

Matrix-Lines

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Symbol	Value	Description
P	$\begin{pmatrix} a \\ 0 \end{pmatrix}$	Point on X-axis
Q	$\begin{pmatrix} 0 \\ b \end{pmatrix}$	Point on Y-axis
R	$\begin{pmatrix} 2 \\ 2 \end{pmatrix}$	Given Point
a + b	9	Given Condition

TABLE I
PARAMETERS

I. PROBLEM STATEMENT

Find equation of a line passing through a point (2,2) and cutting off intercepts on the axes whose sum is 9.

II. CONSTRUCTION

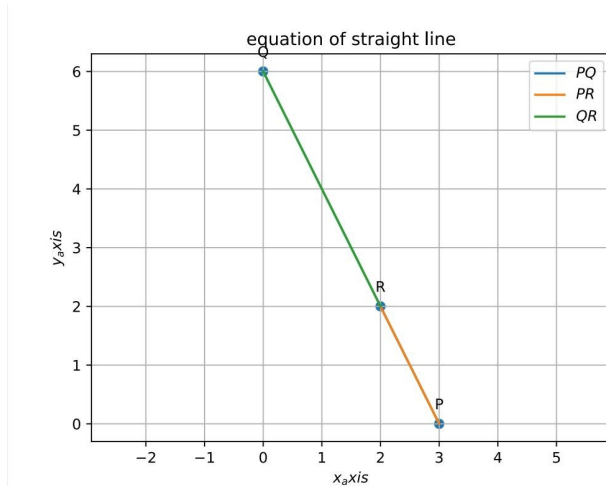


Fig. 1. Equation of the Straight Line

III. SOLUTION

Given that resultant line passes through point(2,2) and intercepts on axes whose sum is 9 (let x intercept is a and y intercept is b therefore, a + b = 9)

so, b = 9 - a

Let $P = \begin{pmatrix} a \\ 0 \end{pmatrix}$, $Q = \begin{pmatrix} 0 \\ 9 - a \end{pmatrix}$, $R = \begin{pmatrix} 2 \\ 2 \end{pmatrix}$

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

Now we have 3 points which lie on same line so,

The Equation of line through P is

$$\mathbf{n}^T \begin{pmatrix} a \\ 0 \end{pmatrix} = c \quad (1)$$

Equation of line passing through Q is

$$\mathbf{n}^T \begin{pmatrix} 0 \\ 9 - a \end{pmatrix} = c \quad (2)$$

Now eq1 + eq2,

$$\mathbf{n}^T \begin{pmatrix} a \\ 9 - a \end{pmatrix} = 2c \quad (3)$$

Equation of line passing through R is

$$\mathbf{n}^T \begin{pmatrix} 2 \\ 2 \end{pmatrix} = c \quad (4)$$

From eq3 and eq4 we can find normal vector \mathbf{n} ,

$$\mathbf{n}^\top \begin{pmatrix} a & 9-a \\ 2 & 2 \end{pmatrix} = c \cdot \begin{pmatrix} 2 \\ 1 \end{pmatrix} \quad (5)$$

Therefore,

$$\mathbf{n}^\top = \begin{pmatrix} a & 9-a \\ 2 & 2 \end{pmatrix}^{-1} \cdot \begin{pmatrix} 2 \\ 1 \end{pmatrix} \cdot c \quad (6)$$

$$\mathbf{n}^\top = \begin{pmatrix} 3a-9 \\ -2 \end{pmatrix} \cdot \frac{c}{4a-18} \quad (7)$$

Now eq4 can be expressed as,

$$\begin{pmatrix} 3a-9 \\ -2 \end{pmatrix} \cdot \begin{pmatrix} 2 \\ 2 \end{pmatrix} \cdot \frac{c}{4a-18} = c \quad (8)$$

Thus, we get $\mathbf{a} = 2$, $\mathbf{b} = 9-\mathbf{a} = 7$

by substituting a in eq6, finally

$$\mathbf{n}^\top = \begin{pmatrix} 0.3 \\ 0.2 \end{pmatrix} \cdot c \quad (9)$$

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

$$\begin{pmatrix} 0.3 \\ 0.2 \end{pmatrix} \cdot \mathbf{X} \cdot c = c \quad (10)$$

i.e,

$$\begin{pmatrix} 3 \\ 2 \end{pmatrix} \cdot \mathbf{X} = 10 \quad (11)$$

Therefore equation of the line is,

$$\begin{pmatrix} 3 \\ 2 \end{pmatrix} \cdot \mathbf{X} = 10 \quad (12)$$

$$3x + 2y = 10$$

IV. SOFTWARE

Download the following code using,
and execute the code by using command

Python3 Assignment4.py

svn co [https://github.com/mygit-sampath-govardhan/fwc-iith-assignments/blob/5b65abbf8e5e3c803b1bff8cf4a95092e100de75/Assignment-4\(Matrices-line\)/codes/Assignment4.py](https://github.com/mygit-sampath-govardhan/fwc-iith-assignments/blob/5b65abbf8e5e3c803b1bff8cf4a95092e100de75/Assignment-4(Matrices-line)/codes/Assignment4.py)

V. CONCLUSION

We found the equation of a line passing through a point (2,2) and cutting off intercepts on the axes whose sum is 9.