Edmund Burke
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LNCS 2079

Practice and Theory of Automated Timetabling III

Third International Conference, PATAT 2000
Konstanz, Germany, August 2000
Selected Papers

Springer

C935-53
P895
2000

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Practice and Theory of Automated Timetabling III

Third International Conference, PATAT 2000
Konstanz, Germany, August 16-18, 2000
Selected Papers

华南理工大学
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E200401841

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Cataloging-in-Publication Data applied for

Die Deutsche Bibliothek - CIP-Einheitsaufnahme

Practice and theory of automated timetabling : third international
conference ; selected papers / PATAT 2000, Konstanz, Germany, August 16 -
18, 2000. Edmund Burke ; Wilhelm Erben (ed.). - Berlin ; Heidelberg ; New
York ; Barcelona ; Hong Kong ; London ; Milan ; Paris ; Singapore ; Tokyo :
Springer, 2001
(Lecture notes in computer science ; Vol. 2079)
ISBN 3-540-42421-0

CR Subject Classification (1998): F.2.2, G.1.6, G.2, I.2.8

ISSN 0302-9743
ISBN 3-540-42421-0 Springer-Verlag Berlin Heidelberg New York

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Printed in Germany

Typesetting: Camera-ready by author, data conversion by PTP-Berlin, Stefan Sossna
Printed on acid-free paper SPIN 10839265 06/3142 5 4 3 2 1 0

Lecture Notes in Computer Science 2079

Edited by G. Goos, J. Hartmanis, and J. van Leeuwen

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Preface

This volume is the third in an ongoing series of books that deal with the state of the art in timetabling research. It contains a selection of the papers presented at the 3rd International Conference on the Practice and Theory of Automated Timetabling (PATAT 2000) held in Constance, Germany, on August 16–18th, 2000. The conference, once again, brought together researchers, practitioners, and vendors from all over the world working on all aspects of computer-aided timetable generation. The main aim of the PATAT conference series is to serve as an international and inter-disciplinary forum for new timetabling research results and directions. The conference series particularly aims to foster multi-disciplinary timetabling research. Our field has always attracted scientists from a number of traditional domains including computer science and operational research and we believe that the cross-fertilisation of ideas from different fields and disciplines is a very important factor in the future development of timetabling research. The Constance conference certainly met these aims. As can be seen from the selection of papers in this volume, there was a wide range of interesting approaches and ideas for a variety of timetabling application areas and there were delegates from many different disciplines.

It is clear that while considerable progress is being made in many areas of timetabling research, there are a number of important issues that researchers still have to face. In a contribution to the previous PATAT conference, George M. White said:

> If a single goal could be formulated to describe the aspirations of timetabling research groups, it would be this: An automatic timetabling system should formulate complete descriptions of which students and which teachers should meet, at what locations, at what times and should accomplish this quickly and cheaply while respecting the traditions of the institutions and pleasing most of the people involved most of the time.[1]

This is discussing university course timetabling, but it also applies to other timetabling application areas. One of the problems with many existing timetabling systems (from across the range of application areas) is that the system is often tailored to the needs of a particular institution or user. However, one individual organisation's requirements are often very different from those of another organisation in the same area. One of the themes of the Constance conference is

[1] George M. White and Junhan Zhang: Generating Complete University Timetables by Combining Tabu Search with Constraint Logic. In: Edmund Burke and Michael Carter (eds.): Practice and Theory of Automated Timetabling II, 2nd International Conference, PATAT '97, Toronto, Canada, August 1997, Selected Papers. Lecture Notes in Computer Science, Vol. 1408. Springer-Verlag, Berlin Heidelberg New York 1998

that the attempt to operate at a higher level of generality is becoming an ever more important timetabling research direction.

A major feature of the 3rd PATAT conference was the diversity of papers from a variety of timetabling fields. The PATAT conferences have always welcomed papers from across the timetabling spectrum but previous events have attracted the majority of their contributions from the educational sector. In this volume, other areas such as employee timetabling, sports timetabling, and transportation timetabling are more strongly represented. Indeed, we have devoted a section of the book to employee timetabling. This diversification motivated us towards organising the whole volume around application areas rather than on the solution methods and techniques employed (in contrast to earlier volumes). This is because we think that people are usually more interested in one specific timetabling sector than in a particular type of approach. We also include a section on Practical Considerations and General Issues containing papers that are of interest to all researchers and practitioners.

The Conference Series

The conference in Constance was the third in a series of international conferences on the Practice and Theory of Automated Timetabling (PATAT). This volume contains a selection of papers from that conference. The first conference was held in Edinburgh in August/September 1995. Selected papers from this also appeared in the Springer Lecture Notes in Computer Science series. The full reference is

> Edmund Burke and Peter Ross (eds.): Practice and Theory of Automated Timetabling, 1st International Conference, Edinburgh, UK, August/September 1995, Selected Papers. Lecture Notes in Computer Science, Vol. 1153. Springer-Verlag, Berlin Heidelberg New York 1996.

The second conference in the series was held in Toronto in August 1997. Selected papers from this appeared in

> Edmund Burke and Michael Carter (eds.): Practice and Theory of Automated Timetabling II, 2nd International Conference, PATAT '97, Toronto, Canada, August 1997, Selected Papers. Lecture Notes in Computer Science, Vol. 1408. Springer-Verlag, Berlin Heidelberg New York 1998.

The fourth conference in the series will be held in Ghent, Belgium, in August 2002. Future conferences will be held every two years. For further information about the conference series, contact the steering committee (whose members are listed below) or see http://www.asap.cs.nott.ac.uk/ASAP/ttg/patat-index.html.

Acknowledgements

Like its two predecessors, the conference in Constance (Konstanz) was very successful. Old acquaintances were renewed and new friends were made. Many people worked very hard to make the conference a valuable, enjoyable, and interesting event. We would like to express our sincere thanks to all the members of the organising committee (listed below). Their help and friendliness in efficiently and effectively dealing with all sorts of problems was very much appreciated.

All the papers that appear in this volume have been through a very rigorous and careful review process. All submissions to the conference were fully refereed in a first round. A second round of refereeing, specifically for this volume, was carried out after the conference. Many thanks go to the members of the programme committee (listed below) who refereed the papers during these two rounds.

We are also very grateful to the staff of Springer-Verlag for their support and encouragement. As series editor of the Lecture Notes in Computer Science series, Jan van Leeuwen was particularly helpful throughout the duration of this project, as he was with the previous two volumes. We would also like to thank Piers Maddox for the excellent job he made of copy editing this volume. His hard work is very much appreciated.

Special thanks go to Alison Payne for all the secretarial support she has given us, particularly during the second round of refereeing and during the preparation of this volume. We would also like to thank Diane French for her secretarial support during the first round of refereeing.

Of course, it is the group of authors, presenters and delegates who ultimately determine the success of a conference. Our thanks go to them for the enthusiasm and support they have given to us and indeed, to the PATAT series of conferences. Finally, we would like to thank the steering committee (listed below) for their continuing work in bringing us this and future PATAT conferences. We apologise for any omissions that have been inadvertently made. So many people have helped with this conference and with the series of conferences that it is difficult to remember them all.

May 2001

Edmund Burke
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Course and School Timetabling

A Multiobjective Genetic Algorithm for the Class/Teacher Timetabling Problem

Marco P. Carrasco[1,3] and Margarida V. Pato[2,3]

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Abstract. The drawing up of school timetables is a slow, laborious task, performed by people working on the strength of their knowledge of resources and constraints of a specific institution. This paper begins by presenting the timetabling problems that emerge in the context of educational institutions. This is followed by a description of the basic characteristics of the class/teacher timetabling problem. Timetables are considered feasible provided the so-called hard constraints are respected. However, to obtain high-quality timetabling solutions, other conditions should be satisfied in this case – those of soft constraints – which impose satisfaction of a set of desirable conditions for classes and teachers. A multiobjective genetic algorithm was proposed for this timetabling problem, incorporating two distinct objectives. They concern precisely the minimization of the violations of both types of constraints, hard and soft, while respecting the two competing aspects – teachers and classes. A brief description of the characteristics of a genetic multiobjective metaheuristic is presented, followed by the nondominated sorting genetic algorithm, using a standard fitness-sharing scheme improved with an elitist secondary population. This approach represents each timetabling solution with a matrix-type chromosome and is based on special-purpose genetic operators of crossover and mutation developed to act over a secondary population and a fixed-dimension main population of chromosomes. The paper concludes with a discussion of the favorable results obtained through an application of the algorithm to a real instance taken from a university establishment in Portugal.

1 Introduction

In most educational institutions, the timetabling activity assumes considerable importance. First, as a result of this task, a set of attributions determining the entire daily activity of all the human resources involved, from students and teachers to employees, is drawn up. Secondly, alongside, a pattern of the use of the institution's physical resources is defined. Rational management of such

E. Burke and W. Erben (Eds.): PATAT 2000, LNAI 2079, pp. 3–17, 2001.
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