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Performance Evaluation of Sequential Assignment and Scheduling Algorithms in Cloudsim

[1]**Malege Sandeep**

[1]Research Scholar, Department of Computer Science and Engineering, P. K. University, Shivpuri, M.P.

[2]**Dr. Rohita Yamaganti**

[2]Associate Professor, Department of Computer Science and Engineering, P. K. University, Shivpuri, M.P.

Abstract

The CloudSim simulator is used for task scheduling, with jobs assigned to available resources according to the sequential and scheduling algorithms. The results demonstrate a significant improvement in both execution cost and completion time when using the scheduling algorithm, as compared to sequential assignment. Specifically, the scheduling algorithm achieves reduced execution costs and improved completion times as the number of cloudlets increases. The performance metrics highlight the effectiveness of the scheduling algorithm in optimizing task execution in a cloud computing environment.

Keywords: Sequential, Scheduling, CloudSim, Task, Resource

I.INTRODUCTION

When it comes to cloud computing, efficient resource allocation and task execution is absolutely dependent on how well sequential assignment and scheduling algorithms function. A modern computing foundation, cloud computing allows businesses to extend their operations without the expense and hassle of maintaining large hardware infrastructures by providing scalable and flexible computing resources. Nevertheless, whether handling large-scale applications or multiple users, effective scheduling and assignment procedures are essential for making the most of these resources. An open-source framework called CloudSim has recently come to light as a powerful tool for testing algorithms that operate on the cloud. It models and simulates various aspects of cloud computing. Data centers, virtual machines (VMs), and cloudlets—representing user tasks or applications—are all part of the cloud, and this platform is adaptable and extensible enough to accommodate them. With CloudSim, researchers may test various algorithms in a controlled environment before implementing them in real-world systems. It simulates the cloud's resource allocation and scheduling process.

Algorithms for task assignment and scheduling primarily aim to find the best way to distribute resources among jobs and guarantee their optimal execution. Time to completion of tasks, resource usage, load balancing, and overall system throughput are all aspects of performance that are directly impacted by these algorithms. In particular, algorithms for sequential assignment and scheduling are those that distribute resources and schedule jobs in a predefined order. Algorithms like these tend to shine in situations when jobs are interdependent or have clear priority.

Due to their ease of use and efficacy in resource management, sequential scheduling algorithms like First-Come-First-Served (FCFS), Shortest Job First (SJF), and Round Robin (RR) have been extensively researched. To keep up with the ever-evolving nature of cloud settings, it is essential to test how well these conventional scheduling algorithms handle situations where workloads, resources, and network conditions are subject to change. It is necessary to thoroughly examine the advantages and disadvantages of sequential scheduling algorithms due to the increasing severity of problems such resource congestion, task dependencies, and the requirement for load balancing. Several performance criteria, including execution time, makespan, resource utilization, energy consumption, and fairness, are used to evaluate sequential assignment and scheduling algorithms in CloudSim. An important metric in task scheduling is makespan, which is the sum of all the time needed to finish a set of tasks. The goal of most algorithms designed to minimize makespan is to speed up overall completion times by distributing work efficiently across available resources. To counteract resource idleness and the associated needless overheads in cloud environments, it is equally critical to achieve high resource utilization while simultaneously balancing loads. Adaptability to changing conditions, such as resource availability or task arrival rates, is another way to measure scheduling algorithms' performance.

Additionally, it is necessary to assess sequential scheduling algorithms' capacity to manage diverse and intricate cloud

infrastructures. Many virtual machines with diverse amounts of RAM, storage space, and computing power are commonplace in cloud environments, among other resources with diverse capabilities. Scheduling algorithms have a problem due to this heterogeneity because they must maximize system efficiency by allocating resources according to the unique needs of each activity. Consider the consequences of assigning a computationally heavy task to a virtual machine (VM) that lacks sufficient processing capacity. This could lead to longer execution times and worse overall system performance. In order to comprehend the scalability and practicality of sequential scheduling algorithms for use in real-world cloud systems, it is crucial to evaluate their performance in diverse cloud settings. One of the most important metrics for measuring cloud computing performance is energy usage. A major amount of the operational expenses of large-scale data centers are related to energy prices. Reduced power usage without sacrificing performance should be the goal of any effective scheduling method. While some sequential algorithms aim to reduce energy expenses by consolidating work onto fewer virtual machines (VMs), others may lead to underutilized resources or wasteful energy use. Because cloud providers are committed to sustainable computing and want to lessen their impact on the environment without sacrificing speed, evaluating scheduling algorithms' energy consumption is crucial.

By simulating a wide range of cloud environments—complete with varied numbers of virtual machines (VMs), cloudlet workloads, and network conditions—CloudSim gives researchers a controlled environment in which to test and compare scheduling tactics. Because it is possible to test algorithms in a simulated environment under a variety of conditions that would be costly or otherwise impractical to replicate in a real cloud setting, it is well suited for use in performance evaluations. Researchers can find the top methods for computationally heavy workloads or tasks with high data transfer requirements by using CloudSim.

II.REVIEW OF LITERATURE

Gollapalli, Mohammed et al., (2023) A continual commitment to customer satisfaction is of the utmost importance, especially with the exponential increase in the number of people using cloud services around the world. So, to improve the cloud computing environment's performance, job scheduling is crucial. It is possible to characterize the majority of the published research in this area by saying that it aims to maximize resource usage, reduce cost, and increase performance. Taking a number of factors into account, this study lays the groundwork for understanding more recent efforts to improve and optimize the current cloud computing task scheduling algorithm. Additionally, this study found the best performing algorithm in the cloud environment by comparing three task scheduling algorithms: Max-Min, First Come First Serve (FCFS), and Round Robin (RR). The performance metrics used were the cost of virtual machine resources, average time, and makespan. The CloudSim simulation tool was used to conduct the experimental evaluations. Based on makespan and average waiting time, Max-Min outperformed the other algorithms in Space and Time-shared policies.

Kaur, Rajbhupinder et al., (2021) With the idea of commercially applying technology to public consumers, cloud computing has become a leading technology. The capacity to dynamically assign resources on-demand, providing noticeable scalability, performance, low maintenance requirements, and cost-effectiveness, is what makes cloud computing so well-known. With the help of virtualization, users are able to share the resources. When job scheduling is done well, cloud computing can yield high performance. When thinking about how to dynamically allocate resources to maximize performance while minimizing makespan, task scheduling should be your first priority. Given its direct impact on other performance monitoring parameters such as power consumption, optimal cost, scalability, and availability, task scheduling is seen an important aspect. This study investigates the makespan in cloud computing using four well-known task scheduling algorithms: first-come-first-serve (FCFS), round-robin (RR), shortest-job-first (SJF), and particle swarm intelligence (PSO). The functioning of the job scheduling algorithms under consideration has been studied using VMs (virtual machines) and data centers with unique IDs. The makespan was calculated by recording the execution time needed to successfully complete each stage. The procedure for carrying out the task scheduling using the right algorithm, pseudocode, and flowchart is detailed in the study article. The outcomes have been derived from four different task scheduling algorithms and compared using makespan as the metric of choice.

Stan, Roxana-Gabriela et al., (2021) T His research lays the groundwork for a suite of techniques that may be used to assess how well a task scheduling scheme works in environments with different types of computers. We run tests on big workloads using simulations and formally state a scheduling paradigm for hybrid edge-cloud computing ecosystems. In addition to the traditional cloud datacenters, we also take into account edge datacenters that use battery-operated devices such as Raspberry Pi edge computers and

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smartphones. We specify the computational resources' practical capabilities. After a timetable is established, the resource capacities determine whether or not the different needs of the tasks can be met. Using the Round-Robin, Min-Min, Max-Min, and Shortest Job First scheduling schemes, we construct an assessment and scheduling framework and measure common scheduling metrics like makespan, throughput, mean waiting time, and mean turnaround time. In contrast to cloud-only mediums, our research and findings reveal that state-of-the-art independent task scheduling algorithms perform worse in heterogeneous edge-cloud environments, with more task failures and less optimum datacenter resource usage. Specifically, for any scheduling system, over 25% of jobs fail to perform when dealing with big collections of tasks because of low battery or restricted memory.

Chowdhury, Nobo et al., (2018) An IT paradigm, cloud computing has seen extensive use in the delivery of a wide range of services over the Internet. It makes it simpler to get resources and premium services. In order for cloud services to be provided to consumers efficiently, their operational procedure needs to be planned. Allocating different computer resources to applications and achieving optimal system throughput are the two main objectives of task scheduling. The unpredictability of the scenario grows in relation to the magnitude of the task, making it highly likely to be solved efficiently. To shed light on this matter within the realm of cloud computing scheduling, a plethora of intellectual approaches are suggested. This study compares and contrasts various cloud-based scheduling algorithms with respect to the parameters that are important to each.

Rajguru, Abhijit & Apte, S.. (2013) Because it is the most crucial component of the computer system, the central processing unit (CPU) needs to be used effectively. The scheduling problem takes on critical importance as the demand for processing power grows. Research in computer engineering is most prominently focused on the critical and difficult topic of work scheduling and load balancing. Allocating processes to processors in a way that minimizes total execution time and optimizes processor utilization is the definition of task scheduling. Redistributing processing demands across available processors is known as load balancing, and it improves system performance. Using a variety of qualitative metrics, this article compares and contrasts the efficiency of many task scheduling methods. According to the results, there are benefits and drawbacks to using task scheduling algorithms. By analyzing current job scheduling algorithms, this research aims to contribute to the future creation of novel scheduling algorithms.

III.MATERIAL AND METHODS

To model a communication and heterogeneous resource environment, one can use the CloudSim toolkit. To confirm the findings, the CloudSim simulator is employed. The scheduling technique and CloudSim's default Sequential assignment are used for the trials. For the sake of generalization, the jobs arrive in a uniformly random distribution. The scheduler then uses these methods to send these jobs to the available resources. To compare the two algorithms, we change all of the parameters in the same way.

The datacenter configuration that was created looks like this: There are two hosts and one processing element.The virtual machines utilized for this experiment are set up as shown in the figure below.

Virtual Machines	Virtual Machine 1	Virtual Machine 2
RAM (MB)	5024	5024
Processing Power (MIPS)	22000	11000
Processing Element (CPU)	1	1

Figure 1: Configuration of VMs

IV.RESULTS AND DISCUSSION

Optimizing Performance in Terms of Execution Cost

By picking the right resource, cost-based tasks decrease the execution cost of individual activities using a greedy approach. Table 1 shows that compared to sequential allocation, the scheduling technique significantly improves the cost of task execution. The quantity of cloudlets has a direct correlation to the improvement in cost.

Table 1 Comparison of Execution Cost

No. Of Cloudlets	Scheduling Algorithm	Sequential Assignment
25	565.88	735.72
50	1131.83	1471.41
75	1697.70	2207.06
100	2263.57	2942.75

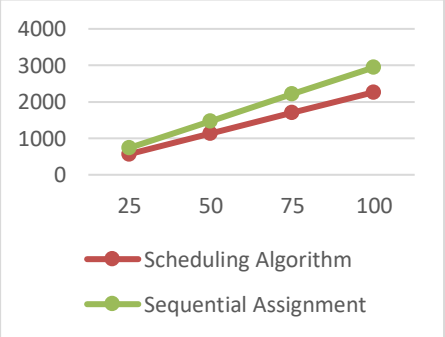

Figure 2: Analysis of Execution Cost

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Scheduling Algorithm and Sequential Assignment are two scheduling algorithms. Table 1 analyzes their execution costs across different numbers of cloudlets. Both approaches have an increasing execution cost with an increasing number of cloudlets. Nevertheless, when contrasted with Sequential Assignment, the Scheduling Algorithm always reveals cheaper costs. The Scheduling Algorithm, for instance, would set you back 565.88 at 25 cloudlets, whereas Sequential Assignment would set you back 735.72.

Performance Optimization with Focus on completion time

The number of cloudlets is increased in each trial of the experiment. The results clearly show that scheduling algorithms outperform sequential approaches when it comes to job completion time.

Table 2 Comparison of Completion Time

No. Of Cloudlets	Scheduling Algorithm	Sequential Approach
25	53.01	58.95
50	164.68	181.65
75	334.50	399.88
100	584.72	654.05
125	910.08	998.03
150	1298.46	1439.77

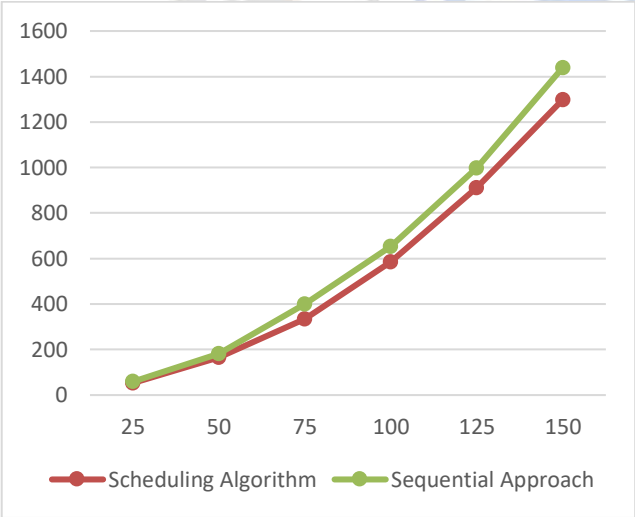

Figure 3: Analysis of Completion Time

According to the results in Table 2, the execution time for both approaches grows in direct proportion to the number of cloudlets. In contrast to the Sequential Approach, the Scheduling Algorithm reliably produces faster completion times. As an example, the Sequential Approach takes 58.95 units of time and the Scheduling Algorithm takes 53.01 units at 25 cloudlets.

V.CONCLUSION

The research shows that compared to the conventional sequential assignment method, the suggested scheduling algorithm is far more efficient in terms of execution time and cost. The results demonstrate that the suggested approach is effective in optimizing cloud resource use by simulating it in a heterogeneous resource environment using CloudSim. The suggested algorithm's ability to steadily decrease execution costs and improve completion times as the number of cloudlets grows verifies its promise for improving cloud computing efficiency. Advanced scheduling approaches are a viable option for managing resources and tasks in the cloud, as the results show how important they are for lowering operational expenses and satisfying deadline requirements.

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