Task Scheduling in a Cloud Environment: A comparative Study

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Abstract:- In this study, we explore the application of Monarch Butterfly Optimization (MBO) algorithms for task scheduling in cloud computing, comparing its performance against widely used optimization techniques, namely Ant Colony Optimization (ACO) and Particle Swarm Optimization (PSO).Task scheduling in the cloud is a critical aspect influencing resource utilization, turnaround time, and overall system efficiency. MBO, known for its effective exploration- exploitation balance, is examined for its suitability in addressing the complexities of cloud computing environments. The study investigates MBO's advantages, such as enhanced adaptability to dynamic conditions, effective handling of multi-objective optimization, and its consideration of bandwidth as a critical resource. Comparative analyses with ACO and PSO highlight MBO's superior performance in achieving near-optimal task schedules, emphasizing its potential to offer innovative solutions to the challenges posed by task scheduling in dynamic and resource-constrained cloud environments. This research contributes valuable insights into the strengths of MBO, paving the way for advancements in optimization methodologies tailored for cloud computing systems.

Keywords:- *MBO, ACO, SPO, Dual Access Control, Task Scheduling.*

I. INTRODUCTION

In recent years, cloud computing has undergone significant transformations, transitioning from traditional models to offer advantages such as on-demand and mobile services. The scheduling process plays a pivotal role in optimizing resource allocation for tasks within a finite time frame to achieve desired quality of service (QoS). With the rise of distributed computing, characterized by high scalability, reliability, information sharing, and cost-effectiveness compared to standalone machines, cloud computing has become the predominant paradigm. Ensuring QoS is crucial for user satisfaction, requiring efficient job allocation toallocated resources. As the mapping of tasks onto unlimited computing resources in the cloud poses NP-hard problems, finding optimal solutions within polynomial time remains a challenge. Metaheuristic techniques like Monarch Butterfly Optimization (MBO), Ant Colony Optimization (ACO), and Particle Swarm Optimization (PSO) have gained popularity for addressing these complexities, providing near-optimal solutions within reasonable timeframes. This paper presents an extensive review of ACO,

PSO, and MBO, highlighting their effectiveness in solving large, complex problems. Scheduling algorithms vary based on task dependencies; while some tasks require a specific order based on precedence, others, as discussed in this paper, are independent andcan be scheduled in any sequence.

II. PROBLEM DEFINITION

The increasing prevalence of cloud computing has underscored the critical need for efficient task scheduling algorithms to optimize resource allocation within dynamic and resource-constrained environments. While existing optimization methods, including Ant Colony Optimization (ACO) and Particle Swarm Optimization (PSO), have been applied to address task schedulingchallenges in the cloud, their efficacy in certain aspects remains asubject of scrutiny. These conventional approaches may exhibit limitations related to their adaptability to dynamic and changing conditions, effective handling of multi-objective optimization criteria, and the consideration of vital resources such as bandwidth. This research addresses these challenges by investigating the application of Monarch Butterfly Optimization (MBO) algorithms for task scheduling in cloud computing. The overarching problem is to assess whether MBO can offer a superior alternative, demonstrating improved performance in achieving near-optimal solutions for task scheduling problems. The study aims to evaluate MBO's effectiveness in minimizing turnaround time, maximizing resource utilization, and enhancing adaptability to fluctuating workloads, contributing to the development of innovative solutions that overcome the limitations inherent in current optimization techniques. This research is crucial for advancing the state-of-the-art in cloud computing task scheduling, offering insights into potential improvements and addressing the evolving demands of dynamic and resource- constrained cloud environments.

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III. LITERATURE REVIEW

The importance of effective task scheduling in this dynamic computing paradigm can be highlighted through various key aspects. It significantly impacts resource utilization efficiency. In a cloud environment, where resources are shared among multiple users and applications, proper task scheduling ensures that computing resources such as CPU, memory, and bandwidth are allocated optimally. This optimization not only leads to improved overall system performance but also contributes to cost-effectiveness by minimizing resource wastage.

"Task scheduling and resource allocation in cloud computing using a heuristic approach" by Mahendra Bhatu Gawali and Shubash K. Shinde (published February 18, 2018) is a new heuristic algorithm developed using True Cybershake and the epigenomics science workflows study. Comparisons are made between BATS and IDEA's existing systems, specifically examining turnaround times, response times and resource usage. The heuristic strategy gives better results in terms of turnaround time and response time compared to the traditional model. Additionally, it shows efficient allocation of resources, especially in the use of most computing resources such as CPU, memory, and bandwidth. More importantly, the approach expanded the evaluation beyond focusing on CPU and memory to include bandwidth as a critical resource. This study highlights the importance of considering multiple sources for performance evaluation. The results suggest that future work will focus on developing scheduling algorithms to improve flexibility and response time in cloud computing environments.

"A Relative Study of Task Scheduling Algorithms in Cloud Computing Environment" by Syed Arshad Ali & Mansaf Alam published in May 2019, Task Scheduling is very important aspect for Cloud Computing. In this paper, recently developed Task Scheduling algorithms in Cloud Computing environment have been studied and various Task Scheduling parameters are used to compare these algorithms. In which Particle Swarm Optimization and Cuckoo Optimization based Task Scheduling Algorithms are inspired from nature based algorithms and DVFS-enabled Energy- efficient Workflow, Green Energy Efficient and Adaptive Energy- Efficient Task Scheduling Algorithms.

"Task Scheduling in Cloud Computing: A Survey" by Gopika Venu, Vijayanand K, published on May 2020, In cloud computing environment, resources with different characteristics are served virtually. Effective planning is essential to effectively manage such resources. This article introduces various planning algorithms and planning methods. This article discusses some scheduling algorithms and their development data. This article also discusses some ways to improve planning. This comparative study will help select appropriate scheduling algorithms for different cloud users and cloud service providers.

Authors	Title	Proposed Model
R. Kaviarasan, P. Harikrishna **(2020)**	Load balancing in cloud environment using enhanced migration and adjustment operator based monarch butterfly optimization	This paper introduces an enhanced version of Monarch Butterfly Optimization (MBO) specifically tailored for load balancing in cloud computing environments. It presents the formulation of the enhanced MBO algorithm and evaluates its performance in terms of load balancing efficiency.
B. Gomathi1, S. T. Suganthi2 (2020)	Monarch Butterfly Optimization for Reliable Scheduling in Cloud	It discusses the formulation of the optimization problem, the implementation of the MBO algorithm, and evaluates its effectiveness in achieving reliable scheduling.
Syed Arshad Ali & Mansaf Alam (2020)	A Relative Study of Task Scheduling Algorithms in Cloud Computing Environment	In this paper, recently developed Task Scheduling algorithms in Cloud Computing environment have been studied and various Task Scheduling parameters are used to compare these algorithms. In which Particle Swarm Optimization and Cuckoo Optimization based Task Scheduling Algorithms are inspired from nature based algorithms.
Tao Hai, Jincheng Zhou, Dayang Jawawi (2022)	Task scheduling in cloud environment	It discusses various optimization techniques, security considerations, and processor selection schemes. The paper also highlights challenges and opportunities in task scheduling research.
Sanjeet KuYanh ong Feng, Suash Deb, Gai-Ge Wang, Amir H. Alavimar Nayak et al (2021)	"Monarch butterfly optimization comprehensi ve review	Since MBO was proposed by Wang et al. in 2015, many scholars have carried out widespread and deepgoing research on the improvement and application. This study carried on a systematic and thorough review to the recent research on the MBO algorithm. The literatures already available can be divided into several categories, including modifications, hybridizations, variants, and applications of MBO algorithms. From these reviewed articles, it can be seen that MBO is more used to solve global numerical optimization problems

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IV. EXISTING SYSTEM

Particle Swarm Optimisation was proposed by Eberhart and Kennedy in the year 1995. PSO is a swarm intelligence metaheuristic algorithm propelled by the swarming behavior of creatures, such as bird flocks or schools of fishes. Comparable to the Genetic Algorithm (GA), it is a population-based strategy, meaning it speaks to the state of the algorithm relative to the populace and is upgraded until the process ends. In the PSO algorithm, the populace of arrangements P={p1,…,pn} is usually called a group. Conceivable or possible solutions p1,...,pn are called particles. The PSO method treats the solution set Rd as the "place" where the object "moves". To solve the problem, the number of items is usually chosen between 10 and 50.

Ant Colony Optimization (ACO) is a global optimization algorithm, influenced and inspired by the social behavior of ants. ACO can be effectively utilized to solve graph-based optimization issues. Investigate ACO and implement an ACO-based a solution to the Traveling Sales-man Issue. The issue is as takes after: Given a list of cities and the distance 11 between each pair of cities, discover the shortest possible path or tour.

ACO is a strategy that has been recommended since the early nineties but was to begin with formally proposed and put forward in a thesis by Belgian analyst Marco Dorigo and Luca Maria Gambardella in 1992, Ant Colony System: A Cooperative Learning Approach to the Traveling Sales-man problem and taken after up by Dorigo, Birattari, and Stutzle's proposal in 2006, "Ant Colony Optimization: Artificial Ants as a Computational Intelligence Technique".

➢ *Drawbacks of Exsiting System*

Particle Swarm Optimization (PSO) has a tendency to get stuck in local optima, challenges in handling constraints, sensitivity to parameter tuning, premature convergence, scalability issues in high-dimensional spaces, limited adaptability to changing problems, overemphasizing top performers, and complexity in parallelization. These limitations must be considered when applying PSO to optimization problems.

Ant Colony Optimization (ACO) include relatively slower convergence, sensitivity to parameter settings, challenges in balancing exploration and exploitation, memory-intensive requirements, difficulty in adapting to dynamic environments, scalability issues in high-dimensional spaces, lack of guaranteed optimality, and complexity in parallelization. These limitations should be considered when applying ACO to optimization problems.

V. PROPOSED WORK

Monarch Butterfly Optimization (MBO) calculation is based on reenacting the migration behavior of ruler butterflies. The algorithm is sketched out, where the populace is separated into two subpopulations, each overhauling its position based on migration and butterfly adjusting operators. MBO is famous for its straightforward structure, few parameters, and vigor, robustness and its application in worldwide numerical optimization, combinatorial optimization, office format issues, vitality administration and change, content categorization, and neural arrange preparing is talked about. Be that as it may, it is specified that MBO has impediments, such as defenselessness to neighborhood optima.

The adjustments of the MBO calculation are altogether checked on, centering on the relocation and butterfly adjusting operators. Also, the hybridizations of MBO with other optimization procedures are examined with a primary highlight on the benefits of hybrid approaches in making strides calculation execution. Besides, the paper investigates different variations of MBO presented by analysts to upgrade optimization execution and examines the inadequacies and advancement techniques for the calculation as well.

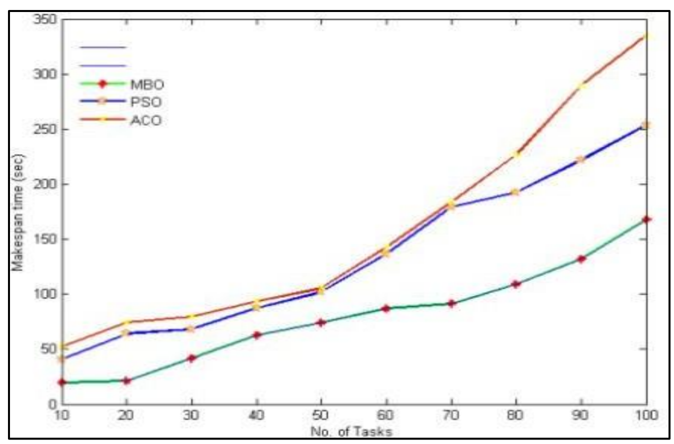

Fig 1: Comparision of Makespan time in ACO, PSO & MBO

VI. METHODOLOGY

Monarch Butterfly Optimization (MBO) algorithm emerges as a promising approach for task scheduling in cloud computing, offering distinct advantages over traditional methods such as Ant Colony Optimization (ACO) and Particle Swarm Optimization (PSO). MBO, inspired by the natural behavior of monarch butterflies, introduces a unique and efficient way of exploring the solution space and optimizing the allocation of computational tasks within a cloud environment. Its adaptability and resilience make it particularly well-suited for the dynamic and complex nature of cloud computing workloads.

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Unlike ACO and PSO, MBO demonstrates a balance between exploration and exploitation, providing robust solutions while minimizing the risk of premature convergence. As the demands on cloud systems continue to evolve, the adoption of innovative optimization algorithms like MBO holds the potential to enhance the overall efficiency and performance of task scheduling in cloud environments, contributing to a more reliable and responsive cloud computing infrastructure. The workflow involves data owners encrypting their data based on self-chosen access policies and uploading the encrypted data to the cloud. Authorized data users can then download the shared data by sending a download request to the cloud.

First, all measurements are started, then the first population is created and measured according to the working power. After this the locations of each monarch butterfly were gradually adjusted until something was met. It is worth noting that in order to improve the population and reduce sanitation measures, the number of monarch butterflies produced by the operator migrated and the butterfly transfer operator were NP1 and NP2, respectively.

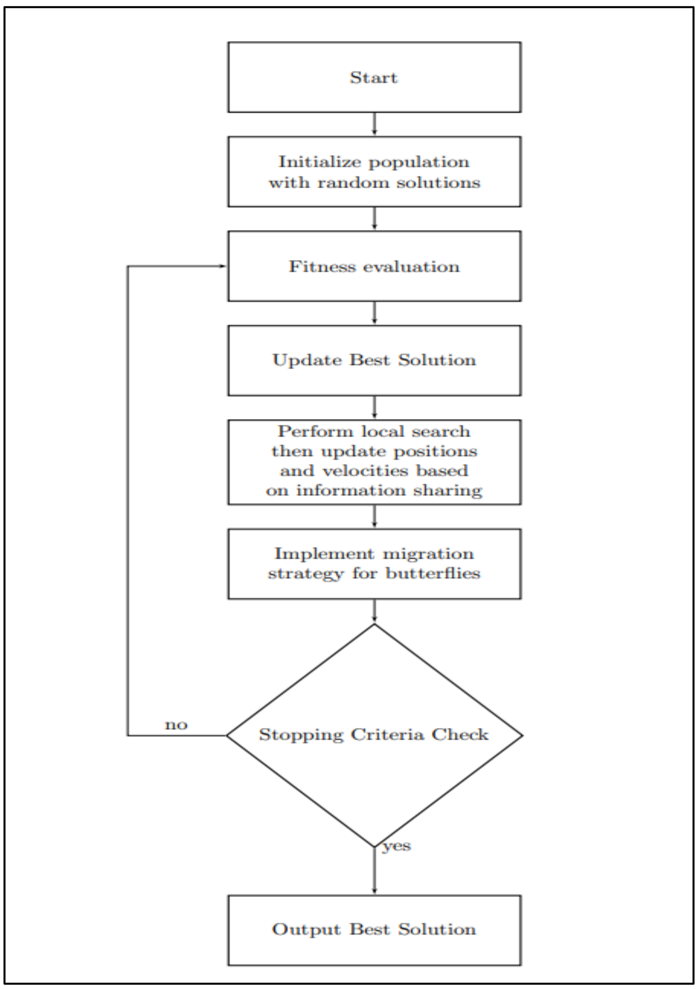

Fig 2: Flowchart of Proposed Model

VII. CONCLUSION

In conclusion, the utilization of Monarch Butterfly Optimization (MBO) for task scheduling in cloud computing presents several noteworthy advantages over traditional approaches such as Ant Colony Optimization (ACO) and Particle Swarm Optimization (PSO). Through a balanced exploration-exploitation strategy, MBO demonstrates enhanced efficiency in finding near-optimal solutions, particularly beneficial in complex cloud computing environments. The algorithm's proficiency in handling multi-objective optimization contributes to a more comprehensive approach, addressing diverse scheduling objectives effectively. While ACO and PSO have been instrumental in optimization tasks, MBO's unique strengths, such as its adaptability to dynamic environments and consideration of bandwidth as a resource, position it as a promising alternative for addressing the evolving challenges of task scheduling in cloud computing. As cloud computing continues to evolve, the effectiveness of MBO in achieving optimal task schedules underscores its relevance and potential for further advancements in this dynamic field. However,ongoing research and experimentation are essential to continuously refine and validate the applicability of MBO in diverse cloud computing scenarios and to explore potential areas for improvement in specific contexts.

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