Random vectors

KUNWAR DUSHYANT SINGH EE22BTECH11031

Consider a triangle with vertices

$$\mathbf{A} = \begin{pmatrix} 4 \\ 3 \end{pmatrix}, \mathbf{B} = \begin{pmatrix} 3 \\ -5 \end{pmatrix}, \mathbf{C} = \begin{pmatrix} -4 \\ -6 \end{pmatrix} \qquad (1)$$
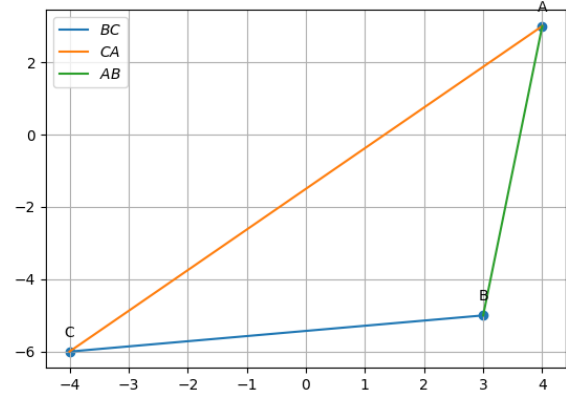
1 VECTORS

Fig. 1: sides

parameters	values	description
$\mathbf{m_1}$	$\begin{pmatrix} -1 \\ -8 \end{pmatrix}$	AB
$\mathbf{m_2}$	$\begin{pmatrix} -7 \\ -1 \end{pmatrix}$	BC
$\mathbf{m_3}$	$\begin{pmatrix} 8 \\ 9 \end{pmatrix}$	CA
$\|A - B\|$	8.06	length of AB
$\|B - C\|$	7.07	length of BC
$\|C - A\|$	12.04	length of CA
$\text{rank}\begin{pmatrix} 1 & 1 & 1 \\ \mathbf{A} & \mathbf{B} & \mathbf{C} \end{pmatrix}$	3	non collinear
$\mathbf{n_1}$	$\begin{pmatrix} -8 \\ 1 \end{pmatrix}$	AB
$\mathbf{n_2}$	$\begin{pmatrix} -1 \\ 7 \end{pmatrix}$	BC
$\mathbf{n_3}$	$\begin{pmatrix} -9 \\ 8 \end{pmatrix}$	CA
Area	27.5	Area of Triangle
$\angle A$	34.5°	
$\angle B$	105.2°	Angles
$\angle C$	40.2°	

2 MEDIAN

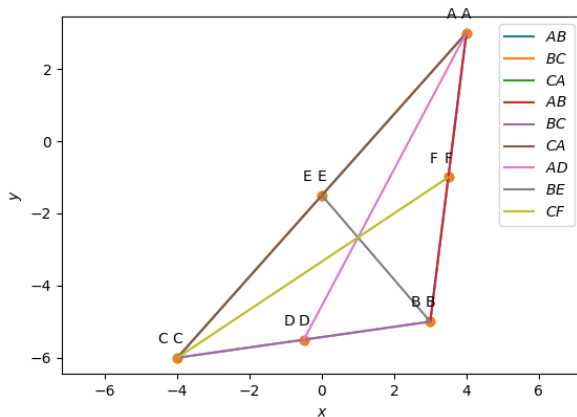| parameters	value	description
D	$\begin{pmatrix} -0.5 \\ -5.5 \end{pmatrix}$	BC midpoint
E	$\begin{pmatrix} 0 \\ -1 \end{pmatrix}$	CA midpoint
F	$\begin{pmatrix} 3.5 \\ -1 \end{pmatrix}$	AB midpoint
$\mathbf{m_4}$	$\begin{pmatrix} 4.5 \\ 8.5 \end{pmatrix}$	AD
$\mathbf{n_4}$	$\begin{pmatrix} -8.5 \\ 4.5 \end{pmatrix}$	
$\mathbf{m_5}$	$\begin{pmatrix} 3 \\ -3.5 \end{pmatrix}$	BE
$\mathbf{n_5}$	$\begin{pmatrix} 3.5 \\ 3 \end{pmatrix}$	
$\mathbf{m_6}$	$\begin{pmatrix} -7.5 \\ -5 \end{pmatrix}$	CF
$\mathbf{n_6}$	$\begin{pmatrix} -5 \\ 7.5 \end{pmatrix}$	
G	$\begin{pmatrix} 1 \\ -2.66 \end{pmatrix}$	Centroid
$\frac{BG}{GE}$ $\frac{CG}{GF}$ $\frac{AG}{GD}$	2	Division ratio by **G**
$\text{rank}\begin{pmatrix} 1 & 1 & 1 \\ \mathbf{A} & \mathbf{D} & \mathbf{G} \end{pmatrix}$ $\text{rank}\begin{pmatrix} 1 & 1 & 1 \\ \mathbf{B} & \mathbf{E} & \mathbf{G} \end{pmatrix}$ $\text{rank}\begin{pmatrix} 1 & 1 & 1 \\ \mathbf{C} & \mathbf{F} & \mathbf{G} \end{pmatrix}$	2	collinear

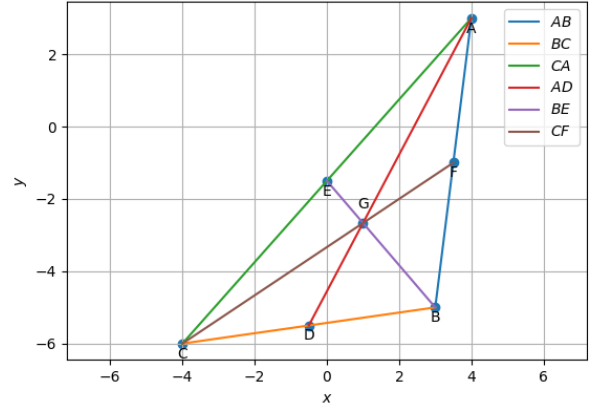

Fig. 2: Midpoints

Fig. 3: centroid

3 ALTITUDE

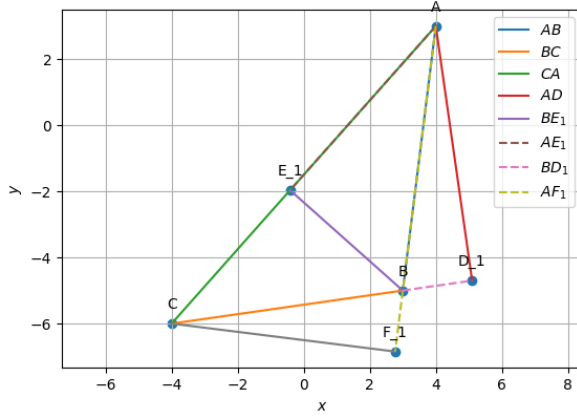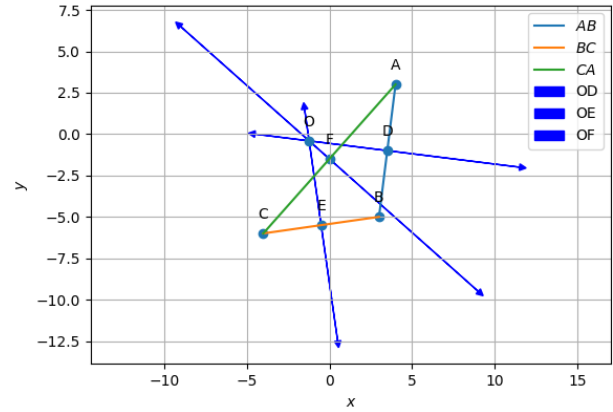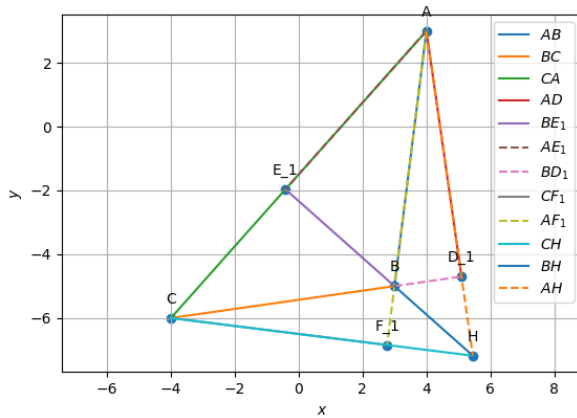| parameters	value	description
$\mathbf{D_1}$	$(5.14.7)$	Foot of altitude from **A**
$\mathbf{E_1}$	$(-0.41, -1.96)$	Foot of altitude from **B**
$\mathbf{F_1}$	$\begin{pmatrix} 2.7 \\ -6.8 \end{pmatrix}$	Foot of altitude from **C**
$\mathbf{m_7}$	$\begin{pmatrix} 1.1 \\ -4.7 \end{pmatrix}$	AD_1
$\mathbf{n_7}$	$\begin{pmatrix} 4.7 \\ 1.1 \end{pmatrix}$	
$\mathbf{m_8}$	$\begin{pmatrix} -3.41 \\ 3.03 \end{pmatrix}$	BE_1
$\mathbf{n_8}$	$\begin{pmatrix} 3.03 \\ 3.41 \end{pmatrix}$	
$\mathbf{m_9}$	$\begin{pmatrix} 6.76 \\ -0.84 \end{pmatrix}$	CF_1
$\mathbf{n_9}$	$\begin{pmatrix} 0.84 \\ 6.76 \end{pmatrix}$	
H	$\begin{pmatrix} 5.45 \\ -7.18 \end{pmatrix}$	Orthocentre

Fig. 4: altitudes

Fig. 6: perpendicular bisector
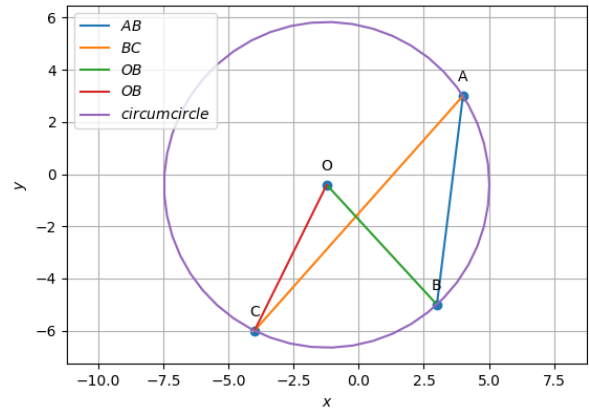

Fig. 5: orthocentre

Fig. 7: circumcircle

5 ANGLE BISECTOR

parameters	value	description
I	$\begin{pmatrix} 1.18 \\ -3.21 \end{pmatrix}$	Incentre
D₃	$\begin{pmatrix} 1.46 \\ -5.21 \end{pmatrix}$	Point of contact with BC
E₃	$\begin{pmatrix} 3.19 \\ -3.46 \end{pmatrix}$	Point of contact with AC
F₃	$\begin{pmatrix} -0.32 \\ -1.87 \end{pmatrix}$	Point of contact with AB
$\|\mathbf{I} - \mathbf{D_3}\|$		
$\|\mathbf{I} - \mathbf{E_3}\|$	2.02	$ID_3 = IE_3 = IF_3 = r$
$\|\mathbf{I} - \mathbf{F_3}\|$		
r		
$\angle BAI$	17.25°	$\angle BAI = \angle CAI$
$\angle CAI$		

4 PERPENDICULAR BISECTOR

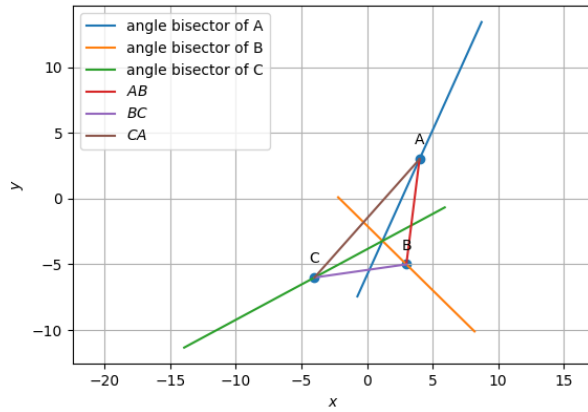| parameters	value	description
O	$\begin{pmatrix} -1.22 \\ -0.40 \end{pmatrix}$	Circumcentre
$\|\mathbf{O} - \mathbf{A}\|$		
$\|\mathbf{O} - \mathbf{B}\|$	6.24	$OA = OB = OC = R$
$\|\mathbf{O} - \mathbf{C}\|$		
R		
$\angle BOC$	69.01°	$\angle BOC = 2\angle BAC$
$\angle BAC$	34.5°	

Fig. 8: angle bisector

Fig. 9: incircle