Resource Allocation in the Cloud Environment Based On Quantum Genetic Algorithm Using Kalman Filter with ANFIS

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Abstract
Cloud computing is a new technology that has become a massive demand for computing solutions. Users can access computing resources from anywhere with the help of the cloud. Nowadays, more companies can hire cloud resources for storage and other computational purposes so that infrastructure costs are considered to be exceedingly reduced. The resource allocation mechanism based on the reservation method can be improved with a useful forecasting model that can provide almost well for developing resource allocation strategies. This can help to improve customer needs and the growth of businesses that are based on cloud computing. Service providers shall endure the cost of resources reserved in the cloud. Resources are allocated to reduce the associated costs. There are many algorithms implemented to predict the allocated resources in the cloud and to reduce the cost. This paper presents a Kalman filter with a Neuro-fuzzy system composed of an ANFIS optimized by the Quantum Genetic Algorithm. The algorithm was evaluated with actual cluster tracking data in Google and demonstrated the comparison method's weakness by showing much improved and better predictions.

Keywords:
Cloud Computing, Resource allocation, ANFIS, Kalman Filter, Quantum Genetic Algorithm

1. Introduction

Cloud computing is raised exhilaration, good low cost, high availability, high dependability, elastic scalability, and robust performance. According to these enchanting characteristics, ranking enterprises like Google, Amazon, and Facebook pack their data into the cloud and operate their procedures using large distributed computing frameworks in the cloud. Also, individuals can use cloud computing services by renting computing resources. Economic advantages and flexibility make the cloud computing experience massive growth. [1], [2]

It allows provisioning of resources using self-services interface.resoursces is pooled to serve multiple consumers. all resources are dynamically assigned and reassigned based on consumer demand. [3], [4]

Cloud computing enables collaboration between disparate groups of people by sharing resources and information and accessing them simultaneously from any location. For example, employees in an organization can place a document centrally in the cloud, enabling them to view and work on it simultaneously. Cloud computing has transpired as a familiar computing model to handle data and implement computationally bushy applications in a pay-as-you-go manner. Besides, the non-homogeneity of cloud resources, the unforeseeable nature of the workload, and the different cloud actors' different objectives help complicate resource allocation in the cloud computing environment. Therefore, both the industry and the academic community have begun considerable research efforts to deal efficiently with the multifaceted challenges mentioned above with the allocation of cloud resources. [5]

One of the most prestigious schemes that attract much attention in recent decades is defined as statistical filtering. These new motives and ideas come from this fact that they use all available data for the system. This means that the statistical filter will use the system noise and also system status. Weiner provided filtering and statistical estimation in 1930. Kalman developed his algorithm and system of the investigation in about 1960. He reduced the error in the system estimation model by using the linear filter's variance matrix. Kalman filter is a class of statistical filters used in the presence of non-interrelated white noise. Using the Kalman filter, the classification anxiety decreases to the state's estimate of the dynamic system. [6]

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The adaptive neuro-fuzzy inference system (ANFIS) is a neural network that revolves around the Takagi–Sugeno.

Numerous neuro-fuzzy formation algorithms are available and known in the literature, such as fuzzy inference networks, fuzzy clustering networks, neural network-driven fuzzy reasoning, fuzzy modeling networks, fuzzy memory systems, etc. The most important goal of integrating fuzzy systems with neural networks is to exercise the ability to learn from the neural network. In contrast, the learning ability is improved for a fuzzy system. For the neural network, there are extra benefits to the hybrid system. [7]

Genetic algorithms (G.A.s) are metaheuristic algorithms to create an optimal global optimization solution based on natural selection and genetics' evolutionary ideas. [8]
Quantum Genetic Algorithm (QGA) is a qubit-based chromosome. Each chromosome can be found in many states in the population overlay, and it represents only one case in the artistic community by applying the measurement. [9]

The proposed model in this work improves the estimation of host load in the cloud environment by applying the Double Chains Quantum Genetic algorithm (DCQGA), using QGA to get the optimal value of one from the neuro-fuzzy parameters in the ANFIS model.

According to the concept above, this research introduces a model to estimate the google cluster trace task load situation. An adaptive neural network was applied in this paper to utilize the fuzzy inference system parameters to beat the constraints of statistical models after applying the Kalman filter to the original data. Finally, the proposed model boost the estimation accuracy using QGA in the optimization process for the neuro-fuzzy system parameter. The evaluation results showed that building the optimization model allows the proposed model to perform better than the comparable model.

This paper is organized as follows: Section 2 describes the background and related work information. Section 3 introduces the proposed model and its implementation. Section 4 demonstrates the evaluation of the model and compare the final result with other models. Finally, the concluding points are mentioned in section 5.

2. Background and Related Work

2.1 Cloud Computing

A cloud is a collection of I.T. resources, including hardware and software resources that a user (consumer) accesses over a network. Cloud infrastructure is built, operated, and managed by a cloud service provider. Cloud computing is a model that enables consumers to conveniently hire I.T. assets as a service from a provider's cloud infrastructure. A cloud service is any combination of I.T. resources, such as network-accessible data storage and processing, fully-featured applications, and software development and deployment tools offered for consumption by a cloud provider. CSP is responsible for create shared pools of resources.

The resources are made available to the consumers as services over a network, such as the Internet or an intranet.

Consumers themselves provision the resources from the pools, as and when required, without interacting with the provider during the process. The resources are returned to the pool when they are released. In general, a cloud system and its consumers employ the client-server model, which means that the consumers (the clients) send messages over a network to compute systems, which then perform operations in response to the received messages[10].
The I.T. resources that make up a cloud infrastructure are deployed in data centers. A data center is a facility that houses and maintains centralized I.T. systems and components, including computing systems, storage systems, and network equipment. A data center also supports infrastructure, such as secure access, uninterruptible power source (UPS), generators, smoke detection/fire suppression, raised floors for cabling and water damage prevention, heating, ventilation, and air conditioning (HVAC) systems. The operations staff of a data center monitors operations and maintains the I.T. and the infrastructural equipment around the clock. A cloud data center may reside at a single physical location or may comprise multiple data centers distributed across geographical locations and are connected over a network[11].

Cloud computing is known to be a low-cost computing solution at any time. Customized cloud access features in cloud computing help cloud customers adopt or transform their business model into Cloud Data Storage and Storage resources. This growing number of cloud adoption by various commercial areas has also been reflected in an increase in cloud providers' numbers. This makes it easy for users to access the required information at any time from anywhere. While the traditional computer needs the user to be in the same place where the data storage is available, the cloud makes the repository and the site retrieval different. Cloud services should deal with tens of thousands of concurrent requests and enable servers to provide the required amount of load balancing to respond to incoming traffic easily while allowing users to access information quickly and accurately. [11], [12], [13]

The statistics and machine learning areas have developed appropriate forecasting methods to predict time series data from economics, finance, and science. Much effort has been spent on improving the accuracy of modeling and forecasting. The problems that still exist when using the prediction methods for resources hosted by cloud computing are The absence of a set of measures to assess forecasting methods' accuracy when applied to the allocation of resources in a cloud. When comparing multiple types of prediction methods, predictive forecasting provides the most accurate load on cloud-hosted resources. [14]

Many other researchers recognized in the literature on Optimization and metaheuristic algorithms and improving cloud computing performance, such as [15-30] studied Cloud computing importance in our lives.

2.2 Kalman Filter

The Kalman filter (K.F.) is an optimal filter by the recursive method that results in an optimal state estimate in a linear system. The KF is a predictor that predicts the future state from the spectrum of noisy measurement for the specified system state. K.F. is a numerical method applied to track a time-varying signal in the existence of noise. It is the issue of predicting a linear system's instant state from a measurement of outputs that are linear compositions of the states but deviated with Gaussian white noise. It can be used appropriately to either smooth, estimate, or predict consecutive past, present, and future states. [31], [32]

2.3 ANFIS Algorithm

The ANFIS has a great ability to deal with inaccuracies and uncertainties of nonlinear systems and is frequently implemented to build the fuzzy IF-THEN rules of logical reasoning through its powerful and effective data mining techniques. ANFIS gather the advantages of the Fuzzy Inference System (FIS) rule base and the learning advantages of Artificial Neural Networks (ANN), utilizes the FIS rule base to explain the relationship between the output and the input parameters and ANN to train the data and find the best parameters for the membership functions of the FIS to obtain the proper fuzzy rules and membership functions. The structure of the neuro-fuzzy model consists of different adaptive layers. Every layer has nodes to a connected network of transfer functions; the fuzzy inputs are processed through it. [33], [34], [35]

2.4 Quantum Genetic Algorithm

2.4.1 Genetic Algorithm:

Genetic algorithms (G.A.s) are adaptive methods that can be used to get the solution for an enormous range of optimization problems. It derives from the genetic processes of biological organisms. Natural populations have evolved according to natural selection principles and "survival of the fittest for many generations." Genetic algorithms are eligible to "develop" solutions to real-world problems by simulating this process if they have been properly encoded. Ga is more applicable to solve the optimization problem where the optimal result is extracted from an extensive random data set, such as the scenario in the search problem. [36]

2.4.2 Quantum Genetic Algorithm:

The quantum genetic algorithm (QGA), a promising new genetic algorithm developed in recent years, is a quantum computing theory and genetic algorithm. The system is based on quantum computing concepts (qubit, quantum superposition, and quantum entanglement) and quantum theory, such as the quantum logic gate. In QGA, the qubit encoding is used to represent the chromosome, and the evolutionary process is performed using the quantum logic gate process on the chromosomes. Much attention is paid to it because it contains robust research capacity characteristics, rapid convergence, short computing time, and small population size. [37], [38]

3. Proposed Model Implementation

The proposed method's main body is based on a double chain quantum technology integrated into a genetic algorithm to improve the accuracy of the optimization process to find the best value for one of the ANFIS model parameters. To improve forecasting accuracy, the Kalman Smoother is used for data preprocessing. Kalman smoother is acceptable for the cloud application's load prediction because it was primarily proposed to estimate time-varying states in dynamic systems.

This paper proposes a technique to estimate the task load situation in google cluster trace. In this paper, an adaptive network was used to optimize the fuzzy inference system parameters to overcome constraints of statistical methods after filtering the original data by the Kalman filter. Finally, the proposed model improves prediction accuracy, using QGA in the optimization process for the ANFIS parameter.

The double chains quantum genetic algorithm (DCQGA) is based on the range of probability of quantum bits. In this way, each qubit's probability value is represented as two

genes, each chromosome carries two gene chains, and each of the gene chains works on the optimal solution. The number of optimization parameters determines the number of genes. Taking each qubit in the optimal chromosome as the target, individuals are updated by quantum rotation gates as represented in (1), and mutated by quantum non-gates to increase the diversity of the population [39].

$$\Delta\theta_{p,r} = -sign(S)\,\Delta\theta_o \exp(-\frac{|\nabla f(X_{p,r})| - \nabla f_p \min}{\nabla f_p \max - \nabla f_p \min}) \quad (1)$$

Where $\Delta\theta_0$ is the initial rotation angle,

$$A = \begin{vmatrix} \alpha_0 & \alpha_1 \\ \beta_0 & \beta_1 \end{vmatrix} \quad (2)$$

Then the direction of rotation angle $\Delta\theta$ can be calculated by such rules as follows: if $S \neq 0$, then sign $(\Delta\theta) = -\text{sign}(S)$, else if $S = 0$, the direction of $\Delta\theta$ is arbitrary,

$$\nabla f(X_{p,r}) = \frac{f(X_{p,q}) - f(X_{p,v})}{(X_{p,r})^q - (X_{p,r})^v} \quad (3)$$

Where $X_{p,q}$ and $X_{p,v}$ represents pth vector in solution space corresponding to the parent colony (q) and child colony (v), and $(X_{p,r})^q$ $(X_{p,r})^v$ represents the rth variable of vector $X_{p,q}$ and $X_{p,v}$, respectively.

Performance measurements evaluated the proposed model. These measurements are significantly used to evaluate the original output gap and the expected output from the proposed model. The proposed model was rated using RMSE.

$$\text{RMSE} = \sqrt{((1/N) * \sum \text{error}^2)} \quad (4)$$

The technique discussed above was used to find the best value for the optimization parameter. It used a double chain quantum genetic algorithm and calculate fitness function according to the ANFIS model using subtractive clustering to generate initial FIS for the ANFIS system after applying the Kalman filter to original data.
The main steps and the conceptual design are illustrated in Algorithm 1

Algorithm 1: Proposed methodology

Step 1: Smearing Kalman Filter (Phase one)
Step 2: Generate an initial random population
Step 3: Calculate parameter value
Step 4: Initialize ANFIS model
Step 5: Perform the optimization algorithm using DCQGA (Phase two)
Step 6: Find the best performance and accuracy.
Step 7: Stop

Two significant phases are constituting the implementation methodology of the proposed model.

A. Phase one: Data Pre-processing:
Pre-processing is a process that turns the raw inputs and outputs into an understandable or acceptable form before the training process. This is often used to reduce the dimensionality of the input data and optimize the generalization performance.
For the volatility characteristic of the load in cloud computing, the first uses Kalman filtering its filtering process, resulting in a more accurately reflect the characteristics of the cloud computing load curve.

B. Phase Two: An optimization algorithm
The double chain quantum Genetic algorithm is the algorithm used in the optimization phase.

4. Results and Discussion

Google cluster trace is a dataset released by Google in May 2011 of a cluster of 11000 machines and contains cell information of about 29 days. Every cell represents a set of several machines sharing a single cluster management system. Each job in the trace includes one or many tasks where each task might contain several processes to be run on a single machine. The trace data contains five tables: Machine Events Table, Machine attribute's Table, Jobs Events Table, Task Events Table, Task Constraints Table, and Task Resource Usage Table. [40]

$$\Delta\theta_{i,j} = -\text{sgn}(A)\,\Delta\theta_o \exp(-\frac{|\nabla f(X_{i,j})| - \nabla f_i \min}{\nabla f_i \max - \nabla f_i \min})$$

To discuss the proposed model's efficiency, testing was done on the Google cluster trace data and compared its result with compared model result in [41], obtained result of the proposed model, as shown in Fig. 1 with RMSE value equal to 0.0054.
Fig. 1 illustrates the proposed model's testing in red marks compared with the blue line's original data.

They compared the model [41] stated that accurate load forecasts need to be developed early to improve cloud-hosted resources. The problem faced by these working titles is that there is no set of measures to assess the accuracy of forecasting methods' performance and compare predictive forecasting methods. It has contributed to the description of the specific assessment measures that have been collected and adapted from literature and used to assess the accuracy of the prediction of six basic ways of presenting literature. Using a dataset of 2011 Google's Cluster usage trace [42], it has evaluated CPU and memory usage, the emphasis was placed on comparing the performance of the prediction methods investigated.

Its experiments choose to use a Training data for about a third of the 29-day data-trace with the length of 3000 samples (250 hours). The Forecasting window is set to 30 samples (2.5 hours), which are 1% of the training window. Finally, it shows that Auto-regression achieves better performance than other methods compared to most CPU usage data metrics with the min RMSE value between 0.065 and 0.085. Data collected is the same as the data used in the proposed model and the same period chosen.

It can be seen clearly that the matching between original data and predicted data is obviously shown in the proposed model.

These results show that the proposed model is better than all comparable models depends on the RMSE value of the proposed model was less than the min RMSE value in the compared models

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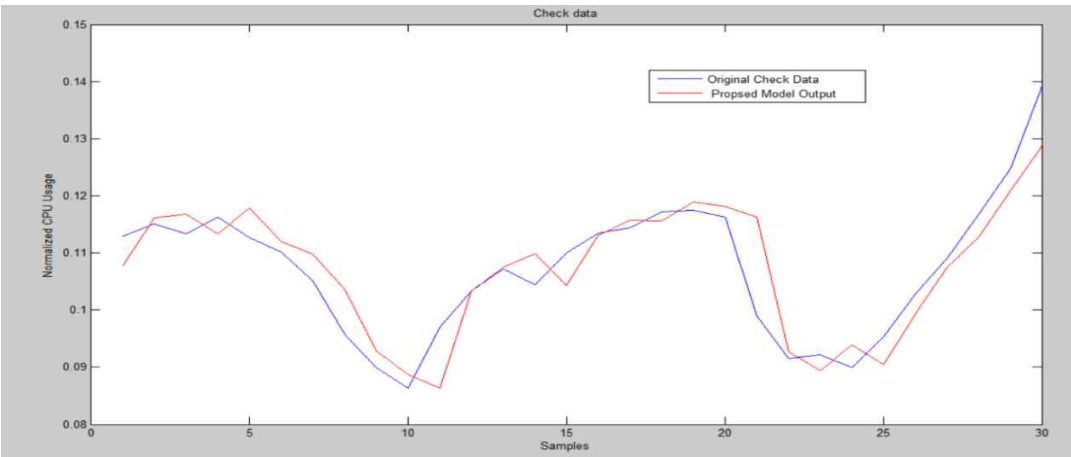

Fig. 1, the Proposed Model Result.

5. Conclusion

Cloud computing technology is progressively used in corporate and global business markets. The assessment shows that the allocation of dynamic resources is a growing need for cloud service providers for a more significant number of users while reducing response time. An efficient resource allocation strategy is needed in the cloud model to obtain user gratification and maximize profit for cloud service providers. The proposed model in this work improved host load estimated in the cloud environment. It applies the double chain quantum technique that integrated with the genetic algorithm to improve the accuracy of the optimization process to find the best value for one of the ANFIS model parameters to train the system by historical data of google cluster trace data after applying Kalman filter for data preprocessing and predict the cloud computing load. The proposed model was implemented and evaluated using the Google cluster trace. Compared with many other techniques, the evaluation results showed that building the optimization model allows the proposed model to perform better than the comparable model.

References

[1] L. Xu and J. Li, "Building Efficient Resource Management Systems in the Cloud: Opportunities and Challenges", Inter. Jour. of Grid and Distri. Comp. Vol. 9, No. 3, pp.157-172 (2016) doi: 10.14257/ijgdc.2016.9.3.18.

[2] C. Pham, P. Cao, Z. Kalbarczyk and R. K. Iyer, "Toward a high availability cloud: Techniques and challenges," IEEE/IFIP (DSN 2012), pp. 1-6, 2012. doi: 10.1109/DSNW.2012.6264687, 2012.

[3] A.T.Saraswathi, Y.R.A.Kalaashri and S.Padmavathi, "Dynamic Resource Allocation Scheme in Cloud Computing". Procedia. Comput. Sci. Vol 47, pp 30-36, 2015. doi: 10.1016/j.procs.2015.03.180.

[4] A. Shawish and M. Salama, "Cloud Computing: Paradigms and Technologies," in Inter-Cooperative Collective Intelligence: Techniques and Applications, Studies in Computational Intelligence, Vol. 495, pp.39-67, Springer-Verlag, Berlin, 2014. doi: 10.1007/978-3-642-35016-0_2

[5] A. Yousafzai, A. Gani, R. Md Noor, M. Sookhak, H. Talebian, M. Shiraz, and M. Khurram Khan, "Cloud resource allocation schemes: review, taxonomy, and opportunities". Knowl. Inf. Syst. Vol.50, Issue 2, pp. 347-381, 2017. doi: 10.1007/s10115-016-0951-y

[6] M. Khodadadi, "Designing and Demonstrating New Intelligence Software in Cloud Computing with use of Kalman Filtering", IJCSNS, Vol.17 No.7, pp.226-230, July 2017.

[7] A.A.M. Ahmed and S.M.A. Shah, "Application of adaptive neuro-fuzzy inference system (ANFIS) to estimate the biochemical oxygen demand (BOD) of Surma River", JKSUES, Vol. 29, Issue 3, pp 237-243, July 2017, doi: 10.1016/j.jksues.2015.02.001.

[8] S. K. Suman, "Improvement of Control System Responses Using GAs PID Controller", IJIMSE. Vol. 2, No. 2, pp. 11-18, 2017, doi: 10.11648/j.ijimse.20170202.12.

[9] R. L. Beltra, "Quantum Genetic Algorithms for Computer Scientists," Computers. Vol. 5, No. 4, Oct. 2016, doi: 10.3390/computers5040024.

[10] M. Nirmala and Dr. T.A. Lakshmi, "Energy-Efficient Load Balancing in Cloud: A Survey on Green Cloud", IJETT, Special Issue April 2017, pp 192-197, ISSN: 2231-5381.

[11] Y. Lu, J. Panneerselvam, L. Liu, and Y. Wu, "RVLBPNN: A Workload Forecasting Model for Smart Cloud Computing," Sci. Program., vol. 2016, Art. ID 5635673, 2016. doi:10.1155/2016/5635673.

[12] R. Vasu, E. I. Nehru and G. Ramakrishnan, "Load Forecasting for Optimal Resource Allocation in Cloud Computing Using Neural Method", MEJSR, Vol. 24, Issue. 6, IDOSI Publications, pp. 1995-2002, June 2016. doi: 10.5829/idosi.mejsr.2016.24.06.23583

[13] S-S. Chen, Y-Y. Chen and S-H. Kuo, "CLB: A novel load balancing architecture and algorithm for cloud services", COMPUT. ELECTR. ENG., Vol. 58, pp 154-160, Feb. 2017. doi:10.1016/j.compeleceng.2016.01.029

[14] H. A. Engelbrecht and M. van Greunen, "Forecasting methods for cloud hosted resources, a comparison," 11th International Conference on Network and Service Management (CNSM), Barcelona, pp. 29-35, Nov. 2015. doi: 10.1109/CNSM.2015.7367335

[15] Diaa Salama Abdul.Elminaam, WADHA MOHAMMED EDKHEEL SAQAR AL-MUTAIRI ,MOHAMED A. AWAD , AND WALAA H. EL-ASHMAWI , , "An Adaptive Fitness-Dependent Optimizer for the One-Dimensional Bin Packing Problem, IEEE ACCESS , Volume 8 , pp 97959-97974 , Septempter 2020

[16] Diaa Salama Abd Elminaam , El-Ashamwi, Walaa H., Ayman M Nabil . " A Chaotic Owl Search Algorithm Based Bilateral Negotiation Model" , Ain Shams Engineering Journal

[17] Diaa Salama Abdul.Elminaam, Mostafa Abdullah Ibrahim, and Elsayed Badr." Chaotic NHCP: Building an Efficient Secure Framework for Cloud Computing Environment Based on Chaos Theory ".International Journal of Network Security (IJNS), VOL.22 No.2, pp: 283- 295, Mar 2020.

[18] El-Ashamwi, Walaa H., and Diaa Salama Abd Elminaam. "A modified squirrel search algorithm based on improved best fit heuristic and operator strategy for bin packing problem." , Applied Soft Computing Journal Volume 82 September 2019

[19]Diaa Salama Abdul.Elminaam, Khalid Hosny , Farah Turkey Abdullah Alanezi , "SMCACC: Developing an Efficient Dynamic Secure Framework for Mobile Capabilities Augmentation Using Cloud Computing , IEEE ACCESS , Volume 7 , Septempter 2019

[20] Diaa Salama Abdul.Elminaam, ,Walaa H. El-Ashmawi, Shaimaa Abdallah Ibraheem, "HMFC: Hybrid MODLEM – Fuzzy Classifier for Liver Diseases Diagnose". The International Arab Journal of e-Technology, Vol.5, No.3, PP.100-109, January 2019

[21] Diaa Salama Abdul.Elminaam , "Improving the Security of Cloud Computing by Building New Hybrid Cryptography Algorithms ".". International Journal of Electronics and Information Engineering (IJEIE), Vol.8, No.1, PP.40-48, Mar. 2018

[22] Diaa Salama Abdul.Elminaam, Khalid Hosny , Farah Turkey Abdullah Alanezi , "Reliable the Resources of Mobile Devices in Cloud Computing". IJACT : International Journal of Advancements in Computing Technology, Vol.10, No.1, PP.61-70, March. 2018

[23] Diaa Salama Abdul.Elminaam, Prof. Khalid Hosny , Ali Abdulridha Taha, " AN IMPROVED SECURITY SCHEMA FOR MOBILE CLOUD COMPUTING USING HYBRID CRYPTOGRAPHIC ALGORITHMSmart ". Far East Journal of Electronics and Communications, Vol.18, No.4, PP.521-546, April. 2018

[24] D. S. Abdul.Elminaam, Shaimaa ABDALLAH IBRAHIM, "Building a robust Heart Diseases Diagnose Intelligent Model Based on RST using LEM2 and MODLEM2", in the Proceedings of the 32nd International Business Information Management Association Conference, IBIMA 2018 - Vision 2020: Sustainable Economic Development and Application of Innovation Management from Regional expansion to Global Growth ,PP 5733-5744 , 15-16 November 2018, Seville, Spain

[25] D. S. Abdul.Elminaam, Farah Turkey Elanezi, Kkalid M Hosny, "An Efficient Framework for Mobile Cloud Computing", in the Proceedings of the 32nd International Business Information Management Association Conference, IBIMA 2018 - Vision 2020: Sustainable Economic Development and Application of Innovation Management from Regional expansion to Global Growth,PP5783-5796, 15-16 November 2018, Seville, Spain

[26] Diaa Salama Abdul.Elminaam, Ahmed A. Toony, Mustafa Abdul Salam , "Prediction of Host Load in Cloud Computing Based on Quantum Evolutionary Algorithm and Kalman Filter with ANFIS ". IJCSNS International Journal of Computer Science and Network Security, VOL.17 No.9 pp: 59- 64, Septemebr 2017.(ISSN: 1738-7906)

[27] Diaa Salama Abdul.Elminaam, Prof.Dr. Khalid Hosny , Ali Abdulridha Taha, "NHCA: Developing New Hybrid Cryptography Algorithm for Cloud Computing Environment ". (IJACSA) International Journal of Advanced Computer Science and Applications, Vol. 8, No. 11,PP 479-486 , Noveber 2017

[28] Diaa Salama Abdul.Elminaam, Prof. Khalid Hosny , Ali Abdulridha Taha, "Enhancement the Security of Cloud Computing using Hybrid Cryptography Algorithms ". International Journal of Advancements in Computing Technology(IJACT) Volume9, Number 3,PP 36-42 , Dec. 2017

[29] Diaa Salama Abdul.Elminaam, Hatem Mohamed Abdul kader, Mohie Mohamed Hadhoud,M S Elsayed:"GPS Test Performance: Elastic Execution Applications between Mobile Device and Cloud to Reduce Power Consumption ". International Journal of Computer Science and Network Security (IJCSNS), VOL.13 No.12, PP. 6-13, December 2013.
[30] D. S. Abdul.Elminaam, H. M. Abdul kader, M. M. Hadhoud, M S Elsayed "Elastic framework for augmenting the performance of mobile applications using cloud computing", The 9th International Computer Engineering Conference (ICENCO), PP 134-141, Cairo-Egypt,December 2013.
[31] D. Meng, L. Miao and H. Shao, "Composite embedded cubature Kalman filter", Int J Adapt Control Signal Process. 2017; pp. 1-11; doi: 10.1002/acs.2797.
[32] J. Pandey and Prof. A. Hiradhar, "Kalman Filter Applied to a Active Queue Management Problem", IOSR-JEEE, Vol. 9, Issue 4 Ver. III, PP 23-27 (Jul – Aug. 2014)
[33] A. Abdel-Aleem, M. A. El-Sharief, M. A. Hassan and M. G. El-Sebaie, "Implementation of Fuzzy and Adaptive Neuro-Fuzzy Inference Systems in Optimization of Production Inventory Problem", Appl. Math. Inf. Sci. Vol. 11, No. 1, pp. 289-298 (2017). doi:10.18576/amis/110135.
[34] N. Mathur, I. Glesk and A. Buis, "Comparison of adaptive neuro-fuzzy inference system (ANFIS) and Gaussian processes for machine learning (GPML) algorithms for the prediction of skin temperature in lower limb prostheses", Med Eng Phys, Vol. 38, pp. 1083–1089, (2016) doi: 10.1016/j.medengphy.2016.07.003.
[35] Dr.B.B.M.K. Kanth, "A Hybrid Network Architecture for Applications of Adaptive Neuro Fuzzy Inference System", IJCTER, Vol. 2 Issue 4, pp. 276 – 284, April 2016.
[36] P. L. N. U. Cooray and T. D. Rupasinghe, "Machine Learning-Based Parameter Tuned Genetic Algorithm for Energy Minimizing Vehicle Routing Problem", Jour. of Indus. Eng., Vol. 2017, Article ID 3019523, (2017) doi: 10.1155/2017/3019523.
[37] A. Arjmandzadeh and M. Yarahmadi, "Quantum Genetic Learning Control of Quantum Ensembles with Hamiltonian Uncertainties", Entropy 2017, Vol. 19, Issue. 8, Article No. 376, doi: 10.3390/e19080376.
[38] U. Roy, S. Roy and S. Nayek, "Optimization with Quantum Genetic Algorithm", IJCA, Vol. 102, No. 16, pp.1-7, 2014.
[39] O. Hegazy, O. S. Soliman and A. A. Toony, "Hybrid of neuro-fuzzy inference system and quantum genetic algorithm for prediction in stock market", IBME, Vol.2 (6), pp. 094-102, June 2014.
[40] S. Pelluri1 and K. Bangari, "Synthetic workload generation in cloud", IJRET, Vol. 4 Special Issue: 06 NCEITCS-2015, May-2015.
[41] A. Engelbrecht, H. van Greunen, "Forecasting methods for cloud hosted resources, a comparison", 11th Inter. CNSM, pp. 29-35, Nov. 2016 doi: 10.1109/CNSM.2015.7367335.
[42] https://github.com/google/cluster-data

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