Personalized hybrid recommendation for group of users: Top-N multimedia recommender

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A B S T R A C T

Nowadays, the increasing demand for group recommendations can be observed. In this paper we address the problem of recommendation performance for groups of users (group recommendation). We focus on the performance of very Top-N recommendations, which are important when recommending the long lasting items (only a few such items are consumed per session, e.g. movie). To improve existing group recommenders we propose a mixed hybrid recommender for groups combining content-based and collaborative strategies. The principle of proposed group recommender is to generate content and collaborative recommendations for each user, apply an aggregation strategy to solve the group conflict preferences for the content and collaborative sets separately, and finally reorder the collaborative candidates based on the content-based ones. It is based on an idea that candidates recommended by both recommendation strategies at the same time are presumably more appropriate for the group than the candidates recommended by individual strategies. The evaluation is performed by several experiments in the multimedia domain (as typical representative for group recommendations). Both, online and offline experiments were performed in order to compare real users' satisfaction to the standard group recommenders and also, to compare performance of proposed approach to the state-of-the-art recommenders based on the MovieLens dataset. Finally, we experimented with the proposed hybrid recommender to generate the recommendation for a group of size one (i.e. single user recommendation). Obtained results, support our hypothesis that proposed mixed hybrid approach improves the precision of the recommendation for groups of users and for the single-user recommendation respectively on very Top-N recommended items.

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1. Introduction

Personalized recommendation was proved to be a one of the most effective solutions to the information overload problem. Personalization typically helps, on the one hand, to reduce the number of items available, which are for user not possible to process in acceptable time. On the other hand, it helps to reduce the problem of informational space invisibility, where a user does not even know about the existence of some interesting content.

Historically, several recommenders have been proposed in the literature. At first, the individual user recommenders have been developed in two main directions (Resnick & Varian, 1997):

- content-based recommendation
- collaborative filtering

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The content-based recommendation methods recommend similar items (based on the items' content similarities), while the collaborative filleting methods generate recommendations based on similar user tastes. Moreover, to overcome some shortcomings of both recommender approaches, their combination – so-called hybrid recommenders are often used (more details are provided in the Section 2 – related work). The research in the personalization area was focused for e-mail, education, news or e-shops domains (Gauch, Speretta, Chandramouli, & Micarelli, 2007). These days, the information overload expanding to new applications and improves our lives in almost every activity (Ricci et al., 2011).

Nowadays, the task of personalization also moved from recommendation to individual users to recommendation to groups. This is based on the fact that we, people, are social beings and we do a lot of our activities together. The difference between single and group recommendation is primarily in taking into account the interests and preferences of multiple users together and to offer them such results, i.e. items, which would satisfy them best all at once. These preferences are usually stored in user models, which are separated from the recommendation methods (Brusilovsky, 1996). In this paper we focus on improving the quality of very Top-N recommended items, which is important in many domains, especially in those with extensive items, which are group members able to experience only a few per session.

The typical and often used representative of the domain where the group recommendation is applied, is the multimedia domain (Boratto & Carta, 2010), or even more specifically subdomain of movies or television content. The consumption of multimedia is for many people an everyday activity, by which they spend substantial part of their free time (often with the companion of other people). Improvement of approaches which help people to choose interesting content therefore helps them to spend their time in a qualitatively better way (more details are provided in Section 2.2).

One of the most popular type of multimedia represent the domain of TV content, where the increase of Smart TVs devices generate a new space for personalization. Surveys[1] show that the average citizen of U.S.A. spends a 5.11 h per day by watching TV, what is 9 years for a lifetime. The average schoolchild in the U.S.A. watches television almost 3.3 h per day. It is in total 1200 h per year, while for comparison in school spends approximately only 900 h per year. These data show that experience of television content represents an essential part of the user's daily activities. People tend to watch television together rather than alone (Cesar, Chorianopoulos, & Jensen, 2008), thus according to Masthoff, the TVs should adapt to groups rather than to individuals (Masthoff, 2011, 2004).

As the personalized recommendation is an effective solution that can be used to reduce the information overload problem, its application in the domain of smart TV brings to the users qualitatively better experience (e.g., TV helps to select the appropriate program from broadcast or to choose from multiple news channels the most interesting ones). Plenty of group recommenders have been proposed in the last years for the multimedia domain, while they, due to heterogeneous group members' preferences, often fail to provide very accurate Top-N recommendations (Kompan & Bieliková, 2014a). The group recommenders are based on the single-user recommendation approaches (content-based and collaborative), while the usage of hybrid recommender is quite rare (see Section 2.2).

Our main contribution in this paper is:

> *a proposal of novel group recommender approach that is based on a combination of collaborative and content-based group recommendation approaches.*

We focus on the improvement of the quality of the very Top-N recommendations and the recommendation list order. This is achieved by generating content-based (Section 3.1) and collaborative candidates (Section 3.2) for group members. Next, these candidates (content-based and collaborative separately) are aggregated in order to resolve conflict preferences of group members (Section 3.3). Finally, the hybrid recommender is applied to merge content-based and collaborative group candidates and to generate final recommendations (Section 3.4).

Obtained results clearly show that the proposed group recommender helps group members with the items selection and consequentially improve their experience with the common activity (results of the evaluation are presented in Section 4). Last but not least, proposed approach is applicable to the single user recommendation as well (while this scenario represents the recommendation to a group of size 1 (for detailed results see Section 4.3)).

2. Related work

The personalized recommendation is often requested by a group of users instead of the single ones. This can be observed over various domains, as the multimedia, holidays, events, trips, restaurants and many others. These domains usually benefit from group recommenders (Kompan & Bieliková, 2014a). Historically, group recommenders are based on the single user approaches. The main challenge for the group recommendation is, in fact, to deal with conflict preferences of group members.

In order to choose and design optimal group recommender approach, it is important to consider multiple additional aspects in comparison to the single user recommendation – as the group size, members' relationships, personal characteristics etc. It is also important to know whether the group behaves as active or passive (Masthoff, 2011). This means to recognize if the group members will actively choose items from the recommendation (tourists who choose a trip, people who go to watch a movie) or just passively experience recommendation (visitors of cafeteria where plays recommended music in background) (Kompan & Bieliková, 2014a). To solve group members' conflict preferences the aggregation type should be chosen based on the group

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[1] BLS American Time Use Survey, A.C. Nielsen Co., date of data publication 2nd July 2012.