**Travel Route Optimizer**



**Session 2023-2027**

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1. **Description:**

The Travel Route Optimizer with Dynamic Pricing System is a system designed to assist users in planning efficient travel routes with dynamically priced tickets. This project involves advanced data structures and algorithms to create a system that can suggest cost-effective travel options and adapt to real-time pricing changes. The goal is to provide users with a travel planning experience, integrating travel options, route optimization, and pricing recommendations.

1. **Objective:**

This project aims to create an efficient travel route optimizer that adjusts prices dynamically and provides real-time updates. Users can expect a system that offers optimized routes, dynamic pricing, and travel recommendations, all supported by data structures that ensure performance and scalability.

1. **Data Structures and purposes:**

The data structures that are to be used in this project are described below along with their purposes:

* 1. **Linked Lists:** Arrays will store the traveling options that will be available at the specific moment. Arrays are simple and efficient for storing and accessing travel options at specific indices. Each node can represent a travel option, containing details like Departure and arrival stations, departure and arrival times, ticket price, route id.
  2. **Queues:** Managing ticketing queues, especially for high demand routes. A queue is a great choice for handling ticketing, where passengers are served on a first-come, first-served basis, especially for high-demand routes. It provides a straightforward way to manage ticketing priority. Each element in the queue can store details like user ID and booking time. We might also use **priority queues** if we want to prioritize certain passengers (VIPs).
  3. **Binary Search Trees/AVL Trees:** A BST is used to track ticket prices and find the cheapest option quickly. In this project, a BST enables efficient retrieval of the cheapest ticket and maintains ticket prices in sorted order, making it easy to access both the minimum and the range of prices if needed. The tree can help in the way that the cheapest ticket prices can be easily found on the left side of the binary search tree.
  4. **Graphs:** Graph will be one of the most important data structures that will be used in this project. It will manage routing by taking the stations as nodes and the traveling routes as the edges. An adjancy list or matrix will be used to represent the graph. The alogrithms such as Dijkstra algorithm will be used to find the shortest distance between two nodes. Graphs allow complex route networks and can represent multiple paths between destinations.
  5. **Hash Tables:** A hash table provides fast and constant access time to access data based on keys which provides efficient storage and retrieval of user details for travelling purposes.

1. **Expected Outcomes:**

The expected outcomes for the traveling route optimizer and dynamic pricing are given below:

* 1. **Efficient Route Selection:** Calculates the most time effective route for the users.
  2. **Dynamic Pricing:** Adjust ticket pricing dynamically based on route.
  3. **Basic Route filtering:** Allow users to filter route based on their preferences such as cheapest route or shortest route.
  4. **Estimated time travel calculations:** Calculate and display estimated travel times for each route, including transfer times for connecting routes.
  5. **Base price comparison:** Show a price comparison for different travel options (e.g., flight vs. train vs. bus) on the same route.
  6. **Feedback mechanism:** Allow users to rate the route they travelled.

1. **Conclusion:**

The travel route optimizer and dynamic pricing system is a comprehensive idea that includes graph theory, dynamic pricing and user friendly features. By using the required data structures, the project will demonstate the requirements for the route optimization.