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Cross Domain Recommendation Using Semantic Similarity And Tensor Decomposition

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Abstract

Online shopping has become the buzzword in this information age. Users want to purchase the best possible item and services at the shortest span of time. In this information age Recommender system is a very useful tool, because it has the capability of filtering the information according to user interest and provide personalized suggestion. One of the major drawbacks of the classical recommender system is that, they deal with the only single domain.In real world scenario domains could be related to each other by some common information. There are many approaches available for cross domain recommendation, but they are not able to provide better accuracy of high dimensional data and these approaches are suffering from data sparsity problem. In this paper, we deal with cross domain recommendation where we exploit knowledge from auxiliary domains (e.g., movies) which contains additional user preference data to improve recommendation on the target domain (e.g., books).. In order to achieve a high level of accuracy, we make use of semantic similarity measure of common information by which domains are related and Tensor decomposition to exploiting the latent factor for high dimensional data**.** Tensor decomposition with semantic similarity is used for making cross domain recommendation where in the data sparsity problem is avoided by normalizing and clustering the data in auxiliary domain. We provide experimental results on real world data sets and compared our proposed method with other similar approaches based on hit ratio and the results show that we achieve a better hit ratio.

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Keywords: Collaborative filtering; Tensor decomposition; Semantic similarity measure; cross domain recommendation

1. Introduction

The usage of e-commerce sites are increasing day by day as people want to purchase the best item at the best possible price. The recommender system helps in dealing with filtering information according to a particular user's preference/interest. For instance, many recommender systems are available for recommending movies/books (Netflix for the movie recommendation and Good reads for recommending books). It is usually the case that recommender systems makes use of rating data (how a user rates a movie) and genre information (science- fiction, comedy, etc.) in order to recommend movies/books. It is also the case that review information from users related to a particular movie/book is taken into consideration by recommender systems for making good recommendation. One of the major drawbacks of most existing recommender systems is that they recommend items to users for only a single domain. For instance, Netflix suggests only movies and Good reads suggests only books. In this paper our focus is on cross domain recommender systems. The intuition

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behind cross domain recommender system is that domains of items (books/movies) could be related to each other in some respect. For example, if some user likes romantic movies, then he/she may have a preference for romantic music as well as romantic books also. More specifically, we can view cross recommender system as if we have an auxiliary domain (A) and target domain (T) and these auxiliary and target domains are represented as set of T /A = {U, I} where U is a user rating matrix and I is item rating matrix in that domain. We have to find some utility function *f* in such a way that $U_T \times I_T \rightarrow 0$ or 1 by taking the help of U_A and I_A. For example, if we consider Table I as auxiliary domain (movie) and table II as target domain (book) and U_T and I_T are user and item rating matrix of target domain, then Our aim is to recommend a movie to user by taking help of U_A and I_A, which are user and item rating matrix of the movie domain (auxiliary) respectively.

Table 1 Example Data For Movie Domain

User	Tag	Item
U1	Romance	The Longest Ride
U1	Romance	Cinderella
U1	Family	Cinderella
U1	Horror	Cinderella
U2	Mystery	Unfriended
U2	SCI-Fic	Unfriended
U3	SCI-Fic	Inception
U3	Family	The Matrix
U4	Family	Rango
U4	Mystery	It Follows
U5	Mystery	Gone Girls
U5	Fantasy	It Follows

Table 2 Example Data For Book Domain

User	Tag	Item
U1’	Fantasy	Dark lover
U1’	Romance	Dark love
U2’	Romance	Easy
U3’	Family	Roots
U4’	Horror	Night Shift
U5’	Mystery	Night Shift
U5’	SCI-fic	Ender game

If we see Table II, U3’ has read only family book. If one wants to recommend some books to U3’, he/she is a unable to recommend because no-one has read a family book in book domain in Table II

Transfer learning has been well utilized in collaborative filtering as rating matrix, i.e. as a binary relation [11]. We have taken three dimensional data for both movie and book domain. These ternary relations can be transferred to binary relation as follows. For example, in Table I (User–Tag-Item) can be transferred to (User-Tag, Item-Tag and User-Item) binary relation.. Shi et. al used tag as a bridge between domains for cross domain recommendation by decomposing ternary relation to binary relation [13]. They have used User-Tag and Item-Tag binary relation only. If we take an example of binary relation from movie domain based on the User-Tag relation, U3’ is similar to U1 and U4 in the movie domain and therefore we can recommend romance type of books like Dark Lover and Easy book to U3’. Cross domain recommendation makes use of knowledge transfer across different domains, thereby increasing prediction accuracy. It has other advantages like to addressing cold start and data sparsity problems. There are many methods used for cross domain recommender system these approaches are based on transfer learning. To improve the transfer learning many computational intelligence techniques emerged. Most of the used methods are based on matrix factorization based approach. But as we know some user might have rated movies/books based on some latent factors and if we decompose the ternary relation to binary, we may lose that latent factor, i.e. there is a chance for loss of information. This can affect prediction accuracy and the main aim of the cross domain recommendation system to have higher prediction accuracy. That is why we are not decomposing higher dimensional data to binary relation.