Topic List

Click here

Category: Basics

Title	Resources
Basic Topics	1 2 3 4 5

Category: Math

#	Title	Resources	Problems	Template	Difficulty
1	Matrix Exponentiation	1	1	code	1
2	FFT	1	1	code	2
3	NTT	1	1	code code	2
4	Online NTT	1	1 2	code	3
5	FWHT	1	1	code	2
6	Lagrange Interpolation	1	1 2	code	2
7	Lagrange Interpolation with Polynomial Extraction		1	code	3
8	Polynomial Sum	1	1	code	3
9	Polynomial with Binomial Coefficients	1	1	code	3
10	Subset Sum Problem		1 2	code	3
11	Generating Functions	1 2			3
11	Polynomial Structure	1		code	3
12	Polynomial Factorization of (x^n — 1)	1	1	code	3
13	Berlekamp Messey	1	1	code	3
14	Reeds–Sloane Algorithm		1	code	3
15	Linear Recurrence using Cayley-Hamilton theorem	1		code	2
16	Linear Recurrence using Generating Functions	1	1	code	3
17	Linear Recurrence with Polynomial Coefficients	1		code	3
18	Linear Recurrence on Matrices	1	1		3

19	Generating Function of a Linear Recurrence		1	code	2
20	Gaussian Elimination	1	1	code	2
21	Gaussian Elimination under Modulo	1	1	code	2
22	Gaussian Elimination Modulo 2	1	1 2	code	2
23	Determinant under Prime Modulo	1	1	code	2
24	Determinant under Composite Modulo		1	code	2
25	Determinant of Product Matrix		1	code	3
26	Determinant of Sparse Matrix		1	code	3
27	Determinant of Permutant Matrix		1	code	3
28	Determinant of Cyclic Matrix		1	code	3
29	Cauchy–Binet formula	1	1		3
30	Thomas Algorithm		1	code	2
31	Inverse of a Matrix			code	3
32	Inverse of a Matrix modulo 2		1	code	3
33	Basis Vector	1	1	code	2
34	Basis Vector Reduced Row Echelon Form.	1	1	code	2
35	Basis Vector ft Weighted Linearly Independent Vectors.		1	code	2
36	Permanent of a Matrix	1		code	2
37	All Possible Perfect Matching XOR Values		1	code	2
38	Hafnian of a Matrix	1	1	code	3
39	Vandermonde Matrix	1	1	code	3
40	Freivalds Algorithm	1		code	3
41	Characteristic Polynomial Faster / Hesserberg Matrix	1	1	code	3
42	Faulhaber's Formula Fastest	1	1	code	3
43	Lagrange Multiplier	1	1 2	code	3

44	Titu's Lemma	1 2	1 2		2
45	Simplex Algorithm	1	1	code	3
46	Integration		1	code code	2
47	Line Integral	1 2			2
48	The Slime Trick	1	1 2		3
49	Gauss's Eureka Theorem	1	1		2
50	LTE Lemma	1	1		2
51	Expected Value	1			1
52	Expected Value Powers Technique	1			2
53	Finite Field Arithmetic Binary	1	1	code	2
54	Max Convolution between Convex Funtions			code	2

Category: Number Theory

#	Title	Resources	Problems	Template	Difficulty
55	Binary Exponentiation	1	1		1
56	Modular Inverse	1	1		1
57	Sieve	1	1	code	1
58	Sieve upto 1e9		1	code	3
59	Extended Euclid	1		code	1
60	Combinatorics Basics	1		code	1
61	Lucas Theorem	1		code	1
62	nCr Modulo Any Mod	1 2	1	code	2
63	Prefix Sum Queries of nCi		1 2	code	2
64	Sum of nCi over a Fixed Congruence Class		1	code	2
65	"Sum of nCr(a(i) k) for each k from 1 to n"		1 2	code	2
66	Sum of nCi for a Fixed Large n	1		code	3
67	Phi Function	1		code	1
68	Power Tower	1	1 2	code	2

69	Mobius Function	1	1	code	1
70	CRT	1	1 2 3 4	code	1
71	Linear Congruence Equation	1		code	1
72	Pollard Rho	1	1	code	2
73	Primitive Root	1	1	code	2
74	Multiplicative Order / Carmichael's Lambda Function	1	1	code	2
75	Discrete Log	1	1 2	code	2
76	Discrete Root	1	1	code	2
77	Discrete Root in O(p^(1/4)) using Tonelli-Shanks Algorithm	1	1	code	3
78	Number of Distinct Kth Powers Modulo n	1		code	3
79	Number of Solutions to x^2 = 1 mod m	1	1	code	2
80	Tonelli Shanks Algorithm	1	1 2	code	3
81	Pells Equation	1 2	1	code	3
82	Linear Diophantine Equation with Two Variables	1	1	code	1
83	Trivariable Linear Diophantine Equation with Nonnegative Solutions	1	1	code	3
84	Multivariable Linear Diophantine Equation with Nonnegative Solutions	1	1 2	code	3
85	Linear Diophantine With N Unknowns and Two Equations		1	code	3
86	Floor Sum of Arithmetic Progression	1	1 2	code	2
87	Generalized Floor Sum of Arithmetic Progression	1	1	code	3
88	Sum of Floors			code	1
89	Number of Nonnegative Integer Solutions to ax+by ≤ c			code	3
90	Number of ax % p in a Range			code	3
91	Smallest Nonnegative Integer x		1 2	code	3

	s.t. l ≤ ax % p ≤ r				
92	Prime Counting Function	1	1 2	code	2
93	K Divisors		1 2	code	3
94	Smallest Number Having Exactly K Divisors		1	code	2
95	Sum of The Number of Divisors in cbrt(n)		1	code	3
96	Linear Sieve for Multiplicative Functions	1		code	1
97	Min_25 Sieve	1 2 3	1 2	code	3
98	Mobius Inversion	1	1 2		2
99	Dirichlet convolution	1 2	1 2 3	code	2
100	Number of Solutions to a Basic Linear Algebraic Equation	1	1	code	1
101	Number of Solutions to a Basic Linear Algebraic Equation with Variable Upper Bound Constraints	1	1 2 3	code	3
102	Partition Function	1	1	code	3
103	Stirling Number of the First Kind for Fixed n	1	1	code	2
104	Stirling Number of the First Kind for Fixed k	1		code	3
105	Stirling Number of the Second Kind for Fixed n	1	1	code	2
106	Stirling Number of the Second Kind for Fixed k	1	1	code	3
107	Bell Number	1		code	2
108	LCM of Fibonacci Numbers	1	1	code	2
109	Phi Field		1 2	code	2
110	Pisano Period	1	1 2	code	3
111	Rational Approximation / Stern-Brocot Tree	1 2 3	1	code	3
112	Factoradic Number System	1	1	code	2
113	Intersection of Arithmetic Progressions	1		code	1

114	Continued Fractions	1 2	1	code	2
115	Maximum Coprime Product		1	code	2

Category: Graph Theory

#	Title	Resources	Problems	Template	Difficulty
116	DFS and BFS	1 2	1		1
117	0/1 BFS	1	1		1
118	Dial's algorithm	1			2
119	Inverse Graph	1	1 2	code	1
120	LCA	1	1	code	1
121	LCA in O(1)	1	1	code	2
122	SCC	1	1	code	1
123	Incremental SCC	1 2			3
124	DFS Tree	1			1
125	Rerooting Technique	1			1
126	Articulation Bridges and Bridge Tree	1 2	1 2	code	1
127	Online Articulation Bridges	1		code	3
128	Strong Orientation	1	1		1
129	Articulation Points.	1	1	code	1
130	Block Cut Tree	1	1	code	2
131	Three Edge Connectivity	1	1 2	code	3
132	Four Edge Connectivity	1			3
133	Dynamic K-Connectivity	1			3
134	Prim's MST	1	1	code	1
135	Krushkal's MST	1	1	code	1
136	Steiner Tree Problem	1	1	code	2
137	Boruvka's Algorithm	1	1	code	2
138	Minimum Diameter Spanning Tree	1	1 2	code	3
139	Manhattan MST		1	code	3

140	Euclidean MST	1			3
141	Directed MST	1	1	code	3
142	Dynamic MST	1	1	code	3
143	Dijkstra's Algorithm	1	1	code	1
144	Dijkstra on Segment Tree		1	code	2
145	Bellman Ford	1	1	code	1
146	Floyd Warshall	1	1	code	1
147	Johnsons Alogrithm	1	1	code	2
148	SPFA	1	1	code	1
149	Cycle Detection	1	1	code	1
150	Minimum Weight Cycle For Each Vertex		1	code	2
151	Minimum Weight Cycle For Each Edge		1	code	2
152	Dominator tree	1	1	code	2
153	2 SAT	1	1 2	code	1
154	3 SAT			code	3
155	Maximum Clique	1 2	1	code	1
156	Number of Different Cliques			code	2
157	Maximum Independent Set		1	code	1
158	Eulerian Path on a Directed Graph	1	1	code	1
159	Eulerian Path on an Undirected Graph	1	1	code	1
160	Path Union		1 2	code	2
161	Path Intersection		1	code	2
162	Virtual Tree	1	1 2 3	code	2
163	Welsh-Powell Algorithm	1 2			2
164	Chromatic Number	1	1	code	1
165	Chromatic Polynoimial ft Number of DAGs		1	code	3
166	Dynamic DAG Reachability	1	1	code	3

167	Minimum Mean Weight Cycle		1	code	3
168	Number of 3 and 4 length Cycles		1	code	3
169	Counting Labeled Graphs	1		code	1
170	Chordal Graph	1	1	code	2
171	Cactus Graph	1 2	1		2
172	Edge Coloring of Simple Graph		1 2	code	3
173	Edge Coloring of Bipartite Graph			code code	3
174	Dynamic Diameter Online		1	code	3
175	Tree Orientation to Maximize Pairs of Reachable Nodes	1	1	code	3
176	Number of Arborescences with n Nodes			code	2
177	Kirchoffs Theorem ft Number of MSTs	1	1	code	2
178	Tuttes Theorem ft Arborescences in a Graph	1	1	code	2
179	BEST Theorem	1			2
180	System Of Difference Constraints	1	1	code	2
181	Prufer Code	1	1	code	1
182	Number of Ways to Make a Graph Connected	1			1
183	Tree Isomorphism	1	1 2 3	code	1
184	Number of Paths of Each Length in a Tree			code	2
185	Ear Decomposition	1	1		2
186	Eppsteins Algorithm	1	1	code	3
187	Hamiltonian Path Heuristic Algorithm	1			3
188	Erdos Gallai Theorem	1			2
189	Havel Hakimi Algorithm	1 2			2
190	Dinics Algorithm	1	1	code	1
191	Push Relabel Algorithm	1		code	2

192	Min Cost Max Flow	1	1 2	code	2
193	Min Cost Max Flow with Negative Cycles			code	3
194	Maximum Closure Problem	1	1 2	code	2
195	Min Cut in a Planar Graph	1	1	code	2
196	Max Cut in a Planar Graph		1		3
197	Unique Min Cut	1	1	code	2
198	L-R Flow	1	1 2	code code	2
199	Gomory-Hu Tree	1	1	code	3
200	Gomory Hu Tree of a Planar Graph		1	code	3
201	Stoer Wagner Algorithm	1	1	code	3
202	HopCroft Karp Algorithm	1		code	1
203	Kuhns Algorithm	1	1	code	1
204	Hungarian Algorithm	1	1	code	1
205	Blossom Algorithm	1	1	code	2
206	Blossom Algorithm Weighted		1	code	3
207	Chinese Postman Problem	1	1	code	1
208	ST-numbering	1		code	3
209	POSET ft Dilworths and Mirskys Theorem	1 2	1		2
210	Stable Marriage Problem	1	1	code	2
211	Halls Theorem	1	1		1
212	Maximum Density Subgraph	1	1	code	3
213	Randomized Matching			code code	2
214	Number of Perfect Matchings in a Graph	1	1	code	3
215	Planarity Check	1 2			3

Category: Data Structures

#	Title	Resources	Problems	Template	Difficulty

216	Segment Tree	1	1 2	code	1
217	Segment Tree with Lazy Propagation	1	1 2	code	1
218	Persistent Segment Tree	1	1	code	1
219	Persistent Segment Tree with Lazy Propagation	1	1	code	2
220	Dynamic Segment Tree	1			1
221	2D Dynamic Segment Tree		1	code	2
222	Iterative Segment Tree	1		code	1
223	Segment Tree ft Arithmetic Progressions		1	code	1
224	Segment Tree Merging	1	1	code	2
225	Segment Tree Beats	1	1	code	3
226	Merge Sort Tree	1	1		1
227	Wavelet Tree	1	1	code	1
228	Sparse Table	1	1	code	1
229	Disjoint Sparse Table	1	1	code	2
230	Sparse Table 2D	1	1	code	2
231	BIT	1	1	code	1
232	Lower bound on BIT	1	1		1
233	BIT with Range Update and Range Query	1		code	2
234	2D BIT with Range Update and Range Query			code	2
235	MOs Algorithm	1 2	1	code	1
236	MOs on Tree	1	1	code	2
237	MOs with Update	1 2	1	code	2
238	MOs Online		1	code	2
239	MOs with DSU		1 2	code	2
240	Sweepline MO	1			3
241	Trie	1	1	code	1
242	Persistent Trie	1	1	code	2

243	DSU	1	1	code	1
244	Reachability Tree/ DSU Tree	1	1 2	code	2
245	DSU with Rollbacks			code	1
246	Partially Persistent DSU	1	1	code	3
247	Persistent DSU		1	code	3
248	Augmented DSU	1		code	2
249	Queue Undo Trick	1	1 2	code	3
250	Dynamic Connectivity Problem	1	1	code	2
251	DSU on Tree	1	1	code	1
252	SQRT Decomposition	1	1		1
253	SQRT Decomposition Split and Build Technique		1	code	3
254	Centroid Decomposition	1	1		1
255	Persistent Centroid Decomposition		1	code	3
256	Binarizing a Tree		1	code	1
257	HLD ft Subtrees and Path Query	1 2	1	code	2
258	HLD ft Persistent Lazy Propagation		1	code	3
259	LCT	1	1	code	2
260	Treap	1	1	code	2
261	Implicit Treap	1	1	code	2
262	Persistent Treap		1 2	code	3
263	SQRT Tree	1	1	code	3
264	KD Tree	1	1	code	2
265	Cartesian Tree	1		code	2
266	Rope	1	1		1
267	Monotonous Queue	1	1	code	1
268	BST using STL	1		code	1
269	Persistent BST	1			3

270	Ordered Set	1 2	1	code	1
271	Static to Dynamic Trick	1 2		code	2
272	Interval Set			code	2
273	Divide and Conquer on Queries		1		2
274	Divide and Conquer for Insert and Query Problems	1	1	code	2
275	Venice Technique	1	1	code	1
276	Permutation Tree	1		code	3
277	Persistent Array		1	code	1
278	Persistent Queue		1	code	3
279	Persistent Meldable Heap	1	1	code	2
280	Top Tree	1	1	code	3
281	PQ Tree	1	1		3
282	Link Cut Cactus	1			3
283	HDLT	1			3

Category: Strings

#	Title	Resources	Problems	Template	Difficulty
284	KMP	1	1	code	1
285	Prefix Automaton	1		code	1
286	Z algorithm	1	1	code	1
287	Aho Corasick	1	1 2	code	1
288	Dynamic Aho Corasick	1		code	2
289	Aho Corasick ft All Pair Occurrence Relation		1	code	2
290	String Matching using Bitsets		1 2	code	1
291	String Matching with FFT	1	1 2	code	2
292	String Hashing	1	1 2	code	1
293	2D String Hashing	1	1	code	2
294	Suffix Array	1	1	code	2
295	Isomorphic Suffix Array		1	code	3

296	Suffix Automaton	1	1	code	2
297	Suffix Automaton ft Distinct Substring Queries in Range.		1 2		3
298	Suffix Tree	1			3
299	Palindromic Tree	1	1	code	2
300	Persistent Palindromic Tree		1	code	3
301	Manachers Algorithm	1	1	code	2
302	Minimum Palindrome Factorization	1	1	code	3
303	Number of Palindromes in Range	1	1 2	code	2
304	Lyndon Factorization	1	1		2
305	Main-Lorentz Algorithm	1			3
306	All Substring Longest Common Subsequence	1		code	3
307	Bit LCS		1	code	3
308	Cyclic LCS			code	3
309	De Bruijn Sequence			code	1
310	LCS on RLE compressed string	1			3

Category: DP

#	Title	Resources	Problems	Template	Difficulty
311	Digit DP	1	1	code	1
312	CHT	1 2	1	code	2
313	Dynamic CHT	1	1	code	2
314	Persistent CHT			code	3
315	Li Chao Tree	1 2	1 2	code	2
316	Persistent Li Chao Tree		1 2	code	2
317	Extended Li Chao tree	1			3
318	Divide and Conquer Optimization	1	1	code	1
319	Knuth Optimization	1 2	1	code	1

320	Substring DP	1	1	code	1
321	Bounded Knapsack	1	1	code	1
322	SOS DP	1	1	code	1
323	Subset Sum Convolution	1		code	2
324	Dynamic Submask Count		1	code	2
325	DP over Divisors			code	1
326	Subset Sum in SQRT		1	code	1
327	LIS Range Query	1	1		2
328	Aliens Trick	1	1		2
329	1D1D DP Optimization	1	1	code	3
330	Connected Component DP	1	1	code	3
331	Slope Trick	1	1		2
332	Subset Union of Bitsets		1	code	2
333	Number of Subsequences Having Product at least K		1	code	2
334	Hirschbergs Algorithm	1	1		3
335	Broken Profile DP/plug dp	1 2	1		2
336	XOR Equation	1	1 2 3		2
337	"x2 +1 trick"	1	1	code	1
338	Open and Close Interval Trick	1	1		1
339	Bitmask DP	1	1		1

Category: Geometry

#	Title	Resources	Problems	Template	Difficulty
340	Geometry 2D Everything	1 2 3 4	1	code	3
341	Basic Point Structure(2D)	1		code	1
342	Polar Sort(2D)	1		code	1
343	Basic Line Structure(2D)	1		code	1
344	Angle Bisector(2D)	1		code	1
345	Dist from Point to Line(2D)	1		code	1

346	Dist from Point to Ray(2D)	1		code	1
347	Dist from Point to Segment(2D)	1		code	1
348	Dist from Segment to Segment(2D)	1		code	1
349	Check if Point is on Segment(2D)	1		code	1
350	Line Line Intersection(2D)	1		code	1
351	Point Line Relation(2D)	1		code	1
352	Project from Point to Line(2D)	1		code	1
353	Project from Point to Segment(2D)	1		code	1
354	Ray Ray Distance(2D)	1		code	1
355	Ray Ray Intersection(2D)	1		code	1
356	Reflection from Point to Line(2D)	1		code	1
357	Segment Line Intersection(2D)	1		code	1
358	Segment Line Relation(2D)	1		code	1
359	Segment Segment Intersection(2D)	1		code	1
360	Basic Circle Structure(2D)	1		code	1
361	Circle Circle Area(2D)	1		code	1
362	Circle Circle Intersection(2D)	1		code	1
363	Circle Circle Relation(2D)	1		code	1
364	Circle Line Intersection(2D)	1		code	1
365	Circle Line Relation(2D)	1		code	1
366	Circle Point Relation(2D)	1		code	1
367	Tangent Lines from Point(2D)	1		code	2
368	Tangent Lines from Circle(2D)	1		code	2
369	Maximum Circle Cover(2D)	1		code	2
370	Maximum Inscribed Circle(2D)	1		code	2
371	Triangle Circle Intersection(2D)	1		code	2
372	Polygon Circle Intersection(2D)	1		code	2

373	Circle Union(2D)	1		code	3
374	Centroid of a Polygon(2D)	1		code	1
375	Convex Hull(2D)	1		code	1
376	Diameter of a Convex Polygon(2D)	1		code	2
377	Extreme Vertex(2D)	1		code	2
378	Geometric Median(2D)	1		code	2
379	Convexity Check(2D)	1		code	1
380	Check if Point is in Convex(2D)	1		code	2
381	Check if Point is in Polygon(2D)	1		code	2
382	Minimum Enclosing Circle(2D)	1		code	2
383	Minimum Enclosing Rectangle(2D)	1		code	2
384	Polygon Line Intersection(2D)	1		code	2
385	Width of a Polygon(2D)	1		code	2
386	Winding Number(2D)	1		code	2
387	Dist from Point to Polygon(2D)	1		code	2
388	Dist from Polygon to Line(2D)	1		code	2
389	Dist from Polygon to Polygon(2D)	1		code	2
390	Maximum Dist from Polygon to Polygon(2D)	1		code	3
391	Tangents from Point to Polygon(2D)	1		code	3
392	Polygon Union(2D)	1		code	3
393	Minkwoski Sum(2D)	1		code	2
394	Geometry 3D Everything	1		code	3
395	Basic Point Structure(3D)	1		code	1
396	Basic Line Structure(3D)	1		code	1
397	Plane Structure(3D)	1		code	1
398	3D Coordinates to 2D	1		code	1
399	Distance from Segment to	1	1	code	2

	Point(3D)				
400	Distance from Triangle to Point(3D)	1	1	code	2
401	Distance from Triangle to Segment(3D)	1	1	code	2
402	Distance from Triangle to Triangle(3D)	1	1	code	2
403	Distance from Segment to Segment(3D)	1			2
404	Plane Plane Intersection	1		code	2
405	Basic Sphere Structure	1		code	1
406	Sphere Line Intersection	1		code	2
407	Segment Segment Intersection on Sphere	1		code	2
408	Oriented Angle on Sphere	1		code	2
409	Area on The Surface of The Sphere	1		code	2
410	Winding Number 3D	1		code	3
411	Convex Hull 3D	1	1	code	3
412	Picks Theorem	1 2	1		1
413	Closest Pair of Points	1	1	code	1
414	All Pair Segment Intersection.	1	1	code	3
415	Dynamic Convex Hull			code	3
416	Delaunay Triangulation	1	1	code	3
417	Voronoi Diagram	1	1	code	3
418	Half Plane Intersection	1	1	code	2
419	Dynamic Half Plane Intersection		1	code	3
420	Onion Decomposition	1		code	3
421	Point Location	1	1	code	3
422	Convex Hull Intersection using Minkowski				2
423	Generating Points without Collinear Triplets	1			2

424	Maximum Area of a Triangle from given Lengths		1	code	3
425	Vertical decomposition	1	1		3

Category: Game Theory

#	Title	Resources	Problems	Template	Difficulty
426	Green Hackenbush on Trees and Graphs		1 2	code	2
427	Blue Red HackenBush	1	1	code	3
428	Games on Arbitrary Graphs	1			2
429	Matching Game On A Graph	1	1	code	2
430	Nimber	1			3

Category: Miscelleneous

#	Title	Resources	Problems	Template	Difficulty
431	Bigint			code	2
432	Two Pointers	1			1
433	Binary Search	1			1
434	Fraction Binary Search		1	code	3
435	Ternary Search	1		code	1
436	Parallel Binary Search	1	1		2
437	Josephus Problem	1		code	1
438	Permutation with no Arithmetic Progression	1	1		1
439	Balanced Brackets	1			1
440	Knight Moves in Infinity Grid			code	2
441	Bishop Placement	1			1
442	Gray Code	1	1	code	1
443	MEX of all Subarrays		1	code	3
444	Dates			code	1
445	Schreier–Sims Algorithm	1	1	code	3
446	Expression Parsing	1		code	1

447	Randomized Algorithms	1			2
448	K-th Root of a Permutation	1	1	code	3
449	Matroid Intersection	1 2 3 4 5	1	code	3
450	SMAWK Algorithm	1			3
451	Lindstrom–Gessel–Viennot lemma	1	1		3

Category: Important Links

Title	Resources
Useful blogs	1
USACO Guide	1
Helpful Extensions	1
Stress Testing	1
Problems That Will Make You Learn Something New	1

UPD: If you want the topics of each category to be under spoilers and **want the most updated version of the list**(I can't seem to update this blog anymore because of the enormous size of this blog), then check here.

Contribute

You can comment the topic names that you think are missing right now and I am pretty sure some links are broken, do point those out if you find some.

Additional Comments

I really wanted to post this blog before I die. Seems like I managed to do that. It's funny that I had this constant fear of what if I die before sharing this blog with the world given that the amount of work I have given to create this is monstrous. But now I am so happy that I am alive at this moment.

Conclusion

The whole purpose of this project is to help you with this astounding journey of you trying to be better, trying to achieve the best of what you can imagine. Hope that my efforts won't go in vain. I am waiting to see you at the top of the building that you made by the bricks of your expectations. I am waiting to see you smile and to be happy. Don't forget to enjoy the journey and have fun while riding the boat.

Best wishes, my friend 😍.

+4128 YouKn0wWho 6 weeks ago 213

Write comment?

Comments (213)