Multi-Agent Based Recommendation System in E-commerce

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Abstract: Based on the status of e-commerce recommendation system analysis, this paper puts an Agent-based recommendation system. Firstly, this paper establishes an e-commerce personalized recommendation system model based on multi-Agent technology; then, introduces the principle and algorithm of the key agent in the model; lastly, simulates the process of personalized recommendation.

Keywords: Multi-agent, Recommendation system, Recommendation strategy, Recommendation agent group

1 Introduction

Now, with the rapid development of computer technology and network technology, electronic commerce is being more and more enterprises and individuals concerned. However, as more and more e-commerce to provide the services, their structures are more complex and which often cause users lost a large number of commodities in the information space, could not find their real needs. In order to solve such problems, the experts proposed the concept of personalized service[1]. Most of personalized service by analyzing customer's personal information, browsing history data to be tapped to obtain the client's interest in preference to recommend to him in order to meet his personal goods or services. Resnick and Varian (1997) have given a definition for e-commerce recommendation system in the formal[2]: It is the use of e-commerce sites to provide customers with product information and recommendations to help customers decide which products would be bought, analog sales staff to help customers complete the purchase process. Currently, more and more personalized recommendation technology has been of concern to scholars, a large number of recommendation systems came into being. The representative systems are:

1. Content filtering based recommendation systems (CB) [3]
2. Collaborative filtering based recommendation systems (CF) [4]
3. Knowledge-based recommendation system (KB)
4. Web data mining-based recommendation system (WDM) [5]

Generally speaking, the above methods are able to use certain technology to record and analyze the user's browsing history, in order to get the recommended result. However, they have their advantages and disadvantages respectively. For example, CB works by analyzing the similarity of products, it has visual affects but it is difficult to find new products for users; and CF works by analyzing the similarity of users, it can discover new products for users without taking into account the characteristics of goods, but during the very sparse matrix which made by users' evaluation to products, the system's performance will be lower and lower. Therefore, many scholars use the combination of technology and even use technology in other areas. Agent has the intelligence, initiative, and social and other characteristics, so the agent can be on behalf of user’s intention, action, interest, and so on. With the recommendation of the above four techniques, the paper proposes a multi-Agent-based personalized recommendation system for e-commerce.

2 The Model of Multi-Agent Based Recommendation System

2.1 Multi-Agent Technology
Now generally agreed that, Agent is an entity, with certain knowledge and the ability to target specific effective use of knowledge to solve problems. It has autonomous, interactive, adaptive, social, evolution
and other characteristics. Multi-agent technology is arrangement of the objectives and resources of Multi-agent system, which include some agent with different objectives and resources, in order to meet each agent’s interest.

Multi-agent technology can adapt to flexible systems, complexity, distribution, and many other features and requirements. Therefore the application of multi-Agent technology to meet the personalized recommendations in e-commerce system is the best choice after all.

2.2 The Role of E-commerce Recommendation System

Based on agent technology and multi-combination of above four kinds of e-commerce recommendation system, this paper defines some roles for E-commerce Recommendation System, such as:

1. User agent. Responsible for capturing customer information, and sending the request based on browsing or purchasing behavior of customers to recommendation engine agent; accepting the results from the recommendation engine agent, and returning to the system; it also can collect the user information submitted to the database agent, update the database user information.

2. Recommendation engines agent. Responsible for receiving the recommendation issued by the user agent request, and querying from the strategy agent for recommended strategy; then according the strategy to drive the recommendation agent group for services in order to get the recommended results, lastly, recommendation engines agent return the results to the user agent.

3. Strategy agent. Responsible for receiving requests for the query strategy of recommendation engines agent, identifying strategic types, returning the corresponding strategy.

4. User model agent. Responsible for receiving the call request of recommendation engines agent, calling the correlation model, completing the recommended features. Its internal model algorithm library containing the user, if necessary, calls the algorithm for the dynamic generation of models to meet the recommended request.

5. Database agent. Responsible for receiving user information collected by user agent, formatting and storing in the database. At the same time accepting the request from recommendation agent user model agent, and the data.

6. Database. Storing the relevant databases, such as product databases, transaction databases, log database, customer database. These databases are recommended resources.

2.3 The System Model of E-commerce Recommendation System

Based on the above analysis, this paper develops a personalized recommendation system model which is shown in figure 1.

User agent identifies the request of the user recommendation and recommends it to recommendation engine agent; Recommendation engine agent requests the strategy to strategy agent (shown as part (1)), and according the strategy to drive the recommendation agent group (shown as part (2)) for services in order to finish the recommendation task, and returns the results. During the whole process, recommendation agent would call the correct model and data from user model agent and database agent, in order to complete the whole recommendation process.
This model has two key points:
First, strategy agent. In short, the recommendation strategy agent is used to provide a strategy for recommending products. It receives a request from the recommendation engine, by means of inference and control, selecting the correct recommended strategy. The strategy used to drive recommended agent group. Among them, the customer strategy is the customer ID stock up and get through some of the recommended strategy for calculating the type of strategy when the recommended agent receiving agent's strategy recommendation engine query, the query in the database corresponding strategy type. Each customer is assigned one of the recommended types. Stock up a series of recommended strategies recommended strategies, which needs to customize according to recommendations, it provides recommended models, algorithms and business strategy recommended by the rational allocation, the strategy library has a default strategy for dealing with default. Figure 2 shows the strategy of the two cases.
Business Strategy S1: strategy for new users: analysis of the similarities between the user's registration information and other users; the classification of goods associated with the CFA results were calculated, the results recommend to the user.

Business Strategy S2: strategy for the old users who browsing frequently: mining the first data of interests from the user’s browsing history by the WDMA, and KBA, and calculate the data with the user by ARA, the results obtained still need to go through several auxiliary algorithm to discard the dross and select the essential, the best results will be returned to the user.

The second key point is recommended Agent group. It generally can be divided into two types: one is the recommended algorithms which used frequently, such as collaborative filtering, content-based recommendation, the recommendation based on knowledge, Web-based mining, the main recommendation for the complete calculation; the other is the auxiliary algorithm, mainly used for the accessibility recommend. Through analysis, this paper uses these four auxiliary algorithms:

1. Association rules. Analyses of the rank correlation of data, associated with users and goods which have a high correlation together, put all these data into the mixer, and then filter into the filter, and last, classify them.

2. Filter algorithm. Filter out the undesired products from a list of recommendation list to meet the expectations of the products and recommend them to the user.

3. Mixer algorithm. Put the different recommendation techniques together so that they can improve the
results of higher precision.

4 Classification algorithm. According to type, price and so on, adjust the recommended results to recommend the products which meet the company's strategy to the client priority.

3 Personalized Recommendation Process Model

Example for customer A and B are logging a web site, the user agent first to obtain their information, and make a recommendation request to the recommendation engine agent; then, recommendation engine agent inquires the strategy to the strategy recommended agent. After inquiries, identify customer A is a new customer, we can just take the simple classification strategies S1 to A; Client B was an old customer, takes the S2 to analysis of its browsing history and interests. And then recommendation agent group begins to service to A and B respectively. If the coordination agent, in the recommended agent group, receives a instruction of implement S1 for A, it will runs the CBA to get a recommendation results R1 * first; and then run the CFA, get the result R1 **, and then calculate the R1 * and R1 ** through ARA, return the results R1, finally, return R1 to the recommendation engine agent; recommendation engine agent send R1 to use agent, user agent format S1 and display to customer A. If the coordination agent receives a instruction of implement S2 for B, it will run WDMA and the KBA, get the results R21 and R22, the same time, the coordination agent will run CFA, analysis of the user and other customers(C) of the similarity of interests and return the result R23 which is interested by C, then calculate R21, R22, R23 together through ARA, and finally calculate the results through the MA, FA, SA and other layers to take sperm, and lastly, get the best recommendation result R2 to customer B.

4 Conclusion

From the simulation model and the process we can see, recommendation system can judge whether the customer is new customer from his browsing history. For different customers, the recommendation strategy is different. For instance, customers often visit Korean clothes are divided into A, the customers often visit European clothes are divided into Class B..., Even if use the same process as KBA-MA-FA-SA..., The recommendation system will provide different results. Future research will be on how to determine the awareness of users, such as price-sensitive, browsing habits, so that the recommendation system being more intelligent.

References