Assignment 1

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EE21MTECH14004

Abstract **- This document contains solution to find the coordinates of a point which divides a line segment internally and Externally**

Vector

Question 21 : Find the coordinates of the points which divide, internally and externally, the line joining the point (a+b, a-b) to the point (a-b, a+b) in the ratio a: b.

Solution :
Let us consider P be the point which divides the AB line segment in the ratio a: b internally and externally.
Given that the coordinates of A point= (a+b, a-b) and coordinates of B point= (a-b, a+b).
So we can write **A** and **B** as product of a constant matrix and a vector,

$$\mathbf{A} = \left[\begin{pmatrix}1 & 1\\ 1 & -1\end{pmatrix}\begin{pmatrix}a\\ b\end{pmatrix}\right]^\top = \begin{bmatrix}a+b\\ a-b\end{bmatrix}^\top = \begin{bmatrix}a+b & a-b\end{bmatrix} \tag{1}$$

$$\mathbf{B} = \left[\begin{pmatrix}1 & -1\\ 1 & 1\end{pmatrix}\begin{pmatrix}a\\ b\end{pmatrix}\right]^\top = \begin{bmatrix}a-b\\ a+b\end{bmatrix}^\top = \begin{bmatrix}a-b & a+b\end{bmatrix} \tag{2}$$

and

$$\frac{\mathbf{AP}}{\mathbf{PB}} = \frac{a}{b} \tag{3}$$

For finding internal division coordinates :

$$b\mathbf{AP} = a\mathbf{BP} \tag{4}$$

$$b(\mathbf{A}-\mathbf{P}) = a(\mathbf{P}-\mathbf{B}) \tag{5}$$

Solving the equation we get:

$$\mathbf{P}(a+b) = a\mathbf{B} + b\mathbf{A} \tag{6}$$

$$\mathbf{P} = \frac{a}{a+b}\begin{bmatrix}a-b & a+b\end{bmatrix} + \frac{b}{a+b}\begin{bmatrix}a+b & a-b\end{bmatrix} \tag{7}$$

Solving this we get coordinates of **P**:

$$\mathbf{P} = \begin{bmatrix}\frac{a(a-b)+b(a+b)}{a+b} & \frac{a(a+b)+b(a-b)}{a+b}\end{bmatrix} \tag{8}$$

For finding external division coordinates :

$$b\mathbf{AP} = a\mathbf{BP} \tag{9}$$

$$b(\mathbf{A}-\mathbf{P}) = a(\mathbf{B}-\mathbf{P}) \tag{10}$$

Solving the equation we get:

$$\mathbf{P}(a-b) = a\mathbf{B} - b\mathbf{A} \tag{11}$$

$$\mathbf{P} = \frac{a}{a-b}\begin{bmatrix}a-b & a+b\end{bmatrix} - \frac{b}{a-b}\begin{bmatrix}a+b & a-b\end{bmatrix} \tag{12}$$

Solving this we get coordinates of **P**:

$$\mathbf{P} = \begin{bmatrix}\frac{a(a-b)-b(a+b)}{a-b} & \frac{a(a+b)-b(a-b)}{a-b}\end{bmatrix} \tag{13}$$

Result

Plot of coordinates of the points obtained from Python code considering a= 6, b=3 is shown below

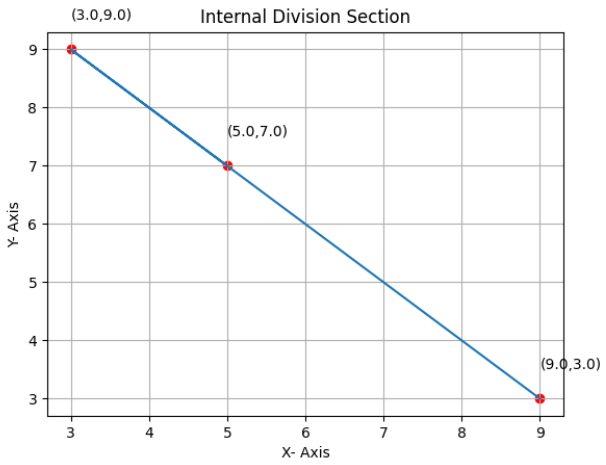

Figure 1: Internal Division Section

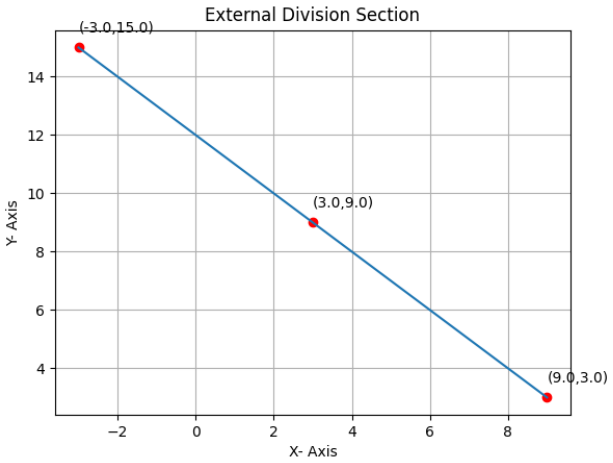

Figure 2: External Division Section