Matrix Theory Assignment 1

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***Abstract*—This document demonstrates a method to find the distance of a point from a line. And that point is along a line.**

Download all codes from

https://github.com/Ritesh622/Assignment1

1 Problem Statement

Find the distance of the line

$$\begin{pmatrix}4 & 7\end{pmatrix}\begin{pmatrix}X\end{pmatrix} = -5 \tag{1.0.1}$$

from the point $\begin{pmatrix}1\\2\end{pmatrix}$ along the line

$$\begin{pmatrix}2 & -1\end{pmatrix}\begin{pmatrix}X\end{pmatrix} = 0 \tag{1.0.2}$$

2 solution

2.1 Finding the point of intersection using row-echelon form

We need to find the solution of equations:

$$\begin{pmatrix}4 & 7\end{pmatrix}\mathbf{x} = -5 \tag{2.1.1}$$

$$\begin{pmatrix}2 & -1\end{pmatrix}\mathbf{x} = 0 \tag{2.1.2}$$

Transforming the matrix into row-echelon form

$$\begin{pmatrix}4 & 7 & -5\\2 & 1 & 0\end{pmatrix} \xleftrightarrow{R1\leftarrow\frac{1}{18}*(R1+7\times R2)} \begin{pmatrix}1 & 0 & -5/18\\2 & -1 & 0\end{pmatrix} \tag{2.1.3}$$

$$\begin{pmatrix}1 & 0 & -5/18\\2 & -1 & 0\end{pmatrix} \xleftrightarrow{R2\leftarrow-(R2-2\times R1)} \begin{pmatrix}1 & 0 & -5/18\\0 & 1 & -10/18\end{pmatrix} \tag{2.1.4}$$

After solving this two equation we will get the point of intersection, which is intersection of these two lines segments. Thus, point of intersection is $\begin{pmatrix}-5/18\\-10/18\end{pmatrix}$. Now we have point of intersection

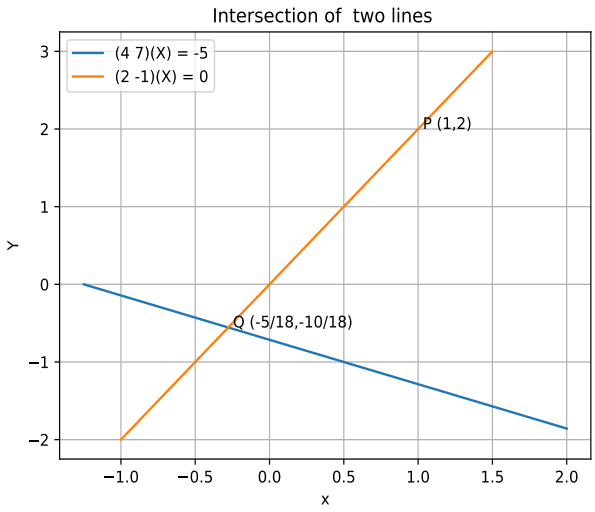

Fig. 1: Intersection of two lines

$$\mathbf{P} = \begin{pmatrix}-5/18\\-10/18\end{pmatrix} \tag{2.1.5}$$

and given point is

$$\mathbf{Q} = \begin{pmatrix}1\\2\end{pmatrix} \tag{2.1.6}$$

Now the distance between two points is given as :

$$\|\mathbf{P}-\mathbf{Q}\| = \left\|\begin{pmatrix}-5/18\\-10/18\end{pmatrix} - \begin{pmatrix}1\\2\end{pmatrix}\right\| = d = 2.85 \tag{2.1.7}$$