EE5609: MATRIX THEORY
Assignment 1

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***Abstract*—This document contains the solution to find value of *h* when two straight lines intersect at right angles using the concept of directional vectors and inner product.**

Git link for python code

https://github.com/ee19acmtech11009/EE5609/tree/master/Assignment1/Assignment1_method2/Codes

Git link for latex code

https://github.com/ee19acmtech11009/EE5609/tree/master/Assignment1/Assignment1_method2

1 Problem Statement

The line through the points $\begin{pmatrix} h \\ 3 \end{pmatrix}$ and $\begin{pmatrix} 4 \\ 1 \end{pmatrix}$ intersects the line $\begin{pmatrix} 7 & -9 \end{pmatrix}\mathbf{x} = 19$ at right angle. Find the value of h.

2 Solution

Let the given points

$$\mathbf{A} = \begin{pmatrix} h \\ 3 \end{pmatrix} \tag{2.0.1}$$

$$\mathbf{B} = \begin{pmatrix} 4 \\ 1 \end{pmatrix} \tag{2.0.2}$$

Directional vector of line passing through points $\mathbf{A}$ and $\mathbf{B}$ is

$$\mathbf{P} = \mathbf{B} - \mathbf{A} \tag{2.0.3}$$

$$\mathbf{P} = \begin{pmatrix} h-4 \\ 2 \end{pmatrix} \tag{2.0.4}$$

Directional vector of the line $\begin{pmatrix} a & b \end{pmatrix}\mathbf{x} = c$ is

$$\mathbf{Q} = \begin{pmatrix} b \\ -a \end{pmatrix} \tag{2.0.5}$$

From (2.0.5) direction vector of line $\begin{pmatrix} 7 & -9 \end{pmatrix}\mathbf{x} = 19$ is

$$\mathbf{Q} = \begin{pmatrix} -9 \\ -7 \end{pmatrix} \tag{2.0.6}$$

If two straight lines intersects at right angles then inner product of their directional vectors is zero.

$$\mathbf{P}^T\mathbf{Q} = 0 \tag{2.0.7}$$

$$\begin{pmatrix} h-4 \\ 2 \end{pmatrix}^T \begin{pmatrix} -9 \\ -7 \end{pmatrix} = 0 \tag{2.0.8}$$

$$\begin{pmatrix} h-4 & 2 \end{pmatrix} \begin{pmatrix} -9 \\ -7 \end{pmatrix} = 0 \tag{2.0.9}$$

$$(h-4)(-9) + 2(-7) = 0 \tag{2.0.10}$$

$$h = \frac{22}{9} \tag{2.0.11}$$

3 Verification

Python Plot used to verify the result obtained from (2.0.11).

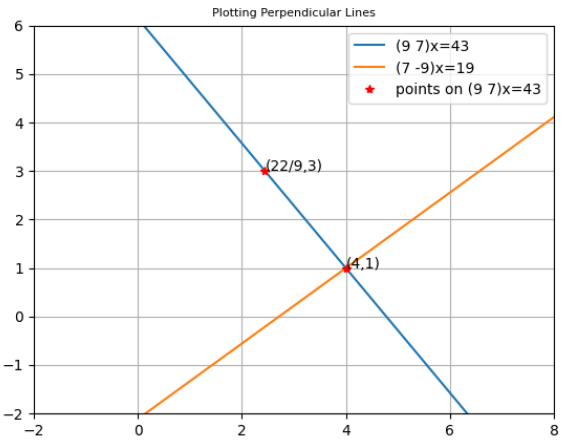

Fig. 0: Figure showing given data and corresponding results

According to the problem statement, equation of line passing through the point $\begin{pmatrix}4\\1\end{pmatrix}$ and perpendicular to the line $\begin{pmatrix}7 & -9\end{pmatrix}\mathbf{x} = 19$ is

$$\begin{pmatrix}9 & 7\end{pmatrix}\mathbf{x} = 43 \tag{3.0.1}$$

Fig.0 shows that equation (3.0.1) passes through the point $\begin{pmatrix}\frac{22}{9}\\3\end{pmatrix}$