Assignment 4 Report – Antonio Santos

What is the Big-O Complexity?

This analysis can be divided into 2 parts. The first part is adjacency matrix and the second is creating the minimum spanning tree, as outlined on the Assignment document [2]. Let V be the number of neighbors and N be the size of each vertex. When analyzing the code for the first part, we see since we check the difference between a vertex and all V vertices, and we do this for all V vertices, it takes a time complexity of O(V*(V+1)) due to the nested for loop. This can be simplified to $O(V^2)$. We Then look at the difference function where a comparison is done N elements of one vertex to N elements of another vertex. This gives us O(N*N) or $O(N^2)$. Then, we look at the Depth First Search function which is used when printing the values in the adjacency matrix. This is similar to creating the adjacency matrix because we are still required to traverse through all the vertices for each vertex. The only difference is that it is done recursively and not through a nested loop. So, combined the big O time complexity of this is O(V*V*N*N) or simply $O(V^2N^2)$.

The next part is creating the minimum spanning tree. This is done through Prim's algorithm. We must also consider that we are using an adjacency matrix and not an adjacency list. At every iteration of the loop, we add one node to the tree and since there are V vertices, we can assume that the loop runs V time so O(V). We can then analyze the code and see that there is a loop that runs V-1 times and within the loop is a another loop and also a function call to minKey() which holds a loop in the method. This These loops are both executed V times since the outer loop runs (V-1 + 1) times for the failed run. Therefore, the overall time complexity of this part is O((V-1)(V+V)+V) which can be simplified to $O(V^2)$. Adding the two parts together we get $O(V^2N^2+ V^2)$. Since V^2N^2 is the dominant term, our overall time complexity for the whole program is $O(V^2N^2)$, where V is the number of vertices and N is the number of elements in the vertex.

References

[1] Sean Ovens, Asgmt4 – Skeleton Code

http://pages.cpsc.ucalgary.ca/~sgovens/code_snippets/assignment4/SkeletonCode/

[2] Dr. Sousa, Asgmt #4 – Graphs

https://d2l.ucalgary.ca/d2l/le/content/252612/viewContent/3442098/View