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A HYBRID GENETIC ALGORITHM FOR JOB SHOP SCHEUDULING

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ABSTRACT

Job Shop Problem is a critical one; to solve such problems genetic operators can be used. Population size must be increased so selection and fitness value needed. In genetic first select chromosome then apply crossover and mutation technique to form next generation.To find the critical path, a new algorithm to find the critical path from schedule was presented. Furthermore, a local search operator was designed, which can improve the local search ability of GA greatly. Based on all these, a hybrid genetic algorithm was proposed and its convergence was proved. The computer simulations were made on a set of benchmark problems and the results demonstrated the effectiveness of the proposed algorithm.

KEYWORDS: –Hybrid genetic algorithm, Job shop scheduling, crossover ,mutation, hybrid scheduler.

INTRODUCTION

Job – shop scheduling is a NP-hard .It is a system i.e used to minimize the makespan, here each process has number of tasks on m number of machines. Here, products are used for low volume. Such differs in term of processing requirements, materials needed, processing time, processing sequence and setup times. Genetic algorithms take advantage from Darwin's theory, how to form evolution. Problem can be solved by Genetic Algorithm. Two ways are used in Genetic Algorithm such as Pure and Hybrid Genetic Algorithm. Genetic Algorithm starts with chromosomes called population. Solutions from one population are taken and used to form a new population. This is motivated by a hope, that the new population will be better than the old one. Solutions which are selected to form new solutions (offspring) are selected according to their fitness - the more suitable they are the more chances they have to reproduce. This is repeated until some condition (for example number of populations or improvement of the best solution) is satisfied.

RELATED WORK

It is very difficult to solve such problems in their general form. Scheduling can be defined as a problem of finding an optimal sequence to execute a finite set of operations satisfying most of the constraints. The problem is extremely difficult to solve, because it has several goals and resources which helps to maximize machine's utilization and to minimize the time which

required for whole process being scheduled [4]. Therefore [5], branch and bound method, dynamic programming and constraint logic programming methods used. For optimal solution the heuristic method is best. Nowadays, new search techniques introduced like genetic algorithms, simulated annealing for the job-shop scheduling problem. Scheduling is process of assigning a set of tasks to resources over a period of time. In manufacturing world effective scheduling is important. Product's quality depends on machine utilization, manufacturing lead times, and inventory costs, meeting due dates, customer satisfaction, and how the jobs are scheduled in the system. So effective scheduling important to achieve desired objectives In real world for customer's requirements, following are manufacturing configuration shops, they are as open shop and close shop. In an open shop the products are built to order where as in a closed shop the demand is met with existing inventory. Based on the complexity of the process, the shops are classified as single-stage; single machine, parallel machine, multi-stage flow shop and multi-stage job shop [2].The single-stage shop configurations require only one operation to be performed on the machines. In multi-stage flow shops, several tasks are performed for each job and there exists a common route for every job. In multi-stage job shops, an option of selecting alternative resource sets and routes for the given jobs is provided. Hence the job shop allows flexibility in producing a variety of parts. The complexity of processing increases from single stage to job shop. Different methods like mathematical programming and priority rules to meta-heuristic and artificial intelligence-based methods [6] used to solve different objectives for different shops. Job shop scheduling is most complex combinatorial optimization problems. A large amount of research has been performed in job shop scheduling area to effectively schedule jobs for various objectives. A huge number of small to medium companies still operate as job shops [3].Research carried out it in such companies continue to experience difficulties with their specific job shop scheduling problems. Effective scheduling methods provide good schedules with less computational time.Imroving performance manufacturing companies must meet customer's requirements [7]. Use the genetic algorithm (GA) to solve JSSP in an efficient manner by using genetic operators in real world problems[3], Genetic Algorithm introduced a new hybrid swarm intelligence algorithm consists of particle swarm optimization, simulated annealing technique and multi-type individual enhancement scheme is presented to solve the job-shop scheduling problem. A combination of heuristic approach with priority rules is employed to give the solution[8].In recurrent network design, a hybrid genetic algorithm and particle swarm optimization used. Disadvantages of PSO and hybrid GA can overcome by using OR-Library [9]. OR-Librarie's collection of test data sets for a variety of Operations Research (OR) problems. The benchmark problems are taken from this OR-Library. Several researchers have addressed the importance of solving Job-shop Scheduling Problems, which will help in solve real world problems in industries and to schedule their jobs perfectly. In the presented work we hybrid the genetic algorithm to solve the job-shop scheduling problems. GA has a strong ability finding the most optimistic result. GA is a computational abstraction of biological evolution that can be used to solve optimization problem. In its simplest form, a GA is an iterative process applying a series of genetic operators such as selection, crossover and mutation to a population of elements. These elements, called chromosomes or individuals represent possible solutions to the problem [10].

2.1 JOB SHOP SCHEDULING

Job-Shop Scheduling Problem (JSSP) is one of the hard problems is known as NP-HARD. Small problems can be optimally solved by branch and bound method. If the scale is larger, exact methods are unlikely to find optimum in acceptable computational time. In practical manufacturing system, the scale of scheduling problems is usually large so that such methods

used. Job-shop scheduling can also be viewed as defining the ordering between all operations that must be processed on the same machine, i.e. to fix precedence's between these operations. In the disjunctive graph model, this is done by turning all undirected (disjunctive) arcs into directed ones. Using Disjunctive graph we can show the processing of machine and flow of operations.

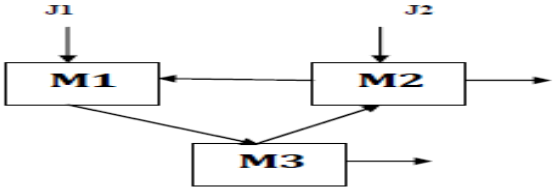

Fig. 1.1 Job Shop Scheduling

Every job has unique path or order to visit machine. In Job Shop Scheduling each job has prespecified path of machine. The JSSP consists of n jobs and m machines. Each job must go through m machines to complete its work. We consider one job consists of m operations. Each operation uses one of m machines to complete one job's work for a fixed time interval. Here two jobs(J1,J2) are given to machines (M1,M2).

J1	M1(7)	M3(8)	M2(10)
J2	M2(6)	M1(4)	M3(12)
J3	M1(8)	M2(8)	M3(7)

Fig. 1.2 Allocation Of Processing Time

Each job having processing time for particular machine. For eg. Job1 having 7 processing time for machine1,for machine3 it takes 8 units of time and for machine2 it require 10 units of time. At time t=0, all jobs available, so each job is waiting in front of machines for processing. Jobs J1,J3 goes in front of machine M1. J2 goes in front of machine M1.Here we are using dispatching rules. Such as:

1. Choose job with smallest processing time (SPT)
2. Do not keep a machine idle when there are jobs waiting.

Here we use Gantt chart tool to represent result of job shop scheduling. Once one operation is processed on a given machine, it cannot be interrupted before it finishes the job's work. The sequence of operations of one job should be predefined and may be different for any job. In general, one job being processed on one machine is considered as one operation noted as Oji (means jth job being processed on it machine,$1 \leq j \leq n, 1 \leq i' \leq m$) [1][2]. The JSSP has n jobs to be processed on m machines.

EXISTING SYSTEM

In the Existing system, Each machine can process only one operation during the time interval. The objective of JSSP is to find an appropriate operation permutation for all jobs that can minimize the makespan Cmax,i.e., the maximum completion time of the final operation in the schedule of n×m operations.

For an n×m JSSP, the problem can be modeled by a set of m machines, denoted by M={1,2,…,m}, to process a set of n×m operations, denoted by O = {0,1,2,…,(n×m)-1} [3]. The notations are as follows:

n : number of jobs
m : number of operations for one job
Oi : completed time of operation i (i=0,1,2,……(n×m)-1)
ti : processing time of operation i on a given machine
Cmax : makespan

3.1 LIMITATIONS OF EXISTING SYSTEM

Following are limitations of Existing System:

- The unpredictability of the nature and receiving time of customer orders.
- The loading of a job only after receiving a customer order and the required material.
- The simultaneous production of diverse, low-quantity jobs using shared resources of finite capacity.

PROPOSED SYSTEM

For low volume systems job shop scheduling (JSS) can be used with different variations in requirements. In job-shop scheduling problem (JSSP) environment, there are j jobs to be processed on m machines to minimize the objectives. Using genetic algorithms (GA) with little modifications it deal with problem of job shop scheduling. Here, we generated an initial population randomly including the result obtain by some well known priority rules ,population go through process of reproduction, crossover to create new population for next generation until some stopping criteria defined were reached.

4.1 ADVANTAGES.

- Simple and fast.
- Generally a superior rule in terms of minimizing completion time through the system.
- Minimizing the average number of jobs in the system
- Usually lower in-process inventories (less shop congestion) and downstream idle time (higher resource utilization).
- Usually lower average job tardiness.

CONCLUSION

The study on GA and job shop scheduling problem provides a rich experience for the constrained combinational optimization problems. Application of genetic algorithm gives a good result most of the time. Although GA takes plenty of time to provide a good result, it provides a Flexible framework for evolutionary computation and it can handle varieties of objective function and constraint.

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