

Rivalry on the Rhine

The Battle of the Neighborhoods

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Background and Motivation

- **Cologne vs. Düsseldorf**
 - two major cities in western Germany
 - only about 40 km apart on the Rhine.
 - similarities in many aspects but competitive relationship
- **Data-driven analysis**
 - to investigate how similar/dissimilar both cities are
 - to help tourists or people/groups who want to develop business make their first decision on place selection



Data and Methodology

Data exploration

- Boroughs/neighborhoods containing names and geospatial coordinates by scraping wiki and related webpages
- Common venue categories in each neighborhood by the Foursquare explore function

Methodology

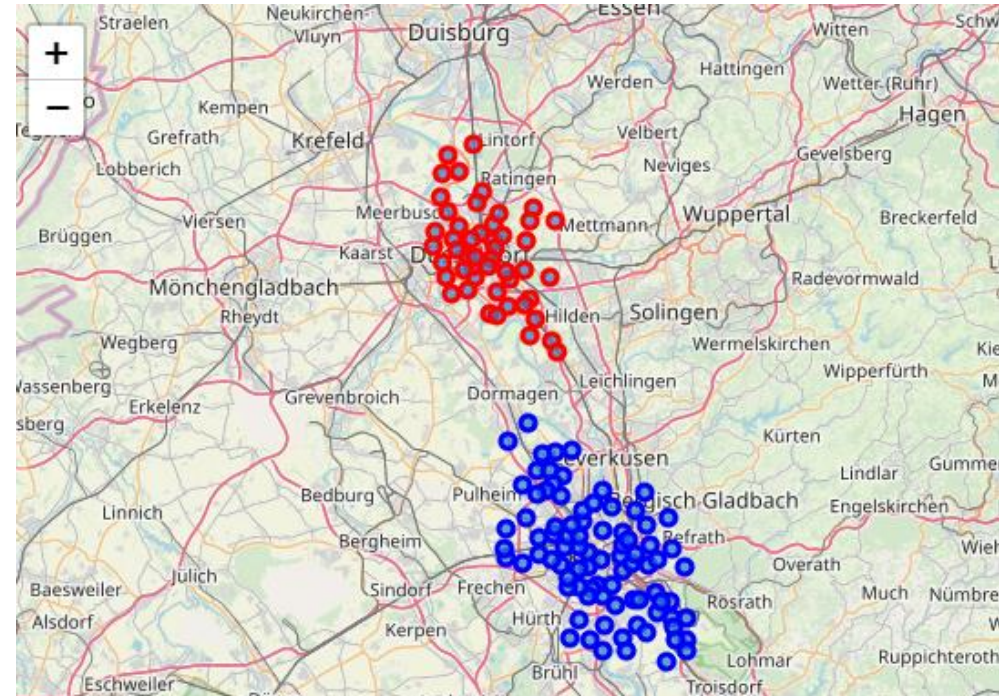
- The Folium library – Visualization of neighborhoods and their distributions on interactive map
- Word clouds of venue categories in city neighborhoods – Identification & Intuitive comparison of really stand-out categories in the city
- k-means clustering algorithm – Grouping city neighborhoods into clusters

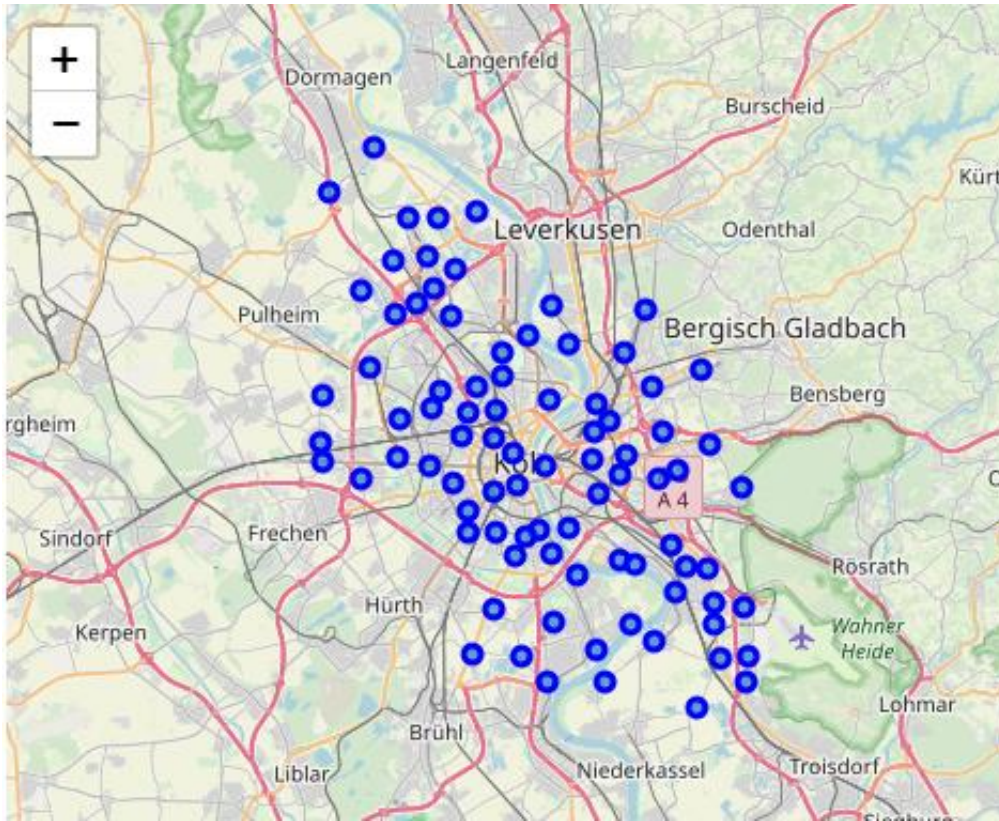
Cologne vs. Düsseldorf

Basics of Cologne and Düsseldorf

	Latitude	Longitude	Boroughs	Neighborhoods	Area (km ²)	Population	Density (/km ²)
Cologne	50.938837	6.970407	9	86	405.12	1019326	2516
Düsseldorf	51.225402	6.776314	10	50	217.20	591829	2724

Map with Cologne and Düsseldorf neighborhoods



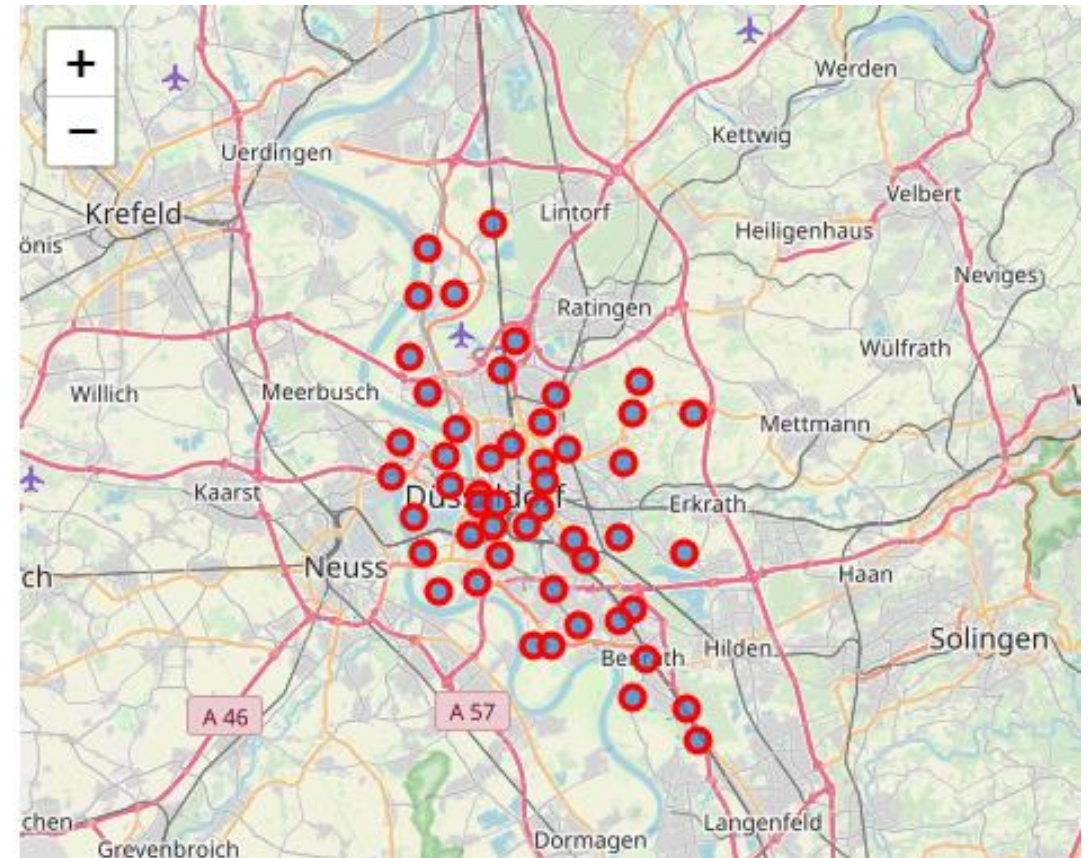


	Neighborhood	Borough	Area	Population	Density	Latitude	Longitude
0	Altstadt-Süd	Innenstadt	2.36	27071	11469	50.929181	6.955329
1	Neustadt-Süd	Innenstadt	3.50	37719	13343	50.926560	6.940406
2	Altstadt-Nord	Innenstadt	2.46	17960	7301	50.942265	6.953188
3	Neustadt-Nord	Innenstadt	2.83	28720	8213	50.947906	6.941059
4	Deutz	Innenstadt	5.24	15563	2968	50.936759	6.973046
...
81	Dellbrück	Mülheim	9.95	21430	2154	50.975921	7.074106
82	Höhenhaus	Mülheim	5.08	15128	2980	50.983012	7.024575
83	Dünnwald	Mülheim	10.85	11779	1086	51.000000	7.038611
84	Stammheim	Mülheim	3.75	7473	1995	50.986393	6.989327
85	Flittard	Mülheim	7.74	7688	994	51.002049	6.977086

9 boroughs and 86 neighborhoods

Neighborhoods in Cologne

	Neighborhood	Borough	Area	Population	Density	Latitude	Longitude
0	Altstadt	Stadtbezirk 1	0.48	1906	3971	51.225912	6.773567
1	Angermund	Stadtbezirk 5	13.30	6061	455	51.328995	6.781416
2	Benrath	Stadtbezirk 9	5.90	15772	2673	51.163356	6.875192
3	Bilk	Stadtbezirk 3	5.56	37275	6704	51.202758	6.785101
4	Carlstadt	Stadtbezirk 1	0.46	2210	4804	51.222142	6.773394
5	Derendorf	Stadtbezirk 1	3.34	19377	5801	51.244549	6.792249
6	Düsseltal	Stadtbezirk 2	2.98	25907	8693	51.237841	6.812116
7	Eller	Stadtbezirk 8	5.86	30048	5127	51.201253	6.837591
8	Flehe	Stadtbezirk 3	2.05	2492	1215	51.192204	6.771713
9	Flingern Nord	Stadtbezirk 2	2.70	21436	7939	51.231381	6.813238
10	Flingern Süd	Stadtbezirk 2	1.50	9593	6395	51.221009	6.810060
11	Friedrichstadt	Stadtbezirk 3	1.04	17839	17152	51.213564	6.781700
12	Garath	Stadtbezirk 10	3.64	18210	5002	51.143719	6.899834



10 boroughs and 50 neighborhoods

Neighborhoods in Düsseldorf

There are 1104 venues in 205 uniques categories found in neighborhoods of Cologne.

	Neighborhood	Latitude	Longitude		Venue	Venue Latitude	Venue Longitude	Venue Category
0	Altstadt-Süd	50.929181	6.955329	Motel One Köln-Waidmarkt	50.931557	6.954513	Hotel	
1	Altstadt-Süd	50.929181	6.955329	Motel One Lounge	50.931571	6.954438	Lounge	
2	Altstadt-Süd	50.929181	6.955329	Toscanini	50.925644	6.957099	Italian Restaurant	
3	Altstadt-Süd	50.929181	6.955329	Hotel im Wasserturm	50.931745	6.951255	Hotel	
4	Altstadt-Süd	50.929181	6.955329	Kaffeeprinzen	50.928887	6.950101	Café	
...	
1099	Stammheim	50.986393	6.989327	Bäckerei Förster	50.987273	6.991915	Bakery	
1100	Flittard	51.002049	6.977086	Deadbull Studios	51.002948	6.975777	Music Store	
1101	Flittard	51.002049	6.977086	Sebastian Hoofs - Maßschneider	51.001451	6.976377	Tailor Shop	
1102	Flittard	51.002049	6.977086	Narrenburg Flittarder KG	51.004355	6.978453	Community Center	
1103	Flittard	51.002049	6.977086	EDEKA Wodarz Getränkemarkt	50.999911	6.980711	Supermarket	

Word cloud of venue categories in Cologne neighborhoods



Most common venue categories

Neighborhoods in Cologne

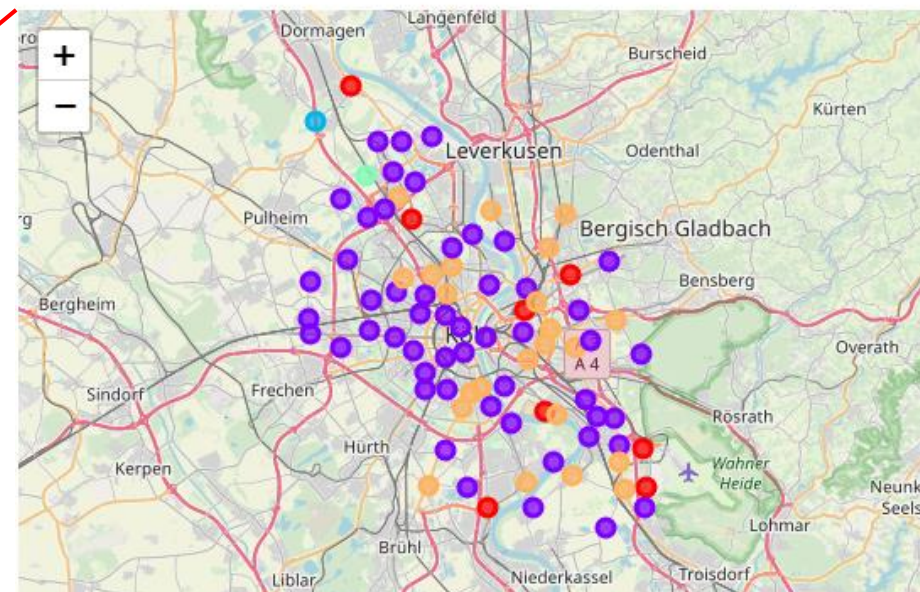
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Cologne vs. Düsseldorf

The K-means scores for clustering Cologne neighborhoods:

	Silhouette	Calinski-Harabasz	Davis-Bouldin
Number Of Clusters			
2.0	0.475438	5.675185	0.385454
3.0	0.476550	6.016329	0.377985
4.0	0.117409	6.098941	1.179512
5.0	0.064519	6.502294	1.663366
6.0	0.066800	5.772340	1.478986
7.0	0.081562	6.455664	1.449834
8.0	0.037347	5.971648	1.944613
9.0	0.047399	5.776876	1.735322
10.0	0.050703	5.522333	1.608711

Map of Cologne superimposed with neighborhood clusters
(num_of_clusters = 5)



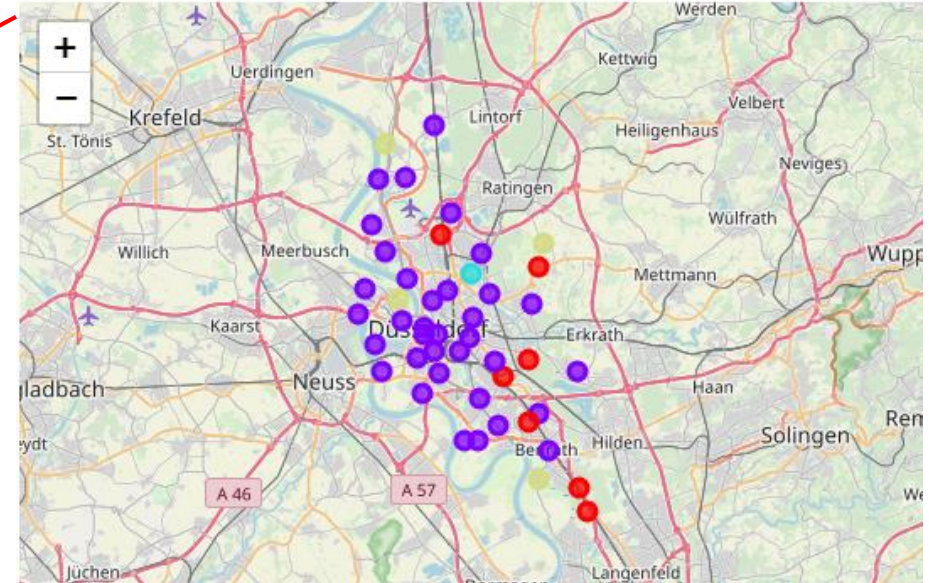
Neighborhood segmentation/clustering

The city of Cologne

The K-means scores for clustering Düsseldorf neighborhoods:

	Silhouette	Calinski-Harabasz	Davis-Bouldin
Number Of Clusters			
2.0	0.330157	7.779359	1.029661
3.0	0.215921	6.286107	1.491451
4.0	0.187477	5.358672	1.368235
5.0	0.103620	5.316643	1.848780
6.0	0.103482	5.333614	1.526571
7.0	0.112444	4.998229	1.333148
8.0	0.081502	4.337789	1.117075
9.0	0.105221	4.320437	1.113701
10.0	0.074970	4.169485	1.475050

Map of Düsseldorf superimposed with neighborhood clusters
(num_of_clusters = 4)



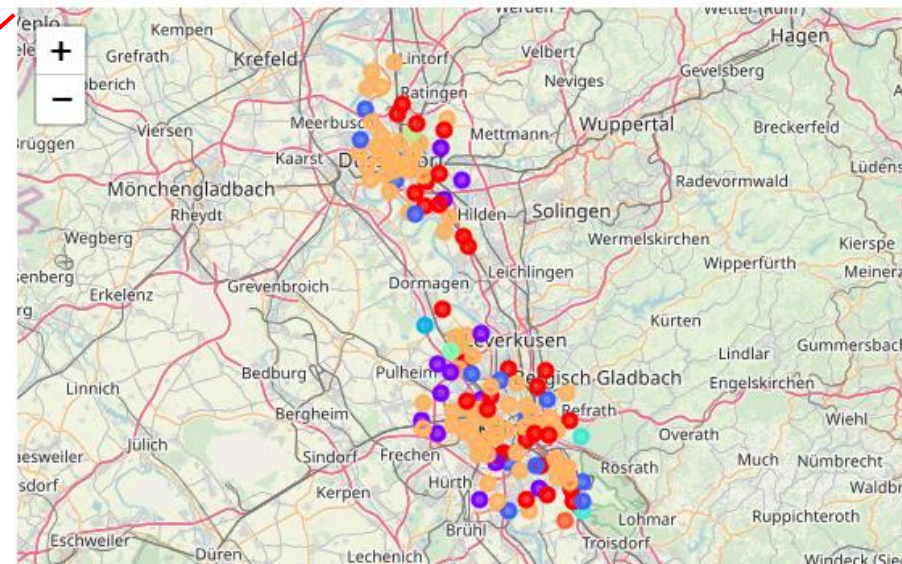
Neighborhood segmentation/clustering

The city of Düsseldorf

The K-means scores for clustering neighborhoods of Cologne and Düsseldorf:

	Silhouette	Calinski-Harabasz	Davis-Bouldin
Number Of Clusters			
2	0.072934	11.378889	2.762288
3	0.079881	8.674134	2.576729
4	0.056277	7.262962	2.488516
5	0.089117	7.859925	2.107350
6	0.090120	7.942384	1.677770
7	0.090369	6.850351	1.905293
8	0.043809	6.320566	2.098879
9	0.095852	6.617653	1.426177
10	0.074890	6.359462	1.735066

Map of Cologne and Düsseldorf superimposed with neighborhood clusters (num_of_clusters = 9)



Neighborhood segmentation/clustering

Cologne + Düsseldorf

Summary & Conclusion

- Based on the venue category data obtained by the Foursquare explore function, the neighborhoods in the cities of Cologne and Düsseldorf have been analyzed.
- The results of neighborhood segmentation indicated that the neighborhoods in Cologne and Düsseldorf are not well distinguished by their venue data.

In Summary,

**Cologne and Düsseldorf are very similar,
and there is no real rivalry in everyday life.**

