

# toronto\_clustering

June 3, 2021

```
[1]: import itertools as it
import os
import json
import requests
import bs4
import geocoder
import folium
import pandas as pd
import numpy as np
from bs4 import BeautifulSoup
from sklearn.cluster import KMeans
pd.set_option('display.max_columns', None)
```

## 1 Neighborhood dataframe creation

I decided to cluster neighborhoods instead of boroughs or postal codes, so I went ahead and split postal codes with multiple neighborhoods into multiple rows.

```
[2]: soup = requests.get("https://en.wikipedia.org/wiki/
↳List_of_postal_codes_of_Canada:_M").content
soup = BeautifulSoup(soup)

[3]: data = pd.DataFrame(columns=['Postal Code', 'Borough', 'Neighborhood'])
table = soup.find('table')
for cell in table.find_all('td'):
    row = list(cell.stripped_strings)
    if "Not assigned" in row:
        continue
    neighborhoods = " ".join(row[2:]).strip("(" ")")
    neighborhoods = " ".join([t.strip() for t in neighborhoods.split(" ")])
    neighborhoods = neighborhoods.replace("(", "/")
    neighborhoods = ", ".join([t.strip() for t in neighborhoods.split(",")])
    neighborhoods = ", ".join([t.strip() for t in neighborhoods.split("/")])
    for nbh in neighborhoods.split(','):
        data = data.append(dict(zip(data.columns, row[:2] + [nbh.strip()])),
        ↳ignore_index=True)
data.head()
```

```
[3]:
```

	Postal Code	Borough	Neighborhood
0	M3A	North York	Parkwoods
1	M4A	North York	Victoria Village
2	M5A	Downtown Toronto	Regent Park
3	M5A	Downtown Toronto	Harbourfront
4	M6A	North York	Lawrence Manor

## 2 Adding Latitude/Longitude

Latitude, longitude, and radius will be added to the data frame created above. The radius used for FourSquare exploration will be that of a circle inscribed in the bounding box of the postal code area.

```
[4]: def save_locations(data):
    latitude = []
    longitude = []
    radius = []
    for nbh, pc in zip(data['Neighborhood'], data['Postal Code']):
        print("Geocoding", nbh)
        for i in range(10):
            response = None
            response = geocoder.arcgis("{} Toronto Canada {}".format(nbh, pc))
            if response is not None:
                break
        else:
            if response is None:
                print("Too many lookup attempts. The geocoding server may be
↳down...")
            latitude.append(response.lat)
            longitude.append(response.lng)
            NE = response.bbox['northeast']
            SW = response.bbox['southwest']
            NW = [NE[0], SW[1]]
            radius.append(min(geocoder.distance([NE, NW], units='meters'), geocoder.
↳distance([NW, SW], units='meters')) / 2)

    latitude = pd.Series(latitude, name='Latitude')
    longitude = pd.Series(longitude, name='Longitude')
    radius = pd.Series(radius, name="Radius")
    data[["Latitude"]] = latitude
    data[["Longitude"]] = longitude
    data[["Radius"]] = radius
    data.to_csv("toronto_neighborhoods.csv")
    return data
```

Load from previously saved data frame if we can, otherwise run the function above and save the updated data frame.

```
[5]: if os.access("toronto_neighborhoods.csv", os.R_OK):
      data = pd.read_csv("toronto_neighborhoods.csv", index_col=0)
      else:
          data = save_locations(data)
```

```
[6]: data.head()
```

```
[6]:   Postal Code      Borough      Neighborhood  Latitude  Longitude \
0      M3A      North York      Parkwoods  43.752450 -79.329910
1      M4A      North York  Victoria Village  43.730570 -79.313060
2      M5A  Downtown Toronto      Regent Park  43.659743 -79.361561
3      M5A  Downtown Toronto      Harbourfront  43.639230 -79.383070
4      M6A      North York      Lawrence Manor  43.714925 -79.449739

      Radius
0  2568.862665
1  1445.852272
2    80.442896
3   402.325087
4    80.368924
```

### 3 Neighborhood Exploration

Load API key and secret and create URL template for calls to the Foursquare exploration endpoint.

```
[7]: if os.access('foursquare_api_keys.txt', os.R_OK):
      with open("foursquare_api_keys.txt") as f:
          foursquare_id = f.readline().strip()
          foursquare_secret = f.readline().strip()
      else:
          foursquare_id = ""
          foursquare_secret = ""
      foursquare_template = "https://api.foursquare.com/v2/venues/{}?
      ↪client_id={} & client_secret={} & v=20210526".format!("{}",
      ↪
      ↪
      ↪foursquare_id,
      ↪
      ↪
      ↪foursquare_secret)
      foursquare_explore = foursquare_template.format("explore") + "&limit={} ".
      ↪format(100) + "&ll={},{} & radius={} "
```

Get top 100 venues for each neighborhood using the Foursquare API and parse response to build a data frame.

```
[8]: def get_venues(data):
      all_venues = pd.DataFrame()
      for i in range(data.shape[0]):
```

```

lat, lng, rad = data[['Latitude', 'Longitude', 'Radius']].iloc[i]
url = foursquare_explore.format(lat, lng, rad)
response = requests.api.get(url)
response.raise_for_status()
venues = response.json()['response']['groups'][0]["items"]
venues = pd.json_normalize(venues)
venues['Neighborhood'] = data.loc[i, 'Neighborhood']
try:
    venues['reasons.items'] = venues['reasons.items'].map(lambda x:
↳ [i['reasonName'] for i in x][0])
    except (TypeError, KeyError):
        pass
    try:
        venues['venue.categories.ids'] = venues['venue.categories'].
↳ map(lambda x: [i['id'] for i in x][0])
        venues['venue.categories.names'] = venues['venue.categories'].
↳ map(lambda x: [i['name'] for i in x][0])
        except KeyError:
            pass
    all_venues = all_venues.append(venues, ignore_index=True)
all_venues.to_csv('toronto_neighborhood_venues.csv')
return all_venues

```

```

[9]: if os.access('toronto_neighborhood_venues.csv', os.R_OK):
    venues = pd.read_csv('toronto_neighborhood_venues.csv', index_col=0)
else:
    venues = get_venues(data)

keep_cols = ['Neighborhood', 'venue.id', 'venue.name', 'venue.location.
↳ address', 'venue.location.lat', 'venue.location.lng',
    'venue.location.distance', 'venue.categories.names', 'venue.
↳ categories.ids']
new_col_names = ['Neighborhood', 'ID', 'Name', 'Address', 'Latitude',
↳ 'Longitude', 'Distance', 'Category', 'Category ID']
venues = venues[keep_cols]
venues.columns = new_col_names
venues.head()

```

```

[9]:
Neighborhood      ID      Name \
0  Parkwoods  4b8991cbf964a520814232e3  Allwyn's Bakery
1  Parkwoods  57e286f2498e43d84d92d34a  Tim Hortons
2  Parkwoods  4bd4846a6798ef3bd0c5618d  Donalda Golf & Country Club
3  Parkwoods  4e8d9dcdd5fbbbbb6b3003c7b  Brookbanks Park
4  Parkwoods  4b8ec91af964a520053733e3  Graydon Hall Manor

Address  Latitude  Longitude  Distance \
0  81 Underhill drive  43.759840  -79.324719  922.0

```

1	215 Brookbanks	43.760668	-79.326368	958.0
2	12 Bushbury Dr	43.752816	-79.342741	1032.0
3	Toronto	43.751976	-79.332140	186.0
4	185 Graydon Hall Drive	43.763923	-79.342961	1652.0

	Category	Category ID
0	Caribbean Restaurant	4bf58dd8d48988d144941735
1	Café	4bf58dd8d48988d16d941735
2	Golf Course	4bf58dd8d48988d1e6941735
3	Park	4bf58dd8d48988d163941735
4	Event Space	4bf58dd8d48988d171941735

If a venue is listed in multiple neighborhoods, keep the one with the minimum distance. This ensures each venue is only associated with one neighborhood and offsets any neighborhood overlap when basing the search radius on neighborhood bounding boxes.

```
[10]: venue_id_groups = venues.groupby('ID')
min_dist_idx = venue_id_groups['Distance'].idxmin()
venue_id_groups['Distance'].min()
venues = venues.iloc[min_dist_idx]
venues.set_index('ID', inplace=True)
venues.head()
```

```
[10]:
```

ID	Neighborhood \
4a8d5b48f964a520840f20e3	Kensington Market
4a9d0a53f964a520d23720e3	Business reply mail Processing Centre 969 Eastern
4aada317f964a5201a6120e3	Yorkville
4ab17387f964a520866920e3	St. James Town
4ab81980f964a5202f7c20e3	The Beaches West

ID	Name	Address	Latitude \
4a8d5b48f964a520840f20e3	The Moonbean Cafe	30 St Andrew St	43.654147
4a9d0a53f964a520d23720e3	Hilton	145 Richmond St W	43.649946
4aada317f964a5201a6120e3	Isabel Bader Theatre	93 Charles St W	43.667329
4ab17387f964a520866920e3	Churchmouse & Firkin	485 Church St.	43.664632
4ab81980f964a5202f7c20e3	The Salty Dog	1982 Queen St E	43.669944

ID	Longitude	Distance	Category \
4a8d5b48f964a520840f20e3	-79.400182	117.0	Café
4a9d0a53f964a520d23720e3	-79.385479	139.0	Hotel
4aada317f964a5201a6120e3	-79.392604	382.0	College Theater
4ab17387f964a520866920e3	-79.380406	729.0	Pub
4ab81980f964a5202f7c20e3	-79.300894	193.0	Restaurant

Category ID

```
ID
4a8d5b48f964a520840f20e3  4bf58dd8d48988d16d941735
4a9d0a53f964a520d23720e3  4bf58dd8d48988d1fa931735
4aada317f964a5201a6120e3  4bf58dd8d48988d1ac941735
4ab17387f964a520866920e3  4bf58dd8d48988d11b941735
4ab81980f964a5202f7c20e3  4bf58dd8d48988d1c4941735
```

## 4 Convert venue category into indicator variables

```
[11]: categories = venues['Category']
categories = pd.get_dummies(categories, columns=['Category'], prefix='',
      ↪ prefix_sep='')
categories.drop(columns='Neighborhood', inplace=True)
categories = pd.concat([venues['Neighborhood'], categories], axis=1)
categories.head()
```

```
[11]:
```

	Neighborhood \
ID	
4a8d5b48f964a520840f20e3	Kensington Market
4a9d0a53f964a520d23720e3	Business reply mail Processing Centre 969 Eastern
4aada317f964a5201a6120e3	Yorkville
4ab17387f964a520866920e3	St. James Town
4ab81980f964a5202f7c20e3	The Beaches West

  

	ATM	Accessories Store	African Restaurant	Airport \
ID				
4a8d5b48f964a520840f20e3	0	0	0	0
4a9d0a53f964a520d23720e3	0	0	0	0
4aada317f964a5201a6120e3	0	0	0	0
4ab17387f964a520866920e3	0	0	0	0
4ab81980f964a5202f7c20e3	0	0	0	0

  

	Airport Lounge	American Restaurant	Antique Shop \
ID			
4a8d5b48f964a520840f20e3	0	0	0
4a9d0a53f964a520d23720e3	0	0	0
4aada317f964a5201a6120e3	0	0	0
4ab17387f964a520866920e3	0	0	0
4ab81980f964a5202f7c20e3	0	0	0

  

	Aquarium	Art Gallery	Art Museum \
ID			
4a8d5b48f964a520840f20e3	0	0	0
4a9d0a53f964a520d23720e3	0	0	0
4aada317f964a5201a6120e3	0	0	0
4ab17387f964a520866920e3	0	0	0

4ab81980f964a5202f7c20e3

0

0

0

Arts & Crafts Store Asian Restaurant \

ID

4a8d5b48f964a520840f20e3

0

0

4a9d0a53f964a520d23720e3

0

0

4aada317f964a5201a6120e3

0

0

4ab17387f964a520866920e3

0

0

4ab81980f964a5202f7c20e3

0

0

Athletics & Sports Auto Dealership Auto Garage \

ID

4a8d5b48f964a520840f20e3

0

0

0

4a9d0a53f964a520d23720e3

0

0

0

4aada317f964a5201a6120e3

0

0

0

4ab17387f964a520866920e3

0

0

0

4ab81980f964a5202f7c20e3

0

0

0

Auto Workshop Automotive Shop BBQ Joint \

ID

4a8d5b48f964a520840f20e3

0

0

0

4a9d0a53f964a520d23720e3

0

0

0

4aada317f964a5201a6120e3

0

0

0

4ab17387f964a520866920e3

0

0

0

4ab81980f964a5202f7c20e3

0

0

0

Baby Store Badminton Court Bagel Shop Bakery \

ID

4a8d5b48f964a520840f20e3

0

0

0

0

4a9d0a53f964a520d23720e3

0

0

0

0

4aada317f964a5201a6120e3

0

0

0

0

4ab17387f964a520866920e3

0

0

0

0

4ab81980f964a5202f7c20e3

0

0

0

0

Bank Bar Baseball Field Baseball Stadium \

ID

4a8d5b48f964a520840f20e3

0

0

0

0

4a9d0a53f964a520d23720e3

0

0

0

0

4aada317f964a5201a6120e3

0

0

0

0

4ab17387f964a520866920e3

0

0

0

0

4ab81980f964a5202f7c20e3

0

0

0

0

Basketball Court Basketball Stadium Beach \

ID

4a8d5b48f964a520840f20e3

0

0

0

4a9d0a53f964a520d23720e3

0

0

0

4aada317f964a5201a6120e3

0

0

0

4ab17387f964a520866920e3	0	0	0
4ab81980f964a5202f7c20e3	0	0	0

	Bed & Breakfast	Beer Bar	Beer Garden	Beer Store \
ID				
4a8d5b48f964a520840f20e3	0	0	0	0
4a9d0a53f964a520d23720e3	0	0	0	0
4aada317f964a5201a6120e3	0	0	0	0
4ab17387f964a520866920e3	0	0	0	0
4ab81980f964a5202f7c20e3	0	0	0	0

	Belgian Restaurant	Big Box Store	Bike Shop \
ID			
4a8d5b48f964a520840f20e3	0	0	0
4a9d0a53f964a520d23720e3	0	0	0
4aada317f964a5201a6120e3	0	0	0
4ab17387f964a520866920e3	0	0	0
4ab81980f964a5202f7c20e3	0	0	0

	Bistro	Boat or Ferry	Bookstore	Botanical Garden \
ID				
4a8d5b48f964a520840f20e3	0	0	0	0
4a9d0a53f964a520d23720e3	0	0	0	0
4aada317f964a5201a6120e3	0	0	0	0
4ab17387f964a520866920e3	0	0	0	0
4ab81980f964a5202f7c20e3	0	0	0	0

	Boutique	Bowling Alley	Boxing Gym \
ID			
4a8d5b48f964a520840f20e3	0	0	0
4a9d0a53f964a520d23720e3	0	0	0
4aada317f964a5201a6120e3	0	0	0
4ab17387f964a520866920e3	0	0	0
4ab81980f964a5202f7c20e3	0	0	0

	Brazilian Restaurant	Breakfast Spot	Brewery \
ID			
4a8d5b48f964a520840f20e3	0	0	0
4a9d0a53f964a520d23720e3	0	0	0
4aada317f964a5201a6120e3	0	0	0
4ab17387f964a520866920e3	0	0	0
4ab81980f964a5202f7c20e3	0	0	0

	Bridal Shop	Bridge	Bubble Tea Shop	Building \
ID				
4a8d5b48f964a520840f20e3	0	0	0	0
4a9d0a53f964a520d23720e3	0	0	0	0



4aada317f964a5201a6120e3	0	0	0	0
4ab17387f964a520866920e3	0	0	0	0
4ab81980f964a5202f7c20e3	0	0	0	0

	Burger Joint	Burrito Place	Bus Line	Bus Station	\
ID					
4a8d5b48f964a520840f20e3	0	0	0	0	
4a9d0a53f964a520d23720e3	0	0	0	0	
4aada317f964a5201a6120e3	0	0	0	0	
4ab17387f964a520866920e3	0	0	0	0	
4ab81980f964a5202f7c20e3	0	0	0	0	

	Bus Stop	Business Service	Butcher	Cafeteria	\
ID					
4a8d5b48f964a520840f20e3	0	0	0	0	
4a9d0a53f964a520d23720e3	0	0	0	0	
4aada317f964a5201a6120e3	0	0	0	0	
4ab17387f964a520866920e3	0	0	0	0	
4ab81980f964a5202f7c20e3	0	0	0	0	

	Café	Camera Store	Campground	Candy Store	\
ID					
4a8d5b48f964a520840f20e3	1	0	0	0	
4a9d0a53f964a520d23720e3	0	0	0	0	
4aada317f964a5201a6120e3	0	0	0	0	
4ab17387f964a520866920e3	0	0	0	0	
4ab81980f964a5202f7c20e3	0	0	0	0	

	Cantonese Restaurant	Caribbean Restaurant	Castle	\
ID				
4a8d5b48f964a520840f20e3	0	0	0	
4a9d0a53f964a520d23720e3	0	0	0	
4aada317f964a5201a6120e3	0	0	0	
4ab17387f964a520866920e3	0	0	0	
4ab81980f964a5202f7c20e3	0	0	0	

	Cheese Shop	Chinese Restaurant	Chocolate Shop	\
ID				
4a8d5b48f964a520840f20e3	0	0	0	
4a9d0a53f964a520d23720e3	0	0	0	
4aada317f964a5201a6120e3	0	0	0	
4ab17387f964a520866920e3	0	0	0	
4ab81980f964a5202f7c20e3	0	0	0	

	Church	Circus	Climbing Gym	Clothing Store	\
ID					
4a8d5b48f964a520840f20e3	0	0	0	0	

4a9d0a53f964a520d23720e3	0	0	0	0
4aada317f964a5201a6120e3	0	0	0	0
4ab17387f964a520866920e3	0	0	0	0
4ab81980f964a5202f7c20e3	0	0	0	0

	Cocktail Bar	Coffee Shop	College Gym	\
ID				
4a8d5b48f964a520840f20e3	0	0	0	
4a9d0a53f964a520d23720e3	0	0	0	
4aada317f964a5201a6120e3	0	0	0	
4ab17387f964a520866920e3	0	0	0	
4ab81980f964a5202f7c20e3	0	0	0	

	College Rec Center	College Theater	\
ID			
4a8d5b48f964a520840f20e3	0	0	
4a9d0a53f964a520d23720e3	0	0	
4aada317f964a5201a6120e3	0	1	
4ab17387f964a520866920e3	0	0	
4ab81980f964a5202f7c20e3	0	0	

	Colombian Restaurant	Comedy Club	\
ID			
4a8d5b48f964a520840f20e3	0	0	
4a9d0a53f964a520d23720e3	0	0	
4aada317f964a5201a6120e3	0	0	
4ab17387f964a520866920e3	0	0	
4ab81980f964a5202f7c20e3	0	0	

	Comfort Food Restaurant	Comic Shop	Concert Hall	\
ID				
4a8d5b48f964a520840f20e3	0	0	0	
4a9d0a53f964a520d23720e3	0	0	0	
4aada317f964a5201a6120e3	0	0	0	
4ab17387f964a520866920e3	0	0	0	
4ab81980f964a5202f7c20e3	0	0	0	

	Construction & Landscaping	Convenience Store	\
ID			
4a8d5b48f964a520840f20e3	0	0	
4a9d0a53f964a520d23720e3	0	0	
4aada317f964a5201a6120e3	0	0	
4ab17387f964a520866920e3	0	0	
4ab81980f964a5202f7c20e3	0	0	

	Cosmetics Shop	Costume Shop	Creperie	\
ID				

4a8d5b48f964a520840f20e3	0	0	0
4a9d0a53f964a520d23720e3	0	0	0
4aada317f964a5201a6120e3	0	0	0
4ab17387f964a520866920e3	0	0	0
4ab81980f964a5202f7c20e3	0	0	0

ID	Cuban Restaurant	Cupcake Shop	Curling Ice \
4a8d5b48f964a520840f20e3	0	0	0
4a9d0a53f964a520d23720e3	0	0	0
4aada317f964a5201a6120e3	0	0	0
4ab17387f964a520866920e3	0	0	0
4ab81980f964a5202f7c20e3	0	0	0

ID	Cycle Studio	Czech Restaurant	Dance Studio \
4a8d5b48f964a520840f20e3	0	0	0
4a9d0a53f964a520d23720e3	0	0	0
4aada317f964a5201a6120e3	0	0	0
4ab17387f964a520866920e3	0	0	0
4ab81980f964a5202f7c20e3	0	0	0

ID	Deli / Bodega	Dentist's Office	Department Store \
4a8d5b48f964a520840f20e3	0	0	0
4a9d0a53f964a520d23720e3	0	0	0
4aada317f964a5201a6120e3	0	0	0
4ab17387f964a520866920e3	0	0	0
4ab81980f964a5202f7c20e3	0	0	0

ID	Dessert Shop	Dim Sum Restaurant	Diner \
4a8d5b48f964a520840f20e3	0	0	0
4a9d0a53f964a520d23720e3	0	0	0
4aada317f964a5201a6120e3	0	0	0
4ab17387f964a520866920e3	0	0	0
4ab81980f964a5202f7c20e3	0	0	0

ID	Discount Store	Distribution Center	Dog Run \
4a8d5b48f964a520840f20e3	0	0	0
4a9d0a53f964a520d23720e3	0	0	0
4aada317f964a5201a6120e3	0	0	0
4ab17387f964a520866920e3	0	0	0
4ab81980f964a5202f7c20e3	0	0	0

ID	Doner Restaurant	Donut Shop	Dry Cleaner \
4a8d5b48f964a520840f20e3	0	0	0
4a9d0a53f964a520d23720e3	0	0	0
4aada317f964a5201a6120e3	0	0	0
4ab17387f964a520866920e3	0	0	0
4ab81980f964a5202f7c20e3	0	0	0

ID			
4a8d5b48f964a520840f20e3	0	0	0
4a9d0a53f964a520d23720e3	0	0	0
4aada317f964a5201a6120e3	0	0	0
4ab17387f964a520866920e3	0	0	0
4ab81980f964a5202f7c20e3	0	0	0

	Dumpling Restaurant	Eastern European Restaurant	\
ID			
4a8d5b48f964a520840f20e3	0		0
4a9d0a53f964a520d23720e3	0		0
4aada317f964a5201a6120e3	0		0
4ab17387f964a520866920e3	0		0
4ab81980f964a5202f7c20e3	0		0

	Egyptian Restaurant	Electronics Store	Escape Room	\
ID				
4a8d5b48f964a520840f20e3	0	0		0
4a9d0a53f964a520d23720e3	0	0		0
4aada317f964a5201a6120e3	0	0		0
4ab17387f964a520866920e3	0	0		0
4ab81980f964a5202f7c20e3	0	0		0

	Ethiopian Restaurant	Event Space	Exhibit	\
ID				
4a8d5b48f964a520840f20e3	0	0	0	
4a9d0a53f964a520d23720e3	0	0	0	
4aada317f964a5201a6120e3	0	0	0	
4ab17387f964a520866920e3	0	0	0	
4ab81980f964a5202f7c20e3	0	0	0	

	Falafel Restaurant	Farm	Farmers Market	\
ID				
4a8d5b48f964a520840f20e3	0	0	0	
4a9d0a53f964a520d23720e3	0	0	0	
4aada317f964a5201a6120e3	0	0	0	
4ab17387f964a520866920e3	0	0	0	
4ab81980f964a5202f7c20e3	0	0	0	

	Fast Food Restaurant	Field	Filipino Restaurant	\
ID				
4a8d5b48f964a520840f20e3	0	0		0
4a9d0a53f964a520d23720e3	0	0		0
4aada317f964a5201a6120e3	0	0		0
4ab17387f964a520866920e3	0	0		0
4ab81980f964a5202f7c20e3	0	0		0

	Financial or Legal Service	Fish & Chips Shop	\
ID			
4a8d5b48f964a520840f20e3	0	0	
4a9d0a53f964a520d23720e3	0	0	
4aada317f964a5201a6120e3	0	0	
4ab17387f964a520866920e3	0	0	
4ab81980f964a5202f7c20e3	0	0	

	Fish Market	Flea Market	Flower Shop	Food	\
ID					
4a8d5b48f964a520840f20e3	0	0	0	0	
4a9d0a53f964a520d23720e3	0	0	0	0	
4aada317f964a5201a6120e3	0	0	0	0	
4ab17387f964a520866920e3	0	0	0	0	
4ab81980f964a5202f7c20e3	0	0	0	0	

	Food & Drink Shop	Food Court	Food Truck	Fountain	\
ID					
4a8d5b48f964a520840f20e3	0	0	0	0	
4a9d0a53f964a520d23720e3	0	0	0	0	
4aada317f964a5201a6120e3	0	0	0	0	
4ab17387f964a520866920e3	0	0	0	0	
4ab81980f964a5202f7c20e3	0	0	0	0	

	French Restaurant	Fried Chicken Joint	\
ID			
4a8d5b48f964a520840f20e3	0	0	
4a9d0a53f964a520d23720e3	0	0	
4aada317f964a5201a6120e3	0	0	
4ab17387f964a520866920e3	0	0	
4ab81980f964a5202f7c20e3	0	0	

	Frozen Yogurt Shop	Fruit & Vegetable Store	\
ID			
4a8d5b48f964a520840f20e3	0	0	
4a9d0a53f964a520d23720e3	0	0	
4aada317f964a5201a6120e3	0	0	
4ab17387f964a520866920e3	0	0	
4ab81980f964a5202f7c20e3	0	0	

	Furniture / Home Store	Gaming Cafe	Garden	\
ID				
4a8d5b48f964a520840f20e3	0	0	0	
4a9d0a53f964a520d23720e3	0	0	0	
4aada317f964a5201a6120e3	0	0	0	
4ab17387f964a520866920e3	0	0	0	
4ab81980f964a5202f7c20e3	0	0	0	

	Garden Center	Gas Station	Gastropub	Gay Bar	\
ID					
4a8d5b48f964a520840f20e3	0	0	0	0	
4a9d0a53f964a520d23720e3	0	0	0	0	
4aada317f964a5201a6120e3	0	0	0	0	
4ab17387f964a520866920e3	0	0	0	0	
4ab81980f964a5202f7c20e3	0	0	0	0	

	General Entertainment	General Travel	Gift Shop	\
ID				
4a8d5b48f964a520840f20e3	0	0	0	
4a9d0a53f964a520d23720e3	0	0	0	
4aada317f964a5201a6120e3	0	0	0	
4ab17387f964a520866920e3	0	0	0	
4ab81980f964a5202f7c20e3	0	0	0	

	Gluten-free Restaurant	Go Kart Track	Golf Course	\
ID				
4a8d5b48f964a520840f20e3	0	0	0	
4a9d0a53f964a520d23720e3	0	0	0	
4aada317f964a5201a6120e3	0	0	0	
4ab17387f964a520866920e3	0	0	0	
4ab81980f964a5202f7c20e3	0	0	0	

	Golf Driving Range	Gourmet Shop	Greek Restaurant	\
ID				
4a8d5b48f964a520840f20e3	0	0	0	
4a9d0a53f964a520d23720e3	0	0	0	
4aada317f964a5201a6120e3	0	0	0	
4ab17387f964a520866920e3	0	0	0	
4ab81980f964a5202f7c20e3	0	0	0	

	Grocery Store	Gym	Gym / Fitness Center	Gym Pool	\
ID					
4a8d5b48f964a520840f20e3	0	0	0	0	
4a9d0a53f964a520d23720e3	0	0	0	0	
4aada317f964a5201a6120e3	0	0	0	0	
4ab17387f964a520866920e3	0	0	0	0	
4ab81980f964a5202f7c20e3	0	0	0	0	

	Hakka Restaurant	Harbor / Marina	Hardware Store	\
ID				
4a8d5b48f964a520840f20e3	0	0	0	
4a9d0a53f964a520d23720e3	0	0	0	
4aada317f964a5201a6120e3	0	0	0	
4ab17387f964a520866920e3	0	0	0	

4ab81980f964a5202f7c20e3	0	0	0
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	Health & Beauty Service	Health Food Store	\
ID			
4a8d5b48f964a520840f20e3	0	0	
4a9d0a53f964a520d23720e3	0	0	
4aada317f964a5201a6120e3	0	0	
4ab17387f964a520866920e3	0	0	
4ab81980f964a5202f7c20e3	0	0	

	Historic Site	History Museum	Hobby Shop	\
ID				
4a8d5b48f964a520840f20e3	0	0	0	
4a9d0a53f964a520d23720e3	0	0	0	
4aada317f964a5201a6120e3	0	0	0	
4ab17387f964a520866920e3	0	0	0	
4ab81980f964a5202f7c20e3	0	0	0	

	Hockey Arena	Hockey Field	Home Service	\
ID				
4a8d5b48f964a520840f20e3	0	0	0	
4a9d0a53f964a520d23720e3	0	0	0	
4aada317f964a5201a6120e3	0	0	0	
4ab17387f964a520866920e3	0	0	0	
4ab81980f964a5202f7c20e3	0	0	0	

	Hong Kong Restaurant	Hookah Bar	Hospital	Hostel	\
ID					
4a8d5b48f964a520840f20e3	0	0	0	0	
4a9d0a53f964a520d23720e3	0	0	0	0	
4aada317f964a5201a6120e3	0	0	0	0	
4ab17387f964a520866920e3	0	0	0	0	
4ab81980f964a5202f7c20e3	0	0	0	0	

	Hotel	Hotel Bar	Hotpot Restaurant	\
ID				
4a8d5b48f964a520840f20e3	0	0	0	
4a9d0a53f964a520d23720e3	1	0	0	
4aada317f964a5201a6120e3	0	0	0	
4ab17387f964a520866920e3	0	0	0	
4ab81980f964a5202f7c20e3	0	0	0	

	Housing Development	Hungarian Restaurant	\
ID			
4a8d5b48f964a520840f20e3	0	0	
4a9d0a53f964a520d23720e3	0	0	
4aada317f964a5201a6120e3	0	0	

4ab17387f964a520866920e3	0	0
4ab81980f964a5202f7c20e3	0	0

	IT Services	Ice Cream Shop \
ID		
4a8d5b48f964a520840f20e3	0	0
4a9d0a53f964a520d23720e3	0	0
4aada317f964a5201a6120e3	0	0
4ab17387f964a520866920e3	0	0
4ab81980f964a5202f7c20e3	0	0

	Indian Chinese Restaurant	Indian Restaurant \
ID		
4a8d5b48f964a520840f20e3	0	0
4a9d0a53f964a520d23720e3	0	0
4aada317f964a5201a6120e3	0	0
4ab17387f964a520866920e3	0	0
4ab81980f964a5202f7c20e3	0	0

	Indie Movie Theater	Indie Theater \
ID		
4a8d5b48f964a520840f20e3	0	0
4a9d0a53f964a520d23720e3	0	0
4aada317f964a5201a6120e3	0	0
4ab17387f964a520866920e3	0	0
4ab81980f964a5202f7c20e3	0	0

	Indonesian Restaurant	Intersection	Irish Pub \
ID			
4a8d5b48f964a520840f20e3	0	0	0
4a9d0a53f964a520d23720e3	0	0	0
4aada317f964a5201a6120e3	0	0	0
4ab17387f964a520866920e3	0	0	0
4ab81980f964a5202f7c20e3	0	0	0

	Italian Restaurant	Japanese Restaurant	Jazz Club \
ID			
4a8d5b48f964a520840f20e3	0	0	0
4a9d0a53f964a520d23720e3	0	0	0
4aada317f964a5201a6120e3	0	0	0
4ab17387f964a520866920e3	0	0	0
4ab81980f964a5202f7c20e3	0	0	0

	Jewelry Store	Juice Bar	Karaoke Bar \
ID			
4a8d5b48f964a520840f20e3	0	0	0
4a9d0a53f964a520d23720e3	0	0	0



4aada317f964a5201a6120e3  
 4ab17387f964a520866920e3  
 4ab81980f964a5202f7c20e3

0 0 0  
 0 0 0  
 0 0 0

ID	Kitchen Supply Store	Korean Restaurant	Lake	\
4a8d5b48f964a520840f20e3	0		0	0
4a9d0a53f964a520d23720e3	0		0	0
4aada317f964a5201a6120e3	0		0	0
4ab17387f964a520866920e3	0		0	0
4ab81980f964a5202f7c20e3	0		0	0

ID	Laser Tag	Latin American Restaurant	Laundromat	\
4a8d5b48f964a520840f20e3	0		0	0
4a9d0a53f964a520d23720e3	0		0	0
4aada317f964a5201a6120e3	0		0	0
4ab17387f964a520866920e3	0		0	0
4ab81980f964a5202f7c20e3	0		0	0

ID	Leather Goods Store	Library	Light Rail Station	\
4a8d5b48f964a520840f20e3	0	0		0
4a9d0a53f964a520d23720e3	0	0		0
4aada317f964a5201a6120e3	0	0		0
4ab17387f964a520866920e3	0	0		0
4ab81980f964a5202f7c20e3	0	0		0

ID	Lighting Store	Liquor Store	Lounge	\
4a8d5b48f964a520840f20e3	0	0	0	
4a9d0a53f964a520d23720e3	0	0	0	
4aada317f964a5201a6120e3	0	0	0	
4ab17387f964a520866920e3	0	0	0	
4ab81980f964a5202f7c20e3	0	0	0	

ID	Mac & Cheese Joint	Malay Restaurant	Market	\
4a8d5b48f964a520840f20e3	0		0	0
4a9d0a53f964a520d23720e3	0		0	0
4aada317f964a5201a6120e3	0		0	0
4ab17387f964a520866920e3	0		0	0
4ab81980f964a5202f7c20e3	0		0	0

ID	Martial Arts School	Massage Studio	Medical Center	\
4a8d5b48f964a520840f20e3	0		0	0

4a9d0a53f964a520d23720e3	0	0	0
4aada317f964a5201a6120e3	0	0	0
4ab17387f964a520866920e3	0	0	0
4ab81980f964a5202f7c20e3	0	0	0

	Medical Supply Store	Mediterranean Restaurant	\
ID			
4a8d5b48f964a520840f20e3	0		0
4a9d0a53f964a520d23720e3	0		0
4aada317f964a5201a6120e3	0		0
4ab17387f964a520866920e3	0		0
4ab81980f964a5202f7c20e3	0		0

	Men's Store	Metro Station	Mexican Restaurant	\
ID				
4a8d5b48f964a520840f20e3	0	0		0
4a9d0a53f964a520d23720e3	0	0		0
4aada317f964a5201a6120e3	0	0		0
4ab17387f964a520866920e3	0	0		0
4ab81980f964a5202f7c20e3	0	0		0

	Middle Eastern Restaurant	Miscellaneous Shop	\
ID			
4a8d5b48f964a520840f20e3		0	0
4a9d0a53f964a520d23720e3		0	0
4aada317f964a5201a6120e3		0	0
4ab17387f964a520866920e3		0	0
4ab81980f964a5202f7c20e3		0	0

	Mobile Phone Shop	Modern European Restaurant	\
ID			
4a8d5b48f964a520840f20e3	0		0
4a9d0a53f964a520d23720e3	0		0
4aada317f964a5201a6120e3	0		0
4ab17387f964a520866920e3	0		0
4ab81980f964a5202f7c20e3	0		0

	Molecular Gastronomy Restaurant	\
ID		
4a8d5b48f964a520840f20e3		0
4a9d0a53f964a520d23720e3		0
4aada317f964a5201a6120e3		0
4ab17387f964a520866920e3		0
4ab81980f964a5202f7c20e3		0

	Monument / Landmark	Moroccan Restaurant	\
ID			

4a8d5b48f964a520840f20e3  
 4a9d0a53f964a520d23720e3  
 4aada317f964a5201a6120e3  
 4ab17387f964a520866920e3  
 4ab81980f964a5202f7c20e3

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 0

ID	Movie Theater	Museum	Music School	Music Store \
4a8d5b48f964a520840f20e3	0	0	0	0
4a9d0a53f964a520d23720e3	0	0	0	0
4aada317f964a5201a6120e3	0	0	0	0
4ab17387f964a520866920e3	0	0	0	0
4ab81980f964a5202f7c20e3	0	0	0	0

ID	Music Venue	Nail Salon	National Park \
4a8d5b48f964a520840f20e3	0	0	0
4a9d0a53f964a520d23720e3	0	0	0
4aada317f964a5201a6120e3	0	0	0
4ab17387f964a520866920e3	0	0	0
4ab81980f964a5202f7c20e3	0	0	0

ID	New American Restaurant	Nightclub	Noodle House \
4a8d5b48f964a520840f20e3	0	0	0
4a9d0a53f964a520d23720e3	0	0	0
4aada317f964a5201a6120e3	0	0	0
4ab17387f964a520866920e3	0	0	0
4ab81980f964a5202f7c20e3	0	0	0

ID	Office	Opera House	Optical Shop	Organic Grocery \
4a8d5b48f964a520840f20e3	0	0	0	0
4a9d0a53f964a520d23720e3	0	0	0	0
4aada317f964a5201a6120e3	0	0	0	0
4ab17387f964a520866920e3	0	0	0	0
4ab81980f964a5202f7c20e3	0	0	0	0

ID	Other Great Outdoors	Outdoor Supply Store \
4a8d5b48f964a520840f20e3	0	0
4a9d0a53f964a520d23720e3	0	0
4aada317f964a5201a6120e3	0	0
4ab17387f964a520866920e3	0	0
4ab81980f964a5202f7c20e3	0	0

Pakistani Restaurant	Paper / Office Supplies Store \
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ID		
4a8d5b48f964a520840f20e3	0	0
4a9d0a53f964a520d23720e3	0	0
4aada317f964a5201a6120e3	0	0
4ab17387f964a520866920e3	0	0
4ab81980f964a5202f7c20e3	0	0

	Park	Pastry Shop	Performing Arts Venue	\
ID				
4a8d5b48f964a520840f20e3	0	0	0	
4a9d0a53f964a520d23720e3	0	0	0	
4aada317f964a5201a6120e3	0	0	0	
4ab17387f964a520866920e3	0	0	0	
4ab81980f964a5202f7c20e3	0	0	0	

	Persian Restaurant	Peruvian Restaurant	Pet Store	\
ID				
4a8d5b48f964a520840f20e3	0	0	0	
4a9d0a53f964a520d23720e3	0	0	0	
4aada317f964a5201a6120e3	0	0	0	
4ab17387f964a520866920e3	0	0	0	
4ab81980f964a5202f7c20e3	0	0	0	

	Pharmacy	Pie Shop	Pizza Place	Playground	Plaza	\
ID						
4a8d5b48f964a520840f20e3	0	0	0	0	0	
4a9d0a53f964a520d23720e3	0	0	0	0	0	
4aada317f964a5201a6120e3	0	0	0	0	0	
4ab17387f964a520866920e3	0	0	0	0	0	
4ab81980f964a5202f7c20e3	0	0	0	0	0	

	Poke Place	Polish Restaurant	Pool	Pool Hall	\
ID					
4a8d5b48f964a520840f20e3	0	0	0	0	
4a9d0a53f964a520d23720e3	0	0	0	0	
4aada317f964a5201a6120e3	0	0	0	0	
4ab17387f964a520866920e3	0	0	0	0	
4ab81980f964a5202f7c20e3	0	0	0	0	

	Portuguese Restaurant	Poutine Place	Pub	\
ID				
4a8d5b48f964a520840f20e3	0	0	0	
4a9d0a53f964a520d23720e3	0	0	0	
4aada317f964a5201a6120e3	0	0	0	
4ab17387f964a520866920e3	0	0	1	
4ab81980f964a5202f7c20e3	0	0	0	

	Racecourse	Racetrack	Ramen Restaurant	\
ID				
4a8d5b48f964a520840f20e3	0	0	0	
4a9d0a53f964a520d23720e3	0	0	0	
4aada317f964a5201a6120e3	0	0	0	
4ab17387f964a520866920e3	0	0	0	
4ab81980f964a5202f7c20e3	0	0	0	

	Record Shop	Recreation Center	Rental Car Location	\
ID				
4a8d5b48f964a520840f20e3	0	0	0	
4a9d0a53f964a520d23720e3	0	0	0	
4aada317f964a5201a6120e3	0	0	0	
4ab17387f964a520866920e3	0	0	0	
4ab81980f964a5202f7c20e3	0	0	0	

	Rental Service	Restaurant	River	Road	Rock Club	\
ID						
4a8d5b48f964a520840f20e3	0	0	0	0	0	
4a9d0a53f964a520d23720e3	0	0	0	0	0	
4aada317f964a5201a6120e3	0	0	0	0	0	
4ab17387f964a520866920e3	0	0	0	0	0	
4ab81980f964a5202f7c20e3	0	1	0	0	0	

	Roof Deck	Sake Bar	Salad Place	\
ID				
4a8d5b48f964a520840f20e3	0	0	0	
4a9d0a53f964a520d23720e3	0	0	0	
4aada317f964a5201a6120e3	0	0	0	
4ab17387f964a520866920e3	0	0	0	
4ab81980f964a5202f7c20e3	0	0	0	

	Salon / Barbershop	Sandwich Place	Scenic Lookout	\
ID				
4a8d5b48f964a520840f20e3	0	0	0	
4a9d0a53f964a520d23720e3	0	0	0	
4aada317f964a5201a6120e3	0	0	0	
4ab17387f964a520866920e3	0	0	0	
4ab81980f964a5202f7c20e3	0	0	0	

	Sculpture Garden	Seafood Restaurant	\
ID			
4a8d5b48f964a520840f20e3	0	0	
4a9d0a53f964a520d23720e3	0	0	
4aada317f964a5201a6120e3	0	0	
4ab17387f964a520866920e3	0	0	
4ab81980f964a5202f7c20e3	0	0	

	Shipping Store	Shoe Repair	Shoe Store	\
ID				
4a8d5b48f964a520840f20e3	0	0	0	
4a9d0a53f964a520d23720e3	0	0	0	
4aada317f964a5201a6120e3	0	0	0	
4ab17387f964a520866920e3	0	0	0	
4ab81980f964a5202f7c20e3	0	0	0	

	Shopping Mall	Shopping Plaza	Skate Park	\
ID				
4a8d5b48f964a520840f20e3	0	0	0	
4a9d0a53f964a520d23720e3	0	0	0	
4aada317f964a5201a6120e3	0	0	0	
4ab17387f964a520866920e3	0	0	0	
4ab81980f964a5202f7c20e3	0	0	0	

	Skating Rink	Ski Chalet	Smoke Shop	Smoothie Shop	\
ID					
4a8d5b48f964a520840f20e3	0	0	0	0	
4a9d0a53f964a520d23720e3	0	0	0	0	
4aada317f964a5201a6120e3	0	0	0	0	
4ab17387f964a520866920e3	0	0	0	0	
4ab81980f964a5202f7c20e3	0	0	0	0	

	Snack Place	Soccer Field	Soccer Stadium	\
ID				
4a8d5b48f964a520840f20e3	0	0	0	
4a9d0a53f964a520d23720e3	0	0	0	
4aada317f964a5201a6120e3	0	0	0	
4ab17387f964a520866920e3	0	0	0	
4ab81980f964a5202f7c20e3	0	0	0	

	Soup Place	South American Restaurant	\
ID			
4a8d5b48f964a520840f20e3	0	0	
4a9d0a53f964a520d23720e3	0	0	
4aada317f964a5201a6120e3	0	0	
4ab17387f964a520866920e3	0	0	
4ab81980f964a5202f7c20e3	0	0	

	Souvlaki Shop	Spa	Spanish Restaurant	Speakeasy	\
ID					
4a8d5b48f964a520840f20e3	0	0	0	0	
4a9d0a53f964a520d23720e3	0	0	0	0	
4aada317f964a5201a6120e3	0	0	0	0	
4ab17387f964a520866920e3	0	0	0	0	

4ab81980f964a5202f7c20e3	0	0	0	0
--------------------------	---	---	---	---

	Sporting Goods Shop	Sports Bar	\
--	---------------------	------------	---

ID

4a8d5b48f964a520840f20e3	0	0
4a9d0a53f964a520d23720e3	0	0
4aada317f964a5201a6120e3	0	0
4ab17387f964a520866920e3	0	0
4ab81980f964a5202f7c20e3	0	0

	Sri Lankan Restaurant	Steakhouse	Storage Facility	\
--	-----------------------	------------	------------------	---

ID

4a8d5b48f964a520840f20e3	0	0	0
4a9d0a53f964a520d23720e3	0	0	0
4aada317f964a5201a6120e3	0	0	0
4ab17387f964a520866920e3	0	0	0
4ab81980f964a5202f7c20e3	0	0	0

	Street Art	Supermarket	Supplement Shop	\
--	------------	-------------	-----------------	---

ID

4a8d5b48f964a520840f20e3	0	0	0
4a9d0a53f964a520d23720e3	0	0	0
4aada317f964a5201a6120e3	0	0	0
4ab17387f964a520866920e3	0	0	0
4ab81980f964a5202f7c20e3	0	0	0

	Sushi Restaurant	Syrian Restaurant	\
--	------------------	-------------------	---

ID

4a8d5b48f964a520840f20e3	0	0
4a9d0a53f964a520d23720e3	0	0
4aada317f964a5201a6120e3	0	0
4ab17387f964a520866920e3	0	0
4ab81980f964a5202f7c20e3	0	0

	Szechuan Restaurant	Taco Place	Tailor Shop	\
--	---------------------	------------	-------------	---

ID

4a8d5b48f964a520840f20e3	0	0	0
4a9d0a53f964a520d23720e3	0	0	0
4aada317f964a5201a6120e3	0	0	0
4ab17387f964a520866920e3	0	0	0
4ab81980f964a5202f7c20e3	0	0	0

	Taiwanese Restaurant	Tanning Salon	\
--	----------------------	---------------	---

ID

4a8d5b48f964a520840f20e3	0	0
4a9d0a53f964a520d23720e3	0	0
4aada317f964a5201a6120e3	0	0

4ab17387f964a520866920e3	0	0
4ab81980f964a5202f7c20e3	0	0

	Tapas Restaurant	Tattoo Parlor	Tea Room \
ID			
4a8d5b48f964a520840f20e3	0	0	0
4a9d0a53f964a520d23720e3	0	0	0
4aada317f964a5201a6120e3	0	0	0
4ab17387f964a520866920e3	0	0	0
4ab81980f964a5202f7c20e3	0	0	0

	Tennis Court	Thai Restaurant	Theater	Theme Park \
ID				
4a8d5b48f964a520840f20e3	0	0	0	0
4a9d0a53f964a520d23720e3	0	0	0	0
4aada317f964a5201a6120e3	0	0	0	0
4ab17387f964a520866920e3	0	0	0	0
4ab81980f964a5202f7c20e3	0	0	0	0

	Theme Restaurant	Thrift / Vintage Store \
ID		
4a8d5b48f964a520840f20e3	0	0
4a9d0a53f964a520d23720e3	0	0
4aada317f964a5201a6120e3	0	0
4ab17387f964a520866920e3	0	0
4ab81980f964a5202f7c20e3	0	0

	Tibetan Restaurant	Toy / Game Store	Track	Trail \
ID				
4a8d5b48f964a520840f20e3	0	0	0	0
4a9d0a53f964a520d23720e3	0	0	0	0
4aada317f964a5201a6120e3	0	0	0	0
4ab17387f964a520866920e3	0	0	0	0
4ab81980f964a5202f7c20e3	0	0	0	0

	Train Station	Tree	Turkish Restaurant	University \
ID				
4a8d5b48f964a520840f20e3	0	0	0	0
4a9d0a53f964a520d23720e3	0	0	0	0
4aada317f964a5201a6120e3	0	0	0	0
4ab17387f964a520866920e3	0	0	0	0
4ab81980f964a5202f7c20e3	0	0	0	0

	Vegetarian / Vegan Restaurant	Video Game Store \
ID		
4a8d5b48f964a520840f20e3	0	0
4a9d0a53f964a520d23720e3	0	0



4aada317f964a5201a6120e3	0	0
4ab17387f964a520866920e3	0	0
4ab81980f964a5202f7c20e3	0	0

	Video Store	Vietnamese Restaurant \
ID		
4a8d5b48f964a520840f20e3	0	0
4a9d0a53f964a520d23720e3	0	0
4aada317f964a5201a6120e3	0	0
4ab17387f964a520866920e3	0	0
4ab81980f964a5202f7c20e3	0	0

	Volleyball Court	Warehouse Store	Whisky Bar \
ID			
4a8d5b48f964a520840f20e3	0	0	0
4a9d0a53f964a520d23720e3	0	0	0
4aada317f964a5201a6120e3	0	0	0
4ab17387f964a520866920e3	0	0	0
4ab81980f964a5202f7c20e3	0	0	0

	Wine Bar	Wine Shop	Wings Joint	Women's Store \
ID				
4a8d5b48f964a520840f20e3	0	0	0	0
4a9d0a53f964a520d23720e3	0	0	0	0
4aada317f964a5201a6120e3	0	0	0	0
4ab17387f964a520866920e3	0	0	0	0
4ab81980f964a5202f7c20e3	0	0	0	0

	Xinjiang Restaurant	Yoga Studio	Zoo	Zoo Exhibit
ID				
4a8d5b48f964a520840f20e3	0	0	0	0
4a9d0a53f964a520d23720e3	0	0	0	0
4aada317f964a5201a6120e3	0	0	0	0
4ab17387f964a520866920e3	0	0	0	0
4ab81980f964a5202f7c20e3	0	0	0	0

## 5 Group venues by neighborhood and get category frequencies

```
[12]: category_counts = categories.groupby('Neighborhood').mean()
```

## 6 Determine top 5 most popular types of places for each neighborhood

```
[13]: def get_top5(category_counts):
    top5 = pd.DataFrame()
    for nbh_id in category_counts.index:
        row = category_counts.loc[nbh_id].nlargest(5).map(lambda x: x if x > 0
        else np.nan)
        row = pd.Series(row.index, name=nbh_id)
        top5 = pd.concat([top5, row], axis=1)
    top5 = top5.T
    top5.index.name = 'Neighborhood'
    top5.columns = ["{}Most Popular".format(n) for n in ['1', '2nd ', '3rd ',
    '4th ', '5th ']]
    return top5
top5 = get_top5(category_counts)
top5.head()
```

```
[13]:
```

	Most Popular	2nd Most Popular	\
Neighborhood			
Adelaide	Salad Place	Thai Restaurant	
Agincourt North	Chinese Restaurant	Coffee Shop	
Alderwood	Coffee Shop	Bank	
Bathurst Manor	Coffee Shop	Deli / Bodega	
Bayview Village	Chinese Restaurant	Bank	

  

	3rd Most Popular	4th Most Popular	\
Neighborhood			
Adelaide		ATM	Accessories Store
Agincourt North		Bakery	Sandwich Place
Alderwood		Bar	Café
Bathurst Manor	Middle Eastern Restaurant		Restaurant
Bayview Village		Café	Clothing Store

  

	5th Most Popular
Neighborhood	
Adelaide	African Restaurant
Agincourt North	Bubble Tea Shop
Alderwood	Discount Store
Bathurst Manor	Sandwich Place
Bayview Village	Coffee Shop

## 7 Cluster neighborhoods

Cluster neighborhoods based on venue category frequencies

```
[14]: def cluster_label(category_counts):
    km = KMeans(n_clusters=5, n_init=1000)
    km.fit(category_counts)
    labels = pd.Series(km.labels_, index=category_counts.index, name='Cluster')
    neighborhoods = data[['Neighborhood', 'Latitude', 'Longitude']].
    ↳groupby('Neighborhood').mean()
    labeled_neighborhoods = pd.concat([labels, neighborhoods], axis=1)
    return labeled_neighborhoods

labeled_neighborhoods = cluster_label(category_counts)
labeled_neighborhoods['Cluster'].value_counts()
```

```
[14]: 0.0    104
      4.0     6
      1.0     3
      2.0     2
      3.0     2
      Name: Cluster, dtype: int64
```

## 8 Map neighborhoods, color-coded by cluster label

Clicking on a neighborhood marker will display a pop-up with the neighborhood name and the top 5 venue categories

```
[15]: def make_map(labeled_neighborhoods, top5):
    color_list = []
    for r, g, b in itertools.product(*[['00', 'cc']] * 3):
        color_list.append("#{}{}{}".format(r, g, b))
    color_list = color_list[1:-2]
    map_clusters = folium.Map(location=[labeled_neighborhoods['Latitude'].
    ↳mean(), labeled_neighborhoods['Longitude'].mean()], zoom_start=11)
    for row in labeled_neighborhoods.iterrows():
        name, row = row
        cluster, lat, lng = row
        try:
            color = color_list[int(cluster)]
        except ValueError:
            color = '#000000'
        try:
            popup_text = "<b>{}</b><br>".format(name) + "<br>".join(["{}. {}".
            ↳format(i, t) for i, t in zip(range(1, 6), top5.loc[name])])
        except KeyError:
            continue
        popup = folium.Popup(popup_text)
        marker = folium.CircleMarker([lat, lng], radius=6, popup=popup,
        ↳color=color, fill=True, fillOpacity=0.7, min_width="100%", max_width='100%')
        marker.add_to(map_clusters)
```

```
return map_clusters
```

```
[16]: map_clusters = make_map(labeled_neighborhoods, top5)
map_clusters
```

```
[16]: <folium.folium.Map at 0x7f6a9d1834c0>
```

## 9 Cluster neighborhoods based on venue category counts, but this time use broader categories

Foursquare has a category hierarchy. We will use this to translate specific venue categories (eg, Indian Restaurant) to a broader categories (eg, Food). This will decrease the dimensionality of the data used for k-means clustering

```
[17]: if not os.access('category_groups.json', os.R_OK):
    foursquare_categories = foursquare_template.format("categories")
    response = requests.get(foursquare_categories)
    response.raise_for_status()
    category_groups = response.json()
    with open('category_groups.json', 'w') as f:
        json.dump(category_groups, f)
else:
    with open('category_groups.json') as f:
        category_groups = json.load(f)
```

```
[18]: mapped_categories = {}
children = []
for parent in category_groups['response']['categories']:
    children.extend(parent['categories'])
    while children:
        child = children.pop()
        children.extend(child['categories'])
        mapped_categories[child['id']] = pd.Series({'Category ID':
↪parent['id'], 'Category': parent['name']})
```

```
[19]: venues_alt = venues.copy()
venues_alt[['Category', 'Category ID']] = venues[['Category', 'Category ID']].
↪apply(lambda x: mapped_categories[x.loc['Category ID']]

↪
↪         if x.loc['Category ID'] in mapped_categories
↪
↪         else x,
↪
↪         axis=1)
```

Perform the same analysis as before: 1. Map 'Category' to boolean indicator features 2. Determine top 5 venue categories 3. Cluster neighborhoods based on venue frequencies 4. Map neighborhoods

color-coded by cluster label

```
[20]: category_alt = venues_alt['Category']
category_alt = pd.get_dummies(category_alt, columns=['Category'], prefix="",
    ↪prefix_sep="")
category_alt = pd.concat([venues_alt['Neighborhood'], category_alt], axis=1)
category_alt_grouped = category_alt.groupby('Neighborhood').mean()
```

```
[21]: top5_alt = get_top5(category_alt_grouped)
labeled_alt = cluster_label(category_alt_grouped)
labeled_alt['Cluster'].value_counts()
```

```
[21]: 2.0    69
0.0    19
3.0    12
4.0     9
1.0     8
Name: Cluster, dtype: int64
```

```
[22]: map_alt = make_map(labeled_alt, top5_alt)
map_alt
```

```
[22]: <folium.folium.Map at 0x7f6a9c37efa0>
```

## 10 Cluster Summaries

```
[23]: def get_summary(labeled_neighborhoods, category_counts):
cat_by_cluster = pd.concat([labeled_neighborhoods, category_counts], axis=1)
cat_by_cluster = cat_by_cluster.drop(columns=['Latitude', 'Longitude']).
    ↪groupby('Cluster').mean()
summary = get_top5(cat_by_cluster)
counts = labeled_neighborhoods['Cluster'].value_counts()
counts.name = 'Neighborhood Count'
summary = pd.concat([counts, summary], axis=1)
summary.index.name = 'Cluster'
return summary
```

### 10.1 Using specific categories

```
[24]: get_summary(labeled_neighborhoods, category_counts).
    ↪sort_values(by='Neighborhood Count', ascending=False)
```

```
[24]:
```

	Neighborhood Count	Most Popular	2nd Most Popular	3rd Most Popular	\
Cluster					
0.0	104	Coffee Shop	Park	Café	
4.0	6	Coffee Shop	Restaurant	Park	
1.0	3	Park	Lighting Store	ATM	

2.0	2	Pharmacy	Grocery Store	ATM
3.0	2	Supermarket	ATM	Accessories Store

	4th Most Popular	5th Most Popular
Cluster		
0.0	Bakery	Pizza Place
4.0	Café	Clothing Store
1.0	Accessories Store	African Restaurant
2.0	Accessories Store	African Restaurant
3.0	African Restaurant	Airport

## 10.2 Using broad categories

```
[25]: get_summary(labeled_alt, category_alt_grouped).sort_values(by='Neighborhood_
      ↳Count', ascending=False)
```

	Neighborhood Count	Most Popular	2nd Most Popular \
Cluster			
2.0	69	Food	Shop & Service
0.0	19	Food	Shop & Service
3.0	12	Shop & Service	Food
4.0	9	Travel & Transport	Arts & Entertainment
1.0	8	Outdoors & Recreation	Shop & Service

	3rd Most Popular	4th Most Popular \
Cluster		
2.0	Outdoors & Recreation	Arts & Entertainment
0.0	Outdoors & Recreation	Arts & Entertainment
3.0	Outdoors & Recreation	Arts & Entertainment
4.0	Professional & Other Places	Nightlife Spot
1.0	Food	Arts & Entertainment

	5th Most Popular
Cluster	
2.0	Nightlife Spot
0.0	Nightlife Spot
3.0	College & University
4.0	Shop & Service
1.0	College & University

## 11 Discussion

It appears that using the broader category definitions helped improve clustering. Using the specific categories, the vast majority of the neighborhoods were assigned to a single cluster, meaning the distinction between neighborhoods was not as good.

Since k-means clustering the venue category frequency assumes independence between venue cate-

gories (eg: frequency differences between ‘Indian Restaurant’ and ‘Italian Restaurant’ are treated with the same weight as frequency differences between ‘Indian Restaurant’ and ‘Dog Park’), it makes sense that broadening the categories would work better. Otherwise, more specifically labeled data takes away from the true frequency count of similar venues. For example, restaurants with the style of food they serve in the name reduce the frequency of the simpler ‘Restaurant’ category and allow the frequency of these types of venues to get washed out when compared to categories for which no sub-sectioning is really possible, like ‘Airport’. Additionally, using the broader categories allows us not to worry about whether a venue labeled ‘Restaurant’ because they serve a wide menu or because whoever tagged the venue as such did not bother to be more specific.

[ ]: