**Project Title: The Traveling Salesman Problem**

**Group Members:**

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**Programming Languages:** C, C++, OpenMP

**Objective:**

The goal of this project is to evaluate and improve code implementations for solving the Traveling Salesman Problem (TSP), which is a well-known graph theory problem involving Hamiltonian cycles. The project will focus on comparing a serial implementation in C with a parallel implementation using OpenMP. The aim is to analyze the efficiency of both implementations by examining speedup and efficiency based on the number of threads used and the input size.

**Problem Statement:**

The Traveling Salesman Problem (TSP) requires finding the shortest possible route that visits each city exactly once and returns to the starting city. This project will focus on solving the TSP, which is related to Hamiltonian cycles in graph theory, by developing a solution that explores all possible paths using nearest neighbour algorithm to find the optimal one. The TSP is computationally intensive, and implementing it using parallel programming could lead to significant performance improvements. The goal is to solve the problem and implement code in both serial and parallel programming environments.

**Code Implementation:**

The first implementation of the solution will be done using C for serial programming. The algorithm will explore possible Hamiltonian cycles to solve the TSP by checking all combinations of routes. The code will be documented with clear comments, explaining the logic behind each part of the implementation, including any optimizations made to improve performance. This implementation will focus on correctness and basic efficiency for solving TSP in a sequential manner.

**Second Language Implementation (Parallel Implementation):**

The second implementation will use OpenMP for parallel programming in C. The TSP algorithm will be parallelized, allowing the exploration of possible routes to be divided among multiple threads. Key language-specific features, such as the use of OpenMP directives for parallelizing loops, will be documented, along with any challenges encountered during the parallelization process. Both implementations will produce the same correct output, but this version will focus on improving performance through parallelism.

**Efficiency Analysis:**

Both implementations will be tested with various input sizes to analyze their performance. The focus of the analysis will be on speedup and efficiency achieved by the parallel implementation compared to the serial one. Metrics such as execution time will be measured and compared based on the number of threads used in the OpenMP implementation. The goal is to understand the performance improvements that parallelization provides for solving the Traveling Salesman Problem and to evaluate the strengths and weaknesses of the parallel versus serial approach.