CS 520 - Advanced Analysis of Algorithms

K. Subramani LDCSEE, West Virginia University, Morgantown, WV k.subramani@mail.wvu.edu

1 General Information

- 1. Semester Fall 2016.
- 2. Meeting Times: Tu-Th, 3:30 4:45 pm. Location: 205 MRB-E.
- 3. Contact Information: 347 AERB.
- 4. Office Hours: Tu-Th, 4:45 5:30 pm.
- 5. Textbook [CLRS09] is a useful reference book. However, the concepts taught in this class are discussed in a number of other books as well.
- 6. Assessment:
 - (a) Homework assignments (4) There will be four Homework assignments; each assignment is worth 20% of your grade. Table (1) details the Homework schedule.

Assignment Date	Submission Date
09/08	09/15
10/06	10/13
10/30	11/07
11/29	12/06

Table 1: Homework Sched	ule
-------------------------	-----

(b) Final - The final will be held on December 12 (in-class, open book, 8 : 00 am - 10 : 00 am) and is worth 20% of your grade.

- (c) A maximum of 5 bonus points will be awarded for class performance.
- 7. Grade Boundaries
 - (a) A: 75 and up
 - (b) **B**: 60 − 74
 - (c) C: 50 59
 - (d) **D**: 45 49
 - (e) **F**: 0 − 44
- 8. Grading policy If you have any questions about the grading, you must contact the intructor within two days of your paper being returned.
- 9. Makeup Policy If for some reason, you are unable to attend a test or an exam, please meet me at the earliest and I will set an alternate date.
- 10. Course Objectives The objectives of this course are as follows:
 - (a) Introduce rigorous algorithmic analysis at the graduate level.
 - (b) Apply algorithm design to problems in logistics.
 - (c) Introduce Linear Programming and its applications.
 - (d) Introduce the theory of NP-completeness.
- 11. Learning Outcomes Upon successful completion of this course, students will be able to:
 - (a) Rigorously apply order metrics to computational problems.
 - (b) Design an algorithm for a problem and analyze its resource complexity.
 - (c) Understand and apply linear programming techniques to problems.
 - (d) Identify the possibility of intractability for a given problem.

2 Syllabus Sketch and Weekly Schedule

2.1 Algorithm Analysis

Algorithm Design, Efficiency, Analysis of Algorithms, Order, Data Structures, Mathematical Review.

2.2 Divide and Conquer

Solving Recurrences, Binary Search, Merge-sort, Quick-sort, Integer Multiplication, Strassen's Matrix Multiplication Algorithm.

2.3 Greedy Algorithms

The algorithms of Prim and Kruskal, Single source shortest paths, parallel machine minimization, job scheduling with deadlines, job scheduling with deadlines and profits, Huffman codes.

2.4 Dynamic Programming

Computing the binomial coefficient, Stage-wise Shortest Paths, Matrix Chain multiplication, Longest common subsequence, Optimal Binary Search Trees.

2.5 Amortized Analysis

Aggregate Analysis, Accounting method, Potential method.

2.6 Linear Programming

Standard and slack forms, Model formulation, The simplex algorithm, Duality.

2.7 NP-completeness

Polynomial-time verification, Reducibility, NP-completeness proofs.

Caveat: I would like to reiterate that this is a sketch of the topics that we will be covering. For various reasons, I may choose to drop a mentioned topic or cover a new topic. In such cases, advance notice will be given. 4 lectures have been reserved for reviewing previously covered material and discussing graded assignments.

3 Inclusivity Statement

West Virginia University community is committed to creating and fostering a positive learning and working environment based on open communication, mutual respect, and inclusion. If you are a person with a disability and anticipate needing any type of accommodation in order to participate in this class, please advise me and make appropriate arrangements with Accessibility Services (293-6700). For more information on West Virginia University's Diversity, Equity, and Inclusion initiatives, please see http://diversity.wvu.edu.

References

[CLRS09] T. H. Cormen, C. E. Leiserson, R. L. Rivest, and C. Stein. *Introduction to Algorithms*. The MIT Press, Cambridge, MA, 3rd edition, 2009.