Preface

Many breakthroughs in research and, more generally, solutions to problems come as the result of someone making *connections*. These connections are sometimes quite subtle, and at first blush, they may not appear to be plausible candidates for part of the solution to a difficult problem. In this book, we think of these connections as *bridges*. A bridge enables the possibility of a solution to a problem that may have a very elementary statement but whose solution may involve more complicated realms that may not be directly indicated by the problem statement. Bridges extend and build on existing ideas and provide new knowledge and strategies for the solver. The ideal audience for this book consists of ambitious students who are seeking useful tools and strategies for solving difficult problems (many of olympiad caliber), primarily in the areas of real analysis and linear algebra.

The opening chapter (aptly called "Chapter 1") explores the metaphor of bridges by presenting a myriad of problems that span a diverse set of mathematical fields. In subsequent chapters, it is left to the *reader* to decide what constitutes a bridge. Indeed, different people may well have different opinions of whether something is a (useful) bridge or not. Each chapter is composed of three parts: the theoretical discussion, proposed problems, and solutions to the proposed problems. In each chapter, the theoretical discussion sets the stage for at least one bridge by introducing and motivating the themes of that chapter—often with a review of some definitions and proofs of classical results. The remainder of the theoretical part of each chapter (and indeed the majority) is devoted to examining illustrative examples—that is, several problems are presented, each followed by at least one solution. It is assumed that the reader is intimately familiar with real analysis and linear algebra, including their theoretical developments. There is also a chapter that assumes a detailed knowledge of abstract algebra, specifically, group theory. However, for the not so familiar with higher mathematics reader, we recommend a few books in the bibliography that will surely help, like [5–9, 11, 12].

Bridges can be found everywhere—and not just in mathematics. One such final bridge is from us to our friends who carefully read the manuscript and made extremely valuable comments that helped us a lot throughout the making of the book. It is, of course, a bridge of acknowledgments and thanks; so, last but not least,

we must say that we are deeply grateful to Gabriel Dospinescu and Chris Jewell for all their help along the way to the final form of our work.

In closing, as you read this book, we invite you to discover some of these bridges and embrace their power in solving challenging problems.

Richardson, TX, USA	Titu Andreescu
Targoviste, Romania	Cristinel Mortici
Barlad, Romania	Marian Tetiva

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