

# **BANK EXPANSION**

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## **INTRODUCTION:**

An integrated business group “Alpha Group” based in Toronto entered into Banking sector by opening the first branch in North York borough back in 2017 with the name of “Alpha Bank Limited”. Now after gaining enough experience of 02 years, they are planning to expand their banking business by opening new branches. The first branch is located in the neighborhood of Glencairn.

Alpha Group has scheduled their expansion in three phases. In the first phase, they are planning to open 03 more branches in the same borough of North York. In the second phase, they will move to other boroughs of Toronto while in the third phase, they will target other commercial cities of Canada.

The scope of this project is limited till the first phase i.e. expansion within the North York borough. Given the successful results of the first branch which is located in the largest borough of Toronto with maximum number of commercial venues, the objective is to identify neighborhood with similar nature and same commercial structure as of neighborhood of Glencairn in order to ensure the reduced risk of the first phase. While the location of the 03 banks to be decided in a way to cover the entire territory of North York.

## **DATA ACQUISITION:**

Data requirement of this project includes list of all boroughs and all associated neighborhoods along with their locations in terms of Longitudes and Latitudes in order to visualize their location on Toronto Map. In addition, a comprehensive data of commercial venues is required particularly for the borough of North York such as number of restaurants, shops, educational institutes, corporates offices etc. This data is inevitable for this project and will be accessed through Foursquare.

## **METHODOLOGY:**

Methodology includes collecting information of all boroughs of city of Toronto along with their postal code and neighborhood. Imported data is given in the table below:

	PostalCode	Borough	Neighbourhood
0	M1A	Not assigned	Not assigned
1	M2A	Not assigned	Not assigned
2	M3A	North York	Parkwoods
3	M4A	North York	Victoria Village
4	M5A	Downtown Toronto	Regent Park, Harbourfront
...	...	...	...
175	M5Z	Not assigned	Not assigned
176	M6Z	Not assigned	Not assigned
177	M7Z	Not assigned	Not assigned
178	M8Z	Etobicoke	Mimico NW, The Queensway West, South of Bloor,...
179	M9Z	Not assigned	Not assigned

The next step involved data cleansing in which all the table rows were deleted with borough “Not assigned”. The modified table after performing this step is given below:

	PostalCode	Borough	Neighbourhood
0	M3A	North York	Parkwoods
1	M4A	North York	Victoria Village
2	M5A	Downtown Toronto	Regent Park, Harbourfront
3	M6A	North York	Lawrence Manor, Lawrence Heights
4	M7A	Downtown Toronto	Queen's Park, Ontario Provincial Government
...	...	...	...
98	M8X	Etobicoke	The Kingsway, Montgomery Road, Old Mill North
99	M4Y	Downtown Toronto	Church and Wellesley
100	M7Y	East Toronto	Business reply mail Processing Centre, South C...
101	M8Y	Etobicoke	Old Mill South, King's Mill Park, Sunnylea, Hu...
102	M8Z	Etobicoke	Mimico NW, The Queensway West, South of Bloor,...

The next step included further data refinement by importing data of neighborhood longitude and latitude and adding it to the above table as shown below:

PostalCode		Borough	Neighbourhood	Latitude	Longitude
0	M3A	North York	Parkwoods	43.753259	-79.329656
1	M4A	North York	Victoria Village	43.725882	-79.315572
2	M5A	Downtown Toronto	Regent Park, Harbourfront	43.654260	-79.360636
3	M6A	North York	Lawrence Manor, Lawrence Heights	43.718518	-79.464763
4	M7A	Downtown Toronto	Queen's Park, Ontario Provincial Government	43.662301	-79.389494
...	...	...	...	...	...
98	M8X	Etobicoke	The Kingsway, Montgomery Road, Old Mill North	43.653654	-79.506944
99	M4Y	Downtown Toronto	Church and Wellesley	43.665860	-79.383160
100	M7Y	East Toronto	Business reply mail Processing Centre, South C...	43.662744	-79.321558
101	M8Y	Etobicoke	Old Mill South, King's Mill Park, Sunnylea, Hu...	43.636258	-79.498509
102	M8Z	Etobicoke	Mimico NW, The Queensway West, South of Bloor,...	43.628841	-79.520999

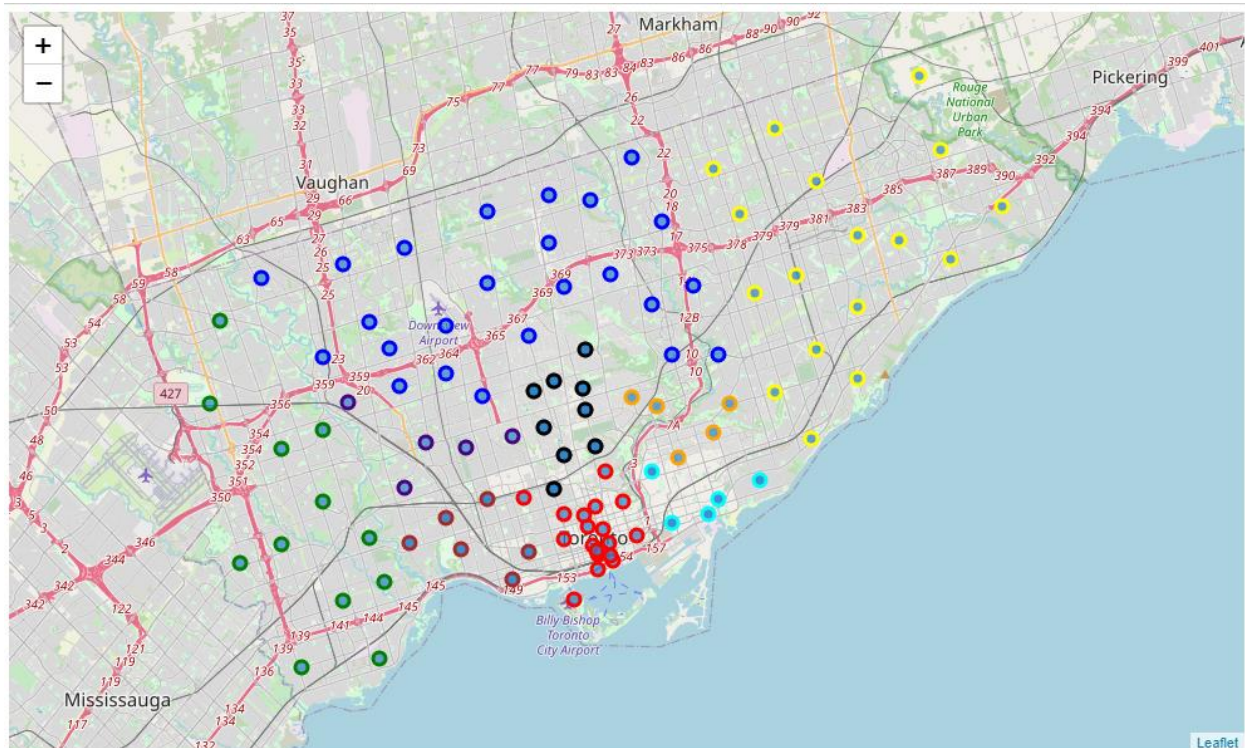
A visual description of above data is given below:



The first branch is located in the borough of North York. This is the largest borough of Toronto in terms of maximum number of neighborhoods as shown below:

Borough	Count
North York	24
Downtown Toronto	19
Scarborough	17
Etobicoke	12
Central Toronto	9
West Toronto	6
East York	5
York	5
East Toronto	5
Mississauga	1

There are 10 boroughs in Toronto, each represented by different colors in the map below. North York is represented in **BLUE**:



The description of all neighborhoods of the North York borough is given in the table below:

	PostalCode	Borough	Neighbourhood	Latitude	Longitude
0	M3A	North York	Parkwoods	43.753259	-79.329656
1	M4A	North York	Victoria Village	43.725882	-79.315572
2	M6A	North York	Lawrence Manor, Lawrence Heights	43.718518	-79.464763
3	M3B	North York	Don Mills	43.745906	-79.352188
4	M6B	North York	Glencairn	43.709577	-79.445073
5	M3C	North York	Don Mills	43.725900	-79.340923
6	M2H	North York	Hillcrest Village	43.803762	-79.363452
7	M3H	North York	Bathurst Manor, Wilson Heights, Downsview North	43.754328	-79.442259
8	M2J	North York	Fairview, Henry Farm, Oriole	43.778517	-79.346556
9	M3J	North York	Northwood Park, York University	43.767980	-79.487262
10	M2K	North York	Bayview Village	43.786947	-79.385975
11	M3K	North York	Downsview	43.737473	-79.464763
12	M2L	North York	York Mills, Silver Hills	43.757490	-79.374714
13	M3L	North York	Downsview	43.739015	-79.506944
14	M6L	North York	North Park, Maple Leaf Park, Upwood Park	43.713756	-79.490074
15	M9L	North York	Humber Summit	43.756303	-79.565963
16	M2M	North York	Willowdale, Newtonbrook	43.789053	-79.408493
17	M3M	North York	Downsview	43.728496	-79.495697
18	M5M	North York	Bedford Park, Lawrence Manor East	43.733283	-79.419750
19	M9M	North York	Humberlea, Emery	43.724766	-79.532242
20	M2N	North York	Willowdale, Willowdale East	43.770120	-79.408493
21	M3N	North York	Downsview	43.761631	-79.520999
22	M2P	North York	York Mills West	43.752758	-79.400049
23	M2R	North York	Willowdale, Willowdale West	43.782736	-79.442259

The next step included importing all venues data of all 24 neighborhoods from Foursquare within the radius of 1500m. The table below shows the number of venues in each neighborhood:

Neighbourhood	Neighbourhood Latitude	Neighbourhood Longitude	Venue	Venue Latitude	Venue Longitude	Venue Category
Bathurst Manor, Wilson Heights, Downsview North	40	40	40	40	40	40
Bayview Village	16	16	16	16	16	16
Bedford Park, Lawrence Manor East	75	75	75	75	75	75
Don Mills	175	175	175	175	175	175
Downsview	105	105	105	105	105	105
Fairview, Henry Farm, Oriole	63	63	63	63	63	63
Glencairn	56	56	56	56	56	56
Hillcrest Village	46	46	46	46	46	46
Humber Summit	20	20	20	20	20	20
Humberlea, Emery	19	19	19	19	19	19
Lawrence Manor, Lawrence Heights	100	100	100	100	100	100
North Park, Maple Leaf Park, Upwood Park	33	33	33	33	33	33
Northwood Park, York University	45	45	45	45	45	45
Parkwoods	35	35	35	35	35	35
Victoria Village	53	53	53	53	53	53
Willowdale, Newtonbrook	75	75	75	75	75	75
Willowdale, Willowdale East	100	100	100	100	100	100
Willowdale, Willowdale West	37	37	37	37	37	37
York Mills West	88	88	88	88	88	88
York Mills, Silver Hills	66	66	66	66	66	66

The venues were then segregated against each neighborhood and transformed in terms of their mean values of occurrence as shown below:

	Neighbourhood	Accessories Store	Airport	American Restaurant	Argentinian Restaurant	Art Gallery	Arts & Crafts Store	Asian Restaurant	Athletics & Sports	BBQ Joint	...	Turkish Restaurant	Udon Restaurant	Video Game Store
0	Bathurst Manor, Wilson Heights, Downsview North	0.00	0.000000	0.025000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	...	0.000000	0.00	0.000000
1	Bayview Village	0.00	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.062500	0.000000	...	0.000000	0.00	0.000000
2	Bedford Park, Lawrence Manor East	0.00	0.000000	0.013333	0.000000	0.000000	0.000000	0.028887	0.000000	0.013333	...	0.000000	0.00	0.000000
3	Don Mills	0.00	0.000000	0.011429	0.000000	0.005714	0.000000	0.017143	0.000000	0.000000	...	0.000000	0.00	0.000000
4	Downsview	0.00	0.009524	0.009524	0.000000	0.000000	0.009524	0.000000	0.028571	0.000000	...	0.028571	0.00	0.000000
5	Fairview, Henry Farm, Oriole	0.00	0.000000	0.015873	0.000000	0.000000	0.000000	0.015873	0.000000	0.000000	...	0.000000	0.00	0.015873
6	Glencairn	0.00	0.000000	0.000000	0.017857	0.000000	0.000000	0.000000	0.000000	0.000000	...	0.000000	0.00	0.000000
7	Hillcrest Village	0.00	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	...	0.000000	0.00	0.000000
8	Humber Summit	0.00	0.000000	0.000000	0.000000	0.000000	0.000000	0.100000	0.000000	0.000000	...	0.000000	0.00	0.000000
9	Humberlea, Emery	0.00	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	...	0.000000	0.00	0.000000
10	Lawrence Manor, Lawrence Heights	0.01	0.000000	0.020000	0.000000	0.000000	0.000000	0.000000	0.010000	0.000000	...	0.020000	0.00	0.000000
11	North Park, Maple Leaf Park, Upwood Park	0.00	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.030303	0.000000	...	0.000000	0.00	0.000000
12	Northwood Park, York University	0.00	0.000000	0.044444	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	...	0.000000	0.00	0.000000
13	Parkwoods	0.00	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.028571	...	0.000000	0.00	0.000000
14	Victoria Village	0.00	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.018888	...	0.000000	0.00	0.000000
15	Willowdale, Newtonbrook	0.00	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	...	0.000000	0.00	0.000000
16	Willowdale, Willowdale East	0.00	0.000000	0.010000	0.000000	0.000000	0.010000	0.000000	0.000000	0.000000	...	0.000000	0.01	0.000000
17	Willowdale, Willowdale West	0.00	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	...	0.000000	0.00	0.000000
18	York Mills West	0.00	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	...	0.000000	0.00	0.000000
19	York Mills, Silver Hills	0.00	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	...	0.000000	0.00	0.000000



The next step includes cluster analysis in order to identify neighborhoods of same commercial nature as of Glencairn based on the type of venues located in each neighborhood. This was achieved through unsupervised learning approach using k-means algorithm. The neighborhoods are characterized in 5 clusters. The results of cluster analysis are mentioned in the next section.

## RESULTS:

The neighborhoods were divided into 05 clusters (0, 1, 2, 3, 4) based on the similarity of the nature of venues as shown in table below:

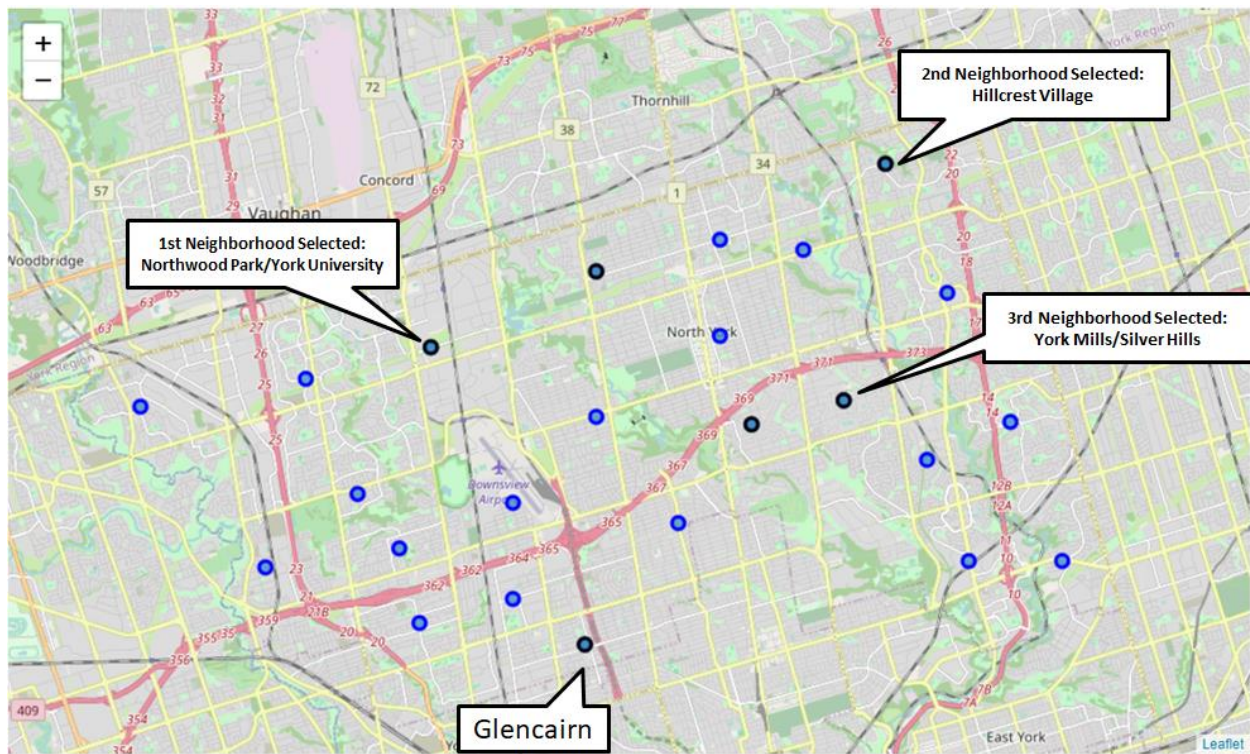
Neighbourhood Cluster Labels		
Ind		
0	Bathurst Manor, Wilson Heights, Downsview North	2
1	Bayview Village	3
2	Bedford Park, Lawrence Manor East	2
3	Don Mills	2
4	Downsview	2
5	Fairview, Henry Farm, Oriole	2
6	Glencairn	0
7	Hillcrest Village	0
8	Humber Summit	1
9	Humberlea, Emery	2
10	Lawrence Manor, Lawrence Heights	2
11	North Park, Maple Leaf Park, Upwood Park	2
12	Northwood Park, York University	0
13	Parkwoods	2
14	Victoria Village	2
15	Willowdale, Newtonbrook	4
16	Willowdale, Willowdale East	4
17	Willowdale, Willowdale West	0
18	York Mills West	0
19	York Mills, Silver Hills	0

As seen in the table above, neighborhood Glencairn is related to cluster 0. Overall number of neighborhoods belonging to the same cluster are 06 including Glencairn. The table below shows neighborhoods belonging to cluster 0.

	Neighbourhood	Cluster Labels	Neighbourhood Latitude	Neighbourhood Longitude
0	Glencairn	0	43.709577	-79.445073
1	Hillcrest Village	0	43.803762	-79.363452
2	Northwood Park, York University	0	43.767980	-79.487262
3	Willowdale, Willowdale West	0	43.782736	-79.442259
4	York Mills West	0	43.752758	-79.400049
5	York Mills, Silver Hills	0	43.757490	-79.374714

## DISCUSSION:

Clearly there are 05 more potential neighborhoods which are candidates of being selected for opening new branches. Since 03 bank branches are required to be opened therefore out of 05 neighborhoods, 03 are to be selected. The 03 locations are therefore selected in a way that they cover the entire territory of New York borough in order to maximize exposure to all commercial venues. In the figure below, the neighborhoods belonging to cluster 0 are mentioned in black with additional marking of selected neighborhoods.



**Selected neighborhoods are Northwood Park/York University, Hillcrest Village and York Mills/Silver Hills.**

## CONCLUSION:

The above mentioned neighborhoods were selected based on their similarity with Glencairn where first branch is already established. The second and third phase, in which Alpha Group will be stepping into others boroughs and other cities should be based on the same clustering approach.