**Example**

Lets consider we have cluster points P1(1,3) , P2(2,2) , P3(5,8) , P4(8,5) , P5(3,9) , P6(10,7) , P7(3,3) , P8(9,4) , P9(3,7).

First, we take our K value as 3 and we assume that our Initial cluster centers are P7(3,3), P9(3,7), P8(9,4) as C1, C2, C3. We will find out the new centroids after 2 iterations for the above data points.

**Solution**

Find the distance between data points and Centroids. which data points have a minimum distance that points moved to the nearest cluster centroid.



**Iteration 1**

Calcualte the distance between data points and K (C1,C2,C3)

C1P1 =>(3,3)(1,3) => sqrt[(1–3)²+(3–3)²] => sqrt[4] =>2

C2P1 =>(3,7)(1,3)=> sqrt[(1–3)²+(3–7)²] => sqrt[20] =>4.5

C3P1 =>(9,4)(1,3) => sqrt[(1–9)²+(3–4)²]=> sqrt[65] =>8.1

For P2,

C1P2 =>(3,3)(2,2) => sqrt[(2–3)²+(2–3)²] => sqrt[2] =>1.4

C2P2 =>(3,7)(2,2)=> sqrt[(2–3)²+(2–7)²] => sqrt[26] =>5.1

C3P2 =>(9,4)(2,2) => sqrt[(2–9)²+(2–4)²]=> sqrt[53] =>7.3

For P3,

C1P2 =>(3,3)(5,8) => sqrt[(5–3)²+(8–3)²] => sqrt[29] =>5.3

C2P2 =>(3,7)(5,8)=> sqrt[(5–3)²+(8–7)²] => sqrt[5] =>2.2

C3P2 =>(9,4)(5,8) => sqrt[(5–9)²+(8–4)²]=> sqrt[32] =>5.7

Similarly for other distances..

Table

Description automatically generated

Cluster 1 => P1(1,3) , P2(2,2) , P7(3,3)

Cluster 2 => P3(5,8) , P5(3,9) , P9(3,7)

Cluster 3 => P4(8,5) , P6(10,7) , P8(9,4)

Now, We re-compute the new clusters and the new cluster center is computed by taking the mean of all the points contained in that particular cluster.

New center of Cluster 1 => (1+2+3)/3 , (3+2+3)/3 => 2,2.7

New center of Cluster 2 => (5+3+3)/3 , (8+9+7)/3 => 3.7,8

New center of Cluster 3 => (8+10+9)/3 , (5+7+4)/3 => 9,5.3

Iteration 1 is over. Now, let us take our new center points and repeat the same steps which are to calculate the distance between data points and new center points with the Euclidean formula and find cluster groups.

**Iteration 2**

Calcualte the distance between data points and K (C1,C2,C3)

C1(2,2.7) , C2(3.7,8) , C3(9,5.3)

C1P1 =>(2,2.7)(1,3) => sqrt[(1–2)²+(3–2.7)²] => sqrt[1.1] =>1.0

C2P1 =>(3.7,8)(1,3)=> sqrt[(1–3.7)²+(3–8)²] => sqrt[32.29] =>4.5

C3P1 =>(9,5.3)(1,3) => sqrt[(1–9)²+(3–5.3)²]=> sqrt[69.29] =>8.3

Similarly for other distances..

Table

Description automatically generated

Cluster 1 => P1(1,3) , P2(2,2) , P7(3,3)

Cluster 2 => P3(5,8) , P5(3,9) , P9(3,7)

Cluster 3 => P4(8,5) , P6(10,7) , P8(9,4)

Center of Cluster 1 => (1+2+3)/3 , (3+2+3)/3 => 2,2.7

Center of Cluster 2 => (5+3+3)/3 , (8+9+7)/3 => 3.7,8

Center of Cluster 3 => (8+10+9)/3 , (5+7+4)/3 => 9,5.3

We got the same centroid and cluster groups which indicates that this dataset has only 2 groups. K-Means clustering stops iteration because of the same cluster repeating so no need to continue iteration and display the last iteration as the best cluster groups for this dataset.

The Below graph explained the difference between iterations 1 and 2. We can see centroids (green dot) changed in the 2nd Iteration.

Chart, bubble chart

Description automatically generated