

## CSCI 4041, Fall 2018, Written Assignment 12

1. Runtimes for Professor Marley's implementation of HT Chaining
  - a. Searches  $O(n)$ : The worst-case runtime remains the same, since the worst that can happen is that we are looking for an element within a slot of the Hash Table where all of the  $n$  elements currently reside.
  - b. Insertion  $O(n \lg n)$ : In the worst-case runtime, we must add an element within a slot of the Hash Table where all of the  $n$  elements currently reside, and then resort this array using some sorting algorithm (for this example we will use merge sort).
  - c. Deletion  $O(n)$ : If we were to use an array, the worst-case scenario happens when we must traverse an array within a slot of the Hash Table where all of the  $n$  elements currently reside, in order to delete the last element. Or, if we were to delete any element with this same array, we must reposition the remaining arrays.

2. Ex.  $M = 10$ , Keys = [1, 10, 100, (1,000), (10,000), (100,000)...(1,000,000,000)]

Slots	Keys
0	10
1	1
2	100
3	
4	1,000
5	
6	10,000
7	
8	100,000
9	

1,000,000?

After (100,000) has been placed in slot 8, (1,000,00) and the other subsequent keys will be unable to be placed into an empty slot. This occurs since the inner hash function will always return 2 when given this set of keys. This causes the value of the function  $i \cdot h_2(k)$  to consistently be a multiple of 2, thus looping over all of the even slots from 0-9.

3. Looking for 42:
  - a. This sequence is not a proper binary tree traversal, since values after the first key looked at (which is 77) are not all either smaller or larger than 77. For example, 84 is traversed after 46 but 46 and 84 should be a left and right descendent of 77 respectively.
  - b. This is a proper sequence of nodes that could be searched
  - c. This is a proper sequence of nodes that could be searched
  - d. This sequence is not a proper binary tree traversal, since values after the key 45 (depth 3 of the tree) are not all either less than or greater than 45. For example, 46 is traversed after 11 but 11 and 46 should be a left and right descendent of 45 respectively.

- e. This is a proper sequence of nodes that could be searched