Special Flowshop Problems to Minimize Total Completion Time

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Abstract

In this dissertation we are concerned with deterministic flowshop problems where the objective is to minimize the sum of completion times of all jobs. With a few exceptions flowshop problems of this type are known to be computationally intractable. Therefore we have restricted our attention to the following two special cases.

The first case deals with two types of specially structured dominance among the machines. It is known [1, 7] that under such a dominance the best schedule among the so called "permutation schedules" can be found in polynomial time. Here we prove that the schedules constructed as in [1, 7] are not only the best permutation schedules but are the optimal ones. In fact we prove a much more general result, namely that under the above machine dominance constraints, the search for optimal schedule can be restricted to the set of all permutation schedules not only for the sum of completion times criterion but for an arbitrary regular objective function.

The second case deals with two machine problems. We study the two machine problems under the assumption that no idle machine time between the consecutive operation is allowed. First we show that some claims in the literature are incorrect. Then we prove statements which have similar "flavor" as the original incorrect claims. From Chapter 5 on, the focus of our study is on the subproblem specified by the additional constraint that all operations on the first machine have the same length. We describe several variants of the branch and cut technique for solving this strongly NP-hard problem and report results of computational experiments.

Keywords: flowshop problem, machine dominance, regular objective function, branch-and-cut