ASSIGNMENT 1

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Question 1.3.1 D_1 is a point on BC such that

$$AD_1 \perp BC$$

and is defined to be the altitude. Find the normal vector of AD_1.
Solution: Given:

$$\mathbf{A} = \begin{pmatrix} 1 \\ -1 \end{pmatrix}, \mathbf{B} = \begin{pmatrix} -4 \\ 6 \end{pmatrix}, \mathbf{C} = \begin{pmatrix} -3 \\ -5 \end{pmatrix}. \tag{1}$$

$$\tag{2}$$

The direction vector of BC:

$$\mathbf{BC} = \mathbf{C} - \mathbf{B} \tag{3}$$

$$= \begin{pmatrix} -3 \\ -5 \end{pmatrix} - \begin{pmatrix} -4 \\ 6 \end{pmatrix} \tag{4}$$

$$= \begin{pmatrix} 1 \\ -11 \end{pmatrix} \tag{5}$$

$$\tag{6}$$

The normal vector of a given vector is calculated using the formula:

$$\mathbf{n} = \begin{pmatrix} 0 & 1 \\ -1 & 0 \end{pmatrix} \mathbf{BC} \tag{7}$$

Also given that

$$AD_1 \perp BC$$

Hence: Direction vector of normal to BC = Direction vector of AD_1:

$$\implies \mathbf{n} = \begin{pmatrix} 0 & 1 \\ -1 & 0 \end{pmatrix} \begin{pmatrix} 1 \\ -11 \end{pmatrix} \tag{8}$$

$$= \begin{pmatrix} -11 \\ -1 \end{pmatrix} \tag{9}$$

Similarly,
Normal vector of AD_1:

$$\implies \mathbf{n} = \begin{pmatrix} 0 & 1 \\ -1 & 0 \end{pmatrix} \begin{pmatrix} -11 \\ -1 \end{pmatrix} = \begin{pmatrix} -1 \\ 11 \end{pmatrix} \tag{10}$$

$$\tag{11}$$

Therefore, normal vector of AD_1 =$\begin{pmatrix} -1 \\ 11 \end{pmatrix}$