

Project 4 Design Document

In previous projects, a linked list was used to store DrillingRecord objects. The time complexity for insertion into a linked list is $O(n)$, as in the worst case scenario, the entire linked list of n elements must be traversed in order to insert an element.

In project 4, the usage of an AVL Tree reduces the time complexity of insertion as an AVL Tree always rebalances itself causing the height to be $\log n$ and the traversal to be $O(\log n)$. Therefore insertion in AVL Tree has a time complexity of $O(\log n)$.

In order to merge an AVL Tree of size m to an AVL Tree of size n , it would take $O(m)$ time to enumerate through the elements of the AVL Tree of size m to be merged. The number of iterations would be $O(m)$ and in each iteration the contains operation, and the replace or the insert operation will be implemented which adds $O(\log n)$, where n is the number of elements in the tree to which another AVL Tree is being merged. The total would be $O(m) + O(m)O(\log n) + O(m)O(\log n)$ which can be written as $O(m \log n)$. The conditional statements are constant time operations.

When merging AVL Trees of size m and n , the worst case space complexity would occur if none on the DrillingRecords matched and the replace function was not used at all. In this case all the elements from one tree would have to be inserted to the other AVL tree which would give a space complexity of $O(m+n)$.

When purging n items from an AVL Tree of size m , it takes $O(n)$ time to traverse the AVL Tree. In every iteration, it will take $O(\log m)$ time to see if the tree contains a given element from tree of size n . After this a DrillingRecord will either be removed or not. If it must be removed, the time complexity for this operation will be $O(\log m)$ as the entire tree must be traversed in the worst case. The purge operation would then be $O(n) + O(n)O(\log m) + O(n)O(\log m)$ giving a time complexity of $O(n \log m)$.

When n elements are to be purged from an AVL Tree of size m , if there is a way to make sure the elements are purged, the space complexity would be $O(m-n)$. In the case where no DrillingRecords are found to match, no elements will be purged and the space complexity will remain $O(m)$.