

Dog Friendly Neighborhoods in Seattle

1. Introduction

1.1 Business Problem

A company that specializes in relocation assistance needs information about neighborhoods in the Seattle area with Pet Services, Pet Stores, Dog Runs and Veterinarians. Current information about dog friendly neighborhoods in the Seattle area does not exist with all these attributes. This company wants to provide dog owners with a more holistic view of dog friendly cities starting with Seattle.

1.2 Background

A company who specializes in relocation assistance for executive level managers in the Seattle area wants to share information about dog friendly neighborhoods in the city. A dog friendly neighborhood should consist of Pet Services, Pet Stores, Dog Runs and Veterinarians. The purpose of this project is to identify which neighborhoods in Seattle make for the best dog friendly places to relocate.

1.3 Justification

It is important to provide reliable information to help people with relocation questions and concerns. A major concern for a dog owner that is relocating to a city is the safety and care of their furry friend. Information about which neighborhoods are dog friendly can save time and reduce the stress of having to relocate.

1.4 Interest

Relocation assistance companies would be interested in this project because it provides valuable information about dog friendly neighborhoods which are import to people with dogs. This information can differentiate the competition and increase customer satisfaction for relocation assistance companies. Dog companies would find this project of interest as well because they could use it to identify dog friendly neighborhoods to promote their products and services.

2. Data

2.1 Description

The location data for the neighborhoods for this project comes from Wikipedia which contains a table that consist of 127 neighborhoods in the city of Seattle. HTML data from the Wikipedia page will be used to create the neighborhood table. The geospatial data for the latitude and

longitude of the neighborhoods will come from the geopy python library. The location data for Pet Stores, Veterinarians, Dog Runs and Pet Services will come from the FourSquare API.

2.2 Use

The list of neighborhoods for Seattle, Washington will be scraped from the Wikipedia page listed under data sources using python libraries which will include the use of Beautiful Soup to parse the HTML into a Pandas dataframe. Information and location data about Pet Services, Pet Stores, Dog Runs and Veterinarians will come from Four Square and be used to cluster these attributes according to the approximate radius by distance from each other. An ideal dog friendly neighborhood would have all four of the attributes which are Pet Stores, Veterinarians, Dog Parks and Pet Services within a neighborhood in Seattle. A list of the top 10 neighborhoods will be identified from the greatest number of attributes to lowest to provide a holistic view using folium to create a map visualization. Matplotlib python library will be used to create graphs to show quantity of attributes for each of the top 10 neighborhoods.

2.3 Data Sources

Wikipedia

The first set of data will be a list of neighborhoods in Seattle that will need to use to get the latitude and longitude. Link [here](#).

Geopy

Will use the geopy library to get the latitude and longitude data for each neighborhood using our Wikipedia data.

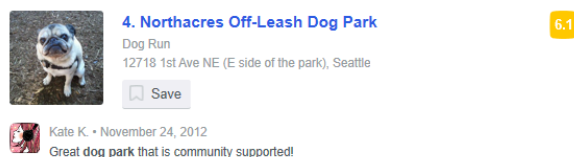
Table 1. Latitude and longitude data.

Latitude	Longitude
47.722320	-122.360407
47.726236	-122.348764
47.696210	-122.392362

FourSquare

Will use the FourSquare API to get nearby venues for pet services, pet stores, dog runs and veterinarians using our Wikipedia and Geopy data sources. Link [here](#).

Figure 1. An example of available FourSquare data attributes.



2.3 Data Clean Up

Data preparation was required for the neighborhood data for use in geopy to extract the latitude and longitude data. The web scrape of the Wikipedia page produced several none values and some additional characters which had to be cleaned before use. The finished data frame will have the neighborhood and city of Seattle separated with a comma as presented in Table 2. This is the first step to retrieval of the latitude and longitude from geopy.

Table 2. Neighborhood Data

Neighborhood
Broadview, Seattle
Bitter Lake, Seattle
North Beach, Seattle

Will use our neighborhood data frame to make a call for location data that will allow us to create a new data frame with the neighborhood, latitude and longitude. Will need to delete the location column from our data frame. Table 3 is how the finished data frame should appear for use with the folium library to get our first map of Seattle with the list of neighborhoods where a person with a canine companion could relocate.

Table 3. Neighborhood, Latitude and Longitude Data

Neighborhood	Latitude	Longitude
Broadview, Seattle	47.722320	-122.360407
Bitter Lake, Seattle	47.726236	-122.348764
North Beach, Seattle	47.696210	-122.392362

The data from Wikipedia and FourSquare required the most cleanup. It is important to build a clean good data frame before analysis. An old saying comes to mind in the world of data, garbage in, garbage out. So, I make sure to take time to prepare and cleanse data until I have a solid data frame to work with (Table 4).

Table 4. Neighborhood, Latitude, Longitude and FourSquare Data

Neighborhood	Neighborhood Latitude	Neighborhood Longitude	Venue	Venue Latitude	Venue Longitude	Venue Category
Bitter Lake, Seattle	47.726236	-122.348764	Banfield Pet Hospital	47.724264	-122.343051	Pet Service
Bitter Lake, Seattle	47.726236	-122.348764	PetSmart	47.724262	-122.343035	Pet Service
Blue Ridge, Seattle	47.701487	-122.375407	Crown Hill Walk	47.698297	-122.375948	Pet Service

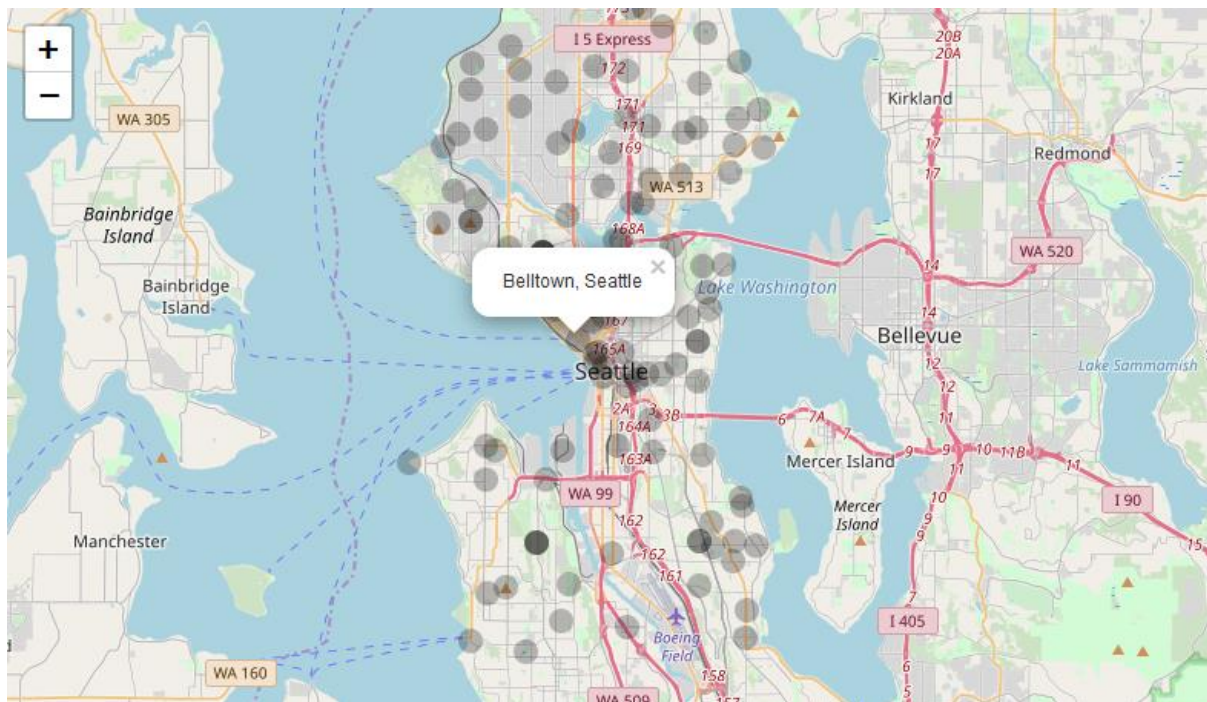
2.3 Data Test

Folium

Will use the Folium library to test our data in the Pandas data frame to produce a map of Seattle, WA to show the list of our potential dog friendly neighborhoods.

Map of Neighborhoods in Seattle

Figure 2. Neighborhoods in Seattle



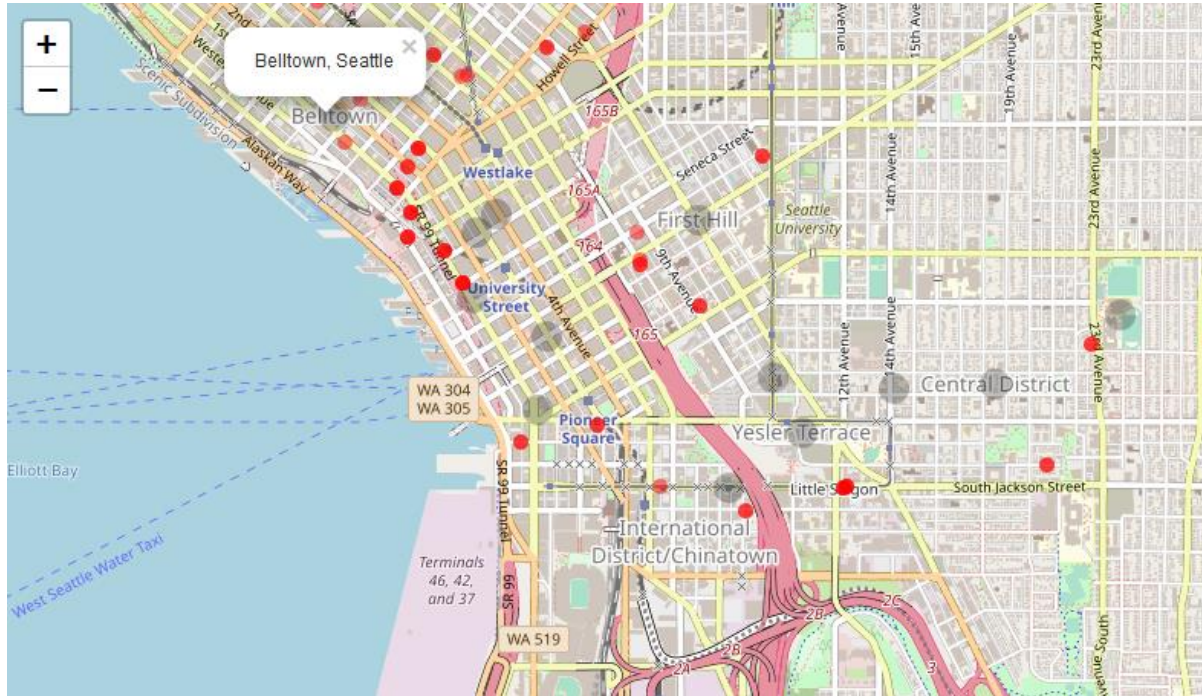
FourSquare

Now that we have identified the neighborhoods in Seattle will use the FourSquare API to get data about Pet Stores, Veterinarians, Dog Runs and Pet Services. Will define the top 10 dog friendly neighborhoods with this information. Will use this information to overlay the locations of each category on the map of Seattle neighborhoods to get a quick look at which neighborhoods contain all four of our dog-friendly categories.

Map of Neighborhoods and Venues

This map shows an overlay of both our Neighborhoods and nearby Venues to give use a quick visualization of the concentration of markers. In the initial test I discovered that I had a limit of 50 records on an API call. I upgraded from the Sandbox to a Personal account which fixed some of the failed call issues that I experienced in the initial use of the API. I spent a good amount of time testing how the API functioned.

Figure 3. FourSquare: Neighborhood, Pet Service, Pet Store, Dog Run and Veterinarian



3. Methodology

The first method that was demonstrated in the data section of this report which is a process known as map overlay. This method uses geospatial data to render a marker on to a map with the folium library. The map overlay concept is a quick and easy technique that can be used to identify an area on a map that looks like a potential dog friendly neighborhood. A relocation assistance company could use this approach to make recommendations to customers who are dog owners. Data is setup as a popup and currently will display the category name for the red markers and the neighborhood name for transparent black.

The downside to this method would be the loss of accuracy and the trouble of zooming in and out. The map overlay approach can appear to look to busy at times and cause confusion. What I have learned over time is to reduce the data points on the map with the use of analysis to reduce the information and narrow the scope of the what can be presented on a map overlay.

The next method I will use will be a data summary table that would group our neighborhoods and the totals of each of our 4 categories. A summary table is a great visual tool to use when you want to find the top 10 pet friendly neighborhoods for a dog owner who is worried about relocation to a city like Seattle. The only downside that I found with a summary table is the lack of details that go into the makeup of the of what total.

I have decided to incorporate a matrix method to add a layer of information that can quickly be consumed to determine which neighborhoods have all 4 categories. This approach is great for a process of elimination problem that has a set of parameters and filters. What I would like to do is

combine our summary table with a simple matrix style column layout to show which of our 4 venue categories are available in a neighborhood. All four categories would be the most ideal, but we have to consider how to present a neighborhood which might be in our top 10 selection which has only 3 categories. The matrix will come in handy to understand a trade-off and make more sense of our summary.

I will use several data visualization methods and techniques like a boxplot to study the results of the 4 categories for example. I think it is important to transform the table data into a more consumable visual for use and distribution. When you run data into a chart you can quickly gain and share insights. I have found from personal experience that this approach is best for telling a story to an audience because a visual chart can send a clear message about the information without a great amount of explanation needed.

Unsupervised Machine Learning:

To finish up the analysis I will use k-means clustering which is an unsupervised method of machine learning. I will run k-means to cluster the neighborhoods into 4 clusters that represent each of the categories. This will partition our observations into k clusters. The centroids will be generated at random and the k clusters will be based on the nearest mean. I essentially think the result will be very similar to the map overlay and I do not expect that the neighborhoods from the initial map overlay observations of Belltown and Denny Triangle will change as our top dog friendly neighborhood contenders.

4. Analysis

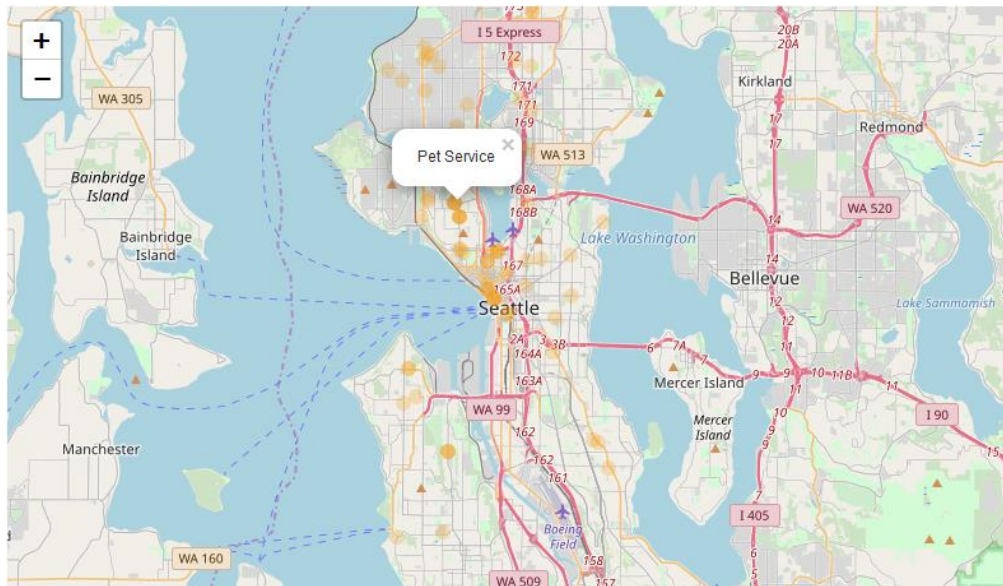
In this section will analyze our dog friendly data to determine which neighborhoods have the greatest selection of venues within a 500 meter radius. The ideal dog friendly neighborhood will consist of all 4 of our categories (pet service, pet store, dog run and veterinarian). Will use Folium, Matplotlib, Seaborn and Scikit-learn to analyze and share our data results on the top 10 dog friendly neighborhoods in Seattle.

4.1 Exploratory Analysis

Map of Pet Service

Will get all the nearby venues, latitude, longitude and category name by category ID for Pet Service from FourSquare API.

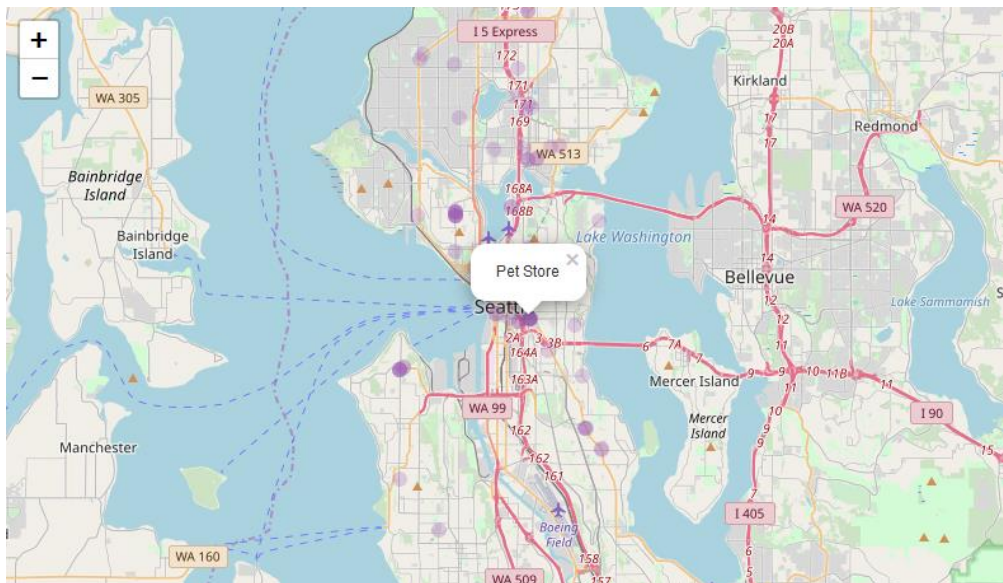
Figure 4. Pet Service locations in Seattle



Map of Pet Store

Will get all the nearby venues, latitude, longitude and category name by category ID for Pet Store from FourSquare API.

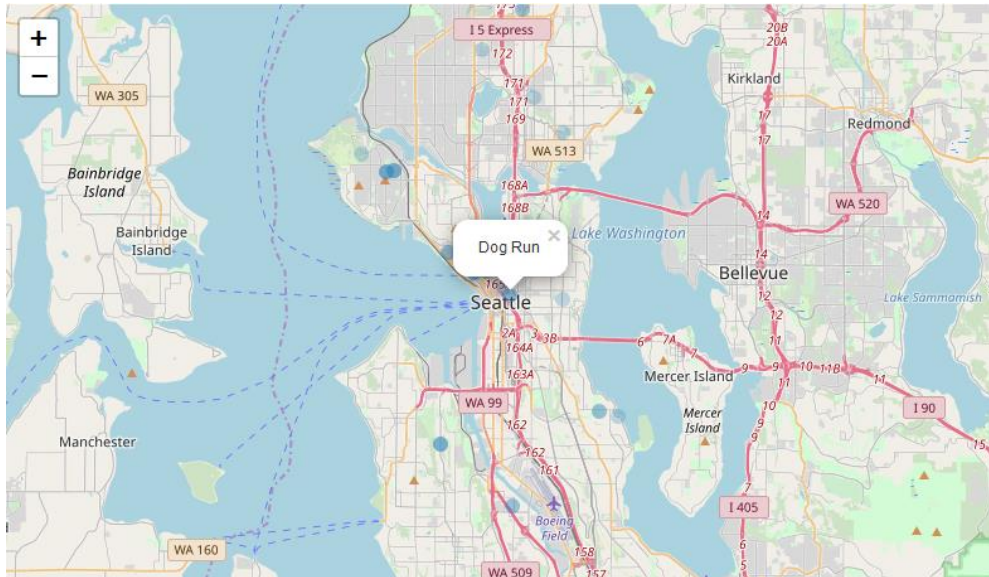
Figure 5. Pet Store locations in Seattle



Map of Dog Run

Will get all the nearby venues, latitude, longitude and category name by category ID for Dog Run from FourSquare API.

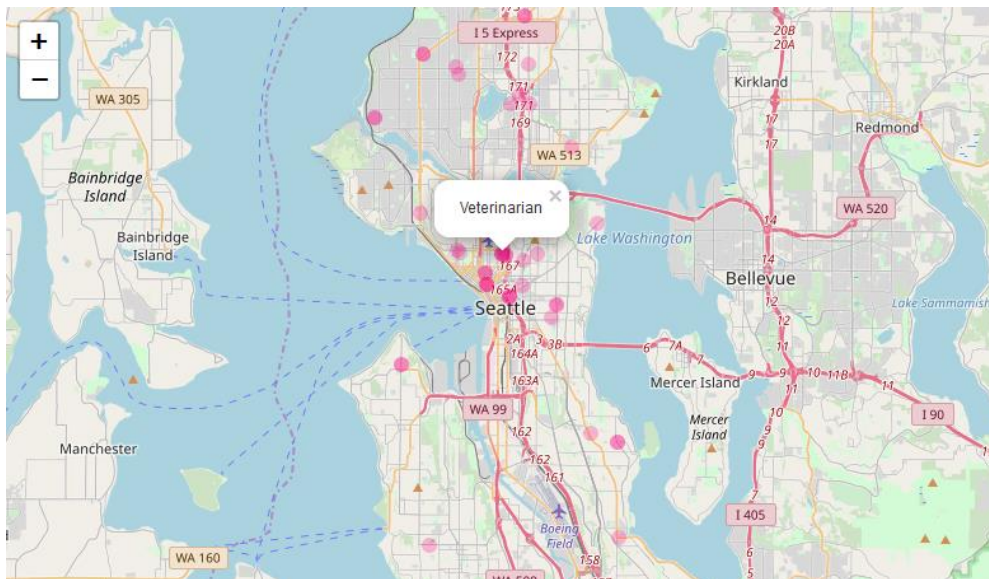
Figure 6. Dog Run locations in Seattle



Map of Veterinarian

Will get all the nearby venues, latitude, longitude and category name by category ID for Veterinarian from FourSquare API.

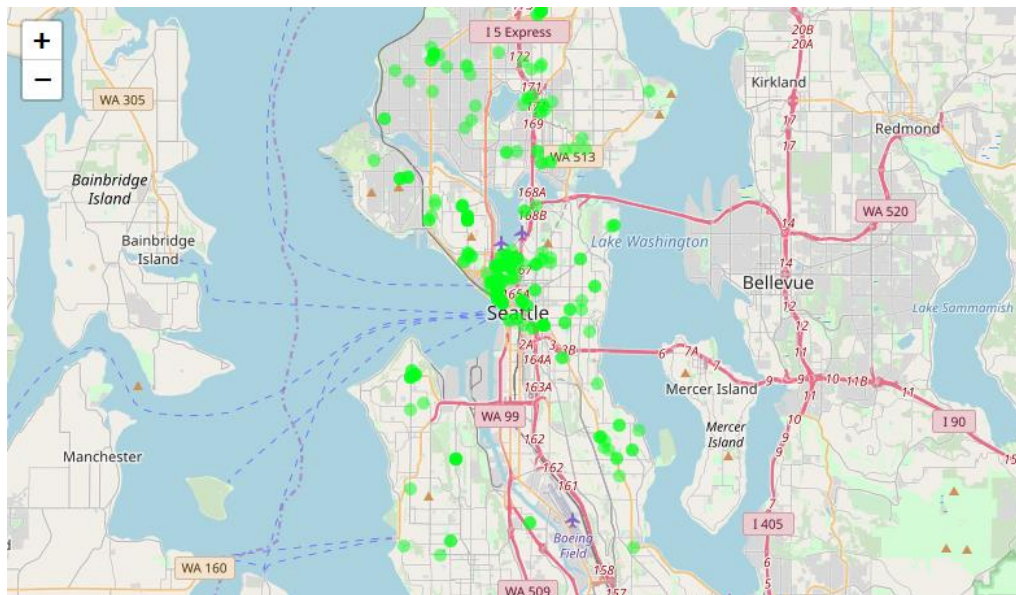
Figure 7. Veterinarian locations in Seattle



Map of Pet Service, Pet Store, Dog Run, Veterinarian

Here is the consolidated map of all locations from our Pet Service, Pet Store, Dog Run and Veterinarian data sources from the FourSquare API. These are the locations that will be further analyzed to determine which 10 neighborhoods to recommend for relocation to a dog owner.

Figure 8. Pet Service, Pet Store, Dog Run, Veterinarian locations in Seattle



Top 10 Matrix

Will need to create a matrix to identify which neighborhoods have all 4 categories and use it to identify the selection of categories and quantities of dog friendly venues. In the case of this data we have 6 neighborhoods that meet the criteria of a dog friendly neighborhood. With the use of the FourSquare API, a relocation assistance company could use additional data to derive more insights for use in a more comprehensive profile for a dog owner to help them make the best decisions on what neighborhood to relocate to in the city of Seattle. This analysis approach is scalable, you just need to add the city to figure out which neighborhoods to recommend.

Here the matrix is setup and I found it simple and easy to follow. The use of an if statement to identify each category as a zero value or not. Created new columns to add a matrix to the left of the summary table data. Now I will know for sure that a high total value is not 11 Pet Stores in one neighborhood. This matrix is simple to analyze. I can answer a dog owners question, for example if I was asked if the Mann neighborhood in Seattle had an area close where I can let the dog run around or if there is a dog park, I can respond that Mann has 2 pet services, 4 pet stores and a veterinarian within a 500 meter radius. With a matrix I can advise the dog owner of this information which could take longer with our summary table.

Table 5. Top 10 Dog Friendly Neighborhoods Matrix

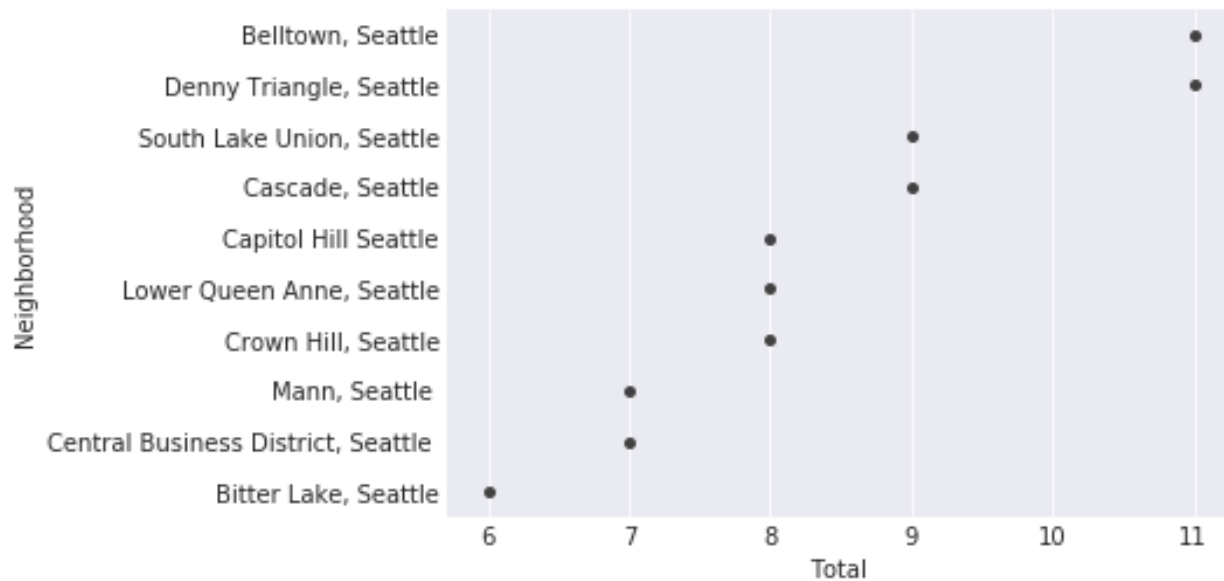
Neighborhood	Dog Run	Pet Service	Pet Store	Veterinarian	Total	1	2	3	4
Belltown, Seattle	4	2	3	2	11	X	X	X	X
Denny Triangle, Seattle	7	1	2	1	11	X	X	X	X
South Lake Union, Seattle	2	3	3	1	9	X	X	X	X
Cascade, Seattle	3	2	2	2	9	X	X	X	X
Capitol Hill Seattle	2	2	2	2	8	X	X	X	X
Lower Queen Anne, Seattle	2	3	1	2	8	X	X	X	X
Crown Hill, Seattle	0	4	2	2	8		X	X	X
Mann, Seattle	0	2	4	1	7		X	X	X
Central Business District, Seattle	0	2	4	1	7		X	X	X
Bitter Lake, Seattle	0	2	1	3	6		X	X	X

4.2 Data Visualization

Swarmplot

In this section I decided to go with a swarmplot to get a fast and simple visual of the Top 10 Most Dog Friendly neighborhoods in Seattle. I really like the simplicity of this code as a visual aid to analyze and compare the data. I will create a horizontal bar chart to show the difference for the final chart which will have a more professional look.

Figure 9. Swarmplot of the Top 10 Dog Friendly Neighborhoods

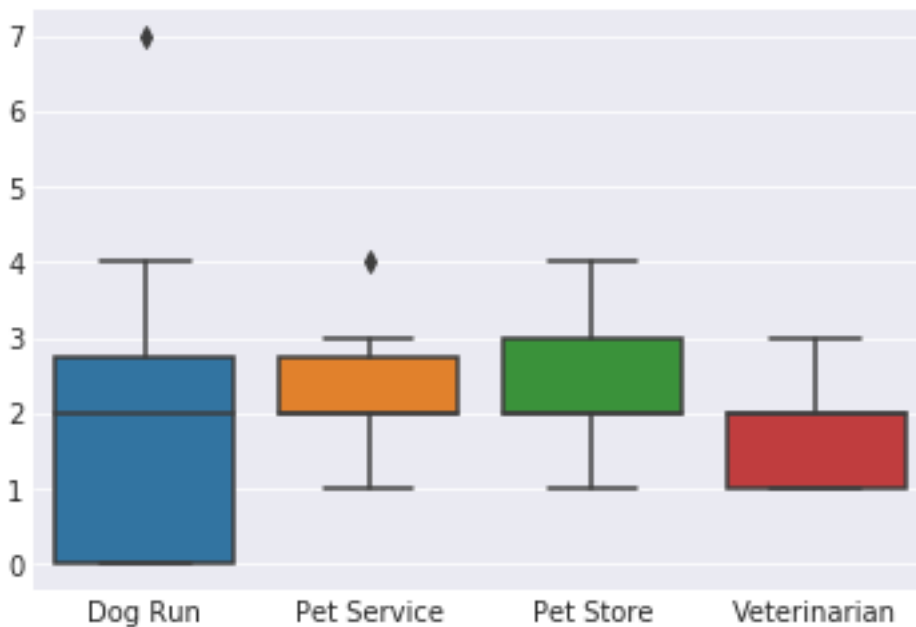


Dog Friendly Categories

In this section I decided to create a boxplot to analyze our results of the Dog Friendly Categories. The minimum value of the boxplot for the Dog Run category is 0 and has the greatest outlier with 7. This points to some neighborhoods that had none and 1 neighborhood that had 7 Dog Run locations within a 500 meter radius. From this one could recommend Denny Triangle to someone who has an active dog. The minimum for the rest of the category was 1 and only 1 other outlier for the Pet Service category which was 4 in the Crown Hill neighborhood which has the most Pet Services available. With this boxplot you can see the median observation line is 2 which is another way of saying on average a neighborhood in the top ten can be expected to have around 2 locations within a 500 meter radius of each category. The maximum observation is at 4 for the Dog Run and Pet Store category. The Pet Store and Veterinarian category has a maximum observation of 3. You should consider it unlikely to find a dog friendly neighborhood in Seattle with more than 4 of each category. I started with 116 neighborhoods and found 6 that contained at least 1 or more of the 4 categories within a 500 meter radius. Just 5% of neighborhoods in Seattle are dog friendly according to our criteria.

Figure 10. Boxplot of the 4 Dog Friendly Categories

Boxplot



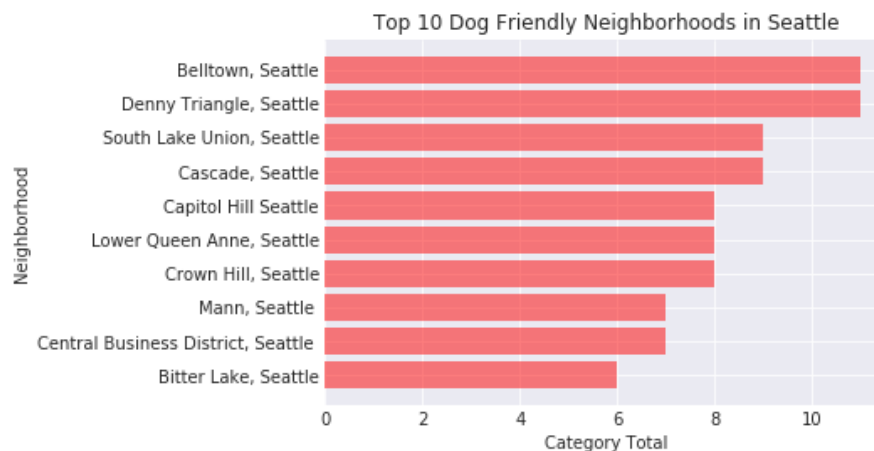
Top 10 Most Dog Friendly Neighborhoods in Seattle

In this section I decided to create a horizontal bar chart to analyze the final results of the Top 10 Dog Friendly Neighborhoods in Seattle. I noticed that Belltown and the Denny Triangle neighborhoods had the largest concentration of dog friendly neighborhoods in Seattle from initial observation. The analysis of the data supports the initial observation. Several neighborhoods are

tied for 2nd and 3rd place. You can see from the horizontal bar chart that Capitol Hill, Lower Queen Anne and Crown Hill have a total of 8 of the 4 categories. This is fine to analyze totals, but it would not let us know that Crown Hill for example does not contain all 4 of the categories as it does not have a dog run. I prefer the matrix I created as a table to show a deeper level of information.

Horizontal Bar Chart

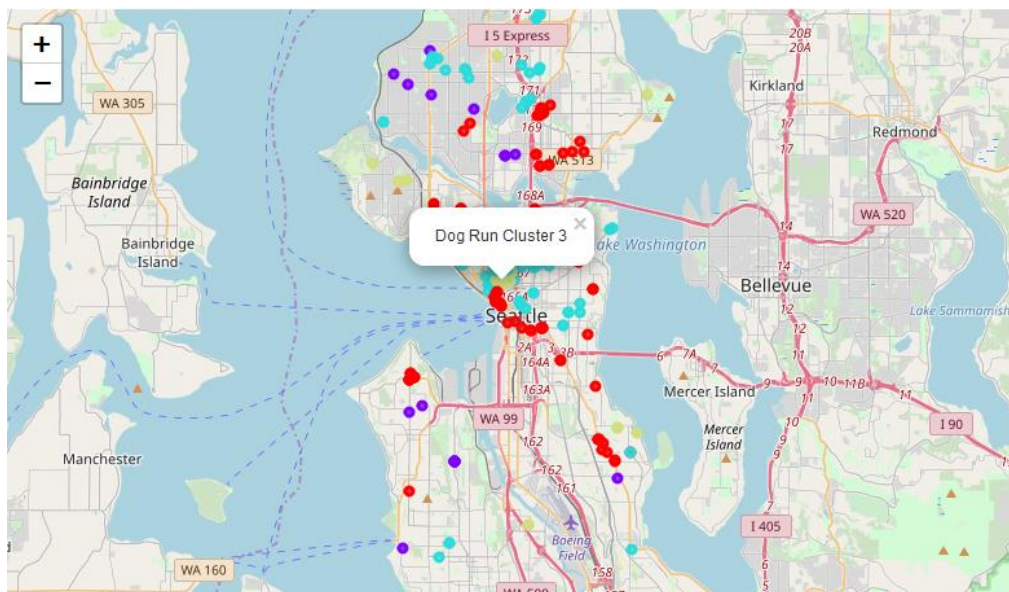
Figure 11. Boxplot of the 4 Dog Friendly Categories



K Means Cluster Map

The map of the k-means clusters is interesting as the concentration of the greatest variety of the 4 categories line up well to Belltown and Denny Triangle neighborhoods which are the top 2.

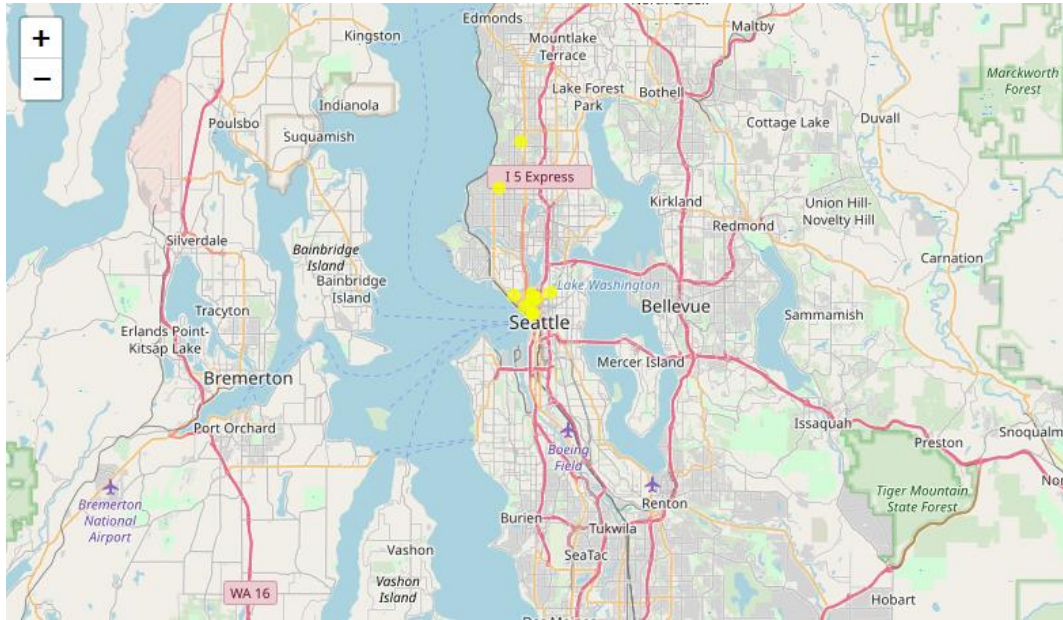
Figure 12. K-Means Clusters of the 4 Dog Friendly Categories



Top 10 Neighborhood Map

The top 10 neighborhood map takes the latitude and longitude of the Top 10 Dog Friendly neighborhoods and assigns the category venue total number. In the map visualization we can see that out of 116 neighborhoods only 6 had all 4 categories and where within a 500 meter radius. This is a representation of about 5% of neighborhoods in the city of Seattle met the definition of a dog friendly neighborhood.

Figure 13. Top 10 Neighborhoods



5. Results & Discussion

The analysis shows that 6 of our Top 10 Dog Friendly neighborhoods in Seattle would be ideal for a dog owner as each category would be available and within a 500 meter radius. This is the kind of information that would give a relocation assistance company a competitive edge over their competitors. This method and approach are scalable and can be applied beyond the city of Seattle. I am satisfied with the results and was somewhat surprised how I was able to accurately select the top two Dog Friendly neighborhoods using the map overlay technique from just the use of the spatial data without the FourSquare API.

However, I did start to have some trouble with the map overlay technique as the category markers were more spread around. To determine which neighborhoods had all 4 categories from the map overlay would at times be hard to make out and get to the popup information. I found the zoom feature of folium to be helpful with the visual of a potential Dog Friendly neighborhood and found that zoom at 14 made it clearer which neighborhoods had the greatest potential to be in the top 5 just from observation.

The results from the data visualization uncovered an average of 2 locations per category would be within a 500 meter radius of our top 10 neighborhoods with the exception of 4 neighborhoods which would not be a good place to exercise your dog. This is important information for a dog owner to know who is going to relocate to Seattle. Now a relocation assistance company can help that dog owner out and suggest the 6 neighborhoods that we know from our study would make an ideal Dog Friendly neighborhood based on the final results of our summary table with the built in matrix.

The k-means cluster map provides an unsupervised machine learning approach that I found to be very similar to the overlay map. However, this method is inconsistent as each time the code runs the results will change. I found the order of values to be different so I feel I would be better off to leave this out of my approach to save computation cost. I will say that this would have been more effective with unknown groups of data.

The top 10 neighborhood map makes for a really interesting observation as you will see all but two of the neighborhoods are clustered together. A possible result of a narrow radius used to get venues from the FourSquare API. I find that 500 meters is in walking distance of most of our pet service, pet stores, dog runs and veterinarians. I think the result of an increase in our radius would increase our overlap and push more neighborhoods to meet our ideal neighborhood with all 4 categories.

Now that I have the final results and looked over the map, I can see that the central part of Seattle is more dog friendly than any other part of the city. Belltown and the area around it stands out the most on our final map. All of the information from this study should provide enough insight to help a relocation assistance company provide the best service to a dog owner and their canine companion.

Recommendation:

Out of 116 neighborhoods in Seattle only 6 had all 4 categories within a 500 meter radius. This accounts for 5% of neighborhoods in the city of Seattle that would be considered dog friendly based on this study. I would recommend to the relocation assistance company that the study found that central Seattle had the most concentration of dog friendly neighborhoods around the Belltown area. The relocation company can now advise a dog owner who wants to relocate to the city of Seattle of the 6 neighborhoods listed below:

Neighborhood	Dog Run	Pet Service	Pet Store	Veterinarian
1. Belltown, Seattle	4	2	3	2
2. Denny Triangle, Seattle	7	1	2	1
3. South Lake Union, Seattle	2	3	3	1
4. Cascade, Seattle	3	2	2	2
5. Capitol Hill, Seattle	2	2	2	2
6. Lower Queen Anne, Seattle	2	3	1	2
7. Crown Hill, Seattle	0	4	2	2
8. Mann, Seattle	0	2	4	1
9. Central Business District, Seattle	0	2	4	1
10. Bitter Lake, Seattle	0	2	1	3

6. Conclusion

Purpose of this project was to identify the top 10 dog friendly neighborhoods in the city of Seattle for a relocation assistance company who would use the information to help a dog owner figure out what part of the city would accommodate their canine based on 4 category venues (Pet Service, Pet Store, Dog Run, and Veterinarian) from the FourSquare API. The city of Seattle only has 6 neighborhoods that are within a 500 meter radius of all 4 of our categories out of 116 neighborhoods. This accounts for just 5% of all neighborhoods which be like trying to find a needle in a haystack.

My initial idea for the study was to look for at least 10 neighborhoods that contained all 4 of the categories within a reasonable walking distance. What I discovered is that the city of Seattle had the greatest concentration in the center of our map. You can see that no neighborhoods in West and South Seattle made the list. Downtown Seattle had a good concentration of pet friendly neighborhoods which was kind of a surprise.

I am a dog owner and have avoided offers to relocate to Seattle and Philadelphia because I felt that they would not be dog friendly. This study really helped to change that perspective and I could see a company like Amazon or Microsoft using a relocation assistance company to garner this kind of information to help a candidate make a decision to relocate to Seattle for a job. When I think about the potential use of the study from this project I start to wonder about power and value of data. All companies can really benefit from a data science practice that is data driven.

With this study a relocation assistance company can now offer a Dog Friendly city matrix to a dog owner for other cities. I would recommend some additional work to the relocation assistance company to transform the information from this project into a more comprehensive 360 degree dashboard that a customer could access from the company website. The study can certainly be more scalable to offer information on the best neighborhoods to move to with your dog in other cities.

In conclusion this project was able to identify 6 dog friendly neighborhoods in Seattle with all 4 categories. From this study I would be able to recommend these neighborhoods based on the data collected and the analysis conducted. I would let the relocation assistance company know that the restriction to the radius of 500 meters is a factor in the results of the study. I surmise that an increase in the radius should result in an increase in neighborhoods with all 4 categories. The percentage of neighborhoods should increase with the radius. In closing I would point out that the data from the FourSquare API is not static, to provide the most accurate information to the relocation assistance company a person will need to maintain and refresh the code.