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MARMARA UNIVERSITY

FACULTY of ENGINEERING

COMPUTER ENGINEERING DEPARTMENT

CSE4197 Engineering Project I Proposal

Title of the Project

Routing and Distribution Optimization

Group Members

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1. Aim of the Project

At the core of this project lies the primary goal of transforming material distribution and route planning processes. By using smart solutions and advanced algorithms, the aim is not only to improve current distribution methods but also to lead the way toward a more efficient and eco-friendly future in the logistics industry. "We create vehicle routes for each set of customers to minimize the total travel distances, connecting consecutive customers starting from a central depot" (Bae & Moon, 2016, p. 6540). This project strives to bring about a significant change by redefining how materials are directed and delivered, ultimately enhancing operational effectiveness.

1.1. Motivation

This project is primarily driven by key factors. Firstly, the escalating fuel costs have placed a significant financial burden on global businesses, necessitating innovative cost saving measures. In essence, this project aims to optimize material distribution and route planning, with a focus on addressing economic challenges.

In conclusion, this project aims to make material distribution and route planning better while dealing with economic, and environmental issues. By using smart solutions and advanced algorithms, it aims to cut costs, reduce environmental impact by reducing usage of fuel.

2. Methodology

Our approach to tackle the challenges of optimizing material distribution and route planning is systematic and data driven. The following steps outline our strategies:

2.1. Data Creating and Analysis

We will start by gathering and creating comprehensive data on material distribution patterns, including past delivery routes, quantities, and schedules. We will use advanced data analysis techniques to spot patterns, identify bottlenecks, and areas for improvement.

2.2. Algorithm Development

2.2.1. Our approach involves utilizing various techniques to address the MDVRPTW problem efficiently. We employ the Clarke and Wright Savings Algorithm as a starting point for generating initial routes. Additionally, we implement the Nearest Neighbor Algorithm, assigning each customer to the nearest depot, to enhance our routing strategy. To further optimize our solution, we adopt the Inside-Out Savings Algorithm, prioritizing customers with the most substantial potential for savings when forming routes.

2.2.2. Furthermore, we leverage Genetic Algorithms, which mimic genetic processes and utilize a population-based approach to explore the solution space, making them a valuable tool for optimizing MDVRPTW problems. Another valuable tool in our toolkit is Simulation-Based Optimization (SBO), where we simulate real-world conditions to fine-tune our routes. We can choose from various SBO approaches tailored to meet our specific problem requirements.

2.2.3. In addition to these techniques, we also employ Metaheuristics, including algorithms like Simulated Annealing, Genetic Algorithms, Particle Swarm Optimization, and Tabu Search. These versatile approaches allow us to tackle MDVRPTW problems from different angles.

2.2.4. To further enhance our optimization efforts, we explore Hybrid Approaches that combine different algorithms or metaheuristics. For instance, we may combine Genetic Algorithms with Tabu Search to create a hybrid approach that capitalizes on the strengths of both methods.

2.3. Route Optimization

We will use routing algorithms, such as advanced heuristics, to dynamically optimize delivery routes based on real-time data. Our aim is to minimize travel time, cut fuel consumption, and boost overall efficiency.

2.4. Testing

We will test various scenarios, including different load sizes, receiving conditions, and delivery constraints.

2.5. Performance Evaluation

We will continuously monitor and evaluate our solutions' performance. Key indicators like delivery time and fuel consumption will help us measure success.

2.6. Iterative Improvement

Our approach is iterative. Using data and feedback, we will keep improving our algorithms and strategies to adapt to changing conditions.

By combining data analysis, advanced algorithms, real-time monitoring, and a commitment to continuous improvement, we aim to create a strong framework for optimizing material distribution and route planning. This methodology empowers businesses to cut costs and reduce environmental impact.

3. Software/Hardware Requirements

3.2. Software Requirements

3.2.1. **Programming Language**: We will primarily use Python as a main programming language for algorithm development and implementation. However, during the implementation of algorithms, if we identify a more performance-efficient language that better suits the algorithm, we will consider using that programming language for algorithm efficiency.

3.2.2. **Database Management System:** A relational database management system (e.g., MSSQL, PostgreSQL) will be used to store and manage distribution data.

3.2.3. **Data Analysis Tools:** Software for data analysis and visualization, such as Python libraries (e.g., Pandas, Matplotlib, Seaborn), will be employed to analyze historical distribution data.

3.3. Hardware Requirements

3.3.1. **Computing Resources:** Computers or cloud computing resources will be required for complex algorithm development.

3.3.2. **Data Storage:** Sufficient data storage capacity for storing historical distribution data and results from simulations, also cloud storage can be used.

3.4. Instructions for Software and Hardware Use:

3.4.1. **Programming Languages:** Ensure developers have the necessary programming environments and use code repositories like Python, VS Code, and Git for collaborative coding.

3.4.2. **Database Management System:** Installing and configure the chosen DBMS software, creating a data schema with tables for routes, deliveries, and vehicles.

3.4.3. **Data Analysis Tools:** Installing Python and required libraries. Using Jupyter Notebook or similar tools for code development, analysis, and visualization.

4. Draft Time Plan

In the initial phase, we will lay the project's foundation. We will start with a literature review to better understand our project's subject. Then, we will outline our project's objectives and scope, creating a Project Scope Document (PSD). By the end of the first semester, we will present our findings and design, and work on an Analysis and Design Document (ADD) will begin.

The second phase focuses on implementing our project and documenting results. We will start coding, develop, and test algorithms, and bring the project to life. Simultaneously, we will prepare the thesis report and document project progress. We will also give a presentation to share developments and findings. Finally, we will complete the project with the thesis report and a summary poster.

5. References

Bae, H., & Moon, I. (2016). Multi-depot vehicle routing problem with time windows considering delivery and installation vehicles. *Applied Mathematical Modelling*, 40, 6536-6549.