

CS 150: Project III

Due: 11:55pm, Tuesday December 11, 2017

Introduction

Project Description

The same popular coffee shop chain from Project I was so impressed with your previous work that they are hiring you as a logistics manager in the country of Coffeeland. You are given a map of Coffeeland on which you can find all cities and roads. You are also given a list of warehouses. Each warehouse sends you a request, listing the weights of the cargos (w_1, w_2, \dots, w_k) to be delivered to the warehouse. The cargos are allowed to arrive in different trucks, as long as they are all delivered.

All delivery trucks originate from a logistics center in one of the cities and return to it at the end of the trip. Each truck has the same capacity $C = 500$ that cannot be exceeded. Your job as a manager is to schedule the truck routes from the logistics center to fulfill the requests from the warehouses, with the goal to minimize the total distance traveled between the cities by all the trucks (ignoring distance traveled within the cities).

After some research, you realized that optimally solving this problem in general is hard (NP-hard to be specific), but the following simple “greedy” approach can find an approximate solution for this specific problem:

Repeat the following process for each truck, until all orders are fulfilled:

1. From the current location of the truck, go to the closest warehouses W whose request has not been completely fulfilled and at least one of whose unfulfilled cargos can be added to the truck without exceeding its capacity. If no such warehouse exists, return to the logistics center. If more than one warehouses are equally close, choose the one whose city name is alphabetically first. Ship as many cargos as possible to W until either
 - (a) all cargos to W are shipped, or
 - (b) shipping any more cargo to W will exceed the truck’s capacity.
2. Move the truck’s current location to W and go to step 1.

Assignments

Your program will take the following input:

1. A file `roads.txt`, in which the first line is n , the number of roads, followed by n lines of the format *city1 city2 length*, where *city1* and *city2* are strings and *length* is an integer. Each city name is a string of English letters without spaces or special symbols. You may assume that all roads are two way and that every pair of cities are reachable from each other by a sequence of roads.

2. A file `warehouses.txt`, in which the first line is m , the number of warehouses, followed by m lines of the format `city w1 w2 ... wk`, indicating the city of the warehouse, and the integer weights of the cargos the warehouse requests. You may assume that all warehouses are located in distinct cities.
3. A file `center.txt`, which contains the city of the logistics center.

The output is a list of truck routes. For each truck, list the cities in the order it visits and the cargos it delivers to the warehouse in each city.

Also output the total distance traveled by the all the trucks.

Guidelines

1. You should use the appropriate data structures and efficient algorithms. Make appropriate use of object-oriented design concepts such as abstract class, encapsulation, modularization, etc.
2. Your analysis and conclusions should be supported by mathematical reasoning and experimental data.

Report

The guideline for wiring the project report is the same as that of Project 1 and 2.

Grading

The project is to be completed by a team of 2 members. Each individual member should make an approximately equal contribution to the project. Each team submits a single package, which contains the code, the raw data, the report, and a statement signed by all members detailing the contributions of each member in all components of the project, including the design and implementation of the program, the experiments, the collection and analysis of the data, and the writing of the report. Your project will be graded on the following criteria:

1. correctness of the program
2. soundness of the analysis
3. documentation (methods and classes) including javadoc
4. unit testing and the ability to allow more testing
5. object oriented design
6. quality of the analysis and simulation
7. quality of the project report
8. teamwork and contribution