Preface

"Progress in Combinatorial Optimization" is associated with the International Symposium on Combinatorial Optimization (ISCO) that took place in Hammamet, Tunisia, from 24 to 26 March 2010. ISCO 2010 was the first of a series of biannual conferences on combinatorial optimization. Its goal is to bring together researchers from all the communities related to combinatorial optimization, including algorithms and complexity, mathematical programming, game theory, and operations research. It is intended to be a forum for the exchange of recent scientific developments and the discussion of new trends. The scope of the conference includes all aspects of combinatorial optimization from fundamental research to numerical experiments and applications. All information about the symposium is available at http://www.lamsade.dauphine.fr/~isco/. A total of 194 papers were presented, along with five plenary invited talks to an audience of 247 participants. ISCO 2010 was preceded by a spring school on "Cutting plane methods for integer and combinatorial optimization". Pierre Bonami, Gérard Cornuéjols, and Andrea Lodi gave 16 hours of lectures on March 22–23, 2010.

Combinatorial optimization has undergone rapid developments in the past years, major advances being obtained in different areas such as computational complexity, approximation algorithms, cutting-plane methods, and stochastic and robust optimization. Written by leading experts in the domain, this book aims at presenting new advances in these areas. It contains 20 chapters that cover most of the aspects of combinatorial optimization. Most of them are surveys, yet the book also contains many new results.

Chapter 1 deals with the so-called partition inequalities. These arise as valid inequalities for many optimization problems such as survivable network design problems. The chapter surveys several variants of these inequalities, and discusses their separation, some extensions, and applications in network design and other

domains. Chapter 2 proposes an overview of the recent developments related to stable sets in claw-free graphs from both the polyhedral and algorithmic points of view. In Chapter 3, the author discusses algorithms for submodular total dual integral problems. Chapter 4 describes a technique to obtain linear descriptions for polytopes from extended formulations. Extended formulations are also addressed in Chapters 7, 8 and 9. Chapter 7 gives an overview of different and new formulations of the asymmetric traveling salesman problem and shows new dominance results. Chapter 8 discusses the use of several families of cut and partition inequalities over extended formulations for some network design, vehicle routing, and scheduling problems. This topic has also connections with Chapter 1. In Chapter 19, the author presents extended MIP Formulations for a production/sequencing and a production/distribution problem. In particular, he considers ways in which extended formulations can be used computationally. In Chapter 5, the authors examine the applications of the Relax-and-Cut approach to the Branch-and-Cut method. They also devise an effective exact solution algorithm for the Degree-Constrained Minimum Spanning Tree Problem based on this hybrid technique. Chapter 6 deals with transversals and blockers. These are combinatorial structures having applications in many settings. The authors give a partial survey of models related to those structures. Chapter 9 deals with stochastic mixed-integer programming. The authors develop model equivalents and cutting-plane decomposition methods for optimization problems with stochastic order constraints induced by linear recourse models with either mixed-integer or continuous variables in the second stage. Chapter 10 reviews some game-theoretic approaches for congestion situations in both the cooperative and non-cooperative cases, where a group of autonomous agents interact in a discrete system (such as a graph) underlying a combinatorial optimization problem. Chapter 11 discusses applications of combinatorial objects such as perfect matchings or spanning trees of graphs, common bases of matroids, and matchings in polymatroids to electric networks. It also shows the connection between these objects and the computation of the determinants of matrices. Chapter 12 gives an overview of robust optimization problems in telecommunications. Chapter 13 reviews recent trends in approximation algorithms dealing with total weighted tardiness and total weighted earliness minimization under a common due date on a single machine. In Chapter 14, the authors introduce a specialization of tabu search for optimal partitioning problems. This new method can also be applied to a wide variety of binary and discrete optimization problems. Chapters 15 and 16 deal with exponential algorithms for NP-hard combinatorial optimization problems. Chapter 15 presents new ideas and advances about the design of moderately exponential time approximation algorithms. Chapter 16 gives an introduction to exponential time exact algorithms for solving NP-hard combinatorial problems, that is, algorithms with worst-case complexity as low as possible. Chapter 17 presents recent progress in semidefinite optimization techniques for satisfiability. It provides an overview of the state of the art in the interaction between these two highly active research areas of semi-definite optimization and satisfiability. In Chapter 18, the

authors present recent developments in applying disjunctive programming theory in the resolution of mixed-integer nonlinear programming problems. The generation of effective cutting planes is discussed for both the convex and non-convex cases. The last chapter deals with the two-phase method for multi-objective combinatorial optimization problems.

We hope that this book will constitute a good basis for future research.

Finally, we would like to take this opportunity to thank all the authors for their valuable contributions. We also thank the referees for their reviews and suggestions for improvements. Moreover, we thank the publisher for the production of this book. In addition many thanks to Raouia Taktak for her technical help.

A. Ridha MAHJOUB
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