Preface

In many ways, working on graph theory problems over the years has always seemed like fun and games. Recently, through examples of large sparse graphs in realistic networks, research in graph theory has been forging ahead into an exciting new dimension. Graph theory has emerged as a primary tool for detecting numerous hidden structures in various information networks, including Internet graphs, social networks, biological networks, or more generally, any graph representing relations in massive data sets.

How will we explain from first principles the universal and ubiquitous coherence in the structure of these realistic but complex networks? In order to analyze these large sparse graphs we will need to use all the tools at our disposal, including combinatorial, probabilistic and spectral methods. Time and again, we have been pushed beyond the limit of the existing techniques and have had to create new and better tools to be able to analyze these networks. The examples of these networks have led us to focus on new, general and powerful ways to look at graph theory. In the other direction, we hope that these new perspectives on graph theory contribute to a sound scientific foundation for our understanding of the discrete networks that permeate this information age.

This book is based on ten lectures given at the *CBMS Workshop on the Combinatorics of Large Sparse Graphs* in June 2004 at the California State University at San Marcos. Various portions of the twelve chapters here are based on several papers coauthored with many collaborators. Indeed, to deal with the numerous leads in such an emerging area it is crucial to have partners to sound out the right approaches, to separate what can be rigorously proved and under what conditions from what cannot be proved, to face seemingly overwhelming obstacles and yet still gather enough energy to overcome one more challenge. Special thanks are due to our coauthors, including Bill Aiello, Reid Andersen, David Galas, Greg Dewey, Shirin Handjani, Doug Jungreis, and Van Vu.

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Fan Chung and Lincoln Lu, May 2006