Assignment 2

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***Abstract*—This document solves a problem based on the inclination of straight lines**

1 Problem

If the lines

$$\begin{pmatrix}-3 & 1\end{pmatrix}\mathbf{x} = 1 \tag{1.1}$$

$$\begin{pmatrix}-1 & 2\end{pmatrix}\mathbf{x} = 3 \tag{1.2}$$

are equally inclined to the line

$$\begin{pmatrix}-m & 1\end{pmatrix}\mathbf{x} = 4 \tag{1.3}$$

Find the value of m.

2 Solution

To find the angle between two lines we use-

$$\cos\theta = \frac{\mathbf{a}^T\mathbf{b}}{\|a\|\|b\|} \tag{2.1}$$

Assume line(1.1), (1.2) and (1.3) as vectors **a**,**b** and **c** respectively

$$\mathbf{a} = \begin{pmatrix}-3\\1\end{pmatrix} \tag{2.2}$$

$$\mathbf{b} = \begin{pmatrix}-1\\2\end{pmatrix} \tag{2.3}$$

$$\mathbf{c} = \begin{pmatrix}-m\\1\end{pmatrix} \tag{2.4}$$

$$\|a\| = \sqrt{10} \tag{2.5}$$

$$\|b\| = \sqrt{5} \tag{2.6}$$

$$\|c\| = \sqrt{m^2+1} \tag{2.7}$$

$$\mathbf{a}^T\mathbf{c} = 3m+1 \tag{2.8}$$

$$\mathbf{b}^T\mathbf{c} = m+2 \tag{2.9}$$

Angle between **a** and **c** using (2.1)

$$\cos\theta = \frac{3m+1}{\sqrt{10}\sqrt{m^2+1}} \tag{2.10}$$

Angle between **b** and **c** using (2.1)

$$\cos\theta = \frac{m+2}{\sqrt{5}\sqrt{m^2+1}} \tag{2.11}$$

Graph

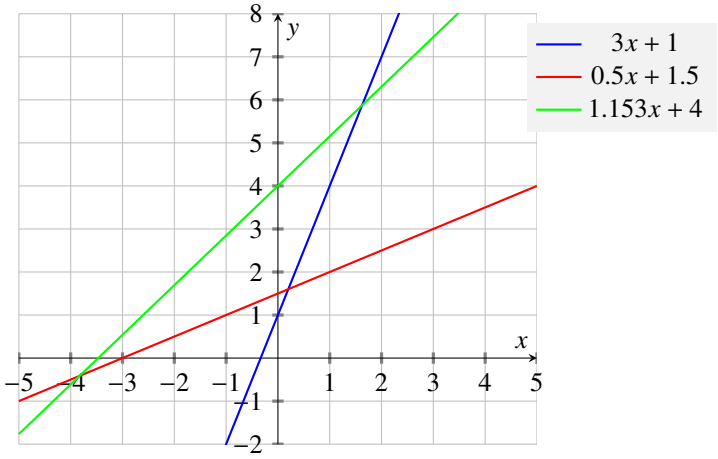

Fig. 1: This is a plot of lines (1.1),(1.2) and (1.3)

According to question **a** and **b** are equally inclined to **c** Therefore, (2.10) and (2.11) are equal

$$\frac{3m+1}{\sqrt{10}\sqrt{m^2+1}} = \frac{m+2}{\sqrt{5}\sqrt{m^2+1}} \tag{2.12}$$

$$\implies \frac{3m+1}{\sqrt{2}} = m+2 \tag{2.13}$$

$$\implies m = \frac{1+5\sqrt{2}}{7} \tag{2.14}$$