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To Enhance Energy Aware Cloud Scheduling By Using Metaheuristic Technique

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ABSTRACT: The trend on usage of cloud computing is growing significantly and the higher demand of cloud leads it to process huge and various amount of data at a time and many tasks are in the form of scientific workflow. Workflows are direct acyclic graphs (DAG) in which each node represents tasks and edges represents dependencies. In order to make cloud fulfill the users request effectively then how scheduling of the workflow can be obtained is vital. In this paper, a proposed technique which is a hybridization of Particle Swarm optimization and Ant colony optimization algorithm has been implemented. Two parameters i.e. cost and last dag finish time is used to compare and analyze the performance. The experiments simulated on CloudSim platform in which comparison between the proposed algorithm and the existing scheduling algorithms is performed that proves the proposed algorithm has better optimization ability than others.

KEYWORDS: Energy Aware, Cloud Scheduling, Cost, Last dag finish time.

I. INTRODUCTION

Cloud computing can be classified as a new paradigm for the dynamic provisioning of computing services supported by state-of-the-art data centers that usually employ Virtual Machine (VM) technologies for consolidation and environment isolation purposes. In industry these services are referred to as Infrastructure as a Service (IaaS), Platform as a Service (PaaS), and Software as a Service (SaaS) respectively. A recent Berkeley report stated: ‘‘Cloud computing, the long-held dream of computing as a utility, has the potential to transform a large part of the IT industry, making software even more attractive as a service’’.

Cloud service providers need to adopt measures to ensure that their profit margin is not dramatically reduced due to high energy costs and time. The rising energy cost and time is a highly potential threat as it increases the Total Cost of Ownership (TCO) and Total Time of Ownership (TTO) and reduces the Return on Investment (ROI) of Cloud infrastructures.

In cloud computing hardware includes both ICT equipment and supporting equipment within a data center, as defined. ICT equipment includes Network and Server domains because they perform the main task of the data center and are the main focus of this survey. Domains such as Power supply, Cooling, and the Data center building itself are considered supporting equipment and are covered only briefly in this survey. Network and Server domains are described and analyzed but Software equipment within a data center includes everything that runs on top of the ICT equipment. It includes two domains that are covered in this survey: Cloud Management Systems (CMS) that are used to manage the entire data center and Appliances, which include software used by a user

In Cloud computing Scheduling is fundamental to computation itself, and an intrinsic part of the execution model of a computer system; the concept of scheduling makes it possible to have computer multitasking with a single central processing unit (CPU).A scheduler may aim at one of many goals, for example, maximizing throughput (the total amount of work completed per time unit), minimizing response time (time from work becoming enabled until the first point it begins execution on resources), or minimizing latency (the time between work becoming enabled and its subsequent completion) before some scheduling algorithm used to schedule like Ant Colony Optimization ACO and Particle Swarm Optimization (PSO) etc. Our aim to produce a new scheduling algorithm which is more efficient than

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the pre proposed algorithm. So in this i am going to make a hybrid model of both ACO and PSO by using metaheuristic technique.

In recent years, distributed computing paradigm has gained much attention due to high scalability, reliability, information sharing and low-cost than single processor machines. Cloud computing has emerged as the most popular distributed computing paradigm out of all others in the current scenario. It provides on-demand access to shared pool of resources in a self-service, dynamically scalable and metered manner with guaranteed Quality of service to users. To provide guaranteed Quality of Service (QoS) to users, it is necessary that jobs should be efficiently mapped to given resources. If the desired performance is not achieved, the users will hesitate to pay. Therefore scheduling is considered as a central theme in cloud computing systems.

Our aim, in general, the problem of mapping tasks on apparently unlimited computing resources in cloud computing belongs to a category of problems known as NP-hard problems. There are no algorithms which may produce optimal solution within polynomial time for such kind of problems. Solutions based on exhaustive search are not feasible as the operating cost of generating schedules is very high [2]. Metaheuristic based techniques [3] deal with these problems by providing near optimal solutions within reasonable time. Metaheuristics have gained huge popularity in the past years due to its efficiency and effectiveness to solve large and complex problems. In this paper, we present an extensive review of various scheduling algorithms based on metaheuristic techniques namely Ant Colony Optimization (ACO) and Particle Swarm Optimization (PSO),

II. LITERATURE SURVEY

In Xin-She Yang et al [2013]: This paper provides a timely review of the bat algorithm and its new variants. A wide range of diverse applications and case studies are also reviewed and summarized briefly here. Further research topics are also discussed. Bat algorithm (BA) is a bio-inspired algorithm developed by Yang in 2010 and BA has been found to be very efficient. As a result, the literature has expanded significantly in the last 3 years. In Qi Zhang et al [2012]: In this paper, they provide a control-theoretic solution to the dynamic capacity provisioning problem that minimizes the total energy cost while meeting the performance objective in terms of task scheduling delay. Specifically, they model this problem as a constrained discrete-time optimal control problem, and use Model Predictive Control (MPC) to find the optimal control policy. Through extensive analysis and simulation using real workload traces from Google's compute clusters, they show that our proposed framework can achieve significant reduction in energy cost, while maintaining an acceptable average scheduling delay for individual tasks. Anton Beloglazov et al [2011]: In this paper they conduct a survey of research in energy-efficient computing and propose: (a) architectural principles for energy-efficient management of Clouds; (b) energy-efficient resource allocation policies and scheduling algorithms considering QoS expectations and power usage characteristics of the devices; and (c) a number of open research challenges, addressing which can bring substantial benefits to both resource providers and consumers. They have validated our approach by conducting a performance evaluation study using the CloudSim toolkit. The results demonstrate that Cloud computing model has immense potential as it offers significant cost savings and demonstrates high potential for the improvement of energy efficiency under dynamic workload scenarios. In Dian Palupi Rini et al [2011]: In this paper, they provide a Basic Information they present our vision, open research challenges, and resource provisioning and allocation algorithms for energy-efficient management of Cloud computing environments.) about Particle Swarm Optimization (PSO) is a biologically inspired computational search and optimization method developed in 1995 by Eberhart and Kennedy based on the social behaviors of birds flocking or fish schooling. found by the PSO. On the other hand, basic PSO is more appropriate to process static, simple optimization problem. Modification PSO is developed for solving the basic PSO problem. The observation and review 46 related studies in the period between 2002 and 2010 focusing on function of PSO, advantages and disadvantages of PSO, the basic variant of PSO, Modification of PSO and applications that have implemented using PSO. The application can show which one the modified or variant PSO that haven't been made and which one the modified or variant PSO that will be developed. In Xin-She Yang et al [2010]: In this paper, they propose a new metaheuristic method, the Bat Algorithm, based on the echolocation behavior of bats. We also intend to combine the advantages of existing algorithms into the new bat algorithm. After a detailed formulation and explanation of its implementation, we will then compare the proposed algorithm with other existing algorithms, including genetic algorithms and particle swarm optimization. Simulations

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show that the proposed algorithm seems much superior to other algorithms, and further studies are also discussed. In Marco Dorigo et al [2010]: These paper overviews recent work on ant algorithms, that is, algorithms for discrete optimization which took inspiration from the observation of ant colonies foraging behavior, and introduces the ant colony optimization (ACO) meta-heuristic. In the first part of the paper the basic biological findings on real ants are overviewed, and their artificial counterparts as well as the ACO meta-heuristic are defined. In the second part of the paper a number of applications to combinatorial optimization and routing in communications networks are described. We conclude with a discussion of related work and of some of the most important aspects of the ACO meta-heuristic. In Guo et al [2010]: In this paper they have proposed and implemented a virtual cluster management system that allocates the resources in a way satisfying bandwidth guarantees. The allocation is determined by a heuristic that minimizes the total bandwidth utilized. The VM allocation is adapted when some of the VMs are de-allocated. However, the VM allocation is not dynamically adapted depending on the current network load. Moreover, the approach does not explicitly minimize energy consumption by the network. In Toni Mastelic et al [2010]: In this article, they perform a comprehensive analysis of an infrastructure supporting the cloud computing paradigm with regards to energy efficiency. First, they define a systematic approach for analyzing the energy efficiency of most important data center domains, including server and network equipment, as well as cloud management systems and appliances consisting of a software utilized by end users. Second, they utilize this approach for analyzing available scientific and industrial literature on state-of-the-art practices in data centers and their equipment. Finally, they extract existing challenges and highlight future research directions. Their share in power consumption generates between 1.1% and 1.5% of the total electricity use worldwide and is projected to rise even more. Such alarming numbers demand rethinking the energy efficiency of such infrastructures. However, before making any changes to infrastructure, an analysis of the current status is required.

III.METHODOLOGY

***A. DESCRIPTION OF THE PROPOSED ALGORITHM*:** Pareto distribution is an allocation method based upon the power law. Its purpose in the beginning of our methodology to compute the distribution of all the tasks to allocate them to available virtual machines when there is no task in the ready list. Depending upon the characteristics of the tasks such as size, deadline, dependency, and distribution takes place.

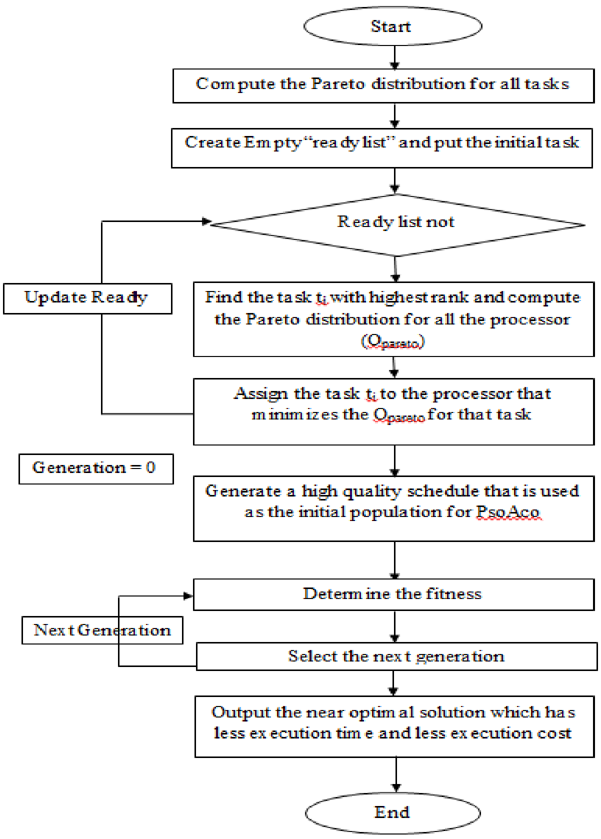

Figure 1.1: Flow Chart of Proposed work Pareto distribution is an allocation method

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a. PSO Algorithm: PSO uses a number of particles that make a swarm moving around in the search space to find the best solution and each particle is served as a point in a N-dimensional space which balance its "flying" following to its own flying experience in addition to the flying experience of other particles. Each particle keeps track of its personal best and global best solution (fitness), so called pbest and gbest solution respectively.

b. ACO Algorithm: Based on the initial solution produced by PSO, it updates the pheromone on the nodes to a certain multiple, which makes the convergence speed of ACO faster. Then the procedure of ants traveling to find the optimal solution becomes rapid. Some ants are arbitrarily positioned on the nodes to move. The transition probability of node i to the resource j for first k ants in the time t shown.

c. Proposed PsoAco algorithm Problem Encoding:-For the workflow scheduling issue, a suitable solution is needed to meet following conditions:-

- A task can only be started after all its predecessors have completed.
- Every task appears only once in the schedule.
- Each task must be designated to one available time slot of a service efficient of executing the task.

Step 1: Every individual in the population presents an appropriate solution to the problem, and composed of a vector of task assignments. Each task assignment involves four elements: taskID, serviceID, startTime, and endTime.
Step 2: Each individual of the initial population is produced through a Pareto, which described in step 4 to step 6 Fitness function is divided according to desired objective.
Step 3: The cost-fitness is an integral part that encourages the formation of the solutions that attain the budget constraint. The time-fitness element is designed to inspire PsoAco to choose individuals with primitive completion time in the existing population.
Step 4: After the fitness interpretation process, the new individuals are compared with the prior produced. All individuals from both generations are ranked on the basis of their fitness values. An individual with a small value of fitness is better than the one with a large value of fitness. The fittest individuals are preserved in the population as successive generations emerged.
Step 5: Crossovers create new individuals on the existing population by adjoining of rearranging parts of the current individuals.
Step 6: The string representing offspring generated by fitness function operators are not a real schedule. Establish a time slot assignment process in order to transfer an offspring string to a profitable solution.
Step 7: Analysis the beneficial solution with time and cost.

IV.RESULTS

In this chapter, experimental results the workflow is in the form of graph, we assume that tasks are both mutually dependent and independent. And the tasks are preemptive, so that they can be moved from one virtual machine to another during the execution. In this paper, to simulate the proposed algorithm cloudsim has been used. The experiments are implemented using 2 data centers and virtual machines with dynamic range from 10 to 50. The total number of tasks range from 200 to 500 with each tasks have varied number of instructions and variable size. The parameter settings of cloud simulator are shown in the table 1.1

Table 1.1: Parameter settings of cloud simulator

Entity type	Parameters	Values
Tasks	Total number of tasks	200-500
Virtual Machines	Total no. of virtual machines	10-50
	Virtual machines memory(RAM)	512mb
	MIPS	12
	Processor speed	3.4 ghz
Data Centers	Number of data centers	2
	Data center storage	20 gb
	Number of hosts	1

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A. EXPERIMENT RESULT:

The experimental results show that the proposed hybrid technique PsoAco can furnish performance as compared to the existing algorithms such as ACO and PSO . In this technique, the fast convergence of Particle swarm optimization and better optimization ability of Ant colony optimization are combined. We have used two applications workflows in the simulation environment which are Genome and Ligo.

Table 1.2: Average cost and Average last dag finish time using Genome workflow

Application	Number of tasks	Number of iterations	Algorithm	Average last dag finish time(millisec)	Average cost
Genome	440	101	ACO	21777.76	25.5
Genome	440	101	PSO	8711.37	271.28
Genome	440	101	PsoAco	704.2	42.8

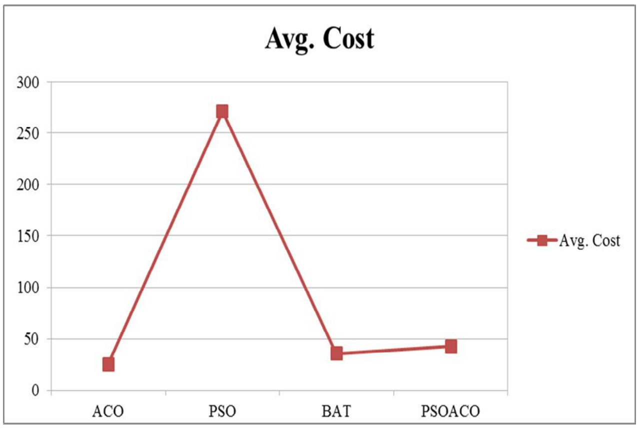

Figure 1.2: The average cost curve using Genome workflow

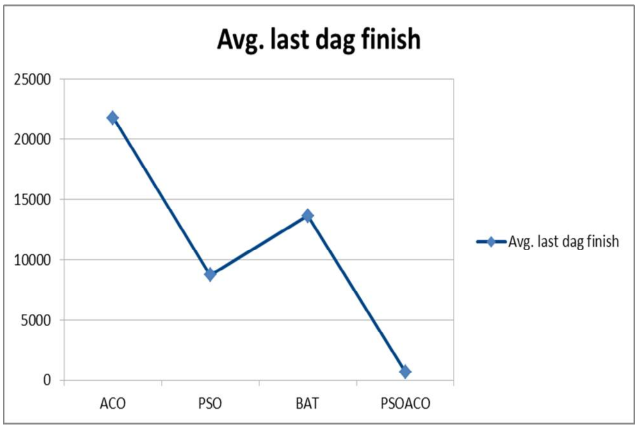

Figure 1.3: The average last dag finish time curve using Genome workflow

Above Table 1.2, Figure 1.2 and Figure 1.3 shows the comparison has in the form of tables and graphs using both workflows. Line graphs show average cost and last dag finish using cost values and last dag values on the left and right side respectively, by using the Genome workflow.

Table 1.3: Average cost and Average last dag finish time using LIGO workflow

Application	Number of tasks	Number of iterations	Algorithm	Average last dag finish time(millisec)	Average cost
Ligo	220	101	ACO	1447.24	9.03
Ligo	220	101	PSO	268.13	5.54
Ligo	220	101	PsoAco	517.15	6.63

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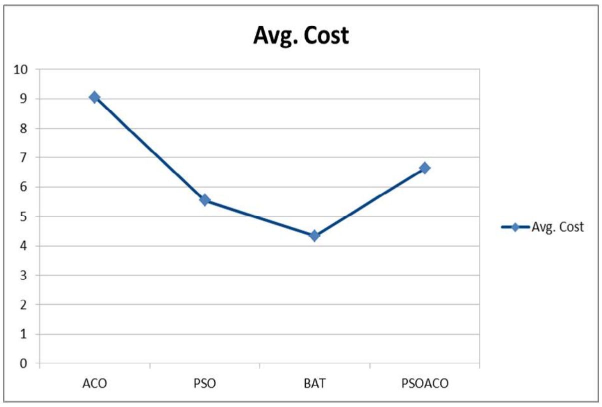

Figure 1.4: The average cost curve using Ligo workflow

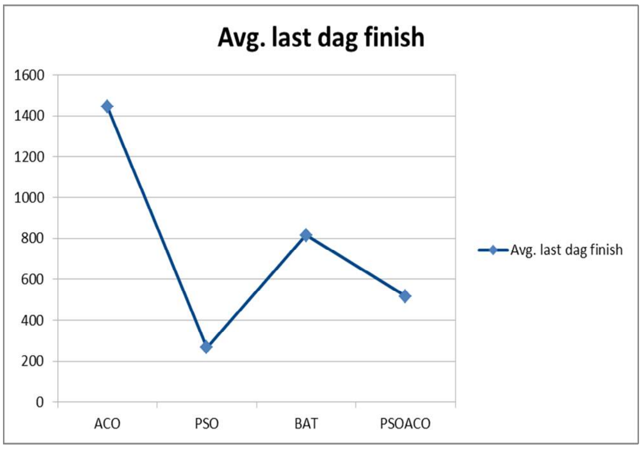

Figure 1.5: The average last dag finish time curve using Ligo Workflow.

Above Table 1.3, Figure 1.3 and Figure 1.4 shows the comparison has in the form of tables and graphs using both workflows. Line graphs show average cost and last dag finish using cost values and last dag values on the left and right side respectively, by using the LIGO workflow.

V. CONCLUSION

Tasks scheduling plays a core part in the cloud computing environment. Without a proper scheduling strategy, timely execution of the tasks and fault tolerance cannot be achieved successfully. As the requirements of the users are dynamic in nature, an efficient schedule should be established. In this paper, a hybrid technique that combines the particle swarm optimization and ant colony optimization algorithm has been proposed which effectively reduces the cost and minimizes the last dag finish time of the workflow. To prove its effectiveness, comparison through simulation environment has done between the proposed algorithm with PSO and ACO algorithm.

VI. FUTURE SCOPE

Further as a future work, tasks migration time can also be considered as a parameter and more hybridization techniques like the combination of ACO and BAT can be performed to optimize result.

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