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Optimizing scheduling performance through time slice management based on Max Min strategy in cloud system

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Abstract—Cloud computing provides the architecture in which multiple virtual machines run in a single physical machine and delivering different types of services to users in pay per use bases. Due to limited resources of the physical machine, scheduling of available resources in an efficient manner is necessary for any cloud system and integration of such scheduling strategy in the system will reduce the overall execution time of the system and thus improve response time. In this paper novel scheduling algorithm is proposed IMT (Improved Makespan Time) which is built on the comprehensive study of existing scheduling algorithms such as max-min, min-min, SJF LJF Hybrid scheduling algorithm and many more. The algorithm is based on minimum execution time and maximum resource utilization strategy. Performance analysis of the proposed algorithm is carried out by comparing the execution time of the algorithm with other algorithms specified above using workflowsim simulation tool. Simulation results show that the proposed scheduling algorithm over performs existing algorithms in term of completion time.

Keywords—CPU Utilization, Scheduling, task allocation, time optimization

I. INTRODUCTION

Cloud computing has recently received considerable attention from academia and industry as a prominent approach for retrieving and sharing resources that supports software, applications, business processes, computational and storage platforms, and infrastructures as well. cloud computing provides the resources as a service over the ubiquitous network with minimal management effort and with minimal or no service provider interaction and by ensuring service level agreements (SLA) [1][3]. However, due to shared resources and uncertainty in incoming requests, it will definitely lead to the west of resources if requests are not allocated to proper resources. Apart from that challenges such as reducing the cost, maximizing the profit, securing the information, consumption of resources, power management, on-demand network access and many more attract the researchers towards this field.

In order to support proper resource utilization and ensuring smooth performance of the system, effective scheduling strategy must be needed to be integrated into the system. In general task scheduling refers to the process of allocating tasks to available resources in such a way that improve system performance [2]. Scheduling problems vary from application to application based on the selection of scheduling parameter.

This paper presents the novel scheduling algorithm to allocate incoming requests to the available virtual machine in such a manner that minimize overall completion time and maximize resource utilization. The proposed algorithm also overcomes the problem of over and underutilization of virtual machines by allocating larger tasks to VM with greater MIPS and smaller tasks to VM with minimum allocation.

The paper is organized as follows: In section II introduces the related works. Section III describes the proposed methodology. Section IV focuses on the experimental results and the analysis of the proposed algorithm with the existing once. Section V concludes the paper.

II. RELATED WORK

This paper focuses on optimizing scheduling performance of the system by maximizing resource utilization and minimizing makespan. The proposed algorithm assigns requests to available VMs in such a way that reduces makespan and enhance resource utilization.

Manjaiah D H and Santhosh B proposed Average Task-Min and Max-Min hybrid algorithm. Here tasks are selected based on the availability of the resources. Authors divided resources into two groups based on their MIPS [4]. Tasks with the length greater than average are allocated to resources with higher MIPS and smaller tasks are allocated to VM with less MIPS. The algorithm is implemented in workflowsim simulation toolkit and the proposed algorithm shows better results than that of existing scheduling algorithms.

Atyaf Dhari, Sheren A. El-Booz, Aida A. Nasr, Adela Arpitha, Suresha Mallappa proposed Hybrid SJF – LJF (HSLJF) algorithm [5]. HSLJF Algorithm combines Shortest Job First and Longest Job First algorithm and considers the load on the resources. The algorithm sorts the submitted tasks in to ascending order. After that algorithm selects the first task using SJF and then next task based on LJF and allocates to the VM with minimum completion Time. Simulation results shows that the HSLJF algorithm minimizing the makespan and response time and also increase the resource utilization compared to existing scheduling algorithms.

M. Sarvabhatla, S. Konda, C. S. Vorugunti and M. N. Babu presented a novel scheduling algorithm that achieves dynamic scheduling of tasks and improves energy efficiency in cloud system [6]. The presented algorithm minimizes VM's energy consumption. The algorithm is implemented using cloudsim simulation tool and simulation results show that the algorithm performs better in the term of energy efficiency and execution time.

Er-raji, Naoufal, Faouzia Benabbou, and Ahmed Eddaoui proposed task scheduling algorithm for improving task execution time in cloud system [7]. This algorithm sorts VMs based on there MIPS and tasks based on task length and for sorting, the algorithm uses quicksort. Performance of the presented algorithm is analyzed by implementing it on cloudsim simulation tool.

Sonam Seth and Nipur Singh proposed Dynamic Heterogeneous Shortest Job First (DHSJF) algorithm [8]. Here more focus is given on resource utilization in a heterogeneous computing system. Tasks are scheduled in such manner that it minimizes system execution time and makespan and also maximize resource utilization of cloud system. Performance analysis of the algorithm is carried out using cloudsim simulation toolkit.

III. METHODOLOGY

To overcome problem discussed here a novel scheduling algorithm is developed which uses max-min strategy to efficiently distribute user requests to resources and as a result optimizes overall response time of the system.

There are total m number of tasks and n number of virtual machines, scheduler starts by selecting a random non-repeating task. After selecting task scheduler checks length of the task is less than average task length Tavg, If than scheduler selects VM with minimum allocation and allocates the task to VM and updates VM allocation count. The allocated task is removed from task list.

$$Tavg = \frac{T1(Length)+T2(Length)\ldots\ldots+Tm(Length)}{\text{Total number of tasks}}$$

If task length is more than Tavg scheduler selects VM with maximum MIPS, if more than one such VM founds than scheduler selects VM with minimum allocation. Else continue with selected VM and allocate the task to VM. This process is repeated until the task list is empty.

After analyzing the performance of existing scheduling algorithms and considering challenges faced by algorithms, a novel scheduling algorithm is derived. The Improved Makespan Time (IMT) algorithm works on a max-min scheduling strategy. The algorithm enhances the response time and resource utilization of the cloud system by minimizing the waiting time of the system. Here the main goal is to achieve maximum resource utilization and minimum response time.

The Proposed Scheduling Algorithm

Input: No of incoming tasks T_1, T_2, ….., T_m.
Available VM: VM_1, VM_2, …..VM_n.

Output: All incoming Tasks T_1, T_2…. T_m are allocated virtual machines among the availableVM_1, VM_2, …..VM_n in such way that enhances resource utilization and minimizes the response time of the system.

Step 1: Initially all the VM's have 0 allocations.
Step2: Scheduler maintains the index table of VMs which consist of Virtual machines ID, the processing power of VM, and the current allocation count of VMs. AND task queue, with task id and information.
Step 3: Scheduler selects the non-repeating random task from the task queue.
Step 4: If (T(Length)< T(Avg)) then
goto step 5
else
goto step 6
Step 5: Select VM with Minimum allocation.
goto step 8
Step 6: Select VM with maximum MIPS
Step 7: If (more than one such VM) then
Select VM with the minimum allocation

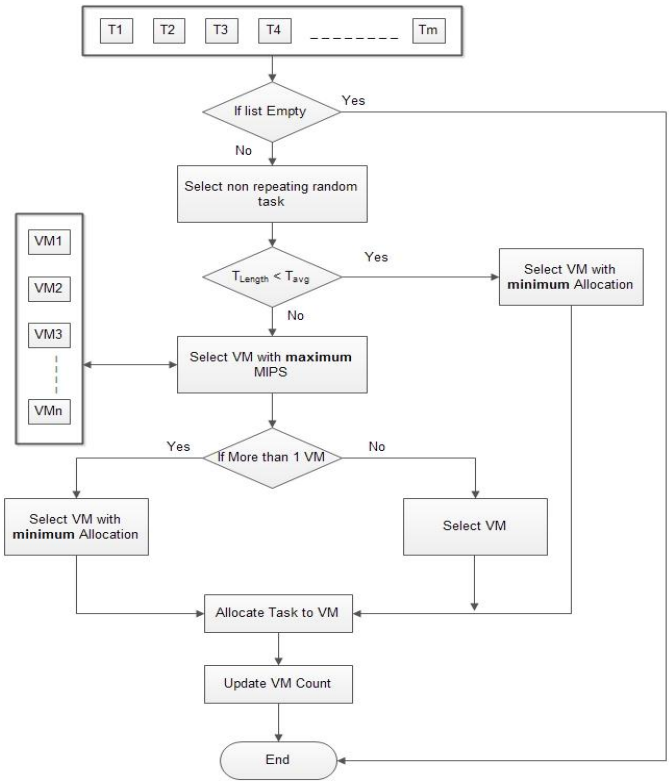
Else

goto step 8

Step 8: Assign Task to VM.
Step 9: Update VM count.
Step 10: Remove the task from the task list.
Step 11: If (Task list != Empty)

Repeat step 3 to 10

Else End.



[Figure 1. Workflow of Proposed System]

Figure l. Shows the complete workflow of the Improved Makespan Time (IMT) algorithm.
The algorithm allocates a larger task to VM with higher processing power and smaller task to VM with minimum request allocations. Thus, it will try to achieve a balanced distribution of tasks based on processing power and better response time as well.

IV. RESULTS AND DISCUSSION

In order to analyze the performance of the proposed algorithm, Max-min, min-min, and SJF-LJF Hybrid algorithms are implemented in WorkflowSim simulation tool [9], which is an extension of CloudSim [10] toolkit. The CloudSim toolkit is a Java-based Cloud simulation toolkit. CloudSim does not support scheduling of the scientific workflows whereas WorkflowSim supports this functionality. WorkflowSim uses scientific workflows which are generated by the Pegasus workflow management system. TABLE I shows the characteristics of the resource used. There is one datacenter which contains 25 hosts in it.

TABLE 1. Characteristics of resources

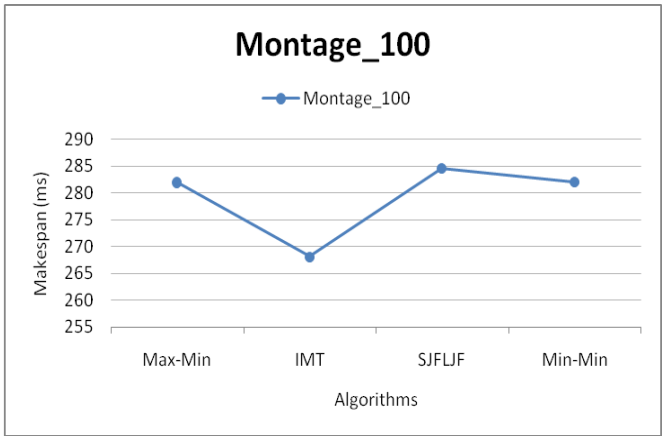
Datacenter	
Number of Datacenter	1
Number of hosts	25
VM (Virtual Machine)	
Number of VMs	5
MIPS of PE per VM	1000-3000 MIPS
VM memory	512
Bandwidth	1000
Type of manager	Space shared

TABLE II shows makespan of algorithms and it is clear from results that IMT algorithm performed better than other three algorithms in terms of makespan.

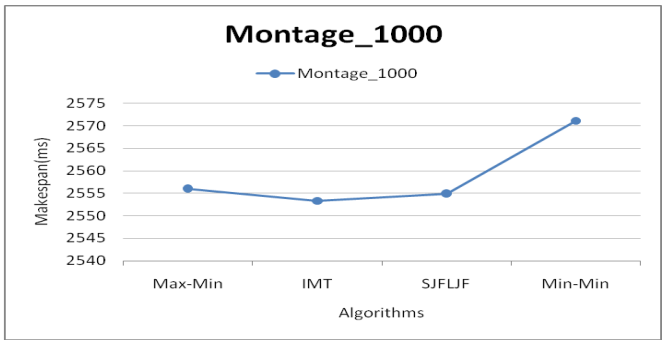
TABLE 2. Analysis of result

Algorithm	**Montage_100**	**Montage_1000**
Max-Min	282.04	2556.04
IMT	268.18	2553.29
SJFLJF	284.61	2554.93
Min-Min	282.07	2571.09

Below Graph1 and Graph 2 shows result comparison of four different algorithms: Max-min, Min-min, SJF-LJF hybrid algorithm and proposed algorithm using Montage_100 and Montage_1000 workflow files



[Graph I. Performance of algorithms on montage_100 file]



[Graph II. Performance of algorithms on montage_1000 file]

It is clear from the graph that the proposed algorithm performs better than the other three algorithms in the term of makespan. The IMT algorithm reduces the waiting time by properly allocating resources to task and that will reduces the overall execution time which is clearly visible from above graphs.

V. CONCLUSION AND FUTURE SCOPE

This Scheduling algorithm not only schedules resources but also provides a balanced distribution of load among available virtual machines and thus enhance the response time of the system. The proposed algorithm uses max-min strategy for scheduling which will maximize resource utilization and minimizes the response time of the system.

In future work, the proposed scheme is analyzed by implementing it on cloud simulation tool using dynamic tasks. As we see that in the simulation we have kept the cloud environment to be static which means that no virtual machines can be created at runtime and no new hosts and datacenter can add themselves to the environment.

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