IJARCCE

ISSN (Online) 2278-1021
ISSN (Print) 2319 5940

International Journal of Advanced Research in Computer and Communication Engineering
Vol. 5, Issue 5, May 2016

A Brief study on Prediction of load in Cloud Environment

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Abstract: Cloud computing is a distributed computing environment where huge number of computers are connected with a communication channel such as the Internet. It provides the facility to run an application on many linked computers at the same time.The rapid growth of power demand from business, and Web applications has led to the emergence of cloud-oriented data centers. Load prediction is a significant cost-optimal resource allocation and efficient energy saving approach for a cloud computing environment. Load classification before prediction improves prediction accuracy.With the increasing demand on cloud provisioning instantly developing Vm in the cloud is not possible; it takes several minutes which leads to latency. So, Load prediction can minimize the downtime of the Vm. various load prediction models and the approaches based on the models are listed out in the paper. Methods through which error rate can be found are also described so that the prediction techniques can be well compared. Also the areas that can be worked upon after the successful Load prediction are listed into the paper.

Keywords : Cloud computing, Load balancing Load prediction, prediction accuracy.

I. INTRODUCTION

Cloud computingg is a term used to refer to a model of network computing where a program or application runs on a connected server or servers rather than on a local computing device such as a PC, tablet or Smartphone.Cloud computing refers to both the applications delivered as service over the Internet and the hardware and system software in the data center that provide those services. Cloud computing is a type of computing in which resources are shared. So, it allows user to use resources according to their needs. The whole internet can be viewed as a cloud. So, we can define cloud computing as internet based computing in which different services are provided to organizations computers.

In cloud computing data centres, Giga-bit speed, or faster, networks interconnect both physical and virtual computers. These systems are dynamically provisioned based on a determination of the required computing resources requested by the end user of the cloud application. [1][3][6]Predicting the processor availability for a new process or task in computer network systems is a basic problem arising in many important contexts. Making such predictions is not easy because of the dynamic nature of current computer systems and their workload. To ensure high scalability, flexibility, and cost effectiveness, cloud platforms need to be able to quickly plan and provide resources, which will ensure that supporting infrastructures can closely match the needs of various applications. Cloud platforms require mechanisms to continuously characterize and predict their loads.

Load prediction is a crucial issue for efficient resource utilization in a dynamic cloud computing environment. Based on future load prediction and an estimate of the future performance of cloud system. Effective load prediction will help administrators take appropriate actions in preventing the system suffering from traffic surge which is caused by high load. The key to accurate load prediction in cloud computing is proper modelling of the relationship between historic data and future values, and a proper understanding of cloud computing backend workloads.

A. Load in Cloud

With the proliferation of private and public cloud data centers, it is quite common today to lease virtual machines to host applications instead of physical machines. Cloud users typically pay for a statically configured VM size, irrespective of the actual resources consumption of the application (e.g., Amazon EC2). This charging mode is obviously unreasonable especially for applications with variable load. It is usually difficult for cloud users to figure out which size of VM is suitable for their applications as their loads are rarely constant. They certainly do not like to pay for the resources they hold but not use when load is light. Furthermore, they have to face the risk of performance degradation when the load is heavy. In addition, cloud providers, such as Amazon EC2, provide resources on a VM basis. VMs are added, released, or migrated according to variation of load. Each process involves significant overhead but does not bring any actual benefit. It would be highly desirable for cloud providers to provide dynamically finer-grained online scalable services that allocate resources according to application's demand that could encourage the customer to pay a higher price for better service compared to paying a flat fee based on the size of their VMs. Moreover, cloud providers can have the flexibility to dynamically optimize the resources allocation, improve resources utilization, and achieve maximum benefit.

Timely and dynamic fine-grained online scalability will greatly increase the pressure on management system to rapidly detect and resolve SLA violation problems. Typically, problem detection is done by specifying threshold tests. Examples include “Do ping response times exceed 0.5s?” and “Are HTTP operations greater than 12 per second on server?” Unfortunately, once the detection occurs, there is often little time to take corrective actions. In addition, if the load changes dramatically, there will be frequent SLA violations. It is desirable that the resources can be acquired earlier than the time when the load actually increases. We need a predictive solution instead of a reactive strategy. This outcome would be possible only if the future load can be predicted. According to the predictive value, we can prepare for retrieving upcoming idle resources, providing them to other users converting them to energy saving mode in advance or we can add resources for the upcoming peak loads in advance to ensure a stable QoS.

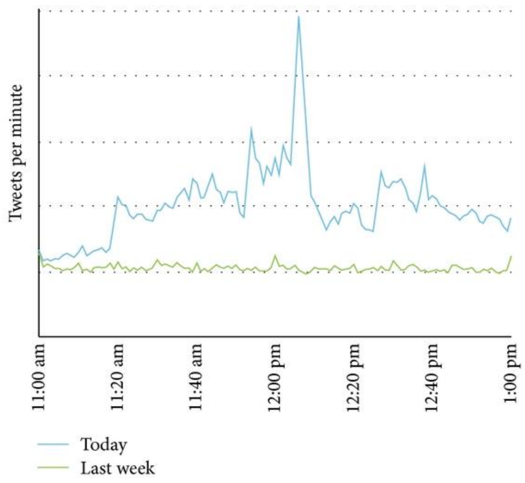

Figure 1: Load of Twitter on Obama's inauguration day

However, load forecasting is difficult in cloud computing environment for the following reasons. First, most modern applications have fluctuant loads which lead to complex behaviors in resources usages as their intensity and composition change over time. For example, Figure 1 depicts a real-world scenario wherein Twitter experienced dramatic load fluctuations on Obama's inauguration day. Such a load is very typical in modern commercial websites, and load forecasting for such application is not easy. Second, for security and privacy, cloud service providers are usually forbidden to access the internal details of the application. So, cloud management system cannot take advantage of the application’s internal characteristics (e.g., a loop code indicates that resources usage will exhibit periodic similarity) to forecast load. For example, Niehorster et al. used sensors to read the behavior of application. It is infeasible in most cases. Third, unlike traditional computing environment, in cloud, the external environment which the applications have to face is dynamic. Interference among applications hosted on the same physical machine leads to complex resources usage behaviors as they compete for various types of resources which are hard to strictly partition. For instance, in the exclusive non virtualized environment, an application with constant workload should have relatively stable resources demand. But in cloud where co hosted applications compete for the shared last level cache or disk I/O band width, the usage of resources that can be strictly partitioned and allocated (e.g., CPU or memory) will likely fluctuate.

B. Challenges in analysis of load on cloud data centers

Workload is a critical factor to achieve high performance on Clouds. Workload analysis and classification is especially challenging when applied in a highly dynamic environment such as cloud computing environment, for various reasons:

1. Due to business and confidentiality reasons, only few genuine cloud trace logs available for analysis. Thus, there is a lack of methodologies to characterize the different behavioral patterns of cloud applications. This is a particular challenge in academia, which relies on the very few publicly available Cloud trace logs.
2. The cloud hosts a wide variety of applications submitted at any time, with different characteristics and user profiles, which have heterogeneous and competing QoS requirements. This leads to complex and massive size of workloads depending on users behavior and resource consumption. Thus, it is challenging to predict workload patterns over time.
3. The virtualization layer promotes an overhead caused by I/O processing and interactions with the Virtual Machine Manager(VMM). This overhead depends on the hardware platform.
4. An in-depth statistical analysis and classification of work load diversity, within a large-scale production Cloud. This is due to the massive size and complexity of workload

II. BENEFITS OF LOAD PREDICTION

Cloud computing is a scenario that works with the aim of providing better services to the end-user. These services are provided in the form of resources. Precise usage of the resources can led to efficient services. The resources are provided by the virtual machines The Vm provides the resources to the user in the form of resources as per the decided SLA. When the user asks for the services the cloud API provides the services in the form of the resources that are available with the Vm.

The problem arises when the numbers of required resources are more than the number of available resources In such a scenario, where number of required resources exceeds than the available one’s instant creation of new virtual machine has to be done. but creation of Vm takes certain time and time is added up for the setting up of the Vm., so if the resources demand is already known problem can be avoided. Though no one can predict the future, it’s better to get something rather than nothing [9]. Load prediction is an estimation of demand at some future period.

A.BACKGROUND AND MOTIVATION :

1.Prediction models:

There is nothing new in the creation, the prediction is based on the historical data.[1][4]. Computer-system logs provide a glimpse into the states of a running system [2]. Log is used to predict and ultimately provision for the future. It can be used for resources allocation, work load management, scheduling and configuration optimization. There are mainly 3 types of approaches one is Analytical models, Analytical model are designed for special type of system that manually identifies dependency and relevant metrics, quality and relation between the components especially for simulators to give answer for what if question?? Examples of using analytical model for performance are I/O prediction. Disk arrays, data bases and static web server. Mostly the analytical models are single tier or the hierarchy gives the result of every single layer and then compares the result of every single layer with the next layer. Secondly the regression model, Prediction uses regression as the statistical modelling techniques. They are basically applied to performance counter which measures the execution time and memory on the subsystem. Classification correlations etc provide model for regression techniques used to predict performance of map reduced jobs.

Third is vector extraction model, Extraction of vector from the log is the non-trivial though it is the most critical step that affects the effectiveness of the prediction model. The log is converted into the vectors in form of 0 and 1 both positive and negative form and is then implemented. All the data of the log are converted to the numeric information which can be easily compared to take the decision of the prediction.[2] Though log based approach for prediction may give distinct range of the values or the single value and may not have confident of the prediction result but it’s better to have something rather than nothing.[2] Decision making can be gradually dependent on the prediction and better approach can be obtained.

2. Load prediction Approaches.

Using the three models of the prediction describe describe, in an intellectual way many authors has given their own approaches for Load prediction which can lead to the betterment of the service providing scenarios of the cloud John j et al. [4] concerned about the increase in energy utilization of the data center, the author carries out the future network load as per the services so that the nodes which are not in use can turned form active to sleep state and save energy. Author uses autocorrelation of the input sequence and the output sequence of all the historical traffic. The author provides the algorithm for the heterogeneous network prediction in which same types of Vm are focused through the IP address by the frequency when compared in MSE mean squared error and RSME root mean squared error. Manish et al lists out the steps of framework for resources Load prediction, tenant requirement model, followed by data pre-processing model, then training testing and validation of the of the datasets, demand predictor model which includes the optimal classification model as the prediction model which follows “train once and predict always” strategy, short term predictor which predicts for the next hour, long term predictor for which future demand is needed to exceed. i.e next week or say next month lastly the resource allocator is used to allocate the resources based on the prediction from the Vm pool. Reptree is taken as the optimal classification model and prediction is carried out using auto-regression and polynomial regression. Auto regression is a best fit for the prediction among both Genetic expression Programming regression model can generate precise model for load prediction of the Vms than other by Lung-Hsuan et al. [12]. GEP is the version of genetic programming. It compares all the result error rates with all the three MSE(mean squared error), MAE(mean absolute error) and MAPE(mean absolute percentage error) resulting with GEP gives more stable result as MAPE provides stability results in which GEP has the lowest rate of following all regression. Jhu-Jyun Jheng et al [8] presents a novel approach of workload prediction “Grey forecasting model”.

All the random and certain variation within the certain range and time are the amount of grey. it is able to predict the future of the uncertain factor and judge the future tendency of the according to the estimated data. It works on the data array. Another data array is derived from the original data array and the randomness is calculated from the interval of both and thus is solved by the derivation formula. The coefficients of the variables of the data array are taken into the matrix form and predictive array data is being formed. Time dependency is taken into consideration. Diego Perez et al. [6] provide an application input as SLA that specifies a maximum response time and probability with which the maximum response time is achieved. Probabilistic resource allocation pattern predicts the number of resources that an application may require at the particular moment of time of Days, weekdays, weekends, week or month. The Resources trace extraction generates the number of virtual machine that are required to satisfy the application at the particular time interval. Resources trace partition further splits the resources trace into small sub traces associated with the time period according to the similar resource usage pattern. Resource profile syntheses use the sub traces and analyses and produce the prediction result.

III. HOST LOAD PREDICTION METHODOLOGY

In the past few years, some studies have been devoted to load prediction in cloud computing environments. This paper gives comparative study of different techniques used for load prediction.

1. Prediction using Bayesian Model

Firstly Bayesian method is discussed, which is an effective Cloud load prediction method that can accurately predict host load over a long-term period up to 16 hours in length. Prediction method based on Bayesian model is used to

IJARCCE

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ISSN (Print) 2319 5940

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predict the mean load over a long-term time interval, as well as the mean load in consecutive future time intervals. It focus on CPU. Using a Bayesian model for prediction effectively retains the important information about load fluctuation and noise.[1] Prediction method based on Bayes model is used to predict the mean load over a long-term time interval, as well as the mean load in consecutive future time intervals. Design an effective Cloud load prediction method that can accurately predict host load over a long term period up to 16 hours in length. This approach is to use a Bayesian model for prediction as it effectively retains the important information about load fluctuation and noise. Here Bayesian prediction method is evaluated using a detailed 1-month load trace of a Google data center with thousands of machines [1].

Objective is to predict the fluctuation of host load over a long-term period, and aim is two-fold. First, at a current time point t0, predict the mean load over a single interval, starting from t0. Second, predict the mean load over consecutive time intervals. A new metric, namely exponentially segmented pattern (ESP), to characterize the host load fluctuation over a some time period. For any specified prediction interval, it is into a set of consecutive segments, whose lengths increase exponentially. It predicts the mean load over each time segment. The pattern prediction is reduced to a set of mean load predictions, each starting from the current time and being with different prediction lengths. To predict load, a predictor often uses recent load samples. The interval that encloses the recent samples used in the prediction is called evidence interval or evidence window.

Given the prediction problem, one approach for prediction is to use feedback control. One could dynamically validate the prediction accuracy at runtime, adjusting the predicted values in the next interval by the error in the previous one. Then, prediction error could converge to a low level. This idea is based on the feed-back control model, which is often used in the one-step look-ahead prediction scenario. Another approach is to use error of short-interval prediction to tune the long-term prediction. For instance, using the prediction error in a 4-hour interval may forecast the prediction error in the 8-hour interval, such that the predicted values could be tuned accordingly. However, this idea is also inapplicable to Cloud load prediction in that short term prediction error always lags behind long-term error.

2. **Neural Network Load Prediction**

A neural network is a machine that is designed to model the way in which the brain performs a particular task. The network is implemented by using electronic components or is simulated in software on a digital computer. Neural Network is used for load prediction, which predicts the future load based on the past historical data. It is a machine that is designed to model the way in which the brain performs a particular task. A neural network is a massively parallel distributed processor made up of simple processing units, which has a natural propensity for storing experimental knowledge and making it available for use. Neural network distinguishes itself by the presence of one or more hidden layers. The input signal is applied to the neurons in the second layer. The output signal of second layer is used as inputs to the third layer, and so on for the rest of the network. [3][4]

Multilayer Feed forward Networks

The Feed forward neural network distinguishes itself by the presence of one or more hidden layers, whose computational nodes are correspondingly called hidden neurons. The function of hidden neuron is to intervene between the external input and the network output in some useful manner. The input signal is applied to the neurons in the second layer. The output signal of second layer is used as inputs to the third layer, and so on for the rest of the network. [3][4]

Back propagation algorithm

Multiple layers have been applied successfully to solve some difficult diverse problems by training them in a supervised manner with a highly popular algorithm known as the error back-propagation algorithm. This algorithm is based on the error-correction learning rule. Error back-propagation learning consists of two passes through the different layers of the network: a forward pass and a backward pass. In the forward pass, an input vector is applied to the nodes of the network, and its effect propagates through the network layer by layer. Finally, a set of outputs is produced as the actual response of the network. During the forward pass the weights of the networks are all fixed. During the backward pass, the weights are all adjusted in accordance with an error correction rule. The actual response of the network is subtracted from a desired response to produce an error signal. This error signal is then propagated backward through the network, against the direction of synaptic connections. The weights are adjusted to make the actual response of the network move closer to the desired response.

The load on each server is predicted for optimal load balancing. A neural network model consisting of three layers with five input nodes. Fig 4 depicts the neural model. The input layer of neurons in the neural model receives five inputs from the external information source. When the network is run, each layer performs the calculation on the input and transfers the result Y_{n+1} I to the next layer.

$$Y_{n+1} = h\left[\left(\sum_{i=1}^{n} X_i w_i + b\right) / n\right] \text{......(1)}$$

The above equation (1) is used for prediction of future load based on the input value. Where Yn+1provides the output of the current node and n is the number of nodes in the previous layer, Xi is the input of the current node from the previous layer b is the bias value and w, is the modified weight based on the mean square error and our proposed algorithmm.

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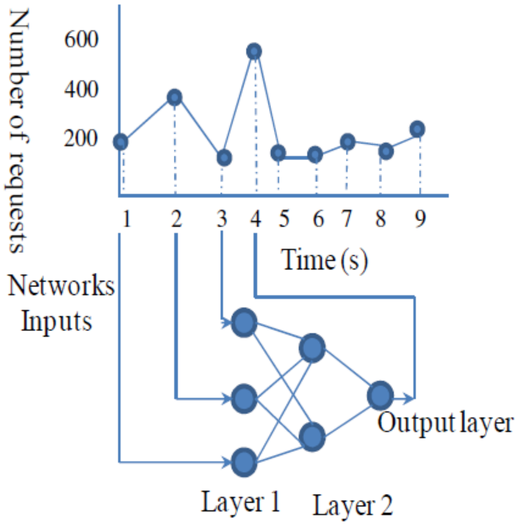

Fig 3.Neural model

Here the neural predictor is developed and the experiment is performed to prove its highly accurate prediction. A sample load of a data center is analysed and given as input for the neural model.

3. Support vector and kalmann smoother

A multi-step-ahead CPU load prediction method based on Support Vector Regression which is suitable for Cloud computing environment. Support vector and kalmann smoother is multi-step-ahead CPU load prediction method based on Support Vector Regression which is suitable for the dynamic characteristics of applications and the complex Cloud computing environment. Kalman smoothing technology is integrated to further reduce the prediction error. It suitable for the complex and dynamic characteristics of the Cloud computing environment. KSSVR is very stable, i.e. its prediction error increases quite slowly as the predicted steps increase. SVM has strict theory and mathematical foundation which could not lead to local optimization and dimensional disaster. [5]

Kalman smoothing technology is integrated to further reduce the prediction error. Real trace data were used to verify the prediction accuracy and stability of this method. The focus of this work is on improving the CPU utilization by load prediction. KSSVR integrates SVR algorithm and Kalman smoothing technology. Furthermore, KSSVR is very stable, i.e. its prediction error increases quite slowly as the predicted steps increase. [5]

A. Support Vector Machine

SVM was used for many machine learning tasks such as pattern recognition, object classification and regression analysis. It is based on the structural risk minimization principle which tries to control the model complexity as well as the upper bound of generalization risk. The principle is based on the fact that the generalization +- error is bounded by the sum of the empirical error and a confidence interval term that depends on the Vapnik – Chervonenk is (VC) dimension. On the contrary, traditional regression techniques, including traditionalArtificial Neural Networks (ANN) , are based on empirical risk minimization principle, which tries to minimize the training error only. Its learning process is quite complex and inefficient for modelling, and the choices of model structures and parameters are lack of strict theory. So, it may suffer from over-fitting or under-fitting with ill chosen parameters.

In contrast, SVM has strict theory and mathematical foundation which could not lead to local optimization and dimensional disaster. It can achieve higher generalization performance especially for small samples set. It has a limited number of parameters to choose for modelling, and there exist fast and memory-efficient algorithms.

B. Kalman Smoother

The Kalman filter has been widely used in the area of autonomous or assisted navigation. It is Kalman smoother is suitable for the Cloud application's load estimation because it was originally developed to estimate time-varying states in dynamic systems. This approach essentially uses a filtering technique to eliminate the noise of resources usage signal coming from error of measurement technique while still discovering its real main fluctuations. In order to achieve a better QoS and higher resource utilization in Cloud.

4. Prediction Based on PSR and EA-GMDH

A new prediction method which combines the Phase Space Reconstruction (PSR) method and the Group Method of Data Handling (GMDH) based on Evolutionary Algorithm(EA). The proposed method could predict not only the mean load in consecutive future time intervals, but also the actual load in each consecutive future time interval.

This method outperforms the other methods by more than 60%in mean load prediction, and performs well on actual load prediction over different time intervals, i.e. 0.5h to 3h. The main idea of this approach is to use PSR method and GMDH method based on evolutionary algorithm for host load prediction.

PSR is an important step in local prediction methods because with a set of appropriate variables, we can reconstruct the time series. The GMDH method is a self organizing method and it has been applied to solve many prediction problems with success. [2]

The Representation of the EA-GMDH Network

To combine the EA and the GMDH network, we should first consider the representation of the EA-GMDH network.

The representation of the EA-GMDH network should contain the number of input variables for each neuron, what is the best type of the polynomials for each neuron, and which input variables should be chosen for each neuron.

Therefore, the chromosome for each individual should contain tree sub chromosomes. Represented as a string of integer and characters

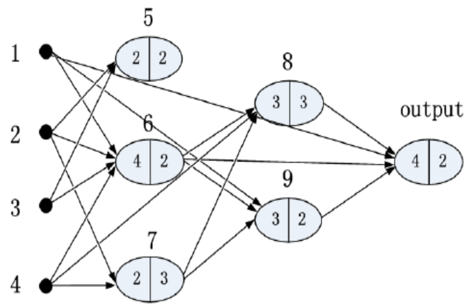

Fig 6. The structure of the EA-GMDH network

The training set is used to calculate the coefficients of each neuron of the model. The validation set is used to evaluate each individual in each generation according to the fitness function. And the prediction set is used to estimate the performance of the model. The output of this proposed is a vector of the host load, which will not generate cumulative errors regardless of the step length, as the current predict value has nothing to do with the last predict value. We quantified the performance of actual load prediction with mean squared error(MSE).

IV. FUTURE OF LOAD PREDICTION

The ultimate goal of cloud computing is to provide the better and efficient services to the end-user. Plenty of work can be carried out as the extension of Load prediction in cloud computing for the betterment to the services. The effective service comprises of the reduced cost, more speedy, less wastage etc. Skewness can be worked up on after prediction [20] Skewness is used to define the unevenness in the utilization of the multi dimension resource utilization of the physical machine or the servers. In green computing: the physical machines that are idle are switched off too save energy. The number of physical machine should be minimized as long as it can be used to satisfy all the virtual machine. Energy aware intelligent controller.[20][7] and providing Optimal power consumption level.[7]. Overload avoidance: The capacity of a physical machine should be enough to satisfy the resource needs of all the virtual machine for running on it else the physical machine is overloaded and can lead to degrade the performance of all the virtual machine working on it[20]

Allocation and de-allocation of the resources: allocation and de-allocation of the resources according to the prediction of past behaviour and the SLA. [13]. Cost calculator after the prediction of the resources the cost of the resources can b multiplied and the cost estimation can be found for the application.[6]. Overhead cost in multi tenant cloud. For more than one cloud if number of virtual machine are known the Vm of the same cloud are found and so no or least over head cost can be applied. [6]

V. CONCLUSION

This paper summarizes the classification of load prediction methods and is impact on cloud environment. Some of the methods discussed above mainly focuses on host load prediction like CPU but are lacking in some factors. As discussed in the below table we conclude that PSR& EA-GMDH out performs other algorithms for dynamic cloud load prediction.[6][2]. It shows very good performance in long term load prediction with high performance accuracy and least error rate (MSE)

REFERNCES

[1]. Sheng Di, Derrick Kondo1, Walfredo Cirne“Host Load Prediction inGoogle Compute Cloud with a Bayesian Model” France, 2Google Inc., USA, 2012 IEEE.

[2]. Qiangpeng Yang, Chenglei Peng, Yao Yu, He Zhao, Yu Zhou, Ziqiang Wang, Sidan Du “Host Load Prediction Based on PSR and EA-GMDH for Cloud Computing System” 2013 IEEE Third International Conference on Cloud and Green Computing.

[3]. Iniya, Venkatalakshmi, Ranjithflalakrishnan “Neural Load Prediction Technique for Power Optimization in Cloud Management System” Proceedings of2013 IEEE Conference on Information and Communication Technologies (IC2013).

[4]. John J. Prevost, KranthiManoj Nagothu, Brian Kelley and Mo Jamshidi, Electrical and Computer Engineering “Prediction of Cloud Data Center Networks LoadsUsing Stochastic and Neural Models” proceedings of 6th international conference, 2011 IEEE.

[5]. Rongdong Hu, Jingfei Jiang, Guangming Liu, Lixin Wang“CPU Load Prediction Using Support Vector Regression and Kalman Smoother for Cloud” 2013 IEEE 33rd International Conference.

[6]. Da-yu XU, Shan-lin YANG, Ren-ping LIU “loadprediction in cloud-oriented data centers” on Distributed Computing Systems Workshops, Journal of Zhejiang University 2013-14

[7]. A Ganapathi, Y. Chen, A.Fox, R. Katz, D. Patterson, “Statistic driven workload modeling for the cloud,” IEEE 26th International conference of data Engineering (ICDEW 2010),pp 87-92,2010

[8]. Adam Ol iner, Ar chana Ganapathi, Wei Xu. “Advances and Challenges in Log Analysis” Volume 55 Issue 2, February 2012 Pages 55-61.

[9]. C. Ferreira, “Gene expression programming: a new adaptive algorithm for solving problems,” Complex Systems, vol. 13, no. 2, pp. 87–129,2001.

[10]. E.Caron, F Desperz and A.Muresan, “forcasting for grid and cloud computing on demand resources based on matching pattern” @nd international conference of cloud computing technology and science,IEEE,2010, pp. 456-463

[11]. Fronza, Ilenia, et al. "Failure prediction based on log files using Random Indexing and Support Vector Machines."Journal of Systems and Software 86.1 (2013): 2-11..” Elsevier, 2013

[12]. Perez-Palacin, Diego, Radu Calinescu, and José Merseguer. "log2cloud: log-based prediction of cost-performance trade-offs for cloud deployments."Proceedings of the 28th Annual ACM Symposium on Applied Computing. ACM, 2013

[13]. Jhu-Jyun Jheng , Fan-Hsun Tseng , Han-Chieh Chao and Li-Der Chou. “ A Novel VM Workload Prediction using Grey Forecasting Model in Cloud Data Center” IEEE - ICOIN 2014,pp 40-45

[14]. KJ. Lang, A.H. Waibel, and G.E. Hinton, "A time-delay neural network architecture for isolated wordrecognition," Neural Networks, vol. 3, 1990, pp. 23-43.

[15]. K. Johnson, S. Reed, and R. Calinescu. “Specification and quantitative analysis of probabilistic cloud deployment patterns.” In Hardware and Software Verification and Testing, volume 7261 of LNCS, pages145–159. Vol. 7261 of LNCS,pp.97-104 Springer, 2012

[16]. Lizhewang Jie, Tao,Kunze M.,Castellanos, A.C,Kramer,D.,Karl,w, “High Performance Computing and Communications”,IEEE International Conference HPCC,2008, pp.825-830.

[17]. Md. Toukir Imamt, Sheikh Faisal Miskhatt, Rashedur M Rahmant, M. Ashraful Amin. “Neural Network and Regression Based Processor Load Prediction for Efficient Scaling of Grid and Cloud Resources” IEEE 14th International Conference on Computer and Information Technology (ICCIT 2011) December, IEEE 2011pp 333-338.