

Implementing Discrete Mathematics

Combinatorics and Graph Theory with Mathematica®

With programs by Steven Skiena and Andri Benseb

Steven Skiena

*State University of
New York, Stony Brook*



ADDISON-WESLEY PUBLISHING COMPANY

The Advanced Book Program

Redwood City, California • Menlo Park, California • Reading, Massachusetts
New York • Don Mills, Ontario • Wokingham, United Kingdom • Amsterdam
Bonn • Sydney • Singapore • Tokyo • Madrid • San Juan

■ Contents

1. Permutations and Combinations	1
1.1 Permutations	3
1.2 Permutation Groups	17
1.3 Inversions and Inversion Vectors	27
1.4 Special Classes of Permutations	32
1.5 Combinations	40
1.6 Exercises and Research Problems	47
2. Partitions, Compositions, and Young Tableaux	49
2.1 Partitions	51
2.2 Compositions	60
2.3 Young Tableaux	63
2.4 Exercises and Research Problems	77
3. Representing Graphs	79
3.1 Data Structures for Graphs	81
3.2 Elementary Graph Operations	89
3.3 Graph Embeddings	98
3.4 Storage Formats	119
3.5 Exercises and Research Problems	124
4. Generating Graphs	127
4.1 Building Graphs from Other Graphs	129
4.2 Regular Structures	140
4.3 Trees	151
4.4 Random Graphs	154
4.5 Relations and Functional Graphs	161
4.6 Exercises and Research Problems	166

5. Properties of Graphs	169
5.1 Connectivity	171
5.2 Graph Isomorphism	181
5.3 Cycles in Graphs	188
5.4 Partial Orders	203
5.5 Graph Coloring	210
5.6 Cliques, Vertex Covers, and Independent Sets	217
5.7 Exercises and Research Problems	220
6. Algorithmic Graph Theory	223
6.1 Shortest Paths	225
6.2 Minimum Spanning Trees	232
6.3 Network Flow	237
6.4 Matching	240
6.5 Planar Graphs	247
6.6 Exercises and Research Problems	252
Appendix	255
Mathematical Preliminaries	257
Mathematica Preliminaries	259
Glossary of Functions	270
References	301
Index	318