Long term care system in Maryland State.

Introduction:

Long-term care analysis is critical for a number of reasons, the most important of which are the aging population and the possible financial load associated with longer healthcare demands. Therefore, I want to do a visual analysis of long-term care facilities and nursing homes to gain a comprehensive understanding of the quality of care provided in our society.

In this report, Maryland State will be used as an example. First of all, there are three datasets will be used in this project. They will be imported to Python by using database connection, api connection, and local file uploaded.

Secondly, according to those data, the program will caculate key indexs. For example, the bed supply rate of nursing houses in each county. This information will aid in identifying counties in Maryland that may require an expansion of long-term care facilities.

Finally, the program will present the obtained data through visualizations to enhance clarity and understanding. In this project, it shows three different data visualizations.

This report will provide relevant authorities with the current aging situation in each county in MD State. In addition, the visually presented map will provide information on senior care centers and geriatric hospitals in each region.

Dataset List:

1)Population in MD State in 2020-2022.

Link:https://www.census.gov/data/datasets/time-series/demo/popest/2020s-counties-detail.html

2)Maryland Long Term Care Assisted Living - Long Term Care

Link: https://data.imap.maryland.gov/datasets/maryland::maryland-long-term-care-assisted-living-long-term-care/explore?location=38.846676%2C-77.306000%2C8.94

3)Maryland Long Term Care Assisted Living - Geriatric Care Hospitals

Link: https://data.imap.maryland.gov/datasets/2d33670813aa4e1e84bcec0c12773ba2_2/explore

Part I. To get the datasets.

Firstly, the program will use differt ways to get those three datasts.

1. database connection
2. api connection
3. local file (csv)

```
"""
In this cell, the program will connect to the MySQL Server which is at the GCP.  (The server of Mysql is created at GCP Clou
Then the SQL command will get the data of the poplation in Maryland State in 2023.
After got the data in python, the program would clean data make sure the data can be used easly later.

request dataset1:
1. using Mysql connection.
2. clean data: to remove the string 'County' in [CTYNAME]. For exapmle: Allegany State -> Allegany
"""

!pip install pymysql
import pymysql
import pandas as pd

#1.
#SQL connection information
conn = pymysql.connect(host="34.171.30.129",user='workbench',password='1234',database='newdb')

#SQL qury command
query = 'SELECT STATE, CTYNAME, AGE65PLUS_TOT,POPESTIMATE,AGE65PLUS_MALE,AGE65PLUS_FEM \
        FROM newdb.`cc-est2022-agesex-24` WHERE STATE =24 AND YEAR = 4 ;'

mysql_result_dataFrame = pd.read_sql(query,conn)

#2.
#clean data
mysql_result_dataFrame['CTYNAME'] = mysql_result_dataFrame['CTYNAME'].str.replace(' County', '')
print(mysql_result_dataFrame)

```

```
Collecting pymysql
  Downloading PyMySQL-1.1.0-py3-none-any.whl (44 kB)
     ━━━━━━━━━━━━━━━━━━━━━━━━━━━━━━━━━━━━━━━━ 44.8/44.8 kB 1.0 MB/s eta 0:00:00
Installing collected packages: pymysql
Successfully installed pymysql-1.1.0
    STATE          CTYNAME  AGE65PLUS_TOT  POPESTIMATE  AGE65PLUS_MALE  \
0      24         Allegany          14185        67267            6333
1      24     Anne Arundel          96019       593286           42867
2      24        Baltimore         156497       846161           66306
3      24          Calvert          15601        94573            7141
4      24         Caroline           5915        33433            2665
5      24          Carroll          31678       175305           14253
6      24            Cecil          18175       104942            8505
7      24          Charles          23629       170102           10206
8      24       Dorchester           7560        32726            3347
9      24        Frederick          44554       287079           19914
10     24          Garrett           6899        28579            3266
11     24          Harford          46276       263867           20629
12     24           Howard          51753       335411           23255
13     24             Kent           5440        19320            2438
14     24       Montgomery         181307      1052521           79527
15     24  Prince George's         144490       946971           59761
16     24     Queen Anne's          10723        51711            5087
17     24       St. Mary's          16285       114877            7647
18     24         Somerset           4440        24546            2035
19     24           Talbot          11584        37932            5108
20     24       Washington          28379       155590           12691
21     24         Wicomico          17826       104664            7802
22     24        Worcester          15625        53866            7262
23     24   Baltimore city          89369       569931           36280

    AGE65PLUS_FEM
0            7852
1           53152
2           90191
3            8460
4            3250
5           17425
6            9670
7           13423
8            4213
9           24640
10           3633
11          25647
12          28498
13           3002
14         101780
15          84729
16           5636
17           8638
18           2405
19           6476
```

```
20          15088
21          10024
22           8363
23          53089
<ipython-input-1-057991a72e26>:23: UserWarning: pandas only supports SQLAlchemy connectable (engine/connection) or database
  mysql_result_dataFrame = pd.read_sql(query,conn)
```

```
"""
In this cell, the program will call api from Maryland.gov. Then, the program will get long term care assisted living informa
In this data set, it shows the assisted living facilities infomation, such as address, longtitue, latitude, capacity etc.
After get the data, the program would do the simple data transformation before calcuation and data visulation.



# 1.request dateset2 by using calling api
# 2.data transformation (rename column, drop column, add new column)
# note: The 'map_use' field is used to determine which data set it comes from and can be visually presented based on the map

"""

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

url = "https://geodata.md.gov/imap/rest/services/Health/MD_LongTermCareAssistedLiving/FeatureServer/6/query?where=1%3D1&outF

try:
    response = requests.get(url)
    # Check if the request was successful (status code 200)
    if response.status_code == 200:
        data = response.json()
        # Now 'data' contains the JSON response from the API
        # 2. Read data
        features = data.get('features', [])
        records = [feature.get('attributes', {}) for feature in features]
        df_LTCLiving = pd.DataFrame(records)
        #print(df_LTCLiving)
    else:
        print(f"Error: {response.status_code}")

except requests.exceptions.RequestException as e:
    print(f"Request error: {e}")


#To rename columns , drop unuseless columns, and add columns

df_LTCLiving.rename(columns={'XCoordinate': 'Longtitude'}, inplace=True)
df_LTCLiving.rename(columns={'YCoordinate': 'Latitude'}, inplace= True)

df_LTCLiving.drop(['OHCQ_Index_No_','OBJECTID'] ,axis=1 ,inplace=True)

#add column 'Map_use'. This is a column to recogize the data is from dataset 2 or dataset 3.
#value = 0 -> dataset2 , value =1 -> dataset3
df_LTCLiving['Map_use']= 0


#print the result
print(df_LTCLiving)

```

```
               County                                    Facility_Name  \
0           Allegany                Allegany Health Nursing and Rehab
1           Allegany  Devlin Manor Nursing and Rehabilitation Center
2           Allegany                                 Egle Nursing Home
3           Allegany              Sterling Care at Frostburg Village
4           Allegany                    Cumberland Healthcare Center
..               ...                                             ...
222          Charles                                  Waldorf Center
223        Frederick                           Ballenger Creek Center
224          Howard          The Lutheran Village at Miller's Grant
225      Montgomery                           Ingleside at King Farm
226  Prince George's                                Riderwood Village

                          Facility_Address  Facility_City Facility_State  \
0                      730 Furnace Street     Cumberland             MD
1           10301 North East Christie Road     Cumberland             MD
2                       57 Jackson Street     Lonaconing             MD
3    One Kaylor Circle Route 36 & Route 40      Frostburg             MD
4                       512 Winifred Road     Cumberland             MD
```

```
..                                  ...           ...            ...
222            4140 Old Washington Highway        Waldorf            MD
223                    347 Ballenger Drive      Frederick            MD
224                    9000 Fathers Legacy  Ellicott City            MD
225                701 King Farm Boulevard      Rockville            MD
226                   3160 Gracefield Road  Silver Spring            MD

    Facility_Zip Facility_Phone  License_Capacity  Longtitude   Latitude  \
0          21502   301-777-5941               153  -78.764100  39.668600
1          21502   301-724-1400               124  -78.720300  39.665100
2          21539   301-463-5451                66  -78.978800  39.562900
3          21532   301-689-7500               122  -78.907600  39.645800
4          21502   301-724-6066               134  -78.743000  39.645700
..           ...            ...               ...         ...        ...
222        20602   301-645-2813               115  -76.932940  38.598529
223        21701   301-663-5181               130  -77.429570  39.396954
224        21042   410-696-6700                12  -76.842724  39.271801
225        20850   240-499-9015                45  -77.178051  39.111969
226        20904   301-572-8420               117  -76.942521  39.048594

     Map_use
0          0
1          0
2          0
3          0
4          0
..       ...
222        0
223        0
224        0
225        0
226        0

[227 rows x 11 columns]
```

```
"""
In this cell, the program will get the csv local file. The local file is provied by Maryland.gov.
In this dataset provide the information of getiatic care hospitals.
After get the data, the program would do the simple data transformation before calcuation and data visulation.



# dataset3
#1.import a csv file from lcoal machine
# 2.data transformation (rename column, drop column, add new column)
# note: The 'map_use' field is used to determine which data set it comes from and can be visually presented based on the map
"""

import pandas as pd
import io

df_LTCHospital = pd.read_csv('Maryland_Long_Term_Care_Assisted_Living_-_Geriatric_Care_Hospitals.csv')
#print(df_LTCHospital)


#To rename columns , drop columns , and new a colmns to recoginze
df_LTCHospital.rename(columns={'XCoordinate':'Longtitude'}, inplace = True)
df_LTCHospital.rename(columns={'YCoordinate':'Latitude'}, inplace = True)

df_LTCHospital.drop(['X', 'Y' ,'MIEMSS_Region', 'OHCQ_Index_No_', 'OBJECTID'] , axis=1, inplace = True)

#add column 'Map_use'. This is a column to recogize the data is from dataset 2 or dataset 3.
#value = 0 -> dataset2 , value =1 -> dataset3
df_LTCHospital['Map_use']= 1

print(df_LTCHospital)

#df_LTCHospital.info()

```

```
             County                                      Facility_Name  \
0        Washington                           Western Maryland Center
1    Baltimore City       Levindale Hebrew Geriatric Center & Hospital
2           Wicomico                                Deer's Head Center
3   Prince George's  Spellman Specialty Hospital And Nursing Care C...

                Facility_Address Facility_City Facility_State  Facility_Zip  \
0       1500 Pennsylvania Avenue    Hagerstown             MD         21742
1     2434 West Belvedere Avenue     Baltimore             MD         21215
2  315 Deer'S Head Hospital Road     Salisbury             MD         21802
```

```
3            3001 Hospital Drive      Cheverly             MD         20785

  Facility_Phone  License_Capacity  Longtitude  Latitude  Map_use
0   301-745-4140                60    -77.7175   39.6656        1
1   410-466-8700               100    -76.6651   39.3545        1
2   410-543-4000                 0    -75.5958   38.3822        1
3   301-497-7953                52    -76.9206   38.9304        1
```

Part II. date calculation part

In the section, 3 function would be created and be used to calcuate the specific value. Some of them would do data merage when using two data frame.

- calc_elders_rate: This function is used to calculate the proportion of elderly people over 65 years old in each county to the total population of the county. This allows us to know which county has a severe aging population.
- calc_male_to_female: This function is used to calculate the proportion of men and women over 65 years old in each county.
- calc_bed_occupancy_rate: This function calculates the bed supply rate of nursing houses in each county. Calculation method: The number of nursing beds available for every 1,000 older adults in the area. The higher the value, the greater the number of nursing home beds in the area.

```
def calc_elders_rate(result_dataFrame):
  """ (pd.dataframe) -> pd.dataframe
  This function is used to calculate the proportion of elderly people over 65 years old in each county to the total populati
  At last, the program will return a new dataframe which has two columns. (1)County Name (2) The ratio of the elders

  """
  #aggregate :groupby county column , sumup age over 65 population and all population
  df_elders_rate = result_dataFrame.groupby('CTYNAME')[['AGE65PLUS_TOT', 'POPESTIMATE']].sum()

  # Reset the index
  df_elders_rate.reset_index(inplace=True)


  # Calculate the ratio
  df_elders_rate['AGE65PLUS_RATIO'] = df_elders_rate['AGE65PLUS_TOT'] / df_elders_rate['POPESTIMATE']

  return(df_elders_rate[['CTYNAME', 'AGE65PLUS_RATIO']])


#test function
df_age65_ratio_result = calc_elders_rate(mysql_result_dataFrame)
print(df_age65_ratio_result)
```

```
             CTYNAME  AGE65PLUS_RATIO
0          Allegany         0.210876
1      Anne Arundel         0.161843
2         Baltimore         0.184949
3    Baltimore city         0.156807
4           Calvert         0.164963
5          Caroline         0.176921
6           Carroll         0.180702
7             Cecil         0.173191
8           Charles         0.138911
9        Dorchester         0.231009
10        Frederick         0.155198
11          Garrett         0.241401
12          Harford         0.175376
13           Howard         0.154297
14             Kent         0.281573
15       Montgomery         0.172260
16  Prince George's         0.152581
17     Queen Anne's         0.207364
18         Somerset         0.180885
19       St. Mary's         0.141760
20           Talbot         0.305389
21       Washington         0.182396
22         Wicomico         0.170316
23        Worcester         0.290072
```

```
def calc_male_to_female(mysql_result_dataFrame):
  """ (pd.dataframe)-> float, float
  This function is used to calculate the proportion of men and women over 65 years old in each county by usingthe aggreate m
  At last, the program will return two float values. (1)the percentage of over 65 yrs old male (2) the percentage of over 65

  """
  #use aggraeted to sum up 'AGE65PLUS_MALE' , 'AGE65PLUS_FEM '
  aggregated_df = mysql_result_dataFrame.groupby('STATE').agg({'AGE65PLUS_MALE': 'sum' , 'AGE65PLUS_FEM': 'sum'})

  # Calculate total for each gender
  total_male = aggregated_df['AGE65PLUS_MALE'].sum()
  total_female = aggregated_df['AGE65PLUS_FEM'].sum()

  # Calculate percentages
  percent_male = (aggregated_df['AGE65PLUS_MALE'] / (total_male +total_female)) * 100
  percent_female = (aggregated_df['AGE65PLUS_FEM'] / (total_male +total_female) ) * 100

  #print(percent_male) #43.8
  #print(percent_female) #56.1

  return percent_male, percent_female


#Test the function
result = calc_male_to_female(mysql_result_dataFrame)
percent_male, percent_female = result
```

```

def calc_bed_occupancy_rate(mysql_result_dataFrame,df_LTCLiving):
  """ (pd.datafrmae, pd.dateframe)->pd.dataframe
  This function calculates the bed supply rate of nursing houses in each county.
  Calculation method: The number of nursing beds available for every 1,000 older adults in the area.
  The higher the value, the greater the number of nursing home beds in the area.

  1. utilize dataframe[df_LTCLiving] and aggregate the total capicity in each county.
  2. use datafrmae [mysql_result_dataFrame] and [df_LTCLiving]. merge two dataframes on county column
  3. calcute the rate.

  """

  #1. use aggregate to sum up df_LTCLiving 'License_Capacity'  by 'County'
  agg_func = {'License_Capacity': 'sum'}
  df_county_capacity = df_LTCLiving.groupby('County').agg(agg_func).reset_index()

  #2.merge two dataframe
  merged_df = pd.merge(mysql_result_dataFrame, df_county_capacity, left_on='CTYNAME', right_on='County')
  # drop the same column
  merged_df = merged_df.drop(columns=['County', 'POPESTIMATE','AGE65PLUS_FEM' ,'AGE65PLUS_MALE'])

  #3. calculate
  #print(df_county_capacity)
  merged_df['Beds_Per_1000'] = (merged_df['License_Capacity'] / merged_df['AGE65PLUS_TOT']) * 1000


  #4. result
  return(merged_df)


#test function
result_df= calc_bed_occupancy_rate(mysql_result_dataFrame,df_LTCLiving)

print(result_df)
```

	STATE	CTYNAME	AGE65PLUS_TOT	License_Capacity	Beds_Per_1000
0	24	Allegany	14185	908	64.011280
1	24	Anne Arundel	96019	1606	16.725856
2	24	Baltimore	156497	347	2.217295
3	24	Calvert	15601	310	19.870521
4	24	Caroline	5915	187	31.614539
5	24	Carroll	31678	921	29.073805
6	24	Cecil	18175	431	23.713893
7	24	Charles	23629	491	20.779551
8	24	Dorchester	7560	233	30.820106
9	24	Frederick	44554	1082	24.285137
10	24	Garrett	6899	316	45.803740

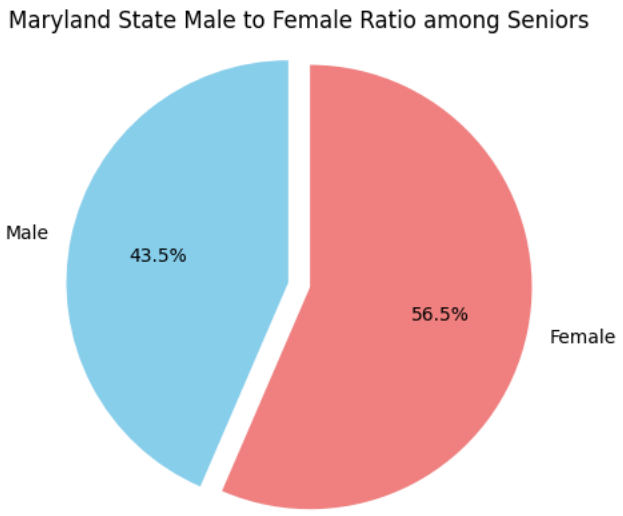
11	24	Harford	46276	769	16.617685
12	24	Howard	51753	576	11.129790
13	24	Kent	5440	228	41.911765
14	24	Montgomery	181307	4544	25.062463
15	24	Prince George's	144490	2803	19.399266
16	24	Queen Anne's	10723	120	11.190898
17	24	St. Mary's	16285	563	34.571692
18	24	Somerset	4440	211	47.522523
19	24	Talbot	11584	269	23.221685
20	24	Washington	28379	1138	40.100074
21	24	Wicomico	17826	613	34.387973
22	24	Worcester	15625	307	19.648000

PartIII. Data Visualization

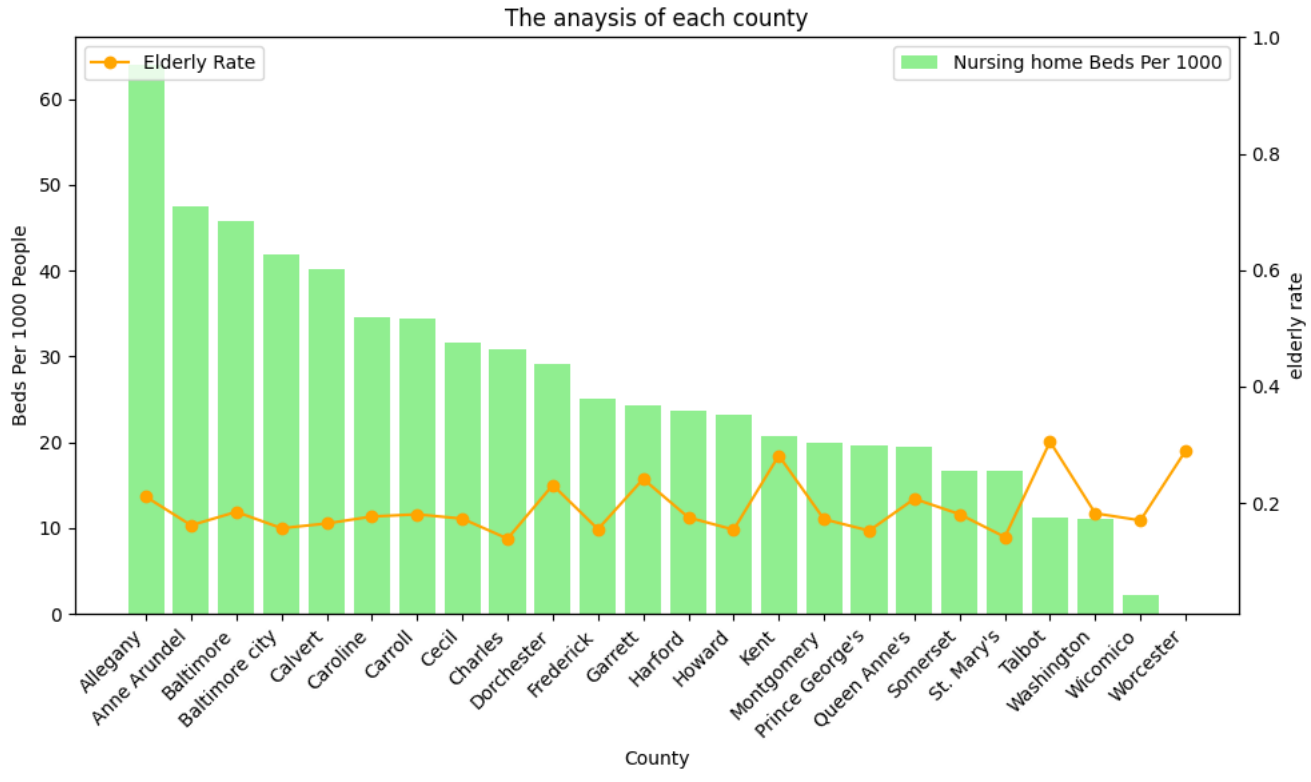
In this part, the above-mentioned function calculation results will be used to present data visualizations.

- Pie chart: The pie chart will show the male to female ratio of elderly people over 65 years old in Maryland state.
- Bar-Line chart: The bar line chart shows two metric values. One is the elder rate. The other is the bed supply rate of nursing houses. The best situation is low elder rate and a high nursing home bed supply rate.
- Map: This map will present the results of the fusion of two datasets (Maryland Long Term Care Assisted Living, Geriatric Care Hospitals) and use the field 'map_use' to determine whether to display icons of nursing homes or geriatric hospitals.This map visualization will exhibit an aggregation and summation effect upon zooming out.

```
import matplotlib.pyplot as plt


def plot_pie_chart(percent_male,percent_female):

  labels = ['Male', 'Female']
  sizes = [percent_male.sum(), percent_female.sum()]
  colors = ['skyblue', 'lightcoral']
  explode = (0.1, 0)  # explode the 1st slice (Male)

  plt.pie(sizes, explode=explode, labels=labels, colors=colors, autopct='%1.1f%%', startangle=90)
  plt.axis('equal')
  plt.title('Maryland State Male to Female Ratio among Seniors')

  # Display the pie chart
  plt.show()

#test function
percent_male, percent_female = calc_male_to_female(mysql_result_dataFrame)
plot_pie_chart(percent_male,percent_female)
```



```
import matplotlib.pyplot as plt

def bar_line_chart(result_df,df_age65_ratio_result):
    """
    bar chart
    """
    #order by desc
    result_df= result_df.sort_values(by='Beds_Per_1000', ascending=False)

     # Create a bar chart with conditional coloring
    plt.figure(figsize=(10, 6))
    bars = plt.bar(result_df['CTYNAME'], result_df['Beds_Per_1000'], color=['lightgreen'])

    plt.xlabel('County')
    plt.ylabel('Beds Per 1000 People')
    plt.title('The anaysis of each county')
    plt.xticks(rotation=45, ha='right')

    # Add a legend for color reference
    legend_labels = ['Nursing home Beds Per 1000']
    plt.legend(bars, legend_labels, loc='upper right')



    """
    line chart
    """
    ax2= plt.twinx()
    ax2.set_ylabel("elderly rate")

    ax2.set_ylim(0.01,1)

    #data from df_elders_rate 'AGE65PLUS_RATIO'
    ax2.plot(df_age65_ratio_result['CTYNAME'], df_age65_ratio_result['AGE65PLUS_RATIO'], color='orange', marker='o', label='
    ax2.legend(loc='upper left')



    plt.tight_layout()
    plt.show()


bar_line_chart(result_df,df_age65_ratio_result)
```



```
"""
LTC_map(df_LTCLiving, df_LTCHospital)

"""
import folium
from folium.plugins import MarkerCluster

# use concat_df dataframe to show the map visulization
def LTC_map(df_LTCLiving, df_LTCHospital):

  # concat dataset2 and dataset3
  concat_df = pd.concat([df_LTCLiving, df_LTCHospital])

  #create map  initize the map
  map = folium.Map(location=[39.5, -78.5], zoom_start=9)

  #create layer which can be add the points
  marker_cluster = MarkerCluster().add_to(map)

  # Add points to the map
  for index, row in concat_df.iterrows():

    lat, lon = row['Latitude'], row['Longtitude']
    #recognize the colomn 'Map_use' to mark different icons
    map_icon = row['Map_use']

    #custom icons
    if map_icon == 0:
          folium.Marker([lat, lon], icon=folium.CustomIcon('home.png')).add_to(marker_cluster)
    else:
          folium.Marker([lat, lon], icon=folium.CustomIcon('hos.png')).add_to(marker_cluster)

  # Display the map
  display(map)
  # download as html file if it can not display on github
  map.save("map.html")


##test
LTC_map(df_LTCLiving, df_LTCHospital)
```


Michaux
State Forest
Gettysburg
Hanover
Waynesboro