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IMPROVE QUALITY OF SERVICE IN OPTIMIZATION OF JOB SCHEDULING USING A HYBRID APPROACH

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Abstract

Computing resources are scattered under unlike ownerships each one possesses their particular access tactic, outlay and a range of constraints. Now a day, the newest paradigm to come into view is Cloud Computing environment that guarantees stable functionalities offered by high-end data centers which are constructed based on storage, computation and virtualization concepts. Users are informed and skilled to get information and use applications throughout the globe on claim from everywhere and anytime in cloud environment. Virtualization is an appellation that associates to the abstraction of computer resources. The functionalities which are normally called as "Cloud Services," are passed through various high-end data centers. In this research paper, Job Scheduling is proposed based on an optimized approach by hybridizing the Genetic Algorithm and Tabu Search algorithm for the cloud environment using CloudSim Simulator to choose the most capable service or application from the correct set of services.

KEYWORDS: Tabu Search, Job Scheduling, Genetic Algorithm,Cloud Computing, Physical Machine, Virtual Machine.

1. Introduction

Cloud computing creates the whole thing more striking as functionality or service and its services to be more immensely reachable, extendable, and self-working [1]. A Job or (sometimes task) scheduling scheme performs a significant part in order to accomplish users' Job QoS needs and requirements and utilize resources competently in a cost effective manner. To select most capable functionality or service from the appropriate various set of services, Job scheduling centered on Hybrid Algorithm HTSGA (Hybridization of Tabu Search with Genetic Algorithm) is proposed as cloud computing environment research work using CloudSim [14]. Job scheduling allots suitable jobs or responsibilities to hosts thus the implementation is finished to assure aim functions forced by users. VM provisioning takes place in the cloud environment at 2 levels: main, at the host stage and another, at the Virtual Machine stage. In stage one and host stage, virtual machine (VM) resources are mapped and scheduled to physical machines (or hosts) in order to achieve the most suitable scheduled solution for achieving the highest degree of device load stability. The foremost aim of mapping is to map compliant VMs to PMs (physical machines) appropriately with

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flexible time that is basically, getting a suitable sequence to improve resource efficiency. In Virtual Machine stage, the Virtual Machine consigns predetermined quantity of existing execution command to the separable application task units which are set up inside its computation engine. This research work proposes approaches at both the above mentioned levels to solve Job Scheduling problem to improve resource utility by tabu search algorithm and hybridizing genetic algorithm.

2. Theoretical Evaluations of Technologies

2.1 The Emergence of Cloud Computing, Virtualization and CloudSim Overview

The foremost approach behind the Cloud structure is providing storage, computation and application "as a functionality or service". Virtualisation is a technique which abstracts physical hardware facts and provides virtualized resources for applications. A virtualized server is normally called a VM (virtual machine) is a virtual implementation of a system that executes applications and jobs like an actual system. The cloud decides how those virtualized resources are allocated delivered, and presented. A very common concern is "Experimental evaluation is too much of work and "expensive" for computing researchers and academicians". A more practicable substitute is the utility of simulation tools (ex. CloudSim). CloudSim simulator has been used in this research work that demonstrates mapping of CPU resources at 2 stages: Host stage and Virtual Machine stage. For this research work TimesharedCloudletScheduler policy was used to assign tasks to VMs.

3. A Scheduling System Design

3.1. Scheduling Problem and Policy

The role of the scheduling system structure is to assign resources for a definite time to an application request. In the circumstance, scheduling works with the allotment of resources like processor nodes to user application requests for large computations. These requests are typically called jobs. Job Scheduling based on Hybrid Algorithm HTSGA (such as Genetic Algorithm with Tabu Search) is a research function for the cloud computing environment to select the most capable service from the most suitable service sets

3.2. Objective Function

The most important intention of schedule/mapping system has to map jobs to the appropriate available VMs in malleable time that engages getting an appropriate succession in that jobs can be accomplished under particular logic restriction.

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Definition1

The foremost objective of the job scheduling system has to establish an accurate mapping sequence so that jobs are performed following certain (logic) restraints. This problem comes under a class known as NP-complete problems, whose execution time for an exact solution raises with N as exp (const.× N), becoming quickly excessive in cost as N raises. So here, scheduling problem consider Jm user jobs m = {1, 2, .M} on Rn dissimilar resources n= {1, 2… N} with a purpose of reducing the completing time and employing the resources efficiently. A task/job from Jm to be proceeded in system resource Rn, till accomplishment.

4. Scheduling Algorithms

4.1. Genetic Algorithm (GA)

An excellent scheduling process is estimated to generate very excellent, if not optimum schedules, in accordance to the objective function while not taking ‘much’ time and ‘many’ resources to decide the schedule. GAs are basically heuristic procedure that mainly enlightens optimization problems depending on the genetic progression of biological organisms. A typical genetic algorithm is illustrated in below.

Stag 1 Create initial population.
Stag 2 Estimate population by calculating fitness value.
Stag 3 Select parents from RouletteWheelList arranged by
RouletteWheelSelection
Stag 4 Use Crossover to produce children.
Stag 5 Use Mutation to children.
Stag 6 Select parents and children to produce the firsthand population for the
subsequent
Generation.
Stag 7 If finishing condition is come to an end, otherwise go to Step 2.

Algorithm 1: Basic GA

The initialization process is an additional significant concern in entirely GAs because it must produce an arbitrary preliminary population which extent in the entire search space.

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Definition 2

An individual's reign in the entire population may be determined by calculating the fitness function. The fitness value (Eq. 1) measures importance of an individual.

$$F = UV/UC \qquad (1)$$

Where F = Fitness Value, UV = Utilized Value UC = Unique Count (i.e. the number of physical machines or hosts utilized)

$$UV = \sum(VMCi/PMCj) \qquad (2)$$

for i=0,1,2,……n VMs and j=0,1,2,…....m PMs Where VMC = Virtual Machine Capacity (or VMCapacity) PMC = Physical Machine Capacity (or PMCapacity)

Crossover operator

Arbitrary pair of chromosomes is selected for crossover operation, and then, an arbitrary point is selected in the initial chromosome. A selection of a few chromosomes is used for roulette wheel selection. A crossover operation (Algorithm 2) is performed for rejoining 2 strings to get a superior chromosome.

Choose randomly a crossover position p
Offspring1 content of parent1' s gene[k],k ∈ [0; p − 1] and
parent2's gene[v] not(∈) gene[k],v ∈ [0; m];
Offspring2 is content of parent2's gene[k],k ∈ [0; p − 1];
and parent1's gene[v] not(∈) gene[k],v ∈ [0; m];

Algorithm 2: Crossover Operation

Mutation

This process supplements, the genetic search process in an arbitrary way with new information and actually helped not to get caught at local optima.

Choose randomly Gene g;
Get the first successor Suc(g) from g to the finish ;
Select randomly a Gene k ∈ (G, Suc(g)) ;
Get the first predecessor Pre(k) from Suc(g) to the start;
if Pre(k) > g then Exchange position of gene g and gene k;
Generate a new offspring;
Endif

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Algorithm 3: Mutation Operation

4.2. Tabu Search (TS)

TS is a heuristic approach used to work out the problems of combinatorial optimization. The main concept of TS, to follow local exploration when finding a local optimum by allowing non-enhancing moves; reverting to already explored solutions is disallowed by the use of memories, which are tabu lists that store up to date account of the search.

Stag 1 Generate current solution y.
Stag 2 Declare the Tabu List.
Stag 3 Calculate fitness(y).
Stag 4 Till set of neighbour solutions Y‟ is not finished.
Stag 4.1 Produce neighbour solution y‟ from existing solution y
Stag 4.2 Supplement y‟ to Y‟ only if y‟ is not stored in tabu or if one of the Aspiration Criterion is fulfilled.
Stag 5 Pick the finest neighbour solution y* in Y‟.
Stag 6 If fitness (y*) > fitness (y) then y = y*.
Stag 7 Modify Aspiration Criteria and Tabu List
Stag 8 If termination condition come to an end, otherwise go to Step 4.

Algorithm 4: Tabu Search

5. Hybrid Tabu Search and Genetic Algorithm (HTSGA)

5.1. Need for the Hybrid Algorithm

Problems with scheduling demonstrate such complexity and variety that no single scheduling approach is satisfactory. The efficacy of a local search in achieving a local optimum incorporates a genetic algorithms ability to identify the most competent basins in the search area. In a proficient algorithm, therefore, the integration of a local search into a genetic algorithm can be created. GA starts with a collection of preliminary solutions during the hybrid search process, and generates a set of new solutions. TS execute a local search on each set of new solutions to better them. GA considers TS 'improved solution to continue with parallel evolution. Integrating a local search approach also initiates an explicit enhancement operator which can produce high excellence solutions.

5.2 Hybridization of Tabu Search and GA

The core intent of the research paper has to decrease execution time, system cost, completion time, resource utilization and power consumption while satisfying all constraints. Hybridization of TS with GA formulates the algorithm more robust. In the hybrid TS and GA (HTSGA) technique, initialization, crossover and mutation in GA is substituted by initialization, crossover and Tabu

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search. In place of random mutation modifies each member of the population goes through a separate optimization procedure illustrated by a tabu algorithm.

Stag 1 Create initial population.
Stag 2 Set the Tabu List
Stag 3 Evaluate population by calculating fitness value.
Stag 4 Select parents from RouletteWheelList arranged by RouletteWheelSelection
Stag 5 Perform Crossover to create children.
Stag 6 Perform Mutation to children.
Stag 6.1 Initialize children as y
Stag 6.2 Till neighbour solutions set Y‟ is not finished.
Step 6.2.1 Create neighbour solution y‟ from existing solution y
Step 6.2.2 Supplement y‟ to Y‟ only if y‟ is not stored in tabu or if minimum one Aspiration Criterion is fulfilled.
Stag 6.3 Pick the finest neighbour solution y* in Y‟.
Stag 6.4 If fitness(y*) > fitness(y) then y = y*.
Stag 6.5 Modify Tabu List and Aspiration Criteria
Stag 6.6 If predefined state achieved, else go to Stag 6.2.
Stag 7 Choose parents and children to generate the firsthand population for the subsequent generation.
Stag 8 If finishing state is encountered, else go to Step 4

Algorithm 5: HTSGA

6. Experiments and Evaluation

6.1. Experimental Evaluation

In this research work, by default VM Allocation Policy is replaced by our algorithms including Tabu Search, Genetic Algorithm and HTSGA. Time-shared policy has been used in the simulation of jobs to VMs. Numbers of experiments were performed using three approaches to genetic algorithm, tabu scan, and HTSGA, considering specific QoS parameters. Their comparative results are also displayed through various charts.

Experiment 1: Execution time comparison

Host is represented as an actual computation machine in a Cloud: it is allotted a reassigned execution competency (represented in MIPS), storage, memory, and a policy for assigning execution cores to VMs. Execution time is the time required for allocation of virtual machines to physical machines at Host level. Figures 7.1 shows time of execution needed to schedule VM number (Rang from 75, 100, 125 …) to PMs (50, 75 …). Therefore, in most cases, genetic algorithm time is smaller than TS and HTSGA. GA. is able to perform a parallel search to determine the global search area. During the parallel search method GA gains meaningful data about what has been obtained from prior generations. GA looks

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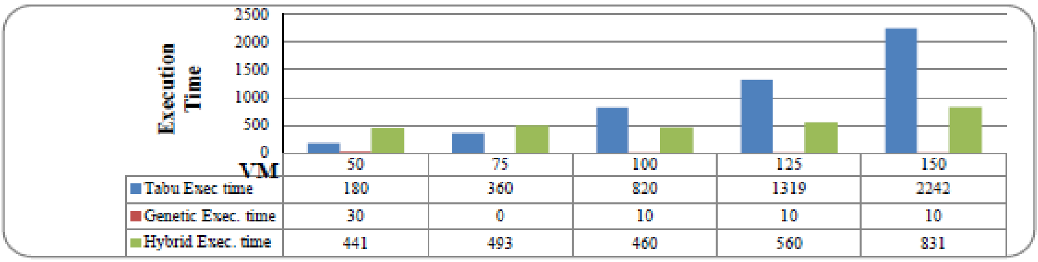
for the solution from the entire population rather than a particular point. Tabu Search performs on the individual string, points within the solution region. Execution time for the hybrid algorithm HTSGA is the enhancement of the tabu search but not as compared to Genetic algorithm.

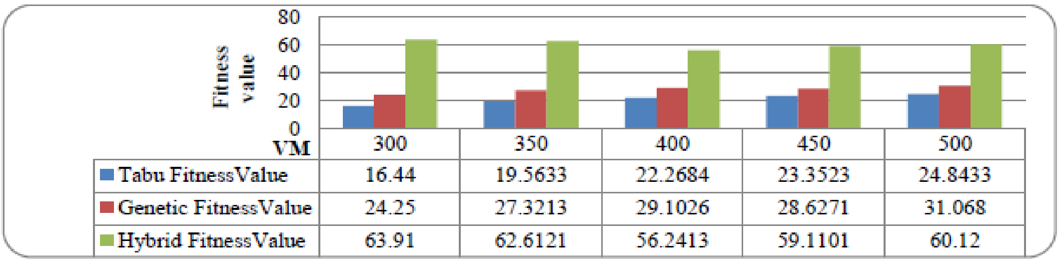


VM	50	75	100	125	150
Tabu Exec time	180	360	820	1319	2242
Genetic Exec. time	30	0	10	10	10
Hybrid Exec. time	441	493	460	560	831

Figure 1: Execution Time comparison for PM = 75

Experiment 2: Fitness Value Comparison

Better the fitness value, better the fitness value approach can evaluate the reliability necessary to ensure consistent and reliable results. Figure 7.2 shows the fitness value for three approaches and it is observed that the HTSGA hybrid algorithm has better fitness value in all cases.



VM	300	350	400	450	500
Tabu FitnessValue	16.44	19.5633	22.2684	23.3523	24.8433
Genetic FitnessValue	24.25	27.3213	29.1026	28.6271	31.068
Hybrid FitnessValue	63.91	62.6121	56.2413	59.1101	60.12

Figure 2: Fitness Value Comparison for PM = 300

Experiment 3: Resource Utilization Comparison

An effective scheduling strategy has as its main objective the proper use of physical resources. Figure 7.3 shows the differences between three approaches and the hybrid algorithm HTSGA used the physical resources correctly in all situations and has less physical machine count compared to other approaches. Machines but GA and TS could not.

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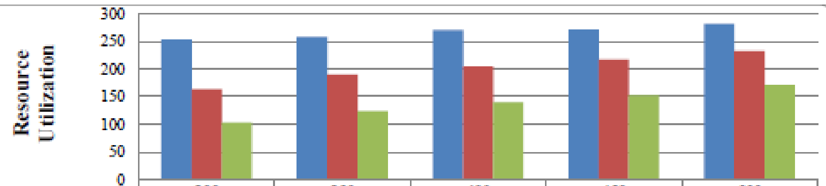


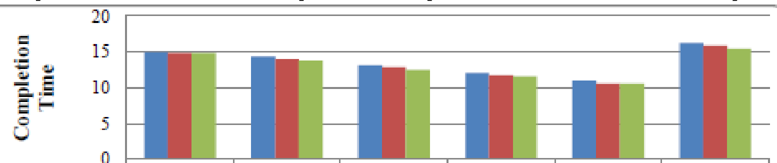
VM	300	350	400	450	500
Tabu ResourceUtil	253	258	270	271	282
Genetic ResourceUtil	163	190	204	217	232
Hybrid ResourceUtil	103	124	140	152	171

Figure 3: Resource Utilization Comparison (for PM = 300)

Experiment 4: Completion Time Comparison

Tasks required to be accomplished within a deadline in the real time environment. Figure 7.4 shows the completion time of various tasks on different VMs and ob-served that the hybrid algorithm generates a minimum completion time in most cases.

Figure 4: Completion Time comparison (for PM=300 VM=400)



Tasks	350	400	450	500	550	600
Tabu CompletionTime	14.93	14.39	13.11	12.02	10.96	16.21
Genetic CompletionTime	14.81	13.96	12.89	11.74	10.55	15.85
Hybrid CompletionTime	14.81	13.77	12.43	11.53	10.55	15.43

7. Conclusion

The main stress in Cloud Computing has to generate the schedules at an optimal ex-tent of time. Especially as demand increases, when the number of jobs and re-sources increases, traditional GAs become time-consuming. Various QoS metrics have been defined for better performance. Considering different QoS parameters metrics have been defined for better performance. Several experiments are conducted taking into account specific QoS parameters, and it is observed that hybrid algorithm (HTSGA) performed much well than genetic algorithm and tabu search. Comparative charts are given, showing the better performance of HTSGA.

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