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Recommendation System for Tree Structure Data Based on Fuzzy Preferences and Clustering

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Abstract: Allwebsites are using personalized Recommendation system to suggest right product to the customer. Existing system handles tree structured items and uncertainty in user preference but it takes high memory, time and computation requirement. To overcome this issue new system is proposed with increased performance.
Keywords: Fuzzy set, Recommendation System, Clustering, Tree similarity, Tree merging.

1.Introduction

Recommender systems are used by E-commerce sites.they help users to select right product in less time .E-commerce sites have loads of information so recommender system works as information filtering technique. Recommender system recommend items to the user based on the past buying behaviors or items purchased by similar users like CF systems or based on preference given by the user.

In CF systems user ratings are expressed as binary values. Rating greater than 3 are considered as item liked by the user and less than 3 as item disliked by the user same rating can have different meaning to different users so ratings depend on the particular human thinking process. This all contributes to Fuzziness.

Item attributes and user behavior are subjective, not clear and inaccurate. These all contributes to uncertainty. To handle this uncertainty Fuzzy theory is used to represent item features and user behavior.

Items or user profiles in ae-commerce sites and in other B2B sites have complicated structures, such as tree structures. ; . In earlier approaches, an item is normally described as a single value or a vector. This study resolve challenges like, Tree structured data,tree structured user preferences, uncertainty in user preferences ,personalization problem in Recommendation system and propose a fuzzy tree structured user preference tree based recommendation system.

Recommendation system Techniques**:**

1.Collaborative Filtering : A collaborative filtering recommendation system recommend items to the user based upon the recommendation of similar user's..[1], [7]

2.Content based Recommender Systems: content based recommendation system recommend items to the user based on the items purchased in the past history and profile of the user.[5]

3. Knowledge base Recommendation system: There are many items which are not purchased frequently so very less ratings are available for these items. In this case knowledge based recommendation system is used. User gives his preferences for the items then items are recommended based on these preferences.[3],[11]

4.Demographic: This technique use information about the user like age,gender,location ,occupation etc.similar users are find out based on this demographic information.[3]

5. Hybrid Recommendation system: this technique combined any two approaches to remove issues in recommendation technique.[6]

Issues in Recommendation System**:**

1.DataSparsity : When there is very less ratings about items then it is very difficult to recommend items to the user.CF systems suffer from this problem.

2.Cold Start: There are two kinds of cold start problem, new user and new item problem. There is no information about new user and new item so it is difficult to recommend items.

3.Scalability: It is the ability of recommendation system to handle growing amount of information. Information about the user and item grows rapidly on the internet. CF systems Becomes expensive to handle growing amount of information and gives inaccurate recommendations.

4.OverSpecialization : Recommendation systems recommend items based on previous history.

User's does not get diversified recommendations.

I. Literature Review

[1]. This paper proposes a Tag based collaborative filtering Recommendation approach for personal learning Environments (PLE), s. Here 16 different tags based collaborative Filtering recommendation algorithms are implemented and compared in terms of accuracy and user satisfaction. User generated tags are combined with traditional collaborative filtering ecommendation. <User-item> Relation converted into the <user,item,tag>relation.. The result of evaluation shows that there is no relation between quality of user experience and high recommendation accuracy measured by statistical measure.

[7].This paper proposes a different approach of CF recommendation system based on object typicality and clustering. similarity of user,s is find out by comparing typicality degree of user,s instead of corated items.this approach solves the problem of Data sparsity and recommendation accuracy.

[3]. This paper proposes a recommendation system for real estate websites that helps users in purchasing new properties or homes. Recommendation system is developed by combining case based reasoning (CBR) and Ontology. Earlier systems supports single attribute search systems but this system support multivalued search system. User search behavior is studied and a knowledge base is prepared.

Then the semantic meaning of attributes and relationship between them is defined by ontology. Result shows that this approach is efficient and affordable for housing search in real estate websites.

[4] This paper proposes a hybrid collaborative filtering recommendation approach based on user preferences and item features. Traditional collaborative filtering recommendation approach have challenges like 1) Data sparsity2) scalability 3) Similarity. To solve these challenges a recommendation algorithm is proposed based on user preferences and item – features. The proposed algorithm is more accurate than other traditional CF methods. it also removes the problem of data sparsity to some extent.

[5]. This paper proposes a new approach of content based Recommendation system that is based on Transfer learning. This approach solves the problem of data sparsity when there is lack of information in target domain but there is sufficient information in other domain. A behavior graph model is prepared From the user preferences. BGM method is compared with other cross domain methods like KNN cross domain method. The result shows that performance of BGM is better than KNN.

[6]. A hybrid recommendation approach for e- learning environment is proposed. Two types of attributes are considered for learning resources 1.Explicit attributes like subject and name of the publisher 2.Implicit attributes can be extracted from the historical ratings of learners. Explicit attribute based RS and implicit attribute based RS prepared and combined to give accurate recommendation, s for learners.rating prediction is done by NNCF. This recommendation approach resolve the problem of Data sparcity, cold start and provide more diverse recommendation list sentences.

II. System Architecture

A.Existing System

Existing system uses fuzzy preference tree model to represent preferences of user towards particular item or feature.For recommendation user's preferences must be captured. User's preferences can be recorded either intentionally or extensionally.

1) Intentional Preferences: Intentional preferences are directly taken from user and expressed in fuzzy preference tree.

2) Extensional Preferences: Extensional preferences are captured when user uses any item and then gives rating or feedback for the item. Feedback or rating given for particular item (Tree structured) is merged into the Fuzzy preference tree of the user

Preference values are expressed in terms f fuzzy format like

Preference value (0/1, 0/2, 0/3, 0.9/4, 1/5) indicates that user likes an item by high membership degree "1" on 5 and very high membership degree 0.9 on 4.

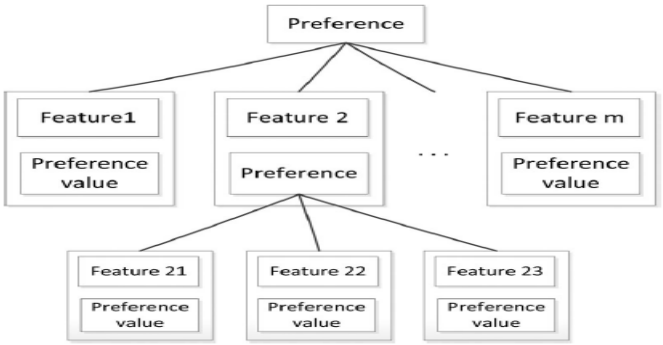

Fig.1 Intentional expressed preference

There are two main modules in Existing system.

(A) Fuzzy preference tree construction

(B) Recommendation

Fuzzy Preference Tree Construction**:**Fuzzy preference tree construction is incremental process. Item which are experience by the user are added into user's fuzzy preference tree. . As user uses the items, fuzzy preference tree of the user grows. Generation of fuzzy preference tree is incremental process.Process of merging user's item preference tree Ti into User preference fuzzy treeTu is described as follows.

1) A maximum conceptual similarity tree mapping between Tu and Ti,Mu,i , is constructed to identify the corresponding parts between two trees using conceptual similarity Algorithm.

2) Merging of item tree Ti into user preference tree Tu using Tree merging Algorithm

Ex. T1 is user,s intentional preference tree, T2 is extensional preference tree, conceptual similarity is find out between twoTrees and then merging is done according to mapping of nodes

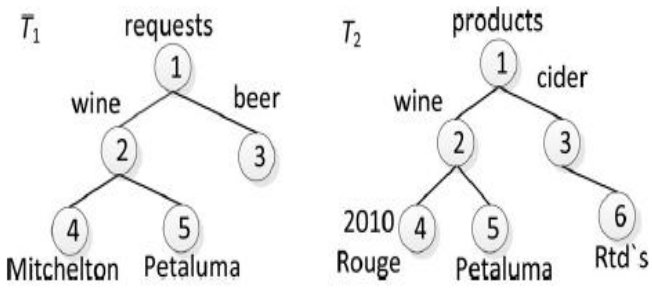

Fig.2 Two tree structured data examples

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1 June 2016

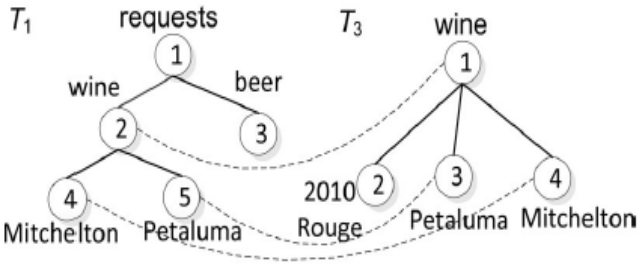

Fig.3 Maximum conceptual similarity between T1 and T2

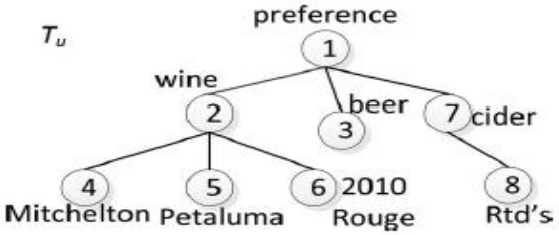

Fig.4 Constructed fuzzy preference tree

(B) Recommendation**:** Rating prediction algorithm is proposed for recommendation.

Issues in the Existing system:In existing system to recommend the items to user, preference for each item available is predicted. To predict the preference value there is need to find conceptual similarity in item tree and user preference tree. Therefore if there are n available items for recommendation then there is need to run 1)Tree matching Algorithm and 2) preference prediction algorithm , n times. If there are large number of items then recommendation process need high computation, memory and time. There is need to recommend the items to user with minimum computation, memory and time requirement.

*B.*Proposed System

Fig.5 shows block diagram of the proposedsystem. Proposed System can be divided into3 modules.
A) Fuzzy tree structured preference generation
B) Clustering
C) Recommendation
Each Module has sub modules as shownin figure 1
Proposed system is extension of the existing system described in above sections with aim to minimize the requirement of computation, memory and time for single recommendation. Proposed system uses item clustering for recommendation to overcome the problem in the existing system. Proposed system is based on heuristic that if user prefers any item i then there are high chances user will prefer similar item to the i and will not prefer items which are not similar as i.. Figure 1 shows the block diagram/ System architecture of the Proposed System. Description of each block is as follows.

A) Fuzzy Tree Structured Preference Generation

Same as existing system, items expressed using tree structure and Preference values are given in Fuzzy sets form.

B) Clustering

Therefore in proposed system first all items are clustered and based on the cluster of the preferred item of the user recommendation is done and all other clusters are discarded.

3) Item Clustering

In proposed system, Item will be kept in clusters. Similar items will be in same cluster and different items will be in different clusters. As k-means is mostly used clustering technique, k-means clustering will be used for clustering items. To find the difference between two items, tree matching algorithm which finds the conceptual similarity in two trees will be used.

4) Preferred Cluster for user

For each user preferred cluster is evaluated. If there are k clusters then, one item from each cluster is selected randomly. {I1, I2, I3, …Ik} where Ik denotes the item from kth cluster. For each selected item preferences will be predicted as in existing system. Cluster of the Item Im whose predicted preferences/Rating is highest is the Preferred Cluster for that user. Items from only preferred cluster will be used for recommendation process for that user.

C) Recommendation

5) Prediction of preferences

To recommend the items to the user, preferences of the items in the preferred clusters are predicted using method in the existing system. Number of items in the preferred cluster is less than total number of items, therefore less number of preference prediction is done than existing system.

6) Recommendation based on Predicted preferences

Once the preferences of the items in the preferred clusters are completed, items with high predicted preferences are predicted to the user. Fuzzy preference tree generation and clustering are the continuous process and they can run in parallel manner without depending on each other. Recommendation of the items is needs preferred cluster and user preference as input.

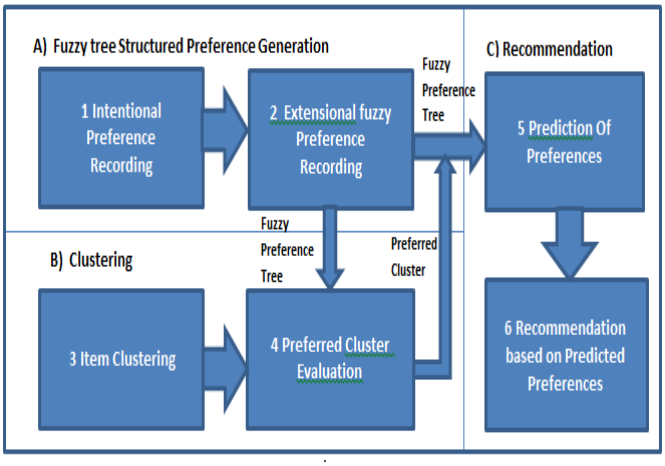

Fig.5 Cluster based recommendation system using Fuzzy tree structured Preferences.

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III. Experimental Results

Proposed system extends existing Fuzzy Preference Tree-Based Recommender System to reduce the computation and time requirement in recommendation.

To validate the effectiveness of proposed system 4 parameters are used.

- Precision = | {preferred} ∩ {recommended}| / |recommended|
- Recall = | {preferred} ∩ {recommended}| | {preferred}|
- Time Requirements : It is expected that proposed system will require less time than existing system
- Memory Requirements :It is expected that proposed system will require less memory than existing system

we will compare the recommendations of proposed system with existing system. During evaluation existing system's recommendations are considered as ideal because effectiveness of existing system is proved in [Reference number of base paper].

HetRec 2011 dataset is extension of Movie Lens dataset was used for experiments. Dataset contains information about movies, tags given by users, actors in the movies, directors of movies, genres and rating given by users. Total dataset contains data of 65k movies. For experiment purpose we will use subset of the whole dataset. 3 subsets are taken from whole data with 100, 200,300 movies data.

Precision and recall is calculated from above formulas. Preferred items are taken from recommendations of the existing system. Recommendations of 10 random users are done for each dataset by proposed and existing system. Precision and recall of each recommendation is calculated. Mean of all precision and recall will be considered as shown in table 1. It is expected that, proposed system will give high precision and recall; it means that proposed system will give similar recommendations to the existing system.

If there are n items in the dataset, to recommend the items to user u1 existing system predicts the preferences for all available n items. In proposed system preferences of k + (m-1) will be predicted for recommending items to one user, where k (k<<<n) is number of clusters and nk (m<<n) is number of items in the preferred cluster. Consider prediction of preferences of one item requires 1 ms. Values in table 1 are calculated using k=5 and m is varied from 20 to 60.

Dataset	Precision	Recall
100M	0.92	0.90
200M	0.90	0.88
300M	0.87	0.84

Table 1. Precision and recall of proposed system

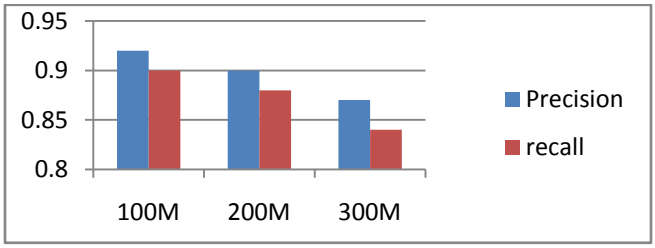

Fig. 6Precision and Recall

Dataset	Time in ms for recommendation by existing system	Time in ms for recommendation by proposed system
100	100	24 (k=5and m=20)
200	200	44 (k=5 and m=40)
300	300	64(k=5 and m=60)

Table 2.Comparison of time requirement for recommendation by existing and proposed method

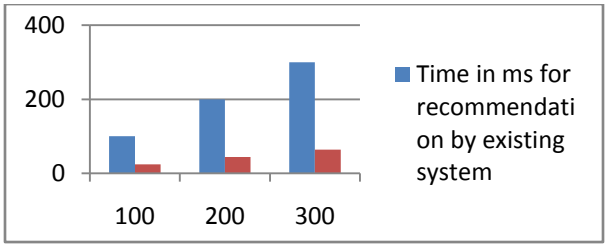

Fig.7Comparison of time requirement for recommendation by existing and proposed method

Dataset	Memory in kb for recommendation by existing system	Memory in Kb for recommendationby proposed system
100	200	48 (k=5 and m =20)
200	400	88 (k=5 and m=40)
300	600	124(k=5 and m=60)

Table3:Comparison of memory requirement for recommendation by existing and proposed method

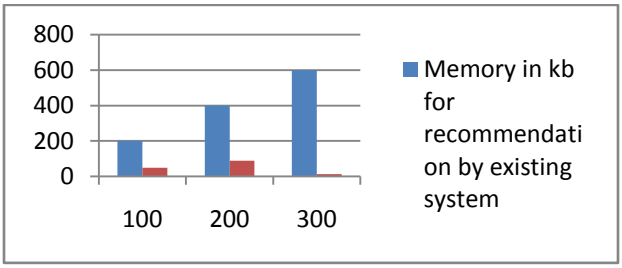

Fig.8 Comparison of Memory requirement for recommendation by existing and proposed method

IV. Conclusion

This paper Describes the Tree-Based Recommender System and identifies the problem in this system i.e. existing system needs to predict the preferences of each item in the database which results into high computation ,memory and time requirement. To overcome this issue existing system is enhanced with clustering of items.

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