Assignment 5

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Download all python codes from

https://github.com/kavyakamal66/IITH-INTERNSHIP/blob/main/Assignment5/code5.py

and latex codes from

https://github.com/kavyakamal66/IITH-INTERNSHIP/blob/main/Assignment5/assignment5.tex

1 Question No.Matrices 1.76

Question 1: Find equation of line joining $\begin{pmatrix}1 & 2\end{pmatrix}$ and $\begin{pmatrix}3 & 6\end{pmatrix}$ using determinants.

2 Solution

Given,

$$\mathbf{A} = \begin{pmatrix}1\\2\end{pmatrix}, \mathbf{B} = \begin{pmatrix}3\\6\end{pmatrix} \tag{2.0.1}$$

Let $\mathbf{n}$ be the normal vector then
Equation of the line is,

$$\mathbf{n}^\top \mathbf{x} = c \tag{2.0.2}$$

ie,

$$\mathbf{n}^\top \mathbf{A} = c \tag{2.0.3}$$

$$\mathbf{n}^\top \mathbf{B} = c \tag{2.0.4}$$

From (2.0.3) and (2.0.4)

$$\mathbf{A}^\top \mathbf{n} = c \tag{2.0.5}$$

$$\mathbf{B}^\top \mathbf{n} = c \tag{2.0.6}$$

$$\begin{pmatrix}\mathbf{A}^\top\\ \mathbf{B}^\top\end{pmatrix}\mathbf{n} = \begin{pmatrix}c\\c\end{pmatrix} \tag{2.0.7}$$

$$\begin{pmatrix}1 & 2\\ 3 & 6\end{pmatrix}\mathbf{n} = \begin{pmatrix}c\\c\end{pmatrix} \tag{2.0.8}$$

Augmented Matrix is

$$\begin{pmatrix}1 & 2 & c\\ 3 & 6 & c\end{pmatrix} \tag{2.0.9}$$

$$\implies \begin{pmatrix}1 & 2 & c\\ 3 & 6 & c\end{pmatrix} \xrightarrow{R_2 \to R_2 - 3R_1} \begin{pmatrix}1 & 2 & c\\ 0 & 0 & -2c\end{pmatrix} \tag{2.0.10}$$

Thus, from the above row reduced form we can conclude that the given system of lines has solution if $c = 0$ and points are collinear.
Direction vector, $\mathbf{m}$ of line AB is

$$\mathbf{m} = \mathbf{B} - \mathbf{A} = \begin{pmatrix}2\\4\end{pmatrix} \tag{2.0.11}$$

The normal vector $\mathbf{n}$ to a line is orthogonal to the direction vector $\mathbf{m}$ then

$$\mathbf{m}^\top \mathbf{n} = 0 \tag{2.0.12}$$

Normal vector,$\mathbf{n}$ is,

$$\mathbf{n} = \begin{pmatrix}-4\\2\end{pmatrix} \tag{2.0.13}$$

Substituting $\mathbf{n}$ and c in (2.0.2),

$$\begin{pmatrix}-4 & 2\end{pmatrix}\mathbf{x} = 0 \tag{2.0.14}$$

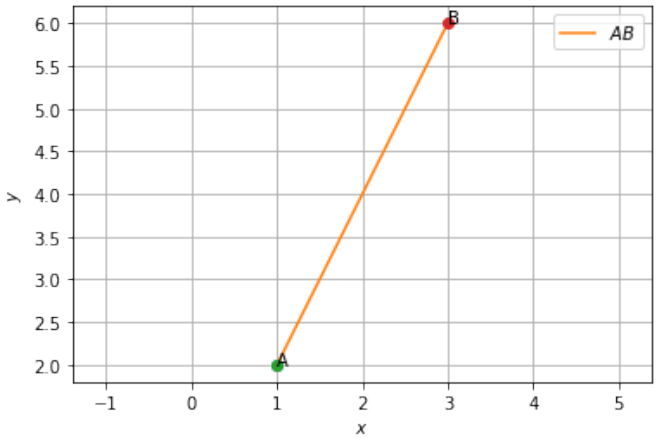

Fig. 0: LINE AB