



Utilizing user tag-based interests in recommender systems for social resource sharing websites



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ARTICLE INFO

Article history:

Received 25 March 2013

Received in revised form 30 October 2013

Accepted 1 November 2013

Available online 16 November 2013

Keywords:

Collaborative recommendation

Folksonomy

Social tagging

Tag

Social resource sharing

Personalization

ABSTRACT

Recently collaborative tagging, also known as “folksonomy” in Web 2.0, allows users to collaboratively create and manage tags to classify and categorize dynamic content for searching and sharing. A user’s interest in social resources usually changes with time in such a dynamic and information rich environment. Additionally, a social network is one innovative characteristic in social resource sharing websites. The information from a social network provides an inference of a certain user’s interests based on the interests of this user’s network neighbors.

To handle the problem of personalized interests changing gradually with time, and to utilize the benefit of the social network, this study models a personalized user interest, incorporating frequency, recency, and duration of tag-based information, and performs collaborative recommendations using the user’s social network in social resource sharing websites. The proposed method includes finding neighbors from the “social friends” network by using collaborative filtering and recommending similar resource items to the users by using content-based filtering.

This study examines the proposed system’s performance using an experimental dataset collected from a social bookmarking website. The experimental results show that the hybridization of user’s preferences with frequency, recency, and duration plays an important role, and provides better performances than traditional collaborative recommendation systems. The experimental results also reveal that the friend network information can successfully collaborate, thus improving the collaborative recommendation process.

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1. Introduction

The new Web 2.0 sites, which provide interactive information sharing and user-centered collaboration, have recently experienced rapid growth in the World-Wide Web. Examples of Web 2.0 website types include social networking, social bookmarking, Web-based communities, blogs, photograph sharing, video sharing, wikis, and knowledge management. Folksonomy is one characteristic of Web 2.0. Folksonomy is also known as collaborative tagging or social tagging, which allows users to collaboratively create and manage tags to classify and categorize contents or user collections. Now collaborative tagging in Web 2.0 is becoming widely used as an important tool to classify dynamic content for searching and sharing [16,38].

Research has shown that social tagging can classify blogs [3], enhance information retrieval [22,18], and improve recommender systems [16]. Recommender systems are developed to deal with information overload and provide personalized recommendations,

and services to users [1]. These software systems have been applied in many areas including e-commerce, news, advertisements, document management, and e-learning. Using tags reduces the limitations of the cold-start and sparsity problems in the collaborative filtering-based recommender systems [16,11].

The tags collected by a user represent part of the user’s interests or preferences in the social bookmarking website. The frequency of a tag represents the strength of user’s preference in this category, defined by this tag. The frequency information of the tag has been used in recommender systems [16]. For recommender systems of the Internet, however, user interests changes with time; thus, learning a user’s interest categories in a dynamic environment like the Web is challenging [37,26].

In an environment in which the user gradually changes interests, tag data close to the current temporal period are usually more important than data temporally far from the current period. That is, based on the tagging information, users are typically interested in items that they recently tagged. For example, a certain user was interested in a Personal Digital Assistant (PDA) six months ago. He is currently interested in the iPad, and the tag of an iPad is used frequently. It is more appropriate to recommend an iPad over a PDA

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to this user. In addition to the recency of a user’s preference, another aspect that represents a user’s interest in social resource sharing websites is the duration of a user’s interests. The duration a certain activated tag represents the continuity of the user’s preference on the category defined by this tag.

How should one utilize and combine tag-based information to handle personalized preferences for recommender systems in social resource sharing websites? This motivates our research to analyze user preferences in frequency, recency, and duration as well as to introduce a hybrid of a collaborative model and a content-based model to improve recommendation quality based on tag-based information. Tag-based information can be extremely useful for user-adaptive applications such as recommender systems [5]. To our knowledge, there has not been any research on a tag-based recommender system that incorporates the frequency, recency, and duration for social resource sharing websites.

Section 2 of this paper describes the related works on social tagging and recommender systems. Section 3 analyzes users’ tagging behaviors in the social resource sharing website. Section 4 introduces proposed procedures for how tag information is used to design a hybrid collaborative and content-based recommender system. Section 5 demonstrates the experimental results. Section 6 suggests conclusions and some possible areas of exploration for future research.

2. Related works

2.1. Recommender systems

Recommender systems use a specific information filtering technique to present information items, which are likely to be of interest to the user. Examples of these information items include blogs, commercial products, movies, music, news, and photographs. Recommender systems make recommendations using three basic steps: acquiring preferences from the users’ explicit or implicit input information, computing recommendations using proper techniques, and presenting the recommendations to users [32,28,35,33].

Recommendation techniques include Content-Based Filtering (CBF), which recommends items similar to the user’s past preferences; Collaborative Filtering (CF), which recommends items similar to preferences of the user’s neighbors; and the hybrid-based approach, which integrates the CBF and CF to improve the recommendation quality and to ease limitation problems of the CF and CBF [29,17,2,27,1]. This study builds on the hybridization of CF and CBF for the folksonomy-based social resource sharing websites, with incorporation of the frequency, recency, and duration of the user’s tag-based preferences.

2.2. Folksonomy and social resource sharing systems

Web 2.0 offers different ways to easily participate in the creation of Web contents: inserting new content, sharing objects, or providing comments [5]. A folksonomy, which is also known as “collaborative tagging,” “social classification,” “social indexing,” and “social tagging” is a classification system that allows users, who are collaboratively creating and managing tags, to annotate and categorize their own content for archiving and sharing. The folksonomy system can minimize the time and effort spent to classify and categorize the dynamic Internet contents, compared with the complex hierarchical classification and categorization schemes. The problem of ambiguity and tag synonyms may arise in folksonomies [20]. Ambiguity of the tags can emerge as users apply the same tag in different ways; synonyms of the tags can emerge as

users employ different tags for the same concept. However, some research alleviated these problems by using tag ontology [4,15].

Folksonomies have become very popular on the Web as part of social software applications such as social bookmarking and photograph annotation. These resource sharing systems are also known as social annotation systems, which enable the organization of online resources with user-defined keywords [8]. Tagging, which is characteristic of Web 2.0 services, allows users to collectively classify and find information. Social resource sharing systems are Web-based systems that allow users to upload their resources, and to label them with arbitrary tags [14]. Users, resources, and tags are three important roles in this sort of system. Users label the resource applying social tags, as shown in Fig. 1. These systems can be categorized according to what kind of resources are supported, such as photos (Flickr), bibliographic references (CiteULike), bookmarks (Delicious, Diigo), merchandise (Amazon), or videos (YouTube). Delicious and Diigo are two popular social resource sharing websites for users to store, share, and discover Web bookmarks, where users can tag each bookmark with freely chosen index terms.

2.3. Tag-based collaborative recommender system

Tags can convey information about the content and creation of a resource [21]. Users tag resources for future retrieval and sharing [19]. Tags identify what the resource is about and the characteristics of a resource [9]. When building the user’s profile on interests or preferences, two types of data collection can be used to explicitly and implicitly build the user’s profile [23,24]. Annotation of tagging and bookmarking Web pages is an example of building a user’s profile of preferences implicitly. Annotations can become a part of the user profile as an indication of his/her perspective on the content collection and interest in the annotated object [34]. The tags collected by the user represent part of this user’s preferences or interests; hence, this study uses the tag-based user profile as the user’s interest in topics of bookmarks in the social bookmarking websites. Rucker and Polanco [30] constructed a recommender system using bookmark lists. Kim et al. [16] used tag-based user profiles in the collaborative filtering-based recommender systems to reduce the limitation of the cold-start and sparsity problems.

Users collect and tag social resource items; thus, a user’s interest can be partially modeled by analyzing this user’s tag information. Because a user’s interest changes with time in the World Wide Web, a tag-based recommender system needs to consider the recency of a user’s interest. This study assumes the newly tagged resource items by the user in a social bookmarking system are more important for this user. That is, based on the tagging

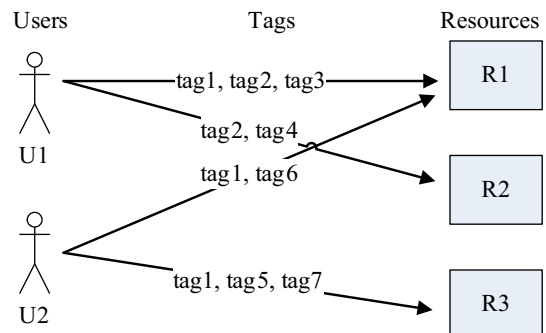


Fig. 1. Relations between the users, tags, and resources in social resource sharing systems.

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