Python Tutorial – Part II: Data

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Overview

Spatial Data and Dataset Transformation

(Working with GeoPandas)

GeoPandas

GeoPandas

GeoPandas is an open source project to make working with geospatial data in Python easier.

Approach:

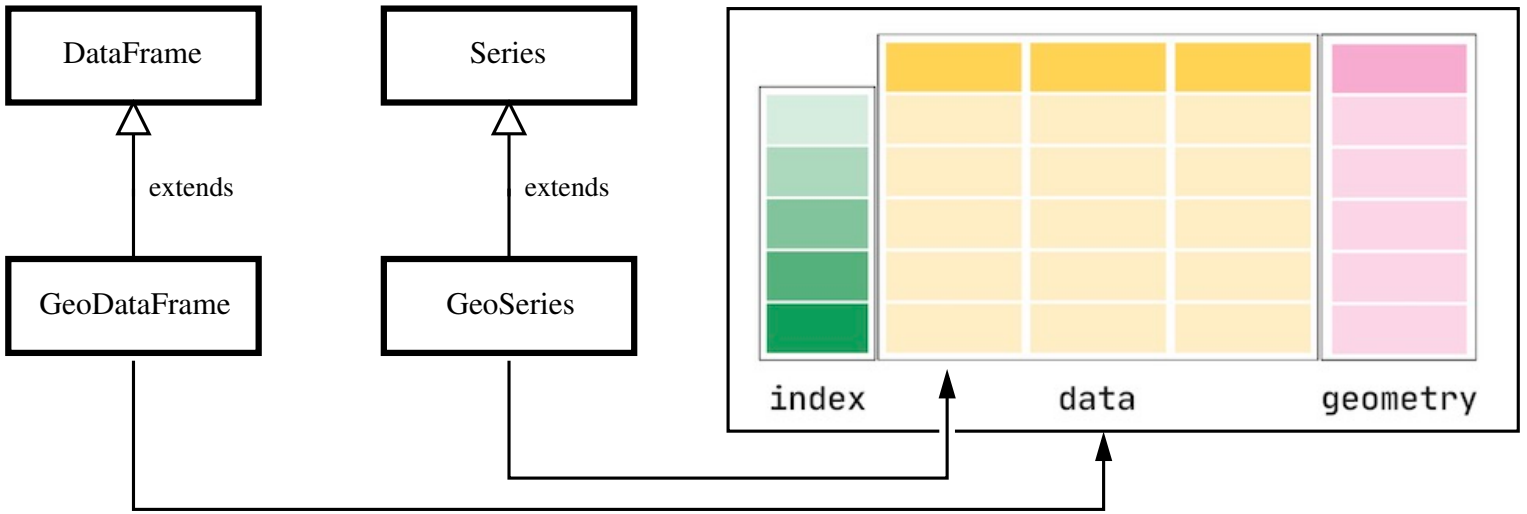
- Extend the datatypes used by Pandas to allow spatial operations on geometric types.
- Geometric operations are performed by shapely.
- Geopandas further depends on fiona for file access and matplotlib for plotting.

Installation

```
prompt >> pip3 install geopandas
```

Working with GeoPandas Dataframes

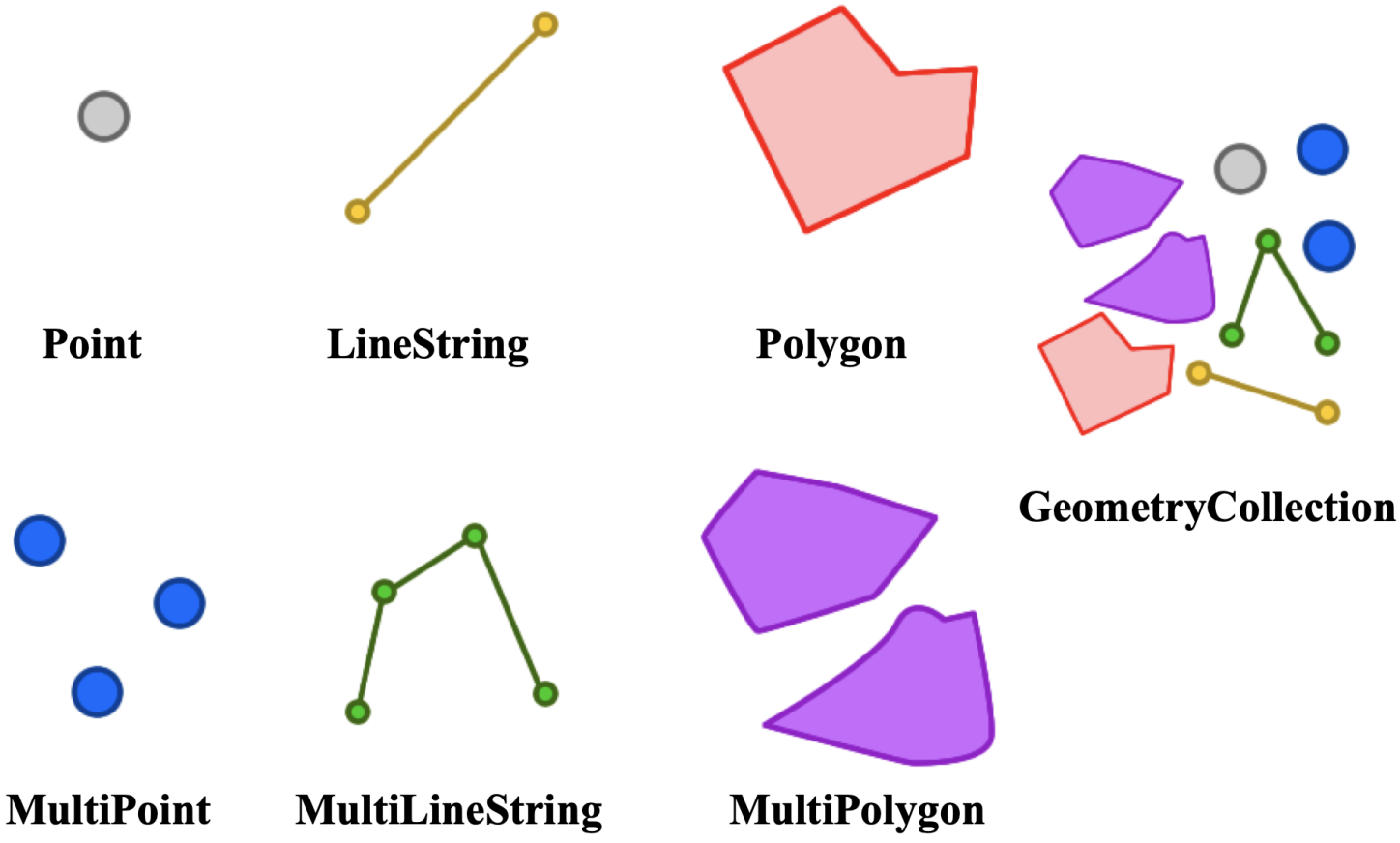
Core Modeling Concepts and Data Structure:



- GeoSeries handle geometries (points, polygons, etc).
- GeoDataFrames store geometry columns and perform spatial operations. They can be assembled from geopandas.GeoSeries.

Working with GeoPandas Dataframes

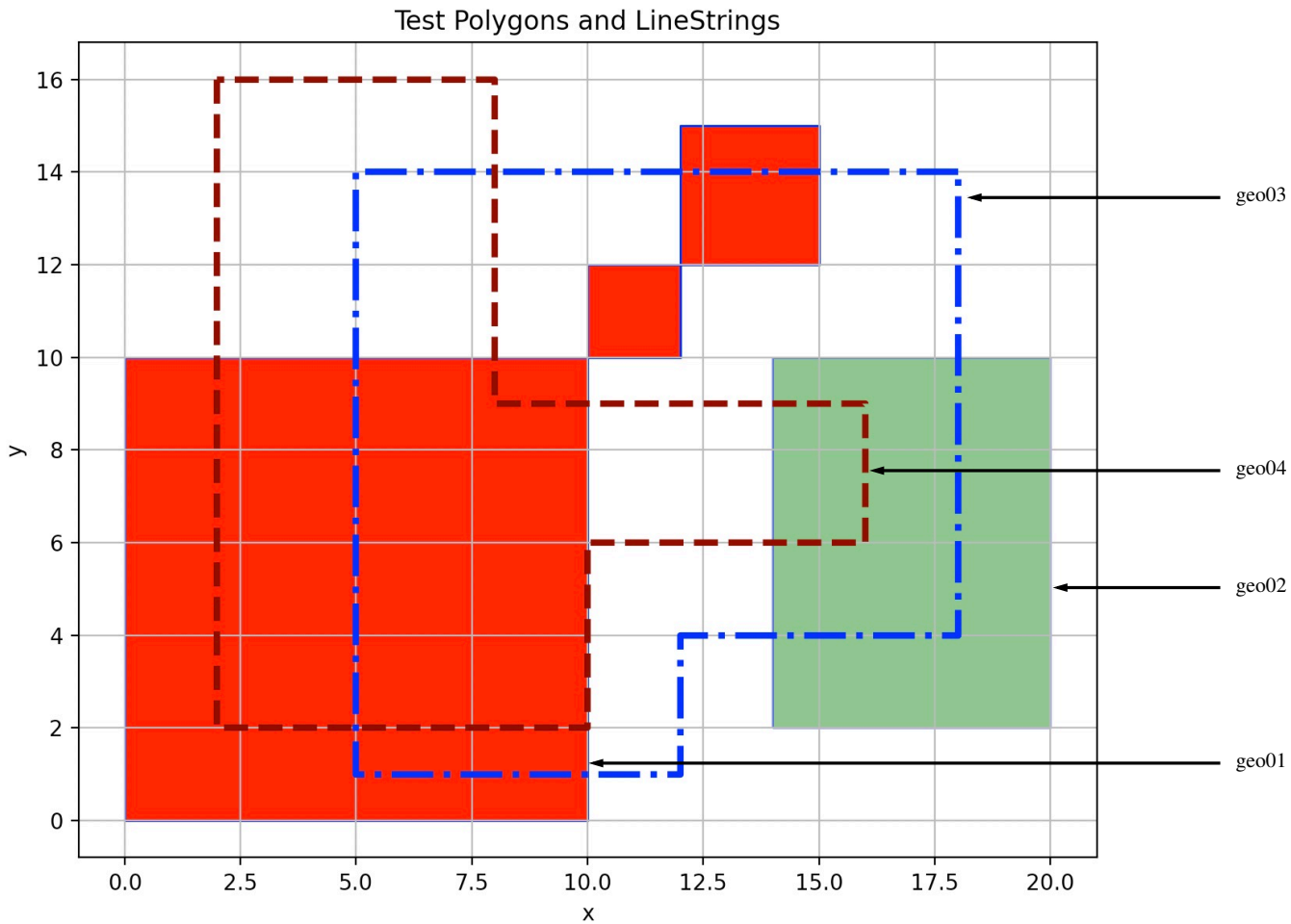
Geometric Objects: points, multi-points, lines, multi-lines, polygons, multi-polygons.



Example 1: Manual Specification of Geometric Shapes

Example 1: Manual specification of polygon and linestring shapes

...



Example 1: Manual Specification of Geometric Shapes

Part I: Problem Setup

```
1   # ========================================================================
2   # TestGeoSeries01.py. Manual assembly of simple geometries.
3   #
4   # Written by: Mark Austin                                        February 2023
5   # ========================================================================
6
7   import geopandas
8   from geopandas import GeoSeries
9   from shapely.geometry import Polygon
10  from shapely.geometry import LineString
11
12  import matplotlib.pyplot as plt
13
14  # ==============================
15  # main method ...
16  # ==============================
17
18  def main():
19      print("--- Enter TestGeoSeries01.main()                ... ");
20      print("--- ======================================== ... ");
21
22      print("--- Part 01: Create individual polygons ... ");
23
24      polygon01 = Polygon([   (0,0),  (10,0), (10,10),  (0,10) ] )
25      polygon02 = Polygon([ (10,10), (12,10), (12,12), (10,12) ] )
26      polygon03 = Polygon([ (12,12), (15,12), (15,15), (12,15) ] )
```

Example 1: Manual Specification of Geometric Shapes

Part I: Problem Setup (Continued) ....

```
27      polygon04 = Polygon([ (14,2), (20,2), (20,10), (14,10) ] )
28
29      print("--- Part 02: Add polygons to GeoSeries ... ");
30
31      geo01 = GeoSeries( [ polygon01, polygon02, polygon03 ]);
32      geo02 = GeoSeries( [ polygon04 ]);
33
34      print("--- Part 03: Create simple linestring GeoSeries ... ");
35
36      line01 = LineString([ (18,14), (5,14), (5,1), (12,1), (12,4), (18,4), (18,14) ] )
37      geo03  = GeoSeries( [ line01 ]);
38      line02 = LineString([ (2,16), (2,2), (10,2), (10,6), (16,6), (16,9), (8,9), (8,16),
39      geo04  = GeoSeries( [ line02 ]);
40
41      print("--- Part 04: Print GeoSeries info and contents ... ");
42
43      print(geo01)
44      print(geo02)
45
46      print("--- Part 05: Area and boundary of geo01 ... ");
47
48      print(geo01.area)
49      print(geo01.boundary)
50
51      print("--- Part 06: Area and boundary of geo02 ... ");
52
53      print(geo02.area)
54      print(geo02.boundary)
```

Example 1: Manual Specification of Geometric Shapes

Part I: Problem Setup (Continued) ....

```
55
56      print("--- Part 07: Spatial relationship of geo01 through geo04 ... ");
57
58      print("--- Compute intersection of (lines) geo03 and geo04 ...")
59      geo02a = geo03.intersects(geo04)
60      print("---   geo03.intersects(geo04) --> {:s} ...".format( str( geo02a[0] ) ))
61      geo02b = geo03.intersection(geo04)
62      print("---   geo03.intersection(geo04) --> {:s} ...".format( str( geo02b[0] ) ))
63
64      print("--- Compute intersection of (region) geo01 and (lines) geo03 and geo04 ...")
65      geo02c = geo01.intersection(geo03)
66      print("---   geo01.intersection(geo03) --> {:s} ...".format( str( geo02c[0] ) ))
67      geo02d = geo01.intersection(geo04)
68      print("---   geo01.intersection(geo04) --> {:s} ...".format( str( geo02d[0] ) ))
69
70      print("--- Compute intersection of (region) geo02 and (lines) geo03 and geo04 ...")
71      geo02e = geo02.intersection(geo03)
72      print("---   geo02.intersection(geo03) --> {:s} ...".format( str( geo02e[0] ) ))
73      geo02f = geo02.intersection(geo04)
74      print("---   geo02.intersection(geo04) --> {:s} ...".format( str( geo02f[0] ) ))
75
76      print("--- Part 08: Plot polygons ... ");
77
78      ax = geo01.plot( color='blue', edgecolor='black')
79      ax.set_aspect('equal')
80      ax.set_title("Test Polygons and LineStrings")
```

Example 1: Manual Specification of Geometric Shapes

Part I: Problem Setup (Continued) ....

```
81
82      # Plot polygons ...
83
84      geo01.plot(ax=ax, edgecolor='blue', color='red',   alpha= 1.0 )
85      geo02.plot(ax=ax, edgecolor='blue', color='green', alpha= 0.5 )
86
87      # Plot linestring ...
88
89      geo03.plot(ax=ax, color='blue',   alpha= 1.0, linewidth=3.0, linestyle='dashdot' )
90      geo04.plot(ax=ax, color='maroon', alpha= 1.0, linewidth=3.0, linestyle='dashed' )
91
92      plt.xlabel('x')
93      plt.ylabel('y')
94      plt.grid(True)
95      plt.show()
96
97      print("--- ======================================== ... ");
98      print("--- Leave TestGeoSeries01.main()             ... ");
99
100 # ================================================
101 # call the main method ...
102 # ================================================
103
104 main()
```

Source Code: See: python-code.d/geopandas/

Example 1: Manual Specification of Geometric Shapes

Part II: Abbreviated Output:

```
--- Enter TestGeoSeries01.main()              ...
--- Part 01: Create individual polygons ...
--- Part 02: Add polygons to GeoSeries ...
--- Part 03: Create simple linestring GeoSeries ...

--- Part 04: Print GeoSeries info and contents ...

0    POLYGON ((0.00000 0.00000, 10.00000 0.00000, 1...
1    POLYGON ((10.00000 10.00000, 12.00000 10.00000...
2    POLYGON ((12.00000 12.00000, 15.00000 12.00000...
dtype: geometry
0    POLYGON ((14.00000 2.00000, 20.00000 2.00000, ...
dtype: geometry

--- Part 05: Area and boundary of geo01 ...

0    100.0
1      4.0
2      9.0
dtype: float64
0    LINESTRING (0.00000 0.00000, 10.00000 0.00000,...
1    LINESTRING (10.00000 10.00000, 12.00000 10.000...
2    LINESTRING (12.00000 12.00000, 15.00000 12.000...
dtype: geometry
```

Example 1: Manual Specification of Geometric Shapes

Part II: Abbreviated Output:

```
--- Part 06: Area and boundary of geo02 ...

0    48.0
dtype: float64
0    LINESTRING (14.00000 2.00000, 20.00000 2.00000...
dtype: geometry

--- Part 07: Spatial relationship of geo01 through geo04 ...

--- Compute intersection of (lines) geo03 and geo04 ...

---   geo03.intersects(geo04) --> True ...
---   geo03.intersection(geo04) --> MULTIPOINT (5 2, 8 14) ...

--- Compute intersection of (region) geo01 and (lines) geo03 and geo04 ...

---   geo01.intersection(geo03) --> LINESTRING (5 10, 5 1, 10 1) ...
---   geo01.intersection(geo04) --> MULTILINESTRING ((10 2, 10 6), (2 10, 2 2, 10 2), (10 9, 8 9, 8 10))

--- Compute intersection of (region) geo02 and (lines) geo03 and geo04 ...

---   geo02.intersection(geo03) --> LINESTRING (14 4, 18 4, 18 10) ...
---   geo02.intersection(geo04) --> LINESTRING (14 6, 16 6, 16 9, 14 9) ...

--- Part 08: Plot polygons ...
--- Leave TestGeoSeries01.main()              ...
```