

# INTRO TO AI/ML

AAYUSH ARORA(EE17BTECH11003)  
AAKASH DASWANI(EE17BTECH11002)

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## QUESTION:

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

- ▶  $(2,1) \ x = 3$
- ▶  $(1,-1) \ x = 1$

## 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

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

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

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

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

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

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

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

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

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

**n** = normal vector of line joining centre and A and direction vector of tangent

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

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

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

R vector traces the line on changing the value of  $\lambda$

Hence the equation of the line is:

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