

Random Vector Assignment

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Consider a triangle with vertices,

$$\mathbf{A} = \begin{pmatrix} 1 \\ -5 \end{pmatrix} \quad \mathbf{B} = \begin{pmatrix} -4 \\ 5 \end{pmatrix} \quad \mathbf{C} = \begin{pmatrix} -1 \\ 0 \end{pmatrix} \quad (1)$$

I. VECTORS

Parameter	Value	Description
\mathbf{m}_{AB}	$\begin{pmatrix} -5 \\ 10 \end{pmatrix}$	Direction vec of AB
\mathbf{m}_{BC}	$\begin{pmatrix} 3 \\ -5 \end{pmatrix}$	Direction vec of BC
\mathbf{m}_{CA}	$\begin{pmatrix} 2 \\ -5 \end{pmatrix}$	Direction vec of CA
$\ \mathbf{A} - \mathbf{B}\ $	11.180	Length of AB
$\ \mathbf{B} - \mathbf{C}\ $	5.831	Length of BC
$\ \mathbf{C} - \mathbf{A}\ $	5.835	Length of CA
$\text{rank} \begin{pmatrix} 1 & 1 & 1 \\ A & B & C \end{pmatrix}$	3	non-collinear
\mathbf{n}_{AB}	$\begin{pmatrix} 0 \\ 5 \end{pmatrix}$	Normal vec of AB
\mathbf{c}_{AB}	25	Constant in AB
\mathbf{n}_{BC}	$\begin{pmatrix} -5 \\ -3 \end{pmatrix}$	Normal vec of BC
\mathbf{c}_{BC}	5	Constant in BC
\mathbf{n}_{CA}	$\begin{pmatrix} 5 \\ -2 \end{pmatrix}$	Normal vec of CA
\mathbf{c}_{CA}	-5	Constant in CA
Area	12.5	Area of $\triangle ABC$
$\cos(\mathbf{A})$	0.3713	cosine of $\angle \mathbf{A}$
$\cos(\mathbf{B})$	0.5145	cosine of $\angle \mathbf{B}$
$\cos(\mathbf{C})$	0.6051	cosine of $\angle \mathbf{C}$

TABLE I
TRIANGLE

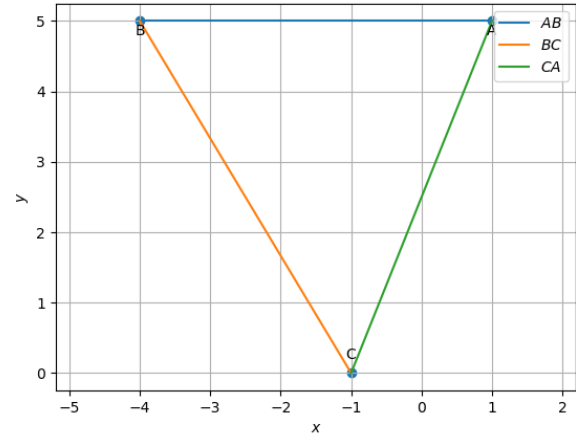


Fig. I. Triangle generated using python

II. MEDIAN

Parameter	Value	Description
D	$\begin{pmatrix} -2.5 \\ 2.5 \end{pmatrix}$	Midpoint AB
E	$\begin{pmatrix} 0.0 \\ 2.5 \end{pmatrix}$	Midpoint BC
F	$\begin{pmatrix} -1.5 \\ -5.0 \end{pmatrix}$	Midpoint CA
\mathbf{n}_{AD}	$\begin{pmatrix} -2.5 \\ 3.5 \end{pmatrix}$	Normal vec of AD
\mathbf{c}_{AD}	15	Constant of AD
\mathbf{n}_{BE}	$\begin{pmatrix} -2.5 \\ -4.0 \end{pmatrix}$	Normal vec of BE
\mathbf{c}_{BE}	-10	Constant of BE
\mathbf{n}_{CF}	$\begin{pmatrix} -5.0 \\ 0.5 \end{pmatrix}$	Normal vec of CF
\mathbf{c}_{CF}	-5	Constant of CF
G	$\begin{pmatrix} -1.333 \\ 3.333 \end{pmatrix}$	Centroid
$\frac{BG}{GE}$	2	Ratio of BG and GE
$\frac{CG}{GF}$		Ratio of CG and GF
$\frac{CG}{GF}$		Ratio of CG and GF
$\text{rank} \begin{pmatrix} 1 & 1 & 1 \\ A & D & G \end{pmatrix}$	2	A, D, G collinear
A – F	$\begin{pmatrix} 2.5 \\ 0.0 \end{pmatrix}$	Direction vec of AF
E – D		Direction vec of ED

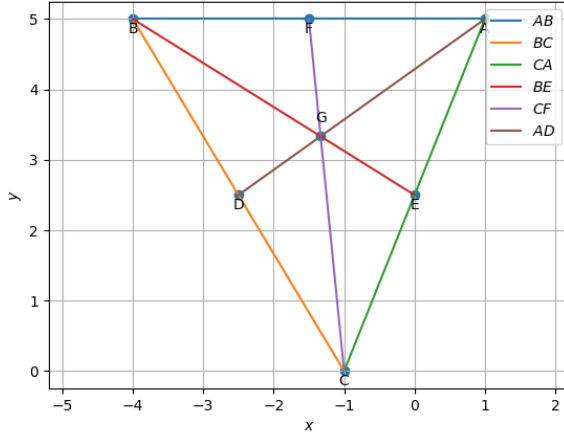


Fig. II. Medians generated using python

III. ALTITUDE

Parameter	Value	Description
D₁	$\begin{pmatrix} -2.676 \\ 2.794 \end{pmatrix}$	altitude foot from A
E₁	$\begin{pmatrix} 0.310 \\ 3.276 \end{pmatrix}$	altitude foot from B
F₁	$\begin{pmatrix} -1 \\ 5 \end{pmatrix}$	altitude foot from C
\mathbf{n}_{AD_1}	$\begin{pmatrix} 3 \\ -5 \end{pmatrix}$	Normal vec of AD_1
\mathbf{c}_{AD_1}	-22	Constant of AD_1
\mathbf{n}_{BE_1}	$\begin{pmatrix} 2 \\ 5 \end{pmatrix}$	Normal vec of BE_1
\mathbf{c}_{BE_1}	17	Constant of BE_1
\mathbf{n}_{CF_1}	$\begin{pmatrix} -5 \\ 0 \end{pmatrix}$	Normal vec of CF_1
\mathbf{c}_{CF_1}	5	Constant of CF_1
H	$\begin{pmatrix} -1 \\ 3.8 \end{pmatrix}$	Orthocenter

TABLE III
ORTHOCENTER

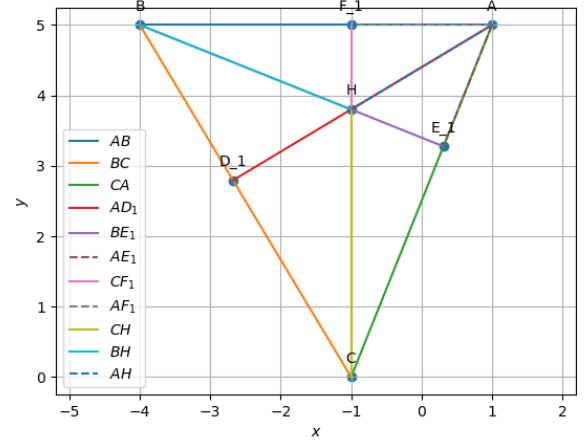


Fig. III. Altitudes generated using python

IV. PERPENDICULAR BISECTOR

Parameter	Value	Description
\mathbf{n}_{OA}	$\begin{pmatrix} 2.5 \\ 1.9 \end{pmatrix}$	Direction vec of OA
\mathbf{n}_{OB}	$\begin{pmatrix} -2.5 \\ 1.9 \end{pmatrix}$	Direction vec of OB
\mathbf{n}_{OC}	$\begin{pmatrix} 0.5 \\ -3.1 \end{pmatrix}$	Direction vec of OC
\mathbf{O}	$\begin{pmatrix} -1.5 \\ 3.1 \end{pmatrix}$	Circumcenter
\mathbf{n}_{OD}	$\begin{pmatrix} 5 \\ 0 \end{pmatrix}$	Normal vec of OD
\mathbf{c}_{OD}	-7.5	Constant of OD
\mathbf{n}_{OE}	$\begin{pmatrix} -3 \\ 5 \end{pmatrix}$	Normal vec of OE
\mathbf{c}_{OE}	20	Constant of OE
\mathbf{n}_{OF}	$\begin{pmatrix} -2 \\ -5 \end{pmatrix}$	Normal vec of OF
\mathbf{c}_{OF}	-12.5	Constant of OF
$\ \mathbf{A} - \mathbf{O}\ $	3.140	Norm of OA
$\ \mathbf{B} - \mathbf{O}\ $		Norm of OB
$\ \mathbf{C} - \mathbf{O}\ $		Norm of OC
\mathbf{R}		Circumradius
$\angle BAC$	68.1986°	Angle $\angle BAC$
$\angle BOC$	136.3972°	Angle $\angle BOC$

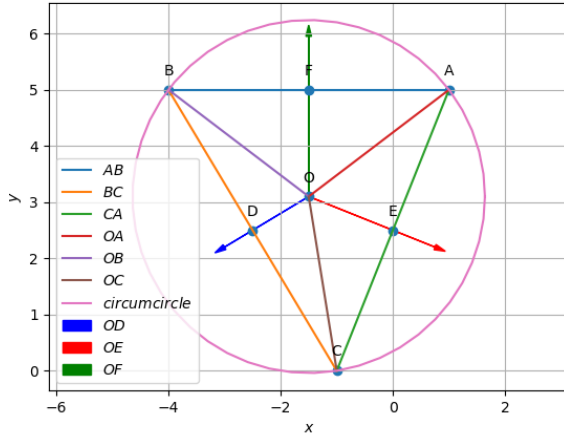
TABLE IV
CIRCUMCENTER

Fig. IV. Perpendicular bisectors generated using python

V. ANGULAR BISECTOR

Parameter	Value	Description
\mathbf{n}_{IA}	$\begin{pmatrix} -0.928 \\ 1.371 \end{pmatrix}$	Normal vec of IA
\mathbf{c}_{IA}	5.928	Constant vec of IA
\mathbf{n}_{IB}	$\begin{pmatrix} 0.857 \\ 1.514 \end{pmatrix}$	Normal vec of IB
\mathbf{c}_{IB}	4.142	Constant vec of IB
\mathbf{n}_{IC}	$\begin{pmatrix} -1.786 \\ -0.143 \end{pmatrix}$	Normal vec of IC
\mathbf{c}_{IC}	1.786	Constant vec of IC
\mathbf{I}	$\begin{pmatrix} -1.277 \\ 3.458 \end{pmatrix}$	Incenter
\mathbf{D}_3	$\begin{pmatrix} -2.599 \\ 2.665 \end{pmatrix}$	POC with AB
\mathbf{E}_3	$\begin{pmatrix} 0.154 \\ 2.886 \end{pmatrix}$	POC with BC
\mathbf{F}_3	$\begin{pmatrix} -1.277 \\ 5.000 \end{pmatrix}$	POC with CA
$\ \mathbf{D}_3 - \mathbf{O}\ $	1.542	Norm of OD_3
$\ \mathbf{E}_3 - \mathbf{O}\ $		Norm of OE_3
$\ \mathbf{F}_3 - \mathbf{O}\ $		Norm of OF_3
\mathbf{r}		Inradius
$\angle BAI$	34.1°	Angle $\angle BAI$
$\angle CAI$		Angle $\angle CAI$

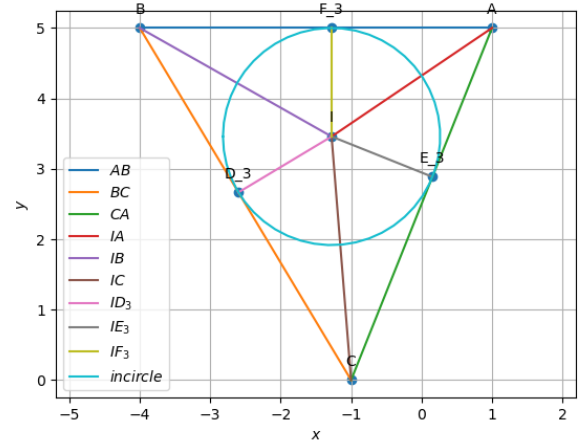
TABLE V
INCIRCLE

Fig. V. Incircle generated using python