SNS COLLEGE OF TECHNOLOGY

Coimbatore-35
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DEPARTMENT OF COMPUTER APPLICATIONS

23CAT702 – MACHINE LEARNING

II YEAR III SEM

UNIT III – DISTANCE-BASED MODELS

TOPIC 20 – Clustering around Medoids

What is k-Medoid

K-Medoids (also called Partitioning Around Medoid) algorithm was proposed in 1987 by Kaufman and Rousseeuw. A medoid can be defined as a point in the cluster, whose dissimilarities with all the other points in the cluster are minimum. The dissimilarity of the medoid(Ci) and object(Pi) is calculated by using E = |Pi – Ci|

Algorithm

1.Initialize: select *k* random points out of the *n* data points as the medoids.

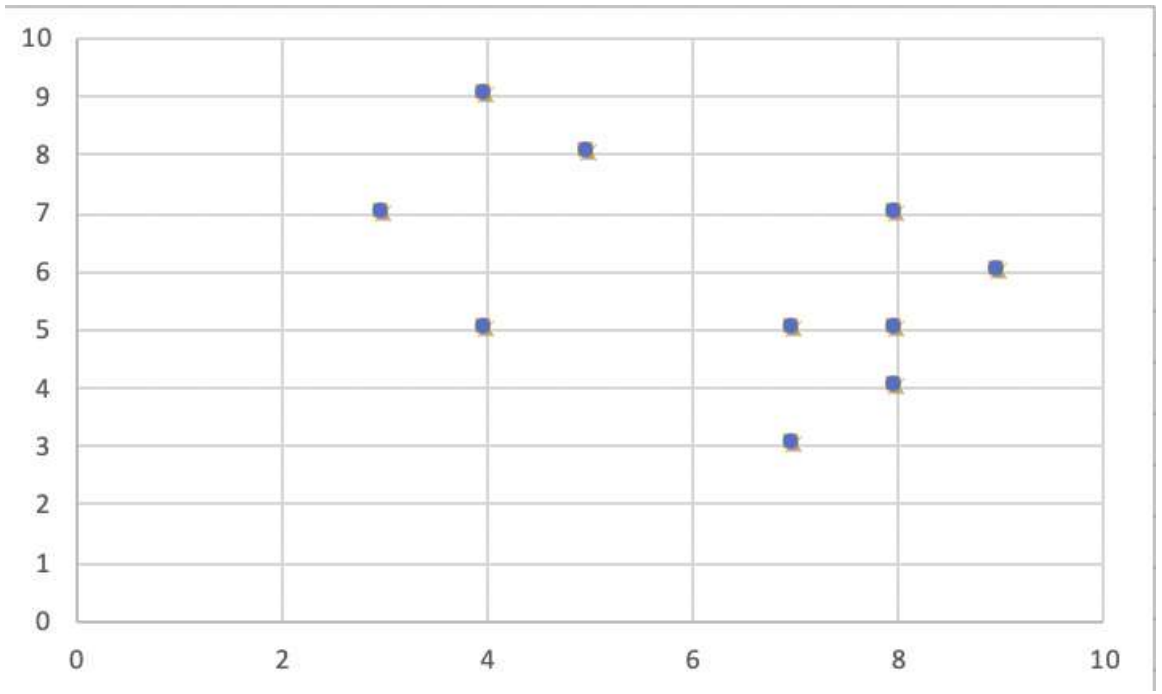
2.Associate each data point to the closest medoid by using any common distance metric methods.

3.While the cost decreases: For each medoid m, for each data o point which is not a medoid:

1. Swap m and o, associate each data point to the closest medoid, and recompute the cost.
2. If the total cost is more than that in the previous step, undo the swap.

Example

	X	Y
0	8	7
1	3	7
2	4	9
3	9	6
4	**8**	**5**
5	5	8
6	7	3
7	8	4
8	7	5
9	**4**	**5**



Step 1: Let the randomly selected 2 medoids, so select k = 2, and let **C1 -(4, 5)** and **C2 -(8, 5)** are the two medoids.

Example…

Step 2: Calculating cost. The dissimilarity of each non-medoid point with the medoids is calculated and tabulated:

	X	Y	Dissimilarity from C1	Dissimilarity from C2
0	8	7	6	2
1	3	7	3	7
2	4	9	4	8
3	9	6	6	2
4	8	5	-	-
5	5	8	4	6
6	7	3	5	3
7	8	4	5	1
8	7	5	3	1
9	4	5	-	-

Here we have used Manhattan distance formula to calculate the distance matrices between medoid and non-medoid points. That formula tell that **Distance = |X1-X2| + |Y1-Y2|.**

Each point is assigned to the cluster of that medoid whose dissimilarity is less. Points 1, 2, and 5 go to cluster C1 and 0, 3, 6, 7, 8 go to cluster C2. The Cost = (3 + 4 + 4) + (3 + 1 + 1 + 2 + 2) = 20

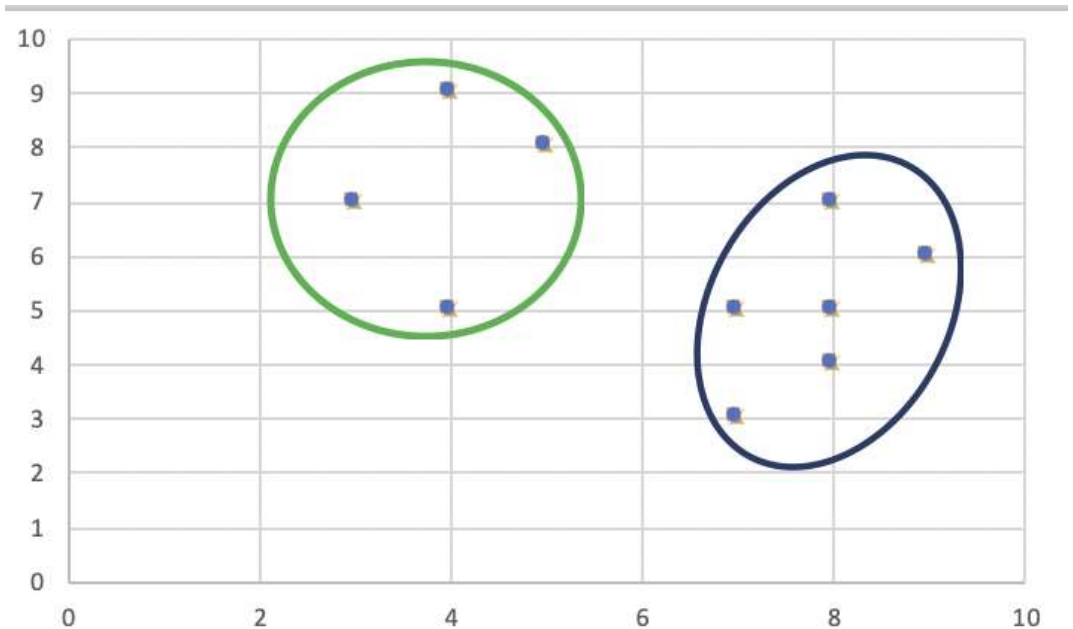
Example…

Step 3: randomly select one non-medoid point and recalculate the cost. Let the randomly selected point be (8, 4). The dissimilarity of each non-medoid point with the medoids – C1 (4, 5) and C2 (8, 4) is calculated and tabulated.

	X	Y	Dissimilarity from C1	Dissimilarity from C2
0	8	7	6	3
1	3	7	3	8
2	4	9	4	9
3	9	6	6	3
4	8	5	4	1
5	5	8	4	7
6	7	3	5	2
7	8	4	-	-
8	7	5	3	2
9	4	5	-	-

Example…

Each point is assigned to that cluster whose dissimilarity is less. So, points 1, 2, and 5 go to cluster C1 and 0, 3, 6, 7, 8 go to cluster C2. The New cost = (3 + 4 + 4) + (2 + 2 + 1 + 3 + 3) = 22 Swap Cost = New Cost – Previous Cost = 22 – 20 and **2 >0** As the swap cost is not less than zero, we undo the swap. Hence (4, 5) and (8, 5) are the final medoids.



Advantages:

- It is simple to understand and easy to implement.
- K-Medoid Algorithm is fast and converges in a fixed number of steps.
- PAM is less sensitive to outliers than other partitioning algorithms.

References

1. Tutorial - Tutorial with introduction of Clustering Algorithms (k-means, fuzzy-c-means, hierarchical, mixture of gaussians) + some interactive demos (java applets).

2. Digital Image Processing and Analysis-byB.Chanda and D.Dutta Majumdar.

3. H. Zha, C. Ding, M. Gu, X. He and H.D. Simon. "Spectral Relaxation for K-means Clustering", Neural Information Processing Systems vol.14 (NIPS 2001). pp. 1057-1064, Vancouver, Canada. Dec. 2001.

4. J. A. Hartigan (1975) "Clustering Algorithms". Wiley.

5. J. A. Hartigan and M. A. Wong (1979) "A K-Means Clustering Algorithm", Applied Statistics, Vol. 28, No. 1, p100-108.

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7. D. Arthur, S. Vassilvitskii: "k-means++ The Advantages of Careful Seeding" 2007 Symposium on Discrete Algorithms (SODA).

8. www.wikipedia.com

Thank You