Matrix-Lines

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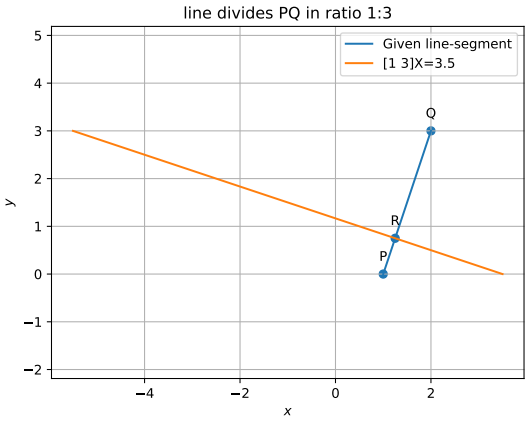

Figure 1: Equation of the required Straight Line

1 Problem Statement

A line perpendicular to the line segement joining the points (1,0)and(2,3)divides it in the ratio 1:n . find the equation of the line? (note: we are taking n as user Input) .

Symbol	Value	Description
P	$\begin{pmatrix}1\\0\end{pmatrix}$	given point
Q	$\begin{pmatrix}2\\3\end{pmatrix}$	given point
R	$\begin{pmatrix}\frac{2+n}{1+n}\\\frac{3}{1+n}\end{pmatrix}$	intersecting point

Table 1: Parameters

2 Solution

Given that resultant will divide the equation of line in the ratio 1:n and the line is perpendicular to line segment joining the points (1,0)and(2,3))

Let $\mathbf{P}=\begin{pmatrix}1\\0\end{pmatrix}$ and $\mathbf{Q}=\begin{pmatrix}2\\3\end{pmatrix}$

Equation of line is $\mathbf{n}^\top\mathbf{X} = c$.

We know if 2 points of the linesegment is given then,

Direction vector of line joining two points **P** **Q** is given by

$$\mathbf{M} = \mathbf{Q} - \mathbf{P} \tag{1}$$

$$\mathbf{M} = \begin{pmatrix} 2 \\ 3 \end{pmatrix} - \begin{pmatrix} 1 \\ 0 \end{pmatrix} \tag{2}$$

$$\mathbf{M} = \begin{pmatrix} 1 \\ 3 \end{pmatrix} \tag{3}$$

We know, that position or directional vector of points P and Q line segement used as the normal vector

The general equation of the required perpendicular line is $\mathbf{M}^\top \mathbf{X} = c$.

The perpendicular line cutting a line segment P and Q in ratio 1:n is passes through the point R.

$$\mathbf{R} = \frac{\mathbf{Q} + n\mathbf{P}}{1+n} \tag{4}$$

Equation of line passing through $\mathbf{R}$ is

$$\mathbf{M}^\top (\mathbf{X} - \mathbf{R}) = 0 \tag{5}$$

$$\mathbf{M}^\top \mathbf{X} - \mathbf{M}^\top \mathbf{R} = 0 \tag{6}$$

From eq4, eq6 and eq3 we can find the required Perpenducular line equation.

$$\begin{pmatrix} 1 & 3 \end{pmatrix} \mathbf{X} = \begin{pmatrix} 1 & 3 \end{pmatrix} \begin{pmatrix} \frac{2+n}{1+n} \\ \frac{3}{1+n} \end{pmatrix} \tag{7}$$

Therefore the equation of a line perpendicular to the given line segement divides it in the ratio 1:n is:

$$\begin{pmatrix} 1 & 3 \end{pmatrix} \mathbf{X} = \frac{11+n}{1+n} \tag{8}$$

3 Software

Download the following code using,

svn co https://github.com/chanduputta/FWC-Module1Assignments/blob/main/assignment4/line/lines3.py

and execute the code by using command

cmd: Python3 lines3.py
Then, input your required n value

4 Conclusion

We found the equation of a line perpendicular to the line segement joining the points (1,0)and(2,3) divides it in the ratio 1:n .