

**University of Isfahan**

**Best Flight Project**

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**Introduction**

In the world of flying, finding the best path between two airports is really important. In this project, we're using two special ways (Dijkstra and A\* algorithms) to help us figure out the best routes through a dataset of flights. This dataset includes details about where the flights start and end, how far they travel, how much they cost, and how long they take.

Our goal is to find the smartest way to go between any two airports in this network of flights. This project is important because it can be used to save fuel, plan flights better, and make traveling more convenient for passengers.

We'll explore the Dijkstra and A\* algorithms, which are like secret tools that help us find these smart routes. These tools are used in lots of places to solve problems, and we're using them to make flying better.

Join us on this journey as we dig into flight data and find the best paths in the sky, thanks to Dijkstra and A\* algorithms.

**Background**

Pathfinding and route planning are fundamental challenges in the field of computer science and have far-reaching applications in various domains, including aviation. To address these challenges, several algorithms have been developed, and two prominent ones, Dijkstra and A\*, have become pillars of pathfinding and optimization.

**Dijkstra Algorithm:** The Dijkstra algorithm, introduced by Dutch computer scientist Edsger W. Dijkstra in 1956, is a foundational approach to solving the single-source shortest path problem in weighted graphs. It finds the shortest path from a source node to all other nodes in a graph, making it invaluable for route planning. Dijkstra's algorithm is characterized by its simplicity and ability to guarantee the shortest path in non-negative weighted graphs. It has been a cornerstone in the realm of pathfinding and is widely utilized in diverse applications.

**A\* Algorithm:** A\* (pronounced as "A-star") is another renowned algorithm that emerged in the late 1960s. Developed by Peter Hart, Nils Nilsson, and Bertram Raphael, A\* extends the capabilities of Dijkstra's algorithm by incorporating heuristic functions to guide the search process. This enhancement enables A\* to find optimal paths in graphs while considering the estimated cost to reach the goal node. The A\* algorithm excels in efficiency and accuracy, making it a compelling choice for route planning in scenarios where time and resource constraints are crucial.

These algorithms, although initially designed for general pathfinding, have found exceptional relevance in the field of aviation. The complexity of flight route planning, encompassing numerous airports, geographical coordinates, pricing, distances, and travel times, demands advanced solutions for route optimization. Dijkstra and A\* algorithms offer the aviation industry valuable tools to enhance flight planning, reduce costs, and improve passenger experiences.

**Project Overview**

This project tackles a key challenge in aviation route planning, focusing on the efficient utilization of two fundamental algorithms: Dijkstra and A\*. The primary problem at hand is the development of an implementation of the Dijkstra algorithm with minimal time and space complexity, tailor-made to accommodate a specific graph structure created for the project.

The flight dataset used in this project is a valuable resource for enhancing flight route planning. It encompasses a range of essential information, including airline details, source and destination airports, airport cities, countries, geographical coordinates, altitudes, flight distance, estimated flight time, and pricing. With this comprehensive dataset, the project aims to optimize the process of finding the best flight routes between airports, taking into account various factors such as distance, travel time, and cost.

The challenge at the core of this project is not only to apply well-established algorithms but also to implement them efficiently within the context of the project's custom graph structure. The goal is to create a tool that can swiftly and effectively determine optimal flight routes while minimizing computational and memory requirements. The efficient implementation of Dijkstra is essential for the successful realization of this objective.

This project's focus is not limited to solving a theoretical problem; it is grounded in the practical realm of aviation route planning. By leveraging the Dijkstra and A\* algorithms, the project seeks to offer real-world solutions for flight route optimization, ultimately contributing to improved flight scheduling, cost-effectiveness, and enhanced passenger experience.

In the following sections, we will delve into the mechanics of the Dijkstra and A\* algorithms, the adaptation of these algorithms to the flight dataset, and the practical results and implications of their implementation.