PYTHON PROGRAMMING ON MATRICES

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IITH Future Wireless Communication (FWC)

FWC22011 Matrix:Circle

Contents

1 Problem

If one of the diameters of the circle, given by the equation, $x^2 + y^2 - 4x + 6y - 12 = 0.$, is a chord of a circle S, whose centre is at (-3, 2),Then find the radius of S.

2 Construction

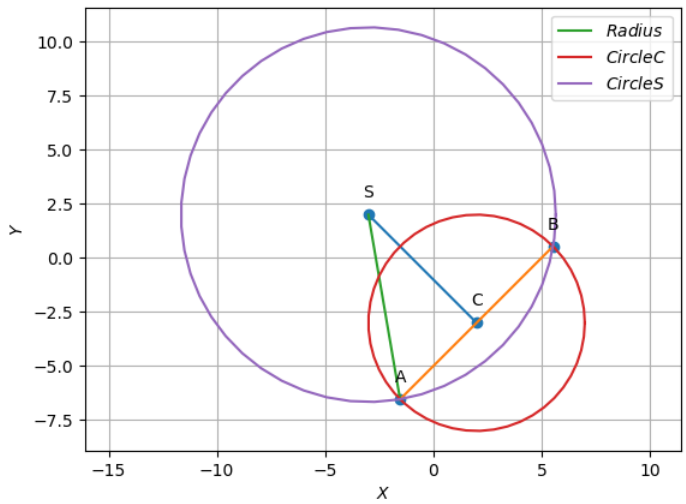

Figure of construction

The steps for constructing above figure are :

1. Generate a circle of radius r with centre $\mathbf{C}$.
2. Locate center of another circle as $\mathbf{S}$,Join $\mathbf{C}$ and $\mathbf{S}$.
3. Find the Directional vector which is orthogonal to $\mathbf{S} - \mathbf{C}$ say $\mathbf{m}$.
4. Find the points of intersection of a line $\mathbf{x} = \mathbf{q} + \mu\mathbf{m}$ with conic passing through $\mathbf{C}$,say $\mathbf{A}$ and $\mathbf{B}$.
5. Generate a circle of radius $\|S - A\|$ or $\|S - B\|$ with centre $\mathbf{S}$.

The input parameters for this construction are

Symbol	Value	Description
$\mathbf{C}$	$\begin{pmatrix} 2 \\ -3 \end{pmatrix}$	center of circle $\mathbf{C}$
$\mathbf{S}$	$\begin{pmatrix} -3 \\ 2 \end{pmatrix}$	center of circle $\mathbf{S}$
r	5	Radius of circle $\mathbf{C}$

Theorem: A line drawn from the centre of a circle to bisect a chord is perpendicular to the chord.

Baudhayana Theorem:In a right-angled triangle, the square of the hypotenuse is equal to the sum of the squares of the other two sides.

$$In \triangle SCA : \angle SCA = 90° \tag{4}$$

By baudhayana theorem,

$$\|\mathbf{S} - \mathbf{A}\|^2 = \|\mathbf{A} - \mathbf{C}\|^2 + \|\mathbf{S} - \mathbf{C}\|^2 \tag{5}$$

$\|\mathbf{S} - \mathbf{A}\|$ gives the radius of circle $\mathbf{S}$.
$\therefore$ Radius of circle $\mathbf{S}$ =5$\sqrt{3}$

termux commands :

```
bash circle.sh............using shell command
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3 Solution

Given circle equation : $x^2 + y^2 - 4x + 6y - 12 = 0$
The standard equation of the conics is given as :

$$\mathbf{x}^\top\mathbf{x} + 2\mathbf{u}^\top\mathbf{x} + f = 0 \tag{1}$$

The given circle can be expressed in conics as

$$\mathbf{u} = \begin{pmatrix} -2 \\ 3 \end{pmatrix}, f = -12 \tag{2}$$

Radius and Centre are

$$r = \sqrt{\mathbf{u}^\top\mathbf{u} - f}, \mathbf{C} = -u \tag{3}$$

Below python code realizes the above construction :

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https://github.com/FWC_module1/blob/main/
matrices/circle/codes/circle.py
```