Shahjalal University of Science and Technology, Sylhet

Department of Computer Science & Engineering

Project 150 Syllabus

Level Zero:

STL	
	string, vector, pair, stack, queue, priority_queue, sort
	Structure sort, reverse, set, map, iterator, next_permutation

Number Theory/Math	
	Prime Generation, Sieve and How to Optimize
	Bitwise Sieve
	Modular Arithmatic (+ - *)
	Modular Inverse (/)
	Big Mod (a^b % p)
	Prime Factorization, Number of Divisor, Sum of Divisor
Graph	
	Graph Representations (Adjacency Matrix and Adjacency List)
	Breadth First Search BFS, Depth First Search DFS
	Bicoloring, Articulation Point, Bridge, SCC, Topological Sorting
	Strongly Connected Components SCC
	Dijkstra and variations
	Bellman Ford and variations
	Floyd Warshall and variations
	Kth Shortest Path
	Minimum Spanning Tree (Prims and Kruskal)

Dynamic Programming
Coin change, Edit Distance and all basic DP
Longest Common Subsequence LCS, LIS, LIS/LCS(nlogn)
For Grade C-/C/C+
➢ 250+ in Uva Easy, Math, **Geometry**, Basic DS/ALGO, Simulation and others ➢ 50 offline Codeforces Contest(Div 2) and solve A,B,C and try rest ➢ Participate on 10+ **Rating** contest on codeforces and other judges (try to solve all offline) ➢ Solve 150+ problems(Different categories) in LightOJ and SPOJ ➢ Complete USACO first two level. ➢ Participate on 10+ onsite contest in SUST and solve all the problems after contest. ➢ Participate on all marathon contest and solve all the problems set by SUST

Shahjalal University of Science and Technology, Sylhet

Department of Computer Science & Engineering

Project 150 Syllabus

Level One:

Number Theory/Math
Extended Euclid, Euler Phi and inverse phi, Factorizing n!, etc
Basic combinatorics, Probability and Game theory

Graph
Maximum Flow (Ford Fulkerson, Dinic and all variations)
Maximum Bipartite Matching and Variations , Weighted Bipartite Matching
Maximum Independent Set, Graph Coloring
Vertex Cover, Edge cover and Stable Marriage Problem
Greedy
Maximum Sum 1D in O(n), 2D in O(n^3), Maximum Rectangle O(n^2), Task Scheduling, Haffman
Geometry
Basic Geometry, Convex hull
Computational Geometry, pick's thorem

Dynamic Programming
Matrix Chain Multiplication, Bitmask DP, Traveling salesman problem, Modular DP(DP with MOD value as a state)
Tree Dp and variations, All Divide and Conquer approach technique
Data Structure
Trie, heap, BST and variations, Union Find
Binary Indexed Tree and Applications, Segment tree, segment tree with lazy propagation
Least Common Ancestor, Range Minimum Query
For Grade B-/B/B+
➢ 500+ in Uva (Medium), Advance Math, Geometry, DS/ALGO, Simulation and objervation problems ➢ 100 offline Codeforces Contest(Div 1) and solve A,B,C and try rest ➢ Participate on 20+ **Rating** contest on codeforces and other judges (try to solve all offline) ➢ Solve 250+ problems(Different categories) in LightOJ and SPOJ ➢ Solve 30+ Geometry problems from LightOJ and SPOJ ➢ Solve 100+ DP problems from LightOJ and Topcoder Div 1(250 and 500) ➢ Complete USACO first four level. ➢ Participate on 20+ Topcoder, CodeChef, Haker Rank, CSAcademy Contest ➢ Participate on 20+ onsite contest in SUST and solve all the problems after contest. ➢ Participate on all marathon contest and solve all the problems set by SUST

Shahjalal University of Science and Technology, Sylhet

Department of Computer Science & Engineering

Project 150 Syllabus

Level Two:

Game Theory
Nim, Grundy Number and Dp Formulation, etc, Alpha Beta Pruning Minimax*
Hackenbush*, Minimum Weighted Bipartite Matching/Kuhn-Munacres/Hungarian/Chinese Postman

String Algorithm
KMP Matcher, Suffix Array Construction*
Longest Common Substring, Aho Chorasic Algorithm, Manacher's Algo
Number Theory/Math
Shanks Algorithm, Dilworth's theorem*, Burnside Lemma
Finding Real roots of an n degree Equation, Wilson's Theorem*, Lucas Theorem*
Data Structure
Trip, Splay Tree, FFT, HLD and others
Geometry
Point inside Convex Polygon (log(n)), Number of Lattice Points inside a polygon
Binary Search, Ternary Search, Segment Segment Intersection, Area Of A Concave Polygon
Point Inside A Polygon (Convex and Concave), Minimum Circle Covering all Points
Union of rectangle (How to cluster, how to make it in nlogn, bently), Closet pair

Advance Dynamic Programming -> All LightOJ, SPOJ and Topcoder Div 1 DP Problems
Miscellaneous
Meet In the Middle Approach, Konigs and Matrix Tree Theorem, Joseph Problem(both $O(n^{2})$ and O(n)), Biginteger
Tower of Hanoi, Variations, Permutation and combination, N-Queen Problem, Finding Determinant of a Matrix
Traveling Salesman Problem (Backtracking with pruning), Finding kth number from a sequence of unsorted numbers in log(n)
Transforming Hexagonal grid, Triangular grid to 3d coordinate system
Solving Linear Recurrence with Matrix Exponentiation,
For Grade A-/A/A+
➢ 1000+ in Uva (Hard), Advance Math, Geometry, DS/ALGO, Simulation and objervation problems ➢ 200 offline Codeforces Contest(Div 1) and solve D, E, F and solve all ➢ Participate on All **Rating** contest on codeforces and other judges (try to solve all offline) During the full semester ➢ Solve 450+ problems(Different categories Medium/Hard prolems) in SPOJ ➢ Complete USACO training program all level. ➢ Participate on 50+ Topcoder, CodeChef, Haker Rank, CSAcademy Contest ➢ Participate on All onsite contest in SUST and solve all the problems after contest.

- Participate on all marathon contest and solve all the problems set by SUST

For Better People ;)

Graph
Minimum Spanning Tree (For Directed Graphs)
Euler Path (Construction and optimization)
Gomory-Hu Tree
Largest Clique
IDA* Search Problem, 15 Puzzle
Group Theory
Hamiltonian Cycle
Min Weight Cycles in Graph
Stoer Wagner (Finding the minimum cut of a graph)
Planar Graph Detection
Havel-Hakimi Algorithm (Construct graph given degree of nodes)
Maximum Matching(Blossom Shrinking)
Max cost-max flow(min cost flow for negative cycle)

Geometry
Convex Hull 3D
Line Sweeping/Angle Sweep
Fitting a Rectangle inside Another
Polygon Intersection
Area of a 3d Polygon
Polygon Clipping*
Rotating Calipers*
Triangulation
Optimal BST
KD tree, Link-cut tree, Interval Tree, Quad tree

For Competative Programming Contest

- 500 offline Codeforces Contest(Div 1) and solve D, E, F and solve all and keep coding....
- Participate on All **Rating** contest on codeforces and other judges (try to solve all offline) During the full semester
- Solve 550+ problems(Different categories Hard prolems) in SPOJ
- Participate on ALL Topcoder, CodeChef, Haker Rank, CSAcademy Contest

N.B: