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Deadline Constrained Cloud Computing Resources Scheduling by Hybrid of Particle Swarm Optimization with Ant Colony Optimization

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Abstract:
Cloud computing is flourishing day by day and it will continue in developing phase until computers and internet era is in existence. An evolutionary algorithm copies the way how evolution occurs in the nature. There are various types of evolutionary algorithms. This paper focuses on Genetic, ACO and PSO algorithms. Genetic algorithm provides solution to various optimization problems Job scheduling is one of the answers to these issues. It is the process of mapping task to available resource. Ant colony optimization is a heuristic algorithm which follows the behavior of ants i.e., the way ants seek food in their environment by starting from their nest. Particle swarm optimization algorithm (PSO) is also an optimization algorithm which also uses a method of searching using some heuristics. In section discuss about cloud computing and scheduling, explanation about job scheduling in cloud computing, existing algorithms for job scheduling are discussed, existing algorithms are compared and lastly conclusion and future work are discussed.

I. INTRODUCTION

With rapid growth in Information Technology, more and more workflow systems are adopting cloud as their execution environment. It becomes progressively competitive on how to efficiently manage various workflows. Workflow is one of the most challenging problems in cloud to execute it while minimizing time as well as cost incurred by set of heterogeneous resources over the cloud simultaneously.

DEFINITION

Workflow can be automated with software tools that use business rules to decide when one step has been completed successfully and the next step can begin. Some workflow management software programs can also coordinate dependent relationships between individual steps, a concept known as workflow orchestration. Workflow documentation and business process modeling are important aspects of business process management.

CLOUD COMPUTING

Nowadays, Cloud computing is a growing area in distributed computing that deliver dynamically adaptable services on demand over the internet through virtualization of hardware and software. The biggest advantage of the cloud is its flexibility to lease and release resources as per the user requirement. Furthermore, the cloud provider offers two type of plans namely short term plan on demand and long term reservation plan. It has got intelligent infrastructure i.e. Transparency, Scalability, Monitoring and Security

WORK SCHEDULING

Scheduling of workflows require huge computation and communication cost. It is the process of mapping inert-dependent tasks on the available resources such that workflow application is able to complete its execution with user defined quality of service. This work target random workflow requests overtime, so it must schedule workflow execution without any knowledge of future requests.

II. REVIEW LITERATURE

This section gives a brief review of the work carried out by various researchers in this field. Work has been done by researchers in **Workflow on Cloud.** Various aspects of the problem were studied. Performance effective and low complexity task scheduling for heterogeneous computing [9] Haluk et al. has proposed two approaches for scheduling a workflow task in heterogeneous computing environment namely HEFT and Critical path on a Processor. They work on the same line with slight differences. HEFT uses the upward rank for task prioritization; the other uses the combination of upward and downward ranks. The latter uses the critical path and assigns the tasks on the critical path to the processor which will give minimum EFT. HEFT is better than other algorithms in same domain because of its high efficiency in terms of makespan and robust nature. A Hybrid Heuristics- Genetic Algorithm for Task Scheduling in Heterogeneous Processor Networks H2GS [7]

Chen et al. [9] proposed an ant colony optimization (ACO) algorithm to schedule massive-scale workflows with numerous QoS parameters. This algorithm permits customers to specify their QoS options as well as outline the minimal QoS thresholds for a sure software. The goal of this set of rules was to find a solution that meets all QoS constraints and optimizes the user-preferred QoS parameter. based totally at the traits of workflow scheduling, author designed seven new heuristics for the ACO technique and proposed an adaptive scheme that lets in synthetic ants to select heuristics based on pheromone values.

Byun et al. [10] advised architecture for the automatic execution of huge-scale workflow-primarily based applications on dynamically and elastically provisioned computing resources. Authors centered on its middle set of rules named

PBTS (Partitioned Balanced Time Scheduling), which estimates the minimal variety of computing hosts required to execute a workflow inside a user-distinctive end time. The PBTS set of rules was designed to in shape each elastic useful resource provisioning models together with AmazonEC2 and malleable parallel utility models consisting of Map lessen. author verified that PBTS estimates the aid potential close to the theoretical low certain.

Kaur et al. proposed a new Modified Genetic Algorithm for scheduling the tasks in private cloud for minimizing the makespan and cost. In MGA, initial population is generating using SCFP(Smallest cloudlet to Fastest Processor), LCFP(Longest cloudlet to Fastest Processor) and 8 random schedules. Two point crossover and simple swap are used. This gives the good performance under the heavy loads. A Performance Effective Genetic Algorithm for Task Scheduling in Heterogeneous Systems (PEGA) [17] Ahmad et al. proposed an effective genetic algorithm called PEGA, which is capable of providing the optimal results in large space with less time complexity. The direct chromosome representation is used having two parts. The right half is made by the b-level (upward rank) which give the better results in terms schedule length when compared with randomly generated population. Two fold cross over is used in which single and two point crossover are executed one after the other in order to enhance the quality and the convergence speed of the solution. The author has concluded that the PEGA provides the better schedule with smaller makespan and low time complexity. 13 A Hybrid Heuristic-Genetic Algorithm for Task Scheduling in Heterogeneous Multi-Core System (HSCGS)[18] Wang et al. presented a hybrid approach which uses a combination of successor concerned list based heuristic and a genetic algorithm. First phase is the seeding method for GA, is a method to generate the initial population by the schedule given by the SCLS(Successor concerned list heuristic). In SCLS, Priority list of the task was formed using the upward rank .In the second phase the good quality schedule generated by the above phase is fed into the genetic algorithm. The authors had proved that HSCGS give better results than HEFT and DLS(Dynamic Level Scheduling) Deadline constrained Workflow Scheduling Algorithms for Infrastructure as a Service Clouds [19]

Saeid et al. have proposed two algorithms for workflow scheduling based on the Partial Critical path to find the optimal solution in terms of minimal cost subject to the defined deadline constraints. IC-PCP(Iaas cloud partial critical path) tries to schedule the tasks on partial critical path by allocating them to the available instances of the service before its latest finish time. ICPCP2(Iaas cloud partial critical path with deadline distribution) uses the new method for path assigning policy and planning is done such that the remaining time of the available instance is used first to execute the task before its subdeadline, rather than starting a new instance of the service. Deadline constraint heuristic-based Genetic Algorithm for Workflow Scheduling in Cloud[20]

Verma et al. has proposed three hybrid genetic algorithm that uses the schedule generate by the bottom level and top level as an initial population to minimize the execution cost of the schedule while following the deadline constraint. BGA(Bottom- level GA) uses the bottom level in descending order to assign the priorities, while TGA (Top-level GA) consider the top-level in increasing order. BTGA (Bottom level and top level) which uses both level has a better performance than the other two. 14 Predict Earliest Finish Time (PEFT)[21]

Arabnejad et al. proposed a new list based scheduling technique named PEFT for heterogeneous distributed computing which gives the better results than HEFT in terms of makespan. It has the same time complexity as that of HEFT. It consists of task prioritizing phase and processor selection phase. Most of the list based scheduling allocates a task to the processor on which it gives the smallest EFT for the current task. They do not consider the impact of children on the current task and hence sometimes lead to the poor decisions. The author implemented an algorithm works in a same way as the Lookahead algorithm and has less time complexity. It makes the use of an optimistic cost table (OCT) which is the basis for finding the task priority and selecting a resource for it. OCT indicates the minimum time required for processing all the tasks which lies on the longest path from the current task to the end task. In task prioritization, task priority is calculated by cumulative OCT. Optimistic EFT is calculated to assign a processor for a task. The aim is to ensure that the children tasks of the current task are finished earlier. The author has shown that PEFT does not give good results if all the tasks lies on critical path. Deadline based Resource Provisioning and Scheduling Algorithm for Scientific Workflows on Clouds [22]

Maria et al. have used PSO metaheuritic technique to optimize the scientific workflow on IaaS cloud. The authors have incorporated the basic features of IaaS cloud such as unlimited heterogeneous resources, flexibility, dynamic provisioning of resources, VMs boot time as well as leased time and performance variation of VMs. The idea is to combine the resource provisioning along with the scheduling strategy with a objective to minimize the execution cost while staying in the defined deadline. Task scheduling using NSGA II with Fuzzy Adaptive Operators for Computational Grids [23] Salimi et al. have represented an improved version of famous multi-objective genetic algorithm known as NSGA-II in the market-based grid environment. Cost is a major optimizing criterion in cloud, thereby along with makespan, cost is also considered in the proposed algorithm. The 15- optimization process is realized with two objectives instead of three objectives by considering the load balancing indirectly using fuzzy operators to improve quality and performance of task scheduling. Three functions are defined to generate inputs for fuzzy systems. Variance of costs, variance of frequency of involved resources in scheduling and variance of genes values are used to determine probabilities of crossover and mutation intelligently. A Hybrid heuristic algorithm for workflow scheduling in cloud systems (HSGA) [24] HSGA is a hybrid algorithm for heterogeneous distributed system like cloud computing which works on genetic algorithm by combing the advantages of two heuristic techniques.

Delavar et al. proposed a new method for initial population so that the algorithm gives the results faster. Task prioritization is done by considering the influence of the tasks on each other according to the graph topology. It combines the Best Fit and Round Robin method for assigning the resources to the tasks. Best Fit is used for assigning resource to a task and for the next chromosome, Round Robin is used, means best resource for assigning to the task will start from next place relative to previous chromosome. It uses the random gene selection crossover and mutation replacement with a better resource. The aim is to decrease the completion time and the failure rate of the application. A Genetic Algorithm for Task Scheduling on Heterogeneous Computing Systems using Multiple Priority Queues[8] MPQGA generates various priority queues using a heuristic based cross over and heuristic based mutation operator in order to minimize the makespan.

Xu et al. had used integer- string coded genetic algorithm that employs roulette-wheel selection and elitism. It uses the advantages of HEFT heuristic algorithm to find a better result in which the highest priority task calculated by the upward rank is mapped on to the processor which gives the less EFT. It generates a set of multiple priority queues based on downward rank, combination of level and upward and downward rank and upward rank for the initial population and the remaining priority queues are chosen randomly. These three heuristic methods are used to generate good seeds which will be uniformly spread into the entire feasible solution space so that no stone is left unturned. This algorithm covers a large search space than the deterministic algorithm without much cost. 16 A review of metaheuristic scheduling techniques in cloud computing [25

III. GAP ANALYSIS

a) In previous work, the budget was not considered and the dealt time of workflow task and this is important for task execution cost.
b) In previous work, workflow was passed according to levels and ignores the dependency between the tasks.
c) In previous work optimization of VM processing time is very high.
d) In previous work data replica is very high so storage capacity very which increase the overhead of storage.
e) In previous work not forecast of future behavior of VM
f)Moreover, randomly scheduled the task by FIFO (First In First Out) and Round Robin and also never consider the length of the task.

IV. PROBLEM STATEMENT

The main problem which is identified through survey is that all algorithms focus on generating approximate or near-optimal solutions, it is impossible to generate an optimal solution within polynomial time and therefore workflow scheduling is NP hard problem. The solutions provided in literature survey are not optimal for utility like environments such as IaaS Clouds however; they focus into the challenges and potential for workflow scheduling. When planning the execution of a workflow in an IaaS Cloud environment. When planning the execution of a workflow in an IaaS Cloud environment there are two main opinions: (a) Resource Provisioning (b) Scheduling. In the resource provisioning phase the computing resources that will be used to run the tasks are selected and provisioned and in Scheduling, a schedule is generated, and each task is plotted onto the best-suited resource. The selection of the resource and mapping of tasks is done in such a way that requirements of different user in terms of Quality of Service (QoS) are met. Numbers of algorithms are proposed till now like PSO, ACO, GA and many more, to meet QoS parameter by scheduling large scale workflows. There are different aims of Resource provisioning and scheduling heuristics. Our effort focuses on scheduling the workflow on IaaS computing resources and finding an optimal solution by minimizing cost and execution time.

V. PROPOSED SOLUTION

The principal idea of this research work is that in order to integrate some basic philosophies of Cloud computing such as the elasticity and heterogeneity of the computing resources and to meet the user's Quality of Service (QoS) requirementson Infrastructure as a Service (IaaS), there should be resource provisioning and scheduling strategy for scientific workflows. In order to minimize cost and execution time, PSO algorithm was proposed but, in some cases,, it fails to produce schedules with worse makespan and greater costs as long as the deadline is met [14]. Hybrid PSO (ACO-PSO) was used in Mobile ad-hoc network and gives better presentation in terms of delay, power, consumption, and communication cost as compare to standard PSO [25]. Therefore, for better results if we use ACO-PSO optimization algorithm in an IaaS Cloud an efficient execution plan can be designed in order to reduce makespan and pay a lower price

VI. OBJECTIVES

A) To merge two algorithms Ant colony optimization algorithm and Particle swarm optimization.
B) To find solution in which total execution cost is minimized and makespan is reduced.
C)To compare the hybrid approach with Particle Swarm Optimization.

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