CS 180: Algorithms and Complexity

Lecture: Cho-Jui Hsieh
Lecture: MW 2:00pm -- 3:50pm

Classroom: Franz 1178

Textbook: Algorithm Design, Kleinberg and Tardos, 2005 (optional)

Course Goals:
The course will cover the basics of the design and analysis of algorithms. The primary goal of the course is to develop "algorithmic thinking". Along the way, we will learn some of the core algorithmic techniques and concrete algorithms that underlie much of computer science, including graph algorithms, divide-and-conquer, greedy method, dynamic programming, complexity measures, time and space complexity and NP completeness.

Lecture plan:
Introduction: 2 lectures
Graphs: 2 lectures
Greedy algorithms: 3 lectures
Divide and conquer: 2 lecture
Dynamic programming: 4 lectures
NP completeness: 2 lectures
Randomized algorithms: 2 lectures

Tentative Grading policy:

(30%) Homeworks: we plan to have 4 homework assignments.
(30%) Midterm exam: Feb 15 in class (tentative)
(40%) Final exam: we'll follow the official final exam schedule (March 24, 11:30am–2:30pm)

Lecture plans:

Lecture 1: Stable matching problem (1.1)
Lecture 2: Stable matching problem (1.1), Asymptotic order of growth (2.1--2.2)
Lecture 3: Asymptotic order of growth (2.1--2.2)
Lecture 4: Asymptotic order of growth (2.1--2.2), Some sampled problems, Gale-Shapley implementation (2.3)
Lecture 5: Priority queue (2.5), Graph algorithms (3.1)
Lecture 6: Graph traversal (3.2, 3.3)
Lecture 7: Graph traversal (3.2, 3.3, 3.4, 3.5)

Lecture 8: Graph algorithms (3.6), Greedy algorithm (4.1)
Lecture 9: Greedy algorithm (4.1) , shortest path (4.4)
Lecture 10: shortest path (4.4), minimum spanning tree (4.5)
Lecture 11: minimum spanning tree and union find (4.5, 4.6)
Midterm (coverage: up to 4.1)
Lecture 12: Divide and conquer (5.1), Master theorem (5.2), Integer multiplication (5.5)
Lecture 13: Closest pair of points (5.4), QuickSelect
Lecture 14: Dynamic programming, weight scheduling (6.1, 6.2), Knapsack (6.4)
Lecture 15: RNA secondary structure (6.5), Sequence alignment (6.6, 6.7)
Lecture 16: Linear space sequence alignment (6.6, 6.7), shortest path with negative edge (6.8, 6.9)
Lecture 17: Polynomial time reduction (8.1, 8.2)
Lecture 18: NP-completeness (8.3, 8.4)