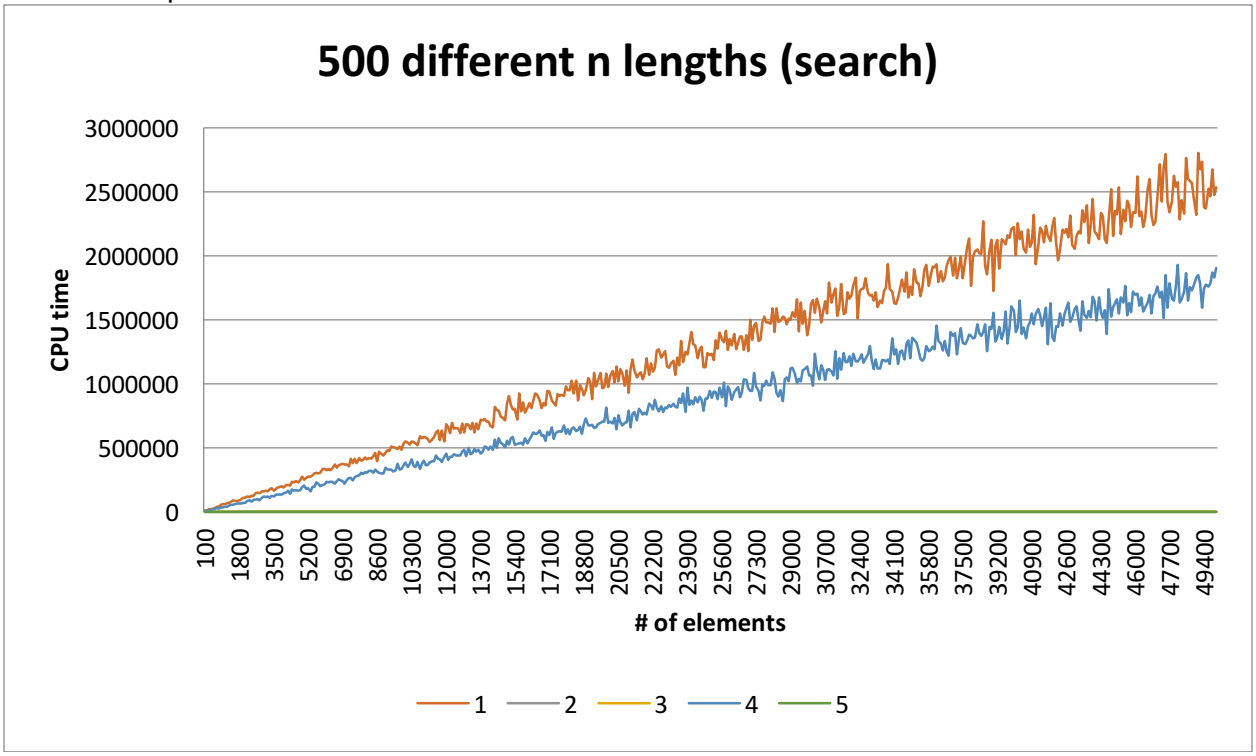
Results:

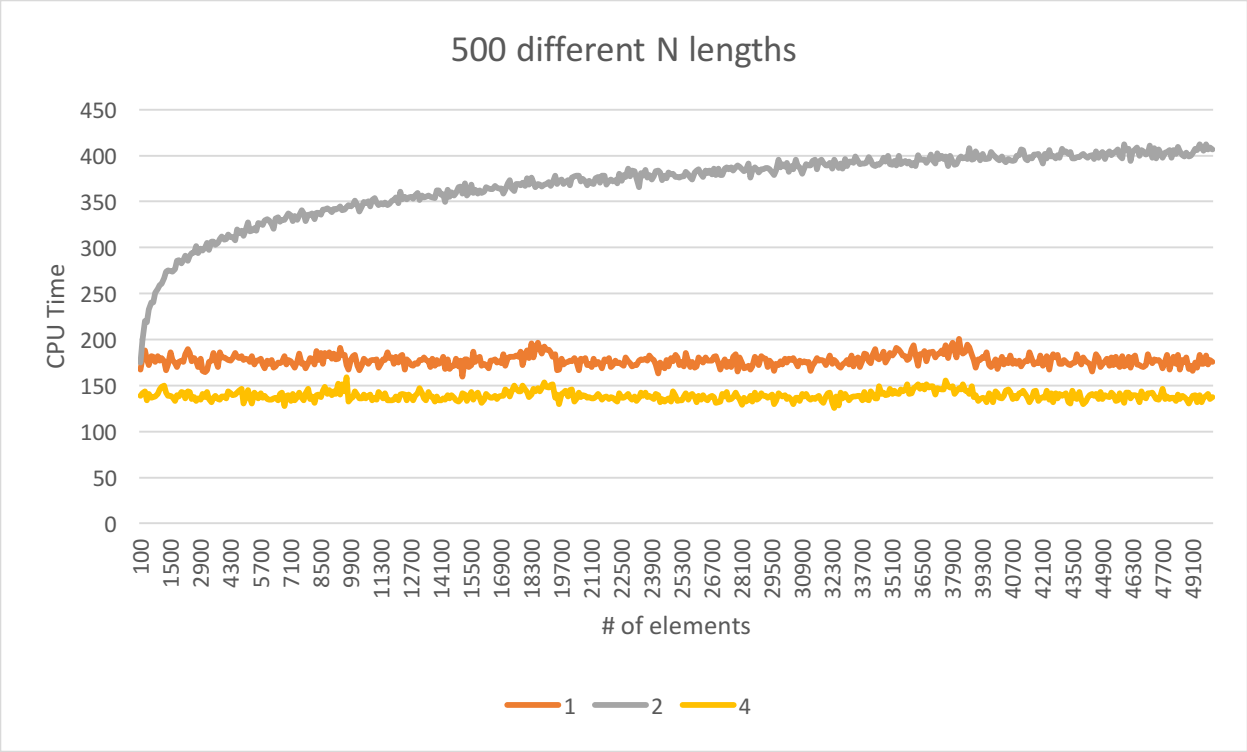
ZERO-BASED INDEX	DATA STRUCTURE
0	Linked list
1	Hash Map
2	Binary Tree
3	Linked List
4	Hash Map

Most of our deductions were made based on testing the average time it took to find an element in a list. The plot is illustrated below:



*** Note that the indices in the graph above are one-based and correspond to the zero-based collections.

Index 0 and 3 are linear, so they must either be a heap or a linked list.
Index 1, 2, and 4 are too small, so I generated a new plot with only them:



This plot shows that Index 2 is logarithmic, and Index 1 and 4 are constant time and surprisingly identical. Since search is only constant time for hash maps, and since they look the same, I concluded that 1 and 4 are both hash maps. The only data structure we were given that should exhibit logarithmic search time is a binary search tree, so that concluded that index 2 is a BST.

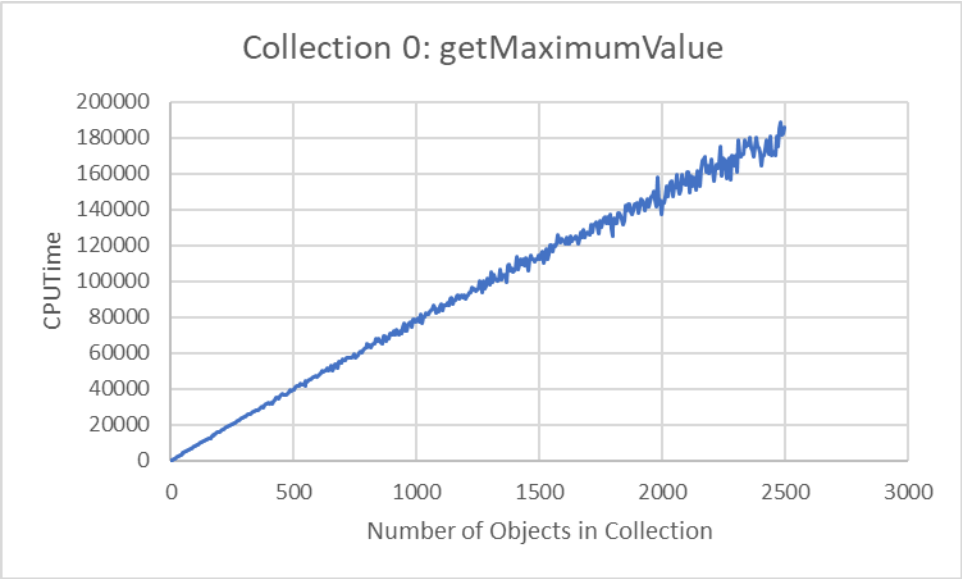
That leaves us to determine whether indices 0 and 3 are heaps or linked list.

To do that, we tested getting the maximum and minimum from each. We expected the following:

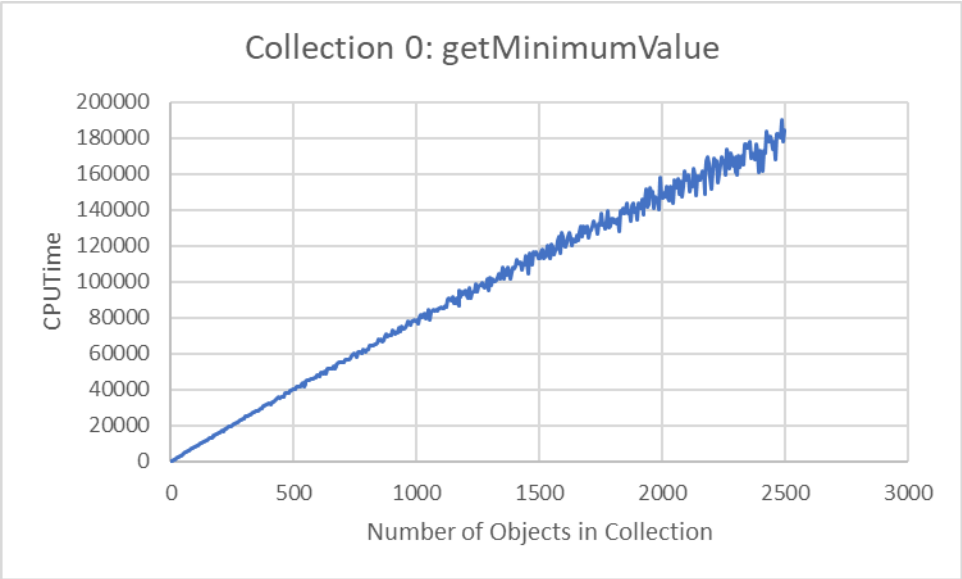
- LinkedLists would yield a linear retrieval time
- HashMaps and Max/Min Heaps would retrieve in constant time
- Binary search trees would retrieve in logarithmic time

Ryan D. Johnson Nicholas Alescio Dung (Kevin) Nguyen

Here are the results of our tests for getting the minimum and maximum value on data structure 0:



conclusion: O(n)

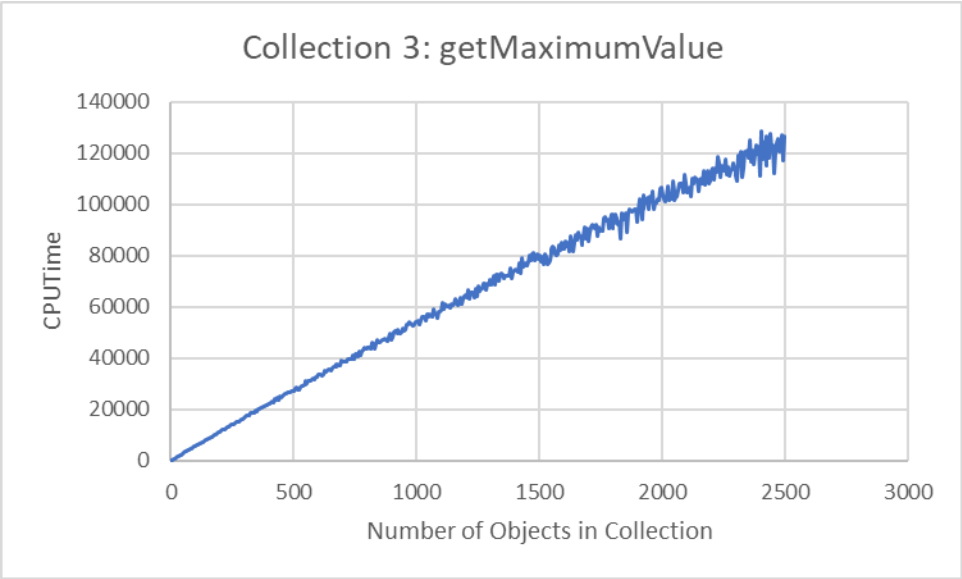


conclusion: O(n)

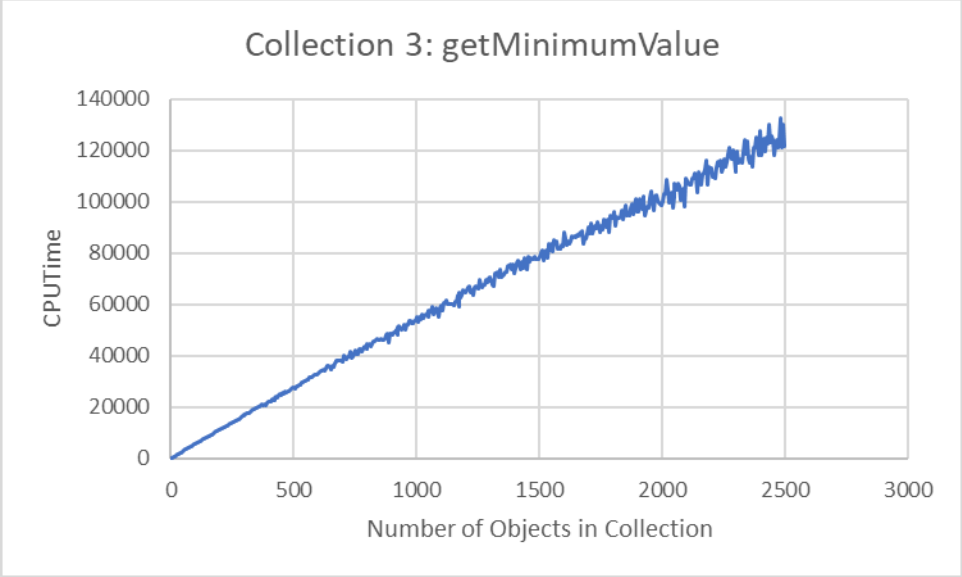
Since both are O(n), these data structures do not exhibit heap behavior. This means the only remaining possibility is a linked list.

Ryan D. Johnson Nicholas Alescio Dung (Kevin) Nguyen

Here are the results of our tests for getting the minimum and maximum value on data structure 3:



conclusion: O(n)

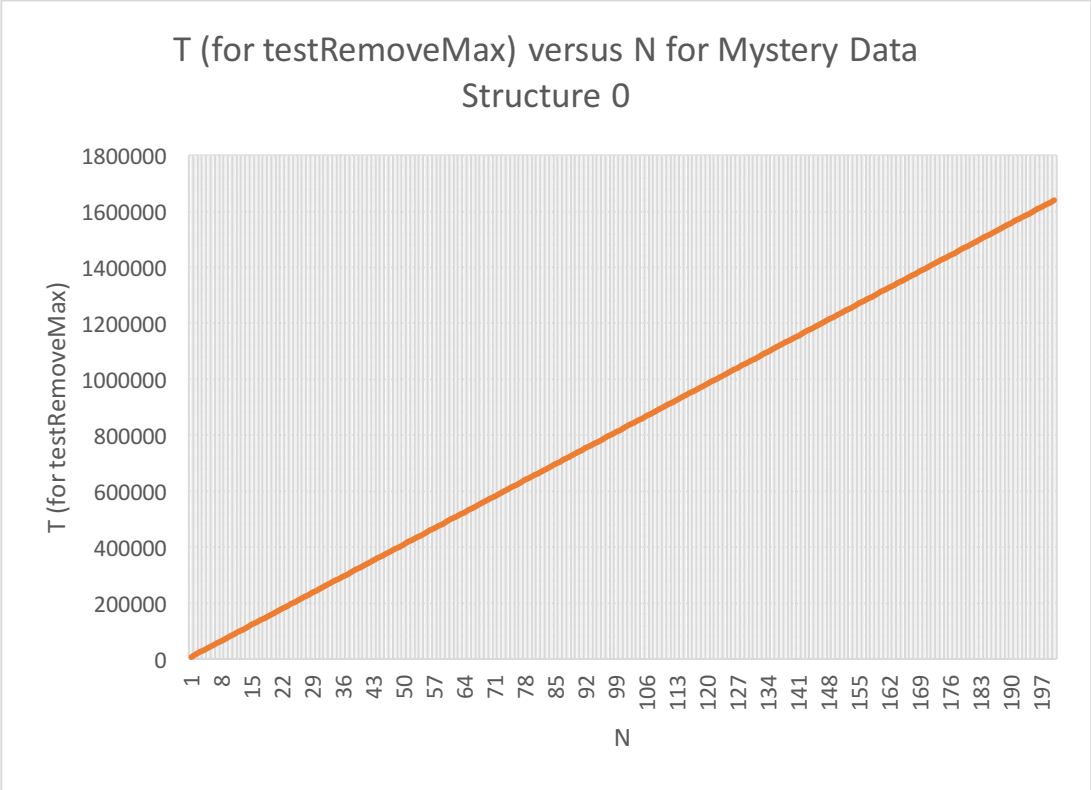


conclusion: O(n)

Since both are O(n), these data structures do not exhibit heap behavior. This means the only remaining possibility is a linked list.

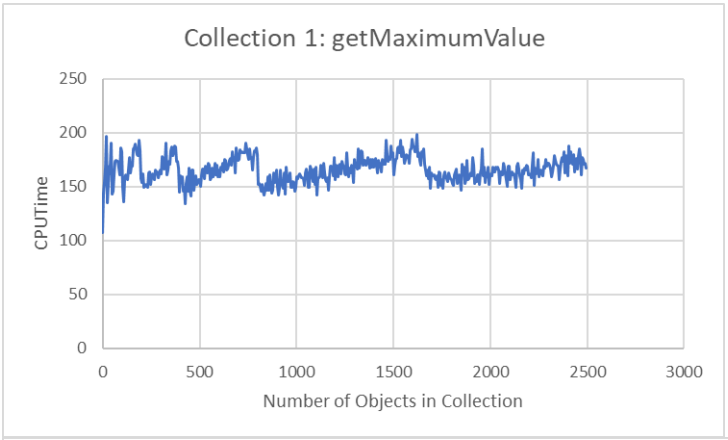
We ran other tests, and to be safe, we made sure that their results matched with our conclusions.

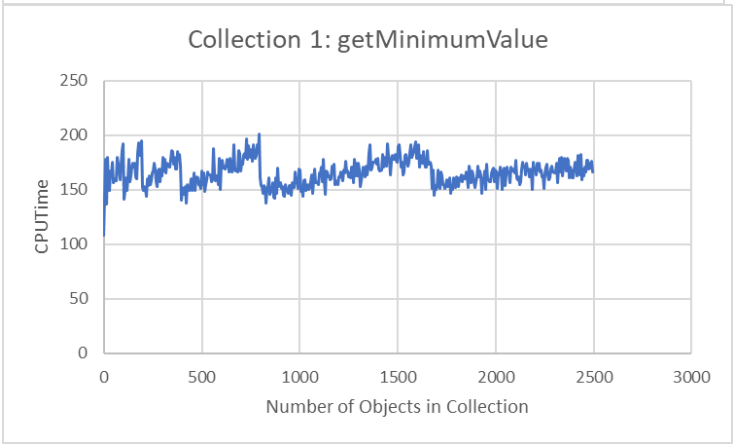
Collection 0:



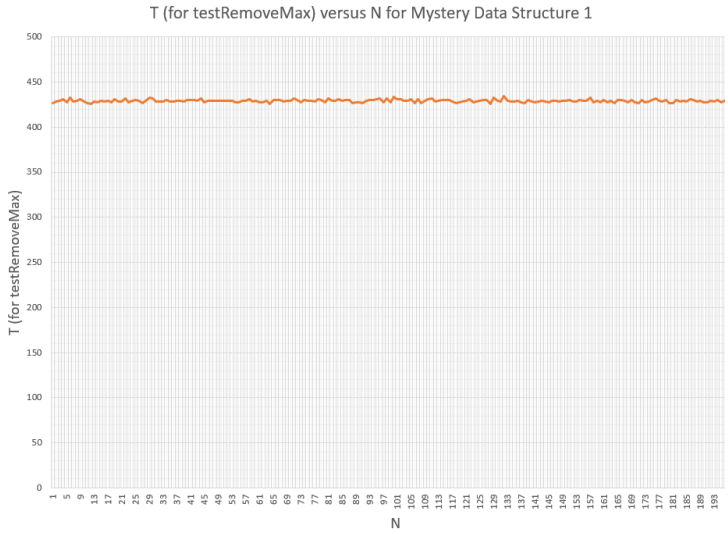
This exhibits linear time for removing the max and indices, which agrees with our original conclusion that it is a linked list.

Collection 1:



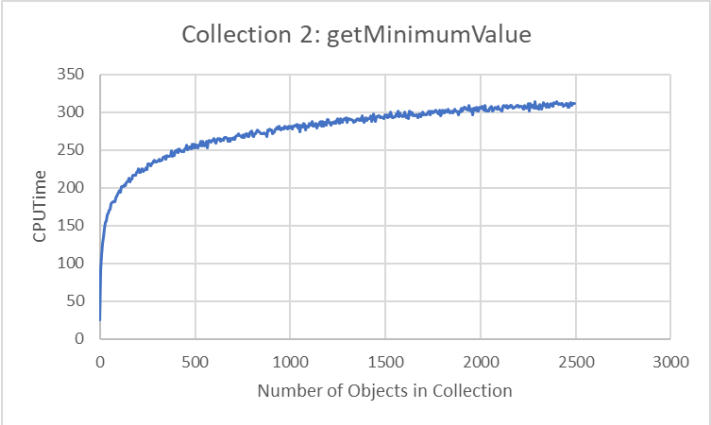


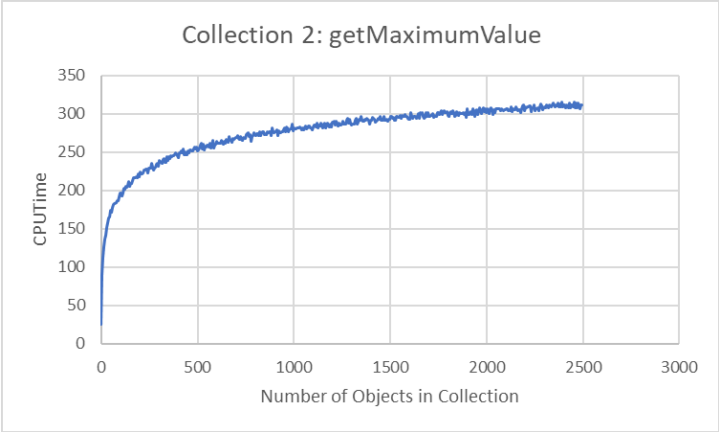
This exhibits constant time for getting the max and the minimum values, which agrees with our original conclusion that it is a hash map.



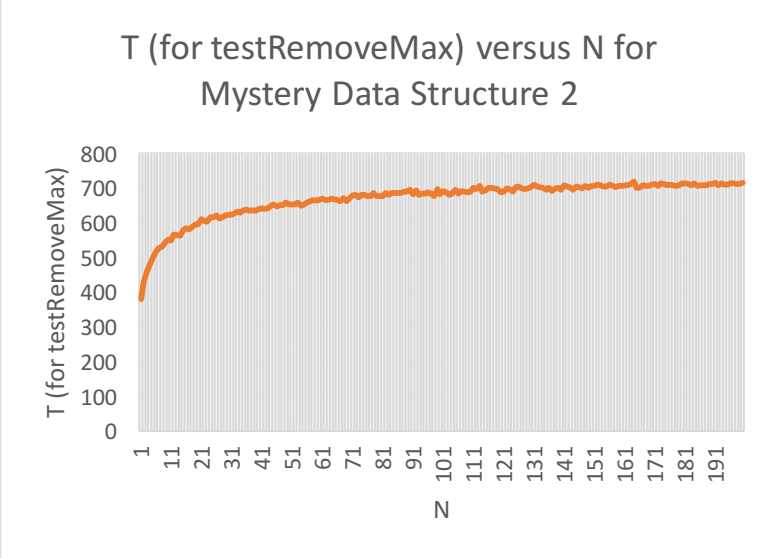
This also exhibits constant removing time for the maximum value, which would also appear on a hash map.

Collection 2:



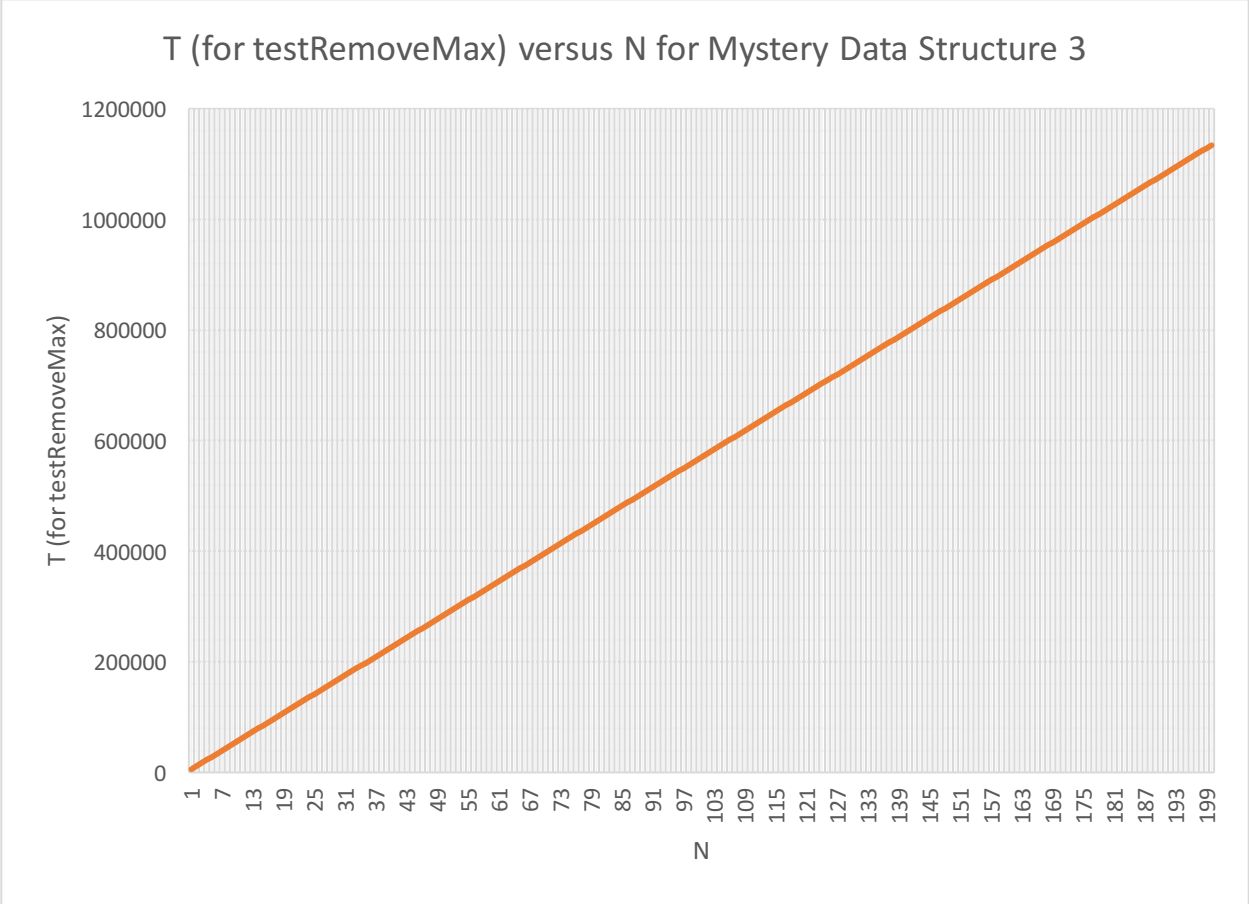


This exhibits logarithmic time for getting the max and the minimum values, which agrees with our original conclusion that it is a BST.



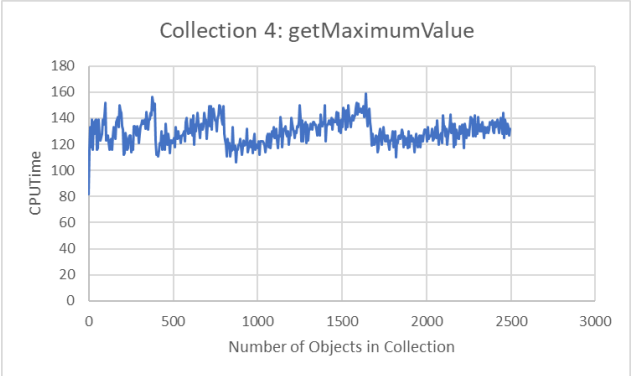
This also exhibits logarithmic removing time for the maximum value, which would also appear on a BST.

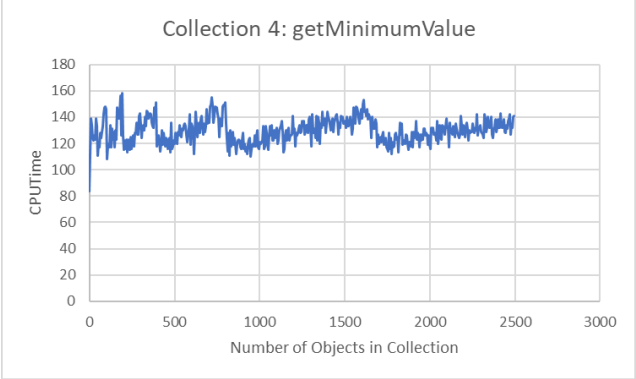
Collection 3:



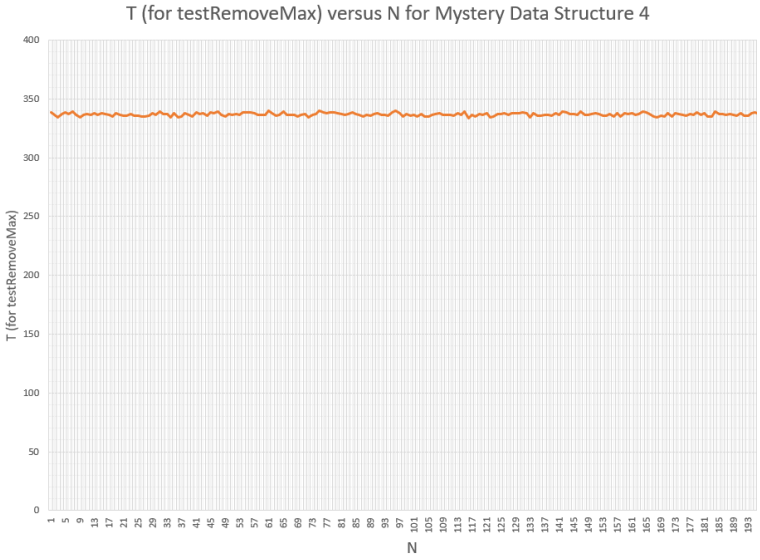
This also exhibits linear removing time for the maximum value, which would also appear on a linked list (which supports out conclusion).

Collection 4:





This exhibits constant time for getting the max and the minimum values, which agrees with our original conclusion that it is a hash map.



This also exhibits constant removing time for the maximum value, which would also appear on a hash map.