MA/CSSE 473 – Design and Analysis of Algorithms

Homework 2 – (9 problems, 67 points total) updated for summer, 2012

These are to be turned in to a drop box on ANGEL. You may write your solutions by hand and scan them if you wish. There is an easy-to-use network scanner in F-217. (Not much help in summer!) It will email the scan to you. When a problem is listed by number, it is from Levitin. 1.1.2 means "problem 2 from section 1.1" .

Problems for enlightenment/practice/review (not to turn in, but you should think about them):
How many of them you need to do serious work on depends on you and your background. I do not want to make everyone do one of them for the sake of the (possibly) few who need it. You can hopefully figure out which ones you need to do.

2.1.7 [2.1.7]	(and 2.1.8. Effect of changing problem size on runtime)
2.1.10a [2.1.10]	(chess-board doubling)
2.2.1 [2.2.1]	(efficiency of sequential search)
2.2.2 [2.2.2]	(informal definitions of asymptotic notations)
2.2.6 [2.2.6]	(orders of growth for polynomials and exponentials)
2.2.9 [2.2.9]	(effect of presorting on running time)
2.3.1 [2.3.1]	(summation practice)
2.3.5 [2.3.5]	(Secret algorithm)
2.3.6 [2.3.6]	(Enigma algorithm)
2.3.12 [2.3.11]	(von Neumann's Neighborhood)

Another good practice problem to prepare for this assignment: The "growable array" exercise from 230. See the three files from days 01 and 02 in the 230-materials folder.

Problems to write up and turn in:

1. 2.1.4 [2.1.4] (6 points) (socks and gloves)
2. 2.1.5 [2.1.5] (9 points) (number of digits in the representation of a positive integer))
   Note that there are four parts of this problem. If you have the 2nd edition
   See the "Problems" document. Points: (3, 3, 1, 2)
3. 2.2.3 [2.2.3] (10 points) (big-theta of specific functions with proofs)
   For parts a&b, use limits;
   for e, use formal definitions of O and Ω;
   you should probably give specific values for the c and n_0
   in the formulas on pages 53-54.
   for c & d, you can use the theorem on p 56.
4. 2.2.7a,d [2.2.7a,d] (4 points) (proof or disproof of properties using the formal definition)
5. 2.2.12 [2.2.10] (6 points) (door in a wall). Show that you algorithm is O(N).
6. 2.3.2 [2.3.2] (8 points) (big-theta for various summations)
7. 2.3.11 [2.3.10] (10 points) (GE Algorithm – yeah, it's a big secret what GE stands for ☺) Include a quantitative indication of how much time is gained by removing the glaring inefficiency.
8. Master Theorem Proof (8 points). These questions refer to the proof of the Master Theorem in Weiss section 7.5.3 (available on ANGEL).

This proof is typically part of CSSE 230, but it happens during the time of the big team project, so many students don't focus on it enough to really understand it. Here is your chance to do so! If you do not already feel comfortable with telescoping as a method of solving recurrence relations, read the early parts of the section carefully. If you do, you can start with the page before the proof.

You'll probably find several formulas form Levitin's Appendix A to be helpful here. **Continued on the next page.**

(a) (5 points) (7.11) Why is it $O(A^M)$? Why is the second equation true ($: O(A^M) = O(N^{\log_B A})$.)?
(b) (3 points) Sentence after (7.11). Why does the sum contain that many terms? Why does $A = B^k$ imply $A^M = N^k$?

9. Dasgupta questions (6 points, 2 for each part). Refers to an excerpts from Dasgupta's book (on ANGEL)
   (a) What does Dasgupta say are the two main ideas that changed the world? Do you agree? What else might you include in the list?
   (b)Why is the simple algorithm at the bottom of page 4 actually not O(n)?
   (c) Show how to use al-Khwarizmi's technique to multiply 9 (first column) by 15 (second column).