

Name: _____

SSN: _____

CS 140A - Midterm November 7, 1997

Be sure to read each problem carefully and follow the directions. Points may be marked off if you do not follow the directions. Please feel free to ask if you have any questions.

You are allowed to write pseudo-code, but be sure that your code is clear and that you state any assumptions you make.

This test is long, so be sure to pay attention to the points assigned to each problem and work wisely, not spending too much time on any one problem. Good luck.

Problem 1	20	
Problem 2	12	
Problem 3	10	
Problem 4	5	
Problem 5	4	
Problem 6	5	
Problem 7	5	
Problem 8	7	
Problem 9	3	
Problem 10	6	
Problem 11	10	
Problem 12	4	
Problem 13	4	
Problem 14	5	
TOTAL	100	

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1. (20 pts) Define the following terms:
 - (a) Abstract Data Type
 - (b) Algorithm
 - (c) Big-Oh Notation (give a mathematical definition)
 - (d) Stack
 - (e) Red-Black Tree

2. (12 pts) Give time complexities for the following (be as specific as possible):

- (a) Pushing an item in a stack implemented by an array.
- (b) Inserting in the front of a linked list.
- (c) Removing an item from a linked list implementation of a red-black tree.
- (d) Finding the minimum node in a binary search tree.
- (e) Dequeuing an item in a linked list implementation of a queue.
- (f) Removing an item from an array implementation of a list.

3. (10 pts) True or False:

- (a) A queue is referred to as a LIFO data structure.
- (b) A self-adjusting list decreases the average time for a search while at the same time keeping the time complexities the same for the other list functions.
- (c) The root of a tree is at depth 0.
- (d) No tree can have the same node listings in preorder, inorder, and postorder.
- (e) Anything that can be implemented with stacks can be implemented with queues.

4. (5 pts) List three advantages of linked lists over arrays, and two advantages of arrays over linked lists.

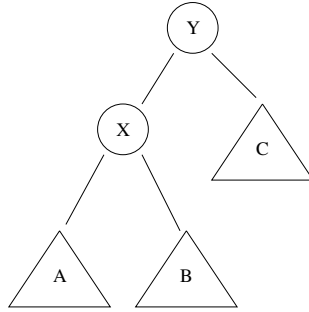
5. (4 pts) Convert the following expression to postfix notation.
 $((a + b) * c + (d * e)) + (f * g)$

6. (5 pts) Explain how a binary search tree can be used to sort a set of numbers. What would be the time complexity of the algorithm?

7. (5 pts) Show the resulting Binary Search Tree if the following items were inserted in the given order. 26, 14, 33, 7, 48, 96, 82, 19, 55

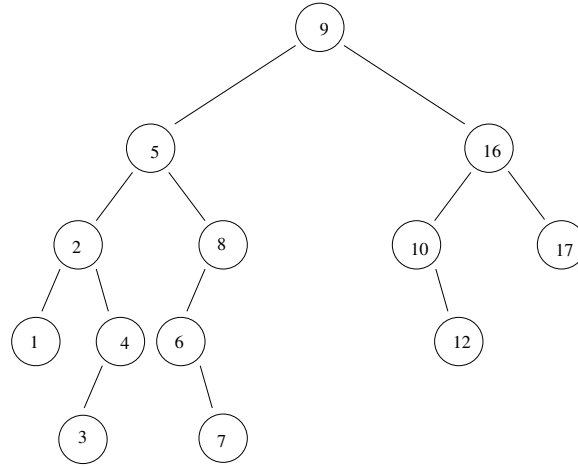
8. (7 pts) Write a recursive function to return a pointer to the node with the item of maximum value in a binary search tree.

9. (3 pts) Given the following figure, let a , b , and c be arbitrary nodes in the subtrees A , B , and C respectively. How do the depths of the nodes change when a right rotation is performed on node Y ?



10. (6 pts) Write a recursive definition to compute the height of a binary subtree given the node pointer to that subtree.

11. (10 pts) Answer the following questions for the given tree.



- (a) What is the height of the tree?
- (b) What depth is node 16 at?
- (c) Show the postorder listing of the nodes.
- (d) Show the resulting tree if node 5 was removed.

12. (4 pts) Show the resulting tree if you performed a right rotation around node 9 in the tree of problem 11.

13. (4 pts) Show the resulting tree if you performed a left rotation around node 2 in the tree of problem 11.

14. (5 pts) Show the resulting 2-3 tree if the following items were inserted in the given order. 20, 6, 13, 2, 19, 16, 8