

**Desired System to inform small business owners on
where to open restaurant at Queens NY**

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INTRODUCTION

In this project we will explore if someone wants to open a business at Queens Area of New York City what will be the recommended neighborhood.

BUSINESS PROBLEM

The Queens area of New York is the economic and administrative center. It is often described as the cultural, financial, media, and entertainment capital of the world. I believe it offers a great opportunity for someone who is trying to open a new shop. However, being a diverse metropolitan, it also poses certain challenges to figure out where to start a new business.

It would be nice if there is a desired system which analyze the different neighborhoods and recommend the best area to open the business. This machine learning desired system will help the small business owner make an informed decision on best areas to open the business.

DATA USED

The desired system will use the Foursquare location data to get details of the presence of similar type of business in each neighborhood. Foursquare rest-based API provide details like Venue Name, Category, customer likes, etc. which are very useful data points to make the decision.

It will then try to use the clustering algorithm to group the neighborhoods and provide addition details of those neighborhoods.

The data from Foursquare will be fetched using the longitude and latitude details of neighborhoods around Queens.

METHODOLOGY

Machine learning Clustering Algorithm is used to group the neighborhoods to find similar pattern. The steps are followed-

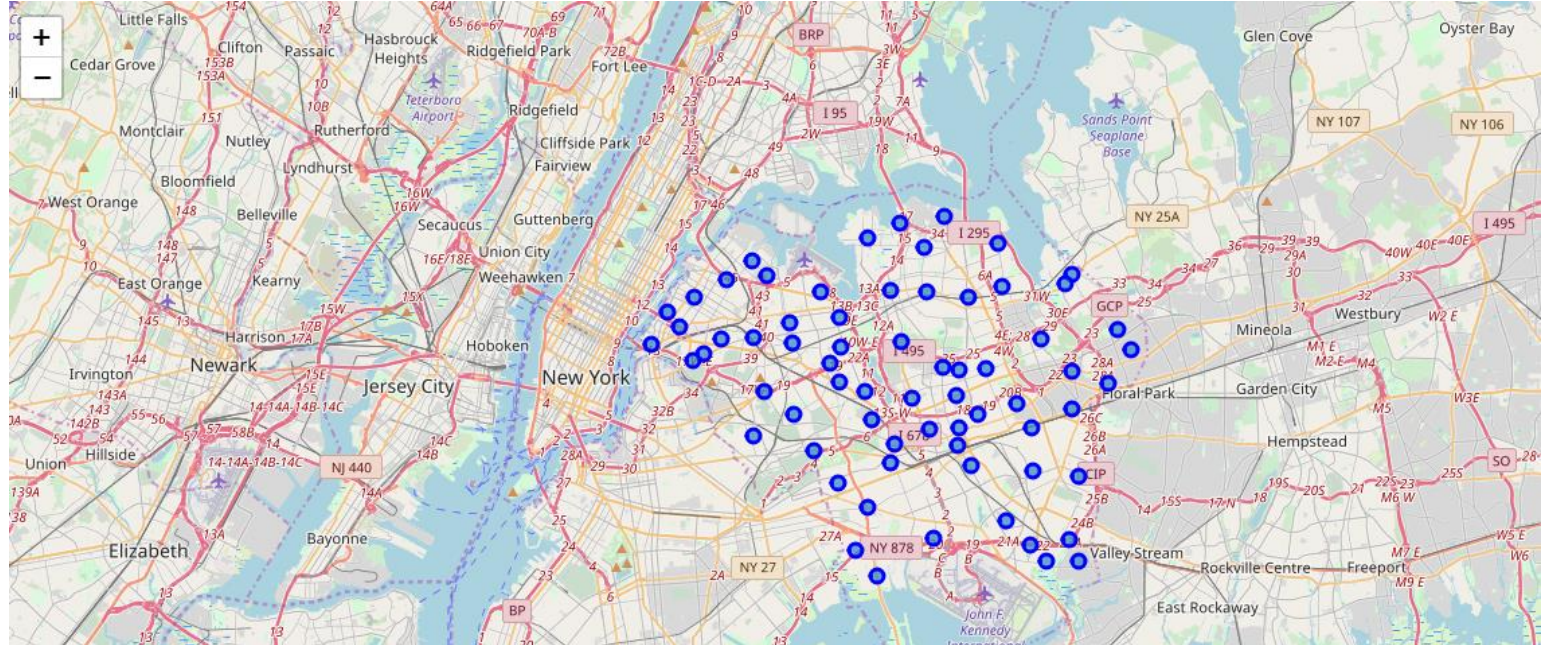
- The data for New York neighborhood along with the longitude and latitude details are obtained from internet.
Sample value –

	Borough	Neighborhood	Latitude	Longitude
0	Bronx	Wakefield	40.894705	-73.847201
1	Bronx	Co-op City	40.874294	-73.829939
2	Bronx	Eastchester	40.887556	-73.827806
3	Bronx	Fieldston	40.895437	-73.905643
4	Bronx	Riverdale	40.890834	-73.912585

-
- Next, we selected the neighborhoods for Borough as Queens only

	Borough	Neighborhood	Latitude	Longitude
0	Queens	Astoria	40.768509	-73.915654
1	Queens	Woodside	40.746349	-73.901842
2	Queens	Jackson Heights	40.751981	-73.882821
3	Queens	Elmhurst	40.744049	-73.881656
4	Queens	Howard Beach	40.654225	-73.838138

- Using the Python folium package and using the longitude and latitude each neighborhood is plotted on the map.



- Next, the venue details from the Manhattan neighborhoods are pulled from Foursquare site. Sample value –

	Neighborhood	Neighborhood Latitude	Neighborhood Longitude	Venue	Venue Latitude	Venue Longitude	Venue Category
0	Astoria	40.768509	-73.915654	Favela Grill	40.767348	-73.917897	Brazilian Restaurant
1	Astoria	40.768509	-73.915654	Orange Blossom	40.769856	-73.917012	Gourmet Shop
2	Astoria	40.768509	-73.915654	Titan Foods Inc.	40.769198	-73.919253	Gourmet Shop
3	Astoria	40.768509	-73.915654	Off The Hook	40.767200	-73.918104	Seafood Restaurant
4	Astoria	40.768509	-73.915654	CrossFit Queens	40.769404	-73.918977	Gym

- The venues are segregated into two groups – type RESTAURANTS & OTHERS

- Pandas dataframe is used to obtain the mean of the frequency of occurrence of each category

- Sample frequencies of different restaurants-

	Neighborhood	Afghan Restaurant	American Restaurant	Arepa Restaurant	Argentinian Restaurant	Asian Restaurant	Brazilian Restaurant	Café	Cajun / Creole Restaurant	Cantonese Restaurant	Caribbean Restaurant	Chinese Restaurant	Coffee Shop	Colombian Restaurant	Comfort Food Restaurant	Cuban Restaurant	Dim Sum Restaurant	Dumpling Restaurant	Eastern European Restaurant
0	Arverne	0.0	0.000000	0.0	0.0	0.000000	0.00	0.00	0.00	0.0	0.0	0.000000	0.00	0.0	0.00	0.0	0.0	0.0	0.0
1	Astoria	0.0	0.000000	0.0	0.0	0.000000	0.01	0.01	0.01	0.0	0.0	0.000000	0.02	0.0	0.01	0.0	0.0	0.0	0.0
2	Astoria Heights	0.0	0.000000	0.0	0.0	0.000000	0.00	0.00	0.00	0.0	0.0	0.076923	0.00	0.0	0.00	0.0	0.0	0.0	0.0
3	Auburndale	0.0	0.047619	0.0	0.0	0.000000	0.00	0.00	0.00	0.0	0.0	0.000000	0.00	0.0	0.00	0.0	0.0	0.0	0.0
4	Bay Terrace	0.0	0.025641	0.0	0.0	0.025641	0.00	0.00	0.00	0.0	0.0	0.000000	0.00	0.0	0.00	0.0	0.0	0.0	0.0

- Next, we found the top 15 Restaurant types for each neighborhoods. Sample –

	Neighborhood	1st Most Common Restaurant	2nd Most Common Restaurant	3rd Most Common Restaurant	4th Most Common Restaurant	5th Most Common Restaurant	6th Most Common Restaurant	7th Most Common Restaurant	8th Most Common Restaurant	9th Most Common Restaurant	10th Most Common Restaurant	11th Most Common Restaurant	12th Most Common Restaurant	13th Most Common Restaurant	14th Most Common Restaurant	15th Most Common Restaurant
0	Arverne	Thai Restaurant	Pizza Place	Vietnamese Restaurant	Filipino Restaurant	Eastern European Restaurant	Egyptian Restaurant	Empanada Restaurant	Falafel Restaurant	Fast Food Restaurant	French Restaurant	Food Court	German Restaurant	Gluten-free Restaurant	Greek Restaurant	Halal Restaurant
1	Astoria	Middle Eastern Restaurant	Greek Restaurant	Seafood Restaurant	Italian Restaurant	Coffee Shop	Indian Restaurant	Mediterranean Restaurant	Latin American Restaurant	Pizza Place	Thai Restaurant	Falafel Restaurant	Comfort Food Restaurant	Japanese Restaurant	Vegetarian / Vegan Restaurant	Cajun / Creole Restaurant
2	Astoria Heights	Italian Restaurant	Chinese Restaurant	Pizza Place	Vietnamese Restaurant	Filipino Restaurant	Egyptian Restaurant	Empanada Restaurant	Falafel Restaurant	Fast Food Restaurant	French Restaurant	Food Court	German Restaurant	Gluten-free Restaurant	Greek Restaurant	Halal Restaurant
3	Auburndale	American Restaurant	Italian Restaurant	Korean Restaurant	Fast Food Restaurant	Vietnamese Restaurant	French Restaurant	Empanada Restaurant	Falafel Restaurant	Filipino Restaurant	Food Court	Gluten-free Restaurant	German Restaurant	Eastern European Restaurant	Greek Restaurant	Halal Restaurant
4	Bay Terrace	Pizza Place	American Restaurant	Asian Restaurant	Restaurant	Gluten-free Restaurant	Filipino Restaurant	Eastern European Restaurant	Egyptian Restaurant	Empanada Restaurant	Falafel Restaurant	Fast Food Restaurant	Vietnamese Restaurant	Food Court	Dumpling Restaurant	German Restaurant

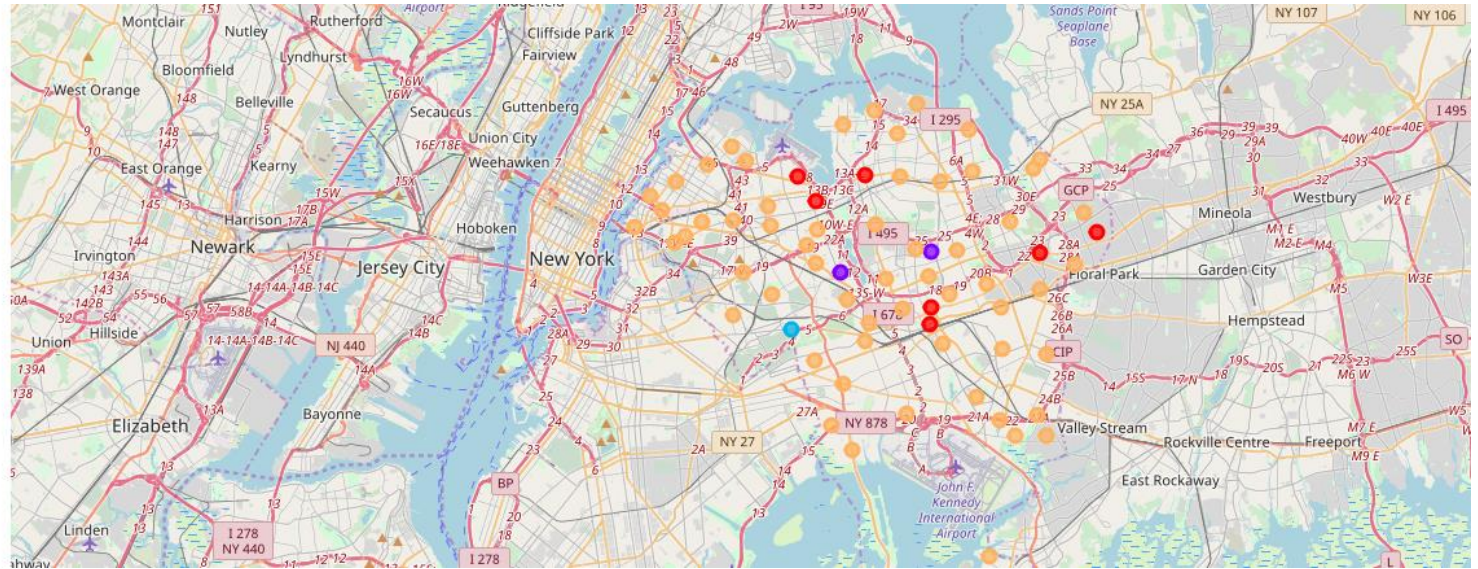
- Similarly, the top 15 venues other than restaurants are also obtained. Sample -

	Neighborhood	1st Most Common Venue	2nd Most Common Venue	3rd Most Common Venue	4th Most Common Venue	5th Most Common Venue	6th Most Common Venue	7th Most Common Venue	8th Most Common Venue	9th Most Common Venue	10th Most Common Venue	11th Most Common Venue	12th Most Common Venue	13th Most Common Venue	14th Most Common Venue	15th Most Common Venue
0	Anverne	Surf Spot	Metro Station	Sandwich Place	Playground	Board Shop	Bed & Breakfast	Bus Stop	Beach	Donut Shop	Flea Market	Fish Market	Fish & Chips Shop	Farmers Market	Farm	Eye Doctor
1	Astoria	Bar	Hookah Bar	Bakery	Pub	Deli / Bodega	Gym / Fitness Center	Gym	Grocery Store	Gourmet Shop	Salon / Barbershop	Food Truck	Ice Cream Shop	Frozen Yogurt Shop	Spa	Souvlaki Shop
2	Astoria Heights	Hostel	Bakery	Deli / Bodega	Bus Station	Burger Joint	Playground	Bowling Alley	Supermarket	Gourmet Shop	Plaza	Gymnastics Gym	Dog Run	Fish & Chips Shop	Farmers Market	Home Service
3	Auburndale	Miscellaneous Shop	Train	Donut Shop	Noodle House	Supermarket	Discount Store	Ice Cream Shop	Toy / Game Store	Athletics & Sports	Deli / Bodega	Train Station	Gymnastics Gym	Mobile Phone Shop	Pet Store	Pharmacy
4	Bay Terrace	Clothing Store	Women's Store	Donut Shop	Lingerie Store	Cosmetics Shop	Mobile Phone Shop	Kids Store	Bus Stop	Movie Theater	Supermarket	Men's Store	Shopping Mall	Diner	Deli / Bodega	Sporting Goods Shop

- Using k-mean clustering algorithm grouped the neighborhoods according to similar type of venues (other than restaurants) into 5 clusters. Sample –

	Neighborhood	1st Most Common Venue	2nd Most Common Venue	3rd Most Common Venue	4th Most Common Venue	5th Most Common Venue	6th Most Common Venue	7th Most Common Venue	8th Most Common Venue	9th Most Common Venue	10th Most Common Venue
0	Astoria	Bar	Hookah Bar	Bakery	Pub	Deli / Bodega	Gym / Fitness Center	Gym	Grocery Store	Gourmet Shop	Salon / Barbershop
1	Woodside	Grocery Store	Bakery	Pub	Donut Shop	Bar	Deli / Bodega	Ice Cream Shop	Gym / Fitness Center	Sandwich Place	Gourmet Shop
2	Jackson Heights	Mobile Phone Shop	Bakery	Diner	Grocery Store	Shoe Store	Donut Shop	Kids Store	Pharmacy	Supplement Shop	Burger Joint
3	Elmhurst	Bubble Tea Shop	Snack Place	Park	Donut Shop	Food	Bar	Bank	Gym / Fitness Center	Salon / Barbershop	Ice Cream Shop
4	Howard Beach	Bagel Shop	Sandwich Place	Bank	Pharmacy	Fried Chicken Joint	Donut Shop	Spa	Supermarket	Event Space	Shipping Store
5	Corona	Bakery	Park	Convenience Store	Donut Shop	Ice Cream Shop	Deli / Bodega	Supermarket	Sandwich Place	Bus Station	Women's Store
7	Kew Gardens	Pet Store	Donut Shop	Bar	Bank	Park	Bridge	Bubble Tea Shop	Fish Market	Sandwich Place	Movie Theater
8	Richmond Hill	Lounge	Clothing Store	Donut Shop	Supermarket	Bank	Discount Store	Diner	Gym / Fitness Center	Sandwich Place	Pet Service
10	Long Island City	Hotel	Bar	Deli / Bodega	Donut Shop	Bus Station	Gym	General Entertainment	Mobile Phone Shop	Steakhouse	Burger Joint
11	Sunnyside	Hotel	Discount Store	Deli / Bodega	Bakery	Food Truck	Gym	Liquor Store	Taco Place	Bar	Grocery Store
13	Maspeth	Diner	Deli / Bodega	Mobile Phone Shop	Grocery Store	Bank	Discount Store	Bakery	Donut Shop	Supermarket	Lounge
14	Ridgewood	Deli / Bodega	Bank	Grocery Store	Playground	Bakery	Sandwich Place	Noodle House	Donut Shop	Supplement Shop	Mobile Phone Shop
16	Rego Park	Bakery	Grocery Store	Sandwich Place	Pharmacy	Donut Shop	Mobile Phone Shop	Diner	Liquor Store	Furniture / Home Store	Martial Arts Dojo
17	Woodhaven	Deli / Bodega	Pharmacy	Bank	Hookah Bar	Dive Bar	Mobile Phone Shop	Shoe Store	Bus Station	Sandwich Place	Supermarket
18	Ozone Park	Pharmacy	Diner	Gym	Bank	Sporting Goods Shop	Cosmetics Shop	Deli / Bodega	Department Store	Recreation Center	Donut Shop
19	South Ozone Park	Park	Deli / Bodega	Hotel	Food Truck	Sandwich Place	Grocery Store	Donut Shop	Bar	Diner	Discount Store
20	College Point	Deli / Bodega	Pharmacy	Sandwich Place	Sporting Goods Shop	Spa	Food Truck	Buffet	Farmers Market	Burrito Place	Bus Station
21	Whitestone	Moving Target	Bubble Tea Shop	Deli / Bodega	Train	Women's Store	Electronics Store	Flower Shop	Flea Market	Fish Market	Fish & Chips Shop
--	--	--	--	--	--	--	--	--	Fruit & Vegetable	--	--

- The 5 neighborhood venue clusters as generated by the algorithm are mapped using folium package with color coding –



Cluster 1:

	Neighborhood	1st Most Common Venue	2nd Most Common Venue	3rd Most Common Venue	4th Most Common Venue	5th Most Common Venue	6th Most Common Venue	7th Most Common Venue	8th Most Common Venue	9th Most Common Venue	10th Most Common Venue
9	Flushing	Bubble Tea Shop	Hotel	Bakery	Gym	Supermarket	Construction & Landscaping	Food Truck	Karaoke Bar	Gym / Fitness Center	Rental Service
12	East Elmhurst	Donut Shop	Indie Movie Theater	Supermarket	Lake	Bakery	Gas Station	Hotel Bar	Ice Cream Shop	Rental Car Location	Farm
31	Jamaica Center	Mobile Phone Shop	Clothing Store	Performing Arts Venue	Sandwich Place	Fried Chicken Joint	Donut Shop	Men's Store	Pharmacy	Sporting Goods Shop	Multiplex
52	Floral Park	Grocery Store	Hobby Shop	Basketball Court	Women's Store	Flower Shop	Flea Market	Fish Market	Fish & Chips Shop	Farmers Market	Farm
65	Bellair	Deli / Bodega	Convenience Store	Bus Station	Grocery Store	Laundromat	Moving Target	IT Services	Construction & Landscaping	Dance Studio	Event Space
66	North Corona	Deli / Bodega	Bakery	Gym / Fitness Center	Hotel Bar	Gym	Mobile Phone Shop	Museum	Hotel	Athletics & Sports	Food Truck
68	Jamaica Hills	Pharmacy	Donut Shop	Grocery Store	Fried Chicken Joint	Shopping Mall	Sandwich Place	Park	Breakfast Spot	Deli / Bodega	Pet Store

- Cluster 2:

	Neighborhood	1st Most Common Venue	2nd Most Common Venue	3rd Most Common Venue	4th Most Common Venue	5th Most Common Venue	6th Most Common Venue	7th Most Common Venue	8th Most Common Venue	9th Most Common Venue	10th Most Common Venue
6	Forest Hills	Gym	Yoga Studio	Gym / Fitness Center	Park	Pharmacy	Convenience Store	Deli / Bodega	Video Game Store	Snack Place	Food Truck
69	Utopia	Basketball Court	Deli / Bodega	Playground	Donut Shop	Paper / Office Supplies Store	Bus Stop	Bakery	Automotive Shop	Spa	Indie Movie Theater

- Cluster 3:

	Neighborhood	1st Most Common Venue	2nd Most Common Venue	3rd Most Common Venue	4th Most Common Venue	5th Most Common Venue	6th Most Common Venue	7th Most Common Venue	8th Most Common Venue	9th Most Common Venue	10th Most Common Venue
15	Glendale	Food & Drink Shop	Arts & Crafts Store	Liquor Store	Brewery	Women's Store	Event Space	Food	Flower Shop	Flea Market	Fish Market

Fourth Cluster

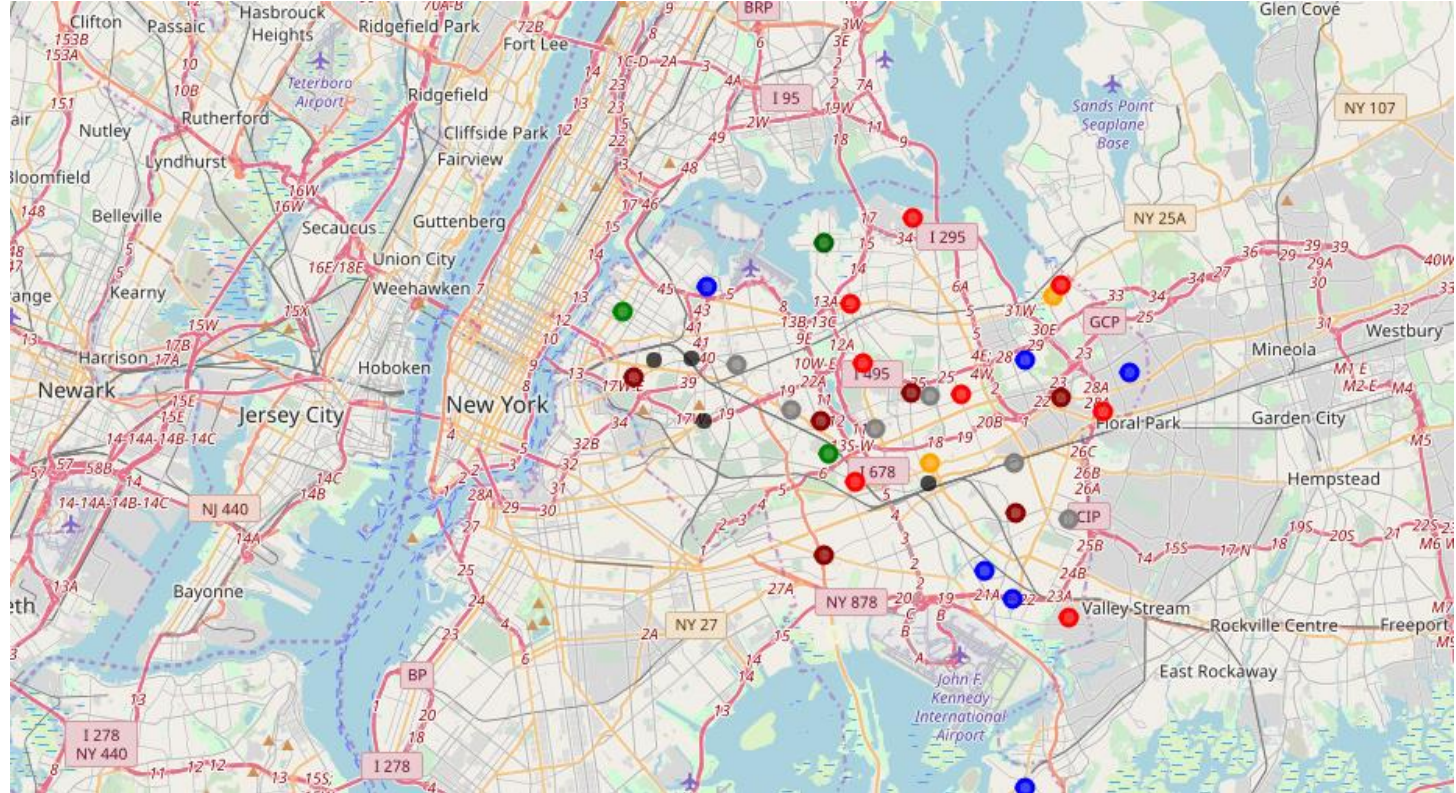
- Cluster 4:

	Neighborhood	1st Most Common Venue	2nd Most Common Venue	3rd Most Common Venue	4th Most Common Venue	5th Most Common Venue	6th Most Common Venue	7th Most Common Venue	8th Most Common Venue	9th Most Common Venue	10th Most Common Venue
48	Anverne	Surf Spot	Metro Station	Sandwich Place	Playground	Board Shop	Bed & Breakfast	Bus Stop	Beach	Donut Shop	Flea Market

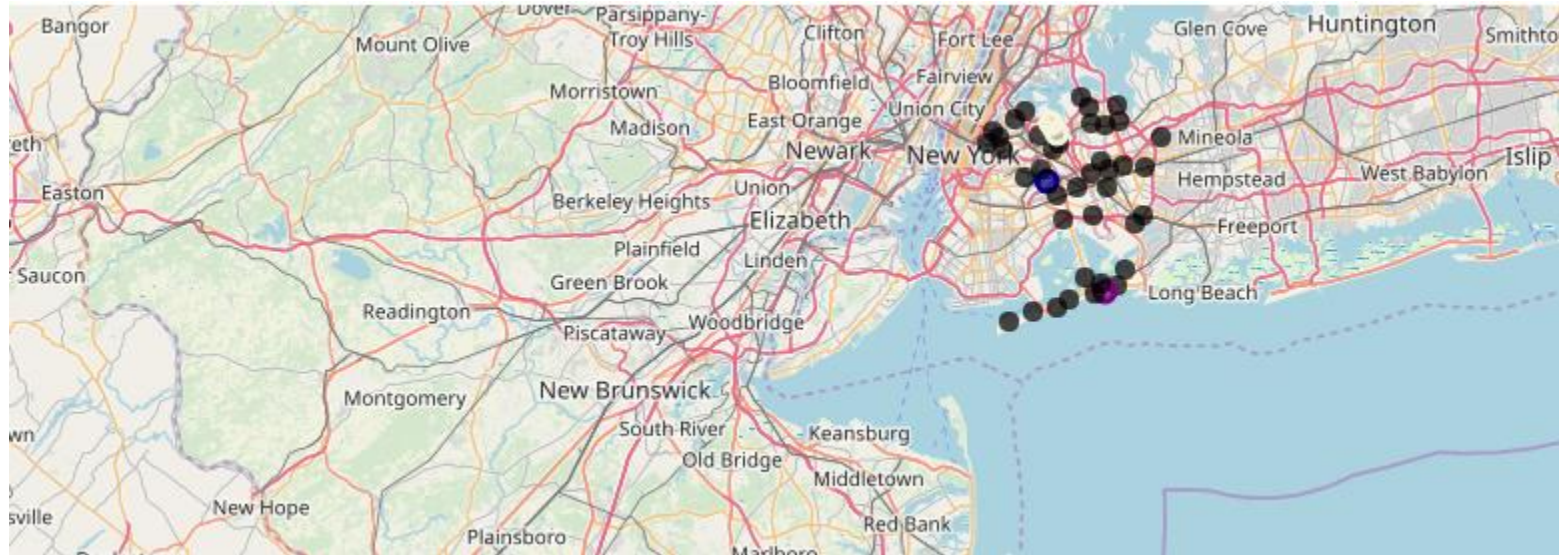
- Cluster 5:

	Neighborhood	1st Most Common Venue	2nd Most Common Venue	3rd Most Common Venue	4th Most Common Venue	5th Most Common Venue	6th Most Common Venue	7th Most Common Venue	8th Most Common Venue	9th Most Common Venue	10th Most Common Venue
0	Astoria	Bar	Hookah Bar	Bakery	Pub	Deli / Bodega	Gym / Fitness Center	Gym	Grocery Store	Gourmet Shop	Salon / Barbershop
1	Woodside	Grocery Store	Bakery	Pub	Donut Shop	Bar	Deli / Bodega	Ice Cream Shop	Gym / Fitness Center	Sandwich Place	Gourmet Shop
2	Jackson Heights	Mobile Phone Shop	Bakery	Diner	Grocery Store	Shoe Store	Donut Shop	Kids Store	Pharmacy	Supplement Shop	Burger Joint
3	Elmhurst	Bubble Tea Shop	Snack Place	Park	Donut Shop	Food	Bar	Bank	Gym / Fitness Center	Salon / Barbershop	Ice Cream Shop
4	Howard Beach	Bagel Shop	Sandwich Place	Bank	Pharmacy	Fried Chicken Joint	Donut Shop	Spa	Supermarket	Event Space	Shipping Store
5	Corona	Bakery	Park	Convenience Store	Donut Shop	Ice Cream Shop	Deli / Bodega	Supermarket	Sandwich Place	Bus Station	Women's Store
7	Kew Gardens	Pet Store	Donut Shop	Bar	Bank	Park	Bridge	Bubble Tea Shop	Fish Market	Sandwich Place	Movie Theater
8	Richmond Hill	Lounge	Clothing Store	Donut Shop	Supermarket	Bank	Discount Store	Diner	Gym / Fitness Center	Sandwich Place	Pet Service
10	Long Island City	Hotel	Bar	Deli / Bodega	Donut Shop	Bus Station	Gym	General Entertainment	Mobile Phone Shop	Steakhouse	Burger Joint
11	Sunnyside	Hotel	Discount Store	Deli / Bodega	Bakery	Food Truck	Gym	Liquor Store	Taco Place	Bar	Grocery Store
13	Maspeth	Diner	Deli / Bodega	Mobile Phone Shop	Grocery Store	Bank	Discount Store	Bakery	Donut Shop	Supermarket	Lounge
14	Ridgewood	Deli / Bodega	Bank	Grocery Store	Playground	Bakery	Sandwich Place	Noodle House	Donut Shop	Supplement Shop	Mobile Phone Shop
16	Rego Park	Bakery	Grocery Store	Sandwich Place	Pharmacy	Donut Shop	Mobile Phone Shop	Diner	Liquor Store	Furniture / Home Store	Martial Arts Dojo
17	Woodhaven	Deli / Bodega	Pharmacy	Bank	Hookah Bar	Dive Bar	Mobile Phone Shop	Shoe Store	Bus Station	Sandwich Place	Supermarket
18	Ozone Park	Pharmacy	Diner	Gym	Bank	Sporting Goods Shop	Cosmetics Shop	Deli / Bodega	Department Store	Recreation Center	Donut Shop
19	South Ozone Park	Park	Deli / Bodega	Hotel	Food Truck	Sandwich Place	Grocery Store	Donut Shop	Bar	Diner	Discount Store
20	College Point	Deli / Bodega	Pharmacy	Sandwich Place	Sporting Goods Shop	Spa	Food Truck	Buffet	Farmers Market	Burrito Place	Bus Station
21	Whitestone	Moving Target	Bubble Tea Shop	Deli / Bodega	Train	Women's Store	Electronics Store	Flower Shop	Flea Market	Fish Market	Fish & Chips Shop
22	Flushing Meadows Corona Park	Bar	Bank	Convenience Store	Donut Shop	Ice Cream Shop	Deli / Bodega	Supermarket	Sandwich Place	Bus Station	Women's Store

- Next, an input is requested from the user to specify which type of new restaurant is of interest
- Once the input is provided the recommender system checks for the presence of that specific restaurant type in top 5 category for each neighborhoods and plot on the map the neighborhoods-

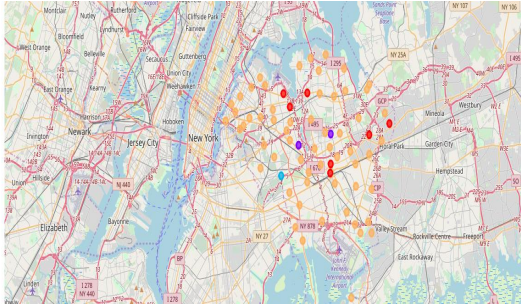


- Next it suggests the neighborhoods where it's a best fit for opening the specific type of restaurant –
- The user visually looking on the 3 maps can decide which will be the best place to open the new restaurant.

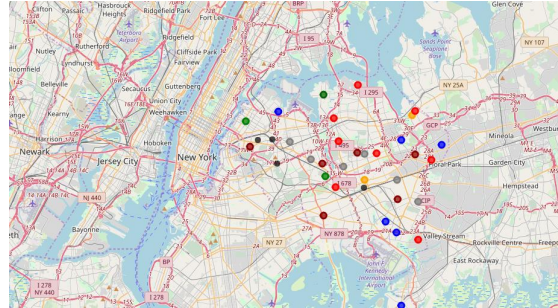


RESULTS

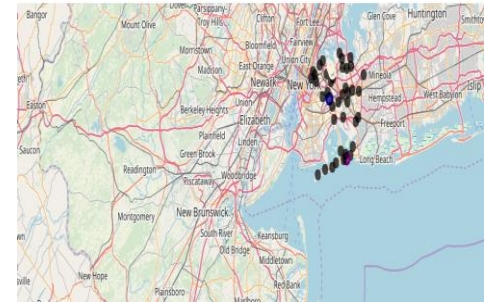
Using the combination of visual guide from the maps and top venues in each cluster one can make an informed decision on which area is best for opening a new restaurant. The below maps are for new restaurant type – Chinese



Neighborhood Clusters



Neighborhood with Chinese Restaurants



Proposed neighborhoods for new one

OBSERVATION

- The top 10 venues provide an idea of how diverse the Queens area is in New York City.
- The clustering provides an insight of the similarities in the neighborhoods.

CONCLUSION

I can conclude that using the location data from Foresquare along with Machine Learning algorithm we can design a system that will help to guide small business owners to make informative decision on which is the best neighborhood to a new restaurant.