



## FUNCTIONS OF RECOMMENDER SYSTEMS

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### ABSTRACT

*On the Internet, where the number of choices is overwhelming, there is need to filter, prioritize and efficiently deliver relevant information in order to alleviate the problem of information overload, which has created a potential problem to many Internet users. Recommender systems solve this problem by searching through large volume of dynamically generated information to provide users with personalized content and services. This paper explores the different function of recommendation systems in order to serve as a compass for research and practice in the field of recommendation systems.*

Recommender Systems (RSs) are software tools and techniques providing suggestions for items to be of use to a user. The suggestions relate to various decision-making processes, such as what items to buy, what music to listen to, or what online news to read. "Item" is the general term used to denote what the system recommends to users. A RS normally focuses on a specific type of item and accordingly its design, its graphical user interface, and the core recommendation technique used to generate the recommendations are all customized to provide useful and effective suggestions for that specific type of item.

RSs are primarily directed towards individuals who lack sufficient personal experience or competence to evaluate the potentially overwhelming number of

alternative items that a Web site, for example, may offer. A case in point is a book recommender system that assists users to select a book to read. In the popular Web site, Amazon.com, the site employs a RS to personalize the online store for each customer. Since recommendations are usually personalized, different users or user groups receive diverse suggestions. In addition there are also non-personalized recommendations. These are much simpler to generate and are normally featured in magazines or newspapers. Typical examples include the top ten selections of books, CDs etc. While they may be useful and effective in certain situations, these types of non-personalized recommendations are not typically addressed by RS research.



In their simplest form, personalized recommendations are offered as ranked lists of items. In performing this ranking, RSs try to predict what the most suitable products or services are, based on the user's preferences and constraints. In order to complete such a computational task, RSs collect from users their preferences, which are either explicitly expressed, e.g., as ratings for products, or are inferred by interpreting user actions. For instance, a RS may consider the navigation to a particular product page as an implicit sign of preference for the items shown on that page. RSs development initiated from a rather simple observation: individuals often rely on recommendations provided by others in making routine, daily decisions. For example it is common to rely on what one's peers recommend when selecting a book to read; employers count on recommendation letters in their recruiting decisions; and when selecting a movie to watch, individuals tend to read and rely on the movie reviews that a film critic has written and which appear in the newspaper they read.

### Functions of system

In the previous section we defined RSs as software tools and techniques providing users with suggestions for items a user may wish to utilize. Now we want to refine this definition illustrating a range of possible roles that a RS can play. First of all, we must distinguish between the role played by the RS on behalf of the service provider from that of the user of the RS. For instance, a travel recommender system is typically introduced by a travel intermediary (e.g., Expedia.com) or a destination management organization (e.g., Visitfinland.com) to increase its turnover (Expedia), i.e., sell more hotel rooms, or to

increase the number of tourists to the destination. Whereas, the user's primary motivations for accessing the two systems is to find a suitable hotel and interesting events/attractions when visiting a destination.

In fact, there are various reasons as to why service providers may want to exploit this technology:

- Increase the number of items sold. This is probably the most important function for a commercial RS, i.e., to be able to sell an additional set of items compared to those usually sold without any kind of recommendation. This goal is achieved because the recommended items are likely to suit the user's needs and wants. Presumably the user will recognize this after having tried several recommendations<sup>1</sup>. Non-commercial applications have similar goals, even if there is no cost for the user that is associated with selecting an item. For instance, a content network aims at increasing the number of news items read on its site. In general, we can say that from the service provider's point of view, the primary goal for introducing a RS is to increase the conversion rate, i.e., the number of users that accept the recommendation and consume an item, compared to the number of simple visitors that just browse through the information.

- Sell more diverse items. Another major function of a RS is to enable the user to select items that might be hard to find without a precise recommendation. For instance, in a movie RS such as Netflix, the service provider is interested in renting all the DVDs in the catalogue, not just the most popular ones. This could be difficult without a RS since the service provider cannot afford the risk of advertising movies



that are not likely to suit a particular user's taste. Therefore, a RS suggests or advertises unpopular movies to the right users

- Increase the user satisfaction. A well designed RS can also improve the experience of the user with the site or the application. The user will find the recommendations interesting, relevant and, with a properly designed human-computer interaction, she will also enjoy using the system. The combination of effective, i.e., accurate, recommendations and a usable interface will increase the user's subjective evaluation of the system. This in turn will increase system usage and the likelihood that the recommendations will be accepted.

- Increase user fidelity. A user should be loyal to a Web site which, when visited, recognizes the old customer and treats him as a valuable visitor. This is a normal feature of a RS since many RSs compute recommendations, leveraging the information acquired from the user in previous interactions, e.g., her ratings of items. Consequently, the longer the user interacts with the site, the more refined her user model becomes, i.e., the system representation of the user's preferences, and the more the recommender output can be effectively customized to match the user's preferences.

- Better understand what the user wants. Another important function of a RS, which can be leveraged to many other applications, is the description of the user's preferences, either collected explicitly or predicted by the system. The service provider may then decide to re-use this knowledge for a number of other goals such as improving the management of the item's stock or production. For instance, in

the travel domain, destination management organizations can decide to advertise a specific region to new customer sectors or advertise a particular type of promotional message derived by analyzing the data collected by the RS (transactions of the users).

We mentioned above some important motivations as to why e-service providers introduce RSs. But users also may want a RS, if it will effectively support their tasks or goals. Consequently a RS must balance the needs of these two players and offer a service that is valuable to both.

Herlocker et al. , in a paper that has become a classical reference in this field, define eleven popular tasks that a RS can assist in implementing. Some may be considered as the main or core tasks that are normally associated with a RS, i.e., to offer suggestions for items that may be useful to a user. Others might be considered as more "opportunistic" ways to exploit a RS. As a matter of fact, this task differentiation is very similar to what happens with a search engine, Its primary function is to locate documents that are relevant to the user's information need, but it can also be used to check the importance of a Web page (looking at the position of the page in the result list of a query) or to discover the various usages of a word in a collection of documents.

- Find Some Good Items: Recommend to a user some items as a ranked list along with predictions of how much the user would like them (e.g., on a one- to five star scale). This is the main recommendation task that many commercial systems address. Some systems do not show the predicted rating.



- Find all good items: Recommend all the items that can satisfy some user needs. In such cases it is insufficient to just find some good items. This is especially true when the number of items is relatively small or when the RS is mission-critical, such as in medical or financial applications. In these situations, in addition to the benefit derived from carefully examining all the possibilities, the user may also benefit from the RS ranking of these items or from additional explanations that the RS generates.

- Annotation in context: Given an existing context, e.g., a list of items, emphasize some of them depending on the user's long-term preferences. For example, a TV recommender system might annotate which TV shows displayed in the electronic program guide (EPG) are worth watching.

- Recommend a sequence: Instead of focusing on the generation of a single recommendation, the idea is to recommend a sequence of items that is pleasing as a whole. Typical examples include recommending a TV series; a book on RSs after having recommended a book on data mining; or a compilation of musical tracks.

- Recommend a bundle: Suggest a group of items that fits well together. For instance a travel plan may be composed of various attractions, destinations, and accommodation services that are located in a delimited area. From the point of view of the user these various alternatives can be considered and selected as a single travel destination.

- Just browsing: In this task, the user browses the catalog without any imminent intention of purchasing an item. The task of the recommender is to help the user to browse the items that are more likely to fall within the scope of the user's

interests for that specific browsing session. This is a task that has been also supported by adaptive hypermedia techniques.

- Find credible recommender: Some users do not trust recommender systems thus they play with them to see how good they are in making recommendations. Hence, some system may also offer specific functions to let the users test its behavior in addition to those just required for obtaining recommendations.

- Improve the profile: This relates to the capability of the user to provide (input) information to the recommender system about what he likes and dislikes. This is a fundamental task that is strictly necessary to provide personalized recommendations. If the system has no specific knowledge about the active user then it can only provide him with the same recommendations that would be delivered to an "average" user.

- Express self: Some users may not care about the recommendations at all. Rather, what it is important to them is that they be allowed to contribute with their ratings and express their opinions and beliefs. The user satisfaction for that activity can still act as a leverage for holding the user tightly to the application (as we mentioned above in discussing the service provider's motivations).

- Help others: Some users are happy to contribute with information, e.g., their evaluation of items (ratings), because they believe that the community benefits from their contribution. This could be a major motivation for entering information into a recommender system that is not used routinely. For instance, with a car RS, a user, who has already bought her new car is aware that the rating entered in the



system is more likely to be useful for other users rather than for the next time she will buy a car.

- Influence others: In Web-based RSs, there are users whose main goal is to explicitly influence other users into purchasing particular products. As a matter of fact, there are also some malicious users that may use the system just to promote or penalize certain items.

As these various points indicate, the role of a RS within an information system can be quite diverse. This diversity calls for the exploitation of a range of different knowledge sources and techniques and in the next two sections we discuss the data a

RS manages and the core technique used to identify the right recommendations.

### Conclusion

A recommendation system is an information service system that connects users and projects: on the one hand, it helps users discover potential projects of interest; on the other hand, it helps project providers to deliver projects to users who are interested in it. The recommendation system is a powerful system that can add value to the company or business. In the future, it will continue to be researched and developed to bring a better experience to users.

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