CS 577: Introduction to Algorithms	**Homework 1**
Out: 09/15/10	**Due: 09/22/10**

Ground Rules

- **Grading.** You will be graded on the correctness as well as clarity of your solutions. You are required to prove any claims that you make. In particular, when you are asked to design an algorithm, you must argue its correctness as well as running time. You may use without proof any theorems proven in class or in the textbook, as long as you state and cite them properly.

- **Collaboration.** You may work and submit solutions in pairs.

- **Lateness.** Homework is due promptly at the start of class. Late homework will receive zero credit.

- **Extra credit questions.** Extra credit questions will not directly contribute to your score. However, they will be taken into account in the final grading and may improve your overall grade if your total score is close to the boundary between two grades. Furthermore they are fun to solve and improve your understanding of the course.

- Start working on your homework early. Plan your work in such a way that you have the opportunity to put some problems on the back burner for a while and revisit them later. Good luck!

Problems

1. (**6 points**) Solve the following recurrences. (If you cannot find an exact answer, give the best upper and lower bounds that you can.)

   (a) $T(n) = 3T(n/2) + n^3$

   (b) $T(n) = T(n/3) + T(2n/3) + 2n$

   (c) $T(n) = T(\sqrt{n}) + 1$

2. (**4 points.**) You are given an unsorted list of n integers, all in the range $[1 \cdots m]$. Give an algorithm for sorting this list in time $O(n + M)$. (Note that for small M this beats the $\Omega(n \log n)$ lower bound.)

3. (**5 points.**) Problem 5.3 in the textbook (Pg. 246–247).

   (**Extra credit.**) Give an $O(n)$ time algorithm for Problem 2. (Hint: In $O(n)$ time can you throw away at least half the cards such that if there is a "majority element" in the original collection, that element continues to form a majority in the remaining collection?)

   Note: Since a few people in class do not have the textbook yet, we have reproduced the questions from the book on the back of this page.