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OPTIMIZATION OF JOB SCHEDULING IN CLOUD COMPUTING

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Abstract: The cloud resources are accessible to cloud users over the internet to accomplish the desired requirements in the fields of finance, education, internet business, and nearly all organizations. Enhancing the effectiveness and performance of a cloud environment requires job scheduling to optimize resource allocation and utilization.. The job scheduling issue mainly focuses on the best or optimal solution for mapping of jobs to the virtual machines to minimize the total processing time of jobs. This paper presents a novel approach for enhancing job scheduling in cloud computing through the Atomic Orbital Search (AOS) algorithm. The Atomic Orbital Search (AOS) is a metaheuristic algorithm which draws inspiration from the principles of atomic orbitals in quantum mechanics, improves scheduling possibilities of jobs to the virtual machines efficiently enabling faster and more optimal scheduling leading to improved resource allocation, reduced time complexity and enhanced overall system performance.

Index Terms – Cloud, Job Scheduling, AOS, Metaheuristic, Quantum Mechanics, Resource Allocation

I. INTRODUCTION

Cloud is a secure virtual workspace. The computing services are mainly popular for sharing large scale of resources and equipment such as storage, database, networking, servers, runtime, O/S and so on. Whereas cloud computing is the delivery of computing services over the internet on the pay-as-you-go on demand services. The data existing in the cloud can be accessed at anywhere and anytime by the cloud user. The hosting infrastructure gets maintained and managed by the cloud service provider and located in data centers; a physical location consists of computing infrastructure and its related hardware. By December 2023, there are approximately 10,978 data centers worldwide.

The services provided by Cloud Computing include IaaS, PaaS, and SaaS. In IaaS, users can deploy and run the applications and can avail servers, storage, networking and virtualization. No knowledge required about the infrastructure for the user and mainly used by network architects. In PaaS, the user can develop their software applications using programming language and tools on the infrastructure managed by the service provider and can avail runtime, middleware, O/S, virtualization, servers, storage, networking. Basic knowledge required for the basic setup. In SaaS, user can avail the basic services such as applications, data, runtime, middleware, O/S, virtualization, servers, storage, networking from the cloud service provider. No technical knowledge required for the user. The cloud service providers make profits by providing the services to the cloud users. The huge serving of various requirements led to decrease in proper utilization of resources results in maximum time consumption. The cloud environment uses a scheduler to allocate incoming user requirements i.e. jobs to limited number of resources i.e. virtual machines. Hence, the efficient scheduling should be done to serve user needs.

In this paper, we address a metaheuristic approach for job scheduling in cloud environment. The remainder of the paper is organized as follows: Section II gives the related work to this paper. Section III describes about scheduling in cloud computing. Section IV gives the proposed methodology. Section V demonstrates the results and experimental analysis. Section VI concludes the paper.

II. LITERATURE SURVEY

Some of the research papers which are related to the job scheduling in cloud computing and Atomic Orbital Search Algorithm are studied and mentioned in Table 1: Literature Survey.

Table 1: Literature Survey

. S. No.	Year	Authors	Title	Optimization Techniques
[1]	2023	Swati Lipsa *et al.*	Task Scheduling in Cloud Computing A Priority-based Heuristic Approach	Priority assignment to task, Preemptive and Non Preemptive task scheduling, BATS, IDEA, BATS+BAR.
[2]	2023	M. Baghalzadeh Shishehgarkhaneh *et al.*	BIM-based resource trade-off in dam project scheduling using Atomic Orbital Search (AOS) algorithm	Building Information method (BIM), Atomic Orbital Search Algorithm (AOS).
[3]	2023	Md Tahmid Hussain *et al.*	Atomic Orbital Search Algorithm For Efficient Maximum Power Point Tracking In Partially Shaded Solar PV Systems	Atomic Orbital Search Algorithm, Maximum Power Point Tracking (MPPT).
[4]	2022	M. O. Agbaje *et al.*	A Survey of Game-Theoretic Approach for Resource Management in Cloud Computing	A comparative analysis of game-theoretic models for resource allocation, Load balancing, task scheduling in cloud architecture

[5]	2022	Feng Shi *et al.*	Virtual Machine Resource Allocation Optimization in Cloud Computing Based on Multiobjective Genetic Algorithm.	MOGANS, MOEA/D, MOGA-D Algorithms
[6]	2022	AN-Ning Zhang *et al.*	Task Scheduling In Cloud Computing Environment Using Advanced Phasmatodea Population Evolution Algorithms.	APPE Algorithm
[7]	2022	Mahdi Azizi *et al.*	Multiobjective Atomic Orbital Search (MOAOS) For Global And Engineering Design Optimization.	Multiobjective Atomic Orbital Search (MOAOS)
[8]	2022	Mehmet Fatih Karakas *et al.*	Metaheuristic FIR Filter Design with Multi-Objective Atomic Orbital Search Algorithm	Atomic Orbital Search (AOS) Algorithm.
[9]	2021	Jafar Ababneh *et al.*	A Hybrid Approach Based on Grey Wolf and Whale Optimization Algorithms for Solving Cloud Task Scheduling Problem	HGWWO, GWO, WOA Algorithms.
[10]	2021	Xiangqiang Gao *et al.*	Hierarchical Multi-Agent Optimization for Resource Allocation in Cloud Computing	hierarchical multi-agent optimization (HMAO) algorithm, genetic algorithm (GA), multi-agent optimization (MAO) algorithm.
[11]	2021	Ambika Aggarwal *et al.*	IFFO: An Improved Fruit Fly Optimization Algorithm for Multiple Workflow Scheduling Minimizing Cost and Makespan in Cloud Computing Environments	improved Fruit Fly Optimization (IFFO) algorithm, FFO, PSO, and GA.
[12]	2021	Lei Shi *et al.*	Multijob Associated Task Scheduling for Cloud Computing Based on Task Duplication and Insertion.	Task Duplication and Insertion Algorithm based on List Scheduling (DILS).

[13]	2020	Mahdi Azizi *et al.*	Atomic Orbital Search: A Novel metaheuristic approach.	Atomic Orbital Search (AOS) Algorithm.
[14]	2018	Bhupesh Kumar Dewangan *et al.*	Resource scheduling In Cloud – A Comparative Study.	STAR, Dynamic Resource Allocation Scheme, Autonomous Agent-Based Load Balancing, Hybrid Job scheduling Algorithm, Honeybee Algorithm, etc..
[15]	2018	Mahendra Bhatu Gawali *et al.*	Task scheduling and resource allocation in cloud computing using a heuristic approach	modified analytic hierarchy process(MAHP), bandwidth aware divisible scheduling (BATS), BAR optimization, longest expected processing time preemption (LEPT), and divide-and-conquer methods.

III. SCHEDULING

The scheduler aims resources to be scheduled needed for the job completion (serving user needs) providing improved system performance. Scheduling is the process of arranging and optimizing the jobs submitted by the user. Scheduling helps for selecting the suitable virtual machines for performing the jobs. Job Scheduling comes under the resource management. In Resource management there are three different approaches namely, Architecture, Infrastructure and Algorithm as shown in Figure. In Resource Management approaches we are using Algorithm approach for the Optimization of Job Scheduling. Algorithm based Resource Management approach contains four different ways namely Discovery, Benchmarking, Load Balancing and Placement. In these four different ways of algorithm approach we are using load balancing for the Optimization of Job Scheduling.

Load Balancing: As edge data centers are deployed across the network edge, the issue of distributing tasks using an efficient load-balancing algorithm has gained significant attention. Typical techniques are, namely, optimization techniques, cooperative load balancing, graph-based balancing, and using balancing, graph-based balancing, and using breadth-first search. We are using optimization techniques under load balancing for the optimization of job scheduling. We are using Atomic Orbital Search algorithm.

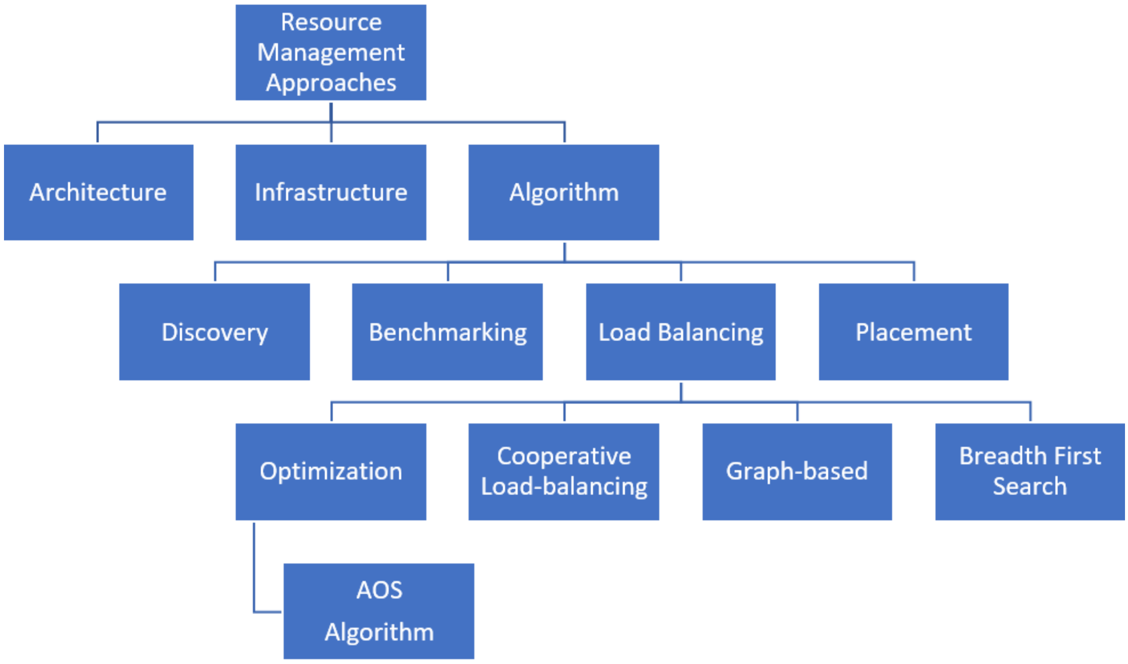

Fig 1. Scheduling in Cloud Computing

IV. PROPOSED METHODOLOGY

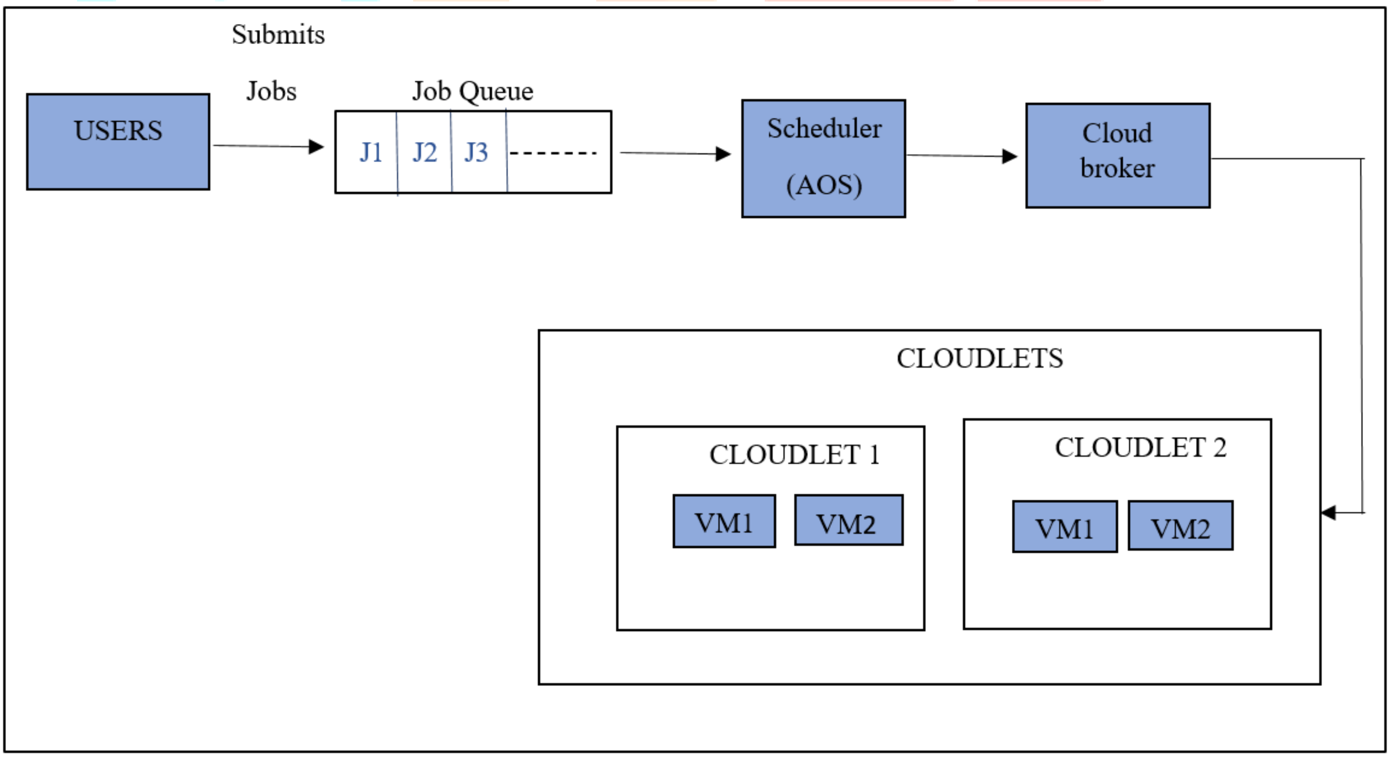

Fig 2. Block Diagram of proposed AOS based job scheduling in cloud environment

The jobs submitted by users are sc heduled by using the Atomic Orbital Search Algorithm. These scheduled jobs are sent to the virtual machines by the cloud broker. These jobs get processed on the virtual machines.

ATOMIC ORBITAL SEARCH ALGORITHM:

This Atomic Orbital Search Algorithm is used to solve a resource allocation problem. It initially defines the parameters are population_size which defines the number of individuals. Here individual is considers as solution (resource allocation strategy for a set of jobs with specific resource allocations), mutation_rate which defines the mutation of an individual to undergo the mutation and num_generations.

We define a function for generating a Random solution by assigning the values of CPU and Memory from the defined resource allocations for each job, Calculate the fitness solution by calculating the total profit by adding the profit generated by the each job. Here, calculating the total profit by adding the profit generated by the each job. To calculate the super position we need to calculate the crossover point by using length of the parent list. By using this crossover point we can obtain the child 1 and child 2 from the parent1 and parent2. This children represents the new potential allocation strategies formed by the information of both parents and individuals. We also performs the tunnel process by considering the random index value from zero to length of mutated solution-1. The index value of the mutated solution is evaluated based on that index value and CPU and memory assigned or the jobs.

We consider the list of population In the range of population size based on the random solution, we iterate the each individual range of defined number of generations in that we sort the population list by considering the negative value of the fitness of individual, so the list will be sorted in the descending order so that the zero index element has more fitness value so that the highest fitness value will be evaluated. By using the super positioning process and tunnel process we can evaluate the final fittest individual by finding the maximum of fittest value of the population. After finding the best fittest solution we optimize the job scheduling. We calculate the total execution time of the algorithm by subtracting the ending and starting time of the process.

V. RESULTS AND EXPERIMENTAL ANALYSIS

This paper implements the Atomic Orbital Search(AOS) and comapared its results with the results of Partticle Swarm Optimaization(PSO) algorithm. This PSO utilizes the Or-Tools library to solve the Job Scheduling problem. It also compares the Execution Time of both the algorithms by Using the time.time() function and these results are stored in a list and these are dispalyed in the tabular form and visualizes in the form of bar graph.

I . For 5 jobs and 5 machines:

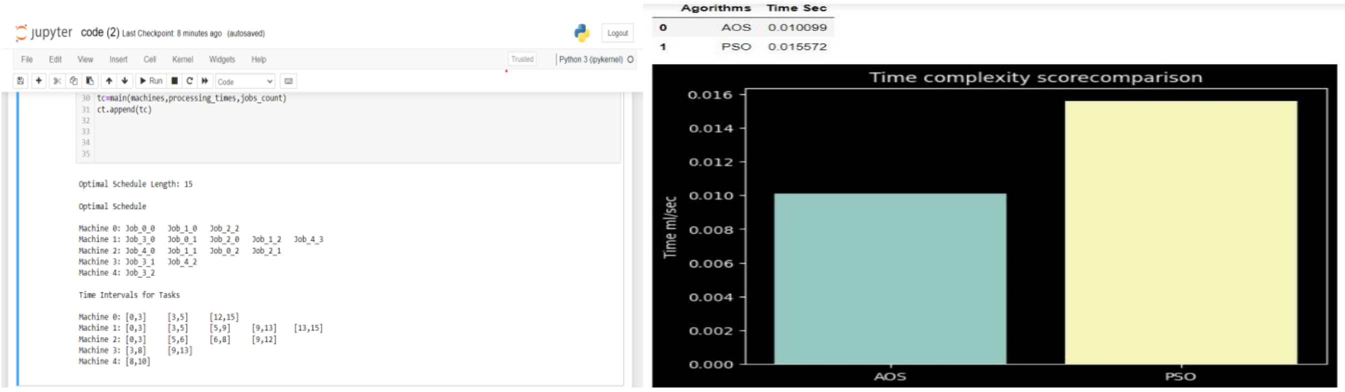

Fig 3. shows output for 5 jobs and 5 machines

II. For 10 jobs and 10 machines:

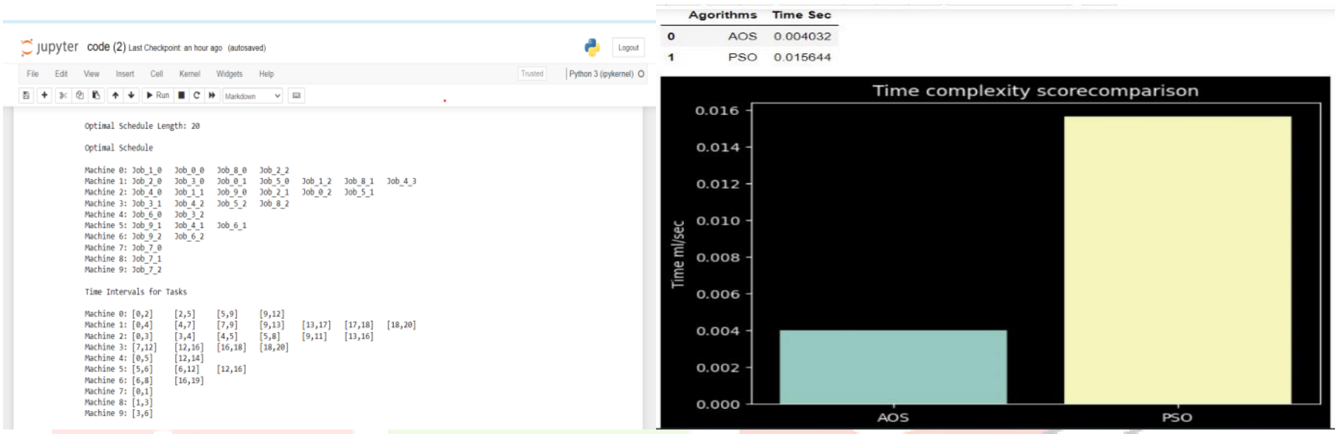

Fig 4. Fig shows the output for 10 jobs and 10 machines

III . For 15 jobs and 15 machines:

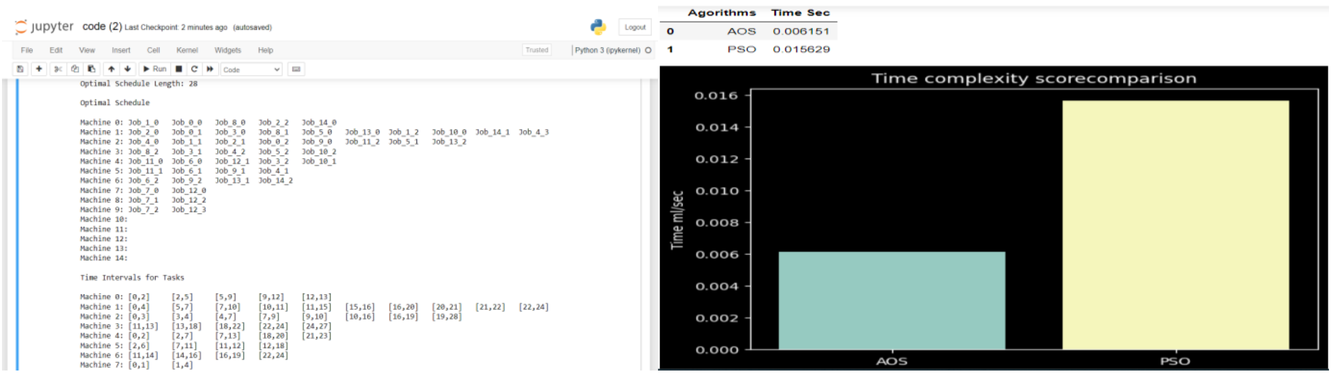

Fig5. Fig shows the output for 15 jobs and 15 machines

The results shows that the Execution Time of AOS algorithm is less when compared to the Execution Time of PSO algorithm. This results finally concludes that the Atomic Orbital Search Algorithm performs well when compared to the PSO algorithm.

VI. CONCLUSION:

This paper uses Atomic Obital Seach algorithm for optimaization of job scheduling. It compares AOS with exsisting PSO algorithms with respect to their execution time and time intervals, both performs well but AOS algorithm gives better results than PSO algorithm.This finally concludes that the Atomic Orbital Search Algorithm performs well when compared to the PSO algorithm .

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