CS 577: Introduction to Algorithms	Homework 2
Out: 09/22/10	**Due: 09/29/10**

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 on 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. **(4+2 points.)**
   (a) Problem 5.1 in the textbook (Pg. 246).
   (b) Prove that any comparison-based algorithm for the problem in part (a) must make $\Omega(\log n)$ comparisons in the worst case.
2. **(5 points.)** Problem 3.6 in the textbook (Pg. 108).
3. **(4 points.)** Alice and Bob play the following number search game. N is fixed to be some large number. Alice picks an integer y in the range $[1 \cdots N]$. Bob's goal is to guess this number as quickly as possible through a series of questions. At step t Bob poses a question x_t, also an integer in the range $[1 \cdots N]$. For $t \geq 2$, Alice responds by "hotter" or "colder" depending on whether x_t is closer or farther from her number y compared to the previous question x_{t-1}. That is, if $|x_t - y| < |x_{t-1} - y|$, Alice responds "hotter"; if $|x_t - y| > |x_{t-1} - y|$, Alice responds "colder"; and if the two are equally far, Alice responds "equal". The game ends as soon as Bob correctly guesses y.

   Give a strategy for Bob that is guaranteed to find the number y in at most $O(\log N)$ steps.

   (Extra credit.) Give a strategy for Bob that finds y in at most $\log_2 N + O(1)$ steps.

Note: Since a few people in class do not have the textbook yet, in the printed version of this homework (available in class and from Shuchi's office) we have reproduced the questions from the book on the back of this page.