Design and Implementation of Learning Management System Based on User Behavior Dynamic Recommendation Algorithm

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Abstract. This paper studies the design and implementation of the learning management system of user behavior dynamic recommendation algorithm. With the rapid development of the Internet and the increasing number of information, the learning and thinking methods of college teachers and students have changed greatly, and the traditional education model has been unable to meet the requirements of teachers and students. In class, the teacher explains the knowledge step by step, and the teacher can't get the feedback from the students in time, which may cause the students to not understand the knowledge and feel great pressure. The existing resources can not be effectively shared, nor can they provide interactive learning. At the same time, it is impossible to provide personalized recommendations based on users' behavior. When more and more students join the classroom, their learning space is not only limited, but also can not meet the basic needs of personalized learning.

Learning management system is the product of the perfect combination of traditional education and the Internet. Through the existing classroom teaching means, teaching activities can transfer knowledge to students more conveniently and effectively. The system provides personalized services such as search, recommendation and resource reuse, which not only simplifies the workload of college teachers, but also provides the function of statistical analysis. Combined with the actual situation, the system uses a unique recommendation model to analyze the user's behavior, and then provides users with personalized recommendation content.

Keywords: Dynamic recommendation algorithm · Learning management · Data processing

1 Introduction

Network education is the modern expression of distance education. Distance education is a form of education in different places at the same time or at different times. With the rapid popularization of network, network education has been greatly developed in recent 20 years, so it is more and more widely used in modern education system. But at present,

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there are still many problems in online education. Although the development of network technology enables the sharing and autonomy of teaching resources at a low level (mainly through HTTP and HTML), it is far from enough for the complete sharing of resources. Such consequences are a large waste of teaching resources and repeated development of small workshops at a low level. Therefore, higher education press and our company jointly develop a learning and education platform for college students, and my group is responsible for developing the core system - online learning management system. Teaching is far from meeting the needs of the majority of learners inside and outside the school, and the network, as a rapidly developing resource, has become an important means to solve China's educational problems, which is favored by everyone. Therefore, there are still many basic theoretical problems to be further studied and discussed in the discipline of network education. Even so, network education is an application level discipline after all. With the continuous development of science and technology, more and more new technologies have been introduced into the field of education. They have played a great role in reform and further promoted the development of education. However, technology can not solve all problems, and the effective application of technology is the fundamental. Therefore, we should not only apply technology efficiently and reasonably, but also pay attention to the theoretical guidance in technology, actively explore the most valuable theory and constantly update and develop the original theory. The value of theory lies in the guidance to practice, which is not only reflected in the application level, but also consistent with the definition of the discipline characteristics of "application level" of network pedagogy, which is the characteristics and trend of the development of network education in China.

At present, the development of network education in China has great limitations, the function is not perfect, the application level is relatively low, and there are many aspects of application, but there is the problem of repeated construction of resources. On the surface, there are a lot of network knowledge, but there are few network knowledge really suitable for learning, and the level of these limited network resources is also uneven. Online education institutions design and produce their own curriculum resources, which are almost each set, resulting in a great waste of human and material resources. They can not learn from each other in the construction of curriculum resources, and there is a state of disorder. In fact, many resources should be shared instead of going their own way. For example, colleges and universities now offer popular majors, such as computer and economic management. Many courses are basically the same. It is not necessary for each school to develop its own resources, resulting in repeated construction of teaching resources and waste of network resources[1].

Online learning management system is the perfect combination of network and teaching work. It provides a good teaching experience between teachers and students. Through the current way of classroom learning, teaching activities can easily transfer knowledge and content to students. Various educational resources from different regions are stored in the database, and learning materials can be updated online in real time, which not only simplifies the workload of classroom teachers and provides the function of statistical analysis, but also students can provide resources, You can also obtain teaching resources and strengthen training through terminal equipment anytime and anywhere.

Students' knowledge teaching is one of the main tasks of the school. With the continuous reform of the university system, students' after-school management is becoming more and more complicated, and relevant education departments greatly promote smart classroom. Therefore, the research on learning management system based on user dynamic behavior recommendation is of great significance.

Visionlms and training treasure are learning management systems that can be searched on Baidu immediately [2]. It only aims at small-scale enterprise training, without considering a series of problems such as resource sharing, personalized learning and solving teachers' workload. In addition to the learning management system used by colleges and universities in China, the learning system on the Internet is mainly divided into two camps. The first is the question bank system platform, among which the ape question bank system, which provides users with personalized test paper generation and simulated examination based on big data, and the easy question bank system, which comprehensively evaluates users through the data of users' online practice, According to the historical data mining user information, teachers strengthen the contact with students according to the practice statistical data of students, which not only allows teachers to fully grasp the situation of students, but also provides assistance for teaching work. The second is the online course platform, such as MOOC (massive open online courses), which not only provides all the courses of coursera, udacity and EDX [3], the three major mainstream course providers, but also sinicizes many courses for the convenience of users. There are also a series of online course learning platforms such as Netease cloud classroom and Baidu education, which are well-known and leading learning and education platforms in China. However, there is no effective learning management system integrating question bank and online classroom education in China.

2 Related Work

2.1 Functional Requirements

According to the business analysis of higher education, the learning management system should meet the various needs of students' online learning and greatly facilitate students' online learning. From the perspective of function, the interface is required to be simple. The courseware in the system can be displayed on the home page to meet the query and demonstration viewing of non login users, and provide students with online course selection and purchase, It is convenient for students to ask questions online and teachers to answer questions online, and it is convenient for teachers to track students' learning online. After the system goes online, it can enable the students of the existing higher education press to realize online learning, attract more students to study on the online learning website of higher education, and attract new users for higher education [4].

In order to achieve the above purpose, the learning management system needs to carry out business planning, organically combine the characteristics of higher education and services that can be put forward with online teaching, and realize an online teaching system with complete functions and convenient learning for students. The business modules and sub modules provided by the above need are: courseware as the carrier of learning content, The function in this system is to carry and display content and encrypt and protect content. The courseware must realize the communication with the system interface, so that the system can provide various control information of the courseware, and the courseware can return the use information to the system. Offline courseware must be encrypted resources protected by the authorized authentication system. It must be able to effectively control the learning duration and validity period, and upload learning records at the same time. The learning time control of offline courseware is completed by the communication between offline courseware and authorized authentication platform [5]. The learning records of offline courseware are displayed in the system only when the offline courseware uploads the learning records through the interface, otherwise the system will not record these data.

Courseware is the carrier of course learning content. A course can have one or more courseware as its learning content. When users learn a courseware in the course, their learning time will be deducted from the allowable learning time of the courseware at the time of purchase. When the remaining class hours of the user's course are O Prevent users from entering the learning courseware again. When the validity period of the courseware reaches the limit, users are also prevented from entering the learning courseware again.

Only when the courseware communicates with the system can it make a corresponding decision on whether to continue learning. When the courseware communicates with the system, it is necessary to give information on whether to continue learning, and judge whether to prevent the courseware from running according to the information.

According to the above analysis, this chapter first needs to analyze the user behavior, then establish relevant models, collect the user behavior data and standardize the data. According to the extracted large amount of key information, LSA (late semantic analysis) argot analysis technology is used to reduce noise and matrix dimensionality, and K-means clustering algorithm is used to statistically cluster the user behavior [6], Thus, the problem of item classification is effectively solved, the error of recommendation is reduced, the use of computing resources is reduced, and the quality of recommendation is improved. Then, after the user's interest is obtained through the user's historical behavior data and its retrieved keywords, the user's interest is analyzed in a deeper level, so as to recommend textbook resources for them. Finally, the above recommendation processes are parallelized to improve the recommendation efficiency. Next, first analyze and model the user behavior.

2.2 Mongodb Database

Mongodb is a memory based document NoSQL (full name is "not only SQL") database. It is developed by 10gen company. It naturally supports distributed storage and is an open source database. It is written in Ch + language to provide users with methods with good performance and strong scalability. It has no fixed data structure format and is different from MySQL and Oracle traditional relational databases. Its data structure is similar to JSON and is called bson in mongodb database, so it can store complex data well. Its main features are: ① support document embedding; ② flexible structure without creating data structure in advance; ③ support multiple replication modes, providing redundancy and automatic failover; ④ good performance and fast speed, and its query speed is much faster than MySQL; ⑤ complete index support; ⑥ built-in gridfs, support mass storage; ⑦ self-contained distributed features, unique primary key, Directly configurable distributed

⑧ adopt efficient network protocol and high performance ⑨ third, rich support and active community, providing many optimization schemes.

Maven is based on the project object model (POM). For maven, the unique identification of a project is jointly determined by the organization unique identification (groupld), artifact ID and version number information. Each project has a packaging type, which can be jar, war, ear or POM. The type of generated package directly determines the type of project export. POM type is used for component multi module engineering. There are two relationships between projects: dependency and aggregation. It can well manage the interdependence and aggregation between projects, especially in the jar package version dependency [7].

Collaborative filtering recommendation algorithm is the so-called domain based algorithm. It mainly involves two types of algorithms, one is the algorithm for recommendation based on user information, and the other is the algorithm for recommendation based on item information. Its main features are as follows:

(1) Files in HDFS are segmented according to block, and the specific parameter DFS block. Size can be accessed through HDFS site Property in XML. If it is not configured manually, in Hadoop 2 The default size of the block in X is 128M, and the default size of the block in the old version is 64M.
(2) the HDFS distributed file system will provide a directory tree for the accessed client, so that the file can be accessed by using the address, such as: hdfs://master:9000/input/a.txt.
(3) Namenode node is mainly responsible for the management of abstract directory tree and block data (metadata). It is the main node of distributed file system cluster.
(4) The datanode node is responsible for the storage of massive data. The same block can store copies on different datanode nodes. The specific parameter is DFS Replication can be through HDFS site Configure the number of replicas according to the property in XML, which cannot exceed the number of cluster datanodes.
(5) HDFS distributed file system is suitable for large file storage, does not support file modification, and is more in line with a large number of read operations.

The specific architecture is shown in Fig. 1.

MapReduce is a distributed programming framework for data computing. Its core function is to integrate user-defined business logic and form a complete distributed computing system with its own components [8]. The frame composition is shown in Fig. 2.

2.3 Dynamic Recommendation Algorithm

The packet length of DES algorithm is 64 bit, and the key K is also 64 bit, but only 56 bit is valid, and the other 8 bits are parity bits. The algorithm mainly includes initial permutation, 16 rounds of iterative product transformation, inverse initial permutation and 16 sub key generation. A set of 64 bit plaintext is input from one end of the algorithm, and 64 bit ciphertext is output from the other end.

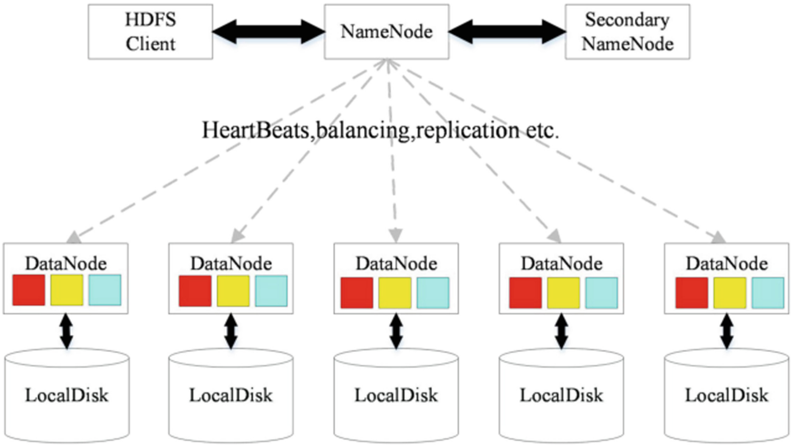

Fig. 1. HDFS architecture diagram

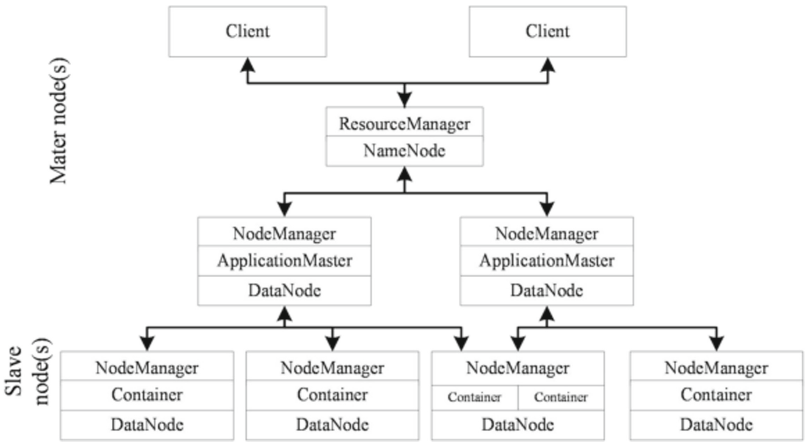

Fig. 2. Architecture diagram of yarn

A group of data to be encrypted must first be processed through the initial replacement IP, and through a series of operations, and then through the inverse replacement IP-1 of the initial replacement to give the encryption result.

(1) Initial replacement IP: first, transpose the 64 bit plaintext according to the initial replacement IP table.
(2) The 64 bit data output by the replacement is divided into left and right halves. The left half is called l0 and the right half is called R0, with 32 bits each.
(3) Calculate 16 iterations of the function. The encryption of R0 by key K1 is realized by encryption function f, and the result is 32-bit data

$$L_i = R_{i-1} \tag{1}$$

$$R_i = L_{i-1} \oplus f(R_{i-1}, K_i), i = 1, 2, ..., 16 \tag{2}$$

(4) For the last iteration, L16 is on the right and R16 is on the left.
(5) Then, through the inverse initial replacement of IP-1, the data is disordered and rearranged to produce 64 bit ciphertext.

Des adopts iterative structure in algorithm structure, which makes its structure compact and clear, and the algorithm is involution operation, which is easy to implement. Moreover, its decryption process is completely similar to the encryption process, except that the order of 16 cycles of pre key sequences K1, K2, …, K16 is reversed, that is, the first cycle uses the 16th sub key K16, the second cycle uses K15, and so on.

3 Design and Implementation of Learning Management System Based on User Behavior Dynamic Recommendation Algorithm

Because the format, arrangement and type of the collected original data are generally different, it is necessary to clean the data and do unified and standard processing, so that the obtained original data can be well used to reduce the impact of disordered data. Due to the differences in the data collected, there are some differences in the processing methods of different types of data [9]. The format of data cleaning and sorting is as follows:

(1) Registration information of mango classroom users: user ID is varchar type, major is varchar type, student number is varchar type, date of birth is DataTime type and gender is varchar.
(2) Basic information of mango classroom user login: the user ID is long type, the student number is varchar type, and the login time is DataTime type.
(3) Mango classroom users browse and search information: the keyword of search and browse is varchar type, the time of search and browse is DataTime type, and the website information of browse and search is varchar type.
(4) User collected textbook resource information: the textbook ID is varchar, the collection time is DataTime type, the name of the collected textbook resource is varchar type, and the access address of the collected textbook resource is varchar type.
(5) Textbook resource information: textbook ID is varchar type, popularity is smallint type, textbook resource access address is varchar type, and textbook resource name is varchar type.

The above are some data format specifications in data cleaning and sorting, including numerical information, nominal data and binary metadata. It is necessary to clean up invalid data and standardize the format of effective data. The specific details are described below.

As the actual received data is incomplete, noisy and inconsistent due to the influence of the network and system, which seriously affects the results of the following recommended calculation, it is necessary to standardize the data, remove the noise and irrelevant data, convert the data into data suitable for storage and calculation, and reduce the dimension and compress the high-dimensional data [10]. The specific operation methods are as follows:

(1) Binary value conversion. For a series of standard values such as gender, Boolean value and location, it needs to be converted to a computable standardized value of 0/1, and the location can be converted to a zip code.
(2) Noise reduction. Through the numerical information calculated by the average value and standard deviation, the discrete and deviation points are excluded, making the calculation more accurate.
(3) Replacement of missing value and wrong value. Replace illegal characters such as null to avoid calculation errors.
(4) Cleaning and sorting of other data. The address information data maintains its original form, the invalid data is set to null, and the date needs to be processed in a unified format.

After the above data cleaning, sorting and conversion, the data initialization has been basically completed. DCI (abbreviation of comsysdata cleaning and integration software) data products independently developed by Kangsai Information Technology Co., Ltd. are used in the process of data cleaning, sorting and conversion.

In order to ensure the clear hierarchy and good expansibility and maintainability of the system, the system adopts hierarchical architecture design. The overall architecture is divided into UI user interface layer, application service layer, technical support layer, data resource layer and basic platform layer.

The user layer is the UI user interface layer. As the name suggests, its responsibility is to interact with users. With the help of browser, html is rendered into a user-friendly interface, and JavaScipt script language is used to complete the interaction with background information request. Among them, the interfaces for teachers include: registration login interface, course creation interface, online classroom interface, correcting and browsing test papers (homework) interface, pre class preparation interface, retrieval interface, etc. the interfaces for students include: registration login interface, classroom practice interface, online question answering interface, retrieval interface, recommendation interface, etc. The pages about teaching assistants include: registration login interface, course creation interface, online classroom interface, correcting and browsing test papers (homework) interface, pre class preparation interface, retrieval interface and other functional interfaces for auxiliary teachers [11]. The system administrator interface includes a list of resource management interfaces, such as textbook management interface, system message push interface, resource audit interface, etc.

Application service layer interface is mainly used to control business logic and provide services for UI user interface. It mainly includes the following functions: creating courses, preparing lessons, attending classes, experiments, reviewing assignments, course question bank, teaching summary, discussion area, adding courses, browsing documents, classroom answers, submitting experiments, completing assignments, uploading exercises, sharing resources, recommending resources, reviewing, reporting resources, resource management, resource retrieval, etc.

Technical support layer: use mature technology to build a system platform to provide service support, mainly including multimedia engine, report engine, search engine, teaching interaction, web crawler, data collection, data mining, data analysis, etc.

Basic platform: the hardware equipment mainly used in the system platform, mainly including MySQL database cluster, mongdb database cluster, web server cluster, distributed file system, cache server redis and other basic platform facilities.

Among them, I am responsible for the creation of courses, lesson preparation, class, course question bank, teaching summary, discussion area, adding courses, browsing documents, classroom answers, uploading exercises, sharing resources, recommending resources, reviewing and reporting resources, the realization of resource management functions, ffmpeg video conversion, webmagic web crawler The construction of open source multidimensional data platform saiku, the establishment of multidimensional database model and a series of technical applications such as recommendation module.

4 System Implementation

This function is mainly to extract the key information in the user's behavior log record, and use MapReduce in the big data framework to parallelize this function. First, create the preprocessmapper class and inherit the mapper class, override the map method, and then split the text file. Then send the standardized data to the preprocessreducer class. The preprocessreducer class summarizes mapper's results and connects them with ":", uses the user ID as the key and the behavior summary results as the value, and outputs them to the distributed file system. The specific code implementation of the preprocessmapper class is shown in Fig. 3:

```
map(uid, bookIds){
    for (bookid: bookIds) {
        context.write(bookid, uid);//
    }
}
```

Fig. 3. Preprocessmapper class specific code

It is mainly composed of application layer, service layer, data processing layer and database. The application layer is divided into foreground application interface and background application interface. The service layer is all business logic processing layers. The data processing service layer is divided into five parts: learning record processing service, general data processing service, other basic services, user authority management service and external interface service, The database consists of three data services: learning record database, core database and user database [12].

Before the establishment of the project, in the project planning stage, the project team made a comprehensive comparison between the development tools and the actual needs, and decided to adopt the combination of cocoon framework and java servlet language. Cocoon framework is a sub project of Apache, which can be seamlessly combined with java servlet. The system plans to query the database with java servlet for business processing, and finally provide cocoon with the required XML output data file. Cocoon organizes the front-end business processing according to the data file output by java servlet and formats it into the pages required by the foreground. In this way, the combination of cocoon and java servlet can make each functional component unitized, which is conducive to development, And later maintenance and upgrading. Cocoon is rarely used in China, and there is a lack of relevant documentation. However, the current technology can be well applied, but we need to explore and find a more effective combination scheme with servlet. Improve the overall performance of the website [13].

Developing projects with cocoon can greatly facilitate developers and is conducive to the healthy and stable progress of the project. The project design adopts the method of outputting XML format data files in the background and outputting static pages in XML format by foreground cocoon. In this way, a stable, efficient and portable background language is needed to support the generation of XML data files. It is the best choice to choose javaservlet as the underlying background development, because javaservlet and cocoon can be well combined. The pipeline in the learning management system is shown in Fig. 4 below.

```
<map:match pattern="*/*">
   <map:generate type="request-extend" />
  <map:transform src="getparameter.xslt" >
    <map:parameter name="file" value="{0}.xml" />
  </map:transform>
  <map:transform type="xinclude" />
  <map:transform src="pagexml2html.xsl" >
    <map:parameter name="basecontext" value="${basecontext}" />
    <map:parameter name="service" value="${service}" />
    <map:parameter name="sessionid" value="{session-attr:sessionid}" />
    <map:parameter name="currenttoken" value="{session-attr:token}" />
  </map:transform>
  <map:transform type="xinclude-extend" />
  <map:serialize type="html"/>
</map:match>
```

Fig. 4. Learn the pipeline code in the management system

5 Conclusion

This paper studies the design and implementation of the learning management system of user behavior dynamic recommendation algorithm. With the online operation of the online learning management system, the learning management system is a construction project based on the Internet. Combined with the actual situation, SSM (Spring +

springmvc + mybatis) framework is selected for the construction of the system, because it is a relatively mature framework at present. Spring is a lightweight control inversion and aspect oriented container framework. With the efficient operation of online learning management system, higher education press has made unique advantages in online education and further consolidated its position in the industry. More and more users have registered in the learning management system, studied in the system and purchased their favorite courseware. On the other hand, the online learning management system has increased the user viscosity of Higher Education Publishing House, making more and more users choose to study in Higher Education Publishing House. The purpose of learning management system is to improve the efficiency of teachers and students, enhance the interaction between teachers and students, strengthen the reuse of resources, and establish a good learning environment for teachers and students.

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