

Contents

Preface

v

CHAPTER 1

Applications of Network Optimization

R.K. Ahuja, T.L. Magnanti, J.B. Orlin and M.R. Reddy,

1. Introduction	1
2. Preliminaries	1
3. Shortest paths	3
4. Maximum flows	5
5. Minimum cost flows	17
6. The assignment problem	27
7. Matchings	35
8. Minimum spanning trees	38
9. Convex cost flows	43
10. Generalized flows	49
11. Multicommodity flows	54
12. The traveling salesman problem	58
13. Network design	62
14. Summary	69
References	74

CHAPTER 2

Primal Simplex Algorithms for Minimum Cost Network Flows

R.V. Helgason and J.L. Kennington

1. Introduction	85
2. Primal simplex algorithm	85
3. Linear network models	93
4. Generalized networks	95
5. Multicommodity networks	108
6. Networks with side constraints	116
7. Reference notes	125
References	130

CHAPTER 3	
Matching	
A.M.H. Gerards	135
1. Introduction	135
2. Finding a matching of maximum cardinality	142
3. Bipartite matching duality	152
4. Non-bipartite matching duality	159
5. Matching and integer and linear programming	164
6. Finding maximum and minimum weight matchings	172
7. General degree constraints	179
8. Other matching algorithms	191
9. Applications of matchings	202
10. Computer implementations and heuristics	207
References	212
CHAPTER 4	
The Traveling Salesman Problem	
M. Jünger, G. Reinelt and G. Rinaldi	225
1. Introduction	225
2. Related problems	227
3. Practical applications	231
4. Approximation algorithms	234
5. Relaxations	268
6. Finding optimal and provably good solutions	294
7. Computation	314
References	323
CHAPTER 5	
Parallel Computing in Network Optimization	
D. Bertsekas, D. Castañon, J. Eckstein and S. Zenios	331
1. Introduction	331
2. Linear network optimization	339
3. Nonlinear network optimization	370
4. Conclusions	393
References	394
CHAPTER 6	
Probabilistic Networks and Network Algorithms	
T.L. Snyder and J.M. Steele	401
1. Introduction	401
2. Probability theory of network characteristics	403
3. Probabilistic network algorithms	410

4. Geometric networks	415
5. Concluding remarks	421
References	421
CHAPTER 7	
A Survey of Computational Geometry	
J.S.B. Mitchell and S. Suri	
1. Introduction	425
2. Fundamental structures	425
3. Geometric graphs	432
4. Path planning	439
5. Matching, traveling salesman, and watchman routes	459
6. Shape analysis, computer vision, and pattern matching	462
7. Conclusion	468
References	469
CHAPTER 8	
Algorithmic Implications of the Graph Minor Theorem	
D. Bienstock and M.A. Langston	
1. Introduction	481
2. A brief outline of the graph minors project	481
3. Treewidth	486
4. Pathwidth and cutwidth	493
5. Disjoint paths	495
6. Challenges to practicality	498
References	501
CHAPTER 9	
Optimal Trees	
T.L. Magnanti and L.A. Wolsey	
1. Introduction	503
2. Tree optimization problems	503
3. Minimum spanning trees	518
4. Rooted subtrees of a tree	540
5. Polynomially solvable extensions/variations	548
6. The Steiner tree problem	557
7. Packing subtrees of a tree	572
8. Packing subtrees of a general graph	585
9. Trees-on-trees	598
10. Summary	604
11. Notes and references	607
References	611

CHAPTER 10	
Design of Survivable Networks	
M. Grötschel, C.L. Monma and M. Stoer	617
1. Overview	617
2. Motivation	618
3. Integer programming models of survivability	620
4. Structural properties and heuristics	627
5. Polynomially solvable special cases	634
6. Polyhedral results	638
7. Computational results	648
8. Directed variants of the general model	663
References	669
CHAPTER 11	
Network Reliability	
M.O. Ball, C.J. Colbourn and J.S. Provan	673
1. Motivation	673
2. Computational complexity and relationships among problems	680
3. Exact computation of reliability	687
4. Bounds on network reliability	696
5. Monte Carlo methods	714
6. Performability analysis and multistate network systems	722
7. Using computational techniques in practice	740
References	745
Biographical Information	763
Subject Index	769
Contents of Previous Volumes	783