

Analyzing of Job Scheduling for Genetic Algorithm with Earliest Deadline First

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Abstract

The problem of scheduling n jobs on m machines with each job having specific machine route has been researched over the decade. The Job Shop Scheduling (JSS) is one of the hardest combinatorial optimization problems. Each resource can process at most one job at a time. A preliminary schedule is obtained the Genetic algorithm; the results are given as an input to earliest deadline first to improve the status of initial scheduling. This article is mainly focus on to reduce the processing time, waiting time, burst time and turnaround time in number of jobs. This study proposes a new approach to evaluate a Job Scheduling problem with the help of genetic algorithm with Earliest Deadline First. This approach is an excellent result with the help of scheduling. The job scheduling is the process of finishing jobs over a time with allocation of shared resources. It is mainly used in proper environment, in which the jobs are allocated to various jobs. The scheduling are used in transportation, services batch system, Distributed Resource Management System (DRMS), Distributed Resource Manager (DRM), workload automation, Real time scheduling in accordance with external, unforeseen events, Notifying the operations personnel, Generating reports of incidents, Audit trails meant for regulation compliance purposes.

Keywords: Job Scheduling (JS), Genetic Algorithm (GA), Earliest Deadline First (EDF), waiting time, Turnaround time and Burst time.

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1. INTRODUCTION

The EDF scheduling model has shown a significant improvement of over First Come First Scheduling (FCFS), Short Test Job First (SJF). This indicated that in the steel making Rolling Mills the model EDF has given effective utilization of LD Converters, Argon rinsing stations, Continuous Casting Machines, Rolling Mills and improvement of productivity over presently being used FCFS modeling [1].

A schedulability tests is an algorithm that given the parameters of all transactions returns true if the set is schedulable. Schedulability analysis of distributed real time systems is an important problem that has been studied for a long time by the research community. Solutions have been proposed both for fixed priority scheduling and for Earliest Deadline First (EDF) [2].

To reduce the time complexity, the frame based packet scheduling has been proposed where a frame consists of a fixed number of consecutive time slots. The scheduling algorithm fetches the arriving packets buffered in the input side once for each frame instead of each slot. Depending on the size of the frame, the algorithm could produce schedules for many time slots in one execution. Recently, we proposed a non-EDF based algorithm called Flow based Iterative Packet Scheduling (FIPS). An optimal schedule is one that allows maximum number of packets to be transmitted before their deadlines [3]. However, they do not consider real time constraint especially task deadline. Therefore, they are not suitable for real time applications where the system response should be fast enough and meeting task deadline is must [4].

Many computer systems interact directly with the physical world in such a way that the notion of real time is important. Hard real time systems such as critical vehicle control and hazardous industrial plants have timing requirements such that there may be catastrophic consequences associated with missing a deadline [5].

Liu & Layland [6] described the Rate Monotonic (RM) and the Earliest Deadline First (EDF) scheduling policies. EDF algorithm is the type of dynamic scheduling algorithm which depends upon the deadline of the task. The task with the nearest deadline gives the highest

priority. EDF algorithm schedules the process and to create particular process some of the parameter is required such as Process Start Time, Execution Time, Deadline of Process, Release Time and the Load Time of each process. After creating the process, the process is store in a queue known as priority queue and the priority of that process depend upon the deadline.

The limitation of EDF algorithm is that it cannot handle the overloaded condition properly. In overload situations, the performance of the system decreases and the desired output will not be achieved when scheduler schedules the process using EDF scheduling algorithm.

When the process is under loaded, the EDF algorithm executes all the process and CPU usage for that process is also minimum but when the process is overloaded some process fails to execute. This is the drawback of EDF algorithm. To overcome this drawback the Hybrid scheduling algorithm combines Earliest Deadline First with the Ant Colony Optimization scheduling algorithm [7].

1.1 Earliest Deadline as Soon as Possible

In this scheduling strategy, priority is defined using a single criterion, time to deadline. A task will be assigned the highest scheduling priority if its current deadline is the nearest, and placed at the front of the ready queue. The task with the furthest deadline is placed at the end of the ready queue. It should be clear that deadline values change during program execution. Thus this scheduling method belongs to the class of dynamic policies. It has its origins in the deadline driven scheduling algorithm and makes the same assumptions as RMS. In the real time literature, the deadline driven strategy is often called the earliest deadline as soon as possible scheduling policy.

1.2 Earliest Deadline as Late as Possible

The EDL scheduling principle uses the criterion of task laxity i.e., spares time. Assume that two tasks are readied at the same instant. It can be seen that, taking into account the time frames set by the deadlines, task 2 has less spare time than task 1. EDL assigns highest priority to the task having least spare time (least laxity). Thus in this example, task 2 takes priority over task 1. Hence it can also be named Least Laxity First (LLF) scheduling algorithm.

In this paper is improved Genetic Algorithm with earliest deadline first is used to assign each operation on a machine and integrated algorithm is used to calculate the individual value of each jobs. The result of evaluations shows that the new algorithm can solve the JSP more effectively.

2. LITERATURE REVIEW

Number of researchers has espoused Genetic Algorithm and Tabu Search technique for dealing with the job shop scheduling problem. They include algorithms such as cultural genetic algorithm, ant optimization, simulated annealing, Genetic Local Search (GLS), Genetic Algorithms (GA), Scatter Search, Tabu Search (TS), and Path Relinking,[8,9,10,11,12,13,14]. integrate genetic algorithm with neural network for JSSP, gave solution for JSSP using neural network, presented hybridization of ant colony optimization strategies in tabu search for solving job shop scheduling problem [15,16,17].

Many real-time systems rely on the earliest deadline first scheduling algorithm. This algorithm has been shown to be optimal under many different conditions. For example, for independent, perceptible tasks, on a uni-processor EDF is optimal in the sense that if any algorithm can find a schedule where all tasks meet their deadline then EDF can meet the deadlines. The purpose of their work is to get good average performance for transactions even in overload. Since they are working in a database environment their assumptions are quite different than ours, e.g., they assume no knowledge of transaction characteristics, they consider firm deadlines not hard deadlines, there is no guarantee, and no detailed analysis of overload. On the other hand, for their environment, they produce a very nice result, a robust EDF algorithm. FCFS Job Grouping Strategy has of two major parts, initial part gives resource management, which selects maximum computational power cluster at the grid level and the next part provides first come first serve job grouping strategy that makes well-organized consumption of the selected cluster by presents a matching group of jobs from a first come first serve job queue [18].

Now a days, there are two widely used approaches that think hard-deadline constraint for developing real-time systems Rate Monotonic (RM) and Earliest Deadline First (EDF) algorithms. In [19] complete comparison of these algorithms was performed in order to figure out strong and weak points of mutually algorithms and dispel misconceptions related to them. It was shown that although RM have simpler functioning, in common it doesn't have

property often credited to it, such as better jitter control or inevitability in excess conditions. EDF, on the other hand, allow better capital utilization and better aperiodic performance receptiveness. Regarding our work, the RM concept of transmission priorities for tasks in reverse to their periods was used in HEFT alteration to put into practice deadlines support.

A genetic algorithm is a local search technique that mimics the natural process of evolution. The process analyses the fitness of a species in their particular environment. From one generation to the next, it preserves good characteristics and eliminates the poor ones. Analogous to this, genetic algorithms use strategies to decide which part of the solutions to retain and which ones to discard. These strategies are defined by a set of functions called genetic operators, the most ordinary of which are selection, crossover and mutation. The aim of assortment operator is to discriminate between good and bad schedules and create more solutions from good solutions with positive fitness values. The crossover operator takes two parents from the selection step and uses these solutions to generate new ones. The mutation operator tries to diversify the search by jumping into new neighbourhoods and hence avoids for converge the local minima.

Genetic algorithms need a starting population, i.e., a set of initial solutions. These solutions can be generated randomly or produced instinctively by heuristics. Heuristic techniques use the particulars of the application, hence are likely to find more accurate solutions.

Scheduling algorithms is an active area of research which has received substantial awareness over the years. In the literature, a number of scheduling algorithms has been planned, for instance, in [20], a First Come First Served (FCFS) algorithm which selects the task with the earliest arrival time was proposed. The system ensures that if it contains periodic tasks, their release time will be considered. The major drawback of this algorithm is that it makes no effort to consider a task's deadline.[21] proposed the Earliest Deadline First (EDF) algorithm which will always choose the task with the earliest deadline. The algorithm is optimal in a uniprocessor system but does not consider priority and therefore cannot analyze it. The algorithm fails under overloading conditions [22] the continuous task scheduling problem is defined as shaping the execution schedule of nonstop media tasks with minimizing the sum of all tasks' deadline missing times under the following conditions:

- 1) All tasks are periodic.
- 2) All tasks are nonpreemptive.

- 3) Only processing requirements are significant; memory, I/O and other resource requirements are negligible.
- 4) All tasks are independent. This means that there are no precedence constraints.
- 5) The deadline of a task is equal to its period.
- 6) Systems are multiprocessor soft real-time systems

Kaladevi & Sathiyabama [23] the main objective of the compare two significant task schedulers such as Earliest Deadline First (EDF) scheduler and Ant Colony Optimization Based (ACO) scheduler. It also presents a system that can be schedule multiple independent tasks. Tasks can obtain minimum guaranteed execution time with its performances. The real-time constraints in Real time system for scheduling the task, different scheduling algorithms were used. Most of the real-time systems are designed using main concern based pre-emptive scheduling and worst case execution time estimates to guarantee the execution of high priority tasks. The main limitations of both algorithms are; during under laden condition, the execution time taken by the EDF algorithm (i.e. less time) and throughout overloaded condition, it gives performance of ACO based scheduling algorithm (i.e. more efficiency). [25].

3. SCHEDULING OBJECTIVES

A system designer must consider a variety of factors in designing a scheduling algorithm, such as type of systems used and what are user's needs. Depending on the system, the user and designer might expect the scheduler.

3.1 Maximize Throughput A scheduling algorithm should be capable of servicing the maximum number of processes per unit of time. Avoid indefinite blocking or starvation: A process should not wait for unbounded time before or while process service.

3.2 Minimize Overhead causes wastage of resources. But when we use system resources effectively, then overall system performance improves greatly.

3.3 Enforcement of Priorities if system assigns priorities to processes, the scheduling mechanism should favor the higher-priority processes. Achieve balance between response and utilization: The scheduling mechanism should keep resources of system busy. Favor processes exhibits desirable behavior. Degrade gracefully under heavy load. A system can accomplish these goals in several ways. The scheduler can prevent indefinite blocking of

processes through the concept of aging. The scheduler can increase throughput by favoring processes whose requests can be satisfied quickly, or whose completion cause other processes to run.

3.4 Scheduling Criteria are various CPU scheduling algorithms which have different properties, and the choice of a particular algorithm may favor one class of processes over another. For selection of an algorithm for a particular situation, we must consider properties of various algorithms.

3.4.1 Context Switch A context switch is process of storing and restoring context of a preempted process, so that execution can be resumed from same point at a later time. Context switching is usually computationally intensive, lead to wastage of time and memory, which in turn increases the overhead of scheduler, so the design of operating system is to optimize only these switches.

3.4.2 Throughput is defined as number of processes completed per unit time. Throughput is slow in round robin scheduling implementation. Context switching and throughput are inversely proportional to each other.

3.4.3 CPU Utilization is a measure of how much busy the CPU is. Usually, the goal is to maximize the CPU utilization.

3.4.4 Turnaround Time refers to the total time which is spend to complete the process and is how long it takes the time to execute that process. The time interval from the time of submission of a process to the time of completion is the turnaround time. Total turnaround time is the sum of the periods spent waiting to get into memory, waiting time in the ready queue, execution time on the CPU and doing I/O.

3.4.5 Waiting Time is the total time a process has been waiting in ready queue. The CPU scheduling algorithm does not affect the amount of time during which a process executes or does input-output; it affects only the amount of time that a process spends waiting in ready queue.

3.4.6 Response Time in an interactive system, turnaround time may not be best measure. Often, a process can produce some output fairly early and can continue computing new

results while previous results are being produced to the user. Thus, response time is the time from the submission of a request until the first response is produced that means time when the task is submitted until the first response is received. So the response time should be low for best scheduling. So we can conclude that a good scheduling algorithm for real time and time sharing system must possess following characteristics.

- Maximum CPU utilization
- Maximum throughput
- Minimum burst time
- Minimum waiting time
- Minimum turnaround time

4. PROPOSED ALGORITHM

4.1 Genetic Algorithm

1. C = set of first operation of each job.
 2. $t(C)$ = the minimum completion time among jobs in C .
 M^* = machine where $t(C)$ is achieved.
 3. G = set of operations in C that run on m^* that and can start before $t(C)$.
 4. Select an operation from G to schedule.
 5. Delete the chosen operation from C . Include its immediate successor (if one exists) in C .
- If all operations are scheduled terminate.
 Else, return to step 2.

5 RESULTS AND DISCUSSION

Waiting time and turnaround time are calculated from burst time data using earliest deadline first, genetic with earliest deadline first scheduling method. Earliest deadline first method for system configuration same and different, same and different work load results are justified below.

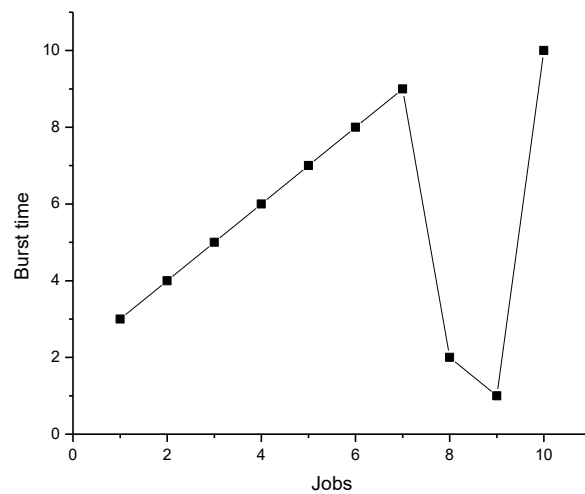


Figure 1 Burst time versus jobs

The Figure 5.1 shows that the Burst time versus jobs. The jobs 1 to 7 are straight line job scheduling. But, all the jobs 1 to 7 the Burst time are same. The 1 to 10 job is known as fish cap burst time job scheduling.

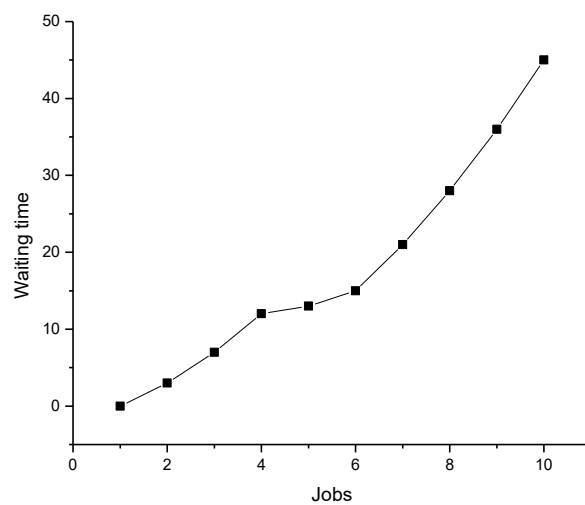


Figure 5.2 Waiting time versus jobs

The Figure 5.2 illustrate that waiting time versus jobs. The job 1 to 4 the waiting time increases. The job 4 to 6 the waiting time slightly increases. The job 6 to 10 quickly increases of waiting time. The job 5 to 10 the waiting time linearly increases. The job 1 to 10 is known as linear job.

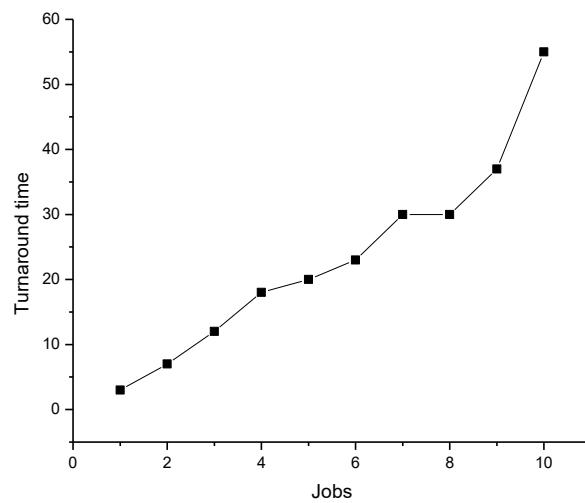


Figure 5.3 Turnaround time versus jobs

The Figure 5.3 illustrate that turnaround time versus jobs. The job 1 to 4 turnaround time is increases. Again the job 4 to 7 slightly turnaround time increased. The job 7 to 8 is zero based jobs. The turnaround time for job 8 to 10 is suddenly increased.

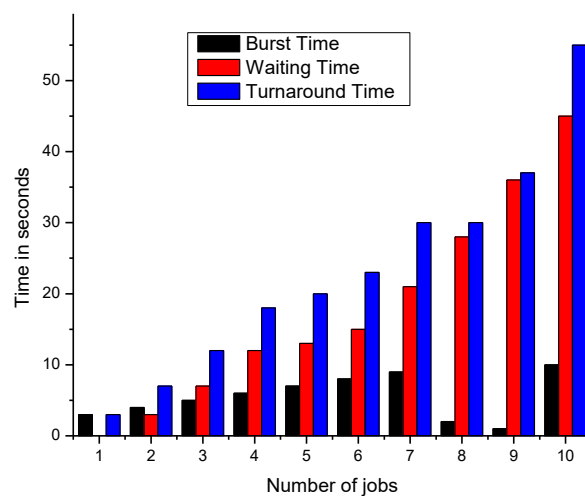


Figure 5.4 Earliest deadline first [Time in seconds (BT, WT and TAT)] versus number of jobs

The Figure 5.4 shows that Earliest deadline first [Time in seconds (BT, WT and TAT)] versus number of jobs. In job 1 the burst time and turnaround time both are equal and waiting time is very low. This type of scheduling is known as low waiting time scheduling. The job 2 waiting time compare than both burst time and turnaround time values is high. The job 3 the burst time is low and waiting time is medium and turnaround time is high. This type of scheduling is normally increasing scheduling. The job 4, 5, 6 and 7 are similarly to job 3.

The job 8, 9 and 10 is low burst time, waiting time and turnaround time is very high. This type of scheduling is known as high turnaround time scheduling.

5.1 Earliest Deadline First with Genetic Algorithm

Pseudo Code for Earliest Deadline First with Genetic Algorithm

The steps of proposed algorithm are as follows:

1. Generate a task queue.
2. Sort the task in the increasing order of their deadlines.
3. Select a suitable number of tasks for a fixed chromosome size.
4. Generate chromosomes for the population.
5. Sort the genes in each chromosomes based on deadlines.
6. Determine the fitness value of each chromosome in the population.
7. Sort the chromosome within the population depending on fitness value.
8. Apply GA operators for a number of iterations:
 - 8.1 Sort the genes in each chromosome based on deadline.
 - 8.2 Determine the fitness value of each chromosome in the population.
 - 8.3 Sort the chromosome within the population depending on the fitness value.
9. Choose the best chromosome. The tasks that are found infeasible are removed from the chromosome so that they are not reconsidered for scheduling.

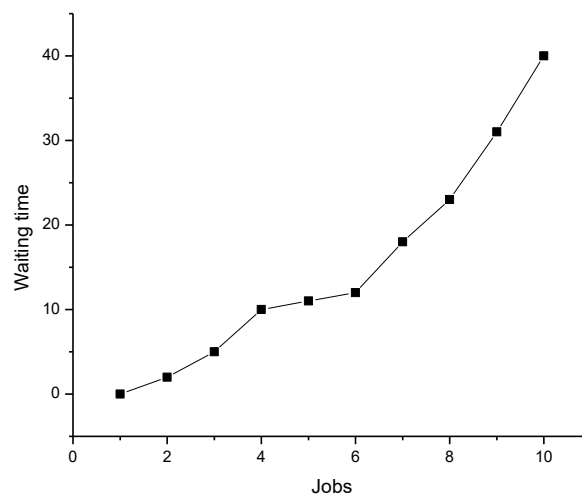


Figure 5.5 Waiting time versus jobs

The Figure 5.5 illustrate that waiting time versus jobs. The job 1 to 4 the waiting time increases. The job 4 to 6 the waiting time slightly increases. The job 6 to 10 quickly increases of waiting time. The job 5 to 10 the waiting time linearly increases. The job 1 to 10 is known as linearly job.

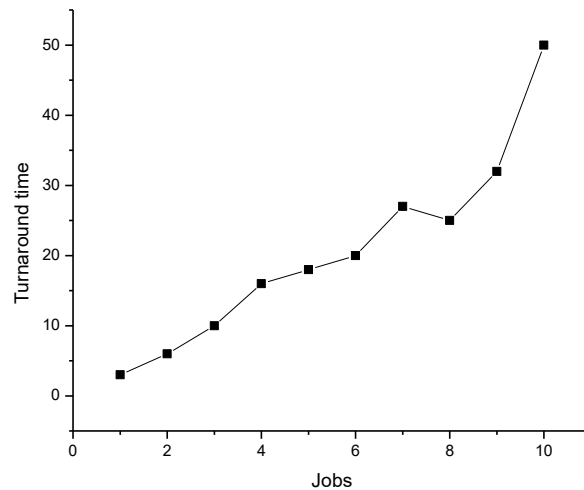


Figure 5.6 Turnaround time versus jobs

The Figure 5.6 shows that turnaround time versus jobs. The job 1 to 4 turnaround time is increased. The turnaround time for job 4 to 6 slightly increased, again job 6 to 7 suddenly increased. The job 7 to 8 turnaround time is low, again job 8 to 10 suddenly increased.

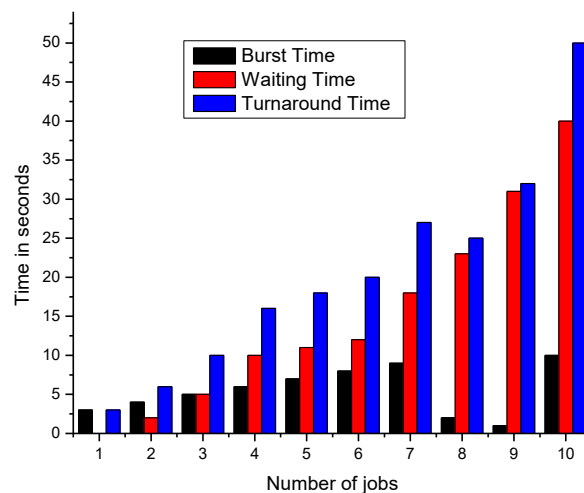


Figure 5.7 Genetic Algorithm with Earliest deadline first [Time in seconds (BT, WT and TAT)] versus number of jobs

The Figure 5.7 shows that Genetic Algorithm with Earliest deadline first [Time in seconds (BT, WT and TAT)] versus number of jobs. In job 1 the burst time and turnaround

time both are equal and waiting time is very low. This type of scheduling is known as low waiting time scheduling. The job 2 waiting time compare than both burst time and turnaround time values is high. The job 3 the burst time is low and waiting time is medium and turnaround time is high. This type of scheduling is normally increasing scheduling. The job 4, 5, 6 and 7 are similarly to job 3. The job 8, 9 and 10 is low burst time, waiting time and turnaround time is very high. This type of scheduling is known as high turnaround time scheduling.

7. Conclusion

This paper presents a genetic algorithm with earliest deadline first for the Job Scheduling problem. The schedules are constructed using a priority rule in which the priorities are defined by the genetic algorithm. Schedules are constructed using a procedure that generates parameterized active schedules. The approach is tested on a set of much number of standard machines taken from the literature and compared with several other approaches. This study proposed a new approach to evaluate a Job Scheduling problem with the help of Genetic Algorithm with earliest deadline first. This approach is a very good result with the help of efficient scheduling. The computational results show that the algorithm produced optimal or near-optimal solutions on all instances tested.

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