Compare and Contrast Two Cities (Manhattan, NY, and Downtown Toronto)

To Assist Foreign Travelers

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PROBLEM & BACKGROUND

Downtown Toronto Canada and Manhattan New York USA are considered two major tourist spots with lots of multicultural venues. Both are considered financial hubs and with many restaurants, coffee shops, theaters, and other attractions such as CN Tower in Toronto. It will be interesting to compare the different venues such as restaurants, hotel accommodations, tourist attractions such as Broadway shows and many other Tourist spots.

Number of Tourists from various parts of the world (Australia, Europe, Asia) when they visit different cities in different countries, they wanted to see different attractions, different food and so forth. They would not like to spend time and money on two different cities for similar experience. Hence, a comparison of Downtown Toronto and Manhattan New York will be valuable for tourist who are travelling from far away so that they can enjoy best of both and feel happy that their time and money are spent wisely.

DATA DESCRIPTION

We have explored Manhattan venues in Week3 module hands on lab using Foursquare API. In addition, through the peer graded assignment for Week3, we analyzed Downtown Toronto using Foursquare API as well. Hence, we have obtained Data frames for both Downtown Toronto and Manhattan New York. From the Jupyter notebook for Toronto and Manhattan. Exported these files to CSV files and named them **DT_Toronto.csv** and **Manhattan_NY.csv**.

METHODOLOGY

Using the CSV files mentioned in the Data description: DT_Toronto.csv and Manhattan_NY.csv which has the names of the neighborhood (Borough) and location information (latitude and longitude) and used the geolocator library and Folium map to display the neighborhood of Manhattan and Downton Toronto. This is to analyze the number of Boroughs and how far are they to each other.

Using the function getNearbyVenues and foursquare API to explore the locations of Boroughs and Venues within 1000 meters radius from the location of Manhattan and Downtown Toronto. First, the venues for Manhattan were explored. Using groupby, count, and nlargest functions to display the first 50 venues in descending order (based on total number of venues). Similarly, explored and displayed the first 50 venues in descending order for Downtown Toronto. After that, created a Data Frame to capture the venues and the counts to compare Manhattan and Downtown Toronto. Exported the data to a csv file named: **Venu_Comparison.csv.** This csv file provided the necessary comparison data between Manhattan and Downton Toronto.

RESULTS

Map of the Boroughs for Manhattan:

2. Read CSV file for Manhattan obtained from Module3 and display Manhattan map

In [183]:
```
manhattan_data=pd.read_csv("Manhattan_NY.csv") #obtained from Module3 lab
manhattan_data.head()
```

Out[183]:

	Unnamed: 0	Borough	Neighborhood	Latitude	Longitude
0	0	Manhattan	Marble Hill	40.876551	-73.910660
1	1	Manhattan	Chinatown	40.715618	-73.994279
2	2	Manhattan	Washington Heights	40.851903	-73.936900
3	3	Manhattan	Inwood	40.867684	-73.921210
4	4	Manhattan	Hamilton Heights	40.823604	-73.949582

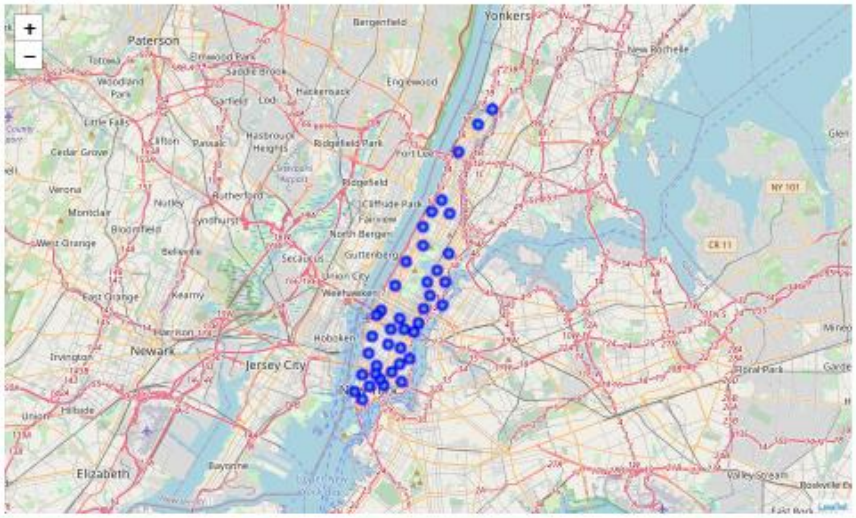
In [184]:
```
print("Number of Boroughs in Manhattan", manhattan_data.shape[0])
```

```
Number of Boroughs in Manhattan 40
```

In [185]:
```
address = 'Manhattan, NY'
geolocator = Nominatim(user_agent="ny_explorer")
location = geolocator.geocode(address)
latitude = location.latitude
longitude = location.longitude
print('The geograpical coordinate of Manhattan are {}, {}.'.format(latitude, longitude))
# create map of Manhattan using latitude and longitude values
map_manhattan = folium.Map(location=[latitude, longitude], zoom_start=11)
# add markers to map
for lat, lng, label in zip(manhattan_data['Latitude'], manhattan_data['Longitude'], manhattan_data['Neighborhood']):
    label = folium.Popup(label, parse_html=True)
    folium.CircleMarker(
        [lat, lng],
        radius=5,
        popup=label,
        color='blue',
        fill=True,
        fill_color='#3186cc',
        fill_opacity=0.7,
        parse_html=False).add_to(map_manhattan)
map_manhattan
```

```
The geograpical coordinate of Manhattan are 40.7896239, -73.9598939.
```

Out[185]:



Map of the Boroughs for Downtown Toronto:

3. Read CSV file for Downtown_Toronto from Module3 and display Downtown Toronto map

In [186]:
```
DT_Toronto=pd.read_csv("DT_Toronto.csv")
DT_Toronto.head()
```

Out[186]:

	Unnamed: 0	Postal Code	Borough	Neighborhood	Latitude	Longitude
0	0	M5A	Downtown Toronto	Regent Park, Harbourfront	43.654260	-79.360636
1	1	M5B	Downtown Toronto	Garden District, Ryerson	43.657162	-79.378937
2	2	M5C	Downtown Toronto	St. James Town	43.651494	-79.375418
3	3	M5E	Downtown Toronto	Berczy Park	43.644771	-79.373306
4	4	M5G	Downtown Toronto	Central Bay Street	43.657952	-79.387383

In [187]:
```
print("Number of Boroughs in Downtown Toronto", DT_Toronto.shape[0])
```

```
Number of Boroughs in Downtown Toronto 17
```

In [188]:
```
addressT = "Downtown, Toronto"
geolocator = Nominatim(user_agent="Toronto")
locationT = geolocator.geocode(addressT)
latitudeT = locationT.latitude
longitudeT = locationT.longitude
print('The geograpical coordinate of Downtown Toronto are {}, {}.'.format(latitudeT, longitudeT))
# create map of Manhattan using latitude and longitude values
map_Toronto = folium.Map(location=[latitudeT, longitudeT], zoom_start=11)
for lat, lng, label in zip(DT_Toronto['Latitude'], DT_Toronto['Longitude'], DT_Toronto['Neighborhood']):
    label = folium.Popup(label, parse_html=True)
    folium.CircleMarker(
        [lat, lng],
        radius=5,
        popup=label,
        color='blue',
        fill=True,
        fill_color='#3186cc',
        fill_opacity=0.7,
        parse_html=False).add_to(map_Toronto)
map_Toronto
```

```
The geograpical coordinate of Downtown Toronto are 43.6541737, -79.38081162653639.
```

Out[188]:

Explore the Neighborhoods in Manhattan and Downtown Toronto within 1000m radius

Define Foursquare Credentials and Version

In [189]:
```
CLIENT_ID = 'CRUHLSKWGYWZDBSJTWRS3YDM4MWLNFJB1SIUU4DNFU2SPUU3' # your Foursquare ID
CLIENT_SECRET = 'PYIPPW4CTXDHTKZCT4S4CWAIZDFPBLL24IOLNV5IW1IADK54' # your Foursquare Secret
ACCESS_TOKEN = 'OMMFWEPTTNGXBLCMIG5MJ1S4W2K3MDI3CMIM2EGLLQYTTC1B' # your FourSquare Access Token
VERSION = '20210515'
LIMIT = 100
print('Your credentails:')
print('CLIENT_ID: ' + CLIENT_ID)
print('CLIENT_SECRET:' + CLIENT_SECRET)
```

```
Your credentails:
CLIENT_ID: CRUHLSKWGYWZDBSJTWRS3YDM4MWLNFJB1SIUU4DNFU2SPUU3
CLIENT_SECRET:PYIPPW4CTXDHTKZCT4S4CWAIZDFPBLL24IOLNV5IW1IADK54
```

Now, let's get the top 100 venues that are in Manhattan and Downtown Toronto within a radius of 600 meters.

4. Explore Neighborhoods in Manhattan and Downtown Toronto Using Foursquare

Let's create a function to repeat the same process to all the neighborhoods in Manhattan

In [213]:
```
def getNearbyVenues(names, latitudes, longitudes, radius=1000):

    venues_list=[]
    for name, lat, lng in zip(names, latitudes, longitudes):
        print(name)

        # create the API request URL
        url = 'https://api.foursquare.com/v2/venues/explore?&client_id={}&client_secret={}&v={}&ll={},{}&radius={}&limit={}'
            CLIENT_ID,
            CLIENT_SECRET,
            VERSION,
            lat,
            lng,
            radius,
            LIMIT)

        # make the GET request
        results = requests.get(url).json()["response"]['groups'][0]['items']

        # return only relevant information for each nearby venue
        venues_list.append([(
            name,
            lat,
            lng,
            v['venue']['name'],
            v['venue']['location']['lat'],
            v['venue']['location']['lng'],
            v['venue']['categories'][0]['name']) for v in results])

    nearby_venues = pd.DataFrame([item for venue_list in venues_list for item in venue_list])
    nearby_venues.columns = ['Neighborhood',
                  'Neighborhood Latitude',
                  'Neighborhood Longitude',
                  'Venue',
                  'Venue Latitude',
                  'Venue Longitude',
                  'Venue Category']

    return(nearby_venues)
```

```
Yoga Studio                    22
Restaurant                     21
Furniture / Home Store         20
Playground                     20
Salad Place                    20
Vegetarian / Vegan Restaurant  20
Boutique                       19
Name: Venue, dtype: int64
```

Let's find out how many unique categories can be curated from all the returned venues

In [205]:
```
print('There are {} uniques categories in Manhattan.'.format(len(manhattan_venues['Venue Category'].unique())))
```

```
There are 329 uniques categories in Manhattan.
```

Explore the Neighborhoods in Manhattan:

Let's Check the top 50 popular Venues based on Venue Category in Manhattan

In [216]:
```
#list= manhattan_venues.groupby(["Venue Category"])["Venue"].count().nlargest(50)
df=manhattan_venues.groupby(["Venue Category"])["Venue"].count().nlargest(n=50)
df
```

Out[216]:
```
Venue Category
Coffee Shop                   169
Italian Restaurant            130
Park                          111
Pizza Place                   109
Café                          107
American Restaurant            95
Bakery                         92
Gym / Fitness Center           77
Hotel                          73
Mexican Restaurant             70
Cocktail Bar                   68
Bar                            65
Gym                            62
Wine Shop                      60
Grocery Store                  54
Japanese Restaurant            54
Sushi Restaurant               54
Wine Bar                       54
French Restaurant              51
Seafood Restaurant             49
Sandwich Place                 47
Ice Cream Shop                 46
Spa                            43
Chinese Restaurant             40
Juice Bar                      40
Art Gallery                    36
Cosmetics Shop                 36
Indian Restaurant              35
Burger Joint                   34
Mediterranean Restaurant       34
Theater                        34
Bagel Shop                     33
Deli / Bodega                  33
Dessert Shop                   33
New American Restaurant        33
Bookstore                      32
Gourmet Shop                   32
Salon / Barbershop             32
Yoga Studio                    32
Vegetarian / Vegan Restaurant  31
Thai Restaurant                30
Salad Place                    29
Korean Restaurant              27
Plaza                          26
Asian Restaurant               25
Lounge                         25
Playground                     25
Clothing Store                 23
Greek Restaurant               22
Spanish Restaurant             22
Name: Venue, dtype: int64
```

Let's find out how many unique categories can be curated from all the returned venues

In [217]:
```
print('There are {} uniques categories in Manhattan.'.format(len(manhattan_venues['Venue Category'].unique())))
```

```
There are 307 uniques categories in Manhattan.
```

Explore the Neighborhoods in Downtown Toronto:

```
In [208]: DT_Toronto_venues.shape
```

```
Out[208]: (1090, 7)
```

```
In [209]: print('There are {} uniques categories in DT Toronto.'.format(len(DT_Toronto_venues['Venue Category'].unique())))
```

```
There are 283 uniques categories in DT Toronto.
```

Top 50 Venue Categories in Downtown Toronto in Descending order

```
In [211]: dFT=DT_Toronto_venues.groupby(["Venue Category"])["Venue"].count().nlargest(n=50)
          dFT
```

```
Out[211]: Venue Category
          Coffee Shop                       111
          Café                               59
          Restaurant                         35
          Hotel                              34
          Japanese Restaurant                28
          Italian Restaurant                 24
          Bakery                             20
          Park                               20
          Clothing Store                     17
          Seafood Restaurant                 17
          Gym                                15
          Pizza Place                        15
          Steakhouse                         14
          Sushi Restaurant                   14
          Thai Restaurant                    14
          American Restaurant                13
          Beer Bar                           13
          Deli / Bodega                      13
          Gastropub                          13
          Burger Joint                       12
          Cocktail Bar                       12
          Salad Place                        12
          Vegetarian / Vegan Restaurant      12
          Bar                                11
          Sandwich Place                     11
          Theater                            11
          Breakfast Spot                     10
          Grocery Store                      10
          Pub                                10
          Art Gallery                         9
          Asian Restaurant                    9
          Bookstore                           9
          Cosmetics Shop                      9
          Bank                                8
          Concert Hall                        8
          Department Store                    8
          Plaza                               8
          Sporting Goods Shop                 8
          Wine Bar                            8
          Bubble Tea Shop                     7
          Burrito Place                       7
          Diner                               7
          Fast Food Restaurant                7
          French Restaurant                   7
          Gym / Fitness Center                7
          New American Restaurant             7
          Pharmacy                            7
          Dessert Shop                        6
          Farmers Market                      6
          Lounge                              6
          Name: Venue, dtype: int64
```

Combine Venue data for both Manhattan and Downton Toronto for comparison

Create a DataFrame to compare the Venues by category between Manhattan and Downtown Toronto

In [212]:
```
dict={"Manhattan":df,"Downtown_Toronto":dfT}
pdf=pd.DataFrame(dict)
df_sorted= pdf.sort_values("Downtown_Toronto", ascending=False)

df_sorted.to_csv("Venue_Comparison.csv")
df_sorted
```

Out[212]:

	Manhattan	Downtown_Toronto
Coffee Shop	140.0	111.0
Cafe	80.0	59.0
Restaurant	21.0	35.0
Hotel	68.0	34.0
Japanese Restaurant	38.0	28.0
Italian Restaurant	123.0	24.0
Bakery	78.0	20.0
Park	70.0	20.0
Clothing Store	40.0	17.0
Seafood Restaurant	35.0	17.0
Pizza Place	79.0	15.0
Gym	53.0	15.0
Steakhouse	22.0	14.0
Sushi Restaurant	44.0	14.0
Thai Restaurant	32.0	14.0
Deli / Bodega	37.0	13.0
American Restaurant	77.0	13.0
Gastropub	NaN	13.0
Beer Bar	NaN	13.0
Vegetarian / Vegan Restaurant	20.0	12.0
Cocktail Bar	56.0	12.0
Burger Joint	33.0	12.0
Salad Place	20.0	12.0
Theater	22.0	11.0
Bar	63.0	11.0
Sandwich Place	43.0	11.0
Pub	NaN	10.0
Grocery Store	32.0	10.0
Breakfast Spot	NaN	10.0
Cosmetics Shop	32.0	9.0
Bookstore	26.0	9.0
Asian Restaurant	NaN	9.0
Art Gallery	27.0	9.0
Sporting Goods Shop	NaN	8.0
Bank	NaN	8.0
Plaza	NaN	8.0

Venue_Comparison.csv file was created:

	Manhattan	Downtown_Toronto
Coffee Shop	169	132
CafÃ©	107	96
Japanese Restaurant	54	45
Park	111	41
Hotel	73	37
Restaurant		37
Theater	34	32
Italian Restaurant	130	27
Vegetarian / Vegan Restaurant	31	26
Gastropub		26
Pizza Place	109	25
Cosmetics Shop	36	24
Seafood Restaurant	49	22
Bakery	92	22
Sushi Restaurant	54	21
Gym	62	20
Thai Restaurant	30	20
Art Gallery	36	19
Plaza	26	17
Pub		17
Beer Bar		17
Grocery Store	54	17
American Restaurant	95	16
Sandwich Place	47	15
Bookstore	32	15
Concert Hall		15
Korean Restaurant	27	14
Diner		14
Yoga Studio	32	13
Farmers Market		12
Mexican Restaurant	70	12
Bar	65	11
Tea Room		11
Steakhouse		11
Creperie		11
Gym / Fitness Center	77	10
Clothing Store	23	10
Monument / Landmark		10
French Restaurant	51	10
Bistro		9
Burrito Place		9
Furniture / Home Store		9
Cocktail Bar	68	9
Neighborhood		9
Museum		9
Middle Eastern Restaurant		9
Ramen Restaurant		9
Dance Studio		8
Bubble Tea Shop		8
Breakfast Spot		8
Asian Restaurant	25	
Bagel Shop	33	
Burger Joint	34	
Chinese Restaurant	40	
Deli / Bodega	33	
Dessert Shop	33	
Gourmet Shop	32	
Greek Restaurant	22	
Ice Cream Shop	46	
Indian Restaurant	35	
Juice Bar	40	
Lounge	25	
Mediterranean Restaurant	34	
New American Restaurant	33	
Playground	25	
Salad Place	29	
Salon / Barbershop	32	
Spa	43	
Spanish Restaurant	22	
Wine Bar	54	
Wine Shop	60	

KMEANS clustering (Manhattan)

In [237]:
```
# set number of clusters
kclusters = 5

manhattan_grouped_clustering = manhattan_grouped.drop('Neighborhood', 1)

# run k-means clustering
kmeans = KMeans(n_clusters=kclusters, random_state=0).fit(manhattan_grouped_clustering)

# check cluster labels generated for each row in the dataframe
kmeans.labels_[0:10]
```

Out[237]:
```
array([2, 1, 1, 3, 0, 3, 3, 1, 0, 3])
```

Let's create a new dataframe that includes the cluster as well as the top 10 venues for each neighborhood.

In [238]:
```
# add clustering labels
neighborhoods_venues_sorted.insert(0, 'Cluster Labels', kmeans.labels_)

manhattan_merged = manhattan_data

# merge manhattan_grouped with manhattan_data to add latitude/longitude for each neighborhood
manhattan_merged = manhattan_merged.join(neighborhoods_venues_sorted.set_index('Neighborhood'), on='Neighborhood')

#manhattan_merged.head() # check the last columns!
```

Finally, let's visualize the resulting clusters

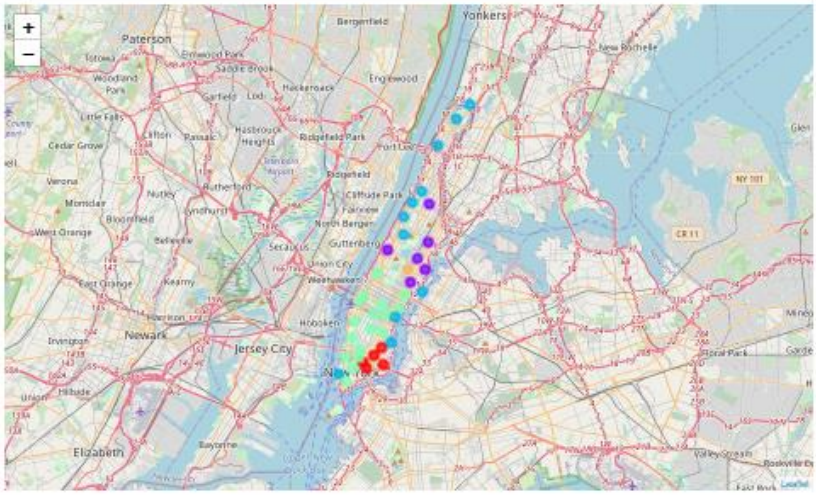
In [239]:
```
# create map
map_clusters = folium.Map(location=[latitude, longitude], zoom_start=11)

# set color scheme for the clusters
x = np.arange(kclusters)
ys = [i + x + (i*x)**2 for i in range(kclusters)]
colors_array = cm.rainbow(np.linspace(0, 1, len(ys)))
rainbow = [colors.rgb2hex(i) for i in colors_array]

# add markers to the map
markers_colors = []
for lat, lon, poi, cluster in zip(manhattan_merged['Latitude'], manhattan_merged['Longitude'], manhattan_merged['Neighborhoo
    label = folium.Popup(str(poi) + ' Cluster ' + str(cluster), parse_html=True)
    folium.CircleMarker(
        [lat, lon],
        radius=5,
        popup=label,
        color=rainbow[cluster-1],
        fill=True,
        fill_color=rainbow[cluster-1],
        fill_opacity=0.7).add_to(map_clusters)

map_clusters
```

Out[239]:



KMEANS clustering (Downtown Toronto)

In [241]:
```
# set number of clusters
kclusters = 5

DT_grouped_clustering = DT_grouped.drop('Neighborhood', 1)

# run k-means clustering
kmeansDT = KMeans(n_clusters=kclusters, random_state=0).fit(DT_grouped_clustering)

# check cluster labels generated for each row in the dataframe
kmeansDT.labels_[0:10]
```

Out[241]:
```
array([1, 4, 0, 3, 0, 0, 0, 0, 0, 0])
```

In [243]:
```
# add clustering labels
#DTneighborhoods_venues_sorted.insert(0, 'Cluster Labels', kmeansDT.labels_)

DT_merged = DT_Toronto

# merge manhattan_grouped with manhattan_data to add latitude/longitude for each neighborhood
DT_merged = DT_merged.join(DTneighborhoods_venues_sorted.set_index('Neighborhood'), on='Neighborhood')

#DT_merged.head() # check the last columns!
```

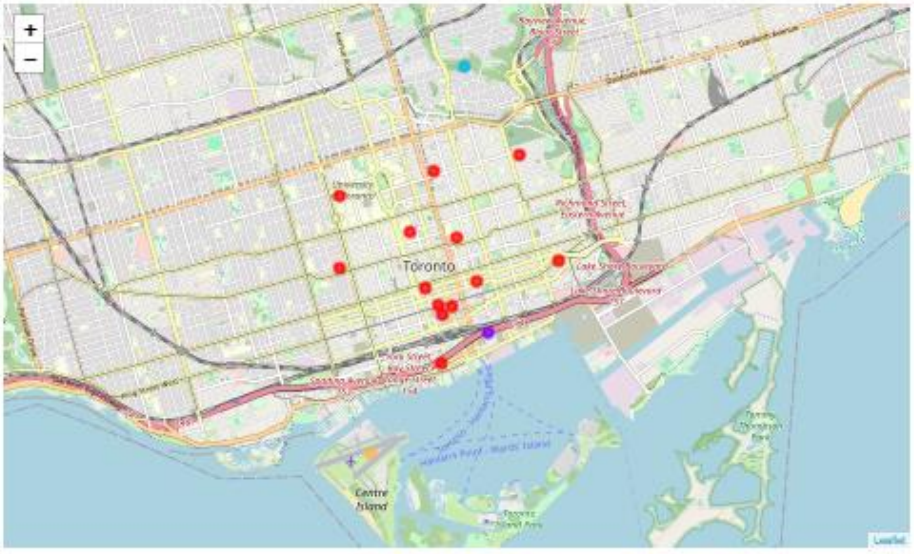
In [244]:
```
# create map
DTmap_clusters = folium.Map(location=[latitudeT, longitudeT], zoom_start=11)

# set color scheme for the clusters
x = np.arange(kclusters)
ys = [i + x + (i*x)**2 for i in range(kclusters)]
colors_array = cm.rainbow(np.linspace(0, 1, len(ys)))
rainbow = [colors.rgb2hex(i) for i in colors_array]

# add markers to the map
markers_colors = []
for lat, lon, poi, cluster in zip(DT_merged['Latitude'], DT_merged['Longitude'], DT_merged['Neighborhood'], DT_merged['Clust
    label = folium.Popup(str(poi) + ' Cluster ' + str(cluster), parse_html=True)
    folium.CircleMarker(
        [lat, lon],
        radius=5,
        popup=label,
        color=rainbow[cluster-1],
        fill=True,
        fill_color=rainbow[cluster-1],
        fill_opacity=0.7).add_to(DTmap_clusters)

DTmap_clusters
```

Out[244]:



DISCUSSION

From the maps for Manhattan and Downtown Toronto, number of Boroughs in Manhattan are 40 and situated close to each other whereas Downtown Toronto has only 17 Boroughs and they are spread wider than Manhattan. Although both Manhattan and Downtown Toronto have remarkably similar venues, Manhattan has much higher number of venues except for the number of Coffee shops. For example: Manhattan has 130 Italian restaurant, 109 Pizza places, 111 parks, 65 bars, 73 hotels, and 36 art galleries etc. in comparison Downtown Toronto has only 27 Italian restaurants, 25 Pizza places, 37 hotels, 11 bars, and 19 art galleries, respectively. Also, based on the exploration of venues, there are number of more venues in Manhattan, but appearing in Downtown Toronto, and it may be since the neighborhoods are far apart in Downtown. The number of venues may slightly vary based on the radius of exploration. Smaller radius will result in lower number of venues particularly for Downtown Toronto, since the neighborhoods are spread wider.

Both places have ample number of Coffee shops. One of the key observations is that Downtown Toronto has an airport whereas Manhattan does not have an airport. It is interesting to notice within 1000 meters radius of Manhattan there are large number of Greek, Indian, Mediterranean, Spanish restaurants whereas Downtown Toronto does not have those restaurants withing 1000 meters but may have those restaurants in the suburbs such Marcom or Scarborough.

Conclusion

Based on the above observations, it is recommended to rent a vehicle in Downtown Toronto, since the neighborhoods and venues are more spread. In Manhattan it may be walkable. Also, Downtown Toronto seems to have less hotels. Moreover, no restaurants for Indian, Greek, Spanish etc. Hence, tourists from these countries may consider visiting Manhattan.

One of the conveniences of Downtown Toronto is that the airport is situated in Downtown. Hence, it will be easier to stay closer to the airport and explore the area. Manhattan may be much crowded due to the large number of venues. People who wanted to shop, Manhattan is the place to be, since there are much more departmental stores.

Although Manhattan has more Theaters, Downtown Toronto has more concert halls which may be something the music lovers need to consider.

For families with children, there are plenty of parks in Manhattan than Downtown Toronto.

In conclusion, both Manhattan and Downtown Toronto have similar venues and hence, tourist could pick and choose different venues in different cities instead of visiting the same venues in both places. Tourists need to book the hotels much earlier in Downtown Toronto than in Manhattan, since Downtown Toronto has only half the number of hotels compared to Manhattan.