



Survey on Recommendation System Techniques

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ABSTRACT: Recommender systems are integral part of any ecommerce store in order to sustain and compete with other growing businesses. There are various recommendation techniques which are used to appropriately recommend a product to the active user. This paper provides different ways/ techniques to evaluate the data from an online retailer for the efficiency, scalability, and accuracy thereby providing appropriate recommended product by a recommender system. In this paper we define and describe techniques like content-based recommendation system, collaborative recommendation system, context aware recommendation system, knowledge based recommendation, hybrid systems and so on. This paper also describes various challenges faced by each of the recommendation systems which can be overcome by using the hybrid systems.

KEYWORDS: Recommender system; Content based recommendation; Collaborative filtering; Hybrid approach

I. INTRODUCTION

Recommender systems are a broad area of research due to large number of applications which provide various kinds of recommendations. The recommendations provided can be of two types namely, personalized recommendations and non-personalized recommendations. Examples of personalized recommendations are the 'People you may know' section based on mutual friends in Facebook or the 'Recommended videos' section based on the previous browsing history in Youtube. Examples of non-personalized recommendations are the hotel recommendations, movie recommendations which are based on other similar users' interest.

Recommendation systems uses the features of information retrieval and using data mining techniques they carry out the recommendation in three steps: data pre-processing, data analysis and result interpretation.[1] Recommendation systems are part of information filtering system which recommends information items, social objects based on the user's interest. These systems have changed the way the user look for information and product. [2] It is a matter of personalized, interesting and usefulness that isolates the recommendation systems from information filtering system or search engines. [3]

Recommendation systems are referred as system which recommends the products to particular user by considering the user's interest and recommending items on prediction based on items, users and item user interaction. The main objective of such systems is to lower the information overload issue by providing user needed information from large data. [4]

From the definition of recommendation system it says something called user profile i.e. the basic unit of each and every recommendation system which takes user preferences and by evaluating it helps in predicting the products to the user. [5] One common problem with recommendation systems is to combine different recommendation systems in order to obtain high performance. Each and every recommendation systems have advantages and disadvantages in which disadvantages can be reduced by combining features of different systems [3]

This paper presents an overview of some of the recommendation system techniques which can be used in various applications for the purpose of appropriate recommendations. The paper focuses on how these recommendation techniques can be used for product recommendation from an online retailer.



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The paper is organised as follows. The next section briefly describes the various recommendation techniques, divided by their features and their corresponding challenges. This is followed by the description of how hybrid recommendation systems can overcome the challenges faced by other recommendation techniques. The last section concludes the paper.

II. RELATED WORK

A. Content Based Recommendation System:

Content-based recommendation is one of the oldest recommendation system techniques. To recommend an item using content based recommendation system, a user profile is first generated. This profile is built using the data that the user provides. The user may either provide the data explicitly (rating an item) or implicitly (clicking on a link). This data is then processed, interpreted and organised into relevant information so as to generate the corresponding user profile. Once the user profile is built, the content based recommendation system analyses the contents/features of the items along with the information in the user profile and then recommends a similar non-rated item from the retailer's database that might be of interest for that particular user. [6] Hence, a content based recommendation system recommends an item similar to the item that the user has previously liked or purchased. For example, if a user A purchases a packet of milk (milk falls under the category of dairy product in the retailer's database), the next time user A logs in, the content based recommendation system recommends another dairy product say curd, to that user A.

Unlike collaborative filtering method, which recommends products that are most liked by the users that have similar taste as that of the active user, content-based recommendation system is user independent, i.e., these recommenders only depend on the active user ratings to build his own user profile. This system also provides transparency as to how a particular product is recommended to the active user by describing the product's features. These features help the user to decide whether to rely on that specific product recommendation.

Challenges [7] in content based recommendation system

- Cold start problem: The system does not provide personalised recommendations for a first time user because the system will not have any data about the user's preferences or purchase history. Hence, the system will not be able to analyse the user profile along with the item's features to provide reliable recommendations.
- Limited content analysis: Content based recommendation system will not be able to provide appropriate recommendations if the analysed content does not contain enough information to discriminate items the user likes from items the user does not like.
- Over specialisation: The system will recommend the product which has high ratings when matched with the user profile. The user will be recommended products which are similar to the ones he's already rated and used. Hence, the recommendations will have a limited degree of novelty.

B. Collaborative Recommendation System

Collaborative recommendation system is one of the most successful, most widely used recommendation techniques. Collaborative recommender system recommends choices to people based on the opinions of other people who have similar taste. [5] The customer gets recommendations that he/she hasn't rated previously, but that were rated by his/her neighbourhood.[2] Basically aggregation of ratings giving by the people (neighbourhood) is done, identify similarities based on their ratings available and recommendation is provided.[3] User based, item based, and model based are three collaborative system types. In the user based type, a customer gets recommendations which are liked by similar customers. In the item based type, a customer gets recommendations of items that are similar to those items that the people have liked before.[4] In the model based type, models are created based on classification and clustering techniques to recommend items using user-item set.

Challenges in collaborative recommendation system [1] [8]

- Scalability: System involves large amount of customers and items, thus requires large amount of resources to make efficient recommendations. Most of the resources will be used up in calculating the recommendation.



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- Cold start: Recommending items to new customer is difficult because there is no enough data as he/she hasn't rated any items before. This is called the cold start problem. The problem is same with the items which haven't rated before. Recommendations cannot be done unless customers rate it. Hybrid systems can be used to solve this issue.
- Sparsity: The most popular items will have very few ratings since customers have rated only few items .In such case customer might get wrong recommendations because of lack of data available.

C. Context Aware Recommendation System

The context can be defined as any data that can be used to indicate the situation of something. That something could be an object, a person, a place, a location or identities that are relevant to the interaction between the customer and the system. Existing recommendation systems uses the context information such as time, temperature, personal history etc. User Context (E.g. user profile, Location) , Physical Context (E.g. Temperature, Weather), Computing Context(E.g. workstations, printers) are the three types of context aware.[9] Context aware system that senses the physical surrounding and change their behaviour accordingly. This recommender system is the extended version of traditional recommendation systems by adding contextual attributes. The recommender system with context awareness is no more a two dimensional function ($F: \text{User} \times \text{Item} \rightarrow \text{Rating}$)but it becomes multi dimensional function ($F: \text{Customer} \times \text{Item} \times \text{Context} \rightarrow \text{Rating}$).[3] Contextual Pre-Filtering, Contextual Post-Filtering and Contextual Modelling processing steps are used for making efficient recommendations. [9]

Challenges in context aware recommendation system

- Need of formal definition for context aware
- Mechanism for context customer preference extraction.
- Privacy and security issues as contextual information consider the customer profile and other important information.

D. Knowledge Based Recommendation System

Knowledge based recommender system recommends items based on specific domain knowledge about how certain item features meet the user needs and preferences and utility, and also based on how the item is useful for the user. Knowledge based recommender system are case based. In this, similarity function estimates how much the user needs match the recommendation. Here, the similarity score can be directly interpreted as the utility of the recommendation for the user. This system works better than the other recommender system at the beginning of their deployment. [10]

Unlike content-based approach that recommends items which are similar to the previous interested items to the user, knowledge-based recommendation exploits deep domain knowledge in the form of mappings between abstract user's preferences and the required product characteristics. This system believes that recommending similar products to the user is not an efficient strategy because the user may not require two products which have similar properties. [11]

In collaborative filtering approach, until the habits of large number of users are known and sufficient number of rated items has been collected, the system cannot be used by users. This is called ramp up problem. A knowledge based recommender system avoids the ramp up problem since its recommendation does not depend on the basis of user ratings. It doesn't have to gather information about a particular user because its judgements are independent of individual tastes.

Challenges in knowledge based recommender system

- The system suffers from bottleneck problem in the knowledge engineering process. Essentially, the important of personalization process is depended on knowledge engineering.
- The methods of user profile development suffer from inherit problems, during the interactions of user with the site, user profiles are generally created.[12]



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E. Hybrid Recommendation System

Hybrid recommendation system which combines one or more recommender systems, to avoid the limitations of traditional recommendation systems, to address the performance and accuracy terms.[5] This can be implemented in various ways, for example: processing content based and collaborative based separately and then combining them, adding content based features to a collaborative based or vice versa.[2] The most commonly used way is to combine the collaborative based technique with any of the other types, in order to avoid the limitations of collaborative recommendation system.[4]

Hybrid recommendation system methods [2] [3]

- **Weighted:** The rating of the recommendation system is the combined result of several recommendation systems.
- **Switching:** The system switches between the recommendation systems based on some criterion and uses the feature selected.
- **Mixed:** Recommendations are presented together at the same time from several different recommender systems.
- **Feature Combination:** Selected features from different recommender systems are combined together and given as the input to hybrid recommender.
- **Feature Augmentation:** Feature evaluated from one recommendation system, which is given as the input to next recommender system.
- **Cascade:** One recommendation system produces several recommendations, which is refined by second recommender system and so on.
- **Meta-level:** A model is generated from one recommendation system, which is given as the input to another recommender system

Weighted, mixed, switching and feature combination are order insensitive and feature augmentation, cascade, Meta level are order sensitive [3]

Challenges [2] in context aware recommendation system

- The question of privacy, security and confidentiality of user provided information arises. The problem can be solved by making use of special algorithms.
- Recommending user becomes difficult when user frequently doesn't agree or disagree to other people opinion.

III. CONCLUSION

The problem of excessive information overload can be resolved using recommendation systems. They provide information needed for the user which are not available to user on system and also help in making decisions. [5] This paper summarized the traditional and modern recommendation systems. The survey shows these systems have both advantages and disadvantages and also described how to overcome the limitations using hybrid systems. Future focus on recommendation system can be on improvising the existing systems for better recommendation

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