Northern University

of Business and Technology Khulna

Project Proposal

Project Title: Travelling Distance Problem

Course Title: **CSE 2202**

Course Title: Linear Programming and Combinatorial Optimization Labs

Submitted By

Name : Hemendra Nath Mondal

Section : 4B

ID : 11220320873

Email :himumondal4775@gmail.com

Dept : Computer Science and Engineering

Submitted To

Name : Shovon Mandal

Designation : Lecturer

Dept : Computer Science and Engineering

Date of Submission: 25 June 2024

Travelling Distance Problem

Project Overview: Long-distance travel has been a relatively overlooked topic in transportation research and policymaking, despite its disproportionate importance in terms of mileage and environmental impact. Outline the complexities surrounding the definition and measurement of long-distance travel. These help to explain why our understanding of this travel segment lags behind that of everyday urban travel, and its low salience on the research and policy agenda. We present available data on trends in long-distance travel, indicating a rapid growth which is projected to continue to mid-century. We discuss macro-drivers of growth and determinants of long-distance travel behavior, some of which are unique to this segment. The goal of travelling distance problem is to determine the shortest possible route that visits each city exactly once and returns to the origin city, minimizing the total traveling distance. This differential access to intercity travel may translate to disadvantage in terms of quality of life or social capital. The use of big data to fill the long-standing gap in long-distance travel runs the risk of ignoring those with the inability to participate in global mobility, thereby demonstrating the disproportionate benefits and contributing negative externalities of long-distance travel. This chapter argues that even with the arrival of large quantities of mobile-device location information, those interested in transport equity must remain dedicated to advocacy for long-distance travel surveys that include person-level socioeconomic measures and trip information.

Objectives: Tourism is a fast-growing sector that can influence other sectors in the development of a country. The aim of travelling distance problem is to determine the shortest possible route in shortest time that visits each city in minimum time exactly once and returns to the origin city and minimizing the total traveling distance. we consider the multi-objective TSP which encompasses the optimization of two conflicting and competing objectives: here the dual minimization of the total travel distance and total travel time at various traffic flow conditions. It is wellknown that travellers can experience extra travel time during peak hours compared to free flow conditions, therefore and under some conditions, minimizing traveled time could conflict and compete with travel distance and viceversa. This problem has been studied in the form of a single objective problem, where either the two objectives have been combined in a single objective function or one of the objectives has been treated as a constraint. The purpose of this paper is to find a set of non-dominated solutions using the notion of Pareto optimality where none of the objective functions can be improved in value without degrading one or more of the other objective values.

Literature Review: Clearly articulate the specifics of the traveling distance problem, including the number of locations (cities) and the requirement to visit each city exactly once and return to the starting point. The traveling distance Problem continues to be a rich area of research with significant theoretical and practical implications. Advances in algorithms and computing power, coupled with innovative approaches like machine learning, are pushing the boundaries of what can be achieved, making TSP solutions more applicable and powerful in solving real-world problems. Gather data on the locations and distances between them. This could include geographic coordinates or a distance matrix.

Source of literature review is Wikipedia , ChatGPT , some online paper and articels.

Methodology: The general form of the TSP appears to have been first studied by mathematicians during the 1930s in Vienna and at Harvard, notably by Karl Menger, who defines the problem, considers the obvious brute-force algorithm, and observes the non-optimality of the nearest neighbour heuristic.

We denote by messenger problem (since in practice this question should be solved by each postman, anyway also by many travelers) the task to find, for finitely many points whose pairwise distances are known, the shortest route connecting the points. Of course, this problem is solvable by finitely many trials. Rules which would push the number of trials below the number of permutations of the given points, are not known. The rule that one first should go from the starting point to the closest point, then to the point closest to this, etc., in general does not yield the shortest route.

Pseudocode of TDP:-

```
function nearestNeighborTSP(distMatrix):

    numCities = length(distMatrix)

    visited = array of False of size numCities

    path = []

    currentCity = 0

    totalDistance = 0



    path.append(currentCity)

    visited[currentCity] = True



    for i from 1 to numCities:

        nextCity = -1

        minDistance = infinity



        for j from 0 to numCities - 1:

            if not visited[j] and distMatrix[currentCity][j] < minDistance:

                minDistance = distMatrix[currentCity][j]

                nextCity = j
```

```
        path.append(nextCity)

        visited[nextCity] = True

        totalDistance += minDistance

        currentCity = nextCity

    totalDistance += distMatrix[currentCity][path[0]]  // return to start

    path.append(path[0])  # complete the tour

    return path, totalDistance
```

Tools:-

Promotional tools such as print media, social media, hoardings, trade shows, advertisements on various platforms.

Expected Outcomes: Find the shortest path and travelling all cites in minimum time.

Project Timeline: 25 June 2024 to one week before the final examination.

Resources Required: General resource considerations is Hardware, Software and Algorithm.

1.Hardware:

- CPU: A powerful processor is beneficial, especially for brute force and dynamic programming approaches.
- Memory (RAM): Sufficient memory is required to handle large data structures, especially for dynamic programming.
- Storage: Not typically a limiting factor for TSP, but sufficient disk space is needed to store the distance matrix and results.

2.Software:

- Programming Languages: Python, C++, Java, etc. Python is popular due to its extensive libraries and ease of use.
- Libraries/Frameworks:
- NumPy: For numerical computations and matrix operations.
- Network-X: For handling graph-based problems in Python.
- SciPy: For scientific and technical computing.

3.Algorithm-Specific Requirements:

- Brute Force: May require additional optimizations to handle slightly larger problem sizes.
- Nearest Neighbor: Simple to implement but may need enhancements for better accuracy.
- Dynamic Programming: Efficient memoization techniques and possibly parallel processing to handle larger subsets.

References:

1. A.K.Prasad and Pankaj(2017),Solving Travelling Salesman Problem using Hungarian Method.
2. Souhail Dhouib(2021),A New Columm Row Method for Travelling Salesman Problem.
3. Munkres,j.(1957),Algorithms for the Assingment and Transportation Problems.