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

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

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

2 SOLUTION

The equation of circle with center c can be expressed as

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

Comparing (2.0.1) with (1.0.1)

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

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

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

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

Point a is outside the circle

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

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

Point b is inside the circle.

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

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

Point d is inside the circle.