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Flickr group recommendation using rich social media information

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ABSTRACT

Today online social media communities have spanned the globe, browsing news from social networks almost becomes an essential part in our daily life. Groups organized by users always share something interesting. Joining groups which fit the users' tastes will help them to obtain information. However, traditional group recommendation methods usually focus on how to recommend an item to a group of users. In this paper, we study how to recommend groups to an individual user and reveal the factors which push a user to join groups. In social networks, a commonly adopted recommendation method takes advantage of the tastes of a user's trust neighbors and recommends groups which his/her neighbors have joined. It will performs poorly for the inactive users who have few trust neighbors. To overcome this problem, we try to find users' similar neighbors using tag information, which is not only from users' photos but also from their favorite photos and the common friend information. Hence we propose a group recommendation scheme utilizing users' trust neighbors and similar neighbors' tastes. We do the experiments on a real-world Flickr dataset and obtain a promising result especially for inactive users.

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1. Introduction

In recent years, social networks have become an essential part in people's daily life and one of the major approaches by which people get fresh news. Social networks usually contain various media data with which their users can express themselves lively. Thus, users can communicate with others conveniently and share/find the contents they are interested in. To gather the users who share the same hobbies, social networks nowadays allow users to join the interest groups which contain rich contents for some topics. For a social website, an efficient group recommendation system should help users find their favorite groups effectively. This work will be helpful for users and advertisements. Efficient group recommendation can therefore have a positive effect on both social network members and other recommendation applications.

We take Flickr, one of the most popular photo sharing social networks to study how to recommend groups to an individual user. Flickr as one of the oldest social networks has a large number of users and is reported to have millions of new images uploaded daily. Flickr offers many services to its users. It allows users to share and self-annotate their photos. Users can follow other users to browse photos and experience others' lifestyles. Groups in Flickr

are self-organized. Users can create their own interest groups and join others. The availability of rich media data helps us explore the behavior of users from different views.

In previous work, most group recommendation methods studied how to recommend an item to a group of users [1,2]. In our work, we study how to recommend groups to users. It is an interesting topic. We need to study the tastes and the social relationship of users to find out the major factors which push the users to join a group. A number of recommendation techniques have been proposed, such as user-based collaborative filtering [3,4], item-based collaborative filtering [5,6], trust-aware collaborative filtering [7,8] and matrix factorization [9]. Collaborative filtering (CF) is the most commonly used technique in social networks. Researchers have proposed a number of CF algorithms. Trust-aware CF makes the recommendation trustiness but suffers from the cold-start problem. User-based/item-based CF can find what the users like efficiently; however, the trust relation among users will be ignored. The matrix factorization method works well for the item recommendation, but is unsuitable for the binary group recommendation problem.

In this paper we propose a group recommendation model using the tastes of users' trust neighbors and similar neighbors, and make recommendation with the collaborative filtering algorithms. We take advantage of the trust-aware CF [7] and user-based CF [4] to handle the neighbors respectively.

Flickr has a direct link structure. A user can follow any other users. It is not like Facebook [10] which has an undirect link

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structure, and can well describe the trustiness among users. However, if a Flickr user A follows another user B, user A must be interested in user B's content or be familiar with B. So we can still assume that A trusts B. To find a user's trust neighbors, we explore the contact list of the user and assume all the users in the contact list to be his/her trust neighbors. Collaborative filtering is then used for group recommendation.

To find users' similar neighbors, we take advantage of users' tag information and common friend information. We try to find the content interests similarity among users from their uploaded/favourite photos. Flickr allows its users to self-annotate their photos. Existing studies reveal that many tags provided by Flickr users are noise. There are only around 50% of those tags actually related to the photos [11]. It is because that tags annotated by different users will be different even for the same photo. Another reason is that users may have interests in something that they do not have the ability to take photos of them. For instance, a user loves the sea but he/she lives far away from it.

To overcome the disadvantages of the tags to some extent, we study the tag information and extract two kinds of content features. We order the different tags from a user's photos by frequency. The tags with high frequency will be precise enough to describe the interests of the user. To solve the various tags description problem, we crawl the tags from the photos which are in the user's favorite photo lists and also order them by frequency. The tags with high frequency from different annotators will be more general and reliable than the tags only from the owner. Thus we have two methods to describe the users' interests and can get the content similarities among users.

Another way to describe the similarity between two users is to count the common friend number. If two users always follow the same users, they may have some common interests. After employing the kernel alignment algorithm [12] to combine the similarity kernels, we use collaborative filtering for group recommendation.

We perform the group recommendation using the trust neighbors and similar neighbor's tastes. In fact, researchers find that there is a tendency that more friends will bring in more logins [13]. So we take the number of a user's followees to describe the active degree of him/her. We assign different users with different weights to make the combination. We find that users with high active degrees tend to join groups by social relationship, whereas users with low active degrees tend to join groups by interests.

In summary, this paper has the following contributions:

- We study a real-world dataset from Flickr. We find that no matter how active a user is, he/she tends to join in groups. So we can assume that browsing the contents of the interest groups is one of the main approaches which users adopt to obtain fresh news.
- We utilize users' similar neighbors tastes for group recommendation with the tag information and the common friend information. The self-annotated photos in Flickr can help us bridge the semantic gap to obtain a series of tags which present the users' interests. However only using the photos which users upload is not sufficient. So we expand the tag information from users' favorite photos and the common friend information. Combining the similarities from different views will improve the performance of our group recommendation.
- We study the relation between users and groups from two aspects. Recommendation using similar neighbors' tastes performances better on inactive users while recommendation using trust neighbors' tastes performances better on active users. We combine these two aspects and assign different users with different weights to make group recommendation.

This paper has published on International Conference on Security, Pattern Analysis, and Cybernetics(ICSPAC) 2014. Comparing with our previous work, we further study the factors which push users to join groups. We use collaborative filtering algorithm with users' similar neighbors and trust neighbors' tastes respectively. When discovering users' similar neighbors, we keep using the tag information. Furthermore we extent another information that is common friend information to enrich the concept for us to discover users' similar neighbors. Now similar users will not only have content interests. When combining the user-base CF and trust-aware CF recommendation lists, we split the users into three parts, e.g inactive users, median active users and active users. Different from the past method which directly give them general weights for combination, we set different weights for different users. More experiments have been done to analysis and illuminate the factors which push users to join groups.

The rest of the paper is organized as follows. Section 2 presents the related work of group recommendation. Section 3 introduces our group recommendation model. Section 4 presents the experiment results, followed by the conclusion in Section 5.

2. Related work

Trust-aware CF is a commonly used technique for recommendation [7,8]. It solves the problem by using the trust networks among users. To evaluate the trust values among users, lots of useful information such as age and occupation can be used. In social networks, it can easily obtain the trust value from a user A to a user B. The value will be 1 if B is in the contact list of A or 0 if not. Finally we count the number of users both in user A's contact list and in group G's member list to present the relation of A to G. This trust-aware CF is commonly adopted in social networks to recommend friends and groups. However, it has a drawback that will perform badly for cold-start users. If a user only has a small number of followees in his/her contact list, the algorithm can not recommend groups which fit the user's interests.

For item recommendation, user-based collaborative filtering (CF) [3,4] is the most commonly used technique in social networks. Usually, we can obtain ratings from users on items and calculate the similarity among users. Whereas on group recommendation, we can only get a binary value which indicates whether a user joins a group or not. The binary value is not precise enough to estimate the similarity among users, so we cannot adopt the same technique used in item recommendation. To solve this problem, Zhuang et al. took full advantage of the Flickr heterogeneous data, estimated the similarity among users from six views, and then used the user-based CF for group recommendation [14]. Matrix factorization is another technique for item recommendation, and it tries to find the latent space of items and users [9]. However, in group recommendation, it suffers from the same problem which is we can only get a binary value to describe the relation of a user and a group. So the no-score matrix makes the technique work not well in group recommendation.

On the other hand, researchers tried to find the users' interests from the contents of photos. Luckily, the self-annotated photos in Flickr can help us bridge the semantic gap to obtain a series of tags which present the users' interests. In fact, users are willing to provide this semantic context through manual annotations to make them better accessible for the general public [15]. Many works focused on analyzing the topic modal of groups [16,17]. Also some researchers tried to connect users to groups through tags using tensor decomposition [18]. However, existing studies reveal that many tags provided by Flickr users are noise. There are only around 50% of those tags actually related to the photos [11]. Also

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