INTRO TO AI/ML

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QUESTION IN MATRIX FORM:

Find the equation of the tangent to the circle, at the point $\begin{bmatrix} 1 \\ -1 \end{bmatrix}$

whose centre is the point of intersection of the straight lines

- $(2,1)\,\mathbf{x} = 3$
- $(1,-1)\,\mathbf{x} = 1$

QUESTION IN 2D FORM:

Find the equation of the tangent to the circle, at the point (1,-1) whose centre is the point of intersection of the straight lines

- ► $2x + y = 3$
- ► $x - y = 1$

APPROACH (USING VECTORS) :

$A = (1, -1)$

$\mathbf{n}_1^T = (2, 1)$

$\mathbf{n}_2^T = (1, -1)$

$p_1 = 3$

$p_2 = 1$

Let

$\mathbf{n}_1^T \mathbf{x} = p_1$

$\mathbf{n}_2^T \mathbf{x} = p_2$

$\begin{bmatrix} \mathbf{n}_1^T \\ \mathbf{n}_2^T \end{bmatrix} \mathbf{x} = p$

$\mathbf{N} = (\mathbf{n}_1, \mathbf{n}_2)$

$\mathbf{x} = (\mathbf{N}^T)^{-1} p$

$\mathbf{x} = (\mathbf{N}^{-T}) p$

$C = \begin{bmatrix} 1/3, 1/3 \\ 1/3, -2/3 \end{bmatrix} * \begin{bmatrix} 3 \\ 1 \end{bmatrix}$

The point of intersection is center C: $(4/3, 1/3)$

m (Direction vector of line joining centre and A) $= A - C$

n $=$

normalvectoroflinejoiningcentreandAanddirectionvectoroftangent

$\mathbf{n}^T \mathbf{m} = 0$

$\mathbf{n} = \begin{bmatrix} 0, 1 \\ -1, 0 \end{bmatrix} \mathbf{m} = \begin{bmatrix} 4/3 \\ -1/3 \end{bmatrix}$

$\mathbf{R} = \mathbf{A} + \lambda * \mathbf{m}$

R vector traces the line on changing the value of λ

Hence the equation of the line is:

$(4, -1)\mathbf{x} = 5$