

Contents

<i>About the Author</i>	vi
<i>Preface</i>	vii
<i>Online Resources</i>	xvi
<i>To the Student</i>	xix

1	The Foundations: Logic and Proofs	1
1.1	Propositional Logic	1
1.2	Applications of Propositional Logic	17
1.3	Propositional Equivalences	26
1.4	Predicates and Quantifiers	40
1.5	Nested Quantifiers	60
1.6	Rules of Inference	73
1.7	Introduction to Proofs	84
1.8	Proof Methods and Strategy	96
	<i>End-of-Chapter Material</i>	115
2	Basic Structures: Sets, Functions, Sequences, Sums, and Matrices	121
2.1	Sets	121
2.2	Set Operations	133
2.3	Functions	147
2.4	Sequences and Summations	165
2.5	Cardinality of Sets	179
2.6	Matrices	188
	<i>End-of-Chapter Material</i>	195
3	Algorithms	201
3.1	Algorithms	201
3.2	The Growth of Functions	216
3.3	Complexity of Algorithms	231
	<i>End-of-Chapter Material</i>	244
4	Number Theory and Cryptography	251
4.1	Divisibility and Modular Arithmetic	251
4.2	Integer Representations and Algorithms	260
4.3	Primes and Greatest Common Divisors	271
4.4	Solving Congruences	290
4.5	Applications of Congruences	303
4.6	Cryptography	310
	<i>End-of-Chapter Material</i>	324

5	Induction and Recursion	331
5.1	Mathematical Induction	331
5.2	Strong Induction and Well-Ordering	354
5.3	Recursive Definitions and Structural Induction	365
5.4	Recursive Algorithms	381
5.5	Program Correctness	393
	<i>End-of-Chapter Material</i>	398
6	Counting	405
6.1	The Basics of Counting	405
6.2	The Pigeonhole Principle	420
6.3	Permutations and Combinations	428
6.4	Binomial Coefficients and Identities	437
6.5	Generalized Permutations and Combinations	445
6.6	Generating Permutations and Combinations	457
	<i>End-of-Chapter Material</i>	461
7	Discrete Probability	469
7.1	An Introduction to Discrete Probability	469
7.2	Probability Theory	477
7.3	Bayes' Theorem	494
7.4	Expected Value and Variance	503
	<i>End-of-Chapter Material</i>	520
8	Advanced Counting Techniques	527
8.1	Applications of Recurrence Relations	527
8.2	Solving Linear Recurrence Relations	540
8.3	Divide-and-Conquer Algorithms and Recurrence Relations	553
8.4	Generating Functions	563
8.5	Inclusion–Exclusion	579
8.6	Applications of Inclusion–Exclusion	585
	<i>End-of-Chapter Material</i>	592
9	Relations	599
9.1	Relations and Their Properties	599
9.2	n -ary Relations and Their Applications	611
9.3	Representing Relations	621
9.4	Closures of Relations	628
9.5	Equivalence Relations	638
9.6	Partial Orderings	650
	<i>End-of-Chapter Material</i>	665

10	Graphs	673
10.1	Graphs and Graph Models	673
10.2	Graph Terminology and Special Types of Graphs	685
10.3	Representing Graphs and Graph Isomorphism	703
10.4	Connectivity	714
10.5	Euler and Hamilton Paths	728
10.6	Shortest-Path Problems	743
10.7	Planar Graphs	753
10.8	Graph Coloring	762
	<i>End-of-Chapter Material</i>	771
11	Trees	781
11.1	Introduction to Trees	781
11.2	Applications of Trees	793
11.3	Tree Traversal	808
11.4	Spanning Trees	821
11.5	Minimum Spanning Trees	835
	<i>End-of-Chapter Material</i>	841
12	Boolean Algebra	847
12.1	Boolean Functions	847
12.2	Representing Boolean Functions	855
12.3	Logic Gates	858
12.4	Minimization of Circuits	864
	<i>End-of-Chapter Material</i>	879
13	Modeling Computation	885
13.1	Languages and Grammars	885
13.2	Finite-State Machines with Output	897
13.3	Finite-State Machines with No Output	904
13.4	Language Recognition	917
13.5	Turing Machines	927
	<i>End-of-Chapter Material</i>	938
	Appendices	A-1
1	Axioms for the Real Numbers and the Positive Integers	A-1
2	Exponential and Logarithmic Functions	A-7
3	Pseudocode	A-11
	Suggested Readings B-1	
	Answers to Odd-Numbered Exercises S-1	
	Index of Biographies I-1	
	Index I-2	