CS 577: Introduction to Algorithms — Homework 0

Out: 09/03/10 — **Due: various dates**

Ground Rules

This is a self-calibration assignment. Some parts of the homework need to be turned in. The remaining are intended to be used to refresh your knowledge of the prerequisites for this course, and to get an idea of the level of difficulty of this course. This homework will not be graded but model solutions will be handed out in class on 9/8.

To be turned in.

1. Email a recent picture of yourself to the TA Yizhen Huang at `huangyz@cs.wisc.edu` by Sept 8th. This will be used for a picture board on the class webpage (with access only through wisc.edu).

2. Respond by Sept 5th to the Doodle poll set-up by Shuchi for scheduling the midterm. This is a hard deadline. A link to the poll is available on the class webpage as well as in an email that Shuchi will send out today.

Not to be turned in.

1. **Reading.** Review Chapter 2 of the course text. This is an important part of the homework, and although we will not review this material in class, future topics rely heavily on a good understanding of it.

2. **Problems from the book.** 2.4, 2.5.

3. **(Treasure Hunt.)** You are in the middle of an infinitely long highway when you find a map to an ancient treasure. The treasure is apparently hidden under one of the milestones along the highway. Unfortunately, there is no way of knowing how far from your current position the treasure is hidden, or whether it is to your left or to your right. The only way to find whether or not the treasure is at a certain milestone is to find a small marker in the sand beside the correct milestone. You can search for the treasure by going left or right and changing your direction as many times as you want. Devise a search strategy that is guaranteed to eventually find the treasure. Assume that you walk at a speed of 1 mile an hour. How much time do you take to find the treasure if it is at a distance of n miles from your current position? (You answer should be in terms of n.)

4. **(The Towers of Hanoi)** An ancient temple at Hanoi, Vietnam contains a large room with three towers in it surrounded by n golden discs[1] of different sizes. The priests at the temple, acting out the command of an ancient prophecy, have been moving these discs in accordance with the following rules: (1) the discs must be moved one at a time from one pole to another, and, (2) a disc can never be placed over a smaller disc. At the beginning of time, the first tower contained all the discs, the largest at the bottom and the smallest at the top. Legend has it that when all the discs are moved to the third tower, the world will end.

   What is the smallest number of steps in which the priests can transfer all the discs from the first tower to the third? (**Hint:** Consider the process that recursively transfers the top $n-1$ discs to the second tower, then the largest disc to the third tower and then the top $n-1$ discs from the second tower to the third.)

[1] In the original problem, the number of discs is 64.