

Recommendation System Using Collaborative Filtering Algorithm Using Mahout

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Abstract: In decision making regarding an item/person recommendation system helps people. Increase in World Wide Web and E-commerce are the channel for recommendation system. Due to large size of data, recommendation system suffers from scalability problem. One of the solutions for this problem is Hadoop. Collaborative filtering is a machine learning algorithm and Mahout is an open source java library which favors collaborative filtering on Hadoop environment.

Keywords: Collaborative Filtering, Distributed System, Hadoop, Machine Learning, Mahout, Map-Reduce

I. INTRODUCTION

In growing world, as time is on its heel, people do not want to go shop by shop and buy the best item according to their requirement. To save time, everyone wants to buy things in home in reasonable cost. They prefer online shopping, online suggestion for an item, so that they can take a decision on a particular item which may be suitable for a particular. In such scenario Recommendation System plays a vital role. When the questions are "Whether I will like this item", "I want to buy an item of a particular type which suits according to my taste", "Can you suggest me an item which we may like?", the feasible answers can be obtained through recommendation system. It helps in recommending items of a similar type as well as predicting an item, whether it will be liked by user or not.

For recommendation, our proposed system uses collaborative filtering machine learning algorithm. Collaborative filtering (CF) is a machine learning algorithm which is widely used for recommendation purpose. Collaborative filtering finds nearest neighbor based on the similarities. The metric of collaborative filtering is the rating given by the user on a particular item. Different users give different ratings to items. Users, who give almost same rating to items, are the nearest neighbors. In case of User based collaborative filtering, based on the ratings given by the users, nearest neighbors has been find. Item based collaborative filtering predicts the similarity among items. To recommend an item, items which are liked by the user in his past have been found. Item which is similar to those items has been recommended [5].

Internet contains a huge volume of data for recommendation purpose. Due to size of data, if recommendation computation has been done in single system, then performance may degrade, and we cannot find an efficient solution. Hence we require distributed environment so that computation can be increased and performance of recommendation system gets improve. An open source cloud environment Hadoop provides distributed environment [3]. Due to Map-Reduce programming, it provides result efficiently and effectively in less amount of time [2]. Proposed system has been modeled on Hadoop.

Mahout is an open source java library which favors Collaborative Filtering. Mahout favors Hadoop for recommendation.

II. RELATED WORK

Zhi-Dan Zhao and Ming-Sheng Shang [9] have used based Collaborative Filtering using Hadoop as distributed framework. The approach is scalable but the response time taken for a single user could not be reduced. Carlos E. Seminario a David C. Wilson [10] use Mahout for recommendation. Use of mahout for Collaborative Filtering has enhanced the accuracy.

Xiao Yan Shi, Hong Wu Ye and Song Jie Gong [23] integrated user based and item based collaborative filtering algorithm to increase performance. Manos Papagelis and Dimitris Plexousakis [11] did qualitative analysis on user based and item based collaborative filtering with implicit and explicit ratings. According to their analysis, prediction based on explicit rating is better than implicit rating. Trouong Khanh Quan, Ishikawa Fuyuki, Honiden Shinichi [12] clustered the items on stability of user similarity and applied Collaborative Filtering. Final clustering of the items may be locally optimal but the prediction accuracy has been increased.

Yanhong Guo, Xuefen Cheng, Dahai Dong, Chunyu Luo and Rishuang Wang [16] used CF based on trust factor. For calculating similarities Cosine correlation and Pearson correlation has been used. They found that CF based on trust factor is better than traditional CF. Mustansar Ali Ghazanfar and Adam Prugel Bnnett [19] had built hybrid recommendation system which combines the rating, feature and demographic information of item. Yajie Hu, Ziqi Wang, Wei Wu, Jianzhong Guo and Ming Zhang [22] used Semantic distance measurement and considered the features of movie. They are able to give a list of recommended movie along with stars of that movie. Dhoha Almazro, Ghadeer Shahatah, Lamia Albbulkarim, Mona Kherees, Romy Martinez and William Nzoukou [13] collected Demographic information of user, clustered all items and then combined both user-based and item-based.

Hee Choon Lee, Seok Jun Lee, Young Jun Chung [14] did a study on improved Collaborative filtering algorithm. They have used Neighborhood CF (NBCFA), Correspondence mean algorithm (CMA). They found that the preference prediction performance of CMA is better than NBCFA. Kai Yu, Xiaowei Xu, Jianhua Tao, Martin Aster and EansPeter Kriegel [17] proposed instance selection techniques for memory based collaborative filtering. It reduces the storage requirement of training data, but there is scalability problem for big data. Alexandros Karatzoglou, Alex Smola and Markus Weimer [21] proposed CF with hashing using ℓ_1 -intensive loss function, Huber loss function. This model can be scaled to bigger data-set on large server and to still data-set on small machines, but time complexity is the problem. Aristomenis S. Lampropoulos and George A. Tsihrantzis [7] did survey on recommendation machine learning algorithms. Sarwar B. et al.[5], Mukund Deshpande et al.[6] and Badrul Sarwar et al.[20] worked on item based collaborative filtering for recommendation.

III. PROPOSED SYSTEM

This paper is focusing to customize a recommendation system using Collaborative Filtering (CF) and clustering techniques. For our approach, we use Apache Hadoop (a widely used open source platform which implements Map-Reduce programming model) and Apache Mahout (An Open source library of scalable data mining algorithms, where it forms a core of the distributed recommender module). The proposed algorithm is worked in two parts. In first phase, we obtain the results for recommendation by applying User-based CF and Item-based CF separately. In second phase, we combine the results obtain from user-based CF and item-based CF.

3.1 User Based CF

The dataset is firstly loaded into Hadoop distributed file system (HDFS). Then we perform User-based CF using Mahout.

We take rating matrix, in which each row represents user and column represents item, corresponding row-column value represents rating which is given by a user to an item. Absence of rating value indicates that user has not rated the item yet. There are many similarity measurement methods to compute nearest neighbors. We have used Pearson correlation coefficient to find similarity between two users. Hadoop is used to calculate the similarity. The output of the Hadoop Map phase i.e. userid and corresponding itemid are passed to reduce phase. In reduce phase, output has been generated and sorted according to userid. Output again has been stored in HDFS. The architecture diagram for User-based CF can be shown in Figure 1.

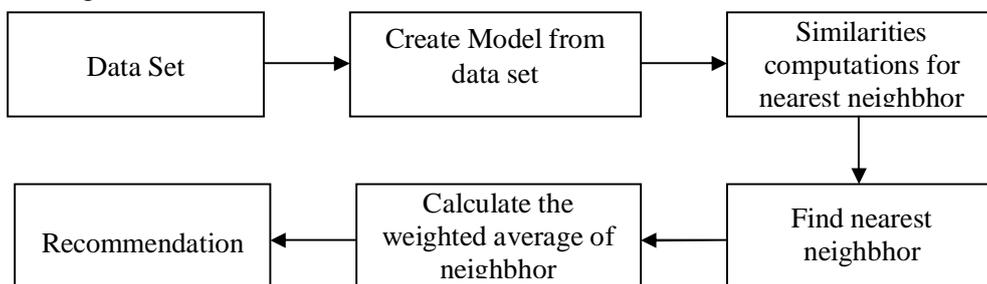


Figure 1: User-based Collaborative Filtering

3.2 Item Based CF

Dataset is loaded into HDFS, then using Mahout we performs Item-based CF. Past information of the user, i.e. the ratings they gave to items are collected. With the help of this information the similarities between items are built and inserted into item to item matrix. Algorithm selects items which are most similar to the items rated by the user in past. In next step, based on top-N recommendation, target items are selected. The processing of Item-based CF can be shown in Figure 2.

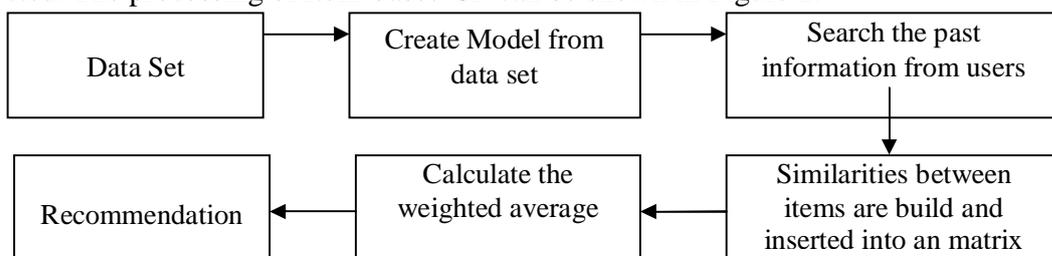


Figure 2: Item-based Collaborative Filtering

3.3 Combined Result

In case of user-based CF, if nearest neighbors (similar users) are not in enough number, i.e. taste of target user is not similar to many users then the recommending an item for that particular user may be not accurate. Item-based CF is based on the past information of the user, so it works well in such cases. The user-based and item-based results that are stored in HDFS are taken and then we combine these results based on threshold value. Suppose the threshold by increasing threshold value, probability of recommending correct item get increases because it has been liked by many users. Flow can be seen in Figure 3.

IV. EXPERIMENT AND RESULT

4.1 Dataset

For experiment, we have used MovieLens dataset of size 1M. The dataset contains 10000054 ratings and 95580 tags applied to 10681 movies by 71567 users. There are three files, movies.dat, ratings.dat and tags.dat. Ratings data file has atleast three columns; those are UserId, given by user to movie.

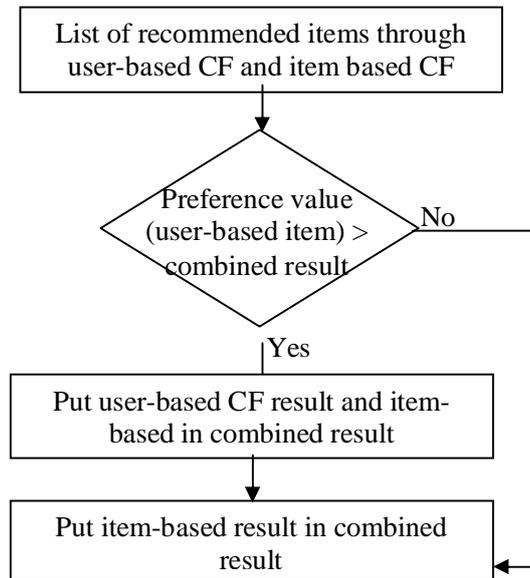


Figure 3: Item-based Collaborative Filtering

4.2 Result Analysis

For movie recommendation, important factor is the list of recommended items as soon as possible. Since we are using Hadoop, speedup and efficiency varies as number of nodes varies. To analyze this we have obtained the number of movies which are recommended as threshold changes, Speedup and efficiency according to number of nodes.

4.3 Movies versus Threshold

Threshold value indicates minimum number of users who like an item which has to be recommended. It means when we increase threshold, accuracy in recommending an item increases because more number of users like that item. When the threshold value increases, the number of items recommended by the users will be reduced. Even though that value is too small, it is the relevant one. Hence such items can be readily recommended to users without any further processes. Comparison graph based on threshold value is given by Figure 4.

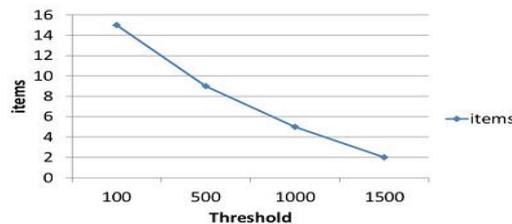


Fig: 4: Comparison graph based on Threshold value

4.4 Speed Up

Speedup is the measure of the performance. It is defined as the ratio between sequential execution time and the parallel execution time.

$$\text{Speed Up} = T(1) / T(b)$$

where T(1) states the execution time taken by single processor. T(b) is the execution time taken by 'b' no. of processor. While running algorithm in Hadoop framework, speedup varies as numbers of nodes vary. As we increase no of nodes, speedup increases. It can be seen in Figure 5.

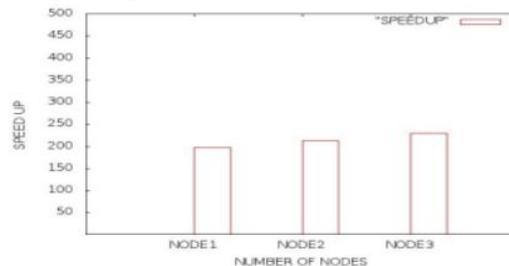


Fig 5: Speed Up with respect to no. of nodes

4.5 Efficiency

It is denoted as the usage of the computational resources. This is the ration between the speedup and no. of processors.

$$\text{Efficiency Ratio} = T(1) / b.T (b)$$

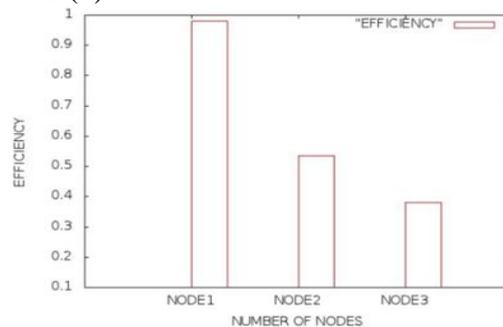


Fig 6: Efficiency with respect to no. of nodes

From the above graph (figure 6) it is visible that if the number of processors is one, the efficiency increases because that processor is fully utilized for the particular program. When the processors increases the efficiency decreases, that means we can utilize the processors for different purposes. This is the one main advantage of the distributed system.

CONCLUSION

This paper presented combined Collaborative Filtering using Mahout on Hadoop for movie recommendation. By combining User-based and Item-based CF, accuracy of the results gets improve. Hadoop has increased throughput. Because of multiple computer nodes, time taken for solving problem has been reduced. Mahout is feasible for handling large amount of structured data. But now a day's data are more unstructured. Hadoop using Mahout can handle big data statistically. To handle real time data randomly, HBASE, HIVE are the better solutions.

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