

Airline Route Optimizer — Project Documentation

1. Introduction

The Airline Route Optimizer is a C++ application designed to solve real-world airline routing problems using graph theory. The system reads a dataset of flight connections and computes optimal paths based on different user requirements. This project demonstrates practical applications of graph traversal, pathfinding, combinatorial optimization, and minimax analysis.

2. Objectives

- Implement core graph algorithms efficiently.
- Provide a command-line tool for airline route analysis.
- Demonstrate BFS, permutations, and minimax logic.
- Apply clean modular C++ design.

3. System Architecture

Project Structure:

code/

- run.sh
- data/flight.txt
- src/
 - main.cpp
 - Graph.h / Graph.cpp
 - FileParser.h / FileParser.cpp
 - RouteFinder.h / RouteFinder.cpp
 - utilis.h

4. Data Structures & Algorithms

Core Data Structures:

- unordered_map>
- queue

- vector

Algorithms:

- Breadth-First Search (BFS)
- Permutation-based route optimization
- Minimax meeting-point calculation
- Graph traversal

5. Program Features

Question 1: Direct Route with Connection Limit

Command:

```
./run.sh 1
```

Example:

```
./run.sh 1 "New York" "London" 3
```

Question 2: Multi-City Routing

Command:

```
./run.sh 2 through and to
```

Question 3: Optimal Meeting Point for Three Travelers

Command:

```
./run.sh 3
```

6. Compilation

Using script:

```
chmod +x run.sh
```

```
./run.sh ...
```

Manual (G++):

```
g++ -std=c++17 -O2 -o routeSearch main.cpp Graph.cpp RouteFinder.cpp FileParser.cpp
```

7. Example Outputs

- Direct route results
- Multi-city route order
- Meeting point summary

8. Dependencies

C++17, standard libraries, G++/Clang++.

9. Academic Significance

This project demonstrates graph theory applications, algorithm design, modular software engineering, and use of real-world datasets.