

# Q.no. 6 in jee linalg 2d

## Matrix Project

Sai Laxman-EE18BTECH11049  
Aashrith-EE18BTECH11035

February 15, 2019

## Geometric Question

The sides of a rhombus  $ABC$  are parallel to the lines

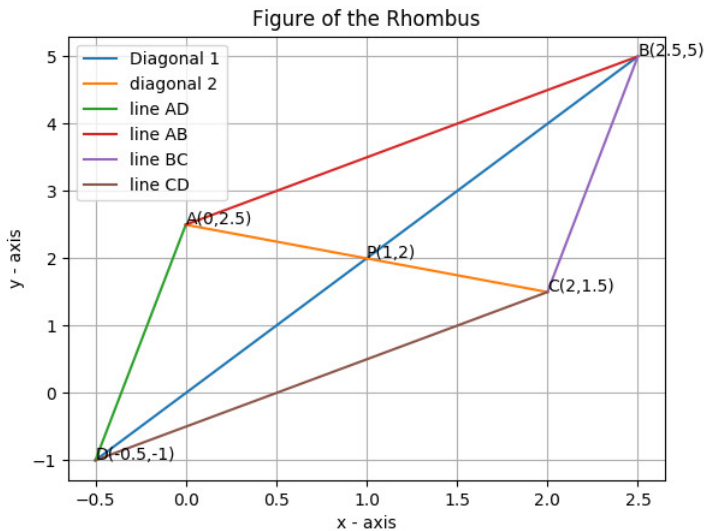
$$\begin{bmatrix} 1 & -1 \end{bmatrix} X + 2 = 0 \longrightarrow (1)$$

$$\begin{bmatrix} 7 & -1 \end{bmatrix} X + 3 = 0 \longrightarrow (2)$$

If the diagonals of the rhombus intersect at

$$P = \begin{bmatrix} 1 \\ 2 \end{bmatrix}$$

and the vertex  $A$  (different) from the origin is on the  $y$ -axis, then find the ordinate of  $A$ .



Shifting the origin to  $\begin{bmatrix} 1 \\ 2 \end{bmatrix}$  we get the new equations as

$$\begin{bmatrix} 1 & -1 \end{bmatrix} X + 1 = 0$$

$$\begin{bmatrix} 7 & -1 \end{bmatrix} X + 8 = 0$$

The slope of the doesn't change if change the origin.

eq(1) can be written in general form as

$$\begin{bmatrix} t - 1 \\ t \end{bmatrix}$$

By using linear transformation of matrices We can rotate  $\begin{bmatrix} t - 1 \\ t \end{bmatrix}$  with respect to origin by multiplying with this matrix

$$\begin{bmatrix} \cos \theta & -\sin \theta \\ \sin \theta & \cos \theta \end{bmatrix}$$

where  $\theta = \text{acute angle between original two equations}$

So after rotation we get the point as  $\begin{bmatrix} t/5 + 1/5 \\ 7t/5 + 7/5 \end{bmatrix}$

$$\begin{bmatrix} 7 & -1 \end{bmatrix} X = 5$$

Solving the obtained equation with eq(1)

$$\begin{bmatrix} 7 & -1 \\ 1 & -1 \end{bmatrix} X = \begin{bmatrix} 5 \\ -1 \end{bmatrix}$$

upon Solving we get

$$\begin{bmatrix} -2/3 \\ 1/3 \end{bmatrix}$$

So the direction vector of diagonal is  $\begin{bmatrix} -2/3 \\ 1/3 \end{bmatrix}$