



Literature review and classification of recommendation systems on social network researches

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ABSTRACT

Social network based-recommendation has some benefits that it approach used for improve of recommendation systems. Recommendation systems are appropriate tools for provide useful and suitable recommendations in social networks. However, in recent years researches has been done on recommender systems on social network, but there is the lack of a comprehensive study on the literature review and classification of these models. We reviewed the related articles and then classified those by the year of publication and their main techniques. The articles are categorized into four techniques, includes tag-based, context-based, social influence-based and trust-based recommendation system on social network. Our research provides information about trends in recommender systems on social network research by examining the publication years of the articles and used techniques, and show future direction on recommender systems on social network.

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Introduction

The plurality and popularity of social networking sites sank users into huge volumes of information and create a great challenge in terms of information overload. When people join social network web sites, first create a profile. User profiles are unique pages that people can express emotions and thoughts. User profile is a backbone of social network. The recommender technology is superior to other information filtering applications because of its ability to provide personalized and meaningful information recommendations [1].

Social network based-recommendation uses for improve recommendation systems because of its benefits. For example, as long as cold-start users are connected to the social network, it can deal with them. Social network based recommendation systems are more robust to fraud, in particular to profile attacks [2]. Also Sinha et al. [3] compare quality of recommendation systems with friends' recommendation. Their results show that users prefer friends' recommendation against generated recommendation from system. In past, finding close friends' user on the internet was difficult. Nowadays obtaining social network information is easy through social networks sites. So, study about the use of social network information in recommendation process will probably produce valuable results [4].

In order to gain insight on recommender systems on social network, In this research, we reviewed and classified articles on recommender systems on social network that were published in academic journals and conferences between 2006 and 2012. The section 2 explains properties of the study and research methodology. Then the section 3 introduces the classification method and in section 4, we present categories of research articles by the year of publication and their main techniques.

Finally, results and future works are explained in section 5.

Research methodology

Research papers on recommender systems on social network are scattered across diverse journals and conferences such as marketing, information technology, information science,

computer science, management and data mining. The electronic journal databases that were searched to provide a comprehensive bibliography of research papers on recommender systems were; ABI/INFORM Database, IEEE Library, Science Direct, Scopus, Springer.

The search was performed based on phrases such as: "Recommender system in social network", "social network Recommendation", "social network collaborative filtering", "recommender system for social networking". We reviewed the full text of each research paper, and papers that were not truly related to recommender systems on social network were deleted.

Golbeck [5] express that Many online communities claim to be or support social networks, but lack some of the properties one may expect of a social network and she uses a very specific definition in [5]. Based on criteria that golbeck expressed [5], A web-based social network must meet the following criteria:

- It is accessible over the web with a web browser. This excludes networks where users would need to download special software in order to participate and social networks based on other technologies, such as mobile devices.
- Users must explicitly state their relationship with other people qua stating a relationship. Although social networks can be built from many different interactions, a WBSN is a website or framework that has the development of an explicit social network as a goal.
- The system must have explicit built-in support for users making these connections. This means that a group of friends who each maintain a simple HTML page with a list of his or her friends would not qualify as a WBSN because HTML itself does not have explicit built-in support for making social connections
- Relationships must be visible and browsable. The data does not necessarily have to be public but should be accessible to at least the registered users of a system.

Recommendation systems divided into two areas of focus: object recommendation and link recommendation. Object recommendation systems recommend products to users based on past behavioral patterns. Social networking sites focus on link

recommendation where friend recommendations are presented to users [6]. Therefore, the articles based on object recommendation area are reviewed and models based on friend recommendation that is sample of link recommendation and tag recommendations are not considered. Finally, among of about 150 reviewed papers, 22 papers were found that met these criteria and were selected for the study. The selected criteria and evaluation framework is represented in Fig. 1.

Categories of recommendation system on social networks

Given the nature of social networks and Recommender Systems, it is difficult to limit each article to a specific field and sometimes multiple fields have been used at the same time in the purposed model of article. The main technique of each model is considered to classify them. The research papers were analyzed by year of publication and their main technique of the model. The overall graphical classification framework for recommender systems research papers is presented in Fig. 2.

We classify models of recommendation system on social networks in 4 main categories: tag-based, context-based, social influence-based and trust-based methods.

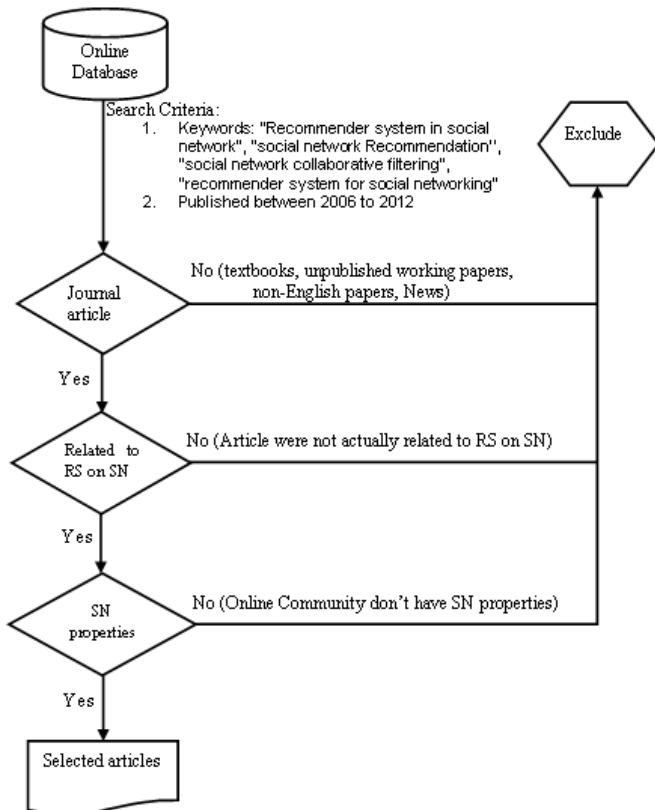


Fig. 1. Selection criteria and evaluation framework

Tag-based models

Social tagging is one of the most important ways to organize and index online resources. Social tagging is the Web 2.0 way to organize online resources. Social tagging allows people to categorize online resources by annotating freely chosen tags to them [7]. Social tags can provide highly abstract information about not only item contents but also personalized preferences; hence they might help generate better personalized recommendations [8].

Zhang et al. [7] believe that information in the content of resources should be considered to improve recommendation quality and to deal with the over sparse problem. They purpose a recommendation approach for social tagging systems that combine content and relation analysis in a single model. The most advantage of this model is that even when relation

information is inadequate, the model can still extract knowledge from content information and reveal relation between objects [7].

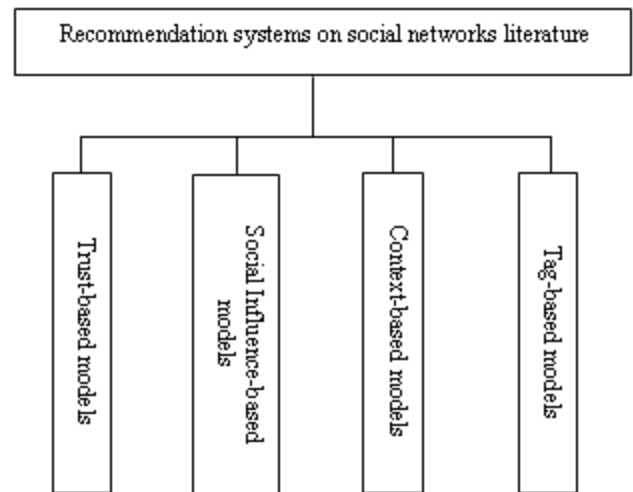


Fig.2. Recommendation systems on social networks categories

Also, Wu and Zhang [8] assume that a basic attraction may exist for each item. Results of Wu and Zhang [8] shows that the usage of both tag information and attractor can significantly improve diversity of personalized recommendations. Durao and Dolog [9] present a tag-based recommender system that suggests similar Web pages based on the similarity of their tags. Lee et al. [10] propose a novel technique for item recommendation within social networks that matches user and group interests over time, and users and tags associated with an item represent and cluster by topics. In addition, Jin and Chen [11] use tags, which can be regarded as users and items feature information, to compute the similarity between users or items. Also, Yuan et al. [12] propose a collaborative filtering recommendation algorithm based on the social tagging in a digital library and Wang et al. [13] present a novel social network based recommendation algorithm that consider users' co-tagging behaviors.

Context-based models

Traditional recommendation systems rely on a user profiles that reflects the personal taste, but do not take other criteria into account like temporal, geospatial or emotion features [14]. Alonso et al. [15] propose a hybrid collaborative filtering model, which provides recommendations based on the context of the travelling users. Also, Akther et al. [16] design a new architecture for user personalization which combines both social network data and context data. In addition, Sim et al. [17] propose a new context-aware recommendation scheme that provides recommendations of services to the user by considering of user's social position and the context.

Social influence-based models

Social influence plays an important role in product marketing. However, it has rarely been considered in traditional recommender systems. Some of recommender systems can utilize information in social networks, including user preferences, item's general acceptance, and influence from social friends [19]. Carmagnola et al. [18] present SoNARS, a new algorithm for recommending content in social recommender systems that targets users as members of social networks, suggests items that reflect the trend of the network itself, based on its structure and on the influence relationships among users. He and Chu [19] present a social network-based recommender

system (SNRS) which makes recommendations by considering a user's own preference, an item's general acceptance and influence from friends. Also Ha et al. [20] propose a recommendation system based on advanced user modeling by using social relationship of users. Zhao et al. [21] present a novel approach that considers relationship strengths between user and his friends for calculate a recommendation score. In addition, shang et al. [22] construct a random walk based collaborating filtering model that considers items, users, item content, user profile and social network information.

Trust-based models

This approach assumes a trust network among users and makes recommendations based on the ratings of the users that are directly or indirectly trusted by source user. Trust-based recommenders, however, can make recommendations as long as a new user is connected to a large enough component of the trust network [25].

Golbeck and Hendler [23] present a recommendation algorithm that trust is core of the algorithm for prediction of ratings that is so-called TidalTrust. Also, Massa and Avesani [24] propose to replace step of finding similar users with use of a trust metric (MoleTrust). Jamali and Ester [25] present a random walk model (TrustWalker) which combines trust-based and item-based recommendation. In addition, Ma et al. [26] propose a factor analysis approach based on probabilistic matrix factorization that is so-called SoRec. This approach assumes that the observed data is a linear combination of several latent factors. Yang et al. [27] propose a framework that exploits homophily to establish an integrated network linking a user to interested services and connecting different users with common interests, upon which both friendship and interests could be efficiently propagated. Aiming at modeling recommender system more accurately and realistically, Ma et al. [28] propose a novel probabilistic factor analysis framework, which naturally fuses the users' tastes and their trusted friends' favors together. Jamali and Ester [29] by employing matrix factorization techniques, explore a trust-based recommendation in social network that is so-called SocialMF.

Classification of research papers

In this section, Understanding of the research process of recommender systems on social networks based on year of publication and used techniques of articles is developed.

Distribution by year of publication

Figure 3 shows Distribution of articles by year of publication. As can be seen, There is a greater increase in publish of papers between 2009 and 2012 which is %86 of the all published articles of recommender systems on social network. Also, as is shown, about %40 of papers are published in 2012.

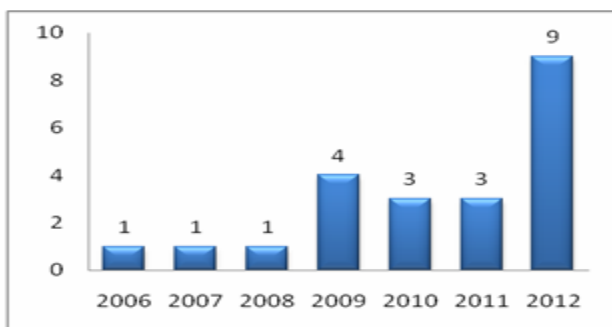


Fig 3. Distribution by year of publication Distribution by the used technique

Figure 4 shows the distribution of articles based on used techniques. As can be seen, about %31 of articles are tag-based and about %31 of articles are trust-based recommender systems which are most of published papers of recommender systems on social network. Also, %23 of articles are social influence based recommender systems and about %13 of published papers are based on context.

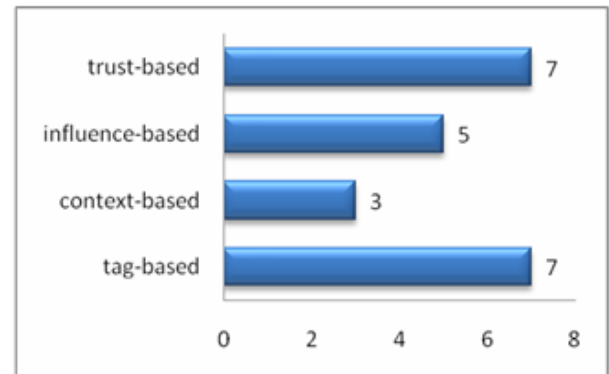


Fig 4. Distribution by the used technique Distribution by year of publication and used technique

Figure 5 shows outline of used methods and number of published papers by the year which is given good view of developed papers. As is shown, developing of articles based on trust-based recommender systems on social networks has an almost constant trend between 2006 and 2012. Also, developing of tag-based models in social networks started from 2010, during the year 2012 has been a growing trend and development of articles in this area is ongoing. Moreover, more social-influence and context based recommender models on social networks are developed in 2012 which shows that tendency to these models has increased.

Conclusion

In this paper, we researched recommender systems on social networks. For selection of articles, Special Features for social network proposed in the papers and Specifications for recommended items are considered. Finally, we selected 22 articles and their main techniques are considered for Classification. Then, the process of developed papers is shown in figures based on the year of publication and main used technique and results showed that developed papers in this area have increased in recent years and most articles are based on trust-based and tag-based recommender systems.

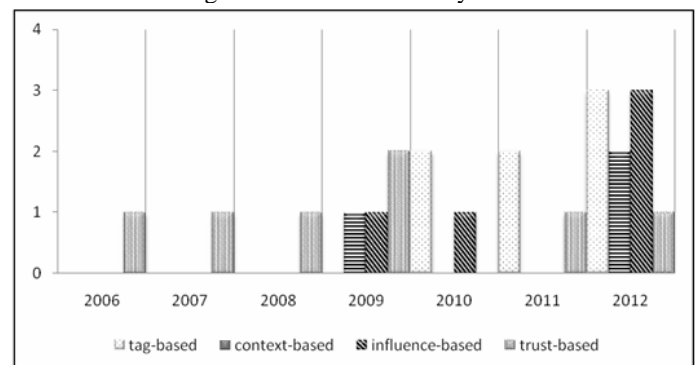


Fig 5. Distribution by used technique and year of publication

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