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

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

2 Solution

Let, given vector

$$\mathbf{P} = \begin{pmatrix}3\\8\end{pmatrix} \tag{2.0.1}$$

Let, image point be $\mathbf{R}$. Let vector,

$$\mathbf{n} = \begin{pmatrix}1\\3\end{pmatrix} \tag{2.0.2}$$

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

Hence m is,

$$\mathbf{m} = \begin{pmatrix}3\\-1\end{pmatrix} \tag{2.0.3}$$

By property in Figure 0, the line PR bisects the mirror equation perpendicularly. Hence,

$$2\mathbf{Q} = \mathbf{P} + \mathbf{R} \tag{2.0.4}$$

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,

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

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

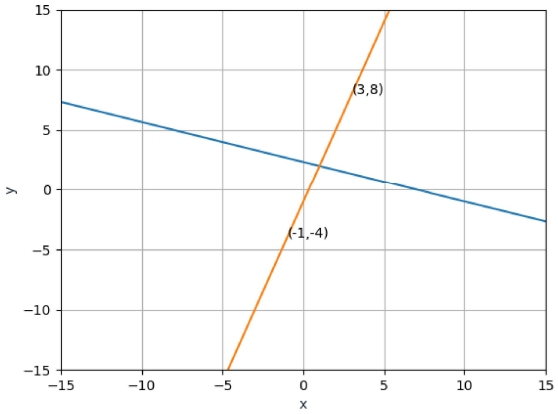

Fig. 0: Image of a point in 2D line

Substituting these values in equation (2.0.5) we get,

$$\mathbf{R} = \begin{pmatrix}-1\\-4\end{pmatrix} \tag{2.0.7}$$

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