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An Optimal Utilization of Cloud Resources using Adaptive Back Propagation Neural Network and Multi-Level Priority Queue Scheduling☆

Anwar Saeed [1,*], Muhammad Yousif [2], Areej Fatima [2], Sagheer Abbas [2], Muhammad Adnan Khan [2], Leena Anum [2], and Ali Akram [2]

[1] *Department of Computer Science, Virtual University, Lahore, Pakistan*

[2] *Department of Computer Science, National College of Business Administration & Economics, Lahore, Pakistan*

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Abstract

With the innovation of cloud computing industry lots of services were provided based on different deployment criteria. Nowadays everyone tries to remain connected and demand maximum utilization of resources with minimum time and effort. Thus, making it an important challenge in cloud computing for optimum utilization of resources. To overcome this issue, many techniques have been proposed shill no comprehensive results have been achieved. Cloud Computing offers elastic and scalable resource sharing services by using resource management. In this article, a hybrid approach has been proposed with an objective to achieve the maximum resource utilization. In this proposed method, adaptive back propagation neural network and multi-level priority-based scheduling are being carried out for optimum resource utilization. This hybrid technique will improve the utilization of resources in cloud computing. This shows result in simulation-based on the form of MSE and Regression with job dataset, on behalf of the comparison of three algorithms like Scaled Conjugate Gradient (SCG), Levenberg Marquardt (LM) and Bayesian Regularization (BR). BR gives a better result with 60 hidden layers Neurons to other algorithms. BR gives 2.05 MSE and 95.8 regressions in Validation, LM gives 2.91 MSE and 94.06 regressions with this and SCG gives 3.92 MSE and 91.85 regressions.

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1 Introduction

In the last few decades, data being communicated through traditional concept to the desktop system is being moved to cloud computing. In the current cloud computing is playing an important role in every field of life which interlinks with internet and semantic web. Telecommunication companies have taken

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* Corresponding author.

Email addresses: anwaar@vu.edu.pk, engineeryousif@hotmail.com, areejfatima@lgu.edu.pk, dr.sagheer@ncbae.edu.pk, madnankhan@ncbae.edu.pk, leenarehman@ncbae.edu.pk , aliakram@ncbae.edu.pk

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a step for virtualization online. With the innovation of cloud computing industry, historical changes have been observed which provides a lot of cloud computing services with different deployment criteria. Today, different enlisted cloud companies such as Amazon Elastic Compute Cloud (EC), google cloud, Microsoft cloud Azure, Wikimedia, Alibaba, red hat open shift, blue Stacks, cloud, and sales force are providing resources with different price schema. Everyone avoids the infrastructure of the physical machine that we have tired to engage with us. In the cloud, computing details are abstracted from the user.

In our daily life, we use these cloud services without our warning like Google Gmail, Yahoo Mail, Yahoo calendar, google-calendar, flicker, Udemy, conference.com, Google docs, online database with a collection of WebPages (WebDB), Amazon simple storage service (Amazon S3), Dropbox, watching movies through internet etc uses cloud computing on the backside [1]. Mostly cloud constitutes three segments similar to data centers, server, and clients. Client behaves for requesting for a resource while the server serves all requests generated by clients. Data center acts as the service provider so it is a central repository which interlinks both the client end and the source end. Cloud optimization show quality of service, power consumption minimum, workload balancing, utilization maximum, etc.

The resource word includes providing bandwidth, storage, data center, software, hardware, by cloud suppliers for getting ready data over the web, the fundamental thought is distributed computing, to give resources through services to users using the affiliated cloud. The provision of resources is almost enforced on customers because they have no choice. Types of resources namely listed as computing resource, networking resource, storage resource, and power resource [2]. Computing resources which include memory, processor, input/output devices, network in the cloud atmosphere. This is also called the physical machine. According to user demands computing resources are allocated or deallocate with different price packages. The idea of the virtual machine comes under physical machine, where physical machine creates virtual software which are used to execute Virtual machine with different operating system and application which also provide a huge virtual security system.

[3] Networking resources are non-volatile such as storage devices, data communication services are enrolled here, latency rate and connectivity of challenges, therefore large scale traffic problems come on the network side. They follow the protocol to enhance the quality of service. Storage Resources a concept is interlinked with a database such as Atomicity, Consistency, Isolation, and Durability (ACID). The ACID database provides the concept of a database which allows safe sharing of data. Presently, multi day's cloud storage isn't relying upon Structured Query Language (SQL). It depends on No SQL which supports storing documents with key-value. The example of storage resource is MongoDB, Power Resource. This is the concept of power consumption per day of resources utilization. The most energy consumed on an idle resource which waits for a response. In cloud computing power resource is lead to another technology known as Green cloud computing [4]. We would like to mention the types of resource allocation namely Static resource allocation and dynamic resource allocation. Static resource allocation is shortly assumed with a single word which is predefining criteria. Dynamic resource allocation scheme is an efficient technique for assigning resources to versatile clients in time changing environment [5].

Wherein, scheduling is the way toward mapping and controlling jobs or process into accessible resources [6]. Furthermore the proficient scheduling plan is fundamental for upgrading the utilization of cloud resources and giving the end clients high effective services with high quality. Optimization standard is utilized when confirming a scheduling choice and describe to the objective of the Scheduling Process. Scheduling problem is related to two types of user's respectively as cloud customer and cloud providers. Cloud customers run to their task for explaining problems of modifying size and complexity and cloud providers contribute resources for executing consumer's job. Mapping of jobs to resources will be done by scheduler path. When your jobs are executing on the schedule on the resources it takes the decision from Intelligent Neural Network to execute that job according to priority preemptive and Non-Preemptive scheduling. Preemptive Scheduling means each job is to be delayed during execution and job can also be shifted to another resource, ignoring its basic allocated resource idle, to be available for another job. So, this is useful in case if you are having different jobs and priority. In non-Preemptive scheduling, job is not allowed to shift on another resource, meaning the job has to strick to one particular resource [7].

Machine learning is an aspect of artificial intelligence that gives the computer the capacity to learn without being explicitly programmed. Machine learning focuses on the development of computer programs that can change, when exposed to new data.Furthermore, Machine learning is about the machines improving from data, knowledge, experience, and interaction. Supervised learning is meant to observe and predict the execution of the task, project or activity. Supervised learning is defined as training data includes desired output. An example of supervised learning is to predict an email is spam or not, as is uses label data.In this research, objective is supervised learning using Artificial Neural Networks. The neural network is a computational framework excited by the structure, processing technique, learning capacity of a biological brain [8]. The artificial neural network has three core elements namely processing unit, topology, learning algorithm.

Hybrid algorithms are using computational intelligence. Computational Intelligence has four branches Fuzzy [9, 10], Swarm [11], Evolutionary [12, 13],traffic congestion [3, 14, 15] with the help of IoT [16] and Neural [17]. The hybrid structures of these branches are favored in various fields like wireless communication, and cloud computing and so on. From these, we are utilizing Artificial Back Propagation Neural Network (ABPNN).

2 System Model

A novel approach for dynamic resource allocation has been used. The method illustrates that resources are then used when they need on the basis of demands. The Java-based framework which is known as Cloudsim simulator has been used in the model. The method which supports Resource allocation system has the functionalities namely the discovery of resources, Monitoring of resources and dynamic allocation. After implementation, simulated results have been achieved which are analyzed and well explain through Figure 2 form [18].

An efficient utilization based integrated task scheduling algorithm has been used. Their method scheduled by using Particle Swarm Optimization (PSO) algorithm by mean of the max-min algorithm. The main objective of this method is to reduce the completion time and enhance the CPU utilization performance. According to this method, the max-min algorithm task gives output. Then this output is given to PSO as input. Task scheduling is performed on the simulation tool [16]. Virtualization allows the division of physical resources of a server platform into numerous autonomous, commonly confined platforms that can run the entire environment for the application. Thus one physical server can have various sensible virtual machines running on it, each having its own working operating System (OS) platform [15].

Particle Swarm Optimization COGENT scheduling algorithm works with three parameters like cost and energy and deadline essential. In this paper, it has been illustrated that most extreme resources may be utilized with the least energy use and increase the greatest [19]. Pandey discusses a survey about resource allocation techniques used in cloud computing. In the paper, they discuss multi-queue scheduling technique with different algorithm Such as FCFS, SJF, Combinational Backfill Algorithm (CBA), Load Balancing Algorithm and Priority based VM. It has also been discussed not single technique is said to be perfect for resource allocation in cloud environment [14].

A Neural Network Predicted Multi-Queue Job Scheduling Has Been Discussed for Cloud Computing and Its Technique Avails in The Performance of MSE And Regression as Compared to Subsisting Technique Proposed ABPNN-MLPQS System Model

This article, proposes a new Model, Artificial Back Propagation Neural Networks and Multilevel Priority Queue Scheduling (ABPNN-MLPQS) for Cloud Resource system. In Figure 1 six components are working properly. In this model, User submits a request for resource utilization through cloud platform and this job information work through controller node, which interacts with resource Monitor, programming model, Performance model and gives a response to the job model. Through this job scheduler work and takes the decision from Artificial Neural Network (ANN) Scheduler.

Proposed Adaptive Back Propagation Neural Network and Multi-level priority Queue scheduling utilized aggregate three layers like input, topology and an output layer. Distinctive advances are engaged with the algorithm of back propagation which incorporates, Initialization of weight, Feedforward, Back Propagation of blunder and refreshing of weight and bias. Each neuron present in the topology layer has an initiation work like f(x)=Sigmoid(x). The sigmoid capacity for input and the topology layer of the proposed Figure 1 Adaptive Back Propagation Neural Network and Multi-level priority Queue scheduling be composed as

$$\yen_j = g_1 + \sum_{q=1}^{s} (\mu_{qp} * \text{ɪ}_q) ......1$$

$h_j = \frac{(1)}{1+e^{-\yen_p}})$
where
$p = 1, 2, 3'n.....2$
Input taken from the output layer is

$$\yen_k = g_2 + \sum_{p=1}^{n} (\Lambda_{pL} * h_p) ......3$$

Output layer activation function is given below
$hL = \frac{1}{1+e^{-\yen_L}}) whereL = 1, 2, 3'\text{ɪ}.........4$

$E^{=} \frac{1}{2} \sum_k (\text{ɟ}_L - hL)^2$................................5

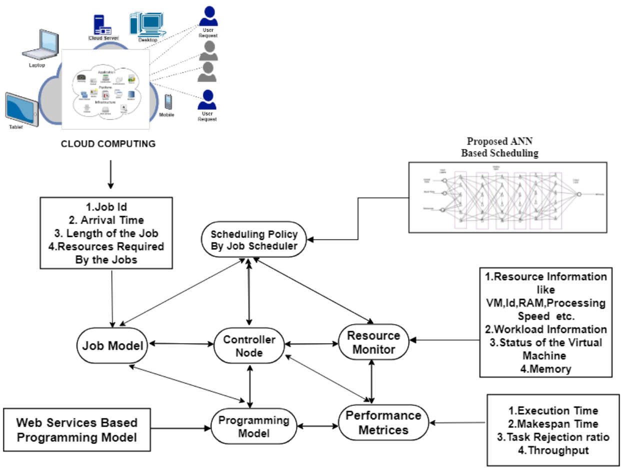

Figure 1. Proposed Resource Allocation Model for Cloud Environment using ABPNN-MLPQS

Above equation represent back propagation error where,ꟻL& represents the desired output and estimated output.

In equation (6) rate of change in weight for the output,the layer is written as.

$\triangle \mathrm{M} \propto -\frac{\partial E}{\partial M}$

$\triangle \mathrm{V}_{j,k} = - \in \frac{\partial E}{\partial \Lambda_{p,L}}$.............................6 After applying Chain rule method above eq can be written as

$\triangle \,\text{ʌ}_{p,L} = - \in \frac{\partial E}{\partial hL} \times \frac{\partial \psi}{\partial ¥_L} \times \frac{\partial ¥_L}{\partial \Lambda_{p,L}}$.............................7

After substituting the values in equation (7), the value of weight changed can be obtained as shown in equation (8)

$\triangle \,\text{ʌ}_{p,L} = \in (ꟻ_L - h_L)$ĂČâĂŤ$h_L(1-h_L)$ĂČâĂŤ$(h_p)$

$\triangle \,\text{ʌ}_{p,L} = \in \xi_L h_p$..........8

Where,

$\xi_L = (ꟻ_L - h_L) \times h_L(1-h_L)$ Apply chain rule for the refreshing of loads between input and hidden layers

$\triangle M_{q,p} \propto -[\sum_L \frac{\partial E}{\partial h_L} \times \frac{\partial h_L}{\partial ¥_L} \times \frac{\partial ¥_L}{\partial h_p}] \times \frac{\partial h_p}{\partial ¥_p} \times \frac{\partial ¥_p}{\partial \omega_{q,p}}$

$\triangle M_{q,p} = - \in [\sum_L \frac{\partial E}{\partial h_L} \times \frac{\partial h_L}{\partial ¥_L} \times \frac{\partial ¥_L}{\partial h_p}] \times \frac{\partial h_p}{\partial ¥_p} \times \frac{\partial ¥_p}{\partial \omega_{q,p}}$

In above eq,$\in$ represents the constant,

$\triangle \mathrm{M}_{q,p} = \in [\sum_L (ꟻ_L - h_L)$ĂČâĂŤ$h_L(1-h_L)$ĂČâĂŤ$(\text{ʌ}_{p,L})] \times h_L(1-h_L) \times \alpha_q$

$\triangle \mathrm{M}_{q,p} = \in [\sum_L 3L(\text{ʌ}_{p,L})] \times h_L(1-h_L) \times \alpha_i$

After simplification above equation can be written as

$\triangle \mathrm{M}_{q,p} = \in 3p\alpha_q$.........9

Where, $\triangle \mathrm{M}_{q,p} = \in [\sum_{3L} (\text{ʌ}_{p,L})] \times h_p(1-h_p)$

$\text{ʌ}^{+}_{p,L} = \text{ʌ}_{p,L} + \lambda_F \triangle \text{ʌ}_{p,L}$.....10

Above equation is used for refreshing the weights between output and hidden layers.

$M^{+}_{q,p} = M_{q,p} + \lambda_F \triangle M_{q,p}$......11

What's more, the above condition is utilized for refreshing the weights between the hidden and input layer.

Algorithm		Validation 40 Neurons	Validation 50 Neurons	Validation 60 Neurons
Scaled Conjugate Gradient	MSE	6.79 e^{-2}	5.61 e^{-2}	3.92 e^{-2}
	Regression (%)	85.52	88.61	91.85
Levenberg -Marquardt	MSE	4.19 e^{-2}	2.62 e^{-2}	2.91 e^{-2}
	Regression (%)	91.40	92.55	94.06
Bayesian Regularization	MSE	3.84 e^{-2}	2.46 e^{-2}	2.05 e^{-2}
	Regression (%)	92.04	95.0	95.8

Figure 2. validations results of Proposed ABPNN-MLPQS system

3 Simulation and Results

Proposed (ABPNN-MLPQS) system shows the Architecture of neural network on Matlab in which dataset are manipulate which taken from kaggle in which 1401 instances are exist with five attribute like Jobid , Burst Time, arrival Time, Preemptive and Resources. This Data show one output (Preemptive). In this proposed methodology (ABPNN-MLPQS) dataset are used as Training which show 981 instances, validation show 210 instances and testing show 210 instances with 40, 50& 60 numbers of hidden neurons. In this training network we choose a Levenberg-Marquardt, Scaled Conjugate Gradient, and Bayesian Regularization Algorithm. This algorithm requires more memory but minimum time. This working automatically stops when generalization stops improving. is shown that using multiple hidden layer neurons 4(40 - 50 - 60) efficiency is improving as increasing the number of neurons and the results of our proposed Bayesian Regularization are better as compared to other two algorithm. Figure 3 also shows the performance of proposed ABPNN-MLPQS System with different number of Hidden Layer neurons in terms of MSE and Regression.

It is shown in Figure 2 that MSE of Scaled Conjugate Gradient approach with 40,50 & 60 neurons in Validation is 6.79 $e^{-2}, 5.61e^{-2}$&$3.92e^{-2}$with 85.52, 88.61 & 91.85 regression respectively. In training the MSE of SCG approach with 40,50 & 60 neurons is $5.02e^{-2}, 4.16e^{-2}$&$4.06e^{-2}$ with 89.3, 91.2& 91.4 Regression respectively. The MSE of Levenberg-Marquardt approach with 40,50 & 60 neurons in Validation is 4.19 $e^{-2}, 2.62e^{-2}$&$2.91e^{-2}$ with 91.40, 92.55 & 94.06 regression respectively.

The MSE of LM approach with 40, 50 & 60 neurons in training is $2.06e^{-2}, 1.93e^{-2}$&$1.69e^{-2}$ with 95.7, 96.04 & 96.5 Regression respectively. In training the MSE of SCG approach with 40, 50 & 60 neurons is $5.0e^{-2}, 4.16e^{-2}$&$4.06e^{-2}$ with 89.3 ,91.2 & 91.4.4 regression respectively. The MSE of Bayesian Regularization approach with 40,50 & 60 neurons in training is $1.77e^{-2}, 1.13e^{-2}$&$8.65e^{-3}$ with 96.3, 97.6 &

Algorithm		Training		
		40 Neurons	50 Neurons	60 Neurons
Scaled Conjugate Gradient	MSE	5.02 e^{-2}	4.16 e^{-2}	4.06 e^{-2}
	Regression (%)	89.3	91.2	91.4
Levenberg -Marquardt	MSE	2.06 e^{-2}	1.93 e^{-2}	1.69 e^{-2}
	Regression (%)	95.7	96.04	96.5
Bayesian Regularization	MSE	1.77 e^{-2}	1.13 e^{-2}	8.65 e^{-3}
	Regression (%)	96.3	97.6	98.25

Figure 3. Training results of Proposed ABPNN-MLPQS system

98.25 regression respectively. In case of hidden layer neurons in our proposed ABNN-MLPQS solution we vary the neurons 40, 50, & 60 and observed that if we increase the neurons then performance of the system is also increased. Its means when the number of neurons is improved the performance of the system is also increased. It also observed that in our proposed technique Bayesian based Regularization gives attractive results as compares to previous approaches with of 60 hidden layer neurons. If in hidden layers the no. of neurons is 60 the BR gives $2.05e^{-2}$ MSE and 95.8 regressions in Validation, LM gives $2.91e^{-2}$ MSE and 94.06 regressions with this and SCG gives $3.92e^{-2}$MSE and 91.85 regressions. It's observed that BR gives attractive results in terms of regression and MSE when hidden layer neurons are 60 as compared to Scale Conjugate Gradient and LM techniques.

4 Conclusion

Proposed Technique has been carefully designed and discusses the resource allocation model with its components for cloud environment. Proposed ANN based scheduling algorithm named as MLPQS-MLT Scheduling that schedule the job at cloud resources in efficient way and also optimize Quality of service (QoS) parameters. This proposed algorithm will perform the higher priority job first and this gives the better allocation resources performance with maximum optimization as compared to other techniques.

In this work, various Artificial Back Propagation Neural Networks algorithms were applied for the job priority detection to the dataset that was received from kaggle Machine Learning Repository. For job priority detection of MLPQS-MLT system, three different algorithms namely Scaled Conjugate Gradient, Levenberg-Marquardt and Bayesian Regularization were applied to job dataset. At the point when the results were compared, it was seen that BR algorithm has the highest precision rate with 70% of training (981 samples), 15% of validation (210 samples) and 15% of testing (210 samples). Our proposed BR technique gives attractive results as to other algorithms. Bayesian based Regularization gives attractive results as compares to previous approaches with of 60 hidden layer neurons. If in hidden layers the no. of neurons is 60 the BR gives 2.05 MSE and 95.8 regression in Validation, LM gives 2.91 MSE and 94.06 regression with this and SCG gives 3.92 MSE and 91.85 regression.

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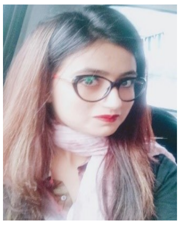
Anwar Saeed has joined Virtual University (VU) of Pakistan in April 2006 and is currently working as an Assistant Professor in Computer Science Department. He has obtained his PhD Degree in computer science from National College of Business Administration & Economics (NCBA&E), Lahore, Pakistan. His area of research is key generation for data encryption and information security. He is also interested in Quantum Computing especially encryption mechanisms used in this field. He is the author of a monograph on framework for Self Organizing Encryption in Ubiquitous Environment, published by VDM Verlag in 2010.

Muhammad Yousif is currently M.Phil Scholar at the Department of Computer Science, of NCBA&E , Lahore, Pakistan. Yousif's research interests primarily include Cloud Computing, IoT,Image Processing and Cognitive machines with various publications in International journals and conferences.



Areej Fatima is currently working as a Lecturer at the Department of Computer Science, Lahore Garrison University, Lahore, Pakistan. He is doing PhD from School of Computer Science, NCBA&E, Lahore, Pakistan.She completed his Master of Computer Sciences from the Department of Computer Science NCBA&E, Lahore, Pakistan. Areej's research interests primarily include Cloud Computing, IoT, Intelligent Agents, Image Processing and Cognitive machines with various publications in International journals and conferences.

Sagheer Abbas is currently working as an Assistant Professor at the School of Computer Science, NCBA&E, Lahore, Pakistan. He completed his M.Phil,PhD from School of Computer Science, NCBA&E, Lahore, Pakistan. In Computer Science from School of Computer Science, NCBA&E, Lahore, Pakistan. He has published about 48 research articles in International Journals as well as reputed International Conferences. Sagheer's research interests primarily include Cloud Computing, IoT, Intelligent Agents, Image Processing and Cognitive machines with various publications in International journals and conferences.

Muhammad Adnan Khan is currently working as an Assistant Professor at the School of Computer Science, NCBA&E, Lahore, Pakistan. He completed his PhD from ISRA University, Pakistan. He has been teaching graduate and undergraduate students in computer science and Engineering for the past 10 years. Presently he is guiding 04 Ph.D. scholars and 3 M.Phil. Scholars. He has published about 109 research articles in International Journals. Khan's research interests primarily include MUD, Channel Estimation in Multi-Carrier Communication Systems Using Soft computing, Image Processing & Medical Diagnosis with various publications in journals and conferences of international repute.

Leena Anum is an Assistant Professor at the School of Business Admisnitration at NCBA&E, Lahore. She did her PhD in Business Administration in March, 2019. Her research interests include various cross disciplinary areas ranging from knowledge management, knowledge based systems to smart cities.

Ali Akram is currently M.Phil Scholar at the Department of Computer Science, of NCBA&E , Lahore, Pakistan. Ali Akram's research interests primarily include Cloud Computing, IoT, Intelligent Agents and Cognitive machines with various publications in International journals and conferences.