

RECOMMENDER SYSTEMS: REVIEW

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ABSTRACT

Large amount of data is available online, and with an increase in data being shared on the internet, the need of systems to analyze and personalize is increasing permanently. Recommender systems are used widely for recommendation of various items and they have emerged as an important way of recommendation on the web. This paper presents a review of the categories of recommender systems and various recommendation techniques.

Keywords: *Recommender systems, recommendation techniques*

INTRODUCTION

Based upon the way a user interacts with different items, a recommender system recommends the most suitable items to the user by predicting the user interest in the item. [1]. The main aspect of a recommender system is to guess users' interest based on their prior interaction with different items. Their aim is to reduce the information overload by extracting and predicting the relevant services from large amounts of data.[2].

Information retrieving and research on filtering led to early research in recommender systems. Recommender systems represent personalization techniques of e-services [3]. Content-based techniques [5], Collaborative filtering [4], and knowledge-based (KB) [6] techniques are some of the mostly used recommender system techniques.

With progress in research on recommender systems and development of different recommendation techniques, many real-world recommender applications have been developed. Some of the applications of recommender systems include recommending books, music, websites, conferences and learning materials, and recommendations in e-commerce. It also has

applications in the areas of e-government, e-library, e-business services.

RECOMMENDATION TYPES

A. *Non-Personalized Recommendation*

Non-personalized recommenders give the same recommendation to every user. The recommendations are not user specific. If we visit amazon.com without logging in as a user, it displays the items that are currently browsed by the previous user. Non-recommender systems do not consider the personal preferences of the user while giving recommendations. The recommendations by these systems are identical for each user.

There are two definitions in this – Predictions and Recommendations.

- 1) **Predictions:** Prediction is a form of output given by recommender systems, it is an estimate of how much a user will like an item. Predictions are bold statements. They are scaled to match some scale. They are often tied to browsing or search for specific products.
- 2) **Recommendations:** Recommendations are the other form of output generated

by recommender systems. Recommendations are not bold statements like predictions, they are only suggestions for items that a user might like. They give recommendation items without any numbers associated with them.

B. *Personalized Recommendation*

Personalized recommendations are based on a user's behavior – both implicit and explicit. Explicit behavior includes giving views in the form of direct ranking or points. Implicit behavior is inferred from user's actions and not asked directly. A personalized product recommendation isn't based on any guess or assumption. Personalization technology enables the dynamic insertion, suggestion of content or customization in any format that is related to the individual user, based on his implicit behavior and preferences, and explicitly given details. The results are based on items that have been continuously viewed, considered, or purchased. A personalized product recommendation is a mechanism that enables to overcome the overload of information that occurs while shopping online.

RECOMMENDATION TECHNIQUES

A. *Content-Based Recommendation Techniques*

These recommendation techniques recommend items based on previously considered items browsed by a particular user [5]. The main principles of CB recommender systems are: 1) Examining the description of the item chosen by a user. These preferences are saved in a profile. 2) Attributes of each item are examined and compared with the items stored in user's profile. Among these, items which have high similarity with the items stored in the user's profile, are recommended [6]. Recommendations can be generated in CB method by using two techniques:

- 1) Common Information retrieval methods may be used to discover recommendations

for a particular user. Like, using the cosine similarity measure to discover recommendations.

- 2) Machine Learning Tools or Statistical Learning Methods may be used to generate recommendations.

B. *Collaborative Filtering-Based Recommendation Techniques*

Collaborative filtering-based recommendation techniques help the user to make choices based on liking of other users who are similar to the user [8]. CF techniques have either user-based or item-based CF approaches [9]. Items liked by similar users are recommended to a particular user in the user-based CF technique. In the item-based approach, a user receives recommendations based on what they had liked in the past.

C. *Knowledge-Based Recommendation Techniques*

Knowledge-based recommendation systems generate recommendations of different items to a user based on the knowledge about what products meet the user requirements, knowledge about the relationship between a user's requirements and recommendations. Items are considered a cases and recommendations are generated by retrieving the cases that are most similar to user's requirements. Ontology, represents the domain concepts [12] and the relationships between those concepts.

D. *Hybrid Recommendation Techniques*

Hybrid recommenders combine two or more recommendation techniques to attain higher performance and defeat the drawbacks of traditional recommendation techniques [13]. The most common practice in the existing hybrid recommendation techniques is to combine the CF recommendation technique with other recommendation techniques in an attempt to avoid cold-start, sparseness and/or scalability problems.

E. **Computational Intelligence-Based Recommendation Techniques**

Computational intelligence techniques like artificial neural networks, clustering techniques and fuzzy logic are used in recommender systems to construct different recommendation models.

F. **Social Network-Based Recommendation Techniques**

Over the recent years, social networking tools have grown dramatically in web-based systems. Social Network-Based Recommender systems use analysis of social networks to generate recommendations. Recommender systems facilitate the users to interact socially with other users, to help improve user experience. The trends of interaction offer data for making recommendations by analyzing users' social interactions and ties. It is especially useful for systems whose rating data is too sparse to conduct collaborative filtering.

E-GOVERNMENT RECOMMENDER SYSTEMS

Electronic government refers to the use of information and communication technologies to support information and services delivery in the public sector to citizens and businesses. There is information overload due to sudden rise in e-governance and it becomes difficult for the users to infer results and make decisions from such vast information. Recommender systems find application in e-governance to overcome this issue. Applications include government-to-citizen (G2C) and government-to-business (G2B) services.

A. **G2C Service Recommendation**

One of the major challenges of e-government is to match the interests and needs of citizens to deliver efficient services by delivering them the most relevant information and thereby addressing the issue of information overload. To support personalized access and services to a

particular citizen, recommender systems are used. By analyzing a citizen's profile and device profile, appropriate recommendations are identified and suggested.

B. **G2B Service Recommendation**

Traditional Collaborative Filtering methods cannot be used to recommend items like events. Events, from a business perspective, have a sparse data collection, because they receive ratings only after the event has ended. Recommender systems specifically for G2B services can recommend potential business partners to businesses.

E-BUSINESS RECOMMENDER SYSTEMS

There are many recommender systems developed for e-business applications. Recommendations are of two types here:

Business to consumer (B2C): Recommendations to individual customers based on their profile and likes

Business-to-business(B2B): Recommendations to business applications. In e-business recommender systems, the Knowledge-based approaches are integrated with CF and CB recommendation methods, such as ontology [12] and semantic Techniques. The reason to use hybrid recommendation techniques is that e-businesses need high domain knowledge to be able to generate their recommendations.

E-SHOPPING RECOMMENDER SYSTEM

E-shopping is a major application of e-commerce. E-shopping websites use recommendation systems to recommend their users, which products to buy, based on their profile and browsing patterns. Rating different products is a popular function in e-shopping systems [15]. In these e-commerce websites, products can be recommended based on customer demographics, or the top overall sellers or

an analysis of the past buying behavior of the customer as a prediction for future buying behavior. Advanced recommender models have been developed to meet different criteria of e-shopping environments.

E-shopping recommender systems are implemented in e-commerce applications for digital products (music, movies, etc.) as well as physical goods (books, bags, etc.). Researchers have developed a number of successful e-shopping systems in which they implement their new algorithms.

E-LIBRARY RECOMMENDER SYSTEM

Collection of digital objects along with services is a digital library. Recommender systems find application in digital libraries to recommend knowledge sources to the users and locate and select information. The hybrid recommendation approach which combine CB, CF and KB techniques are used in e-library recommender systems.

Fab is a hybrid recommender system which combines both CF and CB recommendation techniques. A system called CYCLADES was presented to provide better personalized e-library services; it provides an integrated environment for individual users and group users in personalized and flexible way. Hybrid approaches are used because they take advantages of different recommendation techniques. Fuzzy techniques like multi-granular fuzzy linguistic modeling, are used to represent and analyze the flexible information of linguistic labels.

CONCLUSIONS

With the tremendous growth of customers and items, the challenge for recommendation systems is to produce quality recommendations. There also lies a great challenge for the recommendation system to produce quality output when the data set is huge. In this paper, recommender techniques and their applications are summarized. The classic recommendation approaches, such as content-based, knowledge-based or collaborative filtering

techniques are important in almost all kinds of applications, but hybrid recommender system are more widely used. New recommendation techniques, such as social network-based recommender system and context awareness-based recommender systems, play an important role in application developments. Techniques, such as fuzzy logic, have been applied in all kinds of recommender systems applications to handle uncertainties.

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