List of Algorithms

Swiss Olympiad in Informatics

September 13, 2012

This list contains a few algorithms that may prove useful when solving SOI or IOI related tasks. The current IOI Syllabus can be found here: `http://people.ksp.sk/~misof/ioi-syllabus/ioi-syllabus.pdf`

Please note that this list simply serves as an outline and that tasks are not limited by the algorithms listed below. However, one can also participate (and even be successful) without knowing the algorithms listed below. To guide you better, the most important topics are in bold.

- **Sorting**[1]
- **Binary Search**
- Data Structures
  - ◇ **Stack**[1]
  - ◇ **Queue**[1]
  - ◇ **List: Linked List, Doubly Linked List**[1]
  - ◇ **Tree Sets**[1] **and Tree Maps**[1] **(Binary Search Trees)**
  - ◇ **Priority Queue**[1]
  - ◇ Double ended queue[1]
  - ◇ Binary Heap Data Structure
  - ◇ Interval Tree
  - ◇ Segment Tree
  - ◇ Disjoint–set Data Structure (Union–Find)
  - ◇ Rational Numbers
  - ◇ Bignum (Addition, Subtraction, Multiplication, Division)
  - ◇ Quad Tree
  - ◇ optional: Binary Indexed Tree (BIT) (Fenwick Tree)
- Graph Algorithms
  - ◇ **DFS (Depth–First Search)**
  - ◇ **BFS (Breadth–First Search)**
  - ◇ **Connected Components**
  - ◇ **Topological Sorting (toposort)**
  - ◇ Shortest Path
    - · **Dijkstra's Algorithm**
    - · Bellman–Ford Algorithm
    - · Floyd–Warshall's Algorithm (all–pairs shortest path)
  - ◇ MST (Minimum Spanning Tree)

        - **Kruskal's Algorithm**
        - Prim's Algorithm
        - Find Articulation Points (articfind)
        - Hierholzer's Algorithm (for finding Euler cycles)
- Dynamic Programming (DP)
    - **Prefix Sum**
    - **Edit Distance**
    - **LCS (Longest Common Subsequence)**
    - LIS (Longest Increasing Subsequence)
    - MCM (Matrix Chain Multiplication)
    - MER (Maximum Empty Rectangle)
- Strings
    - Knuth–Morris–Pratt String Search (KMP)
- Computational Geometry
    - Convex Hull
        - Graham's Scan Algorithm
    - Line Intersections and 'Positioning'
        - Point–Segment Distance
        - Line–Line Intersection
        - Segment–Segment intersection
        - Crossing Number, resp. Winding Number (a method to check whether a point is inside a polygon)
        - Area of a Polygon
    - Sweep Line Algorithm
        - Bentley–Ottman Algorithm (to find all intersections of multiple line segments)
        - Shamos–Hoey Algorithm (to check if there is an intersection given multiple line segments)
    - Circle from three points
- Combinatorics
    - All Permutations
    - All Subsets
    - Generate Next Lexicographically higher Permutation
- Number theory
    - **Greatest Common Divisor (gcd), Least Common Multiple (lcm)**
    - Linear Congruence (extended gcd)
    - Prime Factorization
    - Sieve of Eratosthenes
- Various
    - Inclusion–Exclusion Principle
    - Lowest Common Ancestor (LCA)
    - Stable Marriage Problem
    - optional: Range Minimum/ Maximum Query (RMQ)

[1] The C++ STL library may provide useful containers and functions.