Table of Contents

Chapte	er 0. Mathematical Preliminaries	•	•	•	٠	•	•	1
0.1	Linear Algebra and Linear Programming							1
	Basic Notation							1
	Hulls, Independence, Dimension							3
	Eigenvalues, Positive Definite Matrices							4
	Vector Norms, Balls						٠.	5
	Matrix Norms							7
	Some Inequalities							8
	Polyhedra, Inequality Systems							9
	Linear (Diophantine) Equations and Inequalities .							11
	Linear Programming and Duality							14
0.2	Graph Theory							16
0.2	Graphs							17
	Digraphs							18
	Walks, Paths, Circuits, Trees							19
	, , , , , , , , , , , , , , , , , , , ,							
-	er 1. Complexity, Oracles, and Numerical Computation							21 21
1.1	Complexity Theory: \mathscr{P} and \mathscr{NP}							
	Problems							21
	Algorithms and Turing Machines							22
	Encoding							23
	Time and Space Complexity							23
	Decision Problems: The Classes \mathcal{P} and \mathcal{NP}	•	٠	•	٠	٠	•	24
1.2	Oracles							26
	The Running Time of Oracle Algorithms							26
	Transformation and Reduction							27
	NP-Completeness and Related Notions							28
1.3	Approximation and Computation of Numbers							29
	Encoding Length of Numbers							29
	Polynomial and Strongly Polynomial Computations							32
	1 Oly 11 Oli 11 alia alia alia alia alia alia alia							
	Polynomial Time Approximation of Real Numbers					•		33

The sections and chapters marked with * are technical. We recommend that the reader skip these on the first reading.

Table	of	Contents
-------	----	----------

X

1.4	Pivoting and Related Procedures	36
	Gaussian Elimination	36
	Gram-Schmidt Orthogonalization	40
	The Simplex Method	41
	Computation of the Hermite Normal Form	43
Chant	er 2. Algorithmic Aspects of Convex Sets:	
	lation of the Problems	46
2.1	Basic Algorithmic Problems for Convex Sets	47
* 2.2	Nondeterministic Decision Problems for Convex Sets	56
Chapt	er 3. The Ellipsoid Method	64
3.1	Geometric Background and an Informal Description	66
	Properties of Ellipsoids	66
	Description of the Basic Ellipsoid Method	73
	Proofs of Some Lemmas	76
	Implementation Problems and Polynomiality	80 83
	Some Examples	
	The Central-Cut Ellipsoid Method	
* 3.3	The Shallow-Cut Ellipsoid Method	94
Chan	ter 4. Algorithms for Convex Bodies	102
Chapt		
4.1		102
* 4.2	1	
* 4.3	<u> </u>	
* 4.4		
* 4.5		
* 4.6		
* 4.7	•	
	The Sum	
	The Convex Hull of the Union	
	The Intersection	
	rolais, blockers, Altholockers	151
Chap	oter 5. Diophantine Approximation and Basis Reduction	. 133
5.1	1 Continued Fractions	. 134
5.2	2 Simultaneous Diophantine Approximation: Formulation of the	
	Problems	. 138
5.3	Basis Reduction in Lattices	
* 5.4	4 More on Lattice Algorithms	. 150

	Table of Contents	XI
Chapte	r 6. Rational Polyhedra	157
6.1	Optimization over Polyhedra: A Preview	157
* 6.2	*	162
	• •	170
	——————————————————————————————————————	174
	•	18
* 6.6	<u>•</u>	188
* 6.7		192
Chapte	er 7. Combinatorial Optimization: Some Basic Examples	19'
7.1		19
7.2		20
7.3		20
7.4		20
7.5		21
7.6		21
		22
* 8.1 * 8.2	Problems on Bipartite Graphs	22 22
* 8.3		23
* 8.4		24
0.4		24
	Trees and Cuts in Undirected Graphs	24
	Dicuts and Dijoins	25
* 8.5	Matchings, Odd Cuts, and Generalizations	25
	Matching	25
	b-Matching	25
		25 26
	Chinese Tostinen and Traveling Estatement	
* 8.6	Multicommodity Flows	26
Chapt	el 9. Stable Sets in Grapis	27
* 9.1		2
* 9.2	Clique Constraints and Perfect Graphs	27
	Antiblockers of Hypergraphs	28
* 9.3		2
* 9.4	Coloring Perfect Graphs	29
* 9.5	More Algorithmic Results on Stable Sets	29

XII	Table	of	Contents

C	hapter	10. St	ıbn	100	dul	ar	F	une	etic	ons	3	-			-									٠	304
*	10.1	Submodular Functions and Polymatroids																304							
*	10.2	Algorithms for Polymatroids and Submodular Functions																308							
		Packing	Ba	ase	es e	of a	a l	Ma	atro	oid	l				-							•			311
*	10.3	Submoo Crossin	lula o F	ar Tor	Fu	inc	tic	ons	S O	n]	La	ttic	œ,	In	ter	sec	etii	ıg,	a	nd		_			313
*	10.4	Odd Su																							
R	eferen	ces .									-														331
N	otatio	n Index									-														347
A	uthor	Index																							351
S	ubject	Index																							355

Five Basic Problems (see inner side of the back cover)