Research and Design of Online Learning System Based on Cloud Platform

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Abstract. The traditional online learning platform has limited educational resources and isolated resources, so it is difficult to support the operation of massive data. This paper designs an online learning system based on cloud computing platform to effectively integrate resources, reduce operation and maintenance costs. The platform uses big data and distributed computing technology to collect and process user access history data and log data, and uses collaborative filtering algorithm to recommend courses, so as to improve the efficiency of learners.

1. Introduction
Online learning platform is based on the concept of resource sharing to release courses to the platform for learners to learn, which is a popular learning method at present. Traditional online learning platform based on single server has many limitations, such as limited educational resources, isolated resources, few concurrent users, small amount of data storage, poor user experience, which can not satisfy the personalized and diversified needs of users. In order to give full play to the advantages of resource sharing, online learning system is deployed on the cloud platform, so the design of online learning system based on cloud computing platform becomes an urgent problem.

The platform provides a wide range of courses and subjects, so it is difficult for learners to find suitable courses to learn. Massive learning resources cause great trouble to learners. Learners often need to spend a lot of time and energy to find the learning resources they need. The purpose of introducing recommendation system is to guide learners to find their interested information as soon as possible, save the time cost of learners, improve the efficiency of learners, avoid the loss of learners and enhance the experience effect of learners.

2. Related technologies

2.1 Cloud computing technology
Cloud computing is a technology based on distributed and parallel computing, which centralizes the distributed storage, computing, service construction and other resources on the network, and provides services for users in a virtualized way. Cloud computing platform provides infrastructure services for platform users to ensure the normal operation of the hardware system. Cloud computing platform mainly completes big data storage and big data computing.

Online learning cloud computing platform has many advantages:
- Large scale computing power.
- Provide virtualization technology to make efficient use of various computing or storage resources.
• learners can purchase services on demand and realize flexible management.
• Versatility. Such as providing the same application environment, providing a unified API for learners, and avoiding repeated development.
• Data security is guaranteed, and unified data management is easier to build a strong security system.

2.2 Openstack working mechanism
Openstack is a widely used open source software project. It is a cloud computing platform jointly developed by Rackspace and NASA. By building a cloud computing ecosystem, it helps service providers to achieve cloud infrastructure as a service. Its core components include nova, swift, keystone, horizon, cinder, neutron, glance, etc.

2.3 Recommended algorithm
At present, there are many recommended algorithms. Here are two algorithms.

Content-based recommendation algorithm is to recommend products similar to the past preferences of learners according to their past preferences. For example, most of the courses learners have learned are about big data, cloud computing and so on. We can recommend computer courses to the learners.

The idea of collaborative filtering algorithm based on items is to predict the correlation between items by analyzing the user's rating of different items. Firstly, the similarity of items is calculated, and the recommendation list is generated according to the similarity of items and the historical behavior of users. The object here refers to the course.

3. System design of the system
The cloud platform architecture model of this system is composed of four layers: openstack infrastructure layer, management platform layer, web application layer and user layer. As shown in Figure 1 below.

The infrastructure layer provides database, network equipment, server and other software and hardware facilities, including virtualization technology, virtual storage device virtualization. Openstack Sahara is used here as an add-on. As the central node, administrators can deploy Hadoop
and spark distribution architectures on virtual machines. In the architecture, Sahara runs on the openstack controller node, while Hadoop cluster runs on the openstack computing node.

The management platform layer deployed Hadoop and spark. Realize big data distributed computing. Responsible for resource scheduling and job scheduling. It provides an important guarantee for unstructured big data acquisition and processing.

The web application layer is developed with MVC design mode of B/S architecture and MyEclipse software. The back-end adopts SSM framework, and the front-end adopts jQuery and bootstrap framework to realize the adaptive Web presentation page. It is divided into view layer, business control layer and data model layer. The view layer is responsible for the display of the page, the business control layer is responsible for the interaction between the user and the system, the distribution of request processing, and plays a controller role. The data model layer adopts mybatis, a Java based persistence layer framework, and uses simple XML or annotations to configure and map native information.

4. Main functions of the system
The web application layer of online learning system based on cloud computing is divided into seven modules according to function modules: user management module, online experiment module, online examination module, course recommendation module, online assignment module, resource management module and system configuration module.

4.1 user management module
Four types of accounts are set in the system: system administrator, school administrator, teacher account and learner account, and corresponding permissions are set respectively. The system administrator has the highest authority, with the functions of managing account, resource configuration, sub service configuration, viewing real-time data of system operation, etc.; the school administrator has the functions of curriculum review, learner account management, teacher account management, data import, etc.; the teacher account has the functions of curriculum resource management, importing learners, real-time job monitoring, online examination management, etc. Learner account has the functions of online homework, experiment, online examination, etc.

4.2 course recommendation module
Learners can be registered as learners. When registering, they fill in personal information, including interest labels and professional directions. These data provide great convenience for new users to recommend.

For compulsory courses, learners can achieve it through information retrieval technology. For some selected courses, learners have a high degree of freedom and often choose according to their personal interests and hobbies. Therefore, students' browsing history, course collection, course evaluation and other information data are captured, processed and analyzed, and effective recommendation algorithm is used to recommend learners.

The recommended process is:
1) The preservation and generation of learners' historical data. Web log files, browsing time, favorite data and other information are formed into data sets. The data collected by flume is transferred to the distributed file system HDFS for offline processing by spark.
2) Data preprocessing. Statistics, outliers processing and data conversion are carried out for the data, and the recommended model data set is established.
3) Recommend algorithm selection. From the perspective of data analysis, the base number of courses is far less than the number of users. From the perspective of applicable scenarios, the courses are recommended according to the historical items that users like, which is more in line with users' individual needs. Based on some data sets, relevant tests are carried out respectively, and finally the articles based collaborative filtering algorithm is determined to be used for recommendation.
4) The recommended results are uploaded to the storage server of the website.
5) Recommend to learners. When learners log in to the system, they will enter the page and the homepage will display the recommended courses.

4.3 online experiment module
This module provides experiment guidance, online experiment, operation video, experiment resources, Q & a discussion, online evaluation and other functions. According to the needs of the course environment, different virtual machine instances are built to simulate online experiments. Students can do experiments without setting up their own environment, so that all students can do online experiments anytime and anywhere. Resource allocation is based on curriculum, with functions separated and time sharing. Desktop development environment and computing function are separated. Experiments like big data and artificial intelligence require a lot of computing resources, so computing functions can be independent from desktop services, and a dedicated computing cluster can be established, and all people share computing resources. As shown in Figure 2, it is an interface display of online virtual experiment.

![Remote Desktop Workbench](image)

![Applications](image)

Figure 2. Online virtual experiment environment

4.4 online examination module
The determination of course scores also needs examination. The basic process is as follows: the teacher obtains the resources of examination database, or adds new examination questions, and sets up the examination papers after completion. The strategy of paper formation uses the methods of artificial paper formation and intelligent paper formation. After completion, the examination information is set, and the learners can complete the online examination within the specified time.

5. Conclusion
The online learning system based on cloud platform builds an online experiment platform based on virtual equipment, which can maximize the utilization of teaching resources. And the recommendation algorithm is applied to the platform, which greatly improves the enthusiasm of learners to participate in learning. Cloud computing technology and big data technology are updated rapidly. In the next step, we should continue to research and practice the integration of online learning platform, constantly
improve and strengthen its platform functions, and lay a solid foundation and guarantee for efficient learning of learners.

Acknowledgments
Thanks to Dr. Li Chao and his staff of Beihang University, department leaders and colleagues of Shandong Vocational College of science and technology for their technical guidance and help.

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