Krishna Sai Chemudupati **COSC 3020\_Assignment02**

**Problem 1:**

Part1:

1. It omits all coefficients from the analysis. For example:

, and will follow the same asymptotic complexities.

1. During asymptotic analysis, we consider only very large values of n. For example:

, and

Through asymptotic analysis, we say that the is faster than . But, we are only considering high values of n for which is faster than In this example, is faster than till . Which means that, for values of n less than 100 algorithm1 will be more efficient. But, asymptotic analysis misleads us in this case.

1. It doesn’t take into factor how much time it ‘actually’ takes for the CPU to complete a command. For example, if we are working with very large arrays, not all memory can be loaded into the cache. Therefore, the memory must be retrieved from the main memory and it takes more time to do the same element access in arrays.

Part2:

Search in a balanced binary search tree follows the asymptotic complexity of O(logn). The run time depends on much more complicated function than the Big-O approximation as it neglects the lower order terms.

Given, binary search in a tree with 1000 elements takes 5 seconds. Below shown is my attempt to find the neglected lower order terms in the equation.

Let us assume that there is a constant k coefficient for (logn) which is omitted.

In the information given, n=1000 resulted in 5 seconds.

Therefore,

Therefore the time taken for n=10,000:

Therefore, it will take approximately 6.7 seconds to search in a tree with 10,000 elements.

Part3:

1. Tree wasn’t well balanced. Mostly, the elements formed linked list structure.
2. Mostly all elements in this tree were lesser than the element we are searching for.
3. Each node of the tree is stored in random memory locations, and as the tree gets large, the memory location of nodes might not be loaded onto the cache. This can cause further delay in processing the same search.

**Problem 2:**

**Part1:**

Definition of isomorphism: Two undirected graphs are isomorphic if they have the same structure. is isomorphic to if there is a one-to-one and onto function such that iff.

Let there be two graphs G1, and G2 with *n* nodes each. Since both graphs are completely connected, every node is connected to every other node. Now below is the proof that G1, and G2 are isomorphic.

**Graph 1:**

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**Graph 2:**

Therefore, in this case too,

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Consider a bijective function such that:

, such that if then

Therefore, if, then it implies that

This is because, a completely connected graph has edges between every distinct node and since, and have an edge between them, we can say and are distinct. Since there exists a *one-one* function , we can say that and must also be distinct nodes in G2. As, G2 is also a completely connected graph, and and are distinct, there must also exist an edge between them.

As the function is bijective, there must exist an inverse function such that

Therefore, if , it implies that

We can prove this case using the same reasoning above.

From this information, we can say that the two graphs, and are isomorphic because, there is a one-one and onto function , such that if and only if where .

**Part2:**

Let us assume that for two graphs A and B to be isomorphic, they have to be completely connected. By proof by contradiction, we need just one case in which two non-completely connected graphs are isomorphic.

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| Graph 1 | Graph 2 |
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Consider these two graphs. There is a one-one matching between the vertices and respective edges of the two graphs.

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| Graph 1 | Graph 2 | Graph 1 | Graph 2 |
| A | 1 | (A, B) | (1, 2) |
| B | 2 | (B, C) | (2, 3) |
| C | 3 | (C, D) | (3, 4) |
| D | 4 |  |  |

This shows that the shown two graphs, Graph 1 and Graph 2 are isomorphic even though they are not completely connected. This contradicts the assumption made in the beginning of the proof. Therefore, it is proved that two graphs need not be completely connected to be isomorphic.

**Problem 4:**

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cannot be added because it will form a cycle.

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Therefore the minimum spanning tree formed is: 