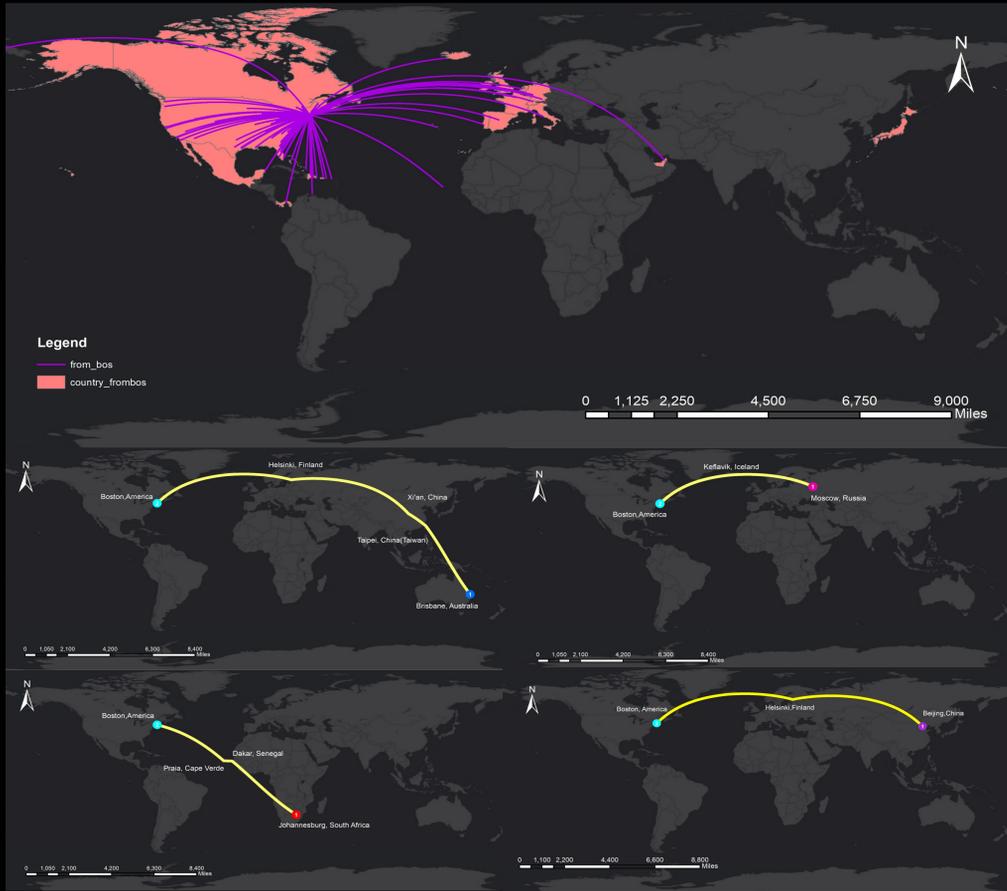


# FLIGHTS AROUND THE WORLD

## Introduction

Travel by air has become a popular mean of transportation because of the advantage of being safe, fast, and convenient. According to the Airports Council International (ACI) World Airport Traffic Report, there are currently 17,678 commercial airports in the world, in other words those which receive airliners, cargo and business aircraft. Since the volume of the air transportation is extremely large, it is very vital for us to have a better understanding of how the airports are connecting to each other. What this project going to analysis is the network and the spatial pattern of the airline route and the airport distribution.



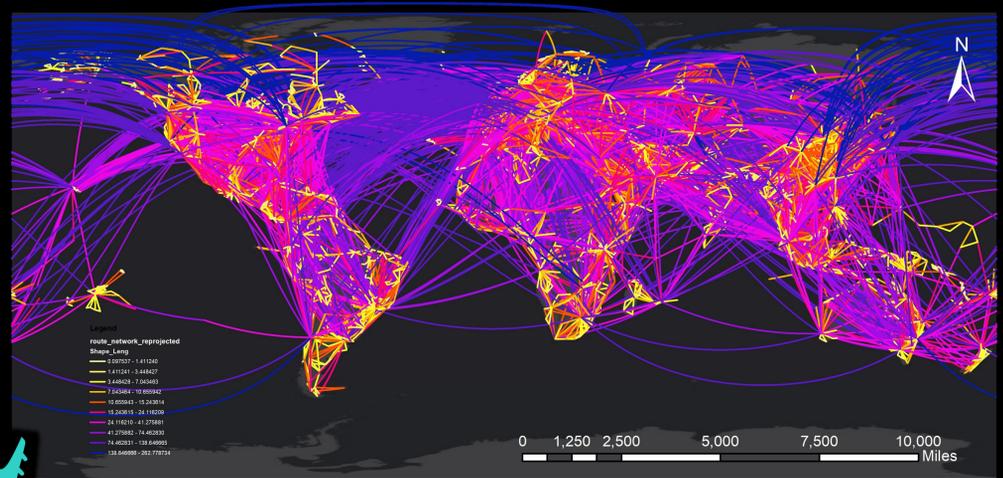
Network Analysis

## Discussions

In the flow map, the flight routes with light yellow color are the ones with the shortest path, and the flight routes with purple color are the ones with the longest path. From this map, we can conclude that most long distance flights are between the continents, and the short distance flights are mainly distributed inside the continents.

The network analysis shows that the areas are direct connected to Boston are mainly distributed around Europe and North America, also Japan and part of Middle East. If one wants to travel from other places around the world to Boston, he or she needs to make a transfer. In this analysis, four busiest airports around the world that can't fly directly from Boston was selected, and distance were set as the cost to decide which route would be the shortest path from Boston to other destinations. From the result, we can see that no matter what the destination is, the shortest path always follows the great circle. It might not be coinciding with the great circle perfectly, because there might not always be an airport on the great circle that connecting the origin to the destination, if so, there might not be an airline between those airports. This analysis could benefit people and also Flight Company to arrange their routes. If the fuel that burns per mile and the speed of the airplane are the same, we can assume that the shortest path would be the one that spend less fuel and spend the shortest time on the airplane. If people find them tired with flight, they could choose the shortest path as their way to travel.

In the grouping analysis, we divided countries into four groups. From the grouping map, we can observe the pattern of airport distribution and the difference between countries easily. In group 1, the amount of people per airport is relatively high, which means in these countries, there are large populations with few airports. The only country in group 2 is India. The reason that India have become a group itself is because its population is extremely large, which will largely affect the grouping result. The countries in group 3 is modest comparing to other groups. In group 4, the amount of people per airport is relatively low, and there are two conditions might lead to this result. Countries like U.S. and Australia are in group 4 because they have large populations and large number of airports, countries like Mongolia are in group 4 because they have smaller population and few airports.



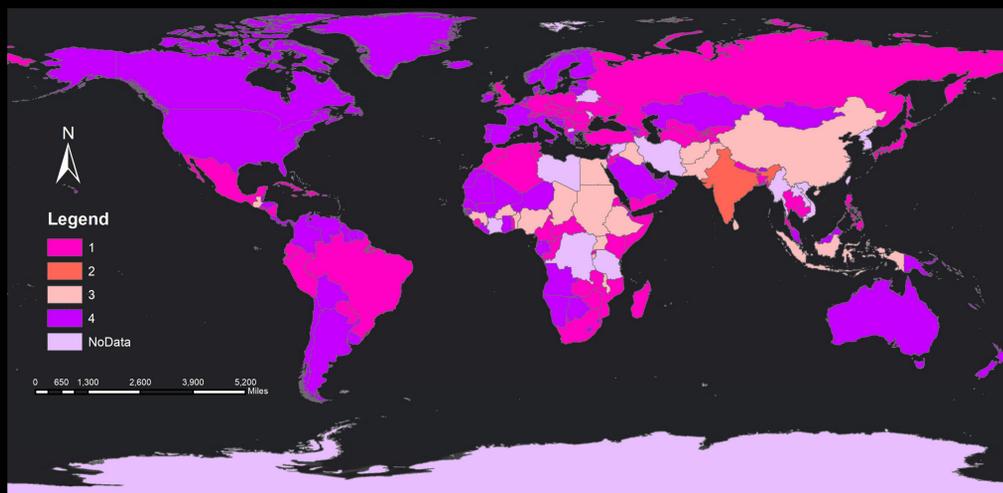
Flow Map

## Spatial Questions

1. Using distance as the cost to create a map that shows how the airport in Boston connected to other places around the world. Find the best way to fly from Boston to China, Australia, South Africa, and Russia.
2. Analyze the airport number shared by the population by each country.

## Methodology

- **SQL:** Use SQL to join the airports data to the routes data. Select all the routes that have Boston as the start point or the end point.
- **Network Analysis:** Use the "XY to line" tool in Arcmap to draw the route between origin and destination. Then export the polylines as the network between airports. The route data that created from the tool "XY to line" have many duplicate polylines, if we don't delete those duplicates, it will occur to an error when we create the network. The tool that we can use to delete those duplicate polylines is "delete identical". Use the length of the route to estimate the shortest path from other places around the world to Boston. Four busiest airports from China, Australia, South Africa, and Russia were selected to be the destination of the shortest path analysis.
- **Multidimensional:** Divide the population in each country by the number of airport that country have to get the number that how many people may share one airport in this country, then use the tool "grouping analysis" to analyze this attribute. By viewing the report that created from this process, choose the best number to interpret the grouping the data.



Grouping Map

## Data Sources

### Airports and Airline Route data:

OpenFlights database: <https://openflights.org/data.html>

The OpenFlights Airlines Database contains 5888 airlines, the OpenFlights Airline Route Mapper Route Database contains 67663 routes between 3321 airports on 548 airlines spanning the globe. In this project we use the airport data and the route data, both of the data types are CSV.

**World countries polygon with population:** ESRI.