SNS COLLEGE OF ENGINEERING

Kurumbapalayam (Po), Coimbatore – 641 107

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DEPARTMENT OF COMPUTER SCIENCE AND ENGINEERING-IoT Including CS & BCT

COURSE NAME :19SB701 PATTERN RECOGNITION TECHNIQUES IN CYBER CRIME

IV YEAR / VII SEMESTER

Unit III- **NONPARAMETRIC TECHNIQUE AND NON-METRIC METHODS**

Topic :Fuzzy Clustering

Fuzzy Clustering

Fuzzy Clustering is a type of clustering algorithm in machine learning that allows a data point to belong to more than one cluster with different degrees of membership.

Unlike traditional clustering algorithms, such as k-means or hierarchical clustering, which assign each data point to a single cluster, fuzzy clustering assigns a membership degree between 0 and 1 for each data point for each cluster.

The steps to perform the algorithm are:

Step 1: Initialize the data points into the desired number of clusters randomly.

Let us assume there are 2 clusters in which the data is to be divided, initializing the data point randomly. Each data point lies in both clusters with some membership value which can be assumed anything in the initial state.

The table below represents the values of the data points along with their membership (gamma) in each cluster.

Cluster	(1, 3)	(2, 5)	(4, 8)	(7, 9)
1)	0.8	0.7	0.2	0.1
2)	0.2	0.3	0.8	0.9

Step 2: Find out the centroid.
The formula for finding out the centroid (V) is:

$$V_{ij} = (\sum_{1}^{n}(\gamma_{ik}^{m} * x_k) / \sum_{1}^{n} \gamma_{ik}^{m}$$

Where, **μ is fuzzy membership value** of the data point, **m is the fuzziness parameter** (generally taken as 2), and **xk is the data point.**
Here,

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V11  = (0.8^2 *1 + 0.7^2 * 2 + 0.2^2 * 4 + 0.1^2 * 7) / ( (0.8^2 + 0.7^2  +
0.2^2  + 0.1^2 ) = 1.568
V12  = (0.8^2 *3 + 0.7^2 * 5 + 0.2^2 * 8 + 0.1^2 * 9) / ( (0.8^2 + 0.7^2  +
0.2^2  + 0.1^2 ) = 4.051
V21  = (0.2^2 *1 + 0.3^2 * 2 + 0.8^2 * 4 + 0.9^2 * 7) / ( (0.2^2 + 0.3^2  +
0.8^2  + 0.9^2 ) = 5.35
V22  = (0.2^2 *3 + 0.3^2 * 5 + 0.8^2 * 8 + 0.9^2 * 9) / ( (0.2^2 + 0.3^2  +
0.8^2  + 0.9^2 ) = 8.215
```

Centroids are: (1.568, 4.051) and (5.35, 8.215)

Step 3: Find out the distance of each point from the centroid.

$$D11 = ((1 - 1.568)^2 + (3 - 4.051)^2)^{0.5} = 1.2$$
$$D12 = ((1 - 5.35)^2 + (3 - 8.215)^2)^{0.5} = 6.79$$

Similarly, the distance of all other points is computed from both the centroids.

Step 4: Updating membership values.

$$\gamma = \sum_{1}^{n} (d_{ki}^2 / d_{kj}^2)^{1/m-1}]^{-1}$$

For point 1 new membership values are:

γ_{11}= [{ [$(1.2)^2$ / $(1.2)^2$] + [$(1.2)^2$ / $(6.79)^2$]} ^ {(1 / (2 – 1))}] $^{-1}$ = 0.96

γ_{12}= [{ [$(6.79)^2$ / $(6.79)^2$] + [$(6.79)^2$ / $(1.2)^2$]} ^ {(1 / (2 – 1))}] $^{-1}$ = 0.04

Alternatively,

$$\gamma_{12} = 1 - \gamma_{11} = 0.04$$

Similarly, compute all other membership values, and update the matrix.

Step 5: Repeat the steps(2-4) until the constant values are obtained for the membership values or the difference is less than the tolerance value (a small value up to which the difference in values of two consequent updations is accepted).

Step 6: Defuzzify the obtained membership values.

Any Query????

Thank you……