Contents

Fundamentals

1. Introduction	3
Algorithms. Outline of Topics.	
2. C	7
Example: Euclid's Algorithm. Types of Data. Input/Output. Concluding Remarks.	
3. Elementary Data Structures	15
Arrays. Linked Lists. Storage Allocation. Pushdown Stacks. Queues. Abstract Data Types.	
4. Trees	35
Glossary. Properties. Representing Binary Trees. Representing Forests. Traversing Trees.	
5. Recursion	51
Recurrences. Divide-and-Conquer. Recursive Tree Traversal. Removing Recursion. Perspective.	
6. Analysis of Algorithms	67
Framework. Classification of Algorithms. Computational Complexity. Average-Case Analysis. Approximate and Asymptotic Results. Basic Re- currences. Perspective.	
7. Implementation of Algorithms	81
Selecting an Algorithm. Empirical Analysis. Program Optimization. Algorithms and Systems.	

Sorting Algorithms

8. Elementary Sorting Methods	93
Rules of the Game. Selection Sort. Insertion Sort. Digression: Bubble	
Sort. Performance Characteristics of Elementary Sorts. Sorting Files with	
Large Records. Shellsort. Distribution Counting.	
9. Quicksort	15
The Basic Algorithm. Performance Characteristics of Quicksort. Removing	
Recursion, Small Subfiles, Median-of-Three Partitioning, Selection,	

Contents

10. Radix Sorting	133
Bits. Radix Exchange Sort. Straight Radix Sort. Performance Character- istics of Radix Sorts. A Linear Sort.	
11. Priority Queues	145
<i>Elementary Implementations. Heap Data Structure. Algorithms on Heaps.</i> <i>Heapsort. Indirect Heaps. Advanced Implementations.</i>	
12. Mergesort	163
Merging. Mergesort. List Mergesort. Bottom-Up Mergesort. Performance Characteristics. Optimized Implementations. Recursion Revisited.	
13. External Sorting	177
Sort-Merge. Balanced Multiway Merging. Replacement Selection. Practi- cal Considerations. Polyphase Merging. An Easier Way.	

Searching Algorithms

x

14.	Elementary Searching Methods	193
	Sequential Searching. Binary Search. Binary Tree Search. Deletion. Indirect Binary Search Trees.	
15.	Balanced Trees	215
	Top-Down 2-3-4 Trees. Red-Black Trees. Other Algorithms.	
16.	Hashing	231
	Hash Functions. Separate Chaining. Linear Probing. Double Hashing.	
	Perspective.	
17.	Radix Searching	245
	Digital Search Trees. Radix Search Tries. Multiway Radix Searching.	
	Patricia.	
18.	External Searching	259
	Indexed Sequential Access. B-Trees. Extendible Hashing. Virtual Memory.	

String Processing

19.	String Searching	277
	A Short History. Brute-Force Algorithm. Knuth-Morris-Pratt Algorithm.	
	Boyer-Moore Algorithm. Rabin-Karp Algorithm. Multiple Searches.	
20.	Pattern Matching	293
	Describing Patterns. Pattern Matching Machines. Representing the Ma- chine. Simulating the Machine.	
21.	Parsing	305
	Context-Free Grammars. Top-Down Parsing. Bottom-Up Parsing. Com- pilers Compiler-Compilers	

-	-	0
-		-

333

22. File Compression

Run-Length Encoding. Variable-Length Encoding. Building the Huffman Code. Implementation.

23. Cryptology

Rules of the Game. Simple Methods. Encryption/Decryption Machines. Public-Key Cryptosystems.

Geometric Algorithms

24.	Elementary Geometric Methods	347
	Points, Lines, and Polygons. Line Segment Intersection. Simple Closed	
5.95	Path. Inclusion in a Polygon. Perspective.	
25.	Finding the Convex Hull	359
	Rules of the Game. Package-Wrapping. The Graham Scan. Interior Elimination. Performance Issues.	
26.	Range Searching	373
	Elementary Methods. Grid Method. Two-Dimensional Trees. Multidimen- sional Range Searching.	
27.	Geometric Intersection	389
	Horizontal and Vertical Lines. Implementation. General Line Intersection.	
28.	Closest-Point Problems	401
202	Closest-Pair Problem Voronoi Diagrams	

Graph Algorithms

29.	Elementary Graph Algorithms	415
	Glossary. Representation. Depth-First Search. Nonrecursive Depth-First	
	Search. Breadth-First Search. Mazes. Perspective.	
30.	Connectivity	437
	Connected Components. Biconnectivity. Union-Find Algorithms.	
31.	Weighted Graphs	451
	Minimum Spanning Tree. Priority-First Search. Kruskal's Method. Short- est Path. Minimum Spanning Tree and Shortest Paths in Dense Graphs. Geometric Problems.	
32.	Directed Graphs	471
	Depth-First Search. Transitive Closure. All Shortest Paths. Topological Sorting. Strongly Connected Components.	
33.	Network Flow	485
	The Network Flow Problem. Ford-Fulkerson Method. Network Searching.	

0				
(OI	n1	PI	nts
\sim	01	u	01	un

495

34	3.5 4 1 1	
.54.	Vlatching	

Bipartite Graphs. Stable Marriage Problem. Advanced Algorithms.

Mathematical Algorithms

35. Random Numbers	509
Applications. Linear Congruential Method. Additive Congruential Method. Testing Randomness. Implementation Notes.	
36. Arithmetic	521
Polynomial Arithmetic. Polynomial Evaluation and Interpolation. Poly- nomial Multiplication. Arithmetic Operations with Large Integers. Matrix Arithmetic.	
37. Gaussian Elimination A Simple Example. Outline of the Method. Variations and Extensions.	535
38. Curve Fitting Polynomial Interpolation. Spline Interpolation. Method of Least Squares.	545
39. Integration Symbolic Integration. Simple Quadrature Methods. Compound Methods. Adaptive Ouadrature.	555

Advanced Topics

40.	Parallel Algorithms	569
	General Approaches. Perfect Shuffles. Systolic Arrays. Perspective.	
41.	The Fast Fourier Transform	583
	Evaluate, Multiply, Interpolate. Complex Roots of Unity. Evaluation at the Roots of Unity. Interpolation at the Roots of Unity. Implementation.	
42.	Dynamic Programming	595
	Knapsack Problem. Matrix Chain Product. Optimal Binary Search Trees. Time and Space Requirements.	
43.	Linear Programming	607
	Linear Programs. Geometric Interpretation. The Simplex Method. Imple- mentation.	
44.	Exhaustive Search	621
	Exhaustive Search in Graphs. Backtracking. Digression: Permutation Generation. Approximation Algorithms.	
45.	NP-Complete Problems	633
	Deterministic and Nondeterministic Polynomial-Time Algorithms. NP-	
	Completeness. Cook's Theorem. Some NP-Complete Problems.	