ENHANCED RECOMMENDER SYSTEMS THROUGH CROSS-DOMAIN KNOWLEDGE TRANSFER

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CERTIFICATE OF AUTHORSHIP/ORIGINALITY

I certify that the work in this thesis has not previously been submitted for a degree nor has it been submitted as part of the requirements for a degree except as fully acknowledged within the text.

I also certify that the thesis has been written by me. Any help that I have received in my research work and the preparation of the thesis itself has been acknowledged. In addition, I certify that all information sources and literature used are indicated in the thesis.

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Abstract

Recommender systems are widely used and have developed rapidly with the explosion of Web 2.0 technologies. The aim of recommender systems is to provide users with items (products or services) that match the users' preferences. Recommender systems provide users with personalized online product and service recommendations and are a ubiquitous part of today's online entertainment smorgasbord.

However, many real-world recommender systems suffer from data sparsity and user-preference drift issues which degrade the recommendation performance and lead to a poor user experience. For the user-preference drift issue, time-window and instance decaying approaches are widely applied, but one research gap is that existing methods proposed for adaptation and weighting decay are biased, since the direction of user preference drift was not appropriately addressed in their study. For the data sparsity issue, cross-domain recommender systems are used to handle data sparsity issues. These systems transfer knowledge from one domain that has adequate preference information to another domain that does not. One significant research gap in the existing methods is that they cannot ensure the knowledge extracted from the source domain is consistent with the target domain, which may impact the accuracy of the recommendations. This research addresses the aforementioned research gaps.

In this research, to solve these problems and enhance recommender systems, a user profile is enhanced with more information in various domains, including data in different time windows and different categories. For recommender systems with time labels, fuzzy set and fuzzy relation theories are adopted to model uncertain user behavior. A distance measure together with a related statistical guarantee is proposed to detect whether a user preference has drifted or not. A fuzzy user-preference drift detection-based recommendation method is proposed to model user preference and predict user ratings in temporal dynamics. For a cross-domain recommender system, to ensure knowledge consistency between the two domains, two sets of methods are developed for two different scenarios. For cross-domain recommender systems with non-overlapping entities, an adaptive knowledge transfer method for cross-domain recommender systems with consistent information transfer is proposed and applied to a telecom product recommender system and a business partner recommender system (Smart BizSeeker). Knowledge consistency is based on user and item latent groups, and domain adaptation techniques are used to map and adjust these groups in both domains to maintain consistency during the transfer learning process. For cross-domain recommender systems with partially overlapping entities, a kernel-induced knowledge transfer method is proposed. Domain adaptation is used to adjust the feature spaces of overlapping entities and diffusion kernel completion is used to obtain the non-overlapping entity correlations between two domains. It shows even with a small number of overlapping entities, knowledge transferred from the source domain to the target domain is very applicable and beneficial.

To conclude, this research addresses user-preference inconsistency which occurs in recommender systems in both different time windows and different categories.

Different contexts (e.g. time) can be treated as different domains. Thus, this research aims to improve prediction accuracy and enhance recommender systems through cross-domain knowledge transfer. Extensive experiment results show that our proposed methods can generally achieve significant improvement in accuracy compared with the existing approaches.

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