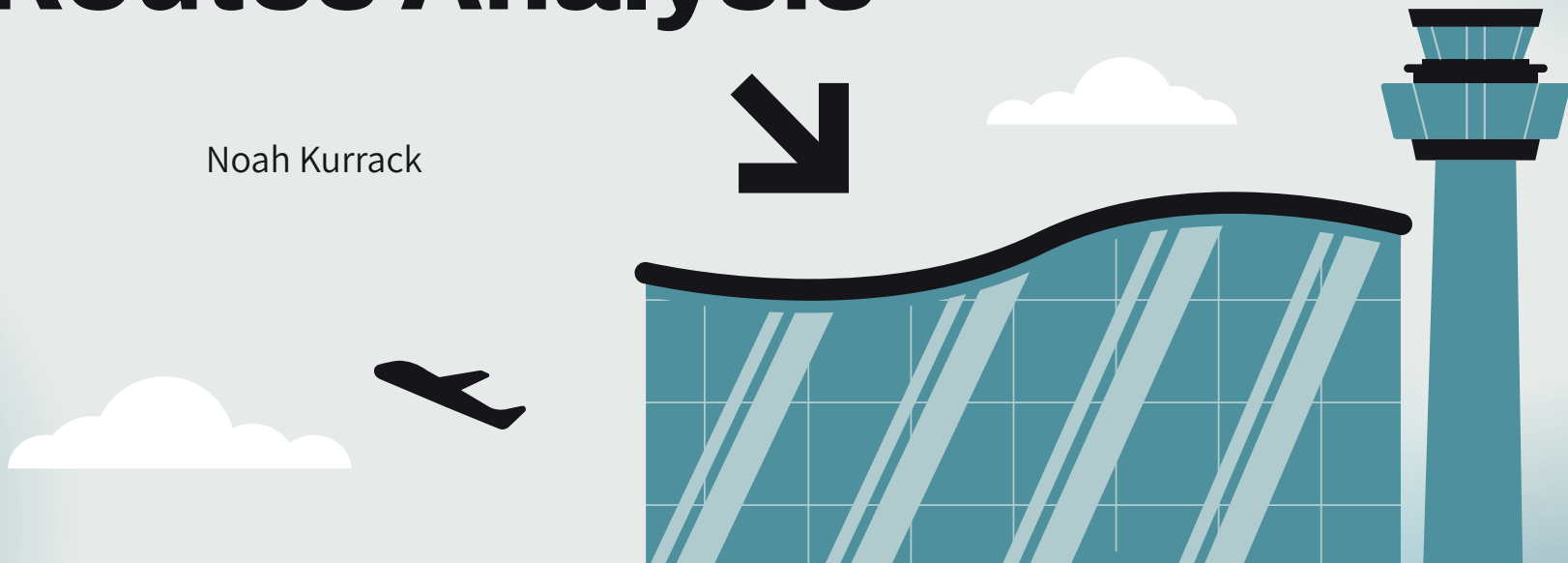


Aircraft Traffic Routes Analysis

Noah Kurrack



Purpose

The goal is to examine the most frequently used routes for commercial aircraft by aircraft type and region.

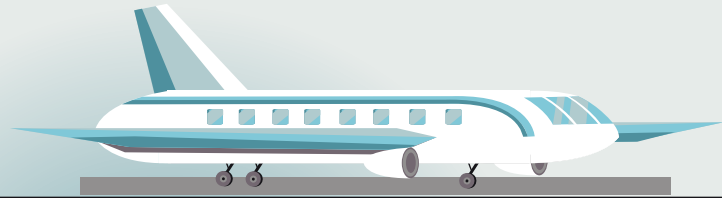
Airlines and air traffic controllers may be interested so that alternative routes can be established that would avoid congestion.

The general population may be interested to know where aircraft frequently travel because a heavily trafficked tract of sky may lead to higher levels of air and noise pollution for residents who live there.

Goodness

Goodness will be assessed visually with GIS mapping software.

The goodness of my results will primarily be evaluated against published FAA flight routes.



```
{ "now" : 1643673600,  
  "messages" : 1385346508,  
  "aircraft" : [  
    {"hex":"a603b0","type":"adsb_icao","flight":"GTI8692 ","r":"N487MC","t":"B744","alt_baro":33000,"alt_geom":32225,"gs":479.4,"tr  
    {"hex":"71bc23","type":"adsb_icao","flight":"AAR241 ","r":"HL7423","t":"B744","alt_baro":34000,"alt_geom":33150,"gs":485.0,"tr  
    {"hex":"ace149","type":"adsb_icao","flight":"N929TG ","r":"N929TG","t":"C208","alt_baro":1375,"alt_geom":1400,"gs":109.2,"track  
    {"hex":"781684","type":"adsb_icao","flight":"CES7317 ","r":"B-307Y","t":"A359","alt_baro":37000,"alt_geom":36150,"gs":475.6,"tr  
    {"hex":"899080","type":"adsb_icao","flight":"BR5 ","r":"B-16737","t":"B77W","alt_baro":34000,"gs":502.0,"track":296.33,"baro_rate  
    {"hex":"a078ec","type":"adsb_icao","flight":"N13AV ","r":"N13AV","t":"GA8","alt_baro":2425,"alt_geom":2450,"gs":119.0,"track":  
    {"hex":"a4d881","type":"adsb_icao","flight":"N411GV ","r":"N411GV","t":"C208","alt_baro":4375,"alt_geom":4325,"gs":163.6,"track  
    {"hex":"a00f60","type":"adsb_icao","flight":"N1026V ","r":"N1026V","t":"C208","alt_baro":1400,"alt_geom":1450,"gs":132.7,"track
```

Dataset

Aircraft telemetry data from global radar

Collected for all commercial aircraft on
February 1st 2022 (in 5 second intervals)

Size: ~60GB

Source:

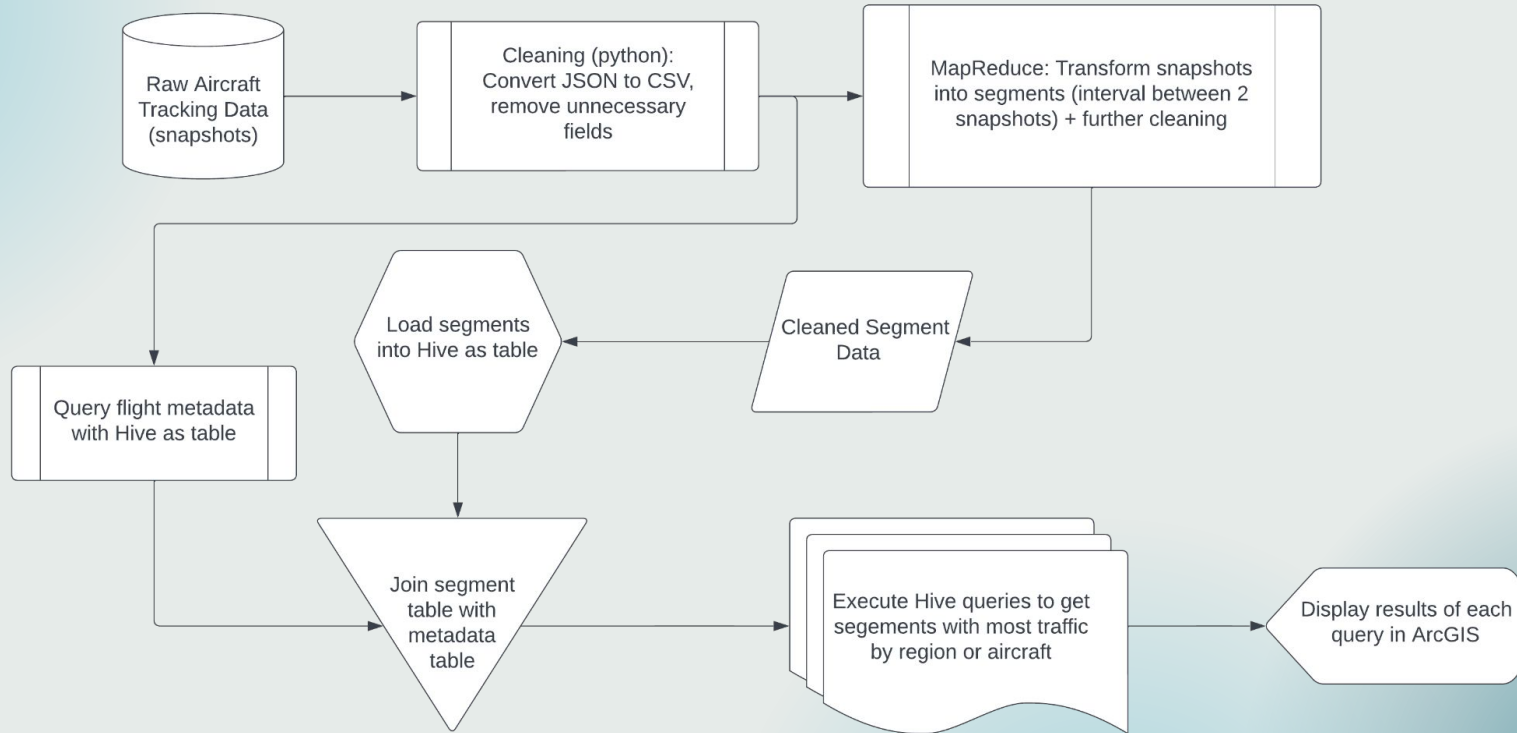
<https://www.adsbexchange.com/data/#sample>

Full schema:

<https://www.adsbexchange.com/version-2-api-wip/>



Data Processing Flow



Code Challenge #1

Used MapReduce chaining to define a single job that ran
2 mappers → 1 reducer → 1 more mapper.

(Timestamp, ID, Lat, Lon, Aircraft) → (ID, Timestamp), (Lat, Lon)

(ID, Timestamp), (Lat, Lon) → (ID), (Lat1, Lon1, Lat2, Lon2)

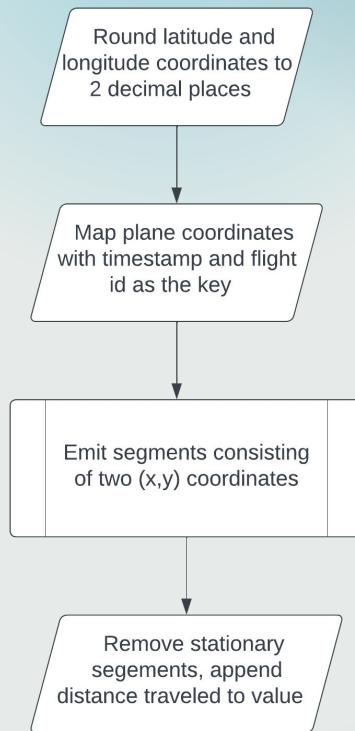
(ID), (Lat1, Lon1, Lat2, Lon2), (Distance)

```
Configuration mapAConf = new Configuration( loadDefaults: false);
ChainMapper.addMapper(mainJob, RoundCoordinatesMapper.class, LongWritable.class, Text.class,
    Text.class, Text.class, mapAConf);

Configuration mapBConf = new Configuration( loadDefaults: false);
ChainMapper.addMapper(mainJob, GenSegmentsMapper.class, Text.class, Text.class,
    FlightSnapshotKey.class, FlightSnapshot.class, mapBConf);

Configuration reduceConf = new Configuration( loadDefaults: false);
ChainReducer.setReducer(mainJob, GenSegmentsReducer.class, FlightSnapshotKey.class, FlightSnapshot.class,
    Text.class, FlightSegment.class, reduceConf);

ChainReducer.addMapper(mainJob, RemoveStationaryMapper.class, Text.class, FlightSegment.class,
    Text.class, Text.class, mapperConf: null);
```



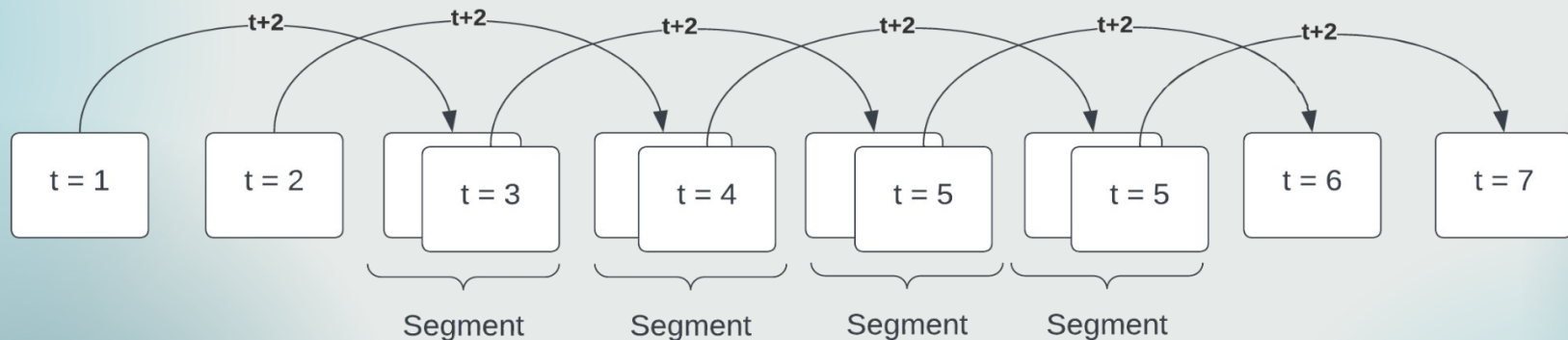
Code Challenge #2

MapReduce Mapper + Reducer to convert
“snapshots” to “segments”

Mapper emitted the snapshot with key t and $t+2$

Reducer combined snapshots with same key t into a
segment

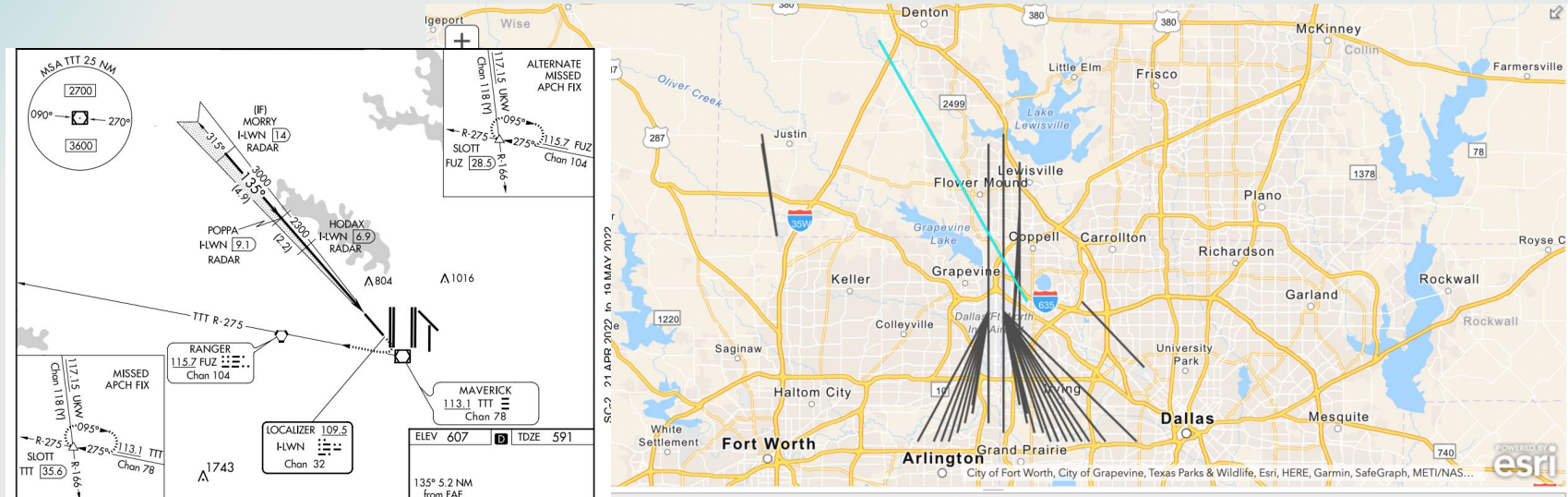
```
reducerValue.set(lat, lon);  
  
reducerKey1.set(hex, ts);  
context.write(reducerKey1, reducerValue);  
  
reducerKey2.set(hex, ts + INTERVAL);  
context.write(reducerKey2, reducerValue);
```



Results #1

Most frequently traveled segment in the US: near Dallas-Ft. Worth Int'l

Number of flights: 1048



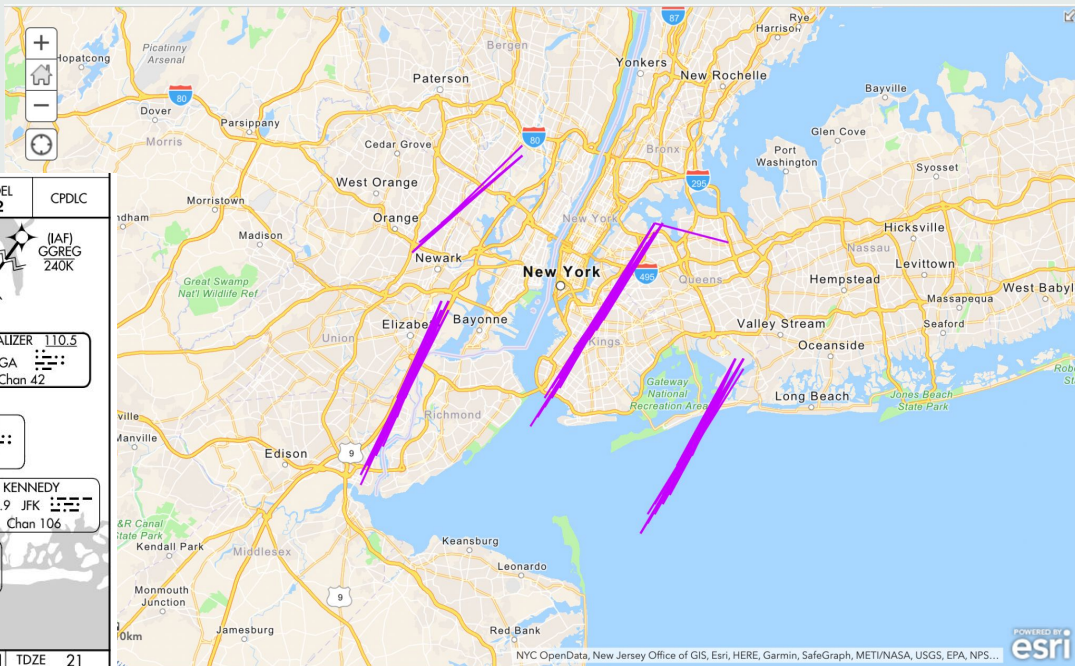
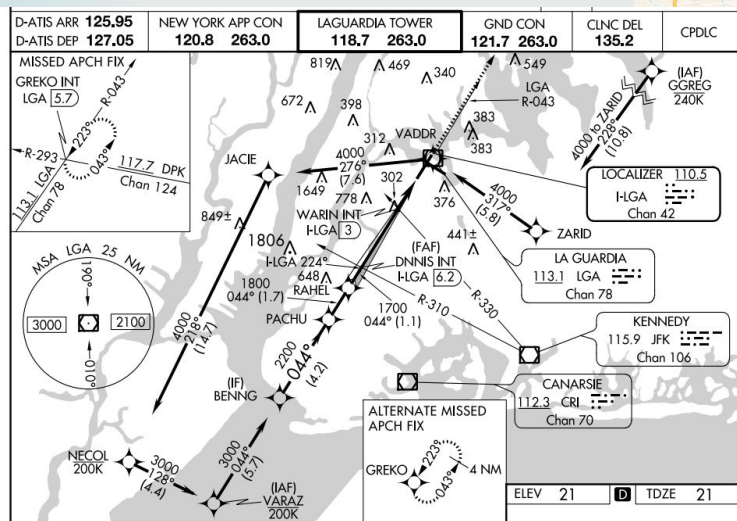
top-1000-any (Features: 1000, Selected: 1)

frequency

1,048

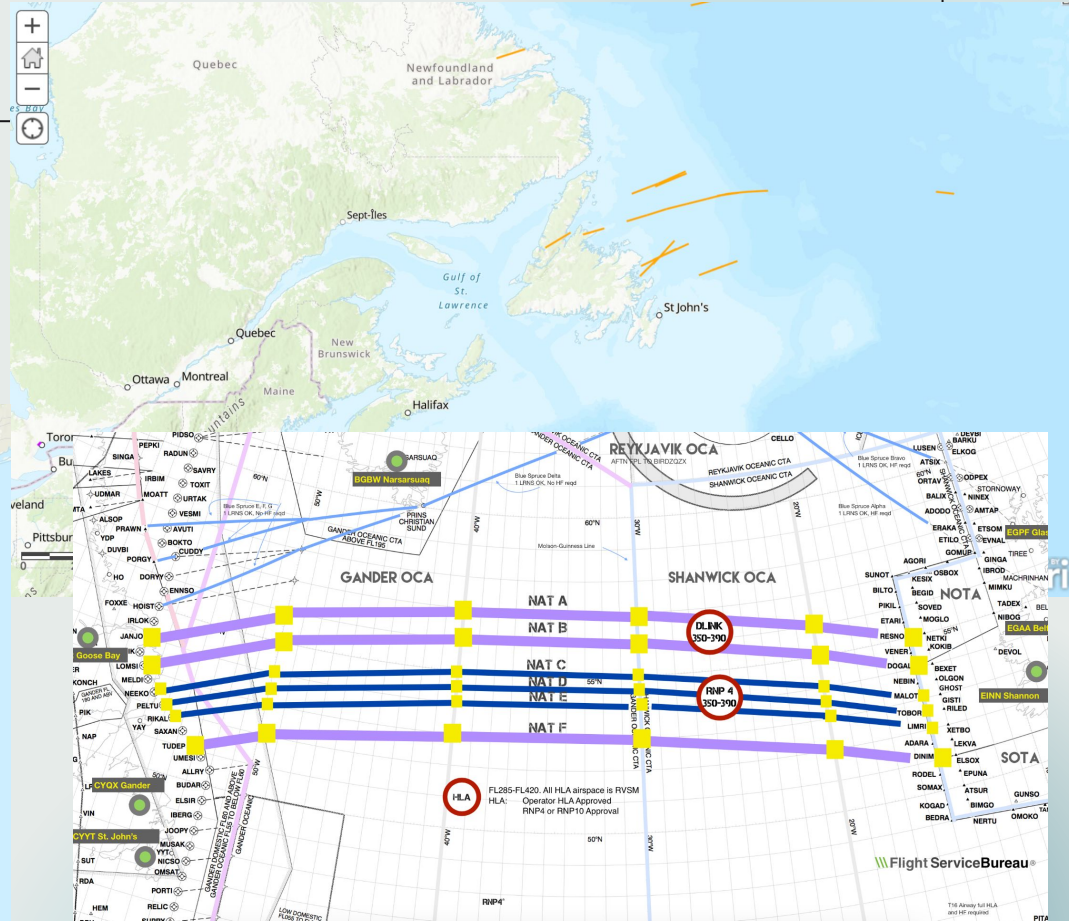
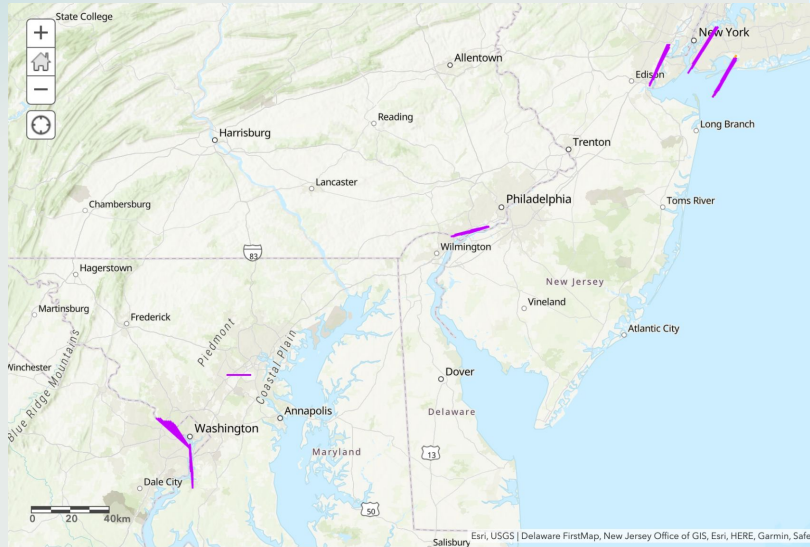
Results #2

Most frequently traveled segments in the NYC area



Results #3

Wide body (e.g. Boeing 747, Airbus A380) versus narrow body (e.g. Boeing 737, 757, Airbus A320)



Acknowledgements

- Professor Malavet for feedback and guidance
- ArcGIS for free student account
- NYU HPC team for great documentation and easy access to computing resources
- ADSB Exchange for free data

CREDITS: This presentation template was created by [Slidesgo](#), including icons by [Flaticon](#) and infographics & images by [Freepik](#)



References

- <https://josephgunnwriting.wordpress.com/2019/06/13/deep-dive-into-new-york-city-air-traffic-control-using-flightradar24/>
- <https://www.adsbexchange.com/data/#sample>
- "From aircraft tracking data to network delay model: A data-driven approach considering en- route congestion" (<https://doi.org/10.1016/j.trc.2021.103329>)
- "Trajectory Clustering and Classification for Characterization of Air Traffic Flows" (<https://doi.org/10.2514/6.2016-3760>)
- "Characterizing air traffic networks via large-scale aircraft tracking data: A comparison between China and the US networks" (<https://doi.org/10.1016/j.jairtraman.2017.12.005>)