International Journal of Grid Distribution Computing
Vol.7, No.5 (2014), pp.181-190
http://dx.doi.org/10.14257/ijgdc.2014.7.5.17

An Architecture for Human Resource Information Management Using Cloud Computing

Wei Chen

Department of Human Resources, Chongqing University of Posts and Telecommunications, Chongqing 400065, China
E-mail: cweicqupt@163.com

Abstract

Cloud computing, with its powerful capability of computing and storage and with its large-scale data resource, provides unprecedented opportunities for management and application of human resource information. How to support complex and even unpredictable human resource services as well as manipulate large scale data at the same time to provide good quality of human resource information, is one of the crucial and fundamental problems for cloud-based human resource information system. This paper proposes establishing a general framework for human resource application and services based on cloud. As a type of compact, structured, and knowledgeable human resource information representation, and publish to the user by Internet. Moreover, the case is evidenced by an application example.

Keywords: *Cloud Computing, Human Resource Management, Information Management, Distributed*

1. Introduction

Cloud computing, which not only brings the new environment for the application of human resources information management but also makes a far-reaching impact on it and its application with the power computing capacity, storage capacity and its vast amounts of data. First of all, powerful cloud computing capacity, storage capacity and pay-as-you-go service mode provide a different mode of processing for the vast and heterogeneous human resources data to make people no longer worry about complex calculations involved and mass storage which related with applications. Thereby, reducing the human resources data source originally isolated problem. Secondly, cloud serves as a unified computing, storage and access platform for human resources data application with transparent access characteristics. People can experience high-quality information service as long as access to the cloud whether PC or mobile phone. More importantly, cloud provides innovative solutions to management and discovery human resource knowledge with its extremely abundant data resource. Many important resources in the hands of specific employees when every enterprise operates accumulated a lot of knowledge, skills, and solutions. The traditional processing method which based on model requires for kinds of modals obtained by trained then classified and recognize the models. However, the trained model often not applicable when applied to the new scene for the limitation by the training data. The model based method is sometimes difficult to conquer the problems such as multiple instance, diversity and multimodal for not fully mining the link between data. Therefore, a variety of human resources information processing method of data driven gradually becomes the mainstream which based on large data in recent years. Cloud has huge amounts of data resources, and the data resource part of which labeled by the users contains abundant knowledge and information.

ISSN: 2005-4262 IJGDC

Cloud computing brings unprecedented opportunities for the development of human resource information. However, people expect cloud not only provides several particular human resource information services such as cloud synergy, cloud monitoring, performance of cloud and the cloud knowledge but also can carry the large-scale user application which complex and even unknown in advance when cloud as "Computing infrastructure". At the same time, it must be in a position to fit a variety of user terminal equipment and a highly heterogeneous network environment, to handle the large amount of real-time human resources data. In one word, cloud computing environment for the multimedia applications is comprised of huge computation, storage, data resources and complicated application, various terminals, heterogeneous network, massive amounts of data. The challenges are the way to deal with not only huge amounts of data but also large-scale complex and unknown application and provide high quality service of such a cloud environment for human resources information management application.

2. Related Words

Data which even regarded as a new asset class [2, 3] plays a more significant role in modern economic activities. The characteristics of the human resources information management are the increasing semi-structured data and the heterogeneity of the resources now. Large amount of the flexible temporary data makes the defect of traditional method such as parallel database gradually appeared. Therefore, human resources information management is mainly driven by data under the background of cloud computing and big data. By using of the massive data and complex types themselves and also their context information with mining information and learning knowledge when faced with them to process and utilize data of human resources. In other words, make "people" as a key resource and turn the data which centered by "person" into service. There are following aspects included:

(1) Relational data customized service. Relational data are a most widely used data type for recent human resource management realm. The key to relational data customized service is establishing the transformation rules between the relationship model and the middle data model, and to define the service interface according to the demands. Lin hua Zhou *etc.*, to discuss the processing of the relational data customized service which in order to turn the relational data model into RDF and provide the interface [4].

(2) Web data customized service. At present, Webpage data are an important source of human resource information. However, the service process can be regarded as how to extract data and turn into the intermediate data model which relied on service and open service interface for the poor structural characteristics of webpage data. The kind of service can be regarded as a specific form of Wrapper [5]. The matching process is based on a set of extraction rules which can be obtained by manual or machine learning.

(3) In recent years, streaming data began to cause human resources information management attention with the development of a network such as data produced by RFID and mobile phone. Take advantage of the data can realize the monitoring of the staff information and then find out the problems of professional work. The data stream can be regarded as a dynamic data set which is infinite growth with time continues. Computer is required to monitor and deal with this new type of data to reflect and influence the true state of the physical world. Web feed is one of the most common methods of flow data package at present. How to establish additional and customized flow data encapsulation method is a problem. Robert Dickerson etc. try to establish a

new data abstract for a data object which included dynamic content such as sensor data [6].

(4) In the last two decades, researchers have started to show interest in HRIS though they focused more on areas such as predominate of HRIS [6], conditions for successful usages [7], use of HRIS and current usages patterns [8], areas in HRIS implementation [9-11], and achieving competitive advantage [12]. Contemporary studies have investigated HRIS adoption determinants in Singapore and Australia [13, 14]. Van Vo proposes a novel framework based on data mining technologies for making a prediction of business environment [15]. However, these authors agreed upon there is a paucity of research in the area and especially it is necessary to investigate to which extent those factors affect adoption of the system. Further work is also essential in addressing HRIS adoption in the private sector organization as research is currently lacking in those areas. Thus, researchers aim to investigate influencing factors of HRIS adoption, identify to what extent those factors affect the HRIS adoption and finally, consider the relationship between factors influencing the adoption of HRIS and perceived effectiveness of HRIS.

The method of data driven which can effectively obtain information improves the multiple instance, diversity and multi-modal problems which hard to solve based on the model method. However, how to deal with massive data and unknown application for human resource information management is an urgent problem to be solved.

3. Human Resources Information Management Method in the Cloud Computing Environment

This paper puts forward a human resources information management method under cloud computing environment in view of the above problems. We aim at the complex human resources data to turn it into intermediate data by using the powerful computing, storage and data resources of “cloud”. Form the specific cloud adaption demand by taking advantage of specific network environment, human resources and application and also the terminal equipment which relied on. The "cloud" quickly generates specific content from the intermediate data according to the demands and transfer data flow to the user through the network.

The key is that obtaining information on human resources as the middle semantic description previously by using a method of machine learning and data mining. And high-level semantics required for the application can obtain through the representation of middle attribute space to the semantic space. The intelligent processing method which advances learning possesses the ability of retractable recognition and adapting the requirement of changing mass trajectory dynamic data which vary in the cloud environment. The exact implementation process as follows in the logical level: in the basic code layer, semantic layer and the cloud adaptation layer (shown as Figure 1).

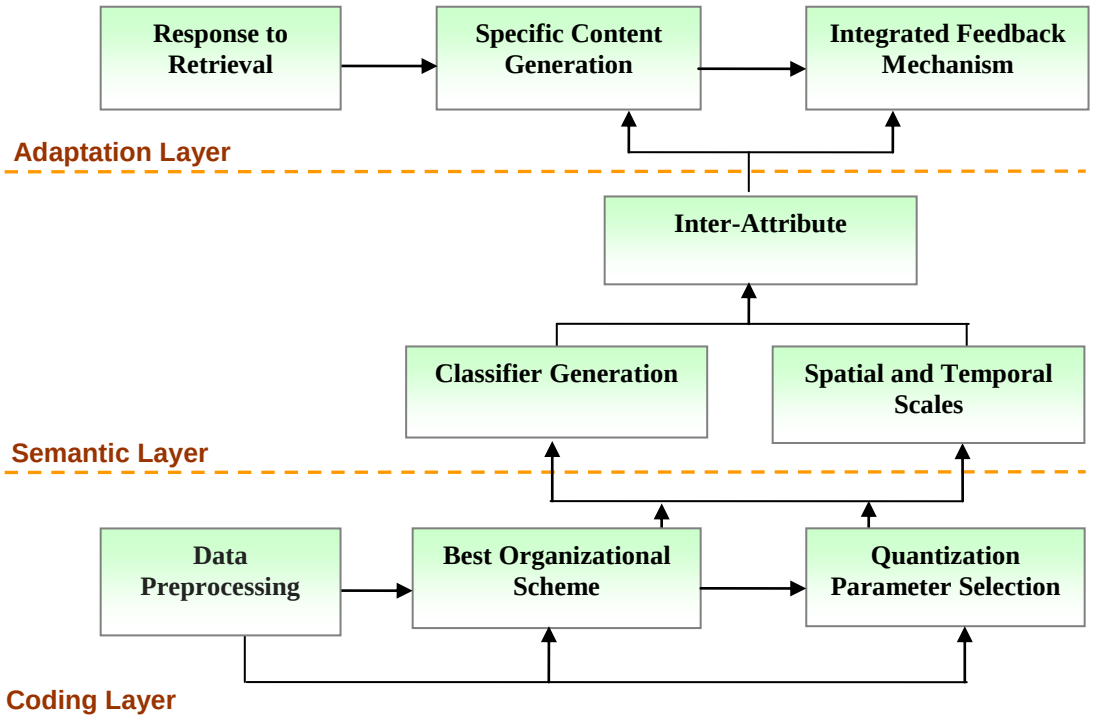

Figure 1. Structure Figure

3.1. The Basic Coding Layer

Take advantage of programming model Map/Reduce which is often used to achieve parallel processing to design Map/Reduce method which fit for the extraction of human resource middle information. Map/Reduce itself is very suitable to deal with large scale and logic operation simple data and also suitable to process the data of human resource [16]. Map/Reduce model is defined as [17]:

$$Map : k_1, v_1 \rightarrow list\ (k_2, v_2)\ ;$$

$$\text{Re}\ duce : k_2, list\ (v_1) \rightarrow list\ (v_2)\ .$$

The basic handle process is turn $[k_1, v_1]$ into $[k_2, v_2]$ by using Map method. Reduce method does list operation to value lists $list\ (v_2)$ of each k_2, and remold mentioned model to the function modality. D is set to be processed data, Map stage intermediate results as I, graphs can be expressed as:

$$MR\ (D) = R(M\ (D)) = List\ (i)$$

We analysis some definitions of human resource information management under the cloud computing environment as follows:

Definition 1: Five tuple S = <U M D V f > is an abstract of all the attributes of an abstract human resources data which centered in "human". In which U={ $x_1, x_2, x_3, x_4 \ldots$ }denotes the non-empty finite set of objects. M = {Text, Graphic, Video, Audio…} denotes the medium types of objects, D is the non-empty finite set of attribution and V is the value range of D. $f : U \times M \rightarrow V$ is an information function which gives each object an information value.

Definition 2: Temporary relation (Relation). Relation= ($Object_i$, $Object_j$, T) which means the temporary relation build between $Object_i$ and $Object_j$ on task T.

Definition 3: The social relationship among objects can be expressed by directed graph G= (V, E, Ω) which is defined as three tuple in which the edge set of graph G is defined in the in probability space Ω. V as vertex set, E as edge set.

Definition 4: (Direct precursor collection). Suppose node $v_i \in V$ is one set of directed graph $G = (V, E)$. If there is node v_j in graph content $(v_j, v_i) \in E$, then set $X^P(v_i) = \{v_j \mid (v_j \mid (v_j, v_i) \in E\}$ is immediate precursor set of node v_i .

Definition 5 :(Direct successor collection). Suppose node $v_i \in V$ is one set of directed graph $G = (V, E)$. If there is node v_j in graph content $(v_j, v_i) \in E$, then set $X^S(v_i) = \{v_j \mid (v_j \mid (v_j, v_i) \in E\}$ is immediate succeed set of node v_i .

Therefore, specific Map/Reduce method is designed as (show as Figure 2):

Map method: distribute the data under each quantitative parameter to each code server by using task. The corresponding theme service is run on the code service and the output result is the optimal modal of each data block.

Reduce method: To import all the optimal model output of application servers to the forecast model. It reduces the information redundancy among applications through the Reduce process and input optimal model of the entire code server to information quantitative module to the model organized information. It can reduce the inner redundancy in the same application by using the Reduce process.

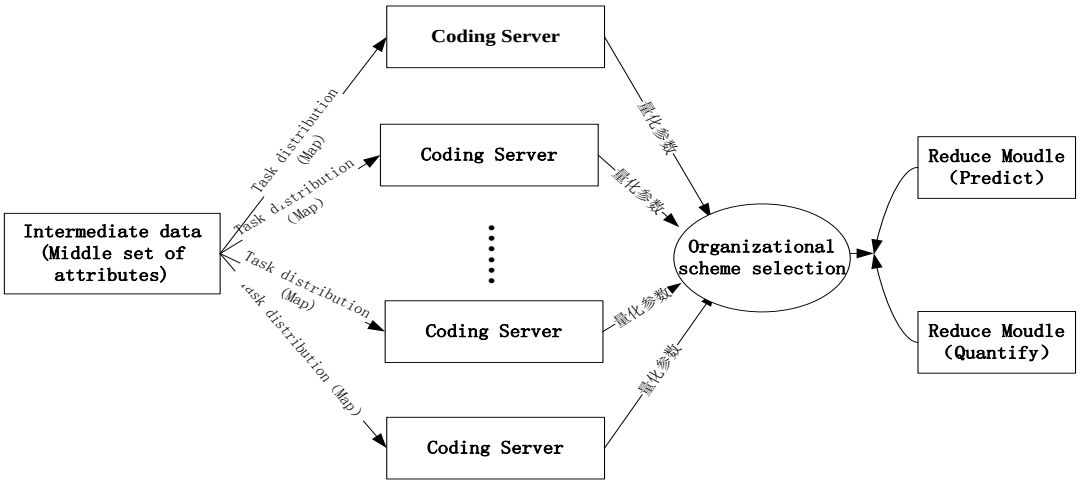

Figure 2. The Generative Process of Middle Data

3.2. Methods to Describe the Semantic Layer

First of all to get the classifier of original data to the middle attribute. Then extract different types of features through the time and multi-scale space dividing of quantity human resources data according to the difference attribute definition. Finally, get the corresponding middle properties through inputting the property features to the different property classifier. Cloud has a strong ability of data parallel processing to extract the different characteristics

and get the different property description by using different classifiers. Generate semantic description finally.

3.3. The Cloud Adaptation Layer

First of all, establish an effective index to adapt to the different forms of retrieval according to the original data of the bottom and middle attribute on the cloud platform.

Secondly, cloud find similar or related search results from store middle data of the data center according to the users' requirement. Furthermore, generate the contents user need through analysis and organization based on the retrieved results.

Finally, confirm optimal parameter through the configuration information of the cloud "extremity" (such as computing power, support data format *etc.*,), along with the information of the "extremity" network environment. Produce the organize mode of the generated adapter user terminal through reuse or merged the intermediate data attributes directly and form the information flow of the specific content or specific format.

3.4. The Dispatch Algorithm

It is important to focus on the parallel operation in the coding frame of the Map Reduce. We can realize the large scale data parallel processing by compiling the Map function and the Reduce function. There are training set attributes recognition and object behavior graphs simulation algorithm as follows:

Algorithm 1. The simulation algorithm of training set

Map Procedure:

***Require**: TD = data for training*

***Ensure**: (attribute − activity), 1*

1. for all object ∈ L do

2. for all attribute ∈ object.attributes do

3. yield ∈ (attribute), 1

4. end for

5. end for

Reduce Procedure:

***Require**: (attribute − activity), ocurrences*

***Ensure**: (attribute − value, activity), (activity probability)*

1. probability ∈ sum(values)

2. yield ∈ (key.attribute, key.value),(key.activity, key.value, probability)

Algorithm 2. The simulation algorithm of behavior recognition

Map Procedure:

***Require:** S = objects*

***Require:** UO = (unclasified object)*

***Ensure:** F = < activity, frequency >*

1: for all object ∈S do

2: yield ∈ sim, object.label

3: end for

Reduce Procedure:

***Require**: S = (sactivity, p)*

***Ensure**: T = (trained object,m)*

1: p_attrib_ combination ∈ sum (values.attribcomboccurrences)

2: m ⇐ p_attrib_combination / values.activityprobability
3: yield ⇐ key.activity, (m)

4. The Case Analysis

4.1. Basic Mentality

This paper based on colleges and universities human resource management and discusses the problem of human resource management under the cloud computing environment. It is the extension and development of related service which provided by the cloud computer. The goal is expanding resource sharing, service mode and technical content to reach the sharing and collaboration of the colleges and universities resources, ability and knowledge sharing. Shown as Figure 3:

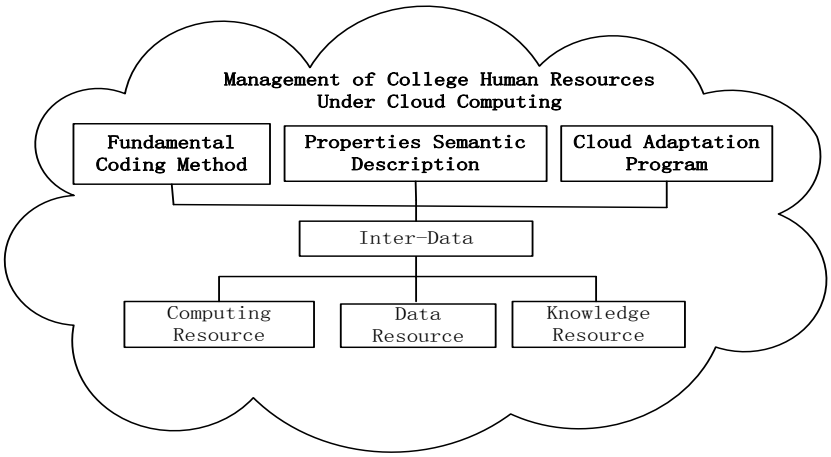

Figure 3. College Human Resource Management Frame in Cloud Computing Environment

Construct the human resources information management under the cloud computing environment which basis of human resource management framework according to the characteristics of colleges and universities to explore the problem of human resources information in cloud computing environment comprehensive management issues as the figure.

First of all, human resources in colleges and universities have characteristics of rich human resources, strong subjective initiative and great liquidity. Each database possesses their format due to the human resources information resources exist in different application of database in different forms in the expressive methods. It is necessary to unite somatization description to ensure the consistency and accuracy of information and overcome the heterogeneity of information format, multiplicity of information semantic problem and the lack of information relationship and not unified. It is lead to further integration of information resources and convenient service after join the cloud computing environment for user query and make more forward to discover new high-level semantic category, along with mining the inner relation.

Secondly, hierarchical organization and storage in the form of attribute vector hierarchical organization by using university human resources data information organization method aim at the sematic description layer which is dynamical and statically middle level. Then packing data in order to fit complicated user requirements and ensure interoperability with other

multimedia system. It is need combine data frame and provide a high efficient, open medium information application interface.

4.2. The Experimental Results and Analysis

Experimental environment consists of four servers, each server is equipped with dual-core CPU (clocked at 2.7GHz), 4 GB of memory, the host operating system is Ubuntu Linux 10.04, a system using Hadoop 0.20.2 build a cloud computing environment, the database uses Oracle 10.2 .0.

Using the above methods, the use of university human resource management business data (including research information, teaching information, file information, *etc*.,) experiment, the results of testing tasks including query teacher information, query information to meet certain conditions of teachers and so on. The adoption of cloud computing methods and traditional methods of distributed database comparison. Response time test results shown in Figure 4, you can see that in the cloud computing environment through the establishment of a buffer read and write synchronization to eliminate the intermediate results of the memory read and write performance improved, reducing the average response time.

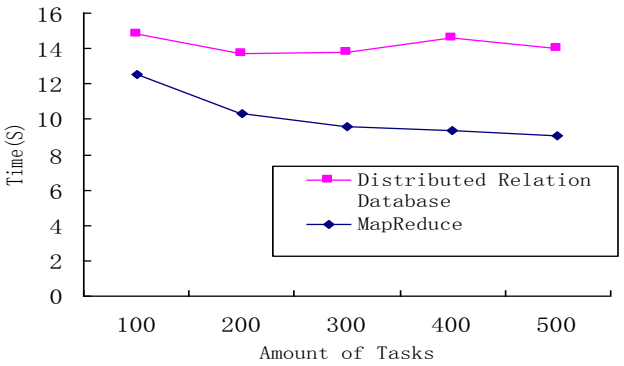

Figure 4. Work Efficiency Test Result

The difference is not obvious although error rate reduce as shows in Figure 5. Moreover, two ways of error rates are increasing the scale of data.

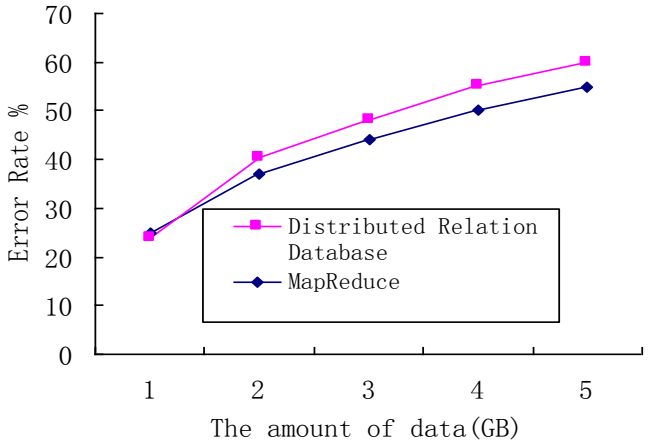

Figure 5. Comparison of Mistaken

5. Conclusion

This paper puts forward a kind of application in the cloud computing environment of human resource management architecture which provide cloud computing environment of vast human resources information organization. By employing advanced learn of middle attribute to get instantly mapping of top concept and use the center data to preforms rapid adaptation complex time-varying demand, the network environment, and terminal equipment.

In addition, further researches include: the transfer of human resource data correlation and refinement, a better adaptation problem of the cloud, such as the angle from the perspective of multiple data space rather than the relativity from the perspective of a single measurement correlation.

References

[1] X. Da-yu, Y. Shan-lin and L. He, "Multi-source information resources management in cloud computing environment", Computer Integrated Manufacturing Systems, vol. 18, no. 9, **(2012)**.
[2] S. Lohr, "The Age of Big Data", **(2012),** http://www.nytimes.com/2012/02/12/sunday-review/big-datas-impact-in-the-world.html.
[3] "Science Magazine Special Online Collection: Dealing with Data", Science, http://www.sciencemag.org/site/special/data, **(2011)**.
[4] Z. Lin-hua, C. Hua-jun and M. Yu-xin, "Data service composition approach based on query rewriting", Computer Integrated Manufacturing Systems, vol. 15, no. 4, **(2009)**.
[5] C. H. Chang, M. Kayed, M. R. Girgis and K. Shaalan, "A Survey of Web Information Extraction System", IEEE Transactions on Knowledge and Data Engineering, vol. 18, no. 10, **(2006).**
[6] R. Dickerson, J. Lu, *et al.*, "Stream Feeds: an Abstraction for the World Wide Sensor Web", Springer-Verlag, Proceedings of the 1st International Conference on the Internet of Things, **(2008)** March 26-28, Zurich, Switzerland.
[7] V. Y. Haines and A. Petit, "Conditions for successful human resource information systems", Human Resource Management, vol. 36, no. 2, **(1997)**.
[8] Z. Hussain, J. Wallace and N. E. Cornelius, "The use and impact of human resource information systems on human resource management professionals", Information & Management, vol. 44, no. 1. **(2007)**.
[9] E. Ngai and F. Wat, "Human resource information systems: a review and empirical analysis", Personnel Review, vol. 35, no. 3, **(2006)**.
[10] M. Z. Razali and D. Vrontis, "The Reactions of Employees Toward the Implementation of Human Resources Information Systems (HRIS) as a Planned Change Program: A Case Study in Malaysia", Journal of Transnational Management, vol. 15, no. 3, **(2010)**.
[11] C. Tansley and S. Newell, "A knowledge-based view of agenda-formation in the development of human resource information systems", Management learning, vol. 38, no. 1, **(2007)**.
[12] V. Browning, F. Edgar, B. Gray and T. Garrett, "Realising competitive advantage through HRM in New Zealand service industries", The Service Industries Journal, vol. 29, no. 6, **(2009)**.
[13] T. S. H. Teo, G. S. Lim and S. A. Fedric, "The adoption and diffusion of human resources information systems in Singapore", Asia Pacific Journal of Human Resources, vol. 45, no. 1, **(2007)**.
[14] I. Troshani, C. Jerram and S. R. Hill, "Exploring the public sector adoption of HRIS", Industrial Management & Data Systems, vol. 111, no. 3, **(2011)**.
[15] V. Vo, L. Jiawei and B. Vo, "Stream Time Series Approach for Supporting Business Intelligence", International Journal of Database Theory and Application, vol. 6, no. 2, **(2013).**
[16] L. Rui, W. Bin, "MapReduce in Text Processing", Journal of Chinese Information Processing, vol. 26, no. 4, **(2012)**.
[17] J. Dean and S. Ghemawat, "MapReduce: Simplified data processing on large clusters", ACM Communication, vol. 51, no. 1, **(2008).**

Author

Wei Chenn, she received her bachelor's degrees from Chongqing University of Posts and Telecommunications in 2003, and her master's degree from Chongqing University of Posts and Telecommunications in 2007. She works as lecturer of Chongqing University of Posts and Telecommunications. Her main research area includes Human Resource Information Management.