EE3980 Algorithms

Project. Two-day Travelling Problem

Due: June 17, 2018

Given n cities and the distance between each pair of cities, a salesperson is planning a two-day trip to visit all cities once and return to the starting city. It is also determined to stay in a particular city at the end of the first day. In addition, in order to balance the travelling distance of the two days, it is desired to have travelling distance of both day as close to each other as possible. That is, given n cities, c_1, c_2, ..., c_n, and $A[1:n, 1:n]$ be the distance matrix, find two paths, $P_1 = \langle p_1^1, p_1^2, \ldots, p_1^k \rangle$, and $P_2 = \langle p_2^1, p_2^2, \ldots, p_2^h \rangle$ such that

1. $p_1^1 = p_2^h$, $p_1^k = p_2^1$ and $P_1 \cup P_2$ is a Hamiltonian cycle.

2. $\left| \sum_{i=1}^{k-1} A[p_1^i, p_1^{i+1}] - \sum_{j=1}^{h-1} A[p_2^j, p_2^{j+1}] \right|$ is minimum.

Please write a `C` program to solve this problem. Again, 6 data files are provided for you to test your program. The starting city should be the first city on the list, and the stay over city is the last city on the list.

As part of this homework, you need to write a report to describe you algorithm, analyze its complexities, show the travelling plans produced by your program, and state your conclusions.

Program execution and output should follow the example below. Note that this is an example of the output format. It is not the optimal plan.

```
$ ./a.out < t1.dat
Two-day travelling plan:
 Day 1:
  Ann Arbor -> Iowa City
  Iowa City -> Manhattan
  Manhattan -> Charlottesville
    Distance: 18
 Day 2:
  Charlottesville -> Corvallis
  Corvallis -> Ann Arbor
    Distance: 10
 Total distance: 28
 Day 1 and day 2 difference: 8
```

Notes.

1. One executable and error-free `C` source file should be turned in. This source file should be named as `proj.c`. Execution of the program is invoked by

```
$ ./a.out < t1.dat
```

And the output of the program is listed above.

2. A `pdf` file is also needed. This report file should be named as `proja.pdf`.

3. Submit your `proj.c` and `proja.pdf` on EE workstations using the following command:

```
$ ~ee3980/bin/submit hw16 proj.c proja.pdf
```

where `hw16` indicates it is the final project.

4. Your report should be clearly written such that I can understand it. The writing, including English grammar, is part of the grading criteria.

5. Six data files have been provided for you to test your program. Some may take a long time to execute. If any data file takes more than 1 minute CPU time, then it is not required to finish execution and report the results in your report. However, program efficiency is one of the important grading criteria for this course and you should try to do the best as you can.