MATRICES USING PYTHON

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Problem statement:
ABC,ABD are 2 triangles on same base AB,if line segment CD is bisected by AB at O,show that
(1)if ar (ABC) = ar (ABD) find relation between r1,r2
(2)point 'O' is the intersection of AB and CD
(3)'o' is the midpoint of CD

Construction

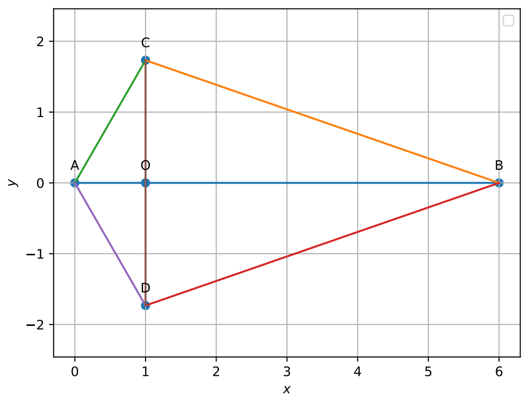

Figure of construction

The input parameters for this construction are

Symbol	Value	Description
θ_1	60	angle between AB and AC
θ_2	-60	angle between AB and AD
r_1	2	length of AC
r_2	-	length of AD
A	$\begin{pmatrix}0\\0\end{pmatrix}$	Point **A**

Solution

Theorom: In 2 triangles with same base and linesegment cd is bisected at O

STEP1: Given areas are equal then, to find relation between $\mathbf{r1}$ and $\mathbf{r2}$

$$\frac{1}{2}\|\mathbf{AC}\times\mathbf{AB}\| = \frac{1}{2}\|\mathbf{AB}\times\mathbf{AD}\| \tag{1}$$

$$\mathbf{A} = \begin{pmatrix}0\\0\end{pmatrix}, \mathbf{B} = \begin{pmatrix}6\\0\end{pmatrix}, \mathbf{C} = \begin{pmatrix}rcos\theta 1\\rsin\theta 1\end{pmatrix}, \mathbf{D} = \begin{pmatrix}scos\theta 2\\ssin\theta 2\end{pmatrix} \tag{2}$$

$$\begin{vmatrix}-r/2 & -6\\-\sqrt{3}r/2 & 0\end{vmatrix} - \begin{vmatrix}-6 & -s/2\\0 & \sqrt{3}s/2\end{vmatrix} = 0 \tag{3}$$

$$\therefore \mathbf{r1} = \mathbf{r2} \tag{4}$$

Step2: Finding $\mathbf{O}$ through intersection of lines AB and CD

line equation is given by

$$\mathbf{n^T}(\mathbf{x}-\mathbf{p}) = 0 \tag{5}$$

$$\begin{pmatrix}0 & -6\end{pmatrix}\left(\begin{pmatrix}\mathbf{x}\\\mathbf{y}\end{pmatrix} - \begin{pmatrix}0\\0\end{pmatrix}\right) = 0 \tag{6}$$

$$\begin{pmatrix}2\sqrt{3} & 0\end{pmatrix}\left(\begin{pmatrix}\mathbf{x}\\\mathbf{y}\end{pmatrix} - \begin{pmatrix}1\\\sqrt{3}\end{pmatrix}\right) = 0 \tag{7}$$

By solving (7) and (8),we get point 'O'

$$\mathbf{O} = \begin{pmatrix}1\\0\end{pmatrix} \tag{8}$$

step3: prove that 'O' is the centre of C and D

$$\mathbf{O} = 0.5*(C+D) \tag{9}$$

$$\mathbf{O} = \begin{pmatrix}1\\0\end{pmatrix} \tag{10}$$

$\therefore$ $\mathbf{O}$ is the midpoint of line $\mathbf{CD}$