INTRODUCTION TO AI AND ML

EE1390

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

$$2x + y = 3 \qquad\qquad (1)$$

,

$$x - y = 1 \qquad\qquad (2)$$

Que. Find 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

$$\begin{bmatrix} 2 & 1 \end{bmatrix} X = 3$$

$$\begin{bmatrix} 1 & -1 \end{bmatrix} X = 1$$

$$\begin{bmatrix} 2 & 1 \end{bmatrix} \begin{bmatrix} x \\ y \end{bmatrix} = 3$$

$$\begin{bmatrix} 1 & -1 \end{bmatrix} \begin{bmatrix} x \\ y \end{bmatrix} = 1$$

$$\begin{bmatrix} 2 & 1 \\ 1 & -1 \end{bmatrix} \begin{bmatrix} x \\ y \end{bmatrix} = \begin{bmatrix} 3 \\ 1 \end{bmatrix}$$

$$\begin{bmatrix} x \\ y \end{bmatrix} = \begin{bmatrix} -1 & -1 \\ -1 & 2 \end{bmatrix} \begin{bmatrix} 3 \\ 1 \end{bmatrix}$$

$x = 4/3 = a$ (3)

Let 'O' be the center of the circle and 'P' be the point at which tangent is to be drawn,

$$O = \begin{bmatrix} a \\ b \end{bmatrix} = \begin{bmatrix} 4/3 \\ 1/3 \end{bmatrix} \tag{5}$$

$$P = \begin{bmatrix} 1 \\ -1 \end{bmatrix} \tag{6}$$

$$OP = r = ||O - P|| \tag{7}$$

$$OP^2 = r^2 = (a-1)^2 + (b+1)^2 \tag{8}$$

$$r^2 = (1/3)^2 + (4/3)^2 = 17/9 \tag{9}$$

Equation of circle:

$$XX^T + \begin{bmatrix} -8/3 \\ -2/3 \end{bmatrix} X = 0 \tag{10}$$

Parametric form of circle:

$$\begin{bmatrix} x \\ y \end{bmatrix} = \begin{bmatrix} 4/3 \\ 1/3 \end{bmatrix} + r \begin{bmatrix} cos(\theta) \\ sin(\theta) \end{bmatrix} \tag{11}$$

$0 < \theta < 2\pi$
Equation of circle:

$$x^2 + y^2 - 8/3x - 2/3y = 0 \tag{12}$$

Direction vector of radius = Direction of normal vector of the tangent:

$$OP = r = \begin{bmatrix} 1/3 \\ 4/3 \end{bmatrix} \qquad (13)$$

Equation of tangent;

$$\begin{bmatrix} 1/3 & 4/3 \end{bmatrix} X = -1 \qquad (14)$$

Hence, equation of tangent is:

$$x + 4y + 3 = 0 \qquad (15)$$

Direction vector of tangent = normal of radius vector

$$\begin{bmatrix} 0 & 1 \\ -1 & 0 \end{bmatrix} \begin{bmatrix} 1/3 \\ 4/3 \end{bmatrix} = \begin{bmatrix} 4/3 \\ -1/3 \end{bmatrix} \tag{16}$$
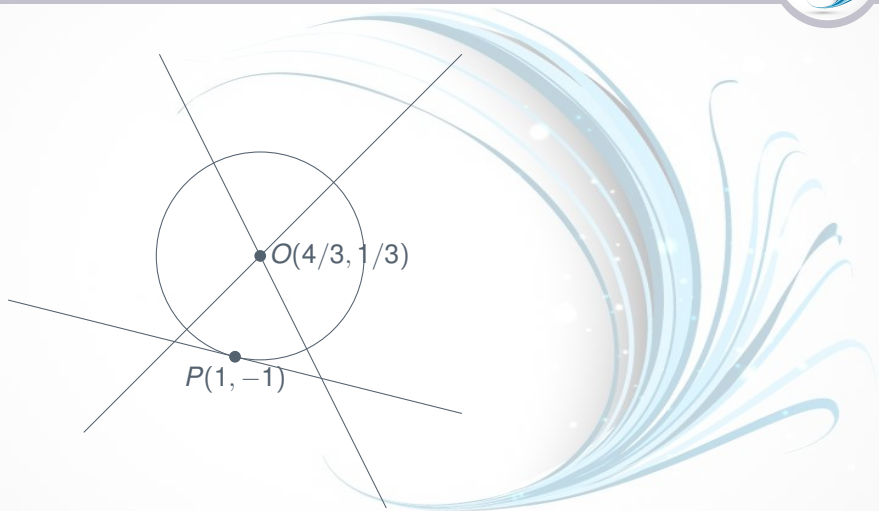
$O(4/3, 1/3)$

$P(1, -1)$