Preface

Increasing competition in the industrial and service sectors has led to a demand for optimal or provably near-optimal solutions to large scale optimization problems, and the exploration of a much larger range of alternatives in the race to improve productivity and efficiency. Many such decision problems involve the choice between a finite set of alternatives. Combinatorial optimization involves careful modeling of such problems, the mathematical analysis of the resulting discrete structures, the development of algorithms and their analysis, and the implementation of software to produce practical solutions.

DONET is a European research network with the participation of research groups in Belgium, England, France, Germany, Italy, Portugal, Switzerland, and The Netherlands, funded by the European Union in the program "Training and Mobility of Researchers (TMR)". The consortium's objectives include:

– consolidation of the network as a cohesive unit with a free flow of information and expertise between member institutions,
– elimination of the gaps between theoreticians and practitioners in discrete optimization,
– provision of a thorough training program for students, which includes strong theoretical and applied components, thus preparing them for entrance into both academic and industrial careers.

In this spirit we organized a

SPRING SCHOOL ON
COMPUTATIONAL COMBINATORIAL OPTIMIZATION
Schloß Dagstuhl, Germany, 15–19 May 2000

in which leading experts from and outside the DONET consortium gave lectures and organized exercises (often involving computer implementations), for half a day at a time, typically split into two units, per topic.

Schloß Dagstuhl provided an excellent atmosphere for teaching and learning. We are grateful that Egon Balas, Vašek Chvátal, Matthias Elf, Carsten Gutwenger, Claude Lemaréchal, Alexander Martin, Yves Pochet, Ted Ralphs, Giovanni Rinaldi, and Leslie Trotter followed our invitation to teach at the school and that we (or rather: they) were able to attract 57 students from 10 countries whose active participation made this school a productive and also a fun event.

We gladly accepted the invitation of Springer-Verlag to publish written versions (some with additional co-authors) of the courses taught at the school. During the school, the teachers agreed to write up their contributions within about a year. Just like the lectures, the written versions reflect the different individual styles of the teachers, and represent not a packing but rather a covering of the subjects taught at the school. We think that the resulting overlaps in the material presented are useful rather than annoying. After all, this is not a textbook

but a collection of lectures on computational combinatorial optimization. Therefore, we restricted our editing of the material provided to the maintenance of a common format and appropriate cross-referencing (indicated by $[\longrightarrow \ \ldots]$ in the text). The lectures appear in the order in which they were presented at the school. Even though they are independent, we recommend reading them in the given order.

The cover illustration shows a tetrahedron contained in a cube. For the triangle graph
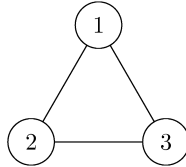
there are four ways to partition the node set into two subsets. Below, we list these four partitions along with those edges that connect nodes in different subsets. Such edge sets are called "cuts" of the given graph. Next to the cuts, we list their characteristic vectors $(\chi_{12}, \chi_{13}, \chi_{23})$ where $\chi_{ij} = 1$ if the edge connecting nodes i and j is in the cut and $\chi_{ij} = 0$ otherwise.

node partition	cut edges	$(\chi_{12}, \chi_{13}, \chi_{23})$
$\{1,2,3\}, \emptyset$	$\emptyset$	$(0,0,0)$
$\{1,2\}, \{3\}$	$\{[1,3],[2,3]\}$	$(0,1,1)$
$\{1,3\}, \{2\}$	$\{[1,2],[2,3]\}$	$(1,0,1)$
$\{2,3\}, \{1\}$	$\{[1,2],[1,3]\}$	$(1,1,0)$

The four resulting 3-dimensional 0-1-vectors are the vertices of the shown tetrahedron, which is the "cut-polytope" for the triangle graph. It can be obtained from the unit cube by "chopping off" the four vertices that are not characteristic vectors of cuts. Polytopes and the "chopping off" process (which is called "separation") play an important rôle in this book. The cut polytope itself is also considered in some detail.

We would like to thank all authors for their productive cooperation, Constantin Hellweg and Ramin Sahamie for producing the cover illustration, and especially Matthias Elf for his help in the technical editing of this book.

September 2001   Michael Jünger and Denis Naddef
                                                          Organizers and Editors

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