Informatics Institute of Technology
In collaboration with
Robert Gordon University, Aberdeen

CM 4601 - Computational Intelligence

Coursework (Group 1)

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1. Identifying the Application

1.1 Industry Application

Shortest Travel Time Optimization

The selected industry for this optimization study is the logistics and delivery sector. In this industry, the timely and efficient movement of goods is crucial for meeting customer expectations and maintaining operational effectiveness. Optimizing the shortest travel time between multiple locations is a key determinant in achieving these goals.

1.2 Scale of Optimization

This study will focus on optimizing the shortest travel time for a company's delivery. The delivery fleet consists of a diverse set of vehicles responsible for transporting goods from the distribution center to various destinations. By improving the efficiency of travel routes, the company aims to reduce delivery times, fuel consumption, and overall operational costs.

1.3 Existing Application

Existing applications in route optimization within the logistics industry have traditionally relied on heuristic algorithms and traditional route planning methods. While these methods have demonstrated some effectiveness, they may struggle to adapt to the dynamic nature of traffic patterns, evolving delivery schedules, and changing customer demands.

1.4 Dataset

Link- https://www.kaggle.com/competitions/nyc-taxi-trip-duration/rules

1.5 GitHub Link

Link - https://github.com/Chathuni-Dev/Shortest-Travel-Time-Optimization---CI-CW

2. Necessity of Evolutionary Algorithms

- Adaptability:
  Delivery routes are dynamic; evolutionary algorithms adapt well to changing conditions.
- Exploration:
  Evolutionary algorithms efficiently explore various route possibilities in the vast solution space.
- Multi-Objective Optimization:
  Balancing delivery times, fuel consumption, and operational costs requires a method adept at multi-objective optimization.
- Dynamic Constraints:
  Evolutionary algorithms handle dynamic constraints, like varying time windows and changing vehicle capacities.
- Comparative Advantage:
  Compared to traditional methods, evolutionary algorithms offer adaptability, efficiency, and robust solutions in dynamic environments.

3. Holistic view of the Solution

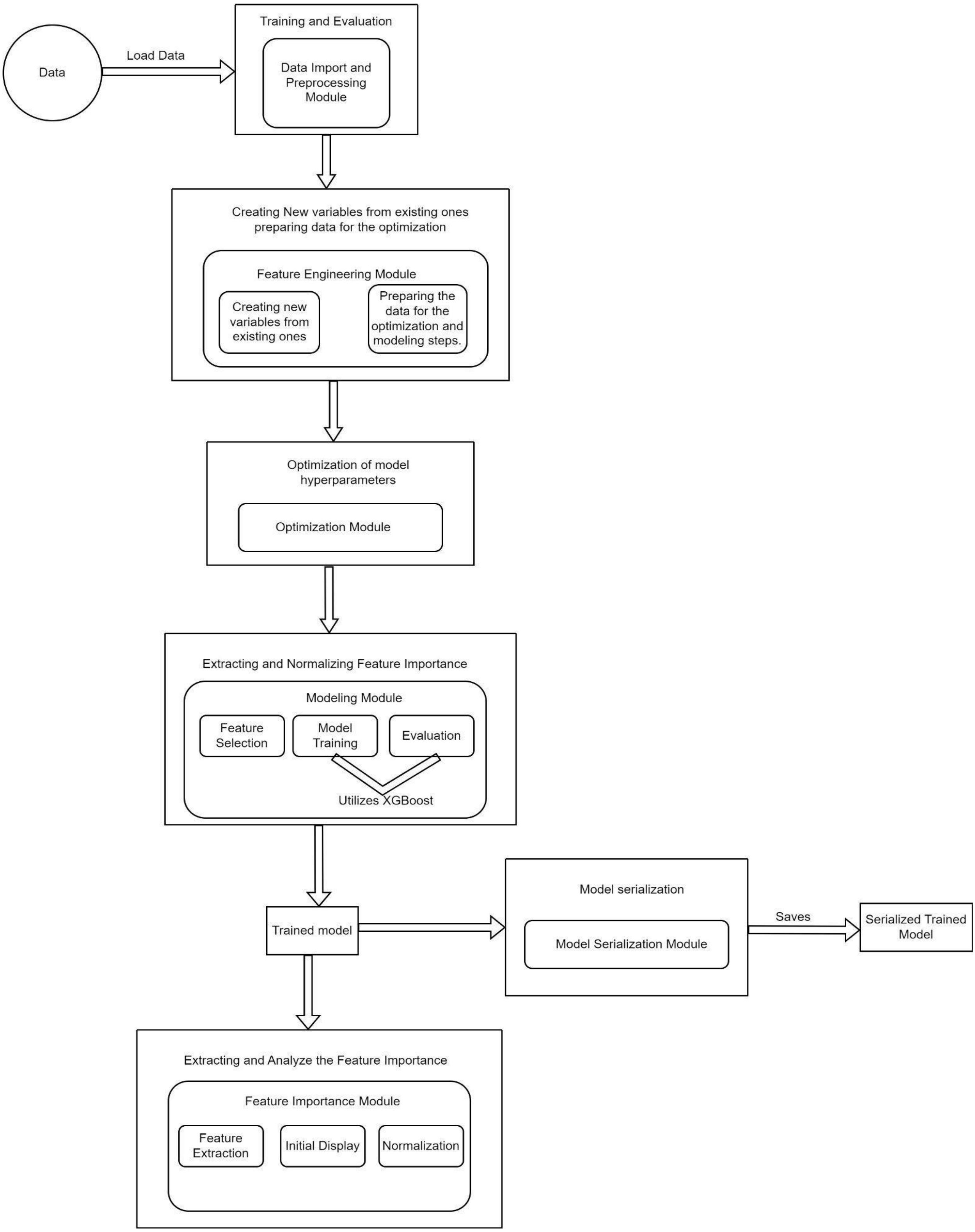

Figure 1: Modularized diagram of the holistic view

4. Methodologies

4.1 Chromosome Structure

- The chromosome structure represents a potential solution to the problem. In the traveling salesman problem, each chromosome consists of genes, and each gene represents a city to be visited. The gene order represents the visiting order.

- To further clarify, according to Figure 2, the best chromosome structure given is in the order of [L6, L7, L2, L1, L3, L4, L10, L8, L9, L11, L5, L6].

4.2 Fitness Function

- The fitness function evaluates the quality of a tour, represented by a chromosome. In the context of the ideal traveling salesman problem, fitness is the total distance of the tour. The shorter the tour, the higher the fitness.

- The goal is to minimize the total distance traveled. In our version of the traveling salesman problem, the best fitness will be the shortest time taken to visit all the cities exactly once.

4.3 Constraints

- Each city must be visited exactly once, and the tour must start and end in the same city.

- The weather has not been taken into account here. This presents itself as a soft constraint.

5. Demonstration of the findings

5.1. Results Visualization

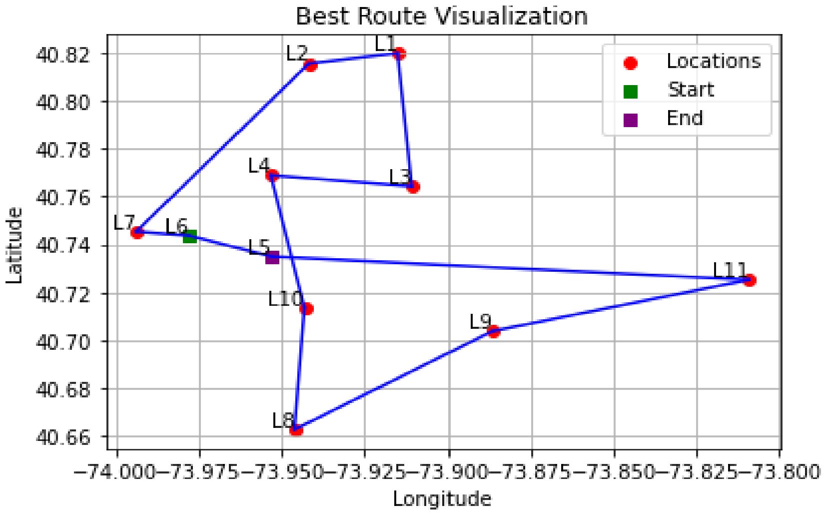

Figure 2: Best Route Visualization