EE5609: Matrix Theory
Assignment-4

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***Abstract*—This document contains a solution determine whether the points lie on a circle.**

Download the python codes from latex-tikz codes from

https://github.com/pavanmanesh/EE5609/tree/master/Assignment4

1 PROBLEM

Without drawing a figure, determine whether the points $\begin{pmatrix}-1\\2\end{pmatrix}$, $\begin{pmatrix}0\\0\end{pmatrix}$, $\begin{pmatrix}3\\-4\end{pmatrix}$ lie outside, on the circumference, or inside the circle

$$\mathbf{x}^T\mathbf{x} + \begin{pmatrix}-5 & 2\end{pmatrix}\mathbf{x} - 5 = 0 \tag{1.0.1}$$

2 SOLUTION

The equation of circle with center c can be expressed as

$$\mathbf{x}^T\mathbf{x} - 2\mathbf{c}^T\mathbf{x} + f = 0 \tag{2.0.1}$$

Comparing (2.0.1) with (1.0.1)

$$\mathbf{c} = \begin{pmatrix}\frac{5}{2}\\-1\end{pmatrix}, f = -5 \tag{2.0.2}$$

$$r = \sqrt{\|\mathbf{c}\|^2 - f} = \sqrt{\frac{49}{4}} \tag{2.0.3}$$

1) Let a= $\begin{pmatrix}-1\\2\end{pmatrix}$

$$\|\mathbf{a}-\mathbf{c}\| = \sqrt{\frac{49}{4}+9} = \sqrt{\frac{84}{4}} \implies \|\mathbf{a}-\mathbf{c}\| > r \tag{2.0.4}$$

Point a is outside the circle

2) Let b= $\begin{pmatrix}0\\0\end{pmatrix}$

$$\|\mathbf{b}-\mathbf{c}\| = \sqrt{\frac{25}{4}+1} = \sqrt{\frac{29}{4}} \implies \|\mathbf{a}-\mathbf{c}\| < r \tag{2.0.5}$$

Point b is inside the circle.

3) Let d= $\begin{pmatrix}3\\-4\end{pmatrix}$

$$\|\mathbf{d}-\mathbf{c}\| = \sqrt{\frac{1}{4}+9} = \sqrt{\frac{37}{4}} \implies \|\mathbf{d}-\mathbf{c}\| < r \tag{2.0.6}$$

Point d is inside the circle.

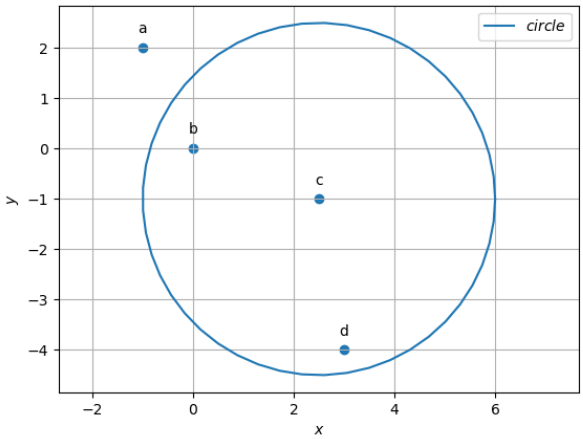

Fig. 3: Points a,b,d in the circle with center c