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SOLVING THE JOB-SHOP SCHEDULING PROBLEM WITH A SIMPLE GENETIC ALGORITHM

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Abstract
The job-shop scheduling is concerned with arranging processes and resources. Proper schedules are very important for the manufacturers, but can cause serious problems because of the enormous solution space. Pressure from the competitive enterprises is the main reason why time is becoming one of the most important success factors. Scheduling tools allow production to run efficiently. The goal in this paper is the development of an algorithm for the job-shop scheduling problem, which is based only on genetic algorithms. Our intention is to prove, that even a relatively simple genetic algorithm is capable for job-shop scheduling. The effectiveness of the algorithm is demonstrated by solving practical problems. The first problem consists of 10×10 instances (10 jobs and 10 machines) and the second one of 20×5 instances (20 jobs and 5 machines). The scheduling efficiency is measured by the time required to complete all jobs (makespan). In case of the first and the second problem, the best obtained solution (i.e., deviation from optimal solution) was 1.2 % and 4 %, respectively.
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Key Words: Job-Shop Scheduling, Manufacturing, Genetic Algorithms, Evolutionary Computation

1. INTRODUCTION

Scheduling is an act of defining priority or arranging activities to meet certain requirements, constraints, or objectives. A schedule is a timetable for both jobs and machines. Time is a major constraint and we must utilise it in an optimum manner. Scheduling the production resources leads to increased efficiency, utilisation and profitability for the enterprise.

Job-shop is one of the most popular generalized production systems. Because of the challenging nature of the problem, many researchers have analysed job-shop scheduling. It belongs to the most intractable problems considered.

In the job-shop problem (with no recirculation) a set of jobs $J = (J_1, J_2, ..., J_n)$ must be processed on a set of machines $M = (M_1, M_2, ..., M_m)$, where n is the number of jobs and m is the number of machines. Each job consists of a sequence of operations, where each operation must be processed on a predefined machine for an exact time [1-4]. All operations of a job must be processed one after another in the given order. We assume that there is sufficient buffer space between the machines to store a job if it finishes on one machine and the next machine is still occupied by another job. There are several constrains on jobs and machines [5, 6]:

- there are no precedence constrains among operations of different jobs,
- operations cannot be interrupted,
- each machine can process only one job at a time,
- a job does not visit the same machine twice,
- neither release times nor due dates are specified.

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