

# ASSIGNMENT-1

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**Question :** Suppose the equations  $AB$ ,  $BC$  and  $CA$  are respectively given by

$$\mathbf{n}_i^\top \mathbf{x} = c_i \quad i = 1, 2, 3 \quad (1)$$

The equations of the respective angle bisectors are given by

$$\frac{\mathbf{n}_i^\top \mathbf{x} - c_i}{\|\mathbf{n}_i\|} = \pm \frac{\mathbf{n}_j^\top \mathbf{x} - c_j}{\|\mathbf{n}_j\|} \quad i \neq j \quad (2)$$

Substitute numerical values and find the equations of the angle bisectors of  $A, B$  and  $C$ .

**Solution :** The parametric equations of sides;

$$BC : \begin{pmatrix} 11 & 1 \end{pmatrix} \mathbf{x} = -38, \quad (3)$$

$$CA : \begin{pmatrix} 1 & -1 \end{pmatrix} \mathbf{x} = 2, \quad (4)$$

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

$$(6)$$

Using the formula mentioned in the question to find out the angular bisector for sides  $AB$  and  $AC$ , naming the angular bisector  $L$  we get,

$$\frac{\mathbf{n}_3^\top \mathbf{x} - c_3}{\|\mathbf{n}_3\|} = \pm \frac{\mathbf{n}_2^\top \mathbf{x} - c_2}{\|\mathbf{n}_2\|} \quad (7)$$

As we can see we will get 2 solutions for  $L$ . This is because one of them is internal angular bisector and the other is the external angular bisector. Internal angular bisector can be evaluated if we take  $+$  in the above formula. Hence,  $L$  is given by,

$$\frac{\mathbf{n}_3^\top \mathbf{x} - c_3}{\|\mathbf{n}_3\|} = \frac{\mathbf{n}_2^\top \mathbf{x} - c_2}{\|\mathbf{n}_2\|} \quad (8)$$

$$\Rightarrow \left( \frac{\mathbf{n}_3}{\|\mathbf{n}_3\|} - \frac{\mathbf{n}_2}{\|\mathbf{n}_2\|} \right) \mathbf{x} = \left( \frac{c_3}{\|\mathbf{n}_3\|} - \frac{c_2}{\|\mathbf{n}_2\|} \right) \quad (9)$$

$$\Rightarrow \left( \frac{\begin{pmatrix} 7 & 5 \end{pmatrix}}{\sqrt{74}} - \frac{\begin{pmatrix} 1 & -1 \end{pmatrix}}{\sqrt{2}} \right) \mathbf{x} = \frac{2}{\sqrt{74}} - \frac{2}{\sqrt{2}} \quad (10)$$

$$\Rightarrow \left( \frac{7-\sqrt{37}}{\sqrt{74}} \quad \frac{5+\sqrt{37}}{\sqrt{74}} \right) \mathbf{x} = \frac{2-2\sqrt{37}}{\sqrt{74}} \quad (11)$$

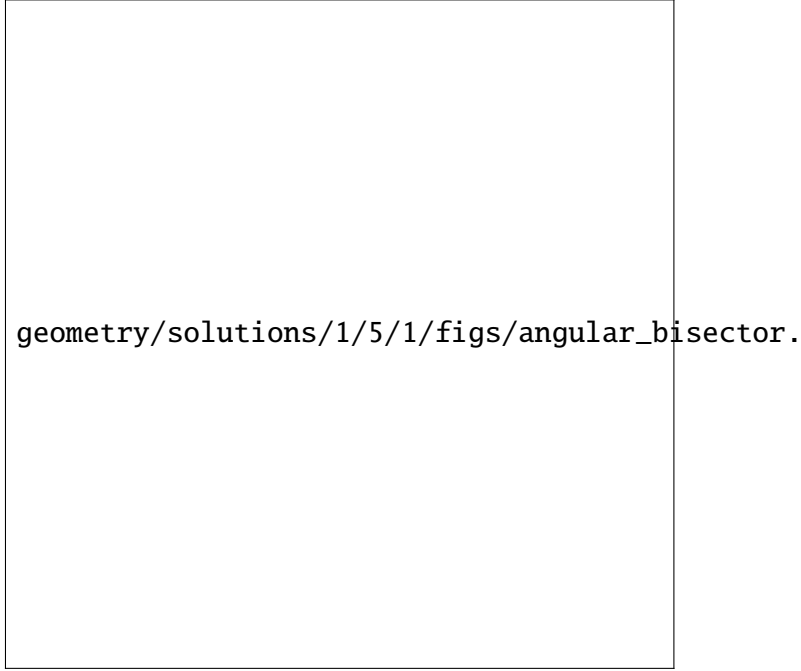


Fig. 0. Triangle generated using python

Hence, the internal angular bisector of angle  $A$ ,  $L$  will be,

$$\Rightarrow \left( \frac{7-\sqrt{37}}{\sqrt{74}} \quad \frac{5+\sqrt{37}}{\sqrt{74}} \right) \mathbf{x} = \frac{2-2\sqrt{37}}{\sqrt{74}} \quad (12)$$

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