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# Bat Algorithm for Resource Scheduling In Cloud Computing

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***Abstract: Scheduling of resources is a complicated process in cloud computing because of the heterogeneous nature of the cloud and multiple copies of same task is given to multiple computers. Therfore in this paper a Bat algorithm is proposed to schedule resources in the cloud environment. This algorithm has a high accuracy value and high efficiency when compared to the other optimization algorithms.***

***Keywords: Cloud,Optimization,Vitualization.***



## 1.INTRODUCTION

Cloud computing increases the speed of the applications with minimum cost and maximum innovations and business agility [19]. The key feature of cloud computing is virtualization which will create multiple copies of the existing environment involving virtual machines. The virtualization technology allows the cloud computing providers to provide any type of resources or computing environments removing the saddle and difficulty of maintaining both the hardware and software components to meet user's needs [7, 18, 19, 21].

Through the process of virtualization the virtualized computers can be provisioned dynamically and can be presented as one or more unified computing resources based on the SLA which is arbitration between service provider and consumers. The resource provided to the users includes a set of volatile memory and non-volatile memory and processors (virtual). Cloud computing provides cheap and easy access to the computational resources. The main objective of scheduling is to attain a high performance computing and best system throughput. The scheduling algorithms in cloud computing can be classified into two groups based on simple classification. The first group is the Batch mode heuristic scheduling algorithms (BMHA) where the jobs are queued and collected as batches as they arrive in the system and the scheduling algorithm will start after a fixed period of time. Examples of BMHA based algorithms are: First Come First Served scheduling algorithm (FCFS), Round Robin scheduling algorithm (RR), Min–Min algorithm and Max–Min algorithm. The second group is On-line mode heuristic scheduling algorithm where the jobs are scheduled when they arrive in the system. Since the cloud environment is a heterogeneous system and the speed of each processor varies quickly, the on-line mode heuristic scheduling algorithms are more appropriate for a cloud environment. Most fit task scheduling algorithm (MFTF) is suitable example of On-line mode heuristic scheduling algorithm [5, 18, 23 ].

The population based optimization algorithms that are used Genetic algorithms (GA), particle swarm optimization (PSO), bacterial foraging optimization (BFO) and bat algorithms (BA) that uses a population of individuals to solve the problems. The victory or collapse of a these algorithms depends on its ability to set up proper exchange between exploration and exploitation. A reduced balance between exploration and exploitation may result in feeble optimization methods which suffer from premature convergence, trapping in a local optima and stagnation [10].

GA is a popular evolutionary algorithm that generates solutions to optimization problems using techniques of selection, mutation and crossover[1,10].

PSO is an example of population based algorithm [10,2,4 ]. PSO optimizes a problem by iteratively trying to calculate the position and velocity of each of the individual particles.

BFO is a global optimization algorithm for distributed optimization and control [15].

BA is a population based algorithm based on the hunting behaviour of bats [9].The probable solution to the problem is represented by bat positions in this algorithm.

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The best position of a bat to its prey represents the quality of the solution. BA has been tested for continuous constrained optimization problems [ 22].

## 2.RELATED WORKS

Gabor et al.[16] have presented the main features of genetic algorithm and several ways in which they can solve difficult design problems. Genetic algorithm uses a separate search space and solution space. The search space is the space of coded solutions and solution space is the space of actual solutions. Six categories of applications in mechanical engineering is also discussed. Conceptual design that takes place in the early stage of design that requires the designer to act creatively. In shape optimization, the values of shape variables had to be determined. In data fitting the data are correctly fitted, in reverse engineering the geometric model is constructed from a physically existing object. In mechanism design the parametric elements are combined into a mechanism. In robot path design the path of robots are designed using the genetic algorithm.

Haghighat et al.[6] have proposed a novel QoS-based multicast routing algorithm based on genetic algorithms. For the genotype representation the connectivity matrix of edges is used. The performance and efficiency is also calculated. The bandwidth-delay-constrained least cost multicast routing tree computation is an NP-complete problem. In this the main steps being performed are:1) an encoding method 2)initial population creation 3) Based on the fitness and selection mechanism an evaluation function is rated. 4) use of genetic operators that alter the genetic composition of offspring during reproduction 5) values of parameters of genetic algorithm.

Nandita et al.[17] have extended the classical bacterial foraging algorithm which is the newly developed stochastic optimization tool. This algorithm is applied on the benchmark grey images and provide suitable for thresholding based image segmentation. The proposed bacterial foraging with adaptation allows the bacteria to tune their foraging behaviour adaptively. The run length unit is the key feature by which self adaptation switches the bacterium between exploitation and exploration states. At the start of the execution of the algorithm, run length is more, so that bacteria will explore the promising regions very rapidly. Then it slows down gradually to tune to refined value to aid exploitation. This is shown in the gradual improvement in the entropy maximization as chemotaxis step progresses.

Bhushan et al.[3] have addressed bacterial foraging algorithm based high performance control system for a DC motor. The Dc motor is being identified and controlled using the bacterial foraging algorithm. An indirect adaptive control has been used to learn a plant model during the operation of the system. Learning rate is viewed as foraging for good model information. Multiple identifier models and social foraging are being used. The BFA search in the parameter space corresponds to getting low identification errors between the model and the plant. According to the sum of the squared identifier errors, at each time instant the model that is the best is being used in a standard certainty equivalence approach to specify a controller. Each identifier model is an affine mapping to match plant nonlinearities. The identifier model parameters represent the forager's position. The cost function for each forager, which defines the nutrient profile, is defined to be the sum of squares of past identifier error values for each identifier model. For parameter adjustment, a foraging algorithm that is based on E. coli chemo tactic behaviour is used. Here a plant model is tuned in order to specify the controller parameters. A set (population) of approximates is used to tune and optimize the set in bacterial foraging optimization algorithm.

Navalertporn et al.[12] have developed an integrated optimization approach using an artificial neural network and a bidirectional particle swarm optimization. An artificial neural network is used to obtain the relationships between decision variables and the performance measures of interest, while the bidirectional particle swarm is used to perform the optimization with multiple objectives. The proposed approach is used to solve a process parameter design problem in cement roof-tile manufacturing. The results showed that the bidirectional particle swarm is an effective method for solving multi-objective optimization problems, and that an integrated approach using an artificial neural network and a bidirectional particle swarm can be used to solve complex process parameter design problems.

Wang et al.[20] have addressed a self-adaptive learning based PSO (SLPSO) to improve the universality of PSO variants. SLPSO uses four PSO based search strategies. In order to evaluate the performance of SLPSO, SLPSO is compared with eight state-of-the-art PSO variants on 26 numerical optimization problems with different characteristics. The four basic PSO strategies are: CLPSO that has good exploration ability and used for handling multi-model problems, PSO_CL_pbest has good exploitation capability, DbV make use of the difference information to effectively adapt the velocity for the rotated problem, EbV is used for fast convergence of uni-model problems.

## 3. PROPOSED ALGORITHM

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Figure below shows the basic resource management and scheduling in cloud environment [18]. Resource pool contains all the various resources available in cloud environment.VM is the virtual machine that will schedule the resources being provided by the cloud service provider. The different users can request for resources from cloud service providers and the cloud service provider will provide the resources if available from resource pool and if more resources are needed the scheduling algorithm is being used. In this the Bat algorithm is used.

Bat Algorithm (BA) is inspired by bat behaviours. Bats are the only mammals with wings and advance capability of echolocation. The three idealised rules for development of bat-inspired algorithm: i) Bat uses echolocation to sense a distance and differentiate between food/prey and background barriers even in the darkness; ii) Bats fly randomly to search prey with velocity, fixed frequency and loudness; iii) the loudness varies from a large loudness to minimum loudness[10].

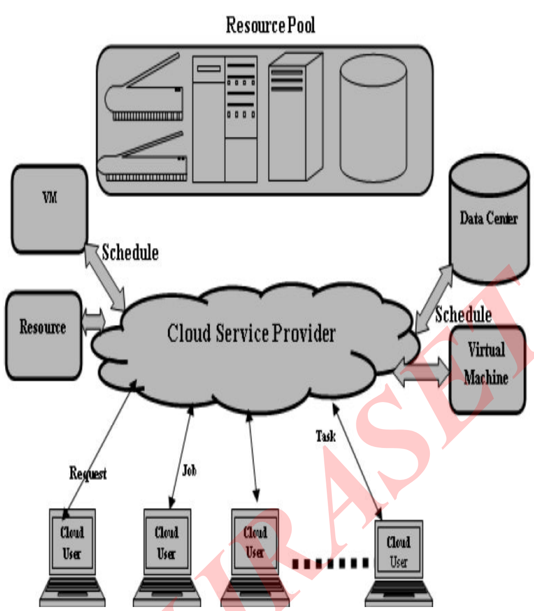


Figure 1: Basic Resource Management & Scheduling in Cloud Environment

The main steps of the Bat Algorithm are[10] :

Step 1. Initializing bat population (positions and velocities): A population of candidate solutions are generated in this step.

Step 2. Echolocation parameters and their initializations : the echolocation parameters are initialized.

Step 3. Evaluating micro-bats in the initial population : In this step the initial population of candidate solutions are evaluated.

Step 4. Storing the current population: The current population that consists of best solutions are stored and counter is increased by one.

Step 5. Generating candidate micro-bats: The candidate micro-bats are generated. A uniform random number $r_i$ is sampled between 0 and 1 for each micro-bat $M_i$ in the current population, and it is compared with the pulse rate $p_i$ of the micro-bat. If $r_i < p_i$ , a new micro-bat is generated by flying $M_i$ randomly to a new position in the design space.

Random Flying: A new candidate solution is generated from a micro-bat $M_i$ through random flying by adjusting its frequency first and updating its velocity and position next.

Local Search: A local search is used on a randomly selected micro-bat $M_i$ from the current population.

Step 6. Evaluating candidate micro-bats: After generating the candidate solution the micro-bats are analyzed.

Step 7. Echolocation parameters update: After the evaluation of candidate micro-bats, echolocation parameters are updated for improving candidates that move to better points than before.

Step 8. Selection: In this step selection is carried out between current and candidate micro-bats to form members of the next population which will parent and guide generation of the subsequent microbats.

Step 9. Termination: Until a termination criterion is met the steps from 4 to 8 are implemented , which can be imposed as a maximum number of iterations or no improvement of the best feasible design over a certain number of iterations is obtained.

## 4. RESULTS AND ANALYSIS

In this section the design and analysis on the computational experiments conducted using the Bat Algorithm (BA) to solve scheduling problem. Scheduling resources include computer, processor, disk, database, network, bandwidth. For evaluating the performance of the bat algorithm in cloud computing two matrices are considered namely makespan, cost and reliability. The makespan is the total execution time and the cost indicates the cost per unit resources. The makespan is measured in seconds and the cost is measured in dollars[11].

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| Parameters | Values |
|---|---|
| Number of virtual machines | 500 |
| Number of tasks | 100000 |
| Bandwidth | 1500-15000 B/S |
| Cost per job | 6.56$ |
| Number of machines per resource | 1 |
| PE ratings | 400-800 MIPS |

Table 1: Scheduling parameters and their values

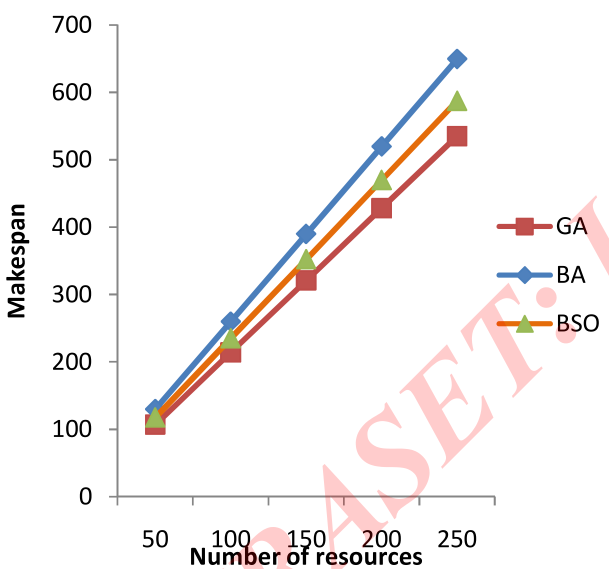


Figure 2: Effect of number of resources on makespan of various algorithms.

The experiments are conducted using cloud simulator. The Bat algorithm is compared with GA,BF, PSO. From the experiments conducted and graph is in figure 2 , from that we can see that the Bat Algorithm has a high accuracy value and highly efficient than all the other algorithms considered. The convergence rate of the Bat Algorithm is also high.

## 5. CONCLUSION

This paper presents the development of Bat Algorithm based Scheduling Tool (BAST) for scheduling of resources in cloud computing. The algorithm can have a high accuracy value and high efficiency value and high convergence rate when compared to other optimization algorithms. Two optimization algorithms are compared with Bat Algorithm and the results are obtained based on the number of resources and the makespan of each of the resources.

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