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Preface

Approximate reasoning in scheduling

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Scheduling is a hard problem both in theory and in practice. On the one hand, practical scheduling problems, although highly constrained, are complex due to the number and variety of constraints involved. Many of these constraints will be 'soft', i.e., potentially relaxable human preference constraints, rather than 'hard' physical constraints. In addition, a 'good' schedule often needs to be evaluated against a number of potentially conflicting goals that themselves may not be precisely defined. Use of analytic techniques to solve practical scheduling problems has in the past been limited due to the lack of suitably expressive languages for knowledge representation. On the other hand, theoretical scheduling problems, that are concerned with searching for optimal schedules subject to a limited number of constraints, suffer from excessive combinatorial complexity. Simply put, the number of feasible schedules grows exponentially along each dimension (machines, tools, orders, etc.). Therefore, evaluating every solution and then choosing the best one is normally intractable. Indeed, many of the most commonly encountered scheduling problems have been shown to be NP-hard. Therefore, algorithms finding exact solutions are in general useless since they will not normally scale up to solving real world problems. One solution that has recently drawn increased interest is the use of approximate reasoning techniques both for optimization algorithms as well as to model the problem and its components in order to solve scheduling problems in a satisfactory way.

As the guest editor of this special issue, I encouraged submissions of papers that report on advances in the core areas of approximate reasoning in the context of scheduling, and on insights derived from building or using applications

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that combine approximate reasoning and scheduling. The idea was to collect a high-quality selection of papers around this subject.

On February 11, 1997 a preparatory workshop on Approximate Reasoning in Scheduling (ARS'97) was held at Swiss Federal Institute of Technology (ETH) in Zürich. Twenty researchers from 14 countries attended the highly focused workshop. This meeting allowed cross-fertilization in the form of nine original presentations of different approaches followed by discussions, as well as a late night panel discussion on the topic of the workshop. Thus, it was a great opportunity to meet and interact with colleagues from different fields doing research related to approximate reasoning in scheduling. I anticipated that this exchange of ideas would stimulate richer, more interesting papers for the special issue. Indeed, five of the papers included in this special issue are extended and revised versions of the papers presented at the workshop. Six more papers were submitted to the special issue. Each submission was thoroughly peer-reviewed by three referees and revised several times by the authors in order to guarantee a high standard. The nine papers included in this special issue are the result of this work.

The paper by Fanti, Maione, Naso, and Turchiano combines fuzzy constraints with genetic algorithms to study production scheduling problems. Dussa – Zieger and Schwehm use the same type of genetic algorithms to optimize the scheduling of a network of transputers. Sinclair presents a new and very efficient algorithm for scheduling a particular class of networks also consisting of parallel processing hardware. The paper by Tan and Hsu is concerned with the scheduling of computing resources under overload conditions in the context of video transmissions. Leopold considers in her paper the scheduling of execution steps of programs on the basis of neighborhood preferences. Wagner, Garvey, and Lesser discuss how the effective scheduling of resources in searching valuable information on the Internet can be modeled with the use of fuzzy constraints. Türkşen and Zarandi analyse in their paper ways to extract hidden fuzzy rules in a steelmaking scheduling application. The paper by Sauer, Suelmann, and Appelrath describes a hierarchical software using fuzzy constraints applied to production scheduling. Finally, Raggl and myself describe how to solve a complex shift scheduling problem with the use of a general purpose optimization library.

It is my hope that the contents of this special issue will serve as a representative sample of solutions to complex scheduling problems and illustrate the value of approximate reasoning methods for solving real world problems.

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