

# SWOT Analysis of Tabu Search and Simulated Annealing Task Scheduling Algorithms in Distributive Environment

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## ABSTRACT

*Distributed system has become the soul of today's computing world and Distributed system have various forms like Grid computing, Ubiquitous computing, Cloud Computing. In the present competitive environment efficient utilization of resources is important, which is possible by efficient task and resource scheduling. For this purpose various task scheduling algorithms has been proposed by eminent scholars. Meta-Heuristic algorithms are the renowned algorithm to achieve the optimum result in term of execution time, load balancing and cost. These type of problem are known as NP-Hard problem. This paper performs the SWOT Analysis of few of the prominent Meta-Heuristic algorithms like genetic algorithm, Tabu Search, Simulated Annealing and optimization techniques. In this paper an extensive comparative study has been performed in terms of their strength, weakness, opportunity and threat to the already proposed algorithm to find out the scope for the further research in these prominent areas.*

**Keyword: Cloud Computing, Heuristic based Task Scheduling, Distributive Environment, Resource Utilization, Makespan**

## I. INTRODUCTION

In the era of Internet, Distributed computing achieves extreme reputation due to its feature to share the resource at lowest cost and trustworthiness. In the late 1960, the idea of Distributed computing come into the real shape with development of Main frame IBM System& which come into the shape of Grid computing, Cloud Computing and Ubiquitous computing, which considered as spirit of Distributive Computing. Cloud Computing and Grid computing works for computationally intensive applications. Grid computing is mainly working for non-interactive applications. On the other hand, Cloud computing work for interactive environment. Basically, Virtual Network of Super Computers is loosely knot to perform the length tasks form the Grid, which is one of Avtar of distributed computing. On the other hand, Cloud computing is an emerging tool that offer diverse variance of services [1] software on demand, infrastructure to perform high computation intensive applications and other various applications which are high on cost but required by enterprises to perform their non-routine but important activities. Cloud can also be defined as a distributed computing prototype and it is a compilation of interconnected and virtualized computers that are provisioned and offered enthusiastically [1] as cohesive computing resources, who offer the services on pay-per use basis.

The basic aim of all Distributed computing is optimum utilization of available distributed resources and performs the large computational problems to achieve the extensive results from the system. To achieve the

optimum result scheduling of available resources and task is important, this process of resource management is known task scheduling and resource scheduling. Mainly two types of scheduling techniques are used for this purpose i.e. Independent task scheduling, workflow task scheduling.

Independent task scheduling deals with the task without any precedence means task can be allocated to any of the machine without bothering about flow of any running task. On the other hand, workflow based task scheduling where all tasks are interdependent, they have precedence relations to each other, so while assigning the task to resources it is important to take consideration precedence before allocation. This type of application deals with the real type situations [3].

As we further classified, it can be categorized into three categories i.e. Heuristic, Meta- Heuristic and Hybrid task scheduling algorithms. Heuristic task scheduling algorithm perform for particular type of problem and better for simple type applications on the other hand Meta- Heuristic task scheduling algorithms are the practical methods which provide ease to schedule the task and provide the best possible solutions, it lead to the optimal result and these methods can be used to speed up the process of finding a satisfactory results. Hybrid algorithms are emerged with the feature of heuristic and meta-heuristic to achieve the optimum result. There are various prominent researchers who proposed renowned algorithms.

The rest of the paper is organized as follows. Section 2 gives the introduction about the SWOT analysis and section 3 provides the extensive study of various tabu search and simulated annealing based task scheduling algorithms in term of SWOT Analysis to find out the scope for further research work and section 4 gives the conclusion about the complete study.

## **II. CONCEPT OF SWOT ANALYSIS**

SWOT analysis is a most renowned tool for audit and analysis of the overall capability of any element. Basically it is considered that it is used only to judge the business or a venture but it gives the basic capability and weakness of elements in terms of internal and external environments in the term of Strength, Weakness, Threat, and Opportunity. So we have chosen the SWOT Analysis to assess the capability of research work till date in the field of task scheduling in distributive environment. As above described above that lot of work has been purposed by various researcher, so there is need of SWOT analysis of these works. In the next section is related to the extensive SWOT Analysis of few prominent Meta-Heuristic Task Scheduling Techniques.

## **III. SWOT ANALYSIS OF SIMULATED ANNEALING AND TABU SEARCH BASED TASK SCHEDULING TECHNIQUES:**

In the field of Meta-Heuristic based task scheduling, the technique of simulated annealing and Tabu Search based algorithms plays the milestone to get the optimum results.

### **3.1 Simulated Annealing:**

The concept of simulated annealing comes into real shape after a long research. In the 1953, the researcher metropolis given the concept of numerical simulation of annealing and establish the criteria to simulate how thermodynamic systems change from one energy level to another [4] and in the year 1980, Krickpatrick gives

the concept of combinatorial optimization, which deals with the feasible solutions, control parameters and heuristic solutions.

gan et. al.[5] has proposed genetic simulated annealing based algorithms for task scheduling in cloud environment. In this proposed algorithm they have emerged the features of simulated annealing with genetic algorithms with consideration of QoS parameters to efficiently access resource and allocation in the cloud. For this purpose they use the basic steps of genetic algorithm like initial population creation, crossover, mutation and the result of this process is provided to annealing module to get the optimum result for resource allocation.

In the field of cloud computing two type of scheduling has been performed task scheduling and resource scheduling. Diptangshuet. al. [6] has proposed simulated annealing based algorithm for the resource management usage of multi parameters to get the optimum result. This algorithm is mainly designed to position of multilayer in the cloud environment. It gives better result as compared to commonly used algorithm FCFS. It gives the near to optimum solution by setting the constraints in the form of hard and soft, which assure that in every iteration cost goes reduced.

Kashaniet. al. [7] proposed a memetic algorithm which overcomes the weakness of Genetic Algorithm and Tabu search algorithms. It schedules the task with minimum makespan and cost while increasing the CPU utilization. Proposed algorithm use simulated annealing as local search. In every iteration step a task is selection from the population and new processor is assigned randomly after the assignment of job new chromosome is created, if it is better then previous one then it is added to population otherwise Boltzmann function is used for selection of new genetic material. This algorithm gives the better result as comparative to genetic and tabu search algorithms.

Ruey-Maw et. al. [8] proposed simulated annealing based algorithm which make the population of different elements by finding the local and global best solutions. For generating the next elements it used the particle swarm optimization technique. By incorporating the feature of Simulated Annealing and discrete PSO equations, researcher has design the proposed algorithm which gives the minimum cost in term of computing and communication. Proposed algorithms moves through three steps firstly initialize the parameters, generate the initial solution and finally generate the velocity of elements for next generations until we doesn't get the optimum result.

### **3.2 Tabu Search Algorithms**

The concept of Tabu Search was given by Fred W. Glover at Centre for Applied Intelligence running in University of Colorado in 1986. This is meta-heuristic technique which is formulated to find the optimal solution. Its name derived from the Tongan language, which the official language of Polynesia (a sub region of 1000 islands on Pacific Ocean). In this language tabu means that things which cannot touch because they are scared. The basic feature in the tabu search technique as compared to simulated annealing is its capability to hold the memory. It can perform the execution by dynamic list of forbidden moves. Memory structures in tabu search operated by four principals consisting of regency, frequency, quality and influence. Basically memory can be used to get the good solution in the problem domain on the basis of these principals. In the present age tabu search is used in various fields like scheduling, graph optimization, telecommunication etc. In the field of

task scheduling also have number of research ideas with tabu techniques, out of which some important algorithms are as below:

Shanmugapriya et. al. [9] has proposed Migration Scheduling Algorithm (MGA) with the consideration of the link contention constraints. Before this algorithm various researcher has given various algorithms but they have assumed network is fully connected and contention free. It gives the optimum schedule in the reasonable time. The best feature of Tabu search based algorithm is that it can take the decision of scheduling as the network topology and gives the optimum result for various parameters

Mariangela et. al.[10] has proposed a static task scheduling based on parallel object-oriented tabu search algorithm. In this method the researcher has used the strategy based on multi search thread to get the optimum with the help of tabu search technique. Tabu search is used with parallelism is basically for two main purpose, one is reduction of execution time and increase the solution quality. For these purpose researchers has performed functional decomposition, domain decomposition and multi search thread coordinating several concurrent searches. By this proposed algorithm we got the significance of tabu search's diversification technique to get the optimum result.

Pan Yi et. al. [11] has proposed an algorithm which is based on tabu search techniques for the purpose to manage the resources allocated. Proposed algorithm decrease the traffic blocking rate from 4 to 30 percent as compared to best fit method and it also gives the better result in term of execution time as compared to standard algorithms.

Yi Wen Wong et. al. [12] has proposed tabu search based algorithm for task scheduling in parallel applications. It uses three neighborhoods various to take the shape of task graph based on DAG. It reduces the length of schedule as compared to HEFT upto an average of 30%. It is viable to strategy to manage the parallel tasks. Basically the goal of Tabu is to prevent solution form the cycling in the search space. By this action in parallel application we can reduce the cost of the system and SLR improvement.

#### **IV. CONCLUSION**

In this research paper we have perform the extensive survey of various Simulated Annealing and Tabu Search based Algorithms with SWOT Analysis. After the SWOT analysis of these algorithms we find that researcher has given various techniques to get the optimum results but All of these techniques are working for two or three objective but there is need to find any technique which can outperform in terms of Makespan, Load balancing, cost and most important element in field of Distributive Environment is security. Our research work is based on these basic parameters which can propose an optimum Algorithm.

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S. No	Performance Parameters	Algo Type	Platform Used	Strengths	Weaknesses	Opportunity	Threat
12	Resource Utilisation	I	Cloud Simulator	Resource utilization of resources. Manage the QoS of require Convergence of algorithm can be granted due to use of SA	QoS constraint are established through weight given to them, if weight is not accurately given then it doesn't appropriate result	It can be easily used in the large network with large set of constraint.	It can lead to inefficient result it generate the initial population through genetic which randomly select the chromosome at initial level
13	Resource Utilisation	I	Java based Simulator	Efficient resource allocation It can be used to perform resource allocation in the multi layered environment of cloud	It gives the nearest to optimum result not optimum result	Faster cooling can be generated by changing cooling rate from linear to nonlinear.	In case of high temperature it can give better solution but it can take more time, which will not be cost effective
14	Makespan, Cost, CPU Utilisation	I	Cloud Sim	Minimum Makespan Reduced Cost Accurate CPU Utilisation	In some cases when pop size is small it doesn't perform well	It can lead to QoS Parameters to get the optimum result.	It run the iterations till we don't get the best selection, so it can lead high energy
16	Cost	I	GridSim	It reduce the computing cost and communication cost with emergence of Simulated Annealing with Discrete PSO and introduction of penalty function	It is considering the cost factor only not bothering other factors like makespan, resource Utilisation etc.	In present age of Cloud computing cost is too important factor so with little modification this idea can be used for cloud computing	It is emergence of two algorithms so error in the selection at one level can lead to inaccurate results.
17	Schedule Length	I	Netbeans 6.1	It gives the optimal solution with consideration of communication cost, network topology, and without contention on links simultaneously dynamically.	It based on assumption that communication links are homogenous means it can't perform well in heterogeneous environment	Due to use of Tabu search there is foremost scope of cost management	It doesn't consider the dynamic nature it may not accurately perform for real time applications
18	Makespan	W	Java	It has given a new multi-threading based algorithm for calculation of makespan	It gives only algorithm not given any type of comparison with existing algorithm	Tabu search diversification can lead to cost improvement application with collaboration of oops features	Influence of precedence relations of task graphs can lead to inaccuracies in the system.
19	Resource Utilisation	I/W	IBM CPLEX GCE topology	Joint resource allocation technique for cloud and Grid. Reduce the blocking rate as compared to Best Fit Method	This algorithm works with some assumption which are unrealistic in present environment like non-primitive scheduling & each link have same bandwidth capacity	With elimination of some assumptions and amendments we can lead to more realistic application	Price model selected for this algorithm is not considering all the cost factor so it can lead to inaccurate unit cost which can cause to infeasible

							solution
20	Search Time Cost	I	Mathematical	It reduces the schedule length with low communication cost Proposed the reduction method which reduce the searching time	It is generate the initial population on random basis so some it is unable to get optimum result	It works better in the field of DAG scheduling, it can be used in task scheduling in Cloud/ Grid	It find the slack variable, if slack increase from limit then it can give unexpected results.

Table 2: SWOT Analysis of Simulated Annealing and Tabu Search Algorithms