CS2302 - Data Structures
Summer 2020
Lab 5
Due Tuesday, July 28, 2020

Part 1

A company wants to establish a drone service to deliver packages from city to city. Your task is to implement algorithms to help them plan the set of flights that will be needed to make sure packages can be delivered from every city to every other city they serve while minimizing flight distances. The file cities.txt contains the names of the cities to be served and the file distances.txt contains the flight distance from each pair of cities from which it is feasible to fly a drone; if flying a drone between two cities is not feasible, the distance appears as -1. For example, the "drone distance" from El Paso to Austin is 851, from Dallas to Las Vegas it's 1700, and it is not feasible to fly a drone from Laredo to San Antonio. To help the company plan its operations, you are asked to do the following:

1. Write a function to read the distance file and build an adjacency list representation of the distance matrix.
2. Write a function to find and display the shortest path from every city to every other city, displaying the sequence of cities (their names, not their numbers) to visit as well as the overall distance. To do this, you need to implement Dijkstra's algorithm and run it once for every city.
3. Now suppose we want to find the set of flights with minimum combined cost that will still make it possible to send packages from a city to any other city. Find this set by applying Kruskal's minimum spanning tree algorithm.
4. Now repeat the second question but only using the flights found in question three. For every route, display the route and distance and state the increase in distance that will result from reducing the number of flights.

Part 2

A man has to get a fox, a chicken, and a sack of corn across a river. He has a rowboat, which can only carry him and one other thing. If the fox and the chicken are left together, the fox will eat the chicken. If the chicken and the corn are left together, the chicken will eat the corn. For part 2, your task is to implement a solution to this problem using a graph search algorithm. Use vertices to represent states of the world and edges to represent transitions between valid states. Then apply a search algorithm to find a path from the vertex representing the initial state to the vertex representing the goal state. Finally, display the sequence of actions that the man must take to cross the river.

As usual, write a report describing your work.