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An Improved Bat Algorithm With Time-Varying Wavelet Perturbations for Cloud Computing Resources Scheduling

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ABSTRACT

Resources scheduling is a major challenge in cloud computing because of its ability to provide many on-demand information technology services according to needs of customers. In order to acquire the best balance between speed of operation, average response time, and integrated system utilization in the resource allocation process in cloud computing, an improved bat algorithm with time-varying wavelet perturbations was proposed. The algorithm provided a perturbation strategy of time-varying Morlet wavelet with the waving property to prevent from local optimum greatly and improve the converging speed and accuracy through the guide of individual distribution to control diversity and time-varying coefficient of wavelets. The experiments showed the proposed could significantly upgrade the overall performance and the capability of resource scheduling in cloud service compared to similar algorithms.

KEYWORDS

Bat Algorithm, Cloud Computing, Morlet Wavelet, Resources Scheduling, Time-Varying Wavelet, Wavelet

INTRODUCTION

Cloud computing is the growing computational technique that depends upon virtualization equipment in response to the user's request via the Internet and dynamic distribution of resources. The services provided by cloud computing are becoming increasingly more diverse and the ability to perform varied and complex tasks involving extremely large amounts of task data, has become necessary. Researches, aimed at meeting the needs of cloud-computing systems considering wider cloud service resource types and collaborative resource scheduling has become the main topic in current studies, which contain cloud computing architecture, management mechanisms, reliability, security, and scalability of resources in cloud-computing environments, and which are capable of hosting more resource models, modeling methods for cloud service resources, resource allocation with collaborative strategy for cloud service, and formulating an optimal, dynamic scheduling method of cloud resources allocation.

Improving the utilization of computing resources, enabling a shorter time to complete tasks, decreasing response time, and improving service quality are the main objectives of resource scheduling

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in cloud computing, which is primarily achieved by allocating tasks to different computing resources in a reasonable manner (Yuan, et al., 2021).

With the growth and applications of the cloud-computing environments, the scheduling problems have achieved gradually more research focuses in recent years. Resource scheduling is the main issue in cloud computing and considers several features, such as total execution cost, fault tolerance, resource utilization, execution time, and energy consumption. The significant measure in task scheduling is load balancing (Jia et al., 2019). It is critical to increase the speed of completing computing tasks and to store less data to take up as little space as possible for customers of pay-as-you-go cloud computing. At the same time, to solve more customers' computing and storage tasks, the cloud service providers improve the efficiency of computing resources by allocating computing resources scientifically and rationally to address specific computing tasks (Gabi et al., 2022). It is critical to reduce the task completion time of users and reasonably consume the resources of operators in order to avoid the waste of computing resources by adapting an effective resource scheduling strategy (Houssein et al., 2021). In selecting the scheduling algorithm, researchers need to concentrate on decreasing the task execution time and makespan value (Sanaj & Prathap, 2020). It is a very critical issue to find an efficient and appropriate cloud-computing resource scheduling strategy and its related algorithm in a cloud-computing environment. The virtual machine plan utilization requests the physical machine (PM) for a certain data point. In consideration of the alterations in the workload over time in the cloud-computing environment, the static algorithms cannot operate; thereby, it requires dynamic methods for balancing the workload among the virtual machines (Abdullahi et al., 2019). Due to the dynamic assets of the cloud-computing environment and heterogeneity, resource scheduling is considered as the nondeterministic polynomial (NP)-hard problem.

The resource-scheduling problem can be solved by applying metaheuristic algorithms, which have acquired growing concentration in recent years. Compared with traditional methods, metaheuristic algorithms are very effective for finding the optimal solution in polynomial time rather than exponential time (Singh & Singh, 2017). There are many metaheuristics, and their alterations were used as resource scheduling strategies in cloud computing. The most typical heuristic algorithms for resource scheduling problems are: the genetic algorithm (GA) (Zhou, et al., 2020), ant colony optimization (ACO) (Jia et al., 2019), particle swarm optimization (PSO) (Pradhan et al., 2021), fish swarm algorithms, and frog leap algorithms. An improved objective function considering the resource scheduling time cost and transportation cost in emergency scheduling of cloud computing resources, based on the genetic algorithm, is proposed, which can effectively improve the efficiency of emergency resource scheduling (Liu et al., 2021). Aimed to improve response time as well as minimize VM failure rate, a multi-objective genetic algorithm for load balancing in a mobile cloud-computing environment was improved, and it performed well by reducing execution time and task wait time at the server (Ramasubbareddy et al., 2021). To improve the service quality of cloud computing, a hybrid multi-objective bandwidth aware divisible (BAT) algorithm, based on the mean square error and the conjugate gradient method, was proposed, and obtained a slightly better cost than the multi-objective genetic algorithm (Zheng & Wang, 2021). These bionic intelligent algorithms can be used to optimize the relative resource scheduling problems to improve resource utilization effectively for the capability of searching and high parallelism. Many researchers developed different algorithms to solve the task-scheduling problem, but there was no perfect algorithm to find the optimal solution for resource scheduling. Although a few of these algorithms describe the enhancement in computing the global optimal solution of the resource scheduling problem, it is affected by premature convergence, so it is difficult to overcome the local minimum when facing a large solution space. These shortcomings lead to sub-optimal solutions that affect system performance and abuse quality of service assurance. It is necessary to construct a new flexible and effective algorithm to solve the global optimal solution of resource scheduling in cloud-computing environments.

The bat algorithm (BA) (Yuan et al., 2021) is a metaheuristic algorithm inspired by emulating a range of bat behaviors, such as searching, locating, and pre-dating on prey through bionic simulation.