Item recommendation using tag emotion in social cataloging services

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ABSTRACT

Due to the overload of contents, the user suffers from difficulty in selecting items. The social cataloging services allow users to consume items and share their opinions, which influences in not only oneself but other users to choose new items. The recommendation system reduces the problem of the choice by recommending the items considering the behavior of the people and the characteristics of the items.

In this study, we propose a tag-based recommendation method considering the emotions reflected in the user's tags. Since the user's estimation of the item is made after consuming the item, the feelings of the user obtained during consuming are directly reflected in ratings and tags. The rating has overall valence on the item, and the tag represents the detailed feelings. Therefore, we assume that the user's rating for an item is the basic emotion of the tag attached to the item, and the emotion of tag is adjusted by the unique emotion value of the tag. We represent the relationships between users, items, and tags as a three-order tensor and apply tensor factorization. The experimental results show that the proposed method achieves better recommendation performance than baselines.

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1. Introduction

Numerous contents appear every day. Thousands of movies are made, and more than one million books are published worldwide in a year. While consuming various contents, people can link the content their own experiences and feelings, and they can interact with others about their interests through various social media. The social cataloging services, such as Goodreads,[1] LibraryThing,[2] and Movielens,[3] allow users to catalog items and share their opinions on them with others through ratings, tags, and reviews. These services usually deal with time consuming content such as books and movies. They provide only meta-data or a fraction of the actual item such as sample teasers or chapters rather than providing the item itself. Thus, users are more likely to choose items that they want to consume carefully based on their personal taste by referring to the estimation of other users.

The inundation of content causes users in social cataloging services to have difficulty in selecting items among plenty of information. Recommendation systems have been proposed to solve the problem, and various recommendation techniques have been studied (Kefalas, Symeonidis, & Manolopoulos, 2016; Qingbiao, Jie, & Xu, 2011). Collaborative filtering is the most widely used recommendation method based on user's past behavior. Since the purpose of the recommendation system is to provide the appropriate information to users and improve their gratification, it is necessary to pay attention to the subjective feedback of the user in addition to the information about the item. Conventional recommendation systems have utilized rating data as user's explicit feedback on items. Unlike rating, tagging data does not explicitly indicate the user's preference for the item, but it contains additional information about the user's experience since the user directly inputs the tag. Especially, a tag that reflects an individual's subjective opinion contains positive or negative valence or certain feeling; it become a cue for understanding how a user considers an item. Therefore, the utilization of tagging data for recommendation can support the user experience and complement the existing rating information, thereby providing the possibility of improving the recommendation performance. In this paper, a tag that reflects user's emotion will be called an *emotion tag*.

The user's emotions play an important role in selecting and consuming items. According to Tkalčič, Kosir, and Tasic (2011), the emotions obtained from the action just before consuming the item affect the user's selection of a new item, and during consumption, the emotion changes with the passage of time. After the consumption, the emotion affects the user's next action; it can be very useful to measure the user's satisfaction with the item. In the social cataloging system, a consideration of the emotion factors can increase the accuracy of the recommendation system, since rating and tagging items can be viewed as a behavior reflecting this postconsumption feeling.

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[1] http://www.goodreads.com.
[2] http://www.librarything.com.
[3] http://movielens.org.

A user's rating means an overall estimation, i.e., an item is positive or negative, and the tags are a detailed and additional reason of the rating. Therefore, emotion tags can be interpreted differently depending on which valence is used. If the same tag is assigned to the different items, it can be understood as positive, negative, or sarcastic meaning depending on whether the user uses the tag to the item with the high rating or with the low rating. For example, "funny" means "peculiar" as well as "humorous". Therefore, it is necessary to consider the intention of the user in the tag for a better understanding of the user's preference.

In this paper, we propose a tag-based item recommendation approach considering the emotions contained in tags. To calculate the tag weight, we first normalize the rating data and assign the value to each tag to consider the user's overall assessment of the item. Then, we obtain the emotion value of the emotion tags based on SenticNet (Cambria, Speer, Havasi, & Hussain, 2010), which is the emotion lexical resource, and arrange the tag weight using the emotion value. In this process, the weight of the same tag can be changed according to the positive or negative valence of the item.

In general, the ternary relationships of users, items, and tags are described by the tripartite graph; however, it cannot reflect the ternary association, but only three pairs of relationship, i.e., user-item, user-tag, and item-tag. Therefore, we model the relationship of users, items, and tags as a three-order tensor, which is a multi-dimensional matrix, and use a High-Order Singular Vector Decomposition (HOSVD) (De Lathauwer, De Moor, & Vandewalle, 2000) as a tensor factorization approach to recommend the appropriate items for each user. The previous research has mainly used the existence of tags as the initial element of a tensor, but we utilized the tag weight based on the emotion as the initial value to provide enriched information of the ternary relationship. We evaluate the performance of the proposed method using Movielens data, which is a social movie cataloging service, and showed that considering the emotions of tags improve the recommendation quality.

The contribution of this paper is in proposing a tag-based recommendation method considering user's emotions in tags to improve recommendation performance. We propose a method to calculate the weight of the tag emotions to take into account the user's emotion using the user's ratings and an emotion dictionary. Our experiments show that user's emotion plays an important role in item recommendation. This paper is organized as follows: Section 2 describes related research. In Section 3, we explain the tag weighting scheme based on emotions and the HOSVD algorithm for item recommendation. Section 4 describes the performance evaluation of the proposed recommendation method. Section 5 discusses the conclusion and future research.

2. Related work

2.1. Tag-based recommendation

Users in social cataloging services use tags for the purpose of facilitating retrieval of items and for sharing their opinions and communicating with other users (Ames & Naaman, 2007). Xu, Fu, Mao, and Su (2006b) classify tags into five categories: content-based tags which describe the content or categories of an object (e.g., Lucene, Germany Embassy), context-based tags which represent time or location that object was created (e.g., San Francisco, 2005-10-19), attribute tags which show the properties of an object (e.g., Jeremy's Blog, Clay Shirky), subjective tags which explain user's opinion or emotion (e.g., funny, Cool), and organizational tags for personal usage (e.g., to-read, to-review, my paper). The former three are informative tags that describe the item itself, and the latter two are tags that contain the user's individual opinion; both can be used together (e.g., good performance).

Much of the research on tagging has focused on why users are tagging, how tagging differs depending on the system, and whether the community affects user's tagging behaviors (Ames & Naaman, 2007; Meo, Ferrara, Abel, Aroyo, & Houben, 2013; Nov & Ye, 2010; Sen et al., 2006). They have reported that most of the social media services understand the importance of tagging. Tags are being payed attention in many studies of recommendation system because it is not the fixed keyword but the user's own subject. Guy, Zwerdling, Ronen, Carmel, and Uziel (2010) integrated tags used in social networks of business systems and proposed an item recommendation method which combines user and tag information. The authors generate the user profile for recommendation based on the various user-tag relations such as used tags, incoming tags, and indirect tags. Zhang and Liu (2012) suggested a diffusion-based hybrid recommendation algorithm considering the two roles of the tags that organizes items and connects between user and item. They shows that the latter role of tags is more helpful to recommend items, and the hybrid approach shows the best result. Kim, Alkhaldi, El Saddik, and Jo (2011) modeled users based on their tags. They classified items into two sets, positive and negative, and calculate the tag weights of the items in both sets. After that, they found the relevant topics based on the tags for the recommendation. Research of Gedikli and Jannach (2010, 2013) has conducted to predict the rating of the item by making rating on the tag itself in order to improve the quality of the tag-based item recommendation. Kim and Kim (2012) suggested an item recommendation method based on implicit trust relationships derived from user's tagging information.

2.2. Emotions in recommendation

The relationship between the emotions and user's consumption have been studied in various fields, and many recommendation studies have focused on how the emotions before and after consumption affect the choice of the next item (Chang, 2009; Gardner, 1985; Oliver, 2008; Tkalčič et al., 2011; Winoto & Tang, 2010). Tkalčič et al. (2011) classified emotion into three stages when the user uses the recommendation system and introduced emotion detection methods and emotion usage at each stage. According to this study, user's emotion before consuming items affects user's item selection. On the consumption stage, one emotion or various emotions appear over time depending on the type of content. Finally, emotion after consumption affects the user's next behavior, which is an indicator of whether the user is satisfied with the item. Zheng, Mobasher, and Burke (2013) studied the role of emotion in recommendation algorithms. They studied the recommendation considering emotion feature in context-aware splitting algorithm and differential context modeling algorithm. The evaluation revealed that emotion features improve the recommendation performance. Winoto and Tang (2010) showed that the rating can be biased according to the user's pre-mood, and they proposed a recommendation method considering the rating bias. SenticRank (Xie et al., 2016) is the framework which maps the tag-based user profile to the sentiment space and ranks the resources suitable for the user's query. The research was conducted for personal search, but it can be applied to the recommendation system. Qingbiao et al. (2011) studied a sentiment enhanced tag-based recommendation method which utilizes the positive and negative polarities of tag synsets for calculating similarities between resources. Dong, OMahony, Schaal, McCarthy, and Smyth (2016) applied the sentiment to product recommendation. They proposed an approach to combine the product similarity and the product sentiment; the product sentiment is obtained by extracting features from the user's review and calculate the sentiment of each feature. Kim, Kim, and Jo (2014) proposed a recommendation method for tackling cold start and data sparsity issues in music recommendation systems. The