Homework 1
Fundamental Algorithms, Fall 2002, Professor Yap

Due: Tue September 24, in class

INSTRUCTIONS:

- Please read questions carefully.
- Note that we do not accept late homeworks because we would like to publish solutions in a timely fashion.
- We put a link from our homework page to the old homework from a previous class, including solutions. It is a good idea to read them, as this gives a clue to what is emphasized in this course.

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1. (10 Points) Please carry out by hand (!) a simulation of Karatsuba's algorithm for the following input: $X = 11 = (1011)_2$, and $Y = 5 = (0101)_2$. Organize your computation in any way you find reasonable, as long as you explain clearly what you are doing.

2. (20 Points) Use the EGVS Method (i.e., Rote Method) to solve the following recurrences:
   (a) $T(n) = T(n-1) + n$
   (b) $T(n) = 4T(n/2) + 1$
   The method involves 4 steps (Expand, Guess, Verify, Stop). Make sure that each step is clearly marked and explained. Be sure to tell us what initial condition you choose.

3. (2 Points) Question 3.1-3, page 50.

4. (4 Points) Question 3.1-4, page 50.

5. (10 Points) Show that $\sum_{i=1}^{n} \log i = \Theta(n \log n)$.

   NOTE: You must divide this argument into two steps (show an upper bound, then a lower bound). You MUST explicitly show the constants c_1, c_2 and n_0 in the definition of the Θ-notation.

6. (10 Points) Question 3-3, page 58. Do part (a) only.

   To help us grade your answer, we want you write each equivalence class in one line of answer. Also, begin with the slowest growing functions first.