

Advanced Scheduling Strategies for Resource Optimization Using Fuzzy Logic Systems

Carlos M. Rodrigues^{*1}, Ana L. Pereira², João M. Silva³

¹Professor, Department of Civil Engineering, University of Porto, Porto, Portugal

²Researcher, Department of Geotechnical Engineering, University of Lisbon, Lisbon, Portugal

³Ph.D. Candidate, Department of Environmental Engineering, University of Porto, Porto, Portugal

ABSTRACT

Cloud computing is an emerging as a distributed computing method taking over the traditional methods to provide a vast usages of resources without owing them. This helps to minimize the cost of users as they will not depend upon hardware resources for their needs^[5] even though that is required. In this paper we will discuss about fuzzy logic using the main parameters like length, cost and Processing elements. The cost which is fuzzy in nature has boosted us to use the fuzzy logic to find a resource scheduling method which will be optimal than existing methods of scheduling like shortest job feeding, round robin etc.^[6]. Here we will compare the final time of some existing algorithms and our discussed algorithm. This result will help to provide useful information and directions for further research in this new field.

KEYWORDS: Cloud computing, FIS, FLS, Fuzzify, Defuzzify

I. INTRODUCTION

Cloud, in today's world has become a pervasive technology in the web based technology. Cloud computing is now considered as vast pay-per-usage resource computing model^[2]. Cloud is defined as distributed and parallel system^[3]. It's consists of a collection of interconnected and virtualized computers available in the cloud. It is becoming more and more popular because it minimizes the cost and time of the user as they don't require to buy hardware resources of their own. The resources are provided to the cloud consumers through Internet based on their request as per their need. One of the technology is Virtualization^[3]. The three types of services in which virtualization is used are IaaS (Infrastructure as a Service), PaaS (Platform as a Service) and SaaS (Software as a Service). Virtualization means placing of virtual machine. Cloud consumers request the resources. The resources can be hardware, software, operating system or applications which are coordinated as virtual machine (VM). The cloud providers provide resources according to VM requirements. Cloud computing requires an optimal method to allocate resources to the users. The more the optimum method the more the customer satisfaction as it will reduce cost and increase efficiency.

Scheduling is the important mean to provide resources for execution of tasks provided by end users until all the tasks have been performed, under some restrictions which focusing on minimizing the processing time of the cloudlets. In order to efficiently allocate computing resources, scheduling becomes a very complicated task in a cloud computing environment where many alternative computers are running with varying capacities are available. The scheduling problem in cloud computing comprises of some issues for both the user and the cloud service provider. In the former case the user wants that his tasks are to be executed within a predefined time period having minimum cost with better quality of services (QoS). In the latter case the service providers' wants that their available resources should be optimally utilized having better cost benefits. So to avoid the scheduling problem in cloud computing an efficient task scheduling mechanism can be used which can meet user's requirements and improve the resource utilization.

The present work of this paper is divided as follows: - the next section will presents material and method used, in the same section it will contain all figures and tables: the results will be discussed in section III: next section will contain conclusion: section 5 shows the acknowledgement followed by reference in next section^[6].

II. MATERIALS AND METHODS

FIS A **fuzzy inference system** (FIS) is a **system** that uses **fuzzy** set theory to map inputs (the fuzzy values) to outputs (the real values i.e. the defuzzify values).

Fuzzification: It is the process of changing a real scalar value into a fuzzy value. This is achieved with the different types of fuzzifiers (membership functions)^[8]. Fuzzy Linguistic Variables are used to represent qualities spanning a particular spectrum.

Defuzzification: It is the process of producing a quantifiable result in Crisp logic, given fuzzy sets and corresponding membership degrees^[7]. It is the process that maps a fuzzy set to a crisp set. It is typically needed in fuzzy control systems

Membership function-

1. Triangular
2. Trapezoidal

Scheduling at broker- Cloudlets which are going to be executed are first scheduled using FIS model. Fuzzification and Defuzzification of cloudlets is done with parameters estimated finishing time, cost, processing elements and then a priority value is assigned to each cloudlet ^[7].

Scheduling at datacenter- When we are taking VM with heterogeneous configuration then scheduling is necessary. Proper scheduling will efficiently reduce the overall performance. Fuzzification and defuzzification of VM is carried out using parameter like bandwidth, cost per VM assigned in datacenter and memory used. After that we get a priority value of each VM, using it we can schedule VM and assign cloudlet ^[8].

We have used the above two scheduling technique and found out the execution time of each tasks and compared to one of the previous scheduling algorithm i.e., Shortest job seek first in which the task with less execution time are executed first and the result is shown in a graph below in result section. The time to complete 40 tasks are taken into consideration and by putting the fuzzy algorithm we calculated the finishing time. In one algorithm we have put the fuzzy rules in the broker to schedule the task accordingly and in another algorithm we have put the fuzzy rule in both broker and datacenter and found the finishing time. And we have checked the both finishing time and result is shown in result section. The flow chart below will give the detail operation of our methods. We have taken many parameters as discussed above for the fuzzy rules and formulated a rule to get an optimal scheduling algorithm. We have used cloudsim to create the cloud environment and test our proposed algorithm.

Figure:

In the flow chart it is shown the process of execution of cloudlets in cloudsim .It shows the detailed movement of task from entering the cloud to final execution of the task. The broker holds all the information of task as well as the scheduling is done in the broker. It also has a register which keeps all the record of datacenter known as CIS. In the datacenter again the scheduling algorithm is put and the task are executed as per scheduled. After execution the task releases the resources and the resources get free for next task.

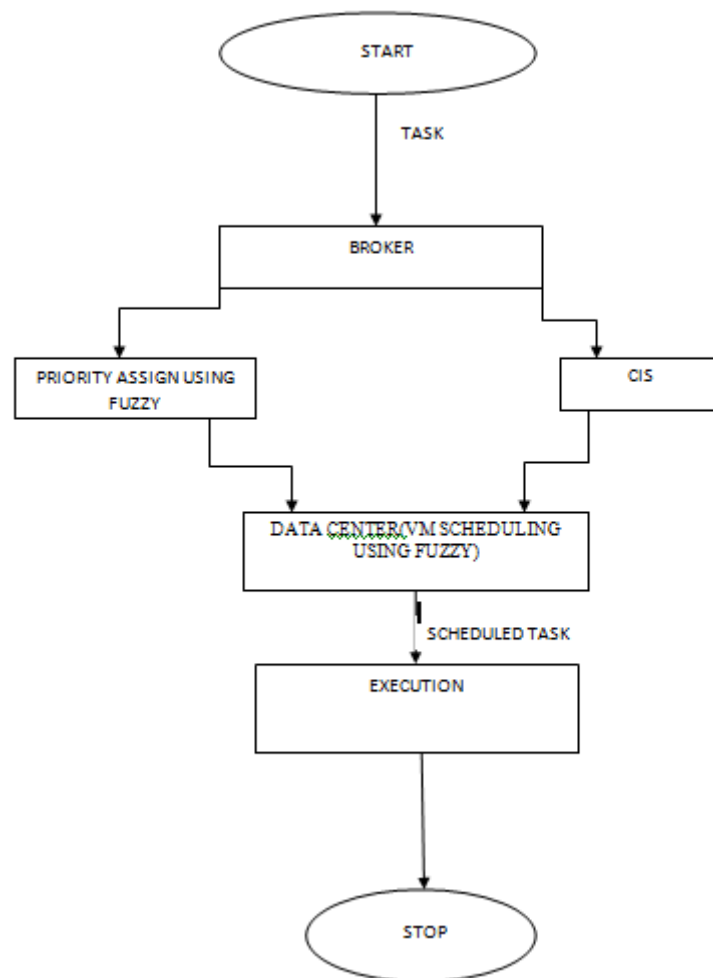


Figure 1. Flow Chart of steps of resource scheduling

III. RESULTS AND DISCUSSION

We had taken same architecture of cloudlets and virtual machines for all three types of scheduling algorithms. The results of the simulation was plotted in the below graph showing the comparison among three scheduling algorithms. The results thus obtained from the graph are summarized below.

- For SJF the finish time of 40 cloudlets seemed to be 16.26secs.
- For fuzzy logic applied only on cloudlets, the finish time of 40 cloudlets seemed to be 14.74secs.
- For fuzzy logic applied both on cloudlets and virtual machines, the finish time of 40 cloudlets was 14.61secs

So, the result obtained from the above discussion shows that the fuzzy scheduling on cloudlets and virtual machines can complete the execution of 40 cloudlets with minimum time in comparison with others. So, we can tell that this algorithm efficiently utilizes the available resources with minimum finish time. Further this algorithm can optimize resource utilization by taking the more accurate rule blocks in fuzzy control logic and some real-time data.

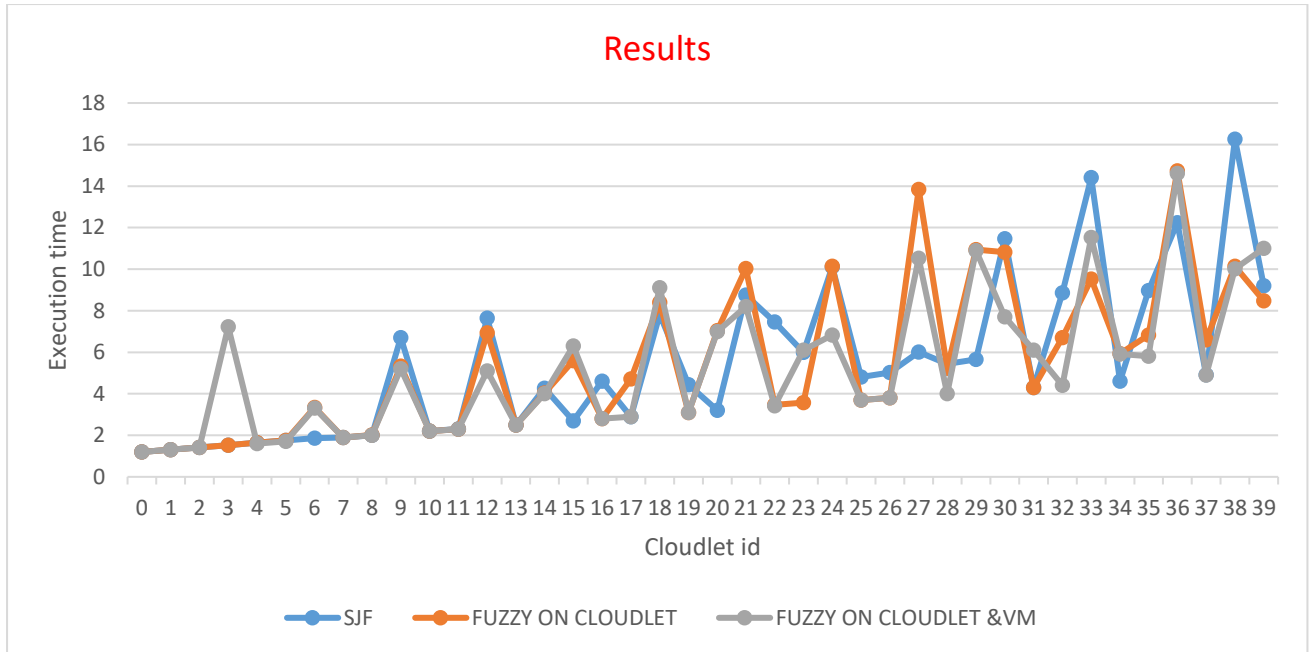


Figure 2: CLOUDLET ID VS EXECUTION TIME

IV. CONCLUSION

Scheduling is one of the most important tasks in cloud computing environment. In this paper we have analysed a fuzzy logic based scheduling algorithm which efficiently schedules the computational tasks in cloud environment. The experiment is conducted by varying number of Virtual Machines and workload traces. The experiment conducted is compared with SJF and a default algorithm. The result shows that the proposed fuzzy logic based algorithm is more efficient than SJF and default algorithm.

The future work of this proposed system is that the fuzzy logic rule block can be implemented in a real cloud environment with some real data to analyse the resource utilization. Load Balancing on each and every data centres for allocating of the resources will be the future work of this algorithm.

V. ACKNOWLEDGEMENTS

First and foremost, we would like to thank Associate Professor Dr.P.K.Sahu who guided us throughout this paper work, provided us invaluable advice, helped us in difficult periods and provided equipment for this paper. His willingness to motivate us contributed tremendously to the success of these projects. Besides we would like to thank all CSE Staff members who helped us by giving advice and providing equipment which we needed. Also, **at last but not the least we would like to thank all who helped and motivated us.**

VI. REFERENCES

1. P. Mell and T. Grance, The NIST definition of cloud computing, National Institute of Standards and Technology, 2009.
2. Michael Armbrust, Armando Fox, Rean Griffith, Anthony D. Joseph, Randy H. Katz, Andrew Konwinski, Gunho Lee, David A. Patterson, Ariel Rabkin, Ion Stoica, Matei Zaharia, Aboveth clouds: a Berkeley view of cloud computing, Technical Report No. UCB/EECS-2009-28, University of California at Berkley, USA, pp.1-23, 2009.
3. D. Nurmi, R. Wolski, C. Grzegorzczak, G. Obertelli, S. Soman, L. Youseff, and D. Zagorodnov, The eucalyptus open-source cloud computing system, in: Cloud Computing and Applications 2008 (CCA08), 2008, and applications conference, pages 102-106, 2012.
4. Armbrust, M., Fox, A., Griffith, R., Joseph, A. D., Katz, R., Konwinski, A., Lee, G., Patterson, D., Rabkin, A. & Stoica, I. 2010. A view of cloud computing. Communications of the ACM, 53(4):5058. Bhoi
5. Filipe Fontinele De Almedia, Areolino De Almeida Neto, Mario Meireles Teixeira, "Resource scheduling in web servers in cloud computing using multiple artificial neural networks" - 2015 Forteenth Mexican International Conference on Artificial Intelligence.

6. D.Seenivasan M.E., P.Gayathri, P.Dhivya, R.Anitha “Optimization of Resource Provisioning in Cloud “*International Journal of Computer Applications® (IJCA) (0975 – 8887) International Conference on Simulations in Computing Nexus, ICSCN-2014.*
7. S.N.rivanandan and S.N.Deepa, “Principals of soft computing”, Wiley India, 2nd Edition, 2011.
8. J.S.R.Jang, C.T.Sun, E.Mitzuani, “Neuro Fuzzy and Soft Computing” PHI.