CS210a Data Structures and Algorithms
Assignment 3
Due date: October 24 at 11:55 pm
Total of 20 Marks

Submit through OWL a pdf file with your answers to the following questions. Remember that no late concept assignments will be accepted. Yu might find this fact useful: $\sum_{i=1}^{n-1} i = \frac{n(n-1)}{2}$

1. (2 marks) Consider a hash table of size $N = 7$ where we are going to store integer values. The hash function is $h(k) = k \bmod 7$. Draw the table that results after inserting, in the given order, the following values: 19, 27, 12, 47, 15. Assume that collisions are handled by separate chaining.

2. (2 marks) Show the result of the previous exercise, assuming collisions are handled by linear probing.

3. (2 marks) Repeat exercise (1) assuming collisions are handled by double hashing, using a secondary hash function $h'(k) = 5 - (k \bmod 5)$.

4. (3.5 marks) Solve the following recurrence equation using repeated substitution **and** give the order of $f(n)$. You must show how you solved the equation.

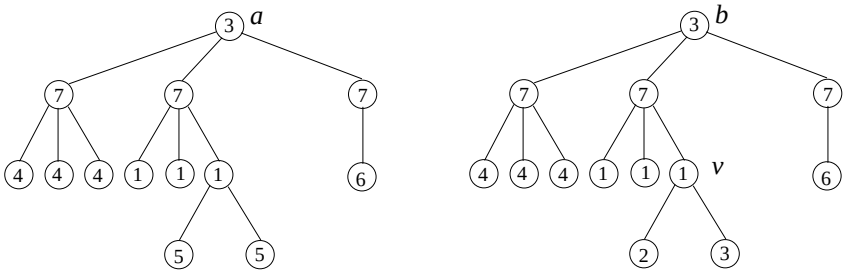
   $f(1) = 3$

   $f(n) = f(n-1) + 2n + 1$

5.(i) (7 marks) A tree is called *symmetric* if for every internal node u all the children of u store the same value. For example the following tree with root a is symmetric, but the tree with root b is not symmetric as one child of node v stores value 2 while the other stores 3.

Write in pseudocode an algorithm `isSymmetric(r)` that receives as input the root r of a tree and it outputs the value *true* if the tree is symmetric and *false* if it is not. For a node v let v.value denote the value stored in v. To access the children of a node r use the following pseudocode

for each child c of r **do**



5.(ii) (3.5 marks) Compute the worst case time complexity of your algorithm as a function of the total number n of nodes in the tree. You must

- explain what the worst case for the algorithm is
- explain how you computed the time complexity
- give the order of the time complexity of the algorithm