Matrix Project

EE1390- Intro to AI and ML

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Outline

JEE Question

Q. Find the Equation of the circle, which is mirror image of the circle

$\mathbf{x}^T\mathbf{x}$ - $\begin{pmatrix}2 & 0\end{pmatrix}\mathbf{x} = 0$

and the line

$\begin{pmatrix}1 & 1\end{pmatrix}\mathbf{x} = 3$

Solution

THE BASIC IDEA OF THIS APPROACH IS TO FIND THE CENTRE OF THE CIRCLE FROM THE GIVEN EQUATION, AND FINDING IT'S REFLECTION IN THE LINE AS THE REFLECTION OF A CIRCLE IS A CIRCLE WITH EQUAL RADIUS, WE KNOW THAT THE ONLY THING TO FIND IS THE REFLECTION OF CENTRE AND PLOT A CIRCLE OF EQUAL RADIUS AROUND IT. THIS IS THE REFLECTED CIRCLE.

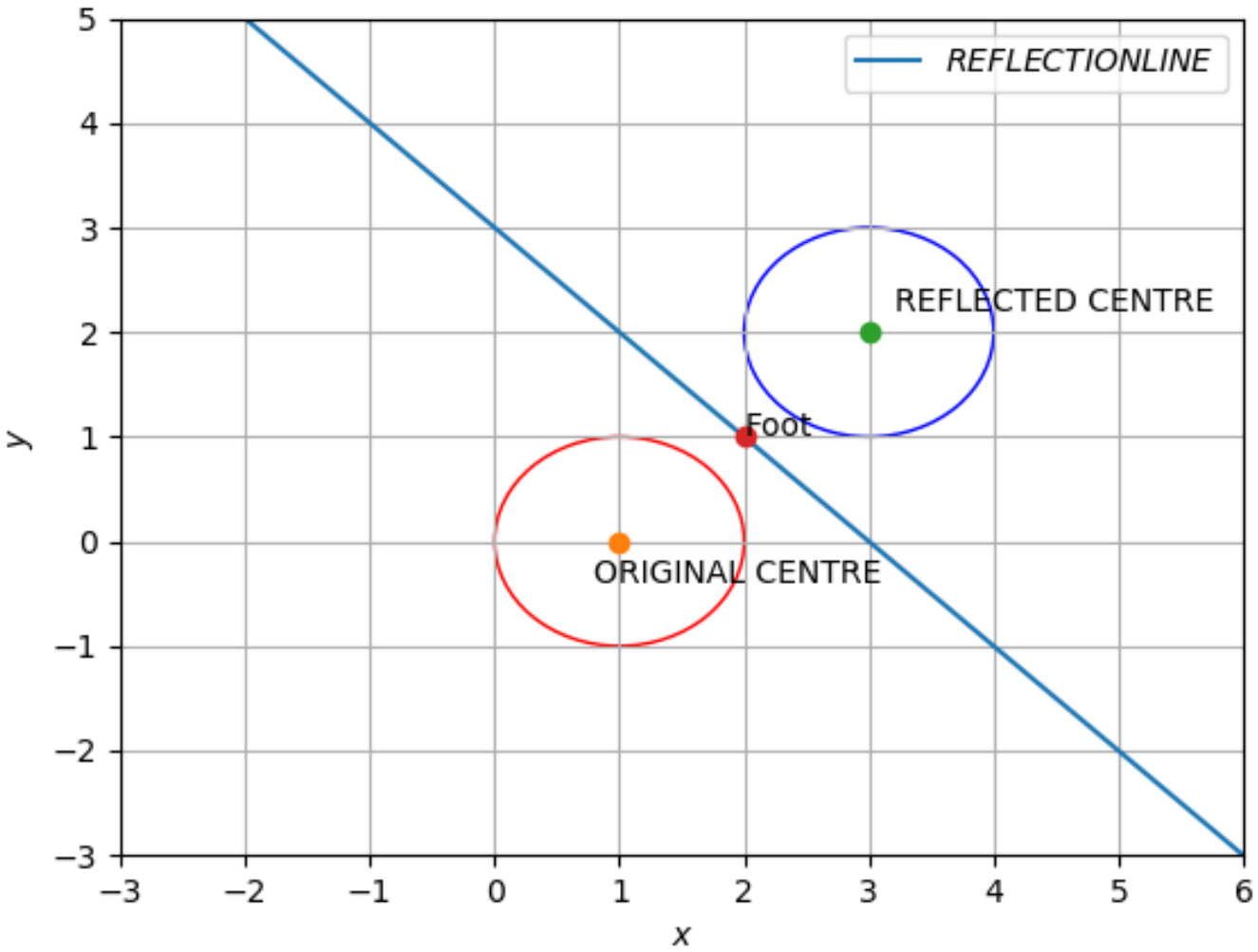
Solution

As the equation of the circle is $\mathbf{x}^\intercal\mathbf{x}$ - $\begin{pmatrix}2 & 0\end{pmatrix}\mathbf{x} = 0$,its centre is $1/2 * \begin{pmatrix}2 & 0\end{pmatrix} = \begin{pmatrix}1 & 0\end{pmatrix}$ Equation of given line is $\mathbf{n_1}^\intercal\mathbf{x} = p_1$, Here $n_1 = \begin{pmatrix}1 & 1\end{pmatrix}$ *and* $p_1 = 3$ And let the equation of line passing through centre of circle and perpendicular to the given line be $\mathbf{n_2}^\intercal\mathbf{x} = p_2$ Now that can be written as $\begin{pmatrix}\mathbf{n_1}^\intercal \\ \mathbf{n_2}^\intercal\end{pmatrix}\mathbf{x} = \begin{pmatrix}p1 \\ p2\end{pmatrix}$ or $\mathbf{N}^\intercal\mathbf{x} = \mathbf{p}$ and $\mathbf{x} = (\mathbf{N}^\intercal)^{-1}\mathbf{p}$ which is the point of intersection of the given line and the normal to the circle which is also normal to the given line.

Solution

Now, $2 * \mathbf{x} - \mathbf{C}$ Where C is the centre of the given circle would give us the reflection of the centre of the given circle.
And now since we know that Radius of the Circle won't change in reflection. Circle can be easily plotted by using the centre and radius

Graphical representation



Final Slide

THANK YOU