

IT University Innopolis

CS-CO-412

Algorithms and Data Structures

Assignment 4

Efficient Shopping:
Solving the Travelling Salesman Problem with Backtracking

Deadline: 5:00 pm 5th December 2014

Problem Definition

Dmitry wants to buy something in all his favourite shops in MegaMegaMall but he is very tired and wants to walk as little as possible. Given the distance between each shop, your task is to produce an optimal route for Dmitry (i.e. the sequence in which he should visit the shops). Dmitry always parks in the same place so we also know the distance from his car to each shop.

Input

The first line of the input file will consist of an integer number k specifying the number of test cases in the file. This is followed by the data specifying each test case, beginning on the next line. There are no blank lines in the input file.

Each test case will begin with a line containing an integer number n giving the number of shops to be visited. This will be followed by $n+1$ lines containing the names of each shop followed the name of the manufacturer of Dmitry's car. You can assume that $n < 10$. Each name is on a separate line. This is followed by $n+1$ lines each containing $n+1$ integers specifying the distances between each shop (including itself). The j^{th} number on line i gives the distance from shop i to shop j . The $(j+1)^{\text{st}}$ number on line i gives the distance from shop i to the car. Note that the distance from shop i to shop j may not be the same as the distance from shop j to shop i since you may not be able to take the same path (it is a short distance from a shop at the top of a 'down' escalator to a shop at the bottom, but it can be a longer distance going the other way as you have to walk around to the 'up' escalator.) Line $n+1$ gives the distance of the car to each shop.

Output

The first line of your output file should contain your name.

For each test case in the input, first output the test case number, then print the total distance that needs to be walked, followed the sequence of shops that Dmitry should use to minimize his walking, starting at his car and returning to his car. If there is more than one tour that gives the same minimum distance, just print the first one you find.

Sample Input

```
1
4
Top Bike Shop
Cars r Us
Everything Electronic
The Hot Chocolate Emporium
Morgan
0   30  100  50 120
30   0  100  80  60
100 110   0  30  60
50   80  40   0  60
120  60  90  70   0
```

Sample Output

```
<student name>
1
240
Morgan
Cars r Us
Top Bike Shop
The Hot Chocolate Emporium
Everything Electronic
Morgan
```

Instructions

The input should be read from a file input.txt and output should be written to a file output.txt.

Submit the following to david@vernon.eu by the deadline shown above.

1. The source code: .c, .cpp, and .h file(s) (maximum of three files).
3. The test input file: input.txt
4. The test output file: output.txt

Do not include the Visual C++ solution files or the executable. Submit only the source code files and the input & output files.

The source code should contain adequate internal documentation in the form of comments. Internal documentation should explain how the code has been tested, e.g. the various scenarios addressed in the test cases. Do not forget to include your name in the internal documentation. Ideally, place this documentation in the .h include file.

Marks will be awarded for internal documentation and the coverage of test cases.

No marks will be awarded for late submissions.

Plagiarised code will be heavily penalised (and you learn nothing which defeats the purpose of the exercise).