

# LINE ASSIGNMENT

G.Kumar

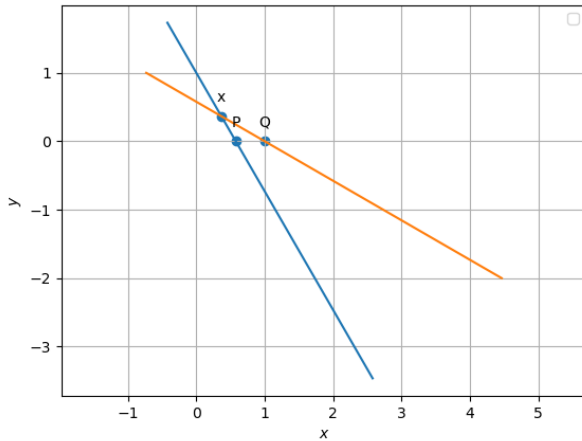
kumargandhamaneni20016@gmail.com

IITH - Future Wireless Communication (FWC)

## Problem

Find angle between the lines,  $\sqrt{3}x+y=1$  and  $x+\sqrt{3}y=1$ .

## Solution



The input parameters for this construction are :

Symbol	Value	Description
P	$\begin{pmatrix} 0.57736 \\ 0 \end{pmatrix}$	Point P
X	$\begin{pmatrix} 0.36603 \\ 0.36603 \end{pmatrix}$	Point X
Q	$\begin{pmatrix} 1 \\ 0 \end{pmatrix}$	Point Q

### Step 1

Given two equations are,

$$\sqrt{3}x + y = 1 \quad (1)$$

$$x + \sqrt{3}y = 1 \quad (2)$$

Equation(1) in vector form is given as,

$$(\sqrt{3} \ 1) \mathbf{x} = 1 \quad (3)$$

From this, Normal vector to the line is given as,

$$\mathbf{n}_1 = \begin{pmatrix} \sqrt{3} \\ 1 \end{pmatrix}$$

So, the direction vector of the line is given as,

$$\mathbf{m}_1 = \begin{pmatrix} -1 \\ \sqrt{3} \end{pmatrix}$$

Similarly, Normal vector to the line(2) is given as,

$$\mathbf{n}_2 = \begin{pmatrix} 1 \\ \sqrt{3} \end{pmatrix}$$

So, the direction vector of the line is given as,

$$\mathbf{m}_2 = \begin{pmatrix} -\sqrt{3} \\ 1 \end{pmatrix}$$

### Step 2

Now, Angle between any two lines, using their direction vectors, is given by,

$$\cos\theta = \frac{(\mathbf{m}_1)^T(\mathbf{m}_2)}{\|\mathbf{m}_1\|\|\mathbf{m}_2\|}$$

So, Angle between the two lines is given by,

$$\cos\angle x = \frac{(\mathbf{m}_1)^T(\mathbf{m}_2)}{\|\mathbf{m}_1\|\|\mathbf{m}_2\|} \quad (4)$$

$$\cos\angle x = \frac{\begin{pmatrix} -1 \\ \sqrt{3} \end{pmatrix}^T \begin{pmatrix} -\sqrt{3} \\ 1 \end{pmatrix}}{\left\| \begin{pmatrix} -1 \\ \sqrt{3} \end{pmatrix} \right\| \left\| \begin{pmatrix} -\sqrt{3} \\ 1 \end{pmatrix} \right\|} \quad (5)$$

By solving the above equation, we get,

$$\cos\angle x = \frac{\sqrt{3}}{2} \quad (6)$$

This Implies,

$$\angle x = 30^\circ$$

Therefore, the angle between given two lines is  $30^\circ$ .