Random Vector Assignment

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Consider a triangle with vertices,

$$\mathbf{A} = \begin{pmatrix} 4 \\ -5 \end{pmatrix}, \tag{1}$$

$$\mathbf{B} = \begin{pmatrix} -6 \\ 2 \end{pmatrix}, \tag{2}$$

$$\mathbf{C} = \begin{pmatrix} -1 \\ -9 \end{pmatrix} \tag{3}$$

I. Vector

A. Table

Parameter	Value	Description
$\mathbf{m}_{AB}$	$\begin{pmatrix} -10 \\ 7 \end{pmatrix}$	Direction vec of AB
$\mathbf{m}_{BC}$	$\begin{pmatrix} 11 \\ 2 \end{pmatrix}$	Direction vec of BC
$\mathbf{m}_{CA}$	$\begin{pmatrix} -1 \\ -9 \end{pmatrix}$	Direction vec of CA
$\|\mathbf{A} - \mathbf{B}\|$	12.21	length of AB
$\|\mathbf{B} - \mathbf{C}\|$	11.18	length of BC
$\|\mathbf{C} - \mathbf{A}\|$	9.06	length of CA
$\mathrm{rank}\begin{pmatrix} 1 & 1 & 1 \\ \mathbf{A} & \mathbf{B} & \mathbf{C} \end{pmatrix}$	3	non-collinear
$\mathbf{n}_{AB}^\top$	$\begin{pmatrix} 7 & 10 \end{pmatrix}$	AB
c	-22	
$\mathbf{n}_{BC}^\top$	$\begin{pmatrix} -2 & 11 \end{pmatrix}$	BC
c	34	
$\mathbf{n}_{CA}^\top$	$\begin{pmatrix} -9 & 1 \end{pmatrix}$	AC
c	-41	
Area	48.5	Area of $\triangle ABC$
Angle	61.35	$\angle$ BAC
Angle	45.30	$\angle$ ABC
Angle	73.35	$\angle$ ACB

TABLE I.1

Equations related to triangle

B. Figure
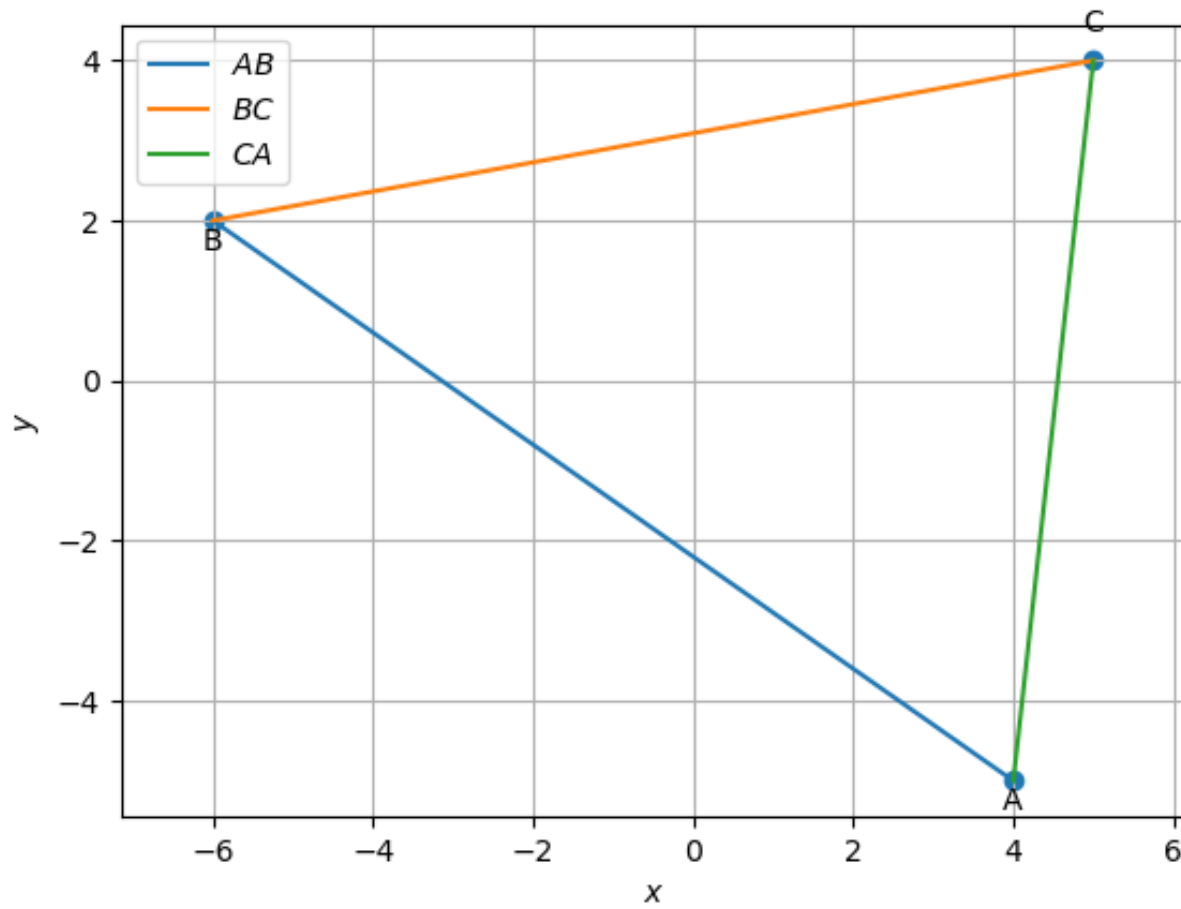
Fig. I.1. Triangle generated using python

II. MEDIAN

A. Table

Parameter	Value	Description
D	$\begin{pmatrix} -0.5 \\ 3 \end{pmatrix}$	Midpoint AB
E	$\begin{pmatrix} 4.5 \\ -0.5 \end{pmatrix}$	Midpoint BC
F	$\begin{pmatrix} -1 \\ -1.5 \end{pmatrix}$	Midpoint CA
$\mathbf{n}_{AD}^{\top}$	$\begin{pmatrix} 8 & 4.5 \end{pmatrix}$	AD
c	9.5	
$\mathbf{n}_{BE}^{\top}$	$\begin{pmatrix} -2.5 & -10.5 \end{pmatrix}$	BE
c	-6	
$\mathbf{n}_{CF}^{\top}$	$\begin{pmatrix} -5.5 & 6 \end{pmatrix}$	CF
c	-3.5	
G	$\begin{pmatrix} 1 \\ 0.33 \end{pmatrix}$	Centroid

TABLE II.1

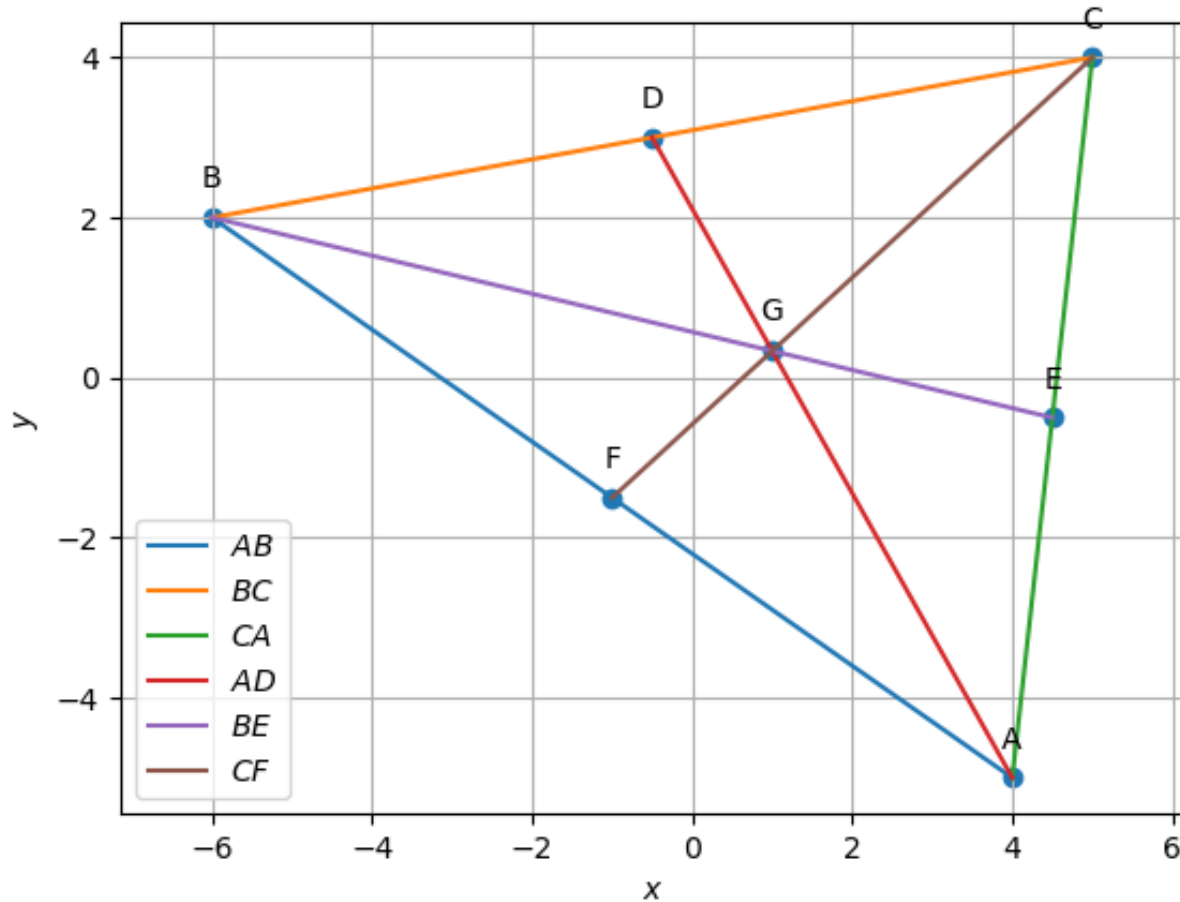Equations related to median

B. Figure
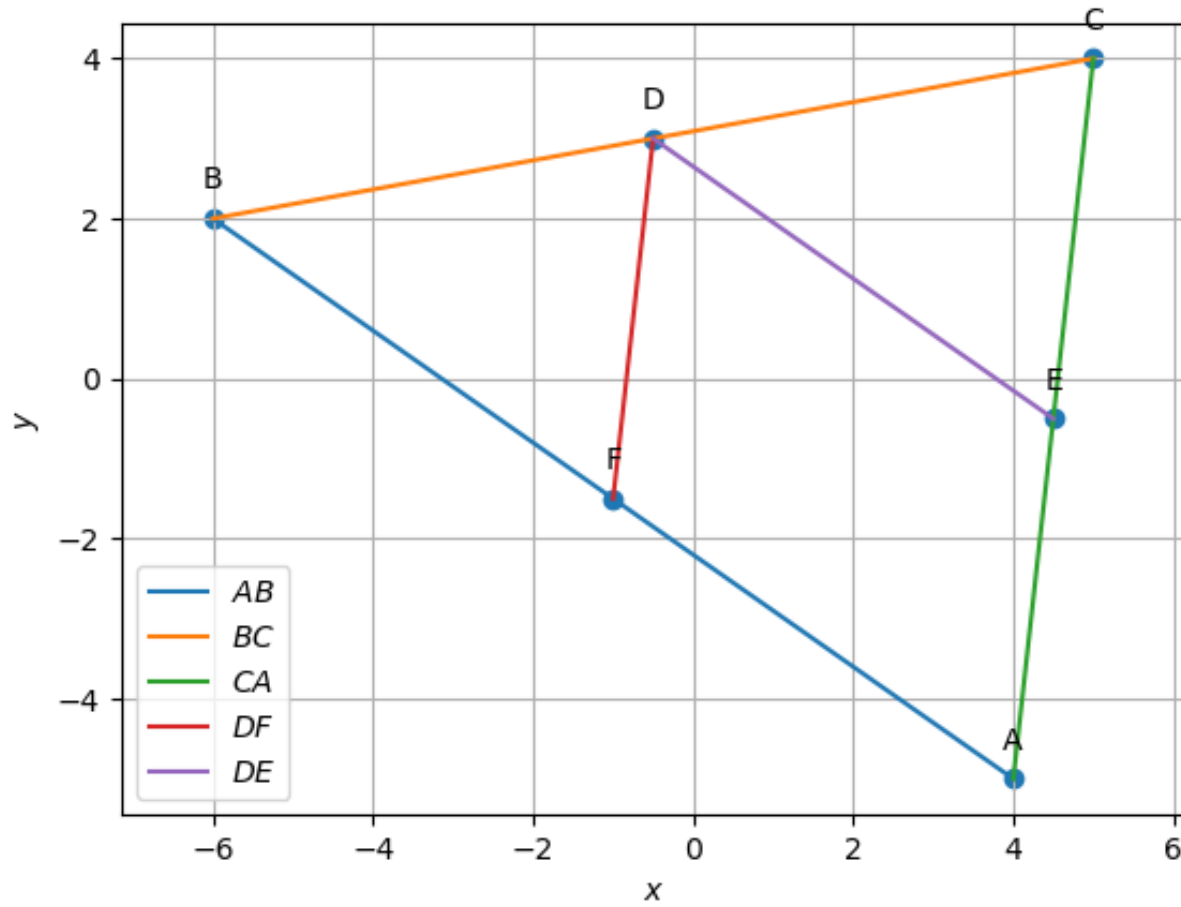

Fig. II.1. Triangle with centroid generated using python

Fig. II.2. Triangle with altitude generated using python

III. ALTITUDE

A. Table

Parameter	Value	Description
$\mathbf{n}_{\mathbf{AD_1}}^{\top}$	$\begin{pmatrix} -11 & -2 \end{pmatrix}$	AD_1
c	-34	
$\mathbf{n}_{\mathbf{BE_1}}^{\top}$	$\begin{pmatrix} -1 & -9 \end{pmatrix}$	BE_1
c	-12	
$\mathbf{n}_{\mathbf{CF_1}}^{\top}$	$\begin{pmatrix} 10 & -7 \end{pmatrix}$	CF_1
c	22	
$\mathbf{H}$	$\begin{pmatrix} 2.907 \\ 1.01 \end{pmatrix}$	Orthocenter

TABLE III.1

EQUATIONS RELATED TO ALTITUDE

B. Figure
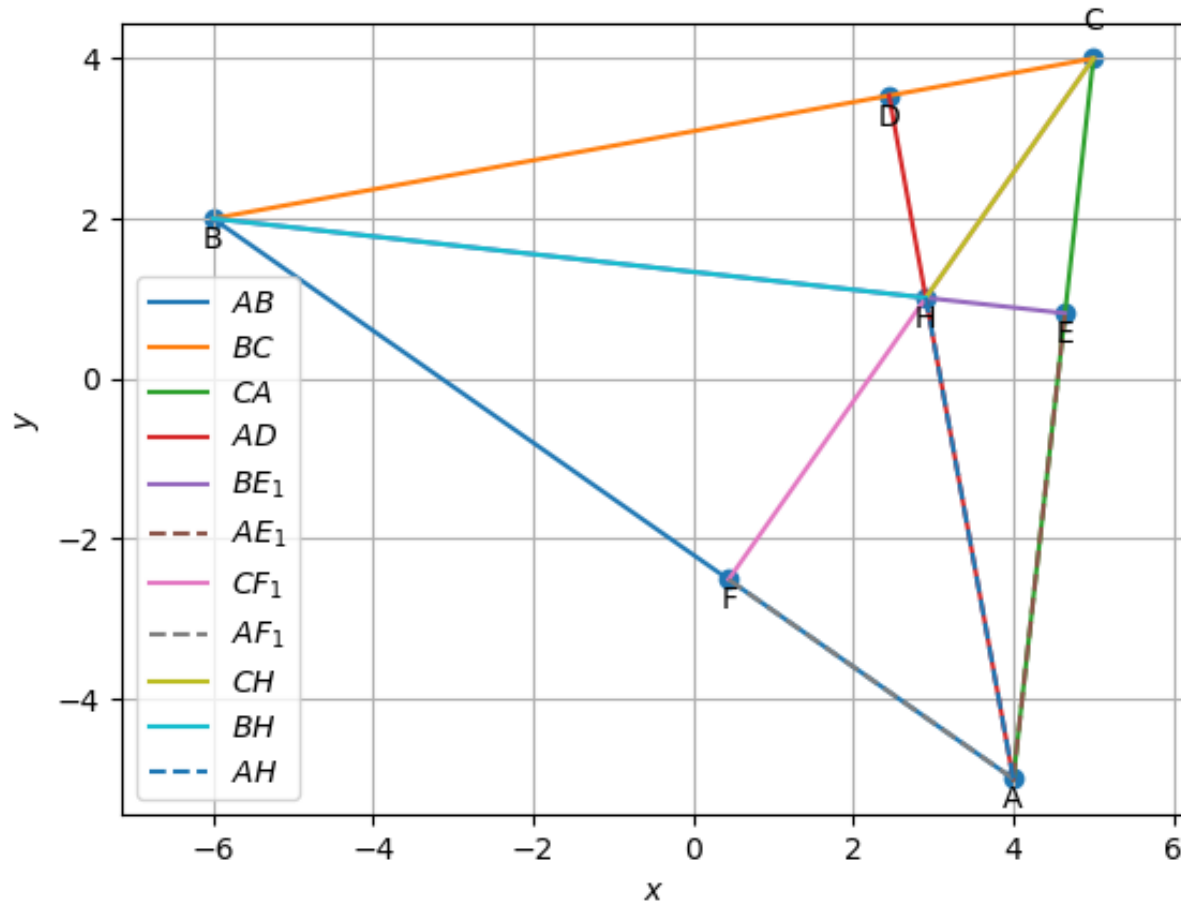
Fig. III.1. Triangle with altitude generated using python

IV. PERPENDICULAR BISECTOR

A. Table

Parameter	Value	Description
$\mathbf{n}^\top$	$\begin{pmatrix} 10 & -7 \end{pmatrix}$	Perpendicular bisector of AB
c	0.5	
$\mathbf{n}^\top$	$\begin{pmatrix} -11 & -2 \end{pmatrix}$	Perpendicular bisector of BC
c	-0.5	
$\mathbf{n}^\top$	$\begin{pmatrix} 1 & 9 \end{pmatrix}$	Perpendicular bisector of CA
c	0	
center($\mathbf{O}$)	$\begin{pmatrix} -0.046 \\ -0.005 \end{pmatrix}$	Circumcircle
radius	6.37	

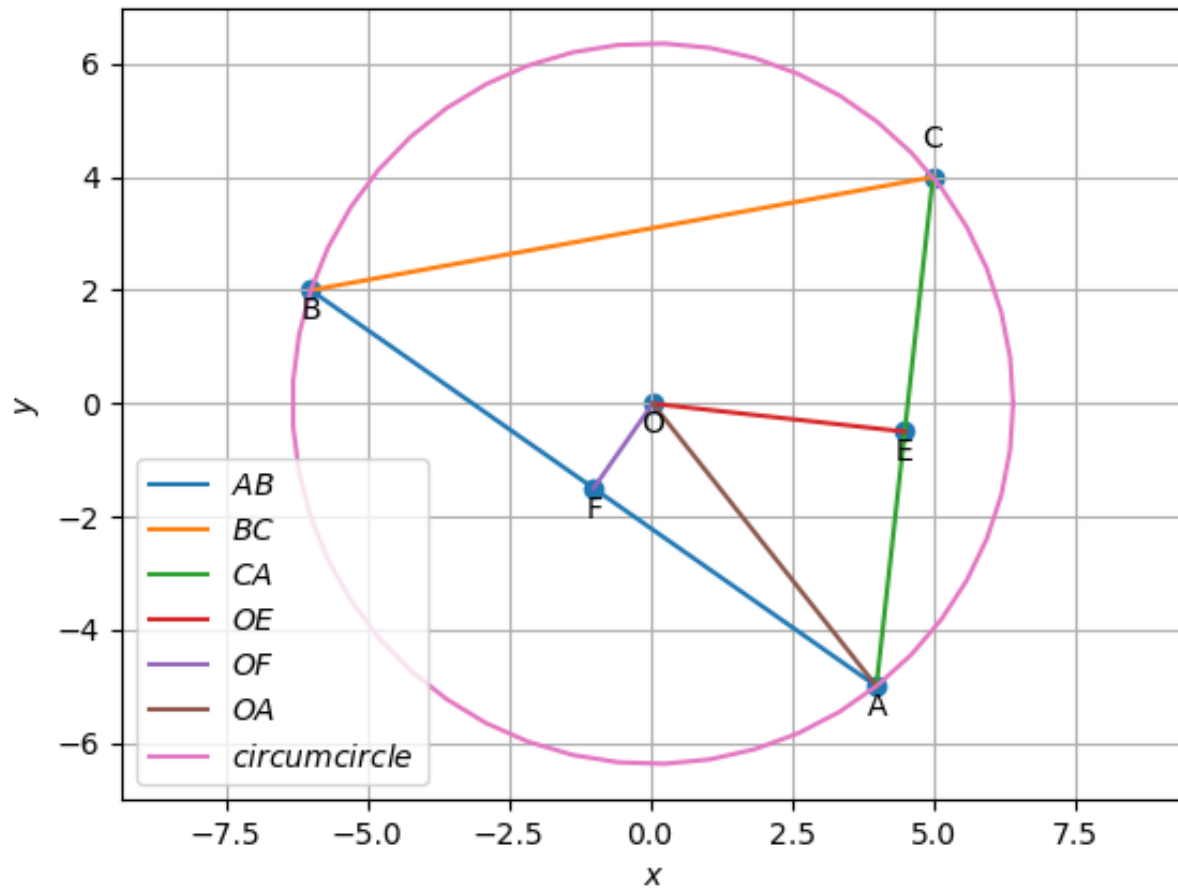TABLE IV.1
EQUATIONS RELATED TO CIRCUMCIRCLE

B. Figure

Fig. IV.1. Triangle with circumcircle generated using python

V. ANGULAR BISECTOR

A. Table

B. Figure

| Parameter	Value	Description
$\mathbf{n}^\top$	$\begin{pmatrix} 1.567 & 0.709 \end{pmatrix}$	Angular bisector of A
c	2.725	
$\mathbf{n}^\top$	$\begin{pmatrix} 0.752 & -0.165 \end{pmatrix}$	Angular bisector of B
c	-4.84	
$\mathbf{n}^\top$	$\begin{pmatrix} 1.173 & -1.094 \end{pmatrix}$	Angular bisector of C
c	1.486	
center($\mathbf{I}$)	$\begin{pmatrix} 1.585 \\ 0.34 \end{pmatrix}$	Incircle
radius	2.989	
Angle	30.67	$\angle$ BAI
Angle	30.67	$\angle$ CAI
$\mathbf{D_3}$	$\begin{pmatrix} 1.06 \\ -1.48 \end{pmatrix}$	POC with AB
$\mathbf{E_3}$	$\begin{pmatrix} 1.06 \\ -4.51 \end{pmatrix}$	POC with BC
$\mathbf{F_3}$	$\begin{pmatrix} 3 \\ -3 \end{pmatrix}$	POC with CA
Length	5.041	AF_3, AE_3
Length	7.166	BD_3, BE_3
Length	4.015	CF_3, CD_3

TABLE V.1

EQUATIONS RELATED TO INCIRCLE
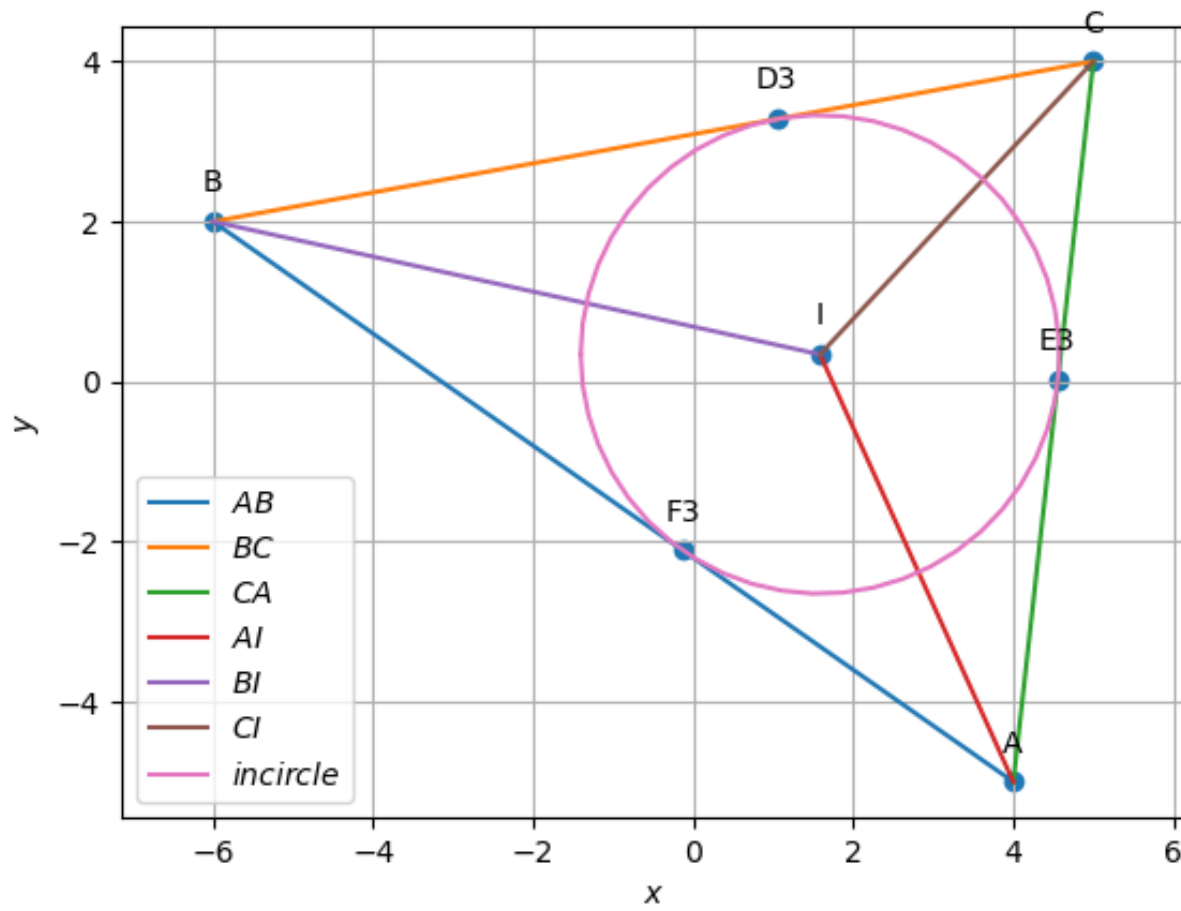
Fig. V.1. Triangle with incircle generated using python