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Resource Allocation Using Improved Grey Wolf andThe Ant Colony Optimization Using in Cloud Environment

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Abstract- Cloud computing is the latest trend in data storage, processing, visualization, and analysis. As more government agencies and commercial businesses adopt cloud computing, its usage has grown dramatically. It entails distributing resources dynamically as required in order to offer clients secure services. Cloud computing is another rapidly expanding segment of the computer industry. Users can use this paradigm to access computational resources such as Internet streaming. Scheduling and resource distribution are important but difficult issues in cloud computing.To overcome the issues using Ant Optimization (ACO) and Improved Gray Wolf (IGW) for allocating the resource in cloud. Initially, we monitoring the performance based on send and receive data from cloud server and user. Then second step using Improved Gray Wolf (IGW) to allocating the task based on the position and weights. And Then Third step is ACO, is connecting with the second step and its evaluating and analysis the sequence of data position. And enhances cloud service performance through the use of fuzzy algorithms. In order to estimate cloud server workloads and resource requirements, fuzzy rules are used to route resource volume and usage throughout the resource allocation process. Based on estimated workloads, determine the completion time for each cloud server. Experiments were conducted using a Java programming environmentand compared with existing work in this direction in terms of resource utilization, resource allocation, Recourse utilization, CPU load and performance, and cloud performance improvements.

Keywords: Cloud computing, Internet, Fuzzy, Resource Utilization, met heuristic, Ant Colony Optimization, Grey Wolf, Throughput.

I. INTRODUCTION

Cloud system of decentralized computing that provides a feasible substance for remotely supplying scalable and scalable resources is cloud computing. Distributed, grid, and parallel computing are also specifically implemented in the cloud. An "on-demand" shared resource pool is made available to users in the cloud environment. Thanks to its powerful processing power and enormous storage capacity, cloud services are available to consumers everywhere, at any time. Computing assets such databases, servers, networking hardware, communication equipment, and software systems make up the cloud data center.

The cloud resource requirements that they have been presented with are similarly rapid, abrupt, and diversified. The majority of cloud resource allocation techniques now in use cannot ensure resource allocation uptime and optimization and do not support emergency mode. Cloud service providers are more concerned with managing massive amounts of resources and optimizing resource utilization, whereas users are more concerned with optimizing timely and sudden resource requests. To accomplish these objectives, resource allocation must be done effectively. A virtual machine placement challenge known as the resource allocation procedure is used to identify appropriate physical servers for housing virtual machines (VMs). This procedure maximizes the cloud platform's resource consumption while also satisfying the virtual machine's resource needs.

Figure 1, that depicts the fundamental process of allocating cloud resources, illustrates a hybrid cloud architecture made up of both a private cloud and an External cloud. A cloud consumer first asks the cloud for computational resources. The cloud is utilized to gather user application requests for the cloud consumer since the user interface module is regarded as a private interface within the cloud. Tasks that users request get saved using cloud task scheduling. The Request Manager module in the cloud manages all user-authorized requests.

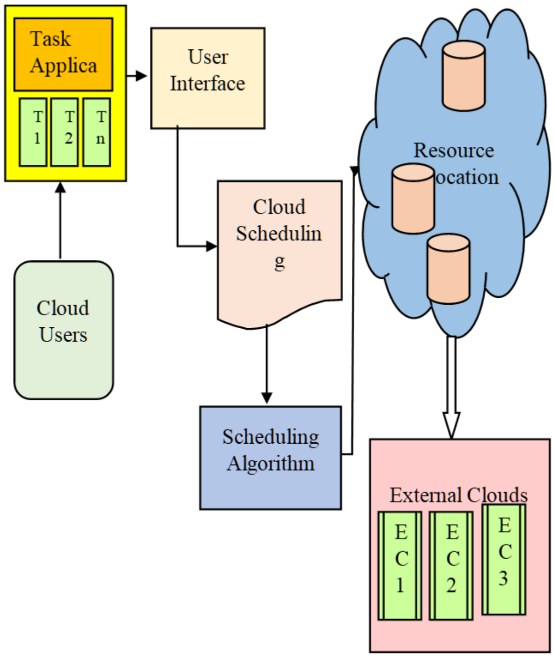

Figure 1: Basic Flow Diagram

The distribution of resources is the primary endeavor. Additionally, choosing the right cluster resources to complete a work at its best involves taking into account a number of factors, including scalability, cost, time, availability, resource consumption, performance, and dependability. This study offers an improved gray wolf and ant colony optimization algorithm (IGW-ACO) as an optimization technique for cloud environments with reference to resource allocation. Implementation and execution times and are based on resource allocation for cloud computing. Cloud providers profit more as a result of this. The suggested resource allocation algorithm, which is based on IGW-ACO, is then assessed in IGWO and ACO utilizing performance indicators including memory use, CPU utilization, and profitability.

Contribution of this work

- The cloud reduces the costs of maintaining and managing systems by avoiding purchasing expensive system memory and other computing resources.
- Cloud service providers can adjust according to demand, allowing to scale down based on demand.
- The cloud protects against data loss due to natural disasters, power outages, or other heads. Cloud support allows you to continue business as usual without sacrificing productivity.
- Fuzzy rules are utilized to path resource volume and usage during the resource allocation process is employed to prediction cloud server workloads.

II. Literature Survey

A user agent represents a cloud user, and a cloud agent represents a cloud service provider. In a dynamic context, they are promoting different arrangements of resources. In order to overcome the computational difficulty of joint auctions, tackle the success with a real payment scheme problem using a greedy approximation technique [1]. One possible way to handle compute-intensive blockchain tasks on resource-constrained IoT devices is to offload computation to a Cloud/Edge Computing Service Provider (CESP). CESP enables users to deploy mobile blockchain services by collaborating with several edge servers and the cloud to deliver computing resources to Internet of Things users [2].

Applications with time limitations, such deadlines, operate in clouds with limited resources that have a large number of heterogeneous computing resource nodes [3]. Its importance is clear because it has a direct influence on even the most important national policy. For instance, China had not yet realized the restructuring of its economic structure prior to the reform and opening up. It was at this period that political and military strategy received more weight. It is not always the case that integrated regional economic development entails concurrent growth or development [4]. In order to meet user needs at a fair cost, cloud resources must be allocated efficiently. The majority of current research concentrates on either costly solutions using on-demand resources or inexpensive solutions using allocated resources, which could result in under- or overprovisioning [5]. A cloud data center's resources fluctuate due to the numerous hosts and application demands it faces. Different needs apply to the distribution of resources. These elements may result in load imbalance, which has an impact on resource usage and scheduling effectiveness [6].

Due to the WAN latency involved, cloud systems become ineffective for handling latency-sensitive applications. Folk computing offers latency-free computing and optimizes cloud service execution. Efficient resource allocation algorithms are necessary due to the diversity of fog-cloud hybrid formations and the delay sensitivity of jobs [7]. To solve the challenges associated with market ownership and operation, propose the use of a shared collaborative infrastructure, where the services across the resources. [8].

Effective global resource sharing is made possible by the growth of small and large geographically dispersed data centers run and managed by different cloud service providers (CSPs). However, a new challenge is the management autonomy control of diverse data center resources prototype [9].

Author/Year	Proposed Method	Drawbacks
J. Li/2020	Particle swarm optimization algorithm [10]	complicated workflow software
W. Wei/2022	Genetic algorithm	Difficulties connected with mobility, security, the environment, and physical limitations. [11]
S. Hosseinalipour/2021	Options-based sequential auctions (OBSAs) [12]	Delayed entry is a problem
S. Singhal/2023	Rock Hyrax-based optimization	An unusual rate of growth has been observed in the need for computing resources to support cloud services [13]
A. B. M. B. Alam/2021	Joint optimization model [14]	Because self-assurance cannot be measured quantitatively, enrichment performance and confidence are traded off.

A resource allocation meta-heuristic known as the Multi-Objective Symbiont Search Algorithm (MOSOS). MOSOS was created with the intention of reducing expenses and completion times. Simulation findings demonstrate that MOSOS outperforms other approaches in terms of results [15].

Despite the increasing effort to quantify migration on mobile edge devices caused by this paradox, there is still a dearth of research in this field. Resource allocation problems for compute migration between mobile edge devices. In particular, start by building the Mobile Social Cloud's (MSC) architecture. In this approach, resource-rich mobile devices are abstracted as resource providers, while resource-poor mobile devices are represented as resource activists. [16].Multicast transmission, which reaches a large number of recipients, is susceptible to many types of attacks. The current system makes use of the MKMP (Multicast Key Management) protocol, which gives different substation groups access to user session information. Understanding the user list under the substation is challenging, and there is a chance that some information is missing or inconsistent with station data [17].

Problem Identification

- Users purchase cloud resources from distant servers for their work, but they have no control over these resources.
- Deep understanding is necessary for controlling and assigning resources in the cloud since the cloud service provider (CSP) is the source of all information regarding how the cloud environment functions.
- Under deployment approaches like public cloud, end user data is susceptible to hacking and other threats like phishing. Malware will be able to propagate throughout the network very easily because cloud servers are open and linked.
- When an end user wishes to switch to a different cloud provider in search of better services or data storage, a migration issue occurs. Moving massive amounts of data from one supplier to another is a challenging and time-consuming procedure.

III. MATERIALS AND METHOD

Develop the model for allocating resources while minimizing them, as well as the cloud resource allocation level. Next, the fuzzy gray wolf ant colony optimization algorithm (IGW-ACO) cost matrix correction is used to provide an efficient resource allocation strategy, and the suggested model is assessed experimentally. The suggested approach performs better in terms of optimal execution time than the hybrid IGW-ACO allocation model, according to performance evaluation.

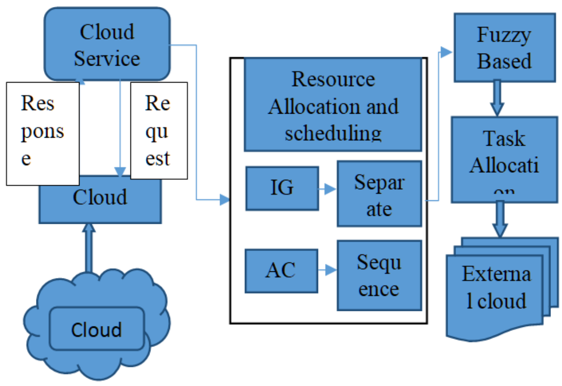

Figure 2: Proposed diagram

Figure 2 proposed a flow chart with rule-based scheduling for resource allocation that permits cloud users to send and receive CSP requests. Use IGW-ACO to allocate resources in the cloud. IGW locates the work by first gathering disjoint subsets and searching for it. After that, the ACO is utilized for the task allocation sequence. To identify the right tasks and download data from an external server, its IGW-ACO is set up for fuzzy allocation.

3.1 Performance of Cloud user and server Performance for resource allocation

A cloud user requests that the necessary data be retrieved or stored from the cloud server by sending an email to a cloud service provider. With the assistance of the decision manager, it also receives responses that have been transmitted by the cloud service provider.

Large amounts of data are kept on cloud servers by all authorized cloud users. To give cloud customers better cloud services, a cloud server's big database handles cloud user data, which is dispersed and kept across several cloud databases.

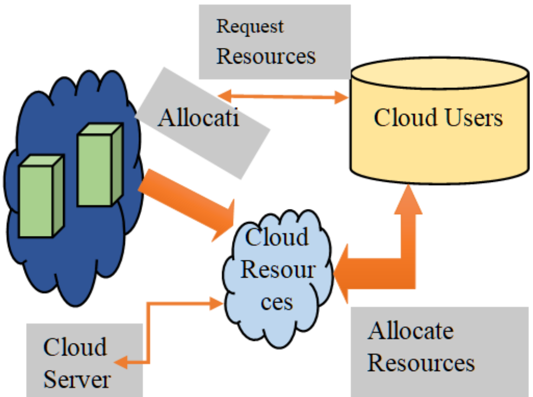

Figure 3: Resource allocation in cloud

Figure 3 shows the distribution of resources in a cloud environment. The user sends the cloud server a request to allocate resources. The user is assigned a resource based on its availability.

3.2 Improve Grey Wolves Algorithm

Gray wolves are regarded as hunters and possess superior hunting skills. A met heuristic search that mimics the actions of gray wolves when exploring, hunting, and scouting prey is called a modified gray wolf algorithm. Wolves come in four varieties: Omega (δ), Beta (β), Delta (δ), and Alpha (α). The mathematical model of wolves encircling their prey during a hunt looks like this:

$$Gs = |\overrightarrow{PS.AB_G} - \overrightarrow{AB}(temp)| \tag{1}$$

$$\overrightarrow{AB}(temp+1) = |\overrightarrow{AB_G}(temp) - \overrightarrow{AB}.GS| \tag{2}$$

Where GS-Prer, temp is the prey's location time, and PS and AB stand for the attribute values. $\overrightarrow{AB_G}$ and $\overrightarrow{AB}$Location of grey wolves in different vectors and iterations.

$$\overrightarrow{AB} = |2.\overrightarrow{ab}.\overrightarrow{Random1} - ab|$$
$$\overrightarrow{PS} = 2.\overrightarrow{Random2} \tag{3}$$

Where, $\overrightarrow{Random1}$ and $\overrightarrow{Random2}$is a random vector that uses iterations to reduce the values of two to 0 from the position values.

$$XX = 2 - temp * \frac{2}{Iteration} \tag{4}$$

In the maximum number of iterations indicates the XX andab vector values, the position of grey wolf values (Ab, XX)is altered, XX, the PS. The vector values (AB) and (PS) are changed by the best grey wolf placements. The symbols and δ are alert to possible prey locations in order to simulate the behavior of the hunting process. The remaining wolves have shifted their locations in accordance with the three positions, which are determined by these symbols. $\overline{(\overrightarrow{AB1}, \overrightarrow{AB2}, \text{and } \overrightarrow{AB3})}$

$$\overrightarrow{AB}(temp+1) = \frac{\overline{(\overrightarrow{AB1}, \overrightarrow{AB2}, \text{and } \overrightarrow{AB3})}}{3} \tag{5}$$

$$\overrightarrow{AB1} = XX_\alpha - \overrightarrow{AB1}.\overline{(PS_\alpha)}, \overrightarrow{PS_\alpha} = |\overrightarrow{PS_\alpha}.\overrightarrow{AB} - \overrightarrow{XX}|$$
$$\overrightarrow{AB2} = XX_\beta - \overrightarrow{AB2}.\overline{(PS_\beta)}, \overrightarrow{PS_\beta} = |\overrightarrow{PS_\beta}.\overrightarrow{AB} - \overrightarrow{XX}|$$
$$\overrightarrow{AB3} = XX_\delta - \overrightarrow{AB3}.\overline{(PS_\delta)}, \overrightarrow{PS_\delta} = |\overrightarrow{PS_\delta}.\overrightarrow{AB} - \overrightarrow{XX}| \tag{6}$$

In this instance, each wolf attacks the prey by shifting postures between its present and prey positions.At this point, |A| is less than 1. Every wolf leaves the α, β, and δ wolves behind to search for prey and to hide when an attack occurs.$\overrightarrow{AB1}$Values less than -1 or greater than 1 are assumed to be random.

3.3 Ant Colony Optimization

Pheromones are released by individual ants in the location distribution model of an ant colony in response to the quality of the food source at their site. These pheromones are scattered throughout space, and as one gets farther away from the source, the concentration of them decreases. Therefore, the probability density function ought to be selected as the ant pheromone distribution model in the continuous domain optimization process. Our assumption is that the ants in the anthill are able to release pheromones into the surrounding environment, and the Gaussian function is a generalized probability density function. The pheromone distribution model linked to ant x in this instance is an arbitrary order of ant a

$$\tau_{ab}(W) = 1 \Big/ \sqrt{2\pi\sigma_b}\, e^{-((a-\mu_{ab})^2/2\sigma_b^2} \tag{7}$$

$$\sigma_a = \frac{(a_x - b_y)}{\psi.(1+\mu_{ab}(n))} \tag{8}$$

Where,μ_{ab} is the positions ant_{ab} and B is the sub colony of ants ant_J,the distribution center, $\sigma_a(\sigma_a > 0)$ means the width of the distribution function,μ_a maximum allowable values of variables X_a, Y_b of the variables.

3.3.1 ACO Position Updating

Select the parent colony from m sub-colonies in order to update the condition of an ant colony. Determine each group of subcolonies' matching test value for the solution.

$$Est_x = \frac{1}{(1+E^{f(ant\,x, ant\,y,,,ant\,n)^T})} \tag{9}$$

Here, $f(ant_x, ant_y,,, ant_n)^T$ is the values of sub colony, ant_x $T(T > 0)$ is the coefficient used to adjust selection.

$$A_x = \frac{Est_x}{\sum_{x=1}^{n} Est_x} \quad (10)$$

Finally, use formula to choose colony (C).

$$c = \begin{cases} \arg\max_{1,2,3..n}(Est_x) & A \leq A_0 \\ C & A > A_0 \end{cases} \quad (11)$$

In this case, pheromone distribution model function of ants in ant colony C, parent ant colony (Est_x_x is a random number generator), A is a random variable (0,1), and ($A \leq A_0$) is a parameter. Subgroups for sampling and generation are formed, and group C with a high evaluation value is chosen from the subgroups of the C+1 group to get updates on the locations of ant colonies. This selection is based on the evaluation value of each subgroup group.

3.3.2 ACO Sequence Optimization Problem

Initially, established a measure limited optimization problem measure solution C.

$$Seq = \sum_{x=1}^{r} S_x(C) \quad (12)$$

Regarding the limitation of inequality $S_x(C) \leq 0, K_x(C) = \max\{0, K_x(C)\}$.for the constraint of sequencing $S_x(C) = 0$.

$$S_x(C) = \begin{cases} |K_x(C)|, & |K_x(C)| > K_x\min \\ 0, & |K_x(C)| > K_x\min \end{cases} \quad (13)$$

Here, $K_x\min$ is a minor positive number, $Seq(c)$ is equal to 0, and it is possible solution. Estimating the Number $Est(C) = (S + C) * Kmax$ of the highest number of unfeasible solutions in the sequence of$(S + C)$ of sub colony.

If $Seq(c)$ is less than$(S + C)$, then set away the entire assessment for the ant colony group. If is greater than , The unsuitable substitutes are arranged in order of decreasing value (C). The assessment value of the larger number (S+C) of impractical solutions is then set to 0, and the Est(C) group of the maximal fitness for the ant colony group is reserved based on the assessment value.

3.4 Fuzzy Rule based Allocating Task

There are subsections on fuzzy logic and fuzzy rules in this section. The fuzzy logic utilized in the fuzzy rule generation process based on resource levels and deadlines is explained in this section. The four parameters that make up the trapezoidal membership function are a, b, c, and d.

$$trapezoidal(A, B, C, D) = \begin{cases} 0, A \leq x \\ \frac{a-b}{b-x}, A \leq x \leq B \\ 1, B \leq x \leq C \\ \frac{c-d}{d-x}, A \leq x \leq B \\ 0, D \leq x \end{cases} \quad (14)$$

The following equation also defines the same fuzzy membership function:$rapezoidal(A, B, C, D) = \max\left(\min\left(\frac{a-b}{b-x}, 1, \frac{c-d}{d-x}\right), 0\right)$Given the x coordinate values, the fuzzy membership degree of the trapezoid is determined is less than b, b is less than or equal to c, and c is less than d, and these are the fuzzy membership function parameters (A, B, C, D).To prioritize tasks and resources according to deadlines and resource size, fuzzy rules are developed.

- **Rule 1:** priority = 0 if limit = low AND resource size > low AND resource size < medium.
- **Rule 2:** If resource size is greater than medium, smaller than large, and limit is low, then priority is 1.
- **Rule 3:** states that Priority = 2 if Limit = Low AND Resource Size > Lower AND Resource Size < Larger;
- **Rule 4**: states that Priority = 3 if Limit = High AND Resource Size > Lower AND Resource Size < Medium;
- **Rule 5:**states that Priority = 4 if Limit = High AND Resource Size > Medium AND Resource Size < Larger;

The above Fuzzy rules are applied to schedule process review comments and allocate resources in an efficient manner. The rule base contains these various fuzzy rules. These rules are taken into account and used to execute effective scheduling and resource allocation.

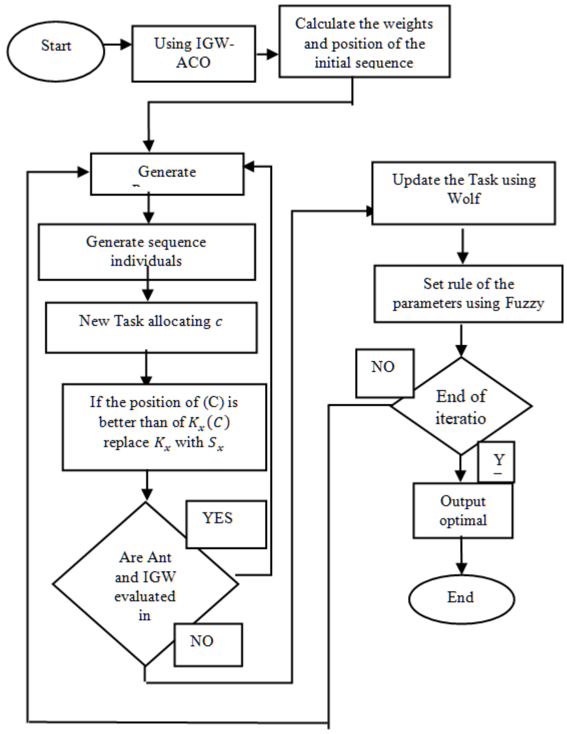

Figure 4: Over all flow Chart

As seen in Figure 4, the fuzzy method is used to first establish the groups and parameters, then determine each member's fitness inside the initial group and choose the top three core members based on their fitness values. An IGW flowchart. The ACO selection appears as a wolf. In the functional part of the method, when new control parameters are obtained by sampling from the binary joint normal distribution, new individuals are created using Kx mutation and crossover functions. Upon completion, the method adaptively modifies the parameters of the binary joint normal distribution and proceeds to the subsequent iteration. At the conclusion of the iteration, the best response and outcome are selected as the best leader wolf.

IV. RESULT AND DISCUSSION

Results that are promising were obtained from the cloud resource allocation procedure, including a significant increase in scalability and efficiency. We successfully optimized resource consumption by utilizing auto-scaling and dynamic provisioning, guaranteeing that computer resources were given exactly where and when needed.

Table 1: Simulation variables and values

Environment	**Values**
Environment of Clod	AWS web service
Users count	500
Development environment	Java

The configurations used in the recommended method to assess the security execution using the Java are shown in Table 1. To confirm the security, a huge AWS server deployment. The outcomes of the Rock Hyrax-based optimization (RHO) and the public key Multi-Objectives Symbiotic Organism Search algorithm (MOSOS) are examined. The table below displays the border that was used to handle the worth in this cloud.

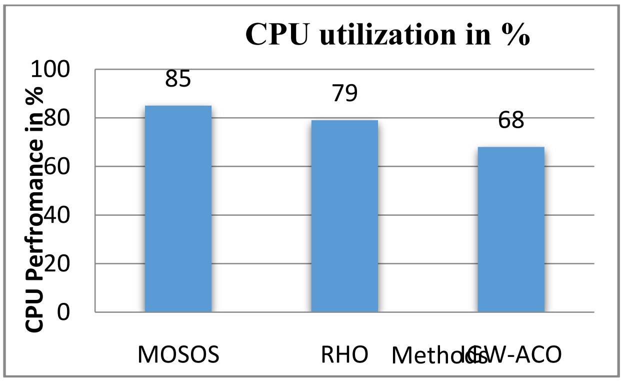

Figure 5. CPU Performance

The effectiveness of the processing in the execution state CPU performance is shown in Figure 5. The suggested method allocates resources for a resource allocation as well as a provisional substitute and IGW-ACO better than previous methods.

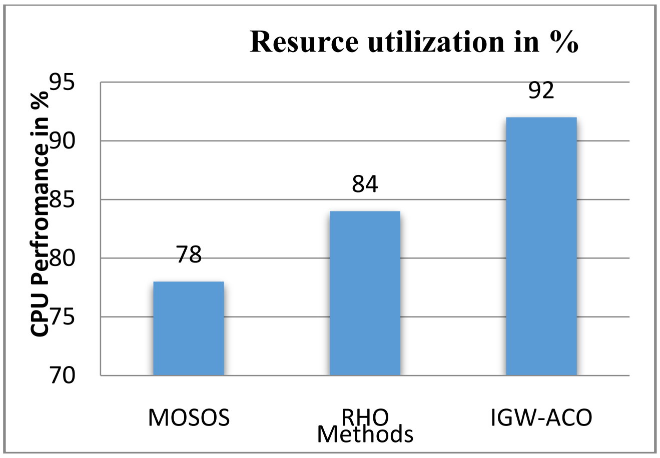

Figure 6Resource Utilization

The recommended approach is shown in Figure 6 with a temporary storage reduces and increase resource allocation for a cloud. The present version of IGW-ACO outperforms earlier methods by a significant margin.

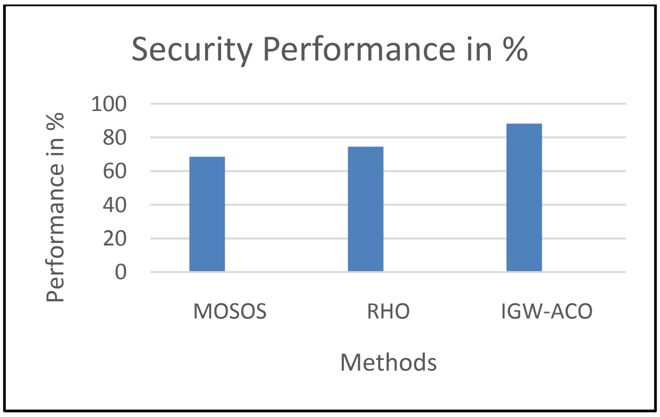

Figure7SecurityPerformance

Figure 7 depicts various analysis methods used to evaluate security by users at various levels. The recommended IGW-ACO system has a higher influence than earlier methods.

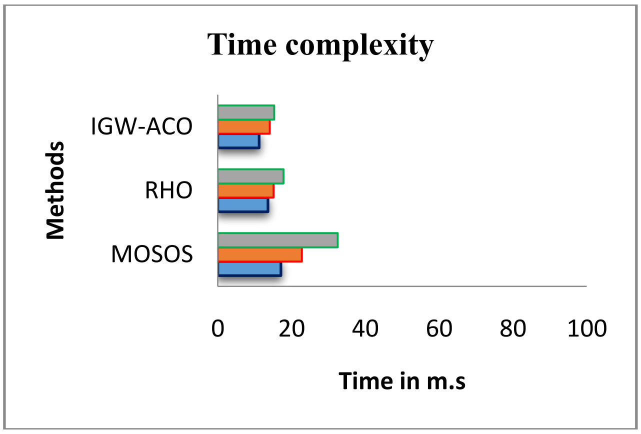

Figure 8. Comparison of time complexity

Figure 8 shows the various file sizes to handle time while being reviewed by various methods. Combining the preceding task allocation with the lowest mean time of 13.6 ms is provided by the recommended system, IGW-ACO. This implementation performed significantly better than earlier methods.

V. Conclusion

An allocating resources in a cloud computing environment and classify previous resource allocation according to various criteria. Suggest a framework for allocating resources that considers cloud users' resource needs as well as the expenses and energy usage of cloud computing environments.Utilizing fuzzy rules and gray wolf optimization techniques, carry out resource allocation and planning. In order to enhance the efficiency of cloud-based applications and distributed computing cloud services, the IGW-ACO algorithm is finally suggested and put into practice. Forecast workloads on cloud servers and the resources needed by cloud users by keeping an eye on past resource allocation and consumption procedures. This model is built through the use of a Java programming simulator, and its benefits in resource consumption and cloud environment performance are compared to those of previous models. New autoscaling methods may be introduced in the future to manage cloud apps with minimal CPU utilization as part of these efforts.

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