CS161 Syllabus

This handout contains the tentative syllabus for CS161. Depending on how quickly we're able to cover various topics, we may proceed more quickly or more slowly than the syllabus indicates.

Readings are taken from *Algorithm Design* by Jon Kleinberg and Eva Tardos.

Date	Topics	Readings	Assignments
M June 24	*How do we reason about algorithms?* Course Overview Analyzing an Algorithm: Insertion Sort O, Ω, and Θ notation	2.1 – 2.2, 2.4	
Part One: Fundamental Graph Algorithms			
W June 26	*How do we find shortest paths in a graph?* Breadth-First Search Graph Representations Dijkstra's Algorithm I	3.1 – 3.3, 4.4	**Problem Set 1 Out**
F June 28	*How do we explore graphs?* Dijkstra's Algorithm II Depth-First Search Directed Acyclic Graphs	3.5 – 3.6	
M July 1	*How do we order prerequisites?* Topological Sorting Strongly-Connected Components Kosaraju's Algorithm I	Notes	
W July 3	*What are the applications of graph theory?* Kosaraju's Algorithm II Applications of Strongly-Connected Components	Notes	**Problem Set 1 Due** **Problem Set 2 Out**
Part Two: Divide-and-Conquer Algorithms			
F July 5	*How do we analyze recursive algorithms?* Mergesort Recurrence Relations Binary Search	5.1	
M July 8	*How can we efficiently implement priority queues?* Binary Heaps Heapsort A Lower Bound on Sorting	2.5	
W July 10	*How do we solve divide-and-conquer recurrences?* The Master Theorem Applications of the Master Theorem	5.2, Notes	
F July 12	*How do we solve non-uniform recurrences?* The Median-of-Medians Algorithm The Substitution Method I	Notes	**Problem Set 2 Due** **Problem Set 3 Out**

Part Three: Randomized Algorithms			
M July 15	*Can random guesses improve performance?* The Substitution Method II Quickselect Linearity of Expectation	13.3, 13.5	
W July 17	*How do we precisely analyze randomized algorithms?* Quicksort Indicator Random Variables Finding Large Cuts	13.5	
F July 19	*Can we guess the right answer with high confidence?* Monte Carlo Algorithms Karger's Min-Cut Algorithm	13.2	
M July 22	*How can we efficiently store associative data?* Hash Functions Hash Tables	13.6	**Problem Set 3 Due** **Problem Set 4 Out**
Part Four: Greedy Algorithms			
W July 24	*Can locally optimal decisions be globally optimal?* Interval Scheduling "Greedy Stays Ahead"	4.1 – 4.2	
F July 26	*How do you link up nodes at a low cost?* Minimum Spanning Trees Prim's Algorithm	4.5	
M July 29	*Can we locally modify solutions to build better ones?* Exchange Arguments Dijkstra's Algorithm Revisited Kruskal's Algorithm	4.4 – 4.6	**Problem Set 4 Due** **Problem Set 5 Out**
Part Five: Dynamic Programming			
W July 31	*Can we reuse work across subcomputations?* Linear Independent Set Definition of Dynamic Programming Sequence Alignment I	6.1 – 6.2, 6.6	
F August 2	*How do Internet routers find paths?* Sequence Alignment II The Bellman-Ford Algorithm	6.8	
M August 5	*Can we precompute shortest paths everywhere?* The Floyd-Warshall Algorithm Johnson's Algorithm	6.8 – 6.9	**Problem Set 5 Due** **Problem Set 6 Out**
Part Six: Intractable Problems			
W August 7	*How do you approach intractable problems?* **NP**-Hardness The Knapsack Problem Pseudopolynomial-Time Algorithms	8.1 – 8.5, 6.4	

F August 9	*Can we find simple cases of otherwise hard problems?* Independent Set on Trees	10.2	
M August 12	*Can we guess the answer to hard problems?* Randomized Approximation Algorithms MAX-3SAT	13.4	**Problem Set 6 Due** **Final Project Out**
W August 14	*Where do we go from here?* Further Topics in Algorithms		
Sa August 17	**Final Project Due at 12:15PM** **No Late Submissions**		