A Sequential Ranking Approach for Improving Recommendation Diversity

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ABSTRACT

Nowadays it is becoming very critical to find the relevant information in online information system. Recommended systems are introduced to deal with the problem of decision making from large amount of information. Recommended systems are used widely in e-commerce applications, as in Amazon and Netflix, and in social networking sites like Facebook etc. There are a lot of techniques for making recommendations. In this paper we have focused on techniques to improve aggregate diversity while maintaining accuracy to improve the recommendations by taking movie databases. The diversity increases with the recommended techniques employing various real-world data sets.

I. INTRODUCTION

The growth of the Internet has made it much more difficult to effectively extract useful information from all the available online information [1]. This problem is not only wide. Recommendation technology help users to deal with these information systems, and are used for research studies and also in many e-commerce applications like flipkart, myntra, e-bay and in social networking sites like face book etc.

Recommender systems are a subclass of information filtering systems that predict the ‘rating’ or ‘preference’ that user would give to an item such as music, books, or movies or social element e.g. people or groups they had not yet considered, using a model built from the characteristics of an item or the user's social environment. Since large amount of data is added to information system day by day these recommendations help users to choose new items which were best and suitable for their requirements.

Recommender systems predict the ratings of unknown items for each user using other users ratings, and recommend top N items with the highest predicted ratings. There are many studies on developing algorithms to improve rating predictions the quality of recommender system is evaluated in many dimensions, and not only the accurate recommendations are sufficient to find most relevant items for users individually. The importance of diversity in recommendations has been investigated several studies. It increases sales by recommending items and it allows users to make decisions such as which item to buy. The goal of recommender systems is to provide a user with highly distinct and diverse recommendations to give more options for users to get recommended such items. There is an inverse relationship between accuracy and diversity. Diversity should be increased by having minimal loss in accuracy [1]. Recommendation can not only be given to single product, it also allows recommending collection of products [2] [3].

In contrast to individual diversity, which has been explored in a number of papers, some recent studies started examining the impact of recommender systems on sales diversity by considering aggregate diversity of recommendations across all users. Where aggregate diversity is retrieved to recommendation list across all users.

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II. LITERATURE SURVEY

Recommendation engine understand user’s needs and provides good recommendations list in which items in the top are highly relevant to user’s needs. User’s preferences are analyzed by RS and it constructs a relationship model between items and users. User’s interests are input to RS whereas output will be list of recommendations. In order to provide users with different recommendations which are related to their requirement there have been many techniques. This section briefly describes about various recommendation techniques to improve diversity while maintaining certain level of accurate recommendations.

1. Neighbourhood Based CF Technique

There exist multiple variations of neighborhood-based CF techniques [5] [6]. In this paper, to estimate $R(u, i)$, i.e., the rating that user $u$ would give to item $i$, we first compute the similarity between user $u$ and other user’s using a cosine similarity metric. Based on the similarity calculation, set of nearest neighbours of user $u$ is obtained. A neighborhood-based CF technique can be user-based or item-based, depending on whether the similarity is calculated between users or items. In this paper, we used both user-based and item-based approaches for rating estimation.

2. Item Popularity Ranking

Standard ranking approach [4] ranks item from high predicted rating to lowest ones. This ranking approach ranks items directly based on their popularity, from lowest to highest, here the popularity is represented by the number of known ratings that each item has. The item popularity-based ranking approach can increase recommendation diversity; however, recommendation accuracy drops. Besides the diversity gain, such a accuracy loss would not be acceptable in most real-life personalization applications. Therefore, we introduce a general technique to parameterize recommendation ranking approaches, which allows achieving diversity gains while controlling accuracy losses.

3. Parameterized Ranking

All ranking approaches proposed in this paper are parameterized with “ranking threshold” $TR[TH, Tmax]$ where $Tmax$ is the largest possible rating to allow user to choose a certain level of accurate recommendations. Given any ranking function $rankX(i)$, ranking threshold $TR$ is used for creating the parameterized version of this ranking function. The items that are predicted above ranking threshold $TR$ are ranked according to $rankX(i)$, while items that are below $TR$ are ranked according to the standard ranking approach $rankStandard(i)$. In addition, all items that are above $TR$ get ranked ahead of all items that are below $TR$. Thus, increasing the ranking threshold $TR[TH, Tmax]$ towards $Tmax$ would enable choosing the most highly predicted items resulting in more accuracy and less diversity.

4. Item Average Absolute Relative Ranking

This ranking technique ranks items according to an average of all known ratings for each item and is computed by the $rankAvgRating$. Similarly, the relationship between predicted rating values and item absolute (or relative) likeability, also suggests that the items with lower likeability, on average, are more likely to have lower predicted rating values likely representing less popular movies and, thus, could be recommended for better diversity. In the Item Absolute Likeability, i.e., ranks items according to how many users liked them i.e., rated the item above $TH$. In the Item Relative Likeability, i.e., ranks items according to the percentage of the users who liked an item among all users who rated it are computed by $rankRelLike$.

5. Item Rating Variance, Neighbour Rating Variance

In this ranking technique we give ranking for items according to each item’s rating variance i.e., ranking items according to the rating variance of neighbors of a particular user for a particular item. In neighbor’s rating variance the closest neighbors of user $u$ among the users who rated the particular item $i$, denoted by $u^*$, are chosen from the set of $U(i)$ and is computed by $rankNeighborVar$.

6. Random Ranking Technique

This technique uses random uniform distribution. The more highly predicted items, on average, tend to be among the more popular items. While the proposed ranking approaches improve the diversity by considering alternative item ranking functions, such as item popularity, we found that reranking the candidate items at random can provide diversity improvements. Here, we defined the random ranking as uniform distribution function where $Random(0, 1)$ is a function that generates uniformly distributed random numbers in the $[0, 1]$ interval.
III. PROPOSED SYSTEM

All the techniques described above resulted in maintaining accuracy but not reached to provide certain diversity gain. In this section, we introduce new techniques of sequential ranking which provides recommendation with diverse items.

1. Sequential Item Likability

In this module, we have ranking items according to an average of all known ratings for each item sequence and is computed by the $\text{rankSeqRating}$. Similar movies which form item sequences and, thus, be recommended for better diversity.

$$\text{rank}(i) = \sum_{i \in j} |U_H(i), \text{where } U_H(i) = \{u \in U(i) | R(u, i) \geq T_H\}$$

2. Enhanced Sequential Ranking Approach

In the sequential ranking approach, once the user makes her choice, a new list of recommended items is presented. Thus, the recommendation process is a sequential process. Moreover, in many domains, user choices are sequential in nature. The main enhancement in using sequential ranking approach is that it is a novel approach to recommender systems based on a DP (Decision Process) model together with appropriate initialization and solution techniques and a novel predictive model that outperforms previous predictive models. Our first step is to construct a predictive model of user purchases, that is, a model that can predict what item the user will buy next. This model does not take into account its influence on the user, as it does not model the recommendation process and its effects. Nonetheless, we shall use a recommendation chain, with an appropriate formulation of the state space, as our model. This information corresponds to previous choices made by users in the form of a set of ordered sequences of selection. Thus, the set of states contains all possible sequences of user selections. Of course, this formulation leads to an unmanageable state space with the usual associated problems.

IV. RESULT & DISCUSSION

The concept of this paper is implemented and different results are shown below. The proposed paper is implemented in Java technology on a Pentium-IV PC with 20 GB hardisk and 256 MB RAM with apache web server. The propose paper’s concepts show efficient results and has been efficiently tested on different datasets. The Fig 1, Fig 2 shows the real time results compared with different number of neighbors.

<table>
<thead>
<tr>
<th>Item Popularity</th>
<th>Parameterized Ranking</th>
<th>Item Absolute Likeability</th>
<th>Item Relative Likeability</th>
</tr>
</thead>
<tbody>
<tr>
<td>Taxi Driver (1976)</td>
<td>5.0</td>
<td>Fargo (1996)</td>
<td>5.0</td>
</tr>
<tr>
<td>Precision</td>
<td></td>
<td>Precision</td>
<td></td>
</tr>
<tr>
<td>(Accuracy): 0.03225386451612903</td>
<td>15.5</td>
<td>(Accuracy): 0.7223806451612903</td>
<td>Diversity: 15.5</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Neigh Rating Variance</th>
<th>Random Ranking</th>
<th>Sequential Ranking</th>
</tr>
</thead>
<tbody>
<tr>
<td>20,000 Leagues Under the Sea (1954)</td>
<td>5.0</td>
<td>Taxi Driver (1976)</td>
</tr>
<tr>
<td>Seven (Sc7eaa) (1995)</td>
<td>3.3378994302724816</td>
<td>Four Rooms (1995)</td>
</tr>
<tr>
<td>Precision (Accuracy): 0.006451361252728046</td>
<td>Precision (Accuracy): 0.01953483870867742</td>
<td>Precision (Accuracy): 0.23923592595292924</td>
</tr>
<tr>
<td>Diversity: 15.5</td>
<td>Diversity: 15.5</td>
<td>Diversity: 27.9</td>
</tr>
</tbody>
</table>

fig1: when N=25, the accuracy and diversity
### A Sequential Ranking Approach for Improving Recommendation Diversity

#### Fig2: when N=35, the accuracy and diversity

#### V. CONCLUSION

In recent years Recommender systems have made significant progress; many techniques have been proposed to improve the performance of recommendations in recommended systems. In many cases techniques were improved in order to increase recommendation accuracy but increment of diversity is left untouched. We showed that in many techniques, while ranking recommendations according to the predicted rating values recommender systems provides good predictive accuracy, but performs poorly with recommendation diversity. Therefore, in this paper, we proposed a sequential ranking recommendation ranking technique that can improve recommendation diversity with only a small amount of accuracy loss. That is to overcome trade off accuracy and diversity[7]. In addition, this ranking technique offer flexibility to system designers, since they are parameterizable and randomized can be used in conjunction with different rating prediction algorithms (i.e., they do not require the designer to use only some specific algorithm). More-over, recommendations can be done based on reviews or suggestions of customer or manufacturer of products. They are also based on scalable sorting based heuristics and, thus, are extremely efficient.

#### REFERENCES

A Sequential Ranking Approach for Improving Recommendation Diversity

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