TABU SEARCH

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Springer Science+Business Media, LLC

Library of Congress Cataloging-in-Publication Data

A C.I.P. Catalogue record for this book is available from the Library of Congress.

ISBN 978-0-7923-8187-7 ISBN 978-1-4615-6089-0 (eBook)
DOI 10.1007/978-1-4615-6089-0

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Printed on acid-free paper.

To Diane and Zuza,
who have brought us to appreciate
the tabus worth transcending.

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PREFACE

Faced with the challenge of solving hard optimization problems that abound in the real world, classical methods often encounter great difficulty — even when equipped with a theoretical guarantee of finding an optimal solution. Vitally important applications in business, engineering, economics and science cannot be tackled with any reasonable hope of success, within practical time horizons, by solution methods that have been the predominant focus of academic research throughout the past three decades (and which are still the focus of many textbooks).

The impact of technology and the advent of the computer age have presented us with the need (and opportunity) to solve a range of problems that could scarcely have been envisioned in the past. We are confronted with applications that span the realms of resource planning, telecommunications, VLSI design, financial analysis, scheduling, space planning, energy distribution, molecular engineering, logistics, pattern classification, flexible manufacturing, waste management, mineral exploration, biomedical analysis, environmental conservation and scores of others.

This book explores the meta-heuristic approach called tabu search, which is dramatically changing our ability to solve problems of practical significance. In recent years, journals in a wide variety of fields have published tutorial articles, computational studies and applications documenting successes by tabu search in extending the frontier of problems that can be handled effectively — yielding solutions whose quality often significantly surpasses that obtained by methods previously applied.

A distinguishing feature of tabu search, represented by its exploitation of adaptive forms of memory, equips it to penetrate complexities that often confound alternative approaches. Yet we are only beginning to tap the potential of adaptive memory strategies, and the discoveries that lie ahead promise to be as exciting as those made to date. The knowledge and principles that have currently evolved give a foundation to create practical systems whose capabilities markedly exceed those available earlier, and at the same time invite us to explore still untried variations that may lead to further advances.

We present the major ideas of tabu search with examples that show their relevance to multiple applications. Numerous illustrations and diagrams are used to elucidate principles that deserve emphasis, and that have not always been wel! understood or applied. Our goal is to provide "hands-on" knowledge and insight alike, rather than to focus exclusively either on computational recipes or on abstract themes. This book is designed to be useful and accessible to researchers and practitioners in management science, industrial engineering, economics, and computer science. It can appropriately be used as a textbook in a masters course or in a doctoral seminar. Because of its emphasis on presenting ideas through illustrations and diagrams, and on identifying associated practical applications, it can also be used as a supplementary text in upper division undergraduate courses.

The development of this book is largely self-contained, and (with the exception of a chapter on applying tabu search to integer programming) does not require prior knowledge of special areas of operations research, artificial intelligence or optimization. Consequently, students with diverse backgrounds can readily grasp the basic principles and see how they are used to solve important problems. In addition, those who have reasonable programming skills can quickly gain a working knowledge of key ideas that will enable them to implement their own tabu search procedures.

Discussion questions and exercises are liberally incorporated in selected chapters to facilitate the use of this book in the classroom. The exercises are designed to be "tutorial," to lead the reader to uncover additional insights about the nature of effective strategies for solving a wide range of problems that arise in practical settings.

A conspicuous feature of tabu search is that it is dynamically growing and evolving, drawing on important contributions by many researchers. Evidence of these contributions will be seen throughout this book. In addition, a chapter is included that underscores the impact of these contributions through a collection of real world applications, together with associated studies of prominent "classical problems."

There are many more applications of tabu search than can possibly be covered in a single book, and new ones are emerging every day. Our goal has been to provide a grounding in the essential ideas of tabu search that will allow readers to create

successful applications of their own. We have also sought to provide an understanding of advanced issues that will enable researchers to go beyond today's developments and create the methods of tomorrow.

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