

Empirical Study of Load Balancing Algorithms in Cloud Computing

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Abstract— *In the present digital era, cloud computing, big data and data science are playing major roles. One of the uses of cloud computing is we can access not only data, all the requirements to do our processing tasks on that data. There are many challenges in cloud computing. Load balancing plays key role. Based on user's demand, there are many load balancing algorithms proposed till now. In this paper, we mainly focused on two best algorithms Min-Min and Max-Min algorithms. We analyzed these two algorithms with performance metrics like responsibility time, waiting time, minimum completion time and execution time.*

Keywords: *Min-Min, Max-Min, Response time, Load Balancing, Minimum completion time, Minimum execution time*

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1. Introduction

Load balancing [1] is a method that distributes the workload among diverse nodes in the given environment such that it ensures no node in the system is over loaded or sits idle for any instant of time. An efficient load balancing algorithm will make sure that every node in the system does more or less same volume of work. The responsibility of load balancing algorithm is that to map the jobs which are set forth to the cloud domain to the unoccupied resources so that the overall available response time is improved as well as it provides efficient resource utilization. Balancing the load became one of the crucial concerns in cloud computing since we cannot predict the number of requests that are issued at each second in cloud environment. The unpredictability is due to the ever changing behaviour of the cloud. The main focus of load balancing in the cloud domain is in allocating the load dynamically among the nodes in order to satisfy the user requirements and to provide maximum resource utilization by assorting the overall available load to distinct nodes.

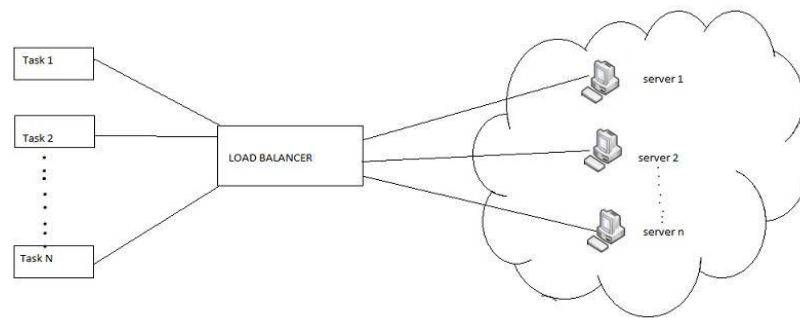


Fig 1. Diagram for load balancing

2. Demand of Load Balancing in Cloud Environment

Load balancing [1] is a method such that it assigns the workload equally among all the available nodes which are present in the system. Higher user satisfaction is the motto behind load balancing. As the number of user's as well as their demands are increasing day by day, the clouds should provide the services to the customers with their at most satisfaction. An appropriate or an ideal load balancing algorithm help in making use of the available resources most favorably, thereby ensuring no node is over loaded or under loaded. Load balancing enables scalability, avoids bottlenecks and also reduces time taken to give the respond. Many load balancing algorithm [2] have been designed in order to schedule the load among various machines. But so far there is no such ideal load balancing algorithm has been developed which will allocate the load evenly across the system. It has been proved that allocating the tasks evenly across the system is considered to be an NP complete problem [7].

3. Load balancing in a cloud computing environment

Load balancing algorithms in cloud environment are manly classified in to two categories which are Immediate mode scheduling Batch mode scheduling Immediate mode scheduling schedules the task on to the resources based on its arrival. In immediate mode scheduling the algorithms used are MET which is expanded as minimum execution time and minimum completion time which is abbreviated to MCT. In MCT algorithm the task which is assumed to have the minimum completion time will get allocated to the analogous node. In Batch mode scheduling tasks are collected based upon their arrival in a Meta task set and they are mapped at prescheduled times to their corresponding machines. Min-Min and Max- Min belongs to the Batch mode scheduling category.

3.1 Min-Min load balancing algorithm

The Algorithm take up with a task set which are initially not assigned to any of the nodes. Initially the minimum completion time is calculated for all the available nodes. Once this calculation gets completed the task having the completion time minimum is chosen and assigned to the respective node. The execution time of all other tasks which are currently available in that machine is updated and the task gets discarded from the available task set. The routine is done time after time until all the tasks have been assigned to the equivalent machines. The algorithm works better when the situation is like where the small tasks are greater in number of than the large tasks. The algorithm has a disadvantage that it leads to starvation. Min-Min is a simple and fast algorithm capable of providing improved performance. Min-Min schedules the ideal tasks at first which results in best schedules and improve the overall make span. Assigning small task first is its drawback. Thus, smaller tasks will get executed first, while the larger tasks keeps on in the waiting stage ,which will finally results in poor machine use. Min-Min exhibits minimum completion time for jobs which are unassigned (similar to MCT), and later allocating the jobs with minimum completion time (hence min-min) to a node that is capable of handling it. Architectural description of Min-Min algorithm is shown below in Fig. 2

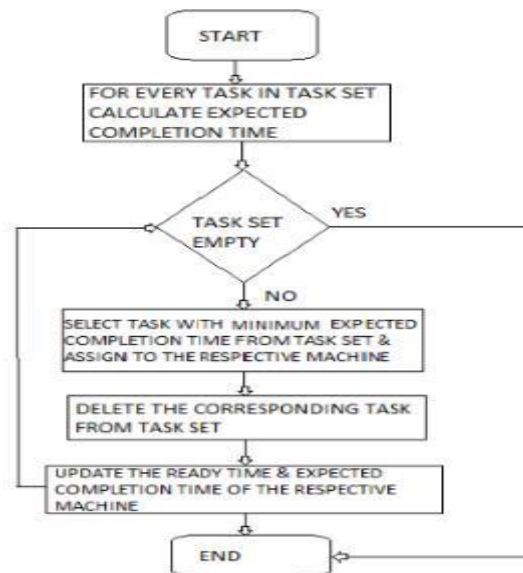


Fig. 2 Architectural description of min-min algorithm.

3.2 Max Min load balancing algorithm

The max-min algorithm is much the same as to min-min algorithm. At first for all the available tasks are submitted to the system and minimum completion time for all of them are calculated, then among these tasks the one which is having the completion time, maximum is chosen and that is allocated to the corresponding machine. This algorithm outperform than Min-Min algorithm where when short tasks are in high numbers when compared to that of long ones. For e.g. if in a task set only a single long task is presented then, Max Min algorithm runs short tasks concurrently along with long task. The make span focus on how much small tasks will get executed concurrently with the large ones. Max-Min is almost identical to Min-Min, except it selects the task having the maximum completion time and allocates to the corresponding machine. The algorithm suffers from starvation where the tasks having the maximum completion time will get executed first while leaving behind the tasks having the minimum completion time. Architectural description of Max Min algorithm is presented below in Fig. 3

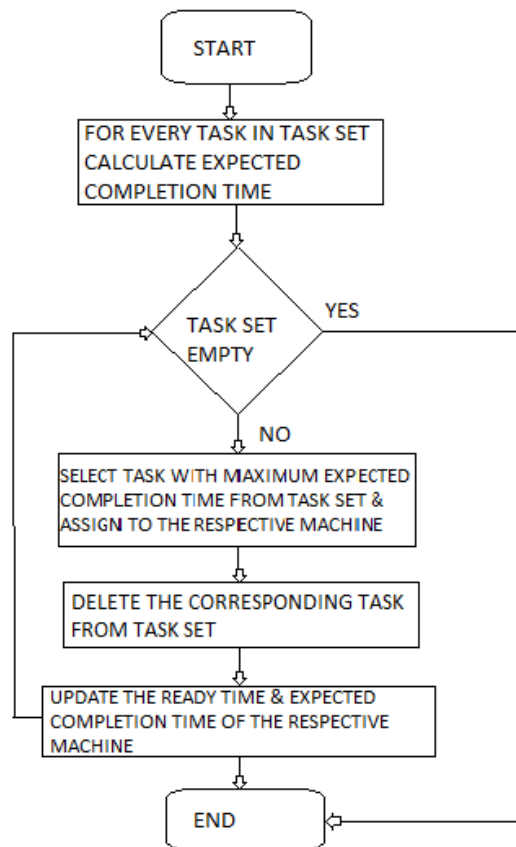


Fig .3 Architectural description of max-min algorithm.

4. Simulation overview

In this section, we are providing an experimental result which shows the comparison between the Min-Min and Max-Min algorithms. For the implementation of both the algorithms we have used CloudSim [8], a simulator for checking the performance of the two algorithms. “CloudSim [9] is an extensible simulation toolkit that enables modelling and simulation of Cloud computing systems and application provisioning environments”. In cloudsim tasks are considered to be the cloudlets and nodes are taken into account as virtual machines.

Using cloudsim the performance of these algorithm is observed in three cases: in first case, we have set the number of nodes to be five which is kept as constant for all the cases and changed the number of tasks to 25. For the second case we have varied the tasks to 50 later in the third case it is changed to 100. Experiments conducted with twenty five, fifty and hundred tasks are assigned to Cloud with 5 resources. The resources are located to one data centre.

Table 1 shows the simulation results of both the algorithms. It shows the make span of Min-Min and Max-Min algorithm for three cases

Number of tasks	Min Min	Max Min
25	159	120
50	230	200
100	510	450

Table 1. Make span of two algorithms

From the above table it is noted that make span get reduced for Max-Min compared with that of Min-Min, Max-Min outperforms than the other and in the later run the assignment of tasks to the resources get changed. i.e. if we are using these two techniques the allocation of tasks to the machine will not be the same it will get changed. Depending upon the type of load balancing algorithm we choose the tasks are allocated to the respective nodes.

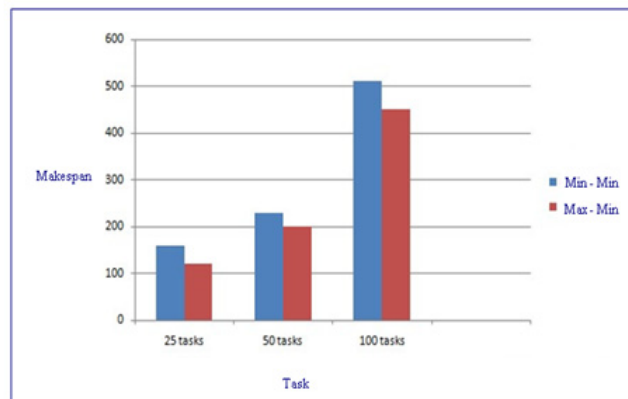


Fig. 4 Results of comparison of Max-Min & Min-Min

The performance of the three cases in accordance with the computed values are shown in chart above as shown in Fig. 4, in which y-axis shows the make span and x-axis shows the two algorithms. From the above simulation results we came into a conclusion that Max-Min achieves better performance than Min-Min with respect to the make span. For an efficient load balancing algorithm it always tries to reduce the make span.

5. Conclusion

We have done an extensive study through the implementation of the two load balancing algorithms namely Max- Min and Min-Min based on our selected cloud environment. The result of our evaluation shows that the Max-Min performs better than Min-Min in terms of make span. But there are other works of load balancing in cloud environment which shows that Min-Min outperform the Max-Min algorithm. Both algorithms have got their own pros and cons, where depending upon the cloud environment one outperforms the other. If the number of lighter tasks outnumbers the heavier tasks then Max-Min performs well better than the Min-Min in terms of resource utilization and make span on the contrary if there are many heavier tasks it results in Min-Min to perform better than Max-Min. So we came in to a conclusion that the performance of load balancing in cloud doesn't depend upon any algorithms but it is purely based on the cloud environment we choose.

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