

PROBLEM

	x_1	x_2
S-1	1	1
S-2	1	2
S-3	2	2
S-4	8	8
S-5	8	9
S-6	9	8

For x_1

① Calculate Centroid. - 1

$$\frac{1 + 2 + 8 + 9}{4} = 5 \cdot (x_1)$$

② Centroid - 2.

$$\frac{1 + 8}{2} = \frac{9}{2} = 4.5 (x_1)$$

Assume $k = 2$. [no. of clusters]

$$C_1 = \{2, 3, 4, 5, 6\}$$

$$C_2 = \{1, 8\}$$

After 1st iteration

$$C_1 = \{4, 5, 6\}$$

$$C_2 = \{1, 2, 3\}$$

For x_2

$$\textcircled{1} \text{ C-1} = \frac{2 + 2 + 8 + 8}{4} = \frac{20}{4} = 5 (x_2)$$

$$\textcircled{2} \text{ C-2} [9 + 1] = \frac{10}{2} = 5 (x_2)$$

Step - ② Calculate euclidean distance. [S-1]

$$d_{S-1, \text{C-1}} = \begin{bmatrix} 5-1 \\ 5-1 \end{bmatrix} \begin{bmatrix} 4^2 \\ 4^2 \end{bmatrix} = \sqrt{\begin{bmatrix} 16 \\ 16 \end{bmatrix}} = \sqrt{32} = 5.65$$

$$d_{S-1, \text{C-2}} = \begin{bmatrix} 4.5-1 \\ 4.5-1 \end{bmatrix} \begin{bmatrix} (3.5)^2 \\ (3.5)^2 \end{bmatrix} = \begin{bmatrix} 12.25 \\ 12.25 \end{bmatrix} = \sqrt{24.5} = 4.94$$

Since $4.94 < 5.65$, so put sample - 1 in.

cluster 2

Step - ③ Calculate euclidean distance for [S-2]. using centroid.

$$C_1 \Rightarrow d_{S-2} = \begin{bmatrix} 5-1 \\ 5-2 \end{bmatrix} \begin{bmatrix} 4^2 \\ 3^2 \end{bmatrix} = \sqrt{4^2 + 3^2} = \sqrt{25} = 5$$

$$C_2 \Rightarrow d_{S-2} = \begin{bmatrix} 4.5-1 \\ 5-2 \end{bmatrix} \begin{bmatrix} 3.5^2 \\ 3^2 \end{bmatrix} = \sqrt{3.5^2 + 3^2} = \sqrt{21} = 4.58$$

→ Since $4.58 < 5 (C_1)$, so put sample ② in cluster 2

Calculate distance of S-3

$$d_{S-3}(C_1) = \begin{bmatrix} 5-2 \\ 5-2 \end{bmatrix} = \sqrt{3^2 + 3^2} = \sqrt{9+9} = \sqrt{18} = 4.24$$

$$d_{S-3}(C_2) = \begin{bmatrix} 4.5-2 \\ 4.5-2 \end{bmatrix} = \sqrt{2.5^2 + 2.5^2} = \sqrt{12.5} = 3.53$$

Since $3.53 < 4.24$ Sample - 3 will go in cluster - 2

Calculate distance S4

$$d_{S-4}(C_1) = \begin{bmatrix} 5-8 \\ 5-8 \end{bmatrix} = \sqrt{3^2 + 3^2} = \sqrt{18} = 4.25$$

$$d_{S-4}(C_2) = \begin{bmatrix} 4.5-8 \\ 4.5-8 \end{bmatrix} = \sqrt{3.5^2 + 3.5^2} = \sqrt{12 \cdot 25 + 12 \cdot 25} = \sqrt{24 \cdot 25} = 4.36$$

∴ Since $4.25 < 4.36$ Sample 4 will go to cluster - 1

Calculate distance S5

$$d_{S-5}(C_1) = \begin{bmatrix} 5-8 \\ 5-9 \end{bmatrix} = \sqrt{3^2 + 4^2} = \sqrt{9+16} = \sqrt{25} = 5$$

$$d_{S-5}(C_2) = \begin{bmatrix} 4.5-8 \\ 4.5-9 \end{bmatrix} = \sqrt{3.5^2 + 4.5^2} = \sqrt{12.25 + 20.25} = \sqrt{32.5} = 5.700$$

∴ Since $5 < 5.70$, Sample 5 will go to cluster - 1

Calculate distance S6

$$d_{S6}(C_1) = \begin{bmatrix} 5-9 \\ 5-8 \end{bmatrix} = \sqrt{4^2 + 3^2} = \sqrt{16+9} = \sqrt{25} = 5$$

$$d_{S6}(C_2) = \begin{bmatrix} 4.5-9 \\ 4.5-8 \end{bmatrix} = \sqrt{4.5^2 + 3.5^2} = \sqrt{20.25 + 12.25} = \sqrt{32.5} = 5.700$$

∴ Since $5 < 5.7$, Sample 6 will go to cluster - 1