**Combination of neighborhood-based algorithm and soft clustering for collaborative filtering**

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**Abstract**

**1. Introduction**

(Nguyen & Shafiq, Mixture Regression Model for Incomplete Data, 2018)

(Ungar & Foster, 1998)

**2. Methodology**

The main problem of neighborhood-based algorithm is how to determine an appropriate set of *k*-top neighbors, which causes two drawbacks:

1. Time cost is high because it is necessary to calculate similarities of rating vectors over entire rating matrix in order to determine high enough similarities corresponding to *k*-top neighbors.
2. The set of *k*-top neighbors is affected by biases in calculate similarities with existence of missing values.

This research proposes a method of the combination of neighborhood-based algorithm and soft clustering in order to alleviate two drawbacks of traditional neighborhood-based algorithm. The proposed method has two main steps:

1. Soft clustering by mixture model and expectation maximization (EM) algorithm, in which probability of rating vectors is modeled by multinomial distribution. Hence, missing values are denoted by special nominal value (NaN).
2. Applying neighborhood-based algorithm into each cluster instead of entire rating matrix as before.

The proposed method is called clustered neighborhood (CN) algorithm. By partitioning rating matrix into many clusters, CN algorithm reduces searching space for traditional neighborhood-based algorithm. As a result, the time cost is reduced too, which alleviates the first drawback of neighborhood-based algorithm. Moreover CN algorithm determines clusters based on probabilistic distribution and statistical estimation, which avoids biases in calculate similarities with existence of missing values. As a result, the second drawback of CN algorithm is alleviated. Note that CN algorithm does not use hard clustering with distance measures to determine clusters because rating vectors contain missing values in incomplete dataset. When distance measures can be considered as inverses of similarity measures, it is easy to recognize that CN algorithm is also combination of numerical calculation and probabilistic calculation. Hence, in CN algorithm, probabilistic calculation is for soft clustering and numerical calculation is for making prediction on missing value.

**3. Experimental design**

**4. Result and discussion**

**5. Conclusion**

**References**

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