CS 344: Design & Analysis of Computer Algorithms

Spring 2020, Sections 1-3, 4 Credits

INSTRUCTOR: Bahman Kalantari , 444 Hill, Tel: (848)445-7297.

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LECTURE: M-W 3:20-4:40 PM, LIV TIL-254

OFFICE HOURS: W 12:00-1:30 PM

Section 1 Recitation : Monday 8:55 - 9:50 AM, LIV BE-250

Section 2 Recitation: Tuesday 10:35 - 11:30 AM, LIV LSH-B115

Section 3 Recitation: Friday 10:35 - 11:30 AM, LIV LSH-B115

Prerequisites: 198:112 Data Structures, 198:206 Introduction to Discrete Structures II

Two Midterms, Final, and Quizzes based on Homeworks

Exams (No Makeup Exams!)

Details will be described in Class Sakai

Grading Guideline: The better of the two scores:

0.15 Quizzes + 0.20 MIDTERM I + 0.20 MIDTERM II + 0.45 FINAL

0.15 Quizzes + 0.25 MIDTERM II + 0.60 FINAL.

TOPICS: The course will cover a large subset of the following topics:

• Methods for expressing and comparing complexity of algorithms: worst and average cases, lower bounds, and asymptotic analysis.

• **Searching, sorting**. Lower bounds for comparison-based sorting; binsort and radix sort.

• **Divide and conquer.** Fast integer multiplication; recurrences; the master theorem; merge-sort; randomized median and selection algorithms; quicksort; fast matrix multiplication.

• **Graph search algorithms.** Graphs representations; depth first search; topological search; strongly connected components. Breadth first search and layered DAGs.

• **Greedy algorithms.** Spanning trees and cuts, union-find and path compression; minimum spanning tree (MST) algorithms; randomized algorithms.

• **Shortest Paths (SPs) in digraphs.** Single-source SPs for nonnegative edge weights; priority queues and Dijkstra's; SPs in DAGs; single-source SPs for general edge weights.

• **Dynamic programming.** Paradigm of SPs in DAGs; longest increasing subsequence; (approximate) string matching; integer and (0,1) knapsack problems; chain matrix multiplication; single-pair reliable SPs, all-pairs SPs; independent sets.

• **Network flows.** Max flow min cut theorem; bipartite matching; Menger's theorem and disjoint dipaths. Global minimum cuts.

• **Elements of NP-completeness & problem reductions.**

• **NP-hard problems.** Approximation algorithms.

Textbook: Algorithms, Dasgupta, Papadimitriou & Vazirani, McGraw Hill, 1st Edn, 2008.

Reference: Introduction to Algorithms, Cormen, Leiserson, Rivest & Stein, McGraw Hill, 3rd Edn, 2001. (Will be placed on reserve at SERC.)

Refresher Material: The Principle of Mathematical Induction, A Chapter from the book: PROOFS: From Schematic to Prose, Part I: Logic, Sets, & Elementary Topics, Iraj Kalantari, Available on Amazon.com.