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Final Project - Option #1

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Assignment approach / theory:

The assignment provides a graph with 7 Vertices and 6 Edges. This suggests that I would need to implement a graph data structure and then use graph traversal algorithms like Dijkstra's / Kruskal's / Primm's algorithms to traverse it in order to answer the questions.

However, upon close inspection of the provided graph details. There is one less edge than vertices which means that this graph is the same thing as a binary tree. Additionally, the binary tree only has one child node per parent node so it is linear in structure.

This means that I don't have to implement a graph data structure, nor do I have to implement any graph traversal algorithms. Instead I can represent the graph as 2 parallel arrays: one containing the list of Vertices (planets) and the other containing the list of Edges (distances between planets).

1. Part ONE wants me to create a minimum spanning tree and normally I would use a graph traversal algorithm to do so but instead I just iterate through both arrays and add up all of the edges.
2. Part TWO wants me to calculate the shortest path from Rakata Prime to Dantooine. Again, normally a Graph traversal algorithm would be used here but since there is only one pathway to take, I can just iterate backwards through the array to solve this.
3. Part THREE wants me to find the best base location to protect all 7 planets the best. If all 7 planets have an equal chance of being attacked, then the best base location would be the planet with the lowest average travel time to all of the other planets. This could be done by running djikstras algorithm 7 times, once with each of the different planets as the starting point to calculate the total pathway. The lowest value here would indicate the best planet. Naturally I can expect that the answer will be a planet in the middle of the graph and not any of the end points of the graph.

Program Explanation:

I create my two parallel arrays and then I iterate through both to display the graph structure to the user.

Part ONE: I iterate through both arrays and add up all of the edges for an answer of 21.5

Part TWO: I iterate backwards through the array to solve this for an answer of 20.5

Part THREE: I iterate through each planet and run 2 functions on each of these planets: A “down” function and an “up” function. The down function calculates the distances from my current planet to all of the planets before it in the array. The up function calculates the distances from my current planet to all of the planets after it in the array. Combining the values from both functions yields the total distance and the planet with the lowest total distance is Kashyyyk at 40.5 so the answer is Kashyyyk.

Program Output

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Taris -- 1 -- Dantooine
Dantooine -- 7 -- Tatooine
Tatooine -- 4 -- Kashyyyk
Kashyyyk -- 0.5 -- Manaan
Manaan -- 3 -- Korriban
Korriban -- 6 -- Rakata Prime

#1 Calculate the Total Path:
Taris <--> Rakata Prime = 1 + 7 + 4 + 0.5 + 3 + 6 = 21.5

#2 Calculate the shortest path from Rakata Prime to Dantooine
Rakata Prime --> Korriban = 0 + 6 = 6
Korriban --> Manaan = 6 + 3 = 9
Manaan --> Kashyyyk = 9 + 0.5 = 9.5
Kashyyyk --> Tatooine = 9.5 + 4 = 13.5
Tatooine --> Dantooine = 13.5 + 7 = 20.5
Shortest path from Rakata Prime to Dantooine = 20.5

#3 What is the best planet for a base?
Taris --> Dantooine = 1      Manaan --> Kashyyyk = 0.5
Taris --> Tatooine = 8      Manaan --> Tatooine = 4.5
Taris --> Kashyyyk = 12     Manaan --> Dantooine = 11.5
Taris --> Manaan = 12.5     Manaan --> Taris = 12.5
Taris --> Korriban = 15.5   Manaan --> Korriban = 3
Taris --> Rakata Prime = 21.5 Manaan --> Rakata Prime = 9
Total distance = 70.5      Total distance = 41

Dantooine --> Taris = 1      Korriban --> Manaan = 3
Dantooine --> Tatooine = 7   Korriban --> Kashyyyk = 3.5
Dantooine --> Kashyyyk = 11   Korriban --> Tatooine = 7.5
Dantooine --> Manaan = 11.5   Korriban --> Dantooine = 14.5
Dantooine --> Korriban = 14.5 Korriban --> Taris = 15.5
Dantooine --> Rakata Prime = 20.5 Korriban --> Rakata Prime = 6
Total distance = 65.5      Total distance = 50

Tatooine --> Dantooine = 7   Rakata Prime --> Korriban = 6
Tatooine --> Taris = 8       Rakata Prime --> Manaan = 9
Tatooine --> Kashyyyk = 4     Rakata Prime --> Kashyyyk = 9.5
Tatooine --> Manaan = 4.5     Rakata Prime --> Tatooine = 13.5
Tatooine --> Korriban = 7.5   Rakata Prime --> Dantooine = 20.5
Tatooine --> Rakata Prime = 13.5 Rakata Prime --> Taris = 21.5
Total distance = 44.5      Total distance = 80

Kashyyyk --> Tatooine = 4     Best planet = Kashyyyk
Kashyyyk --> Dantooine = 11   Total distance = 40.5
Kashyyyk --> Taris = 12       Average distance = 5.78571
Kashyyyk --> Manaan = 0.5
Kashyyyk --> Korriban = 3.5   Worst planet = Rakata Prime
Kashyyyk --> Rakata Prime = 9.5 Total distance = 80
Total distance = 40.5      Average distance = 11.4286

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