Task Scheduling in Cloud Computing

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Cloud computing resources have become one of the trending technologies that permit the user to manage diverse resources and a huge amount of data in the cloud. Task scheduling is considered one of the most significant challenges and ineffective management results in performance degradation. It is necessary to schedule the task effectively with maximum resource utilization and minimum execution time.

Keywords: task scheduling ; security

1. Introduction

Resource allocation is defined as the process of scheduling and assigning resources and the advantage of the combined form of resource allocation and task scheduling is to reduce the entire system delay. The virtualization platform is used for resource allocation and the resources such as output and input devices, central processing unit (CPU), and memory will be virtualized through the virtualization platform. Due to the virtualization, the system has some improvements such as minimum execution time, energy minimization, and effectiveness of cloud resources in the data centers [1]. The various issues such as energy management, server consolidation, data security, data management, managing automated services, and traffic problems mainly damage the performance, security, and availability of cloud computing [2]. The policies in resource allocation can identify the perfect task requirements before the utilization of the virtual machine. This policy will manage the availability of resources, and eliminate service level agreement violations and task deadlines. The standard techniques are employed to overcome the problems in task scheduling in cloud computing [3].

The scheduling problems in cloud computing are mainly concentrated around the task allocation and virtual servers. Security and energy consumption are the key elements of task scheduling, storage of data and information, and the processing of modern cloud systems. Blockchain technology can act as a secure and effective technology and the data can be stored in a small database instead of using a central data center for data storage. This will increase security and prevents database damage from attacks on the entire cloud system [4]. The large-scale difficult applications have various service components that require distinctive combinations of reliability and security. The various stages of reliability and security schemes are required on the cloud side. Due to the inadequate security service, the multi-cloud system can eliminate the inefficient adaptation between cloud services and tasks, information leakage, and extreme level of computing time [5]. The task allocation with resource problems falls under the NP-hard problem category and the quality of service will solve task scheduling problems in cloud computing [6].

For the development of storing, sensing, and computing, a large amount of data is produced, which has difficulties in implementation and design of security-critical systems [7]. Cloud computing technology is eminent for the processing of big data, which contains computing problems and data storage problems [8]. Cloud computing contains performance and security issues in resource allocation, which requires improvements for increasing the quality and reducing the computational cost. The storage of data and processing of data are implemented by using private clouds through the public clouds [9]. Cloud computing includes various phases such as parallel computing, utility computing, distributed computing, and grid computing, which results in the rapid growth of data centers. Due to rapid growth, some issues occurred such as performance reduction and response delay. The combined form of cloud computing and green communication technology can be used for developing the data center’s computing capabilities [10]. The process of scheduling and allocating resources and the advantage of an integrated form of resource allocation and task scheduling is to reduce overall system latency. Researchers developed several techniques for task scheduling algorithms. Meanwhile, these techniques have various issues such as energy management, server consolidation, data security, data management, managing automated services, and traffic problems, mainly damage the performance, security, and availability of cloud computing.

2. Task Scheduling in Cloud Computing

Rekha et al. [11] proposed an efficient task allocation method for a cloud environment employing a genetic algorithm. An effective task allocation method was employed for acquiring minimum completion time. For task scheduling, throughput and makespan were the parameters utilized in this paper. The experimentation results demonstrated that the scheme achieved higher performance than the other methods. Energy consumption was not considered in this paper.

Sun et al. [12] discussed task scheduling security in the cloud environment. The functional domain construction was utilized for determining the sets of fog nodes included in the functional domain. The service time, success rate, average delay, and cost are the parameters employed in this paper. The results showed that the scheme achieved better performance when compared to the other techniques. However, this paper failed to focus on the reliability of service in the fog-clouds environment.

Nawrocki et al. [13] presented a security-aware task allocation model for resource management and secure task allocation in mobile cloud computing (MCC). To meet the consumers' data confidentiality requirements, they developed a resource allocation protocol that assigns optimal and secure communication. A machine learning model is adopted for resource utilization and their model is evaluated in a MocSecSim environment. The results show that their model enhances the security level for task allocation with minimal processing time and energy consumption.

Li, W. et al. [14] presented an agent learning method in a trust basis form in a mobile cloud computing atmosphere that involved service composition. This technique was developed to increase user skills such as risks in security and provision of quality of service (QOS) uncertainty. The efficiency was analyzed by applying Java Agent Development Framework (JADE). The experimentation result showed that the scheme achieved improvement in the satisfaction of users and success rate for transactions through the fuzzy c-means (FCM) learning algorithm.

The cloud computing and ant colony optimization algorithm (ACOA) was developed by Su, Y.et al. [15] to schedule tasks and allocate resource optimization. The cost and time expectation was achieved through optimized ACOA (Q-ACOA). The time, cost, and load balance-enhanced ant colony optimization (TCLB-EACO) algorithm, min-min (MM) algorithm, and the round robin scheduling (RR) algorithms were used in this scheme. The experimentation result demonstrated that the scheme evaluated the value of expected heuristic factor β is 4.5 and pheromone heuristic factor α is 3, which consumed low cost in Q-ACOA over related algorithms. However, the scheme does not execute the correlation process.

Amer, A.A. et al. [16] investigated an optimized collaborative scheduling (OCS) algorithm in a cloud computing and mobile-edge computing (MEC) scheme which involved resource-sharing methods for performing task prioritization. The presence of service satisfaction was verified by a resource optimization algorithm and the supply of resources was established. The experimentation results validated that the scheme achieved the best performance in a proposed scheduling algorithm over the previous scheduling algorithm. However, the scheme consumed more power and energy.

Zhu, Q.H. et al. [5] developed a multi-mound allocation (MMA) scheduling method called matching to optimize submitted tasks with respect to the total cost, makespan, reliability constraints, and security. Hybrid chaotic particle search (HCPS), modified artificial bee colony (MABC), and modified cuckoo search (MCS) are the techniques used to achieve these objectives. A better trade-off between time and economic cost, higher resource utilization lower cost, and shorter makespan is achieved using this technique.

The symmetric key cryptographic technique was proposed by Sohal, M. et al. [17] based on binary deoxyribonucleic acid (BDNA) and asymmetric deoxyribonucleic acid (ADNA) which involved data encryption on the client side for the analysis of cloud computing security. This technique was evaluated to reduce the usage of more encryption algorithms. The scheme related the developed technique with the existing Data Encryption Standard (DES), Advanced Encryption Standard (AES), Blowfish, and deoxyribonucleic acid (DNA) symmetric key algorithms. The experimentation analysis revealed that the scheme reached better encryption time, throughput, and ciphertext size than symmetric key algorithms. **Table 1** describes the literary works of task scheduling in cloud computing based on several authors.

Table 1. Literature survey based on several authors.

Author and Year	Technique Used	Pros	Cons
Rekha et al. (2019) [11]	**Genetic Algorithm (GA)**	**Completion time was low**	**Energy consumption was not considered**

Author and Year	Technique Used	Pros	Cons
Sun et al. (2021) [12]	Functional Domain construction	Low latency, and minimal service time	Does not focus on the reliability of service in the fog-clouds environment
Nawrocki et al. (2022) [14]	Machine Learning model (ML)	Enhances the security level for task allocation with minimal processing time	The service cost was high
Li, W. et al. (2019) [15]	Fuzzy C-Means (FCM) learning algorithm.	The security level was high	Low success rate
Su, Y.et al. (2021) [16]	Time, Cost, and Load Balance-Enhanced Ant Colony Optimization (ACO)	Low cost and Execution time	Does not execute the correlation process
Amer, A.A. et al. (2022) [17]	Optimized Collaborative Scheduling (OCS) algorithm	Provide high security	Consumed more energy and power
Zhu, Q.H. et al. (2021) [5]	Modified Artificial Bee Colony (MABC), and modified cuckoo search (MCS)	The better trade-off between time and economic cost	The accuracy level was low
Sohal, M. et al. (2022) [17]	Encryption Standard (DES) and Advanced Encryption Standard (AES)	Achieved higher throughput	Execution time was high

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