

CS 210X: Accelerated Object Oriented Programming Concepts

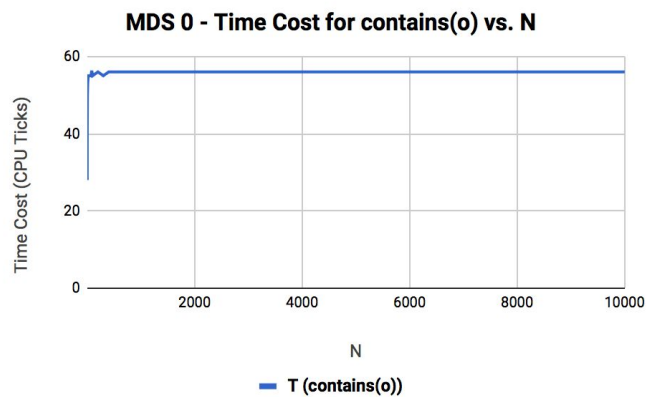
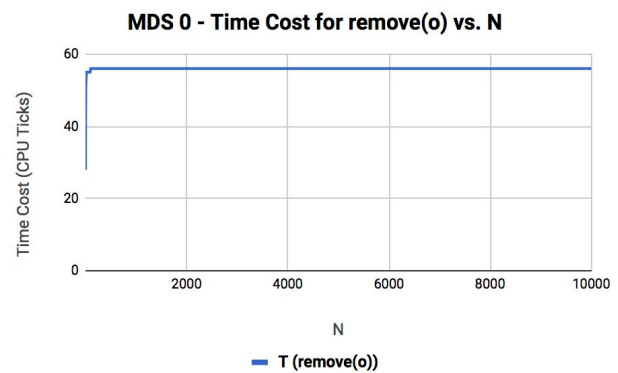
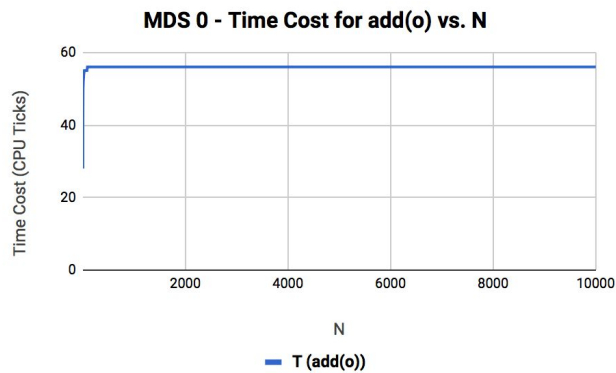
Project 4: Mystery Data Structures

Charan Sankaran, Aditya Hoque, and Nilay Barde

The following table provides the asymptotic time cost of the `add()`, `contains()`, and `remove()` methods for a Doubly Linked List, Heap, Binary Search Tree, and Hash Set.

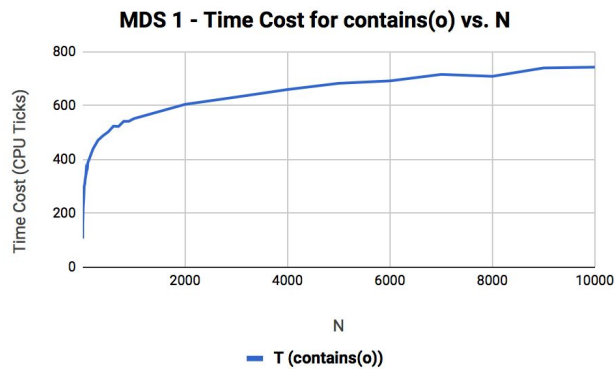
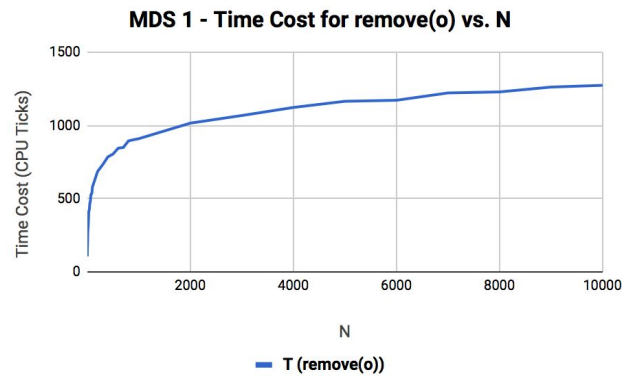
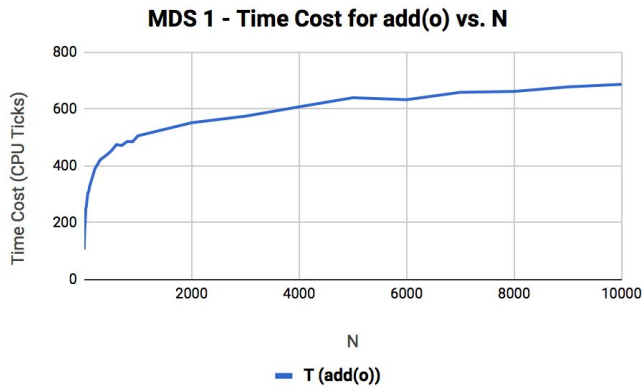
| | Add | Remove | Contains |
|--------------------|-----------------------------|-----------------------------|-----------------------------|
| Doubly Linked List | $O(1)$ | $O(N)$ (Worst) | $O(N)$ (Worst) |
| Heap | $O(\log N)$ (Worst/Average) | $O(N)$ (Worst/Average) | $O(N)$ (Worst/Average) |
| Binary Search Tree | $O(\log N)$ (Worst/Average) | $O(\log N)$ (Worst/Average) | $O(\log N)$ (Worst/Average) |
| Hash Set | $O(1)$ (Average) | $O(1)$ (Average) | $O(1)$ (Average) |

Mystery Data Structure (Index 0):



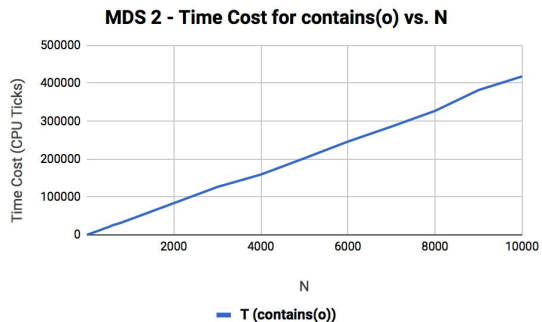
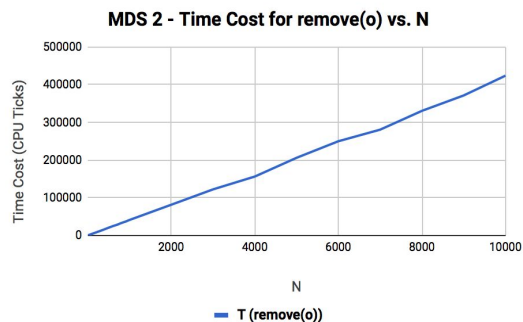
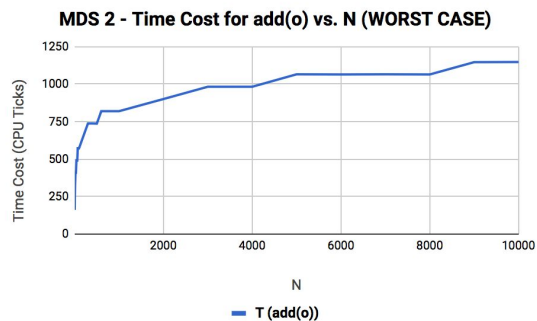
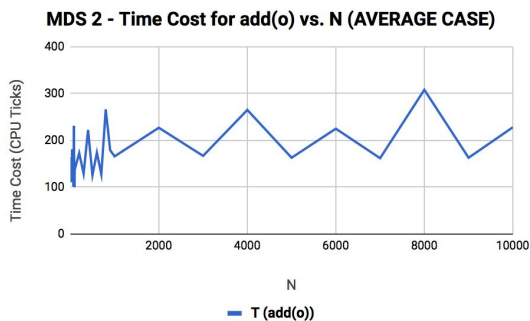
Based on the fact that the `add`, `remove`, and `contains` methods all have an $O(1)$ asymptotic time cost in the average case, we can conclude that this data structure is a Hash Set.

Mystery Data Structure (Index 1):



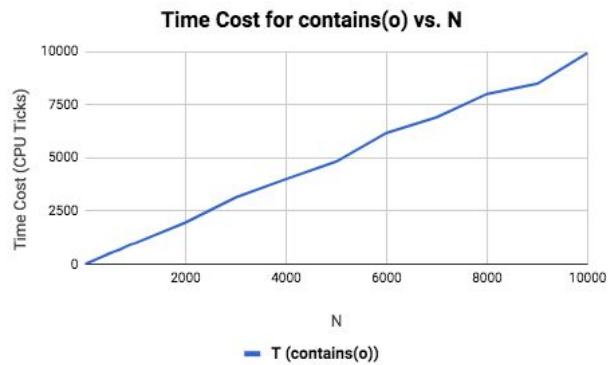
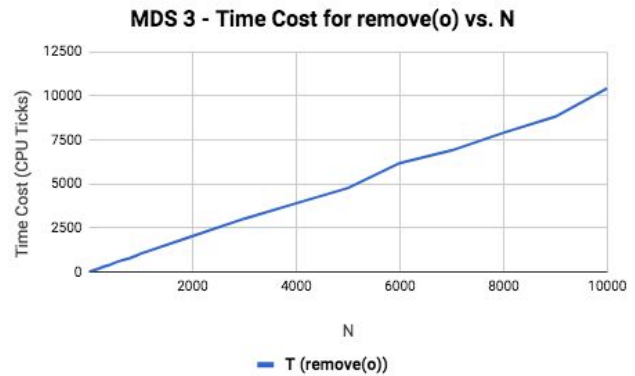
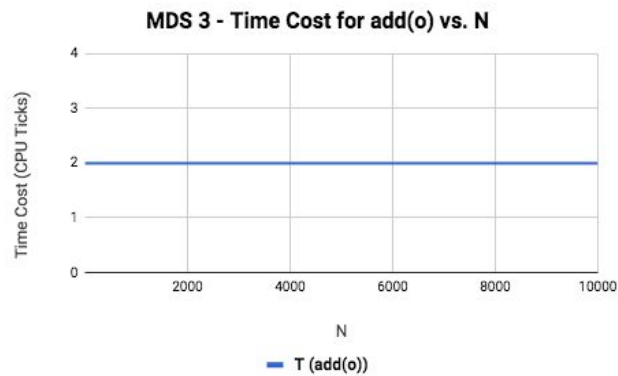
Based on the fact that the add, remove, and contains methods all have an $O(\log(n))$ asymptotic time cost in the average case, we can conclude that this data structure is a Binary Search Tree.

Mystery Data Structure (Index 2):



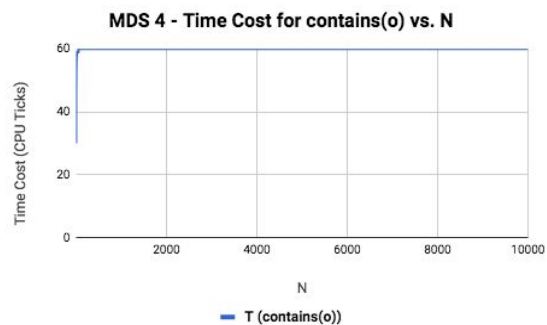
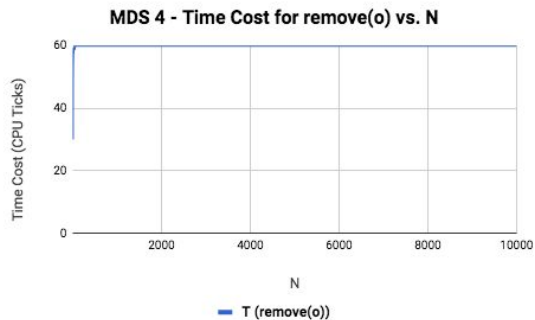
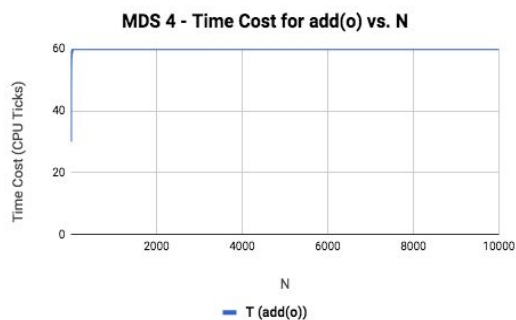
Based on the fact that the add method has an $O(\log(n))$ asymptotic time cost in the worst case, and that the remove and contains methods have an $O(n)$ asymptotic time cost in the average case, we can conclude that this data structure is a Heap. We needed to resort to using worst case instead of average case for the add method because in the average case, the fluctuation in data made the asymptotic time cost unclear.

Mystery Data Structure (Index 3):



Based on the fact that the add method has $O(1)$ asymptotic time cost and that the remove and contains methods have an $O(n)$ asymptotic time cost in the average case, we can conclude that this data structure is a Doubly Linked List.

Mystery Data Structure (Index 4):



Based on the fact that the add, remove, and contains methods all have an $O(1)$ asymptotic time cost in the average case, we can conclude that this data structure is a Hash Set.