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A dual-perspective latent factor model for group-aware social event recommendation

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ABSTRACT

Event-based social networks (EBSNs) have experienced increased popularity and rapid growth. Due to the huge volume of events available in EBSNs, event recommendation becomes essential for users to find suitable events to attend. Different from classic recommendation scenarios (e.g., movies and books), a large majority of EBSN users join groups unified by a common interest, and events are organized by groups. In this paper, we propose a dual-perspective latent factor model for group-aware event recommendation by using two kinds of latent factors to model the dual effect of groups: one from the user-oriented perspective (e.g., topics of interest) and another from the event-oriented perspective (e.g., event planning and organization). Pairwise learning is used to exploit unobserved RSVPs by modeling the individual probability of preference via Logistic and Probit sigmoid functions. These latent group factors alleviate the cold-start problems, which are pervasive in event recommendation because events published in EBSNs are always in the future and many of them have little or no trace of historical attendance. The proposed model is flexible and we further incorporate additional contextual information such as event venue, event popularity, temporal influence and geographical distance. We conduct a comprehensive set of experiments on four datasets from *Meetup* in both regular and cold-start settings. The results demonstrate that the proposed approach yields substantial improvement over the state-of-the-art baselines by utilizing the dual latent factors of groups.

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1. Introduction

Event recommender systems have recently gained prevalence with the advent of *Event-Based Social Networks (EBSNs)*. EBSNs allow like-minded people to gather together and socialize on a wide range of topics. Among all the elements in EBSNs, events are the most significant one, which bridges the gap of online and offline interactions. As of December 2015, *Meetup*,[1] one of the largest EBSNs today, has over 24 million members, with approximately 200,000 groups in 181 countries. There are approximately 500,000 events organized every month on *Meetup*. The sheer volume of available events, especially in large cities, often undermines the users' ability to find the ones that best match their interests. Consequently, personalized event recommendation is essential for overcoming such an information overload.

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[1] http://www.meetup.com.

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Users indicate their interest to attend an event by responding to a RSVP[2] for the event. *Meetup* generates over 3 million RSVPs every month. The RSVP indicates a user's preference on an event, and it allows future events to be recommended to the user. At first glance, event recommendation is the same as recommending any other kind of items (e.g., movies and books), with the only difference that the item here refers to an event. However, the key distinction is that EBSNs allow users to organize themselves into groups that are created based on a topic of interest. The events are hosted by groups at venues that are often in the vicinity of the local community. Such group structures are generally not available for other recommendation problems. We can view the group information from a dual perspective: user-oriented and event-oriented. The user-oriented perspective regards a group as a topic of interest so that users associated with a group are interested in the same topic with the group. On the other hand, the event-oriented perspective views a group as an organizing entity. The events organized by the same group have the same organizing style such as logistics, event planning, structure, quality of talks, etc. These two perspectives complement each other and together they form a complete view of a group. For event recommendation, an interesting question here is: how can we leverage this dual perspective of group information to provide effective event recommendation?

Moreover, optimal use of group information can largely alleviate the cold-start problems, which are pervasive in the setting of event recommendation. New events and new users are constantly emerging in EBSNs. Many events published in EBSNs have little or no trace of prior attendance because the events are always in the future and they are often short-lived. Also, as EBSNs grow rapidly, there are many new users joining without record of historical attendance. By knowing the group that organizes the new event, we can expect the organizing style of the event based on the event-oriented perspective of groups. Similarly, by looking at the groups that the new user is associated with, we can infer the interests of the user based on the user-oriented perspective of groups. Therefore, this dual perspective of groups can help address both new item and new user cold-start problems.

In EBSNs, a user may RSVP for an event in the affirmative by a positive response (*"yes"*), or the user may provide a negative response to an event with a RSVP as (*"no"*). The numbers of positive responses and negative responses are largely disproportional. Many users just ignore RSVPs if they are not interested in attending the events. Therefore, it is more desirable to treat event recommendation as the top-*N* ranking task (Kassak, Kompan, & Bielikova, 2016) than a binary rating prediction problem. On the other hand, the absence of a response does not necessarily mean that the user is not interested in the event. It may be that the user is not aware of the event, or that the user is unable to attend this event due to other conflicts. Thus, the event recommendation model needs to take into account not only the positive and negative RSVPs, but also the missing/unobserved RSVPs.

Event recommendation is much less studied in the literature than traditional recommendation tasks such as movie and book recommendations. To address the unique characteristics of event recommendation, we propose a dual-perspective group-aware latent factor model. The proposed model utilizes pairwise ranking by taking unobserved RSVPs into account. In addition to the typical user and item latent factors, two novel latent factors are used to model a group: one for its user-oriented characteristics and another for its event-oriented characteristics. The influences of the groups on the user is then modeled as the linear combination of the latent factors for the user-oriented characteristics of its groups. The experimental results show that the proposed model outperforms the state-of-the-art baselines. The results also indicate that the performance can be further improved when incorporating factors associated with event venue, event popularity, temporal influence and geographical distance. It is worth noting that while adding more features helps, the group influence drives the most performance gain and it is the focus of this work. The main contributions of this paper can be summarized as follows.

- We characterize two different perspectives of groups (user-oriented vs. event-oriented). We make use of these two complementary perspectives in event recommendation, especially for addressing the cold-start problems. To the best of our knowledge, no prior work has studied the dual-perspective of group influence on event recommendation.
- We propose a probabilistic latent factor model by incorporating two different types of latent factors to represent the user-oriented and event-oriented characteristics of groups. Pairwise learning is used to exploit unobserved RSVPs by modeling the individual probability of preference via Logistic and Probit sigmoid functions.
- The proposed model is flexible to further incorporate additional contextual information including event venue, event popularity, temporal influence and geographical distance. We incorporate these additional parameters in our model and study their impact on recommendations.
- We thoroughly evaluate our proposed approach on four datasets from *Meetup*. The results demonstrate its effectiveness compared to the state-of-the-art baselines. The source code and data will be made publicly available once the work is published.

The remainder of the paper is organized as follows. Section 2 covers the related work that is relevant to our study. Section 3 provides data analysis that motivates our models. Section 4 introduces our event recommender models in detail, and Section 5 discusses the experimental setup and the results of this study. Section 6 concludes with a summary and an outline of the future work that will follow this study.

[2] RSVP is a French expression, which means "please respond".

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