MAXimal

algo

There are 145 algorithms presented here. All algorithms are given brief descriptions and programs in C++.

Show: last added , last edited algorithms.

You can also download the PDF book , which contains all the articles in one large file.

Algebra (23)

elementary algorithms (20)

- Euler function and its calculation [TeX]
- Binary exponentiation in O(log N) [TeX]
- Euclidean algorithm for finding GCD (greatest common divisor) [TeX]
- Sieve of Eratosthenes [TeX]
- Extended Euclidean Algorithm [TeX]
- Fibonacci numbers and their fast calculation [TeX]
- Inverse element in a modulo ring [TeX]
- Gray code [TeX]
- Long arithmetic [TeX]
- Discrete logarithm modulo M with Shanks' baby-step-giant-step algorithm in O (sqrt(M) log M) [TeX]
- Diophantine equations with two unknowns: AX+BY=C [TeX]
- First order modular linear equation: AX=B [TeX]
- Chinese remainder theorem. Garner's algorithm [TeX]

- Finding the degree of the factorial divisor [TeX]
- Ternary balanced number system [TeX]
- Calculation of factorial N! modulo P per O (P log N) [TeX]
- Enumerate all submasks of a given mask. Estimate 3^N for the total number of submasks of all masks [TeX]
- Primordial root. Algorithm for finding [TeX]
- Discrete root extraction [TeX]
- Sieve of Eratosthenes with linear operating time [TeX]

complex algorithms (3)

- BPSW primality test in O(log N)
- Efficient factorization algorithms: Pollard p-1, Pollard p, Bent, Pollard Monte Carlo, Fermat
- Fast Fourier transform in O(N log N). Application to multiplication of two polynomials or long numbers [TeX]

Counts (51)

elementary algorithms (4)

- Breadth First Search [TeX]
- Depth First Search
- Topological sorting [TeX]
- Finding connected components [TeX]

strongly connected components, bridges, etc. (4)

- Finding strongly connected components, constructing graph condensation in O(N + M) [TeX]
- Finding bridges in O(N+M) [TeX]
- Finding articulation points in O(N+M) [TeX]
- Finding bridges online in O(1) on average [TeX]

shortest paths from one vertex (4)

- Dijkstra's algorithm for finding the shortest paths from a given vertex to all other vertices in $O(N^2 + M)$ [TeX]
- Dijkstra's algorithm for a sparse graph finding the shortest paths from a given vertex to all other vertices in $O(M \log N)$ [TeX]
- Ford-Bellman algorithm for finding the shortest paths from a given vertex to all other vertices in $O(NM)$ [TeX]
- Levit's algorithm for finding the shortest paths from a given vertex to all other vertices in O(NM)

shortest paths between all pairs of vertices (2)

- Finding the shortest paths between all pairs of vertices in a graph using the Floyd-Warshell method in $O(n^3)$ [TeX]
- Counting the number of fixed-length paths between all pairs of vertices, finding the shortest fixed-length paths in $O(n^3 \log k)$ [TeX]

minimum skeleton (5)

- Minimum spanning tree. Prim's algorithm in $O(n^2)$ and $O(m \log n)$ [TeX]
- Minimum spanning tree. Kruskal's algorithm in $O(M \log N + N^2)$
- Minimum spanning tree. Kruskal's algorithm with data structure 'system of disjoint sets' in O(M log N)
- Kirchhoff's matrix theorem. Finding the number of spanning trees in $O(N3)$
- Prüfer code. Cayley's formula. Number of ways to make a graph connected [TeX]

cycles (3)

- Finding a negative cycle in a graph in O(NM) [TeX]
- Finding Euler Path or Euler Cycle in O(M)
- Checking a graph for acyclicity and finding a cycle in O(M)

least common ancestor (LCA) (5)

- Least common ancestor. Finding in O(sqrt(N)) and O(log N) with O(N) preprocessing
- Smallest common ancestor. Finding in O(log N) with O(N log N) preprocessing (binary lifting method)
- Smallest common ancestor. Finding in O(1) with O(N) preprocessing (Farah-Colton and Bender algorithm)

- Problem RMQ (Range Minimum Query - minimum on a segment). Solution in O(1) with O(N) preprocessing
- Least common ancestor. Finding in O(1) offline (Tarjan's algorithm) [TeX]

threads and related tasks (10)

- Edmonds-Karp algorithm for finding the maximum flow in $O(NM^2)$
- Preflow Push Method for Finding Maximum Flow in $O(N^4)$
- Modification of the method of Pushing the preflow for $O(N^3)$
- Restricted flow
- Min-cost-flow. Augmenting paths algorithm in $O(N^3 M)$
- The assignment problem. Solving with min-cost-flow in $O(N^5)$
- The assignment problem. Hungarian algorithm (Kuhn algorithm) in $O(N3^)$ [TeX]
- Finding the minimum cut using the Stohr-Wagner algorithm in $O(N^3)$ [TeX]
- Minimum cost flow, minimum cost circulation. Algorithm for removing negative weight cycles [TeX]
- Algorithm Unit for finding the maximum flow [TeX]

matchings and related problems (6)

- Kuhn's algorithm for finding the largest matching in O(NM) [TeX]
- Checking a graph for bipartiteness and partitioning into two parts in O(M)
- Finding the largest weighted vertex-weighted matching in $O(N^3)$
- Edmonds' algorithm for finding the largest matching in arbitrary graphs in $O(N^3)$ [TeX]
- Path coverage of a directed acyclic graph [TeX]
- Tatta Matrix. Randomized algorithm for finding the maximum matching in an arbitrary graph [TeX]

connectivity (3)

- Edge connectivity. Properties and location [TeX]
- Vertex connectivity. Properties and location [TeX]

- Construction of a graph with the specified values of vertex and edge connectivity and the smallest degree of the vertices [TeX]

K-paths (0)

inverse problems (2)

- Inverse SSSP problem (inverse-SSSP - inverse shortest path problem from one vertex) in O(M)
- Inverse MST problem (inverse-MST - inverse minimum spanning problem) in O(NM^2)

miscellaneous (3)

- Coloring tree edges (data structures) - O(log N) solution
- Problem 2-SAT (2-CNF). Solution in O(N+M)
- Heavy-light decomposition [TeX]

Geometry (23)

elementary algorithms (10)

- The length of the union of segments on a line in O (N log N)
- Signed area of a triangle and the predicate 'Clockwise' [TeX]
- Checking two segments for intersection [TeX]
- Finding the equation of a straight line for a segment [TeX]
- Finding the point of intersection of two lines [TeX]
- Finding the intersection point of two segments [TeX]
- Finding the area of a simple polygon in O(N)
- Pick's theorem. Finding the area of a lattice polygon in O(1) [TeX]
- The problem of covering segments with points
- Centers of gravity of polygons and polytopes [TeX]

more complex algorithms (13)

- The intersection of a circle and a line
- Intersection of two circles
- Constructing a convex hull using the Graham-Andrew algorithm in O(N log N)

- Finding the area of the union of triangles. Vertical decomposition method
- Checking a point to see if it belongs to a convex polygon in O(log N)
- Finding the incircle of a convex polygon using ternary search in $O(N \log^2 C)$
- Finding the incircle in a convex polygon using the side compression method in $O(N \log N)$ [TeX]
- Voronoi diagram in a two-dimensional case, its properties, application. The simplest construction algorithm in $O(N^4)$ [TeX]
- Finding all faces, outer edge of a planar graph in $O(N \log N)$ [TeX]
- Finding a pair of closest points using the divide-and-conquer algorithm in $O(N \log N)$ [TeX]
- Geometric inversion transformation [TeX]
- Finding common tangents to two circles [TeX]
- Finding a pair of intersecting segments using the sweeping line algorithm in $O(N \log N)$ [TeX]

Lines (12)

- Z-function of a string and its calculation in O(N) [TeX]
- Prefix function, its calculation and applications. Knuth-Morris-Pratt algorithm [TeX]
- Hashing algorithms in string problems
- Rabin-Karp algorithm for finding a substring in a string in O(N)
- Parsing expressions in O(N). Reverse Polish notation [TeX]
- Suffix array. Construction in O(N log N) and applications [TeX]
- Suffix machine. Construction in O(N) and applications [TeX]
- Finding all subpalindromes in O(N) [TeX]
- Lyndon decomposition. Duval's algorithm. Finding the smallest cyclic shift in O(N) time and O(1) memory [TeX]
- Aho-Corasick algorithm [TeX]
- Suffix tree. Ukkonen Algorithm [TeX]

- Finding all tandem repeats in a string using the Maine-Lorentz algorithm (divide-and-conquer) in $O(N \log N)$ [TeX]

Data structures (7)

- Sqrt decomposition [TeX]
- Fenwick tree
- System of disjoint sets [TeX]
- Segment tree [TeX]
- Cartesian tree (treap, deramid)
- Modifying the stack and queue to find the minimum in O(1)
- Randomized heap [TeX]

Algorithms on sequences (3)

- Problem RMQ (Range Minimum Query - minimum on a segment)
- Finding the longest increasing subsequence in $O(N^2)$ and $O(N \log N)$ [TeX]
- Kth order statistics in O(N)

Dynamics (2)

- Dynamics by profile. "Parquet" problem
- Finding the largest zero submatrix in O(NM) [TeX]

Linear algebra (3)

- Gauss method for solving a system of linear equations in $O(N^3)$ [TeX]
- Finding the rank of a matrix in $O(N^3)$
- Calculation of the matrix determinant using the Gaussian method in $O(N^3)$

Numerical methods (3)

- Integration using Simpson's formula [TeX]
- Finding roots by Newton's method (tangents) [TeX]
- Ternary search [TeX]

Combinatorics (9)

- Binomial coefficients [TeX]
- Catalan numbers [TeX]
- Necklaces [TeX]
- Arrangement of bishops on a chessboard
- Correct bracket sequences. Finding the lexicographically next, K-th, number definition [TeX]
- Number of labeled graphs, connected labeled graphs, labeled graphs with K connected components [TeX]
- Generating combinations of N elements
- Burnside's Lemma. Polya's theorem [TeX]
- Inclusion-exclusion principle [TeX]

Game theory (2)

- Games on arbitrary graphs. Hindsight method in O(M)
- Sprague-Grundy theory. Nim [TeX]

Schedules (3)

- Johnson problem with one machine [TeX]
- Johnson problem with two machines [TeX]
- Optimal selection of jobs given known completion times and execution durations [TeX]

Miscellaneous (4)

- Joseph's Problem [TeX]
- Game of Fifteen: existence of a solution [TeX]
- Stern-Broco tree. Farey series [TeX]
- Finding a subsegment of an array with a maximum/minimum sum in O(N) [TeX]