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Bio inspired Optimization Algorithms for Scheduling Task in Cloud Environment: Review

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Abstract

Cloud Computing is an evolving technology that provides consumers with low cost services upon their demand. Based on the incoming tasks for the respective resources an efficient task scheduling must be measure the system performed. Solving the issue, an efficient task scheduling algorithm needs to be evaluated Bio-inspired computing is a computational problem-solving technique based on nature. In recent years, this bio inspired algorithm has become very prominent in solving NP hard and NP complete problems. This paper discusses more than 15 Bio-inspired task scheduling algorithms focus on Ant colony optimization (ACO), Cuckoo search optimization Algorithm (CSA), Chicken swarm optimization (CSO) based on task scheduling with specific performance metrics.

Keywords: *Bio inspired Algorithms, Cloud Computing, NP hard, Task Scheduling, Optimization Algorithms.*

1. Introduction

Cloud computing relies shared resources, on-demand computing system with different types of data and services are hosted on a data center that includes large number of virtual machines (VMs) intermingled in a difficult way. In the modern big data era, the cloud computing paradigm has attracted attention in major scientific, mobile communication, medical and business fields. This computing model offers an on-demand computing model for the customers to access the shared resources more conveniently [1]. The cloud service providers (CSP) or Cloud brokers execute pay as per resource usage model. The cloud users can utilize different type of services such as Software as a service, Infrastructure as a service, and Platform as a service based their needs. The cloud environment can allocate, re-allocate, increase or decrease resources or even withdraw the services dynamically during the task processing. This property enables the cloud users to obtain high performance services through the cloud optimization of the resource allocation to the users' tasks [2].As task scheduling is dependent on physical resource usage and has direct influence on the Quality of service and customer satisfaction, the policy making for efficient task scheduling becomes crucial in any cloud environment.

The main components in the cloud world are cloud users, database servers and a wide variety of data centers. Data center is a series of servers that host variety of applications, and also focused on storage facilities. End user wishes to access the data center to connect to different services. A data center is normally located far from end users [3]. Distributed servers are parts of a cloud platform that are accessible via various internet applications. The active complexity of the cloud computing system requires a complex algorithm for effective node-to-node scheduling and load balance. Static scheduling algorithms can only operate when the workloads vary less. The problem of cloud scheduling is called NP hard (non-deterministic polynomial time) issues. Bio-inspired algorithms play an energetic role in solving complex problems in real time,

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which are difficult to solve with conventional methods. These complicated NP problems can be overcome within a period of time. Naturally-inspired algorithms construct optimal or essentially optimal solutions to these real-time problems in polynomial time split. The concept behind the algorithm is that many simple agents will target local people to achieve an easy goal. [4]

The evolutionary behavior of natural systems is focused on evolutionary algorithms. Intelligent algorithms based on swarm behavioral, also called swarm optimization techniques; improvise the issue by imitating Natural Swarms' collective behavior such as ant colony, artificial bee colony, particle swarm, bacterial foraging algorithm, etc.

2. Related Works

Computing resources are distributed in a cloud environment while a client (or user application) is making a requesting a different services. Based on Quality of service, the different type of services and resources to be allocated are decided by user request and there source availability, and the customer details (or its processes) is stored some other location where in the data center of the cloud service provider. Resource allocation involves defining what, how many, where and when the user will access the resource. Users typically specify the type and amount of resources to be requested, and providers then locate the required resources in their data centers on nodes.

The type of resources should be well suited to the task characteristics and should be appropriate for the application to meet the constraints in order to run the application effectively (e.g., maximum completion time). It is also important to remember when implementing this adaptation in a scalable environment like the Cloud, where users can dynamically request or return resources.[5]

2.1 Task Scheduling Algorithms

Cloud computing is an NP-Hard task to schedule and handle high-performance computing resources. We must therefore consider an algorithm to solve this problem almost optimally. The computational algorithms concentrate primarily on the allocation of resources between applicants to ensure that QoS parameters are maximized. The scheduling algorithm is designed to optimize the use of resources in consideration of tasks and accessible virtual machines.

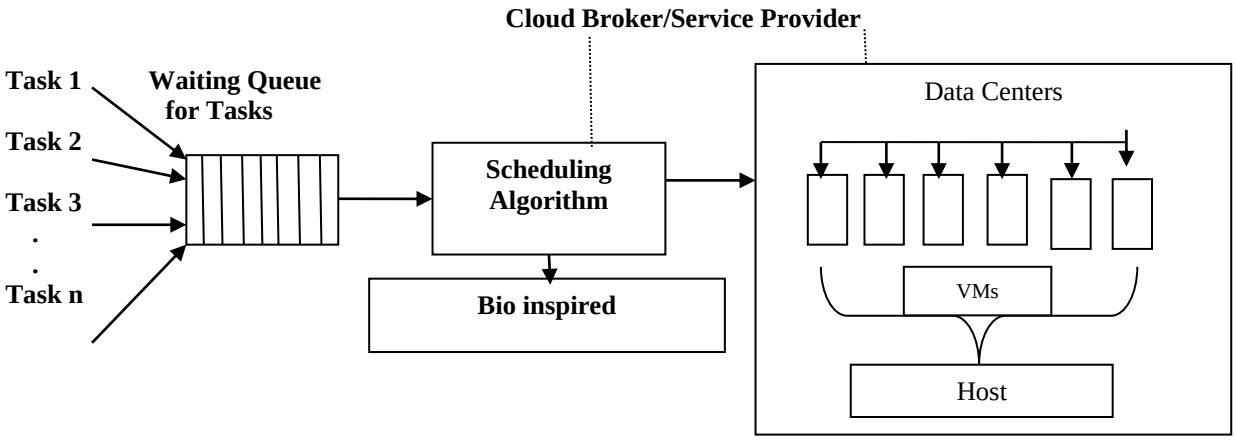

Fig. 1: Task Scheduling Process

Bio inspired algorithms are inspired exclusively by nature. Figure 1 shown the details of scheduling process in the cloud computing. While little information is available about the research area, complicated relationships can still be defined and resolved by basically simple initial conditions and standards. It's no wonder researchers in technology try to imitate nature. In fact, it can be assumed that nature and technology are intertwined by logically believe based on logic that new or current issues in computer technology may have problems with popular nature has come up with and solved with long period. These methods provide a different possibility between nature behavior and latest technology issues. [6]

Bio inspired computing has created a new concept of computing that covers a wide range of applications, covering virtually including distribution of networks, security measures, Machine learning, bio engineering, Big data, parallel computing, soft and high performance computing, etc.

3. COMPARISON OF EXISTING BIO INSPIRED OPTIMIZATION ALGORITHMS FOR TASK SCHEDULING

3.1 Ant colony optimization algorithm

The Ant colony optimization algorithm was developed in the early 1990's using an Optimization approach. It was first implemented by Dorigo, Maniezzo and Colorni as a metaphor for solving complex combinatorial problems. Methodology for Ant colony optimization (ACO) is the ant's ability to find the shortest path from the nest to a food place. An ant hops repeatedly from one position to another to end up hitting the destination (food). [7]

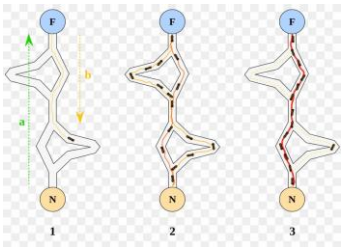

Fig. 2: Ant Nest to Food Path

Figure 2 sampled the different food path of chain of ants from ant nest to food path. The inspiring source of optimization of ant colony is the foraging behavior of true ant colonies. In artificial ant colonies, this practice is used to evaluate approach solutions to discrete problems of optimization, current problems of optimization, and major telecommunications problems such as efficient routing process and dynamic load balancing method. [8]

Table 1: Comparison study of Ant colony optimization algorithm scheduling the task

Authors	Objectives	Concept/ Methodology	Parameters	Features
Yue Zhou et al [9]	• Avoid the premature phenomenon. • Pre-execution time is required to avoid the	Two-path ant mechanism (Forward ant and Back ant)	Pre execution Time, Execution Time	Shorten time to find the resources and significantly improve the efficiency.

	optimal local time based on different tasks may be efficiently allocate highest effective allocation of resources.			
Shanchen Pang et.al [10]	• Reduce the Power consumption • CPU energy efficient issues are investigated based on cloud data center energy efficiency.	Stochastic Petri Net, and a task-oriented resource allocation method are discussed based on power efficient scheduling process.	Running Time, Energy Consumption	Energy consumption achieved at the level of 28% - 40% based on many performance metrics.
Medhat Tawfeek et al [11]	• Minimizing makespan • Highest utilization of resources at the same time reduce the energy consumption. • To concentrate on SLA violation and achieve customer satisfaction.	Applied to any combinatorial problem.	Makespan, Degree of Imbalance	Out performs FCFS and RR algorithms
Sambit Kumar Mishra et al [12]	• To improvise the makespan • Minimize the waiting time based on the overall time.	• Probabilistic Transition Rule • Constraint satisfaction method to overcome the he local searching technique optimally and restrict infeasible solutions.	Makespan, Average Waiting Time	Based on the priority, the profit can be achieved by CSP.
Young Ju Moon et al [13]	• NP-hard problem, are addressed based on how much cloud servers are utilized efficiently.	• Adapt slave Ants diversification and enhancement strategies	Makesspan, Preprocessing Time combined with makespan	Instead of local problems are overcome and other optimization problem with child ants by eliminate very long paths whose leading ants incorrectly accumulate the pheromones.

In the above table 1, the recently discussed research work done by ant colony optimization is contrasted by methodology and parameter value.

3.2 Cuckoo search optimization algorithm

Cuckoo search algorithm is a meta heuristic algorithm which was invented in 2009 by Xin-She Yang and Suash Deb. Cuckoo search algorithm (CSA) is inspiration of cuckoo bird breeding behavior. They select their home nest by accidentally taking over for reproduction the nest of some other birds. It mainly lays their eggs on the nest of the host bird and drops them into the egg's of the host bird.[14]

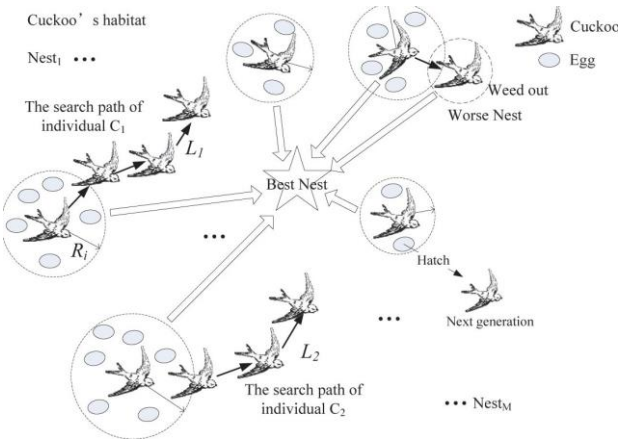

Fig. 3: Cuckoo breeding behavior

Figure 3 outlined the nature behavior of cuckoo's breeding for laying the eggs. Based on the probability, many number of hosts nests are fixed to find the cuckoo's egg by the host bird. But unfortunately, the host bird can utilize the place of the cuckoo's eggs may be throwing out or by removing the current and complete design of the new nest.

Table 2: Comparison study of Cuckoo search algorithm for scheduling the task

Authors	Objectives	Concept/ Methodology	Parameters	Features
Madni et al [15]	• Solving the multi-objective resource scheduling for optimal scheduling problems optimally in different environment.	• Set up the rules based on priority. • Based on the demand resources are distributed among themselves to overcome the Single optimization technique to multi-objective optimization for resource allocation.	Makespan, cost, CPU utilization	Efficient scheduling for multi objective problems in precise and suitability in IaaS cloud computing
Agarwal et al [16]	• Minimize the overall response time • Efficiently distribute the task to VM's s) and retain the QOS.	• Based on processing power and tasks length, VM's are allocated.	Average Response time	Better outcomes in response time compared existing mechanism.
Sundarrajan [17] 2017	Improvise the resource usage at the same focus on makespan.	Load balance differs arbitrarily and pareto method found for unique loads merge to single purpose.	Makespan, Turnaround time, Searching Speed	• System failure is less compared with different processors. • Better performance for multiple data center utilization.

Nima Jafari Navimipou. et al 2015 [18]	To minimize the execution time and task waiting time.	Assumptions and hypothesis based on the nest probability.	Execution Time Waiting Time	Calculated probability value is less at that time of coverage and speed become more.
Kiruthiga et al [19]	Resource scheduling in terms of Neutrosophic inference system.	Priority based cache allocation policy are introduced.	Response Time, Execution Time, Maximum Throughput	Assigns the tasks among the virtual machines on the basis of their vagueness in adversarial situation.

In the above table 2, the recently discussed research work done by Cuckoo Search optimization is contrasted by methodology and parameter value.

3.3 Chicken swarm optimization algorithm

A recent bio-inspired algorithm for single objective optimization is the swarm optimization (CSO) algorithm for chicken (Meng et al. 2014). CSO imitates the hierarchical order and behavior of a chicken swarm when searching for food, where every chicken provides a potential solution to the problem of optimization. [20] Figure 4 structured the different hierarchy levels such as Rooster, Hens and chickens.

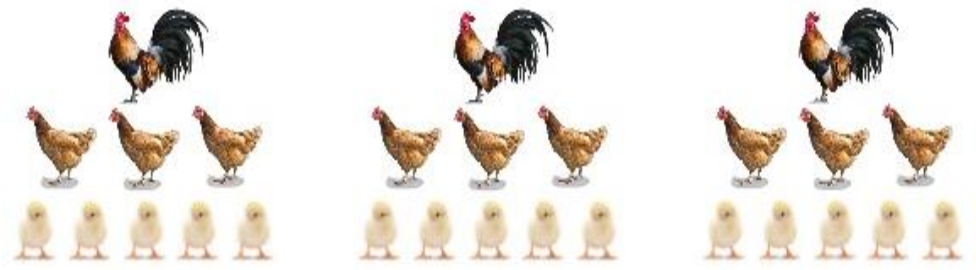

Fig. 4: Chicken swarm Hierarchy

Table 3. Comparison study of Chicken swarm optimization algorithm for scheduling task

Authors	Objectives	Concept/ Methodology	Parameters	Features
Liru Han et al [21]	• Solve the low efficiency issues in task scheduling	• Learning based on opposition is implemented to initialize population • For global search, weight and factor value are used. • Introduce boundary process to overcome the	Completion time, Energy Consumption, Load Balancing	Compared with other swarm based algorithms in terms of various parameters.

		cross boundary.		
Torabi et al [22]	• Balanced scheduling between the searching locally and globally manner. • Focused on premature convergence problems.	• Introduce velocity, roosting optimization in the searching mechanism. • Improved raven roosting optimization algorithms are used.	Execution, Response Time	Minimize the testing parameters and the increase in throughput for dynamic Scheduling.
Yancang Li et al[23]	• To maximize the structural optimization efficiency design using truss calculation	• Combine the different strategies in chaos and reverse learning for searching succeed in global manner. • Unique independent position of the algorithm was optimized.	Weighting factor, Learning factor	Different factors are optimized efficiently.
Yu Wu [24]	• Focus on high-dimensional optimization problem.	• Introduce and combine the nonlinear criteria and cost function • Introducing the crossover principles.	Cost Fitness value	Ratio between hen and rooster are measured, then cost reduced.
Nursyiva Irsalinda et al.[25]	• Proposed a method for global optimization. • Excludes the parameter roosters, hens and chicks.	• Experiments were performed on benchmark problems and a speed reducer architecture are compared.	Cost Fitness value	Clear, high robustness, fast convergence and less control

In the above table 3, the recently discussed research work done by Chicken swarm optimization is contrasted by methodology and parameter value.

4. Discussion

Scheduling tasks are one of the cloud computing major key challenges. The main motivation for task scheduling is the migration of incoming tasks from users to the virtual machines available, bearing in mind the various parameters Makespan, Execution time, Load balance, Quality of service, CPU energy consumption, response time and equal allocation of resources for the task to be executed. Many algorithms consider load balancing only, while others take response time into account. As most algorithms work with one or two parameters, the results are not successful. Better results can be created by adding more scheduling metrics for an enhancement to produce an efficient algorithm.

5. Conclusion

Efficient algorithms for scheduling can provide customers with more suitable services and increase cloud efficiency. The primary aim of cloud tasks is to minimize task

execution and to optimize the usage of resources. In this report, a review was presented on various existing tasks scheduling algorithms in the cloud. There is a brief overview of each algorithm techniques, and most algorithms take one or two parameters into account. Adding more metrics to existing algorithms will yield more reasonable performance. Tabulated details are focused on Ant colony, Chicken swarm, and Cucukoo search with various scheduling parameters such as time, load balance, service quality, performance, response time and make-up. Load balancing, response time, resource usage and storage are the key problems in the task scheduling. The combination of various parameters to already-existence algorithms will allow the efficient planning algorithm to boost its overall cloud efficiency.

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