

# Development of Internet Forum System Based on Knowledge Recommendation

Ke Chen\*, Yanming Li

School of Applied Technology, University of Science and Technology Liaoning, Anshan, China  
18653799014@163.com

\*Corresponding author

**Abstract:** The virtual community established by online forums is the most typical, mature, and representative concrete form in the online society. The knowledge recommendation based online forum system is a type of thematic forum that provides users with a richer and more diverse knowledge experience by launching high-quality content that meets their needs. Firstly, the characteristics of openness, anonymity, and interactivity of online forums were analyzed; Next, this article constructs a knowledge recommendation process consisting of user preference model construction, knowledge model construction, and recommendation algorithm design; Then, a collaborative filtering algorithm process was designed, and a mathematical model was constructed based on the process of constructing a user rating matrix, searching for similar users, and generating recommendation results; Finally, this article designs an overall system architecture consisting of user operation layer, system function layer, business logic layer, and data persistence layer. The research results provide a complete solution for the development of knowledge recommendation based online forum systems.

**Keywords:** Knowledge Recommendation; Internet Forums; System Development; Collaborative Filtering Algorithm; Architecture Design

## 1. Introduction

In the era of Web 2.0, individual networks represent a new generation of media power, forming a brand new public sphere where countless individuals interact and organize society, forming a powerful public force. As a product of the Internet Web2.0 era, online forums have developed rapidly with strong interactivity and sharing [1]. Online forums, blogs, and post bars are all concrete forms that make up online public spaces. The virtual community established by online forums is the most typical, mature, and representative concrete form in the online society. Online forums, also known as BBS forums or electronic forums, are a network discussion system and diverse speech space established in the information age through the BBS function of the network. They are electronic bulletin boards or bulletin boards, which are electronic databases established using computers and software. People can log in through the network and leave various types of information. The information on a forum can usually be divided into several topic groups, and users can freely read or submit information in the public areas they are interested in. With the development of Internet technology, more types of social media applications can be used to obtain information and exchange views, but online forums are still one of the most popular social media services [2].

According to the different scope of discussion in online forums, they can be divided into comprehensive online forums and thematic online forums. Forums with news, information, sports, entertainment, and history have a comprehensive feature, while thematic forums generally only discuss certain aspects or issues. The knowledge recommendation based online forum system is a type of thematic forum that provides users with a richer and more diverse knowledge experience by launching high-quality content that meets their needs. The system organically connects user needs with content creators through high-quality content recommendations and thematic compilation, presenting users with high-quality knowledge content. This not only helps to stimulate user interest in learning, but also promotes deep interaction between users and content creators, forming a good user ecosystem.

## 2. Characteristics of Internet Forum

Online forums are an online platform that provides users with a space for communication and

discussion. On online forums, users can express their opinions, share knowledge, ask questions, or participate in discussions. Online forums are usually composed of one or more thematic sections, and users can choose topics of interest to participate in.

### 2.1 Open

Online forums are a free, equal, and open information platform that is open to everyone. Elite individuals and grassroots often gather together to discuss issues. Netizens can freely log in and browse information, participate equally in various topic discussions, or set their own topic to attract other netizens to participate in discussions. The scope of topics discussed in forums is very broad, and almost all topics in daily life can be content from online forums. Registered users can post any message at any time and join various communication activities anytime and anywhere after logging in, expanding their public space.

### 2.2 Anonymity

Anonymity is the main characteristic that distinguishes online forums from other online services. Individuals who are highly valued in real society, such as their name, gender, age, and occupation, are eliminated and participate in discussions on topics anonymously, without being constrained by their roles in real society. In this state, individuals will no longer follow the principle of rational communication and can fully express their opinions on a certain topic according to their own wishes. Few people use real names, and the correctness of their speech is constrained by factors such as individual education level, moral standards, values, legal awareness, and social responsibility.

### 2.3 Interactive Quality

The dissemination in online forums has strong flexibility and interactivity, and can achieve point-to-point, point-to-point, or face-to-face dissemination; It can be synchronous propagation or asynchronous propagation. In the era of traditional media, the vast audience can only passively receive information sent by the media. In the era of the internet, the audience is no longer simply information receivers, but also producers and disseminators of information. On online forums, netizens can participate in different discussion forums according to their interests and interact with multiple people online. They can not only seek opinions from other netizens in the discussion forum, but also express their own opinions in the discussion forum.

## 3. Knowledge Recommendation Process

Knowledge recommendation has been widely applied in many fields, mainly including three parts: user preference model construction, knowledge model construction, and recommendation algorithm design. The knowledge recommendation process is shown in Figure 1.

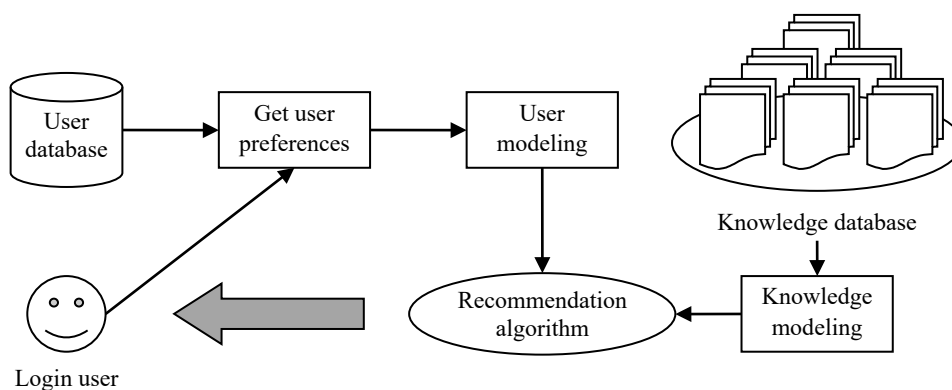


Figure 1: Knowledge recommendation process

Preferences exhibit significant individual differences and also exhibit group characteristics. Preference is actually a hidden emotion and tendency in the heart, with more emotional factors than

rational factors causing preference. User preference is a biased choice made by users after weighing their cognitive, psychological, and rational feelings. User behavior is an important part of understanding user preferences. Based on the hidden user interests and preferences in user behavior characteristics, depict the interest profile of the target group and obtain the interest preferences of the target user group. Track user behavior, maintain user relationships, provide accurate behavior output, improve user profiles, and conduct analysis of differences in user preferences. In order to avoid the limitations of sensitive information on user behavior characteristics research and discover patterns of different types of user behavior characteristics, it is necessary to characterize user behavior characteristics and complete preference prediction. The user preference model is the key to precise recommendation. By tracking and analyzing user behavior, an abstract description of user preferences is established, which is used in the recommendation process to calculate the target user's evaluation of unknown resources, thereby providing high rated knowledge to the user.

#### 4. Collaborative Filtering Algorithm

Collaborative filtering algorithm is based on the idea of "grouping people together". For a knowledge system, a user uses knowledge resources to find other users with similar behaviors, and recommends knowledge resources to similar users. Encouraging collaboration among users in knowledge resource recommendation systems allows all users to benefit from feedback from similar users and discover their potential interests. The collaborative filtering algorithm process is shown in Figure 2. Referring to relevant literature [3-5], construct a mathematical model for collaborative filtering algorithm.

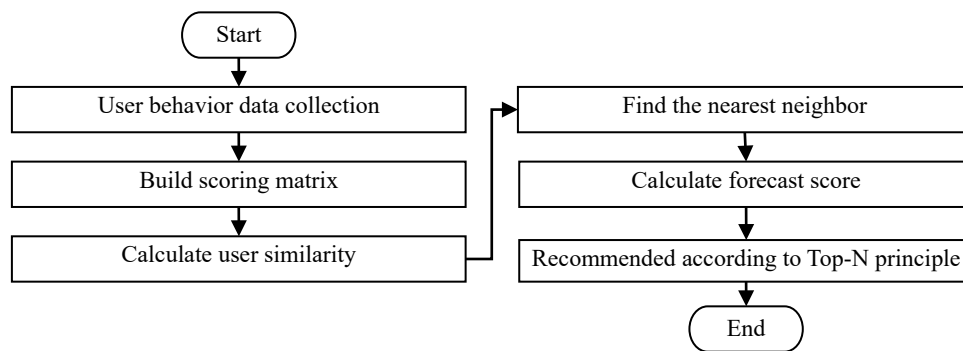


Figure 2: Collaborative filtering algorithm flow

##### 4.1 Building a User Rating Matrix

Collect user ratings and evaluation behaviors for knowledge, clean data to address issues such as inconsistency and invalid values, and convert them into a format acceptable to the system. Sometimes, it is necessary to convert evaluation behaviors into rating data. There are  $m$  users, forming a set of  $U = \{U_1, U_2, \dots, U_i, \dots, U_m\}$ ; There are  $n$  types of knowledge resources, forming a set of  $K = \{K_1, K_2, \dots, K_j, \dots, K_n\}$ . The rating matrix consisting of  $m$  users and  $n$  types of knowledge is:

$$R < m \times n > = \begin{bmatrix} R_{1,1} & R_{1,2} & \dots & R_{1,j} & \dots & R_{1,n} \\ R_{2,1} & R_{2,2} & \dots & R_{2,j} & \dots & R_{2,n} \\ \vdots & \vdots & \dots & \vdots & \dots & \vdots \\ R_{i,1} & R_{i,2} & \dots & R_{i,j} & \dots & R_{i,n} \\ \vdots & \vdots & \dots & \vdots & \dots & \vdots \\ R_{m,1} & R_{m,2} & \dots & R_{m,j} & \dots & R_{m,n} \end{bmatrix} \quad (1)$$

In the above equation, each row vector of the matrix represents a user's rating on different knowledge, each column vector represents a different user's rating on the same knowledge, and matrix  $R_{i,j}$  represents the user  $i$ 's rating on knowledge  $j$ .

#### 4.2 Searching for Similar Users

Similar users refer to other users who share similar interests and hobbies with the target user, also known as finding the nearest neighbor set. Search for similar readers using similarity calculation methods to calculate the similarity between users and find a set of users with high similarity to the target user. This article uses Pearson correlation coefficient, and the similarity calculation formula for user  $i$  and user  $j$  is:

$$sim(i, j) = \frac{\sum_{k \in K(i) \cap K(j)} (R_{ki} - \bar{R}_i) \cdot (R_{kj} - \bar{R}_j)}{\sqrt{\sum_{k \in K(i) \cap K(j)} (R_{ki} - \bar{R}_i)^2} \sqrt{\sum_{k \in K(i) \cap K(j)} (R_{kj} - \bar{R}_j)^2}} \quad (2)$$

In the above equation,  $k$  represents the intersection of user  $i$  and user  $j$ 's knowledge ratings,  $R_{ki}$  and  $R_{kj}$  represent the ratings of user  $i$  and user  $j$  for the  $k$ -th knowledge, and  $\bar{R}_i$  and  $\bar{R}_j$  represent the average ratings of user  $i$  and user  $j$  for all knowledge, respectively.

#### 4.3 Generate Recommendation Results

Based on similar user ratings, predict the target user's rating for unrated knowledge, recommend  $N$  knowledge with higher ratings to the target user, and the value of  $N$  is a constant, dynamically adjusted according to the rating value. The calculation formula for predicting the rating of user  $u$  on knowledge  $k$  that has not been rated excessively is:

$$R_{uk} = \bar{R}_u + \frac{\sum_{n \in C_u} sim(u, n) \cdot (R_{nk} - \bar{R}_n)}{\sum_{n \in C_u} sim(u, n)} \quad (3)$$

In the above equation,  $C_u$  represents a set of similar users,  $sim(u, n)$  represents the similarity between user  $u$  and user  $n$ ,  $R_{nk}$  represents the score of user  $n$  on knowledge  $k$ , and  $\bar{R}_n$  represents the average score of user  $n$  on knowledge.

### 5. System Architecture Design

MVC is a software design paradigm that organizes code in a way that separates business logic, data storage, and interface display, reducing coupling and improving cohesion. When modifying the display interface, there is no need to modify the business logic, which improves the maintainability of the system. In order to design a knowledge recommendation based online forum system as a people-oriented knowledge service platform and a flexible and autonomous knowledge dissemination platform, drawing on the design ideas of MVC, the system functional layer is separated from the business logic layer on the basis of the traditional three-layer structure, and the business logic layer provides support for the system functional layer. A four layer architecture consisting of user operation layer, system function layer, business logic layer, and data persistence layer was designed, as shown in Figure 3 [6-8].

#### 5.1 User Operation Layer

The system provides users with both fixed and mobile services. Fixed services are aimed at forum moderators and system administrators, while mobile services are aimed at ordinary users. Users access web servers through smartphones, desktops, laptops, tablets, and other user terminals, which provide online browsing and learning services for their knowledge resources.

#### 5.2 System Functional Layer

According to three types of roles: ordinary users, forum moderators, and system administrators, functions are divided. Ordinary users are knowledge browsing and users, forum moderators are

knowledge providers, and system administrators are system maintainers. The system functional layer is separated from the business logic layer to provide users with various operational functions. The application server provides a way to access business logic and integrates various business logic and application implementations.

### 5.3 Business logic Layer

Business logic is the logic that software possesses within a certain business domain, and is the core and soul of the software. As a part of the system architecture that embodies core values, focusing on the formulation of business rules and the implementation of business processes is beneficial for the development, maintenance, deployment, and expansion of the system. The business logic layer of this system consists of basic information processing, knowledge recommendation processing, user learning support, auxiliary recommendation decision-making, user evaluation processing, and system maintenance processing components, providing access interfaces for the system functional layer.

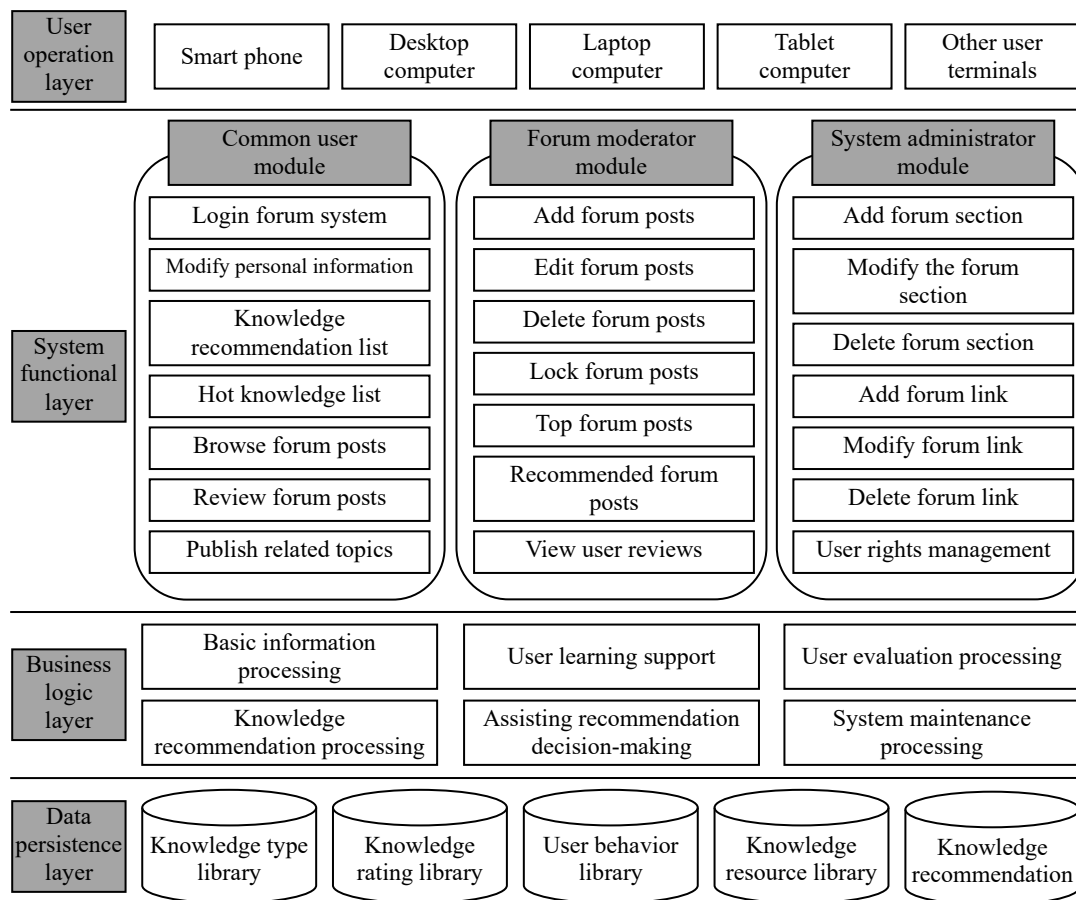


Figure 3: Overall architecture of internet forum system based on knowledge recommendation

### 5.4 Data Persistence Layer

The interaction between traditional software development applications and databases is mainly achieved through SQL statements, which act as a bridge between the application and the database. The disadvantage of this method is that it requires a large maintenance workload. When the data structure changes, the application needs to be maintained, and when users need to make changes, the application also needs to be maintained. Persistence is a mechanism for converting program data between persistent and transient states, using data persistence methods to build a bridge between applications and databases through configuration files, without the need for maintenance.

## 6. Conclusions

Online forums are a public discourse space that does not restrict user identity, allows users from different social classes to express their personal opinions and interests freely in virtual identities. Online forums satisfy the desire of netizens to express themselves. Netizens of different identities and professions gather together to discuss and exchange various topics, perspectives, viewpoints, and emotions, which can be fully expressed here. Due to the concealment of identity, netizens do not have to worry about the influence of external factors, so they can express their opinions more boldly and straightforwardly. Some words in real life that cannot be said or dare not be said for some reason can find a place to live in the forum. The knowledge recommendation based online forum system studied in this article integrates the functions of knowledge recommendation and online forums, recommends various knowledge to users based on their interests, and users discuss knowledge in online forums. The system adopts a modular design, with a friendly interface and convenient use, while also having good scalability to meet the needs of future information growth.

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