ACODO FOR META-TASK SCHEDULING IN CLOUD COMPUTING

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Abstract : The computational problems are solved by probabilistic technique used in Ant Colony Optimization. It constitutes meta-heuristics for optimization. For task Scheduling ACO uses artificial ants. It stands for multi-agent method inspired by the behavior of real ants. Optimization of task scheduling is NP-hard combinatorial problems. This paper proposed a new algorithm called Ant Colony Optimization based on Dual Objectives (ACODO), for meta-task scheduling in cloud environment, which uses Time and Resource Utilization as parameters in fitness function to update the pheromone value. This strategy optimizes the time and resource Utilization by setting the values to the weighting factors of time and resource Utilization. The algorithm is implemented in cloud-sim and results are compared with ACO.

Keywords: M**eta-task, ACO, pheromone, ACODO, resource utilization, makespan, fitness function.**

I. INTRODUCTION

Cloud Computing offers an easy access to the remote resources through internet. These resources help the user to do their task in efficient manner without compromising the QoS. Task Scheduling in cloud environment is very tough process because it has to mind the different users with their different QoS needs. The main aim of task scheduling is to achieve maximum profit in order to maximize the resource utilization and minimize the makespan. One way of designing such algorithm is in heuristic way. Another way is using meta-heuristics algorithms like Ant Colony Optimization, Partial Swam Optimization, Genetic Algorithm etc., ACO created the schedule in less time when compared to GA, PSO [1]. This paper concentrates in developing an optimization algorithm using ACO which optimizes the makespan, resource utilization without increasing the cost.

II. RELATED WORK

Scheduling the meta-task is a critical and vital process in cloud. Meta-heuristic strategies are well understand and experimentally proven approaches. It calculates viable solutions in very less time and hence it is ideal for scheduling. ACO is developed by the inspiration of real ants which find the shortest path when searching the food with the help of pheromone deposition. In scheduling artificial ant agents are used. Pheromone depositing and updating are based on fitness function [2]. It is better understood by the following review work.

T. Kokilavani et.al. [3] aimed for sharing the load on all the resources and reduced both the task's wait time and makespan based on the behaviour of ants. Davinder Kaur et.al. [4] proposed MMAC algorithm which minimizes the makespan and maximizes the utilization of resource using advantages of Min-Min algorithm and ACO. Ratan Mishra et.al. [5] proposed the strategy in which, the pheromone table of a resource is updated by incoming ants. For occasion, an ant travelling from source to destination will update the respective entry in the pheromone table. Then the routing ants are influenced by updated information in the pheromone.

Shagufta khan et.al. [6] investigated the various algorithms that are used Ant Colony Optimization strategy, aimed the load balancing of resources. G. Umarani et.al. [7] used ACO for generating Schedule for the given set of tasks, which balances the load and minimizes makespan and results are compared with FCFS. Wei-Neng Chen et.al. [8] developed an effective technique for scheduling the task and allocation of human resource in software project planning with ACO algorithm. Authors developed a methodology with novel event-based scheduler (EBS). This combines task list and a planned employee allocation matrix. The priorities of tasks which consume resources are defined in the task list and originally planned workload assignment is specified by the planned employee allocation matrix. Preeti Kushwah et.al. [9] designed the technique which balancing the load with the help of ACO algorithm. This strategy is used to achieve well-organized resource allocation in cloud environment.

Dr. D. Maruthanayagam et.al. [10] used ACO to select the specific resource based on computing power of the resources. This algorithm increases the resource utilization and decreases the congestion. Liyun Zuo et.al. [11] proposed a Muti-Objective ACO. Here memory and cost are the two objectives used. The main purpose is to minimize the cost of memory and execution cost. T.Kokilavani et.al. [12] developed a new Meta task scheduling algorithm which considers memory requirement and processor time to effectively schedule the tasks. Harshada Raut et.al. [13] used Ant colony optimization algorithm with travelling salesman problem. When resource gets overloaded this method gives the solution for finding the minimum distance from one node to neighbouring nodes. Qiang Guo et.al. [14] proposed a Muti-Objective ACO. Here time and cost are the two objectives used. With the help of fitness function, it allocated the tasks to the resources.

After the above mentioned review, the new algorithm ACODO (ACO based on Dual-Objective) is proposed in this paper.

III. OPTIMIZATION STRATEGY OF PROPOSED (ACODO) ALGORITHM

A proposed algorithm, ACODO is designed with the help of fitness function which has completion time and resource Utilization as two objectives. Probability function given in equation (1) is used to select next resource for allocation of task. Fitness function is used to update pheromone. It is calculated by equation (2) and is based on linear weighting method. Updating Pheromone is computed using equation (5).

$$Pb(t_{ij}) = (hue_{ij})^{alpha} (ph_{ij})^{beta} / \sum (hue_{ij})^{alpha} (ph_{ij})^{beta} \quad (1)$$

where 'hue' is heuristic function and hue=1/completion time of task t_i in resource r_j, 'ph' is initial pheromone, alpha and beta are heuristic factors in which alpha=3 and beta=2.

$$F_f = wf_1 Time + wf_2 Ru \quad (2)$$

Where F_f is objective function, wf_1=0.5 and wf_2=0.5 are weighting factors of time and resource utilization rate.
Time is calculated using the equation-3

$$Time = max(R_{ctj}) \quad (3)$$

where $R_{ctj} = \sum^{k} Et_{ij}$ and Et_{ij} is execution time of task t_i in resource r_j.

Resource Utilization rate is calculated using the equation-4.

$$ru = \sum ru_j / m; \quad 1 \leq j \leq m \quad (4)$$

where, ru_j is the resource utilization rate of resource r_j and m is number of resource.

Updating the pheromone is done by the equation-5

$$ph_{ij}(t+1) = (1- phevo)\, ph_{ij}(t) + phevo * \Delta ph_{ij}(t) \quad (5)$$

where, phevo is pheromone volatilization factor and $\Delta ph_{ij}(t) = 1/F_f$

Figure 1. shows the ACODO algorithm

1. Start
2. Initialize ACO parameters like ph, phevo, alpha, beta, wf1,wf2,nit,nant
3. Input number of tasks and resources
4. Do
5. For each ant do
6. For each task do
7. Choose next resource using $Pb(t_{ij}) = (hue_{ij})^{alpha} (ph_{ij})^{beta} / \sum (hue_{ij})^{alpha} (ph_{ij})^{beta}$
8. End for
9. Compute fitness on individual schedule using $F_f = wf_1 Time + wf_2 Ru$
10. Assign t_i to r_j which has high probability
11. Update pheromone by $ph_{ij}(t+1) = (1- phevo)\, ph_{ij}(t) + phevo * \Delta ph_{ij}(t)$
12. End for
13. Until nit
14. end

Figure 1. ACODO Algorithm

In above algorithm 'nit' is number of iterations which initialized as 50 and 'nant' is number of ants which initialized as 10.

IV. SIMULATION RESULTS IN CLOUD SIM

CloudSim is a tool for the simulation of algorithms in cloud. It endows with critical classes for unfolding data centers, resources for computations, virtual machines, applications, clients, and guiding principles for the administration of different parts of the system. Data center, data center broker, virtual machine, cloudlet and coordinator of the cloud are the components of cloudsim. The characteristics of cloudsim are simulation and modeling the data centers in large scale, virtualized server hosts, energy efficient computational resources, adding simulation fundamentals energetically, user-defined guidelines for distribution of hosts to virtual machines. The following table mentioned the parameter used in Cloudsim for simulation of ACODO.

Table 1. Parameters in CloudSim

Parameters	Values
Tasks in meta-task set	10-1000
Resources allocated	3-50
MIPS	1000-48000
Memory in VM	512-4096

Table 2. shows the makespan and resource utilization of proposed ACODO algorithm. ACODO maximizes the resource utilization and minimizes the maskspan without increasing the cost when comparing to ACO. Pictorial representation of makespan of ACODO and ACO is in Figure 2. Figure 3. shows the Resource utilization of ACO and ACODO.

Table 2. Makespan, Resource Utilization and Cost of different meta-task set in Cloud Sim

No. of Tasks	No. of Resources	ACO			ACODO		
		Makespan in seconds	Resource Utilization in %	Cost in Rs.	Makespan in seconds.	Resource Utilization in %	Cost in Rs.
10	3	43.93	44	3.13	35.39	92	3.13
25	5	123.06	40	4.0	76.4	76	4.0
50	7	216.29	60	32.52	193.57	87	32.52
100	10	566.47	85	81.99	479.35	97	81.99
250	16	491.90	90	150.39	435	99	150.39
500	22	559.67	79	320.53	420.51	96	320.53
750	27	600.97	84	450.81	492.83	96	450.81
1000	32	1214.89	80	617.06	1152.26	96	617.06

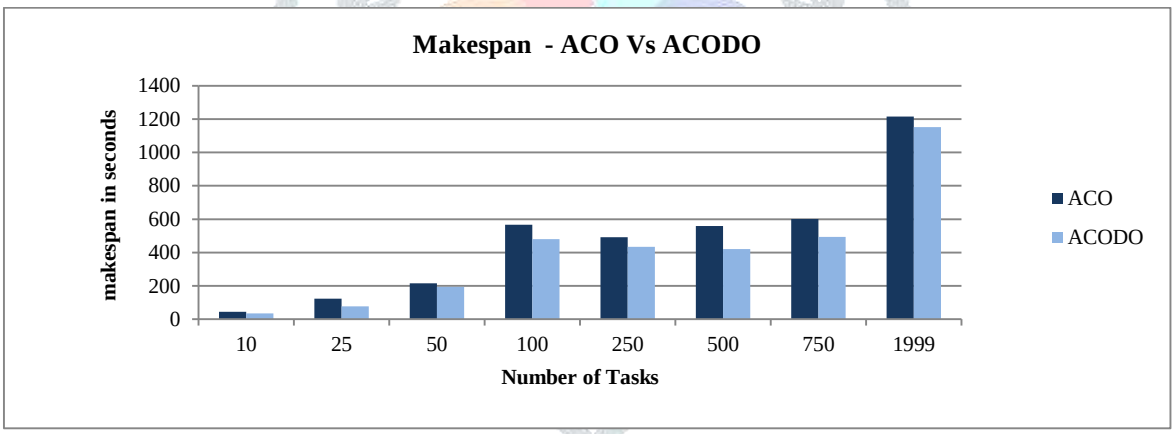

Figure 2. Makespan of ACO Vs ACODO

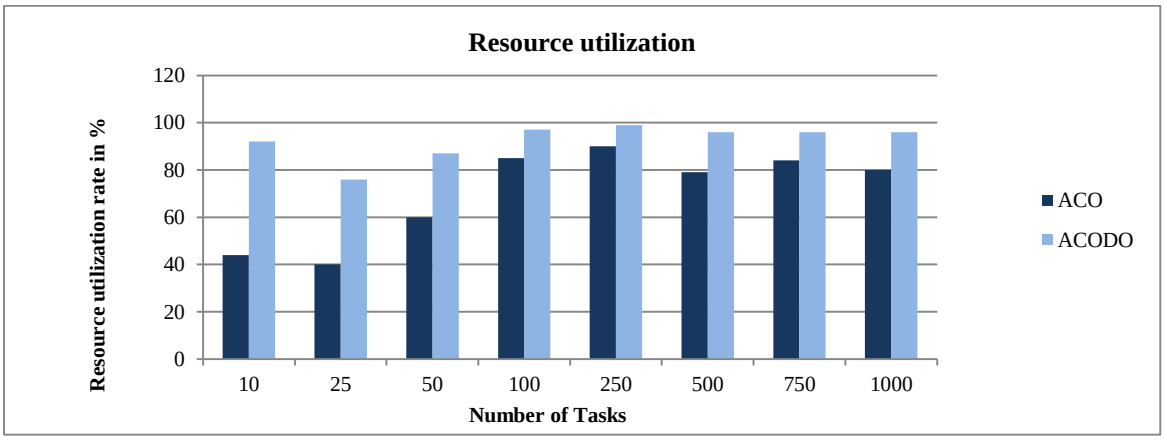

Figure 3. Resource Utilization ACO Vs ACODO

To analyze the ACODO, the testing has been carried out in cloudsim with the meta-task sets having task and machine heterogeneity. Makespan, Resource utilization and Cost are parameters used to compare the results of ACODO with ACO. The performance of these three metrics is used to conclude that ACODO is more effective than existing ACO.

V. CONCLUSION

ACO algorithm is pertinent for single objective. The performance of ACO can be improved by using dual-objective. Time and Resource Utilization are two objectives used in proposed ACODO algorithm for meta-task scheduling. These two parameters are used in fitness function for updating the pheromone which can be used for computing probability function. This fitness function is used to obtain optimality principle. Then the each task can be assigned to the resource which gives high probability value. The better result can be achieved by setting different values to the heuristic factors alpha and beta and finalized alpha=3 and beta=2. The simulation results from cloudsim of ACODO for different set of problems confirm that it has better performance over ACO algorithm. It minimizes the makespan, and maximizes the utilization of resources without increasing the cost. The research may be extended by taking into account of periodic task applications in cloud.

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