Project Report

Capstone Project- The Battle of Neighborhoods

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1. Introduction / Business Problem

1.1 Introduction

Toronto, the most populous city in Canada is the capital of the province of Ontario. It is a major Canadian city along Lake Ontario's northwestern shore. It is a dynamic metropolis with a core of soaring skyscrapers, all dwarfed by the iconic, free-standing CN Tower. Toronto has, in recent decades, been transformed into one of the most culturally and ethnically diverse cities in the world. More than 80 ethnic communities are represented, and over half of the city's residents were born outside Canada.

Multicultural Toronto is home to a culinary wonderland of many cuisines and dishes unique to the city. Toronto's plethora of ethnic food places is a direct result of its multiculturalism. Indian cuisine has always been one of the most popular cuisines not only among the resident population but also among the tourists visiting this city.

1.2 Business Problem

With the amount of popularity that this cuisine has gained over the period of time and especially in the city of Toronto, Indian restaurants are also gaining popularity from a business perspective. If you are someone looking to start your own Indian restaurant, then this information is for you. There are several aspects to be considered when starting a new business, we will be focusing on a few aspects here.

The success of any business, especially a restaurant, is heavily dependent on its location. The area has to be convenient and safe for the public. One of the other important factors is competition from existing peers. Fierce competition can be a great entry barrier and should be avoided as much as possible. So, an area where there is a scarcity of Indian restaurants would be preferred.

This final project is directed towards finding a best neighborhood in Toronto based on its location, rating and most important, in my opinion, considering the safety of that neighborhood.

1.3 Target Audience

The organizations, individuals and group of people who would be using and be benefited from this project are:

1. Any organization or individual that wants to setup a new Indian restaurant or want to expand their footprint in Toronto area.
2. Foodies who are looking for areas with best options for Indian cuisine based on ratings.
3. People who are looking for neighborhoods with higher number of Indian restaurants.

2. Data and Data Sources

For this project we will need the following data:

1. List of Postal Codes in Toronto area along with the Boroughs and Neighborhoods they belong to.

This data set contains list of Postal Codes and corresponding Boroughs and Neighborhoods in Toronto area. This dataset will be merged with other dataset that contains geospatial co-ordinates of various postal codes in Toronto to obtain Latitude & Longitude for each Neighborhood.

Link: https://en.wikipedia.org/wiki/List_of_postal_codes_of_Canada:_M

2. List of postal codes in Toronto area along with their latitude and longitude.

This data set contains geospatial co-ordinates of various postal codes in Toronto. This dataset will be merged with other dataset that contains list of Postal Codes and corresponding Boroughs and Neighborhoods in Toronto to obtain Latitude & Longitude for each Neighborhood.

Link: http://cocl.us/Geospatial_data

3. Current footprint of Indian restaurants in each neighborhood of Toronto area.

This information will be gathered by marking a call to FourSquare API to fetch venues around each neighborhood within certain radius. We will then filter this dataset to get information about only Indian restaurants.

Link: https://developer.foursquare.com/docs/api-reference/venues/search/

4. **Recent Crime Data in Toronto neighborhoods.**

This dataset contains Toronto Police Data for Years 2014 through 2019. It provides information about what type of offenses were reported along with their location and type of premise where the crimes were committed.

Link: https://www.kaggle.com/kapastor/toronto-police-data-crime-rates-by-neighbourhood

3. Problems to be solved with the help of above data

- Which boroughs & neighborhoods in Toronto have ample of Indian Restaurants and which areas they are scarce?
- Based on the ratings, which boroughs & neighborhoods have the best Indian Restaurants in Toronto?
- In order to find a safer location for a new restaurant, which boroughs & neighborhoods have least crime rate in commercial premises?
- Considering above factors, what is the recommended location to setup a new Indian Restaurant in Toronto?

4. Approach

1. Build a dataset of boroughs & neighborhoods in Toronto area along with their geospatial coordinates.
2. Using FourSquare Venue API, get list of all venues within half a mile radius for each neighborhood.
3. Filter this list to build a dataset of only the Indian Restaurants in each neighborhood.
4. Analyze above dataset to find boroughs & neighborhoods with the greatest number of Indian Restaurants & least number of Indian Restaurants.
5. Using FourSquare Venue Details API, get details for each restaurant such as rating, tips and number of likes.
6. Sort the list of restaurants by ratings and identify the boroughs & neighborhoods that have the best Indian Restaurants.
7. Create a map of Toronto area to visualize the neighborhoods that have the best Indian Restaurants.
8. Build a dataset of crimes committed in Toronto area in year 2019 with details such as Borough, Neighborhood, type of offence and type of premise.
9. Filter this dataset to get information about crimes committed only in Commercial premises.
10. Analyze the above dataset and identify the boroughs & neighborhoods that have least crime rate in commercial premises.
11. Considering the above data holistically, recommended a location to setup a new Indian Restaurant in Toronto.

5. Methodology

5.1 Build a dataset of boroughs & neighborhoods in Toronto area along with their geospatial coordinates

Scraping the raw data (Wikipedia page) to build a dataframe of postal codes, boroughs & neighborhoods in Toronto.

In [2]:
```
raw_data = requests.get("https://en.wikipedia.org/wiki/List_of_postal_codes_of_Canada:_M").text
soup = BeautifulSoup(raw_data, 'xml')

table = soup.find("table")
table_rows = table.tbody.find_all("tr")


res = []
for tr in table_rows:
    td = tr.find_all("td")
    row = [tr.text for tr in td]

    # Cleaning up the data by ignoring cells with a borough that is Not assigned.
    if row != [] and row[1] != "Not assigned\n":
        row[2] = row[2].split(",")[0]
        # Assigning neighborhood to be the same as the borough, when a cell has a borough but a "Not assigned" neighborhood.
        if "Not assigned" in row[2]:
            row[2] = row[1]
        res.append(row)

# Creating a Dataframe with 3 columns
df = pd.DataFrame(res, columns = ["PostalCode", "Borough", "Neighborhood"])
df["PostalCode"] = df["PostalCode"].str.replace("\n","")
df["Borough"] = df["Borough"].str.replace("\n","")
df["Neighborhood"] = df["Neighborhood"].str.replace("\n","")
df.head()
```

Out[2]:

	PostalCode	Borough	Neighborhood
0	M3A	North York	Parkwoods
1	M4A	North York	Victoria Village
2	M5A	Downtown Toronto	Regent Park
3	M6A	North York	Lawrence Manor
4	M7A	Downtown Toronto	Queen's Park

Getting the latitude and the longitude co-ordinates of each neighborhood

In [3]:
```
df_geo_coordinates = pd.read_csv('http://cocl.us/Geospatial_data')
df_geo_coordinates.head()
```

Out[3]:

	Postal Code	Latitude	Longitude
0	M1B	43.806686	-79.194353
1	M1C	43.784535	-79.160497
2	M1E	43.763573	-79.188711
3	M1G	43.770992	-79.216917
4	M1H	43.773136	-79.239476

Combining the dataframe for neighborhood data with dataframe for geographical coordinates of each postal code to get final data frame

In [4]:
```
df_neighb_geo = pd.merge(df, df_geo_coordinates, how='left', left_on = 'PostalCode', right_on = 'Postal Code')

# removing the "Postal Code" columns
df_neighb_geo.drop(["Postal Code","PostalCode"], axis=1, inplace=True)

# as the postal code column was dropped, it would create duplicate records few boroughs & neighborhoods that had mutiple postal codes associated
#dropping the duplicates
df_neighb_geo=df_neighb_geo.drop_duplicates(subset=['Borough', 'Neighborhood'])
df_neighb_geo.head()
```

Out[4]:

	Borough	Neighborhood	Latitude	Longitude
0	North York	Parkwoods	43.753259	-79.329656
1	North York	Victoria Village	43.725882	-79.315572
2	Downtown Toronto	Regent Park	43.654260	-79.360636
3	North York	Lawrence Manor	43.718518	-79.464763
4	Downtown Toronto	Queen's Park	43.662301	-79.389494

5.2 Get list of all venues within half a mile radius for each neighborhood

Let's define a function to get top 100 venues within a radius of 800 meters (roughly 1/2 mile) around a given latitude and longitude using FourSquare API. Below function will return a dataframe containing the venue ID, venue name and category.

In [5]:
```
def get_venues_foursq(lat,long):

    #setting up parameters to call foursquare api
    radius=800 #roughly 1/2 mile
    LIMIT=100
    CLIENT_ID = 'EKAARII0A5OS21BF4HLAILPFX4AGU5YZD32CW2PR0IWCR2EZ' # Foursquare ID
    CLIENT_SECRET = 'JHRKVXOZLOG1U42NTUBKJU1X3UNQMNX10OOMUIYKGFKLWXD2' # Foursquare Secret
    VERSION = '20180605' # Foursquare API version

    #call foursquare api to get top 100 venues within a radius of 800 meters around a given latitude and longitude
    url = 'https://api.foursquare.com/v2/venues/explore?&client_id={}&client_secret={}&v={}&ll={},{}&radius={}&limit={}'.format(
            CLIENT_ID,
            CLIENT_SECRET,
            VERSION,
            lat,
            long,
            radius,
            LIMIT)

    # get the result to a json file
    results = requests.get(url).json()

    #read the json file and convert it to a list
    venues=results["response"]['groups'][0]['items']
    venue_list=[]
    for row in venues:
        try:
            venue_id=row['venue']['id']
            venue_name=row['venue']['name']
            venue_category=row['venue']['categories'][0]['name']
            venue_list.append([venue_id,venue_name,venue_category])
        except KeyError:
            pass

    df = pd.DataFrame(venue_list,columns=['ID','Name','Category'])
    return df
```

5.3 Filter this list to build a dataset of only the Indian Restaurants in each neighborhood.

Building a dataframe of neighborhood that contains Indian restaurants.

In [6]:
```
toronto_indian_rest=pd.DataFrame(columns=['Borough', 'Neighborhood', 'ID','Name'])
count=1
for row in df_neighb_geo.values.tolist():
    Borough, Neighborhood, Latitude, Longitude=row
    venues = get_venues_foursq(Latitude,Longitude)
    indian_restaurants=venues[venues['Category']=='Indian Restaurant']
    print(Neighborhood+', '+ Borough+ ' has '+str(len(indian_restaurants))+' indian restaurants ')
    for resturant_detail in indian_restaurants.values.tolist():
        id, name , category=resturant_detail
        toronto_indian_rest = toronto_indian_rest.append({'Borough': Borough,
                                                'Neighborhood': Neighborhood,
                                                'ID': id,
                                                'Name' : name
                                               }, ignore_index=True)
    count+=1
```

```
Parkwoods, North York has 0 indian restaurants
Victoria Village, North York has 0 indian restaurants
Regent Park, Downtown Toronto has 0 indian restaurants
Lawrence Manor, North York has 0 indian restaurants
Queen's Park, Downtown Toronto has 1 indian restaurants
Islington Avenue, Etobicoke has 0 indian restaurants
Malvern, Scarborough has 0 indian restaurants
Don Mills, North York has 0 indian restaurants
Parkview Hill, East York has 0 indian restaurants
Garden District, Downtown Toronto has 0 indian restaurants
Glencairn, North York has 0 indian restaurants
West Deane Park, Etobicoke has 0 indian restaurants
Rouge Hill, Scarborough has 0 indian restaurants
Woodbine Heights, East York has 0 indian restaurants
St. James Town, Downtown Toronto has 0 indian restaurants
Humewood-Cedarvale, York has 0 indian restaurants
Eringate, Etobicoke has 0 indian restaurants
Guildwood, Scarborough has 0 indian restaurants
The Beaches, East Toronto has 1 indian restaurants
Berczy Park, Downtown Toronto has 0 indian restaurants
Caledonia-Fairbanks, York has 0 indian restaurants
Woburn, Scarborough has 0 indian restaurants
Leaside, East York has 1 indian restaurants
Central Bay Street, Downtown Toronto has 0 indian restaurants
Christie, Downtown Toronto has 2 indian restaurants
```

In [7]:
```
toronto_indian_rest.head()
```

Out[7]:

	Borough	Neighborhood	ID	Name
0	Downtown Toronto	Queen's Park	4bedf8b5e24d20a17b567214	Kothur Indian Cuisine
1	East Toronto	The Beaches	4dcd7c6352b1f8915b7e7f7e	Delhi Bistro
2	East York	Leaside	504bcf32e4b0ef19b0e2ecf8	Mt Everest Restaurant
3	Downtown Toronto	Christie	4adb969ef964a520332921e3	Banjara Indian Cuisine
4	Downtown Toronto	Christie	4b7369d7f964a52049ad2de3	Madras Masala

In [8]:
```
toronto_indian_rest.shape
```

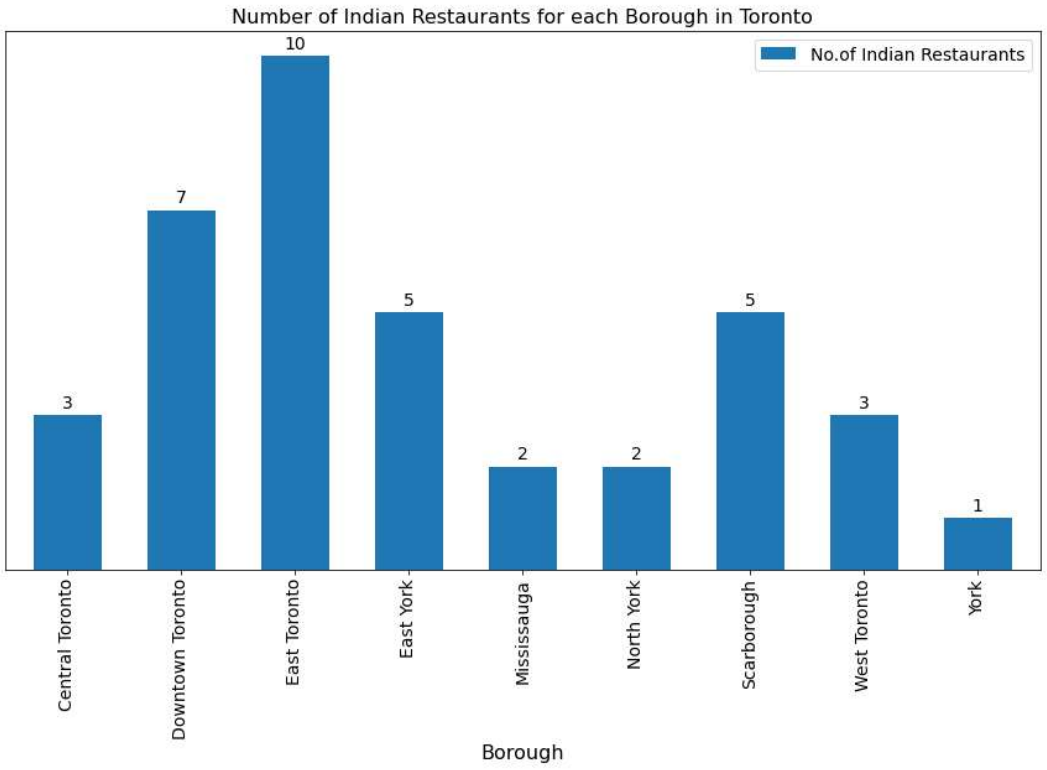
Out[8]: (38, 4)

From the above information we get that, there are total 38 Indian Restaurants around half a mile radius of neighborhoods in Toronto.

5.4 Analyze above dataset to find boroughs & neighborhoods with the greatest number of Indian Restaurants & least number of Indian Restaurants.

Let's create a plot of Number of Indian Restaurants for each Borough in Toronto.

In [16]:
```
# grouping the data by boroughs
toronto_indian_rest_b=toronto_indian_rest.groupby('Borough')['ID'].count()

#creating a plot
ax = toronto_indian_rest_b.plot.bar(rot=90,figsize=(15, 8),color="tab:blue",width=0.6,fontsize=14)
plt.title(label="Number of Indian Restaurants for each Borough in Toronto",fontdict={'fontsize':"16"} )
plt.legend(['No.of Indian Restaurants'],loc='upper right', fontsize=14)
plt.xlabel('Borough', fontsize = 16)
ax.get_yaxis().set_visible(False)
for p in ax.patches:
    ax.annotate(format(p.get_height(), '.0f'),
                (p.get_x() + p.get_width() / 2., p.get_height()),
                ha = 'center', va = 'center',
                size=14,
                xytext = (0, 10),
                textcoords = 'offset points')
```



From the above plot, we can tell that **East Toronto & Downtown Toronto** have large number of Indian restaurants and **York & Central Toronto** have least number of Indian restaurants.

Let's take a glimpse of Indian restaurants in 'East Toronto' borough

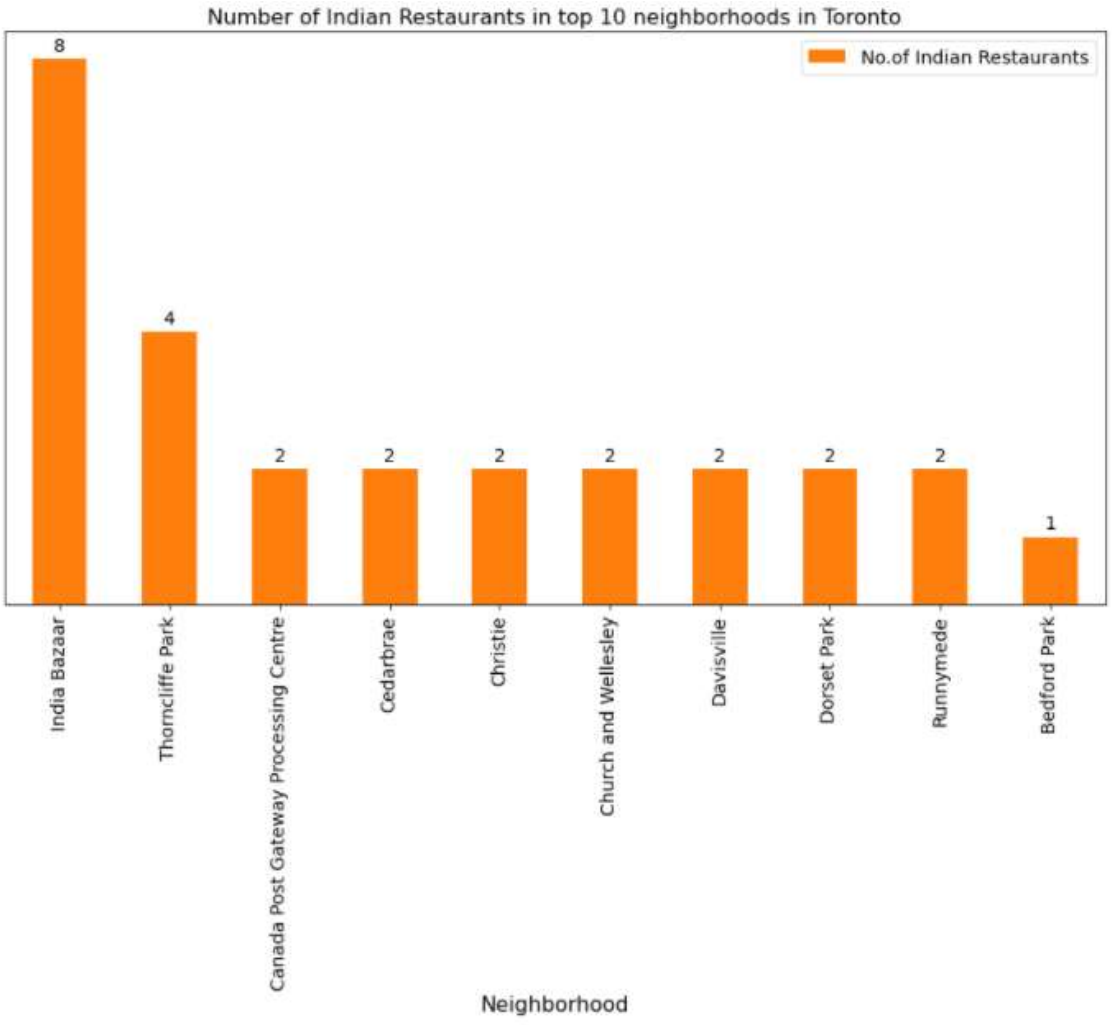
```
In [15]: toronto_indian_rest[toronto_indian_rest['Borough']=='East Toronto']
```

Out[15]:

	Borough	Neighborhood	ID	Name
1	East Toronto	The Beaches	4dcd7c6352b1f8915b7e7f7e	Delhi Bistro
12	East Toronto	The Danforth West	4c1d5337eac020a1cb1048c2	Sher-E-Punjab
14	East Toronto	India Bazaar	4ae0c7a8f964a520638221e3	Udupi Palace
15	East Toronto	India Bazaar	4afc9816f964a520312422e3	Motimahal
16	East Toronto	India Bazaar	4bac30a2f964a52018ea3ae3	Bombay Chowpatty
17	East Toronto	India Bazaar	4ad9052cf964a520301721e3	Regency Restaurant
18	East Toronto	India Bazaar	4bbcc0efa0a0c9b60ebd1a0f	Haandi 2000
19	East Toronto	India Bazaar	4d8d278a1d06b1f712942a3b	Gautama
20	East Toronto	India Bazaar	4ae4c793f964a5201b9e21e3	The Famous Indian Restaurant
21	East Toronto	India Bazaar	4edd30c09adfe5cbe2818dc4	Lahori Taste & Burger House

Now, let's create a plot of Number of Indian restaurants in Top 10 Neighborhoods in Toronto

In [17]:
```
#grouping the data by neighborhoods and taking 10 largest
toronto_indian_rest_n=toronto_indian_rest.groupby('Neighborhood')['ID'].count().nlargest(10)

#creating a plot
ax = toronto_indian_rest_n.plot.bar(rot=90,figsize=(15, 8),color="tab:orange",width=0.5,fontsize=14)
plt.title(label="Number of Indian Restaurants in top 10 neighborhoods in Toronto",fontdict={'fontsize':"16"} )
plt.legend(['No.of Indian Restaurants'],loc='upper right', fontsize=14)
plt.xlabel('Neighborhood', fontsize = 16)
ax.get_yaxis().set_visible(False)
#plt.ylabel('No.of Indian Restaurants', fontsize=12)
for p in ax.patches:
    ax.annotate(format(p.get_height(), '.0f'),
                   (p.get_x() + p.get_width() / 2., p.get_height()),
                   ha = 'center', va = 'center',
                   size=14,
                   xytext = (0, 10),
                   textcoords = 'offset points')
```



Above plot tells us that the neighborhood of **India Bazaar** has the greatest of Indian restaurants.

5.5 Get details for each restaurant such as rating, tips and number of likes.

Let's define a function to get venue details such as numeric rating (on the scale of 0 to 10), count of tips, no. of likes for a given venue id. This information will be used for ranking the restaurants.

In [20]:
```
def get_venue_details_foursq(venue_id):

    CLIENT_ID = 'EKAARII0A5OS21BF4HLAILPFX4AGU5YZD32CW2PR0IWCR2EZ' # Foursquare ID
    CLIENT_SECRET = 'JHRKVXOZLOG1U42NTUBKJU1X3UNQMNX10OOMUIYKGFKLWXD2' # Foursquare Secret
    VERSION = '20180605' # Foursquare API version

    #call foursquare api to get venue details
    url = 'https://api.foursquare.com/v2/venues/{}?&client_id={}&client_secret={}&v={}'.format(
            venue_id,
            CLIENT_ID,
            CLIENT_SECRET,
            VERSION)

     # get the result to a json file
    results = requests.get(url).json()
    venue_data=results['response']['venue']
    venue_details=[]
    try:
        venue_id=venue_data['id']
        venue_name=venue_data['name']
        venue_rating=venue_data['rating']
        venue_tips=venue_data['tips']['count']
        venue_likes=venue_data['likes']['count']
        venue_details.append([venue_id,venue_name,venue_rating,venue_tips,venue_likes])
    except KeyError:
        pass

    column_names=['ID','Name','Rating','Tips','Likes']
    df = pd.DataFrame(venue_details,columns=column_names)
    return df
```

Now let's get the statistics about each restaurant which will help us in further analysis and ranking.

```
In [21]: toronto_indian_rest_stats=pd.DataFrame(columns=['Borough', 'Neighborhood', 'ID','Name','Rating','Tips','Likes'])
         count=1

         for row in toronto_indian_rest.values.tolist():
             Borough,Neighborhood,ID,Name=row
             try:
                 venue_details=get_venue_details_foursq(ID)
                 print(venue_details)
                 id,name,rating,tips,likes=venue_details.values.tolist()[0]
             except IndexError:
                 print('No data available for id=',ID,',so setting up stats as 0')
                 # we will assign 0 value for these resturants as they may have been
                 #recently opened or details does not exist in FourSquare Database
                 id,name,rating,tips,likes=[0]*5
             toronto_indian_rest_stats = toronto_indian_rest_stats.append({'Borough': Borough,
                                                 'Neighborhood': Neighborhood,
                                                 'ID': id,
                                                 'Name' : name,
                                                 'Rating' : rating,
                                                 'Tips' : tips,
                                                 'Likes' : likes
                                                }, ignore_index=True)
             count+=1
```

```
                          ID                  Name  Rating  Tips  Likes
0  4bedf8b5e24d20a17b567214  Kothur Indian Cuisine     8.0    19     16
                          ID          Name  Rating  Tips  Likes
0  4dcd7c6352b1f8915b7e7f7e  Delhi Bistro     6.9     3      6
                          ID                  Name  Rating  Tips  Likes
0  504bcf32e4b0ef19b0e2ecf8  Mt Everest Restaurant     6.8     6      8
                          ID                   Name  Rating  Tips  Likes
0  4adb969ef964a520332921e3  Banjara Indian Cuisine     8.6    75    142
                          ID            Name  Rating  Tips  Likes
0  4b7369d7f964a52049ad2de3  Madras Masala     7.8    22     35
                          ID             Name  Rating  Tips  Likes
0  4d6008f829ef236a8832a059  CANBE Foods Inc     7.9     8     22
                          ID           Name  Rating  Tips  Likes
0  4c77fc87bd346dcb8c90f0ef  La Sani Grill     6.7    12     12
                          ID                        Name  Rating  Tips  Likes
0  4daf08e66e81e2dffdd4fe40  Iqbal Kebab & Sweet Centre     7.5     5     12
                          ID           Name  Rating  Tips  Likes
0  4bed9f2fbac3c9b6ad93fee9  Hakka Garden     6.3    12      9
```

```
In [22]: toronto_indian_rest_stats.head()
```

Out[22]:

	Borough	Neighborhood	ID	Name	Rating	Tips	Likes
0	Downtown Toronto	Queen's Park	4bedf8b5e24d20a17b567214	Kothur Indian Cuisine	8.0	19	16
1	East Toronto	The Beaches	4dcd7c6352b1f8915b7e7f7e	Delhi Bistro	6.9	3	6
2	East York	Leaside	504bcf32e4b0ef19b0e2ecf8	Mt Everest Restaurant	6.8	6	8
3	Downtown Toronto	Christie	4adb969ef964a520332921e3	Banjara Indian Cuisine	8.6	75	142
4	Downtown Toronto	Christie	4b7369d7f964a52049ad2de3	Madras Masala	7.8	22	35

5.6 Sort the list of restaurants by ratings and identify the boroughs & neighborhoods that have the best Indian Restaurants.

Grouping the dataframe that contains statistics for each indian restaurant by neighborhood

```
In [25]: toronto_neigh_stats=toronto_indian_rest_stats.groupby('Neighborhood',as_index=False).mean()[['Neighborhood','Rating']]
         toronto_neigh_stats.columns=['Neighborhood','Average Rating']
```

Let's find top 10 neighborhoods with top average rating of Indian restaurants.

```
In [27]: toronto_neigh_stats.sort_values(['Average Rating'],ascending=False).head(10)
```

Out[27]:

	Neighborhood	Average Rating
16	The Annex	8.50
9	High Park	8.30
4	Christie	8.20
1	Brockton	8.20
5	Church and Wellesley	8.05
13	Queen's Park	8.00
11	Kensington Market	7.80
6	Davisville	7.50
3	Cedarbrae	7.30
0	Bedford Park	7.30

Grouping the dataframe that contains statistics for each Indian restaurant by borough.

```
In [29]: toronto_borough_stats=toronto_indian_rest_stats.groupby('Borough',as_index=False).mean()[['Borough','Rating']]
         toronto_borough_stats.columns=['Borough','Average Rating']
```

Let's find top boroughs with top average rating of Indian restaurants.

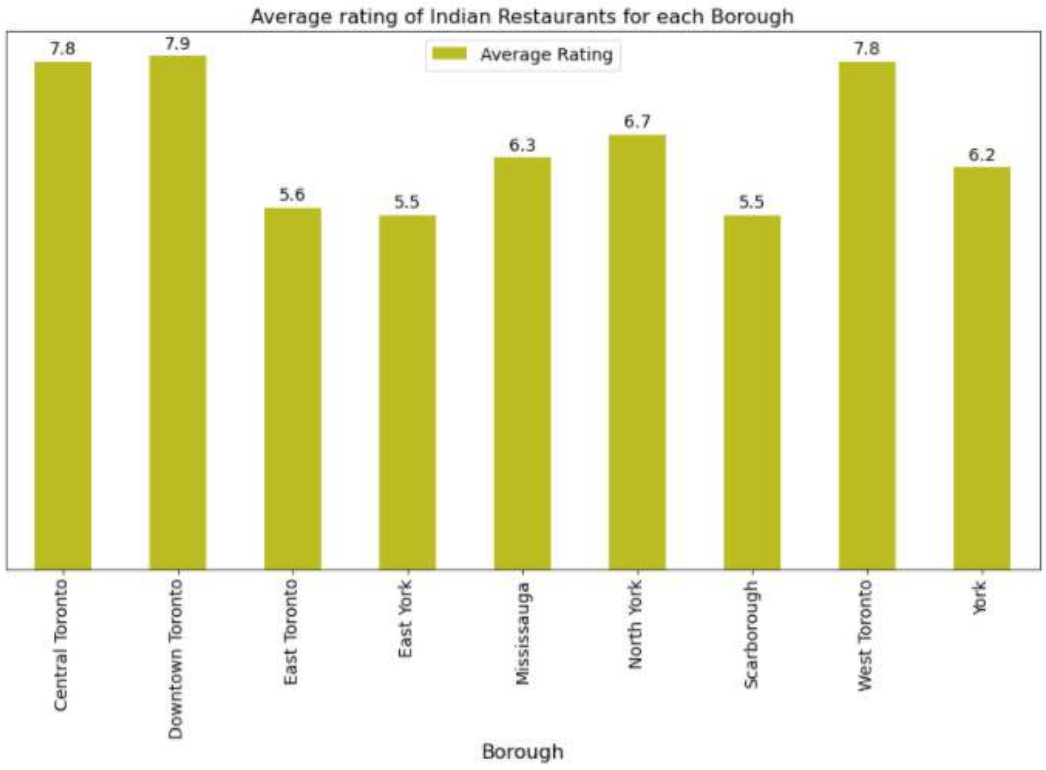
```
In [31]: toronto_borough_stats.sort_values(['Average Rating'],ascending=False).head(10)
```

Out[31]:

	Borough	Average Rating
1	Downtown Toronto	7.914286
0	Central Toronto	7.833333
7	West Toronto	7.833333
5	North York	6.700000
4	Mississauga	6.350000
8	York	6.200000
2	East Toronto	5.580000
6	Scarborough	5.460000
3	East York	5.460000

Now let's create a plot for Average rating of Indian Restaurants for each Borough.

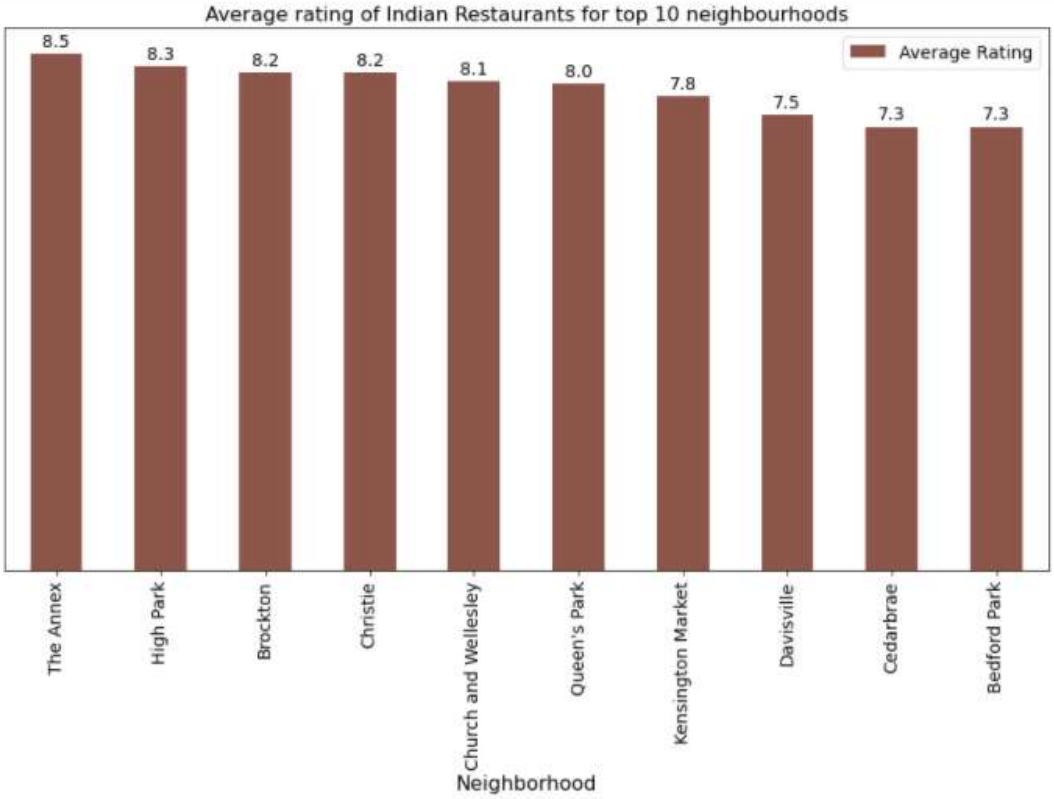
```
In [35]: #grouping the data by boroughs
toronto_indian_rest_stats_b=toronto_indian_rest_stats.groupby('Borough').mean()['Rating']

#creating a plot
ax = toronto_indian_rest_stats_b.plot.bar(rot=90,figsize=(15, 8),color="tab:olive",width=0.5,fontsize=14)
plt.title(label="Average rating of Indian Restaurants for each Borough",fontdict={'fontsize':"16"} )
plt.legend(['Average Rating'],loc='upper center', fontsize=14)
plt.xlabel('Borough', fontsize = 16)
ax.get_yaxis().set_visible(False)
for p in ax.patches:
    ax.annotate(format(p.get_height(), '.1f'),
                   (p.get_x() + p.get_width() / 2., p.get_height()),
                   ha = 'center', va = 'center',
                   size=14,
                   xytext = (0, 10),
                   textcoords = 'offset points')
```



From the above plot, we can conclude that **Downtown Toronto** has the best Indian restaurants with highest average rating.

Now let's create a plot for Average rating of Indian Restaurants for top 10 neighborhoods.

```
In [36]: #grouping the data by neighborhoods
toronto_indian_rest_stats_n=toronto_indian_rest_stats.groupby('Neighborhood').mean()['Rating'].nlargest(10)

#creating a plot
ax = toronto_indian_rest_stats_n.plot.bar(rot=90,figsize=(15, 8),color="tab:brown",width=0.5,fontsize=14)
plt.title(label="Average rating of Indian Restaurants for top 10 neighbourhoods",fontdict={'fontsize':"16"} )
plt.legend(['Average Rating'],loc='upper right', fontsize=14)
plt.xlabel('Neighborhood', fontsize = 16)
ax.get_yaxis().set_visible(False)
for p in ax.patches:
    ax.annotate(format(p.get_height(), '.1f'),
                (p.get_x() + p.get_width() / 2., p.get_height()),
                ha = 'center', va = 'center',
                size=14,
                xytext = (0, 10),
                textcoords = 'offset points')
```



From the above plot, we can conclude that the neighborhood of **The Annex** has the best Indian restaurants with highest average rating.

5.7 Create a map of Toronto area to visualize the neighborhoods that have the best Indian Restaurants.

We will consider all the neighborhoods with average rating greater or equal 7.0 to visualize on map.

```
In [38]: toronto_neigh_stats_7=toronto_neigh_stats[toronto_neigh_stats['Average Rating']>=7]
         toronto_neigh_stats_7=toronto_neigh_stats_7.sort_values(['Average Rating'],ascending=False)
         toronto_neigh_stats_7
```

Out[38]:

	Neighborhood	Average Rating
16	The Annex	8.50
9	High Park	8.30
1	Brockton	8.20
4	Christie	8.20
5	Church and Wellesley	8.05
13	Queen's Park	8.00
11	Kensington Market	7.80
6	Davisville	7.50
3	Cedarbrae	7.30
0	Bedford Park	7.30
8	Harbourfront East	7.10
18	The Danforth West	7.10

Let's join this dataset to the Toronto geospatial dataset to get longitude and latitude information.

```
In [39]: toronto_neigh_stats=pd.merge(toronto_neigh_stats,df_neighb_geo, on='Neighborhood')
         toronto_neigh_stats=toronto_neigh_stats[['Borough','Neighborhood','Latitude','Longitude','Average Rating']]
         toronto_neigh_stats
```

Out[39]:

	Borough	Neighborhood	Latitude	Longitude	Average Rating
0	North York	Bedford Park	43.733283	-79.419750	7.300
1	West Toronto	Brockton	43.636847	-79.428191	8.200
2	Mississauga	Canada Post Gateway Processing Centre	43.636966	-79.615819	6.350
3	Scarborough	Cedarbrae	43.773136	-79.239476	7.300
4	Downtown Toronto	Christie	43.669542	-79.422564	8.200
5	Downtown Toronto	Church and Wellesley	43.665860	-79.383160	8.050
6	Central Toronto	Davisville	43.704324	-79.388790	7.500
7	Scarborough	Dorset Park	43.757410	-79.273304	6.350
8	Downtown Toronto	Harbourfront East	43.640816	-79.381752	7.100
9	West Toronto	High Park	43.661608	-79.464763	8.300
10	East Toronto	India Bazaar	43.668999	-79.315572	5.225
11	Downtown Toronto	Kensington Market	43.653206	-79.400049	7.800
12	East York	Leaside	43.709060	-79.363452	6.800
13	Downtown Toronto	Queen's Park	43.662301	-79.389494	8.000
14	York	Runnymede	43.673185	-79.487262	6.600
15	West Toronto	Runnymede	43.651571	-79.484450	6.600
16	Scarborough	Steeles West	43.799525	-79.318389	0.000
17	Central Toronto	The Annex	43.672710	-79.405678	8.500
18	East Toronto	The Beaches	43.676357	-79.293031	6.900
19	East Toronto	The Danforth West	43.679557	-79.352188	7.100
20	East York	Thorncliffe Park	43.705369	-79.349372	5.125
21	North York	Willowdale	43.789053	-79.408493	6.100

Let's visualize this data on Toronto map

Getting geographical coordinates of Toronto city.

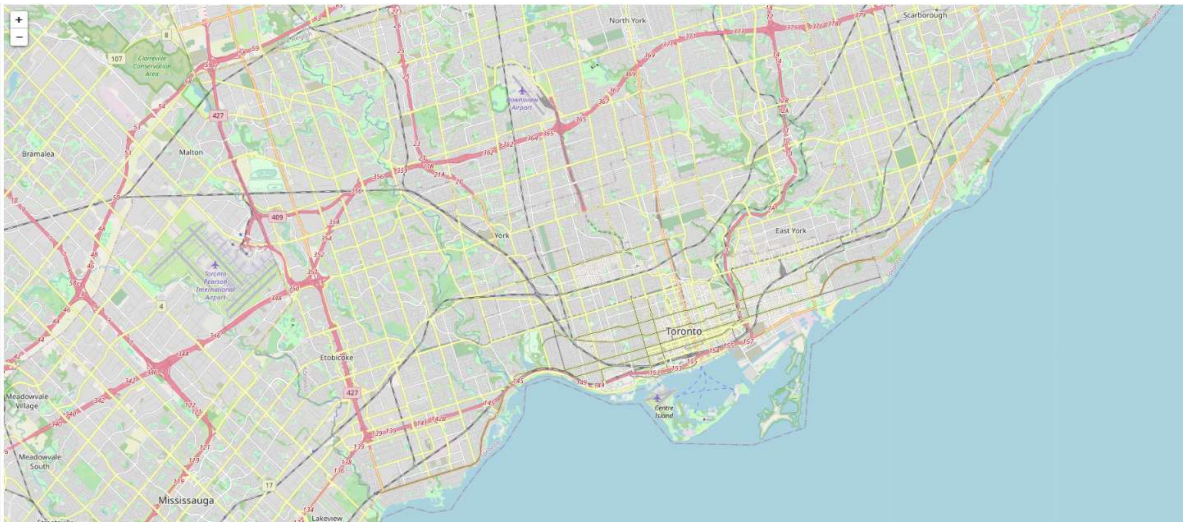
```
In [41]: address = "Toronto, ON"

geolocator = Nominatim(user_agent="toronto_explorer")
location = geolocator.geocode(address)
latitude = location.latitude
longitude = location.longitude
print('The geograpical coordinate of Toronto city are {}, {}.'.format(latitude, longitude))
```

```
The geograpical coordinate of Toronto city are 43.6534817, -79.3839347.
```

Creating map for Toronto

```
In [43]: toronto_map = folium.Map(location=[latitude, longitude], zoom_start=12)
toronto_map
```

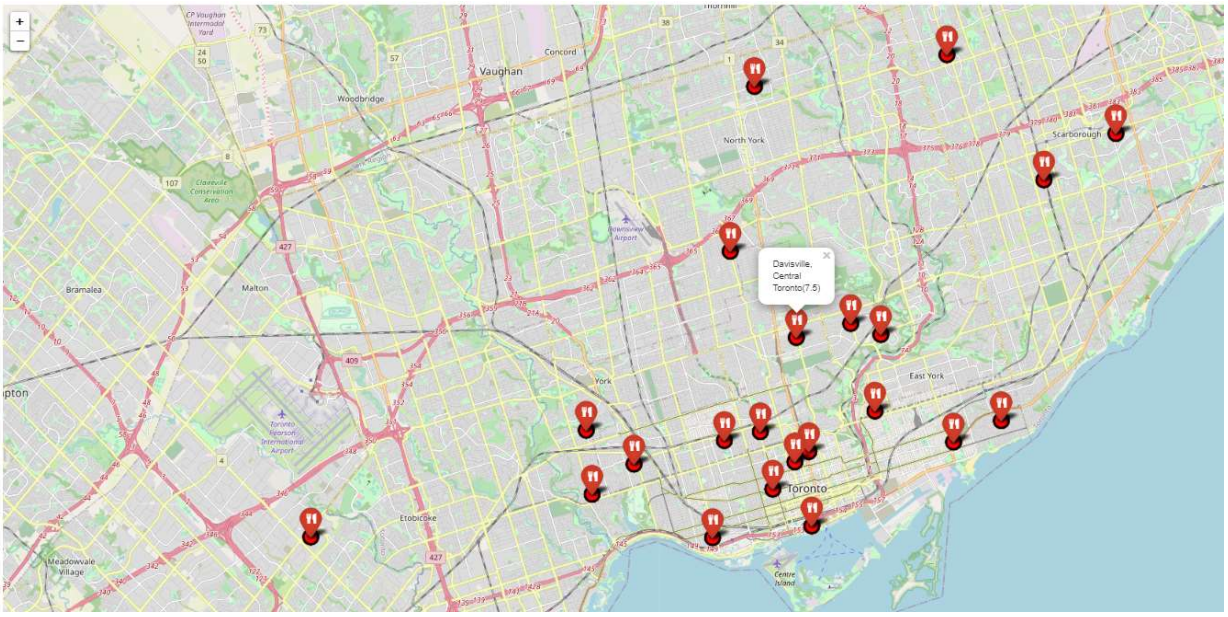
Out[43]:



Adding markers to the map.

```
In [64]: # instantiate a feature group for the neighborhoods in the dataframe
neigh = folium.map.FeatureGroup()

# loop through the neighborhoods and add each to the neigh feature group
for lat, lng, in toronto_neigh_stats[['Latitude','Longitude']].values:
    neigh.add_child(
        folium.CircleMarker(
            [lat, lng],
            radius=10, # define how big you want the circle markers to be
            color='black',
            fill=True,
            fill_color='red',
            fill_opacity=0.6
        )
    )

toronto_neigh_stats['Label']=toronto_neigh_stats['Neighborhood']+', '+toronto_neigh_stats['Borough']+'('+toronto_neigh_stats['Average Rating'].map(str)+')'

for lat, lng, label in toronto_neigh_stats[['Latitude','Longitude','Label']].values:
    folium.Marker([lat, lng],icon=folium.Icon(color="red",icon="cutlery"), popup=label).add_to(toronto_map)
# add incidents to map
toronto_map.add_child(neigh)


toronto_map
```

Out[64]:



5.8 Build a dataset of crimes committed in Toronto area in year 2019 with details such as Borough, Neighborhood, type of offence and type of premise.

As the real-world dataset 'https://www.kaggle.com/kapastor/toronto-police-data-crime-rates-by-neighbourhood' is huge, we will consider data only for year 2019 for our analysis. Subset of above dataset has been uploaded to github repository after dropping irrelevant columns at below location: https://raw.githubusercontent.com/Anagha37/Coursera_Capstone/main/MCI_2019.csv.

Using this csv, let's build a dataset of crimes committed in Toronto area in year 2019 with details such as Borough, Neighborhood, type of offence and type of premise.

In [58]:
```
#reading the csv file
toronto_crime_df = pd.read_csv('https://raw.githubusercontent.com/Anagha37/Coursera_Capstone/main/MCI_2019.csv', index_col=None)
toronto_crime_df.drop(['event_unique_id','ucr_code','ucr_ext','Division','ObjectId','Hood_ID','reporteddayofyear','reporteddayofweek','reportedhour',
toronto_crime_df.head()
```

Out[58]:

	premisetype	offence	reportedyear	reportedmonth	reportedday	MCI	Neighbourhood	Borough	Long	Lat
0	Apartment	Assault With Weapon	2019	June	14	Assault	Bedford Park-Nortown	North York	-79.415932	43.723015
1	Commercial	Robbery - Business	2019	January	3	Robbery	Princess-Rosethorn	Etobicoke	-79.555473	43.674221
2	Apartment	Assault - Resist/ Prevent Seiz	2019	January	4	Assault	Roncesvalles	West Toronto	-79.435364	43.644207
3	Outside	Discharge Firearm - Recklessly	2019	January	5	Assault	Tam O'Shanter-Sullivan	Scarborough	-79.322212	43.773506
4	Commercial	B&E	2019	January	27	Break and Enter	Long Branch	Etobicoke	-79.532402	43.594738

For our analysis, let's create a new dataframe that has only few columns.

```
In [60]: crime_neigh_pt = toronto_crime_df[['Borough','Neighbourhood','premisetype','offence']]
         crime_neigh_pt.head()
```

Out[60]:

	Borough	Neighbourhood	premisetype	offence
0	North York	Bedford Park-Nortown	Apartment	Assault With Weapon
1	Etobicoke	Princess-Rosethorn	Commercial	Robbery - Business
2	West Toronto	Roncesvalles	Apartment	Assault - Resist/ Prevent Seiz
3	Scarborough	Tam O'Shanter-Sullivan	Outside	Discharge Firearm - Recklessly
4	Etobicoke	Long Branch	Commercial	B&E

5.9 Filter this dataset to get information about crimes committed only in Commercial premises.

```
In [61]: comm_crime= crime_neigh_pt[crime_neigh_pt['premisetype']=='Commercial']
         comm_crime.head()
```

Out[61]:

	Borough	Neighbourhood	premisetype	offence
1	Etobicoke	Princess-Rosethorn	Commercial	Robbery - Business
4	Etobicoke	Long Branch	Commercial	B&E
6	North York	Downsview-Roding-CFB	Commercial	B&E
8	East Toronto	South Riverdale	Commercial	B&E
16	Downtown Toronto	Waterfront Communities-The Island	Commercial	Assault With Weapon

5.10 Analyze the above dataset and identify the boroughs & neighborhoods that have least crime rate in commercial premises.

Let's group the data by Boroughs

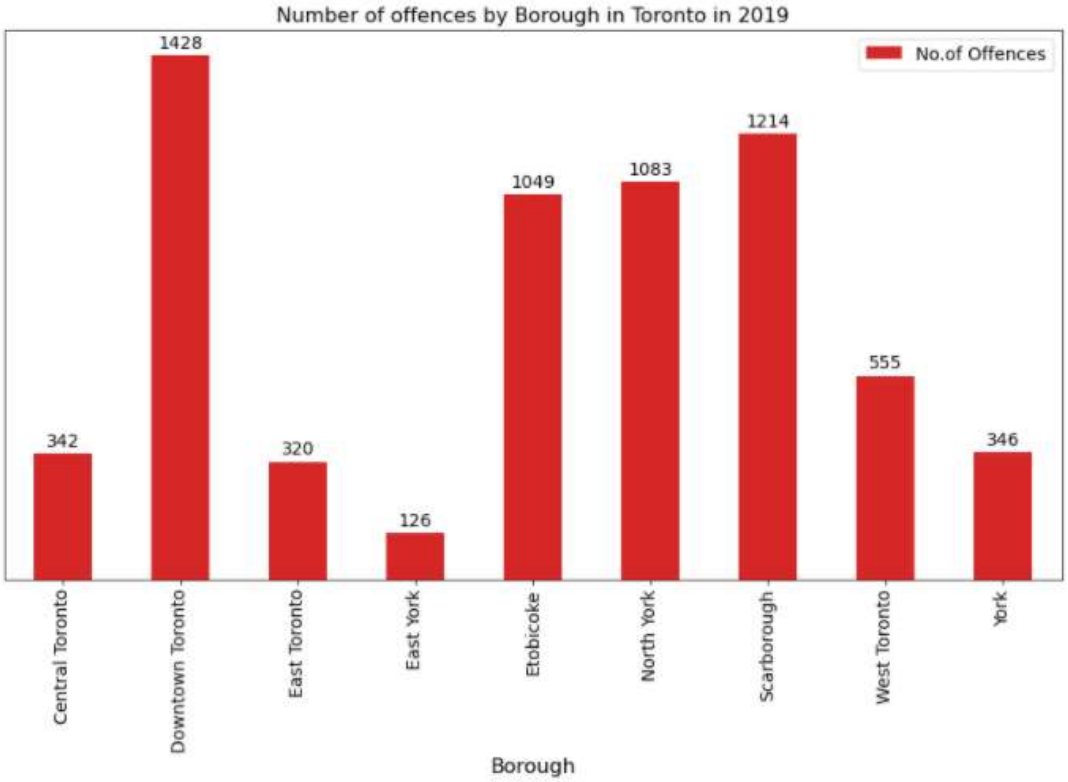
```
In [62]: comm_crime_b=comm_crime.groupby(['Borough'])['offence'].count()
         comm_crime_b
```

Out[62]:

```
Borough
Central Toronto      342
Downtown Toronto    1428
East Toronto         320
East York            126
Etobicoke           1049
North York          1083
Scarborough         1214
West Toronto         555
York                 346
Name: offence, dtype: int64
```

Now let's create a plot for number of offences by Borough in Toronto in 2019.

```
In [63]: #creating a plot
ax = comm_crime_b.plot.bar(rot=90,figsize=(15, 8),color="tab:red",width=0.5,fontsize=14)

plt.title(label="Number of offences by Borough in Toronto in 2019",fontdict={'fontsize':"16"} )
plt.legend(['No.of Offences'],loc='upper right', fontsize=14)
plt.xlabel('Borough', fontsize = 16)
ax.get_yaxis().set_visible(False)
#plt.ylabel('No.of Indian Restaurants', fontsize=12)
for p in ax.patches:
    ax.annotate(format(p.get_height(), '.0f'),
                (p.get_x() + p.get_width() / 2., p.get_height()),
                ha = 'center', va = 'center',
                size=14,
                xytext = (0, 10),
                textcoords = 'offset points')
```



The above plot shows that **Downtown Toronto** is the most vulnerable area and areas like **East York, York, East & Central Toronto** are safer compared to other boroughs.

6. Results

Based on the above analysis & visualization of the data, here is what we have found:

1. East Toronto & Downtown Toronto have large number of Indian restaurants and York & Central Toronto have least number of Indian restaurants.
   When setting up a new business, it is best to avoid competition with existing established businesses. So, one should consider areas like Central Toronto and York which has a scarcity of Indian restaurants.
2. Downtown Toronto & Central Toronto have the best Indian restaurants with higher average rating compared to Indian restaurants in other boroughs.
   When an area is famous for a cuisine, people tend to be attracted to that area more. This can give an edge when starting a new restaurant with same cuisine.
3. Downtown Toronto is the most vulnerable area and areas like East York, York, East & Central Toronto are safer compared to other boroughs.
   Safety is one of the most important aspects to consider while starting a new business. It is best to avoid areas where crime rates are high in commercial establishments.

7. Discussion

Even though Downtown Toronto has best Indian restaurants, the competition from existing Indian restaurants will be very high in that area. Moreover, it has highest crime rate in commercial establishments. Hence, this area wouldn't be recommended.

Areas like York and East York, despite of being safer and having relatively less competition from existing Indian restaurants, are not known for having good Indian restaurants. Hence, this area wouldn't be recommended either.

Central Toronto seems to be having least competition from existing Indian restaurants and has best Indian restaurants with higher average ratings. It is also one of the safer areas with lower crime rates in commercial establishments.

Hence, this area is highly recommended for setting up a new Indian Restaurant in Toronto.

8. Conclusion

We analyzed and did a visual representation of the Indian restaurant data and crimes data within the commercial premise type in the city of Toronto using data analysis and data visualization techniques. This helped us understand the best and the safest place to start a new or establish existing Indian restaurant business. If you are just a customer looking for Indian restaurants around Toronto, this data will help you find places with the best Indian cuisine.