Assignment 1

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Download all python codes from

https://github.com/Digjoy12/Signal−Processing/blob/main/Assignment%201/Code/untitled1.py

and latex codes from

https://github.com/Digjoy12/Signal−Processing/blob/main/Assignment%201/main.tex

Problem

(Vectors - Q2.8) By using the concept of equation of a line, prove that the three points $\begin{pmatrix}3\\0\end{pmatrix}, \begin{pmatrix}-2\\-2\end{pmatrix}, \begin{pmatrix}8\\2\end{pmatrix}$ are collinear.

Solution

Let,

$$\mathbf{A} = \begin{pmatrix}3\\0\end{pmatrix}, \mathbf{B} = \begin{pmatrix}-2\\-2\end{pmatrix} \text{ and } \mathbf{C} = \begin{pmatrix}8\\2\end{pmatrix} \tag{0.0.1}$$

Now,

$$\mathbf{B} - \mathbf{A} = \begin{pmatrix}-2-3\\-2-0\end{pmatrix} = \begin{pmatrix}-5\\-2\end{pmatrix} \tag{0.0.2}$$

$$\mathbf{C} - \mathbf{A} = \begin{pmatrix}8-3\\2-0\end{pmatrix} = \begin{pmatrix}5\\2\end{pmatrix} \tag{0.0.3}$$

Forming the matrix $\mathbf{M}$,

$$\mathbf{M} = \begin{pmatrix}\mathbf{B}-\mathbf{A} & \mathbf{B}-\mathbf{C}\end{pmatrix}^\top \tag{0.0.4}$$

$$= \begin{pmatrix}-5 & 5\\-2 & 2\end{pmatrix}^\top \tag{0.0.5}$$

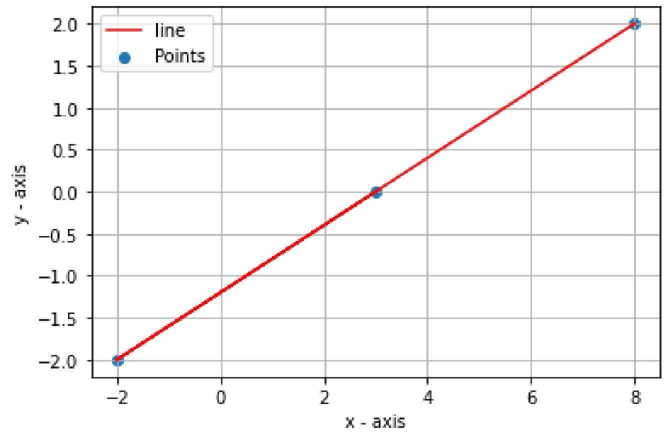
$$= \begin{pmatrix}-5 & -2\\5 & 2\end{pmatrix} \tag{0.0.6}$$

Using matrix transformation,

$$\mathbf{M} = \begin{pmatrix}-5 & -2\\5 & 2\end{pmatrix} \xleftrightarrow{R_1 \to -R_1} \begin{pmatrix}5 & 2\\5 & 2\end{pmatrix} \tag{0.0.7}$$

$$\xleftrightarrow{R_2 \to R_2 - R_1} \begin{pmatrix}5 & 2\\0 & 0\end{pmatrix} \tag{0.0.8}$$

$$\implies \text{rank(M)} = 1$$



Thus, the points are **collinear**.