

Contents

Introduction	3
Algorithms, Outline of Topics	
1. Preview.	9
Pascal, <i>Euclid's</i> Algorithm, <i>Recursion</i> , Analysis of Algorithms	
Implementing Algorithms	
MATHEMATICAL ALGORITHMS	
2. Arithmetic	21
Polynomials, Matrices, Data <i>Structures</i>	
3. Random Numbers	33
Applications, Linear Congruential Method, Additive	
Congruential Method, Testing Randomness, Implementation <i>Notes</i>	
4. Polynomials	45
Evaluation, Interpolation, Multiplication, Divide-and-conquer	
Recurrences, Matrix Multiplication	
5. Gaussian Elimination	57
A Simple Example, Outline of the Method, Variations and <i>Extensions</i>	
6. Curve Fitting	67
<i>Polynomial</i> Interpolation, <i>Spline</i> Interpolation, Method of <i>Least Squares</i>	
7. Integration	79
<i>Symbolic</i> Integration, Simple Quadrature Methods, Compound Methods,	
Adaptive Quadrature	
SORTING	
8. Elementary Sorting Methods	91
<i>Rules of the Game</i> , Selection Sort, Insertion Sort, <i>Shellsort</i> ,	
Bubble Sort, Distribution Counting, Non-Random <i>Files</i>	
9. Quicksort	103
The <i>Basic</i> Algorithm, Removing Recursion, Small <i>Subfiles</i> ,	
Median-of- <i>Three</i> Partitioning	
10. Radix Sorting	115
<i>Radix Exchange Sort</i> , Straight Radix <i>Sort</i> , A Linear <i>Sort</i>	
11. Priority Queues	127
Elementary Implementations, Heap Data Structure, Algorithms	
on Heaps, Heapsort, Indirect Heaps, Advanced Implementations	
12. Selection and Merging	143
Selection, <i>Merging</i> , Recursion Revisited	
13. External Sorting	155
Sort-Merge, Balanced <i>Multiway Merging</i> , Replacement <i>Selection</i> ,	
Practical Considerations, Polyphase Merging, <i>An Easier Way</i>	

SEARCHING

14. Elementary Searching Methods 171
Sequential Searching, Sequential List Searching, Binary Search, Binary Tree Search, Indirect Binary Search Trees
15. Balanced Trees 187
Top-Down 2-3-4 Trees, Red-Black Trees, Other Algorithms
16. Hashing 201
Hash Functions, Separate Chaining, Open Addressing, Analytic Results
17. Radix Searching 213
Digital Search Trees, Radix Search Tries, Multitway Radix Searching, Patricia
18. External Searching 225
Indexed Sequential Access, B-Trees, Extendible Hashing, Virtual Memory

STRING PROCESSING

19. String Searching 241
A Short History, Brute-Force Algorithm, Knuth-Morris-Pratt Algorithm, Boyer-Moore Algorithm, Rabin-Karp Algorithm, Multiple Searches
20. Pattern Matching 257
Describing Patterns, Pattern Matching Machines, Representing the Machine, Simulating the Machine
21. Parsing 269
Context-Free Grammars, Top-Down Parsing, Bottom-Up Parsing, Compilers, Compiler-Compilers
22. File Compression 283
Run-Length Encoding, Variable-Length Encoding
23. Cryptology 295
Rules of the Game, Simple Methods, Encryption/Decryption Machines, Public-Key Cryptosystems

GEOMETRIC ALGORITHMS

24. Elementary Geometric Methods 307
Points, Lines, and Polygons, Line Intersection, Simple Closed Path, Inclusion in a Polygon, Perspective
25. Finding the Convex Hull 321
Rules of the Game, Package Wrapping, The Graham Scan, Hull Selection, Performance Issues
26. Range Searching 335
Elementary Methods, Grid Method, 2D Trees, Multidimensional Range Searching
27. Geometric Intersection 349
Horizontal and Vertical Lines, General Line Intersection
28. Closest Point Problems 361
Closest Pair, Voronoi Diagrams

GRAPH ALGORITHMS

29. Elementary Graph Algorithms	373
<i>Glossary, Representation, Depth-First Search, Mazes, Perspective</i>	
30. Connectivity	389
<i>Biconnectivity, Graph Traversal Algorithms, Union-Find Algorithms</i>	
31. Weighted Graphs	407
<i>Minimum Spanning Tree, Shortest Path, Dense Graphs, Geometric Problems</i>	
32. Directed Graphs	421
<i>Depth-First Search, Transitive Closure, Topological Sorting, Strongly Connected Components</i>	
33. Network Flow	433
<i>The Network Flow Problem, Ford-Fulkerson Method, Network Searching</i>	
34. Matching	443
<i>Bipartite Graphs, Stable Marriage Problem, Advanced Algorithms</i>	

ADVANCED TOPICS

35. Algorithm Machines	457
<i>General Approaches, Perfect Shuffles, Systolic Arrays</i>	
36. The Fast Fourier Transform	471
<i>Evaluate, Multiply, Interpolate, Complex Roots of Unity, Evaluation at the Roots of Unity, Interpolation at the Roots of Unity, Implementation</i>	
37. Dynamic Programming	483
<i>Knapsack Problem, Matrix Chain Product, Optimal Binary Search Trees, Shortest Paths, Time and Space Requirements</i>	
38. Linear Programming	497
<i>Linear Programs, Geometric Interpretation, The Simplex Method, Implementation</i>	
39. Exhaustive Search	513
<i>Exhaustive Search in Graphs, Backtracking, Permutation Generation, Approximation Algorithms</i>	
40. NP-complete Problems	527
<i>Deterministic and Nondeterministic Polynomial-Time Algorithms, NP-Completeness, Cook's Theorem, Some NP-Complete Problems</i>	