MARMARA UNIVERSITY

FACULTY OF ENGINEERING

CSE2246

ANALYSIS OF ALGORITHMS

HOMEWORK 2

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Introduction

The Two Traveling Salesmen Problem (2-TSP) is a problem which two salesmen start from different arbitrary cities and must visit all given cities exactly once, finally returning to their respective starting points.

The objective is to minimize the total distance traveled by both salesmen. This report outlines our approach to solving the 2-TSP, detailing the algorithm, implementation, and division of labor among team members.

Problem Specification

Given a list of cities with their coordinates, the goal is to:

- Determine the tours for two salesmen such that each city is visited exactly once by one of the salesmen.
- Minimize the total distance traveled by both salesmen.
- Ensure each salesman returns to their starting city.

Input Format

A text file where each line defines a city with three numbers: city ID, x-coordinate, and y-coordinate.

Output Format

A text file with:

- The total length of both tours.
- The length and details of the first salesman's tour.
- The length and details of the second salesman's tour.

Algorithm Description

1. Parsing the Input

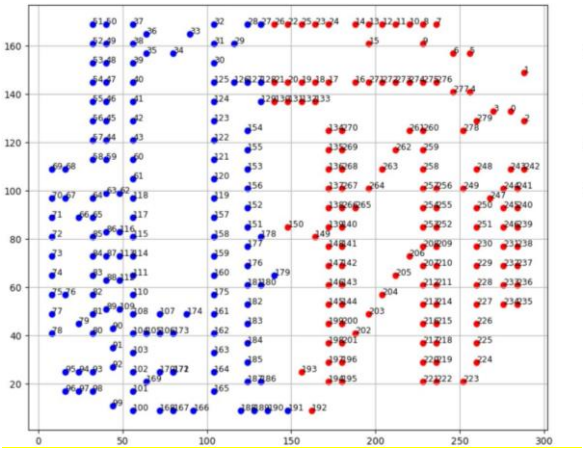
We start by reading the input file and storing the city data in a list of tuples. Each tuple contains the city ID, x-coordinate, and y-coordinate.

2. K-Means Clustering

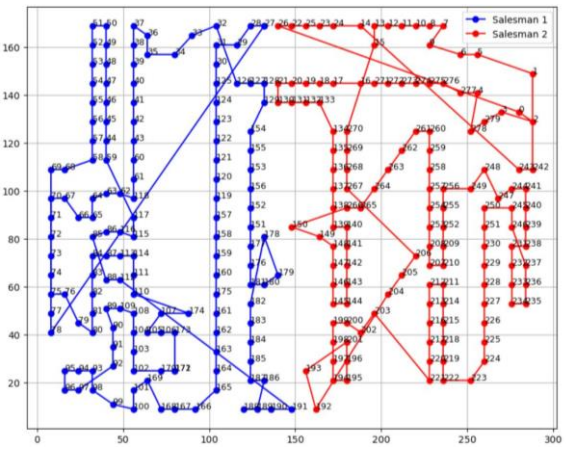
To divide the cities into two regions, we use the K-Means clustering algorithm with k=2. This approach helps distribute the cities efficiently between the two salesmen. After this dividing process, the problem becomes a Traveling Salesman Problem for each salesman.

The reason we use this algorithm is to divide the cities into two equal regions, allowing us to find the nearest tour length for each salesman.

Coordinates of the Cities



Route of the Tours



3. Nearest Neighbor Heuristic

For each region, we construct an initial tour using the nearest neighbor heuristic:

Start from an arbitrary city.

Repeatedly visit the nearest unvisited city until all cities in the region are visited.

4. 2-Opt Optimization

We improve the initial tours using the 2-Opt algorithm, which iteratively improves the tour by reversing segments to reduce the total distance.

5. Calculating Tour Length

The length of a tour is calculated by summing the Euclidean distances between consecutive cities, including the return to the starting city.

6. Output the Results

We write the total distance and individual tour details to the output file in the specified format.

Division of Labor

Safa Bakırcıoğlu: Research and initial implementation of K-Means clustering and data visualization for the report. Assist in the final code review and debugging.

Esra Uğurbaş: Conversion of the algorithm into C code and implementation of 2-Opt optimization and final touches on the code. Collaborate on integrating the K-Means clustering results into the C implementation.

Rıdvan Ünlüerler: Write a comprehensive report detailing the implementation, and results of the project. Document the best-case scenarios and overall effectiveness of the solution.

Collaborative Tasks: All members will participate in initial brainstorming sessions to design the overall algorithm and project structure. Ensure all aspects of the project are clearly documented and explained.

Conclusion

This project demonstrates the application of heuristic and local search algorithms to solve the 2-TSP.

By combining K-Means clustering, nearest neighbor heuristic, and 2-Opt optimization, we were able to produce reasonably efficient solutions.