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DIFFERENTIAL EVOLUTION- GSA BASED OPTIMAL TASK SCHEDULING IN CLOUD COMPUTING

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ABSTRACT

Cloud computing is an emerging technology now a days and has a lot of research potential in various areas like resource allocation, task scheduling, security and privacy etc. Task scheduling in cloud means for task execution selecting the best suitable resource. It is used to maximize resource utilization and minimize finishing time (Makespan). The total time taken for all tasks to be finished is known as makespan. The main objective of this paper is to optimize the task scheduling that uses DE-GSA to minimize the execution time (makespan).

KEYWORDS: Cloud Computing, Cloud Sim, Differential Evolution- Gravitational Search Algorithm (DE-GSA), Makespan, Task Scheduling

INTRODUCTION

Cloud computing is technology for enabling pervasive, suitable, on demand access of network to a shared pool of structure computing resources like network, storage, application and services [1]. It has appeared as a latest generation of distributed system that provides services like software as a service (SaaS), platform as a service (PasS), and infrastructure as a service (IasS). Three types of clouds in cloud computing are public cloud, private cloud, hybrid cloud. Public cloud is that cloud in which services over the internet are for public use. Private cloud is cloud in which services are used for particular organization. Hybrid cloud is aggregation of public and private cloud with many providers. It provides different types of storage and resources through internet to users. It provides on demand computing services to client. In cloud computing, efficiency, throughput & resource utilization is sometimes degraded. One way to enhance efficiency, throughput and resource utilization is task scheduling. Task scheduling is used to manage utilization of resources. So, that throughput of system is also increased. Scheduling means to assign a task to particular resources, so that resources are properly utilized. The high performance of cloud computing environment depends upon resource scheduling. It is an NP-hard problem.

Task scheduling in cloud computing: Task scheduling is an NP hard problem and it is an optimal usage of available resources. To design an effective scheduling approach and to determine how to minimize the makespan, resource utilization are problems in task scheduling in cloud computing. Meta heuristic approaches like particel swarm optimization, differential algorithm is used to find the solution for these optimization problems. Numerous task scheduling algorithms that have been proposed are discussed here:

PSO algorithm is a method that is influenced by common nature of a bird flock. This algorithm is a search space based approach and started by generating particle randomly. For an optimization problem, each particle is a candidate solution that moves in a search space. By using number of iterations, particles adjusted their position to reach the position that is closest to the target. In each iteration, particles velocity and position are updated based on the best position. PSO is used to optimize the real values because of its continuous domain. So, encoding needs to expand it to discrete domain. In PSO algorithm, each candidate (particle) act as a task and the candidate value show the index

of cloud resource. In every iteration of PSO, the velocity update and position update are helpful to find globally optimal solutions in search space. When no powerful advancement is found or a maximum number of tests had done then PSO will usually stop. PSO makes use of either social interaction or self interaction for pBest and gBest. The major advantages of this algorithm is its simplicity and easy implementation and good to search solution in large search space. The main drawback is its low convergence rate.

Differential Algorithm: Differential evolution is a technique used to enhance an agent in iterative manner. These types of methods are known as meta- heuristics. Some assumptions are taken for optimizing the problems and searching is done to find best agent in very large spaces. DE algorithm works with population of agents. By using mathematical formulae, these candidates are transferred in the search space and their positions are added up with position of existing candidate in population. If any candidate has improved new position only, then it is accepted and it becomes a part of population, otherwise that new position is simply rejected. The advantages of this algorithm are its simplicity, fast convergence and finding optimal solution approximately in every run. The drawbacks are that parameter tuning is necessary and same parameters may not guarantee the global optimal solution.

GSA (gravitational search algorithm): It is an optimization algorithm which is based on gravity law. In this, candidates are taken as objects and performance is calculated by their mass. These objects are attracted by a force which is known as gravity force which causes the movement of these objects globally towards the objects having heavy mass. By using gravitational force, objects are communicated to each other. The heavy mass which means good candidate solution move slow than lighter mass object. The candidate (mass) has four types: position candidate, inertial candidate, active gravitational candidate and passive gravitational candidate. The position of mass tells about the solution of the problem. By using fitness function, gravitational and inertial mass can also be determined. Every mass represent a solution, the mass which is attracted by light mass that is known as optimal candidate solution in population. This algorithm uses the law of gravity and law of motion. This algorithm gives better result than other heuristic approaches. The advantage of GSA is that it is very fast to get optimal solution and it searches the problem solution locally in the search space. The drawback of GSA is that, the particles do not use memory, because in GSA only current position of candidate plays a role in updating velocity.

RELATED WORK

The authors Antony Thomas et al [2] discussed about an efficient scheduling algorithm which was based on priority of user and length of task. No special importance is given to high prioritized task when they arrive. Min-Min algorithm was used by considering the task length to reduce makespan of tasks. The proposed credit based scheduling algorithm considered all the factors like task length, makespan, resource utilization. The author R K Jena [3] discussed about optimization of energy and execution time which used nested PSO algorithm for multiple purposes in task scheduling. The authors QI Cao et al [4] discussed about an Activity Based Cost (ABC) algorithm which is optimized algorithm for task scheduling and by comparing it with traditional algorithms, it was found that ABC algorithm gives correct cost than traditional one. The authors Dr. C. Rama Krishna et al [5] discussed about improved honey bees life scheduling algorithm which is Meta heuristic algorithm. It is used to optimize the cost efficiently. The authors Shivani Dubey et al [6] discussed task scheduling in cloud computing. The authors Wang Meihong et al [7] discussed four popular heuristic algorithms that are (PSO) particle swarm optimization, (ACO) ant colony optimization, (GA) genetic algorithm and simulated annealing algorithm. The factors like makespan, response time and schedule creating time were included. The result is that PSO performance is better than other algorithms. The authors Lili Xu et al [8] discussed about green cloud computing. An improved binary PSO algorithm is based on green cloud task scheduling algorithm. This algorithm has less execution time and resource consumption also got reduced. The authors LI Kun – Lun et al [9] discussed about improved GEP algorithm to solve the problems in multiple tasks scheduling in cloud computing. Improved GEP algorithm has double fitness value. It has good convergence rate and it reduces the optimization time.

PROPOSED WORK

Differential algorithm is capable for global searching and its local searching is weak. To overcome the drawbacks of existing algorithm a hybrid approach of Differential algorithm with Gravitational search algorithm is proposed. The goal of this proposed algorithm is to improve the performance of DE to find a solution and minimize the makespan and good convergence rate.

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Input: population size, velocity, gravitational force
Output: an optimal solution
1. start
2. Initialize the population generation.
3. Initialize the velocity creation for all individuals (candidate).
4. Calculate the fitness value of individuals.
5. Update the value of pBest, gBest and worst from population in search space.
6. By using equation (mass= fitness - worst/ best – worst), calculate mass and we get updated mass in result.
7. Calculate force based on updated mass by using equation (Force= gravitational constant* masses/ distance between the candidates).
8. Calculate acceleration based upon updated force by using equation (acceleration= gravitational force/ Mass).
9. Update the individuals (candidate) position by using acceleration.
a) Select changes= max (acceleration)
b) For i=1: changes
Select two random position of candidate i.e r1, r2
Interchange candidate (r1) and candidate (r2)
End for
10. Stop when best candidate is found.
11. End

Objective function: Makespan: The makespan is total time taken to complete all the tasks. The makespan evaluates completion time of all tasks on each virtual machine and returns highest completion time as a makespan. In result, at the end Best candidate solution is found. It returns a schedule of execution time. A schedule contains allocation of tasks on resources properly. A low value of execution time is selected from this schedule. This is makespan value.
Formula: Makespan= max[EST+ ET] Where EST is execution starting time and ET is execution time.

IMPLEMENTATION

Cloud computing gives an simulation background for scheduling. It consist of various data centre and by using virtualization, resources are used to give the services to users. For proposed algorithm verification, we conducted experiment on Intel inside® core(TM) i5 Processor 2.30 GHz, window 7 ultimate platform and cloud Sim 3.0.3 simulation tool integrated with net beans. The Net Beans Integrated Development Environment is open source software development platform written in the Java. It provides the services to develop applications such as user window management, management of storage and netbeans visual library. The NetBeans platform support for developing applications for profitable and non- profitable use, and supported by Sun Microsystems. The cloud Sim tool kit is used for modeling the cloud components like data centers, virtual machines and scheduling methods.

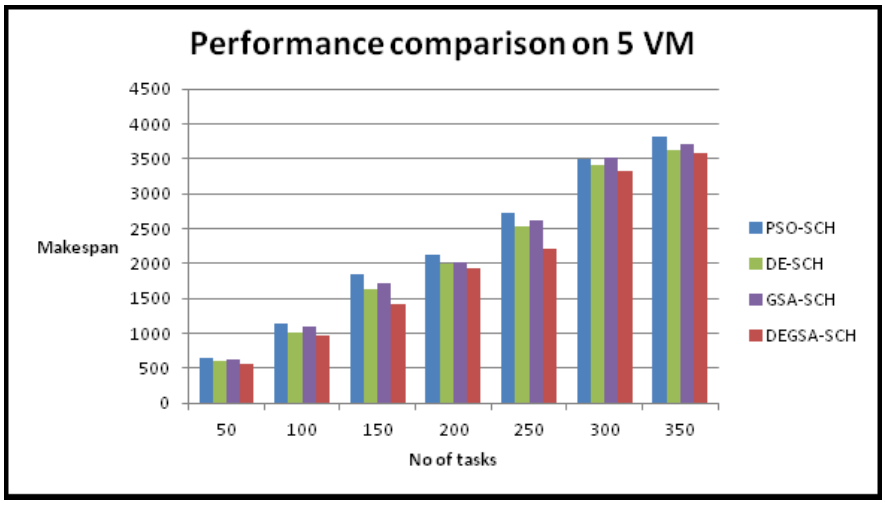

Fig 1: performance comparison of existing and proposed algorithm

In figure 1, DE-GSA scheduling algorithm has been compared with PSO, DE and GSA Scheduling. This graph is made up between no. of tasks and makespan. This shows that our proposed approach is perform better than existing approaches by taking Virtual machines (5) with increasing number of tasks.

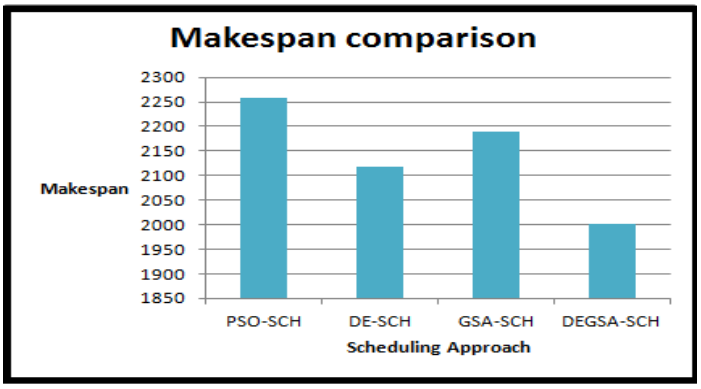

Fig 2: Makespan Comparison between PSO, DE and GSA with DE-GSA

The figure 2 shows makespan of PSO, DE, GSA and DE-GSA algorithms. From the experiment, it was found that makespan (time) value of DE-GSA algorithm was lowest (2002) as compared to PSO (2258), DE (2116) and GSA (2188). It means that DE- GSA algorithm performs better than PSO, DE and GSA algorithm, because of its convergence rate and it is a local search optimization.

Table 1: Comparison among all task scheduling algorithms (Makespan)

No. of tasks	PSO	DE	GSA	DE-GSA
50	650	600	630	560
100	1150	1010	1100	960
150	1840	1640	1720	1420
200	2120	2000	2019	1940
250	2729	2539	2610	2219
300	3500	3400	3520	3330
350	3820	3627	3720	3589

This table shows the comparison of makespan values of different algorithms. This table shows that DE-GSA proposed algorithm performs better than PSO, DE and GSA.

CONCLUSION

This paper proposed DE-GSA algorithm with the goal of the minimum finishing time of tasks. Differential evolution algorithm can effectively optimize task scheduling in cloud computing, but convergence rate is slow, so GSA is used to resolve this problem. The experiment shows proposed DE-GSA algorithm has improved makespan by comparing it with other three algorithms makespan values. In future, the proposed algorithm can be used to solve the task deadline issue by changing the objective function.

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