

Contents

Contents	i
1 Introduction and Applications	1
1.1 Linear Programs	1
1.2 Shortest Path and Network Flow Problems	6
2 The Simplex Method	11
2.1 Linear Programs in Standard Form	12
2.2 Basic Solutions: Optimality Test and Basis Exchange	13
2.3 The Fundamental Theorem of Linear Programming	30
2.4 Degeneracy and Finiteness of the Simplex Method	33
2.5 Finding a Feasible Starting Solution	39
2.6 The Revised Simplex Method	45
2.7 Linear Programs with Bounded Variables	50
3 Duality and Further Variations of the Simplex Method	59
3.1 Dual Programs and the Duality Theorem	59
3.2 Complementary Slackness Conditions	65
3.3 The Dual Simplex Method	68
3.4 The Primal-Dual Simplex Method	71
4 Interior Point Methods: Karmarkar's Projective Algorithm	79
4.1 Basic Ideas	79
4.2 One Iteration of Karmarkar's Projective Algorithm	85
4.2.1 Projective Transformation	85
4.2.2 Moving in the Direction of Steepest Descent	89
4.2.3 Inverse Transformation	92
4.3 The Algorithm and its Polynomiality	92
4.4 A Purification Scheme	99
4.5 Converting a Given LP into the Required Format	102
5 Introduction to Graph Theory and Shortest Spanning Trees	105
5.1 Introduction to Graph Theory	105
5.2 Shortest Spanning Trees	111

6	Shortest Path Problems	117
6.1	Shortest Dipaths with Nonnegative Costs	117
6.2	Shortest Dipaths with Negative Costs	121
6.3	Pairwise Shortest Dipaths	127
6.4	Shortest Path Problems	130
6.5	Shortest Dipath Problems and Linear Programs	130
7	Network Flow Problems	133
7.1	Definition and Basic Properties of Network Flows	133
7.2	Maximal Flows	149
7.3	Feasible Flows for NFP and the Negative Dicycle Algorithm	155
7.4	The Network Simplex Algorithm	160
8	Matchings	179
8.1	Definition and Basic Properties	179
8.2	Bipartite Matching Problems	185
8.2.1	Maximal Matching Problems in Bipartite Graphs	186
8.2.2	Minimal Cost Matching Problems in Bipartite Graphs	191
8.3	Matching Problems in Arbitrary Graphs	199
8.3.1	MMP in Arbitrary Graphs	202
8.3.2	MCMP in Arbitrary Graphs	217
	References	231
	Stichwortverzeichnis	233
	Index	237