Defuzzification Method for NP-Hard Problem in Cloud

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Abstract:- The cloud computing is that the one that deals with the commerce of the resources with efficiency in accordance to the user's would like. Employment programming is that the selection of a perfect resource for any job to be dead with reference to waiting time, value or turnaround. A cloud job programming are associate NP-hard downside that contains n jobs and m machines every} job is processed with each of those m machines to reduce the makespan. the safety here is one among the highest most considerations within the cloud. so as to calculate the worth of fitness the fuzzy abstract thought system makes use of the membership operate for crucial the degree up to that the input parameters that belong to each fuzzy set has relevancy. Here the fuzzy is employed for the aim of programming energy similarly as security within the cloud computing.

Keywords: *Cloud Computing, Job scheduling, Cloud job scheduling, fuzzy inference system*

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1. INTRODUCTION

Advancement of technology with the way within which the organizations run business within the cloud era may be a clear proof in cloud computing which can be the long run platform for each business and individual desires of computing. The cloud computing can have gained some large attention in addition as quality in IT as most of the organizations, people and corporations won't be during a position to shop for resources each hardware and package because of a high value that's concerned in procuring them [1]. A Cloud computing is currently more and more changing into a platform that's wide most well-liked for each the people and {also the} organizations and it's also been able to bring down the barriers of many high prices that ar related to the desired hardware and package.

Cloud computing currently features a reborn storage, just like the 'pay as you go service' that has enabled the organizations and also the people not having the necessity to buy of their resources each hardware and package or maybe for the aim of paying for the price of maintenance. The cloud computing has an impression that's felt within the day to day activities and has conjointly compact the lives during a wider vary of innovations that are fully reworked supported however the services are being made, priced or maybe delivered. The organizations and also the people can drive this on the minimization of value, the meeting of the strain of consumers and also the sharing of handiness of knowledge. The essential issues thereupon of a cloud computing atmosphere are going to be the resource allocation and also the cloudlets planning.

Security is taken into account very necessary for the cloud users resulting in the relinquishment of the physical possession for the information computation which will create the chance in terms of security that is towards each confidentiality and also the integrity. there's lots of analysis that's initiated within the provisioning of hypervisors and also there are bound different issues that have to be compelled to be self-addressed for the important time tasks and the security aware tasks that run on the virtual machines. By mistreatment the services of security a overhead for the computation time will|that may violate the deadlines of applications can happen [2].

This type of a distributed nature within the cloud model can involve additional such transits over the information and their networks resulting in more difficult security risks. The cloud computing are going to be completed by means that of the technologies as well as virtualization thereby securing the virtual machines that ar the key to the securing of the cloud applications. although there ar major issues in terms of security that are related to that of the virtual machines that ar similar however not the image of those that ar on the physical platforms and also the Virtual Machines(VMs) have some potential weaknesses because of the essential nature of the multi-tenancy support. The virtual machines can allow users to share their resources of that of the host laptop and conjointly offer some isolation among the VM and its host. however because of the restrictions of design the VM and its vendor's approach to isolation or the bugs within the virtualization package which will cause the power of compromising the isolation and so demands a tight security check [3].

Another easy technique for achieving the modelling of such parameters is mistreatment formal logic. The planning of period of time threads thereon of the multi-core processors that are supported fuzzy illation used for the planning of the package or the planning of the hardware controller has been punctually researched. there's a way for the definition of sleek membership functions (MFs) for the deadlines in addition because the execution that's projected by mistreatment the mixed cubic-exponential Hermite interpolation constant quantity curves at the side of the impact of the changes within the MFs that ar parameterized supported the task planning and

also the task priorities that are reported [4].

Most such researches that concern the period of time system planning can assume the planning constraints and in most such things the values of such parameters can counsel the usage of formal logic for deciding on in what order of the requests can have to be compelled to be dead for mistreatment the system higher and so transfer down the probabilities of the request obtaining delayed or maybe incomprehensible. Therefore, the planning parameters are going to be treated because the fuzzy variables and during this paper there's a fancy and a true world planning of the roles that are soft and non-periodic that are being dead at intervals one processor and its period of time system that produces use of the formal logic algorithmic program that has been developed. This algorithmic program has created an endeavor to deliver the roles on time for satisfying the strain of consumers.

2. LITERATURE SURVEY

The Scheduling of the user tasks is found to be a process in the environment of cloud computing. The Min-min algorithm and its shortcoming will be the long tasks that are not scheduled. So Liu et al [5] made a proposal of an improved algorithm that has been based on the min-min algorithm along with three other constraints which are the quality of service, the model of dynamic priority and finally the cost of service. By means of making use of the Cloud Sim software is used in simulation for running the experiment and it is compared with the min-min algorithm the results of experiment will show executing of long tasks within a reasonable time ,the increase in the utilization of resources and the requirements hasmeet the users demand.

Konjaang et al [4] made a proposal of another new mechanism known as the Modified Max-Min (MMax-Min) algorithm that is inspired from the Max-Min algorithm. This proposed algorithm has found a cloudlet that has a maximum completion time along with a minimum completion time which either assigns the cloudlets for the execution that is dependent on the specifications for boosting the cloud scheduling process and also for increasing throughput. From the simulation results that use a CloudSim, it has shown that this proposed approach can produce solutions of good quality and some good values of make span and the balancing of the load more effectively compared to a standard Round Robin and a Max-Min algorithm.

The Job scheduling (which is allocation of hardware resources to their tasks) is a very challenging issue in cloud computing and a good policy of scheduling will help in the effective utilization of the Virtual Machines (VMs). This Job scheduling algorithm is one NP-complete problem that will place a very important role in cloud computing. Mohammadi et al [6] further made a survey on the existing type of algorithms of job scheduling in a cloud computing environment and also summarized methods for improving their performance.

Pandey and Singh [7] made a proposal for an algorithm of Job scheduling to ensure the fairness of the allocation of resources in accordance to that of the Quality of Service. This focusses mainly on two different problems one being the selection of virtual machines eligible for executing tasks. One more problem will be the task justification in accordance to the quality of service. This proposed approach has simplified the algorithm's complexity with a reduced overhead that is associated with the choice of an appropriate as well as a justified virtual machine for any task. This also ensures a fairness in the allocation of resources for all such classified tasks thereby justifying the allocation of the overall system. Furthermore, it uses fuzzy logic for adjusting the expectation of the vector of the task that is based on the allocation and its fairness.

Fahmy [8] made an implementation of a fuzzy logic algorithm which will assume a heavily loaded machine along with a single processor that is shared by the multi users. The jobs are assumed to have various times of processing, wasting time and different priority of exterior. The jobs have also assumed the non-periodic that have the deadlines for execution. The main idea in this is to make use of the algorithm of fuzzy logic for investigating the priority of the job that has to be executed first. The second fuzzy algorithm will be used for adapting the priorities of the other jobs waiting in that case of an arrival of a new job keeping the deadlines in mind. The fuzzy logic load and its scheduling algorithm will be used inside the multi-objective algorithm for bringing down the average delay, the number of jobs that are overdue and throughput times of the job. The Objectives will be to reduce the total time of throughput and improve the satisfaction of the user. The test cases having various job factors that are used for evaluating the algorithms and also demonstrating its strength are used and the jobs that have less processing time will be assigned some newer priorities of processing thereby improving the user satisfaction.

Guo et al., [9] presented a Workflow Task Scheduling algorithm based on the resources' Fuzzy Clustering named FCBWTS. The major objective of scheduling was to be minimized makespan of the precedence constrained applications, which can be modeled as a directed acyclic graph. In FCBWTS, the resource characteristics of cloud computing are considered, a group of characteristics, which described the synthetic performance of processing units in the resource system. With these characteristics and the execution time influence of the ready task in the critical path, processing unit network was pretreated by fuzzy clustering method in order to be realized the reasonable partition of processor network. Therefore, it largely reduced the cost in deciding which processor to execute the current task.

Alla et al., [10] focused on Task Scheduling using a novel architecture with Dynamic Queues based on hybrid algorithm using Fuzzy Logic and Particle Swarm Optimization algorithm (TSDQ-FLPSO) to be optimized makespan and waiting time. The experimental result based on an open source simulator (CloudSim) show that the proposed TSDQ-FLPSO provides an optimal balance results, minimizing the waiting time, reducing the makespan and improving the resource utilization compared to existing scheduling algorithms.

Xiaojun et al., [11] proposed a new cloud computing resources allocation strategy, on the basis of cost model of the parallel task performance, using the improved Fuzzy Clustering Algorithm (CBFCM - C Cost based Fuzzy Clustering Algorithm) to be classified the cloud computing resources set on the service level of user, and the jobs submitted by guest were analyzed using four different scheduling algorithms, and the generated resource scheduling scheme. The experimental results show that job scheduling strategy based on CBFCM resources classification in the cloud computing services have certain advantages. Adaptive First Come Fist Served (AFCFS) job scheduling algorithm in Average Response Time (ART), the Average Waiting Time (AWT), Average Operating Cost (ACP) performance items, has great advantage than the other three algorithm.

Priya&Babu [12] proposed a method called, Moving Average-based Fuzzy Resource Scheduling (MV-FRS) for virtualized cloud environment to be optimized the scheduling of resources through virtual machines. Initially, the MV-FRS method starts by predicting the resource (i.e. bandwidth, memory and processing cycle) requirements. Then a measure of relationships between availability of resources and the requirements of resources are made. Finally, a fuzzy control theory is designed to accomplish system accessibility between user cloud requirements and cloud users resources availability. The simulations results demonstrated that the MV-FRS method was able to be reduced the total waiting time of cloud user resource requirements and also ensure the feasibility and effectiveness of the overall system accessibility in terms of average success rate and resource usage when running in a cloud computing environment.

Singh & Chana [13] presented the fuzzy logic based energy-aware autonomic resource scheduling framework for cloud for energy efficient scheduling of cloud computing resources in data centers. It have been evaluated the proposed framework in CloudSim based simulation environment and real cloud environment. The experimental results show that the proposed framework performs better in terms of resource utilization and energy consumption along with other Quality of Service (QoS) parameters.

Panda & Jana [14] presented the three task scheduling algorithms, called Minimum Completion Cloud (MCC), MEdian MAX (MEMAX) and Cloud Min–Max Normalization (CMMN) for heterogeneous multi-cloud environment, which aim to be minimized the makespan and maximized the average cloud utilization. The proposed MCC algorithm was a single-phase scheduling whereas rests are two-phase scheduling. It performed rigorous experiments on the proposed algorithms using various benchmark as well as synthetic datasets. Their performances are evaluated in terms of makespan and average cloud utilization and experimental results are compared with that of existing single-phase and two-phase scheduling algorithms to be demonstrated the efficacy of the proposed algorithms.

Kumar & Nagarajan [15] provided a secure communication between one cloud parties to another cloud provider. A public key will be generated by key generator in the cloud for every registered user to communicate secretly. The number of cloud users in cloud computing are growing in an exponential rate at every day. Due to this, many users use the same resource in the cloud. In this situation, the server troubles with high load. To reduce the high load problem, we can use Priority Based Scheduling Algorithm (PBSA) and Load balancing algorithm. Exchanging the information from one to another is called data communication. Security is the main problem in data communication. We can solve this problem by using Advanced Encryption Standard (AES) algorithm. In this two algorithms achieve the security and resource allocation in cloud computing. This Concept was achieved by FUZZY logic with the help of MATLAB tool.

3. METHODOLOGY

Here in this section, details of the Min-Min, the Max-Min algorithm along with the proposed fuzzy scheduling has been presented.

3.1 Min-Min Algorithm

The Min-Min algorithm will consider all unassigned task for each such task mapping. The Min-min executes the tasks that are parallel as well as the long tasks will be executed until the entire task set is found to be empty. The Min-min algorithm executes parallely the short tasks that are in parallel and long tasks will follow these short tasks. The Min-min algorithm has a shortcoming that the short tasks are first scheduled before executing the long tasks. The Min-min cause the entire batch tasks that are executed for getting longer and an unbalanced load. Even such long tasks will not be executed. The actual purpose of the Min-Min algorithm [16] will be to ensure that these tasks having a minimum time for completion in parallel and this will further be done to their long jobs once the short task is successfully executed but the main disadvantage is that at time the long tasks remain unattended.

There are two different phases in the Min-Min algorithm. In the first phase it finds the minimum execution time of all tasks. Then in the second phase it chooses the task with the least execution time among all the tasks. The algorithm proceeds by assigning these tasks to their resource which will produce their completion time and this same procedure will be repeated by that of the Min-Min until all tasks which are scheduled.

There are some more limitations of Min-Min algorithm:

- The resources that have high computational power are utilized by the selected smaller tasks.
- Only a single job can be executed by a single resource at a time.
- The size and the number of resources will be static and known earlier [17].

1. *If task queue T is not Empty, then continue to execute or execute step 13*
2. *For (all tasks t_i in task set T)*
3. *For (all resources r_j in resource set R)*
4. $C_{ij} = tr_{ij} + tw_{ij}$
5. *End for*
6. *End for*
7. *For (every elements in C)*
8. *Searching tasks t_i with maximum and earliest complete time, relative resource r_j*
9. *End for*
10. *Assigning tasks t_i to resource r_j*
11. *Removing task t_i from T*
12. *Updating t_{ij}, return to step 1*
13. *Exiting loop*

3.2 Max-Min Algorithm

The Max-Min [18] will be both a resource allocation and a scheduling algorithm that is used in case of cloud computing for minimizing the make span, cost and also the maximization of profit and the utilization of resource. This will be done by means of choosing the task in a job list having a high completion time based on a resource which may execute this inside a much shorter period. The main concern here is to provide priority to those tasks that have a maximum completion time by means of executing them initially before assigning them to the other tasks having a minimal completion time. But the disadvantage of the Max-Min algorithm will be the execution of such tasks having a maximum completion time that can increase the total time of response for the system making it more efficient.

3.3 Proposed Fuzzy

There is a dynamic algorithm of scheduling that makes use of the fuzzy logic controller. This controller will take advantage of two different inputs which are the actual number of requests that have been received in the host from that of the virtual machines and also the value of the tasks and their precedence running in each such virtual machine. The actual number of requests is mentioned as the AGE along with the values of the tasks precedence will be named as the PREC for simplicity. The output of such a fuzzy controller will be the virtual machine id that is assigned to that of the host. By using the scheduling scheme, these virtual machines that are fairly assigned to that of the host in accordance to the time slot of the waiting in the queue along with their precedence [19]. In case of simulation, every task will have the precedence value from 0 to 3 and this AGE value will range between 0 and 3 for four different virtual machines. The Design of such fuzzy control routing systems will contain of a series of steps which are:

1. *If task queue T is not Empty, then continue to execute or execute step 13*
2. *For (all tasks t_i in task set T)*
3. *For (all resources r_j in resource set R)*
4. $C_{ij} = tr_{ij} + tw_{ij}$
5. *End for*
6. *End for*
7. *For (every elements in C)*
8. *Searching tasks t_i with minimum and earliest complete time, relative resource r_j*
9. *End for*
10. *Assigning tasks t_i to resource r_j*
11. *Removing task t_i from T*
12. *Updating t_{ij}, return to step 1*
13. *Exiting loop*

Step 1: Define both the input and the output variables, and the number of requests received in the host from the virtual machines along with the value of tasks precedence running on all virtual machines and ID of the virtual machine which has to be assigned to its host as their output.

Step2: Each such variable is quantified, for example the AGE are the requests that are sent to a host and set it to 0, 1, 2 and 3 (the four virtual machines), it is quantified as a Zero, a Small, a Medium and also a Big. Each such quantification of variables is assigned one membership function the cost of which are singletons.

Step3: The fuzzy rule base is designed that determines the action that takes place.

Step4: A method of defuzzification is applied to fuzzy control actions for producing crisp costs and this method will be the "centers of gravity" used for a crisp output.
Step5: These virtual machine IDs having a low cost of AGE and the PREC values is chosen for the output in order to access its host.

For any first fuzzy algorithm [20], the membership functions are three in number which are high, medium and low. An inference mechanism in a fuzzy logic algorithm will resemble the reasoning process of humans. In this the fuzzy logic technology will be associated with the artificial intelligence.

3.3.1 Project/Task Description

The fuzzy system designed consists of four input variables for the scheduling process, one output variable that is used to decide the job selected based on the fuzzy rules. The input variables defined in this system are job length assigned to represent the length of the job, VM memory assigned to represent the available memory in virtual machine, security level to represent the level of security available in the fuzzy based cloud, Energy required to represent the required energy to execute the tasks requested by the user [21]. The output variable is defined as Result that is used to decide the scheduled job assignment selected to a particular task. The parameters and the details for the project used in this system are also shown in the table 1.

Table 1: Project Statistics

Input Variables	4
Output Variables	1
Intermediate Variables	0
Rule Blocks	1
Rules	405
Membership Functions	17

3.3.2 System Structure

The structure of this system will identify the fuzzy logic and its inference flow from both the input variables and the output variables. This fuzzification in the input and their interfaces will translate the analog inputs into the fuzzy values and the fuzzy inference will take place in that of the rule blocks that contain the rules of linguis tic control. The total output of rule blocks will be the linguistic variables and the defuzzification in these output interfaces will translate these linguistic variables among the analog variables. The aim of improving the utilization of the resources by scheduling is achieved.

The entire structure of the fuzzy system that includes the input variables, input interfaces, the rule blocks and the output interfaces is given in figure 1. Their connecting lines hereby symbolize the data flow. The fuzzy inference system consists of three steps including fuzzification, rule evaluation and defuzzification [22].

The process of mapping the real values to categorical or linguistic variables which represents the characteristics of the input is called as fuzzification. The conversion takes place with the help of membership function. The membership function maps the input value to a value between 0 and 1. Rule evaluation is a decision structure to determine the rules which is in the form “if”- “then” rules. Certain operators are required for determining the rules along with the expert knowledge. The 'if' part will describe the situation based on the domain and the 'then' part will provide the response of their fuzzy system.

Defuzzification transposes the fuzzy outputs to crisp outputs. There are many methods used in defuzzificztion. Some of them are Center of Maximum (COM), MOM, Center of Gravity (COG). The fuzzy outputs are transposed to their membership functions similarly as in fuzzification. Output of the inferencing system is a crisp output that is used to process or control events or element elsewhere [23]

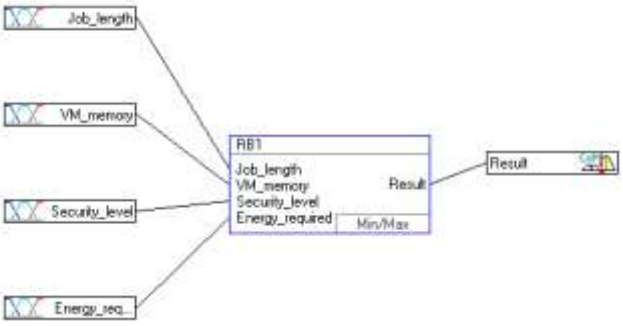

Figure 1: Structure of the Fuzzy Logic System

3.3.3 Input Variables

The input variables are the requirements of tasks’ to utilize available resource of users’ virtual machines. The fuzzy values of the input variables are described as low, medium and high. The details of the variables job length, VM memory, security level, Energy required are given in table 2.

Table 2: Variables of Group "Inputs"

#	Variable Name	Type	Unit	Min	Max	Default	Term Names
1	Energy_required		Units	0	1	0.5	Low medium high

#	Variable Name	Type	Unit	Min	Max	Default	Term Names
2	Job_length		Units	0	1	0.5	Low medium high
3	Security_level		Units	0	1	0.5	Low medium high
4	VM_memory		Units	0	1	0.5	Low medium high

3.3.4 Output Variables

The output variable is the decision to assign a job to corresponding VM. The fuzzy values of the output variables are described as very_low, low, medium, high and very_high. The details of the variableResult is given in the table 3.

Table 3: Variables of Group "Outputs"

#	Variable Name	Type	Unit	Min	Max	De-fault	Term Names
5	Result		Units	0	1	0.5	very_low low medium high very_high

The default value of an output variable is used if no rule is firing for this variable. Different methods can be used for the defuzzification, resulting either into the 'most plausible result' or the 'best compromise'.

The best compromise is produced by the methods:

CoM (Center of Maximum)

CoA (Center of Area)

CoA BSUM, a version especially for efficient VLSI implementations

The most plausible result is produced by the methods:

MoM (Mean of Maximum)

MoM BSUM, a version especially for efficient VLSI implementations

4. CONCLUSION

The Scheduling is the manner in which the tasks get assigned to be run on the resources available and the cloud will submit its request with the user request that is formed as tasks. Such tasks are scheduled to their corresponding services and they may need various security services like integrity, confidentiality and its authentication having various levels that are denoted by users. The results have proven that the Makespan for this proposed Fuzzy has performed better than that of the Min-Min.

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