CSE 521: Design and Analysis of Algorithms — Autumn 2006

Problem Set #2 — Instructor: Anna Karlin

Due on **October 27, 2006, by 4pm**

Turn-in: You can either email your homework to Roee or you can leave it in his mailbox on the first floor of the Allen Center (in the room with all the CSE grad student mailboxes).

Instructions: You are allowed to collaborate with fellow students taking the class in solving problem sets. You may also collaborate with one other classmate on writing up your solutions. If you do collaborate in any way, you must acknowledge for each problem the people you worked with on that problem.

The problems have been carefully chosen for their pedagogical value and hence might be similar or identical to those given out in past offerings of this course at UW, or similar courses at other schools. Using any pre-existing solutions from these sources, from the Web or other algorithms textbooks constitutes a violation of the academic integrity expected of you and is strictly prohibited.

Most of the problems require only one or two key ideas for their solution – spelling out these ideas should give you most of the credit for the problem even if you err in some finer details. So, make sure you clearly write down the main idea(s) behind your solution even if you could not figure out a complete solution.

A final **important** piece of advice: Begin work on the problem set early and don't wait till the deadline is only a few days away.

Readings: Kleinberg and Tardos: Chapters 5, 6.

Each problem is worth 10 points unless noted otherwise. All problem numbers refer to the Kleinberg-Tardos textbook.

1. Chapter 4, Problem 19.
2. Chapter 4, Problem 22.
3. Chapter 5, Problem 2.
4. Chapter 5, Problem 5.
5. Modify Karatsuba's algorithm for integer multiplication by using divide-and-conquer based on splitting the integer into 3 pieces intead of 2. Base your algorithm on an algorithm for multiplying two quadratic polynomials that uses evaluation and interpolation. Find a way to do this multiplication of polynomials with 5 multiplications. What is the asymptotic running time of your algorithm? (Note: we are shooting here for a running time that is better than the $O(n^{1.59})$ achieved by the basic Karatsuba algorithm.)
6. Describe the generalization of the FFT procedure to the case where n is a power of 3. Give a recurrence for the running time, and solve the recurrence.
7. Chapter 6, Problem 1.

8. Chapter 6, Problem 16.
9. Chapter 6, Problem 24.