CS 5633 Analysis of Algorithms – Spring 05

1/25/05

1. Homework
Problems 1 and 2 are due **Tuesday 2/1/05** before class
Problem 3 is due **Thursday 2/3/05** before class

Please submit your answers to problems 1 and 2 on paper in class (at the beginning of class) on 2/1/05. The implementation for problem 3 should be emailed to Carola before class on 2/3/05.

1. **Code snippet (6 points)**

   Give the Θ-runtime (depending on n) for the code snippet below. Justify your answer. $sqrt(n)$ denotes the *square root* of n.

   ```
   int i,j,k;
   for(i=n; i>0; i=i-4){
     for(j=n; j>=1; j=j/3){
       for(k=n; k>=2; k=sqrt(k)){
         print(''hello'');
       }
     }
   }
   ```

2. **Big-Oh ranking (14 points)**

   Rank the following functions by order of growth, i.e., find an arrangement $f_1, f_2, ...$ of the functions satisfying $f_1 \in O(f_2)$, $f_2 \in O(f_3),...$. Partition your list into equivalence classes such that f and g are in the same class if and only if $f = \Theta(g)$. For every two functions f_i, f_j that are adjacent in your ordering, prove shortly why $f_i \in O(f_j)$ holds. And if f and g are in the same class, prove that $f = \Theta(g)$.

   $$n^2, \; n^3, \; 7n^2 + 3n + 2, \; 3^{2^n}, \; \log\log n, \; \log n, \; 1, \; n\log n + n^3, \; n, \; 2^n,$$
   $$n\log n, \; 3^{n+1}, \; 3^n, \; \sqrt{n}$$

   Bear in mind that in some cases it might be useful to show $f \in o(g)$, since $o(g) \subset O(g)$. If you try to show that $f \in o(g)$, then it might be useful to apply the rule of l'Hôpital which states that

   $$\lim_{n\to\infty} \frac{f(n)}{g(n)} = \lim_{n\to\infty} \frac{f'(n)}{g'(n)}$$

   if the limits exist; where $f'(n)$ and $g'(n)$ are the derivatives of f and g, respectively.

3. **Heapsort in LEDA (10 points)**

Write a C++ program using LEDA which implements and tests heapsort. The program should contain the following:

   (a) A way to input data (e.g., input a sequence of integers using an input stream or a file).

   (b) An implementation of heapsort using the data type p_queue.

   (c) A way to output data (e.g., print the sorted sequence of integers).

   (d) A test case: Give some specific input data and show which output the program computes. (A screenshot or printout of the test case would be nice, but is not necessary.)

Please email the C++-source of your implementation to carola@cs.utsa.edu. The program should compile and run under linux using g++ and the LEDA library.