

CTY Course Syllabus

Data Structures and Algorithms (DATA)

Summary

Morning: New concepts, lectures, group activities, discussion
 Afternoon: Programming exercises, problem solving
 Evening: Review, thought experiments, puzzles, challenges

Detailed Schedule

Week 1 – Introduction, complexity, recursion

Day	Morning	Afternoon	Evening
Sunday (Intro)			<ul style="list-style-type: none"> • Course overview • Honor code • Pre-assessment
Monday (Growth)	<ul style="list-style-type: none"> • Searching problem • Rates of growth 	<ul style="list-style-type: none"> • Java programming 	<ul style="list-style-type: none"> • Discussion
Tuesday (Big-O)	<ul style="list-style-type: none"> • Asymptotic complexity • Scalability • Big-O notation • Maximum Subsequence Sum 	<ul style="list-style-type: none"> • Benchmarking/profiling code • Arrays / Linked lists 	<ul style="list-style-type: none"> • Complexity problems
Wednesday (Sorting)	<ul style="list-style-type: none"> • Sorting: selection, insertion, bubble 	<ul style="list-style-type: none"> • Sorting activities 	<ul style="list-style-type: none"> • Sorting visualizations
Thursday (Recursion)	<ul style="list-style-type: none"> • Recursion and fractals • Designing recursive functions • Fibonacci • Turtle graphics (fractal trees) 	<ul style="list-style-type: none"> • Lab / problem solving • Tower of Hanoi 	<ul style="list-style-type: none"> • Recursion challenges
Friday (Divide & Conquer)	<ul style="list-style-type: none"> • Recursion continued • Merge and mergesort 	<ul style="list-style-type: none"> • Collaborative activity: drawing merges and fractals 	

Week 2 – Data structures and graphs

Day	Morning	Afternoon	Evening
Sunday (Misc)			<ul style="list-style-type: none">• Quiz• Jeopardy review
Monday (Linear ADTs)	<ul style="list-style-type: none">• Stacks / queues• Trees• Quicksort, Induction• Comparison-sort lower bound• Bucket sort	<ul style="list-style-type: none">• Tree ADT lab	<ul style="list-style-type: none">• Lab continued• Using stacks for postfix expression evaluation
Tuesday (Search ADTs)	<ul style="list-style-type: none">• Hash tables• Heaps• AVL trees• Building heaps and trees	<ul style="list-style-type: none">• Lab	<ul style="list-style-type: none">• Problems/challenges• Recursive path counting
Wednesday (Graphs)	<ul style="list-style-type: none">• Graph representation• Modeling with graphs• Euler/Hamiltonian paths• MST: Prim/Kruskal	<ul style="list-style-type: none">• Lab	<ul style="list-style-type: none">• Puzzles/challenges
Thursday (Greedy algorithms)	<ul style="list-style-type: none">• Dijkstra's algorithm• BFS/DFS	<ul style="list-style-type: none">• Quicksort lab	<ul style="list-style-type: none">• Designing greedy algorithms
Friday (Network flows)	<ul style="list-style-type: none">• Dynamic programming• Lab / review	<ul style="list-style-type: none">• Graph coloring• Generalized geography	

Week 3 – Algorithm design, computability, complexity

Day	Morning	Afternoon	Evening
Sunday			<ul style="list-style-type: none"> • Special: Xeno plumbers sketch
Monday (Dynamic Programming)	<ul style="list-style-type: none"> • Dijkstra review • Graph applications and discussion 	<ul style="list-style-type: none"> • BFS lab 	<ul style="list-style-type: none"> • Graph lab • Jeopardy review
Tuesday (Intractability)	<ul style="list-style-type: none"> • Group problem solving <ul style="list-style-type: none"> - TSP approximation via MST - Topological sort - Inversion counting via divide & conquer - Greedy interval scheduling 	<ul style="list-style-type: none"> • Problem solving continued • Presentations 	<ul style="list-style-type: none"> • Catch-up time for labs
Wednesday (Intractability)	<ul style="list-style-type: none"> • Karatsuba multiplication • Turing machines and non-determinism 	<ul style="list-style-type: none"> • Problem solving: <ul style="list-style-type: none"> - Closest points in a plane - String edit distance - Knapsack / subset sum 	<ul style="list-style-type: none"> • Problem solving continued • Presentations • 3-SAT
Thursday (Misc)	<ul style="list-style-type: none"> • 3-SAT reductions • Reduction problem solving 	<ul style="list-style-type: none"> • Problem solving presentations 	<ul style="list-style-type: none"> • Review • Post assessment
Friday (Misc)	<ul style="list-style-type: none"> • Large numbers • Uncomputability • Busy beaver 		