MATCH
Communications in Mathematical and in Computer Chemistry

MATCH Commun. Math. Comput. Chem. **62** (2009) 741-742

ISSN 0340 - 6253

BOOK REVIEW

Combinatorial Matrix Theory (Second Edition)

by

Bolian Liu

Science Press, Beijing , 2005, X+320 pp. ISBN 7-03-014366-3

The first edition of "*Combinatorial Matrix Theory*" (in Chinese) by Bolian Liu was published in 1996. It was the first publication introducing combinatorial matrix theory and filling a gap in China. It was recommended by the Ministry of Education as a national graduate text. We quote the most famous Chinese mathematician Lizhi Xu's comment: *From this new book, one may find that Chinese scholars have played an especially important role in the development of 'combinatorial matrix theory', the new branch of mathematics. This book will open up some promising directions for the combinatorial theory researchers in the future.*

Extended by newest results and the author's own research in this area, this book (the 2nd Edition) has been published in 2005. It had its 4th printing in January 2006. Inside the front cover is an note by Yuan Wang, a member of the Chinese Academy of Sciences.

The first edition has five chapters and 578 pages. The 2nd edition is organized into four chapters and has 320 pages. In contrast to the 1st edition, the 2nd edition has a few considerable improvements. At the end of each chapter, a few selected exercises are inserted. Their solutions and hints are added at the end of the book.

The theme of the book is the interaction between matrix theory and properties of graphs and digraphs. The book is divided into : 2nd Edition Preface, 1st Edition Foreword (By Lizhi Xu), Preface, four chapters (1. Matrix and Graph Spectrum 2. Combinatorial Properties of Matrices 3. Power Sequences of Nonnegative Matrices 4. Matrix Methods and Analysis, each ending with a list of exercises and references), followed by Answers and Hints, Appendix, Index of symbols, and Index of names.

Chapter 1 presents the connection between digraphs and matrices. It focuses on the eigenvalues of adjacent matrices. Bounds for spectral radius are given. The spectra of line graphs and total graphs presented as well as some new results on cospectral graphs. The results on spectral radius are extended to the (0,1)-matrices.

The combinatorial properties of (0,1)-matrices are outlined in Chapter 2. Digraphs are a useful tool to study (0,1)-matrices . By permutation similarity, non-negative matrices are divided into two classes: reducible and irreducible. By permutation equivalence, non-negative matrices are divided into partly decomposable and fully indecomposable. The author outlines properties of irreducible and fully indecomposable matrices. From irreducible and fully indecomposable matrices, the normalized form of matrix permutation similarity and equivalence are studied. The subclasses of irreducible matrices, i. e., nearly reducible matrices, and fully indecomposable matrices, i. e., nearly decomposable matrices are covered. As the application of Köing Theorem, the stochastic and doubly stochastic matrices are considered.

Beginning with physical examples, Chapter 3 is devoted to the power sequence of non-negative matrices. The author and other Chinese researchers have remarkable achievements in this area. The primitive matrix, primitive index and the general primitive index are the classic results. Other subjects of more general interest, such as density index, fully indecomposable exponent, Hall exponent are also covered.

Chapter 4 provides some additional combinatorial matrix topics. The sign matrix is a hot subject in recent years. Specially, the qualitative matrix class is originated from qualitative economics.

The book ends with the hints and answers. Form the exercises, the readers may train themselves how to use combinatorial matrix theory to solve related problems. Also, in the Appendix the readers may acquire some basic knowledge about linear algebra and graph theory.

The editors of the book suggest that it is suitable for graduate students who major in Information Science, Economic Mathematics, Computer Networks, Parallel Computing, etc. We fully agree with this, adding that we deem that this book is suitable for any student or researcher interested in combinatorial matrix theory. Readers of *MATCH Communications in Mathematical and in Computer Chemistry* may also find this book valuable.

Zhifu You
School of Mathematics
South China Normal University
Guangzhou
P. R. China

Ivan Gutman
Faculty of Science
University of Kragujevac
Kragujevac
Serbia