

685.621 Algorithms for Data Science
Homework 6
Assigned at the start of Module 12
Due at the end of Module 13
Total Points 100/100

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Collaboration groups have been set up in Blackboard. Make sure your group starts one thread for the collaborative problem. You are required to participate in the collaborative problem. Do not directly post a complete solution, the goal is for the group to develop a solution after everyone has participated.

1. [50 points] Consider the following algorithm for doing a postorder traversal of a binary tree with root vertex *root*. Prove that this algorithm run in time $\Theta(n)$ when the input is an n -vertex

Algorithm 1 Postorder Traversal

```
function POSTORDER(root)  
  if root  $\neq$  null then  
    POSTORDER(root.left)  
    POSTORDER(root.right)  
    visit root  
  end if  
end function
```

binary tree.

2. [50 points] ***Note this is a Collaborative Problem*** We define an AVL binary search tree to be a tree with the binary search tree property where, for each node in the tree, the height of its children differs by no more than 1. For this problem, assume we have a team of biologists that keep information about DNA sequences in an AVL binary search tree using the specific weight (an integer) of the structure as the key. The biologists routinely ask questions of the type, “Are there any structures in the tree with specific weight between a and b , inclusive?” and they hope to get an answer as soon as possible. Design an efficient algorithm that, given integers a and b , returns true if there exists a key x in the tree such that $a \leq x \leq b$, and false if no such key exists in the tree. Describe your algorithm in pseudocode *and* English. What is the time complexity of your algorithm? Explain.