Complex Networks 2025

Task 1
Microscale and Macroscale Analysis

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Task 1
Microscale and Macroscale Analysis

Summary

1 Network Description

- We have been working with the **Air Transportation Multiplex Dataset**.
  - Airline routes among European airports, where each of the 37 edge types represents **routes** by a different airline.
  - **Undirected, unweighted, multiplex network**.

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Let's go to the notebook and see the network!

1 Network Description

- **Data Selection:**
  - **Lufthansa:** traditional, hub-and-spoke airline.
  - **Air France:** traditional, hub-and-spoke airline.
  - **Ryanair:** low-cost, point-to-point airline.

    ✚
  - **Whole European Network**: collapse of all airlines network.

1 Network Description

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  - **Lufthansa:** hub-and-spoke.
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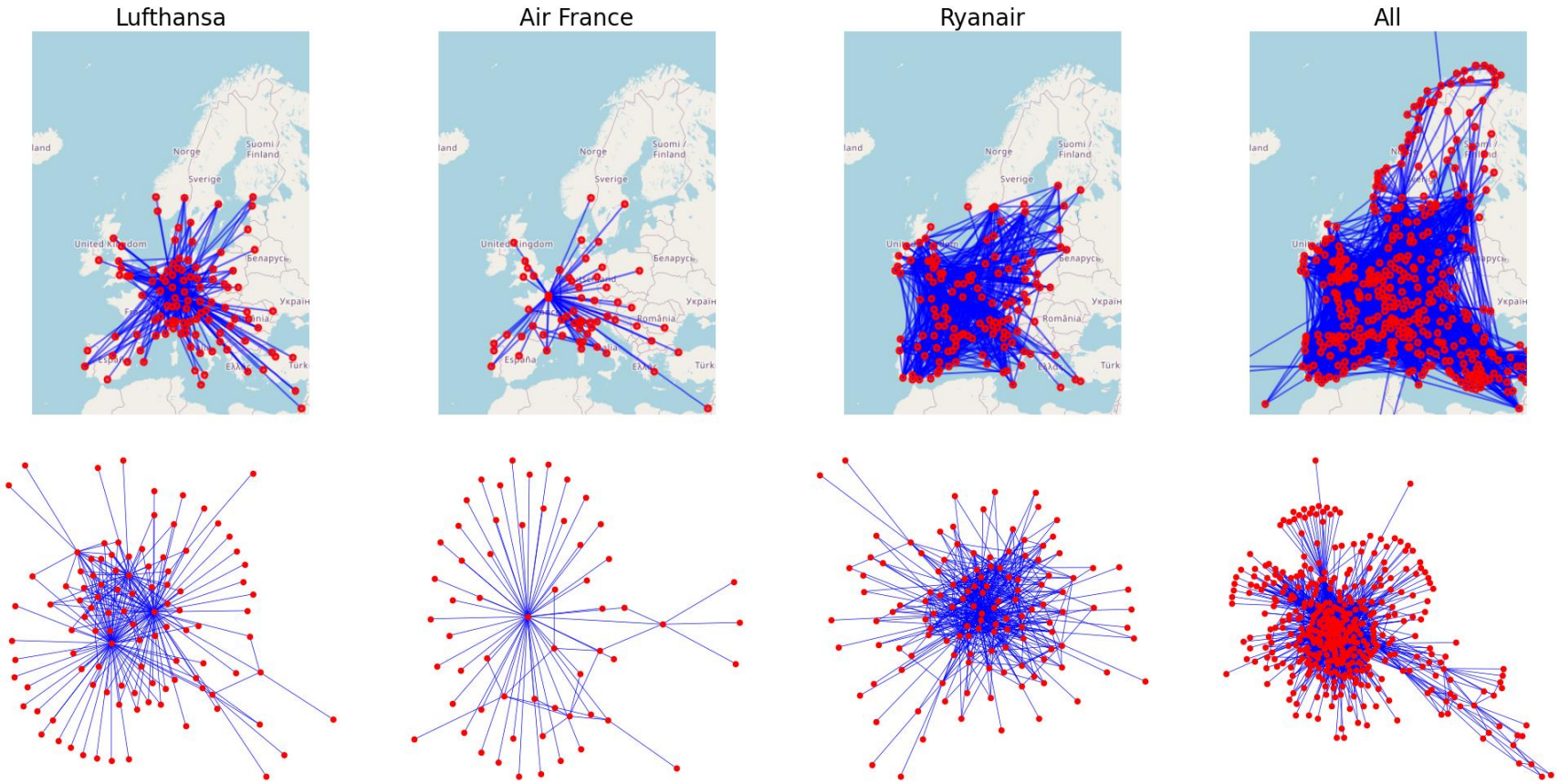
  - **Whole European Network**.



In the plots, we can already see some interesting insights...

→ **Goal**: confirm them quantitatively

2 Microscale Analysis

We have computed the following **microscale measures** for each airport (node) and each airline network:

- **Degree centrality.**
- **Closeness centrality.**
- **Betweenness centrality.**
- **Eigenvector centrality.**
- **Page-rank centrality.**
- **Katz centrality.**
- **Clustering coefficient.**

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Let's go to the notebook and see some results!

3 Macroscale Analysis

We have computed the following **macroscale measures** for each airport (node) and each airline network:

- **Average shortest path length.**
- **Diameter.**
- **Radius.**
- **Average clustering coefficient.**
- **Average number of triangles per node.**
- **Transitivity coefficient.**

3 Macroscale Analysis

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- **Average shortest path length.**
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- **Transitivity coefficient.**

Moreover, we also computed the **periphery** of each network plus its **degree distribution**.

4 Conclusions

The air transport network is a natural network and follows the same patterns presented in class. It has high interpretability and can also be naturally visualized in geographical terms, making it suitable for applying the networks theory to a practical example, further strengthening our intuitive understanding of it.

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Thanks for your Attention!

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Any questions?