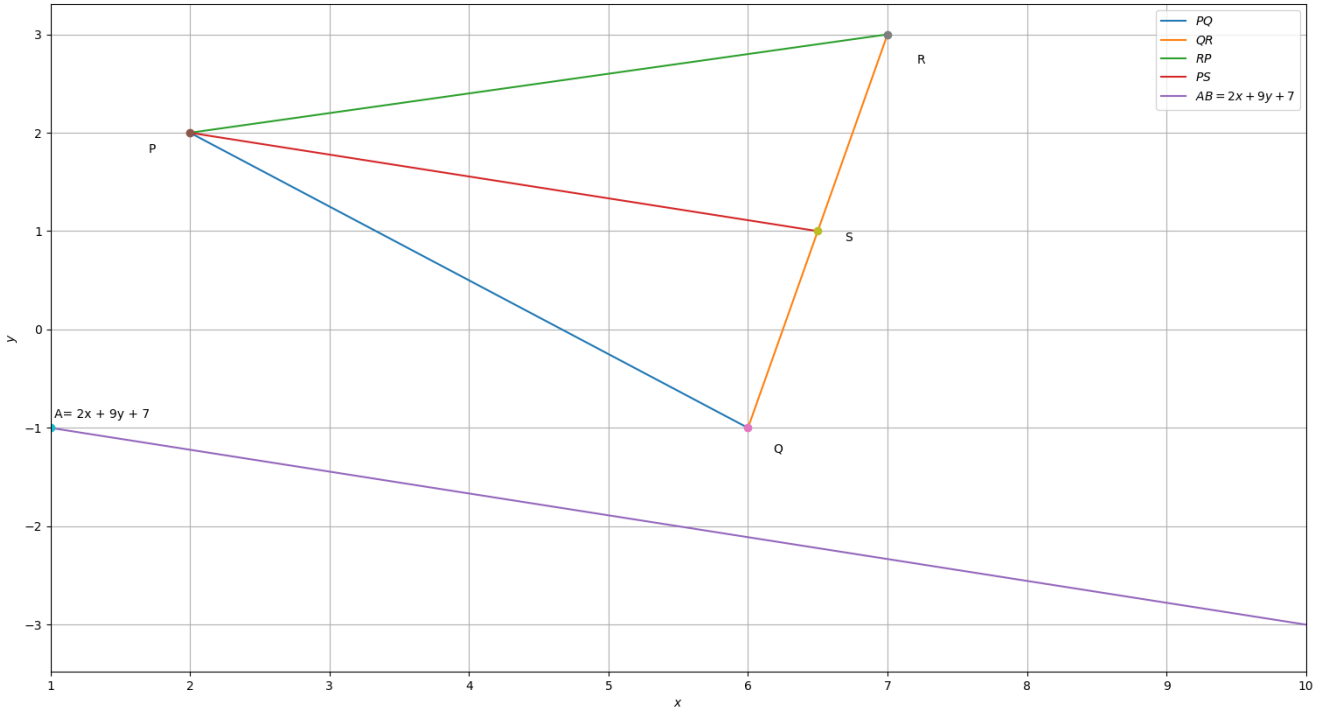
where c is the parameter

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

Multiplying with horizontal matrix [-1 -4.5] on both sides:

$$\begin{bmatrix} -1 & -4.5 \end{bmatrix} \begin{bmatrix} x \\ y \end{bmatrix} = 3.5$$

This gives equation of the required line in matrix form.
The equation in algebraic form is: 2x+9y+7


PQ
QR
RP
PS
AB = 2x + 9y + 7
P
R
S
Q
A= 2x + 9y + 7
x
y