University of Technology Sydney

Doctor of Philosophy

Algorithms for scheduling without preemptions

by
Julia Memar

Thesis supervisors: A/Prof Dr Yakov Zinder, Dr Hanyu Gu

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School of Mathematical and Physical Sciences

Declaration

I, Julia Memar, declare that this thesis, is submitted in fulfilment of the requirements for the award of Doctor of Philosophy, in the School of Mathematical and Physical Sciences, Faculty of Science at the University of Technology Sydney.

This thesis is wholly my own work unless otherwise referenced or acknowledged. In addition, I certify that all information sources and literature used are indicated in the thesis.

This document has not been submitted for qualifications at any other academic institution.

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Abstract

This thesis is concerned with algorithms for scheduling without preemptions and it contributes to research as follows.

The new area of research, which has gained attention only in the last 15 years, is concerned with flow shop models where the storage requirement varies from job to job and a job occupies the storage continuously from the start of its first operation till the completion of its last operation. This thesis contributes to research by developing a new approach of constructing feasible solutions for such flow shop problems with job-dependent storage. This approach utilises Lagrangian relaxation and decomposition - the techniques that have never been used before for such flow shop problems. In this thesis, several Lagrangian relaxation and decomposition-based heuristics are developed for NP-hard flow-shop problems with job-dependent storage and the effectiveness of these heuristics is demonstrated by the results of computational experiments.

In this thesis, a new discrete optimisation procedure is introduced. This optimisation procedure can be viewed as an alternative exact method to a branch and bound algorithm for a class of discrete optimisation problems with certain properties. This class includes several NP-hard scheduling problems. This discrete optimisation procedure is an iterative algorithm, that searches for a feasible solution with the objective value of the current lower bound or determines that such a solution does not exist. Various methods of how this search can be carried out are investigated, and these methods are compared computationally in application to a scheduling problem.

The worst-case analysis of a polynomial-time approximation algorithm for a maximum lateness scheduling problem with parallel identical machines, arbitrary processing times and arbitrary precedence constraints is provided. The algorithm is a modification of the Brucker-Garey-Johnson algorithm originally developed as an exact algorithm for the case of the problem with unit execution time tasks and precedence constraints represented by an in-tree. For the case when the largest processing time does not exceed the number of machines, a worst-case performance guarantee which is tight for arbitrary large instances of the considered maximum lateness problem has been obtained. It is shown that, if the largest processing time is greater than the number of machines, then the worst-case performance guarantee for the list algorithm, obtained by Hall and Shmoys, is tight.

Thesis supervisors: Associate Professor Dr Yakov Zinder, Dr Hanyu Gu

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This doctoral thesis has been examined by a Committee of the School of Mathematical and Physical Sciences, Faculty of Sciences, UTS as follows:

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