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A hybrid approach for movie recommendation via tags and ratings ☆

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ABSTRACT

Selecting a movie often requires users to perform numerous operations when faced with vast resources from online movie platforms. Personalized recommendation services can effectively solve this problem by using annotating information from users. However, such current services are less accurate than expected because of their lack of comprehensive consideration for annotation. Thus, in this study, we propose a hybrid movie recommendation approach using tags and ratings. We built this model through the following processes. First, we constructed social movie networks and a preference-topic model. Then, we extracted, normalized, and reconditioned the social tags according to user preference based on social content annotation. Finally, we enhanced the recommendation model by using supplementary information based on user historical ratings. This model aims to improve fusion ability by applying the potential effect of two aspects generated by users. One aspect is the personalized scoring system and the singular value decomposition algorithm, the other aspect is the tag annotation system and topic model. Experimental results show that the proposed method significantly outperforms three categories of recommendation approaches, namely, user-based collaborative filtering (CF), model-based CF, and topic model based CF.

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1. Introduction

Many online movie platforms provide abundant resources, which brings convenience for the general audience. However, given the rapid growth of network information resources, users have to spend plenty of time in searching movies that they are interested. Helping users to find resources that they want rapidly has become an important requirement. With the success of the movie market, the addition of new movies causes a problem of information overload. Recommender systems have been regarded as effective solutions to the information overload problem and have become an important research field.

As effective information resources, ratings may significantly affect the recommendation of unknown social media content. For example, MovieLens[1] predicts the unknown ratings of users on movies according to the existing known ratings. A recommendation is then made based on the similarities among movies and the common features that connect users. MovieLens can also provide an accurate suggestion list according to the social ratings. Tagging, which is an effective recommendation tool or extension of recommender systems, has also been extensively applied to major social media recommender systems recently (Movahedian and Khayyambashi 2015). Primarily, tags directly reflect the tastes and preferences of an individual consumer toward media content. In addition, tags do not have a strict organizational structure. Nonetheless, tags provide rich and clear topic information. As a result, information with long comments is omitted by users. Thus, tags can catalog user experience more flexibly. Therefore, tagging has increased in popularity and is extensively applied in personalized recommendations (Jung 2014). In addition, the main user activities involve posting text contents and annotating contents, as well as ratings or tags. Fig. 1 shows the typical online movie platform. All social content annotations (Chelmis and Prasanna 2013), (Hoi et al. 2011) are tagged and classified. As depicted in Fig. 2, movie recommendations are intended to improve user experience by providing a set of movies that are relevant to the tags and can be given a high score. The online movie platform is a typical representation of the collaboration and common interests of users (Colace et al. 2015). Therefore, we developed our movie recommendation strategy based on annotations.

With the development of online social networks, information overload has become a more severe problem. The Recommender system, as an effective tool to information filtering (Liu et al. 2013a), has recently been the focus of considerable attention. The recommender system suffers from poor accuracy problem because the user and the item have not interacted with the system

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[1] http://movielens.org.

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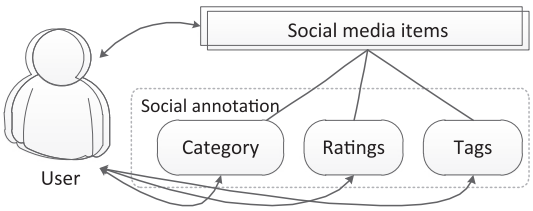

Fig. 1. A typical online movie platform.

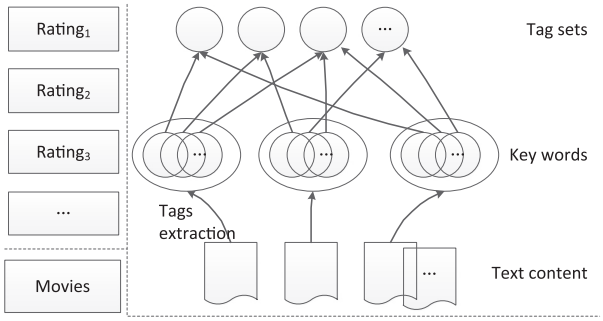

Fig. 2. Extraction of tags and movie ratings.

yet. Reducing the effects of the cold-start problem on personalized recommendation has become a research topic that has been extensively investigated to grantee premise accuracy. Moreover, the current recommender system, particular social media content recommendation (Lee and Phang 2015) must be improved. The following aspects are key to improving the recommender system: low recommendation precision and low automatic degree. Most of the recommendations made by users in the system are based on content filtering and on keywords used in searching. In addition, service is not persistent. Many recommendations are based on the login information of the user that is on record, browsing history of the user, and purchase information.

Related methods have been applied to different social media objects on the Internet, including micro-blogs (Mishne 2006), questions and answers, e-commerce, web bookmarks (Wetzker et al. 2010), blind dating systems, instant messaging applications, social games, social networks for business, music (Jschke et al. 2007), and photos (Sigurbjrnsson and van Zwol 2008). The hybrid method of recommendation is also employed in many applications, such as the temporal purchase patterns derived from sequential pattern analysis (SPA) (Choi et al. 2012). On one hand, these applications derived implicit ratings that can be used in online transaction data for collaborative filtering (CF). On the other hand, these applications used the temporal purchase patterns to eliminate the harmful effect on recommendation services through SPA. Eventually, CF and SPA are eventually integrated, improving recommendation quality. Each approach has its advantages. Meanwhile, the different approaches have their respective suitable application scenarios. Therefore, according to different scenarios, selecting different methods and making them work together can significantly improve recommendation performance. Another example is StereoTrust (Liu et al. 2013b), a trust model inspired by real-life stereotypes. StereoTrust analyzes the historical behavioral information to build the trust relationships to come up with recommendations. However, most of the aforementioned existing approaches, only generally highlight special scenarios. Moreover, the extensibility of these applications must be further improved.

In this study, we propose a hybrid movie recommendation approach via social tags and preferred ratings. First, we extract, normalize, and recondition social tags according to user preference. The user preference is based on social content annotation, which includes tags and ratings. Then, our model can benefit from unifying the potential capability of a personalized scoring system (e.g., singular value decomposition [SVD] of a matrix) and a tagging system (e.g., the preference-topic model, tag normalization and reconditioning). Finally, in terms of the recommendation results, our hybrid method has outperformed the existing user-based collaborative filtering (CF) algorithms including the user-based CF, the CF model, and the topic model based CF model.

The current paper is structured as follows: Section 2 reviews the related literature on the different recommendation approaches. Section 3 describes the hybrid model for movie recommendation. Section 4 describes the experiments and analyzes the experimental results. Section 5 concludes the paper and discusses future works.

2. Related works

In this section, we present related works on recommender systems, including recommendations based on social tagging, recommendations based on a topic model, and recommendations based on matrix factorization (MF) approaches.

2.1. Recommendations based on social tagging

Social tagging is extensively used in the industry. This process has generated many new applications, including Flickr, Delicious, and Last FM. Any user can make unconstrained annotations based on their own understanding and interests (Wen et al. 2014, 2012), and all annotations are visible to other users. In fact, this annotation mode is open and shared, and it reflects the actual view and understanding of the user. This concept revolutionizes information-resource organization, retrieval, and sharing. Moreover, annotation is generated based on swarm intelligence. The difference between tag annotation and previous recommender systems is how users select the keywords. This process reflects understanding toward resources. This understanding plays an important role in the links among users. Such tagging systems are dynamic. The problem that we face and need to overcome is the establishment and evolution of dynamic tags. The problem can be addressed by two methods (Yao et al. 2012), namely, taxonomy extraction and evolutionary taxonomy. A tag represents the main characteristics of information resources and simultaneously covers the relationships between users and resources and the relationships among users. A tag embeds the features derived from content and association. A recommender that displays effective content and CF may be developed by using tag-based datasets (Guy et al. 2010, Zhang et al. 2011). Given the aforementioned benefits of using social tagging, we not only take tags as the original data of our model, but also optimize tag data to make recommendations that are more accurate.

2.2. Recommendations based on a topic model

Topic models are used to discover topics by adopting a hierarchical Bayesian analysis of original texts (Blei et al. 2010) in a document. As the simplest topic model, latent dirichlet allocation (LDA) has been used in many applications, including recommender systems (Blei et al. 2003). Researchers have recently focused on the use of LDA to mine useful and rich-text content. Wang and Blei (2011) proposed collaborative topic regression (CTR), which combines the merits of MF and probabilistic topic modeling. Purushotham et al. (2012) combined CTR with SoRec (Ma et al. 2008) to generate a consistent and compact feature representation method called CTR-SMF to improve recommendation performance. However, all users are treated differently because CTR-SMF uses

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