GES723
GEOVISUALIZATION
Lab Practical Title: Recreating John Snow's 1854 Cholera Map Using Python

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Contents

1.0 GES723_JohnSnowLab.ipynb

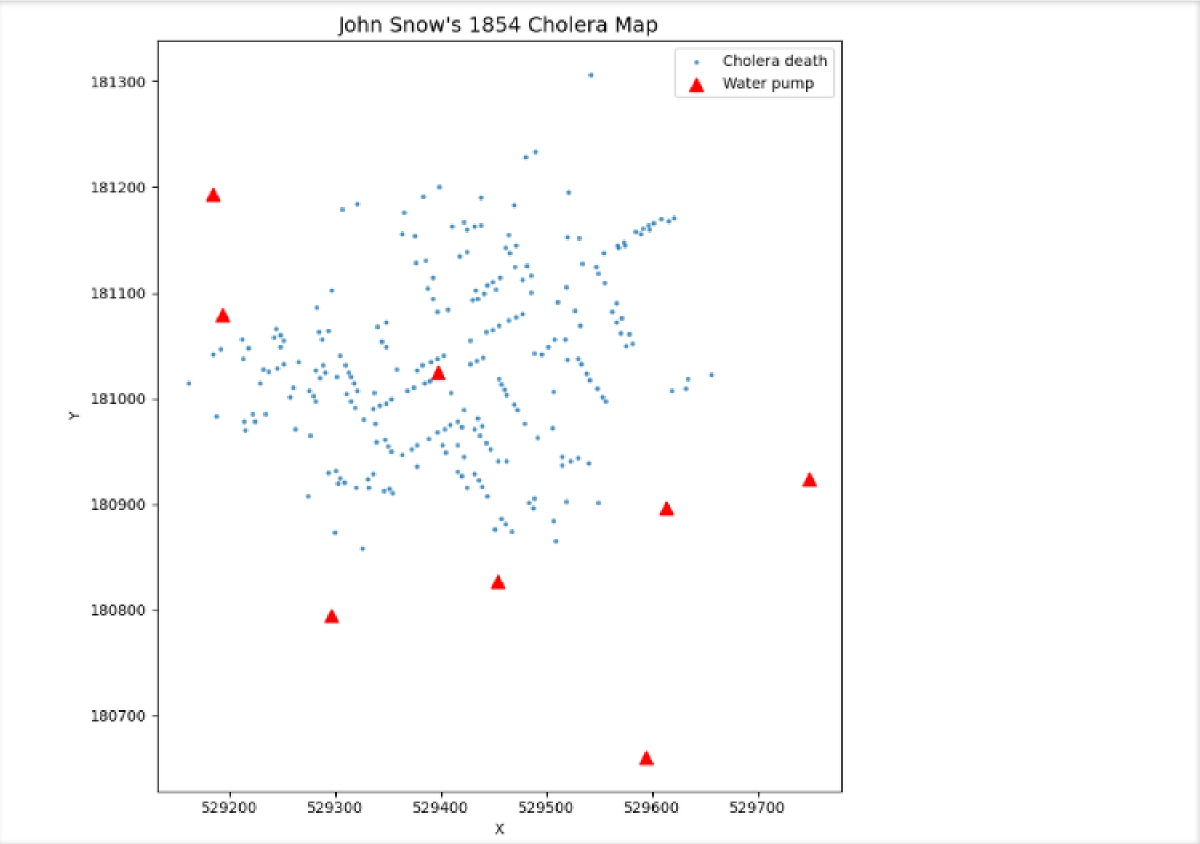
```python
import pandas as pd
import geopandas as gpd
from shapely.geometry import Point


deaths_df = pd.read_csv(r"C:\Users\User\Downloads\cholera-deaths\death.csv")
pumps_df  = pd.read_csv(r"C:\Users\User\Downloads\cholera-deaths\Pumps.csv")

print("Deaths:")
print(deaths_df.head())
print("\nPumps:")
print(pumps_df.head())
```

```
Deaths:
   Id  Count        POINT_X        POINT_Y
0   0      3  529308.741420  181031.351546
1   0      2  529312.163571  181025.172401
2   0      1  529314.382429  181020.293688
3   0      1  529317.379645  181014.258771
4   0      4  529320.675449  181007.871628

Pumps:
   Id        POINT_X        POINT_Y
0   1  529396.539395  181025.063047
1   2  529192.537868  181079.391380
2   3  529183.739766  181193.735013
3   4  529748.911089  180924.207251
4   5  529613.205238  180896.804121
```

```python
import pandas as pd
import geopandas as gpd
import matplotlib.pyplot as plt
from shapely.geometry import Point


deaths_df = pd.read_csv(r"C:\Users\User\Downloads\cholera-deaths\death.csv")
pumps_df  = pd.read_csv(r"C:\Users\User\Downloads\cholera-deaths\Pumps.csv")


deaths_gdf = gpd.GeoDataFrame(
    deaths_df,
    geometry=gpd.points_from_xy(deaths_df["POINT_X"], deaths_df["POINT_Y"]),
    crs=None
)

pumps_gdf = gpd.GeoDataFrame(
    pumps_df,
    geometry=gpd.points_from_xy(pumps_df["POINT_X"], pumps_df["POINT_Y"]),
    crs=None
)

print("Check geometry deaths:", deaths_gdf.geometry.head())
print("Check geometry pumps :", pumps_gdf.geometry.head())
print("Total bounds pumps   :", pumps_gdf.total_bounds)
```

```
Check geometry deaths: 0    POINT (529308.741 181031.352)
1    POINT (529312.164 181025.172)
2    POINT (529314.382 181020.294)
3     POINT (529317.38 181014.259)
4    POINT (529320.675 181007.872)
Name: geometry, dtype: geometry
Check geometry pumps : 0    POINT (529396.539 181025.063)
1    POINT (529192.538 181079.391)
2     POINT (529183.74 181193.735)
3    POINT (529748.911 180924.207)
4    POINT (529613.205 180896.804)
Name: geometry, dtype: geometry
Total bounds pumps   : [529183.739766 180660.454749 529748.911089 181193.735013]
```

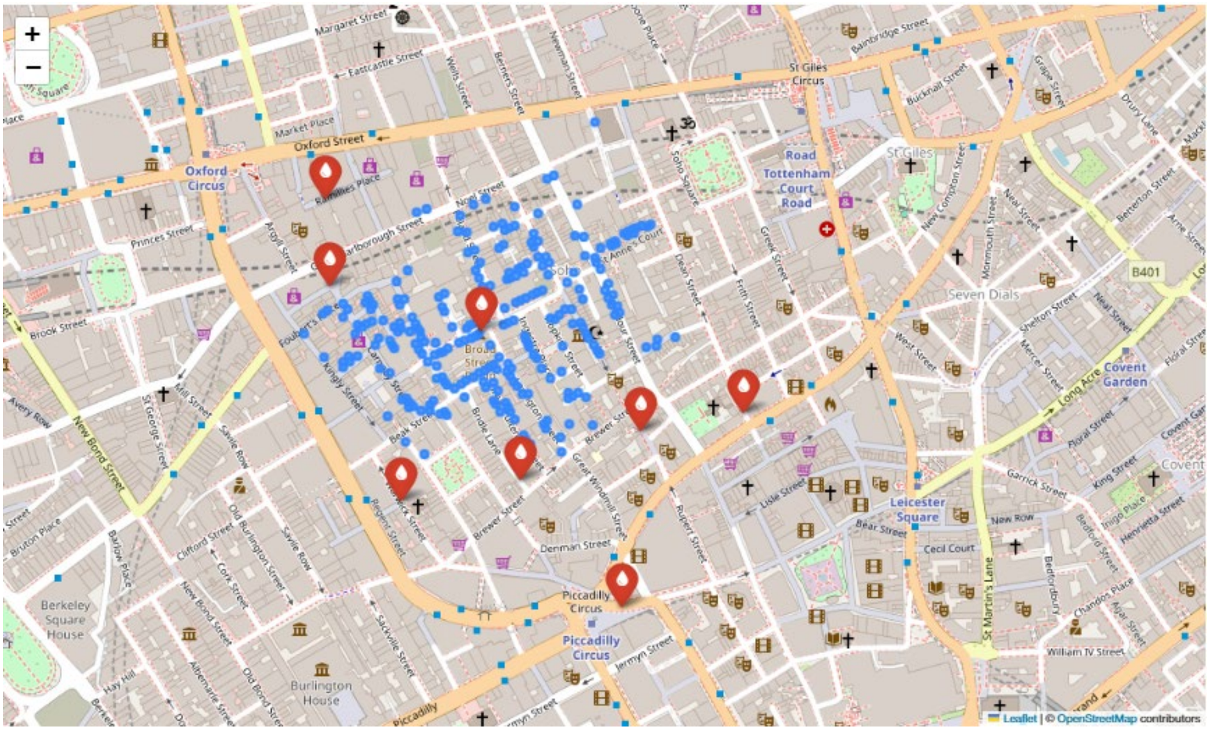
```
fig, ax = plt.subplots(figsize=(8, 8))

# death
deaths_gdf.plot(
    ax=ax,
    markersize=5,
    alpha=0.7,
    label="Cholera death"
)

# pump
pumps_gdf.plot(
    ax=ax,
    marker="^",
    color="red",
    markersize=80,
    label="Water pump"
)

ax.set_title("John Snow's 1854 Cholera Map", fontsize=14)
ax.set_xlabel("X")
ax.set_ylabel("Y")
ax.legend()


ax.set_aspect("equal")

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



```python
import geopandas as gpd


deaths_gdf = gpd.GeoDataFrame(
    deaths_df,
    geometry=gpd.points_from_xy(deaths_df["POINT_X"], deaths_df["POINT_Y"]),
    crs="EPSG:27700"
)

pumps_gdf = gpd.GeoDataFrame(
    pumps_df,
    geometry=gpd.points_from_xy(pumps_df["POINT_X"], pumps_df["POINT_Y"]),
    crs="EPSG:27700"
)


deaths_wgs = deaths_gdf.to_crs(epsg=4326)
pumps_wgs  = pumps_gdf.to_crs(epsg=4326)

print(deaths_wgs.head())
print(pumps_wgs.head())
```

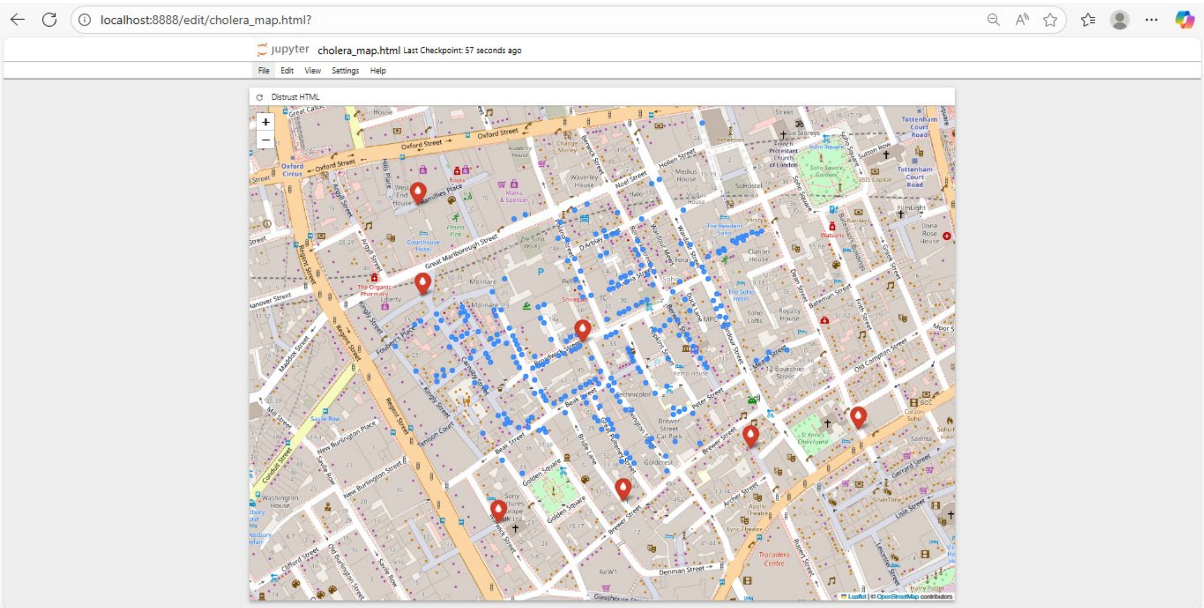
```
   Id  Count        POINT_X        POINT_Y                   geometry
0   0      3  529308.741420  181031.351546  POINT (-0.13793 51.51342)
1   0      2  529312.163571  181025.172401  POINT (-0.13788 51.51336)
2   0      1  529314.382429  181020.293688  POINT (-0.13785 51.51332)
3   0      1  529317.379645  181014.258771  POINT (-0.13781 51.51326)
4   0      4  529320.675449  181007.871628   POINT (-0.13777 51.5132)
   Id        POINT_X        POINT_Y                   geometry
0   1  529396.539395  181025.063047  POINT (-0.13667 51.51334)
1   2  529192.537868  181079.391380  POINT (-0.13959 51.51388)
2   3  529183.739766  181193.735013  POINT (-0.13967 51.51491)
3   4  529748.911089  180924.207251  POINT (-0.13163 51.51235)
4   5  529613.205238  180896.804121  POINT (-0.13359 51.51214)
```

```python
import folium


center_x = deaths_wgs.geometry.x.mean()
center_y = deaths_wgs.geometry.y.mean()

m = folium.Map(location=[center_y, center_x], zoom_start=17, tiles="OpenStreetMap")


for idx, row in deaths_wgs.iterrows():
    folium.CircleMarker(
        [row.geometry.y, row.geometry.x],
        radius=3,
        popup=f"Kematian ID: {row.get('Id', idx)}, Count: {row.get('Count', '')}",
        fill=True,
        fill_opacity=0.7
    ).add_to(m)


for idx, row in pumps_wgs.iterrows():
    folium.Marker(
        [row.geometry.y, row.geometry.x],
        popup=f"Pam {row.get('Id', idx)}",
        icon=folium.Icon(color="red", icon="tint", prefix="fa")
    ).add_to(m)

m
```



2.0 Johnsnow_dashboard_app.py

3.0 Cholera_map.html



4.0 Lab Report

This exercise has provided practical experience in recreating John Snow's 1854 cholera map using modern geospatial applications based on Python coding. Students can learn new techniques and some knowledge on how spatial data can be used to understand the relationship between environmental factors, water resources, and the distribution of patient case records. The main elements in this laboratory learning are the process of uploading, managing, and analyzing spatial data using Geopandas, Python notebooks, and the Anaconda prompt. Beside that, students can also learn how to handle datasets that do not have coordinate information by taking several steps to enable the spatial format and information to be filled in for further analysis.

Students can also learn about coordinate reference systems (CRS). The dataset used in the British National Grid (EPSG:27700), and how to reproject it to WGS84 (EPSG:4326) to ensure compatibility with the Folium technique for web-based data visualization. This step is important to ensure the interactive map displays accurate and meaningful spatial information.

Throughout the development process, several challenges were encountered, including geometric conversion errors, module installation issues, and compatibility problems with Streamlit. Errors like ArrowTypeError and NameError require debugging and adjusting the code structure, especially when displaying GeoDataFrames in Streamlit. This challenge helps students gain a deeper understanding of error handling in Python and the importance of testing code incrementally.

Developing an interactive dashboard using Streamlit and Folium was a very valuable experience. Students can learn how to integrate spatial data into interactive web applications, control UI elements like checkboxes and filters, and dynamically display Folium maps. This provides exposure to how GIS can be combined with modern visualization frameworks for public communication and decision support.

Overall, this lab enhances students' understanding of spatial data and the role of GIS in analyzing disease patterns. By re-visualizing John Snow's historical map. The skills learned in this training, such as data processing, CRS management, web mapping, and dashboard development, are very useful and can be applied in many other GIS fields.