CISC 235 Assignment 4

Student Name: Thomas Wilkinson

Student ID: 20269155

"I confirm that this submission is my own work and is consistent with the Queen's regulations on Academic Integrity."

Part 1:

```
Adjacency list of generated tree:
Vertex: 0, Connections: 1 5

Vertex: 1, Connections: 0 2 4 7

Vertex: 2, Connections: 1 3

Vertex: 3, Connections: 2

Vertex: 4, Connections: 1

Vertex: 5, Connections: 0 6

Vertex: 6, Connections: 5

Vertex: 7, Connections: 1

Graph Diameter: 5


Adjacency list of generated tree with 8 added edges:
Vertex: 0, Connections: 1 5 7 2

Vertex: 1, Connections: 0 2 4 7

Vertex: 2, Connections: 1 3 7 0

Vertex: 3, Connections: 2 6

Vertex: 4, Connections: 1 5

Vertex: 5, Connections: 0 6 4

Vertex: 6, Connections: 5 3

Vertex: 7, Connections: 1 2 0

Graph Diameter: 3
```

Part 2:

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Part 2:
Average Tree Diameter for n=100: 14.0
Average Graph Diameter for n=100: 7.1
Average Tree Diameter for n=200: 16.7
Average Graph Diameter for n=200: 8.2
Average Tree Diameter for n=400: 20.5
Average Graph Diameter for n=400: 8.8
Average Tree Diameter for n=800: 24.1
Average Graph Diameter for n=800: 9.9
Average Tree Diameter for n=1600: 28.3
Average Graph Diameter for n=1600: 10.9
```

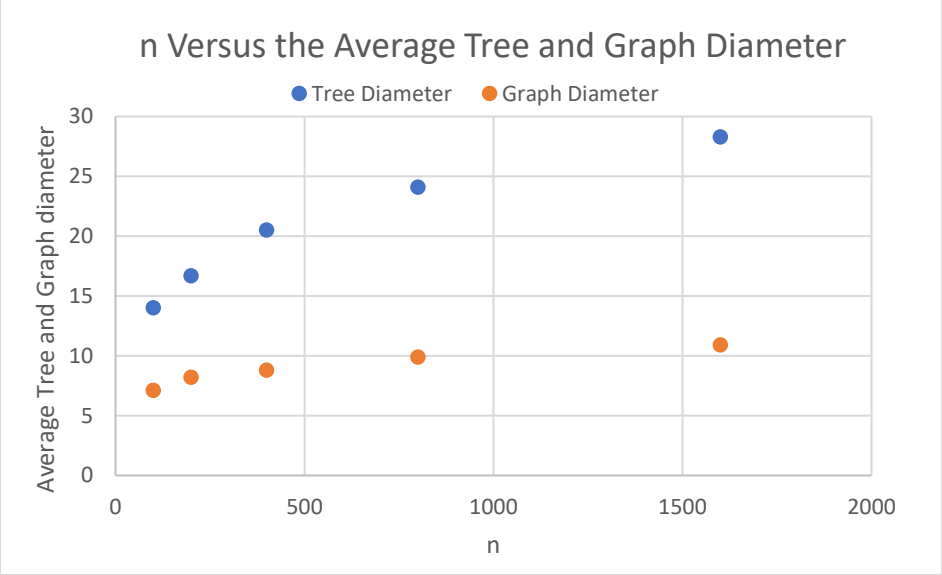

Figure 1: Scatter plot depicting the relationship between the number of vertices and edges of a graph and tree to their average diameters.

As seen in Figure 1, as n increases the average tree and graph diameters increase logarithmically. This can be seen as they both start increasing almost linearly but then start to slow down as their slope decreases. It makes sense that the average graph diameters are a lot less than the average tree diameters since the graphs have more connections, and therefore, more possibles routes that can be used during traversals.

Part 3:

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Part 3:
Average Ratio for n=100: 5.354761904761904
Average Ratio for n=200: 9.073809523809526
Average Ratio for n=400: 17.07845238095238
Average Ratio for n=800: 29.525
Average Ratio for n=1600: 49.6452380952381
```

Based on the observations I made by varying the n values in this experiment I could conclude that as the number of vertices and edges are added to a given graph, the DFS algorithm becomes less and less efficient compared to the BSF algorithm. As seen just above, when dividing the traversal edge sum using the DFS by the traversal edge sum using the BFS a ratio can be found, when averaging this ratio for a given number of samples and increasing n it increases significantly. This means that the traversal edge sum calculated from the DFS increases a lot more than the traversal edge sum calculated from the BFS and proves the previously stated point.