

# Assignment 1

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CE20RESCH13001

## PROBLEM II (2I)

Find the distance between points (7,6) and (4,5) with the axes at  $60^\circ$

### 1 SOLUTION

Let the points be  $P_1 (7,6)$  and  $P_2 (4,5)$  and also the angle between axes is  $60^\circ$

$$\mathbf{P}_1 = \begin{pmatrix} 4 \\ 5 \end{pmatrix}; \mathbf{P}_2 = \begin{pmatrix} 7 \\ 6 \end{pmatrix} \quad (1.0.1)$$

The problem can be solved by transformation of the given coordinate system to the rectangular coordinate system.

In order to convert to rectangular coordinate system, the y-axis should be rotated by  $30^\circ$  in anti-clockwise and x-axis will remain unaltered.

Let the projections of points  $P_1$  and  $P_2$  on x-axis and y-axis of angular axes be  $X_1, X_2$  and  $Y_1, Y_2$  respectively.

Let x&y ordinates of the points  $P_1$  &  $P_2$  on rectangular axes be  $X_3, X_4$  &  $Y_3, Y_4$  respectively.

From the Fig1,  $\angle P_1 X_1 X_3 = \angle P_2 X_2 X_4 = 60^\circ$  and  $\angle Y_1 O Y_3 = \angle Y_2 O Y_4 = 30^\circ$ .

$$OX_3 = OX_1 + X_1 X_3 = 4 + X_1 P_1 \cos 60^\circ = 4 + 5\left(\frac{1}{2}\right) = \frac{13}{2}$$

$$OX_4 = OX_2 + X_2 X_4 = 7 + X_2 P_2 \cos 60^\circ = 7 + 6\left(\frac{1}{2}\right) = 10$$

$$OY_3 = OY_1 \cos 30^\circ = \frac{5\sqrt{3}}{2}$$

$$OY_4 = OY_2 \cos 30^\circ = \frac{6\sqrt{3}}{2} = 3\sqrt{3}$$

The transformed coordinates of points  $P_1, P_2$  are as follows,

$$\mathbf{P}_1 = \begin{pmatrix} \frac{13}{2} \\ \frac{5\sqrt{3}}{2} \end{pmatrix}; \mathbf{P}_2 = \begin{pmatrix} 10 \\ 3\sqrt{3} \end{pmatrix}$$

Now, obtained points are in the rectangular coordinate system and the distance vector between points will be

$$\mathbf{P}_{12} = \mathbf{P}_2 - \mathbf{P}_1 = \begin{pmatrix} 10 \\ 3\sqrt{3} \end{pmatrix} - \begin{pmatrix} \frac{13}{2} \\ \frac{5\sqrt{3}}{2} \end{pmatrix} = \begin{pmatrix} \frac{7}{2} \\ \frac{\sqrt{3}}{2} \end{pmatrix}$$

and the magnitude will be  $\|\mathbf{P}_2 - \mathbf{P}_1\|$

Therefore, the distance between the points is equal to  $\sqrt{13}$  units

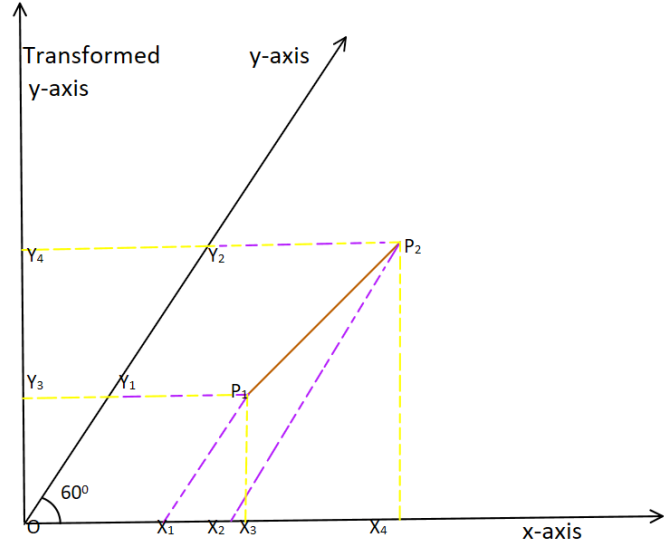


Fig1: Points defined on angular & rectangular axes

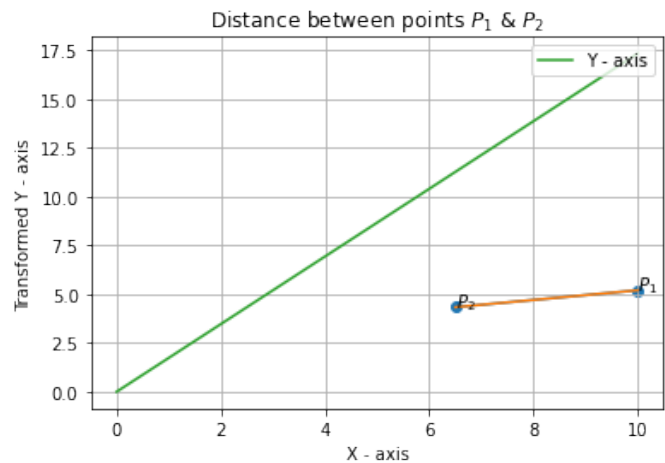


Fig2: Points plotted in Python