Preface

The notion of a "perfect" graph was introduced by Claude Berge at the birth of the 1960s. Since that time many classes of graphs, interesting in their own right, have been shown to be perfect. Research, in the meantime, has proceeded along two lines. The first line of investigation has included the proof of the perfect graph theorem (Theorem 3.3), attempts at proving the strong perfect graph conjecture, studies of critically imperfect graphs, and other aspects of perfect graphs. The second line of approach has been to discover mathematical and algorithmic properties of special classes of perfect graphs: comparability graphs, triangulated graphs, and interval graphs, to name just a few. Many of these graphs arise quite naturally in real-world applications. For example, uses include optimization of computer storage, analysis of genetic structure, synchronization of parallel processes, and certain scheduling problems.

Recently it appeared to me that the time was ripe to assemble and organize the many results on perfect graphs that are scattered throughout the literature, some of which are difficult to locate. A serious attempt has been made to coordinate the mélange of some 200 papers referenced here in a manner that would make the subject more accessible to those interested in algorithmic and algebraic graph theory. I have tried to include most of the important results that are currently known. In addition, a few new results and new proofs of old results appear throughout the text. In particular, Chapter 9, on superperfect graphs, contains results due to Alan J. Hoffman, Ellis Johnson, Larry J. Stockmeyer, and myself that are appearing in print for the first time.

The emphasis of any book naturally reflects the bias of the author. As a mathematician and computer scientist, I am doubly biased. First, I have tried to present a rigorous and coherent theory. Proofs are constructive and are streamlined as much as possible. The notation has been chosen to facilitate these matters. Second, I have directed much attention to the algorithmic aspects of every problem.

Algorithms are expressed in a manner that will make their adaptation to a particular programming language relatively easy. The complexity of every algorithm is analyzed so that some measure of its efficiency can be determined.

These two approaches enhance one another very well. By exploiting the mathematical properties satisfied a priori by a structure, one is often able to reduce the time or space complexity required to solve a problem. Conversely, the algorithmic approach often leads to startling theoretical results. To illustrate this point, consider the fact that certain NP-complete problems become tractable when restricted to certain classes of perfect graphs, whereas the algorithm for recognizing comparability graphs gives rise to a matroid associated with the graph.

A glance at the table of contents will provide a rough outline of the topics to be discussed. The first two chapters are introductory in the sense that they provide the foundations, respectively, of the graph theoretic notions and the algorithmic design and analysis techniques that will be used in the remaining chapters. The reader may wish to read these two chapters quickly and refer to them as needed. The chapters are structured in such a way that the book will be suitable as a textbook in a course on algorithmic combinatorics, graph theory, or perfect graphs. In addition, the book will be very useful for applied mathematicians and computer scientists at the research level. Many applications of the theoretical and computational aspects of the subject are described throughout the text. At the end of each chapter there are numerous exercises to test the reader's understanding and to introduce further results. An extensive bibliography follows each chapter, and, when possible, the *Mathematical Reviews* number is included for further reference.

The topics covered in this book have been chosen to fill a vacuum in the literature, and their interrelation and importance will become evident as early as Section 1.3. Since the intersection of this volume with the traditional material covered by most graph theory books has been designed to be small, it is highly recommended that the serious student augment his studies with one of these excellent textbooks. A one-year course with two concurrent texts is suggested.

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