

# Problem 1.1.5

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question :The normal form of the equation of **AB** is

$$\mathbf{n}^\top (\mathbf{x} - \mathbf{A}) = 0 \quad (1)$$

where

$$\mathbf{n}^\top \mathbf{m} = \mathbf{n}^\top (\mathbf{B} - \mathbf{A}) = 0 \quad (2)$$

or,

$$\mathbf{n} = \begin{pmatrix} 0 & 1 \\ -1 & 0 \end{pmatrix} \mathbf{m} \quad (3)$$

Find the normal form of the equations of **AB** **BC** and **CA**

**Solution:** : The normal equation for the side **BC** is

$$\mathbf{n}^\top (\mathbf{x} - \mathbf{B}) = 0 \quad (4)$$

$$\implies \mathbf{n}^\top \mathbf{x} = \mathbf{n}^\top \mathbf{B} \quad (5)$$

Now our task is to find the **n** so that we can find  $\mathbf{n}^\top$  As given in the question

$$\mathbf{n} = \begin{pmatrix} 0 & 1 \\ -1 & 0 \end{pmatrix} \mathbf{m} \quad (6)$$

Here  $\mathbf{m} = \mathbf{C} - \mathbf{B}$  for side **BC**

$$\implies \mathbf{m} = \begin{pmatrix} -3 \\ -5 \end{pmatrix} - \begin{pmatrix} -4 \\ 6 \end{pmatrix} \quad (7)$$

$$= \begin{pmatrix} 1 \\ -11 \end{pmatrix} \quad (8)$$

Now as we have obtained vector **m**. we can use this to obtain vector **n**

$$\mathbf{n} = \begin{pmatrix} 0 & 1 \\ -1 & 0 \end{pmatrix} \begin{pmatrix} 1 \\ -11 \end{pmatrix} = \begin{pmatrix} -11 \\ -1 \end{pmatrix} \quad (9)$$

The transpose of **n** is

$$\mathbf{n}^\top = \begin{pmatrix} -11 & -1 \end{pmatrix} \quad (10)$$

Hence the normal equation of side **BC** is

$$\begin{pmatrix} -11 & -1 \end{pmatrix} \mathbf{x} = \begin{pmatrix} -11 & -1 \end{pmatrix} \begin{pmatrix} -4 \\ 6 \end{pmatrix} \quad (11)$$

$$\implies \begin{pmatrix} -11 & -1 \end{pmatrix} \mathbf{x} = 38 \quad (12)$$

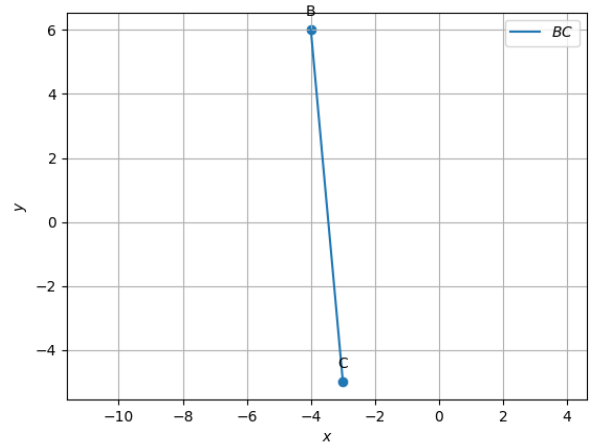


Fig. 0. The line **BC** plotted using python