ISSN(Online): 2320-9801
ISSN (Print): 2320-9798

International Journal of Innovative Research in Computer and Communication Engineering

(An ISO 3297: 2007 Certified Organization)

Vol. 3, Issue 8, August 2015

Efficient Qos Based Tasks Scheduling using Multi-Objective Optimization for Cloud Computing

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ABSTRACT: Computing is a service based on-demand, pays per use model consisting of an inter-connected and virtualizes resources delivered over internet. In cloud computing number of user are increasing day-by-day and volume of data is also very huge. So, to meet the needs of customers and proper assignment of resources to available VMs task scheduling is the important aspect. Mostly cloud resources are not utilized efficiently because of poor task scheduling. This paper introduces the multi-objective task scheduling algorithm for optimization of throughput of the system. This algorithm not only performs multi objective task scheduling but also performs non-dominated sorting for ordering of tasks. Thus, aim of this research work is to prove the effectiveness of the optimization method.

KEYWORDS*:* Task scheduling, Multi-objective optimization, Non-dominated sorting, QoS, Pareto-optimality

I. INTRODUCTION

In today's world, cloud computing is the hottest emerging area in field of Information technology [1]. Cloud computing is a service based, on-demand, pay per use model consisting of an inter-connected and virtualizes resources delivered over internet. In the cloud platform, task scheduling is the most important concern that aims to ensure that user's requirement are properly and correctly satisfied by cloud infracture. Basically, scheduling is the process of mapping or assigning task to the available resources after looking the characteristics of task. An efficient scheduling mechanism should meet user's requirement and helps service provider to provide good quality of service, so as to enhance the overall system performance.

Many of the task scheduling algorithm in cloud computing uses single criteria, which degrade resource utilization. So to enhance the system performance and increase resource utilization we need to consider multiple criteria. There are many criteria like execution time, cost, bandwidth for communication, deadline, makespan etc. So, we proposed an efficient multi-objective task scheduling algorithm based on 3 criteria (task size, makespan, and deadline). This algorithm also integrated with non-dominated sorting for ordering of tasks.

In cloud computing broker plays an important role. Broker act as a medium between users and cloud service provider. In cloud computing broker plays an important role. Broker act as a medium between users and cloud service provider. Cloud broker maintains list of virtual machines (VMs) and it's QoS. User send s the request to the cloud broker and cloud broker send the request to the VM server. After selecting the proper VM that meet the user's requirement and Service level agreement (SLA), broker binds the task to that particular VM.

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II PROBLEM STATEMENT

In task scheduling the main problem is ti map tasks received by broker to the particular VM in the way that minimize the execution time which in turn increase the system throughput. Single objective optimization algorithm does not give expected result. There are many scheduling algorithm like FCFS (First Come First Serve), SJF(Shortest Job First), Priority Scheduling etc. FCFS and SJF [3,4] does not give best result in both cases. In priority based scheduling task with higher priority always executed first and the task with lower priority has to wait for long time. So an efficient scheduling algorithm is required which can improve the datacenter's performance without violating SLA.

Here, we defined characteristics of VM ans task. VM characteristic Vi ={IDi , Mi } , where Vi is the ith Virtual machine, IDi is the ID of VM and Mi is the MIPS of ith VM. Task characteristic Ti ={IDi , Si, Mi, Di } , Where IDi is the task ID, Si is the size of the task(MI), Mi is the makespan and Di is the deadline of ith Task.

III LITERATURE SURVEY

Cloud computing is an emerging technology and still is in the developing stage. There are many tasks scheduling algorithm in cloud computing that are based on QoS. Various QoS parameters are execution time, deadline, cost, bandwidth, make span, reliability etc and many others. Priority scheduling, FCFS (First Come First Serve), SJF (Shortest Job First) [3,4] are the traditional scheduling methods for selecting a task from a list of tasks. FCFS is a non-pre-emptive algorithm. SJF and Priority algorithm can be pre-emptive or non-pre-emptive. Task's priority can be assigned statically or dynamically using the QoS parameter. Multi-objective optimization methods were studied by many researchers [5, 6,7-10] for grid workflow scheduling. Basically, there are two methods used. The first is weighted sum method which converts all the objectives into single by assigning weights to all objectives. The next method is to search for a non-dominated solution, also called the Pareto optimal front [12]. In [14,15] authors proposed an algorithm based on multiple criteria and multiple decision model to map a task to a particular VM. Multiple criteria include the various QoS parameters. These algorithm helps to minimize the make span and improve the performance of the system. Optimized task scheduling algorithms using genetic algorithms with greedy approach not only performs task scheduling but also perform load balancing [13].

Load balancing algorithm based on NSGA- II is proposed in [16]. Nature inspired algorithm such as ant colony optimization bee colony optimization is also used. In ant colony optimization ant are tasks that move in any direction for the search of food source that are VMs. In [17], author proposed novel, efficient approach of non-dominated sorting (ENS). This algorithm decreases number of comparisons. A modified ant colony optimization algorithm in[18,19] is used to minimizing the execution time and cost. This algorithm consider various criteria such as execution time , arrival time and other QoS parameter for searching a best VM for the execution of tasks which minimize make span.

In cloud computing broker has to allocate the VM to a task at runtime. In [20] author proposed a scheduling algorithm for real time tasks and also used game theory concept for ensuring the truthfulness of service provider. Some algorithm based on the execution time and arrival time are proposed in [21, 22] which picks a specific task from the group of task for the allocation of VM. Sometimes the tasks from the list is selected linearly and submitted to the VM. This process of allocation is done repeatedly until the all tasks in the list finish its execution. This leads to reduced completion time and minimized make span of the VMs. Generally, in tasks scheduling algorithm our goal is to minimize the execution time, cost, make span. There are some algorithm that also used to increase the scalability [23] and reliability [24] of the system.

IV PROPOSED WORK

In cloud computing, there are many datacenters that are used to serve customers need. Datacenters consists of number of servers and each server runs number of VM. Different VMs have different capacity to execute tasks with different QoS parameter. Proposed algorithm is simulated using CloudSim simulation toolkit and result gives better throughput.

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Cloud broker sends request to the cloud service provider for the QoS of requested task and for list of VMs created in the VM server. Here task's priority is assigned according to the QoS value of task. Hence, the task with lower QoS value has high priority and the task with high QoS value has low priority. After that cloud broker assigns QoS to the VMs. For the VMs we have considered Millions of instructions per second (MIPS) of VM as a QoS value. VM with high MIPS is a high QoS VM and VM with low MIPS is low QoS VM.

Cloud broker have a list of VM. This list is updated in fixed time interval. Based on the MIPS of VM, VMs list is sorted in descending order. The first VM in the list have high QoS and at the end of the list low QoS VM. Non-dominated sorting is performed on the task list to finally generate non-dominated task's set. Then tasks from non-dominated task's set bound to the VMs sequentially. The first task from the task's list is mapped to the first VM from the VM's list and this process continues till we reached to the last VM. Then the next task will be submitted once again to the first VM of the VM's list and the process of allocation will be repeated for all tasks.

A. *Multi-objective optimization and Dominance Relation*

Multi-objective optimization [25] is a mathematical optimization that includes more than one objective functions to be minimized simultaneously. This is the area of MCDA (Multiple Criteria Decision Making). In mathematical terms,

Find X = {x1,x2,…………xn}
Which Min(f1(x), f2(x),………fk(x))

Where the integer k>=2 is the number of objectives and X is the set of feasible solutions. In multi-objective optimization, there does not normally exist a sufficient solution that minimizes all objective functions at the same time. So Pareto optimal solutions are considered; that is, solutions that cannot be enhanced for any objectives without degrading minimum one of the other objectives. Because objectives are usually conflicting in nature. (Ex: Minimize cost, Maximize Productivity). A set of Pareto optimal solutions is also called as the Pareto Optimal Set.

An important concept of multi-objective optimization is that of domination. A Dominated solution is the one for which there exists at least one feasible solution that is better than it in all objective. For example, if a solution 'a' dominates another solution 'b', then the solution 'a' is better than 'b'. Non Dominated solution is the one, where there does not exist any feasible solution better than it. Pareto Optimal solution is non-dominated and hence is also known as Non-dominated solution. In mathematical form, a feasible solution *x1* is said to dominate another solution *x2* , if

1. $fi(x1) \leq fi(x2)$ for all objectives i Є {1,2,……,k } and
2. $fj(x1) < fj(x2)$ for at least one objective j Є {1,2,……,k }

Here we can say that solution x1 is Pareto optimal or non-dominated solution, because there does not exist better solution that dominates it.

B. *Multi-Objective Tasks Scheduling Algorithm*

Step 1: Create a list of tasks.
Step 2: Create a list of VMs.
Step 3: Perform non-dominated sorting for task list.
Step 4: Sort the VMs list in the descending order according to MIPS.
Step 5 : The first VM from the VM's list to the first task in the task's list and second VM in the VM's list with second task in the task's list.
Once the allocation reached the last VM, the next task will be submitted once again to the first VM of the VM's list and the process of allocation will be repeated for all tasks.

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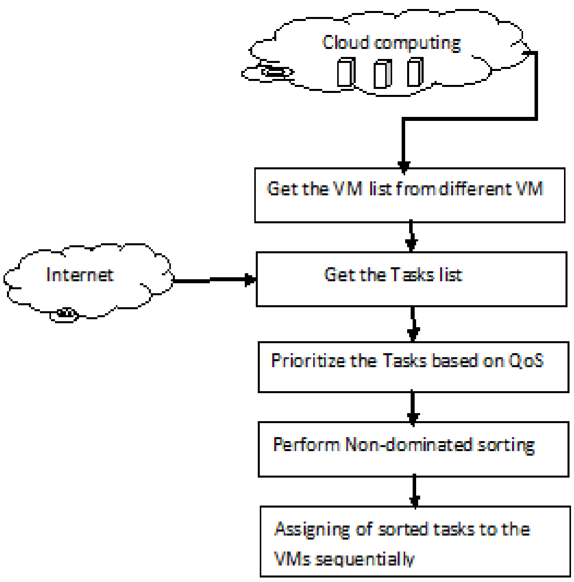
C. *Non-dominated sorting*

A non-dominated sorting [26] is used to solve the multi-objective problems. It is very effective method for finding Pareto-optimal solutions. In non-dominated sorting based on the dominance relationships, solutions in the population are allocated to different fronts. The set of non-dominated solutions is also called as the Pareto-Front. Comparisons of dominance relation between the solutions is the main action in non-dominated sorting. In proposed algorithm dominance comparison is performed on the basis of goal programming approach.

```
Non-dominated sorting(task list)
i=0
Create empty non-dominated list
Initially put task(i) into non-dominated list
  For all i=1 to size of task list
      For all j=0 to size of non-dominated list

            If task(j) dominates task(i) then
                 Put task(j) into non-dominated set
            Else If task(i) dominates task(j) then
                 Put task(i) into non-dominated set
            Else
                 Put task(i) and task(j) into non-dominated set
            End if
      End for
 End for.
```



V. SIMULATION RESULTS

The proposed algorithm is implemented using cloudSim simulator which runs on NetBeans IDE 7.2.1. CloudSim is a simulation toolkit which is used for checking performance of algorithm. The proposed algorithm compared with existing task scheduling algorithm. Here we considered 3 parameter such as task size, makespan and deadline. Here we have created many VMs with processing power range 1000-6000MIPS. We have also created many tasks with different task size. Range of task size is 1000-7000MI. For illustration, we have considered different QoS value range for

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makespan and deadline for different size of tasks. Our result shows that proposed algorithm performs better for above three quality parameter and gives better throughput.

V. CONCLUSION AND FUTURE WORK

Scheduling of task is one of the most challenging issues in cloud computing. The proposed task scheduling algorithm for cloud computing environment is based on multi objective optimization. This algorithm use non-dominated sorting for task ordering. This algorithm has better makespan than other task scheduling algorithm. And hence improve the throughput of the system. Proposed algorithm can be further improved by considering more QoS parameter.

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