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Activating the Crowd: Exploiting User-Item Reciprocity for Recommendation

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ABSTRACT

Recommender systems have always faced the problem of sparse data. In the current era, however, with its demand for highly personalized, real-time, context-aware recommendation, the sparse data problem only threatens to grow worse. Crowdsourcing, specifically, outsourcing micro-requests for information to the crowd, opens new possibilities to fight the sparse data challenge. In this paper, we lay out a vision for recommender systems that, instead of consulting an external crowd, rely on their own user base to actively supply the rich information needed to improve recommendations. We propose that recommender systems should create and exploit reciprocity between users and items. Specifically, recommender systems should not only recommend items for users (who would like to watch or buy them), but also recommend users for items (that need additional information in order that they can be better recommended by the system). Reciprocal recommendations provide a gentle incentivization that can be deployed non-invasively, yet is powerful enough to promote a productive symbiosis between users and items. By exploiting reciprocity, recommender systems can "look inwards" and activate their own user base to contribute the information needed to improve recommendations for the entire user community.

Categories and Subject Descriptors

H.3.3 [**Information Storage and Retrieval**]: Information Search and Retrieval – *information filtering, retrieval models.*

Keywords

recommender systems, human computation, crowdsourcing

1. INTRODUCTION

Today's recommender systems go beyond generating general recommendations to offering specific recommendations for users in particular situations and at certain moments in time. The amount of information needed about an item increases dramatically, since such systems deal not in single items, but rather in pairs, (i.e., recommend a book for a user to read during a specific holiday). The result is a potential exacerbation of the classical sparse data problem. In order to address this problem, recommender systems need a reliable source of information on items that can be used as the basis for recommendation. Such information includes not only views and ratings, but also other sorts of information. In particular, recommender systems oriented to user experience can exploit user comments, reviews, context, and interactions [4]. Conventional recommender systems must wait passively for users to contribute information. However, if a recommender system had the potential to actively "request" more information for certain items (a particular movie), or certain pairs (the suitability of a particular book for an airplane), the sparse data problem could be addressed directly and recommender systems would be able to improve the quality of their recommendations substantially.

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Crowdsourcing, i.e., micro-outsourcing tasks to a large number of general public users, represents a promising mechanism by which recommender systems can actively gather more information to improve recommendations. However, it presents the obvious drawback of how the crowd is to be remunerated for its contribution. We propose that recommender systems turn inward to exploit their own users as a crowd that is capable of contributing information. Instead of financial incentives, we propose using another mechanism to motivate the crowd. Under our vision of a recommender system with crowd activation (illustrated in Figure 1), users are motivated to contribute because the recommender system matches them with items that they find fun and interesting to comment on, review or interact with.

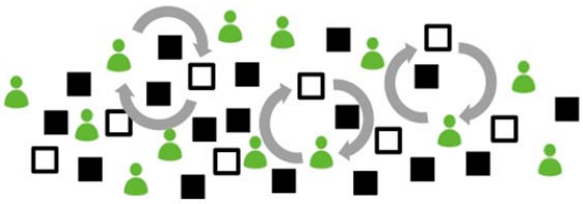

Figure 1: A recommender system with crowd activation. The arrows show reciprocal relationships between a user interested in an item and an item in need of user attention. These relationships motivate user contributions that improve recommendation.

An important characteristic of the user-item match is that it is reciprocal: users are paired with items that lack adequate information and, as such, stand to benefit the most from user contributions. An example might be the following: a new Indonesian restaurant opens in a location that is off the beaten track. Normally, it would take weeks for it to be discovered. The system recommends this restaurant to a person who lives in that area to review. The user enjoys Indonesian food and also is motivated by the thought that this particular review makes a important contribution to improving the recommendation system. The overall result is that better recommendations are attained for the entire user base.

2. ACTIVATION VIA INCENTIVIZATION

In the context of crowdsourcing, *incentivization* refers to the factors that motivate members of a crowd to make a contribution and to care about the quality of their contribution. A categorization of incentives has been established by work investigating commercial crowdsourcing platforms [1][3]. Crowd member

incentives can be divided into two basic categories. The first is *intrinsic motivation*, motivation arising from internal factors such as enjoyment, identification with a community and need for social contact. Note that fun can include crowd members exercising their skill sets, perceived usefulness of the result of work, degree of freedom the crowd member is granted in carrying out the task and feedback on a "job well done". The second is *extrinsic motivation*, which is motivation arising from external factors such as awards, increase in social capital, and external obligation. Note that awards include not only monetary awards, but also other payoffs.

Our vision of a recommender system with crowd activation exploits both types of motivation. However, it emphasizes intrinsic motivation, deploying a recommender system that pairs users with items that they are interested in (triggering a feeling of enjoyment) and at the same time targeting items that need user attention (triggering users to feel that they are contributing). The net effect is that users are satisfied with the recommendations that they received (i.e., that the recommender system is fulfilling its basic function of providing good recommendations) and that they are also engaged to contribute for the good of the community.

The power of these kinds of incentives has been demonstrated by crowdsourcing-based applications such as Podcastle[1] (users contribute to creating transcriptions of podcasts) and Songle[2] (users help to annotate music). As discussed in [2], the motivations for users to use these systems include fun, desire to contribute, and a close connection to the content (e.g., they are fans of the person speaking in the podcast). The authors of [2] report that the quality of the contributed information is high, exceeding what would be possible using a commercial crowdsourcing platform. These applications, in contrast with our own vision, do not pair users with content, rather users must search to make their own matches. We anticipate reciprocal recommendations to actively match users to items not only interesting to the users, but also in need of annotation.

3. USER-ITEM RECIPROCITY

The vision for recommender system with crowd activation that we put forward in this paper aims to create a symbiosis between users and items. Two considerations must be taken into account for realizing such a symbiosis. First, the users who are recommended to items should be not only interested in those items, but also have a certain amount of knowledge about the items. In other words, the users should have the potential to enrich the data for the cold/tail items. Second, it is also necessary to have mechanisms that make users willing or even eager to provide data for those items, to which they are recommended. Although the first consideration may still fall in the conventional scope of recommendation, the second consideration will require extending existing recommender system algorithms. A promising direction for providing this extension is building on existing work in *reciprocal recommendation*, which creates a bidirectional match between the target item and the target user. The classic example is dating recommendation, which generates pairs of users with mutual preference [5]. In order to establish a truly productive symbiosis, the concept of reciprocal recommenders must be extended to scenarios in which item related constraints, like duration of availability, novelty, interestingness, intrinsically limit the potential users the item can be recommended to. The ways in which reciprocal preference modeling can improve recommendation must also be understood, including the relation between the recommendations and the response rate, the collection of a critical amount of feedback to better characterize media content, the duration of the cold-start for new users and contents, and optimization not only for users but also business objectives.

4. CONCLUSION AND OUTLOOK

We have introduced a vision for the combination of crowdsourcing and recommender systems. Our insight is that recommender systems need look no further than their own user base for a crowd that can contribute the rich information needed to address the sparse data problem faced by recommender systems. By using reciprocal recommendation to identify not only items that are suited to users, but also users that are suited to items, we propose that it is possible to create an incentivization for users to contribute information on items. The resulting symbiosis between users and items will generate richer, high-quality information, leading to an overall improvement of recommendations. In this paper, we emphasized real-time and context-aware recommendation as contributing to the sparse data problem. We would also like to mention that other factors could be important as well. For example, for the task of video recommendation, it is increasingly interesting to recommend not only whole videos, but also time-points within specific videos. It might be that rich information at the time-point level is only possible if actively recruited users are also interested in specific videos. They would then be interested in interacting with and tagging videos along their entire length. Further, by activating the crowd, we can move beyond the problem of addressing sparse data to the problem of addressing low quality data. The crowd can not only contribute, but also validate information that is used as a basis for recommendations. In closing, we would like to mention the practical side of our vision. We will soon start a large project dedicated to this idea, which will develop algorithms for user-item reciprocity and also validate them in a real-world setting.

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