International Journal of Advanced Trends in Computer Applications
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Improved Energy Efficient Job Scheduling in Cloud Computing

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Abstract: *Cloud computing has offered services related to utility aligned IT services. Reducing the schedule length is considered as one of the significant QoS need of the cloud provider for the satisfaction of budget constraints of an application. Task scheduling in a parallel environment is one of the NP problems, which deals with the optimal assignment of a task. To deal with the favorable assignment of some task, task scheduling is considered as one of the NP problem. In this research work the jobs are distributed in a centralized environment. In Centralized environment every job request is forwarded to a central server. The central server passed the jobs to sub servers that are present with in the area of request. This has been performed by using distance formula. Also to reduce the energy consumption by each sub-server is possible by using formation of feedback queue. Job scheduling has been optimized on the basis of priority by using genetic algorithm. Rules are set according to the priorities of the job then scheduling is done by using genetic algorithm. Fuzzy logic also used for classification of the jobs to decide which job has been allotted to the system. Metrics namely, SLR, CCR (Computation Cost Ratio) and Energy consumption are used for the evaluation of the proposed work. All the simulations will be carried out in CLOUDSIM environment.*

Keywords: *CLOUDSIM, Computation cost ratio (CCR), Genetic algorithm (GA), SLR, energy consumption, Fuzzy logic.*

I. INTRODUCTION

Cloud Computing is an innovation technology which utilizes mainly internet along with centralized remote-servers to keep data as well as applications. The idea of cloud computing is established on a basic principal of "re-usability of Information Technology capabilities". The difference that cloud computing brings is compared to the traditional concepts of "grid computing", "utility computing", "autonomic computing" or "distributed computing", and broaden horizons across organizational boundaries. Through virtualization, cloud computing is capable to address with the same type of physical infra-structure with dissimilar computational requirements. In cloud computing, Job scheduling is a time based approach in which maximum number of jobs should be executed in a given interval of time. The main problem which is often faced is managing the jobs in appropriate fashion so that they can be executed on time. Cloud network is not expensive; hence memory management also adds a cost monitoring factor in order to avoid extra cost. The problem of this research work is organised in three sections. The problem of this research work also includes the distribution of the jobs in centralized environment. Centralized environment refers to a network in which each request ends to a central server. Then, the central server looks for the sub servers present in area from where the request has come. The search is based on distance formula mentioned below

$$Dist = (x2 - x1)\text{^}2 + (y2 - y1)\text{^}2$$

Where x1, y1 is the co ordinate axes of the requesting node and x2, y2 are the co ordinates of the sub servers. The problem statement also includes formation of a feedback queue that helps in reducing the energy consumed in search of sub servers. In proposed work, introduced a rule sets with genetic algorithm to optimize the job scheduling problem according to the priority.

1) Organization of cloud environment.
2) Organizing responses according to jobs
3) Define the rule sets according to the priority
4) Job scheduling and VM migration using Genetic Algorithm

The evaluation will be done on the basis of the following parameters

a) Number of jobs executed in a given time span
b) Total energy consumed in order to execute the jobs
c) Resource Utilization and VM is- utilization
Objectives and Methodology

In the proposed research work, Genetic algorithm is used for optimization and Fuzzy logic is used for classifying the optimized results of the network.

GA (Genetic Algorithm) is basically utilized in the applications where the search space is large. The advantage of a Genetic Algorithm is that the procedure is fully automatic and avoids local minima. The major components of Genetic Algorithm are named as crossover, mutation, and a fitness function. The crossover operations are utilized for generating a novel chromosome from parents sets while the mutation operators add variation. The fitness function executes a chromosome dependent on the criteria already defined. An improved fitness value of a chromosome increases its survival chance. The population is a chromosomes collection. A novel population is carried out by utilizing standard genetic operations like single-point crossover, mutation, and selection operator [52].

Step 1: To initialize random population having chromosomes.

Step 2: To calculate fitness function in the population.

Step 3: To develop novel population with individuals.

Step 4: To select parent chromosomes for best fitness function.

Step 5: To perform crossover to have copy of parents.

Step 6: To perform mutation to mutate novel off springs.

Step 7: To place novel offspring in the population.

Step 8: To repeat the steps to get a satisfied solution.

Step 9: Stop.

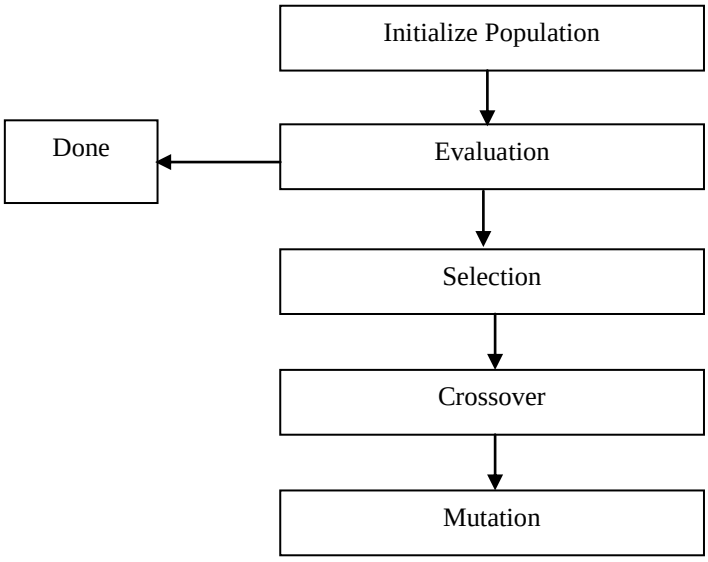

Figure 1: Genetic algorithm flowchart

Fuzzy logic is based on the standard form of right or wrong, realism rather than modern computers based (1 or 0) Boolean logic calculations. Natural language (like most other life activities or even the universe) is not readily converted to the absolute value of 0 and 1. This can be useful as a way to see the fuzzy logic inference real job, binary or Boolean logic is a special case. Fuzzy logic as 0 and 1, includes an extreme case of truth (or 'state of things' or 'truth'), but also includes a variety of real estate in the middle, so that, for example, the comparison results between the two things cannot be 'high or 'short', but 'high'. Fuzzy logic works as the human brain works. Fuzzy logic is for the development of human capabilities with AI (Artificial Intelligence) requirements and generates the representation of human cognitive abilities in software. The fuzzy logic implements on the possibilities level of input for achieving the desired output. Fuzzy Logic is applicable for practical and commercial purposes as defined below:

It might not provide exact reasoning but suitable reasoning.

- It controls consumer and machine products.
- It helps for some uncertainty in engineering.

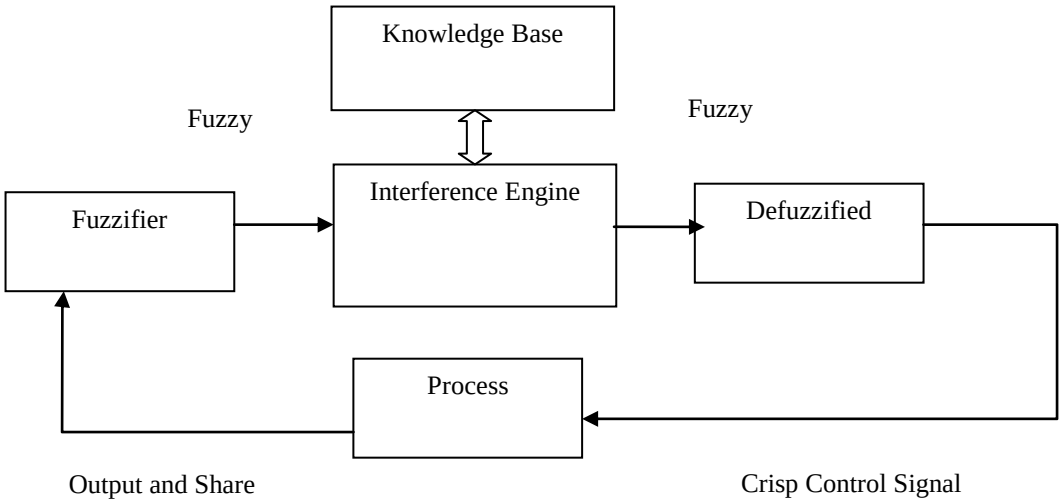

Figure 2: Fuzzy controller architecture

II. LITERATURE SURVEY

A comprehensive survey has been given related to various job scheduling techniques, like, Genetic algorithm and fuzzy logic algorithms.

Abdul Razaque et.al [2016], proposed a task scheduling algorithm using a non-linear programming model for separable task scheduling that assigns the correct number of tasks to each virtual machine. Based on this assignment, an algorithm for separable load scheduling is designed by considering the network bandwidth.

Dr. Amit Agarwal et.al [2014], proposed Generalized Priorities. The algorithm was used to effectively perform tasks and Comparison with FCFS and Round Robin Scheduling. The algorithm was simulated in the cloud Sim Toolkit and the results show that it provides better performance compared to other traditional scheduling algorithms.

Jichao Hu et.al [2015], proposed resources in the cloud model and predicts the effect of the model time closer to the actual time. It could effectively limit the possibility of falling into the local convergence and shorten the time of the optimal solution of the objective function value, and more satisfy the user's needs.

Raja Manish Singh et.al [2014], proposed different algorithms that were compared and studied Adaptability, feasibility, adaptability in the context of the cloudSim, after which the author is tried to propose a hybrid approach can be used to further strengthen the existing platform and so on. It can help cloud providers to provide better quality of the service.

VahidAshktorab, Seyed Reza Taghizadeh [2012] has discussed the advantages of the cloud platform and the security risks of keeping the data on a cloud server. In this research, author have provided basic information about the security thefts of cloud server like SQL injection problem , DOS attacks and others.

Tao Lin et al. [2017] proposed an iterative algorithm for solving the problem of multi-objective optimization. Authors adopted a Game Theoretical approach for managing the data traffic so that energy can be optimized. Authors worked with transport layer to form an energy efficient framework in cloud computing.

Jiayang et.al [2011], has proposed an adaptive resource allocation algorithm for the cloud system with pre-empt able tasks in which algorithms adjust the resource allocation adaptively based on the updated of the actual task executions. In this paper, author has presented two algorithms i.e. Adaptive list scheduling (ALS), Adaptive Min-min scheduling (AMMS).

Gouzardi et.al [2010], has solved resource allocation problem using SLA violations. In this, the upper bound of total profit is provided with the help of force-directed resource assignment (FRA) heuristic algorithm, in which initial solution is based on providing the better solution for profit upper bound problem.

III. SIMULATION MODEL

The simulation environment is created using Cloudsim environment in Net Beans. The number of virtual machines, Servers and Sub Servers are created with their initial properties. The Servers availability has been checked for Sub Servers to check the allocation of the tasks.

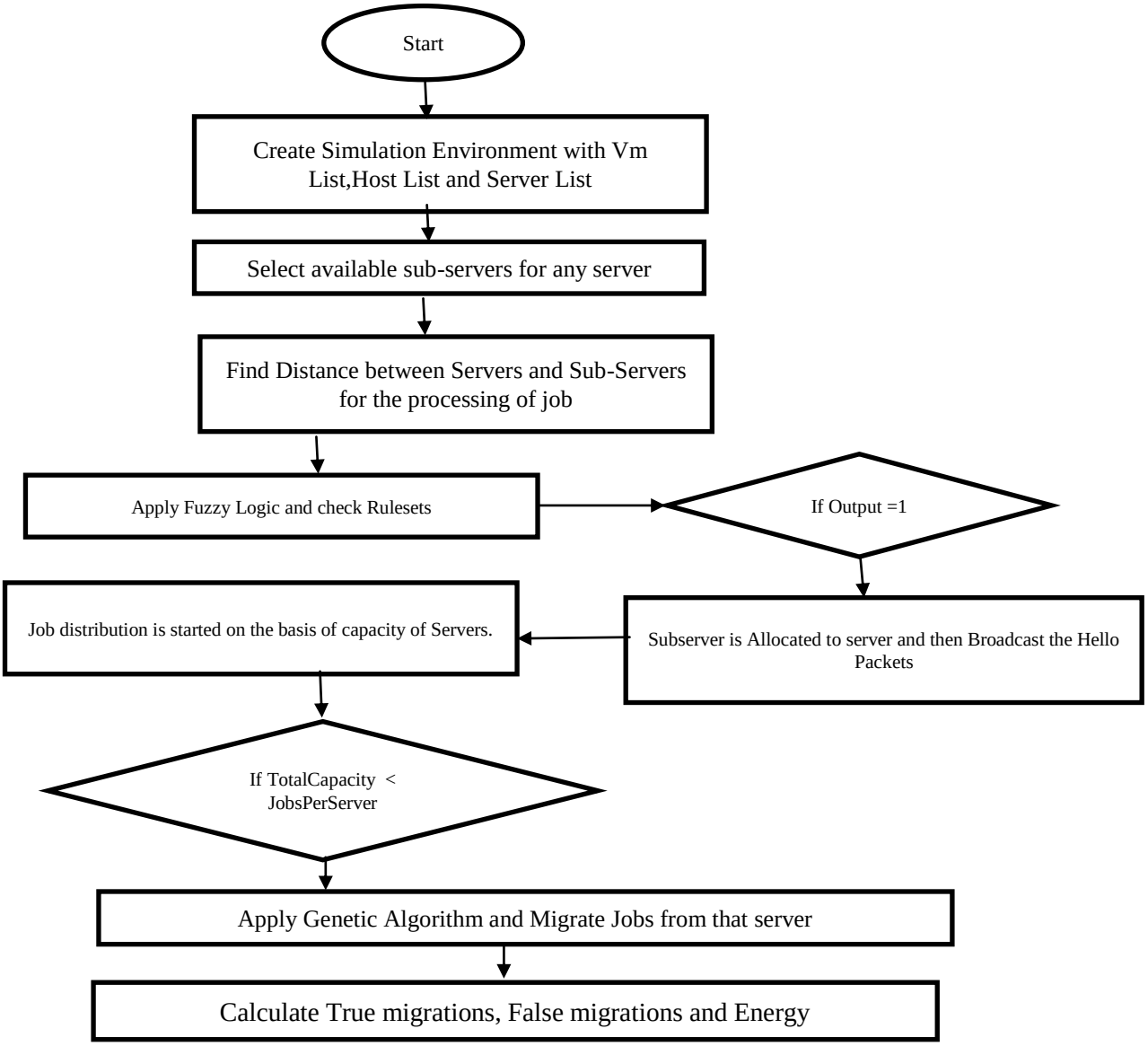

Figure 3: Simulation Flowchart

The distance between available Servers and Sub Servers is being found out. The processing is done of Fuzzy Logic and rule sets are applied on the List of tasks and Virtual machines. The virtual machines are implied on the sub servers. So, after checking the rule sets if output is 1 then tasks are allocated to virtual machines. Then the Capacity of the Servers is being checked. The capacity of server is exceeded after allocation of tasks then the problem of Load balancing is occurred. To solve the load balancing problem, the tasks are migrated to other virtual machines or sub servers. Then the Genetic algorithm is applied.

The methodology is described in steps:
Step 1: Start and design the simulation work frame in CloudSim Environment with CPU, Memory and Disk Properties.
Step 2: Firstly, we Initialize VM and set their properties.
Step 3: After that, Initialize Hosts and define features for the Host
Step 4: For each VM in the allocation table at each host, Apply Neural Network Approach.
Step 5: To apply genetic Algorithm for Virtual Machine Migration if Load on Host exceed from its capacity.
Step 6: Evaluate the performance metrics.
Step 7: Stop

IV. SIMULATION RESULTS

The results are executed in CLOUDSIM Environment. The Number of Virtual Machines is varying during Input so different iterations are calculated. The Servers are same for all the processes. The Results are based on Number of Migrations and Energy.

Table 1: Results calculation with different number of Virtual Machines

NUMBER OF VMS	FALSE MIGRATION	TRUE MIGRATION	ENERGY
10	1	8	38
20	7	22	132
30	9	30	124
40	4	45	205
50	6	56	254
60	17	52	292
70	2	67	367
80	1	78	407
90	16	63	430
100	7	92	523

The above Table defines all the Migrations with False and True Rate. The Energy is also calculated during this process. The Number of Virtual Machines is varying from 10 to 100. These Virtual machines are situated on sub servers and have multiple tasks that are allocated on them. During this research, the load balancing problem is solved by migrated Virtual Machines from Sub Servers. The above results are calculated after 10 iterations.

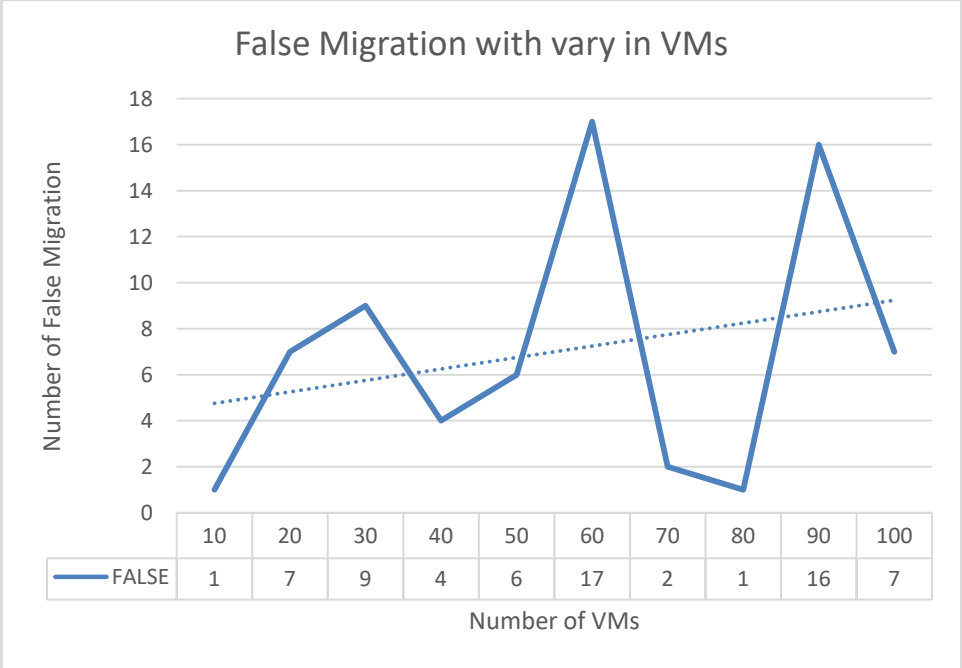

Figure 4: False Migrations during Task allocation

The above Figure shows the number of False Migration during migration process when Load is balanced on servers. The Trendline explains shows that the number of false migrations are incremented with increase in number of Virtual machines on Servers.

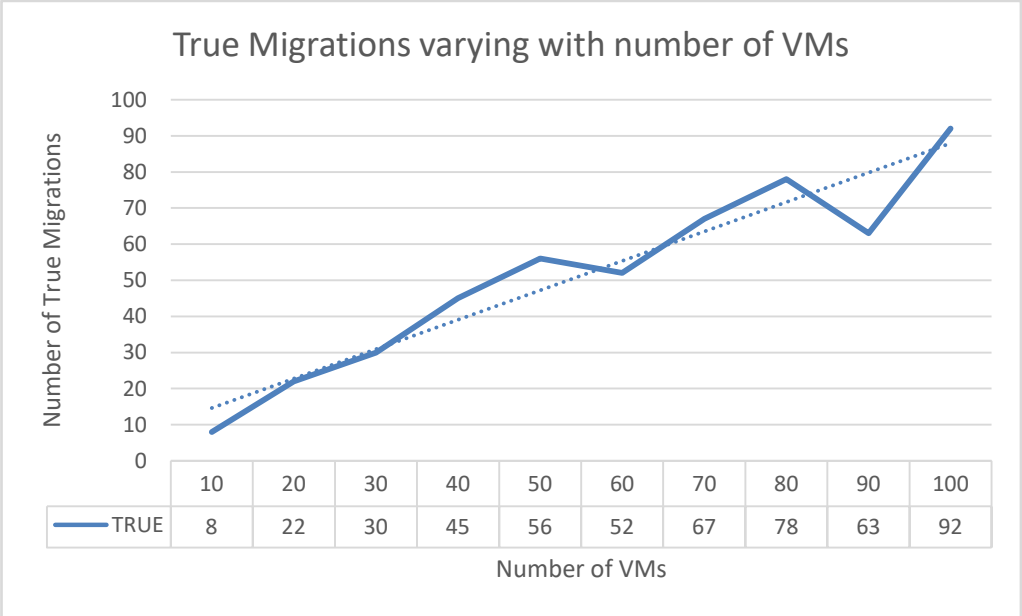

Figure 5: True Migration during Task Allocation

The above defines the Number of True Migrations during the working of thesis. The results show that the numbers of True Migrations are incremented with increment in Number of Virtual Machines within a network.

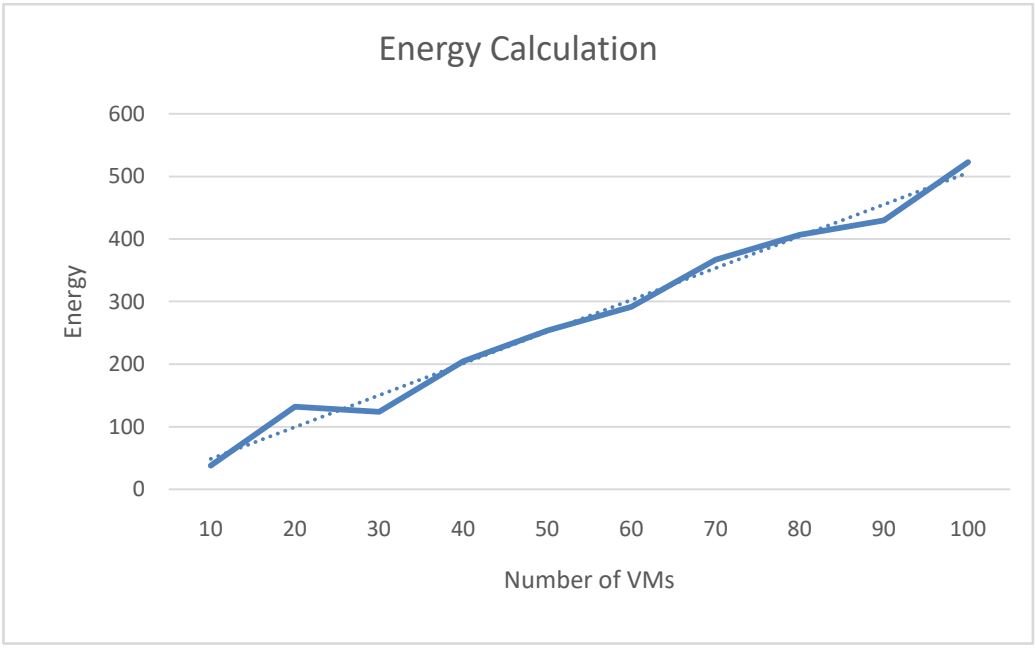

Figure 6: Energy Consumption during Task Allocation process

The Energy Calculation results are shown in above Figure. The Trend line shows that the Energy Consumption is more when the numbers of virtual machines are incremented within any Network.

V. CONCLUSION

Fuzzy logic for task scheduling in cloud computing. Genetic algorithm has been used for analyzing the number of jobs according to their execution time, cost, SLR etc. Then the analyzed jobs are scheduled or selected by using Fuzzy logic. The main aim to use fuzzy logic algorithm is to investigate the priority of a job that must be executed first. Secondly fuzzy logic has been used to adapt priorities of other jobs being waiting in case of new jobs arrives and considering deadlines for this jobs.Jobs having little processing time are assigned new higher processing priorities and hence improving user satisfaction.

The parallel machine scheduling problem receives considerable attention in both academic and industrial fields. Various factors involved in scheduling problems are often imprecise or uncertain. The fuzzy set theory provides a convenient alternative framework for modelling real-world systems mathematically and offers several advantages in the use of heuristic approaches. In this study, the parallel machine scheduling problem with GA is considered and a Fuzzy rule set is used to allocate tasks on virtual machines. The load balancing problem is also solved in this approach by migrating number of virtual machines. The resulted parameters are calculated at the last to check the optimization. In future, other algorithms like ACO, ABC, and Firefly are applied on the same approach for better results.

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