Disjunctive Programming

Egon Balas

Disjunctive Programming

Springer

Egon Balas
Tepper School of Business
Carnegie Mellon University
Pittsburgh, PA, USA

ISBN 978-3-030-00147-6 ISBN 978-3-030-00148-3 (eBook)
https://doi.org/10.1007/978-3-030-00148-3

Library of Congress Control Number: 2018957148

This Springer imprint is published by the registered company Springer Nature Switzerland AG
The registered company address is: Gewerbestrasse 11, 6330 Cham, Switzerland

Preface

This book is meant for students and practitioners of optimization, mainly integer and nonconvex optimization, as an introduction to, and review of, the recently developed discipline of disjunctive programming. It should be of interest to all those who are trying to overcome the limits set by convexity to our problem-solving capability. Disjunctive programming is optimization over disjunctive sets, the first large class of nonconvex sets shown to be convexifiable in polynomial time.

There are no prerequisites for the understanding of this book, other than some knowledge of the basics of linear and integer optimization. Clarity of exposition was a main objective in writing it. Where background material is required, it is indicated through references.

Habent sua fata libelli, goes the Latin saying: *books have their own fate*. The basic document on Disjunctive Programming is the July 1974 technical report "Disjunctive Programming: Properties of the convex hull of feasible points. MSRR #348", which however has not appeared in print until 24 years later, when it was published as an invited paper with a remarkable foreword by Gerard Cornuejols and Bill Pulleyblank [7] (for a history of this episode see the introduction to [11]). The new theory, which was laid out without implementation of its cutting planes, let alone computational experience, stirred little if any enthusiasm at the time of its inception. But 15 years later, when Sebastian Ceria, Gerard Cornuejols and myself recast essentially the same results in a new framework which we called lift-and-project [19], the reaction was quite different. This time our work was focused on algorithmic aspects, with the cutting planes generated in rounds and embedded into an enumerative (branch and cut) framework, and was accompanied by an efficient computer code, MIPO, that was able to solve many problem instances that had been impervious to solution by branch-and-bound alone. This has led to a general effort on the part of software builders to incorporate cutting planes into a new generation of integer programming solvers, with the outcome known as the revolution in the state of the art in mixed integer programming that took place roughly in the period 1990–2005.

From a broader perspective, disjunctive programming is one of the early bridges between convex and nonconvex programming.

Several friends and colleagues have contributed to the improvement of this book through their comments and observations. Their list includes David Bernal, Dan Bienstock, Gérard Cornuéjols, Ignacio Grossmann, Michael Juenger, Alex Kazachkov, Tamas Kis, Andrea Qualizza, Thiago Serra, and an anonymous editor of the Springer Series Algorithms and Combinatorics.

The research underlying the results reported on in this book was supported generously throughout the last four decades by the National Science Foundation and the US Office of Naval Research. The writing of the book itself was supported by NSF Grant 1560828 and ONR Contract N000141512082.

Pittsburgh, PA, USA Egon Balas

Contents