Name:Somisetty.Kedareswari

Roll No.: FWC22049

mail2kedari@gmail.com

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MATRIX ASSIGNMENT

0.1 Problem:

Construct a triangle ABC in which BC=8cm, $\angle B = 45^0$ and AB - AC = 3.5 cm.

0.2 Solution

The input parameters for this construction are

Symbol	Value	Description
BC	a	where a is 8cm
$\angle BC$	45^0	ΔABC
k	3.5	constant value

Caluclating Other Coordinate:

The coordinates of B and C are X_2,Y_2 respectively.

Let $\mathbf{A} = c \times \begin{pmatrix} \cos\theta \\ \sin\theta \end{pmatrix}$

Using the Cosine formula in ΔABC,

$$b^2 = a^2 + c^2 - 2ac cos\mathbf{B} \tag{1}$$
$$(b+c)(b-c) = a^2 - 2ac cos\mathbf{B} \tag{2}$$

Given
$$c - b = k \tag{3}$$

Upon Simplifaction we get:-

$$(b+c)(-k) = a^2 - 2ac cos\mathbf{B} \tag{4}$$
$$-kc - kb + 2ac cos\mathbf{B} = a^2 \tag{5}$$
$$-kb - c(-k + 2ac cos\mathbf{B}) = a^2 \tag{6}$$

From the above, we obtain the matrix equation:-

$$\begin{pmatrix} -k & k+2a cos\mathbf{B} \\ -1 & 1 \end{pmatrix} \begin{pmatrix} c \\ b \end{pmatrix} = \begin{pmatrix} k \\ a^2 \end{pmatrix}$$

$$\begin{pmatrix} -3.5 & 3.5+2(8)cos45^0 \\ -1 & 1 \end{pmatrix} \begin{pmatrix} c \\ b \end{pmatrix} = \begin{pmatrix} 3.5 \\ 64 \end{pmatrix}$$

Augmented Matrix $\implies \begin{pmatrix} -3.5 & 3.5+2(8)cos45^0 & 3.5 \\ -1 & 1 & 64 \end{pmatrix}$

Reducing to echelon form:-

$$\left(\begin{pmatrix} 1 & -1 & \frac{7}{2} \\ -\frac{7}{2} & \frac{781154172560113}{10000000000000} & 64 \end{pmatrix} \xleftarrow{-R_1 \leftarrow R_1} \right)$$

$$\left(\begin{pmatrix} 1 & -1 & \frac{7}{2} \\ 0 & 1 & \frac{517500000000000}{43154172560113} \end{pmatrix} \xleftarrow{\frac{10000000000000 R2}{43154172560113} \leftarrow R_2} \right)$$

$$\left(\begin{pmatrix} 1 & 0 & \frac{732920792079209}{86308345120226} \\ 0 & 1 & \frac{517500000000000}{43154172560113} \end{pmatrix} \xleftarrow{R1+R2 \leftarrow R_2} \right)$$

Reduced Echelon Form: $\left(\begin{pmatrix} 1 & 0 & 8.491887905604763 \\ 0 & 1 & 11.991887905604763 \end{pmatrix} \right)$

$$\begin{pmatrix} c \\ b \end{pmatrix} = \begin{pmatrix} 11.99 \\ 8.49 \end{pmatrix}$$

The vertices of Δ ABC are

$$\mathbf{A} = 11.99 \begin{pmatrix} cos45 \\ sin45 \end{pmatrix} = \begin{pmatrix} 8.4 \\ 8.4 \end{pmatrix}$$

$$\mathbf{B} = \begin{pmatrix} 0 \\ 0 \end{pmatrix}$$

$$\mathbf{C} = \begin{pmatrix} 8 \\ 0 \end{pmatrix}$$

Below python code realizes the above construction :

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https://github.com/kedareswari200/
fwc-moudle1/blob/Matri_lines/triangle.py
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0.3 Construction