



Northeastern University, Shenyang

# Test

Asm.Def

ACM-ICPC,CCPC

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# 目录

## Techniques (A)

techniques.txt

162 lines

Recursion 递归

Divide and conquer 分治

Finding interesting points in  $N \log N$

Algorithm analysis 复杂度分析

Master theorem 主定理

Amortized time complexity 摊还分析

Greedy algorithm 贪心

Scheduling

Max contiguous subvector sum

Invariants 循环不变量

Huffman encoding 哈夫曼编码

Graph theory 图论

Dynamic graphs (extra book-keeping)

Breadth first search BFS

Depth first search DFS

\* Normal trees / DFS trees

Dijkstra's algorithm 单源最短路

MST: Prim's algorithm 最小生成树

Bellman-Ford 负权-单元最短路

Konig's theorem and vertex cover 柯尼希定理:  
二分图最小点覆盖数=最大匹配数

Min-cost max flow 费用流

Lovasz toggle 给定  $x, y$ , 对图染色, 使得每个  
红色点的红色邻居不超过  $x$ , 每个蓝色点的蓝色  
邻居不超过  $y$

Matrix tree theorem 生成树计数, (度数矩阵-  
邻接矩阵) 的行列式=生成树个数

Maximal matching, general graphs 带花树算法

Hopcroft-Karp  $O(N\sqrt{M})$  求最大匹配

Hall's marriage theorem 二分图存在完美匹配  
的条件:  $X$  中任意  $k$  个点都至少与  $Y$  中  $k$  个点相  
邻

Graphical sequences 图的度数序列的性质

Floyd-Warshall 多源多汇最短路

Euler cycles 欧拉回路

Flow networks 网络流

\* Augmenting paths 增广路

\* Edmonds-Karp

\* Push-Relabel 预流推进重贴标签

Bipartite matching 二分图匹配

Min. path cover 最短路覆盖

Topological sorting 拓扑排序

Strongly connected components 强连通分量  
2-SAT

Cut vertices, cut-edges och biconnected  
components 割顶、桥、双连通分量

Edge coloring 边集染色

\* Trees

Vertex coloring 点集染色

\* Bipartite graphs ( $\Rightarrow$  trees)

\*  $3^n$  (special case of set cover)

Diameter and centroid 树的直径和重心

$K$ 'th shortest path  $K$  短路

Shortest cycle 最小环, 用 Floyd 求解

Dynamic programming 动态规划

Knapsack

Coin change

Longest common subsequence

Longest increasing subsequence

Number of paths in a dag

Shortest path in a dag

Dynprog over intervals

Dynprog over subsets

Dynprog over probabilities

Dynprog over trees

$3^n$  set cover 集合覆盖

Divide and conquer

Knuth optimization

Convex hull optimizations

RMQ (sparse table a.k.a  $2^k$ -jumps)

Bitonic cycle

Log partitioning (loop over most restricted  
)

Combinatorics 组合

Computation of binomial coefficients 二项式  
系数

Pigeon-hole principle 鸽笼原理

Inclusion/exclusion 容斥原理

Catalan number 卡特兰数

Pick's theorem 皮克定理, 格点多边形面积=  
(边界格点数) / 2 + 内部格点数 - 1

Number theory

Integer parts

Divisibility

Euclidean algorithm 欧几里得算法-求 gcd

Modular arithmetic 同余算术

\* Modular multiplication

\* Modular inverses

\* Modular exponentiation by squaring

Chinese remainder theorem 中国剩余定理  $x = \sum (a_i * t_i * M_i)$ ,  $t_i * M_i \equiv 1 \pmod{m_i}$ ,  $M_i = \prod_{j \neq i} m_j$

Fermat's little theorem 费马小定理

Euler's theorem 欧拉定理

Phi function 欧拉函数

Frobenius number = Coin Problem, 指最大的不  
能用给定的若干种硬币凑成的数。  $n=2: xy-x-y$ ;  
 $n=3:$

Quadratic reciprocity 二次互反定律.  $p, q$  为奇  
素数, 定义

$f(q,p)=\{1 \text{ if } n^2=q \bmod p \text{ for some integer } n\{-1 \text{ otherwise}\}, \text{ 则 } f(p,q)*f(q,p) = (-1)^{\{(p-1)/2*(q-1)/2\}}$ Pollard-Rho 期望时间 $O(N^{\{1/4\}})$ 的随机化质因数分解 Miller-Rabin 基于概率的素性测试, 可以确保数据在一定范围内时不会出错 Hensel lifting $t$ 为 $f(r)=0 \bmod p^{\{k-1\}}$ 的根, 则 $f(r+tp^{\{k-1\}})=f(r)+tp^{\{k-1\}}f'(r) \bmod p^k$ Vieta root jumping 对于任意有序对 $(a,b)$ , 要证明 $k=(f(a,b)/g(a,b,ab))$ (其中 $f$ 为二次函数, $g$ 为一次函数) 的性质时, 将等式整理成关于 $a,b$ 中较大值 (不妨取 $a$ ) 的函数, 利用 Vieta 定理理解出另一个根 $x_2$ , 用 $(x_2,b)$ 的性质归纳证明 $(a,b)$ Game theory Combinatorial games Game trees Mini-max Nim Games on graphs Games on graphs with loops Grundy numbers Sprague-Grundy 定理 Bipartite games without repetition General games without repetition Alpha-beta pruning Probability theory Optimization Binary search Ternary search Unimodality and convex functions Binary search on derivative Numerical methods Numeric integration	Newton's method Root-finding with binary/ternary search Golden section search Matrices Gaussian elimination Exponentiation by squaring Sorting Radix sort Geometry Coordinates and vectors * Cross product * Scalar product Convex hull Polygon cut Closest pair Coordinate-compression Quadtrees KD-trees All segment-segment intersection Sweeping Discretization (convert to events and sweep) Angle sweeping Line sweeping Discrete second derivatives Strings Longest common substring Palindrome subsequences Knuth-Morris-Pratt Tries Rolling polynomial hashes Suffix array Suffix tree Aho-Corasick Manacher's algorithm	Letter position lists Combinatorial search Meet in the middle Brute-force with pruning Best-first ( $A^*$ ) Bidirectional search Iterative deepening DFS / $A^*$ Data structures LCA ( $2^k$ -jumps in trees in general) Pull/push-technique on trees Heavy-light decomposition Centroid decomposition Lazy propagation Self-balancing trees Convex hull trick ( <a href="http://wcipeg.com/wiki/Convex_hull_trick">wcipeg.com/wiki/Convex_hull_trick</a> ) Monotone queues / monotone stacks / sliding queues Sliding queue using 2 stacks Persistent segment tree
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