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# Improved Scheduling Procedure for Intensify Resource Utilization in Heterogeneous Cloud Environment

**Lovejoban Preet Singh [1], Anil Kumar [2]**

[1*] CSE,G.N.D.U, Amritsar, Punjab, India;

[2] CSE,G.N.D.U, Amritsar, Punjab, India;

[*]*Corresponding Author:* lovesinghonline@gmail.com *Tel.: +91-7837474081*

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***Abstract***— Resource allocation is critical to investigate the need for resources in substantially enhancing every day. To tackle this issue our proposed policy presents a new hybrid strategy known as the fittest job firefly algorithm(FJFFA) which sorts the jobs in the queue according to least cost and maximum profit. This queue is presented to firefly algorithm. Jobs are again sorted randomly and presented to firefly algorithm. The solution thus obtained from the algorithm is superior. Makespan and Flowtime obtained as a result is improved by 6%.

***Keywords—****FJFFA, Optimal job selection, least cost and maximum cost*

## 1. INTRODUCTION

Cloud computing is used extensively nowadays to provide resources to the clients on pay per use basis. Cloud services generally include service level agreement (SLA). [1], [2] Resources that cloud service provider (CSP) provides to the user is according to the SLA. Theoretically, cloud contains infinite resources but user requirements are enhancing day by day causing a deficiency of resources within the cloud. To tackle the issue of deficiency of resources,[3], [4] resource sharing was suggested. Resource sharing enhances the performance of cloud in short run as resource utilization improves. Resource sharing, however, degrades the performance in the long run as the[5] load on individual resource got enhanced. Load balancing strategies were thus being researched over[6], [7] to overcome the problem of performance degradation by the application of overload.

One of the strategies to tackle the overloading is job scheduling. Job scheduling using [8], [9]multi-heuristic strategies like genetic approach is common. The problem with this approach is poor convergence rate. Modification to GA leads to particle swarm optimization. It simulates the collective behavior of social animals. [10], [11] this algorithm looks for optimal solution by spreading the particles along all the directions. The swarm that finds the food at first place is followed by all the other swarms. Convergence rate is poor in case frequency of jobs becomes extremely high causing Makespan and Flowtime to increase beyond specified proportions.

To overcome the problems caused by existing literature, proposed literature uses another meta-heuristic firefly algorithm with job selection phase modified with min cost and max profit objective function. Rest of the paper is organised as under: section 2 gives the literature survey of existing job scheduling mechanisms used for achieving optimal results, section 3 gives the proposed system with the methodology to be followed, section 4 gives result and performance analysis, section 5 gives conclusion and future scope and last section gives the references.

## 2. LITERATURE SURVEY

This section puts light on various multi-heuristic approaches used to optimize the process of job execution in a multi-cluster environment. [12] [13], [13] proposed job ordering mechanism by the use of the genetic algorithm. Genetic algorithm uses a population i.e. the jobs presented to the system. The random selection procedure was followed to generate offspring. Execution of jobs lists the result in terms of Makespan and Flowtime. Chromosomes randomly shuffled are again to be presented to the first phase. Process iterates until the desired objective was met or generation expires. This procedure although results in best possible job ordering but poor convergence rate hunts the overall procedure. [14] Proposed ant colony optimization for load balancing in a parallel system. Ant colony optimization mechanism achieves load balancing at the expense of convergence rate. [15] Proposed a multi-objective ACO for job scheduling. The primary parameter used for optimization includes cost. This literature used two constraints: user

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budget and Makespan. User budget used in this literature becomes threshold beyond which cost encountered causes the schedule to fail. Makespan associated with the schedule was recorded and checked for optimization. [16] Proposed firefly optimization mechanism where energy efficiency becomes critical in the migration process. This approach migrates heavily loaded VM to least loaded VM without affecting energy efficiency associated with the data center. [17] Proposed efficient firefly algorithm to solve the problem of job shop scheduling. Harmony search algorithm was used in collaboration with firefly algorithm in this approach. Harmony search provides optimality in resource searching and firefly allocates the jobs to the resources for execution. Convergence rate, however, becomes poor as complex and larger number of jobs becomes a participant of the system.

To overcome the problem, proposed literature combines firefly algorithm with the fittest job first algorithm. Description of the proposed system is given in the next section.

## 3. PROPOSED SYSTEM

This section gives the in-depth study of the proposed system that is followed to reduce Makespan and Flowtime associated with the system. The phases associated with Fittest Job First Firefly Approach (FJFFA) is described as under.

### *I. FITTEST JOB FIRST APPROACH*

In this approach fittest job is being identified. The fittest job is identified by determining the cost associated with the job. Higher the cost, minimum will be the profit. Job cost is assumed to be directly proportional to burst time of the job. Sorting of jobs on the basis of the cost associated with the job is done and then presented to the next phase of execution. The algorithm associated with fittest job first mechanism is given as under-

- Input job list and obtain cost associated with each job.
- For i=1:N
- For j=1:N-i
- If($Job\_cost_j > Job\_cost_{j+1}$ )
- Perform swapping of jobs
- T= $Job\_cost_j$
- $Job\_cost_{j=}$ $Job\_cost_{j+1}$
- $Job\_cost_{j+1}$=Temp
- End of if
- End of for
- End of for
- Store Jobs in $Job\_List_i$

This job list is transferred to the next phase of execution by firefly algorithm. Firefly algorithm executes the jobs by allotting the jobs to the resource cluster.

### *II. Firefly algorithm for job execution*

The job list so obtained from previous phase is presented to the firefly algorithm to determine the optimal solution in terms of Makespan and Flowtime. Job list is arranged in terms of maximum profit or low cost basis. The algorithm used to achieve result is given as under

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Firefly algorithm

- Receive job list from fittest job first approach described in section 3.1
- Generate fireflies corresponding to jobs in the job list
- Input number of generations(G)
- Repeat while generations exhausted
- Obtain local solution($Makespan_i$ and $Flowtime_i$)
- Assign fireflies to the resource clusters
  If (available ($Resource_i$)
  $Resource_i$=$Resource_i$-$Fireflies\_Req_i$
  Highlight the firefly for path following by predecessors
  Else
  I=i+1
  End of if
  Repeat this step until job list becomes empty
- Check the result in terms of $Makespan_i$ and $Flowtime_i$
- Initialize job list
- End of generation loop
- Output min(Makespan) and min(Flowtime) along with job sequencing

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The proposed system gives the best possible solution in terms of Makespan and Flowtime. Makespan is observed to be time taken to complete schedule of jobs and Flowtime is the time taken to complete one job. Result obtained through the proposed system is better as compared to individual firefly algorithm as described in the next section.

## 4. PERFORMANCE ANALYSIS AND RESULT

Simulation of the proposed system is conducted in MATLAB 2017a. The simulation environment consists of 5 clusters containing 100 machines each. Job list is randomly initialized. Sorting operation is applied in order to sort the jobs within the queue on the basis of minimum cost first. For this purpose burst time of the job is analyzed. The result is obtained in terms of Makespan and Flowtime. Simulation is conducted by varying the number of jobs within the queue. Simulation results are given as under.

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**Results in terms of Makespan**

| Number of jobs | Existing without an optimal job first | Proposed with the optimal job first |
|---|---|---|
| 50 | 1133 | 903 |
| 100 | 1235 | 1023 |
| 150 | 1356 | 1200 |
| 200 | 1452 | 1353 |
| 250 | 1470 | 1450 |

Table1: Comparison of Makespan of existing and proposed Makespan

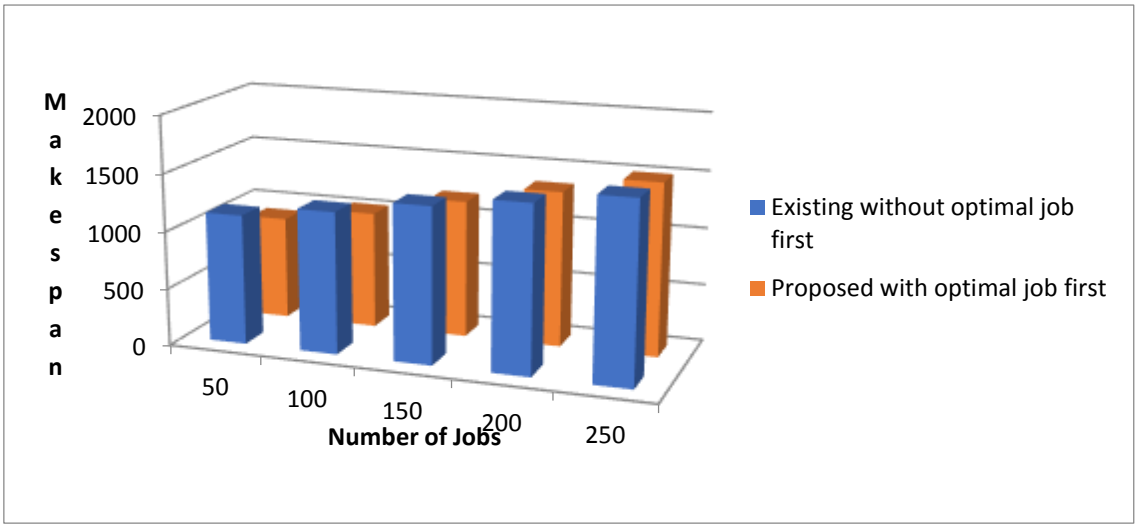


Figure1: Makespan Plot of existing and proposed system

Results in terms of Flowtime is given as under

| Number of jobs | Existing system Flowtime | Proposed system Flowtime |
|---|---|---|
| 50 | 53 | 32 |
| 100 | 59 | 41 |
| 150 | 69 | 51 |
| 200 | 75 | 63 |
| 250 | 98 | 72 |

Table 2: Comparison of Flowtime

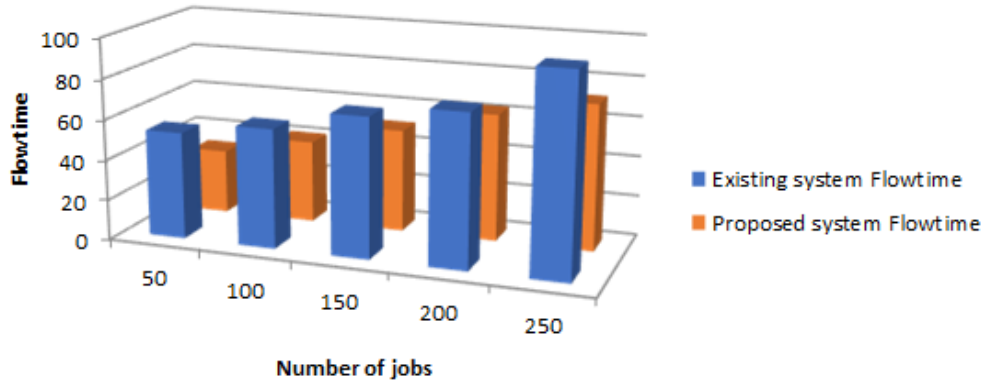


Figure 2: Plots of Flowtime

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The comparison indicates that proposed system with optimal job first algorithm collaborated with firefly algorithm produce a better result as compared to existing literature without optimal job first approach. The below plot indicates the job allocation process i.e. the number of jobs that are coming in a given time to accomplish its task.
As a result, from the graphs, it is seen that the makespan and flowtime readings have improved in our proposed system by 6% thus improving the performance and reducing the cost.

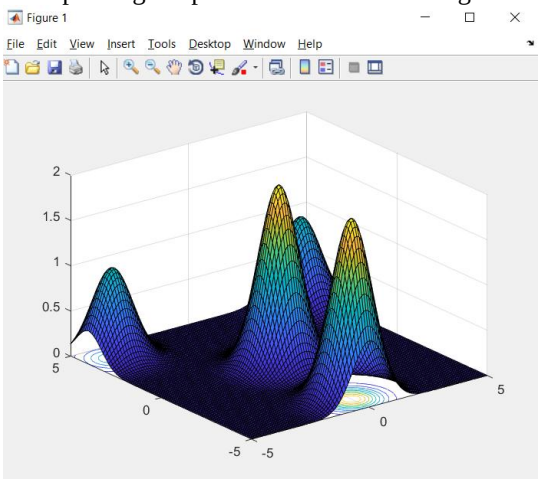


**Figure 1: shows the number of jobs coming to process**

The below plot indicates the firefly convergence which indicating the jobs meeting the resources.

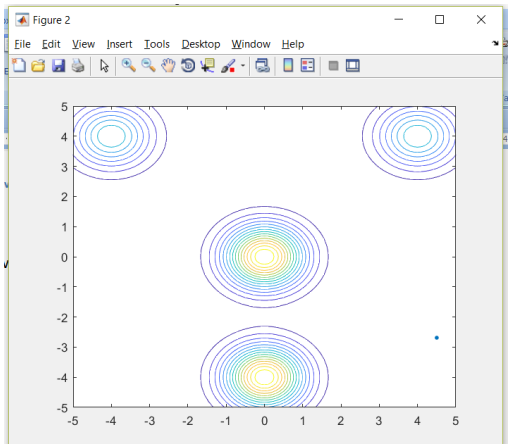


**Figure 2: shows firefly convergence**

## 5. CONCLUSION AND FUTURE SCOPE

Job scheduling becomes the need of the hour since resources are limited within the advanced computing system. Job scheduling collaborated with multi-heuristic approach allow the best possible solution to be generated however convergence rate is sometimes poorer. To tackle the issue, a best possible solution with firefly approach is proposed. The simulation result shows optimization in terms of Makespan and Flowtime. Job sorting is initiated with the help of cost comparison. The list obtained after sorting is presented to the firefly algorithm for execution. Steps are repeated until the desired level of optimization is met.
In future particle swarm optimization and genetic approach will be tested along with proposed approach for optimization and performance comparison.

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## Authors Profile

*Mr. l j p Singh* pursued Bachelor of Computer Science from GIMET, India in 2016 and pursuing Master of Science from GND University in the year 2016. He has published more than 3 research papers in reputed international journals including. His main research work focuses on Cryptography Algorithms, Network Security, Cloud Security and Privacy, Big Data Analytics, Data Mining, IoT, and Computational Intelligence based education.

*Mr. A Kumar* pursued Bachelor of Computer Science from Punjabi University, India, and Master of Science from GND University in the year 2016. He is currently pursuing Ph.D. and currently working as Assistant Professor in Department of Computer Sciences, He has published more than 20 research papers in reputed international journals including Thomson Reuters (SCI & Web of Science) and conferences including IEEE and it's also available online. His main research work focuses on Cryptography Algorithms, Network Security, Cloud Security and Privacy, Big Data Analytics, Data Mining, IoT and Computational Intelligence based education. He has 5 years of teaching experience and 4 years of Research Experience.

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