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Research and Application of Personalized Recommendation in E-Commerce System

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ABSTRACT

With the rapid development of the Internet, personalized recommendation has become an indispensable part of e-commerce system. How to solve the miscellaneous information in e-commerce system through personalized recommendation has become a research hotspot. This paper analyses the development background and significance of personalized recommendation, compares and analyses the relevant algorithms of personalized recommendation through the research of e-commerce system and personalized recommendation, and deeply studies the application of personalized recommendation technology in e-commerce system. The research of personalized recommendation system will contribute to the further development of e-commerce system and make Internet life closer to reality.

Keywords: E-Commerce; Personalized Recommendation; Personalized Recommendation Algorithm

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1. Research Status and Significance of Personalized Recommendation System

1.1 Research Background and Significance

With the advent of the Internet era, the emergence of personalized recommendation system has become a necessity. The development of cloud computing and big data analysis technology has injected new vitality into personalized recommendation. Nowadays, e-commerce is quite developed. Businessmen can obtain customers' interests and preferences through personalized recommendation. They can provide personalized recommendation services for users and establish long-term and stable relationships with users in order to gain advantages in the fierce business competition.

1.2 Research Status

It was not until 1990 that personalized recommendation became an independent concept. As Web 2.0 technology gradually has a relatively complete architecture, users can change from passive readers to active participants in Web pages. Due to the increase in the number of web users, the number of products recommended by the actual recommendation system is increasing day by day, so the personalized service recommendation system is imminent.

In March 1995, Robert Armstrong of Mellon University put forward the personalized navigation system Web Watcher on the artificial intelligence association of the United States. Marko Balabanovic introduced the personalized recommendation system LIRA at the same meeting, which marked the emergence of personalized service and recommendation system. Researchers focus more on data analysis of user behavior and practical research in e-commerce. They take the lead in proposing various algorithms of personalized recommendation to ensure that personalized recommendation serves

customers systematically.

2. Electronic Commerce System

2.1 The Concept of Electronic Commerce System

In the past, due to various conditions, commercial circulation has been a headache for businessmen. With the advent of the Internet era, the special distance that is difficult to overcome is also becoming accessible to each other because of the arrival of the Internet. A large number of new industries and IT applications follow, and e-commerce system is one of them. E-commerce system is the system of realizing Internet transactions. In accordance with the basic principles of market transactions, enterprises and consumers realize payment and settlement of transactions through the Internet. This digital communication channel makes communication between sellers and consumers more efficient. Although both parties can trade and pay through the Internet, but the distribution of goods still needs to be carried out in traditional ways. E-commerce service providers are intermediaries to ensure the smooth completion of business and realize commodity circulation.

2.2 Classification of Electronic Commerce Systems

E-commerce system can be divided into three main categories: B2C e-commerce system, B2B e-commerce system and C2C e-commerce system.

B2C e-commerce system is mostly used by sales enterprises and ordinary businesses or individuals. This e-commerce system communicates and trades between businesses and consumers by establishing a shopping environment on the Internet. It greatly saves time for businesses and consumers. Businessmen can also save many links of physical stores to

achieve cost savings. Customers can also buy good quality products at prices lower than physical stores. This new sales channel greatly improves the efficiency of business and consumer transactions.

B2B e-commerce system is mainly used for communication between enterprises. B2B e-commerce system can realize the functions of enterprise commodity display and online transaction. Not only have that, B2B website will closely link enterprise intranet with customers. Through good network feedback, we can better serve customers to attract more customers, improve the efficiency of business development, and make more profits for enterprises.

C2C e-commerce website management system uses C2C mode to achieve personal e-commerce activities. It is the advantage of C2C e-commerce in all e-commerce to realize popular transactions. How to prioritize the use of their own resources in order to gain advantage in the competition is the key issue that businesses in C2C mode need to consider.

2.3 Mobile Electronic Commerce System

Talking about the development of e-commerce system, we have to mention mobile e-commerce system. With the gradual spread of mobile facilities around the world and the development of the Internet, mobile e-commerce system has become an indispensable part of e-commerce. Its mobility, personalized service and security make the mobile e-commerce system well received by consumers. Quick and easy, omnipresent mobile e-commerce can do business at any time and place. It really solves the problem of time and space restriction between consumers and merchants. Mobile e-commerce may become a new starting point for the progress of e-commerce.

3. Relevant Algorithms of Personalized Rec-

ommendation System

Personalized recommendation is widely used in e-commerce system. Its main algorithms include association rule-based recommendation algorithm, content-based recommendation algorithm, collaborative filtering recommendation algorithm and combination recommendation algorithm.

3.1 Recommendation Algorithm Based Association Rules

The domain of data mining is the association rule. The set of data in large amounts of data achieves some interesting or useful association rules through association rules. In the form of "rule head to rule tail", it is similar to causal association. The recommendation system based on association rules is based on Association rules. The customer's behavior, namely purchase behavior, is the rule head of association rules, and the rule body is the target of recommendation. The recommendation system of this way has been praised by individual households and retail industry in varying degrees, and has been successfully applied.

Association rules can be displayed with a simple identifier: $A \Rightarrow B$, A is the header of rules; B is the body of rules. Formally, let $I = \{i_1, i_2, i_3, \dots, i_n\}$

be a collection of all items. Let data set D be a set of database transactions, in which any transaction t_m is a set of items, and $t_m \subseteq I$ is

a set of items too. The transaction t_m contains A if and only if an association rule is the implied form of $A \Rightarrow B$. Rule $A \Rightarrow B$ has support in data set D. It is defined as the proportion of transactions in D that contain $A \cup B$ (the union of item sets A and B):

$$\text{Support}(A \Rightarrow B) = P(A \cup B) = \frac{\text{count}(A \cup B)}{|D|}$$

The confidence of rule $A \Rightarrow B$ in data set D is defined as the proportion of transactions that

contain A in D and also B in D:

$$\text{Confidence } (A \Rightarrow B) = P(B | A) = \frac{\text{sup port}(A \cup B)}{\text{sup port}(A)}$$

$$= \frac{\text{count}(A \cup B)}{\text{count}(A)}$$

Generally speaking, an item set is a frequent item set or a large item set, which means that it meets the minimum support degree min_sup . The set containing K items is abbreviated as K item set, and the set of all frequent K item sets is recorded as L_K .

The classical algorithm Apriori is the earliest algorithm based on Association rules. The algorithm derives transaction sets from transaction databases. Each transaction is composed of identifiers and item sets. On the basis of this transaction set, all frequent item sets are searched, and association rules are generated from frequent item sets. Finally, recommendation is made. The generation of frequent item sets is the focus of association rule mining.

3.2 Recommendation Algorithms Based Content

The main problem to be solved in content-based recommendation is to reasonably use the characteristics or preferences of users to make reasonable recommendation. Based on content recommendation, user preference documents are constructed by collecting user information through web pages, collected documents or evaluating the content of articles shared by users, through which users can be recommended. The content-based recommendation algorithm involves three parts: content analyzer, file learner and filter.

Content analyzer: Extract available information from previous commodity information and present it in an appropriate way. This representa-

tion will be used as input nodes of attribute learners and filter components.

File learner: This module collects data representing users' preferences and forms users' daily information. It uses machine learning method to infer a model of user's preference from the information of goods that users used to like and dislike. For example, an attribute learner based on Web recommendation system can form a method of related feedback, which combines the vectors representing positive and negative examples of users with the prototype vectors representing users' daily information.

Filter components: Analyze and sort out the products that users browse and purchase daily, and compare the recommended products with the prototype based on this, and calculate their similarity. Then a list of products that users may be interested in is formed according to the rating level to calculate the cosine similarity between the products they like and the products they recommend.

3.3 Recommendation Algorithms Based Collaborative Filtering

Collaborative filtering recommendation can only be said to be the earliest in all recommendation methods. In fact, as early as 1992, collaborative filtering recommendation has been proposed. He is not only confined to the Internet, but also can often see the existence of collaborative filtering recommendation in real life. Collaborative filtering algorithms are similar to the common saying called "birds of a feather flock together". Collaborative filtering algorithms are mainly divided into two categories, one is collaborative filtering algorithm based on users, and the other is collaborative filtering algorithm based on goods. Two

User-based system filtering algorithm is commonly used to find a set of users similar to the

target they want to find, and then in this set to find things they have not heard or used. When looking for a similar set of target users, formulas or cosine similarities are often used to measure the similarity between the two.

The formula is expressed as follows:

$$w_{im} = \frac{|N(u) \cap N(v)|}{|N(u) \cup N(v)|}$$

The cosine similarity formula is expressed as follows:

$$w_{im} = \frac{|N(u) \cap N(v)|}{\sqrt{|N(u)| \times |N(v)|}}$$

Among them, w_{im} representing the similarity

between customer u and customer n , $N(u)$ is the set of items that customer u is interested in, and $N(v)$ is the set of items that customer V is interested in.

3.4 Analysis and Comparison of Three Algorithms

The above three algorithms are more general and basic in personalized recommendation system. But these algorithms have not been improved. Each algorithm has its own advantages and disadvantages. The following Tab.1 lists the advantages and disadvantages of the three algorithms:

Tab.1 Comparisons of Algorithms

Advantages and disadvantages The Algorithms	Advantages	Disadvantages
Recommendation Algorithm Based Association Rules	Recommendations are intuitive and easy to understand.	There is a data sparsity problem, and Complex requirements are not handled well.
Recommendation Algorithms Based Content	<ol style="list-style-type: none"> 1. The algorithm does not require data from other users. 2. The algorithm does not have the problem of data sparsity. 3. The algorithm can recommend not very popular or new products. 4. The existing technology of the algorithm is relatively mature. 	<ol style="list-style-type: none"> 1. Require users to have obvious preferences for feature content. 2. It is difficult to extract content of special significance.
Recommendation Algorithms Based Collaborative Filtering	<ol style="list-style-type: none"> 1. The algorithm can avoid the inconvenience caused by incomplete structural analysis. 2. The algorithm can model user interest based on complex concepts. 3. The algorithm has the ability to 	<ol style="list-style-type: none"> 1. There is data sparsity problem in large data processing. 2. The scalability problem exists when the algorithm is faced with a large amount of data.

recommend Department projects.

4. The algorithm can effectively use user feedback information.

These three algorithms have their own advantages and disadvantages. They are the most basic three algorithms in personalized recommendation system. Nowadays, most e-commerce systems use hybrid algorithms based on these three algorithms, making full use of the advantages of each algorithm.

4. Application of Personalized Recommendation in E-Commerce System

Personalized recommendation has a wide range of applications in e-commerce system, mainly reflected in: article retrieval, e-supermarket, search engine, distance education and so on. In e-commerce system, personalized recommendation mainly consists of three parts: input plate, output plate and recommendation method plate. The input board is mainly used for searching user-related information; the output board provides the recommendation content for users based on the information obtained from the input board; the recommendation board is to solve how to go from the input board to the output board, which determines the performance of the recommendation system. Personalized recommendation plays an important role in web page extraction, feature analysis, behavior record, and interest modeling and information recommendation.

The emergence of personalized recommendation system is of great significance to e-commerce system. Firstly, in the application of e-commerce, personalized recommendation can change the user's identity from a web browser to a purchaser to a certain extent, and promote the sales ability of e-commerce. Secondly, e-com-

merce system can obtain consumers' purchase information through personalized recommendation, and realize the promotion and bundling sales of similar products. At the same time, personalized push realizes the optimization of e-commerce system, improves the attraction of businesses or enterprises to consumers, and achieves the goal of profitability.

5. Summary

With the advent of the Internet era, e-commerce, a new marketing model, has been well received by many consumers. Personalized recommendation has also become an indispensable part of e-commerce system. In this era of intense business competition, how to better use and build personalized recommendation system has become one of the key to gain advantages in the competition. This paper mainly introduces the relevant content of e-commerce system and several algorithms of personalized recommendation, and briefly discusses the application of personalized recommendation in e-commerce system. It is believed that personalized recommendation will be brilliant in e-commerce system in the near future.

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