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Design of Cloud Computing Platform for Education Laboratory

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Abstract

In an educational laboratory, a large amount of computational experiment is often required. It is not realistic to prepare a large number of computers and other computing devices in the laboratory. Computer equipment will be limited without a large amount of computational experiments, so it is needed to make full use of computational resources. Cloud computing can be used to load the computing tasks to each computing unit, so as to make full use of network computing resources. Therefore, this paper proposes a kind of educational experiment platform based on cloud computing, which can improve the utilization of educational resources. The experimental results show the effectiveness of the method and the construction platform.

Keywords*: laboratory; cloud computing; cloud platform; resource sharing*

1. Introduction

Education network has been popularized in various colleges and universities and scientific research institute. Researchers in scientific research institutes need to call for the calculation of resources in universities and other research institutions， Which is in accordance with the principles of computing resources and other test equipment lease. Among them, with the popularity of smart phones and other intelligent terminal devices, mobile Internet will become more popular. Researchers can use intelligent terminals to prepare the tasks, as well as the related experiments. It can be imagined, if the task and data can be collected through the mobile Internet and then transferred to the cloud, you can directly use the computing resources of various colleges and universities, so as to ultimately calculate the allocation of resources and data resources through the cloud. After passing the experimental data through the cloud to the desired user, the user can view the results of the experiment through the smart terminal and according to the results of the experiment to arrange a new experiment or writing related papers and documents. It can be seen that the mobile Internet will make the time working in large computing resources laboratories greatly reduced. Scientific research personnel only need to carry on the intelligent terminal with common calculation and storage resources and can carry out scientific research experiment anytime and anywhere, thus greatly improving the efficiency of scientific research. Cloud computing is a business model, which will calculate the tasks distributed to a large number of computers in the pool of resources, so that users can on-demand access to computing power, storage space and information services. Cloud computing provides a convenient, efficient and cheap service for enterprises and individuals. Relying on the continuous growth of network bandwidth, under the mature conditions, users can communication with clients limited in computing and storage through some protocol and server and translate the mouse and keyboard as input to the server through a thin client, then the server returns the results. Different clients can log on to the server, which can simulate the working environment of a mutual independent and on the same server, so as to avoid too much hardware investment, and bring down the cost of management and hardware costs, easy to protect data, reduce

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energy consumption, and many other benefits. Some people will be cloud computing model compared to the power supply mode from a single generator to the power plant to focus on the mode. It means that computing power can also be used as a kind of commodity, like gas, water and electricity, which takes conveniently and costs low. It can be said that cloud computing is a revolutionary initiative and the development of information technology and information society reached a certain stage of the inevitable result. Applying Cloud computing to the laboratory of resource scheduling and resource sharing is a scientific research commercialization and resource sharing initiative, which requires a suitable Educational Laboratory of computational resource mobilization of cloud platform.

At present, when the government and some Internet companies is in the construction of data centers, sometimes encountered a sudden increase in traffic volume. Therefore, it must be in accordance with the peak value of planning capacity. Survey results show that the storage capacity of departments is not fully utilized and the low utilization rate is not due to the low level of management. This is because the server performance must have a certain margin to meet the critical business cycle or sudden demand. But this will cause a lot of redundancy and waste of resources. Using cloud services, a large number of application units and agencies can focus on sharing IT infrastructure. By transferring the relevant loads and applications to the IT infrastructure, which is managed by the third party building, the consolidation of the data center is implemented. As a result, the server performance can meet a set of application needs of the peak, not only to meet the needs of a single application. With the application of demand accumulation and proper management, we can cut the peak and fill in the valley, so that the application needs to be connected with each other and easy to manage. So resources can be integrated and dynamic use. With the increase in the utilization of assets, the existing equipment can produce more value, so as to reduce the demand for the performance of sustained growth. The decline in the number of devices will make it less expensive to run maintenance, floor space and power consumption. Simple cloud computing technology in the network services have been seen everywhere, such as instant messaging, search engines, web mail and large online multiplayer role-playing game. Cloud computing technology is also playing an increasingly important role in the field of non personal application (such as enterprises, government, etc.). The speed of the wireless network bandwidth is far behind that of the cable network. When the Internet bubble began to collapse, China Mobile has just begun to fully turn to GSM and Mobile communication began to bid farewell to their mobile phones and BB, namely mobile phones in China began to gradually spread. But with the mobile Internet, watching video is still not possible at that time. The popularity of the current mobile phone is more than the computer, and even more than the fixed phone. In 2009, China has 52.5 mobile phones per 100 people, while the cost of mobile phone calls also showed a gradual downward trend. It should be said that the mobile network has a more massive user base. With the introduction of 3G, as well as the future 4G technology, wireless bandwidth has been able to support multimedia Internet content transmission Mobile device users demand for mobile network applications will gradually from the voice transmission over to the use of Multimedia. Of course, it needs to further enhance the mobile bandwidth and the use of the cost of further decline. Due to the size, weight and power consumption of the mobile terminal equipment, the computing power and storage capacity are limited. Therefore, the mobile device will be more dependent on cloud computing platform to provide computing and storage capacity. Microsoft proposed cloud - end computing, the foundation is: in the cloud computing era, the balance created by the law of Moore and WINTEL is broken. But a new balance of hardware, bandwidth and content is being formed. The development of terminal performance and bandwidth will never be able to catch up with the growth rate of the content, and the three will always maintain a dynamic optimal balance. Microsoft's Yaqin Zhang proposed that entering the Internet as the center of the era after the data will concentrate, but not all

concentrated. A lot of data may exist in different data centers - clouds, while many of which may be in the terminal. The increase in bandwidth makes it possible for Cloud Computing. And cloud computing is the basis of large-scale computing and storage resources[1-2]. These resources are centralized and managed. Like power plants, the steady flow of outward to provide computing power and storage capacity and bandwidth, computing resources and storage resources have also experienced a low to high, from high to low cost process to follow Moore's law. CPU or a large scale integrated circuit, which is integrated with the number of transistors on it every 18 months, is a source of information age. Cloud computing system is required to provide five key functions, among which quick scalability and dynamic resource pool are that the cloud computation platform should have. Virtualization technology provides a dynamic scalability for the open source cloud computing platform and can migrate virtual machine between the physical servers, so as to achieve load balancing. In the software layer, a single physical machine can perform multiple operating systems simultaneously (and its application). In the virtual machine monitor, there is an object named machine virtual, which is encapsulated by the operating system, application and configuration.

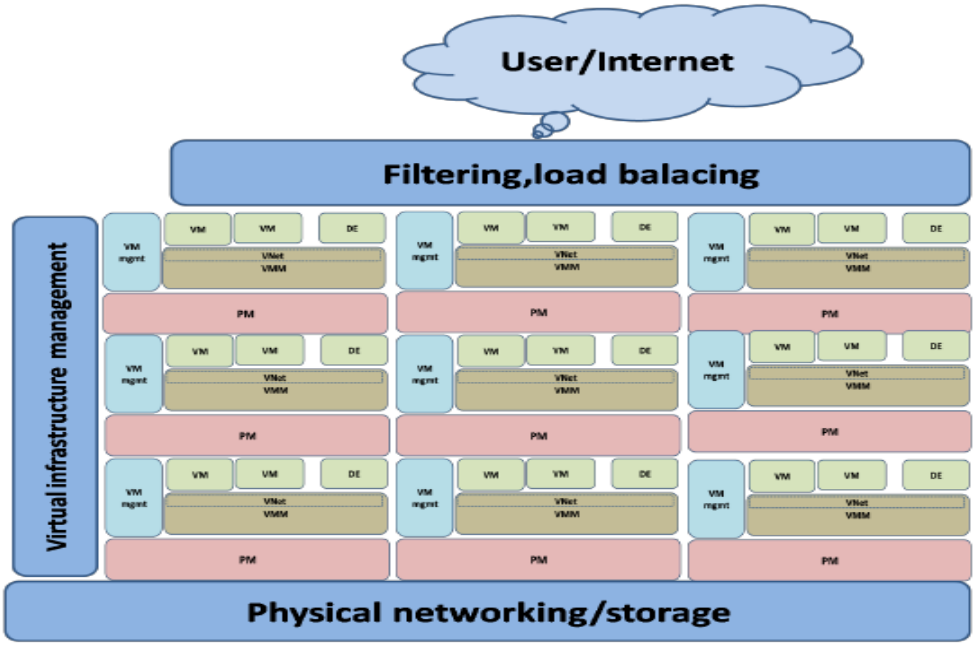

Figure 1. Cloud Platform Infrastructure

Cloud resource pool is divided into two layers. The upper layer is the interface layer, which is mainly used for data communication and exchange with the virtual resource pool. This layer uses API mapping technique. Developers do not need to understand the underlying OpenStack code details of each module and all operations with the virtual resource pool are done in this layer. The lower layer is the various components of the open source cloud platform OpenStack and they work together to build a huge virtual resource pool to provide resources and services to the upper level[3-4].. The cloud computing platform of the education laboratory not only can satisfy the students' basic experiment, which supports a large number of access devices, but also can organize a large number of computing resources and storage resources to complete the experiment. So, it will allow the entire Internet resource efficient use and transfer.

2. Related Research

2.1 Cloud Computing Resource Allocation

With the continuous accumulation of data, the expansion of the data scale, diversification of data types and the rapid accumulation of data, the analysis of the data in order to find the value of the process has gradually evolved into big data services. With the arrival of the era of big data, the traditional data management and analysis tools can't meet the requirements of data storage and processing of large data service. Specifically embodied in the following three aspects: (1) The data size is huge. Traditional business performance based on computing clusters of data processing infrastructure faces expensive hardware and software investment and post maintenance costs, which let the majority of companies feel helpless facing the big data service applications; (2) The diversity of data types makes the traditional database systems (such as relational databases) no longer meet the needs of large data storage and query applications for the type of diversification. (3) The speed of the data growth is flying at the time. The traditional data mining methods are faced with the problem of low efficiency and poor real-time performance. The emergence of cloud computing and the formation of large data processing technology, tools and cloud services provide a strong technical support in order to solve the above data processing and application of the challenges. Cloud computing has great potential and advantages in the construction of large data services in the use and management of resources. Specific performance in: (1) According to the need of cloud computing and the use of IT Pay-as-you-go resource, it can reduce the cost of large data processing and construction of large data service. Cloud computing companies such as Amazon EC2I75 (please use Google search EngineWl App) provides computing and storage resources for external users according to demands and usage. This payment method allows the user does not need to build and maintain their own infrastructure, but to obtain the required resources in the form of on-demand call anytime, which reduce the cost of infrastructure, software and hardware platform used. This is also attracting large data processing needs of enterprises or organizations through the use of existing computing resources, the existing application migration to the environment in the implementation, or in the cloud deployment of large data services, to achieve a low cost of large data services. (2) The development of cloud computing has spawned a large number of big data processing techniques and tools based on G bits(such as HDFS and Hadoop MapReduce). These big data processing techniques and tools reduce the development of large data services and promote the development of large data services[5-6]. It provides the technical reference and supports for the enterprise or organizations to construct efficient and big data services and mining big data valuable information.

In practical application, the construction of large data services in the cloud environment can not be separated from the support of the two key elements: (1) the application model of large data services; (2) the key technology of big data services. On one hand, the application mode of the big data service is to decompose the large data service from the macro point of view, and then analyze and summarize the large data processing flow and key technology involved in the process of building large data services; On the other hand, the key technology of big data service is from the micro point of view, to build the key technology issues involved in the construction of large data services in the cloud environment, including data collection, data processing task planning, large data service based on Cloud platform combination evaluation, big data processing and analysis algorithm design and implementation, etc. Cloud computing system resource management can be divided into resource monitoring and resource scheduling. Resource monitoring is a record of the operating status of the system. According to time can be divided into two kinds of real-time and non real time. According to the monitoring method can be divided into two kinds of active monitoring and passive monitoring. Real

time monitoring of system resources is that the system needs to record all the time, while non real time monitoring is to record the operating status of the system at each time interval, or the behavior of an event. Active monitoring is that the central node sends a message to each node in the active parameters of the system, while the passive monitoring is the system state when the nodes send a message to the central node. Taking into account the load brought by the system, the cloud computing environment uses the non real time passive monitoring mode, that is, each node sends a message to the central node each time interval to the center node. Hadoop provides a system resource monitoring solution called chukwa, which is developed by Yahoo. Chukwa is an open source data collection system used to monitor large-scale distributed systems, which is built on the HDFS MapReduce and Hadoop framework. Chukwa can display the user's job running time, the occupancy of resources, the remaining resources, the system performance bottleneck, the overall job performance, hardware errors and the failure of a job. Chukwa provides a collection of data from the Agent and Agent set of data sent to the Collector of Cluster by HTTP. The Collector will be stored in the data Hadoop, and regularly run MapReduce to analyze the data. The results will be presented to the user[7-8].

Resource scheduling refers to the use of certain resources in a specific environment to meet the needs of different users in a distributed way. Scheduling strategy is the upper level technology of resource management, which is to determine the purpose of scheduling resources and how to meet all the processing strategies when the resource supply and demand conflict. The classification of scheduling resources is as follows: Maximize user requests, maximize resource utilization, minimum cost and maximum profit margins, etc. According to the above purposes, cloud computing load balancing scheduling strategy and algorithm can be divided into two types of performance priority and economic priority.

2.2 Cloud Computing Platform

In order to carry out the management of cloud computing resources, we need to understand the macro resource management framework. Architecture can be divided into physical and logical architectures. Physical structure is the physical connection structure of computer, server and network; The logical framework is to distinguish their roles from the perspective of the function of each element, and describe the relationship among them. Physical schema and logical architecture can be mapped each other. A good resource management architecture can highly improve the cloud computing system in the availability, robustness, etc. System architecture is a key issue to be considered in the establishment of cloud computing environment. Scheduling system architecture is closely related to the data center architecture. Hadoop is one of the most famous of the many open source cloud computing frameworks. Many large enterprises have carried on the application to Hadoop and has carried on the massive improvement work with the enterprise's concrete business. Hadoop was originally a sub project of the Lucene project of the Apache foundation, and later became a separate project with its importance. Hadoop consists of many modules, including Common Hadoop, HDFS, Mapreduce and Zookeeper, etc. The Hadoop framework allows users to use simple parallel programming languages on a large scale cluster device to perform a distributed processing of massive amounts of data sets. Users can operate on the data without understanding the details of the distributed implementation. In the Hadoop cluster system, it may have hundreds of independent physical devices. Each physical device has its own computing and storage capacity. Unlike other conventional schemes that rely on hardware to provide high reliability, the Hadoop itself is designed to detect and handle node failure problems at any time in the application layer. The main design goal of Hadoop is to search and log analysis work and is not suitable as a general distributed service architecture. HDFS (Distributed File System Hadoop) is a core component of Hadoop. Hadoop is a distributed system infrastructure supported by the Apache foundation. It was first introduced as a part

of the Lucene Nutch sub project, after being independent for a separate project. Hadoop includes common, HDFS, Reduce Avro, Map, Chukwa, Hbase and other sub items. HDFS provides the basis for the upper components such as Mapreduce, Hbase, and so on. HDFS is a file system designed to store large file and stream data access patterns (typically 64Mb above). It can usually run on a more common hardware. HDFS cluster is similar to that of GFS, which is also a common master slave architecture, which consists of a node (NameNode) and a number of data nodes. The architecture ensures that the data stream is not the name of the node, which reduces the load of the node, so that it will not become the bottleneck of the system performance in this area. The architecture usually has a backup node as a backup of the name node so that the node is a single point of failure and the backup node is immediately able to assume the responsibility of the name node. The name node is the most important node in the HDFS architecture. It manages the metadata of all the files, not the file itself. The HDFS namespace is a hierarchical structure of a file and directory. Files and directories are represented by inodes in the name node. Inodes records various properties including licensing, modification, and access time, namespace, and disk space allocation, etc. The name node also needs to maintain a map of all HDFS files, and a table for the location of a file block and file block, or BlockMap. The name node stores inodes and BlockMap in a binary file, called fsimage. The binary file is closely related to the reading and writing operations of the system. Every operation before the fsimage saved is recorded in a log file named editlog. When the editlog file reaches a certain size or exceeds the default window time, the name node will refresh the metadata and save it to the fsimage. The name node holds the whole fsimage in its memory. In addition, the name node also needs to provide management and control functions.

When a data node started and is added to the HDFS, it will scan the local disk and report its file block information to the name node. The name node stores the information in memory, and then establishes a list of files to each node. The information stored in the graph is stored in a structure called BlockMap. BlockMap can save data nodes, file block and copy of the information. Data nodes store and manage the real data itself. Each file is divided into one or several data blocks (Block), which are stored in a series of data nodes. The Block class contains three variables: blockid, numBytes, and generationStamp. Therefore, it can be considered that the data nodes store the contents of ID block, block, and the mapping relationship. A HDFS cluster usually has hundreds or thousands of data nodes. These data nodes communicate regularly with the names of nodes by the heartbeat signal.

3. Proposed Scheme

The architecture of cloud computing is composed of 5 parts, which are application layer, platform layer, resource layer, user access layer and management layer. The essence of cloud computing is to provide services through the network, so the system structure to serve as the core.

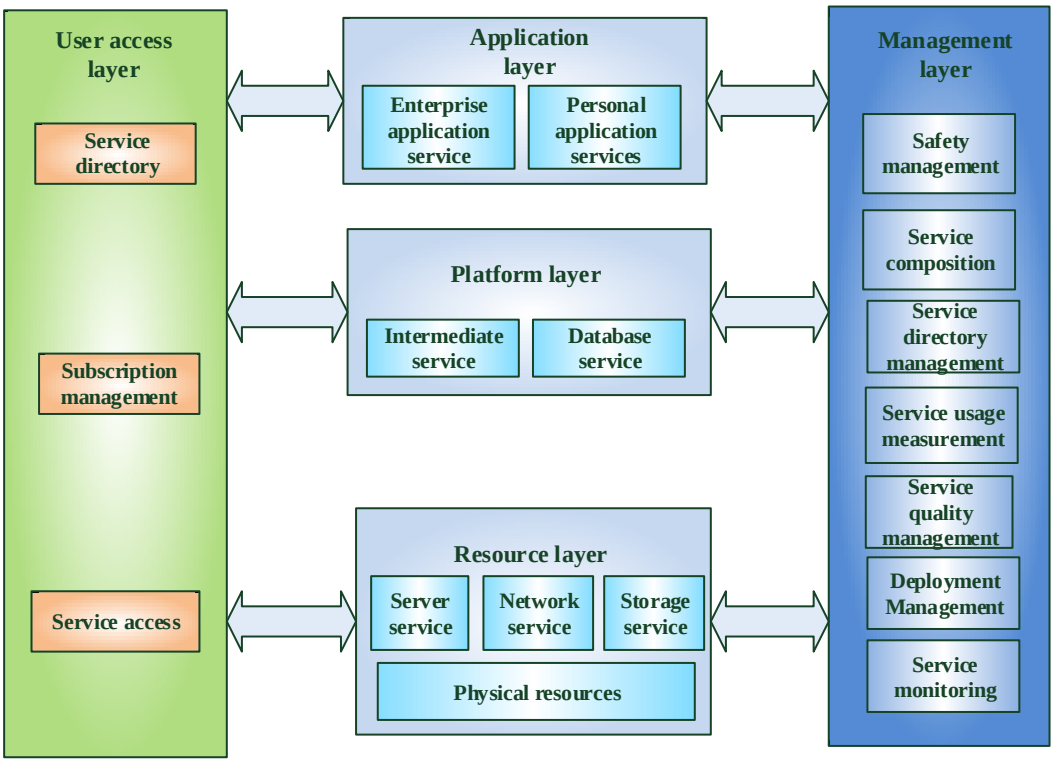

Figure 2. Research Cloud Computing Platform Architecture

(1) Resource layer

The resource layer is the cloud computing service, which can provide the virtual resources, and then hide the complexity of the physical resources. Physical resources are physical devices, such as servers, etc. Server service refers to the operating system environment, such as Linux cluster, etc. Network service refers to the ability to provide the network processing, such as firewall, VLAN, load, etc. Storage services is to provide users with storage capacity.

(2) Platform Layer

The platform layer provides the user with the encapsulation of the resource layer service, which enables the user to construct their own application. Database services can provide the ability to extend the database processing. Middleware services for the user provide scalable message middleware or transaction processing middleware services.

(3) Application Layer

Application layer provides software services. Enterprise application is the business of the user, such as financial management, customer relationship management and business intelligence etc. Personal application refers to the service of individual users, such as email, text processing and personal information storage etc.

(4) User access Layer

User access layer is a variety of support services for the user to use cloud computing services. For each level of cloud computing services are required to provide the appropriate access interface. Service directory is a service list that users can choose to use cloud computing services. Subscription management is provided to the user's management functions, which users can access their own subscription services, or to terminate the subscription service. Service access is an access interface for each level of cloud computing services. The access to the resource layer may be remote desktop or windows, while the application layer access may be provided by the web.

(5) Management Layer.

Management layer can provide a management function for all levels of cloud computing services. Security management is used to provide the service to the authorization control, user authentication, audit, consistency check and other functions. Service composition provides a combination of their own cloud computing services so that new services can be created based on existing services. Service directory management services can provide services to the directory and service management functions. Administrators can add new services, or remove services from the service directory. Based on the user's usage, the use of measurement begins to count and charge. Service quality management provides the performance, reliability, and scalability of the service. Deployment management provides automated deployment and configuration of service instances. When the user adds a new service subscription through subscription management, the deployment management module is automatically ready for the user to serve an instance. Service monitoring provides a record of the health status of the service.

Cloud data processing platform need to use HBase, Hive, Hadoop, etc. to build a cluster environment. After integrating Hadoop and other new features seamlessly into the cloud platform, it can form a platform to meet the needs of the system. Need to emphasize the following three points:

First, because only build a cluster containing four nodes, in order to guarantee the data access efficiency, it should be installed on each sub node zookeeper that such access data can improve the degree of parallelism.

Second, Hadoop version is 0.20.2. HBase version is 0.20.3. Hive version is 0.6.0. The platform should not change the software version, otherwise it's easy to produce version that does not match the situation caused by the false.

Third, need to use Hive to achieve the multidimensional analysis of OLAP. Its starting command is: /hive--auxpath /home/hadoop/hive-0.6.0/lib/hive-hbase-handler-0.6.0.jar，/home/hadoop/hive-0.6.0/lib/hbase-0.20.3.jar

/home/hadoop/hive-0.6.0/lib

/zookeeper-3.2.2.jar -hiveconf hbase.zookeeper.quorum=hostname

The intermediate path needs to be modified according to the actual path.

ETL process is initiated by MapReduce Diver. It first reads many kinds of parameter information such as the data source and its data structure, the degree of parallelism, the increment field, the exception handling method and so on. Then, the data is divided according to the maximum value of the parallel field of parallelism and data source, and adjusted according to the current maximum of the increment field. Finally, each data partition is assigned to a Map for processing. In the stage of Map, the data is processed by the record, until all the records are processed. Each of the records is converted to a field in the HBase table, and then the converted data is written to the HBase table. If an exception occurs during processing, it will be processed according to the exception handling method. If exception handling is stopped, Map stops; If exception handling is to throw an exception data or write log, the record is discarded or written to the log file, and then the next record is processed.

According to the characteristics of the ETL process and MapReduce computing framework, the ETL implementation process should include the following classes:

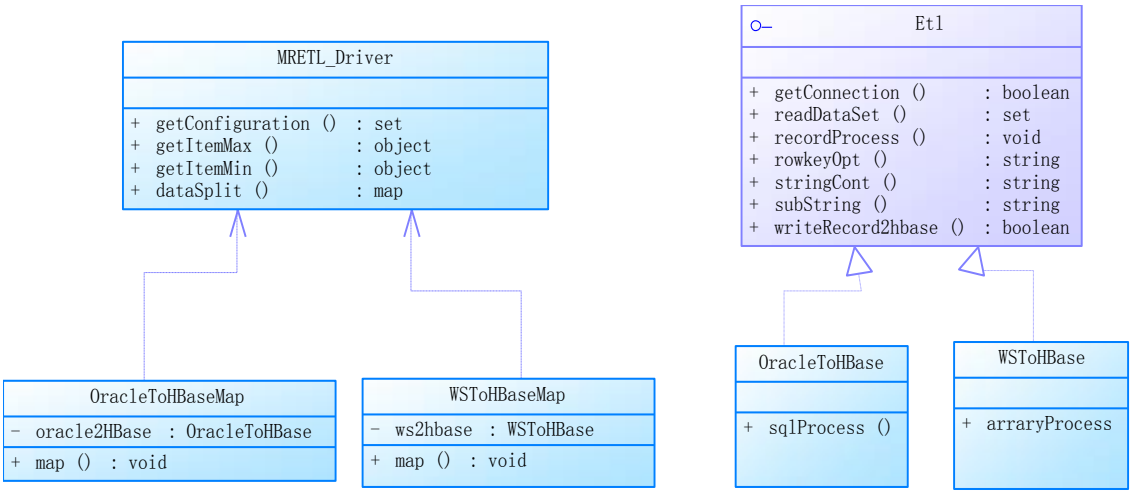

Figure 3. ETL Layer Class Diagram

MRETL_Driver is the Driver class of the MapReduce framework. In order to meet the functional requirements of ETL, it also needs to implement other functions, in which getConfiguration () to achieve the configuration parameters of the read. GetItemMax () achieves the maximum value of a field in the data and getItemMin () achieves the minimum value of a field in the data; DataSplit () completes the division of data.

Etl is an interface, which defines the operating functions required by ETL. GetConnection () can obtain a connection to a data source; ReadDataSet () is used to complete data extraction; RecordProcess () completes the conversion function of the data; RowkeyOpt (), stringCont (), subString () are used respectively to achieve the optimization of the rowkey and HBase, string concatenation, character strings and other data conversion functions substring. writeRecord hbase () achieves the loading of data.

Both of Oracle HBase and WTo HBase achieve the interface Etl, and have their own unique processing functions, according to the data source for different. For example, because the OracleToHBase data source is the Oracle database, sqlProcess () is used to complete the SQL statements for the Oracle database; WSToHBase for the data source is provided by the WebService, and the results returned are mostly array. ArraryProcess () function is specifically defined for dealing with these data.

OracleToHBaseMap and WSToHBaseMap two classes are used to implement the Oracle and ETL for data Map WebService class, so they must be called by Driver MRETL_Driver, namely, MapReduce. At the same time they are the MapReduceBase class of the MapReduce framework provided by the class and we must implement the map () function.

3.1 Secure Access Design for Cloud Computing Platform

The main goal is to make the static analyzer difficult to obtain a correct control flow graph (CFG). In normal program analysis, the control flow graph of the program is not complicated. It's only need to determine the branch statement and control flow jump instruction. Therefore, the main task of BOSH is to hide the program's branching statements and control flow jump instruction by using the non trust tags. To do this, BOSH first needs to determine a static, non - trust label stream, which can be used in normal program flow diagrams, but can not be used without security; Secondly, all of the control flow in the BOSH collection program and the instruction will be randomly converted to a certain proportion of the security exception for the jump instruction. Because the security exception control flow is usually not unconditional jump, so the security exception flow can not handle conditional jump. So BOSH converts all of the conditional jump into unconditional jump. All of the security exception control flows are

explicitly or implicitly handled by the security exception handling mechanism. The BOSH uses a jump table to implement the conditional jump for an implicit exception handling machine. In order to obtain the mapping between the correct jump target and the security exception, the BOSH maintains the PC and its jump table mapping of the original control flow transformation instruction. To avoid exposing this mapping table, BOSH uses a perfect hash function to map the PC to the jump table. This can effectively avoid the static analysis to determine the starting position of the basic block. Hidden abnormal machine may cause some performance overhead, but it has good privacy. For an explicit exception handling machine, the BOSH inserts an instruction to check the presence of a non trusted label and the control flow is directly converted to a real jump target. This approach has little performance overhead, but to a certain extent, it has sacrificed its privacy.

On the basis of the further control flow obfuscation, the main purpose of the data stream confusion is to make the program data stream confused. In the last step, The spread of the non trust label is only related to the normal use of the data with no confidence in the label, thus its anti attack power is still weak. As a result, the BOSH needs to be more likely to use the false code of data that can be used without the security of the data that is not trusted. In addition, BOSH uses the cross process analysis of the difficulty of /NP-Hard. to improve its resistance to analysis. For example, BOSH can be used to analyze the difficulty of aliasing analysis for data flow. BOSH can make a lot of alias pointers that are not relevant to the data and use them to modify the data in the forge. In order to confuse the call graph, the BOSH will selectively replicate some function calls in the forgery code.

4. Experimental Results and Analysis

In this paper, the decision layer is made to forecast and adjust the resource by calculating the demand budget model. Computing resource pool based on the decision level of information call standard cloud platform instance management unit, start and close the corresponding instance, which is not completely the case to start with the smallest unit to adjust, but to predict the calculation of resources based on the table after the start of virtual machine or off idle virtual machine. In the actual adjustment of resource pool, the decision layer combined with cloud computing platform calculates the load of nodes and makes a certain combination to meet the needs of the resource. Demand control table is shown below:

Table 1. Forecast Resources and the Corresponding Virtual Machine Structure

Forecast resources	1	2	3	4	5	6	7	8
Virtual machine structure	Single core 512M	Single core 1G	Dual core 1G	Dual core 2G	Dual core 4G	Quad core 2G	Quad core 4G	Quad core 16G

When the forecast resource is 9, the decision layer first inquires the current instance to calculate the load of the node. If a low load node can satisfy the start of a quad core, 8G memory instance, the instance starts and a minimum unit instance resource starts at the other node. If the instance of the node can not meet the high resource instance, the system can query the resource of the node in the current instance and select the number of resources to be 4+5, then start the corresponding calculation example.

5. Conclusion

According to the characteristics and the security of the resources of scientific research, this paper constructs a cloud computing platform based on data and computing resource allocation and scheduling. Based on the characteristics of scientific research laboratories and the characteristics of large-scale basis experiments, this platform can deal with the scheduling of large-scale resources and large-scale access. This cloud computing platform can be used to predict the task and also takes into account the security, which is able to achieve confidentiality for scientific research and large-scale access.

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