

SPRING 2002: **COP 3530** DATA STRUCTURES
[PROGRAMMING ASSIGNMENT 5; DUE APRIL 18 IN MY OFFICE.]
SHORTEST PATHS

Problem Description

Your task is to write a program to use Dijkstra's algorithm to compute the shortest paths between two cities. In the first part, read in the coordinates of all the cities from file `att532.dat`. (These are coordinates of reasonable sized cities in the US.) The first line of this data file tells you how many cities (N) have their coordinates listed. This is followed by N lines containing the x and y coordinates of the N cities. Assume that the cities are numbered 0 through $N - 1$ in the order in which they are read. Next construct a graph with the N cities as vertices. The edges in the graph consists of every possible edge whose length is at most `LENGTH_THRESHOLD` (use 200 units for this assignment). For the graph, output the number of vertices, the number of edges, the average degree of a vertex, the average length of an edge, the vertex with the maximum degree (and its degree).

In the second part of this assignment, read in pairs of cities from the data file `CityPairs.dat`. For each pair of cities (u, v) : print out the vertices on the shortest path from vertex u to vertex v , the length of this shortest path, and the ratio between the length of the shortest path and the direct (Euclidean) distance between the cities. If no path exists, print out an error message to the effect. The file `CityPairs.dat` contains several (unknown) number of lines. In each line two integers are provided. These integers are indices of two vertices in the graph for which a shortest path query is being made.

The data files will be available to you on your course website as usual. Use the class `Graph` and the method `dijkstra` (pg 472) from your text. You can download the code from the course website. Any other classes that this code might need will also be made available to you on the course website.

Challenges for the bored

For extra credit, you could try the following problems:

Easy Print out the number of connected components for a given value of `LENGTH_THRESHOLD`.

Medium Draw a picture of the graph and the shortest path on the screen using Java's graphical tools.

Hard Write a program that reads in a pair of cities (u, v) and outputs the smallest value of `LENGTH_THRESHOLD` for which they are connected.

Hard Using Java's graphical tools animate the operations of Dijkstra's algorithm.