MATRICES USING PYTHON

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Contents

1 Problem

If diagonals of a parallelogram are equal then show that it is a rectangle

2 Solution

Theory:

Given ABCD is a parallelogram and AC = BD

To Prove: It is a rectangle.
Rectange is a parallelogram with all its interior angles as 90 degrees. As given all diagonals are equall so if we prove anyone angle in the triangle is 90 then it will automatically become rectangle.

In $\triangle$ ABC and $\angle$ DCB
AB = DC (opposite sides of parallelogram are equal)

BC = BC (Common)

AC = DB (Given)

$\triangle ABC \cong \triangle DCB$ are congruent to each other by SSS congruency.

therefore $\angle$ ABC = $\angle$ DCB (CPCT)

Now, AB $\parallel$ BC

And BC is a transversal Therefore $\angle$ B + $\angle$ C = 180 $\deg$(interior angles on the same side of transversal are supplementary)

$\angle$B + $\angle$B = 180 $/deg$

2$\angle$B = 180 $\deg$

$\angle$B = 90 $\deg$

AD=DC

Therefore $\angle$ DAC= $\angle$ DCA

Termux commands :

```
python3 matrixline.py
```

The input parameters for this construction are

Symbol	Value	Description
r	6	AC
k	4	AB
θ	arccos(k/r)	$\angle$AC
A	$\begin{pmatrix} 0 \\ 0 \end{pmatrix}$	Point A

To Prove:
ABCD is a rectangle

Given

$$\mathbf{AC} = \mathbf{BD} \tag{1}$$

By Triangle law of vector addition

$$\mathbf{AC} = \mathbf{AD} + \mathbf{DC} \tag{2}$$
$$= \mathbf{AD} - \mathbf{CD} \tag{3}$$
$$= \mathbf{BC} - \mathbf{CD} \tag{4}$$
$$\mathbf{BD} = \mathbf{BC} + \mathbf{CD} \tag{5}$$
$$\tag{6}$$

$$\mathbf{a1} = \mathbf{C} - \mathbf{B} \tag{7}$$
$$\mathbf{a2} = \mathbf{C} - \mathbf{D} \tag{8}$$

'Angle between vectors a1,a2 is given by

$$\cos\theta = \frac{(\mathbf{D} - \mathbf{C})^T(\mathbf{C} - \mathbf{B})}{\|(\mathbf{B} - \mathbf{C})\|\|(\mathbf{C} - \mathbf{D})\|} \tag{9}$$
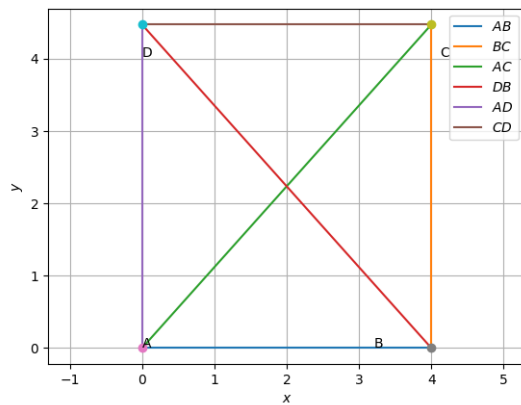
$$cos\theta = 0 \tag{10}$$
$$\theta = 90 \deg \tag{11}$$

$\therefore$ It is a rectangle

3   Construction

Figure of Construction

The below python code realizes the above construction:
https://github.com/Rahulraj00/Assignments/tree/main/
Assignments/assg_4