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
$\operatorname{rank}\begin{pmatrix} 1 & 1 & 1 \\ \mathbf{A} & \mathbf{B} & \mathbf{C} \end{pmatrix}$	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 ΔABC
Angle	61.35	$\angle$ BAC
Angle	45.30	$\angle$ ABC
Angle	73.35	$\angle$ ACB

TABLE I.1
Equations related to triangle

B. Figure

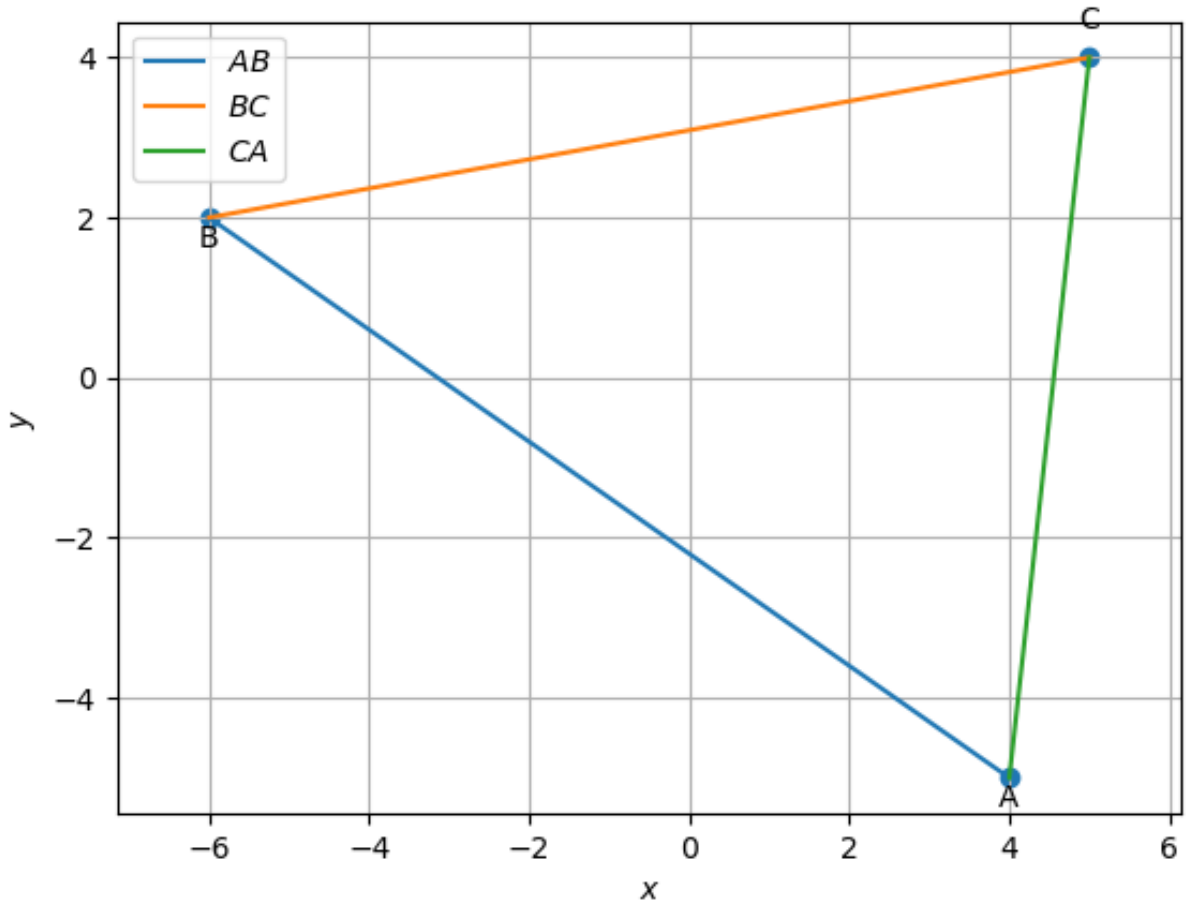

Fig. I.1. Triangle generated using python

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
$\mathbf{n}_{\mathbf{AD}}^{\top}$	$\begin{pmatrix} 8 & 4.5 \end{pmatrix}$	AD
c	9.5	
$\mathbf{n}_{\mathbf{BE}}^{\top}$	$\begin{pmatrix} -2.5 & -10.5 \end{pmatrix}$	BE
c	-6	
$\mathbf{n}_{\mathbf{CF}}^{\top}$	$\begin{pmatrix} -5.5 & 6 \end{pmatrix}$	CF
c	-3.5	
G	$\begin{pmatrix} 1 \\ 0.33 \end{pmatrix}$	Centroid

TABLE II.1
EQUATIONS RELATED TO MEDIAN

B. Figure

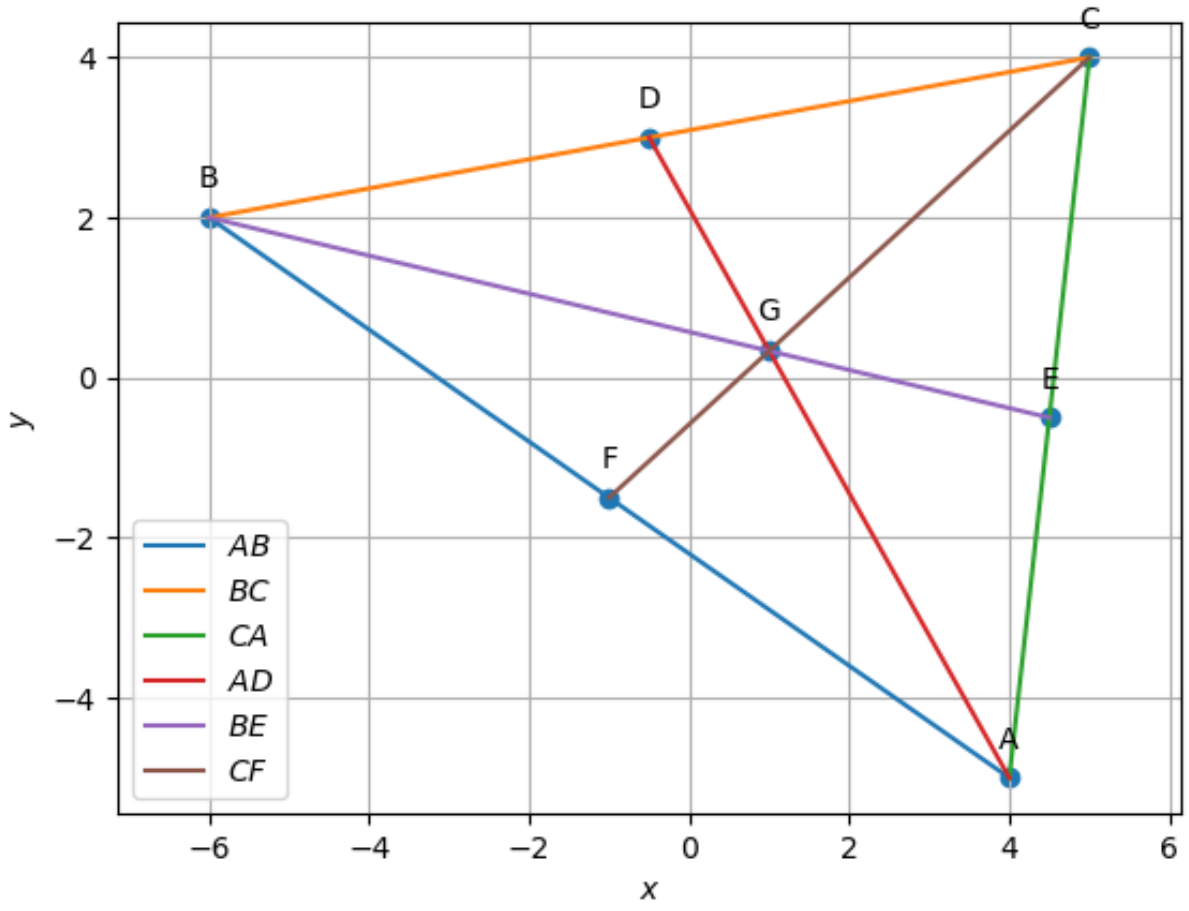

Fig. II.1. Triangle with centroid generated using python

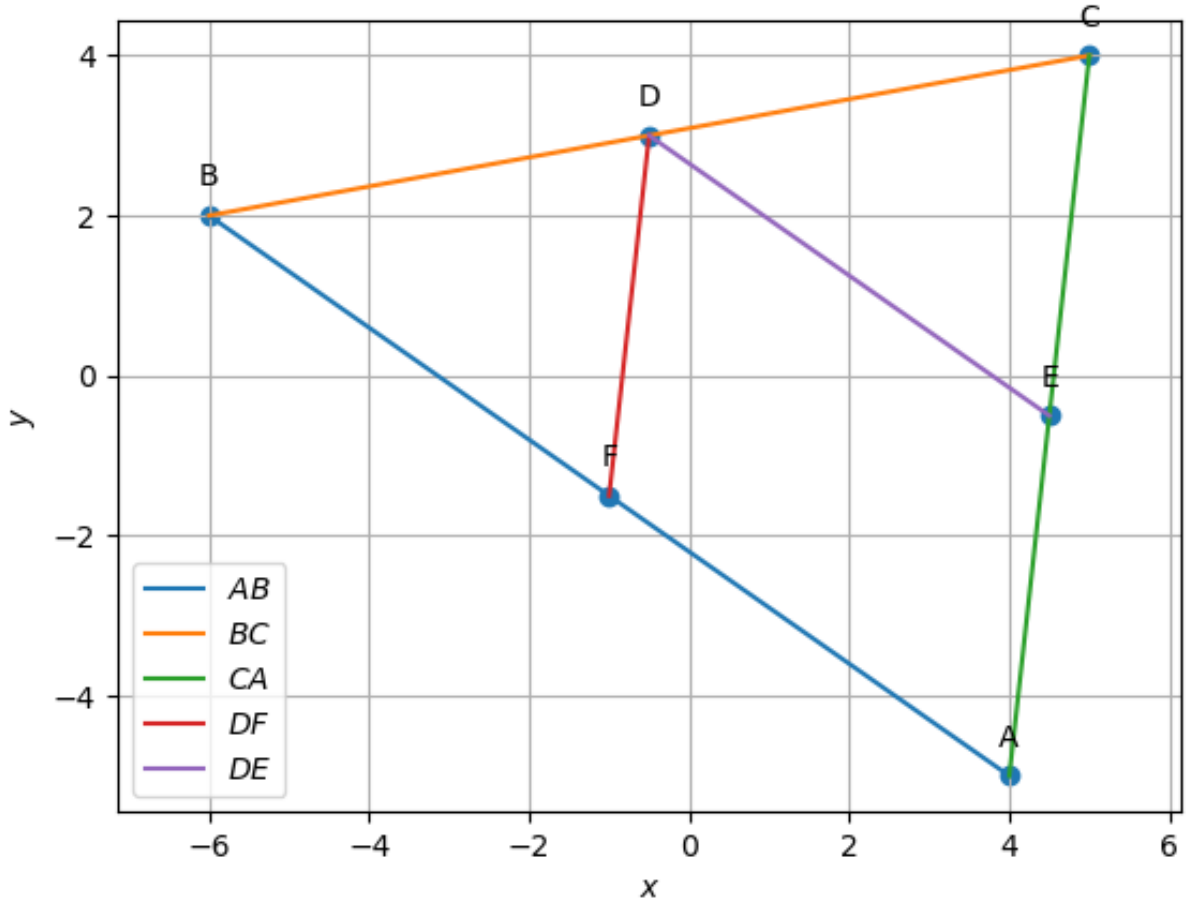

Fig. II.2. Proving EAFD is a parallelogram

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	
H	$\begin{pmatrix}2.907\\1.01\end{pmatrix}$	Orthocenter

TABLE III.1
Equations related to altitude

B. Figure

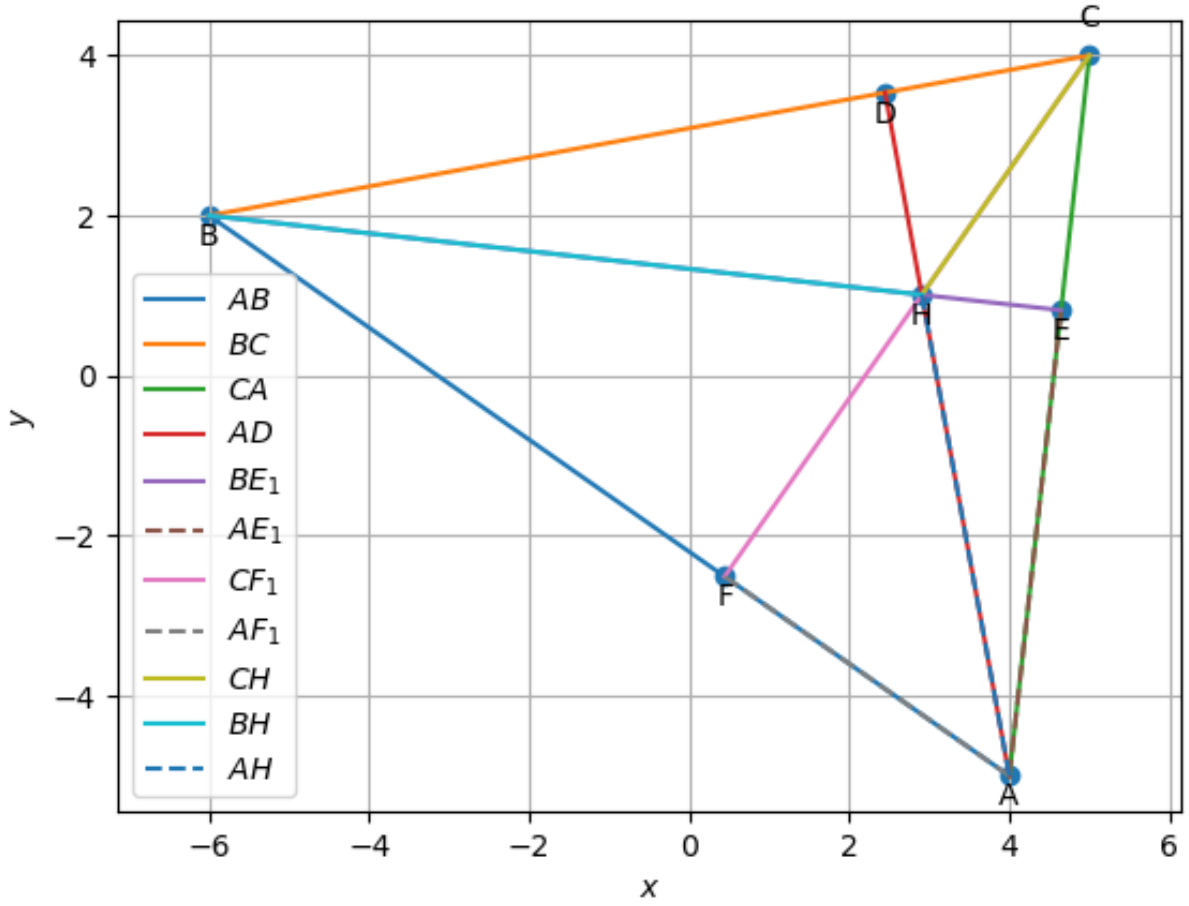

Fig. III.1. Triangle with altitude generated using python

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

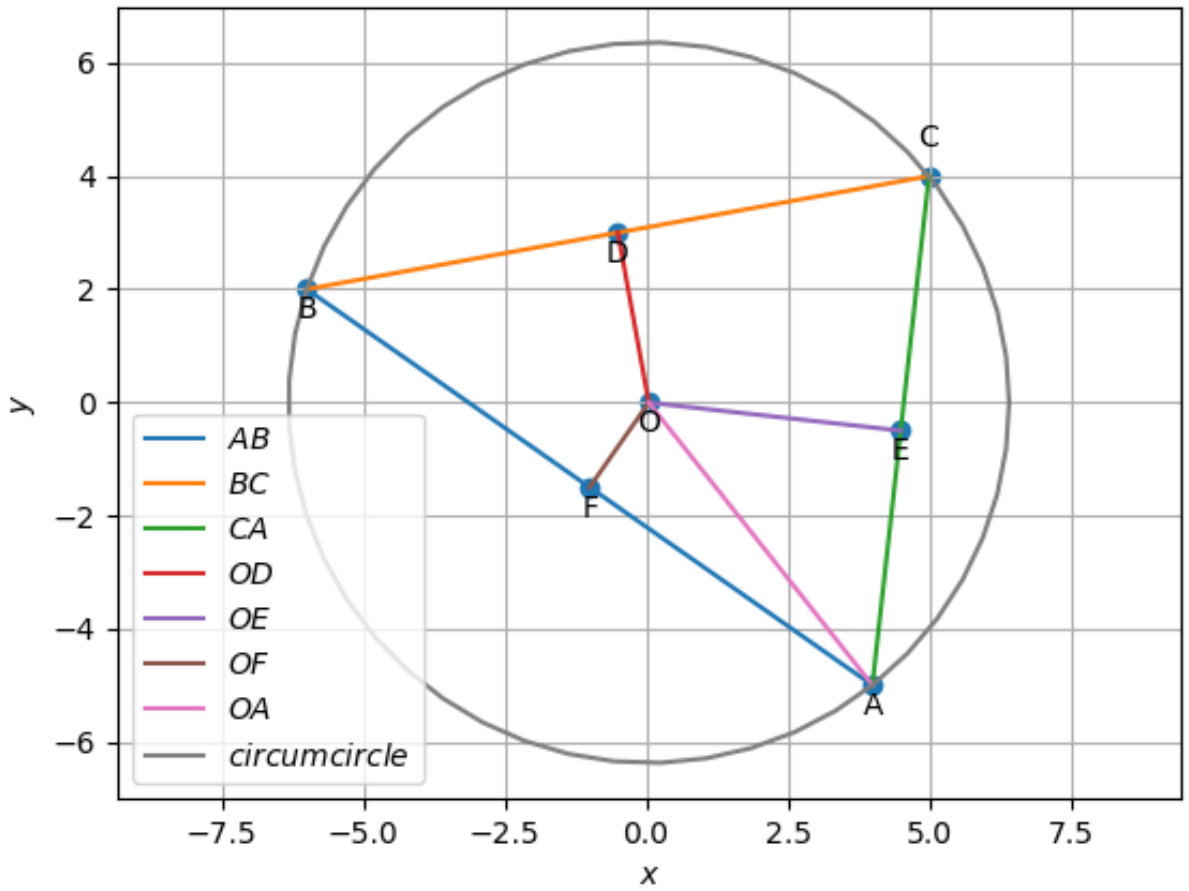

Fig. IV.1. Triangle with circumcircle generated using python

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

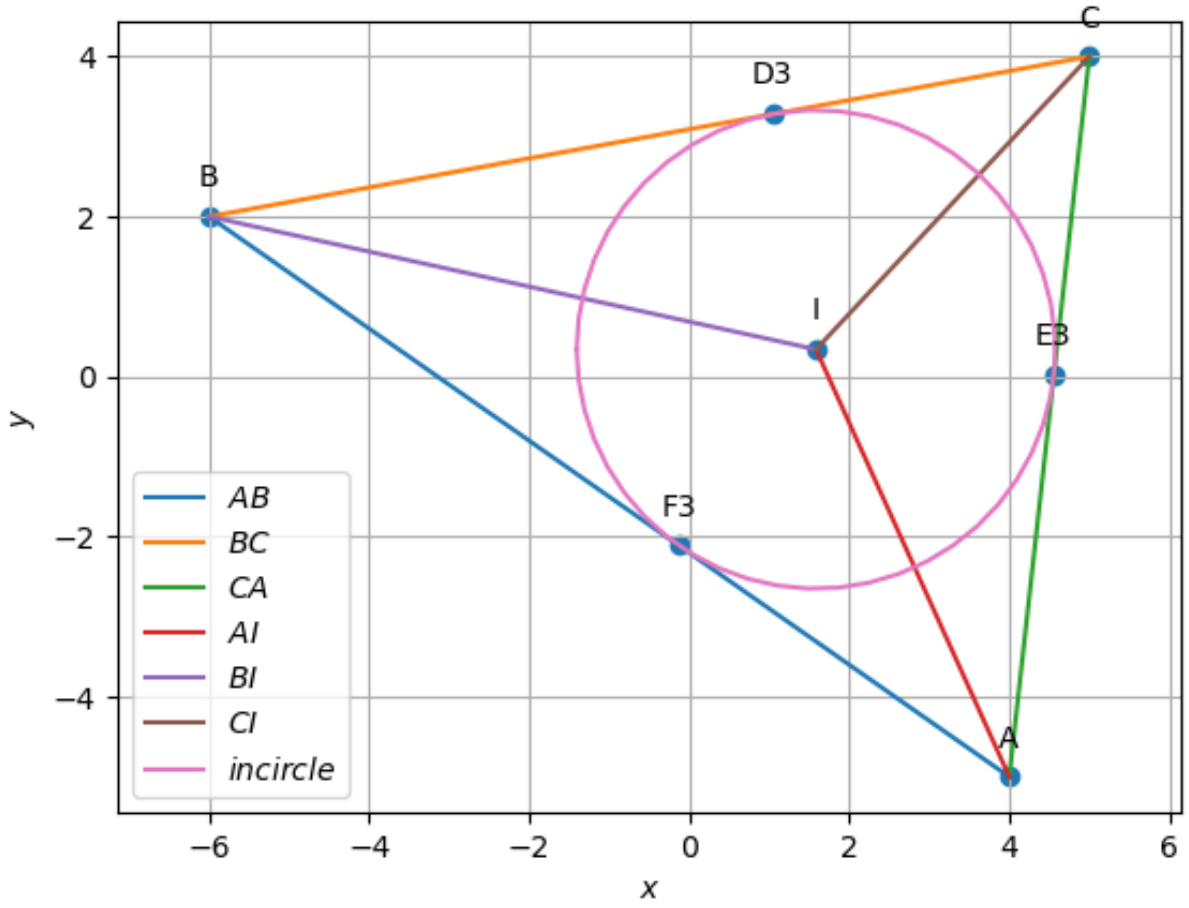

Fig. V.1. Triangle with incircle generated using python