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MODIFIED ACO ALGORITHM FOR RESOURCE ALLOCATION IN CLOUD COMPUTING ENVIRONMENT

V. Sathya, Prof. R. Madhumathi, Dr. R. Radhakrishnan

Abstract— In Cloud computing, private cloud is a model where resource sharing is becoming more popular now-a-days. The importance of resource sharing has lead to the development of many algorithms. The existing works in the field of resource sharing used many optimization techniques. The two techniques namely Service Composition Optimal Selection (SCOS) and Optimal Allocation of Computing Resources (OACR) are combined and named as Dual Scheduling of Cloud Services and Computing Resources (DS-CSCR). This dual scheduling is not suitable for large scale problems and hence, a new Ranking Chaos Optimization (RCO) was introduced. RCO executes with low time consumption. But the design of heuristic function is complex and hence, a Modified Adaptive Chaos Optimization (MACO) technique with Roulette Wheel Selection (RWS) is used for allocating tasks to the resources. Finally the comparison of the proposed work with the existing RCO proves that, the resource allocation can be made with low time consumption and the stability of the virtual machine increases.

Index Terms— Cloud Computing, Service Composition Optimal Selection (SCOS), Optimal Allocation of Computing Resources (OACR), Dual Scheduling of Cloud Services and Computing Resources (DS-CSCR), Ranking Chaos Optimization (RCO), Roulette Wheel Selection (RWS), Modified Adaptive Chaos Optimization (MACO).

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1 INTRODUCTION

Cloud computing delivers infrastructure, platform and software that are made available as subscription-based services in a pay as-you-go model to consumers. These services are referred to as Infrastructure as a Service (IaaS), Platform as a Service (PaaS) and Software as a Service (SaaS). Cloud computing can be defined as "a type of parallel and distributed system consisting of a collection of inter-connected and virtualized computers that are dynamically provisioned, and presented as one or more unified computing resources based on Service- Level Agreements established through negotiation between the service provider and consumers".

In Cloud, task scheduling techniques are frequently depends on trusting the accuracy of the information about the position of resources (e.g., their load). This information is typically submitted by resource providers to a central database which is available to schedulers. Since the power of the Internet in solving large-scale problem is rising, the situation of having multiple self-interested agents is becoming more and more accepted. In a industrial multi cloud environment consisting of a set of selfish cloud providers with private information about their resources, application schedulers should perform cautiously and not trust the information accepted by providers about the position of their resources, as there is always the opportunity of misrepresenting private information.

Cloud computing is a recent technology in intellectual world. On cloud computing platform, resources are offered as service and by needs and it assurance to the subscribers that it fixes to the Service Level Agreement (SLA). Still, due to the situation that the resources are shared and the needs of the subscribers have big dynamic heterogeneity and platform insignificance, it will certainly escort to resource waste if the resources cannot be distributed properly. The properties of cloud services have become more composite and principally need higher computing ability to drive.

In such environment, when a set of task is submitted, the console of conglomerate is not suitable for cloud services. To achieve high-quality and low cost, Service Composition Optimal Selection (SCOS) and Optimal Allocation of Computing Resource (OACR) [1] simultaneously critical for efficient resource sharing and flexible service management.

Consequently, in presents the design of combining two stages decision-making into one and put forward the concept, Dual Scheduling of Cloud Service and Computing Resource (DS-CSCR), in private cloud of corporation. In the direction of this idea, we get the complex features of hardware/software cloud service and computing resource in cloud computing in two levels and investigate their mutual relations in detail. The formulation of DS-CSCR with multi-objectives and multi-constraints are described. In addition, to achieve high efficient one-time decision in DS-CSCR, a novel Ranking Chaos Optimization (RCO) is considered in this project.

The most generally used selection operator in GA is roulette wheel selection. By means of high randomness, bad individuals may be decide on more than good ones, higher diversity can be attained in population. But high diversity has been executed by chaos and what we need previous to chaos is just a set of good seeds. In this state, roulette wheel selection becomes inappropriate. Additionally, RCO obtainable in this project still has some limitations. The dynamic heuristic operator is composite and hard though. And its convergence has not been proved. As a new improved intelligent algorithm, its usefulness in various other composite combinatorial optimization problems. To deal with these drawbacks in this work proposed system presents a modified ACO algorithm.

The structure of this paper is as follows. Section 2 gives the related work of cloud computing private cloud and the research of SCOS and OACR. Section 3 propose a new MACO for DS-CSCR and describes its procedure in detail. Section 4 the performance analysis of RCO and MACO. Finally we conclude this paper with future work in Section 5.

2 RELATED WORKS

In cloud computing, two critical optimization factors in deciding resource sharing efficiency and platform application performance are SCOS and OACR exactly.

Ferrer.A.J [2], introduces the holistic challenges that enable elastic and dynamic provisioning of cloud services. A holistic approach is suitable for service provisioning, it provides reliable and trustful cloud computing. The OPTIMIS tools to perform monitoring and automated management of services and infrastructures.

Fujii.K [3], represents Complex services, without pre installation the distributed components cannot provide new services dynamically. For dynamic allocation, this project proposes semantics-based service composition architecture. The proposed architecture contains several services like, Component Service Model with Semantics (CoSMoS), Component Runtime Environment (CoRE), and Semantic Graph-Based Service Composition (SeGSeC).

Ghanbari.H [4], the allocation of resources in a private cloud addressed optimization problem for minimizing cost to meet all client requirements. Based upon multiple service level objectives, it focused only on response time and will not change the complexity of solving the optimization problem.

Ma.Y [5], genetic algorithm managed a novel quickly convergent population diversity handling genetic algorithm (CoDiGA) has presented for web service selection with global Quality-of-Service (QoS) constraints. CoDiGA has characterized by good stability and quick convergence. A self-adaptive genetic algorithm for web service selection with global QoS constraints is designed for possible extension of CoDiGA. Simulated Annealing (SA) is a stochastic search technique which can be employed to solve the combinatorial optimization problems.

Zhang.Y.H [6] ,in an emerging cloud service, which allows customers to request virtual machines in the cloud and in certain cases, besides having the virtual hardware and system software, it becomes necessary to deploy the application software in a same way in order to provide a fully-functional work environment. The user-level virtualization technology is proposed to improve the flexibility of application software from VM. Using this technology, the application software from the cloud accessed easily. The main advantage of the process to decrease the storage capacity and improves the VM access performance.

F. Tao [8], the resources provide high quality service to user for both Resource Service Optimal-Selection (RSOS) and Manufacturing Grid (MGrid). It contains five steps to process they are (1) decomposing the submitted task into multiple tasks; (2) search the qualified resource services for each task; (3) the task can be easily retrieved and evaluated based upon the Quality of Service; (4) the quality of each candidate resource can be evaluated and ranking them; (5) based upon that candidate resource service set and constructing a new composite services. Based on this work, the proposed method is mentioned as MGrid-RSOSCF. Using this method, the success rate and the execution efficiency is improved.

3 RESEARCH METHODOLOGIES

Modified Adaptive Chaos Optimization (MACO) includes two main operators, i.e., roulette wheel selection and Adaptive Chaos Optimization. Our proposed flow chart is represented in Fig.1.

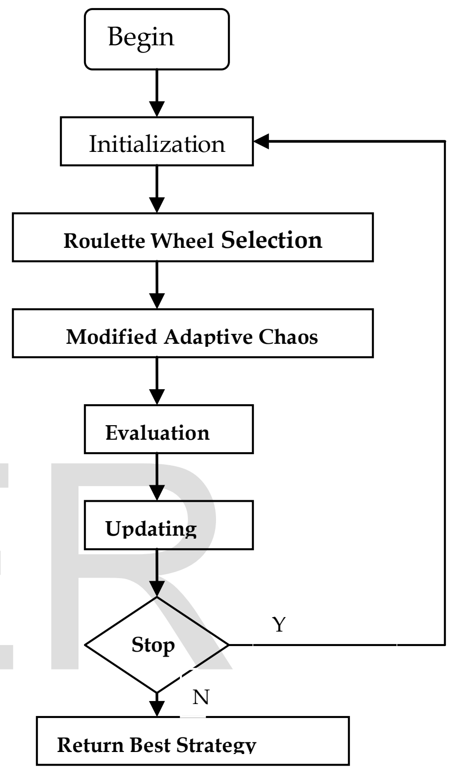

Fig1. Flow Chart

Adaptive Chaos Optimization

Chaos optimization[11] is one of the intelligent algorithms to search the solution space and represents the individual solution. With its strong randomness and internal regularity, to developed a wide range random search and avoid local optimization (or premature convergence). Inspired by this, a new modified Adaptive Chaos Operator of each generation is dynamically changed according to the current individual evolutionary state.

Roulette Wheel Selection

The chaotic optimal specified above in iteration are based on the individuals regardless of whether the individuals are good or bad. In this case, the algorithm is easy to trap into bad conditions with large randomly searching range and extremely strong diversity. For overcoming this shortcoming, roulette wheel selection operator is introduced before chaos operator. The beforehand roulette wheel selection can weed out worse individuals while keep better individuals. On the basis of excellent individuals, adaptive chaos operator can

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search for better neighborhood individuals with stable diversity.

Inspired by this, we presented a new modified ranking chaos operator in which the length of chaotic sequence in each generation is dynamically changed according to the current individual evolutionary state. Let population [N] is the whole population with N individuals, and pop[i] in the population be the i^{th} individual. Pop[i] includes its gene-bit values pop[i].gene[j](j=[1:M])and fitness value pop[i].fit , where M represents the length of gene code (i.e., the number of subtasks). Let *Chaos_ N* be the length of chaotic sequences in the operator for all the population. The specific pseudo-code can be shown as follows.

Going into detail, the evolutionary state of population is defined as Var, and

$$\text{Var}=\frac{(\text{pop[best].fit - pop[average].fit})}{(pop[best].fit - pop[worst].fit)+1} \quad (1)$$

$\text{Chaos}_N = 1+A^{*}\ \text{Var}$

Where A is the upper bound of Chaos_N, and *best* and *worst* represent the serial numbers of the individual with the best and the worst fitness value, respectively. The closer the worst fitness value to the best fitness value in population, the lower diversity is, and the longer the length of chaotic sequences is Chaos_N, so the larger the searching range is, vice versa.

Modified Adaptive Chaos (population [N])

$$Z(X) = \alpha T(X) + \beta C(X) + \gamma E(X) + \frac{\epsilon}{R(X)} + \delta S(X)$$

$$S(X) = \sum \frac{\alpha avg,i - \alpha sla,i / T}{n}$$

Where

$\alpha, \beta, \gamma, \varepsilon, \delta$ – Scaling Factor
T(X) – Service Execution Duration
C(X) – Cost of Service
E(X) – Energy Consumption of Service
R(X) – Execution Reliability of Service
S(X) - Stability of a Service
$\alpha_{avg,i}$ - Observed average performance of the user i.
$\alpha_{sla,i}$ - promised value in the SLA.
T - Service Time
N – Total number of users.

4 EXPERIMENTAL RESULTS

The following are the graphical results of our implemented systems namely Modified Adaptive Chaos Optimization (MACO) parameters considered for the comparison of these methods are namely, Average Time Consumption, Average Fitness Value.

Category	RCO	MACO
Scale 1	1813	1459.2
Scale 2	1781	1431.4
Scale 3	1954	1476.5
Scale 4	1719	1451.9
Scale 5	1703	1323.2
Scale 6	1625	1319.5
Scale 7	1703	1361.0

Table 1 Fitness value comparison

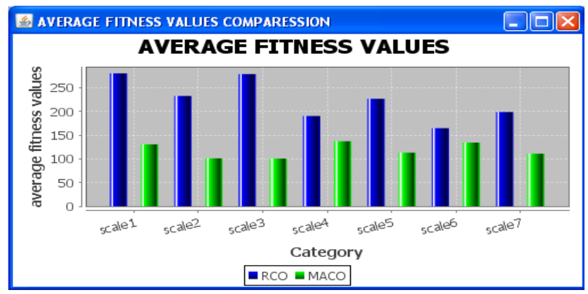

Fig.2 Average Fitness Value comparison of RCO and MACO
The average fitness value of Modified ACO is less

Category	RCO	MACO
Scale 1	280.9	130.8
Scale 2	233.1	101.0
Scale 3	279.4	100.7
Scale 4	190.9	137.4
Scale 5	227.1	113.3
Scale 6	164.9	134.7
Scale 7	199.2	111.1

Table 2 Time Comparison

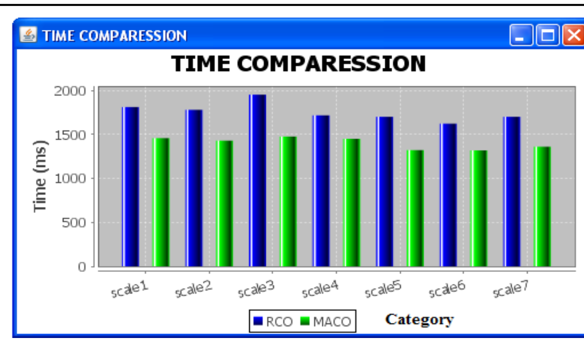

Fig.3Time comparison of RCO and MACO
The average time value of Modified ACO is less than RCO

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5 CONCLUSIONS AND FUTURE WORK

Service Composition Optimal Selection (SCOS) and Optimal Allocation of Computing Resource (OACR) are both very critical in cloud system. Current works found that the two steps decision of SCOS and OACR in private cloud are quite cumbersome and the mutual relations between cloud services and underlying computing resources are always ignored. Thus this project deeply analyzed the characteristics of these two problems and their interactions. Based on this, the idea of one-time decision of SCOS and OACR was presented accordingly. Our proposed system presents novel algorithm as Modified ACO, the selection operation is based on Roulette Wheel method. The new Modified ACO optimization in combination of the virtues of the adaptation of chaotic sequences and roulette wheel selection was designed for high quality decision. We compare the results of Modified ACO and Ranking Chaos Optimization. Computational comparison of these techniques on various benchmark instances has clearly shown the competence of the modified ACO methods in solving complex combinatorial optimization problems and the improvement in optimal solutions.

This work can be extended by developing other local search techniques and testing the features to solve combinatorial optimization problems such as Scheduling, Travelling Salesman Problem and Bin packing and so on.

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