Group Inspired Single-User Collaborative Filtering

Michal Kompan*
Institute of Informatics and Software Engineering
Faculty of Informatics and Information Technologies
Slovak University of Technology in Bratislava
Ilkovičova 3, 842 16 Bratislava, Slovakia
kompan@fiit.stuba.sk

Abstract

Personalized recommendation is well researched area, but the group recommendation still needs to be explored. In this paper we propose an idea of approach for the single user recommendation based on the principles of the group recommendation. We explore several setting of such an approach in order to the group size or the number of similar users used for the recommendation. Experiments are performed over the standard MovieLens dataset and proposed approach is compared to the standard collaborative recommender. Obtained results support hypothesis that proposed approach brings statistically significant improvement and thus can be used for the standard recommendation.

Categories and Subject Descriptors

H.3.3 [**Information Storage and Retrieval**]: Information Search and Retrieval; D.3.4 [**Information Storage and Retrieval**]: Systems and Software—*user profiles and alert services*

Keywords

Group recommendation, collaborative recommendation, virtual communities

1. Introduction

Personalized recommendation is intensively studied area in the last years. The need for the web adaptation increases day by day as users are experiencing information overload. Similarly, the second side - business tries to increase profits or visits of web sites. Personalised recommendation is the most used approach to satisfy both - users and business.

Historically, several approaches have been proposed for the recommendation task. The content-based recommendation uses the similarity between recommended items. The similarity can be computed based on several aspects as simple text similarity, or various enhancements for specific domains as news have been proposed [4], [9]. The second and still more and more used approach is collaborative recommendation [8]. This approach instead of content similarity takes advantage of user's similarity, which is usually computed based on user's rating or user's context [10]. While these approaches are designed for the single-user environment, in the last years the phenomenon of social networking and mobile devices bring us to the increasing demand for recommendations designed for groups of users. In the group recommendation we use inter-group relations in order to provide sufficient recommendation for the whole group.

Various approaches for the personalized recommendation have been proposed in the literature. Hand by hand with the social activity over the web increase; the group recommendation is more popular and researched. Most of the proposed approaches deal with the TV or music domain, as these are activities which are usually performed in the group of users. The classic example of such a system is MusicFX [7], which was designed to influence a music played in the gym by actual present users. Intrigue [1] recommends tourist information around Torino city and thus helps to plan tour, which is interesting for the whole group of visitors.

In this paper we propose an idea of the novel approach of usage the group recommendation approach to generate recommendations for single-user environment. Our hypothesis is that, including such principles of group recommendation can bring variety of generated recommendations and thus improve the quality of recommendation.

The paper is organized as follows. In section 2 we provide a short introduction into the group recommendation, the idea of proposed approach is described in section 3. The evaluation we performed is described in section 4.

2. Group recommendation

Thanks to the social networking increase, the number of domains characterised by the group of users instead of sin-

*Doctoral degree study programme in field Software Engineering. Supervisor: Professor Mária Bieliková, Institute of Informatics and Software Engineering, Faculty of Informatics and Information Technologies, STU in Bratislava. Work described in this paper was presented at the 8th Student Research Conference in Informatics and Information Technologies IIT.SRC 2012.

Kompan, M. Group Inspired Single-User Collaborative Filtering. Information Sciences and Technologies Bulletin of the ACM Slovakia, Special Section on Student Research in Informatics and Information Technologies, Vol. 4, No. 2 (2012) 35-37

gle users is increasing. Not only movie or TV/programs recommendation for several viewers but also digital libraries, e-learning systems or task recommendation in games with purpose have been proposed [3].

Broadly speaking, while the standard single user recommendation tries to satisfy actual user needs, the group recommendation based on the used strategy and the goal of the recommendation tries to maximize satisfaction of every user of the group.

One of the most important inputs of every recommender method is a user model [2]. In the context of group recommendation, the user model is enhanced to the group preference model. In order to provide one list of recommended items for the whole group, some kind of aggregation has to be performed. Two basic approaches for the aggregation are widely used:

- User preferences aggregation - aggregation strategy is applied to the single user profiles and thus one group preference user model is constructed.
- User recommendation aggregation - firstly the single user recommendation are constructed for every user from the group. Next these recommendation are aggregated into one list, presented to the group.

It is clear that aggregating user models and generating recommendation list from such a group profile allows us to reflect complex social aspects and inner processes of the group. Generally, the aggregation of single user profiles brings better results [5].

Several aggregation strategies have been proposed in the literature [6]. When the standard plurality voting is used, several users can be highly unsatisfied. Strategies when the majority of users is taking into account (average, dictatorship etc.) are generally considered as strategies without minimal satisfaction.

3. Group to single-user recommendation

We propose the method which extends the task of group recommendation described above to the single-user recommendation. The aggregation of single user profiles in order to obtain one group profile combines user preferences and also in some settings can introduce variety, which can be interesting from the recommendation improvement point of view.

The main difference between classic single-user collaborative recommendation process is that we recommend not based on user similarity, but based on the similarity between users and group to which is the user assigned. Thanks to various settings as group size or inner-group similarity it is possible to control and improve results in order to fulfil specific goal - obtain various results, of to focus on specific interest area. Proposed approach consists of three basics steps:

1. Generating of groups. Every user is assigned to the virtual group. These groups are generated based on inter-group similarity, which is computed as average of user to user similarities. Primary, we construct groups using average strategy, which takes users' preferences (ratings) and calculates the average rating of specific item for the whole group.

   Likewise, various group sizes can be constructed, while it is clear that larger groups should increase the variety of recommended items and vice versa.

2. Similarity computation between created groups and other users. This is similar to standard collaborative recommendation but not user to user similarity however user to group similarity is computed. For the task of similarity computation, we propose standard widely used cosine similarity. In this manner we obtain list of most similar user for specific group based on the average ratings within the group.

3. Generating recommendation for the specific user of the group, whose preferences are represented as the average of the group (by a virtual user) instead of concrete user preferences. The recommendation approach is similar as the single-user collaborative approach. We look for the most visited items by the similar users, which were not visited by the user to whom the recommendation is generated. These items are reordered based on the number of visits and highest rating obtained.

4. Evaluation

As there are several aspects, which can influence the approach outcome, we investigate the influence of specific parameters as the group size or the neighbourhood of the similar user. We developed recommender system, which is based on proposed group recommendation approach. Similarly, we developed standard collaborative recommender, in order to compare expected improvements.

For the experiments we use the MovieLens 100k dataset, which is widely used as the gold standard dataset for recommender systemsŠ evaluation. The dataset consists of 100 000 ratings (scale 1-5) from 943 users on 1682 items (minimal 20 ratings per user). The dataset was split into train (80%) and test data (20%). In addition, 5 fold cross validation was performed.

We involved several metrics widely used for recommender system's evaluation. The Precision@3 and Precision@10 are computed as standard Precision metrics for the top 3 and top 10 recommended items respectively. Correspondingly, we computed the Mean Absolute Error (MAE) and the Root Mean Absolute Error (RMSE) in order to measure predicted ratings. While the RMSE prefers more and small errors, the MAE prefers larger and few errors.

Firstly, we focus on the user and group similarity. The groups were generated randomly. For every group size (3-7 members) we generated groups with various inner-groups similarities (0.0-0.5). The inner-group similarity was computed as the average of the user to user similarity.

Next we experimented with the group size and with the number of similar users used for the recommendation. As the collaborative approach uses the similar users to predict the user's interest, we created recommendations based on several user sets (1-101 similar users). The results clearly show that the standard collaborative recommender brings the best results based on 41 similar users, while our proposed recommender brings better results when the size of similar users' set is between 91 and

Table 1: Results of proposed single-user group approach for 3 and 10 top recommended items compared to the standard collaborative approach (Std.).

Gr. size	Top 3			Top 10		
	P@3	MAE	RMSE	P@10	MAE	RMSE
3	**0.42**	0.51	0.42	**0.32**	0.61	0.52
4	0.39	0.48	0.40	0.31	0.60	0.51
5	0.39	0.48	0.40	0.30	0.59	0.50
6	0.39	0.48	0.39	0.30	0.59	0.50
7	0.38	**0.47**	**0.38**	0.29	**0.58**	**0.49**
Avg.	**0.39**	0.49	**0.40**	**0.30**	**0.59**	**0.50**
Std.	0.3819	**0.48**	**0.40**	0.27	**0.59**	0.51

101. Because the interests of a single user are more clearly expressed when standard recommendation is used, the decreasing trend over the similar user set size of precision can be observed.

Finally we compared results of the proposed approach (the top 3 and top 10) to standard collaborative approach. As we can see (Table 1) while the precision of proposed approach is decreasing with the size of the group used for recommendation, MAE and RMSE is improving with the group size. This is an expected result, while it is clear that the more users can predict the expected rating more accurately. From the other hand, the difference between predicted ratings over various group sizes is very small and in the average it is almost identical to the standard collaborative approach. When compared the best performer (group size 3 and 91 similar users, ratings considered as positive feedback >=3) to the standard approach, our proposed approach brings the improvement more than 11.5% for the P@3 and 10.4% for the top P@10 recommendation respectively. This is a huge improvement for the recommender approach and thus indicates that proposed approach can be used for the task of single user recommendation.

5. Conclusions

In this paper we proposed an idea of the single user recommender based on the group recommendation principles. The user is assigned to the virtual group, based on the user to user similarity. For every group are single user's preferences aggregated in order to create one user model -"virtual" user preferences. For groups (virtual users) are standard user to user similarities computed and then the collaborative recommendation constructed.

Our results of experiments support our hypothesis, that proposed approach overcomes the standard collaborative recommendation. We compared three aggregation approaches for the group preferences computation.

Our approach do not consider items' content, so various domains can be used for the recommendation. In the same way, the process of the group construction can be not random (based on the inner-group similarity), but various social aspects can be used. This is useful in order to overcome some standard recommender systems' shortcomings as the cold start, while the group can be constructed based on other information as social networks, moreover natural groups (real life) can be considered.

Acknowledgements. This work was partially supported by the Slovak Research and Development Agency under the contract No. APVV-0208-10 and by the Scientific Grant Agency of Slovak Republic, grant No. VG1/0971/11.

References

[1] L. Ardissono, A. Goy, G. Petrone, M. Segnan, and P. Torasso. Intrigue: personalized recommendation of tourist attractions for desktop and hand held devices. *Applied Artificial Intelligence*, 17(8):687–714, 2003.

[2] M. Barla. Towards social-based user modeling and personalization. In *Information Sciences and Technologies Bulletin of the ACM Slovakia*, volume 3, pages 52–60. ACM Slovakia, 2011.

[3] M. Kompan. Personalized recommendation with social aspects consideration. In F. Babic and J. Paralic, editors, *Workshop on Intelligent and Knowledge oriented Technologies*, pages 155–160. FEI TU Kosice, 2011.

[4] M. Kompan and M. Bieliková. Content-based news recommendation. In F. Buccafurri and G. Semeraro, editors, *EC-Web*, volume 61 of *Lecture Notes in Business Information Processing*, pages 61–72. Springer, 2010.

[5] J. Masthoff. Group Modeling: Selecting a Sequence of Television Items to Suit a Group of Viewers. In *User Modeling and User-Adapted Interaction 14: 37ˆ85, 2004.*, volume 64, pages 37–85. Springer, 2004.

[6] J. Masthoff. Group Recommender Systems: Combining Individual Models. In F. Ricci, L. Rokach, B. Shapira, and P. B. Kantor, editors, *Recommender Systems Handbook*, pages 677–702. Springer, 2011.

[7] J. F. Mccarthy and T. D. Anagnost. MUSIC FX : An Arbiter of Group Preferences for Computer Supported Collaborative Workouts. In *Proceedings of the 1998 ACM conference on Computer supported cooperative work*, pages 363–372, New York, New York, USA, 1998. ACM.

[8] C. Senot, D. Kostadinov, M. Bouzid, J. Picault, and A. Analysis of Strategies for Building Group Profiles. *User Modeling, Adaptation and Personalization 2010*, pages 40–51, 2010.

[9] J. Suchal and P. Návrat. Full text search engine as scalable k-nearest neighbor recommendation system. In M. Bramer, editor, *Artificial Intelligence in Theory and Practice III*, volume 331 of *IFIP Advances in Information and Communication Technology*, pages 165–173. Springer Boston, 2010.

[10] D. Zeleník. An approach to context aware event reminding. In *Information Sciences and Technologies Bulletin of the ACM Slovakia*, volume 3, pages 126–130. ACM Slovakia, 2011.