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INTRODUCTION

Motivation: Exploring Foursquare mobility networks and investigation of phenomena of clustering networks

Data Sources: 10 cities (Istanbul, Jakarta, London, Tokyo, Seoul, New York, Chicago, Paris, Los Angeles, Singapore) for the period of two years.

Methods: We performed **graph-based clustering** to detect venues that highly interact among each other in terms of aggregated users mobility flows.

Graph - directed and weighted

- **Nodes:** venues
- **Edges:** movements between venues

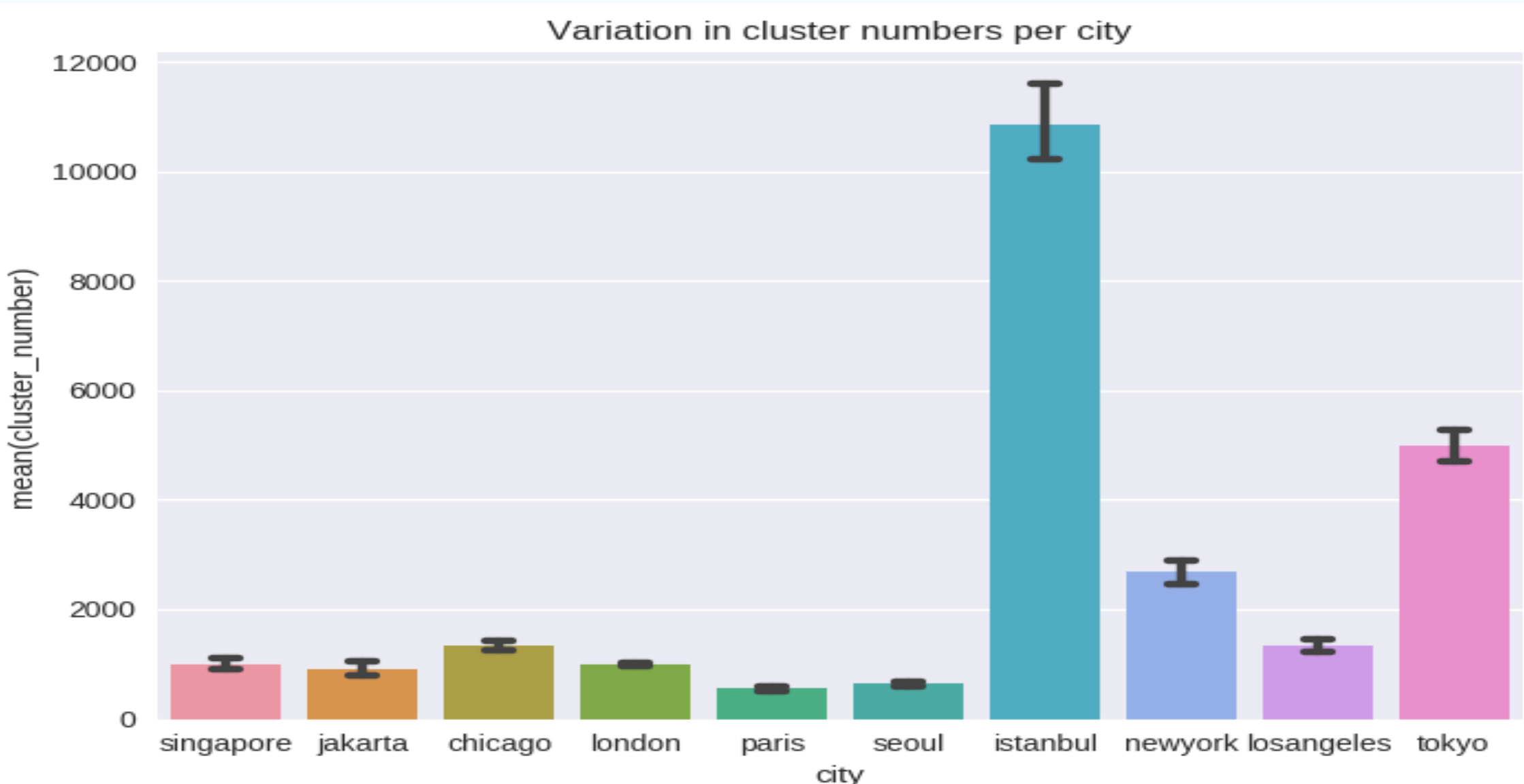
To cluster movements across the city we used **Louvain algorithm**.

$$Q = \frac{1}{2m} \sum_{i,j} [A_{i,j} - \frac{\sum_j A_{i,j} \cdot \sum_i A_{j,i}}{2m}] \delta(c_i, c_j)$$

Detecting a cluster means detecting a group of venues that are frequently visited together by users.

Venue categories: Art & Entertainment, College & University, Event, Food, Nightlife Spot, Outdoors & Recreation, Professional & Other, Shop & Service, Travel & Transport, Other

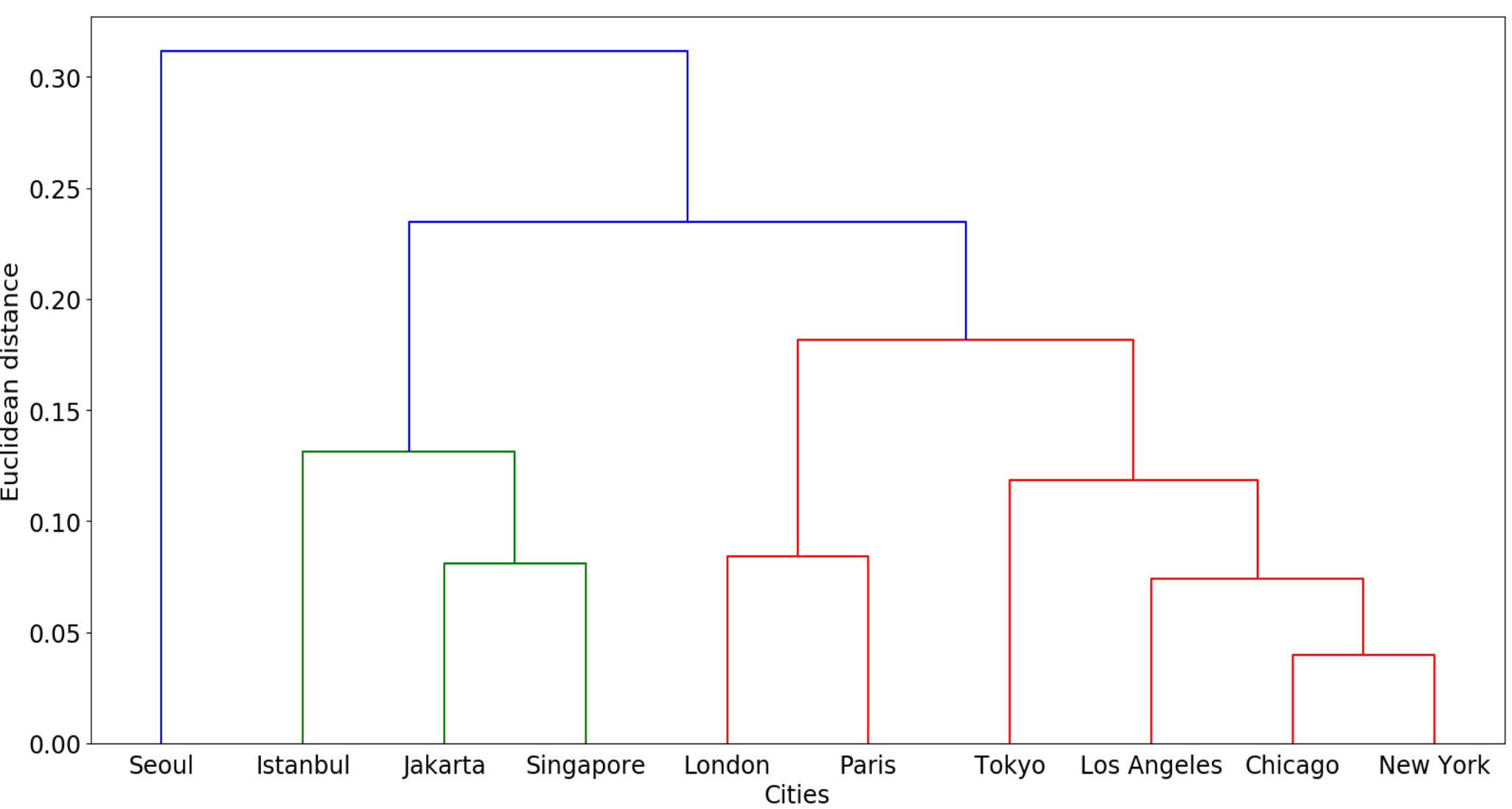
RESULTS



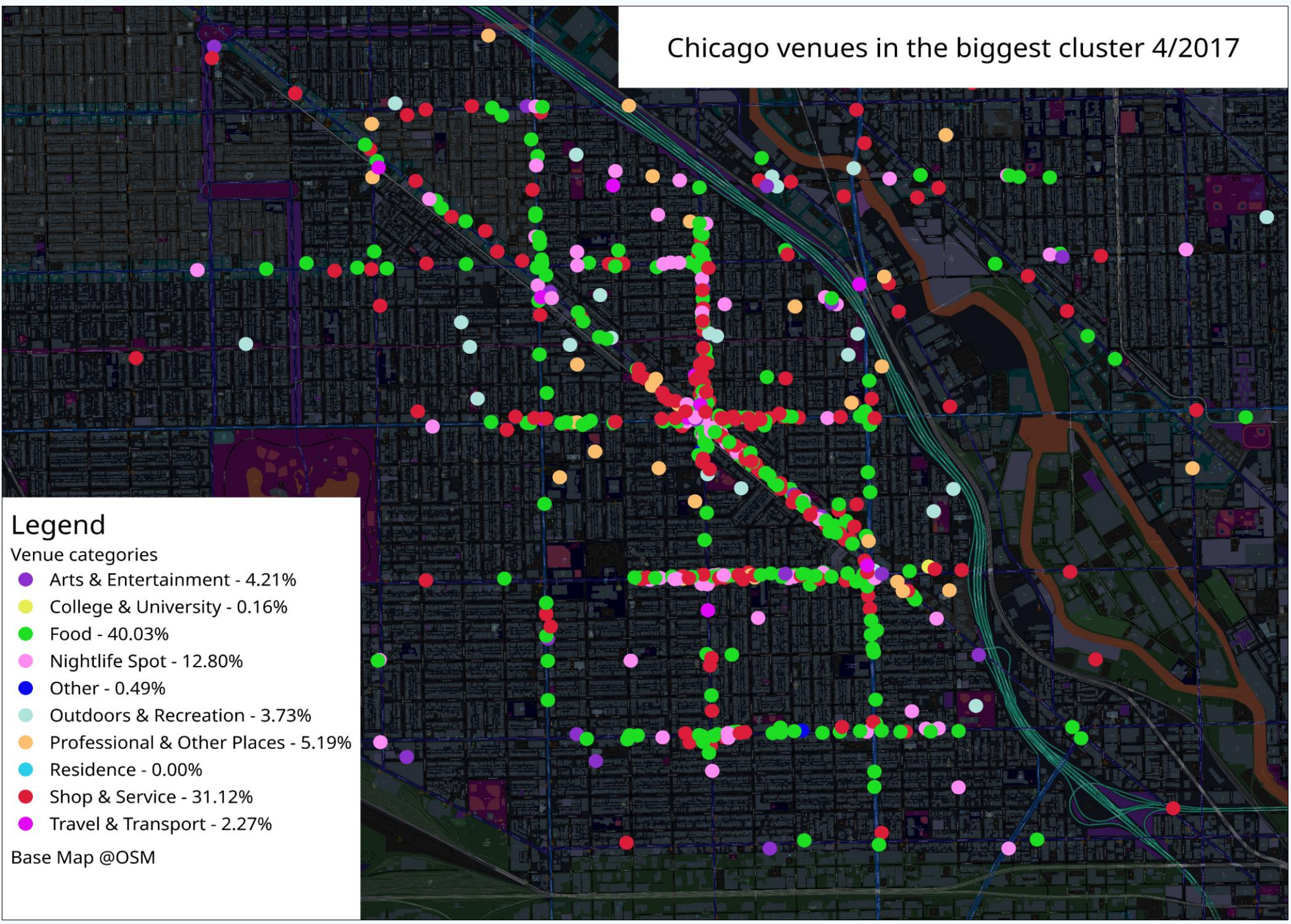
➤ Number of clusters per city and variation between number of clusters per month

➤ In order to obtain global view and compare the cities, **hierarchical clustering** is performed

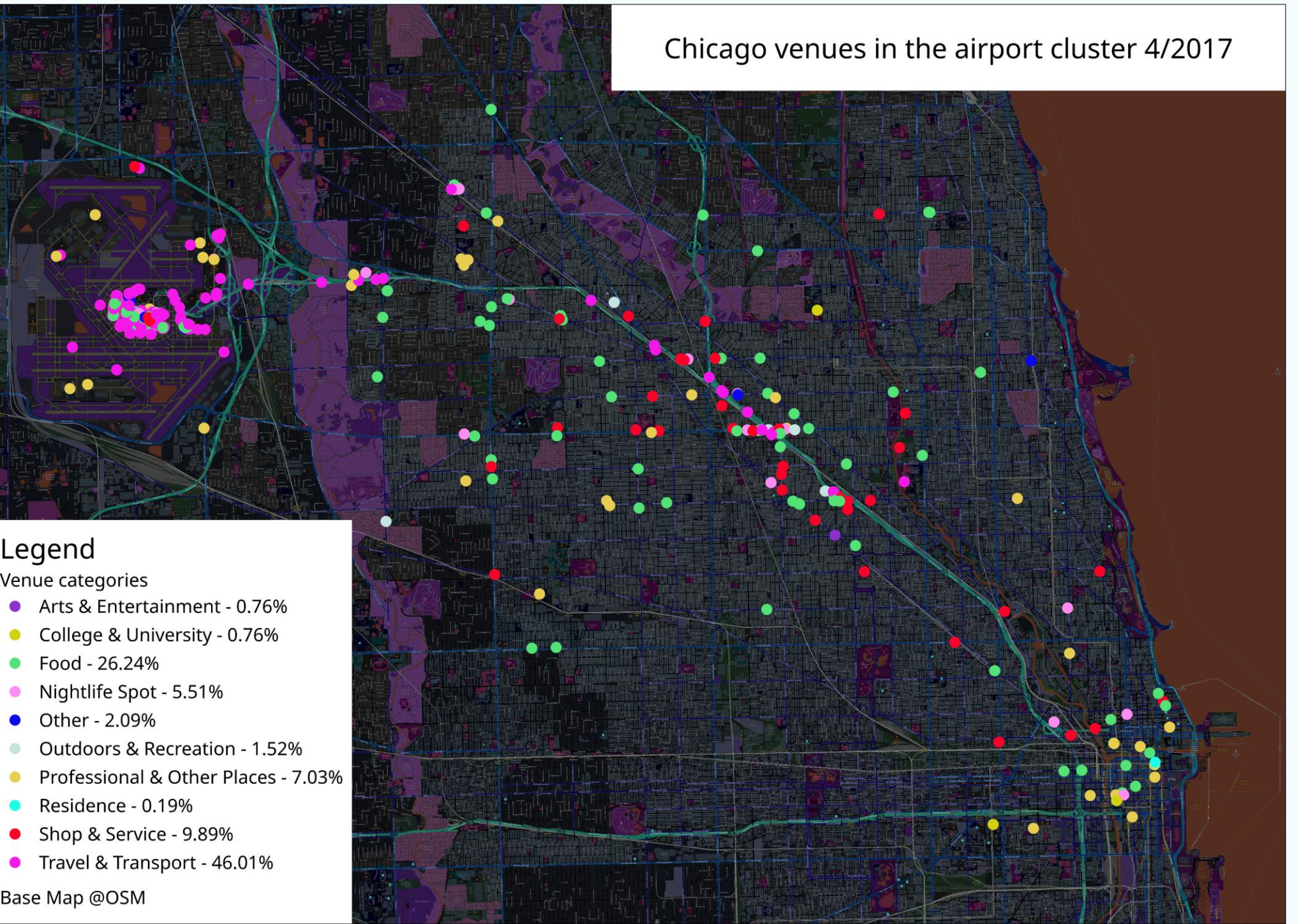
➤ Dendrogram: with color of branches is indicating how we could group cities



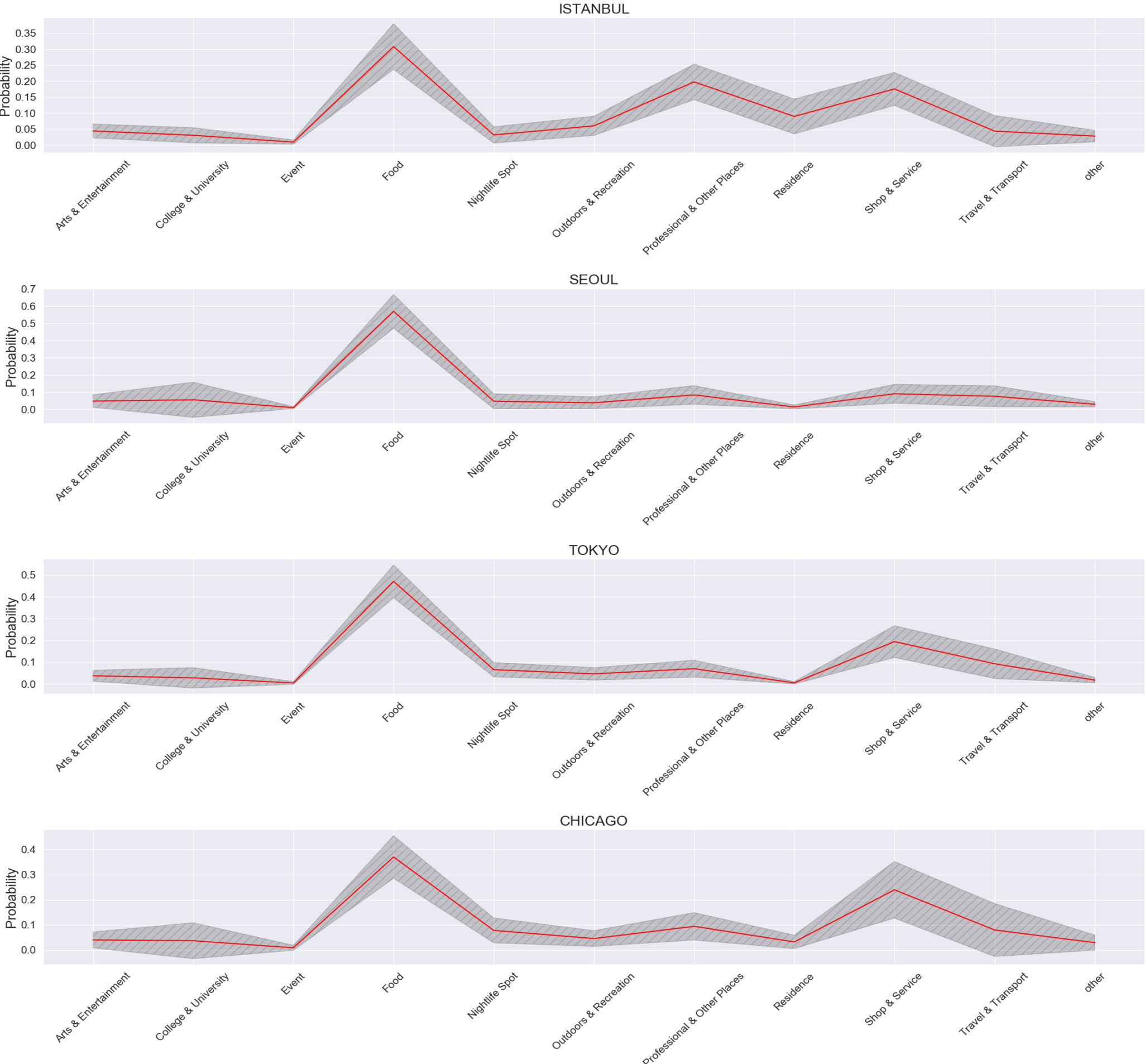
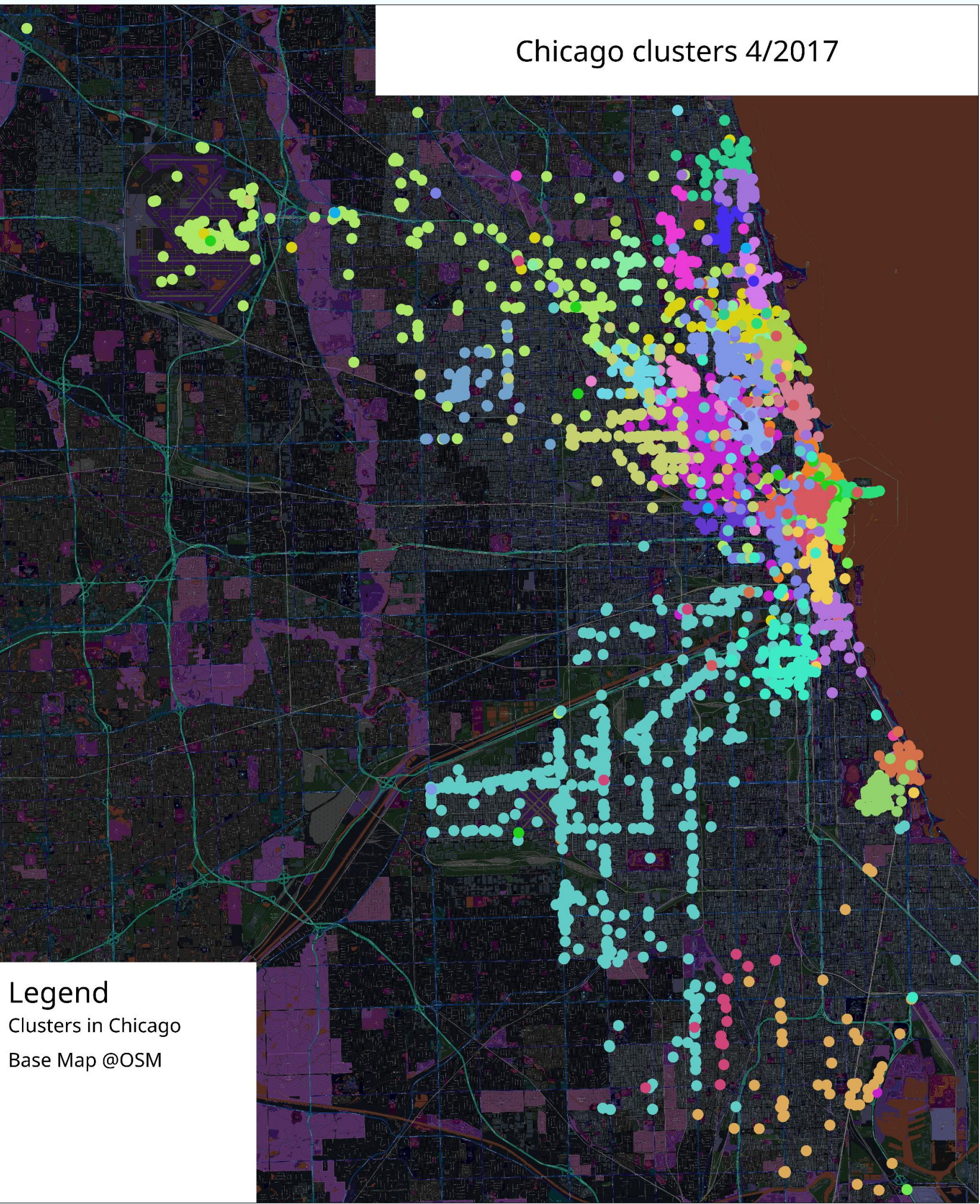
➤ **High similarity between:**
 US cities: Chicago, New York, Los Angeles
 European cities: Paris & London
 Istanbul, Jakarta and Singapore
 ➤ Tokyo stands between US and European cities
 ➤ Seoul has unique pattern completely different from all cities



➤ The biggest cluster in the city of Chicago classifies by category
 ➤ Most present category: Food



➤ One of the clusters in the city of Chicago
 ➤ Venues are around O' Hare international airport and are spread in almost regular form following Interstate 90 road (one of the main highway in the State of Illinois)
 ➤ Most present categories: Travel & Transport and Food



➤ **Semantic profiles of venues clusters**
 Mean profile and standard deviation of categories probability distribution in detected clusters of venues

➤ In Chicago and Tokyo people are very likely to move between venues in categories Food and Shop & Services.
 ➤ In Istanbul people are very likely to move between venues in categories Food, Shop & Services and Professional & Other
 ➤ Seoul has strong dominance of Food category

CONCLUSION

➤ Majority of venues in cluster are either spatially close or they are well connected with transport infrastructure, indicating that users tend to move between locations in limited spatial distance forming this way urban sub-spaces

➤ Utilization in application: targeted advertising, recommendation system

➤ **Future work:** we plan to perform venues clustering in higher time resolution to get more detailed insight into evolving patterns in clustering results

CLUSTERS

IN CHICAGO