

# Solution to Q1.3.4

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Question: Find the intersection  $\mathbf{H}$  of altitudes  $BE_1$  and  $CF_1$

**Solution:** Equation of  $BE_1$

$$\begin{pmatrix} 1 & 1 \end{pmatrix} \mathbf{x} = 2 \quad (1)$$

Equation of  $CF_1$

$$\begin{pmatrix} 5 & -7 \end{pmatrix} \mathbf{x} = 20 \quad (2)$$

Therefore, we need to solve the following equation to get  $\mathbf{H}$ :

$$\begin{pmatrix} 1 & 1 \\ 5 & -7 \end{pmatrix} \mathbf{x} = \begin{pmatrix} 2 \\ 20 \end{pmatrix} \quad (3)$$

Solving the above equation by Gauss-Jordan method

$$\begin{pmatrix} 1 & 1 & 2 \\ 5 & -7 & 20 \end{pmatrix} \xrightarrow{R_2 \leftarrow R_2 - 5R_1} \begin{pmatrix} 1 & 1 & 2 \\ 0 & -12 & 10 \end{pmatrix} \quad (4)$$

$$\xrightarrow{R_2 \leftarrow \frac{R_2}{-12}} \begin{pmatrix} 1 & 1 & 2 \\ 0 & 1 & -\frac{5}{6} \end{pmatrix} \quad (5)$$

$$\xrightarrow{R_1 \leftarrow R_1 - R_2} \begin{pmatrix} 1 & 0 & \frac{17}{6} \\ 0 & 1 & -\frac{5}{6} \end{pmatrix} \quad (6)$$

Therefore point of intersection  $\mathbf{H}$  is

$$\mathbf{x} = \frac{1}{6} \begin{pmatrix} 17 \\ -5 \end{pmatrix} \quad (7)$$

$$= \begin{pmatrix} 2.833 \\ -0.833 \end{pmatrix} \quad (8)$$

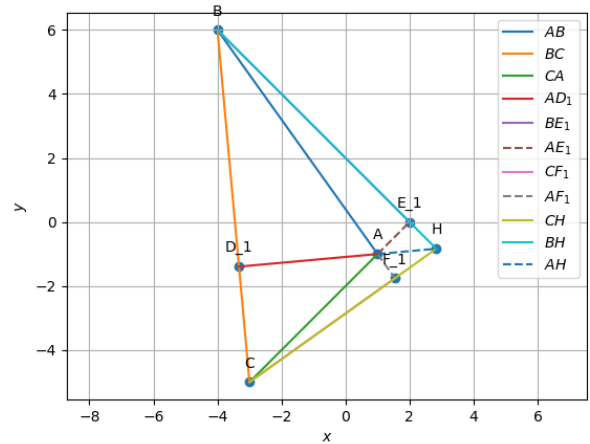


Fig. 0. Intersection point  $\mathbf{H}$  of altitudes  $BE_1$  and  $CF_1$  plotted using python