# Project 4

December 7, 2021

[71]:
```
#!pip install folium
import folium
from folium import plugins
from folium.plugins import HeatMap
import requests
import pandas as pd
import warnings
warnings.simplefilter(action='ignore', category=FutureWarning)
```

[72]:
```
'''
Part 1: Getting the Data
'''

arrest_table = pd.read_csv("https://cmsc320.github.io/files/BPD_Arrests.csv")

arrest_table = arrest_table[pd.notnull(arrest_table["Location 1"])]

arrest_table["lat"], arrest_table["long"] = arrest_table["Location 1"].str.
 ↪split(",").str
arrest_table["lat"] = arrest_table["lat"].str.replace("(", "").astype(float)
arrest_table["long"] = arrest_table["long"].str.replace(")", "").astype(float)

arrest_table.head()

#Sample randomly from all arrests
arrest_table = (arrest_table.sample(n=15000)).reset_index()
```

[73]:
```
'''
Part 2: Making a map
'''
map_osm = folium.Map(location=[39.29, -76.61], zoom_start=11)
map_osm
```

[73]:
```
<folium.folium.Map at 0x2a580e77550>
```

[74]:
```
'''
Part 3: Combining Parts 1 and 2
```

```
'''

map_osm = folium.Map(location=[39.29, -76.61], zoom_start=12)
#This map looks at the narcotics arrests (87, 870) across all of Baltimore

color_dict = {
    '87-':'darkred', # Narcotics arrest
    '870':'red'} # Narcotics (Outside) arrest

for index, row in arrest_table.iterrows():
    code = str(row['incidentOffense'])[0:3]
    if code == '87-' or code == '870':
        folium.CircleMarker(location=[row['lat'], row['long']], radius = 1.5,␣
 ↪popup=row['incidentOffense'], fill=True, color=color_dict[code],␣
 ↪fill_opacity=0.8).add_to(map_osm)

map_osm
```

[74]: <folium.folium.Map at 0x2a586dc0b50>

This map shows narcotics arrests from the sample data in Baltimore. A dark red marker indicates an indoor narcotics arrest while a red marker indicates an outdoor narcotics arrest. We can see how clustered the arrests be in the downtown areas. However, there is considerable clustering in the North Western portion of the city, as well as several small clusters in the North Eastern part.

[75]:
```
map_osm = folium.Map(location=[39.29, -76.61], zoom_start=12)

#This map looks at search & seizure arrests (97) and towed vehicle arrests (24)␣
 ↪across all of Baltimore

color_dict = {
    '97':'purple', # Search & Seizure arrest
    '24':'black'} # Towed Vehicle

for index, row in arrest_table.iterrows():
    code = str(row['incidentOffense'])[0:2]
    if code == '97' or code == '24':
        folium.CircleMarker(location=[row['lat'], row['long']], radius = 1.5,␣
 ↪popup=row['incidentOffense'], fill=True, color=color_dict[code],␣
 ↪fill_opacity=0.8).add_to(map_osm)

map_osm
```

[75]: <folium.folium.Map at 0x2a58b4bc9a0>

This map shows search & seizure arrests and towed vehicle arrests from the sample data in Baltimore. A black marker indicates a towed vehicle arrest while a purple marker indicates a search and seizure arrest. When only looking at the towed vehicle arrest markers, it clearly shows how

most of these occur near roads and city streets. The markers for search and seizures reveal several dense clusters spread throughout the city.

[76]:
```
map_osm = folium.Map(location=[39.29, -76.61], zoom_start=12)

#This map looks at burgulary arrests (5A, 5C, 5D) across all of Baltimore

color_dict = {
    '5A':'blue',   # Burgularly Residential (Force) arrest
    '5C':'black',  # Burgularly Residential (Noforce) arrest
    '5D':'purple'} # Burgularly Other (Force) arrest

for index, row in arrest_table.iterrows():
    code = str(row['incidentOffense'])[0:2]
    if code == '5A' or code == '5C'or code == '5D':
        folium.CircleMarker(location=[row['lat'], row['long']], radius = 1.5,␣
 ↪popup=row['incidentOffense'], fill=True, color=color_dict[code],␣
 ↪fill_opacity=0.8).add_to(map_osm)

map_osm
```

[76]: <folium.folium.Map at 0x2a58c883fd0>

This map shows burgularly arrests from the sample data in Baltimore. A blue marker indicates a residential burgurlarly with force while a black marker indicates a residential burgularly without force. We see more blue and black markers near residential neighborhoods in Baltimore which tend to be far from the downtown. A purple maker indicates some "other" type of burgularly with force. Some of thse markers seem to be near black and blue markers whlie others are not.

[77]:
```
map_osm = folium.Map(location=[39.29, -76.61], zoom_start=12)

#This map looks at assault arrests (4B, 4C, 4E) across all of Baltimore

color_dict = {
    '4B':'orange',   # Aggrevated Assault Cut arrest
    '4C':'red',      # Aggrevated Assault Other arrest
    '4E':'darkred'}  # Common Assault arrest

for index, row in arrest_table.iterrows():
    code = str(row['incidentOffense'])[0:2]
    if code == '4B'or code == '4C'or code == '4E':
        folium.CircleMarker(location=[row['lat'], row['long']], radius = 1.5,␣
 ↪popup=row['incidentOffense'], fill=True, color=color_dict[code],␣
 ↪fill_opacity=0.8).add_to(map_osm)

map_osm
```

[77]: <folium.folium.Map at 0x2a58bc78250>

This map shows assault arrests from the sample data in Baltimore. A dark red marker shows a common assault arrest and is the most represented assault on this map. A red and orange markers indicate an aggrevated assault using some weapon. Although the data is spread out throughout the city, there are large clusters inbetween the downtown and surrounding neighborhoods on the East and West sides of the city.

[78]:
```
map_osm = folium.Map(location=[39.29, -76.61], zoom_start=12)


#This map looks at unknown offense arrests and "other" arrests (79) across all␣
 ↪of Baltimore

color_dict = {
    'Un':'gray',  # Unknown incident arrest
    '79':'black'} # "Other" arrest

for index, row in arrest_table.iterrows():
    code = str(row['incidentOffense'])[0:2]
    if code == 'Un' or code == '79':
        folium.CircleMarker(location=[row['lat'], row['long']], radius = 1.5,␣
 ↪popup=row['incidentOffense'], fill=True, color=color_dict[code],␣
 ↪fill_opacity=0.8).add_to(map_osm)

map_osm
```

[78]:
```
<folium.folium.Map at 0x2a58bc78070>
```

This map shows unknown incident arrests and “other” arrests from the sample data in Baltimore. A black marker indicates an “other” arrest while a gray marker indicates an unknown arrest. The markers are spread pretty evenly throughout the city and due to the ambiguous nature of the data we cannot confidently speculate as to why that is

[79]:
```
map_osm = folium.Map(location=[39.29, -76.61], zoom_start=12)


#This map looks at robbery arrests (3A, 3B, 3K, 3N) across all of Baltimore

color_dict = {
    '3A':'black',      # Robbery Highway / Carjack Armed arrest
    '3B':'black',      # Robbery Highway / Carjack Unarmed arrest
    '3K':'purple',     # Robbery Residential Unarmed arrest
    '3J':'purple',     # Robbery Residential Armed arrest
    '3N':'blue',       # Robbery Misc Armed arrest
    '3P':'blue'}       # Robbery Misc Unarmed arrest


for index, row in arrest_table.iterrows():
    code = str(row['incidentOffense'])[0:2]
```

```
    if code == '3B' or code == '3A' or code == '3N' or code == '3J' or code ==␣
↪'3K' or code == '3P':
        folium.CircleMarker(location=[row['lat'], row['long']], radius = 2,␣
↪popup=row['incidentOffense'], fill=True, color=color_dict[code],␣
↪fill_opacity=0.8).add_to(map_osm)

map_osm
```

[79]: <folium.folium.Map at 0x2a5853b69d0>

This map shows robbery arrests from the sample data in Baltimore. A blue marker indicates a miscellaneous robbery arrest (unarmed and armed). Based on the spread of the blue markers, it seems like they're most common in residential neighborhoods far from the downtown of the city. A black marker indicates a highway robbery or a carjacking (unarmed and armed). Obviously, these markers correlate with highways and streets throughout the city, but they appear in the downtown and in the outer limits of the city pretty equally. A purple marker indicates a residential robbery (unarmed and armed) and thus appear in residential neighborhoods.

[80]:
```
map_osm = folium.Map(location=[39.29, -76.61], zoom_start=13)

#Creates a heat map of data for gambling arrests
arrest_table['lat'] = arrest_table['lat'].astype(float)
arrest_table['long'] = arrest_table['long'].astype(float)
heat_df = arrest_table[arrest_table['incidentOffense'] == '78-Gambling']
heat_df = heat_df[['lat', 'long']]
heat_df = heat_df.dropna(axis=0, subset=['lat','long'])
heat_data = [[row['lat'],row['long']] for index, row in heat_df.iterrows()]
HeatMap(heat_data).add_to(map_osm)

map_osm
```

[80]: <folium.folium.Map at 0x2a5853b6c40>

This map shows gambling arrests from the sample data in Baltimore. The data is heavily concentrated in the center of the city across the Eastern and Western sides. Since this is illegal gambling, it is hard to know exactly why the data appears where it does, but it could be indicative of the locations of underground casinos.

[81]:
```
map_osm = folium.Map(location=[39.29, -76.61], zoom_start=13)

#Creates a heat map of data for tresspassing arrests
heat_df = arrest_table[arrest_table['incidentOffense'] == '115-Trespassing']
heat_df = heat_df[['lat', 'long']]
heat_df = heat_df.dropna(axis=0, subset=['lat','long'])
heat_data = [[row['lat'],row['long']] for index, row in heat_df.iterrows()]
HeatMap(heat_data).add_to(map_osm)
```

```
map_osm
```

[81]: <folium.folium.Map at 0x2a58f270ee0>

This map shows tresspassing arrests from the sample data in Baltimore. The data is heavily concentrated in the center of the city especially across the Western portion. It seems like there are many churches and schools congregated around the densest clusters. Additionally, near the Orioles baseball stadium there is another large cluster.

[82]:
```
map_osm = folium.Map(location=[39.29, -76.61], zoom_start=13)

#Creates a heat map of data for prostitution arrests
heat_df = arrest_table[arrest_table['incidentOffense'] == '55A-Prostitution']
heat_df = heat_df[['lat', 'long']]
heat_df = heat_df.dropna(axis=0, subset=['lat','long'])
heat_data = [[row['lat'],row['long']] for index, row in heat_df.iterrows()]
HeatMap(heat_data).add_to(map_osm)
map_osm
```

[82]: <folium.folium.Map at 0x2a581991910>

This map shows prostitution arrests from the sample data in Baltimore. The data isn't particularly concentrated around any particular area, as instead there are several distinct clusters that form. Since prostitutes often work in similar places, it makes sense as to why large clusters would appear. As to why the show up where they do is unknown however.

To begin analyzing the data, I first randomly sample 15 thousand data points from the original dataset of 60 thousand. Since narcotics make up a large portion of arrests, I decided to see if any interesting patterns emerge. Although most of the map is covered, there are still discernable clusters of points. From there, I use circle markers and heat maps to look at other interesting patterns using incident offenses that I believe will produce maps with unique characteristics to the crime in nature. For instance, car jackings and towed vehicle arrests tend to show up near roads and highways, while residential burgularlies and robberies appear near where most people live. Although some maps are more distinct than others, I like how the circle marker maps reveal the scale of the number of arrests as well.