Chapter 11

METAHEURISTICS APPROACH FOR RULE ACQUISITION IN FLEXIBLE SHOP SCHEDULING PROBLEMS

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Abstract: In this paper, we deal with an extended class of flexible shop scheduling problems. A solution is composed under the condition where information on jobs to be processed may not be given beforehand, i.e., under the framework of real-time scheduling. To realize a solution, we apply such a method where jobs are to be dispatched by applying a set of rules (a rule-set), and propose an approach in which rule-sets are generated and improved by using the genetics-based machine learning technique. Through some computational experiments, the effectiveness and the potential of the proposed approach are investigated.

Keywords: Rule acquisition, genetics-based machine learning, flexible shop scheduling problem, simulation.
11.1 INTRODUCTION

Recently, scheduling has been recognized as one of the most important issues in the planning and operation of manufacturing system. Extensive researches on scheduling have been reported from the theoretical as well as the practical viewpoints. Most of them deal with the static environment, i.e., the problems on the assumption that all information with respect to the jobs is given beforehand [1, 2].

In actual manufacturing system, not a few unexpected troubles happen, and it is important to make feasible schedules promptly once any trouble happens. Furthermore, there is no guarantee that every parameter of the problems are given beforehand. These kinds of the problems are called real-time scheduling problems, to which rule-based dispatching approaches are widely applied [3–5]. In these approaches, the jobs are dispatched just when they arrive. It is rather difficult, however, to acquire the effective rules for scheduling from the practical viewpoint.

In this paper, a class of flexible shop scheduling problems is considered in the framework of real-time scheduling. That is, each shop includes more than one machines of the parallel machine type in the framework of job shop scheduling problems, and there are several auxiliary restrictions that originate from the necessity of set-up processes. In our past study to this class of scheduling problems, we have dealt with the problems as deterministic and static ones. And we have proposed a method of modeling the problem based on a mathematical programming approach, in which an integer programming method and a genetic algorithm are combined to obtain good schedules rapidly [6].

In our approach adopted here, jobs are to be dispatched in real-time using some rules, and the dispatching rules are generated and improved, in an off-line manner, by using the genetics-based machine learning (GBML) frameworks [7, 9]. In implementing a GBML, we use the Pitt approach, where a rule-set is represented symbolically as an individual of genetic algorithms. The fitness of an individual, i.e., the (global) objective function value of the problem, is calculated according to the results of some simulations using the rule-set. By extending the ways of some applications adopting this framework presented so far [10, 11], in the paper, a way of applying our Pitt approach to a class of flexible shop scheduling problems are proposed. Here, the target is to obtain such a rule-set that remains effective when the situation is changed to some extent. Furthermore, some computational experiments are also shown, where the effectiveness and the potential of the proposed approach are discussed.