

folium

```
In [1]: import folium
```

6. 지도에 원 그리기

: 지도에 데이터 값, 영역 등의 정보를 표현하기 위한 방법

- folium.Circle()
- folium.CircleMarker()

Circle() 생성

```
In [5]: m = folium.Map(location=[37.54, 127.05461953077439], zoom_start=15)
```

```
In [6]: folium.Circle(location=[37.54, 127.0546],
                      radius=100,
                      color='red').add_to(m)

m
```

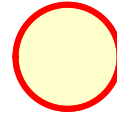
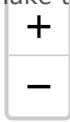
Out[6]:




```
In [7]: folium.Circle(location=[37.54, 127.0546],
                      radius=100,
                      color='red',
                      fill_color='yellow',
                      popup='Circle',
                      tooltip='Circle').add_to(m)

m
```

Out[7]: Make this Notebook Trusted to load map: File -> Trust Notebook



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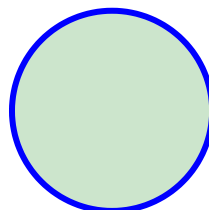
CircleMarker 생성


In [8]: `m = folium.Map(location=[37.54, 127.05461953077439], zoom_start=15)`In []:

```
folium.CircleMarker([37.54, 127.05461953077439],
                    radius=50,
                    fill=True,
                    color='blue',
                    fill_color='green',
                    popup='CM',
                    tooltip='CirceMarker')
                    .add_to(m)
```

In [10]: `m`

Out[10]: Make this Notebook Trusted to load map: File -> Trust Notebook



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7. MarkerCluster 생성

- 가까운 거리의 Marker들을 그룹화하여 Marker의 개수로 표현

MarkerCluster 추가 방법

1. Map 객체 생성
2. MarkerCluster 객체 생성하여 Map에 추가
3. MarkerCluster 객체에 Marker 추가


```
In [2]: # 서울시 구청 위치 정보
data = {'강남구청': [37.52579, 127.0483],
        '서초구청': [37.49093, 127.0329],
        '동작구청': [37.51871, 126.9364],
        '구로구청': [37.50237, 126.8890],
        '양천구청': [37.52007, 126.9549],
        '영등포구청': [37.54240, 126.8402],
        '관악구청': [37.48467, 126.9515],
        '용산구청': [37.53804, 126.9913],
        '서대문구청': [37.58567, 126.9357],
        '마포구청': [37.57003, 126.9019],
        '은평구청': [37.60675, 126.9302],
        '종로구청': [37.57615, 126.9790],
        '중구청': [37.56798, 126.9975],
        '성북구청': [37.59342, 127.0172],
        '동대문구청': [37.57792, 127.0401],
        '중랑구청': [37.60961, 127.0931],
        '노원구청': [37.65664, 127.0559],
        '도봉구청': [37.67214, 127.0462],
        '강북구청': [37.64278, 127.0253],
        '광진구청': [37.54104, 127.0826],
        '강동구청': [37.53246, 127.1237],
        '송파구청': [37.51803, 127.105]}
```

- map 객체 생성

```
In [3]: m = folium.Map([37.57402594173796, 126.97385569402873],
                        zoom_start=10,
                        tiles = 'https://tiles.stadiamaps.com/tiles/osm_bright/{z}/{x}/{y}{r}.p
                        attr='&copy; <a href="https://stadiamaps.com/">Stadia Maps</a>, W
                        &copy; <a href="https://openmaptiles.org/">OpenMapTiles</a> W
                        &copy; <a href="http://openstreetmap.org">OpenStreetMap</a> contributors'
m
```

Out[3]: Make this Notebook Trusted to load map: File -> Trust Notebook



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- MarkerCluster 추가

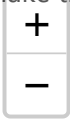
```
In [4]: from folium.plugins import MarkerCluster
```


```
In [5]: mc = MarkerCluster().add_to(m)
```

```
In [6]: for gu, loc in data.items():
#       print(gu, loc)
        folium.Marker(location=loc,
                        popup=folium.Popup(gu, max_width=200)).add_to(mc)
```

```
In [7]: m
```

Out[7]: Make this Notebook Trusted to load map: File -> Trust Notebook



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서울시 유동인구 데이터에서 조사지점 정보들을 MarkerCluster로 추가하기

- 데이터셋 : 서울시유동인구 조사지점정보(2015년)
- 조사구분이 '본조사'인 데이터만 대상으로 함
- <https://data.seoul.go.kr/dataList/OA-21707/F/1/datasetView.do>

```
In [8]: import pandas as pd
```

```
In [9]: loc_pos = pd.read_excel('data/유동인구/4_유동인구_조사지점정보_2015.xlsx',
                               skiprows=[0,1,3])
```

```
In [10]: loc_pos.head()
```

```
Out[10]:
```

	조 사 지 점 코 드	조 사 지 점 명	구코드	동코드	주 번 지	부 번 지	도 로 명	보 도 너 비	차 선 수	버 스 차 로 유 무	...	지 구 중 심 상 세 내 용	도 심 부 도 심 지 역 명	용 도 구 분	거 주 유 형 구 분	입 지 유 형 명	
0	01-003	신흥 모피 명품 전문 크리 닝.	11010.0	1101055.0	127	11	NaN	3.0	8.0	유	...	NaN	NaN	2 종 주 거	NaN	NaN	196
1	01-004	GS25	11010.0	1101055.0	94	2	세검 정로 230	3.0	7.0	유	...	NaN	NaN	2 종 주 거	NaN	NaN	196
2	01-005	세검 정정 류장	11010.0	1101055.0	92	0	세검 정길	4.0	5.0	유	...	NaN	NaN	1 종 주 거	NaN	NaN	196
3	01-008	안성 타워 內 굿 모닝 파워 공인 중개 사.	11010.0	1101056.0	72	72	NaN	4.0	4.0	유	...	NaN	NaN	2 종 주 거	NaN	NaN	197
4	01-009	복실 손뜨 기.	11010.0	1101056.0	88	46	NaN	2.0	7.0	유	...	NaN	NaN	2 종 주 거	NaN	NaN	196

5 rows × 37 columns

```
In [11]: loc_pos.info()
```

```
<class 'pandas.core.frame.DataFrame'>
RangeIndex: 1500 entries, 0 to 1499
Data columns (total 37 columns):
#   Column                Non-Null Count  Dtype
---  -
0   조사지점코드          1500 non-null   object
1   조사지점명            1500 non-null   object
2   구코드                1408 non-null   float64
3   동코드                1408 non-null   float64
4   주변지                1418 non-null   object
5   부번지                1373 non-null   object
6   도로명                1233 non-null   object
7   보도너비              1421 non-null   float64
8   차선수                1421 non-null   float64
9   버스차로유무          1421 non-null   object
10  중앙선여부            1421 non-null   object
11  장애물유무            1421 non-null   object
12  장애물종류            1421 non-null   object
13  보행도로구분          1421 non-null   object
14  점자블록유무          1421 non-null   object
15  경사로유무            1421 non-null   object
16  펜스유무              1421 non-null   object
17  버스정류장유무        1421 non-null   object
18  기타시설유무          0 non-null      float64
19  지하철유무            1421 non-null   object
20  횡단보도유무          1421 non-null   object
21  보도형태              0 non-null      float64
22  글로벌존지역명        0 non-null      float64
23  주거지역명            0 non-null      float64
24  지역중심명            0 non-null      float64
25  지역중심상세명        0 non-null      float64
26  지구중심명            0 non-null      float64
27  지구중심상세내용      0 non-null      float64
28  도심부도심지역명      0 non-null      float64
29  용도구분              1273 non-null   object
30  거주유형구분          0 non-null      float64
31  입지유형명            0 non-null      float64
32  X좌표                 1413 non-null   float64
33  Y좌표                 1413 non-null   float64
34  집계구코드            1413 non-null   float64
35  년도                  1500 non-null   int64
36  조사구분              1500 non-null   object
dtypes: float64(18), int64(1), object(18)
memory usage: 433.7+ KB
```

```
In [12]: loc_pos = loc_pos[loc_pos.조사구분 == '본조사']
loc_pos.shape
```

```
Out[12]: (1227, 37)
```

```
In [13]: loc_pos = loc_pos[['조사지점명', 'X좌표', 'Y좌표']]
loc_pos.shape
```

```
Out[13]: (1227, 3)
```

```
In [14]: data = loc_pos[:100]
data
```

Out[14]:

	조사지점명	X좌표	Y좌표
0	신흥모피명품전문크리닝.	196423.97707	455511.52968
1	GS25	196315.80243	455621.38262
2	세검정정류장	196357.17125	455680.82580
3	안성타워內 굿모닝파워공인중개사.	197904.19277	456718.34996
4	복실 손뜨기.	196360.44943	456405.89296
...
106	파인 에비뉴빌딩	199004.34348	451824.82262
108	미샤	200713.94049	451965.02145
109	농협중앙회(충무로지점)	199335.99415	451295.32474
111	노루표페인트	199192.16140	451842.82205
112	동대문우동장공사현장	200842.15605	452039.38981

100 rows × 3 columns

(x, y)좌표계를 (위도, 경도) 좌표계로 변환

- pyproj 모듈을 사용하여 좌표계 변환
- pyproj 모듈 설치
 - pip install pyproj

In [36]: !pip install pyproj

Requirement already satisfied: pyproj in c:\wprogramdata\anaconda3\lib\site-packages (3.4.1)
 Requirement already satisfied: certifi in c:\wprogramdata\anaconda3\lib\site-packages (from pyproj) (2022.9.14)

In [15]: from pyproj import Proj, transform

```
In [16]: def convert(x, y):
          inProj = Proj(init='epsg:5181')    # 투영좌표계
          outProj = Proj(init='epsg:4326')   # 지리좌표계
          lon, lat = transform(inProj, outProj, x, y)  # lon=경도, lat=위도
          return [lat, lon]
```

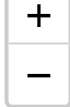
In [17]: convert(196423.97707, 455511.52968)


C:\WProgramData\Anaconda3\lib\site-packages\pyproj\wcrs\wcrs.py:141: FutureWarning: 'init=<authority>:<code>' syntax is deprecated. '<authority>:<code>' is the preferred initialization method. When making the change, be mindful of axis order changes: https://pyproj4.github.io/pyproj/stable/gotchas.html#axis-order-changes-in-proj-6
 in_crs_string = _prepare_from_proj_string(in_crs_string)
 C:\WProgramData\Anaconda3\lib\site-packages\pyproj\wcrs\wcrs.py:141: FutureWarning: 'init=<authority>:<code>' syntax is deprecated. '<authority>:<code>' is the preferred initialization method. When making the change, be mindful of axis order changes: https://pyproj4.github.io/pyproj/stable/gotchas.html#axis-order-changes-in-proj-6
 in_crs_string = _prepare_from_proj_string(in_crs_string)
 C:\WUsers\student\AppData\Local\Temp\ipykernel_6072\707734460.py:4: FutureWarning: This function is deprecated. See: https://pyproj4.github.io/pyproj/stable/gotchas.html#upgrading-to-pyproj-2-from-pyproj-1
 lon, lat = transform(inProj, outProj, x, y) # lon=경도, lat=위도

Out[17]: [37.599169622314946, 126.95950527754184]

```
In [18]: m = folium.Map([37.599169622314946, 126.95950527754184],  
                        zoom_start=15)  
m
```

Out[18]: Make this Notebook Trusted to load map: File -> Trust Notebook



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```
In [19]: data['위경도'] = data.apply(lambda pos : convert(pos.X좌표, pos.Y좌표), axis=1)
```



```

C:\WProgramData\WAnaconda3\WLib\site-packages\Wpyproj\Wcrs\Wcrs.py:141: FutureWarning: '+i
nit=<authority>:<code>' syntax is deprecated. '<authority>:<code>' is the preferred
initialization method. When making the change, be mindful of axis order changes: htt
ps://pyproj4.github.io/pyproj/stable/gotchas.html#axis-order-changes-in-proj-6
    in_crs_string = _prepare_from_proj_string(in_crs_string)
C:\WProgramData\WAnaconda3\WLib\site-packages\Wpyproj\Wcrs\Wcrs.py:141: FutureWarning: '+i
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ps://pyproj4.github.io/pyproj/stable/gotchas.html#axis-order-changes-in-proj-6
    in_crs_string = _prepare_from_proj_string(in_crs_string)
C:\WUsers\Wstudent\WAppData\WLocal\WTemp\Wipykernel_6072\W07734460.py:4: FutureWarning: Th
is function is deprecated. See: https://pyproj4.github.io/pyproj/stable/gotchas.html
#upgrading-to-pyproj-2-from-pyproj-1
    lon, lat = transform(inProj, outProj, x, y) # lon=경도, lat=위도
C:\WProgramData\WAnaconda3\WLib\site-packages\Wpyproj\Wcrs\Wcrs.py:141: FutureWarning: '+i
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C:\WProgramData\WAnaconda3\WLib\site-packages\Wpyproj\Wcrs\Wcrs.py:141: FutureWarning: '+i
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#upgrading-to-pyproj-2-from-pyproj-1
    lon, lat = transform(inProj, outProj, x, y) # lon=경도, lat=위도
C:\WProgramData\WAnaconda3\WLib\site-packages\Wpyproj\Wcrs\Wcrs.py:141: FutureWarning: '+i
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    in_crs_string = _prepare_from_proj_string(in_crs_string)
C:\WUsers\Wstudent\WAppData\WLocal\WTemp\Wipykernel_6072\W07734460.py:4: FutureWarning: Th
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#upgrading-to-pyproj-2-from-pyproj-1
    lon, lat = transform(inProj, outProj, x, y) # lon=경도, lat=위도
C:\WProgramData\WAnaconda3\WLib\site-packages\Wpyproj\Wcrs\Wcrs.py:141: FutureWarning: '+i
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#upgrading-to-pyproj-2-from-pyproj-1
    lon, lat = transform(inProj, outProj, x, y) # lon=경도, lat=위도
C:\WProgramData\WAnaconda3\WLib\site-packages\Wpyproj\Wcrs\Wcrs.py:141: FutureWarning: '+i
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```

```

ps://pyproj4.github.io/pyproj/stable/gotchas.html#axis-order-changes-in-proj-6
    in_crs_string = _prepare_from_proj_string(in_crs_string)
C:\Users\Wstudent\AppData\Local\Temp\Wipykernel_6072W707734460.py:4: FutureWarning: Th
is function is deprecated. See: https://pyproj4.github.io/pyproj/stable/gotchas.html
#upgrading-to-pyproj-2-from-pyproj-1
    lon, lat = transform(inProj, outProj, x, y) # lon=경도, lat=위도
C:\ProgramData\Anaconda3\Lib\site-packages\pyproj\Wcrs\Wcrs.py:141: FutureWarning: '+i
nit=<authority>:<code>' syntax is deprecated. '<authority>:<code>' is the preferred
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ps://pyproj4.github.io/pyproj/stable/gotchas.html#axis-order-changes-in-proj-6
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C:\ProgramData\Anaconda3\Lib\site-packages\pyproj\Wcrs\Wcrs.py:141: FutureWarning: '+i
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```

```

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    lon, lat = transform(inProj, outProj, x, y) # lon=경도, lat=위도
C:\WUsers\Wstudent\WAppData\WLocal\WTemp\Wipykernel_6072\W4142397542.py:1: SettingWithCopyW
arning:
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: https://pandas.pydata.org/pandas-docs/stable/u
ser_guide/indexing.html#returning-a-view-versus-a-copy
    data['위경도'] = data.apply(lambda pos : convert(pos.X좌표, pos.Y좌표), axis=1)

```

```
In [32]: data = data.reset_index()
data.head()
```

```
Out[32]:
```

	level_0	index	조사지점명	X좌표	Y좌표	위경도
0	0	0	신흥모피명품전문 크리닝.	196423.97707	455511.52968	[37.599169622314946, 126.95950527754184]
1	1	1	GS25	196315.80243	455621.38262	[37.600158960377534, 126.95827976042075]
2	2	2	세검정정류장	196357.17125	455680.82580	[37.60069470246644, 126.95874792945385]
3	3	3	안성타워內 굿모 닝파워공인중개 사.	197904.19277	456718.34996	[37.6100475136769, 126.97626371692706]
4	4	4	복실 손뜨기.	196360.44943	456405.89296	[37.60722749795384, 126.9587814478111]

- 좌표계 변환 warning 해결 : 완벽하지 않음

```
In [44]: from pyproj import Transformer


transformer = Transformer.from_crs('epsg:5181', 'epsg:4326')
transformer.transform(196423.97707, 455511.52968)
```

```
Out[44]: (35.231807288603704, 129.80651596957898)
```

```
In [45]: m = folium.Map(location=[35.231807288603704, 129.80651596957898],
                             zoom_start=10)
m
```

```
Out[45]: Make this Notebook Trusted to load map: File -> Trust Notebook
```



 Leaflet (<https://leafletjs.com>) | Data by © OpenStreetMap (<http://openstreetmap.org>), under ODbL (<http://www.openstreetmap.org/copyright>).

유동인구조사지점을 마커로 만들고 **MarkerCluster**를 적용하여 시각화

```
In [25]: m = folium.Map(location=[37.566535, 126.9779691999996],
                             zoom_start=10)
```

```
mc = MarkerCluster().add_to(m)
```

```
In [24]: list(enumerate(data.위경도))
```



```

Out[24]: [(0, [37.599169622314946, 126.95950527754184]),
(1, [37.600158960377534, 126.95827976042075]),
(2, [37.60069470246644, 126.95874792945385]),
(3, [37.6100475136769, 126.97626371692706]),
(4, [37.60722749795384, 126.9587814478111]),
(5, [37.57189585575478, 127.01093986576858]),
(6, [37.5742705577399, 127.01909338960732]),
(7, [37.57074463392461, 127.00262338744986]),
(8, [37.57596032499436, 126.99927072516557]),
(9, [37.58240785755108, 126.99774653014185]),
(10, [37.581860705095, 127.00229395758608]),
(11, [37.568748573616745, 126.9851493859376]),
(12, [37.56996960441363, 126.98568750376982]),
(13, [37.57083848702518, 126.9956262179747]),
(14, [37.5702911940144, 126.99061873346157]),
(15, [37.57271181215452, 126.98289942476514]),
(16, [37.57924228275812, 126.97952735607045]),
(17, [37.585199160250326, 126.97133919632157]),
(18, [37.57579860405918, 126.97102700952424]),
(19, [37.57024959111768, 126.97949158385843]),
(20, [37.570708560950834, 126.96185975430792]),
(21, [37.56988722654926, 126.9730327562972]),
(22, [37.56997204029241, 126.9713901771636]),
(23, [37.57288825361462, 126.97828956164231]),
(24, [37.57513866158984, 126.95742839895145]),
(25, [37.56939647333361, 126.99770582864966]),
(26, [37.57084518181747, 126.99853543350594]),
(27, [37.57734777778048, 126.9792588602516]),
(28, [37.56867506757757, 126.99340260436438]),
(29, [37.57031951072167, 126.9855129559265]),
(30, [37.569985073137225, 126.9895927339847]),
(31, [37.57031059866805, 126.98552439699829]),
(32, [37.569833277541, 126.9761578394427]),
(33, [37.57346674060522, 127.0006059696071]),
(34, [37.573269180935895, 127.00281613185898]),
(35, [37.57266487076183, 127.00594865775517]),
(36, [37.573640412934715, 127.00516588399343]),
(37, [37.569661607432664, 126.98969898441098]),
(38, [37.56879641659778, 126.98967671116078]),
(39, [37.57607381816301, 126.98407636859098]),
(40, [37.57232349141933, 126.98384430465852]),
(41, [37.579463741864764, 126.97285594574947]),
(42, [37.586659553277286, 126.98495154903124]),
(43, [37.58283058369664, 126.98500354008432]),
(44, [37.58052957614798, 126.98671039249953]),
(45, [37.57830895498707, 126.98938968931509]),
(46, [37.574948782100286, 126.97484251034]),
(47, [37.572454770574446, 126.97505782647227]),
(48, [37.57191697145219, 126.98163102898371]),
(49, [37.57528780264266, 126.98802672661257]),
(50, [37.575569526717906, 126.98935878757432]),
(51, [37.56992740808484, 126.97766212376528]),
(52, [37.571093729433215, 126.979163097881]),
(53, [37.58425500880319, 127.00093729509886]),
(54, [37.5713892757661, 126.9789552980624]),
(55, [37.572181300636124, 126.98721972969368]),
(56, [37.568668150700496, 126.99048215790562]),
(57, [37.569600067936115, 126.99198646787178]),
(58, [37.58788405910937, 126.99962063220924]),
(59, [37.58351681408268, 127.00101509365467]),
(60, [37.570603848164524, 126.99876506935468]),
(61, [37.57108851421545, 127.01029396489619]),
(62, [37.58310456094619, 126.98333547159028]),
(63, [37.577565830109826, 127.01554056232857]),

```

```
(64, [37.58024444008435, 127.00402510039567]),
(65, [37.573533049007246, 126.9726430725664]),
(66, [37.57393349730415, 126.97310171995724]),
(67, [37.57354851939956, 126.98484651797177]),
(68, [37.5836379026399, 126.98249037705371]),
(69, [37.58148410212569, 126.9845463028057]),
(70, [37.58090645475569, 126.98862998539107]),
(71, [37.573824458599816, 127.0152954778212]),
(72, [37.571445644182035, 127.0056139322599]),
(73, [37.57054747874864, 127.00275053892372]),
(74, [37.573997527015614, 126.98467061193506]),
(75, [37.56989830344526, 126.97327032608675]),
(76, [37.56514490097383, 127.01391557937141]),
(77, [37.56894756813417, 127.01610680536895]),
(78, [37.563962574520914, 127.02452596570507]),
(79, [37.55985168856771, 127.01450600021566]),
(80, [37.55828309989844, 126.9731807258612]),
(81, [37.554264690543405, 126.96598120632711]),
(82, [37.55577862068171, 126.97012529204075]),
(83, [37.567805174511996, 127.0023795887703]),
(84, [37.56606487058503, 127.00650047132962]),
(85, [37.55794322142663, 126.98283988680996]),
(86, [37.559796324440484, 126.9824864564388]),
(87, [37.56087392935743, 126.98625225843381]),
(88, [37.560265231754926, 127.00579649980591]),
(89, [37.55811829543745, 127.00764727910428]),
(90, [37.56562573480826, 126.97723418049611]),
(91, [37.557932227494035, 126.97324213215788]),
(92, [37.56397081625344, 126.98175052809245]),
(93, [37.56523091891203, 126.98787980672614]),
(94, [37.56376141972206, 126.98778649651086]),
(95, [37.56595904051932, 126.98873023756106]),
(96, [37.56722248759723, 127.00808117604643]),
(97, [37.56118858237064, 126.9924846461643]),
(98, [37.56612139845749, 126.99085611484216]),
(99, [37.56789243512195, 127.00953254836266])]
```

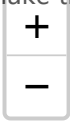
In [29]: `data.index`

Out[29]: `Int64Index([0, 1, 2, 3, 4, 5, 6, 8, 9, 11, 12, 14, 15, 16, 18, 19, 20, 21, 22, 23, 24, 25, 26, 27, 28, 29, 30, 31, 32, 33, 34, 36, 37, 38, 39, 40, 41, 42, 43, 44, 45, 46, 47, 48, 49, 50, 51, 52, 53, 54, 55, 57, 58, 59, 60, 61, 62, 63, 65, 67, 68, 69, 71, 72, 73, 74, 75, 76, 77, 78, 79, 80, 81, 82, 84, 85, 86, 87, 88, 89, 90, 91, 92, 93, 94, 95, 96, 97, 98, 99, 100, 102, 103, 104, 105, 106, 108, 109, 111, 112], dtype='int64')`


In [33]: `for idx, loc in enumerate(data.위경도) :
 folium.Marker(location=loc,
 popup=data.조사지점명[idx],
 tooltip=data.조사지점명[idx],
 icon=folium.Icon(color='blue')).add_to(mc)

m`

Out[33]: Make this Notebook Trusted to load map: File -> Trust Notebook



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 Leaflet (<https://leafletjs.com>) | Data by © OpenStreetMap (<http://openstreetmap.org>), under ODbL (<http://www.openstreetmap.org/copyright>).

```
In [35]: list(data.iterrows())
```

```

Out[35]: [(0,
  level_0          0
  index           0
  조사지점명      신흥모피명품전문크리닝.
  X좌표          196423.97707
  Y좌표          455511.52968
  위경도          [37.599169622314946, 126.95950527754184]
  Name: 0, dtype: object),
 (1,
  level_0          1
  index           1
  조사지점명      GS25
  X좌표          196315.80243
  Y좌표          455621.38262
  위경도          [37.600158960377534, 126.95827976042075]
  Name: 1, dtype: object),
 (2,
  level_0          2
  index           2
  조사지점명      세검정정류장
  X좌표          196357.17125
  Y좌표          455680.8258
  위경도          [37.60069470246644, 126.95874792945385]
  Name: 2, dtype: object),
 (3,
  level_0          3
  index           3
  조사지점명      안성타워內 굿모닝파워공인중개사.
  X좌표          197904.19277
  Y좌표          456718.34996
  위경도          [37.6100475136769, 126.97626371692706]
  Name: 3, dtype: object),
 (4,
  level_0          4
  index           4
  조사지점명      북실 손뜨기.
  X좌표          196360.44943
  Y좌표          456405.89296
  위경도          [37.60722749795384, 126.9587814478111]
  Name: 4, dtype: object),
 (5,
  level_0          5
  index           5
  조사지점명      24시 동대문 설렁탕.
  X좌표          200966.43423
  Y좌표          452483.73642
  위경도          [37.57189585575478, 127.01093986576858]
  Name: 5, dtype: object),
 (6,
  level_0          6
  index           6
  조사지점명      서울전문학교.
  X좌표          201686.66781
  Y좌표          452747.41594
  위경도          [37.5742705577399, 127.01909338960732]
  Name: 6, dtype: object),
 (7,
  level_0          7
  index           8
  조사지점명      서울 종묘농약
  X좌표          200231.75517
  Y좌표          452355.91115
  위경도          [37.57074463392461, 127.00262338744986]
  Name: 7, dtype: object),

```

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(8,
  level_0          8
  index            9
  조사지점명       삼성카드빌딩
  X좌표            199935.57893
  Y좌표            452934.78947
  위경도           [37.57596032499436, 126.99927072516557]
  Name: 8, dtype: object),
(9,
  level_0          9
  index            11
  조사지점명       TIFS(성우빌딩)
  X좌표            199800.95512
  Y좌표            453650.39376
  위경도           [37.58240785755108, 126.99774653014185]
  Name: 9, dtype: object),
(10,
  level_0          10
  index            12
  조사지점명       KFC
  X좌표            200202.62257
  Y좌표            453589.66617
  위경도           [37.581860705095, 127.00229395758608]
  Name: 10, dtype: object),
(11,
  level_0          11
  index            14
  조사지점명       영안빌딩(미샤)
  X좌표            198688.03274
  Y좌표            452134.47214
  위경도           [37.568748573616745, 126.9851493859376]
  Name: 11, dtype: object),
(12,
  level_0          12
  index            15
  조사지점명       우리은행
  X좌표            198735.59303
  Y좌표            452269.98495
  위경도           [37.56996960441363, 126.98568750376982]
  Name: 12, dtype: object),
(13,
  level_0          13
  index            16
  조사지점명       종묘공원
  X좌표            199613.61204
  Y좌표            452366.33351
  위경도           [37.57083848702518, 126.9956262179747]
  Name: 13, dtype: object),
(14,
  level_0          14
  index            18
  조사지점명       U+
  X좌표            199171.23557
  Y좌표            452305.62273
  위경도           [37.5702911940144, 126.99061873346157]
  Name: 14, dtype: object),
(15,
  level_0          15
  index            19
  조사지점명       성중사
  X좌표            198489.34152
  Y좌표            452574.37932
  위경도           [37.57271181215452, 126.98289942476514]
  Name: 15, dtype: object),

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(16,
  level_0          16
  index            20
  조사지점명       금호미술관
  X좌표            198191.61215
  Y좌표            453299.24582
  위경도           [37.57924228275812, 126.97952735607045]
  Name: 16, dtype: object),
(17,
  level_0          17
  index            21
  조사지점명       남원추어탕 맞은편.
  X좌표            197468.53801
  Y좌표            453960.58038
  위경도           [37.585199160250326, 126.97133919632157]
  Name: 17, dtype: object),
(18,
  level_0          18
  index            22
  조사지점명       대영빌딩
  X좌표            197440.64238
  Y좌표            452917.23467
  위경도           [37.57579860405918, 126.97102700952424]
  Name: 18, dtype: object),
(19,
  level_0          19
  index            23
  조사지점명       픽스딕스.
  X좌표            198188.23447
  Y좌표            452301.16163
  위경도           [37.57024959111768, 126.97949158385843]
  Name: 19, dtype: object),
(20,
  level_0          20
  index            24
  조사지점명       세실치과의원
  X좌표            196630.61453
  Y좌표            452352.58803
  위경도           [37.570708560950834, 126.96185975430792]
  Name: 20, dtype: object),
(21,
  level_0          21
  index            25
  조사지점명       금호아시아나 1관.
  X좌표            197617.6337
  Y좌표            452261.08752
  위경도           [37.56988722654926, 126.9730327562972]
  Name: 21, dtype: object),
(22,
  level_0          22
  index            26
  조사지점명       lg광화문 빌딩
  X좌표            197472.52625
  Y좌표            452270.54377
  위경도           [37.56997204029241, 126.9713901771636]
  Name: 22, dtype: object),
(23,
  level_0          23
  index            27
  조사지점명       안경마을 콘택트
  X좌표            198082.11244
  Y좌표            452594.04638
  위경도           [37.57288825361462, 126.97828956164231]
  Name: 23, dtype: object),

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(24,
  level_0          24
  index            28
  조사지점명       세란병원.
  X좌표            196239.3625
  Y좌표            452844.44602
  위경도           [37.57513866158984, 126.95742839895145]
  Name: 24, dtype: object),
(25,
  level_0          25
  index            29
  조사지점명       에이스조명
  X좌표            199797.32477
  Y좌표            452206.28026
  위경도           [37.56939647333361, 126.99770582864966]
  Name: 25, dtype: object),
(26,
  level_0          26
  index            30
  조사지점명       매헌빌딩
  X좌표            199870.61751
  Y좌표            452367.06857
  위경도           [37.57084518181747, 126.99853543350594]
  Name: 26, dtype: object),
(27,
  level_0          27
  index            31
  조사지점명       경북궁 돌담길 경북궁동문 정류장에서 춘추관앞 방향으로 60M
  X좌표            198167.84898
  Y좌표            453088.98273
  위경도           [37.57734777778048, 126.9792588602516]
  Name: 27, dtype: object),
(28,
  level_0          28
  index            32
  조사지점명       버스정류장에서 도로 바라보고 좌측20미터 일성틀
  X좌표            199417.15706
  Y좌표            452126.23062
  위경도           [37.56867506757757, 126.99340260436438]
  Name: 28, dtype: object),
(29,
  level_0          29
  index            33
  조사지점명       우리은행
  X좌표            198720.17896
  Y좌표            452308.82284
  위경도           [37.57031951072167, 126.9855129559265]
  Name: 29, dtype: object),
(30,
  level_0          30
  index            34
  조사지점명       Tworld 대리점
  X좌표            199080.59246
  Y좌표            452271.65642
  위경도           [37.569985073137225, 126.9895927339847]
  Name: 30, dtype: object),
(31,
  level_0          31
  index            36
  조사지점명       준코 뮤직타운
  X좌표            198721.18954
  Y좌표            452307.83355
  위경도           [37.57031059866805, 126.98552439699829]
  Name: 31, dtype: object),

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(32,
  level_0          32
  index           37
  조사지점명      광화문 빌딩
  X좌표          197893.7113
  Y좌표          452255.02517
  위경도          [37.569833277541, 126.9761578394427]
  Name: 32, dtype: object),
(33,
  level_0          33
  index           38
  조사지점명      서울보증보험 조형물
  X좌표          200053.53059
  Y좌표          452658.03034
  위경도          [37.57346674060522, 127.0006059696071]
  Name: 33, dtype: object),
(34,
  level_0          34
  index           39
  조사지점명      효제초교 지하주차장입구
  X좌표          200248.77419
  Y좌표          452636.10706
  위경도          [37.573269180935895, 127.00281613185898]
  Name: 34, dtype: object),
(35,
  level_0          35
  index           40
  조사지점명      대일빌딩
  X좌표          200525.50255
  Y좌표          452569.04854
  위경도          [37.57266487076183, 127.00594865775517]
  Name: 35, dtype: object),
(36,
  level_0          36
  index           41
  조사지점명      운촌빌딩
  X좌표          200456.34661
  Y좌표          452677.31833
  위경도          [37.573640412934715, 127.00516588399343]
  Name: 36, dtype: object),
(37,
  level_0          37
  index           42
  조사지점명      국일관
  X좌표          199089.97499
  Y좌표          452235.75446
  위경도          [37.569661607432664, 126.98969898441098]
  Name: 37, dtype: object),
(38,
  level_0          38
  index           43
  조사지점명      성제종합취장타운
  X좌표          199087.99675
  Y좌표          452139.72858
  위경도          [37.56879641659778, 126.98967671116078]
  Name: 38, dtype: object),
(39,
  level_0          39
  index           44
  조사지점명      안국역 6번 출구 건너편
  X좌표          198593.37554
  Y좌표          452947.50485
  위경도          [37.57607381816301, 126.98407636859098]
  Name: 39, dtype: object),

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(40,
  level_0          40
  index            45
  조사지점명       농협중앙회 앞
  X좌표            198572.80445
  Y좌표            452531.26545
  위경도           [37.57232349141933, 126.98384430465852]
  Name: 40, dtype: object),
(41,
  level_0          41
  index            46
  조사지점명       SINDO 앞
  X좌표            197602.32079
  Y좌표            453323.97458
  위경도           [37.579463741864764, 126.97285594574947]
  Name: 41, dtype: object),
(42,
  level_0          42
  index            47
  조사지점명       감사원뒷길
  X좌표            198670.87338
  Y좌표            454122.38772
  위경도           [37.586659553277286, 126.98495154903124]
  Name: 42, dtype: object),
(43,
  level_0          43
  index            48
  조사지점명       서울 닭 문화관
  X좌표            198675.39755
  Y좌표            453697.41488
  위경도           [37.58283058369664, 126.98500354008432]
  Name: 43, dtype: object),
(44,
  level_0          44
  index            49
  조사지점명       애지중지
  X좌표            198826.12373
  Y좌표            453442.00663
  위경도           [37.58052957614798, 126.98671039249953]
  Name: 44, dtype: object),
(45,
  level_0          45
  index            50
  조사지점명       창덕궁
  X좌표            199062.75924
  Y좌표            453195.51304
  위경도           [37.57830895498707, 126.98938968931509]
  Name: 45, dtype: object),
(46,
  level_0          46
  index            51
  조사지점명       정부 중앙청사 후문
  X좌표            197777.66315
  Y좌표            452822.81715
  위경도           [37.574948782100286, 126.97484251034]
  Name: 46, dtype: object),
(47,
  level_0          47
  index            52
  조사지점명       새마을식당
  X좌표            197796.61005
  Y좌표            452546.00566
  위경도           [37.572454770574446, 126.97505782647227]
  Name: 47, dtype: object),

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(48,
  level_0          48
  index            53
  조사지점명       소송동 스타벅스
  X좌표            198377.27466
  Y좌표            452486.18237
  위경도           [37.57191697145219, 126.98163102898371]
  Name: 48, dtype: object),
(49,
  level_0          49
  index            54
  조사지점명       덕성여대, 교동초교, 사이 골목
  X좌표            198942.3219
  Y좌표            452860.21439
  위경도           [37.57528780264266, 126.98802672661257]
  Name: 49, dtype: object),
(50,
  level_0          50
  index            55
  조사지점명       일등 의상실
  X좌표            199059.99516
  Y좌표            452891.46835
  위경도           [37.575569526717906, 126.98935878757432]
  Name: 50, dtype: object),
(51,
  level_0          51
  index            57
  조사지점명       동아일보
  X좌표            198026.60682
  Y좌표            452265.43991
  위경도           [37.56992740808484, 126.97766212376528]
  Name: 51, dtype: object),
(52,
  level_0          52
  index            58
  조사지점명       이디야 커피
  X좌표            198159.23596
  Y좌표            452394.85755
  위경도           [37.571093729433215, 126.979163097881]
  Name: 52, dtype: object),
(53,
  level_0          53
  index            59
  조사지점명       명륜동2가 새마을금고
  X좌표            200082.78752
  Y좌표            453855.40453
  위경도           [37.58425500880319, 127.00093729509886]
  Name: 53, dtype: object),
(54,
  level_0          54
  index            60
  조사지점명       한가람 노래바
  X좌표            198140.88595
  Y좌표            452427.66385
  위경도           [37.5713892757661, 126.9789552980624]
  Name: 54, dtype: object),
(55,
  level_0          55
  index            61
  조사지점명       일식레스토랑
  X좌표            198870.98765
  Y좌표            452515.43801
  위경도           [37.572181300636124, 126.98721972969368]
  Name: 55, dtype: object),

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(56,
  level_0          56
  index           62
  조사지점명      웰빙콩나물
  X좌표          199159.1519
  Y좌표          452125.48505
  위경도          [37.568668150700496, 126.99048215790562]
  Name: 56, dtype: object),
(57,
  level_0          57
  index           63
  조사지점명      종로 골뱅이
  X좌표          199292.05809
  Y좌표          452228.9046
  위경도          [37.569600067936115, 126.99198646787178]
  Name: 57, dtype: object),
(58,
  level_0          58
  index           65
  조사지점명      태양전기
  X좌표          199966.49359
  Y좌표          454258.18761
  위경도          [37.58788405910937, 126.99962063220924]
  Name: 58, dtype: object),
(59,
  level_0          59
  index           67
  조사지점명      더페이스샵
  X좌표          200089.66004
  Y좌표          453773.47339
  위경도          [37.58351681408268, 127.00101509365467]
  Name: 59, dtype: object),
(60,
  level_0          60
  index           68
  조사지점명      한의원
  X좌표          199890.90361
  Y좌표          452340.28305
  위경도          [37.570603848164524, 126.99876506935468]
  Name: 60, dtype: object),
(61,
  level_0          61
  index           69
  조사지점명      동대문종합시장앞 동대문역 6번출구 전방 10m 가판대
  X좌표          200909.38478
  Y좌표          452394.12444
  위경도          [37.57108851421545, 127.01029396489619]
  Name: 61, dtype: object),
(62,
  level_0          62
  index           71
  조사지점명      cafe nanuri
  X좌표          198528.06633
  Y좌표          453727.84806
  위경도          [37.58310456094619, 126.98333547159028]
  Name: 62, dtype: object),
(63,
  level_0          63
  index           72
  조사지점명      식당
  X좌표          201372.75841
  Y좌표          453113.09533
  위경도          [37.577565830109826, 127.01554056232857]
  Name: 63, dtype: object),

```

```

(64,
  level_0          64
  index            73
  조사지점명      작은 스위스 요리전문점
  X좌표            200355.54006
  Y좌표            453410.28438
  위경도          [37.58024444008435, 127.00402510039567]
  Name: 64, dtype: object),
(65,
  level_0          65
  index            74
  조사지점명      외환은행 앞
  X좌표            197583.32569
  Y좌표            452665.74144
  위경도          [37.573533049007246, 126.9726430725664]
  Name: 65, dtype: object),
(66,
  level_0          66
  index            75
  조사지점명      Fdex 앞
  X좌표            197623.85471
  Y좌표            452710.17487
  위경도          [37.57393349730415, 126.97310171995724]
  Name: 66, dtype: object),
(67,
  level_0          67
  index            76
  조사지점명      관훈클럽신영기금회관
  X좌표            198661.36199
  Y좌표            452667.21461
  위경도          [37.57354851939956, 126.98484651797177]
  Name: 67, dtype: object),
(68,
  level_0          68
  index            77
  조사지점명      35번지 100호 주택
  X좌표            198453.4324
  Y좌표            453787.05649
  위경도          [37.5836379026399, 126.98249037705371]
  Name: 68, dtype: object),
(69,
  level_0          69
  index            78
  조사지점명      茂
  X좌표            198634.98626
  Y좌표            453547.97734
  위경도          [37.58148410212569, 126.9845463028057]
  Name: 69, dtype: object),
(70,
  level_0          70
  index            79
  조사지점명      상원빌라트
  X좌표            198995.68719
  Y좌표            453483.81359
  위경도          [37.58090645475569, 126.98862998539107]
  Name: 70, dtype: object),
(71,
  level_0          71
  index            80
  조사지점명      출애굽 교회
  X좌표            201351.17674
  Y좌표            452697.8427
  위경도          [37.573824458599816, 127.0152954778212]
  Name: 71, dtype: object),

```

```

(72,
  level_0          72
  index           81
  조사지점명      광남 한의원
  X좌표          200495.94109
  Y좌표          452433.72672
  위경도          [37.571445644182035, 127.0056139322599]
  Name: 72, dtype: object),
(73,
  level_0          73
  index           82
  조사지점명      승진문구사 건물 입구
  X좌표          200242.98862
  Y좌표          452334.02954
  위경도          [37.57054747874864, 127.00275053892372]
  Name: 73, dtype: object),
(74,
  level_0          74
  index           84
  조사지점명      도한사
  X좌표          198645.83082
  Y좌표          452717.05178
  위경도          [37.573997527015614, 126.98467061193506]
  Name: 74, dtype: object),
(75,
  level_0          75
  index           85
  조사지점명      아시아나 항공 정자
  X좌표          197638.62167
  Y좌표          452262.31093
  위경도          [37.56989830344526, 126.97327032608675]
  Name: 75, dtype: object),
(76,
  level_0          76
  index           86
  조사지점명      태화빌딩
  X좌표          201229.42149
  Y좌표          451734.494
  위경도          [37.56514490097383, 127.01391557937141]
  Name: 76, dtype: object),
(77,
  level_0          77
  index           87
  조사지점명      성동공업고등학교정문 우측 담벽
  X좌표          201422.94083
  Y좌표          452156.57649
  위경도          [37.56894756813417, 127.01610680536895]
  Name: 77, dtype: object),
(78,
  level_0          78
  index           88
  조사지점명      도로교통공단
  X좌표          202166.86817
  Y좌표          451603.46137
  위경도          [37.563962574520914, 127.02452596570507]
  Name: 78, dtype: object),
(79,
  level_0          79
  index           89
  조사지점명      둔신뎃앞갈비
  X좌표          201281.675
  Y좌표          451147.01769
  위경도          [37.55985168856771, 127.01450600021566]
  Name: 79, dtype: object),

```

```

(80,
  level_0          80
  index            90
  조사지점명       화남빌딩
  X좌표            197630.33824
  Y좌표            450973.1621
  위경도           [37.55828309989844, 126.9731807258612]
  Name: 80, dtype: object),
(81,
  level_0          81
  index            91
  조사지점명       GS자이공인중개사
  X좌표            196994.05124
  Y좌표            450527.37234
  위경도           [37.554264690543405, 126.96598120632711]
  Name: 81, dtype: object),
(82,
  level_0          82
  index            92
  조사지점명       롯데마트
  X좌표            197360.28193
  Y좌표            450695.27609
  위경도           [37.55577862068171, 126.97012529204075]
  Name: 82, dtype: object),
(83,
  level_0          83
  index            93
  조사지점명       보영약국
  X좌표            200210.22578
  Y좌표            452029.66485
  위경도           [37.567805174511996, 127.0023795887703]
  Name: 83, dtype: object),
(84,
  level_0          84
  index            94
  조사지점명       로쉬치킨.호프
  X좌표            200574.30026
  Y좌표            451836.52868
  위경도           [37.56606487058503, 127.00650047132962]
  Name: 84, dtype: object),
(85,
  level_0          85
  index            95
  조사지점명       Molinari Cafe
  X좌표            198483.78266
  Y좌표            450935.23996
  위경도           [37.55794322142663, 126.98283988680996]
  Name: 85, dtype: object),
(86,
  level_0          86
  index            96
  조사지점명       LG CNS 건물앞 주차장
  X좌표            198452.59291
  Y좌표            451140.91819
  위경도           [37.559796324440484, 126.9824864564388]
  Name: 86, dtype: object),
(87,
  level_0          87
  index            97
  조사지점명       신일빌딩
  X좌표            198785.3374
  Y좌표            451260.46426
  위경도           [37.56087392935743, 126.98625225843381]
  Name: 87, dtype: object),

```



```

(88,
  level_0          88
  index           98
  조사지점명      원조장총동 할머니집
  X좌표           200512.14585
  Y좌표           451192.83298
  위경도          [37.560265231754926, 127.00579649980591]
  Name: 88, dtype: object),
(89,
  level_0          89
  index           99
  조사지점명      파파존스피자
  X좌표           200675.6896
  Y좌표           450954.56018
  위경도          [37.55811829543745, 127.00764727910428]
  Name: 89, dtype: object),
(90,
  level_0          90
  index          100
  조사지점명      배스킨라빈스
  X좌표           197988.6854
  Y좌표           451788.01351
  위경도          [37.56562573480826, 126.97723418049611]
  Name: 90, dtype: object),
(91,
  level_0          91
  index          102
  조사지점명      한음보청기
  X좌표           197635.75281
  Y좌표           450934.21788
  위경도          [37.557932227494035, 126.97324213215788]
  Name: 91, dtype: object),
(92,
  level_0          92
  index          103
  조사지점명      DOUGHNUT PLANT 가게
  X좌표           198387.66001
  Y좌표           451604.24991
  위경도          [37.56397081625344, 126.98175052809245]
  Name: 92, dtype: object),
(93,
  level_0          93
  index          104
  조사지점명      중앙시네마
  X좌표           198929.19953
  Y좌표           451744.01901
  위경도          [37.56523091891203, 126.98787980672614]
  Name: 93, dtype: object),
(94,
  level_0          94
  index          105
  조사지점명      이화빌딩
  X좌표           198920.93452
  Y좌표           451580.92293
  위경도          [37.56376141972206, 126.98778649651086]
  Name: 94, dtype: object),
(95,
  level_0          95
  index          106
  조사지점명      파인 에비뉴빌딩
  X좌표           199004.34348
  Y좌표           451824.82262
  위경도          [37.56595904051932, 126.98873023756106]
  Name: 95, dtype: object),

```

```

(96,
 level_0          96
 index           108
 조사지점명      미사
 X좌표           200713.94049
 Y좌표           451965.02145
 위경도          [37.56722248759723, 127.00808117604643]
 Name: 96, dtype: object),
(97,
 level_0          97
 index           109
 조사지점명      농협중앙회(충무로지점)
 X좌표           199335.99415
 Y좌표           451295.32474
 위경도          [37.56118858237064, 126.9924846461643]
 Name: 97, dtype: object),
(98,
 level_0          98
 index           111
 조사지점명      노루표페인트
 X좌표           199192.1614
 Y좌표           451842.82205
 위경도          [37.56612139845749, 126.99085611484216]
 Name: 98, dtype: object),
(99,
 level_0          99
 index           112
 조사지점명      동대문우동장공사현장
 X좌표           200842.15605
 Y좌표           452039.38981
 위경도          [37.56789243512195, 127.00953254836266]
 Name: 99, dtype: object)]

```

```

In [36]: m = folium.Map(location=[37.566535, 126.9779691999996],
                             zoom_start=10)

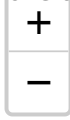
mc = MarkerCluster().add_to(m)

for idx, val in data.iterrows():
    folium.Marker(location=val.위경도,
                  popup=folium.Popup(val.조사지점명, max_width=300),
                  tooltip=val.조사지점명,
                  icon=folium.Icon(color='blue')).add_to(mc)


m

```

Out[36]: Make this Notebook Trusted to load map: File -> Trust Notebook



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 Leaflet (<https://leafletjs.com>) | Data by © OpenStreetMap (<http://openstreetmap.org>), under ODbL (<http://www.openstreetmap.org/copyright>).

```
In [45]: # 1. Map 객체를 만든다. 위에서 만든 m을 썼음
m = folium.Map([37.57402594173796, 126.97385569402873],
               zoom_start=10,
               tiles = 'https://tiles.stadiamaps.com/tiles/osm_bright/{z}/{x}/{y}{r}.p
               attr='&copy; <a href="https://stadiamaps.com/">Stadia Maps</a>, W
               &copy; <a href="https://openmaptiles.org/">OpenMapTiles</a> W
               &copy; <a href="http://openstreetmap.org">OpenStreetMap</a> contributors'

#2. MarkerCluster를 추가한다.
mc = MarkerCluster().add_to(m)

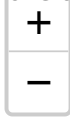
#3. data의 100개에 대한 정보를 지도에 표시하기
```

In []: d

```
In [46]: for gu, loc in zip(data['조사지점명'], data['위경도']):
          folium.Marker(location=loc,
                        popup=folium.Popup(gu, max_width=200)).add_to(mc)

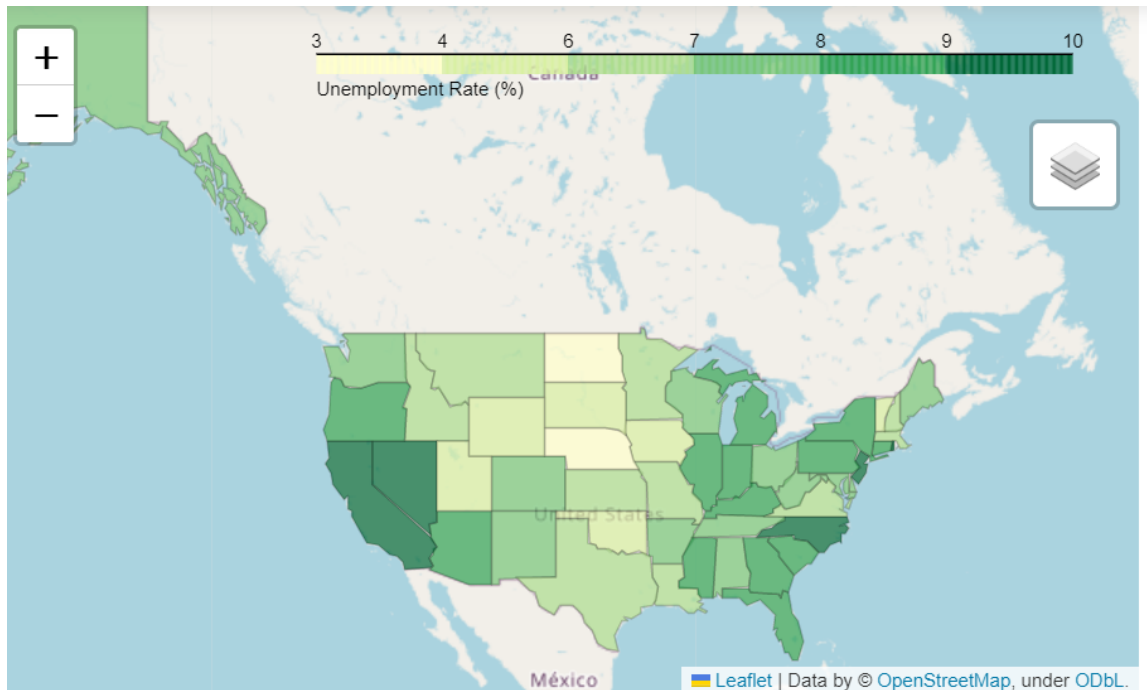
m
```

Out[46]: Make this Notebook Trusted to load map: File -> Trust Notebook



100

Leaflet (<https://leafletjs.com>) | © Stadia Maps (<https://stadiamaps.com/>), © OpenMapTiles (<https://openmaptiles.org/>) © OpenStreetMap (<http://openstreetmap.org>) contributors



8. GeoJson을 활용한 경계 표현

- GeoJson : 행정구역과 같은 경계선이나 경로를 표현하는데 효율적

```
In [48]: import pandas as pd
```

```
In [49]: df_geo = pd.read_json('data/geojson/경기도행정구역경계.json')
df_geo
```

Out[49]:

	type	features
0	FeatureCollection	{'type': 'Feature', 'properties': {'code': 313...
1	FeatureCollection	{'type': 'Feature', 'properties': {'code': 313...
2	FeatureCollection	{'type': 'Feature', 'properties': {'code': 313...
3	FeatureCollection	{'type': 'Feature', 'properties': {'code': 312...
4	FeatureCollection	{'type': 'Feature', 'properties': {'code': 312...
5	FeatureCollection	{'type': 'Feature', 'properties': {'code': 312...
6	FeatureCollection	{'type': 'Feature', 'properties': {'code': 312...
7	FeatureCollection	{'type': 'Feature', 'properties': {'code': 312...
8	FeatureCollection	{'type': 'Feature', 'properties': {'code': 312...
9	FeatureCollection	{'type': 'Feature', 'properties': {'code': 312...
10	FeatureCollection	{'type': 'Feature', 'properties': {'code': 312...
11	FeatureCollection	{'type': 'Feature', 'properties': {'code': 312...
12	FeatureCollection	{'type': 'Feature', 'properties': {'code': 311...
13	FeatureCollection	{'type': 'Feature', 'properties': {'code': 311...
14	FeatureCollection	{'type': 'Feature', 'properties': {'code': 311...
15	FeatureCollection	{'type': 'Feature', 'properties': {'code': 311...
16	FeatureCollection	{'type': 'Feature', 'properties': {'code': 311...
17	FeatureCollection	{'type': 'Feature', 'properties': {'code': 311...
18	FeatureCollection	{'type': 'Feature', 'properties': {'code': 311...
19	FeatureCollection	{'type': 'Feature', 'properties': {'code': 311...
20	FeatureCollection	{'type': 'Feature', 'properties': {'code': 311...
21	FeatureCollection	{'type': 'Feature', 'properties': {'code': 311...
22	FeatureCollection	{'type': 'Feature', 'properties': {'code': 311...
23	FeatureCollection	{'type': 'Feature', 'properties': {'code': 311...
24	FeatureCollection	{'type': 'Feature', 'properties': {'code': 311...
25	FeatureCollection	{'type': 'Feature', 'properties': {'code': 311...
26	FeatureCollection	{'type': 'Feature', 'properties': {'code': 310...
27	FeatureCollection	{'type': 'Feature', 'properties': {'code': 310...
28	FeatureCollection	{'type': 'Feature', 'properties': {'code': 310...
29	FeatureCollection	{'type': 'Feature', 'properties': {'code': 310...
30	FeatureCollection	{'type': 'Feature', 'properties': {'code': 310...
31	FeatureCollection	{'type': 'Feature', 'properties': {'code': 310...
32	FeatureCollection	{'type': 'Feature', 'properties': {'code': 310...
33	FeatureCollection	{'type': 'Feature', 'properties': {'code': 310...
34	FeatureCollection	{'type': 'Feature', 'properties': {'code': 310...
35	FeatureCollection	{'type': 'Feature', 'properties': {'code': 310...

	type	features
36	FeatureCollection	{'type': 'Feature', 'properties': {'code': 310...
37	FeatureCollection	{'type': 'Feature', 'properties': {'code': 310...
38	FeatureCollection	{'type': 'Feature', 'properties': {'code': 310...
39	FeatureCollection	{'type': 'Feature', 'properties': {'code': 310...
40	FeatureCollection	{'type': 'Feature', 'properties': {'code': 310...
41	FeatureCollection	{'type': 'Feature', 'properties': {'code': 310...
42	FeatureCollection	{'type': 'Feature', 'properties': {'code': 310...
43	FeatureCollection	{'type': 'Feature', 'properties': {'code': 310...

```
In [47]: import json

In [54]: with open('data/geojson/경기도 행정구역경계.json', encoding='utf-8') as f:
         geo_gg = json.loads(f.read())

In [56]: type(geo_gg)
Out[56]: dict

In [58]: geo_gg.keys()
Out[58]: dict_keys(['type', 'features'])

In [62]: geo_gg['features']
```



```

Out[62]: [{ 'type': 'Feature',
  'properties': { 'code': 31380,
    'name': '양평군',
    'name_eng': 'Yangpyeong-gun',
    'base_year': 2013},
  'geometry': { 'type': 'Polygon',
    'coordinates': [[[127.56113535909492, 37.6256560539258],
      [127.57290963929243, 37.61087369350498],
      [127.56366973908277, 37.5842624297699],
      [127.52226606559191, 37.5828628697518],
      [127.50048767007603, 37.569036373178626],
      [127.47687473909174, 37.574448241913856],
      [127.47565866803647, 37.60512112601634],
      [127.44699730711024, 37.64497584741164],
      [127.4272349102434, 37.66284420898682],
      [127.40156700708162, 37.64806970784708],
      [127.3732642199939, 37.6453987554284],
      [127.3542931884407, 37.6250006376975],
      [127.34360057873045, 37.588997440929354],
      [127.31002843450217, 37.53523876142835],
      [127.30923294884336, 37.5135706079458],
      [127.32809611134748, 37.53133849534739],
      [127.3663244453597, 37.52716845880826],
      [127.38286320755414, 37.50147517965334],
      [127.39046783039153, 37.47413422098595],
      [127.37490698722792, 37.455072688441305],
      [127.39174400683049, 37.4256483411369],
      [127.40276739880215, 37.41856433413549],
      [127.4250053080982, 37.43669952587185],
      [127.4817900304572, 37.42084413829662],
      [127.51015267026155, 37.43699555518635],
      [127.52501209957308, 37.43192043868044],
      [127.53910572062166, 37.40849283821634],
      [127.60528700481163, 37.416969769508924],
      [127.63754040237271, 37.41065607591271],
      [127.6491838950862, 37.402042953108506],
      [127.66976823475012, 37.40884431255766],
      [127.71071536074867, 37.40736583858037],
      [127.70347417929173, 37.371054026073324],
      [127.76165381178268, 37.36421926003675],
      [127.77952402154285, 37.368441789396854],
      [127.80397287036232, 37.432516049235865],
      [127.79833492163134, 37.460500237870505],
      [127.77664798308412, 37.48883635932707],
      [127.77611527652192, 37.50328615763377],
      [127.80855972024105, 37.53220450961153],
      [127.8445769305193, 37.53621789699497],
      [127.85162286006927, 37.55037340096326],
      [127.81507964099751, 37.5618389022189],
      [127.79492564827493, 37.58252978378627],
      [127.76838776707211, 37.580178216134605],
      [127.75614914198108, 37.589477424718204],
      [127.7102810556826, 37.58360128682645],
      [127.69869383868397, 37.59757031454811],
      [127.65553070991882, 37.61954565135447],
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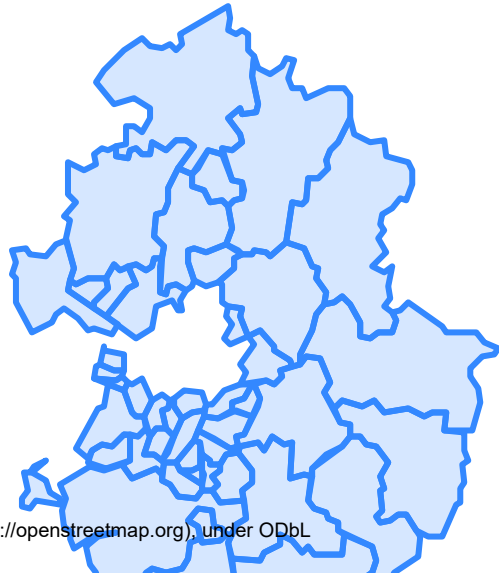
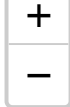


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```

행정구별 경계선 표시 데이터

```
In [63]: m = folium.Map(location=[37.566535, 126.9779691999996],
                             zoom_start=8)
          folium.GeoJson(geo_gg).add_to(m)
          m
```

Out[63]: Make this Notebook Trusted to load map: File -> Trust Notebook



Leaflet (<https://leafletjs.com>) | Data by © OpenStreetMap (<http://openstreetmap.org>), under ODbL (<http://www.openstreetmap.org/copyright>).

실습. 서울시 구별 경계 시각화

In []:

In []:

9. 단계 구분도(Choropleth Map)

- 행정구역 등과 같이 지도상의 어떤 경계로 구분된 지도 영역에 색을 칠하거나 음영 등을 넣어 정보를 나타낸 지도
- 데이터를 지도 그림에 반영시켜서 전달하는 그래프

- 보통 folium 에 layer로 얹게 됨

Choropleth를 활용하여 GeoJson과 데이터 결합

- Choropleth : 행정구역별로 다른 색상을 표현

folium.choropleth()

- 사용 인수
 - geo_data : 지도 파일 경로와 파일명
 - data : 지도에 표현되어야 할 값 변수
 - columns = [key로 사용할 data, 실제 data의 필드명]
 - key_on : 지도 경계파일인 json에서 사용할 키 값이며 지도 Data는 표준 형식으로 만들어져야 함
 - key_on 지칭 문법 : feature(키워드).json에서 나타나기 필드명
- folium.LayerControl().add_to(map) : 단계구분도를 map에 표시하는 함수
- 참고:
 - <https://python-visualization.github.io/folium/>
 - <https://python-visualization.github.io/folium/quickstart.html#Choropleth-maps>

예제 데이터

- 미국 각 주별 2012년 10월 실업률 data
 - https://raw.githubusercontent.com/python-visualization/folium/master/examples/data/US_Unemployment_Oct2012.csv
- 지도 경계 data : json 파일로 작성
 - <https://raw.githubusercontent.com/python-visualization/folium/master/examples/data/us-states.json>

```
In [64]: url = (
    "https://raw.githubusercontent.com/python-visualization/folium/master/examples/d
)

# 지도 데이터 링크
state_geo = f"{url}/us-states.json"

# 데이터 링크
state_unemployment = f"{url}/US_Unemployment_Oct2012.csv"
```

실업률 데이터 프레임

```
In [65]: df_us = pd.read_csv(state_unemployment)
```

```
In [66]: df_us
```

Out[66]:

	State	Unemployment
0	AL	7.1
1	AK	6.8
2	AZ	8.1
3	AR	7.2
4	CA	10.1
5	CO	7.7
6	CT	8.4
7	DE	7.1
8	FL	8.2
9	GA	8.8
10	HI	5.4
11	ID	6.6
12	IL	8.8
13	IN	8.4
14	IA	5.1
15	KS	5.6
16	KY	8.1
17	LA	5.9
18	ME	7.2
19	MD	6.8
20	MA	6.7
21	MI	9.1
22	MN	5.6
23	MS	9.1
24	MO	6.7
25	MT	5.8
26	NE	3.9
27	NV	10.3
28	NH	5.7
29	NJ	9.6
30	NM	6.8
31	NY	8.4
32	NC	9.4
33	ND	3.2
34	OH	6.9
35	OK	5.2

	State	Unemployment
36	OR	8.5
37	PA	8.0
38	RI	10.1
39	SC	8.8
40	SD	4.4
41	TN	7.8
42	TX	6.4
43	UT	5.5
44	VT	5.0
45	VA	5.8
46	WA	7.8
47	WV	7.5
48	WI	6.8
49	WY	5.1

미국 주별 지도 경계 데이터

In [67]: state_geo

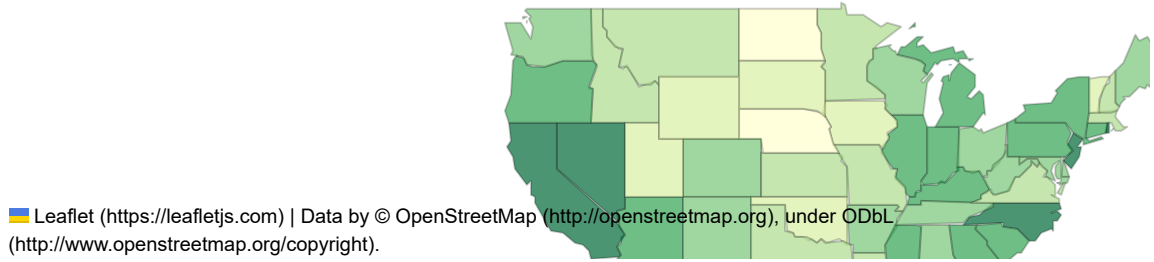
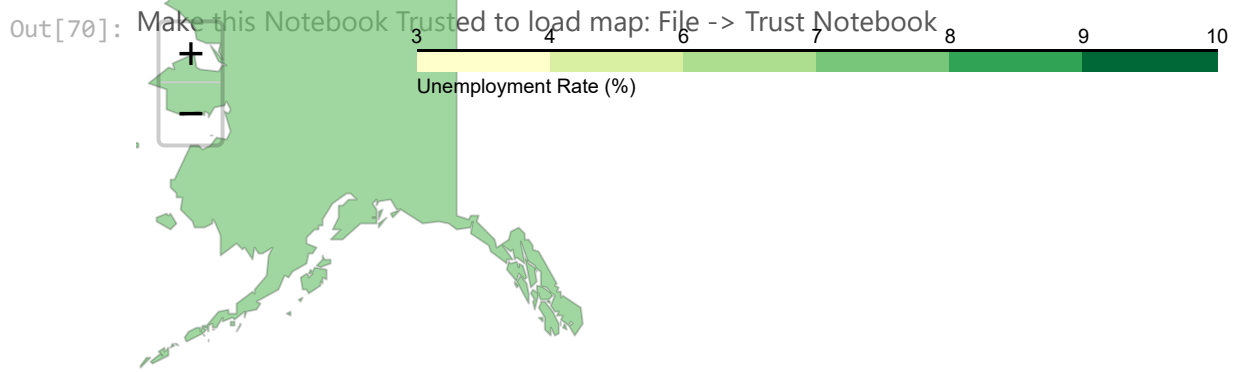
Out[67]: 'https://raw.githubusercontent.com/python-visualization/folium/master/examples/data/us-states.json'

단계구분도를 적용한 지도 시각화

```
In [70]: m = folium.Map(location=[48, -102], zoom_start=3)

folium.Choropleth(geo_data=state_geo,
                  name="choropleth",
                  data=df_us,
                  columns=["State", "Unemployment"],
                  key_on="feature.id",
                  fill_color="YlGn", fill_opacity=0.7,
                  line_opacity=0.2,
                  legend_name="Unemployment Rate (%)",
                  ).add_to(m)

m
```



실습

- 한국 지도 데이터 이용해서 단계 구분도 그리기
- 데이터 : 경기도 시군별 인구현황

지도 경계 json 데이터 파일 로드

```
In [86]: with open('data/geojson/경기도행정구역경계.json', encoding='utf-8') as f:
          geo_gg = json.loads(f.read())
          geo_gg
```

```

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```

데이터 읽기

```
In [87]: df_gg = pd.read_excel('data/경기도인구데이터.xlsx', index_col='구분',
                             engine='openpyxl')
df_gg.head()
```

Out[87]:

	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017
구분											
수원시장안구	287474	285803	290798	293692	290999	291757	300908	301196	299016	296479	293828
수원시권선거구	310553	308177	304097	306783	321176	332633	331773	339835	351053	358393	365653
수원시팔달구	216945	213235	219833	216503	209772	206794	204805	203479	199180	198515	193311
수원시영통구	252730	260210	258421	260557	266542	289074	310671	329718	335375	340654	349836
성남시수정구	256744	248452	242161	241070	236123	233997	228167	223539	219531	232841	236932

```
In [76]: df_gg.columns
Out[76]: Int64Index([2007, 2008, 2009, 2010, 2011, 2012, 2013, 2014, 2015, 2016, 2017], dtype='int64')
In [88]: df_gg.columns = df_gg.columns.map(str)
```

Map객체 생성

```
In [93]: m = folium.Map(location=[37.566535, 126.9779691999996],
                             zoom_start=8)

In [91]: df_gg.index
Out[91]: Index(['수원시장안구', '수원시권선구', '수원시팔달구', '수원시영통구', '성남시수정구', '성남시중원구', '성남시분당구',
               '의정부시', '안양시만안구', '안양시동안구', '부천시원미구', '부천시소사구', '부천시오정구', '광명시', '평택시',
               '동두천시', '안산시상록구', '안산시단원구', '고양시덕양구', '고양시일산동구', '고양시일산서구', '과천시',
               '구리시', '남양주시', '오산시', '시흥시', '군포시', '의왕시', '하남시', '용인시처인구', '용인시기흥구',
               '용인시수지구', '파주시', '이천시', '안성시', '김포시', '화성시', '광주시', '양주시', '포천시', '여주시',
               '연천군', '가평군', '양평군'],
              dtype='object', name='구분')
```

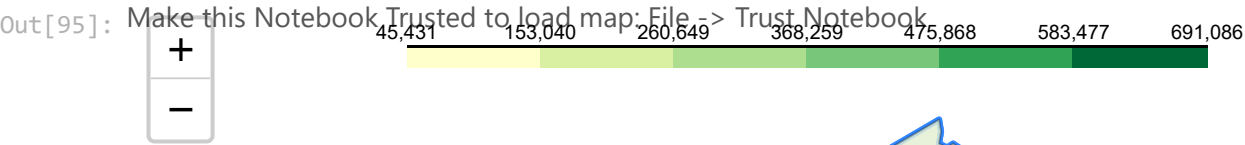
단계 구분도 표시

```
In [95]: year = '2017'

         folium.GeoJson(geo_gg).add_to(m)

         folium.Choropleth(geo_data=geo_gg,
                             data=df_gg[year],
                             columns=[df_gg.index, df_gg[year]],
                             fill_color='YlGn', fill_opacity=0.7,
                             line_opacity=0.3,
                             key_on='feature.properties.name',
                             ).add_to(m)

m
```



Leaflet (<https://leafletjs.com>) | Data by © OpenStreetMap (<http://openstreetmap.org>), under ODbL (<http://www.openstreetmap.org/copyright>).

```
In [96]: m = folium.Map(location=[37.566535, 126.9779691999996],
                             zoom_start=8)

year = '2007'

folium.GeoJson(geo_gg).add_to(m)

folium.Choropleth(geo_data=geo_gg,
                  data=df_gg[year],
                  columns=[df_gg.index, df_gg[year]],
                  fill_color='YlGn', fill_opacity=0.7,
                  line_opacity=0.3,
                  key_on='feature.properties.name',
                  ).add_to(m)

m
```



Leaflet (<https://leafletjs.com>) | Data by © OpenStreetMap (<http://openstreetmap.org>), under ODbL (<http://www.openstreetmap.org/copyright>).

지도 저장

```
In [97]: # Save to html  
m.save('경기도2007년인구.html')
```

```
In [98]: import webbrowser  
  
webbrowser.open_new('경기도2007년인구.html')
```

```
Out[98]: True
```
