University of Waterloo
CS 341 — Algorithms
Winter 2009
Problem Set 2

Distributed Tuesday, January 13 2009.

Due Tuesday, January 20 2009. Hand in to assignment boxes on the 3rd floor of MC by 3 PM.

1. [10 marks]

   Using the description of the RAM model in the online lecture notes, Write a RAM program for the following problem: you are given a list L of $n-1$ integers $x_1, x_2, \ldots, x_{n-1}$ for some $n \geq 2$, and you are told that L contains every number in $\{1, 2, \ldots, n\}$ exactly once (in unknown order), except that one number m is missing. You must find m, the missing number.

   You may assume that the input tape reads as follows: the number n, followed by the $n - 1$ numbers $x_1, x_2, \ldots, x_{n-1}$. For example, if $n = 6$, the input might look like 6 3 2 5 6 1 and the output in this case should be 4 (the missing number).

   Try to find the most efficient algorithm (in terms of time and space) you can, under the unit-cost model. Your solution will be marked on efficiency and correctness. (Hint: the problem can be solved by first sorting the input, but this is not the best way.)

2. [10 marks]

   Analyze your algorithm's worst-case time and space complexity using the unit-cost method. Express your answer as accurately as possible, in terms of n and (possibly) m.

3. [10 marks]

   Analyze your algorithm's worst-case time and space complexity using the log-cost method. You may express your answer using asymptotic notation.