CS 58000 – Detailed Syllabus, Fall 2008

The course plans to follow the syllabus outlined below. The number of lectures listed is an estimate. Changes and adjustments may be made during the semester.

Review (2 lectures)

- Asymptotic notation (Ch. 3, Appendix A)
- Graphs (Ch. 22, Appendix B)
- Fundamental Data Structures (Ch. 10)
- Recurrences (Ch. 4)
    - Master theorem

Algorithm Design Techniques (12 lectures)

- Divide and Conquer (Ch. 9.3, 33.4, 30) – 2 lectures
    - Selection in worst-case linear time
    - Fast Fourier Transform
- Randomization (Ch. 5) - 3 lectures
    - Review probability (Appendix C.1 – C.3)
    - Minimum Cut Algorithm
    - Quicksort (Ch. 7.3)
    - Selection in expected linear time (Ch. 9.2)
    - Fingerprinting technique
    - Rabin-Karp Pattern Matching Algorithm (Ch. 32.2)
- Greedy (Ch. 16) – 2 lectures
    - Fractional knapsack
    - Caching
    - Minimum Spanning Tree --- Kruskal, Prim, expected linear time algorithm
    - Single source shortest paths -- Dijsktra
- Dynamic Programming (Ch. 15) – 3 lectures
    - Matrix chain multiplication
    - Longest common subsequence
    - Knapsack
    - Shortest Paths: Bellman-Ford, Floyd-Warshall (Ch. 24, 25)
- Amortization (Ch. 17) – 2 lectures
    - Aggregate method
    - Accounting method
    - Potential function method
    - Knuth-Morris-Pratt Algorithm (Ch. 32)

Advanced Data Structures (7 lectures)

- Disjoint set union-find – 1 lecture
    - Union by rank and path compression techniques (Ch. 21)
    - Application: Kruskal's algorithm (Ch. 23)
- Balanced Binary Search Trees – 2 lectures
    - Splay Trees

    - Skip Lists
- Heaps – 2 lectures
    - Fibonacci Heaps (Ch. 20)
    - Application: Prim's and Dijsktra's algorithm (Ch. 23)
- Hashing – 2 lectures (Ch. 11)
    - Universal Hashing
    - Perfect Hashing

More Graph Algorithms (2 lectures)

- Network Flow (Ch 26)
    - Ford-Fulkerson
    - Edmonds-Karp
    - Faster Algorithms
    - Applications

Approximation Algorithms (4 lectures)

- NP-completeness review (Ch. 34)
- Vertex Cover, Set Cover, Traveling Salesman (Ch. 35.1-3)
- Fully polynomial time approximation scheme (Ch. 35.5)
- Linear Programming based schemes (Ch. 35.4)
    - Randomized Rounding
    - Primal Dual

Distributed Algorithms (Time permitting)

- Distributed Computing Model
- Locality
- Maximal Independent Set
- Minimum Spanning Tree

Midterm and reviews (3 lectures)