ICS 23 — Data Structures — Winter 2005 — Goodrich — First Midterm B

Name:

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total:

1. (30 points). Please answer of the following short questions dealing with trees:

(a) Define *external node* of a tree.

(b) What does it mean that a tree is an *unordered* tree?

(c) If a tree has n nodes in total, and $n \geq 3$, what is the maximum number of children that the root can have?

2. (30 points). Give a recursive, pseudo-code description of an algorithm for performing a postorder traversal of the subtree rooted at a node v in a binary tree T. You may not use a loop in your description.

3. (30 points). Using the definition of Big-oh, show that each of the following is true.

(a) $3n^2 + 2n + 5$ is $O(n^2)$.

(b) $2n \log n + 2n + 10$ is $O(n \log n)$.

(c) $22 \log n + 10$ is $O(\log n)$.

4. (30 points). This problem deals with linked lists.

(a) Describe a recursive algorithm for adding up the values stored at the nodes in a singly linked list L given a reference, f, to its first node (the **next** pointer for the last node is null, and if f is null, then the list is empty). You may not use a loop for this question.

(b) Describe an algorithm for solving the above problem using an iterator x for the elements stored in L. You must use a loop for this question.

5. (30 points). Consider the following algorithm, which takes as input an array A of n integers (indexed from 0 to $n-1$):

$i \leftarrow 1$
$p \leftarrow 1$
while $i \leq n$ **do** {
  $p \leftarrow p \cdot A[i-1]$
  $i \leftarrow 2 \cdot i$
  }
Print "The product of the integers in A is " p

(a) Use the Big-oh notation to characterize the asymptotic running time of this algorithm, as a function of n (you may assume that the array A is already in memory; hence, you don't have to count the time to read in A).

(b) For which values of n is this a correct algorithm for multiplying all the integers in A?