

Matrix Theory Assignment 1

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Abstract—This document contains the procedure to get image of a point in a line.

Download the python code from the below link.
Go through the README file in the repository.

<https://github.com/ankuraditya13/EE5609-Assignment-1>

1 PROBLEM

Find the image of the point $\begin{pmatrix} 3 \\ 8 \end{pmatrix}$ with respect to the line

$$\begin{pmatrix} 1 & 3 \end{pmatrix} \mathbf{x} = 7. \quad (1.0.1)$$

2 SOLUTION

Let, given vector

$$\mathbf{P} = \begin{pmatrix} 3 \\ 8 \end{pmatrix} \quad (2.0.1)$$

Let, image point be \mathbf{R} .

Let vector,

$$\mathbf{n} = \begin{pmatrix} 1 \\ 3 \end{pmatrix} \quad (2.0.2)$$

Let \mathbf{m} be the directional vector along the line,
 $\begin{pmatrix} 1 & 3 \end{pmatrix} \mathbf{x} = 7$.

Hence \mathbf{m} is,

$$\mathbf{m} = \begin{pmatrix} 3 \\ -1 \end{pmatrix} \quad (2.0.3)$$

By property in Figure 0, the line \mathbf{PR} bisects the mirror equation perpendicularly. Hence,

$$2\mathbf{Q} = \mathbf{P} + \mathbf{R} \quad (2.0.4)$$

Where, \mathbf{Q} is the point on the line, $\begin{pmatrix} 1 & 3 \end{pmatrix} \mathbf{x} = 7$.

Hence the reflection vector \mathbf{R} is given as,

$$\frac{\mathbf{R}}{2} = \frac{\mathbf{m}\mathbf{m}^T - \mathbf{n}\mathbf{n}^T}{\mathbf{m}^T\mathbf{m} + \mathbf{n}^T\mathbf{n}} \mathbf{P} + c \frac{\mathbf{n}}{\|\mathbf{n}\|^2} \quad (2.0.5)$$

$$\|\mathbf{n}\| = \sqrt{1^2 + 3^2} = \sqrt{10} \quad (2.0.6)$$

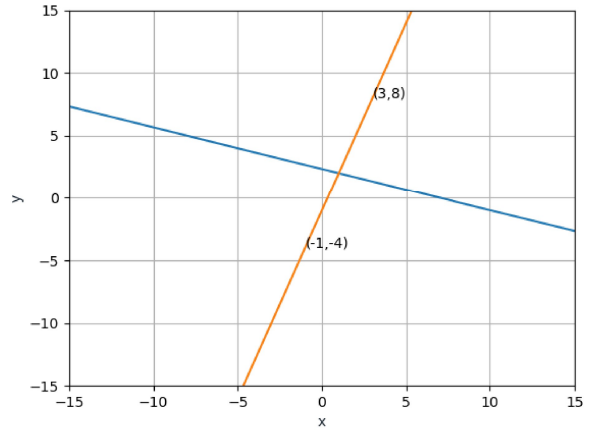


Fig. 0: Image of a point in 2D line

Substituting these values in equation (2.0.5) we get,

$$\mathbf{R} = \begin{pmatrix} -1 \\ -4 \end{pmatrix} \quad (2.0.7)$$

Hence, it is the required answer for image of \mathbf{P} in line $\begin{pmatrix} 1 & 3 \end{pmatrix} \mathbf{x} = 7$.