Assignment 1

Savarana Datta - AI20BTECH11008

Download all python codes from

https://github.com/SavaranaDatta/EE3900/tree/main/codes

and latex codes from

https://github.com/SavaranaDatta/EE3900/tree/main/Assignment1/Assignment1.tex

Vector 2.9

Find the value of x for which the points $\begin{pmatrix} x \\ -1 \end{pmatrix}, \begin{pmatrix} 2 \\ 1 \end{pmatrix}$ and $\begin{pmatrix} 4 \\ 5 \end{pmatrix}$ are collinear.

Solution(Vector 2.9)

Let

$$\mathbf{A} = \begin{pmatrix} x \\ -1 \end{pmatrix}, \mathbf{B} = \begin{pmatrix} 2 \\ 1 \end{pmatrix}, \mathbf{C} = \begin{pmatrix} 4 \\ 5 \end{pmatrix} \tag{0.0.1}$$

Now,

$$\mathbf{B} - \mathbf{A} = \begin{pmatrix} 2 - x \\ 1 - (-1) \end{pmatrix} \tag{0.0.2}$$

$$= \begin{pmatrix} 2 - x \\ 2 \end{pmatrix} \tag{0.0.3}$$

$$\mathbf{B} - \mathbf{C} = \begin{pmatrix} 2 - 4 \\ 1 - 5 \end{pmatrix} \tag{0.0.4}$$

$$= \begin{pmatrix} -2 \\ -4 \end{pmatrix} \tag{0.0.5}$$

Forming the matrix $\mathbf{M}$,

$$\mathbf{M} = \begin{pmatrix} \mathbf{B} - \mathbf{A} & \mathbf{B} - \mathbf{C} \end{pmatrix}^\top \tag{0.0.6}$$

$$= \begin{pmatrix} 2 - x & 2 \\ 2 & -4 \end{pmatrix}^\top \tag{0.0.7}$$

$$= \begin{pmatrix} 2 - x & 2 \\ -2 & -4 \end{pmatrix} \tag{0.0.8}$$

Using matrix transformation,

$$\mathbf{M} = \begin{pmatrix} 2 - x & 2 \\ -2 & -4 \end{pmatrix} \xleftrightarrow{R_2 \to R_2/2} \begin{pmatrix} 2 - x & 2 \\ -1 & -2 \end{pmatrix} \tag{0.0.9}$$

$$\xleftrightarrow{R_2 \to R_2 + R_1} \begin{pmatrix} 2 - x & 2 \\ 1 - x & 0 \end{pmatrix} \tag{0.0.10}$$

$$rank(\mathbf{M}) = 1 \Leftrightarrow R_2 = 0 \tag{0.0.11}$$

$$\implies 1 - x = 0 \tag{0.0.12}$$

$$\implies x = 1 \tag{0.0.13}$$

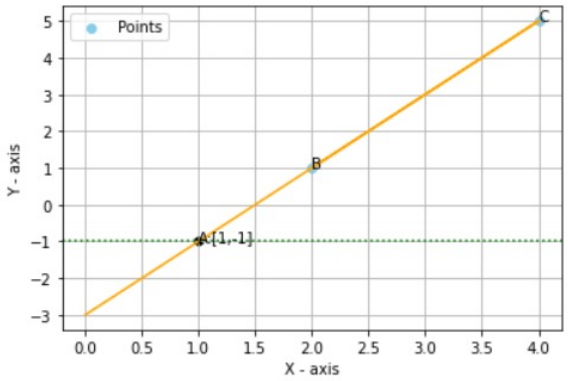

Fig. 0: Plot of the line