Entry Assessment II

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Instructions

Assessment Instructions:

- **Programming Language/Tool:** Use the programming language or tool that you are most comfortable with. We understand that multiple approaches can be developed/applied to solve this problem. Remark that we prefer to see one complete implementation rather than several partial ones.
- **Assumptions:** Clearly state any assumptions you have made about the data or the problem in your report.
- **Discussion:** Be prepared to discuss the questions presented in Part II and Part III of the assessment.

We expect to receive back:

- A clearly written report of your method and respective results. We prefer a paper-like report.
- The source code of your implementation. All your results must be **reproducible**.

Problem

Given a set of nodes $V = \{0, 1, \ldots, n+1\}$ and the distance between each pair of nodes $i \in V$ and $j \in V$ given as d_{ij}. A feasible path should satisfy the following constraints:

- the path must begin at node 0 and ends at node $n + 1$
- each node is visited exactly once
- travelling from node $i \in V \setminus \{0, n+1\}$ to node $j \in V \setminus \{0, n+1\}$ is forbidden if (i) i is an even number, (ii) j is an odd number, and (iii) $i < n/2$

- travelling from node $i \in V \setminus \{0, n+1\}$ to node $j \in V \setminus \{0, n+1\}$ is forbidden if (i) i is odd, (ii) j is even, and (iii) $i \geq n/2$

Find the feasible path that minimises the function $(n\Delta \max_{i,j \in V} d_{ij} + D)$, where D is the total distance of the route, and Δ is the difference between the longest and the shortest node pair distance of a given path.

For instance, consider the path $0-3-1-2-4$ with respective node pair distances $d_{03} = 10, d_{31} = 5, d_{12} = 8, d_{24} = 7$, then $D = 30$ and $\Delta = d_{03} - d_{31} = 5$.

Part I

Design and code a program that can read a csv file of the form:

Node_ID	X-cor	Y-cor
0	40.8	24.1
1	82	10
2	34.12	23.1

Calculate the Euclidean distances between nodes and rounded up to the first decimal place. Provide a solution to the above problem in a txt file using the following format:

$$\text{Path} : 0-1-2-3-4-5$$
$$\text{Total distances} : 2323.12$$

Part II

Be prepared to discuss the following questions:

Q1) How is your method scaling?

Q2) What is the required time by your method to get a good solution?

Q3) How would you change your method if you were asked to significantly reduce the computational time?

Q4) How would you change your method to deal with dynamic arrival of requests?

Q5) What aspects of the problem could be enhanced to include stochastic information?

Part III

Q6) Explore the potential of **Evolutionary Algorithm** (EA) and **Ant Colony Optimization** (ACO)! Try to implement them for this problem and show us the comparison (in table) among baselines!