

Recommendation System for a Bookstore Electronic Commerce Site

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Abstract

"AwarenessNet" is a real-time recommendation engine. In May 2003, an experimental service using it was begun at the online bookstore "bk1" (<http://www.bk1.co.jp/>) operated by Book1, Inc., as a joint experiment between Book1, Inc., NTT East Corporation, and NTT Information Sharing Platform Laboratories. AwarenessNet can give real-time recommendations about products and information to individual customers based on an analysis of their access or purchase log, even without personal customer information such as interest categories.

1. What is a recommendation system?

Many companies are now using the Internet to market products or offer information services. Among the huge number of sites that provide information and electronic commerce (EC) sites existing today, however, Web sites that simply list products and information are not very attractive to customers. The conven-

tional form of providing information in which the information is presented to all customers in a uniform way is gradually changing to a new form of one-to-one marketing, in which each customer is handled individually.

One way of implementing one-to-one marketing on the Web is to employ a Web recommendation function (Fig. 1). This allows personal, one-to-one handling of customers that visit the Web site, something that is limited to important customers in real shops, by organizing a large quantity of products and information and by timely providing products and infor-

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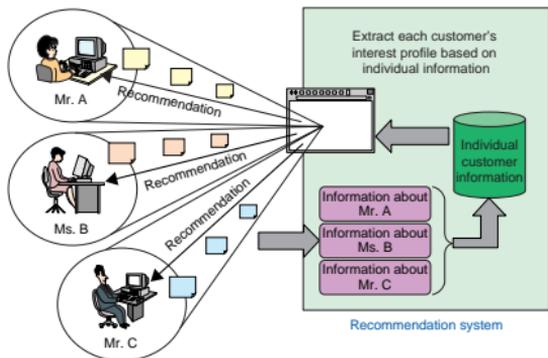


Fig. 1. Web recommendation system.

mation that match a customer's interests and preferences. For the customer, this increases the probability that desired products or information can be found quickly on the Web site, and for the store, it increases the opportunities for cross-selling^{*1}. It also allows the store to maintain good relations with the customers, thus promising higher profits.

2. Problems with conventional recommendation systems

With ordinary recommendation systems, individual customer information such as age, sex, occupation, and interests is used together with an analysis of customer activity on the Web (access behavior) to extract products and information that match the customer's preferences. Those products and information are then introduced to the customer. Some systems also need feedback from customers, such as asking them to input their interest in the introduced products on a numerical scale [1]. On the service provider side, some systems require settings for product classification information. There are also rule-based recommendation systems, which require the setting of rules that specify the intention of the service provider, such as "what products or information should be offered to which customers". However, such systems face several problems. For example, there is no guarantee that the information about the customer's preferences and interests is up to date, and service providers incur a maintenance cost if they continually update customer

information, product classification information, and rules. Another big problem is that conventional recommendation systems frequently tend to recommend some products that are similar to best-selling products as a result of analysis. We think that this leads to inaccurate recommendations, because recommending best-selling products is too trivial and it is not personalized to each customer.

3. AwarenessNet

AwarenessNet is a recommendation engine developed by NTT Information Sharing Platform Laboratories and marketed by NTT East Corporation. It is based on "collaborative filtering", which infers user preferences from the preferences of other users who have similar behavior by analyzing the user's access log. To illustrate the basic operation of a recommendation system that employs collaborative filtering, we explain the procedure for extracting the products and information to be introduced to customer A from the customer's access log (Fig. 2). It assumes that customer A is likely to be interested in the products and information that have been accessed by other people having similar tendencies.

- 1) Identify the products and information that have been accessed by customer A.
- 2) Identify other persons who have also accessed the same products and information, i.e., ones who have similar access tendencies.
- 3) Introduce to customer A the products and information accessed by these other persons if customer A has not accessed them yet.

*1 Cross-selling is a way to increase the value of a sale by suggesting related products.

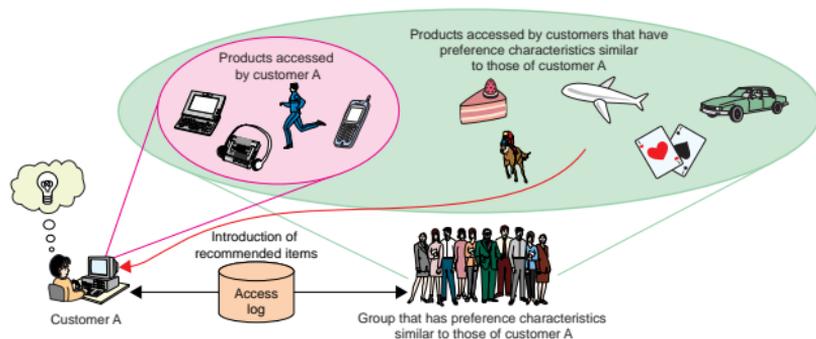


Fig. 2. Basic operation of recommendation using collaborative filtering.

3.1 Features

The AwarenessNet system has three features than allow sites handling huge numbers of products and customers to provide highly appropriate recommendations that suit the customer's interests in real time.

- 1) Recommendation is possible just by analyzing the access or purchase log

It is possible to identify products that are appropriate for the customer's interests simply by analyzing the access or purchase log, even without personal customer information such as age, sex, occupation and interests, and product classification information. Doing so makes it unnecessary to maintain personal information about customers and product classification schemes.

- 2) Highly accurate analysis made possible by noise reduction technology

The AwarenessNet system employs noise reduction technology that we developed. We call it "screening behavior filtering". This can reduce the problems caused by tending to recommend best-sellers. We consider this kind of situation to be a kind of noisy state. The AwarenessNet system uses noise reduction technology to achieve more accurate extraction of suitable products to recommend to the customer.

- 3) High-speed recommendation is possible

We achieve high-speed recommendation of products selected from a large quantity of products to a large number of users as follows. Information that can be interpreted from a large log is mapped to information called a memory-expandable "distance order map", which expresses the strength of the relationship between products and users. Then the system is separated into a server

for analyzing the log and a server for making real-time recommendation, to distribute the server load and achieve fast, real-time recommendation.

3.2 System configuration

In its basic configuration, the AwarenessNet system is composed of two servers: a log management server and a service control server. An overview of the server configuration for the joint experiment is presented in Fig. 3.

- (1) Log management server

The log management server executes the log analysis. Normally, the access or purchase log is read once a day and analyzed, and the distance order map used for making recommendations is updated. The constructed distance order map is transferred to the service control server.

- (2) Service control server

The service control server makes recommendations that correspond to actual customer actions. Using the distance order map transferred from the log management server, the service control server returns recommendation results in response to requests from the Web application server. Those results are reflected in an HTML page within the Web application server for display to the customer.

The AwarenessNet recommendation function can be incorporated into a Web application server by constructing an application program that calls the AwarenessNet application programming interface (API: C Library and Java API).

4. Example of application to a bookstore EC site

In May 2003, an experimental service using the

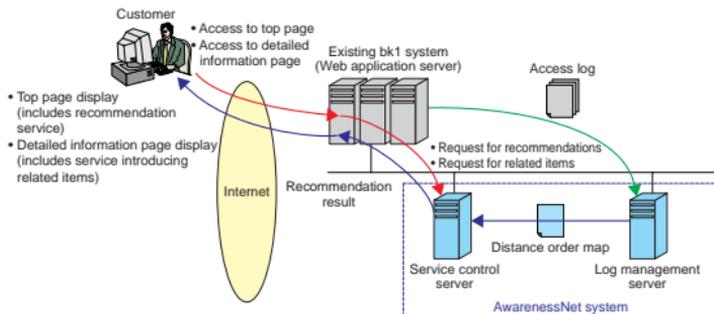


Fig. 3. System configuration for the joint experiment.

AwarenessNet system was begun at the online bookstore "bk1" (<http://www.bk1.co.jp/>) operated by Book1, Inc., as a joint experiment between Book1 Inc., NTT East Corporation, and NTT Information Sharing Platform Laboratories.

4.1 Objectives

Previous evaluation of the AwarenessNet system only got as far as the effect of the analysis using previous customer data. The objective of this joint experiment was to measure the effectiveness from a practical viewpoint by investigating the application and introduction of the AwarenessNet system to an actual product sales site and determining the correlation with an improvement in sales.

We also plan to use this joint experiment to conduct a trial evaluation of a still-under-development marketing analysis tool that applies the AwarenessNet system function to marketing analysis.

4.2 Tasks for constructing the experimental system

The following tasks had to be done before the beginning of the experimental service. They took about three months.

- 1) Studying what kind of recommendation service to offer customers on the bk1 site.
- 2) In parallel, studying the suitability of AwarenessNet for the bk1 site by analyzing an actual access log.

- 3) Constructing and testing an application program that incorporates the AwarenessNet API.

4.3 Offering the service to customers

The bk1 site used to offer various services for introducing customers to books, aiming at customer convenience. These included keyword search, classification of books by genre, top ten list (ranked by book sales), book reviews, new publications and arrivals, and introduction by topic. The introduction of the AwarenessNet system made it possible to offer two new introduction services that are personalized for each customer (Fig. 4).

- 1) Recommendation service

When the top page of the bk1 site is displayed, three products that match the preferences of the customer are introduced.

- 2) Related item introduction service

When the detailed description of a book is displayed, three books that are strongly related to it are introduced.

To provide information that is personalized for each customer in these services, it is necessary to identify individual customers. In this experiment, customer identification employed the cookie used by the bk1 site in the past.



Recommendation using AwarenessNet (personalized for each customer)

Related item introduction using AwarenessNet (these books are strongly related to the one displayed in the center of the screen)

(a) Top page of bk1 web site

(b) Detailed description page of book

Fig. 4. Example of screen from the bk1 web site.

5. Knowledge obtained from the experiment so far

Because this joint experiment is still continuing, we have not yet obtained a final conclusion about the effectiveness of introducing the AwarenessNet System. Therefore, in this section, we describe the system parameter adjustment process that will affect the click rate².

To increase the effectiveness of the recommendation function, it is necessary to adjust the parameters of the AwarenessNet system while observing the resulting click rate. To determine effective parameters in this experiment, we tested four different patterns of recommendation. They differ in (a) a tendency to buy best-sellers, for which noise reduction is weakened, as opposed to niche books, for which noise reduction is strengthened and (b) whether or not the relatively recent log is emphasized. We also analyzed the click rates for all seven patterns, including the case in which randomly selected items were displayed as well (Table 1). The “priority on most recent access log” condition means that when paying attention to a certain record in the access log, products that are closer in the past relative to that record are regarded as having a stronger relationship and are given greater importance.

Because the access log used for the analysis covered only one month at the time this article was written, no clear conclusion could be drawn. However, a tendency for relatively high click rates was seen for the two extreme cases of best-sellers with no priority on recent log and niche books with priority on recent log. We will continue with judgments based on a more detailed and continuous analysis of long-term log.

² Click rate is a measure of how many of the presented products a customer clicks on.

Table 1. Seven patterns for click rates analysis.

Tending toward best-sellers with	priority on most recent access log (1) no priority (2)
Tending toward the middle ground with	priority on most recent access log (3) no priority (4)
Tending toward niche books with	priority on most recent access log (5) no priority (6)
Random display of	three items selected randomly from positions 10 to 20 on the best-seller list (7)

6. Future work

To evaluate the recommendation function, we plan to continue with not only analyses of click rate on the bk1 site, but also analyses that include sales data and evaluation from the practical viewpoint of determining to what extent the function is linked to improved sales. We also plan to conduct a trial of using the marketing analysis function during the joint experiment to test its functionality.

Reference

- [1] P. Resnick, N. Iacovou, M. Sushak, P. Bergstrom, and J. Riedl, “GroupLens: An open architecture for collaborative filtering of news,” ACM, OISW’94 Proceedings of the Conference on Computer Supported Collaborative Work, Chapel Hill, NC, U.S.A., pp. 175-186, Oct. 1994.



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