

# Design and Implementation of E-commerce Recommendation System Model Based on Cloud Computing

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**Abstract**—With the continuous expansion of the company's scale, the original offline sales model can no longer meet the demand. In order to keep up with the current trend of Internet technology, companies need to develop their own e-commerce platform. With the rapid development of e-commerce, its information structure is becoming more and more complex, and the amount of information is becoming larger and larger. Users are often lost in massive commodity information, and merchants cannot establish effective customer relationships in massive user information. In order to improve the service level and market competitiveness of Internet commerce, many e-commerce websites begin to introduce data mining technology. According to users' purchase records and historical browsing records, they can find the goods they like and recommend them to users. In order to manage massive commodity information and user information more efficiently, this paper proposes a solution to build e-commerce recommendation system on the cloud computing platform to improve the ability of massive data mining and business intelligence analysis, and realize high-performance computing at a lower cost.

**Keywords**—E-commerce, Cloud computing, Recommendation system

## I. INTRODUCTION

With the rapid development of e-commerce, its information structure is becoming more and more complex, and the amount of information is becoming more and more huge. Users are often lost in massive commodity information, and businesses cannot establish effective customer relationships in massive user information [1]. E-commerce has also entered the era of big data. E-commerce platform aggregates a large number of commodity resources and customers, which not only brings more choices to customers, but also causes the dilemma of customers' sea election resources [2]. In the current environment, e-commerce is developing rapidly. Because of the increasing information structure and information amount, many users will get lost in the massive commodity information. In this case, merchants can't establish a continuous and effective customer relationship with users in the mass of user information [3]. With the development of e-commerce in the era of big data, the amount of data in its field is growing geometrically, and the content of goods is rich and varied, which not only provides users with a wide range of goods, but also provides users with richer choices [4]. As an important tool of e-commerce, the development of recommendation engine is also limited. The proposal and development of cloud computing has laid a foundation for

the e-commerce recommendation engine to handle massive data and its application in clusters [5]. With the increasing amount of information in e-commerce, it takes a lot of time for consumers to find satisfactory information. For merchants, how to optimize the design of websites according to consumers' interests as much as possible to facilitate consumers' shopping has become an urgent problem to be solved [6].

With the increasing amount of information, recommendation system has become an indispensable part of every e-commerce platform. In order to improve the service level and market competitiveness of Internet commerce, many e-commerce websites began to introduce data mining technology. According to users' purchase records and historical browsing records, they found products that users like and recommended them to users [7]. As a platform for customers to shop online, e-commerce websites hope to recommend products that may be of interest to customers more accurately by using more efficient recommendation technology. Customization, personalization and differentiation have become the core competitiveness of enterprises. The two major trends and challenges of data analysis are: the expansion of data volume and the increasing demand for deep data analysis [8]. E-commerce recommendation system can capture key data from rich data information, tap potential customers for businesses, expand sales scope, and provide product recommendation for old customers and expand user groups [9]. In order to manage massive commodity information and user information more efficiently, this paper proposes a solution to build e-commerce recommendation system on the basic platform of cloud computing, so as to improve the ability of massive data mining and business intelligence analysis, and achieve high-performance computing at a lower cost.

## II. ARCHITECTURE OF E-COMMERCE PERSONALIZED RECOMMENDATION SYSTEM

E-commerce is becoming a new direction in the development of commodity trading, which means that trading is no longer restricted by regions, changes the trading form, accelerates the circulation of commodities, reduces the capital turnover time of enterprises, and facilitates the consumption of consumers. Therefore, e-commerce has become an indispensable part of the market economy. Cloud computing provides computing and storage to Internet users in the form of services. The resources used

by users, such as data, servers, application software and development platforms, come from the virtualized computing center on the Internet, which is responsible for distributing various resources distributed on the Internet, balancing loads, deploying software, and controlling security.

Real-time recommendation of e-commerce websites mainly requires real-time and accuracy. If the accuracy of product recommendation is high, it will take more time to mine and analyze product information, which will lead to the delay of e-commerce recommendation system. Cloud computing system is a parallel and distributed computing system composed of a group of interconnected virtual machines, which can dynamically provide computing resources according to the service level agreement negotiated between service providers and customers. During the operation of the system, the number of goods and users are constantly changing, and the interests of users may change. In order to make effective recommendations, it is necessary to update the database in time. Cloud computing service operation platform must have business support system, including capacity planning, billing, monitoring, security, scalability, upgradeability and other functions. The process of e-commerce personalized recommendation system is a circular process, which needs to be updated periodically. However, when the data in the data is transformed to a certain extent, not only the database but also the data warehouse and even the data model should be updated to improve the quasi-group degree of recommendation. The architecture of the recommendation system is shown in Figure 1.

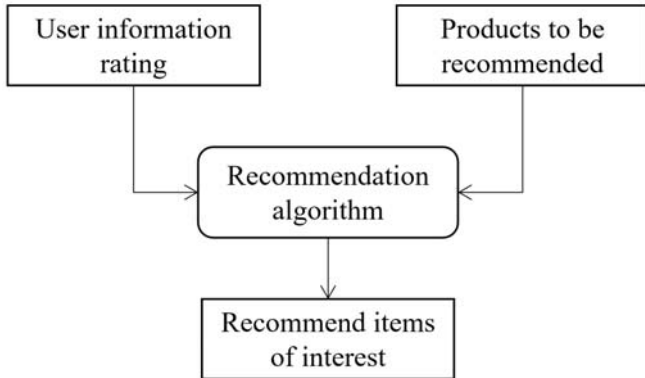


Figure 1 E-commerce recommendation system architecture

Recommendations are mainly used to predict the target user's interest in items that have not been rated in the nearest neighbor information. The prediction of user interest can be calculated as follows:

$$P_{u,i} = \bar{R}_u + \frac{\sum_{m=1}^n (R_{m,i} - \bar{R}_m) \times \text{sim}(u, m)}{\sum_{m=1}^n \text{sim}(u, m)} \quad (1)$$

Where  $\bar{R}_u$  is the average score of user  $u$  on the resource,  $R_{m,i}$  is the score of user  $m$  on item  $i$ ,  $\bar{R}_m$  is the average score of user  $m$  on the resource, and  $\text{sim}(u, m)$  is the

similarity between users  $u$  and  $m$ .

With the continuous growth of data and content on the Internet, the amount of data on the Internet becomes huge, and it is difficult for users to find the information they want. It is impossible to meet the needs of users by simply providing a single server or a small cluster. The related business systems of e-commerce platform can be built directly on this platform, and can also be integrated into this platform to share computing and storage resources and build the required recommendation model. The e-commerce business system actively provides the recommendation system with some information that can represent the characteristics and attributes of users, such as user registration information, commodity attribute information, user transaction information, user evaluation information and other hidden information, such as the historical browsing records and log files of the target users. Because there are many users in the Internet, and each user has its corresponding log data, the common storage system mines and stores a huge amount of user data. Therefore, the distributed storage system is the foundation of building an e-commerce recommendation system, which provides important basic support for the tasks such as user behavior analysis and association rules generation of the recommendation system. With the rapid development of e-commerce, people's life has become inseparable from it. People interact with e-commerce all the time, and in the process of interaction, huge users access data, in addition, the number of users is increasing every day [11]. Because the recommended objects only have the same fields as the objects recommended by users, the user-based recommendation system can not expand users' interests. In the aspect of data integration, the data analysis middleware layer can be used to import the source data of the business system for analysis, and the data of the business system can also be directly stored in the distributed file system layer for management and access.

### III. PERSONALIZED RECOMMENDATION PROCESS OF E-COMMERCE RECOMMENDATION SYSTEM

The huge data scale brought by big data environment makes it difficult for traditional data processing methods to meet the data processing requirements in this environment. In the existing online e-commerce platform, in order to make online shopping convenient and fast for users, the advertising space on each page is manually configured for commodity recommendation. Doing so not only makes all users see the same results, but also increases the workload of background configuration. At this time, it is necessary to establish a recommendation system to provide different products for different users. An e-commerce platform often includes many modules, including commodity management, order management, inventory management, store management, sales management, user management and other modules, which together constitute the overall framework of the existing e-commerce platform [12]. In the big data environment, the data scale is usually tens of millions or even billions. In this context, data mining will face serious scalability problems, and cloud computing is considered as an effective means to solve this problem.

The database of e-commerce system records the transaction data of each customer. Each transaction data records the products purchased by customers, and each product has a category attribute. Therefore, according to the

data and the user's evaluation information, the user's preference for each product category can be calculated as follows:

$$PC_{u,j} = \frac{\sum_{i \in I_u} PI_{u,i} \times \mu_j(x_i)}{\sum_{i \in I_u} \mu_j(x_i)} \quad j = 1, 2, 3 \dots \quad (2)$$

In the formula:  $PC_{u,j}$  represents user u's preference value for category,  $PI_{u,i}$  represents user u's rating value for product i,  $I_u$  represents the product set that user u has evaluated, and  $\mu_j(x_i)$  represents product i's membership degree to category j.

In order to realize the function of recommending commodities to users, it is necessary to prepare data. Firstly, it is necessary to calculate the relationship between two commodities, and then calculate the user's characteristic value through the user's behavior data. Based on the existing e-commerce recommendation system, we integrate resources, realize the virtualization of physical resources, realize the functions of resource pooling and resource dynamic expansion through virtualization technology, and dynamically store the data of each e-commerce system by using distributed file system. The storage of massive data has become a key factor restricting the development of recommendation engine. The system performance of recommendation engine greatly depends on the underlying file system. If you only rely on the operating system to provide the basic functions of the file system, you will not get the ideal performance.

Due to the timely interaction between people and computers, the low degree of automation of suggestions is a problem. When the user interacts with the computer, it will inform the system of the information and products he or she is interested in, but the recommendation effect is not good due to the delay of system update or delay effect. This is a method of mining time series relationship in transaction intensive, just like mining related data, looking for general rules in the user's access log. The relationship between "forwarding or not" and "posting tool" in the distribution comparison about behavior data is shown in Figure 2.

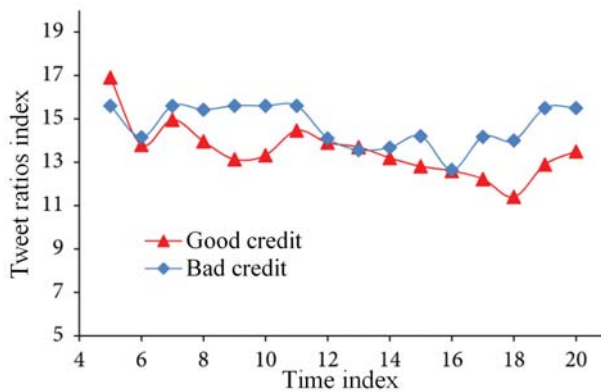


Figure 2 Relationship between "forwarding or not" and "posting tool" in behavior data

The key of the algorithm is to find similar users, that is,

neighbor users, so the quality of recommendation efficiency largely depends on the total number of users who have made recommendations. In an e-commerce system, there are usually a lot of users and commodities, but users will only evaluate a few commodities, which is a typical matrix sparse problem [13]. When calculating the similarity of commodities, we only calculate the similarity between the same subcategories, and select different eigenvalues for each subcategory of commodities, and give different weights to different eigenvalues. At the initial stage of the establishment of the recommendation system, it is difficult for the system to use these evaluations to find similar users because the system resources have not received enough evaluations. Most recommendation technologies guarantee the real-time requirements, while sacrificing the recommendation quality of the recommendation system. When recording users' preferences, users can fill them out by themselves, record their historical behaviors, and make a comprehensive calculation.

#### IV. CONCLUSIONS

E-commerce has become the most mainstream business model in contemporary society. With the explosive growth of information in the era of big data in e-commerce, personalized recommendation system has attracted more and more attention. E-commerce provides more and more shopping and consumption platforms for people. Using recommendation algorithms such as data mining can recommend products that users like to consumers and improve the turnover rate of e-commerce websites. With the rapid development of internet commercial websites, the total amount of information in e-commerce system is increasing day by day, and the problem of information overload is becoming more and more serious. Because the recommendation system is based on user behavior, malicious user behavior should be filtered. Malicious behaviors include users browsing certain products frequently through programs, creating a large number of user behaviors, or businesses adjusting commodity attributes according to algorithms. The powerful storage, operation and security functions of cloud computing, as well as the ideal mode of resource allocation and sharing, have laid a good foundation for the development of e-commerce recommendation engine, resulting in a brand-new business recommendation mode. In the aspect of data integration, the data analysis middleware layer can be used to import the source data of the business system for analysis, and the data of the business system can also be directly stored in the distributed file system layer for management and access.

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