J Sched (2010) 13: 451–452
DOI 10.1007/s10951-010-0196-7

Guest editorial

Special issue "New challenges in scheduling theory" (Marseilles Workshop, May 12–16, 2008)

Michael Bender · Jacek Blazewicz · Erwin Pesch · Denis Trystram · Guochuan Zhang

Published online: 21 August 2010
© Springer Science+Business Media, LLC 2010

Traditionally, scheduling research is concerned with the sequencing of tasks on one machine or on several parallel or different machines, subject to a set of constraints. Over the years, researchers have studied a huge variety of problems, developing numerous heuristics, approximation and exact algorithms, and complexity results. Some of these problems are interesting because of their intractability. Others are interesting because of their applications in production planning, personnel planning, scheduling in parallel and distributed systems, etc. For the most recent introduction to the state of the art, see Błażewicz et al. (2007).

In recent years, researchers have begun studying the scheduling problems derived from new applications and settings. For example, there are scheduling problems in decentralized systems and selfish organizations, grid computing, bioinformatics, and logistical airport operations management processes. Some of these scheduling problems reflect real-life situations by including learning effects or non-constant job processing times because of deteriorating jobs. This listing is only a small sample of the many new applications and resulting scheduling problems that researchers are studying.

From May 12th to 16th, 2008 the workshop "New challenges in scheduling theory" was held in the Marseille-Luminy scientific complex. (We greatly appreciate the friendly atmosphere created by the CIRM team.) The objective of the workshop was to explore new ideas scheduling theory and applications that have emerged in recent years.

The papers in this special issue highlight some of the results of this workshop. We received many high-quality submissions. After a reviewing process, eight papers were chosen for inclusion in the special issue. The papers are listed below alphabetically by the first author.

The paper "Scheduling of Coupled Tasks with Unit Processing Times" by J. Blazewicz, K. Ecker, T. Kis, C.N. Potts, M. Tanas and J. Whitehead deals with the problem of scheduling tasks consisting of two operations where the second has to be processed some time after a completion of the first one. They prove NP-hardness in the strong sense if the precedence constraints have the form of a general graph even if there is only a single processor in the system, all time lags are equal, and all processing times are equal to 1. Polynomial algorithms for special cases are described.

The paper "Parallel Batch Scheduling of Equal-Length Jobs with Release and Due Dates" by A. Condotta, S. Knust and N.V. Shakhlevich describes polynomial algorithms for scheduling of equal processing time jobs in batches. The batches are limited in size and their processing time is equal to the jobs' processing time.

In "Makespan Minimization of Multislot Just-In-Time Scheduling on Single and Parallel Machines" D. Dereniowski and W. Kubiak consider scheduling jobs into mul-

M. Bender
State University of New York at Stony Brook, Stony Brook, USA
e-mail: bender@cs.sunysb.edu

J. Blazewicz
Poznan University of Technology, Poznan, Poland
e-mail: jblazewicz@cs.put.poznan.pl

E. Pesch (✉)
University of Siegen, Siegen, Germany
e-mail: erwin.pesch@uni-siegen.de

D. Trystram
Laboratoire Informatique et Distrinution de Grenoble, Grenoble, France
e-mail: denis.trystram@imag.fr

G. Zhang
Zhejiang University, Hangzhou, China
e-mail: zgc@zju.edu.cn

tiple slots of identical length so that the deadline requirements are satisfied and the makespan is minimized. Both the single-machine case and the multiple-machine case are investigated.

In the paper "Multicriteria, Multi-user Scheduling in Grids with Advance Reservation" K. Kurowski, A. Oleksiak and J. Weglarz consider the problem of processing jobs submitted by multiple users on a computational grid platform. The authors provide a solution for determining a fair schedule when a large number of users share the same resources for executing their jobs. This goal is achieved by using multi-objective evolutionary algorithms after modeling the user's preferences. The central point is to solve the problem by introducing advanced reservation capabilities for providing more knowledge and control to the grid scheduler. Thus, it is more efficient to plan the execution of jobs of multiple users in advance. The proposed method is assessed by extensive experiments.

The paper "A Fluid Approach to Job Shop Scheduling: Theory, Software and Experimentation" by Y. Nazarathy and G. Weiss addresses deterministic job shop scheduling and stochastic optimization of queuing networks. The authors combine both ideas, and solve a fluid job shop problem and schedule the jobs on line to track the fluid solution giving a lower bound to the original one. Implementation details and computational results are discussed.

In the paper "Multiprocessor Scheduling by Generalized Extremal Optimization" by P. Switalski and F. Seredynski, the problem to be considered is one of scheduling a set of multiprocessor tasks on a parallel processor system. The set of processors is represented by an undirected graph: nodes representing processors and edges – communication links. The set of tasks is defined by a weighted directed graph, where weights on nodes define task processing times and weights on arcs represent communication times between pairs of tasks assigned to neighboring processors. The optimization problem consists in finding a schedule (an assignment of tasks to processors) such that the total cost of processing and transmission is minimized. To solve the above problem the authors propose a new metaheuristic called Generalized Extremal Optimization inspired by a coevolutionary model. The tests conducted by the authors showed a clear advantage of this approach over the existing methods.

The paper "On-line Hierarchical Job Scheduling on Grids with Admissible Allocation" by A. Tchernykh, U. Schwiegelshohn, R. Yahyapour and N. Kuzjurin deals with the problem of scheduling task sets on grid systems. The assumed model of a grid is a two-layer one, where each machine in the system can be a parallel processing unit. The adopted scheduling model is a two-layer, on-line grid-scheduling model. At the first layer tasks are allocated to a suitable machine and then scheduled on a parallel machine by a local scheduler. No task migration is allowed. The authors discuss strategies based on various combinations of allocation strategies and local scheduling algorithms. The proposed approach – adaptive admissible strategy, is then tested for real workloads and the ways of its implementation are pointed out.

Finally, the paper "PTAS for Scheduling Problems with Time Lags" by X. Zhang and S. van de Velde devises PTASes for two classes of scheduling problems with time lags. It aims at minimizing either the makespan or the total flow time. The two classes consist of a number of NP-hard shop scheduling models.

Editing this issue would not have been possible without the help of many referees. We greatly appreciate their critical and encouraging evaluation of the submissions.

June 2010

References

Błażewicz, J., Ecker, K., Pesch, E., Schmidt, G., & Węglarz, J. (2007). *Handbook on scheduling*. Berlin: Springer.