

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 Recurrences. 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** **115**
The Basic Algorithm. Performance Characteristics of Quicksort. Removing Recursion. Small Subfiles. Median-of-Three Partitioning. Selection.

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

Searching Algorithms

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

String Processing

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

- 22. File Compression** 319
Run-Length Encoding. Variable-Length Encoding. Building the Huffman Code. Implementation.
- 23. Cryptology** 333
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 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. Multidimensional Range Searching.
- 27. Geometric Intersection** 389
Horizontal and Vertical Lines. Implementation. General Line Intersection.
- 28. Closest-Point Problems** 401
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. Shortest 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.

- 34. Matching** 495
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. Polynomial Multiplication. Arithmetic Operations with Large Integers. Matrix Arithmetic.
- 37. Gaussian Elimination** 535
A Simple Example. Outline of the Method. Variations and Extensions.
- 38. Curve Fitting** 545
Polynomial Interpolation. Spline Interpolation. Method of Least Squares.
- 39. Integration** 555
Symbolic Integration. Simple Quadrature Methods. Compound Methods. Adaptive Quadrature.

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. Implementation.
- 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.

- Index** 643