

# Multi Class Classification Using Holistic Non-Unique Clustering

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## Technical Note

### Abstract

In this research technical Note the author have presented a novel method to find all Possible Clusters given a set of M points in N Space.

### Theory

Given  $M$  number of points  $\bar{x}_i \in R^N$ ,  $i = 1$  to  $M$ , each belonging to  $R^N$ , we first find the Proximity Matrix  $P_{ij}$  for each ( $M$  number of) point with each of all ( $M$  Number of points) points, inclusive of itself. The Proximity can be found using Euclidean distance or using the concept stated in [1]. We now find the *Proximity Full Contrast Ratio*

$\delta_{\frac{Min}{Max}} = \frac{Min(P_{ij})}{Max(P_{ij})}$  with only those values of  $P_{ij} \neq 0$ . Now, we consider any

$P(i, j)$  which are  $\left(\frac{M^2 - M}{2}\right)$  in number as The Proximity Matrix is

Symmetric and also all the diagonal elements are equal to zero, and

compute the distance  $d\left\{P(i, j), \delta_{\frac{Min}{Max}}\right\} = P(i, j) \pm \left(\delta_{\frac{Min}{Max}}\right)(P(i, j))$ . Now, we

consider any point  $\bar{x}_i \in R^N$  and find all points (inclusive of  $\bar{x}_i$ ) that have

at least one neighbouring point within the distance  $d\left\{P(i, j), \delta_{\frac{Min}{Max}}\right\}$ ,

considered among themselves. We say that all such points form one

Cluster. In this fashion, we can find at most  $\binom{M^2 - M}{2}$  number of overlapping Clusters where the membership of a point may not be unique to a given Cluster. We call this type of Clustering as Holistic Non-Unique Clustering. Also, we can consider, all possible Proximity Contrast Ratio's among the  $\binom{M^2 - M}{2}$  number of unique elements in the Proximity Matrix and can get at most  $2^{\binom{M^2 - M}{2}}$  number of overlapping Clusters for each of the  $\binom{M^2 - M}{2} C_2$  number of possible Proximity Contrast Ratio's Possible. Therefore, we can see at most  $2^{\left\{ \binom{M^2 - M}{2} C_2 \right\}} \binom{M^2 - M}{2}$  number of clusters for the given Set of M Points.

Here, the *Proximity Contrast Ratio* can be defined as *Proximity Contrast Ratio*

$$\delta_{\substack{i,j \\ l,m}} = \frac{P(i,j)}{P(l,m)}$$

with only those values of  $P_{ij} \neq 0$  and  $i = 1$  to  $M$ ,  $j = 1$  to  $M$  with  $(i, j) \neq (l, m)$ , i.e.,  $i \neq l$  and  $j \neq m$  simultaneously, they can be equal. Also,  $l = 1$  to  $M$ ,  $m = 1$  to  $M$ .

### Advantages

This theory can be used for multi class classification, wherein an entity of concern may belong to more than one class.

### References

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