

CSCE3110 Data Structures and Algorithm Analysis  
Midterm Sample  
Mar. 05, 2007

1.

a. Show that the function  $f(n)=2n^2 + 7n + 6$  is  $O(n^2)$  using the definition of big-Oh.

b. Give the worst running time of the following algorithm, using the big-Oh notation, in terms of  $n$ . Show your work.

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for i ← 1 to n-1 do
  for j ← i+1 to n do
    A statement that takes  $O(1)$  time
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c. What is the running time for the recursive function characterized by the equation. Show your work (no credit will be given without intermediate steps).

$$T(n) = 2T(n/2)+O(1).$$

d. Write the pseudo-code for an algorithm that reverses the order of the elements in an array of size  $N$ . You can only use a few more extra spaces for variables. Analyze the running time of the algorithm.

2. What is a queue? Show two possible implementations for a queue. Discuss advantages and disadvantages.

3. Assume a stack is represented using a singly linked list, with the top of the stack at the end of the list. The singly linked list only keeps track of the head of the list. Give the pseudo-code or C/C++ code for the push and pop methods. What is the running time of each method (based on your implementation)

4. a. Define what is meant by the depth of a node in a tree. What is the height of a node in a tree. Give examples to show your point.

b. Give a short pseudo-code or C/C++ code fragment to compute the depth of a node  $v$  in a binary tree  $T$ . You should work under the assumption that the nodes in the tree do not have a pointer from child to parent.

c. Use the big-Oh notation to characterize the worst-case running time of your method in terms of the number  $n$  of nodes in the binary tree  $T$ .

5. Show the binary search tree as the result of inserting 78,2,3,45,12,23,21,90 into an empty tree in the given order. Is the tree an AVL tree? Why and why not?

6. Show the 2-4 tree as the result of inserting 78,2,3,45,12,23,21,90,15,44,1 into an empty tree in the given order.