HW1 GIS

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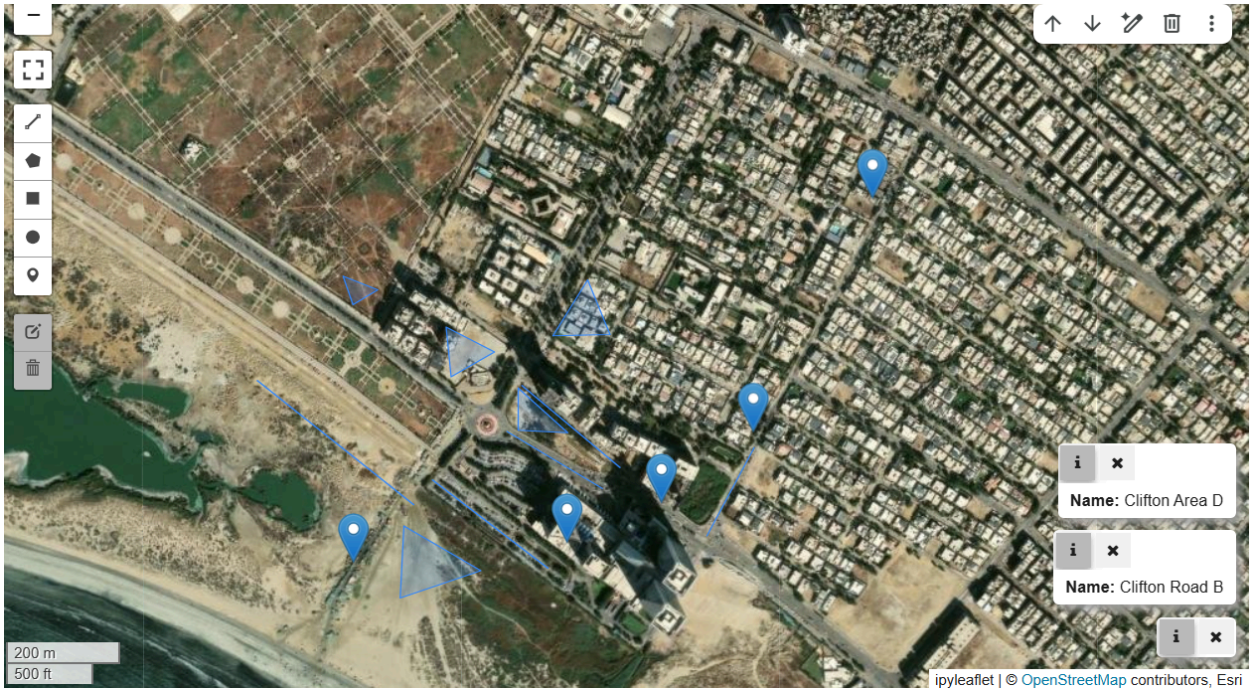
Original Map:

Modified Map:



Notebook Code:

[1]
```
!pip install geopandas
!pip install leafmap
```

[2]
```
from google.colab import output
output.enable_custom_widget_manager()
```

[3]
```
import geopandas as gpd
import leafmap
from shapely.geometry import Point
from shapely.geometry import LineString
from shapely.geometry import Polygon
import pandas as pd
```

Import Three Layers (Point, Line, and Polygons) as GeoDataframe and Display on a Single Map

[4]

```
geojson_point_layer_file = '/content/pointlayer.geojson'
point_gdf = gpd.read_file(geojson_point_layer_file)
display(point_gdf)
geojson_line_layer_file = '/content/linelayer.geojson'
line_gdf = gpd.read_file(geojson_line_layer_file)
display(line_gdf)
geojson_polygon_layer_file = '/content/polygonlayer.geojson'
Polygon_gdf = gpd.read_file(geojson_polygon_layer_file)
display(Polygon_gdf)
m1 = leafmap.Map(center=(24, 70), zoom=5)
m1.add_basemap('HYBRID')
m1.add_gdf(point_gdf, layer_name="Points")
m1.add_gdf(line_gdf, layer_name="Lines")
m1.add_gdf(Polygon_gdf, layer_name="Polygons")
m1
```

CRUD Operations on Point Layer (Using GeoPandas)

[5]

```
point_gdf['Location'] = None
#display(point_gdf)
point_gdf.loc[0, 'Location'] = "Clifton,Karachi"
point_gdf.loc[1, 'Location'] = "Clifton,Karachi"
point_gdf.loc[2, 'Location'] = "Clifton,Karachi"
point_gdf.loc[3, 'Location'] = "Clifton,Karachi"
point_gdf.loc[4, 'Location'] = "Clifton,Karachi"
#display(point_gdf)
new_point = Point(67.03470093307786,24.807428443067337)
new_row = {
    'geometry': new_point,
    'Name': 'Cafe E Street',
    'Location': 'Clifton,Karachi'
}
new_gdf = gpd.GeoDataFrame(
    [new_row],
    crs=point_gdf.crs
)
point_gdf = gpd.GeoDataFrame(pd.concat([point_gdf, new_gdf], ignore_index=True))
#display(point_gdf)
point_gdf.drop(0, inplace=True)
point_gdf = point_gdf.reset_index(drop=True)
display(point_gdf)
```

CRUD Operations on Line Layer (Using GeoPandas)

[6]

```
line_gdf['Name'] = None
#display(line_gdf)
line_gdf.loc[0, 'Name'] = "Clifton Road A"
line_gdf.loc[1, 'Name'] = "Clifton Road B"
line_gdf.loc[2, 'Name'] = "Clifton Road C"
line_gdf.loc[3, 'Name'] = "Clifton Road D"
line_gdf.loc[4, 'Name'] = "Clifton Road E"
#display(line_gdf)
new_line = LineString([(67.02406653021805,24.80458117242034),(67.02677177440552,24.80262297261433)])
new_line_row = {
    'geometry': new_line,
    'Name': 'Clifton Road F',
}
new_line_gdf = gpd.GeoDataFrame(
    [new_line_row],
    crs=line_gdf.crs
)
#display(new_line_gdf)
line_gdf = gpd.GeoDataFrame(pd.concat([line_gdf, new_line_gdf], ignore_index=True))
#display(line_gdf)
line_gdf.drop(0, inplace=True)
line_gdf = line_gdf.reset_index(drop=True)
display(line_gdf)
```

CRUD Operations on Polygon Layer (Using GeoPandas)

[7]

```
Polygon_gdf['Name'] = None
#display(Polygon_gdf)
Polygon_gdf.loc[0, 'Name'] = "Clifton Area A"
Polygon_gdf.loc[1, 'Name'] = "Clifton Area B"
Polygon_gdf.loc[2, 'Name'] = "Clifton Area C"
Polygon_gdf.loc[3, 'Name'] = "Clifton Area D"
Polygon_gdf.loc[4, 'Name'] = "Clifton Area E"
#display(Polygon_gdf)
new_polygon = Polygon([(67.02554784680336,24.806208890876036),(67.02571109429752,24.805774919825666),
 (67.02615419463851,24.80600778252935),(67.02554784680336,24.806208890876036)])
new_polygon_row = {
    'geometry': new_polygon,
    'Name': 'Clifton Area F',
}

new_polygon_gdf = gpd.GeoDataFrame(
    [new_polygon_row],
    crs=Polygon_gdf.crs
)
#display(new_polygon_gdf)
Polygon_gdf = gpd.GeoDataFrame(pd.concat([Polygon_gdf, new_polygon_gdf], ignore_index=True))
#display(Polygon_gdf)
Polygon_gdf.drop(0, inplace=True)
Polygon_gdf = Polygon_gdf.reset_index(drop=True)
display(Polygon_gdf)
```

Display the Three Modified Layers on a Single Map

[8]

```
m1 = leafmap.Map(center=(24, 70), zoom=5)
m1.add_basemap('HYBRID')
m1.add_gdf(point_gdf, layer_name="New_Points")
m1.add_gdf(line_gdf, layer_name="New_Lines")
m1.add_gdf(Polygon_gdf, layer_name="New_Polygons")
m1
```

Using GeoPandas library, calculate the following under two different map projections: a) Area of each polygon in the polygon layer b) Distance of each point (in the points layer) from Habib University campus.

[9]

```
#Part B
#print("Default CRS: " + str(point_gdf.crs))
new_point1 = Point(67.1377,24.9053)
new_row1 = {
    'geometry': new_point1,
    'Name': 'Habib University',
    'Location': 'Gulshan Juhar,Karachi'
}
new1_gdf = gpd.GeoDataFrame(
    [new_row1],
    crs=point_gdf.crs
)
point_gdf = gpd.GeoDataFrame(pd.concat([point_gdf, new1_gdf], ignore_index=True))
display(point_gdf)
#Calculation of Distance in EPSG: 3857
```

[9]

```
point_gdf = point_gdf.to_crs("EPSG:3857")
#print("Default CRS: " + str(point_gdf.crs))
Seaview_Hotel_gdf = point_gdf.loc[point_gdf['Name'] == 'Seaview Hotel']
Habib_University_gdf = point_gdf.loc[point_gdf['Name'] == 'Habib University']
distance = (Seaview_Hotel_gdf.geometry.iloc[0]).distance(Habib_University_gdf.geometry.iloc[0])
print("Distance (EPSG:3857): " + str(distance))
Sindbad_Playland_gdf = point_gdf.loc[point_gdf['Name'] == 'Sindbad Playland']
Habib_University_gdf = point_gdf.loc[point_gdf['Name'] == 'Habib University']
distance1 = (Sindbad_Playland_gdf.geometry.iloc[0]).distance(Habib_University_gdf.geometry.iloc[0])
print("Distance (EPSG:3857): " + str(distance1))
Clifton_Beach_gdf = point_gdf.loc[point_gdf['Name'] == 'Clifton Beach']
Habib_University_gdf = point_gdf.loc[point_gdf['Name'] == 'Habib University']
distance2 = (Clifton_Beach_gdf.geometry.iloc[0]).distance(Habib_University_gdf.geometry.iloc[0])
print("Distance (EPSG:3857): " + str(distance2))
Xanders_gdf = point_gdf.loc[point_gdf['Name'] == 'Xanders']
Habib_University_gdf = point_gdf.loc[point_gdf['Name'] == 'Habib University']
distance3 = (Xanders_gdf.geometry.iloc[0]).distance(Habib_University_gdf.geometry.iloc[0])
print("Distance (EPSG:3857): " + str(distance3))
Cafe_E_Street_gdf = point_gdf.loc[point_gdf['Name'] == 'Cafe E Street']
Habib_University_gdf = point_gdf.loc[point_gdf['Name'] == 'Habib University']
distance4 = (Cafe_E_Street_gdf.geometry.iloc[0]).distance(Habib_University_gdf.geometry.iloc[0])
print("Distance (EPSG:3857): " + str(distance4))
```

[9]

```
#Distance Calculation in EPSG: 32642

point_gdf = point_gdf.to_crs("EPSG:32642")
#print("Default CRS: " + str(point_gdf.crs))
Seaview_Hotel_gdf = point_gdf.loc[point_gdf['Name'] == 'Seaview Hotel']
Habib_University_gdf = point_gdf.loc[point_gdf['Name'] == 'Habib University']
distance = (Seaview_Hotel_gdf.geometry.iloc[0]).distance(Habib_University_gdf.geometry.iloc[0])
print("Distance (EPSG:32642): " + str(distance))
Sindbad_Playland_gdf = point_gdf.loc[point_gdf['Name'] == 'Sindbad Playland']
Habib_Univer (variable) Seaview_Hotel_gdf: DataFrame ] == 'Habib University']
distance1 = (Sindbad_Playland_gdf.geometry.iloc[0]).distance(Habib_University_gdf.geometry.iloc[0])
print("Distance (EPSG:32642): " + str(distance1))
Clifton_Beach_gdf = point_gdf.loc[point_gdf['Name'] == 'Clifton Beach']
Habib_University_gdf = point_gdf.loc[point_gdf['Name'] == 'Habib University']
distance2 = (Clifton_Beach_gdf.geometry.iloc[0]).distance(Habib_University_gdf.geometry.iloc[0])
print("Distance (EPSG:32642): " + str(distance2))
Xanders_gdf = point_gdf.loc[point_gdf['Name'] == 'Xanders']
Habib_University_gdf = point_gdf.loc[point_gdf['Name'] == 'Habib University']
distance3 = (Xanders_gdf.geometry.iloc[0]).distance(Habib_University_gdf.geometry.iloc[0])
print("Distance (EPSG:32642): " + str(distance3))
Cafe_E_Street_gdf = point_gdf.loc[point_gdf['Name'] == 'Cafe E Street']
Habib_University_gdf = point_gdf.loc[point_gdf['Name'] == 'Habib University']
distance4 = (Cafe_E_Street_gdf.geometry.iloc[0]).distance(Habib_University_gdf.geometry.iloc[0])
print("Distance (EPSG:32642): " + str(distance4))
```

```
#Part A

#Calculation of Area in EPSG: 3857

Polygon_gdf = Polygon_gdf.to_crs("EPSG:3857")
Polygon_gdf['Area in 3857'] = Polygon_gdf.area
print(Polygon_gdf[['Name','Area in 3857']])

#Calculation of Area in EPSG: 32642

Polygon_gdf = Polygon_gdf.to_crs("EPSG:32642")
Polygon_gdf['Area in 32642'] = Polygon_gdf.area
print(Polygon_gdf[['Name','Area in 32642']])
```

Comments(Why the results are same/different under two different map projections)

Answer The results are different under the two map projection because each projections uses a different mathematical model for representing the curved surface of earth on a flat surface due to this different map projections have different distortions. These distortions are subjective to the region they are made for. For example the UTM 42N projection (EPSG : 32642) provides more accurate results for Pakistan region.

AI Disclosure: Please provide a list of AI prompts that were used during the process of completing this assignment.

1- what to do to import line instead of point (from shapely.geometry import Point) ? Websites used : https://www.distancesfrom.com/pk/Habib-University-latitude-longitude-Habib-University-latitude-Habib-University-longitude/LatLongHistory/6768154.aspx https://www.geeksforgeeks.org/python/geopandas-tutorial/#geopandas-operations