Andrea Baretta

February 16, 2023

Professor Smallberg

Homework 4 Write-Up

1e. The third test case fails because the vector dynamically allocates new memory when new items are added to it. Then the beginning point of the iterator prior to the insertion of new elements is now freed memory, and so it reads completely random memory.

3. The compiler throws an error because the user tried to use Coord as ItemType. However, Set calls certain operators on ItemType, specifically “operator<”, which the class Coord does not define.

4b. A recursive solution could not have been found with a single parameter, as information on the file path leading up to every file needs to be passed down somehow, but it can’t be through just the File pointer.

5a. Every one of the three nested for loops is O(N). Then time complexity is O(N\*N\*N) = O(N3).

5b. Although this improvement approximately halves the number of computations that need to be done, the algorithm will still be on the order of O(N3).

6a. Worst case, set2 needs to be fully traversed, which is O(N), and at every iteration, something is inserted. Insertion is O(N), so worst case time complexity is O(N2).

6b. The first two for loops are O(N), and both of them use push\_back() at every iteration, which is O(N) in the worst case, but usually closer to O(1). Then the worst case time complexity is O(N2), although the more normal time complexity is O(N2). Then, the sort is O(N log N), and erasing the existing set is O(N). When it comes to inserting the non-duplicate nodes, the loop goes over 2N items at worst, and insertBefore() is time complexity O(1), since it always inserts before the first element. Then the average overall time complexity is O(N + N log N + N + 2N) = O(N log N), but in the worst case (when the vector reallocates memory at every use of push\_back()), time complexity is O(N2 + N log N + N + 2N) = O(N2).

6c. The while loop iterates over both linked lists, and consequently has time complexity O(2N) = O(N). The insertBefore() method inside of that has a time complexity of O(1). The while loop, overall, has time complexity O(N). The last for loop iterates over one of the lists, which is time complexity O(N), and inserts at head, which is O(1). Then the worst time complexity is O(N).