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A Hybrid Approach to Social Context Based Scalable Recommender System

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Abstract

Social networking sites produce an exponential amount of information and it is necessary to incorporate scalable recommender systems. In Existing Recommendation Techniques, Social Relationship Information has not been fully used. It is hard to find the contextual factors and integrate them into efficient recommendation framework. In addition to that, Prediction qualities are the most important challenges. This paper analyses this recommendation problem on the basis of psychology of the person and social relation among the persons, that exhibit two factors – User's Preference and Relationship Influence. It proposes Hybrid Filtering Approach to incorporate user's preference and relationship influence. This paper uses the priority based ranking algorithm to improve accuracy of social recommendation.

Keywords: User's Preference, Relationship Influence, Hybrid Filtering Approach

1. Introduction

The Large amount of information generated by social networking sites demands effective and scalable recommender systems to give useful results. Recommender Systems attempts to suggest the items that are likely to the interest of users. Traditional recommendation techniques do not consider interpersonal relations, making them difficult to provide efficient recommendations. Ma et al [1], proposed a social recommender systems that use the social relation data, from which information about their relation are influenced. But the social contextual information was not fully adopted in this work. It is difficult to find social contextual factors from the contextual information.

For example, in Facebook, when a user receives a item that is posted by the sender (may be his friend), he usually reads the content to see whether the item is interesting. We can get this information, from item content and user-item interaction information. In this case, the user cares about who the sender is and whether the sender is a close friend or others. If the user receives the same item from more persons, then probability of reading that item will be more. This information can be gained from relationship and user-user influence information. Both of these aspects are important for the user to decide whether to share (adopt) the item. The above can be summarized as (i) user's own preference and (ii) Relationship influence.

The psychological and sociological studies have proved that user's own preference and relationship influence affect user's item adoption decisions. In Bond's work [4], it is indicated that purely preference based approach is less accurate. This work demonstrates that the inclusion of relationship influence into the preference based decision process which is more complicated and thus increases the unpredictability of the item adoption. Therefore, only when user's own preference and relationship influence are properly incorporated into recommendation, the uncertainty can be reduced and quality improved.

To address this problem, we propose a social contextual recommendation model. This model is based on a Hybrid Filtering approach to incorporate user's preference and relationship influence to improve the accuracy of recommender system.

More specifically, we filter the user-item interaction matrix into two intermediated latent matrices including user-item influence matrix and user-item preference matrix, which are generated from three objective latent matrices: user latent feature matrix, item latent feature matrix, and user-user influence matrix. Moreover, as we can partially observe

individual preference and interpersonal influence based on previous user-item and user-user interaction data, we further utilize the observed social contextual factors to compute the three objective latent matrices.

2. Related Work

In this section, several major approaches of recommendation methods are analysed. Content-based filtering and collaborative filtering have been mostly used for recommending the items to users. With the evolution of online networking sites, researchers have designed trust-based and influence-based methods to gain the knowledge from user relationships.

Content-based filtering introduces the basic idea of ranking problem on the basis of item content. With the evolution of topic modeling distribution, the current trend of content-based approaches identifies user's preferred items. These approaches working on individual preference is not able to get knowledge about user behavior patterns.

Collaborative filtering methods, which consists of Item-based and User-based methods are mostly used. The user-based approaches calculate the similarity between all users based on their ratings of items. Liu et al. [5] build a model-based collaborative filtering approach with user-interests item to help ranking of items based on preference. Collaborative filtering only utilizes interaction of users with items, but it is not able to make full use of relationship among users and social knowledge that includes user profiles and item content.

The matrix factorization model uses the user-item rating matrix and latent feature matrix for recommendation with low dimensional value. The relationship influence focus the dynamics of social networks, influence-based recommendation involves interpersonal influence into social recommendation cases. SoCo [2], a novel context-aware recommender system handle the contextual information by applying random decision trees to partition the original user-item-rating matrix such that the ratings with similar contexts are grouped. SoRec [1] uses the factor analysis approach based on matrix factorization to solve the data sparsity, scalability and poor prediction accuracy problems by considering person's own behavior on the web. Huang [3] uses the approach to model the utility of a social recommendation through combining different factors that is user's interests, item content and influences to improve the quality of recommender systems by incorporating users' social relationship information. But this work only considers users' individual interest from interpersonal side, which makes the framework lack of complete contextual information to further improve the performance.

Author defines abstract with the fast development of social media, the information overload problem becomes increasingly severe and recommender systems play an important role in helping online users find relevant information by suggesting information of potential interests[8]. Author present a novel framework in which the link prediction problem in temporal social networks is formulated as trajectory prediction in a continuous space[7]. Trust & Share (T&S) in [9] aims at providing relationship-based access control in the Facebook realm. T&S is a third-party Facebook application, designed to support a flexible and controlled sharing of user data. [10] present a collaborative filtering approach for predicting QoS values of Web services and making Web service recommendation by taking advantages of past usage experiences of service users.

However, it is a serious issue to find what motivate user adoption on recommended items. For social networks, the factors exactly represent user's preference and relationship influence. This encourages proposing a social contextual recommendation framework to incorporate them by identifying both the user's influence and the mechanism to recommendation systems for social networking sites. In this paper, both user's preference and relationship influence are used in an effective way..

3. Proposed Work

In this paper, the first task requires the recommender to predict whether the particular user adopts the specific item. Then, among the adopted items, ranking should be done based on priority for accurate recommendation.

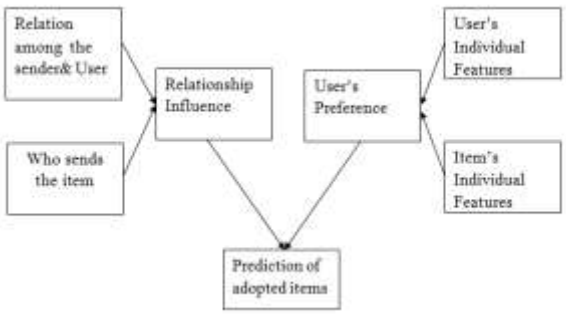

Figure 1: A Social Recommendation Framework

3.1 Data Collection

The data for this experiment include users, items, ratings given by user to items, interaction among users, social relationship among users and the item's latent Features. The interaction among users, ratings, user-item interaction and the social relationship is derived from facebook type website where the relationship among users may be friends or mutual friends. The specific features of items are derived from snapdeal website. Here in user-item interaction, the items are derived based on the specific context. Based on the context snapdeal website is crawled to find the item's features.

3.2 Preference Analysis

In this section, the probability of user's individual preference on different items is identified. This analysis is based on user's latent features and item's latent features. The item's latent features are known from dataset. The user's latent features are identified by using the concept of Content based filtering. The Content based filtering approach explains that based on the user's rating, the user's preferences are identified. Based on this concept, we derived the user's latent features by means of using ratings. The highest ratings given by user on items are identified and that item's features are more or less similar to the user's latent features. Based on this user's latent features and item's latent features, the individual preference of user on particular item is identified.

$$P_{i,j} = | X_{i,k} - Y_{j,k} |$$

where $P_{i,j}$ is the preference of user i on item j ; $X_{i,k}$ is the latent features k of user i and $Y_{j,k}$ is the latent features k of item j.

Algorithm 1: Content Based Approach

Input: user individual features, Item individual Features.
Output: Highest Preferred Items

```
For each user
    For each item
        Difference => User's features - Item's features.
        Lower the difference, higher the preference.
        Return preferred items of user.
    End
End
```

3.3 Influence Analysis

In this section, the user item influence is identified by the influence between the users and who the sender is. This is identified by using Collaborative Filtering approach. This approach identifies the similarity between the users using social relation. For example, if two users are friends, their tastes will be similar. This paper uses this concept in which if a person is close to user, then his influence will be more on user. For other relations, the influence will be less. Thus, if the sender is close to user and if he sends an item to the user, that item will be more influenced by user.

$$I_{i,j} = Q_{i,l} \text{ Ú } R_{l,j}$$

Where $I_{i,j}$ is the influence of user i on item j; $Q_{i,l}$ is the influence between receiver i and sender l and $R_{l,j}$ is the sender l of item j.

Algorithm 2: Collaborative Approach

Input: Item Sender, Relation among Users.

Output: Highest Influenced Items by other users

```
For Each user
    For Each Item
        Identify which user sends the item
        Identify the relationship between sender and user
        Closer the relation, influence is higher.
        Return Highest influenced item of user
    End
End
```

3.3 Prediction

This model predicts whether the user adopts the item or not in a more accurate manner. The major problem in this prediction is that whether the user reads and refuses the item or the user did not read the item. The first problem is solved by using hybrid filtering approach. A Threshold value (T) is set to both influence and preference. If the predicted influence on a item is more than the threshold value and his individual preference is also more than the threshold value, then that item

will be adopted by the user. The second problem is solved by Session approach. This approach identifies that whether the user is Online, while receiving that item. A Session parameter is set to calculate his Session length.

$$A_{i,j} = (P_{ij} > T) \; n \; (I_{ij} > T)$$

where $A_{i,j}$ is the predicted item adoption, P_{ij} denotes the individual preference and I_{ij} is the interpersonal influence and T is the threshold value.

Algorithm 3: Hybrid Filtering Approach

Input: User's Own preference, Relationship Influence
Output: Predicted User Adopted Items
For each User
For each Item
Set Threshold Value
Identify items in which both Influence and
Preference is more than threshold value
Return the items
End
End

3.4 Ranking

After predicting the user adopted items, the items are ranked based on the highest priority algorithm. This algorithm ranks the list of adopted items by the user, by predicting how much the user likes the item. This ranking is done to improve the efficiency of the recommender system.

4. Implementation

4.1 Data Collecton

We have collected our datasets from facebook of 10,499 users. It includes social relationship among users, user shared items, ratings for the item. Although we have extracted the features of items i.e mobile from snapdeal that includes price, operating system, ROM, Rear camera and its battery.

4.2 Preference Analysis

User's individual preference is identified from user's latent features and item's latent features. The features of items is analysed from dataset. The features of users are identified by correlating the ratings given by the user to the item and the features of that item. Based on the user's features and item's features, it is identified whether the user preferred that item or not.

4.3 Influence Analysis

The user's interpersonal influence is identified by analysing who will be the item sender and the social relationship among the sender and user. If the item sender is close friend to the user, then the sender has more influence on that user because close friends are like minded and hence the user has more influence on that item.

4.4 Prediction

The prediction framework is based on Hybrid Filtering Algorithm. Here the influence is analysed by using the concept of collaborative filtering and the preference is analysed by using the concept of content based filtering. Thus by correlating both preference and influence, the user adopted items will be predicted.

4.5 Ranking

After predicting the items adopted by the particular user, the items must be ranked for recommendation to the user. This ranking is based on the priority of the user given to the item in both preference and influence.

4.6 Performance Measure

In order to compare hybrid filtering approach with other approaches, this paper uses a popular metric called MAE (Mean Absolute Error). This MAE is defined by

$$\mathbf{MAE = 1/|A| \; \Sigma_A \; | A_{i,j} - Q_i . R_j^T . X_i^T Y_j |}$$

where $A_{i,j}$ is the predicted item rank.

Table 1: Performance Measure

PREDICTION/ METHOD	CONTEXT MF	HYBRID FILTERING
PREDICTION BY USING PREFERENCE	0.303	0.280
PREDICTION BY USING INFLUENCE	0.310	0.285
PREDICTION BY USING PREFERENCE & INFLUENCE	0.242	0.201

Figure 2: Performance Measure

5. Future Work

The current approach considers the ratings given by the user to predict the user's likely items. In future, ratings along with the comments given by the user to the item received will be considered to predict more accurately. The existing system uses the hybrid filtering algorithm for prediction. In future, novel filtering algorithm can be used to get accurate results.

6. Conclusion

This project proposed the hybrid filtering approach utilizing user's own preference and relationship influence. User's own preference refers to which items does user likes and relationship influence refers to the social relation between the item sender and the item receiver. This approach is applied on social networks and predicted that consideration of relationship influence improves the accuracy. The experimental analysis proved that this approach provides better results than existing system in terms of accuracy. This approach is very effective and highly adapted to the different type of the real world scenarios.

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