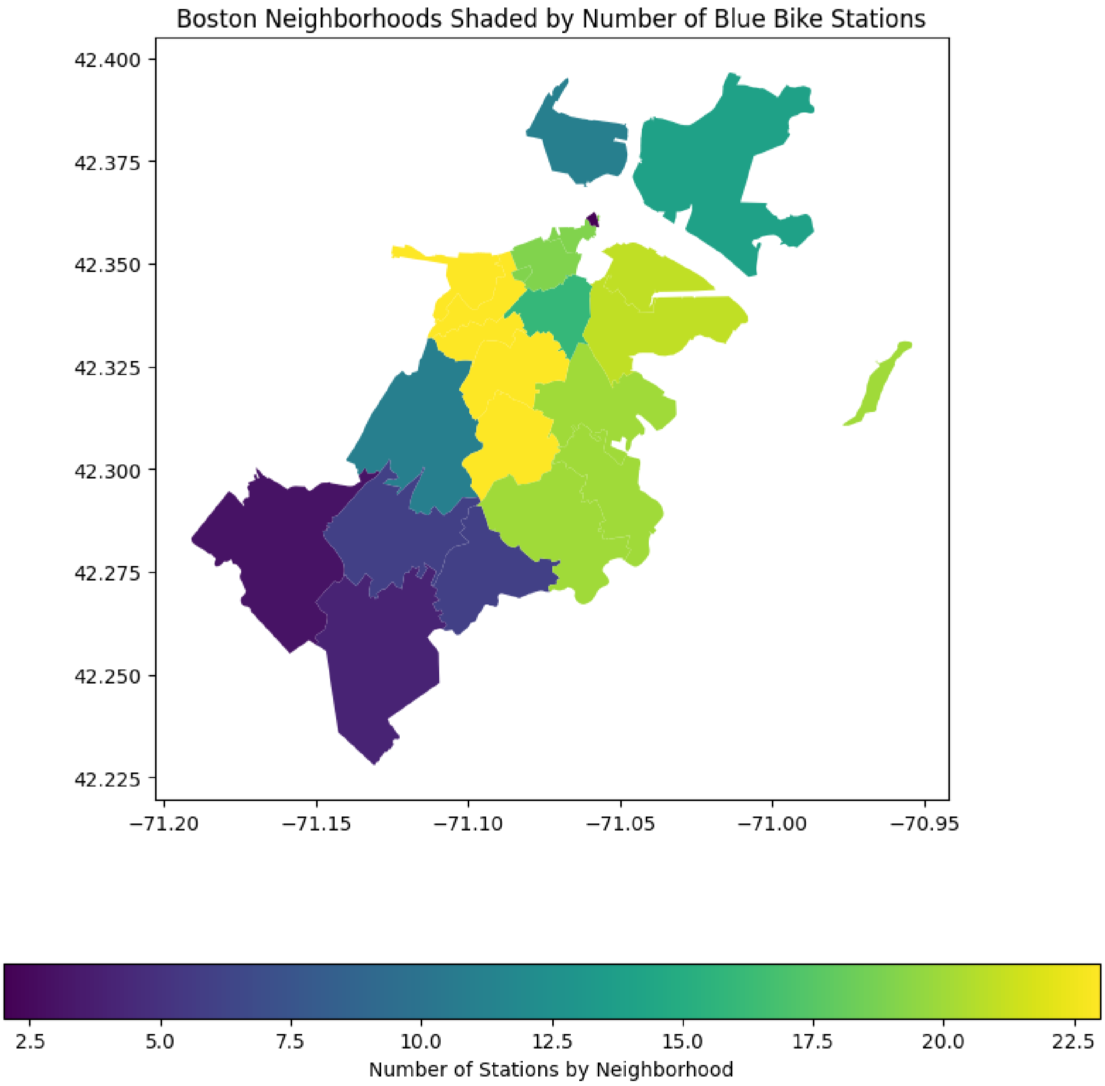
Mappings

April 12, 2024

[2]:
```
import pandas as pd
import geopandas as gpd
import matplotlib.pyplot as plt
from Helpful_functions import get_lat_long



#? Did this as a failed experiment to see if I could get the number of stations␣
 ↪in each neighborhood, however the zip codees more unintuitive than I thought␣
 ↪so I got another data set
#? but I thought this highlighted some of the things I learned in the course so␣
 ↪I kept it in the repo
neighborhood_data = {
    "Neighborhood": [
        "Allston/Brighton", "Back Bay", "Central Boston", "Charlestown",
        "Dorchester", "East Boston", "Fenway/Kenmore", "Hyde Park",
        "Jamaica Plain", "Mattapan", "Roslindale", "Roxbury",
        "South Boston", "South End"
    ],
    "ZIP Codes": [
        "02108, 02116, 02117, 02123, 02133, 02199, 02216, 02217, 02295",
        "02201, 02202, 02203, 02204, 02205, 02206, 02207, 02208, 02209, 02211,␣
 ↪02212, 02222, 02293",
        "02129", "02122, 02124, 02125", "02128, 02228", "02115, 02215",
        "02136", "02130", "02126", "02131", "02119, 02120, 02121",
        "02127, 02210", "02118", "02132"
    ]
}

#? I have more accurate data than this since mapping zip codes to neighborhoods␣
 ↪is harder than I thought
neighborhood_df = pd.DataFrame(neighborhood_data)
expanded_zip_codes = neighborhood_df['ZIP Codes'].str.split(', ', expand=True).
 ↪stack().reset_index(level=1, drop=True)
neighborhood_df = neighborhood_df.drop(columns=['ZIP Codes']).
 ↪join(expanded_zip_codes.rename('ZIP5')).reset_index(drop=True)
```

```
zip_shapes = gpd.read_file('ZIP_Codes.geojson')

zip_shapes['ZIP5'] = zip_shapes['ZIP5'].astype(str)

merged_data = zip_shapes.merge(neighborhood_df, on='ZIP5')



points_df = pd.read_csv('Blue_Bike_Stations.csv')
gdf_points = gpd.GeoDataFrame(points_df, geometry=gpd.points_from_xy(points_df.
  ↪Longitude, points_df.Latitude))

points_in_neighborhoods = gpd.sjoin(gdf_points, merged_data, op='within')

neighborhood_station_counts = points_in_neighborhoods.groupby('Neighborhood').
  ↪size().reset_index(name='StationCount')

neighborhoods_with_counts = merged_data.merge(neighborhood_station_counts,␣
  ↪on='Neighborhood', how='left').fillna(0)

fig, ax = plt.subplots(figsize=(10, 10))
neighborhoods_with_counts.plot(column='StationCount', ax=ax, legend=True,
                               legend_kwds={'label': "Number of Stations by␣
  ↪Neighborhood",
                                            'orientation': "horizontal"})
plt.title('Boston Neighborhoods Shaded by Number of Blue Bike Stations')
plt.show()
```

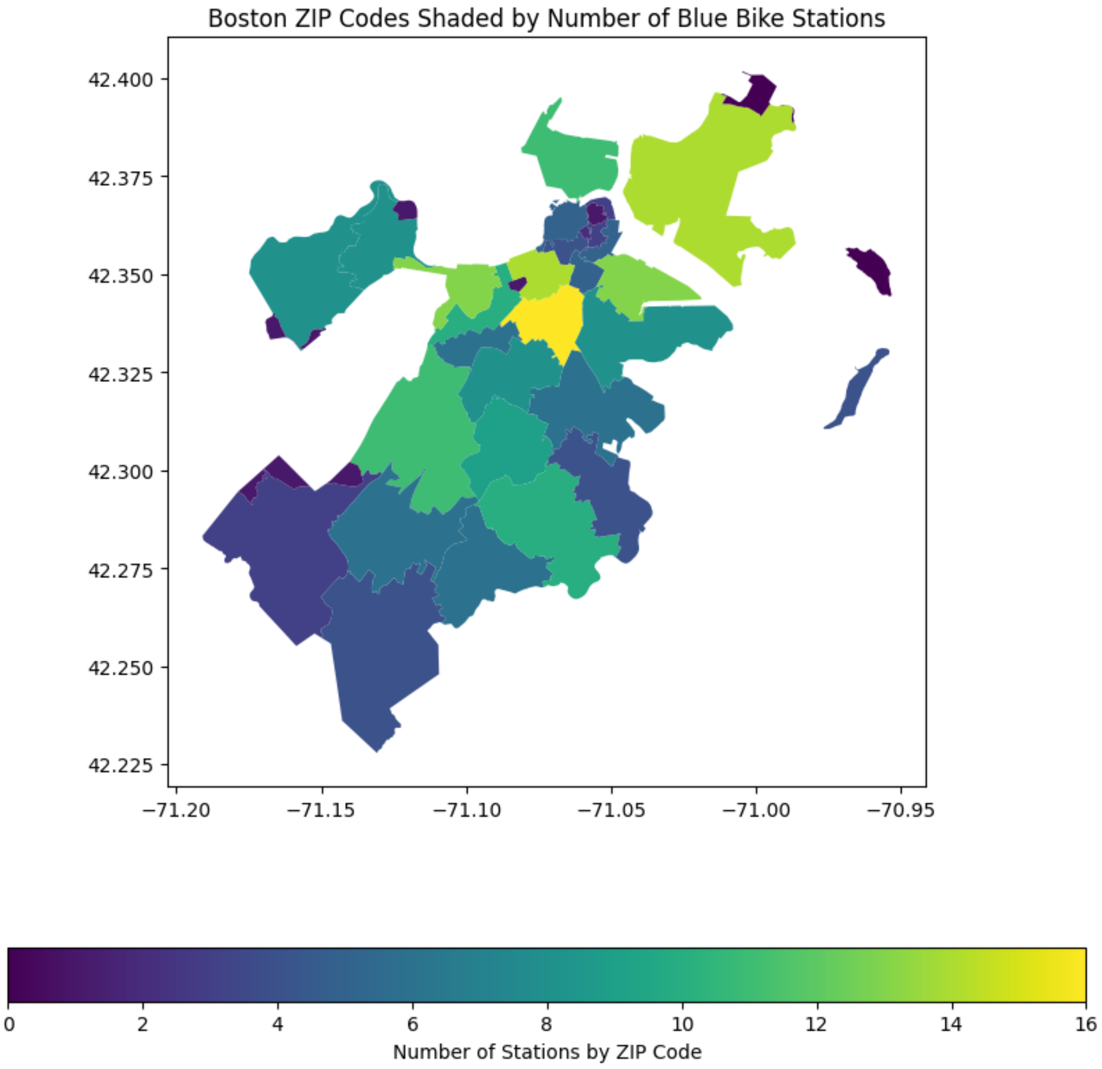
```
/home/daniyal-ahmed/.local/lib/python3.11/site-
packages/IPython/core/interactiveshell.py:3517: FutureWarning: The `op`
parameter is deprecated and will be removed in a future release. Please use the
`predicate` parameter instead.
  if await self.run_code(code, result, async_=asy):
/tmp/ipykernel_27665/1341924827.py:42: UserWarning: CRS mismatch between the CRS
of left geometries and the CRS of right geometries.
Use `to_crs()` to reproject one of the input geometries to match the CRS of the
other.

Left CRS: None
Right CRS: EPSG:4326

  points_in_neighborhoods = gpd.sjoin(gdf_points, merged_data, op='within')
```



[3]:
```
import pandas as pd
import geopandas as gpd
import matplotlib.pyplot as plt


#? Instead of using the neighborhoods I used the zip codes to get a more␣
  ↪accurate count of the number of stations in each area
#? BUT thats not very intuitive if we were to analyze nieghborhoods but this is␣
  ↪here if the clients ever get to see this
#? Since I would never put this in the presentation
zip_shapes = gpd.read_file('ZIP_Codes.geojson')
zip_shapes['ZIP5'] = zip_shapes['ZIP5'].astype(str)
```

```
points_df = pd.read_csv('Blue_Bike_Stations.csv')


#?Making a geodataframe from the points data
gdf_points = gpd.GeoDataFrame(
    points_df,
    geometry=gpd.points_from_xy(points_df.Longitude, points_df.Latitude),
    crs='EPSG:4326'
)

#? Joining the two dataframes
points_in_zip = gpd.sjoin(gdf_points, zip_shapes, op='within')

zip_station_counts = points_in_zip.groupby('ZIP5').size().
 ↪reset_index(name='StationCount')

zip_shapes_with_counts = zip_shapes.merge(zip_station_counts, on='ZIP5',␣
 ↪how='left').fillna(0)

fig, ax = plt.subplots(figsize=(10, 10))
zip_shapes_with_counts.plot(column='StationCount', ax=ax, legend=True,
                            legend_kwds={'label': "Number of Stations by ZIP␣
 ↪Code",
                                         'orientation': "horizontal"})
plt.title('Boston ZIP Codes Shaded by Number of Blue Bike Stations')
plt.show()
```

```
/home/daniyal-ahmed/.local/lib/python3.11/site-
packages/IPython/core/interactiveshell.py:3517: FutureWarning: The `op`
parameter is deprecated and will be removed in a future release. Please use the
`predicate` parameter instead.
  if await self.run_code(code, result, async_=asy):
```

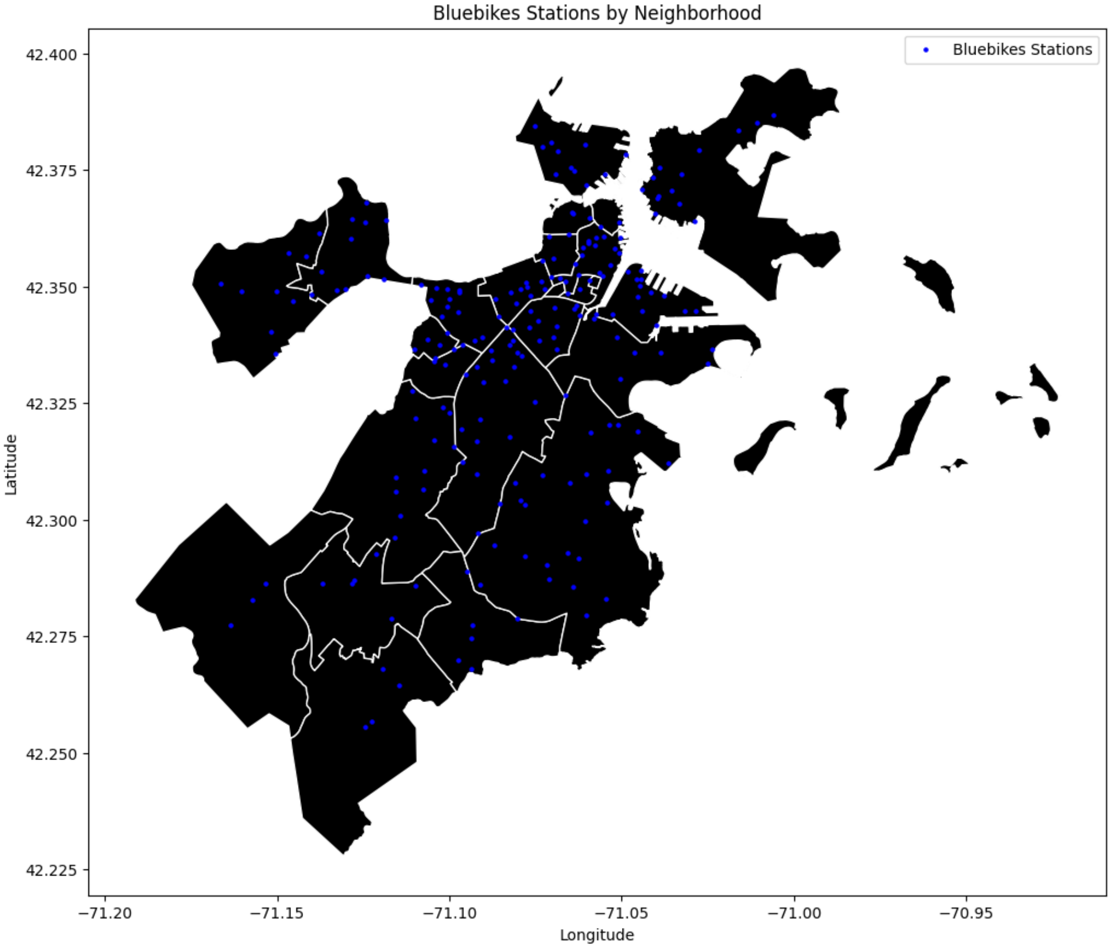


[4]:

```
import pandas as pd
import geopandas as gpd
import matplotlib.pyplot as plt

#?Reloading the file incase I accidentally modified it earlier in the notebook
neighborhoods_gdf = gpd.read_file('BPDA_Neighborhood_Boundaries.geojson')

stations_df = pd.read_csv('Blue_Bike_Stations.csv')
stations_gdf = gpd.GeoDataFrame(
    stations_df,
    geometry=gpd.points_from_xy(stations_df.Longitude, stations_df.Latitude),
    crs='EPSG:4326'
)
```

```python
stations_in_neighborhoods = gpd.sjoin(stations_gdf, neighborhoods_gdf,␣
 ↪how='inner', op='within')

fig, ax = plt.subplots(figsize=(12, 12))
neighborhoods_gdf.plot(ax=ax, color='black', edgecolor='white',␣
 ↪label='Neighborhoods')
stations_in_neighborhoods.plot(ax=ax, markersize=5, color='blue',␣
 ↪label='Bluebikes Stations')
plt.legend()
plt.title('Bluebikes Stations by Neighborhood')
plt.xlabel('Longitude')
plt.ylabel('Latitude')
plt.show()
```

```
/home/daniyal-ahmed/.local/lib/python3.11/site-
packages/IPython/core/interactiveshell.py:3517: FutureWarning: The `op`
parameter is deprecated and will be removed in a future release. Please use the
`predicate` parameter instead.
  if await self.run_code(code, result, async_=asy):
/tmp/ipykernel_27665/2675367031.py:20: UserWarning: Legend does not support
handles for PatchCollection instances.
See: https://matplotlib.org/stable/tutorials/intermediate/legend_guide.html#impl
ementing-a-custom-legend-handler
  plt.legend()
```



[5]:

```
import folium
from folium.plugins import HeatMap
import pandas as pd


#?A really cool heatmap showing the concentration and locations of the blue␣
↪bike stations, VERY COMPUTATIONALLY INTENSIVE (atleast for my computer :( )
stations_df = pd.read_csv('Blue_Bike_Stations.csv')

map_boston = folium.Map(location=[42.3601, -71.0589], zoom_start=13)


heat_data = [[row['Latitude'], row['Longitude']] for index, row in stations_df.
↪iterrows()]
HeatMap(heat_data).add_to(map_boston)
```

```
map_boston.save('bluebikes_heatmap.html')
```

[6]:

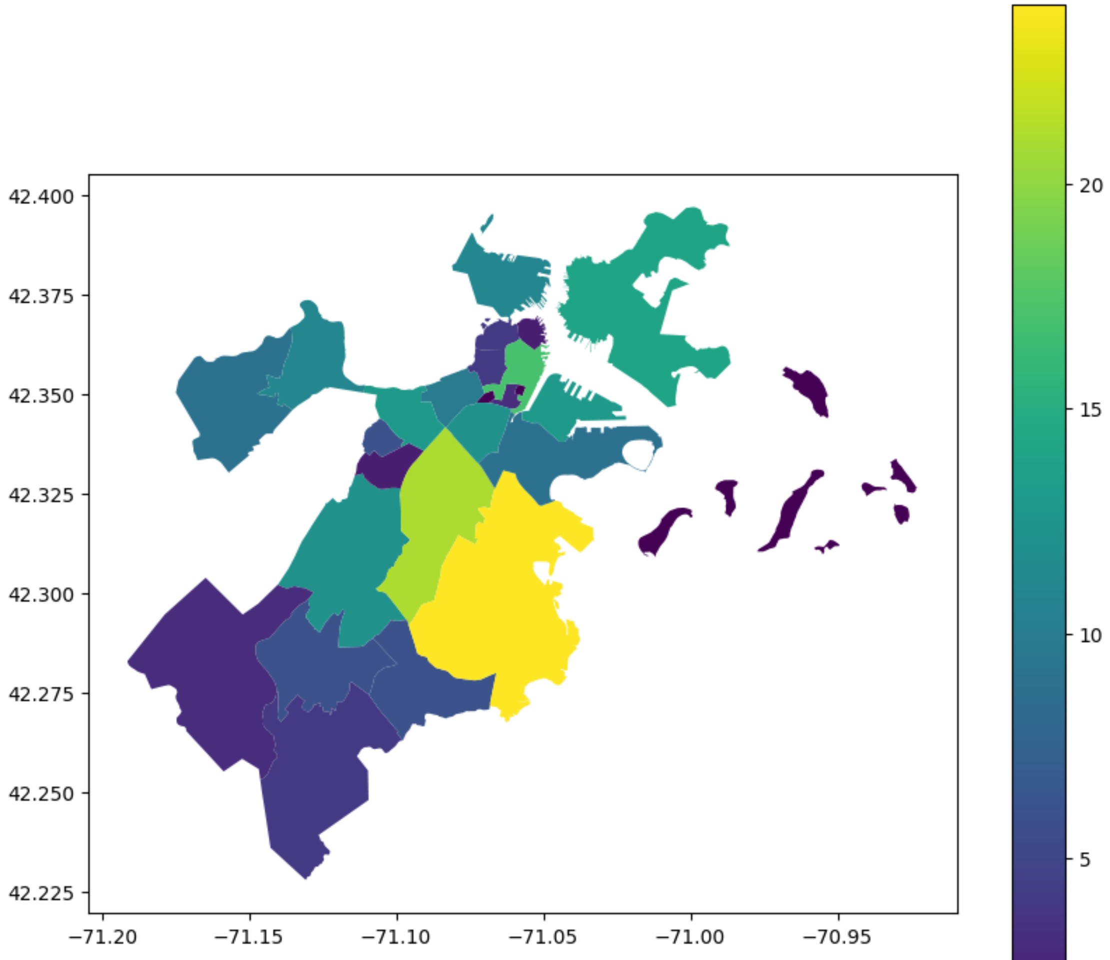
```
import pandas as pd
import geopandas as gpd
import matplotlib.pyplot as plt


#? ALot of this code is copy pasted but here I basically used a different␣
 ↪geodataset that maps out the nieghborhoods


neighborhoods_gdf = gpd.read_file('BPDA_Neighborhood_Boundaries.geojson')

stations_df = pd.read_csv('Blue_Bike_Stations.csv')

stations_gdf = gpd.GeoDataFrame(
    stations_df,
    geometry=gpd.points_from_xy(stations_df['Longitude'],␣
 ↪stations_df['Latitude']),
    crs='EPSG:4326'
)


stations_with_neighborhoods = gpd.sjoin(stations_gdf, neighborhoods_gdf,␣
 ↪op='within')
print(stations_with_neighborhoods)

station_counts = stations_with_neighborhoods['name'].value_counts().
 ↪reset_index()
station_counts.columns = ['name', 'station_count']

merged_gdf = neighborhoods_gdf.merge(station_counts, on='name', how='left')

merged_gdf['station_count'] = merged_gdf['station_count'].fillna(0)

fig, ax = plt.subplots(1, 1, figsize=(10, 10))
merged_gdf.plot(column='station_count', ax=ax, legend=True, cmap='viridis')
plt.show()
```

```
/home/daniyal-ahmed/.local/lib/python3.11/site-
packages/IPython/core/interactiveshell.py:3517: FutureWarning: The `op`
parameter is deprecated and will be removed in a future release. Please use the
`predicate` parameter instead.
  if await self.run_code(code, result, async_=asy):
```

```
             X          Y  Number  \
0   -71.128525  42.360274  A32040
2   -71.073046  42.380045  D32060
```

```
4   -71.098870  42.336586  B32033
6   -71.116012  42.296067  C32089
7   -71.122509  42.256838  E32013
..         …        …     …
410 -71.045693  42.351586  C32034
415 -71.096271  42.337586  B32021
416 -71.064467  42.365908  D32022
418 -71.092189  42.332863  B32059
419 -71.107669  42.306539  D32040

                                                  Name   Latitude  Longitude  \
0                                        Honan Library  42.360274 -71.128525
2                                            Hood Park  42.380045 -71.073046
4                           Huntington Ave at Mass Art  42.336586 -71.098870
6                        Hyde Park Ave at Walk Hill St  42.296067 -71.116012
7                                    Hyde Park Library  42.256838 -71.122509
..                                                 …        …        …
410  Watermark Seaport - Boston Wharf Rd at Seaport…  42.351586 -71.045693
415  Wentworth Institute of Technology - Huntington…  42.337586 -71.096271
416                                      West End Park  42.365908 -71.064467
418                          Whittier St Health Center  42.332863 -71.092189
419                       Williams St at Washington St  42.306539 -71.107669

    District Public_  Total_docks  ObjectId                    geometry  \
0     Boston     Yes           15         1  POINT (-71.12852 42.36027)
2     Boston     Yes           23         3  POINT (-71.07305 42.38005)
4     Boston     Yes           15         5  POINT (-71.09887 42.33659)
6     Boston     Yes           15         7  POINT (-71.11601 42.29607)
7     Boston     Yes           15         8  POINT (-71.12251 42.25684)
..       …     …          …       …                          …
410   Boston     Yes           15       411  POINT (-71.04569 42.35159)
415   Boston     Yes           12       416  POINT (-71.09627 42.33759)
416   Boston     Yes           35       417  POINT (-71.06447 42.36591)
418   Boston     Yes           19       419  POINT (-71.09219 42.33286)
419   Boston     Yes           23       420  POINT (-71.10767 42.30654)

     index_right  sqmiles                     name neighborhood_id  \
0             24     1.56                  Allston              24
2             12     1.36              Charlestown               4
4              3     0.29                 Longwood              28
6              1     3.94            Jamaica Plain              11
7             19     4.57                Hyde Park              10
..           …      …                      …             …
410           22     0.97  South Boston Waterfront              29
415           16     0.88                   Fenway              34
416           13     0.30                 West End              31
418            8     3.29                  Roxbury              16
419            1     3.94            Jamaica Plain              11
```

```
          acres  SHAPE__Length  objectid   SHAPE__Area
0    998.534479   37859.091242        77  4.349599e+07
2    871.541223   57509.688645        65  3.796418e+07
4    188.611947   11908.757148        56  8.215904e+06
6   2519.245394   56349.937161        54  1.097379e+08
7   2927.221168   66861.244955        72  1.275092e+08
..          …             …      …           …
410  621.843524   38391.352905        75  2.708740e+07
415  560.618461   24620.876452        69  2.442044e+07
416  190.490732   17728.590027        66  8.297743e+06
418 2108.469072   49488.800485        61  9.184455e+07
419 2519.245394   56349.937161        54  1.097379e+08

[216 rows x 19 columns]
```



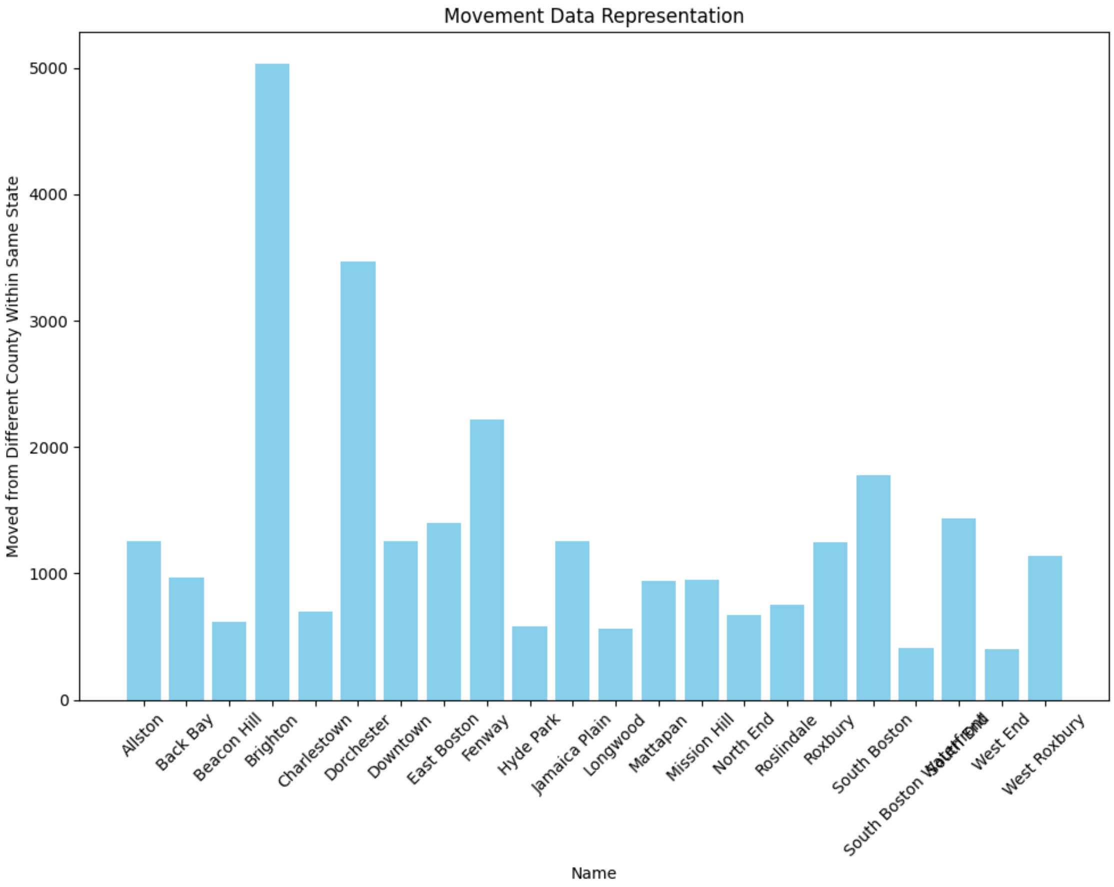
[7]:

```python
import pandas as pd
import matplotlib.pyplot as plt

data = pd.read_csv('Movement.csv')

print(data.columns)

#?Removing Boston, Mass, and Us
data = data[data['Name'] != 'United States']
data = data[data['Name'] != 'Massachusetts']

data = data[data['Name'] != 'Boston']

data = data.dropna()


print(data)

plt.figure(figsize=(10, 8))
plt.bar(data['Name'], data['Moved from different county within same state:'].
  ↪astype(int), color='skyblue')
plt.xlabel('Name')
plt.ylabel('Moved from Different County Within Same State')
plt.title('Movement Data Representation')
plt.xticks(rotation=45)
plt.tight_layout()
plt.show()
```

```
Index(['Name', 'Total:', 'Same house 1 year ago:', '%',
       'Moved within same county:', '%.1',
       'Moved from different county within same state:', '%.2',
       'Moved from different state:', '%.3', 'Moved from abroad:', '%.4'],
      dtype='object')
                     Name    Total:  Same house 1 year ago:      %  \
3                 Allston   19240.0                  11775.0  61.2%
4                Back Bay   17659.0                  12449.0  70.5%
5             Beacon Hill    9629.0                   6675.0  69.3%
6                Brighton   54937.0                  39938.0  72.7%
7             Charlestown   19401.0                  16529.0  85.2%
8              Dorchester  125045.0                 107377.0  85.9%
9                Downtown   18189.0                  12666.0  69.6%
10            East Boston   46868.0                  38545.0  82.2%
11                 Fenway   33450.0                  19349.0  57.8%
12              Hyde Park   38453.0                  35159.0  91.4%
13          Jamaica Plain   40277.0                  33179.0  82.4%
```

```
14                 Longwood    5347.0                  3323.0  62.1%
15                 Mattapan   26136.0                 22208.0  85.0%
16             Mission Hill   17306.0                 11465.0  66.2%
17                North End    8715.0                  5966.0  68.5%
18               Roslindale   29631.0                 26005.0  87.8%
19                  Roxbury   53578.0                 47617.0  88.9%
20             South Boston   36192.0                 29726.0  82.1%
21  South Boston Waterfront    4317.0                  3064.0  71.0%
22                South End   32187.0                 25563.0  79.4%
23                 West End    6554.0                  4554.0  69.5%
24             West Roxbury   33135.0                 29621.0  89.4%

    Moved within same county:    %.1  \
3                      2088.0  10.9%
4                      1947.0  11.0%
5                      1116.0  11.6%
6                      5278.0   9.6%
7                      1526.0   7.9%
8                     11138.0   8.9%
9                      1579.0   8.7%
10                     5302.0  11.3%
11                     4637.0  13.9%
12                     1980.0   5.1%
13                     3611.0   9.0%
14                      246.0   4.6%
15                     2390.0   9.1%
16                     2699.0  15.6%
17                     1427.0  16.4%
18                     2136.0   7.2%
19                     3178.0   5.9%
20                     3836.0  10.6%
21                      434.0  10.1%
22                     3213.0  10.0%
23                      862.0  13.2%
24                     1751.0   5.3%

    Moved from different county within same state:    %.2  \
3                                           1255.0   6.5%
4                                            967.0   5.5%
5                                            613.0   6.4%
6                                           5031.0   9.2%
7                                            694.0   3.6%
8                                           3466.0   2.8%
9                                           1251.0   6.9%
10                                          1395.0   3.0%
11                                          2219.0   6.6%
12                                           582.0   1.5%
13                                          1256.0   3.1%
```

```
14                                           567.0  10.6%
15                                           937.0   3.6%
16                                           949.0   5.5%
17                                           669.0   7.7%
18                                           756.0   2.6%
19                                          1245.0   2.3%
20                                          1777.0   4.9%
21                                           411.0   9.5%
22                                          1432.0   4.4%
23                                           405.0   6.2%
24                                          1140.0   3.4%

    Moved from different state:    %.3  Moved from abroad:   %.4
3                         2663.0  13.8%              1459.0  7.6%
4                         1648.0   9.3%               648.0  3.7%
5                          846.0   8.8%               379.0  3.9%
6                         3287.0   6.0%              1403.0  2.6%
7                          535.0   2.8%               117.0  0.6%
8                         1658.0   1.3%              1406.0  1.1%
9                         2040.0  11.2%               653.0  3.6%
10                         989.0   2.1%               637.0  1.4%
11                        4646.0  13.9%              2599.0  7.8%
12                         545.0   1.4%               187.0  0.5%
13                        1869.0   4.6%               362.0  0.9%
14                         921.0  17.2%               290.0  5.4%
15                         290.0   1.1%               311.0  1.2%
16                        1223.0   7.1%               970.0  5.6%
17                         512.0   5.9%               141.0  1.6%
18                         520.0   1.8%               214.0  0.7%
19                        1009.0   1.9%               529.0  1.0%
20                         796.0   2.2%                57.0  0.2%
21                         365.0   8.5%                43.0  1.0%
22                        1403.0   4.4%               576.0  1.8%
23                         589.0   9.0%               144.0  2.2%
24                         338.0   1.0%               285.0  0.9%
```



[8]:

```
import pandas as pd
import matplotlib.pyplot as plt


data = pd.read_csv('Movement.csv')


print(data.columns)


data = data[data['Name'] != 'United States']
data = data[data['Name'] != 'Massachusetts']

data = data[data['Name'] != 'Boston']


data = data.dropna()

print(data)
```

```
plt.figure(figsize=(10, 8))
#?slightly different column but none the less important for my own analyzation
plt.bar(data['Name'], data['Moved within same county:'].astype(int),␣
 ↪color='skyblue')
plt.xlabel('Name')
plt.ylabel('Moved from Different County Within Same State')
plt.title('Movement Data Representation')
plt.xticks(rotation=45)
plt.tight_layout()
plt.show()
```

```
Index(['Name', 'Total:', 'Same house 1 year ago:', '%',
       'Moved within same county:', '%.1',
       'Moved from different county within same state:', '%.2',
       'Moved from different state:', '%.3', 'Moved from abroad:', '%.4'],
      dtype='object')
                       Name    Total:  Same house 1 year ago:      %  \
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9                  Downtown   18189.0                 12666.0  69.6%
10              East Boston   46868.0                 38545.0  82.2%
11                   Fenway   33450.0                 19349.0  57.8%
12                Hyde Park   38453.0                 35159.0  91.4%
13            Jamaica Plain   40277.0                 33179.0  82.4%
14                 Longwood    5347.0                  3323.0  62.1%
15                 Mattapan   26136.0                 22208.0  85.0%
16             Mission Hill   17306.0                 11465.0  66.2%
17                North End    8715.0                  5966.0  68.5%
18               Roslindale   29631.0                 26005.0  87.8%
19                  Roxbury   53578.0                 47617.0  88.9%
20             South Boston   36192.0                 29726.0  82.1%
21  South Boston Waterfront    4317.0                  3064.0  71.0%
22                South End   32187.0                 25563.0  79.4%
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    Moved within same county:    %.1  \
3                      2088.0  10.9%
4                      1947.0  11.0%
5                      1116.0  11.6%
6                      5278.0   9.6%
```
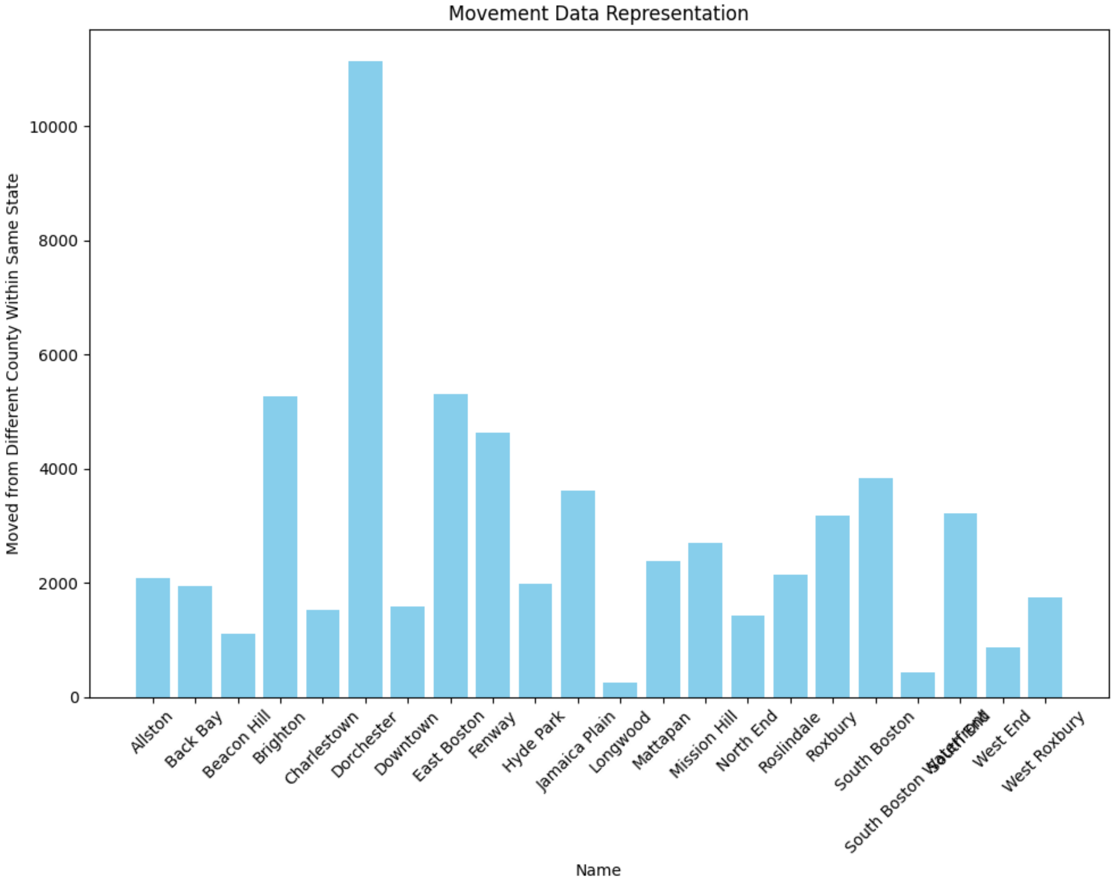
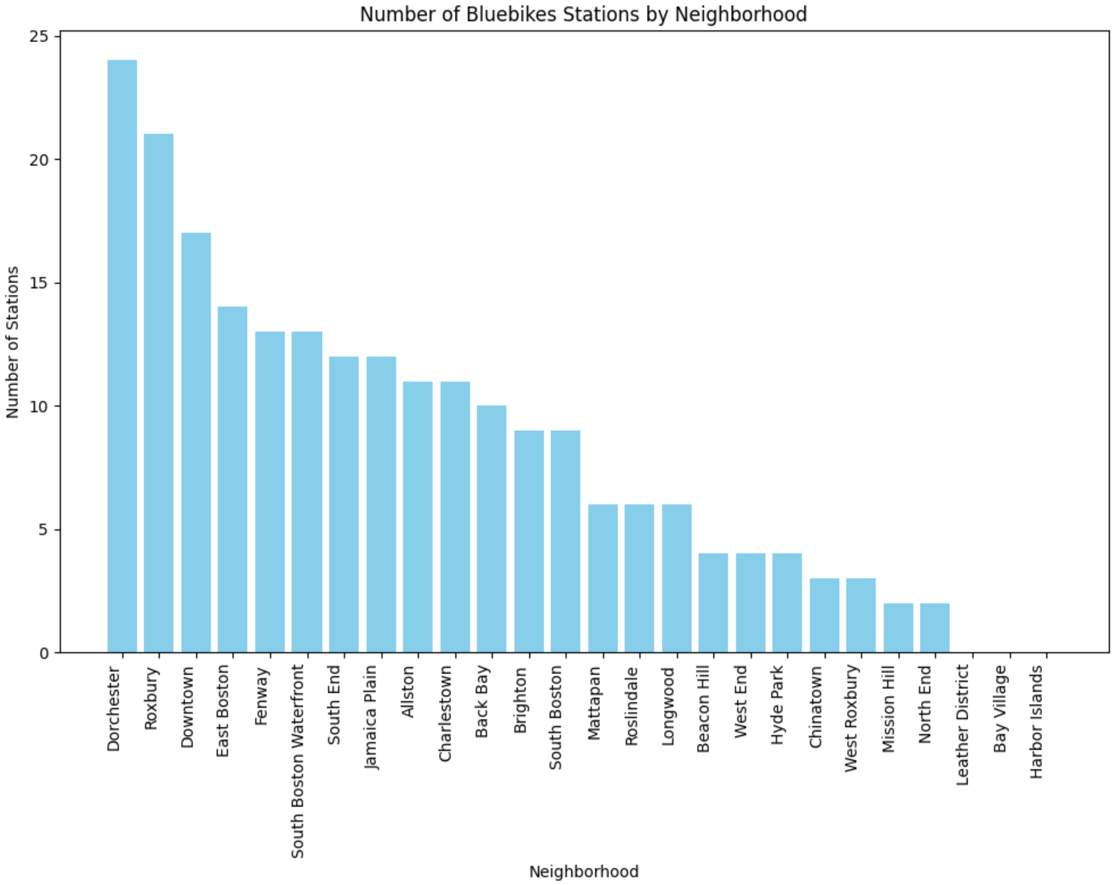

```
7                      1526.0   7.9%
8                     11138.0   8.9%
9                      1579.0   8.7%
10                     5302.0  11.3%
11                     4637.0  13.9%
12                     1980.0   5.1%
13                     3611.0   9.0%
14                      246.0   4.6%
15                     2390.0   9.1%
16                     2699.0  15.6%
17                     1427.0  16.4%
18                     2136.0   7.2%
19                     3178.0   5.9%
20                     3836.0  10.6%
21                      434.0  10.1%
22                     3213.0  10.0%
23                      862.0  13.2%
24                     1751.0   5.3%

    Moved from different county within same state:    %.2  \
3                                           1255.0   6.5%
4                                            967.0   5.5%
5                                            613.0   6.4%
6                                           5031.0   9.2%
7                                            694.0   3.6%
8                                           3466.0   2.8%
9                                           1251.0   6.9%
10                                          1395.0   3.0%
11                                          2219.0   6.6%
12                                           582.0   1.5%
13                                          1256.0   3.1%
14                                           567.0  10.6%
15                                           937.0   3.6%
16                                           949.0   5.5%
17                                           669.0   7.7%
18                                           756.0   2.6%
19                                          1245.0   2.3%
20                                          1777.0   4.9%
21                                           411.0   9.5%
22                                          1432.0   4.4%
23                                           405.0   6.2%
24                                          1140.0   3.4%

    Moved from different state:    %.3  Moved from abroad:   %.4
3                         2663.0  13.8%              1459.0  7.6%
4                         1648.0   9.3%               648.0  3.7%
5                          846.0   8.8%               379.0  3.9%
6                         3287.0   6.0%              1403.0  2.6%
```

```
7                          535.0   2.8%              117.0  0.6%
8                         1658.0   1.3%             1406.0  1.1%
9                         2040.0  11.2%              653.0  3.6%
10                         989.0   2.1%              637.0  1.4%
11                        4646.0  13.9%             2599.0  7.8%
12                         545.0   1.4%              187.0  0.5%
13                        1869.0   4.6%              362.0  0.9%
14                         921.0  17.2%              290.0  5.4%
15                         290.0   1.1%              311.0  1.2%
16                        1223.0   7.1%              970.0  5.6%
17                         512.0   5.9%              141.0  1.6%
18                         520.0   1.8%              214.0  0.7%
19                        1009.0   1.9%              529.0  1.0%
20                         796.0   2.2%               57.0  0.2%
21                         365.0   8.5%               43.0  1.0%
22                        1403.0   4.4%              576.0  1.8%
23                         589.0   9.0%              144.0  2.2%
24                         338.0   1.0%              285.0  0.9%
```



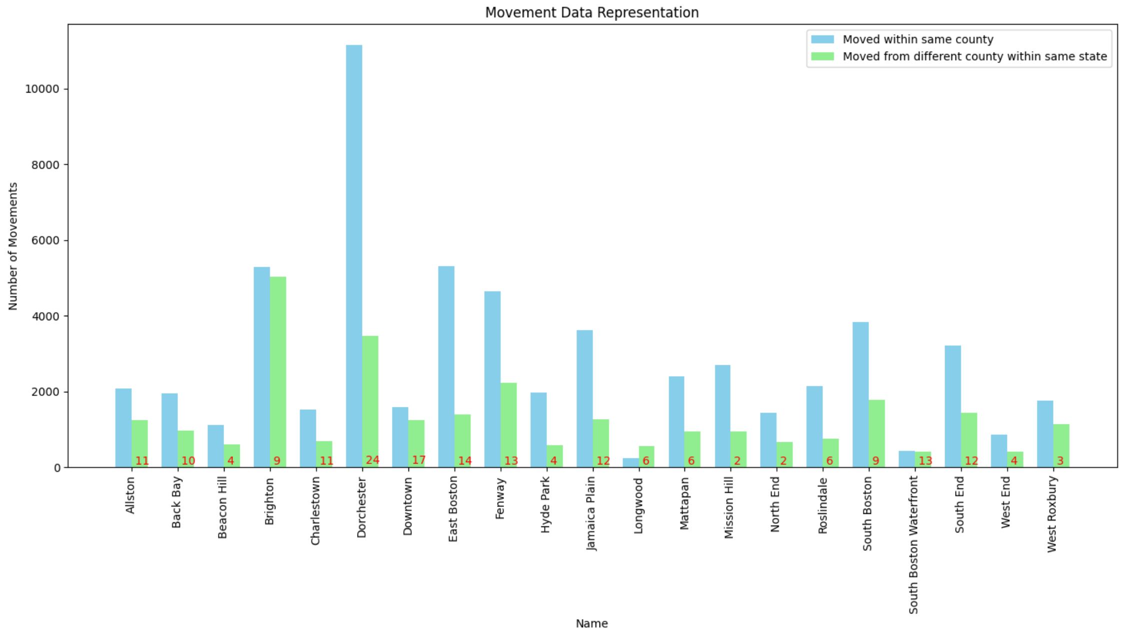
```
[9]: #?getting the number of bike stations per nieghborhood
     station_counts = stations_in_neighborhoods.groupby('index_right').size()
     neighborhoods_gdf['station_count'] = station_counts

     neighborhoods_gdf['station_count'] = neighborhoods_gdf['station_count'].
       ↪fillna(0)




     neighborhood_station_counts = neighborhoods_gdf[['name', 'station_count']]

     neighborhood_station_counts = neighborhood_station_counts.
       ↪sort_values('station_count', ascending=False)

     plt.figure(figsize=(10, 8))
     plt.bar(neighborhood_station_counts['name'],␣
       ↪neighborhood_station_counts['station_count'], color='skyblue')

     plt.xlabel('Neighborhood')
     plt.ylabel('Number of Stations')
     plt.title('Number of Bluebikes Stations by Neighborhood')
     plt.xticks(rotation=90, ha='right')
     plt.tight_layout()
     plt.show()
```



[10]:

```
import pandas as pd
import matplotlib.pyplot as plt
import numpy as np



#? combined the two from above
data = pd.read_csv('Movement.csv')

data = data[~data['Name'].isin(['United States', 'Massachusetts', 'Boston'])]

data = data.dropna()
data = data[data['Name'] != 'Roxbury']


data = data[data['Name'].isin(neighborhood_station_counts['name'])]
neighborhood_station_counts =␣
  ↪neighborhood_station_counts[neighborhood_station_counts['name'].
  ↪isin(data['Name'])]
```

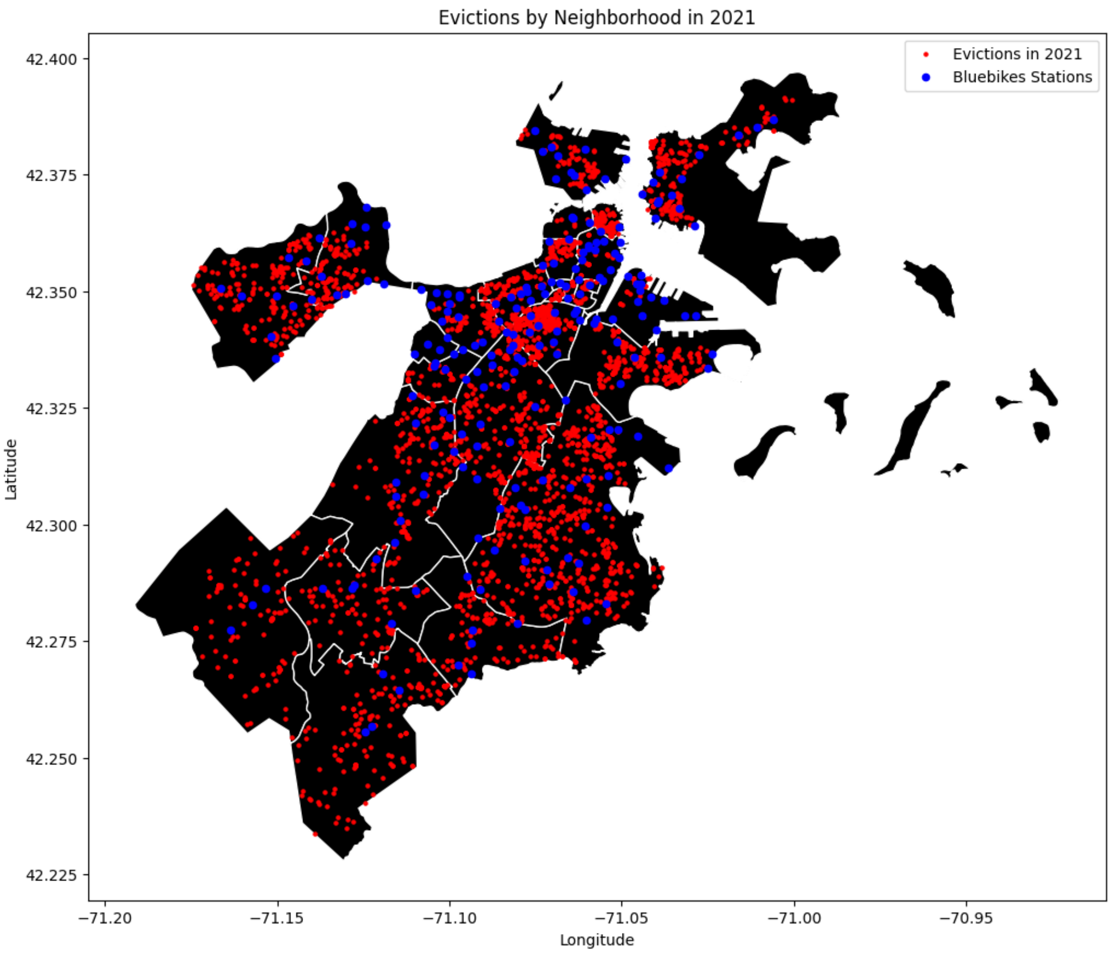
```
data.sort_values('Name', inplace=True)
neighborhood_station_counts.sort_values('name', inplace=True)



data.reset_index(drop=True, inplace=True)
neighborhood_station_counts.reset_index(drop=True, inplace=True)

positions = np.arange(len(data['Name']))

bar_width = 0.35

plt.figure(figsize=(14, 8))

plt.bar(positions - bar_width / 2, data['Moved within same county:'].
 ↪astype(int), width=bar_width, color='skyblue', label='Moved within same␣
 ↪county')

plt.bar(positions + bar_width / 2, data['Moved from different county within␣
 ↪same state:'].astype(int), width=bar_width, color='lightgreen', label='Moved␣
 ↪from different county within same state')

plt.xlabel('Name')
plt.ylabel('Number of Movements')
plt.title('Movement Data Representation')

plt.xticks(positions, data['Name'], rotation=90)

for pos, count in zip(positions, neighborhood_station_counts['station_count']):
    plt.text(pos, count, f' {int(count)}', color='red',␣
 ↪verticalalignment='bottom')

plt.legend()

plt.tight_layout()
plt.show()
```



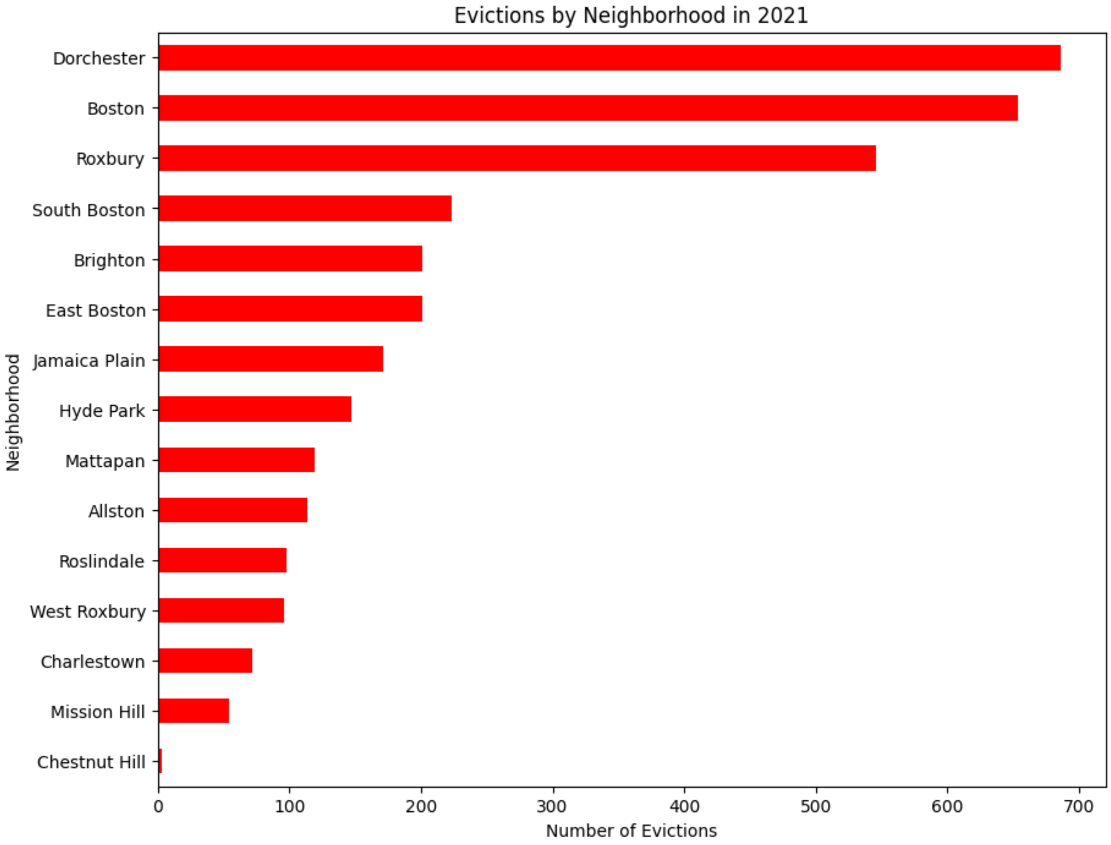
[11]:
```
import pandas as pd
import geopandas as gpd
import matplotlib.pyplot as plt


#?COmbined evictions and bike station data and sectioned it by neighborhood
neighborhoods_gdf = gpd.read_file('BPDA_Neighborhood_Boundaries.geojson')

Evictions = pd.read_csv('RentSmart.csv')

Evictions['date'] = pd.to_datetime(Evictions['date'], errors='coerce',␣
 ↪infer_datetime_format=True)

Evictions_2021 = Evictions[Evictions['date'].dt.year == 2021]
Evictions_2021_gdf = gpd.GeoDataFrame(
    Evictions_2021,
    geometry=gpd.points_from_xy(Evictions_2021.longitude, Evictions_2021.
 ↪latitude),
    crs='EPSG:4326'
)

Evictions_in_neighborhoods_2021 = gpd.sjoin(Evictions_2021_gdf,␣
 ↪neighborhoods_gdf, how='inner', op='within')

fig, ax = plt.subplots(figsize=(12, 12))
```

```
neighborhoods_gdf.plot(ax=ax, color='black', edgecolor='white',␣
 ↪label='Neighborhoods')
Evictions_in_neighborhoods_2021.plot(ax=ax, markersize=5, color='red',␣
 ↪label='Evictions in 2021')
stations_in_neighborhoods.plot(ax=ax, markersize=20, color='blue',␣
 ↪label='Bluebikes Stations')

plt.legend()
plt.title('Evictions by Neighborhood in 2021')
plt.xlabel('Longitude')
plt.ylabel('Latitude')
plt.show()
```

```
/tmp/ipykernel_27665/2259486400.py:11: UserWarning: The argument
'infer_datetime_format' is deprecated and will be removed in a future version. A
strict version of it is now the default, see
https://pandas.pydata.org/pdeps/0004-consistent-to-datetime-parsing.html. You
can safely remove this argument.
  Evictions['date'] = pd.to_datetime(Evictions['date'], errors='coerce',
infer_datetime_format=True)
/home/daniyal-ahmed/.local/lib/python3.11/site-
packages/IPython/core/interactiveshell.py:3517: FutureWarning: The `op`
parameter is deprecated and will be removed in a future release. Please use the
`predicate` parameter instead.
  if await self.run_code(code, result, async_=asy):
/tmp/ipykernel_27665/2259486400.py:27: UserWarning: Legend does not support
handles for PatchCollection instances.
See: https://matplotlib.org/stable/tutorials/intermediate/legend_guide.html#impl
ementing-a-custom-legend-handler
  plt.legend()
```



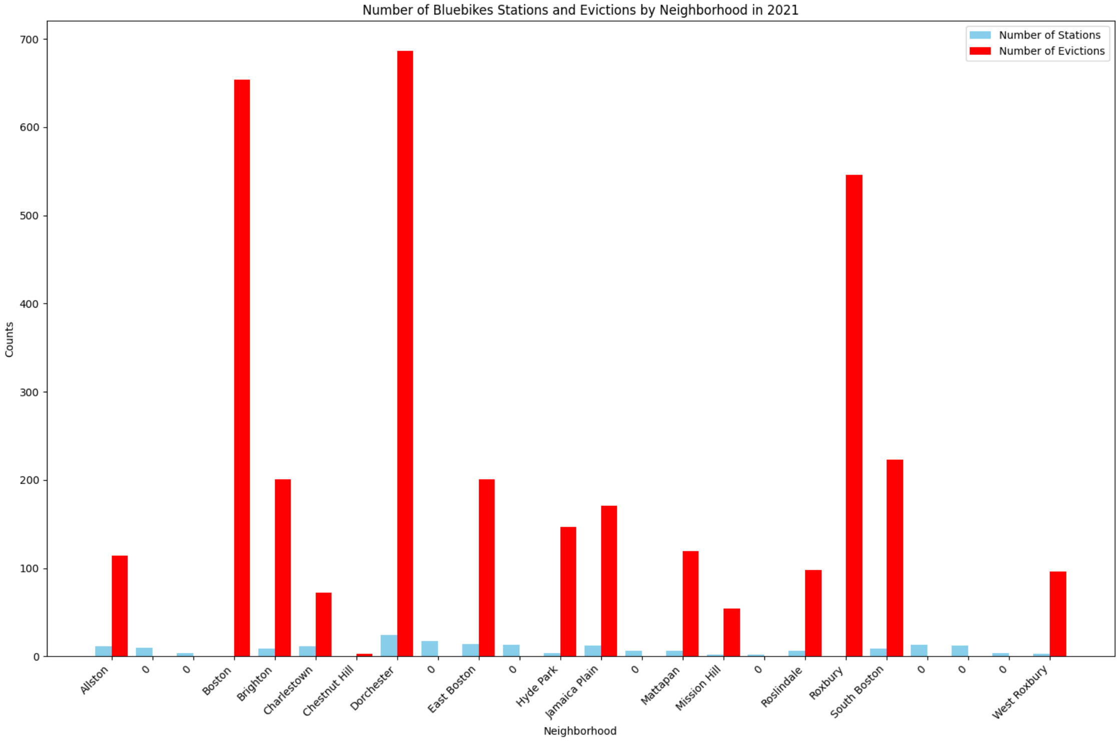
[12]:
```
#? Literally just made this graph because I literally couldn't find it in the␣
↪drive :(

eviction_counts = Evictions_2021['neighborhood'].value_counts()
Evictions_2021= Evictions_2021[Evictions_2021['neighborhood'] != 'Boston']

eviction_counts_sorted = eviction_counts.sort_values(ascending=True)

fig, ax = plt.subplots(figsize=(10, 8))
eviction_counts_sorted.plot(kind='barh', ax=ax, color='red')
ax.set_title('Evictions by Neighborhood in 2021')
ax.set_xlabel('Number of Evictions')
ax.set_ylabel('Neighborhood')

plt.show()
```



[13]:

```
import pandas as pd
import matplotlib.pyplot as plt

eviction_counts_df = eviction_counts.reset_index()
eviction_counts_df.columns = ['neighborhood', 'eviction_count']


merged_data = pd.merge(neighborhood_station_counts, eviction_counts_df,␣
 ↪left_on='name', right_on='neighborhood', how='outer')

merged_data.fillna(0, inplace=True)

fig, ax = plt.subplots(figsize=(15, 10))

indices = range(len(merged_data))
width = 0.4

bar1 = ax.bar(indices, merged_data['station_count'], width, label='Number of␣
 ↪Stations', color='skyblue')
```

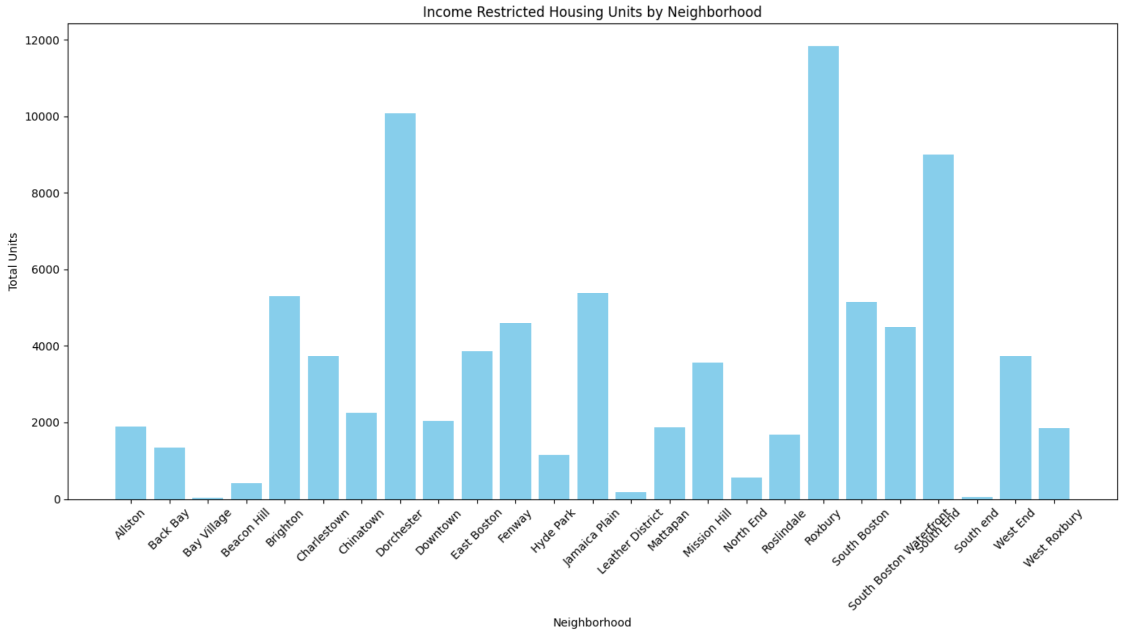
```
bar2 = ax.bar([p + width for p in indices], merged_data['eviction_count'],␣
 ↪width, label='Number of Evictions', color='red')

ax.set_xlabel('Neighborhood')
ax.set_ylabel('Counts')
ax.set_title('Number of Bluebikes Stations and Evictions by Neighborhood in␣
 ↪2021')
ax.set_xticks([p + width / 2 for p in indices])
ax.set_xticklabels(merged_data['neighborhood'], rotation=45, ha='right')
ax.legend()

plt.tight_layout()
plt.show()
```



[14]:

```
income_restricted_housing = pd.read_csv('income-restricted-inventory-2021.csv')

income_restricted_housing = income_restricted_housing.groupby('Neighborhood').
 ↪sum().reset_index()

plt.figure(figsize=(14, 8))
plt.bar(income_restricted_housing['Neighborhood'],␣
 ↪income_restricted_housing['TtlProjUnits'], color='skyblue')
plt.xlabel('Neighborhood')
```

```python
plt.ylabel('Total Units')
plt.title('Income Restricted Housing Units by Neighborhood')
plt.xticks(rotation=45)
plt.tight_layout()
plt.show()
```



[15]:
```python
import pandas as pd
import geopandas as gpd
from shapely.geometry import LineString
import folium





#!THESE GRAPHS DONT REPRESENT THE DATA AS WELL AS I WANTED

travel_df = pd.read_csv('202103-bluebikes-tripdata.csv')


travel_df = travel_df[travel_df['start station latitude'] != travel_df['end␣
 ↪station latitude']]
travel_df = travel_df[travel_df['start station longitude'] != travel_df['end␣
 ↪station longitude']]


travel_df = travel_df.sample(n=100)
```

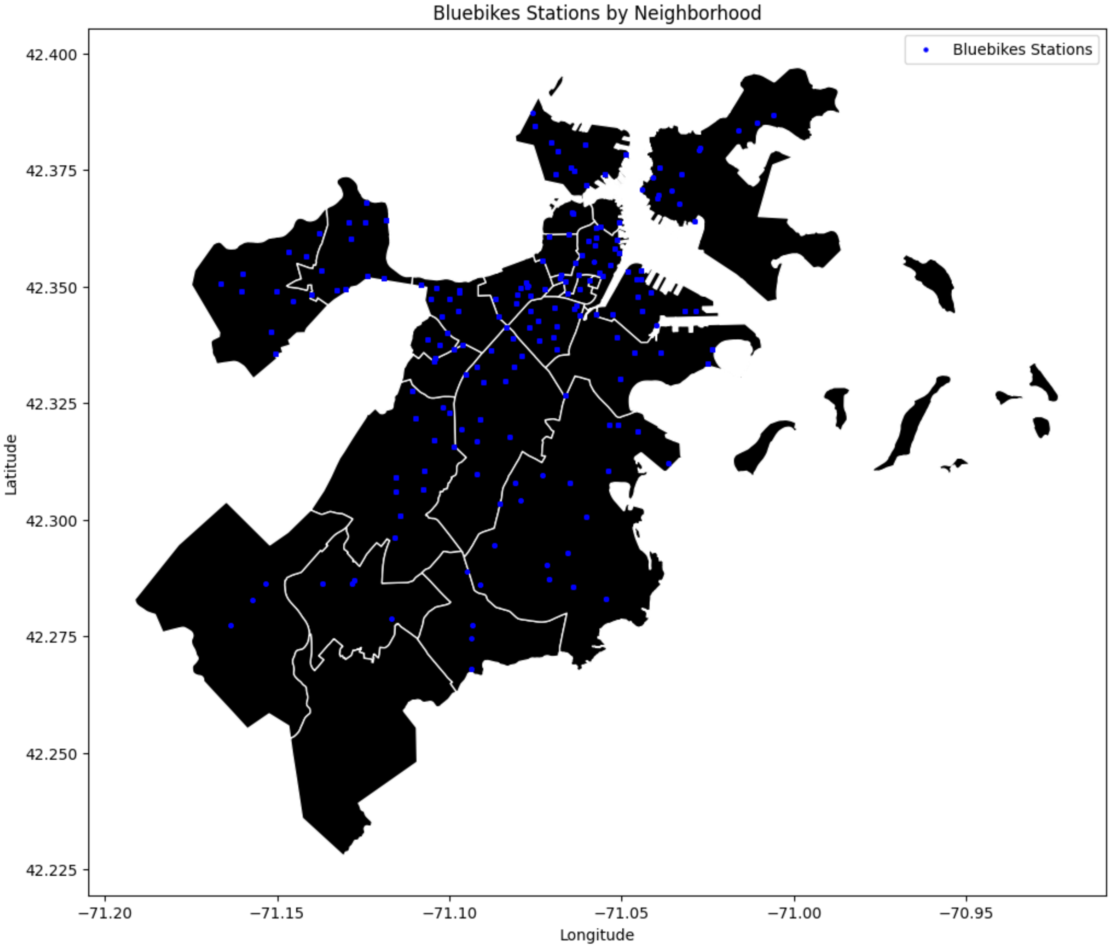
```
geometry = [LineString([(row['start station longitude'], row['start station␣
 ↪latitude']),
                        (row['end station longitude'], row['end station␣
 ↪latitude'])]) for idx, row in travel_df.iterrows()]
routes_gdf = gpd.GeoDataFrame(travel_df, geometry=geometry, crs='EPSG:4326')

neighborhoods_gdf = gpd.read_file('BPDA_Neighborhood_Boundaries.geojson')



map_boston = folium.Map(location=[42.3601, -71.0589], zoom_start=12)

folium.GeoJson(
    neighborhoods_gdf,
    name='Neighborhoods',
    style_function=lambda feature: {
        'fillColor': '#ffff00',
        'color': 'black',
        'weight': 2,
        'fillOpacity': 0.3,
    }
).add_to(map_boston)

for _, row in routes_gdf.iterrows():
    folium.PolyLine(
        locations=[
            [row.geometry.coords[0][1], row.geometry.coords[0][0]],
            [row.geometry.coords[1][1], row.geometry.coords[1][0]]
        ],
        color='blue',
        weight=3,
        opacity=0.8
    ).add_to(map_boston)

map_boston

map_boston.save('boston_routes.html')
```

[16]:

```
import pandas as pd
import geopandas as gpd
import matplotlib.pyplot as plt



#! THIS CELL WAS LITERALLY FOR DEBUGGING PURPOSES
neighborhoods_gdf = gpd.read_file('BPDA_Neighborhood_Boundaries.geojson')
```

```
stations_df = pd.read_csv('202103-bluebikes-tripdata.csv')


stations_df = stations_df[(stations_df['start station latitude'] !=␣
 ↪stations_df['end station latitude']) &
                          (stations_df['start station longitude'] !=␣
 ↪stations_df['end station longitude'])]




stations_gdf = gpd.GeoDataFrame(
    stations_df,
    geometry=gpd.points_from_xy(stations_df['start station longitude'],␣
 ↪stations_df['start station latitude']),
    crs='EPSG:4326'
)

stations_in_neighborhoods = gpd.sjoin(stations_gdf, neighborhoods_gdf,␣
 ↪how='inner', op='within')

fig, ax = plt.subplots(figsize=(12, 12))
neighborhoods_gdf.plot(ax=ax, color='black', edgecolor='white',␣
 ↪label='Neighborhoods')
stations_in_neighborhoods.plot(ax=ax, markersize=5, color='blue',␣
 ↪label='Bluebikes Stations')
plt.legend()
plt.title('Bluebikes Stations by Neighborhood')
plt.xlabel('Longitude')
plt.ylabel('Latitude')
plt.show()
```

```
/home/daniyal-ahmed/.local/lib/python3.11/site-
packages/IPython/core/interactiveshell.py:3517: FutureWarning: The `op`
parameter is deprecated and will be removed in a future release. Please use the
`predicate` parameter instead.
  if await self.run_code(code, result, async_=asy):
/tmp/ipykernel_27665/2029784764.py:31: UserWarning: Legend does not support
handles for PatchCollection instances.
See: https://matplotlib.org/stable/tutorials/intermediate/legend_guide.html#impl
ementing-a-custom-legend-handler
  plt.legend()
```

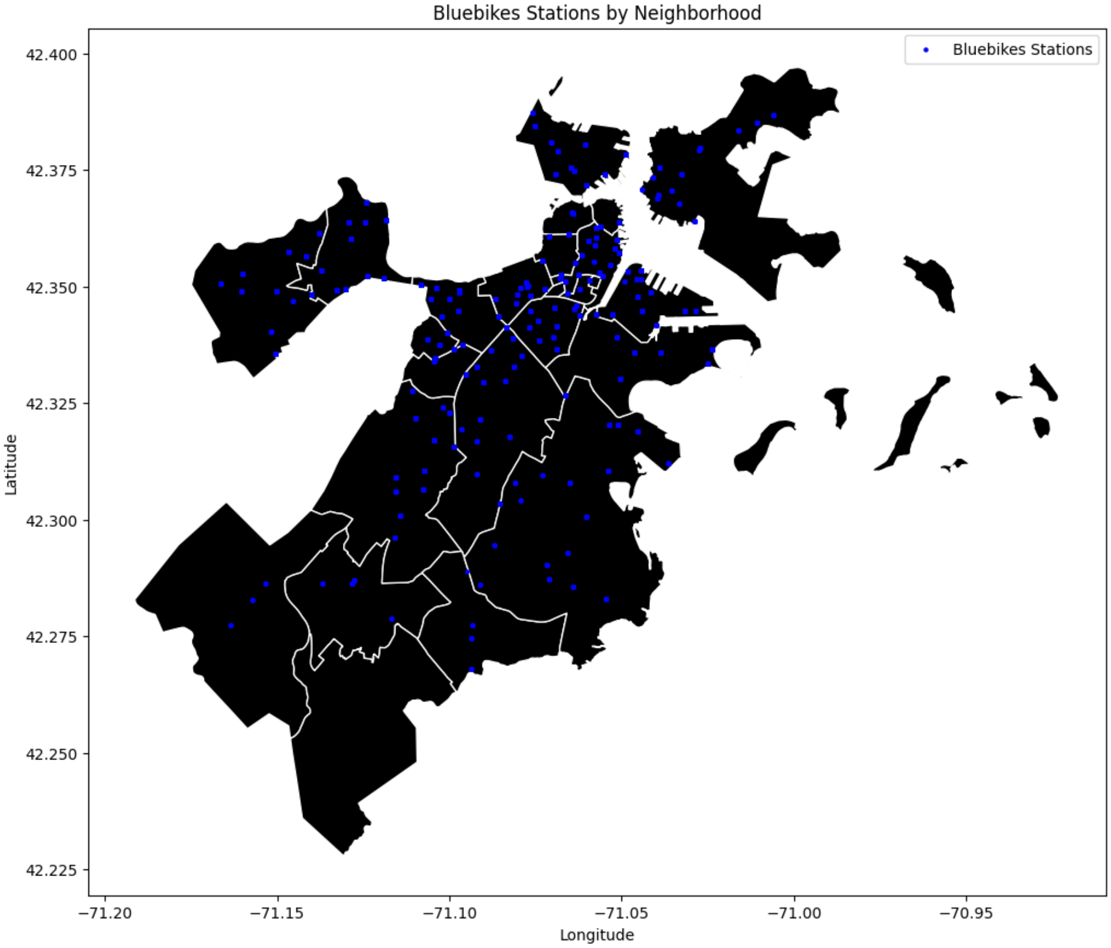


[17]:

```
import pandas as pd
import geopandas as gpd
import matplotlib.pyplot as plt

neighborhoods_gdf = gpd.read_file('BPDA_Neighborhood_Boundaries.geojson')


routes_df = pd.read_csv('202103-bluebikes-tripdata.csv')




routes_df = stations_df[(routes_df['start station latitude'] != routes_df['end␣
 ↪station latitude']) &
                          (routes_df['start station longitude'] !=␣
 ↪routes_df['end station longitude'])]
```

```
routes_df.to_csv('routes.csv', index=False)


routes_gdf = gpd.GeoDataFrame(
    routes_df,
    geometry=gpd.points_from_xy(routes_df['end station longitude'],␣
  ↪routes_df['end station latitude']),
    crs='EPSG:4326'
)

routes_in_neighborhoods = gpd.sjoin(routes_gdf, neighborhoods_gdf, how='inner',␣
  ↪op='within')

fig, ax = plt.subplots(figsize=(12, 12))
neighborhoods_gdf.plot(ax=ax, color='black', edgecolor='white',␣
  ↪label='Neighborhoods')
routes_in_neighborhoods.plot(ax=ax, markersize=5, color='blue',␣
  ↪label='Bluebikes Stations')
plt.legend()
plt.title('Bluebikes Stations by Neighborhood')
plt.xlabel('Longitude')
plt.ylabel('Latitude')
plt.show()
```

```
/tmp/ipykernel_27665/2394312211.py:12: UserWarning: Boolean Series key will be
reindexed to match DataFrame index.
  routes_df = stations_df[(routes_df['start station latitude'] != routes_df['end
station latitude']) &
/home/daniyal-ahmed/.local/lib/python3.11/site-
packages/IPython/core/interactiveshell.py:3517: FutureWarning: The `op`
parameter is deprecated and will be removed in a future release. Please use the
`predicate` parameter instead.
  if await self.run_code(code, result, async_=asy):
/tmp/ipykernel_27665/2394312211.py:31: UserWarning: Legend does not support
handles for PatchCollection instances.
See: https://matplotlib.org/stable/tutorials/intermediate/legend_guide.html#impl
ementing-a-custom-legend-handler
  plt.legend()
```


Bluebikes Stations by Neighborhood
● Bluebikes Stations
42.400
42.375
42.350
42.325
42.300
42.275
42.250
42.225
Latitude
−71.20
−71.15
−71.10
−71.05
−71.00
−70.95
Longitude