MATRICES USING PYTHON

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FWC22040 IITH Future Wireless Communication (FWC) ASSIGN-5

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1 Construction

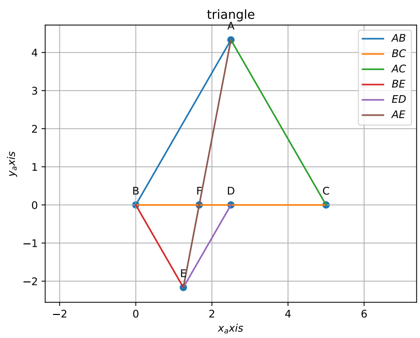

Figure of construction

2 Problem

ABC and BDE are two equilateral triangles such that D is the mid-point of BC. If AE intersects BC at F, show that

(i) ar(BDE) =1/4 ar(ABC)

(ii)ar(BDE) =1/2 ar(BAE)

(iii)ar(ABC) =2 ar(BEC)

(iv)ar(BFE) = ar(AFD)

(v)ar(BFE) =2ar(FED)

(vi)ar(FED) =1/8 ar(AFC)

3 Solution

Theory:

To Prove: ar(BDE)=1/4 ar(ABC)

ABC and BDE are two equilateral triangles such that D is the mid-point of BC.If AE intersets BC at F

termux commands :

```
python3 matrix.py
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The input parameters for this construction are

Symbol	Value	Description
r	5	AB
$\mathbf{A}$	$r\begin{pmatrix}\cos\theta\\ \sin\theta\end{pmatrix}$	Point A
$\mathbf{B}$	$\begin{pmatrix}0\\0\end{pmatrix}$	Point B
$\mathbf{C}$	$\begin{pmatrix}r\\0\end{pmatrix}$	Point C
θ	$\pi/3$	∠ABC

$\mathbf{F}$ is Point of intersection of the lines BD and AE

The line equation of BD is

$$\begin{pmatrix}0 & 1\end{pmatrix}x = 0 \tag{1}$$

The line equation of AE is

$$\begin{pmatrix} -3\tan\theta & 1 \end{pmatrix} x = 2r\sin\theta \tag{2}$$

The augmented matrix is

$$\begin{pmatrix} -3\tan\theta & 1 & -2r\sin\theta \\ 0 & 1 & 0 = \end{pmatrix} \xleftarrow{R_1 \leftarrow R_1 - R_2}$$

$$\begin{pmatrix} 1 & 0 & \frac{2}{3}r\cos\theta \\ 0 & 1 & 0 \end{pmatrix}$$

$$\mathbf{F} = \begin{pmatrix} \frac{2}{3}r\cos\theta \\ 0 \end{pmatrix}$$

$$\mathbf{D} = \frac{\mathbf{B}+\mathbf{C}}{2}$$

$$\mathbf{E} = \frac{\mathbf{A}}{2}\begin{pmatrix} 1 & 0 \\ 0 & -1 \end{pmatrix} = \begin{pmatrix} \frac{r}{2}\cos\theta \\ \frac{-r}{2}\sin\theta \end{pmatrix}$$

To Prove: ar(BDE)=1/4 ar(ABC)

$$\mathbf{v1} = \mathbf{A} - \mathbf{B}$$
$$\mathbf{v2} = \mathbf{A} - \mathbf{C}$$

$$ar(\Delta ABC) = \frac{1}{2}\|\mathbf{v1} \times \mathbf{v2}\| \tag{3}$$

$$\mathbf{v3} = \mathbf{B} - \mathbf{D}$$
$$\mathbf{v4} = \mathbf{B} - \mathbf{E}$$

$$ar(\Delta BDE) = \frac{1}{2}\|\mathbf{v3} \times \mathbf{v4}\| \tag{4}$$

$$ar(BDE) = \frac{1}{4}ar(ABC)$$

To Prove: ar(BDE)=1/2 ar(BAE)

$$\mathbf{v5} = \mathbf{A} - \mathbf{E}$$
$$\mathbf{v6} = \mathbf{A} - \mathbf{B}$$

$$ar(\Delta BAE) = \frac{1}{2}\|\mathbf{v5} \times \mathbf{v6}\| \tag{5}$$

$$ar(BDE) = \frac{1}{2}ar(BAE)$$

To Prove: ar(ABC)=2 ar(BEC)

$$\mathbf{v7} = \mathbf{B} - \mathbf{C}$$
$$\mathbf{v8} = \mathbf{B} - \mathbf{E}$$

$$ar(\Delta BEC) = \frac{1}{2}\|\mathbf{v7} \times \mathbf{v8}\| \tag{6}$$

$$ar(ABC) = 2ar(BEC)$$

To Prove: ar(BFE)=ar(AFD)

$$\mathbf{v9} = \mathbf{B} - \mathbf{F}$$
$$\mathbf{v10} = \mathbf{B} - \mathbf{E}$$
$$\mathbf{v11} = \mathbf{A} - \mathbf{D}$$
$$\mathbf{v12} = \mathbf{A} - \mathbf{F}$$

$$ar(\Delta BFE) = \frac{1}{2}\|\mathbf{v9} \times \mathbf{v10}\| \tag{7}$$

$$ar(\Delta AFD) = \frac{1}{2}\|\mathbf{v11} \times \mathbf{v12}\| \tag{8}$$

ar(BFE)=ar(AFD)

To prove : ar(BFE) =2ar(FED)

$$\mathbf{v13} = \mathbf{F} - \mathbf{E}$$
$$\mathbf{v14} = \mathbf{F} - \mathbf{D}$$

$$ar(\Delta FED) = \frac{1}{2}\|\mathbf{v13} \times \mathbf{v14}\| \tag{9}$$

$$ar(BFE) = 2ar(FED)$$

To prove : $ar(FED) = \frac{1}{8}ar(AFC)$

$$\mathbf{v15} = \mathbf{A} - \mathbf{F}$$
$$\mathbf{v16} = \mathbf{A} - \mathbf{C}$$

$$ar(\Delta AFC) = \frac{1}{2}\|\mathbf{v15} \times \mathbf{v16}\| \tag{10}$$

$$ar(FED) = \frac{1}{8}ar(AFC)$$

The below python code realizes the above construction:

https://github.com/Vamsi9849/iithfwc/blob/main/
Matrix_line/codes/matrix.py