The Battle of Neighborhoods.

Capstone Project.

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Contents

1 Introduction: Business problem

In this project, I will try to find the optimal pet-friendly areas in different cities. People who have pets and are moving, either to a new city or to a new place in the same city, probably want to live in a pet-friendly area. In this work, we are going to find the best areas to find trendy venues for pets. We are going to analyse these pet-friendly areas in the following cities:

- Detroit, MI
- Chicago, IL
- Boston, MA
- Philadelphia, PA

To look for the most trendy pet venues, we are going to explore the different categories of venues related to pets, such as stores, veterinarians or medical centers. We are going to detect the areas with most common types of venues. The areas will be found by the postal codes and the different type of venues will form different clusters. Depending on the needs of the people, we will suggest moving to an area organized in one cluster or by another. For instance, a couple with an old dog will prefer move closer to an area where they could easily find a veterinarian or a medical center.

2 Data description

Taking into account all the above described, in order to make a suggestion of a pet-friendly area to move in, first we need to know the kind of pet venues in the area, such as pet stores, pet clinics, veterinarians, and so on.

We are going to use *Foursquare API* to look for the trendy pet venues in the cities of Detroit, Chicago, Boston and Philadelphia within a radius of 10 km from the downtown. This API will give the number of the existing pet venues in the area, their locations and the category of each of them.

With this information and after processing the extracted data, we will be able to plot the maps of each city with the different venues around the downtown. We use *geopy* library to get the latitude and longitude values for each of the cities and *follium* library to generate a map. We will add to the maps the location of the venues.

Also, for each city, the top 5 most common venues for each postal code are examined.

Finally, k-means clustering by category of pet venue will be done by using sklearn package. A new map is created for each of the cities. Clusters, which are represented with different colors, are analyzed and compared.

3 Methodology

3.1 Data acquisition for pet venues

Assume we have a pet and want to move to a pet-friendly area. A pet-friendly area will probably have many pet stores, pet clinics,... So, we will find for venues for pets in some cities within a radius of 10 km and compare the cities. The considered cities are:

- Detroit, MI
- Chicago, IL
- Boston, MA
- Philadelphia, PA

To get data from *Foursquare API* we can make *search* requests or *explore* queries. First, we are going to define the url for the *search* query for word 'pet' around the cities, limiting the results to 500. Results are given in a JSON and we have to trasform it into a *pandas* dataframe. Then, we filter the dataframe and select the columns we are interesting in, which are the name of the pet venues, its address, latitude, longitude and postal code. For the city of Detroit we show the first ten rows of the results:

```
Detroit, MI
```

	Name	Address	Latitude	Longitude	PostalCode
0	Pet Value	NaN	42.317648	-83.045837	NaN
1	Urban Pet Shoppe	2472 Riopelle St	42.346248	-83.038390	48207
2	Corbret's Pet Depot	3165 Walker Rd	42.281010	-82.981633	N8W 3R6
3	Painted petalZ	NaN	42.330171	-83.047628	NaN
4	Pete's Barbershop	438 Macomb St	42.335375	-83.043566	48226
5	Pet Valu	300 Tecumseh Road East	42.298502	-83.020557	N8X 5E8
6	Pet Valu	1556 Huron Church Road	42.288329	-83.059693	N9C 3Z3
7	Peter Pan @ Detroit	NaN	42.338235	-83.053838	NaN
8	Pet Valu	Tecumseh Rd W	42.290019	-83.058210	N9C 3Z3
9	le petit dejeuner	2548 Grand River Ave	42.338174	-83.062604	NaN

Similarly, we obtain the following results for the rest of the cities:

```
Chicago, IL
```

	Name	Address	Latitude	Longitude	PostalCode
0	Out-U-Go! Pet Care	1100 W Cermak Road Suite 111	41.853193	-87.653539	60608
1	Pet Supplies Plus	3145 S Ashland Ave	41.837128	-87.663911	60608
2	Banfield Pet Hospital	1101 S Canal St	41.868224	-87.638530	60607
3	Kriser's Natural Pet	1103 S. State St.	41.869137	-87.627229	60605
4	Pet Supplies Plus Wicker Park	1289 North Milwaukee	41.905233	-87.669375	60622
5	AMSTAPHY, Senior Pet Photography	1200 W 35th St #290	41.831633	-87.656597	60609
6	PetSmart	1101 S Canal St	41.867523	-87.638877	60607
7	Pet Supplies Plus N. Lincoln	3757 N Lincoln Ave	41.950083	-87.675568	60613
8	Vianey's Pet Salon	1824 S Ashland Ave	41.856996	-87.666533	60608
9	PetSmart	1415 N Kingsbury St	41.906464	-87.650007	60642

```
Boston, MA
```

	Name	Address	Latitude	Longitude	PostalCode
0	Pet Supplies Plus Medford	630 Fellsway	42.406831	-71.083285	02155
1	Peter L. Stern & Company, Inc.	15 Court Sq Lbby 101	42.358613	-71.059011	02108
2	Red Dog Pet Resort & Spa	274 Southampton St	42.331243	-71.063957	02118
3	PETROCELLI LAW	1 Boston St Suite 2600	42.358891	-71.058508	02127
4	Charlestown Pet Clinic	NaN	42.378468	-71.068389	02129
5	D'Tails Pet Boutique	73 Berkeley St	42.346844	-71.070680	02116
6	Boston Pet Sitters	144 Commonwealth Ave Apt 3	42.351577	-71.077642	02116
7	PetSmart	160 Alewife Brook Pkwy	42.390646	-71.140164	02138
8	Peters Park	1205 Washington	42.342662	-71.067686	02118
9	BluePearl Pet Hospital	56 Roland St	42.381259	-71.080117	02129

```
Philadelphia, PA
```

	Name	Address	Latitude	Longitude	PostalCode
0	Banfield Pet Hospital	1112 Chestnut St Spc 1120	39.950042	-75.159325	19107
1	Rittenhouse Pet Supply	135 S 20th St	39.950758	-75.173750	19103
2	Litterpaw Pet Supply	267 S 10th St	39.946476	-75.157771	19107
3	The Pet Snobs Boutique	534 S 4th St	39.941778	-75.149323	19147
4	Fairmount Pet Shoppe	2024 Fairmount Ave	39.967280	-75.171041	19130
5	Fetch! Pet Care	1229 Chestnut St	39.950823	-75.163651	19107
6	BONeJOUR Pet Supply	53 N 3rd St	39.951846	-75.145359	19106
7	Pet Cemetery	NaN	39.959384	-75.161552	NaN
8	The Pet Mechanic	920 South St	39.942714	-75.158006	19147
9	PetSmart	2360 W Oregon Ave	39.918076	-75.188899	19145

We can use also define an **explore** request of *Foursquare API* to get trending venues around the cities of interest. The resulting JSON has to be transformed into a *pandas* dataframe. We can filter the new dataframe and save only the relevant information. Similar as before, we obtain columns with name of the venue, its address, its latitude and longitude, the postal code and, finally, the category of the venue. We show ten of the popular spots around each of the cities:

```
Detroit, MI
```

	Name	Address	Latitude	Longitude	PostalCode	Category
0	Cass Corridog	4240 Cass Ave	42.351110	-83.063349	48201	Pet Store
1	City Bark	1222 Griswold st	42.332935	-83.049280	48226	Pet Store
2	PetSmart	5650 Mercury Dr	42.330686	-83.203075	48126	Pet Store
3	3Dogs1Cat	2472 Riopelle St	42.346373	-83.038368	48207	Pet Store
4	Urban Pet Shoppe	2472 Riopelle St	42.346248	-83.038390	48207	Pet Service
5	PetSmart	3164 Dougall Ave.	42.269737	-83.009991	N9E 1S6	Pet Store
6	Pet Valu	300 Tecumseh Road East	42.298502	-83.020557	N8X 5E8	Pet Store
7	Pet Valu	Tecumseh Rd W	42.290019	-83.058210	N9C 3Z3	Pet Store
8	Pet Valu	1556 Huron Church Road	42.288329	-83.059693	N9C 3Z3	Pet Store
9	Corbret's Pet Depot	3165 Walker Rd	42.281010	-82.981633	N8W 3R6	Pet Store

```
Chicago, IL
```

	Name	Address	Latitude	Longitude	PostalCode	Category
0	Kriser's Natural Pet	1103 S. State St.	41.869137	-87.627229	60605	Pet Service
1	Bark N' Bites	702 W 35th St	41.830842	-87.643930	60616	Pet Store
2	Paw Naturals	932 W Monroe St	41.880418	-87.650930	60607	Pet Store
3	The Anti-Cruelty Society	169 West Grand Avenue	41.891375	-87.632548	60654	Animal Shelter
4	Tucker Pup's Pet Resort	219 North Carpenter Street	41.886281	-87.653276	60607	Pet Service
5	Kriser's Natural Pet	1658 N. Milwaukee Ave.	41.911733	-87.679972	60647	Pet Service
6	Doggy Style Pet Shop	2023 W Division St	41.903182	-87.678284	60622	Pet Store
7	K9 University Chicago	2945 W Lake St	41.884079	-87.700532	60612	Pet Store
8	PetSmart	1101 S Canal St	41.867523	-87.638877	60607	Pet Store
9	VCA Lake Shore Animal Hospital	960 W Chicago Ave	41.896566	-87.652178	60642	Veterinarian

```
Boston, MA
```

	Name	Address	Latitude	Longitude	PostalCode	Category
0	The Fish & Bone	217 Newbury St	42.350022	-71.081334	02116	Pet Store
1	The Urban Hound	129 Malden St	42.339344	-71.066116	02118	Pet Store
2	Polka Dog	256 Shawmut Ave	42.343340	-71.068586	02118	Pet Store
3	Pawsh Dog Boutique	31 Gloucester St	42.349394	-71.084243	02115	Pet Store
4	Red Dog Pet Resort & Spa	274 Southampton St	42.331243	-71.063957	02118	Pet Service
5	Unleashed by Petco	1310 Washington St	42.341936	-71.068186	02118	Pet Store
6	The Pet Shop	165 Harvard Ave	42.351437	-71.131609	02134	Pet Store
7	Polka Dog Bakery	42 South St	42.308198	-71.115421	02130	Pet Store
8	LaundroMutt	489 Concord Ave	42.386901	-71.140664	02138	Pet Store
9	Unleashed by Petco	5 Austin St	42.375598	-71.065395	02129	Pet Store

```
Philadelphia, PA
```

	Name	Address	Latitude	Longitude	PostalCode	Category
0	BONeJOUR Pet Supply	53 N 3rd St	39.951846	-75.145359	19106	Pet Store
1	Doggie Style	1635 Spruce St	39.947662	-75.169523	19103	Pet Store
2	Baltimore Pet Shoppe	4532 Baltimore Ave	39.948954	-75.213978	19143	Pet Store
3	Doggie Style	315 Market St	39.950295	-75.146308	19106	Pet Store
4	Fairmount Pet Shoppe	2024 Fairmount Ave	39.967280	-75.171041	19130	Pet Store
5	Doggie Style	2101 South St	39.945219	-75.177205	19146	Pet Store
6	Doggie Style	1700 E Passyunk Ave	39.928551	-75.165086	19148	Pet Store
7	PetSmart	1415 Washington Ave	39.938397	-75.166976	19146	Pet Store
8	PetSmart	1112 Chestnut St	39.950128	-75.159289	19107	Pet Store
9	Unleashed by Petco	1939 Callowhill St	39.960682	-75.170396	19130	Pet Store

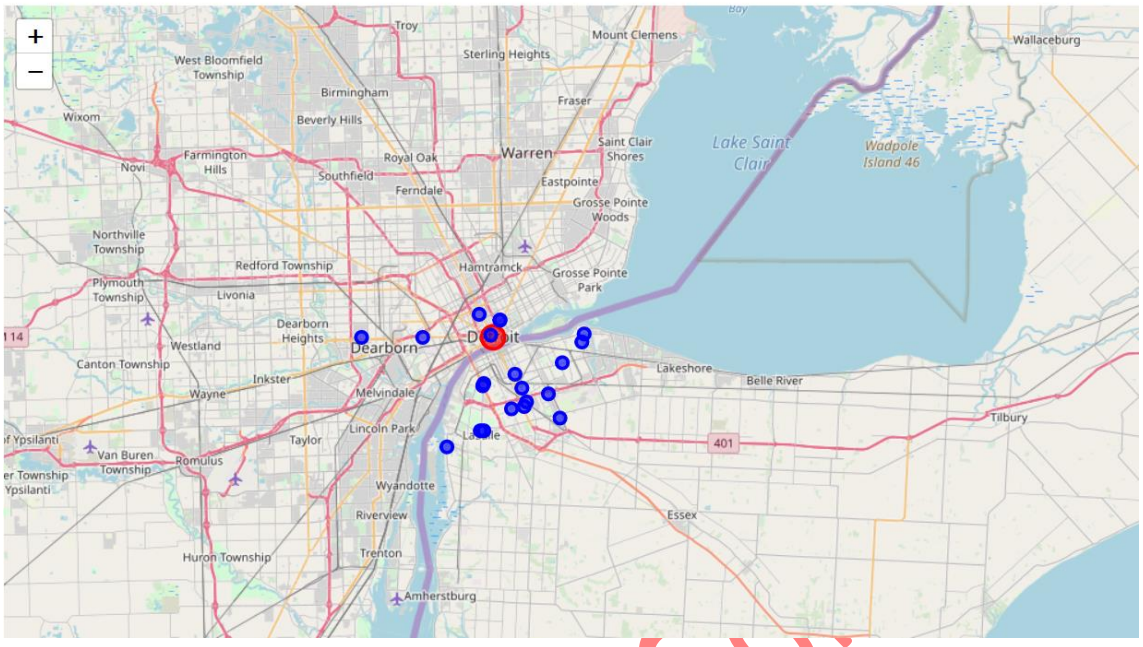
3.2 Visualization of pet venues locations in the selected cities

Let us start focusing on data from Detroit, MI. We are going to use *geopy* library to get the latitude and longitude values of the city:

```
The geograpical coordinate of Detroit, MI are 42.3315509, -83.0466403.
```

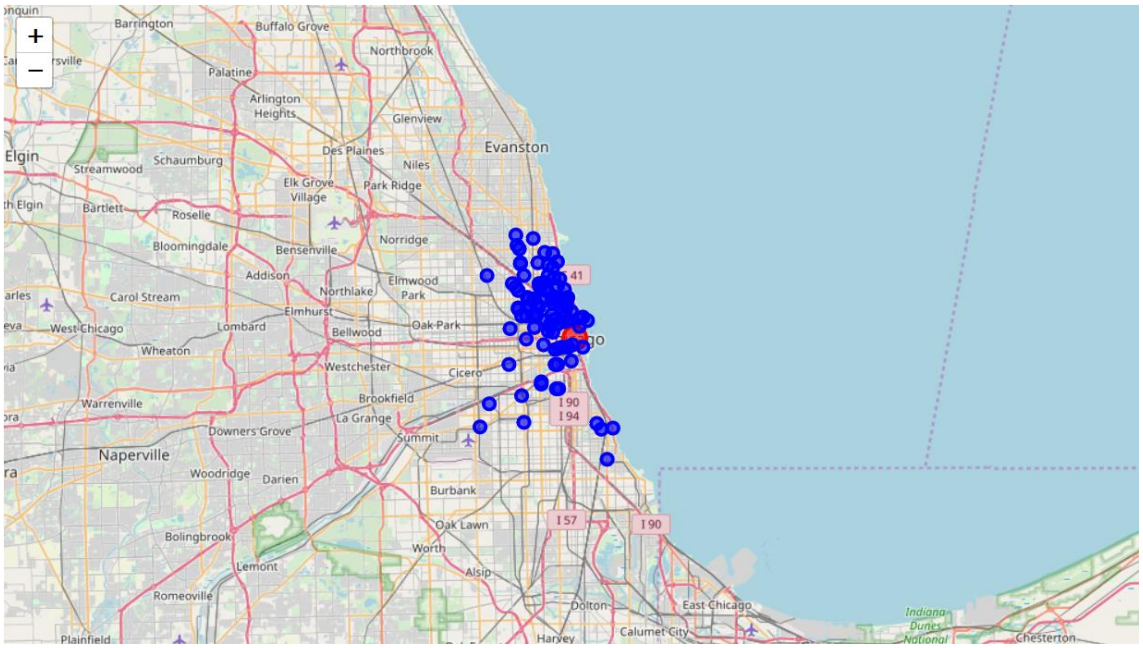
First step is to generate a map centred around Detroit. Then we add a red circle marker to represent the center of the city and as blue circle markers to represent the pet venues:

```
City Detroit, MI
The geograpical coordinate of Detroit, MI are 42.3315509, -83.0466403.
Total number of pet venues in Detroit, MI: 59
```

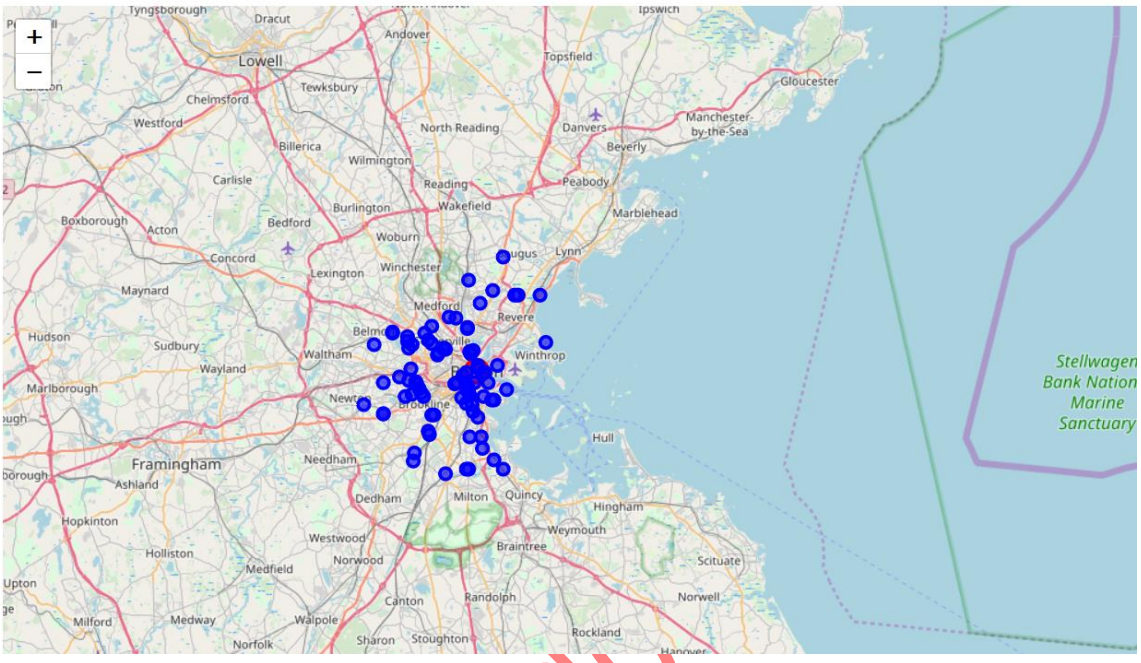


We do the same procedure for the rest of the cities:

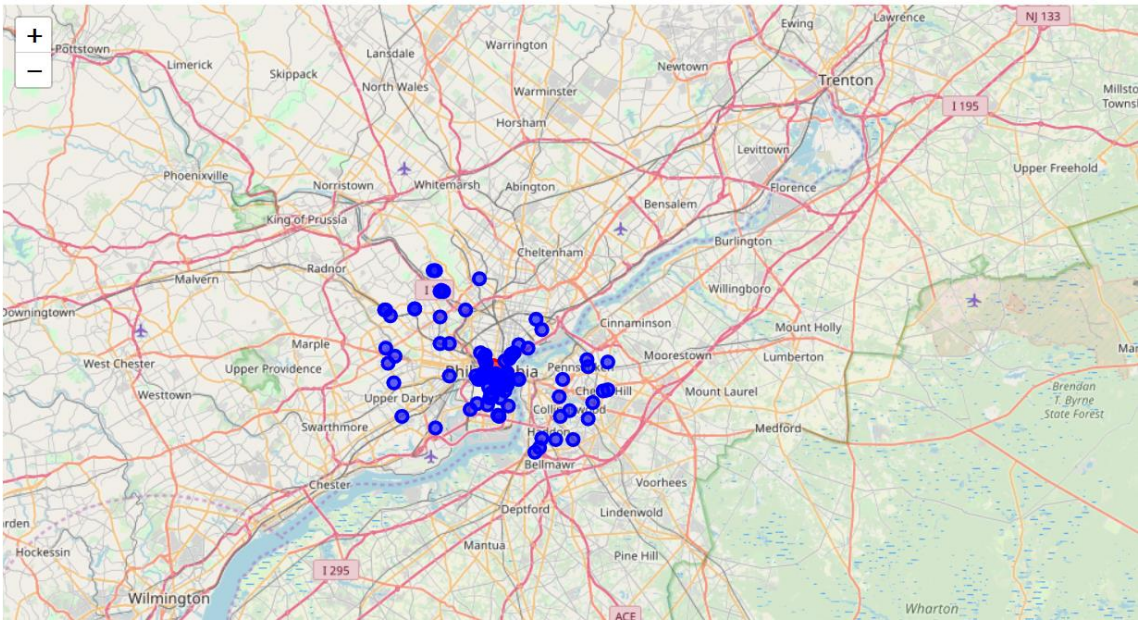
```
City Chicago, IL
The geograpical coordinate of Chicago, IL are 41.8755616, -87.6244212.
Total number of pet venues in Chicago, IL: 151
```



```
City Boston, MA
The geograpical coordinate of Boston, MA are 42.3602534, -71.0582912.
Total number of pet venues in Boston, MA: 85
```




```
City Philadelphia, PA
The geograpical coordinate of Philadelphia, PA are 39.9527237, -75.1635262.
Total number of pet venues in Philadelphia, PA: 119
```



4 Results

4.1 Analysis of each pet venue category

Analysis of 'Category' feature:

As already said, we have extracted the names of the venues, their addresses, latitude and longitude values and their categories. We can group the data by the category of the venue. We can see an example with Detroit data:

```
There are 4 uniques categories.
```

Category	Name	Address	Latitude	Longitude	PostalCode
Animal Shelter	1	1	1	1	1
Pet Service	1	1	1	1	1
Pet Store	18	17	18	18	17
Veterinarian	1	1	1	1	1

Since we want to do clustering, we are going to transform the categorical variable 'Category' into one-hot encoding features and obtain the following dataframe with 21 rows and 5 columns:

	PostalCode	Animal Shelter	Pet Service	Pet Store	Veterinarian
0	48201	0	0	1	0
1	48226	0	0	1	0
2	48126	0	0	1	0
3	48207	0	0	1	0
4	48207	0	1	0	0

Analysis of 'PostalCode' feature:

We can also group the data by the postal code of the venue and by taking the mean of the frequency of occurrence of each category. We can see first rows for data of Detroit, which is a dataframe with 18 rows and 5 columns:

	PostalCode	Animal Shelter	Pet Service	Pet Store	Veterinarian
0	48126	0.0	0.0	1.0	0.0
1	48201	0.0	0.0	1.0	0.0
2	48207	0.0	0.5	0.5	0.0
3	48210	0.0	0.0	1.0	0.0
4	48226	0.0	0.0	1.0	0.0
5	N8S 1T6	0.0	0.0	1.0	0.0
6	N8S 3M8	0.0	0.0	1.0	0.0
7	N8T 1C1	0.0	0.0	1.0	0.0
8	N8W 3R6	0.0	0.0	1.0	0.0
9	N8X 0A8	0.0	0.0	1.0	0.0

From last dataframe we can create a new dataframe to display the most common venues for each postal code. To do this, we first sort the venues in descending order and then create the new dataframe with the top venues. Next image shows the first rows of the new dataframe showing the top three categories for each postal code:

	PostalCode	1st Most Common Venue	2nd Most Common Venue	3rd Most Common Venue
0	48126	Pet Store	Veterinarian	Pet Service
1	48201	Pet Store	Veterinarian	Pet Service
2	48207	Pet Store	Pet Service	Veterinarian
3	48210	Pet Store	Veterinarian	Pet Service
4	48226	Pet Store	Veterinarian	Pet Service
5	N8S 1T6	Pet Store	Veterinarian	Pet Service
6	N8S 3M8	Pet Store	Veterinarian	Pet Service
7	N8T 1C1	Pet Store	Veterinarian	Pet Service
8	N8W 3R6	Pet Store	Veterinarian	Pet Service
9	N8X 0A8	Pet Store	Veterinarian	Pet Service
10	N8X 3W7	Veterinarian	Pet Store	Pet Service

We repeat the same procedure for Chicago:

```
Chicago, IL


Show city venues grouped by Category:
There are 7 uniques categories.
```

Category	Name	Address	Latitude	Longitude	PostalCode
Animal Shelter	1	1	1	1	1
Aquarium	1	1	1	1	1
Dog Run	1	1	1	1	1
Pet Service	10	10	10	10	10
Pet Store	82	77	82	82	79
Salon / Barbershop	1	1	1	1	1
Veterinarian	4	4	4	4	4

```
Show city venues grouped by PostalCode:
There are 25 uniques postal codes.
```

PostalCode	Name	Address	Latitude	Longitude	Category
60601	1	1	1	1	1
60605	3	3	3	3	3
60607	6	6	6	6	6
60608	4	4	4	4	4
60610	9	9	9	9	9
60611	4	4	4	4	4
60612	4	4	4	4	4

```
Show city venues grouped by PostalCode and by taking the mean of the frequency of ocurrence of each category:
```

	PostalCode	Animal Shelter	Aquarium	Dog Run	Pet Service	Pet Store	Salon / Barbershop	Veterinarian
0	60601	0.00	0.000000	1.0	0.000000	0.000000	0.00	0.000000
1	60605	0.00	0.333333	0.0	0.333333	0.333333	0.00	0.000000
2	60607	0.00	0.000000	0.0	0.166667	0.833333	0.00	0.000000
3	60608	0.00	0.000000	0.0	0.000000	0.750000	0.25	0.000000
4	60610	0.00	0.000000	0.0	0.000000	0.888889	0.00	0.111111

```
Show top 5 most common pet venues by postal code:
```

	PostalCode	1st Most Common Venue	2nd Most Common Venue	3rd Most Common Venue	4th Most Common Venue	5th Most Common Venue
0	60601	Dog Run	Veterinarian	Salon / Barbershop	Pet Store	Pet Service
1	60605	Pet Store	Pet Service	Aquarium	Veterinarian	Salon / Barbershop
2	60607	Pet Store	Pet Service	Veterinarian	Salon / Barbershop	Dog Run
3	60608	Pet Store	Salon / Barbershop	Veterinarian	Pet Service	Dog Run
4	60610	Pet Store	Veterinarian	Salon / Barbershop	Pet Service	Dog Run
5	60611	Pet Store	Veterinarian	Salon / Barbershop	Pet Service	Dog Run

Similarly, for Boston we have the following results:

```
Boston, MA


Show city venues grouped by Category:
There are 8 uniques categories.
```

Category	Name	Address	Latitude	Longitude	PostalCode
Animal Shelter	1	1	1	1	1
Aquarium	2	2	2	2	2
Dog Run	2	0	2	2	0
Office	1	1	1	1	1
Park	1	1	1	1	1
Pet Service	6	6	6	6	6
Pet Store	67	62	67	67	63
Veterinarian	5	5	5	5	5

```
Show city venues grouped by PostalCode:
There are 37 uniques postal codes.
```

PostalCode	Name	Address	Latitude	Longitude	Category
01906	1	1	1	1	1
02108	1	1	1	1	1
02110	2	2	2	2	2
02111	1	1	1	1	1
02113	1	1	1	1	1
02114	1	1	1	1	1

```
Show city venues grouped by PostalCode and by taking the mean of the frequency of ocurrence of each category:
```

	PostalCode	Animal Shelter	Aquarium	Dog Run	Office	Park	Pet Service	Pet Store	Veterinarian
0	01906	0.00	0.0	0.0	0.0	0.0	0.000000	1.000000	0.000000
1	02108	0.00	0.0	0.0	0.0	0.0	0.000000	1.000000	0.000000
2	02110	0.00	1.0	0.0	0.0	0.0	0.000000	0.000000	0.000000
3	02111	0.00	0.0	0.0	0.0	0.0	0.000000	1.000000	0.000000
4	02113	0.00	0.0	0.0	0.0	0.0	0.000000	1.000000	0.000000

```
Show top 5 most common pet venues by postal code:
```

	PostalCode	1st Most Common Venue	2nd Most Common Venue	3rd Most Common Venue	4th Most Common Venue	5th Most Common Venue
0	01906	Pet Store	Veterinarian	Pet Service	Park	Office
1	02108	Pet Store	Veterinarian	Pet Service	Park	Office
2	02110	Aquarium	Veterinarian	Pet Store	Pet Service	Park
3	02111	Pet Store	Veterinarian	Pet Service	Park	Office
4	02113	Pet Store	Veterinarian	Pet Service	Park	Office
5	02114	Park	Veterinarian	Pet Store	Pet Service	Office

Finally, we obtain the following results for Philadelphia:

```
Philadelphia, PA


Show city venues grouped by Category:
There are 6 uniques categories.
```

Category	Name	Address	Latitude	Longitude	PostalCode
Aquarium	2	2	2	2	2
Miscellaneous Shop	2	2	2	2	2
Park	2	2	2	2	2
Pet Service	8	7	8	8	8
Pet Store	72	69	72	72	66
Veterinarian	6	5	6	6	6

```
Show city venues grouped by PostalCode:
There are 37 uniques postal codes.
```

PostalCode	Name	Address	Latitude	Longitude	Category
08002	2	2	2	2	2
08003	1	1	1	1	1
08030	3	3	3	3	3
08103	2	2	2	2	2
08105	1	1	1	1	1
08106	2	2	2	2	2
08108	1	1	1	1	1
08109	3	3	3	3	3

Show city venues grouped by PostalCode and by taking the mean of the frequency of ocurrence of each category:

	PostalCode	Aquarium	Miscellaneous Shop	Park	Pet Service	Pet Store	Veterinarian
0	08002	0.0	0.0	0.000000	0.000000	1.000000	0.000000
1	08003	0.0	0.0	0.000000	1.000000	0.000000	0.000000
2	08030	0.0	0.0	0.000000	0.000000	1.000000	0.000000
3	08103	1.0	0.0	0.000000	0.000000	0.000000	0.000000
4	08105	0.0	1.0	0.000000	0.000000	0.000000	0.000000

Show top 5 most common pet venues by postal code:

	PostalCode	1st Most Common Venue	2nd Most Common Venue	3rd Most Common Venue	4th Most Common Venue	5th Most Common Venue
0	08002	Pet Store	Veterinarian	Pet Service	Park	Miscellaneous Shop
1	08003	Pet Service	Veterinarian	Pet Store	Park	Miscellaneous Shop
2	08030	Pet Store	Veterinarian	Pet Service	Park	Miscellaneous Shop
3	08103	Aquarium	Veterinarian	Pet Store	Pet Service	Park
4	08105	Miscellaneous Shop	Veterinarian	Pet Store	Pet Service	Park
5	08106	Pet Store	Veterinarian	Pet Service	Park	Miscellaneous Shop

4.2 Clustering

Preprocessing data

We are going to consider now the Philadelphia data and group them into 5 different clusters.

First, we are going to show the first rows of the dataframe of the venues, which has 92 rows and 6 columns:

City venues:

	Name	Address	Latitude	Longitude	PostalCode	Category
0	BONeJOUR Pet Supply	53 N 3rd St	39.951846	-75.145359	19106	Pet Store
1	Doggie Style	1635 Spruce St	39.947662	-75.169523	19103	Pet Store
2	Baltimore Pet Shoppe	4532 Baltimore Ave	39.948954	-75.213978	19143	Pet Store
3	Doggie Style	315 Market St	39.950295	-75.146308	19106	Pet Store
4	Fairmount Pet Shoppe	2024 Fairmount Ave	39.967280	-75.171041	19130	Pet Store

And the first rows of the dataframe grouped by postal code and by taking the mean of the frequency of occurrence of each category, which has 36 rows and 7 columns:

```
City grouped data:
```

	PostalCode	Aquarium	Miscellaneous Shop	Park	Pet Service	Pet Store	Veterinarian
0	08002	0.0	0.0	0.000000	0.000000	1.000000	0.000000
1	08003	0.0	0.0	0.000000	1.000000	0.000000	0.000000
2	08030	0.0	0.0	0.000000	0.000000	1.000000	0.000000
3	08103	1.0	0.0	0.000000	0.000000	0.000000	0.000000
4	08105	0.0	1.0	0.000000	0.000000	0.000000	0.000000

We are going to run a k-means algorithm to cluster the postal codes into 5 different clusters. We add the cluster labels to the dataframe with the top 5 most common venues for each postal code:

	Cluster Labels	PostalCode	1st Most Common Venue	2nd Most Common Venue	3rd Most Common Venue	4th Most Common Venue	5th Most Common Venue
0	0	08002	Pet Store	Veterinarian	Pet Service	Park	Miscellaneous Shop
1	1	08003	Pet Service	Veterinarian	Pet Store	Park	Miscellaneous Shop
2	0	08030	Pet Store	Veterinarian	Pet Service	Park	Miscellaneous Shop
3	2	08103	Aquarium	Veterinarian	Pet Store	Pet Service	Park
4	3	08105	Miscellaneous Shop	Veterinarian	Pet Store	Pet Service	Park

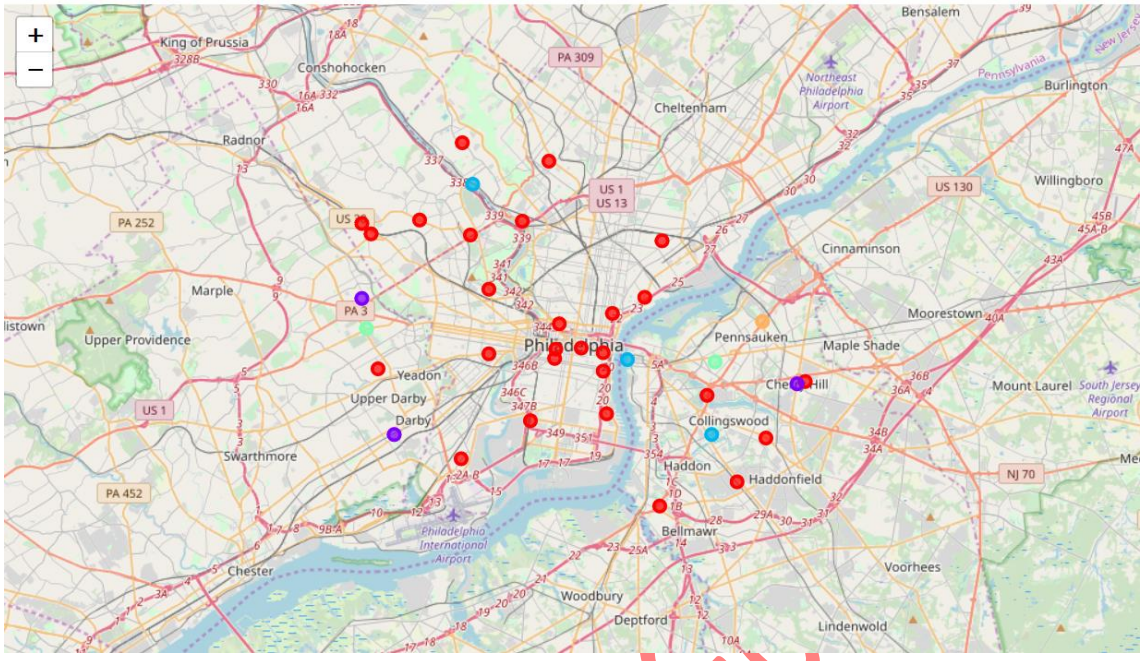
We add the latitude and longitude of each postal code to the previous dataframe. To do this, we have to merge the dataframe above with the city venues dataframe. Note that NaN postal codes are eliminated. We show the first rows of the new dataframe, which has 39 rows and 9 columns:

	Latitude	Longitude	PostalCode	Cluster Labels	1st Most Common Venue	2nd Most Common Venue	3rd Most Common Venue	4th Most Common Venue	5th Most Common Venue
15	39.936052	-75.025914	08002	0.0	Pet Store	Veterinarian	Pet Service	Park	Miscellaneous Shop
84	39.934840	-75.030730	08003	1.0	Pet Service	Veterinarian	Pet Store	Park	Miscellaneous Shop
22	39.879206	-75.111969	08030	0.0	Pet Store	Veterinarian	Pet Service	Park	Miscellaneous Shop
19	39.945932	-75.131219	08103	2.0	Aquarium	Veterinarian	Pet Store	Pet Service	Park
90	39.945255	-75.078951	08105	3.0	Miscellaneous Shop	Veterinarian	Pet Store	Pet Service	Park

Creating map of clusters

We visualize the resulting clusters in a map. First, we create a new map centred around Philadelphia. We set a different color for each of the clusters and add the markers of the venues to the map. Finally, we obtain the following map:

```
Philadelphia, PA
The geograpical coordinate of Philadelphia, PA are 39.9527237, -75.1635262.
Number of clusters: 5
```



5 Discussion

Now we can examine each of the clusters and see the venues categories distinguish by each cluster.

Cluster 1:

	PostalCode	1st Most Common Venue	2nd Most Common Venue	3rd Most Common Venue	4th Most Common Venue	5th Most Common Venue
15	08002	Pet Store	Veterinarian	Pet Service	Park	Miscellaneous Shop
22	08030	Pet Store	Veterinarian	Pet Service	Park	Miscellaneous Shop
83	08106	Pet Store	Veterinarian	Pet Service	Park	Miscellaneous Shop
25	08109	Pet Store	Veterinarian	Pet Service	Park	Miscellaneous Shop
78	08332	Pet Store	Veterinarian	Pet Service	Park	Miscellaneous Shop
85	19003	Pet Store	Veterinarian	Pet Service	Park	Miscellaneous Shop
67	19004	Pet Store	Veterinarian	Pet Service	Park	Miscellaneous Shop
75	19050	Pet Store	Veterinarian	Pet Service	Park	Miscellaneous Shop
14	19072	Pet Store	Veterinarian	Pet Service	Park	Miscellaneous Shop
23	19096	Pet Store	Veterinarian	Pet Service	Park	Miscellaneous Shop
18	19103	Pet Store	Veterinarian	Pet Service	Park	Miscellaneous Shop
65	19106	Pet Store	Veterinarian	Pet Service	Park	Miscellaneous Shop
39	19107	Pet Store	Veterinarian	Pet Service	Park	Miscellaneous Shop
52	19123	Pet Store	Pet Service	Veterinarian	Park	Miscellaneous Shop
54	19125	Pet Store	Veterinarian	Pet Service	Park	Miscellaneous Shop
81	19128	Pet Store	Veterinarian	Pet Service	Park	Miscellaneous Shop
63	19129	Pet Store	Veterinarian	Pet Service	Park	Miscellaneous Shop
49	19130	Pet Store	Pet Service	Veterinarian	Park	Miscellaneous Shop
60	19131	Pet Store	Veterinarian	Pet Service	Park	Miscellaneous Shop
64	19134	Pet Store	Veterinarian	Pet Service	Park	Miscellaneous Shop
2	19143	Pet Store	Veterinarian	Pet Service	Park	Miscellaneous Shop
72	19144	Pet Store	Veterinarian	Pet Service	Park	Miscellaneous Shop
17	19145	Pet Store	Veterinarian	Pet Service	Park	Miscellaneous Shop
62	19146	Pet Store	Veterinarian	Pet Service	Park	Miscellaneous Shop
44	19147	Pet Store	Veterinarian	Pet Service	Park	Miscellaneous Shop
21	19148	Pet Store	Veterinarian	Pet Service	Park	Miscellaneous Shop
69	19153	Pet Store	Veterinarian	Pet Service	Park	Miscellaneous Shop

Cluster 2:

	PostalCode	1st Most Common Venue	2nd Most Common Venue	3rd Most Common Venue	4th Most Common Venue	5th Most Common Venue
84	08003	Pet Service	Veterinarian	Pet Store	Park	Miscellaneous Shop
11	19079	Pet Service	Veterinarian	Pet Store	Park	Miscellaneous Shop
79	19083	Pet Service	Veterinarian	Pet Store	Park	Miscellaneous Shop

Cluster 3:

	PostalCode	1st Most Common Venue	2nd Most Common Venue	3rd Most Common Venue	4th Most Common Venue	5th Most Common Venue
19	08103	Aquarium	Veterinarian	Pet Store	Pet Service	Park
30	08108	Park	Veterinarian	Pet Store	Pet Service	Miscellaneous Shop
77	19127	Pet Store	Pet Service	Park	Veterinarian	Miscellaneous Shop

Cluster 4:

	PostalCode	1st Most Common Venue	2nd Most Common Venue	3rd Most Common Venue	4th Most Common Venue	5th Most Common Venue
90	08105	Miscellaneous Shop	Veterinarian	Pet Store	Pet Service	Park
20	19082	Pet Store	Miscellaneous Shop	Veterinarian	Pet Service	Park

Cluster 5:

	PostalCode	1st Most Common Venue	2nd Most Common Venue	3rd Most Common Venue	4th Most Common Venue	5th Most Common Venue
86	08110	Veterinarian	Pet Store	Pet Service	Park	Miscellaneous Shop

In summary,

- Cluster 1 corresponds to areas that have mostly pet stores, followed by veterinarians.
- Cluster 2 has mostly pet services, followed by veterinarians.
- Cluster 3 most common venues are a mix of aquarium, park and pet store.
- Cluster 4 most common venues are miscellaneous shops and pet stores in first place.
- Cluster 5 is composed of an only postal code, where most common venue is veterinarian.

6 Conclusions

Most pet-friendly postal codes are in clusters 1 and 2, since they have much more pet venues around. If you want to move to an area plenty of pet stores, cluster 1 should be a good choice, and if you prefer to live near venues with pet services, cluster 2 will be recommended. However, if you want to live close to a park, postal codes in cluster 3 will be optimal for you. Moreover, miscellaneous shops are closer to areas of postal codes of cluster 4. Finally, veterinarians are in areas of cluster 5.