# Study on Collaborative Methods for Recommender System

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**Abstract – Recommender systems are being very popular in todays online scenarios including social sites, ebussiness sites to improve the promotions, sales and links. Recommender systems are the intelligent system that performs a proper analysis on user and the required criteria to suggest some similar or better services or products. In this paper, a study of the significance of recommender system is provided for different applications. The paper has described common recommendation system methods in detail in constraint specification. The major concern of the paper is to formulate the features and different processes of collaborative recommender system with relative measures.**

**Index Terms – Recommender System, Collaborative, Content Based, Probabilistic.**

## 1. INTRODUCTION

Recommender system is an intelligent system that makes suggestions about items to a user. We can also define the recommender system as a system which produce individualized recommendations as output or have the effect of guiding the user in personalized way to interesting or useful items in a large space of alternatives. The most famous online recommender system is Amazon, which suggests books and other articles to their customers.

### *1.1 Types of Recommender System*

*1. Content based Recommender System:* content- based recommender system i.e. system that recommend an item to a user based upon a description of the item and a profile of the user's interests. Content-based recommendation systems may be used in a variety of domains ranging from recommending web pages, news articles, restaurants, television programs, and items for sale. Although the details of various systems differ, content-based recommendation systems share in common a means for describing the items that may be recommended, a means for creating a profile of the user that describes the types of items the user likes, and a means of comparing items to the user profile to determine what to recommend. The profile is often created and updated automatically in response to feedback on the desirability of items that have been presented to the user.

*2. Collaborative Recommender System :* Collaborative filtering, also referred to as social filtering, filters information by using the recommendations of other people. It is based on the idea that people who agreed in the evaluation of certain items in the past are likely to agree again in the future. A person who wants to see a movie for example, might ask for recommendations from friends. The recommendations of some friends who have similar interests are trusted more than recommendations from others. This information is used in the decision on which movie to see.

*3. Hybrid Recommender System :* Hybrid recommender systems combine two or more recommendation techniques in order to increase the overall performance.

### *1.2 Applications of Recommender System*

1 *E-Commerce :* Recommender systems are used by E-commerce sites to suggest products to their customers and to provide consumers with information to help them decide which products to purchase. The products can be recommended based on the top overall sellers on a site, on the demographics of the consumer, or on an analysis of the past buying behavior of the consumer as a prediction for future Product buying behavior

2 *Movies :* Recommendation system is particularly useful when online merchants are selling large number of products that are in similar domains such as Music CDs, Movies, etc. The recommendation is based on the ratings on products that users have previously rated. A useful recommendation system is efficient since in practice the system handles millions of ratings and prediction is calculated in real times.

3 *Education :* Recommender System provides support for the students to better choose how many and which courses to enroll on having as basis the experience of previous students with similar academic achievements.

4 *Online shopping recommendation mechanism and its influence on consumer decisions and behaviors:* Online product recommendation mechanism (agents) are becoming increasingly available on websites to assist

consumers with reducing information overload, provide advice in finding suitable products, and facilitate online consumer decision-making.

5 *E-tourism :* e-Tourism is a tourist recommendation and planning application to assist users on the organization of a leisure and tourist agenda. First, a recommender system offers the user a list of the city places that are likely of interest to the user. This list takes into account the user demographic classification, the user likes in former trips and the preferences for the current visit. Second, a planning module schedules the list of recommended places according to their temporal characteristics as well as the user restrictions; that is the planning system determines how and when to realize the recommended activities.

*1.3 Approaches of collaborative filtering*

1 *K nearest neighbour :* K Nearest Neighborhood Algorithm is a collaborative filtering algorithm. In order to predict rating for a new song "i" by user "u", weighted average of ratings of songs common among the songs rated by user "u" and songs present in the neighborhood (k songs which are most similar to song "i") of song "i".In order to find k nearest neighbors, we need to find the similarity between all pairs of songs. Once we have a similarity vector for song "i" having all other songs in the data-set in the similarity vector which contains the weight of their similarity. We can then sort in decreasing order and find k-most similar neighbors(they for set Ni). The formula for calculating the adjusted cosine similarity between a pair of song "i" and "j" rated by users in the set Uij(those users who have rated by song "i" and "j"), is given as follows, where wij is the similarity weight.

$$w_{ij} = \frac{\sum_{u \in U_{ij}} (r_{ui} - \bar{r}_u)(r_{uj} - \bar{r}_u)}{\sqrt{\sum_{u \in U_{ij}} (r_{ui} - \bar{r}_u)^2 \sum_{u \in U_{ij}} (r_{uj} - \bar{r}_u)^2}}.$$

These similarity weights are obtained for all other songs in the dataset with song "i". Given k, we then create a neighborhood set Ni which has k most similar songs to song "i" Now, in order to predict the rating of song "i" by user "u". We create a set Ru which contains tuples of type (song,rating) for all songs rated by user "u".Predicted rating for song "i" by user "u" is calculated by the following formulae:

$$\widehat{r}_{ui} = \frac{\sum_{j \in R_u \cap N_i} w_{ij} r_{uj}}{\sum_{j \in R_u \cap N_i} |w_{ij}|}.$$

2 *Probabilistic Neighborhood Selection:* For the probabilistic neighborhood selection phase of the proposed algorithm, we suggest ancient method for weighted sampling of k neighbors without replacement that also takes into consideration the similarity levels between the target user and the population of n candidate neighbors. In particular, the set of candidate neighbors at any time is described by values $\{w'_1,w'_2,w'_3.....w'_n\}$.In general, if the $w'_i=w_i$ if the i user/item is still a candidate for selection, and $w'_i=0$ if it has been selected in the neighborhood and, hence, removed from the set of candidates.

Denote the sum of the probabilities of the remaining candidate neighbors by $S_j=\sum_{i-1}^{j} w'_i$, where j= 1,…,n, and let Q=Sn be the sum of the $\{w_i\}$ of the remaining candidates. In order to draw a neighbor, we choose x with uniform probability from [0,Q] and we find l such that $s_{l-1} \leq x \leq s_l$. Then, we add j to the neighborhood and remove it from the set of candidates while we set $w'_j = 0$. After a neighbor has been selected, this neighbor is in principle no longer available for later selection.

This method can be easily implemented using a binary search tree having all n candidate neighbors as leaves with values $\{w_1,w_2,….,w_n\}$, while the value of each internal node of the tree is the sum of the values of the corresponding immediate descendant nodes. This sampling method requires O(n) initialization operations,O(klogn) additions and comparisons, and O(k) divisions and random number generations .The suggested method can be used with any valid probability distribution including the empirical distribution derived based on the user/item similarity.

## 2. RELATED WORK

Utkarsh Gupta(2015) has defined a clustering method based recommender system. Author integrated the collaborative filteration under user and item specifications. In this work, an efficient technique for recommender system based on Hierarchical Clustering is proposed. The user or item specific information is grouped into a set of clusters using Chameleon Hierarchical clustering algorithm. Further voting system is used to predict the rating of a particular item. In order to evaluate the performance of Chameleon based recommender system, it is compared with existing technique based on K-means clustering algorithm[1].

M.K.Kavitha Devi(2010) has resolved the problem of collaborative recommender system by including the probabilistic neural network. The algorithm improved the trust between the users and the rating method in an extensive form. The product level analysis is provided under performance matrix and the work is applied on benchmark databases[2].

Go Hirakawa(2015) has provided a work on data collection for location recommender system for tourism. Author has collected the travel context and relative content information as training data and digitize it. In this paper, Author introduce an architecture of a tourist support information system including VR contents that are aimed at promoting Iwate area in Japan. Also, Author propose a system for gathering contents repository and training data to construct regional specific recommender engine on the tourist support system[3].

Sarika Jain(2015) has provided a work on problem and solution map applied under recommender system. Author collected the required relevant information and processed under personalization vector. Author have described the various approaches used in the various recommender systems such as Content based, Collaborative and Hybrid recommender system. Author focus on some of the main challenges faced by the web recommender systems and analyze some techniques to overcome them[4].

Pooja Vashisth(2011) has provided the work on personalization of recommender system and deal with the information overload. Author describe the method used for personalization of recommendations generated by an Interest- Based Recommender System (IBRS). This paper proposes a design framework for a personalized multi-agent IBRS. The IBRS is an agent- based recommender system that takes into account user's preferences to generate recommendations. The explanation process uses argumentation so that the recommender can look deeper into the reasons behind user's likes and dislikes[5].

Mustansar Ali Ghazanfar(2010) has presented a content based, collaborative and hybrid recommender system. In this paper, Author propose a unique cascading hybrid recommendation approach by combining the rating, feature, and demographic information about items. Author empirically show that presented approach outperforms the state of the art recommender system algorithms, and eliminates recorded problems with recommender systems[6].

Hirdesh Shivhare(2015) has provided a work on FCM Integrated genetic algorithm under weighted similarity measure to improve the clustering response. Author defined the rating based method to improve the clustering impact. Author have also computed the quality measures of the recommender system on the basis of the number of similar values retrieved with respect to the number of iteration runs performed by an algorithm. The results obtained show an improvement in the quality of the recommender system[7].

Ebunoluwa Ashley-Dejo(2015) defined a study work on context aware recommender system. This paper presents a survey of Context-aware recommender systems, the background and algorithms of Context-aware Recommender System, and also discusses the open issues of context-aware recommender systems[8].

Leily Sheugh(2015) provided the work on correlation cofficent based metric similarity analysis. The work was focused on the accuracy improvement of recommendation algorithms. Choosing appropriate similarity measure is a key to the recommender system success for this target. In This paper Author present an extension toward Pearson Correlation Coefficient measure for cases which does not exist similarity between users by using it[9].

M.K.Kavitha Devi(2009) has provided the work on improved collaborative recommender system under kernel specification. Author design and implementation an intelligent kernel based Fuzzy Collaborative Recommender System for map user needs to products that can satisfy them based on ratings. In this paper Author present an intelligent, smoothened, fuzzy kernel based approach to solving this problem. The system is intelligent, so the user gets recommendation based on fuzzy similarity with the neighbours[10].

Guillermo Fernandez (2014) has presented a recommendation system for groups of users that go to the cinema. The system uses the Slope One algorithm for computing individual predictions and the Multiplicative Utilitarian Strategy as a model to recommend to an entire group. Author show how Author solved all practical aspects of the system; including its architecture and a mobile application for the service, the lack of user data (ramp-up and cold-start problems), the scaling fit of the group model strategy, and other improvements in order to reduce the response time[11]

Namita Mittal(2010) proposed a framework based on, application of data partitioning/clustering algorithm on ratings dataset followed by collaborative filtering for developing a Movie Recommender System. The proposed system reduces the computation time considerably and increases the prediction accuracy.

Sumit Kumar Verma(2013) presented a hybrid system that is capable of handling these issues that is based on collaborative filtering and fuzzy c-means clustering algorithms. Experimental results show the effectiveness of the proposed recommender system.

Punam Bedi(2014) has presented a fuzzy integrated hybrid recommender system with user preference evaluation. In this paper, a hybrid multi-agent recommender system is designed and developed where user's preferences; needs and satisfaction are modeled using interval type-2 (IT2) fuzzy sets. This results in improving the prediction accuracy of the system and hence better recommendations are generated. Experimental study was conducted on book recommender system and promising results were obtained.

Guohui Song(2012) provided the work on user and item interest based recommender system. This article gives the improved algorithm which based on ratings and user interest. By the improved algorithm, Author can improve the effectiveness of the recommender systems.

Shafiq Alam (2012) has presented a PSO based recommender system to observe the activities of the web users. In this research, Author tackle the first problem of generating patterns efficiently for recommender system by proposing Hierarchical Particle Swarm Optimization based clustering (HPSO-clustering). HPSO-clustering is a clustering approach based on Particle Swarm Optimization which combines both the

properties of hierarchical and partitional clustering. Author grouped the users' session into different clusters. Recommendations for an active user are generated from these clusters.

## 3. CONCLUSION

In this paper, some of the requirement of recommender system for different real time applications is identified. The paper has discussed the scope and features of content based and collaborative recommender system. The paper also defined different methods of collaborative recommender system with relative features, constraints and process specification.

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