Capstone Project

Introduction

Chicago, officially the City of Chicago, is the most populous city in the U.S. state of Illinois and the third most populous city in the United States. With an estimated population of 2,705,994 (2018), it is also the most populous city in the Midwestern United States. Chicago is the county seat of Cook County, the second most populous county in the US, with portions of the northwest city limits extending into DuPage County near O'Hare Airport. Chicago is the principal city of the Chicago metropolitan area, often referred to as Chicagoland. At nearly 10 million people, the metropolitan area is the third most populous in the nation.

Chicago is an international hub for finance, culture, commerce, industry, education, technology, telecommunications, and transportation. It is the site of the creation of the first standardized futures contracts, issued by the Chicago Board of Trade, which today is the largest and most diverse derivatives market in the world, generating 20% of all volume in commodities and financial futures alone. The Chicago area has one of the highest gross domestic products (GDP) in the world, generating $680 billion in 2017. In addition, the city has one of the world's most diversified and balanced economies, with no single industry employing more than 14 percent of the workforce. Chicago is home to several Fortune 500 companies, including Allstate, Boeing, Exelon, Kraft Heinz, McDonald's, Mondelez International, Sears, United Airlines Holdings, and Walgreens.

Chicago's 58 million domestic and international visitors in 2018 made it the second most visited city in the nation, not far behind New York City's 65 million visitors in 2018. The city was ranked first in the 2018 Time Out City Life Index, a global quality of life survey of 15,000 people in 32 cities. Landmarks in the city include Millennium Park, Navy Pier, the Magnificent Mile, the Art Institute of Chicago, Museum Campus, the Willis (Sears) Tower, Grant Park, the Museum of Science and Industry, and Lincoln Park Zoo. Chicago's culture includes the visual arts, literature, film, theatre, comedy (especially improvisational comedy), food, and music, particularly jazz, blues, soul, hip-hop, gospel, and electronic dance music including house music.

This also means that the market is highly competitive. As it is highly developed city so cost of doing business is also one of the highest. Thus, any new business venture or expansion needs to be analysed carefully. The insights derived from analysis will give good understanding of the business environment which help in strategically targeting the market. This will help in reduction of risk, and the Return on Investment will be reasonable.

Business problem

Our Client has asked to research the are of Chicago for the possibility of new Movie theaters in the area. Our goal is to identify the suitable places, that have land areas available for purchase from City Govt. as well.

Find a suitable and available location.

If you plan a movie theater that provides best environemnt for entertainment, you need to look for an area greater than 5K sq/ft. So, we need to look for areas which have suitable areas for opening a movie theater.

Data Collection

We will look for a suitable place for our business based on neihborhoods in City of Chicago. For this we need relevant data to go ahead with our analysis. Data will be collected from the following, we will need names of neighborhoods, zip codes, lat,lng for map marking

- **For NeigbourHood names**: https://en.wikipedia.org/wiki/List_of_neighborhoods_in_Chicago (https://en.wikipedia.org/wiki/List_of_neighborhoods_in_Chicago)
- **For Zip Codes** https://data.cityofchicago.org/api/views/unjd-c2ca/rows.csv?accessType=DOWNLOAD (https://data.cityofchicago.org/api/views/unjd-c2ca/rows.csv?accessType=DOWNLOAD)
- **For Lat Lng** https://simplemaps.com/data/us-zips (https://simplemaps.com/data/us-zips)
- **FourSquare API for Venues** https://developer.foursquare.com/docs/resources/categories (https://developer.foursquare.com/docs/resources/categories)

After that we will form clusters and analyze which cluster have space/land for commercial activity for this data will be obatined from the following.

- **Chicago City Owned Lands** https://data.cityofchicago.org/Community-Economic-Development/City-Owned-Land-Inventory/aksk-kvfp/data (https://data.cityofchicago.org/Community-Economic-Development/City-Owned-Land-Inventory/aksk-kvfp/data)

Setting up the environment

In [2]:
```
import numpy as np
import pandas as pd
# pd.set_option('display.max_columns', None)
# pd.set_option('display.max_rows', None)

import json

from geopy.geocoders import Nominatim

from bs4 import BeautifulSoup
from urllib.request import urlopen
import requests
from pandas.io.json import json_normalize
import geocoder
import matplotlib.pyplot as plt
import matplotlib.cm as cm
import matplotlib.colors as colors
import seaborn as sns
from sklearn.cluster import KMeans
import folium
```

Geting Neighborhoods for City of Chicago

Parsing the html

In [3]:
```
url = 'https://en.wikipedia.org/wiki/List_of_neighborhoods_in_Chicago'
page = urlopen(url).read().decode('utf-8')
soup = BeautifulSoup(page, 'html.parser')

wiki_table = soup.body.table.tbody
```

Extracting data from the table to the data frame

In [4]:
```
def get_cell(element):
    cells = element.find_all('td')
    row = []

    for cell in cells:
        if cell.a:
            if (cell.a.text):
                row.append(cell.a.text)
                continue
        row.append(cell.string.strip())

    return row
```

In [5]:
```
def get_row():
    data = []

    for tr in wiki_table.find_all('tr'):
        row = get_cell(tr)
        if len(row) != 2:
            continue
        data.append(row)

    return data
```

In [6]:
```
data = get_row()
columns = ['Neighborhood', 'Community Area']
df = pd.DataFrame(data, columns=columns)
df.head()
```

Out[6]:

	Neighborhood	Community Area
0	Albany Park	Albany Park
1	Altgeld Gardens	Riverdale
2	Andersonville	Edgewater
3	Archer Heights	Archer Heights
4	Armour Square	Armour Square

In [7]:
```
df.shape
```

Out[7]:
```
(246, 2)
```

Cleaning the data

In [8]:
```
df = df[df.Neighborhood != 'Not assigned']
df = df.sort_values(by=['Neighborhood','Community Area'])

df.reset_index(inplace=True)
df.drop('index',axis=1,inplace=True)

df.head()
```

Out[8]:

	Neighborhood	Community Area
0	Albany Park	Albany Park
1	Altgeld Gardens	Riverdale
2	Andersonville	Edgewater
3	Archer Heights	Archer Heights
4	Armour Square	Armour Square

In [9]:
```
df.shape
```

Out[9]:
```
(246, 2)
```

We have our Neighborhoods but we need more info to get geographical locations. One way is to use ZipCodes and this city of chicago website (https://data.cityofchicago.org/api/views/unjd-c2ca/rows.csv?accessType=DOWNLOAD) provides relevant data.

In [10]:
```
df_zip=pd.read_csv('Zip_Codes.csv')
df_zip.head()
```

Out[10]:

	the_geom	OBJECTID	ZIP	SHAPE_AREA	SHAPE_LEN
0	MULTIPOLYGON (((-87.67762151065281 41.91775780...	33	60647	1.060523e+08	42720.044406
1	MULTIPOLYGON (((-87.72683253163021 41.92264626...	34	60639	1.274761e+08	48103.782721
2	MULTIPOLYGON (((-87.78500237831095 41.90914785...	35	60707	4.506904e+07	27288.609612
3	MULTIPOLYGON (((-87.6670686895295 41.888851884...	36	60622	7.085383e+07	42527.989679
4	MULTIPOLYGON (((-87.70655631674127 41.89555340...	37	60651	9.903962e+07	47970.140153

We only need ZIP column

In [11]:
```
df_zip=df_zip['ZIP']
```

In [12]:
```
df_zip=pd.DataFrame(df_zip)
df_zip.head()
```

Out[12]:

	ZIP
0	60647
1	60639
2	60707
3	60622
4	60651

We have Zip codes but we don't know, which Zip codes fall in which neigbourhood or what there lat, lng is so, we need to look for some data that can either provide some info that could help us in mapping these zip codes to lat lng and then to neigborhoods. The data set at SimpleMaps (https://simplemaps.com/data/us-zips) provide us with this info. So, we will use it.

In [13]:
```
df3=pd.read_csv('uszips.csv')
df3.head()
```

Out[13]:

	zip	lat	lng	city	state_id	state_name	zcta	parent_zcta	population	density
0	601	18.18004	-66.75218	Adjuntas	PR	Puerto Rico	True	NaN	18570	111.4
1	602	18.36073	-67.17517	Aguada	PR	Puerto Rico	True	NaN	41520	523.5
2	603	18.45439	-67.12202	Aguadilla	PR	Puerto Rico	True	NaN	54689	667.9
3	606	18.16724	-66.93828	Maricao	PR	Puerto Rico	True	NaN	6615	60.4
4	610	18.29032	-67.12243	Anasco	PR	Puerto Rico	True	NaN	29016	312.0

In [14]:
```
df3['city'].unique()
```

Out[14]:
```
array(['Adjuntas', 'Aguada', 'Aguadilla', ..., 'Metlakatla',
       'Point Baker', 'Wrangell'], dtype=object)
```

We only need data related to Chicago

In [15]:
```
df3=df3[df3['city']=='Chicago']
```

In [16]:
```
df3.rename(columns={'zip':'ZIP'}, inplace=True) # renaming column for merging
chicago_df=pd.merge(df_zip, df3,  how='left')
```

In [17]:
```
chicago_df
```

Out[17]:

	ZIP	lat	lng	city	state_id	state_name	zcta	parent_zcta	population	dens
0	60647	41.92068	-87.70167	Chicago	IL	Illinois	True	NaN	87291.0	838
1	60639	41.92056	-87.75603	Chicago	IL	Illinois	True	NaN	90407.0	715
2	60707	NaN	NaN	NaN	NaN	NaN	NaN	NaN	NaN	N
3	60622	41.90274	-87.68331	Chicago	IL	Illinois	True	NaN	52548.0	821
4	60651	41.90206	-87.74095	Chicago	IL	Illinois	True	NaN	64267.0	709
5	60611	41.89472	-87.61938	Chicago	IL	Illinois	True	NaN	28718.0	1356
6	60638	41.78145	-87.77056	Chicago	IL	Illinois	True	NaN	55026.0	191
7	60652	41.74795	-87.71479	Chicago	IL	Illinois	True	NaN	40959.0	315
8	60626	42.00903	-87.66963	Chicago	IL	Illinois	True	NaN	50139.0	1135
9	60615	41.80223	-87.60272	Chicago	IL	Illinois	True	NaN	40603.0	708
10	60621	41.77638	-87.63944	Chicago	IL	Illinois	True	NaN	35912.0	371
11	60645	42.00853	-87.69481	Chicago	IL	Illinois	True	NaN	45274.0	774
12	60643	41.69957	-87.66277	Chicago	IL	Illinois	True	NaN	49952.0	262
13	60660	41.99110	-87.66604	Chicago	IL	Illinois	True	NaN	42752.0	1279
14	60640	41.97236	-87.66347	Chicago	IL	Illinois	True	NaN	65790.0	1053
15	60614	41.92280	-87.65139	Chicago	IL	Illinois	True	NaN	66617.0	824
16	60631	41.99475	-87.81316	Chicago	IL	Illinois	True	NaN	28641.0	297
17	60646	41.99304	-87.75962	Chicago	IL	Illinois	True	NaN	27177.0	229
18	60628	41.69182	-87.61797	Chicago	IL	Illinois	True	NaN	72202.0	255
19	60625	41.97335	-87.70014	Chicago	IL	Illinois	True	NaN	78651.0	783
20	60641	41.94659	-87.74676	Chicago	IL	Illinois	True	NaN	71663.0	684
21	60657	41.93998	-87.65374	Chicago	IL	Illinois	True	NaN	65996.0	1120
22	60636	41.77576	-87.66912	Chicago	IL	Illinois	True	NaN	40916.0	403
23	60649	41.76303	-87.57031	Chicago	IL	Illinois	True	NaN	46650.0	614
24	60617	41.71591	-87.55431	Chicago	IL	Illinois	True	NaN	84155.0	234
25	60633	41.66435	-87.56136	Chicago	IL	Illinois	True	NaN	12927.0	48
26	60643	41.69957	-87.66277	Chicago	IL	Illinois	True	NaN	49952.0	262
27	60612	41.88033	-87.68767	Chicago	IL	Illinois	True	NaN	33472.0	344
28	60604	41.87814	-87.62837	Chicago	IL	Illinois	True	NaN	570.0	237
29	60624	41.88056	-87.72335	Chicago	IL	Illinois	True	NaN	38105.0	416
30	60656	41.97424	-87.82692	Chicago	IL	Illinois	True	NaN	27613.0	326
31	60644	41.88021	-87.75746	Chicago	IL	Illinois	True	NaN	48648.0	536
32	60655	41.69476	-87.70379	Chicago	IL	Illinois	True	NaN	28550.0	250
33	60603	41.88022	-87.62549	Chicago	IL	Illinois	True	NaN	493.0	131

	ZIP	lat	lng	city	state_id	state_name	zcta	parent_zcta	population	dens
34	60605	41.86684	-87.61983	Chicago	IL	Illinois	True	NaN	24668.0	764
35	60653	41.81925	-87.61008	Chicago	IL	Illinois	True	NaN	29908.0	495
36	60609	41.81252	-87.65565	Chicago	IL	Illinois	True	NaN	64906.0	323
37	60666	NaN	NaN	NaN	NaN	NaN	NaN	NaN	NaN	N
38	60618	41.94696	-87.70262	Chicago	IL	Illinois	True	NaN	92084.0	711
39	60616	41.84522	-87.62721	Chicago	IL	Illinois	True	NaN	48433.0	467
40	60602	41.88309	-87.62912	Chicago	IL	Illinois	True	NaN	1204.0	533
41	60601	41.88526	-87.62194	Chicago	IL	Illinois	True	NaN	11110.0	1189
42	60608	41.84876	-87.67130	Chicago	IL	Illinois	True	NaN	82739.0	506
43	60607	41.87500	-87.65157	Chicago	IL	Illinois	True	NaN	23897.0	403
44	60661	41.88307	-87.64401	Chicago	IL	Illinois	True	NaN	7792.0	1012
45	60606	41.88195	-87.63731	Chicago	IL	Illinois	True	NaN	2308.0	405
46	60827	NaN	NaN	NaN	NaN	NaN	NaN	NaN	NaN	N
47	60630	41.97215	-87.75706	Chicago	IL	Illinois	True	NaN	54093.0	437
48	60642	41.90161	-87.65803	Chicago	IL	Illinois	True	NaN	18480.0	431
49	60659	41.99108	-87.70416	Chicago	IL	Illinois	True	NaN	38104.0	725
50	60707	NaN	NaN	NaN	NaN	NaN	NaN	NaN	NaN	N
51	60634	41.94635	-87.80610	Chicago	IL	Illinois	True	NaN	74298.0	403
52	60613	41.95583	-87.65796	Chicago	IL	Illinois	True	NaN	48281.0	857
53	60610	41.90487	-87.63615	Chicago	IL	Illinois	True	NaN	37726.0	1258
54	60654	41.89227	-87.63729	Chicago	IL	Illinois	True	NaN	14875.0	1015
55	60632	41.81133	-87.71335	Chicago	IL	Illinois	True	NaN	91326.0	474
56	60623	41.84808	-87.71778	Chicago	IL	Illinois	True	NaN	92108.0	662
57	60629	41.77567	-87.71176	Chicago	IL	Illinois	True	NaN	113916.0	646
58	60620	41.74080	-87.65250	Chicago	IL	Illinois	True	NaN	72216.0	393
59	60637	41.78143	-87.60318	Chicago	IL	Illinois	True	NaN	49503.0	422
60	60619	41.74373	-87.60549	Chicago	IL	Illinois	True	NaN	63825.0	409

Drop Null Entries

In [18]:
```
chicago_df = chicago_df[np.isfinite(chicago_df['lat'])]
```

In [19]:
```
chicago_df.drop(['zcta','parent_zcta','county_fips','all_county_weights','imprec
```

```
F:\Anaconda3\lib\site-packages\pandas\core\frame.py:3697: SettingWithCopyWarnin
g:
A value is trying to be set on a copy of a slice from a DataFrame

See the caveats in the documentation: http://pandas.pydata.org/pandas-docs/stab
le/indexing.html#indexing-view-versus-copy (http://pandas.pydata.org/pandas-doc
s/stable/indexing.html#indexing-view-versus-copy)
  errors=errors)
```

In [20]:
```
chicago_df
```

Out[20]:

	ZIP	lat	lng	city	state_id	state_name	population	density	county_name
0	60647	41.92068	-87.70167	Chicago	IL	Illinois	87291.0	8385.0	Cook
1	60639	41.92056	-87.75603	Chicago	IL	Illinois	90407.0	7156.5	Cook
3	60622	41.90274	-87.68331	Chicago	IL	Illinois	52548.0	8213.0	Cook
4	60651	41.90206	-87.74095	Chicago	IL	Illinois	64267.0	7099.1	Cook
5	60611	41.89472	-87.61938	Chicago	IL	Illinois	28718.0	13562.3	Cook
6	60638	41.78145	-87.77056	Chicago	IL	Illinois	55026.0	1913.0	Cook
7	60652	41.74795	-87.71479	Chicago	IL	Illinois	40959.0	3153.6	Cook
8	60626	42.00903	-87.66963	Chicago	IL	Illinois	50139.0	11355.1	Cook
9	60615	41.80223	-87.60272	Chicago	IL	Illinois	40603.0	7086.4	Cook
10	60621	41.77638	-87.63944	Chicago	IL	Illinois	35912.0	3718.9	Cook
11	60645	42.00853	-87.69481	Chicago	IL	Illinois	45274.0	7743.1	Cook
12	60643	41.69957	-87.66277	Chicago	IL	Illinois	49952.0	2625.0	Cook
13	60660	41.99110	-87.66604	Chicago	IL	Illinois	42752.0	12796.8	Cook
14	60640	41.97236	-87.66347	Chicago	IL	Illinois	65790.0	10530.6	Cook
15	60614	41.92280	-87.65139	Chicago	IL	Illinois	66617.0	8244.5	Cook
16	60631	41.99475	-87.81316	Chicago	IL	Illinois	28641.0	2971.5	Cook
17	60646	41.99304	-87.75962	Chicago	IL	Illinois	27177.0	2295.2	Cook
18	60628	41.69182	-87.61797	Chicago	IL	Illinois	72202.0	2553.0	Cook
19	60625	41.97335	-87.70014	Chicago	IL	Illinois	78651.0	7837.6	Cook
20	60641	41.94659	-87.74676	Chicago	IL	Illinois	71663.0	6845.9	Cook
21	60657	41.93998	-87.65374	Chicago	IL	Illinois	65996.0	11207.9	Cook
22	60636	41.77576	-87.66912	Chicago	IL	Illinois	40916.0	4038.1	Cook
23	60649	41.76303	-87.57031	Chicago	IL	Illinois	46650.0	6148.9	Cook
24	60617	41.71591	-87.55431	Chicago	IL	Illinois	84155.0	2345.8	Cook
25	60633	41.66435	-87.56136	Chicago	IL	Illinois	12927.0	485.3	Cook
26	60643	41.69957	-87.66277	Chicago	IL	Illinois	49952.0	2625.0	Cook
27	60612	41.88033	-87.68767	Chicago	IL	Illinois	33472.0	3447.3	Cook
28	60604	41.87814	-87.62837	Chicago	IL	Illinois	570.0	2376.8	Cook
29	60624	41.88056	-87.72335	Chicago	IL	Illinois	38105.0	4162.1	Cook
30	60656	41.97424	-87.82692	Chicago	IL	Illinois	27613.0	3261.9	Cook
31	60644	41.88021	-87.75746	Chicago	IL	Illinois	48648.0	5360.9	Cook
32	60655	41.69476	-87.70379	Chicago	IL	Illinois	28550.0	2502.6	Cook
33	60603	41.88022	-87.62549	Chicago	IL	Illinois	493.0	1313.9	Cook
34	60605	41.86684	-87.61983	Chicago	IL	Illinois	24668.0	7647.5	Cook

	ZIP	lat	lng	city	state_id	state_name	population	density	county_name
35	60653	41.81925	-87.61008	Chicago	IL	Illinois	29908.0	4950.5	Cook
36	60609	41.81252	-87.65565	Chicago	IL	Illinois	64906.0	3237.2	Cook
38	60618	41.94696	-87.70262	Chicago	IL	Illinois	92084.0	7114.6	Cook
39	60616	41.84522	-87.62721	Chicago	IL	Illinois	48433.0	4677.4	Cook
40	60602	41.88309	-87.62912	Chicago	IL	Illinois	1204.0	5339.8	Cook
41	60601	41.88526	-87.62194	Chicago	IL	Illinois	11110.0	11892.3	Cook
42	60608	41.84876	-87.67130	Chicago	IL	Illinois	82739.0	5068.9	Cook
43	60607	41.87500	-87.65157	Chicago	IL	Illinois	23897.0	4031.2	Cook
44	60661	41.88307	-87.64401	Chicago	IL	Illinois	7792.0	10120.5	Cook
45	60606	41.88195	-87.63731	Chicago	IL	Illinois	2308.0	4051.1	Cook
47	60630	41.97215	-87.75706	Chicago	IL	Illinois	54093.0	4374.4	Cook
48	60642	41.90161	-87.65803	Chicago	IL	Illinois	18480.0	4316.4	Cook
49	60659	41.99108	-87.70416	Chicago	IL	Illinois	38104.0	7256.4	Cook
51	60634	41.94635	-87.80610	Chicago	IL	Illinois	74298.0	4033.0	Cook
52	60613	41.95583	-87.65796	Chicago	IL	Illinois	48281.0	8572.6	Cook
53	60610	41.90487	-87.63615	Chicago	IL	Illinois	37726.0	12585.9	Cook
54	60654	41.89227	-87.63729	Chicago	IL	Illinois	14875.0	10154.9	Cook
55	60632	41.81133	-87.71335	Chicago	IL	Illinois	91326.0	4744.1	Cook
56	60623	41.84808	-87.71778	Chicago	IL	Illinois	92108.0	6621.1	Cook
57	60629	41.77567	-87.71176	Chicago	IL	Illinois	113916.0	6466.2	Cook
58	60620	41.74080	-87.65250	Chicago	IL	Illinois	72216.0	3935.6	Cook
59	60637	41.78143	-87.60318	Chicago	IL	Illinois	49503.0	4220.3	Cook
60	60619	41.74373	-87.60549	Chicago	IL	Illinois	63825.0	4092.5	Cook

In [21]:
```
chicago_df['coord_pairs']=chicago_df[['lat', 'lng']].values.round(4).tolist()
```

```
F:\Anaconda3\lib\site-packages\ipykernel_launcher.py:1: SettingWithCopyWarnin
g:
A value is trying to be set on a copy of a slice from a DataFrame.
Try using .loc[row_indexer,col_indexer] = value instead

See the caveats in the documentation: http://pandas.pydata.org/pandas-docs/st
able/indexing.html#indexing-view-versus-copy (http://pandas.pydata.org/pandas
-docs/stable/indexing.html#indexing-view-versus-copy)
  """Entry point for launching an IPython kernel.
```

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

Out[22]:

	ZIP	lat	lng	city	state_id	state_name	population	density	county_name	c
0	60647	41.92068	-87.70167	Chicago	IL	Illinois	87291.0	8385.0	Cook	
1	60639	41.92056	-87.75603	Chicago	IL	Illinois	90407.0	7156.5	Cook	
3	60622	41.90274	-87.68331	Chicago	IL	Illinois	52548.0	8213.0	Cook	
4	60651	41.90206	-87.74095	Chicago	IL	Illinois	64267.0	7099.1	Cook	
5	60611	41.89472	-87.61938	Chicago	IL	Illinois	28718.0	13562.3	Cook	

Getting NeihborHood Names for Each ZIP code

We will now use geocoder to extract neighborhood names names for the lat lng pairs which are already mapped to zip codes.

In [23]:
```
def get_neighbor(latlng):
    g=geocoder.mapbox(latlng, method='reverse',key='pk.eyJ1IjoiaGNkNzQ5ODYiLCJhI
    a=g.json['raw']['neighborhood']
    return a
```

In [24]:
```
# df['Neighbour']=df['new'].apply(lambda x : get_neighbour(x))
chicago_df['Neighborhood'] = chicago_df['coord_pairs'].apply(get_neighbor)
```

```
F:\Anaconda3\lib\site-packages\ipykernel_launcher.py:2: SettingWithCopyWarnin
g:
A value is trying to be set on a copy of a slice from a DataFrame.
Try using .loc[row_indexer,col_indexer] = value instead

See the caveats in the documentation: http://pandas.pydata.org/pandas-docs/st
able/indexing.html#indexing-view-versus-copy (http://pandas.pydata.org/pandas
-docs/stable/indexing.html#indexing-view-versus-copy)
```

In [25]:
```
chicago_df.head()
```

Out[25]:

	ZIP	lat	lng	city	state_id	state_name	population	density	county_name	c
0	60647	41.92068	-87.70167	Chicago	IL	Illinois	87291.0	8385.0	Cook	
1	60639	41.92056	-87.75603	Chicago	IL	Illinois	90407.0	7156.5	Cook	
3	60622	41.90274	-87.68331	Chicago	IL	Illinois	52548.0	8213.0	Cook	
4	60651	41.90206	-87.74095	Chicago	IL	Illinois	64267.0	7099.1	Cook	
5	60611	41.89472	-87.61938	Chicago	IL	Illinois	28718.0	13562.3	Cook	

In [26]:
```
chicago_df.describe()
```

Out[26]:

	ZIP	lat	lng	population	density
count	57.000000	57.00000	57.000000	57.000000	57.000000
mean	60630.105263	41.86477	-87.674223	47902.385965	5874.859649
std	17.726780	0.09327	0.060866	26884.982808	3196.442690
min	60601.000000	41.66435	-87.826920	493.000000	485.300000
25%	60615.000000	41.78145	-87.711760	28641.000000	3447.300000
50%	60630.000000	41.88056	-87.662770	48281.000000	4950.500000
75%	60644.000000	41.93998	-87.629120	65996.000000	7743.100000
max	60661.000000	42.00903	-87.554310	113916.000000	13562.300000

In [27]:
```
chicago_df['Neighborhood'].value_counts()[:10]
```

Out[27]:
```
The Loop            5
West Rogers Park    2
East Beverly        2
South Loop          2
West Englewood      1
Hyde Park           1
Jefferson Park      1
Chatham             1
Gresham             1
West Loop Gate      1
Name: Neighborhood, dtype: int64
```

Some neighbourhoods appear to have more than 1 Zip codes, this will be surplus for us and may effect our clusters and their analysis so, we need to drop them.

In [28]:
```
chicago_df.drop_duplicates(subset ="Neighborhood", keep = 'first', inplace = Tru
```

```
F:\Anaconda3\lib\site-packages\ipykernel_launcher.py:1: SettingWithCopyWarning:
A value is trying to be set on a copy of a slice from a DataFrame

See the caveats in the documentation: http://pandas.pydata.org/pandas-docs/stab
le/indexing.html#indexing-view-versus-copy (http://pandas.pydata.org/pandas-doc
s/stable/indexing.html#indexing-view-versus-copy)
  """Entry point for launching an IPython kernel.
```

Saving the cleaned data for further analysis.

In [29]:
```
chicago_df.to_csv('Chicago.csv')
```

Getting Lat,Lng for the city of Chicago

In [30]:
```
address = 'Chicago, IL'
geolocator = Nominatim(user_agent="ch_explorer")
location = geolocator.geocode(address)
latitude = location.latitude
longitude = location.longitude
print('The geograpical coordinate of Chicago City are {}, {}.'.format(latitude,
```

```
The geograpical coordinate of Chicago City are 41.8755616, -87.6244212.
```

Create Map for Chicago and Place markers over to idenity neighborhoods

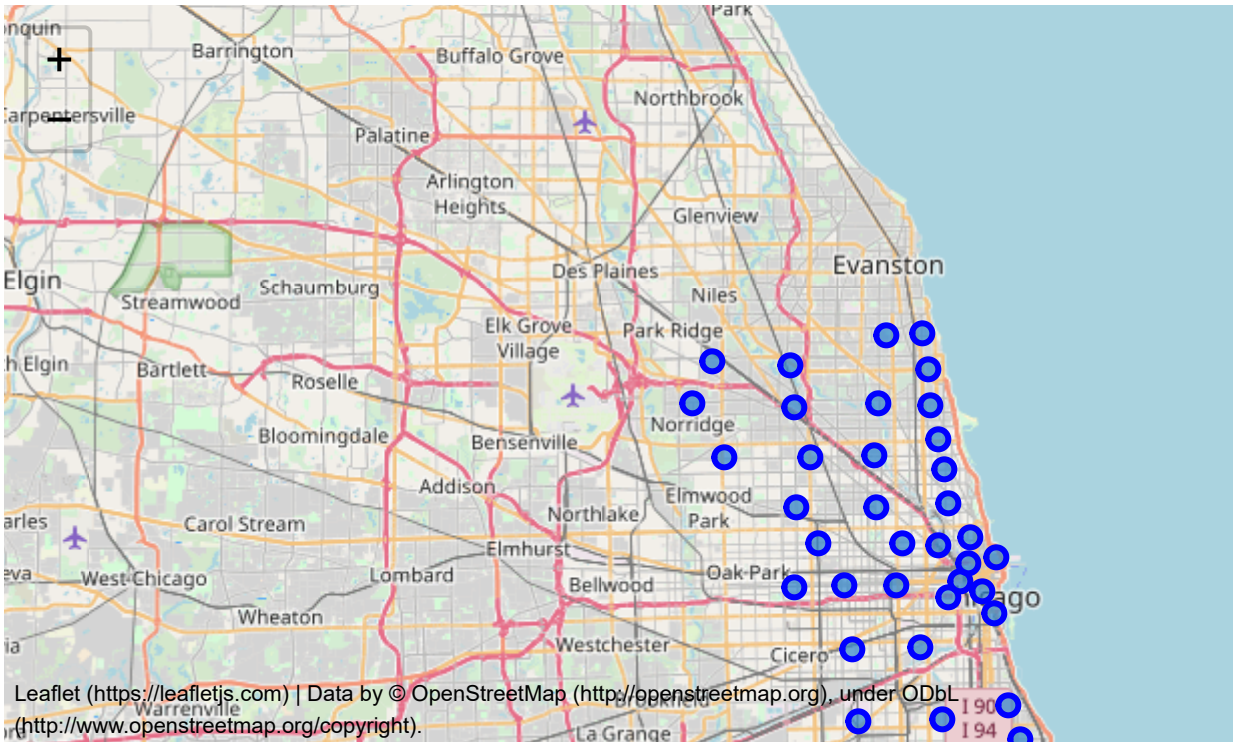
Folium is a great visualization library. We can zoom into the below map, and click on each circle mark to reveal the name of the neighborhood and its respective borough.

In [31]:
```
# create map of Chicago using latitude and longitude values
map_Chicago = folium.Map(location=[latitude, longitude], zoom_start=10)

# add markers to map
for lat, lng, neighborhood in zip(chicago_df['lat'], chicago_df['lng'], chicago_
    label = '{}'.format(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_Chicago)

map_Chicago
```

Out[31]:



Using FourSquare API to get Venues near each nei

In [32]:
```
CLIENT_ID = 'DWX0XUN1PRDFZMOZNKOAJ1PSNRN2LVMDBWWFWVDKZ1DWZGQP'# your Foursquare
CLIENT_SECRET = 'RYJECQLPYK3GLEKGQXH1LIQKXG21E1VHR3MOWYUZHDOTPWI3' # your Foursq
VERSION = '20191023'
LIMIT = 50
```

In [33]:
```
import urllib
def getNearbyVenues(names, latitudes, longitudes, radius=5000, categoryIds='4bf5
    try:
        venues_list=[]
        for name, lat, lng in zip(names, latitudes, longitudes):
            # create the API request URL
            url = 'https://api.foursquare.com/v2/venues/search?&client_id={}&clie
            if (categoryIds != ''):
                url = url + '&categoryId={}'
                url = url.format(categoryIds)
            # make the GET request
            response = requests.get(url).json()
            results = response["response"]['venues']
            # return only relevant information for each nearby venue
            for v in results:
                success = False
                try:
                    category = v['categories'][0]['name']
                    success = True
                except:
                    pass
                if success:
                    venues_list.append([(
                        name,
                        lat,
                        lng,
                        v['name'],
                        v['location']['lat'],
                        v['location']['lng'],
                        v['categories'][0]['name']
                    )])
        nearby_venues = pd.DataFrame([item for venue_list in venues_list for iter
        nearby_venues.columns = ['Neighborhood',
                  'Neighborhood Latitude',
                  'Neighborhood Longitude',
                  'Venue',
                  'Venue Latitude',
                  'Venue Longitude',
                  'Venue Category']

    except:
        print(url)
        print(response)
        print(results)
        print(nearby_venues)

    return(nearby_venues)
```

In [34]:
```
chicago_venues_ = getNearbyVenues(names=chicago_df['Neighborhood'], latitudes=ch
chicago_venues_.head()
```

Out[34]:

	Neighborhood	Neighborhood Latitude	Neighborhood Longitude	Venue	Venue Latitude	Venue Longitude	Venue Category
0	Palmer Square	41.92068	-87.70167	AMC Naperville 16	41.919169	-87.705621	Multiplex
1	Palmer Square	41.92068	-87.70167	Logan Square International Film Series	41.928527	-87.706228	Indie Movie Theater
2	Palmer Square	41.92068	-87.70167	Movies on the lawn	41.918720	-87.698418	Movie Theater
3	Palmer Square	41.92068	-87.70167	Rob's Cinema	41.923706	-87.708672	Indie Movie Theater
4	Palmer Square	41.92068	-87.70167	Red Box	41.924362	-87.710957	Movie Theater

In [35]:
```
colnames = ['Neighborhood', 'Neighborhood Latitude', 'Neighborhood Longitude', '
chicago_venues_.columns = chicago_venues_.columns.str.replace(' ', '')

chicago_venues_.shape
```

Out[35]:
```
(205, 7)
```

Checking how many Movie Theaters are in each neighborhood and find out no. of unique categories can be curated from all the returned venues

In [36]:
```
chicago_grouped = chicago_venues_.groupby('Neighborhood').count()
print('There are {} uniques categories.'.format(len(chicago_venues_['VenueCategor
chicago_grouped
```

```
There are 10 uniques categories.
```

Out[36]:

Neighborhood	NeighborhoodLatitude	NeighborhoodLongitude	Venue	VenueLatitude	VenueLongi
Ashburn	1	1	1	1	
Brighton Park	1	1	1	1	
Calumet River	2	2	2	2	
Dunning	1	1	1	1	
Edgewater Glen	8	8	8	8	
Englewood	1	1	1	1	
Goose Island	10	10	10	10	
Graceland West	9	9	9	9	
Gresham	1	1	1	1	
Hanson Park	1	1	1	1	
Heart of Chicago	1	1	1	1	
Hyde Park	3	3	3	3	
Jefferson Park	1	1	1	1	
Lake View	11	11	11	11	
Marquette Park	1	1	1	1	
O'Hare	1	1	1	1	
Old Irving Park	1	1	1	1	
Old Town	7	7	7	7	
Palmer Square	7	7	7	7	
River North	21	21	21	21	
Rogers Park	7	7	7	7	
Sheffield Neighbors	6	6	6	6	
South Loop	23	23	23	23	
South Shore	2	2	2	2	
Streeterville	23	23	23	23	
The Loop	26	26	26	26	

Neighborhood	NeighborhoodLatitude	NeighborhoodLongitude	Venue	VenueLatitude	VenueLongi
Ukrainian Village	5	5	5	5	
University Village - Little Italy	4	4	4	4	
Uptown	6	6	6	6	
West Loop Gate	12	12	12	12	
Woodlawn	2	2	2	2	

In [37]:
```
chicago_venues_.groupby('VenueCategory')['Venue'].count().sort_values(ascending=
```

Out[37]:
```
VenueCategory
Movie Theater            114
Indie Movie Theater       52
Multiplex                 28
Theater                    2
Office                     2
Lounge                     2
College Arts Building      2
Park                       1
Music Venue                1
College Library            1
Name: Venue, dtype: int64
```

We can see that the returned categories also contains some listing of offices library, which wea are not looking for. So, we need to look for only those categories that are related to our specific business type eg theater, multiples etc.

In [38]:
```
# one hot encoding
chicago_venues_onehot = pd.get_dummies(chicago_venues_[['VenueCategory']], prefi

#column lists before adding neighborhood
column_names = ['Neighborhood'] + list(chicago_venues_onehot.columns)

# add neighborhood column back to dataframe
chicago_venues_onehot['Neighborhood'] = chicago_venues_['Neighborhood']

# move neighborhood column to the first column
chicago_venues_onehot = chicago_venues_onehot[column_names]

chicago_venues_onehot.head()
```

Out[38]:

	Neighborhood	College Arts Building	College Library	Indie Movie Theater	Lounge	Movie Theater	Multiplex	Music Venue	Office	Park	The
0	Palmer Square	0	0	0	0	0	1	0	0	0	
1	Palmer Square	0	0	1	0	0	0	0	0	0	
2	Palmer Square	0	0	0	0	1	0	0	0	0	
3	Palmer Square	0	0	1	0	0	0	0	0	0	
4	Palmer Square	0	0	0	0	1	0	0	0	0	

In [39]:
```
theaters = []
search = ['Theater', 'Multiplex']
for i in chicago_venues_onehot.columns :
    if search[0] in i:
        theaters.append(i)
    if search[1] in i:
        theaters.append(i)
```

In [40]:
```
theaters
```

Out[40]:
```
['Indie Movie Theater', 'Movie Theater', 'Multiplex', 'Theater']
```

In [41]:
```
col_name = []
col_name = ['Neighborhood'] + theaters
chicago_movie_theaters = chicago_venues_onehot[col_name]
chicago_movie_theaters = chicago_movie_theaters.iloc[:,0::]
chicago_movie_theaters
```

Out[41]:

	Neighborhood	Indie Movie Theater	Movie Theater	Multiplex	Theater
0	Palmer Square	0	0	1	0
1	Palmer Square	1	0	0	0
2	Palmer Square	0	1	0	0
3	Palmer Square	1	0	0	0
4	Palmer Square	0	1	0	0
5	Palmer Square	0	1	0	0
6	Palmer Square	1	0	0	0
7	Hanson Park	0	0	1	0
8	Ukrainian Village	0	1	0	0
9	Ukrainian Village	0	1	0	0
10	Ukrainian Village	0	0	1	0
11	Ukrainian Village	1	0	0	0
12	Ukrainian Village	1	0	0	0
13	Streeterville	0	0	1	0
14	Streeterville	0	1	0	0
15	Streeterville	0	0	1	0
16	Streeterville	0	0	1	0
17	Streeterville	0	1	0	0
18	Streeterville	0	1	0	0
19	Streeterville	0	0	1	0
20	Streeterville	1	0	0	0
21	Streeterville	0	1	0	0
22	Streeterville	1	0	0	0
23	Streeterville	0	1	0	0
24	Streeterville	0	1	0	0
25	Streeterville	0	0	1	0
26	Streeterville	0	0	1	0
27	Streeterville	1	0	0	0
28	Streeterville	0	1	0	0
29	Streeterville	0	1	0	0
30	Streeterville	0	1	0	0

	Neighborhood	Indie Movie Theater	Movie Theater	Multiplex	Theater
31	Streeterville	0	1	0	0
32	Streeterville	0	1	0	0
33	Streeterville	0	1	0	0
34	Streeterville	0	1	0	0
35	Streeterville	1	0	0	0
36	Ashburn	0	0	1	0
37	Rogers Park	0	1	0	0
38	Rogers Park	0	1	0	0
39	Rogers Park	0	1	0	0
40	Rogers Park	1	0	0	0
41	Rogers Park	1	0	0	0
42	Rogers Park	0	1	0	0
43	Rogers Park	0	1	0	0
44	Hyde Park	0	1	0	0
45	Hyde Park	1	0	0	0
46	Hyde Park	1	0	0	0
47	Englewood	0	1	0	0
48	Edgewater Glen	1	0	0	0
49	Edgewater Glen	0	1	0	0
50	Edgewater Glen	0	1	0	0
51	Edgewater Glen	1	0	0	0
52	Edgewater Glen	0	1	0	0
53	Edgewater Glen	1	0	0	0
54	Edgewater Glen	0	1	0	0
55	Edgewater Glen	1	0	0	0
56	Uptown	1	0	0	0
57	Uptown	0	0	1	0
58	Uptown	0	1	0	0
59	Uptown	0	0	1	0
60	Uptown	1	0	0	0
61	Uptown	1	0	0	0
62	Sheffield Neighbors	0	1	0	0
63	Sheffield Neighbors	0	1	0	0
64	Sheffield Neighbors	0	0	0	1
65	Sheffield Neighbors	1	0	0	0
66	Sheffield Neighbors	1	0	0	0

	Neighborhood	Indie Movie Theater	Movie Theater	Multiplex	Theater
67	Sheffield Neighbors	0	1	0	0
68	Old Irving Park	0	1	0	0
69	Lake View	0	0	0	0
70	Lake View	1	0	0	0
71	Lake View	1	0	0	0
72	Lake View	1	0	0	0
73	Lake View	1	0	0	0
74	Lake View	0	1	0	0
75	Lake View	1	0	0	0
76	Lake View	0	1	0	0
77	Lake View	1	0	0	0
78	Lake View	1	0	0	0
79	Lake View	1	0	0	0
80	South Shore	0	1	0	0
81	South Shore	0	0	1	0
82	Calumet River	0	0	0	0
83	Calumet River	0	1	0	0
84	The Loop	0	1	0	0
85	The Loop	0	1	0	0
86	The Loop	0	1	0	0
87	The Loop	0	1	0	0
88	The Loop	1	0	0	0
89	The Loop	0	1	0	0
90	The Loop	0	1	0	0
91	The Loop	0	1	0	0
92	The Loop	0	1	0	0
93	The Loop	0	1	0	0
94	The Loop	0	1	0	0
95	The Loop	0	1	0	0
96	The Loop	0	1	0	0
97	The Loop	1	0	0	0
98	The Loop	0	0	0	0
99	The Loop	0	0	1	0
100	The Loop	0	1	0	0
101	The Loop	0	1	0	0
102	The Loop	0	1	0	0

	Neighborhood	Indie Movie Theater	Movie Theater	Multiplex	Theater
103	The Loop	0	1	0	0
104	The Loop	0	0	1	0
105	The Loop	1	0	0	0
106	The Loop	1	0	0	0
107	The Loop	0	1	0	0
108	The Loop	0	0	0	0
109	The Loop	0	0	1	0
110	O'Hare	0	0	1	0
111	South Loop	0	1	0	0
112	South Loop	0	1	0	0
113	South Loop	0	1	0	0
114	South Loop	0	1	0	0
115	South Loop	0	1	0	0
116	South Loop	0	1	0	0
117	South Loop	0	0	0	0
118	South Loop	0	1	0	0
119	South Loop	0	1	0	0
120	South Loop	0	0	1	0
121	South Loop	0	1	0	0
122	South Loop	0	1	0	0
123	South Loop	0	1	0	0
124	South Loop	0	0	1	0
125	South Loop	0	1	0	0
126	South Loop	0	1	0	0
127	South Loop	0	1	0	0
128	South Loop	0	1	0	0
129	South Loop	0	1	0	0
130	South Loop	0	0	1	0
131	South Loop	0	0	0	0
132	South Loop	0	0	1	0
133	South Loop	1	0	0	0
134	Heart of Chicago	1	0	0	0
135	University Village - Little Italy	0	1	0	0
136	University Village - Little Italy	0	1	0	0
137	University Village - Little Italy	1	0	0	0
138	University Village - Little Italy	0	1	0	0

	Neighborhood	Indie Movie Theater	Movie Theater	Multiplex	Theater
139	West Loop Gate	0	1	0	0
140	West Loop Gate	0	1	0	0
141	West Loop Gate	0	1	0	0
142	West Loop Gate	0	1	0	0
143	West Loop Gate	0	1	0	0
144	West Loop Gate	0	1	0	0
145	West Loop Gate	0	1	0	0
146	West Loop Gate	0	0	0	0
147	West Loop Gate	0	1	0	0
148	West Loop Gate	0	1	0	0
149	West Loop Gate	1	0	0	0
150	West Loop Gate	0	1	0	0
151	Jefferson Park	0	0	1	0
152	Goose Island	0	1	0	0
153	Goose Island	1	0	0	0
154	Goose Island	0	1	0	0
155	Goose Island	1	0	0	0
156	Goose Island	1	0	0	0
157	Goose Island	1	0	0	0
158	Goose Island	0	0	0	1
159	Goose Island	1	0	0	0
160	Goose Island	0	1	0	0
161	Goose Island	0	1	0	0
162	Dunning	0	0	1	0
163	Graceland West	1	0	0	0
164	Graceland West	1	0	0	0
165	Graceland West	1	0	0	0
166	Graceland West	0	1	0	0
167	Graceland West	1	0	0	0
168	Graceland West	0	0	1	0
169	Graceland West	0	1	0	0
170	Graceland West	0	1	0	0
171	Graceland West	0	0	1	0
172	Old Town	0	1	0	0
173	Old Town	0	1	0	0
174	Old Town	0	1	0	0

	Neighborhood	Indie Movie Theater	Movie Theater	Multiplex	Theater
175	Old Town	0	1	0	0
176	Old Town	0	1	0	0
177	Old Town	0	1	0	0
178	Old Town	0	1	0	0
179	River North	0	1	0	0
180	River North	0	1	0	0
181	River North	0	1	0	0
182	River North	0	1	0	0
183	River North	0	1	0	0
184	River North	0	1	0	0
185	River North	0	0	1	0
186	River North	0	1	0	0
187	River North	1	0	0	0
188	River North	0	1	0	0
189	River North	1	0	0	0
190	River North	0	1	0	0
191	River North	0	0	0	0
192	River North	0	0	1	0
193	River North	0	1	0	0
194	River North	0	1	0	0
195	River North	0	1	0	0
196	River North	0	1	0	0
197	River North	0	1	0	0
198	River North	0	1	0	0
199	River North	1	0	0	0
200	Brighton Park	0	1	0	0
201	Marquette Park	1	0	0	0
202	Gresham	0	0	1	0
203	Woodlawn	1	0	0	0
204	Woodlawn	0	0	0	0

In [42]:
```
chicago_movie_theaters_grouped = chicago_movie_theaters.groupby('Neighborhood').
```

In [43]:
```
chicago_movie_theaters_grouped['Total'] = chicago_movie_theaters_grouped .sum(ax
chicago_movie_theaters_grouped
```

Out[43]:

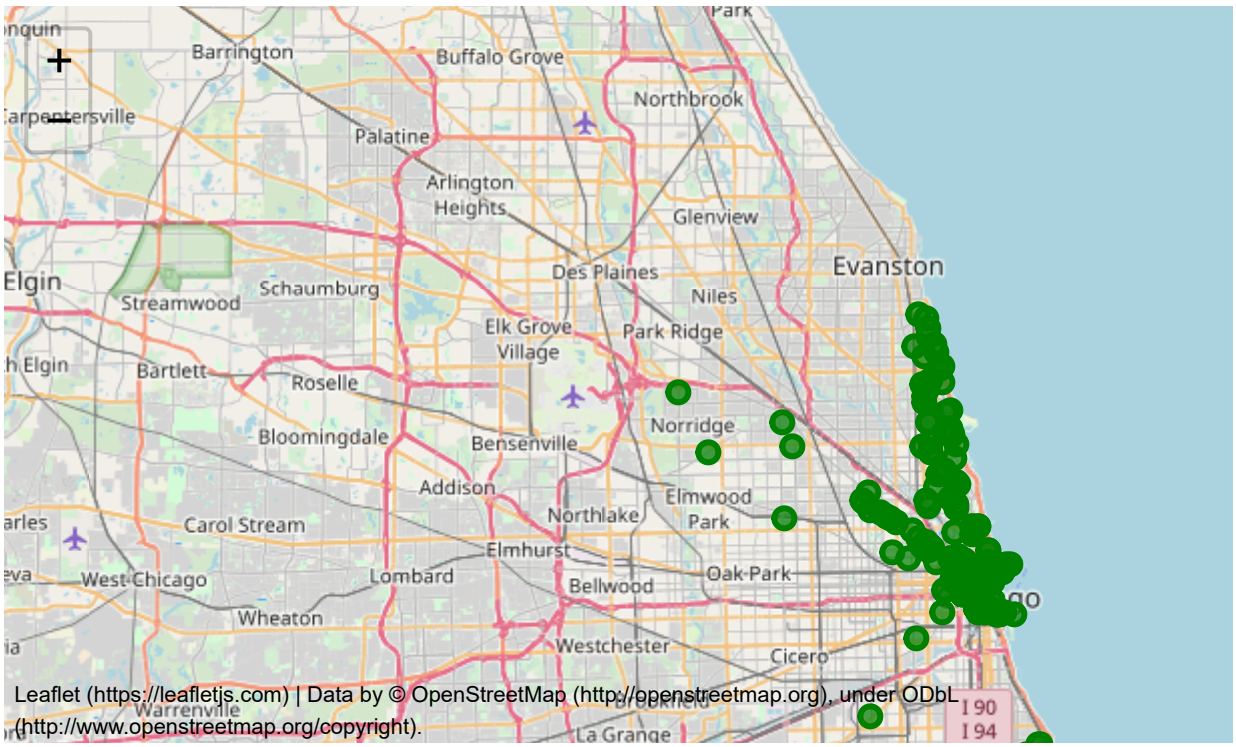
	Neighborhood	Indie Movie Theater	Movie Theater	Multiplex	Theater	Total
0	Ashburn	0	0	1	0	1
1	Brighton Park	0	1	0	0	1
2	Calumet River	0	1	0	0	1
3	Dunning	0	0	1	0	1
4	Edgewater Glen	4	4	0	0	8
5	Englewood	0	1	0	0	1
6	Goose Island	5	4	0	1	10
7	Graceland West	4	3	2	0	9
8	Gresham	0	0	1	0	1
9	Hanson Park	0	0	1	0	1
10	Heart of Chicago	1	0	0	0	1
11	Hyde Park	2	1	0	0	3
12	Jefferson Park	0	0	1	0	1
13	Lake View	8	2	0	0	10
14	Marquette Park	1	0	0	0	1
15	O'Hare	0	0	1	0	1
16	Old Irving Park	0	1	0	0	1
17	Old Town	0	7	0	0	7
18	Palmer Square	3	3	1	0	7
19	River North	3	15	2	0	20
20	Rogers Park	2	5	0	0	7
21	Sheffield Neighbors	2	3	0	1	6
22	South Loop	1	16	4	0	21
23	South Shore	0	1	1	0	2
24	Streeterville	4	13	6	0	23
25	The Loop	4	17	3	0	24
26	Ukrainian Village	2	2	1	0	5
27	University Village - Little Italy	1	3	0	0	4
28	Uptown	3	1	2	0	6
29	West Loop Gate	1	10	0	0	11
30	Woodlawn	1	0	0	0	1

In [44]:
```
def addToMap(df, color, existingMap):
    for lat, lng, local, venue, venueCat in zip(df['VenueLatitude'], df['VenueLo
        label = '{} ({}) - {}'.format(venue, venueCat, local)
        label = folium.Popup(label, parse_html=True)
        folium.CircleMarker(
            [lat, lng],
            radius=5,
            popup=label,
            color=color,
            fill=True,
            fill_color=color,
            fill_opacity=0.7).add_to(existingMap)
```

In [45]:
```
map_chicago_ = folium.Map(location=[latitude, longitude], zoom_start=10)
addToMap(chicago_venues_, 'green', map_chicago_)

map_chicago_
```

Out[45]:



In [46]:
```
chicago_grouped = chicago_venues_onehot.groupby('Neighborhood').mean().reset_inde
chicago_grouped
```

Out[46]:

	Neighborhood	College Arts Building	College Library	Indie Movie Theater	Lounge	Movie Theater	Multiplex	Music Venue	Office
0	Ashburn	0.000000	0.0	0.000000	0.000000	0.000000	1.000000	0.000000	0.000000
1	Brighton Park	0.000000	0.0	0.000000	0.000000	1.000000	0.000000	0.000000	0.000000
2	Calumet River	0.000000	0.0	0.000000	0.000000	0.500000	0.000000	0.000000	0.000000
3	Dunning	0.000000	0.0	0.000000	0.000000	0.000000	1.000000	0.000000	0.000000
4	Edgewater Glen	0.000000	0.0	0.500000	0.000000	0.500000	0.000000	0.000000	0.000000
5	Englewood	0.000000	0.0	0.000000	0.000000	1.000000	0.000000	0.000000	0.000000
6	Goose Island	0.000000	0.0	0.500000	0.000000	0.400000	0.000000	0.000000	0.000000
7	Graceland West	0.000000	0.0	0.444444	0.000000	0.333333	0.222222	0.000000	0.000000
8	Gresham	0.000000	0.0	0.000000	0.000000	0.000000	1.000000	0.000000	0.000000
9	Hanson Park	0.000000	0.0	0.000000	0.000000	0.000000	1.000000	0.000000	0.000000
10	Heart of Chicago	0.000000	0.0	1.000000	0.000000	0.000000	0.000000	0.000000	0.000000
11	Hyde Park	0.000000	0.0	0.666667	0.000000	0.333333	0.000000	0.000000	0.000000
12	Jefferson Park	0.000000	0.0	0.000000	0.000000	0.000000	1.000000	0.000000	0.000000
13	Lake View	0.000000	0.0	0.727273	0.000000	0.181818	0.000000	0.090909	0.000000
14	Marquette Park	0.000000	0.0	1.000000	0.000000	0.000000	0.000000	0.000000	0.000000
15	O'Hare	0.000000	0.0	0.000000	0.000000	0.000000	1.000000	0.000000	0.000000
16	Old Irving Park	0.000000	0.0	0.000000	0.000000	1.000000	0.000000	0.000000	0.000000
17	Old Town	0.000000	0.0	0.000000	0.000000	1.000000	0.000000	0.000000	0.000000
18	Palmer Square	0.000000	0.0	0.428571	0.000000	0.428571	0.142857	0.000000	0.000000
19	River North	0.000000	0.0	0.142857	0.000000	0.714286	0.095238	0.000000	0.047619
20	Rogers Park	0.000000	0.0	0.285714	0.000000	0.714286	0.000000	0.000000	0.000000
21	Sheffield Neighbors	0.000000	0.0	0.333333	0.000000	0.500000	0.000000	0.000000	0.000000
22	South Loop	0.043478	0.0	0.043478	0.043478	0.695652	0.173913	0.000000	0.000000
23	South Shore	0.000000	0.0	0.000000	0.000000	0.500000	0.500000	0.000000	0.000000
24	Streeterville	0.000000	0.0	0.173913	0.000000	0.565217	0.260870	0.000000	0.000000
25	The Loop	0.038462	0.0	0.153846	0.038462	0.653846	0.115385	0.000000	0.000000
26	Ukrainian Village	0.000000	0.0	0.400000	0.000000	0.400000	0.200000	0.000000	0.000000
27	University Village - Little Italy	0.000000	0.0	0.250000	0.000000	0.750000	0.000000	0.000000	0.000000

	Neighborhood	College Arts Building	College Library	Indie Movie Theater	Lounge	Movie Theater	Multiplex	Music Venue	Office
28	Uptown	0.000000	0.0	0.500000	0.000000	0.166667	0.333333	0.000000	0.000000
29	West Loop Gate	0.000000	0.0	0.083333	0.000000	0.833333	0.000000	0.000000	0.083333
30	Woodlawn	0.000000	0.5	0.500000	0.000000	0.000000	0.000000	0.000000	0.000000

In [47]:
```
def return_most_common_venues(row, num_top_venues):
    row_categories = row.iloc[1:]
    row_categories_sorted = row_categories.sort_values(ascending=False)

    return row_categories_sorted.index.values[0:num_top_venues]
```

In [48]:
```
num_top_venues = 5

indicators = ['st', 'nd', 'rd']

# create columns according to number of top venues
columns = ['Neighborhood']
for ind in np.arange(num_top_venues):
    try:
        columns.append('{}{} Most Common Venue'.format(ind+1, indicators[ind]))
    except:
        columns.append('{}th Most Common Venue'.format(ind+1))

# create a new dataframe
neighborhoods_venues_sorted = pd.DataFrame(columns=columns)
neighborhoods_venues_sorted['Neighborhood'] = chicago_movie_theaters_grouped['Ne

for ind in np.arange(chicago_grouped.shape[0]):
    neighborhoods_venues_sorted.iloc[ind, 1:] = return_most_common_venues(chicag

neighborhoods_venues_sorted.head()
```

Out[48]:

	Neighborhood	1st Most Common Venue	2nd Most Common Venue	3rd Most Common Venue	4th Most Common Venue	5th Most Common Venue
0	Ashburn	Total	Multiplex	Theater	Movie Theater	Indie Movie Theater
1	Brighton Park	Total	Movie Theater	Theater	Multiplex	Indie Movie Theater
2	Calumet River	Total	Movie Theater	Theater	Multiplex	Indie Movie Theater
3	Dunning	Total	Multiplex	Theater	Movie Theater	Indie Movie Theater
4	Edgewater Glen	Total	Movie Theater	Indie Movie Theater	Theater	Multiplex

Clustering of NeighborHood and analysis

In [49]:
```
# set number of clusters
kclusters = 5

chicago_grouped_clustering = chicago_movie_theaters_grouped.drop('Neighborhood',

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

# check cluster labels generated for each row in the dataframe
kmeans.labels_[0:50]
```

Out[49]:
```
array([0, 0, 0, 0, 2, 0, 2, 2, 0, 0, 0, 0, 0, 2, 0, 0, 0, 3, 4, 1, 4, 4,
       1, 0, 1, 1, 4, 4, 4, 3, 0])
```

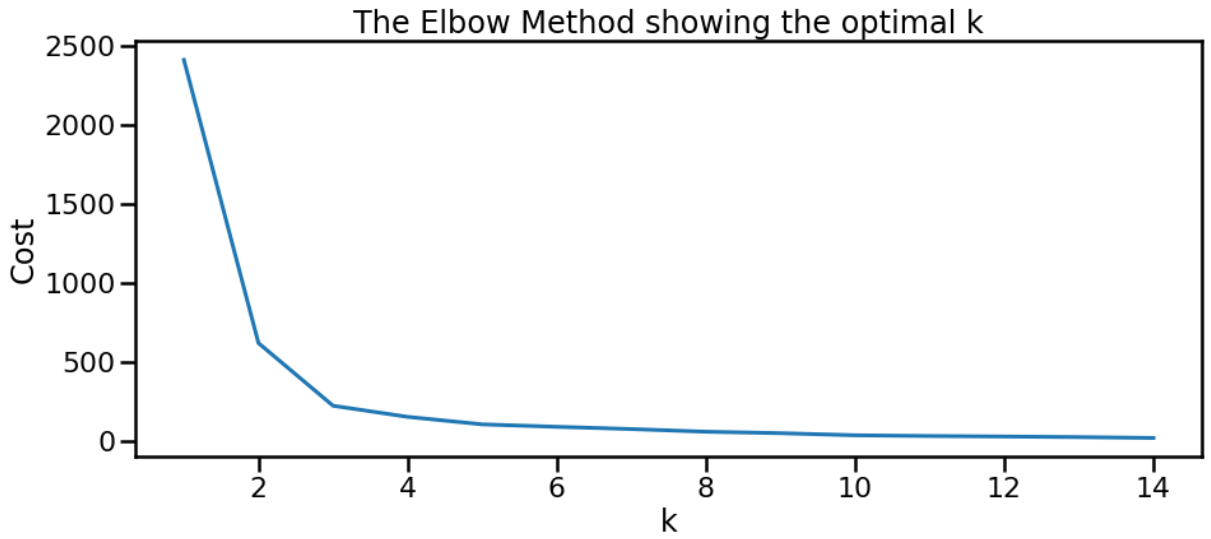
Getting Optimal Value of K

In [50]:
```
cost = []
for k in range(1, 15):
    kmeanModel = KMeans(n_clusters=k, random_state=0).fit(chicago_grouped_cluste
    cost.append([k,kmeanModel.inertia_])
```

In [51]:
```
cost
```

Out[51]:
```
[[1, 2408.903225806452],
 [2, 619.7962962962963],
 [3, 223.78409090909088],
 [4, 153.65277777777777],
 [5, 106.23333333333335],
 [6, 90.73333333333333],
 [7, 76.53333333333335],
 [8, 59.63333333333334],
 [9, 50.5],
 [10, 37.16666666666667],
 [11, 32.666666666666664],
 [12, 29.333333333333336],
 [13, 25.666666666666664],
 [14, 20.333333333333336]]
```

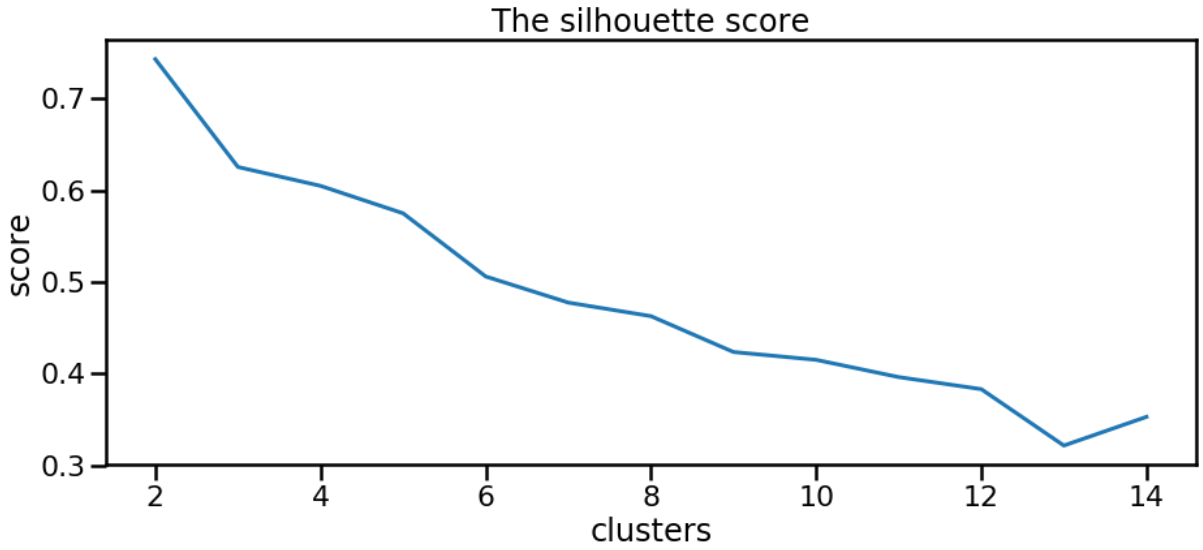
In [52]:
```
plt.figure(figsize=(15,6))
sns.set_context('poster')
plt.plot(pd.DataFrame(cost)[0], pd.DataFrame(cost)[1])
plt.xlabel('k')
plt.ylabel('Cost')
plt.title('The Elbow Method showing the optimal k')
plt.show()
```



In [53]:
```
from sklearn.metrics import silhouette_score
```

In [54]:
```
s_score = []
for k in range(2, 15):
    kmeans = KMeans(n_clusters=k, random_state=0).fit(chicago_grouped_clustering
    s_score.append([k, silhouette_score(chicago_grouped_clustering, kmeans.label
```

In [55]:
```
plt.figure(figsize=(15,6))
sns.set_context('poster')
plt.plot( pd.DataFrame(s_score)[0], pd.DataFrame(s_score)[1])
plt.xlabel('clusters')
plt.ylabel('score')
plt.title('The silhouette score')
plt.show()
```



From the above two Graphs it is very much clear that K=2 is optimal.

Elbow is formed at n=2 and value of Silhouette Score is also greater at n=2

In [56]:
```
# set number of clusters
kclusters = 2

chicago_grouped_clustering = chicago_movie_theaters_grouped.drop('Neighborhood',

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

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

Out[56]:
```
array([0, 0, 0, 0, 0, 0, 0, 0, 0, 0])
```

In [57]:
```
CMT_results = pd.DataFrame(kmeans.cluster_centers_)
CMT_results.columns = chicago_grouped_clustering.columns
CMT_results.index = ['cluster0','cluster1']
CMT_results['Total Sum'] = CMT_results.sum(axis = 1)
CMT_results
```

Out[57]:

	Indie Movie Theater	Movie Theater	Multiplex	Theater	Total	Total Sum
cluster0	1.481481	1.962963	0.481481	0.074074	4.0	8.0
cluster1	3.000000	15.250000	3.750000	0.000000	22.0	44.0

In [58]:
```
CMT_results_merged = pd.DataFrame(chicago_movie_theaters_grouped['Neighborhood'],

CMT_results_merged['Total'] = chicago_movie_theaters_grouped['Total']
CMT_results_merged = CMT_results_merged.assign(Cluster_Labels = kmeans.labels_)
CMT_results_merged
```

Out[58]:

	Neighborhood	Total	Cluster_Labels
0	Ashburn	1	0
1	Brighton Park	1	0
2	Calumet River	1	0
3	Dunning	1	0
4	Edgewater Glen	8	0
5	Englewood	1	0
6	Goose Island	10	0
7	Graceland West	9	0
8	Gresham	1	0
9	Hanson Park	1	0
10	Heart of Chicago	1	0
11	Hyde Park	3	0
12	Jefferson Park	1	0
13	Lake View	10	0
14	Marquette Park	1	0
15	O'Hare	1	0
16	Old Irving Park	1	0
17	Old Town	7	0
18	Palmer Square	7	0
19	River North	20	1
20	Rogers Park	7	0
21	Sheffield Neighbors	6	0
22	South Loop	21	1
23	South Shore	2	0
24	Streeterville	23	1
25	The Loop	24	1
26	Ukrainian Village	5	0
27	University Village - Little Italy	4	0
28	Uptown	6	0
29	West Loop Gate	11	0
30	Woodlawn	1	0

Joining The cluster labels with the original DataFrame

In [59]:
```
chicago_df
```

Out[59]:

	ZIP	lat	lng	city	state_id	state_name	population	density	county_name
0	60647	41.92068	-87.70167	Chicago	IL	Illinois	87291.0	8385.0	Cook
1	60639	41.92056	-87.75603	Chicago	IL	Illinois	90407.0	7156.5	Cook
3	60622	41.90274	-87.68331	Chicago	IL	Illinois	52548.0	8213.0	Cook
4	60651	41.90206	-87.74095	Chicago	IL	Illinois	64267.0	7099.1	Cook
5	60611	41.89472	-87.61938	Chicago	IL	Illinois	28718.0	13562.3	Cook
6	60638	41.78145	-87.77056	Chicago	IL	Illinois	55026.0	1913.0	Cook
7	60652	41.74795	-87.71479	Chicago	IL	Illinois	40959.0	3153.6	Cook
8	60626	42.00903	-87.66963	Chicago	IL	Illinois	50139.0	11355.1	Cook
9	60615	41.80223	-87.60272	Chicago	IL	Illinois	40603.0	7086.4	Cook
10	60621	41.77638	-87.63944	Chicago	IL	Illinois	35912.0	3718.9	Cook
11	60645	42.00853	-87.69481	Chicago	IL	Illinois	45274.0	7743.1	Cook
12	60643	41.69957	-87.66277	Chicago	IL	Illinois	49952.0	2625.0	Cook
13	60660	41.99110	-87.66604	Chicago	IL	Illinois	42752.0	12796.8	Cook
14	60640	41.97236	-87.66347	Chicago	IL	Illinois	65790.0	10530.6	Cook
15	60614	41.92280	-87.65139	Chicago	IL	Illinois	66617.0	8244.5	Cook
16	60631	41.99475	-87.81316	Chicago	IL	Illinois	28641.0	2971.5	Cook
17	60646	41.99304	-87.75962	Chicago	IL	Illinois	27177.0	2295.2	Cook
18	60628	41.69182	-87.61797	Chicago	IL	Illinois	72202.0	2553.0	Cook
19	60625	41.97335	-87.70014	Chicago	IL	Illinois	78651.0	7837.6	Cook
20	60641	41.94659	-87.74676	Chicago	IL	Illinois	71663.0	6845.9	Cook
21	60657	41.93998	-87.65374	Chicago	IL	Illinois	65996.0	11207.9	Cook
22	60636	41.77576	-87.66912	Chicago	IL	Illinois	40916.0	4038.1	Cook

	ZIP	lat	lng	city	state_id	state_name	population	density	county_name
23	60649	41.76303	-87.57031	Chicago	IL	Illinois	46650.0	6148.9	Cook
24	60617	41.71591	-87.55431	Chicago	IL	Illinois	84155.0	2345.8	Cook
25	60633	41.66435	-87.56136	Chicago	IL	Illinois	12927.0	485.3	Cook
27	60612	41.88033	-87.68767	Chicago	IL	Illinois	33472.0	3447.3	Cook
28	60604	41.87814	-87.62837	Chicago	IL	Illinois	570.0	2376.8	Cook
29	60624	41.88056	-87.72335	Chicago	IL	Illinois	38105.0	4162.1	Cook
30	60656	41.97424	-87.82692	Chicago	IL	Illinois	27613.0	3261.9	Cook
31	60644	41.88021	-87.75746	Chicago	IL	Illinois	48648.0	5360.9	Cook
32	60655	41.69476	-87.70379	Chicago	IL	Illinois	28550.0	2502.6	Cook
34	60605	41.86684	-87.61983	Chicago	IL	Illinois	24668.0	7647.5	Cook
35	60653	41.81925	-87.61008	Chicago	IL	Illinois	29908.0	4950.5	Cook
36	60609	41.81252	-87.65565	Chicago	IL	Illinois	64906.0	3237.2	Cook
38	60618	41.94696	-87.70262	Chicago	IL	Illinois	92084.0	7114.6	Cook
42	60608	41.84876	-87.67130	Chicago	IL	Illinois	82739.0	5068.9	Cook
43	60607	41.87500	-87.65157	Chicago	IL	Illinois	23897.0	4031.2	Cook
44	60661	41.88307	-87.64401	Chicago	IL	Illinois	7792.0	10120.5	Cook
47	60630	41.97215	-87.75706	Chicago	IL	Illinois	54093.0	4374.4	Cook
48	60642	41.90161	-87.65803	Chicago	IL	Illinois	18480.0	4316.4	Cook
51	60634	41.94635	-87.80610	Chicago	IL	Illinois	74298.0	4033.0	Cook
52	60613	41.95583	-87.65796	Chicago	IL	Illinois	48281.0	8572.6	Cook
53	60610	41.90487	-87.63615	Chicago	IL	Illinois	37726.0	12585.9	Cook
54	60654	41.89227	-87.63729	Chicago	IL	Illinois	14875.0	10154.9	Cook
55	60632	41.81133	-87.71335	Chicago	IL	Illinois	91326.0	4744.1	Cook

	ZIP	lat	lng	city	state_id	state_name	population	density	county_name
56	60623	41.84808	-87.71778	Chicago	IL	Illinois	92108.0	6621.1	Cook
57	60629	41.77567	-87.71176	Chicago	IL	Illinois	113916.0	6466.2	Cook
58	60620	41.74080	-87.65250	Chicago	IL	Illinois	72216.0	3935.6	Cook
59	60637	41.78143	-87.60318	Chicago	IL	Illinois	49503.0	4220.3	Cook
60	60619	41.74373	-87.60549	Chicago	IL	Illinois	63825.0	4092.5	Cook

In [60]:
```
# add clustering labels
# neighborhoods_venues_sorted.insert(0, 'Cluster Labels', kmeans.labels_)
chicago_df_merge = chicago_df
chicago_df_merge = chicago_df_merge.join(CMT_results_merged.set_index('Neighborh
```

In [61]:
```
# chicago_df_merge['Cluster_Labels']=chicago_df_merge['Cluster_Labels'].astype('
# chicago_df_merge['Cluster_Labels'] = np.where(chicago_df_merge['Cluster_Labels
```

The clustering we performed was for NeigbourHoods which only had movie theaters, but after joining with original data we found that many neighbourhoods didn't even had any movie theater. So, for sake of analysis and visulaizations we will them with our own cluster value

In [62]:
```
chicago_df_merge['Cluster_Labels'].fillna(2, inplace=True)
```

In [63]:
```
chicago_df_merge['Cluster_Labels']=chicago_df_merge['Cluster_Labels'].astype('in
```

In [64]:
```
chicago_df_merge['Total'].fillna(0, inplace=True)
```

In [65]:
```
chicago_df_merge.head()
```

Out[65]:

	ZIP	lat	lng	city	state_id	state_name	population	density	county_name	c
0	60647	41.92068	-87.70167	Chicago	IL	Illinois	87291.0	8385.0	Cook	
1	60639	41.92056	-87.75603	Chicago	IL	Illinois	90407.0	7156.5	Cook	
3	60622	41.90274	-87.68331	Chicago	IL	Illinois	52548.0	8213.0	Cook	
4	60651	41.90206	-87.74095	Chicago	IL	Illinois	64267.0	7099.1	Cook	
5	60611	41.89472	-87.61938	Chicago	IL	Illinois	28718.0	13562.3	Cook	

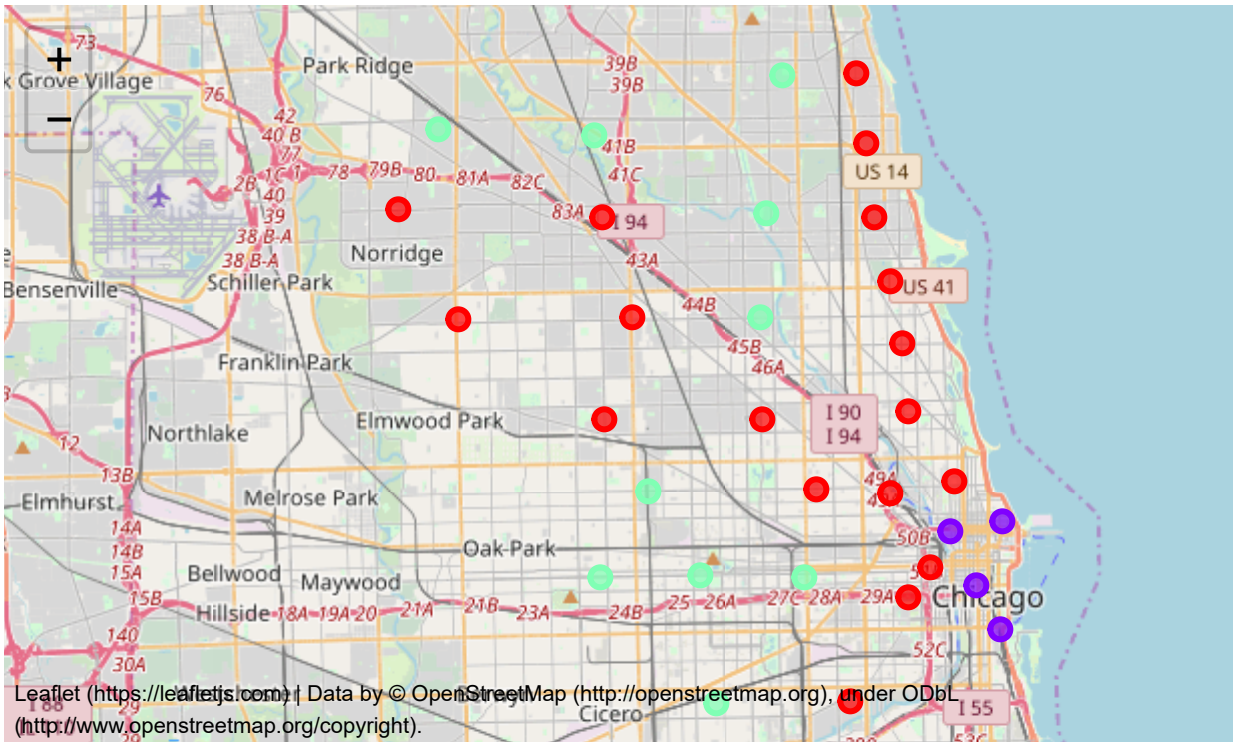
In [66]:
```
# create map
map_clusters = folium.Map(location=[latitude, longitude], zoom_start=11)

# set color scheme for the clusters
kclusters=3
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(chicago_df_merge['lat'], chicago_df_merge['lng
    label = folium.Popup(str(poi) + ' Cluster ' + str(cluster), parse_html=True)
#     print(cluster)
    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[66]:



Markets with few installments

In [67]:
```
chicago_df_merge[chicago_df_merge['Cluster_Labels'] == 0].reset_index(drop=True)
```

Out[67]:

	ZIP	lat	lng	city	state_id	state_name	population	density	county_name
0	60647	41.92068	-87.70167	Chicago	IL	Illinois	87291.0	8385.0	Cook
1	60639	41.92056	-87.75603	Chicago	IL	Illinois	90407.0	7156.5	Cook
2	60622	41.90274	-87.68331	Chicago	IL	Illinois	52548.0	8213.0	Cook
3	60652	41.74795	-87.71479	Chicago	IL	Illinois	40959.0	3153.6	Cook
4	60626	42.00903	-87.66963	Chicago	IL	Illinois	50139.0	11355.1	Cook
5	60615	41.80223	-87.60272	Chicago	IL	Illinois	40603.0	7086.4	Cook
6	60621	41.77638	-87.63944	Chicago	IL	Illinois	35912.0	3718.9	Cook
7	60660	41.99110	-87.66604	Chicago	IL	Illinois	42752.0	12796.8	Cook
8	60640	41.97236	-87.66347	Chicago	IL	Illinois	65790.0	10530.6	Cook
9	60614	41.92280	-87.65139	Chicago	IL	Illinois	66617.0	8244.5	Cook
10	60641	41.94659	-87.74676	Chicago	IL	Illinois	71663.0	6845.9	Cook
11	60657	41.93998	-87.65374	Chicago	IL	Illinois	65996.0	11207.9	Cook
12	60649	41.76303	-87.57031	Chicago	IL	Illinois	46650.0	6148.9	Cook
13	60633	41.66435	-87.56136	Chicago	IL	Illinois	12927.0	485.3	Cook
14	60656	41.97424	-87.82692	Chicago	IL	Illinois	27613.0	3261.9	Cook
15	60608	41.84876	-87.67130	Chicago	IL	Illinois	82739.0	5068.9	Cook
16	60607	41.87500	-87.65157	Chicago	IL	Illinois	23897.0	4031.2	Cook
17	60661	41.88307	-87.64401	Chicago	IL	Illinois	7792.0	10120.5	Cook
18	60630	41.97215	-87.75706	Chicago	IL	Illinois	54093.0	4374.4	Cook
19	60642	41.90161	-87.65803	Chicago	IL	Illinois	18480.0	4316.4	Cook
20	60634	41.94635	-87.80610	Chicago	IL	Illinois	74298.0	4033.0	Cook
21	60613	41.95583	-87.65796	Chicago	IL	Illinois	48281.0	8572.6	Cook

	ZIP	lat	lng	city	state_id	state_name	population	density	county_name
22	60610	41.90487	-87.63615	Chicago	IL	Illinois	37726.0	12585.9	Cook
23	60632	41.81133	-87.71335	Chicago	IL	Illinois	91326.0	4744.1	Cook
24	60629	41.77567	-87.71176	Chicago	IL	Illinois	113916.0	6466.2	Cook
25	60620	41.74080	-87.65250	Chicago	IL	Illinois	72216.0	3935.6	Cook
26	60637	41.78143	-87.60318	Chicago	IL	Illinois	49503.0	4220.3	Cook

Conjusted Markets

In [68]:
```
chicago_df_merge[chicago_df_merge['Cluster_Labels'] == 1].reset_index(drop=True)
```

Out[68]:

	ZIP	lat	lng	city	state_id	state_name	population	density	county_name	c
0	60611	41.89472	-87.61938	Chicago	IL	Illinois	28718.0	13562.3	Cook	
1	60604	41.87814	-87.62837	Chicago	IL	Illinois	570.0	2376.8	Cook	
2	60605	41.86684	-87.61983	Chicago	IL	Illinois	24668.0	7647.5	Cook	
3	60654	41.89227	-87.63729	Chicago	IL	Illinois	14875.0	10154.9	Cook	

Untapped Markets

In [69]:
```
chicago_df_merge[chicago_df_merge['Total'] == 0].reset_index(drop=True)
```

Out[69]:

	ZIP	lat	lng	city	state_id	state_name	population	density	county_name
0	60651	41.90206	-87.74095	Chicago	IL	Illinois	64267.0	7099.1	Cook
1	60638	41.78145	-87.77056	Chicago	IL	Illinois	55026.0	1913.0	Cook
2	60645	42.00853	-87.69481	Chicago	IL	Illinois	45274.0	7743.1	Cook
3	60643	41.69957	-87.66277	Chicago	IL	Illinois	49952.0	2625.0	Cook
4	60631	41.99475	-87.81316	Chicago	IL	Illinois	28641.0	2971.5	Cook
5	60646	41.99304	-87.75962	Chicago	IL	Illinois	27177.0	2295.2	Cook
6	60628	41.69182	-87.61797	Chicago	IL	Illinois	72202.0	2553.0	Cook
7	60625	41.97335	-87.70014	Chicago	IL	Illinois	78651.0	7837.6	Cook
8	60636	41.77576	-87.66912	Chicago	IL	Illinois	40916.0	4038.1	Cook
9	60617	41.71591	-87.55431	Chicago	IL	Illinois	84155.0	2345.8	Cook
10	60612	41.88033	-87.68767	Chicago	IL	Illinois	33472.0	3447.3	Cook
11	60624	41.88056	-87.72335	Chicago	IL	Illinois	38105.0	4162.1	Cook
12	60644	41.88021	-87.75746	Chicago	IL	Illinois	48648.0	5360.9	Cook
13	60655	41.69476	-87.70379	Chicago	IL	Illinois	28550.0	2502.6	Cook
14	60653	41.81925	-87.61008	Chicago	IL	Illinois	29908.0	4950.5	Cook
15	60609	41.81252	-87.65565	Chicago	IL	Illinois	64906.0	3237.2	Cook
16	60618	41.94696	-87.70262	Chicago	IL	Illinois	92084.0	7114.6	Cook
17	60623	41.84808	-87.71778	Chicago	IL	Illinois	92108.0	6621.1	Cook
18	60619	41.74373	-87.60549	Chicago	IL	Illinois	63825.0	4092.5	Cook

Checking which Neighborhoods have land for purchase

In [75]:
```
df_city_owned=pd.read_csv('City-Owned_Land_Inventory.csv')
df_city_owned.head()
```

Out[75]:

	ID	PIN	Address	Legal Description	Property Status	Date of Acquisition	Date of Disposition	Sq. Ft.	Ward	Community Area Number
0	59392	20-22-108-043-0000	6640 S DR MARTIN LUTHER KING JR DR	NaN	Sold	NaN	11/20/2018	0.0	20.0	69.0
1	8901	16-11-109-010-0000	3945 W ERIE ST	NaN	Sold	NaN	03/20/2018	0.0	37.0	23.0
2	59389	20-22-100-022-0000	37 E 63RD ST	NaN	Sold	NaN	11/20/2018	0.0	20.0	69.0
3	62117	19-10-119-054-8001	NaN	NaN	Sold	NaN	09/29/2017	NaN	NaN	NaN
4	24250	25-16-404-029-0000	10730 S PERRY AVE	NaN	Owned by City	09/26/1991	NaN	0.0	34.0	49.0

In [76]:
```
df_city_owned=df_city_owned[df_city_owned['Property Status']=='Owned by City']
```

In [77]:
```
df_city_owned.head()
```

Out[77]:

	ID	PIN	Address	Legal Description	Property Status	Date of Acquisition	Date of Disposition	Sq. Ft.	Ward	Communit Are Numb
4	24250	25-16-404-029-0000	10730 S PERRY AVE	NaN	Owned by City	09/26/1991	NaN	0.0	34.0	49
5	37276	25-19-410-039-0000	11747 S VINCENNES AVE	NaN	Owned by City	08/08/2006	NaN	0.0	34.0	75
6	24205	25-05-212-030-0000	8830 S MORGAN ST	NaN	Owned by City	09/30/1997	NaN	0.0	21.0	71
7	20292	20-28-102-034-0000	7152 S LOWE AVE	NaN	Owned by City	03/19/1991	NaN	0.0	6.0	68
8	58594	16-16-221-074-0000	510 S CICERO AVE	Lot 82 in Mandell's Subdivision of Lots 14 t...	Owned by City	10/12/1982	NaN	0.0	29.0	25

In [78]:
```
df_city_owned.isnull().sum()
```

Out[78]:
```
ID                          0
PIN                         0
Address                   366
Legal Description       12752
Property Status             0
Date of Acquisition     12262
Date of Disposition     14151
Sq. Ft.                   416
Ward                     1790
Community Area Number    1790
Community Area Name      1793
Zoning Classification    1790
Zip Code                  416
Last Update                 0
X Coordinate              161
Y Coordinate              161
Latitude                  161
Longitude                 161
Location                  161
Boundaries - ZIP Codes   1790
Community Areas          1790
Zip Codes                1790
Census Tracts            1790
Wards                    1790
:@computed_region_awaf_s7ux    1790
dtype: int64
```

There are null values even in the zip codes so we nned to extract these by using Latitude, Longitude

In [79]:
```
df_city_owned.dtypes
```

Out[79]:
```
ID                          int64
PIN                        object
Address                    object
Legal Description          object
Property Status            object
Date of Acquisition        object
Date of Disposition        object
Sq. Ft.                   float64
Ward                      float64
Community Area Number     float64
Community Area Name        object
Zoning Classification      object
Zip Code                  float64
Last Update                object
X Coordinate              float64
Y Coordinate              float64
Latitude                  float64
Longitude                 float64
Location                   object
Boundaries - ZIP Codes    float64
```

In [80]:
```
df_city_owned['Zip Code'].dropna(axis=0,inplace=True)
df_city_owned['Zip Code'].isnull().sum()
```

Out[80]:
```
0
```

In [81]:
```
chicago_df_merge.rename(columns={'ZIP': 'Zip Code'}, inplace=True)
chicago_df_merge.head(5)
```

Out[81]:

	Zip Code	lat	lng	city	state_id	state_name	population	density	county_name	c
0	60647	41.92068	-87.70167	Chicago	IL	Illinois	87291.0	8385.0	Cook	
1	60639	41.92056	-87.75603	Chicago	IL	Illinois	90407.0	7156.5	Cook	
3	60622	41.90274	-87.68331	Chicago	IL	Illinois	52548.0	8213.0	Cook	
4	60651	41.90206	-87.74095	Chicago	IL	Illinois	64267.0	7099.1	Cook	
5	60611	41.89472	-87.61938	Chicago	IL	Illinois	28718.0	13562.3	Cook	

In [82]:
```
df_city_owned['Zip Code'].dropna(axis=0,inplace= True)
df_city_owned['Zip Code']=df_city_owned['Zip Code'].astype('int64')
df_city_owned=df_city_owned[df_city_owned['Zip Code']>0.0]
df_city_owned.head()
```

Out[82]:

	ID	PIN	Address	Legal Description	Property Status	Date of Acquisition	Date of Disposition	Sq. Ft.	Ward	Commu Nur
4	24250	25-16-404-029-0000	10730 S PERRY AVE	NaN	Owned by City	09/26/1991	NaN	0.0	34.0	
5	37276	25-19-410-039-0000	11747 S VINCENNES AVE	NaN	Owned by City	08/08/2006	NaN	0.0	34.0	
6	24205	25-05-212-030-0000	8830 S MORGAN ST	NaN	Owned by City	09/30/1997	NaN	0.0	21.0	

In [83]:
```
df_city_owned['Zip Code']=df_city_owned['Zip Code'].astype('int64')
df_city_owned['Zip Code'].dtypes
```

Out[83]:
```
dtype('int64')
```

In [84]:
```
df_city_owned.groupby(['Zip Code'])['Zip Code'].agg({'Count': 'count'}).reset_in
```

```
F:\Anaconda3\lib\site-packages\ipykernel_launcher.py:1: FutureWarning: using a
dict on a Series for aggregation
is deprecated and will be removed in a future version
  """Entry point for launching an IPython kernel.
```

Out[84]:

	Zip Code	Count
0	60601	6
1	60602	1
2	60603	1
3	60604	2
4	60605	11

In [85]:
```
chicago_df_merge
```

Out[85]:

	Zip Code	lat	lng	city	state_id	state_name	population	density	county_nam
0	60647	41.92068	-87.70167	Chicago	IL	Illinois	87291.0	8385.0	Coo
1	60639	41.92056	-87.75603	Chicago	IL	Illinois	90407.0	7156.5	Coo
3	60622	41.90274	-87.68331	Chicago	IL	Illinois	52548.0	8213.0	Coo
4	60651	41.90206	-87.74095	Chicago	IL	Illinois	64267.0	7099.1	Coo
5	60611	41.89472	-87.61938	Chicago	IL	Illinois	28718.0	13562.3	Coo
6	60638	41.78145	-87.77056	Chicago	IL	Illinois	55026.0	1913.0	Coo
7	60652	41.74795	-87.71479	Chicago	IL	Illinois	40959.0	3153.6	Coo

In [86]:
```
zips=df_city_owned['Zip Code'].unique().tolist()
```

In [87]:
```
df_available=chicago_df_merge[chicago_df_merge['Zip Code'].isin(zips)]
```

In [88]:
```
df_available[df_available['Total']<10]
```

Out[88]:

	Zip Code	lat	lng	city	state_id	state_name	population	density	county_name
0	60647	41.92068	-87.70167	Chicago	IL	Illinois	87291.0	8385.0	Cook
1	60639	41.92056	-87.75603	Chicago	IL	Illinois	90407.0	7156.5	Cook
3	60622	41.90274	-87.68331	Chicago	IL	Illinois	52548.0	8213.0	Cook
4	60651	41.90206	-87.74095	Chicago	IL	Illinois	64267.0	7099.1	Cook
6	60638	41.78145	-87.77056	Chicago	IL	Illinois	55026.0	1913.0	Cook
7	60652	41.74795	-87.71479	Chicago	IL	Illinois	40959.0	3153.6	Cook
8	60626	42.00903	-87.66963	Chicago	IL	Illinois	50139.0	11355.1	Cook
9	60615	41.80223	-87.60272	Chicago	IL	Illinois	40603.0	7086.4	Cook
10	60621	41.77638	-87.63944	Chicago	IL	Illinois	35912.0	3718.9	Cook
11	60645	42.00853	-87.69481	Chicago	IL	Illinois	45274.0	7743.1	Cook
12	60643	41.69957	-87.66277	Chicago	IL	Illinois	49952.0	2625.0	Cook
13	60660	41.99110	-87.66604	Chicago	IL	Illinois	42752.0	12796.8	Cook
14	60640	41.97236	-87.66347	Chicago	IL	Illinois	65790.0	10530.6	Cook
15	60614	41.92280	-87.65139	Chicago	IL	Illinois	66617.0	8244.5	Cook
16	60631	41.99475	-87.81316	Chicago	IL	Illinois	28641.0	2971.5	Cook
17	60646	41.99304	-87.75962	Chicago	IL	Illinois	27177.0	2295.2	Cook
18	60628	41.69182	-87.61797	Chicago	IL	Illinois	72202.0	2553.0	Cook
19	60625	41.97335	-87.70014	Chicago	IL	Illinois	78651.0	7837.6	Cook
20	60641	41.94659	-87.74676	Chicago	IL	Illinois	71663.0	6845.9	Cook
22	60636	41.77576	-87.66912	Chicago	IL	Illinois	40916.0	4038.1	Cook
23	60649	41.76303	-87.57031	Chicago	IL	Illinois	46650.0	6148.9	Cook
24	60617	41.71591	-87.55431	Chicago	IL	Illinois	84155.0	2345.8	Cook

	Zip Code	lat	lng	city	state_id	state_name	population	density	county_name
25	60633	41.66435	-87.56136	Chicago	IL	Illinois	12927.0	485.3	Cook
27	60612	41.88033	-87.68767	Chicago	IL	Illinois	33472.0	3447.3	Cook
29	60624	41.88056	-87.72335	Chicago	IL	Illinois	38105.0	4162.1	Cook
30	60656	41.97424	-87.82692	Chicago	IL	Illinois	27613.0	3261.9	Cook
31	60644	41.88021	-87.75746	Chicago	IL	Illinois	48648.0	5360.9	Cook
32	60655	41.69476	-87.70379	Chicago	IL	Illinois	28550.0	2502.6	Cook
35	60653	41.81925	-87.61008	Chicago	IL	Illinois	29908.0	4950.5	Cook
36	60609	41.81252	-87.65565	Chicago	IL	Illinois	64906.0	3237.2	Cook
38	60618	41.94696	-87.70262	Chicago	IL	Illinois	92084.0	7114.6	Cook
42	60608	41.84876	-87.67130	Chicago	IL	Illinois	82739.0	5068.9	Cook
43	60607	41.87500	-87.65157	Chicago	IL	Illinois	23897.0	4031.2	Cook
47	60630	41.97215	-87.75706	Chicago	IL	Illinois	54093.0	4374.4	Cook
51	60634	41.94635	-87.80610	Chicago	IL	Illinois	74298.0	4033.0	Cook
52	60613	41.95583	-87.65796	Chicago	IL	Illinois	48281.0	8572.6	Cook
53	60610	41.90487	-87.63615	Chicago	IL	Illinois	37726.0	12585.9	Cook
55	60632	41.81133	-87.71335	Chicago	IL	Illinois	91326.0	4744.1	Cook
56	60623	41.84808	-87.71778	Chicago	IL	Illinois	92108.0	6621.1	Cook
57	60629	41.77567	-87.71176	Chicago	IL	Illinois	113916.0	6466.2	Cook
58	60620	41.74080	-87.65250	Chicago	IL	Illinois	72216.0	3935.6	Cook
59	60637	41.78143	-87.60318	Chicago	IL	Illinois	49503.0	4220.3	Cook
60	60619	41.74373	-87.60549	Chicago	IL	Illinois	63825.0	4092.5	Cook

Results: So, these are the Neighborhoods that don't have enough Movie Theaters or don't have any.

Further Analysis

At this pont we can tell our client about these locations, if they want to go ahead with their plans further analysis can be done on whether such installment is allowed in these areas or not. Or whether the areas available for purchase are suitable for Movie theaters e.g. such sq/ft etc. all these locations have enough population living within these areas and could be excited and attracted to a new addiction to their neihborhood.