Assignment 1

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1 QUESTION No. 62

A line perpendicular to the line segment joining the points (1,0) and (2,3) divides it into the ratio 1:n. Find the equation of the line.

1.1 Solution
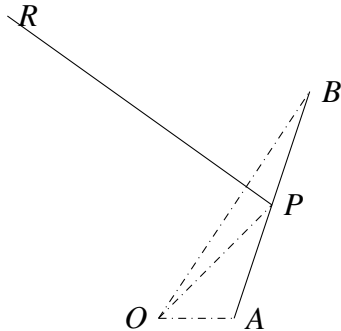
Given that

$$\mathbf{A} = \begin{pmatrix} 1 \\ 0 \end{pmatrix} and \ \mathbf{B} = \begin{pmatrix} 2 \\ 3 \end{pmatrix} \tag{1.1.1}$$

The line RP intersect the line AB in 1:n ration, using section formula

$$\mathbf{P} = \frac{\mathbf{B} + n\mathbf{A}}{n + 1} \tag{1.1.2}$$

Using equations (1.1.1) and (1.1.3),

$$\mathbf{P} = \begin{pmatrix} \frac{n+2}{n+1} \\ \frac{3}{n+1} \end{pmatrix} \tag{1.1.3}$$

Direction vector of line AB

$$\mathbf{m} = \begin{pmatrix} 2 \\ 3 \end{pmatrix} - \begin{pmatrix} 1 \\ 0 \end{pmatrix} = \begin{pmatrix} 1 \\ 3 \end{pmatrix} \tag{1.1.4}$$

Let $\mathbf{x}$ is the point on line PR, direction vector of line PR will be $(\mathbf{x} - \mathbf{P})$

Since line AB and line PR are perpendicular to each other, dot product of direction vectors will be zero.
Therefore,

$$(\mathbf{m})^T (\mathbf{x} - \mathbf{P}) = 0 \tag{1.1.5}$$

$$\mathbf{m}^T \mathbf{x} = \mathbf{m}^T \mathbf{P} \tag{1.1.6}$$

Putting the values of $\mathbf{m}$, $\mathbf{x}$ and $\mathbf{p}$ in equation (1.1.6)

$$\begin{pmatrix} 1 & 3 \end{pmatrix}\begin{pmatrix} x \\ y \end{pmatrix} = \begin{pmatrix} 1 & 3 \end{pmatrix}\begin{pmatrix} \frac{n+2}{n+1} \\ \frac{3}{n+1} \end{pmatrix} \tag{1.1.7}$$

Solving the equation (1.1.7), equation of the line PR is

$$x + 3y = \frac{n + 11}{n + 1} \tag{1.1.8}$$