**BSDS3003 – Data Structure & Algorithm**

**Individual Assignment – Applications of Graph Algorithms (weighting: 35%)**

**Problem Description**

Many real-life problems can be modeled by graphs and resolved by relevant graph algorithms. In this assignment, you are given different problem scenarios and asked to resolve those problems by using selected graph algorithms.  **You need to look for right tools in NetworkX and apply them to tackle the problems.**

There are six places the distances (in kilometers) between pairs of them are given below:

**Table 1**. Distances (in km) between pairs of places.

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| **Place Number** | **1** | **2** | **3** | **4** | **5** | **6** |
| 1 | - | 1.9 | 1.8 | 3.4 | 2.8 | 3.2 |
| 2 | - | - | 2.3 | 1.8 | 2.2 | 1.8 |
| 3 | - | - | - | 2.6 | 1.1 | 3.5 |
| 4 | - | - | - | - | 1.6 | 3.3 |
| 5 | - | - | - | - | - | 3.6 |
| 6 | - | - | - | - | - |  |

1. Assuming all the places mentioned in Table 1 are islands on the sea and the government wants to connect them by bridges so that each island can be reached from any other one. The cost of constructing a bridge is proportional to its length.
   1. Select a suitable graph algorithm to solve the problem such that the construction cost is minimized. Identify each pair of islands to be connected by a bridge and the sum of the lengths of those bridges.
   2. Suppose the islands and the bridges in the results of 1.1 are nodes and edges of a new graph G, without considering edge weighting perform a depth-first traversal and a breadth-first traversal on graph G starting at the node that represents Place 1. Compare the results of the traversals.
2. The data in Table 1 can be interpreted as a complete graph with nodes for places and edges for distance between each pair of places. Ignoring the weightings of the edges, perform a depth-first traversal and a breadth-first traversal on G starting at the node that represents Place 1. Compare the results of the traversals. Then contrast such results with those found in 1.2 and discuss your findings.
3. Based on the graph described in Q1.2, find the shortest path that connects places 3 and 6, and the path length.
4. Once again, let us assume each entry in Table 1 specifies the distance of the road connecting each pair of places. A company wants to set up a new warehouse in one of the places such that there will be one delivery from the warehouse to each other place ***at the same time by different trucks every day***. The delivery cost is proportional to the distance travelled.
   1. Which place should the warehouse be established? Justify your suggestion.
   2. If one single truck is adequate to deliver all the goods to all other places in one go, would this change your suggestion in 4.1? Why or why not?

**Submission Requirements**

Submit a report of your answers to the above questions along with all relevant Python programs (in .py extension) no later than Monday, 17 May 2021.

This assignment amounts to 35% of the course grade. Grading will be based on solution correctness and completeness of your answers (85%), and the quality of your report (15%). Your report should give a clear indication of the sources of any materials that you have referenced when preparinjg this assignment.